schweisskraft®
Schweißtechnik

SYN-MIG

Operating instructions

MIG welding machine

- SYN-MIG Series

SYN-MIG 323-4 Synergic

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Foreword

Dear Customer,

Thank you for purchasing the schweisskraft welding machine.

schweisskraft Welding machines offer the highest level of quality, technically optimal solutions and an outstanding price-performance ratio. Continuous development and product innovation ensure that our machines are always at the cutting edge of technology and safety.
Before starting operation, please read this operating manual thoroughly and familiarise yourself with the welding machine. Also ensure that all persons who operate the welding machine have read and understood the operating manual beforehand. Keep this operating manual carefully in the vicinity of the welding machine.

Information

The operating instructions contain information on the safe and proper installation, operation and maintenance of the welding machine. Constant observance of all the instructions contained in this manual ensures the safety of persons and the welding machine.

The manual specifies the intended purpose of the welding machine and contains all the information required for its economical operation and long service life.

The maintenance section describes all maintenance work and functional tests that must be carried out regularly by the user.

The illustrations and information contained in this manual may differ from the current design of your welding machine. As a manufacturer, we are constantly striving to improve and update our products, which means that changes may be made without prior notice. The illustrations of the welding machine may differ in some details from the illustrations in this manual, but this does not affect the operability of the welding machine.

No claims can therefore be derived from the information and descriptions provided. We reserve the right to make changes and errors!

Your suggestions regarding this operating manual are an important contribution to optimising the service we offer our customers. Please contact our service department if you have any questions or suggestions for improvement.

If you still have questions after reading this operating manual or if you cannot solve a problem with the help of this operating manual, please contact your specialist dealer.

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Information on the operating instructions

Original operating instructions
in accordance with DIN EN
ISO 20607:2019

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Product identification

Welding machine	Item number
SYN-MIG 201-2 P Synergic	1071202
SYN-MIG 203-2 P Synergic	1071203
SYN-MIG 253-4 Synergic	1071254
SYN-MIG 323-4 Synergic	1071323
SYN-MIG 353-4 W Synergic	1071353
SYN-MIG 403-4 W Synergic	1071403
Syn-Mig 353-4 W Pulse	1072353

1 Safety

Display conventions

☞	provides additional information
➔	calls on you to take action
❍	Lists

This part of the operating instructions

❍ explains the meaning and use of the warnings used in this operating manual

❍ specifies the intended use of the welding machine,

❍ alerts you to dangers that could arise for you and others if these instructions are not followed,

❍ and informs you about how to avoid hazards. In addition to the

operating instructions, please observe

❍ the applicable laws and regulations,

❍ the legal provisions for accident prevention,

❍ prohibition, warning and instruction signs.

Always keep the documentation close to the welding machine.

1.1 Safety instructions (Warning notices)

Hazard classification

We divide safety instructions into different levels. The table below provides an overview of the symbols (pictograms) and signal words assigned to specific hazards and their (possible) consequences.

Pictogram	Signal word	Definition/consequences
	**DANGER!**	Immediate danger that will result in serious injury or death.
	WARNING	Risk: a hazard could result in serious injury or death.
	CAUTION!	Dangerous or unsafe practices that could result in injury to persons or damage to property.
	**CAUTION!**	Situations that could result in damage to the welding equipment or other damage. No risk of injury to persons.
	**Information**	Application tips and other important/useful information and notes. No dangerous or harmful consequences for persons or property.

Pictograms indicating specific hazards

General warning sign

Warning of electrical voltage

Warning of hand injuries

Warning of hot surface

Warning about automatic start-up

Warning of obstacles on the ground

Warning of tipping hazard!

Warning of floating objects load

Warning of flammable substances

Pictograms indicating commands/prohibitions

Prohibition for persons with pacemakers

Wear ear protection!

Before starting up Read the operating instructions!

Disconnect the mains plug!

Wear safety goggles!

Wear protective gloves!

Wear safety shoes!

Wear protective clothing!

1.2 Intended use

The welding machine with wire feed is suitable for arc welding, which is specially designed for MIG (metal inert gas welding) or MAG welding (metal active gas welding) of carbon steels or low-alloy steels with CO_2shielding gas or $argon/CO_2$mixtures.

It is also suitable for MIG welding of stainless steels with argon gas and aluminium with argon gas, as well as for MMA welding.

The welding equipment is designed for professional use and may therefore only be used by qualified personnel in accordance with these operating instructions.

Part of the intended use is that you

- observing the operating instructions,
- comply with the inspection and maintenance instructions.

1.3 Reasonably foreseeable misuse

- Use in areas with hazardous substances, explosion risk or fire hazard.
- Use for heating objects or liquids.
- Use for processing non-metallic products.
- Use for igniting fuels.

WARNING!

This Class A welding equipment is not intended for use in residential facilities where the power supply is provided by a public low-voltage supply system. It may be difficult to ensure electromagnetic compatibility in these areas due to both conducted and radiated interference.

If the welding machine is used in a manner other than that specified in "1.2 Intended use" or is modified without the approval of Stürmer Maschinen GmbH, the welding machine is no longer being used as intended.

WARNING!

Improper use of the welding equipment

- **, this poses a risk to personnel**
- **the welding machine and other property of the operator may be endangered,**
- **and the function of the device may be impaired.**

We accept no liability for damage resulting from improper use.

Any use beyond the intended use or any other use is considered misuse. To avoid misuse, the operating instructions must be read and understood before initial use.

Operating personnel must be qualified.

ATTENTION!

Modifications and alterations to the welding machine are prohibited! They endanger people and can lead to damage to the welding machine.

Improper use of the welding machine and failure to observe the safety regulations or operating instructions will void the manufacturer's liability for any resulting damage to persons or property and will invalidate the warranty!

Danger in case of misuse!

Misuse of the welding machine can lead to dangerous situations.

- Only operate the welding machine within the power range specified in the technical data.
- Never bypass or disable the safety devices.
- Only operate the welding machine when it is in perfect technical condition.
- Only use original spare parts.

1.4 Residual risks

Even if all safety regulations are observed and the welding machine is used in accordance with the instructions, there are still residual risks, which are listed below:

- Eye damage when using defective or unsuitable eye protection.
- Damage to the respiratory tract when inhaling fumes.
- Electric shock due to defective electrical insulation or moisture
- Burns to the upper limbs when using unsuitable gloves
- Damage to the workpiece if the user is not sufficiently qualified or experienced.

If the welding machine is operated and maintained by insufficiently qualified personnel, incorrect operation or improper maintenance can result in hazards arising from the welding machine.

INFORMATION!

All persons involved with the welding machine must

- have the necessary qualifications
- follow these operating instructions carefully.

1.5 e Staff Qualifications

Target group

These instructions are intended for

- operators,
- operators,
- maintenance personnel.

The warnings therefore refer to both the operation and maintenance of the welding machine.

Clearly and unambiguously define who is responsible for the various activities on the welding machine (operation, maintenance and repair).

Unclear responsibilities are a safety risk!

This manual specifies the qualifications required for the various tasks listed below:

Operator

The operator has been instructed by the operator on the tasks assigned to him and the possible dangers of improper behaviour. The operator may only perform tasks that go beyond normal operation if this is specified in these instructions and the operator has expressly entrusted him with this task.

Qualified electrician

Due to their professional training, knowledge and experience, as well as their knowledge of the relevant standards and regulations, electricians are able to carry out work on electrical systems and independently identify and avoid potential hazards.

The qualified electrician is specially trained for the working environment in which they operate and is familiar with the relevant standards and regulations.

Specialist personnel

Due to their specialist training, knowledge and experience, as well as their knowledge of the relevant regulations, qualified personnel are able to carry out the work assigned to them and to independently identify and avoid potential hazards.

Trained person

The instructed person has been instructed by the operator on the tasks assigned to them and the potential hazards associated with improper behaviour.

Authorised persons

WARNING!

Improper operation and maintenance of the welding equipment poses a risk to people, property and the environment.

Only authorised persons may operate the welding machine!

Authorised persons for operation and maintenance are the trained and qualified personnel of the operator and the manufacturer.

The operator must

- train the personnel,
- instruct the personnel at regular intervals (at least once a year) on
  - all safety regulations relating to the welding machine,
  - operation,
  - the recognised rules of technology,
- test the knowledge of the personnel,
- document the training/instruction,
- confirm participation in training/instruction by signature,
- Check that personnel are working in a safety-conscious manner and observing the operating instructions.

The operator must

- have received training in the use of the welding machine and
- be familiar with its function and mode of operation,
- have read and understood the operating instructions
  - have read and understood the operating instructions,
  - be familiar with all safety devices and regulations.

1.6 General **safety instructions**

PLEASE NOTE THE FOLLOWING:

- Check the welding machine for visible damage and defects before commissioning. Defects and damage must be repaired immediately.
- Protect the welding machine from moisture.
- Never use the welding machine in environments
  - containing unknown substances
  - with a risk of explosion or fire hazard.
  - with poor ventilation.
- Never work under the influence of illnesses that impair concentration, fatigue, drugs, alcohol or medication.
- Keep the air inlet and outlet openings clear.
- Do not use aggressive cleaning agents to clean the welding equipment.
- Repairs may only be carried out by qualified persons.
- Only use original spare parts and accessories.

Electrical voltage

- Do not touch any parts that are live.
- Disconnect the welding machine from the power supply before working on it.
- Insulate yourself from the workpiece to be welded and from the ground; wear insulating gloves and clothing.
- Do not work with damaged or poorly connected cables or with loose clamp cables.
- Keep your work clothes and body dry.
- Do not work in damp or wet environments.
- Do not lean your body against the workpiece to be cut.
- Do not use the device if any components or protective devices have been removed.
- Ensure that the welding machine is always stable so that it cannot fall or tip over. Use fall protection when working at heights.
- Only switch on the welding machine once all cables have been connected correctly.
- Ensure that all accessories are connected correctly and always ensure that the earth connection is correct.

Explosion hazard

- Ensure that there are no flammable materials in the vicinity of the work area.
- Be aware of flammable gas mixtures in the work area (ventilation and extraction).
- Never weld containers that contain flammable or combustible substances.
- When welding aluminium, bear in mind that hydrogen atoms are stored in the aluminium when using water welding tables and underwater welding. Stored hydrogen can lead to explosions.
- Replace gas pipes that appear to be damaged.
- Keep pressure reducers in good working order.
- Do not weld in environments containing dust, gas or explosive vapours.

Fire hazard

- Ensure that there are no combustible, flammable materials near the work area and keep suitable extinguishing agents on hand.
- Prevent the spread of open flames caused by sparks, slag and glowing material.
- Ensure that fire protection equipment is available near the work area.
- Remove flammable materials and fuels from the work area.

Burns

- Protect your body from burns and ultraviolet radiation by wearing fireproof protective clothing (glov headgear, shoes, masks, etc.).
- Moving parts or thermal parts may cause injury to your body or harm other people.
- Keep the tip of the electrode away from your own body and other people.
- Do not wear contact lenses. The intense heat emitted by the arc could cause them to fuse with your cornea.
- Ensure that first aid equipment is available near the work area.
- Replace the viewing window of the welding mask if it is damaged or unsuitable for the welding work to be carried out.
- Wait until the processed parts have cooled down before handling them.
- The arc throws sparks and spatter. Always wear oil-free protective clothing such as leather gloves, trousers with turn-ups and high shoes. Cover your hair with a cap.

Wearers of pacemakers

- ❍ Magnetic fields from high-voltage circuits can affect the functioning of pacemakers.
- ❍ Persons who wear vital electronic devices of this type must consult their doctor before entering areas where such welding equipment is present.

Radiation

- ❍ Welding radiation can cause damage to eyesight and burns.
  Radiation generates strong ultraviolet and infrared light.
- ❍ The electric arc generates radiation that can damage the eyes and cause burns to the skin; use appropriate protective equipment.

Vapours and gases

- ❍ Welding produces gases that are hazardous to health:
- ❍ Avoid inhaling the harmful substances.
- ❍ Keep your head as far away as possible during the welding process.
- ❍ Ensure adequate ventilation, extraction or, if necessary, a supply of breathing air.
- ❍ The type of vapours and gases produced is determined by the base material, coating, etc.
- ❍ Particular caution is required if the material to be welded contains the following elements:
  - Antimony, chromium, mercury, beryllium, arsenic, cobalt, nickel, lead, silver, selenium, copper, barium, cadmium, manganese and vanadium.
- ❍ Ideally, use welding tables with extraction systems.
- ❍ Cleaning agents containing chloride can form phosgene gases (poisonous gas) during welding. Before welding, ensure that there are no residues on the workpiece surface.
- ❍ Never weld in areas where there is a risk of fire or explosion.
- ❍ Read and understand the operating instructions provided by the filler material manufacturers and read the safety data sheets carefully.

Electromagnetic interference

- ❍ The welding machine complies with electromagnetic interference emission standards and is suitable for use in industrial environments.
- ❍ However, it must be noted that the following interference may occur, and in such cases appropriate measures must be taken.
  - Data transmission systems
  - Communications
  - Control
  - Safety devices
  - Calibration and measuring devices

1.7 EMC e measures

In exceptional circumstances, the specified range may be affected even though the radiation limit standard has been complied with (e.g. equipment that is easily affected by electromagnetism is used at the installation site, or there is a radio or television near the installation site). In such circumstances, the user should take appropriate measures to eliminate interference.

In accordance with domestic and international standards, the surrounding equipment must be checked for electromagnetic compatibility and interference suppression capabilities:

- ❍ Fuse
- ❍ Power line, signal transmission line and data transmission cable
- ❍ Data processing equipment and telecommunications equipment
- ❍ Inspection and calibration equipment

These effective measures prevent EMC problems:

- Power supply:
  - Even if the power supply source complies with regulations, additional measures must always be taken to eliminate electromagnetic fields. (e.g. suitable power filter).
- Welding cable length:
  - Keep the cable length as short as possible.
  - Lay the cables side by side
  - Lay the cables far away from other cables
- Equipotential bonding
- Earthing the workpiece connection:
  - if necessary, use suitable capacitors to connect to the ground.
- Shield if necessary:
  - Shield the surrounding equipment
  - Shield the entire welding machine

1.8 Safety marking on the welding machine

NOTE:

Damaged or missing safety symbols on the welding machine can lead to incorrect operation, resulting in personal injury and property damage. The safety symbols attached to the welding machine must not be removed. Damaged safety symbols must be replaced immediately.

Please note the following:

- The instructions on the safety labels on the welding machine must be followed under all circumstances. If the safety labels fade or become damaged during the service life of the welding machine, new labels must be affixed immediately.
- If the signs are not immediately recognisable and understandable at first glance, the welding machine must be taken out of service until the new signs are affixed.

Fig. 1-1: Safety labelling on the welding machine

Electric shock

An electric shock can be fatal. Touching live parts can result in serious shocks or burns. Ensure that all parts are connected correctly and that the earth connection is correct. Ensure that there is always insulation between your body and the workpiece and avoid any contact with live parts with your bare hands. Wear dry, insulating protective clothing during welding and never operate the machine with the housing open.

Welding spatter

Welding spatter can cause fires and explosions. Do not weld near flammable materials or containers that have contained flammable materials.

Electric arcs

An electric shock can be fatal. Touching live parts can result in serious shocks or burns. Ensure that all parts are connected correctly and that the earth connection is correct. Always ensure that there is insulation between your body and the workpiece and avoid any contact with live parts with your bare hands. Wear dry, insulating protective clothing during welding and never operate the machine with the housing open.

Fumes and gases

Welding produces vapours and gases that are hazardous to health. Try to keep your head as far away from the vapours as possible during welding. Ensure adequate ventilation, extraction or a supply of breathing air to keep these out of your breathing air.

2 Technical data

SYN-MIG parameters	SYN-MIG 201-2 P Synergic	SYN-MIG 203-2 P Synergic	SYN-MIG 253-4 Synergic
Item number	**1071202**	**1071203**	**1071254**
Length [mm]	1100	1100	1100
Width [mm]	530	530	530
Height [mm]	850	850	850
Weight [kg]	44.7	52.5	52.5
Connection voltage [V]	110/230	400	400
Phase(s)	1	3	3
Type of current	AC	AC	AC
Mains frequency [Hz]	50/60	50/60	50/60
Protection class [IP]	IP 21 S	IP 21 S	IP 21 S
Insulation class	F	F	F
EMC class	A	A	A
Marking	CE	CE	CE
Fuse rating [A]	No	No	No
Required generator power [kVA]	>7	>7	>8
Mains plug	—	32	—
No-load voltage [V]]	MMA: 66.5 TIG: 66.5 MIG: 66.5	MMA: 74 MMA: 74 MMA: 74	MMA: 75 TIG: 73 MIG: 73
Power consumption [kVA]	33.7 / 28.2	13.8	18
Power consumption when idle (W)	< 50 W	< 50 W	< 50 W
Operating temperature [°C]	-10 - 40	-10 - 40	-10 - 40
Weldable wires Steel [mm]	0.6 / 0.8 / 0.9 / 1.0	0.6 / 0.8 / 0.9 / 1.0	0.6 / 0.8 / 0.9 / 1.0 / 1.2
Weldable wires Stainless steel [mm]	0.8 / 0.9 / 1.0	0.8 / 0.9 / 1.0	0.8 / 0.9 / 1.0 / 1.2
Weldable wires Aluminium [mm]	1.0 / 1.2	1.0 / 1.2	1.0 / 1.2
Weldable wires CuSi [mm]	1.0	1.0	1.0
Weldable wires, flux-cored wire [mm]	0.8 / 0.9 / 1.0	0.8 / 0.9 / 1.0	0.8 / 0.9 / 1.0 / 1.2
Wire feed unit [rollers]	2	2	4
Wire feed speed [m/min]	16	18	24
Wire feed rollers driven	1 roller/single drive	1 roller/single drive	2 rollers / dual drive
Adjustment range MIG/MAG [A]	30-140 / 30-200	30-200	30-250
Adjustment range TIG DC [A]	10-140 / 10-200	10-200	10-250
Adjustment range electrode [A]	10-100 / 10-200	10-200	10-250
Adjustment range 230 V - Connection	30-200	—	—
Adjustment range 400 V connection	—	30-200	30-250
Duty cycle at max. current 40°C [%]	40/30	40	60
Current at ED 60% 40°C [A]	100/145	165	250
Current at ED 100% 40°C [A]	80/110	130	195
Power consumption MIG/MAG [kVA]	3.7/5.7	8.5	11.2
Power consumption electrode [kVA]	3.0/6.5	9.6	12.5
Power consumption TIG DC [kVA]	2.8/4.4	6.8	8.9
Power factor [cos phi]	0.99/0.99	0.64	0.67
Efficiency [%]	80/86	89	89
Cooling type	Air	Air	Air
Burner cooling	Air	Air	Air
Process MIG/MAG	√	√	√
MMA process	√	√	√
2-stroke/4-stroke switch	2T/4T	2T/4T	2T/4T
Spot welding	Spot	Spot	Spot
Interval welding	Not supported	Not supported	Not supported
Gas test function	√	√	√
Adjustable throttle	0-10	0-10	0-10
Operating indicator	LCD	LCD	LCD
Overload indicator	√	√	√

SYN-MIG parameters	SYN-MIG 323-4 Synergic	SYN-MIG 353-4 W Synergic	SYN-MIG 403-4 W Synergic	Syn-Mig 353-4 W Pulse
Item number	**1071323**	**1071353**	**1071403**	**1072353**
Length [mm]	1100	1100	1100	1100
Width [mm]	530	530	530	530
Height [mm]	850	850	850	850
Weight [kg]	53.5	66.5	66.5	66.5
Connection voltage [V]	400	400	400	400
Phase(s)	3	3	3	3
Type of current	AC	AC	AC	AC
Mains frequency [Hz]	50/60	50/60	50/60	50/60
Protection class [IP]	IP 21 S	IP 21 S	IP 21 S	IP 23 S
Insulation class	F	F	F	F
EMC class	A	A	A	A
Marking	CE	CE	CE	CE
Fuse rating [A]	No	No	No	No
Required generator power [kVA]	>10	>13	>15	>13
Mains plug	32	—	—	—
Open-circuit voltage [V]]	MMA: 74 TIG: 74 MIG: 74	MMA: 76.5 TIG: 76.5 MIG: 76.5	MMA: 75 TIG: 75 MIG: 75	MMA: 73 TIG: 73 MIG: 76
Current consumption [kVA]	22.2	20.8	25.9	26.5
Power consumption when idle	< 50 W	< 50 W	< 50 W	37
Operating temperature [°C]	-10 - 40	-10 - 40	-10 - 40	-10 - 40
Weldable wires Steel [mm]	0.8 / 0.9 / 1.0 / 1.2	0.8 / 0.9 / 1.0 / 1.2	0.8 / 0.9 / 1.0 / 1.2	0.8/0.9/1.0/1.2/1.6
Weldable wires Stainless steel [mm]	0.8 / 0.9 / 1.0 / 1.2	0.8 / 0.9 / 1.0 / 1.2	0.8 / 0.9 / 1.0 / 1.2	0.8/1.0/1.2/1.6
Weldable aluminium wires [mm]	1.0 / 1.2	1.0 / 1.2	1.0 / 1.2	1.0/1.2/1.6
Weldable wires CuSi [mm]	1.0	1.0	1.0	1.0
Weldable wires, flux-cored wire [mm]	0.8 / 0.9 / 1.0 / 1.2	0.8 / 0.9 / 1.0 / 1.2	0.8 / 0.9 / 1.0 / 1.2	0.9/1.0/1.2/1.6
Wire feed unit [rollers]	4	4	4	2
Wire feed speed [m/min]	24	24	24	1.5 - 24
Wire feed rollers driven	2 rollers / double drive	2 rollers / double drive	2 rollers / double drive	—
Adjustment range MIG/MAG [A]	30-315	30	30-40	10-350
Setting range TIG DC [A]	10-30	10-350	10-400	10-350
Electrode adjustment range [A]	10-250	10-350	10-400	20-350
Adjustment range 400 V connection	30-315	30-350	30-400	10-350
Duty cycle at max. current 40°C [%]	40	60	60	60
Current at ED 60% 40°C [A]	260	350	400	350
Current at ED 100% 40°C [A]	200	275	310	270
Power consumption MIG/MAG [kVA]	15.4	13.5	16.8	12.4
Power consumption electrode [kVA]	12.7	14.4	17.9	13.4
Power consumption TIG DC [kVA]	11.4	10.8	13.6	9.8
Power factor [cos phi]	0.67	0.9	0.92	0.726
Efficiency [%]	89	89.9	87.7	89.02
Cooling type	Air	Air	Air	Air
Burner cooling	Air	Water	Water	—
MIG/MAG process	√	√	√	√
MMA process	√	√	√	√
2-stroke/4-stroke switch	2T/4T	2T/4T	2T/4T	2T/4T/4T+
Spot welding	Spot	Spot	Spot	Spot
Interval welding	Not supported	Not supported	Not supported	Not supported
Gas test function	√	√	√	—
Adjustable throttle	0-10	0-10	0-10	-10 - +10
Operating indicator	LCD	LCD	LCD	LCD
Overload indicator	√	√	√	√

2.1 Type plate

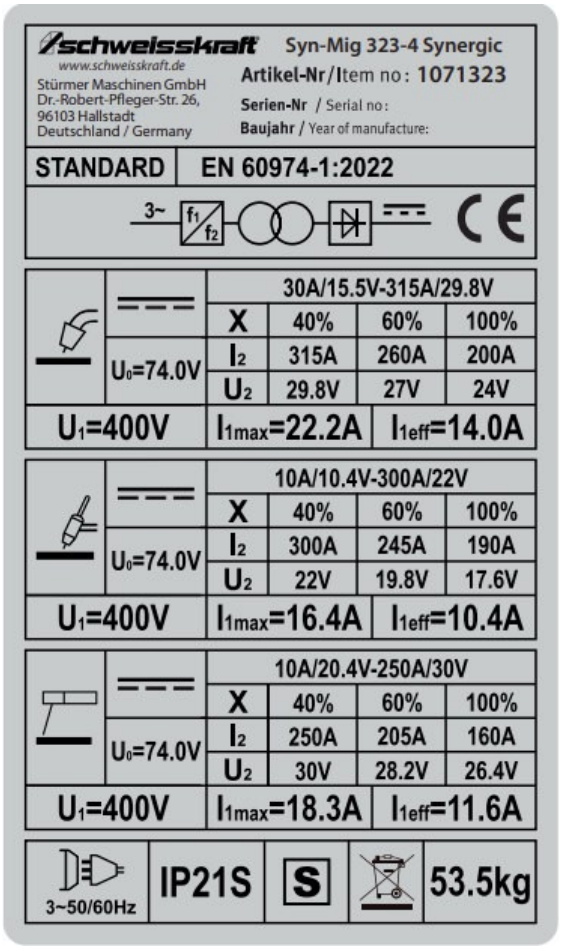


Fig. 2-1: Type plate SYN-MIG 201-2 P Synergic

3 , packaging and storage

3.1 Transport

After delivery, check the welding machine for visible transport damage.
If you discover any damage to the welding machine, report it immediately to the transport company or dealer.

3.1.1 Transport information

Improper transport, installation and commissioning can lead to accidents and cause damage or malfunctions to the welding machine, for which we accept no liability or warranty.

Transport the scope of delivery to the installation site secured against shifting or tipping using a sufficiently dimensioned industrial truck or crane.

WARNING!

Serious to fatal injuries caused by machine parts falling off the forklift truck or transport vehicle. Observe the instructions and information on the transport crate.

Observe the total weight of the welding machine. The weight of the welding machine is specified in the "Technical data". When the welding machine is unpacked, the weight of the welding machine can also be read on the type plate.

Only use means of transport and load-lifting equipment that can carry the total weight of the welding machine.

WARNING!

Serious to fatal injuries caused by damaged or insufficiently load-bearing lifting gear and loa securing equipment that breaks under load.

Check the lifting gear and load-securing equipment to ensure that they have sufficient load-bearing capacity and are in perfect condition.

Observe the accident prevention regulations of the professional association responsible for your company or other supervisory authorities.

Secure loads carefully. Never stand under suspended loads!

3.1.2 General hazards during internal transport

WARNING: RISK OF TIPPING!

The welding machine may be lifted a maximum of 2 cm without being secured.

Employees must remain outside the danger zone and out of reach of the load. Warn employees and make them aware of the danger.

Welding equipment may only be transported by authorised and qualified persons. Act responsibly during transport and always consider the consequences. Refrain from reckless and risky actions.

Inclines and slopes (e.g. driveways, ramps and similar) are particularly dangerous. If it is unavoidable to drive on such passages, special caution is required.

Before starting transport, check the transport route for potential hazards, uneven surfaces and obstructions, and ensure that it is sufficiently stable and load-bearing.

Hazards, uneven surfaces and obstructions must be inspected before transport. The removal of hazards, obstructions and uneven surfaces at the time of transport by other employees leads to considerable dangers.

Careful planning of internal transport is therefore essential.

3.2 Packaging

All packaging materials and packing aids used for the welding machine are recyclable and must always be sent for material recycling.

Cardboard packaging components should be shredded and disposed of with waste paper.

The films are made of polyethylene (PE) and the padding is made of polystyrene (PS). These materials should be taken to a recycling centre or your local waste disposal company.

3.3 Storage

The welding machine must be set up in closed, dry and well-ventilated rooms. It must not be exposed to moisture or intense sunlight.

4 Installation and connection

4.1 Installation conditions

- Firm, level surface
- Altitude above sea level: </= 1000 m
- Operating temperature range: -10 to +40 °C
- Relative humidity below 90% (at 20 °C)

The welding machine is designed for use in covered areas and must be set up in a dry environment. The ambient air in which the welding machine is used should have a temperature below
+40°C and low humidity. The ambient air must be free of dust, acids, salts or concentrations of iron or metal powders.

Ensure there is sufficient space in front of the welding machine so that the controls can be easily reached and seen. Position the machine so that the air inlet and outlet are not obstructed (minimum distance from the wall 40 cm). Do not cover the welding machine. Ensure that no metal parts, debris or other foreign objects can enter the welding machine.

The housing protects the electrical components against external influences and direct contact. Depending on the situations in which they can be used, it offers varying degrees of protection against the ingress of solid objects and water. The degree of protection is indicated by the letters IP, followed by two digits: the first digit indicates the degree of protection against solid objects and the second digit indicates the degree of protection against water.

The environmental conditions must be appropriate for protection class IP21!

1. Digit	Description	2nd digit	Description	Additional field	Description
2	Protected against solid objects with dimensions of 12.5 mm	1	Protected against vertically falling water drops		

4.2 Mains connection

DANGER! Electrical voltage

Connection to the mains and maintenance must be carried out in accordance with VDE regulations! Defective or damaged parts on the burner or the device must be replaced immediately!

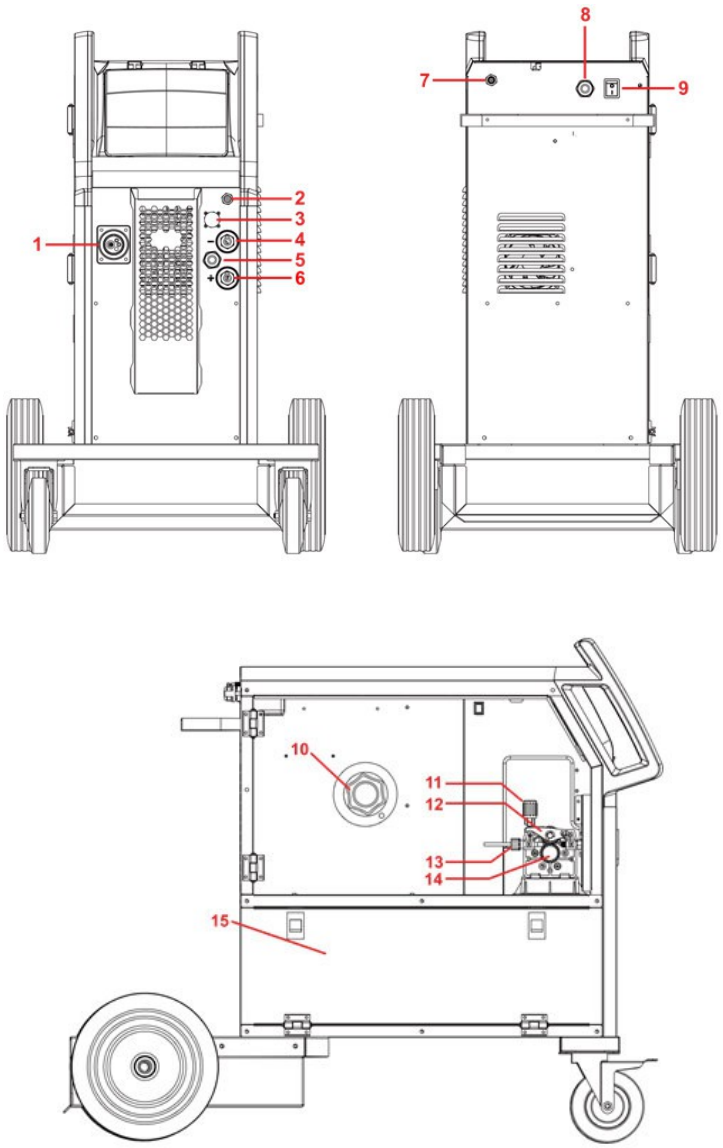
Check that the voltage specified on the type plate corresponds to the nominal voltage of your power supply.

- The welding machine may only be used with sockets and extension cables with safety plugs that have been installed by an authorised specialist.
- The fuses in the supply cables to the mains sockets must comply with the regulations. According to these regulations, only fuses or circuit breakers corresponding to the cable cross-section may be used.
- Overloading the fuse can result in cable fires or damage to the building.
- Switch off the power supply after completing the process to optimise energy consumption.
- Ensure that the power supply is 110 V/230 V AC, single-phase: 50/60 Hz.
- Clear the work area before operation. Do not look into the arc without protection.
- If the power switch shuts off due to a fault for safety reasons, do not restart the device until the problem has been rectified. Failure to do so may result in permanent damage.

5 Control panel functions and description of the SYN-MIG 201-2 P Synergic and SYN-MIG

5.1 SYN-MIG 201-2 P Synergic & SYN-MIG 203-2 P Synergic

5.1.1 Structure



	Designation
1	Euro connection for MIG torch
2	Gas connection for TIG torch
3	Remote connection plug
4	Connection socket for negative output voltage (-)
5	Power connection for MIG torch with switchable polarity
6	Connection socket for positive output power (+)
7	Connection for gas inlet
8	Power cable
9	Power switch
10	Coil holder
11	Adjustment of wire feed tension
12	Clamping arm for wire feed tension
13	Wire inlet guide
14	Wire drive roller
15	Toolbox

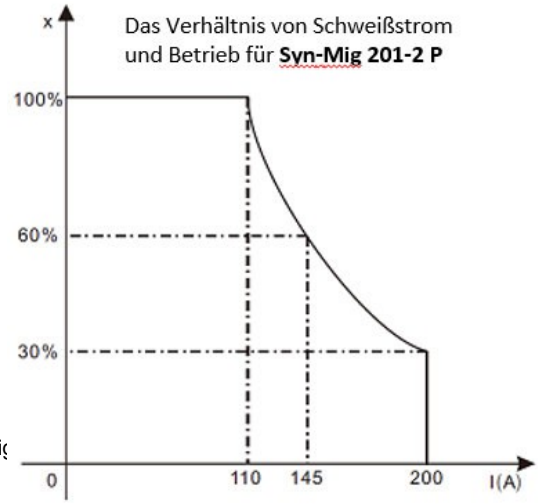
Fig. 5-1: Device description SYN-MIG 201-2 P Synergic

5.1.2 Duty cycle and overheating SYN-MIG 201-2 P

The letter "X" stands for the duty cycle, which is defined as the portion of time during which a welding machine can continuously weld at its rated output current within a given period of operation (10 minutes).

The relationship between the duty cycle "X" and the welding output current "I" is shown in the figure on the right.

If the welding machine overheats, the IGBT overheating protection sends a signal to the welding machine's control unit to turn the welding current OFF, and the error code is displayed on the screen. In this case, the machine should not be used for welding for 10 to 15 minutes to allow it to cool down with the fan running. When restarting the machine, the welding current or duty cycle should be reduced.

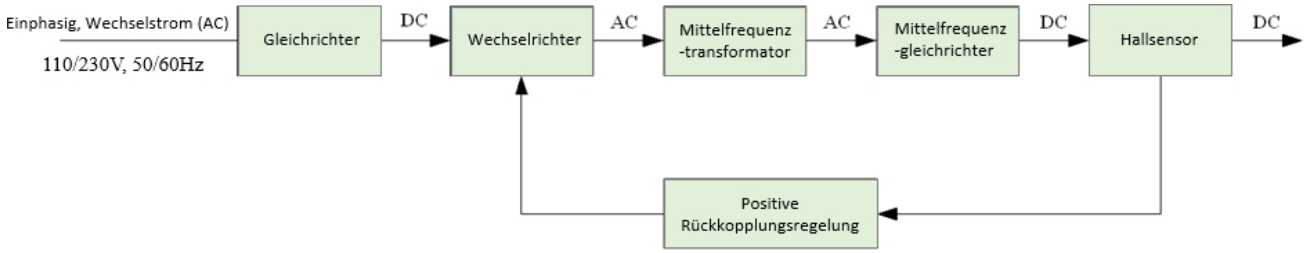


Fig

5.1.3 Working principle

The operating principle of the MIG series welding machine is shown in the following diagram. Single-phase alternating current with a working frequency of 110 V/230 V is converted into direct current and then converted into medium-frequency alternating current by a frequency converter (IGBT), after the voltage has been reduced by a centre transformer (the main transformer) and rectified by a medium-frequency rectifier (fast-switching diodes), and is output by inductance filtering. The circuit uses current feedback control technology to ensure stable current output for MMA or TIG welding. It also uses voltage feedback control technology to ensure stable voltage output for MIG welding. Meanwhile, the welding current parameter can be continuously and steplessly adjusted to meet the requirements of the welding craft.

Fig. 5-3: Working principle



5.1.4 Volt-ampere characteristic curve

The welding machines in the MIG series have an optimal volt-ampere characteristic curve, which is shown in the diagram below. The relationship between the nominal load voltage U2 and the welding current I2 is as follows: U2=14+0.05I2 (V).

