Creative Energy to the World
EN TECHNOLOGIES

USER MANUAL

EnerPulse 5 (v2.3)

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Contents

Chapter 1. Introduction

1.1 Manual Outline

This manual is designed for those people who will be installing and operating the EN's power unit. It provides the information required to safely install and operating the power unit.
If used properly, the information contained in this manual will not only promote reliable power output performance, but will also encourage a safe operating for all customers.

〈Appearance〉

1.2 Warranty

This product is manufactured under strict quality control and inspection by the engineers at EN Technologies Inc.

EN Technologies Inc.'s warrants to the original purchaser for a period of 12 months from the date of delivery.

During the warranty period, products damaged under the proper usages will be repaired at request of the customers.

Damage caused by improper use or unauthorized modification of the device dose not constitute grounds for a warranty claim.

Chapter 1. Introduction

1.3 EMC/EMI Standards

This device has been tested for and complies with EMC standard(s):

* EN61000-6-2
* EN61000-6-4

1.4 Safety Notice supplement

This equipment complies with EN/IEC61010-1:2001
This equipment is MEASUREMENT CATEGORY II (CAT II)
This equipment is POLLUTION DEGREE 2, INDOOR USE product

Chapter 1. Introduction

1.5 Safety symbol


CAUTION


Protective earth ground


Alternating current.


Direct current

ON


OFF


CE label


This **Warning** sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.


This **Caution** sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to of destruction of part or all of the product.


Note denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

Chapter 2. General Description

2.1 Features

Superior Arc Management

Arc energy minimization method decreases damages on substrate during the process; resulting excellent thin film coating. Furthermore, process control parameters (arc level, time, etc.) for arc control, providing diverse process recipe for users.

High Performance and Reliability

Applied very stable control topology, realizing high-speed and precise output control during excessive status caused by load. Constant voltage, current, and power control is possible by output regulation selection. Applied system protection device through self diagnosis function.

Chapter 3. Specifications

3.1 Specifications

ITEM		CONTENTS	REMARK
ELECTRICAL SPEC.	Input voltage/ current	187VAC to 228VAC, 3-Phase, 4-wire; 50 to 60Hz; leakage current <3.5mA	
		<17Arms; 30A circuit breaker	
		198VAC to 242VAC, 3-Phase, 4-wire; 50 to 60Hz; leakage current <3.5mA	
		<16Arms; 30A circuit breaker	
		342VAC to 418VAC, 3-Phase, 4-wire; 50 to 60Hz; leakage current <3.5mA	
		<9Arms; 15A circuit breaker	
	Output power	5kW	
	Output Accuracy	<±0.2%(RATING OUTPUT)	
	Efficiency	>90%	
	Power factor	>0.9	
	Output Frequency	20kHz~150kHz	
	Pulse Output	1000V(6.25A)/400(12.5A) at Duty rate 25%	
	Reverse Time	DC mode, 1.5us~7us(Decrease according to Frequency)	See Fig 3-1
	Average Output	800V(6.25A)/400V(12.5A)	
	Max. Peak Voltage	Max. 1700V	
	Operating Range	See Fig 3-2	
	Regulation	Power/Current/Voltage	
	Arc energy	Less than 1mJ/1kW	
	Arc Detection time	Less than 0.4us	
	Arc control	Level, Delay/Pause time, etc See ARC Processing Menu	
	Communication	RS-232, RS-485	
	Interface	Host, Remote, Local	
	Sag	See Fig 3-3, 3-4	
	Analog Interface Scaling	0 ~ 10V(0 ~ MAX. value)	

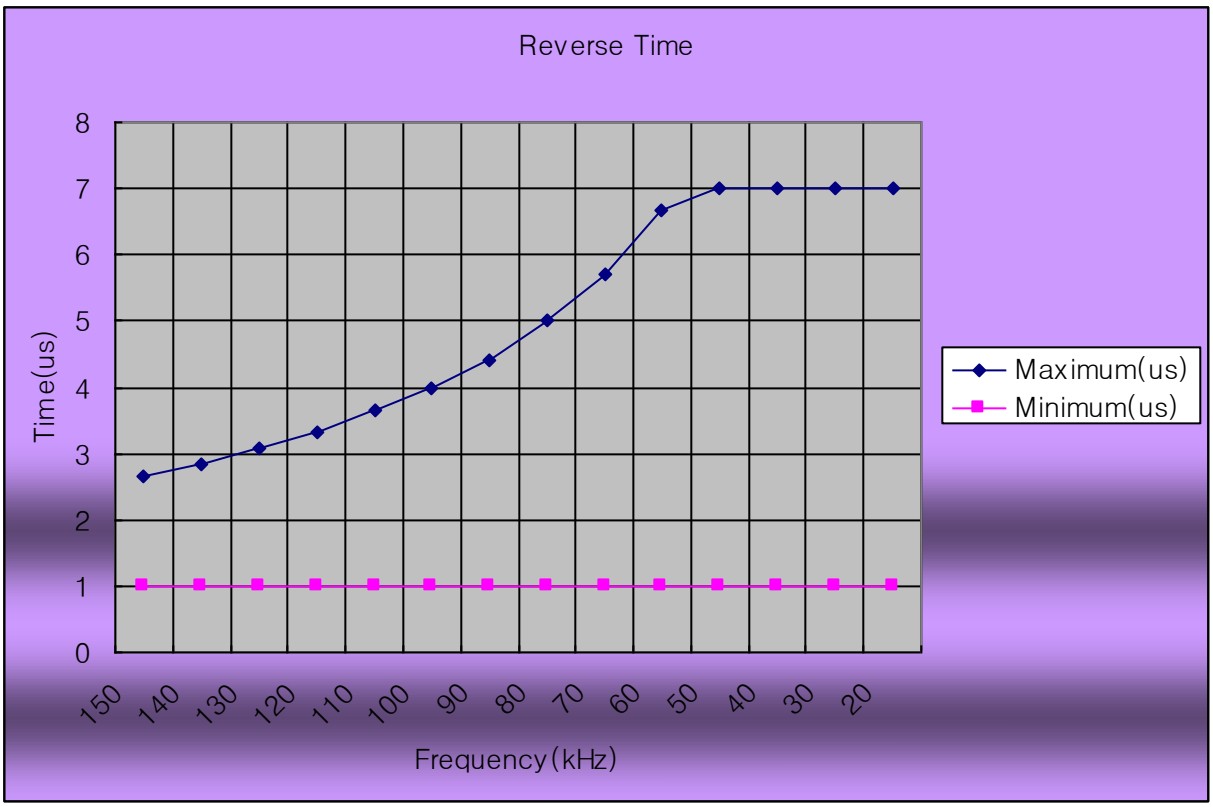
Chapter 3. Specifications

3.1 Specifications

ITEM		CONTENTS	REMARK
PHYSICAL SPEC.	Dimension [mm]	133[H]*483[W]*600[D]	
	Weight	29kg	
	Display	VFD(2line,20characters), Status LED	
ENVIRONMENTAL SPEC.	Operating Temp.	+5℃~40℃(Ambient Temperature)	
	Operating Humidity	5% to 85%	
	Operating Pressure	0 to 6,562ft(2000M) above sea level	
OPTION	Input cable	>3Phase, 6㎟	Optional
	Output cable	RG-214	Optional
	Output connector	SO-239(Amphenol)	

Chapter 3. Specifications

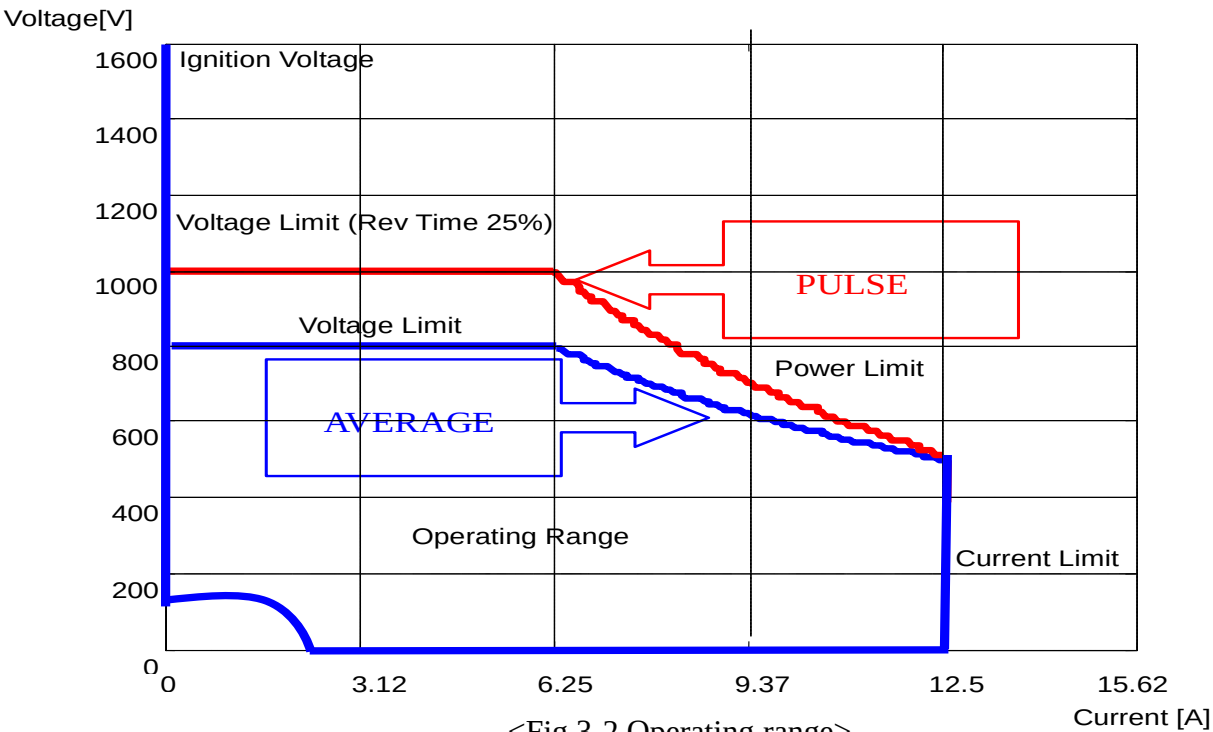
▶ Reverse Time curve at Operating Frequency.



