Universidade de Aveiro
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Afinação de parâmetros laser de máquina de impressão 3D em metais

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Engenharia Mecânica, realizada sob a orientação científica do Doutor António Manuel de Bastos Pereira, Professor Associado com Agregação do Departamento de Engenharia Mecânica da Universidade de Aveiro.

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resumo

O fabrico aditivo tem sido um tema cada vez mais popular na indústria devido às suas capacidades. Esta dissertação foca-se no funcionamento e numa das fases do desenvolvimento de uma máquina de fabrico do tipo fusão em leito de pó. Engloba as tecnologias existentes de fabrico aditivo, as vantagens e desvantagens da tecnologia e a afinação dos parâmetros laser da máquina concebida e construída no Departamento de Engenharia Mecânica da Universidade de Aveiro. É descrito o estado inicial da máquina, as dificuldades encontradas e as alterações e afinações feitas.

No final, embora com ainda vários assuntos pendentes, a máquina apresenta um sistema laser operacional e capaz de fundir pós metálicos.

Keywords

Laser; Powder bed fusion; Additive manufacturing

abstract

Additive manufacturing has been a growing trend in the industrial and academic space due to its promising and current capabilities. This dissertation focuses on how a powder bed fusion machine operates and especially on the fine tuning of its laser parameters. The machine in question was developed and produced in the Mechanical Engineering Department of the University of Aveiro. This dissertation contents include the machine's initial state, the challenges encountered, and the modifications and calibrations done.

In the end, although with some challenges left for future works, the machine is left with a functional laser system capable of melting metallic powders.

Conteúdo

Índice de Figuras

1. Introdução

Esta dissertação foca na finalização e aperfeiçoamento de uma máquina de fabrico aditivo de metais desenvolvida e construída no Departamento de Engenharia Mecânica da Universidade de Aveiro, focando principalmente na colocação em funcionamento, calibração e afinação do sistema laser.

O objetivo desta dissertação centra-se em torno da fusão de pós metálicos, implicando a otimização dos parâmetros laser da máquina tal como a finalização do sistema laser, que não se encontrava operacional.

Esta dissertação irá abordar inicialmente o estado da arte do fabrico aditivo, posteriormente irá ser introduzida a máquina em questão, depois serão abordadas as alterações e aperfeiçoamentos feitos à máquina, e finalmente será apresentado um manual de instruções para a operação da máquina. Na conclusão serão abordados alguns pendentes e propostas de melhoria para trabalhos futuros.

2. Revisão do Estado da Arte

2.1 Fabrico Aditivo e a sua evolução

O fabrico aditivo ou manufatura aditiva é uma tecnologia de construção de peças e objetos tridimensionais pelo método de adicionar material, contrastando com o tradicional fabrico subtrativo, o qual produz o objeto pretendido a partir de um bloco de material bruto que irá ser desbastado até se obter o objeto final.

O fabrico aditivo cria o objeto ou peça partindo de uma matéria-prima tal como pós, filamentos ou soluções metálicas ou poliméricas, adicionando o material necessário para se obter o objeto pretendido, como ilustrado pela Figura 1[1] .

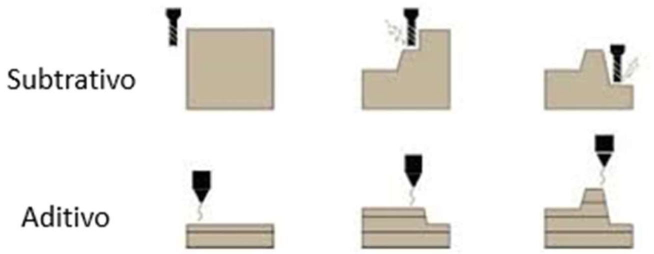

Figura 1- Fabrico subtrativo e aditivo [1]

É considerado que o início do fabrico aditivo se deu em 1987 com a comercialização da primeira máquina de fabrico aditivo a SLA-1 pela 3D Systems (Figura 2)[2] .O equipamento operava seguindo os princípios da esteriolitografia, (SLA - *stereolithography apparatus*), patenteada por Chuck Hull em 1984, em que o objeto era dividido em camadas que depois são projetadas por um laser ultravioleta sobre uma resina fotopolimerizável, dando assim forma ao objeto camada a camada [3]. Com a introdução da SLA-1 também foi introduzido o formato de ficheiro STL que até à data ainda é usado na indústria [2].

Figura 2 - SLA-1 da 3D Systems [2]

Em outubro de 1986 Carl R. Deckard apresentou uma patente para um novo método de fabrico aditivo conhecido como sinterização seletiva por laser (SLS - *selective laser sintering*), um método em que as camadas do objeto eram formadas por pós sinterizados por um laser.[4] Este processo é comum em máquinas de maior qualidade que produzem peças metálicas, poliméricas e cerâmicas.

Em 1991 foi feita uma nova introdução importante para o mercado do fabrico aditivo, a introdução do método de modelação por deposição de material fundido (FDM – (*fused* d*eposition modeling*) pela StrataSys [5]. Este método cria as diferentes camadas do objeto fundindo o material a adicionar e depositando-o sobre a camada anterior, um dos métodos mais populares até à data (Figura 3).

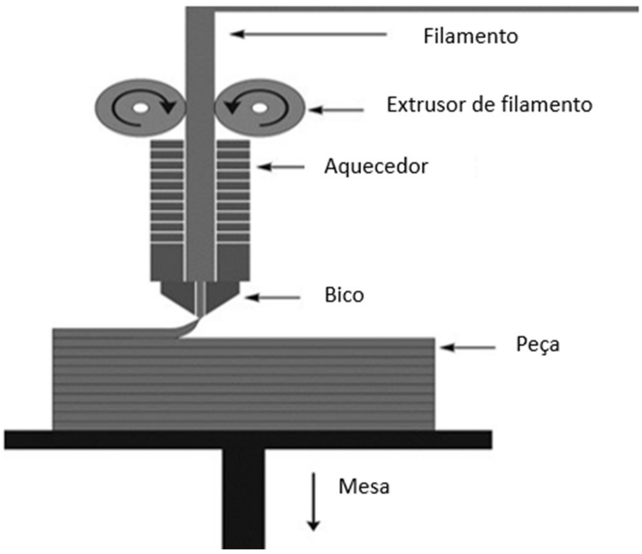

Figura 3 – FDM *Fused Deposition Modeling* [22]

Inicialmente o mercado do fabrico aditivo estava muito restrito e protegido por patentes, o que manteve o custo da tecnologia elevado, no entanto, com o avanço do tempo estas patentes foram expirando, e continuam a expirar, o que levou ao aumento da concorrência e por sua vez fez com que estas tecnologias se tornassem mais económicas de operar e adquirir, tendo-se assim dado uma expansão do fabrico aditivo [6].

2.2 Aplicações do fabrico aditivo

Uma das principais aplicações do fabrico aditivo é a prototipagem rápida, devido à sua capacidade de transformar modelos e objetos digitais em peças reais e palpáveis de forma rápida e baixo custo. Estes modelos servem para atestar os 3F's (Forma, *Fit* (montagem; alojamento) e Função). Inicialmente somente era possível atestar a forma devido à fragilidade dos objetos produzidos, mas com os avanços nos métodos e materiais tornou-se possível também produzir peças para atestar a sua funcionalidade e ajustamento a outros componentes [7].

A otimização topológica é um processo de obter geometrias que minimizam a quantidade de material, por questões de peso ou custo e maximizam as suas propriedades.

O fabrico aditivo possibilitou a produção mais eficiente e económica de peças topologicamente otimizadas. De facto, estes componentes, em regra geral, apresentam geometrias muito complexas e difíceis de executar com métodos de fabrico tradicionais (Figura 4) [8].
Muitas geometrias que previamente à introdução do fabrico aditivo eram impossíveis de

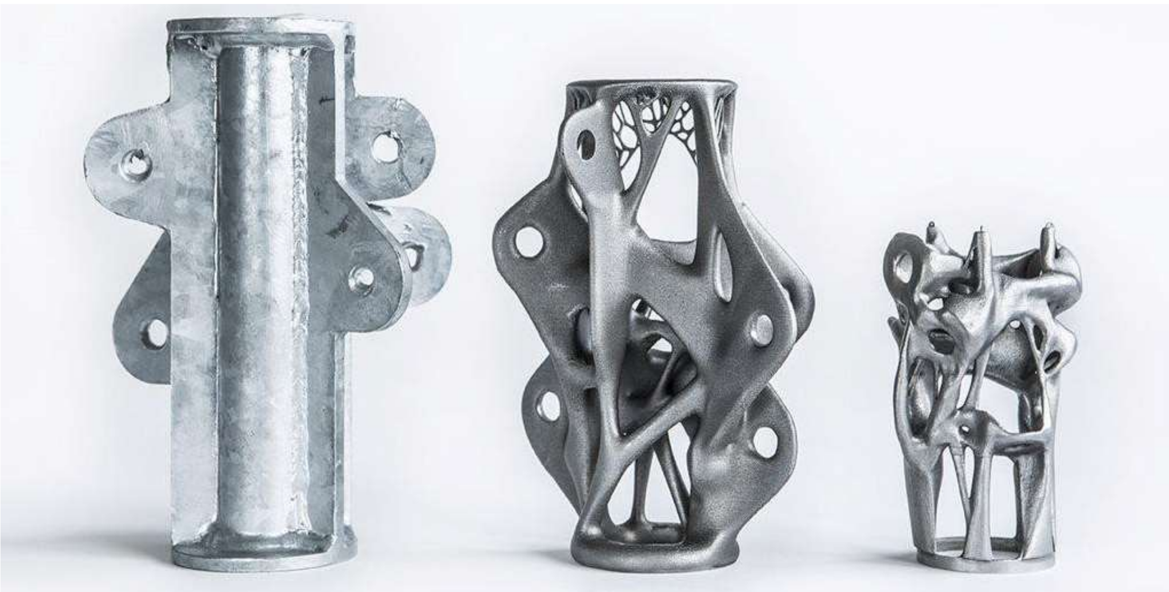

Figura 4 – Design generativo [23]

fabricar ou simplesmente demasiado complexas tornaram-se possíveis e viáveis através deste novo método.

Outra aplicação do fabrico aditivo é a criação de canais de arrefecimento curvos em moldes de injeção de plásticos, os quais melhoram significativamente a qualidade e eficiência de um molde de injeção[9]. Tradicionalmente os canais de arrefecimento de moldes são constituídos por uma serie de furos retos, facto que causa gradientes térmicos na superfície do molde que, por sua vez, reduz a qualidade da peça injetada. O fabrico aditivo possibilita a criação de canais curvos e mais complexos que arrefecem a peça a injetar de forma mais uniforme, evitando assim defeitos na mesma (Figura 5) [10].

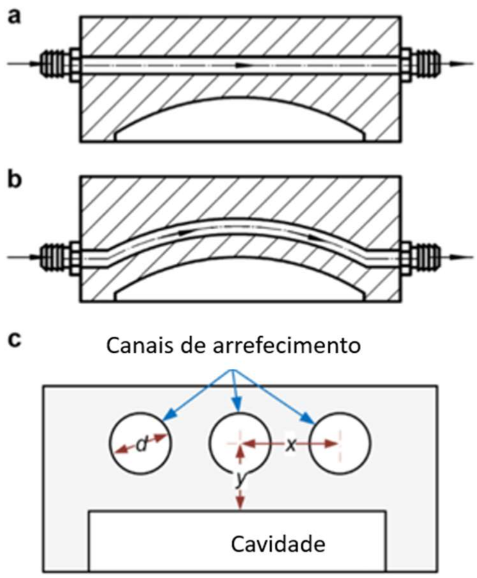

Figura 5 – Canais Conformáveis num molde

a) Canal reto tradicional; b) Canal conformável que acompanha a cavidade do molde; c) Vista em corte dos canais. [9]

A expansão do mercado do fabrico aditivo também possibilitou a produção mais económica de pequenas series de produtos, produtos que somente seriam económicos em grandes quantidades são possíveis de produzir rentavelmente à pequena escala.

2.3 Vantagens do fabrico aditivo

Uma das vantagens do fabrico aditivo é que este produz as peças ou objetos num só passo, a "impressão". Fabricar as peças de uma só vez permite aumentar a complexidade das mesmas sem grande alteração do tempo de fabrico, por exemplo adicionar um chanfro ou furo no centro de uma peça. Tradicionalmente uma pequena adição ao design básico significa um aumento significativo dos passos e métodos para o fabrico da peça, e por sua vez o tempo e custo de produção, desta forma é possível produzir peças mais complexas sem o custo acrescentado que tradicionalmente se aplica [7 11].

Uma outra vantagem do fabrico aditivo são os benefícios para o ambiente, visto que a fabrico aditivo utiliza somente o material necessário para a formação da peça ou objeto que se pretende fabricar, eliminando assim o desperdício. Este fenómeno é especialmente relevante em peças grandes de elevada complexidade que embora a sua grande dimensão tem volumes finais reduzidos. A otimização topológica e *design* generativo também contribuem para a economia de matéria-prima, reduzindo a quantidade de material necessária para a formação da peça (Figura 6) [8].

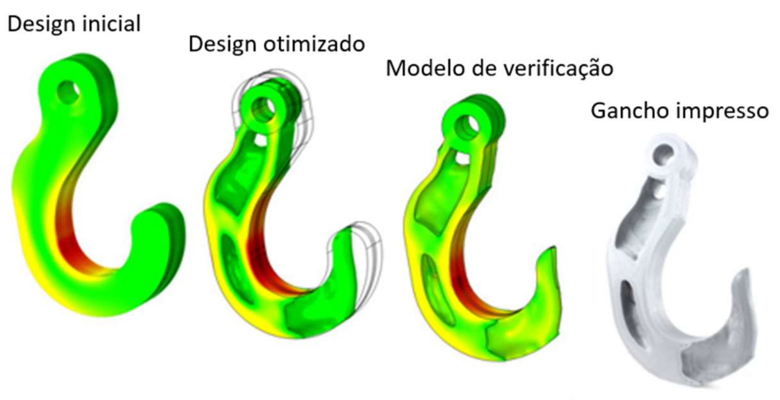

Figura 6 – Evolução de uma peça com otimização de topologia [12]

Outra grande vantagem do fabrico aditivo é a sua velocidade de produção, em especial na produção de protótipos, a impressão 3D facilita a criação de modelos reais de modelos digitais, facilita a iteração de *design*, dimensões e tolerâncias. Isto e especialmente útil em áreas onde o fabrico de modelos é dispendioso e crucial ao desenvolvimento de produto [7].

2.4 Desvantagens do fabrico aditivo

Uma das desvantagens do fabrico aditivo é a quantidade limitada de materiais disponíveis para fabrico aditivo, embora haja cada vez mais variedade de pós, resinas e filamentos para impressão 3D, como por exemplo filamentos de fibra de carbono contínua e pós de titânio.

Comparado com o fabrico tradicional as dimensões máximas dos componentes ainda são reduzidas, não só devido ao tempo de produção, mas também a dimensão máxima das máquinas [11] .
De momento a maior impressora 3D é a 3Dirigo da Universidade de Maine, que imprimiu um barco com 7.62 m de comprimento e pesa 2268 kg (Figura 7).

Figura 7 – Barco produzido pela 3Dirigo [24]

Com a tecnologia atual as peças produzidas são normalmente anisotrópicas e com precisão dimensional e acabamentos de superfície inferiores aos obtidos por métodos tradicionais, sendo assim muitas peças de fabrico aditivo pós-processadas com métodos de fabrico tradicionais [11] [13] Na Figura 8 e Figura 9 é possível observar os resultados de ensaios de tração em provetes imprimidos em diferentes direções. Como é possível observar na Figura 9 os provetes foram mais fortes quando as camadas se encontravam paralelas à tensão aplicada no provete.

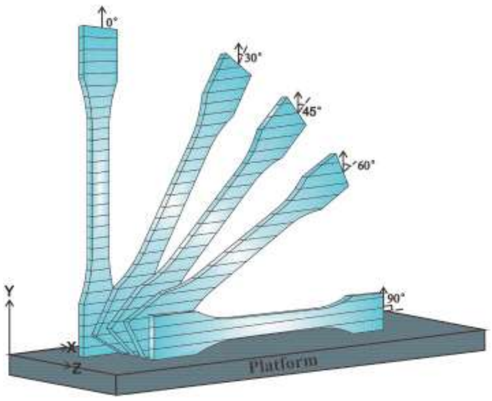

Figura 8 – Resultados dos ensaios de tração [13]

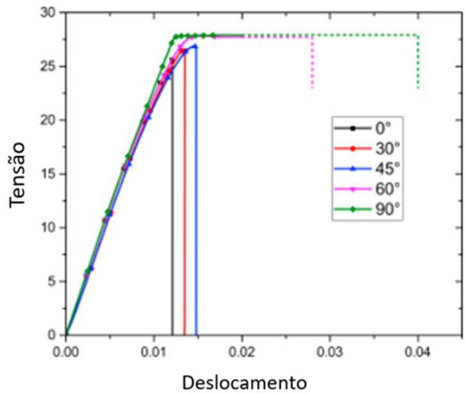

Figura 9 – Orientação das camadas nos provetes [13]

De uma das vantagens do fabrico aditivo, a produção de uma peça na sua totalidade e de uma só vez, vem também uma das suas desvantagens, a dificuldade de otimizar o processo para grandes quantidades de componentes. No fabrico tradicional cada processo é otimizado para produzir um certo efeito no produto final podendo assim se criar linhas de produção para a produção em serie, o que leva à diminuição do tempo de produção, no fabrico aditivo o processo é único, não especializado para nenhuma operação em concreto, levando assim a tempos de produção demorados em produções em escala [11]. Na Figura 10 é possível observar a comparação do tempo de produção por fabrico aditivo contra o fabrico tradicional para uma determinada peça [14].

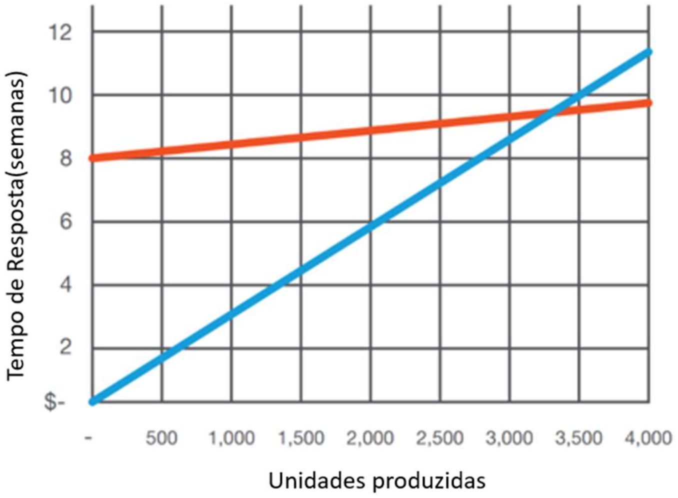

Figura 10 – Tempo de resposta

Extrusão de material (Azul) e injeção de plástico (Vermelho) [14]

2.5 Tecnologias existentes

Neste capítulo serão apresentadas as diferentes tecnologias de fabrico aditivo seguindo a classificação ISO/ASTM 52900:2015.

1. Extrusão de Material (*Material Extrusion*)

A tecnologia mais utilizada na impressão 3D amadora, em que o material, normalmente um filamento polimérico, é aquecido e extrudido por um orifício onde se liga ao restante material extrudido formando assim as camadas da peça [15] (Figura 11).

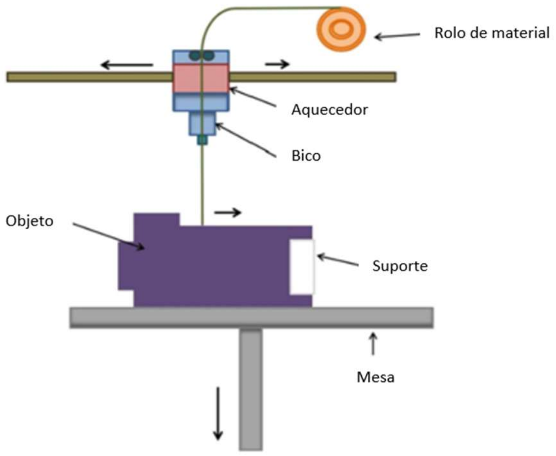

Figura 11 - Extrusão de Material [15]

Esta tecnologia é aplicável a materiais poliméricos, metálicos e cerâmicos.

2. Jato de material (*Material Jetting)*

A tecnologia de jato de material opera através da foto polimerização de material depositado por uma cabeça de impressão, normalmente são usadas resinas foto polimerizáveis [15] (Figura 12).

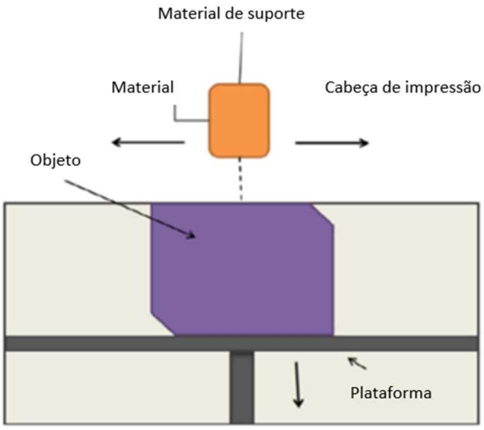

Figura 12 - Jato de material [15]

Esta tecnologia é aplicável a materiais poliméricos.

3. Fusão de leito em pó

A tecnologia de fusão de leito em pó baseia-se consecutiva fusão de finas camadas de pó, através do uso de um laser ou feixe de eletrões [15] (Figura 13).

Esta tecnologia é aplicável a materiais poliméricos, metálicos e cerâmicos.

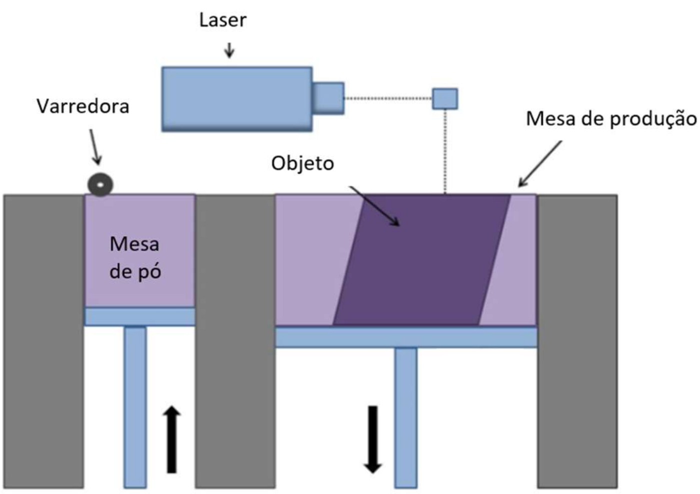

Figura 13 - Fusão de leito em pó [15]

4. Jato de Aglutinante (*Binder Jetting)*

O jato de aglutinante opera de forma semelhante à fusão de leito em pó, no entanto usa uma cabeça de impressa que introduz um agente aderente que adere as partículas de pó em vez de o fundir [15] (Figura 14).
Esta tecnologia é aplicável a materiais poliméricos, metálicos e cerâmicos.

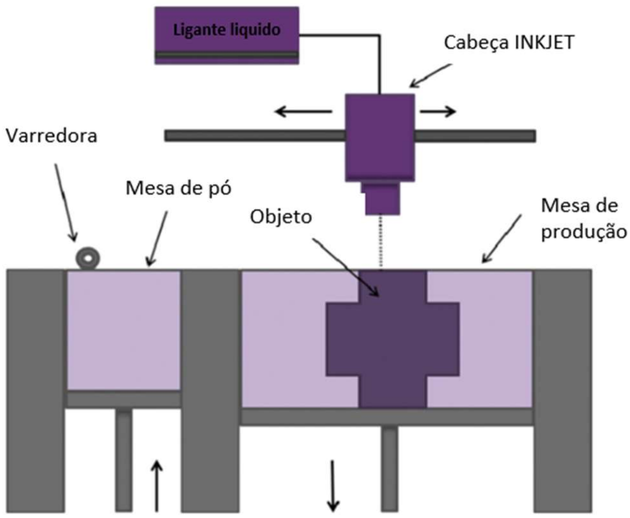

Figura 14 - Jato de Aglutinante [15]

5. Foto polimerização em tina (Vat Photopolymerization)

Na foto polimerização em tina, uma fonte de laser ou luz ultravioleta cura uma resina nas sucessivas camadas do objeto a imprimir [15] (Figura 15).
Esta tecnologia é aplicável a materiais poliméricos. Normalmente resinas, bio resinas e polímeros foto polimerizáveis.

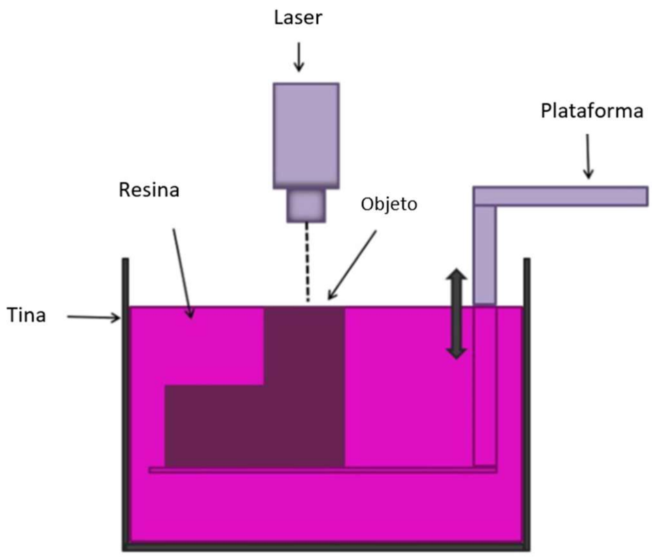

Figura 15 - Foto polimerização em tina [15]

6. Laminagem de folhas (*Sheet Lamination)*

A laminagem de folhas consiste na fusão de várias folhas de forma a obter o objeto desejado [15] (Figura 16).
Esta tecnologia é aplicável a materiais poliméricos, metálicos e cerâmicos, também é aplicável em alguns compósitos.

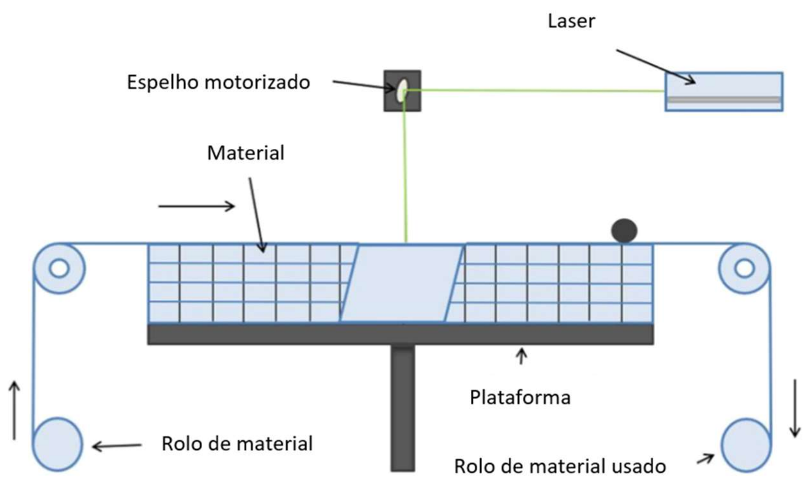

Figura 16 - Laminagem de folhas [15]

7. Deposição direta de energia (*Direct Energy Deposition)*

A deposição direta de energia usa material na forma de filamento que é fundida numa cabeça de deposição por um laser ou feixe de eletrões [15] (Figura 17).

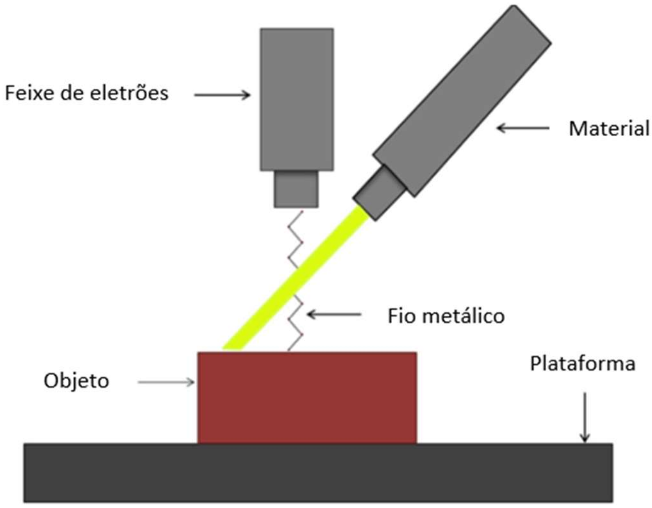

Figura 17 - Deposição direta de energia [15]

Esta tecnologia é aplicável a materiais metálicos.

2.6 Fusão em leito de pó

Visto que a máquina na qual este trabalho se foca é do tipo fusão em leito de pó será agora abordado mais em detalhe o funcionamento e tipos de máquina.

Existem vários tipos de máquinas de fusão em leito de pó, entre elas sinterização seletiva a laser (SLS), fusão seletiva a laser (SLM), sinterização direta de metal a laser (DMLS), sinterização seletiva a calor (SHS) e fusão por feixe de eletrões (EBM). Este processo funciona através da formação por camadas de uma peça, fundindo partículas de pó por ação de uma fonte de calor normalmente um feixe laser ou um feixe de eletrões.

Estas máquinas geralmente dispõem de uma varredora que varre o pó sobre a superfície de impressão, sobre a qual posteriormente irá incidir a fonte de calor. Este processo é repetido várias vezes aplicando camada de pó sobre camada de pó [16] (Figura 18).

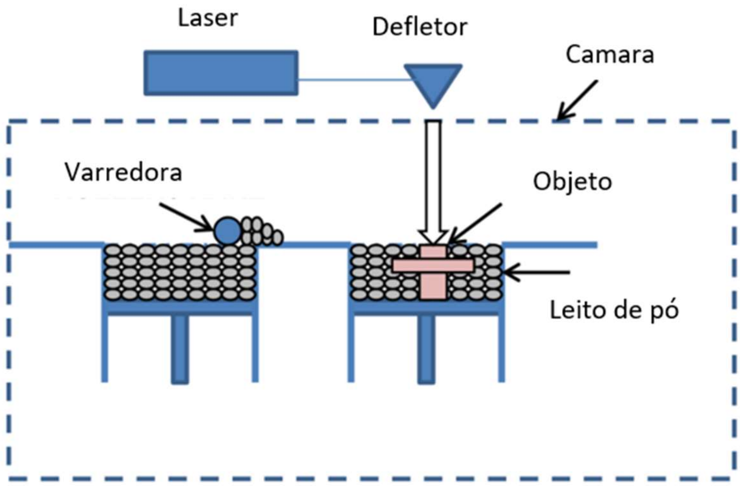

Figura 18 - Fusão em leito de pó [25]

Sinterização ou Fusão

Ambos o processo de fusão e de sinterização são muito usados no fabrico aditivo, especialmente nos sistemas de fusão em leito de pó usando lasers ou feixes de eletrões.

Muitas vezes estes termos geram alguma confusão à volta de que tipo de processo se trata, como por exemplo: fusão seletiva a laser e sinterização seletiva a laser (SLM e SLS).

A principal diferença entre fusão e sinterização é a forma como as partículas se unem. Na sinterização a união é feita através da fusão superficial dos pós metálicos, ou seja, somente ocorre fusão à superfície de cada partícula, nunca entrando a sua totalidade em estado líquido.

Nos processos de fusão ocorre a liquefação total das partículas, formando assim uma só estrutura metálica contínua [17].

Como é possível observar na Figura 19 é possível ver a fusão superficial no método SLS e a fusão total no método SLM e DMLS.

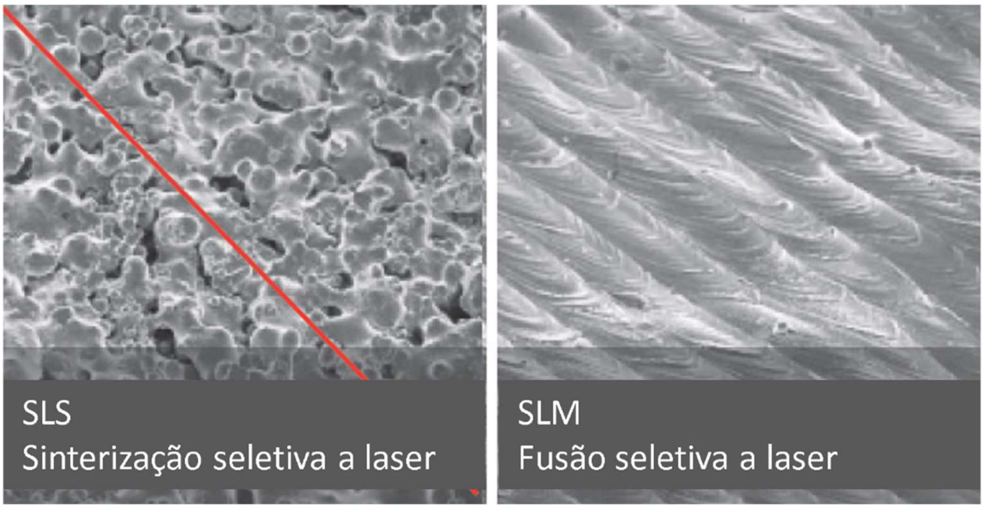

Figura 19 – Fusão e sinterização ao microscópio eletrónico [26]

3. Desenvolvimento

3.1 Introdução à máquina de fabrico aditivo

A máquina de teste é do tipo fusão em leito de pó, tendo sido desenvolvida, projetada e construída por alunos do Departamento de Engenharia Mecânica da Universidade de Aveiro. Para introduzir o funcionamento da máquina esta será dividida em 4 subconjuntos, nomeadamente, o laser, a componente mecânica, o quadro elétrico, sensores e atuadores, e o software de controlo.

A Figura 20 apresenta o estado inicial da máquina, que não se encontrava operacional, tendo sido necessário finalizar partes da mesma.

Figura 20 – Estado inicial da máquina

Nesta máquina a alimentação da mesa de produção é efetuada por uma varredora que transporta o pó existente em uma primeira cavidade (designada por mesa de alimentação ou mesa de pó), depositando uma camada fina do pó metálico sobre a mesa de produção (Figura 21). Esta camada de pó na mesa de produção é depois fundida por um feixe laser. De seguida, a mesa de produção desce um incremento e a mesa de pó sobe um incremento. A varredora volta a transportar pó da mesa de pó para a mesa de produção e o processo repete-se até se finalizar a peça.

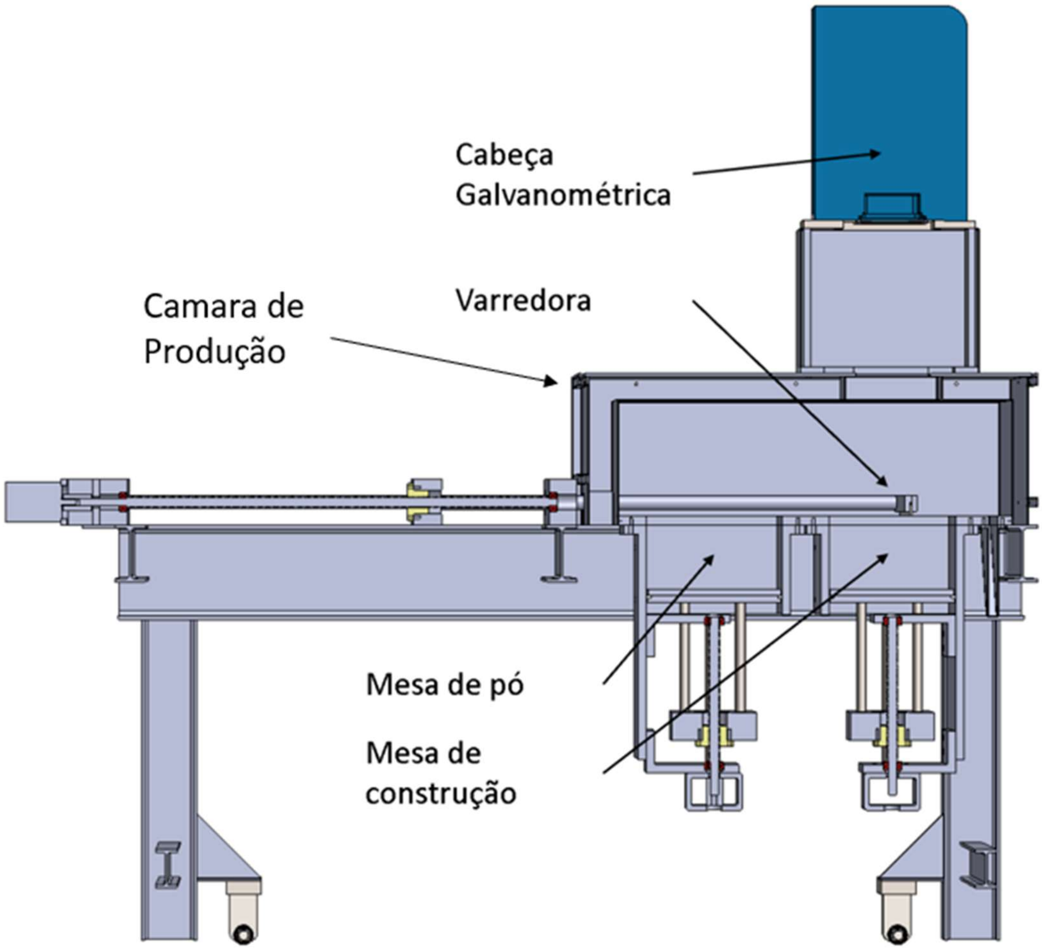

Figura 21 – Máquina em corte e alguns componentes

3.1.1 O laser

O sistema laser é constituído por 2 componentes: a cabeça galvanométrica "Raylase AM module", também conhecida por defletor laser, que direciona o feixe do laser para a mesa de produção, e o "IPG YLR-200-AC", fonte de geração do feixe laser.

O feixe laser é gerado no IPG e redirecionado para o AM module usando uma fibra ótica, de onde é depois direcionado para a mesa de produção, na qual irá fundir os pós metálicos.

O sistema de deflexão do laser é um protótipo de um "AM Module" da marca Alemã Raylase, (Figura 22). Este modulo deflete o feixe laser, conduzido por uma fibra ótica desde a fonte do laser, com uso a espelhos no seu interior e permite assim avançar no plano X e Y na mesa de trabalho, (Figura 23). Este modulo tem também uma lente Z motorizada que permite alterar o foco do laser. Possui uma área de trabalho de 400 mm x 400 mm e uma distância focal de 470 mm.

Figura 22 – Raylase AM Module [27]

O modulo necessita de 2 conexões de cabos marcados como SL2, uma ligação fibra ótica, uma de corrente elétrica e duas ligações para água de arrefecimento.

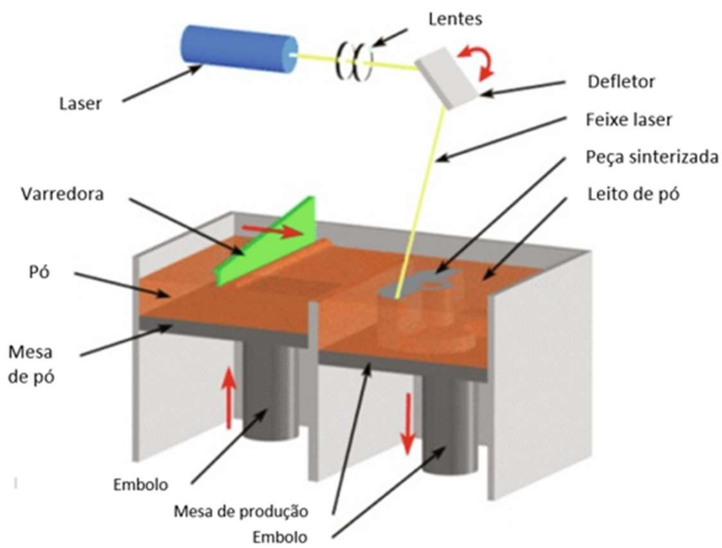

Figura 23 – Processo de Fusão em leito de pó [28]

A fonte que gera o laser é o "IPG YLR-200-AC" da marca IPG Photonics, uma fonte de laser de itérbio contínua com um comprimento de onda de 1,07 ± 0,01 μm e uma potência máxima de 200 W (Figura 24). Esta fonte tem dois modos de operação "Remote" e "Local" e as suas configurações são essenciais para a operação da máquina, tema que será abordado em mais detalhe à frente. O feixe laser aqui gerado é conduzido por uma fibra ótica até ao AM module.

Figura 24 – IPG YLR-200-AC

3.1.2 Sistema Mecânico

A varredora, cuja função é transportar pó desde a mesa de pó até à mesa de produção, é atuada por um motor trifásico, está configurada para operar com uma mesa de trabalho reduzida de modo a poderem ser feitos ensaios utilizando menos pó do que com a mesa de trabalho de 250 mm x 250 mm originalmente prevista.

Este sistema funciona usando um fuso trapezoidal com 900 mm de comprimento e 5 mm de passo, um motor trifásico IEC IE3 90L de 1,5 kW, 1500 RPM B5 230/400 V 50 Hz, guias lineares de 30 mm de diâmetro e uma varredora modular que permite substituir a superfície de contacto facilmente (Figura 25) de forma a poderem ser testadas várias geometrias de varredora [18] [19].

Figura 25 – Varredora

O curso da varredora é controlado por dois fins de curso Honeywell GLLA01A1B ajustáveis conforme a necessidade de curso da varredora (Figura 26).

Figura 26 – Fim de curso
Honeywell [29]

Embora o sistema seja robusto e simples a obtenção de camadas de pó regulares provou-se uma dificuldade devido a dificuldade de garantir o paralelismo entre a varredora e a mesa de produção, o que causa camadas desniveladas e com espessuras diferentes, como é possível verificar na Figura 27.

Figura 27 – Pó metálico sobre a mesa de produção

O sistema das mesas de produção e pó é operado por 2 motores de passo usando fusos de 5 mm, ambas as mesas usam barras de TEFLON para conter o pó e manter uma atmosfera inerte no interior. A mesa de pó usa um motor de passo 34HS38-4204D-E1000 da marca StepperOnline sem redução e a mesa de produção usa um motor de passo 23HS22-2804D-PG15-E1000 com uma redução de 15:1 (Figura 28).

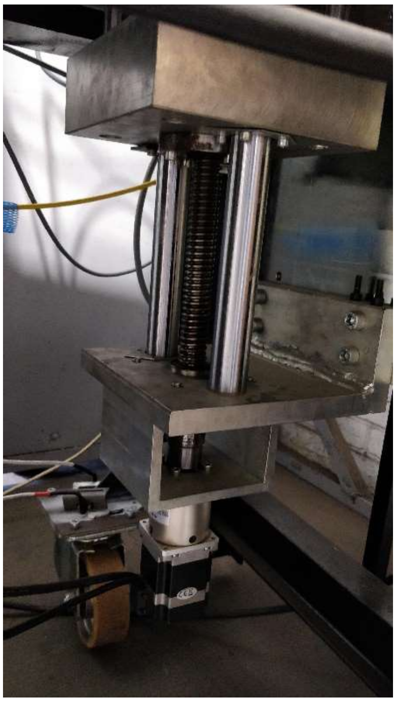

Figura 28 – Sistema de motorização das mesas de pó e produção

Sobre as mesas de pó originais (250 mm x 250 mm) foi aplicada uma nova mesa com duas mesas cilíndricas de 60 mm (Figura 29). Aplicando dois pistões nas mesas originais da máquina [19].

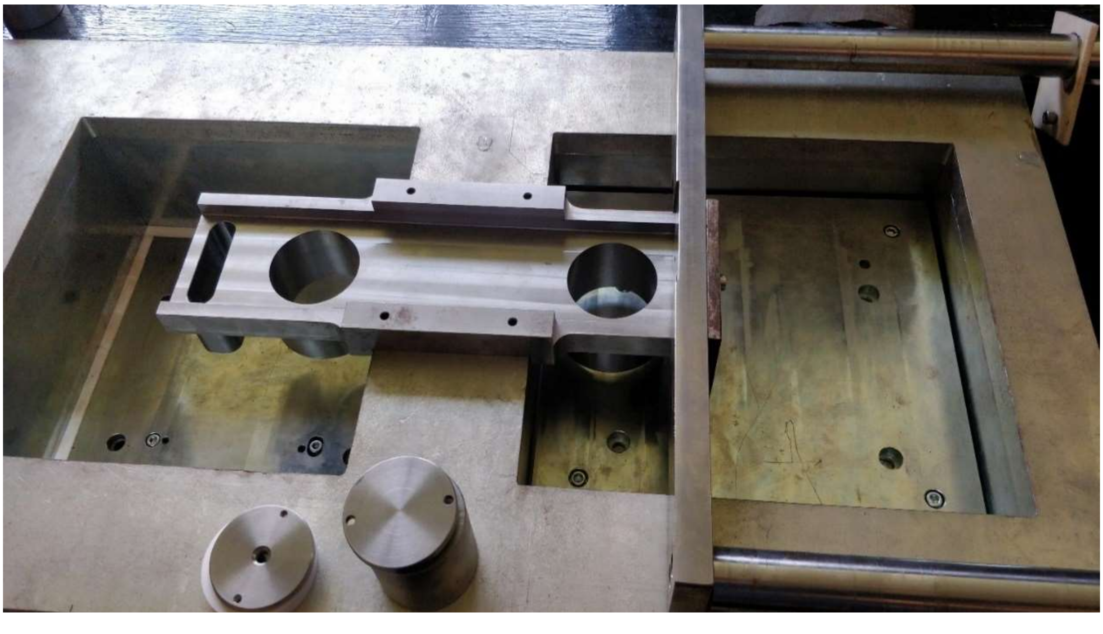

Figura 29 – Mesa de produção reduzida

A câmara de produção cobre as mesas, a varredora e suporta a cabeça galvanométrica. A sua principal função é criar uma atmosfera inerte no seu interior de forma a possibilitar a fusão dos pós metálicos sem se oxidarem (Figura 30). Tal como muitas partes da máquina foi construída por alunos da unidade curricular tecnologia de processos de ligação ao longo dos anos e também alterada algumas vezes desde a sua construção. Teve de ser alterada para acomodar um novo apoio para o AM module, devido a um erro de produção prévio. É constituída por perfil metálico quadrado e por chapas galvanizadas quinadas e soldadas. Foi isolada com lã de rocha e vedada o melhor possível com silicone de alta temperatura. Na porta foi aplicado um vedante para tentar manter um ambiente inerte no interior.

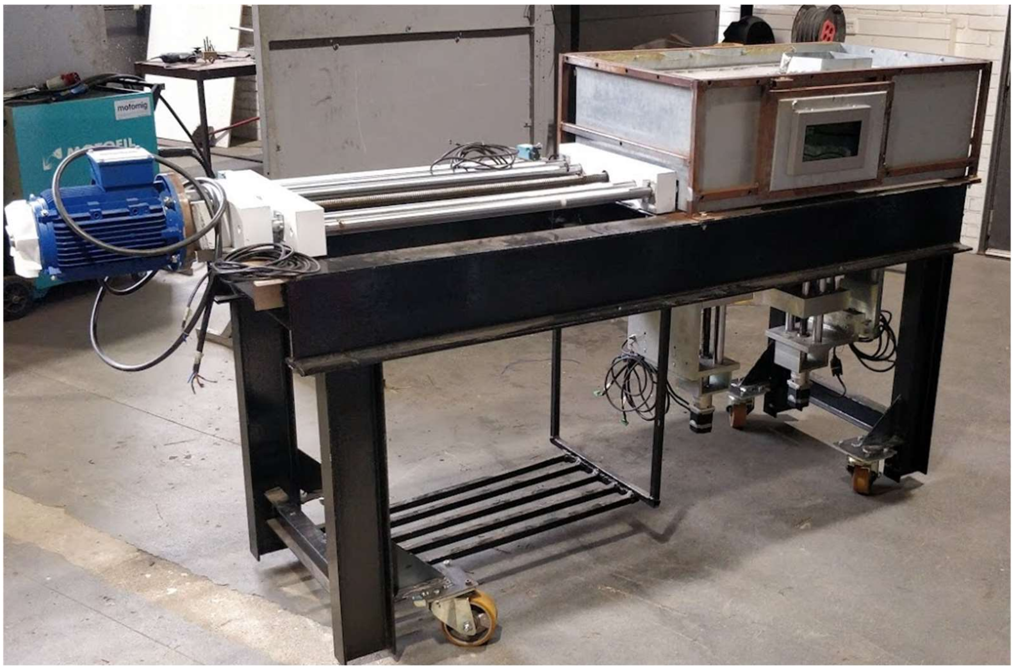

Figura 30 – Sistema da varredora e camara de produção exposta

3.1.3 Quadro Elétrico

O quadro elétrico (Figura 31), cujo esquema elétrico se encontra em Anexo B, tem como principais componentes uma placa NI cDAQ (*Compact data aquisition*), os controladores dos motores de passo das mesas e o variador de velocidade da varredora.

Figura 31 – Quadro elétrico

A placa NI cDAQ, modelo NI 9174 (Figura 32) é um sistema modular de aquisição de dados e controlo que comanda o sistema da varredora, mesas de pó e produção. A NI 9174 está equipada com os módulos NI 9401 e NI 9403 (Figura 33) com 8 e 32 entradas e saídas digitais respetivamente. A NI 9401 foi instalada posteriormente quando foi determinado que a NI 9403 não conseguia criar os sinais PWM (*Pulse Width Modulation*) necessários para os controladores dos motores de passo.

Figura 32 – NI 9174 [30]

Este conjunto NI cDAQ comunica com o computador, onde se encontra a interface LabView para o controlar, que irá ser abordada num próximo capítulo, através de um cabo USB.

Figura 33 – NI 9403[31]

Os controladores dos motores de passo comandam os motores da mesa de pó e construção recebendo sinais da NI 9401 e da NI 9403.

Para controlar a mesa de produção é utilizado um controlador CL54T (Figura 34) da marca StepperOnline, este opera sob o princípio que cada pulso que receba nos seus canais *Pull+/Pull-* equivale a um certo grau de rotação segundo a direção definida por *Dir+/Dir-* e somente quando o sinal *Enable+/Enable-* está ativo.

Figura 34 – Controlador de motor de passo CL57T [32]

Existem dois destes controladores no interior do quadro elétrico e possuem uma interface RS485 para a sua configuração, para além dos interruptores de configuração neles presentes.

O variador de velocidade RS510 3PH-440V-1.5kW da marca RS-PRO controla o motor trifásico da varredora, recebe sinais da NI 9403 para avançar ou recuar a varredora e tem os seus parâmetros de arranque e velocidade configurados internamente (Figura 35). Os fins de curso da varredora limitam diretamente este variador de velocidade.

Figura 35 – Variador de Velocidade RS Pro [33]

Existem no total 5 fontes de alimentação no quadro elétrico. São duas fontes MeanWell, de 5V e 48V, a de 5V para os sinais digitais e a de 48V para alimentar a cabeça galvanométrica; uma fonte de 24V que alimenta o sistema NI cDAQ; e duas fontes da marca StepperOnline de 24V e 48V que alimentam os controladores das mesas de construção e pó respetivamente.

3.1.4 Sistema de controlo

A nível de controlo existem dois sistemas a controlar, a NI cDAQ, que controla o sistema motor da máquina, e o sistema laser composto por IPG e AM Module. A NI cDAQ é controlada pelo computador local através de um cabo USB e o sistema IPG e AM Module são controlados pela placa SP-ICE3 que se encontra instalada no mesmo computador. Posteriormente irão ser abordados os softwares de cada sistema.

A NI cDAQ comunica por USB com o computador que opera o programa LabView [20].

O programa LabView tem 2 modos de operação principais, automático e manual, sendo que até à data a máquina somente conseguiu operar em modo manual, nunca tendo sido testado o automático (Figura 36). O modo automático baseia-se na iteração de uma camada sempre que o software do laser o requisitar. O modo manual permite a operação manual de todos os sistemas ligados a NI cDAQ.

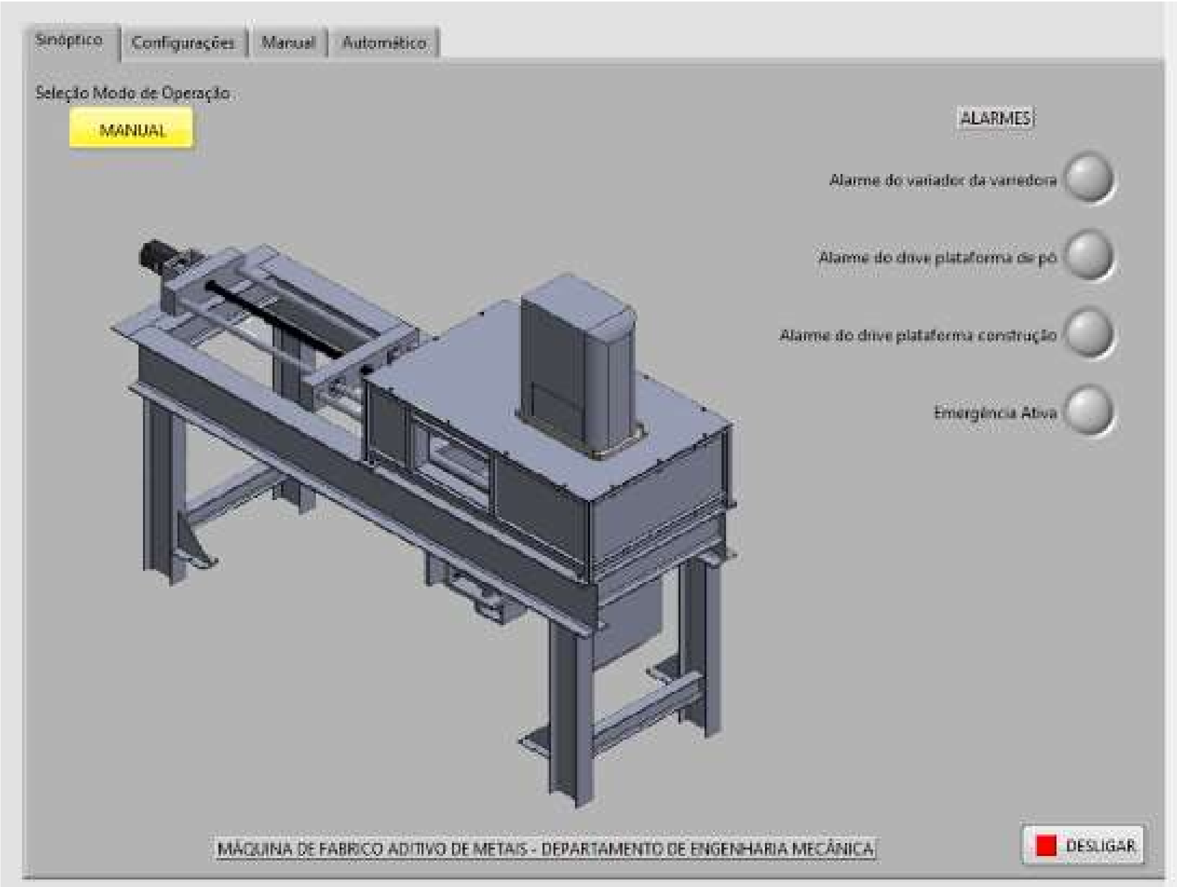

Figura 36 – Sinótico LabView

A placa SP-ICE 3 é a placa que controla o sistema laser da máquina. Está instalada no computador e pode ser configurada usando o programa NIConfig. O *software* para a sua operação é o WeldMark 3 (Figura 37), que permite importar ou desenhar geometrias que depois irão ser executadas pelo sistema laser. A SP-ICE 3 conecta com o laser IPG através da ficha X907 e com o a cabeça galvanométrica através da X904 e X905 (Figura 38).

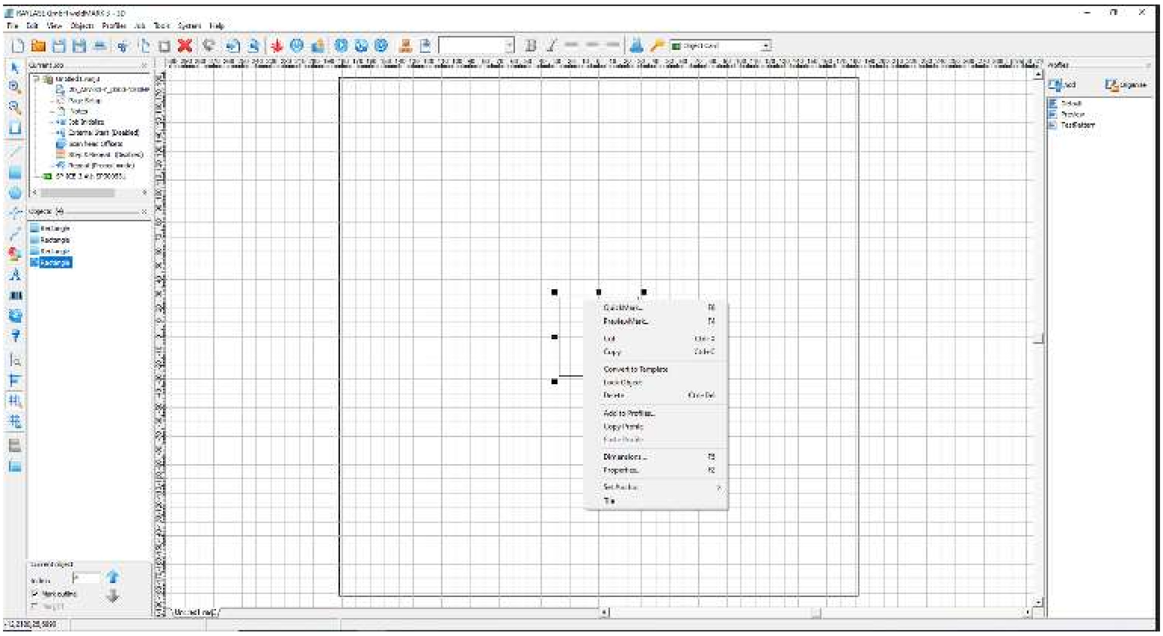

Figura 37 – Software WeldMark 3

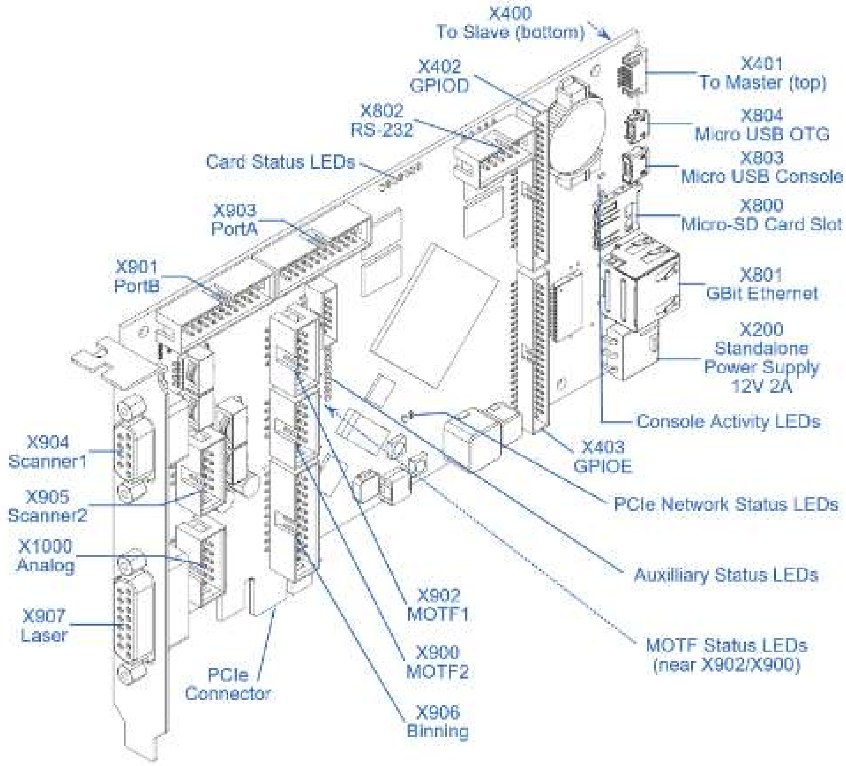

Figura 38 – Entradas e saídas da placa SP ICE 3 da Raylase

3.2 Afinações e alterações feitas na máquina

No início desta dissertação, havia ainda sistemas que não estavam operacionais e outros que necessitavam de ser refeitos. O principal em falta era atribuir ao sistema de controlo da SP ICE 3 a capacidade de ligar e desligar o feixe de laser, estabelecendo a comunicação entre a placa SP ICE 3 e a fonte do Laser IPG. Após o estabelecida a comunicação foi necessário determinar o ponto focal da cabeça galvanométrica e efetuar a sua calibração.

3.2.1 Comunicação SP ICE 3 IPG

Para estabelecer a comunicação teve de ser solicitada ajuda ao fabricante, Raylase, e ao vendedor de ambos estes componentes, Lasermaq Lda. Foi necessário aceder à interface do laser IPG pela sua ficha RJ45 e configurados os parâmetros (Figura 39), no browser do computador. Para criar a ligação física de comunicação entre a SP-ICE 3 e o Laser IPG foi seguido o manual enviado pelo fabricante em Anexo A.

Figura 39 – Configurações do Laser IPG

3.2.2 Distância focal

Uma vez estabelecida a comunicação com a fonte do laser foi possível para o sistema de controlo operar o laser e a cabeça galvanométrica e foram feitos alguns ensaios. Verificou-se que o laser somente marcava as chapas colocadas na mesa de produção utilizando uma potência superior a 50 %. Segundo indicações do fabricante, este laser deveria conseguir marcar o metal com potências em torno de 15 %. Como isto não se verificou tentou-se determinar se o laser estava focado. Para tal, foi ativado o laser e movimentada uma chapa para cima e baixo ao longo do feixe, observado a intensidade da luz emitida pela chapa, e assim foi possível visualizar que o local de intensidade máxima não era na superfície da mesa de produção, mas sim aproximadamente 150 mm acima do nível da mesa. Conclui-se assim que a distância focal desta cabeça galvanométrica não era a inicialmente considerada na construção da máquina. Para se poder operar este sistema seria então necessário determinar a distância focal e posteriormente alterar a distância entre a mesa de produção e a cabeça galvanométrica de forma a acomodar a distância focal correta.

A distância focal de uma lente é a distância entre a lente e o ponto onde a luz que ela converge tem o menor diâmetro. Na Figura 40 é possível ver a representação gráfica deste fenómeno, onde se observa uma convergência até ao ponto focal e uma divergência após o mesmo. Visto que se trata de um laser pode-se assumir que a densidade energética é máxima no ponto focal e o diâmetro do feixe mínimo.

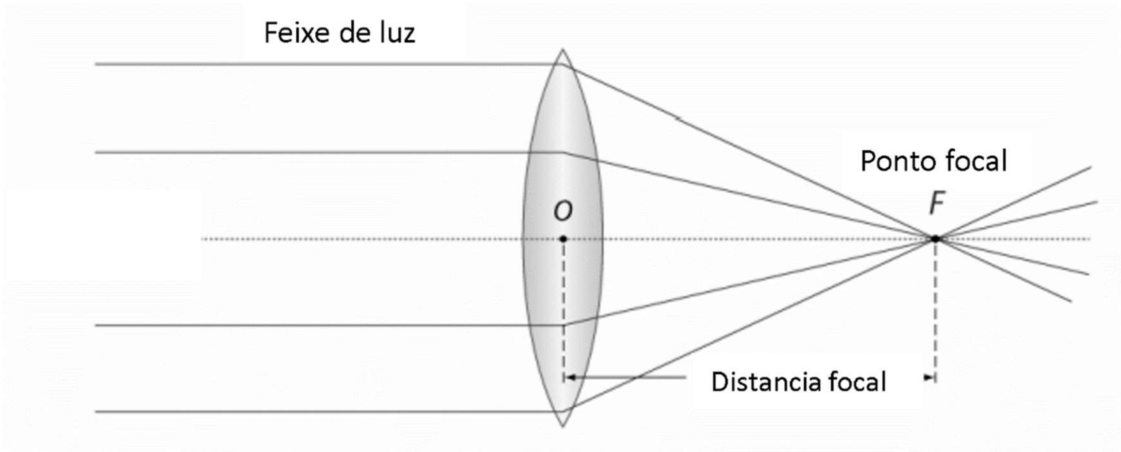

Figura 40 – Ponto e distância focal [34]

Para determinar a distância focal da cabeça galvanométrica, foi utilizado o seguinte método experimental

- Colocar uma chapa de aço inoxidável a uma determinada cota acima da mesa de produção;
- Executar a marcação dos caracteres e linhas e geometrias correspondentes à cota 0 mm (Figura 41);
- Baixar a mesa de suporte da chapa em teste 2 mm, no sentido de se afastar da emissão do laser, ou seja, aumentando a distância entre a chapa e a cabeça galvanométrica;
- Executar novamente a marcação correspondente à cota ("2 mm") a que a chapa se encontra (Figura 41);
- Repetição do processo de baixar a chapa e de marcação da mesma. (4, 6, 8, .. mm);
- Retirar a chapa marcada e analisar visualmente, a olho nu, a existência e qualidade das marcações nas diferentes cotas;
- Interpretação dos resultados obtidos
    - Tendo em consideração que o diâmetro do feixe é mínimo e a sua densidade energética máxima no ponto focal pode-se concluir que na cota da distância focal as marcações irão ser mais definidas e com maior intensidade;
- Realização de um novo teste com potências e cotas iniciais diferentes;

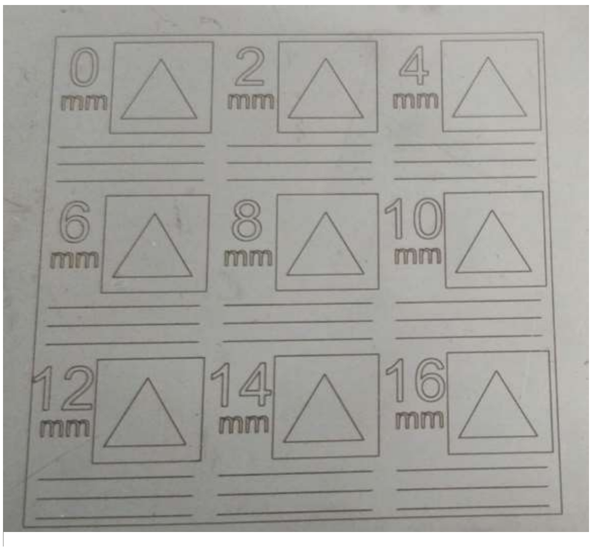

Figura 41 – Padrão de teste

Visto que as marcações que iriam ser feitas na chapa ocupam uma determinada área no campo de trabalho do laser foi feito um teste para aferir se o laser fazia marcações homogéneas nessa zona. Como é possível observar na Figura 41 e na Figura 42 as marcações são homogéneas em toda a área.

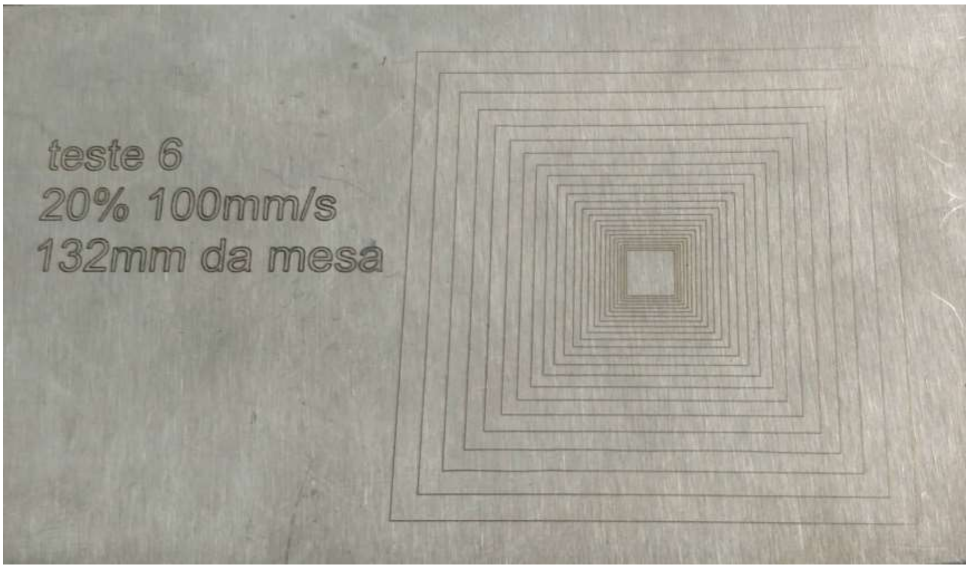

Figura 42 – Teste 6

No teste 5 foi feito um varrimento que iniciou a uma cota de 148 mm e com 20 % de potência. Como é possível verificar na Figura 43 as marcações tornam-se mais pronunciadas ao logo do varrimento, assumindo-se assim que o feixe está a convergir ao longo deste teste, no entanto não é possível verificar a divergência do mesmo.

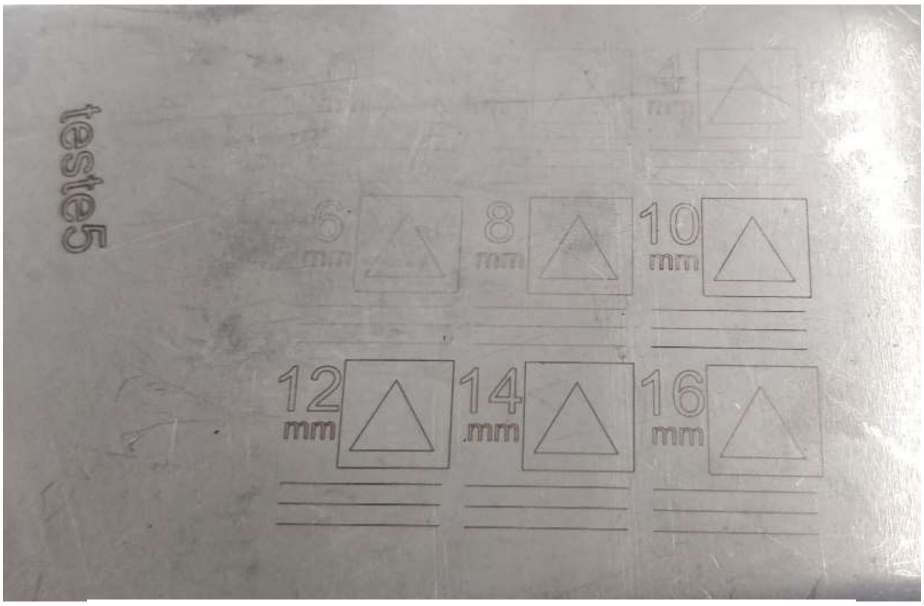

Figura 43- Teste 5

Considerando que no Teste 5 não foi possível verificar a divergência do laser no teste 7 (Figura 44) foi reduzida a cota da posição inicial de forma a se poder identificar a convergência e divergência do feixe laser. Embora seja notável alguma maior definição dos resultados entre 4 mm e 10 mm abaixo da cota inicial não é facilmente identificável quais apresentam maior intensidade.

Figura 44 – Teste 7

O teste 8 (Figura 45) foi executado com a mesma potência do teste 5 e 7, no entanto com uma cota inicial ainda inferior à do teste 7, numa tentativa de observar a divergência do feixe. No entanto não foi possível retirar conclusões.

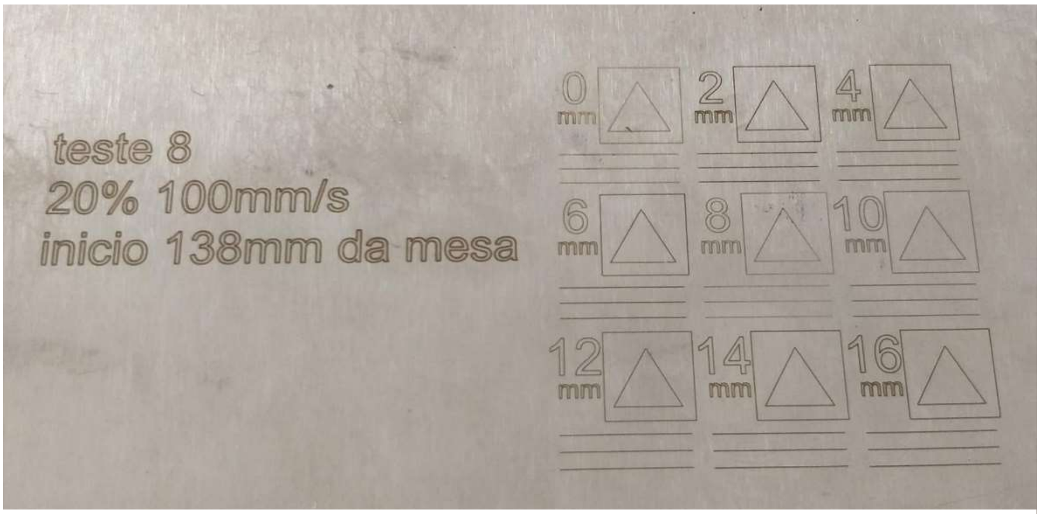

Figura 45 – Teste 8

Observando os resultados dos três testes apresentados, conclui-se que não era facilmente visualizável a diferença das marcações, então foi reduzida a potência de 20 % para 15 %.

Na Figura 46 é possível visualizar o teste 9, executado a 15 % de potência do laser, que iniciou a 148 mm acima da mesa de produção. É notável que as marcações entre 12 mm e 16 mm abaixo da cota de início são mais visíveis, no entanto não é possível observar a divergência visto que o teste acaba na cota menos 16 mm.

Figura 46 – Teste 9

Foi então reduzida a cota de início do teste para 142 mm no teste 10.1 (Figura 47), executado também com 15 % de potência. É possível verificar uma clara convergência e divergência do feixe e que a maior intensidade se apresenta entre 4 mm e 14 mm abaixo da cota inicial.

Figura 47 -Teste 10.1

Este teste foi repetido mais uma vez para assegurar a exatidão dos resultados (Figura 48).

Figura 48 – Teste 10.2

Também foram executados testes com menores potências de forma a tentar determinar com mais precisão o ponto focal, mas conclui-se que com potências inferiores a 15 % e com uma velocidade de 100 mm/s já não era possível ver nenhuma marcação na chapa.

Analisando os dados retirados dos testes foi construída a Tabela 1 com os dados da cota de início do teste e as cotas máximas e mínimas do início da convergência e da divergência do feixe laser. Conclui-se então que o ponto focal se encontrava aproximadamente 133 mm acima da mesa de produção. Este valor foi comunicado ao fabricante que criou um ficheiro de calibração que posteriormente foi inserido nas configurações do WeldMark.

Teste	Potência	Velocidade [mm/s]	Início [mm]	Min. [mm]	Max. [mm]	Ponto Focal [mm]
Teste 5	20%	100	148	Inconclusivo		
Teste 7	20%	100	142	Inconclusivo		
Teste 8	20%	100	138	Inconclusivo		
Teste 9	15%	100	148	12	16	134
Teste 10.1	15%	100	142	4	14	133
Teste 10.2	15%	100	142	4	14	133
Teste 11	12.5%	100	142	Não visível		

Tabela 1 – Resultados dos testes do ponto focal

Com os resultados deste ensaio o fabricante determinou que, possivelmente, a distância focal deste AM module seria de 470 mm. Com esta informação o apoio do AM module foi alterado de forma a posicionar esta cabeça galvanométrica 470 mm acima da mesa de produção (Figura 49).

Figura 49 – AM Module com suporte modificado

3.2.3 Calibração do AM Module

Neste capítulo ir-se-á abordar como foi executada e como se procedeu à calibração do AM Module.

Para assegurar o correto funcionamento do sistema laser é necessário afinar os parâmetros do mesmo, nomeadamente aqueles referentes ao AM Module da Raylase. O ajuste do AM module foca-se em dois aspetos principais, a calibração do eixo Z, que calibra o foco do laser e a calibração XY que compensa a distorção do feixe laser ao longo da área de trabalho.

A calibração do eixo Z faz-se com um *offset* global de Z, que determina uma posição ideal única para a lente do Z que depois se aplicará a toda a área de trabalho, ou com uma calibração "*Multipoint* Z", em que se determina uma posição da lente de Z para vários pontos em toda a área da mesa de produção.

A calibração dos eixos XY corrige as deformações causadas pelos espelhos XY e pela lente *F-Theta*, esta calibração pode ou ser feita com o uso de um simples ganho que determina um valor para escalar os objetos a projetar conforme se afastam do centro da mesa de produção, ou com uso a um *XY-Multipoint* em que é definido um ganho e escala para vários pontos em toda a área da mesa de produção.

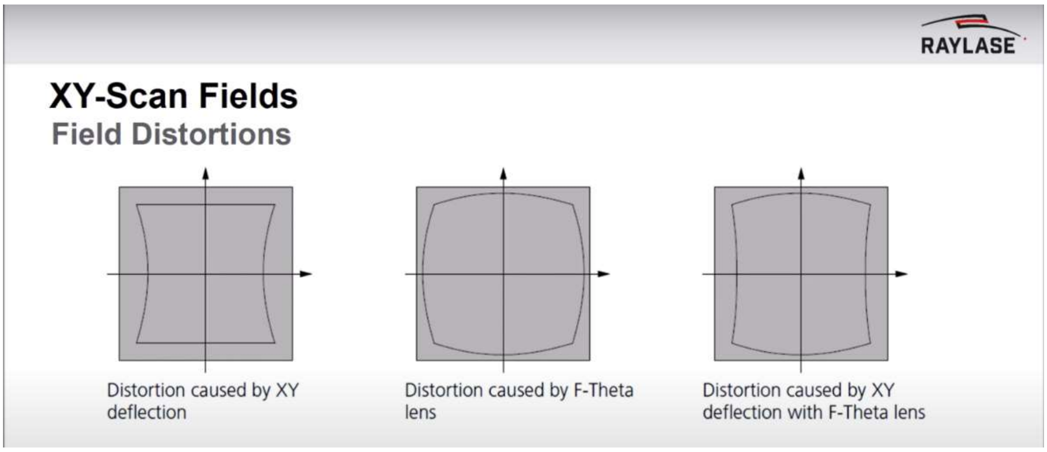

Figura 50 – Distorções do campo de trabalho

Neste trabalho a calibração do Z foi feita usando um offset global de Z, dado à pequena área de trabalho do laser, e um XY-*Multipoint*, para garantir a precisão do laser nos extremos da área de trabalho.

3.2.3.1 Calibração do eixo/lente Z

O primeiro passo para a calibração do sistema AM module é garantir que a face inferior do AM module se encontra a uma distância de 470 mm da mesa de trabalho, com uma tolerância inferior a 2 mm. Caso esta distância esteja errada ou o AM module não esteja paralelo à mesa de trabalho serão visíveis assimetrias no mapa de correção XY que se abordará na calibração XY-*Multipoint*. Para proceder à afinação desta distância foram usados os parafusos de afinação localizados no suporte do AM module (Figura 51) e um esquadro.

Figura 51 – Mecanismo de ajuste da distância focal

Após garantir que o AM module se encontra paralelo e a 470 mm da mesa de trabalho desenhou-se um quadrado no software WeldMark 3, e projetou-se o laser sobre uma folha previamente impressa a preto com uma potência de entre 13 % a 15 % com variadas velocidades até se encontrar uma velocidade em que o quadrado ficasse melhor visível (Figura 52).

Figura 52 – Ensaios sobre folhas impressas a preto

Quando encontrada uma configuração de velocidade e potência em que se visualiza bem o quadrado, estes parâmetros (velocidade e potência) devem ser inseridos no "*Test Pattern*" , canto superior direito da Figura 53. A sequência de parametrização continua com o seguinte:

- "Current Job"->"SP-ICE 3"->" 2D_ASV-30-Y_0300-1200HP_364_WD470"
- Selecionar "*Calibrate*"
- Selecionar "No" na "*Multipoint correction*"
- Selecionar "*Yes*" no "*Fine Focal Point adjustment*".

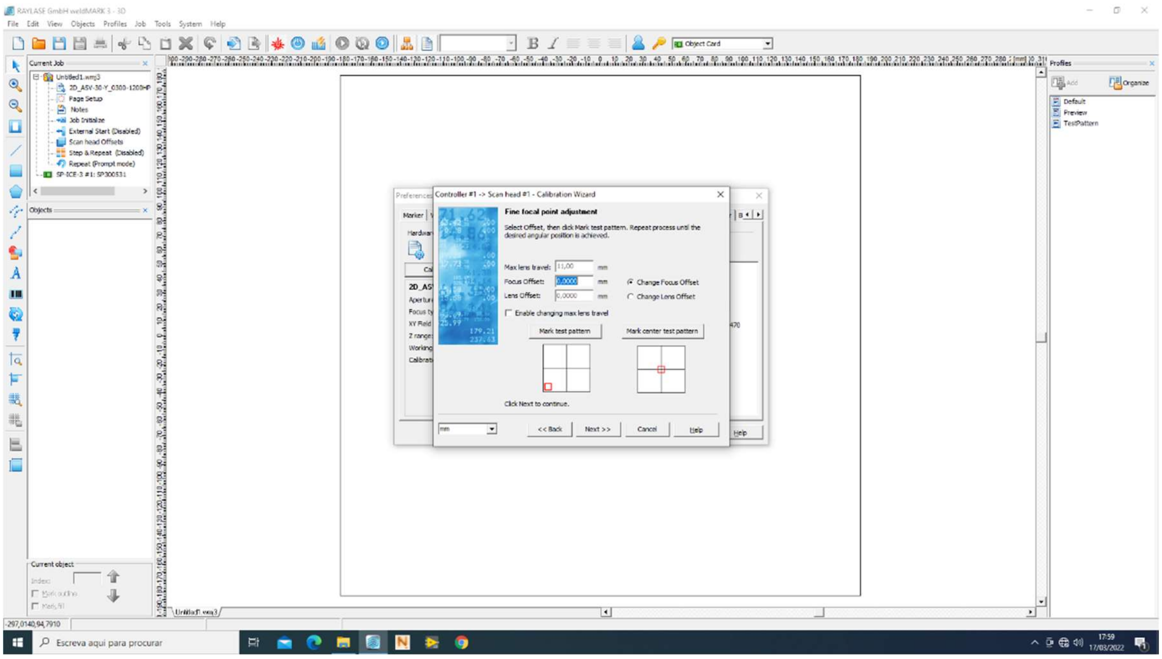

Figura 53 – Ajuste do ponto focal no software WeldMark 3

Uma vez aberta a configuração do ponto focal e selecionado "*Change Lens Offset*" deve ser incrementado o valor de "*Lens Offset*" em valores de 0.05 mm a 0.1 mm fazendo várias marcações com "*Mark center test pattern*", movimentando a folha após cada marcação (Figura 54). No final deve ser selecionado o valor de "Z-Lens-Offset" em que a marcação do quadrado se tornou mais nítida.