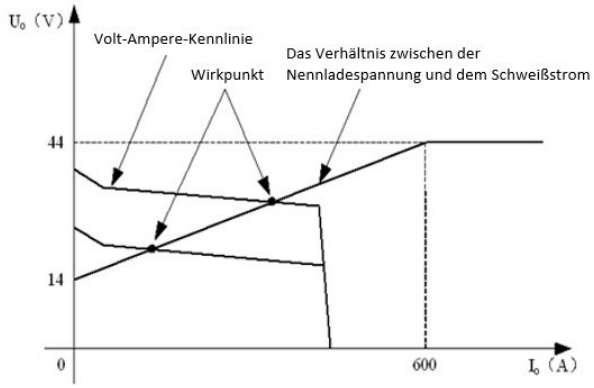


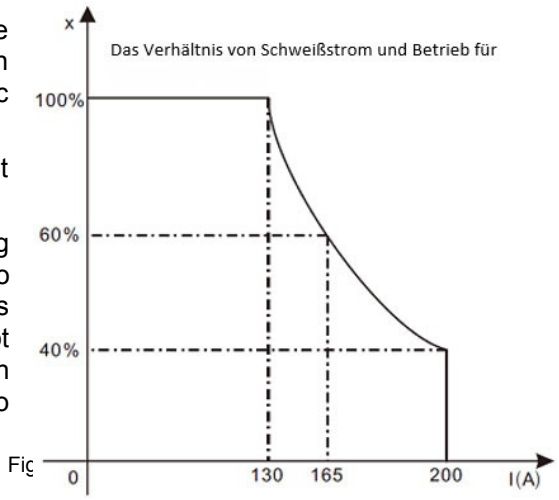
Fig. 5-4: Volt-ampere characteristic curve

5.1.5 Duty cycle and overheating SYN-MIG 203-2

The letter "X" stands for the duty cycle, which is defined as the proportion of time during which a welding machine can continuously weld at its rated output current within a specific time cycle (10 minutes).

The relationship between the duty cycle "X" and the output welding current "I" is shown in the figure on the right.

If the welding machine overheats, the IGBT overheating protection sends a signal to the welding machine's control unit to switch off the output welding current, and the error code is displayed on the screen. In this case, the machine should not be used for welding for 10 to 15 minutes to allow it to cool down with the fan running. When the machine is put back into operation, the welding current or duty cycle should be reduced.



Fig

The operating principle of the MIG series welding machine is shown in the following figure. Three-phase alternating current with a working frequency of 400 V is converted into direct current and then converted into medium-frequency alternating current by a frequency converter (IGBT), after the voltage has been reduced by a centre transformer (the main transformer) and rectified by a medium-frequency rectifier (fast-switching diodes), and is output by inductance filtering. The circuit uses current feedback control technology to ensure stable current output for MMA or TIG welding, and it uses voltage feedback control technology to ensure stable voltage output for MIG welding. Meanwhile, the welding current parameter can be continuously and steplessly adjusted to meet the requirements of the welding craft.

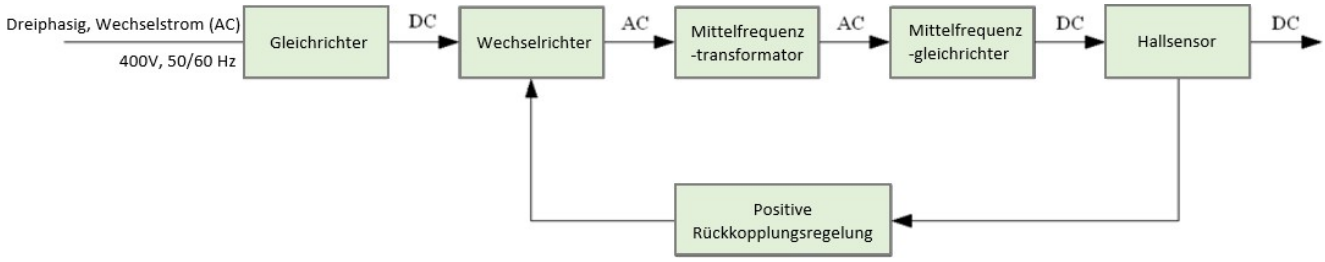


Fig. 5-6: Working principle

5.1.6 Volt-ampere characteristic curve

The welding machines in the MIG series have an optimal volt-ampere characteristic, which is shown in the diagram below. The relationship between the nominal charging voltage U2 and the welding current I2 is as follows: U2=14+0.05I2 (V).

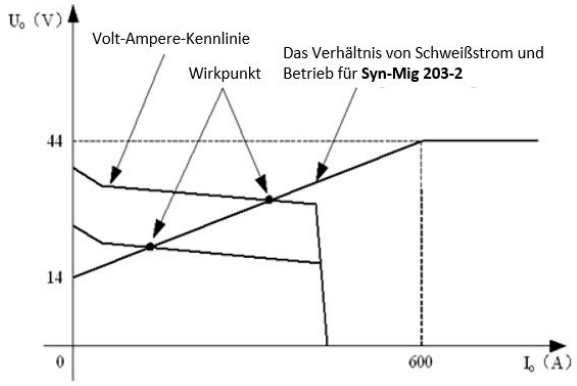
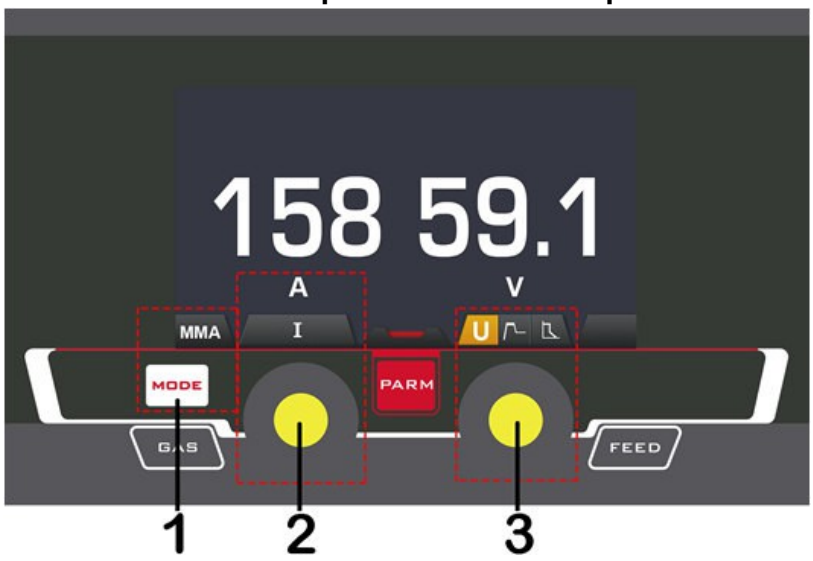


Fig. 5-7: Volt-ampere characteristic curve

5.1.7 General description of the control panel



	Designation
1	Button for the welding process
2	L parameter knob:
3	R parameter knob:

Fig. 5-8: MMA display

1. Button for the welding process

Press this to select the appropriate welding mode.

2. L parameter knob

Turn this to adjust the welding current.

3. R parameter knob

Press this to select Hot Start or Arc Force, and turn it to adjust the values.

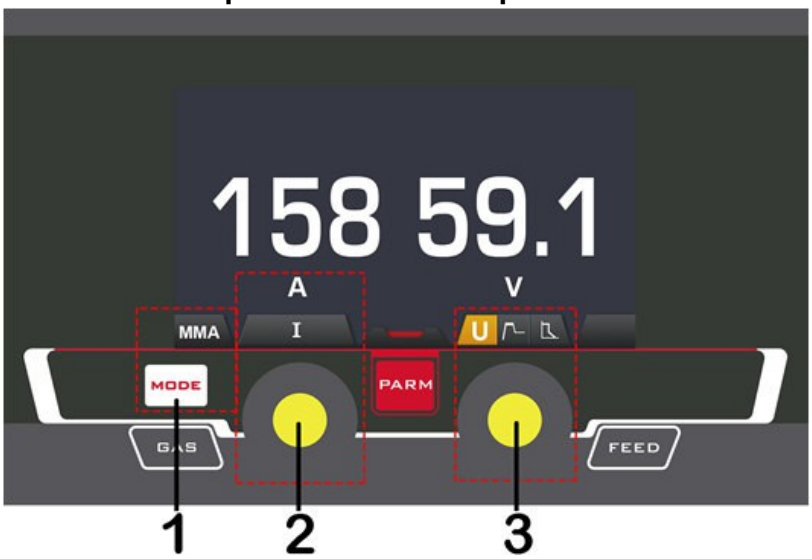
Hot Start

The hot start function in MMA welding causes a brief increase in the welding current at the start of the welding process. This helps to ignite the arc more quickly and prevents the electrode from sticking to the workpiece. The adjustment range is from 0 to 10, with higher values meaning a greater increase in current.

Arc Force

Arc Force is a function that automatically increases the welding current if the arc becomes too short or the voltage is too low. This ensures stable arc control and prevents the arc from extinguishing. The setting also ranges from 0 to 10, with higher values allowing for greater current adjustment. This function is particularly useful for electrodes that require higher voltages or for welding positions with a short arc.

5.1.8 Control panel for the MMA process



	Designation
1	Button for the welding process
2	L parameter knob:
3	R parameter knob:

Fig. 5-9: MMA display

1. Button for the welding process

Press this button to select the MMA welding process

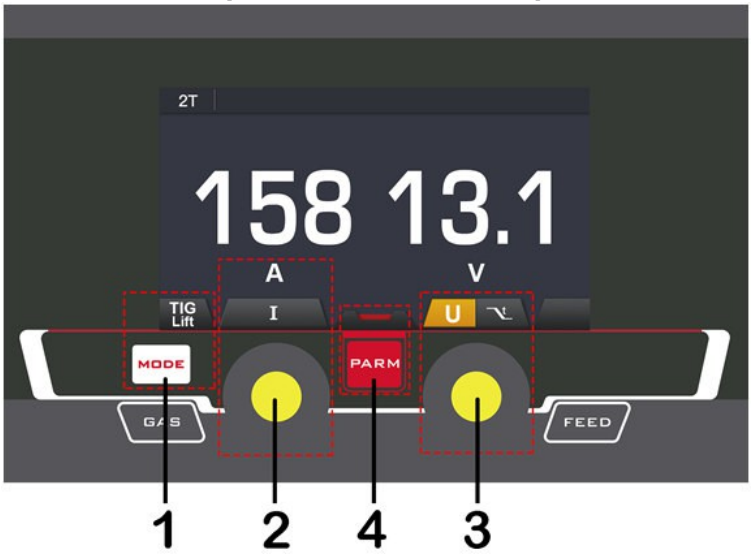
2. L parameter knob

This knob is used to select parameters and set values such as the welding current. It can be turned in the function interface to select parameters.

3. R-parameter knob:

Press this knob to select "**Hot** Start" or "**Arc** Force" and turn it to adjust the value. Adjustment range: 0 ~ 10.

5.1.9 Control panel for the Lift TIG process



	Designation
1	Button for the welding process
2	L parameter rotary knob
3	R parameter knob
4	Function button

Fig. 5-10: Lift TIG display

1. Button for the welding process

Press this button to select the Lift TIG welding process.

2. L parameter knob

Turn this knob to adjust the welding current.
Turn it in the function parameter interface to select parameters.

3. R parameter knob

Turn this knob to adjust the time for the down-slope phase and other parameters.

4. Function button

Press it to call up the function interface.

5.1.10 Function interfaces

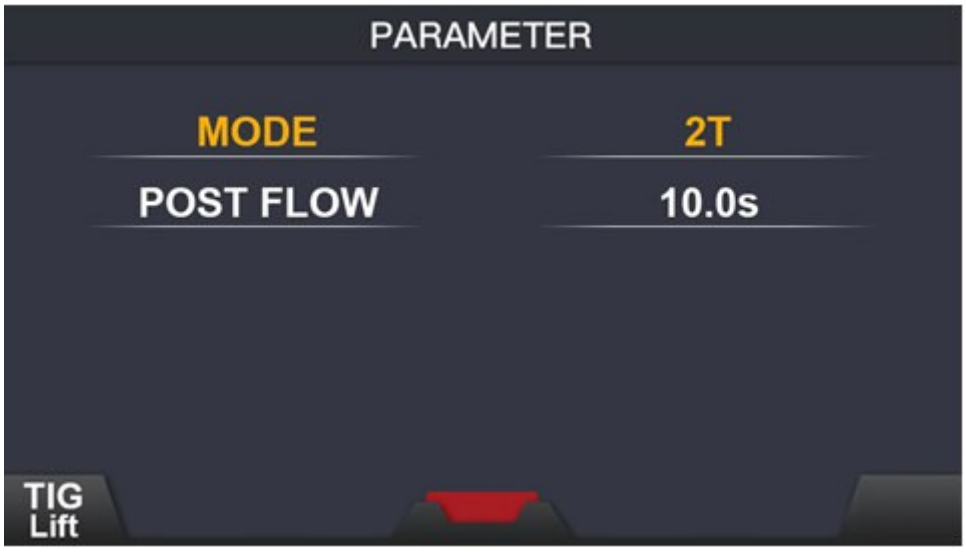
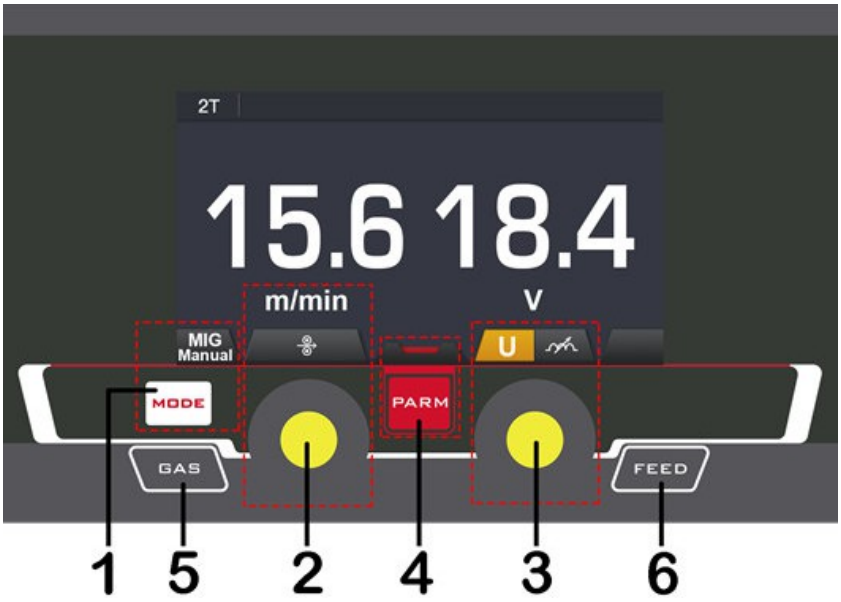


Fig. 5-11: Function interfaces

1. Mode: 2T or 4T.
2. Post Flow: 0~10s.

5.1.11 Control panel for MIG Manual procedure



	Designation
1	Button for welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for air test
6	Button for manual wire feed

Fig. 5-12: MIG display Manual procedure

1. Button for welding process

Press this button to select the MIG welding process.

2. L- Parameter rotary knob

Turn it to adjust the wire feed speed. Turn it in the function parameter interface to select parameters.

3. R-parameter rotary knob

Turn it to adjust the inductance or other parameters.

4. Function button

Press the button to call up the function interface.

5. Air test button

6. Manual wire feed button

Function interface

Fig. 5-13: Function interface MIG (manual)

1. Mode: 2T or 4T
2. Pre-flow time: 0 ~ 5 s.
3. Post Flow: 0 ~ 10 s.
4. Burnback: 0 ~ 10
5. Slow feed: 0 ~ 5.
6. Spool gun: ON/OFF

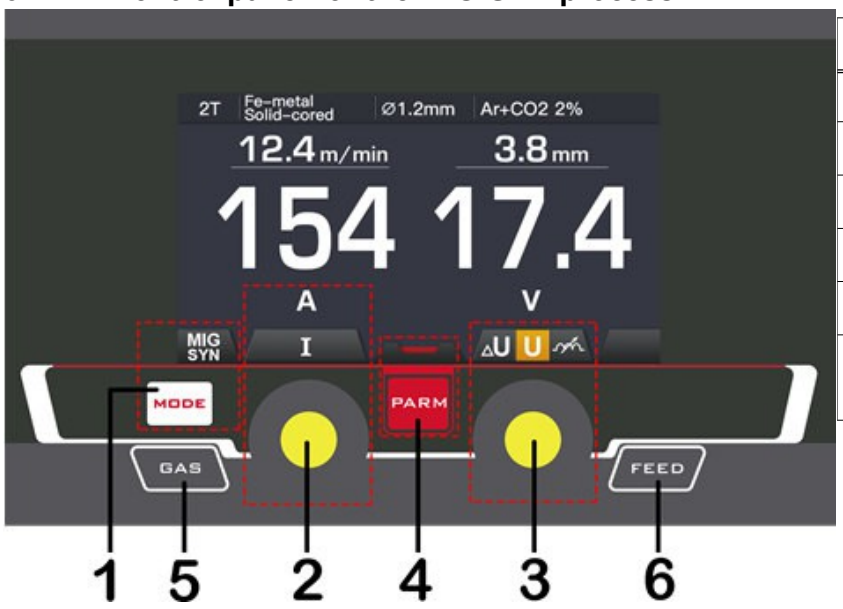
Burnback

A short circuit between the welding wire and the molten pool causes an increase in current, which causes the welding wire to melt too quickly and the wire feed speed to be unable to keep up, separating the welding wire and the workpiece. This phenomenon is known as "back burning". Range: 0-10.

Slow feed

This function is used to regulate the speed of the wire feed. Range: 0-5.

5.1.12 Control panel for the MIG-SYN process



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for air test
6	Button for manual wire feed

Fig. 5-14: Display MIG-SYN process

1. Button for welding process

Press this button to select the MIG-SYN process.

2. L parameter knob

Turn it to adjust the wire feed speed. Turn it in the function parameter interface to select parameters.

3. R parameter knob

Turn it to adjust the inductance or other parameters.

4.Function button

Press the button to call up the function interface.

5. Air test button

Press it to select the welding voltage or inductance. Turn it to adjust the value.

6. Manual wire feed button Function

interface

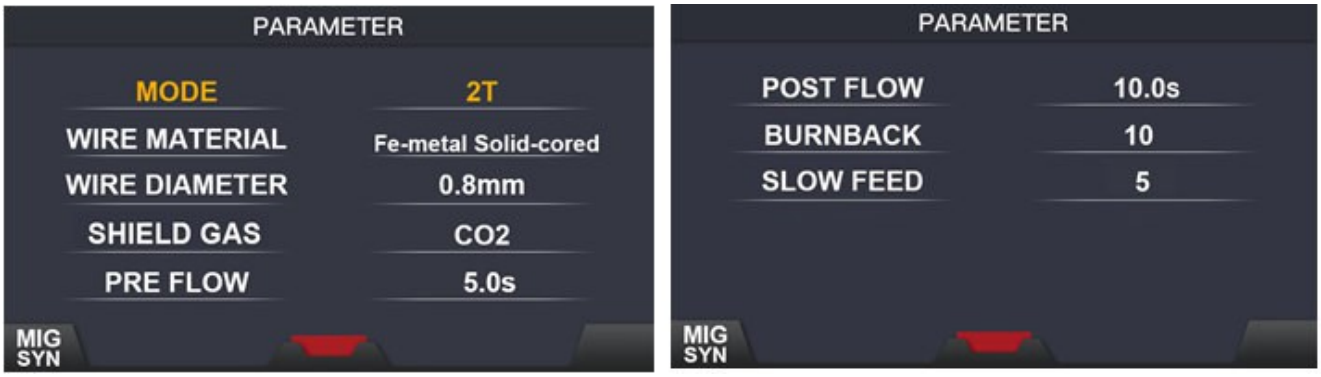
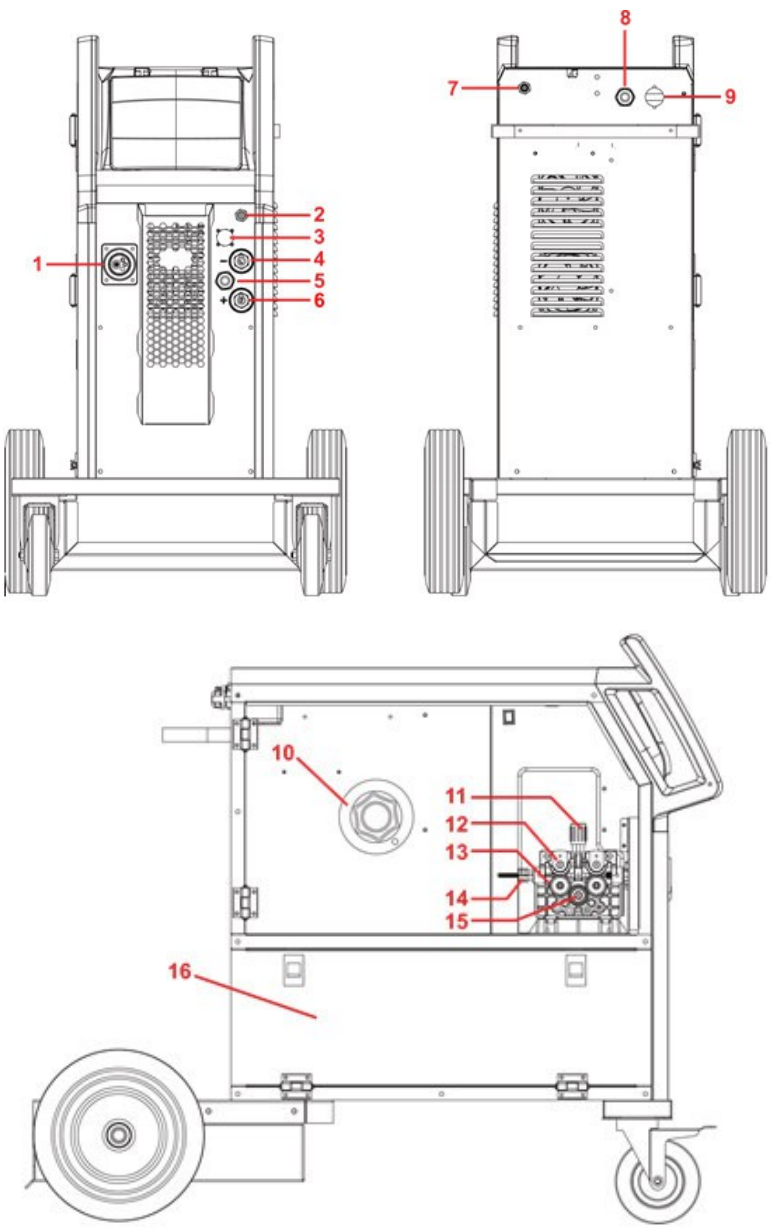


Fig. 5-15: MIG-SYN function interface

1. Mode: 2T or 4T
2. Wire material: SS metal solid wire/ Fe metal solid wire/ Fe metal cored wire/ CuSi/SS metal cored wire
3. Wire diameter: 0.8 ~ 1.0 mm
4. Shielding gas: CO2/Ar/98% Ar + 2% CO2/80% Ar + 20% CO2
5. Pre-flow/pre-flow time: 0 ~ 5 s.
6. Post flow/post-flow time: 0 ~ 10 s.
7. Burnback: 0 ~ 10
8. Slow feed: 0 ~ 5.

5.2 SYN-MIG 253-4 Synergic & SYN-MIG 323-4 Synergic

5.2.1 Structure



	Designation
1	Euro connection for MIG torch
2	Gas connection for TIG torch
3	Remote connection plug
4	Connection socket for negative output voltage (-)
5	Power connection for MIG torch with switchable polarity
6	Connection socket for positive output power (+)
7	Connection for gas inlet
8	Power cable
9	Power switch
10	Coil holder
11	Adjustment of wire feed tension
12	Clamping arm for wire feed tension (2x)
13	Wire feed roller (2x)
14	Wire inlet guide
15	Wire drive roller
16	Toolbox

Fig. 5-16: Device description SYN-MIG 253-4 Synergic

5.2.2 Duty cycle and overheating SYN-MIG 253-4 and SYN-MIG 323-4

The letter "X" stands for the duty cycle, which is defined as the portion of time during which a welding machine can continuously weld at its rated output current within a given operation (10 minutes).

The relationship between the duty cycle "X" and the welding output current "I" is shown in the figure on the right.

If the welding machine overheats, the IGBT overheating protection sends a signal to the welding machine's control unit to turn the welding current OFF, and the error code is displayed on the screen. In this case, the machine should not be used for welding for 10 to 15 minutes to allow it to cool down with the fan running. When the machine is put back into operation, the welding current or duty cycle should be reduced.

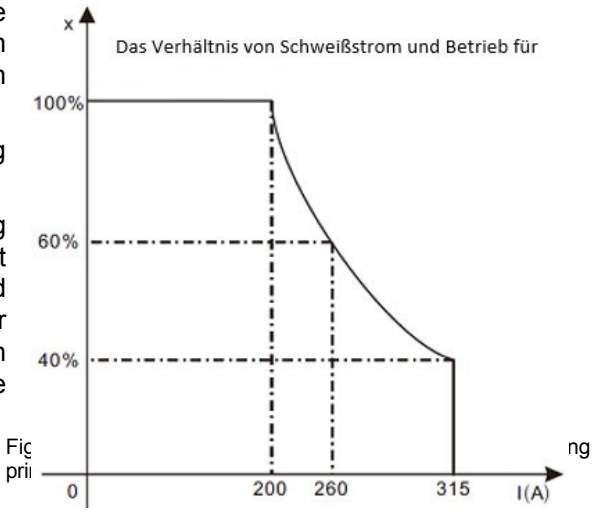


Fig. 5-17: Duty cycle and overheating

5.2.3 Working principle

The operating principle of the MIG series welding machine is shown in the following figure. Three-phase alternating current with a working frequency of 400 V is converted into direct current and then converted into medium-frequency alternating current by a frequency converter (IGBT), after the voltage has been reduced by a medium-frequency transformer (the main transformer) and rectified by a medium-frequency rectifier (fast-switching diodes), and is output by inductance filtering. The circuit uses current feedback control technology to ensure stable current output for MMA or TIG welding. It also uses voltage feedback control technology to ensure stable voltage output for MIG welding. Meanwhile, the welding current parameter can be continuously and steplessly adjusted to meet the requirements of the welding craft.

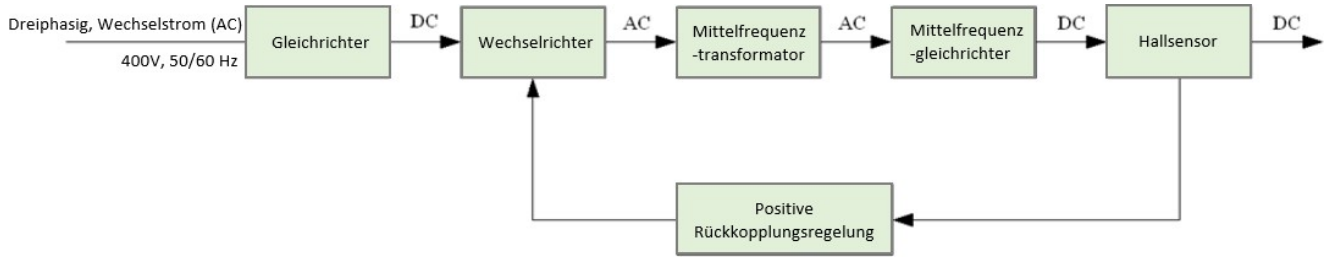


Fig. 5-18: Working principle

5.2.4 Volt-ampere characteristic curve

The welding machines in the MIG series have an optimal volt-ampere characteristic curve, which is shown in the diagram below. The relationship between the rated load voltage U2 and the welding current I2 is as follows: U2=14+0.05I2 (V).

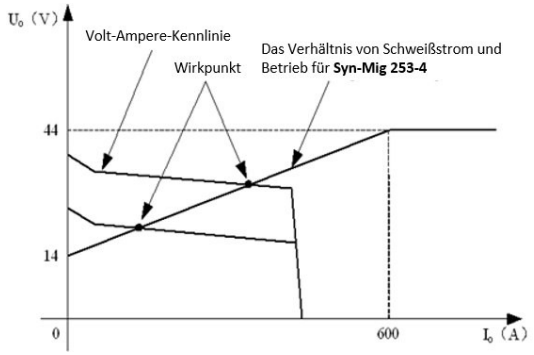
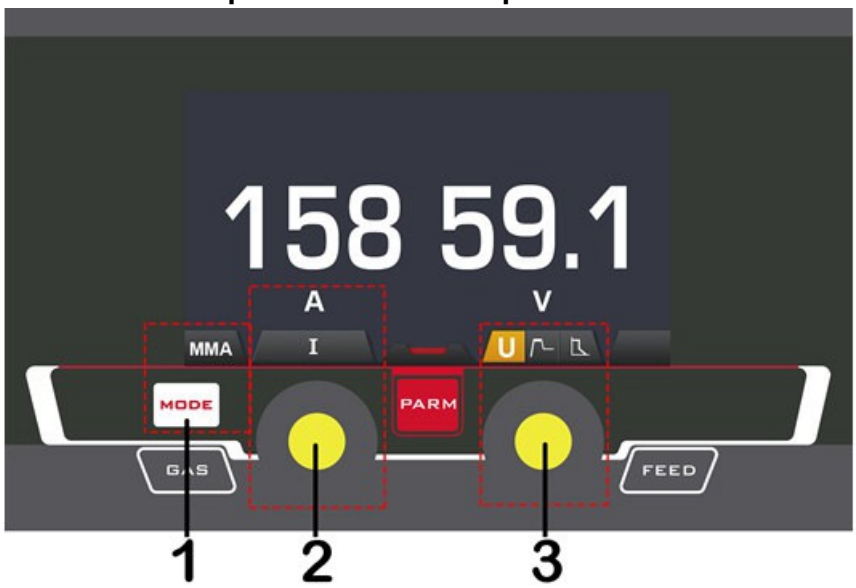


Fig. 5-19: Volt-ampere characteristic curve

5.2.5 Control panel for the MMA process



	Designation
1	Welding mode button
2	L parameter knob
3	R parameter knob

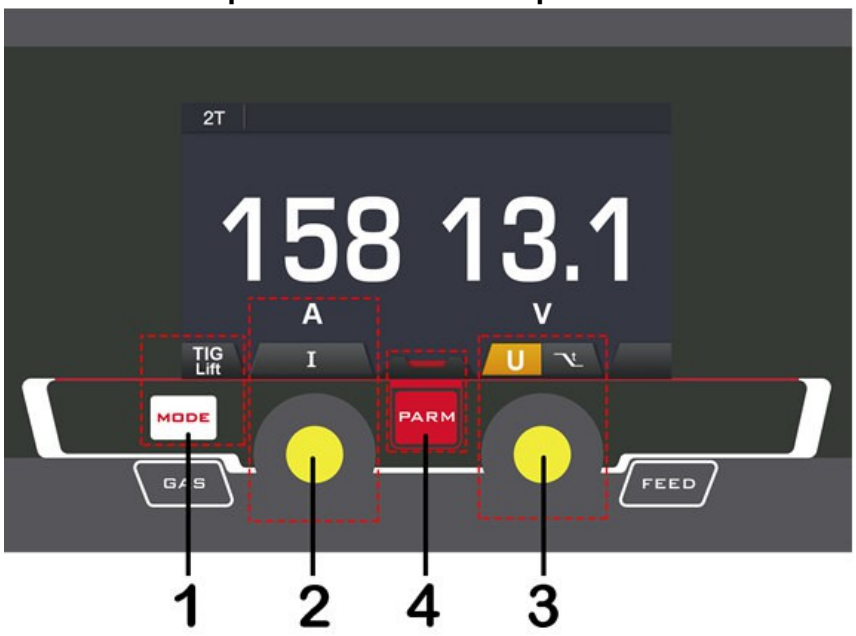
Fig. 5-20: Display MMA

1. Button for the welding process
Press this button to select the MMA welding process.

2. L parameter knob
Turn this knob to adjust the welding current.

3. R parameter knob
Press this knob to select "Hot Start" or "Arc Force" and turn it to adjust the values.

5.2.6 Control panel for the Lift TIG process



	Designation
1	Welding mode button
2	L parameter knob
3	R parameter knob
4	Function button

Fig. 5-21: Lift TIG display

1. Button for the welding process
Press this button to select the TIG lift welding process.

2. L parameter knob
Turn this knob to adjust the welding current. Turn it in the function parameter interface to select parameters.

3. R parameter knob
Turn this knob to adjust the down-slope time and other parameters.

4. Function button
Press this key to call up the function interface.

Function interface

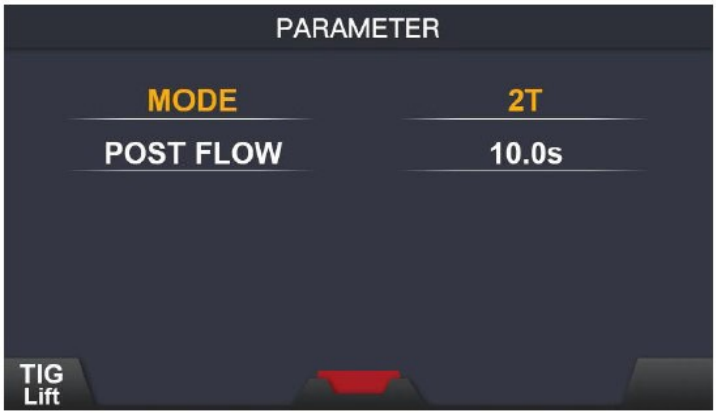
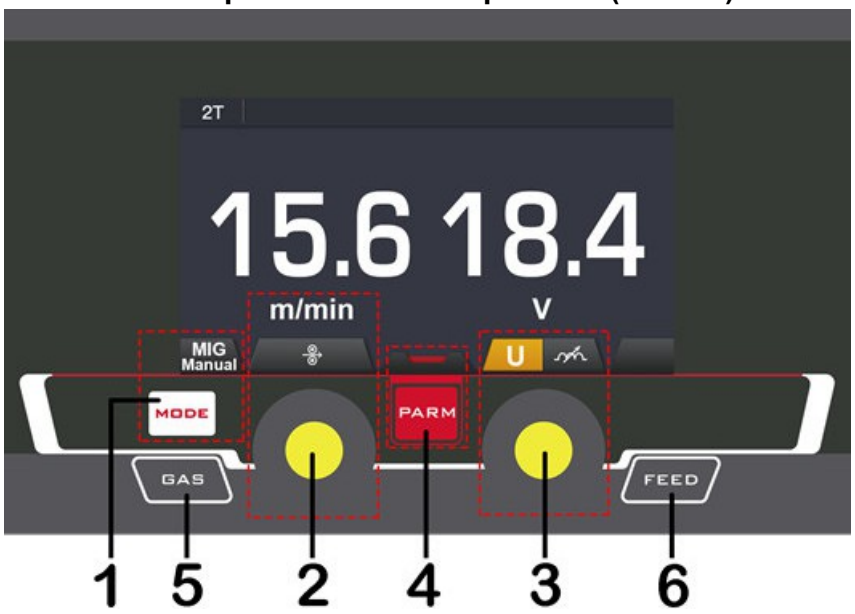


Fig. 5-22: Function interface Lift TIG

1. Mode: 2T or 4T.

2. Post Flow: 0~10 s.

5.2.7 Control panel for the MIG process (manual)



	Designation
1	Welding mode button
2	L parameter knob
3	R parameter knob
4	Function button
5	Air control
6	Manual wire feed

Fig. 5-23: MIG display (manual)

1. Button for the welding process
Press this button to select the MIG welding process.

2. L parameter knob
Turn this knob to adjust the wire feed speed. Turn it in the function parameter interface to select parameters.

3. R parameter knob
Turn this knob to adjust the inductance or other parameters.

4. Function button
Press this key to call up the function interface.

5. Air check button.

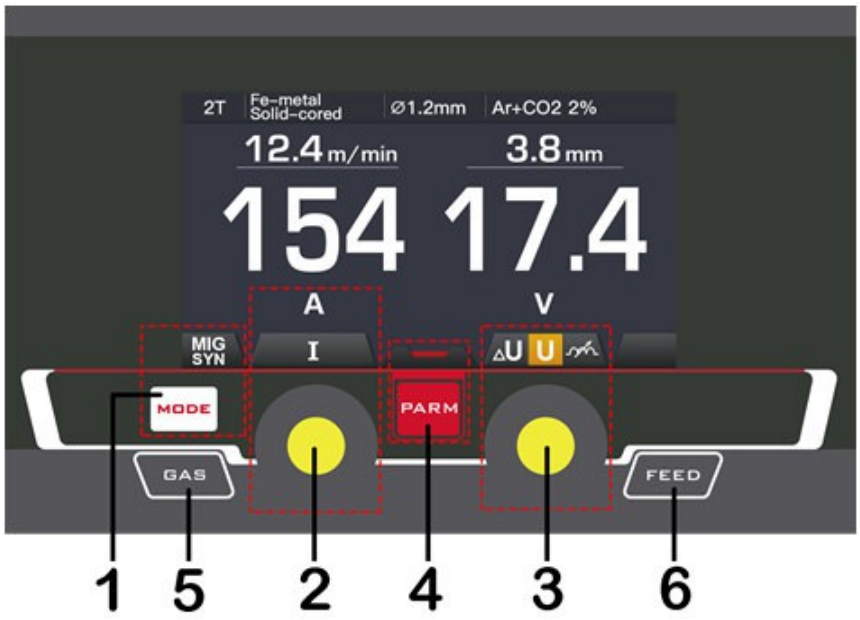
6. Button for manual wire feed.

Function interface

Fig. 5-24: Function interface MIG (manual)

1. Mode: 2T/4T.
2. Pre-flow/pre-run time: 0–5 s.
3. Post flow/follow-up time: 0~10 s.
4. Burnback: 0~10.
5. Slow feed: 0~5.
6. Spool gun: ON/OFF.