<Fig 3-1. Reverse Time Curve>

Chapter 3. Specifications

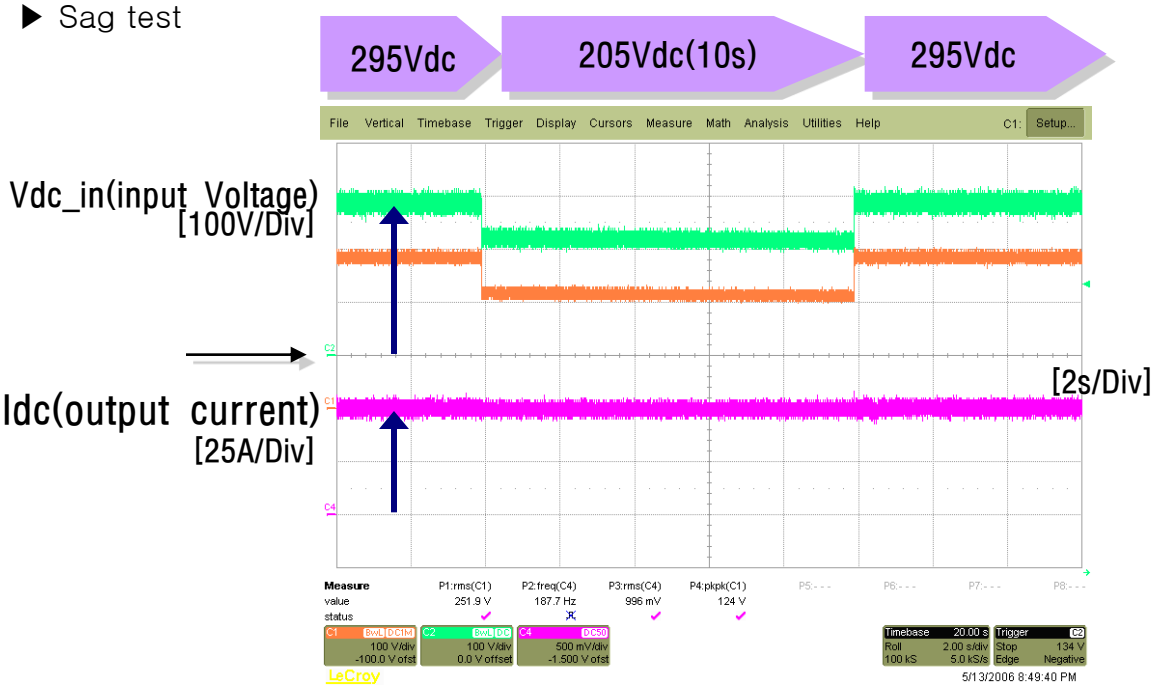
▶ Operating range



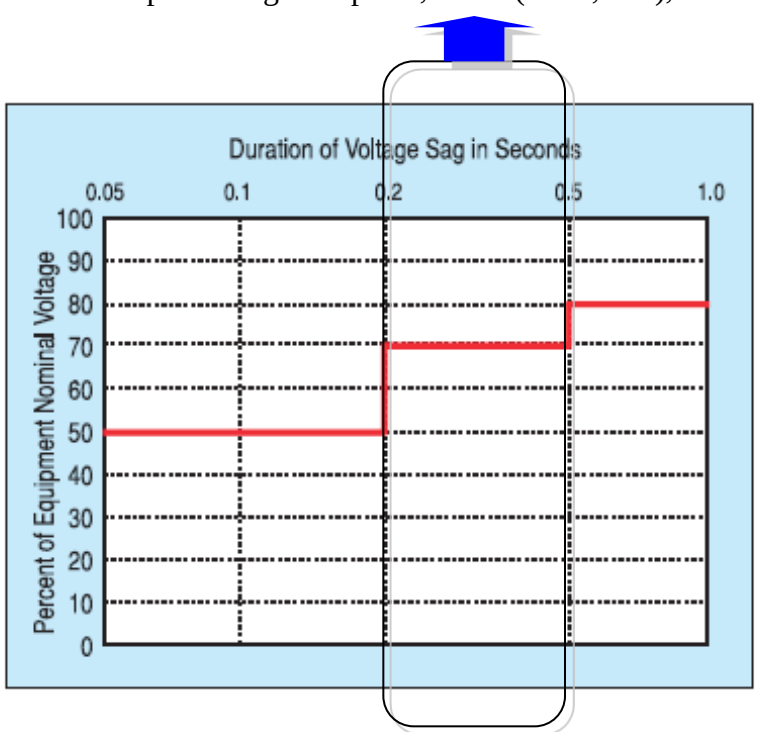
<Fig 3-2 Operating range>

Chapter 3. Specifications

▶ Sag test

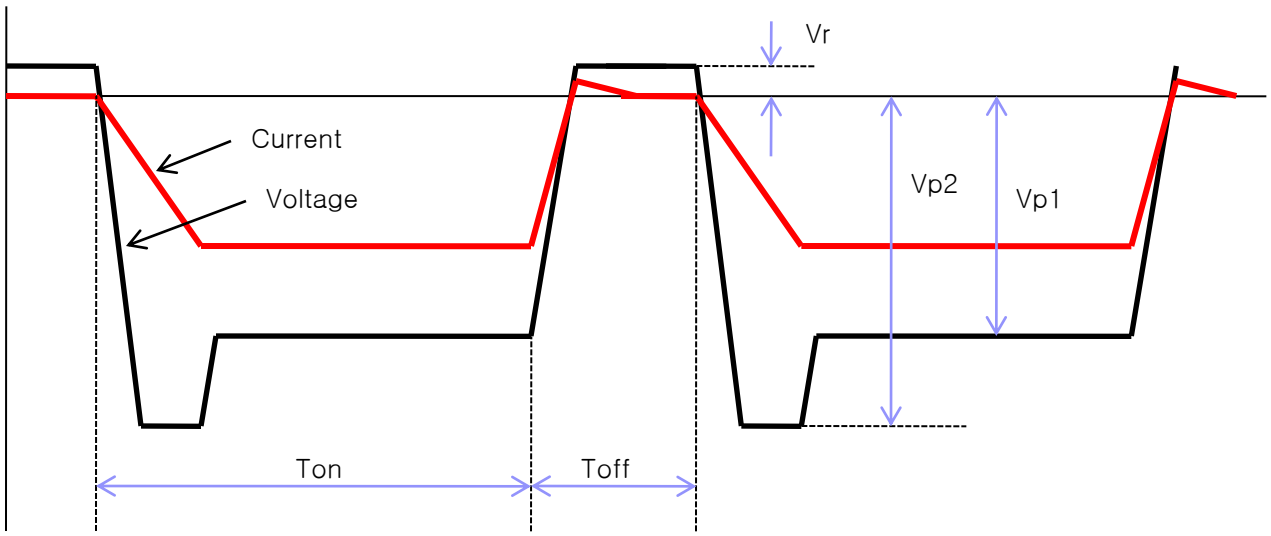


< Fig 3-3. 30% Input Voltage Drop test, 20kW(400V,50A), 10s >



<Fig 3-4 SEMI F47 SPEC.>

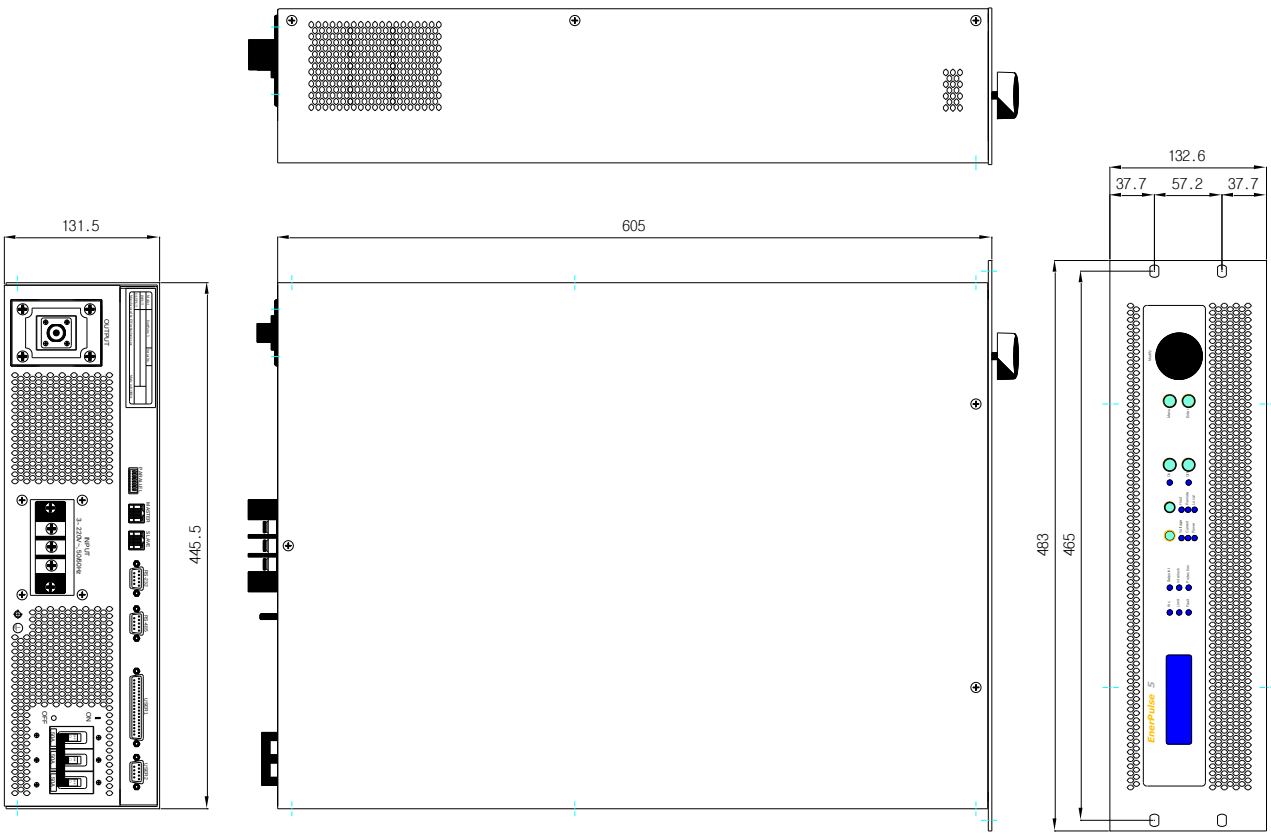
▶ Output Waveform



< Fig3-5. Pulse waveform >

- * Vp1 : Nominal Pulse Voltage
- – Adjustable by user
- * Vp2 : Imposed Voltage
- – Improved ionization and Ignition performance
- – Vp1 + dV, dV = 100~300V (default 100V)
- – Width depend on chamber condition (= current rising time), Not adjustable
- * Vo : Average value of Vp1

3.2 Dimension



<Dimensional drawing>

Chapter 4. Installation

4.1 Requirements

4.1.1 For the safe operation

▶ Condition of Use

To meet with the stated directives and standards, you must meet with the following conditions of use.