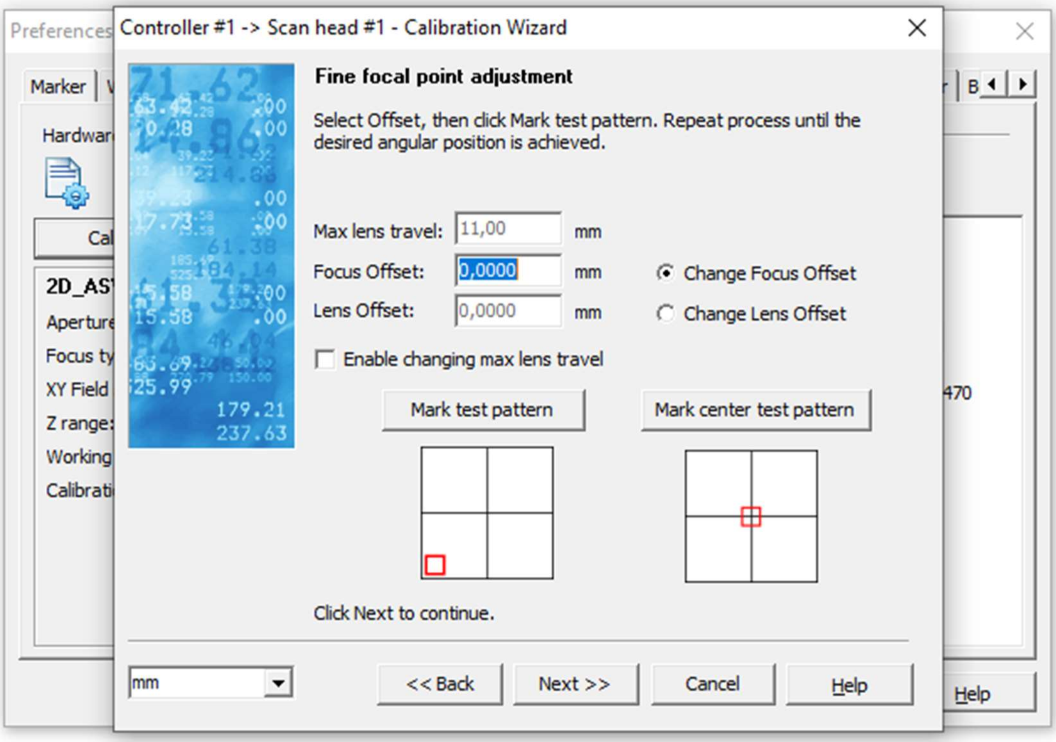

Figura 54 – *Calibration Wizard*

3.2.3.2 Calibração dos Eixos XY

Após concluída a calibração da Lente Z é possível passar à calibração dos eixos XY, sendo que para este ajuste é necessária a ferramenta "*Multipoint Editor*" da Raylase. Esta calibração esta detalhada em [21] .

O primeiro passo é arrancar com o *software* "*MultiPoint Editor*" e aí abrir o ficheiro de calibração do AM Module (C:\ProgramData\Raylase\Correction Files\2D_ASV-30-Y_0300-1200HP_364_WD470.fc3). Os passos seguintes são:

- fazer "Discover"
- conectar a Placa SP-ICE3

Uma vez ligado à placa SP-ICE3 e com o ficheiro de calibração aberto passa-se à configuração da marcação, usando o parâmetro "*Z Lines*" no "*Pattern*" e 9X9 como "*Grid Points*", deixando todos os restantes parâmetros inalterados somente inserido o "*Mark*

Speed” e “*Power*” que também foram usados na calibração da lente Z. Para proceder à marcação basta armar o laser e proceder à marcação. (Figura 55)

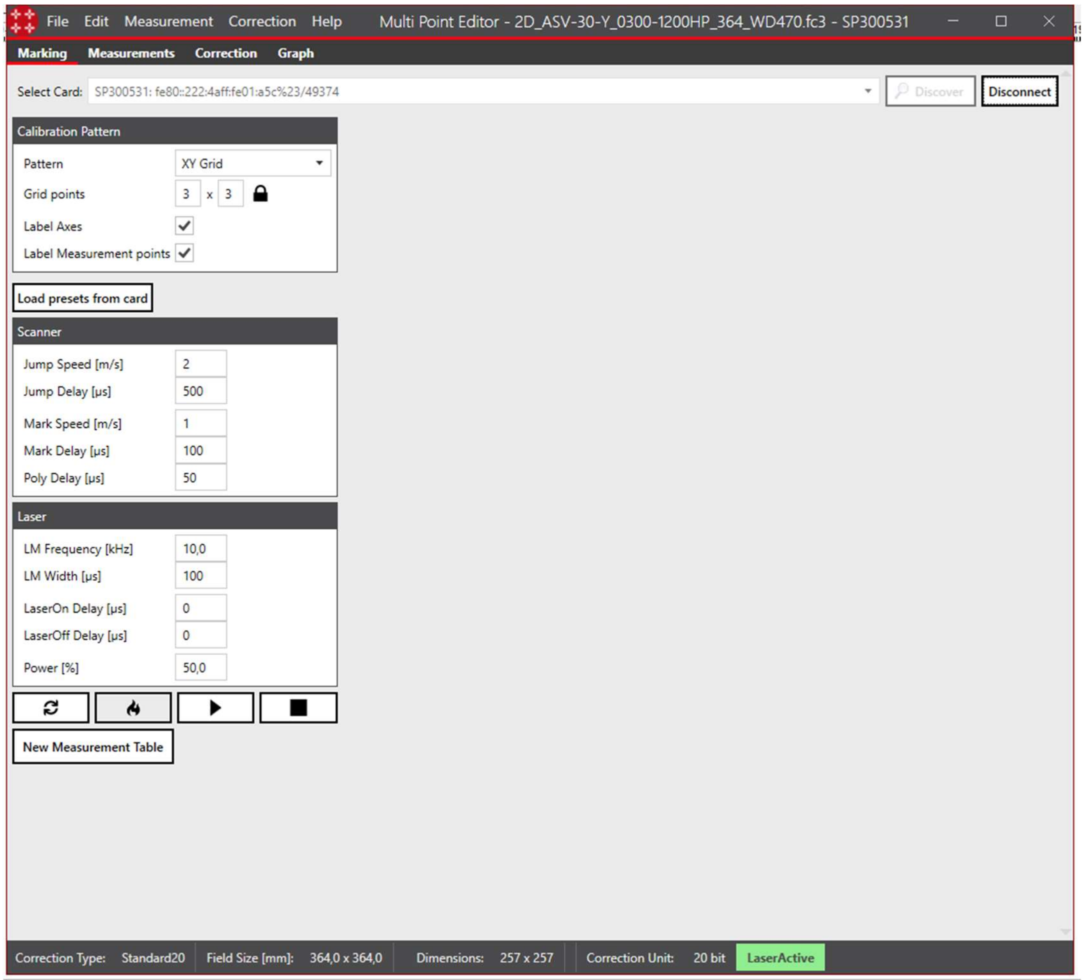

Figura 55 – Calibração XY com *MultiPoint Editor*

Uma vez feita a marcação, poderá passar-se à medição do comprimento das linhas Z e inserir os seus resultados premindo em “*New Measurment tables*” e inserindo o valor das medições nos respetivos locais. Posteriormente carregando em “*Apply*”, depois guardando o novo ficheiro de correção com um nome diferente do original.

Uma vez concluído este processo, o mesmo deve ser repetido duas a três vezes para assegurar que a calibração foi bem feita. No final, quando os resultados forem consistentes, deve ser carregado o novo ficheiro de correção no software WeldMark, através da opção “*Change*”. (Figura 56).

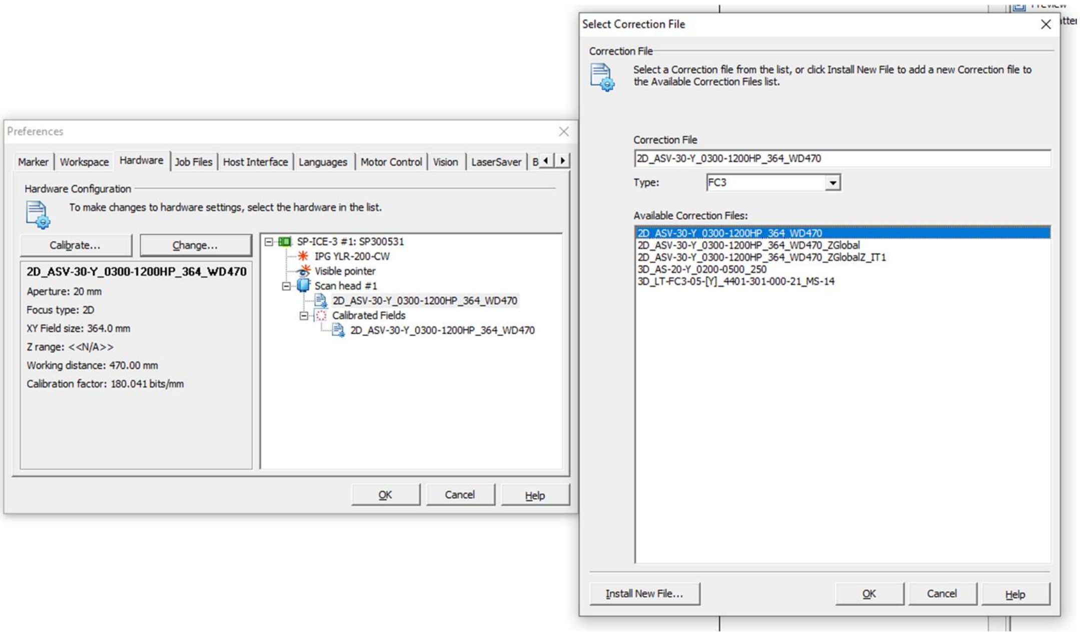

Figura 56 – Seleção do ficheiro de correção

Uma vez ajustada a distância focal entre a mesa de produção e a cabeça galvanométrica foram feitos ensaios com pós metálicos. Espalhou-se manualmente o pó de aço inoxidável (Figura 57) MetcoAdd 316L -A da empresa Oerlikon metco (Figura 59) sobre uma chapa de aço macio, com espessuras de aproximadamente 50 µm e foram testadas varias velocidades e potências laser (Figura 58).

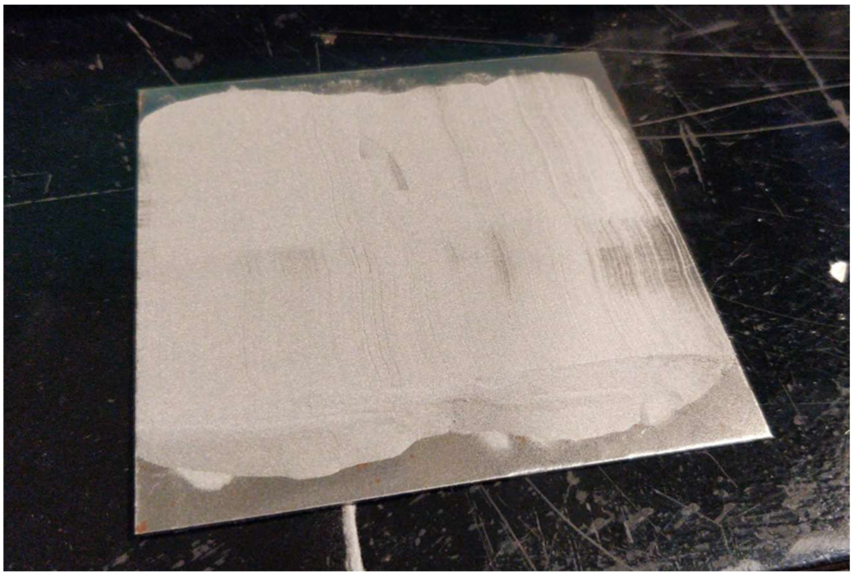

Figura 57 – Pó metálico espalhado sobre uma chapa de aço macio

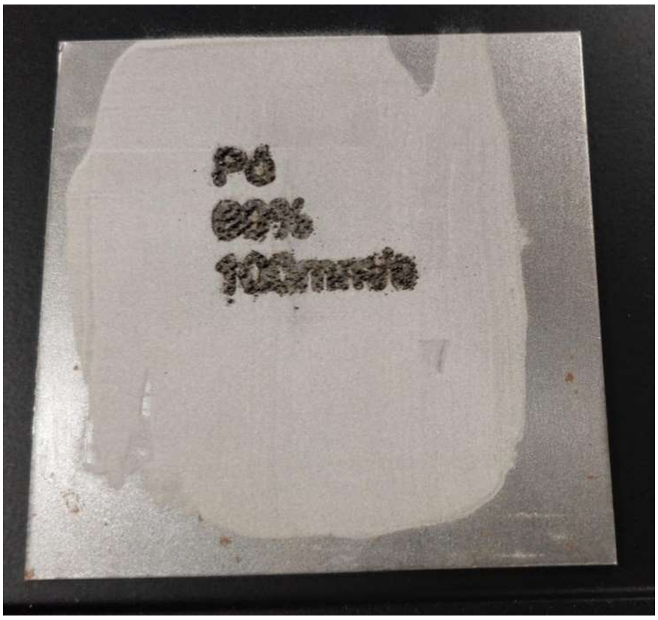

Figura 58 – Pós metálicos fundidos

Após se ensaiarem com várias velocidades e potências foi possível obter excelentes resultados usando 40 % de potência e uma velocidade de 100 mm/s (Figura 60).

Figura 59 – Pó MetcoAdd 316L -A

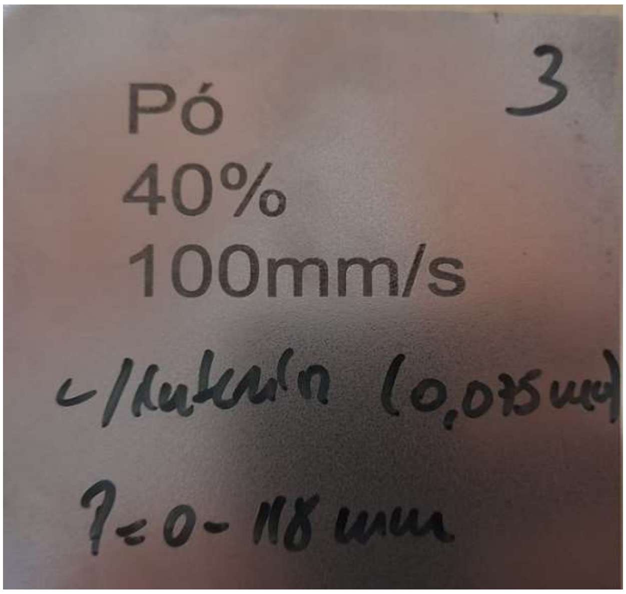

Figura 60 – Escrita com pó metálico

Na Figura 61 é possível observar o pó fundido ao microscópio ótico. Trata-se de operar o laser contínuo de fibra de itérbio de 200 W, usando apenas 40% de potência à velocidade de varrimento do feixe de 100 mm/s, em impressão numa camada de aproximadamente 50 µm.

Tendo sido provado que o equipamento consegue fundir pó metálico de aço inoxidável AISI 316L importa explicar o funcionamento do equipamento (secção seguinte).

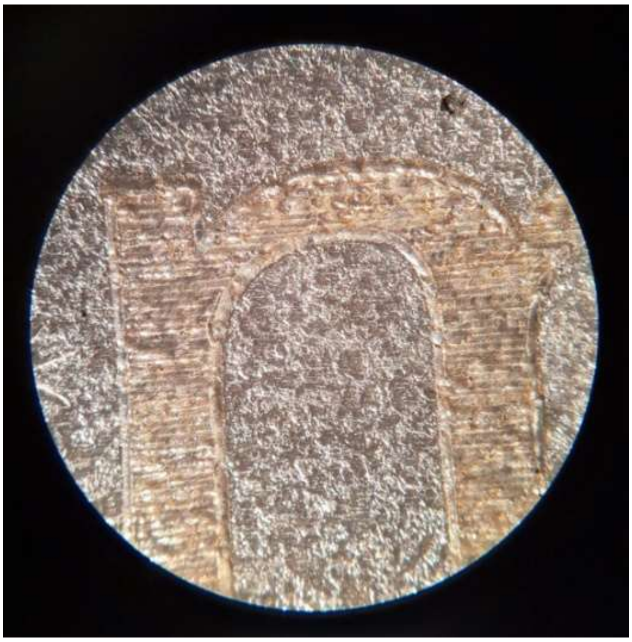

Figura 61 – Escrita com pó metálico ao microscópio ótico

3.3 Método de operação da máquina

A máquina de fabrico aditivo encontra-se agora operacional em modo manual. O processo de funcionamento é o seguinte

- Ligar o seccionador geral que está no quadro elétrico da máquina, certificando-se que o botão de emergência não está premido. De facto, sempre que a luz dos leds indicadores de segurança estiver ligada, tal significa que a máquina está em paragem de emergência. Se for o caso, carregar no botão verde (operadores do sistema de segurança – Figura 63) para a colocar novamente em funcionamento.
    - Ligar o sistema de refrigeração (chiller) CW-3000 da cabeça galvanométrica (Figura 62)

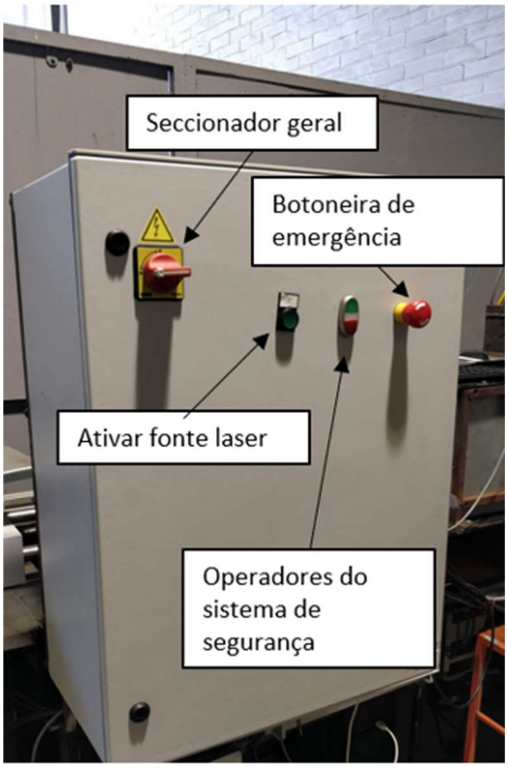

Figura 62 – Quadro Elétrico

- Ligar o laser em modo “*Remote*” rodando a chave para o lado esquerdo, Figura 64, e premindo o botão “Ativar fonte laser” (Figura 63).
- Ligar o computador
- Iniciar os programas WeldMark e “LabView MFA”, que se encontram no ambiente de trabalho.

Figura 63 – Sistema de refrigeração CW-3000

Figura 64 – Gerador laser IPG
YLR-200-AC

O programa elaborado em Labview está já com janelas preparadas para vários tipos de funcionamento, no entanto, neste documento somente o modo manual será abordado pois é o único completamente funcional. Assim, após arranque do programa o primeiro passo consiste em selecionar o modo "manual" na página "Sinóptico". Seguidamente descrevem-se as várias aplicações necessárias ao processamento:

- Movimentação das plataformas de pó e construção

i. Selecionar a página da plataforma que se tenciona operar "Plataforma de Pó" ou "Plataforma de Construção" (Figura 65)
ii. Selecionar "*Enable Motor*"
iii. Definir o sentido do movimento
iv. Definir a distância a percorrer
v. Definir a velocidade (ex: 2000 Hz, mais detalhes em Anexo C)
vi. Selecionar "Fazer movimento pó" e com isso dá-se o movimento
vii. Desselecionar "*Enable motor*"

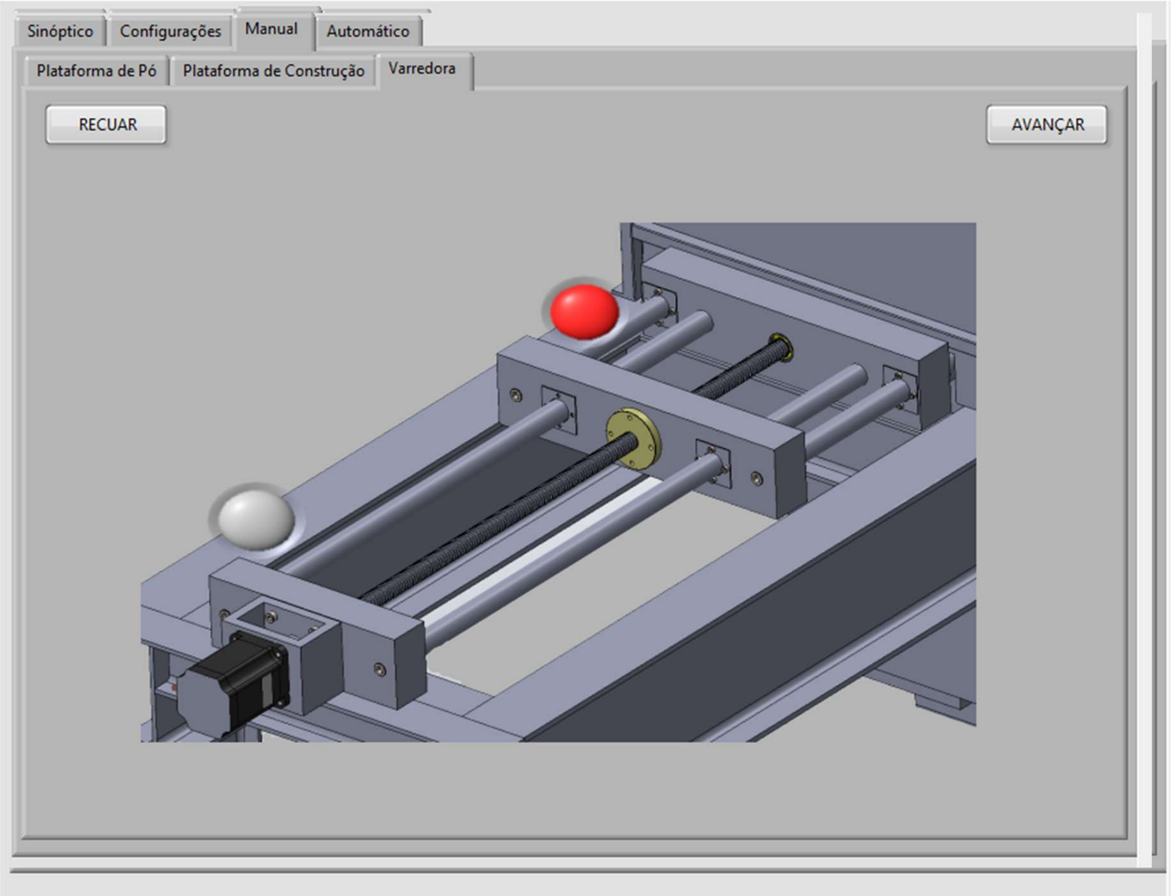

Figura 65 – Subida e descida das mesas no software LabView

O acionamento mecânico das mesas é efetuado por um sistema motor-acoplamento rígido-fuso de aço-porca de bronze. Naturalmente, há folga na ligação fuso/porca, pelo que se deve ter em consideração este facto quando se fazem inversões de sentido. Obviamente, durante o movimento no mesmo sentido, que é o que se passa durante o fabrico aditivo propriamente dito, a folga não existe.

- Movimento da varredora
    i. Selecionar a página da varredora
    ii. Para avançar a varredora pressionar "Avançar"
    iii. Para recuar a varredora pressionar "Recuar"
    iv. Os indicadores luminosos indicam o estado dos sensores fins de curso da varredora (Figura 66)

O software Weldmark está amplamente documentado em Anexo D. A utilização básica do programa e a marcação de peças faz-se da seguinte forma:

Figura 66 – Movimento da Varredora

- Iniciar o Software Weldmark 3 (Figura 67)
- Desenhar a geometria pretendida usando as Ferramentas de Desenho e opção de "Dimensões" e alterar parâmetros laser em "Propriedades" (25 % e 250 mm/s são o suficiente para marcar metais tais como o aço macio e o inoxidável).
- Iniciar a fonte do laser pressionado o botão "Ativar fonte laser" que se encontra no quadro elétrico da máquina (Figura 63). A fonte do laser deve apresentar uma luz verde.
- Ligar a emissão com o botão "*Arm all lasers*" / "*Emission Enable*" no *software*. A fonte do laser deverá nessa altura ter uma luz cor de laranja ligada, que indica que o laser está pronto a disparar.
- Selecionar a opção QuickMark. A marcação é efetuada.
- Desativar o sistema abrindo a porta da máquina ou pressionando o botão de emergência.

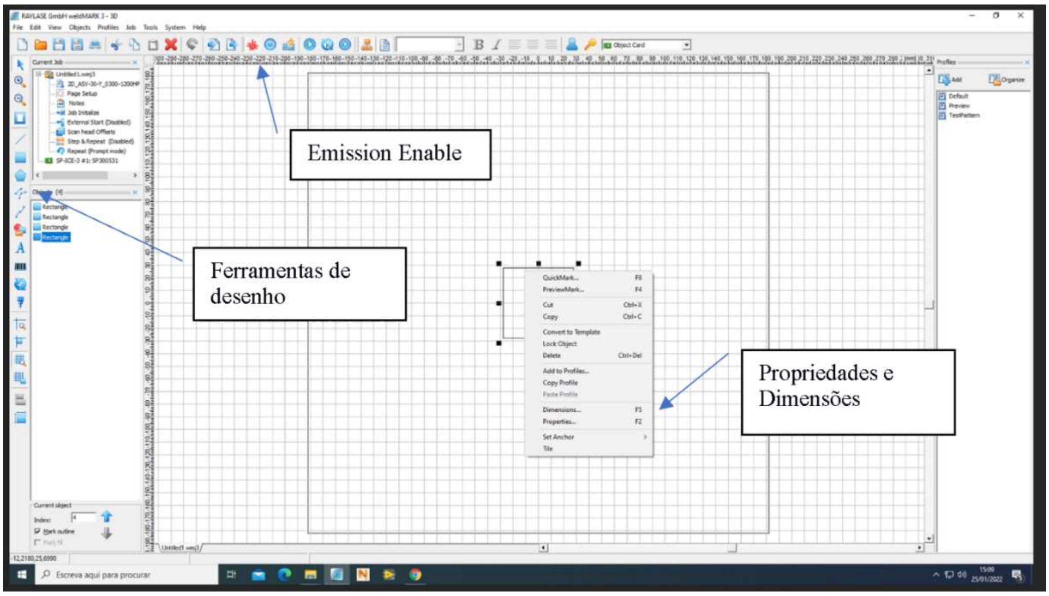

Figura 67 – Software WeldMark 3 com descritivos

Para desligar a máquina a sequência consiste em desligar a fonte do laser, o computador, o Sistema de refrigeração e por fim o seccionador geral.

4. Conclusão

Este trabalho relatou uma parte do processo de evolução da máquina de fabrico aditivo desenvolvida e concebida no Departamento de Engenharia Mecânica da Universidade de Aveiro, da sua melhoria, as suas oportunidades de melhoria e a sua calibração e afinação.

As principais conclusões são as seguintes:

- Foi determinado o ponto focal do laser e efetuada a sua calibração, pelo que esta dissertação poderá servir como guia para ajustes futuros da máquina.
- É possível operar a máquina em modo manual e fundir uma camada de pó de aço AISI 316 sobre uma chapa de aço macio.
- Com laser contínuo de fibra de itérbio de 200 W, usando apenas 40% de potência à velocidade de varrimento do feixe de 100 mm/s, o resultado visual da impressão numa camada de aproximadamente 50 µm é de excelente qualidade, conforme visível na Figura 61.
- A máquina conseguiu obter excelentes resultados visuais na deposição de uma camada metálica, mesmo sem qualquer gás de proteção. Naturalmente, poderão existir problemas de porosidade ou oxidação que não foram explorados. A olho nu, o resultado está perfeito.

Em suma, cumpriu-se os objetivos de colocar em operação o sistema laser da máquina e da sua calibração, bem como se validou a capacidade de máquina de fundir pó metálico de aço inoxidável AISI 316.

Numa perspetiva de continuidade do desenvolvimento da máquina nos seguintes parágrafos irão ser abordados alguns pendentes da máquina, bem como propostas de melhoria para trabalhos futuros.

Para ocorrer a fusão de pós na máquina é necessário que a espessura da camada de pó seja controlada, para isso é importante colocar em operação o sistema de zeros máquina que se encontra instalado, mas, no entanto, não se encontra operacional.

Para garantir uma camada de pó homogénea também irá ser necessário fazer alterações ao sistema da varredora visto que o atual não se mantém paralelo à mesa, desgastando-a e criando uma camada irregular (Figura 27).

Em relação à mesa de produção existe um problema de nivelamento idêntico, pelo que seria útil a alteração da mesa atual de forma a possibilitar o seu nivelamento. O sistema de nivelamento pode ser tão simples como o apresentado na Figura 68, o qual consiste na adição de 2 parafusos à mesa atual de forma a se poder nivelar a mesa com 4 parafusos.

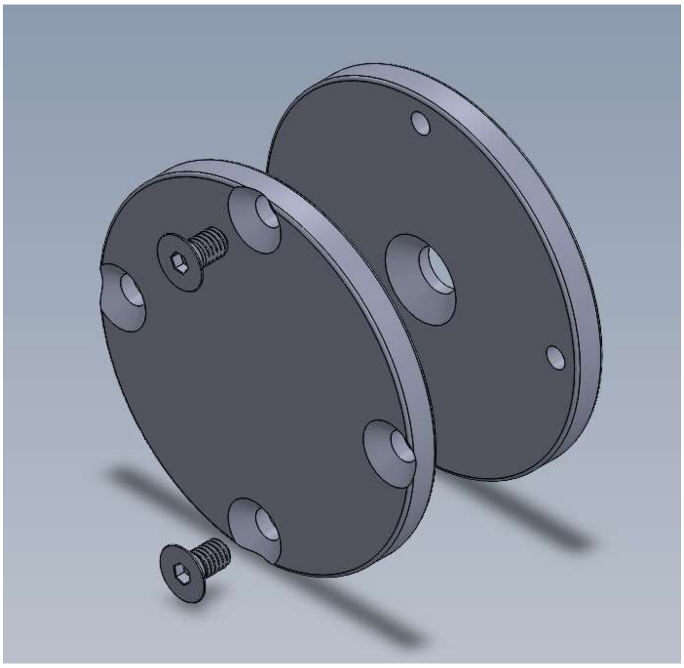

Figura 68 – Proposta de sistema de nivelamento da mesa de produção

Quanto ao software de controlo ainda está pendente a integração do LabView com o software WeldMark, para ser possível operar a máquina em modo automático.

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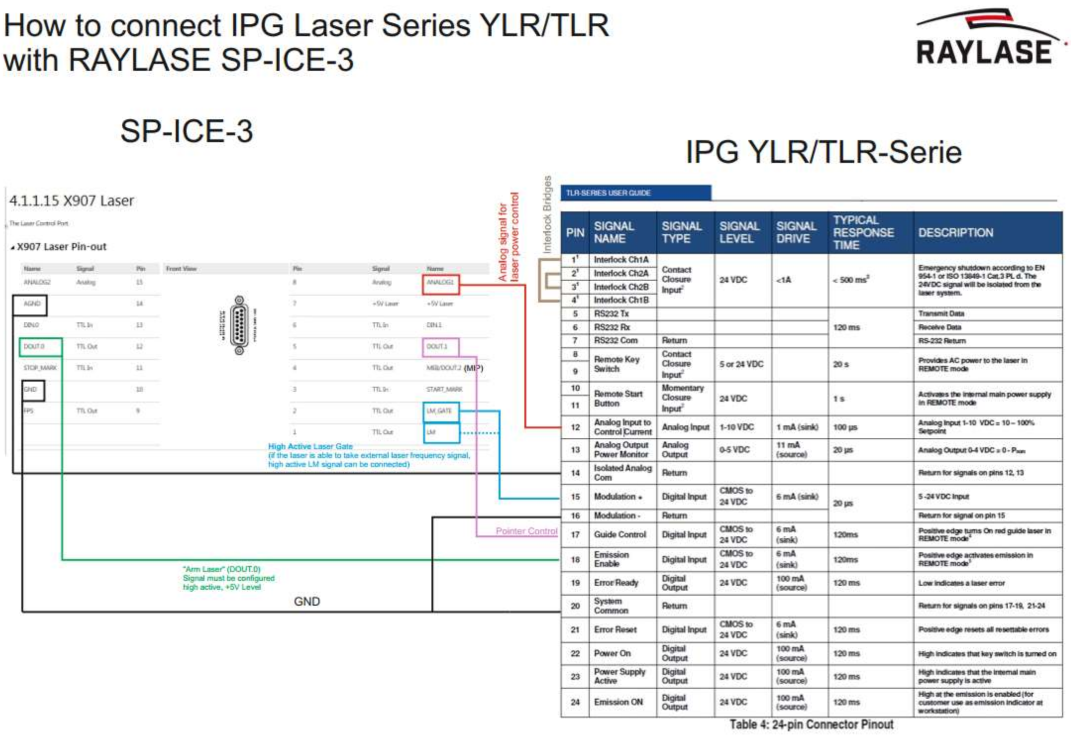
6. Anexos

Anexo A: Manual Ligação IPG SP ICE 3



PIN	SIGNAL NAME	SIGNAL TYPE	SIGNAL LEVEL	SIGNAL DRIVE	TYPICAL RESPONSE TIME	DESCRIPTION
1[1]	Interlock Ch1A	Contact Closure Input[2]	24 VDC	<1A	< 500 ms[2]	Emergency shutdown according to EN 954-1 or ISO 13849-1 Cat.3 PL d. The 24VDC signal will be isolated from the laser system.
2[1]	Interlock Ch2A					
3[1]	Interlock Ch2B					
4[1]	Interlock Ch1B					
5	RS232 Tx				120 ms	Transmit Data
6	RS232 Rx					Receive Data
7	RS232 Com	Return				RS-232 Return
8	Remote Key Switch	Contact Closure Input[2]	5 or 24 VDC		20 s	Provides AC power to the laser in REMOTE mode
9						
10	Remote Start Button	Momentary Closure Input[2]	24 VDC		1 s	Activates the internal main power supply in REMOTE mode
11						
12	Analog Input to Control Current	Analog Input	1-10 VDC	1 mA (sink)	100 µs	Analog Input 1-10 VDC = 10 – 100% Setpoint
13	Analog Output Power Monitor	Analog Output	0-5 VDC	11 mA (source)	20 µs	Analog Output 0-4 VDC = 0 - P_{nom}
14	Isolated Analog Com	Return				Return for signals on pins 12, 13
15	Modulation +	Digital Input	CMOS to 24 VDC	6 mA (sink)	20 µs	5 -24 VDC Input
16	Modulation -	Return				Return for signal on pin 15
17	Guide Control	Digital Input	CMOS to 24 VDC	6 mA (sink)	120ms	Positive edge turns On red guide laser in REMOTE mode[3]
18	Emission Enable	Digital Input	CMOS to 24 VDC	6 mA (sink)	120ms	Positive edge activates emission in REMOTE mode[3]
19	Error Ready	Digital Output	24 VDC	100 mA (source)	120 ms	Low indicates a laser error
20	System Common	Return				Return for signals on pins 17-19, 21-24
21	Error Reset	Digital Input	CMOS to 24 VDC	6 mA (sink)	120 ms	Positive edge resets all resettable errors
22	Power On	Digital Output	24 VDC	100 mA (source)	120 ms	High indicates that key switch is turned on
23	Power Supply Active	Digital Output	24 VDC	100 mA (source)	120 ms	High indicates that the internal main power supply is active
24	Emission ON	Digital Output	24 VDC	100 mA (source)	120 ms	High at the emission is enabled (for customer use as emission indicator at workstation)

Table 4: 24-pin Connector Pinout

Anexo B: Esquema Eletrico

0	1	2	3	4	5	6	7	8	9

F26_001

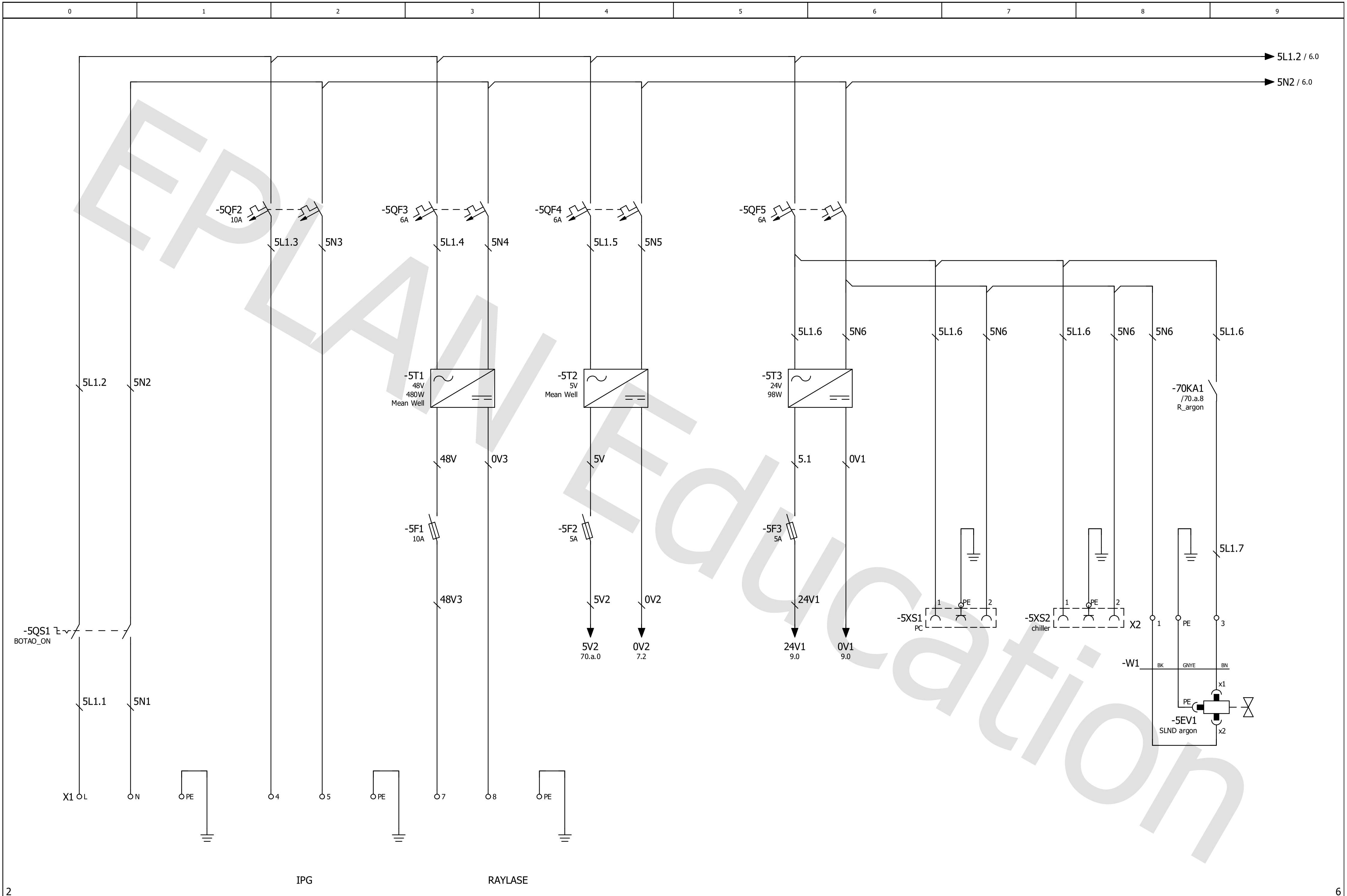
EPLAN Software & Service

Phone

Company / customer	
Project description	Projeto elétrico: Máquina DMLS
Job number	IEC_tpl003
Commission	EPLAN
Manufacturer (company)	EPLAN Software & Service
Path	EPLAN sample project
Project name	New project
Make	
Type	
Place of installation	
Responsible for project	
Author	Luís Costa

Created on 23/05/2021

Edit date 11/10/2021 by (short name) luis1 Number of pages 11



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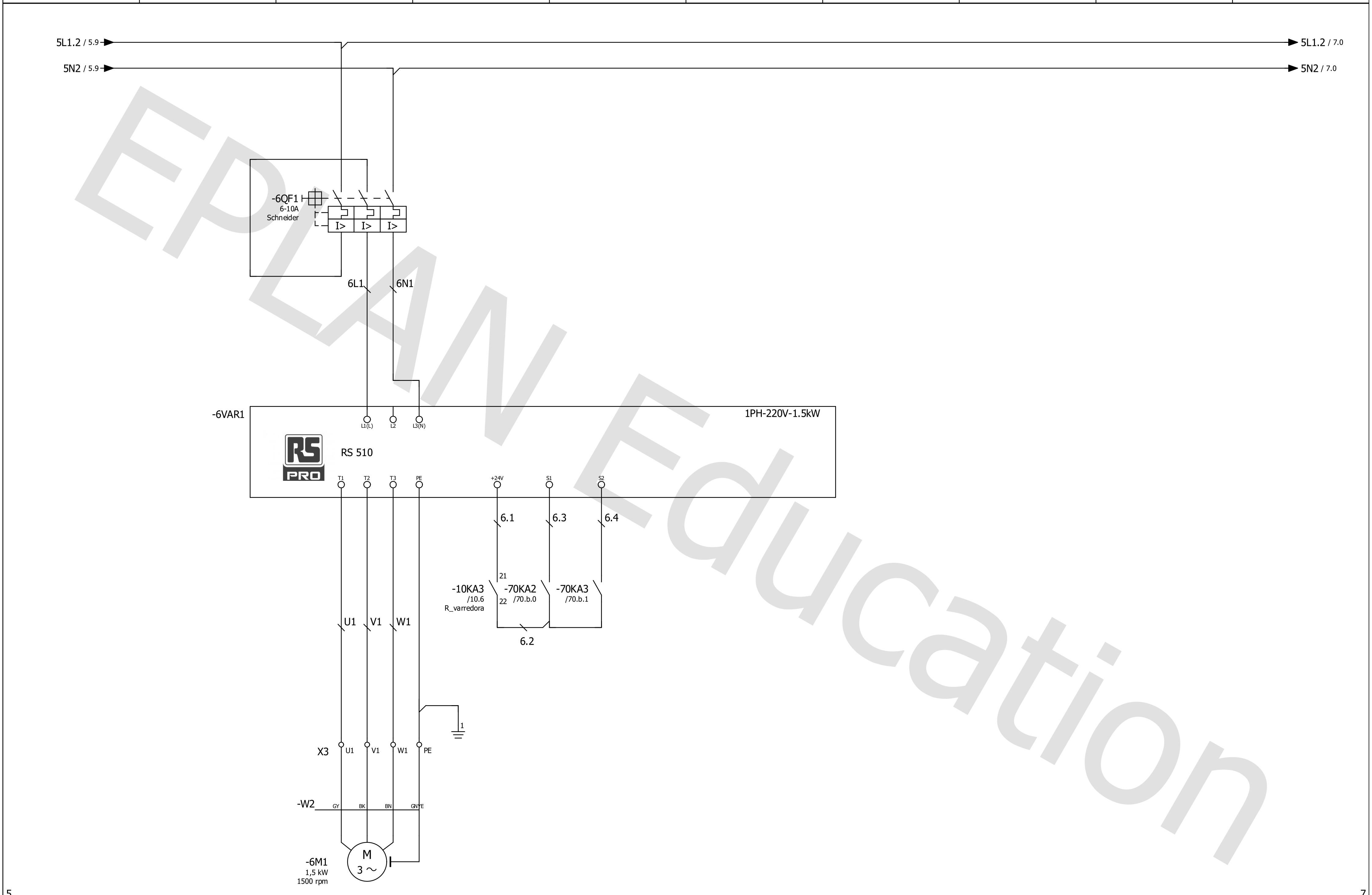

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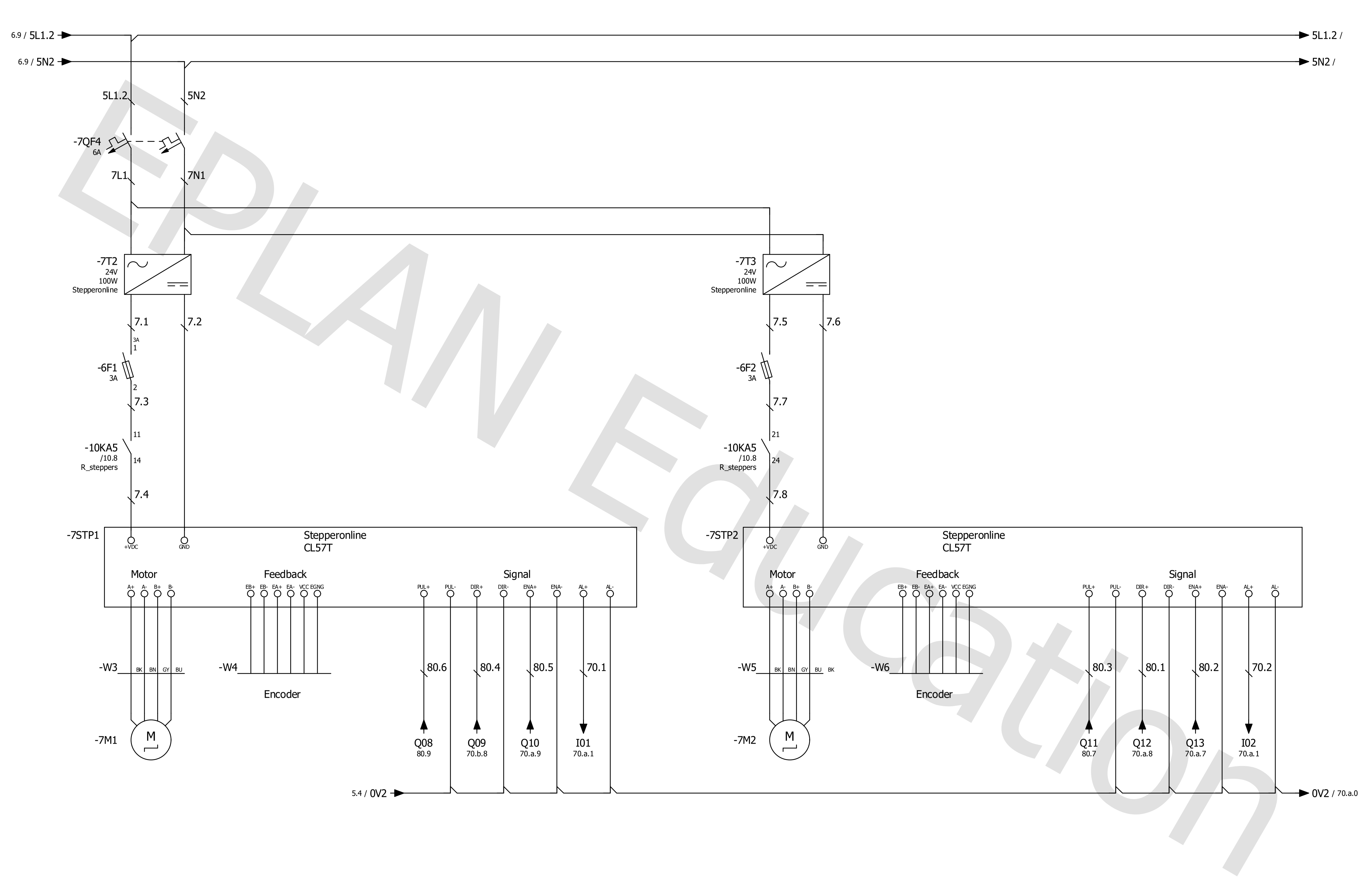

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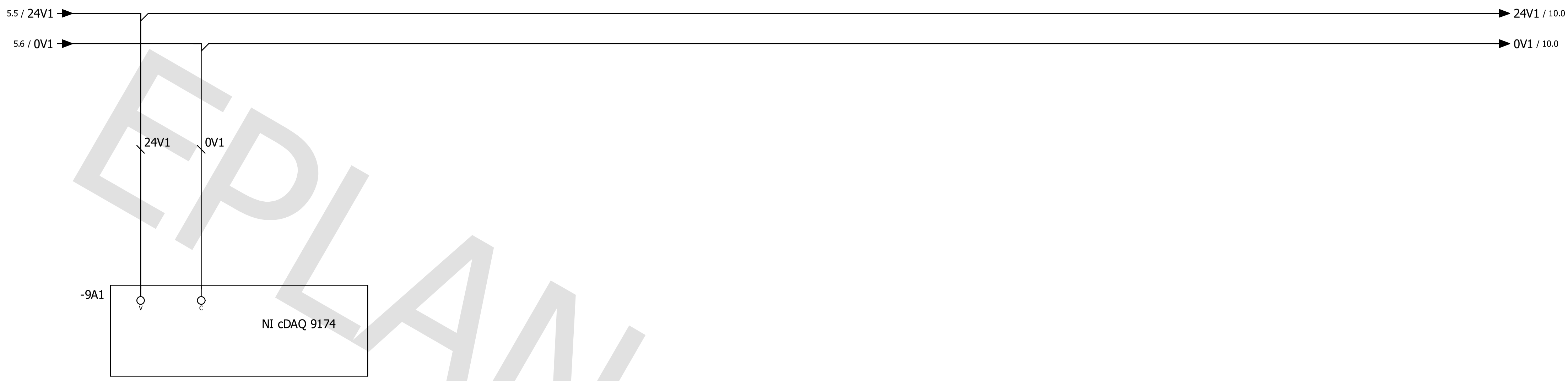

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Page 9

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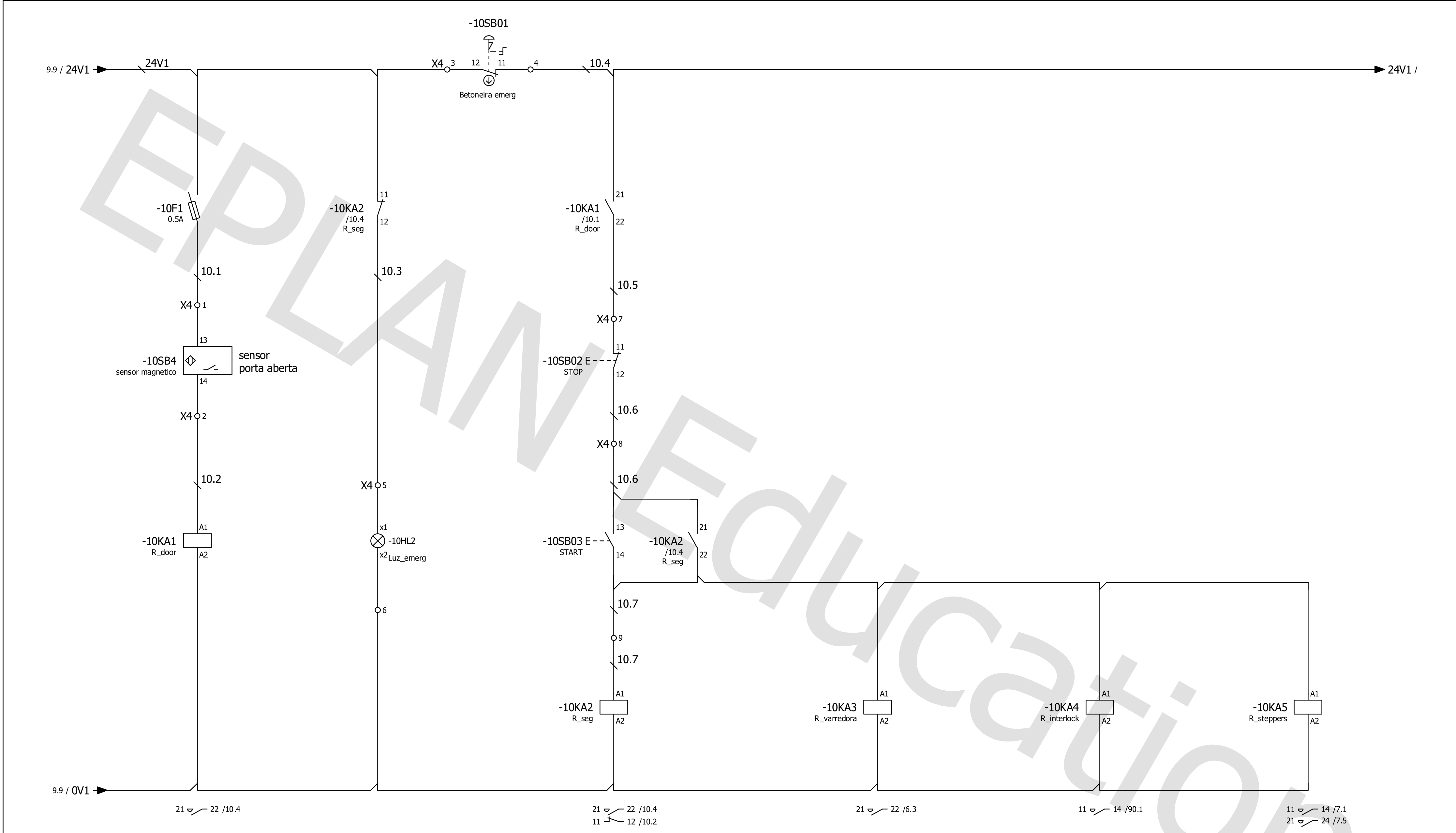

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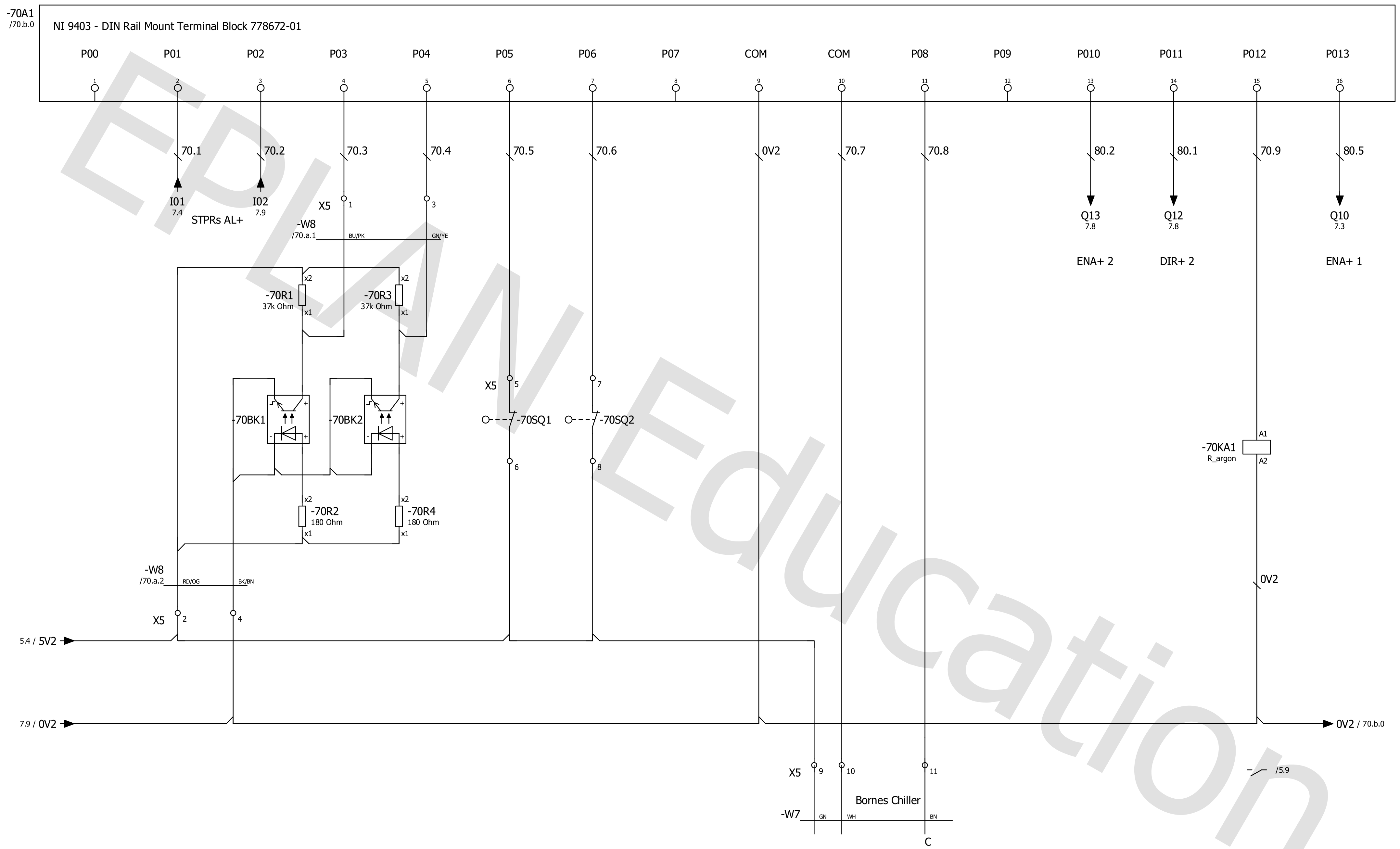

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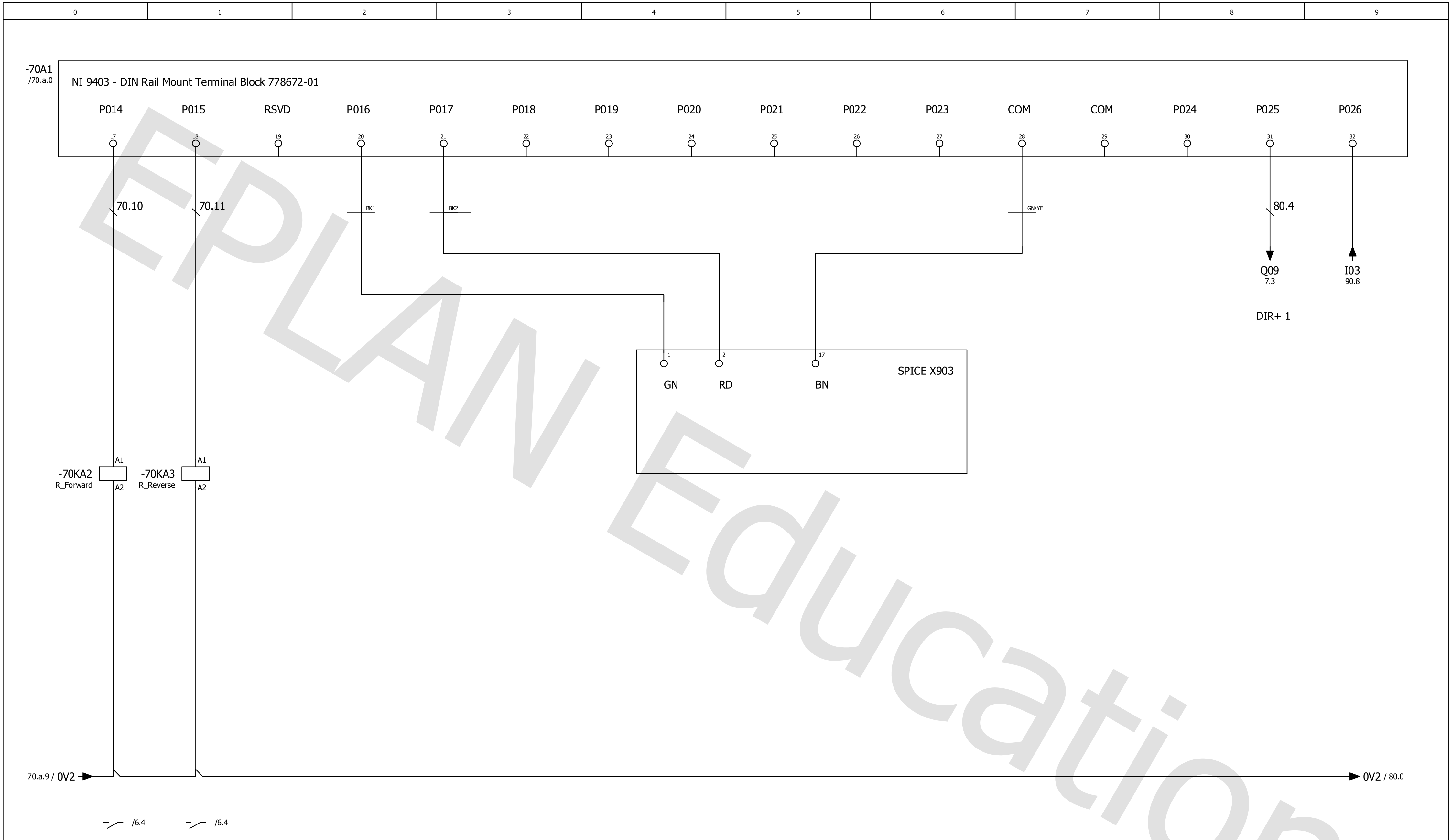

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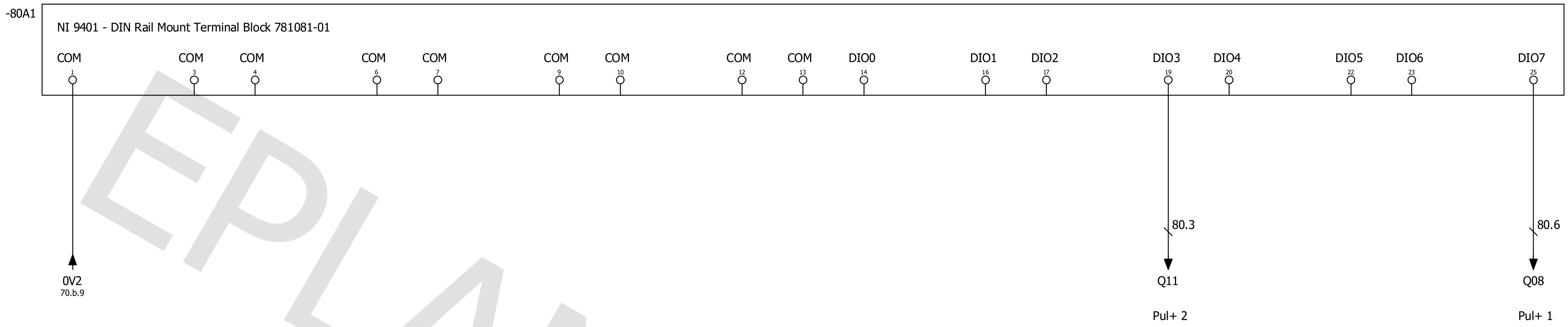

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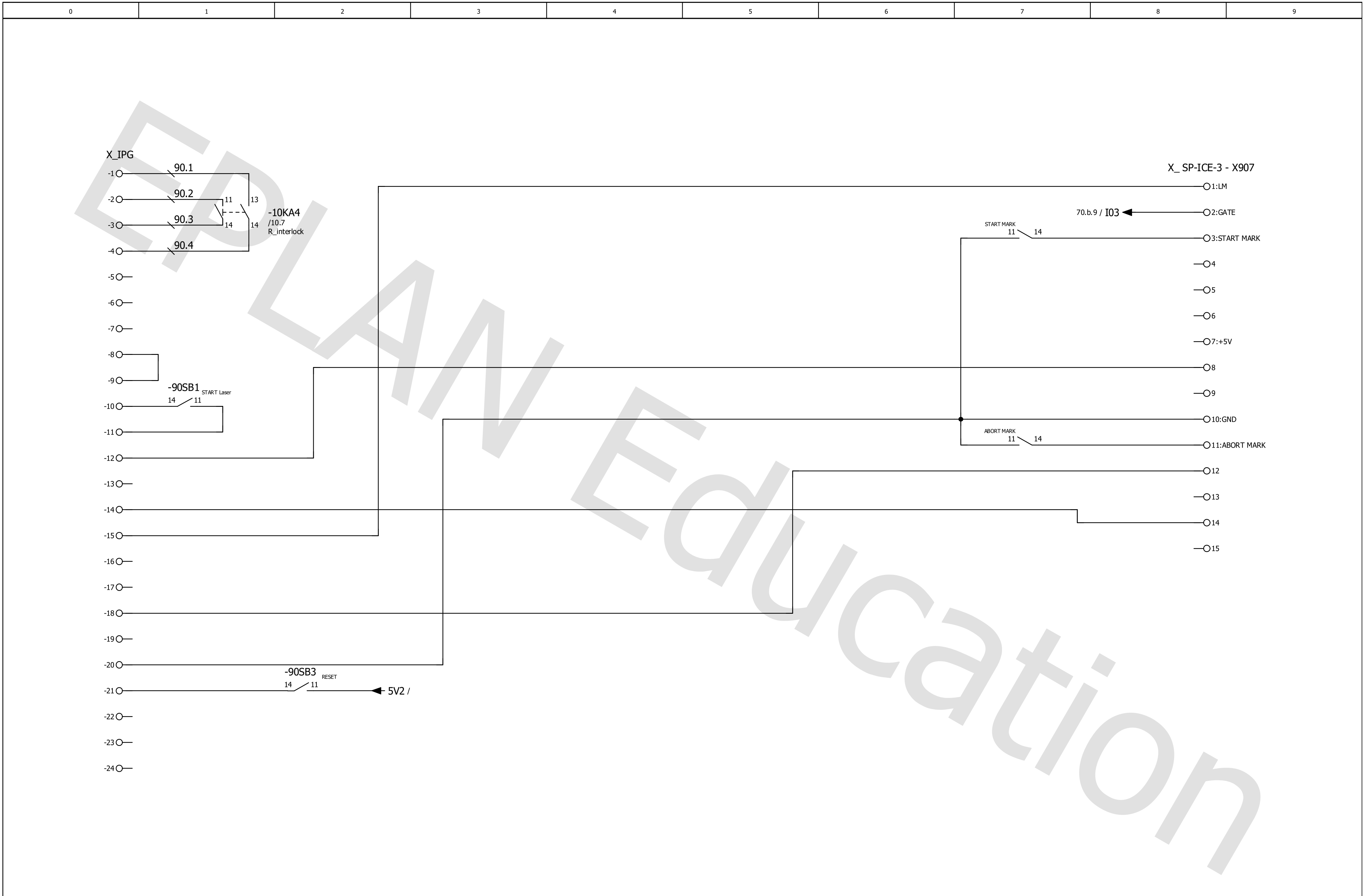

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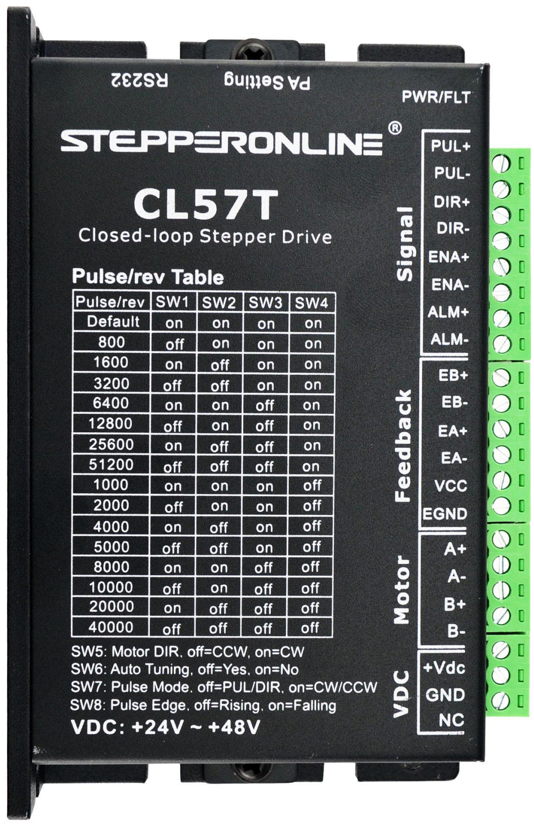
Anexo C: Manual Controlador de motor de passo CL57T

STEPPERONLINE®

User Manual

CL57T(V3.0)

Closed Loop Stepper Driver



Revision 3.0

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Notice

Read this manual carefully before any assembling and using. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information regarding installation requirements.

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Table of Contents

1. Introductions

This **Closed Loop Stepper Driver,** offers an alternative for applications requiring higher performance and higher reliability than open loop stepper system, and it remains cost-effective. The matched stepper motors are NEMA17,23 and 24 combined with an internal encoder which is used to close the position, velocity and current loops in real time.

1.1 Features

- Input voltage 24-48VDC, output peak current 0-8.0A
- Closed-loop, eliminates loss of synchronization
- No Tuning and always stable
- Do not need a high torque margin
- Broader operating speed range
- Reduced motor heating and more efficient
- Smooth motion and super-low motor noise
- Protections for over-voltage, over-current and position following error

1.2 Applications

Its great features of quicker response and no hunting make STEPPERONLINE's closed loop stepper driver is ideal for applications such as bonding and vision systems in which rapid motions with a short distance are required and hunting would be a problem. And it is ideal for applications where the equipment uses a belt-drive mechanism or otherwise has low rigidity and you don't want it to vibrate when stopping.

2. Specifications

2.1 Electrical Specifications

Parameters	**CL57T**			
	Min	Typical	Max	Unit
Output Current	0	-	8	A
Supply Voltage	24	36	48	VDC
Logic signal current	7	10	16	mA
Pulse input frequency	0	-	200	kHz
Minimal pulse width	2.5	-	-	μS
Minimal direction setup	5.0	-	-	μS
Isolation resistance	500			MΩ

2.2 Environment

Cooling	Natural Cooling or Forced cooling	
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	0°C — 65°C (32°F - 149°F)
	Humidity	40%RH—90%RH
	Operating Temperature	0°C — 50°C (32°F - 122°F)
	Vibration	10-50Hz / 0.15mm
Storage Temperature	-20°C — 65°C (-4°F - 149°F)	
Weight	Approx. 280 g (9.9 oz)	

2.3 Mechanical Specifications

(unit: mm [1inch=25.4mm])

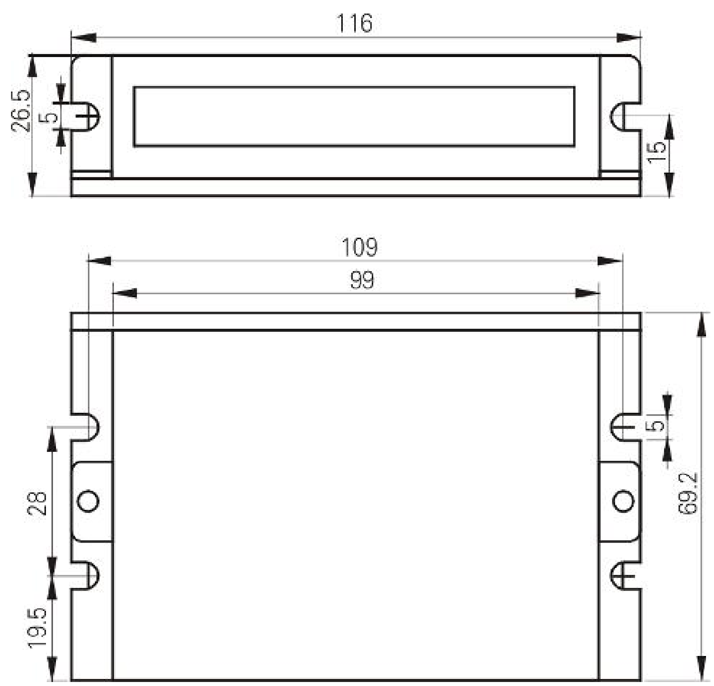


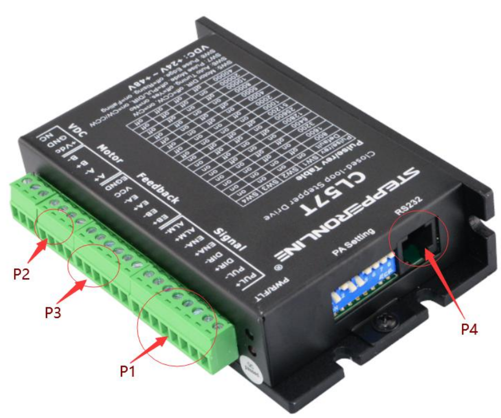
Figure 1: Mechanical specifications

*** Side mounting recommended for better heat dissipation**

2.4 Elimination of Heat

- CL57T reliable working temperature should be < 60℃ (140°F)
- It is recommended to mount the drive vertically to maximize heat sink area. Use forced cooling method to cool if necessary.

3. Connection Interface and LED Indication



The CL57T has four connector blocks P1&P2&P3&P4 (see above picture). P1 is for control signals connections, P2 is for power and motor connections, P3 is for encoder signals input connections, and P4 is for connecting with PC tuning software. The following tables are brief descriptions of the four connectors. More detailed descriptions of the pins and related issues are presented in section 4, 5, 9.

3.1 Connector P1 Interface

3.1.1 Pin Assignments of P1

Pin Name	I/O	Details
PUL+	I	Pulse signal: (1) In single pulse (pulse & direction) control mode, this input represents pulse signal. A pulse signal is active at the rising or falling voltage edge (set by DIP switch SW8). (2) In double-pulse (CW/CCW) control mode (set by DIP switch SW7), this signal input represents clockwise (CW) pulse, and is active at both high voltage level and low voltage level. (3) 4.5-5V for voltage HIGH, 0-0.5V for voltage LOW (same for DIR signals). (4) Pulse width should be set to 2.5μs or longer.
PUL-	I	
DIR+	I	Direction signal: (1) **.** In single pulse (step & direction) control mode, this signal's low and high voltage levels represent the two directions of motor rotation (e.g. clockwise and counterclockwise). (2) In double-pulse (CW & CCW) control mode, this signal represents counterclockwise (CCW) rotation. It is active at both voltage high level and low level. (3) Minimal DIR signal setup time should be at least 5μs. (4) You can reverse the default rotation direction by toggling the SW5 DIP switch.
DIR-	I	
ENA+	I	Enable signal: This signal is used for enabling/disabling the drive. High voltage level of 4.5-24VDC (NPN control signal) for enabling the drive and low voltage level of 0-0.5VDC for disabling the drive. PNP and Differential control signals are on the contrary, namely Low level for enabling. By default this signal is left **UNCONNECTED & ENABLED**.
ENA-	I	
ALM+	O	Configurable Digital Output Signal: A configurable OC output signal. It takes a sinking or sourcing 20mA current at 5-24V. It can to be configured as one of the 3 types, *ALARM* (default)*, IN POSITION*, or *BRAKE CONTROL* through PC software.
ALM-	O	

Notice **Notes:** (1) shielding control signal wires is suggested;

(2) To avoid interference, don't tie PUL/DIR control signal and motor wires together;

3.1.2 Control Signal Wiring(P1)

The CL57T can accept differential and single-ended inputs (including open-collector and PNP output). The CL57T has 3 optically isolated logic inputs which are located on connector P1 to accept line drive control signals. These inputs are isolated to minimize or eliminate electrical noises coupled with the drive control signals. Recommend using line drive control signals to increase noise immunity for the drive in interference environments. In the following figures, connections to open-collector and PNP signals are illustrated.

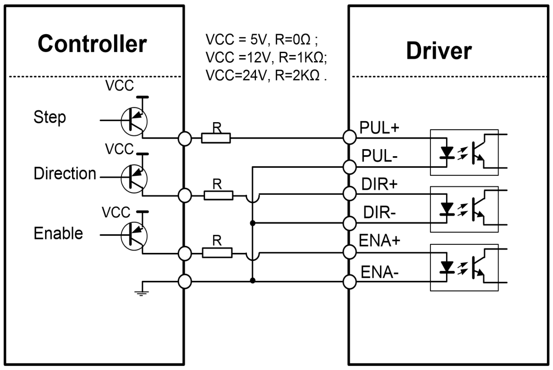


Figure 2: Connections to PNP signal (common-cathode)

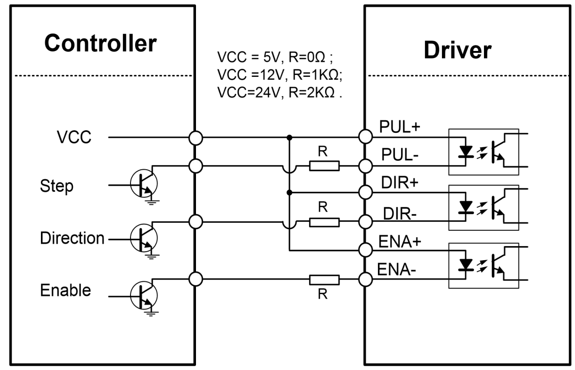


Figure 3: Connections to open-collector signal (common-anode)

3.2 Connector P2

3.2.1 Pin Assignments of P2

Pin Name	Details
A+, A-	Motor Phase A connections. Connect motor A+ wire to A+ Pin; motor A- wire to A-
B+, B-	Motor Phase B connections. Connect motor B+ wire to B+ Pin; motor B- wire to B-
+Vdc	Power supply positive connection. Suggest 24-48VDC power supply voltage
GND	Power supply ground connection.

Warning **Warning:** Don't plug or unplug the P1 & P2 terminal block to avoid drive damage or injury when CL57T is powered on.

3.2.2 Motor and Power Supply Wiring(P2)

The CL57T can drive NEMA17, 23 and 24 closed loop stepper motor with encoder resolution of 1000 ppr. The current loop PID will be adjusted automatically regarding to function of motor auto-identification and parameter auto-configuration, to output optimal torque from wide-range motors. However, the user can also configure the current in the tuning software. The configurable parameters include motor peak current, closed loop holding current, micro step and etc.

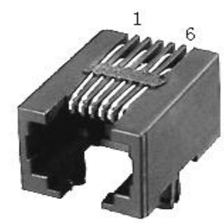
Warning **Warning:** For NEMA17 closed loop motor, need to change the value of motor peak current from 80 to 30, if not, it will burning the motor as too high current output.

3.3 Connector P3

Drive Pin Name	Description
EB+	Encoder B+ input
EB-	Encoder B- input
EA+	Encoder A+ input
VCC	+5V power output
EGND	Signal ground

3.4 Connector P4

It is a RS232 communication port using to connect with PC software to configure the motor peak current, closed loop holding current, microstep, active level.

RS232 Communication Port – RJ11				
Pin	**Name**	**I/O**	**Description**	
1	**NC**	-	Not connected.	
2	**+5V**	O	+5V power output.	
3	**TxD**	O	RS232 transmit.	
4	**GND**	GND	Ground.	
5	**RxD**	I	RS232 receive.	
6	**NC**	-	Not connected.	

3.5 LED Light Indication

There are two LED lights for CL57T. The GREEN one is the power indicator which will be always on generally. The RED one is a protection indicator which will flash 1,2 or 7 times in a 5-second period, when protection enabled for a CL57T. Different number of flashes indicates different protection type (read section 8 for detail).

4. Power Supply Selection

The CL57T can power medium and small size closed loop stepper motors (frame size from NEMA17 to 34). To get good driving performances, it is important to select supply voltage and output current(by configuring motor peak current) properly. Generally speaking, supply voltage determines the high speed performance of the motor, while output current determines the output torque of the driven motor (particularly at lower speed). Higher supply voltage will allow higher motor speed to be achieved, at the price of more noise and heating. If the motion speed requirement is low, it's better to use lower supply voltage to decrease noise, heating and improve reliability.

4.1 Regulated or Unregulated Power Supply

Both regulated and unregulated power supplies can be used to supply the driver. However, unregulated power supplies are preferred due to their ability to withstand current surge and fast response for current change. If you prefer to a regulated power supply, it is suggested to choose such a power supply specially designed for stepper/servo controls Or, in the case when only normal switching power supplies are available, it is important to use "OVERSIZE" high current output rating power supplies (for example, using a 4A power supply for 3A stepper motor) to avoid problems such as cunt clamp. On the other hand, if unregulated supply is used, one may use a power supply of lower current rating than that of motor (typically 50%～70% of motor current). The reason is that the driver draws current from the power supply capacitor of the unregulated supply only during the ON duration of the PWM cycle, but not during the OFF duration. Therefore, the average current withdrawn from power supply is considerably less than motor current. For example, two 3A motors can be well supplied by one power supply of 4A rating.

4.2 Power Supply Sharing

Multiple CL57T drivers can share one power supply to reduce cost, if that power supply has enough power capacity. To avoid cross interference, connect each stepper drive directly to the shared power supply separately. To avoid cross interference, DO NOT daisy-chain connect the power supply input pins of the Drivers. Instead connect them to power supply separately.

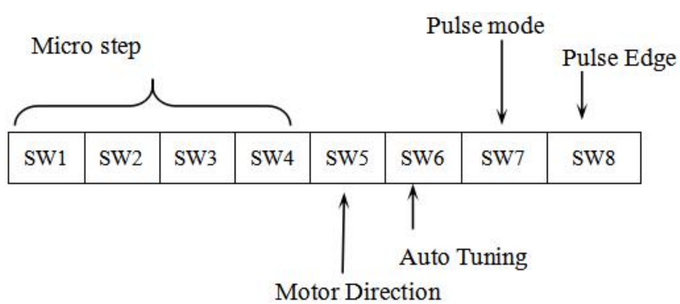
4.3 Selecting Supply Voltage

The CL57T is designed to operate within +24 - +48VDC voltage input. When selecting a power supply, besides voltage from the power supply power line voltage fluctuation and back EMF voltage generated during motor deceleration needs also to be taken into account. Ideally it is suggested to use a power supply with the output of +36VDC, leaving room for power line voltage fluctuation and back -EMF.

Higher supply voltage can increase motor torque at higher speeds, thus helpful for avoiding losing steps. However, higher voltage may cause bigger motor vibration at lower speed, and it may also cause over-voltage protection or even driver damage. Therefore, it is suggested to choose only sufficiently high supply voltage for intended applications.

5. DIP Switch Configurations

This drive uses an 8-bit DIP switch to set microstep resolution, motor direction, auto tuning switch and so on.



5.1 Microstep Resolution(SW1-SW4)

Microstep resolution is set by SW1, 2, 3, 4 of the DIP switches as shown in the following table:

Steps/Revolution	SW1	SW2	SW3	SW4
Software Configured (Default 1600)	on	on	on	on
800	off	on	on	on
1600	on	off	on	on
3200	off	off	on	on
6400	on	on	off	on
12800	off	on	off	on
25600	on	off	off	on
51200	off	off	off	on
1000	on	on	on	off

2000	off	on	on	off
4000	on	off	on	off
5000	off	off	on	off
8000	on	on	off	off
10000	off	on	off	off
20000	on	off	off	off
40000	off	off	off	off

5.2 Other DIP Switch Setting(SW5-SW8)

	Function	On	Off
SW5	Default Direction	CW (clock-wise)	CCW (counter-clock-wise)
SW6	Auto Tuning	No	Yes
SW7	Pulse Model	CW/CCW(double pulse)	PUL/DIR(single pulse)
SW8	Pulse Edge	Falling	Rising

Notice **Notes:** (1) The factory setting of DIP switch are 'on off on on off off off off';

(2) The default direction is related to the DIR level, you can toggle SW5 to change it .

6. Typical Connection

A complete closed loop stepper system should include closed loop motor, drive, power supply and controller (pulse generator). A typical connection is shown as figure 4.

