INVERTER FUSION 210 AC/DC
OPERATING INSTRUCTIONS
WITH SPECIAL MODE

Product identification

Product identification: TIG - Gas Shielded Tungsten Arc Welding units

Type: FUSION 210 AC/DC 000602

Manufacturer: **Inverter Fusion Ltd**

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Subject to change without prior notice.

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Product Identification

1. Introduction

1.1 Foreword

Dear Customer

Congratulations, you have purchased a I/F TIG / Stick-electrode welding unit, and therefore a UK branded appliance. Thank you for the confidence you have shown in our quality product.

Only components of the highest quality are used in the development and production of I/F welding units. In order to ensure a high service life that can be used under arduous working conditions, only components that satisfy the I/F stringent quality control requirements are used in our production. The FUSION range of welding units have been developed and designed in accordance with the current valid recognised technical safety regulations. All of the relevant statutory provisions have been observed and incorporated; confirmation of this is given through the CE mark and the Declaration of Conformity.

I/F endeavours to respond quickly to technological progress in the interests of the customer. We reserve the right to change the design of these welding units from time to time, and without notice in order to ensure compatibility with the current state of the art technical requirements.

Areas of use

Unless specifically stated in writing to the contrary by Inverter Fusion Ltd I/F welding units are only for sale to commercial / industrial users and are intended only for use by these users.

I/F gas shielded tungsten arc welding units are only to be used:

a) For the correct purpose.

b) Under perfect safety conditions.

Qualification of operating personnel

I/F welding units must only be operated and maintained by people who are trained in the use and maintenance of welding units. Only qualified, authorised and assigned staff may work on, and with these units.

Purpose of this document

This operating manual contains important instructions as to how you can operate this equipment, safely, correctly and economically. A copy of the operating manual is always to be kept at a suitable location at the site where the unit is being used. It is imperative that you read the information that is compiled for you in this operating manual before you use the unit. You will find important instructions for use of the equipment, which will allow you to fully make use of the technical superiority of your I/F equipment. In addition, you will find information on servicing, maintenance, and operating safety, as well as functional reliability.

This operating manual does not replace the instructions from the I/F service staff.
Documentation about any additional options that are provided must also be observed.

Alterations to the unit

Modifications to the unit or the attachment of, or installation of any additional devices is strictly forbidden. Such alterations automatically invalidate all warranty and liability claims.

The interference by non-authorised third parties, and the tampering of safety interlocks, or devices automatically invalidate all warranty and liability claims.

1.2 General description

1.2.1 Performance features of the FUSION gas shielded tungsten arc welding unit

The FUSION AC/DC is a real powerhouse, compact in size and weighing a mere 9.0 kg The robust housing makes the
AC/DC the ideal companion for coping with the arduous working conditions on-site. However the AC/DC is also at home in the workshop as well, having all of the attributes associated and expected of professional units.

The AC/DC is based on the primary inverter design principle. The user has a fully portable unit and also enjoys the Ingress protection classification of IP23 so it can be used under difficult operating conditions. The units offer flexibility and are for the universal use on high and low alloyed steels as well as Aluminium and its alloys (only for AC/DC units).

- **Design housing**

  The ergonomic design of the machine is a result of the further development of The I/F Design concept. The housing has ingress protection classification IP23. The plastic housing is formed such that is it completely enclosed.

- **Thermal protection**

  The AC/DC is protected against damage caused by over heating by a thermal sensor. The position of the sensor is directly next to the power transistors and measures the temperature directly from within the „Hot Spot“.

- **All round protection**

  The power transistors are the heart of any inverter; they are completely potted and sealed together with the primary rectifier and the thermal protection probe in a single module. This means that dirt and damp will have no affect on this module. The outer plastic housing is durable nylon and ensures
  the highest protection against mechanical damage.

  All of the electrical components are
  coated with a protective lacquer to protect them against dirt and dampness.

- **Automation**

  Connection to an automatic welding system is extremely easy due to the precise processor control system.

- **Inverter Technology**

  The I/F inverter technology ensures excellent ignition characteristics, and a steady, stable arc.
  By the use of high quality and performance components, the machine can be produced in an extremely compact design with a low weight.

- **Ergo-System**

  The I/F Ergo-System enables your AC/DC to be your sympathetic
  partner for all of your welding applications. Apart from the obvious ergonomic advantages such as the turn and set control knob - which is ideal for right or left handed persons, and the clearly arranged, easy to
  understand operating panel simplify life for the operator. These are many small details, which help the operator do his job better.

- **Operating concept**

  The AC/DC has an entirely new operating concept; this enables setting up the machine very simply, quickly and safely. The numerous options can all be accessed from this single control knob The settings are all done via a single control knob, this can be turned to select or alter the parameter and then pressed to confirm the setting. Using the combination of LED's and the 3-digit digital display the setting can always be accurately set and reproduced for all welding applications.

- **Noise Reduction System for AC**

  The noise is significantly reduced during the welding of Aluminium, by means of a patented noise reduction process.

- **Automatic Frequency Control**

  Low stress and long service life combined with optimum economy by means of patented Automatic frequency control.

- **Wave Balance Control**

  Improved welding speed by the use of a small diameter electrode, combined with optimum penetration.

- **Control System**

  The processor control system makes this generation of welding units ready to face the future. New process variants and application developments can simply be retrofitted by means of a software updates.

- **TIG-Energy (Intelligent Ignition Energy)**

  TIG-Energy results in an intelligent control sequence for both TIG and stick-electrode welding. The ignition process takes into consideration the welding process that has been selected and is controlled via the processor. This results in a reliable start every time with a stable arc, cleaning the electrode and the workpiece.

- **ESA-System (Electronic Stabilised Arc)**

  The ELSA-System: The optimum welding performance, even with mains supply cables up to 100m long is ensured.

- **EC (Electronic Power Control)**

  The EC continuously monitors the mains supply voltage and protects the machine under critical situations.

1.2.2 Principle of TIG welding

With the TIG welding processes, the arc is established between a Tungsten electrode and the workpiece. The inert gas used is a rare gas, such as Argon, Helium, or a mixture of these gases. One of the electrical poles of the power source is connected to the tungsten electrode, the other against the workpiece. The tungsten electrode is the current conductor and sustains the arc (non-consumable). The filler material is usually introduced into the weld pool by hand, in the form of a rod, or by a separate cold wire feed unit, in the from of a wire. The tungsten electrode and the molten pool, as well as the molten end of the filler material, are protected from the atmosphere by the inert shielding gas, which flows from the shielding-gas nozzle, which is positioned concentrically around the electrode.

1.2.3 Areas of application for TIG welding units

AC/DC welding units are direct current power sources. They are suitable for welding all mild, low and high-alloyed steels, stainless steels, and non-ferrous metals.

AC/DC welding units are direct current and alternating current power sources. They can be used to weld all mild, low and high-alloyed steels, stainless steels, and non-ferrous metals, Aluminium and Aluminium alloys.

1.2.4 Operating principle of TIG welding units

With the TIG welding processes, the arc is established between a Tungsten electrode and the workpiece. The inert gas used is a rare gas, such as Argon, Helium, or a mixture of these gases.

One of the electrical poles of the power source is connected to the tungsten electrode, the other against the workpiece. The tungsten electrode is the current conductor and sustains the arc (non-consumable). The filler material is usually introduced into the weld pool by hand, in the form of a rod, or by a separate cold wire feed unit, in the from of a wire. The tungsten electrode and the molten pool, as well as the molten end of the filler material, are protected from the atmosphere by the inert shielding gas, which flows from the shielding-gas nozzle, which is positioned concentrically around the electrode.

1.2.5 Correct use

I/F welding units are designed for welding various metals, such as mild, low and high-alloyed steels, stainless steels, and non-ferrous metals, Aluminium and Aluminium alloys. The special safety instructions that apply to the area in which the welding takes place must be observed at all times. If you are unsure about anything at all, then consult your Health and Safety officer, or contact the I/F Customer Services department.

Unless specifically stated in writing to the contrary by Inverter Fusion Ltd welding units are only for sale to commercial / industrial users and are only intended for use by these users. Persons who are trained in the use and maintenance of welding units are the only person qualified to operate this equipment.

Welding power sources must not be placed in areas of high electrical risk.
see Chapter 5, Commissioning.

This operating manual contains rules and guidelines relating to the correct use of your unit. If these rules and guidelines are adhered to then the use of the equipment can be considered to be correct. Risks generated from use of this equipment are the sole responsibility of the operator. Where special care and attention is required, provision must be made for this where appropriate.

If you are unsure about anything at all, then consult your Health and Safety officer, or contact the I/F Customer Services department.

The documentation supplied with the machine explains the limitations of use of the equipment and must be adhered to.

The use of this equipment must also be carried out in strict accordance with the local Health and Safety regulations.

Correct use also entails observing the prescribed assembly, dismantling and re-assembly, commissioning, operating and maintenance conditions as well as disposal measures. Please observe in particular the information contained in chapter 2 Safety.

The unit must only be operated under the above conditions. Any other form of use is not regarded as correct. The operator bears sole from responsibility for the consequences of such actions.

1.3 Symbols used in this manual

Typographical markings

- Lists preceded by a bullet mark: General list

Lists preceded by a square symbol: Working or operating steps which must be carried out in the order listed.

Chapter 2.2, Warning symbols on the unit
Cross-reference: Refer here to Chapter 2.2, Warning symbols on the unit

Bold type is used for emphasis

Note!

... indicates tips for use and other particularly useful information.

Safety symbols

The safety symbols used in this chapter: **Chapter 2.1**

2. Safety information

2.1 Safety symbols in this operating manual

Warning notes and symbols

You will find this symbol or a symbol giving more precise details of the hazard with all safety notes in this operating manual that involve any danger to life or limb.

One of the following instructions (Danger!, Warning!, Caution!) will be used to show the severity of the hazard:

Danger! … Warns of a hazard which and represents a direct threat. If this is disregarded, death or very serious injury may be the result.

Warning! ... Warns of a potentially dangerous situation. If this is disregarded, death or very serious injury may be the result.

Caution! ... Warns of the possibly of harmful situation. If this is disregarded, the result may be slight or minor injury and material damage may ensue.

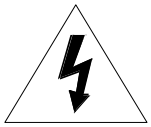
Important!

Indicates a potentially harmful situation. If this is disregarded, the product, persons, or nearby objects may sustain damage.

Substances that can damage health and/or the environment. Materials/substances that need to be handled carefully and/or disposed of according to statutory requirements.

