



**Inverter Series
AC/DC Pulse TIG
Welding Machines**

Operating Manual

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Thank you for selecting WARPP brand inverter welding machine. In order to keep you safe away from unexpected accidents, and enjoy full benefits offered by our quality products during welding, please read the instruction in details prior to operation. Complying with procedures defined in this manual is always appreciated.

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Usage & Features

IN TIG (AC/DC) series inverter multifunctional welding machines can be divided into three types (315A、500A and 630A). They can perform DC constant current TIG welding, DC pulse TIG welding, square wave AC constant current TIG welding, square wave AC pulse TIG welding, which are used for carbon steel, copper, titanium, aluminum as well as aluminum-magnesium alloy welding. Because of reasonable static and sound dynamic characteristic the welders enjoy, they have comprehensive operational functions. The features are showed below:

- 👍 *IGBT HF soft-switch-transfer technology. High frequent , small , light ;*
- 👍 *Notable control and adjust function ,multifunctional ,convenient ;*
- 👍 *Additional foot pedal switch for adjusting welding current;*
- 👍 *Using non-source power factor correction technology , power factor is high ;*
- 👍 *Easy to start arc、 stable arc , good performance ;*
- 👍 *High success rate of arc-starting while in low welding current ;*
- 👍 *The penetration, melt pool width and pass form which commensurate with weld can be obtained by adjusting pulse current, pulse frequency and pulse width as well as prolonging tungsten electrode lifespan, especially suitable for automatic and robot welding.*



General safety precaution:

- Please strictly comply with rules defined in this manual to avoid unexpected accidents
- How to connect power supply ,select working area and use pressure gas, please comply with proper rules
- Not allow non-operator to enter working area
- Welder installation, inspection, maintenance, and manipulation must be completed by authorized person.
- Don't use welding machine for unrelated purpose (Such as recharging, heating or pipeline thaw, etc.)
- Must take safe precaution in case welder falling when it is put on the uneven ground



Avoid being electric shocked or burnt

- Never touch on hot electrical units.
- Please instruct the authorized electrician to ground the welder frame by using proper-sized copper wire.
- Please instruct the authorized electrician to connect the welder to power supply by using proper-sized, well-insulated copper wire.
- When operating in the damp, space limited area, must ensure well-insulated between body and work piece
- When operating in the high-rising location, must ensure safety by using safe net.
- Please power off the machine while no longer welding.



Avoid breathing in hazardous welding fume or gas

- Please use specified ventilation to prevent being gas poisoned and asphyxiated,
- Especially in the container where oxygen is depleted easily.



Avoid being harmed by arc flash, hot spatter, slag

- Arc rays can injure your eyes and make your eyes feel uncomfortable. Hot spatter and slag can burn your skin.
- Please wear proper welding helmet, leather gloves, long-sleeved suit, hat, apron and boots before welding.



Preventing from fire, explosion, container break accidents

- Don't put flammable material in the working area. Hot spatter and hot weld can easily start a fire.
- Cable must be connected the work piece firmly to ensure good conductivity in case causing fire by resistance heat.
- Don't weld in the flammable gas or weld container which contains flammable material, otherwise it can cause explode.
- Don't weld encapsulated container, otherwise it can break.
- Ensure a fire extinguisher at hand in case a fire breaks out.



Avoid being hurt by moving parts

- Never let the finger, hair, and cloth near the rotary cooling fan and wire feeder rollers.
- When feeding wire, don't let the bottom of gun near your eyes, face and body, to prevent being harmed by wire.



Avoid gas bottle falling or gas regulator breaking

- Gas bottle must be firmly fixed on the ground, else if injure will exerts on.
- Never place bottle under high temperature or sun light.
- Never let your face near gas outlet while turning on the gas valve to prevent from being hurt by pressure gas.
- Customer should use gas regulator provided by our company, and comply with the proper instruction.



Avoid being hurt by welding machine while in transport

- When moving the welding machine by fork-lift truck or crane, nobody can be allowed for standing downright the route of the moving welder, in case being hurt by the falling welding machine.
- The ropes or wires which used for hanging up the welding machine must be strong enough to withstand corresponding tension strength. The rope or wire inclination hanging on the tackle must be no more than 30°

1 . Installing situation

- (1) Must place welding machine in the room where is no straight sunlight, no rain, less dust, low humidity, and temperature range of $-10^{\circ}\text{C} \sim +40^{\circ}\text{C}$
- (2) The gradient of ground must be no more than 15°
- (3) Ensure no wind at the welding position, or use screen to block the wind.
- (4) The distance between welder and wall must be more than 20cm, between welders more than 10cm to ensure enough heat radiation.
- (5) When using water cooled gun, must be care of not being frozen.

2 . Requirement of input volt:

- (1) Input volt must be standard sine wave, effective value $380\text{V} \pm 10\%$, frequency 50Hz/60Hz
- (2) Unbalance degree of 3- phase volt must be no more than 5%

3. Power supply:.

Product type		315	500	630
Power supply		3 phase AC380V		
Min. capacity	Power network	14KVA	27KVA	45KVA
Input volt protection	Fuse	20A	40A	60A
	Circuit breaker	40A	60A	100A
Cable size (cross-section)	Input volt	4mm ²	6mm ²	10mm ²
	Output volt	35mm ²	50mm ²	70mm ²
	Ground lead	4mm ²	6mm ²	10mm ²

Table1: The size of fuse and breaker in the table are for reference only

4. Installation

The input power of this series welding machines is three phase AC 380v/50Hz. Operator must use the properly disconnected switchboard or switch box(not provided by our company) which is equipped circuit breaker, and should ground the welder safely and firmly.

- (1) Connect ground lead.
- (2) Connect terminal socket (+) to workpiece on DC TIG, to stick holder cable on SMAW.
- (3) Connect terminal socket (~) to workpiece on AC TIG (IN TIG 315 AC/DC) still use terminal socket (+) to connect workpiece).
- (4) Connect TIG torch to terminal socket (-) on AC or DC TIG, connect socket (-) to workpiece on SMAW.
- (5) Connect welder's gas inlet to gas regulator by gas hose.
- (6) Connect TIG torch's gas inlet to welder's gas outlet.

- (7) Wire foot pedal switch or torch control cable to control cable socket.
- (8) When use water-cooled torch, connect water circulator to welder's water inlet and torch's water inlet to welder's water outlet.
- (9) Power on air switch on the welder's rear panel.
- (10) Connect input power cable to switch box and power on.

Definition of Product Model Number

Product model codification of Series is illustrated by Picture 1 :

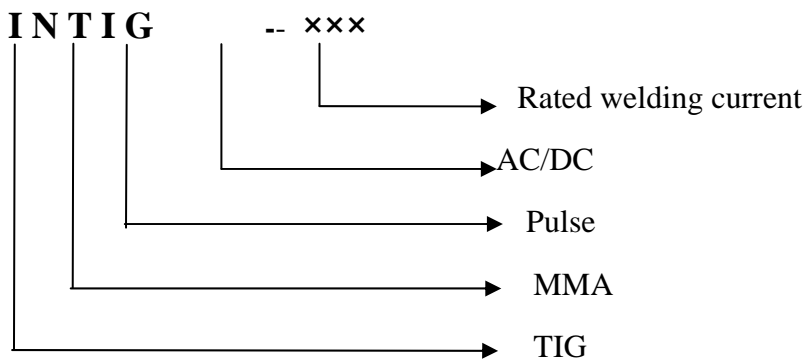


Fig.1: Product model definition of IN TIG AC/DC series

Principle in Brief

Block diagram of principle :

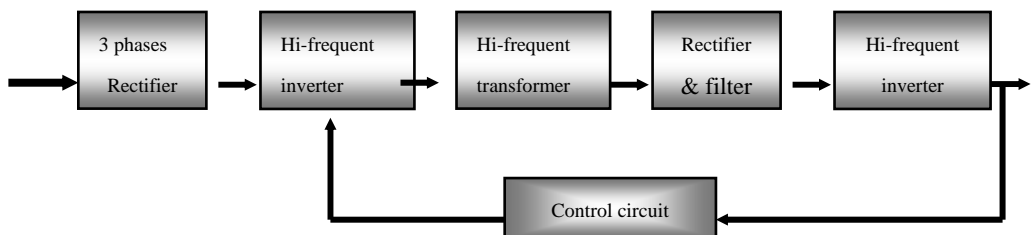


Fig.2: Block diagram of Series principle

This series welding machines apply IGBT HF inverter technology. Inputted line frequency 3-phase 380V are rectified by rectifier, inverted into HF AC, reduced by HF transformer, rectified and filtered by HF rectifier, then output DC volt or 50Hz AC square wave volt suitable for welding by second invert. After this process, the welder's dynamical responsive speed has been great increasing, the size and weight of welder's transformer and reactor are reduced noticeable. Power source enjoy sound anti-fluctuating ability due to excellent circuit loop control.

Power source can reach their potential as well as easy arc-start, stable arc, pretty weld formation and continuous regulation of welding current during external context changes(As to fluctuation in input power supply and extended welding cables) due to reasonable control circuit design .

