



# SOFTWARE MANUAL

RF POWER AMPLIFIER

CA186BW3-7878R-LB

R&K Company Limited

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## Revision History

Version	Date	Author(s)	Revision Note
DRAFT Rev.1	June 30, 2017	H.Usami	Draft
Ver. 1.00	August 21, 2017	J.Aranami	1st release

## 1. Function Overview

This product is controlled by programmable logic. You can read all status by controlling various functions.

### 1.1. Construction

This product is constructed with 1 controller module and 32 SSA modules.

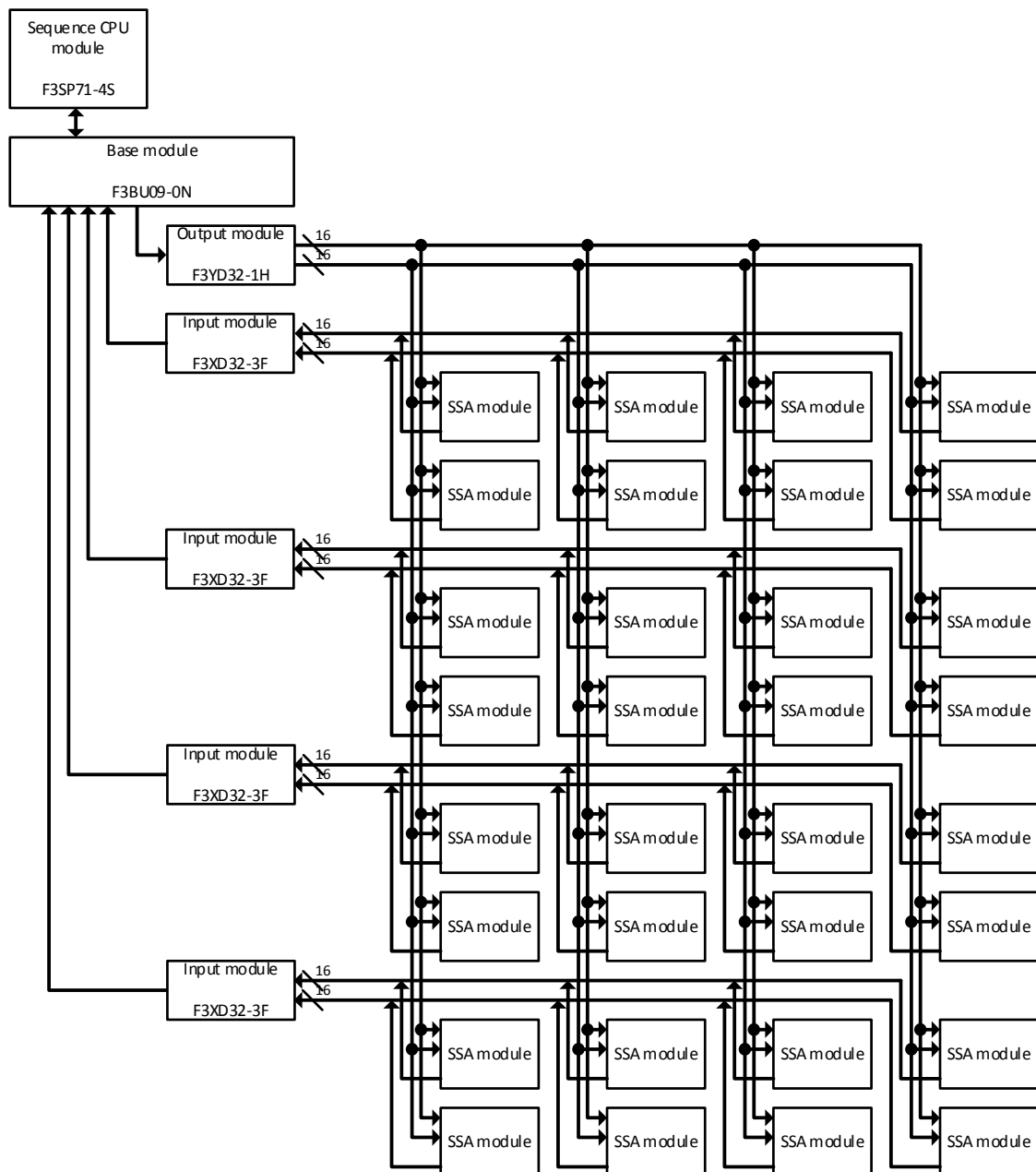


Fig. 1: Construction of Control System

## 1.2. Control Interface

This product has both human interface and network interface.

- Human Interface : Touch Screen
- Network Interface : Modbus/TCP

Modbus/TCP controls SSA by accessing register similar to “CA1300BW1-5766R-SL”.

## 1.3. Monitoring System

The system monitors and collects each status of SSA. Collected status can be seen via control interface in real time. Collected status are also recorded to SD card.

## 1.4. Protection Function

This product has following protection function.

- Interlock : When abnormal status occurs internally or externally, it stops HPA and send fault signal
- Warning : When abnormal status occurs internally, warning is notified on control interface.

## 2. Function Information

Information of each function is as following.

### 2.1. Control Construction

#### 2.1.1. Controller Module

Controller module is controlled by PLC (FA-M3V) by Yokogawa Electric Corporation. It collects data which taken by SSA modules by polling

It controls SSA by processing orders from control interface

Table 1: PLC system

Category	Type name	Number	Specification
Base Module	F3BU09-0N	1	For power supply (F3PU20-0S), 9 slot (CPU+I/O).
Power Supply Module	F3PU20-0S	1	100-240 VAC, 5 VDC / 4.3 A rated output.
CPU Module	F3SP71-4S	1	Ladder 60K steps, basic instruction 0.00375us or logger, with network and Modbus/TCP slave (server) functions (USB2.0, Ethernet).
PC link Module	F3LC11-2F	1	115kbps maximum RS-422/RS-485 port For panel (GP-4301TM Module Type) communication.
I/O Module	F3YD08-6A	1	Output Module Send an instruction to Interlock board. Restart and Instruction Execution.
	F3XD32-4F	1	Input Module For receiving alarm signal
	F3YD32-1H	1	Output Module For FPGA data transmission
	F3XD32-3F	4	Input Module For receiving FPGA data

PLC software can be updated via Ethernet

### 2.1.2. SSA Module

SSA modules are controlled by FPGA (Spartan 6) by Xilinx. It monitors and measures the internal status of SSA. Measured values are sent by polling of PLC. When measured value is abnormal, warning is sent to PLC.

Table 2: Monitoring Items

Parameter	Resolution	Sampling rate	Note
SSA Device current	12 bit	3MSPS	SSA module
SSA Drain Voltage	12 bit	3MSPS	SSA module
SSA Forward power	12 bit	3MSPS	SSA module
SSA Reflection power	12 bit	3MSPS	SSA module
60kW Forward power	12 bit	3MSPS	Controller unit
60kW Reflection power	12 bit	3MSPS	Controller unit
Input power	12 bit	3MSPS	Controller unit
Heat Sink temperature	12 bit	100kSPS	SSA module
Heat Sink thermostat	1 bit	-	SSA module
AC/DC Power Supply current	12 bit	3MSPS	SSA module
AC/DC Power Supply voltage	12 bit	100kSPS	SSA module
AC/DC Power Supply alarm	1 bit	-	SSA module
FAN speed(1/4 rpm)	12 bit	-	SSA module, Controller unit
Humidity	12 bit	100kSPS	Controller unit
Water flow	12 bit	100kSPS	Controller unit
Water temperature	12 bit	100kSPS	Controller unit
Module temperature	12 bit	100kSPS	SSA module, Controller unit
Cabinet temperature	12 bit	100kSPS	Controller unit
480 VAC voltage	12 bit	3MSPS	Controller unit

## 2.2. Control Interface

### 2.2.1. Human Machine Interface

HMI is controlled by touch screen by Pro-face (GP-4301TM). It communicates with PLC via PC link Modules.

Table 3: Specification of Touch Screen

Screen Size	5.7 inch
Screen Resolution	320×240 dot (QVGA)
Display Device	TFT color (16bit high color)
Internal Memory	8MByte

Touch screen displays HPA's data in one second cycle. By pressing menu button, voltage, current, and temperature of each unit can be shown in screen.

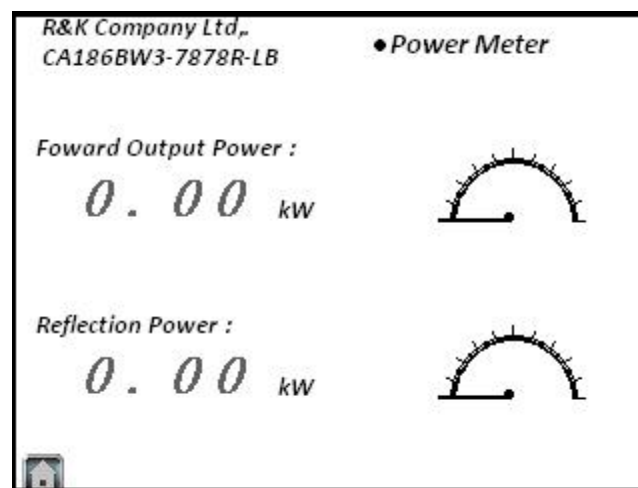


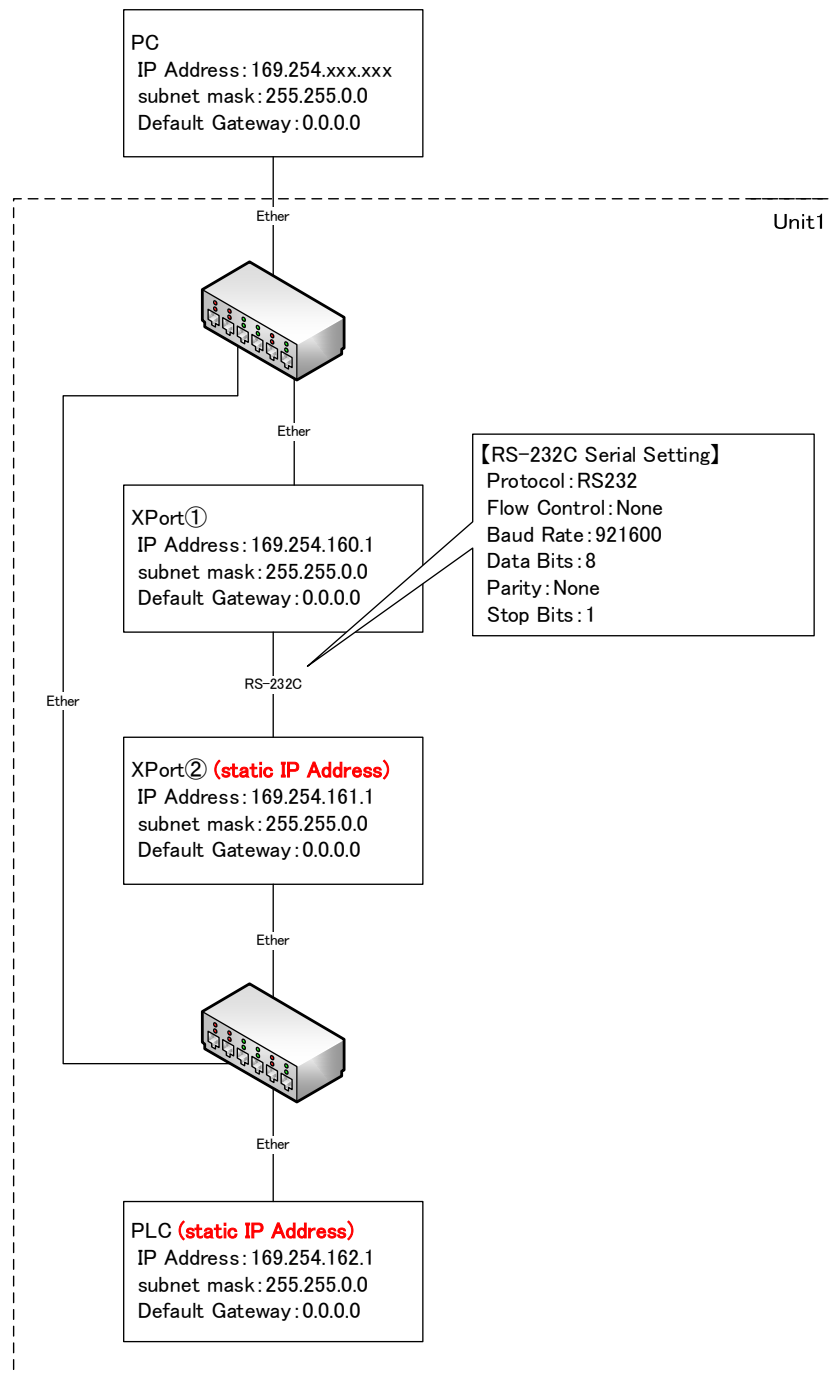
Fig. 2: Sample Display

## 2.2.2. Network Interface

### 2.2.2.1 IP Address setting

For Network interface with external, XPort 1 is used. The setting of XPort 1 is editable. For updating of PLC, IP Address of PLC is used. IP Address setting of PLC and XPort2 are unable to edit. Please do not try to change them.

#### (1) Internal network system





(2) XPort setting

Setting of XPort is editable by "Device Installer.exe" of Lantronix. Please find following lists of initial setting of Xport.