- This device must be installed according to the installation instruction of the manual
- To make any connection, connect the auxiliary protective earth ground stud on the rear panel.
- Must connect input power cables after checking the rated input power of the device.
- Use only a shield cable on the input power connector and on the output power connector.
- Do not use non-standard connectors for input and/or output power
- If your system does not have a circuit breaker, install and operate it with an approved circuit breaker on the ac input to provide the required over-current protection.

▶ Installation Location

Avoid excessive moisture.
Avoid extremely high temperature places.
Avoid places with frequent vibration.
Avoid dusty places.
Avoid air circulation is interrupted.

▶ Cautions

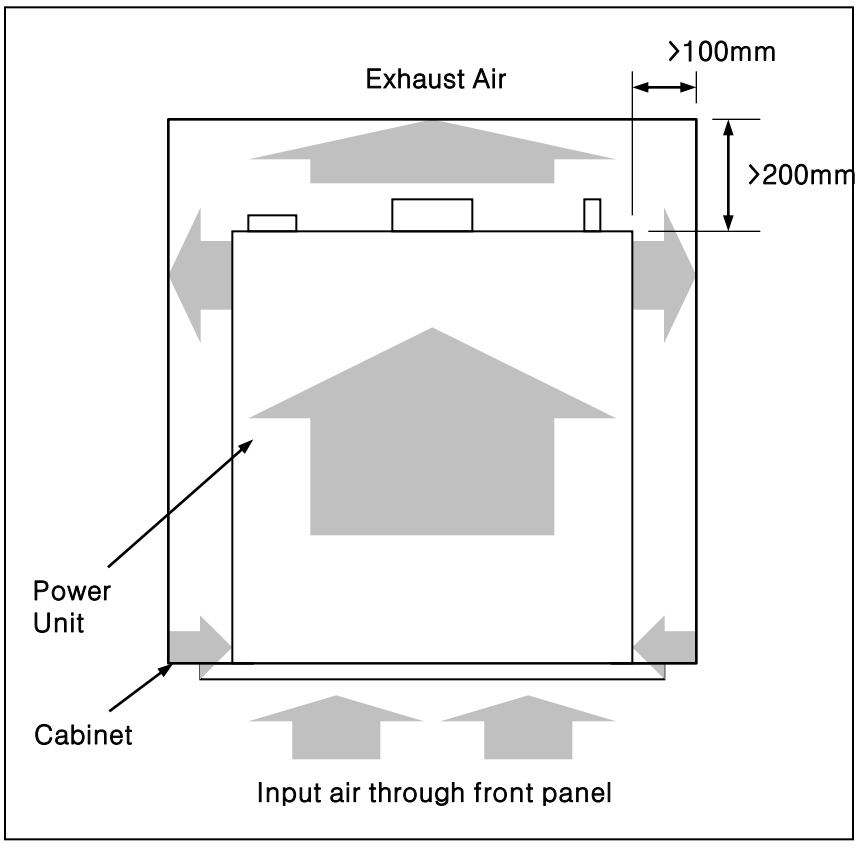
Use ground stud for your safety.

Use proper voltage.
(Prior to connecting input power, check whether it fits power supply's specifications)

Be cautious about disconnection of input & output cables.

4.1.2 Airflow requirements

Coolant each air inlet located on the unit's front panel and front-side panel provide for air intake.Exhausted warm air leaves the unit through coolant air outlets located on the unit's rear panel and rear-side panel
Consideration must be given to the power unit's installation so as not to impede the supply or flow of air to the unit.

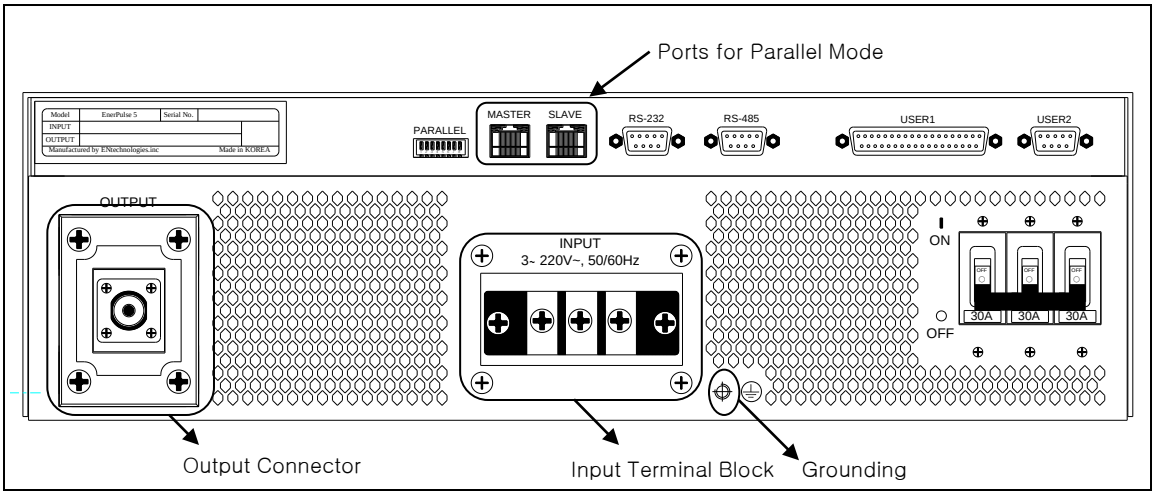


<Side clearance for the power unit in a cabinet>

If the space above-mentioned cannot guaranteed, The power supply may be Shut down on the operation. Please the circumstance temperature should be managed under 40degrees.

4.2 Connecting

4.2.1 Rear side connections



〈Rear side〉

*Please make sure to follow the connecting turn as below.

① Ground connection
Before making any other connection, connect a ground stud to earth ground. For your safety, use after grounding the power supply.(Leakage Current : < 3.5mA)

② Output power connecting
The standard output connector is SO-239.

③ Input power connection
Input terminal is made of 3Pin Terminal block.
The power unit' s input voltage is three phase, 50/60Hz. Note that no neutral connection is required.

▶ Warning

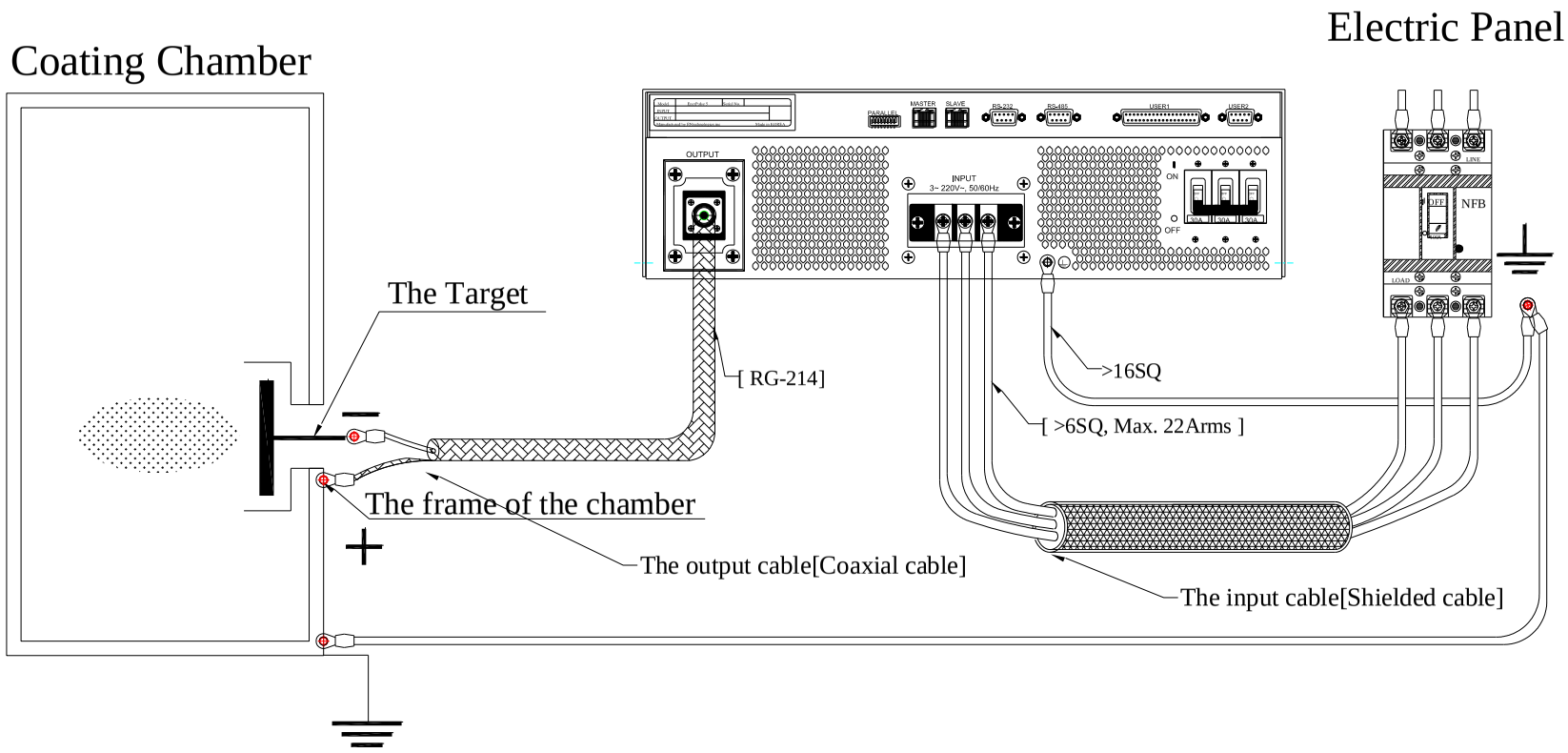
1.Off the Switch(NFB) on the main Electric panel, and then connect the cable in orders. If not, There would be a electrical shock.

