



SOFTWARE MANUAL

RF POWER AMPLIFIER
CA1300BW1-6068R-SL

R&K Company Limited

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Revision History

Revision	Date	Author(s)	Revision Note
00	August 25, 2020	S. Makino	Original
01	September 07, 2020	S. Makino	Added SLAC Requirements
02	September 09, 2020	Y. Kobayashi	Title of Table 3, 4 changed Description of Table 15 Added
03	September 17, 2020	S. Makino	Added 1.6. Momentary Switch Function
04	September 24, 2020	S. Makino	Corrected the contents of Table 16

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1. Control System

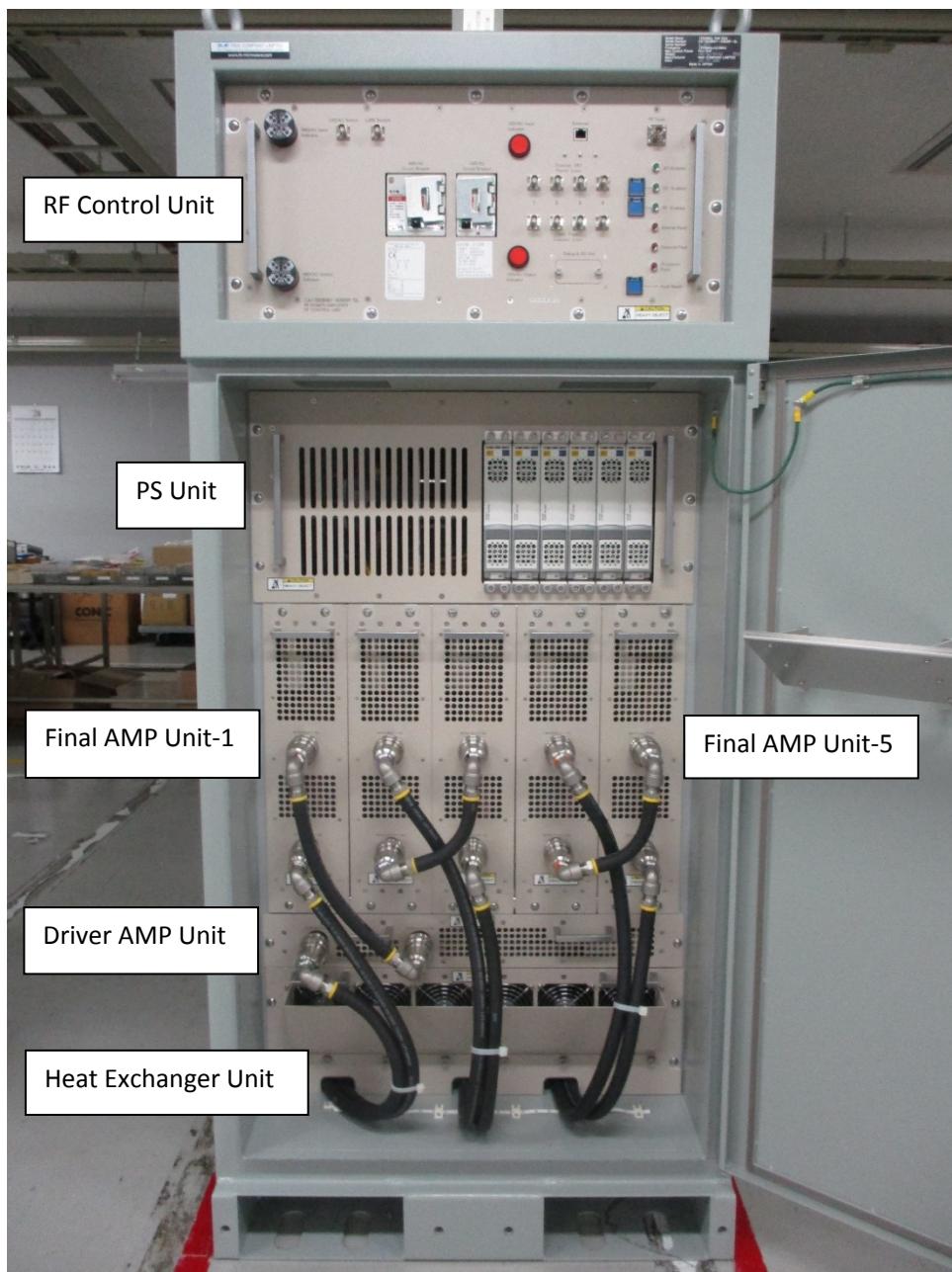
This manual covers the digital control system of CA1300BW1-6068R-SL.

The product is a 1.3GHz Solid State Amplifier (SSA) system in a rack controlled by 10 CPUs which consist of Main CPU, Debug-SD CPU and 8 Sub CPUs.

1.1. Construction

This product consists of RF Control Unit, PS Unit, Final AMP Unit-1, Final AMP Unit-2, Final AMP Unit-3, Final AMP Unit-4, Final AMP Unit-5, Driver AMP Unit and Heat Exchanger Unit.

Following are photos of the total system, a block diagram and photos of the control chassis and the individual chassis controlled by it.



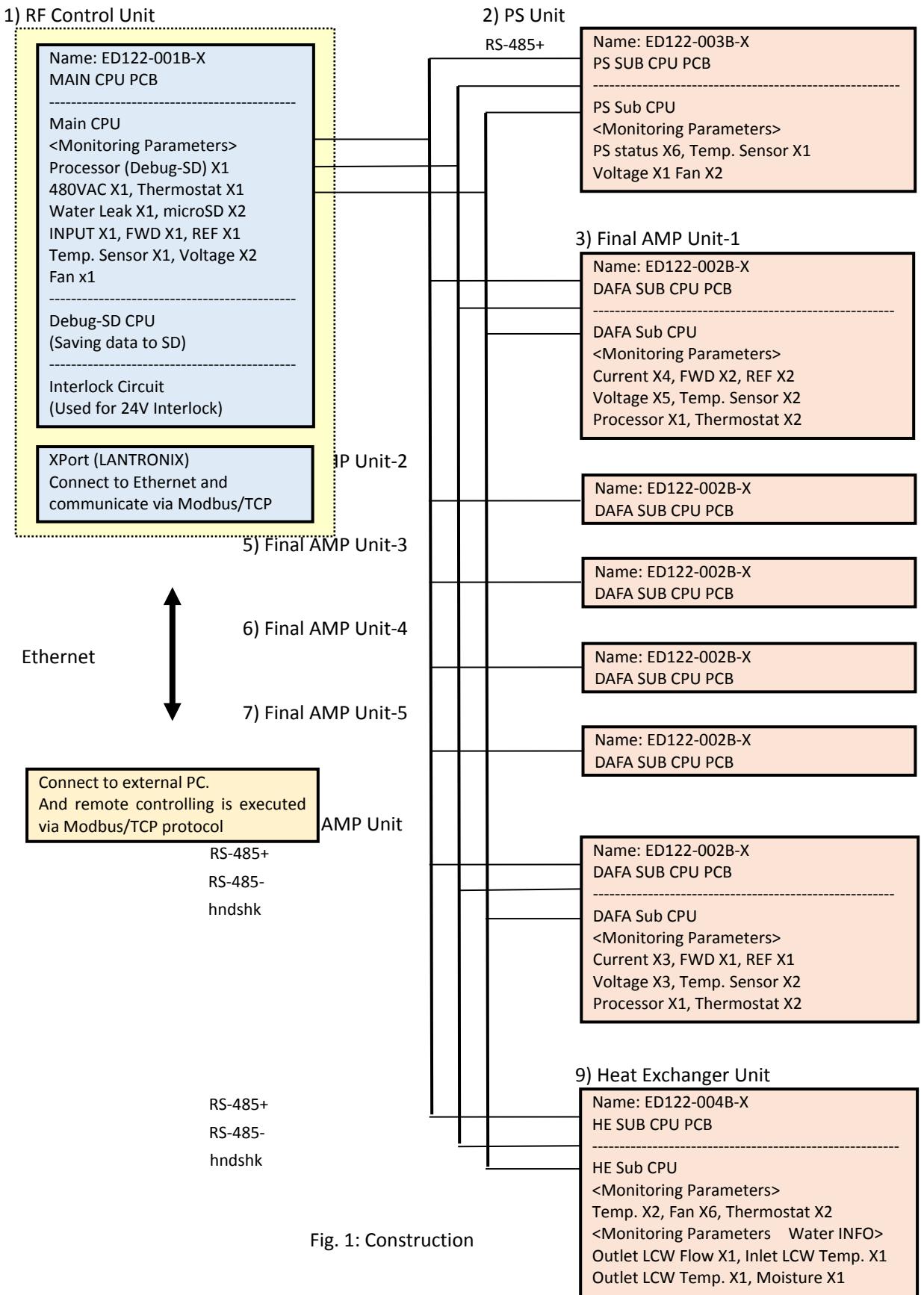


Fig. 1: Construction

1) RF Control Unit

The MAIN CPU PCB (Printed Circuit Board) and the Debug-SD CPU (=Secure Digital) are built into the RF Control Unit. (There are SUB CPU PCBs in the other Units as described below.) The MAIN CPU PCB controls all the systems.

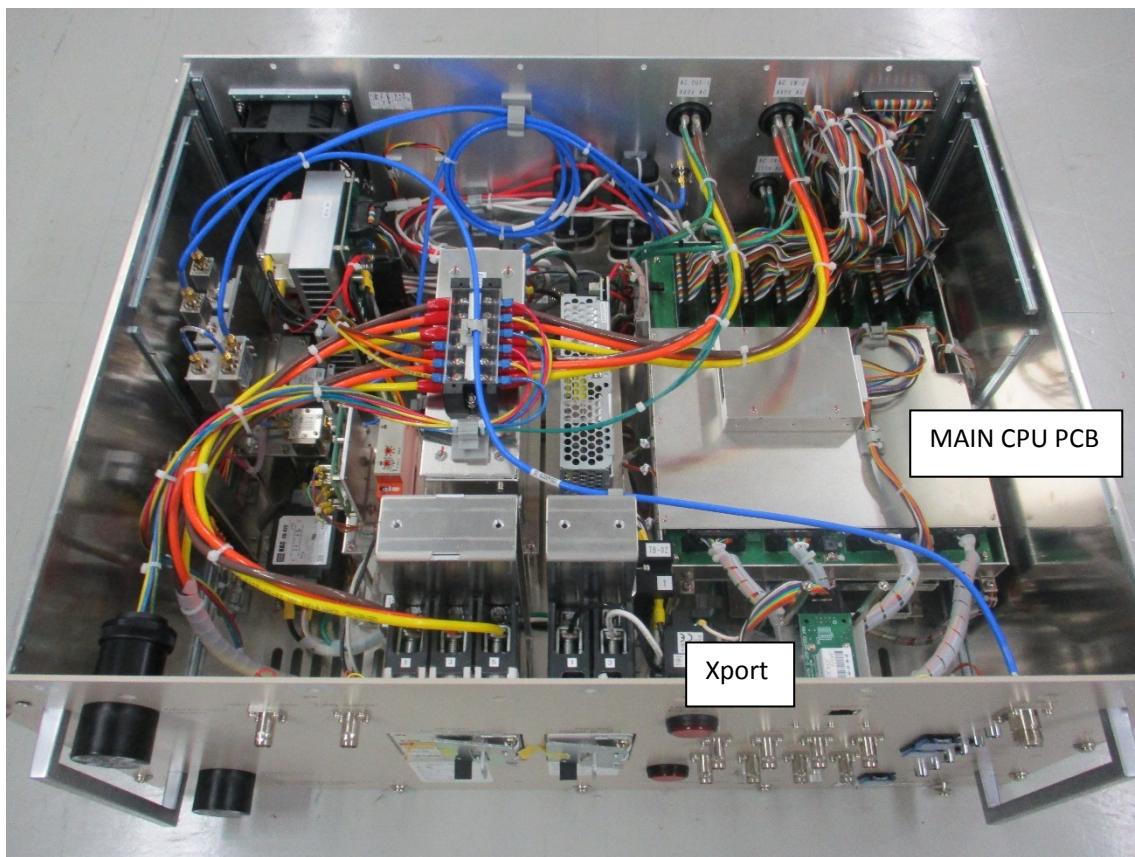
Communication is performed by computer bus standard RS485. The SUB CPU PCBs are daisy-chain-connected with the MAIN CPU PCB. Measurement data (power, voltage and current) is collected by each PCB via RS485 on each unit and saved to MODBUS register. The measurement can be remotely confirmed via MODBUS communication. MODBUS data is also saved in microSD memory by the Debug-SD CPU.

The Sub CPU analyses the data collected by the SUB CPU PCB and determines if there should be a warning. It sends the information to the MAIN CPU PCB. The Main CPU executes the resulting action.

480VAC Status, Thermostat, Water Leak Status, External Fault (External 24V Permit Lines) and Processor Fault are monitored by hardware circuit. When ALM state occurs on these items, SSA would be turned off directly by hardware circuit.

PS Status is monitored by the PS Sub CPU on the PS SUB CPU PCB hardware circuit. When ALM state occurs on this item, SSA would be turned off directly by hardware circuit.

The other items are monitored by CPUs on each chassis. When ALM state occurs on these other items, SSA would be turned off by a command from Main CPU based on information provided by RS485 communication.

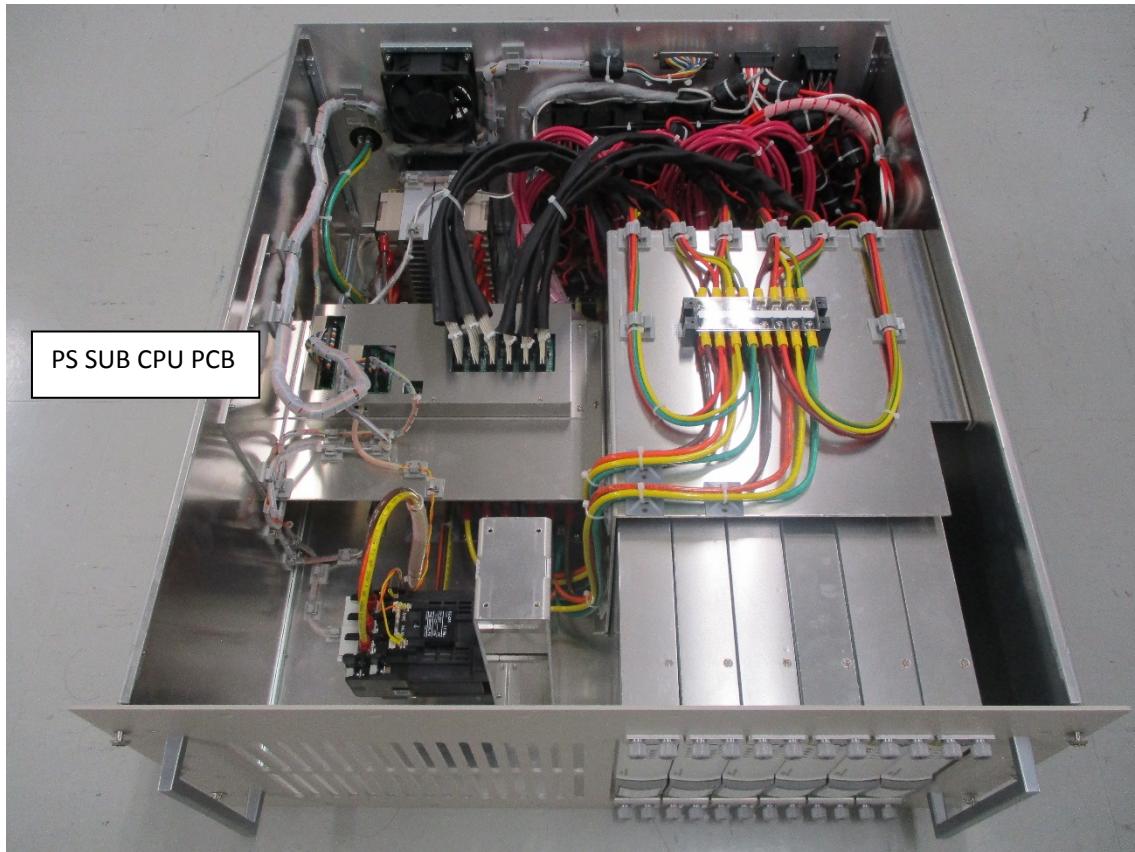


2) PS Unit

A PS Sub CPU is built into the PS SUB CPU PCB which is on the PS Unit.

6 of ACDC Power Supplies are built into the PS Unit to provide 480VAC. And those power supplies are operated parallelly.

The PS SUB CPU PCB monitors operation states of each ACDC Power Supply, and controls their output voltage in between 18 and 48VDC. Controlling of output voltage is executed by RS485 Communication between PS SUB CPU PCB and MAIN CPU PCB.

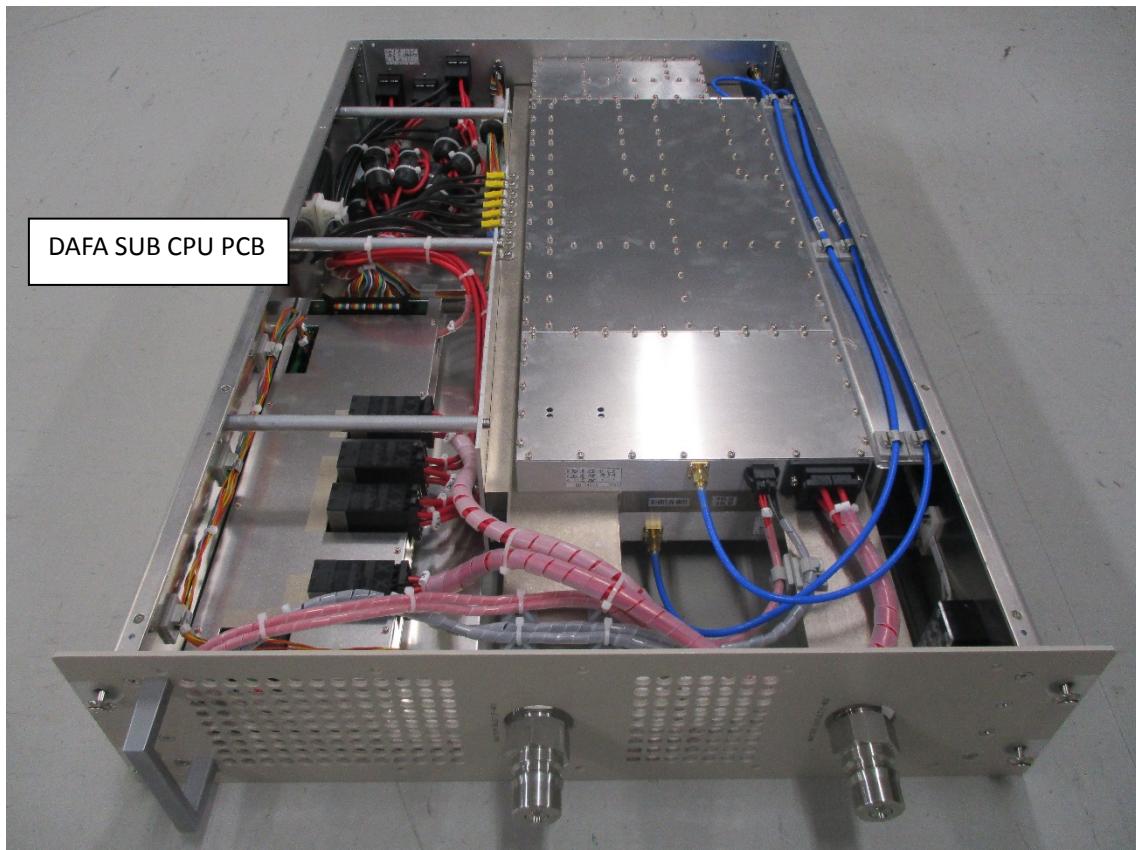


3 Final AMP Unit-1 4 Final AMP Unit-2 5 Final AMP Unit-3

6 Final AMP Unit-4 7 Final AMP Unit-5

A DAFA Sub CPU is built into the DAFA SUB CPU PCB which is on the Final AMP Unit-1~5.