Table 4: Unit1 XPort setting

	XPort1	XPort2
"Network" – "IP Configuration"		
IP Address	169.254.160.1	169.254.161.1
Subnet Mask	255.255.0.0	255.255.0.0
Default Gateway	0.0.0.0	0.0.0.0
DNS Server	0.0.0.0	0.0.0.0
"Server" – "Advanced"		
CPU Performance Mode	High	High
"Serial Setting" – "Port Settings"		
Protocol	RS232	RS232
Flow Control	None	None
Baud Rate	921600	921600
Data Bits	8	8
Parity	None	None
Stop Bits	1	1
"Connection" – "Endpoint Configuration"		
Local Port	502	502
Remote Port	0	502
Remote Host	0.0.0.0	169.254.162.1

Table 5: Unit2 XPort setting

	XPort1	XPort2
“Network” – “IP Configuration”		
IP Address	169.254.160.2	169.254.161.2
Subnet Mask	255.255.0.0	255.255.0.0
Default Gateway	0.0.0.0	0.0.0.0
DNS Server	0.0.0.0	0.0.0.0
“Server” – “Advanced”		
CPU Performance Mode	High	High
“Serial Setting” – “Port Settings”		
Protocol	RS232	RS232
Flow Control	None	None
Baud Rate	921600	921600
Data Bits	8	8
Parity	None	None
Stop Bits	1	1
“Connection” – “Endpoint Configuration”		
Local Port	502	502
Remote Port	0	502
Remote Host	0.0.0.0	169.254.162.2

(3) PLC IP Address setting

IP Address setting of PLC is editable by “CPU Properties” – “SET UP” – “ETHERNET” of Wide Field3 tool of Yokogawa. If there is no problem with initial setting, please do not edit the setting of CPU Properties.

Please find following lists for initial setting of PLC’s IP Address.

Table 6: Unit1 PLC IP Address setting

	Unit1 PLC
“CPU Properties” – “SETUP” – “ETHERNET”	
IP Address	169.254.162.1
Subnet Mask	255.255.0.0
Default Gateway	0.0.0.0
DNS Server	0.0.0.0
“CPU Properties” – “SETUP” – “HIGHER-LEVEL_LINK_SERVICE”	
HLLINK_PROTOCOL_A	2 (=Modbus/TCP Slave)
HLLINK_DATA_FORMAT_A	1 (=Binary)
HLLINK_PROTOCOL_B	2 (=Modbus/TCP Slave)
HLLINK_DATA_FORMAT_B	1 (=Binary)
HLLINK_PROTECT	0 (=Disabled)

Table 7: Unit2 PLC IP Address setting

	Unit2 PLC
“CPU Properties” – “SETUP” – “ETHERNET”	
IP Address	169.254.162.2
Subnet Mask	255.255.0.0
Default Gateway	0.0.0.0
DNS Server	0.0.0.0
“CPU Properties” – “SETUP” – “HIGHER-LEVEL_LINK_SERVICE”	
HLLINK_PROTOCOL_A	2 (=Modbus/TCP Slave)
HLLINK_DATA_FORMAT_A	1 (=Binary)
HLLINK_PROTOCOL_B	2 (=Modbus/TCP Slave)
HLLINK_DATA_FORMAT_B	1 (=Binary)
HLLINK_PROTECT	0 (=Disabled)

### 2.2.2.2 Communication protocol

The Model CA186BW3-7878R-LB can be controlled with Lantronix Xport.

Xport is set up by Deviceinstaller.

IP address is assigned automatically. Port is 502.

Table 8: Modbus/TCP

Transaction Identifier	Protocol Identifier	Length	Unit Identifier
2byte 0XXXXX	2byte 0XXXXX	2byte 0XXXXX	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 9: 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
0XX	0XX	0XX	0XX	0x00	0x06	0XX	0x03	0x00	0x02	0x00	0x03

#### 2) Response

Table 10: Response packet format (0x03)

Transaction Identifier		Protocol Identifier		Length		Unit Identifier	Function	Byte court	Data 1		Data 2		Data 3	
byte0	byte1	byte2	byte3	bite4	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
0XX	0XX	0XX	0XX	0x00	0x09	0XX	0x03	0x06	0XX	0XX	0XX	0XX	0XX	0XX

### 3) Exception Response

Table 11: 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 12: 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 range
0x03	Illegal Data Number	Specify the number outside the range
0x04	Processing abnormality	Write protect setting
0x0A	CPU number error	Unit ID designation other than 1 to 4
0x0B	Timeout	The CPU specified by the unit ID does not exist.

#### <0x06 Write Single Register>

Write only

One register rewriting is enabled

It is used to command below

- Power ON/OFF
- RF ON/OFF
- Voltage control setting of switching power supply
- Reset for warning clear
- Reboot
- Time setting

### 1) Request

Table 13: 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 14: 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 15: 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 16: 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 range
0x03	Illegal Data Number	Specify the number outside the range
0x04	Processing abnormality	Write protect setting
0x0A	CPU number error	Unit ID designation other than 1 to 4
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.

◆ Definition: Default: AC Enable, DC Disable, RF Disable

◆ Reset Operation

➤ Default

When these errors are detected, SSA operation goes to Default: AC Enable, DC Disable and RF Disable.

To recover from this state:

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 "RF Enable" command (Address 2) to the SSA via Modbus.

➤ Remove Cause:

When errors are detected, SSA operation continues as before the error detection.

To remove these error:

1. Check what causing the error and remover or fix the error cause.
2. Send the "Fault Reset" command (Address 4) to the SSA via Modbus. SSA operation continues as before putting reset command.

Table 17: Register map

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
1	0x0001	DC Enable/Disable	n/a	0x06	0 or 1	n/a	n/a	n/a	0 : Disable 1 : Enable	n/a	n/a	n/a
2	0x0002	RF Enable/Disable	n/a	0x06	0 or 1	n/a	n/a	n/a	0 : Disable 1 : Enable	n/a	n/a	n/a
3	0x0003	PS Output Control Voltage	mV	0x06	700 - 2500	700	2500	Value*1	Operation Value	n/a	n/a	n/a
4	0x0004	Fault Reset	n/a	0x06	0 or 1	n/a	n/a	n/a	1 : Fault Reset	n/a	n/a	n/a
5	0x0005	X-Port Reboot	n/a	0x06	0 or 1	n/a	n/a	n/a	1 : X-Port Reboot	n/a	n/a	n/a
6	0x0006	System Reboot	n/a	0x06	0 or 1	n/a	n/a	n/a	1 : System Reboot	n/a	n/a	n/a
7	0x0007	Pulse Mode	n/a	0x06	0 or 1	n/a	n/a	n/a	0 : Disable 1 : Enable	n/a	n/a	n/a
8	0x0008	-	-	-	-	-	-	-	-	-	-	-
9	0x0009	-	-	-	-	-	-	-	-	-	-	-
10	0x000A	AC Enabled (480VAC)	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : Disable 1 : Enable	n/a	n/a	n/a
11	0x000B	DC Enabled	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : Disable 1 : Enable	n/a	n/a	n/a
12	0x000C	RF Enabled	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : Disable 1 : Enable	n/a	n/a	n/a
13	0x000D	Internal Fault	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : No Error 1 : Error	Interlock	RF/DC: Disable	Default

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
14	0x000E	External Fault	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : No Error 1 : Error	Interlock	RF/DC: Disable	Default
15	0x000F	Warning	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : No Error 1 : Error	Warning	Notification Only	Remove Cause
16	0x0010	Year for Calendar	Year	0x03	0-99	n/a	n/a	Value*1	n/a	n/a	n/a	n/a
17	0x0011	Month for Calendar	Month	0x03	1-12	n/a	n/a	Value*1	n/a	n/a	n/a	n/a
18	0x0012	Date for Calendar	Date	0x03	1-31	n/a	n/a	Value*1	n/a	n/a	n/a	n/a
19	0x0013	Hour for Calendar	Hour	0x03	0-23	n/a	n/a	Value*1	n/a	n/a	n/a	n/a
20	0x0014	Minute for Calendar	Minute	0x03	0-59	n/a	n/a	Value*1	n/a	n/a	n/a	n/a
21	0x0015	Second for Calendar	Second	0x03	0-59	n/a	n/a	Value*1	n/a	n/a	n/a	n/a
22	0x0016	Wire-Check Status	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : Incomplete 1 : Complete	n/a	n/a	n/a
23	0x0017	Configuration Status	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : Incomplete 1 : Complete	n/a	n/a	n/a
24	0x0018	-	-	-	-	-	-	-	-	-	-	-
25	0x0019	-	-	-	-	-	-	-	-	-	-	-
26	0x001A	-	-	-	-	-	-	-	-	-	-	-
27	0x001B	-	-	-	-	-	-	-	-	-	-	-
28	0x001C	-	-	-	-	-	-	-	-	-	-	-
29	0x001D	-	-	-	-	-	-	-	-	-	-	-
30	0x001E	Forward Power Alarm Limit (max.)	kW	0x06	0-63	0 kW	63 kW		n/a	n/a	n/a	n/a
31	0x001F	Reflection Power Alarm Limit (max.)	kW	0x06	0-10	0 kW	10 kW		n/a	n/a	n/a	n/a
32	0x0020	LCW Outlet Temperature Limit (max.)	degC	0x06	1001-2065	0 degC	50 degC	25+(Value-1638)/25.5	n/a	n/a	n/a	n/a
33	0x0021	LCW Flow Rate Limit (min.)	L/min	0x06	1154-1775	65 L/min	100 L/min	Value*1/17.745	n/a	n/a	n/a	n/a
...	-	-	-	-	-	-	-	-	-	-	-	-

93	0x005D	Year for Calendar	Year	0x06	15-99	15	99	Value*1	n/a	n/a	n/a	n/a
94	0x005E	Month for Calendar	Month	0x06	1-12	1	12	Value*1	n/a	n/a	n/a	n/a
95	0x005F	Date for Calendar	Date	0x06	1-31	1	31	Value*1	n/a	n/a	n/a	n/a
96	0x0060	Hour for Calendar	Hour	0x06	0-23	0	23	Value*1	n/a	n/a	n/a	n/a
97	0x0061	Minute for Calendar	Minute	0x06	0-59	0	59	Value*1	n/a	n/a	n/a	n/a
98	0x0062	Second for Calendar	Second	0x06	0-59	0	59	Value*1	n/a	n/a	n/a	n/a
99	0x0063	PLC Version	n/a	0x03	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
100	0x0064	480VAC_1 U-V	VAC	0x03	0 -570	> -5%	> +5%		n/a	Interlock	RF/DC: Disable	Default



	Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
101	0x0065	480VAC_2 V-W	VAC	0x03	0 -570	> -5%	> +5%			n/a	Interlock	RF/DC: Disable	Default
102	0x0066	480VAC_3 U-W	VAC	0x03	0 -570	> -5%	> +5%			n/a	Interlock	RF/DC: Disable	Default
103	0x0067	Input Drive Power	dBm	0x03	-15 to +15	n/a	3			n/a	Interlock	RF/DC: Disable	Default
104	0x0068	Forward Power	kW	0x03	0-120	n/a	63 kW			n/a	Interlock	RF/DC: Disable	Default
105	0x0069	Reflected Power	kW	0x03	0-120	n/a	10 kW			n/a	Interlock	RF/DC: Disable	Default
106	0x006A	Humidity Rate	%	0x03	0-755	n/a	n/a	Value/7.548		n/a	n/a	n/a	n/a
107	0x006B	LCW Flow Rate	L/min	0x03	0-1775	65 L/min	n/a	Value/17.745		n/a	Interlock	RF/DC: Disable	Default
108	0x006C	Control Unit Hi A/D Interlock monitor	n/a	0x03	n/a	n/a	n/a	n/a		2^0 : 480VAC_1 U-V 2^1 : 480VAC_1 V-W 2^2 : 480VAC_1U-W 2^3: Input Driver Power 2^4 : Forward Power 2^5 : Reflected Power 2^6: - 2^7: LCW Flow Rate	Interlock	RF/DC: Disable	n/a
109	0x006D	-	-	-	-	-	-	-	-	-	-	-	-
110	0x006E	System Rack Air Temperature	degC	0x03	1000-4060	n/a	50 degC	25+(Value-1638)/25.5		n/a	Interlock	RF/DC: Disable	Default
111	0x006F	LCW Inlet Temperature	degC	0x03	1000-4060	22 degC	34 degC	25+(Value-1638)/25.5		n/a	Interlock	RF/DC: Disable	Default
112	0x0070	LCW Outlet Temperature	degC	0x03	1000-4060	n/a	45 degC	25+(Value-1638)/25.5		n/a	Interlock	RF/DC: Disable	Default
113	0x0071	Heat Exchanger_1 Temperature	degC	0x03	1000-4060	n/a	50 degC	25+(Value-1638)/25.5		n/a	Interlock	RF/DC: Disable	Default
114	0x0072	Heat Exchanger_2 Temperature	degC	0x03	1000-4060	n/a	50 degC	25+(Value-1638)/25.5		n/a	Interlock	RF/DC: Disable	Default
115	0x0073	Control Unit Air Temperature	degC	0x03	1000-4060	n/a	50 degC	25+(Value-1638)/25.5		n/a	Interlock	RF/DC: Disable	Default
116	0x0074	Radial Combiner Temperature	degC	0x03	1000-4060	n/a	50 degC	25+(Value-1638)/25.5		n/a	Interlock	RF/DC: Disable	Default
117	0x0075	-	-	-	-	-	-	-	-	-	-	-	-
118	0x0076	Control Unit Lo A/D Interlock monitor	n/a	0x03	n/a	n/a	n/a	n/a		2^0 : System Rack Air Temperature 2^1 : LCW Inlet Temperature 2^2 : LCW Outlet Temperature 2^3: Heat Exchanger1 Temperature 2^4: Heat Exchanger2 Temperature 2^5: Control Unit Air Temperature 2^6: Radial Combiner Temperature 2^7: --	Interlock	RF/DC: Disable	Default
119	0x0077	-	-	-	-	-	-	-	-	-	-	-	-
120	0x0078	Control Unit	n/a	0x03	0 or 1	n/a	n/a	n/a		0 : OFF	n/a	n/a	n/a