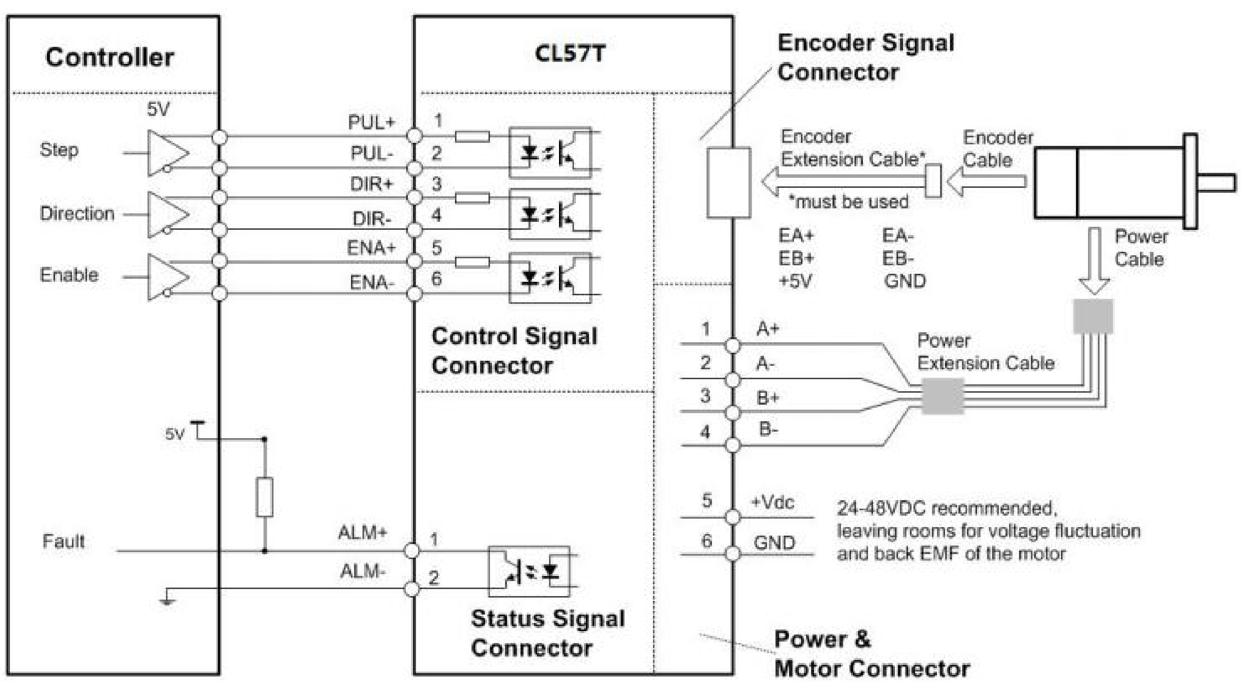


Figure 4: Typical connection

7. Sequence Chart of Control Signals

In order to avoid some fault operations and deviations, PUL, DIR and ENA should abide by some rules, shown as following diagram:

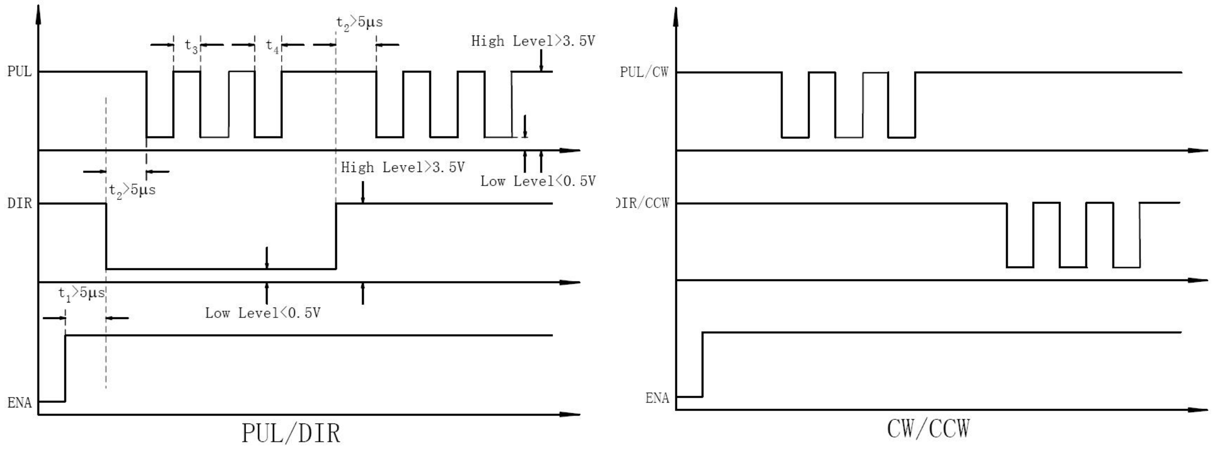


Figure 5: Sequence chart of control signals

Remark:

a）t1: ENA must be ahead of DIR by at least 5μs.. Usually, ENA+ and ENA- are NC (not connected). See "Connector P1 Configurations" for more information.

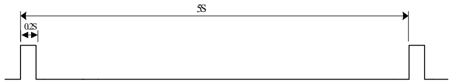
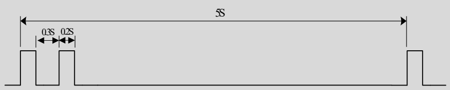
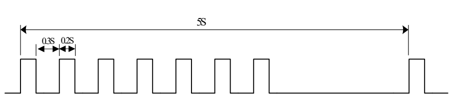
b) t2: DIR must be ahead of PUL effective edge by 5μs to ensure correct direction;

c) t3: Pulse width not less than 2.5μs;

d) t4: Low level width not less than 2.5μs.

8. Protection and Troubleshooting

To improve reliability, the drive incorporates some built-in protections features.

Blink time(s)	Sequence wave of red LED	Description	Trouble shooting
1		Over-current	Turn off the power immediately. a) Check wiring is short-circuited or not; b) b) Check motor is short-circuited or not.
2		Over-voltage	Turn off the power immediately. a) Check if the power voltage is higher than over-voltage point
3		Chip error	Restart the power supply, if the drive is still alarm, please contact after-sale
4		Fail to lock motor shaft	a) The drive is not connected to a motor; b) If alarm is occurred when connect a motor , set DIP switch SW6 to ‘on’ and restart power supply; If it still alarm, please check the motor power cable.
5		EEPROM error	Restart the power supply, if the drive is still alarm, please contact after-sale
6		Fail to auto tuning	Set DIP switch SW6 to ‘on’
7		Position following error	a) The acceleration time setting is too small,increase the value of appropriately; b)Motor torque is not enough or motor speed is too high; b) Motor wiring error, check wiring
Always	-	PCB board is burned out	Contact after-sale a) Power supply connection is wrong

9. Warranty

STEPPERONLINE warrants its products against defects in materials and workmanship for a period of 12 months from shipment. During the warranty period, STEPPERONLINE will either, at its option, repair or replace products which proved to be defective. To obtain warranty service, a returned material authorization number (RMA) must be obtained before returning product for service.

Exclusions: The above warranty does not extend to any product damaged by reasons of improper or inadequate handlings by customer, improper or inadequate customer wirings, unauthorized modification or misuse, or operation beyond the electrical specifications of the product and/or operation beyond environmental specifications for the product.

If your product fail during the warranty period, please contact your seller for how and where to ship the failed product for warranty or repair services first,you can also e-mail at Technical@stepperonline.com to obtain a returned material authorization number (RMA) before returning product for service. Please include a written description of the problem along with contact name and address.

Anexo D: Manual WeldMark

RAYLASE
focus on laser

Software Manual
weldMARK™ 3

CONTENTS

1 INTRODUCTION

weldMARK™ is a powerful and flexible laser processing software suite. The software package sets new standards with its flexible, powerful and easy to learn user interface. It is easy for the user to create or import text, barcode or graphic elements and to use them to create a complete marking job. Objects and laser-specific parameters can be edited with simple entries.

The weldMARK™ software package supports the following RAYLASE control cards:
SP-ICE, SP-ICE-1 PCI PRO and RLC-USB.

1.1 The weldMARK™ Software Package

The weldMARK™ software package consists of the following modules:

- weldMARK™ graphical user interface
- COMServer (ActiveX) interface
- TCP/IP Test Client
- weldMARK™ COM-Tester

The sections below provide a brief description of these modules.

1.1.1 Function overview

The following weldMARK™ functions are particularly important:

- Opening up to ten jobs simultaneously, easy selection of opened jobs with just one mouse click
- Support for various laser types, precise control of laser parameters
- Creation of linear, rectangular, polygonal, drill and Bezier objects
- Output of drill objects as single points or grid points
- Scaling, moving and rotation of objects on screen
- Use of objects as templates in the background for easy positioning of marking objects
- Import of wide types of vector and bitmap files
- Support for all TrueType™ fonts installed on the computer (displayed filled or as contour)
- Serialization functions for text and barcode objects
- Easy creation of automation scripts
- Programming of alarms, warnings, user entries for job numbers and batch numbers
- Control of rotary tables, XY tables or one-dimensional movements using the integrated 4-Axis motor control
- Detection of object movements with an optional encoder
- Password protection: Restriction of users for performing pre-prepared jobs
- weldMARK™ includes all the elements and tools required for the integration into an automated process environment. Most procedures can efficiently be operated from within the program itself.
- Support of 2-Axis standard Scan Heads and 3-Axis subsystems (AXIALSCAN, AXIALSCAN motorized, FOCUSSHIFTER)

1.1.2 COM Automation Server API

weldMARK™ provides a COM automation server interface. This enables external programs to access the library functions in weldMARK™. For more detailed information, refer to the COM-Server manual, which is available from RAYLASE.

1.1.3 TCP/IP test client

The TCP/IP test client allows the weldMARK™ software's server interface to be tested by a remote computer. Any errors detected can be corrected over the network using the TCP/IP test client.

The Appendix includes instructions for starting and using the TCP/IP test client.

1.1.4 weldMARK™ COM Sample Program

The weldMARK™ software is supplied with a COM sample program with source text. Use this simple COM automation server program as a template for programming your own application programs.

1.2 Laser Safety

The user is responsible for safe operation and for safeguarding the surrounding area against hazards that can be caused by laser radiation. OEM customers must ensure compliance with all local and national regulations.

WARNING:
Turn on the PC before turning on the laser system. This prevents the laser from behaving in an uncontrolled manner when the PC is turned on.

Check your application carefully before using the laser system. Defective software can block the entire system and lead to uncontrolled operation of laser or Scan Head.

1.3 Manufacturer

RAYLASE AG
Argelsrieder Feld 2-4
82234 Wessling
Germany
Tel.: +49 (0) 81 53 - 88 98 - 0
Fax: +49 (0) 81 53 - 88 98 - 10
http://www.raylase.de
E-mail: info@raylase.de

1.4 Customer Service

RAYLASE Customer Service can assist you with any queries or problems with the subsystem or this manual. Before contacting Customer Service, assure whether your question can be resolved with the provided instructions on CD.

If you need further assistance, you can contact RAYLASE Customer Service from Monday to Friday between 08:00 and 17:00.

Germany (Wessling)
Tel.: +49 (0) 81 53 - 88 98 – 0
E-Mail: support@raylase.de

...simply request the Customer Service

2 REQUIREMENTS AND INSTALLATION

This chapter provides you with an overview of the system requirements and the necessary steps to be taken to install weldMARK™.

2.1 Hardware requirements

The following hardware configuration is required at the least:

- Intel Pentium or compatible computer with operating system Windows Vista or Windows 7 (32bit).
- CD-ROM drive for installing the software
- 1024 MB RAM or more is recommended
- 150 MB free disk space on the local drive

2.2 Software installation

To install weldMARK™ proceed with the following steps:

- Start your computer and log in as administrator.
- Insert the weldMARK™ installation CD in the CD-ROM drive.
  The installation routine starts automatically.
- Click on the *Software installation* button and after that click on the *Installation weldMARK* button.
- Follow the instructions on the screen.

2.3 Dongle Variations

The weldMARK™ software runs with the supplied hardware key (dongle) only. The dongle is plugged into a free USB port on the computer. Every computer having weldMARK™ installed requires a separate dongle. The following table shows different dongle variations and the activated functional range.

Feature	Standard	Premium	3D
MARK	+	+	+
RUN	+	+	+
RUN FROM HARDWARE	+	+	+
AUTOMATION	+	+	+
CALIBRATION	+	+	+
MOTF		+	+
PREVIEW MARK	+	+	+
HOST-INTERFACE	+	+	+
MULTIPLE CARDS	+	+	+
SAVE TO CONTROLLER (Download to HW)	+	+	+
MOTORCONTROL	+	+	+
TILING	+	+	+
POLYLINE, PREVIEW Outline, WS Rotation	+	+	+
FOCUS SHIFTER		+	+
AXIALSCAN motorized		+	+
IPG LASER	+	+	+
SPI LASER	+	+	+
SERIAL LASER	+	+	+

Feature	Standard	Premium	3D
BEZIER OBJECT	+	+	+
NEW BITMAP ALGORITHMS	+	+	+
NEW IMPORT FILTER	+	+	+
LAYERS	+	+	+
ANCHOR POINT	+	+	+
MIRROR GROUP	+	+	+
JOB DEPENDANT OFFSETS	+	+	+
JOB WORKSPACE ROTATION	+	+	+
FONT COMPILER (Tools)	+	+	+
CORRECTION EDITOR (Tools)	+	+	+
F-THETA COR (Tools)	+	+	+
MASTER-SLAVE		+	+
Vector Graphic DESIGNER	+	+	+
SKY WRITING	+	+	+
GENERATE CORRECTION (3D)			+
Digital Scan Heads		+	+
2.5D with Acial Scan Heads			+
3D MARKING			+
3rd Axis Multipoint Correction		+	+
SP-ICE 2 (MONITOR)	+	+	+
MARK & PREVIEW	+	+	+
FINE FOCAL POINT ADJUSTMENT		+	+
IMPORT TXT AS POLYLINE			+
SPOT OFFSET	+	+	+
TREPANNING			+
DEEP CUTTING		+	+

3 INTRODUCTION TO THE SOFTWARE PACKAGE

3.1 Starting and Exiting weldMARK™

Starting weldMARK™

Select *Start >All Programs >RAYLASE >weldMARK*. The program starts with the set access level (➜ page 24, Changing the Access Level).

When you start weldMARK™ a new job is created automatically. You can disable this and specify that weldMARK™ should start with a particular existing job. (➜ page 197, Settings for the Job File)

Exiting weldMARK™

○ Select *File >Exit*.

3.2 Basic Concepts

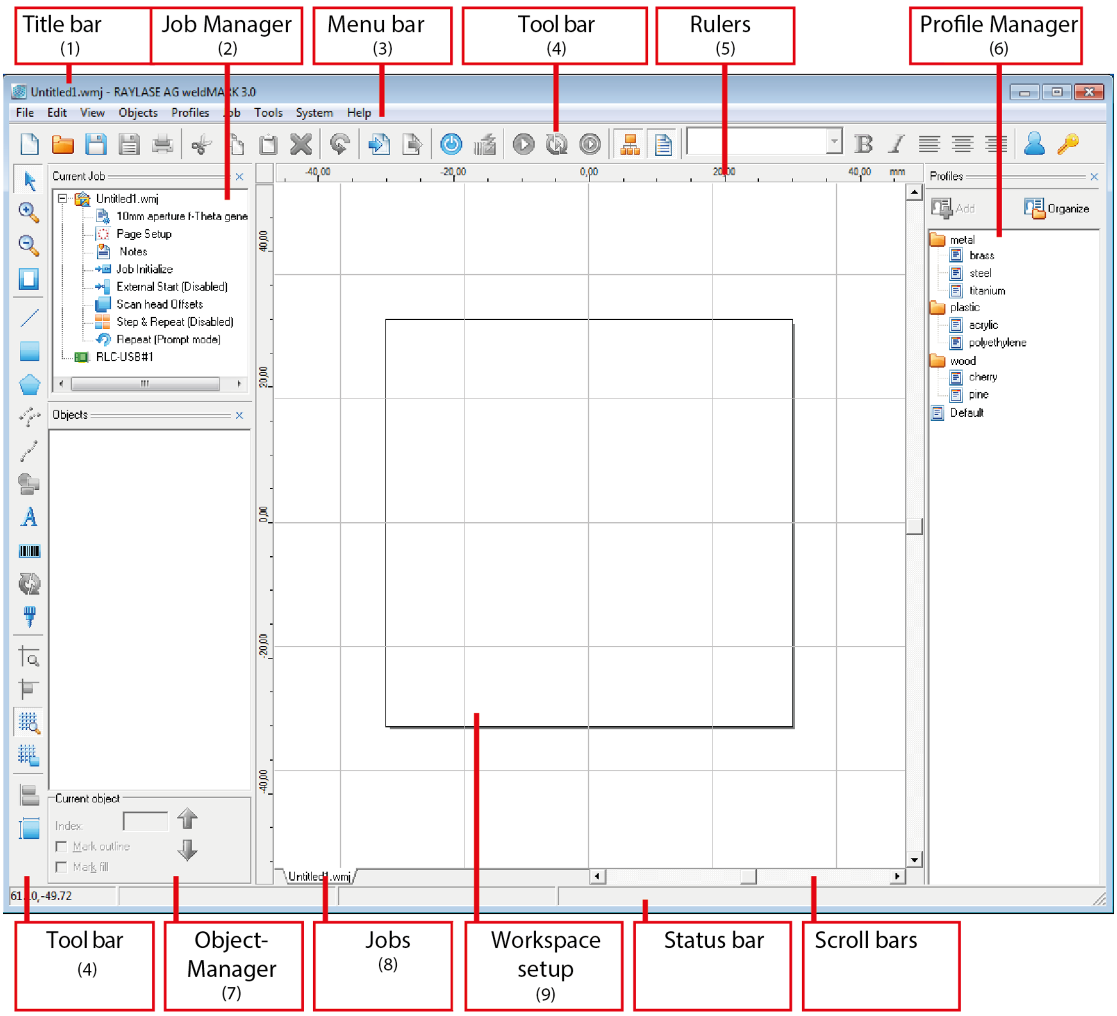
Marking objects	Marking objects represent the graphical elements and texts to be marked by the laser. The following object types are available in weldMARK™: ■ Graphic objects, i.e. imported vector or bitmap graphics ■ Line ■ Rectangle ■ Polygon ■ Polyline ■ Bezier ■ Text ■ Barcode... ■ Drill... ■ Vector-Object ➜ page 25, Working with Objects
Template	A template is an object that won't be marked. For example, it can be used to align objects. ➜ page 118, Templates
Automation-Objects	Automation objects allow communication with the user via dialogue windows and allow control of external components. ➜ page 25, Working with Objects
Profile	Every marking object is assigned a profile, which specifies the parameters for the laser marking. ➜ page 135, Using Profiles
Job	A job is a collection of objects and settings. The settings determine the actions of the Scan Head, the laser and the additional equipment. ➜ page 165, Job Settings, run Job

3.3 Access levels

weldMARK™ has three access levels that allow different types of access to the software's functions. The program starts with the preset access level (➜ page 24, Changing the Access Level). When changing access levels, password protection can be applied (➜ page 203, System Security Settings).

Access levels	Description
All editing functions	All software functions can be used without restrictions. ➜ page 12, "All Editing Functions" Access Levels
Operator interface only	Only saved jobs can be opened and executed. These jobs cannot be modified. ➜ page 22, "Operator interface only" Access Level
Touchscreen interface	Only saved jobs can be opened and executed. These jobs cannot be modified. The design of this access level is optimized for touchscreens. Mouse control is also possible. ➜ page 23, "Touchscreen interface" Access Level

3.3.1 "All Editing Functions" Access Levels

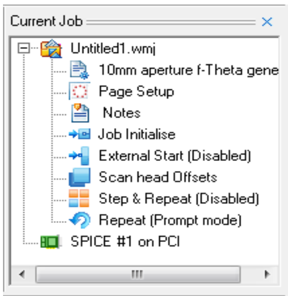


(1) Title bar

The title bar shows the name of the current job, the company name, the dongle type and the name of the program.

(2) Job-Manager

The Job Manager shows the name of the current job with the elements of the job settings below. Additionally the installed control cards are listed.



To view or edit a job setting, double click on the corresponding element. Right clicking on the element will display a pop-up menu containing element-specific options.

➜ page 165, Editing the Job Settings

(3) Menu bar

The menu bar contains the following menus (some menu commands are only available after setting the corresponding function or setting up the corresponding hardware drivers):

<table>
<tr><th colspan="3">File menu</th></tr>
<tr><td>New</td><td>Opens a new job with a blank workspace.</td><td rowspan="2">Up to ten jobs can be opened simultaneously.</td></tr>
<tr><td>Open Job...</td><td>A previously saved job can be opened.</td></tr>
<tr><td>Close Jobs</td><td colspan="2">Closes the current job.</td></tr>
<tr><td>Close All Jobs</td><td colspan="2">Closes all open jobs.</td></tr>
<tr><td>Import...</td><td colspan="2">Allows you to select and import objects in different file formats.</td></tr>
<tr><td>Export...</td><td colspan="2">Allows you to export the currently selected weldMARK™objects in various file formats.</td></tr>
<tr><td>Import and Export Profiles...</td><td colspan="2">Opens the Import/Export Wizard for profiles. Profiles can be exported from or imported to the Profile Manager.</td></tr>
<tr><td>Save Job</td><td colspan="2">Saves the current job. The first time you save a new job, the Save Job as window will be opened. File name and storage location have to be specified.</td></tr>
<tr><td>Save Job as...</td><td colspan="2">Allows you to save an open job under a new name.</td></tr>
<tr><td>Save Job to Embedded Controller</td><td colspan="2">Jobs can be saved to a stand alone control card and executed from there without the need for a PC (➜ page 180, Enabling "Save to stand alone control card" Mode).</td></tr>
<tr><td>Print Setup...</td><td colspan="2">Allows you to enter settings for the printer you want to use.</td></tr>
<tr><td>Print</td><td colspan="2">Allows you to enter print settings, change printer settings and start printing the current job.</td></tr>
<tr><td>Exit</td><td colspan="2">Exits the weldMARK™ program.</td></tr>
</table>

Menu Edit	
Undo	Reverses the last action performed. You can undo the last ten actions.
Cut	Removes all selected objects from the job and sends them to the clipboard.
Copy	Copies all selected objects to the clipboard.
Insert Point	Pastes objects copied or cut in weldMARK™ into the current job.
Paste Special	Allows objects on the clipboard to be pasted into the current job as image or text objects. This command enables you to paste objects from other applications.
Delete Element	Deletes all selected objects.
Select All	Selects all objects contained in the current job.
Snap To Guidelines	If this function is enabled, objects that are moved get aligned with the guidelines.
Snap To Grid	If this function is enabled, objects that are moved get aligned with the grid lines.

View menu	
Host-Monitor	This command shows and hides the Job-Manager. The host monitor allows you to observe the communication between a host and weldMARK™ (➜ page 197, Editing the Host Interface Settings). This option is only available if the remote interface is activated.
Job Manager	This command shows and hides the Job-Manager.
Object-Manager	This command shows and hides the Object-Manager. See ➜ page 136, Marking Object Profile.
Profile-Manager	This command shows and hides the Profile-Manager. See ➜ page 141, Showing and hiding the Profile Manager.
Digital Scan Head Monitor	This command shows and hides the Digital Scan Head Monitor. See ➜ page 200, Digital Scan Head Status Monitor Window.
Motor-Manager	Only available if a motor control card is installed. Opens the window for operating the optional stepper motor control card.
Guidelines	Shows or hides guidelines.
Grid	Shows or hides gridlines.
Rulers	Shows or hides rulers.
Millimeters	Selects the unit for the ruler display and for the input dialogue boxes.
Inches	
Bits	

Objects menu		
Add	The following submenus are available:	
	Automation...	Opens a window for selecting an automation object.
	Barcode...	Inserts the selected object in the center of the work-space.
	Automation	
	Line	
	Polygon	
	Rectangle	
	Text	
	Polyline	
	Bezier	
	Vector	
Convert To Template	Converts the selected object into a template. The template is automatically added to the Job Manager.	
Lock Object/ Unlock Object	Locks or releases the selected object for editing.	
Lock All/ Unlock All	Locks or releases all objects in the job for editing.	
Defaults...	Allows you to make default settings for various object types (➜ page 27, Object Defaults).	
Dimensions...	Allows you to change the size, shape and position of the selected objects.	
Properties...	Allows you to edit various parameters of the selected objects.	
Vector Design	Opens the Vector Graphic Designer (➜ page 32, Vector Graphic Designer (VGD)).	

Profiles menu	
Add to Profiles...	The parameters of the selected object can be combined under a profile name and added to the Profile Manager under that name.
Organize Profiles...	Allows you to specify the folder structure for the profiles.

Job Menu	
Preview	Creates a frame representing the rectangular boundaries of the selected objects using the visible pointer and opens the "Preview" window. This window allows you to adjust the boundaries of the objects to the target object. (To activate the visible pointer ➜ page 218, Configuring a Laser Driver).
QuickMark	Allows you to start execution of either the selected objects or all objects included in the job. Automation objects are skipped.
Run...	Allows you to start execution of the current job including all marking and automation objects.
Run from Hardware…	To ensure that jobs are executed without interruption, they are first sent to the control card and then started. This function is particularly useful when using a slow PC. (➜ page 178, Run from Hardware)
Convert Template to Object	Converts the selected template into a marking object.
Jobs	View of open jobs.
Settings...	Allows you to make job-specific settings.

Tools Menu	
Configure Tools	Allows you to add external programs to the Tools menu.
Align...	Allows you to align selected objects with one another based on particular settings.
Open App.Data Folder	Opens the directory where weldMARK™ automatically saves specific files for windows.
Grid/Guidelines...	Allows you to set parameters for the grid and for guidelines.
Configure I/O Cards...	Starts the Configuration Wizard for the I/O card.
I/O Card&Diagnostics...	Allows you to check the ports of the standard I/O board.
Laser Diagnostics Tool	Allows you to set parameters for laser radiation and to test the position and effect of the laser beam.
Reduce power to minimum	Using this menu item, the laser power can be set to the registered minimum laser power [minbits] in the config file. This function is not available for CO_2 lasers.
Generate Correction...	Opens a menu for creating 3D Correction Files via STL files.

System Menu		
Preferences...	You can set various preferences in weldMARK™.	
Properties...	Displays the properties of the operating system and relevant hardware for weldMARK™.	
Globals...	Allows you to enter general settings for laser power, marking speed and marking offset. weldMARK™ can be adjusted for changing external parameters, for example, diminishing laser power.	
Run from Host...	Sets weldMARK™ to host mode, enabling it to accept commands from external host programs. The menu item is only available if the remote interface is enabled.	
Security	*Access level*	Allows you to change the access level. Any changes take effect immediately.
	Change Password	You can set a password for changing the access level, changing the password or cancelling password protection.
	Startup Options	Sets the access level used to start the program.
Backup...	Opens the *Browse for Folder* window. In the tree structure of this window, you can select a storage location for the backup file containing the weldMARK™ system settings.	
Restore...	Opens the *Restore Application Settings* window. In this window, you can select a backup file. Opening the file restores the saved system settings for weldMARK™.	

Help Menu	
Content & Index	Opens the weldMARK™ online help.
Online Updates...	Displays information about the current program version. Clicking on *Check for Updates* calls up the RAYLASE homepage, provided you are connected to the Internet.
About...	Displays the currently installed weldMARK™ version number. The *Info* button can be used to obtain additional copyright information.

(4) Toolbars

The toolbars provide fast access to frequently used functions.

The toolbar below the menu bar contains the following standard commands:

	New		Mark on the Fly
	Open Job...		QuickMark
	Save in		Starting execution
	Save as		Run from Hardware
	Print		Show/Hide Job Manager
	Cut		Show/Hide Profile Manager
	Copy		Text attribute bold
	Insert Point		Text attribute italics
	Delete Element		Align text left
	Undo		Center text
	Import...		Align text right
	Export...		Change Access Level
	Nd:YAG only Reduce laser power to minimum		Change Password

The toolbar on the left-hand side of the screen contains functions for adding, selecting and manipulating objects:

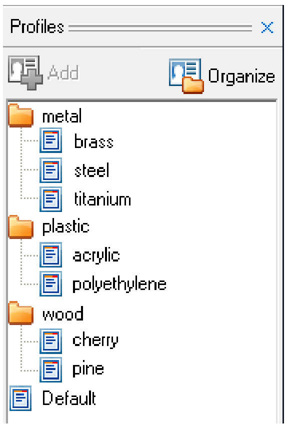
Select objects	Insert text object	
Zoom in	Insert barcode object	
Zoom out	Insert automation object	
Full view	Insert drill object	
Insert line object	Show/Hide guidelines	Only available if guidelines have been entered.
Insert rectangle object	Snap To Guidelines	
Insert polygon object	Show/Hide grid	
New polyline	Snap To Grid	
Insert Bezier object	Align...	
New vector object	Dimensions	

(5) Rulers

The rulers can be displayed with the following units: "Millimeters", "Inches" or "Bits". The rulers are scaled automatically based on the Correction File for the deflection unit lens.

(6) Profile-Manager

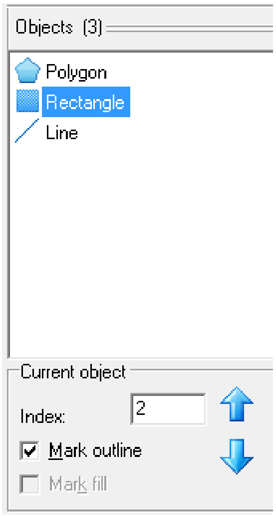
The Profile Manager displays a hierarchical overview of the profile folders and profiles created by the user. Profiles can be applied to selected objects or to all objects in a job. To do this, right click on the corresponding profile and select the required option in the pop-up menu. Double clicking on the profile allows you to modify its parameters.



Related Sections:

➜ page 135, Using Profiles

(7) Object-Manager



The Object Manager lists all marking and automation objects in the job. The objects appear in the order in which they were created and in which they will be executed. You can change the order of the objects using the blue arrow buttons in the Object Manager screen.

You can select a contiguous list of objects using the Shift key, or a non-contiguous list using the Ctrl key. To select a contiguous list, hold down the Shift key and click on the first object in the list and then the last object in the list. To select a non-contiguous list, click the first object, then hold down the Ctlr key and select the other objects you want to add. A selected contiguous list can be changed to a non-selected list.

The number of objects within a job is given in the title line of the Object Manager. You can select an object by clicking the Object Manager or by entering the appropriate index in the *Index* field.

Using the option *Mark outline* certain objects can be tagged to be contour marked or not. Select this option for when an object that has no contour (such as a Bitmap object) is to be marked.

Select the option *Mark fill* to mark the content of objects that have the fill feature.

(➜ page 25, Working with Objects)

(8) The "Jobs" Tab

The tabs at the bottom of the screen provide an overview of the currently open jobs and allow you to select these jobs directly.

(9) Workspace

The size of the workspace can be set individually or automatically adjusted to the size of the operating field of the deflection unit(➜ page 166, Job Settings - "Page Setup"). The maximum size of the workspace is determined by the size of the deflection unit's operating field. Objects that are partly located outside the workspace are not marked.

Popup Menu

The pop-up menu provides fast access to frequently used functions for editing objects.

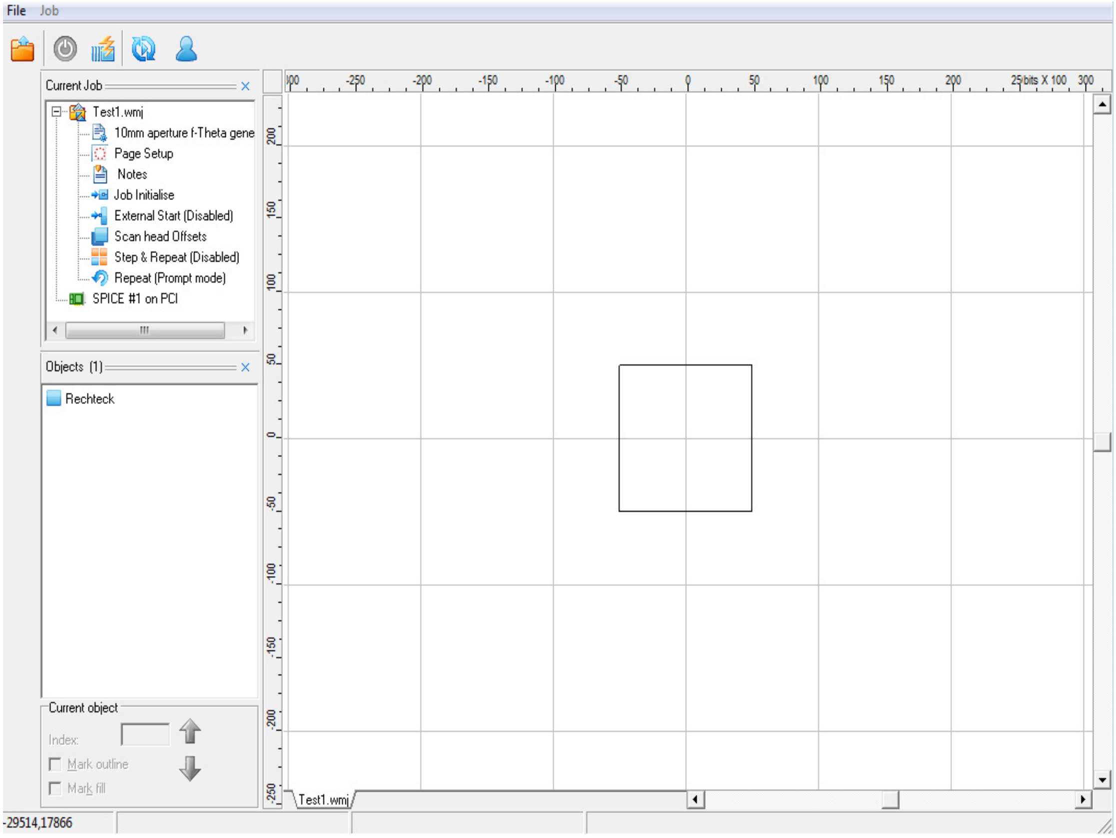
○ Right click on an object to open the pop-up menu.

The following functions are available:

QuickMark… (F8)	Allows you to start execution of either the selected objects or all objects included in the job. Automation objects are skipped.
PreviewMark... (F4)	Creates a frame representing the rectangular boundaries of the selected objects using the visible pointer and opens the "Preview" window. This window allows you to adjust the boundaries of the objects to the target object. (To activate the visible pointer ➜ page 218, Configuring a Laser Driver).
Cut	Removes all selected objects from the job and sends them to the clipboard.
Copy	Copies all selected objects to the clipboard.
Convert To Template	Converts the selected object into a template. The template is automatically added to the Job Manager.
Lock Object/ Unlock Object	Locks or releases the selected object for editing.
Delete Element	Deletes all selected objects.
Add to Profiles...	The parameters of the selected object can be combined under a profile name and added to the Profile Manager under that name.
Copy Profile	Copies the profile for the selected object to the clipboard.
Paste Profile	Applies the profile saved to the clipboard to the selected object.
Dimensions (F5)	Allows you to change the size, shape and position of the selected objects. ➜ page 102, The "Dimensions" Toolbox
Properties (F2)	Allows you to edit various parameters of the selected objects. ➜ page 27, Object Defaults ➜ page 136, Marking Object Profile
Design / Teach-In (F6)	Only for Bezier and Vector Graphic objects. The shape of selected objects can be changed. ➜ page 32, Vector Graphic Designer (VGD)
	Only available for polyline and Bezier objects. The shape of selected objects can be changed. ➜ page 54, Setup of a Polyline object ➜ page 57, Modifying a Bezier Object
Set Anchor	Specifies the point of reference of the object.
Tile	Used to divide oversized objects that are bigger than the marking area. ➜ page 109, Manual Tiling

3.3.2 "Operator interface only" Access Level

This access level allows the user to open and execute prepared jobs. The jobs to be executed must be located in the pre-set folder (➜ page 197, Settings for the Job File).

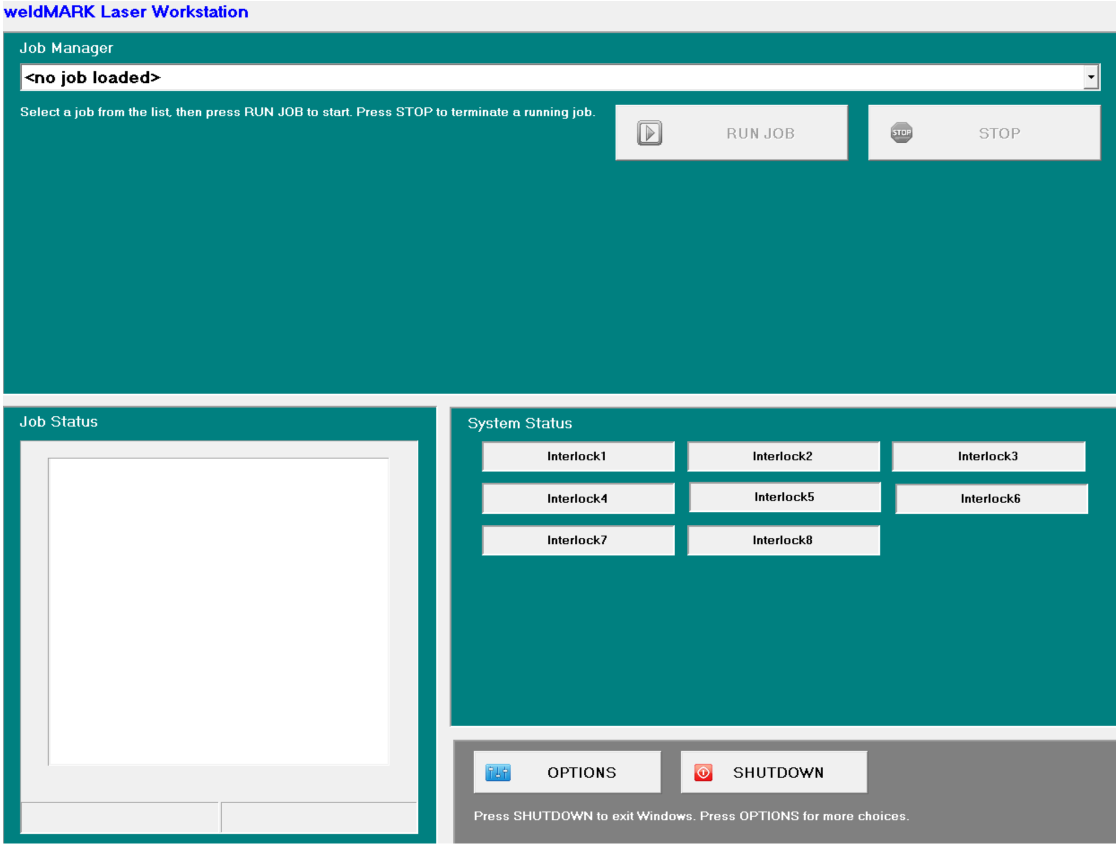


The following functions are available:

File >Open Job...		A previously saved job can be opened.
File >Exit		Exits the weldMARK™ program.
Reduce laser power to mini-mum		Nd:YAG only Reduce laser power to minimum
Mark on the Fly		Mark on the Fly
Job >Run...		Allows you to start execution of the current job including all marking and automation objects.
Change Access Level		If password protection is activated, you need to enter the password to change access level.

3.3.3 "Touchscreen interface" Access Level

This access level allows the user to open and execute prepared jobs. The jobs to be executed must be located in the pre-set folder (➜ page 197, Settings for the Job File).
The design of the user interface is optimized for touchscreens. Mouse control is also possible.



The following functions are available:

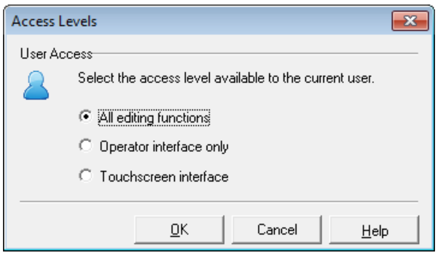
Job Manager	A previously saved job can be opened. Only one job at a time can be opened.
Run Job	Executes the open job.
Stop	Stops execution of the job.
Job Status	Shows the workspace and the marking objects positioned on it.
System Status	The fields show the status of interlocks 1 to 8. Depending on the setting, a particular status can be a prerequisite for marking individual or all objects. The names of the interlock fields can be changed.
Options	Allows you to adjust the job for changed external conditions (➜ page 202, Global Settings) or to change the access level (➜ page 24, Changing the Access Level).
Shutdown	The weldMARK™ program will end and Windows will close.

3.3.4 Changing the Access Level

"All editing functions" or "Operator interface only" Access Level

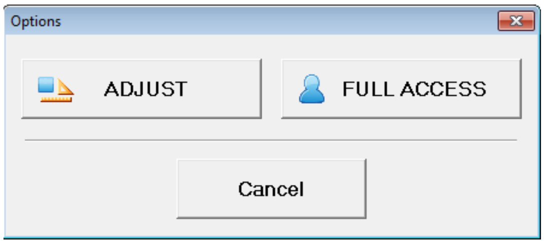
Change Access Level

- Select the Menu Item *System >Security >User Access* or click on the *Change Access* icon.
  If password protection is activated, you will be prompted to enter the password.
  The dialogue on the right opens.
- Choose the desired access level.



"Touchscreen interface" Access Level

- Touch the *OPTIONS* button.
  The dialogue on the right opens.
- Touch the *FULL ACCESS* button.
  If password protection is activated, you will be prompted to enter the password.



4 WORKING WITH OBJECTS

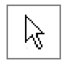
This chapter provides an overview of the objects available in weldMARK™ and describes how to use them.

4.1 Basic Principles

4.1.1 Selecting and deselecting Objects

Objects must be selected in order to edit them or display their properties. You can select multiple objects at the same time. Selected objects are identified by squares (resizing handles) around them and by emphasis in the Object Manager.

Selection tool



Arrow cursor

Selecting Objects with the Selection Tool

- Select the *Selection tool* icon in the toolbar.
- Click on the desired object with the arrow cursor.
- To select multiple objects drag the cursor with pressed down right mouse button over all objects that need to be selected. Alternatively hold down the shift button and select each object with the cursor that needs to be selected.

Selecting Objects using the Object Manager

- Click on the desired object in the Object Manager.
- To select multiple objects, click on the first object in the Object Manager. Hold down the Ctrl key and then click on all of the other objects you want to select.

Selecting all Objects

- Select *Edit >Select All* option from the menu.

Deselecting Objects

- Select the *Selection tool* icon in the toolbar.
- With the arrow cursor, click on a point outside the object or object group, or click on a free space in the Object Manager.

Selection tool

4.1.2 Moving Objects

- Select the desired objects.
- Click on the objects and, with the mouse button held down, drag them to the desired position or use the *Nudge* tool (➜ page 106, Nudging Objects).

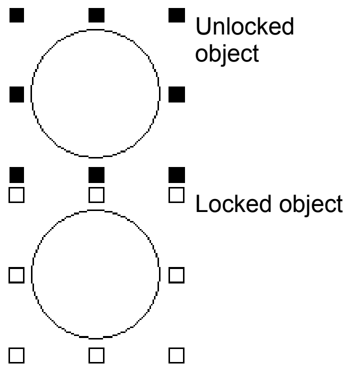
4.1.3 Locking and unlocking Objects

Locked objects cannot be edited or deleted. This prevents the object or its properties from being inadvertently modified.

Lock Object

- Click on the object to be locked.
- Select *Objects >Lock Object* option from the menu. The resizing handles of locked objects appear as unshaded squares.
- You can use the *Objects >Unlock Object* command to release the object for editing.

  The resizing handles for unlocked objects appear as shaded squares.



4.1.4 Object Types

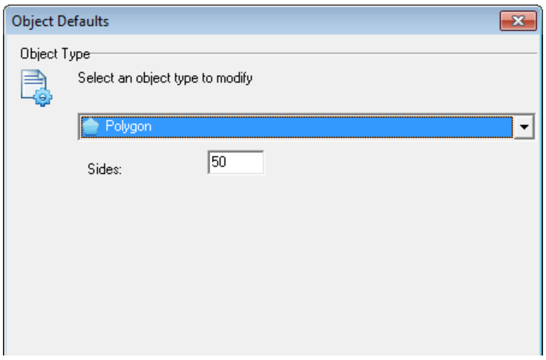
The following object types are available in weldMARK™:

Marking objects		*Graphic objects*	
		Line	The adjacent marking object types can be selected.
		Rectangle	
		Polygon	
		Polyline	
		Bezier	
		Text	
		Barcode...	
		Drill...	
		Vector	
Automation-Objects		*Automation...*	Automation objects allow communication with the user and allow control of external components.

4.1.5 Object Defaults

Object defaults are set for some objects. For example, when creating new polygons the number of corners is preset. You can change these object defaults as follows:

- Select
  Objects >Defaults.
  The dialogue on the right opens.
  The table below lists all object types for which object defaults exist.



Polygon	→ page 50, Defaults for Polygon Objects
Text	→ page 59, Defaults for Text Objects
1D Barcode	→ page 70, Defaults for 1D Barcode Objects
Data Matrix ECC200	→ page 75, Default settings for Data Matrix Objects
Bitmap Graphic	→ page 42, Properties of a Bitmap Object
Wait for External Signal	→ page 120, Defaults for "Wait for External Signal"
Set I/O port	→ page 122, Defaults for "Set I/O port"
Show Messagebox	→ page 125, Defaults for "Show Messagebox"
Vector Graphic	→ page 30, Defaults for Vector Graphic Objects

4.1.6 Object Properties

You can change the properties of objects as follows:

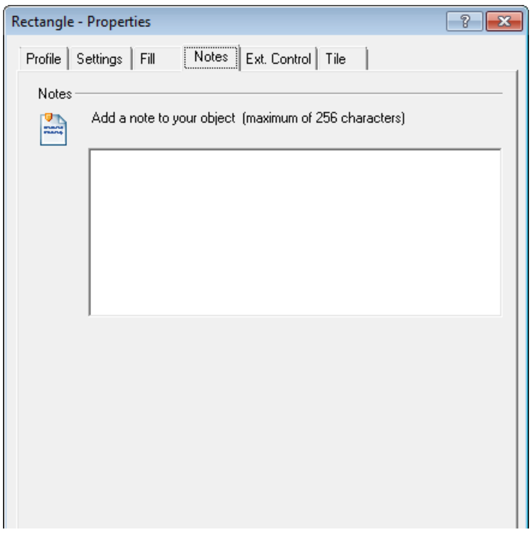
- Right click on a object.
- Select *Properties...*.
- Carry out the required changes. Refer to the following sections to see which properties are possible for which object types.

The following properties can be set for all object types:

Notes

Notes can be added to objects as follows:

- Right click on the object to which you want to add a note.
- Select *Properties...*.
- Select *Notes* tab.
- The dialogue on the right opens.
- Enter the desired text.
- Confirm your entry with the *OK* button.

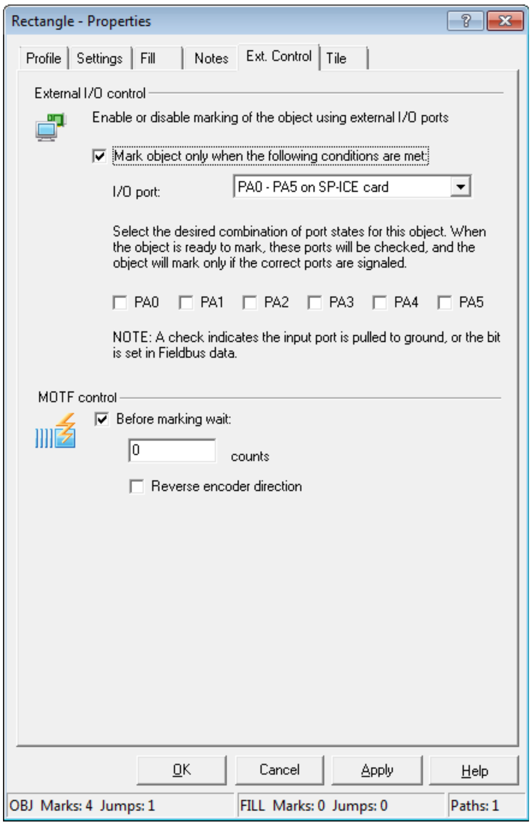


External Control

During execution of the job, each individual marking object can be marked or skipped depending on external signals. The settings for this can be called up as follows:

- Right click on the object to which you want to add an external marking control.
- Select *Properties...*.
- Select *Ext. Control* tab.

  The dialogue on the right opens.
  Refer to the table below for explanations.



External control activated	If this function is enabled, the I/O ports are checked before marking the selected object. If they accord with the setting in IN1-IN6, the object is marked, otherwise it is skipped.
I/O port	Selection of the input ports on either the control card or the standard I/O card, that need to be checked.
IN1–IN6 *PA0–PA5*	Specification for port status (high / low). If the specification is met, the object is marked. If the specification is not met, the object is skipped The port status values can either be read from the standard I/O card or from the control card (SP-ICE or RLC-USB).
MOTF control	The marking process of an object can be started with a definable amount of units (impulses, mm or Inch) which are read from a pulse transmitter. ➜ page 110, Tiling and the "Mark-on-the-Fly" function

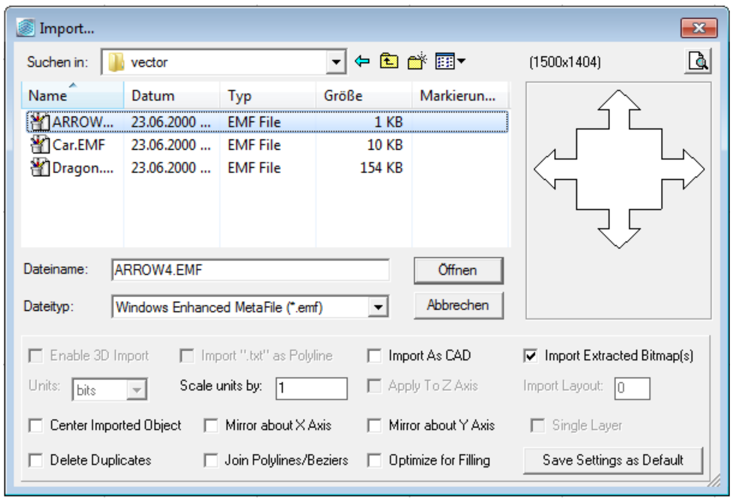
(➜ page 226, Standard I/O Card / Interlock Card)

4.2 Importing and editing Vector Graphic Objects

4.2.1 Importing Vector Graphic Files

Mathematically, Vector Graphics are defined as a sequence of points connected by lines to each other. Vector Graphics can be scaled as required without loss of quality. They are ideally suited for use with laser processing systems as the deflection unit is a vector output device.

- Select *File >Import Job*. The dialogue on the right opens.



Import...

The table below contains explanations to the Vector Graphic formats that can be imported.

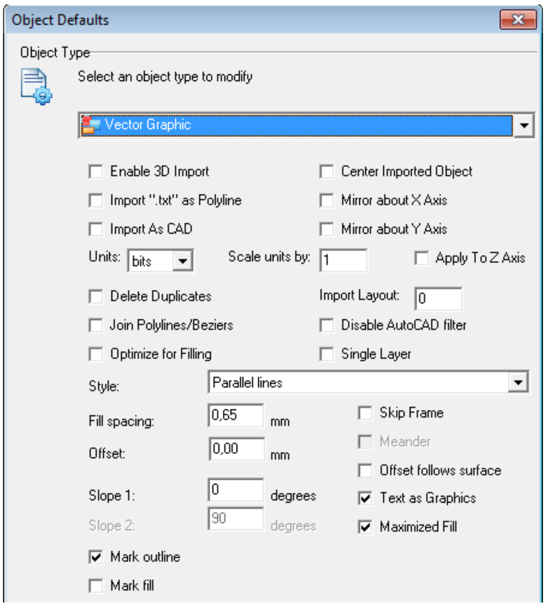
Since import parameter can be defined as default setting, they are described with the default settings.(➜ page 30, Defaults for Vector Graphic Objects).

File types	*CAD Drawings*	File formats and export formats of different CAD programs (*.dgw; *.dxf; *.plt; *.hgl; *.hg; *.hpg; *.plo; *.hp; *.hp1; *. hp2; *.hpgl ; *. hpgl2; *.gl2; *.pm; *.spl; *.rtl; *.cgm; *.svg) Editing with the Vector Graphic Designer is not possible, with only these file formats.
	weldMARK™ 3 Object	weldMARK™ format for objects *(*.wlo)*.
	HPGL Plotter File	The industry standard (*.plt); this format is primarily used for output to a pen plotter. Note that the resolution of the plotter file to be imported must match to the resolution set in weldMARK™ so that the output size will be displayed in weldMARK™ correctly. The resolution in weldMARK™ depends on the F-Theta lens used. It is referred to as the calibration factor and can be seen under *System >Preferences* in *Hardware* tab.
	Windows Enhanced Meta File	A format developed by Microsoft *(*.emf)*. It can be used to store both Vector Graphic information and bitmaps embedded in the file. When Vector Graphic objects are copied to the clipboard, EMF format is used.
	Windows MetaFile	A format developed by Microsoft *(*.wmf)*, the precursor of the EMF format.
	AutoCAD	An export format *(*.dxf)*, normally from AutoCAD.
	Encapsulated PostScript	A graphic format, optimized for importing into other documents *(*.eps)*.
	further	➜ page 41, Importing Bitmap Files
additional import options		➜ page 30, Defaults for Vector Graphic Objects

4.2.2 Defaults for Vector Graphic Objects

This section describes how you can call up and modify the defaults for Vector Graphic objects. The defaults apply to all new Vector Graphic objects.

- Select *Objects >Defaults*.
- Select the *Vector Graphic* Default option. The dialogue on the right opens. Refer to the table below for explanations.



Enable 3D Import	This option has to be checked, to import 3D Vector Graphic objects. ➜ page 158, Importing 3D Vector-Objects
Center	Positions the object in the center of the workspace.
Import ".txt" as Polyline	3D coordinates within a txt-file are imported as polyline.
Mirror about X Axis	The object is automatically mirrored upon importing. The options are summable.
Mirror about Y Axis	
Import As CAD	Imports a CAD-file.
Units	The unit with which the data is interpreted can be specified in this field. This setting should match the setting that was used when exporting.
Scale units by:	A factor with which the data is scaled upon import can be defined here.
Apply to Z Axis	Must be selected when 3D data is scaled in the Z axis.
Delete Duplicates	Vector objects with the same coordinates can be automatically removed, upon import with this function.
Import Layout	Allows for a specific layout of the file to be imported. Layout "0" is used as default. The correspondent layout number has to be used, to import another layout.
Join Polylines/Bezier	This function activates a filter, that is active during the import. It joins all polylines and Bezier objects, if their starting and ending points are identical.
Disable AutoCAD filter	Enables or disables the appearance the AutoCAD filter.
Optimize for Filling	Optimizes the imported object for the filling. Particularly useful when the spot offset function is used.
Single Layer	This function combines all single layers to one overall level and it is especially recommended when filling or spot offset functions are applied.
Style	Defines which filling style is used.
Fill spacing	The distance between the individual fill lines can be set for all new text objects. Entering "0" means that the characters will not be filled.
Offset	Defines the offset from the filling to the contour.
Slope 1	Defines the angle between parallel lines.
Slope 2	Defines the angle between cross hatches.

Mark object	Enabling this function means that the object will be marked. This function is enabled by default.
Mark fill	If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.
Skip Frame	Inverts the filling of a vector object with multiple layers. All previously unfilled areas are filled, and vice versa.
Mäander	This function refers to bidirectional parallel lines and/or crosshatches. When changing the direction the end of a fill line is connected to the beginning of the next fill line without the laser stopping or turning off.
Offset follow surface	For 3D objects the position of the offset is adjusted to the 3D surface.
Text as Graphic	Text within the graphic object should be part of the filled layout.
Maximized Fill	Use if graphic has closed and non-closed contour.

4.2.3 Vector Graphic Designer (VGD)

The Vector Graphic Designer can be used to adjust Vector Graphic objects to the requirements needed for marking with the laser. The following examples represent a few possibilities:

- The position of a graphics' elements can be changed in order to adjust to the component to be marked.
- To remove single elements or complete layers from the marking process, they can be deleted.
- The elements of the graphic can be arranged in up to 8 layers. It is possible to allot one of 8 pens to each layer (SET_PEN). The marking parameters of each single pen can be set in the profile settings.
- The marking sequence and direction can be modified to optimize the marking speed. Thus the marking speed can be optimized.
- New elements can be inserted, like text, ellipses, circles or points.
- Layers can be joined or split.
- 2D vector objects can be projected onto a 3D surface with a STL file.

To access the Vector Graphic Designer, follow the instructions:

- ○ Right click on a Vector Graphic object.
- ○ Select *Design*.

The Vector Graphic Designer is parted into six areas. The following chart gives a short description of them. For detailed information, refer to the related sections.

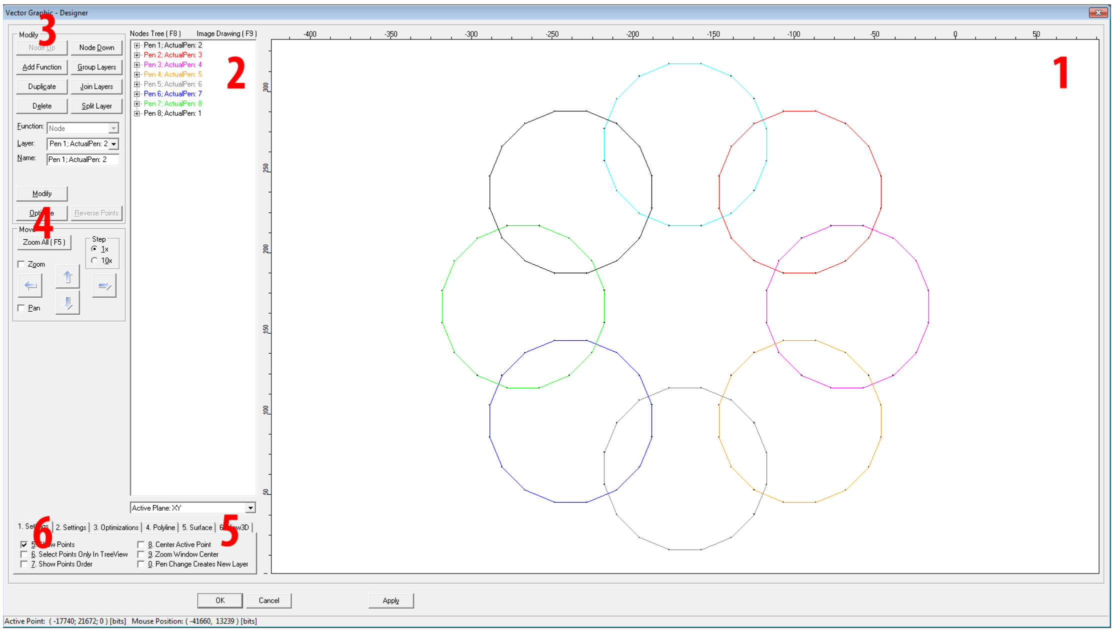


Image Drawing (1)	This area shows a preview of the Vector Graphic object.
Nodes Tree (2)	The node tree lists all elements of the selected vector object and simultaneously defines the marking sequence and distribution of levels.
Modify (3)	This area provides several functions to edit the selected object.
Move (4)	This area provides several functions to adjust the position of elements or the active point. Furthermore, the zoom can be changed.
Change view plane (5)	The axis view of an 3D-Vector object can be selected. (Top-View, Side-View, Front-View)
Additional functions (6)	Additional functions can be activated for several topics in this area.

(1) Image Drawing

In the Image Drawing area, single elements of the Vector Graphic object can be selected and dragged by the mouse.

After opening the Vector Graphic Designer, the starting point of the graphic is automatically chosen as active point. By clicking the left mouse-button, another point can be selected as active point.

By using the right mouse-button, the focus can be changed. It does not influence the position of the object.

Editing functions can be activated by clicking in the image drawing area or by pressing the F9 key. If the Image Drawing view is active, the mouse wheel can be used to zoom the focus in and out.

(2) Nodes Tree

In the Nodes Tree view, it is easy to select single points or groups of points of an element for editing. Depending on the selected items, different editing functions are available in the Modify area.
The nodes tree allows for a detailled view on different layers. By clicking the "+"-symbol the nodes tree kann be extended up to the coordinate layer.

(3) Modify

Node up/ Node down	Change of the position in the node and also in the marking sequence.
Add Function	Inserts the content from the *Function* field into the selected node.
Duplicate	Creates a copy of the selected function, that can be inserted.
Delete	Deletes the selected node. The function SET_PEN can not be deleted since it is associated with the current layer. Points can only be deleted if they are not required for the definition of the function.
Group Layers	Group all function from the same layer in the nodes tree.
Join Layers	Join all function from the same layer in the nodes tree. The marking sequence is optimized this way.
Split Layer	Splitting the selected layer into two nodes. Splitting will take place between the active node and the following node.
Join Polyline	Joining the selected node with the previous node, for polylines.
Split Polyline	Splitting the selected polyline into two separate lines. The distribution is made by duplicating the selected node. The first and last node can not be used.
Function	The *Function* field contains a list of the supported functions and their parameters. First, it displays the type of the selected node in the Nodes Tree. Furthermore, the field is used to choose the function to be added to the Nodes Tree. ⇨ above
Change...	Applying all changes made. The same effect is achieved by pressing the *Enter* key or clicking into another field with the mouse button.
Optimize	Applying the chosen optimizations to the selected layers. ➜ page 34, (6) Additional functions
Reverse Points	Reversing the sequence of points of any function and thus changing the marking sequence.

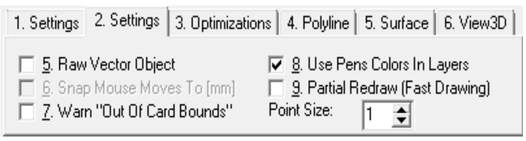
(4) Move

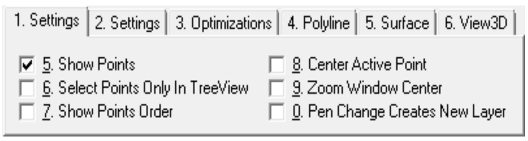
Zoom all (F5)	Clicking on this button zooms the preview to display the whole Vector Graphic object.	
Arrow Keys	By using the arrow keys, the selected function and its sub functions can be moved in the preview. ■ If the selected node is a point (Level 2), only that point is selected. ■ If the selected node is an object (Level 1), the first point will be selected and all other points from the objects are in the valid selection area. ■ If the selected node is a layer (Level 0), the first point of the first object will be selected and all other points from the layer are in the valid selection area.	
	Zoom	If this option is selected, the focus can be zoomed in and out via the arrow keys.
	Pan	If this option is selected, the arrow keys move the whole workspace.
	Step	By this options field, the step width of the arrow key movement can be defined. *1x* = 0.1 mm, *10x* = 1 mm. **Note:** Alternatively the switch to *10x* can be done via the shift key.

(5) Change view plane

An object can be viewed from different directions with this function. Available options are "Active Plane: XY", "XZ" and "YZ". Depending on the chosen option, 2 of the 3 axis are figuratively put in front, so the user can view the object from the sides, from above or from the front for example.

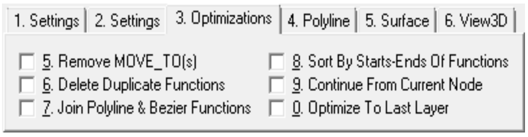
(6) Additional functions

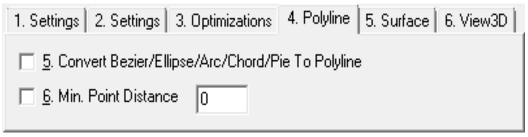




Show points	If this function is enabled, points are shown in the preview. This function is enabled by default.
Select Points Only In TreeView	If this function is enabled, the selection of the active point can only be made in the nodes tree. Thus, the accidental selection of a wrong point can be avoided, even if the point density is high. This function is disabled by default.
Show Points Order	If this function is enabled, the marking sequence of the points is shown in the preview. All points that define a function are shown in the Image Drawing, not only the points intended to be marked. This function is disabled by default.
Center Active Points	This function always displays the active point in the center of the preview. This function is disabled by default.
Zoom Window Center	This function zooms in the focus up to the size of the whole Image Drawing field.
Point Size	By selecting a value between 1 and 10, the size of the points in the preview can be adjusted.
Raw Vector-Object	It's possible to modify or move Vector Graphic objects without the Vector Graphic Designer via dimension tools. Thus the object can be positioned out of the preview window. If *Raw Vector Object* function is enabled, the Vector Graphic object is displayed in its original form and position.
Snap Mouse Moves To [mm]	If this function is enabled, the mouse is moving in steps of 1 mm. The function is only available if *Raw Vector Object* is enabled.
Warn "Out Of Card Bounds"	If this function is enabled, the borders of the marking field are shown by dotted lines. If *Show Points* is enabled, points outside the marking field are shown in red color. This function is disabled by default.

Use Pens Colors in Layers	If this function is enabled, the diverse pen colors are shown in the Nodes Tree and the Image Drawing. Otherwise they are all shown in black color. This function is enabled by default.
Partial Redraw (Fast Drawing)	If this function is enabled, only the selected point, function or layer is redrawn while moving the mouse, so that the rest is masked. The rest is masked. This function improves speed and display time and is disabled by default. Can be used to avoid burning effects caused by poly delay. **Note:** Curved lines will be combined by straight lines within minimal point distance.





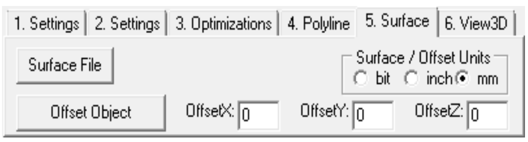
Tab *3. Optimizing* and tab *4. Polyline* contain a number of optimization options which are taken into account when the button *Optimize* is pressed.

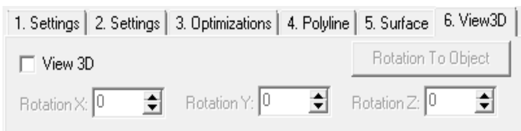
➜ page 33, Optimize

All optimizations are applied only to the selected layer or the layer the currently active node belongs.

To optimize all layers of the Vector Graphic object at once, enable the function *Optimize To Last Layer*.

Remove MOVE_TO(s)	If this function is enabled, pairs of MOVE_TO, LINE_TO, POLYLINE_TO and BEZIER_TO functions are combined into a single polyline or Bezier function. If the object contains functions, that are named above, this function needs to be enabled when using the *Sort By Starts-Ends Of Functions* function.
Delete Duplicate Functions	All functions with identical X/Y values will be deleted if this function is enabled.
Join Polyline & Bezier functions	If this function is enabled, polyline functions that have common ending respectively starting points are joined to longer chains of polylines.
Sort By Starts-Ends of Functions	If this function is enabled, the optimal marking path can be found to reduce the marking time. The functions are automatically brought into the optimal order. If the object contains MOVE_TO, LINE_TO, POLYLINE_TO or BEZIER_TO functions, *Remove MOVE_TO (s)* has to be enabled as well.
Continue From Current Node	If this function is enabled, the optimization starts from the current node instead of the first node of the layer.
Optimize To Last Layer	If this function is enabled, all layers of the Vector Graphic object are optimized at once.
Convert Bezier/ Ellipse/ Arc/ Chord/ Pie To Polyline	If this function is enabled, Bezier, Ellipse, Arc, Chord and Pie functions are converted into polyline functions.
Min. PointDdistance	If this function is enabled, the points that are closer than the selected minimal distance are removed.





These tabs are used for creation and editing of 3D vector objects only.

The *Surface to Object* button is only available until an imported STL file is combined with a vector object. During this period offset values are used onto the position of the STL files directly.

If the option *View 3D* is checked, other options on different tabs can not be used.

Surface File	STL surface file selection
Surface Units	Defines the unit of measurement of the imported surface file.
Offset Object / Surface to Object	Activates the object offset by the defined value / Maps the 2D file onto the 3D surface.

Offset X/Y/Z	Offsets the selected object, or imported STL file, along the correspondent axis of coordination. To move the objects, the highest layer has to be chosen in the nodes tree.
View 3D	Activates *Rotation X/Y/Z*.
Rotation X/Y/Z	Specification of the angle in degrees to rotate the object along the specific axis.

4.2.4 Properties of a Vector Graphic Object

Properties are assigned to Vector Graphic objects, which determine how the objects are displayed on the screen and how the behave during laser processing. These properties are divided up as follows:

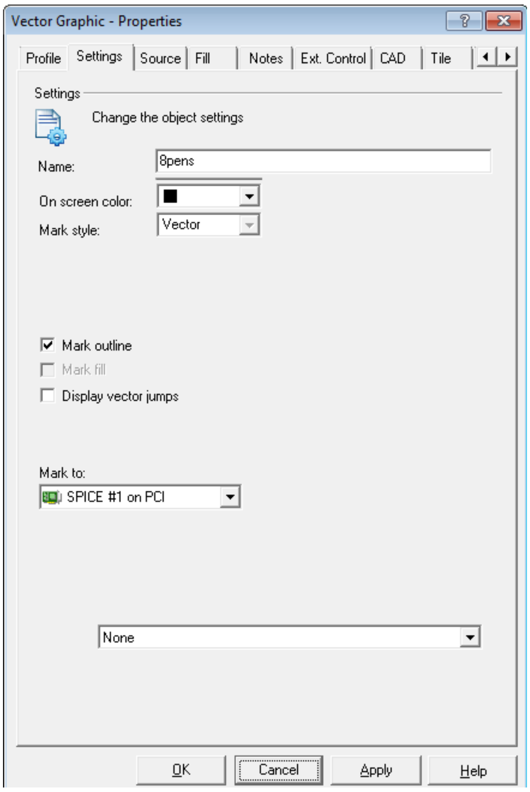
Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 37, Settings for a Vector Graphic Object
Source	Allows you to see the path to the source file.	➜ page 38, Source File for a Vector Graphic Object
Fill	Fill parameters for the object can be entered.	➜ page 86, Object Fill
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
CAD	For Vector Graphic objects special settings can be adjusted.	➜ page 39, CAD Settings of a Vector Graphic Object
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings for a Vector Graphic Object

Every Vector Graphic object is assigned specific settings that can be called up and, if necessary modified as follows:

- Right click on a Vector Graphic object.
- Select *Properties...*.
- Select *Settings* tab.

The dialogue on the right opens.
Refer to the table below for explanations.



<table>
<tr><td>Name</td><td colspan="2">The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.</td></tr>
<tr><td>On screen color</td><td colspan="2">The color selection list can be used to select one of the preset colors to display the object on screen.</td></tr>
<tr><td>Mark object</td><td colspan="2">If this function is enabled, the object contour is marked. This function is enabled by default.</td></tr>
<tr><td>Mark fill</td><td colspan="2">If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.</td></tr>
<tr><td>Display vector jumps</td><td colspan="2">If this function is enabled, the vector jumps between the individual part of the object are displayed on screen. This function is disabled by default.</td></tr>
<tr><td rowspan="3">Inline Parameter Switching</td><td colspan="2">Only for vector objects with a contour composed of several pens. This can be the case as following:</td></tr>
<tr><td>a)
Import of a vector object, that has been split into multiple layers with a graphic program beforehand.</td><td>b)
Import of a single layer file, that has to be split into multiple layers with the Vector Graphic Designer ➜ page 32, Vector Graphic Designer (VGD).
> Split Polyline
> Change Pen color</td></tr>
<tr><td colspan="2">If this functions is active, the laser is not switched of, while marking the contour at the transition from one pen to another, but it is switched to the new marking parameters "on the fly".</td></tr>
<tr><td>Mark to</td><td colspan="2">If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.</td></tr>
<tr><td>Object-specific Preview</td><td colspan="2">Preview option that is used before the actual marking in the job. After choosing this option, specific parameters are available (➜ page 164, Object Preview).</td></tr>
</table>

Source File for a Vector Graphic Object

Vector graphic objects are created in external programs and imported into weldMARK™. The path to the source file can be displayed as follows:

- Right click on a Vector Graphic object.
- Select *Properties...*.
- Select *Source* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

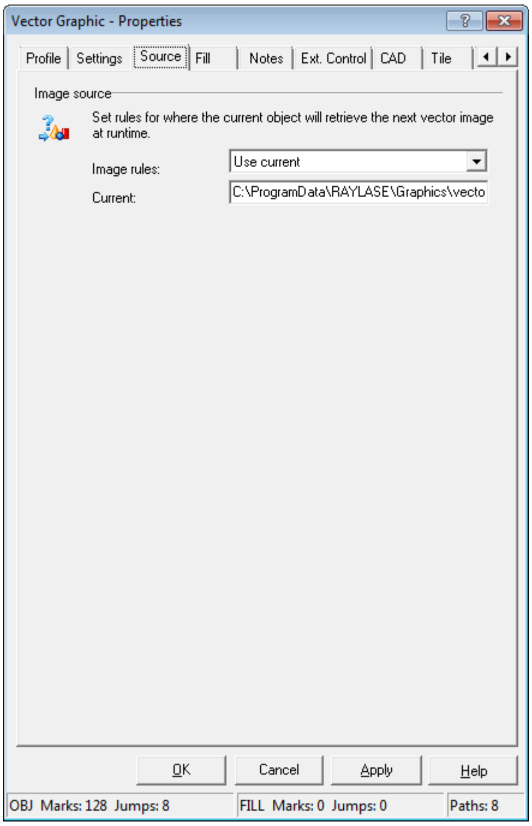


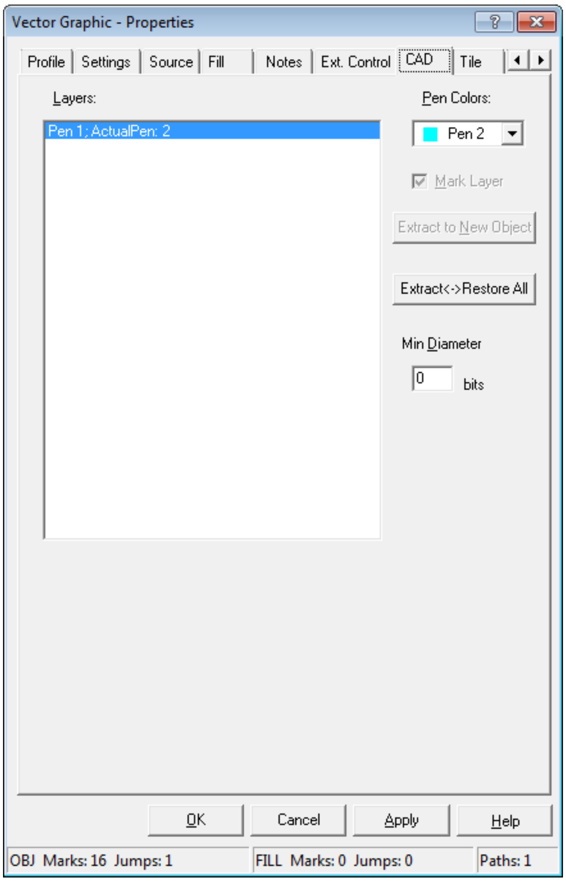
Image rules	For graphic objects no rules can be configured.
String position	This field specifies the path to the source file. If the Vector Graphic file has been imported with the CAD drawings filter (➜ page 30, Defaults for Vector Graphic Objects), the graphic is saved within the job.

CAD Settings of a Vector Graphic Object

For Vector Graphic objects of the type CAD an additional tab *CAD* is available. This tab is called up as follows:

- Right click on a Vector Graphic object.
- Select *Properties...*.
- Select *CAD* tab.

  The dialogue on the right opens. Refer to the table below for explanations.



Layers	All layers of the Vector Graphic object are listed.
Pen Colors	A specific pen can be defined for each layer. Therefor eight predefined pens are available (Pen 1 to Pen 8). Via the profile settings it is possible to set marking parameters for each pen separately ➜ page 136, Marking Object Profile).
Mark Layer	Via this field marking can be activated or deactivated for each layer separately.
Extract to New Object	By clicking this button, the selected layer is removed from the Vector Graphic object and added as a new object to the object manager.
Extract <-> Restore all	This option separates single layers into single objects. The function must be confirmed with *Apply*.
Min. Diameter	Circular objects that fall below this diameter are converted into drill objects.

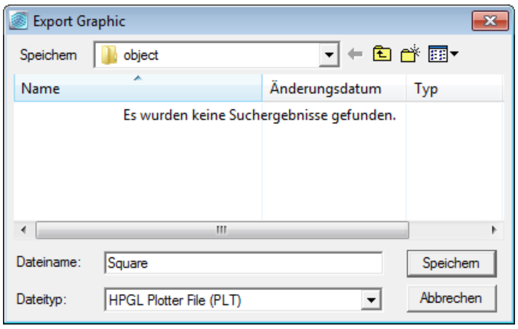
* These options are only available for Vector Graphic objects imported as CAD drawing.

4.2.5 Exporting Vector Graphics

Vector graphic objects can be exported for use in other programs.

- Right click on the Vector Graphic you want to export.
- Select *File >Export*.

  The dialogue on the right opens. Refer to the table below for explanations.



Save in	Folder in which the graphic should be saved.	
File name	The object name is suggested as the file name. However, you can overwrite this with the name of your choice.	
Save as type	The graphic can be saved in the following formats:	
	PLT	HPGL Plotter File
	WLO	weldMARK™ object-format

4.3 Importing and editing Bitmap Objects

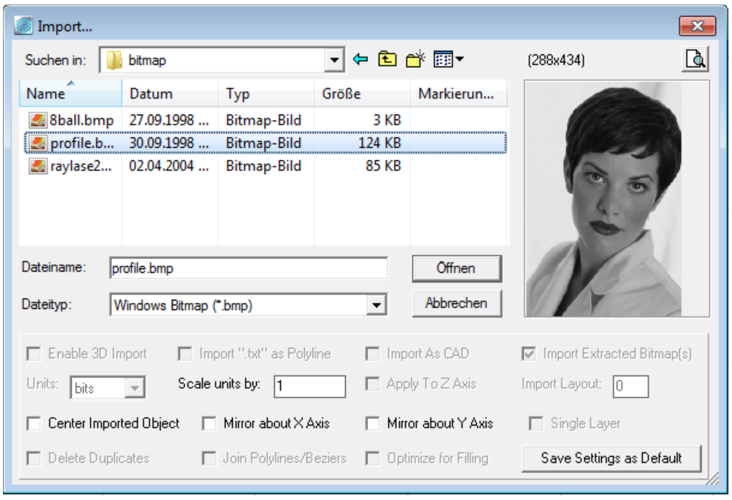
4.3.1 Importing Bitmap Files

A bitmap is a rectangular grouping of pixels. For laser marking, the bitmap must be rastered. As the Scan Head is a vector output device, this raster has to be simulated. To do this, the laser beam moves repeatedly over the image and marks a series of pixels each time. This process can take a long time. It normally takes longer to mark a bitmap representation of an object than a vector representation. However, some images only allow bitmap marking, e. g. photographs.

weldMARK™ supports the import of bitmap files with monochrome, gray or colored content. Once imported, all images are automatically converted into gray scale images.

- Select *File >Import Job*.

  The dialogue on the right opens.



The table below contains explanations to the bitmap formats that can be imported.

Since import parameter can be defined as default setting, they are described with the default settings.(➜ page 45, Defaults for Bitmap Objects).

Files of type	*Windows Bitmap (BMP)*	A Windows bitmap format.
	JPEG Bitmap (JPG)	Compressed bitmap format.s.
	CompuServe Bitmap (GIF)	
	PaintBrush (PCX)	A PaintBrush bitmap format.
	Further	➜ page 29, Importing Vector Graphic Files ➜ page 29, Importing and editing Vector Graphic Objects

4.3.2 Properties of a Bitmap Object

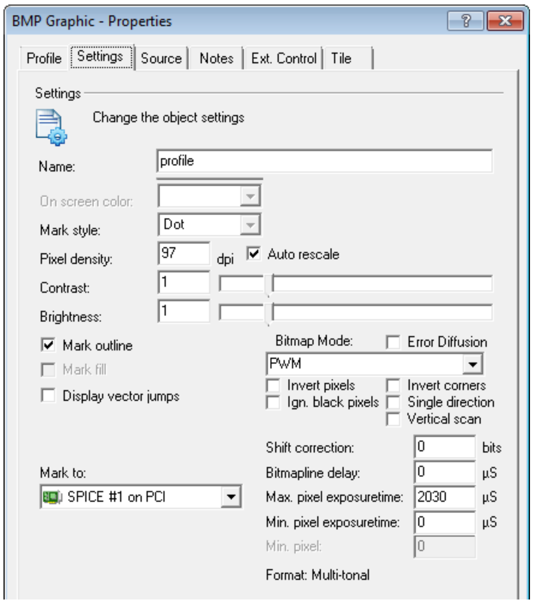
Properties are assigned to bitmap objects, which determine how the objects are displayed on the screen and how the behave during laser processing. These properties are divided up as follows:

Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 42, Settings of a Grayscale Bitmap Object
Source	Allows you to see the path to the source file.	➜ page 44, Source File for a Bitmap Object
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings of a Grayscale Bitmap Object

Every bitmap object is assigned specific settings that can be called up and, if necessary, modified as follows:

- Right click on a bitmap object.
- Select *Properties...*.
  Select *Settings* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
Mark Style	Default setting for bitmap graphics is "Dot Matrix".
Pixel density *Auto scaling*	*Pixel density* specifies in which resolution the picture will be marked. If the option *Auto scaling* is activated, the picture size remains the same, even if the *Pixel density* is changed.
Contrast	The difference between lightest and darkest pixels can be modified.
Brightness	The brightness of the marking result can be changed. If the value is increased, the laser rests longer on each pixel; the marking result will be brighter or darker depending on the material.
Mark object	Enabling this function means that the object will be marked. This function is enabled by default.
Display vector jumps	If this function is enabled, the vector jumps between the individual part of the object are displayed on screen. This function is disabled by default.

Bitmap mode	Depending on the kind of the bitmap object and the preset laser type, the following modes can be selected (➜ page 44, Selectable bitmap modes).	
	PWM	If this function is enabled, the levels of gray are generated through the exposure time. The Scan Head rests at each pixel for a various time.
	PWM-2	If this function is activated the levels of gray are generated through the laser power. The Scan Head processes the pixels with a constant speed.
	Analog	If this function is selected, the laser power is controlled via an analogue signal (0V to10V).
	Digital	If this function is selected, the laser power is controlled via a digital signal (8bit digital output).
	Error Diffusion	If this function is selected, the bitmap object is converted into a monochrome bitmap using the default error diffusion algorithm. Black pixels are positioned in a way that the picture seems to consist of shades of grey.

Invert pixels	Creates a negative of the original bitmap object.		
Single direction	Bitmap objects are marked line by line, where at the marking is performed in alternating direction. If this function is enabled, marking is only performed in one direction, which can improve the marking quality (deactivation of the hysteresis of the scanner mirrors).		
Ign. black pixels	Activates the *Min. Pixel* field (see below).		
Invert corners	When rotating bitmap objects, pixels, which do not exist in the original, can be generated in the corners. The color of these superfluous pixels can be set to black (no marking) or white.		
Vertical scan	Turns the pixel processing by 90 degrees. This way the picture is processed vertically instead of the default given horizontal way.		
Shift correction	Mechanical inertia and laser specific delay may cause hysteresis errors in bidirectional operation, especially when marking with high speed. Via the parameter *Shift Correction* this hysteresis can be compensated.		
	 not corrected	 compensated	 correction value too high
Bitmapline delay	Via this parameter an idle time after each bitmap line is defined. The next line is not marked until the set time has elapsed.		
Max. pixel exposuretime	With this parameter the maximum and minimum time, that the laser can use to mark one point, can be set. Through the parameters the marking intensity can be adjusted, so that the graphic quality is affected.		
Min. pixel exposuretime			
Min. pixel	Via this parameter a minimal grey value is defined. Only pixels of the bitmap object of the same or a higher value are marked. If more than three pixels can be ignored, a jump command is performed to the next pixel to be marked automatically. This may increase the marking speed. The value for *Min. pixel* ranges from 0 to 1000. If the value is set to 0 or 1, no pixels are skipped.		
Format	The recognized file format of the bitmap object is displayed.		
Mark to	If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.		