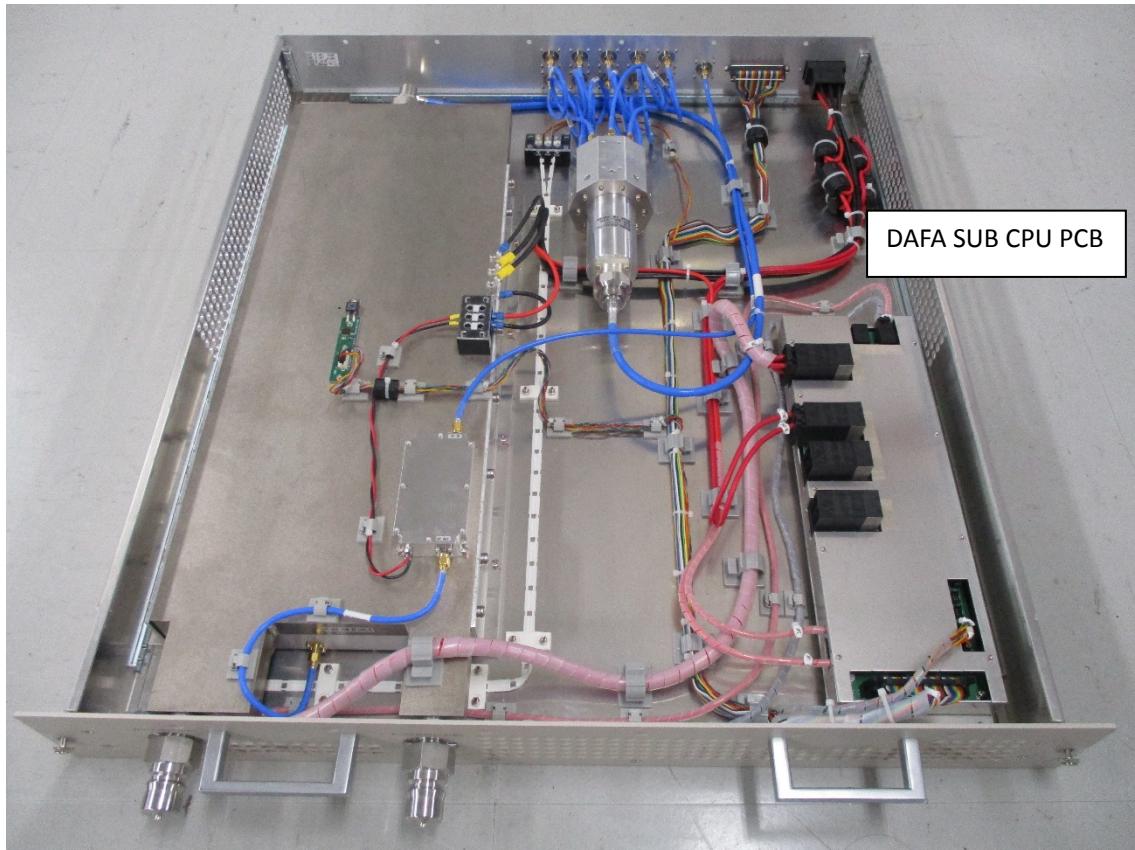
DAFA SUB CPU PCB sets up monitored values in the unit to designated Modbus addresses via RS485 Communication with MAIN CPU PCB.



8 Driver AMP Unit

A DAFA Sub CPU is built into the DAFA SUB CPU PCB which is on the Driver AMP Unit.

DAFA SUB CPU PCB sets up monitored values in the unit to designated Modbus addresses via RS485 Communication with MAIN CPU PCB.

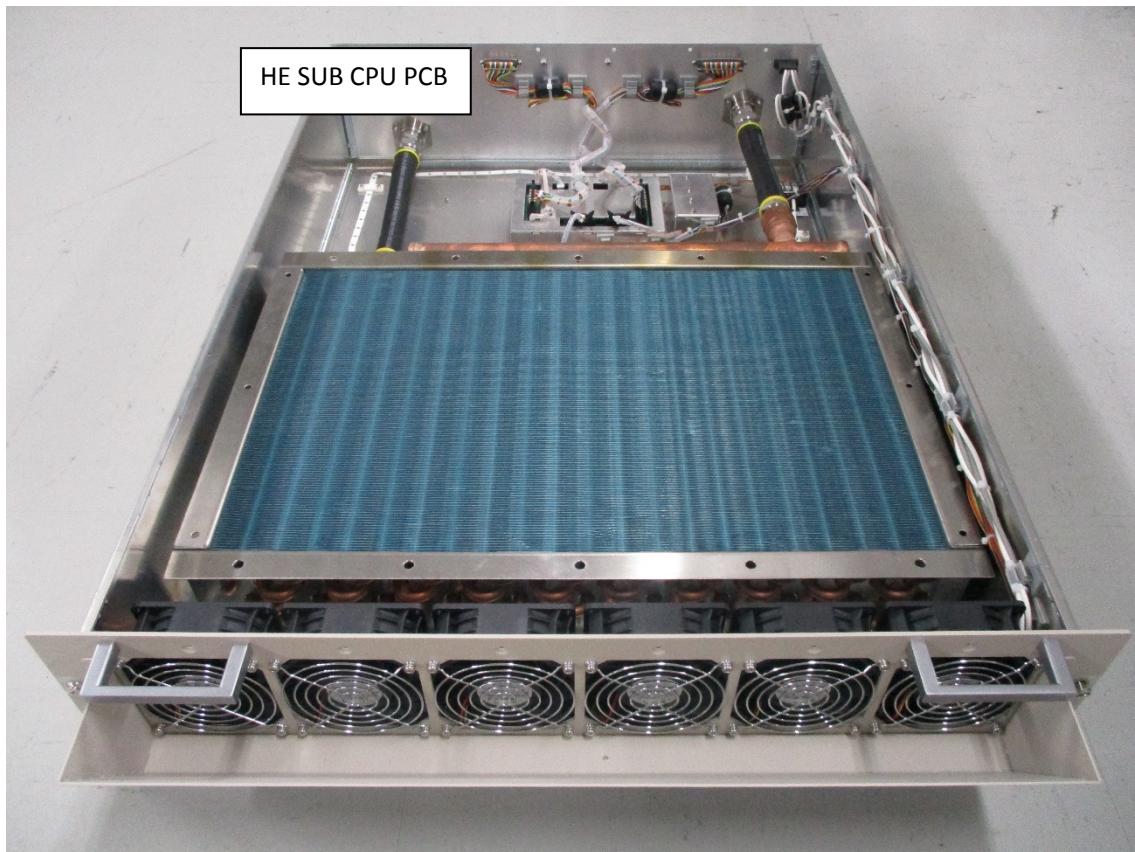


9 Heat Exchanger Unit

A HE Sub CPU is built into the HE SUB CPU PCB which is on the Heat Exchanger Unit.

HE SUB CPU PCB sets up monitored values in the unit to designated Modbus addresses via RS485 Communication with MAIN CPU PCB.

HE SUB CPU PCB also monitors status of Outlet LCW Flow Rate, Inlet/Outlet LCW Temperature, and Moisture through the Water INFO PCB Module which is connected by a D-Sub 25pin cable.



1.2. Control Interface

This product has a network interface.
Network Interface Modbus/TCP

1.3. Control Function

Behavior at DC Enable

After DC Enable command by Modbus Communication or Momentary Switch, SSA denies RF Enable Command and PS Output Control Voltage Command for about 90 seconds. (SSA will accept any other commands.) This 90 seconds is for preventing in-rush current of 480VAC P.S. and waiting 480VAC P.S. to operate stably.

The number of 480VAC P.S. provided power by DC Enable command is six. And these six P.S. would operate parallelly for redundant operation.

Also, these P.S. would be controlled its 480AC input power by 6 Solid State Relays.

P.S. 1,2,3 are grouped as one and 4,5,6 are also grouped as the other, then those two groups are powered separately.

Following is turn-on flow of P.S. :

Line 1 and Line 2 of P.S. 1,2,3 ON \Rightarrow 3 seconds \Rightarrow Line 3 of P.S. 1,2,3 ON \Rightarrow 3 seconds \Rightarrow

Line 1 and Line 2 of P.S. 4,5,6 ON \Rightarrow 3 seconds \Rightarrow Line 3 of P.S. 4,5,6 ON \Rightarrow 11 seconds \Rightarrow

P.S. 1,2,3,4,5,6 DC Out \Rightarrow 70 seconds \Rightarrow Ready for Accepting Modbus Command

Even right after the DC Enable command (in 90 seconds), SSA would accept DC Disable command.

There is Ready for RF on Address 28 of Table 15: Register Map. Address 28: Ready for RF is 90 second-countdown-timer, which start counting down right after DC Enable command.

When the number on this "Address 28 Ready for RF" is any from 1-90, SSA doesn't accept RF Enable and PS Output Control Voltage.

Only when it is 0, those commands will be acceptable.

At counting down, Error Code 504: "Not Ready for RF Enable. 90 sec hold timer on DC PS not expired" will be on Address 13 Warning Code.

Behavior at 120VAC Power On

Soon as 120VAC is supplied to SSA, all CPUs start working. This SSA has SD Cards to save all operation log for the case any problem occurred and Electric Double Layer Capacitor for SD Data Protection at Power Off. This Electric Double Layer Capacitor requires 6 minutes for charging from Power On, so, log data for 6 minutes from 120VAC Power On won't be recorded.

Even though saving log data to SD Card requires 6 minutes from 120VAC On, SSA can be operated without waiting SD card begins log recording.

Behavior at 120VAC Power Off (about 5 seconds)

When 120VAC is turned off, power won't be no longer supplied to +12VDC Power Supply which is power source of all CPUs. A Main CPU which always watches voltage supplied to Main CPU Printed Circuit Board starts final procedure of Operation Stop when the voltage gets <+6VDC. Following is the list of all the procedure of Operation Stop which is about 5 seconds. At this procedure, CPUs works with power from Electric Double Layer Capacitor.

1. DC Power to Main CPU Printed Circuit Board gets lower than +6VDC.
2. SD-Debug CPU saves log data to SD Card in 2 seconds.
3. According to an order from Main CPU, SD-Debug CPU closes log data file safely in 2 seconds.
4. Main CPU kills output power of Electric Double Layer Capacitor.

Then, operation of SSA is completely stopped.

1.4. Monitoring System

The system monitors and records the statuses of the RF Control Unit, the Power Supply Unit(PS Unit), the five Final Amplifier Unit(Final AMP Unit-1~5), the Driver Amplifier Unit(Driver AMP

Unit) and the Heat Exchanger Unit. The system monitors information can be viewed via the Modbus interface in real time. These data are also recorded to a microSD card.

Main CPU and the other Sub CPUs monitors each parameter like FWD, REF, Voltage, Current and etc., and 12bit AD converters are used for those measurement. Main CPU and the other Sub CPUs are communicating by RS485 Communication. The only CPU communicates with external system by Modbus is Main CPU.

Measured values of Input Drive Power, Forward Power, and Reflected Power which are monitored by Main CPU are averaged by following method.

4 times of data measured 180times/40ms are collected (data for 160ms) first. Then, rearrange this data from large to small, and remove 4ms size data from the largest. After removal, 8ms data from the largest value is averaged. This averaged value will be indicated as measured value.

1.5. Protection Function

This product has following protection functions.

Fault(Internal, External, Processor) When an abnormal status occurs internally or externally that adversely affects its continued operation, the unit is shut down and a fault signal (24V indicator) is generated.

Warning When abnormal status occurs internally that warrants the operators attention, warning registers are set that can be viewed via Modbus, but the operation of the unit continues without change.

Critical Warning: When abnormal status which requires attention of an operator occurs inside the SSA, this warning register is set, and can be confirmed via Modbus. At this warning status, RF is disabled, and Internal Fault LED starts flashing. Other operations would be kept on.

Regarding warning/fault threshold value, only when out of threshold value is measured continuously three times, warning or fault will be given.

1.6. Momentary Switch Function

There are 3 Momentary Switches at the Front Panel of the RF Control Unit on Front Side of the SSA.

Descriptions of these switches follow.

DC Enabled SW

By pressing this switch, DC power can be enabled or disabled. This switch has the same function with sending Modbus Address 1.

RF Enabled SW

By pressing this switch, RF output can be enabled or disabled. This switch has the same function with sending Modbus Address 2.

Fault Reset SW

By pressing this switch, Fault status will be reset. The Fault kinds which are reset by this switch are Internal Fault, External Fault, and Critical Warning. (All these Faults are reset all together)

This Fault Reset switch removes fault status only when SSA is on any of 3 Fault status listed above. The SSA ignores the fault resetting command and nothing happens when there is no fault

status on the SSA.

This switch is equivalent to Modbus Address 4-1, 4-2, 4-4.

<NOTE>

When resetting Processor Fault, Modbus Address 4-8 corresponds to this fault status.

As other choices to reset Processor Fault, you can cycle 120VAC Circuit Breaker or sending 120VAC Switch (BNC-Female Connector). These choices will set the SSA to the initial state.

Warning status will be reset automatically. Also, even though SSA is on warning state, SSA operates with no problem.

2. Function Information

Information of each function is as following.

2.1. Control Construction

2.1.1. Controller Module

Controller Unit is controlled by Main PCB. It collects data which is taken by SSA by polling
It controls the SSA by processing orders from control interface.

Table 1: Control System

Category	Type name	Number	Specification
MAIN CPU PCB (Main CPU)	ED122-001B-X	1	①CPU:PIC24EP256GU814-I/PH ②Input Port x32 ③Output Port x18 ④Open Collector Output Port x2 ⑤LED Output Port x6 ⑥ADC Input Port (12bit) x5 ⑦RS-485 (MAX14782EASA+) ⑧RX, TX ⑨Real Time Clock (DS3232SN#) ⑩EEPROM (24LC16BTI/SN)
(Debug-SD CPU)			①CPU:PIC24EP512GU814-I/PH ②EEPROM (24LC16B) ③SD-SLOT x2
XPort	XPort (LANTRONIX)	1	①Module to convert RX, TX to Ethernet ②Modbus/TCP ③MAC address is displayed on the Front Panel
PS SUB CPU PCB	ED122-003B-X	1	①CPU:PIC24EP256GU810-I/PF ②Input Port x8 ③Open Collector Output Port x1 ④ADC Input Port (12bit) x1 ⑤DAC Output Port x1 ⑥RS-485 (MAX14782EASA+) ⑦RX, TX ⑧EEPROM (24LC16BTI/SN)

All CPUs software except Debug-SD CPU can be updated via Ethernet.

Table 2: Monitoring Items

Parameter	Resolution (bit)	Sampling rate (Kilo Samples per Second)	Note
480VAC Breaker Position	1 bit	-	RF Cont Unit
External Fault Status	1 bit	-	RF Cont Unit
Processor Fault Status	1 bit	-	RF Cont Unit
480VAC Status	1 bit	-	RF Cont Unit
Thermostat Status	1 bit	-	RF Cont Unit
Water Leak Status	1 bit	-	RF Cont Unit
microSD Status	1 bit	-	RF Cont Unit
Input Driver Power	12 bit	100	RF Cont Unit
Forward Power	12 bit	100	RF Cont Unit
Reflected Power	12 bit	100	RF Cont Unit
Temperature	12 bit	100	PCB, Heat Sink
Control Voltage	12 bit	100	RF Cont, PS Unit
Rotation Speed (FAN)	12 bit	-	RF Cont, PS, HE Unit
Power Supply Status	1 bit	-	PS Unit
Device Current	12 bit	100	DA, FA Unit
Module FWD	12 bit	100	DA, FA Unit
Module REF	12 bit	100	DA, FA Unit
Device Drain Voltage	12 bit	100	DA, FA Unit
Air Temperature	12 bit	100	HE Unit
Outlet LCW Flow Rate	12 bit	100	HE Unit
LCW Temperature	12 bit	100	HE Unit
Moisture	12 bit	100	HE Unit

Voltage is detected by 12bit A/D.

Because detected value by A/D is converted to measured value by created A/D value vs actual value table, and shown on Modbus Register, there is no conversion formula.

Internal conversion method from detected SSA's Forward Power to wattage (just for your information)

There are a directional coupler and RF power detector after SSA's Forward Power. Detected voltage at here is send to an Analog-Digital converter on Main CPU PCB. Then, Main CPU on the Main CPU PCB converts the detected voltage to wattage in below method. Although used tables are different, Amplified Power from Final AMP Unit 1 to 5 and Driver AMP Unit is converted in the similar method.

Calculation Method

There are two series of Tables and Equations.

For calculation of 100-1000W power, Table 3 and Equation A are used.

For calculation of 1000-10000W power, Table 4 and Equation B are used.

Table

Table 3: Calculated FWD Power from ADC Detected Voltage (below 1000 W)

#	0	1	2	3	4	5	6	7	8	9	10
Power (Watt)	100	150	200	250	300	350	400	450	500	550	600
Detected Voltage (mV)	158	207	249	285	319	348	377	402	426	450	473
#	11	12	13	14	15	16	17	18			
Power (Watt)	650	700	750	800	850	900	950	1000			
Detected Voltage (mV)	493	513	533	552	572	588	604	621			

Table 4: Calculated FWD Power from ADC Detected Voltage (above 1000 W)

#	0	1	2	3	4	5	6	7	8	9	10
Power (Watt)	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
Detected Voltage (mV)	621	767	889	992	1090	1178	1258	1336	1407	1476	1541
#	11	12	13	14	15	16	17	18			
Power (Watt)	6500	7000	7500	8000	8500	9000	9500	10000			
Detected Voltage (mV)	1603	1662	1720	1775	1824	1872	1920	1961			

Equation

Equation A

$$\text{Forward Power} = \frac{(\text{Detected Voltage} - \text{Lower Bound Voltage}) * 50}{(\text{Upper Bound Voltage} - \text{Lower Bound Voltage})} + \text{Lower Bound Power (Watt)}$$

Equation B

$$\text{Forward Power} = \frac{(\text{Detected Voltage} - \text{Lower Bound Voltage}) * 500}{(\text{Upper Bound Voltage} - \text{Lower Bound Voltage})} + \text{Lower Bound Power (Watt)}$$

Example / Explanation continues on next page.

Example / Explanation

Example 1

1. 265mV is detected
2. Main CPU seeks what numbers 265mV is located between.
3. In this case, numbers are #2 and #3 of Fwd Table A because 265mV is bigger than 249mV and smaller than 285mV.
4. To fill up the Equation A, Main CPU seeks Lower Bound Voltage, Upper Bound Voltage, and Lower Bound power of #2 and #3 from the table.

In this case,

Lower Bound Voltage = 249, Upper Bound Voltage = 285, Lower Bound Power = 200.

Lower Bound Power										
#	0	1	2	3	4	5	6	7	8	9
Power (Watt)	100	150	200	250	300	350	400	450	500	550
Detected Voltage (mV)	158	207	249	285	319	348	377	402	426	450

The diagram shows a table with columns for Power (Watt) and Detected Voltage (mV). The detected voltage 249 is highlighted in the mV column. Two arrows point upwards from this value to the corresponding rows in the table: one arrow points to the row where the detected voltage is 249 (Power 200), and another arrow points to the row where the detected voltage is 285 (Power 300). These two rows are labeled 'Lower Bound Voltage' and 'Upper Bound Voltage' respectively.

5. So, calculation is: Forward Power = $((265-249)*50 / (285-249)) + 200$
As the result, power is calculated as 222W (cut off after the decimal point)

Example 2

1. 1050mV is detected
2. Main CPU seeks what numbers 1050mV is located between.
3. In this case, numbers are #3 and #4 of Fwd Table B because 1050mV is bigger than 992mV and smaller than 1090mV.
4. To fill up the Equation B, Main CPU seeks Lower Bound Voltage, Upper Bound Voltage, and Lower Bound power of #3 and #4 from the table.

In this case,

Lower Bound Voltage = 992, Upper Bound Voltage = 1090, Lower Bound Power = 2500.

Lower Bound Power										
#	0	1	2	3	4	5	6	7	8	9
Power (Watt)	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500
Detected Voltage (mV)	621	767	889	992	1090	1178	1258	1336	1407	1476

The diagram shows a table with columns for Power (Watt) and Detected Voltage (mV). The detected voltage 992 is highlighted in the mV column. Two arrows point upwards from this value to the corresponding rows in the table: one arrow points to the row where the detected voltage is 992 (Power 2500), and another arrow points to the row where the detected voltage is 1090 (Power 3000). These two rows are labeled 'Lower Bound Voltage' and 'Upper Bound Voltage' respectively.

5. So, calculation is: Forward Power = $((1050-992)*500 / (1090-992)) + 2500$
As the result, power is calculated as 2795W (cut off after the decimal point)

2.2. Control Interface

2.2.1. XPort Setting

The XPort settings are editable by the Lantronix “Device Installer.exe” program. The XPort initial settings are given in Table 3.

Table 5: XPort Setting

Property	XPort
IP Address	169.254.150.1
Subnet Mask	255.255.0.0
Default Gateway	0.0.0.0
DNS Server	0.0.0.0
CPU Performance Mode	High
Protocol	RS232
Flow Control	None
Baud Rate	230400bps
Data Bits	8
Parity	None
Stop Bits	1
Local Port	502
Remote Port	0
Remote Host	0.0.0.0

The default IP address for all SSAs is 169.254.150.1

2.2.2. Communication Protocol

The unit is monitored and controlled via Modbus commands through Ethernet.
The IP address is assigned automatically and the Port is 502.

Table 6: Modbus/TCP

Transaction Identifier	Protocol Identifier	Length	Unit Identifier
2byte 0xFFFF	2byte 0xFFFF	2byte 0xFFFF	1byte 0XX

Response returns same one as received Header
(Transaction identifier, Protocol identifier, Unit identifier)

<Function Code>

Supports following Function Code.

<0x03 Read Holding Registers>

Read only.

One or continuous registers read is enabled. (125 max.)