2.Operating and maintenance personnel should be suitably trained before setting up and maintaining high-energy electrical equipment. This equipment has to be installed according to applicable requirement.

3.Do not apply RF power directly to the output of the device. It can cause damage to EN power supply. If you use both a RF power and EN power supply in the same system, put a RF filter in the system.

4.2 Connecting

4.2.2 The connection diagram of the Power supply



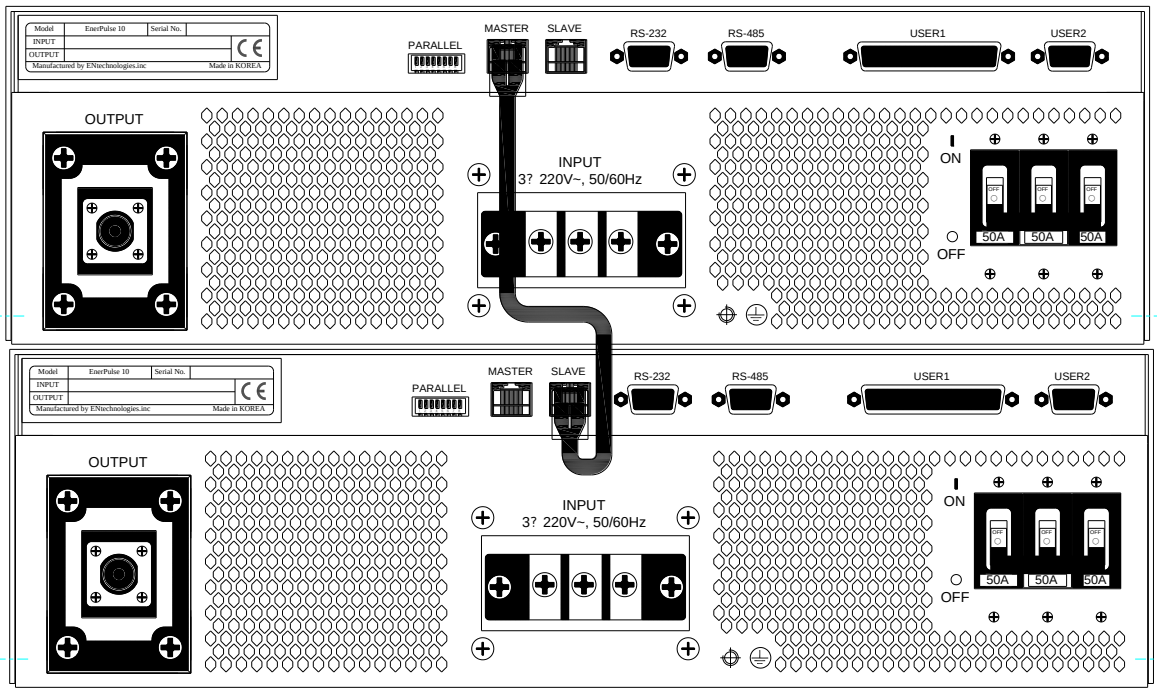
Warning

Before connecting the input cable, be sure to putting down the main switch on the main electric panel , and connect as following sequence 'Ground cable→Output Cable→Input Cable'.The input voltage should be checked before putting the main switch on, and If it is measured more than Max. Input voltage, Do not put the switch(NFB)On the main electric panel.

4.2 Connecting

4.2.3 The connection for Pulse synchronization.

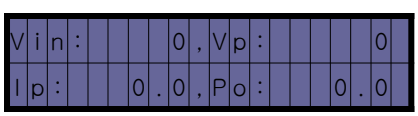
1. Connecting the master with the slave by the UTP cable(..Shorter than 50cm)

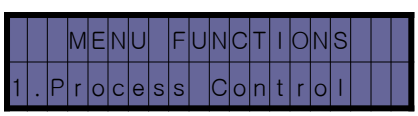


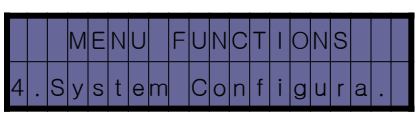
2. Setting the Process Control
(Synchronize EnerPulse)
※ change set point of EnerPulse

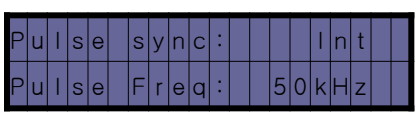
1. Press Menu key.
You will see the screen
on the right.

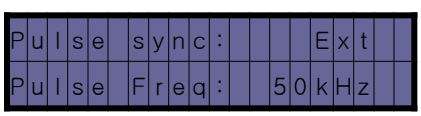
2. Press Enter key, use
Volume knob to move
to Pulse sync.
(Int⇒ Ext)









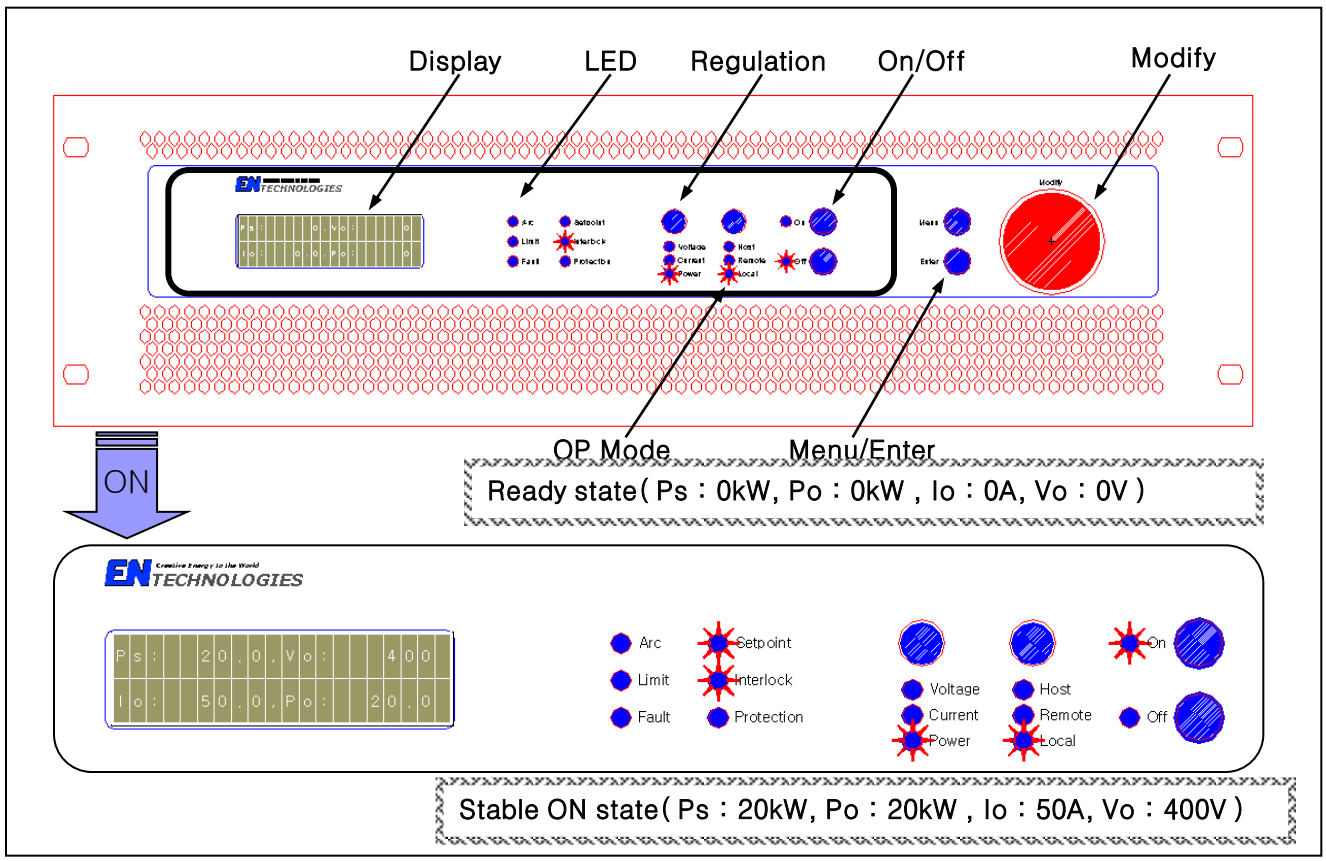


Pulse Synchronization.

- Output frequency synchronization of two or more Enerpulse10
- Other parameters are self-control (Ramping Time, Reverse Time, etc)

Chapter 5. Operation

5.1 Front Panel



Display Used for indicating the status of the power.