Settings for a monochrome Bitmap Object

Monochrome bitmap objects have the following different parameters.

Dot spacing	Spacing of the picture dots. Consistent with the *Pixel density* of bitmap objects with levels of gray.
Pulse on time	Through the parameters the length of the laser pulse and the following pause can be adjusted.
Pause	
Pulses per dot	The parameter defines how many pulses are sent out for each marked pixel.

Generally the option *Mark on dark material* is available for bitmap files. to invert the levels of gray.

Selectable bitmap modes

Laser type	Setting for laser power	Bitmap mode				
		PWM	PWM-2	Analog	Digital	Error Diffusion[3]
CO_2	PWM	●	●			●
YAG	Analog [1]	●		●		●
	Digital [2]	●			●	●
IPG	Digital [2]	●			●	●
SPI	Analog [1]	●		● [4]	● [5]	●

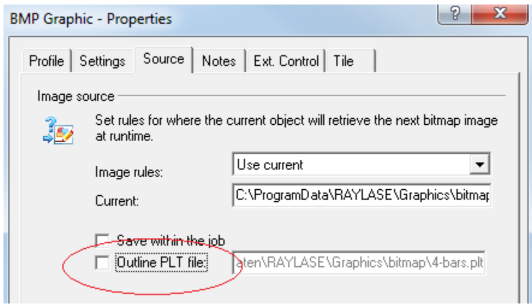
● = selectable, 1 = DAC, 2 = PortB, 3 = not possible for combination with monochrome bitmaps
4 = SPI Basic Interface, 5 = SPI Extended Interface

Source File for a Bitmap Object

Bitmap objects are created in external programs and imported into weldMARK™. The path to the source file can be displayed as follows:

- ○ Right click on a bitmap object.
- ○ Select *Properties...*.
- ○ Select *Source* tab.

  The dialogue on the right opens.
  Refer to the table below for explanations.
  When the "Outline PLT file" is checked, a pop-up window will be shown and a corresponding PLT file can be selected.



The name of the outline "*.PLT" file is saved within the bitmap object data in the weldMARK job

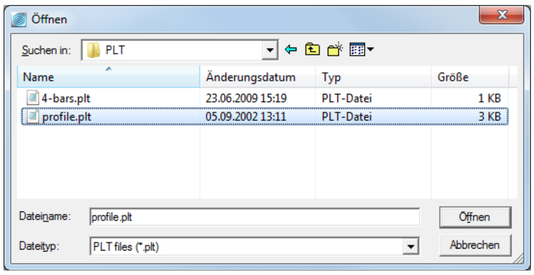
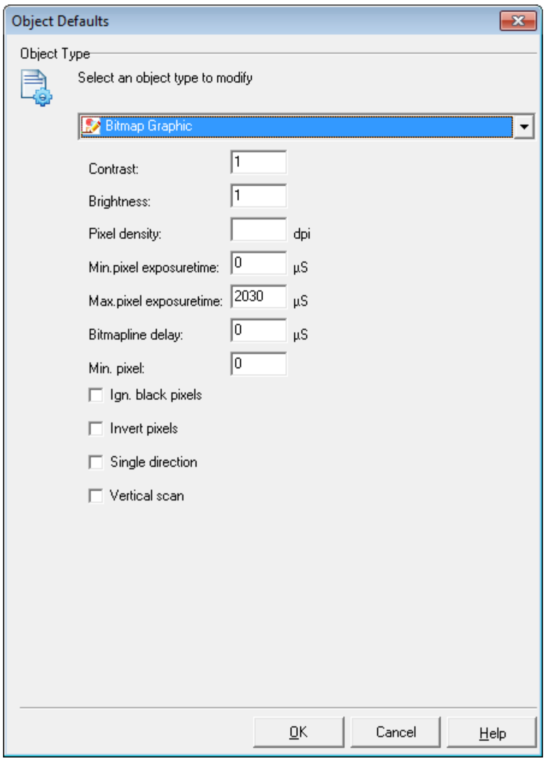


Image rules	For graphic objects no rules can be configured.
String position	This field specifies the path to the source file.
Save within job	With this option the bitmap file is saved within the job. If the option is deselectedm the bitmap file will be loaded upon every start of the job. In case the job is moved to another computer, the file needs to be available from there.
Outline PLT File	Activates the option to connect a PLT-File with Bitmap to be used as outline preview and shows path of the linked PLT file. See ➜ page 163, Preview Mark

4.3.3 Defaults for Bitmap Objects

This section describes how the defaults for bitmap objects can be called up and changed. The defaults apply to all new bitmap objects.

- Select *Objects >Defaults...* option from the menu.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Contrast	The ratio between dark and light pixels in the image can be changed.
Brightness	The brightness of all pixels in the bitmap image can be changed.
Pixel density	The pixel density can be set in an area between 10 and 2400 dpi.
Max. pixel exposuretime *Min. pixel exposuretime*	With this parameter the maximum and minimum time, that the laser can use to mark one point, can be set. Through the parameters the marking intensity can be adjusted, so that the graphic quality is affected.
Bitmapline delay	Via this parameter an idle time after each bitmap line is defined. The next line is not marked until the set time has elapsed.
Min. pixel	Via this parameter a minimal grey value is defined. Only pixels of the bitmap object of the same or a higher value are marked. If more than three pixels can be ignored, a jump command is performed to the next pixel to be marked automatically. This may increase the marking speed. The value for *Min. pixel* ranges from 0 to 1000. If the value is set to 0 or 1, no pixels are skipped.
Ign. black pixels	During marking, the laser beam ignores pixels that have a 100% black value and are not marked therefore. This reduces the processing time.
Invert pixels	Creates a negative of the original bitmap object.
Single direction	Bitmap objects are marked line by line, where at the marking is performed in alternating direction. If this function is enabled, marking is only performed in one direction, which can improve the marking quality (deactivation of the hysteresis of the scanner mirrors).
Vertical scan	Turns the pixel processing by 90 degrees. This way the picture is processed vertically instead of the default given horizontal way.

4.4 Adding and editing Marking Objects

Marking objects are objects that can be marked with a laser. weldMARK™ allows you to select the following marking object types:

Line
Rectangle
Polygon
Polyline
Bezier
Vector object
Text
Barcode...
Drill...

The sections below describe how marking objects are added to a job and how these objects can be modified subsequently.

4.4.1 Line Objects

A line is a one-dimensional object. It causes the laser to mark a straight line.

New line

Adding a Line Object

- Select *Objects >Add >Line* option from the menu.
  A new line is inserted in the center of the workspace.

Properties of a Line Object

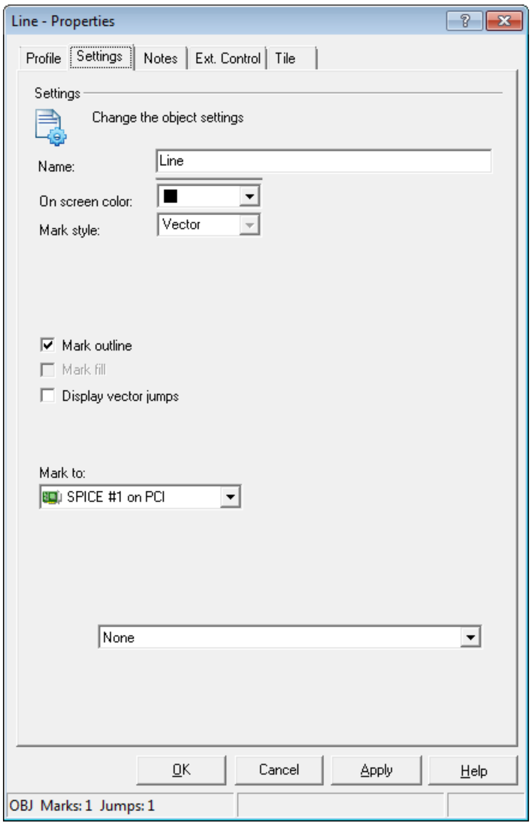
Properties are assigned to line objects, which determine how the objects are displayed on the screen and how the behave during laser processing. These properties are divided up as follows:

Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 47, Settings for a Line Object
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings for a Line Object

Every line object is assigned specific settings that can be called up and, if necessary, modified as follows:

- Right click on a line object.
- Select *Properties...*.
- Select *Settings* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
On screen color	The color selection list can be used to select one of the preset colors to display the object on screen.
Mark object	Enabling this function means that the object will be marked. This function is enabled by default.
Display vector jumps	If this function is enabled, the vector jumps between the individual part of the object are displayed on screen. This function is disabled by default.
Mark to	If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.
Object-specific Preview	Preview option that is used before the actual marking in the job. After choosing this option, specific parameters are available(➜ page 164, Object Preview).

4.4.2 Rectangle Objects

A rectangle is a marking object with four corners.

New rectangle

Adding a Rectangle Object

- Select *Objects >Add >Rectangle* option from the menu.
  A new rectangle object is inserted in the center of the workspace.

Properties of a Rectangle Object

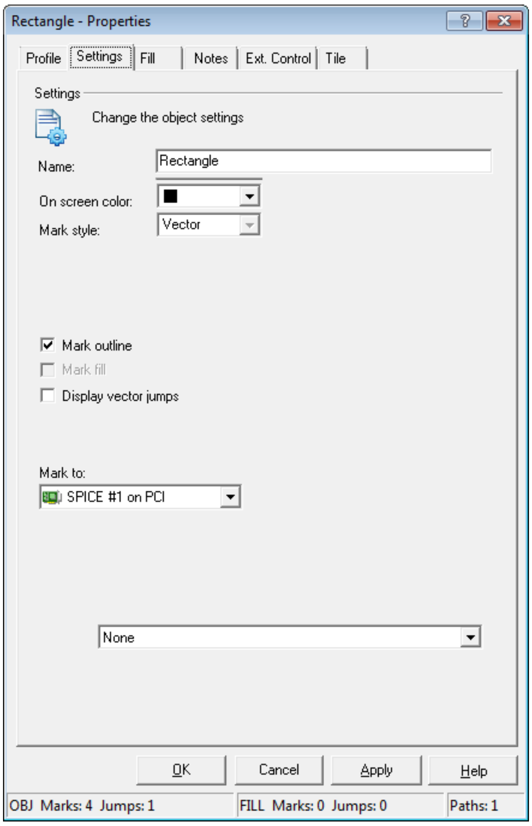
Properties are assigned to rectangle objects, which determine how the objects are displayed on the screen and how the behave during laser processing. These properties are divided up as follows:

Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 49, Settings for a Rectangle Object
Fill	A fill can be applied to the object.	➜ page 86, Object Fill
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings for a Rectangle Object

Every rectangle object is assigned specific settings that can be called up and, if necessary, modified as follows:

- Right click on a rectangle object.
- Select *Properties...*.
- Select *Settings* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
On screen color	The color selection list can be used to select one of the preset colors to display the object on screen.
Mark object	If this function is enabled, the object contour is marked. This function is enabled by default.
Mark fill	If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.
Display vector jumps	If this function is enabled, the vector jumps between the individual part of the object are displayed on screen. This function is disabled by default.
Mark to	If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.
Object-specific Preview	Preview option that is used before the actual marking in the job. After choosing this option, specific parameters are available. (➜ page 164, Object Preview)

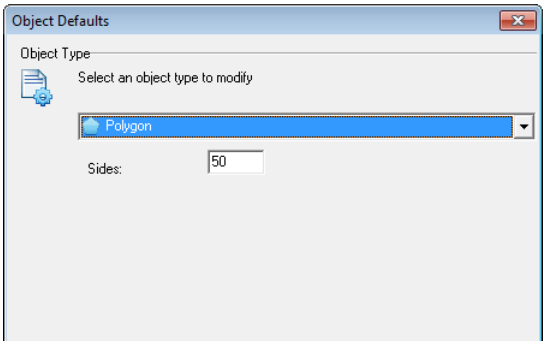
4.4.3 Polygon Objects

A polygon object is an object that can be marked and has a definable number of sides of equal length. The distance from a corner to the center of the object is always the same.

Defaults for Polygon Objects

This section describes how you can call up and modify the defaults for polygon objects. The defaults apply to all new polygon objects.

- Select *Objects >Defaults...* option from the menu.
- Select the object type *Polygon*.
- The dialogue on the right opens.
  Refer to the table below for explanations.



Sides	All new polygons are created with the number of corners entered.

New polygon

Adding a Polygon Object

- Select *Objects >Add >Polygon* option from the menu.
  A new polygon object is inserted in the center of the workspace.

Properties of a Polygon Object

Properties are assigned to polygon objects, which determine how the objects are displayed on the screen and how the behave during laser processing. These properties are divided up as follows:

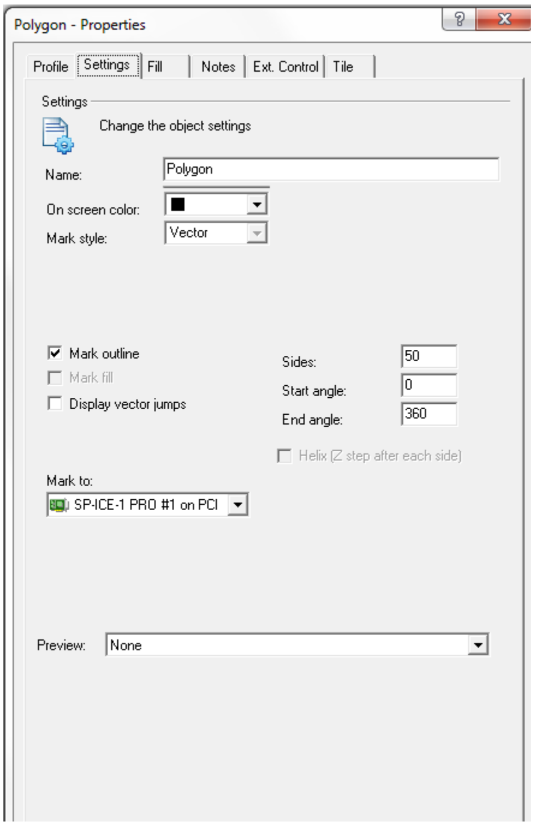
Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 51, Settings for a Polygon Object
Fill	A fill can be applied to the object.	➜ page 86, Object Fill
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings for a Polygon Object

Every polygon object is assigned specific settings that can be called up and, if necessary, modified as follows:

- Right click on a polygon object.
- Select *Properties...*.
- Select *Settings* tab.

  The dialogue on the right opens.
  Refer to the table below for explanations.



Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
On screen color	The color selection list can be used to select one of the preset colors to display the object on screen.
Mark object	If this function is enabled, the object contour is marked. This function is enabled by default.
Mark fill	If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.
Display vector jumps	If this function is enabled, the vector jumps between the individual part of the object are displayed on screen. This function is disabled by default.
Sides	Specifies the number of sides of the polygon.
Start angle	Specifies the angle position at which the first line segment begins. An angle of "0" corresponds to the 12:00 position on a clock.
End angle	Specifies the angle position at which the first line segment ends.
Helix (Z-step after each side)	Only available for Scan Heads of the FOCUSSHIFTER type (➜ page 152, Trepanning Parameters).
Mark to	If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.
Object-specific Preview	Preview option that is used before the actual marking in the job. After choosing this option, specific parameters are available (➜ page 164, Object Preview).

4.4.4 Polyline Objects

Polyline objects are markable objects consisting of at least 2 lines, which are connected by reversal points. The shape of the object can be adjusted according to the individual requirements.

Adding a Polyline Object

New polyline

- Select *Objects >Add >Polyline* option from the menu.
  A new polyline object is inserted in the center of the workspace. At first, it appears as a small point, which can be edited individually.
  ➜ page 54, Setup of a Polyline object

Properties of a Polyline Object

Properties are assigned to polyline objects, which determine how the objects are displayed on the screen and how the behave during laser processing. These properties are divided up as follows:

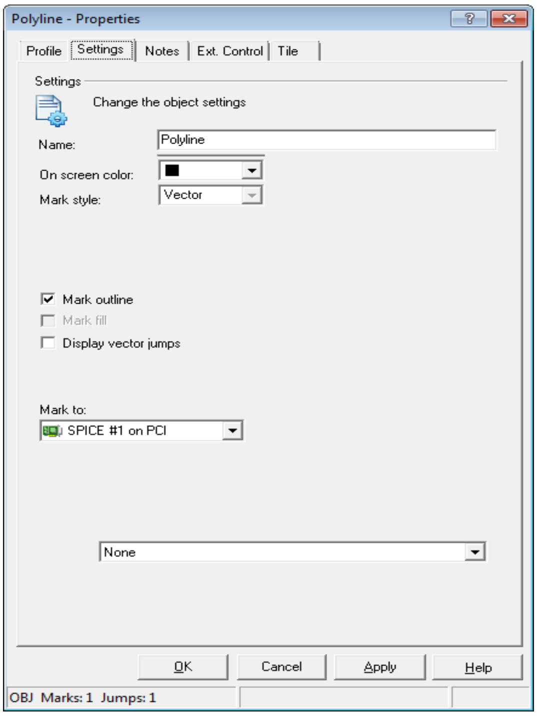
Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 53, Settings for a Polyline Object
Fill	A fill can be applied to polyline objects with a closed contour.	➜ page 86, Object Fill
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings for a Polyline Object

Every polyline object is assigned specific settings that can be called up and, if necessary, modified as follows:

- Right click on a polyline object.
- Select *Properties...*.
- Select *Settings* tab.

The dialogue on the right opens.
Refer to the table below for explanations.

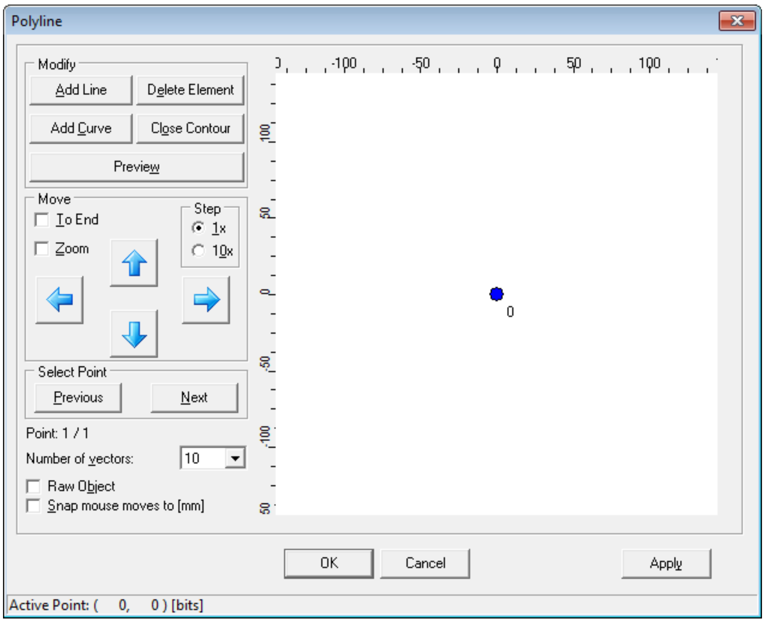


Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
On screen color	The color selection list can be used to select one of the preset colors to display the object on screen.
Mark object	If this function is enabled, the object contour is marked. This function is enabled by default.
Display vector jumps	If this function is enabled, the vector jumps between the individual part of the object are displayed on screen. This function is disabled by default.
Mark to	If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.
Object-specific Preview	Preview option that is used before the actual marking in the job. After choosing this option, specific parameters are available (➜ page 164, Object Preview).

Setup of a Polyline object

Each new polyline object is added as a point. The shape can be modified as described in the following section:

- Click on a polyline object.
- Press key *F6*.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Polyline Editing Window (1)		This area shows all changes applied to the polyline object. By clicking on the *OK* or *Apply* button, the changes are saved. By clicking the *Cancel* button, the changes are discarded. The laser displays the active point on the marking field. If the active point (blue color) is moved in the *Polyline Editing Window*, the display of the marking field will be updated. So, the object can be adjusted exactly in the area that is to be marked by using the visible pointer.
Add Line		A new point is inserted behind the active point. The points are connected by a line.
Add Curve		A new point is inserted behind the active point. The points are connected by a curve.
Delete Element		Deletes the active point.
Close Contour		As described for the function *Add Line*, a new point is inserted behind the active point. Using this function, the new point is inserted exactly on the same position as point no.1 of the polyline object. Thus a closed contour is created. Areas with closed contours can be filled via the object properties if necessary. If one of these both points, the first or the last one, are moved afterwards, the contour may not be recognized as closed any more.
Preview		Clicking on this button creates a preview of the polyline object in the marking field. This function is available only if a SP-ICE control card is used. During the preview, no elements can be added or changed.
Arrow Keys		The selected point can be moved via the arrow keys in the desired direction.
	End	If this function is activated, the active point and all subsequent points can be moved at once via the arrow keys. Consequently, the first point can be selected to move the whole polyline object.
	Zoom	If this function is activated, the preview of the Bezier object can be zoomed in and out via the arrow keys.
	1x *10x*	By this options field, the step width of the arrow key movement can be defined. *1x = 0.1 mm, 10x = 1 mm.*

Previous	Selects the previous or next point subject to the active point.
Next	
Number of vectors	Via this pop-up menu, the accuracy of the added curve can be defined. It sets how many vectors constitute the curve.
Raw Object	It's possible to modify or move polyline objects without the *Polyline Editing Window* via dimension tools. Thus the polyline object can be positioned out of the *Polyline Editing Window*. In this case activate function *Raw Object* to display the original Bezier object at its point of origin in the Bezier Editing Window.
Snap mouse moves to [mm]	If this function is activated, the point is snapped to a grid (1mm), when moving it via mouse.

4.4.5 Bezier Objects

A Bezier object is a markable object consisting of free-style spline curves. The curve linearity can be defined by moving the individual points.

Adding a Bezier object

New
Bezier Object

- Select *Objects >Add >Bezier* option from the menu.
  A new Bezier object is added to the center of the screen.

Properties of a Bezier Object

Bezier objects are assigned properties defining their displayed on the screen and the behavior during laser processing. These properties are divided up as follows:

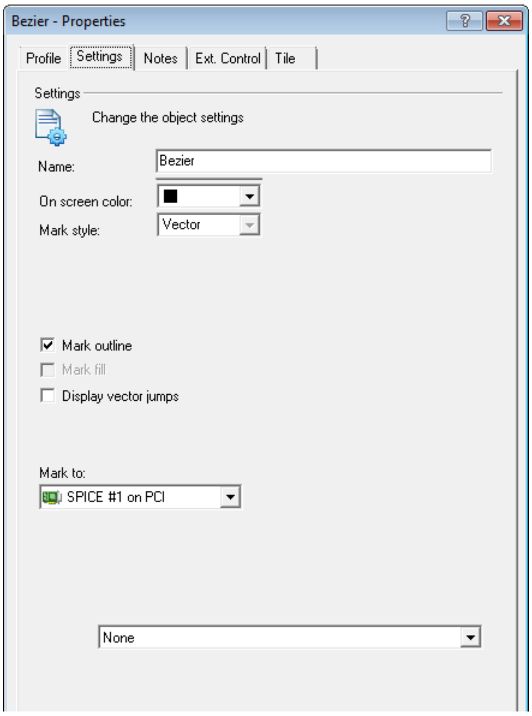
Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 56, Settings of a Bezier Object
Fill	A fill can be applied to Bezier objects with a closed contour.	➜ page 86, Object Fill
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings of a Bezier Object

Every Bezier object is assigned specific settings that can be called up and, if necessary, modified as follows:

- Right click on a Bezier object.
- Select *Properties...*.
- Select *Settings* tab.

The dialogue on the right opens.
Refer to the table below for explanations.



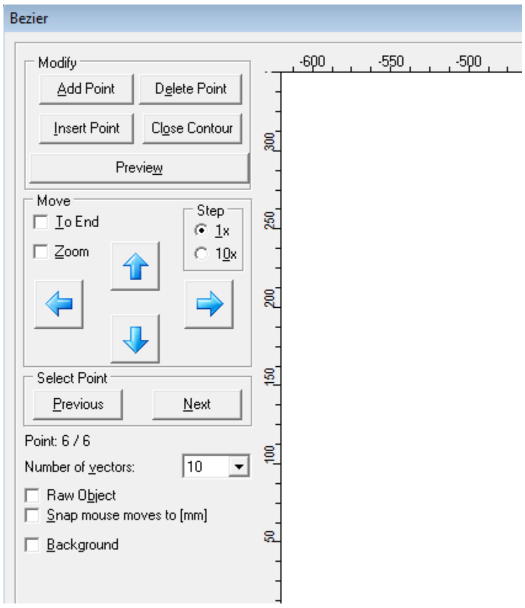
Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
On screen color	The color selection list can be used to select one of the preset colors to display the object on screen.
Mark object	If this function is enabled, the object contour is marked. This function is enabled by default.
Mark fill	If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.
Display vector jumps	If this function is enabled, the vector jumps between the individual part of the object are displayed on screen. This function is disabled by default.
Mark to	If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.
Object-specific Preview	Preview option that is used before the actual marking in the job. After choosing this option, specific parameters are available (➜ page 164, Object Preview).

Modifying a Bezier Object

Every new Bezier object is inserted with a standard shape. The shape can be modified as desired as described in the following:

- Left click on a Bezier object.
- Press key *F6*.

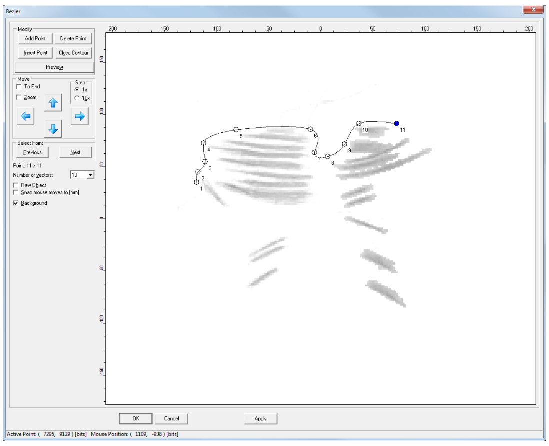
  The dialogue on the right opens.
  Refer to the table below for explanations.



Bezier Editing Window (1)		This area shows all changes applied to the Bezier object. By clicking on the *OK* or *Apply* button, the changes are saved. By clicking the *Cancel* button, the changes are discarded. The laser displays the active point on the marking field. If the active point (blue color) is moved in the *Bezier Editing Window*, the display of the marking field will be updated. So, the object can be adjusted exactly in the area that is to be marked.
Add Point		A new point is inserted behind the active point (no. 6 in the picture above).
Insert Point		A new point is inserted in front of the active point.
Delete		Deletes the active point.
Close Contour		As described for the function *Add point*, a new point is inserted behind the last point. Using this function, the new point is inserted exactly on the same position as point no.1. Thus a closed contour is created. Areas with closed contours can be filled via the object properties if necessary. If one of these both points, the first or the last one, are moved afterwards, the contour may not be recognized as closed any more.
Preview		Clicking on this button, creates a preview of the Bezier object on the marking field. This function is available only if a SP-ICE control card is used. During the preview, no elements can be added or changed.
Arrow Keys		The selected point can be moved via the arrow keys in the desired direction.
	To End	If this function is activated, the active point and all subsequent points can be moved at once via the arrow keys.
	Zoom	If this function is activated, the preview of the Bezier object can be zoomed in and out via the arrow keys.
	1x *10x*	By this options field, the step width of the arrow key movement can be defined. *1x = 0.1 mm, 10x = 1 mm.*
Previous *Next*		Selects the previous or next point subject to the active point.
Number of vectors		Via this pop-up menu, the accuracy of the added curve can be defined. It appoints how many vectors generate the curve. If for example "1" is set, the points are linked with just on line.

Raw Object	It's possible to modify or move Bezier objects without the Bezier Editing Window via dimension tools. Thus the Bezier object can be positioned out of the Bezier Editing Window. In this case activate function *Raw Object* to display the original Bezier object at its point of origin in the Bezier Editing Window.
Snap mouse moves to [mm]	If this function is activated, the point is snapped to a grid (1mm), when moving it via mouse.
Background	All objects on the workspace are displayed as background to be able to align other objects.

Sample of a Bezier-line to draw the effective bitmap-outline for being used as a preview.



4.4.6 Text Objects

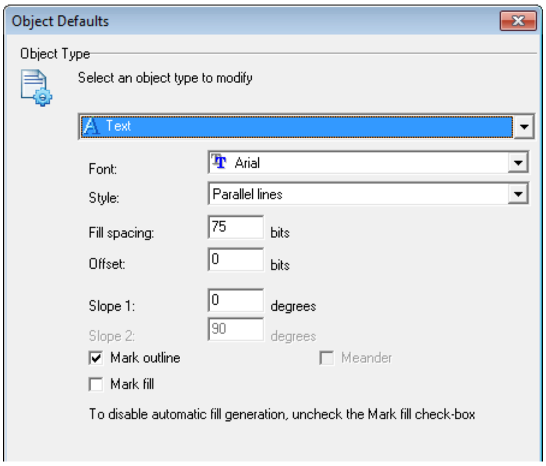
Text objects can be created using either TrueType™ fonts or laser-optimized fonts. For TrueType™ Fonts, the characters are defined by their contour. The contour can be given a fill. For laser-optimized fonts, the characters are made up of lines or points. The laser-optimized fonts "Stroke" and "SEMI Dot Matrix" are included in the weldMARK™ installation package.

Defaults for Text Objects

This section describes how you can call up and modify the defaults for text objects. The defaults apply to all new text objects.

- Select *Objects >Defaults...* option from the menu.
- Select the object type *Text*.

  The dialogue on the right opens.
  Refer to the table below for explanations.

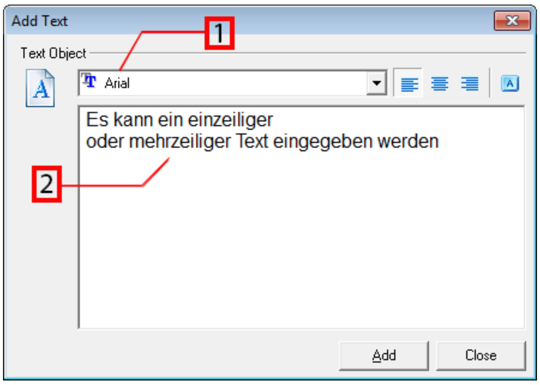


Font	The character set for all new text objects can be selected.
Style	Defines which filling style is used.
Fill spacing	The distance between the individual fill lines can be set for all new text objects. Entering "0" means that the characters will not be filled.
Offset	Defines a spacing between the filling and the contour.
Mark object	If this function is enabled, the contour lines for the characters will be marked. This function is enabled by default.
Mark fill	If this function is enabled, the character fill will be marked. The function can only be enabled if a fill spacing > 0 has been set. This function is disabled by default.

New text

Adding a Text Object

- Select *Objects >Add >Text* option from the menu.
  The dialogue on the right opens.
  Refer to the table below for explanations.



(1)	Selection of the font to be used for the new text object.
(2)	Content of the new text object (string).
	Text alignment buttons for multi-line texts (left aligned, centered, right aligned).
	The Windows character map is called up to make it easier to enter special characters. (➜ page 68, Unicode Character Map)
Add	The new object is included in way, so that the first letter is in the center of the workspace.

Properties of a Text Object

Text objects are assigned properties defining their displayed on the screen and the behavior during laser processing. These properties are divided up as follows:

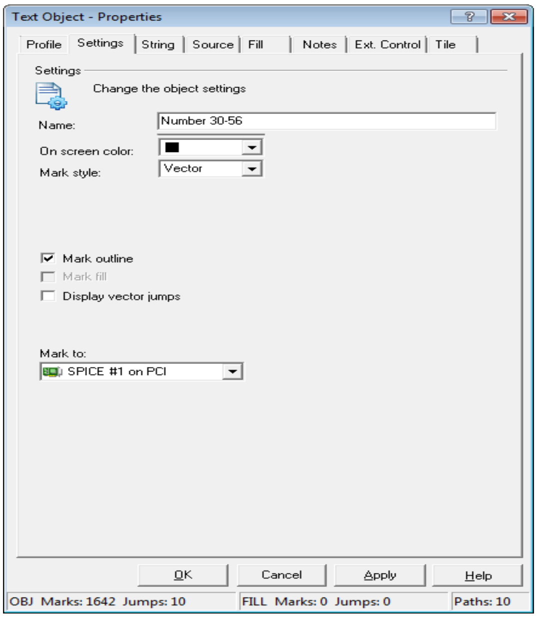
Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 61, Settings of a Text Object
String	Content and formatting of the text object.	➜ page 64, String of a Text Object
Source	The content of text objects can be changed dynamically based on various rules.	➜ page 89, String rules
Fill	A fill can be applied to the object.	➜ page 86, Object Fill
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings of a Text Object

Every text object is assigned specific settings that can be called up and, if necessary, modified as follows:

- Right click on a text object.
- Select *Properties...*.
- Select *Settings* tab.

The dialogue on the right opens.
Refer to the table below for explanations.

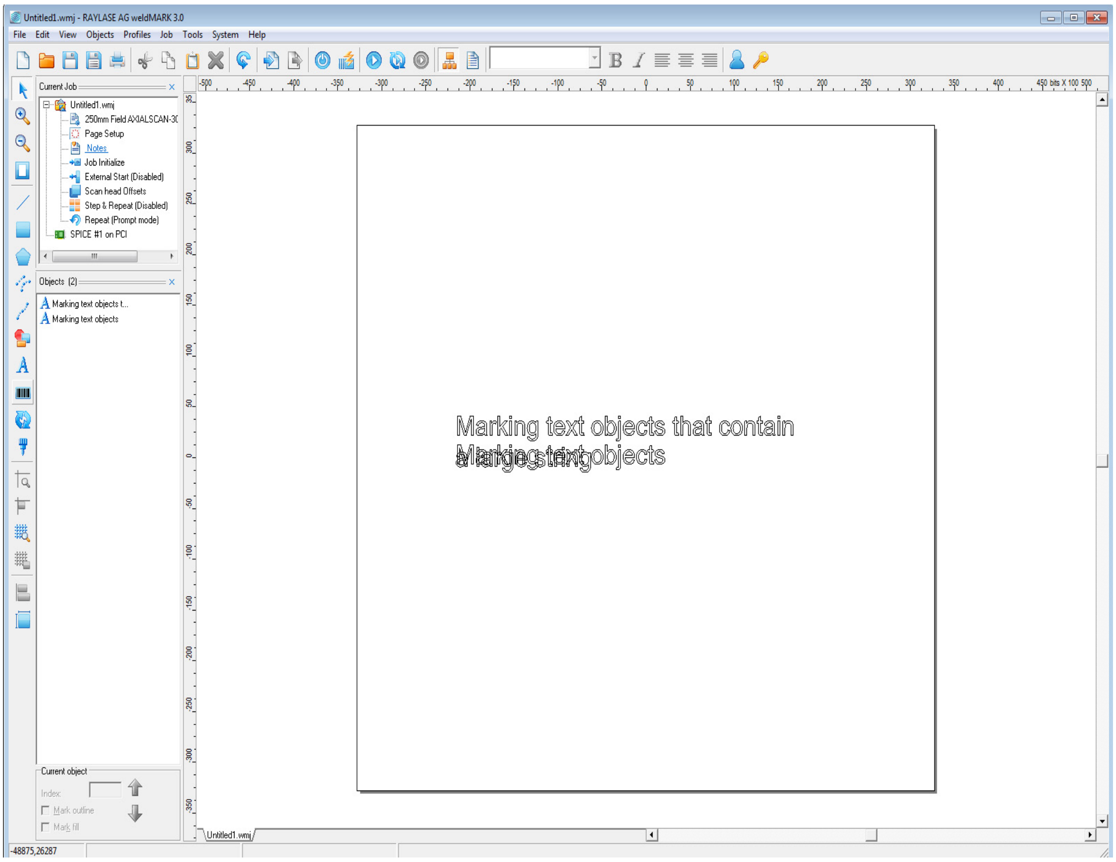


Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
On screen color	The color selection list can be used to select one of the preset colors to display the object on screen.
Mark Style	The text object is marked in either a vector-based or Dot Matrix style. Additional settings are available for the Dot Matrix marking style. See ➜ page 63, Additional Settings for Dot Style Fonts
Mark object	If this function is enabled, the contour lines (shape) for the characters will be marked. This function is enabled by default.
Mark fill	If this function is enabled, the character fill will be marked. The function can only be enabled for TrueType™ Fonts and if an object fill has been set. This function is disabled by default.
Display vector jumps	If this function is enabled, the entire sequence of movements is displayed on the screen, including the times in which the laser is deactivated while moving to the next vector to be marked (vector jumps). This function is disabled by default.

Marking Text Objects with long Strings

To mark text objects that are larger than the marking field, they have to be tiled.
➜ page 109, Manual Tiling

Example:



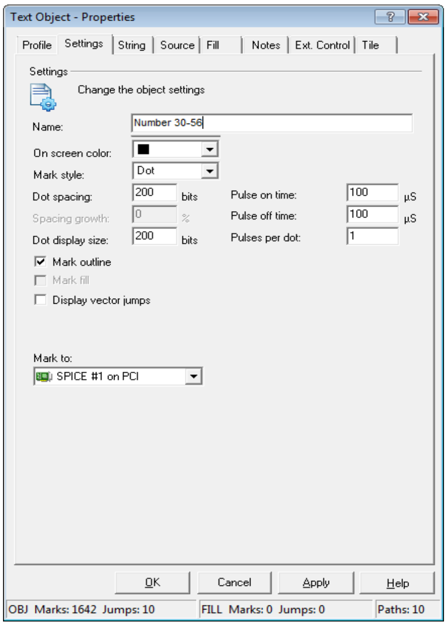
The example shows how a text object is displayed in the working space after tiling. The rectangle represents the size of the marking field. The undivided string is located above the parts which are lying upon each other. This option is most commonly used in connection with the "Mark on the Fly" function.

Additional Settings for Dot Style Fonts

Dot style fonts are special character sets in which the characters are made up of individual dots. The character set SEMI Dot Matrix is included in the weldMARK™ installation package. Special settings are available for this kind of character set:

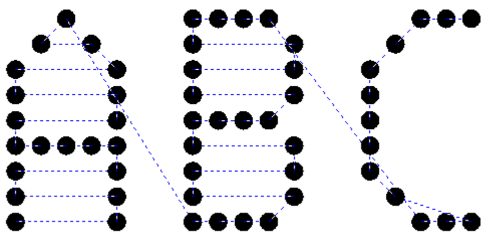
- Right click on a text object.
- Select *Properties...*.
- Select *Settings* tab.
- Choose the marking style *Dot*.

  The dialogue on the right opens.
  Refer to the table below for explanations.



Dot spacing	Distance between the marking points in the X and Y axis.	
Dot display size	Dot size on the screen. This parameter has no influence on the actual marking.	
Pulse on time	Laser activation time per pulse.	These values are directly in interplay with the laser power and frequency.
Pulse off time	Laser deactivation time between the individual pulses (with > 1 pulses).	
Pulses per dot	Number of pulses emitted per marking point.	

Example:



Screen display of a Dot Matrix font with vector jumps shown.

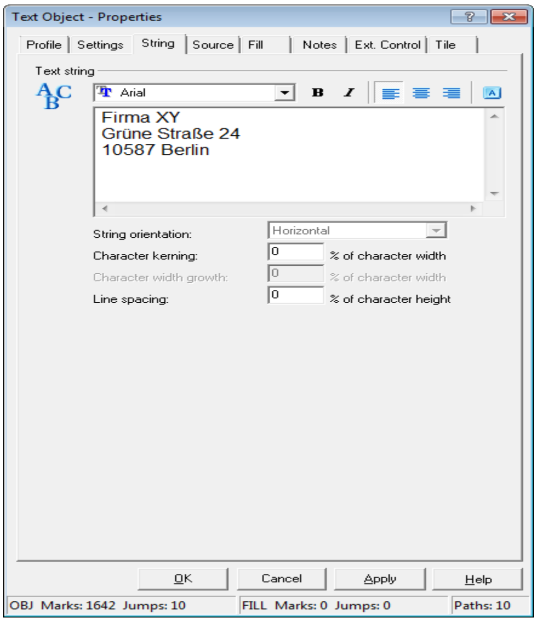
String of a Text Object

The content of a text object consists a string. In turn, this string can consist of any combination of letters and numbers. weldMARK™differentiates between one-line and multi-line strings (with paragraph breaks) and provides different functions for each case.

Content and Display Options for *multi-line* Text Objects

- Right click on a a multi-line text object.
- Select *Properties...*.
- Select *String* tab.

  The dialogue on the right opens.
  Refer to the table below for explanations.

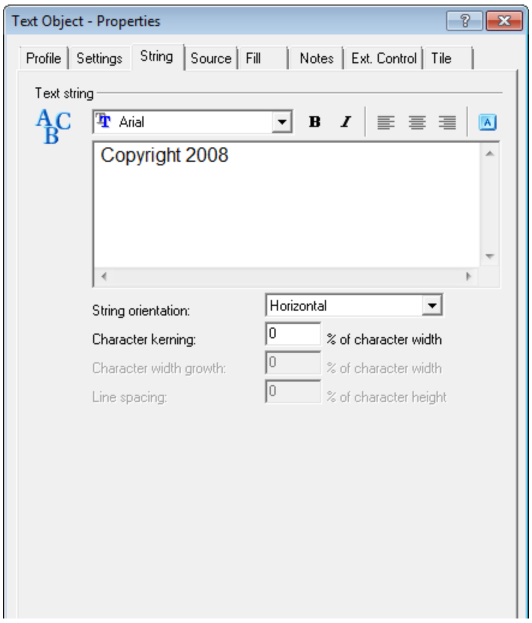


(1)	Font of the text object.
(2)	Content of the text object (string).
String orientation	Multiline Text objects can only be created with horizontal orientation.
	The font styles "Bold" and/or "Italic" can be applied to text object. The font styles are available only for TrueType™ Fonts.
	Text alignment buttons for multi-line texts (left aligned, centered, right aligned).
	The Windows character map is called up to make it easier to enter special characters. (➜ page 68, Unicode Character Map)
Character kerning	The spacing between the individual characters can be changed. Positive values increase the spacing, negative values reduce it. Setting the value "0" uses the kerning defined in the character set.
Character width growth	The width of the individual characters can be changed. Positive values increase the character width, negative values reduce it. Setting the value "0" uses the character width defined in the character set.
Line spacing	The spacing between the lines can be changed. Positive values increase the spacing, negative values reduce it. Setting the value "0" uses the line spacing defined in the character set.

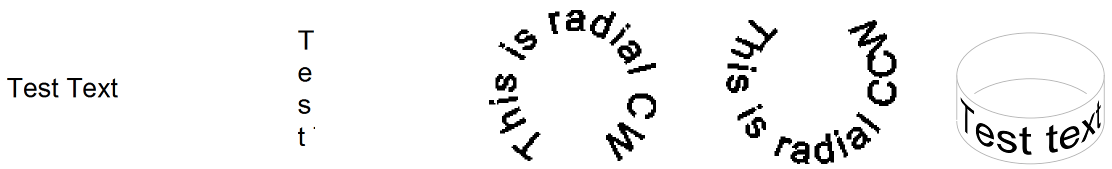
Content and Display Options for *single line* Text Objects

- Right click on a a single line text object.
- Select *Properties...*.
- Select *String* tab.

  The dialogue on the right opens.
  Refer to the table below for explanations.



(1)	Font of the text object.
(2)	Content of the text object (string).
	The font styles "Bold" and/or "Italic" can be applied to text object.
	The Windows character map is called up to make it easier to enter special characters. (➜ page 68, Unicode Character Map)
String orientation	You can choose between *Horizontal*, *Vertical*, *Radial* and *Radial – fixed*. If a 4-Axis motor control card is installed, the additional option *circumferential* is also available.
Character kerning	The spacing between the individual characters can be changed. Positive values increase the spacing, negative values reduce it. Setting the value "0" uses the kerning defined in the character set.
Character width growth	The width of the individual characters can be changed. Positive values increase the character width, negative values reduce it. Setting the value "0" uses the character width defined in the character set.



Horizontal Vertical Radial Clockwise (CW fit) Radial Anticlockwise (CCW fit) Circumferential

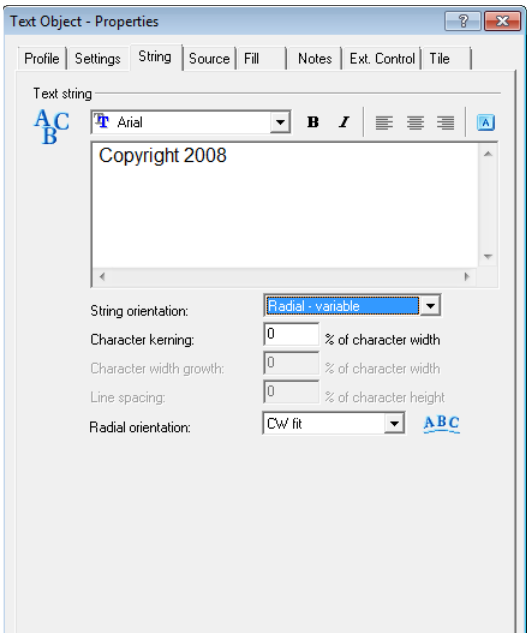
The difference between *Radial* and *Radial Text – fixed* lies in the extended editing functions. The height can be changed for example. Additionally the Radial Text fixed can directly be adjusted to radii.

➜ page 66, Additional Setting Options for Radial Text

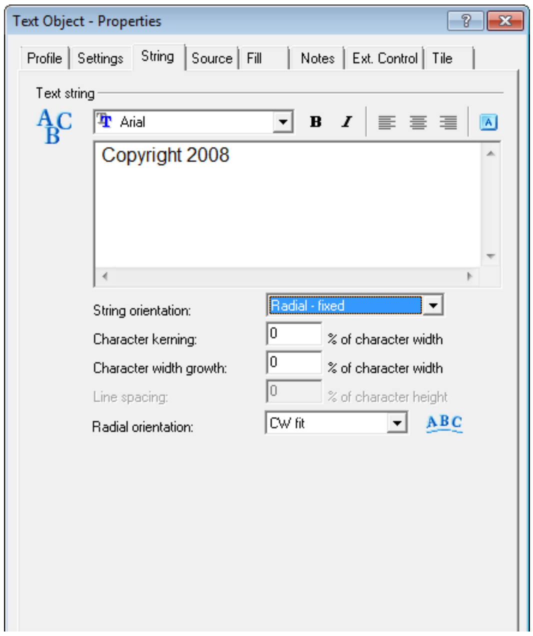
➜ page 67, Additional Setting Options for Circumferential Text

➜ page 104, Size Option for Standard and radial Text Objects

Additional Setting Options for Radial Text



Radial



Radial - fixed

Radial orientation	The text can run clockwise *(CW fit)* or anticlockwise *(CCW fit)*.
Character width growth	The width of the individual characters can be changed. Positive values increase the character width, negative values reduce it. Setting the value "0" uses the character width defined in the character set.

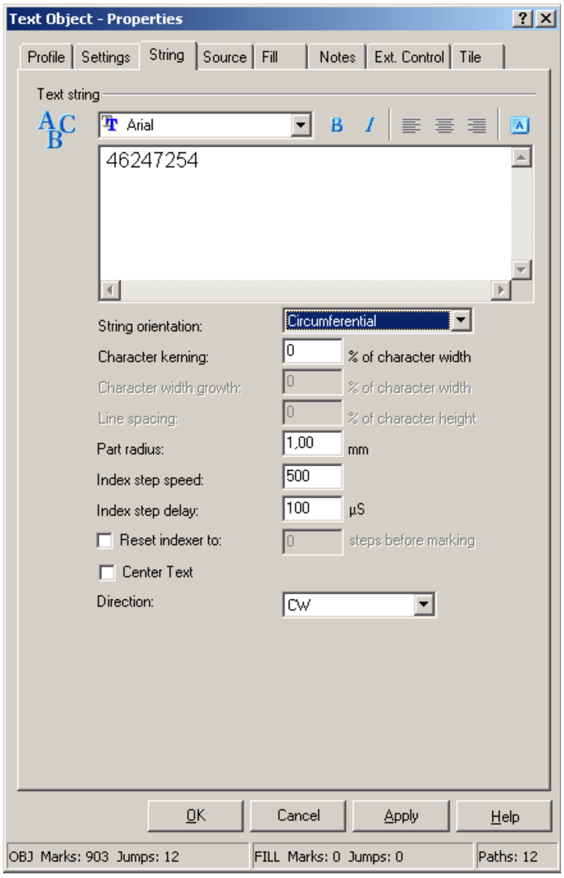
Additional Setting Options using Keyboard Commands

The following settings can be made exclusively using keyboard commands if the *Properties* and *Dimensions* windows are closed:

Radius	Make sure that the required text object is selected. Hold down the *ALT* key and use the *Up* and *Down* arrow keys to enlarge or reduce the object radius.
Rotation	Make sure that the required text object is selected. Hold down the *ALT* key and use the *Right* and *Left* arrow keys to rotate the object radius.

Additional Setting Options for Circumferential Text

The *Circumferential* option is only available if the optional 4-Axis motor control card is installed and the rotary axis activated. The following additional settings are available:



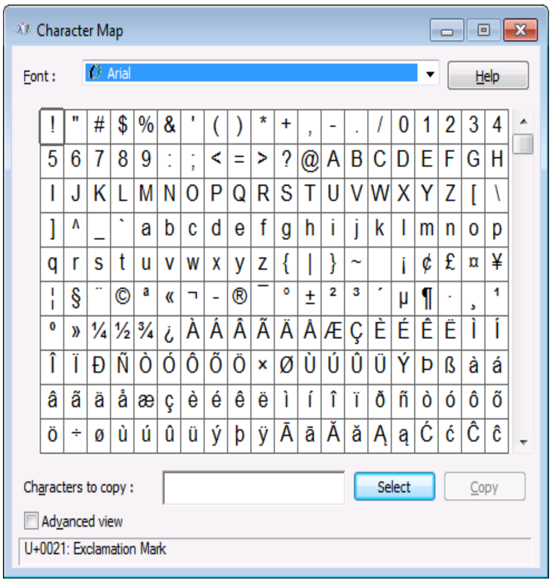
Part radius	Radius of the cylinder.
Index step speed	Step speed of the motor.
Index step delay	Delay between the movement of the motor and marking of the character. This allows the motor to come to rest before marking is performed.
Reset indexer to	Enable this function to return the motor to a defined start position before processing an object.
Center Text	The text is placed in the middle of the range starting point.
Direction	CW/CCW: Cylinder will be marked in clockwise or counter clockwise movement.

Unicode Character Map

The Windows Unicode character map enables you to insert any characters in a font, particularly special characters, into the string of characters in a text object.

Character Map

- Right click on a text object.
- Select *Object >Properties...*.
- Select *String* tab.
- Click on the *Character Map* icon.
  The dialogue on the right opens.
  Refer to the table below for explanations.

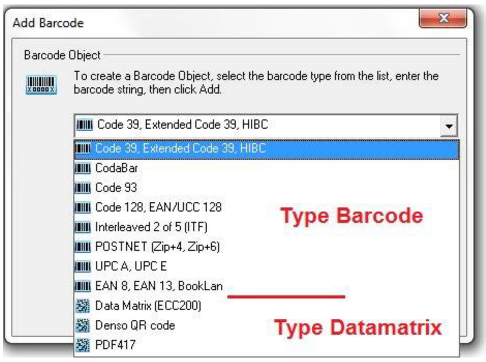


Font	This selection box can be used to select a font.
Select	Clicking on this button adds the selected character to the list of *Characters to copy*.
Characters to copy	This field lists the selected characters.
Group by	This selection box can be used to display a subgroup of characters from the selected font.
Copy	Clicking on this button copies the characters in the *Characters to copy* list to the clipboard.

4.4.7 Barcode/Data Matrix Objects

Adding a Barcode Object

- Select *Objects >Add >Barcode* option from the menu. The selection can not be change afterwards.
  The dialogue on the right opens.
- Select the required barcode type.
- Enter the desired data for the barcode.
- Click on *Add* button.
  A new barcode object is inserted in the center of the workspace.



New barcode

Properties of a Barcode Object

Properties are assigned to barcode objects, which determine how the objects are displayed on the screen and how they behave during laser processing. These properties are divided up as follows:

Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 76, Settings for a Data Matrix Object ➜ page 70, Defaults for 1D Barcode Objects
String	Content of the barcode object.	➜ page 80, String for a Barcode/Data Matrix Objects
Source	The content of barcode objects can be changed dynamically based on various rules.	➜ page 89, String rules
Tuner	The barcode can be adapted to individual requirements.	➜ page 74, Tuner Values for Barcode Objects ➜ page 81, Tuner Values for Data Matrix Objects
Fill	A fill can be applied to the object.	➜ page 86, Object Fill
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Barcode Objects (1D Code)

The following 1D Barcode objects are supported by weldMARK™:

Barcodes	
Code 39, Extended Code 39, HIBC	Interleaved 2 of 5 (ITF)
CodeBar	POSTNET (Zip+4, Zip+6)
Code 93	UPC A, UPC E
Code 128, EAN/UCC 128	EAN 8, EAN 13, BookLan

EAN 8 and EAN 13 can be supplemented by 2 or 5 digits. Therefore, enter the desired string and, separated with a comma, the supplementary 2 or 5 digits.

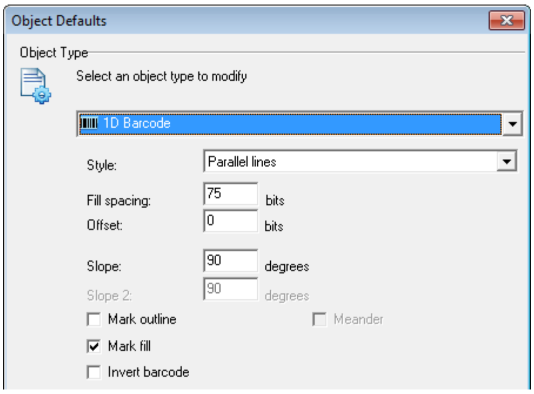
The following examples sum up the possibilities:

EAN 8	EAN 13
12345678,12	123456789012,12
12345678,12345	123456789012,12345

Defaults for 1D Barcode Objects

This section describes how to call up and modify the defaults for 1D Barcode objects. The defaults apply to all new 1D Barcode objects.

- Select *Objects >Defaults...* option from the menu.
- Select the object type *1D Barcode*.
  The dialogue on the right opens.
  Refer to the table below for explanations.

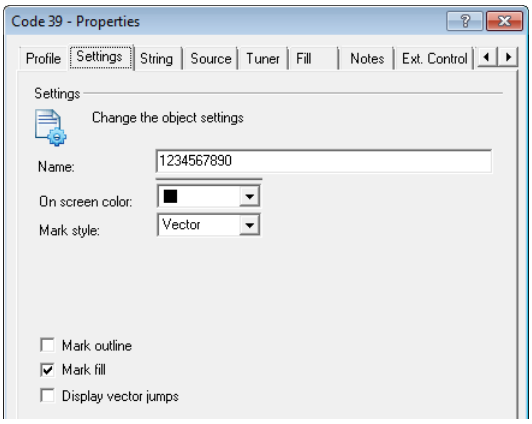


Style	Provides the selection of hatches.
Fill spacing	When marking a barcode object, each bar is created with single lines. Via this input box the distance between these fill lines can be set. A value of "0" means that the bars will not be filled.
Offset	Distance between the filling and the contour.
Slope	Hatching angle for parallel lines.
Mark outline	If this function is enabled, the contour lines for bars will be marked. This function is disabled by default.
Mark fill	If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.
Invert barcode	Enabling this function creates a negative of the original barcode. This function is disabled by default.
Meander	The fill of the object is marked in one go, i.e., without switching off the laser between end and start point of the single lines.

Settings for a 1D Barcode Object

Specific settings are assigned to each barcode object. They can be called up and, if necessary, modified as follows:

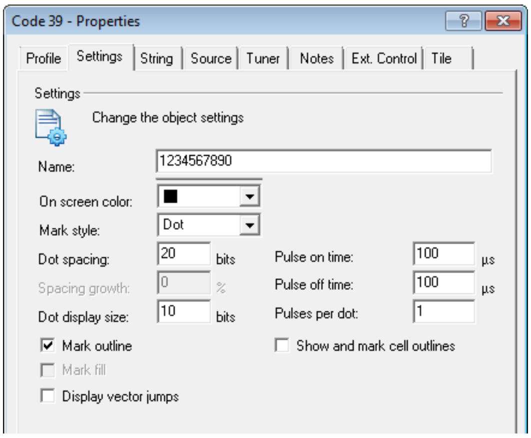
- Right click on a 1D Barcode object.
- Select *Properties...*.
- Select *Settings* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



General Settings for all Mark Styles

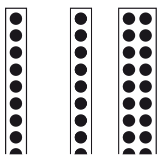
Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
On screen color	The color selection list can be used to select one of the preset colors to display the object on screen.
Mark style	Barcode objects can be marked by using vectors, dots or circle dots. ➜ page 72, Settings for "Dot" Mode ➜ page 73, Settings for "Circle dots" Mode In both cases the mark style replaces the filling and the fill tab is hidden.
Mark outline	If this function is enabled, the contour lines of the bars will be marked. This function is disabled by default.
Mark fill	If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.
Display vector jumps	If this function is enabled, the entire sequence of movements is displayed on the screen, including the times in which the laser is deactivated while moving to the next vector to be marked (vector jumps). This function is disabled by default.

Settings for "Dot" Mode

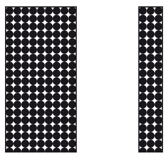


<table>
<tr><td>Dot spacing</td><td colspan="2">Defines the spacing of the dots to each other and to the cell edge. At the same time, the number of dots, which are placed side by side, is determined.</td></tr>
<tr><td>Dot display size</td><td colspan="2">This parameter does not influence the actual marking. Ideally, the Dot display size matches the effect size of the dot marking. This allows the prediction of the marking quality on the computer screen.</td></tr>
<tr><td>Pulse on time</td><td>Laser activation time per pulse.</td><td rowspan="3">These values interplay with laser power and frequency directly. Consequently they determine the effect size of dot marking.</td></tr>
<tr><td>Pulse off time</td><td>Laser deactivation time between the individual pulses (with > 1 pulses).</td></tr>
<tr><td>Pulses per dot</td><td>Number of pulses emitted per dot.</td></tr>
<tr><td>Show and mark cell outlines</td><td colspan="2">If this function is enabled, the contour of the cells is displayed and marked even if Mark Object is deactivated.</td></tr>
</table>

Example:

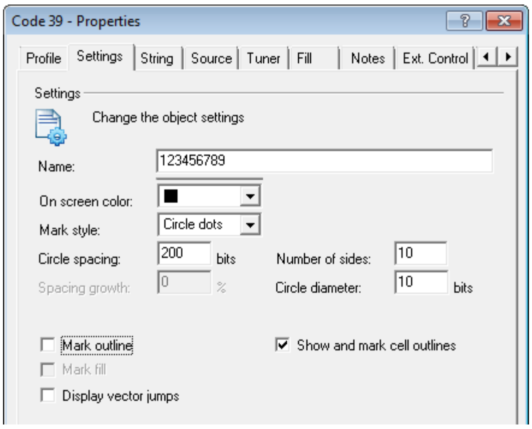


Dot spacing: 40px



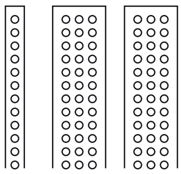
Dot spacing: 20px

Settings for "Circle dots" Mode

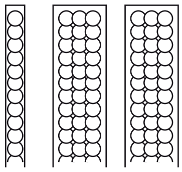


Circle spacing	Sets the midpoints distance of the circle dots. At the same time it is determined how many circle dots are placed side by side.
Number of sides	Each circle is made up by a number of lines. The more lines, the more rounded the circle appears.
Circle diameter	Allows to set the circle diameter.
Show and mark cell outlines	If this function is enabled, the contour of the cells is displayed and marked even if *Mark Object* is deactivated.

Example:



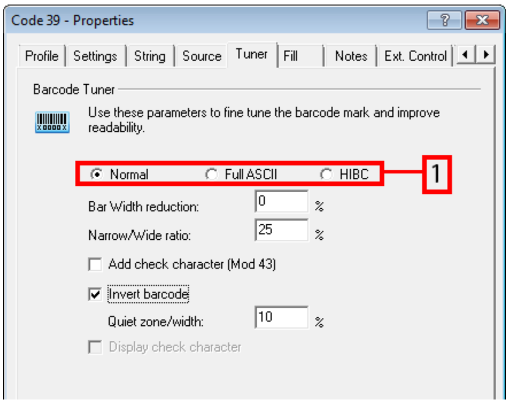
Circle spacing: 35bit
Circle diameter: 20bit



Circle spacing: 35bit
Circle diameter: 40bit

Tuner Values for Barcode Objects

- Right click on a barcode object.
- Select *Properties...*.
- Select *Tuner* tab.



1D Barcode objects

1D Barcode objects		
(1) Norm type	Selection on norm type depends on the barcode type.	
Bar Width reduction	The bar width can be adjusted between -99% and 99%. A positive value reduces the bar width, a negative value increases it.	
Narrow/Wide ratio	Ratio of dark and light areas in the barcode (the value must be an integer between 20 and 30).	
Add check character	Enabling this function adds a check character to the barcode.	
Display check character	When enabled, the check character is displayed as plain text (only available if *Add check character* is selected).	
Invert barcode	Enabling this function creates a negative of the original barcode. This function is disabled by default	
	Quiet zone/width	The width of the quiet zone can be set relative to the barcode width.

Data Matrix Objects (2D Code)

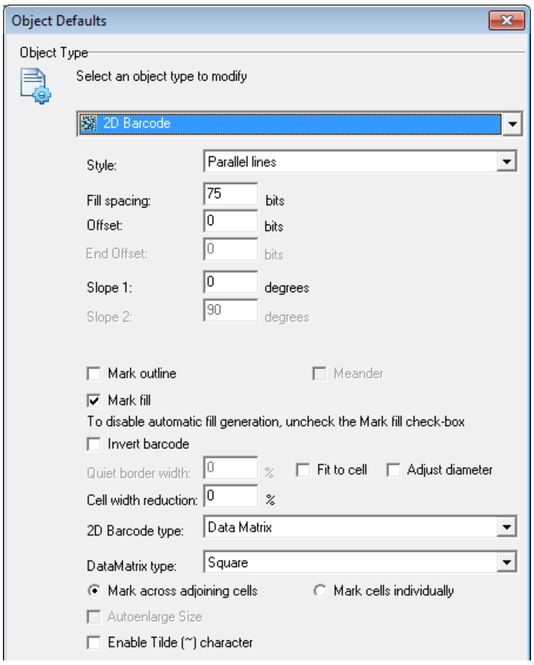
The following Data Matrix objects are supported by weldMARK™:

Codes	
Data Matrix (ECC200)	Square and rectangular shapes
Denso QR code	Type 4 (max. 33x33 cells)
PDF417	

Default settings for Data Matrix Objects

This section describes how to call up and modify the defaults for Data Matrix ECC200 objects. The defaults apply to all new Data Matrix ECC200 objects.

- Select *Objects >Defaults...* option from the menu.
- Select the object type *Data Matrix ECC200*.
  The dialogue on the right opens.
  Refer to the table below for explanations.



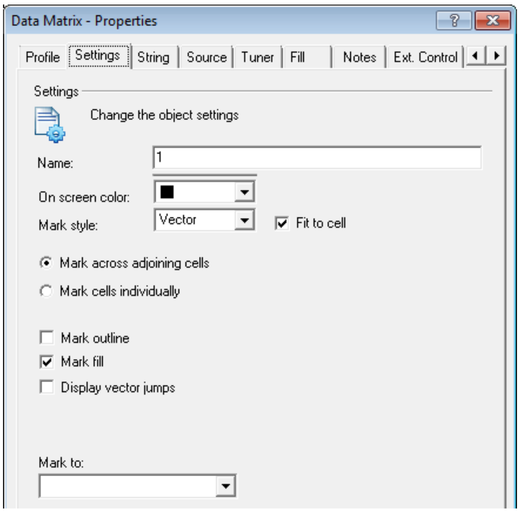
Style	Provides the selection of hatches. ➜ page 88, Set Spiral filling
Fill spacing	When marking, each cell in the barcode is created with single lines. Via this input box the distance of these fill lines can be set. A value of "0" means that the bars will not be filled.
Offset	Distance between the filling and the contour.
Slope	Hatching angle for parallel lines.
Mark outline	If this function is enabled, the contour lines of the cells will be marked. This function is disabled by default.
Mark fill	If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.
Invert barcode	Enabling this function creates a negative of the original barcode. This function is disabled by default.
Quiet border width	Defines the width of the frame of an inverted barcode relative to the barcode size.
Fit to cell	Adjusts the position of the elements (circles, circle dots or vector lines) in such a way that they fit into the respective cell. The cell size maintains constant.
Adjust diameter	Adjusts the size of circle dots in such a way that they fit into the respective cell. This means that they do not overflow the cell boundary and fill the whole cell area.
Cell width reduction	Allows percentage reduction or extension of the cell width.

2D Barcode type	Allows the selection of a 2D Barcode type. For each type, different settings are offered.
Data Matrix type	
Mark across adjoining cells	Combines nearby cells to reduce marking time.
Mark cells individually	Marks each cell individually in order to optimize the marking quality.
Autoenlarge Size	Adjusts the amount of cells automatically, when the barcode content changes.
Enable Tilde (~) character	Allows to embed the tilde character into the barcode content.

Settings for a Data Matrix Object

Specific settings are assigned to each barcode object. They can be called up and, if necessary, modified as follows:

- Right click on a Data Matrix ECC200 object.
- Select *Properties...*.
- Select *Settings* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

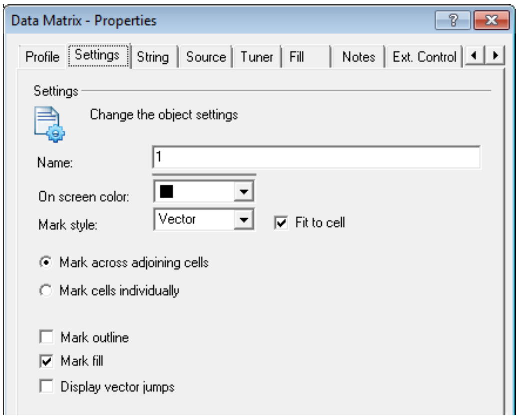


General Settings for all Mark Styles

Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
On screen color	The color selection list can be used to select one of the pre-set colors to display the object on screen.
Mark style	Barcode objects can be marked by using vectors, dots or circle dots. ➜ page 77, Settings for Mark Style "Vector" ➜ page 78, Settings for Mark Style "Dot" ➜ page 79, Settings for Mark Style "Circle dots"
Display vector jumps	If this function is enabled, the entire sequence of movements is displayed on the screen, including the times in which the laser is deactivated while moving to the next vector to be marked (vector jumps). This function is disabled by default.
Mark to	If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.

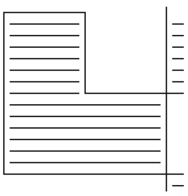
Settings for Mark Style "Vector"
With this mark style the individual cells of Barcode Objects are marked by the succession of lines. The arrangement of these lines can be set via the *Fill* tab.

- Right click on a Data Matrix object.
- Select *Properties...*.
- Select *Settings* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.
  See also: ➜ page 76, General Settings for all Mark Styles

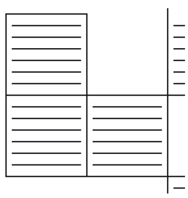


Fit to cell	Adjusts the position of vector lines. The fitting process for vector marking style takes into account the *Fill spacing* and the fill *Offset* defined in the *Fill* tab to space the lines evenly and to assure that the size of the cells is constant. Fill spacing is recalculated so that the first and the last filling lines are placed on the same filling offset distance to the outline. If *Fit to cell* is disabled, the number of lines to mark the cells may vary. This may lead to various cell sizes.
Mark across adjoining cells	The barcode filling is processed column-wise along the Data Matrix width.
Mark cells individually	Each barcode cell is processed sequentially.
Mark outline	If this function is enabled, the contour lines of the cells will be marked. This function is disabled by default.
Mark fill	If this function is enabled, the object fill will be marked. The function can only be selected if a fill has been set. This function is disabled by default.

Example:



Fill with parallel lines,
Fit to cell,
Fill Offset,
Mark across adjoining cells

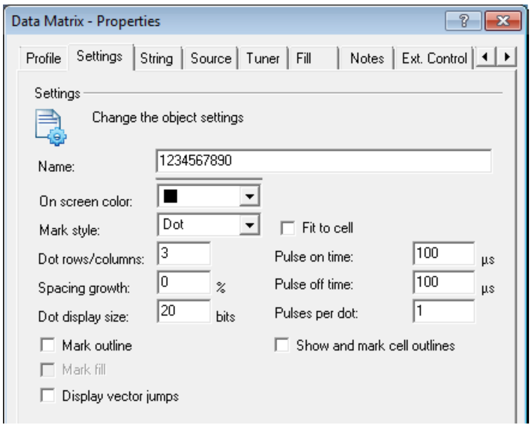


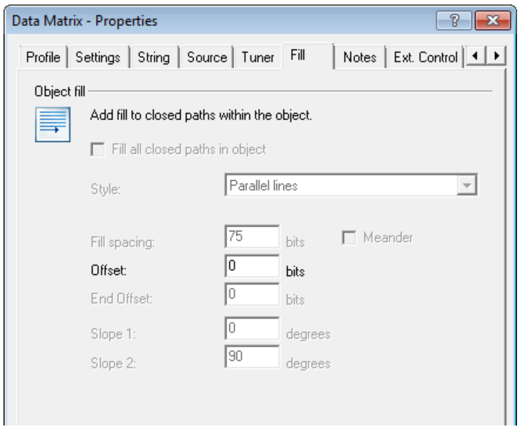
Fill with parallel lines,
Fit to cell,
Fill Offset,
Mark cells individually

Hint: Since *Fit to cell* is a relative parameter, the marking quality is obtained even if the object size has been changed.

Settings for Mark Style "Dot"

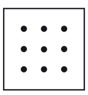
- Right click on a Data Matrix object.
- Select *Properties...*.
- Select *Settings* tab.
  The corresponding dialogue opens. Refer to the table below for explanations.
  See also: ➜ page 76, General Settings for all Mark Styles

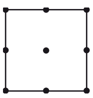


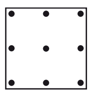


Fit to cell	The distance of dot centers is recalculated so that the edge of the outermost circles (dots) lay on the edge of the object (cell) reduced by the fill *Offset*.	
Offset (*Fill* tab)	Allows to set a distance to the cell edge.	
Dot row/columns	Sets indirectly the number of dots per cell.	
Spacing growth	Allows to add a percentage factor to the automatically calculated distance of the circle centers. Can not be used if *Fit to cell* is enabled.	
Dot display size	This parameter does not influence the actual marking. Ideally, the *Dot display size* matches the effect size of the dot marking. This allows the prediction of the marking quality on the computer screen.	
Pulse on time	Laser activation time per pulse.	These values interplay with laser power and frequency directly.
Pulse off time	Laser deactivation time between the individual pulses (with > 1 pulses).	
Pulses per dot	Number of pulses emitted per dot.	
Show and mark cell outlines	If this function is enabled, the contour of the cells is displayed and marked even if *Mark Object* is deactivated.	

Example:


Dot row/columns: 3

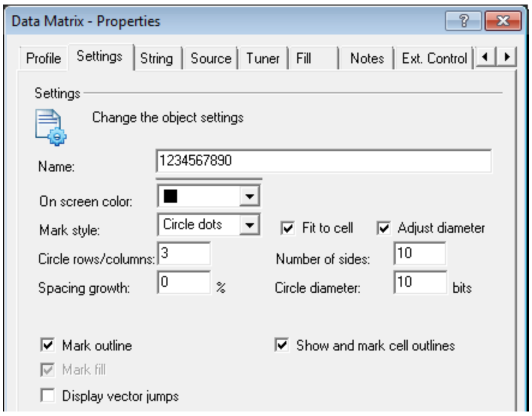

Fit to cell

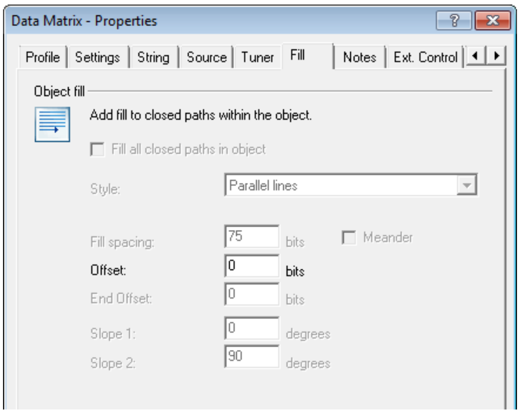

Offset

Hint: Since *Fit to cell* is a relative parameter, the marking quality is obtained even if the object size has been changed.

Settings for Mark Style "Circle dots"

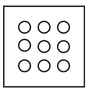
- Right click on a Data Matrix object.
- Select *Properties...*.
- Select *Settings* tab.
  The corresponding dialogue opens. Refer to the table below for explanations.
  See also: ➜ page 76, General Settings for all Mark Styles

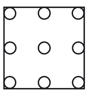


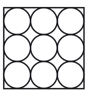


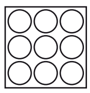
Fit to cell	The distance of circle dot centers is recalculated so that the edge of the outermost circles lay on the edge of the object (cell) reduced by the fill *Offset*. The spacing between circle dots is increased by the fill *Offset* value. Thus, the marked circles will not overlap if lasers with different spot sizes are used.
Adjust diameter	Changes the diameter of the circles so that they fit exactly together to the cell. If the diameter is smaller than the distance between circle dot centers, it is increased so that circles are spaced evenly and cover the whole cell. If the diameter is larger than the distance between circle dot centers, the diameter is reduced so that circles dots do not overlap. If the diameter is that large that circle dots overflow the cell outline, it is reduced so that the size of the cell doesn‘t increase.
Circle row/columns	Sets indirectly the number of circular dots per cell.
Offset (*Fill* tab)	Allows to specify a distance between neighbouring circle dots and also to the cell edge.
Spacing growth	Allows to add a percentage factor to the automatically calculated distance of the circle centers. Can not be used if *Fit to cell is* enabled.
Number of sides	Each circle is made up by a number of lines. The more lines, the more rounded the circle appears.
Circle diameter	Allows to set the circle diameter. Hint: This diameter will be also maintained if the object size has been changed.
Show and mark cell outlines	If this function is enabled, the contour of the cells is displayed and marked even if *Mark Object* is deactivated.

Example 1:

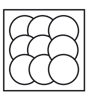
 *Circle row/columns:* 3

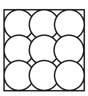
 *Fit to cell*

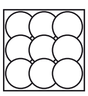
 *Adjust diameter*

 *Offset*

Example 2:

 *Circle row/columns:* 3

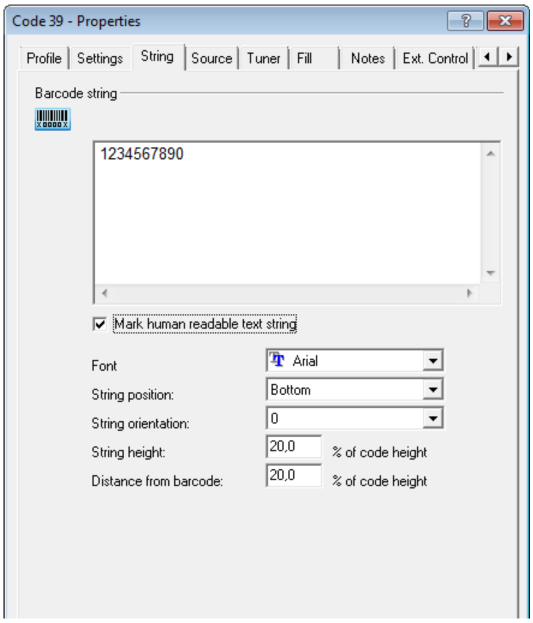
 *Fit to cell*

 *Offset*

Hint: Since *Fit to cell* and *Adjust diameter* are relative parameters, the marking quality is obtained even if the object size has been changed.

String for a Barcode/Data Matrix Objects

- Right click on a barcode object.
- Select *Properties...*.
- Select *String* tab.
- The dialogue on the right opens.
  Refer to the table below for explanations.

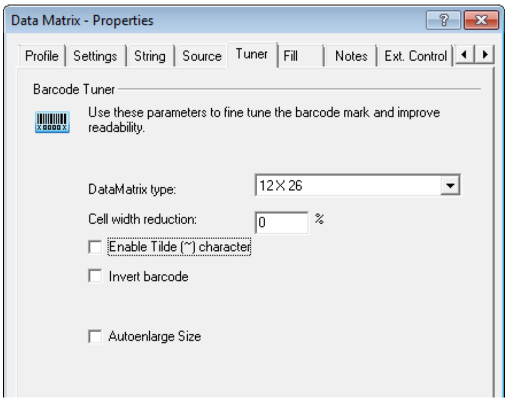


Barcode string	Content of the barcode object. If content should not be a fixed string different options are available. ➜ page 89, String rules	
Mark human readable text string	If this function is enabled, in addition to the barcode the associated string is marked in plain text.	
	Font	Font for the plain text.
	String position	The string can be positioned below, above, left or right to the barcode.
	String orientation	The alphanumeric string can be rotated in 90° increments.
	String height	The height of the characters relative to the height of the barcode can be set.
	Distance from barcode	The distance between the string and the barcode can be set relative to the height of the barcode.

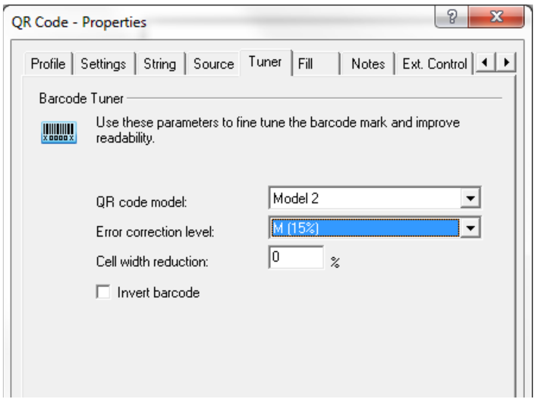
Tuner Values for Data Matrix Objects

Some barcode types require individual options and tuner settings. The tuner values in the following example represent the values for Data Matrix type ECC200 and QR-Code objects. Please refer to the respective Data Matrix specifications for non-listed tuner values of other Data Matrix types.

- Right click on a barcode object.
- Select *Properties...*.
- Select *Tuner* tab.



Data Matrix ECC200 objects



QR-Code objects

Data Matrix ECC200	
Data Matrix type	Defines the cell to column proportion as well as the amount of cells in the Data Matrix code. See table ➜ page 82, Code Pattern ECC200.
Cell width reduction	Reduces the cell size in percentage. Empty spaces between cells can be created this way.
Enable Tilde (~) character	Allows to embed the tilde character into the barcode content.
Invert barcode	Enabling this function creates a negative of the original barcode. This function is disabled by default
Quiet border width	In this field the relation between the width and the size of the barcode can be set.
Autoenlarge Size	Adjusts the amount of cells automatically, when the barcode content changes.

Code Pattern ECC200			
Square	Rectangular	Fixed square	
	8x18	10x10	44x44
	8x32	12x12	48x48
	12x26	14x14	52x52
	12x36	16x16	64x64
	16x36	18x18	72x72
	16x48	20x20	80x80
		22x22	88x88
		24x24	96x96
		26x26	104x104
		32x32	120x120
		36x36	132x132
		40x40	144x144
	Code pattern is fixed, even if content is getting larger, unless auto-enlarge option is selected		

8x18 Barcode size - extended option		
In case of Data Matrix Barcodes with 8x18 size the maximum allowed capacity is 10 digits or 6 alphanumeric characters. With the new option, the allowed capacity is extended to 8 characters with not more than 1 alphanumeric character and 7 digits, or 2 alphanumeric character and 6 digits.		
Symbol Size	**Capacity**	
	Digits	**Alphanumeric Characters**
Square min 10x10 max 144x144	3116	2335
8x18	10	6
	7/6 Digits & 1/2 Alphanumeric Character	7/6 Digits & 1/2 Alphanumeric Character
8 x 32	20	13
12x26	32	22
12x36	44	31
16x36	64	46
16x48	98	72

Denso QR-Code	
Model	Model 1 > Spec = AIM International Symbol Specification 97-001 Model 2 > Norm = ISO/IEC 18004 First Edition MicroQR > Norm = (JIS Japan Industry Standard) X 0510
Error Correction Level	L = Low > 7% of codewords can the restored M = Medium > 15% of codewords can the restored Q = Quartile > 25% of codewords can the restored H = High > 33% of codewords can the restored
Cell Width reduction	Allows percentage or extension of cell size

Capacity of QR-Codes (Type Version 4) Pattern Limit 33x33		
Mode	Error	Content limit in [bits]
1	L	≈ 622
1	M	≈ 462
1	H	≈ 380
1	Q	≈ 253
2	L	≈ 627
2	M	≈ 495
2	H	≈ 369
2	Q	≈ 275
MicroQR	L	≈ 120
Needed bits:		
Small letter	8 bits	
Capital letter	5,5 bits	
Digit	3,3 bits	

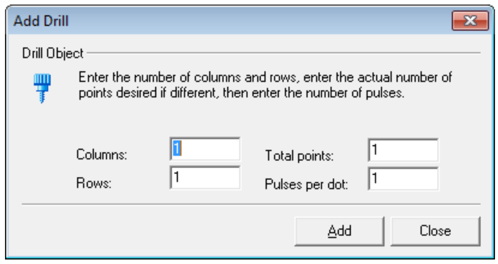
4.4.8 Drill objects

When executing drill objects, the laser is moved to the specified coordinates and activated for a set time. Drill objects consist of individual dots arranged in rows and columns. Drill objects are used for perforating or drilling through a workpiece, for example.
Drill points are always arranged alongside both axis in constant spacings and are processed in bidirectional order.

Adding a Drill Object

New
drill object

○ Select *Objects >Add >Drill...* option from the menu.
The dialogue on the right opens.
Refer to the table below for explanations.



Columns	Number of (dot) rows and columns that the drill object will consist of. The total amount is 1000 points for columns/cells.
Rows	
No. of points	Number of dots that the drill object consists of. This is the product of *cells* and *columns* per default. If an amount of points is chosen, that is smaller than the product, the difference in points is subtracted at the end of the Dot Matrix. Note that a value of "1" creates a single dot.
Pulses per dot	Number of pulses emitted per marking point.

Properties of a Drill Object

Properties are assigned to drill objects, which determine how the objects are displayed on the screen and how the behave during laser processing. These properties are divided up as follows:

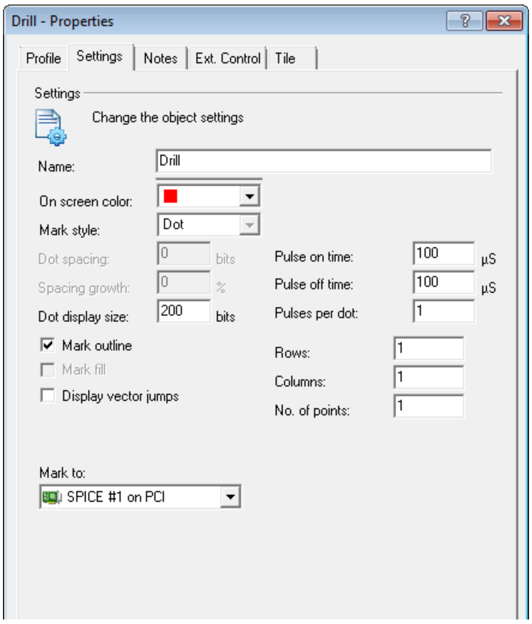
Profile	A marking profile is assigned to the object. The parameters of this profile can be changed.	➜ page 135, Using Profiles
Settings	Various settings can be made for the object.	➜ page 85, Settings of a Drill Object
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be applied to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control
Tiling while marking	Used to mark oversized objects that are bigger than the marking area.	➜ page 111, Automatic Tiling

Settings of a Drill Object

Every drill object is assigned specific settings that can be called up and, if necessary, modified as follows:

- Right click on a drill object.
- Select *Properties...*.
- Select *Settings* tab.