2.2 Warning symbols on the machine

Identify hazards and sources of hazard on the unit.



Danger!

Electrical voltage hazard!

Non-compliance may result in death or injury.

2.3 General

Dangers of non-compliance

The unit has been designed, developed and produced on current generally accepted engineering regulations and standards.

Nevertheless, using it may endanger life and limb for the user, any bystander, or result in damage to the unit or other items of value.

No safety equipment should ever be dismantled or disabled as this risks creating hazards and no longer guarantees that the unit is being used correctly and safely. There are particular guidelines for dismantling safety equipment when carrying out equipment, repair and servicing work. Safety equipment must always be reassembled immediately after such work has been completed.

When the use of unusual materials is necessary (e.g. cleaning solvents), the operator must ensure that the unit is safe to use before switching on and using the equipment.

All safety and hazard notes as well as the manufacturer's nameplate on the unit should, without exception, be maintained in a legible state and must be heeded.

Safety-notes

Safety notes are used for work safety and for the prevention of accidents. They must be heeded.

It is not only the safety notes contained in this chapter that have to be complied with, but also the special safety notes contained throughout the text.

Besides the notes contained in this operating manual, all safety and accident-prevention regulations with general validity

as well as, in particular, stipulations for arc
welding and cutting mentioned in this publication, or the relevant National regulations) must be heeded.

In addition, make sure that you read the safety notices posted in the factory where the machine is being used.

3. Description of function

3.1 Operating concept: Turn and Set

The AC/DC has an entirely new operating concept; this enables setting up the machine very simply, quickly and safely. The numerous options can all be accessed from this single control knob

The settings are all done via a single control knob, this can be turned to select or alter the parameter and then pressed to confirm the setting. Using the combination of LED's and the 3-digit digital display the setting can always be accurately set and reproduced using the same principle:

1. Rotate the knob until the required setting is found, the LED's associated with the setting will illuminate, and the set value for this setting will show on the digital display.
2. Depress the knob to select the setting to be changed; the associated LED will start to blink.
3. Turn the knob to alter the value of the parameter selected.
4. Depress the knob once again to confirm the new value (enter). The associated LED will then remain continually lit.

For the settings which can only be switched on or off (e.g. non-latch (2-step) with TIG), the LED will start to blink immediately, once the knob is depressed then the function is immediately selected.

3.2 Operators panel

3.2.1 General description

The operation of the TIG welding units is achieved via panel as shown in Fig 3

The only operating element is the turn and set knob (22). This knob is position centrally and integrated within the operating panel and is therefore well protected against mechanical damage. This knob is simple and precise and can be turned easily with the thumb. All of the operating elements including the turn and set knob (22), the LED's (1)-(21) and the digital display (23), are fully protected against both mechanical and moisture. This enables the machine to be used in the most arduous of operating environments (e.g. site work).

The operating panel is split into several elements, the welding parameter settings in the welding cycle diagram (1)-(6). The section below this is the AC operating section (7)-(10). On the right hand side are the TIG functions (11)-(14). In the middle is the digital display (23). On the left hand side is the welding process selection (15)-(17). To the left of the control knob is the "special mode" (18). The sequence in which the LED's are selected is according to the numbering shown in Fig 3.1 and 3.2.

3.2.2 The operators panel at a glance

No.	Symbol	Meaning
1	I1	Setting for **welding current I1** for TIG - and Stick-electrode welding (see Chapter 3.3.1) (Stick-electrode welding means manual metal arc welding)
2	t1	Setting for **t1-peak time** for pulsed TIG-Welding (see Chapter 3.3.2)
3	I2	Setting for **welding current I2** for TIG welding (see Chapter 3.3.3)
4	t2	Setting for **t1-background time** for pulsed TIG-Welding (see Chapter 3.3.4)
5	td	Setting for **downslope time td** for TIG-welding (see Chapter 3.3.5)
6		Setting for **Gas post flow time** for TIG-welding (see Chapter 3.3.6)
7		**Direct current welding (DC)** is selected, the electrode is connected to the minus pole (see Chapter 3.3.7)
8		**Alternating current (AC)**, the electrode is alternately connected to the positive and negative polarity, according to the Frequency and Balance setting. (only for AC/DC-machines, see. Chapter 3.3.8).
9		Setting for **Balance** for AC-TIG-welding (only for AC/DC-machines, see. Chapter 3.3.9).
10		Setting for **Frequency & for activating the Automatic Frequency control** for AC-TIG-welding (only for AC/DC-machines, see. Chapter 3.3.10).
11		**Latched torch trigger mode (4-Step)** for TIG-welding (see Chapter 3.3.11)
12		**Non-Latched torch trigger mode (2-Step)** for TIG-welding (see Chapter 3.3.12)
13		The **high frequency start (HF) is switched on** for igniting the arc during TIG-welding (see Chapter 3.3.13)
14		The **high frequency start (HF) is switched off** for igniting the arc during TIG-welding (see Chapter 3.3.14)
15		The machine is set to the stick-electrode welding mode with **Power-Function** (see Chapter 3.3.15)
16		The machine is set to the stick-electrode welding mode with **Fuse-Hold function** (see Chapter 3.3.16)
17		The machine is set to the **TIG-Welding mode** (see Chapter 3.3.17)
18		For the activating of the **Special-Mode** setting of special parameters (see Chapter 3.3.18)
19		This control lamp indicates that the machine has switched because of **over-temperature** (see Chapter 3.3.19)
20		This control lamp indicates: **operation**, meaning that the machine is in operation, and there is a **voltage on the welding output sockets**. (see Chapter 3.3.19)
21		This control lamp indicates that the **Pulse mode** is on (see Chapter 3.3.19)
22 23		The turn and set knob, and the digital display (see Chapter 3.3.20 and Chapter 3.3.21)

3.2.3 Special characteristics relating to the operating panel

The microprocessor controller supports the function of the control panel ensuring that simplicity and speed are the result.

- All of the parameters, which have been set on the machine and last used for welding, remain stored even after the mains switch has been switched off. When the machine is switched on again the settings that will be displayed are those that were last use for welding. NOTE: In order to ensure that the parameters are saved after switching off, the arc must be ignited with those settings.
- Only those parameters that are relevant to the process can be set. E.g. in the stick-welding mode the setting for 2/4 step, H.F. on/off etc. cannot be set. In the same way when in the DC mode the parameters for balance and frequency cannot be set.
- After machine is switched on the display runs through all of the settings one after the other, showing the values set on the display. This enables the operator to see how the machine is set up. Either by pressing the turn and set knob, or the torch trigger then this sequence can be interrupted at any time.
- If the turn and set knob is not depressed for 20 seconds then the display automatically returns to the I1 welding current setting. Thereby the start setting on the display is the value of the current I1, which is also important for the orientation for the operator.
- If the turn and set knob is not pressed for 20 seconds, then the display automatically returns to the I1 welding current setting. As a result, you always have as the start setting the display of the most important value, current I1, and the same starting point for the operator. The exception to this is the selection of the welding current I1 (LED I1 flashing), which remains selected until the knob is pressed again. This makes it easier – for example – to quickly find and set the suitable welding current I1 by means of welding tests.
- In the interests of safety, and to prevent incorrect operation by mistake, the turn and set knob must be pressed for more than 2 seconds in order to activate the special mode or to save or load a program.

3.3 The function of the operators panel

The functions are described in sequence as per Fig. 3

3.3.1 The welding current setting I1

The setting of the welding current I1 is performed as described in sections 3.1 and 3.2.3. The setting of welding current I1 is done as described in section 3.1, and is dependant upon the welding process and the power source.

The setting of the welding current I1 can also be done quickly without selecting it on the operating panel. This is done by depressing the torch button whilst at the same time alter the current setting to the required value by using the turn and set knob.

WARNING: Care must be taken when setting the current in this manner, as the high voltage generator, open circuit voltage, and gas solenoid will be switched on for 3 seconds; this results in danger for the operator. Furthermore the operator must also take care that the torch does not come in contact with the workpiece when using this function as he may strike the arc accidentally.

The AC/DC is a 230V-mains supply primary inverter, due to the high efficiency virtually all of the mains supply power is converted into power for welding operation.

During TIG welding the arc voltage is as defined by EN 60974 (UA=0,04*I1+10V) is less than that as defined for stick-electrode welding (UA=0,04*I1+20V). Therefore with the same input power TIG welding can supply a higher current.

In addition to this the AC/DC have PFC (**P**ower **F**actor **C**orrection) to ensure the power from the mains has a pure sine wave form. This results in a power factor (Cos. phi 0,99) this increases the electrical efficiency of the unit, enabling a higher welding current to be available for welding.

The special features offered by the AC/DC include the choice of the Fuse hold mode or the Booster mode when stick-electrode welding. When using the Fuse hold mode the actual mains current being drawn is monitored and according to the output required for welding is automatically reduced so that the fuse does not trip. The machine uses the trip-switching characteristic of the fuse (Fast acting, Class L) to ensure that welding can always take place. In the POWER mode the mains current monitoring function is deactivated, and the machine always welds with the welding current set (I1).

The following ranges can be set:

		Fusion AC/DC
TIG		3 A ... 210 A
Stick- electrode Fuse hold mode		3 A ... 160 A
Electrode POWER-Mode		3 A ... 170 A

3.3.2 The Pulse-Function (Pulse time t1)

The setting of the pulse time t1 is performed as described in section 3.1. The setting of the pulse time t1 is done as described in section 3.1. The pulsed welding function is basically divided into two distinct ranges:

1. Conventional pulsing, with pulse times between 0,1 ... 5,0 Seconds
2. High frequency pulsing, with pulsed frequencies between 50 ... 500 Hz

Switching of the pulse function “on” or “off”, as well as the setting of the pulse times for conventional pulsing as well as high frequency pulsing can be done either from the setting of t1 or t2. The pulse mode “off” can also be selected by either of these settings. The setting of Pulse time or the Pulse frequency is achieved via the turning the “turn and set” setting knob with to the left or the right. The pulse times t1 and t2 can be set independent from each other between 0,1...5,0 seconds. The high pulse frequency for t1 and t2 can be set between 50...500 Hz in 50-Hz-steps.

During Pulsed TIG welding the current continuously changes between the current levels I1 and I2. Thereby it is selectable to choose the values of the peak and background current levels. Fig. 3.3 displays the current/time sequence during pulsing.