5.2.8 Control panel for the MIG-SYN process



	Designation
1	Welding mode button
2	L parameter knob
3	R parameter knob
4	Function button
5	Air control
6	Manual wire feed

Fig. 5-25: MIG-SYN display

1. Button for the welding process
Press this button to select the MIG-SYN welding process.

2. L parameter knob
Turn this knob to adjust the wire feed speed. Turn it in the function parameter interface to select parameters.

3. R parameter knob
Turn this knob to adjust the inductance or other parameters.

4. Function button
Press this key to call up the function interface.

5. Air check button.

6. Manual wire feed button.

Function interface

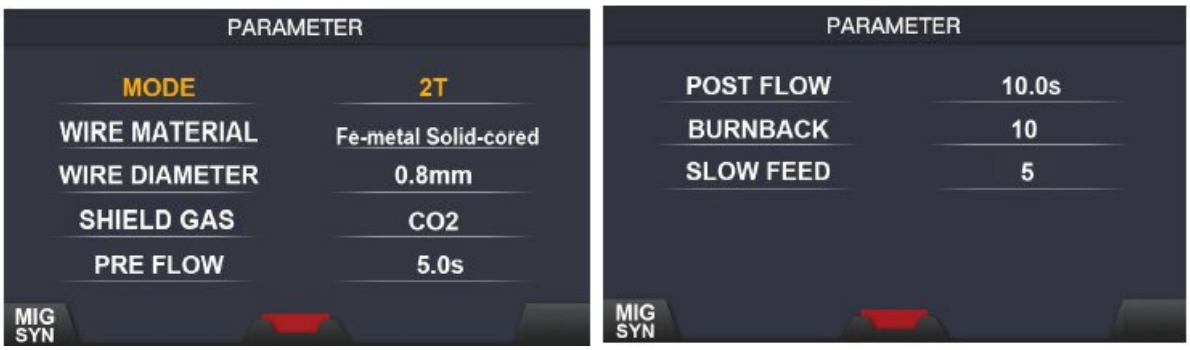
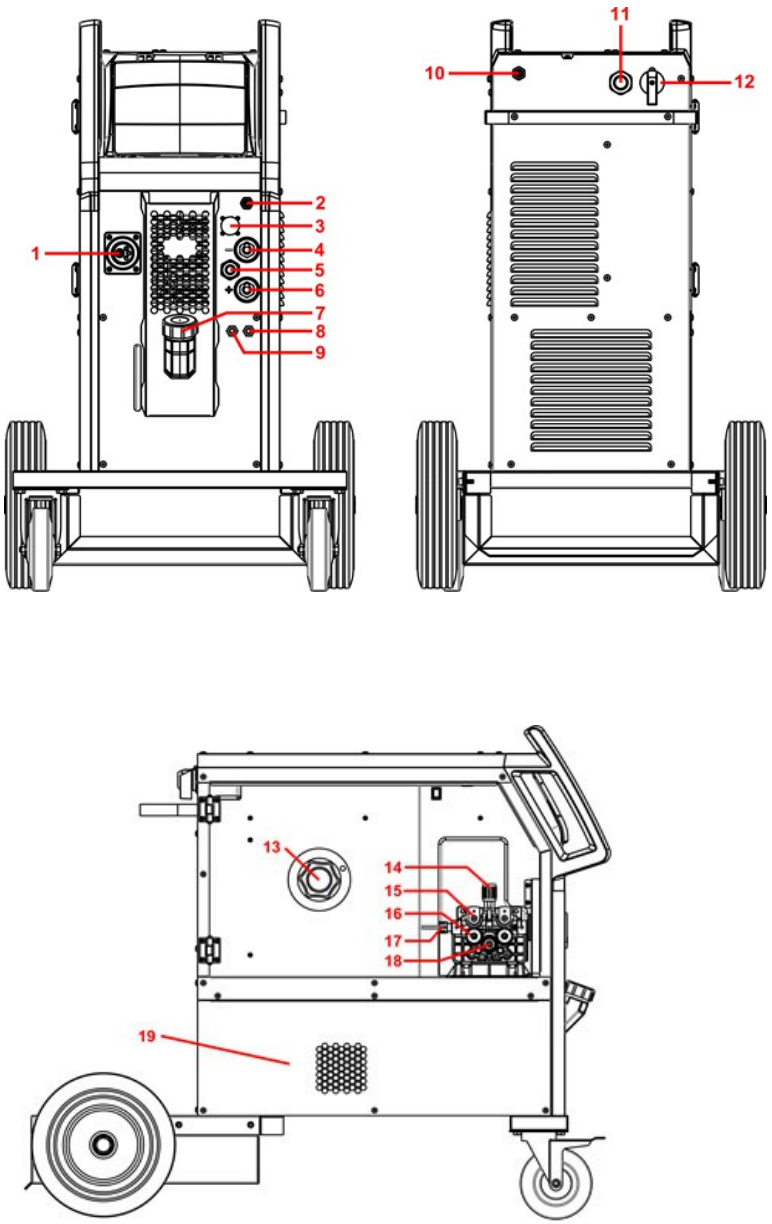


Fig. 5-26: Function interface MIG-SYN

1. Mode: 2T/4T
2. Wire material: SS metal solid wire/Fe metal solid wire/Fe metal cored wire/CuSi/SS metal cored wire.
3. Wire diameter: 0.8~1.2 mm.
4. Shield Gas: CO2 /Ar / 98%Ar+2%CO2 / 80%Ar+20%CO2
5. Pre-flow time: 0~5s.
6. Post flow/post-flow time: 0–10 seconds.
7. Burnback: 0~10.
8. Slow feed: 0~5.

5.3 SYN-MIG 353-4 W synergic, SYN-MIG 403-4 W synergic

5.3.1 Structure



	Designation
1	Euro connection for MIG torch
2	Gas connection for TIG torch
3	Remote connection plug
4	Connection socket for negative output voltage (-)
5	Power connection for MIG torch with switchable polarity
6	Connection socket for positive output power (+)
7	Inlet: Water, coolant, antifreeze, etc. can be injected into the tank from here.
8	Water outlet (blue)*
9	Return inlet (red)*
10	Gas inlet connection
11	Power cable
12	power switch
13	Coil holder
14	Adjusting the wire feed tension
15	Clamping arm for wire feed tension (2x)
16	Wire feed roller (2x)
17	Inlet guide for wire feed
18	Wire drive roller
19	Water tank

Fig. 5-27: Device description

Explanation Water outlet (blue, item 8, Fig. 5-18) and return inlet (red, item 9, Fig. 5-18):

The two nozzles on the same side of the inlet (item 7, Fig. 5-18) can be connected to the nozzles on the welding torch.
Blue corresponds to the outlet: cold water is supplied from the tank.
Red corresponds to the return inlet: hot water is fed into the tank for cooling.

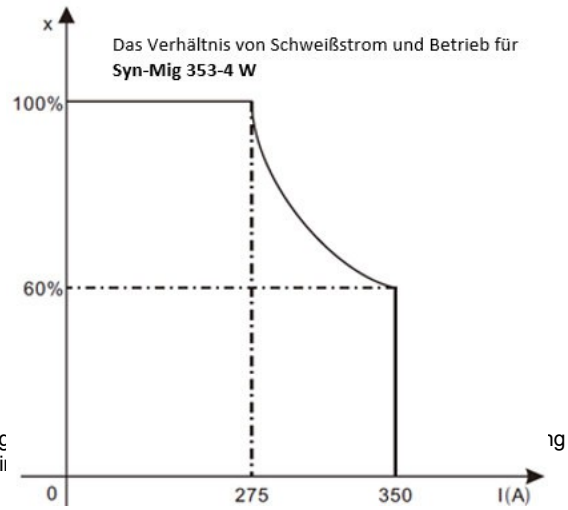
Note: The blue outlet and the red return inlet must not be mixed up!

Duty cycle and overheating SYN-MIG 353-4 W and SYN-MIG 403-4 W The

letter "X" stands for the duty cycle, which is defined as the part of the time during which a welding machine can continuously weld at its rated output current within a specific operating period (10 minutes).

The relationship between the duty cycle "X" and the welding output current "I" is shown in the figure on the right.

If the welding machine overheats, the IGBT overheating protection sends a signal to the welding machine's control unit to turn the welding current OFF, and the error code is displayed on the screen. In this case, the machine should not be used for welding for 10 to 15 minutes to allow it to cool down with the fan running. When the machine is put back into operation, the welding current or duty cycle should **be** reduced**.**



Fig
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5.3.2 Working principle

The operating principle of the MIG series welding machine is shown in the following figure. Three-phase alternating current with a working frequency of 400 V is converted into direct current and then converted into medium-frequency alternating current by a frequency converter (IGBT), after the voltage has been reduced by a medium-frequency transformer (the main transformer) and rectified by a medium-frequency rectifier (fast-switching diodes), and is output by inductance filtering. The circuit uses current feedback control technology to ensure stable current output for MMA or TIG welding. It also uses voltage feedback control technology to ensure stable voltage output for MIG welding. Meanwhile, the welding current parameter can be continuously and steplessly adjusted to meet the requirements of the welding craft.

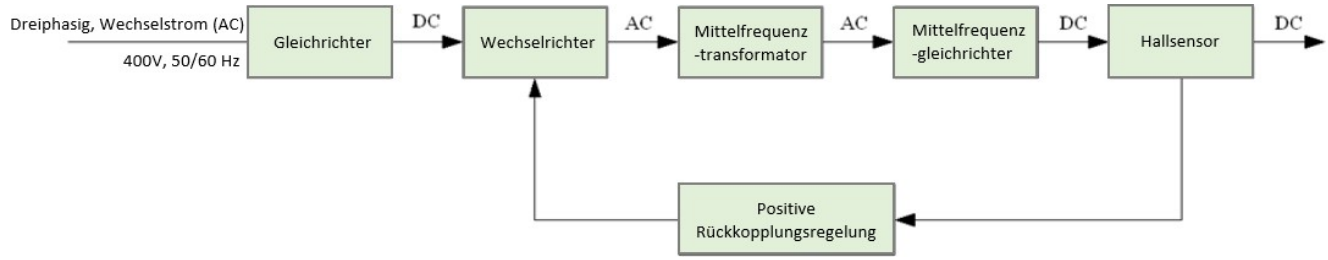


Fig. 5-29: Working principle

5.3.3 Volt-ampere characteristic curve

The welding machines in the MIG series have an optimal volt-ampere characteristic curve, which is shown in the diagram below. The relationship between the rated load voltage U2 and the welding current I2 is as follows: U2=14+0.05I2 (V).

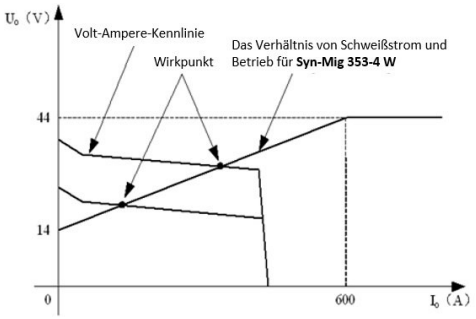
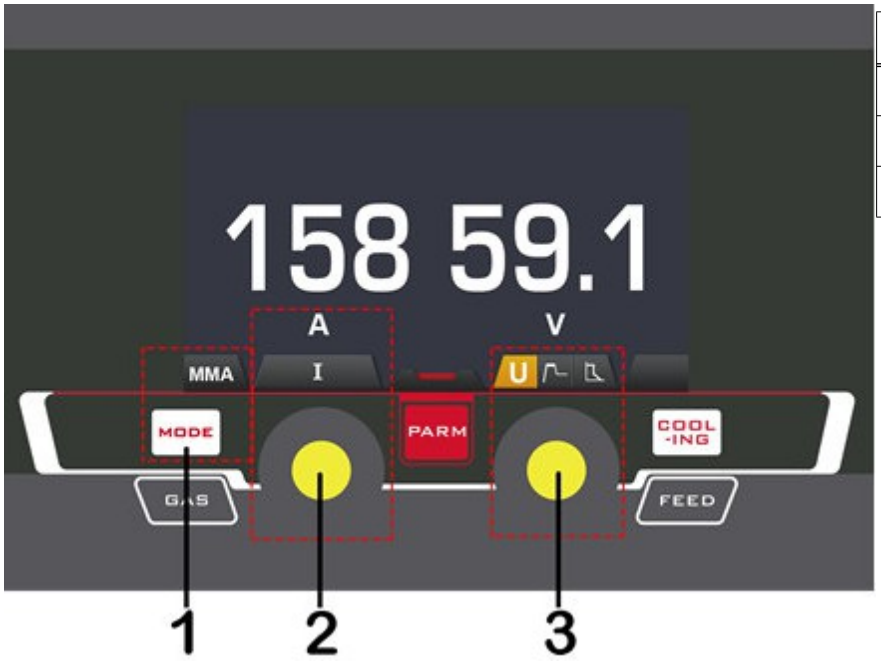


Fig. 5-30: Volt-ampere characteristic curve

5.3.4 Control panel for the MMA process



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob

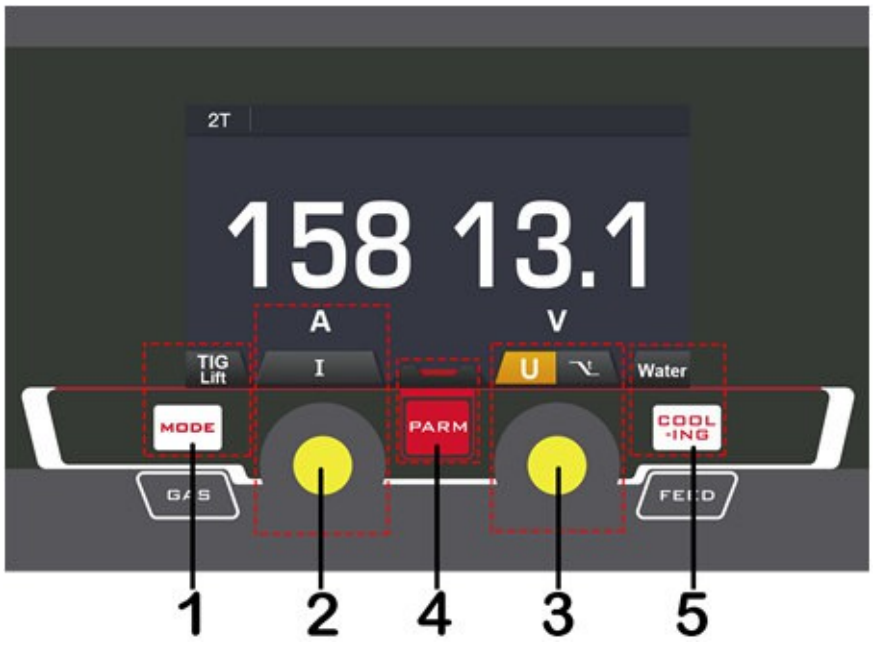
Fig. 5-31: Display MMA

1. Button for the welding process
Press this button to select the MMA welding process.

2. L parameter knob
Turn this knob to adjust the welding current.

3. R parameter knob
Press this knob to select "Hot Start" or "Arc Force" and turn it to adjust the values.

5.3.5 Control panel for the Lift TIG process



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for the cooling process

Fig. 5-32: Display Lift-TIG

1. Button for the welding process
Press this button to select the lift TIG welding process.

2. L-Parater knob
Turn this knob to adjust the welding current. Turn it in the function interface setting to select parameters.

3. R- Parameter knob

Turn this knob to adjust the down-slope time and other parameters.

4. Function button

5. Cooling process button
Press this button to select the water cooling process.

Function interface

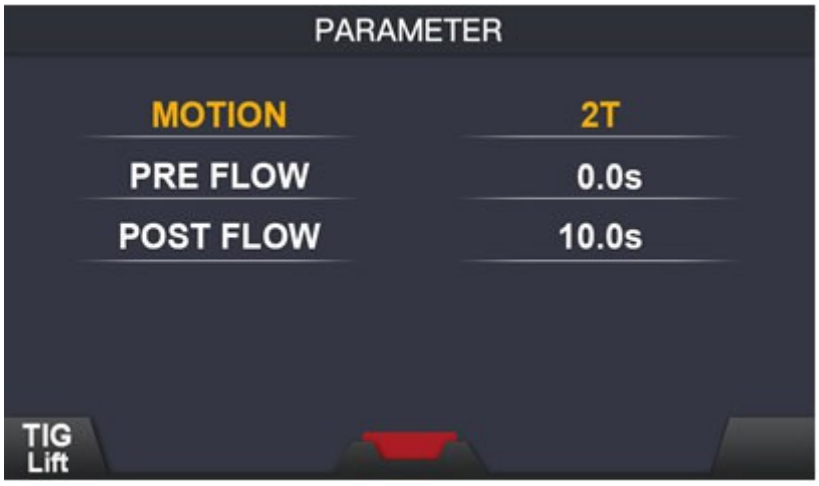
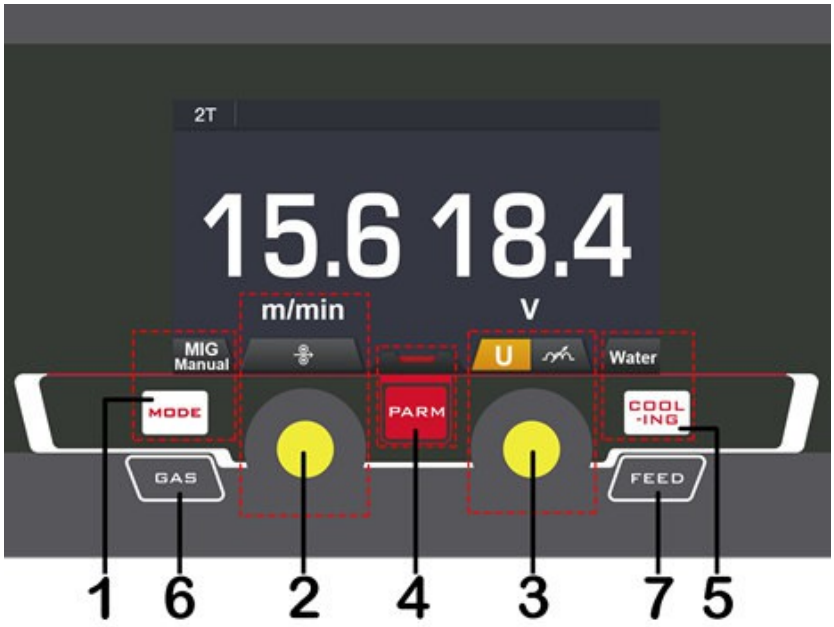


Fig. 5-33: Function interface Lift-TIG

1. Mode: 2T or 4T.
2. Pre-flow time: 0~2 s.
3. Post flow/run time: 0–10 s.

Control panel for the MIG process (manual)



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for the cooling process
6	Manual protective gas control button
7	Manual wire feed button

Fig. 5-34: Display description SYN-MIG 353-4 W Synergic

1. Button for the welding process
Press this button to select the MIG welding process.

2. L parameter knob
Turn it to adjust the wire feed speed. Turn it in the function parameter interface to select parameters.

3. R parameter knob
Turn it to set parameters.

4. Function button

5. Cooling method button
Press it to select the water cooling process

6. Manual shielding gas control button

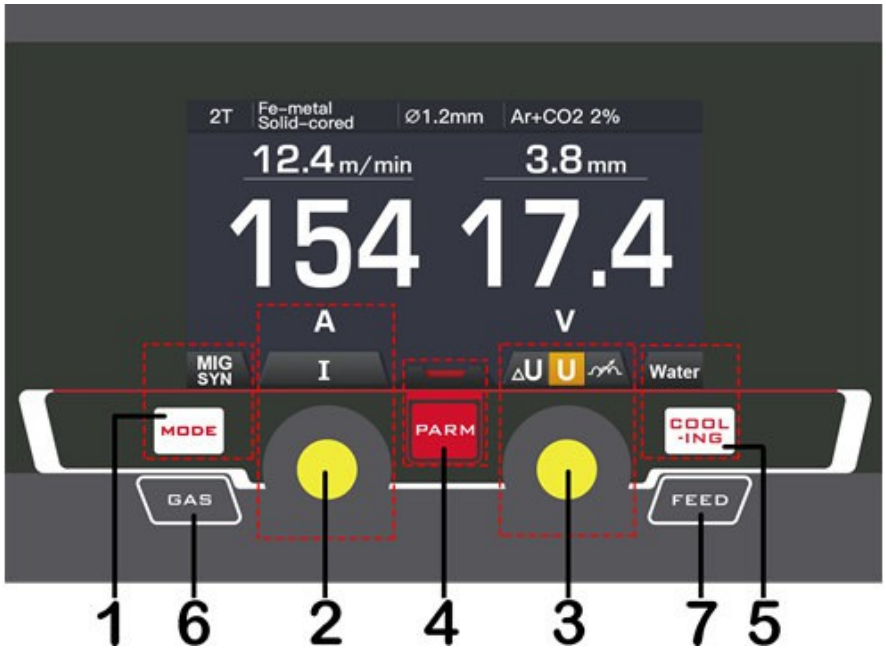
7. Manual wire feed button

Function interface

Fig. 5-35: MIG function interface (manual)

1. Mode: 2 T or 4 T
2. Pre-flow time: 0 ~ 5s
3. Post flow: 0 ~ 10 s
4. Burnback: 0 ~ 10
5. Slow feed: 0 ~ 5
6. Spool Gun: ON/OFF

5.3.6 Control panel for the MIG-SYN process



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for the cooling process
6	Manual protective gas control button
7	Manual wire feed button

Fig. 5-36: Display MIG-SYN

1. Button for the welding process
Press this button to select the MIG-SYN welding process

2. L-parameter knob
Turn it to adjust the wire feed speed. Turn it in the function parameter interface to select parameters

3. R parameter knob
Turn it to set parameters

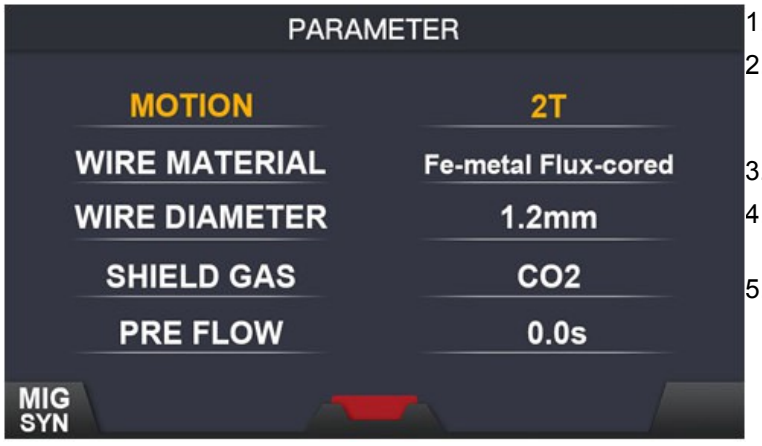
4. Function parameter button

5. Cooling method button
Press it to select the water cooling mode

6. Manual shielding gas control button

7. Manual wire feed button

Function interface



1. Mode: 2 T or 4 T
2. Wire material
   SS solid wire/Fe solid wire/Fe cored wire/Al-Mg solid wire/CuSi
3. Wire diameter 0.8 ~ 1.2 mm
4. Shield gas
   CO2/ 80% Ar + 20% CO2 / 98% Ar + 2% CO2
5. Pre-flow/pre-run time: 0 ~ 5 s

Fig. 5-37: MIG-SYN function interface

5.3.7 Monitoring systems

2T mode

The trigger is pressed and held to activate the welding circuit. When the trigger is released, the welding circuit is interrupted. This function, which does not require adjustment of the start current and end crater current, is suitable for spot welding, short-time welding, welding thin sheets and many more applications.

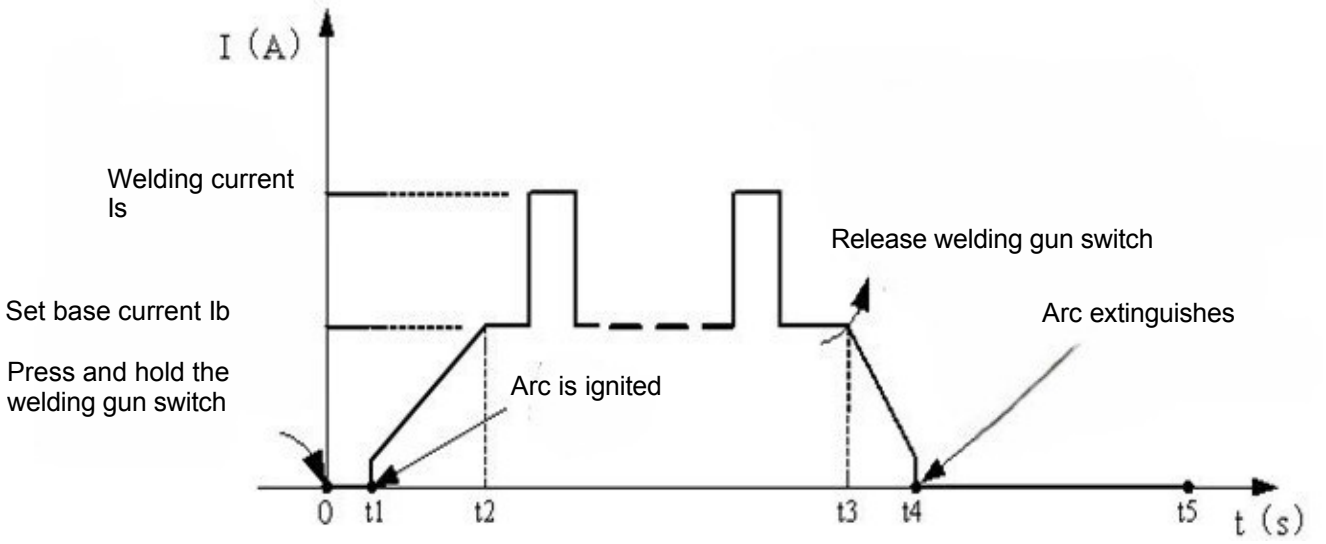


Fig. 5-38: Diagram of 2T mode

1. 0:
   Press and hold the gun switch. The electromagnetic gas valve is activated. The shielding gas begins to flow.
2. 0~t1:
   Pre-gas time (0.1~2.0s).
3. t1~t2:
   The arc is ignited and the output current rises from the minimum welding current to the set welding current (Iw or Ib).
4. t2~t3:
   The gun switch is held down throughout the entire welding process without releasing it.
   Note: When pulsed output is selected, the base current and welding current are output alternately; otherwise, the set value of the welding current is output.
5. t3:
   Release the gun switch and the welding current will decrease according to the selected decay time.
6. t3~t4:
   The current decreases from the set current (Iw or Ib) to the minimum welding current, and then the arc is switched off.
7. t4~t5:
   Post-gas time after the arc has been switched off. You can set this time (0.0~10s) by turning the knob on the front panel.
8. t5:
   The electromagnetic gas valve is switched off, the shielding gas stops flowing, and welding is complete.

4T mode

This is referred to as "latching" mode. The trigger is pressed and released once to activate the welding circuit, and pressed and released again to stop the welding circuit. This feature is useful for longer welds, as the trigger does not need to be held down continuously. The TIG series of welding machines also offers more current control options that can be used in 4T mode. The start current and end crater current can be preset. This function can compensate for the possible crater that occurs at the beginning and end of welding. 4T is therefore suitable for welding medium-thick plates.

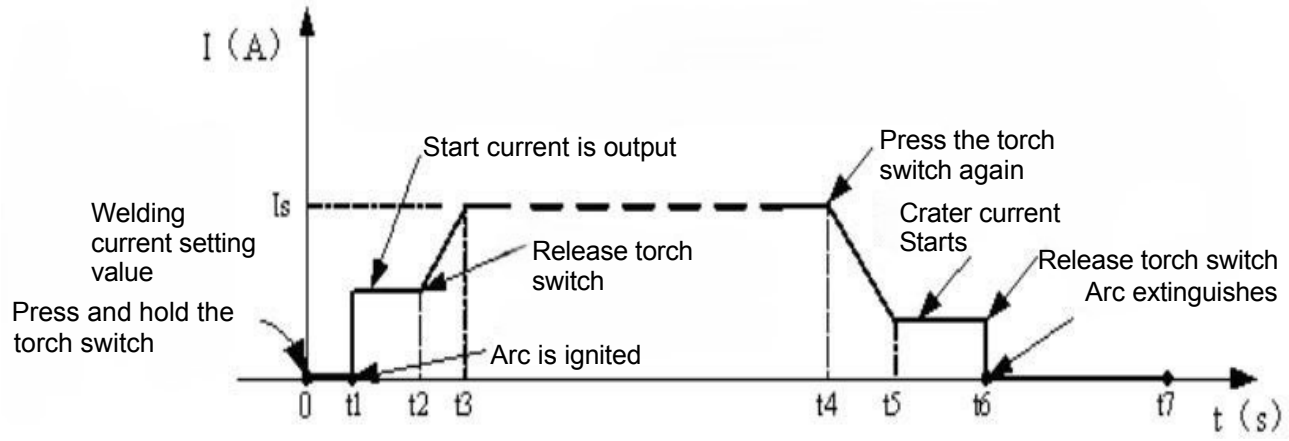


Fig. 5-39: Diagram of 4T mode

1. 0:
   Press and hold the torch switch; the gas valve opens. The shielding gas begins to flow.
2. 0~t1:
   Pre-gas time (0.1~2.0 seconds).
3. t1~t2:
   The arc is ignited at t1 and then the set starting current is output.
4. t2:
   Release the torch switch and the output current increases from the starting current.
5. t2~t3:
   The output current rises to the set value (Iw or Ib); the rise time can be adjusted.
6. t3~t4:
   During the welding process, the torch switch is not activated during this period.
   Note: Select the pulsed output, the base current and the welding current are output alternately; otherwise, the set welding current is output.
7. t4:
   Press the torch switch again and the welding current will decrease in accordance with the selected decay time.
8. t4~t5:
   The output current decreases to the crater current. The decay time can be adjusted.
9. t5~t6:
   The crater current time.
10. t6:
    Release the torch switch, the arc extinguishes and the argon continues to flow.
11. t6~t7:
    The post-gas time can be set using the post-gas time adjustment knob (0.0~10 seconds).
12. t7:
    The valve closes, the argon stops flowing, and the welding process is complete.

Pulse frequency

Can only be selected when pulse mode is activated. Sets the frequency at which the welding current alternates between peak and base current.

Duty cycle

Can only be selected when pulse mode is enabled. Sets the time ratio between peak and base current in pulse mode as a percentage. The neutral setting is 50%, which means that the time interval for peak and base current is the same. A higher duty cycle results in greater heat input, while a lower duty cycle has the opposite effect.

5.3.8 System settings control panel

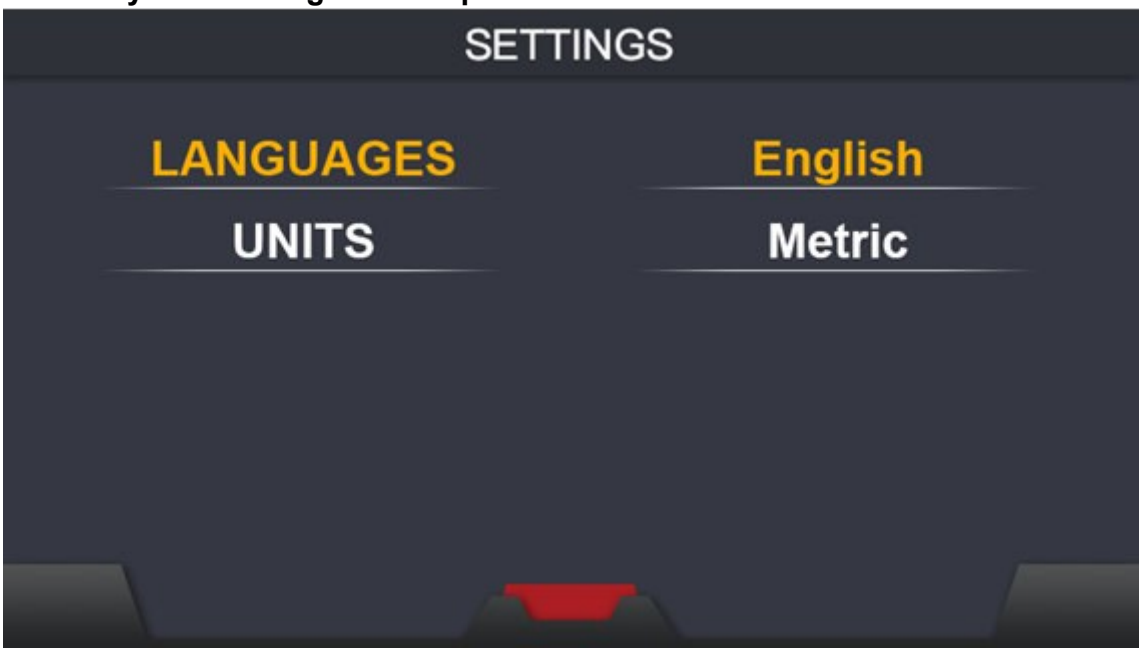
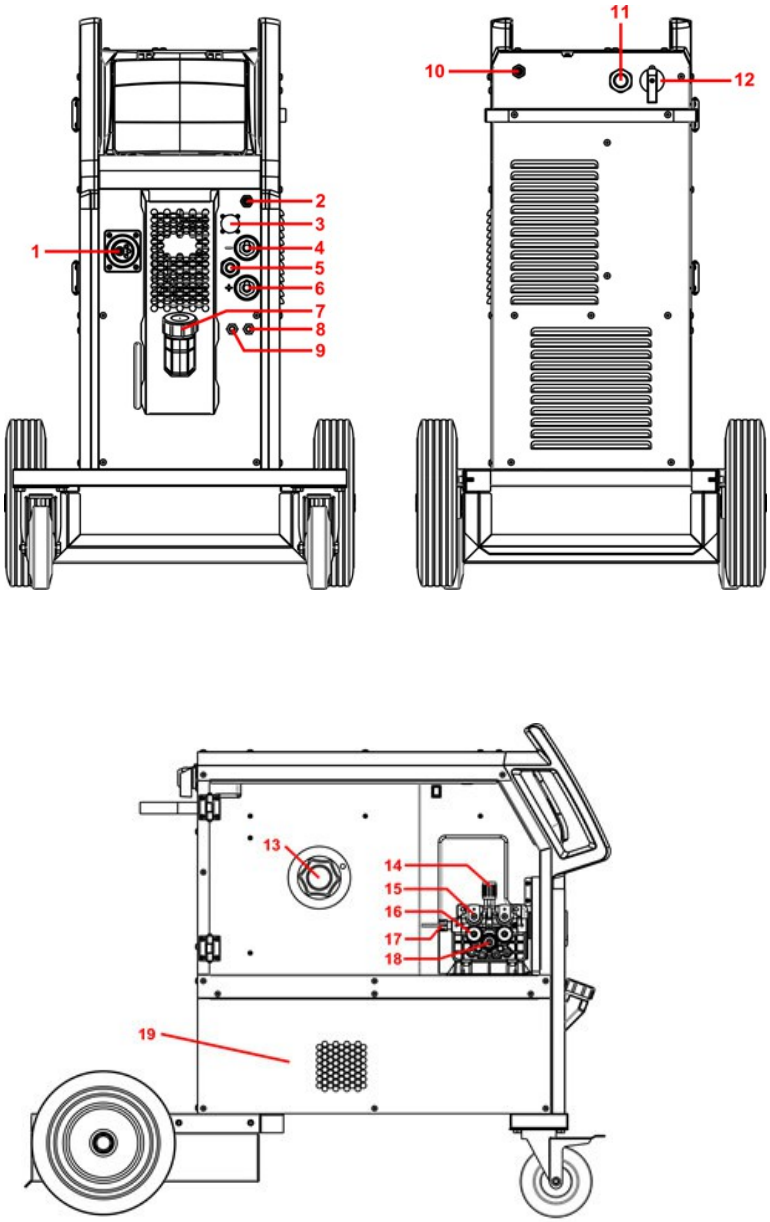


Fig. 5-40: System settings control panel

Press and hold the function parameter button for 3 seconds to access the system interface. Here you can use the L parameter knob and the R parameter knob to set the language and unit settings.

5.4 Syn-Mig 353-4 W Pulse

5.4.1 Design



	Designation
1	Euro connection for MIG torch
2	Gas connection for TIG torch
3	Remote connection plug
4	Connection socket for negative output voltage (-)
5	Power connection for MIG torch with switchable polarity
6	Connection socket for positive output power (+)
7	Inlet: Water, coolant, antifreeze, etc. can be injected into the tank from here.
8	Water outlet (blue)*
9	Return inlet (red)*
10	Gas inlet connection
11	Power cable
12	Power switch
13	Coil holder
14	Adjusting the wire feed tension
15	Clamping arm for wire feed tension (2x)
16	Wire feed roller (2x)
17	Inlet guide for wire feed
18	Wire drive roller
19	Water tank

Fig. 5-41: Device description

Explanation of water outlet (blue, item 8, Fig. 5-18) and return inlet (red, item 9, Fig. 5-18):

The two nozzles on the same side of the inlet (item 7, Fig. 5-18) can be connected to the nozzles on the welding torch.
Blue corresponds to the outlet: cold water is supplied from the tank
Red corresponds to the return inlet: hot water is fed into the tank for cooling.