  The dialogue on the right opens.
  Refer to the table below for explanations.



Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.	
On screen color	The color selection list can be used to select one of the pre-set colors to display the object on screen.	
Dot display size	Dot size on the screen. Points are shown squared. This parameter has no influence on the actual marking.	
Pulse on time	Laser activation time per pulse.	These values are directly in interplay with the laser power and frequency.
Pulse off time	Laser deactivation time between the individual pulses (with > 1 pulses).	
Pulses per dot	Number of pulses emitted per marking point.	
Mark object	Enabling this function means that the object will be marked. This function is enabled by default.	
Display vector jumps	If this function is enabled, the entire sequence of movements is displayed on the screen, including the times in which the laser is deactivated while moving to the next vector to be marked (vector jumps). This function is disabled by default.	
Rows	Number of rows of dots in the drill object.	
Columns	Number of columns of dots in the drill object.	
No. of points	Number of dots that the drill object consists of. This is the product of *cells* and *columns* per default. If an amount of points is chosen, that is smaller than the product, the difference in points is subtracted at the end of the Dot Matrix. Note that a value of "1" creates a single dot.	
Mark to	If more than one control card is installed, this drop-down menu sets the desired control card for marking the object.	

4.5 Object Fill

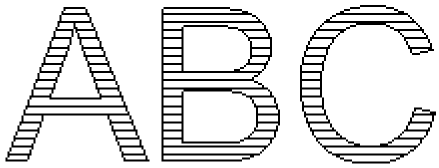
weldMARK™ enables areas of objects to be filled. Only objects with a completely closed contour can be filled. This may be either characters of a text object, polygon or rectangle objects, enclosed Bezier or polyline objects, barcode objects or objects of an imported Vector Graphic.

The exceptions are bitmap objects, laser optimized fonts, Dot Matrix fonts and drill objects.

Overlapping objects can not be filled.

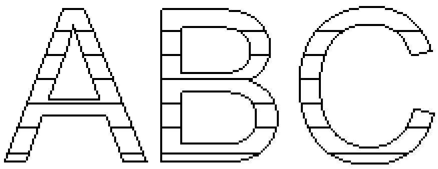
The fill is created by densely packed lines that can be identified as hatching with a larger spacing.

Empty object

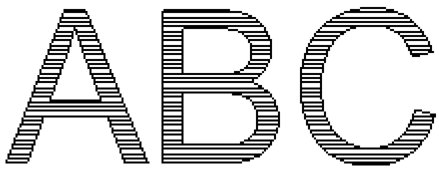


Filled object

The optimum spacing between the individual lines in a fill depends on the wavelength of the laser, the spot size, the material and other factors. The set line spacing is saved along with the object and remains unchanged even if the size of the object is changed.
The examples below show different fill spacings:

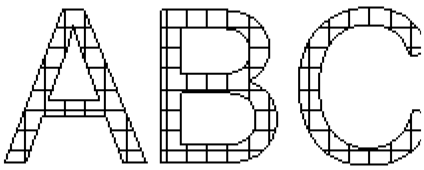


Fill spacing = 150 bits

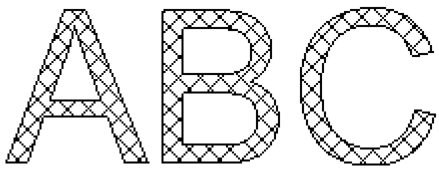


Fill spacing = 30 Bits

In addition to parallel lines, a crosshatch fill with different angles is available:

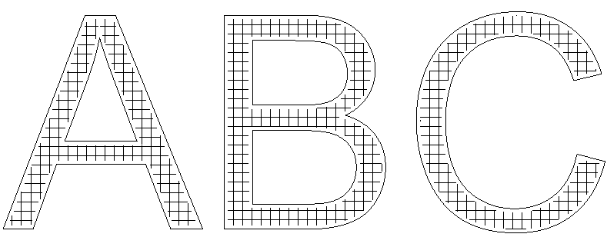


Crosshatch with 0 and 90 degrees



Crosshatch with –45 and +45 degrees

Via the "Offset" option a distance between the object filling and the object outline can be defined:

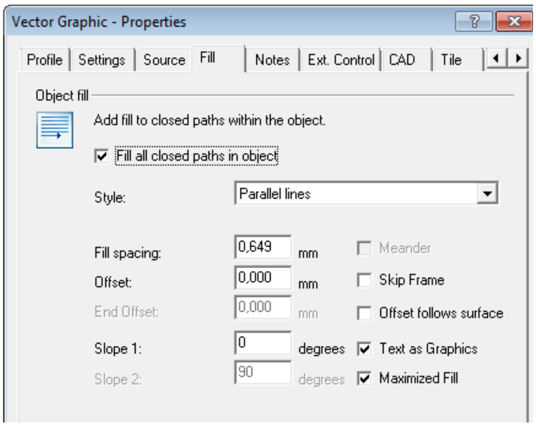


Object fill with a distance to the object outline

Set Object Fill
The filling of a selected object is activated and set as following:

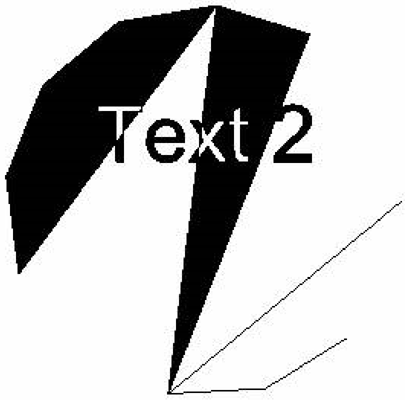
- Right click on the object you want to fill.
- Select *Properties...*.
- Select *Fill* tab.

  The dialogue on the right opens.
  Refer to the table below for explanations.



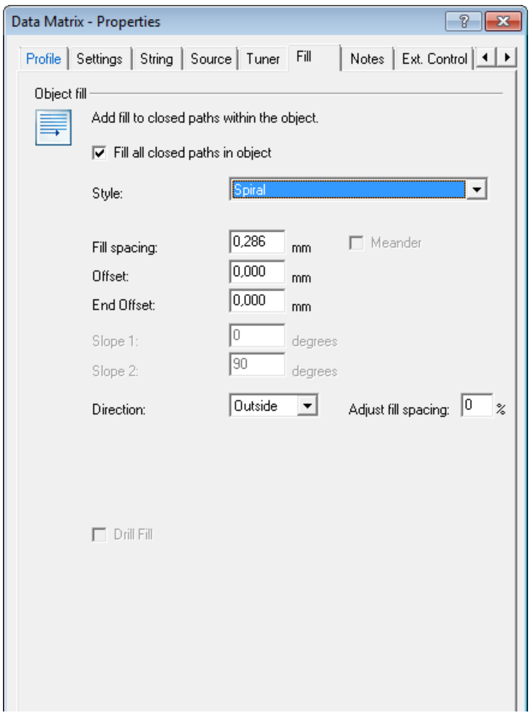
Fill all closed paths in object	If this function is enabled, all closed paths in the selected object are filled.		
	Style		Parallel lines
			Crosshatch
			Parallel lines, bidirectional
			Crosshatch, bidirectional
			Spiral (only for Data Matrix ECC200 barcodes)
	Meander		Only for barcode objects with bidirectional hatches (not for Data Matrix ECC200): The filling of the objects is marked in one go, i.e. without switching off of the laser between end and start point of the single lines.
	Fill spacing	Spacing of the fill lines.	
	Skip Frame	Inverts the filling of vector objects with multiple layers. All previously unfilled areas are filled, and vice versa.	
	Offset	This option enables an improvement of the marking quality of a filled object. The laser beam creates rounded start and end dots with the diameter of the laser spot on each fill line. This causes a waved appearance of the object outline The outline is straightened by an additional marking of the outline itself. Because the outline overlaps the start and end points of the filling lines, these areas are marked twice. This can be prevented by an offset, i.e. a distance between the outline and the filling lines.	
	Slope 1	Hatching angle for parallel lines.	
	Slope 2	Hatching angle for crosshatch.	
	Text as Graphic	Text within the graphic object should be part of the filled layout.	
	Maximized Fill	Use if graphic has closed and non-closed contour.	
Drill fill	If this function is enabled, the filling of the object is marked with details instead of lines. This function is available if *Fill all closed paths in object* is enabled. The point array follows the direction of fill-lines.		
	Drill pulse count	Number of pulses per point.	
	Drill spacing	Spacing between the drills.	
	Drill pixel size	Size of the drills.	

Example for the combination of the two options "Text as Graphic" and "Maximized Fill".



Set Spiral filling
Spiral filling (only available for Data Matrix ECC200 barcodes) of a selected barcode is activated and set as following.

- Optiopn is only selectable when barcode is optimized for quality (*Mark cells individually*)
- Right click on the object you want to fill.
- Select *Properties...*.
- Select *Fill* tab.



The dialogue on the right opens.
Refer to the table below for explanations.

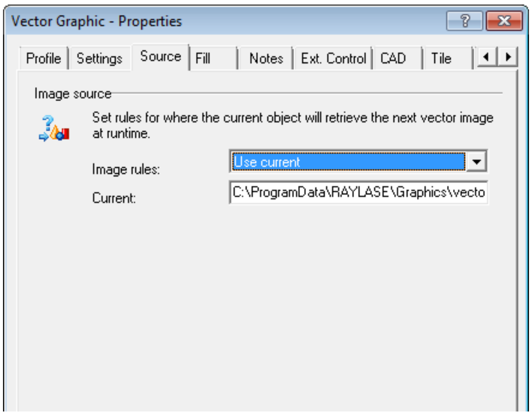
End Offset	Offset Settings for the barcodes from inside.
Radial orientation	Inside: Filling is marked from inside to outside. Outside: Filling is marked from outside to inside.
Adjust fill spacing	Spacing of the fill lines.

4.6 String rules

The strings on which text and barcode objects are based can be changed dynamically during execution of the job. The context of the string is adjusted at regular intervals according to the selected string rule..
The string rule for a text or barcode object can be called up and, if necessary, modified as follows:

- Right click on a text or barcode object.
- Select *Properties...*.
- Select *Source* tab.

  The dialogue on the right opens. The table below contains an overview of the available string rules.



<table>
<tr><td colspan="2">Justify</td><td>With strings of different lengths, this function aligns the strings with the selected point in the original string (left, right, centered / top, center, bottom).</td></tr>
<tr><td colspan="2">Use current string.</td><td>The content of the String tab acts as the source for the string. This is the default setting.</td></tr>
<tr><td colspan="2">User TextMerge</td><td>The source of the string is a linked text file.
➜ page 90, "Use TextMerge" string rule (one line objects)
➜ page 91, "Use TextMerge" string rule (multi-line objects)</td></tr>
<tr><td rowspan="7">For barcode objects and single row text objects only.</td><td>Use AutoDate</td><td>Depending on the setting, the string will either consist of the current date, the current time or the current shift code.
➜ page 92, "Use AutoDate" string rule</td></tr>
<tr><td>Supply string at start</td><td>The string must be entered by the user before starting each job. This entry is then valid until the end of the job.
➜ page 94, "Supply string at start" string rule</td></tr>
<tr><td>Supply string every mark</td><td>The string must be entered by the user each time the object is marked.
➜ page 95, "Supply string every mark" string rule</td></tr>
<tr><td>Serialize w/current start value</td><td>The content of the string is changed in specified increments. The content of the String tab is used as start value.
➜ page 96, "Serialize w/current start value" string rule</td></tr>
<tr><td>Serialize w/supplied start value</td><td>The content of the string is changed in specified increments. The user is prompted to enter a start value.
➜ page 97, "Get string from memory buffer" string rule</td></tr>
<tr><td>Get string from memory buffer</td><td>The content of one of the ten weldMARK™ buffers is used as the source for the string.
➜ page 98, "Get string from memory buffer" string rule</td></tr>
<tr><td>Custom string</td><td>The content of the string is determined by a formatting code.
➜ page 99, "Custom string" string rule</td></tr>
</table>

The range of options available is reduced for multi-line text objects.

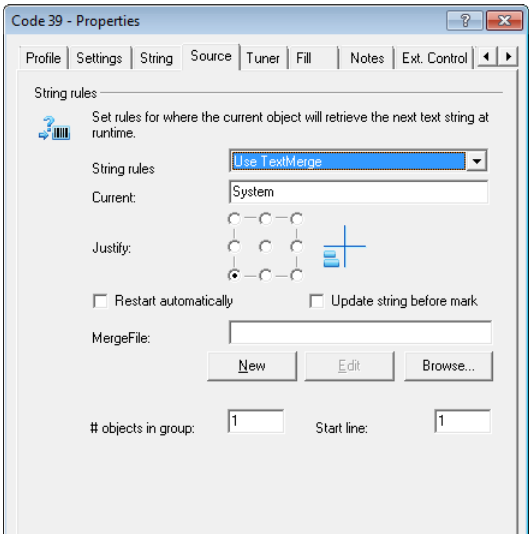
4.6.1 "Use TextMerge" string rule (one line objects)

This rule enables the strings for one line text or barcode objects to be loaded from a merge file. A simple text file with the extension ".txt" is used as the merge file. Each string in the merge file must be completed with a line break (Enter key). This also applies to the last line in the merge file.

The parameters of the TextMerge function can be set as follows for one line objects:

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Use TextMerge* string rule.

  The dialogue on the right opens.
  Refer to the table below for explanations.



Justify	With strings of different lengths, this function aligns the strings with the selected point in the original string (left, right, centered / top, center, bottom).
Restart automatically	If this function is enabled, the merge file will be re-processed as soon as its end has been reached.
Update string	If this function is enabled, the merge file will be read again before executing.
MergeFile	The specified text file is completely loaded when starting the job. For each marking operation, the string for the text or barcode object is overwritten with the next line from the merge file. If the job is ended, weldMARK™ sets a bookmark in this text file to indicate the last item processed.
New	The merge file can be created, searched, loaded and edited in weldMARK™.
Edit	
Browse...	
# objects in group	Number of text or barcode objects in current job that read their string from the same merge file. The value entered corresponds to the increment for reading the lines: For each marking operation, lines in the merge file are skipped corresponding to the number of objects in the group.
Start line	Number of the first line to be read from the merge file.
Update string	Updates the display while the marking process is ongoing.

Upon reaching the end of the merge file, the user is prompted to start with the first entry again or cancel, per dialogue.

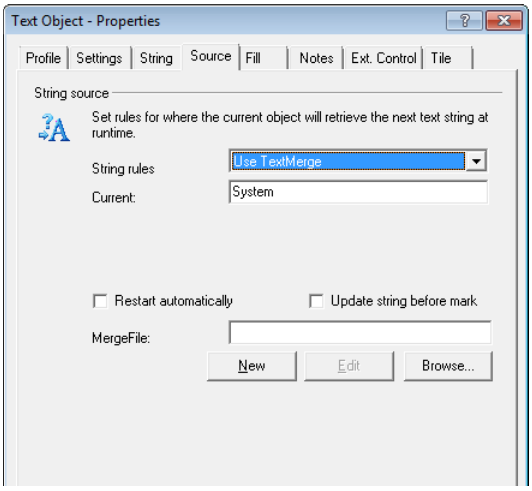
4.6.2 "Use TextMerge" string rule (multi-line objects)

This rule enables the strings for multi-line text or barcode objects to be loaded from a merge file. A simple text file with the extension ".txt" is used as the merge file. Each string in the merge file must be completed with a line break (Enter key). This also applies to the last line in the merge file.

The parameters of the TextMerge function can be set as follows for multi-line objects:

- oRight click on a multi-line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Use TextMerge* string rule.

  The dialogue on the right opens.
  Refer to the table below for explanations.



MergeFile	The specified text file is completely loaded when starting the job. For each marking operation, the string for the text or barcode object is overwritten with the next lines from the MergeFile. If the job is ended, weldMARK™ sets a bookmark in this text file to indicate the last item processed.
Restart automatically	If this function is enabled, the merge file will be re-processed as soon as its end has been reached.
Update string	If this function is enabled, the merge file will be read again before executing.
New	The merge file can be created, searched, loaded and edited in weldMARK™.
Edit	
Browse...	
Update string before mark	Updates the display while the marking process is ongoing.

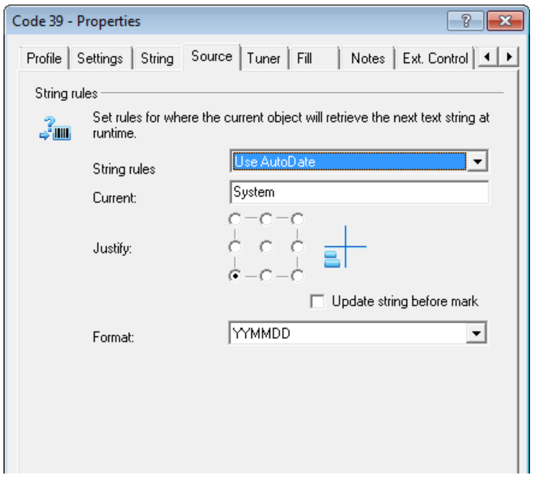
Upon reaching the end of the merge file, the user is prompted to start with the first entry again or cancel, per dialogue.

4.6.3 "Use AutoDate" string rule

This rule enables text or barcode objects to be marked with the current date, the current time or the current shift code. This information is derived from the Windows system clock and is updated for each marking operation

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Use AutoDate* string rule.

  The dialogue on the right opens.
  Refer to the table below for explanations.



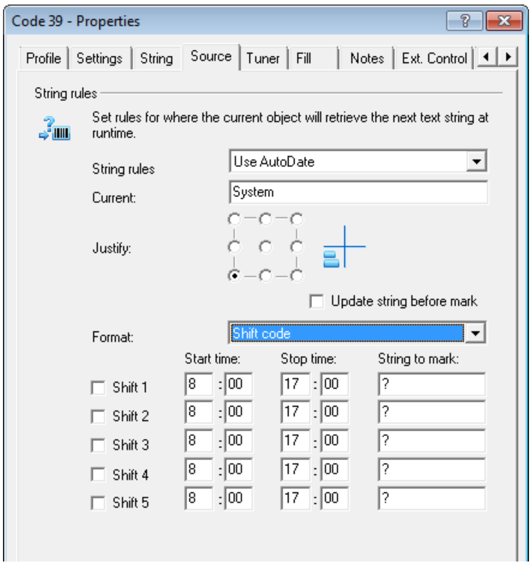
Justify	With strings of different lengths, the strings are aligned with the selected point in the original string (left, right, centered).	
Format	Format selection for the AutoDate string. The available AutoDate formats are as follows (example date 15th January 2006):	
	Format	Output
	YYMMDD	060115
	MM/DD/YY	01/15/06
	DD/MM/YY	15/01/06
	Month DD, YYYY	January 15, 2006
	DD Month, YYYY	15 January, 2006
	YWW	602 (WW: Week number)
	YMD	61E (single digit alphanumeric values for year, month and day. Sequence: 1,2,3...9,0,A,B,C...)
	DDD	015 (three digit value for day of the year)
	DDDY	0156 (three digit value for day of the year and single digit value for the year)
	YY	06
	Shift code	See next section.
	DDMY	1516
	HH:MM:SS	11:55:00
Update string before mark	Updates the display while the marking process is ongoing.	

4.6.4 String rule "AutoDate", Format "Shift code"

This format is part of the *AutoDate* string rule (➜ page 92, "Use AutoDate" string rule). If this format is selected, the current shift code is applied to the object as a string for each marking operation. The information is derived from the Windows system clock.

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Use AutoDate* string rule.
- Select the *Shift code* format.

The dialogue on the right opens.
Refer to the table below for explanations.



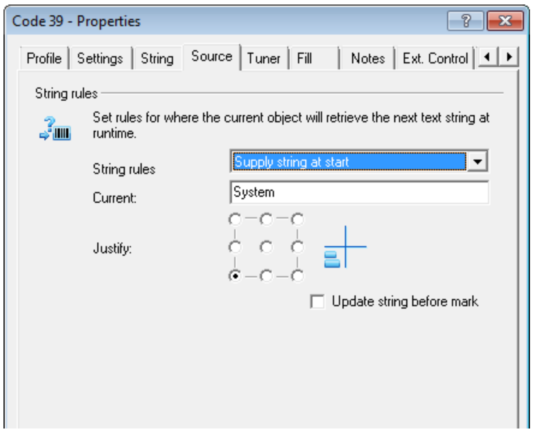
Shift 1 … Shift 5	These check boxes can be used to activate up to five shifts.	
	Start time	These fields are used to define the start and end times for each shift. If the shifts overlap, the first permissible shift is used. The remaining shifts are ignored. If there are periods of time that are not assigned to an active shift, a "?" is output. If a shift includes the time 0:00 (change of date), it must be split into two sections with the same shift code.
	Stop time	
	String to mark	These fields can be used to enter the shift codes to be marked with the laser.
Update string before mark	Updates the display while the marking process is ongoing.	

4.6.5 "Supply string at start" string rule

If this rule is selected, each time a job is started the user is prompted to enter a string for the text or barcode object. This string rule will be used until the end of the job and will stay the same during repeated cycles for example.

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Supply string at start* string rule.

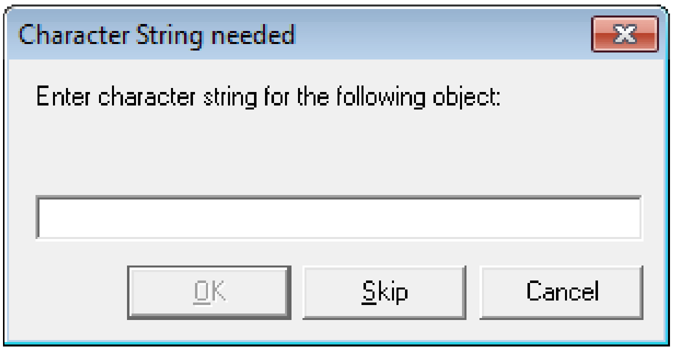
  The dialogue on the right opens.
  Refer to the table below for explanations.



Justify	With strings of different lengths, the strings are aligned with the selected point in the original string (left, right, centered).
Update string before mark	Updates the display while the marking process is ongoing.

Starting dialogue

The following dialgue is shown after starting the job.



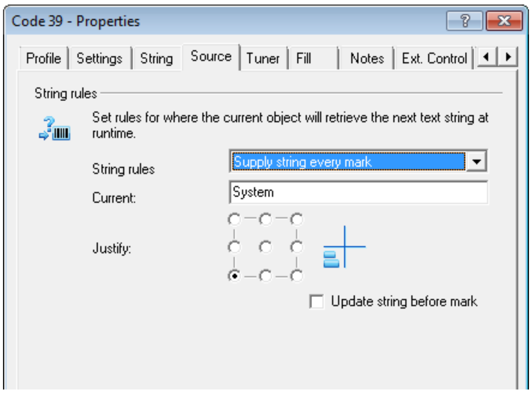
OK	Confirms the value.
Skip	Repeats the previous value
Cancel	Cancels the cycle at this point.

4.6.6 "Supply string every mark" string rule

If this rule is selected, the value of a text or barcode object is automatically increased or reduced by a particular value. The entered string will be used for one marking only.

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Supply string every mark* string rule.

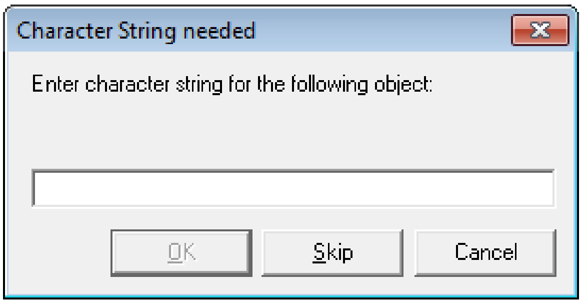
  The dialogue on the right opens.
  Refer to the table below for explanations.



Justify	With strings of different lengths, the strings are aligned with the selected point in the original string (left, right, centered).
Update string before mark	Updates the display while the marking process is ongoing.

Starting dialogue

The following dialogue is shown after starting the job.



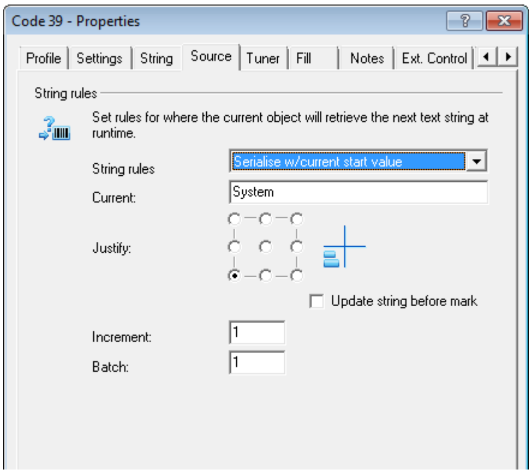
OK	Confirms the value.
Skip	Repeats the previous value
Cancel	Cancels the cycle at this point.

4.6.7 "Serialize w/current start value" string rule

If this rule is selected, the value of a text or barcode object is automatically increased or reduced by a particular value.
When starting the job the user is prompted to enter a string as the start value.

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Serialize w/current start value* string rule.

  The dialogue on the right opens.
  Refer to the table below for explanations.



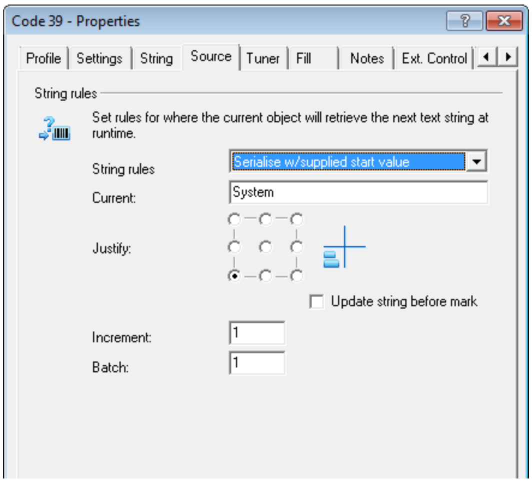
Justify	With strings of different lengths, the strings are aligned with the selected point in the original string (left, right, centered).
Increment	Sets the increment by which the string will be changed. A positive value increases the value of the string, a negative value reduces it. Both letters and numbers can be incremented: 0001A is increased to 0001B. Note that an arrangement of letters is only permissible for ANSI text. It is possible that Unicode text consisting of letters will not be incremented correctly. Leading zeroes are retained.
Batch	Batch size for serialization. The string is only incremented when the number of markings specified under *Batch* has been performed.
Update string before mark	Updates the display while the marking process is ongoing.

4.6.8 "Get string from memory buffer" string rule

If this rule is selected, the value of a text or barcode object is automatically increased or reduced by a particular value.
When starting the job the user is prompted to enter a string as the start value.

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Serialize w/supplied start value* string rule..

  The dialogue on the right opens.
  Refer to the table below for explanations.



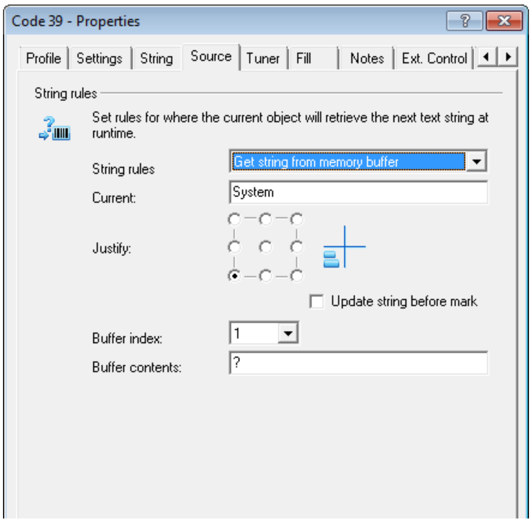
Justify	With strings of different lengths, the strings are aligned with the selected point in the original string (left, right, centered).
Increment	Sets the increment by which the string will be changed. A positive value increases the value of the string, a negative value reduces it. Both letters and numbers can be incremented: 0001A is increased to 0001B. Note that an arrangement of letters is only permissible for ANSI text. It is possible that Unicode text consisting of letters will not be incremented correctly. Leading zeroes are retained.
Batch	Batch size for serialization. The string is only incremented when the number of markings specified under *Batch* has been performed.
Update string before mark	Updates the display while the marking process is ongoing.

4.6.9 "Get string from memory buffer" string rule

This rule enables the strings for text and barcode objects to be read from one of the ten weldMARK™-buffers immediately prior to the marking operation. The content of the buffer can constantly be changed using an external host program (➜ page 234, Remote Interface and ➜ page 202, Global Settings).

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Get string from memory buffer* string rule.

  The dialogue on the right opens.
  Refer to the table below for explanations.



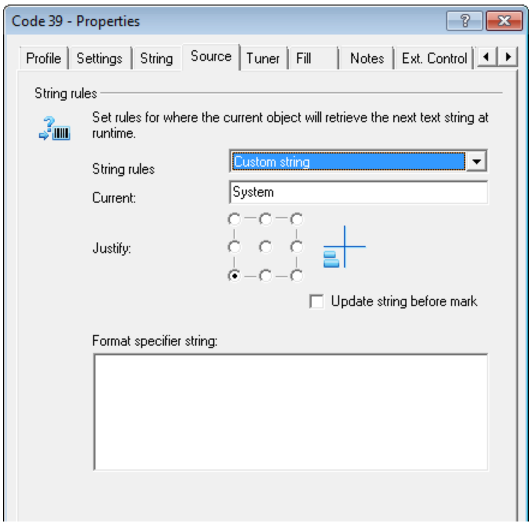
Justify	With strings of different lengths, the strings are aligned with the selected point in the original string (left, right, centered).
Buffer index	Number of the weldMARK™ memory buffer to be used to obtain the data.
Buffer contents	Current content of the weldMARK™ *Buffer Index*. When the application is started, the buffers are set to a value of "?".
Update string before mark	Updates the display while the marking process is ongoing.

4.6.10 "Custom string" string rule

This rule enables the string for the text or barcode object to be created using a custom string.

- Right click on a one line text or barcode object.
- Select *Properties...*.
- Select *Source* tab.
- Select the *Custom String* string rule.

The dialogue on the right opens.
Refer to the table below for explanations.



Justify	With strings of different lengths, the strings are aligned with the selected point in the original string (left, right, centered).
Format specifier string	Enter the custom string to be used to create a string for the object (see table below).

Code	Code example	Text created for string
%A		Abbreviated day of the week (Mon, Tue, Wed, Thu, Fri, Sat, Sun)
%B		Abbreviated month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec)
%C		Date and time (MM/DD/YY HH:MM)
%D		Day of the month (01 - 31)
%H		Hour (00 - 23)
%h		Hour (00 - 12)
%J		Day of the year (001 - 366)
%K		Month code (1 - 9, O, N, D)
%L		Last digit of year (0 - 9)
%M		Month (01 - 12)
%N		Minutes (00 - 59)
%F		Seconds (00-59
%E		After recall, the previously string is added by the actual string.
%O		Ascending numerical value. Starts with a value of "1" at the beginning of the process.
%o		Same as code *%O*. After restart, the last used numerical value will be used as start value.
%P		AM or PM
%Q#	*%Q1*	The string is copied from the weldMARK™ buffer (# 1-10).
%R		Week (01-53). Week "01" is the week that includes 1st January.
%r		Week (01-53). Week "01" is the week that includes the first Thursday of the new year.

Code	Code example	Text created for string
%S,d,s,i,b	*%S,9,1,1,1*	S = Consecutive number d = End number s = Start number i = Increment b = batch **Note**: Only integer values are supported. The parameters "i" and "b" must be positive.
%s		Same as code *%S*. After restart, the last used numerical value will be used as start value.
%T		Time (HH:MM)
%V"	*%V'RAYLASE'*	Any text can be entered here. The text must be placed between quotation marks ("RAYLASE" in the code example).
%W		Day of the week (coding: 1 = "Sunday" ... 7 = "Saturday")
%w		Day of the week (coding: 1 = "Monday" ... 7 = "Sunday")
%X#	*%X5*	A particular number of spaces can be inserted (5 spaces in the code example).
%Y		Year (00 - 99)

5 TOOLS FOR EDITING MARKING OBJECTS

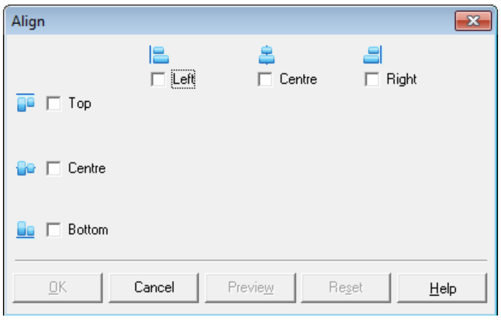
weldMARK™ provides the following tools for editing marking objects:

Align objects	Objects can be aligned relative to one another.	➜ page 101, Aligning Objects
Dimensions	Objects can be positioned, scaled, rotated or skewed.	➜ page 102, The "Dimensions" Toolbox
Grid/Guidelines	The grid and the guidelines are used to make it easier to align objects on the screen. Their properties can be set.	➜ page 114, Grid Line Settings ➜ page 114, Modify Guidelines
Zoom tools	The display size of the workspace on the screen can be enlarged or reduced.	➜ page 117, Appliance of the Zoom tools

5.1 Aligning Objects

The *Align...* tool enables the alignment relative to one another. Objects are always aligned to the last selected object.

- Select the objects you want to align.
- Select *Tools >Align...* option from the menu. The dialogue on the right opens. Refer to the table below for explanations.



Align objects

Top, Center, Bottom *Left, Center, Right*	These check boxes allow you to specify the required vertical and horizontal alignment of the objects to one another.
Preview *Reset*	Clicking on this button displays the expected result of the alignment. Then the alignment can be reversed either by clicking on *Reset* or confirmed by clicking on *OK*.

5.2 The "Dimensions" Toolbox

The "Dimensions" toolbox contains the following tools for editing marking objects:

String position	➜ page 102, Positioning objects
Scale	➜ page 103, Scaling and mirroring Objects
Size	➜ page 103, Changing the Object Size
Rotate	➜ page 106, Rotating Objects
Move to Folder...	➜ page 106, Nudging Objects
Skew	➜ page 107, Skewing Objects

Definition frame-spot:

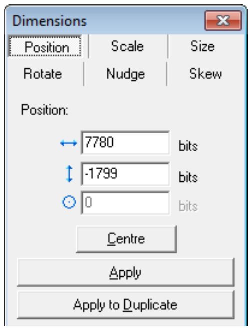
The frame spot is defined as the lower-right corner of the virtual frame that covers objects.

5.2.1 Positioning objects

The *Position* tool enables you to display and change an object's current position.

- Select a marking object.
- Select *Objects >Dimensions...* option from the menu.
- Select *Position* tool.

  The dialogue on the right opens. Refer to the table below for explanations.

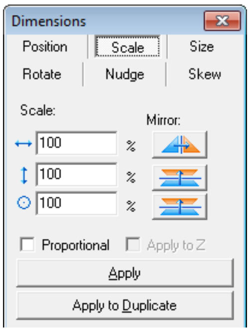


String position	The current position of the selected object is shown in the two input boxes. The specified position can be overwritten with your required target position. The data relates to the frame spot of the object. Additionally a Z position for the lower edge can be defined for solid modellings (STL File Import).
Center	Clicking on this button positions the selected object in the center of the workspace.
Apply	Clicking on this button applies the settings made to the selected object.
Apply to Duplicate	Clicking on this button copies the selected object and applies the changed settings to the copy.

5.2.2 Scaling and mirroring Objects

The *Scale* tool enables you to scale objects by a specified factor and, if required, to mirror them.

- Select a marking object.
- Select *Objects >Dimensions...* option from the menu.
- Select *Scale* tool.
  The dialogue on the right opens. Refer to the table below for explanations.



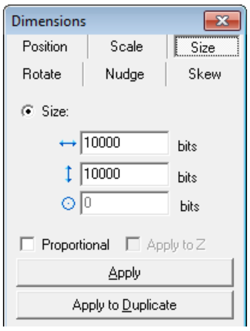
Scale	The desired scaling factor for the X, Y and Z axis can be defined here.
Proportional	If this function is activated all axis of the object will be scaled with the same factor.
Mirror	Clicking on this button, mirrors the selected object horizontally or respectively vertically.
Apply to Z	Scalings of 3D Vector Objects and solid modellings will be set proportionally to the Z axis (height axis).
Apply	Clicking on this button applies the settings made to the selected object.
Apply to Duplicate	Clicking on this button copies the selected object and applies the changed settings to the copy.

A separate tool is available for fixed radial text objects (➜ page 105, Changing the Object Size (Radial Text - fixed)).

5.2.3 Changing the Object Size

The *Size* tool enables you to change the width and height of objects by entering the required values.

- Select a marking object.
- Select *Objects >Dimensions...* option from the menu.
- Select *Size* tool.
  The dialogue on the right opens. Refer to the table below for explanations.

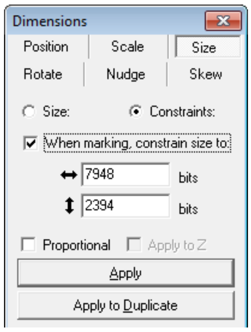


Size	These input boxes display the current width, height and depth of the selected object if necessary. The values can be changed as required. The change in size is performed from the center of the selected object or object group.
Proportional	If this function is enabled, the width and height of the object are changed by the same factor horizontally and vertically. Making an entry in one field changes the value in the other field automatically.
Apply to Z	Size alteration of 3D Vector Objects and solid modellings will be set proportionally to the Z axis (height axis).
Apply	Clicking on this button applies the settings made to the selected object.
Apply to Duplicate	Clicking on this button copies the selected object and applies the changed settings to the copy.

The object size can also be changed by using the anchor points with the mouse. However, the value of the Z axis stays unchanged with 3D objects.

Size Option for Standard and radial Text Objects

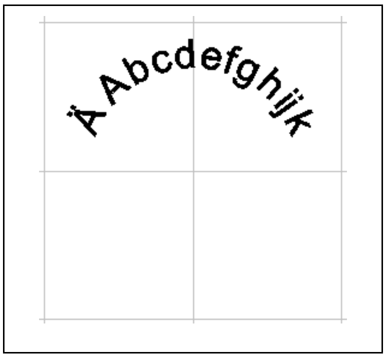
For standard text objects and for text objects with the *Radial* display option, in addition to the option of changing the size (➜ page 103, Changing the Object Size) the special *Constraints* function is available. This function enables assigning a different output size in relation to the size shown on the screen to these objects for the marking process.



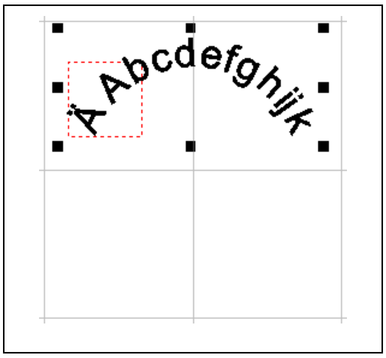
- Select a text or radial text object.
- Select *Objects >Dimensions...* option from the menu.
- Select *Size* tool.
- Select *Constraints* option field.
  The dialogue on the right opens. Refer to the table below for explanations.

When marking, constrain size to	Enabling this function allows you to specify the output size of the radial text object. ↔ ↕ The required output size for the radial text objects can be entered in these fields.
Apply	Clicking on this button applies the settings made to the selected object.
Apply to Duplicate	Clicking on this button copies the selected object and applies the changed settings to the copy.

Example:



Radial text variable

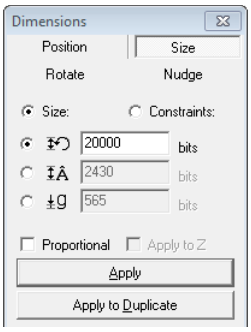


Option: *Constraints*
The red rectangle indicates the output size.

Changing the Object Size (Radial Text - fixed)

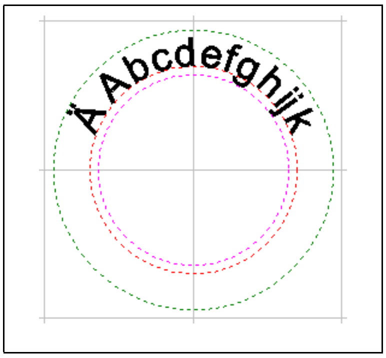
Special options are available for changing the size of *Radial - fixed* type objects. Furthermore you can assign a different output size in relation to the size shown on the screen to these objects for the marking process.

- Select a fixed radial text object.
- Select *Objects >Dimensions...* option from the menu.
- Select *Size* tool.
  The dialogue on the right opens.



Size		The diameter for the base line of the text can be specified here.
		The font size can be specified by entering the x-height and the ascender.
		The font size can be specified by entering the descender.
Constraints	Enabling this function allows selecting a different diameter for the marking process.	
Apply	Clicking on this button applies the settings made to the selected object.	
Apply to Duplicate	Clicking on this button copies the selected object and applies the changed settings to the copy.	

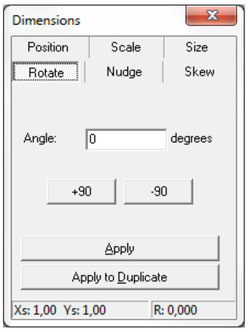
Example:



Radial text - fixed

5.2.4 Rotating Objects

The *Rotate* tool enables objects to be rotated by a specified angle. The middle of the object frame is the centre of rotation.

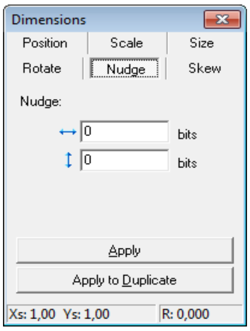


- Select a marking object.
- Select *Objects >Dimensions...* option from the menu.
- Select *Rotate* tool.
  The dialogue on the right opens. Refer to the table below for explanations.

Angle	An angle for object rotation can be selected in this entry field. Positive value: Rotation clockwise Negative value: Rotation counter-clockwise
-90 | +90	Shortcuts to rotate object +90 / -90 degree.
Apply	Clicking on this button applies the settings made to the selected object.
Apply to Duplicate	Clicking on this button copies the selected object and applies the changed settings to the copy.

5.2.5 Nudging Objects

The *Nudge* tool enables objects to be shifted by a specified angle.



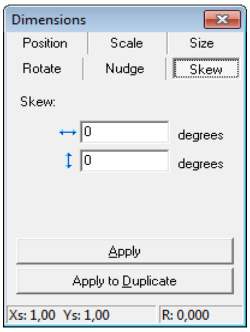
- Select a marking object.
- Select *Objects >Dimensions...* option from the menu.
- Select *Nudge* tool.
  The dialogue on the right opens. Refer to the table below for explanations.

Nudge	These input boxes can be used to specify values for the required movement of the object in horizontal and vertical direction.
Apply	Clicking on this button applies the settings made to the selected object.
Apply to Duplicate	Clicking on this button copies the selected object and applies the changed settings to the copy.

5.2.6 Skewing Objects

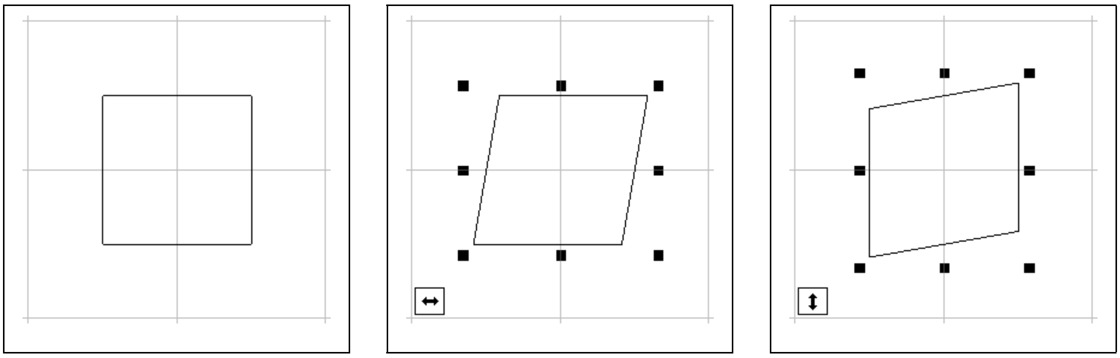
The *Skew* tool enables skewing objects by a specified angle.

- Select a marking object.
- Select *Objects >Dimensions...* option from the menu.
- Select *Skew* tool.
  The dialogue on the right opens. Refer to the table below for explanations.



Skew	These input boxes can be used to specify values for skewing the object. Refer to the example below for details.
Apply	Clicking on this button applies the settings made to the selected object.
Apply to Duplicate	Clicking on this button copies the selected object and applies the changed settings to the copy.

Example:



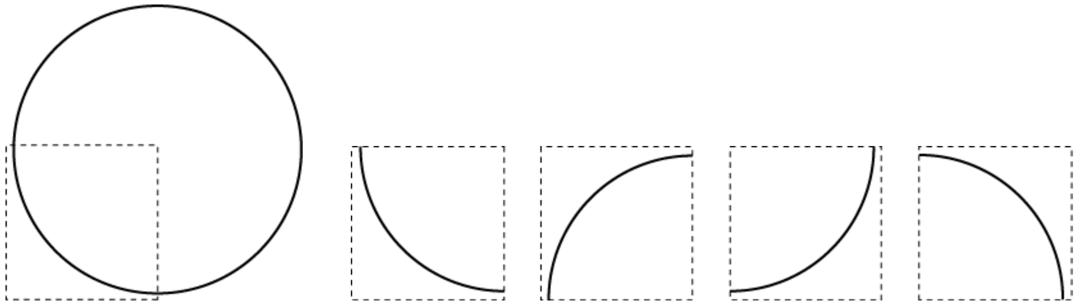
This tool is not available for fixed radial text objects.

5.3 Tiling

To mark an object that is larger than the marking field, it has to be tiled.
Two types of tiling are available, Tiling before marking (➜ page 109, Manual Tiling) and Tiling while marking (➜ page 111, Automatic Tiling), which are explained in the following sections. Tiling still shows the object as a whole and processes the parts, so they can be reassembled like a puzzle. The circle in the left drawing represents the marking object.

The dashed lines show the size of the marking field. The object has to be marked in 4 steps. Thereby, the component needs to be moved after every step.

Example:

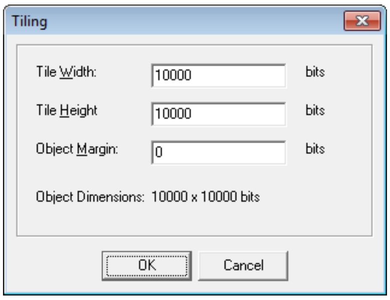


5.3.1 Manual Tiling

The following section specifies how to tile a marking object into a tiled object:

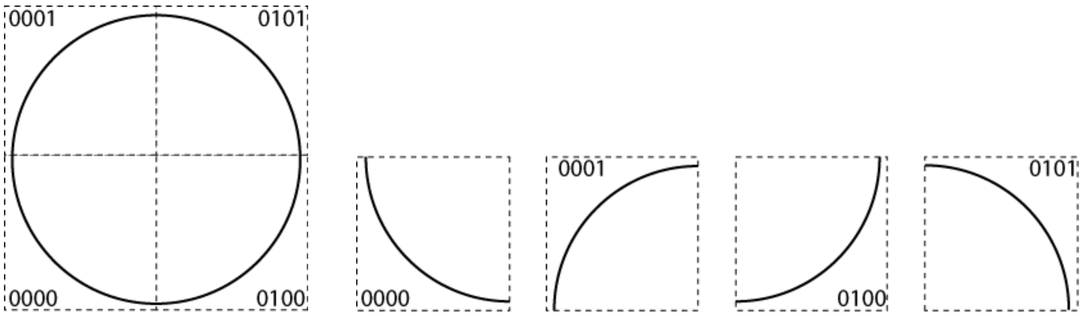
- Right click on a marking object.
- Select *Tiling*.

The dialogue on the right opens. Refer to the table below for explanations.

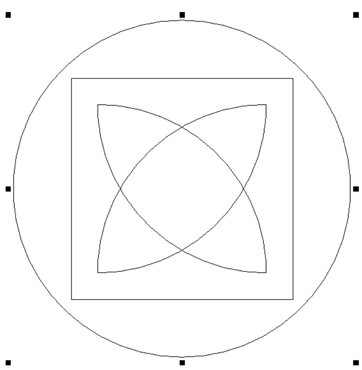


Tile Width	Defines the width of each single tiled object.
Tile Height	Defines the height of each single tiled object.
Object Margin	Defines the space between tiled objects.

The object will be tiled in multiple tiled objects which are shown in the Object Manager. The naming of the tiled objects is composed out of the object name, the index number of the object and the coordinates of the tiled objects compared to the whole object. Parts with no content will not be contained in the object manager.



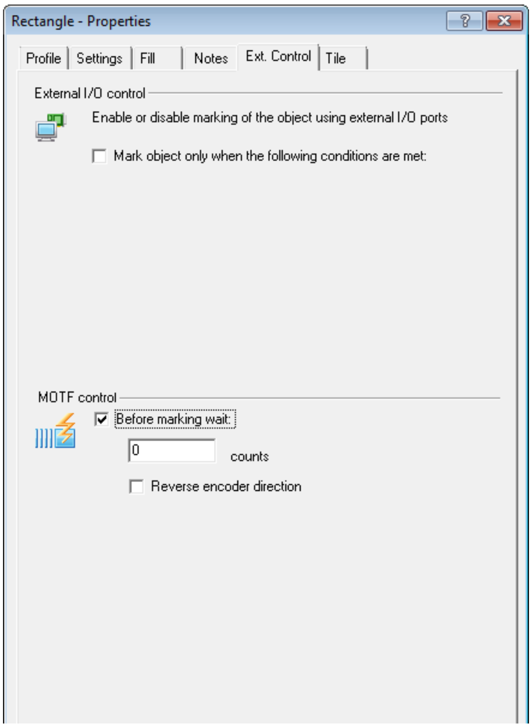
The following figure shows how a circle, tiled into four tiled objects, is displayed on the work space. The square shows the size of the marking field. Outside the untiled object is shown, which will can be deleted if it will no be used any more. On the insed the tiled objects stack on top of each other. The tiled parts can be stringed together with either **automation objects (** ➜ page 127, "XY Table" Automation Object) positioned to each other on the marking field, or along the marking direction (Mark on the Fly) via the *Distance Encoder Steps* function.



Tiling and the "Mark-on-the-Fly" function

If a tiled object has to be marked with the "Mark-on-the-Fly" function, additional settings have to be configured. To prevent that tiled objects are marked on top of each other, a marking pause in the size of the previous object has to be assigned to the second object and all tiled objects after. The settings for the first tiled object must not be changed. After clicking the *OK* or *Apply* button, the specified value will be marginally changed, which has no consequences whatsoever.

- Right click on the tiled object.
- Select *Properties...*.
- Select *Ext. Control* tab.
- Activate *Before marking wait*.
  The red marked area, displayed in the figure on the right, will be activated. Refer to the table below for explanations.



MOTF control	*Before marking wait... Impulse*	If bits is chosen as measuring unit. If this function is activated and a value greater than zero is entered, marking of the chosen tiled object will begin after the marking pause.
	Before marking wait...mm	If mmis chosen as measuring unit. If this function is activated and a value greater than zero is entered, marking of the chosen tiled object will begin after the marking pause.
	Before marking wait...Inch	If inch chosen as measuring unit. If this function is activated and a value greater than zero is entered, marking of the chosen tiled object will begin after the marking pause.
	Switch direction of the encoder	In some cases, caused by installation, the sensor signal arrives with the wrong moving sense. Though the direction of the encoder is reversed.

5.3.2 Automatic Tiling

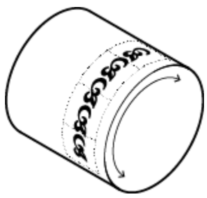
This function is only available for vector objects (Rectangle, Polygon, Polyline and Bezier) and bitmap objects.

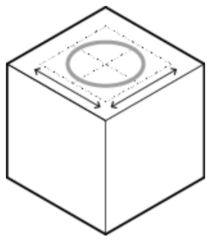
The object is tiled in rectangle shaped parts and marked. A good comparison to this process would be placing floor tiles.

There are two selectable marking types. In the *Rotary Indexer* mode marking takes place after each rotary movement, on the *XY-Table* Mode after each linear movement. The order of the tiles is autocratically defined and processed by the software. The individual tile-pieces are always marked in the field centre position.

The rotary axis lay on the X axis of the field.

Example:



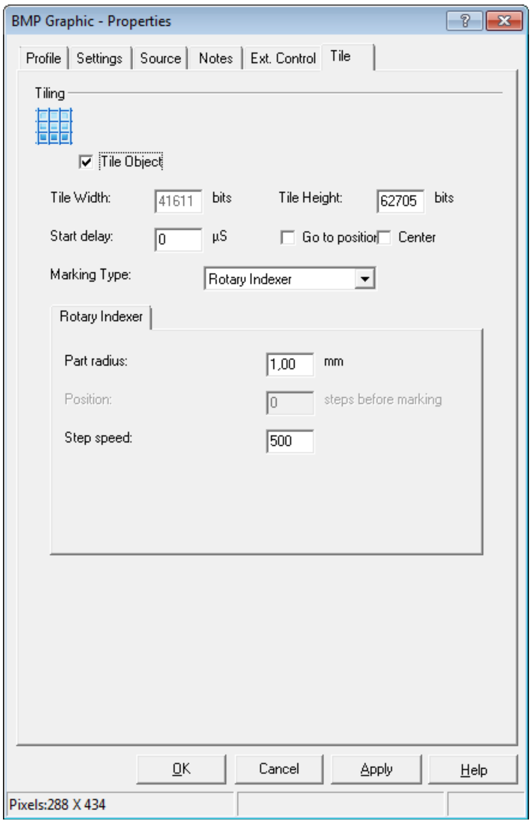


Rotary Indexer

Marking process tiled in four parts with XY-movement.

Settings for the rotary indexer marking mode

- Right click on a Vector Graphic or bitmap object.
- Select *Properties...*.
- Select *Tile* tab.
- Activate *Tile object*.
  The dialogue on the right opens. Refer to the table below for explanations.

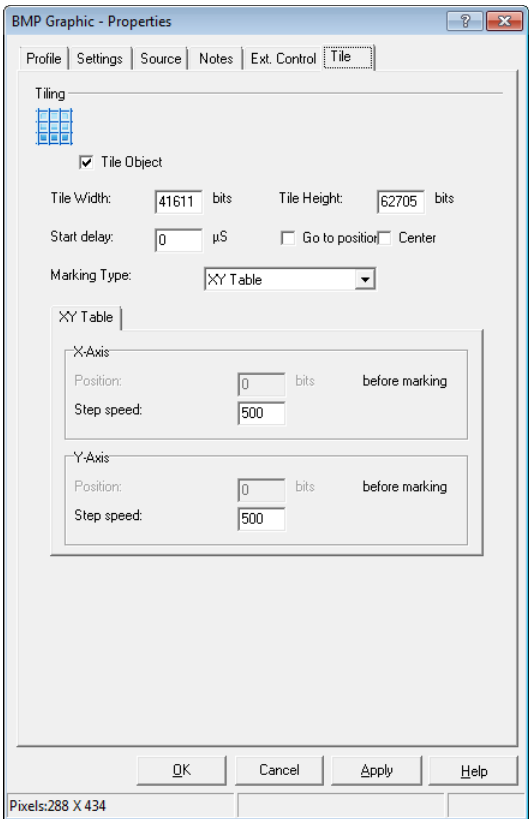


Tile object	If this function is activated, the object will be tiled according to the following parameters. This function is disabled by default.
Tile Width	The tile width can not be changed in the "Rotary Indexer" Mode.
Tile Height	The tile height defines the height of the tiled parts.
Start Delay	Defines the delay after the next tiled part is marked.
Go to position	If this function is activated the rotary axis is brought to a predefined starting position. this position is the new starting position for the next marking. If this function is not activated the position of the Home Sensor will be used as reference points.
Center	If this function is activated, the object is marked centrally to the starting position.
Marking Type	Defines the Marking Type. The Rotary Indexer or the XY-Table can be chosen.
Radius	This field is used to enter the radius of the cylinder generated surface.
Starting position ... degrees before marking	Can be chosen if the presetting for the unit is mm or inch. Defines the starting position prior to the marking of the object. The starting position can only be set if the *Go to position* function has been activated.
Starting position ... degrees before marking	Can be chosen if the presetting for the unit is bits. Defines the starting position prior to the marking of the object. The starting position can only be set if the *Go to position* function has been activated.
Step speed	Displays the step speed for the motor.

Settings for the XY-table marking mode

- Right click on a Vector Graphic or bitmap object.
- Select *Properties...*.
- Select *Tile* tab.
- Activate *Tile object*.
- Choose the *XY-Table* option.

The dialogue on the right opens. Refer to the table below for explanations.



Tile object	If this function is activated, the object will be tiled according to the following parameters. This function is disabled by default.	
Tile Width	The width and height can be used to define the size of the tiled objects.	
Tile Height		
Start Delay	Defines the delay after the next tiled part is marked.	
Go to position	When this option is enabled, the X and Y axis will be set to a predefined position. this position is the new starting position for the next marking. If this function is not activated the position of the Home Sensor will be used as reference points.	
Center	If this function is activated, the object is marked centrally to the starting position.	
Marking Type	Defines the *Marking Type*. The options rotary indexer and XY-table are available.	
X Axis	*Starting position...before marking*	Defines the starting position of the X axis before the marking of the object. The starting position is only available, if the function *Go to position* is selected.
	Step speed	Defines the step speed of the X axis before the marking of the object.
Y Axis	*Starting position...before marking*	Defines the starting position of the Y axis before the marking of the object. The starting position is only available, if the function *Go to position* is selected.
	Step speed	Defines the step speed of the Y axis before the marking of the object.

5.4 Grid/Guidelines

The grid and the guidelines are used to make it easier to align objects on the screen. Their properties can be set.

5.4.1 Grid Lines

The grid is formed out of horizontal and vertical lines in a constant distance and facilitates drawing and ordering objects.

Grid

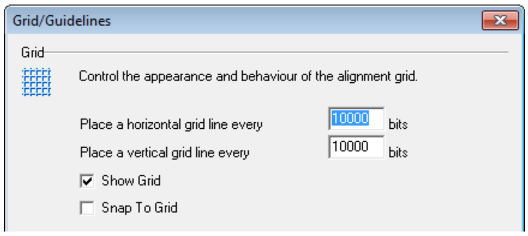
Show and Hide Grid Lines

- Select *View >Grid* option from the menu.
  Shows or hides grid lines.

Grid Line Settings

The Grid Line Settings define the appearance of the grid on the screen, as well as the behaviour of the object when it is pulled near the Grid Lines.

- Select *Tools >Grid/Guidelines...* option from the menu.
  The dialogue on the right opens. The figure shows grid line relevant information only.
  Refer to the table below for explanations.



Horizontal Grid	The horizontal and vertical distances between each grid line can be set here.
Vertical Grid	
Show Grid	If this function is enabled, the grid lines are displayed.
Snap To Grid	If this function is enabled, objects that are moved get aligned with the grid lines.

5.4.2 Guidelines

The horizontal and vertical distances between each guide line can be set here. Any combination of guide lines can be saved and loaded again later on.

Show and Hide Guidelines

- Select *View >Guidelines* option from the menu.

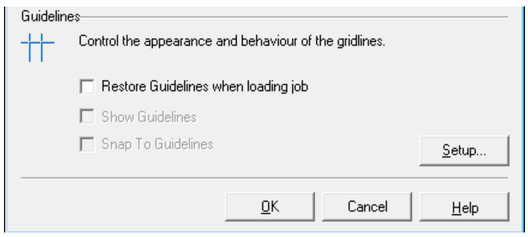
Shows or hides guidelines. This function is only available, if the guide lines have been set under (⇨ below).

Guidelines

Modify Guidelines

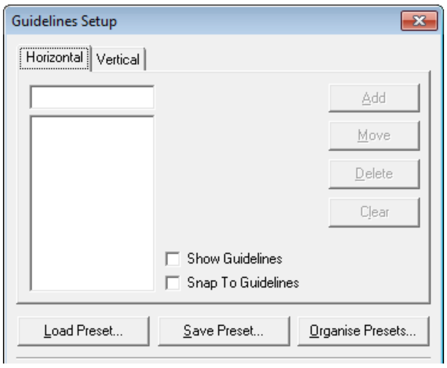
Guidelines can be added, moved or deleted. An unlimited amount of guide lines can be put on the workspace.

- Select *Tools >Grid/Guidelines...* option from the menu.
  The dialogue on the right opens. The figure shows only the section that is relevant for the guidelines.
  Refer to the table below for explanations.



Restore Guidelines when loading job	If this function is activated, the created guide lines are saved with the job,
Setup	Opens a window for guide line creation.

- Click on the *Setup* button.
  The dialogue on the right opens. Refer to the table below for explanations.

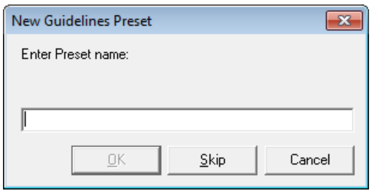


Horizontal, *Vertical*	There is a tab for horizontal and vertical guide lines.
(1)	Entry field for the position of the created guide lines.
Add	Clicking this button adds a new guide line to the selected position.
(2)	List of all guide lines.
Move to Folder...	Clicking this button moves the guide line from field *(2)* to the position set in field *(1)*.
Delete	Clicking this button deletes the guideline selected in field *(2)*.
Reset	Clicking this button deletes all horizontal and vertical guidelines Horizontal and vertical guide lines are not deleted simultaneously.
Show Guidelines	If this function is enabled, guidelines are shown.
Snap To Guidelines	If this function is enabled, objects that are moved get aligned with the guidelines.
Load Preset	Saved Presets can be loaded for the active job (➜ page 116, Loading Preset).
Save Preset	All guide lines can be saved and used for other. (➜ page 115, Saving Presets).
Organise Presets	Saved Presets can be renamed or deleted (➜ page 116, Organizing Presets).
Clear All	All guidelines contained in the job will be deleted.

Saving Presets

Presets are all guidelines contained in one job. A Preset can be used for new jobs and is saved as explained below. If the preset shall only be saved with the current job, the option *Restore Guidelines when loading job* can be used. (➜ page 114, Modify Guidelines).

- Select *Tools >Grid/Guidelines...* option from the menu.
- Click on the *Setup* button.
- Click on *Save Preset* button.
  The dialogue on the right opens.

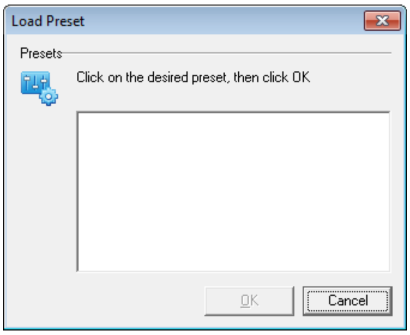


OK	After choosing a name for the preset, it can be saved.
Skip	This button enables saving the preset without specifying a name. The internal preset will be overwritten this way.

Loading Preset

Saved presets can be loaded as into the active job as described below. Potentially existing guidelines are overwritten.

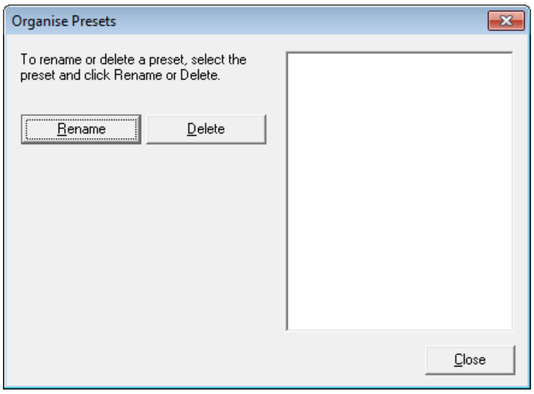
- Select *Tools >Grid/Guidelines...* option from the menu.
- Click on the *Setup* button.
- Click on the *Load Preset* button The dialogue on the right opens.
- Select the desired preset and click *OK*.



Organizing Presets

Saved presets can be renamed and saved as follows:

- Select *Tools >Grid/Guidelines...* option from the menu.
- Click on the *Setup* button.
- Click on the *Organise Preset* button. The dialogue on the right opens.



5.5 Appliance of the Zoom tools

There are three different kinds of tools available for changing the zoom factor of the work-space.

Zoom in

- Click on the *Zoom In* button.
- Drag, with pressed mouse button, along the area you want to zoom in.

Zoom in

Zoom out

- Click on the *Zoom out* button.
  The workspace will be displayed smaller.
- To further scaling down the display, click the *Zoom out* button again.

Zoom out

Full view

- Click the *Full View* button
  The workspace will be extended as far as possible to enable a full view.

Full view

6 TEMPLATES

A template is an object that cannot be modified and is not marked either. It is created from a marking object. In order to edit a template, it must be reconverted into a marking object first. Only one template can be created in each job.

Examples of using a template would include aligning objects or placing additional information on the workspace that should not to be marked.

Creating Templates

- Add the object you want to use as a template to your job.
- Edit the object as required if applicable.
- Select the object.
- Select the *Objects >Convert to Template* option from the menu.
  The object converted into a template appears in the Job Manager (*Current Job* window) as a *Template* and disappears from the Object Manager.

Convert To Template

Converting a Template into a Marking Object

- Right click on *Template* in *Current Job* window and select *Convert to Object*.

7 USING AUTOMATION OBJECTS

Automation objects allow communication with external applications and control devices. They are used to automate processing and the internal weldMARK™ processes. weldMARK™ provides the following automation objects:

Wait for External Signal	This object checks whether a signal is present at a selected I/O port. The marking process is not continued until the signal is present.	➜ page 120, "Wait for External Signal" Automation Object
Set I/O port	This object sets one or more I/O ports to "Low" or "High".	➜ page 122, "Set I/O port" Automation Object
Insert Time Delay	This object inserts a time delay between the marking of two objects. The marking process of the second object starts when the specified time span has been elapsed.	➜ page 124, "Insert Time Delay" Automation Object
Show Messagebox	This object displays a message window on the screen during the marking process. The process is stopped until the user closes the message box.	➜ page 125, "Show Messagebox" Automation Object
XY Table	This object controls an optional XY Table that is connected.	➜ page 127, "XY Table" Automation Object
Rotary axis	This object controls an optional rotary indexer that is connected.	➜ page 129, "Rotary Indexer" Automation Object
Custom Axis	This object controls an optional custom axis that is connected.	➜ page 131, "Custom Axis" Automation Object
Serial Output	This object allows commands and scripts to be sent to the laser appliance via the serial interface of the pc.	➜ page 133, Automation Object "Serial Output"

Note:
Automation objects are only processed if the job was started with the *Starting execution* function. Automation objects are ignored with jobs that are startet with *Quickmark* or *Run from Hardware*.

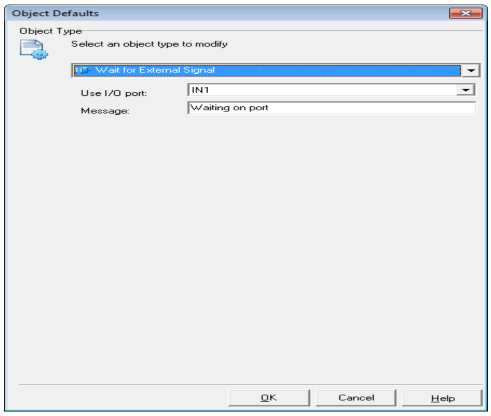
7.1 "Wait for External Signal" Automation Object

This object checks whether a signal is present at a selected I/O port. The marking process is not continued until the signal is present.

Defaults for "Wait for External Signal"

This section describes how the defaults for "Wait for External Signal" type automation objects can be called up and changed. The defaults apply to all new automation objects of this type.

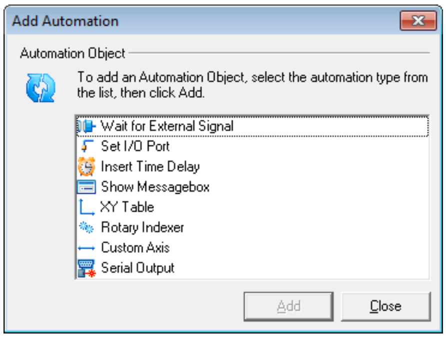
- Select *Objects >Defaults...* option from the menu.
- Select the object type *Wait for External Signal*. The dialogue on the right opens. Refer to the table below for explanations.



Use I/O port	Preset of the I/O port to be monitored.
Message	A text can be entered for a message displayed during the waiting time.

Adding a "Wait for External Signal" Object

- Select *Objects >Add >Automation...* option from the menu.
  The dialogue on the right opens.
- Select *Wait for External Signal* automation object type.
- Click on *Add* button.
  The automation object is added to the Object Manager.



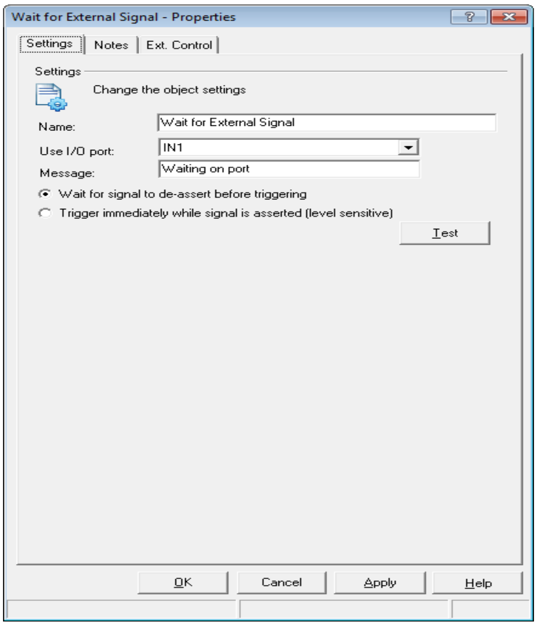
Properties

Properties, which are classified as follows, are assigned to the automation object:

Settings	Various settings can be made for the object.	➜ page 121, Settings
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be assigned to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control

Settings

- In Object Manager, right click on a *Wait for External Signal* type automation object.
- Select *Properties...*.
  The dialogue on the right opens. Refer to the table below for explanations.



Wait for External Signal

Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
I/O port	You can select the input port to be checked.
Message	A text can be entered for a message to be displayed during the waiting time. The text entered in *Defaults...* is used if you do not enter anything here.
(1)	The marking process is not started until the start signal is terminated.
(2)	The marking process is started as soon as the start signal is assented.
Test	Clicking on this button reads the I/O port and displays the result.

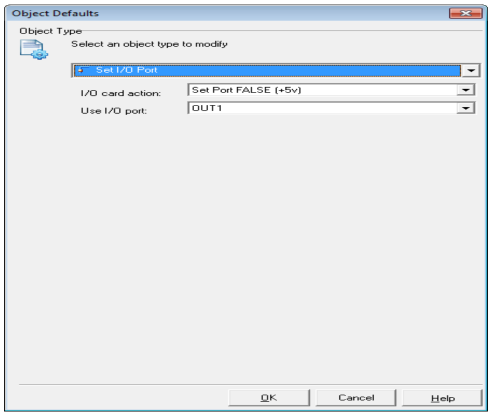
7.2 "Set I/O port" Automation Object

This object sets the status of one or more I/O ports to "Low" or "High".

Defaults for "Set I/O port"

This section describes how the defaults for "Set I/O port" type automation objects can be called up and changed. The defaults apply to all new automation objects of this type.

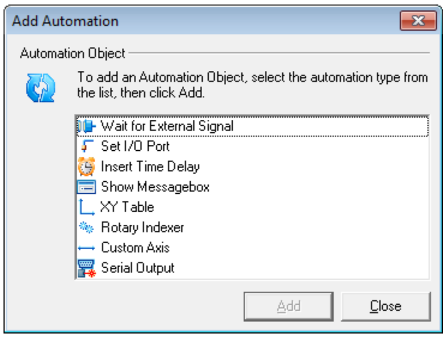
- Select *Objects >Defaults...* option from the menu.
- Select object type *Set I/O port*.
  The dialogue on the right opens. Refer to the table below for explanations.



I/O card action	The required behaviour of the port can be selected.
Use I/O port	You can select the input port to be set.

Adding a "Set I/O port" Object

- Select *Objects >Add >Automation...* option from the menu.
  The dialogue on the right opens.
- Select automation object type *Set I/O port*.
- Click on *Add* button.
  The automation object is added to the Object Manager.



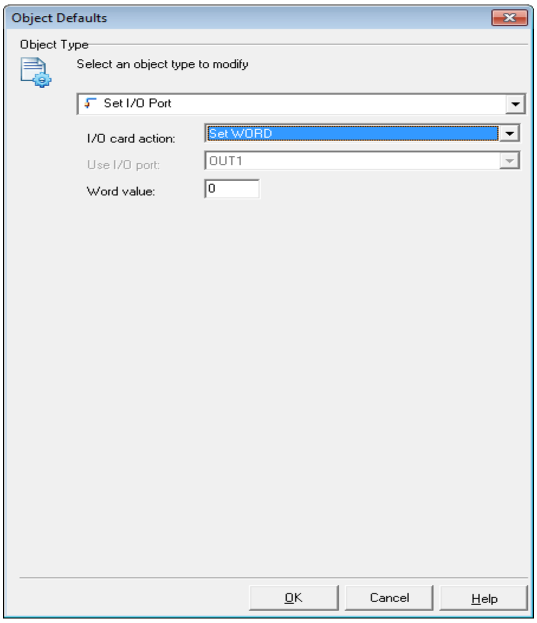
Properties

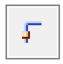
Properties, which are classified as follows, are assigned to the automation object:

Settings	Various settings can be made for the object.	➜ page 123, Settings
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be assigned to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control

Settings

- In Object Manager, right click on a *Set I/O port* type automation object.
- Select *Properties...*.
  The dialogue on the right opens. Refer to the table below for explanations.





Set I/O port

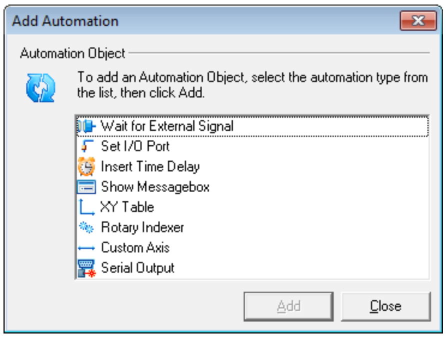
Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.	
I/O card action	The following actions can be selected:	
	Set Port TRUE	The selected port is set to TRUE.
	Set Port FALSE	The selected port is set to FALSE.
	Pulse Port	The selected port is alternately set to FALSE - TRUE - FALSE. The time span for the TRUE status can be adjusted. Note that the value for the time span is only an approximate value.
	SET WORD	The word consists of 6 bits, corresponding to the six output ports OUT1 to OUT6 of optional I/O-Card. Each bit sets one output port.
Use I/O port	The output port to be set either on optional I/O-Card or SP-ICE Pro card (➜ page 136, Marking Object Profile).	
Word value	This input box is only active if the *Set WORD* action has been selected. A value between 0 and 63 (decimal) can be set. It complies with a binary value of 6 bit.	
Test	Clicking on this button sets the I/O port in line with the settings made for testing purposes. The setted port and the current status are displayed.	

7.3 "Insert Time Delay" Automation Object

This object inserts a time delay between the marking of two objects. The marking process of the second object starts when the specified time span has been elapsed.

Adding an "Insert Time Delay" Object

- Select *Objects >Add >Automation...* option from the menu.
  The dialogue on the right opens.
- Select automation object type *Insert Time Delay*.
- Click on *Add* button.
  The automation object is added to the Object Manager.



Properties

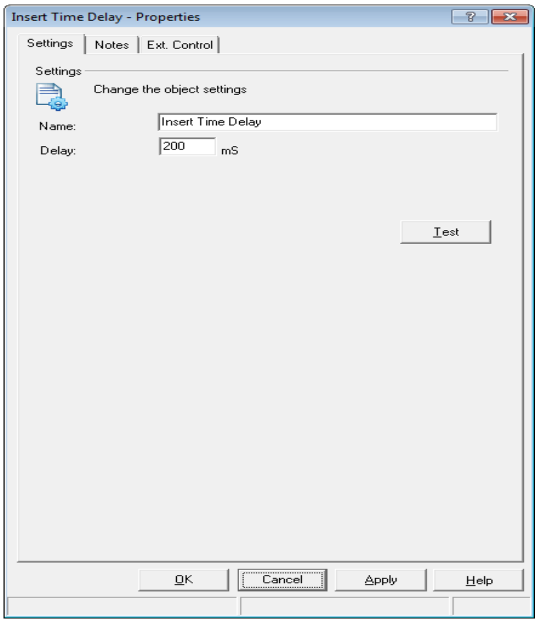
Properties, which are classified as follows, are assigned to the automation object:

Settings	Various settings can be made for the object.	➜ page 124, Settings
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be assigned to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control

Settings

Insert Time Delay

- In Object Manager, right click on an *Insert Time Delay* type automation object.
- Select *Properties...*.
  The dialogue on the right opens. Refer to the table below for explanations.



Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
Delay	Time delay in milliseconds.
Test	Clicking on this button displays a window specifying the current time delay setting.

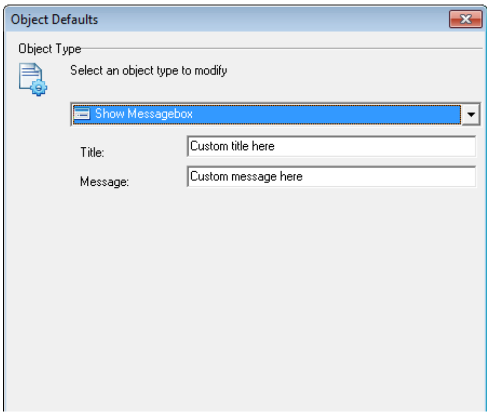
7.4 "Show Messagebox" Automation Object

This object displays a message window on the screen during the marking process. The process is stopped until the user closes the message box.

Defaults for "Show Messagebox"

This section describes how the defaults for "Show Messagebox" type automation objects can be called up and changed. The defaults apply to all new automation objects of this type.

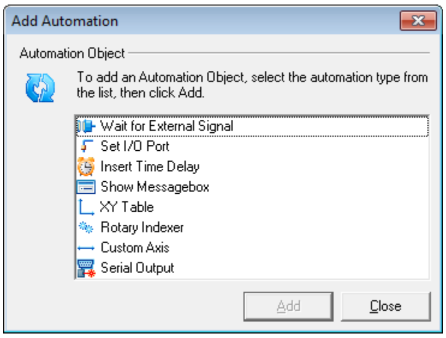
- Select *Objects >Defaults...* option from the menu.
- Select object type *Show Messagebox*.
  The dialogue on the right opens. Refer to the table below for explanations.



Title	The text that will appear in the title bar of the message window.
Message	The text that will appear as the message.

Adding a "Show Messagebox" Object

- Select *Objects >Add >Automation...* option from the menu.
  The dialogue on the right opens.
- Select automation object type *Show Messagebox*.
- Click on *Add* button.
  The automation object is added to the Object Manager.



Properties

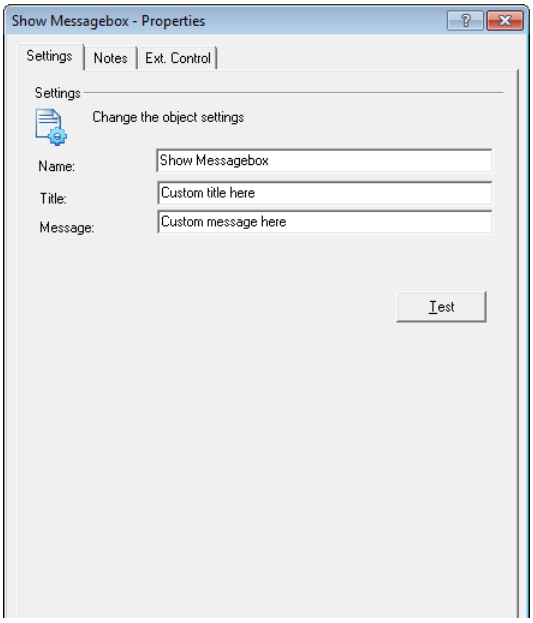
Properties, which are classified as follows, are assigned to the automation object:

Settings	Various settings can be made for the object.	➜ page 126, Settings
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be assigned to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control

Show Messagebox

Settings

- In Object Manager, right click on an *Show Messagebox* type automation object.
- Select *Properties...*.
  The dialogue on the right opens. Refer to the table below for explanations.



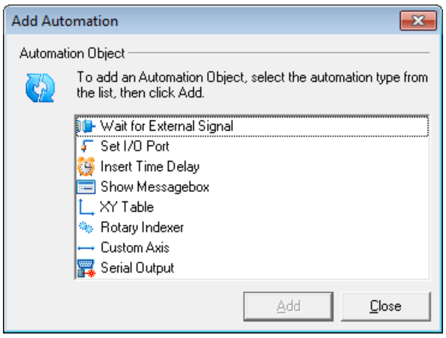
Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
Title	The text for the message box title bar can be adjusted.
Message	The text that will be displayed in the message box can be entered in this field.
Test	Clicking on this button displays the message box for test purposes.

7.5 "XY Table" Automation Object

This object controls an optional XY Table that is connected. A motor controller card is necessary to control the table (➜ page 228, Operating Stepper Motors).

Adding an "XY Table" Automation Object

- Select *Objects >Add >Automation...* option from the menu.
  The dialogue on the right opens.
  Select automation object type *XY Table*.
- Click on *Add* button.
  The automation object is added to the Object Manager.



Properties

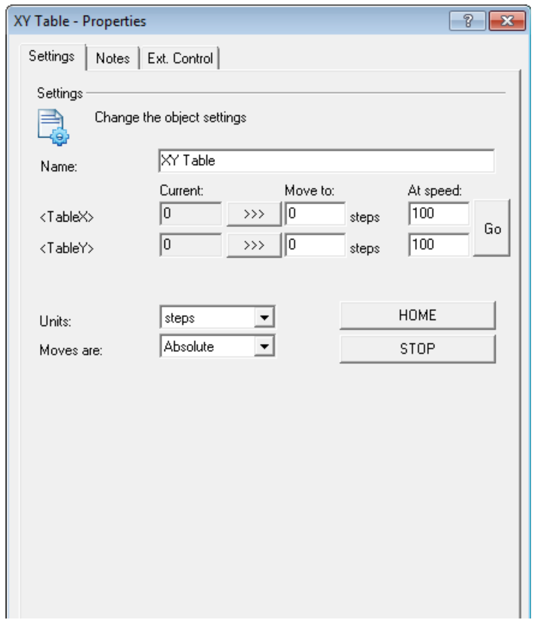
Properties, which are classified as follows, are assigned to the automation object:

Settings	Various settings can be made for the object.	➜ page 128, Settings
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be assigned to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control

Settings

XY Table

- In Object Manager, right click on an *XY Table* type automation object.
- Select *Settings*.
  The dialogue on the right opens. Refer to the table below for explanations.