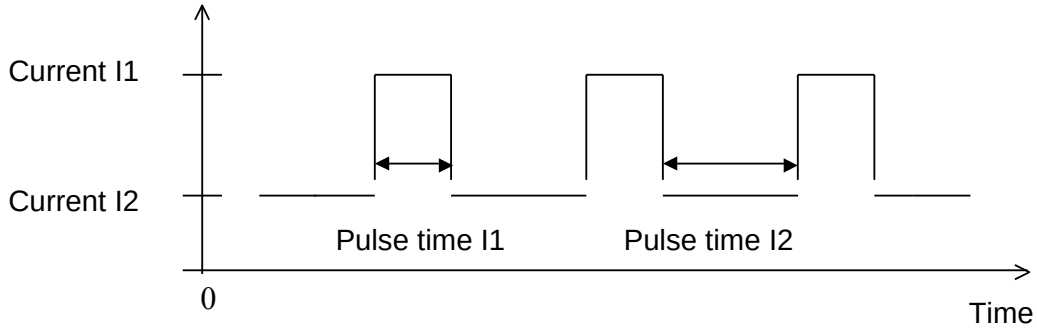


Fig 3.3: Welding current during pulsed welding

If a twin-button torch is used, pulsing can be switched off and also back on during welding by pressing torch button 2. If torch button 2 is pressed while the welding current is pulsing, pulsing is switched off and welding is continued using welding current I2. This can for example be used to ensure that the lower welding current I2 is used until a new filler metal is provided and welding is continued with pulsing welding current by again pressing the torch button 2.

Conventional pulsing: Pulsing with pulse times greater than 0,1 second

The settings of the peak current time (t1) and the background current (t2) times determine the time in which the peak current (I1) and the background current (I2) is switched on and off. The digital display instrument always shows the currently emitted welding current.

The welding current and the time for each pulse should be such that the workpiece melts during the peak current phase and then is allowed to cool down during the background current phase. Pulsed TIG welding allows the operator to have better control of the welding pool under difficult conditions. Particularly when for example, when welding out of position, bridging gaps, and welding thin materials.

Note: If a twin button torch is being used, and button 2 is depressed during pulsing, the pulsing will be switched off and the welding will continue with the welding current setting I2. Depressing torch button 1 restores the pulsing process once again.

High frequency pulsing: with a pulse frequency of 50 Hz up to 500 Hz

The welding current values set for the current I1 and I2 determine the pulse amplitude. The active time for duration of these current settings is equal. With HF pulsing switching from one current level to another occurs very quickly, hence the name high frequency pulsing.

In order to calculate the pulse frequency, the following relationship exists between the pulse timing t1 and t2:

Total pulse time = I1-Pulse time + I2-Pulse time = 1 / Pulse frequency
I1-Pulse time = I2-Pulse time = 0,5 * Total / Pulse time

Example:
Pulse frequency = 50 Hz
Total Pulse time = I1-Pulse time + I2-Pulse time = 1 / 50 Hz = 20 ms = 0,02 s
I1-Pulse time = 0,5 * Total Pulse time = 0,01s
I2-Pulse time = 0,5 * Total Pulse time = 0,01s
This means that the welding current has the value set for I1 for 0,01 s (=10 ms) and that the welding current has the value set for I2 for 0,01 s (=10 ms), the switching from once current to the other continues ad. Infinitum.

The pulse time can be reduced down to 0,001s (= 1 ms) peak current I1 and 0,001s (= 1 ms) background current I2 this gives a pulsed frequency of = 500 Hz. When pulsing at this very high frequency the arc is extremely concentrated and focused, resulting in high stability with deep penetration.
The digital display instrument shows, because of the rapid changes, always the prevailing mean value, i.e. with a welding current I1 = 100A and I2 = 50A 75A is displayed.

Pulsing with synchronised pulse start

The program-controlled synchronisation fixes a precisely defined sequence for each welding operation, thus ensuring that welding results can be reliably reproduced. This is for extremely important when mechanised welding. Once the ignition has successfully established the arc, the peak current time (t1) always commences the welding process. Following this the pulse process is active pulsing the welding current between the peak and background current settings for the respective peak and background times (t1 and t2). The settings for the start current, the welding current upslope downslope and crater fill current can influence the actual pulsed welding currents.

3.3.3 The intermediate welding current setting I2

The setting of the welding current I2 is performed as described in section 3.1. The setting of welding current I2 is done as described in section 3.1. The use of the intermediate welding current I2 only makes sense when TIG welding, therefore it can only be set in the TIG welding mode. The I2 current level setting is used for pulsed TIG welding (See chapter 3.3.2) and when it is required to switch from the main welding current a lower setting during welding, dual current level control:

Dual level control:

General notes on this function:

Using the dual level current control and a torch equipped with a double pole switch makes it possible for the user to work between two different current levels during welding. The welding current can be switched between two different levels I1 and I2. Pressing the switch 2 on the welding torch changes over the current level. Some applications are as given below:

- Changing from a high current to a low current or visa versa. Useful when changing position.
- Manual pulsing.
- Starting with a higher current I1 to heat up the workpiece, then weld with a reduced current I2.
- Starting with a low current I1 on the edge of the workpiece, and then weld with a higher current I2.

The dual current switching can only be done in the latched torch trigger mode (4-step) without pulsing.

The welding current I1 can be set within the following range:

		Fusion AC/DC
TIG		3 A … 210 A

The setting of the intermediate current I2 can be done by setting the level required in the parameter I2, or quickly and simply by pressing the torch button 2

before starting the welding operation. Whilst holding the button 2 down the value for the current will be shown on the digital display and using the turn and set knob the value can be adjusted as required.

3.3.4 The Pulsed Function (Pulse time t2 – see chapter 3.3.2)

See chapter 3.3.2

3.3.5 Current downslope and manual pulsing

The setting of the current downslope time is performed as described in section 3.1. The downslope time is the time is which the welding current decays in a linear progression to the crater fill current. In the non-latched torch trigger mode, (2-step) the downslope time starts when the trigger is released. In the latched torch trigger mode (4-step), the downslope time starts when the torch button 1 is depressed during welding. The controlled decay in the current level reduces the possibility of end crater cracking.

Manual Pulsing:

If the torch trigger is depressed during the downslope then the welding current jumps back up to the I1 value. This torch operation enables manual pulsing to be achieved. (see Chapter 3.2.6) The operator controls the heat input during the pulsing manually by the length of time that has elapsed between the activating of the torch trigger during the downslope time.

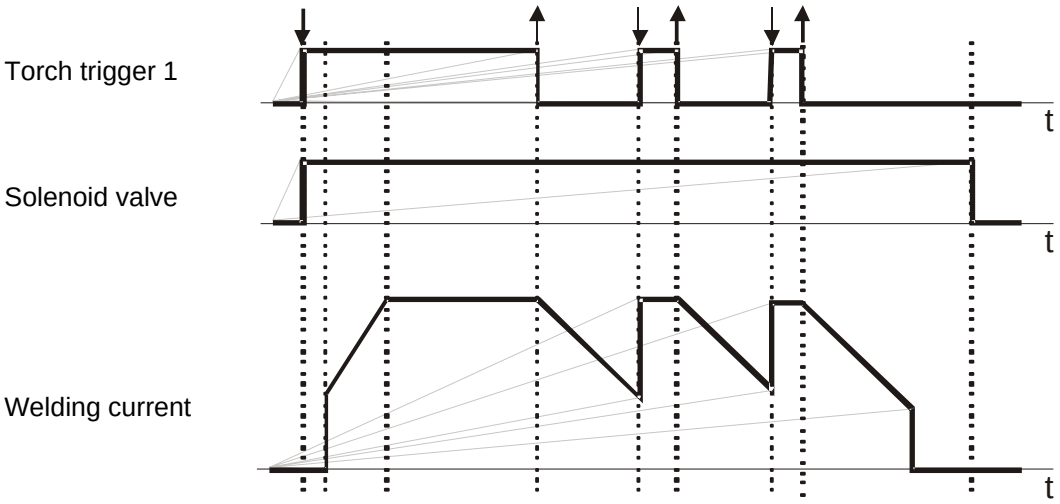


Fig. 3.4: The current cycle diagram when manual pulsing.

3.3.6 Post flow gas time

The setting of the gas post-flow time is performed as described in section 3.1. The gas post-flow time is the time that elapses after the arc is extinguished before the shielding gas solenoid closes again. The shielding gas post-flow protects the weld pool and the tungsten electrode from oxidisation until they have cooled down. The pre-selected post-flow time is only activated at the end of the welding cycle. Accidental activation of the torch button does not result in the activating the post-flow time. This gas management function lowers the shielding gas consumption.

3.3.7 Setting for Direct Current (DC)

The setting for direct current is performed as described in section 3.1. The Fusion 210 AC/DC can weld with either direct current (DC) or alternating current (AC).

When welding with DC the polarity of the output sockets always remains the same. The marking on the outlet sockets indicate which outlet is positive polarity and which is the negative polarity. When TIG welding the torch is always connected to the negative pole. The reason for this is that the positive pole has an extremely high thermal loading during welding. The negative pole also has the torch symbol assigned to it.

When stick-electrode welding the polarity is dependant upon the type of electrode being used, and therefore which socket should be connected to the electrode holder. For this information the manufacturers data sheet should be referred to ensure correct usage.

3.3.8 Setting for Alternating Current (AC)

The setting for alternating current is performed as described in section 3.1. The Fusion 210 AC/DC has the possibility of operating in the Direct Current (DC) or the Alternating Current (AC) welding output modes

With AC welding mode the electrode polarity continually changes from positive to negative. The electrical loading on the electrode alters from negative to positive according to the balance and frequency setting on the machine for each positive or negative cycle. During TIG welding the torch is connected to the negative pole of the power source. The use of AC enables the welding of Aluminium and Aluminium alloys.

When stick-electrode welding the machine parameters for frequency and balance are automatically set to 50Hz and 50% respectively. This mean that it is then irrelevant which socket is connected to the stick-electrode holder and which is connected to the workpiece cable. AC stick-electrode welding offers the advantage that arc blow because of strong magnetic fields can be minimised.

3.3.9 Wave balance

The setting of the wave balance is performed as described in section 3.1. The wave balance setting option is possible with alternating current (AC) welding. It can be varied from -80 % to +80 % and makes it possible to influence the arc from, the penetration, and cleaning effect when welding Aluminium within a very wide range. In the middle position (50 %), the negative and positive welding current is distributed equally for each current cycle. In the event of increasing negative balance, the proportion of negative welding current is increased (up to - 80 %) and the positive proportion is reduced. This makes the arc slimmer and produces a deeper penetration combined with a reduced electrode load. In the event of increasing positive balance, the proportion of positive welding current is increased (up to + 80 %) and the negative proportion is reduced. The positive proportion improves cleaning of the weld pool. The arc becomes wider and the penetration is reduced.