1) Request

Table 7: Request Packet Format (0x03)

Transaction Identifier		Protocol Identifier		Length		Unit Identifier	Function	Starting Address		Quantity of Registers	
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8	byte9	byte10	byte11
Hi	Lo	Hi	Lo	Hi	Lo	1 byte	1 byte	Hi	Lo	Hi	Lo
0xFF	0xFF	0xFF	0xFF	0x00	0x06	0xFF	0x03	0x00	0x02	0x00	0x03

2) Response

Table 8: Response Packet Format (0x03)

Transaction Identifier		Protocol Identifier		Length		Unit Identifier	Function	Byte count	Data 1		Data 2		Data 3	
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8	byte9	byte10	byte11	byte12	byte13	byte14
Hi	Lo	Hi	Lo	Hi	Lo	1 byte	1 byte	1 byte	Hi	Lo	Hi	Lo	Hi	Lo
0xFF	0xFF	0xFF	0xFF	0x00	0x09	0xFF	0x03	0x06	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF

3) Exception Response

Table 9: Exception Response Packet Format (0x03)

Transaction Identifier		Protocol Identifier		Length		Unit Identifier	Function	Exception Code
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8
Hi	Lo	Hi	Lo	Hi	Lo	1 byte	1 byte	1 byte
0xXX	0xXX	0xXX	0xXX	0x00	0x03	0xXX	0x83	0xXX

Table 10: Exception Code (0x03)

Exception Code	MODBUS Name	Comments
0x01	Illegal Function Code	The function code is unknown by the server
0x02	Illegal Data Address	Address specification outside the allowed range
0x03	Illegal Data Value	Specified value outside the allowed range
0x04	Processing abnormality	Write protect setting

<0x06 Write Single Register>

Write only to a single register

This command is used to:

- DC Enable/Disable
- RF Enable/Disable
- Voltage control setting of each switching power supply
- Fault Reset
- Reboot
- Time setting
-

1) Request

Table 11: Request Packet Format (0x06)

Transaction Identifier		Protocol Identifier		Length		Unit Identifier	Function	Register Address		Register Value	
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8	byte9	byte10	byte11
Hi	Lo	Hi	Lo	Hi	Lo	1 byte	1 byte	Hi	Lo	Hi	Lo
0xXX	0xXX	0xXX	0xXX	0x00	0x06	0xXX	0x06	0x00	0x02	0x01	0x03

2) Response

Table 12: Response Packet Format (0x06)

Transaction Identifier		Protocol Identifier		Length		Unit Identifier	Function	Register Address		Register Value	
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8	byte9	byte10	byte11
Hi	Lo	Hi	Lo	Hi	Lo	1 byte	1 byte	Hi	Lo	Hi	Lo
0xXX	0xXX	0xXX	0xXX	0x00	0x08	0xXX	0x06	0x00	0x02	0x01	0x03

3) Exception Response

Table 13: Exception Response Packet Format (0x06)

Transaction Identifier		Protocol Identifier		Length		Unit Identifier	Function	Exception Code
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8
Hi	Lo	Hi	Lo	Hi	Lo	1 byte	1 byte	1 byte
0xXX	0xXX	0xXX	0xXX	0x00	0x03	0xXX	0x86	0xXX

Table 14: Exception Code (0x06)

Exception Code	MODBUS Name	Comments
0x01	Illegal Function Code	The function code is unknown by the server
0x02	Illegal Data Address	Address specification outside the allowed range
0x03	Illegal Data value	Specified value outside the allowed range
0x04	Processing abnormality	Write protect setting
0x05	No Action	
0x0B	Timeout	The CPU specified by the unit ID does not exist.

<Register Map>

Below is the list of Register Map. Address offset is enabled.

Note:

- When Faulted, the default state is: DC Disabled, PS Output Control Voltage 0mV and RF Disabled. The reason for the fault is listed in at Address 10, 11, 15.

Reset Operation

1. Send the "Fault Reset" command (Address 4) to the SSA via Modbus.
2. Send the "DC Enable" command (Address 1) to the SSA via Modbus.
3. Send the "PS Output Control Voltage" command (Address 3) to the SSA via Modbus.
4. Send the "RF Enable" command (Address 2) to the SSA via Modbus.

- When Warnings, the information will be listed at Address 13 and 20, 31, 165 - 173 but SSA operation continues as before the error detection.

To remove these warnings: Check what causing the warning and remove or fix the error cause.

- Multiplier for the data read back.

Multiply the number on Multiplier to Modbus register value, and put the Unit next to it to get the actual status.

- Lower Threshold and Upper Threshold

Threshold values against error occasion are listed. For ones have parentheses, warning code will be generated on values in the parenthesis, and interlock function trips SSA on values out of the parenthesis.

i.e.: For Address 24, when the temperature at Main CPU on the Main PCB gets lower than +8.0 degC, warning is generated. Then, when it gets lower than +4.0 degC, SSA trips by interlock.

Also, when the temperature at Main CPU on the Main PCB gets higher than +55.0 degC, warning is generated. And, when it gets higher than +60.0 degC SSA trips by interlock.

At warning state, the error code (550 for Address 24) is indicated on the Address 13. And the error code is indicated on the Address 10 when SSA tripped by interlock.

Table 15: Register Map

Address	Description	Function	Display Range	Multiplier	Unit	Permitted Raw Value	Lower Threshold	Upper Threshold	Command / Status	Error Code	Error Type	Error Operation
1	DC Enable / Disable	0x03,06	0 or 1	n/a	n/a	0 or 1	n/a	n/a	0: Disable 1: Enable	n/a	n/a	n/a
2	RF Enable / Disable	0x03,06	0 or 1	n/a	n/a	0 or 1	n/a	n/a	0: Disable 1: Enable	n/a	n/a	n/a
3	PS Output Control Voltage	0x03,06	0 - 2080	1	n/a	0 - 2080	n/a	n/a	(refer to: Table 17)	n/a	n/a	n/a
4	Fault Reset	0x06	0 or 1	n/a	n/a	1, 2, 4, 8	n/a	n/a	1: Internal 2: External 4: Critical Warning 8: Processor	n/a	n/a	n/a
5	LAN Reboot	0x06	0 or 1	n/a	n/a	1	n/a	n/a	1: Reboot	n/a	n/a	n/a
6	System Reboot	0x06	0 or 1	n/a	n/a	1	n/a	n/a	1: Reboot	n/a	n/a	n/a
7	SD Card Operation	0x03,06	0 or 1	n/a	n/a	0 or 1	n/a	n/a	0: Disable (Hot swap allowed) 1: Enable (Hot swap not allowed)	n/a	n/a	n/a
8	Set threshold to Factory default value	0x06	0 or 1	n/a	n/a	1	n/a	n/a	1: Set default value	n/a	n/a	n/a
9	AC Enable / Disable (480VAC Breaker Position)	0x03	0 or 1	n/a	n/a	Read Only	n/a	n/a	0: Disable 1: Enable	n/a	n/a	n/a
10	Internal Fault Error Code (This code Indicates the first Fault.)	0x03	0 or 11 - 732	1	n/a	Read Only	n/a	n/a	0: No Error 11 - 732: Error	Error code	Internal①②③	DC / RF Disable

11	External Fault Error Code (This code Indicates the first Fault.)	0x03	0 or 511 - 518	1	n/a	Read Only	n/a	n/a	0: No Error 511 - 518: Error	External 1: 511 External 2: 512 External 3: 514 External 4: 518	External	DC / RF Disable
12	External Fault Status (bit)	0x03	0 - 0x000F	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: External 1 bit1: External 2 bit2: External 3 bit3: External 4 bit4 - bit15: 0	(511 - 518)	n/a	n/a
13	Warning Code (This code Indicates the last Warning that occurred.)	0x03	0 or 1 - 733	1	n/a	Read Only	n/a	n/a	0: No Error 1 - 733: Error	Error code	Warning	Notification Only
14	Critical Warning Code (This code Indicates the first Critical Warning.)	0x03	0 or 500 - 501	1	n/a	Read Only	n/a	n/a	0: No Error 500 - 501: Error	Error code	Critical Warning	RF Disable (Internal Fault LED Flashing)
15	Processor Fault Error Code (This code Indicates the first Fault.)	0x03	0 or 591 - 599	1	n/a	Read Only	n/a	n/a	0: No Error 591 - 599: Error	Main CPU: - Debug-SD CPU: 591 PS Sub CPU: 592 FA-1 DAFA Sub CPU: 593 FA-2 DAFA Sub CPU: 594 FA-3 DAFA Sub CPU: 595 FA-4 DAFA Sub CPU: 596 FA-5 DAFA Sub CPU: 597 DA DAFA Sub CPU: 598 HE Sub CPU: 599	Processor	DC / RF Disable
16	Processor Fault Status (bit)	0x03	0 - 0x03FE	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: 0 bit1: Debug-SD CPU bit2: PS Sub CPU bit3: FA-1 DAFA Sub CPU bit4: FA-2 DAFA Sub CPU bit5: FA-3 DAFA Sub CPU bit6: FA-4 DAFA Sub CPU bit7: FA-5 DAFA Sub CPU bit8: DA DAFA Sub CPU bit9: HE Sub CPU bit10 - bit15: 0	(591 - 599)	n/a	n/a
17	480VAC Status	0x03	0 or 1	n/a	n/a	Read Only	n/a	n/a	0: No Error 1: Error	580	Internal①	DC / RF Disable
18	Thermostat Status (bit)	0x03	0 - 0xFFFF	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: Main CPU PCB bit1: PS Sub CPU PCB bit2: FA-1_DAFA Sub CPU PCB bit3: FA-1_HeatSink bit4: FA-2_DAFA Sub	560	Internal①	DC / RF Disable

								CPU PCB bit5: FA-2_HeatSink bit6: FA-3_DAFA Sub CPU PCB bit7: FA-3_HeatSink bit8: FA-4_DAFA Sub CPU PCB bit9: FA-4_HeatSink bit10: FA-5_DAFA Sub CPU PCB bit11: FA-5_HeatSink bit12: DA_DAFA Sub CPU PCB bit13: DA_HeatSink bit14: HE Sub CPU PCB bit15: HE Unit Air Inlet				
19	Water Leak Status	0x03	0 or 1	n/a	n/a	Read Only	n/a	n/a	0: No Error 1: Error	502	Internal①	DC / RF Disable
20	microSD Status (Master, Slave) (bit)	0x03	0 - 0x0003	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: Master bit1: Slave bit2 - bit15: 0	Master: 541 Slave: 542	Warning	Notification Only
21	Input Drive Power	0x03	0 - 2000	1	n/a	Read Only	0	1550 (1335)	(Table 18)	500	Critical Warning (Warning)	RF Disable (Notification Only)
22	Forward Power	0x03	0 - 10000	1	W	Read Only	0W	7700W (7350W)	Operation Value	501	Critical Warning (Warning)	RF Disable (Notification Only)
23	Reflected Power	0x03	0 - 10000	1	W	Read Only	0W	700W (350W)	Operation Value	530	Internal③ (Warning)	DC / RF Disable (Notification Only)
24	Main CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+55.0degC)+8.0degC	+60.0degC (+55.0degC)	Operation Value	550	Internal③ (Warning)	DC / RF Disable (Notification Only)
25	Main CPU PCB Input Voltage +12VDC	0x03	0 - 100.0	0.1	V	Read Only	+8.0V	+16.0V	Operation Value	521	Internal③	DC / RF Disable
26	Main CPU PCB Input Voltage +24VDC	0x03	0 - 100.0	0.1	V	Read Only	+20.0V	+28.0V	Operation Value	522	Warning	Notification Only
27	RF Control Unit Fan Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	503	Warning	Notification Only
28	Ready for RF (Operates Only at DC Enable, and Only for 90 Seconds after setting DC Enable)	0x03	90 - 0	1	sec	Read Only	n/a	n/a	Countdown Timer 0: No Error (Ready) 90 - 1: Error (Not Ready)	504	Warning	Notification Only
29	-	-	-	-	-	-	-	-	-	-	-	-
30	PS Status (More than Three Faults)	0x03	0 - 6	1	n/a	Read Only	n/a	>=3 (Error)	0 - 2: No Error 3 - 6: Error	420	Internal②	DC / RF Disable
31	PS Status (bit)	0x03	0 - 0x0AAA	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: 0 bit1: PS 1_FAULT# bit2: 0 bit3: PS 2_FAULT# bit4: 0 bit5: PS 3_FAULT# bit6: 0	PS 1: 421 PS 2: 422 PS 3: 423 PS 4: 424 PS 5: 425 PS 6: 426	Warning	Notification Only

									bit7: PS 4_FAULT# bit8: 0 bit9: PS 5_FAULT# bit10: 0 bit11: PS 6_FAULT# bit12 - bit15: 0			
32	-	-	-	-	-	-	-	-	-	-	-	-
33	PS Sub CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+8.0degC)	+60.0degC (+55.0degC)	Operation Value	404	Internal③ (Warning)	DC / RF Disable (Notification Only)
34	-	-	-	-	-	-	-	-	-	-	-	-
35	PS Sub CPU PCB Input Voltage +24VDC (for MC, SSA)	0x03	0 - 100.0	0.1	V	Read Only	+20.0V	+28.0V	Operation Value	442	Warning	Notification Only
36	PS Unit Fan 1 Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	437	Warning	Notification Only
37	PS Unit Fan 2 Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	438	Warning	Notification Only
38	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	-	-	-	-
40	FA Unit-1 ① Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	101	Warning	Notification Only
41	FA Unit-1 ② Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	102	Warning	Notification Only
42	FA Unit-1 ③ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	103	Warning	Notification Only
43	FA Unit-1 ④ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	104	Warning	Notification Only
44	FA Unit-1 ①② FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	111	Internal③ (Warning)	DC / RF Disable (Notification Only)
45	FA Unit-1 ①② REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	115	Internal③ (Warning)	DC / RF Disable (Notification Only)
46	FA Unit-1 ③④ FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	112	Internal③ (Warning)	DC / RF Disable (Notification Only)
47	FA Unit-1 ③④ REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	116	Internal③ (Warning)	DC / RF Disable (Notification Only)
48	FA Unit-1 ① +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	121	Warning	Notification Only
49	FA Unit-1 ② +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	122	Warning	Notification Only
50	FA Unit-1 ③ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	123	Warning	Notification Only
51	FA Unit-1 ④ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	124	Warning	Notification Only
52	FA Unit-1 +12VDC	0x03	0 - 100.0	0.1	V	Read Only	+8.0V	+16.0V	Operation Value	125	Warning	Notification Only
53	FA Unit-1 Heat Sink Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+22.0degC	+60.0degC	Operation Value	131	Warning	Notification Only
54	FA-1 FADA Sub CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+8.0degC)	+60.0degC (+55.0degC)	Operation Value	132	Internal③ (Warning)	DC / RF Disable (Notification Only)
55	-	-	-	-	-	-	-	-	-	-	-	-
56	-	-	-	-	-	-	-	-	-	-	-	-
57	FA Unit-2 ① Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	201	Warning	Notification Only
58	FA Unit-2 ② Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	202	Warning	Notification Only
59	FA Unit-2 ③ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	203	Warning	Notification Only
60	FA Unit-2 ④ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	204	Warning	Notification Only
61	FA Unit-2 ①② FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	211	Internal③ (Warning)	DC / RF Disable (Notification Only)
62	FA Unit-2 ①② REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	215	Internal③ (Warning)	DC / RF Disable (Notification Only)
63	FA Unit-2 ③④ FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	212	Internal③ (Warning)	DC / RF Disable (Notification Only)

64	FA Unit-2 ③④ REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	216	Internal③ (Warning)	DC / RF Disable (Notification Only)
65	FA Unit-2 ① +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	221	Warning	Notification Only
66	FA Unit-2 ② +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	222	Warning	Notification Only
67	FA Unit-2 ③ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	223	Warning	Notification Only
68	FA Unit-2 ④ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	224	Warning	Notification Only
69	FA-2 Unit +12VDC	0x03	0 - 100.0	0.1	V	Read Only	+8.0V	+16.0V	Operation Value	225	Warning	Notification Only
70	FA Unit-2 Heat Sink Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+22.0degC	+60.0degC	Operation Value	231	Warning	Notification Only
71	FA-2 FADA Sub CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+8.0degC)	+60.0degC (+55.0degC)	Operation Value	232	Internal③ (Warning)	DC / RF Disable (Notification Only)
72	-	-	-	-	-	-	-	-	-	-	-	-
73	-	-	-	-	-	-	-	-	-	-	-	-
74	FA Unit-3 ① Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	301	Warning	Notification Only
75	FA Unit-3 ② Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	302	Warning	Notification Only
76	FA Unit-3 ③ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	303	Warning	Notification Only
77	FA Unit-3 ④ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	304	Warning	Notification Only
78	FA Unit-3 ①② FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	311	Internal③ (Warning)	DC / RF Disable (Notification Only)
79	FA Unit-3 ①② REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	315	Internal③ (Warning)	DC / RF Disable (Notification Only)
80	FA Unit-3 ③④ FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	312	Internal③ (Warning)	DC / RF Disable (Notification Only)
81	FA Unit-3 ③④ REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	316	Internal③ (Warning)	DC / RF Disable (Notification Only)
82	FA Unit-3 ① +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	321	Warning	Notification Only
83	FA Unit-3 ② +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	322	Warning	Notification Only
84	FA Unit-3 ③ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	323	Warning	Notification Only
85	FA Unit-3 ④ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	324	Warning	Notification Only
86	FA Unit-3 +12VDC	0x03	0 - 100.0	0.1	V	Read Only	+8.0V	+16.0V	Operation Value	325	Warning	Notification Only
87	FA Unit-3 Heat Sink Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+22.0degC	+60.0degC	Operation Value	331	Warning	Notification Only
88	FA-3 FADA Sub CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+8.0degC)	+60.0degC (+55.0degC)	Operation Value	332	Internal③ (Warning)	DC / RF Disable (Notification Only)
89	-	-	-	-	-	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-	-	-	-	-	-
91	FA Unit-4 ① Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	601	Warning	Notification Only
92	FA Unit-4 ② Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	602	Warning	Notification Only
93	FA Unit-4 ③ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	603	Warning	Notification Only
94	FA Unit-4 ④ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	604	Warning	Notification Only
95	FA Unit-4 ①② FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	611	Internal③ (Warning)	DC / RF Disable (Notification Only)
96	FA Unit-4 ①② REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	615	Internal③ (Warning)	DC / RF Disable (Notification Only)
97	FA Unit-4 ③④ FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	612	Internal③ (Warning)	DC / RF Disable (Notification Only)
98	FA Unit-4 ③④ REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	616	Internal③ (Warning)	DC / RF Disable (Notification Only)
99	FA Unit-4 ① +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	621	Warning	Notification Only
100	FA Unit-4 ② +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	622	Warning	Notification Only

101	FA Unit-4 ③ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	623	Warning	Notification Only
102	FA Unit-4 ④ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	624	Warning	Notification Only
103	FA Unit-4 +12VDC	0x03	0 - 100.0	0.1	V	Read Only	+8.0V	+16.0V	Operation Value	625	Warning	Notification Only
104	FA Unit-4 Heat Sink Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+22.0degC	+60.0degC	Operation Value	631	Warning	Notification Only
105	FA-4 FADA Sub CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+8.0degC)	+60.0degC (+55.0degC)	Operation Value	632	Internal③ (Warning)	DC / RF Disable (Notification Only)
106	-	-	-	-	-	-	-	-	-	-	-	-
107	-	-	-	-	-	-	-	-	-	-	-	-
108	FA Unit-5 ① Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	701	Warning	Notification Only
109	FA Unit-5 ② Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	702	Warning	Notification Only
110	FA Unit-5 ③ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	703	Warning	Notification Only
111	FA Unit-5 ④ Final AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	20.0A	Operation Value	704	Warning	Notification Only
112	FA Unit-5 ①② FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	711	Internal③ (Warning)	DC / RF Disable (Notification Only)
113	FA Unit-5 ①② REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	715	Internal③ (Warning)	DC / RF Disable (Notification Only)
114	FA Unit-5 ③④ FWD	0x03	0 - 2000	1	W	Read Only	0W	1100W (1000W)	Operation Value	712	Internal③ (Warning)	DC / RF Disable (Notification Only)
115	FA Unit-5 ③④ REF	0x03	0 - 2000	1	W	Read Only	0W	1000W (500W)	Operation Value	716	Internal③ (Warning)	DC / RF Disable (Notification Only)
116	FA Unit-5 ① +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	721	Warning	Notification Only
117	FA Unit-5 ② +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	722	Warning	Notification Only
118	FA Unit-5 ③ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	723	Warning	Notification Only
119	FA Unit-5 ④ +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	724	Warning	Notification Only
120	FA Unit-5 +12VDC	0x03	0 - 100.0	0.1	V	Read Only	+8.0V	+16.0V	Operation Value	725	Warning	Notification Only
121	FA Unit-5 Heat Sink Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+22.0degC	+60.0degC	Operation Value	731	Warning	Notification Only
122	FA-5 FADA Sub CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+8.0degC)	+60.0degC (+55.0degC)	Operation Value	732	Internal③ (Warning)	DC / RF Disable (Notification Only)
123	-	-	-	-	-	-	-	-	-	-	-	-
124	DA Unit Pre Driver AMP Current	0x03	0 - 5.0	0.1	A	Read Only	0.5A	3.0A	Operation Value	1	Warning	Notification Only
125	DA Unit ① Driver AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	11.5A	Operation Value	2	Warning	Notification Only
126	DA Unit ② Driver AMP Current	0x03	0 - 30.0	0.1	A	Read Only	0.0A	11.5A	Operation Value	3	Warning	Notification Only
127	-	-	-	-	-	-	-	-	-	-	-	-
128	-	-	-	-	-	-	-	-	-	-	-	-
129	DA Unit ①② FWD	0x03	0 - 1250	1	W	Read Only	0W	550W (500W)	Operation Value	11	Internal③ (Warning)	DC / RF Disable (Notification Only)
130	DA Unit ①② REF	0x03	0 - 1250	1	W	Read Only	0W	500W (250W)	Operation Value	15	Internal③ (Warning)	DC / RF Disable (Notification Only)
131	-	-	-	-	-	-	-	-	-	-	-	-
132	-	-	-	-	-	-	-	-	-	-	-	-
133	DA Unit ① +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	22	Warning	Notification Only
134	DA Unit ② +45VDC	0x03	0 - 70.0	0.1	V	Read Only	+10.0V	+50.0V	Operation Value	23	Warning	Notification Only
135	-	-	-	-	-	-	-	-	-	-	-	-
136	-	-	-	-	-	-	-	-	-	-	-	-
137	DA Unit +12VDC	0x03	0 - 100.0	0.1	V	Read Only	+8.0V	+16.0V	Operation Value	21	Warning	Notification Only
138	DA Unit Heat Sink Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+22.0degC	+60.0degC	Operation Value	31	Warning	Notification Only
139	DA FADA Sub CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+8.0degC)	+60.0degC (+55.0degC)	Operation Value	32	Internal③ (Warning)	DC / RF Disable (Notification Only)