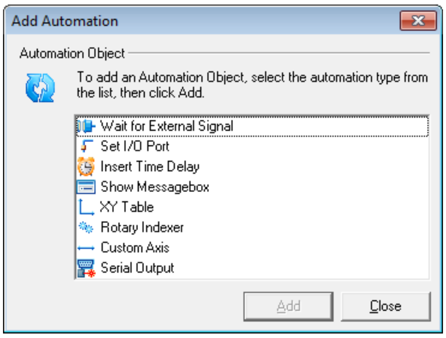
Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.	
Current	These fields show the current position of the motor axes.	
Move to	These fields can be used to enter an absolute target position, i.e. the position to which you want the table to move. These fields are only available if the *Absolute* setting has been selected in the *Moves are* list box.	
Move	These fields can be used to enter a relative target position, i.e. the distance you want the table to move. These fields are only available if the *Relative* setting has been selected in the *Moves are* list box.	
Display Speed	These fields can be used to enter the speed [steps per second] at which you want the table to move.	
Units	*mm*	The distances can be entered in millimeters, inches or motor steps.
	Inches	
	Steps	
Moves are	The mode for specifying the moves must be selected:	
	Physical	The table moves to the position specified in *Move to* field.
	Relative	The table moves by the values specified under *Move*.
Go	Clicking on this button performs the specified table movement.	
HOME	Clicking on this button moves the table to its home position.	
STOP	Stops the movement of the XY table.	

7.6 "Rotary Indexer" Automation Object

This object controls an optional rotary indexer that is connected. A motor controller card is necessary for this (➜ page 228, Operating Stepper Motors).

Adding a "Rotary Indexer" Automation Object

- Select *Objects >Add >Automation...* option from the menu.
  The dialogue on the right opens.
- Select automation object type *Rotary Indexer*.
- Click on *Add* button.
  The automation object is added to the Object Manager.



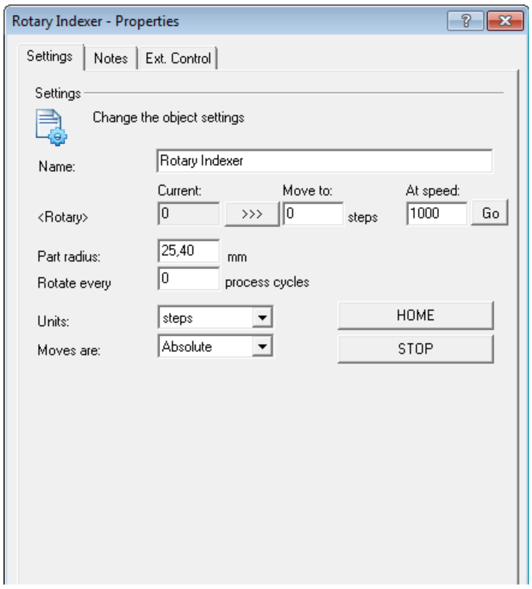
Properties

Properties, which are classified as follows, are assigned to the automation object:

Settings	Various settings can be made for the object.	➜ page 130, Settings
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be assigned to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control

Settings

- Right click on the object you want to change in the Object Manager.
- Select *Properties...*.
  The dialogue on the right opens. Refer to the table below for explanations.



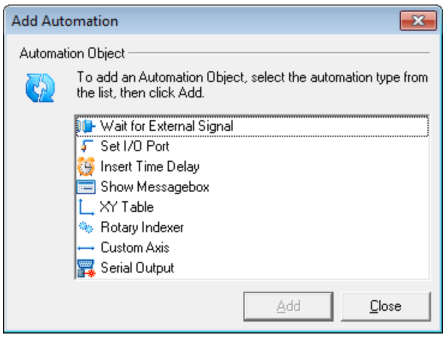
Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.	
String position	This field shows the current position of the rotary indexer.	
Move to	In this field, you can enter an absolute angle position, i.e. the position you want the rotary indexer to rotate to. This field is only available if the *Absolute* setting has been selected in the *Moves are* list box.	
Move	In this field, you can enter a relative target position, i.e. the angle you want the axis to rotate by. This field is only available if the *Relative* setting has been selected in the *Moves are* list box.	
Display Speed	This field can be used to enter the speed [steps per second] at which you want the axis to rotate.	
Radius	This field is used to enter the radius of the rotating component. The radius is required to calculate the target position or distance, if they are entered in inches or millimeters.	
Rotate every … process cycles	This field is used to enter the number of process cycles to be performed before the axis is rotated.	
Units	*mm*	The distances can be entered in millimeters, inches, degrees or motor steps. The length specifications [mm] and [inch] refer to the range.
	Inches	
	Degrees	
	Steps	
Moves are	The mode for specifying the moves must be selected:	
	Physical	The axis is rotated to the position specified under *Move to*.
	Relative	The axis is rotated by the value specified under *Move*.
Go	Clicking on this button performs the specified rotary movement.	
HOME	Clicking on this button rotates the rotary indexer to its home position.	
STOP	Stops the movement of the rotary indexer.	

7.7 "Custom Axis" Automation Object

This object controls an optional custom axis that is connected. The custom axis can be configured for linear or rotating applications either. A motor controller card is necessary for this (➜ page 228, Operating Stepper Motors).

Adding a "Custom Axis (Z axis)" Object

- Select *Objects >Add >Automation...* option from the menu.
  The dialogue on the right opens.
- Select automation object type *Custom Axis*.
- Click on *Add* button.
  The automation object is added to the Object Manager.



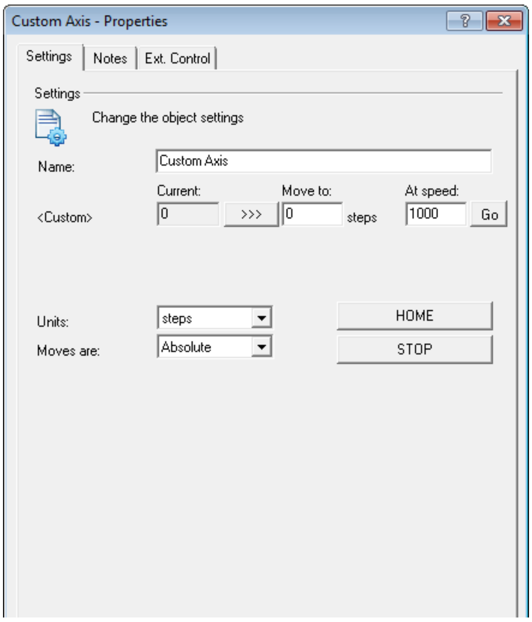
Properties

Properties, which are classified as follows, are assigned to the automation object:

Settings	Various settings can be made for the object.	➜ page 132, Settings
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be assigned to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control

Settings

- Right click on the object you want to change in the Object Manager.
- Select *Properties...*.
  The dialogue on the right opens. Refer to the table below for explanations.



Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.	
Current	This field shows the current position of the custom axis.	
Move to	In this field, you can enter an absolute target position, i.e. the position you want the custom axis to move to. This field is only available if the *Absolute* setting has been selected in the *Moves are* list box.	
Move	In this field, you can enter a relative target position, i.e. the distance you want the custom axis to move by. This field is only available if the *Relative* setting has been selected in the *Moves are* list box.	
Display Speed	These fields can be used to enter the speed [steps per second] at which you want the custom axis to move.	
Units	*mm*	The distances can be entered in millimeters, inches or motor steps.
	Inches	
	Steps	
Moves are	The mode for specifying the moves must be selected:	
	Physical	The axis is moved to the position specified under *Move to*.
	Relative	The axis is moved by the value specified under *Move*.
Go	Clicking on this button performs the specified movement of the custom axis.	
HOME	Clicking on this button rotates the custom axis to its home position.	
STOP	Stops the movement of the custom axis.	

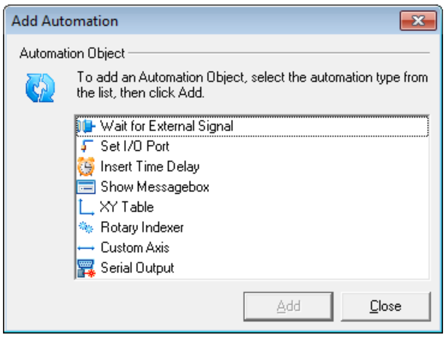
7.8 Automation Object "Serial Output"

This object allows commands and scripts to be sent to the laser appliance via the serial interface of the pc. If the installed component has to be initialized, the automation object must be put before all marking objects. If commands have to be executed before marking of a certain object, the *Serial Output* object must be put before that object.

The automation object sends the commands to the installed component as a text string. With each command a request to verify can be sent and a time-out value can be set. The confirmation has to be acknowledged with the text string "ACK". If this text string is not received within a certain time, the current job will be cancelled.

Adding a "Serial Output" object

- Select *Objects >Add >Automation...* option from the menu.
  The dialogue on the right opens.
- Select automation object type *Serial Output*.
- Click on *Add* button.
  The automation object is added to the Object Manager.



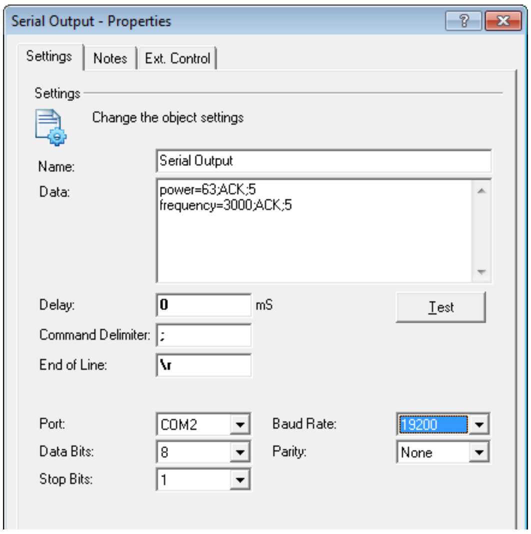
Properties

Properties, which are classified as follows, are assigned to the automation object:

Settings	Various settings can be made for the object.	➜ page 132, Settings
Notes	A note can be assigned to the object.	➜ page 27, Notes
Ext. Control	A marking condition can be assigned to the object. If the external control is activated, external signals determine whether the object is marked or skipped.	➜ page 28, External Control

Settings

- Right click on the object you want to change in the Object Manager.
- Select *Properties...*.
  The dialogue on the right opens. Refer to the table below for explanations.



Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
Data	A command can be entered in this field.
Delay	A Time-Out value can be entered here, if the command line hasn't been received and no confirmation of the component has been sent meanwhile.
Command Delimiter	The text string that defines the end of a command can be entered here.
End of Line	The text string that defines the end of a command line can be entered here.
I/O port	In this field the COM-Port and its' command parameters can be defined.
Data Bits	
Stop Bits	
Baud Rate	
Parity	

8 USING PROFILES

This chapter provides an overview of how to manage the profiles in weldMARK™.

Every marking object is assigned a profile, which specifies the parameters for the laser marking. When you create a new object, the default profile is applied automatically. This profile can be adapted to your individual requirements, however, changes only affect the objects that are created subsequently.

If different laser settings are required (e.g. for marking different materials), any number of profiles can be created with different parameters. This is done using the Profile Manager.

The Profile Manager lists all available profiles. The profiles can be organized and applied to marking objects. In addition, the parameters of a selected profile can be applied to the default profile.

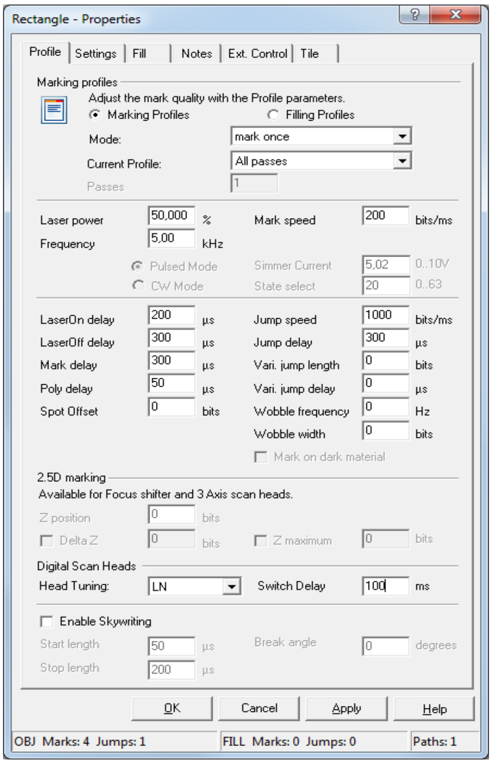
A profile can also be transferred from one marking object to another.

Profiles contained in the profile manager are available for all jobs.

8.1 Marking Object Profile

The profile applied to the marking object determines the settings for laser processing, such as the power, frequency etc. These parameters are summarized on the *Profile* tab and can be changed as follows:

- Right click on the marking object whose profile you want to change and then select *Properties...*.
- Select the *Profile* tab.
  The dialogue on the right opens. Refer to the table below for explanations.



Marking profile		
Mode	*Mark once*	The outlines of the object are marked once according to the parameters of Pen 1. These parameters are shown in the lower part of the screen and are modifiable.
	Mark multiple times	The object is marked the number of times entered in the *Passes* field according to the parameters of Pen 1.
	2 pass Cut & Clean	The object is marked two, three or four times, and different laser parameters can be set for each pass (according to Pen 1 up to 4). The settings can be called up using the passes that are available for selection in the *Current Profile* list box.
	3 pass Cut & Clean	
	4 pass Cut & Clean	
Current Profile	If variable passes are selected in the *Mode* list box, this field can be used to call up the parameters for each individual pass (Pen 1 up to 4).	
Passes	The *Passes* field is only available if *Mark multiple times* mode has been selected. In this field, you can enter the required number of passes for the marking object. The object is marked according to the parameters of Pen 1 the number of times during execution of the job even if it is only listed once in the object list.	
Use pens	This field is only available if an imported object with layers is selected. In this case marking parameters can be defined for each pen after activating this function. For visualization, the elements are displayed with the defined pen colour. Elements on layers which are not selected for marking (tab *CAD*) are not shown. A maximum of eight pens can be used.	

Marking profile	
Laser power % power	This field can be used to specify the laser power. The laser power can be entered in percent or watts depending on the settings in the laser configuration file.
Frequency	This field can be used to set the frequency of the laser modulation signal. In association with YAG lasers, this is also referred to as the Q-Switch frequency. The setting area is also defined in the laser config file
Marking Speed	This field can be used to specify the speed at which the laser beam moves over the object during processing. If a speed is entered in mm/s or inch/s the actual speed can vary depending on the calibration factor bit/mm in the selected laser config file.
Pulse width	This field can be used to set the pulse width of the laser modulation signal. The maximum possible pulse width is determined by the frequency entered. This parameter is not available when using CO2 lasers.
Simmer current	Only available if SPI-laser config file selected.
State select (Wave form)	
Pulsed vs. CW	
LaserOn delay	The adjacent parameters are described in detail in the application manual and/or in the "Commands and Functions" manual. The laser delays are entered with positive values only. Negative values have to be defined in the laser config file if required.
LaserOff delay	
Mark delay	
Poly delay	
Spot offset	Defines the offset in which the laser is positioned to the outline.
Jump speed	The adjacent parameters are described in detail in the application manual and/or in the "Commands and Functions" manual.
Jump delay	
Var. jump length	
Var. jump delay	
Wobble frequency	Defines the wobble excursion per second.
Wobble width	Defines the wobble excursion width
Zero power after mark	If this function is activated, the laser power is set to zero after marking via *Job >Run*. This function is not available for all laser types.
Mark on dark material	**Only for bitmap objects** If this function is activated, the bitmap object will be marked inverted. This allows you to mark a pseudo-positive image on dark materials. In the weldMARK™ window the bitmap object is not displayed inverted.
Z position	Via Z position the focal plane of the Scan Head can be adapted to the object to be marked. This field only is displayed if a 3-Axis subsystem with FOCUSSHIFTER/AXIALSCAN with 3D Head config file is set as Scan Head. The value for the z position can be positive or negative. It is limited to the maximum values of the used 3-Axis subsystem.
Delta-Z/Z-Maximum	Delta-Z defines the change in the Z-Postion per pass. If Z-Maximum is entered, the software devides the Z-Range in the number of passes.

Marking profile		
Digital Head Tuning	The available tunings for digital heads are LN (Low noise), RA (Rapid) and ST (Step). Switching between head tunings requires a delay. Beside a global delay defined in the Scan Head configuration file, this delay can be adjusted for each markable object. Switch Delay is a positive value in the range of 0 to 1500 ms.	
	Switching the tuning	During marking, if the requested tuning for a certain object is different from the last used tuning, then a command for switching the tuning and a delay will be inserted in the list of commands, before sending marking parameters and vectors. This applies to all marking modes *Run*, *Quick Mark* and *Run from Hardware*. In case of Vector Graphic objects, or objects which have the possibility to use the *Use Pens* flag it is possible to switch the tuning even within the same object. In this case, each Pen can have different Tuning settings and it will be switched when the Set_Pen command is encountered in the object.
Enable Skywriting	➜ page 139, Skywriting	

The following filling parameters are only required, if the filling is marked with differing parameters to the outline.

Filling Profiles		
Mode	*Mark once*	The filling of the object is marked once according to the current profile. You cannot select other modes for filling.
Current Profile	With this field the parameters for up to 8 pens can be accessed. For the filling of the object, the selected pen is used.	
Passes	The number of passes cannot be changed for the filling. The count of passes is defined in the marking profile.	
Use pens	This field is not available here.	

Hints for optimizing delay times

The delay times must be adapted to the application and the jump and marking speeds entered. Unoptimized delay times will lead to poor processing results and can increase the processing time. The length of the laser on and off delays has no influence on the processing time. Please refer to the Application-Manual for further information.

Set the delay times as described below:

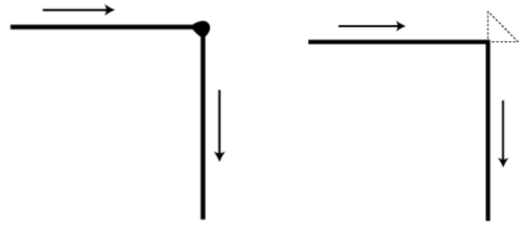
- Optimize the laser on and off delay.
  We recommend setting a high value for the jump and mark delays.
- Optimize the delay times for controlling the galvanometer scanners, e. g. the jump, mark and poly delay.
- All profile settings are effected by the option copy/paste profile. See ➜ page 143, Applying Profiles.

8.2 Skywriting

At the reversal point of a polyline, the higher retention time of the laser causes a strengthened marking effect. By using the "Skywriting" function, the laser radiation switches off at the reversal point. Afterwards, the scanner mirrors change direction. The laser radiation switches on again, when the laser arrives at the reversal point. In this way, a constant marking speed can be achieved.

Except of bitmap objects, this function is available for all object types.

Example:



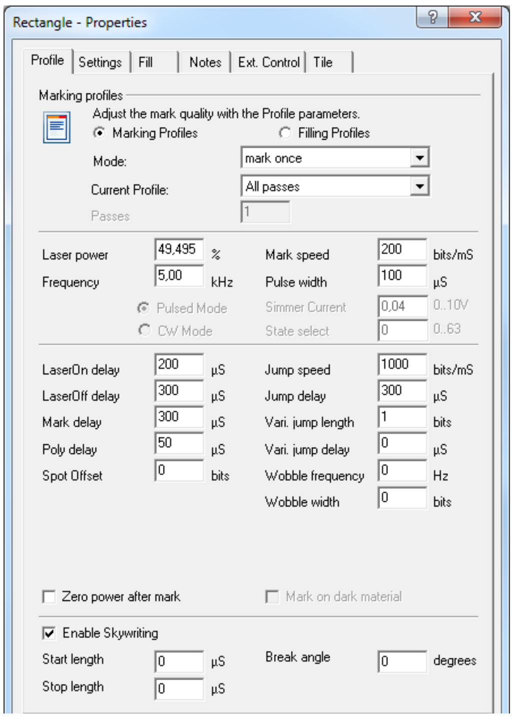
Skywriting disabled Skywriting enabled

8.2.1 Skywriting Parameter

The adjustment of the Skywriting parameters is located in the Profile settings. They can be edited either individually in the object properties for each object or for each profile based on the Profile Manager.

In the following, the object-specific way is shown:

- Right click on the desired marking object and select *Properties...*.
- Select the *Profile* tab.
- Check *Enable Skywriting*.
  The red bordered area is displayed. Refer to the table below for explanations.

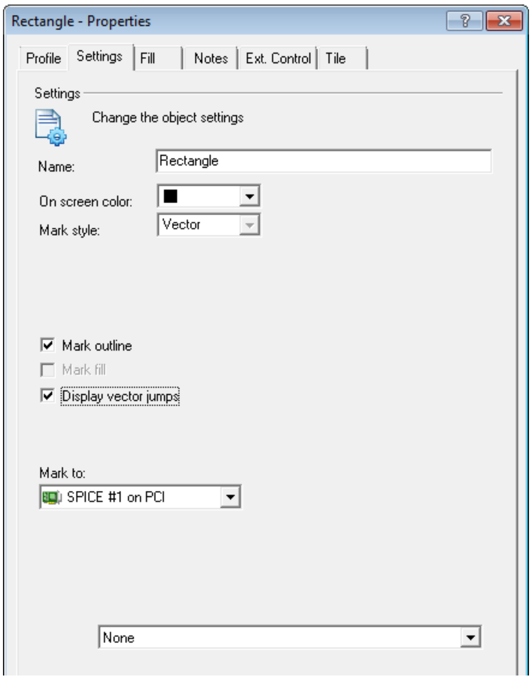


Enable Skywriting	If this function is disabled, all values are set to zero.	
	Start Length	The fore-run time of the switched off laser before arriving the reversal point.
	Stop Length	The backlash time of the switched off laser after arriving the reversal point.
	Break Angle	If a value is entered into this field, *Skywriting* function is triggered only if the angle between two vectors is less than or equal to this value.

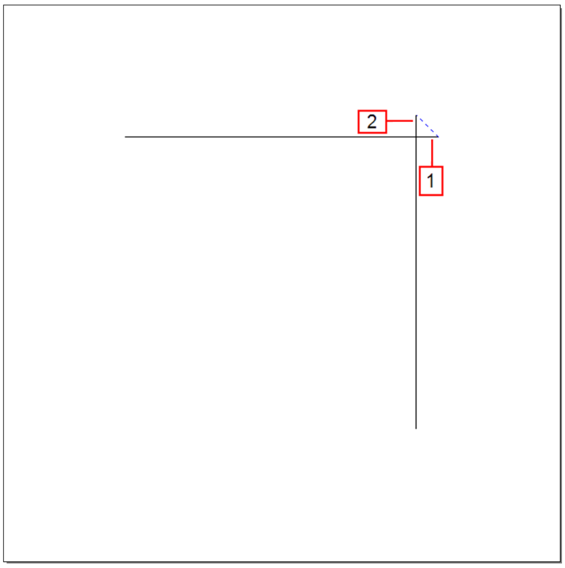
8.2.2 Preview

The vector jumps, which are added for the Skywriting, can be made visible as described in the following:

- Right click on the marking object.
- Select *Properties...*.
- Select *Settings* tab.
- Check *Display vector jumps*.
  The dialogue on the right opens. Refer to the table below for explanations.



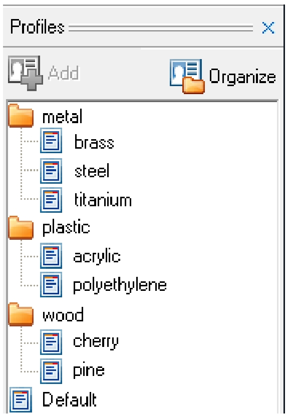
As an example, a preview of a rectangle with displayed vector jumps is shown. To improve the visibility, high values for the start and the stop length were entered.



(1)	Stop Length
(2)	Start Length

8.3 Showing and hiding the Profile Manager

- Select *View >Profile Manager* option from the menu.
  The adjacent window is shown or hidden.



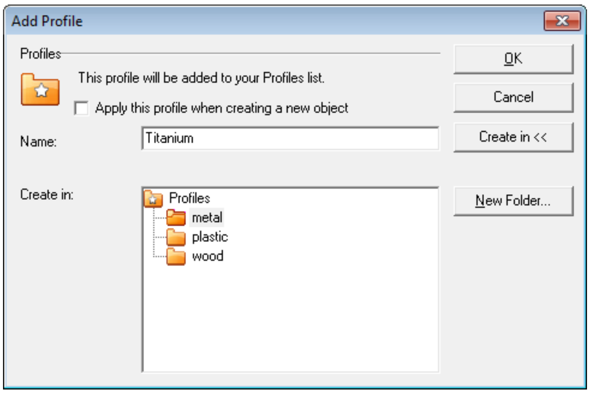
Show/Hide Profile Manager

8.4 Creating and managing Profiles

In the Profile Manager, you can view, delete and modify existing object profiles and apply them to objects. You can also add new object profiles and organize all object profiles hierarchically.

8.4.1 Creating Profiles

- Right click on the object whose profile you want to add to the Profile Manager.
- Select *Add to Profile Manager*.
  The dialogue on the right opens. Refer to the table below for explanations.

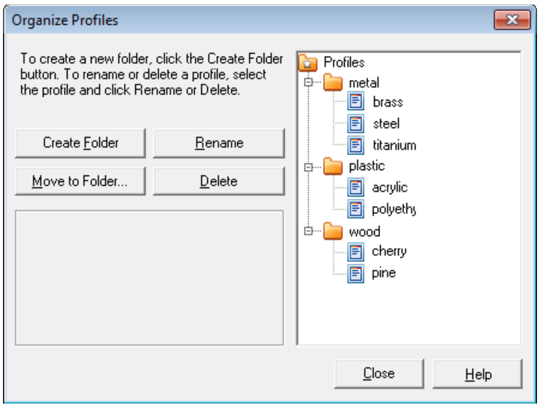


Parameters are added to the profile manager	If this function is enabled, the profile parameters for the selected object are applied to the default profile in the Profile Manager. The default profile is automatically applied to all new marking objects.
Name	The name of the profile is entered in this field.
Create in <<	This window shows the Profile Managers folder structure. The new profile is saved in the selected folder. If no folder is selected, the profile is saved on the highest level in the Profile Managers structure.
OK	Clicking on this button saves the profile in the Profile Manager.

8.4.2 Organizing Profiles

You can structure individual profiles in folders or rename, move and delete them.

- Select *Profiles >Organize Profiles...* option from the menu.
  The dialogue on the right opens. Refer to the table below for explanations.
- Click on *OK* to add the changed structure to the Profile Manager.



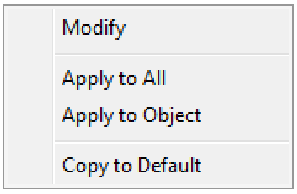
Create Folder	Clicking on this button prompts the user to enter a folder name. Thereupon a new profile folder is created with the name entered.
Rename	Clicking on this button allows you to rename a selected folder or a profile.
Move	Clicking on this button allows moving a selected profile to a different folder.
Delete selection	Clicking on this button deletes either a selected folder and the profiles it contains or a selected individual folder.

8.5 Applying Profiles

The profiles saved in the Profile Manager can be applied to selected marking objects. Furthermore the profile of a marking object can be applied to other marking objects.

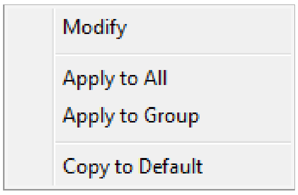
8.5.1 Applying a Profile from the Profile Manager to an Object

- Select the object to which you want to apply a profile.
- Right click on the profile you want to apply in the Profile Manager.
- Select *Apply to Object*.



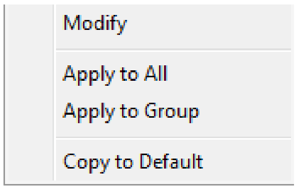
8.5.2 Applying a Profile from the Profile Manager to multiple Objects

- Select the objects to which you want to apply a profile.
- Right click on the profile you want to apply in the Profile Manager.
- Select *Apply to Group*.



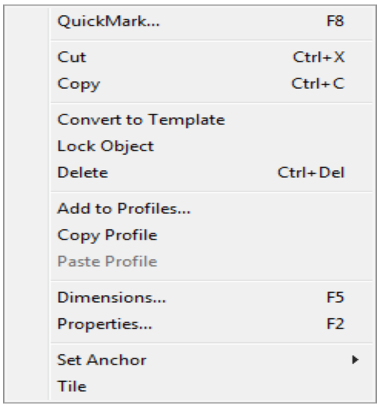
8.5.3 Applying a Profile from the Profile Manager to all Objects

- Right click on the profile you want to apply in the Profile Manager.
- Select *Apply to All*.



8.5.4 Copying a Profile from Object to Object

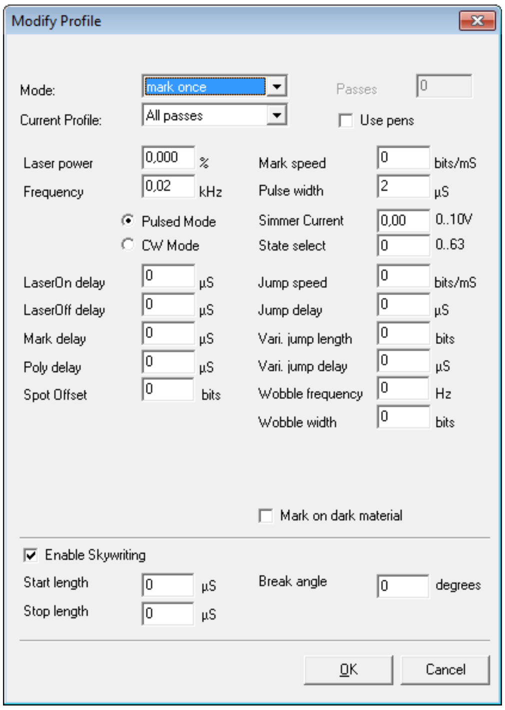
- Right click on the object whose profile you want to copy.
- Select *Copy Profile*.
- Select the objects to which you want to copy the object.
- Right click on the selected objects.
- Select *Paste Profile*.



8.5.5 Saving Object Profile to the Profile Manager

- Right click on the object whose profile you want to save.
- Select *Add to Profile Manager*.
- Continue as described at (➜ page 141, Creating Profiles).

8.6 Modifying a saved Profile



- In the Profile Manager, right click on the profile whose parameters you want to modify.
- Select *Modify*.
  The dialogue on the right opens. Explanations can be found in the section below:
  ➜ page 136, Marking Object Profile

Note:
Any other object specific parameters can be defined in the relative object defaults.

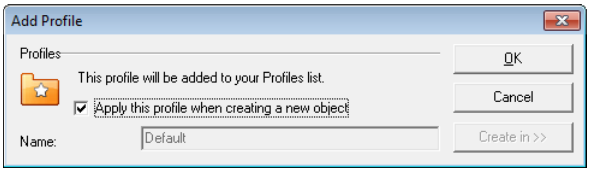
8.7 The Default Profile

The default profile is listed under the name *Default* in the Profile Manager. It cannot be deleted or moved to another folder. When you create a new marking object, the default profile is applied automatically. Markings performed to calibrate the marking field are performed using the settings in the test pattern profile.

The default profile can be adapted to your individual requirements; however, changes only affect the objects that are created subsequently.

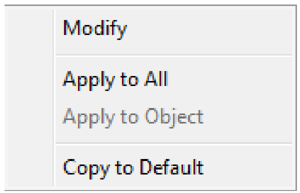
8.7.1 Assigning the Parameters of a Marking Object to the Default Profile

- Right click on the marking object whose profile parameters you want to apply to the default profile.
- Select *Add to Profile Manager*.
  The dialogue on the right opens.
- Activate the checkmark *Apply this profile when creating a new object*.
- Confirm the operation with *OK*.



8.7.2 Applying the Parameters of a different Profile to the Default Profile

- In the Profile Manager, right click on the profile whose parameters you want to apply to the default profile.
- Select *Copy to Default*.



8.7.3 Modifying the Default Profile

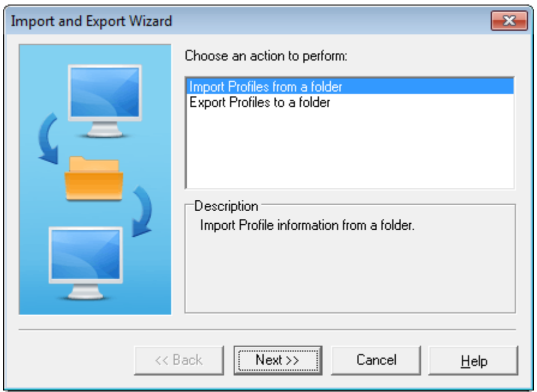
The default profile can be modified in the same way as any other profile (➜ page 144, Modifying a saved Profile).

8.8 Importing and exporting profiles

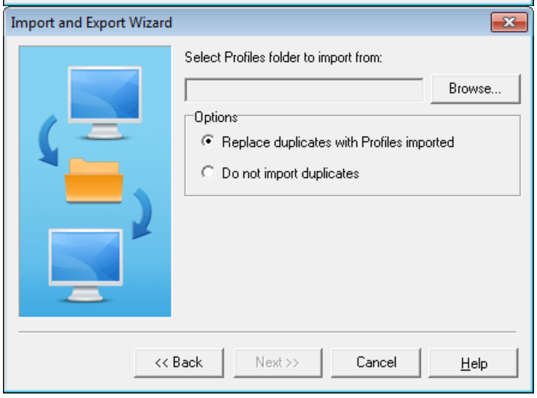
8.8.1 Importing profiles

Only profile folders can be imported, not individual profiles. The profile folder to be imported must be located in a folder with the name "Profiles".

- Select the *File >Import and Export Profiles...* option from the menu.
  The dialogue on the right opens.
- Select *Import Profiles from a folder* and click on *Next*.
  The following window is opened.



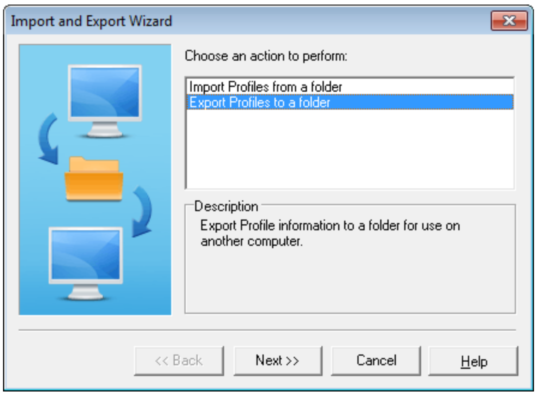
- Click on *Browse...* and then select the folder named "Profiles", which contains the profiles to be imported.
- Select option *Replace duplicates with Profiles imported* if you want to replace profiles with the same name or *Do not import duplicates* if you do not want.
- Click on *Next* to import the profiles.



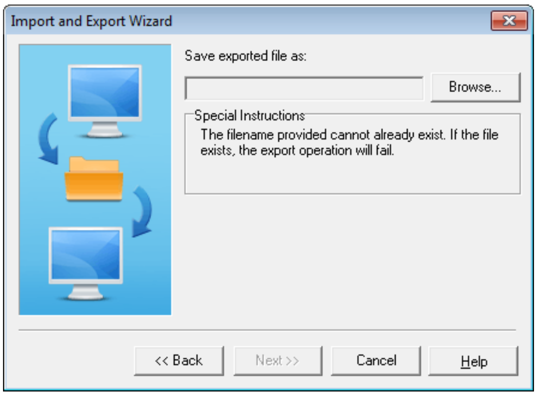
8.8.2 Exporting profiles

Only profile folders can be exported, not individual profiles. The profile folder to be exported is saved in a folder with the name "Profiles" (weldMARK™ creates this folder if there is no folder with this name at the specified location).

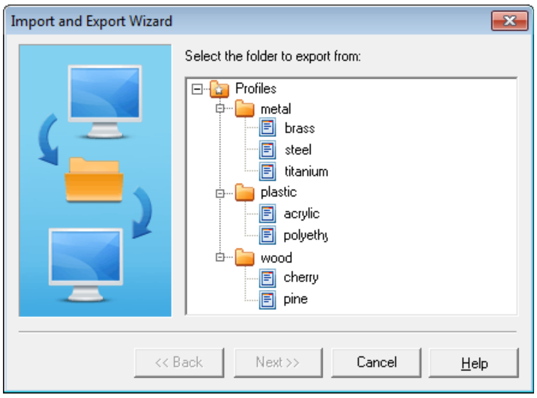
- Select the *File >Import and Export Profiles...* option from the menu.
  The dialogue on the right opens.
- Select *Export profiles to a folder* and click on *Next*.
  The following window is opened.



- Click on *Browse* button.
- Select the location in which you want to save the "Profiles" folder
  or
  select the location of an existing "Profiles" folder in which you want to save the profile folder to be exported.
- Click on the *Next* button.
  The following window is opened.

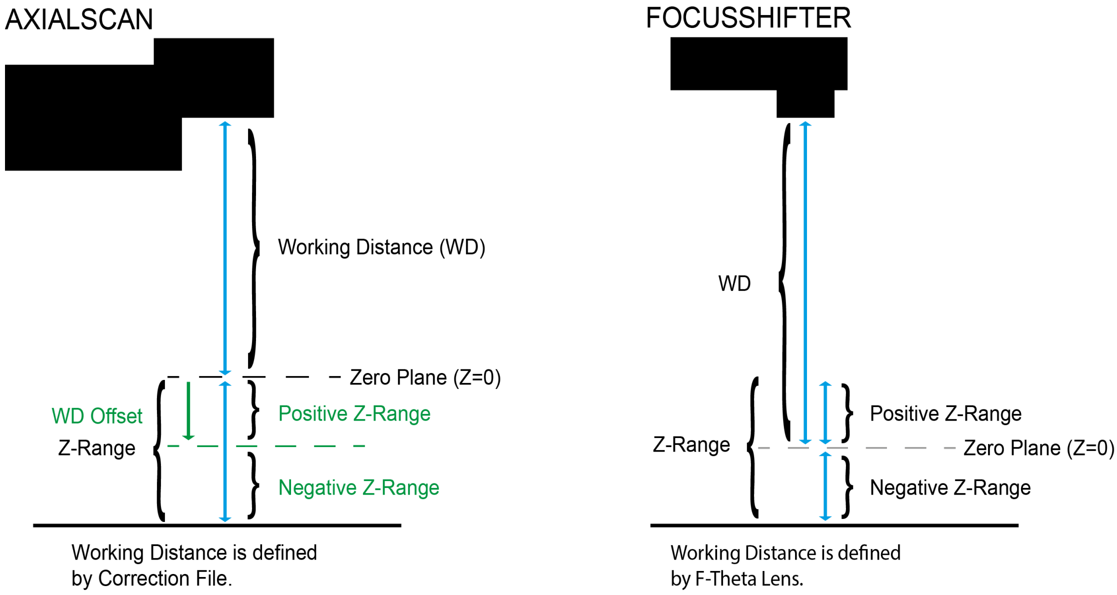


- Select the profile folder to be exported.
- Click on *Next* to export the profiles.



9 MARKING APPLICATIONS WITH DIFFERENT FOCUS POSITIONS

9.1 Z-Range of 3-Axis System



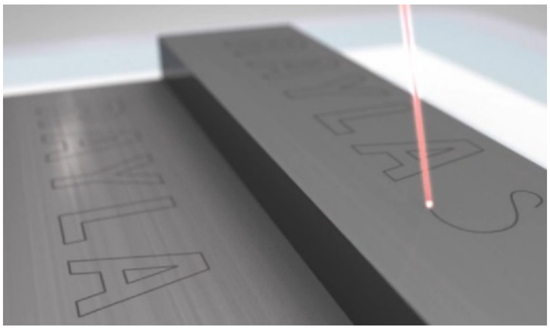
9.2 2.5D Marking

2.5D marking describes different options for marking on a flat surface, with focus position varying either from object to object or, in case of marking in multiple passes, the focus position changes from pass to pass.

Latter option can be used for a kind of deep engraving. In this case the outline path does not vary in depth and the outline should be filled.

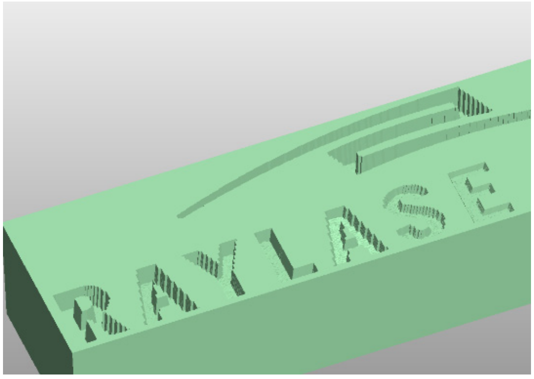
2.5D marking requires either a FOCUSSHIFTER or AXIALSCAN RAYLASES Scan Head. Theses Scan Heads allow focus position to be changed during marking.

2.5D Marking



- To define the Z position of a individual Layout see ➜ page 136, Marking Object Profile

2.5D Engraving



- When 2.5D marking is used to cut or engrave into material, the Object settings *Mark multiple times* with number of *Passes* and either a *Delta Z* per each pass or the total engraving depth *Z maximum* should be defined.
  See ➜ page 136, Marking Object Profile.

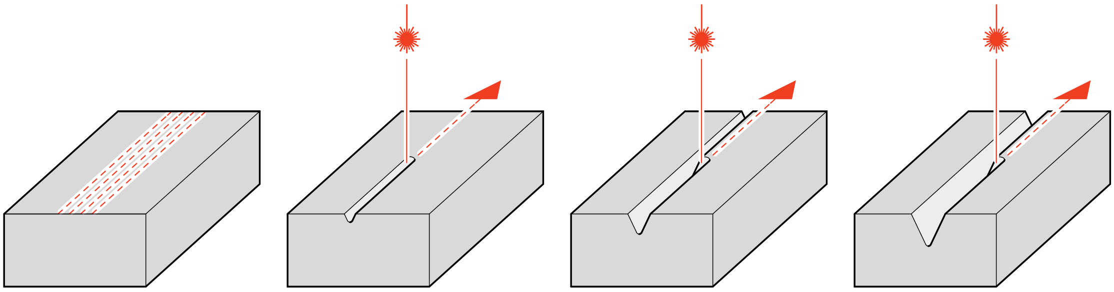
Note:
If an AXIALSCAN Scan Head is used, the Job Flag *Mark 3D / 2.5D* must be set (➜ page 166, Job Settings - "Page Setup").
The Zero Plane (Z=0), can be adjusted and moved further down, allowing positive Z positions, by changing the *Working Distance offset (2.5D only)* (➜ page 148, Z-Range of 3-Axis System)

9.3 Deep processing applications

9.3.1 Deep Cutting

The deep cutting function is currently for objects, imported as a Vector Graphic only. It is recommended to activate the option *Optimize for filling* in most cases. This way vectors will be reassessed and optimized for the filling process and deep cutting. Imported objects can be reworked in the Vector Graphic Designer if necessary (➜ page 32, Vector Graphic Designer (VGD)).

The Deep cutting is designed for RAYLASE FOCUSSHIFTER and AXIALSCAN only. In case of AXIALSCAN the *Mark 3D / 2.5D* setting must be set. If no focus change is needed, every type of RAYLASE Scan Head can be used.

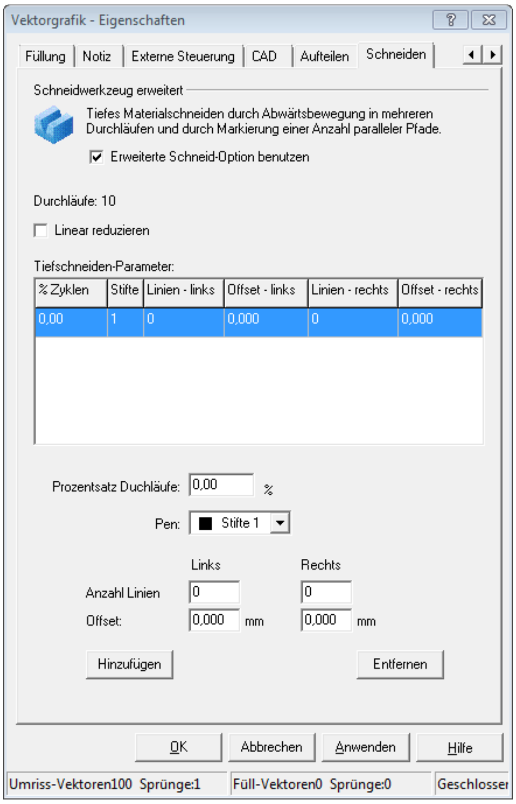


Deep cutting is realized with definable amount of parallel cuts. The cut lines can be defined to either cut within or outside the object.

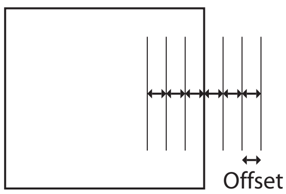
9.3.2 Cutting Parameters

The cutting parameters can be defined as follows:

- Right click on the vector object whose profile you want to change and then select *Properties*.
- Select the *Cutting* tab.
  The dialogue on the right opens. Refer to the table below for explanations.



Use advance cutting option	Activates the advanced cutting options.
Passes	Displays how often the object has to be cut repeatedly. Definition is done in the profile tab (➜ page 136, Marking Object Profile).
Reduce linearly	This option linearly reduces the offset between lines after each cycle automatically. Only the first row of the *parameters for deep cutting* is considered. All other parameter rows are ignored.
parameters for deep cutting	Deep cutting can be done with an amount of passes which are executed one after another. Different parameters can be set, depending on the progress (percentage portion of one pass compared to the total amount of passes. The table *parameters for deep cutting* shows all parameters.
% of Passes	Defines from which percentage portion of the total amount of passes the corresponding row should be used.
Pen	The pen that is used for the marking can be chosen in this field.
Number of Lines	Defines the amount of parallel lines, which are offset to the outline. If Offset=0 no parallel lines will be marked.
Offset - Left	Defines the offset of the parallel lines to the outline. For closed objects *Offset - Left* stands for lines inside and *Offset - Right* for lines outside the the object. For open objects the lines are marked on the marking direction either left or right.
Offset - Right	
Add	A new parameter row is added in the *parameters for deep cutting* table.
Remove	Deletes the currently selected parameter row.

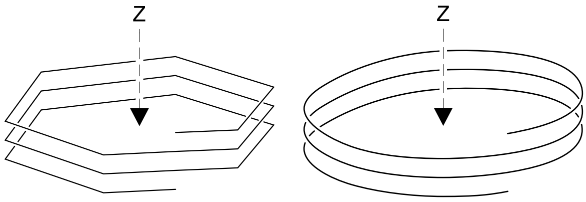


9.4 Trepanning

Different methods of drilling can be applied depending on the application.

Methods for fine drilling are specified here: ➜ page 84, Drill objects.

The Trepanning function allows for drillings that are much wider than the diameter of the laser itself. Polygon objects with any number of sides can be used as a base. The following example shows a polygon with six sides and a polygon with a multitude of sides.

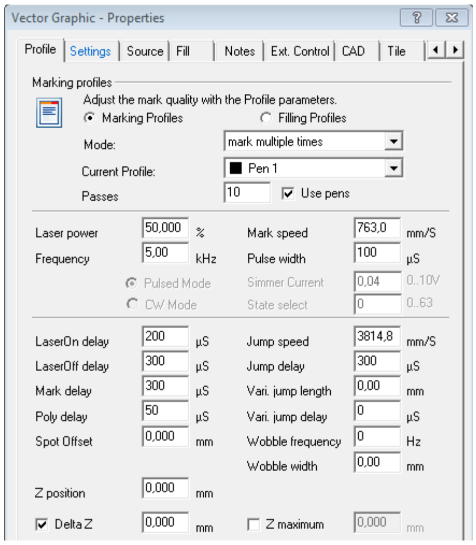


For Trepanning the polygon object is marked spirally. This is accomplished with a constant shift of the Z axis after every marked side of the polygon.

9.4.1 Trepanning Parameters

The Trepanning parameters can be set as follows:

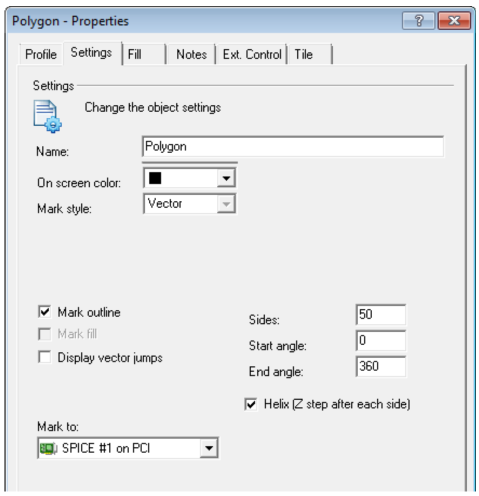
- Option only available Head config file for type FOCUSSHIFTER is loaded.
- ○ Right click on the vector object whose profile you want to change and then select *Properties*.
- ○ Select *Settings* tab.
  The dialogue on the right opens.



To use a polygon object for Trepanning, the option *Helix (Z-step after each side)* has to be selected.

Further setting options for the polygon object are found in the "Polygon Object" section (➜ page 51, Settings for a Polygon Object).

- ○ Select the *Profile* tab.
  The dialogue on the right opens. Further Information for Trepanning are found in the following table. All remaining parameters are explained in the section "Profile" ➜ page 135, Using Profiles.



9.5 Deep Engraving (Slicing)

To use the Deep Engraving function, a STL file is required to define the surface. This 3D surface will be engraved in layers. The steps of the Z axis can be predefined as layer size or as layer amount, for automatic calculation. The layer size depends on the texture of the marking material and the cutting ability of the laser system.

9.5.1 Import STL file

STL-files can be imported just like Vector Graphics (➜ page 29, Importing Vector Graphic Files). Currently only binary data formats are supported. ASCII files will be supported in the future. IGES- and STEP-Files will not be supported. All non-supporting options are displayed gray in the dialogue. If there is no unit specified in the file, it can be specified during the import.

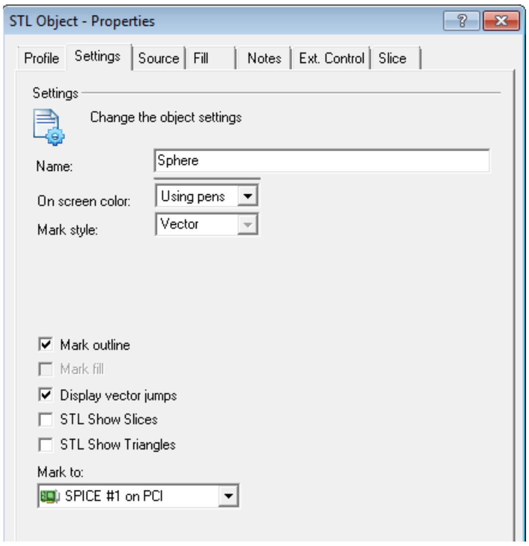
9.5.2 Positioning of a STL object

The positioning and scaling of the STL object can be done with the "Dimensions" tool (➜ page 102, The "Dimensions" Toolbox).

9.5.3 STL-Object settings

For each STL object special settings can be applied, which can be opened and changed at will as described below:

- Right click on the STL object.
- Select *Properties...*.
  Select *Settings* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

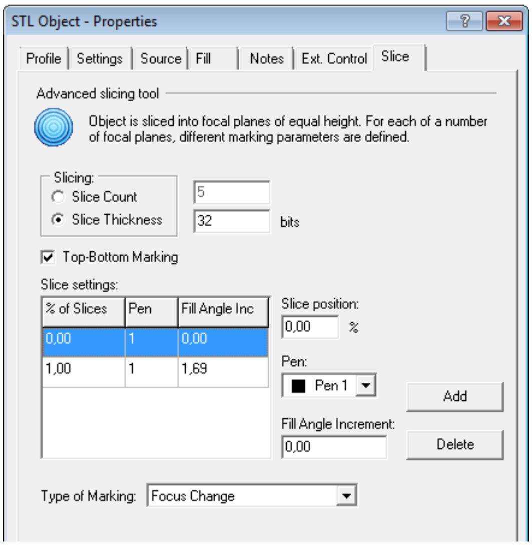


Name	The object name entered in this text box is used to list the object in the Object Manager. The name also appears in all information and dialogue boxes related to the object.
Mark Style	Defines the marking Style.
Mark outline	If this function is enabled, the object contour is marked. This function is enabled by default.
Display vector jumps	If this function is enabled, the vector jumps between the individual part of the object are displayed on screen. This function is disabled by default.
Show STL Layers *Show STL Triangulation*	If no option is activated, the STL object will be used as XY projection of the 3D object. The option *Show STL Layers* shows the edges of all defined layers. If the option *Show STL Triangulation* is activated, the STL object is displayed with the resulting triangles.

9.5.4 Adjust Layer parameters of a STL object

Before a STL object can be engraved, the following parameters have to be defined:

- Right click on the STL object.
- Select *Properties...*.
  Select *Slice* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

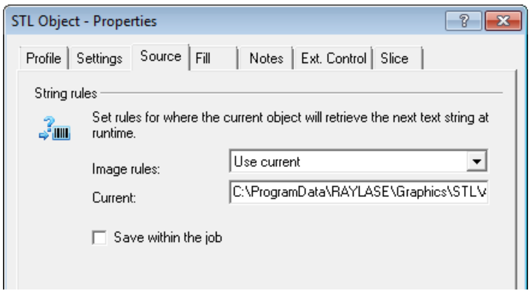


Slice Count	The amount of layers for engraving the STL object can be set in this field. The resulting *Slice Thickness* is calculated and set automatically.
Slice Thickness	The size of layers for engraving the STL object can be set in this field. The resulting *Slice Thickness* is calculated and set automatically. The minimal possible slice thickness equals one bit. Conversion of [bit] to [mm] depends on the calibration factor of the Correction File.
Top-Bottom Marking	Layers will be marked from top to bottom if this function is activated.
Slice Settings	Layers can be defined with different settings. They are commonly combined in groups, due to great amounts of single layers. The distribution in layer groups is made percent-aged. This way the last 50% of the layers can be engraved with different parameters to the previous layers.
Slice Position	Defines when a parameter row will be used. Definition is resulting from the chosen percentage value and selected layers.
Pen	Defines which pen is used for which parameter. If no pen is defined in the STL file, pen1 will be used as default.
Filling Angle increment	In each marking pass, when moving to the next slice, the fill angle is incremented by the value specified in this field.
Type of Marking	*Change Focus* ■ The Z position is achieved through a change of the focus position with a FOCUSSHIFTER Scan Heads. ■ AXIALSCAN can achieve the focus change with the Z-Offset by using 3D-vectors. Object height and layer size have to be within the technical data of the corresponding Scan Head.
	Auxiliary Axis (currently not implemented)
	Port Definition (currently not implemented)

9.5.5 Saving options of a STL file in the job file

A STL object can be saved and referenced within the job. If the file is referenced, the currently updated file will be loaded upon opening the job. Files saved within the job will save their file path, but not their contents. With the file path, the object can be manually loaded anew. These options can be set as follows:

- Right click on the STL object.
- Select *Properties...*.
  Select *Source* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Character string rules	No settings necessary.
String position	Shows the path where the file is saved.
Save within job	If this function is activated the file will be saved within the job. Changes on the original file will not be loaded automatically. If this function is deactivated, the newest file will be loaded automatically upon opening the job. The job can only be accessed from another computer, it the original file can be found in the saved file path. Loading times can increase due to the loading the STL file.

9.6 3D Applications

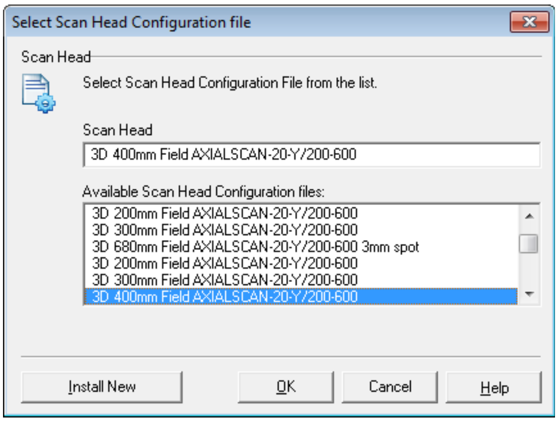
3D application needs dynamic focus adaptation to any 3D shaped surface. There are several possibilities for 3D marking in weldMARK™. A proper Scan Head (AXIALSCAN or FOCUSSHIFTER) and a special 3D Dongle has to be available for the 3D marking. Particular 3D Correction Files can be created, objects can be imported as 3D vectors and 2D objects can be projected onto a 3D surface.

9.6.1 Preparation for 3D Applications

To use the different 3D functions in weldMARK™ a 3D surface marking compatible Scan Head (either 3D Scan Head config file of AXIALSCAN or 3rd Axis for FOCUSSHIFTER) has to be used and the proper Correction File has to be selected.

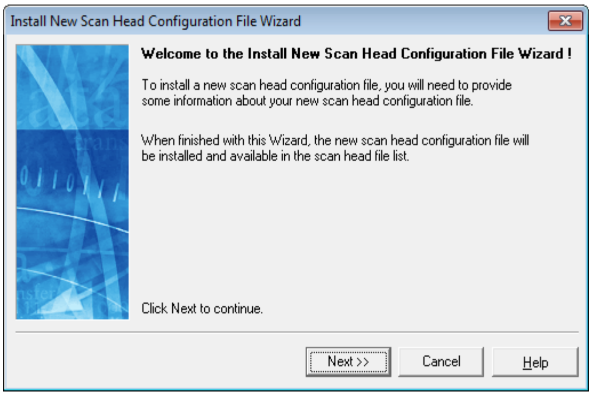
Selecting a Scan Head for 3D Surfaces

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- Select the Scan Head you want to change from the directory tree.
- Click on *Change* button.
- Read and acknowledge the security query that appears.
  The dialogue on the right opens.
- Select a 3D Application compatible Scan Head and confirm your choice with *OK* (➜ page 193, Select/change Type of Scan Head).

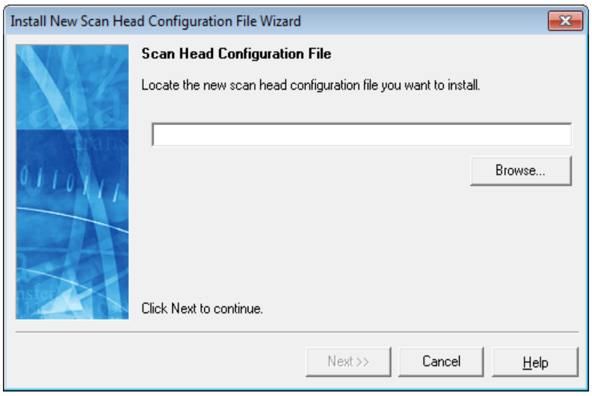


Add a new Correction

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In directory tree, click on the Correction File of the deflection unit you want to optimize.
- Click on *Change* button.
- Read and acknowledge the security query that appears.
- Click on *Install New File* button.
  The dialogue on the right opens.
- Click on *Next* button.
  The following window is opened.



- Select the correspondent configuration file by clicking the *Search* button.



9.6.2 Importing 3D Vector-Objects

This method allows to directly import vector-objects (3Ddxf) as a three-dimensional Layout. Alternatively the 3D-coordinates can be provided in a separate txt-File. Import Details ➜ page 29, Importing and editing Vector Graphic Objects.

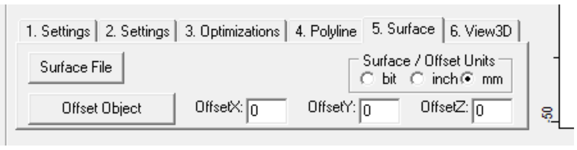
After the import, the Z position (height position) of the layout has to be set, so the complete layout is underneath the zero level, meaning all Z-coordinates have to be negative. This is done in the Vector Graphic Designer. ➜ page 32, Vector Graphic Designer (VGD) (Tab: *Surface* > *Offset Object*)

To finally mark the object in 3D the *Mark3D* option has to be activated ➜ page 166, Job Settings - "Page Setup".

9.6.3 Projection of a 2D-layout onto a 3D-surface

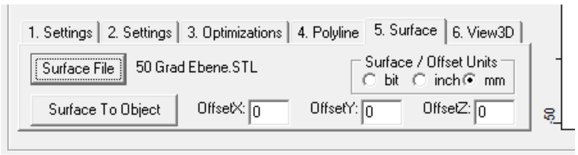
This method allows to project 2D-layouts onto a 3D-surface within the Vector Graphic Designer ➜ page 32, Vector Graphic Designer (VGD).

a) Tab: *Surface* > *Import Surface File* (=STL File with 3D surface information)



b) The Surface will be displayed as a purple out-bounding rectangle. Positioning the surface to the layout: Tab: *Surface* > *OffsetX* + *OffsetY*

c) Tab: *Surface* > *Surface to Object*



d) Afterwards, the Z position (height position) of the layout has to be set, so the complete layout has to be within the available Z-Range. (Tab: *OffsetZ* > *Offset Object*)

To finally mark the object in 3D the *Mark3D* option has to be activated ➜ page 166, Job Settings - "Page Setup".

Note:
9.4.2 and 9.4.3 can be used with either AXIALSCAN or FOCUSSHIFTER.
Both methods process 3D-Vectors.

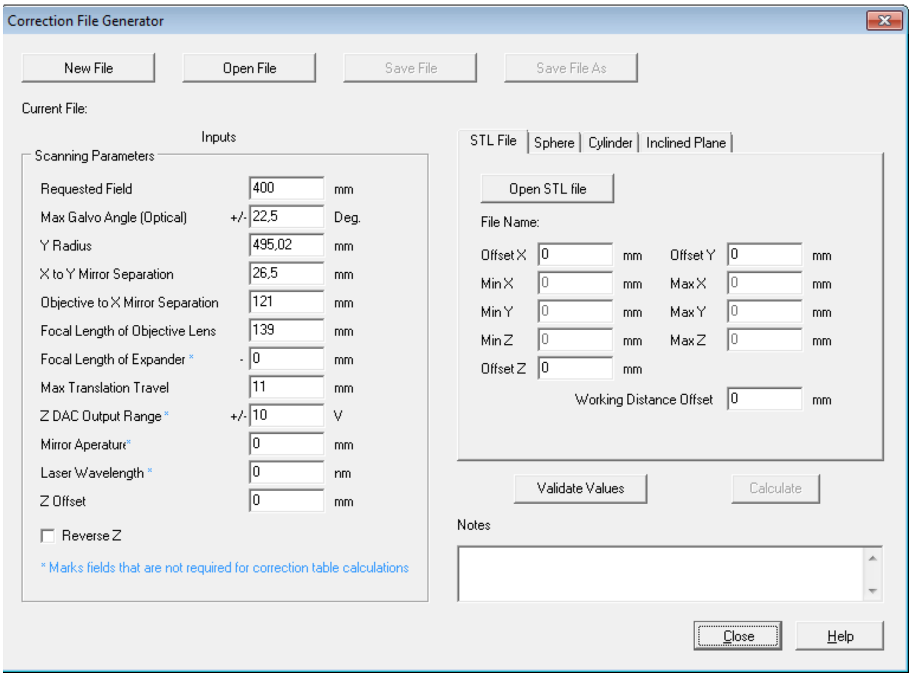
9.6.4 Marking with modified Correction Files

This type of marking depends on Correction Files, that can be changed to adjust to different surfaces. Standard Correction Files for 3-Axis Scan Heads, as well as Correction Files for 3D surface markings can be created with the Correction File generator.

Note: This method works only with AXIALSCAN.

Correction File Generator

To start the Correction File generator choose the menu point *Tools >Generate Correction*. This option is only available for type "Professional 3D" dongles. The following window is opened.



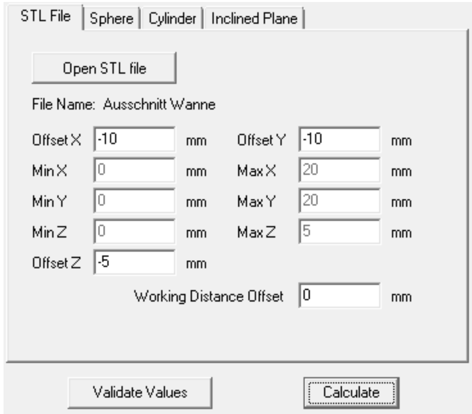
The following table shows all functions of the Correction File generator:

New File	Creating a new Correction File
Open File	Opening a Correction File
Save File	Saving a Correction File
Save File As	Choose path & save Correction File
Scanning Parameters	Values from the Scan Head Correction File are entered here. They can be changed at will. The values have to be verified with the function *Validate Values* and *Calculate* a new.
Z-Offset	If the standard Correction File uses an integrated offset this value must be entered here to be integrated into the new 3D Correction File.
Z inverted	Do not use this option!
Open STL-File	Loads the STL-File which contains the 3D surface information.
Offset X, Offset Y, Offset Z	Position of the surface of STL-File relative to coordinate origin of the working field. By default software puts origin of surface to origin of working field and position surface in Z axis so that peak of surface equals Z=0.
Working Distance Offset	Value must be positive! It defines the Z value of all the area besides the surface of STL-File. Only values between Z=0 and Z=Working Distance Offset are valid for the calculation of 3D Correction File.
Validate Values	Checks if the *Scanning Parameters* function is valid and shows an error message if the values are not in the area of validity.
Calculate	Calculates changed values after the function *Validate Values* has been checked for it's validity. After successful evaluation the options *Save File* and *Save File As* become available.

Creating Correction Files for different surfaces

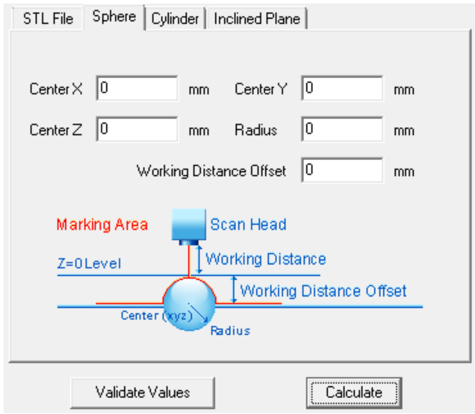
weldMARK™ enable the creation of Correction Files which can be adjusted to different surfaces. Standard options for surfaces are sphere, cylinder and inclined plane. By assigning a STL-File other surfaces can be defined. To create a Correction File based on a STL File follow the steps below:

- In the Correction File generator click on *Open STL file*.
- Choose the corresponding STL-File and -confirm with *Open*.
- The STL-File data is displayed in the right are of the Correction File generator, as shown in the adjacent picture.
- If necessary, change the correspondent values (especially offset), confirm them with *Validate Values*, and click on the button *Calculate*.
- Save new 3D Correction File with either *Save File* or *Save File As*.



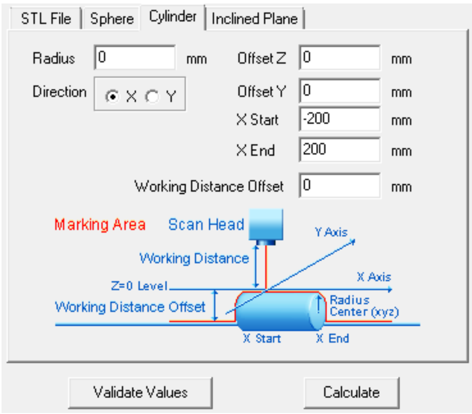
Create a Correction File for spheres

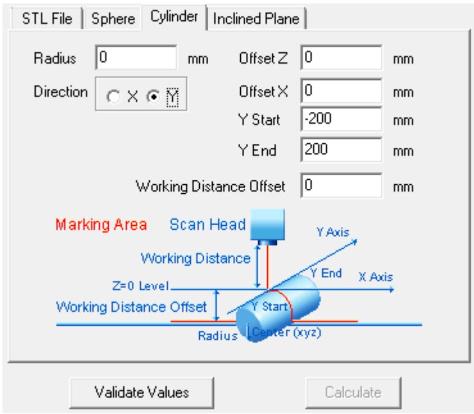
- Click on the tab *Sphere* in the Correction File generator.
- The area pictured adjacent opens.
- Enter values to define sphere surface, confirm them with *Validate Values*, and click on the button *Calculate*.
- Save new 3D Correction File with either *Save File* or *Save File As*.



Create a Correction File for cylinders

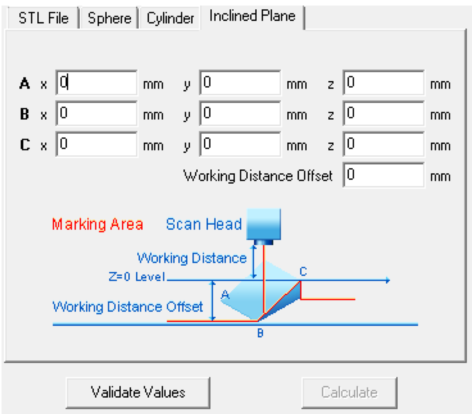
- Click on the tab *Cylinder* in the Correction File generator.
- The area pictured adjacent opens. Depending on the chosen direction of X and Y the view is altered.
- Enter values to define cylinder surface, confirm them with *Validate Values*, and click on the button *Calculate*.
- Save new 3D Correction File with either *Save File* or *Save File As*.





Create a Correction File for inclined planes

- Click on the tab *Inclined Plane* in the Correction File generator.
- The area pictured adjacent opens.
- To specify the inclined plane, the points A, B and C are defining a restricting triangle in a X/Y/Z coordinate system.
- Change the correspondent values, confirm them with *Validate Values*, and click on the button *Calculate*.
- Save new 3D Correction File with either *Save File* or *Save File As*.



10 EXECUTING MARKING OBJECTS (QUICKMARK)

This chapter provides an overview of the QuickMark function. The function enables you to execute the marking process without automation objects or additional functions (e.g. serialization). It is also possible to mark only certain marking objects of a job.

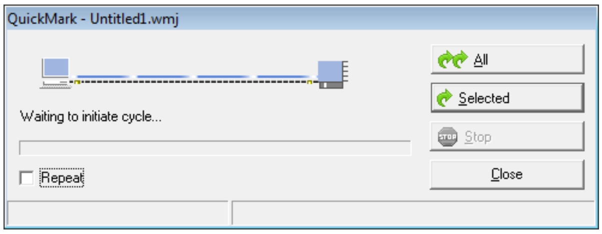
Before using QuickMark function, you should familiarize with the job settings (➜ page 165, Job Settings, run Job).

Warning
The laser beam can cause severe injury to the eyes and the skin. Make sure that there are no reflective objects in the beam path before starting the QuickMark function and turning on the laser. Note that laser beams can be reflected even by apparently matt objects.

All persons in the room must wear appropriate laser protection goggles, or the marking area must be covered completely. Follow the local safety regulations, which can be obtained from the person responsible for laser safety.

QuickMark

- ○ Select the objects you want to mark. It you want to process all objects, you do not need to select an object.
- ○ Select *Job >QuickMark...* option from the menu. The dialogue on the right opens. Refer to the table below for explanations.



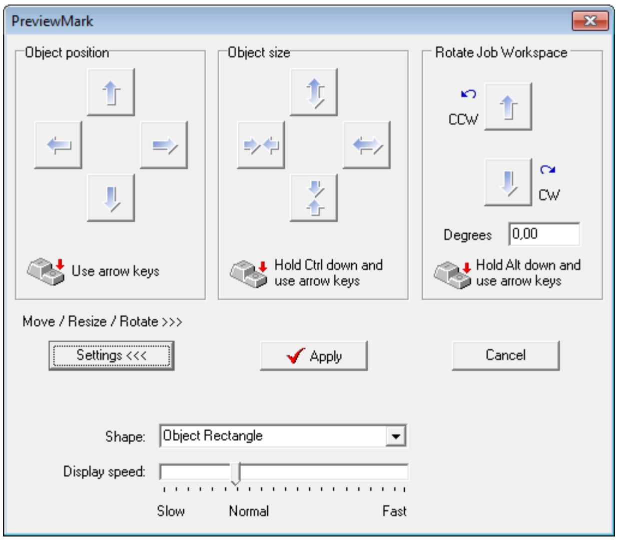
Repeat Process	Enabling this function means that once the marking process has been started it will be repeated until you stop it by clicking the *Stop* button.
All	Executes all marking objects of the current job.
Selected	Executes only the selected marking objects.
Stop	Clicking on this button stops the marking process immediately. Alternatively, you can do this by pressing the *ESC* key.
(1)	When laser marking has been completed, the attended marking time is displayed in the status bar.

10.1 Preview Mark

The PreviewMark can be used if the laser system is fitted with a visible pointer and you have selected a laser driver file that supports a visible pointer in the system preferences. Note that the visible pointer needs to be calibrated in order to represent the position of the marking laser correctly (➜ page 222, Calibrating the Visible Pointer).

The PreviewMark shows the shape of a marking object or a group of marking object using the visible pointer. Thereby the marking laser remains off. The shape can be used to position and scale marking objects exactly on the target Furthermore, the workspace can be rotated.

- Select the marking objects whose marking position and size you want to set.
- Select *Job >PreviewMark...*option from the menu.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Object position		These buttons can be used to change the marking position of the selected objects.
Object size		These buttons can be used to change the size of the selected objects.
Rotate Job Workspace		These buttons can be used to rotate the workspace of the selected job. Thereby the arrow key down rotates clockwise (negative angle) and the arrow key up rotates anti-clockwise (positive angle). The angle can be entered into the field below the arrow keys, too. Please mind the algebraic sign. The rotation of the job workspace can also be set via *Job Settings >Page Setup*.
Settings		Selection of preview shape and ruler to adjust speed of the visible pointer.
Shape	*Preview Profile*	The object is shown as a rectangle whose shape symbolizes the object dimensions. **This option should not be used for 2.5D or 3D objects.**
	Display Speed	The visible pointer represents the object outline, even if only the filling is selected for marking. It is used for the preview of the Bitmap linked with the PLT outline. Only available with a SPICE control card. **Use this option for 2.5D or 3D objects.**
Preview Profile		The speed of the outline preview is set by profile.
Display Speed		This slider can be used to adjust the speed of the preview rectangle.
Apply		Clicking on this button applies the settings made.

Arrow keys are normally reserved for navigating through forms and moving from one control to another, similarly as with TAB button.

In order to avoid uncertainties and not limit the standard functionality of these keys a new ‘Move / Resize / Rotate’ field is introduced.

When ‘Move / Resize / Rotate’ field is selected then arrow keys are used for adjusting the size, position and rotation of the object. Otherwise, they are used the same as on any other form.

Use TAB key to move between the controls.

10.2 Object Preview

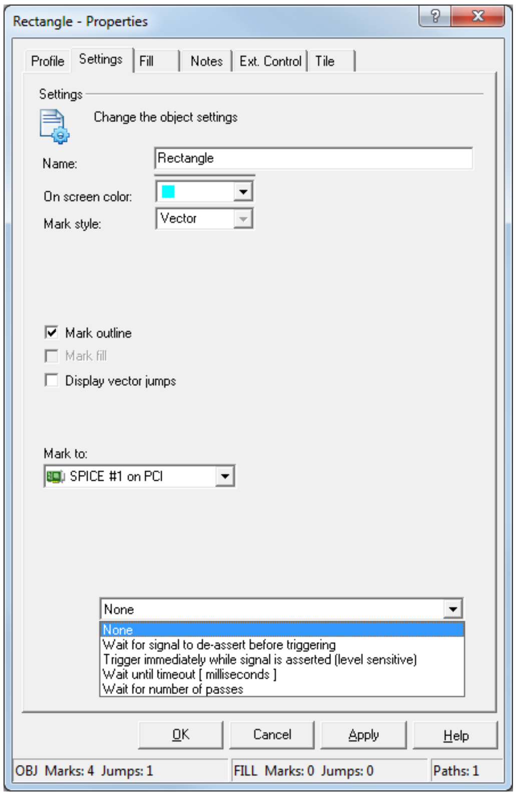
Object is an option available for some marking objects in

Object > *Properties* > *Settings* tab.

This option can be used to preview an object for a defined time before it gets marked.

The object preview will start when it is the objects turn to be processed.

(In case the object is used for preview reason only, uncheck the *Mark outline* flag.).



The following options are available:

Wait for signal to de-assert before triggering	Object gets outline-previewed until a signal de-asserts. New drop down for selection of signal-input pin becomes available.
Trigger Immediately while signal is asserted (level sensitive)	Object gets outline-previewed until a signal low sensitive signal assert. New drop down for selection of signal-input pin becomes available.
Wait until timeout	Object gets outline-previewed until a defined time elapses.
Wait for number of passed	Object gets outline-previewed until a defined number of passes is carried out.

11 JOB SETTINGS, RUN JOB

This chapter provides an overview about the sequence of a job, which settings you can make and how you run a job.

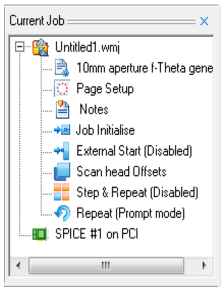
When executing a job, all objects contained in the job are executed, including the automation objects and all additional functions of the objects, e.g. serialization.

11.1 The Job Manager

The Job Manager gives an overview about the job settings. The settings can only be changed at the *All editing functions* access level. In *Operator interface only* mode, the Job Manager is displayed only, while it does not appear at all in *Touchscreen interface* mode.

Showing and hiding the Job Manager

- Select *View >Job Manager* option from the menu.
  The adjacent window is shown or hidden.



Show/Hide Job Manager

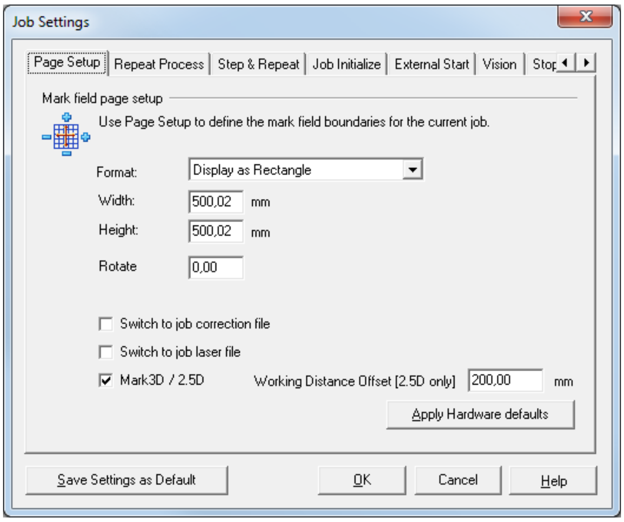
11.2 Editing the Job Settings

The job settings enable you to adapt the execution of a job to specific requirements. The job settings are saved within the job. They are divided up as follows:

Page Setup	Allows you to set the format and size of the workspace.	→ page 166, Job Settings - "Page Setup"
Repeat Process	Execution of the job can be repeated several times or continuously.	→ page 167, Job Settings "Repeat Process"
Step & Repeat	The Step & Repeat function allows a job content to be marked several times. The duplication is based on adjustable row and column arrangements.	→ page 168, Job settings - "Step & Repeat"
Job Initialize	When starting the job, external components can be automatically prepared for the marking process.	→ page 169, Job Settings "Job Initialize"
External Start	The start of job execution can be controlled by external signals.	→ page 170, Job Settings - "External Start"
Stop Mark	Sets the behaviour of the laser if an external stop signal appears.	→ page 172, Job Settings - "Stop Mark"
Scan head Offsets	→ page 174, Job Settings - "Scan head Offsets"	
Notes	A note can be added to the job.	→ page 174, Job Settings - "Notes"
Interlocks	Execution of the job can be interrupted by external interlock loops. This option is only available, if the Interlock card is installed.	→ page 175, Job Settings - "Interlocks"

11.2.1 Job Settings - "Page Setup"

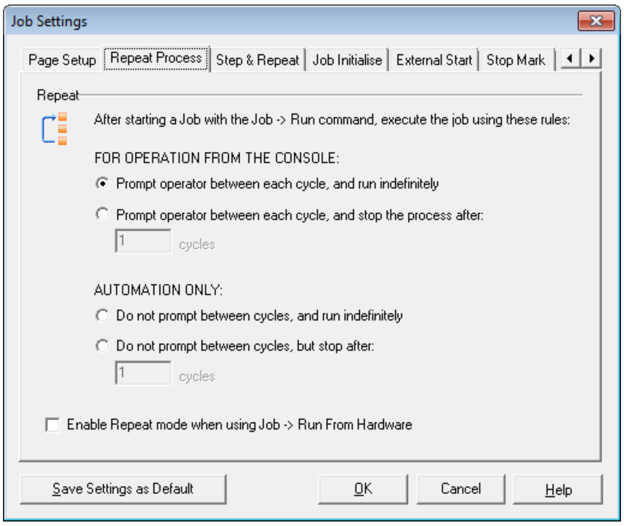
- Select *Job >Settings...* option from the menu
  or
  double click on *Page Setup* option in the Job Manager.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Format	You can select a rectangular or circular workspace.
Width	The size of the workspace can be adjusted. The maximum size of the workspace is determined by the size of the deflection unit's operating field.
Height	
Rotate	Into this field, a rotation angle to rotate the job workspace can be entered. A negative value rotates the workspace clockwise, a positive one anti-clockwise. These settings can also be modified via *Job >Preview Mark...*.
Switch to job Correction File	If this option is selected, the path for the currently selected Correction File is saved and the Correction File will be loaded automatically upon the next opening of the job.
Switch to job laser file	If this option is selected, the path to the currently selected file will be saved and is automatically loaded upon the next opening of the job.
Mark 3D / 2.5D	If this option is selected, vectors with 3-dimensional coordinates can be processed if a suitable Scan Head is connected.
Working Distance Offset (2.5D only)	Possibility to offset Zero Plane when doing 2.5D marking with AXIALSCAN. Value is always positive. See ➜ page 148, Z-Range of 3-Axis System
Apply Hardware defaults	Clicking on this button sets the workspace to its maximum possible size (size of deflection unit's operating field).
Save Settings as Default	Clicking on this button allows to save the current settings as defaults for the *Page Setup*.

11.2.2 Job Settings "Repeat Process"

- Select *Job >Settings...* option from the menu.
- Select *Repeat Process* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

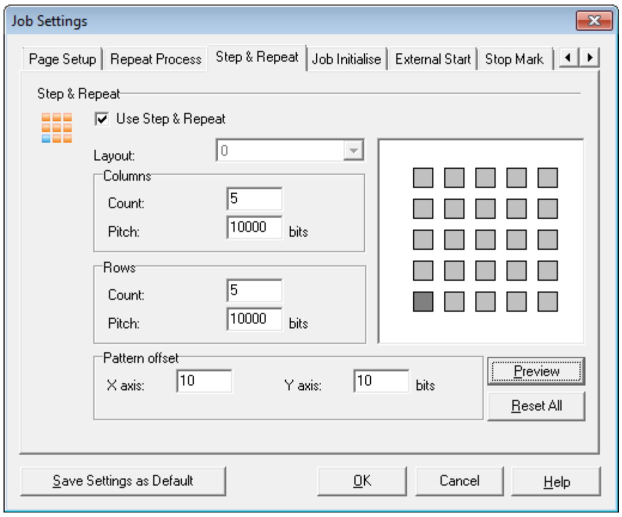


FOR OPERATION FROM THE CONSOLE	If you select a manual repeat function, each new execution of the job must be started manually.	
	(1)	The job is executed as many times you wish.
	(2)	The frequency of execution is limited by the specified number of *Cycles*.
AUTOMATION ONLY	If you select an automatic repeat function, execution of the job is automatically restarted after completion of a cycle.	
	(3)	The job is automatically and continuously repeated until it is cancelled manually.
	(4)	Execution of the job is repeated automatically for the specified number of *Cycles*. The limitation is not considered with the *Run form Hardware* mode.
(5)	**Only selectable if a SP-ICE Control Card is used** If this function is enabled, the settings are also used in *Run from Hardware* mode. This option is available only if *Run from Hardware* mode is enabled (➜ page 178, Run from Hardware).	
Save Settings as Default	Clicking on this button uses the current settings as defaults for *Repeat Process*.	