Note: The blue outlet and the red return inlet must not be mixed up!

Duty cycle and overheating

The letter "X" stands for the duty cycle, which is defined as the portion of time during which a welding machine can continuously weld at its rated output current within a given operation (10 minutes).

The relationship between the duty cycle "X" and the welding output current "I" is shown in the figure on the right.

If the welding machine overheats, the IGBT overheating protection sends a signal to the welding machine's control unit to turn the welding current OFF, and the error code is displayed on the screen. In this case, the machine should not be used for welding for 10 to 15 minutes to allow it to cool down with the fan running. When the machine is put back into operation, the welding current or duty cycle should **be** reduced**.**

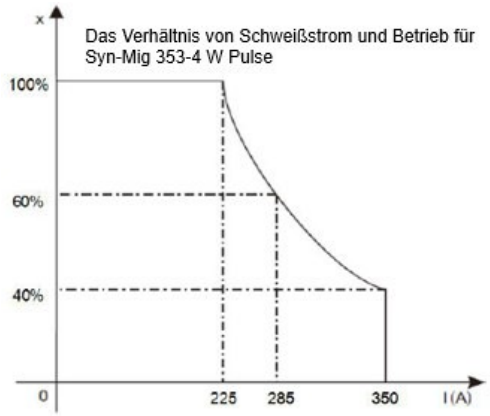


Fig.

5.4.2 working principle

The operating principle of the MIG series welding machine is shown in the following diagram. Three-phase alternating current with a working frequency of 400 V is converted into direct current (approx. 530 V) and then converted into medium-frequency alternating current by a frequency converter (IGBT), after the voltage has been reduced by a medium-frequency transformer (the main transformer) and rectified by a medium-frequency rectifier (fast-switching diodes), and is output by inductance filtering. The circuit uses current feedback control technology to ensure stable current output for MMA or TIG welding. It also uses voltage feedback control technology to ensure stable voltage output for MIG welding. Meanwhile, the welding current parameter can be continuously and steplessly adjusted to meet the requirements of the welding craft.

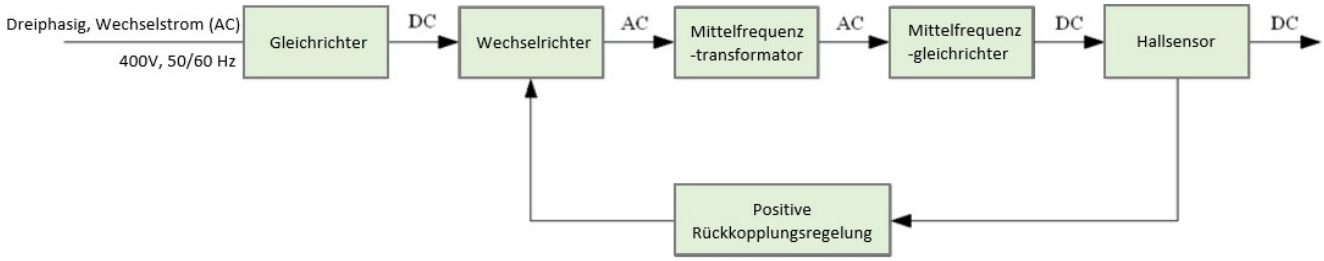


Fig. 5-43: Working principle

5.4.3 Volt-ampere characteristic curve

The welding machines in the MIG series have an optimum volt-ampere characteristic curve, which is shown in the diagram below. The relationship between the rated load voltage U2 and the welding current I2 is as follows: $U2=14+0.05\ I^2(V)$.

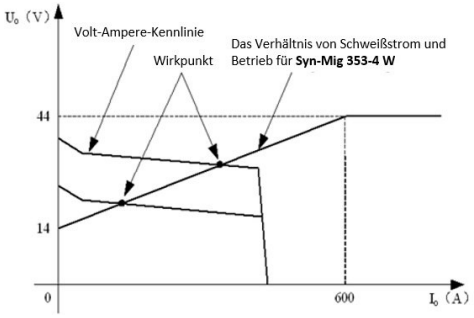
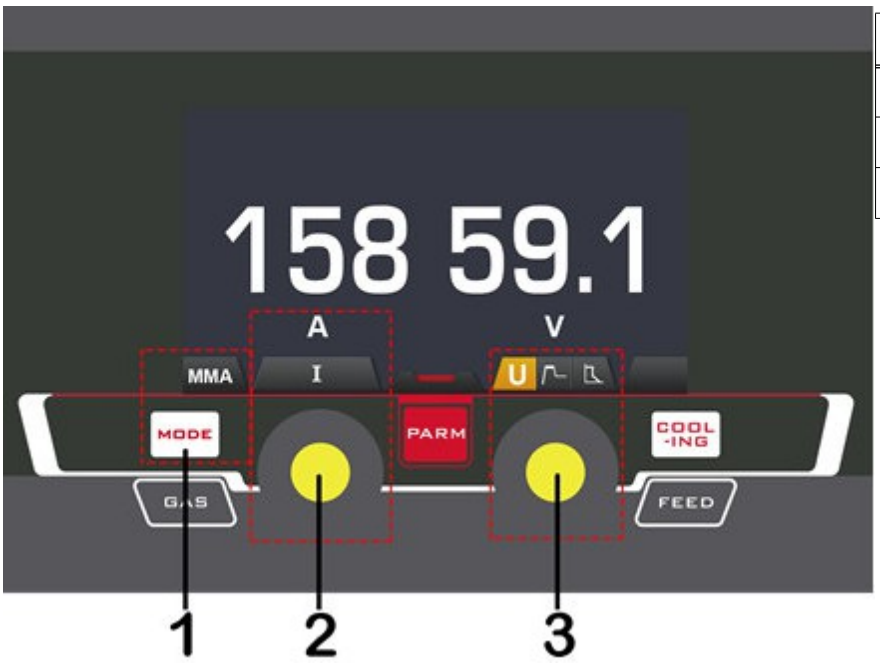


Fig. 5-44: Volt-ampere characteristic curve

5.4.4 Control panel for the MMA process



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob

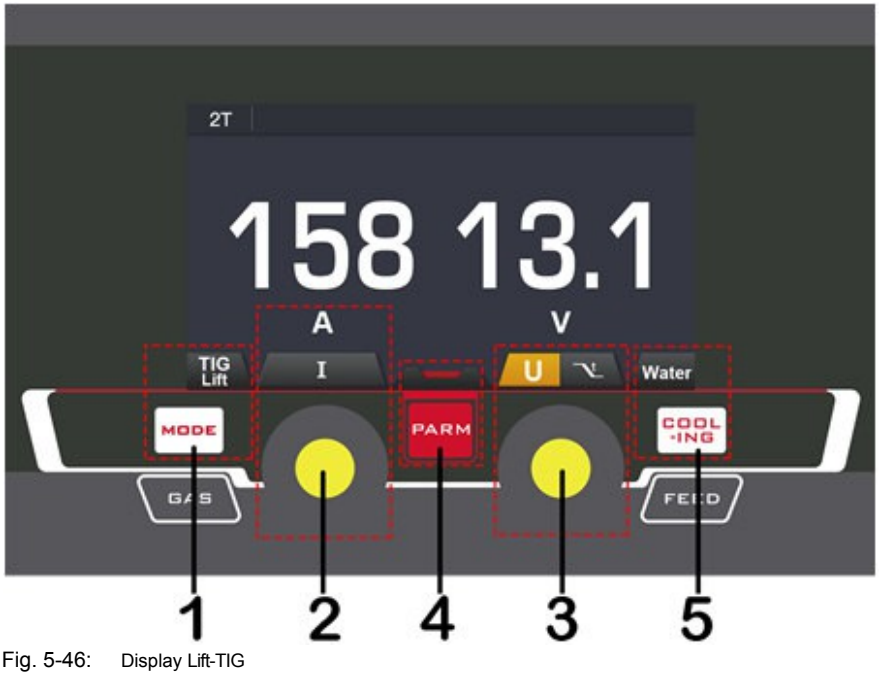
Fig. 5-45: Display MMA

1. Button for the welding process
Press this button to select the MMA welding process.

2. L parameter knob
Turn this knob to adjust the welding current.

3. R parameter knob
Press this knob to select "Hot Start" or "Arc Force" and turn it to adjust the values.

5.4.5 Control panel for the Lift TIG process



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for the cooling process

Fig. 5-46: Display Lift-TIG

1. Button for the welding process
Press this button to select the lift TIG welding process.

2. L-Parater knob
Turn this knob to adjust the welding current. Turn it in the function interface setting to select parameters.

3. R- parameter knob

Turn this knob to adjust the down-slope time and other parameters.

4. Function button

5. Cooling process button
Press this button to select the water cooling process.

Function interface

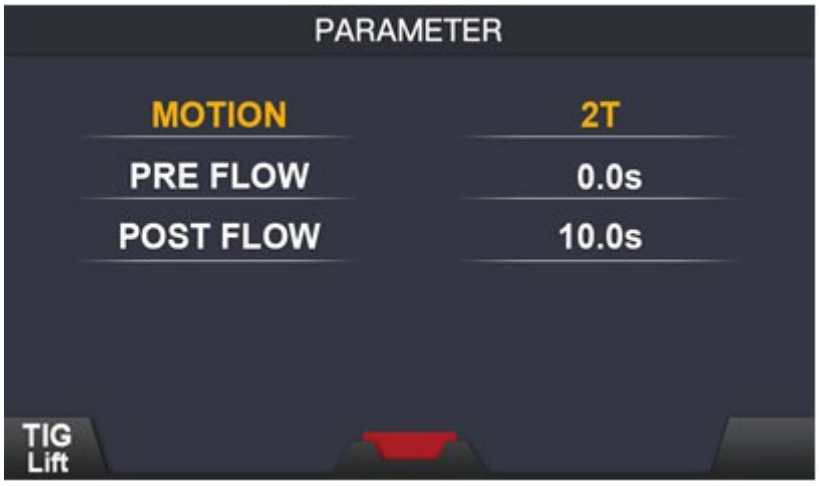
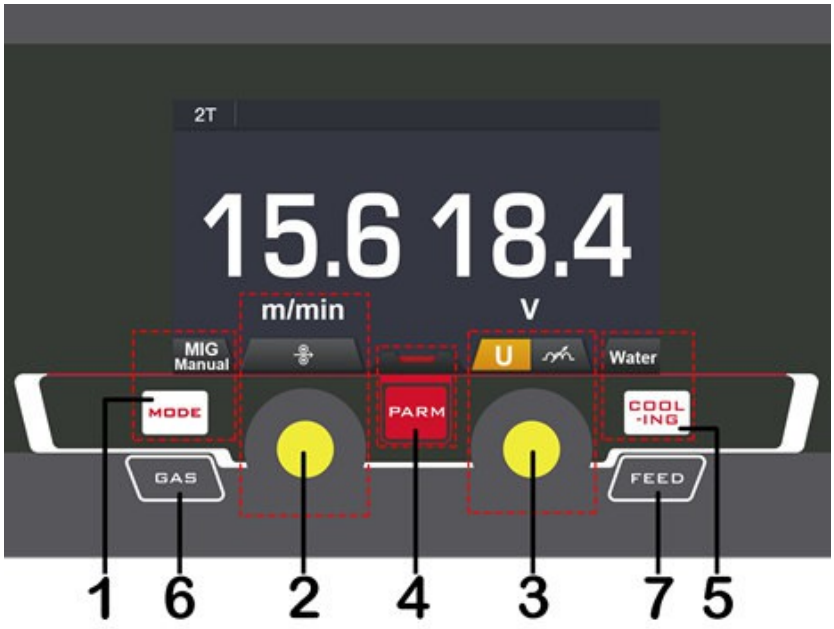


Fig. 5-47: Function interface Lift-TIG

1. Mode: 2T or 4T.
2. Pre-flow time: 0~2 s.
3. Post flow/run time: 0–10 s.

Control panel for the MIG process (manual)



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for the cooling process
6	Manual protective gas control button
7	Manual wire feed button

Fig. 5-48: Display description SYN-MIG 353-4 W Synergic

1. Button for the welding process
Press this button to select the MIG welding process.

2. L parameter knob
Turn it to adjust the wire feed speed. Turn it in the function parameter interface to select parameters.

3. R parameter knob
Turn it to set parameters.

4. Function button

5. Cooling method button
Press it to select the water cooling process

6. Manual shielding gas control button

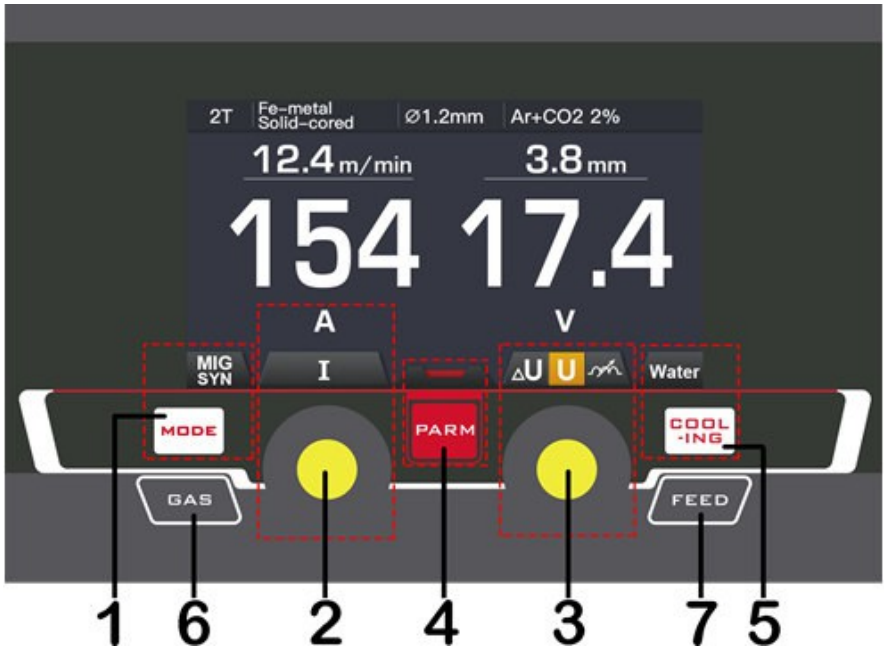
7. Manual wire feed button

Function interface

Fig. 5-49: MIG function interface (manual)

1. Mode: 2 T or 4 T
2. Pre-flow time: 0 ~ 5s
3. Post flow: 0 ~ 10 s
4. Burnback: 0 ~ 10
5. Slow feed: 0 ~ 5
6. Spool Gun: ON/OFF

5.4.6 Control panel for the MIG-SYN process



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for the cooling process
6	Manual protective gas control button
7	Manual wire feed button

Fig. 5-50: Display MIG-SYN

1. Button for the welding process
Press this button to select the MIG-SYN welding process

2. L parameter knob
Turn it to adjust the wire feed speed. Turn it in the function parameter interface to select parameters

3. R parameter knob
Turn it to set parameters

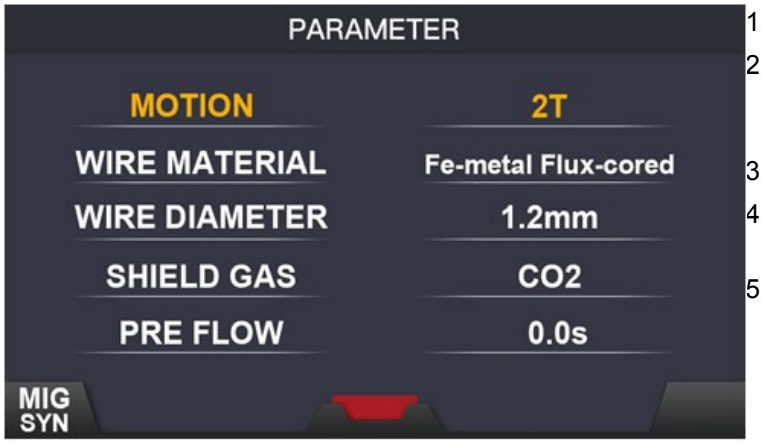
4. Function parameter button

5. Cooling method button
Press it to select the water cooling mode

6. Manual shielding gas control button

7. Manual wire feed button

Function interface



1. Mode: 2 T or 4 T
2. Wire material
   SS solid wire/Fe solid wire/Fe cored wire/Al-Mg solid wire/CuSi
3. Wire diameter 0.8 ~ 1.2 mm
4. Shield gas
   CO2/ 80% Ar + 20% CO2 / 98% Ar + 2% CO2
5. Pre-flow/pre-run time: 0 ~ 5 s

Fig. 5-51: MIG-SYN function interface

5.4.7 Monitoring systems

2T mode

The trigger is pressed and held to activate the welding circuit. When the trigger is released, the welding circuit is interrupted. This function, which does not require adjustment of the start current and end crater current, is suitable for spot welding, short-time welding, welding thin sheets and many more applications.

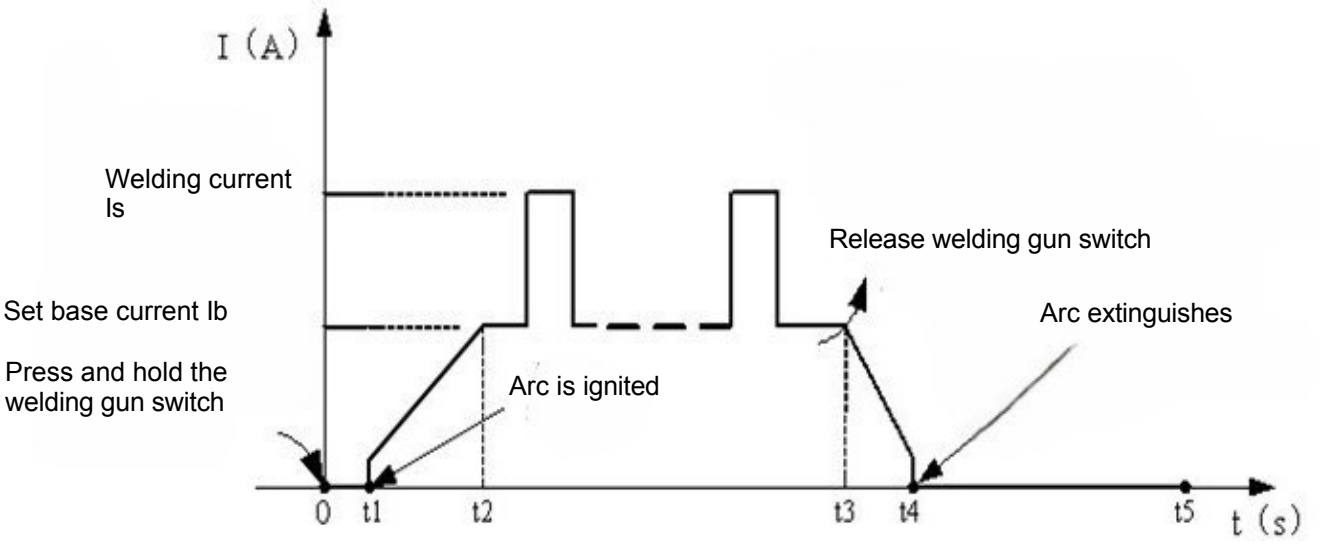


Fig. 5-52: Diagram of 2T mode

13. 0:
    Press and hold the gun switch. The electromagnetic gas valve is activated. The shielding gas begins to flow.
14. 0~t1:
    Pre-gas time (0.1~2.0 s).
15. t1~t2:
    The arc is ignited and the output current rises from the minimum welding current to the set welding current (Iw or Ib).
16. t2~t3:
    The gun switch is held down throughout the entire welding process without releasing it.
    Note: When pulsed output is selected, the base current and welding current are output alternately; otherwise, the set value of the welding current is output.
17. t3:
    Release the gun switch and the welding current will decrease according to the selected decay time.
18. t3~t4:
    The current decreases from the set current (Iw or Ib) to the minimum welding current, and then the arc is switched off.
19. t4~t5:
    Post-gas time after the arc has been switched off. You can set this time (0.0~10s) by turning the knob on the front panel.
20. t5:
    The electromagnetic gas valve is switched off, the shielding gas stops flowing, and welding is complete.

4T mode

This is referred to as "latching" mode. The trigger is pressed and released once to activate the welding circuit, and pressed and released again to stop the welding circuit. This feature is useful for longer welds, as the trigger does not need to be held down continuously. The TIG series of welding machines also offers more current control options that can be used in 4T mode. The start current and end crater current can be preset. This function can compensate for the possible crater that occurs at the beginning and end of welding. 4T is therefore suitable for welding medium-thick plates.

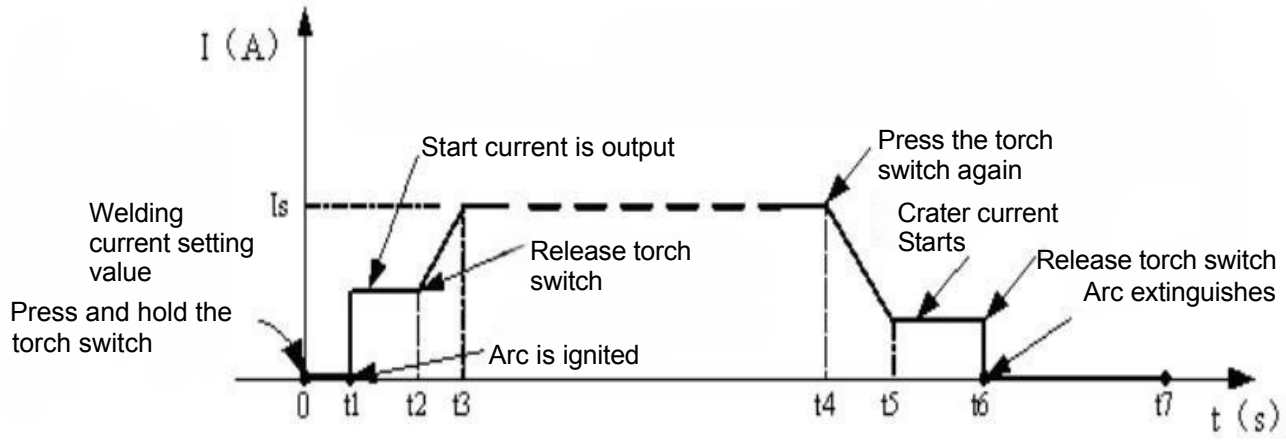


Fig. 5-53: Diagram of 4T mode

1. 0:
   Press and hold the torch switch; the gas valve opens. The shielding gas begins to flow.
2. 0~t1:
   Pre-gas time (0.1~2.0 seconds).
3. t1~t2:
   The arc is ignited at t1 and then the set starting current is output.
4. t2:
   Release the torch switch and the output current increases from the starting current.
5. t2~t3:
   The output current rises to the set value (Iw or Ib); the rise time can be adjusted.
6. t3~t4:
   During the welding process, the torch switch is not activated during this period.
   Note: Select the pulsed output, the base current and the welding current are output alternately; otherwise, the set welding current is output.
7. t4:
   Press the torch switch again and the welding current will decrease in accordance with the selected decay time.
8. t4~t5:
   The output current decreases to the crater current. The decay time can be adjusted.
9. t5~t6:
   The crater current time.
10. t6:
    Release the torch switch, the arc extinguishes and the argon continues to flow.
11. t6~t7:
    The post-gas time can be set using the post-gas time adjustment knob (0.0~10 seconds).
12. t7:
    The valve closes, the argon stops flowing, and the welding process is complete.

Pulse frequency

Can only be selected when pulse mode is activated. Sets the frequency at which the welding current alternates between peak and base current.

Duty cycle

Can only be selected when pulse mode is enabled. Sets the time ratio between peak and base current in pulse mode as a percentage. The neutral setting is 50%, which means that the time interval for peak and base current is the same. A higher duty cycle results in greater heat input, while a lower duty cycle has the opposite effect.

5.4.8 System settings control panel

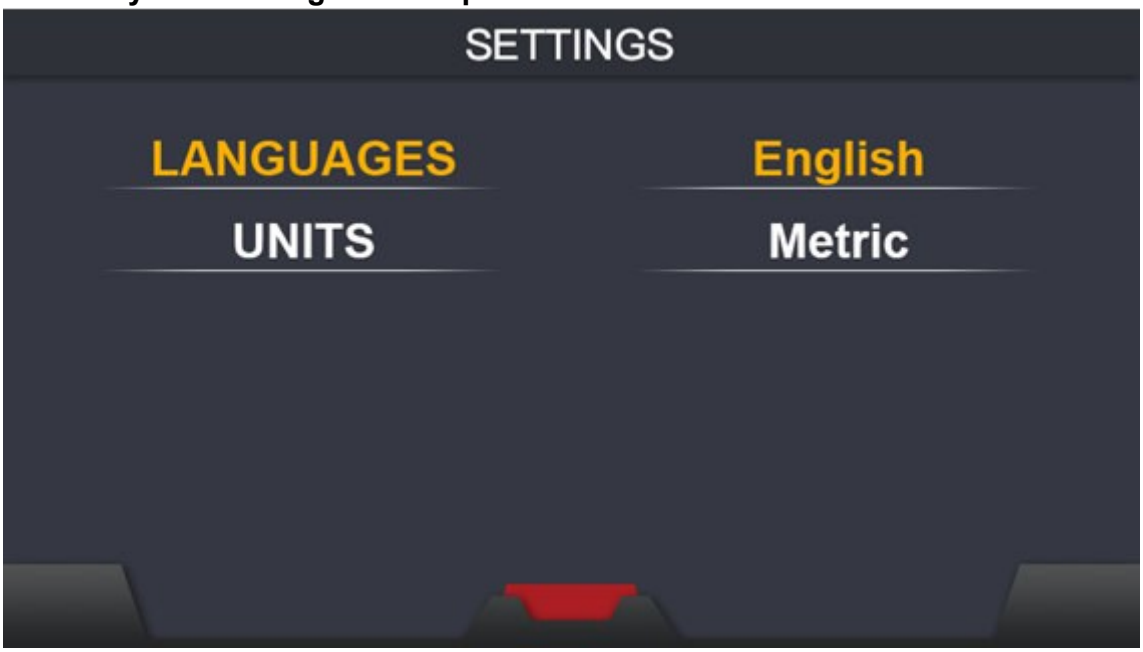
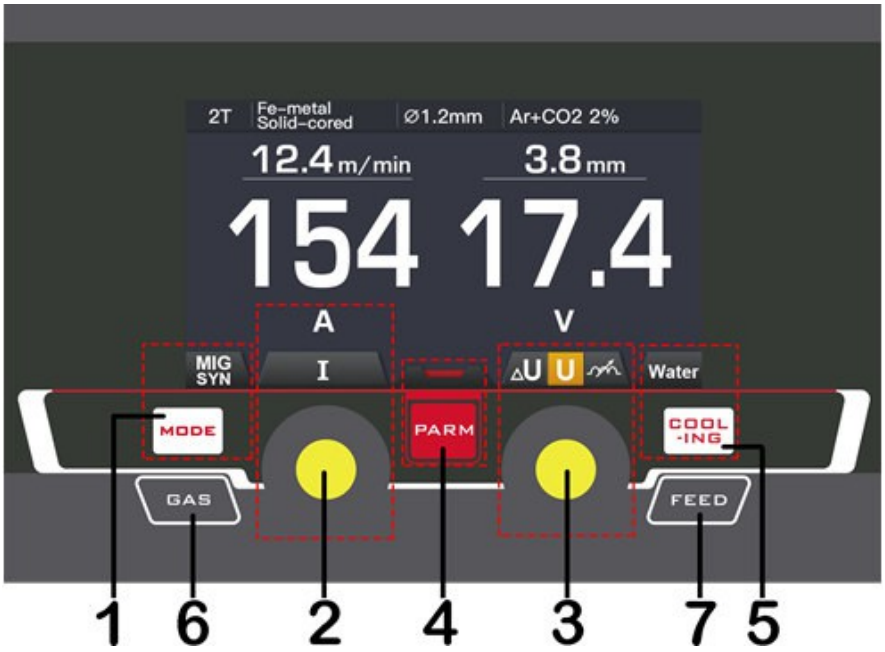


Fig. 5-54: System settings control panel

Press and hold the function parameter button for 3 seconds to access the system interface. Here you can use the L parameter knob and the R parameter knob to set the language and unit settings.

5.4.9 Control panel for the MIG pulse process



	Designation
1	Button for the welding process
2	L parameter knob
3	R parameter knob
4	Function button
5	Button for the cooling process
6	Manual protective gas control button
7	Manual wire feed button

Fig. 5-55: Display MIG-SYN

1. Button for the welding process
Press this button to select the MIG pulse welding process.

2. L parameter knob
Turn it to adjust the wire feed speed. Turn it in the function parameter interface to select parameters

3. R parameter knob
Turn it to set parameters

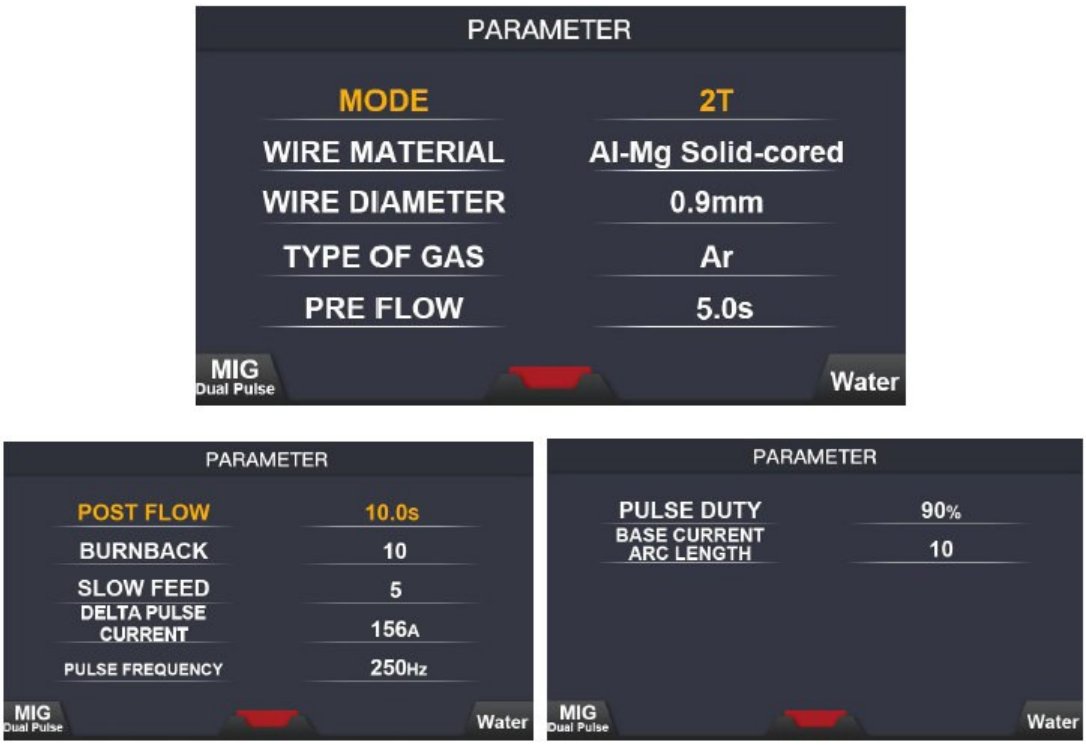
4. Function parameter button

5. Cooling method button
Press it to select the water cooling mode

6. Manual shielding gas control button

7. Manual wire feed button

Function interface



1. Mode: 2-stroke or 4-stroke
2. Wire material
   SS solid wire/Fe solid wire/Fe cored wire/Al-Mg solid wire/CuSi
3. Wire diameter 0.8 ~ 1.2 mm
4. Shielding gas
   CO2/ 80% Ar + 20% CO2 / 98% Ar + 2% CO2
5. Pre-flow time: 0 ~ 5 s
6. Post flow: 0 ~ 10 s
7. Burnback: 0 ~ 10 s
8. Slow feed: 0 ~ 5 s
9. Delta pulse current: 20 ~ 200 A.
10. Pulse frequency: 0.5 ~ 3 Hz.
11. Pulse duration: 10 to 90%.
12. Base current arc length: -10 to +10.

Fig. 5-56: MIG-SYN function interface

Single pulse function

The single pulse function enables the transition to a spray arc even at lower currents and wire feed speeds than with conventional welding. This results in a faster welding process with high deposition rates, while at the same time minimising the heat-affected zone through the targeted application of energy in the peak area of the pulse current. This welding technique is particularly suitable for joining stainless steel or aluminium edges and for precise seam welding.

Double pulse function

The dual pulse function enables particularly precise control of heat input by balancing the high energy of the pulse peak with a lower base current phase. This keeps the welding tip stable and controllable, even with varying sheet thicknesses or demanding materials.

This technology is used in particular when welding aluminium alloys in order to achieve deep penetration with a narrow seam profile and an even, smooth surface. In addition, the periodic alternation of peak and base current can produce a so-called ripple effect – similar to the appearance of a TIG weld seam, but without manual torch movement.

A typical form of the reference wave for the double pulse is shown in the following figure:

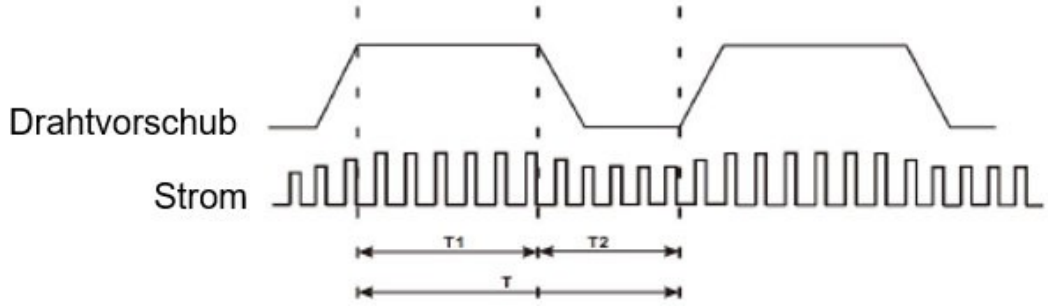


Fig. 5-57: Reference wave for double pulse

Double pulse – frequency

The double pulse frequency determines the temporal pattern of the alternation between pulse and base current. As shown in the figure, the frequency influences the duration of the periods (time T) and thus the structure of the waveform of the welding current. Higher frequencies generate many short cycles, resulting in a finer structured ripple pattern, but with a slightly reduced penetration depth. Low frequencies produce coarser patterns with a stronger thermal influence on the workpiece.

Double pulse – duty cycle

The duty cycle of the double pulse describes the ratio between the duration of the high-current phase (T1 – pulse peak) and the duration of the low-current phase (T2 – base). T1 has a significant influence on the penetration of the melting power, while T2 ensures cooling and helps determine the shape and depth of the resulting ripple pattern on the weld seam surface. By specifically adjusting these parameters, both the visual quality of the weld seam and the heat-affected zone can be precisely controlled.

S4T - Trigger mode:

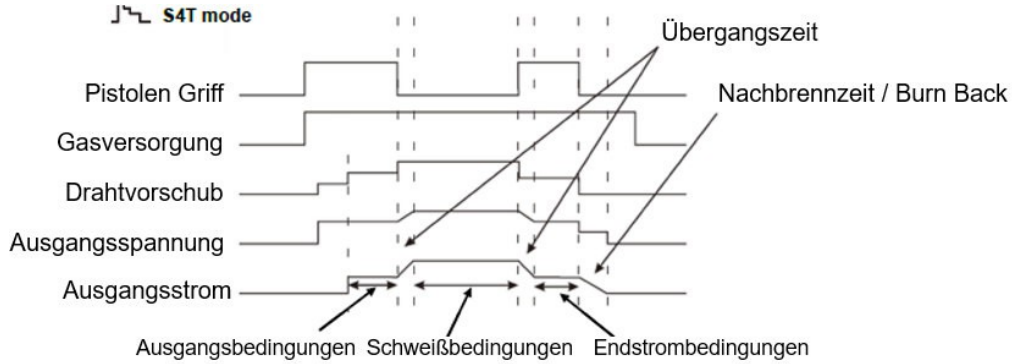
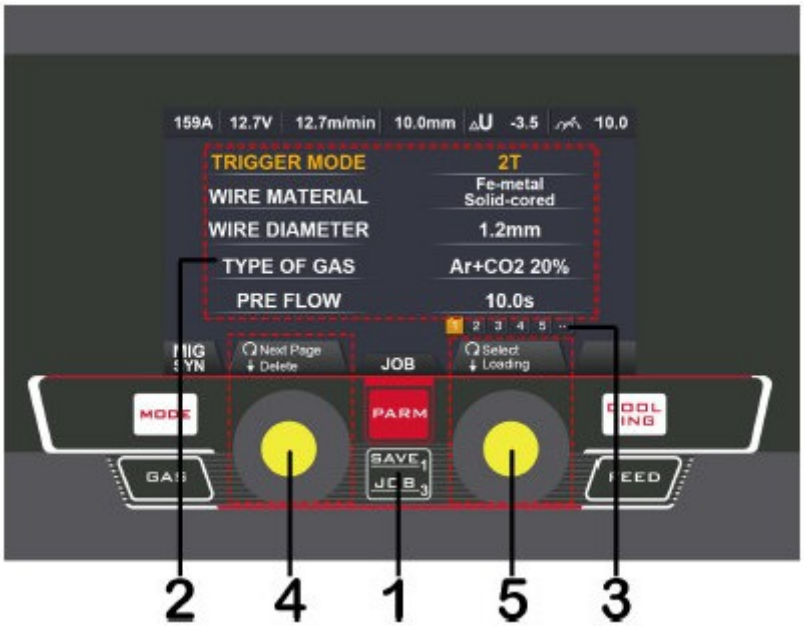


Fig. 5-58: S4T trigger mode

5.4.10 Control panel for the JOB programme

In JOB mode, up to 10 different JOB sets can be saved, retrieved and managed. This function allows the user to quickly and conveniently call up frequently used welding parameters – ideal for recurring applications or different material groups.