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140	-	-	-	-	-	-	-	-	-	-	-	-	-
141	HE Unit Air Inlet Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC	+45.0degC	Operation Value	405	Internal③	DC / RF Disable	
142	HE Sub CPU PCB Temperature	0x03	0 - 100.0	0.1	degC	Read Only	+4.0degC (+8.0degC)	+60.0degC (+55.0degC)	Operation Value	406	Internal③ (Warning)	DC / RF Disable (Notification Only)	
143	-	-	-	-	-	-	-	-	-	-	-	-	-
144	-	-	-	-	-	-	-	-	-	-	-	-	-
145	HE Unit Fan 1 Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	431	Warning	Notification Only	
146	HE Unit Fan 2 Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	432	Warning	Notification Only	
147	HE Unit Fan 3 Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	433	Warning	Notification Only	
148	HE Unit Fan 4 Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	434	Warning	Notification Only	
149	HE Unit Fan 5 Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	435	Warning	Notification Only	
150	HE Unit Fan 6 Rotation Speed	0x03	0 - 9450	1	rpm	Read Only	5000rpm	9000rpm	Operation Value	436	Warning	Notification Only	
151	-	-	-	-	-	-	-	-	-	-	-	-	-
152	-	-	-	-	-	-	-	-	-	-	-	-	-
153	-	-	-	-	-	-	-	-	-	-	-	-	-
154	Outlet LCW Flow Rate	0x03	0 - 40.0	0.1	L/min	Read Only	20L/min (22L/min)	-	Operation Value	409	Internal③ (Warning)	DC / RF Disable (Notification Only)	
155	Inlet LCW Temperature	0x03	15.0 - 60.0	0.1	degC	Read Only	+22.0degC	+38.0degC	Operation Value	410	Internal③	DC / RF Disable	
156	Outlet LCW Temperature	0x03	15.0 - 60.0	0.1	degC	Read Only	+22.0degC	+45.0degC	Operation Value	411	Internal③	DC / RF Disable	
157	Moisture Sensor Status	0x03	0 - 100.0	0.1	%	Read Only	n/a	n/a	Operation Value	n/a	n/a	n/a	
158	SSA Software Version	0x03	0 - 9999	0.01	Versio n	Read Only	n/a	n/a	Operation Value	n/a	n/a	n/a	
159	Debug-SD CPU Software Version	0x03	0 - 9999	0.01	Versio n	Read Only	n/a	n/a	Operation Value	n/a	n/a	n/a	
160	Year for Calendar	0x03,06	00 - 99	1	Year	00 - 99	n/a	n/a	Operation Value	n/a	n/a	n/a	
161	Month for Calendar	0x03,06	1 - 12	1	Month	1 - 12	n/a	n/a	Operation Value	n/a	n/a	n/a	
162	Date for Calendar	0x03,06	1 - 31	1	Date	1 - 31	n/a	n/a	Operation Value	n/a	n/a	n/a	
163	Hour for Calendar	0x03,06	0 - 23	1	Hour	0 - 23	n/a	n/a	Operation Value	n/a	n/a	n/a	
164	Minute for Calendar	0x03,06	0 - 59	1	Minute	0 - 59	n/a	n/a	Operation Value	n/a	n/a	n/a	
165 (21-27)	RF Control Unit_Warning Status (bit)	0x03	0 - 0x003F	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: Input Driver Power bit1: Forward Power bit2: Reflected Power bit3: Main CPU PCB Temp. bit4: Main CPU PCB Volt. +24VDC bit5: Fan Rotation Speed bit6 - bit15: 0	bit0: 500 bit1: 501 bit2: 530 bit3: 550 bit4: 522 bit5: 503	(Warning)	(Notification Only)	
166 (33-37)	PS Unit_Warning Status (bit)	0x03	0 - 0x003A	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: 0 bit1: PS Sub CPU PCB Temp. bit2: 0 bit3: PS Sub CPU PCB Volt. +24VDC bit4: Fan 1 Rotation Speed bit5: Fan 2 Rotation	bit0: - bit1: 404 bit2: - bit3: 442 bit4: 437 bit5: 438	(Warning)	(Notification Only)	

								Speed bit6 - bit15: 0				
167 (40-54)	FA Unit-1_Warning Status (bit)	0x03	0 - 0xFFFFE	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: 0 bit1: ①Final AMP Curr. bit2: ②Final AMP Curr. bit3: ③Final AMP Curr. bit4: ④Final AMP Curr. bit5: ①②FWD bit6: ①②REF bit7: ③④FWD bit8: ③④REF bit9: ①+45VDC bit10: ②+45VDC bit11: ③+45VDC bit12: ④+45VDC bit13: HeatSink Temp. bit14: DAFA Sub CPU PCB Temp. bit15: +12VDC	bit0: - bit1: 101 bit2: 102 bit3: 103 bit4: 104 bit5: 111 bit6: 115 bit7: 112 bit8: 116 bit9: 121 bit10: 122 bit11: 123 bit12: 124 bit13: 131 bit14: 132 bit15: 125	(Warning)	(Notification Only)
168 (57-71)	FA Unit-2_Warning Status (bit)	0x03	0 - 0xFFFFE	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: 0 bit1: ①Final AMP Curr. bit2: ②Final AMP Curr. bit3: ③Final AMP Curr. bit4: ④Final AMP Curr. bit5: ①②FWD bit6: ①②REF bit7: ③④FWD bit8: ③④REF bit9: ①+45VDC bit10: ②+45VDC bit11: ③+45VDC bit12: ④+45VDC bit13: HeatSink Temp. bit14: DAFA Sub CPU PCB Temp. bit15: +12VDC	bit0: - bit1: 201 bit2: 202 bit3: 203 bit4: 204 bit5: 211 bit6: 215 bit7: 212 bit8: 216 bit9: 221 bit10: 222 bit11: 223 bit12: 224 bit13: 231 bit14: 232 bit15: 225	(Warning)	(Notification Only)
169 (74-88)	FA Unit-3_Warning Status (bit)	0x03	0 - 0xFFFFE	n/a	n/a	Read Only	n/a	n/a	0: No Error bit0: 0 bit1: ①Final AMP Curr. bit2: ②Final AMP Curr. bit3: ③Final AMP Curr. bit4: ④Final AMP Curr. bit5: ①②FWD bit6: ①②REF bit7: ③④FWD bit8: ③④REF bit9: ①+45VDC bit10: ②+45VDC bit11: ③+45VDC bit12: ④+45VDC	bit0: - bit1: 301 bit2: 302 bit3: 303 bit4: 304 bit5: 311 bit6: 315 bit7: 312 bit8: 316 bit9: 321 bit10: 322 bit11: 323 bit12: 324 bit13: 331	(Warning)	(Notification Only)

								bit13: HeatSink Temp. bit14: DAFA Sub CPU PCB Temp. bit15: +12VDC	bit14: 332 bit15: 325		
170 (91-105)	FA Unit-4_Warning Status (bit)	0x03	0 - 0xFFFF	n/a	n/a	Read Only	n/a	0: No Error bit0: 0 bit1: ①Final AMP Curr. bit2: ②Final AMP Curr. bit3: ③Final AMP Curr. bit4: ④Final AMP Curr. bit5: ①②FWD bit6: ①②REF bit7: ③④FWD bit8: ③④REF bit9: ①+45VDC bit10: ②+45VDC bit11: ③+45VDC bit12: ④+45VDC bit13: HeatSink Temp. bit14: DAFA Sub CPU PCB Temp. bit15: +12VDC	bit0: - bit1: 601 bit2: 602 bit3: 603 bit4: 604 bit5: 611 bit6: 615 bit7: 612 bit8: 616 bit9: 621 bit10: 622 bit11: 623 bit12: 624 bit13: 631 bit14: 632 bit15: 625	(Warning)	(Notification Only)
171 (108- 122)	FA Unit-5_Warning Status (bit)	0x03	0 - 0xFFFF	n/a	n/a	Read Only	n/a	0: No Error bit0: 0 bit1: ①Final AMP Curr. bit2: ②Final AMP Curr. bit3: ③Final AMP Curr. bit4: ④Final AMP Curr. bit5: ①②FWD bit6: ①②REF bit7: ③④FWD bit8: ③④REF bit9: ①+45VDC bit10: ②+45VDC bit11: ③+45VDC bit12: ④+45VDC bit13: HeatSink Temp. bit14: DAFA Sub CPU PCB Temp.	bit0: - bit1: 701 bit2: 702 bit3: 703 bit4: 704 bit5: 711 bit6: 715 bit7: 712 bit8: 716 bit9: 721 bit10: 722 bit11: 723 bit12: 724 bit13: 731 bit14: 732 bit15: 725	(Warning)	(Notification Only)

								bit15: +12VDC			
172 (124-139)	DA Unit_Warning Status (bit)	0x03	0 - 0xE667	n/a	n/a	Read Only	n/a	0: No Error bit0: Pre Driver AMP Curr. bit1: ①Driver AMP Curr. bit2: ②Driver AMP Curr. bit3: 0 bit4: 0 bit5: ①②FWD bit6: ①②REF bit7: 0 bit8: 0 bit9: ①+45VDC bit10: ②+45VDC bit11: 0 bit12: 0 bit13: HeatSink Temp. bit14: DAFA Sub CPU PCB Temp. bit15: +12VDC	bit0: 1 bit1: 2 bit2: 3 bit3: - bit4: - bit5: 11 bit6: 15 bit7: - bit8: - bit9: 22 bit10: 23 bit11: - bit12: - bit13: 31 bit14: 32 bit15: 21	(Warning)	(Notification Only)
173 (142-154)	HE Unit, Water INFO_Warning Status (bit)	0x03	0 - 0x13F2	n/a	n/a	Read Only	n/a	0: No Error bit0: 0 bit1: HE Sub CPU Temp. bit2: 0 bit3: 0 bit4: Fan 1 Rotation Speed bit5: Fan 2 Rotation Speed bit6: Fan 3 Rotation Speed bit7: Fan 4 Rotation Speed bit8: Fan 5 Rotation Speed bit9: Fan 6 Rotation Speed bit10: 0 bit11: 0 bit12: Outlet Flow Rate bit13 - bit15: 0	bit0: - bit1: 406 bit2: - bit3: - bit4: 431 bit5: 432 bit6: 433 bit7: 434 bit8: 435 bit9: 436 bit10: - bit11: - bit12: 409	(Warning)	(Notification Only)
174	Input Drive Power Upper Limit (Warning Limit)	0x03,06	0 - 2000	1	mV	Read Write	n/a	1335mV	(0 - 2000)	(500)	n/a
175	Input Drive Power Upper Limit (Critical Warning Limit)	0x03,06	0 - 2000	1	mV	Read Write	n/a	1550mV	(0 - 2000)	(500)	n/a
176	Forward Power Upper Limit (Warning Limit)	0x03,06	0 - 10000	1	W	Read Write	n/a	7350W	(0 - 7700)	(501)	n/a
177	Forward Power Upper Limit (Critical Warning Limit)	0x03,06	0 - 10000	1	W	Read Write	n/a	7700W	(0 - 7700)	(501)	n/a
178	Reflected Power Upper Limit (Warning Limit)	0x03,06	0 - 10000	1	W	Read Write	n/a	350W	(0 - 700)	(530)	n/a
179	Reflected Power Upper Limit	0x03,06	0 - 10000	1	W	Read	n/a	700W	(0 - 700)	(530)	n/a

	(Fault Limit)					Write						
180	Main CPU PCB Temperature Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+55.0degC	(4.0 - 60.0)	(550)	n/a	n/a
181	Main CPU PCB Temperature Upper Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+60.0degC	(4.0 - 60.0)	(550)	n/a	n/a
182	Main CPU PCB Temperature Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+8.0degC	n/a	(4.0 - 60.0)	(550)	n/a	n/a
183	Main CPU PCB Temperature Lower Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+4.0degC	n/a	(4.0 - 60.0)	(550)	n/a	n/a
184	Main CPU PCB Input Voltage +12VDC Upper Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	n/a	+16.0V	(8.0 - 16.0)	(521)	n/a	n/a
185	Main CPU PCB Input Voltage +12VDC Lower Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	+8.0V	n/a	(8.0 - 16.0)	(521)	n/a	n/a
186	Main CPU PCB Input Voltage +24VDC Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	n/a	+28.0V	(20.0 - 28.0)	(522)	n/a	n/a
187	Main CPU PCB Input Voltage +24VDC Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	+20.0V	n/a	(20.0 - 28.0)	(522)	n/a	n/a
188	RF Control Unit Fan Rotation Speed Upper Limit (Warning Limit)	0x03,06	0 - 9450	1	rpm	Read Write	n/a	9000rpm	(5600 - 9000)	(503)	n/a	n/a
189	RF Control Unit Fan Rotation Speed Lower Limit (Warning Limit)	0x03,06	0 - 9450	1	rpm	Read Write	5000rpm	n/a	(5600 - 9000)	(503)	n/a	n/a
190	-	-	-	-	-	-	-	-	-	-	-	-
191	-	-	-	-	-	-	-	-	-	-	-	-
192	PS Status Upper Limit (Fault Limit)	0x03,06	0 - 6	1	n/a	Read Write	n/a	3	(1 - 3)	(420)	n/a	n/a
193	-	-	-	-	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-	-	-	-	-
195	PS Sub CPU PCB Temperature Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+55.0degC	(4.0 - 60.0)	(404)	n/a	n/a
196	PS Sub CPU PCB Temperature Upper Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+60.0degC	(4.0 - 60.0)	(404)	n/a	n/a
197	PS Sub CPU PCB Temperature Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+8.0degC	n/a	(4.0 - 60.0)	(404)	n/a	n/a
198	PS Sub CPU PCB Temperature Lower Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+4.0degC	n/a	(4.0 - 60.0)	(404)	n/a	n/a
199	-	-	-	-	-	-	-	-	-	-	-	-

200	-	-	-	-	-	-	-	-	-	-	-	-
201	PS Sub CPU PCB Input Voltage +24VDC Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	n/a	+28.0V	(20.0 - 28.0)	(442)	n/a	n/a
202	PS Sub CPU PCB Input Voltage +24VDC Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	+20.0V	n/a	(20.0 - 28.0)	(442)	n/a	n/a
203	PS Unit Fan 1, 2 Rotation Speed Upper Limit (Warning Limit)	0x03,06	0 - 9450	1	rpm	Read Write	n/a	9000rpm	(5600 - 9000)	(437, 438)	n/a	n/a
204	PS Unit Fan 1, 2 Rotation Speed Lower Limit (Warning Limit)	0x03,06	0 - 9450	1	rpm	Read Write	5000rpm	n/a	(5600 - 9000)	(437, 438)	n/a	n/a
205	-	-	-	-	-	-	-	-	-	-	-	-
206	-	-	-	-	-	-	-	-	-	-	-	-
207	FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ Final AMP Current Upper Limit (Warning Limit)	0x03,06	0 - 30.0	0.1	A	Read Write	n/a	20.0A	(0.0 - 20.0)	(101 - 104) (201 - 204) (301 - 304) (601 - 604) (701 - 704)	n/a	n/a
208	FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ Final AMP Current Lower Limit (Warning Limit)	0x03,06	0 - 30.0	0.1	A	Read Write	0.0A	n/a	(0.0 - 20.0)	(101 - 104) (201 - 204) (301 - 304) (601 - 604) (701 - 704)	n/a	n/a
209	FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ FWD Upper Limit (Warning Limit)	0x03,06	0 - 2000	1	W	Read Write	n/a	1000W	(0 - 1100)	(111, 112) (211, 212) (311, 312) (611, 612) (711, 712)	n/a	n/a
210	FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ FWD Upper Limit (Fault Limit)	0x03,06	0 - 2000	1	W	Read Write	n/a	1100W	(0 - 1100)	(111, 112) (211, 212) (311, 312) (611, 612) (711, 712)	n/a	n/a
211	FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ REF Upper Limit (Warning Limit)	0x03,06	0 - 2000	1	W	Read Write	n/a	500W	(0 - 1000)	(115, 116) (215, 216) (315, 316) (615, 616) (715, 716)	n/a	n/a
212	FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ REF Upper Limit (Fault Limit)	0x03,06	0 - 2000	1	W	Read Write	n/a	1000W	(0 - 1000)	(115, 116) (215, 216) (315, 316) (615, 616) (715, 716)	n/a	n/a
213	FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ +45VDC Upper Limit (Warning Limit)	0x03,06	0 - 70.0	0.1	V	Read Write	n/a	+50.0V	(10.0 - 50.0)	(121 - 124) (221 - 224) (321 - 324) (621 - 624)	n/a	n/a

										(721 - 724)		
214	FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ +45VDC Lower Limit (Warning Limit)	0x03,06	0 - 70.0	0.1	V	Read Write	+10.0V	n/a	(10.0 - 50.0)	(121 - 124) (221 - 224) (321 - 324) (621 - 624) (721 - 724)	n/a	n/a
215	FA Unit-1, 2, 3, 4, 5 +12VDC Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	n/a	+16.0V	(8.0 - 16.0)	(125) (225) (325) (625) (725)	n/a	n/a
216	FA Unit-1, 2, 3, 4, 5 +12VDC Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	+8.0V	n/a	(8.0 - 16.0)	(125) (225) (325) (625) (725)	n/a	n/a
217	FA Unit-1, 2, 3, 4, 5 Heat Sink Temperature Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+60.0degC	(22.0 - 60.0)	(131) (231) (331) (631) (731)	n/a	n/a
218	FA Unit-1, 2, 3, 4, 5 Heat Sink Temperature Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+22.0degC	n/a	(22.0 - 60.0)	(131) (231) (331) (631) (731)	n/a	n/a
219	FA-1, 2, 3, 4, 5 DAFA Sub CPU PCB Temperature Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+55.0degC	(4.0 - 60.0)	(132) (232) (332) (632) (732)	n/a	n/a
220	FA-1, 2, 3, 4, 5 DAFA Sub CPU PCB Temperature Upper Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+60.0degC	(4.0 - 60.0)	(132) (232) (332) (632) (732)	n/a	n/a
221	FA-1, 2, 3, 4, 5 DAFA Sub CPU PCB Temperature Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+8.0degC	n/a	(4.0 - 60.0)	(132) (232) (332) (632) (732)	n/a	n/a
222	FA-1, 2, 3, 4, 5 DAFA Sub CPU PCB Temperature Lower Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+4.0degC	n/a	(4.0 - 60.0)	(132) (232) (332) (632) (732)	n/a	n/a
223	-	-	-	-	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	-	-	-	-	-	-

225	DA Unit Pre Driver AMP Current Upper Limit (Warning Limit)	0x03,06	0 - 5.0	0.1	A	Read Write	n/a	3.0A	(0.5 - 3.0)	(1)	n/a	n/a
226	DA Unit Pre Driver AMP Current Lower Limit (Warning Limit)	0x03,06	0 - 5.0	0.1	A	Read Write	0.5A	n/a	(0.5 - 3.0)	(1)	n/a	n/a
227	DA Unit_①, ② Driver AMP Current Upper Limit (Warning Limit)	0x03,06	0 - 30.0	0.1	A	Read Write	n/a	11.5A	(0.0 - 11.5)	(2, 3)	n/a	n/a
228	DA Unit_①, ② Driver AMP Current Lower Limit (Warning Limit)	0x03,06	0 - 30.0	0.1	A	Read Write	0.0A	n/a	(0.0 - 11.5)	(2, 3)	n/a	n/a
229	DA Unit_①, ② FWD Upper Limit (Warning Limit)	0x03,06	0 - 1250	1	W	Read Write	n/a	500W	(0 - 550)	(11)	n/a	n/a
230	DA Unit_①, ② FWD Upper Limit (Fault Limit)	0x03,06	0 - 1250	1	W	Read Write	n/a	550W	(0 - 550)	(11)	n/a	n/a
231	DA Unit_①, ② REF Upper Limit (Warning Limit)	0x03,06	0 - 1250	1	W	Read Write	n/a	250W	(0 - 500)	(15)	n/a	n/a
232	DA Unit_①, ② REF Upper Limit (Fault Limit)	0x03,06	0 - 1250	1	W	Read Write	n/a	500W	(0 - 500)	(15)	n/a	n/a
233	DA Unit_①, ② +45VDC Upper Limit (Warning Limit)	0x03,06	0 - 70.0	0.1	V	Read Write	n/a	+50.0V	(10.0 - 50.0)	(22, 23)	n/a	n/a
234	DA Unit_①, ② +45VDC Lower Limit (Warning Limit)	0x03,06	0 - 70.0	0.1	V	Read Write	+10.0V	n/a	(10.0 - 50.0)	(22, 23)	n/a	n/a
235	DA Unit +12VDC Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	n/a	+16.0V	(8.0 - 16.0)	(21)	n/a	n/a
236	DA Unit +12VDC Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	V	Read Write	+8.0V	n/a	(8.0 - 16.0)	(21)	n/a	n/a
237	DA Unit Heat Sink Temperature Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+60.0degC	(22.0 - 60.0)	(31)	n/a	n/a
238	DA Unit Heat Sink Temperature Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+22.0degC	n/a	(22.0 - 60.0)	(31)	n/a	n/a
239	DA DAFA Sub CPU PCB Temperature Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+55.0degC	(4.0 - 60.0)	(32)	n/a	n/a
240	DA DAFA Sub CPU PCB Temperature Upper Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+60.0degC	(4.0 - 60.0)	(32)	n/a	n/a
241	DA DAFA Sub CPU PCB Temperature Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+8.0degC	n/a	(4.0 - 60.0)	(32)	n/a	n/a
242	DA DAFA Sub CPU PCB Temperature Lower Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+4.0degC	n/a	(4.0 - 60.0)	(32)	n/a	n/a
243	-	-	-	-	-	-	-	-	-	-	-	-
244	-	-	-	-	-	-	-	-	-	-	-	-
245	HE Unit Air Inlet Temperature	0x03,06	0 - 100.0	0.1	degC	Read	n/a	+45.0degC	(4.0 - 45.0)	(405)	n/a	n/a