LED Used for efficient monitoring of the output status

Arc	illuminates when an arc occurs
Limit	illuminates when output voltage/power/ current or interior temperature value exceeds than maximum set value
Fault	illuminates when an error occurs on the power supply
Setpoint	illuminates when output reaches to set value
Interlock	illuminates off when the interlock signal occures(Normal ON)
Protection	illuminates when the over-current or hard arc occurs

Regulation Used for setting the output regulation mode (Voltage/ Current/ Power)

OP Mode Used for selecting the user interface

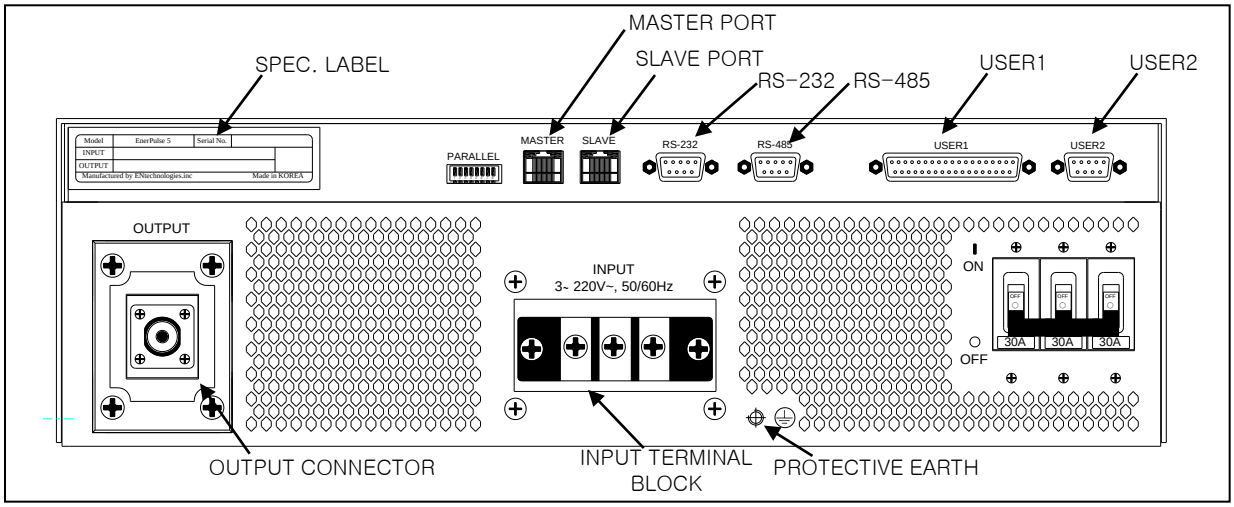
Host	Gives control to the host computer through the serial port
Local	Takes back control from the serial port or user port and give it to the control panel at the front
Remote	Gives control to the controller through the user port. (37Pin D-sub, Refer to 5.6 Interface)

Menu/Enter keys
Used for navigating in menu lists and for setting values

On/Off Used for turning output power on and off

Modify Used for navigating in menu lists and setting the required values and parameters

5.2 Rear Panel



<Rear panel>

Dip switch Provides the operator a way to select the master or slave unit and set the slave address of this unit (Not Used)

Master/Slave
Used for operating parallel running

RS-232 Used for operating the serial communications with a host computer

RS-485 Used for operating the serial communications with a host computer

User1 This interface lets you use the digital/Analog interface
Connector type is D-sub 37p female
Currently, User1's interface is customized to customer's request, Please refer to 5.6 Interface.

User2 Connector type is D-sub 9p female
(Not Used)

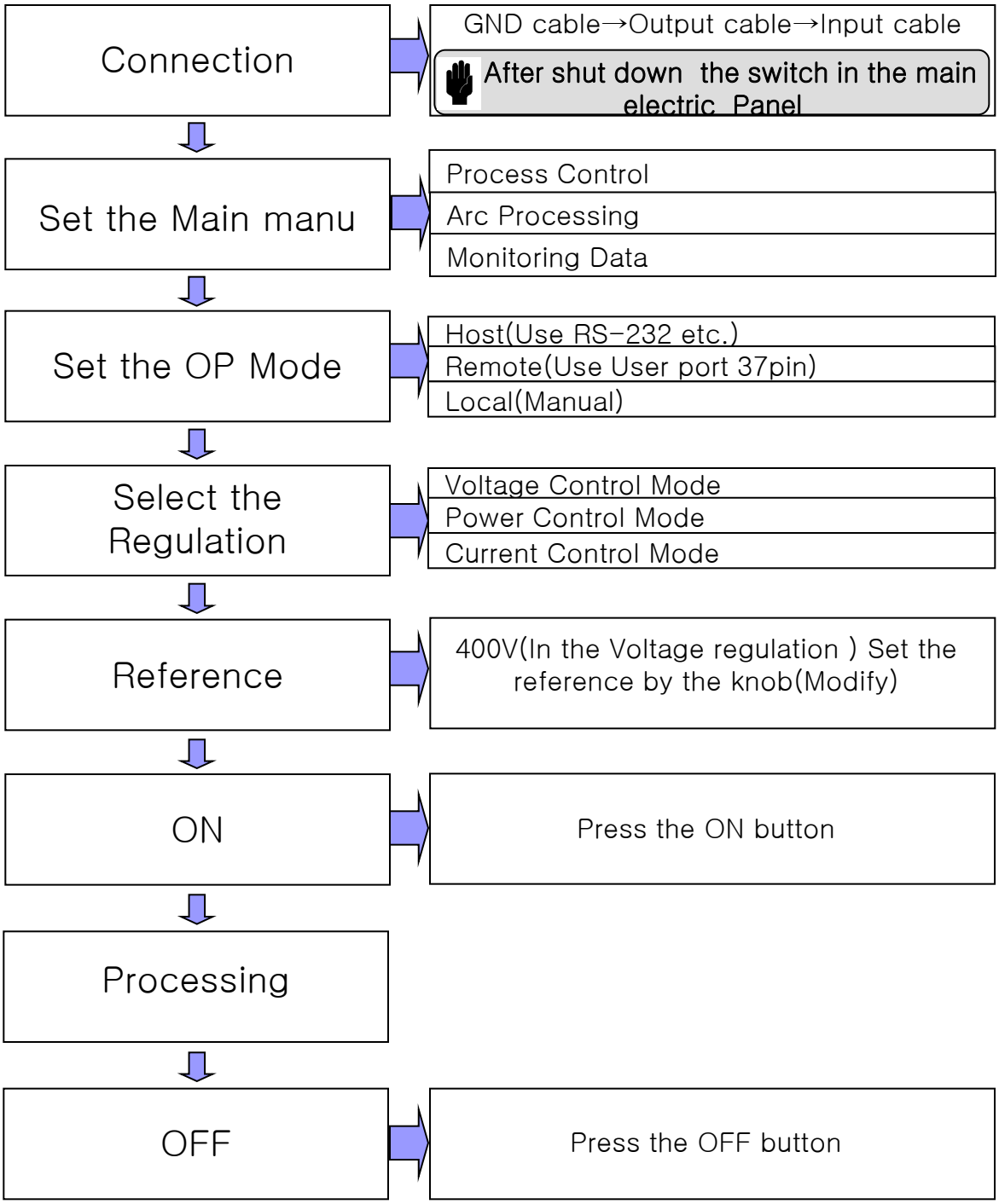
Output
The output connector is UHF type
(SO-239)
The center conductor is the output of a negative voltage.
(Contact to the chamber.)
The shell conductor is the output of a positive voltage.
(Contact to the target.)

Input
This power unit's input voltage is three phase, 50/60Hz.
The ac input connection is provided
by means of a three terminal block.

Ground
Used for grounding the body of the power unit
Always use after grounding the power supply
for your safety.

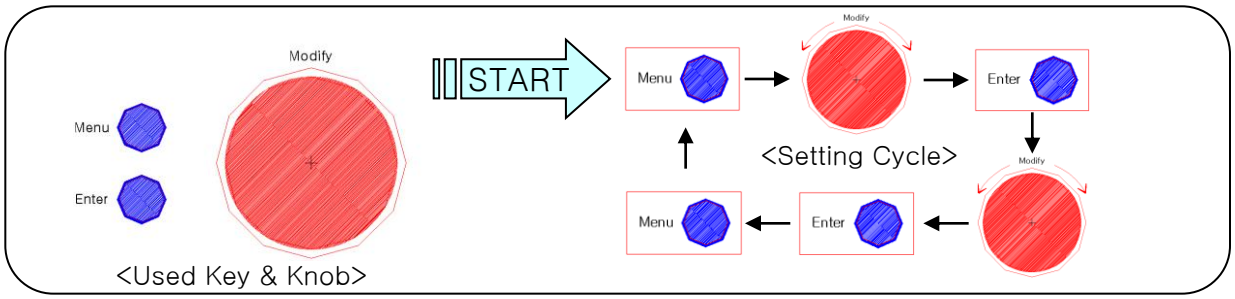
Input switch
Used as the switch for supplying input power to
power unit. Circuit protection function is internalized
inside the switch.

5.3 Operating Diagram.



5.4 Menu Map

5.4.1 Setting Main Menu



5.4.2 Main Menu

Main Menu	Sub Menu	Default
Process Control	Max Power (2.0 ~ 5.0kW)	5kW
	Max Current (5 ~ 12.5A)	12.5A
	Max Voltage (500 ~ 800V)	800V
	Ramp Time (500 ~ 2000ms)	500ms
	Pulse Synchro(Int, Ext.)	Int.
	Pulse Freq(20~150kHz)	50kHz
	Rev Time(OFF:DC, 1.5~7us)	2us
	Target Life(OFF~9999kWh)	OFF
	Run Time Sq(OFF~99:99:99)	OFF
Arc Processing	Delay Time (0 ~ 5us)	0us
	Pause Time (40 ~ 200us)	50us
	Arc Voltage(Disable,11~100V	50V
	Increment A (Disable,5~30A)	10A
	Sensitivity (Disable~6Steps)	Middle
	Limit Arc Number(0~4000/s)	Disable
	Total ARC Number(0~99999)	Disable