No JOB programmes are pre-installed when the machine leaves the factory, so the user must first save their own parameters in order to use this function.



1. **JOB button**
   - Press and hold (3 seconds): Opens the JOB programme menu.
   - Press briefly (1 second): Saves the current settings to the next available memory location.
2. **Parameter display**
   - Displays all currently set welding parameters for the active JOB programme.
3. **Display of the JOB number**
   - Indicates the number of the current or selected JOB programme (1-10).
4. **L parameter rotary knob**
   - Turn: Scroll through pages/parameters.
   - Press: Deletes the currently selected JOB set.
5. **R parameter knob**
   - Turn: Select the JOB programme (1-10).
   - Press: Activates the selected JOB programme.

Saving, calling up and deleting JOB programmes Saving:
After selecting the desired welding parameters, press the JOB button for 1 second. The settings are automatically saved in the next free memory channel.

Recalling:
Hold down the JOB button for 3 seconds, select the desired JOB number with the R rotary knob and activate it by pressing the R button.

Deleting:
Select the corresponding JOB with the L knob and delete it by pressing it.

6 Installation and operation

6.1 Safety

Only operate the welding machine under the following conditions:

- The technical condition of the welding machine is flawless.
- The welding machine is used as intended.
- The operating instructions are observed.
- All safety devices are present and active.

Rectify any faults or have them rectified immediately. In the event of malfunctions, shut down the device immediately and secure it against accidental or unauthorised start-up.

Report any changes immediately to the responsible authority.

6.2 MMA e electrode welding

6.2.1 Setup and installation

This welding machine has two connections, one for positive (+) and one for negative (-) polarity, for connecting the MMA/electrode holder cable and the earth cable. Different electrodes require different polarities for optimum results, so special attention should be paid to polarity. Please consult the electrode manufacturer's information for the correct polarity.

DCEP: Electrode connected to the positive (+) output terminal.

DCEN: Electrode connected to the negative (-) output terminal.

MMA (DC): Select the connection of DCEN or DCEP according to the different electrodes. Please refer to the electrode manual.

MMA (AC): No requirements for polarity connection.

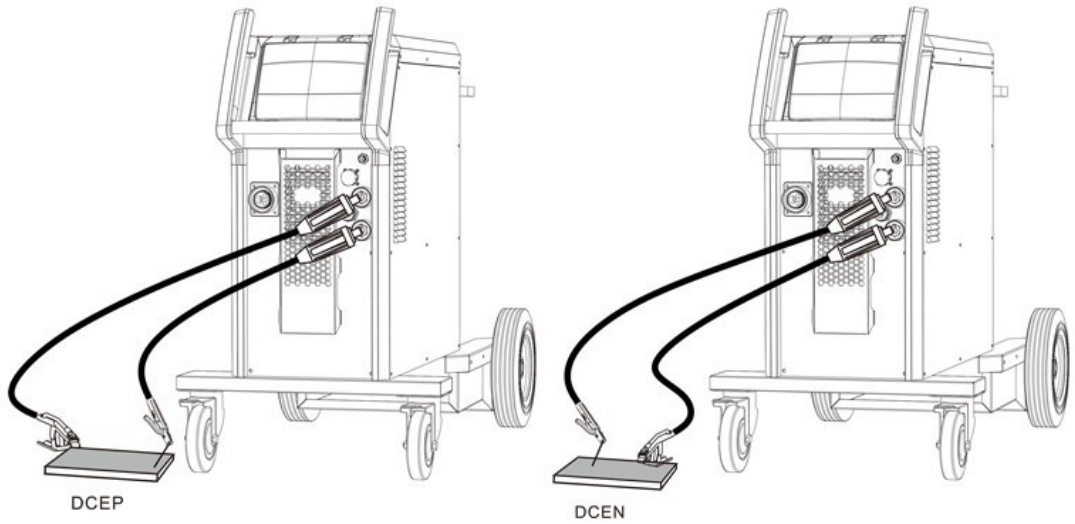


Fig. 6-1: Setup and installation

1. Switch on the power source and press the welding mode button to activate MMA welding mode.
2. Set the welding current according to the electrode type and size recommended by the electrode manufacturer.
3. Adjust Hot Start and Arc Force as required using the knobs and buttons.
4. Insert the electrode into the electrode holder and clamp it securely.
5. Strike the electrode against the workpiece to create an arc and hold the electrode steady to maintain the arc.

6.2.2 MMA/stick electrode welding

One of the most common types of arc welding is manual metal arc welding (MMA) or electrode welding. This involves using an electric current to create an arc between the base material and a melting electrode or "rod". The electrode is made of a material that is compatible with the base material and is coated with a flux that releases gaseous vapour during welding. This vapour acts as a shielding gas and forms a slag layer that protects the weld area from atmospheric contamination. The core of the electrode itself acts as filler material, and the flux residues that form a slag layer over the weld metal must be tapped off after welding.

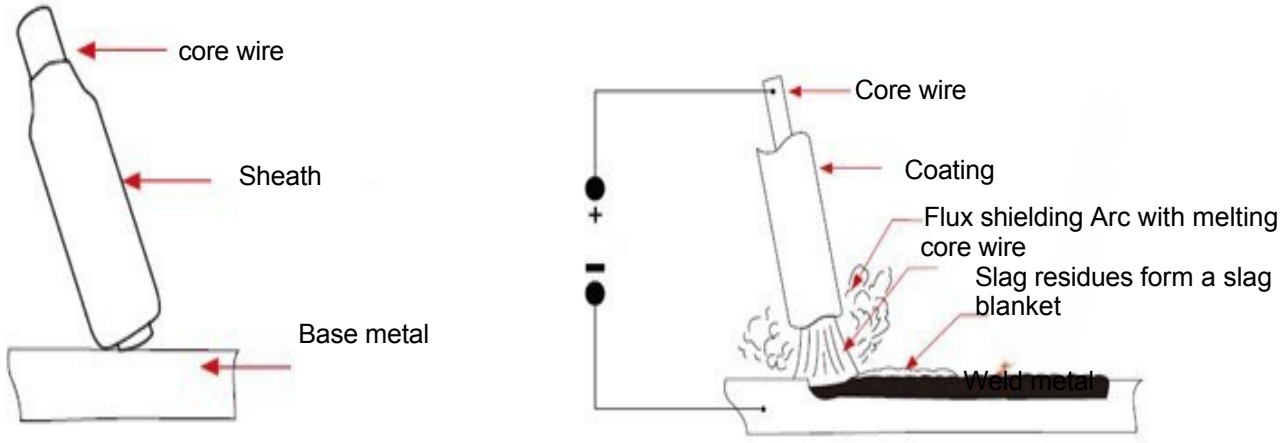


Fig. 6-2: MMA/stick electrode welding

MMA/stick electrode

- The arc is ignited by briefly touching the electrode to the base metal.
- The molten electrode material is transferred to the molten pool via the arc and becomes part of the weld seam.
- The weld seam is covered and protected by the slag that forms from the electrode coating.

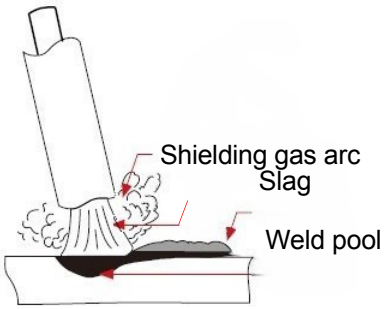


Fig. 6-3: MMA/stick electrode

Flux properties

- Generation of a protective gas around the welding area.
- Provision of fluxes and deoxidants.
- Creation of a protective slag coating over the weld seam.
- Production of arc properties.
- Addition of alloying elements.
- Stick electrodes fulfil many other functions in addition to feeding the weld metal to the molten pool. These additional functions are mainly performed by the various coatings on the electrode.

9.

6.2.3 Basics of MMA welding

Selecting the electrode

Selecting an electrode is usually straightforward, as it is generally a matter of choosing an electrode with a similar chemical composition to the base metal. However, for some metals there are several electrodes to choose from, each with specific properties for particular applications. It is advisable to consult your welding supplier.

Average material thickness	Max. recommended electrode diameter
1.0 - 2.0 mm	2.5 mm
2.0 - 5.0 mm	3.2
5.0 - 8.0 mm	4.0 mm
> 8.0 mm	5.0 mm

Welding current (strength)

Choosing the right welding current is a crucial factor in arc welding. If the current is set too low, difficulties arise in igniting and maintaining a stable arc. In such cases, the electrode tends to stick to the workpiece, penetration is insufficient, and weld seams with a rounded profile are produced. If, on the other hand, the current is set too high, this can lead to overheating of the electrode, which in turn causes the base material to burn through and results in excessive spatter and undercuts. For electrode type E6013, which is often used for general welding work, there are recommended current ranges based on the diameter of the electrode:

Electrode diameter	Current measurement range
2.5 mm	60 - 95
3.2 mm	100 - 130
4.0	130 - 165
5.0	165 - 260

Arc size

To ignite the arc, the electrode should be gently stroked over the workpiece until the arc is formed. There is a simple rule of thumb for the correct arc length: it should be as short as possible to achieve a good weld surface. An arc that is too long reduces the penetration depth, causes spatter and results in a rough weld seam. An arc that is too short, on the other hand, causes the electrode to stick and the weld quality to suffer. A general rule of thumb for welding in the downhand position (also known as downhand welding) is that the arc length should not be greater than the diameter of the cored wire.

Angle of the electrode

The angle of the electrode during welding is crucial for uniform and clean metal transfer. When welding in the **downhand position** (also known as **"down hand"**), fillet welds, in the horizontal position or in the overhead position, the electrode should generally be held at an angle of 5 to 15 degrees in the direction of welding. This ensures an even weld seam. When welding in the **vertical up position** (**vertically upwards)**, however, the electrode should be guided at an angle of 80 to 90 degrees to the workpiece surface. This steeper position is necessary to maintain control over the weld pool and achieve a high-quality weld seam.

Welding speed

When welding, the electrode must be guided along the joint at a speed that ensures sufficient seam size. At the same time, it is important to move the electrode downwards to maintain the correct arc length. Excessive welding speeds result in poor fusion and insufficient penetration, while welding too slowly can cause arc instability, slag inclusions and poor mechanical properties.

Material and seam preparation

The material to be welded must be thoroughly cleaned to remove contaminants such as moisture, paint, oil, grease, scale and rust, as these can adversely affect the welding process. The seam is prepared using methods such as sawing, punching, shearing or flame cutting. The edges of the material must be clean and free of residue. The choice of seam type (e.g. butt, overlap, T or corner seam) depends on the specific application and requirements.

6.3 TIG e welding

6.3.1 Setup and installation

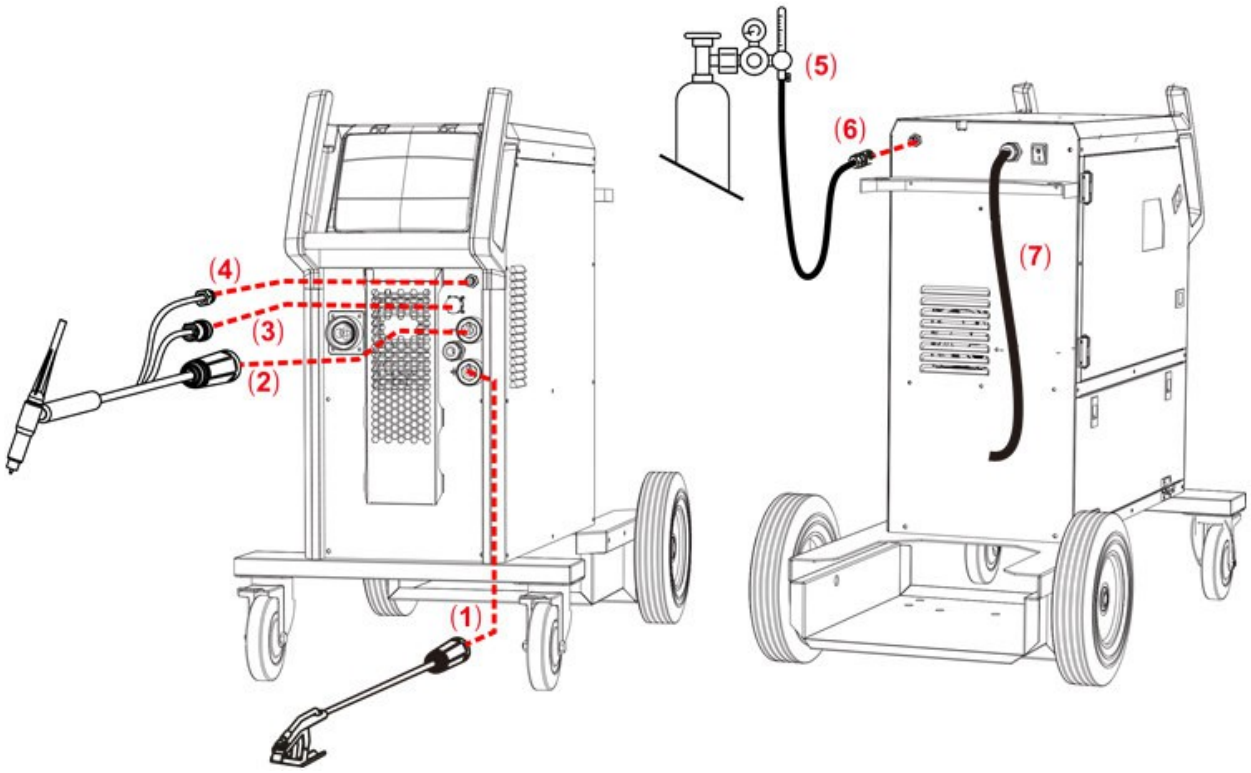
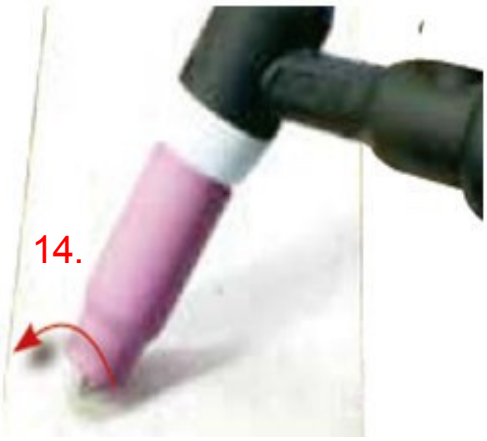


Fig. 6-4: Setup and installation TIG welding machine

1. Plug the earth cable connector into the positive socket on the front of the unit and turn it to lock it in place.
2. Connect the welding torch to the negative socket on the front panel and turn it to lock it in place.
3. Connect the control cable of the torch switch to the 9-pin socket on the front of the device.
4. Connect the gas line of the TIG torch to the gas outlet connection on the front of the unit.
5. Connect the gas regulator to the gas cylinder and the gas line to the gas regulator.
6. Connect the gas hose to the gas inlet connection on the rear of the device.
7. Connect the power cord of the welding machine to a power outlet.
8. Carefully open the valve on the gas cylinder and set the desired gas flow rate.
9. Select the TIG function on the control panel at the front of the device.
10. Set the torch operation to 2T, 4T or ON.

11. Select the required welding current. The set welding current is shown on the display. Set the desired dwell time, which is also shown on the digital display.

12. Assemble the front parts of the TIG torch and insert a pointed tungsten electrode that is suitable for the material to be welded.



13. Place the outer edge of the TIG torch on the workpiece, with the tungsten electrode 1-2 mm away from the workpiece. Press and hold the trigger button on the TIG torch to start the gas flow.
14. Turn the torch forward slightly so that the tungsten electrode touches the workpiece.

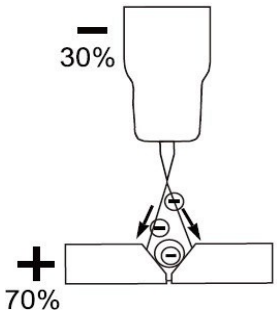
15. Now turn the torch in the opposite direction to lift the tungsten electrode away from the workpiece and create the arc.
16. Release the trigger to stop welding.

IMPORTANT NOTE:

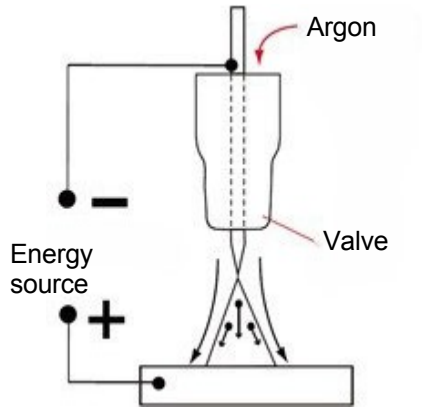
It is recommended to check for gas leaks before operation and to close the cylinder valve when the machine is not in use.

6.3.2 DC/TIG welding

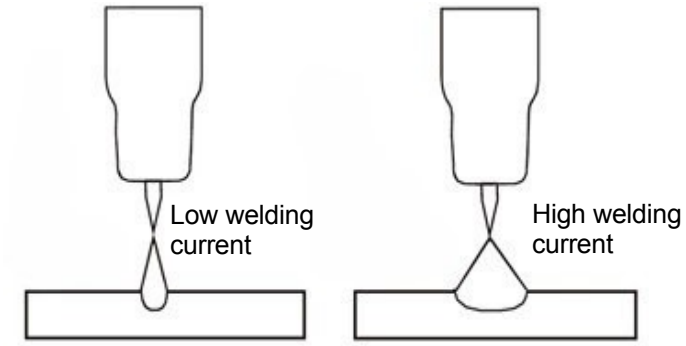
The direct current source uses what is known as direct current (DC), in which the main electrical component, the electrons, flow in only one direction from the negative pole (-) to the positive pole (+). In a direct current circuit, there is an electrical principle that states that 70% of the energy (heat) is always on the positive side. This is important because it determines which pole the TIG torch must be connected to.



TIG direct current welding is a process in which an electric arc is ignited between a tungsten electrode and the metal workpiece. The welding area is shielded by a stream of inert gas to prevent contamination of the tungsten, molten pool and welding area. When the TIG arc is ignited, the inert gas is ionised and superheated, changing its molecular structure and converting it into a plasma stream. This plasma stream, which flows between the tungsten and the workpiece, is the TIG arc and can reach temperatures of up to 19,000 °C. It is a very pure and concentrated arc that allows controlled melting of most metals into a weld pool. TIG welding offers the user maximum flexibility for welding a wide variety of materials, thicknesses and profiles. TIG direct current welding is also the cleanest welding process without sparks or spatter.

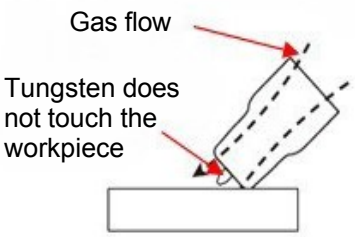


The intensity of the arc is proportional to the current flowing through the tungsten. The welder regulates the welding current to adjust the power of the arc. Thin material usually requires a weaker arc with less heat to melt the material, so less current (amps) is needed; thicker material requires a stronger arc with more heat, so more current (amps) is needed to melt the material.

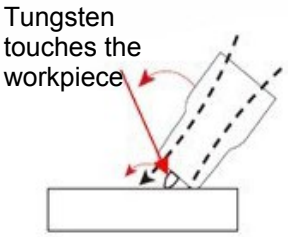


Lift arc ignition for TIG welding

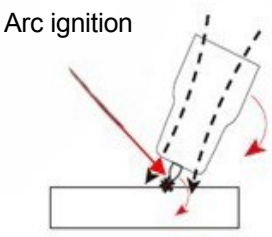
Lift arc ignition is an ignition method for welding arcs that uses low voltage and limited current to prevent contamination of the electrode. As soon as the machine detects a spark, it immediately increases the power and generates a stable arc. It is a cost-effective, safe alternative to high-frequency ignition and offers better control than the scratch start method.



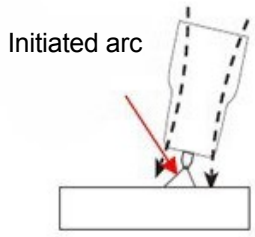
Place the nozzle on the workpiece without the tungsten touching the workpiece.



Swivel the torch sideways so that the tungsten touches the workpiece and hold it briefly.

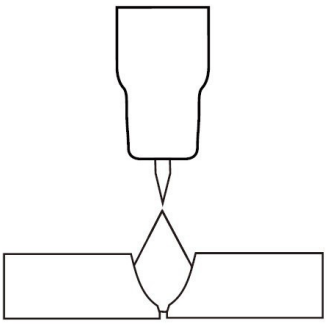


Tilt the torch in the opposite direction; the arc will ignite when the tungsten lifts off.

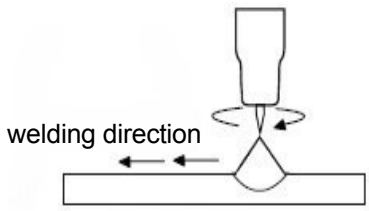


Raise the torch to maintain the arc.

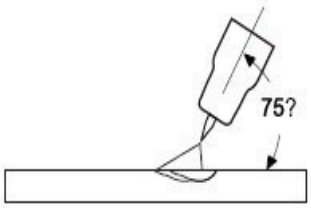
6.3.3 TIG welding Fusion technology



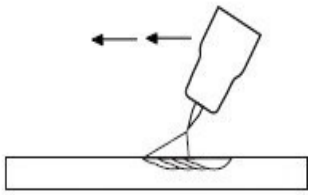
Manual TIG welding is considered the most demanding welding process, as the welder must maintain a short arc length to prevent contact between the electrode and the workpiece. It requires skill and the use of both hands: one hand guides the filler wire into the weld pool, while the other operates the welding torch. For certain welds, such as those on thin materials, no filler material is required. This process is called fusion welding, in which the metal edges are fused together solely by the heat of the arc.



Weld pool formation

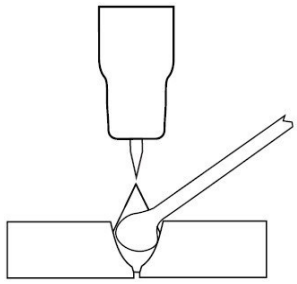


Torch angle

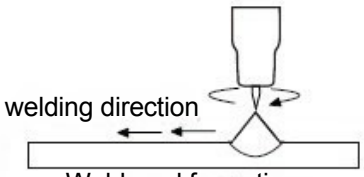


Guide the torch slowly and steadily

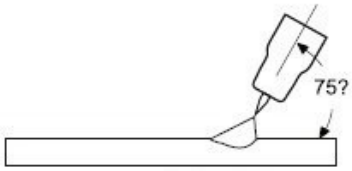
6.3.4 TIG welding with flux-cored wire



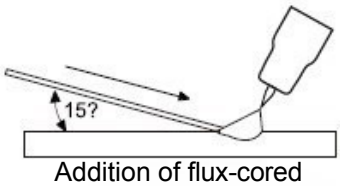
In TIG welding, a filler wire is often introduced into the weld pool to reinforce the weld seam. After igniting the arc, the tungsten tip of the torch is held in place until a weld pool is formed. A circular movement of the torch aids the formation of the weld pool. The torch is then guided along the seam at an angle of approximately 75°, while the filler wire is fed at an angle of approximately 15° at the leading edge of the weld pool. The arc melts the wire as the torch is moved forward. The wire feed can be controlled by repeatedly inserting and withdrawing it ("dabbing"). It is important that the molten wire end remains in the shielding gas to prevent oxidation and contamination.



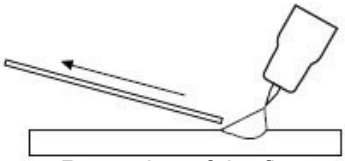
Weld pool formation

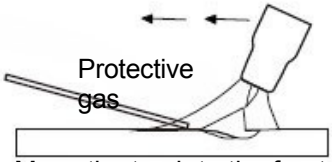


Torch angle

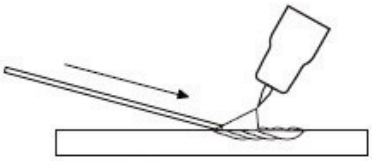


Addition of flux-cored wire


Retraction of the flux-cored wire



Move the torch to the front of the weld pool


Repeat the process

6.3.5 Tungsten electrodes

Tungsten is a rare metallic element used in the manufacture of TIG welding electrodes. The TIG process relies on the hardness and high-temperature resistance of tungsten to conduct the welding current to the arc. Tungsten has the highest melting point of any metal, at 3,410°C. They are made from pure tungsten or an alloy of tungsten and other rare earth elements and are available in a variety of sizes. Choosing the right tungsten depends on the material being welded, the amperages required, and whether you are welding with alternating or direct current. Tungsten electrodes are colour-coded at the end for easy identification.

Thorium (RED) 

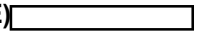
Thoriated tungsten electrodes (AWS classification EWTh-2) contain at least 97.30% tungsten and 1.70 to 2.20% thorium and are referred to as 2% thoriated. They are the most commonly used direct current electrodes today and are preferred for their durability and ease of use. However, thorium poses a low-level radioactive hazard, so many users have switched to other alternatives. In terms of radioactivity, thorium is an alpha emitter, but when enclosed in a tungsten matrix, the risks are negligible. Thorium-containing tungsten should not come into contact with open cuts or wounds. The greater danger to the welder is if thorium oxide enters the lungs. This can happen through exposure to fumes during welding or through ingestion of material/dust when grinding the tungsten. Follow the manufacturer's warnings and instructions, as well as the Material Safety Data Sheet (MSDS).

Cerium oxide (ORANGE) 

Cerium oxide tungsten electrodes (AWS classification EWCe-2) contain at least 97.30% tungsten and 1.80 to 2.20% cerium and are designated as containing 2% cerium oxide. Cerium oxide tungsten electrodes are best suited for DC welding at low current settings and have excellent arc starts at low amperages and are used in applications such as orbital pipe welding and thin sheet metal work. They are best suited for welding carbon steel, stainless steel, nickel alloys and titanium and can in some cases replace 2% thoriated electrodes. Cerium tungsten is best suited for lower currents and should last longer than thoriated tungsten. For higher current applications, thoriated or lanthanated tungsten should be used.

Lanthanate (GOLD) 

Lanthanated tungsten electrodes (AWS classification EWLa-1.5) contain at least 97.80% tungsten and 1.30 to 1.70% lanthanate and are designated as 1.5% lanthanated. These electrodes have excellent arc ignition, low burn rate, good arc stability and excellent re-ignition properties. Lanthanated tungsten also has the same conductivity properties as 2% thoriated tungsten. Lanthanated tungsten electrodes are ideal if you want to optimise your welding capabilities. They are well suited for use with negatively polarised AC or DC pointed electrodes, or can be formed into balls for use with AC sine wave power sources. Lanthanated tungsten maintains its sharp tip well, which is advantageous when welding steel and stainless steel with direct or alternating current from square wave power sources.

Zirconium oxide (WHITE) 

Tungsten electrodes with zirconium oxide coating (AWS classification EWZr-1) contain at least 99.10% tungsten and 0.15 to 0.40% zirconium oxide. Tungsten with zirconium oxide is most commonly used for alternating current welding and produces a very stable arc and is resistant to tungsten spatter. It is ideal for alternating current welding as it retains a ball tip and has high resistance to contamination. Its current carrying capacity is equal to or greater than that of thoriated tungsten. Tungsten with zirconium oxide is not recommended for direct current welding.

E3 (PURPLE)

E3 tungsten electrodes (AWS classification EWG) contain at least 98% tungsten and up to 1.5% lanthanum, as well as small amounts of zirconium and yttrium, and are referred to as E3 tungsten. E3 tungsten electrodes offer conductivity similar to that of thoriated electrodes. This generally means that E3 tungsten electrodes are interchangeable with thoriated electrodes without changing the welding process. E3 electrodes offer better arc ignition, longer electrode life and better value for money. When comparing E3 tungsten electrodes with 2% thoriated tungsten, E3 requires less regrinding and offers a longer overall service life. Tests have shown that ignition actually improves ignition delay with E3 tungsten electrodes over time, while 2% thoriated tungsten deteriorates after only 25 ignitions. At the same energy output, E3 tungsten electrodes run cooler than 2% thoriated tungsten, extending the overall life of the tip. E3 tungsten electrodes work with both alternating and direct current. They can be used as a DC electrode, positive or negative, with a pointed tip, or bundled for use with alternating current sources.

Rating for welding currents with tungsten electrodes

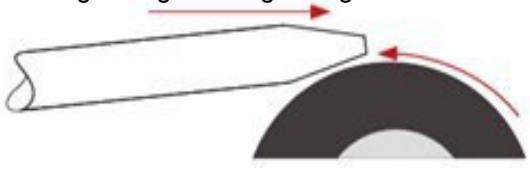
Tungsten Ø (mm)	DC current (A) Negative torch 2% thoried	AC current (A) Unbalanced wave 0.8% zirconium-coated	AC current (A) Balanced shaft 0.8% zirconium
1.0	15	15	20-60
1.6	70-150	70-150	60-120
2.4	150-250	140-235	100-180
3.2	250-400	225-325	160-250
4	400-500	300-400	200-320

6.3.6 Tungsten preparation

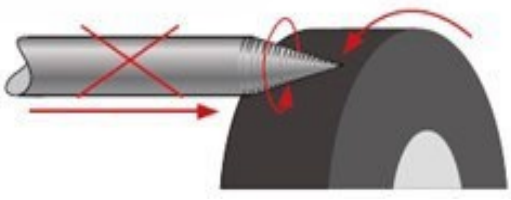
Always use diamond-coated grinding discs for grinding and cutting. Although tungsten is a very hard material, the surface of a diamond disc is even harder, ensuring a smooth grinding process. Grinding without diamond discs, such as aluminium oxide discs, can result in jagged edges, unevenness or poor surface finish, which is not visible to the naked eye but contributes to irregularities and defects in the weld.

Always ensure that the tungsten is ground lengthwise on the grinding wheel. Tungsten electrodes are manufactured with the molecular structure of the grain in a lengthwise direction, so grinding in a crosswise direction
Grind "against the grain". When electrodes are ground crosswise, the electrons have to jump over the grinding marks and the arc can start in front of the tip and wander. When grinding lengthwise with the grain, the electrons flow evenly and easily to the end of the tungsten tip. The arc starts straight and remains narrow, concentrated and stable.

Longitudinal grinding on the grinding wheel



Do not grind across the grinding wheel



Electrode shape and angle

The shape of the tungsten electrode tip is an important process variable in precision arc welding. Choosing the right size for the tip and flat spot strikes a balance between various advantages. The larger the flat spot, the more likely the arc is to wander and the more difficult it is to start the arc. However, increasing the flat spot to the maximum level that still allows arc starting and prevents arc wandering improves weld penetration and increases electrode life. The inclusion angle determines the shape and size of the weld bead. In general, as the inclusion angle increases, the penetration depth increases and the bead width decreases.

Some welders still grind the electrodes to a sharp point, which makes it easier to ignite the arc. However, they risk reduced welding performance due to melting at the tip.

Inclusion angle/cone of the electrode – direct current welding

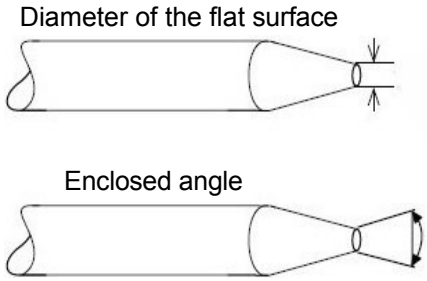
Tungsten electrodes for direct current welding should be ground to a specific inclusion angle in conjunction with tip/face preparation in a longitudinal direction and concentrically with diamond discs. Different angles produce different arc shapes and offer different welding capabilities.

Blunter electrodes with a larger inclusion angle offer:

- a longer holding time
- better penetration of the weld seam
- a narrower arc shape
- can handle higher currents without eroding

Sharper electrodes with a smaller included angle offer:

- less arc welding
- a wider arc
- a more uniform arc



Tungsten Ø [mm]	Tip Ø [mm]	Constant included angle - [degrees]	Current range [Amps]	Pulsating current range [Amps]
1.0	.250	20	05 - 30	05 - 60
1.6	,500	25	08 - 50	05 - 100
1.6	.800	30	10 - 70	10 - 140
2.4	.800	35	12 - 90	12 - 180
2.4	1,100	45	15 - 150	15 - 250
3.2	1,100	60	20 - 200	20 - 300
3.2	1,500	90	25 - 250	25 - 350

6.4 MIG- e welding

6.4.1 Setup and installation

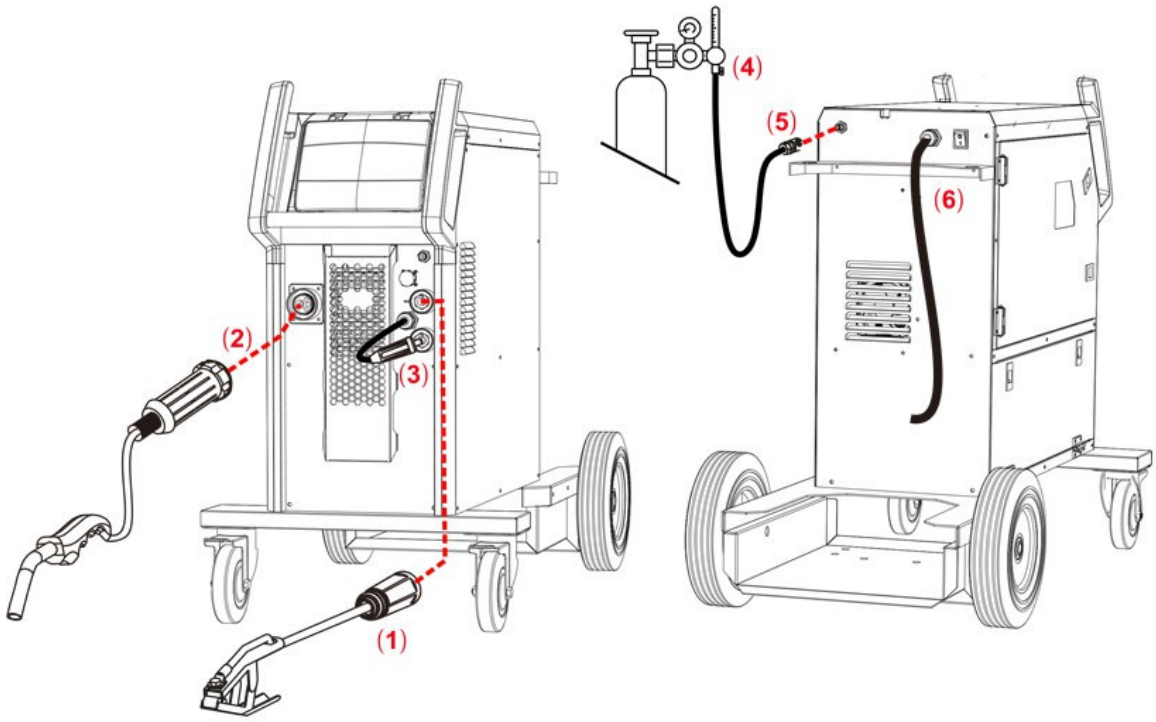
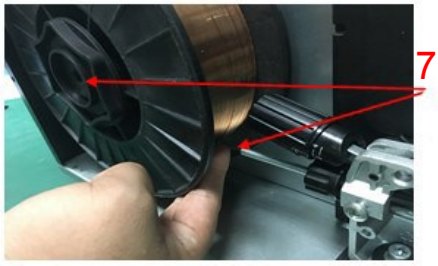


Fig. 6-5: Setup and installation of MIG welding machine

1. A - Plug the earth cable connector into the negative (-) socket and tighten it.
   B - Plug the earth cable connector into the positive (+) socket and tighten it.
2. Plug the MIG welding gun into the MIG torch Euro connection on the front panel and tighten the lock nut securely.
3. A - Plug the polarity switch cable connector into the positive socket on the front of the machine and tighten it.
   B - Plug the polarity switch cable connector into the negative (-) socket on the front of the machine and tighten it.
4. Connect the gas regulator to the gas cylinder and connect the gas line to the regulator.
5. Connect the gas pipe to the gas connection on the back of the appliance.
6. Connect the welding machine's power cord to the power outlet.
7. Place the wire on the spool holder (the spool holder nut is left-handed). Feed the wire through the inlet guide tube onto the drive roller.
8. Guide the wire over the drive roller into the outlet guide wire tube and push it through 150 mm.
9. Close the upper roller holder and snap the pressure arm into place with moderate pressure.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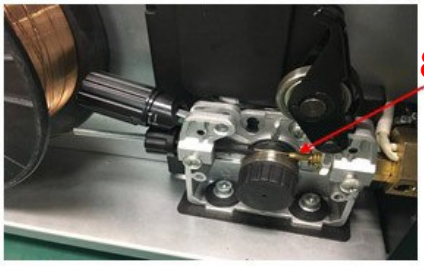
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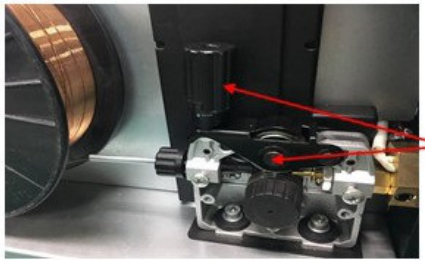
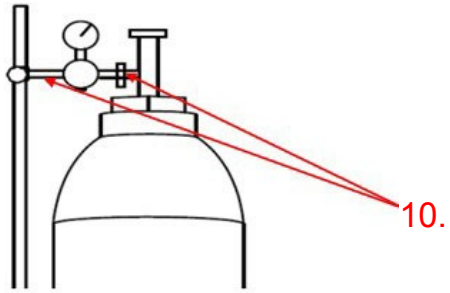




10. Carefully open the valve on the gas cylinder and set the desired gas flow rate. 11. Remove the gas nozzle and contact nozzle from the torch neck.