	Upper Limit (Fault Limit)					Write						
246	HE Unit Air Inlet Temperature Lower Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+4.0degC	n/a	(4.0 - 45.0)	(405)	n/a	n/a
247	HE Sub CPU PCB Temperature Upper Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+55.0degC	(1.0 - 60.0)	(406)	n/a	n/a
248	HE Sub CPU PCB Temperature Upper Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	n/a	+60.0degC	(1.0 - 60.0)	(406)	n/a	n/a
249	HE Sub CPU PCB Temperature Lower Limit (Warning Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+8.0degC	n/a	(4.0 - 60.0)	(406)	n/a	n/a
250	HE Sub CPU PCB Temperature Lower Limit (Fault Limit)	0x03,06	0 - 100.0	0.1	degC	Read Write	+4.0degC	n/a	(4.0 - 60.0)	(406)	n/a	n/a
251	-	-	-	-	-	-	-	-	-	-	-	-
252	-	-	-	-	-	-	-	-	-	-	-	-
253	-	-	-	-	-	-	-	-	-	-	-	-
254	-	-	-	-	-	-	-	-	-	-	-	-
255	HE Unit Fan 1, 2, 3 Rotation Speed Upper Limit (Warning Limit)	0x03,06	0 - 9450	1	rpm	Read Write	n/a	9000rpm	(5600 - 9000)	(431 - 433)	n/a	n/a
256	HE Unit Fan 1, 2, 3 Rotation Speed Lower Limit (Warning Limit)	0x03,06	0 - 9450	1	rpm	Read Write	5000rpm	n/a	(5600 - 9000)	(431 - 433)	n/a	n/a
257	HE Unit Fan 4, 5, 6 Rotation Speed Upper Limit (Warning Limit)	0x03,06	0 - 9450	1	rpm	Read Write	n/a	9000rpm	(5600 - 9000)	(434 - 436)	n/a	n/a
258	HE Unit Fan 4, 5, 6 Rotation Speed Lower Limit (Warning Limit)	0x03,06	0 - 9450	1	rpm	Read Write	5000rpm	n/a	(5600 - 9000)	(434 - 436)	n/a	n/a
259	-	-	-	-	-	-	-	-	-	-	-	-
260	-	-	-	-	-	-	-	-	-	-	-	-
261	-	-	-	-	-	-	-	-	-	-	-	-
262	-	-	-	-	-	-	-	-	-	-	-	-
263	Outlet LCW Flow Rate Lower Limit (Warning Limit)	0x03,06	0 - 40.0	0.1	L/min	Read Write	22.0L/min	n/a	(20.0 - 40.0)	(409)	n/a	n/a
264	Outlet LCW Flow Rate Lower Limit (Fault Limit)	0x03,06	0 - 40.0	0.1	L/min	Read Write	20.0L/min	n/a	(20.0 - 40.0)	(409)	n/a	n/a
265	Inlet LCW Temperature Upper Limit (Fault Limit)	0x03,06	15.0 - 60.0	0.1	degC	Read Write	n/a	+38.0degC	(22.0 - 38.0)	(410)	n/a	n/a
266	Inlet LCW Temperature Lower Limit (Fault Limit)	0x03,06	15.0 - 60.0	0.1	degC	Read Write	+22.0degC	n/a	(22.0 - 38.0)	(410)	n/a	n/a
267	Outlet LCW Temperature Upper Limit (Fault Limit)	0x03,06	15.0 - 60.0	0.1	degC	Read Write	n/a	+45.0degC	(22.0 - 45.0)	(411)	n/a	n/a
268	Outlet LCW Temperature Lower Limit (Fault Limit)	0x03,06	15.0 - 60.0	0.1	degC	Read Write	+22.0degC	n/a	(22.0 - 45.0)	(411)	n/a	n/a

Description about Error Type on the Register Table

- 1) Internal Fault① (RED colored on the Register Table)

Detect ⇒ Hard Wire ⇒ Interlock Circuit Operation (Main CPU PCB)

Interlock function by hard wire.

- 2) Internal Fault② (ORANGE colored on the Register Table)

Detect ⇒ CPU ⇒ Hard Wire ⇒ Interlock Circuit Operation (Main CPU PCB)

Interlock function by hard wire which occurs after detection of Internal Fault on the Main CPU and Sub CPUs.

- 3) Internal Fault③ (**YELLOW** colored on the Register Table)
 Detect ⇒ Main CPU Operation (Main CPU PCB)
 Detect ⇒ Sub CPU ⇒ RS485 ⇒ Main CPU Operation (Main CPU PCB)
 Interlock function by communication which occurs after detection of Internal Fault from Main CPU and Sub CPUs via RS 485 communication on the Main CPU.
- 4) Warning (**GREEN** colored on the Register Table)
 Detect ⇒ Main CPU Operation (Main CPU PCB)
 Detect ⇒ Sub CPU ⇒ RS485 ⇒ Main CPU Operation (Main CPU PCB)
 Notification only.
- 5) Critical Warning (**GREEN** colored on the Register Table)
 Detect ⇒ Main CPU Operation (Main CPU PCB)
 RF will be disabled and Internal Fault LED starts flashing.

<Error Code>

Below is the list of Error Codes.

The Factory set threshold values can be changed at user's discretion and risk.

In cases of registers 10, 11, 13 or 15, the codes below are displayed if any errors have occurred.

Error Code 0: No error

- - Default (AC Enable, DC Disable, RF Disable, PS Output Control Voltage set to 0)
- - Error Code for Notification Only (Warning)

Table 16: Error Code

Error Code	Error Name	Threshold	Internal Fault	External Fault	Warning	Processor Fault
1	DA Unit Pre Driver AMP Current	<0.5A or >3.0A			○	
2	DA Unit ① Driver AMP Current	<0.0A or >11.5A			○	
3	DA Unit ② Driver AMP Current	<0.0A or >11.5A			○	
11	DA Unit ①② FWD	>550W	●			
		>500W			○	
15	DA Unit ①② REF	>500W	●			
		>250W			○	
21	DA Unit +12VDC	<+8.0V or >+16.0V			○	
22	DA Unit ① +45VDC	<+10.0V or >+50.0V			○	
23	DA Unit ② +45VDC	<+10.0V or >+50.0V			○	
31	DA Unit Heat Sink Temperature	<+22.0°C or >+60.0°C			○	
32	DA FADA Sub CPU PCB Temperature	<+4.0°C or >+60.0°C	●			
		<+8.0°C or >+55.0°C			○	
101	FA Unit-1 ① Final AMP Current	<0.0A or >20.0A			○	
102	FA Unit-1 ② Final AMP Current	<0.0A or >20.0A			○	
103	FA Unit-1 ③ Final AMP Current	<0.0A or >20.0A			○	
104	FA Unit-1 ④ Final AMP Current	<0.0A or >20.0A			○	
111	FA Unit-1 ①② FWD	>1100W	●			
		>1000W			○	
112	FA Unit-1 ③④ FWD	>1100W	●			
		>1000W			○	
115	FA Unit-1 ①② REF	>1100W	●			
		>1000W			○	
Error Code	Error Name	Threshold	Internal Fault	External Fault	Warning	Processor Fault
116	FA Unit-1 ③④ REF	>1100W	●			
		>1000W			○	
121	FA Unit-1 ① +45VDC	<+10.0V or >+50.0V			○	
122	FA Unit-1 ② +45VDC	<+10.0V or >+50.0V			○	

123	FA Unit-1 ③ +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
124	FA Unit-1 ④ +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
125	FA Unit-1 +12VDC	<+8.0V or >+16.0V			<input type="radio"/>	
131	FA Unit-1 Heat Sink Temperature	<+22.0°C or >+60.0°C			<input type="radio"/>	
132	FA-1 FADA Sub CPU PCB Temperature	<+4.0°C or >+60.0°C	●			
		<+8.0°C or >+55.0°C			<input type="radio"/>	
201	FA Unit-2 ① Final AMP Current	<0.0A or >20.0A			<input type="radio"/>	
202	FA Unit-2 ② Final AMP Current	<0.0A or >20.0A			<input type="radio"/>	
203	FA Unit-2 ③ Final AMP Current	<0.0A or >20.0A			<input type="radio"/>	
204	FA Unit-2 ④ Final AMP Current	<0.0A or >20.0A			<input type="radio"/>	
211	FA Unit-2 ①② FWD	>1100W	●			
		>1000W			<input type="radio"/>	
212	FA Unit-2 ③④ FWD	>1100W	●			
		>1000W			<input type="radio"/>	
215	FA Unit-2 ①② REF	>1100W	●			
		>1000W			<input type="radio"/>	
216	FA Unit-2 ③④ REF	>1100W	●			
		>1000W			<input type="radio"/>	
221	FA Unit-2 ① +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
222	FA Unit-2 ② +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
223	FA Unit-2 ③ +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
224	FA Unit-2 ④ +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
225	FA Unit-2 +12VDC	<+8.0V or >+16.0V			<input type="radio"/>	
231	FA Unit-2 Heat Sink Temperature	<+22.0°C or >+60.0°C			<input type="radio"/>	
232	FA-2 FADA Sub CPU PCB Temperature	<+4.0°C or >+60.0°C	●			
		<+8.0°C or >+55.0°C			<input type="radio"/>	
301	FA Unit-3 ① Final AMP Current	<0.0A or >20.0A			<input type="radio"/>	
302	FA Unit-3 ② Final AMP Current	<0.0A or >20.0A			<input type="radio"/>	
303	FA Unit-3 ③ Final AMP Current	<0.0A or >20.0A			<input type="radio"/>	
Error Code	Error Name	Threshold	Internal Fault	External Fault	Warning	Processor Fault
304	FA Unit-3 ④ Final AMP Current	<0.0A or >20.0A			<input type="radio"/>	
311	FA Unit-3 ①② FWD	>1100W	●			
		>1000W			<input type="radio"/>	
312	FA Unit-3 ③④ FWD	>1100W	●			
		>1000W			<input type="radio"/>	
315	FA Unit-3 ①② REF	>1100W	●			
		>1000W			<input type="radio"/>	
316	FA Unit-3 ③④ REF	>1100W	●			
		>1000W			<input type="radio"/>	
321	FA Unit-3 ① +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
322	FA Unit-3 ② +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
323	FA Unit-3 ③ +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
324	FA Unit-3 ④ +45VDC	<+10.0V or >+50.0V			<input type="radio"/>	
325	FA Unit-3 +12VDC	<+8.0V or >+16.0V			<input type="radio"/>	
331	FA Unit-3 Heat Sink Temperature	<+22.0°C or >+60.0°C			<input type="radio"/>	
332	FA-3 FADA Sub CPU PCB Temperature	<+4.0°C or >+60.0°C	●			
		<+8.0°C or >+55.0°C			<input type="radio"/>	
404	PS Sub CPU PCB Temperature	<+4.0°C or >+60.0°C	●			

		<+8.0°C or >+55.0°C			○	
405	HE Unit Air Inlet Temperature	<+4.0°C or >+45.0°C	●			
406	HE Sub CPU PCB Temperature	<+4.0°C or >+60.0°C	●			
		<+8.0°C or >+55.0°C			○	
409	Outlet LCW Flow Rate	<20L/min	●			
		<22L/min			○	
410	Inlet LCW Temperature	<+22.0°C or >+38.0°C	●			
411	Outlet LCW Temperature	<+22.0°C or >+45.0°C	●			
420	PS Status (More than Three Faults)	>=3 (Error)	●			
421	PS Status (bit)	PS 1_FAULT#			○	
422		PS 2_FAULT#			○	
423		PS 3_FAULT#			○	
424		PS 4_FAULT#			○	
425		PS 5_FAULT#			○	
426		PS 6_FAULT#			○	
Error Code	Error Name	Threshold	Internal Fault	External Fault	Warning	Processor Fault
431	HE Unit Fan 1 Rotation Speed	<5000rpm or >9000rpm			○	
432	HE Unit Fan 2 Rotation Speed	<5000rpm or >9000rpm			○	
433	HE Unit Fan 3 Rotation Speed	<5000rpm or >9000rpm			○	
434	HE Unit Fan 4 Rotation Speed	<5000rpm or >9000rpm			○	
435	HE Unit Fan 5 Rotation Speed	<5000rpm or >9000rpm			○	
436	HE Unit Fan 6 Rotation Speed	<5000rpm or >9000rpm			○	
437	PS Unit Fan 1 Rotation Speed	<5000rpm or >9000rpm			○	
438	PS Unit Fan 2 Rotation Speed	<5000rpm or >9000rpm			○	
442	PS Sub CPU Input Voltage +24VDC (for MC, SSR)	<+20.0V or >+28.0V			○	
500	Input Drive Power	>1550			○	
					Critical	
			RF Disable & Internal Fault LED Flashing			
		>1350			○	
501	Forward Power	>7700W			○	
					Critical	
			RF Disable & Internal Fault LED Flashing			
		>7350W			○	
502	Water Leak Status	0 (No Error) or 1 (Error)	●			
503	RF Control Unit Fan Rotation Speed	<5000rpm or >9000rpm			○	
504	Ready for RF (Operates Only at DC Enable, and Only for 90 Seconds after setting DC Enable)	Countdown Timer 90 (No Error)			○	
511	External 24V Permit Line No.1 Fault	<+5.0VDC Input Voltage		●		
512	External 24V Permit Line No.2 Fault	<+5.0VDC Input Voltage		●		
514	External 24V Permit Line No.3 Fault	<+5.0VDC Input Voltage		●		
518	External 24V Permit Line No.4 Fault	<+5.0VDC Input Voltage		●		
521	Main CPU PCB Input Voltage +12VDC	<+8.0V or >+16.0V	●			
522	Main CPU PCB Input Voltage +24VDC	<+20.0V or >+28.0V			○	
530	Reflected Power	>700W	●			
		>350W			○	
					○	

541	microSD Status (Master)	0 (No Error) or 1 (Error)				
542	microSD Status (Slave)	0 (No Error) or 1 (Error)			○	
Error Code	Error Name	Threshold	Internal Fault	External Fault	Warning	Processor Fault
550	Main CPU PCB Temperature	<+4.0°C or >+60.0°C	●			
		<+8.0°C or >+55.0°C			○	
560	Thermostat Status (bit)	0 (No Error) or 1 (Error)	●			
570	120VAC OFF or System Reboot	Start of SSA	●			
580	480VAC Status	0 (No Error) or 1 (Error)	●			
591	Debug-SD CPU	0 (No Error) or 1 (Error)				●
592	PS Sub CPU	0 (No Error) or 1 (Error)				●
593	FA-1 DAFA Sub CPU	0 (No Error) or 1 (Error)				●
594	FA-2 DAFA Sub CPU	0 (No Error) or 1 (Error)				●
595	FA-3 DAFA Sub CPU	0 (No Error) or 1 (Error)				●
596	FA-4 DAFA Sub CPU	0 (No Error) or 1 (Error)				●
597	FA-5 DAFA Sub CPU	0 (No Error) or 1 (Error)				●
598	DA DAFA Sub CPU	0 (No Error) or 1 (Error)				●
599	HE Sub CPU	0 (No Error) or 1 (Error)				●
601	FA Unit-4 ① Final AMP Current	<0.0A or >20.0A			○	
602	FA Unit-4 ② Final AMP Current	<0.0A or >20.0A			○	
603	FA Unit-4 ③ Final AMP Current	<0.0A or >20.0A			○	
604	FA Unit-4 ④ Final AMP Current	<0.0A or >20.0A			○	
611	FA Unit-4 ①② FWD	>1100W	●			
		>1000W			○	
612	FA Unit-4 ③④ FWD	>1100W	●			
		>1000W			○	
615	FA Unit-4 ①② REF	>1100W	●			
		>1000W			○	
616	FA Unit-4 ③④ REF	>1100W	●			
		>1000W			○	
621	FA Unit-4 ① +45VDC	<+10.0V or >+50.0V			○	
622	FA Unit-4 ② +45VDC	<+10.0V or >+50.0V			○	
623	FA Unit-4 ③ +45VDC	<+10.0V or >+50.0V			○	
624	FA Unit-4 ④ +45VDC	<+10.0V or >+50.0V			○	
625	FA Unit-4 +12VDC	<+8.0V or >+16.0V			○	
631	FA Unit-4 Heat Sink Temperature	<+22.0°C or >+60.0°C			○	
Error Code	Error Name	Threshold	Internal Fault	External Fault	Warning	Processor Fault
632	FA-4 FADA Sub CPU PCB Temperature	<+4.0°C or >+60.0°C	●			
		<+8.0°C or >+55.0°C			○	
701	FA Unit-5 ① Final AMP Current	<0.0A or >20.0A			○	
702	FA Unit-5 ② Final AMP Current	<0.0A or >20.0A			○	
703	FA Unit-5 ③ Final AMP Current	<0.0A or >20.0A			○	

704	FA Unit-5 ④ Final AMP Current	<0.0A or >20.0A				
711	FA Unit-5 ①② FWD	>1100W	●			
		>1000W			○	
712	FA Unit-5 ③④ FWD	>1100W	●			
		>1000W			○	
715	FA Unit-5 ①② REF	>1100W	●			
		>1000W			○	
716	FA Unit-5 ③④ REF	>1100W	●			
		>1000W			○	
721	FA Unit-5 ① +45VDC	<+10.0V or >+50.0V			○	
722	FA Unit-5 ② +45VDC	<+10.0V or >+50.0V			○	
723	FA Unit-5 ③ +45VDC	<+10.0V or >+50.0V			○	
724	FA Unit-5 ④ +45VDC	<+10.0V or >+50.0V			○	
725	FA Unit-5 +12VDC	<+8.0V or >+16.0V			○	
731	FA Unit-5 Heat Sink Temperature	<+22.0°C or >+60.0°C			○	
732	FA-5 FADA Sub CPU PCB Temperature	<+4.0°C or >+60.0°C	●			
		<+8.0°C or >+55.0°C			○	

Table 17:

**Drain Voltage to PS Output
Control Voltage Conversion**

Drain Voltage (V)	PS Output Control Voltage Value Address 3
48V	2080
47V	2015
46V	1950
45V	1885
44V	1820
43V	1750
42V	1685
41V	1620
40V	1550
39V	1485
38V	1420
37V	1355
36V	1290
35V	1225
34V	1155
33V	1090
32V	1025
31V	955
30V	890
29V	825
28V	760
27V	690
26V	625
25V	560
24V	495
23V	425
22V	360
21V	290
20V	225
19V	160
18V	≥90

Table 18:

Input Drive Power to ADC Conversion

Input Drive Power (dBm)	ADC Value Address 21
-10.0dBm (0.10mW)	141
-9.5dBm (0.11mW)	154
-9.0dBm (0.13mW)	167
-8.5dBm (0.14mW)	182
-8.0dBm (0.16mW)	198
-7.5dBm (0.18mW)	214
-7.0dBm (0.20mW)	231
-6.5dBm (0.22mW)	249
-6.0dBm (0.25mW)	268
-5.5dBm (0.28mW)	288
-5.0dBm (0.32mW)	309
-4.5dBm (0.35mW)	330
-4.0dBm (0.40mW)	354
-3.5dBm (0.45mW)	379
-3.0dBm (0.50mW)	405
-2.5dBm (0.56mW)	433
-2.0dBm (0.63mW)	461
-1.5dBm (0.71mW)	492
-1.0dBm (0.79mW)	524
-0.5dBm (0.89mW)	558
0dBm (1.00mW)	593
+0.5dBm (1.12mW)	630
+1.0dBm (1.26mW)	670
+1.5dBm (1.41mW)	712
+2.0dBm (1.58mW)	754
+2.5dBm (1.78mW)	801
+3.0dBm (2.00mW)	849
+3.5dBm (2.24mW)	900
+4.0dBm (2.51mW)	952
+4.5dBm (2.82mW)	1008
+5.0dBm (3.16mW)	1067
+5.5dBm (3.55mW)	1127
+6.0dBm (4.00mW)	1194
+6.5dBm (4.47mW)	1264
+7.0dBm (5.01mW)	1336
+7.5dBm (5.62mW)	1415
+8.0dBm (6.31mW)	1499
+8.5dBm (7.08mW)	1584
+9.0dBm (7.94mW)	1677
+9.5dBm (8.91mW)	1775
+10.0dBm (10.00mW)	1873

Drain voltage range of this amplifier's power supply (see Table 17) is from 18 to 48VDC.

2.3. RS-485 Communication

After AC120V power is input to the SSA,

- ① Threshold data is read from MAIN CPU PCB's EEPROM.
- ② Communication to synchronize clock of Main CPU and Debug-SD CPU begins on the MAIN CPU PCB.
- ③ Communication between MAIN CPU PCB and each Sub CPU PCBs begins.
- ④ MAIN CPU PCB submits Requirement of transmission to each Sub CPU PCBs, and collect monitored data.
- ⑤ Collected data can be confirmed via Modbus Communication, and is saved into microSD card.

Description of RS-485

2.3.1. Serial Setting

Communication Setting

Check Sum is provided to prevent malfunction

Table 19: Serial Setting

Item	Value
Baud Rate	115200bps
bit number	8bit
parity	None
Stop bit number	1bit
Check Sum	2byte

2.3.2. Clock Setting of Debug-SD CPU

For the time-stamp of saved data on microSD card, Clock needs to be set.

- ① Clock data of Main CPU is transmitted to Debug-SD CPU on the MAIN CPU PCB.