3.3.10 AC-Frequency

The setting of the frequency is performed as described in section 3.1. The setting for the frequency can only be done in conjunction with the AC TIG welding. The value for the frequency determines how fast the polarity changes from negative to positive on the welding outlet sockets of the power source. The setting range for this parameter is between 50Hz to 200Hz for example with a frequency setting of 200Hz the polarity changes from plus to minus every 5ms (=0.005

seconds). As the welding current changes from one polarity to the other it passes through zero, and the arc has to be re-stuck as the current changes direction and rises to the desired current value. The processor controls this whole process. This processor regulates the manner in which the current rises, such that the arc is extremely responsive. A further advantage is that it has a noise level reduction effect. This not only provides significant advantages for the operator, but also substantially improves the welding result.

Another special feature of the Tiger AC/DC machines is that in the AC welding mode the patented Rehm Automatic Frequency Control can also be selected. To active this function the selection “Aut” is made, this is the one before the 50Hz setting in the frequency function parameter.

The automatic frequency control, which is a Rehm development, enables that the machine has an extremely stable arc in the lower operating current range and that the electrode can carry high current loads in the upper current ranges. The AC operating frequency is automatically synchronised to the actual welding current.

This function means simplifies the job for the operator, as he no longer has to select the frequency for welding task. However in some special cases the operator can also override this control and set the value for the application as required, giving him a free choice for flexibility.

3.3.11 The TIG latched trigger mode (4-step)

The setting for the 4-step function is performed as described in section 3.1. In the latched trigger mode (4-Step) the torch trigger must not be permanently depressed which minimises operator fatigue.

Step 1: Torch button is depressed.

The gas solenoid opens and gas flows.
The arc will be struck once the pre-flow gas time has elapsed.
The welding current level will be that as set by the start current parameter.

Step 2: Torch button is released.

The welding current will rise automatically for the time set by the upslope time parameter to the welding current level I1.

Step 3: Torch button is depressed.

The welding current will decay automatically for the time set by the downslope time parameter to the crater fill current level.
The current stays at the crater fill current level.

Step 4: Torch button is released.

The arc extinguishes itself.
The shielding continues to flow for the time set by the post-flow gas time parameter.

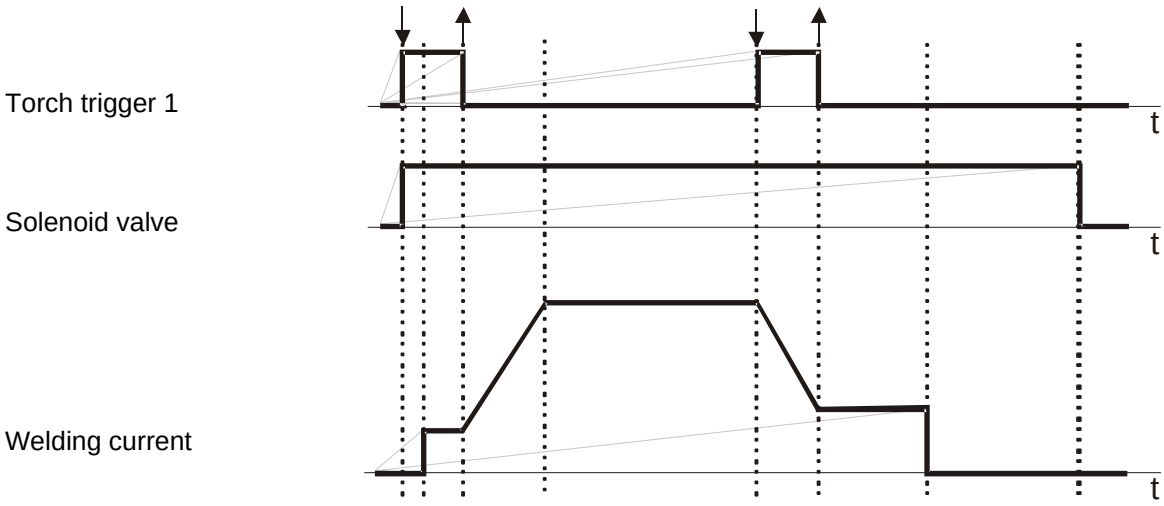


Fig. 3.5 The current cycle diagram for latched trigger operation (4 step)

Special Note:

to Step 2 If the torch button is pressed during the downslope phase, the arc will extinguish and the shielding gas flows for the time set by the post flow gas parameter.

to Step 3 The arc can be extinguished at any time during the downslope phase. Releasing the torch button before the crater fill current extinguishes the arc and the shielding gas flows for the time set by the post flow gas parameter.

3.3.12 The non-latched torch trigger mode (2 step)

The setting for the 2-step function is performed as described in section 3.1. The non-latched torch trigger mode is recommended for fast controlled tacking, and for manual spot welding operations.

Step 1: Torch button is depressed.

The gas solenoid opens and gas flows.
The arc will be struck once the pre-flow gas time has elapsed.
The welding current level will automatically rise in the time set by the upslope time parameter for the start current up to the welding current (I1).

Step 2: Torch button is released.

The welding current will decay automatically for the time set by the downslope time parameter to the crater fill current level and the arc extinguishes itself.
The shielding continues to flow for the time set by the post-flow gas time parameter.

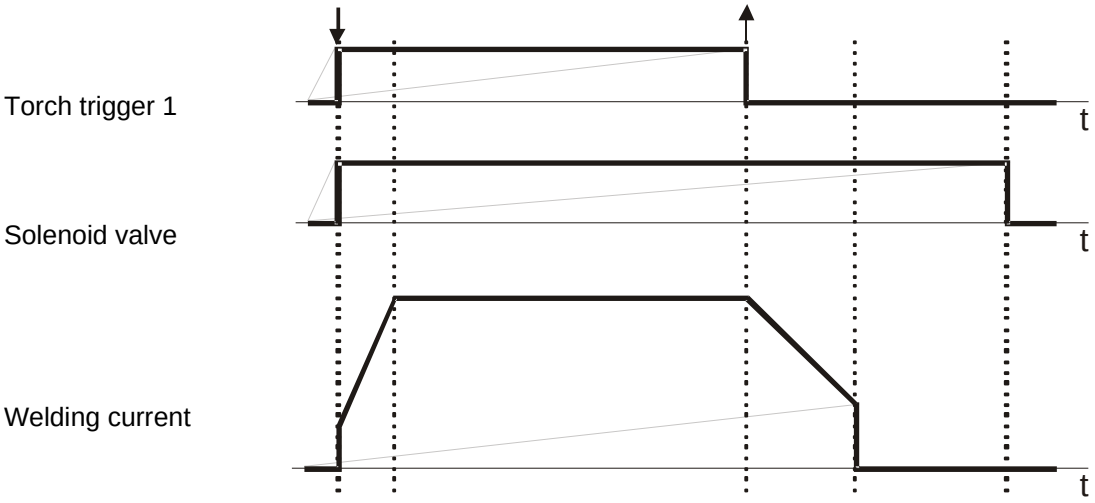


Fig. 3.6 The current cycle diagram for non-latched trigger operation (2 step).

Special note:

to step 2 If the torch trigger is depressed during the downslope then the welding current jumps back up to the I1 value. This torch operation enables manual pulsing to be achieved. (see Chapter 3.2.6)

3.3.13 TIG welding with high voltage ignition

The setting for HF ignition is performed as described in section 3.1. The Tiger is equipped with a high voltage ignition unit as standard. When the stick-electrode welding mode is selected, the high frequency ignition unit is automatically disconnected.

The high voltage ignition unit pre-ionises the gas surrounding the tip of the electrode. This enables contact free ignition to take place between the electrode and the workpiece in both the AC and the DC welding modes. Contact free ignition eliminates tungsten inclusions that result in faulty welds. In both modes of operation the high voltage generator is automatically switched off after the arc has struck. Chapter 3.3.10 describes the re-ignition process when AC welding, this is achieved without a high voltage generator.

This results in a significant reduction in the electrical radiation emitted by the high voltage generator. Furthermore the AC welding process can then be completely HF free, as has been the case for DC welding for some time now. (See chapter 3.3.14)

3.3.14 TIG welding without high voltage ignition, (Lift Arc)

The setting for Lift Arc is performed as described in section 3.1. When welding with DC contact arc ignition (Lift Arc) ignition can be carried out. “HF-Off” is selected, microprocessor controlled contact ignition takes place to strike the arc. In order to ignite the welding arc, the tip of the electrode must be placed on the workpiece and the torch button depressed. The processor control system reduces the ignition current so that the tip of the electrode does not heat up. The electrode is then gradually lifted away from the workpiece, this action ignites the arc under the system processor control, this results in arc ignition without HF and also minimum wear on the tungsten electrode. This process is essential when welding in areas where sensitive electronic equipment is in operation (e.g. repair welds on CNC-controlled machines in hospitals etc.) and where there may be a risk of damage caused by high-voltage.

3.3.15 Stick-electrode welding with the POWER-Function

The setting for POWER function is performed as described in section 3.1. In the Booster mode the mains current monitoring function is deactivated, and the machine always welds with the welding current set (I1), which is on the Fusion 210 170 A. If a higher value is set, then the machine automatically reduces this to 170 A .

When stick welding, improved ignition and a more stable arc can be achieved by fine tuning of the settings for Hot-start and Arc-force (see chapters 3.3.18.7 and 3.3.18.8)

3.3.16 Stick-electrode welding in the Fuse Hold mode

The setting for Fuse Hold function is performed as described in section 3.1. In this mode of operation, the actual current drawn from the mains is continuously monitored. If necessary, the welding current is reduced to the level required to prevent the mains fuse form tripping out. A fast acting circuit breaker Type L, similar to the type normally installed in households should be installed in the mains supply cabinet as the Fuse Hold function is designed for use in conjunction with this type of circuit breaker.

The machine is designed for use with all the common types of stick-electrodes. The maximum current on the Fusion 210 is 160 A. If a higher current is set, the current is automatically limited to 160A.

This current enables the welding of standard electrodes up to 3.25mm to be used

The polarity of the electrode can be obtained from the manufacturers data sheet.

If there is a permanent short circuit between the electrode and the workpiece during welding, the Anti-Stick Function is automatically activated after approx. 1.3s. This function automatically limits the welding current to approx. 35 A. This prevents the electrode from overheating and burning out. The operator terminates the short circuit simply by removing the contact between the electrode and the workpiece.