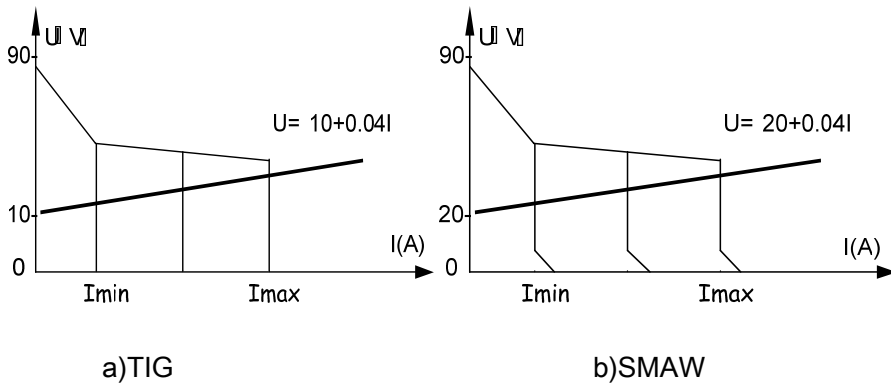


Fig.3: IN TIG AC/DC Series output characteristic

Operating Instruction

1 . Function introduction

1.1 Front panel illustration and parts number reference

1.1.1 IN TIG-315 AC/DC Front panel illustration and parts number reference

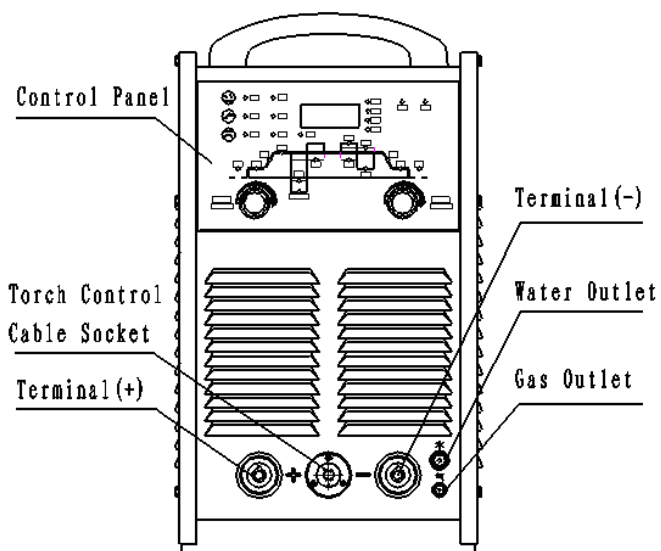


Fig. 4: IN TIG -315 AC/DC's front panel

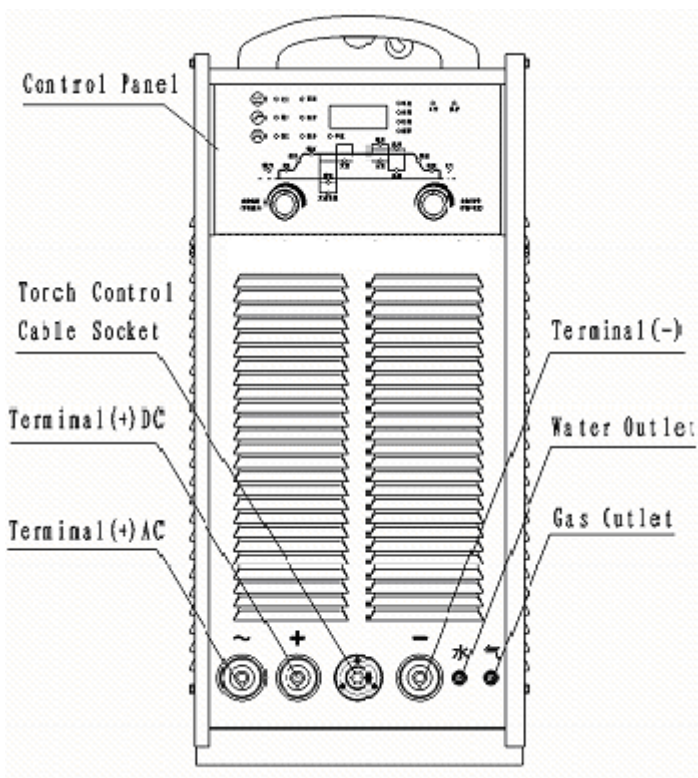


Fig.5: IN TIG-500 / 630 AC/DC's front panel

1.2 Foot pedal switch with adjustable welding current

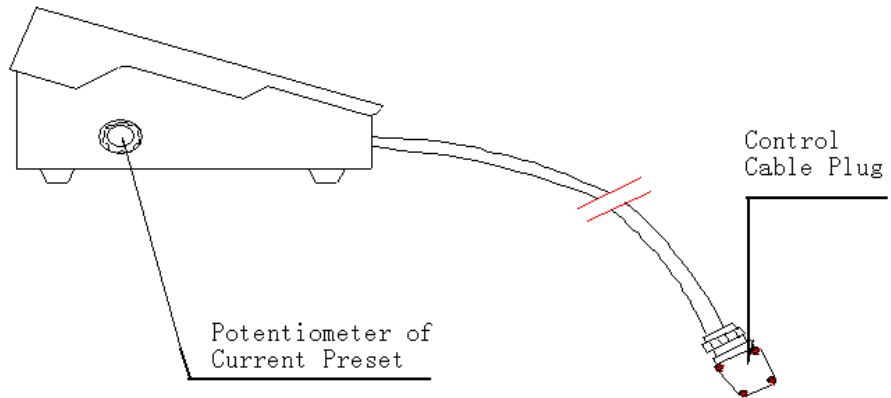


Fig.6: Foot pedal switch

Foot pedal switch can be used for arc start control and welding current regulation of IN TIG-315 AC/DC. Welder will switch automatically to foot pedal control after the control plug is connected to welder's control cable socket. When the pedal is stepped on, the welder begins to work at welding current in line with the degree of the pedal being pressed. The ceiling current is controlled by regulating current preset potentiometer.

Note: If customers demand foot pedal switch for IN TIG-500 AC/DC or IN TIG-630 AC/DC, please underline in order(s).

1.3 Rear panel illustration and parts number reference

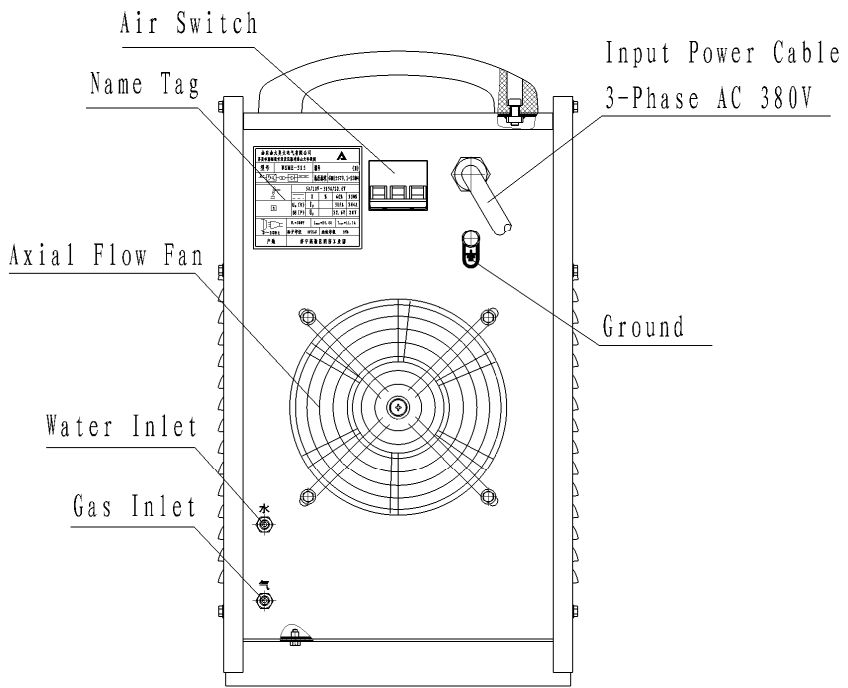


Fig.7: IN TIG-315 AC/DC Rear panel

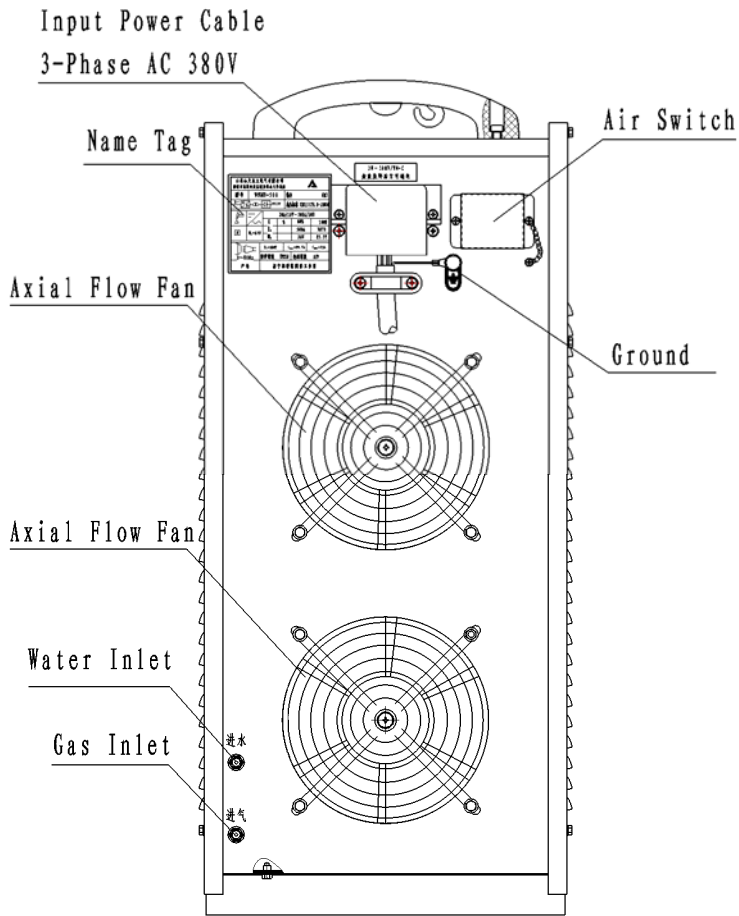
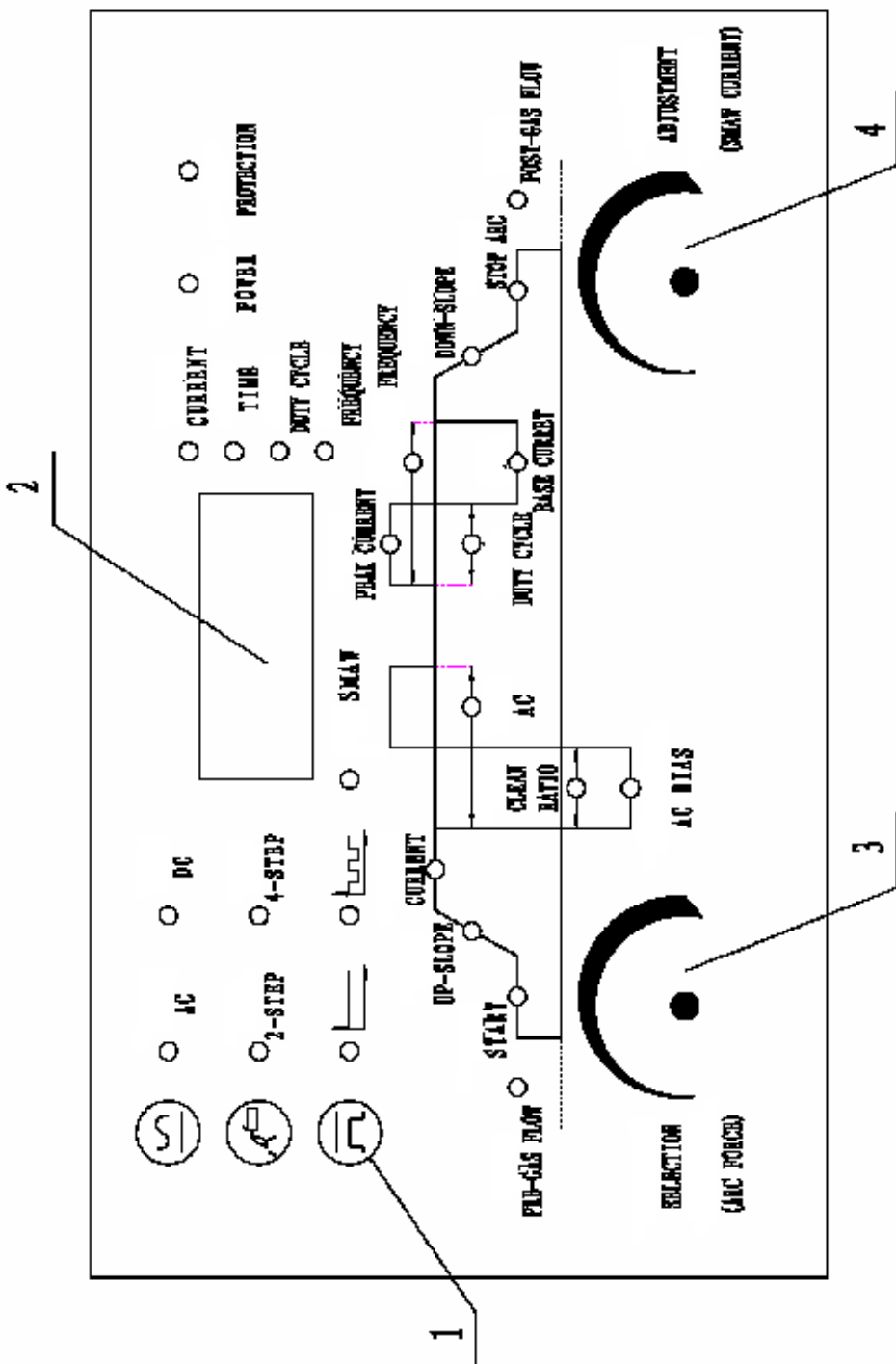
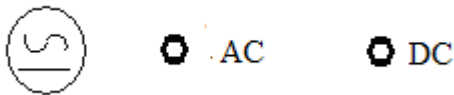