Table 20: Clock Data

Buffer	Item	Data Range
[0]	Year	0-99
[1]	Month	1-12
[2]	Date	1-31
[3]	Week	0-6
[4]	Hour	0-23
[5]	Minute	0-59
[6]	Second	0-59

- ② According to received data, Debug-SD CPU synchronize their clocks inside of CPU
- ③ Synchronized clock data is transferred to Main CPU.
- ④ Main CPU compares received data and own ① data. When deviation is less than 1 min., OK command is submitted to Debug-SD CPU.
- Clock setting is completed as above.
- ⑤ In the case deviation of Main CPU clock and Debug-SD CPU is longer than 1 min., whole flow from ①to④ is repeated.

When setting is still not OK with repeating this flow two times, clock setting is finished.

2.3.3. Threshold Data

Main CPU sets up from Add174 to Add268 on Modbus/TCP based on threshold data provided by EEPROM.

Following threshold data of each Unit is factory default setting. Threshold setting can be modified via Modbus/TCP. And modified setting will be saved on EEPROM.

Threshold data of each Unit is as below table.

Table 21: RF Control Unit Threshold Data

Item	Threshold
Input Drive Power Upper Limit (Warning Limit)	1335
Input Drive Power Upper Limit (Critical Warning Limit)	1550
Forward Power Upper Limit (Warning Limit)	7350
Forward Power Upper Limit (Critical Warning Limit)	7700
Reflected Power Upper Limit (Warning Limit)	350
Reflected Power Upper Limit (Fault Limit)	700
Main CPU PCB Temperature Upper Limit (Warning Limit)	550
Main CPU PCB Temperature Upper Limit (Fault Limit)	600
Main CPU PCB Temperature Lower Limit (Warning Limit)	80
Main CPU PCB Temperature Lower Limit (Fault Limit)	40
Main CPU PCB Input Voltage +12VDC Upper Limit (Fault Limit)	160
Main CPU PCB Input Voltage +12VDC Lower Limit (Fault Limit)	80
Main CPU PCB Input Voltage +24VDC Upper Limit (Warning Limit)	280
Main CPU PCB Input Voltage +24VDC Lower Limit (Warning Limit)	220
RF Control Unit Fan Rotation Speed Upper Limit (Warning Limit)	9000
RF Control Unit Fan Rotation Speed Lower Limit (Warning Limit)	5000

Table 22: PS Unit Threshold Data

Item	Threshold
PS Status Upper Limit (Fault Limit)	3
PS Sub CPU PCB Temperature Upper Limit (Warning Limit)	550
PS Sub CPU PCB Temperature Upper Limit (Fault Limit)	600
PS Sub CPU PCB Temperature Lower Limit (Warning Limit)	80
PS Sub CPU PCB Temperature Lower Limit (Fault Limit)	40
PS Sub CPU PCB Input Voltage +24VDC Upper Limit (Warning Limit)	28
PS Sub CPU PCB Input Voltage +24VDC Lower Limit (Warning Limit)	20
PS Unit Fan 1, 2 Rotation Speed Upper Limit (Warning Limit)	9000
PS Unit Fan 1, 2 Rotation Speed Lower Limit (Warning Limit)	5000

Table 23: FA Unit-1~5 Threshold Data

Item	Threshold
FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ Final AMP Current Upper Limit (Warning Limit)	200
FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ Final AMP Current Lower Limit (Warning Limit)	0
FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ FWD Upper Limit (Warning Limit)	1000
FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ FWD Upper Limit (Fault Limit)	1100
FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ REF Upper Limit (Warning Limit)	500
FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ REF Upper Limit (Fault Limit)	1000
FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ +45VDC Upper Limit (Warning Limit)	500
FA Unit-1, 2, 3, 4, 5_①, ②, ③, ④ +45VDC Lower Limit (Warning Limit)	100
FA Unit-1, 2, 3, 4, 5 +12VDC Upper Limit (Warning Limit)	160
FA Unit-1, 2, 3, 4, 5 +12VDC Lower Limit (Warning Limit)	80
FA Unit-1, 2, 3, 4, 5 Heat Sink Temperature Upper Limit (Warning Limit)	600
FA Unit-1, 2, 3, 4, 5 Heat Sink Temperature Lower Limit (Warning Limit)	220
FA-1, 2, 3, 4, 5 DAFA Sub CPU PCB Temperature Upper Limit (Warning Limit)	550
FA-1, 2, 3, 4, 5 DAFA Sub CPU PCB Temperature Upper Limit (Fault Limit)	600
FA-1, 2, 3, 4, 5 DAFA Sub CPU PCB Temperature Lower Limit (Warning Limit)	80
FA-1, 2, 3, 4, 5 DAFA Sub CPU PCB Temperature Lower Limit (Fault Limit)	40

Table 24: DA Unit Threshold Data

Item	Threshold
DA Unit Pre Driver AMP Current Upper Limit (Warning Limit)	30
DA Unit Pre Driver AMP Current Lower Limit (Warning Limit)	5
DA Unit_①, ② Driver AMP Current Upper Limit (Warning Limit)	115
DA Unit_①, ② Driver AMP Current Lower Limit (Warning Limit)	0
DA Unit_①, ② FWD Upper Limit (Warning Limit)	500
DA Unit_①, ② FWD Upper Limit (Fault Limit)	550
DA Unit_①, ② REF Upper Limit (Warning Limit)	250
DA Unit_①, ② REF Upper Limit (Fault Limit)	500
DA Unit_①, ② +45VDC Upper Limit (Warning Limit)	500
DA Unit_①, ② +45VDC Lower Limit (Warning Limit)	100
DA Unit +12VDC Upper Limit (Warning Limit)	160
DA Unit +12VDC Lower Limit (Warning Limit)	80
DA Unit Heat Sink Temperature Upper Limit (Warning Limit)	600
DA Unit Heat Sink Temperature Lower Limit (Warning Limit)	220
DA DAFA Sub CPU PCB Temperature Upper Limit (Warning Limit)	550
DA DAFA Sub CPU PCB Temperature Upper Limit (Fault Limit)	600
DA DAFA Sub CPU PCB Temperature Lower Limit (Warning Limit)	80
DA DAFA Sub CPU PCB Temperature Lower Limit (Fault Limit)	40

Table 25: HE Unit Threshold Data

Item	Threshold
HE Unit Air Inlet Temperature Upper Limit (Fault Limit)	450
HE Unit Air Inlet Temperature Lower Limit (Fault Limit)	40
HE Sub CPU PCB Temperature Upper Limit (Warning Limit)	550
HE Sub CPU PCB Temperature Upper Limit (Fault Limit)	600
HE Sub CPU PCB Temperature Lower Limit (Warning Limit)	80
HE Sub CPU PCB Temperature Lower Limit (Fault Limit)	40
HE Unit Fan 1, 2, 3 Rotation Speed Upper Limit (Warning Limit)	9000
HE Unit Fan 1, 2, 3 Rotation Speed Lower Limit (Warning Limit)	5000
HE Unit Fan 4, 5, 6 Rotation Speed Upper Limit (Warning Limit)	9000
HE Unit Fan 4, 5, 6 Rotation Speed Lower Limit (Warning Limit)	5000
Outlet LCW Flow Rate Lower Limit (Warning Limit)	220
Outlet LCW Flow Rate Lower Limit (Fault Limit)	200
Inlet LCW Temperature Upper Limit (Fault Limit)	380
Inlet LCW Temperature Lower Limit (Fault Limit)	220
Outlet LCW Temperature Upper Limit (Fault Limit)	450
Outlet LCW Temperature Lower Limit (Fault Limit)	220

Above process is done in the initialization process of Main CPU.

Procedure and format of transmission request is as following.

Procedure

- ① Confirm Hand Shake Line is High
- ② Set Hand Shake Line to Low
 - ③ Submit 0xff command of Transmission start
 - ④ Submit 0xa0
- ⑤ Transfer threshold data of PS
 - ⑥ Set Hand Shake Line to High
- ⑦ After receiving 0xff from PS, Main CPU wait until receiving 0xb0.
- ⑧ Confirm Hand Shake Line is High
- ⑨ Set Hand Shake Line to Low
- ⑩ Submit 0xff
- ⑪ Submit 0xb1
- ⑫ Transfer threshold data of FA1
- ⑬ Set Hand Shake Line to High
- ⑭ After receiving 0xff from FA1, Main CPU wait until receiving 0xb1.
- ⑮ As similar as above, FA2, FA3, FA4, FA5, DA, HE transfer their threshold data.

Table 26: Format

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Transmission Start				Address of each PCB			
1	0	1	0				
Response of Reception							
1	0	1	1				

Table 27: Transmission / Reception Code

Unit	Address Value	Transmission Code	Reception Code
FA Unit-1	1	0 a1	0xb1
FA Unit-2	2	0 a2	0xb2
FA Unit-3	3	0 a3	0xb3
FA Unit-4	4	0 a4	0xb4
FA Unit-5	5	0 a5	0xb5
DA Unit	6	0 a6	0xb6
HE Unit	7	0 a7	0xb7
PS Unit	0	0 a0	0xb0

2.3.4. Monitoring System

2.3.4.1. Measurement

RF, Current, Temperature, Flow Rate, Humidity and more monitored contents are converted to voltage and read by A/D Converter in Voltage. The rotation speed of FAN is calculated by monitoring the period of the pulse signal. Other High / Low signals such as thermostat and water leakage are monitored as they are. After power supplied, these monitored items will be periodically monitored without interruption. The measured data will be averaged and sent to the MAIN CPU PCB.

2.3.4.2. Transmission request by Control Unit (MAIN CPU PCB)

MAIN CPU PCB becomes Master, and submits transmission requests to each SUB CPU PCB and PS SUB PCB (Slave).

Procedure and format of transmission request is as following.

Procedure

- ① Confirm Hand Shake Line is High
- ② Set Hand Shake Line to Low
 - ③ Submit 0xff command of Transmission start
 - ④ Submit 0x40 address When address is 1: 0x41
- ⑤ Set Hand Shake Line to High

Table 28: Format

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Transmission request	spare			Address of each PCB			
0	1	0	0	0	0	0	1

Table 29: Transmission Code

Unit	Address Value	Transmission Code
FA Unit-1	1	0 41
FA Unit-2	2	0 42
FA Unit-3	3	0 43
FA Unit-4	4	0 44
FA Unit-5	5	0 45
DA Unit	6	0 46
HE Unit	7	0 47

PS Unit	0	0 40
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2.3.4.3. Response by each Unit

A unit received transmission request replies Response of Transmission and its data.

Procedure and format of Response of Transmission is as following.

Procedure

- ① Confirm Hand Shake Line is High
- ② Set Hand Shake Line to Low
 - ③ Submit 0xff command of Transmission start
 - ④ Submit 0x80 address When address is 1: 0x81
 - ⑤ After that, transmit 8 bit data to 44 byte (22 data) and transmit 2 byte Check Sum at the end.
- ⑥ Set Hand Shake Line to High

Table 30: Format

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Response of Transmission		Spare		Address of each PCB			
1	0	0	0	0	0	0	1

Table 31: Transmission Code

Unit	Address Value	Transmission Code
FA Unit-1	1	0 81
FA Unit-2	2	0 82
FA Unit-3	3	0 83
FA Unit-4	4	0 84
FA Unit-5	5	0 85
DA Unit	6	0 86
HE Unit	7	0 87
PS Unit	0	0 80

When an Internal, External or Processor Fault occurs.

- ① The four 24V indicators are set to zero volts
- ② RF is disabled.
- ③ RF Enable LED is turned off.
- ④ Control voltage setting values of Switching Power Supplies is changed to 0.
- ⑤ DC is disabled for both supplies.
- ⑥ DC Enable LED is turned off.
- ⑦ Internal or External Fault LED is turned on.
- ⑧ An Error Code is listed in the registers (see Table 14 for a list of Error Code)
- ⑨ Fault Status bits are set in the registers
- ⑩ These faults can be reset via a Modbus command.

Table 32: Processor Fault

Item	Description	Error Code
------	-------------	------------

Processor Fault	<p>When Main CPU failures, MAIN CPU PCB resets Main CPU by watchdog output.</p> <p>Following Main CPU's resetting, SSA starts shutting down.</p> <p>After resetting is succeeded and Main CPU started its normal operation,</p> <p>SSA gets back to Error code 570 Internal Fault state. (120VAC OFF or System Reboot)</p> <p>When any Sub CPU failures, SSA is shutdown by hardwire after watchdog output of each SUB CPU PCB is latched.</p> <p>Main CPU sets up internal fault state on Modbus register. And indication LED light for Processor Fault would be turned on.</p>	Main CPU: - Debug-SD CPU: 591 PS Sub CPU: 592 FA-1 DAFA Sub CPU: 593 FA-2 DAFA Sub CPU: 594 FA-3 DAFA Sub CPU: 595 FA-4 DAFA Sub CPU: 596 FA-5 DAFA Sub CPU: 597 DA DAFA Sub CPU: 598 HE Sub CPU: 599
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FA Unit-1

Monitoring points are Current (4 points), Detection Output (4 points), Voltage (5 points) and Temperature (2 points).

Table 33: FA Unit-1 Monitoring Item

Add No.	Description	Measurement Frequency		Lower Limit	Upper Limit	Error Code
40	FA Unit-1 ① Final AMP Current	1ms	ADC	0.0A	20.0A	101/Warning
41	FA Unit-1 ② Final AMP Current	1ms	ADC	0.0A	20.0A	102/Warning
42	FA Unit-1 ③ Final AMP Current	1ms	ADC	0.0A	20.0A	103/Warning
43	FA Unit-1 ④ Final AMP Current	1ms	ADC	0.0A	20.A	104/Warning
44	FA Unit-1 ①② FWD	10ms	ADC	0W	1100W 1000W	111/Internal 111/Warning
45	FA Unit-1 ①② REF	10ms	ADC	0W	1000W 500W	115/Internal 115/Warning
46	FA Unit-1 ③④ FWD	10ms	ADC	0W	1100W 1000W	112/Internal 112/Warning
47	FA Unit-1 ③④ REF	10ms	ADC	0W	1000W 500W	116/Internal 116/Warning
48	FA Unit-1 ① +45VDC	10ms	ADC	+10.0V	+50.0V	121/Warning
49	FA Unit-1 ② +45VDC	10ms	ADC	+10.0V	+50.0V	122/Warning
50	FA Unit-1 ③ +45VDC	10ms	ADC	+10.0V	+50.0V	123/Warning
51	FA Unit-1 ④ +45VDC	10ms	ADC	+10.0V	+50.0V	124/Warning
52	FA Unit-1 +12VDC	10ms	ADC	+8.0V	+16.0V	125/Warning
53	FA Unit-1 Heat Sink Temperature	100ms	I2C	+22.0degC	+60.0degC	131/Warning
54	FA-1 FADA Sub CPU PCB Temperature	100ms	I2C	+4.0degC +8.0degC	+60.0degC +55.0degC	132/Fault 132/Warning

FA Unit-2

Monitoring points are Current (4 points), Detection Output (4 points), Voltage (5 points) and Temperature (2 points).

Table 34: FA Unit-2 Monitoring Item

Add No.	Description	Measurement Frequency		Lower Limit	Upper Limit	Error Code
57	FA Unit-2 ① Final AMP Current	1ms	ADC	0.0A	20.0A	201/Warning
58	FA Unit-2 ② Final AMP Current	1ms	ADC	0.0A	20.0A	202/Warning
59	FA Unit-2 ③ Final AMP Current	1ms	ADC	0.0A	20.0A	203/Warning
60	FA Unit-2 ④ Final AMP Current	1ms	ADC	0.0A	20.A	204/Warning
61	FA Unit-2 ①② FWD	10ms	ADC	0W	1100W 1000W	211/Internal 211/Warning
62	FA Unit-2 ①② REF	10ms	ADC	0W	1000W 500W	215/Internal 215/Warning
63	FA Unit-2 ③④ FWD	10ms	ADC	0W	1100W 1000W	212/Internal 212/Warning
64	FA Unit-2 ③④ REF	10ms	ADC	0W	1000W 500W	216/Internal 216/Warning
65	FA Unit-2 ① +45VDC	10ms	ADC	+10.0V	+50.0V	221/Warning
66	FA Unit-2 ② +45VDC	10ms	ADC	+10.0V	+50.0V	222/Warning
67	FA Unit-2 ③ +45VDC	10ms	ADC	+10.0V	+50.0V	223/Warning
68	FA Unit-2 ④ +45VDC	10ms	ADC	+10.0V	+50.0V	224/Warning
69	FA Unit-2 +12VDC	10ms	ADC	+8.0V	+16.0V	225/Warning
70	FA Unit-2 Heat Sink Temperature	100ms	I2C	+22.0degC	+60.0degC	231/Warning
71	FA-2 FADA Sub CPU PCB Temperature	100ms	I2C	+4.0degC +8.0degC	+60.0degC +55.0degC	232/Fault 232/Warning

FA Unit-3

Monitoring points are Current (4 points), Detection Output (4 points), Voltage (5 points) and Temperature (2 points).

Table 35: FA Unit-3 Monitoring Item

Add No.	Description	Measurement Frequency		Lower Limit	Upper Limit	Error Code
74	FA Unit-3 ① Final AMP Current	1ms	ADC	0.0A	20.0A	301/Warning
75	FA Unit-3 ② Final AMP Current	1ms	ADC	0.0A	20.0A	302/Warning
76	FA Unit-3 ③ Final AMP Current	1ms	ADC	0.0A	20.0A	303/Warning
77	FA Unit-3 ④ Final AMP Current	1ms	ADC	0.0A	20.A	304/Warning
78	FA Unit-3 ①② FWD	10ms	ADC	0W	1100W 1000W	311/Internal 311/Warning
79	FA Unit-3 ①② REF	10ms	ADC	0W	1000W 500W	315/Internal 315/Warning
80	FA Unit-3 ③④ FWD	10ms	ADC	0W	1100W 1000W	312/Internal 312/Warning
81	FA Unit-3 ③④ REF	10ms	ADC	0W	1000W 500W	316/Internal 316/Warning
82	FA Unit-3 ① +45VDC	10ms	ADC	+10.0V	+50.0V	321/Warning
83	FA Unit-3 ② +45VDC	10ms	ADC	+10.0V	+50.0V	322/Warning
84	FA Unit-3 ③ +45VDC	10ms	ADC	+10.0V	+50.0V	323/Warning
85	FA Unit-3 ④ +45VDC	10ms	ADC	+10.0V	+50.0V	324/Warning
86	FA Unit-3 +12VDC	10ms	ADC	+8.0V	+16.0V	325/Warning
87	FA Unit-3 Heat Sink Temperature	100ms	I2C	+22.0degC	+60.0degC	331/Warning
88	FA-3 FADA Sub CPU PCB Temperature	100ms	I2C	+4.0degC +8.0degC	+60.0degC +55.0degC	332/Fault 332/Warning

FA Unit-4

Monitoring points are Current (4 points), Detection Output (4 points), Voltage (5 points) and Temperature (2 points).

Table 36: FA Unit-4 Monitoring Item

Add No.	Description	Measurement Frequency		Lower Limit	Upper Limit	Error Code
91	FA Unit-4 ① Final AMP Current	1ms	ADC	0.0A	20.0A	601/Warning
92	FA Unit-4 ② Final AMP Current	1ms	ADC	0.0A	20.0A	602/Warning
93	FA Unit-4 ③ Final AMP Current	1ms	ADC	0.0A	20.0A	603/Warning
94	FA Unit-4 ④ Final AMP Current	1ms	ADC	0.0A	20.A	604/Warning
95	FA Unit-4 ①② FWD	10ms	ADC	0W	1100W 1000W	611/Internal 611/Warning
96	FA Unit-4 ①② REF	10ms	ADC	0W	1000W 500W	615/Internal 615/Warning
97	FA Unit-4 ③④ FWD	10ms	ADC	0W	1100W 1000W	612/Internal 612/Warning
98	FA Unit-4 ③④ REF	10ms	ADC	0W	1000W 500W	616/Internal 616/Warning
99	FA Unit-4 ① +45VDC	10ms	ADC	+10.0V	+50.0V	621/Warning
100	FA Unit-4 ② +45VDC	10ms	ADC	+10.0V	+50.0V	622/Warning
101	FA Unit-4 ③ +45VDC	10ms	ADC	+10.0V	+50.0V	623/Warning
102	FA Unit-4 ④ +45VDC	10ms	ADC	+10.0V	+50.0V	624/Warning
103	FA Unit-4 +12VDC	10ms	ADC	+8.0V	+16.0V	625/Warning
104	FA Unit-4 Heat Sink Temperature	100ms	I2C	+22.0degC	+60.0degC	631/Warning
105	FA-4 FADA Sub CPU PCB Temperature	100ms	I2C	+4.0degC +8.0degC	+60.0degC +55.0degC	632/Fault 632/Warning

FA Unit-5

Monitoring points are Current (4 points), Detection Output (4 points), Voltage (5 points) and Temperature (2 points).