When stick welding, improved ignition and a more stable arc can be achieved by fine tuning of the settings for Hot-start and Arc-force (see chapters 3.3.18.7 and 3.3.18.8)

3.3.17 TIG - welding

The setting for TIG welding is performed as described in section 3.1. It is possible to weld with up to 210 A on the Fusion 210
The mains current monitoring is deactivated in the TIG welding mode. Even though the welding current is higher, the load on the mains supply is lower than by stick-electrode welding, therefore the chances of the mains fuse tripping are greatly reduced.

When TIG welding the arc is established between the end of the non-consumable Tungsten electrode and the workpiece. An inert shielding gas protects the electrode and the weld pool and prevents them from oxidising during the welding process. The usual selection of gas is pure Argon, however Helium and other mixtures can also be used depending upon the application.

The negative pole of the power source is connected to the torch, and the positive pole to the workpiece. The tungsten electrode is the current conductor and sustains the arc (non-consumable). The filler material is usually introduced into the weld pool by hand, in the form of a rod, or by a separate cold wire feed unit, in the from of a wire. The tungsten electrode and the molten pool, as well as the molten end of the filler material, are protected from the atmosphere by the inert

3.3.18 The Special mode

3.3.18.1 General Description

The operating panel enables the complete overview of the important settings for the both TIG and stick-electrode welding on the AC/DC machine. In addition to this the numerous special parameters and functions in the special mode can also be set and altered according to the individual requirements.

These are:

A – The gas pre-flow time

B – The ignition energy

C – The start current

D – The up-slope time

E – The crater fill current

F – Dual Wave

H – Hot Start

I – Arc Force

S – Save programme

L – Load programme

The special mode is activated by turning the turn and set knob until the special mode LED (Fig 3.1 and Fig 3.2, LED18) is illuminated, and then depressing the turn and set knob for longer than 2 seconds. Once the mode is activated the digital display show the letter assigned to the special parameter and the value set. (e.g. “A2.4” means that the gas pre flow time (A) is set to 2.4 seconds). The alteration of the parameters and their values is done by using the turn and set knob as described on the following page:

The alteration of the parameters,

Turn the knob until the required parameter is displayed

Depress the knob to select the parameter, the letter on the digital display starts to blink

Turn the knob until the required value is reached

Press the knob to save the value (enter)

Particular characteristics of the Special mode

The processor also controls the special mode, in that only those functions that relate to the operating mode selected can be accessed and altered.

For TIG-welding

A – The gas pre-flow time

B – The ignition energy

C – The start current

D – The up-slope time

E – The crater fill current

F – Dual Wave

For Stick-electrode welding:	H – Hot Start
	I – Arc Force
For TIG- and Stick-electrode welding:	S – Save programme
	L – Load programme

For loading and saving programs, the turn and set knob must be pressed for longer than 2 seconds. This prevents already selected settings or saved programs from being overwritten inadvertently or due to incorrect operation.

In order to recognise whether or not a programme is already stored in a certain programme number, then the digital displays shows a point next to the letter „S“.

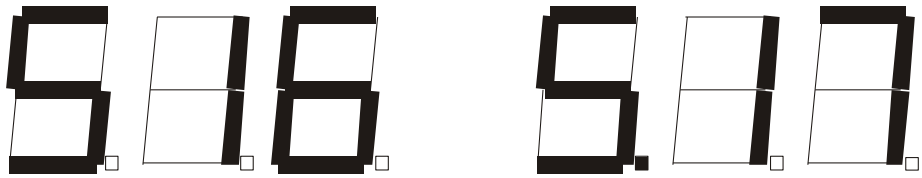


Fig. 3.7. Saving a program. Program 16 is not yet reserved (the point on the „S“ is not illuminated). Program 17 is reserved (the point on the „S“ is illuminated)

When the newly developed welding process is activated („F-1“), both LED’s for DC and AC illuminate (see Fig 3.1 LED7 und LED8)

The orientation of the letters to the machine parameter settings

The orientation of the letters to the machine parameter settings is simplified by following the letters placed along the current cycle diagram printed next to the special mode on the panel. As shown in Fig. 3.8: The gas pre flow time (A), the ignition energy (B), the start current (C), the upslope time (D), and the crater fill current (E) easily recognisable by their position.

Fig. 3.8: Position of the special mode on the operator’s panel

The alteration and setting of the parameters can be made by the selection of the letter for the parameter as shown:

H – Hot Start: **H**ot Start begins with **H**

I – Arc Force: for changing the current characteristic, Current = **I**

S – Save programme: **S**ave begins with **S**

L – **L**oad programme: **L**oad begins with **L**

F – Dual Wave: **V** from Dual Wa**v**e cannot be displayed, but **F** is used instead

3.3.18.2 Pre-flow gas time (A)

The pre-flow gas time is the time for which the gas solenoid opens after depressing the torch button 1 until the arc ignition cycle starts. This ensures that the tip of the tungsten electrode and the workpiece is protected from the atmosphere before the ignition takes place

If during the gas post flow time the welding process is re-started, the processor automatically set the gas pre-flow time to „zero“. This reduces the waiting time and improves efficiency of the machine. This is very important when tack welding for example.

3.3.18.3 Ignition Energy (B)

The ignition energy is infinitely variable between 10% and 99% for both the Lift Arc and HF ignition arc starting modes.

In direct relationship to the welding current setting I1, the processor then automatically applies the pre-selected value depending upon the setting of the welding current I1 during the ignition cycle. The pre-selected value of the ignition energy will be dependant upon the type of tungsten electrode, and the diameter, as well as the welding application.

When welding on thin materials and when using small diameter tungsten electrodes the value for the ignition energy will be lower.

3.3.18.4 Start current (C)

The start current is the current at which the machine produces directly after the arc is struck. The value is infinitely variable between 10% and 99% of the welding current I1. E.g. if the start current is set at 40% (C40) and the welding current is set at 100A then the start current will be 40A. The advantages of adjusting the start current are:

- Lower loading on the electrode due to lower thermal shock.
- Search arc can be set in the latched (4 step) trigger mode, to start at the beginning of a weld.
- The welding with a reduced current is possible at the beginning of a weld, or where heat build up occurs.

3.3.18.5 Current upslope time (D)

The current upslope time is the time in which the welding current rises in a linear transition from the start current to the welding current (I1). In the non-latched torch trigger mode (2step), the time commences directly after the arc has ignited. In the latched torch trigger mode (4step), the time starts as soon as the trigger is released after step 1 and current is flowing.

3.3.18.6 Crater fill current (E)

The crater fill current is the current at which the welding process will be terminated. The setting is infinitely variable between 10% and 99% of the welding current I1. E.g. if the crater fill current is set at 40% (E40) and the welding current is set at 100A then the crater fill current will be 40A. The advantages of adjusting the crater fill current are:

- The elimination of crater cracking and cracking at the end of the weld seam due to rapid cooling of the weld pool.
- Manual pulsing (see chapter 3.2.6).
- The welding with a reduced current is possible at the end of the weld on edges, or where heat build up occurs.

3.3.18.7 Hot start (H)

In order to improve the ignition when stick-electrode welding, the ignition current is given a short boost when starting. This hot start current is higher than the welding current that has been set (I1). The setting value for the hot start is a direct relationship to the welding current. The setting can be adjusted between 0% and 70%; this means that with a setting of 30% (H30) and the welding current of 100A the hot start current is 130A.

3.3.18.8 Arc Force (I)

In order to ensure a stable arc during stick-electrode welding it is very important for the smooth droplet transfer that in addition to the welding current (I1) that a very short current pulse is also given by the welding unit this is called the Arc force. The size of the pulse is defined by the Arc force setting which can be infinitely variable from 0% to 70% of the welding current (I1) which is set, this means that with a setting of 50% (I50) and the welding current at 100A the arc force current will be 150A.

3.3.18.9 Program save and load (S) (L)

There can be up to 99 different programmes with machine settings stored under a freely selectable programme number and recalled for use. All for the machine parameters settings that can be set are stored and then reloaded for implementation.

Thereby the entire machine settings can be simply reloaded for those repeat jobs within seconds saving a great deal of time and ensuring consistent quality

Additionally the basic parameter setting of the machine such as the start current, crater fill current, ignition energy, etc. can be individually set for each person who uses the machine. Recalling these is done at the touch of a button.

Loading a programme:

Selecting the load setting in the special mode does the loading of a programme. The first digit of the digital display shows the letter „L“ which stands for **L**oad

By depressing the turn and set knob the function load is activated and the „L“ begins to blink.

The turn and set knob is then turned and the required programme number can be selected.

The turn and set knob is depressed once again for **more than 2 seconds** and the selected programme number will be loaded into the machine. The loading of the programme can be recognised as the display will go blank for a short time, additionally the LED’s will change their position according to those determined by the programme settings.

Saving a Programme:

Selecting the load setting in the special mode does the loading of a programme. The first digit of the digital display shows the letter „S“ which stands for **S**ave.

Depressing the turn and set knob activates the load function, and the „S“ begins to blink.

The turn and set knob is then turned and the required programme number can be selected.

The turn and set knob is depressed once again for **more than 2 seconds** then all of the parameters which are set at that time will be saved. The saving of the programme can be recognised, as the display will go blank for a short time. The knob must be pressed for more than 2 seconds in order to prevent the accidental saving or overwriting of an existing programme, (similar to a car radio).

In order to recognise whether or not a programme is already stored in a certain programme number, then the digital displays shows a point next to the letter „S“.

It is also recommended that a list is made of the programmes stored in the machine together with their application, this will reduce the risk of mistakes when loading a programme.

3.3.18.10 Dual-Wave (F)

The Dual Wave process from IFL is a combination of AC and DC welding. The processor controls the welding process and automatically alternates the current from AC for 0.2 seconds to DC for 0.3 seconds. The selected values for the welding current I1 or I2, the frequency and the wave balance are applied as for DC-only or AC-only welding.

The Dual Wave process is activated by setting the value "1" at the "F" setting option in the Special mode. In the display, the LEDs for DC and AC light up at the same time. To deactivate the Dual Wave process, either the value can be altered to "0" or DC or AC can be set directly (see sections 3.3.7 and 3.3.8).

NOTE: The Dual Wave function is activated by the special mode, when it is active both the AC and DC LED’s illuminate. Deactivating the Dual Wave can be done either via the special mode, or by selecting either the AC or the DC mode on the control panel.

The Dual-Wave process enables the operator to have more control over the welding pool. This is particularly important, when for example welding out of position or when joining two differing thickness together on Aluminium or Aluminium alloys.