Fig.8: IN TIG-500 / 630 AC/DC rear panel

1.4 Control panel

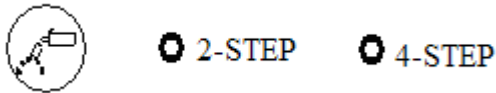
The control panel is shown as Picture 4, which is used to select welder functions and to set up parameters. The control panel is consisting of digital displayer, regulation knobs, and LED indication lamps.





1st line. DC TIG/AC square wave TIG

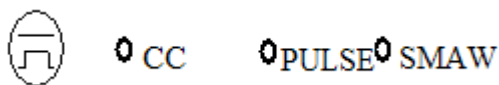
2nd line. 2-step (Non-Autolock)/4-step (Autolock)



When the lamp in 5th or 7th line is selected, the digital displayer will show values of respective parameter setting. They can be adjusted by pressing and tuning the regulation knob clockwise to increment, counter clockwise to decrement. Press the knob and tune simultaneously for quick setting.

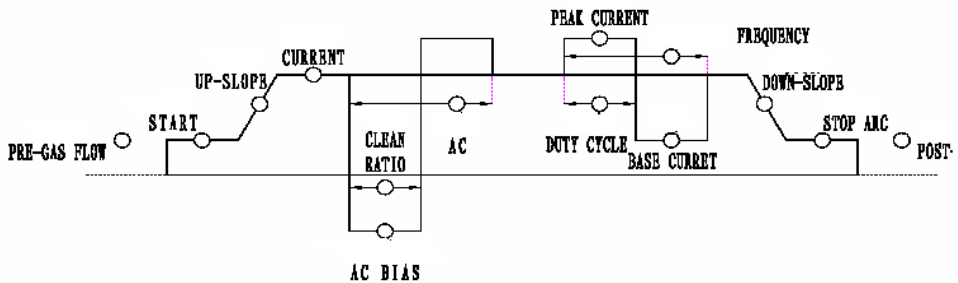
“2-step” refers to start welding while push torch trigger, stop welding while releasing it.

“4-step” refers to output starting-arc current while firstly pushing torch trigger, then current slopes up to where can welding normally while releasing it. When welding finished, current slopes down to where fills crater and maintains while pushing it again, then stop outputting current while releasing it.



3th line Constant current TIG/Pulse TIG /SMAW

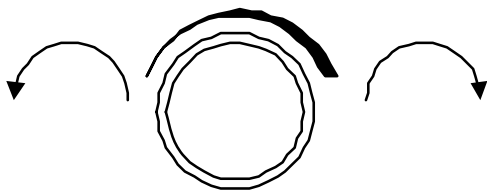


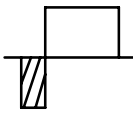
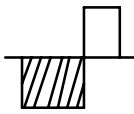
4th line



1.4.1 Glossary:

1. Pre-gas flow: Time elapse of gas flow before welding
2. Arc-start: Min current of start arc
3. Up-slope: Time elapse of welding current slopes up
4. Constant current: welding current on output constant current
5. Oxide clean ratio: time ratio of output clean current

While in AC TIG, regulate clean width and penetration to obtain optimum welding quality.

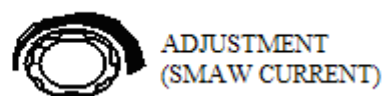
Control panel		
Clean effect	 Narrow & deep	 Wide & shallow
Wave form of current		
Consumption of tungsten electrode	More	Less

6. AC Bias: Ratio of clean current dividing by welding current.

By adjusting the parameter, as to adjusting clean current result in reasonable oxide clean effect.

Suggestion: At the same clean effect, reduce clean ratio and increase AC bias to obtain deeper penetration, higher productivity and prolong tungsten electrode lifespan.

7. AC frequency: Frequency of output AC
8. Peak: Peak value of output pulse
9. Pulse ratio: Time ratio between length of peak value current and length of whole single pulse applied in pulse TIG, can be easily used for controlling penetration in all-position or thin sheet welding.
10. Pulse frequency: Output pulse frequency
11. Base current: Arc maintenance current of output pulse
12. Down –slope: Time of welding current slopes down
13. Crater filling: Welding current of crater filling.
14. Post-gas flow: Time of gas flow after ending welding



Function selection knob: Used for shifting modes illustrated previously. Tuning clockwise can select modes orderly from left to right, while select reversely by tuning counter-clockwise.

Parameters preset knob: Used for adjusting the values of parameters. Increase by tuning clockwise, reducing by tuning counter-clockwise. Press the knob and tune right or left for quick adjustment.

Welder can automatically save the set-up for next use while turning off the machine

1.4.2 “Protection” indicator lamp: lights on yellow and stops

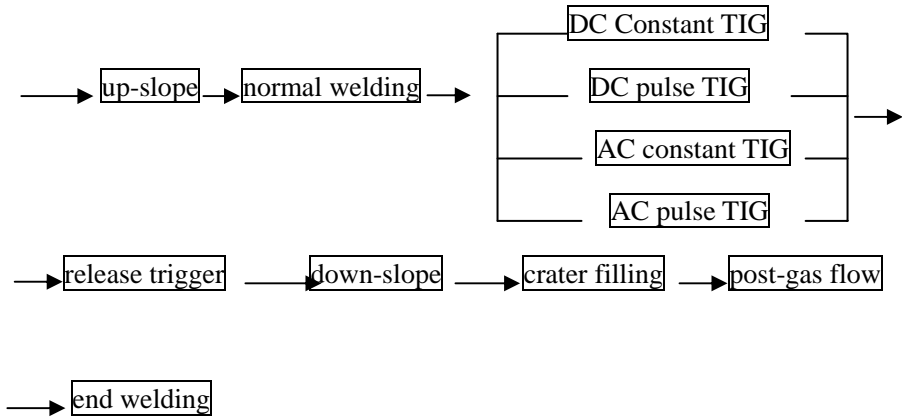
welding automatically while in overheat, over-current, over-voltage or water insufficient, but will not light on while in normal welding. Protection codes are illustrated below:

- 1 . Display 801: Over-voltage protection. Please turn off welder immediately and inform authorized reseller to repair.
- 2 . Display 802 or 803: Over-current protection. Please turn off welder immediately and inform authorized reseller to repair.
- 3 . Display 804: overheat protection. Please turn off welder immediately to cool it down.
- 4 . Display 805: Pulling torch trigger for a long time with no current or torch damaged. Repair welding torch or foot pedal
- 5 . Display 806(500,630 types): water insufficient protection. The default setting is “water cooled”. It does work while using a water-cooled torch at normal water circulation. When applied air-cooled torch, the welder’s protection lamp will light on and display “806” protection code. Press the Function selection and parameter preset knobs simultaneously for up to 3 seconds to eliminate water insufficient protection. Redo the same way to back to previous mode.

1.4.3 Power on/off lamp: It displays red when power on

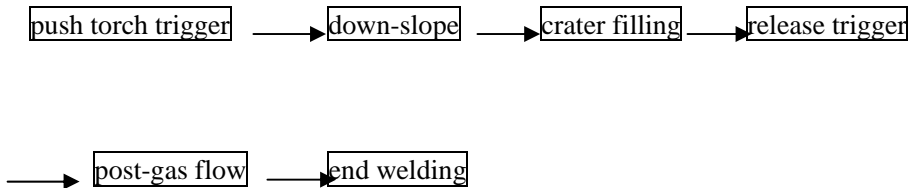
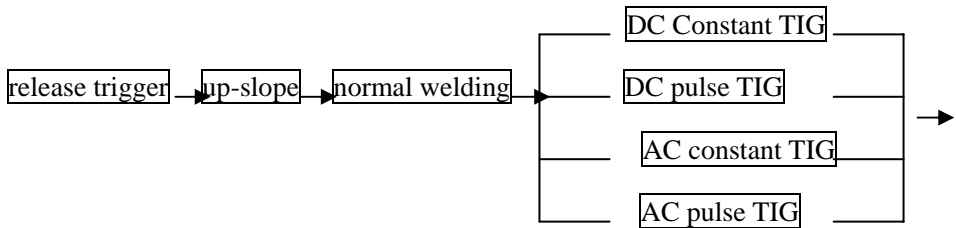
2. Operation procedure :

1). 2-step: push torch trigger → pre-gas flow → arc start → arc start current



2). 4-step:

push torch trigger → pre-gas flow → arc start → arc start current →



TIG welding parameters for Al and Al-Mg alloy (Only for reference)

Sheet/ plate thickness (mm)	Diameter of Tungsten electrode (mm)	welding current(A)	Wire diameter /mm	Argon flow rate/L.min ⁻¹	welding layer face/back	preheat temperature	Remark
1	2	40-60	1.6	7-9	Face 1		flange welding
1.5		50-80	1.6-2.0				flange welding or single side butt welding
2	2-3	90-120	2-2.5	8-12			butt welding
3	3	150-180	2-3				
4	4	180-200	3	10-15	1-2/1		v-shape bevel butt welding
5		180-240	3-4				
6	5	240-280	4	14-16	1-2/1		
8		260-320	4-5		2/1	100	
10		280-340			3-4/1-2	100-150	
12	5-6	300-360	5-6	16-20	3-4/1-2	150-200	
14		340-380				180-200	
16					6	4-5/1-2	
18		200-240					
20	6-7	360-400	5-6	20-22	2-3/2-3	200-260	
16-20		340-380	16-22	3-4/3-4			
22-25		360-400	20-22	3-4/3-4			

SMAW welding parameters (Only for reference)

workpiece thickness (mm)	< 1	2	3	4 ~ 5	6 ~ 12	≥ 13
welding electrode diameter (mm)	1.5	2	3.2	3.2 ~ 4	4 ~ 5	5 ~ 6
welding current (A)	20 ~ 40	40 ~ 50	90 ~ 110	90 ~ 130	160 ~ 250	250 ~ 400

Repair & Maintenance

In principle welders maintenance will be completed by us. Operators will be instructed by us to solve the problems which they come across in using.