11.2.3 Job settings - "Step & Repeat"

The Step & Repeat function allows marking of objects several times on the workspace. Reproduction takes place in an adjustable row and column arrangement and applies to all marking objects in the job.

- Select *Job >Settings...* option from the menu.
- Select *Step & Repeat* tab.
  The dialogue on the right opens. Refer to the table below for explanations.

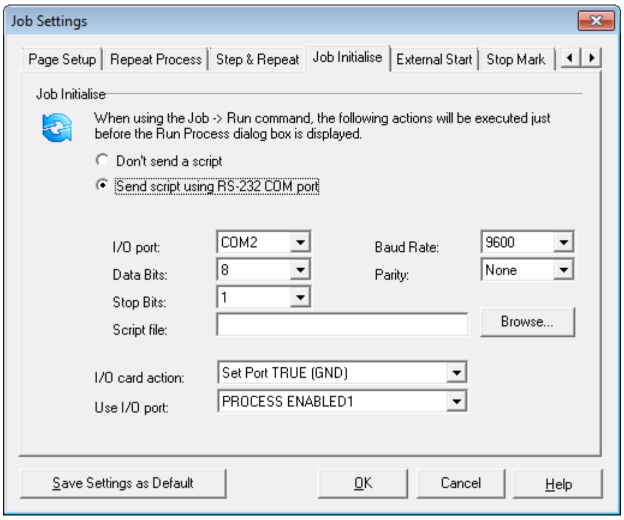


Use Step & Repeat	If this function is enabled, the following parameters can be set:		
	Layer		If a standard I/O card is installed, up to four matrix layouts can be created. Each layout can have a different matrix arrangement. The layout can be selected using the ports on the standard I/O card.
	Columns	*Count*	The matrix is made up of columns and rows. You can specify the number of rows and columns and the distance between them (pitch). The offset is based on the bottom-left corner.
		Pitch	
	Rows	*Count*	
		Pitch	
	Pattern offset	*X axis*	The position of the matrix on the marker can be adjusted using these offset values.
		Y axis	
	Preview		Clicking on this button updates the preview window.
	Reset All		Clicking on this button resets all settings to the defaults.
	Save Settings as Default		Clicking on this button uses the current settings as defaults for *Step & Repeat*.

11.2.4 Job Settings "Job Initialize"

When the job is started, the RS232 port can be used to output a string for initialization of external components. In addition, you can specify a port to report execution of the job to external components. As initialization is job specific, the components can be initialized in a different way for each loaded job.

- Select *Job >Settings...* option from the menu.
- Select *Job Initialize* tab.
  The dialogue on the right opens. Refer to the table below for explanations.



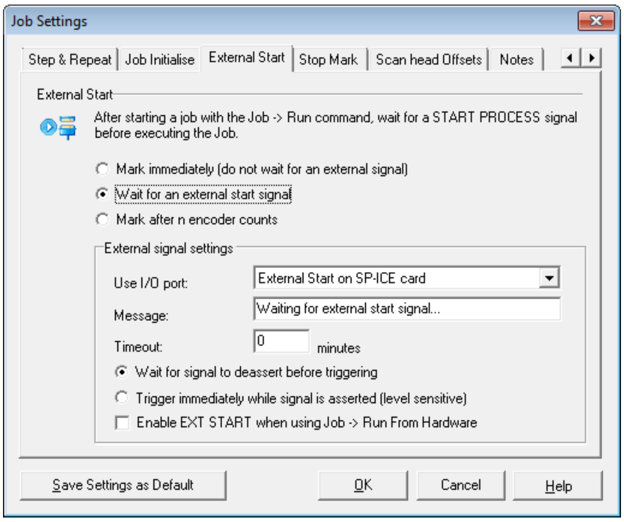
<table>
<tr><td>Don't send a script</td><td colspan="2">No script is sent to initialize external components.</td></tr>
<tr><td rowspan="8">Send script using RS-232 COM port</td><td colspan="2">A script is sent to initialize external components using an RS232 port.</td></tr>
<tr><td>I/O port</td><td>Select an RS232 port for sending the script.</td></tr>
<tr><td>Data Bits</td><td rowspan="4">These parameters are used to adapt the RS232 port to the parameters of the script recipient.</td></tr>
<tr><td>Stop Bits</td></tr>
<tr><td>Baud Rate</td></tr>
<tr><td>Parity</td></tr>
<tr><td>Script file</td><td rowspan="2">Selection of the script file to be sent using the RS232 port.</td></tr>
<tr><td>Browse...</td></tr>
<tr><td>I/O card action</td><td colspan="2" rowspan="2">A port of the I/O-card can be selected. An action that should be executed when the job is started must be assigned to this port.</td></tr>
<tr><td>Use I/O port</td></tr>
<tr><td>Save Settings as Default</td><td colspan="2">Clicking on this button uses the current settings as defaults for Initialization.</td></tr>
</table>

11.2.5 Job Settings - "External Start"

The "External Start" function allows the control of job execution by an external signal. This tab is available only if the standard I/O card is installed and/or SP-ICE/RLC series control cards are installed.

Wait for an external Start Signal

- Select *Job >Settings...* option from the menu.
- Select *External Start* tab.
- Enable *Wait for an external start signal*.
  The dialogue on the right opens. Refer to the table below for explanations.

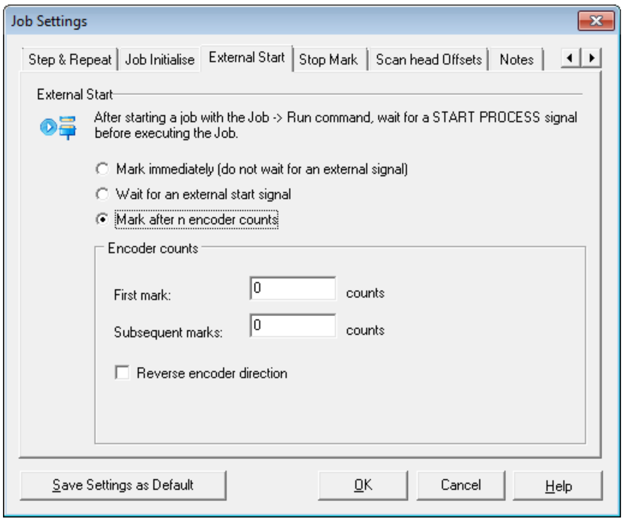


(1)	If this check box is selected, the *External Start* function is deactivated.	
(2)	If this check box is selected, the *External Start* function is activated and the following setting options are available:	
	Use I/O port	This choice box can be used to choose the port for the start signal. The options vary depending on the cards installed.
	Message	A text can be entered for a message displayed during the waiting time.
	Timeout	A time limit can be placed on the waiting time for the external start signal. When this time has elapsed, an error message will be output. If the value "0" is entered, the waiting time is unlimited.
	(3)	The job is not started until the start signal is terminated.
	(4)	The job is started as soon as the start signal is assented.
	(5)	If this function is enabled, the selected parameters are also used in *Run from Hardware* mode. This option is available only if *Run from Hardware* mode is enabled (➜ page 178, Run from Hardware).
	Save Settings as Default	Clicking on this button uses the current settings as defaults for *External Start*.

Mark after n Encoder Counts

- Select *Job >Settings...* option from the menu.
- Select *External Start* tab.
- Enable *Mark after n encoder counts*.
  The dialogue on the right opens. Refer to the table below for explanations.

This option is only useful in combination with MOTF-Function.

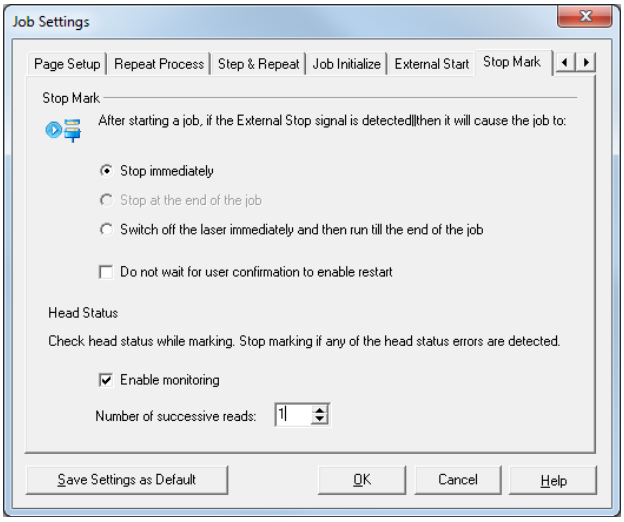


(1)	If this option is enabled, the mark starts after an adjustable number of encoder counts.	
	First mark	Number of encoder counts before the marking operation starts.
	Subsequent marks	Number of encoder counts before starting the following marks.
	(2)	In some cases, caused by installation, the sensor signal arrives with the wrong moving sense. Though the direction of the encoder is reversed.
	Save Settings as Default	Clicking on this button uses the current settings as defaults for *External Start*.

11.2.6 Job Settings - "Stop Mark"

This function sets the reaction at an external stop signal or if the Scan Head reports an error.

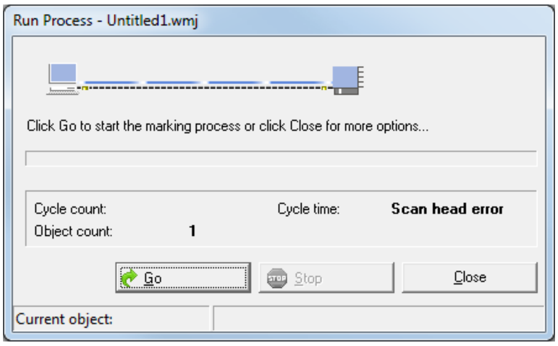
- Select *Job >Settings...* option from the menu.
- Select *Stop Mark* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



(1)	Mark stops immediately after the external stop signal has appeared. This function is enabled by default.
(2)	The marking laser switches off immediately after the external stop signal has appeared. Subsequently, the job runs to end.
(3)	If this function is enabled the job is repeated without waiting for a confirmation by the user.
(4)	Function to stop marking automatically if any error is read back from deflection unit. Additionally, the external signal on the controller card "Remote_Execute_2" is set. This signal is reset when the error message is confirmed. (Also applies to all non-digital Scan Heads)

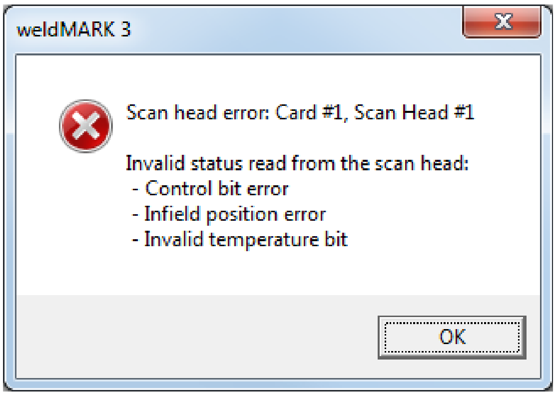
Displaying Scan Head error status

Run mode
Scan Head error status is displayed in the the same way as if the Stop Mark was detected, i.e. in the *Cycle time* field.

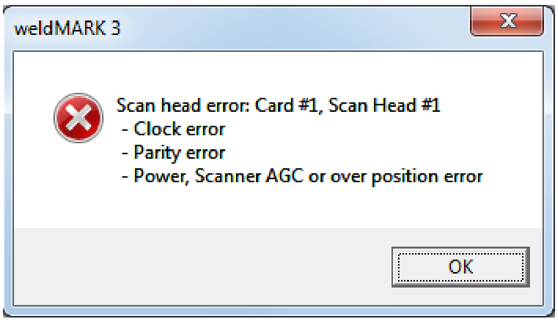


On top of this, depending on the error status, an Error message is also shown:

- If an invalid status was read from the Scan Head



- If a valid status was read, but some of the error signals were set



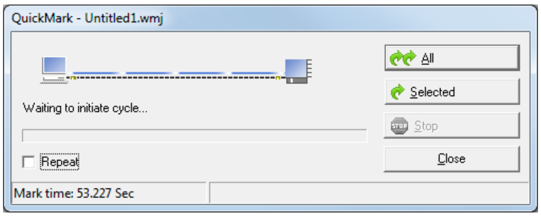
Confirming the OK button will reset the error, enabling further marking.

If the error still persists, it will be reported again.

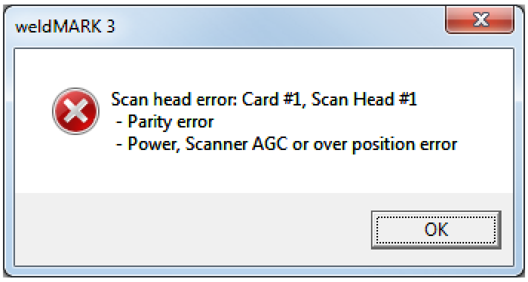
Quick mark mode

In case of Quick mark mode:

- Marking will be stopped
- Error will not be displayed on the Quick mark form.



- An error message will be shown in the same way as for Run mode.



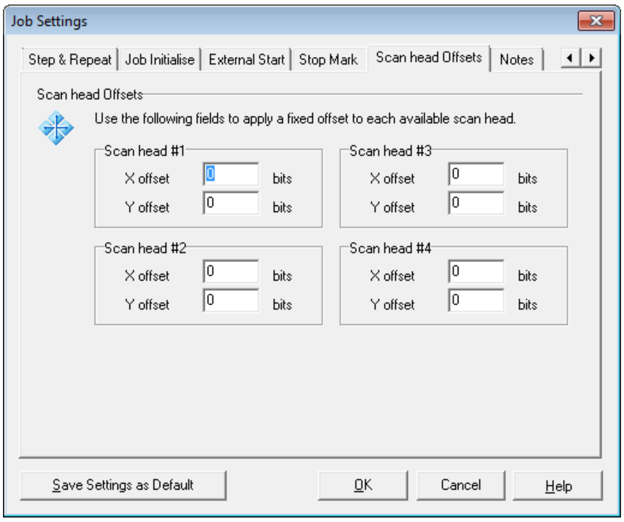
Confirming the OK button will reset the error, enabling further marking.

If the error still persists, it will be reported again.

11.2.7 Job Settings - "Scan head Offsets"

If several Scan Heads are used, it can be necessary to balance the offset. For this purpose, individual settings can be specified for every Scan Head.

- Select *Job >Settings...* option from the menu.
- Select *Scan head Offsetst* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

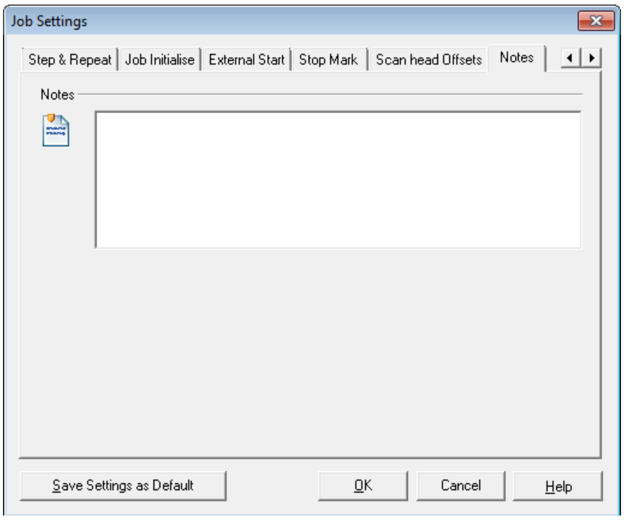


Scan head 1	*X offset*	It is possible to set the X and Y offset for each single Scan Head.
	Y offset	
Scan head 2	*X offset*	
	Y offset	
Scan head 3	*X offset*	
	Y offset	
Scan head 4	*X offset*	
	Y offset	

11.2.8 Job Settings - "Notes"

A note can be added to the job. weldMARK™ can be set up in such a way that the job note is displayed automatically when loading the job and has to be acknowledged by the user (➜ page 197, Settings for the Job File).

- Select *Job >Settings...* option from the menu.
- Select *Notes* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

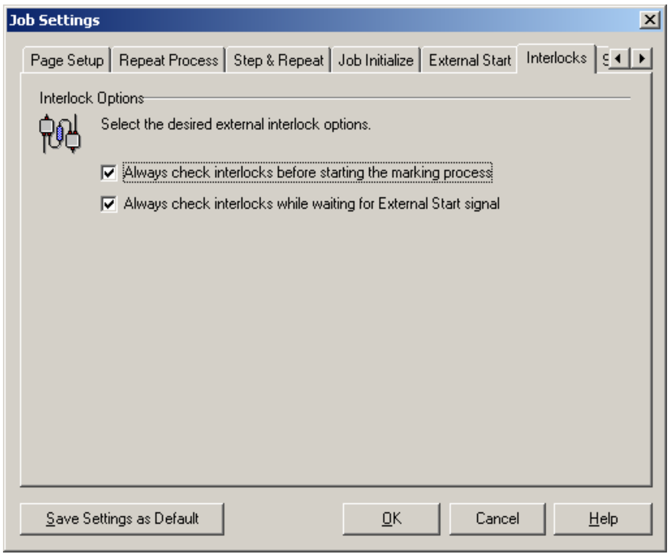


Save Settings as Default	Clicking on this button uses the text entered as default for *Notes*.

11.2.9 Job Settings - "Interlocks"

Use the settings on the *Interlocks* tab to set when and how weldMARK™ will report interlock events. The *Interlocks* tab is only available if an interlock card is installed.

- Select *Job >Settings* option and then select the *Interlocks* tab. The dialogue on the right opens. Refer to the table below for explanations.



Always check interlock before...	If this check box is enabled, the interlock status is checked before starting each job. If there is an interlock event, the job is not started and an error message is output.
Always check interlock while...	If this check box is enabled, the interlock status is checked while the system is waiting for the external start signal and, if necessary, an error message is output. If the check box is not enabled, an interlock event does not result in an error message. However the start signal is ignored and the READY signal on the standard I/O card changes to BUSY.
Save Settings as Default	Clicking on this button uses the current settings as defaults for *Interlocks*.

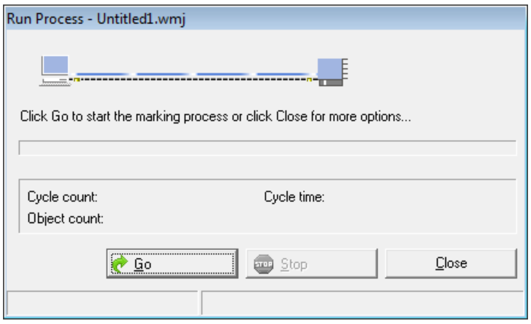
11.3 Executing a Job

In order to be able to execute a job, the Object Manager must contain at least one object that can be marked. The procedure for starting a job differs depending on the access level and is described below.

Warning
The laser beam can cause severe injury to the eyes and the skin. Make sure that there are no reflective objects in the beam path before starting a job and turning on the laser. Note that laser beams can be reflected even by apparently matt objects. All persons in the room must wear appropriate laser protection goggles, or the marking area must be covered completely. Follow the local safety regulations, which can be obtained from the person responsible for laser safety.

Starting a Job at "All editing functions" Access Level

- If necessary, open the required job.
- Select *Job >Run* option from the menu.
  The dialogue on the right opens.
- Click on *Go* button.
  The job is executed.

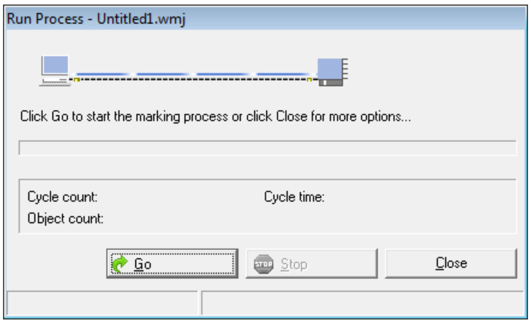


Stopping the Job

Click on *Stop* button or press the *ESC* key.
Upon restarting the execution of the job begins with the first object

Starting a Job at "Operator interface only" Access Level

- If necessary, open the required job.
- Select *Job >Run*option from the menu.
  The dialogue on the right opens.
- Click on *Go* button.
  The job is executed.



Stopping the Job

- Click on *Stop* button or press the *ESC* key.

Starting a Job at "Touch screen interface" Access Level

- If necessary, open the required job.
- Touch the *Run* button.
  The job is executed.

Stopping the Job

- Touch the *Stop* button or press the *ESC* key.

11.3.1 Displays during a Job

While the job is executed, the following values are displayed in the status bar:

Cycle count	How often the entire job has been executed so far.
Object count	Number of objects processed so far.
Cycle time	Required time for the execution of the current job (current cycle).
Current object	The object that is currently being processed.

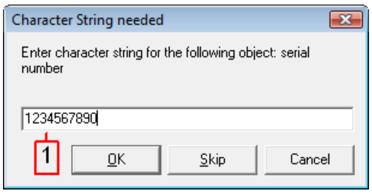
11.3.2 Events during a Job

Depending on the objects included in the job and their properties, the program may ask the user for input during execution.

Entering a String

If an object has been created for which the user needs to enter a string, The dialogue on the right opens.

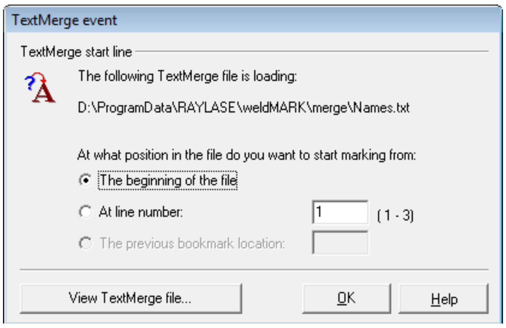
Refer to the table below for explanations.



(1)	Input box for the string with which the object is marked. Execution of the job is continued as soon as the entry is confirmed by clicking the *OK* button.
OK	
Skip	Clicking on this button skips the input prompt. The object is marked with the last string used.

Parameters for TextMerge

If an object has been created that uses a Text-Merge function, The dialogue on the right opens. Refer to the table below for explanations.



The beginning of the file	The first string for the object is taken from the first line of the merge file.
At line number	The first string for the object is taken from the specified line of the merge file. The available line numbers are specified in brackets.
The previous bookmark location	The first string is taken from the line in the merge file that is bookmarked. This option is not available until at least one line has been read from the merge file. The bookmark is inserted each time a line from the merge file is read and specifies the next line to be read. This allows serialization to continue seamlessly after restarting the job.

11.3.3 Run from Hardware

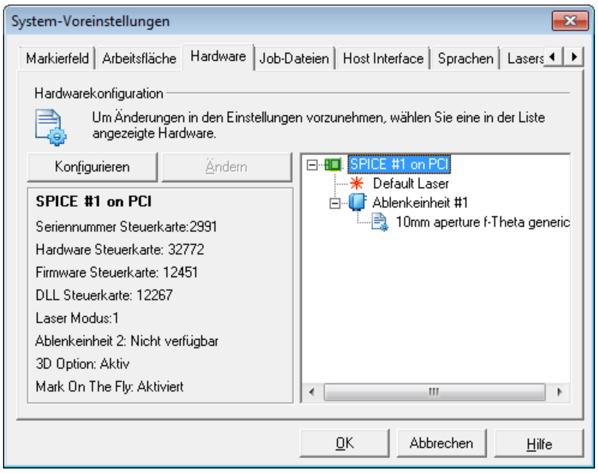
weldMARK™ allows loading all marking objects of a job to the control card's memory. Thus, the job can be executed very quick and potential delays caused by the operating system are avoided. With this function, no automation objects run and no signals for "External Control" processed.

To allow direct operation, the following conditions must be met:

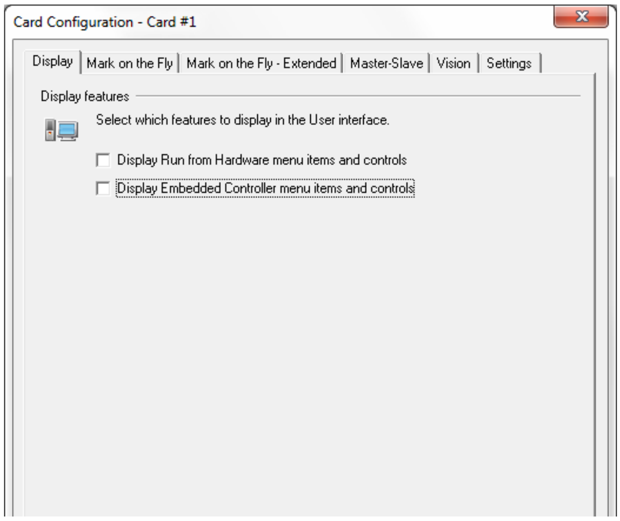
- A SP-ICE control card must be used.
- The *Run from Hardware* mode must be activated.

Activating "Run from Hardware" Mode

- Select *System > Preferences* option from the menu.
- Select *Hardware* tab.
  The dialogue on the right opens.
- Select the control card for which you want to activate the mode.
- Click on *Configure…* button.
  The following window is opened.



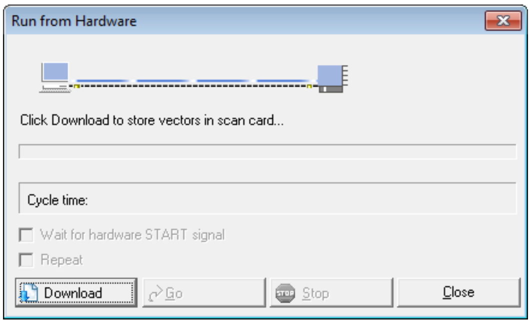
- Select *Display* tab.
- Activate the check box *Job > Run from Hardware*.



Running a Job from Hardware

Warning
The laser beam can cause severe injury to the eyes and the skin. Make sure that there are no reflective objects in the beam path before starting a job and turning on the laser. Note that laser beams can be reflected even by apparently matt objects. All persons in the room must wear appropriate laser protection goggles, or the marking area must be covered completely. Follow the local safety regulations, which can be obtained from the person responsible for laser safety.

- Select *Job >Run from Hardware* option from the menu.
  The dialogue on the right opens. Refer to the table below for explanations.



Download	Clicking on this button sends the marking objects to the control card.	
	Go	This button becomes active only when all marking objects have been saved on the control card. Clicking on the button starts the execution of the job.
	(1)	If this function is enabled, the job is not executed until the hardware signal is present (➜ page 170, Job Settings - "External Start").
	(2)	If this function is enabled, the job is executed repeatedly (➜ page 167, Job Settings "Repeat Process").
	Stop	Clicking on this button or pressing the *ESC* key stops execution immediately.

Note:

The job is saved only in virtual memory of the card and gets deleted once weldMARK-Software is closed.

11.3.4 Stand Alone Operation

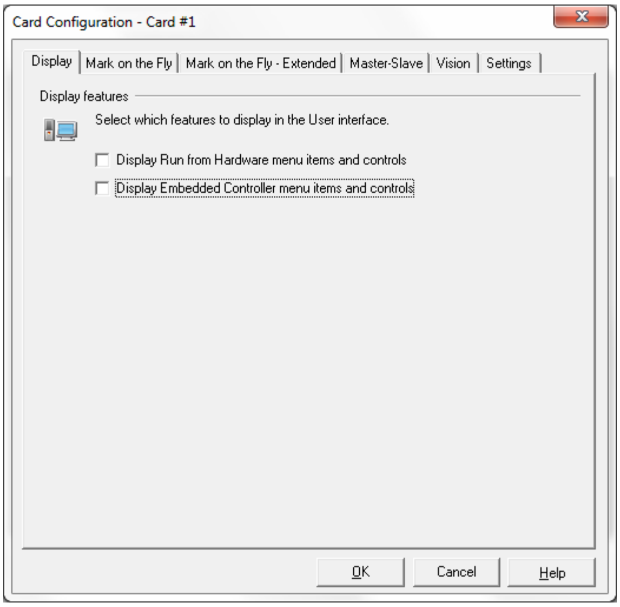
weldMARK™ allows loading all objects of a job to the memory of a stand alone control card. Then the job can be executed from the control card itself without connection to weldMARK™. This function is available only with SP-ICE control cards.

In order to be able to save a job on a stand alone control card, the following conditions must be met:

- The appropriate hardware must be available
- The function must be enabled.
- The job may not contain more objects that can be saved on the controller.

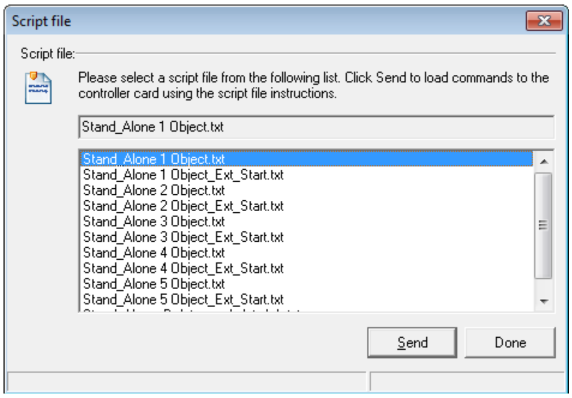
Enabling "Save to stand alone control card" Mode

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- Select the control card for which you want to activate the mode.
- Click on *Configure…* button.
  The dialogue on the right opens.
- Select *Display* tab.
- Select *File >Save Job to Embedded Controller*.



Saving a Job to a Stand Alone Control Card

- Select *File >Save Job to Embedded Controller*.
  The dialogue on the right opens.
- Select a script file from the list.
- Click on the *Send* button to start saving.



11.4 The "Mark on the Fly" Option

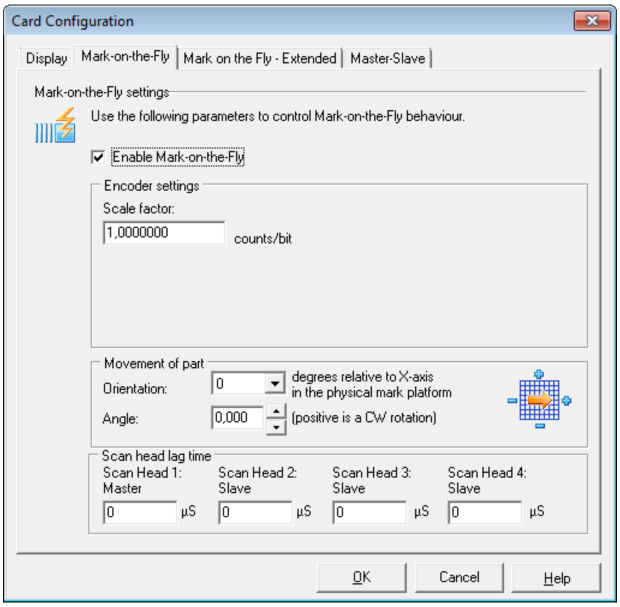
The "Mark on the Fly" option allows marking of moving target. The vectors of a job are corrected corresponding to the respective velocity.

In order to use the "Mark on the Fly" option, the following conditions must be met:

- A suitable SP-ICE control card and a suitable encoder signal need to be available. Please note the hints in the respective manual to the SP-ICE control card.
- The "Mark on the Fly" option must be enabled.

Activating the "Mark on the Fly" Option

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- Select the control card for which you want to activate the mode.
- Click on *Configure…* button.
- Select *Mark on the Fly* tab.
  The dialogue on the right opens. Refer to the table below for explanations.



Enable Mark on the Fly	If this function is enabled, the following settings are available		
	Scale factor	This field can be used to enter the number of pulses emitted by the encoder per adjusted measuring unit.	
	String orientation	Rough setting for the direction of movement of the marked target. "0" corresponds to a horizontal movement from the left to the right. The orientation which is entered under *System >Preferences*, tab *Marker* is not considered. Rotation is clockwise.	If the marker is moving at a 20° angle relative to the X axis, enter "0" in the *Orientation* field and "20" in the *Angle* field.
	Angle	Precise setting for the direction of movement of the marked target. You can enter an angle between -45° and +45°. Rotation is clockwise, relative to the X axis configured under *System >Preferences...* on the *Marker* tab.	
	Scan head lag time	Scan Head 1: Master	The Tracking Error Compensation can not be used, if the inertia of the Galvos is affecting the Mark-on-the-Fly-function. Therefore, it is possible to set individual lag times for each single Scan Head. The Tracking Error Compensation is activated automatically as soon as one value bigger than zero is entered into one of the fields.
		Scan Head 2: Slave	
		Scan Head 3: Slave	
		Scan Head 4: Slave	

11.4.1 Mark-on-the-Fly extended (2. channel)

Activate edge following control	If this function is activated, the following settings are available tor the second MOTF-channel.
Scale factor	This field can be used to enter the number of pulses emitted by the encoder per adjusted measuring unit.
String orientation	Rough setting for the direction of movement of the marked target. "0" corresponds to a horizontal movement from the left to the right. The orientation entered under *System > Preferences*, tab register *Marker* will not be considered. Rotation is clockwise.
Angle	Precise setting for the direction of movement of the marked target. You can enter an angle between -45° and +45°. Rotation is clockwise, relative to the X axis configured under *System >Preferences*, on the *Marker* tab.

11.5 Master-Slave-Operating

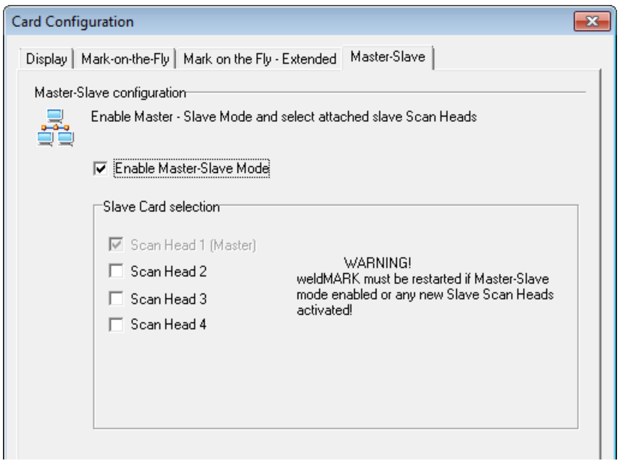
In a PC one SP-ICE control card can be defined as master card and up to three cards as slave cards.

In master/slave operation weldMARK™ sends the job file to the master control card. This master card controls the connected Scan Head and the laser by means of the job file – like in normal operation the SP-ICE control card. Additionally, the SP-ICE card in master mode controls the slave control cards. Thus the content of a job file can be sent to up to four SP-ICE control cards (one master and three slave cards). Slave cards can control Scan Heads but not the laser itself.

Information in detail about hardware configuration can be found in the hardware manual of the SP-ICE control card.

Activating "Master-Slave" Option

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- Select the control card for which you want to activate the mode.
- Click on *Configure…* button.
- Select *Master-Slave* tab.
  The dialogue on the right opens. Refer to the table below for explanations.



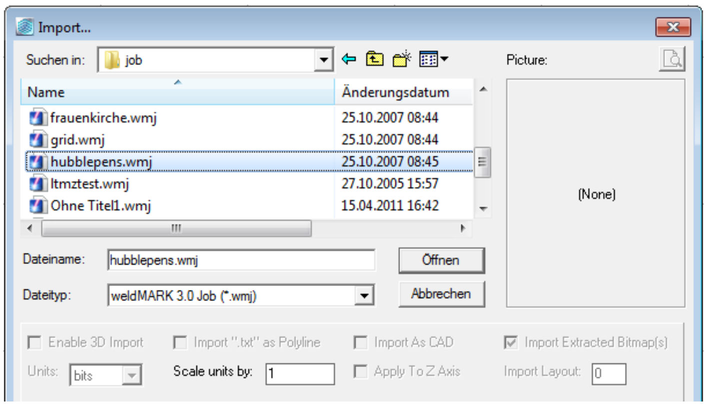
Scan Head 1 (Master)	This check box shows, that Scan Head "1" is defined as master.
Scan head 2	Via these check boxes the built-in SP-ICE control cards can be activated for slave operation.
Scan head 3	
Scan head 4	

An individual Correction File can be loaded for each slave card in the system configuration

11.6 Importing a Job

A job is a collection of objects and settings. The settings determine the actions of the Scan Head, the laser and the additional equipment. If a job is imported into another job, the objects and settings it contains will be added to the currently opened job.

- Select *File >Import Job*.
  The dialogue on the right opens.
  Refer to the table below for explanations.



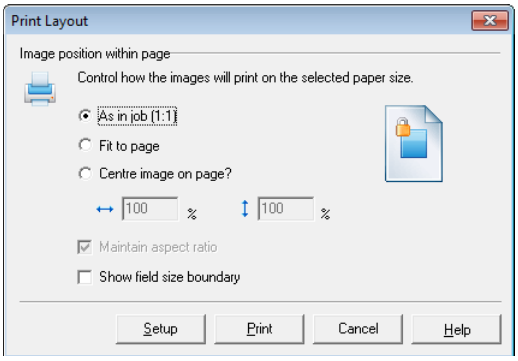
Import job

Look in	Allows you to choose the folder in which the job to be imported is saved.	
File name	This text box displays the name of the currently selected file.	
File type	The file type of a job file must be selected. Only files of the selected type will be displayed. The following file formats can be imported:	
	weldMARK 3 Job (.wmj)*	A weldMARK™ job file format. weldMARK™ jobs can be imported 1.x, 2.x and 3.x
	TruvVewJob (.job)*	A file type developed by the GSI Group Inc. which is bas on the Truview® software package.
	WinLase Job (.wlj)*	A WinLase job file format.
	further	➜ page 29, Importing Vector Graphic Files ➜ page 41, Importing Bitmap Files

11.7 Printing a Job

The content of the workspace can be printed as described below:

- Select *File >Print Setup...* option from the menu and do the required settings (printer, paper size, orientation).
- Select *File > Print* option from the menu.
  The dialogue on the right opens. Refer to the table below for explanations.



As in job (1:1)	The objects are printed at actual size.	
Fit to page	The printout is scaled to use the full size of the page.	
Center image on page	The printout is scaled as specified and centered on the page.	
	Width	The width and height of the printout can be changed as a percentage of the actual size.
	Height	
	Maintain aspect ratio	If this function is enabled, the aspect ratio of the printout remains unchanged even if the print size is changed (no distortion).
Show field size boundary	If this function is enabled, the boundaries of the workspace are printed as a frame.	
Setup or *Print* buttons	Clicking on these buttons calls up the printer settings.	

12 SYSTEM TOOLS

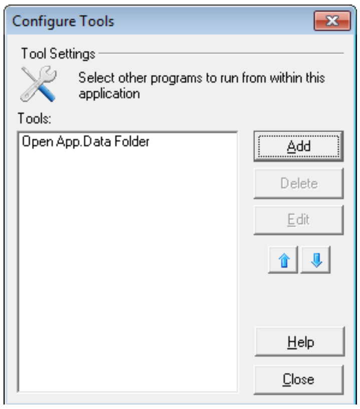
weldMARK™ provides the following system tools:

Configure Tools	The tool menu can be extended with options for calling up external programs.	➜ page 184, Configure Tools
Configure I/O Cards...	This tool allows you to configure newly installed I/O cards.	➜ page 185, Configure I/O Cards
Laser Diagnostics Tool	This tool allows you to check the positioning and power of the marking laser.	➜ page 186, Laser Diagnostics Tool
I/O Card diagnostics		➜ page 187, "I/O Card Diagnostics" Tool

12.1 Configure Tools

The weldMARK™ *Tools* menu can be extended with additional tools (external programs). These programs can then be launched from weldMARK™.

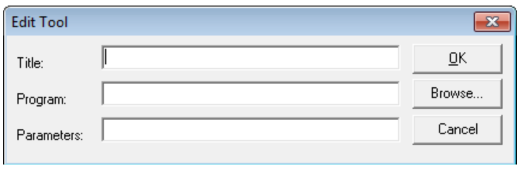
- Select *Tools >Configure Tools...* option from the menu.
  The dialogue on the right opens. Refer to the table below for explanations.



Tools	This section of the window lists all programs added.
Add	Clicking on this button allows the addition of new tools to the *Tools* list (➜ page 184, Adding / editing Tools).
Delete Element	Clicking on this button removes the selected tool from the list.
Edit	Clicking on this button allows you to edit the settings for the tool selected in the Tools list (➜ page 184, Adding / editing Tools).
	These buttons can be used to change the position of a program in the list (and also in the Tools menu).

Adding / editing Tools

- Select *Tools >Configure Tools...* option from the menu.
- Click on *Add* button.
  The dialogue on the right opens. Refer to the table below for explanations.



Title	The name of the selected program file is automatically entered in this field when the *Browse* button has been used to select a program. This name can be changed as required. The entry in the *Title* field is used in the *Tools* menu.
Program	The location of the selected program file is automatically entered in this field when the *Browse* button has been used to select a program. The path to the selected program can also be entered manually.
Parameters	This field can be used to enter parameters for calling up the program. Refer to the manual of the respective program for details about the available parameters.

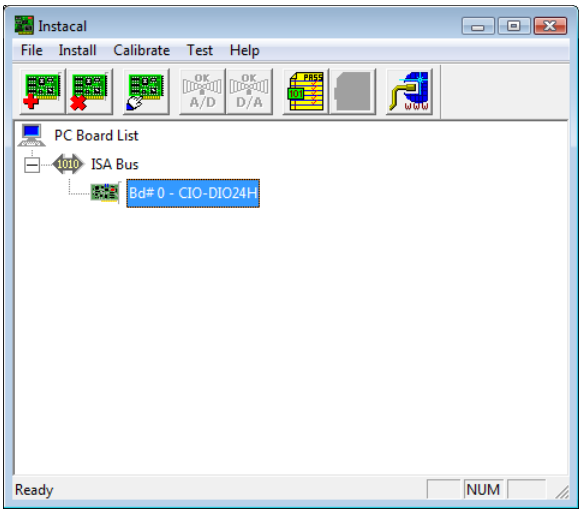
12.2 Configure I/O Cards

If a new standard I/O card and/or interlock I/O card (type: CIO-DIO24H card) has been installed in the computer, it must be configured using the *Configure I/O Cards...* tool.

Configuration must be performed again if a PCI card is removed, added or moved within the computer.

Warning
This tool is only necessary when using I/O cards with a PCI slot. Do NOT use this tool for ISA I/O cards, otherwise the communication with the ISA card may be lost.

- Select *Tools >Configure I/O Cards...* option from the menu.
  A warning message relating to ISA I/O cards appears.
- Read and acknowledge the warning message that appears.
  The *Instacal* program is opened with the adjacent window.
  All installed I/O cards are displayed in the list. The cards are now set up for use with weldMARK™.
- Exit *Instacal* by selecting *File >Exit*.

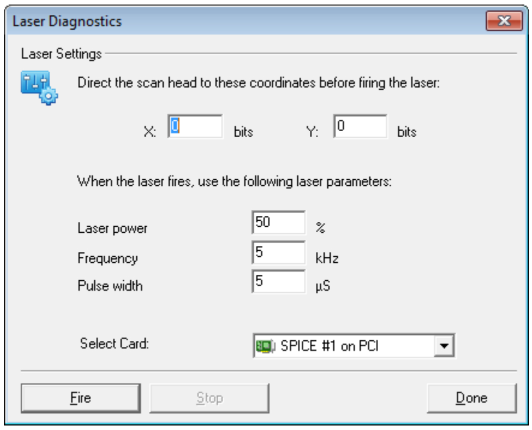


12.3 Laser Diagnostics Tool

The Laser Diagnostics tool can be used to diagnose and, if necessary, adjust the impact point and power of the marking laser you are using.

Warning
The laser beam can cause severe injury to the eyes and the skin. Make sure that there are no reflective objects in the beam path before starting a job and turning on the laser. Note that laser beams can be reflected even by apparently matt objects. All persons in the room must wear appropriate laser protection goggles, or the marking area must be covered completely. Follow the local safety regulations, which can be obtained from the person responsible for laser safety.

- Select *Tools >Laser Diagnostics...*.
  The dialogue on the right opens. Refer to the table below for explanations.



X:	The values in these input boxes determine the position to which the laser beam is directed after clicking the *Fire* button.
Y:	
Laser power % power	This input box determines the laser power.
Frequency	This input box determines the frequency of the laser modulation signal.
Pulse width	This input box determines the pulse width of the laser modulation signal.
Select Card	This selection field allows the user to map the control signals which are output to the laser, if more than one control card is installed.
Fire	Clicking this button turns the laser on immediately.
Stop	Clicking this button turns the laser off immediately.
Save and Exit	Clicking this button closes the Laser Diagnostics tool.

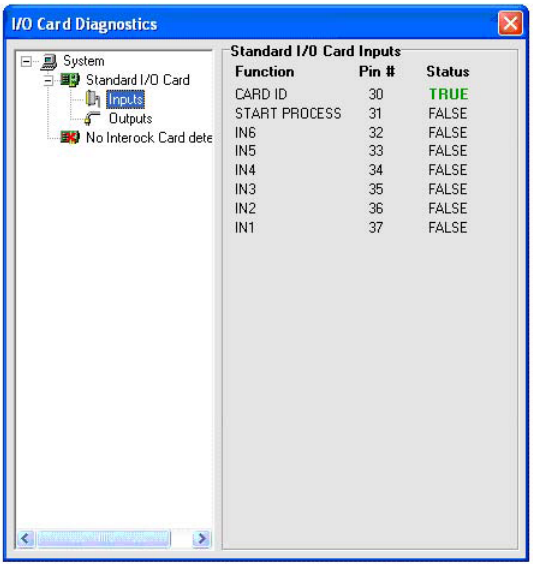
12.4 "I/O Card Diagnostics" Tool

This tool allows testing the ports of the standard I/O card and the interlock I/O card (type: CIO-DIO24H card). The tool is available only if one of these cards is installed.

Reading Inputs of the Standard I/O Card

The following function is available only if a standard I/O card is installed:

- Select *Tools >I/O Card Diagnostics...* option from the menu.
  A warning message appears.
- Read and acknowledge the warning message that appears.
- Select the *Inputs* option under *Standard I/O Card*.
  The dialogue on the right opens. Refer to the table below for explanations.

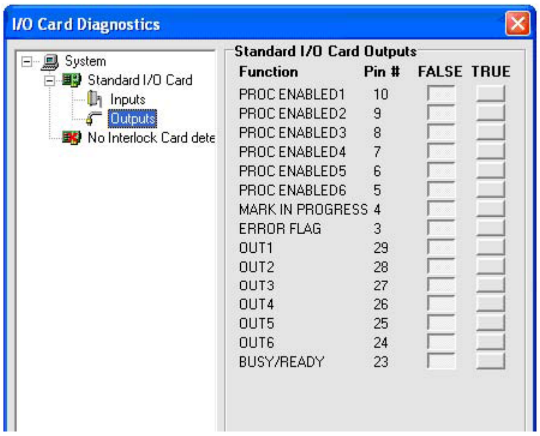


Function	This column lists the names used for the input ports in weldMARK™.
Pin #	This column lists the PIN numbers on the 37-pin connector of the I/O card.
Status	This column specifies the current status of the input ports. If the status is *TRUE*, the corresponding port is connected to GND.

Testing Outputs on the Standard I/O Card

The following function is available only if a standard I/O card is installed:

- Select *Tools >I/O Card Diagnostics...* option from the menu.
  A warning message appears.
- Read and acknowledge the warning message that appears.
- Select the *Outputs* option under *Standard I/O Card*.
  The dialogue on the right opens.

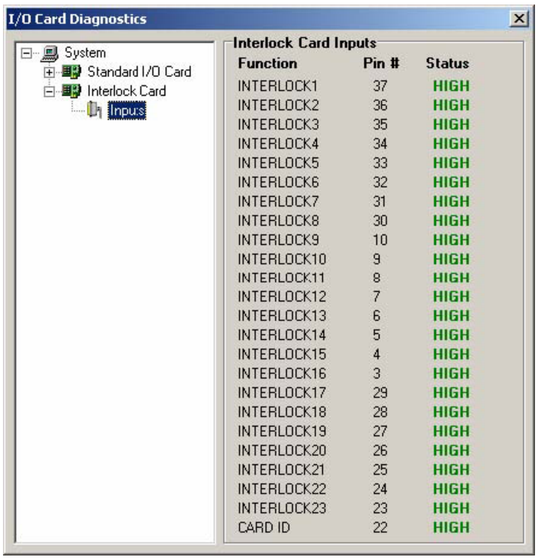


Function	This column lists the names used for the output ports in weldMARK™.
Pin #	This column lists the PIN numbers on the 37-pin connector of the I/O card.
FALSE	Clicking on these buttons allows you to switch the corresponding output to the status *FALSE* or *TRUE* for testing purposes. If the status is *TRUE* the corresponding input is connected to GND.
TRUE	

Reading Inputs from the Interlock I/O Card

The following function is available only if an interlock I/O card is installed:

- Select *Tools >I/O Card Diagnostics...* option from the menu.
  A warning message appears.
- Read and acknowledge the warning message that appears.
- Select the *Inputs* option under *Interlock Card*.
  The dialogue on the right opens.



Function	This column lists the names used for the input ports in weldMARK™.
Pin #	This column lists the PIN numbers on the 37-pin connector of the I/O card.
Status	This column specifies the current status of the ports. Each interlock port can have the status *HIGH* or *LOW*. If the status is *LOW*, the corresponding port is connected to GND.

13 SYSTEM SETTINGS

This chapter provides an overview of the configuration of the weldMARK™ environment:

Preferences...	The settings for the weldMARK™ user interface can be changed throughout the system.	➜ page 189, Preferences
Properties...	The current system properties for Windows and all of the configured hardware can be changed.	➜ page 201, System Properties Displays
Globals...	The laser power, the marking speed and the position of the marking objects can be changed throughout the system.	➜ page 202, Global Settings
Security	Access to weldMARK™ can be controlled using access rights and passwords.	➜ page 203, System Security Settings
Backup.../ Restore...	All system settings used by weldMARK™ can be saved in a backup file and respectively loaded from a backup file.	➜ page 204, Backing up System Settings

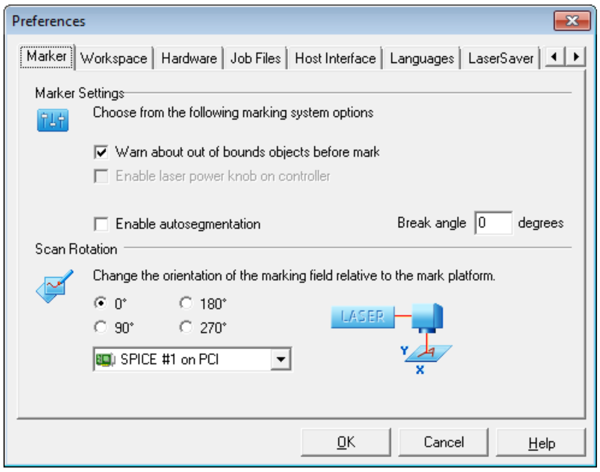
13.1 Preferences

The weldMARK™ system preferences are divided into groups and split across several tabs:

Marker	➜ page 190, Settings for Marking Field	
Page Setup	➜ page 190, Workspace Settings	
Hardware	weldMARK™ can be adapted to various deflection units, control cards and laser systems.	➜ page 191, Hardware Configuration (without Control Card) ➜ page 191, Hardware configuration (with control card)
Job Files	Job files can be automatically saved and loaded. In addition, you can also specify a folder in which jobs are saved to be loaded when using the *Operator interface only* and *Touchscreen interface* access levels.	➜ page 197, Settings for the Job File
Host Interface	weldMARK™ can communicate with external programs using different protocols and parameters.	➜ page 197, Editing the Host Interface Settings
Languages	The weldMARK™ user interface can be set to one of the supported languages.	➜ page 198, Language Settings
LaserSaver	After a certain time has elapsed, the laser can be automatically blocked and/or the laser power reduced.	➜ page 199, Setting the LaserSaver
Beam Home position	The scanner mirrors in the deflection unit can automatically be moved to a particular position at the end of a processing sequence.	➜ page 200, Setting up the Beam Home Position
Motor control	The parameters for an installed motor control card can be adjusted.	➜ page 228, Operating Stepper Motors

13.1.1 Settings for Marking Field

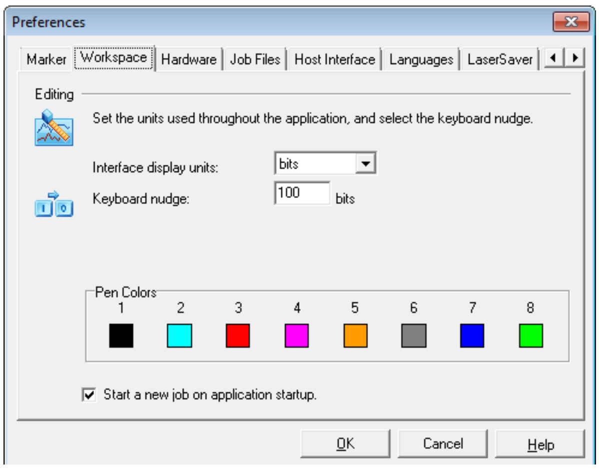
- Select *System >Preferences* option from the menu.
- Select *Marker* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Warn about out of bounds objects...	If this function is enabled, a warning is displayed on the screen if one of the objects is located outside the marking field.
Enable laser power knob on controller	If this function is enabled, the laser power settings specified in the object profiles are ignored. The laser power can then be adjusted externally. This function can only be enabled if it has been released when installing the laser driver (➜ page 218, Configuring a Laser Driver).
Enable autosegmentation	Activates the autosegmentation function.
Break angle	Indicates the critical angle between two vectors, from which the autosegmentation is used.
Rotation	Note the orientation of the marking field, which is represented in the figure next to the check boxes.

13.1.2 Workspace Settings

- Select *System >Preferences* option from the menu.
- Select *Workspace* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

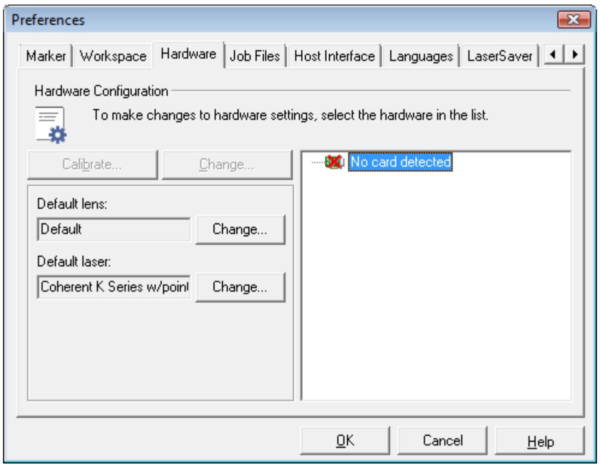


Interface display units	Selection box for the unit for the ruler display and for the input dialogues.
Keyboard nudge	This field determines how far an object is moved when it is nudged using the arrow keys (arrow + CTRL key).
Start a new job on application startup	If this function is enabled, a new job opens automatically when weldMARK™ is started.

13.1.3 Hardware Configuration (without Control Card)

If weldMARK™ does not find a control card when it is started for the first time, the defaults for the Correction File and for the laser driver are automatically activated. If you want to create jobs without connected hardware, however, it is necessary to adjust the Correction File for the deflection unit and the laser that you will use later. This means that weldMARK™ sets the correct workspace size and releases all options for the selected laser.

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

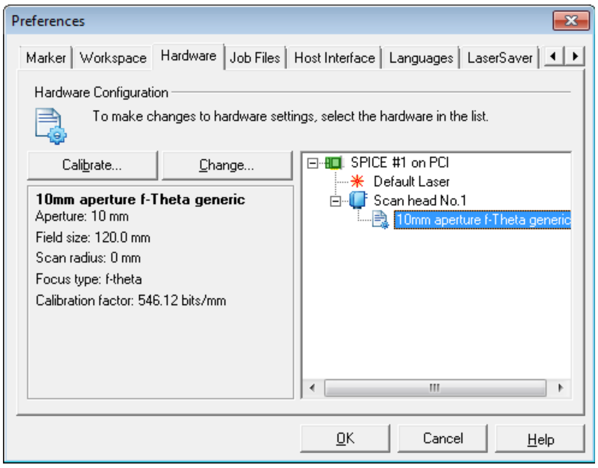


Lens, Change...	➜ page 196, Select Correction File
Laser, Change...	➜ page 193, Select Laser Driver

13.1.4 Hardware configuration (with control card)

If a control card is installed, the currently set laser driver file and the Correction File for the deflection unit can be viewed and, if necessary, changed as follows:

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
  The dialogue on the right opens.
- Select the driver you want to change from the list.
  Refer to the table below for explanations.

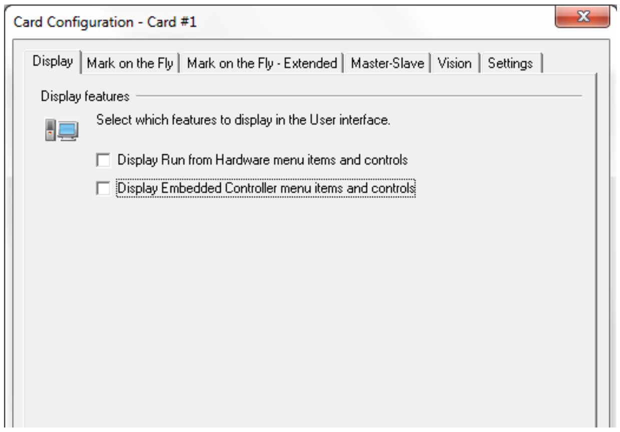


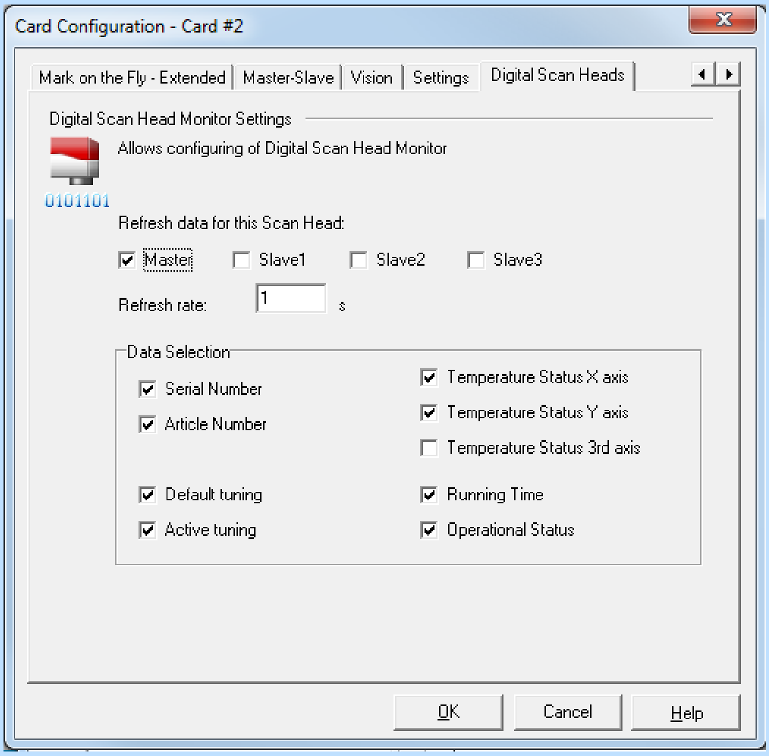
(1)	Control Card	*Configure...*	➜ page 192, Configure Control Card
(2)	Laser Driver	*Configure...*	➜ page 218, Configuring a Laser Driver
		Change...	➜ page 193, Select Laser Driver
	Visible pointer	*Calibrate*	➜ page 222, Calibrating the Visible Pointer
(3)	Scan Head	*Configure...*	Selectable only with a connected Dongle and after selecting a suitable Scan Head. ➜ page 197, Settings for the Job File
		Change...	➜ page 193, Select/change Type of Scan Head
(4)	Correction File	*Calibrate*	➜ page 205, Calibrating the Marking Field
		Change...	➜ page 196, Select Correction File

Configure Control Card

Only valid for SP-ICE control cards

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- Click on the required control card in the hardware list.
- Click on *Configure…* button.
- Select *Display* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

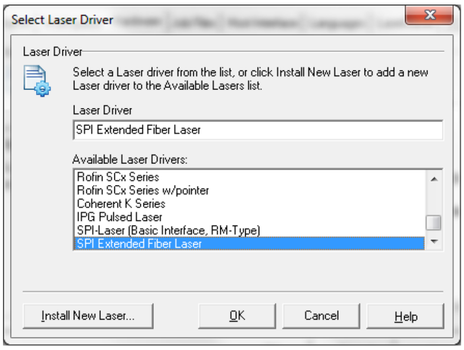


Display Run from Hardware menu items and controls	If this function is enabled, marking objects can be completely saved on the control card first and then executed directly from the card.
Display Embedded Controller menu items and controls	If this function is enabled, marking objects can be completely saved on a control card first and then executed directly from the card without a PC connection.
Mark on the Fly	→ page 181, The "Mark on the Fly" Option
Mark-on-the-Fly - Extended	→ page 182, Mark-on-the-Fly extended (2. channel)
Master-Slave	→ page 182, Master-Slave-Operating
Settings	Setting of minimum step period. ■ 20 µsec for RLC and SP-ICE-1 PCI PRO cards ■ 60 µsec for SP-ICE cards
Digital Scan Heads	Digital Scan Head Monitor settings: Enable the information you want to display from the digital Scan Head (→ page 200, Digital Scan Head Status Monitor Window) 

Select Laser Driver

This section describes how to select a laser driver if a control card is connected:

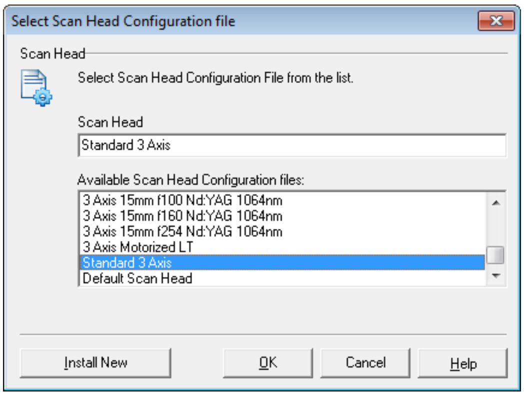
- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In the hardware list, click on the laser driver file you want to change.
- Click on *Change* button.
- Read and acknowledge the security query that appears.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Laser Driver	This text box displays the currently selected laser driver file.
Available Laser Drivers	This list box displays all available laser driver files.
Install New Laser...	Clicking on this button starts the wizard for installing laser driver file that is not included in the list.

Select/change Type of Scan Head

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In the hardware list select the desired Scan Head.
- Click on *Change* button.
- Read and acknowledge the warning message that appears.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Scan Head	Shows the actually selected Scan Head.
Available Scan Head Configuration files	Selection list of all Scan Heads for which configuration files are installed.
	Standard 2 Axis: All standard 2-Axis Scan Heads.
	2 Axis digital: For all digital 2-Axis Scan Heads.
	Standard 2 Axis galvo Calibration Sensor: 2-Axis Scan Heads with auto calibration.
	Standard 3 Axis: All AXIALSCAN Scan Heads without a motor.
	3 Axis Motorized LT: All AXIALSCAN Scan Heads with a motor.
	3 Axis Digital Scan Head w/ Pointer: Choose for AXIALSCAN Type NewGen with integrated Pointer and digital Scan Head. Slave Scan Heads with a Pointer are not supported at the moment. Only Scan Heads connected to the Master card can be used with a pointer.
	3 Axis | aperture | focal length | wave length: For specific type of Scan Head with FOCUSSHIFTER and F-Theta Objective.
	3D | field size | AXIALSCAN description: For specific type of AXIALSCAN and field size, required for 3D / 2.5D marking.
OK	Confirm the selection and returns to the hardware configuration. ➜ page 191, Hardware configuration (with control card)

Examples for Scan Head Configuration Files

.

```
[HEADER]
Owner=Copyright © 2014 RAYLASE AG
Name=Scan Head Configuration Data
Modified=04.08.2014

[SCAN HEAD]
name= 600mm Field AXIALSCAN-20-Y/600-1200
3Element=1

[DIGITAL SCAN HEAD]
Digital=1
DefaultTuning=0
TuningSwitchDelay=100
Pointer=1
XMirrorTiltValue=-14
YMirrorTiltValue=-5
```

This is an example of a Scan Head configuration file with the LTM pointer settings.

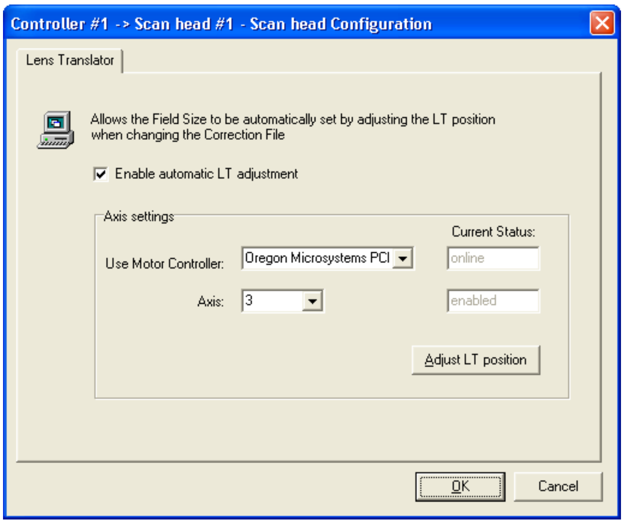
```
[HEADER]
Owner=Copyright © 2013 RAYLASE AG
Name=Scan Head Configuration Data
Modified=26.11.2013

[SCAN HEAD]
name= 2 Axis Digital Scan Head
3Element=0

[DIGITAL SCAN HEAD]
Digital=1             // 1 - digital, 0 - non digital
DefaultTuning=0       // 0, 1, 2 → LN, RA, ST
TuningSwitchDelay=100 // in [ms]
```

Information whether a head is digital or not is supplied in the head configuration.

Configure 3-Axis Subsystem

Only valid for 3-Axis subsystems with motorised linear translator

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In the hardware list select the desired Scan Head.
- Click on *Configure…* button. The dialogue on the right opens. Refer to the table below for explanations.



Enable automatic LT Adjustment	Enables the control of the linear translator.
Use Motor Controller	Allows selecting the motor controller.
Axis	Allows the mapping of the motor axis. For the linear translator, axis 3 is set as default.
Adjust LT position	➜ page 195, Positioning of Linear Translator

Positioning of Linear Translator

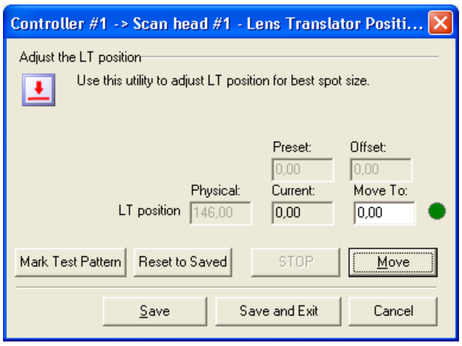
Only valid for Scan Heads with motorised linear translator

The 3-Axis subsystem has to be focused on the working plane manually prior to initial operation. The linear translator is gradually moves until the test pattern output from weldMARK™ is in focus

In case the working plane field size has been changed, the 3-Axis subsystem has to be focused again.

Warning
The laser beam can cause severe injury to the eyes and the skin. Make sure that there are no reflective objects in the beam path before marking the test pattern and turning on the laser. Note that laser beams can be reflected even by apparently matt objects. All persons in the room must wear appropriate laser protection goggles, or the marking area must be covered completely. Follow the local safety regulations, which can be obtained from the person responsible for laser safety.

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In the hardware list select the desired Scan Head.
- Click on *Configure…* button.
- Click on *Adjust LT position* button .
  The dialogue on the right opens.
  Refer to the table below for explanations.

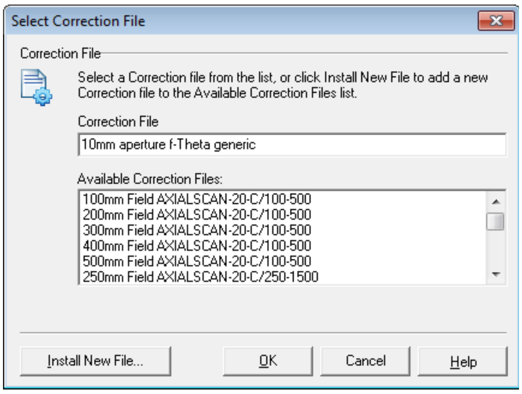


Beam Home position	Displays the linear translator's home position.
Offset	Displays the saved working position of the linear translator. It is indicated relative to the home position.
Physical	Displays the absolute position of the linear translator.
Current	Displays the actual position of the linear translator relative to the home position.
Move To	Field to enter a nominal value for the position of the linear translator.
Mark Test Pattern	Issues a test pattern for judgement of the focusing quality.
Reset	The value of *Move To* is reset to the last saved position of the linear translator.
STOP	Stops the movement of the linear translator.
Move	Moves the linear translator to the position defined in field *Move To*.
Save	Saves the actual position of the linear translator.
Save and Exit	Saves the actual position of the linear translator and exits the adjustment window.

Select Correction File

This section describes how to select a Correction File if a control card is installed:

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In the hardware list, click on the Correction File displayed under the deflection unit you are using.
- Click on *Change* button.
- Read and acknowledge the security query that appears.
  The dialogue on the right opens.
  Refer to the table below for explanations.

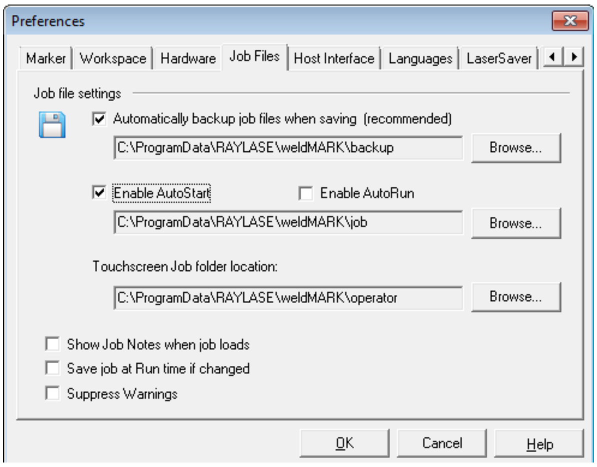


Correction File	This text box displays the currently selected Correction File.
Available Correction Files	This list box displays all available Correction Files.
	2-Axis: Name includes: Aperture, focal length and wave length.
	3-Axis: Name includes: Field size, description LTM.
Install New File...	Clicking on this button starts the wizard for installing a Correction File that is not included in the list.

13.1.5 Settings for the Job File

The settings for job files are shown in the window below.

- Select *System >Preferences* option from the menu.
- Select *Job Files* tab.
  The dialogue on the right opens. Refer to the table below for explanations.

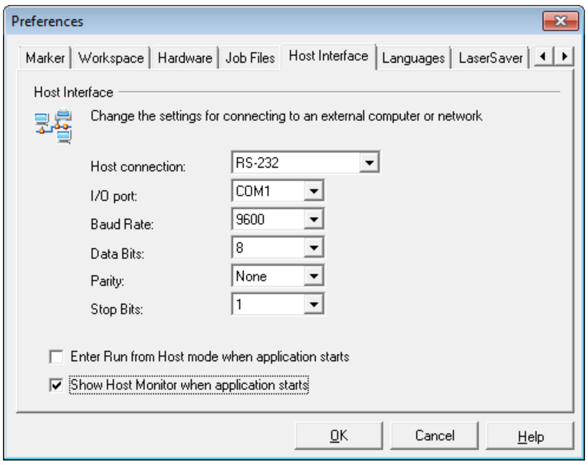


(1)	If this function is enabled, a backup file (with the extension .bak) is created automatically when saving a job file. This function is enabled by default. The backup file is saved in the specified folder. Clicking on *Browse* button allows you to select a different folder.
(2)	If this function is enabled, the job file specified in the text box will be opened automatically each time you start weldMARK™. Clicking on *Browse* button allows you to select a different job file.
(3)	When enabled, the text box specified job file is automatically executed after starting weldMARK™ (serialization).
(4)	This field specifies the location for jobs that can be loaded when working in the access levels *Operator interface only* and *Touchscreen interface*.
(5)	If this function is enabled, any job notes will be displayed automatically when a job is loaded (➜ page 174, Job Settings - "Notes").
(6)	If this function is enabled, the job will be saved during execution, if it is changed during processing (serialization).
(7)	When enabled, warnings from weldMARK™ are supressed.

13.1.6 Editing the Host Interface Settings

The host interface provides an interface that external programs can use to communicate with weldMARK™.

- Select *System >Preferences* option from the menu.
- Select *Host Interface* tab.
  The dialogue on the right opens. For further information on the settings, refer to the RAYLASE Remote Interface Manual, which you will receive separately.

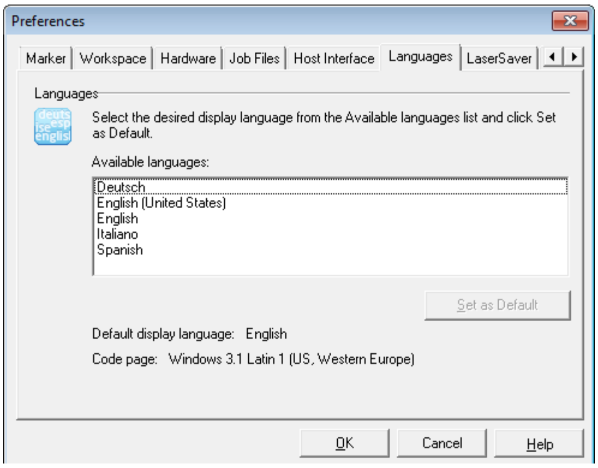


More details are in the "Remote" manual.

13.1.7 Language Settings

weldMARK™ supports various languages for the user interface. After installation, English (United States) is set as default language.

- Select *System >Preferences* option from the menu.
- Select *Languages* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Available languages	This list box shows all available languages. When you change the language, you must first click on the *Set as Default* button and then restart weldMARK™. The user interface will then be available in the selected language. The selection depends on the installed language files (*.stl) and the code page selected in the operation system, in support of the language.
Set as Default	Clicking on this button sets the language selected in the list box as default language.

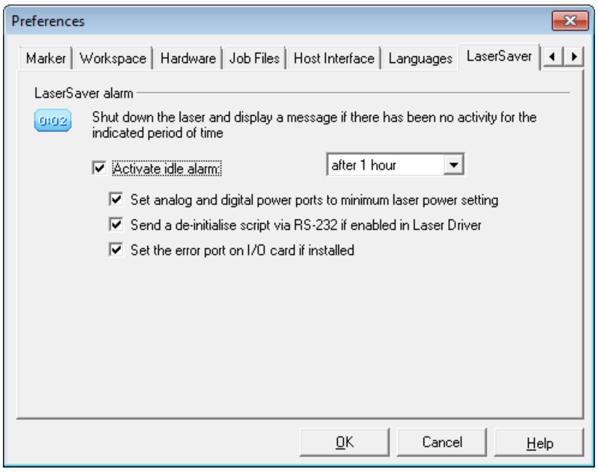
weldMARK™ offers the option to translate the GUI text into other languages. Please refer to App.-Note "Translation Manager".

13.1.8 Setting the LaserSaver

After a certain time has elapsed, the laser can be automatically blocked and/or the laser power reduced. Furthermore, an optional error message can be set.

Note: The LaserSaver is intended for Nd:YAG lasers primarily.

- Select *System > Preferences* option from the menu.
- Select *LaserSaver* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.

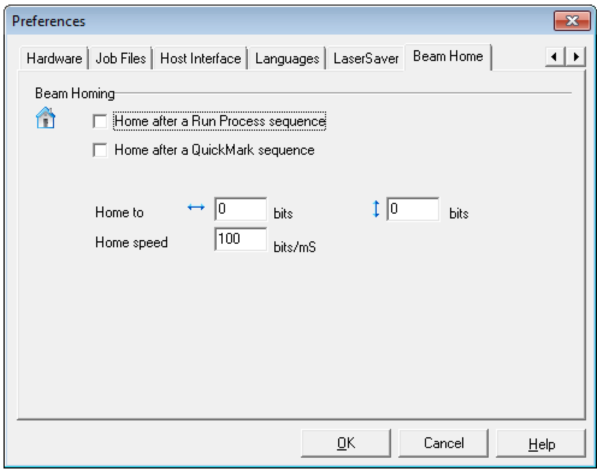


(1)	If this function is enabled, the time controlled LaserSaver is activated; options *(2)* to *(4)* are available then.	
	(2)	If this function is enabled, the interface that controls the laser power is set to its minimum settings when the time entered has been elapsed.
	(3)	If this function is enabled, a corresponding script is sent to the laser via the RS233 port when the time entered has been elapsed. Further information on this function is available from the manufacturer.
	(4)	If this function is enabled, the error port on the standard I/O card is set when the time entered has been elapsed.

13.1.9 Setting up the Beam Home Position

The scanner mirrors in the deflection unit can be moved to a particular position automatically at the end of a processing sequence. If this function is disabled, the mirrors remain at the end position of the object marked last.

- Select *System >Preferences* option from the menu.
- Select *Beam Home* tab.
  The dialogue on the right opens.
  Refer to the table below for explanations.



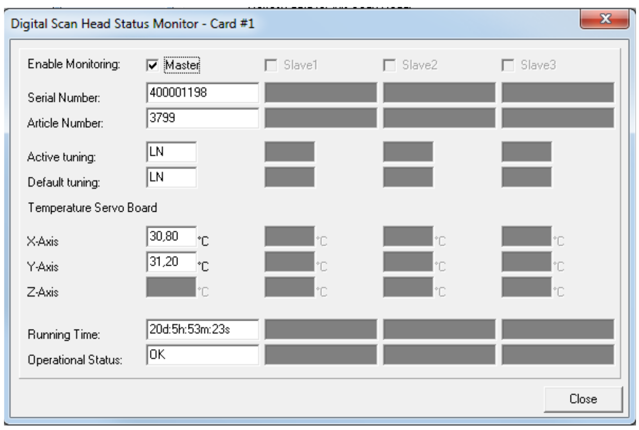
(1)	If this function is enabled, the beam moves to the home position entered at the end of a job initiated using the *Job >Run* command in the menu.	
(2)	If this function is enabled, the beam moves to the home position entered at the end of a job initiated using the *Job >QuickMark* command in the menu.	
Home to	These input boxes are used to define the home position.	The unit used can be changed (➜ page 190, Workspace Settings).
Display Speed	This input box is used to specify the speed with which the beam moves to the home position.	

Note: This option is not considered under the job setting *Run from hardware*.

13.2 Digital Scan Head Status Monitor Window

Digital Scan Head status window is displayed on the Main Form as a separate window and can be moved around freely.

Selection of parameters which will get monitored during operation.
➜ page 192, Configure Control Card

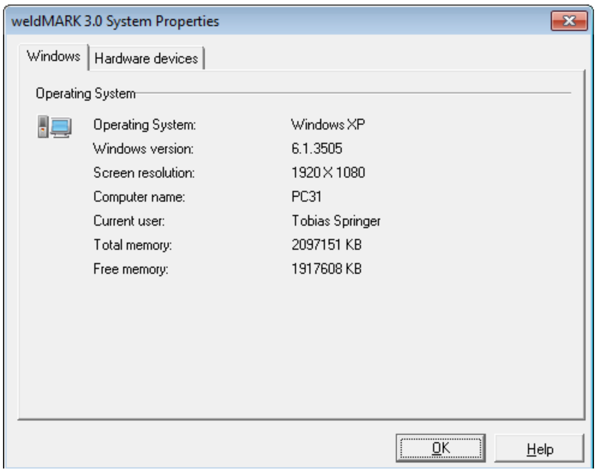


13.3 System Properties Displays

You can display the software and hardware properties of weldMARK™:

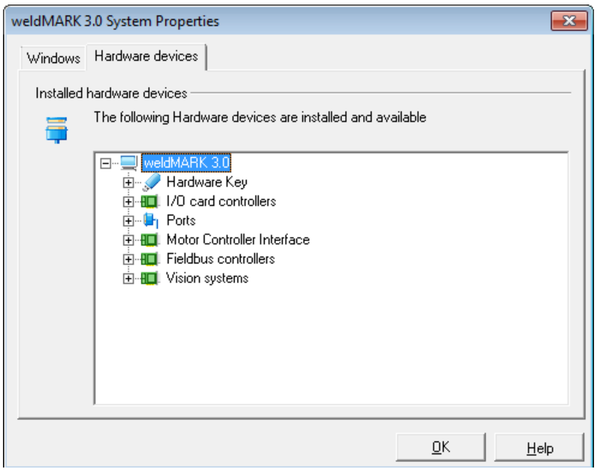
Software properties

- Select *System >Properties...* option from the menu.
- Select *Windows* tab.
  The dialogue on the right opens.



Hardware Properties

- Select *System >Properties...* option from the menu.
- Select *Hardware* tab.
  The dialogue on the right opens.
  You can view the respective hardware properties by opening the associated tree view.

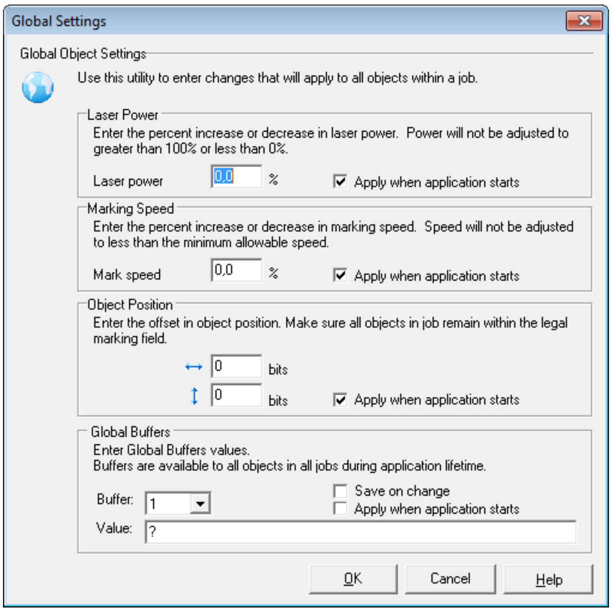


13.4 Global Settings

The "Globals..." allow weldMARK™ to be adapted to changed external conditions. For example, this can be necessary because of a slowly declining laser power or a slight change in the position of the objects to be marked. The windows to carry out these adaptations can differ in the various access levels.

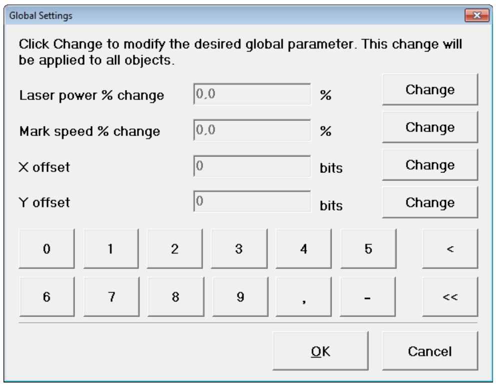
Globals at the "All editing functions" access level:

- Select *System >Globals...* option from the menu.
  The dialogue on the right opens.
  Refer to the table below for explanations.