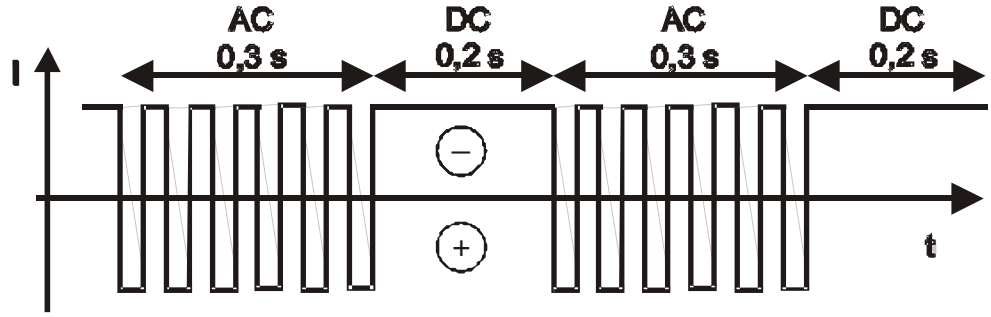


Fig. 3.9: The welding current cycle for the Dual-Wave- process

3.3.19 The control LED's

The following control LED's give an overview of the important status conditions of the machine:

	Whether conventional or high frequency pulsing this LED will illuminate to indicate that pulsing is activated. (See chapter 3.3.2. und 3.3.4.)
	There is open circuit voltage on the torch or the electrode holder. In the case that this LED flashes on and off then an internal fault condition has been recognised. This can be reset by power off and then on again. If fault cannot be cleared then please contact Rehm customer service (RKS).
	Temperature control. This (yellow) LED will illuminate if the maximum allowable temperature of the machine has been exceeded. As long as this LED is illuminated then the power module is disabled, therefore there is no output from the power source possible. In the TIG welding mode when this fault condition occurs the post flow gas time will still elapse. Once the machine cools down again the LED will extinguish and the welding operation can continue as before. If this Led starts to flash off and on, and the digital display shows and „Err" then an internal fault has been recognised. This can be reset by power off and then on again. If fault cannot be cleared then please contact Rehm customer service (RKS).

3.3.20 The Digital display

The digital display enables the selection of the parameters and their values to be displayed. The display is a three-digit display. Its large display area with self-illuminating digits enables the display to be easily read, even from a distance and also in poorly lit conditions. As the display is control via the processor it always show the values and status in real time. This means for example that when a programme is to be stored the point beside the letter "S" can also be displayed to indicate that the programme is already number selected is already occupied.

3.3.21 The Turn and Set knob

The settings are all done via a single control knob, this can be turned to select or alter the parameter and then pressed to confirm the setting. Using the combination of LED's and the 3-digit digital display the setting can always be accurately set and reproduced using the same principle. This turn and set knob is positioned centrally on the operating panel and is suitable for both right handed and left handed personnel, as it can easily be operated with the thumb. The form of the knob enables both simple and precise setting of the parameters and functions. It is fully integrated within the housing of the Tiger and is therefore protected by mechanical damage. Even if it is knocked from above the electrical components within the housing remain undamaged. The turn and set knob is a combined encoder and switch. As such it does not have an end stop therefore it cannot be damage by truing it past the end point.

3.4 Anti-Stick Function

If there is a permanent short circuit between the electrode and the workpiece during welding, the Anti-Stick Function is automatically activated after approx. 1.3s. This function automatically limits the welding current to approx. 35 A. This

prevents the electrode from overheating and burning out. The operator terminates the short circuit simply by removing the contact between the electrode and the workpiece.

3.5 INTIG-Energy

The highly intelligent processor ensures that the ideal ignition energy is automatically chosen depending upon the actual weld current setting; this applies not only for HF, but also for the Lift-Arc ignition sequence.

When "HF-On", is selected the high-frequency ignition unit is ready for operation. To ignite the arc, the electrode must be held about 3 to 5 mm above the workpiece. When the torch button is pressed, the shielding gas is pre-ionised by a high-voltage, the current flows between the end of the electrode and the workpiece so that the main arc is established. The ignition of the arc without contact between the tungsten electrode prevents tungsten inclusions in the weld. Once the arc has successfully been ignited the high-frequency ignition unit is switched off automatically during welding

When “HF-Off” is selected, microprocessor controlled contact ignition takes place (Lift Arc) to strike the arc. In order to ignite the welding arc, the tip of the electrode must be placed on the workpiece and the torch button depressed. The processor control system reduces the ignition current so that the tip of the electrode does not heat up.

The electrode is then gradually lifted away from the workpiece, this action ignites the arc under the system processor control, this results in arc ignition without HF and also minimum wear on the tungsten electrode. This process is essential when welding in areas where sensitive electronic equipment is in operation (e.g. repair welds on CNC-controlled machines in hospitals etc.) and where there may be a risk of damage caused by high-voltage.

The electrode diameter depends on the welding current. A diameter of 1.6 mm is recommended for welding currents up to 70 A and 2.4 mm for higher currents.

When stick-electrode welding in either the Booster or Fuse-hold mode is selected, then the HF-ignition is automatically switched off.

During stick-electrode welding the INTIG-Energy is always determines the correct setting of the Hot-start current. The ignition process is carefully controlled by the processor and ensures that the output for a soft and safe start is realised. Even the re-starting of difficult electrodes (e.g. Basic coated) can be achieved as the power is controlled when the electrode makes contact with the workpiece (similar to the Lift-Arc process during TIG welding).

3.6 EPC: Continuous Mains voltage monitoring

The EPC (Electronic Power Control) system continually monitors the mains supply voltage. As soon as an over voltage is detected, the EPC unit disconnects the machine electronics from the mains supply. The separation is via electrical components that due to the fault condition become overheated, and thereby alter their electrical resistance. Thereby it is essential that when the over voltage fault has been corrected, that sufficient time is allowed to enable these components to reach their required operating temperature again, which can depending upon the ambient and machine temperature be more than a few minutes.

If the Tiger is switched on and off several times in succession then the EPC unit operates as described above. This is a safety function that prevents the inverter from becoming damaged from voltage or current surges.

3.7 Resetting to Factory settings

If the turn and set knob is depressed and at the same time the machine is switched on by the mains switch then the function of the Tiger will be reset to that which was delivered from the factory. The welding current I1 will remain saved.

The factory setting resets your Tiger to the default values in all parameters for TIG welding in 2-step mode with high-voltage ignition.

Please note that ignition with high-voltage pulses is selected for TIG welding in the factory setting.

Extra care must be taken when the HF is activate by the factory setting, The HF ignition may cause a safety hazard if incorrectly used.

Care must also be taken when using the factory reset. All of the set-up parameters are set to the default values. This includes the parameters in the Special mode as well. This means that before the machine can be used each parameter must be checked and altered in necessary before welding.

The resetting of the machine to the factory setting does not affect programmes that have been saved in the machine (see Chapter 3.3.18.9)

4. Accessories

The equipment listed below can be supplied as accessories. This equipment is connected to the remote control socket, which is fitted as standard. This connection is automatically recognised by the control unit. There is no need for manual switchover. Remote control units remain active for as long as they are plugged into the power source!

4.1 Foot operated remote control

By means of the foot remote control, the welding current can be adapted to the welding job all the time during welding, via a foot pedal. The current set at the machine is the current set when the pedal is depressed. This makes it possible to set the maximum desired current, resulting in optimum resolution in the particular current range!

When the foot-operated remote control is used, the torch control cable is not to be plugged into the 7-pole socket. The remote control is connected to this socket and the ignition of the torch is achieved by depressing the foot control. Striking the arc and switching between two current with the torch button is not possible when using the foot control.

The foot operated remote control has a selector switch, which has the following functions:

4.1.1 Switch position; Foot-operated control signal

In this operating mode, the welding current is switched on and off automatically using the foot pedal and is controlled using the foot. The welding machine automatically operates in the 2-step mode of operation. The upslope and downslope times are automatically disabled.

Warning: The operator must make sure that his foot does not switch on the machine inadvertently. When the foot pedal is actuated, there is a risk of electric shock from high-voltage!

4.1.2 Switch position; Hand-operated control signal

The welding current is controlled via the foot pedal. This enables that during stick-electrode welding the welding current can be varied as required. This possibility is not suitable for TIG welding, as the torch trigger control cable is not plugged in, therefore the ignition via the torch button cannot take place.

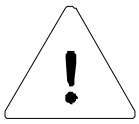
4.2 Hand remote control

Using the hand remote control on the machine enables the welding current to be altered from between 0 % und 100 % of the set value. This remote control is designed for stick-electrode welding. This remote control is not designed for use in conjunction with TIG welding, as the torch trigger control cable is not plugged in, therefore the ignition via the torch button cannot take place.

4.3 TIG-torch with Potentiometer

The TIG torch with potentiometer
enables the welding current to be adjusted remotely from the torch handle. The connection of the torch to the machine is via the built-in 7-pole connection socket. The Tig Torch with
integrated potentiometer are specifically designed for use
with the AC/DC machine series. The use of any other torch with remote control potentiometer can cause damage to the electrical components of the machine

When the torch button is pressed the display instrument shows the value that would result during welding from the setting of the torch potentiometer. This permits precise setting of the welding current prior to welding. Please note here that when HF ignition is activated high-voltage pulses are applied to the electrode.



ATTENTION: The use of TIG torches with remote control potentiometers of any other type other than expressly specified or recommended by I/F, will invalidate the manufacturers warranty.

4.7 Mechanised welding

The **option** mechanised welding enables the AC/DC to be used in conjunction with simple automated applications. The connection is via the standard 7-pole torch connection socket. The following signals are available:

Torch socket Pin1:	Welding cycle On/Off
Torch socket Pin2:	GND
Torch socket Pin3:	Switching to current I2
Torch socket Pin4:	+5V
Torch socket Pin5:	Set value for I1
Torch socket Pin6:	Arc established signal (AES)
Torch socket Pin7:	Earth

Machines fitted with the mechanised welding interface the machine can also be used with the options described in chapter 4.1 to chapter 4.4. Note: the automatic setting of non-latch (2 step) and the minimum upslope and downslope does not operate, and must be set manually.

5. Commissioning

5.1 Safety Notes

Before the unit is used for the first time, read through the operating manual, particularly **Chapter 2, Safety,** thoroughly prior to starting to work with this welding power supply.

Warning!

Only persons trained in the use and servicing of welding equipment and in the relevant safety regulations must operate I/F welding equipment.