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
		Sub Circuit Breaker Status							1 : ON			
121	0x0079	-	-	-	-	-	-	-	-	-	-	-
122	0x007A	-	-	-	-	-	-	-	-	-	-	-
123	0x007B	-	-	-	-	-	-	-	-	-	-	-
124	0x007C	-	-	-	-	-	-	-	-	-	-	-
125	0x007D	Control Unit I/O_3 Interlock monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0: - 2^1: - 2^2: - 2^3: - 2^4: Thermostat(Transformer) 2^5: - 2^6: -	Interlock	RF/DC: Disable	Default
126	0x007E	Control Unit I/O_1 Warning monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0: Heat Exchanger_1 FAN_1 Rotation Speed 2^1: Heat Exchanger_1 FAN_2 Rotation Speed 2^2: Heat Exchanger_1 FAN_3 Rotation Speed 2^3: Heat Exchanger_1 FAN_4 Rotation Speed 2^4: Heat Exchanger_1 FAN_5 Rotation Speed 2^5: Heat Exchanger_1 FAN_6 Rotation Speed 2^6: Heat Exchanger_1 FAN_7 Rotation Speed	Warning	Notification Only	Remove Cause
127	0x007F	Control Unit I/O_2 Warning monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0: Heat Exchanger_1 FAN_8 Rotation Speed 2^1: Heat Exchanger_2 FAN_1 Rotation Speed 2^2: Heat Exchanger_2 FAN_2 Rotation Speed 2^3: Heat Exchanger_2 FAN_3 Rotation Speed 2^4: Heat Exchanger_2 FAN_4 Rotation Speed 2^5: Heat Exchanger_2 FAN_5 Rotation Speed 2^6: Heat Exchanger_2 FAN_6 Rotation Speed	Warning	Notification Only	Remove Cause

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
128	0x0080	Control Unit I/O_3 Warning monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0: Heat Exchanger_1 FAN_8 Rotation Speed 2^1 : Heat Exchanger_2 FAN_1 Rotation Speed 2^2 : Heat Exchanger_2 FAN_2 Rotation Speed 2^3 : Heat Exchanger_2 FAN_3 Rotation Speed 2^4 : Heat Exchanger_2 FAN_4 Rotation Speed 2^5 : Heat Exchanger_2 FAN_5 Rotation Speed 2^6 : Heat Exchanger_2 FAN_6 Rotation Speed	Warning	Notification Only	Remove Cause
129	0x0081	-	-	-	-	-	-	-	-	-	-	-
130	0x0082	-	-	-	-	-	-	-	-	-	-	-
131	0x0083	Heat Exchanger_1 FAN Rotation Speed_1	rpm	0x03	0 - 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
132	0x0084	Heat Exchanger_1 FAN Rotation Speed_2	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
133	0x0085	Heat Exchanger_1 FAN Rotation Speed_3	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
134	0x0086	Heat Exchanger_1 FAN Rotation Speed_4	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
135	0x0087	Heat Exchanger_1 FAN Rotation Speed_5	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
136	0x0088	Heat Exchanger_1 FAN Rotation Speed_6	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
137	0x0089	Heat Exchanger_1 FAN Rotation Speed_7	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
138	0x008A	Heat Exchanger_1 FAN Rotation Speed_8	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
139	0x008B	Heat Exchanger_2 FAN Rotation Speed_1	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
140	0x008C	Heat Exchanger_2 FAN Rotation Speed_2	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
141	0x008D	Heat Exchanger_2 FAN Rotation Speed_3	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
142	0x008E	Heat Exchanger_2 FAN Rotation Speed_4	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
143	0x008F	Heat Exchanger_2 FAN Rotation Speed_5	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
144	0x0090	Heat Exchanger_2 FAN Rotation Speed_6	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
145	0x0091	Heat Exchanger_2 FAN Rotation Speed_7	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
146	0x0092	Heat Exchanger_2 FAN Rotation Speed_8	rpm	0x03	0 – 4075	5980 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
147	0x0093	Control Unit FAN Rotation Speed_1	rpm	0x03	0 – 4075	5304 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
148	0x0094	Control Unit FAN Rotation Speed_2	rpm	0x03	0 - 4075	5304 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
...	-	-	-	-	-	-	-	-	-	-	-	-
190	0x00BE	Control Unit Communication Wire Error_1 Warning monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : SSA module - Driver 2^1 : SSA module - 00 2^2 : SSA module - 01 2^3 : SSA module - 02 ... 2^14: SSA module - 13 2^15: SSA module – 14	Warning	Notification Only	Remove Cause
191	0x00BF	Control Unit Communication Wire Error_2 Warning monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : SSA module -15 2^1 : SSA module - 16 ... 2^12: SSA module – 27 2^13: SSA module - 28 2^14: SSA module - 29 2^15: SSA module - 30	Warning	Notification Only	Remove Cause
192	0x00C0	-	-	-	-	-	-	-	-	-	-	-
193	0x00C1	-	-	-	-	-	-	-	-	-	-	-
194	0x00C2	Control Unit FPGA Response Error_1 Warning monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : SSA module - Driver 2^1 : SSA module - 00 2^2 : SSA module - 01 2^3 : SSA module - 02 ... 2^13: SSA module - 12 2^14: SSA module - 13 2^15: SSA module – 14	Warning	Notification Only	Remove Cause
195	0x00C3	Control Unit FPGA Response Error_2 Warning monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : SSA module -15 2^1 : SSA module - 16 2^2 : SSA module - 17 2^3 : SSA module -18 ... 2^13: SSA module - 28 2^14: SSA module - 29 2^15: SSA module - 30	Warning	Notification Only	Remove Cause
196	0x00C4	-	-	-	-	-	-	-	-	-	-	-

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
197	0x00C5	-	-	-	-	-	-	-	-	-	-	-
198	0x00C6	-	-	-	-	-	-	-	-	-	-	-
199	0x00C7	Control Unit FPGA Version	n/a	0x03	0.00 - 31.99	n/a	n/a	Value[11:7] + Value[6:0]/100	n/a	n/a	n/a	n/a
200	0x00C8	-	-	-	-	-	-	-	-	-	-	-
201	0x00C9	-	-	-	-	-	-	-	-	-	-	-
202	0x00CA	SSA module - Driver Gain Amplifier Current	A	0x03	0 – 2830	n/a	2.0 A	Value*1.0602 /1000	n/a	Warning	Notification Only	Remove Cause
203	0x00CB	SSA module – Driver Driver Amplifier Current	A	0x03	0 – 2830	n/a	1.5 A	Value*1.0602 /1000	n/a	Warning	Notification Only	Remove Cause
204	0x00CC	SSA module – Driver PS_1 DC Output Current	A	0x03	0 – 3280	n/a	2.2 A	Value*1.0602 /1000	n/a	Warning	Notification Only	Remove Cause
205	0x00CD	SSA module – Driver PS_2 DC Output Current	A	0x03	0 – 2830	n/a	2.0 A	Value*1.0602 /1000	n/a	Warning	Notification Only	Remove Cause
206	0x00CE	-	-	-	-	-	-	-	-	-	-	-
207	0x00CF	-	-	-	-	-	-	-	-	-	-	-
208	0x00D0	-	-	-	-	-	-	-	-	-	-	-
209	0x00D1	SSA module - Driver Hi A/D Warning Monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 :- 2^1 :- 2^2 : Gain Amplifier Current 2^3 : Driver Amplifier Current 2^4 : P.S.1 DC Output Current 2^5 : P.S.2 DC Output Current 2^6 :- 2^7 :-	Warning	Notification Only	Remove Cause
210	0x00D2	SSA module - Driver GAIN AMP Drain Voltage	VDC	0x03	0 – 2640	10 VDC	14 VDC	Value/176	n/a	Warning	Notification Only	Remove Cause
211	0x00D3	SSA module - Driver Driver AMP Drain Voltage	VDC	0x03	0 – 3606	43 VDC	50 VDC	Value*0.01719	n/a	Warning	Notification Only	Remove Cause
212	0x00D4	SSA module – Driver PS_1 DC Output Voltage	VDC	0x03	0 – 2640	10 VDC	14 VDC	Value/176	n/a	Warning	Notification Only	Remove Cause
213	0x00D5	SSA module – Driver PS_2 DC Output Voltage	VDC	0x03	0 – 3606	43 VDC	50 VDC	Value*0.01719	n/a	Warning	Notification Only	Remove Cause
214	0x00D6	-	-	-	-	-	-	-	-	-	-	-
215	0x00D7	SSA module - Driver LCW Heat Sink Temperature	degC	0x03	1000-4060	n/a	60 degC	25+(Value-1638)/25.5	n/a	Warning	Notification Only	Remove Cause
216	0x00D8	SSA module – Driver Air Temperature	degC	0x03	1000-4060	n/a	50 degC	25+(Value-1638)/25.5	n/a	Warning	Notification	Remove

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
											Only	Cause
217	0x00D9	-	-	-	-	-	-		-	-	-	-
218	0x00DA	-	-	-	-	-	-	-	-	-	-	-
219	0x00DB	SSA module - Driver Lo A/D Warning Monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : Gain Amplifier Drain Voltage 2^1 : Driver Amplifier Drain Voltage 2^2 : PS_1 DC Output Voltage 2^3 : PS_2 DC Output Voltage 2^4 : - 2^5 : LCW Heat Sink Temperature 2^6 : SSA Module Air Temperature 2^7 : -	Warning	Notification Only	Remove Cause
220	0x00DC	SSA module - Driver Sub Circuit Breaker Status	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : OFF 1 : ON	n/a	n/a	n/a
221	0x00DD	-	-	-	-	-	-	-	-	-	-	-
222	0x00DE	-	-	-	-	-	-	-	-	-	-	-
223	0x00DF	-	-	-	-	-	-	-	-	-	-	-
224	0x00E0	-	-	-	-	-	-	-	-	-	-	-
225	0x00E1	-	-	-	-	-	-	-	-	-	-	-
226	0x00E2	SSA module - Driver I/O_1 Warning Monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : Thermostat (Heat Sink) 2^1 : Thermostat (Transformer) 2^2 : - 2^3 : - 2^4 : - 2^5 : - 2^6 : -	Warning	Notification Only	Remove Cause
227	0x00E3	SSA module - Driver I/O_2 Warning Monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : FAN_1 Rotation Speed (Transformer) 2^3 : FAN_2 Rotation Speed (Transformer) 2^2 : FAN_ Rotation Speed (SSA) 2^3 : - 2^4 : - 2^5 : - 2^6 : -	Warning	Notification Only	Remove Cause
228	0x00E4	-	-	-	-	-	-	-	-	-	-	-
229	0x00E5	SSA module - Driver Power ON/OFF Monitor	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : OFF 1 : ON	n/a	n/a	n/a
...	-	-	-	-	-	-	-	-	-	-	-	-
238	0x00EE	Transformer Unit_01 FAN Rotation Speed_1-	rpm	0x03	0 – 4075	6080 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
239	0x00EF	Transformer Unit_01 FAN Rotation Speed_2-	rpm	0x03	0 – 4075	6080 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
240	0x00F0	SSA module - Driver FAN Rotation Speed	rpm	0x03	0 – 4075	5304 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
...	-	-	-	-	-	-	-	-	-	-	-	-
299	0x012B	SSA module - Driver FPGA Ver.	n/a	0x03	0.00 - 31.99	n/a	n/a	Value[11:7] + Value[6:0]/100	n/a	n/a	n/a	n/a
300	0x012C	SSA module_00 Forward Output Power	kW	0x03	0-3.6	n/a	n/a		n/a	n/a	n/a	n/a
301	0x012D	SSA module_00 Reflect Power	kW	0x03	0-3.6	n/a	n/a		n/a	n/a	n/a	n/a
302	0x012E	SSA module_00 Device_1 Drain Current	A	0x03	0 – 3694	n/a	50 A	Value*16.2439 /1000	n/a	Warning	Notification Only	Remove Cause
303	0x012F	SSA module_00 Device_2 Drain Current	A	0x03	0 – 3694	n/a	50 A	Value*16.2439 /1000	n/a	Warning	Notification Only	Remove Cause
304	0x0130	SSA module_00 PS_1 DC Output Current	A	0x03	0 – 3694	n/a	44 A	Value*16.2439 /1000	n/a	Warning	Notification Only	Remove Cause
305	0x0131	SSA module_00 PS_2 DC Output Current	A	0x03	0 – 3694	n/a	44 A	Value*16.2439 /1000	n/a	Warning	Notification Only	Remove Cause
306	0x0132	SSA module_00 PS_3 DC Output Current	A	0x03	0 – 3694	n/a	44 A	Value*16.2439 /1000	n/a	Warning	Notification Only	Remove Cause
307	0x0133	-	-	-	-	-	-	-	-	-	-	-
308	0x0134	-	-	-	-	-	-	-	-	-	-	-
309	0x0135	SSA module_00 Hi A/D Warning Monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 :- 2^1 :- 2^2 : Device_1 Drain Current 2^3 : Device_2 Drain Current 2^4 : PS_1 DC Output Current 2^5 : PS_2 DC Output Current 2^6 : PS_3 DC Output Current 2^7 :-	Warning	Notification Only	Remove Cause
310	0x0136	SSA module_00 Drain Voltage	VDC	0x03	0 – 3606	15 VDC	50 VDC	Value*0.01719	n/a	Warning	Notification Only	Remove Cause
311	0x0137	-	-	-	-	-	-	-	-	-	-	-
312	0x0138	SSA module_00 PS_1 DC Output Voltage	VDC	0x03	0 – 3606	15 VDC	50 VDC	Value*0.01719	n/a	Warning	Notification Only	Remove Cause
313	0x0139	SSA module_00 PS_2 DC Output Voltage	VDC	0x03	0 – 3606	15 VDC	50 VDC	Value*0.01719	n/a	Warning	Notification Only	Remove Cause
314	0x013A	SSA module_00 PS_3 DC Output Voltage	VDC	0x03	0 – 3606	15 VDC	50 VDC	Value*0.01719	n/a	Warning	Notification Only	Remove Cause

Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
315	0x013B	SSA module_00 LCW Heat Sink Temperature	degC	0x03	1000 - 4060	n/a	60 degC	25+(Value-1638)/25.5	n/a	Warning	Notification Only	Remove Cause
316	0x013C	SSA module_00 SSA Module Air Temperature	degC	0x03	1000 - 4060	n/a	50 degC	25+(Value-1638)/25.5	n/a	Warning	Notification Only	Remove Cause
317	0x013D		-	-	-	-	-	-	-	-	-	-
318	0x013E		-	-	-	-	-	-	-	-	-	-
319	0x013F	SSA module_00 Lo A/D Warning Monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : SSA Drain Voltage 2^1 :- 2^2 : PS_1 DC Output Voltage 2^3 : PS_2 DC Output Voltage 2^4 : PS_3 DC Output Voltage 2^5 : LCW Heat Sink Temperature 2^6 : SSA Module Air Temperature 2^7 :-	Warning	Notification Only	Remove Cause
320	0x0140	SSA module_00 Sub Circuit Breaker Status	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : OFF 1 : ON	n/a	n/a	n/a
...	-	-	-	-	-	-	-	-	-	-	-	-
326	0x0146	SSA module_00 I/O_1 Warning Monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : Thermostat (Heat Sink) 2^1 :Thermostat (Transformer) 2^2 : PS_1 Alarm 2^3 : PS_2 Alarm 2^4 : PS_3 Alarm 2^5 :- 2^6 :-	Warning	Notification Only	Remove Cause
327	0x0147	SSA module_00 I/O_2 Warning Monitor	n/a	0x03	n/a	n/a	n/a	n/a	2^0 : FAN_1 Rotation Speed (Transformer) 2^1 :FAN_2 Rotation Speed (Transformer) 2^2 :FAN_ Rotation Speed (SSA) 2^3 :- 2^4 :- 2^5 :- 2^6 :-	Warning	Notification Only	Remove Cause
328	0x0148	-	-	-	-	-	-	-	-	-	-	-
329	0x0149	SSA Module_00 Power ON/OFF Monitor	n/a	0x03	0 or 1	n/a	n/a	n/a	0 : OFF 1 : ON	n/a	n/a	n/a
...	-	-	-	-	-	-	-	-	-	-	-	-
338	0x0152	SSA module_00 FAN Rotation Speed_1 (Transformer)	rpm	0x03	0 – 4075	6080 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
339	0x0153	SSA module_00 FAN Rotation Speed_2 (Transformer)	rpm	0x03	0 – 4075	6080 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause
340	0x0154	SSA module_00 FAN Rotation Speed	rpm	0x03	0 – 4075	5304 rpm	n/a	Value*4	n/a	Warning	Notification Only	Remove Cause



Address	Address (Hex)	Description	Unit	Function	Permitted Raw Value	Threshold (Lower)	Threshold (Upper)	Convert to Engineering units	command /status	Error Type	Error Operation	Reset Operation
...	-	-	-	-	-	-	-		-	-	-	
349	0x015D	SSA module_00 FPGA Version	n/a	0x03	0.00 - 31.99	n/a	n/a	Value[11:7] + Value[6:0]/100	n/a	n/a	n/a	n/a

Address	Address(Hex)	Description
350-399	0x015E-0x018F	SSA_0 is as same as Address pattern of SSA Module_01 *SSA_1-30
400-449	0x0190-0x01C1	SSA Module_02
450-499	0x01C2-0x01F3	SSA Module_03
500-549	0x01F4-0x0225	SSA Module_04
550-599	0x0226-0x0257	SSA Module_05
600-649	0x0258-0x0289	SSA Module_06
650-699	0x028A-0x02BB	SSA Module_07
700-749	0x02BC-0x02ED	SSA Module_08
750-799	0x02EE-0x031F	SSA Module_09
800-849	0x0320-0x0351	SSA Module_10
850-899	0x0352-0x0383	SSA Module_11
900-949	0x0384-0x03B5	SSA Module_12
950-999	0x03B6-0x03E7	SSA Module_13
1000-1049	0x03E8-0x0419	SSA Module_14
1050-1099	0x041A-0x044B	SSA Module_15
1100-1149	0x044C-0x047D	SSA Module_16
1150-1199	0x047E-0x04AF	SSA Module_17
1200-1249	0x04B0-0x04E1	SSA Module_18
1250-1299	0x04E2-0x0513	SSA Module_19
1300-1349	0x0514-0x0545	SSA Module_20
1350-1399	0x0546-0x0577	SSA Module_21
1400-1449	0x0578-0x05A9	SSA Module_22
1450-1499	0x05AA-0x05DB	SSA Module_23
1500-1549	0x05DC-0x060D	SSA Module_24
1550-1599	0x060E-0x063F	SSA Module_25
1600-1649	0x0640-0x0671	SSA Module_26
1650-1699	0x0672-0x06A3	SSA Module_27
1700-1749	0x06A4-0x06D5	SSA Module_28
1750-1799	0x06D6-0x0707	SSA Module_29
1800-1849	0x0708-0x0739	SSA Module_30
...	-	-

Address	Address(Hex)	Description
4000	0x0FA0	External Fault 1
4001	0x0FA1	External Fault 2
4002	0x0FA2	External Fault 3
4003	0x0FA3	External Fault 4
4004	0x0FA4	External Fault 5
4005	0x0FA5	External Fault 6
4006	0x0FA6	Internal Fault / 120 VAC Boot-up
4007	0x0FA7	480 VAC 1 (U-V)
4008	0x0FA8	480 VAC 2 (V-W)
4009	0x0FA9	480 VAC 3 (U-W)
4010	0x0FAA	RF Input Power
4011	0x0FAB	Forward Power
4012	0x0FAC	Reflection Power
4013	0x0FAD	-
4014	0x0FAE	LCW Flow Rate
4015	0x0FAF	System Rack Air Temperature
4016	0x0FB0	LCW Inlet Temperature
4017	0x0FB1	LCW Outlet Temperature
4018	0x0FB2	Heat Exchanger 1 Air Temperature
4019	0x0FB3	Heat Exchanger 2 Air Temperature
4020	0x0FB4	Control Unit Air Temperature
4021	0x0FB5	Radial Combiner Temperature
4022	0x0FB6	-
4023	0x0FB7	Control Unit Sub Circuit Breaker
4024	0x0FB8	-
4025	0x0FB9	Thermostat (FAN P.S. Transformer)
4026	0x0FBA	LCW Leak sensor
4027	0x0FBB	Alarm Bus-line (Control Unit Internal Faults)
4028-4031	0x0FBC-0x0FBF	-
4032	0x0FC0	FAN P.S. Alarm
4033	0x0FC1	Communication Wire Error (Controller Unit FPGA)
4034	0x0FC2	FPGA Error (Controller Unit FPGA)



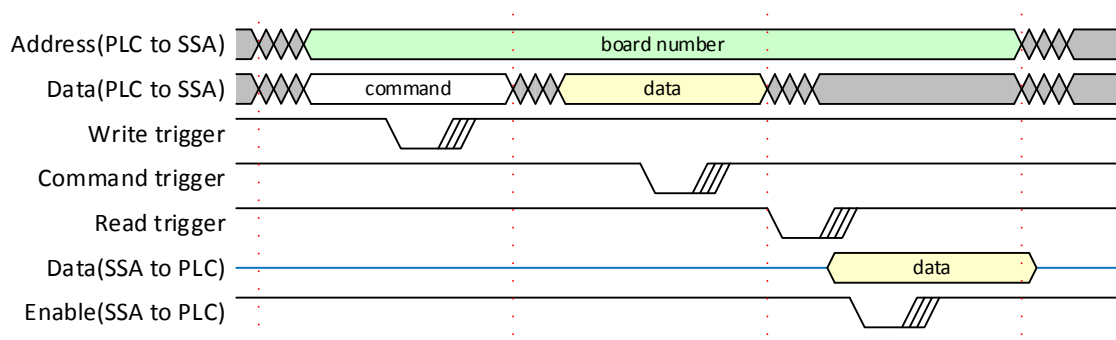


Fig. 4: Writing Sequence

PLC does write action for setting and/or commanding to SSA modules. (see Fig. 4)

PLC accesses to SSA modules by setting write enable after setting address signals, data signals, and data enable.

PLC can access to all SSA modules at the same time by one write action.

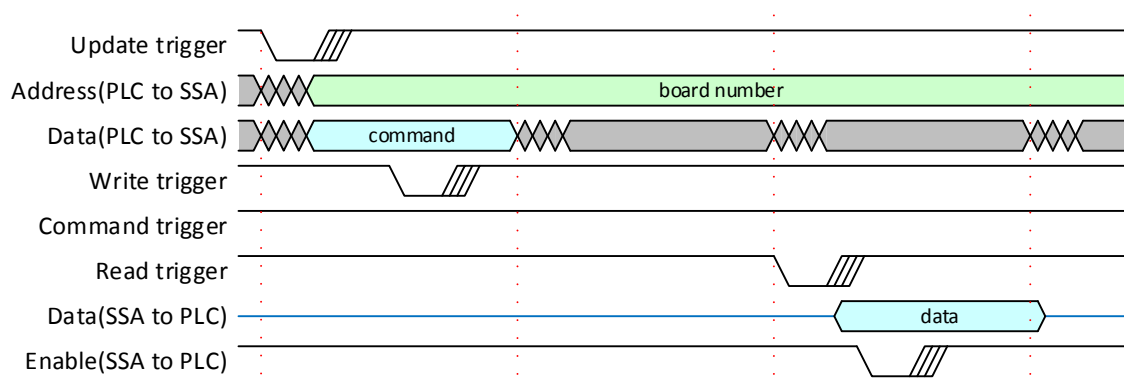


Fig. 5: Reading Sequence

PLC does read action for reading status from SSA modules. (see Fig. 5)

PLC accesses to SSA modules by setting read enable after setting address signals, data signals, and data enable.

PLC can access to 8 SSA modules at the same time by one read action

Update Trigger is provided by PLC in 620 ms period.

### 2.3.3. Display / Recording

Collected data is shown on touch screen and recorded to SD card at the same time. (Recorded data is used when a fault occurs.)

#### 2.3.3.1. Display design and Operation manual

Screen displayed and operating manual are as the followings.

##### (1) Configuration

Configuration Display is displayed after inputting power into the SSA.

It will automatically switch to Information Display after completing all the FPGA Configurations –  
FPGA\_1 (Control Unit), FPGA\_2 (SSA Module\_Driver), and FPGA\_3-33(SSA Module\_0-30).

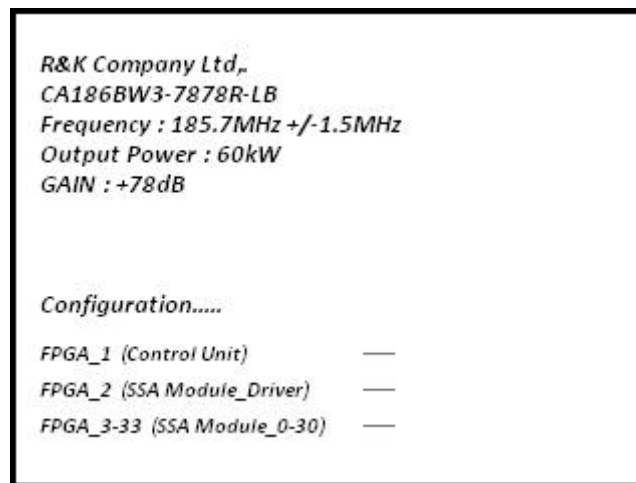


Fig. 6: Screenshot

Table 18: Display contents

No.	parameter	description
1	FPGA_1 (Control Unit)	---- : FPGA Configuration is incomplete.
		Check : FPGA Configuration is completed.
2	FPGA_2 (SSA Module_Driver)	---- : FPGA Configuration is incomplete.
		Check : FPGA Configuration is completed.
3	FPGA_3-33 (SSA Module_0-30)	---- : FPGA Configuration is incomplete.
		Check : FPGA Configuration is completed.

(2) Information Display

This is the screen image of Information Display.

During the normal operation, this is displayed after all the FPGA Configurations are completed.

By pressing the button of each item, the selected item will be displayed.

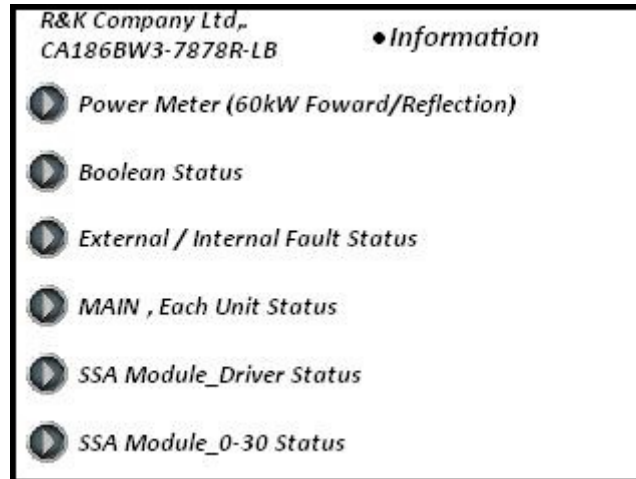


Fig. 7: Screenshot

Table 19: Display contents

No.	parameter	description
1	Power Meter (60kW Forward/Reflection)	By pressing the button, it switches to Power Meter Display.
2	Boolean Status	By pressing the button, it switches to Boolean Status Display.
3	External/Internal Fault Status	By pressing the button, it switches to External/Internal Fault Status Display.
4	MAIN, Each Unit Status	By pressing the button, it switches to MAIN, Each Unit Status Display.
5	SSA Module_Driver Status	By pressing the button, it switches to SSA Module_Driver Status Display.
6	SSA Module_0-30 Status	By pressing the button, it switches to SSA Module_0-30 Status Display.