5.4.2 Main Menu

Main Menu	Sub Menu	Default
Monitoring Data	Cs(Vs,Is,Ps ,Reference)	Enable
	Vp1 (Nominal Pulse Voltage)	Enable
	Ip (Output Pulse current)	Enable
	Po (Output power, W)	Enable
	AN (Arc count, Arc/s)	Disable
	ANT(Total Arc , Arc/1batch)	Disable
	RT(Running time,h:m/1batch)	Disable
	WhR(Total power in Run time)	Disable
	WhT (Accumulated power)	Disable
	Vp2(Imposed Voltage)	Disable
	Vo(Output Average Voltage)	Disable
	Pp(Output Pulse Power)	Disable
Interface Setup	ON/OFF Master	Orgin
	Reference Master	Orgin
	Mode Master	Orgin
	Rate Voltage(1.0~10.0V)	10.0V
	Rate Current(1.0~10.0V)	10.0V
	Rate Power(1.0~10.0V)	10.0V
	Ref. Deadzone(0.3%~20%)	1%
	A/Ri Offset(-9.9%~9.9%)	0%
	A/Vo Offset(-9.9%~9.9%)	0%
	A/Io Offset(-9.9%~9.9%)	0%
	A/Po Offset(-9.9%~9.9%)	0%
	A/Ro Offset(-9.9%~9.9%)	0%

5.4.2 Main Menu

Main Menu	Sub Menu	Default
Communication Set	Protocol Type(1~5)	3
	Comm. Mode(RS232,RS485)	RS232
	Comm. IP address(forRS485) (disable, 1~50)	disable
System Configuration	Parallel Number : 1 (Not Used. ※Must "1" set up)	
Oper. Record Data	Integral Run power (kWh)	00000
	Aver Run Watt(watt)	00000
	Power ON Count	00000
	Integral Run Hour	00000
	Total Run kWh	00000
	Total ON Count	00000
	Total Run Hour	00000
Fault Record Data	Fault State : #0/0 =>Fault Data Empty	

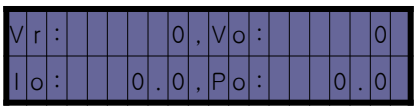
5.5 Operating Parameter

5.5.1 Process control

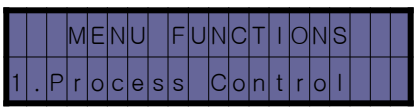
Max Power	Sets a limited Max.output power.
Max Current	Sets a limited Max.output current.
Max Voltage	Sets a limited Max.output voltage.
Ramp time	Time to reach up to the setpoint.
Pulse Sychro.	Output frequency synchronization. (Int / Ext)
Pulse Frequency	Sets Output Pulse Frequency.
Reverse Time	Sets a Reverse Time(1.5~8us, Self Limited)
Run Time Sq	Setting the operating time.
Target life	Set the Target life(kWh/Target), see the interface,5-6)

▶ Using the process control
(To modify Max current of 12.5A to 10A)

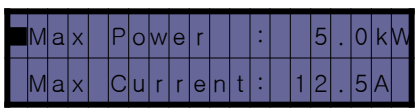
1. Press Menu key.
   You will see the screen on the right.

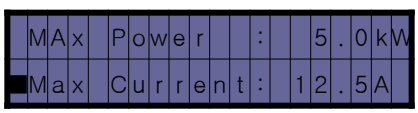


2. Press Enter key.
   You will see the screen on the right.

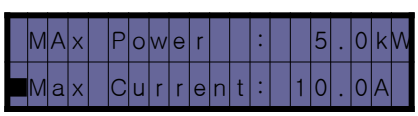


3. Use Volume knob to move to [Max current] item.





4. Press Enter key, then cursor will blink. Use Volume knob to set the desired value. Press Enter key again.

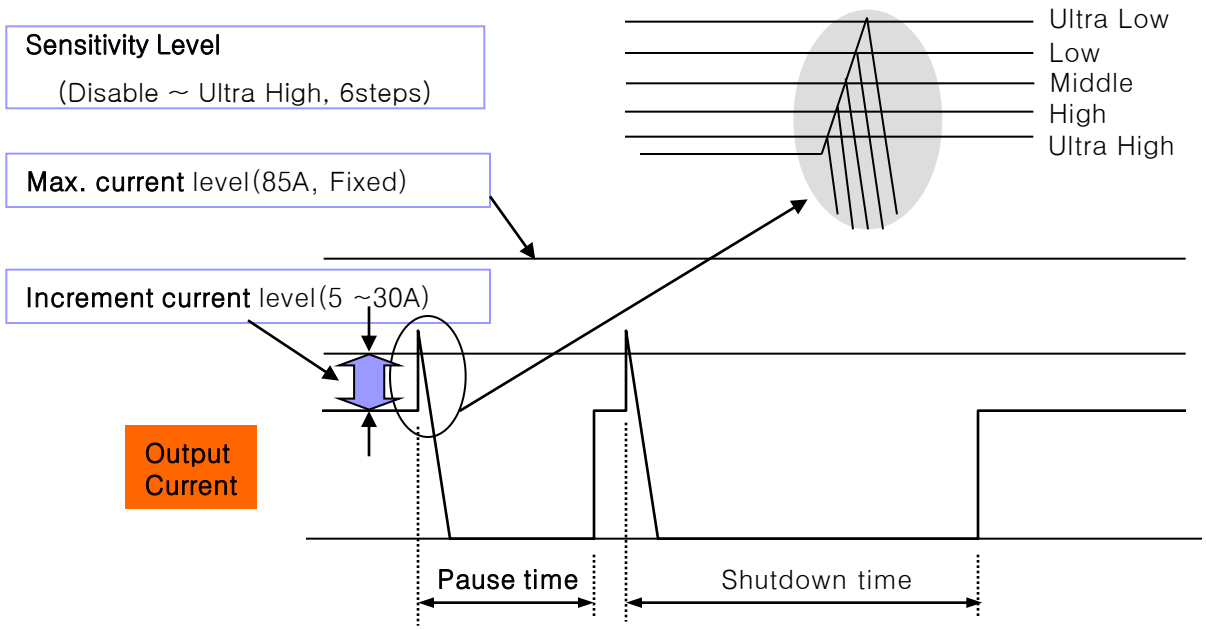


※ Follow the same steps to control and set other control parameters.

5.5.2 Arc Processing

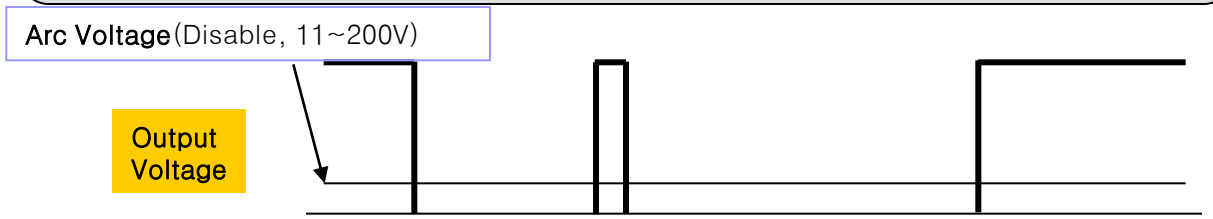
Delay time	Sets to keep the output without interruption when arc detects(0 ~5us)
Pause time	Sets shutdown time until re-start after arc occurrence (40 ~ 200us)
Arc Voltage	Sets Voltage level to detect Arc. (Disable, 11 ~ 100V)
Increment Current	Sets Current level to detect Arc. (Disable, 5A ~ 15A)
Sensitivity	Sets the level to detect soft arc(Micro Arc), control parameter for interruption of soft arc that is relatively more sensitive than Increment Current or arc voltage. (disable/UT-Low/Low/Middle/High/UT-High)
Limit Arc Number	Sets the number of Arc that is restricted per sec. if it exceeds, The message is displayed. The power supply continues to process.
Total Arc Number	Sets the total number of Arc that is required in the full processing. if it exceeds, The message is displayed. The power supply continues to process.

▶ Parameters for arc control



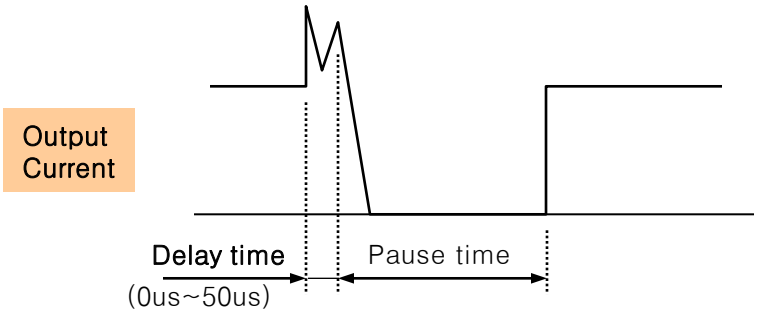
Caution

Arc Energy is changed according to the increment current level, so you should set the appropriate level according to process..



Caution

If it is set under the operating voltage level, Normal process is impossible, so you may set the appropriate voltage according to process.

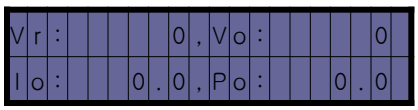


Caution

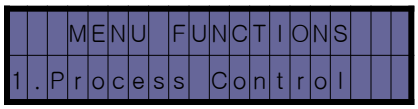
Arc Energy can be increased from 0.4mJ/kW to Max.30mJ/kW, By reason of this. It can be damaged on the coated material.

▶ Using the Arc processing
(To set Pause time of
40us to 100us)

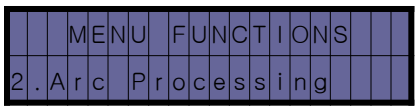
1. Press Menu key then you will see the screen on the right.



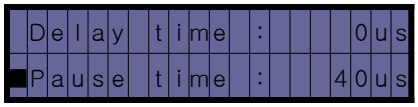
2. Use Volume knob to move to [2.Arc processing] menu.

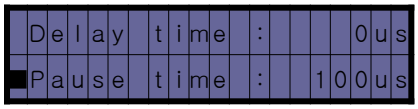


3. Press Enter key, use Volume knob to move to [Pause time] item.



4. If you press Enter key, cursor will blink. Then use Volume knob to set to desired value.
Press Enter key again.





※ Follow the same steps to control and set other Control parameters.