Warning: Should not open up case freely, the max volt inside machine will be 600V. Customers must take safe precautions preventing from being electric shock while in maintenance.

1. Apparently misunderstood failures

Normal phenomenon occurs in welding

- (1) Welder doesn't work while in pretty low input volt.
- (2) When welder has worked for a long time in high temperature or in high welding current context, the thermal-sensitive circuit breaker will tripped to stop welder working, protection lamp will light on and LED will show "804" protection code. Welder will automatically reinstate after merely running up for several minutes in open load (not necessarily shut down welder).
- (3) When welder has worked for a long time in high temperature or in high welding current context, the circuit breaker on the rear panel will tripped to power off. When this situation occurs, please switch off the disconnected switchboard, and then halt the welder lasting at least five minutes to restart. When restarting the welder, please reset the circuit breaker firstly, then turn on the disconnect switchboard or switch box to power on welder, finally use for welding after running up for several minutes in open load.

2 . Attention

The input volt range is must between 340-420V, and no phase missing.

- (1) Check if the ground lead is connected correctly and firmly
- (2) Must connect welding cable to terminal plug socket firmly, otherwise will burn out the terminal which lead to welding process instability.
- (3) The direction of cooling fan rotary should be in line with requirement.
- (4) Power off as soon as finished welding
- (5) When use in outdoor, make sure welder be shielded from rains or snows, but don't block air circulation.

3. Troubleshooting

3.1 Routine checking procedure prior to maintenance

- (1) Check if the input volt has the phase to be lost, and range are between 340-420V.
- (2) Check if input primary power cable is connected correctly and firmly.
- (3) Check if the ground lead is connected correctly and firmly.
- (4) Check if the cables are connected correctly and firmly

3.2 Ordinary failures, probable cause and countermeasures refer to Appendix A

4. Periodical check and maintenance

- (1) Must remove dust from power resource with pressure air by authorized maintainer each year as well as checking if the jointers become loosen. Must check frequently if quick plug or terminal socket is loosely connected, knobs are loose, at least per month.
- (2) Must check timely if knobs become loosen.

Technical data

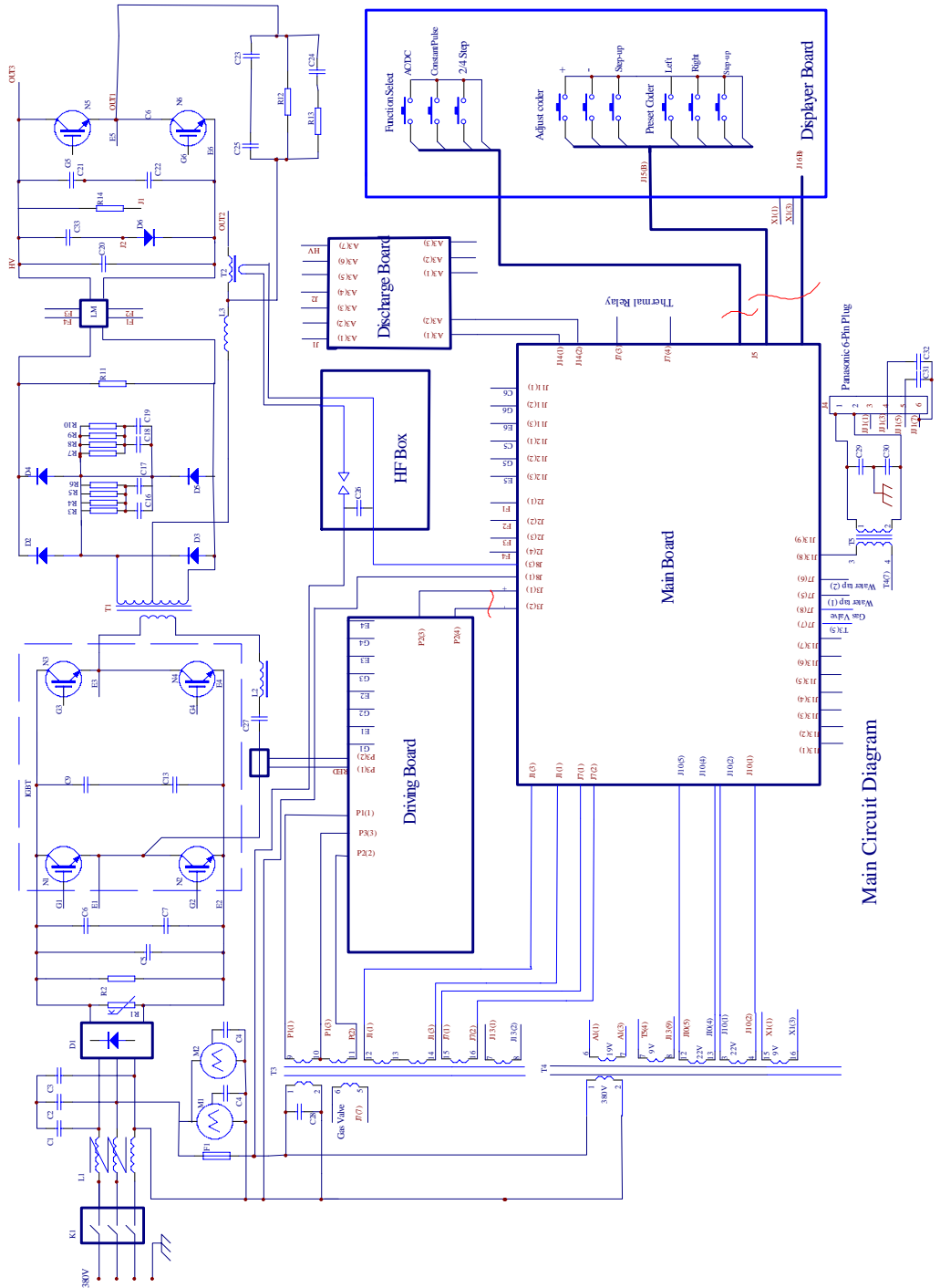
1. Main technical parameters

	IN TIG-315 AC/DC	IN TIG-500 AC/DC	IN TIG-630 AC/DC
Rated input volt	3 phases 380V±10%/50Hz		
Rated input capacity	9.3KVA	18.2KVA	30KVA
Rated input current	14.4A	29.7A	55A
Constant current	5-315A	20-500A	20-630A
Peak current	5-315A	20-500A	20-630A
Welding current for SMAW	20-315A	20-500A	20-630A
Arc force current for SMAW	10-200A		
Base current	5-315A	20-500A	20-630A
Arc-start current	20-160A		
Crater fill current	5-315A	20-500A	20-630A
Pulse ratio	1-100%		
AC bias	-50% ~ +30%		
Pulse frequency	0.2-50Hz		

Pre-gas flow	0.1-15s		
Post-gas flow	0.1-15s		
Up-slope	0.2-10s		
Down -slope	0.1-15s		
Oxide clean ratio	-40% ~ +40%		
Rated duty cycle	60%	60%	35%
Voltage in open load	64V	76V	76V
Efficiency	79%	77%	
Power factor	0.95		
Insulation degree of main transformer	H		
Insulation degree of output reactor	B		
Weight	40Kg	70Kg	80 Kg

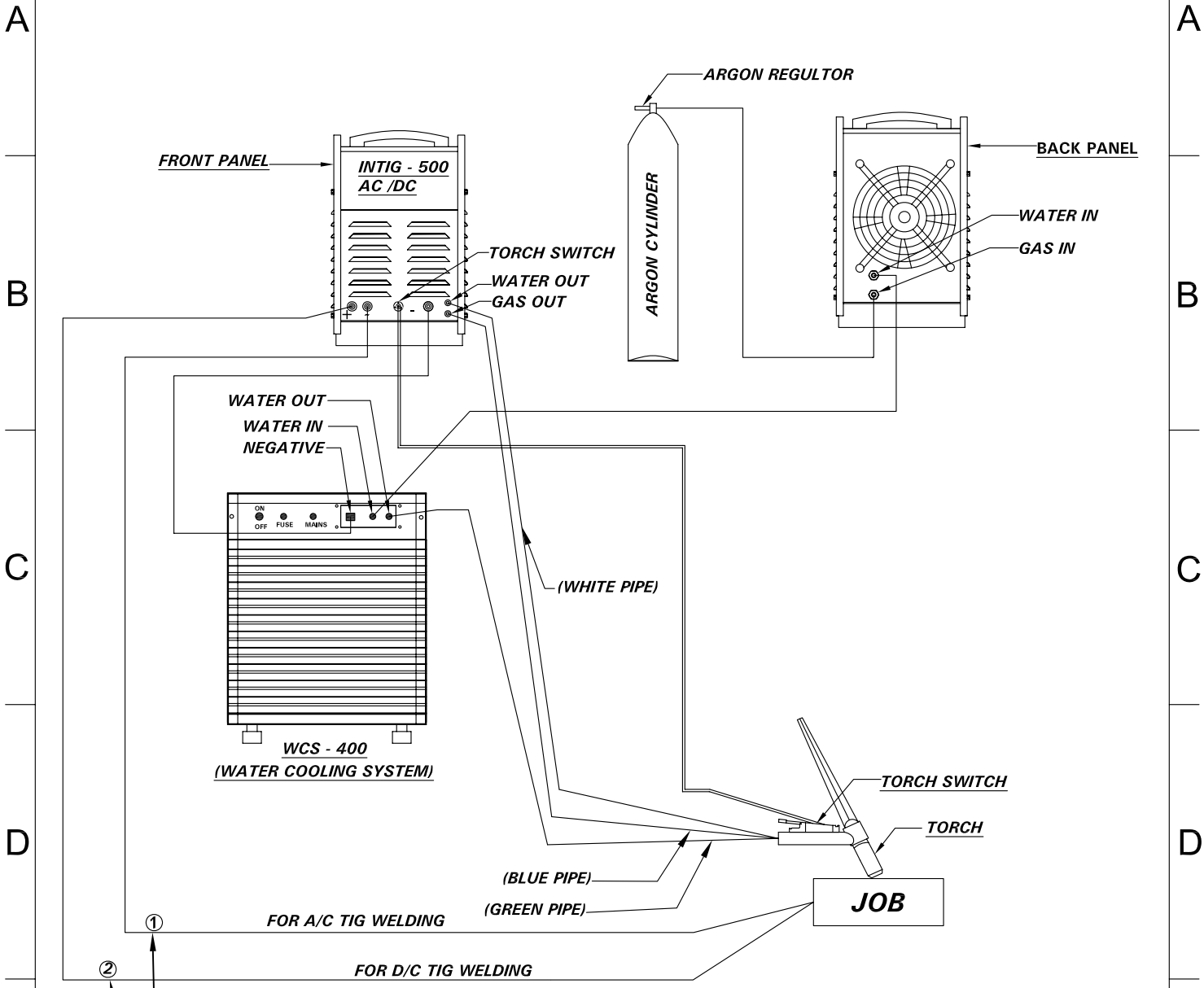
2. Main circuit diagram (1) IN TIG-315 AC/DC