### (3) Power Meter Display

This is the screen image of Power Meter Display.

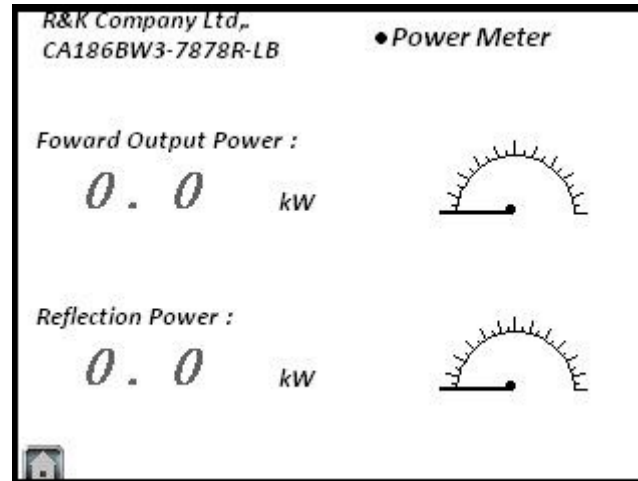


Fig. 8: Screenshot

Table 20: Display contents

No.	parameter	description
1	Forward Output Power	It displays Forward Output Power value in kilowatt (kW).
2	Reflection Power	It displays Reflection Power value in kilowatt (kW).
3	Home button	By pressing the button, it switches to Information Display.



(4) Boolean Status Display – page 1

This is the screen image of Boolean Status\_1 Display.

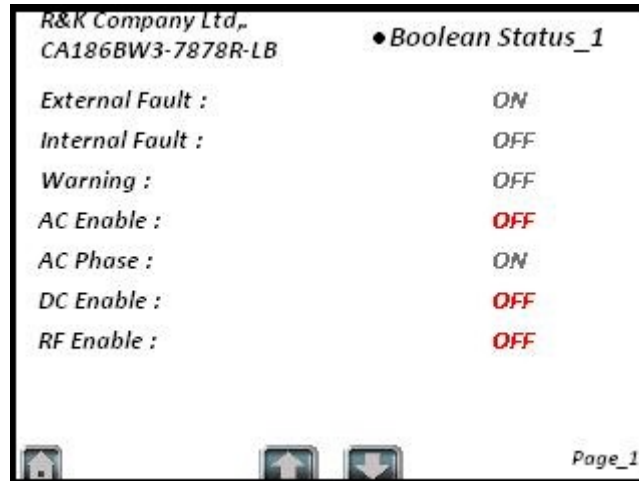


Fig. 9: Screenshot

Table 21: Display contents

No.	parameter	description
1	External Fault	It displays the External Fault status (ON/OFF). When this status is ON, it automatically switches to External Fault Status Display.
2	Internal Fault	It displays the Internal Fault status (ON/OFF). When this status is ON, it automatically switches to Internal Fault Status Display.
3	Warning	It displays the Warning status (ON/OFF). When this status is ON, it automatically switches to MAIN Status Display.
4	AC Enable	It displays the AC Enable status (ON/OFF).
5	AC Phase	It displays the AC Phase status (ON/OFF).
6	DC Enable	It displays the DC Enable status (ON/OFF).
7	RF Enable	It displays the RF Enable status (ON/OFF).
8	Home button	By pressing the button, it switches to Information Display.
9	Page up button	By pressing the button, it switches to Boolean Status_4 Display.
10	Page down button	By pressing the button, it switches to Boolean Status_2 Display.

(5) Boolean Status Display – page 2

This is the screen image of Boolean Status\_2 Display.

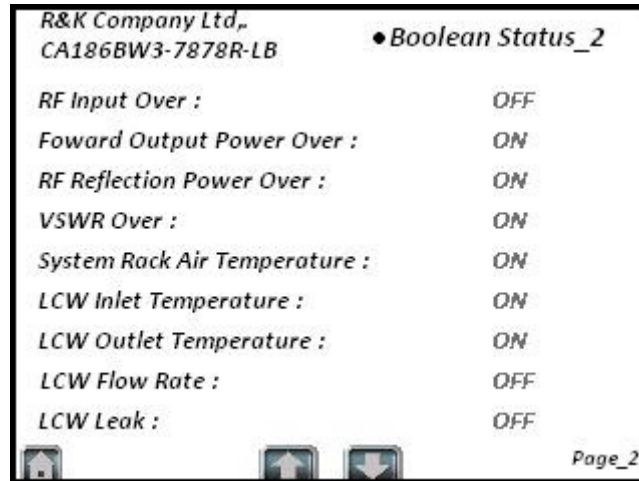


Fig. 10: Screenshot

Table 22: Display contents

No.	parameter	description
1	RF Input Over	It displays the RF Input Over status (ON/OFF).
2	Forward Output Power Over	It displays the Forward Output Power Over status (ON/OFF).
3	RF Reflection Power Over	It displays the RF Reflection Power Over status (ON/OFF).
4	VSWR Over	It displays the VSWR Over status (ON/OFF).
5	System Rock Air Temperature	It displays the System Rock Air Temperature status (ON/OFF).
6	LCW Inlet Temperature	It displays the LCW Inlet Temperature status (ON/OFF).
7	LCW Outlet Temperature	It displays the LCW Outlet Temperature status (ON/OFF).
8	LCW Flow Rate	It displays the LCW Flow Rate status (ON/OFF).
9	LCW Lock	It displays the LCW Lock status (ON/OFF).
10	Home button	By pressing the button, it switches to Information Display.
11	Page up button	By pressing the button, it switches to Boolean Status_1 Display.
12	Page down button	By pressing the button, it switches to Boolean Status_3 Display.

(6) Boolean Status Display – page 3

This is the screen image of Boolean Status\_3 Display.

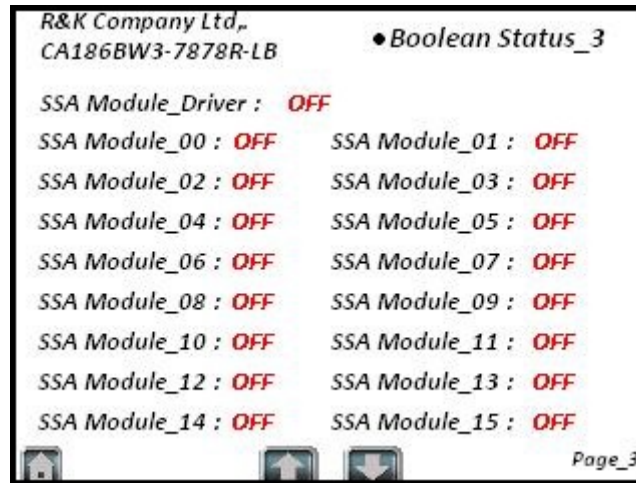


Fig. 11: Screenshot

Table 23: Display contents

No.	parameter	description
1	SSA Module_Driver	It displays the SSA Module_Driver status (ON/OFF).
2	SSA Module_00	It displays the SSA Module_00 status (ON/OFF).
3	SSA Module_01	It displays the SSA Module_01 status (ON/OFF).
4	SSA Module_02	It displays the SSA Module_02 status (ON/OFF).
5	SSA Module_03	It displays the SSA Module_03 status (ON/OFF).
6	SSA Module_04	It displays the SSA Module_04 status (ON/OFF).
7	SSA Module_05	It displays the SSA Module_05 status (ON/OFF).
8	SSA Module_06	It displays the SSA Module_06 status (ON/OFF).
9	SSA Module_07	It displays the SSA Module_07 status (ON/OFF).
10	SSA Module_08	It displays the SSA Module_08 status (ON/OFF).
11	SSA Module_09	It displays the SSA Module_09 status (ON/OFF).
12	SSA Module_10	It displays the SSA Module_10 status (ON/OFF).
13	SSA Module_11	It displays the SSA Module_11 status (ON/OFF).
14	SSA Module_12	It displays the SSA Module_12 status (ON/OFF).
15	SSA Module_13	It displays the SSA Module_13 status (ON/OFF).
16	SSA Module_14	It displays the SSA Module_14 status (ON/OFF).
17	SSA Module_15	It displays the SSA Module_15 status (ON/OFF).
18	Home button	By pressing the button, it switches to Information Display.
19	Page up button	By pressing the button, it switches to Boolean Status_2 Display.
20	Page down button	By pressing the button, it switches to Boolean Status_4 Display.

(7) Boolean Status Display – page 4

This is the image of Boolean Status\_4 Display.

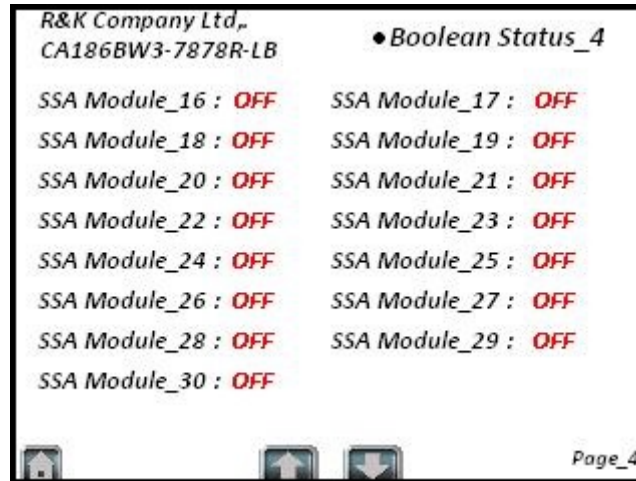


Fig. 12: Screenshot

Table 24: Display contents

No.	parameter	description
1	SSA Module_16	It displays the SSA Module_16 status (ON/OFF).
2	SSA Module_17	It displays the SSA Module_17 status (ON/OFF).
3	SSA Module_18	It displays the SSA Module_18 status (ON/OFF).
4	SSA Module_19	It displays the SSA Module_19 status (ON/OFF).
5	SSA Module_20	It displays the SSA Module_20 status (ON/OFF).
6	SSA Module_21	It displays the SSA Module_21 status (ON/OFF).
7	SSA Module_22	It displays the SSA Module_22 status (ON/OFF).
8	SSA Module_23	It displays the SSA Module_23 status (ON/OFF).
9	SSA Module_24	It displays the SSA Module_24 status (ON/OFF).
10	SSA Module_25	It displays the SSA Module_25 status (ON/OFF).
11	SSA Module_26	It displays the SSA Module_26 status (ON/OFF).
12	SSA Module_27	It displays the SSA Module_27 status (ON/OFF).
13	SSA Module_28	It displays the SSA Module_28 status (ON/OFF).
14	SSA Module_29	It displays the SSA Module_29 status (ON/OFF).
15	SSA Module_30	It displays the SSA Module_30 status (ON/OFF).
16	Home button	By pressing the button, it switches to Information Display.
17	Page up button	By pressing the button, it switches to Boolean Status_3 Display.
18	Page down button	By pressing the button, it switches to Boolean Status_1 Display.

(8) Fault Status Display – page 1

This is the screen image of External Fault Status Display.

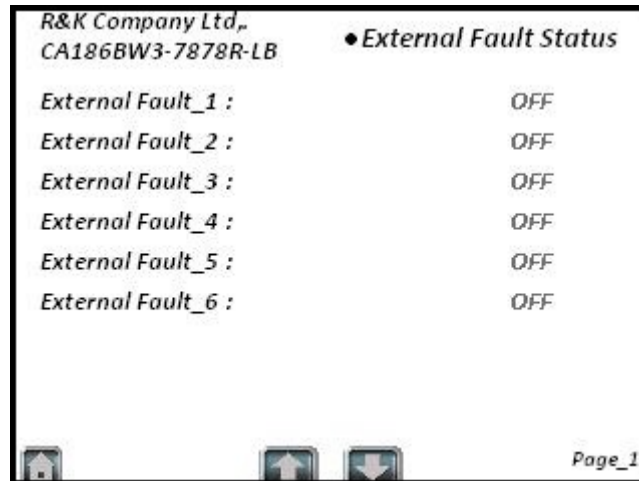


Fig. 13: Screenshot

Table 25: Display contents

No.	parameter	description
1	External Fault_1	It displays the External Fault_1 status (ON/OFF).
2	External Fault_2	It displays the External Fault_2 status (ON/OFF).
3	External Fault_3	It displays the External Fault_3 status (ON/OFF).
4	External Fault_4	It displays the External Fault_4 status (ON/OFF).
5	External Fault_5	It displays the External Fault_5 status (ON/OFF).
6	External Fault_6	It displays the External Fault_6 status (ON/OFF).
7	Home button	By pressing the button, it switches to Information Display.
8	Page up button	By pressing the button, it switches to Internal Fault Status_3 Display.
9	Page down button	By pressing the button, it switches to Internal Fault Status_1 Display.

(9) Fault Status Display – page 2

This is the screen image of Internal Fault Status\_1 Display.