Always wear protective clothing when welding and make sure that other people nearby are not endangered by the UV radiation of the arc.

5.2 Working with an increased electrical hazard in accordance with regulations of IEC 974, EN 60 974-1 and VBG 15 (S)

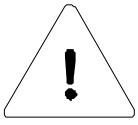
The I/F TIG welding units comply with the regulations listed above. I/F TIG welding units have an open circuit voltage of 85VDC max, (113 V is permitted).
When AC welding, a safety device has been installed in the electronic control unit. In this way, during AC welding the arc is in principle only ignited by means of a DC voltage, and the unit only switches over to AC once the welding current is flowing. If the arc is suddenly interrupted during welding, the machine automatically switches off the welding current. The machine is then in the safe condition.

It is necessary to ensure that when working with a high electrical hazard, the welding power source is not set up in this area. Observe the stipulations given in EN 60974-1 and VBG 15 / BGV-D1.

5.3 Setting up the welding unit

Set up the I/F welding equipment so that the welder has sufficient space in front of the equipment to be able to monitor and operate the controls.

The relevant accident prevention regulations must be complied with whenever the equipment is being transported.



Danger! Electricity!

Do not use the welding unit outdoors when it is raining!

5.4 Connecting the welding unit

Always comply with current VDE regulations when connecting the I/F welding power supply to the mains power supply, and, in addition, make sure that the regulations of the appropriate professional associations are complied with.

When connecting the equipment, observe the details provided relating to the mains supply voltage and the mains protective fuse sizing. Safety cut outs and fuses must always be designed for the current specified. The necessary information can be found in:

Chapter 11, Technical Data.

Always turn the equipment off when it is not in use.

Secure the gas regulator correctly on the gas cylinder, and check the connection is leak-tight. Always close the cylinder valve when work is finished. Ensure that the appropriate regulations of the relevant professional associations are complied with at all times.

5.5 Ventilation of the welding power source

The I/F welding unit must be positioned so that ventilating and cooling air can enter and leave without obstruction. The duty cycle specified for the power source can only be achieved if there is sufficient ventilation (see also “Technical Data”). Make sure that it is not possible for any metal parts, dust or other foreign bodies to enter the equipment through the ventilation slots.

5.6 Guidelines for working with welding power sources

Only specialists or trained personnel who are experienced in the use of the equipment and the process may undertake welding work. When welding, wear protective clothing and make sure that there is no risk to other people in the area. When the welding work is complete, you should leave the unit switched off for a few minutes, so that the fan continues to run and is able to dissipate the heat from the unit.

5.7 Connecting of the torch or electrode holder cables

I/F welding equipment is fitted with quick action connections for connecting the earth cable, the TIG welding torch, or the electrode cable. Plugging it in and turning it to the right makes the connection. The shielding gas hose of the TIG welding torch are also connected to the power source by means of quick action connections. The torch button control plug is plugged into the 7-pole control socket.

Important!

To avoid loss of welding power during welding, ensure that all the welding leads are secure connected and well insulated.

5.8 Recommended welding lead cross sections

Cross sections for copper leads:

With a length of	up to 5m	up to 10m	up to 15m
up to 170A	16 mm^2	25 mm^2	25 mm^2
up to 210A	25 mm^2	25 mm^2	35 mm^2

6. Operation

6.1 Safety instructions

Read the operating instructions, in particular **Chapter 2, Safety Instructions**, thoroughly before commissioning and before you start to work with this welding power source.

Warning!

Personnel who are trained in the use and maintenance of welding units and are familiar with the relevant safety regulations are the only persons who are qualified to operate I/F welding units.

Working with and maintenance of electrical welding units always involves possible hazards. People who are not familiar with such equipment and units may harm themselves or other people. For these reasons, the operating staff must be warned of the following potential hazards and the safety measures which are required in order to avoid possible harm. Irrespective of the above, the operator of a welding unit must be informed of the safety regulations that apply in the particular area in which he is working.

6.2 Electrical hazard

Connection of and maintenance work on welding units and their accessories must only be carried out in accordance with the applicable VDE regulations and the regulations of the appropriate trade associations.

- Never touch metal parts to which voltage is applied with your bare skin or with wet clothing.
- When welding, always wear gloves, welder’s protective clothing, and eye protection with the correct protective filter glass.
- Make sure that all parts which you have to touch when working, such as your clothing, your working area, the welding torch, the electrode holder and the welding unit are always dry. Never work in wet surroundings.
- Make sure you are well insulated; by only wearing dry gloves and rubber-soled shoes and by standing on a dry insulated surface, particularly when you are standing on metal when working or are in areas with increased electrical hazard.
- Do not use worn or damaged welding cables. Make sure that welding cables are not overloaded. Replace any damaged items of equipment or cabling immediately.
- Switch off the welding unit in the event of a prolonged interruption to work.
- Do not either wrap the welding cables around power source, or in lay in coils.
- Never leave the welding machine unattended when it is switched on.

6.3 Personal safety instructions

The action of the radiation of the electric arc or of pieces of the hot metal may lead to severe burns to the unprotected skin and eyes.

- Only use undamaged welder's protective clothing, and eye protection with the correct protective filter glass: The use of leather gloves and a welder's helmet to protect your eyes and body from sparks and radiation from the arc is essential (see VBG 15, § 27). Wear this protection even when you are only supervising the welding work.
- Warn bystanders of the dangers of arc radiation and of splashes of hot metal, and protect them by the use of non-flammable screens.
- Compressed-gas cylinders represent a potential hazard. Therefore, make sure you adhere rigidly to the safety regulations of the appropriate trade associations and suppliers. Secure all gas cylinders so that they cannot accidentally fall over.

6.4 Fire prevention.

Hot slag or sparks may cause fires if they come into contact with flammable substances, liquids or gases. Remove all flammable materials from the welding area and make sure a fire extinguisher is ready and available.

6.5 Ventilation.

Fume extraction equipment must always be used in conjunction when welding. This must be in good working condition, regularly maintained and served.

The place of work must be designed and arranged in such a way that it is best suited to the processes, materials, and conditions of use. The working area must be clear of dangerous substances that represent a health hazard within the operators breathing zone. (see VBG 15, 4 and 29).
Make sure that the welding area is fully ventilated either by natural ventilation or by industrial extraction equipment.

Do not carry out any welding work on workpieces that have been painted or treated with degreasing agents, as they may give off toxic vapours.

6.6 Tests before switching on.

It is assumed that:

The unit has been set up correctly as specified in **Chapter 5, Commissioning**

All the connections (inert gas, torch connection) have been made correctly as specified in **Chapter 5, Commissioning**,

The tasks due at each maintenance interval have been carried out **Chapter 8, Maintenance,**

The safety devices and the components of the unit (particularly the torch connection hoses) have been tested by the operator and are ready for operation.

The operator and all participating staff will wear the right protection clothing and the welding place will be protected safely.

6.7 Connecting the earth cable.

Warning!

Chapter 6.2; Electrical Hazard. Ensure that the welding current cannot flow through chains of lifting appliances, crane cables or other electrically conductive components.

Chapter 6.2, Electrical Hazard. Ensure that the earth cable is connected to the workpiece as close as possible to the welding position. Earth connections that are at a distance to the welding operation reduce effectiveness, and increase the risk of electric shocks and stray currents.

6.8 Practical hints for use.

Practical hints for use listed below are only able to portray an overview of the various applications of I/F TIG welding units. In the event of questions concerning special welding jobs, materials, inert gases or welding equipment, please refer to appropriate technical literature or manufacturer's recommendations.

Weldable materials

For TIG welding, a distinction is drawn between materials that can be welded using DC and those which can be welded using AC. DC can be used to weld Copper, Nickel, Titanium and their alloys as well as mild steel, low and high-alloyed. AC is generally used to weld Aluminium and its alloys.

Tungsten electrodes

Various tungsten electrodes are offered and used for TIG welding. The difference lies in the level of oxide additions and in the oxides used. The compositions are listed in EN 26848 and generally consist of Thorium oxide, Cerium oxide, Zirconium oxide, or Lanthanum oxide. Advantages of oxide-enriched tungsten electrodes have:

- Improved ignition properties.
- A more stable arc.
- Higher current-carrying capacity.
- Longer lifetime.

The relevant literature provides details of the most common electrode diameters and their current-carrying capacity. Please note that the values given in this literature have usually been established using machines that fall well short of the balance range of the I/F TIG welding units. A suitable guideline is that for a given electrode the current is too high if it forms droplets or assumes a broom type structure. You can then choose between reducing the current or, in the AC mode, increase the negative proportion of the wave balance.

When DC welding, the tip of the electrode should be a point.

With the I/F TIG welding units, a pointed electrode may also be used in AC mode with balance settings in the minus range. This has the advantage that the arc becomes even more concentrated and effective. In most cases, the welding speed is increased as a result.

Special care and attention should be taken when grinding tungsten electrodes, always use a protective mask and eye shields. In addition a suitable dust extraction unit must also be used to protect the operator for the grinding dust, which are dangerous if inhaled.

Shielding gases

Argon is the main shielding gas used for TIG welding. For particular applications, Helium, Argon-Helium mixtures or Argon-Hydrogen mixtures may be used. Increasing the Helium content makes the arc more difficult to ignite and increases the introduction of heat. The volume of shielding gas required is dependent on the electrode diameter, the size of the gas nozzle, the welding current level and the movement of air caused by workplace conditions. For a workpiece thickness of 4 mm, when Argon is the shielding gas used, an initial guideline for Aluminium, for example, is approx. 8 litres/minute, and for steel and chrome/nickel steel is approx. 6 litres/minute. If Helium is used, the volume required is significantly higher.

TIG - Welding torch

The standard length of the TIG welding torch is 4 metres. However, longer torches may also be connected to these machines. The appropriate tungsten electrode, clamping collet, and gas nozzle have to be selected depending on the welding job and current intensity. In torches with two buttons, the two-current controller can be used to switch the current between two differing values during welding.

Welding with and without filler material

During manual welding, welding filler material is usually provided in rod form. The correct material is to be selected depending on the base metal. However, excellent results can also be achieved if the weld pool from two parts is simply allowed to run together, for example at corner seams.

Direct current welding

In DC welding, the negative pole is usually to the electrode. The negative pole is the cooler, with the result that the current carrying capacity, and the service life of the tungsten electrodes are significantly higher than with positive pole welding.