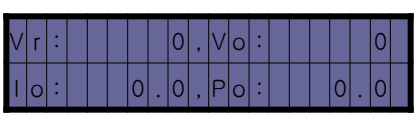
5.5.3 Monitoring Data

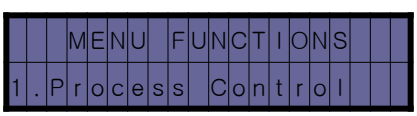
▶ This function allows users to select variables displayed at front panel for monitoring power supply's output status. Four is the maximum number of parameters that can be displayed.

Cs	Indicates Control Mode setpoint value.
Vp1	Indicates Output Pulse Voltage
Ip	Indicates Output Pulse Current
Po	Indicates Output Average Power
AN	Indicates Number of Arc occurrence per second
ANT	Indicates Number of the total Arc (total Arc/batch)
RT	Running time
WhR	Indicates the used power during the process.
WhT	Indicates Accumulated Power
Vp2	Indicates the input DC bank Voltage
Vo	Indicates Output Average Voltage
Pp	Indicates Output Pulse Power

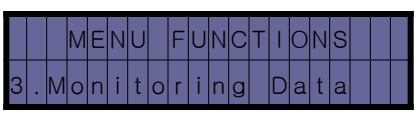
▶ Using the monitoring data (Modify indicating factors from Vr, Vo, Io, Po to Vr, Vo, Io, AN.)

1. Press Menu key. You will see the screen on the right.

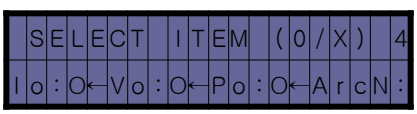




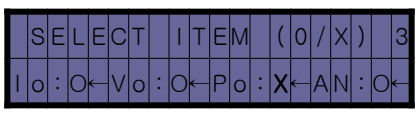
2. Move to [3.Monitoring Data] using Volume knob



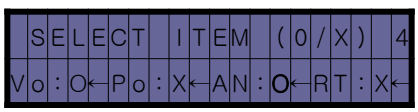
3. Press Enter key, use Volume knob to move to [Po] item.



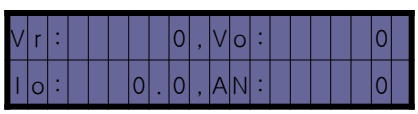
4. Change [Po:o] to [Po:x] using Enter key



5. Press Enter key, move to [AN] using Volume knob.



6. Change [AN:x] to [AN:o] using Enter Key



7. Then you will see the screen on the top-right.

※ Other factors can also show their monitoring variables by following the same steps

5.5.4 Interface Setup

▶ This function is setting menu of interface per user's request.

ON/OFF Master	Set ON/OFF of input interface (Orgin, Local, Remote, Host)
Reference Master	Set Reference of input interface. (Orgin, Local, Remote, Host)
Mode Master	Set Mode of input interface. (Orgin, Local, Remote, Host, Always)
Max. Analog I/O Ref. (Voltage)	Set Max. value of analog input/output (Voltage) (1.0 ~10.0V)
Max. Analog I/O Ref. (Current)	Set Max. value of analog input/output (Current) (1.0 ~10.0V)
Max. Analog I/O Ref. (Power)	Set Max. value of analog input/output (Power) (1.0 ~10.0V)
Reference Deadzone	Ignored reference of less than setting value.(0.3%~20%)
A/Ri Offset	Adjust the Analog Reference Input Offset at USER1 port(−9.9%~9.9%)
A/Vo Offset	Adjust the Analog Voltage Output Offset at USER1 port(−9.9%~9.9%)
A/Io Offset	Adjust the Analog Current Output Offset at USER1 port(−9.9%~9.9%)
A/Po Offset	Adjust the Analog Power Output Offset at USER1 port(−9.9%~9.9%)
A/Ro Offset	Adjust the Analog Reference Output Offset at USER1 port(−9.9%~9.9%)

•For example, even if it is operating by Local Mode, If set by Remote from ON/OFF Master when ON/OFF enables in Remote, ON/OFF is possible in Remote(PLC).

5.5.5 Communication Set

▶ This menu is about RS232, RS485 and protocol.

Protocol type	Set protocol type. (1~5, refer to the attached protocol, Preliminary)
Communication Mode	Set the RS232, RS485. (RS232, RS485)
Comm. IP Address	Set address in RS485 communication (disable, 1~50)

5.5.6 System Configuration

▶ Set the parallel operating

Parallel Number	Set the total number of units in parallel operating (Master+Slave) (Min : 1, Max : 8) ※Not Used.

5.5.7 Operation Record Data

▶ Display operation record data of unit

Integral Run kWh	.
Average Run watt	.
Power ON Counter	.
Integral Run Hour	.
Total Run kWh	.
Total ON Counter	.
Total Run Hour	.

5.5.8 Fault Record Data

▶ Save Fault date When fault happens

*** Fault State #0/0**	Display Fault data. Max. 30(30/30)
=>Fault Data Empty	

5.6 Interface

5.6.1 User1(D-sub 37pin, Digital I/O, Analog I/O)

No.	Name	Description	Remark
7	ON	Enables output power	Digital/Input
14	OFF	Used for turning output power shut off	D/I
5	Regulation	LH : Current HL : Power HH : Voltage	D/I
6	Regulation		
11	AUX	Interrupt the interlock system	D/I
12	VACUUM	Interrupt the interlock system	D/I
13	WATER	Interrupt the interlock system	D/I
2	ON/OFF state	Indicates that output power is ON	Digital/Output
1	Limit	When the output reach the limit.	D/O
3	Setpoint	Indicates when output reach to set value	D/O
33	FAULT	Indicates when fault occurs	D/O
22	EOTL	Indicates target life is ended(N/A)	D/O
20	Protection	When it's happening protection.	D/O
21	ARC	Indicates when arc occurs	D/O
36	COM.D	Dedicated return for digital signal	
19	COM.D	Dedicated return for digital signal	
37	COM.D	Dedicated return for digital signal	
27	Reference	The output reference set(Analog/Input)	Analog/Input
25	Iout	The output current show(Analog/Output)	Analog/Output
31	Ref.out	The output reference show(A/O)	A/O
18	15V	15V	Nonisolated
9	G	25,31,23,24(Return G)	A/O
10	G	27(Return G)	A/I
23	Vout	The output voltage show(A/O)	A/O
24	Pout	The output power show(A/O)	A/O

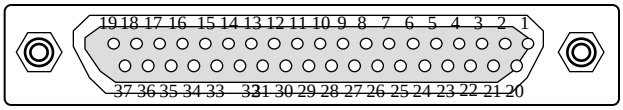
D-Sub 37 Pin

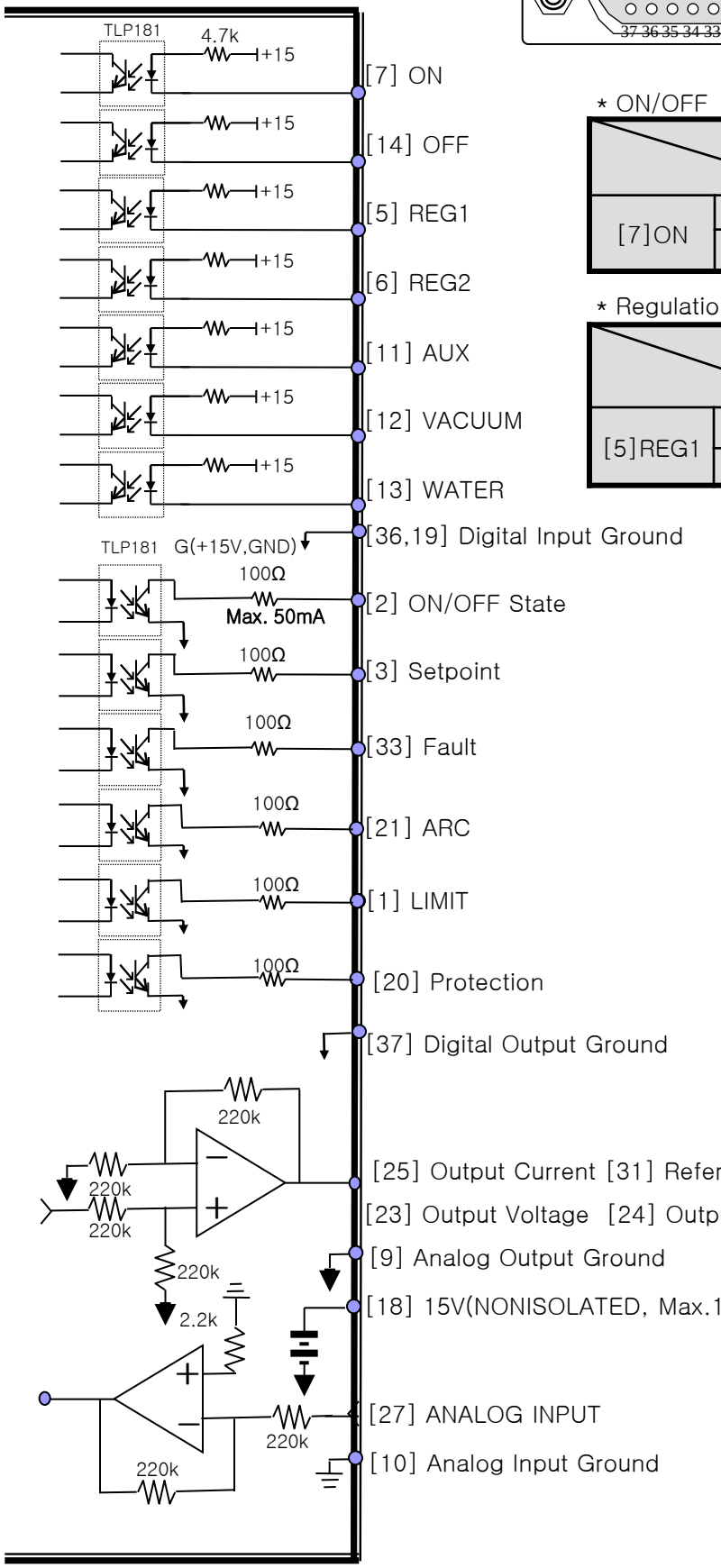
Digital Input

Digital Output

Analog I/O

User port(37Pin)