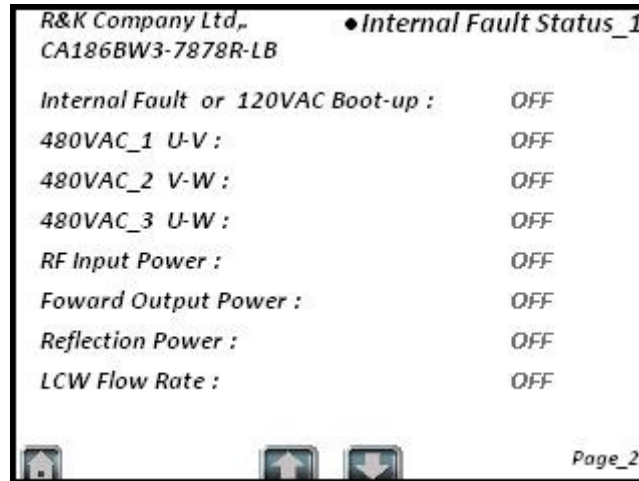


Fig. 14: Screenshot

Table 26: Display contents

No.	parameter	description
1	Internal Fault or 120VAC Boot-up	It displays the Internal Fault or 120VAC Boot-up status (ON/OFF).
2	480VAC_1 U-V	It displays the 480VAC_1 U-V status (ON/OFF).
3	480VAC_1 V-W	It displays the 480VAC_2 V-W status (ON/OFF).
4	480VAC_1 U-W	It displays the 480VAC_3 U-W status (ON/OFF).
5	RF Input Power	It displays the RF Input Power status (ON/OFF).
6	Forward Output Power	It displays the Forward Output Power status (ON/OFF).
7	Reflection Power	It displays the Reflection Power status (ON/OFF).
8	LCW Flow Rate	It displays the LCW Flow Rate status (ON/OFF).
9	Home button	By pressing the button, it switches to Information Display.
10	Page up button	By pressing the button, it switches to External Fault Status Display.
11	Page down button	By pressing the button, it switches to Internal Fault Status_2 Display.

(10) Fault Status Display – page 3

This is the screen image of Internal Fault Status\_2 Display.

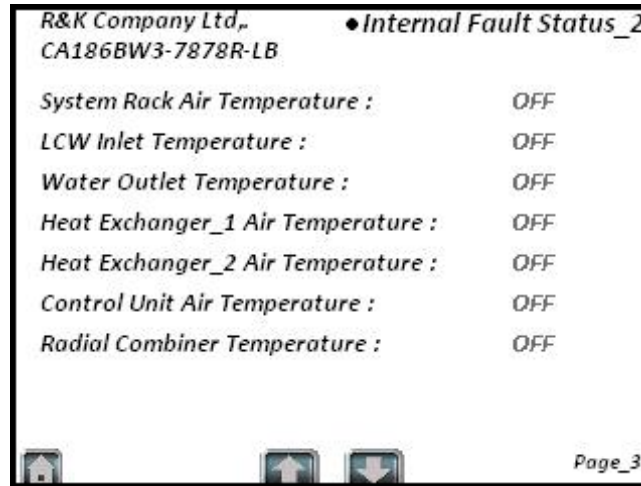


Fig. 15: Screenshot

Table 27: Display contents

No.	parameter	description
1	System Rock Air Temperature	It displays the System Rock Air Temperature status (ON/OFF).
2	LCW Inlet Temperature	It displays the LCW Inlet Temperature status (ON/OFF).
3	Water Outlet Temperature	It displays the Water Outlet Temperature status (ON/OFF).
4	Heat Exchanger_1 Air Temperature	It displays the Heat Exchanger_1 Air Temperature status (ON/OFF).
5	Heat Exchanger_2 Air Temperature	It displays the Heat Exchanger_2 Air Temperature status (ON/OFF).
6	Control Unit Air Temperature	It displays the Control Unit Air Temperature status (ON/OFF).
7	Radial Combiner Temperature	It displays the Radial Combiner Temperature status (ON/OFF).
8	Home button	By pressing the button, it switches to Information Display.
9	Page up button	By pressing the button, it switches to Internal Fault Status_1 Display.
10	Page down button	By pressing the button, it switches to Internal Fault Status_3 Display.

(11) Fault Status Display – page 4

This is the screen image of Internal Fault Status\_3 Display.

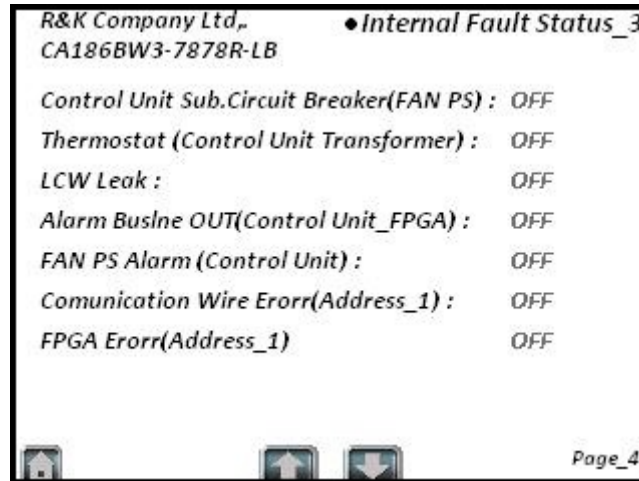


Fig. 16: Screenshot

Table 28: Display contents

No.	parameter	description
1	Control Unit Sub.Circuit Breaker (FAN PS)	It displays the Control Unit Sub.Circuit Breaker status (ON/OFF).
2	Thermostat (Control Unit Transformer)	It displays the Thermostat (Control Unit Transformer) status (ON/OFF).
3	LCW Leak	It displays the LCW Leak status (ON/OFF).
4	Alarm Busline OUT (Control Unit_FPGA)	It displays the Alarm Busline OUT (Control Unit FPGA) status (ON/OFF).
5	FAN PS Alarm (Control Unit)	It displays the FAN PS Alarm (Control Unit) status (ON/OFF).
6	Communication Wire Error (Address_1)	It displays the Communication Wire Error (FPGA Address 1) status (ON/OFF).
7	FPGA Error Address_1	It displays the FPGA Error Address_1 status (ON/OFF).
8	Home button	By pressing the button, it switches to Information Display.
9	Page up button	By pressing the button, it switches to Internal Fault Status_2 Display.
10	Page down button	By pressing the button, it switches to External Fault Status Display.



(12) Main Status Display – page 1

This is the screen image of MAIN Status\_1 Display.

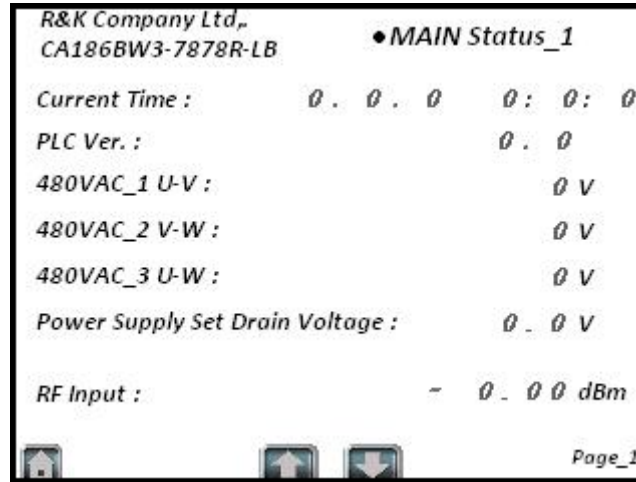


Fig. 17: Screenshot

Table 29: Display contents

No.	parameter	description
1	Current Time	It displays the current time.
2	PLC Ver.	PLC Version Information
3	480VAC_1 U-V	It displays the 480VAC_1 U-V value in volt (V).
4	480VAC_2 V-W	It displays the 480VAC_2 V-W value in volt (V).
5	480VAC_3 U-W	It displays the 480VAC_3 U-W value in volt (V).
6	Power Supply Set Drain Voltage	It displays the Power Supply Set Drain Voltage value in volt (V).
7	RF Input	It displays the RF Input value (dBm).
8	Home button	By pressing the button, it switches to Information Display.
9	Page up button	By pressing the button, it switches to MAIN Status_8 Display.
10	Page down button	By pressing the button, it switches to MAIN Status_2 Display.

(13) Main Status Display – page 2

This is the screen image of MAIN Status\_2 Display.

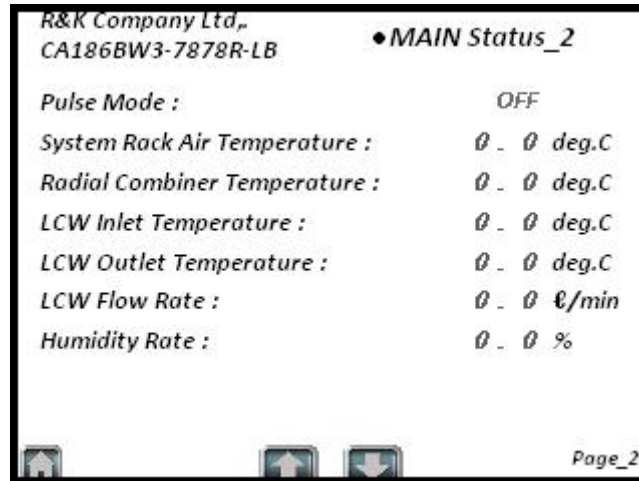


Fig. 18: Screenshot

Table 30: Display contents

No.	parameter	description
1	Pulse Mode	It displays the Pulse Mode status (ON/OFF).
2	System Rack Air Temperature	It displays the System Rack Air Temperature value (deg.C).
3	Radial Combiner Temperature	It displays the Radial Combiner Temperature value (deg.C).
4	LCW Inlet Temperature	It displays the LCW Inlet Temperature value (deg. C).
5	LCW Outlet Temperature	It displays the LCW Outlet Temperature value (deg. C).
6	LCW Flow Rate	It displays the LCW Flow Rate value (ℓ/min).
7	Humidity	It displays the Humidity value (%).
8	Home button	By pressing the button, it switches to Information Display.
9	Page up button	By pressing the button, it switches to MAIN Status_1 Display.
10	Page down button	By pressing the button, it switches to MAIN Status_3 Display.

(14) Main Status Display – page 3

This is the screen image of MAIN Status\_3 Control Unit Display.

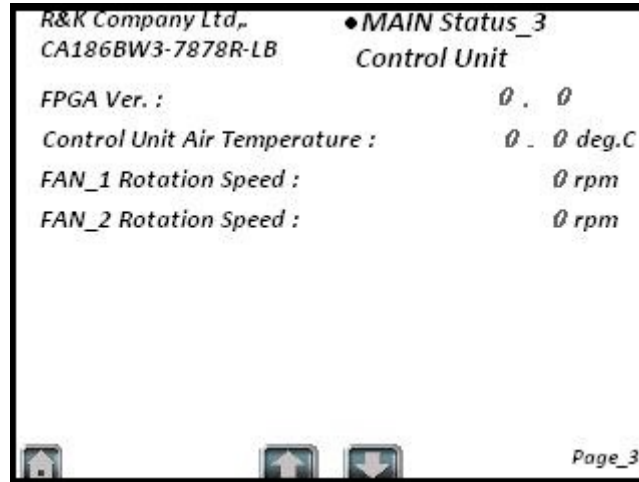


Fig. 19: Screenshot

Table 31: Display contents

No.	parameter	description
1	FPGA Ver.	It displays the FPGA Version Information.
2	Control Unit Air Temperature	It displays the Control Unit Air Temperature value (deg.C).
3	FAN_1 Rotation Speed	It displays the FAN_1 Rotation Speed value (rpm).
4	FAN_2 Rotation Speed	It displays the FAN_2 Rotation Speed value (rpm).
5	Home button	By pressing the button, it switches to Information Display.
6	Page up button	By pressing the button, it switches to MAIN Status_2 Display.
7	Page down button	By pressing the button, it switches to MAIN Status_4 Display.

(15) Main Status Display – page 4

This is the screen image of MAIN Status\_4 Heat Exchanger\_1 Unit Display.

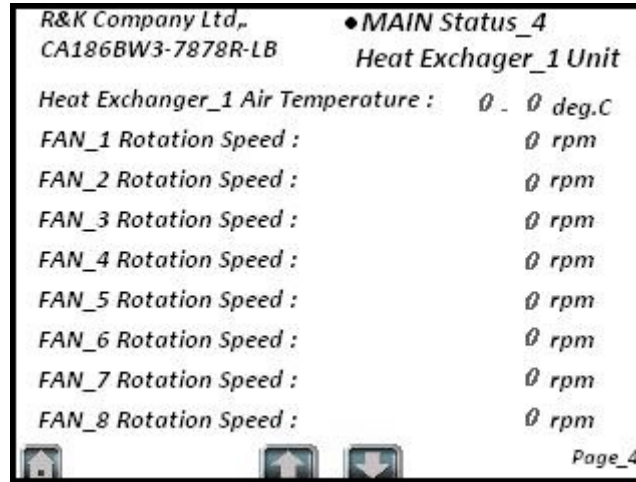


Fig. 20: Screenshot

Table 32: Display contents

No.	parameter	description
1	Hear Exchanger_1 Air Temperature	It displays the Hear Exchanger_1 Air Temperature value (deg.C).
2	FAN_1 Rotation Speed	It displays the FAN_1 Rotation Speed value (rpm).
3	FAN_2 Rotation Speed	It displays the FAN_2 Rotation Speed value (rpm).
4	FAN_3 Rotation Speed	It displays the FAN_3 Rotation Speed value (rpm).
5	FAN_4 Rotation Speed	It displays the FAN_4 Rotation Speed value (rpm).
6	FAN_5 Rotation Speed	It displays the FAN_5 Rotation Speed value (rpm).
7	FAN_6 Rotation Speed	It displays the FAN_6 Rotation Speed value (rpm).
8	FAN_7 Rotation Speed	It displays the FAN_7 Rotation Speed value (rpm).
9	FAN_8 Rotation Speed	It displays the FAN_8 Rotation Speed value (rpm).
10	Home button	By pressing the button, it switches to Information Display.
11	Page up button	By pressing the button, it switches to MAIN Status_3 Display.
12	Page down button	By pressing the button, it switches to MAIN Status_5 Display.

(16) Main Status Display – page 5

This is the screen image of MAIN Status\_5 Heat Exchanger\_2 Unit Display.