Table 37: FA Unit-5 Monitoring Item

Add No.	Description	Measuremen t Frequency		Lower Limit	Upper Limit	Error Code
108	FA Unit-5 ① Final AMP Current	1ms	ADC	0.0A	20.0A	701/Warning
109	FA Unit-5 ② Final AMP Current	1ms	ADC	0.0A	20.0A	702/Warning
110	FA Unit-5 ③ Final AMP Current	1ms	ADC	0.0A	20.0A	703/Warning
111	FA Unit-5 ④ Final AMP Current	1ms	ADC	0.0A	20.A	704/Warning
112	FA Unit-5 ①② FWD	10ms	ADC	0W	1100W 1000W	711/Internal 711/Warning
113	FA Unit-5 ①② REF	10ms	ADC	0W	1000W 500W	715/Internal 715/Warning
114	FA Unit-5 ③④ FWD	10ms	ADC	0W	1100W 1000W	712/Internal 712/Warning
115	FA Unit-5 ③④ REF	10ms	ADC	0W	1000W 500W	716/Internal 716/Warning
116	FA Unit-5 ① +45VDC	10ms	ADC	+10.0V	+50.0V	721/Warning
117	FA Unit-5 ② +45VDC	10ms	ADC	+10.0V	+50.0V	722/Warning
118	FA Unit-5 ③ +45VDC	10ms	ADC	+10.0V	+50.0V	723/Warning
119	FA Unit-5 ④ +45VDC	10ms	ADC	+10.0V	+50.0V	724/Warning
120	FA Unit-5 +12VDC	10ms	ADC	+8.0V	+16.0V	725/Warning
121	FA Unit-5 Heat Sink Temperature	100ms	I2C	+22.0degC	+60.0degC	731/Warning
122	FA-5 FADA Sub CPU PCB Temperature	100ms	I2C	+4.0degC +8.0degC	+60.0degC +55.0degC	732/Fault 732/Warning

DA Unit

Monitoring points are Current (3 points), Detection Output (2 points), Voltage (3 points) and Temperature (2 points).

Table 38: DA Unit Monitoring Item

Add No.	Description	Measurement Frequency		Lower Limit	Upper Limit	Error Code
124	DA Unit Pre Driver AMP Current	1ms	ADC	0.5A	3.0A	1/Warning
125	DA Unit ① Driver AMP Current	1ms	ADC	0.0A	11.5A	2/Warning
126	DA Unit ② Driver AMP Current	1ms	ADC	0.0A	11.5A	3/Warning
129	DA Unit ①② FWD	10ms	ADC	0W	550W 500W	11/Internal 11/Warning
130	DA Unit ①② REF	10ms	ADC	0W	500W 250W	15/Internal 15/Warning
133	DA Unit ① +45VDC	10ms	ADC	+10.0V	+50.0V	22/Warning
134	DA Unit ② +45VDC	10ms	ADC	+10.0V	+50.0V	23/Warning
137	DA Unit +12VDC	10ms	ADC	+8.0V	+16.0V	21/Warning
138	DA Unit Heat Sink Temperature	100ms	I2C	+22.0degC	+60.0degC	31/Warning
139	DA FADA Sub CPU PCB Temperature	100ms	I2C	+4.0degC +8.0degC	+60.0degC +55.0degC	32/Fault 32/Warning

HE Unit

Monitoring points are Temperature (4 points), Rotation Speed (6 points), Flow Rate (4 points), and Moisture (1 point).

Table 39: HE Unit Monitoring Item

Add No.	Description	Measuremen t Frequency		Lower Limit	Upper Limit	Error Code
141	HE Unit Air Inlet Temperature	100ms	I2C	+4.0degC	+45.0degC	405/Warning
142	HE Sub CPU PCB Temperature	100ms	I2C	+4.0degC +8.0degC	+60.0degC +55.0degC	406/Fault 406/Warning
145	HE Unit Fan 1 Rotation Speed	1s	Counter	5000rpm	9000rpm	431/Warning
146	HE Unit Fan 2 Rotation Speed	1s	Counter	5000rpm	9000rpm	432/Warning
147	HE Unit Fan 3 Rotation Speed	1s	Counter	5000rpm	9000rpm	433/Warning
148	HE Unit Fan 4 Rotation Speed	1s	Counter	5000rpm	9000rpm	434/Warning
149	HE Unit Fan 5 Rotation Speed	1s	Counter	5000rpm	9000rpm	435/Warning
150	HE Unit Fan 6 Rotation Speed	1s	Counter	5000rpm	9000rpm	436/Warning
154	Outlet LCW Flow Rate	1ms	ADC	- -	20L/min 22L/min	409/Internal 409/Warning
155	Inlet LCW Temperature	1ms	ADC	+22.0degC	+38.0degC	410/Internal
156	Outlet LCW Temperature	1ms	ADC	+22.0degC	+45.0degC	411/Internal
157	Moisture Sensor Status	1ms	ADC	0%	100%	Read Only

PS Unit

Monitoring points are P.S. (6 points), Temperature (1 point), Voltage (1 point) and Rotation Speed (2 points).

Table 40: PS Unit Monitoring Item

Add No.	Description	Measurement Frequency		Lower Limit	Upper Limit	Error Code
30	PS Status (More than Three Faults)	-	-	-	≥ 3	420/Internal
31	PS Status (bit)	1ms	Port	-	Hi ALM	421/Warning 422/Warning 423/Warning 424/Warning 425/Warning 426/Warning
33	PS Sub CPU PCB Temperature	100ms	I2C	+4.0degC +8.0degC	+60.0degC +55.0degC	404/Fault 404/Warning
35	PS Sub CPU PCB Input Voltage +24VDC (for MC, SSA)	10ms	ADC	+20.0V	+28.0V	442/Warning
36	PS Unit Fan 1 Rotation Speed	1s	Counter	5000rpm	9000rpm	437/Warning
37	PS Unit Fan 2 Rotation Speed	1s	Counter	5000rpm	9000rpm	438/Warning

2.3.4.4. Communication Interval

The Main CPU polls the full set of sub-CPUs every 10ms in the following order
 PS Unit → FA Unit-1 → FA Unit-2 → FA Unit-3 → FA Unit-4 → FA Unit-5 → DA Unit → HE Unit

2.3.4.5. Data averaging

In some cases, the data are an average of six (6) measurements, excluding the two (2) highest and two (2) lowest values.

2.4. Protection Function

2.4.1. External Interlocks

When any of the four input 24 VDC External Fault lines drop below 5 VDC, (1) all four 24 VDC Fault Indicator lines are set to zero within 10 microseconds (this is hardwired), (2) the two RF relay switches are opened within 20 milliseconds (this is hardwired) and (3) a shutdown sequence is initiated, that is, the PS voltages are reduced to minimum, the PSs are disabled and the External Fault indicator LED is turned on (this is done through software).

The status of the four input 24 VDC lines can be read via Modbus. Fault information is latched and is resettable by a Reset command.

Table 41: 24V Fault State Definitions

No Fault State Voltage	24 VDC nominal
Input Impedance of External Fault Lines	4.7 kOhm
Fault State Voltage	< 5 VDC
Output Impedance of the External Fault Indicator Lines	10 kOhm

2.4.2. Warnings

In the SSA module, items such as current, voltage, temperature, etc. are monitored. When the measured values exceed the allowed thresholds, warnings (instead of faults) are issued in some cases as noted in Tables 32-36. These warnings can be monitored via Modbus.

3. Flowchart

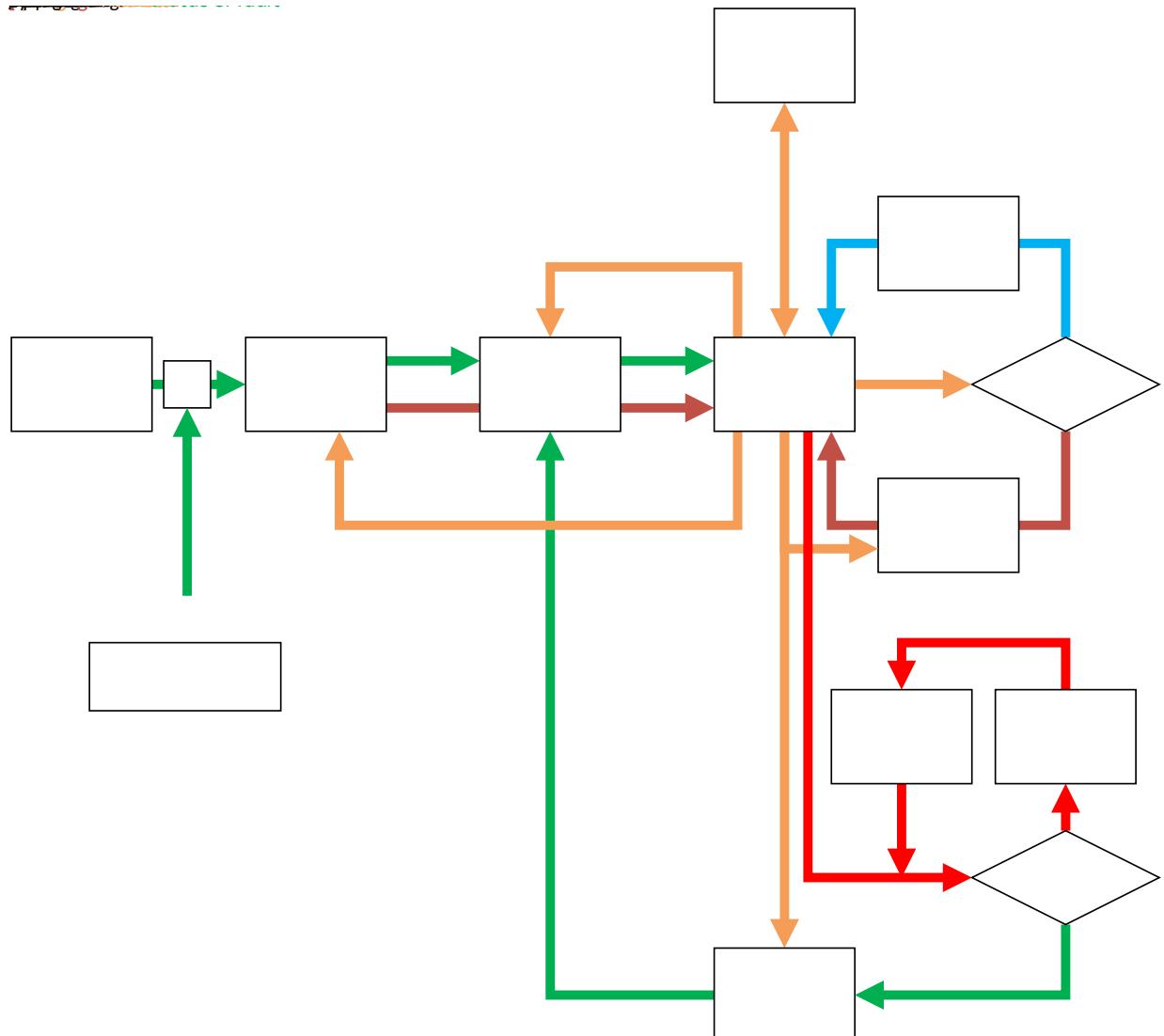
3.1. Main CPU Flowchart

Operational Sequence List - these commands can be executed independently of whether the RF and DC are Disabled or Enabled

- A) DC Enable/Disable
- B) RF Enable/Disable
- C) PS Output Control Voltage
- D) Fault Reset
 - 1. Internal Fault Reset
 - 2. External Fault Reset
 - 3. Critical Warning Reset
 - 4. Processor Fault Reset
- E) LAN Reboot
- F) System Reboot
- G) SD Card Operation
- H) Set threshold to Factory default value
- I) Read Status

Change Parameter List - these commands will only be executed when the RAS is RF and DC Disabled

- A) -
- B) -
- C) Reflection Power Maximum Limit
- D) Temperature Limit
- E) Voltage Limit
- F) LCW Flow Rate Limit
- G) Outlet LCW Temperature Limit
- H) Warning Limit
- I) Calendar



3.1.1. Boot up / Reboot

The operations below begin when the 120 VAC Circuit Breaker turns ON.

<Boot up>

- 1) Set CPU port
- 2) Initialize variable
- 3) Initialize ADC
- 4) Initialize Uart1 (XPort)
- 5) Initialize Uart2 (RS-485)
- 6) Initialize I2C
- 7) Initialize Timer
- 8) Transfer time data from Main CPU to Debug-SD CPU for adjusting time of MAIN CPU PCB.
- 9) Turn ON +12VDC power supply of each SUB CPU PCB.
(Initialization of each SUB CPU PCB starts)
- 10) Main CPU transfers threshold data read from EEPROM.
- 11) LED of Internal Fault lights up and Fault Code on Modbus becomes 570.
In waiting state for Reset command of Modbus.

<Reboot>

Save time stamp in EEPROM after receiving Modbus command, and reset Main CPU.

Execute the above 1) through 11), but confirm time stamp of reboot with EEPROM when initializing I2C (the above 6)) and indicate time stamp of Last Reboot on Modbus.

3.1.2. Change parameter

See "Change Parameter List" in Section 3.1 Main CPU Flowchart for changeable parameters.

Follow the procedure below to change Threshold data and/or Calendar.

< Change of Threshold Data>

- 1) Designate Function0x06 of Modbus/TCP, set address and changed values.
- 2) Rewrite threshold data of EEPROM.
- 3) Change of threshold is reflected.

<Change of Calendar>

- 1) Have RF and DC disabled by sending Modbus commands.
- 2) Designate Function0x06 of Modbus/TCP, set address and changed values.
- 3) Rewrite Calendar data of built-in SRAM of DS3232SN.
- 4) Main CPU is automatically rebooted.
- 5) Change of threshold is reflected.
- 6) 120VAC has to be turned OFF to let Debug-SD CPU save data onto a microSD.

3.1.3. Interlock

- 1) There is an Internal or External Fault.
- 2) At least one of the Fault Status1, Fault Status2 or Fault Status3 bits are set.
- 3) An Internal or External Fault Error Code is generated.
- 4) The system is shutdown (RF Disable and DC Disable).
- 5) Remove cause of the fault.
- 6) Issue an Internal or External Fault Reset command via Modbus.

Fault information will be latched even after the cause of the fault is removed. The Fault Reset command is ignored when the cause of an Interlock still exists.

3.1.4. Warning

- 1) Warning condition occurs.
- 2) Warning status bit set.
- 3) A Warning Error Code is generated.
- 4) Clear Warning by issuing a Warning Reset command via Modbus.
- 5) Warning bit set again if monitored data is still outside of threshold limits.
- 6) Warning bit information will be vanished when all monitoring items are in normal value.

When Warning occurs, the warning information can be read from the registers via Modbus/TCP. The SSA module continues to operate, but when a fault such as Thermostat etc. occurs, the RAS shuts off (goes into the Default Interlock state).

Debug-SD CPU Firmware update procedure

- 1 Kill 120VAC input of the SSA.
- 2 Remove a cover of Debug & SD Slot on the Front Panel of the RF Control Unit. Then, connect a jig cable for firmware writing onto the leftmost connector.
- 3 Connect the other end of the jig cable to Pickit 3.
- 4 Connect Pickit 3 and PC by USB cable.
- 5 Open up a folder storing a firmware of “SSA ver. 1.02_Debug ver. 1.00_Ca1300BW1-6068R-SL” on PC. Factory default name of its folder is “SLAC 2020.09.24”. (This firmware is Ver. 1.00)
- 6 Open up “debug-sd” folder on the above folder. (see Fig. 3)
- 7 Open up “src” folder, then “ca1300bw1_6068r_sl_pic24writer_v100”

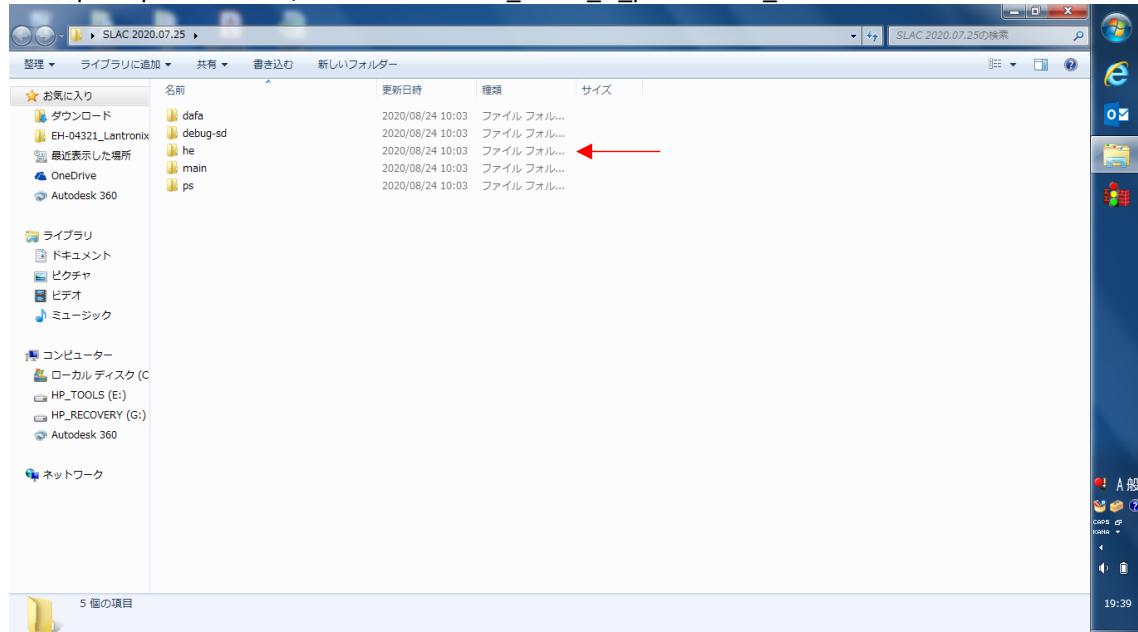


Fig. 3

8 Launch “ca1300bw1_6068r_sl_pic24writer.mcp” file (see Fig. 4)

9 Turn on 120VAC input of the SSA

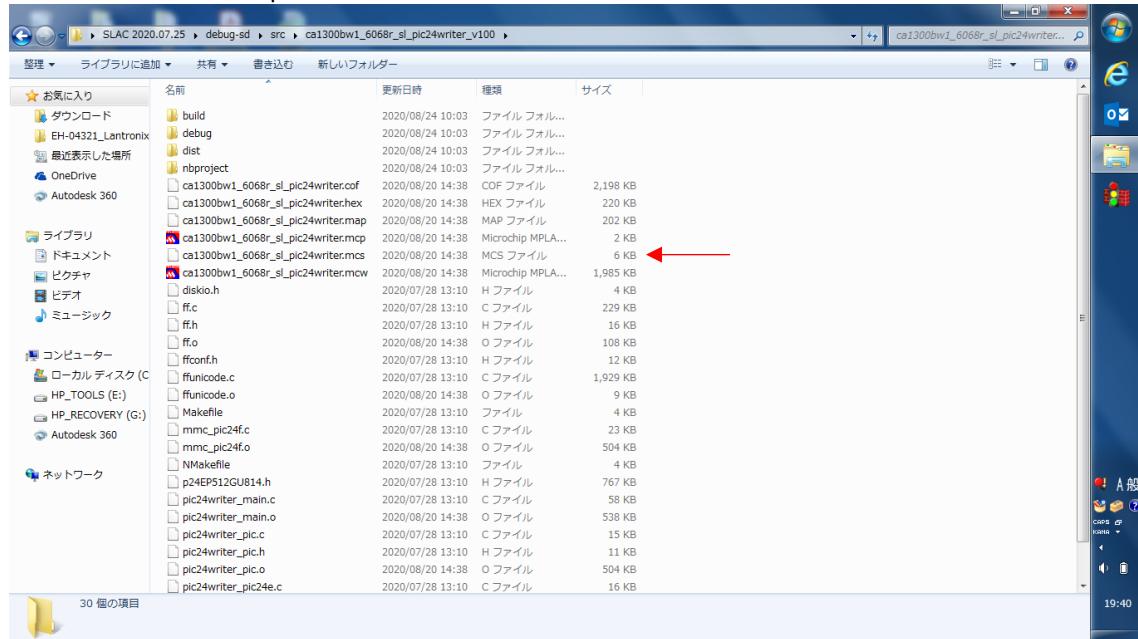


Fig. 4

10 If there is no problem on all connection and operation, description on app would be like red circled area on below Fig. 5.

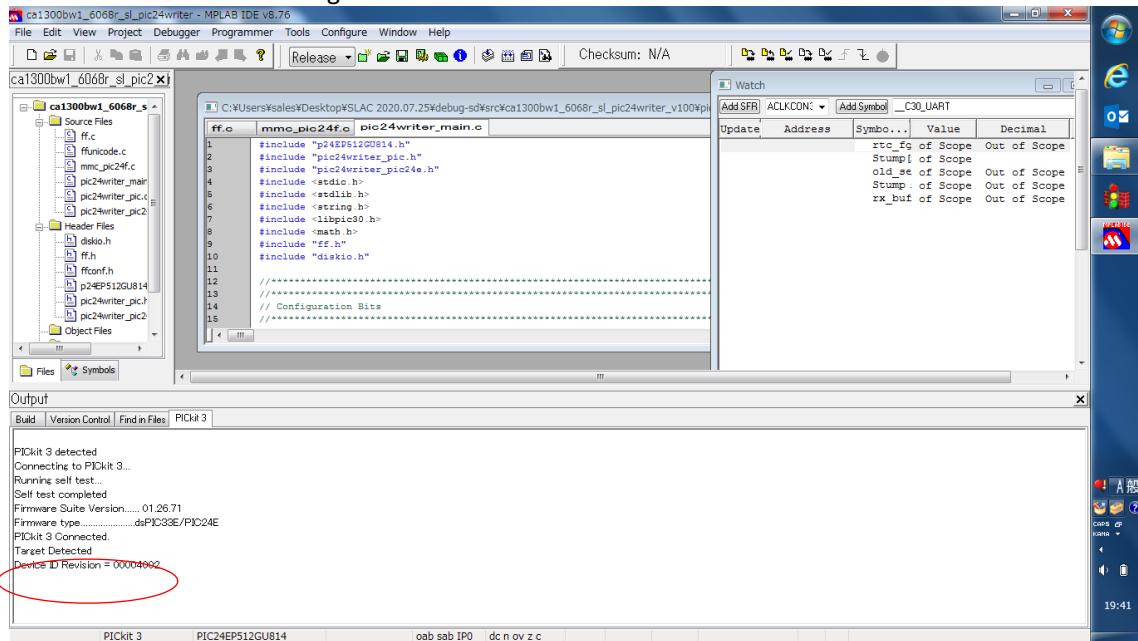


Fig. 5

- 11 Execute “Build All” which is under “Project” on the menu bar.
- 12 If “Build All” successfully executed, description on app would be as red circled area on below

Fig. 6.