Alternating current welding

In AC welding, the current-carrying capacity of the electrode is affected to a considerable extent by the wave balance setting. The wave balance setting distributes the positive and negative components of the welding current between the electrode and the workpiece. During the positive half wave, the Aluminium oxide skin is destroyed and a higher temperature is generated at the electrode. During the negative half wave, the electrode cools down again and the Aluminium is heated. Since usually only a short positive pulse is needed in order remove the Aluminium oxide skin, a greater negative proportion can be used with I/F TIG units.

This has a number of advantages:

1. The temperature load on the electrode is reduced.
2. A higher current can be applied to the electrode.
3. The current range of the electrode is increased.
4. A pointed electrode can be used for welding.
5. The arc becomes more slender.
6. The penetration becomes deeper.
7. The heat-affected zone of the electrode becomes smaller.
8. The welding speed becomes higher.
9. Less heat is introduced into the workpiece.

Practical values for setting the wave balance for AC welding are:

- for butt-welds negative proportion 60% to 70%.
- for fillet welds negative proportion 70% to 80%.

- see also "Tungsten Electrodes"

Ignition with and without high frequency (HF)

High-voltage ignition units are fitted as standard in the I/F AC/DC machines in order to provide contact-free ignition of the welding arc. The high voltage electrically ionises the distance between the tungsten electrode and the workpiece in such a way that the welding arc can bridge this gap. A high oxide content in the tungsten electrode and a close distance between it and the workpiece has a beneficial effect on the ignition performance.

For DC welding, the arc can also be ignited without high voltage using the installed program control unit:

The function selector switch HF is set to “Off”, the tungsten electrode is set on the workpiece, then the torch button is pressed and the electrode is lifted off the workpiece by tilting the torch. Igniting the arc without high voltage is important if, for example, repair welding work in which the high-voltage ignition unit may interfere with the control sequence is being carried out on electronically controlled machines.

Welding of stick-electrodes

The I/F TIG welding units are eminently suitable as current sources for stick-electrode welding, due to their rapid and fast control dynamics. The current intensity and polarity which are to be set are specified by the electrode manufacturers. Positive pole welding is to be used for welding basic electrodes.

7. Troubleshooting

7.1 Safety instructions

WARNING!

If a fault occurs which represents a risk to personnel, equipment and/or their surroundings; the equipment and all work MUST BE STOPPED immediately. It must also be ensured that it is not possible to turn on the equipment again until the fault is cleared and made safe.

The equipment should only be used the unit again once the cause of the fault has been traced and there is no longer any danger represented to personnel, equipment and/or their surroundings.

Faults can only to be corrected repaired or eliminated by qualified staff, which observe and implement all of the relevant safety instructions. Chapter 2

Following a fault, the equipment can only be put back into service after it has been checked by and approve by suitably qualified staff.

7.2 Fault finding table

REHM-operators panel does not function
The digital display does not illuminate and neither does any of the LED's

Possible cause:	Possible remedy:
No mains voltage (e.g. mains fuse)	Check mains voltage and fuses
Cable break or plug defect	Check and repair
Mains supply over-voltage	Check mains voltage, (use other socket)
Machine has been switched on and several times	Allow machine to cool down app. 10 mins. (see Ch. 3.6)

Error messages.
The display shows "Err" and the over-temperature LED is blinking.

Possible cause:	Possible remedy:
Primary current has reached the critical value.	Call for service.

The Upslope and Downslope times are set at „0.0" and cannot be changed.

Possible cause:	Possible remedy:
The remote foot-control is plugged in. foot-control.	These times are controlled manually by the Unplug foot-control.

The Upslope and/or the Downslope times are not correct as set.

Possible cause:	Possible remedy:
Start current set at 100 %.	Change the start current.
Crater fill current set at 100%.	Change the crater fill current.

Trigger latch (4-step) cannot be set.

Possible cause:	Possible remedy:
The remote foot-control is plugged in.	Unplug foot-control.

Balance and Frequency cannot be selected.

Possible cause:	Possible remedy:
Polarity is not set on „ ~ "	Can only be selected in AC mode.

The unit has different parameters than it had when switched off.

Possible cause:	Possible remedy:
The values will only be saved after the first	Weld with the machine.

No gas flows.

Possible cause:	Possible remedy:
The cylinder is empty or the gas hose is kinked.	Check and rectify.
Defective regulator.	Check and rectify.
Solenoid valve in the machine is defective.	Call for service.
The cable connection to valve is loose.	Check and rectify.
Stick welding mode is selected.	The gas valve remains closed.

The fan cannot be heard.

Possible cause:	Possible remedy:
The fan is dependant upon temperature. and increases its speed on demand	Check whether the fan increases its speed during higher temperature loading
Fan is defective.	Call for service.

No high voltage (HF) impulse

Possible cause:	Possible remedy:
HF-Ignition is off	Switch on HF-ignition
No shielding gas	Check and rectify.
Workpiece cable has a poor connection	Check and rectify.
Electrode is contaminated	Re-grind electrode
Wrong electrode is being used	Change electrode
Gas pre-flow set too long	Shorten gas pre-flow time or wait longer
High voltage tracking in torch	Change torch
Torch and workpiece polarity swapped	Connect to correct polarity

Required welding current is not reached or arc will not establish

Possible cause:	Possible remedy:
Workpiece cable wrongly connected.	Check and rectify.
Remote foot control is connected but not depressed.	Check and rectify.
Hand remote is connected	Set current on remote control.
Incorrect or no shielding gas	Check and rectify.

Arc jumps and flutters

Possible cause:	Possible remedy:
The workpiece and electrode does not reach the right working temperature.	Use smaller diameter electrode
The electrode is not correctly ground	Re-grind electrode
Incorrect electrode	Change electrode

Arc has an unusual colour

Possible cause:	Possible remedy:
No, too little, or wrong shielding gas	Check and rectify.
Electrode is contaminated	Re-grind electrode

Tungsten electrode burns away

Possible cause:	Possible remedy:
No shielding gas	Check and rectify.
Loading is too high	Use thicker electrode
Too much positive component during AC welding	Increase the minus component with balance
Torch and workpiece cable exchanged	Connect correctly
Stick-electrode setting is selected	Set up for TIG welding

Unit will not pulse

Possible cause:	Possible remedy:
Pulsing is not selected	Set peak and background times T1 and T2
Values for I1 and I2 are the same	Change the values

Arc extinguishes during ignition

Possible cause:	Possible remedy:
Ignition energy is set too low	Set the ignition energy to higher value, or use thinner electrode.
Electrode is damaged or contaminated	Re-grind electrode

8. Service and maintenance

8.1 Safety instructions

Warning!

Only people who have been trained by I/F are authorised to carry out maintenance and repair work. Contact your I/F distributor. In the event of parts being required, only use original I/F spares.

If people who have not been trained by I/F, or are not authorised to carry out such work undertake maintenance or repair work then the warranty and liability claims against I/F are automatically invalidated.

Before commencing any cleaning, the welding unit must be switched off and disconnected from the mains.

Before carrying out maintenance work, the welding unit must be switched off and disconnected from the mains. It must be ensured that it cannot be switched on again inadvertently.

Gas supply lines must be shut off and emptied.
The warning notes listed in Chapter 2 “Safety” are to be taken into account.

The welding unit and its components are to be maintained in accordance with the instructions given in the maintenance table.
Inadequate or incorrect servicing or maintenance may lead to operating faults.
Regular servicing of the unit is therefore essential. No modifications, alterations, or additions to the unit are to be carried out.

8.2 Preventative maintenance table.

The maintenance intervals are a I/F recommendation given normal standard demands (e.g. single shift operation, use in clean and dry surroundings). Your Safety Supervisor should determine the exact intervals.

Action	Chapter	Interval
Cleaning the machine internals		In accordance with the working environment
Functionality and Safety inspection by operators		Daily
Visual inspection of equipment, particularly the torch hoses.		Daily
Check that earthing trip is operational.		Daily (for portable equipment) otherwise monthly

Action	Chapter	Interval
Have connection cables and torch hoses checked by specialist staff; record testing in test book provided for that purpose. **Test also to be carried out more frequently depending on local regulations.**		Every six months
Have entire welding unit checked by specialist staff; record testing in test book provided for that purpose. **Test also to be carried out more frequently depending on state law**		Annually

8.3 Cleaning the inside of the unit

If the I/F welding unit is used in a dusty atmosphere, the inside of the unit must be cleaned at regular intervals by either blowing them out or using suction.

The frequency of this cleaning is dependent on the particular conditions of use. Use only clean dry air for blowing through the unit, or employ a vacuum cleaner.

If maintenance or repair work is carried out on this equipment by non-authorised personnel, or by personnel who have not been specifically trained by I/F in the use and repair of this equipment, then manufactures warranty is automatically invalidated.

8.4 Orderly waste management

Only for EU countries.

Do not dispose of electric tools together with household waste material.

In observance of European Directive 2002/96/EC on waste electrical and electronic equipment and its implementation in accordance with national law, electric tools that have reached the end of their life must be collected separately and returned to an environmentally compatible recycling facility.

9. Technical Data

Type			**FUSION 210 AC/DC**
Setting range	*TIG*	[A]	5 - 210
	Stick	[A]	5 - 170
Duty cycle at $I_{max.}$	*TIG*	[%]	50 / 30
(10 min) at 20°C / 40°C	*Stick*	[%]	90 / 35
Welding current at 100 % duty cycle	*TIG*	[A]	175/140
at 20°C / 40°C	*Stick*	[A]	160 / 120
Power consumption at	*TIG*	[kVA]	4,8
$I_{max.}$	*Stick*	[kVA]	5,5
Mains voltage			230V/50Hz
Mains voltage compensation			-15% +10%
Fuse rating		[A]	16
Power factor		Cos ϕ	0,99
Protection classification			IP 23
Insulation classification			H
Torch cooling			Gas
Dimensions L/B/H		[mm]	36 x 24 x 38
Weight		[kg]	9.0

The use of a free-standing mobile generator.

The AC/DC is designed to run in conjunction with a free-standing mobile generator. However the section relating to the technical must be strictly adhered to.

We recommend that the generator has a capacity of 8kVA continuously available for the AC/DC unit. The generator should also be of the Asynchronous type.

It should be noted that the EPC-System which continuously monitors the mains supply voltage will also operate during use with the generator, this means that in the case whereby the voltage fluctuations are outside of the pre-described limits then the safety cut-out will operate on the machine.

In addition to this if the mobile generator is unable to supply a stable voltage due to the lack of power available (e.g. the mobile generator is undersized). Then the welding result can be diversely affected, this is particularly the case when using the AC/DC in the higher power range.