(2) IN TIG-500 / 630 AC/DC




Main Circuit Diagram

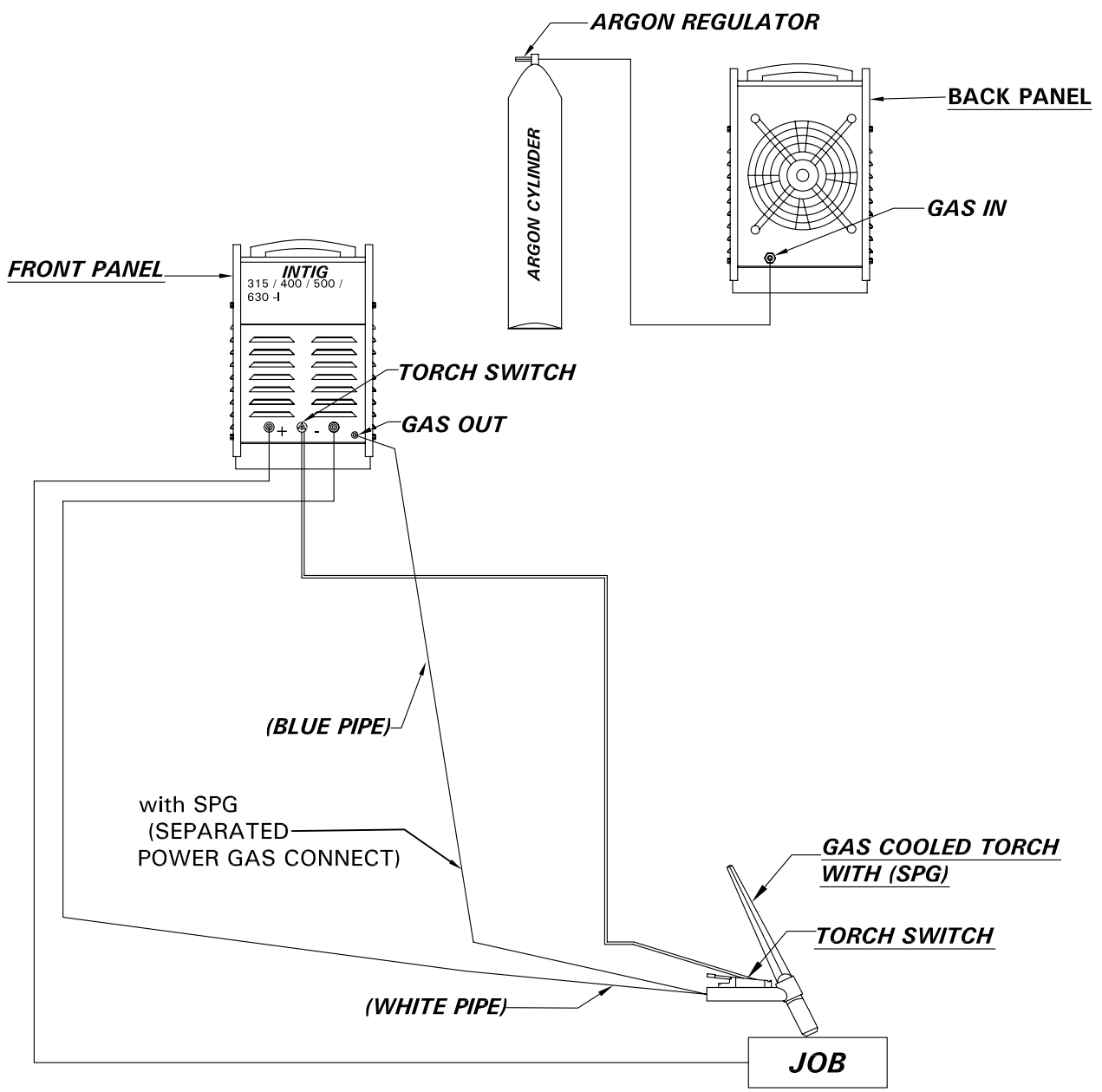
1	2	3	4
RevNo	Revision note	Date	Signature
			Checked



NOTE:- EITHER 1,2 SHOULD BE CONNECTED AS PER REQUIREMENT, BOTH CABLE SHOULD NOT BE CONNECTED SIMULTANEOUSLY.


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Drawn by Shrutika	Checked by Prabhudas	Approved by Ramakanth	File name Inverter	Date 23-06-2010	Scale 1:1
 AN ISO 9001-2008 CERTIFIED COMPANY		MACHINE NAME:- INTIG-315 / 400 / 500 / 630 AC-DC WITH WCS-400			Drawing No.
		MODEL:- INVERTER			
		PART NAME:- INSTALLATION DIAGRAM			

1	2	3	4
RevNo	Revision note	Date	Signature
			Checked



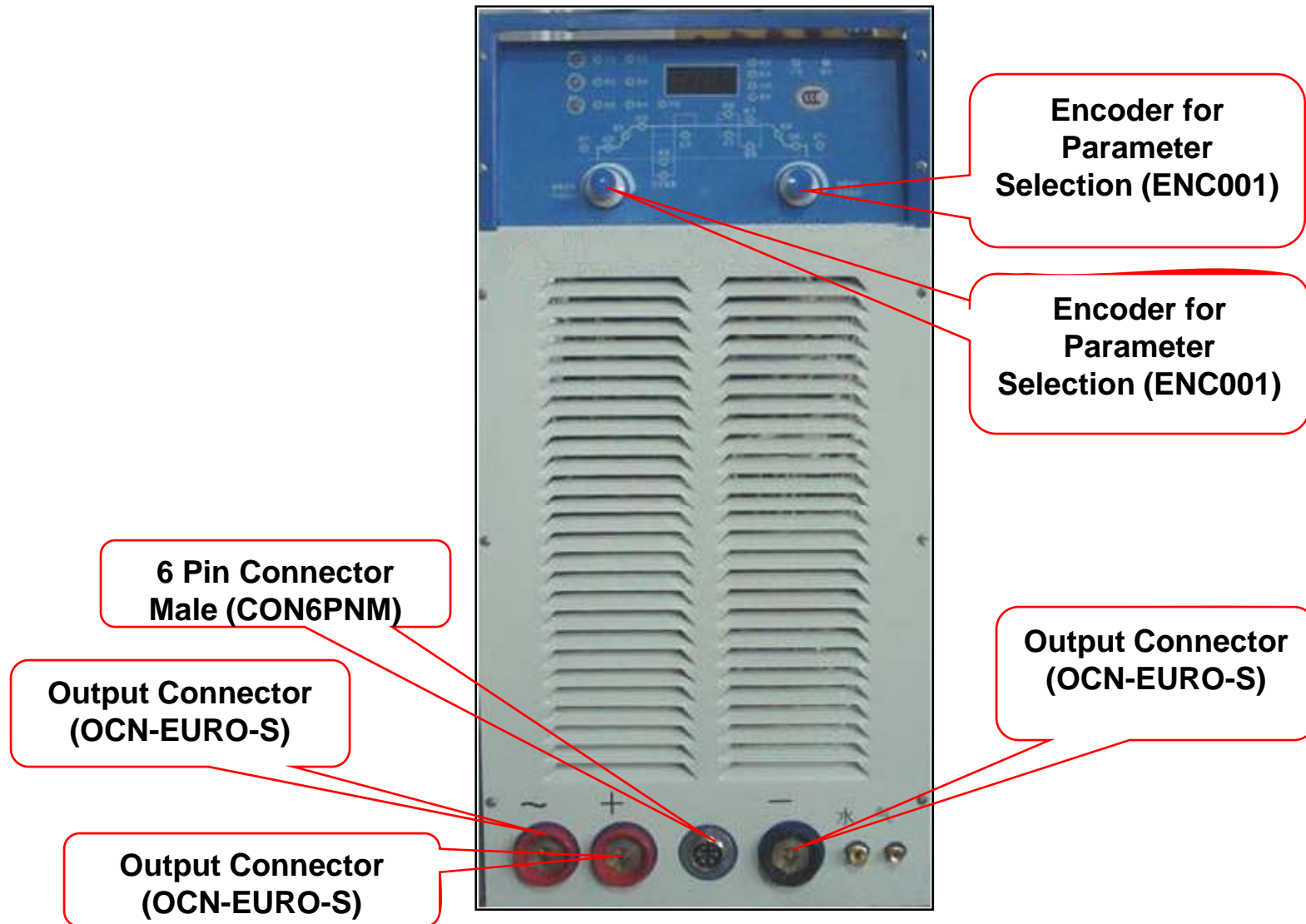
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KANDIVLI(W),MUMBAI-400 067(INDIA).PHONE:-022-8687298 / 022-29672013 / 14. FAX:- 022-28687919.
E-mail:-warpp@vsnl.com. Website:- www.warpp.co.in