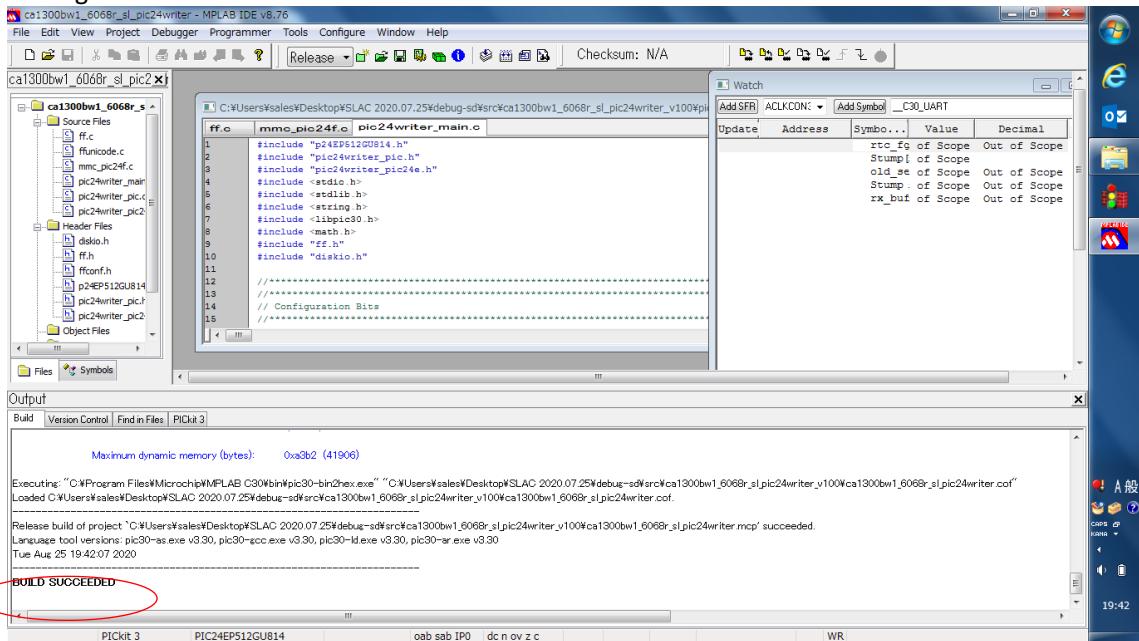


Fig. 6

- 13 After Build All, execute “Program” which is under “Programmer” on the menu bar.
- 14 If “Program” successfully executed, description on app would be as red circled area on below Fig. 7.
- 15 Kill 120VAC input of the SSA.
- 16 Remove a jig cable for firmware writing on the leftmost connector of Debug & SD Slot on the Front Panel.
- 17 Install a cover of Debug & SD Slot on the Front Panel of the RF Control Unit.
- 18 Debug-SD CPU Firmware update is completed

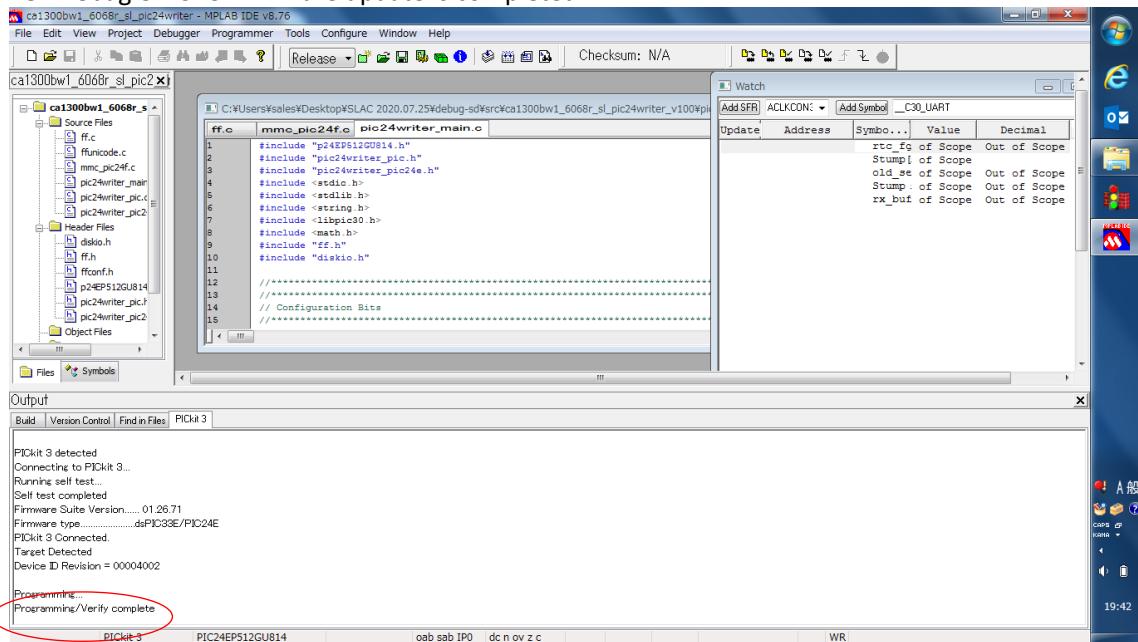


Fig. 7

Other CPUs Firmware update procedure

- 1 Kill 120VAC input of the SSA.
- 2 Connect PC and the Ethernet connector on the Front Panel of the RF Control Unit.
- 3 To use a firmware writing program for “SSA ver. 1.02_Debug ver. 1.00_CA1300BW1-6068R-SL”, open up “FirmwareUpdateTool_v102_1click” folder on PC.
- 4 Open “FirmwareUpdateTool_v100.exe” under “Release” folder. (see Fig. 8)
- 5 Select “CA1300BW1-6068R-SL” on a newly opened application window.
- 6 Turn on 120VAC input of the SSA. Before turning on, please confirm there is no other app which tries to communicate with SSA other than “FirmwareUpdateTool_v100.exe”.

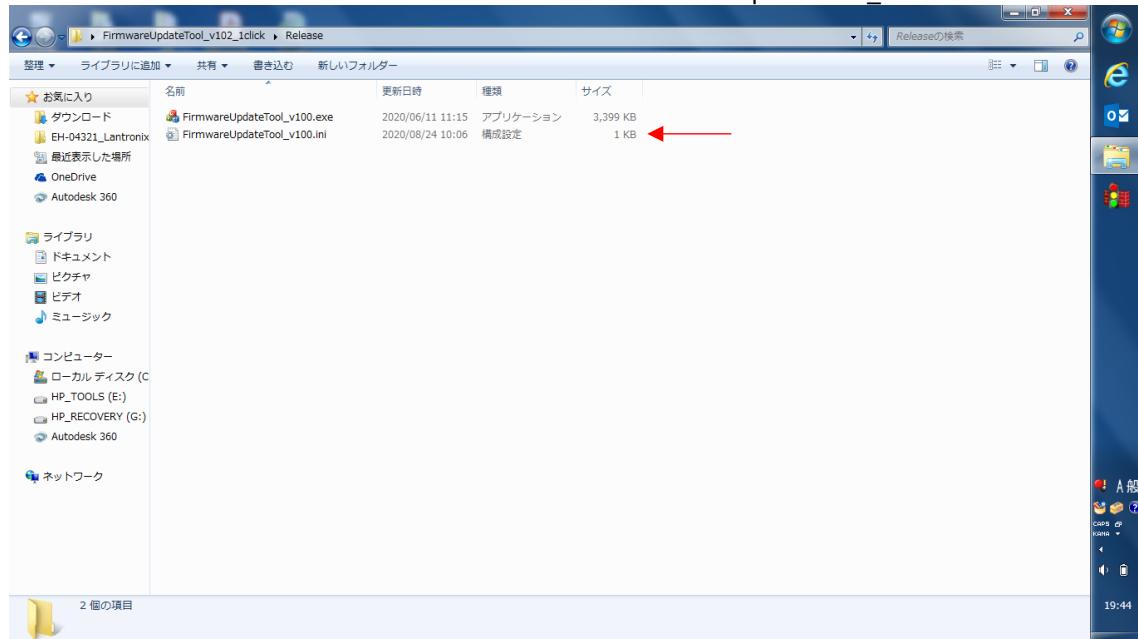


Fig. 8

7 Input IP Address of SSA which is updating firmware on red circled area of Fig. 9.

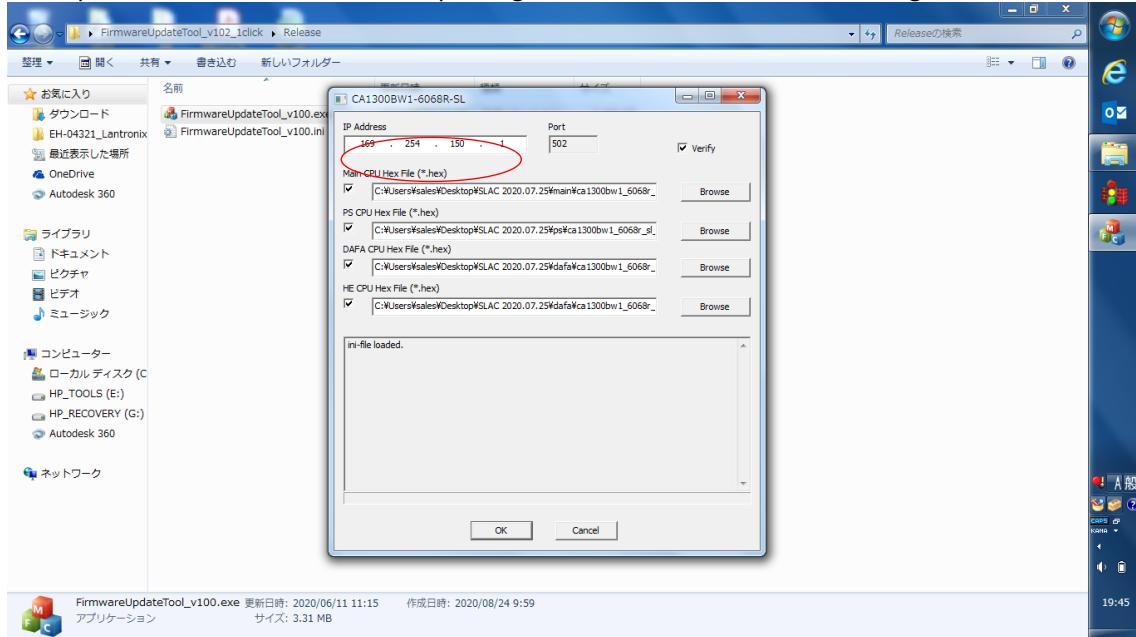


Fig. 9

8 Put check next to updating CPUs. (see left red circle of Fig. 10)

9 Next to do is setting up hex file for each checked CPUs.

10 Click "Browse" on the right red circle of Fig. 10 for each CPUs.

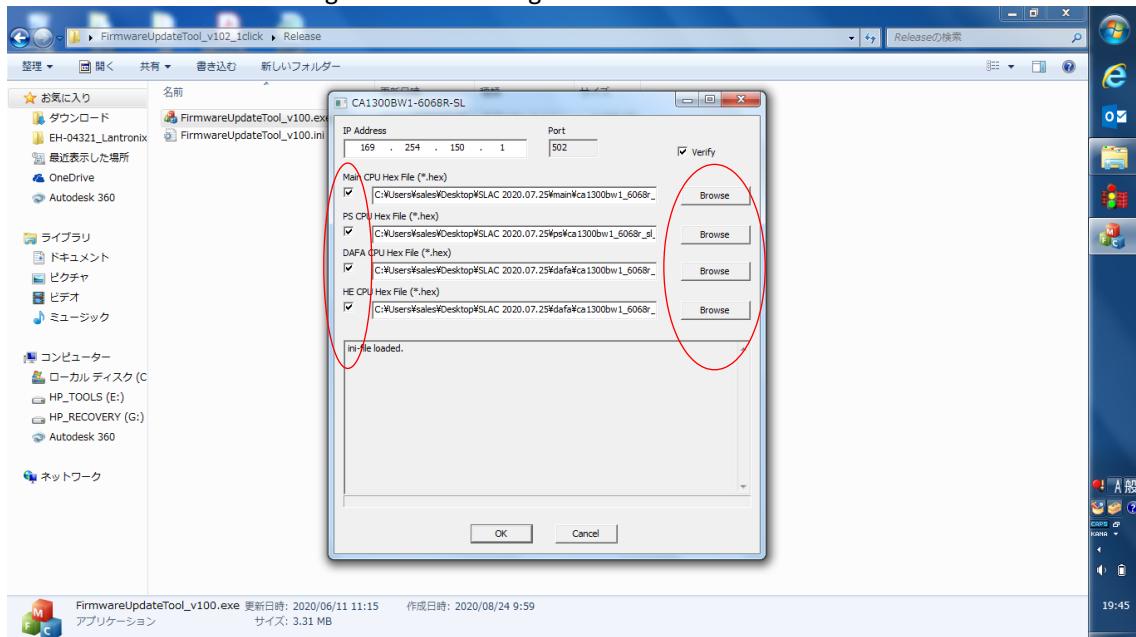


Fig. 10

11 hex file for each CPU is stored on the same folder with firmware of "SSA ver. 1.02_Debug ver. 1.00_CA1300BW1-6068R-SL". Factory default name is "SLAC 2020.09.24". (Firmware Ver. 1.02)

Setting of Main CPU Hex File (*.hex)

SLAC 2020.09.24 main ca1300bw1_6068r_sl_main.hex

Setting of PS CPU Hex File (*.hex)

SLAC 2020.09.24 ps ca1300bw1_6068r_sl_ps.hex

Setting of DAFA CPU Hex File (*.hex) NOTE: 6 CPUs (FA-1 to FA-5, and DA) will be updated.

SLAC 2020.09.24 dafa ca1300bw1_6068r_sl_dafa.hex

Setting of HE CPU Hex File (*.hex)

SLAC 2020.09.24 he ca1300bw1_6068r_sl_he.hex

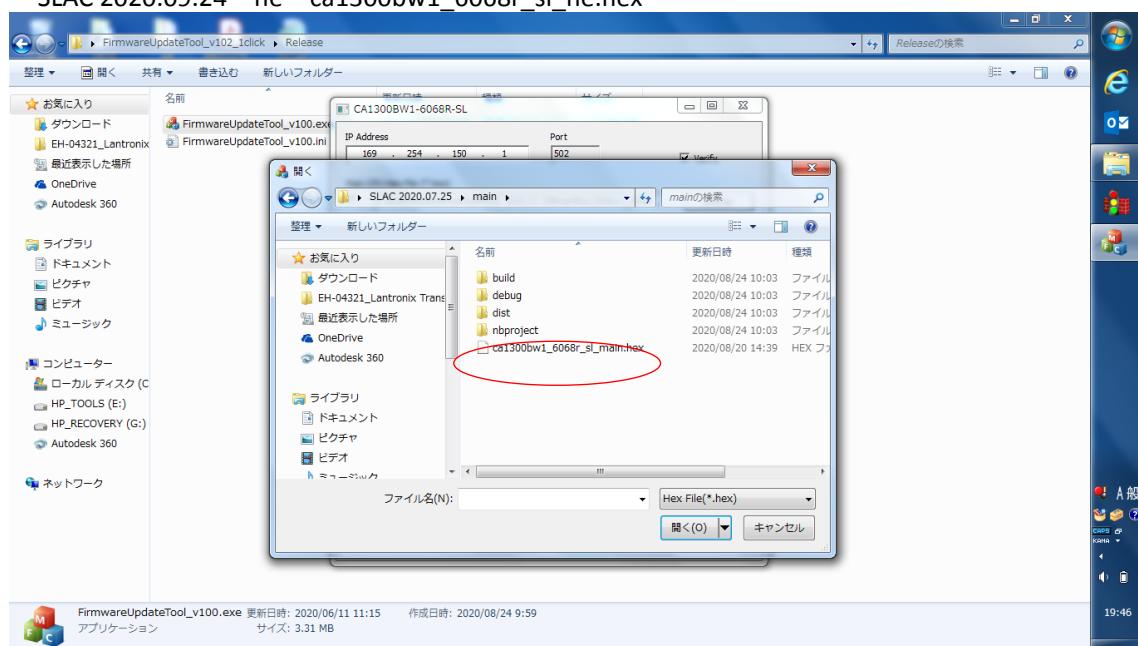


Fig. 11

- 12 After setting of hex file, click OK. (see Fig. 12) By clicking OK, "FirmwareUpdateTool_v100.exe" sets up hex file. Unless hex files are moved to anywhere, there is no need for resetting hex file.

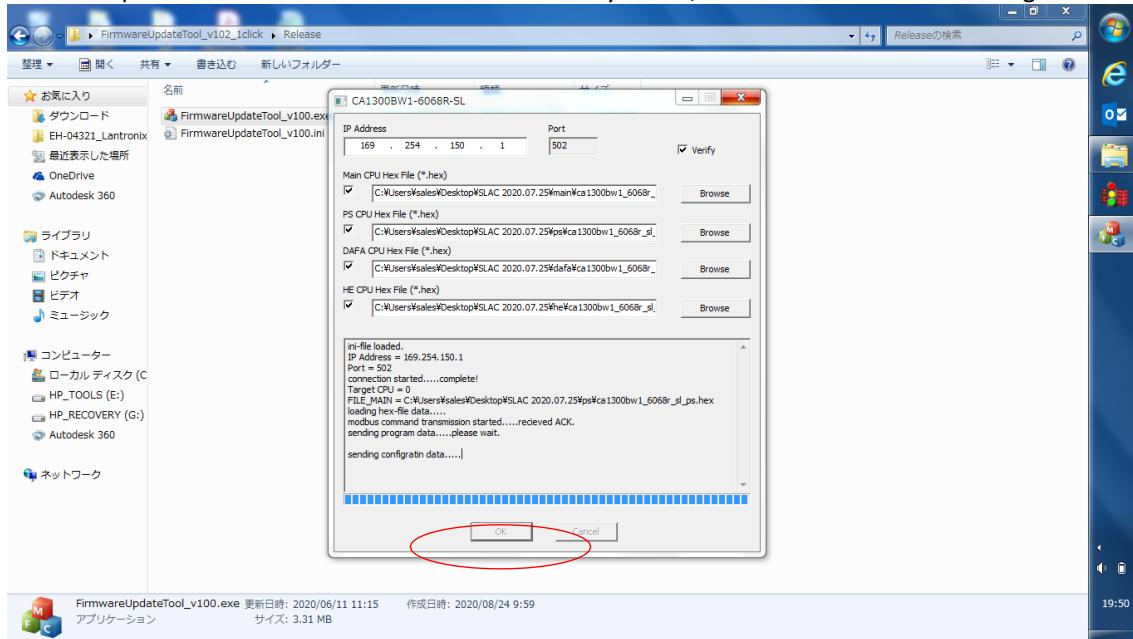


Fig. 12

- 13 If firmware is successfully updated, dialog box will open as Fig. 13. Click OK.

14 Kill 120VAC input of the SSA.

15 Selected CPU's Firmware update is completed

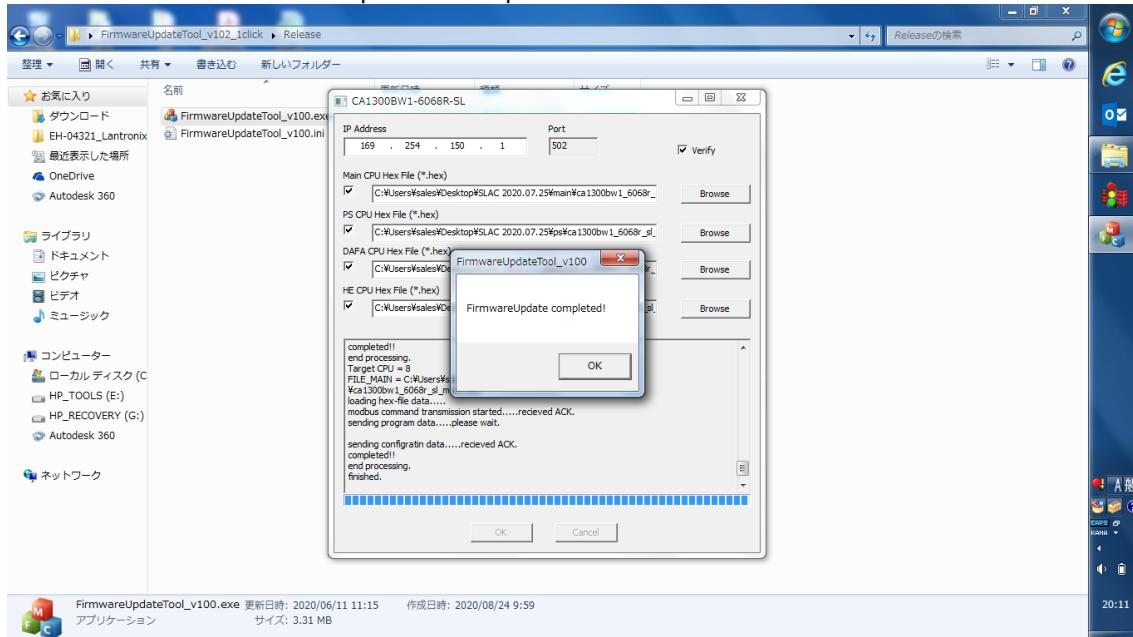


Fig. 13