12. Press and hold the manual wire button to feed the wire through the burner neck; release the manual wire button when the wire emerges from the burner neck.
13. Insert the correct size contact nozzle and feed the wire through it, screw the contact nozzle into the nozzle holder on the torch neck and clamp it tight.
14. Place the gas nozzle on the burner head.
15. Carefully open the gas cylinder valve and set the desired gas flow rate on the regulator.
16. Select the desired MIG function and select the programme number according to the wire diameter and the type of gas used, as shown on the display.
17. Select the torch switch mode: 2T/ 4T/ spot welding.
18. Set the required welding parameters according to the thickness of the material to be welded.

6.4.2 Selection of wire feed rollers

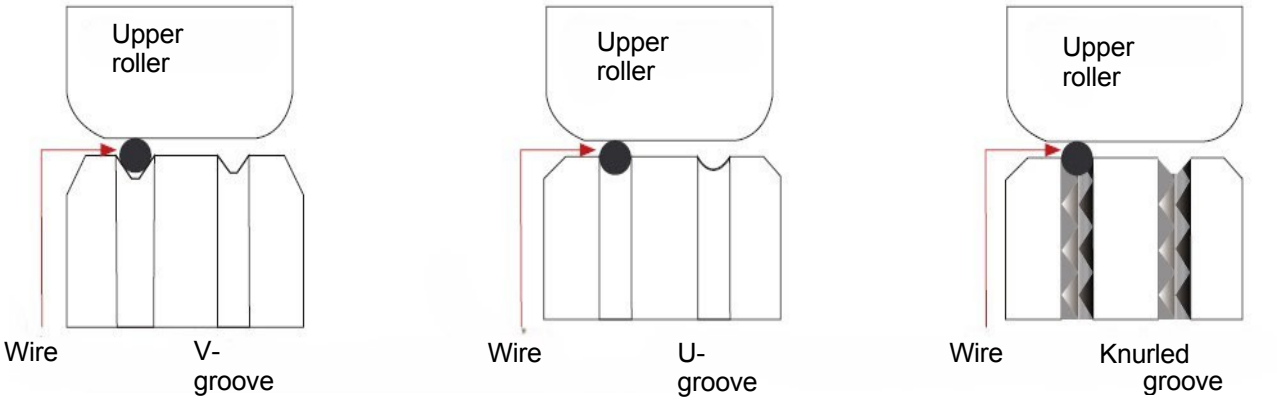
A consistent wire feed is extremely important in MIG welding. The more consistent the wire feed, the better the weld seam.

Feed rollers or drive rollers are used to mechanically guide the wire through the length of the welding gun cable. The feed rollers are designed for specific types of welding wire and have different grooves that are suitable for the different types of wire. The wire is held in the groove by the upper roller of the wire drive unit, known as the pressure roller; pressure is applied by a tension arm that can be adjusted to increase or decrease the pressure as required. The type of wire determines how much pressure can be applied and which type of drive roller is best suited to achieve optimum wire feed.

Hard solid wires, such as steel and stainless steel, require a drive roller with a V-shaped groove for optimum grip and drive. With solid wires, the upper pressure roller that holds the wire in the groove can exert more tension on the wire, and the V-shaped groove is better suited for this purpose. Solid wires are easier to transport due to their higher cross-sectional strength; they are stiffer and do not bend as easily.

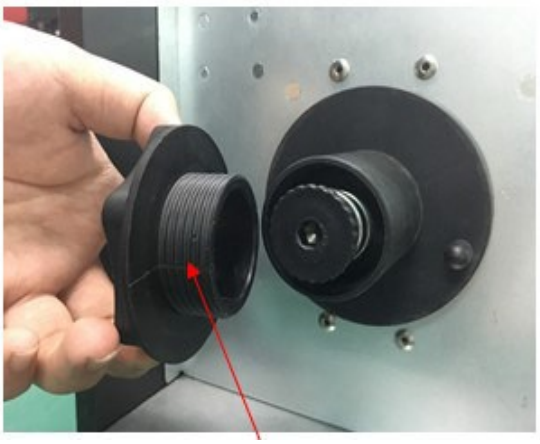
Soft wires, such as aluminium, require a U-shaped groove. Aluminium wire has a much lower column strength, can bend easily and is therefore more difficult to feed. Soft wires can easily bend at the wire feed when the wire is inserted into the torch inlet guide tube. The U-shaped roller provides a larger gripping surface and traction to feed the softer wire. Softer wires also require less tension on the upper pressure roller to prevent deformation of the wire; too much tension would push the wire out of shape and cause it to catch in the contact tip.

Flux-cored/gasless wire; These wires consist of a thin metal sheath coated with flux and metal compounds, which are then rolled into a cylinder to form the finished wire. The wire cannot withstand too much pressure from the top roller, as it can be crushed and deformed if the pressure is too high. A knurled V-drive roller has been developed that has small serrations in the groove. The serrations grip the wire and help to drive it without too much pressure from the top roller. The disadvantage of the knurled wire feed roller for cored wire is that, over time, it gradually wears away the surface of the welding wire, and these small pieces eventually end up in the liner. This leads to blockages in the sleeve and additional friction, which in turn causes problems with wire feeding. A U-groove wire can also be used for cored wire without the wire particles coming off the wire surface. However, it is assumed that the knurled roller allows for a more positive feed of the cored wire without deforming the wire shape.

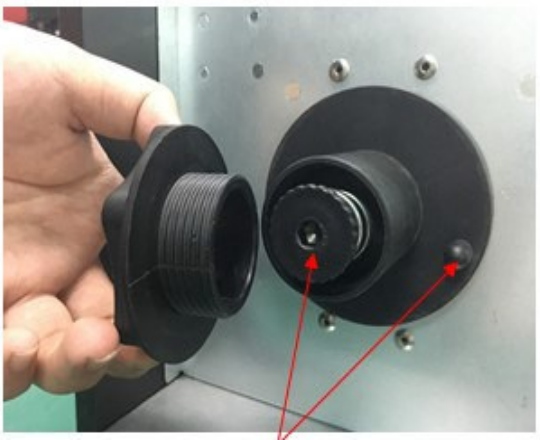


6.4.3 Installation and setup of wires/cables

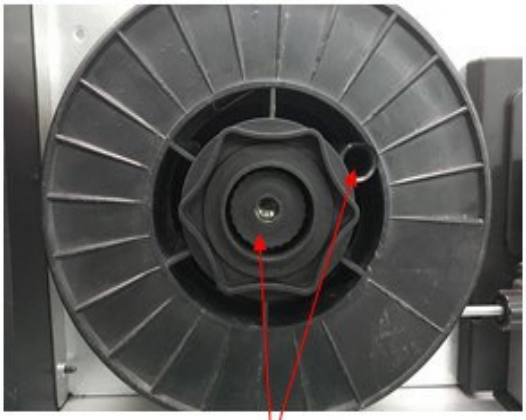
Correct installation of the wire spool and wire in the wire feed unit is crucial for smooth and consistent wire feed. A high percentage of faults in MIG welding machines are due to poor adjustment of the wire in the wire feed unit. The following instructions will help you to adjust your wire feed correctly.



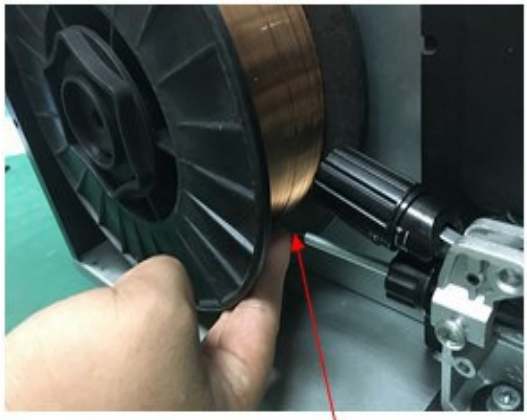
1. Remove the fastening nut



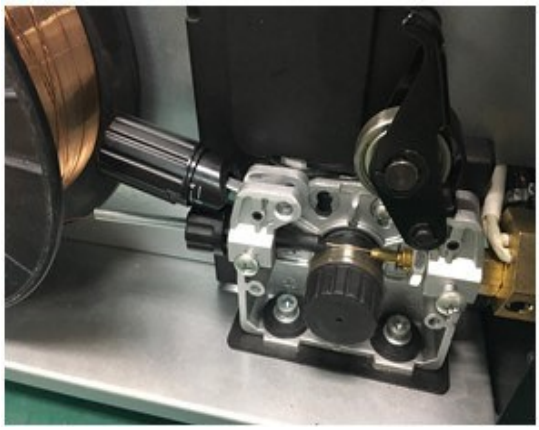
2. Pay attention to the tension spring adjuster and coil fixing pin



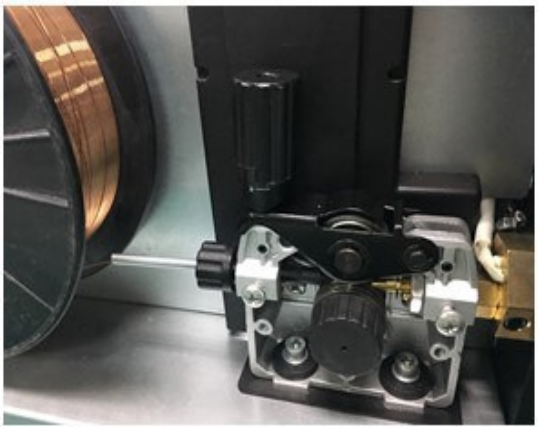
3. Place the wire spool on the spool holder and insert the dowel pin, then secure the spool with the fastening nut.



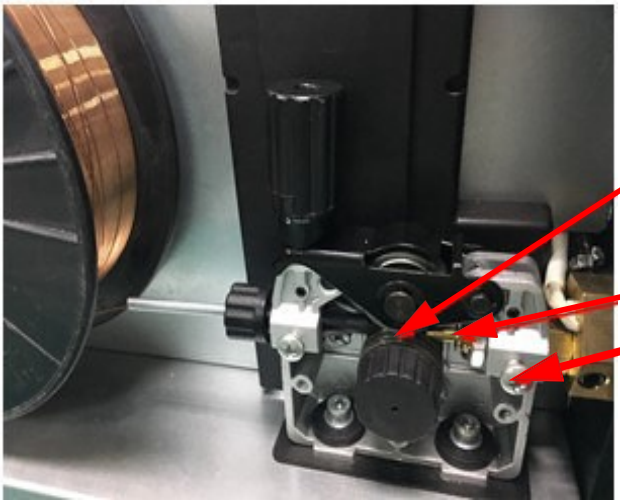
4. Carefully cut the wire, making sure that the coil does not unwind. Carefully insert the wire into the inlet guide tube of the wire feed unit.



5. Guide the wire through the drive roller and into the outlet guide tube of the wire feed.

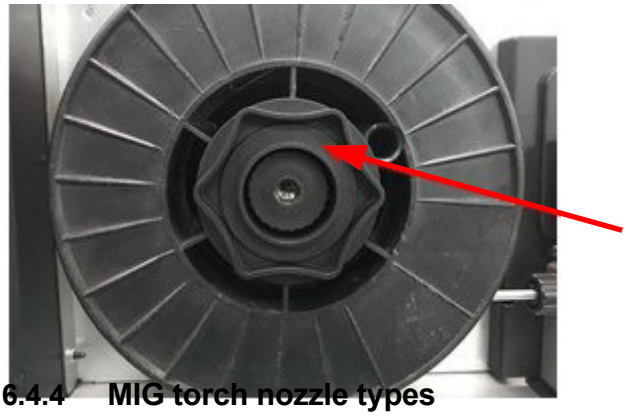


6. Lock the upper pressure roller and apply medium pressure using the tension regulator.



7. Check that the cable runs through the centre of the outlet guide tube without touching the sides. Loosen the locking screw and then the locking nut on the outlet guide tube to make any necessary adjustments. Carefully tighten the locking nut and screw again to secure the new position.

8. A simple method to check the correct tension of the drive is to bend the end of the wire and hold it about 100 mm away from your hand and let it run into your hand. It should roll up in your hand without stopping and slipping on the drive rollers. Increase the tension if it slips.



9. The weight and speed of the rotating wire spool create inertia, which can cause the spool to continue running and the wire loop to run over the side of the spool and become tangled. If this happens, increase the pressure on the tension spring inside the spool holder using the tension screw.

6.4.4 MIG torch nozzle types

MIG torch liners

The liner is one of the simplest yet most important components of a MIG gun. Its sole purpose is to guide the welding wire from the wire feeder through the gun cable to the contact tip.

Steel liners

Most MIG wire feeders consist of coiled steel wire, also known as piano wire, which gives the wire feeder good rigidity and flexibility and allows the welding wire to feed smoothly through the welding cable as it bends during operation. Steel wire feeders are mainly used for feeding solid steel wire. Other wires such as aluminium, silicon bronze, etc. work better with a Teflon or polyamide cable. The inner diameter of the wire guide is important and depends on the wire diameter used. The correct inner diameter supports smooth feeding and prevents the wire from kinking or tangling on the drive rollers. If the cable is bent too much during welding, the friction between the wire guide and the welding wire increases, making it more difficult to push the wire through the wire guide, resulting in poor wire feeding, premature wear of the wire guide and tangles. Dust, dirt and metal particles can accumulate inside the liner over time, causing friction and blockages. It is recommended to blow out the liner regularly with compressed air. Small diameter welding wires (0.6 - 1.0 mm) have relatively low column strength and, when used with an oversized liner, can cause the wire to wander or drift within the liner. This in turn leads to poor wire feeding and premature liner failure due to excessive wear. In contrast, welding wires with a larger diameter of 1.2 - 2.4 mm have much higher column strength, but it is important to ensure that the liner has a sufficient internal diameter. Most manufacturers produce liners that are sized to match the wire diameter and length of the welding torch cable, and most are colour-coded accordingly.

Steel linings

Blue 0.6 - 0.8 mm

Red 0.9 - 1.2 mm

Yellow 1.6 mm

Green 2.0 - 2.4 mm

Teflon and polyamide (PA) intermediate layers

Teflon liners are well suited for feeding soft wires with low column strength, such as aluminium wires. The inside of these liners is smooth and ensures stable feeding, especially for small-diameter welding wires. Teflon is well suited for higher heat applications where water-cooled torches and brass liners are used. Teflon has good abrasion resistance properties and can be used with a variety of wire types such as silicon bronze, stainless steel and aluminium. It should be noted that the end of the welding wire must be carefully checked before it is inserted into the sleeve. Sharp edges and burrs can damage the inside of the liner, leading to blockages and accelerated wear. Polyamide (PA) liners are made of carbon-infused nylon and are ideal for softer aluminium and copper alloy welding wires, as well as push-pull torch applications. These sleeves are typically equipped with a floating collet to allow the sleeve to be inserted up to the feed rollers.

Teflon linings

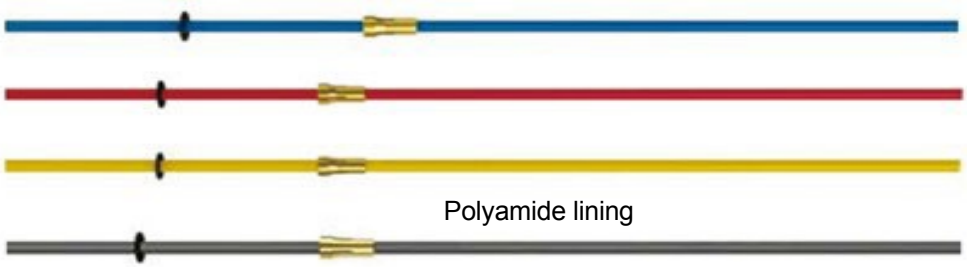
Blue 0.6 - 0.8 mm

Red 0.9 - 1.2 mm

Yellow 1.6 mm

Polyamide lining

Black 1.0 - 1.6 mm



Copper-brass neck pieces

In high-heat applications, attaching brass or copper bridging to the end of the liner increases the working temperature of the liner and improves the electrical conductivity of the welding current transfer to the wire. It is recommended for all aluminium and silicon bronze welding applications.

6.4.5 Torch and wire feed setup for aluminium wire

The same process is used for Teflon and/or polyamide (PA) liners.

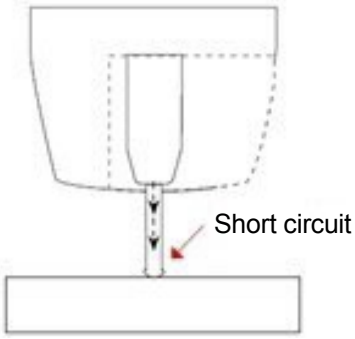
6.4.6 MIG welding

Definition

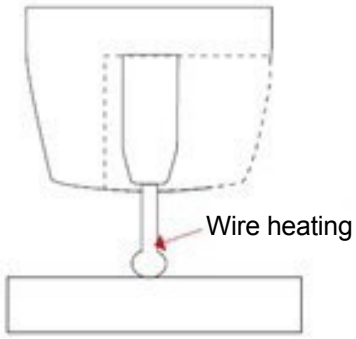
MIG (metal inert gas) welding, also known as GMAW (gas metal arc welding) or MAG (metal active gas welding), is a semi-automatic or automatic arc welding process in which a continuous, consumable wire electrode and a shielding gas are fed through a welding gun. MIG welding typically uses a direct current source with constant voltage. There are four main methods of metal transfer in MIG welding: short circuit transfer (also known as submerged transfer), globular transfer, spray transfer and pulsed spray transfer, each of which has different characteristics and corresponding advantages and limitations.

short-circuit transmission

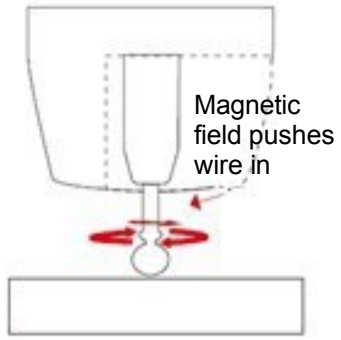
Short-circuit transfer is the most commonly used method, in which the wire electrode is continuously fed through the welding torch to the current nozzle and out of it. The wire touches the workpiece and causes a short circuit. The wire heats up and begins to form a molten bead, which detaches from the end of the wire and forms a drop that is transferred into the weld pool. This process is repeated about 100 times per second, making the arc appear constant to the human eye.



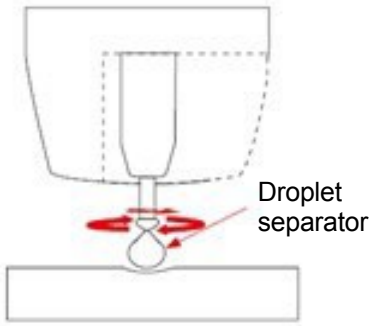
The wire touches the workpiece, causing a short circuit. Since there is no gap between the wire and the base metal, no electric arc is formed.



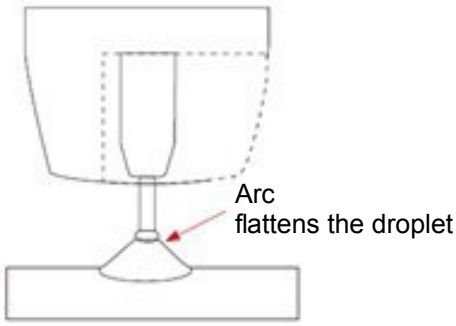
The wire cannot withstand the flow of current, so resistance builds up and the wire begins to melt.



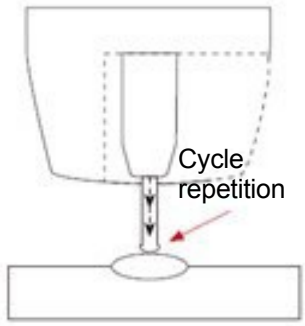
The current flow creates a magnetic field that begins to crush the molten wire and causes it to form droplets.



The squashing separates the forming drop, which falls towards the weld pool that is now forming.



An arc is created at the point where the drop is separated, and its heat and force flatten the drop into the weld pool.



The wire feed speed overcomes the heat of the arc and the wire approaches the workpiece again to create a short circuit and repeat the cycle.

Basics of MIG welding

Good welding quality and a good weld profile depend on the angle of the welding gun, the direction of movement, the electrode extension (stick out), the speed of movement, the thickness of the base metal, the wire feed speed and the arc voltage. Below are some basic tips to help you with the setup.

Gun position – direction of movement, working angle

The gun position or technique usually refers to how the wire is directed onto the base metal, as well as the angle and the chosen direction of movement. The travel speed and working angle determine the characteristics of the weld bead profile and the degree of penetration.

Pushing technique

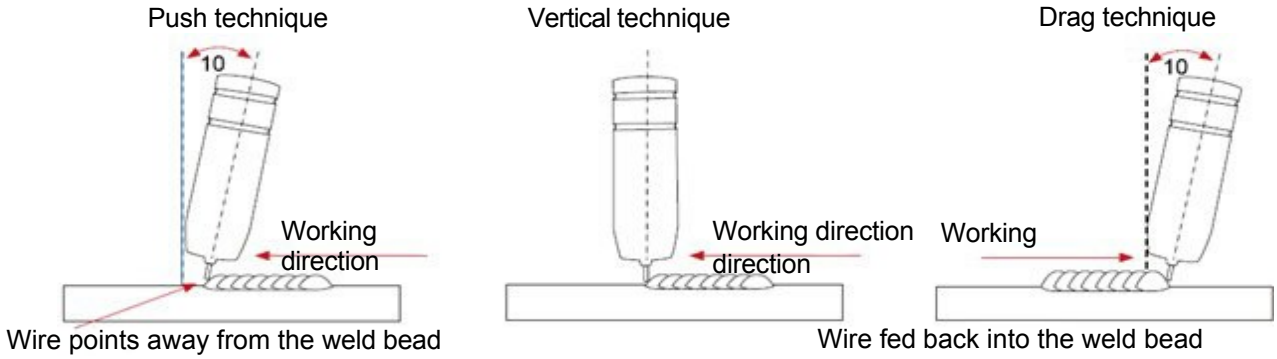
The wire is located at the front edge of the weld pool and is pushed towards the unmelted work surface. This technique provides a better view of the weld seam and the direction of the wire into the weld seam. With the push technique, the heat is directed away from the weld pool, which allows for a faster travel speed and results in a flatter weld profile with slight penetration – useful when welding thin materials. The weld seams are wider and flatter, which minimises cleaning and grinding time.

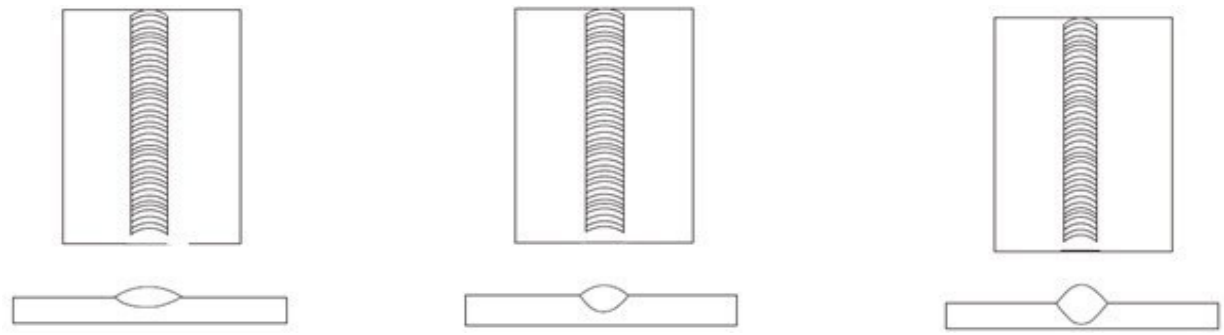
Vertical technique

The wire is fed directly into the weld seam. This technique is mainly used in automated situations or when conditions require it. The weld profile is generally higher and a deeper penetration is achieved.

Trailing technique

The gun and wire are pulled away from the weld bead. The arc and heat are concentrated on the weld pool, the base metal is heated more intensely, melts deeper, penetrates deeper and the weld profile is higher with a stronger fusion.





Flat, even weld profile with slight penetration.

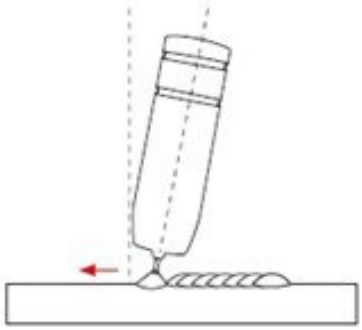
Narrower weld profile, even penetration.

Narrow, higher weld profile, greater penetration depth.

Travel angle

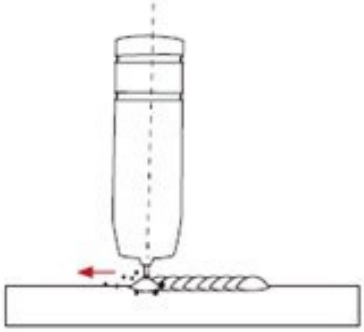
The travel angle is the angle from right to left in relation to the welding direction. A travel angle of 5° ~ 15° is ideal and allows good control over the weld pool. A travel angle of more than 20° leads to an unstable arc with poor transition of the weld metal, lower penetration, heavy spatter, poor shielding gas and poor weld seam quality.

Angle 5° - 15°



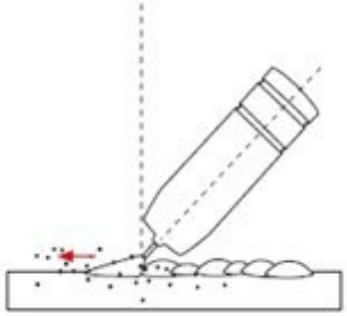
Good control over the weld pool, even with flat welds.

Angle too small



Less control over the weld pool, more spatter.

Angle greater than 20°

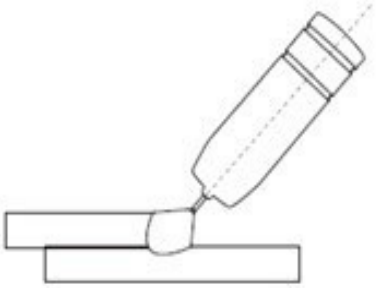


Poor control, unstable arc, low penetration, many spatters.

Working angle

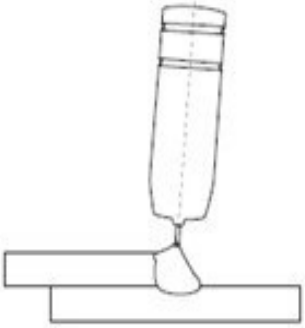
The working angle is the forward-backward angle of the gun in relation to the workpiece. The correct working angle ensures a good bead shape and prevents undercuts, uneven penetration, poor shielding gas and poor quality of the finished weld seam.

Correct angle



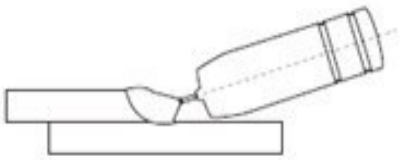
Good control over the weld pool, even with flat weld seams.

Insufficient angle



Less control over the weld pool means more spatter.

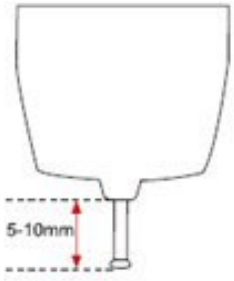
Excessive angle

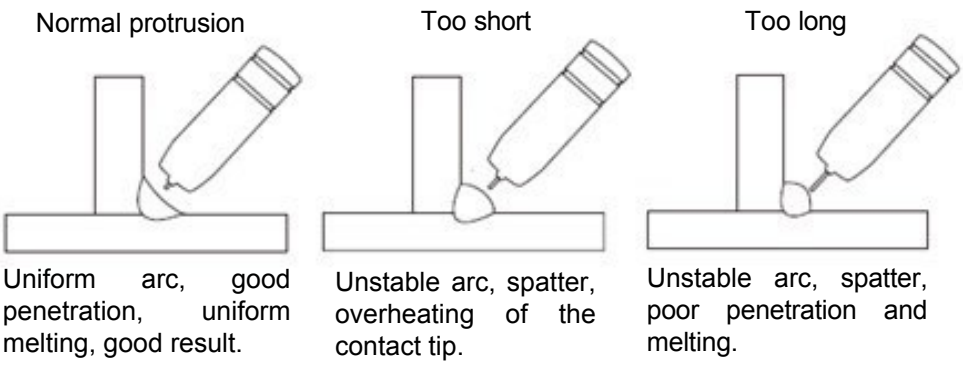


Poor control, unstable arc, low penetration, lots of spatter.

Overhang

The stick-out length is the length of the unmelted wire protruding from the end of the contact tip. A constant, uniform stick-out of 5–10 mm produces a stable arc and an even current flow, enabling good penetration and uniform fusion. A protrusion that is too short causes an unstable weld pool, produces spatter and overheats the current nozzle. A protrusion that is too long leads to an unstable arc, poor penetration, poor melting and increased spatter.



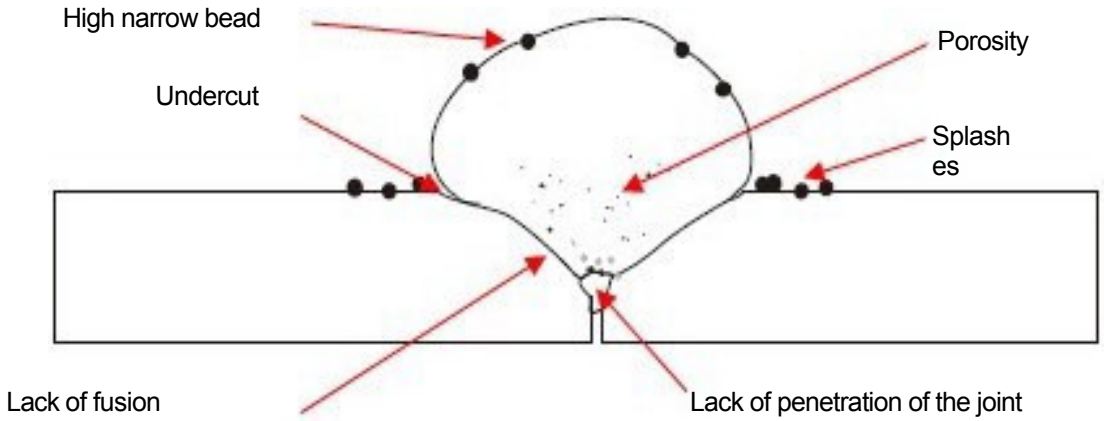


Travel speed

The travel speed is the speed at which the tongs are moved along the weld seam and is usually measured in inches per minute (IPM). The travel speed can vary depending on the conditions and the skills of the welder and is limited by the welder's ability to control the weld pool. The push technique allows for faster travel speeds than the drag technique. The gas flow must also correspond to the travel speed, i.e. it must increase at faster travel speeds and decrease at slower speeds. The travel speed must correspond to the current strength and decreases with increasing material thickness and current strength.

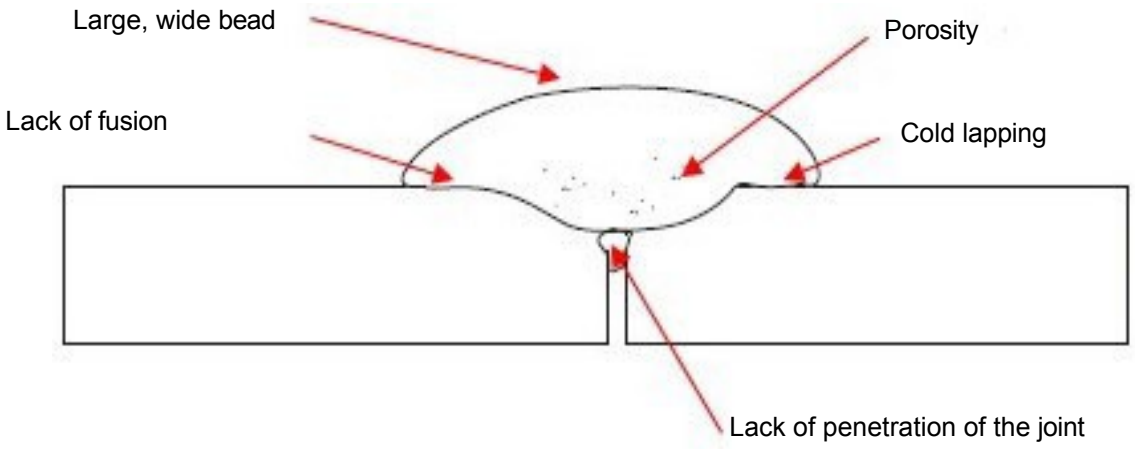
Travel speed too fast

An excessively high travel speed generates too little heat per mm of travel, resulting in reduced penetration and a smaller weld seam; the weld bead solidifies very quickly and traps gases in the weld metal, leading to porosity. Undercutting of the base material can also occur, and an unfilled groove is created in the base material if the travel speed is too high for the molten metal to flow into the weld crater created by the heat of the arc.



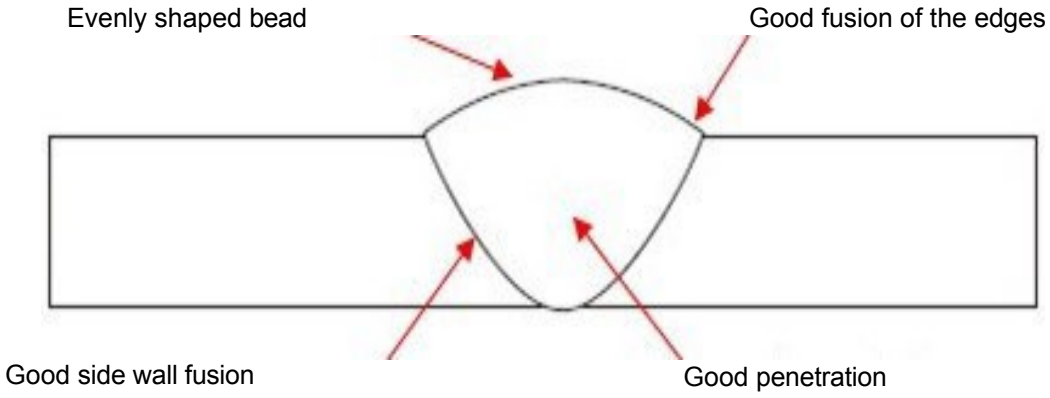
Travel speed too slow

Travel speed too slow - A travel speed that is too slow results in a large weld seam with insufficient penetration and fusion. The energy of the arc remains on the weld pool and does not penetrate the base metal. This results in a wider weld bead with more weld metal deposited per mm than necessary, resulting in poor quality weld metal.



Correct travel speed

The correct travel speed keeps the arc at the front edge of the weld pool so that the base material can melt sufficiently to produce good penetration, melting and wetting of the weld pool and thus a good quality weld metal.