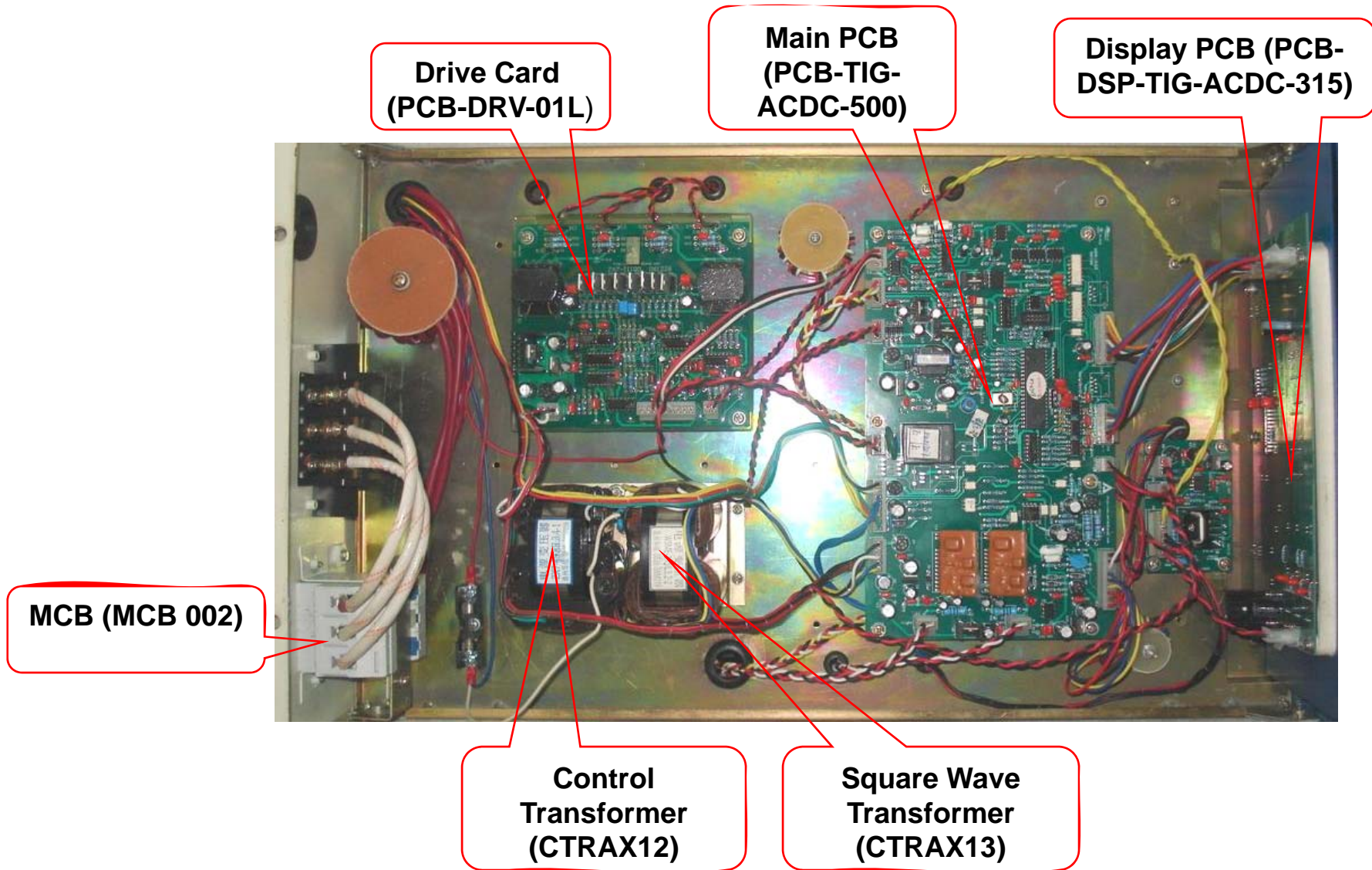
Drawn by Shrutika	Checked by Prabhudas	Approved by Ramakanth	File name Inverter	Date 23-06-2010	Scale 1:1
 <p>AN ISO 9001-2008 CERTIFIED COMPANY</p>		MACHINE NAME:- INTIG-315 / 400 / 500 / 630 AC-DC WITHOUT WCS-400			Drawing No.
		MODEL:- INVERTER			
		PART NAME:- INSTALLATION DIAGRAM			

No	Trouble	Probable cause	Remedies
1	Indicator lamp does not light on and doesn't work when machine switches on.	(1) Phase missing (2) Fuse size (2A) breaks (3) Input cable break down	(1)Inspect power source (2)Inspect fan, power source transform and control board are in good condition or not (3)Inspect cable
2	Air switch trips automatically while welder working on without big welding current for long time	The following components may probably damaged : IGBT module, 3 phase rectified module, output diode module, other components Short circuited	(1)Inspection and replacement (2)When IGBT module breakdown, check if resistors 12Ω . 5.1Ω and SR160 on driving board are damaged or not.
3	Welding current is not stable.	(1) Phase missing (2) Main control board is damaged.	(1)Inspect power source (2)Inspection and replacement
4	Welding current is not adjustable.	(1) Conductive wire broken. (2) Main control board is damaged. (3) Coder is damaged	Inspection and replacement
5	Display 801 protection code (overvolt))	(1) Secondary IGBT module is damaged (2) Main board is damaged	Replace secondary IGBT module and main board
6	Display 802 or 803 protection code (overcurrent)	(1) Secondary IGBT module is damaged (2) Main board is damaged	Replace secondary IGBT module and main board
7	Display 804 Protection code (overheat)	(1) Welding current is too large (2) Context temperature is too high. (3) Thermal relay is damaged	(1) Working in open load, idle and cooling down (2) Replace thermal relay
8	Display 805 protection code	(1) Torch trigger has been pushed for a long time in open load (2) Welding torch trigger or foot pedal switch are damaged	(1) Inspect the torch or foot pedal switch and replace it (2) Release the trigger
9	Display 805 protection code(water insufficient)	(1) No water supply (2) Bad water circulation (3) Water valve, water circulator or torch are damaged	(1)Connect to water supply (2)Inspect water circulation (3)Replace the valve, circulator or torch