Globals at the "Touchscreen interface" access level:

- Touch the *OPTIONS* button.
- Touch the *ADJUST* button.
  The dialogue on the right opens.
  Refer to the table below for explanations.



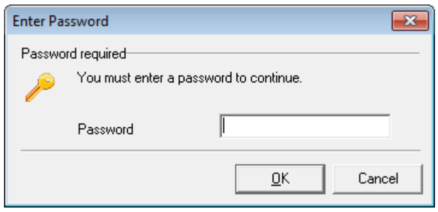
Laser power % power	Adapting the laser power or the marking speed affects all marking objects included in the job. Enter value in range between 80-120 percent.
Mark speed % change	
X offset	All objects included in the job are marked offset by the X and Y values entered here.
Y offset	
Apply when application starts	**Only available at "All editing functions" access level:** If this function is enabled, the settings will be saved along with weldMARK™. Then they apply throughout the system.
Global Buffers	Usage ➜ page 98, "Get string from memory buffer" string rule.
Buffer	Used to select the ten buffers.
Value	The buffer contents can be edited in this selection field.
Save on change	The buffer is overwritten after a change (e.g. serial number) with current value, if this option is enabled. This option applies to all ten buffers and will affect the values that are carried out via the REMOTE-Interface.
Apply when application starts	If this option is enabled, the initial values are read from the buffers each time weldMARK™ is started.

13.5 System Security Settings

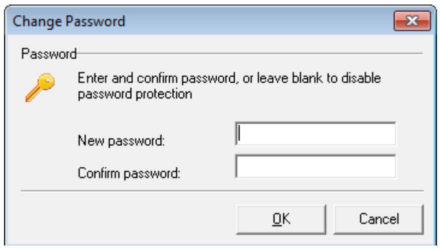
13.5.1 Password Protection

weldMARK™ provides three access levels, which allow full or limited access to the program's functions (➜ page 12, Access levels). Changing the access level can be protected by a password.

- Select *System >Security >Change Password* option from the menu.
  If a password has been entered already, you will be prompted to enter it.



  The dialogue on the right opens.
  Refer to the table below for explanations.



New password *Confirm password*	Enter the password of your choice in the input boxes. The password can consist of any string of characters. If you want to disable password protection, do not enter a password.

13.5.2 Job Files for restricted Access Levels

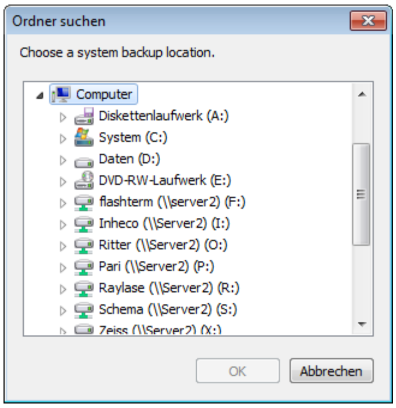
At the *Operator interface only* and *Touchscreen interface* access levels, you can only load jobs that are located in the preset folder. The folder set during installation of weldMARK™ can be changed (➜ page 197, Settings for the Job File). All jobs which should be accessible at the restricted access levels must be stored in this folder.

13.6 Backing up System Settings

The entries in the operating system's registry can be saved in a backup file. This backs up the entries or allows to transfer them to a different weldMARK™ system.

13.6.1 Backing up System Settings

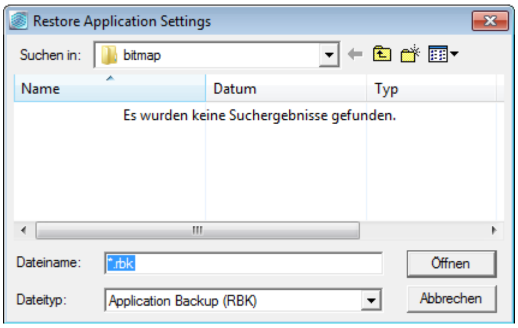
- Select *System >Backup...* option from the menu.
- Select the folder where you want to save the backup file.
  The system settings will be saved in the file "system.rbk".



13.6.2 Restoring System Settings

Note:
The following procedure overwrites all existing system settings in the weldMARK™ system!

- Select *System >Restore...* option from the menu.
- Browse to the file to be loaded - *system.rbk*.
- Select the file and click *Open*.
  The system settings saved in the backup file are loaded.



14 CALIBRATING THE MARKING FIELD

Because of the construction of the X/Y deflection units and the optical properties of F-Theta lenses, a distorted marking field is output. Therefore, a specific Correction File is provided for each deflection unit, which allows the software to compensate this distortion. Further information on field distortion can be found in the application manual available by RAYLASE.

14.1 Correction of Mechanical Tolerances

The type-specific field distortion of a deflection unit is compensated automatically when the corresponding weldMARK™ Correction File has been assigned. However, because of laser divergence, optical and mechanical tolerances every deflection unit can also produce its own individual field distortion. The procedures below allow the compensation of this distortion as well.

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In directory tree, select the lens under the deflection unit you want to calibrate.
- Click on *Calibrate* button.

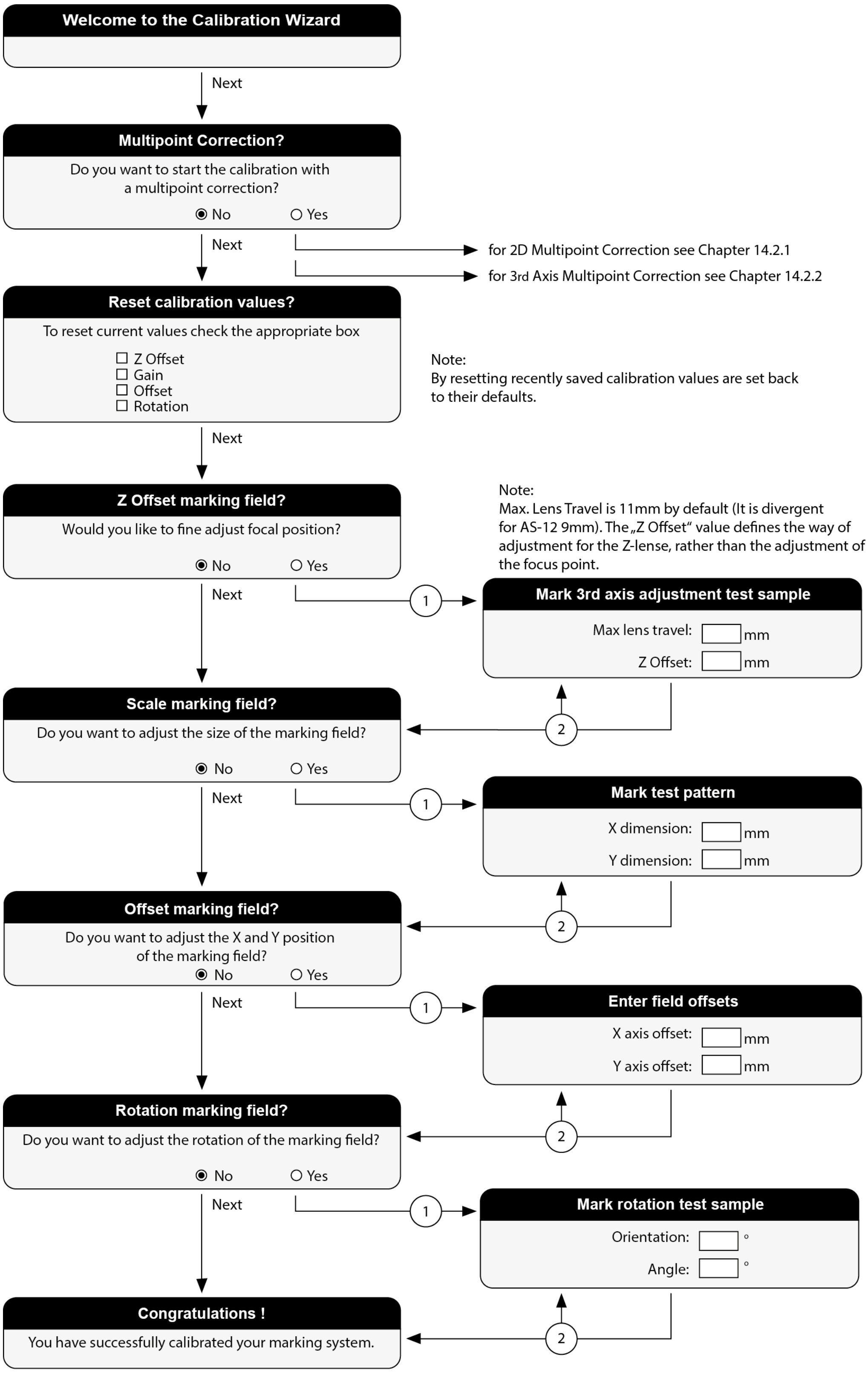
Warning

The marking is activated, if this symbol appears in the following diagram.

The laser beam can cause severe injury to the eyes and the skin. Make sure that there are no reflective objects in the beam path before starting a job and turning on the laser. Note that laser beams can be reflected even by apparently matt objects.

All persons in the room must wear appropriate laser protection goggles, or the marking area must be covered completely. Follow the local safety regulations, which can be obtained from the person responsible for laser safety.

14.2 The Correction-File Calibration Wizard



1 - place test pattern
- mark test pattern
The parameters of the „test pattern“ profile will be used for marking.

2 - mark test pattern repeatedly
- Check calibration

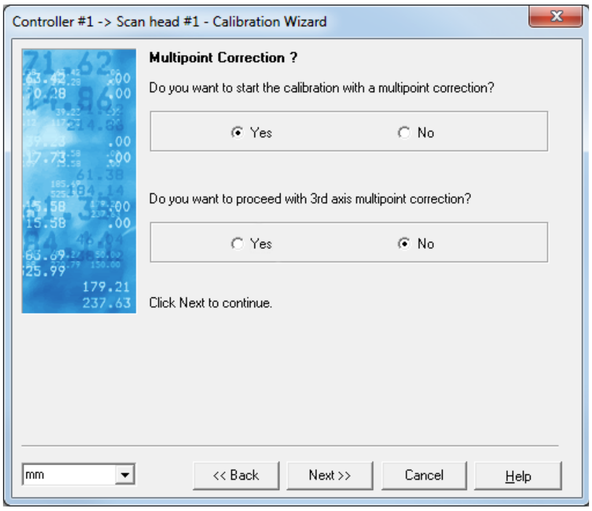
14.2.1 2D Multipoint Correction

The multi-point correction is a field-correction based on Correction Files. More points are taken into account by dividing the field with horizontal and vertical lines into squares. The points of contact can be changed in order to achieve correction of the field distortion.

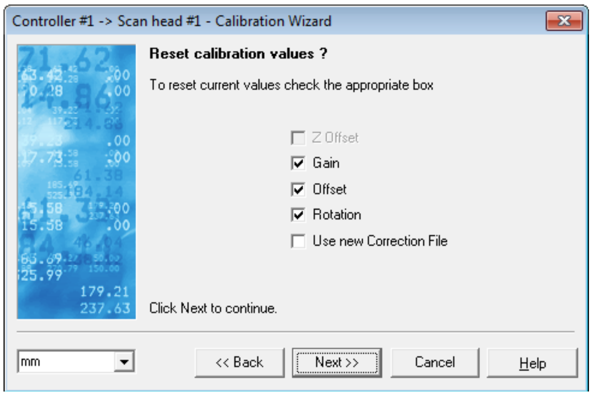
Important Note:

The multipoint correction must be executed with 0 degrees field orientation!

- After starting the calibration wizard, select *Yes* for the multipoint correction and then click the *Next* button.

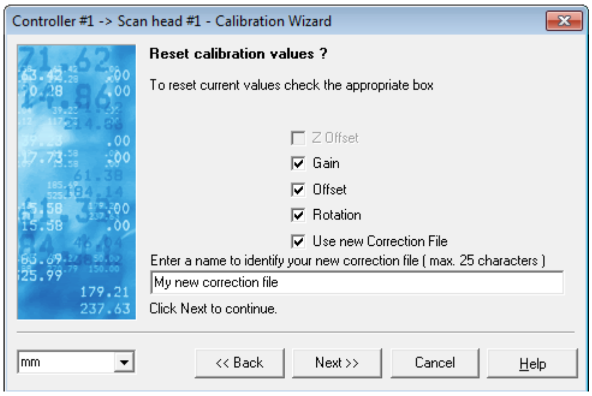


- Previous calibration values can be reset by activating the corresponding checkboxes and clicking on the *Next* button.
- It is recommended to reset the parameters *Gain*, *Offset* and *Rotation*.
- If necessary, select *Use new Correction File* to create a new Correction File.



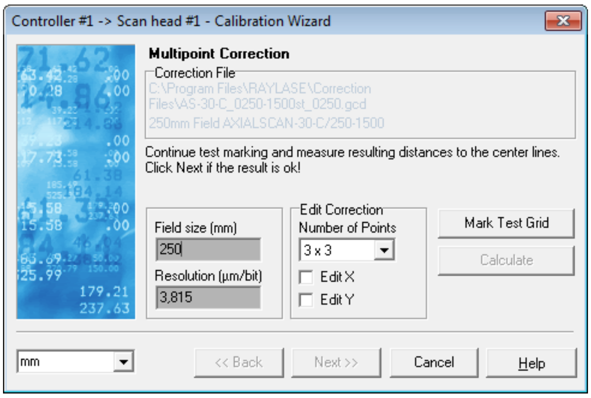
Creating a new Correction File

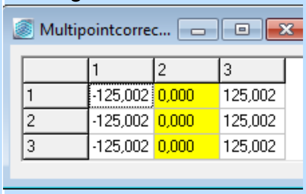
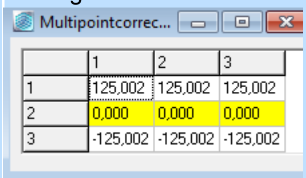
- Choose a name for the Correction File.
- The specified name can not be empty and not a name of an existing file.
- Click the *Next* button to continue with the multipoint correction.



Performing the Multipoint Correction

- The dialogue on the right opens.
  The following table shows all parameters.



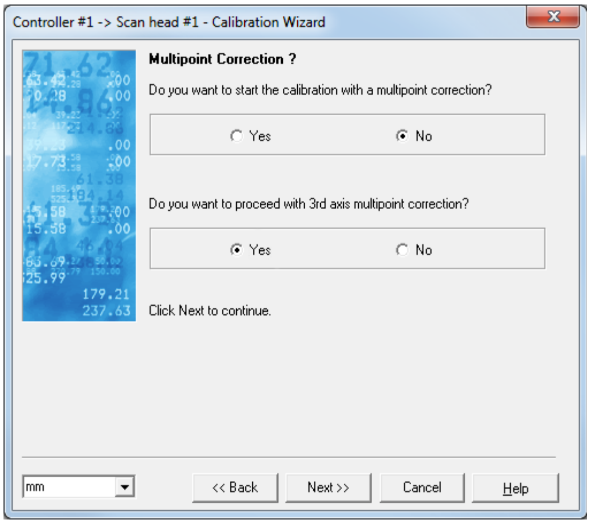
<table>
<tr><td>Field size (mm)</td><td colspan="2">Display the field size in mm</td></tr>
<tr><td>Resolution (µm/bit)</td><td colspan="2">Display the resolution in µm/bit</td></tr>
<tr><td rowspan="4">Edit Correction</td><td colspan="2">The of the grid to be marked, and the correction for the X and Y axis can be set here.</td></tr>
<tr><td>Number of Points</td><td>Number of points for the correction.
Available patterns are: 3x3, 5x5, 9x9, 11x11, 17x17, 33x33, 65x65... grid points.</td></tr>
<tr><td>Edit X</td><td>Setting the correction on the X axis

</td></tr>
<tr><td>Edit Y</td><td>Setting the correction on the Y axis

</td></tr>
<tr><td>Mark Test Grid</td><td colspan="2">Starts the marking process. Prepare the work piece to mark the test-grid. Note that the complete marking field is used. Confirm the warning message when you are ready to mark, or cancel the operation.</td></tr>
<tr><td>Calculate</td><td colspan="2">Verification of the changes on the X and Y axis. An invalid area can be indicated as the case may be.</td></tr>
</table>

14.2.2 3rd Axis Multi Point Correction

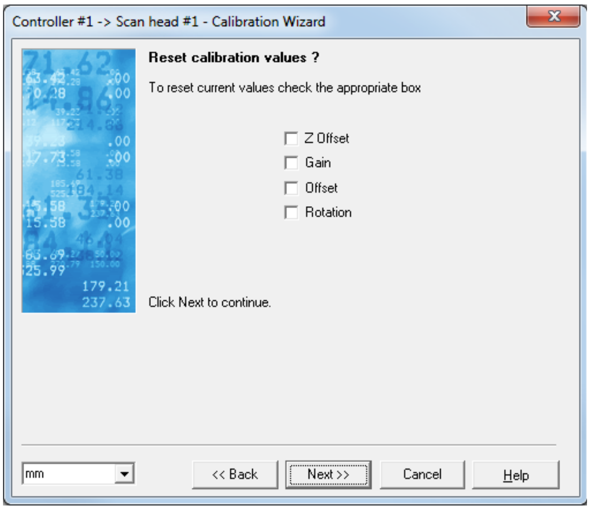
This correction is used to correct local focus deviations in working field working with AXIALSCAN deflection unit. The tools marks line pattern at virtual grid points and changes focus per line. By entering index number of best fitting line, tool calculates adaptations.

Important Note:
The multipoint correction must be executed with 0 degrees field orientation!

- On the Multipoint Correction selection form select *Yes* for Multipoint Correction in the *3rd axis multipoint correction* box and the regular (2D) Multipoint correction must select *No*.

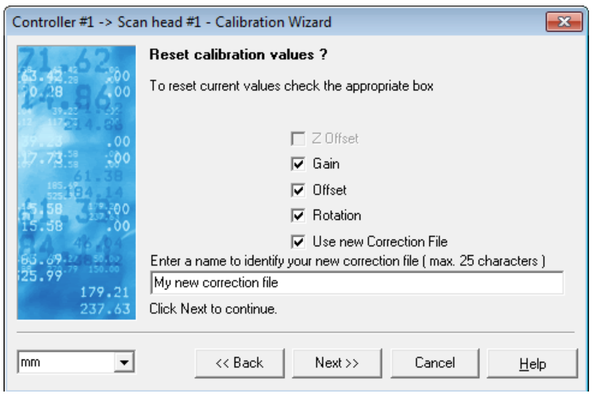


On the next screen, it is recommended that values for *Z-Offset*, *Gain*, *Offset* or *Rotation* are kept as they are. These values should, in general, be reset only in case of Gain calibration.



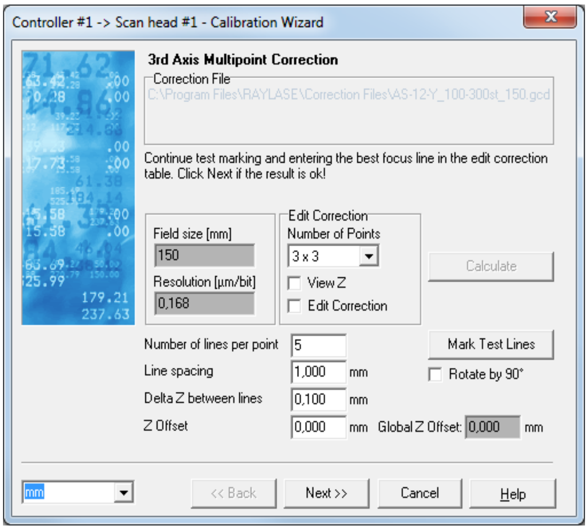
Creating a new Correction File

- Choose a name for the Correction File.
- The specified name can not be empty and not a name of an existing file.
- Click the *Next* button to continue with the multipoint correction.



Performing the Multipoint Correction

- The dialogue on the right opens.
  The following table shows all parameters.



Field size (mm)	Setting the field size in mm
Resolution (µm/bit)	Setting the resolution in µm/bit

Edit Correction

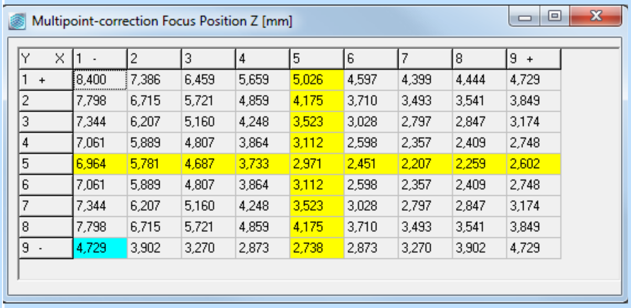
The of the grid to be marked, and the correction for the X and Y axis can be set here.

Number of Points

By selecting one of the options for *Number of Points* on the form it is possible to increase / reduce the number of points used for marking the test pattern and then using them for interpolating the values for the rest of the points in the Correction File.
If more points are selected then the accuracy is better, but on the other side requires more work for entering data in the table used for correcting the values.
Available sizes are: 3x3, 5x5, 9x9, 11x11, 17x17, 33x33, 65x65 (By selection 65x65 a complete Correction File table is shown).

View Z

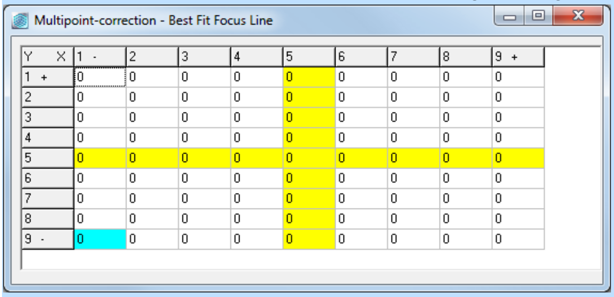
When checked the current 3rd axis positions read from the currently active Correction File can be viewed.
This information can be used for checking if and how the values are changed after the corrections are applied to the Correction File.


Multipoint-correction Focus Position Z [mm]

Y X	1 -	2	3	4	5	6	7	8	9 +
1 +	8,400	7,386	6,459	5,659	5,026	4,597	4,399	4,444	4,729
2	7,798	6,715	5,721	4,859	4,175	3,710	3,493	3,541	3,849
3	7,344	6,207	5,160	4,248	3,523	3,028	2,797	2,847	3,174
4	7,061	5,889	4,807	3,864	3,112	2,598	2,357	2,409	2,748
5	6,964	5,781	4,687	3,733	2,971	2,451	2,207	2,259	2,602
6	7,061	5,889	4,807	3,864	3,112	2,598	2,357	2,409	2,748
7	7,344	6,207	5,160	4,248	3,523	3,028	2,797	2,847	3,174
8	7,798	6,715	5,721	4,859	4,175	3,710	3,493	3,541	3,849
9 -	4,729	3,902	3,270	2,873	2,738	2,873	3,270	3,902	4,729

Edit Correction

When checked the *Best Fit Focus Line* table is shown. The lower left cell is shown in "turquoise" colour and correspond to the lower left corner of the x, y coordinate system, maximum negative x and y positions.
For the selected "Number of Points" (3 x 3, 5 x 5, ...) a row /column field is available. By de-fault all the values are zero, meaning that the centre marked line has the best focus. After marking a test pattern, and inspecting marking results, index numbers of lines with best focus should be entered in the corresponding cells.
If the "best fit" marked lines is on the left of the centre line then the Index number should be entered with a negative sign.


Multipoint-correction - Best Fit Focus Line

Y X	1 -	2	3	4	5	6	7	8	9 +
1 +	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9 -	0	0	0	0	0	0	0	0	0

Mark Test Lines

Starts the marking process. A certain number of lines, each with an own Z-value around intersection points.

Number of lines per point

Total number of lines marked at each grid intersection point
There is always a centre line and then 2 sets of lines left and right of the centre line.
The number of lines per pattern are limited as well, in case that either the number of lines or the line spacing is too large.
Valid value is an odd number and in the range 3 to 99.

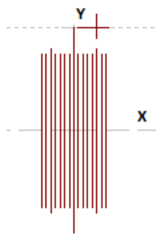
Line spacing

Distance between marked lines in a pattern. Valid range is 0.1 to 100 mm.
The number of lines and the distance between them must be smaller than the possible cell width.

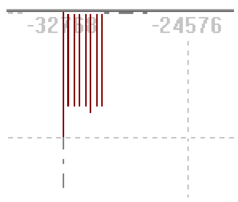
Delta Z between lines	Defines the change in focus for each line of the pattern. This value is the 3rd lens offset value that will be applied between lines. For the lines left of the centre line, 3rd lens will be moved in the negative direction, causing the focus in the field to shift up to-wards the head. For the lines on the right side of the centre line, the position of the 3rd lens will move in the positive direction causing focus to go further away from the head. If Delta Z is a negative value then the reverse logic will apply. This can be useful in case when the marking plane has a different slope. Valid range is -100,000 to 100,000 mm, although only +/- allowed Lens Translator movement range, usually 9 or 11 mm, should be used for most of the Scan Heads.
Z Offset	This value can be useful when an additional offset is required to already defined Global Z Offset value or if the Global Z Offset value is reset. IMPORTANT: This value will be taken into account when modifying the Correction File. After pressing calculate it is reset to zero since the values in the Correction File are al-ready modified to take this offset into account. A global 3rd lens offset can be used. Care must be taken that if a negative Z Offset is used it might overflow the minimum zero value
Global Z Offset	The value for *Global Z Offset* is displayed in the lower right corner of the form. Global Z-Offset is preserved and taken into account during Test pattern marking. If the Global Z Offset is to be included in the modified Correction File, then it should be reset to zero on the *Reset calibration values* form and then entered in the *Z Offset* value on the *3rd Axis Multipoint Correction* form.
Calculate	Verification of the changes on the X and Y axis. An invalid area can be indicated as the case may be.
Rotate by 90°	When checked, the test pattern is marked in the y direction.

Defining the test pattern

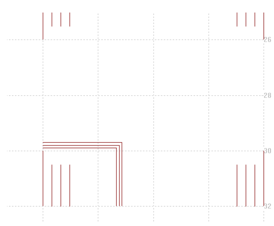
- Test pattern is a set of lines marked at the grid intersection point. The centre line a little bit longer then the side lines. Each 5th line, counted from the centre is slightly longer than other non-centre lines.



- In the centre of the field an additional + sign is marked so that the coordi-nate system is bet-ter visible once the marked material is taken away from the marking area.



- Patterns at the edge of the field are marked only partially so that the field is not exceeded.
- Here is an example of the pattern in the left upper corner, where the lines on the left are not marked:
- In the lower, left corner (-x,-y) the fol-lowing pattern is marked in addition:



Focus adjustment procedure

A usual way of doing the fine adjustment would be to

- Select the number of points used to investigate the focus (3 x 3, 5 x 5, etc.)
- Set the pattern parameters
  - *Number of lines per point*
  - *Line spacing*
  - *Delta Z*
  - Optionally *Z Offset*
  - In case that the surface is inclined in the y direction, check *Rotate by 90°* and/or set the *Line spacing* to a negative value.
- Mark test pattern by pressing *Mark Test Lines*
- Inspect the marking result and notify the ordinal number of the best fitting line in the pattern
- Open the *Best Fit Focus Line* table by checking the *Edit Correction* check box
- Enter index numbers of lines that are best fitting the focus for each pattern. For lines left from the centre line use negative values, and for lines on the right positive values
- Press *Calculate*
- Mark test patterns again and check if the middle lines are marked with best focus in all places.
- If not re-adjust the values for "not so good" table fields and repeat the procedure.

On *Calculate* a temp file is created and sent to the card.

Only on *Next* is the original corr file overwritten.

14.2.3 Saving Modified Correction Files

During parameter adjustment, a temporary version of the Correction File is created in the original Correction File folder.

For example, if the original Correction File is "AS-20-C_0100-500st_0400.gcd", then the temporary file with the name "AS-20-C_0100-500st_0400Temp.gcd" is created in

"C:\Program Files\RAYLASE\Correction Files\"

A temporary Correction File is calculated and sent to the controller card each time when Calculate and then *Mark test Lines* is pressed.

The "*Temp" file is deleted when the Wizard proceeds to the next step regardless if *Cancel* or *Next* is pressed.

If this step of the wizard is exited with *Next*, then the original Correction File is saved in the backup folder

"C:\Program Files\RAYLASE\Correction Files\backup"

and the last Temp version of the Correction File replaces the original one.

If the backup folder already contains previous versions of the same Correction File then additional backup versions are created with an index number which is always increased.

For example, if the original Correction File was AS-20-C_0100-500st_0400.gcd then after running *3rd axis multipoint correction* 3 times and always changing the values, the backup folder would contain the following files:

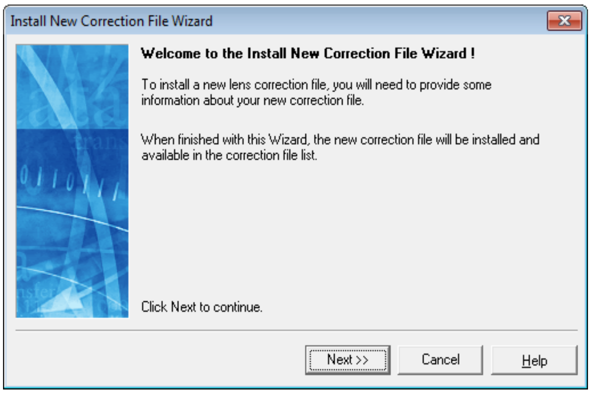
- AS-20-C_0100-500st_0400.gcd
- AS-20-C_0100-500st_0400_1.gcd
- AS-20-C_0100-500st_0400_2.gcd

If *Cancel* is pressed, then the original Correction File is preserved and it is sent to the card so that the Temp versions of the card are removed.

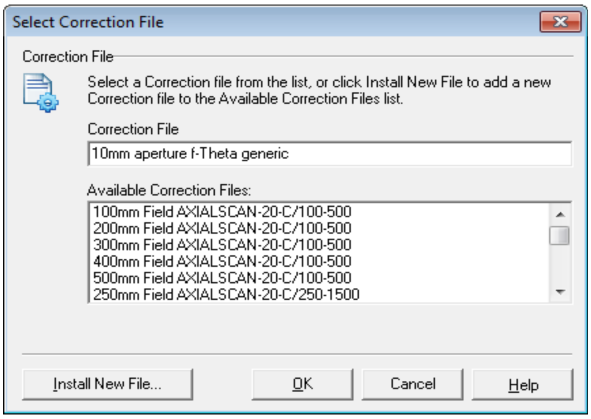
14.3 Adding a new Correction File

This wizard enables the import of Correction Files into the standard correction folder and if only the gcd-file is present the txt-file will be created. Information in the txt-file will be displayed in weldMARK™ while loading.

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In the directory tree, click on the Correction File of the deflection unit you want to optimize.
- Click on *Change* button.



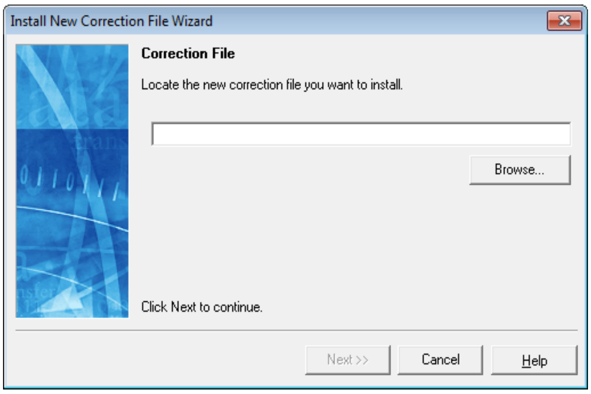
- Click on *Install New File* button.
  The following window is opened.

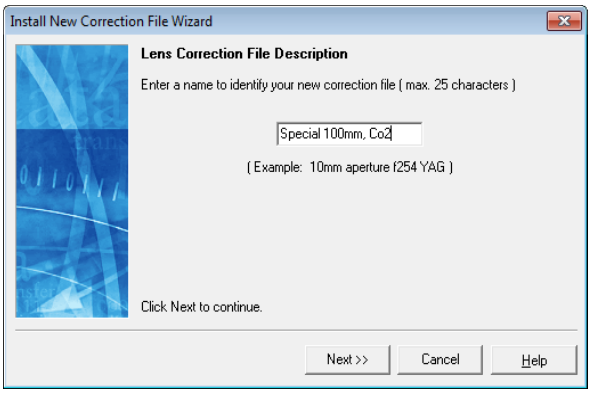


- Click on *Browse...* and select the Correction File you want to add to the list.
- It will be imported in the Correction File folder, If both the gcd- and the txt-file are present
  Click on the *Next* button. The wizard will quit at this point.

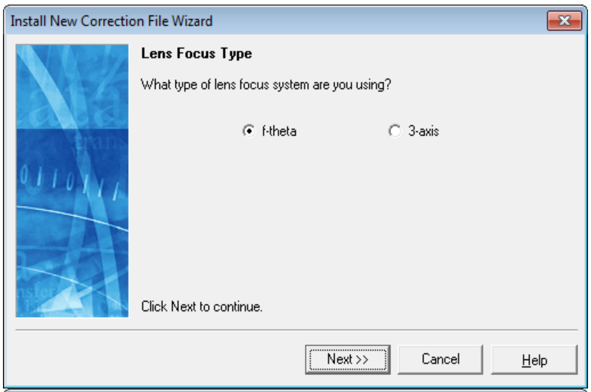
or

- The wizard continues and creates a txt-file, if no gcd-file is present.
  Click on *Next* button to open the following window.
- Enter a name for the new Correction File (max. 25 characters).
- Click on *Next* button.
  The following window is opened.

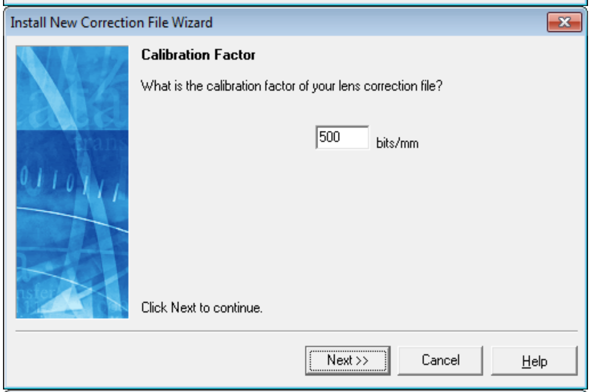




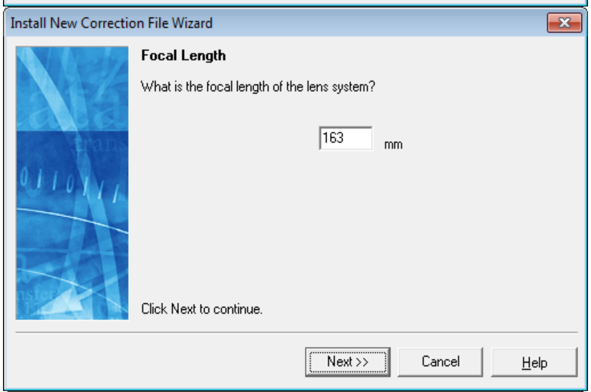
- Specify the type of focusing system used.
- Click on *Next* button.
  The following window is opened.



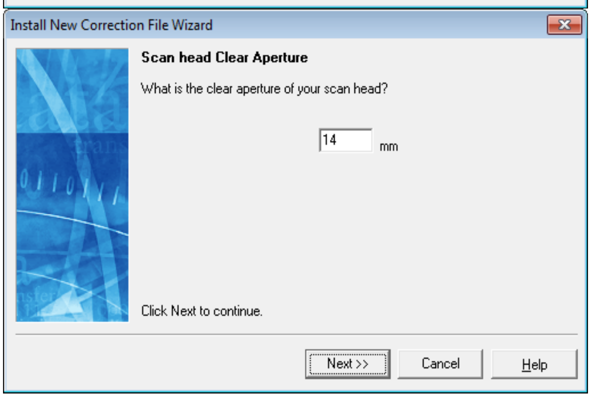
- Enter the calibration factor in bits/mm.
  This value can be obtained from the manufacturer of the deflection unit.
- Click on *Next* button.
  The following window is opened.



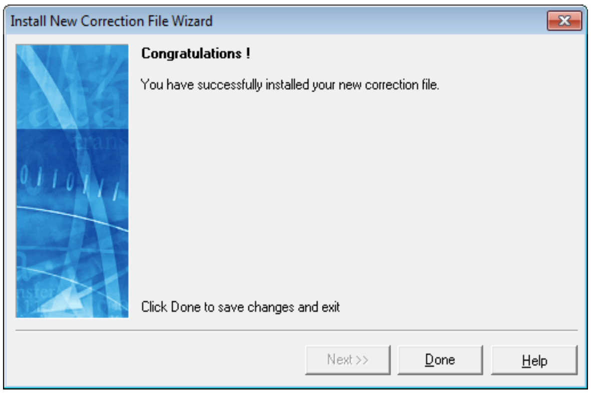
- Enter the focal distance of the lens used.
- Click on *Next* button.
  The following window is opened.



- Enter the input aperture of the deflection unit.
  This value can be obtained from the manufacturer of the deflection unit.
- Click on *Next* button.
  The following window is opened.



- Exit the wizard by clicking on *Done*. The new Correction File is added to the list.



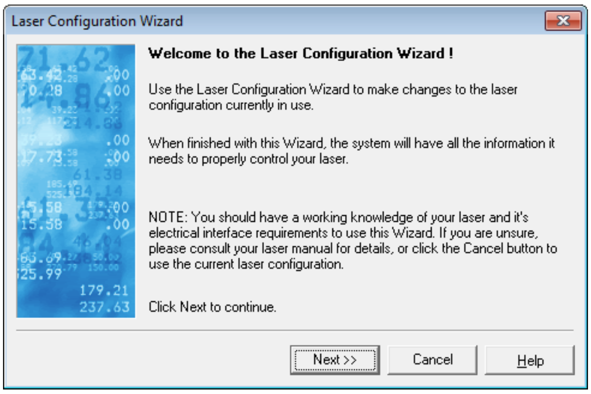
15 CONNECTING THE LASER

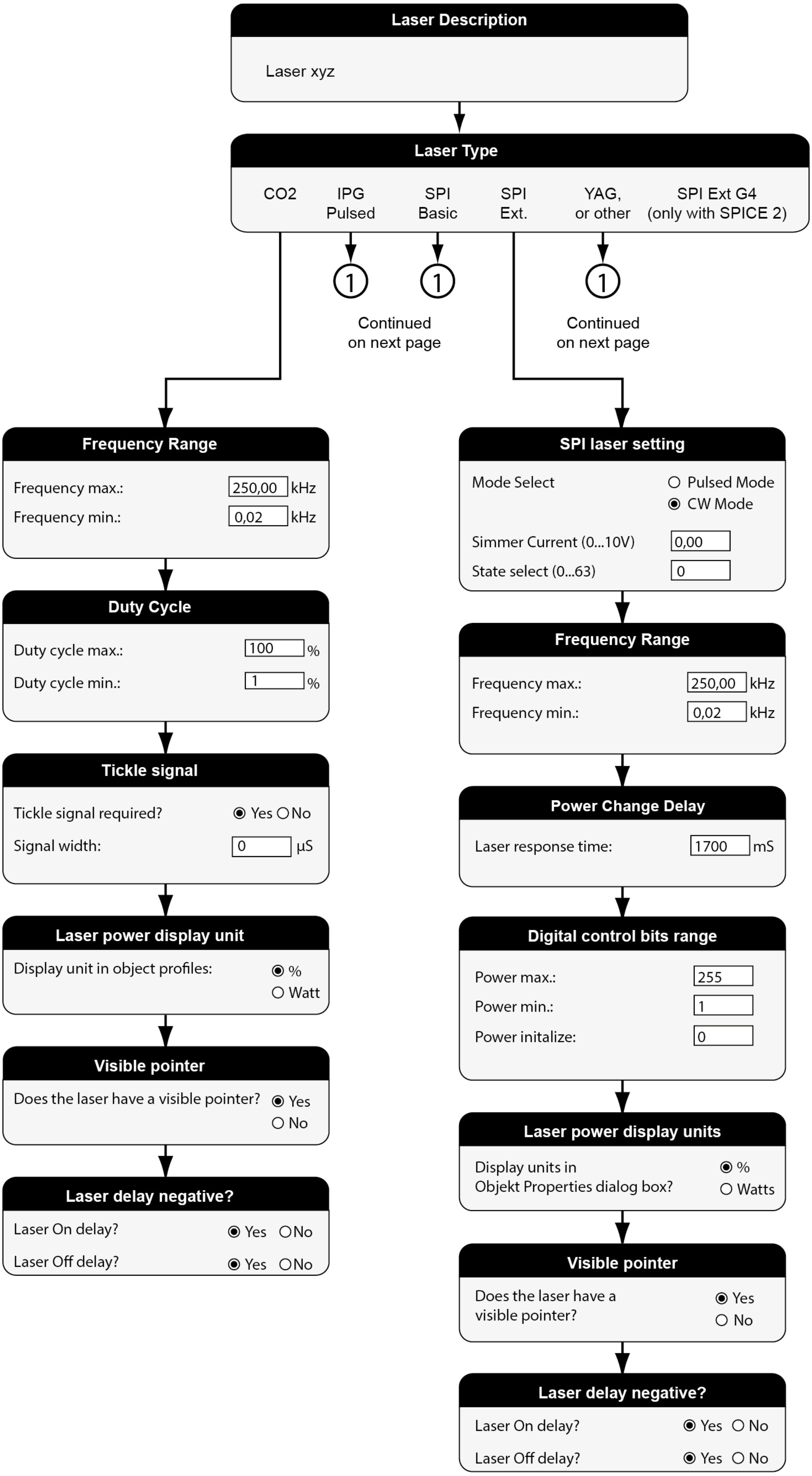
weldMARK™ supports SP-ICE, RLC-USB and RLC-PCI control cards. For details of how to connect a laser to the respective control card, refer to the corresponding control card manual.

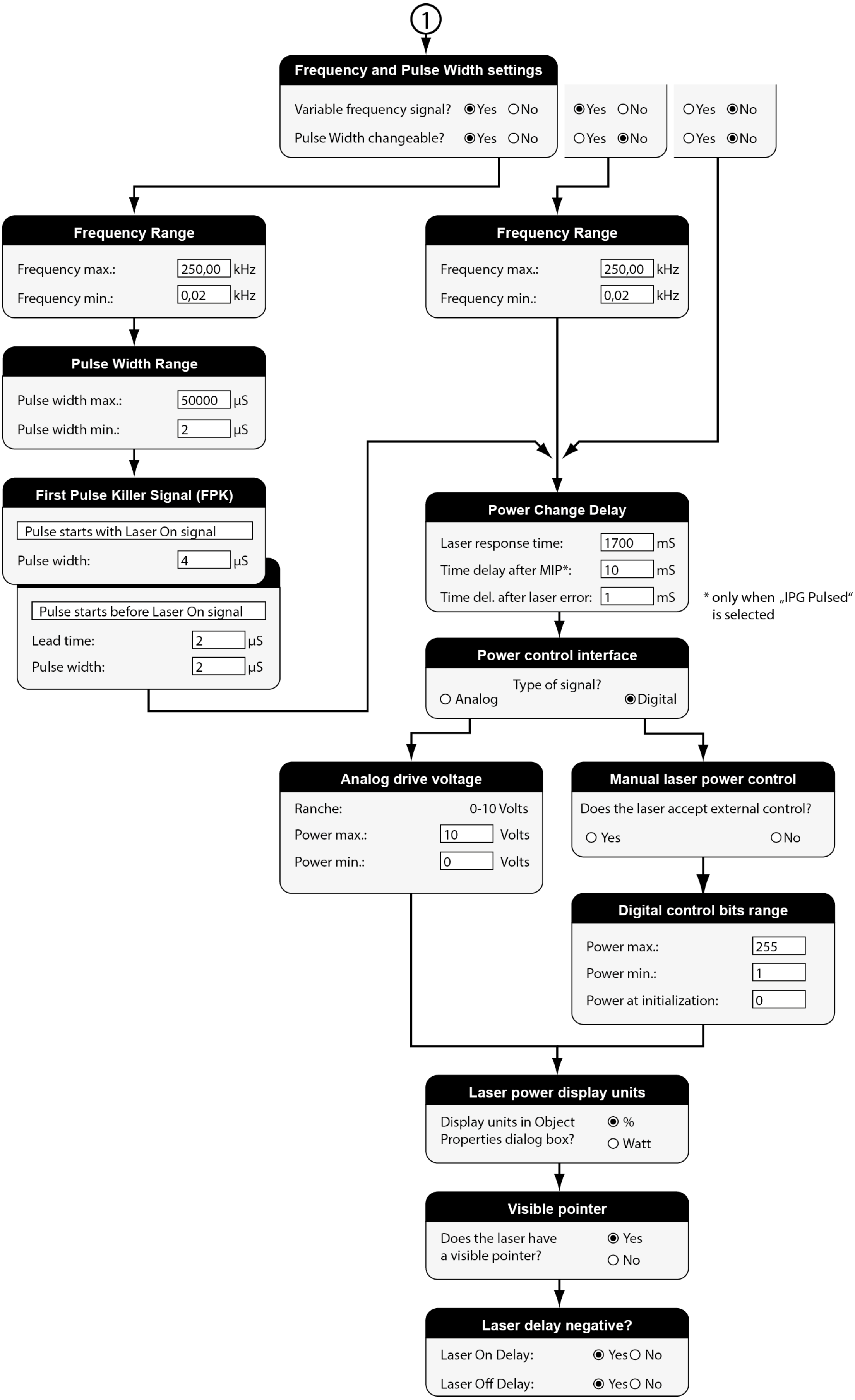
15.1 Configuring a Laser Driver

weldMARK™ is supplied with drivers for various laser systems. If any changes to the settings of these drivers are necessary, the procedure is as follows:

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In the directory tree, click on the laser driver file you want to configure.
  Note: The directory tree is visible only if a Scan Head card is detected after starting the software.
- Click on *Configure…* button.
  Note: The button is available only if a valid dongle is connected.
- Read and acknowledge the security query that appears.
  The dialogue on the right opens.
- Click on *Next* button.
  See the flow diagram on the following pages for settings.




Laser Description
Laser xyz
Laser Type
CO2
IPG Pulsed
SPI Basic
SPI Ext.
YAG, or other
SPI Ext G4 (only with SPICE 2)
1
1
1
Continued on next page
Continued on next page
Frequency Range
Frequency max.: 250,00 kHz
Frequency min.: 0,02 kHz
Duty Cycle
Duty cycle max.: 100 %
Duty cycle min.: 1 %
Tickle signal
Tickle signal required? Yes No
Signal width: 0 µS
Laser power display unit
Display unit in object profiles: % Watt
Visible pointer
Does the laser have a visible pointer? Yes No
Laser delay negative?
Laser On delay? Yes No
Laser Off delay? Yes No
SPI laser setting
Mode Select Pulsed Mode CW Mode
Simmer Current (0...10V) 0,00
State select (0...63) 0
Frequency Range
Frequency max.: 250,00 kHz
Frequency min.: 0,02 kHz
Power Change Delay
Laser response time: 1700 mS
Digital control bits range
Power max.: 255
Power min.: 1
Power initalize: 0
Laser power display units
Display units in Objekt Properties dialog box? % Watts
Visible pointer
Does the laser have a visible pointer? Yes No
Laser delay negative?
Laser On delay? Yes No
Laser Off delay? Yes No


1
Frequency and Pulse Width settings
Variable frequency signal? Yes No
Pulse Width changeable? Yes No
Yes No
Yes No
Yes No
Yes No
Frequency Range
Frequency max.: 250,00 kHz
Frequency min.: 0,02 kHz
Frequency Range
Frequency max.: 250,00 kHz
Frequency min.: 0,02 kHz
Pulse Width Range
Pulse width max.: 50000 µS
Pulse width min.: 2 µS
First Pulse Killer Signal (FPK)
Pulse starts with Laser On signal
Pulse width: 4 µS
Pulse starts before Laser On signal
Lead time: 2 µS
Pulse width: 2 µS
Power Change Delay
Laser response time: 1700 mS
Time delay after MIP*: 10 mS
Time del. after laser error: 1 mS
* only when „IPG Pulsed“ is selected
Power control interface
Type of signal?
Analog
Digital
Analog drive voltage
Ranche: 0-10 Volts
Power max.: 10 Volts
Power min.: 0 Volts
Manual laser power control
Does the laser accept external control?
Yes
No
Digital control bits range
Power max.: 255
Power min.: 1
Power at initialization: 0
Laser power display units
Display units in Object Properties dialog box?
%
Watt
Visible pointer
Does the laser have a visible pointer?
Yes
No
Laser delay negative?
Laser On Delay: Yes No
Laser Off Delay: Yes No

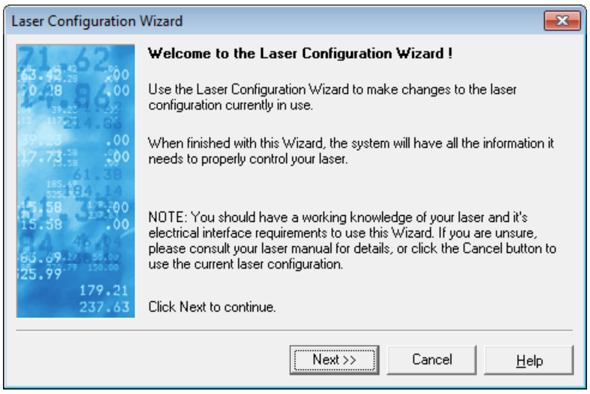
15.2 Adding a new Laser Driver

A laser driver is a file that contains the operating parameters for the laser. This file enables weldMARK™ to control the laser correctly and to display the accurate laser parameters.

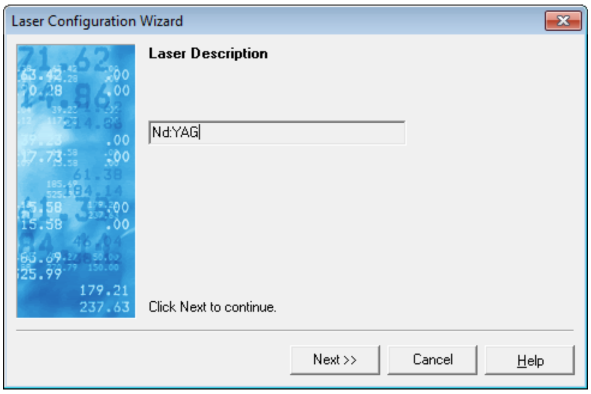
weldMARK™ is supplied with various drivers for standard lasers. If the laser type you want to use is not included in the list of available laser driver files, you can add a new driver file:

- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- In directory tree, click on the laser driver you want to configure.
  Note: The directory tree is visible only if a Scan Head card is detected after starting the software.
- Click on *Change* button.
  Note: The button is available only if a valid dongle is connected.
- Read and acknowledge the security query that appears.

- Click on *Install New Laser...* button.
  The dialogue on the right opens.
- Click on *Next* button.
  The following window is opened.



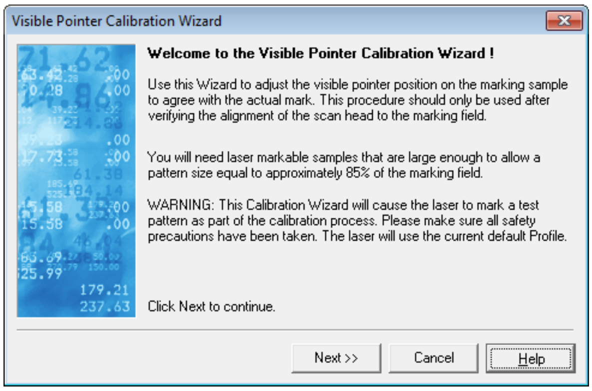
- Enter a name for the laser driver file in the input box.
  This name will appear in the list of available laser drivers.
- Click on *Next* button.
- Continue with the procedure as described in the next section:
  ➜ page 218, Configuring a Laser Driver



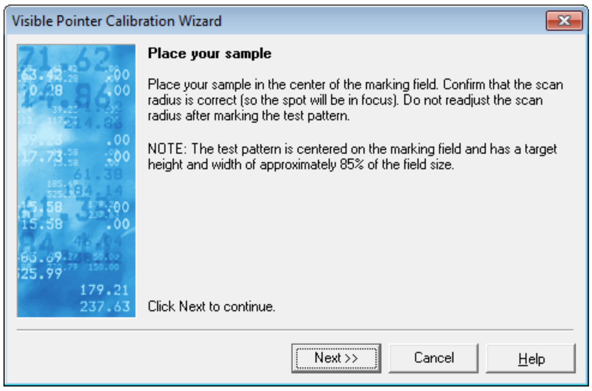
15.3 Calibrating the Visible Pointer

As a result of wavelength differences between the visible pointer and the marking laser, the position of the visible pointer in the marking field does not always correspond exactly to that of the marking laser. It is therefore necessary to calibrate the visible pointer. This chapter describes how to do this.

- If necessary, activate the visible pointer in the laser driver (➜ page 218, Configuring a Laser Driver).
- Select *System >Preferences* option from the menu.
- Select *Hardware* tab.
- Click on the visible pointer in the directory tree.
- Click on *Calibrate* button.
  The dialogue on the right opens.
- Click on *Next* button.



- Place a sufficiently large sample in the center of the marking field and click on *Next*.
  The dialogue on the right opens.



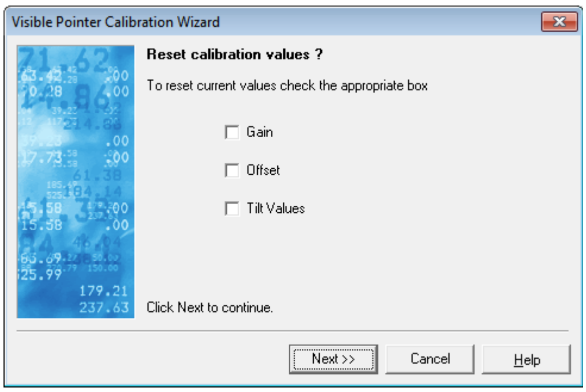
Warning

The next action activates the marking laser.

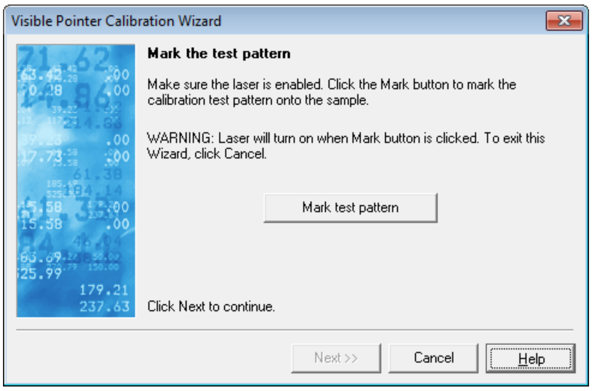
The laser beam can cause severe injury to the eyes and the skin. Make sure that there are no reflective objects in the beam path before starting a job and turning on the laser. Note that laser beams can be reflected even by apparently matt objects.

All persons in the room must wear appropriate laser protection goggles, or the marking area must be covered completely. Follow the local safety regulations, which can be obtained from the person responsible for laser safety.

- Optional menu when an NewGen AXIALSCAN with integrated Pointer is selected, so that it would be possible to reset the values for the pointer *Gain*, *Offset* and *Tilt Values*.



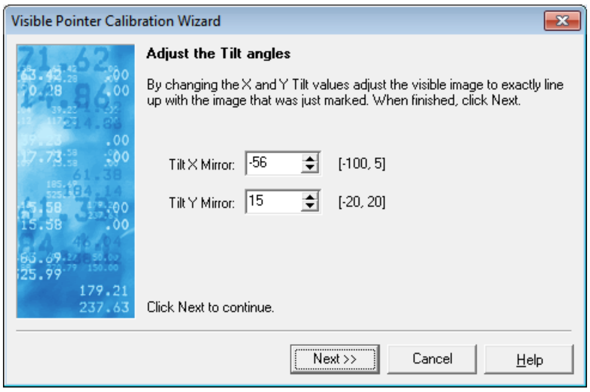
- Click on *Mark test pattern* button.
  The pattern is marked using the parameters set in the test pattern profile.
- Click on *Next* button.
  The following window is opened.



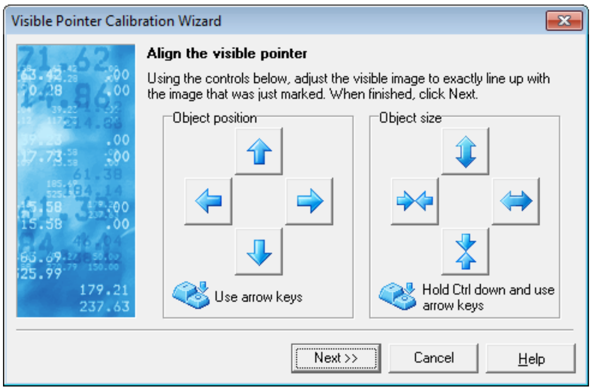
The following dialogue is optional and opens when a NewGen AXIALSCAN with integrated pointer is selected:

- The maximum and minimum values of X and Y mirror tilt angles are retrieved from the Scan Head.
  During this procedure the system will try to position the mirrors to the maximum possible positive and negative positions. The Scan Head will allow it to go only up to the maximum stored value in the Scan Head and report back the allowed value.
  These values are shown on the form on the right side of the Tilt values.
- The pointer is turned on and starts marking a cross.

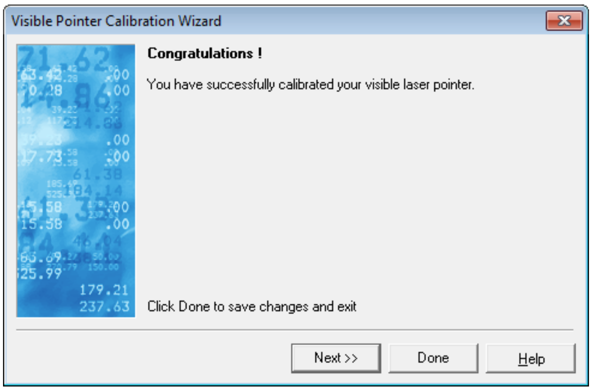
Observe the position of the cross. Change the Tilt values by pressing up/ down arrows. Mirrors will move to a new position. Repeat until the previewed cross matched the marked cross.



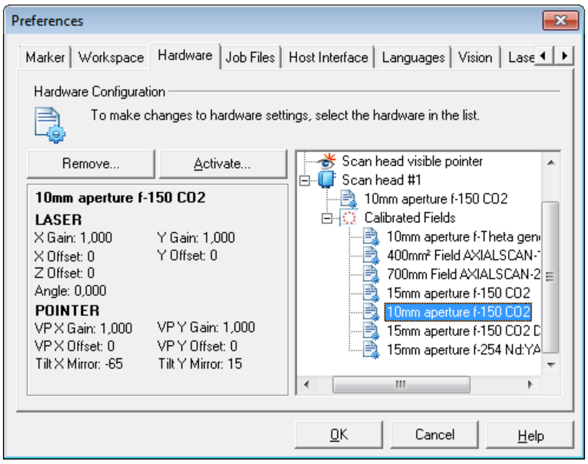
- Use the arrow keys to adjust the position and size of the test pattern shown by the visible pointer.
- Click on *Next* button.
  The following window is opened.
  Note:
  In case of 3-Axis Digital Scan Heads with pointer only adjust size, not position.



- Click on *Done* to exit the wizard.
- Calibration results are saved, as in case of a laser pointer, in the system ini file "atlens.ini".
- Two additional entries are added for Scan Heads with pointer:
- XMirrorTiltValue
- YMirrorTiltValue
- The values from the calibration wizard will be written in these entries.
- The same values are written in the calibrated heads "*.ini" file "cardN-headM.ini", for the corresponding card, head under the active Correction File.
- When weldMARK™ starts the values from these *.ini files will overwrite the values taken from the Scan Head configuration file, if they are read from them correctly



Screenshot shows sample display of calibration values.



16 CONNECTING DEFLECTION UNITS

weldMARK™ uses the XY2-100 or XY2-100Enhanced protocol to operate deflection units with RAYLASE control cards. Deflection units made by other manufacturers can also be used, provided they support this protocol. Detailed information on connecting the deflection units to the control cards can be found in the manual of the respective control card.

16.1 Connecting multiple Control Cards (Master-Master setup)

weldMARK™ can operate with multiple control cards in one computer. Each card can be used to operate one laser and one deflection unit. This is only possible with control cards that have multi-card capability. With the SP-ICE control card, up to four cards can be installed in one computer.

Installation of control cards is described in the supplied manuals. Starting weldMARK™ after installation of control cards, the program detects the new cards and shows them in Job Manager.

16.2 Connecting multiple Deflection Units to a Control Card (Master-Slave setup)

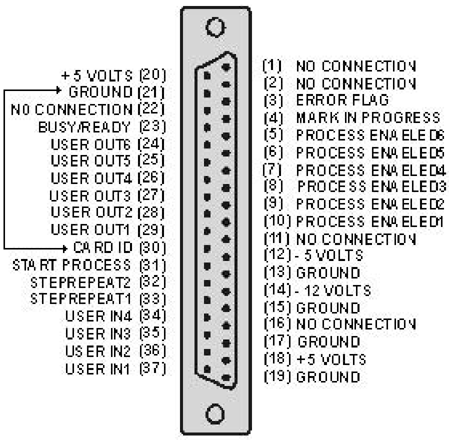
If the SP-ICE control card is used, multiple deflection units and a laser can be connected to a single SP-ICE card. Output of the vectors to the individual deflection units is synchronized. For details, refer to the SP-ICE card manual.

17 CONNECTING TO EXTERNAL DEVICES

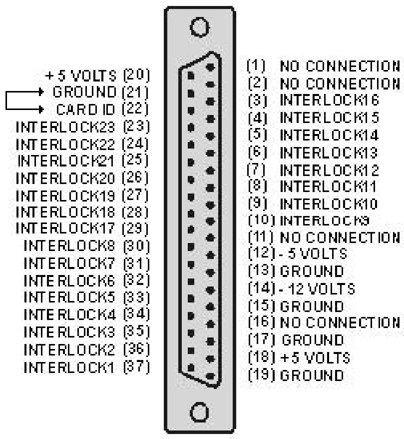
weldMARK™ supports various I/O interfaces for the communication with external devices. In addition, weldMARK™ can be operated with up to four stepper motor controls.

17.1 Standard I/O Card / Interlock Card

weldMARK™ uses the same card type as the standard I/O card and the interlock card. The mode is set by a bridge from GND to the corresponding pin (CARD ID). Depending on the mode, it results in one of the following pin assignments:



Standard I/O card



Interlock card

Signal		Explanation
UserI1-4	I	Trigger (>50mS LOW)
STEPREPEAT1-2	I	
START PROCESS	I	
PROCESS ENABLED1-6	O	LOW active
MARK IN PROGRESS	O	LOW during mark
ERROR FLAG	O	LOW on error
USEROUT1-6	O	programmable
BUSY/READY	O	programmable
INTERLOCK1-23	I	Trigger (>50mS LOW)

I = Input, O = Output

All inputs and outputs are TTL connected and have a pull-up resistance of 2.2kΩ. The ports must be electrically isolated from the connected hardware. Electrical interference pulses must be prevented as far as possible. When using a relay a recovery diode has to be used. The connecting cables must be shielded and kept as short as possible. Moreover the shield must be connected to the computer housing.

I/O card

The optional standard I/O card allows job sequences to be controlled by external signals using automation objects. In addition, weldMARK™ can use automation objects to output control signals to operate external components.

Interlock Card

The optional interlock card enables weldMARK™ to respond to interlock signals from external components. Each interlock input (INTERLOCK1 to INTERLOCK23) can be configured as HIGH or LOW when active. This configuration is carried out in the file "\Program Files\raylase\weldmark\bin\intmsg.txt", as shown below.

```
Interlock Messages
[ASSERTION]
AssertLevel0=0
AssertLevel1=0
AssertLevel2=0
AssertLevel3=0
AssertLevel4=0
AssertLevel5=0
AssertLevel6=0
AssertLevel7=0
AssertLevel8=0
AssertLevel9=0
AssertLevel10=0
AssertLevel11=0
AssertLevel12=0
AssertLevel13=0
AssertLevel14=0
AssertLevel15=0
AssertLevel16=0
AssertLevel17=0
AssertLevel18=0
AssertLevel19=0
AssertLevel20=0
AssertLevel21=0
AssertLevel22=0
AssertLevel22=0
[MESSAGE]
Msg0=Interlock 1 error !
Msg1=Interlock 2 error !
Msg2=Interlock 3 error !
Msg3=Interlock 4 error !
Msg4=Interlock 5 error !
Msg5=Interlock 6 error !
Msg6=Interlock 7 error !
Msg7=Interlock 8 error !
Msg8=Interlock 9 error !
Msg9=Interlock 10 error !
Msg10=Interlock 11 error !
Msg11=Interlock 12 error !
Msg12=Interlock 13 error !
Msg13=Interlock 14 error !
Msg14=Interlock 15 error !
Msg15=Interlock 16 error !
Msg16=Interlock 17 error !
Msg17=Interlock 18 error !
Msg18=Interlock 19 error !
Msg19=Interlock 20 error !
Msg20=Interlock 21 error !
Msg21=Interlock 22 error !
Msg22=Interlock 23 error !
```

In the lines *AssertLEVEL0* to *AssertLEVEL22*, the active status of each interlock input can be set to "0" or "1".

A name using the lines *Msg0-Msg22* is assigned to each interlock input. This name is displayed by weldMARK™ if there is a corresponding interlock event.

In some situations, it may be necessary to use different interlock names and AssertLevels for different laser types. weldMARK™ supports this function by linking the interlock configuration file with the laser driver file. Please contact RAYLASE for further details.

17.2 Operating Stepper Motors

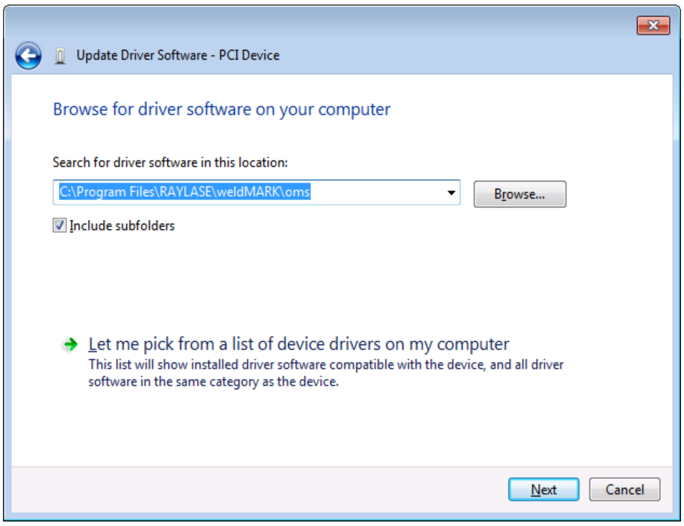
weldMARK™ can be operated with up to four stepper motor controls. For example, this allows the control of an XY table, a Z axis and a rotary axis.

Note:
RAYLASE provides the OMS-Motor-Control-Card PCIx04 for activation.
This cards allows activation only for stepper motors.

17.2.1 Installing the Plug&Play Drivers in Windows

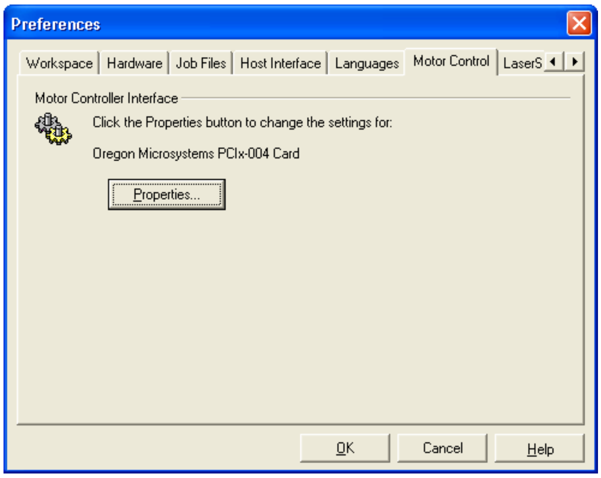
The card for operating stepper motors must be installed in your computer.

- Start the computer.
  Windows detects the new hardware and starts the wizard for installing the driver files.
- Click on *Browse* button.
- Select the directory …\Program Files\raylase\weldmark\oms.
- Click on the *Next* button.
  Windows installs the OMS driver.



17.2.2 Configuring the Motor Control Settings

- Select *System >Preferences* option from the menu.
- Select *Motor Control* tab.
  The dialogue on the right opens.
- Edit the settings as described in the next section.

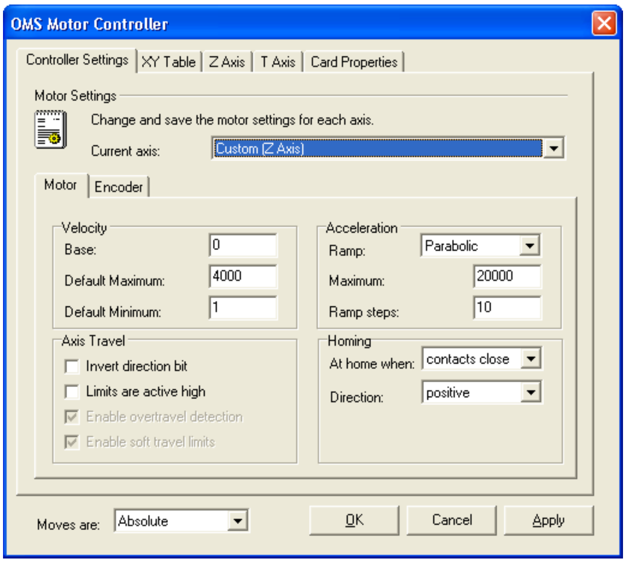


Editing the Motor Settings

The settings for the stepper motor control determine the default speed, the default acceleration and the functions for moving the individual axes and moving to the home position.

- Select *System >Preferences* option from the menu.
- Select *Motor Control* tab.
- Click on *Properties* button.
- Select *Controller Settings* tab.

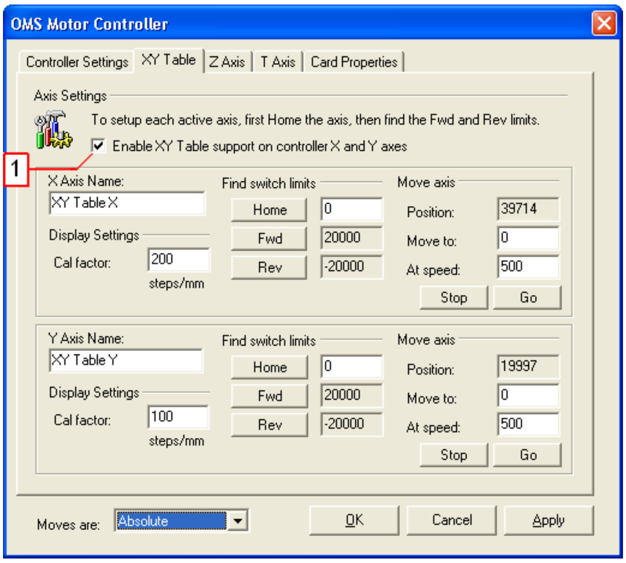
  The dialogue on the right opens. The displayed values are default settings used with motorized linear translators.



Current axis	This list box can be used to select the required axis.	
Velocity	*Base*	These input boxes can be used to determine the basic, maximum and minimum speed of the stepper motor.
	Default Maximum	
	Default Minimum	
Acceleration	*Ramp*	These input boxes can be used to determine the acceleration characteristics, the maximum acceleration and the number of acceleration steps.
	Maximum	
	Ramp steps	
Axis Travel	*Invert direction bit*	If this function is enabled, the direction of movement is inverted.
	Limits are active high	If this function is enabled, the status of the limit switch is set from active LOW to active HIGH.
	Enable overtravel detection	If this function is enabled, the limit switches are monitored during movement.
	Enable soft travel limits	If both, the *Enable overtravel detection* function and this function, are enabled the control card stops the axis when a limit switch is detected.
Homing	*At home when*	Status of the limit switch when the home position is reached.
	Direction	Driving direction of the movement unit when searching for the home position.
Moves are	*Absolute*	For destinations, the coordinates to which the movement unit should move are specified.
	Relative	For destinations, the distances by which the movement unit should move are specified.

Editing the Settings for the XY Table

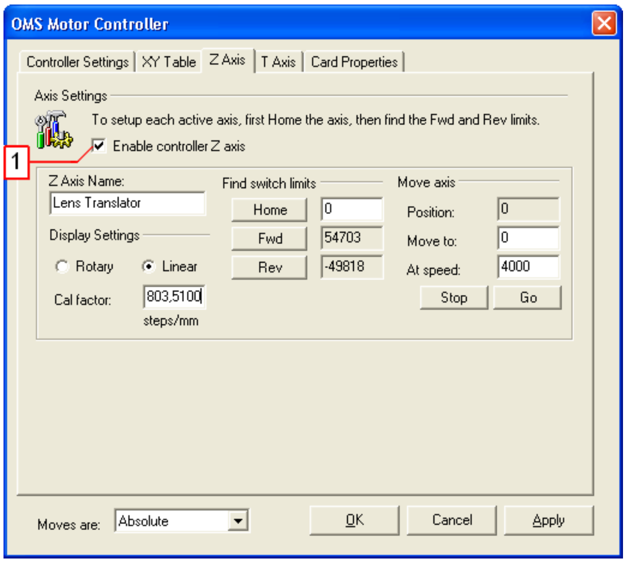
- Select *System >Preferences* option from the menu.
- Select *Motor Control* tab.
- Click on *Properties* button.
- Select *XY Table* tab.
- Carry out the required changes. The dialogue on the right opens. Refer to the table below for explanations.



(1)	This check box can be used to activate the movement unit. Then, the corresponding functions in the program interface are available.		
	Axis Name	These text boxes can be used to specify the names of the movement unit X- and Y-axes. The names are used in the corresponding dialogs of the program interface then.	
	Cal factor	Calibration factor for the axes in steps per millimeter.	
	Home	Clicking on this button returns the movement unit to its home position. The home position is defined in the field right to the *Home* button.	
	Fwd / *Rev*	Clicking on these buttons determines the limit switch position. As soon as the movement unit arrives at the limit switch, the position is saved and displayed. This information advises the user of the physical boundaries in the program sequence.	
	Timeout	A time value can be entered in this field. If no limit switch is found before this time has elapsed, the movement unit stops as a precaution.	
	Go	Clicking on this button moves the movement unit with the following parameters for testing purposes:	
		Move to	This field can be used to specify the position to which the XY table moves when clicking on the *GO* button.
		At speed	This field can be used to specify the speed at which the XY table moves when clicking on the *GO* button.
	Stop	Clicking on this button stops movement of the motor immediately.	
Moves are	*Absolute*	For destinations, the coordinates to which the movement unit should move are specified.	
	Relative	For destinations, the distances by which the movement unit should move are specified.	

Editing the Settings for the Z axis (Laser Lift or Linear Translator)

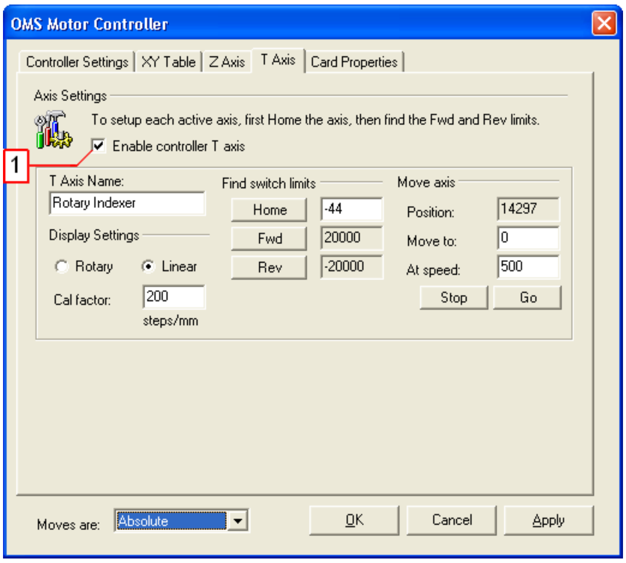
- Select *System >Preferences* option from the menu.
- Select *Motor Control* tab.
- Click on *Properties* button.
- Select *Custom Axis* tab.
- The dialogue on the right opens. The displayed values are default settings used with motorized linear translators.



(1)	This check box can be used to activate the movement unit. Then, the corresponding functions in the program interface are available.		
	Z axis Name		This text box can be used to specify the name of the movement unit's Z axis. The name is then used in the corresponding dialogs in the program interface.
	Display Settings	*Rotary*	These check boxes specify whether you want to operate a rotary or a linear axis.
		Linear	
	Cal factor		Calibration factor for the axis in steps per millimeter.
	Home		Clicking on this button returns the movement unit to its home position. The home position is defined in the field right to the *Home* button.
	Fwd		Clicking on these buttons determines the limit switch position. As soon as the movement unit arrives at the limit switch, the position is saved and displayed. This information advises the user of the physical boundaries in the program sequence.
	Rev		
	Timeout		A time value can be entered in this field. If no limit switch is found before this time has elapsed, the movement unit stops as a precaution.
	Go		Clicking on this button moves the movement unit with the following parameters for testing purposes:
		Move to	This field can be used to specify the position to which the Z table moves when clicking on the *GO* button.
		At speed	This field can be used to specify the speed at which the Z table moves when clicking on the *GO* button.
	Stop		Clicking on this button stops movement of the motor immediately.
Moves are	*Absolute*		For destinations, the coordinates to which the movement unit should move are specified.
	Relative		For destinations, the distances by which the movement unit should move are specified.

Editing the Settings for the Rotary Axis (Indexer)

- Select *System >Preferences* option from the menu.
- Select *Motor Control* tab.
- Click on *Properties* button.
- Select *Rotary* tab.
- The dialogue on the right opens. Refer to the table below for explanations.

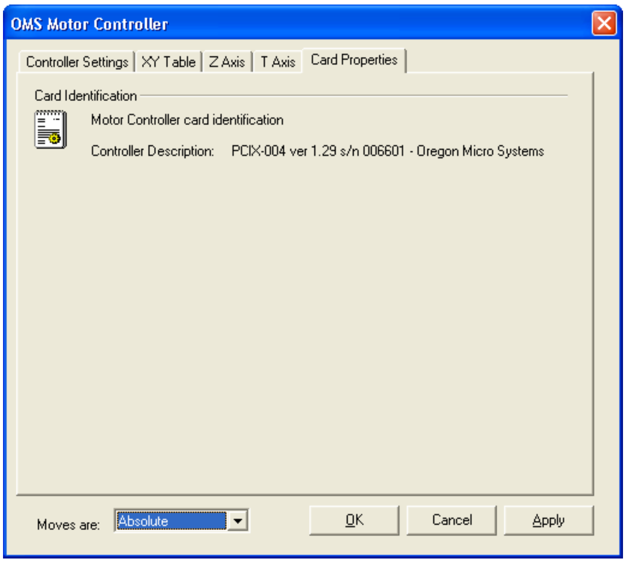


(1)	This check box can be used to activate the movement unit. Then, the corresponding functions in the program interface are available.		
	T Axis Name	This text box can be used to specify the name of the movement unit's rotary axis. The name is then used in the corresponding dialogs in the program interface.	
	Display Settings	*Cal factor*	Calibration factor for the axis in steps per millimeter.
	Home	Clicking on this button returns the movement unit to its home position. The home position is defined in the field right to the *Home* button.	
	Fwd	Clicking on these buttons determines the limit switch position. As soon as the movement unit arrives at the limit switch, the position is saved and displayed. This information advises the user of the physical boundaries in the program sequence.	
	Rev		
	Timeout	A time value can be entered in this field. If no limit switch is found before this time has elapsed, the movement unit stops as a precaution.	
	Go	Clicking on this button moves the movement unit with the following parameters for testing purposes:	
		Move to	In this field, you can specify the position to which the movement unit moves when clicking on the *GO* button.
		At speed	In this field, you can specify the speed at which the movement unit moves when clicking on the *GO* button.
	Stop	Clicking on this button stops movement of the motor immediately.	
Moves are	*Absolute*	For destinations, the coordinates to which the movement unit should move are specified.	
	Relative	For destinations, the distances by which the movement unit should move are specified.	

Stepper Motor Control Properties

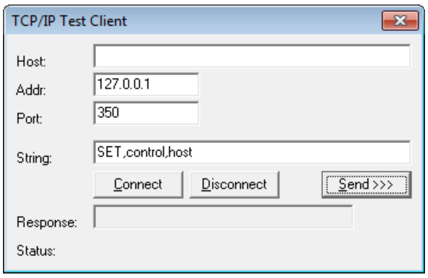
- Select *System >Preferences* option from the menu.
- Select *Motor Control* tab.
- Click on *Properties* button.
- Select *Card Properties* tab.

  The dialogue on the right opens. This window shows the stepper motor control properties.



18 PROGRAMMABLE INTERFACES

18.1 Remote Interface



- Enter the following command lines (with variations on meaning), and send each line with the button *Send>>>*.
  weldMARK™ acknowledges each accepted command line with "ACK".
  - SET,control,host
  - OPEN,file,c:\Ts00t.wmj
  - RUN
  - MODIFY,filed,01,123456
  - OFFLINE
  - SET,control,local

The remote interface enables the control of weldMARK™ by using a remote program. The external program can run jobs, dynamically change the content of marking objects and execute jobs. After each command executing, weldMARK™ sends a response to the remote program.

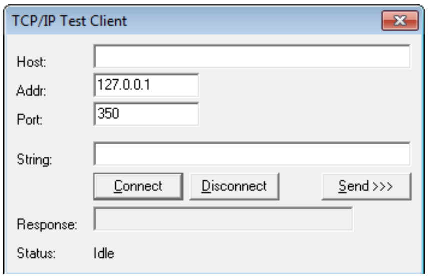
While weldMARK™ is being controlled by the remote program, the normal weldMARK™ user interface is blocked to prevent the user from intervening in processes that are in progress.

Detailed information about the remote interface can be found in the weldMARK™Remote Interface manual.

18.1.1 TCP/IP Test Client

The TCP/IP test client is a tool for testing the weldMARK™ remote interface functionality. For further information about the remote interface refer to the corresponding manual. This is available separately from RAYLASE.

Starting the TCP/IP test client



- Start the program tcptestclient.exe, located in the directory …\Program Files\raylase \weldmark\bin.
- If the TCP/IP test client is running on the same computer as weldMARK™, enter the IP address "127.0.0.1".
  If the TCP/IP test client is running on a different (remote) computer, you must enter the IP address of the computer on which weldMARK™ is running in the *Addr.* field.
- Enter the value "350" in the *Port* field.
- Make sure that weldMARK ™ is running on the local computer or on the remote computer.
- Click on the *Connect* button.
  The TCP/IP test client connects to the weldMARK™ instance and is ready to exchange data with weldMARK™.

Note:
For this example, weldMARK™ must be configured in such a way that the program will accept commands from the TCP/IP port. Detailed information can be found in the remote interface manual.

18.2 COMserver Interface

The COMserver Interface allows weldMARK functions to be used with an ActiveX Interface, to customize different user specific Automations. The wmCOM.exe is started instead of the wmgui.exe. Refer to the COMserver manual for more detailled information.

INDEX