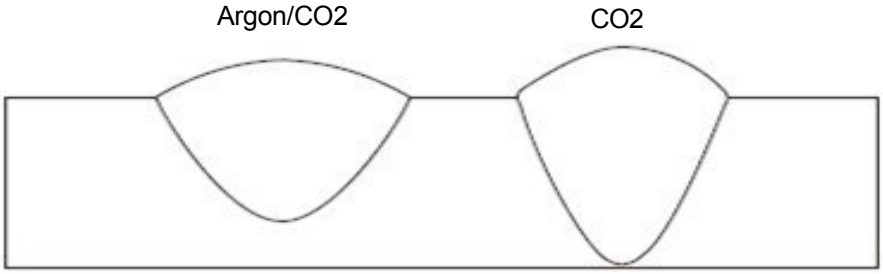


Gas selection

The purpose of the gas in the MIG process is to protect the wire, the arc and the molten weld metal from the atmosphere. Most metals react with the air in the atmosphere when heated to a molten state. Without the protection of the shielding gas, the weld seam produced would not be of good quality, with porosity, lack of fusion and slag inclusions.

The correct gas flow is also very important to protect the welding zone from the atmosphere.

Use the correct shielding gas. CO2 is well suited for steel and provides good penetration; the weld profile is narrower and slightly more raised than that achieved with argon/CO2 mixed gas. The argon-CO2 gas mixture (80% argon & 20% CO2) offers better weldability with thin metals and has a wider tolerance range when adjusting the machine.



Argon gas in a 100% mixture is well suited for aluminium and silicon bronze applications. It offers good penetration and weld seam control. CO2 is not recommended for these metal alloys.

Wire types and sizes

Use the correct wire type for the base metal being welded. Use stainless steel wire for stainless steel, aluminium for aluminium and steel wires for steel.

Use a smaller diameter wire for thin base metals. For thicker materials, use a larger wire diameter and a larger machine; check the recommended welding power for your machine. The table below, "Welding wire thicknesses", serves as a guide.

Welding wire thicknesses Diameter [mm]					
Material thickness	**Preferred welding wire thickness Ø**				
	0.8	0.9	1	1.2	1.6
0.8	X				
0.9	X				
1.0	X	X			
1.2	X	X			
1.6	X	X			
2.0	X	X	X		
2.5	X	X	X	X	
3.0	X	X	X	X	X
4.0	X	X	X	X	X
5.0	X	X	X	X	X
6.0	X	X	X	X	X
8.0		X	X	X	X
10			X	X	X
14			X	X	X
18				X	X
22					X
					X
For material thicknesses of 5.0 mm and above, depending on the amperage of your welding machine, several passes or a bevelled joint construction may be necessary.					

6.5 Spool Gun

6.5.1 Setup and installation

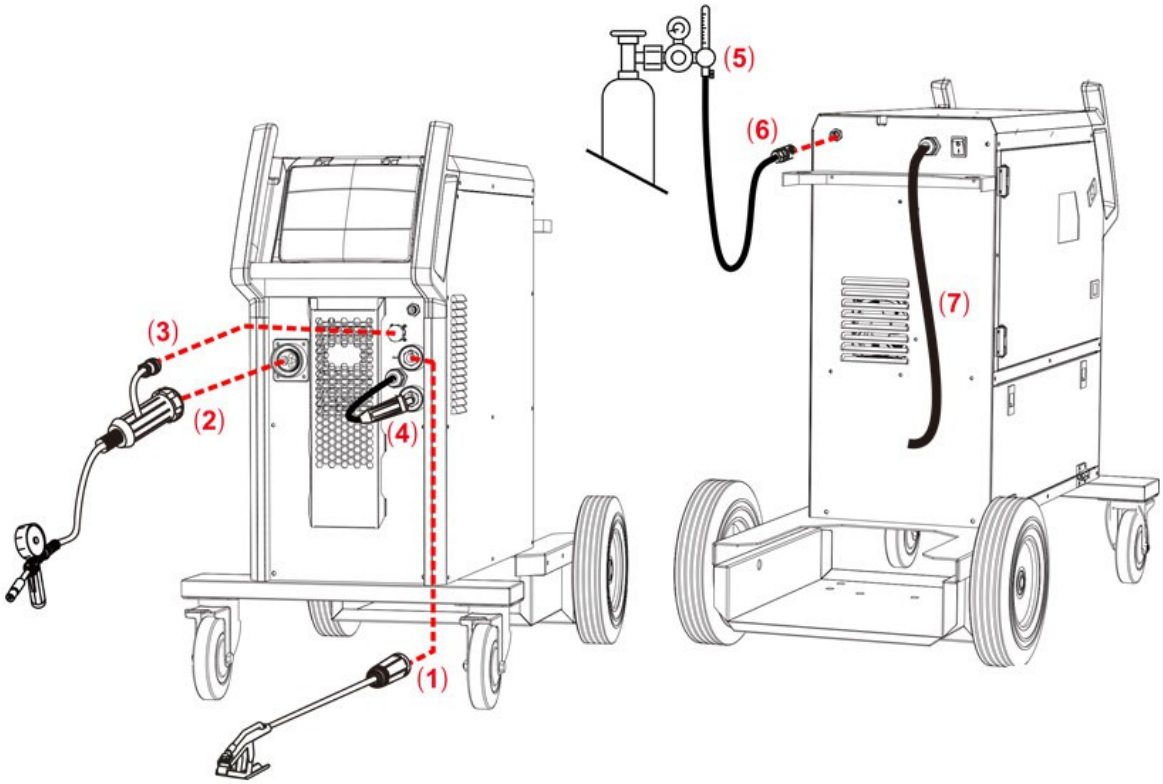
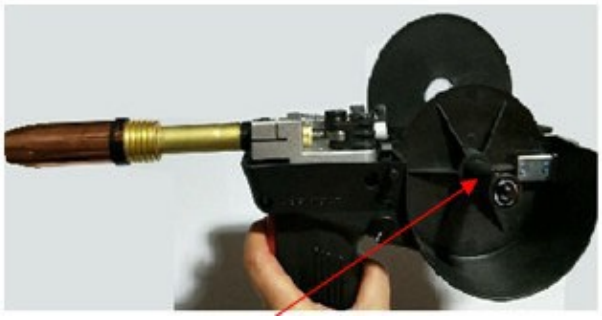


Fig. 6-6: Installation and setup of the spool gun

1. Plug the ground cable connector into the negative (-) socket on the front of the unit and tighten it securely.
2. Insert the spool gun into the Euro Connect socket on the front and tighten it.
   WARNING
   When connecting the torch, ensure that you tighten the union nut completely. A loose connection can cause arcing between the gun and the machine connection, which can severely damage both the torch and the machine connections.
3. Connect the spool gun control cable to the 9-pin socket on the front of the machine.
4. Plug the polarity switch cable connector into the positive socket on the front of the machine and tighten it.
5. Connect the gas regulator to the gas cylinder and connect the gas line to the regulator.
6. Connect the gas line to the gas connection on the rear of the unit.
7. Connect the power cord of the welding machine to the socket on the switch box.

8. Remove the coil cover by pressing and lifting the cover.

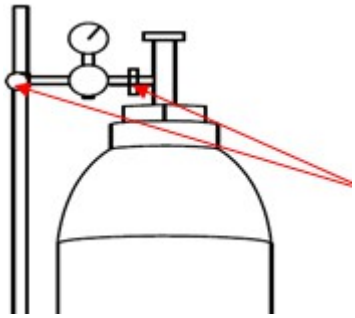


9. Place a wire spool in the spool holders on the post.

10. Feed the wire through the drive rollers and into the inlet guide tube. Tighten the wire tension lever.

11. Pull the trigger to push the wire down the neck until it emerges from the contact tip.

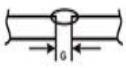
12. Select the MIG manual welding mode by pressing the welding process button and call up the function interface to set "SPOOL GUN" to "ON" by pressing the function button. Then set the welding parameters using the knobs and buttons.



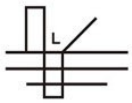
13. Carefully open the valve on the gas cylinder and set the desired gas flow rate on the regulator.

6.6 Welding parameters

Process reference for CO2 butt welding of solid low-carbon steel wire

	Material thickness [mm]	c-dimension G [mm]	Wire diameter [mm]	Welding current [A]	Welding voltage [V]	Welding speed [cm/min]	Gas flow [l/min]
Butt joint 	0.8	0	0.8	60	16-16.5	50	10
	1	0	0.8	75-85	17-17.5	50-60	10
	1.2	0	0.8	80-90	17-18	50-60	10-15
	2	0-0.5	1.0 / 1.2	110-120	19-19.5	45-50	10
	3.2	0-1.5	1.2	130-150	20-23	30-40	10-20
	4.5	0-1.5	1.2	150-180	21-23	30-35	10-20
	6	0	1.2	270-300	27-30	60-70	10
	6	1.2-1.5	1.2	230-260	24-26	40-50	15-20
	8	0-1.2	1.2	300-350	30-35	30-40	15-20
	8	0-0.8	1.6	380-420	37-38	40-50	15-20
	12	0-1.2	1.6	420-480	38-41	50-60	15

Process reference for CO2 corner welding of solid wire made of low-carbon steel

	Material thickness [mm]	Wire Ø [mm]	Welding current [A]	Welding voltage [V]	Welding speed [cm/min]	Gas flow [l/min]
Corner joint 	1.0	0.8	70	17-18	50	10-15
	1.2	1	85-90	18-19	50-60	10-15
	1.6	1.0/1.2	100-110	18-19.5	50-60	10
	1.6	1.2	120-130	19-20	40-50	10-20
	2.0	1.0/1.2	115-125	19.5-20	50-60	10-15
	3.2	1.0/1.2	150-170	21-22	45	15
	3.2	1.2	200-250	24-26	45-60	10
	4.5	1.0/1.2	180-200	23-24	40-45	15-20
	4.5	1.2	200-250	24-26	40-50	15-20
	6	1.2	220-250	25-27	35-45	15-20
	6	1.2	270-300	28-31	60-70	15-20
	8	1.2	270-300	28-31	60-70	15-20
	8	1.2	260-300	26-32	25-35	15-20
	8	1.6	300-330	25-26	30-35	15-20
	12	1.2	260-300	26-32	25-35	15-20
	12	1.6	300-330	25-26	30-35	15-20
	16	1.6	340-350	27-28	35-40	15-20
	19	1.6	360-370	27-28	30-35	15-20

6.7 operation Environment

▲ Altitude above sea level ≤1000 m.

▲ Operating temperature range 14 ~ 104°F (-10 ~ +40°C).

▲ Relative humidity is below 90%.

▲ Preferably, the machine should be placed at an angle of no more than 15° above the ground.

▲ Protect the machine from high humidity, water and direct sunlight.

▲ Ensure adequate ventilation during welding. There must be a clear space of at least 38 cm (1-1/2") between the machine and the wall.

6.7.1 Operating instructions

➔ Connect the grounding cable directly to the machine.

➔ Ensure that the input is single-phase: 50/60 Hz, 110/230 V ±10%.

➔ Before operation, ensure that no persons, especially children, are present in the work area. Do not look into the arc without protection.

➔ Ensure that the machine is well ventilated to improve operation.

➔ Switch off the motor after completing the operation to optimise energy consumption.

➔ If the switch shuts down due to a fault, do not restart it until the problem has been rectified. Otherwise, the problem will only get worse.

6.8 Scope of delivery

SYN-MIG 201-2 P	SYN-MIG 203-2	SYN-MIG 253-4
1x 3 m earth cable 16 mm²	1x 3 m earth cable 16 mm²	1x 3 m ground cable 25 mm²
1x pressure reducer	1x pressure reducer	1x pressure reducer
1x 4 m gas hose	1x 4 m gas hose	1x 4 m gas hose
1x 4 m MAG torch SMB 15	1x 4 m MAG torch SMB 15	1x 4 m MAG torch SMB 25

SYN-MIG 323-4	SYN-MIG 353-4 W	SYN-MIG 403-4 W
1x 3 m earth cable 25 mm²	1x 3 m earth cable 35 mm²	1x 3 m earth cable 35 mm²
1x pressure reducer	1x pressure reducer	1x pressure reducer
1x 4 m gas hose	1x 4 m gas hose	1x 4 m gas hose
1x 4 m MAG torch SMB 25	1x 4 m MAG torch SMB 400	1x 4 m MAG torch SMB 400

7 Care and maintenance of the welding machine

Regular and conscientious maintenance of the welding machine is a basic requirement for a long service life, good working conditions and maximum productivity of the welding machine. Ensure that maintenance work is carried out regularly.

Warning! Danger if persons are insufficiently qualified:

Insufficiently qualified persons cannot assess the risks to the user resulting from improper repair work on the welding machine and expose themselves and others to the risk of serious injury.

All maintenance work must only be carried out by qualified persons.

If maintenance and repair work on this device is carried out by persons who are not authorised to do so, the warranty claim against craftweld shall lapse.

Before performing any maintenance work, the welding machine must be switched off and left to cool down for at least 5 minutes.

NOTE:

Always disconnect the welding machine from the power supply before performing maintenance work or replacing components.

After cleaning, maintenance and repair work, check that all covers and protective devices are correctly refitted to the welding machine. Damaged protective devices and machine parts must be repaired or replaced by customer service.

7.1 Cleaning

- Unplug the power cord from the socket.
- Clean the outside of the welding machine with a dry cloth.

7.2 Maintenance table

The maintenance intervals are recommendations from Stürmer Maschinen GmbH for normal standard requirements (e.g. single-shift operation, use in a clean and dry environment). The exact intervals are determined by your safety officer.

ATTENTION:

Before servicing the welding machine, switch off the device and wait 5 minutes so that the voltage of the capacitors has dropped to a safe voltage of 36V!

Time (interval)	Maintenance work
Daily maintenance	Ensure that the buttons and switches on the front and rear of the welding machine are functional and correctly positioned. If a button or switch is defective, please contact our service department. After switching on the power supply, check whether the welding machine vibrates, whistles or emits a strange odour. If any of the above problems occur, find out the cause and rectify it. If you cannot find the reason, please contact our service department. Ensure that the LCD display is intact. If the display value is not intact, please adjust it. If it still does not work, service or replace the display board. Ensure that the min/max values on the LCD display match the set value. If there is a deviation and this affects normal welding results, correct it. Check whether the fan is damaged and whether it rotates normally. If the fan is damaged, please replace it immediately. If the fan does not rotate but starts up when the blades are turned towards the fan, the start unit should be replaced. Check whether the quick connectors are loose or overheated. If the welding machine has the above problems, they should be tightened or replaced. Check whether the power output cable is damaged. If it is damaged, it should be insulated or replaced.
Monthly maintenance	Use dry compressed air to clean the interior of the welding machine, especially for cleaning aluminium heat sinks, inductors, IGBT modules, diodes, PCBs, etc. Check the screw connections in the machine. If any are loose, please tighten them. Check all burners, grounding terminals and hose connections to ensure they are secure. Loose connections can lead to serious malfunctions.
Quarterly maintenance	Check that the actual current matches the displayed value. If they do not match, the values should be adjusted. The actual welding current value can be measured and adjusted using an ammeter.
Annual maintenance	Measure the insulation resistance between the main circuit, the circuit board and the housing. If it is less than 1 M, the insulation is probably damaged and must be replaced to reinforce the insulation.

8 Fault tables

ATTENTION:

Only qualified personnel may service and repair the welding machine! Always switch off the machine and wait 5 minutes before troubleshooting!

No.	Fault		Possible cause	Remedy
1	The device is switched on but the operating indicator is not lit.		Switch, fuse or power cord damaged.	Check and replace any defective parts.
2	The fan is not working.		Fan damaged. Cable loose.	Replace fan. Secure the cable.
3	No shielding gas is supplied when the pistol switch is activated.	No output gas with test gas	No gas in the gas cylinder.	Refill the gas.
			Gas is escaping from the gas hose.	Replace the hose.
			Damaged valve.	Replace valve.
		Output gas for test gas	Control switch damaged.	Repair control switch.
			Control circuit damaged.	Check circuit board.
4	Wire feed not working.	Wire spool not working.	Motor damaged.	Check and replace if necessary.
			Control circuit damaged.	Check the circuit board.
		Wire coils are working.	The deflection roller is loose.	Secure the pulley.
			Drive pulley fits does not to the diameter of the welding wire.	Roller or Replace the wire.
			Cable reel damaged.	Replace cable reel.
			Wire feed tube blocked.	Feed tube Clean or replace.
			Tip is stuck due splash water.	Repair or replace.
5	Arc does not ignite and no output voltage		Output cable incorr ectly connected or loose.	Correct and securely.
			Control circuit damaged.	Check control circuit.
6	Welding stops and alarm lights up.		Emergency stop.	Check the voltage, current, temperature.
7	Welding current decreases and cannot be regulated.		Potentiometer damaged.	Check and repair.
			Control circuit damaged.	Check circuit.
8	Peak current cannot be regulated.		Circuit board damaged.	Check circuit board.
9	No post-gas.		Circuit board damaged.	Check circuit board.

Troubleshooting table for MIG welding

No	Fault	Possible cause	Remedy
1	Excessive spatter	Wire feed speed Set too set too high.	Reduction the wire feed speed.
		Tension too high.	Reduce the voltage.
		Incorrect polarity set.	Select correct polarity for wire used. wire.
		Distance to workpiece.	Adjust the distance (5-10 mm to the welded part).
		Material being processed.	Removal of paint, grease and oil, including mill scale.
		Contaminated MIG wire	Use clean, dry and rust-free wire without adding oil or grease.
		Gas flow too weak or too strong.	Check the hoses, gas valve and torch for narrowing or blockages. Also check whether the above are correctly and tightly connected. Avoid draughts and wind.

No.	Fault	Possible cause	Remedy
2	Porosity Small cavities or holes caused by gas inclusions in the weld metal.	Incorrect gas.	Check the gas.
		Gas flow too weak or too strong.	Check the hoses, gas valve and burner for narrowing or blockages. Also check whether the above are correctly and tightly connected. Avoid wind and draughts.
		Moisture on the base material.	Dry the welded area.
		Processed material.	Removal of paint, grease and oil, including mill scale.
		Contaminated MIG wire.	Use clean, dry and rust-free wire without adding oil or grease.
		Gas nozzle clogged.	Clean the nozzle Clean or replace.
		Missing or damaged gas diffuser.	Replace the gas diffuser.
		MIG torch Euro connection O-ring is missing or damaged.	Check and replace if necessary.
3	Wire stub during welding.	Distance to workpiece.	Adjust of the distance (5-10 mm to the welded part).
		Welding voltage too low.	Increase welding voltage.
		Wire feed speed too high.	Reduce wire feed speed.

No.	Fault	Possible cause	Remedy
4	Insufficient fusion of the weld metal.	Processed material.	Removal of paint, grease and oil, including mill scale.
		Insufficient heat input.	Increase voltage range or regulate wire feed speed.
		Incorrect welding technique.	Keep the arc at the front edge of the weld pool. The angle of the gun to the workpiece should be between 5 and 15°. Direct the arc towards the weld seam. Adjustment of the working angle or widen the groove to allow access to the bottom during welding. Briefly hold the arc on the side walls when using the web technique.
5	Melting of the weld metal through the base material.	Excessive heat input.	Reduce the voltage range or regulate the wire feed speed.

No	Fault	Possible cause	Remedy
6	Insufficient fusion between weld metal and base material.	Poor or incorrect preparation of the joint.	The material is too thick. The joint preparation and design must allow access to the bottom of the groove while maintaining the correct welding wire expansion and arc characteristics. Keep the arc at the front edge of the weld pool and maintain the angle of the welding gun between 5 and 15°, so that the stick protrudes between 5 and 10 mm.
		Insufficient heat supply.	Increase voltage range or Adjust wire feed speed.
		Processed material.	Removal of paint, grease and oil, including mill scale.

Troubleshooting table MIG wire feed

No.	Fault	Possible cause	Remedy
1	No wire feed.	Incorrect mode selected.	Check mode. TIG/MMA/MIG selector switch must be set to MIG.
		Incorrect torch selector switch selected.	Ensure that the selector switch between wire feed and spool gun is set to wire feed for MIG welding and to spool gun when using the spool gun.
2	Worn drive rollers	Incorrect settings.	Ensure that you adjust the wire feed and voltage regulators for MIG welding. The current regulator is for MMA and TIG welding modes.
		Incorrect polarity selected.	Correct polarity for wire used.
		Incorrect wire feed speed.	Adjust wire feed speed.
		Tension set incorrectly.	Adjust voltage.
		MIG torch cable too long.	Small-diameter wires and soft wires such as aluminium do not feed well through long torch cables. Replace the torch with a shorter one.
		MIG torch cable bent or held at too sharp an angle.	Remove them the kink and increase the angle.
		Flow nozzle worn, wrong size, wrong type.	Insert tip of correct size and type.
		Worn or clogged liner. (Most common cause of poor feeding.)	Try to clean the liner by blowing it out.
		Incorrect liner size.	Install the correct size liner.
		Clogged or worn inlet guide tube.	Clean the inlet guide tube.
		Wire misaligned in the groove of the drive roller.	Insert the wire into the groove of the drive roller.
		Incorrect size of drive roller.	Insert the correct size of drive roller. e.g. a 0.8 mm wire requires a 0.8 mm roller.

No.	Fault	Possible cause	Remedy
2	Worn drive rollers.	Incorrect type of drive roller.	Select the correct roller type
		Worn drive rollers.	Replace drive rollers.
		Drive roller pressure too high.	If the wire electrode can flatten so that it gets stuck in the contact tip, the pressure of the drive roller must be reduced.
		Tension on the wire spool hub too high.	Tension of the coil hub brake.
		Crossed or tangled wire on the coil.	Remove Remove and untangle untangle or replace the wire.
		Contaminated MIG wire.	Use clean, dry and rust-free wire without adding oil or grease.

Troubleshooting table for DC TIG welding

No.	Fault	Possible cause	Remedy
1	Tungsten burns away quickly.	Gas cylinder empty or no gas.	Use pure argon. Check whether the gas cylinder is full, connected and turned on, and also check whether the burner valve is open.
		Insufficient gas flow.	Check whether the gas is connected. Check that the hoses, gas valve and burner are leak-proof.
		Rear cap not correctly fitted.	Check whether the burner cap is fitted and that the O-ring is in the burner body.
		Burner connected to DC +.	Burner to the DC output.
		Incorrect tungsten used.	Check the tungsten type and replace it if necessary.
		Tungsten oxidises after welding is complete.	Allow the shielding gas to flow for 10-15 seconds after interrupting the arc. 1 second per 10 A welding current.
2	Contaminated tungsten.	Introducing tungsten into the weld pool	The tungsten must not come into contact with the welding fluid. Lift the torch so that the tungsten is 2-5 mm away from the workpiece.
		Welding wire touching the tungsten.	The welding wire must not touch the tungsten during welding; insert the welding wire into the front edge of the weld pool in front of the tungsten.
3	Porosity Weld seam and colour of weld seam looks poor.	Incorrect gas, poor gas flow, gas leak.	Check whether the gas is connected. Check whether the hoses, gas valve and torch are leak-proof. Set the gas flow to 6-12 l/min. Check everything for leaks.
		Processed material.	Removal of paint, grease and oil, including mill scale.
		Contaminated flux-cored wire.	Removal of grease, oil or moisture from welding filler material.
		Incorrect cored wire.	Check the cored wire and replace if necessary.

No.	Fault	Possible cause	Remedy
4	Yellowish residues. Smoke on the aluminium oxide gas nozzle. Discoloured tungsten.	Incorrect gas.	Use pure argon gas.
		Insufficient gas flow.	Set the gas flow to a flow rate of 10-20 l/min.
		Aluminium oxide gas nozzle too small.	Enlarge the aluminium oxide gas nozzle.
5	Unstable arc with DC Sche	Torch connected to DC +.	Torch to the DC output.
		Processed material.	Removal of paint, grease and oil, including mill scale.
		Contaminated tungsten.	Remove 10 mm of the contaminated tungsten and weld again.
		Arc length too long.	Maintain a tungsten distance of 2-5 mm from the workpiece.
6	The arc wanders during welding	Poor gas flow.	Check the gas flow and set it between 10-20 l/min.
		Incorrect arc length.	Maintain a distance of 2-5 mm from the workpiece.
		Incorrect tungsten or poor condition.	Check the tungsten type. Remove 10 mm of the contaminated tungsten and weld again.
		Insufficiently prepared tungsten.	The grinding direction for tungsten should be longitudinal, NOT circular. Use the correct grinding method and disc.
		Machined material.	Removal of paint, grease and oil, including mill scale.
7	Arc is difficult or impossible to ignite	Incorrect machine settings.	Check settings.
		No gas, incorrect gas flow.	Check whether gas is connected and valve is open. Check whether hoses, valve or torch are constricted. Gas flow setting to 10-20 l/min.
		Incorrect tungsten size or type.	Check and, if necessary, change the tungsten.
		Loose connections.	Check connections and tighten.
		Grounding clamps not connected to the workpiece.	It is preferable to connect the earth clamp directly to the workpiece.

Troubleshooting table for MMA welding

No	Fault	Possible cause	remedy
1	No arc.	Incomplete welding cycle.	Check whether grounding cable is connected . Check all cable connections.
		Incorrect mode.	Check whether the MMA selector switch is activated.
		No power supply.	Check whether the device is switched on. Check the power supply.
2	Porosity Small cavities or holes caused by gas inclusions in the weld metal.	Arc length too long.	Shorten the arc length.
		Workpiece Dirty, contaminated or damp.	Remove paint, grease and oil, including mill scale. Keep dry.
		Damp electrodes.	Use dry electrodes.
3	Excessive spatter	Current too high.	Reduce the current or select a larger electrode.
		Arc length too long.	Shorten the arc length.
4	Weld seam does not adhere properly.	Insufficient heat input.	Increase the current or select a larger electrode.
		Workpiece Dirty, contaminated or damp.	Remove paint, grease and oil, including mill scale. Keep dry.
		Poor welding technique.	Check your welding technique and seek assistance if necessary.
5	Insufficient welding.	Insufficient heat input.	Increase the amperage or select a larger electrode.
		Poor welding technique.	Check your welding technique and seek assistance if necessary.
		Poor joint preparation.	The material is too thick. The joint preparation and design must allow access to the bottom of the groove while maintaining the required welding properties.
6	Excessive welding.	Excessive heat input.	Reduce the current or use a smaller electrode.
		Incorrect welding speed.	Increase welding speed.
7	Uneven weld seam.	Unsteady hand.	Practise your technique.

No	Problem	Possible cause	Remedy
8	Delay in the base metal during welding.	Excessive heat input.	Reduce the current or use a smaller electrode.
		Poor welding technique.	Practise your welding technique and seek help if necessary.
		Poor joint preparation.	The material is too thick. The joint preparation and design must allow access to the bottom of the groove while maintaining the required welding properties.
9	Electrode welding with different or unusual arcs.	Incorrect polarity.	Change the polarity. Check with the electrode manufacturer for correct polarity.

8.1 Error codes

Fig. 8-1: Example

Error type	Code	Description
Thermal relay	E01	Overheating (1st thermal relay).
	E02	Overheating (2nd thermal relay).
	E03	Overheating (3rd thermal relay).
	E04	Overheating (4th thermal relay).
	E09	Overheating (programme specification).
Welding machine	E10	Phase loss.
	E11	No water
	E12	No gas.
	E13	Under voltage.
	E14	Overvoltage.
	E15	Overcurrent.
	E16	Overload of the wire feed.

Error type	Code	Description
Switch	E20	Key error on the control panel when switching on the machine.
	E21	Other malfunction on the control panel when switching on the machine.
	E22	Burner fault when switching on the machine.
	E23	Burner fault during normal operation.
Accessories	E30	Shutdown of the cutting torch.
	E31	Shutdown of the water cooler.
Communication	E40	Connection problem between wire feed and power source.
	E41	Communication error.

9 Spare parts

Risk of injury due to use of incorrect spare parts!

The use of incorrect or faulty spare parts can pose a risk to the operator and cause damage and malfunctions.

Stürmer Maschinen GmbH accepts no liability and provides no guarantee for damage and operational faults resulting from failure to observe these operating instructions. Only use faultless and suitable tools, original spare parts or series parts expressly approved by Stürmer Maschinen GmbH for repairs.
The manufacturer's warranty is void if unauthorised spare parts are used.

Information about technical customer service

Repairs covered by the warranty may only be carried out by technicians authorised by us. Only use original spare parts.

9.1 Ordering spare parts

Spare parts can be obtained from your specialist dealer.

Send a copy of the spare parts drawing with the marked components to the specialist dealer and provide the following information:

- Item number
- Device designation
- Date of manufacture
- Item numbers of the components and, if applicable, the corresponding spare parts drawing number
- Quantity
- Desired shipping method (post, freight, sea, air, express)
- Shipping address

Spare part orders without the above information cannot be processed. If no shipping method is specified, shipping will be at the supplier's discretion.

Information on the device type, item number and year of manufacture can be found on the type plate attached to the welding machine.

Example

The top cover for the SYN-MIG 201-2 P Synergic welding machine must be ordered. The cover has position number 1 in the spare parts drawing.

When ordering spare parts, send a copy of the spare parts drawing with the component marked (upper cover) and position number 1 marked to the authorised dealer and provide the following information:

- Item number 1071202
- Model SYN-MIG 201-2 P Synergic
- Item number 1
- Drawing number 1