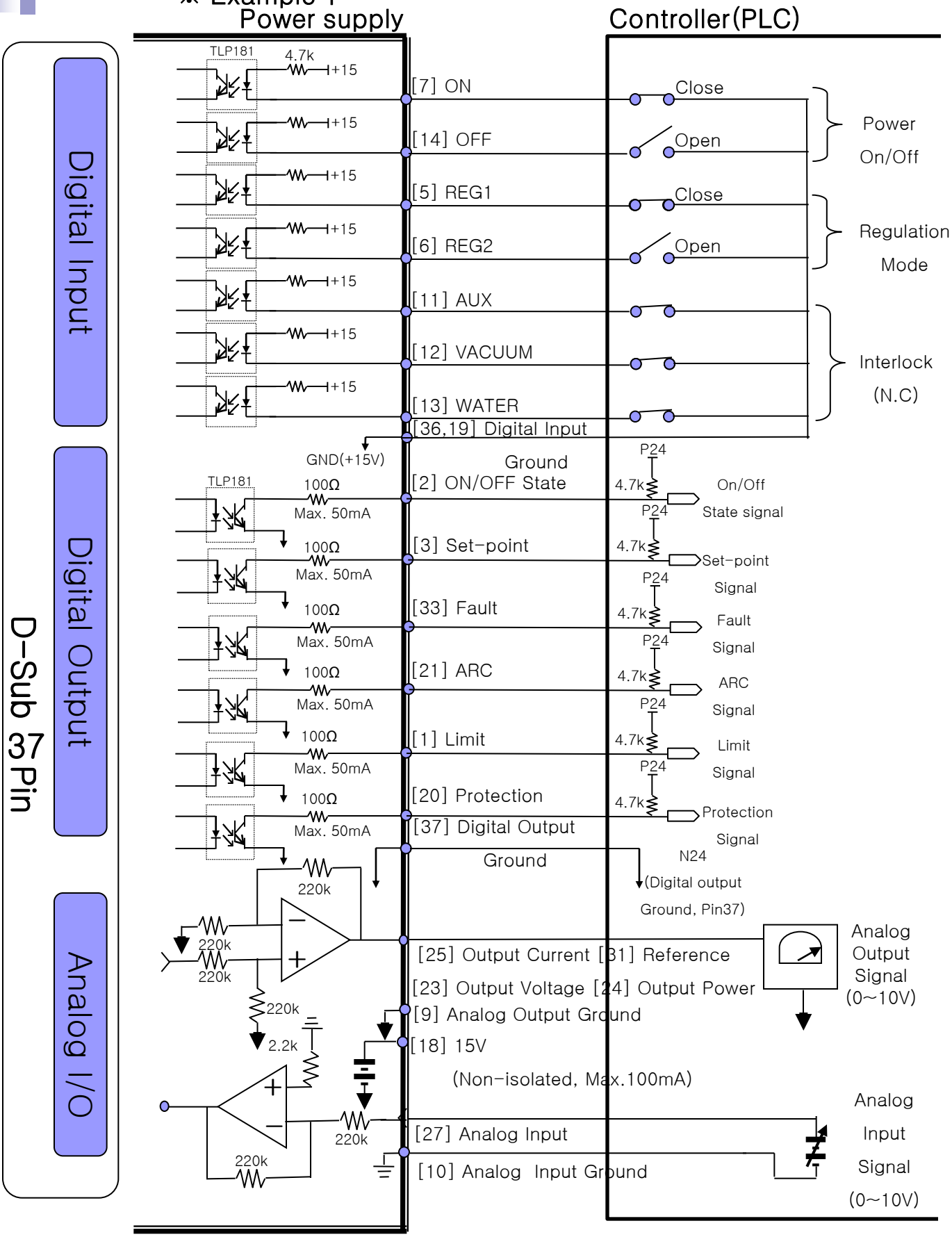
* ON/OFF

		[14]OFF	
		Closed	Opened
[7]ON	Closed	OFF	ON
	Opened	OFF	X

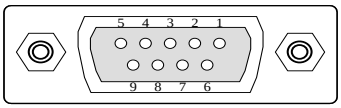
* Regulation Mode Selection

		[6]REG2	
		Closed	Opened
[5]REG1	Closed	X	Current
	Opened	Power	Voltage

※ Example 1


Power supply
Controller(PLC)
D-Sub 37 Pin
Digital Input
Digital Output
Analog I/O
TLP181
4.7k
+15
[7] ON
[14] OFF
[5] REG1
[6] REG2
[11] AUX
[12] VACUUM
[13] WATER
[36,19] Digital Input
Close
Open
Power On/Off
Regulation Mode
Interlock (N.C)
GND(+15V)
Ground
[2] ON/OFF State
[3] Set-point
[33] Fault
[21] ARC
[1] Limit
[20] Protection
[37] Digital Output
100Ω
Max. 50mA
P24
On/Off State signal
Set-point Signal
Fault Signal
ARC Signal
Limit Signal
Protection Signal
N24
(Digital output Ground, Pin37)
220k
2.2k
[25] Output Current [31] Reference
[23] Output Voltage [24] Output Power
[9] Analog Output Ground
[18] 15V
(Non-isolated, Max.100mA)
Analog Output Signal (0~10V)
[27] Analog Input
[10] Analog Input Ground
Analog Input Signal (0~10V)

5.6.2 RS-232



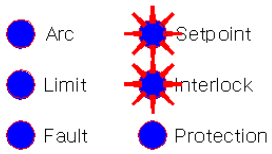
<9-Pin D female connector>

Pin	Name	Description
2	RxD	Receive Data
3	TxD	Transmit Data
5	GND	Ground

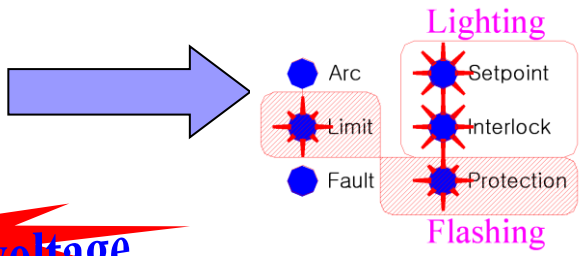
D-Sub	No.	Command	Description	Range	Data Byte
RS-232 (TX)	1	Output ON	Output ON		1
	2	Output OFF	Output OFF		1
	3	Regulation	Output regulation		1
	4	Reference	Output level		2
	5	Detection time	Arc detection time		2
	6	Pause time	Arc pause time		2
	7	Arc voltage	Arc voltage level		2
	8	Arc current	Arc current level		2
	9	Soft arc level	Soft arc level		2
	10	Shutdown delay time	Shutdown delay time		2
	11	Shutdown Pause time	Shutdown Pause time		2
	12	Power limit			2
	13	Current limit			2
	14	Voltage limit			2
	15	Ramp time			2
	16	Ignition voltage			2
RS-232 (RX)	17	Output ON	Request data		1
	18	Output OFF			1
	19	Regulation			1
	20	Reference			2
	21	Detection time			2
	22	Pause time			2
	23	Arc voltage			2
	24	Arc current			2
	25	Soft arc level			2
	26	Shutdown delay time			2
	27	Shutdown Pause time			2
	28	Power limit			2
	29	Current limit			2
	30	Voltage limit			2
	31	Ramp time			2
	32	Ignition voltage			2

Chapter 6. Maintenance

6.1 Error message or LED status in the front panel(For example).

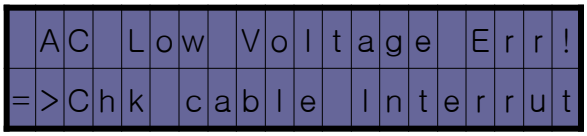


[Stable state]

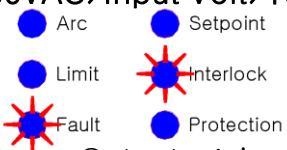


Happening the input low voltage

During 1 minute
[180VAC>Input Volt>165VAC]



[Display Error message In VFD]



[Shut Down Output, <about 165VAC]

	Error message	Contents	LED	Remarks
1	AC Low Voltage Err! =>Chk cable or Sag	Input cable misconnection or Sag phenomenon Input Low Voltage		Fault LED after 1min.
2	AC Low Voltage Err! =>Chk cable, Interrut	Input cable misconnection or input Voltage interruption(less than 165VAC)		Fault LED after 1min.
3	AC OverVoltage Err =>Chk Input Voltage	Over input voltage(+10%)		Directly Fault LED, output off
4	AC Unbalance Err! =>Chk cable, terminal	Input cable misconnection or Unbalance phase		Fault LED after 1min.
5	Inv. Unbalance Err =>Chk Stack Fuse/cap	Inverter unbalance in the power, Broken the Fuse at the power stack, Broken the current sensor circuit.		Directly Fault LED, output off
6	Over Temperatur Err =>Chk 24V P/S or Fan	Overtemperature(more than 90℃), Ambient Temp. is above 40degree. Broken the 24V SMPS for Operating the fan in the power, a poor required region for cooling the power supply, Filled the Hole with dusty particle in the front panel.		Output off more than 92℃ on the heatsink in the power
7	Controller/SMPS Err =>Chk MCU & SMPS	SMPS breakdown or drop the control volt.(less than 4.5V)		Directly Fault LED, output off
8	Ignition Fail ! =>Chk GAS state, etc.	No the output current (less than 100mA) , No supply the gas(Ar etc.)		
9	Hard Arc State ! =>Chk Target(Chamb)	Output is short circuit. Happening the Arc decharge.		
10	Now, Stopped by External Signal Check Interlock Port ->Water, Door, Vacuum	Interlock signal by the User Port, Opening the door etc.		

Chapter 6. Maintenance

6.2 General Troubleshooting

Symptoms	Probable Cause	Recommendations
Display(VFD) does not light	AC input power not connected. AC input circuit protector not turned on.	Check rear panel input connector's connection and input power Turn the input circuit protector on
No output	Output power connector Interlock is open. The load is not connected	Check the interlock port Make sure that the load Is connected

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