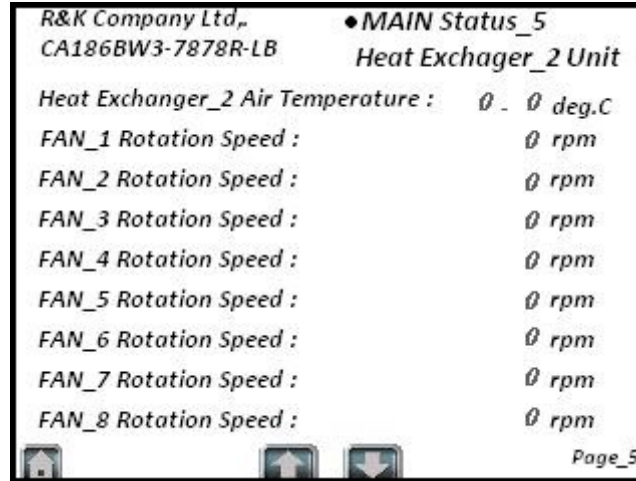


Fig. 21: Screenshot

Table 33: Display contents

No.	parameter	description
1	Hear Exchanger_2 Air Temperature	It displays the Hear Exchanger_1 Air Temperature value (deg.C).
2	FAN_1 Rotation Speed	It displays the FAN_1 Rotation Speed value (rpm).
3	FAN_2 Rotation Speed	It displays the FAN_2 Rotation Speed value (rpm).
4	FAN_3 Rotation Speed	It displays the FAN_3 Rotation Speed value (rpm).
5	FAN_4 Rotation Speed	It displays the FAN_4 Rotation Speed value (rpm).
6	FAN_5 Rotation Speed	It displays the FAN_5 Rotation Speed value (rpm).
7	FAN_6 Rotation Speed	It displays the FAN_6 Rotation Speed value (rpm).
8	FAN_7 Rotation Speed	It displays the FAN_7 Rotation Speed value (rpm).
9	FAN_8 Rotation Speed	It displays the FAN_8 Rotation Speed value (rpm).
10	Home button	By pressing the button, it switches to Information Display.
11	Page up button	By pressing the button, it switches to MAIN Status_4 Display.
12	Page down button	By pressing the button, it switches to MAIN Status_6 Display.

(17) Main Status Display – page 6

This is the screen image of MAIN Status\_6 Control Unit Display.

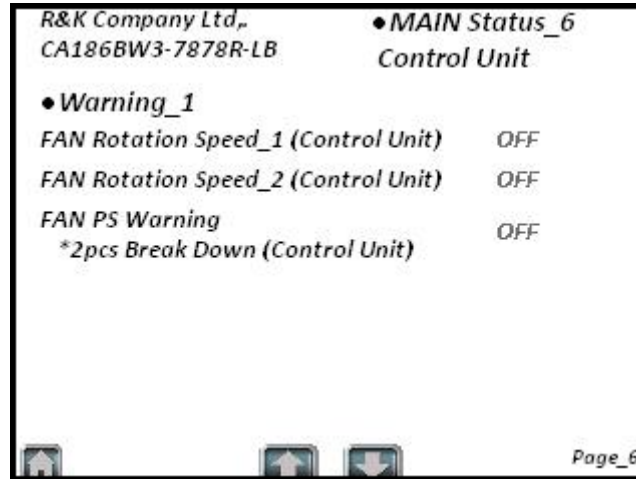


Fig. 22: Screenshot

Table 34: Display contents

No.	parameter	description
1	FAN Rotation Speed_1 (Control Unit)	It displays the FAN_1 Rotation Speed_1 (Control Unit) status (ON/OFF).
2	FAN Rotation Speed_2 (Control Unit)	It displays the FAN_1 Rotation Speed_2 (Control Unit) status (ON/OFF).
3	FAN PS Warning (Control Unit)	It displays the FAN PS Warning (Control Unit) status (ON/OFF).
4	Home button	By pressing the button, it switches to Information Display.
5	Page up button	By pressing the button, it switches to MAIN Status_5 Display.
6	Page down button	By pressing the button, it switches to MAIN Status_7 Display.

(18) Main Status Display – page 7

This is the screen image of MAIN Status\_7 Heat Exchanger\_1 Display.

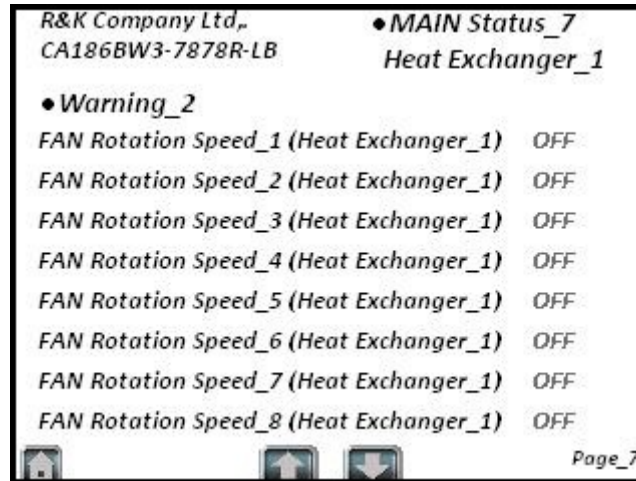


Fig. 23: Screenshot

Table 35: Display contents

No.	parameter	description
1	FAN Rotation Speed_1 (Heat Exchanger_1)	It displays the FAN Rotation Speed_1 (Heat Exchanger_1) status (ON/OFF).
2	FAN Rotation Speed_2 (Heat Exchanger_1)	It displays the FAN Rotation Speed_2 (Heat Exchanger_1) status (ON/OFF).
3	FAN Rotation Speed_3 (Heat Exchanger_1)	It displays the FAN Rotation Speed_3 (Heat Exchanger_1) status (ON/OFF).
4	FAN Rotation Speed_4 (Heat Exchanger_1)	It displays the FAN Rotation Speed_4 (Heat Exchanger_1) status (ON/OFF).
5	FAN Rotation Speed_5 (Heat Exchanger_1)	It displays the FAN Rotation Speed_5 (Heat Exchanger_1) status (ON/OFF).
6	FAN Rotation Speed_6 (Heat Exchanger_1)	It displays the FAN Rotation Speed_6 (Heat Exchanger_1) status (ON/OFF).
7	FAN Rotation Speed_7 (Heat Exchanger_1)	It displays the FAN Rotation Speed_7 (Heat Exchanger_1) status (ON/OFF).
8	FAN Rotation Speed_8 (Heat Exchanger_1)	It displays the FAN Rotation Speed_8 (Heat Exchanger_1) status (ON/OFF).
9	Home button	By pressing the button, it switches to Information Display.
10	Page up button	By pressing the button, it switches to MAIN Status_6 Display.
11	Page down button	By pressing the button, it switches to MAIN Status_8 Display.

(19) Main Status Display – page 8

This is the screen image of MAIN Status\_8 Heat Exchanger\_2 Display.

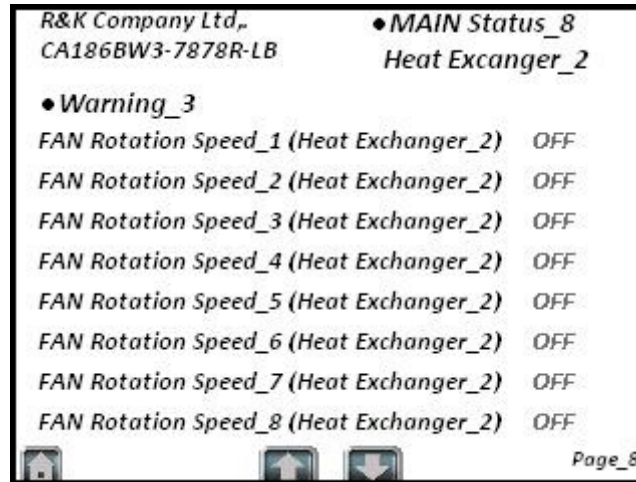


Fig. 24: Screenshot

Table 36: Display contents

No.	parameter	description
1	FAN Rotation Speed_1 (Heat Exchanger_2)	It displays the FAN Rotation Speed_1 (Heat Exchanger_2) status (ON/OFF).
2	FAN Rotation Speed_2 (Heat Exchanger_2)	It displays the FAN Rotation Speed_2 (Heat Exchanger_2) status (ON/OFF).
3	FAN Rotation Speed_3 (Heat Exchanger_2)	It displays the FAN Rotation Speed_3 (Heat Exchanger_2) status (ON/OFF).
4	FAN Rotation Speed_4 (Heat Exchanger_2)	It displays the FAN Rotation Speed_4 (Heat Exchanger_2) status (ON/OFF).
5	FAN Rotation Speed_5 (Heat Exchanger_2)	It displays the FAN Rotation Speed_5 (Heat Exchanger_2) status (ON/OFF).
6	FAN Rotation Speed_6 (Heat Exchanger_2)	It displays the FAN Rotation Speed_6 (Heat Exchanger_2) status (ON/OFF).
7	FAN Rotation Speed_7 (Heat Exchanger_2)	It displays the FAN Rotation Speed_7 (Heat Exchanger_2) status (ON/OFF).
8	FAN Rotation Speed_8 (Heat Exchanger_2)	It displays the FAN Rotation Speed_8 (Heat Exchanger_2) status (ON/OFF).
9	Home button	By pressing the button, it switches to Information Display.
10	Page up button	By pressing the button, it switches to MAIN Status_7 Display.
11	Page down button	By pressing the button, it switches to MAIN Status_1 Display.



(20) SSA Module\_Driver Display – page 1

This is the screen image of SSA Module\_Driver Status\_1 Display.

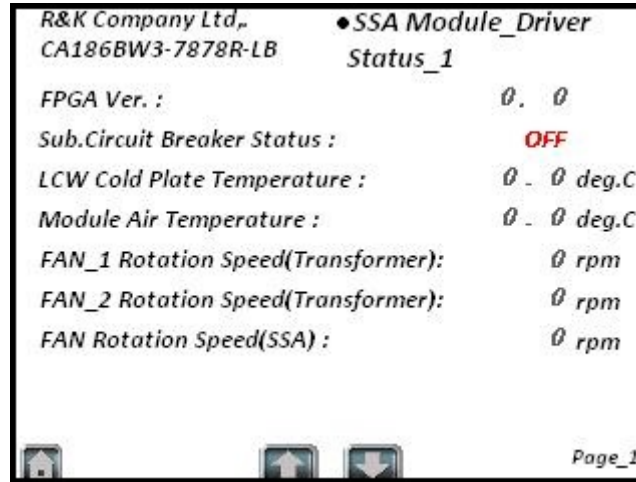


Fig. 25: Screenshot

Table 37: Display contents

No.	parameter	description
1	FPGA Ver.	It displays the FPGA Version Information.
2	Sub.Circuit Breaker Status	It displays the Sub Circuit Breaker Status (ON/OFF).
3	LCW Cold Plate Temperature	It displays the LCW Cold Plate Temperature value (deg.C).
4	Module Air Temperature	It displays the Module Air Temperature value (deg.C).
5	FAN_1 Rotation Speed (Transformer)	It displays the FAN_1 Rotation Speed (Transformer) value (rpm).
6	FAN_2 Rotation Speed (Transformer)	It displays the FAN_2 Rotation Speed (Transformer) value (rpm).
7	FAN Rotation Speed(SSA)	It displays the FAN Rotation Speed (SSA) value (rpm).
8	Home button	By pressing the button, it switches to Information Display.
9	Page up button	By pressing the button, it switches to SSA Module_Driver Status_5 Display.
10	Page down button	By pressing the button, it switches to SSA Module_Driver Status_2 Display.

(21) SSA Module\_Driver Display – page 2

This is the screen image of SSA Module\_Driver Status\_2 Display.

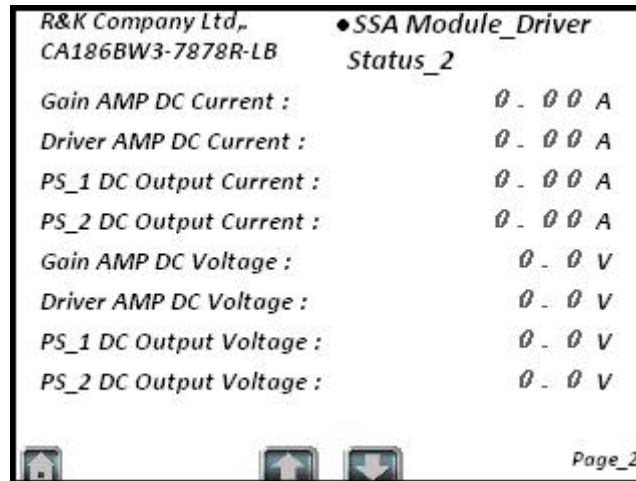


Fig. 26: Screenshot

Table 38: Display contents

No.	parameter	description
1	Gain AMP DC Current	It displays the Gain Amplifier DC Current value (A).
2	Driver AMP DC Current	It displays the Driver Amplifier DC Current value (A).
3	PS_1 DC Output Current	It displays the Power Supply_1 DC Output Current value (A).
4	PS_2 DC Output Current	It displays the Power Supply_2 DC Output Current value (A).
5	Gain AMP DC Voltage	It displays the Gain Amplifier DC Voltage value (A).
6	Driver AMP DC Voltage	It displays the Driver Amplifier DC Voltage value (A).
7	PS_1 DC Output Voltage	It displays the Power Supply_1 DC Output Voltage value (A).
8	PS_2 DC Output Voltage	It displays the Power Supply_2 DC Output Voltage value (A).
9	Home button	By pressing the button, it switches to Information Display.
10	Page up button	By pressing the button, it switches to SSA Module_Driver Status_1 Display.
11	Page down button	By pressing the button, it switches to SSA Module_Driver Status_3 Display.

(22) SSA Module\_Driver Display – page 3

This is the screen image of SSA Module\_Driver Status\_3 Display.