9.2 Spare parts drawings

SYN-MIG 201-2 P Synergic

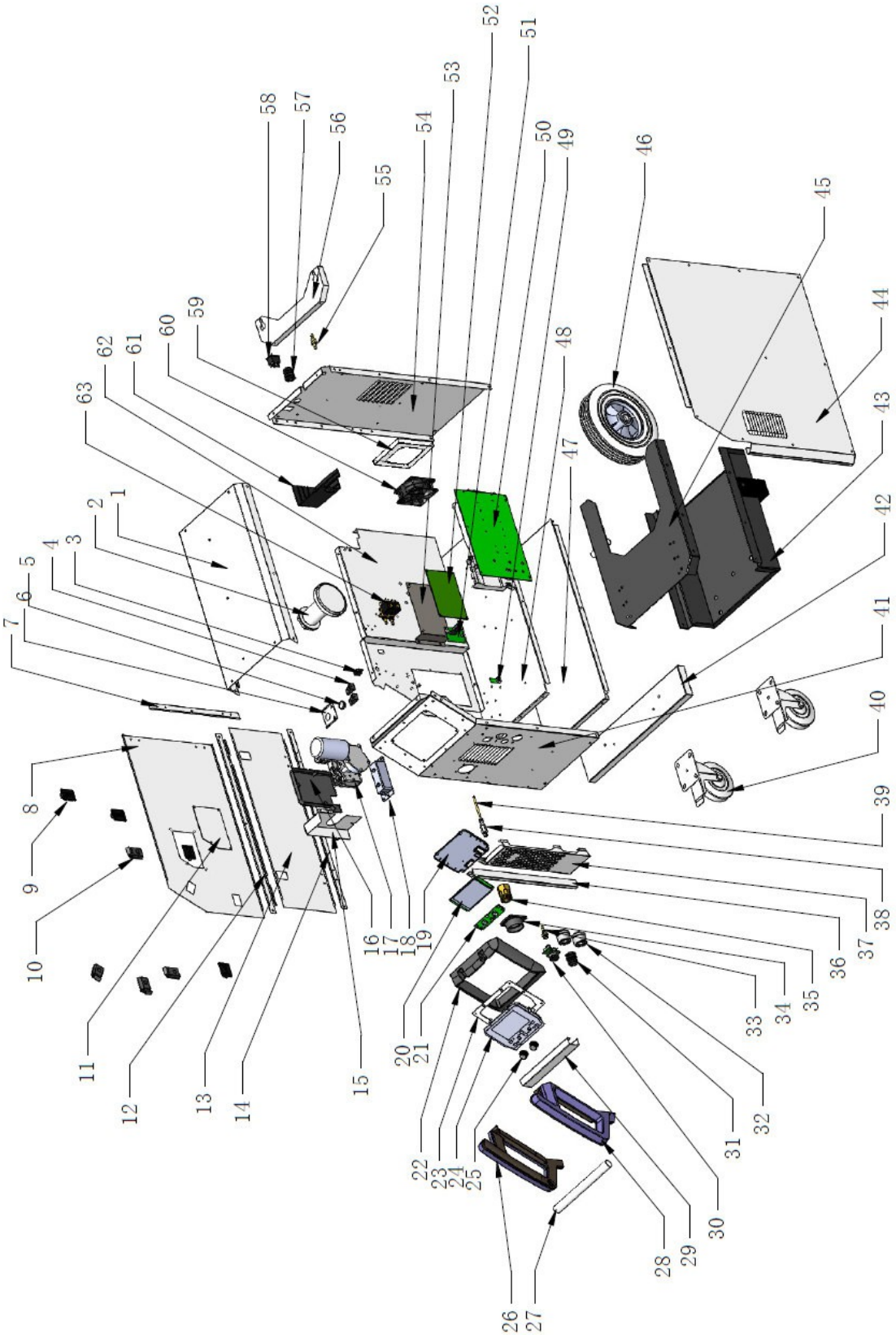


Fig. 9-1: Spare parts drawing SYN-MIG 201-2 P Synergic

SYN-MIG 203-2 P Synergic

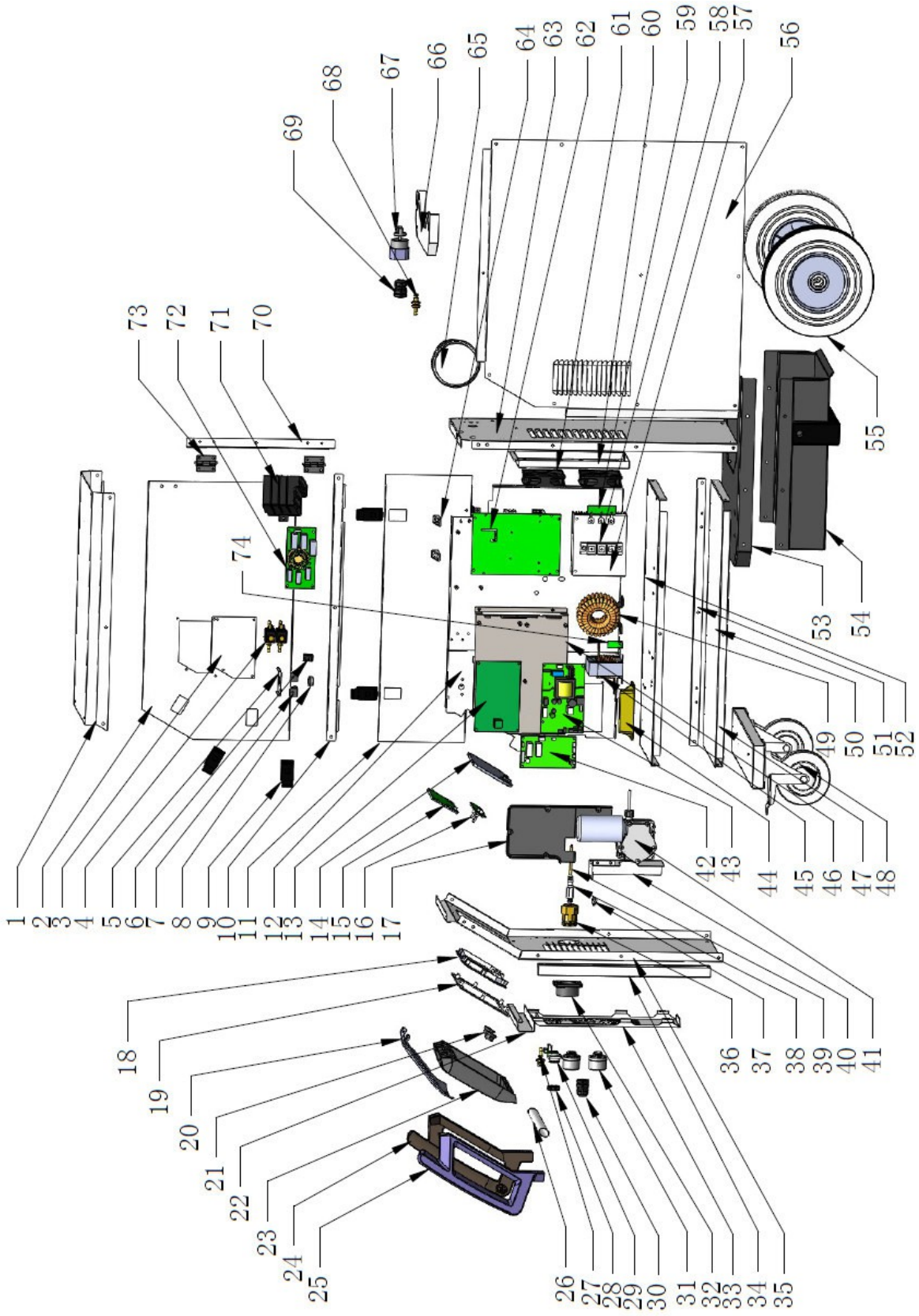


Fig. 9-2: Spare parts drawing SYN-MIG 203-2 P Synergic

SYN-MIG 253-4 Synergic

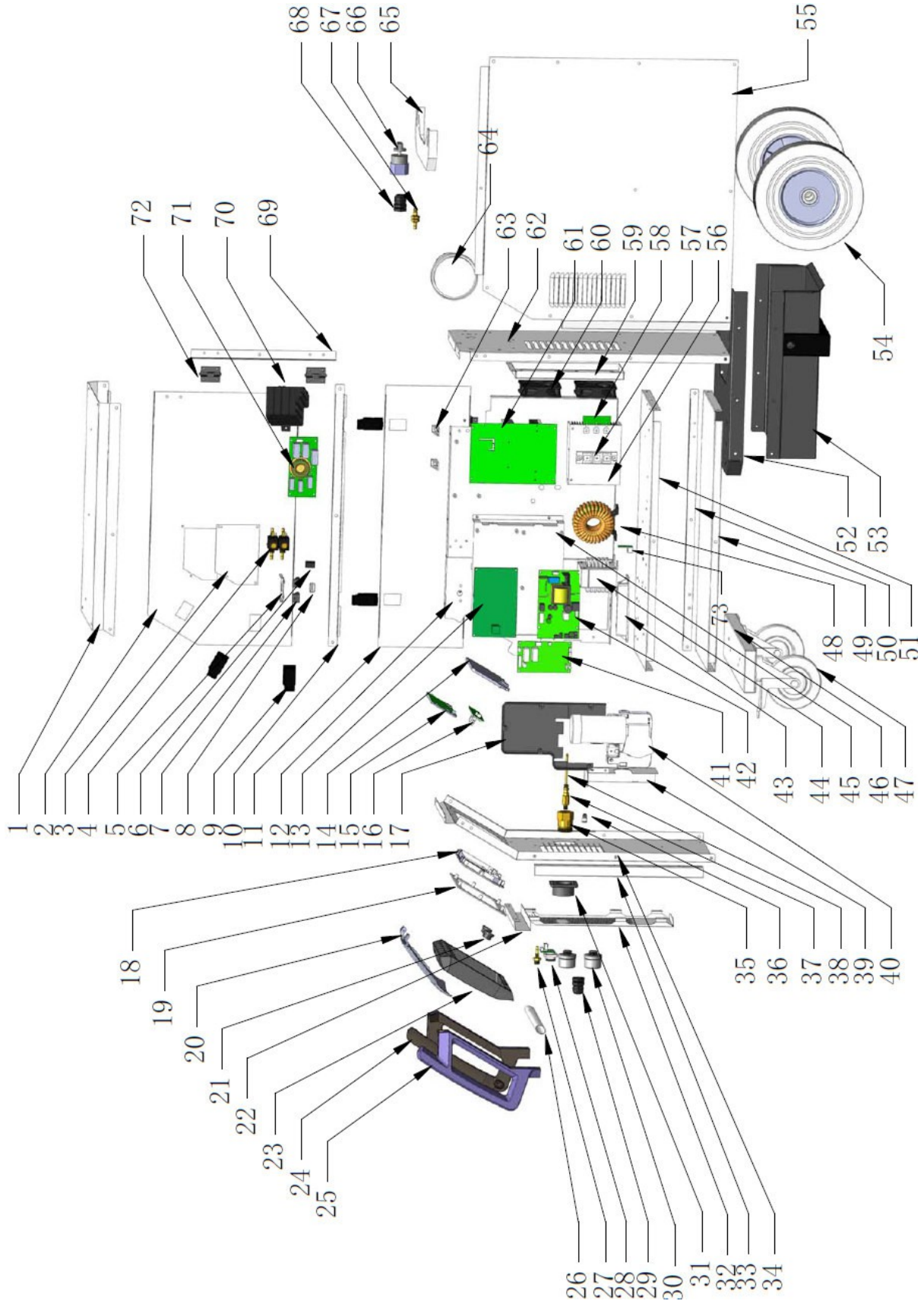


Fig. 9-3: Spare parts drawing SYN-MIG 253-4 Synergic

SYN-MIG 323-4 Synergic

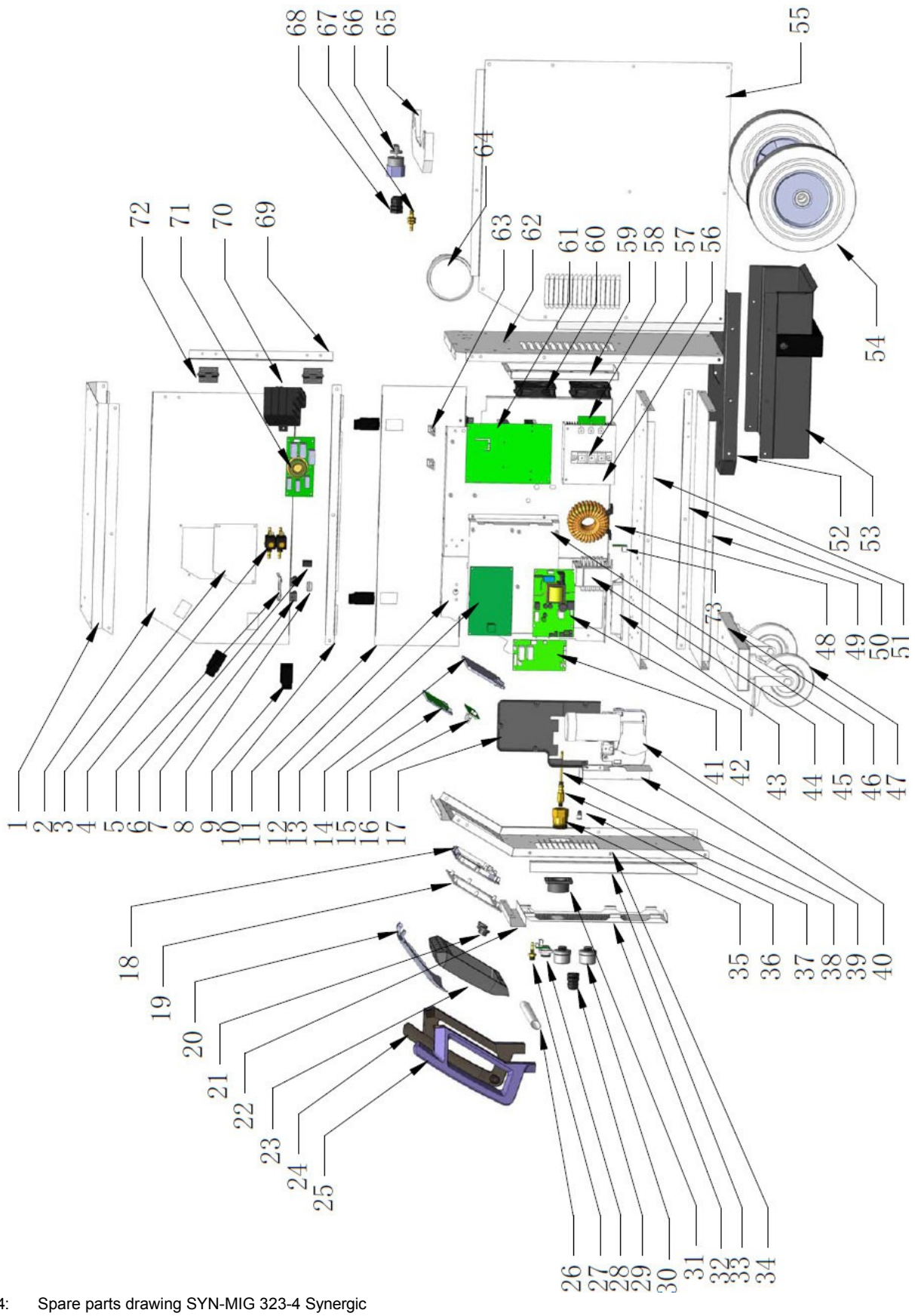


Fig. 9-4: Spare parts drawing SYN-MIG 323-4 Synergic

SYN-MIG 353-4 W Synergic

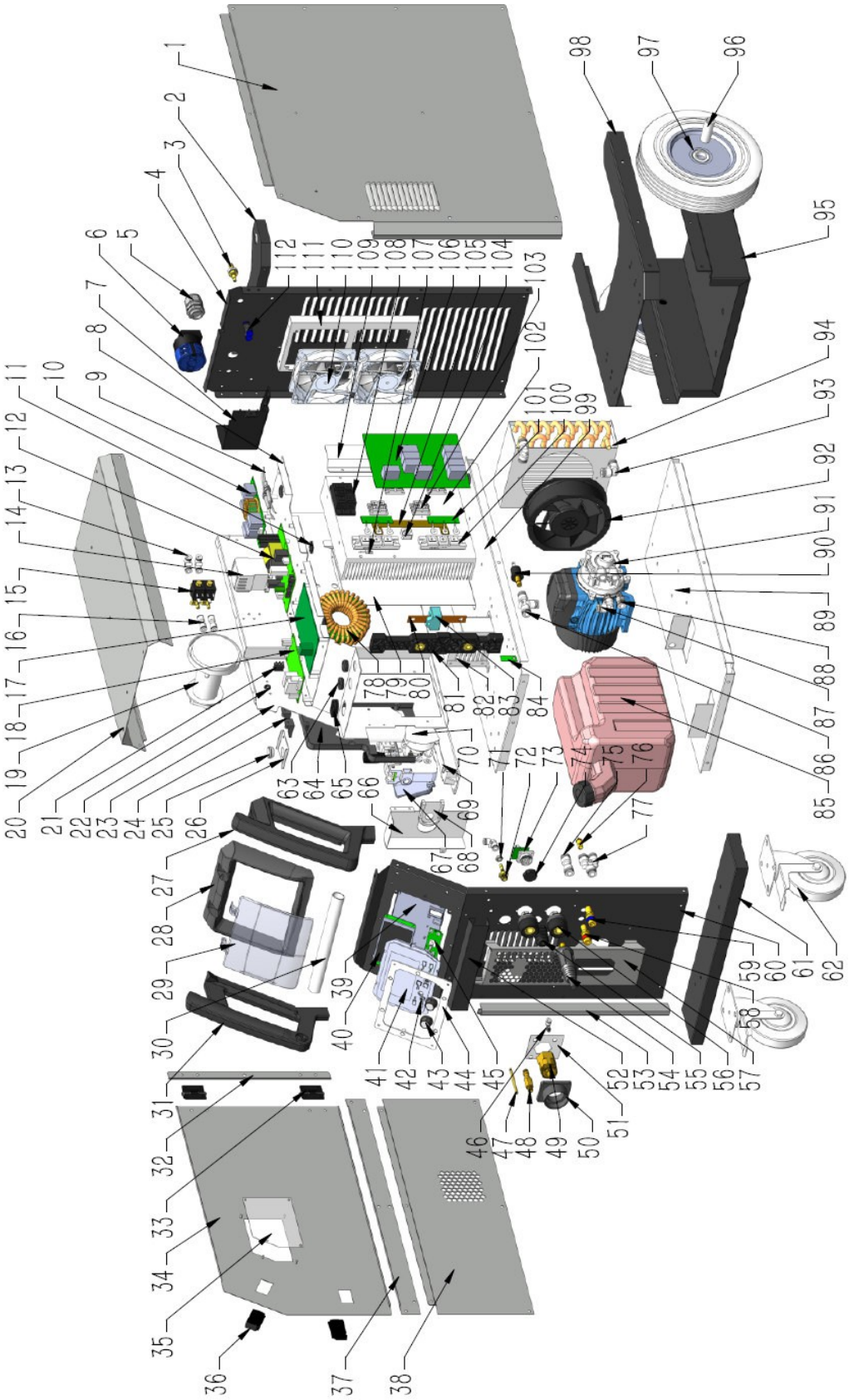


Fig. 9-5: Spare parts drawing SYN-MIG 353-4 W Synergic

SYN-MIG 403-4 W Synergic

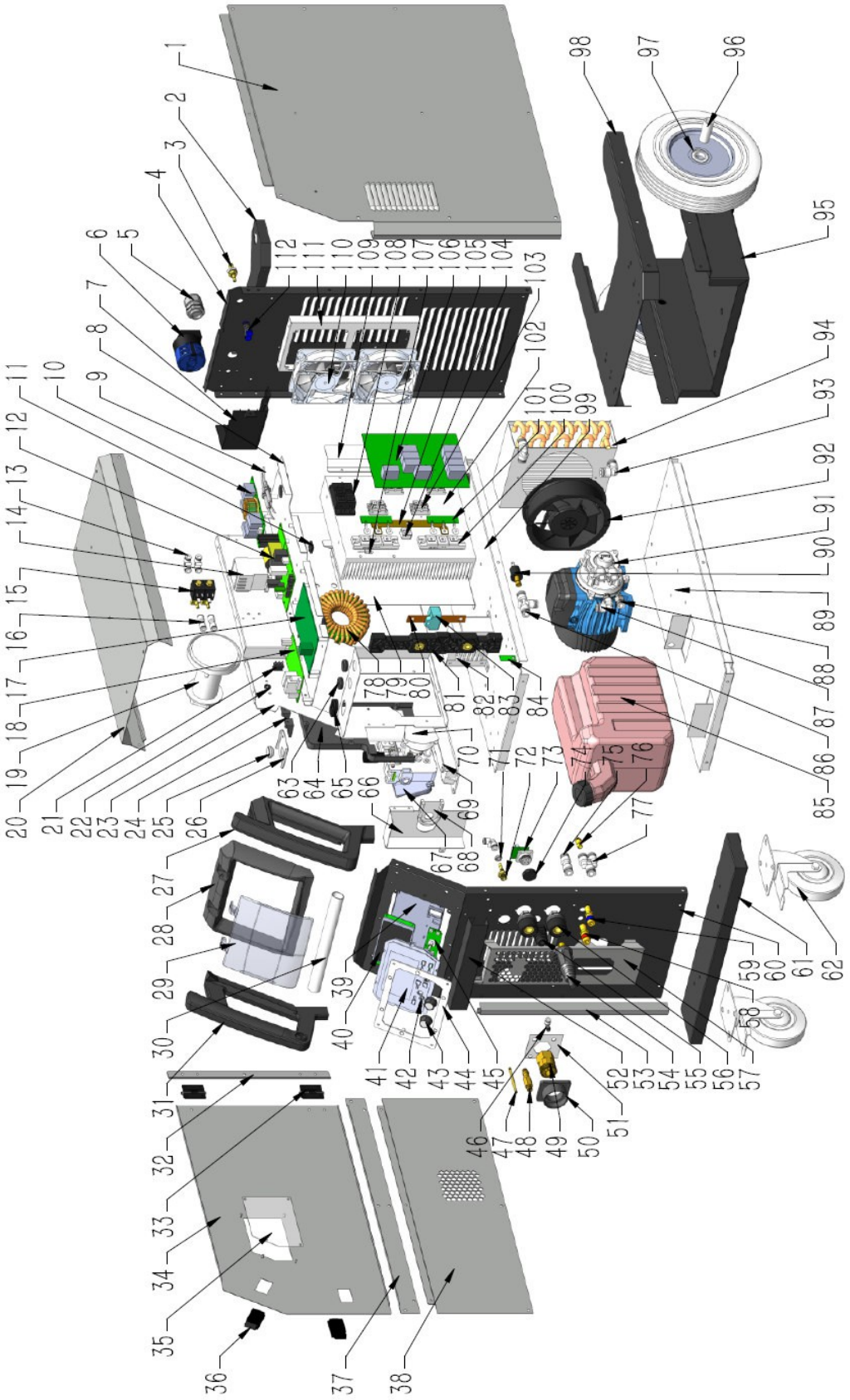


Fig. 9-6: Spare parts drawing SYN-MIG 403-4 W Synergic

Syn-Mig 353-4 W Pulse

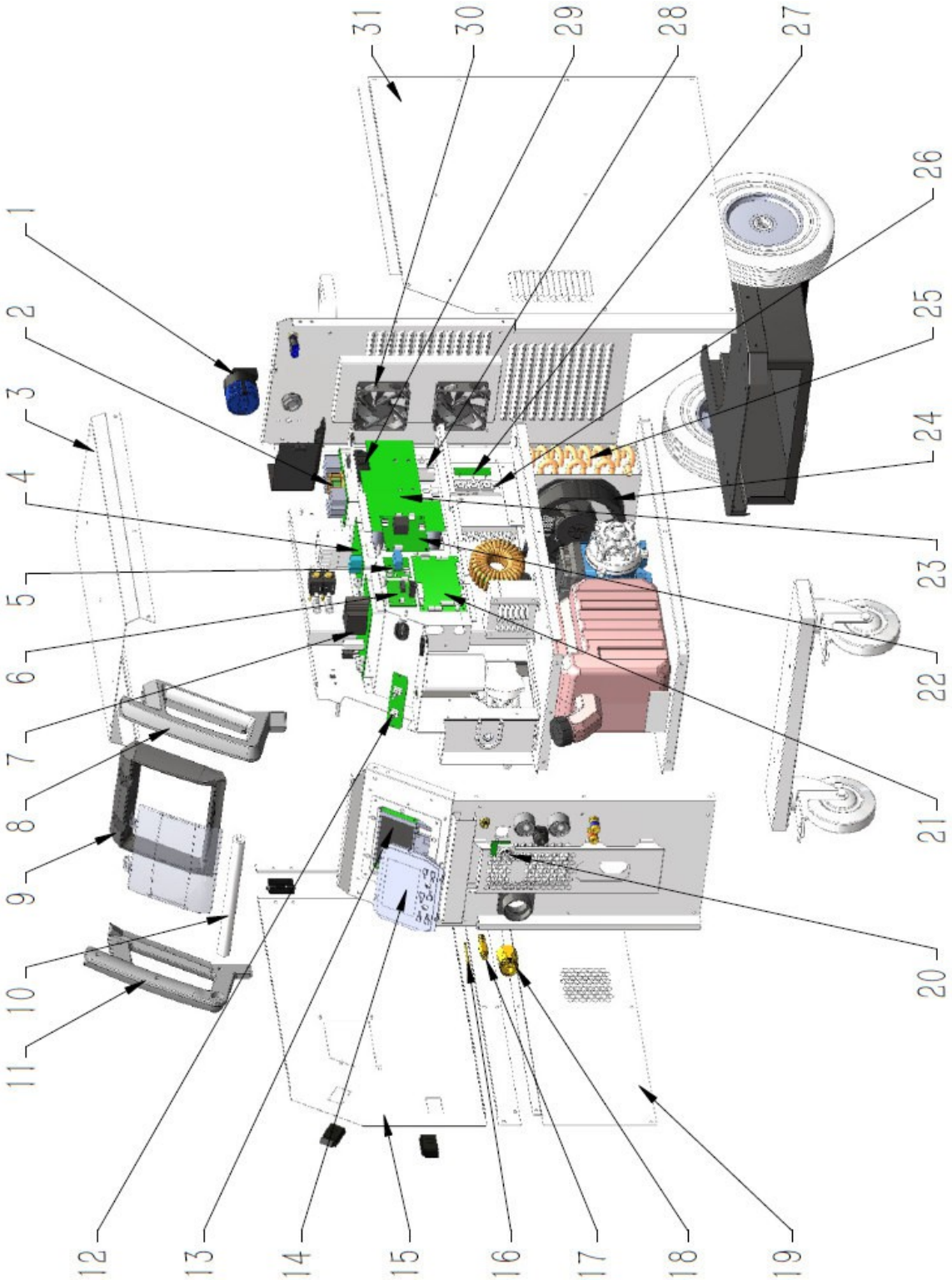


Fig. 9-7: Spare parts drawing Syn-Mig 353-4 W Pulse

10 Electrical circuit diagrams

SYN-MIG 201-2 P Synergic

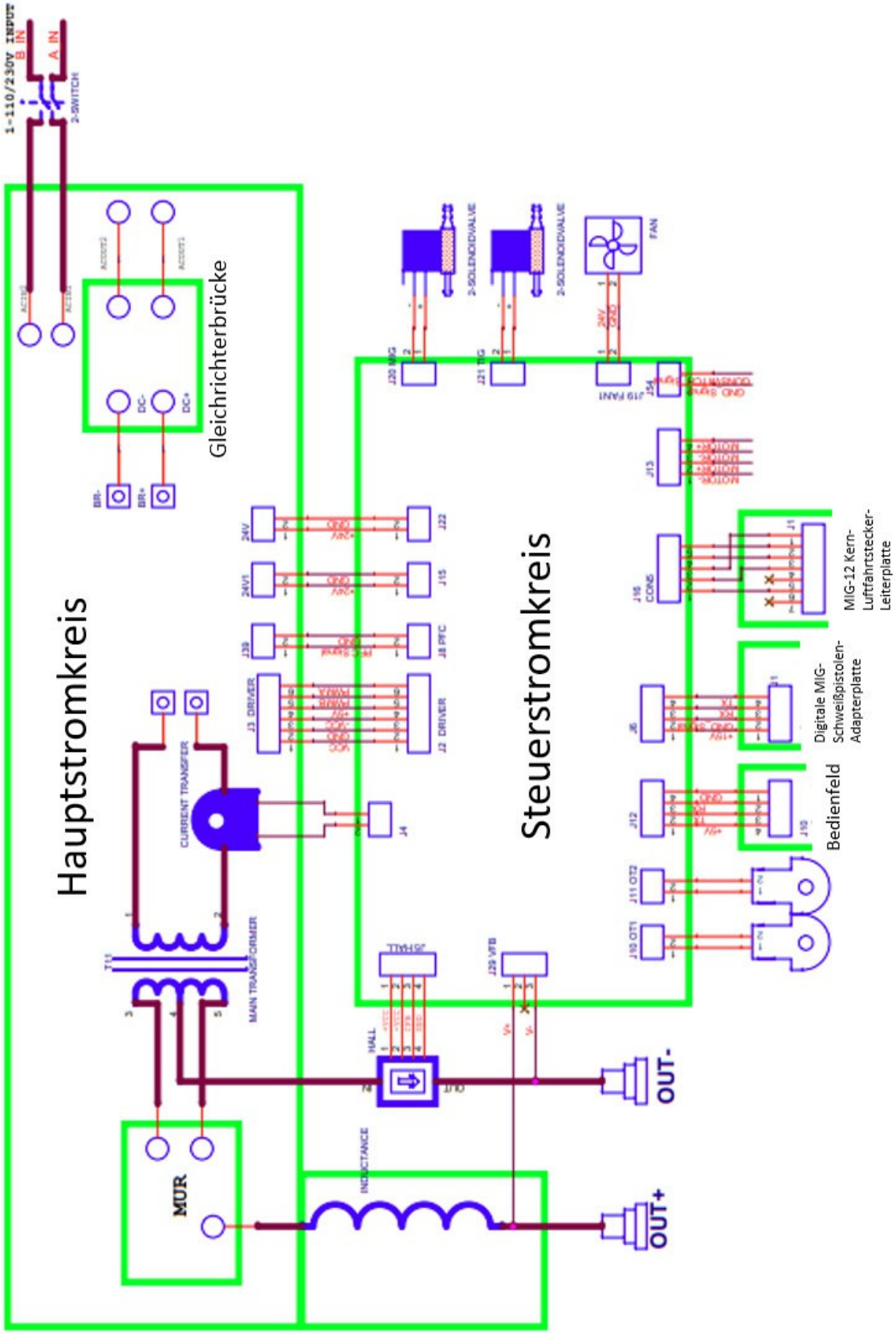


Fig. 10-1: Electrical circuit diagram SYN-MIG 201-2 P Synergic

SYN-MIG 203-2, SYN-MIG 253-4 & SYN-MIG 323-4 Synergic

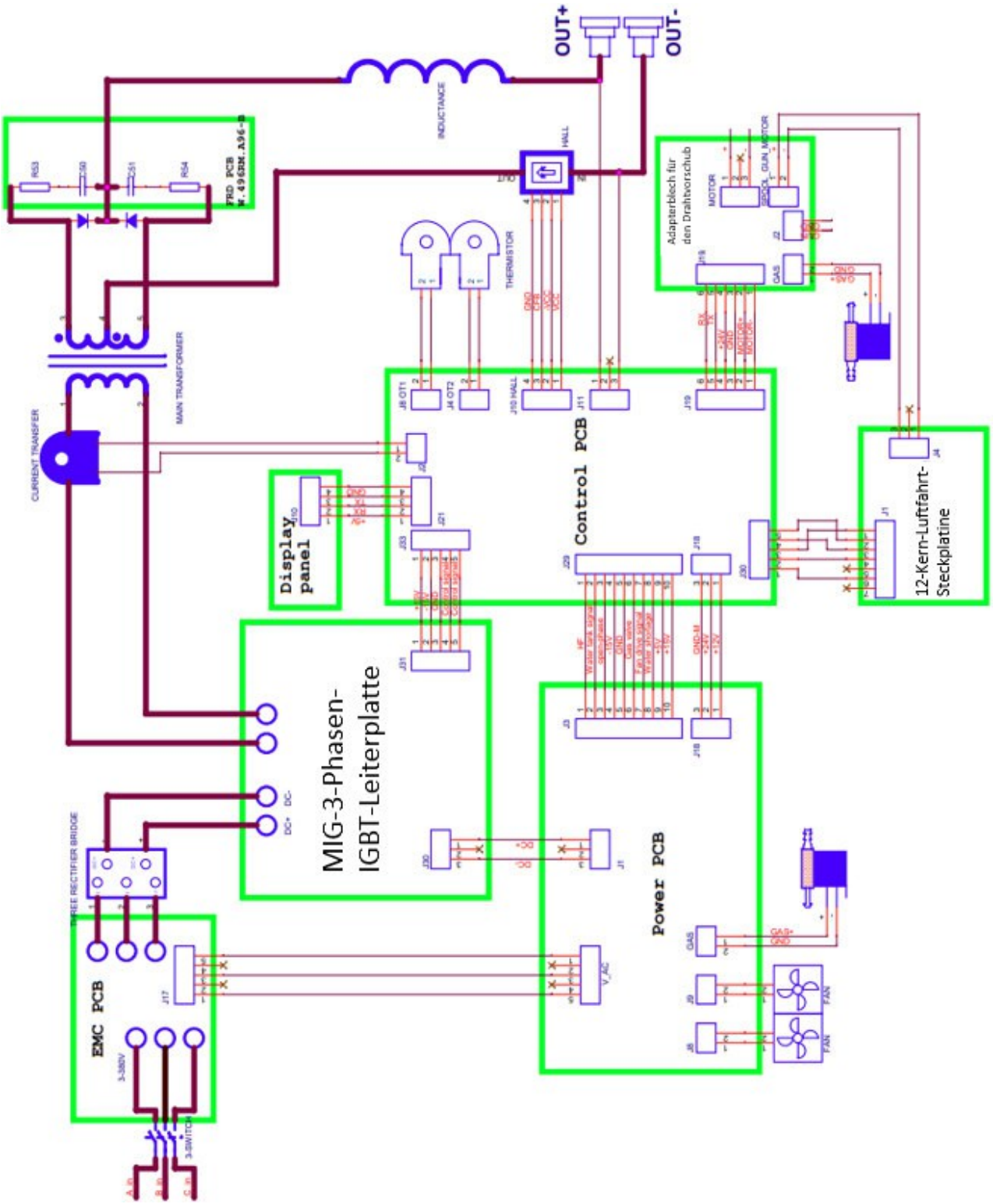


Fig. 10-2: Electrical circuit diagram SYN-MIG 203-2, SYN-MIG 253-4 & SYN-MIG 323-4

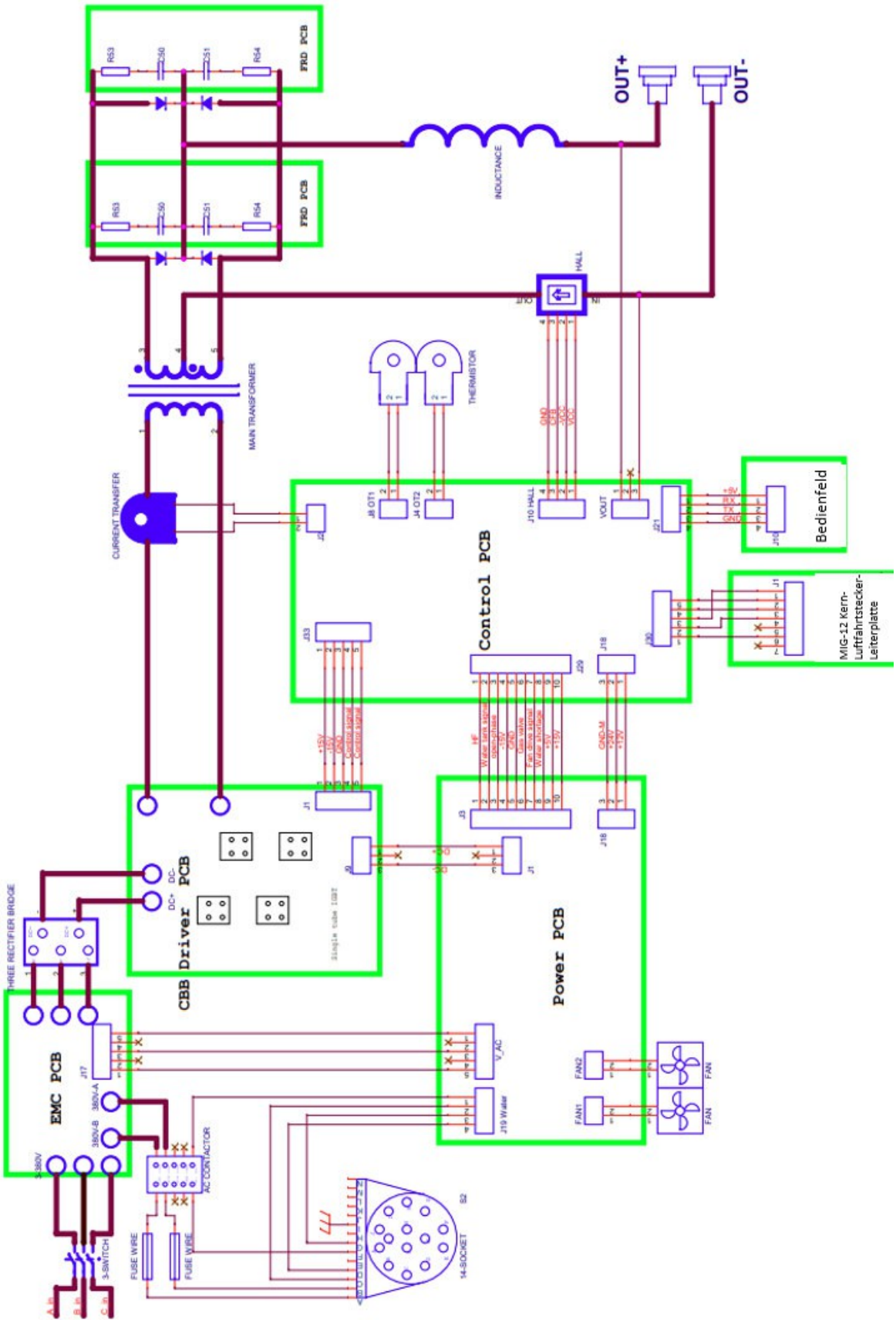


Fig. 10-3: Electrical circuit diagram SYN-MIG 353-4 W & SYN-MIG 403-4 W

11 EU Declaration of Conformity

For the following designated products

Manufacturer/distributor:	Stürmer Maschinen GmbH Dr.-Robert-Pfleger-Str. 26 D-96103 Hallstadt	
Product group:	schweisskraft® welding equipment	
Type designation:	MIG/MAG inverter	Item number
Product name: *	☐ SYN-MIG 201-2 P Synergic	☐ 1071202
	☐ SYN-MIG 203-2 P Synergic	☐ 1071203
	☐ SYN-MIG 253-4 Synergic	☐ 1071254
	☐ SYN-MIG 323-4 Synergic	☐ 1071323
	☐ SYN-MIG 353-4 W Synergic	☐ 1071353
	☐ SYN-MIG 403-4 W Synergic	☐ 1071403
	☐ Syn-Mig 353-4 W Pulse	☐ 1072353
Serial number: *		
Year of manufacture:		

* Fill in these fields using the information on the type plate.

We hereby confirm that they comply with the essential protection requirements set out in Council Directive **2014/30/EU (EMC Directive)** on the approximation of the laws of the Member States relating to electromagnetic compatibility and in Directive **2014/35/EU** on electrical equipment for use within certain voltage limits.

Applicable EU regulations: ECV 1907/2006 REACH Regulation

The above-mentioned products comply with the provisions of these directives and with **RoHS 2011/65/EU** and meet the safety requirements for arc welding equipment in accordance with the following product standards:

The following harmonised standards have been applied:

EN IEC 60974-1:2022 +	Arc welding equipment - Part 1: Welding power sources
A11:2022 EN IEC 60974-10:2021	Arc welding equipment - Part 10: Electromagnetic compatibility (EMC) requirements

In accordance with EC Directive **2006/42/EC Article 1**, the above-mentioned products fall exclusively within the scope of Directive **2014/35/EU** concerning electrical equipment for use within certain voltage limits.

Electromagnetic compatibility EMC (DIN EN 60974-10)

The device is constructed and tested in accordance with standard EN 60974-10 in class A. This class A welding equipment is not intended for use in residential areas where the power supply is provided by a public low-voltage supply system.

Name and address of the person authorised to compile the technical documentation: Kilian Stürmer, Stürmer Maschinen GmbH, Dr.-Robert-Pfleger-Str. 26, D-96103 Hallstadt

Kilian Stürmer (Managing Director)

Hallstadt, 12 June 2025

12 Appendix

12.1 Copyright

The contents of this manual are protected by copyright and are the sole property of Stürmer Maschinen GmbH. Their use is permitted within the scope of the use of the welding machine. Any use beyond this is not permitted without the written consent of the manufacturer.

The distribution and reproduction of this document, as well as the use and communication of its contents, are prohibited unless expressly permitted. Violations will result in liability for damages.

We register trademark, patent and design rights to protect our products, where possible in individual cases. We strongly oppose any infringement of our intellectual property.

We reserve the right to make technical changes at any time.

12.2 Storage

ATTENTION!

Incorrect and improper storage can damage and destroy electrical and mechanical componen

Store packaged or unpacked parts only under the specified environmental conditions.

Consult your specialist dealer if the device and accessories need to be stored for longer than three months and under conditions other than the specified environmental conditions.

12.3 Recycling options:

Please dispose of your welding machine in an environmentally friendly manner by disposing of waste properly rather than releasing it into the environment.

Please do not simply throw away the packaging and later the used welding machine, but dispose of both in accordance with the guidelines issued by your local authority or the responsible waste disposal company.

12.3.1 Decommissioning

CAUTION!

Disused devices must be decommissioned immediately and properly to prevent subsequent misuse and danger to the environment or persons.

- Remove batteries and rechargeable batteries, if present.
- If necessary, dismantle the device into manageable and recyclable assemblies and components.
- Dispose of the device components using the designated disposal channels.

12.3.2 Disposal of new device packaging

All packaging materials and packaging aids used for the welding device are recyclable and must always be sent for material recycling.

Any wooden packaging can be disposed of or recycled. Cardboard packaging components can be shredded and disposed of with waste paper.

The films are made of polyethylene (PE) and the padding is made of polystyrene (PS). These materials can be reused after processing if you take them to a recycling centre or your local waste disposal company.

Please ensure that the packaging material is sorted by type so that it can be sent directly for reuse.

12.3.3 Disposal of old appliances

INFORMATION

In your own interest and in the interest of the environment, please ensure that all components of the device are disposed of only in the manner specified and approved.

Please note that electrical devices contain a variety of recyclable materials as well as environmentally harmful components. Please help to ensure that these components are separated and disposed of properly. If in doubt, please contact your local waste disposal authority. If necessary, seek the assistance of a specialised waste disposal company for processing.

12.3.4 Disposal of electrical and electronic components

Please ensure that electrical components are disposed of properly in accordance with legal requirements.

The device contains electrical and electronic components and must not be disposed of as household waste. In accordance with the European Directive on Waste Electrical and Electronic Equipment and its implementation in national law, used power tools and electrical appliances and machines must be collected separately and recycled in an environmentally friendly manner.

As the operator, you should obtain information about the authorised collection and disposal system that applies to you.

Please ensure that batteries and/or rechargeable batteries are disposed of properly in accordance with legal requirements. Please only dispose of discharged batteries in the collection boxes at retailers or municipal waste disposal facilities.

12.4 Disposal via municipal waste collection points ( )

Disposal of used electrical and electronic equipment
(Applicable in European Union countries and other European countries with a separate collection system for these devices).

The symbol on the product or its packaging indicates that this product should not be treated as normal household waste, but must be taken to a collection point for the recycling of electrical and electronic equipment.

By disposing of this product correctly, you are helping to protect the environment and the health of others. Incorrect disposal poses a risk to the environment and health. Recycling materials helps to reduce the consumption of raw materials. For more information on recycling this product, please contact your local authority, your local waste disposal service or the shop where you purchased the product.

13 Product monitoring

We are obliged to monitor our products even after delivery. Please inform us of

anything that may be of interest to us:

- Changed settings.
- Experiences with the welding machine that are important for other users.
- Recurring faults.

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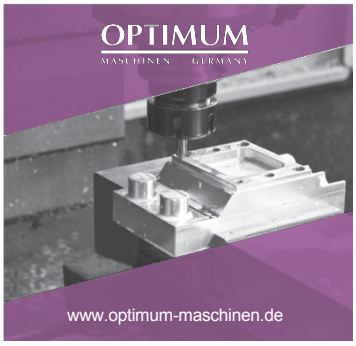

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