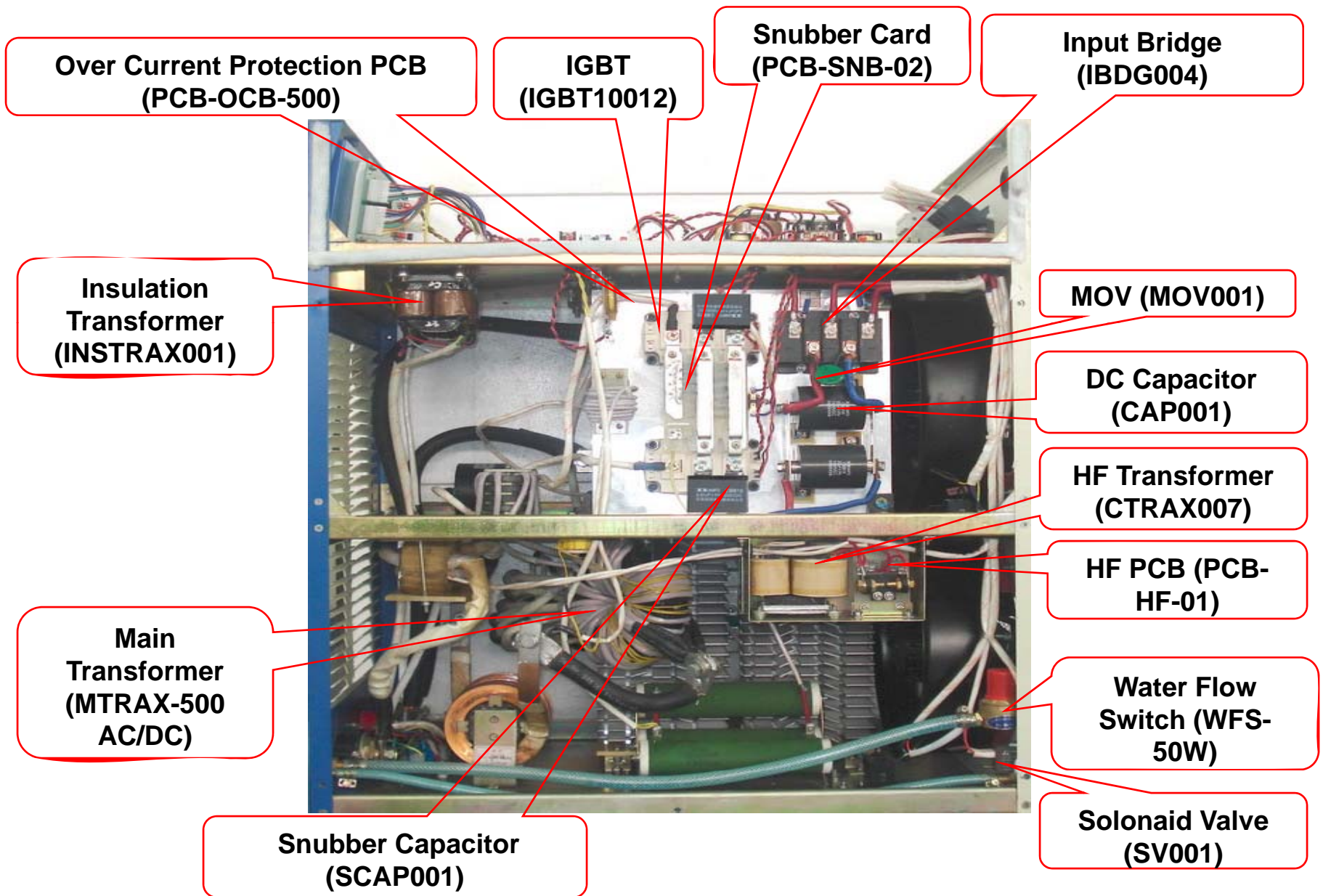
1.1 INTIG 500 AC/DC Front Panel



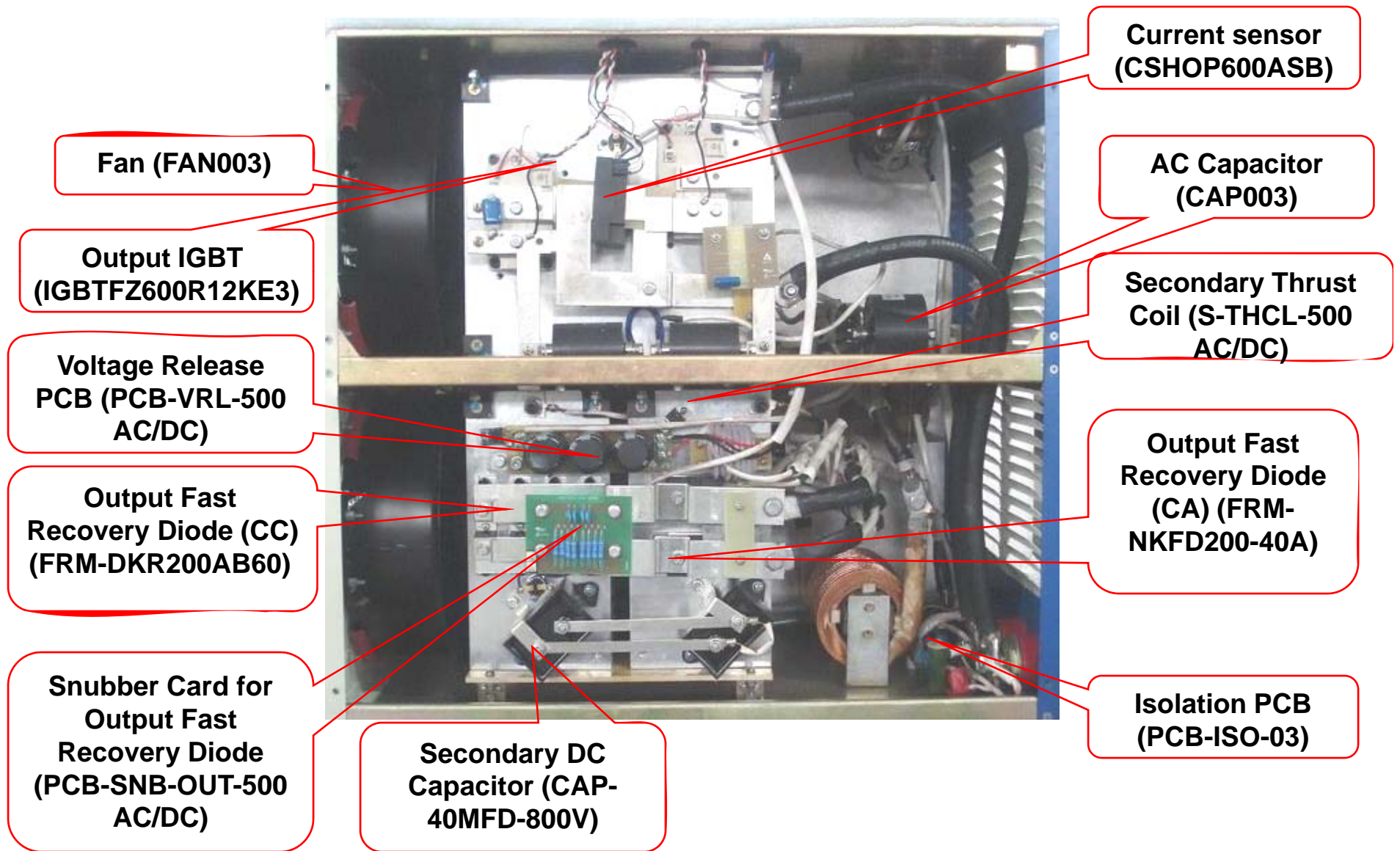
1.2 INTIG 500 AC/DC Top View



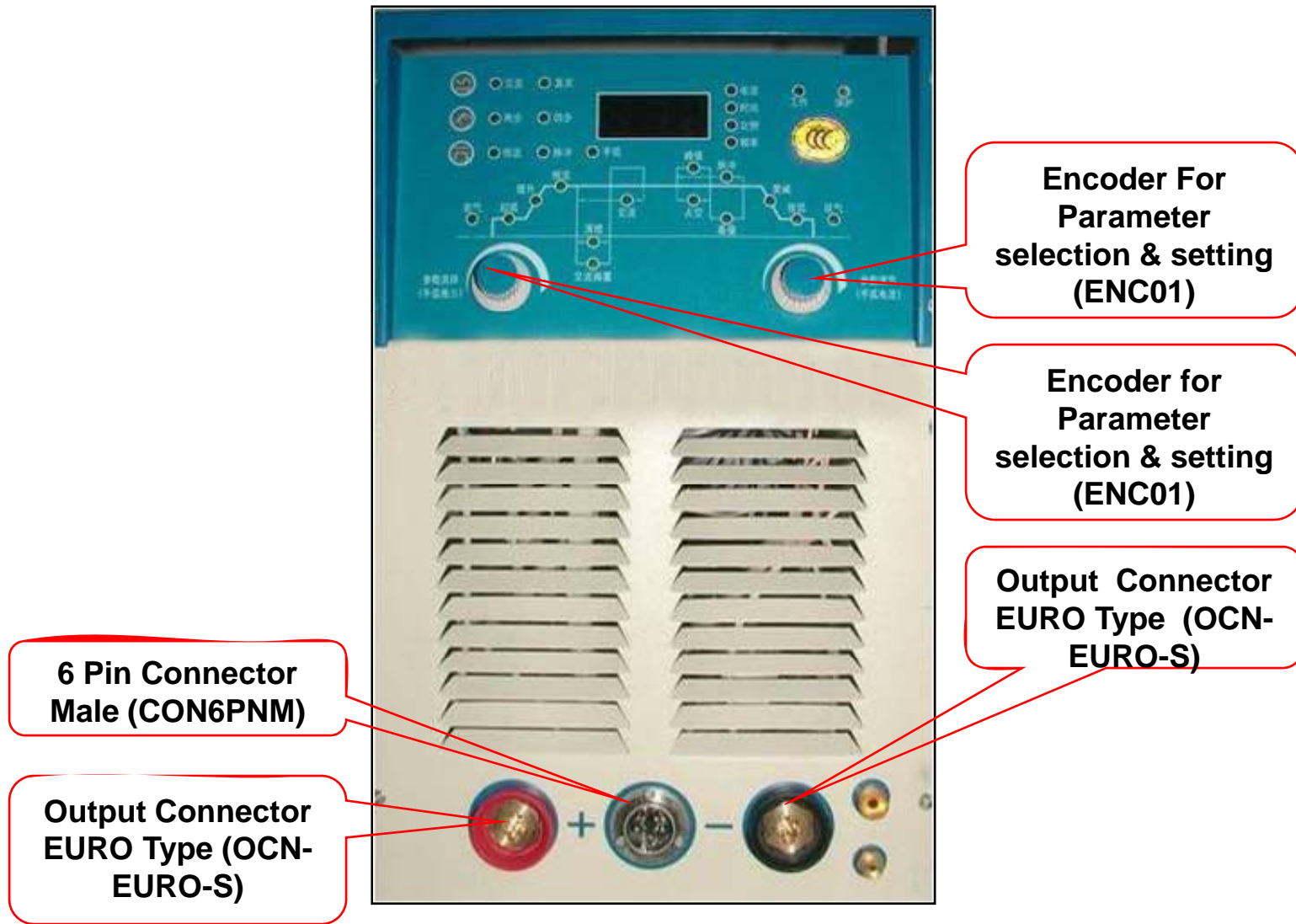
1.3 INTIG 500 AC/DC Right View



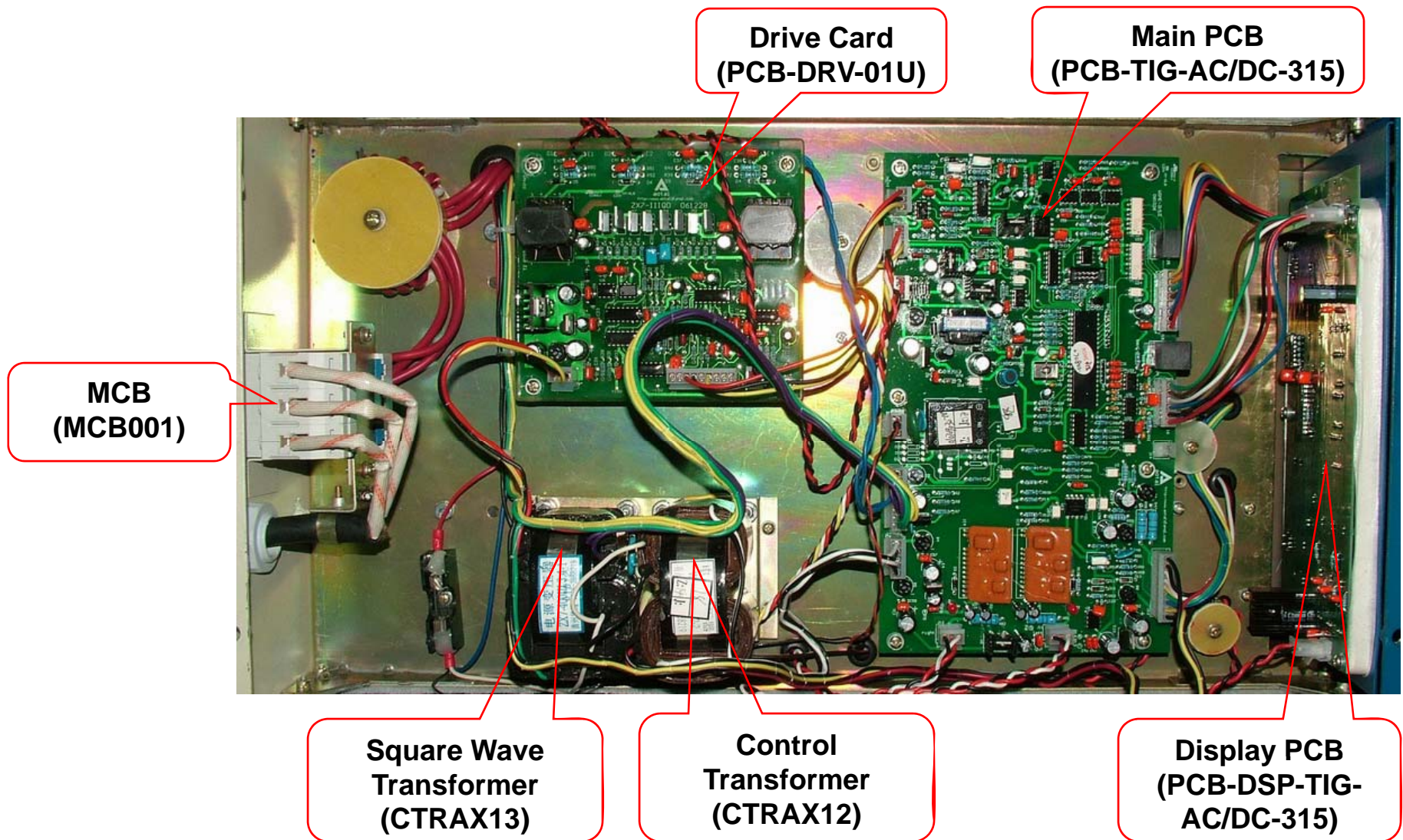
1.4 INTIG 500 AC/DC Left View



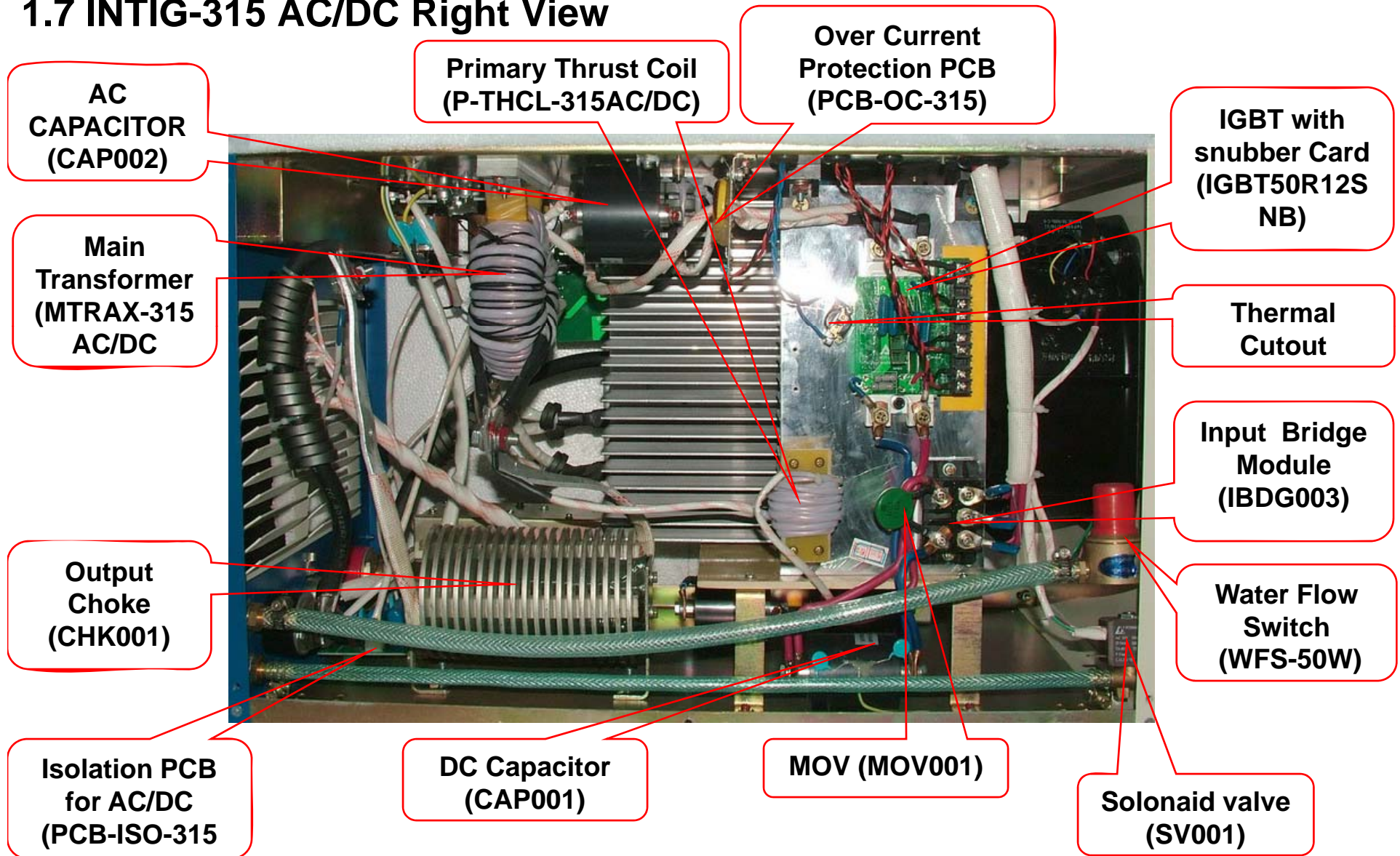
1.5 INTIG-315 AC/DC Front Panel



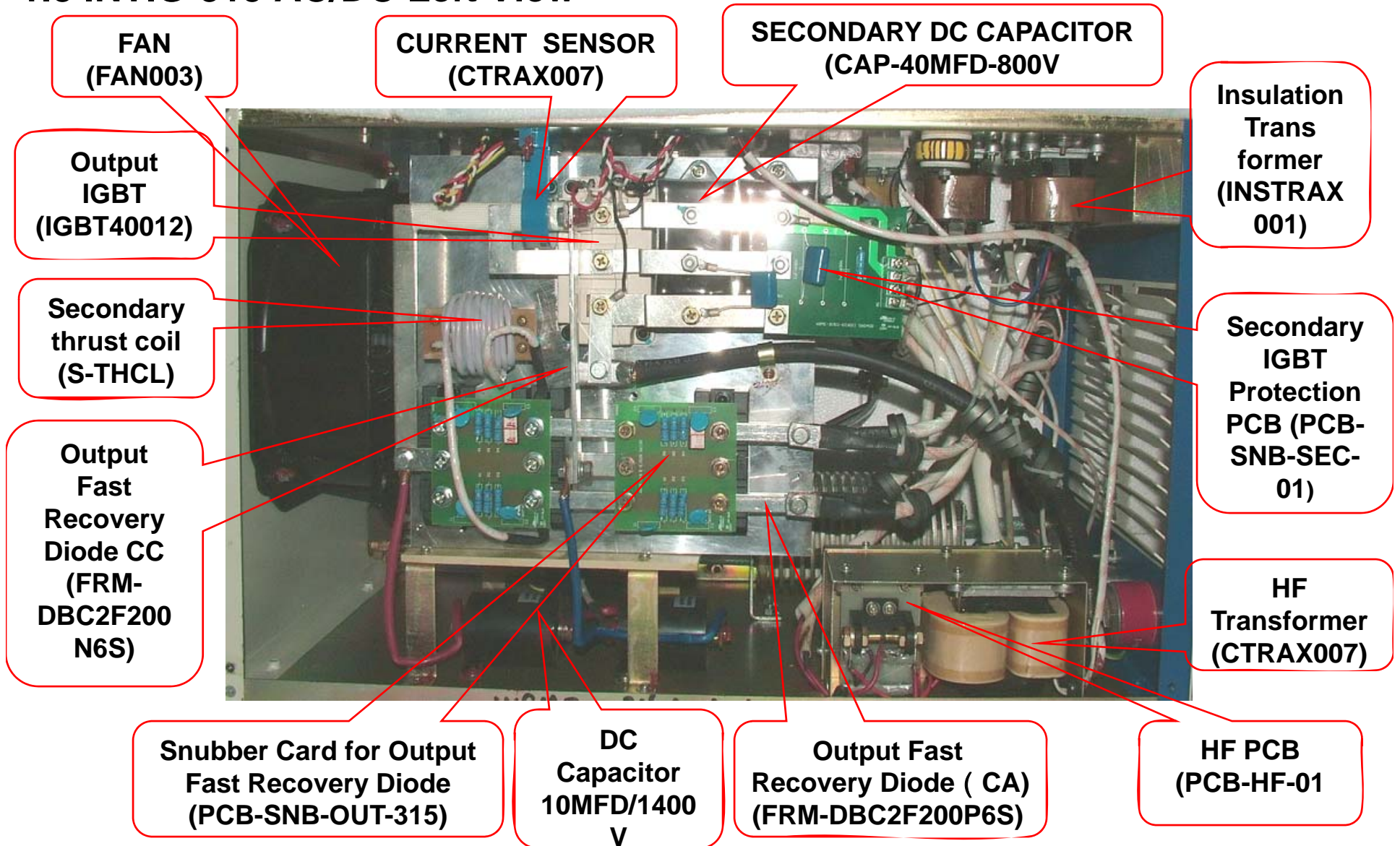
1.6 INTIG-315 AC/DC Top View



1.7 INTIG-315 AC/DC Right View



1.8 INTIG-315 AC/DC Left View



List for the spare of INTIG AC/DC Series Machine		
	INTIG-315 AC/DC	INTIG-500 AC/DC
Description	Part Code	Part Code
MAIN PCB	PCB-TIG-AC/DC-315	PCB-TIG-AC/DC-500
DRIVE CARD	PCB-DRV-01U	PCB-DRV-01L
DISPLAY PCB	PCB-DSP-AC/DC-315	PCB-DSP-TIG-AC/DC-500
DC CAPACITOR	CAP001	CAP001
AC CAPACITOR	CAP002	CAP003
INPUT BRIDGE MODULE	IBDG003	IBGD004
INPUT SURGE SUPPRESSOR	ISS001	ISS001
CONTROL TRANSFORMER	CTRAX12	CTRAX12
SQUARE WAVE TRANSFORMER	CTRAX13	CTRAX13
INSULATION TRANSFORMER	INSTRAX001	INSTRAX001
MCB	MCB001	MCB002
IGBT WITH SNUBBER CARD	IGBT50R12SNB	NA
IGBT	NA	IGBT10012
SNUBBER CARD	NA	PCB-SNB-02
SNUBBER CAPACITOR	NA	SCAP001
OUT PUT FAST RECOVERY DIODE (CC)	FRM-DBC2F200N6S	FRM-DKR200AB60
OUT PUT FAST RECOVERY DIODE (CA)	FRM-DBC2F200P6S	FRM-NKFD200-40A
OUT PUT IGBT FOR INTIG-315 AC/DC	IGBT40012	NA
OUT PUT IGBT FOR INTIG 500 AC/DC	NA	IGBTFZ600R12KE3
MAIN TRANSFORMER	MTRAX-315 AC/DC	MTRAX-500 AC/DC
FAN	FAN003	FAN003
SECONDARY IGBT PROTECTION PCB	PCB-SNB-SEC-01	NA
VOLTAGE RELEASE PCB	PCB-VRL-315 AC/DC	PCB-VRL-500AC/DC
SNUBBER CARD FOR OUT PUT FAST RECOVERY DIODE	PCB-SNB-OUT-315 AC/DC	PCB-SNB-OUT-500 AC/DC
SECONDARY DC CAPACITOR	CAP-40MFD-800V	CAP-40MFD-800V
CURRENT SENSOR	CS-CSK1-300A	CSHOP600ASB
HF TRANSFORMER	CTRAX007	CTRAX007
HF PCB	PCB-HF-01	PCB-HF-01
ISOLATION PCB FOR AC/DC	PCB-ISO-03	PCB-ISO-03
SOLONAID VALVE	SV001	SV001
OVER CURRENT PROTECTION PCB	PCB-OC-315	PCB-OC-500
DC CAPACITOR 10MFD-1400V	CAP-10MFD-1400V	CAP-10MFD-1400V
ENCODER FOR PARAMETER SELECTION AND SETTING	ENC01	ENC01
OUT PUT CONNECTOR EURO TYPE WITH STRIP	OCN-EURO-S	OCN-EURO-S
6 PIN CONNECTOR MALE	CON6PNM	CON6PNM
6 PIN CONNECTOR FEMALE CABLE SIDE	CON-6-CM-01	CON-6-CM-01
PRIMARY THRUST COIL	P-THCL-315 AC/DC	P-THCL-500 AC/DC
SECONDARY THRUST COIL	S-THCL-315 A/CDC	S-THCL-500 AC/DC
WATER FLOW SWITCH	WFS-50W	WFS-50W