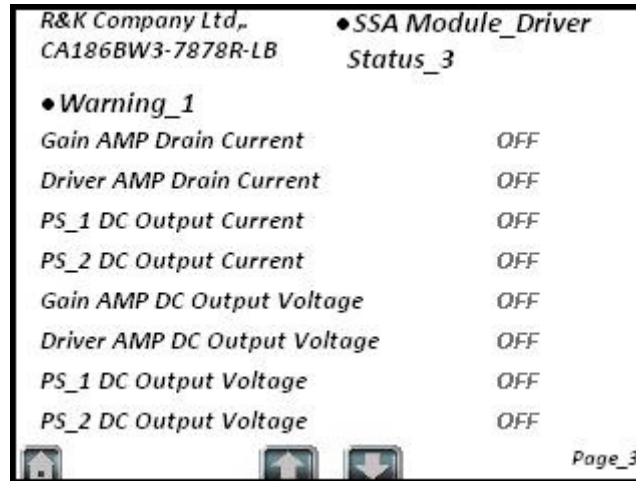


Fig. 27: Screenshot

Table 39: Display contents

No.	parameter	description
1	Gain AMP DC Current	It displays the Gain Amplifier DC Current status (ON/OFF).
2	Driver AMP DC Current	It displays the Driver Amplifier DC Current status (ON/OFF).
3	PS_1 DC Output Current	It displays the Power Supply_1 DC Output Current status (ON/OFF).
4	PS_2 DC Output Current	It displays the Power Supply_2 DC Output Current status (ON/OFF).
5	Gain AMP DC Voltage	It displays the Gain Amplifier DC Voltage status (ON/OFF).
6	Driver AMP DC Voltage	It displays the Driver Amplifier DC Voltage status (ON/OFF).
7	PS_1 DC Output Voltage	It displays the Power Supply_1 DC Output Voltage status (ON/OFF).
8	PS_2 DC Output Voltage	It displays the Power Supply_2 DC Output Voltage status (ON/OFF).
9	Home button	By pressing the button, it switches to Information Display.
10	Page up button	By pressing the button, it switches to SSA Module_Driver Status_2 Display.
11	Page down button	By pressing the button, it switches to SSA Module_Driver Status_4 Display.

(23) SSA Module\_Driver Display – page 4

This is the screen image of SSA Module\_Driver Status\_4 Display.



Fig. 28: Screenshot

Table 40: Display contents

No.	parameter	description
1	LCW Cold Plate Temperature	It displays the LCW Cold Plate Temperature status (ON/OFF).
2	SSA Module Air Temperature	It displays the SSA Module Air Temperature status (ON/OFF).
3	Thermostat(LCW Cold Plate)	It displays the Thermostat (LCW Cold Plate) status (ON/OFF).
4	Thermostat(Transformer)	It displays the Thermostat (Transformer) status (ON/OFF).
5	Home button	By pressing the button, it switches to Information Display.
6	Page up button	By pressing the button, it switches to SSA Module_Driver Status_3 Display.
7	Page down button	By pressing the button, it switches to SSA Module_Driver Status_5 Display.

(24) SSA Module\_Driver Display – page 5

This is the screen image of SSA Module\_Driver Status\_5 Display.

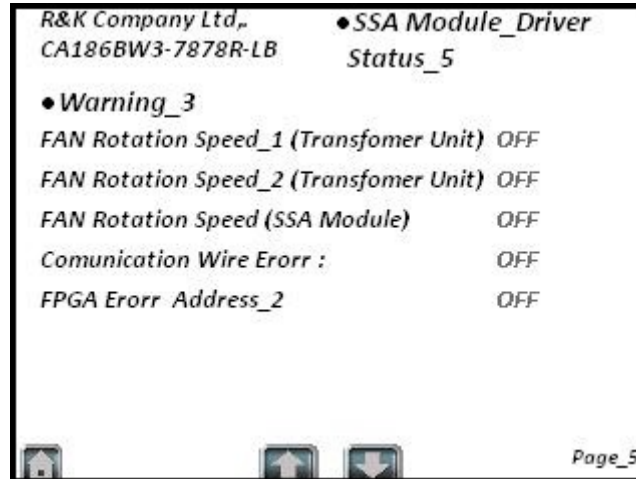


Fig. 29: Screenshot

Table 41: Display contents

No.	parameter	description
1	FAN Rotation Speed_1 (Transformer Unit)	It displays the FAN Rotation Speed_1 (Transformer Unit) status (ON/OFF).
2	FAN Rotation Speed_2 (Transformer Unit)	It displays the FAN Rotation Speed_2 (Transformer Unit) status (ON/OFF).
3	FAN Rotation Speed (SSA Module)	It displays the FAN Rotation Speed (SSA Module) status (ON/OFF).
4	Communication Wire Error	It displays the Communication Wire Error status (ON/OFF).
5	FPGA Error Address_2	It displays the FPGA Error Address_2 status (ON/OFF).
6	Home button	By pressing the button, it switches to Information Display.
7	Page up button	By pressing the button, it switches to SSA Module_Driver Status_4 Display.
8	Page down button	By pressing the button, it switches to SSA Module_Driver Status_1 Display.

(25) SSA Module\_0 Display – page 1

This is the screen image of SSA Module\_0 Status\_1 Display.

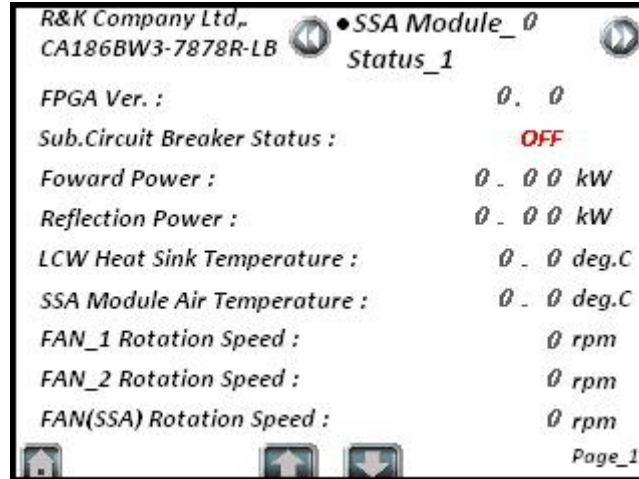


Fig. 30: Screenshot

Table 42: Display contents

No.	parameter	description
1	FPGA Ver.	FPGA Version Information
2	Sub.Circuit Breaker Status	It displays the Sub Circuit Breaker Status (ON/OFF).
3	Forward Power	It displays the Forward Power value (kW).
4	Reflection Power	It displays the Reflection Power value (kW).
5	LCW Heat Sink Temperature	It displays the LCW Heat Sink Temperature value (deg.C).
6	SSA Module Air Temperature	It displays the SSA Module Air Temperature value (deg.C).
7	FAN_1 Rotation Speed	It displays the FAN_1 Rotation Speed value (rpm).
8	FAN_2 Rotation Speed	It displays the FAN_2 Rotation Speed value (rpm).
9	FAN(SSA) Rotation Speed	It displays the FAN (SSA) Rotation Speed status (rpm).
10	Home button	By pressing the button, it switches to Information Display.
11	Page up button	By pressing the button, it switches to SSA Module_0 Status_5 Display.
12	Page down button	By pressing the button, it switches to SSA Module_0 Status_2 Display.

(26) SSA Module\_0 Display – page 2

This is the screen image of SSA Module\_0 Status\_2 Display.

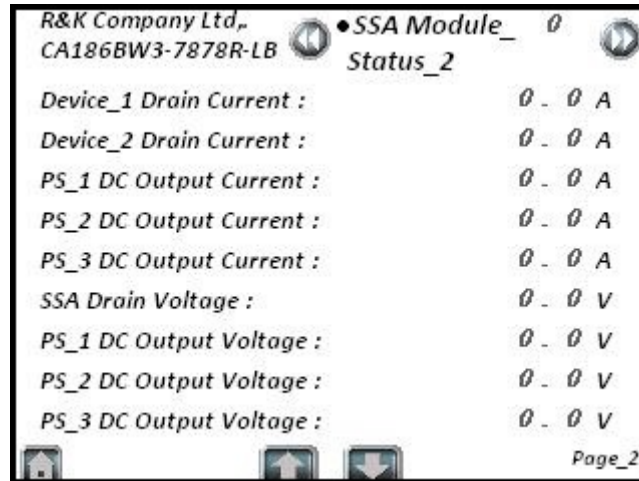


Fig. 31: Screenshot

Table 43: Display contents

No.	parameter	description
1	Device_1 Drain Current	It displays the Device_1 Drain Current value (A).
2	Device_2 Drain Current	It displays the Device_2 Drain Current value (A).
3	PS_1 DC Output Current	It displays the Power Supply_1 DC Output Current value (A).
4	PS_2 DC Output Current	It displays the Power Supply_2 DC Output Current value (A).
5	PS_3 DC Output Current	It displays the Power Supply_3 DC Output Current value (A).
6	SSA Drain Voltage	It displays the SSA Drain Voltage value (A).
7	PS_1 DC Output Voltage	It displays the Power Supply_1 DC Output Voltage value (A).
8	PS_2 DC Output Voltage	It displays the Power Supply_2 DC Output Voltage value (A).
9	PS_3 DC Output Voltage	It displays the Power Supply_3 DC Output Voltage value (A).
10	Home button	By pressing the button, it switches to Information Display.
11	Page up button	By pressing the button, it switches to SSA Module_0 Status_1 Display.
12	Page down button	By pressing the button, it switches to SSA Module_0

		Status_3 Display.
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(27) SSA Module\_0 Display – page 3

This is the screen image of SSA Module\_0 Status\_3 Display.

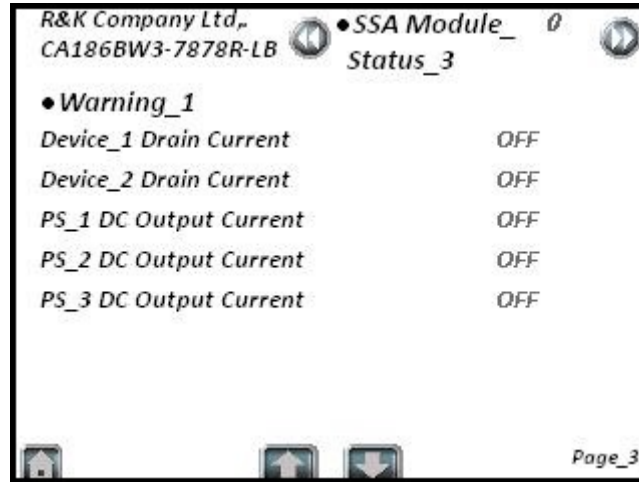


Fig. 32: Screenshot

Table 44: Display contents

No.	parameter	description
1	Device_1 Drain Current	It displays the Device_1 Drain Current status (ON/OFF).
2	Device_2 Drain Current	It displays the Device_2 Drain Current status (ON/OFF).
3	PS_1 DC Output Current	It displays the PS_1 DC Output Current status (ON/OFF).
4	PS_2 DC Output Current	It displays the PS_2 DC Output Current status (ON/OFF).
5	PS_3 DC Output Current	It displays the PS_3 DC Output Current status (ON/OFF).
6	Home button	By pressing the button, it switches to Information Display.
7	Page up button	By pressing the button, it switches to SSA Module_0 Status_2 Display.
8	Page down button	By pressing the button, it switches to SSA Module_0 Status_4 Display.

(28) SSA Module\_0 Display – page 4

This is the screen image of SSA Module\_0 Status\_4 Display.



Fig. 33: Screenshot

Table 45: Display contents

No.	parameter	description
1	SSA Drain Voltage	It displays the SSA Drain Voltage status (ON/OFF).
2	PS_1 DC Output Voltage	It displays the PS_1 DC Output Voltage status (ON/OFF).
3	PS_2 DC Output Voltage	It displays the PS_2 DC Output Voltage status (ON/OFF).
4	PS_3 DC Output Voltage	It displays the PS_3 DC Output Voltage status (ON/OFF).
5	Heat Sink Temperature	It displays the Heat Sink Temperature status (ON/OFF).
6	SSA Module Air Temperature	It displays the SSA Module Air Temperature status (ON/OFF).
7	Thermostat(LCW Heat Sink)	It displays the Thermostat (LCW Heat Sink) status (ON/OFF).
8	Thermostat(Transformer)	It displays the Thermostat (Transformer) status (ON/OFF).
9	Home button	By pressing the button, it switches to Information Display.
10	Page up button	By pressing the button, it switches to SSA Module_0 Status_3 Display.
11	Page down button	By pressing the button, it switches to SSA Module_0 Status_5 Display.

(29) SSA Module\_0 Display – page 5

This is the screen image of SSA Module\_0 Status\_5 Display.

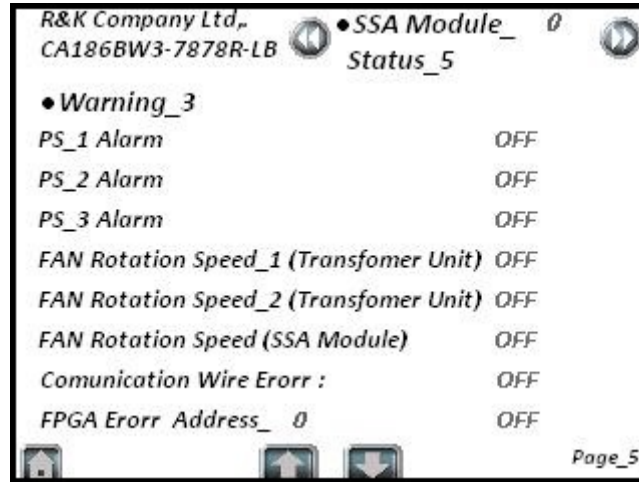


Fig. 34: Screenshot

Table 46: Display contents

No.	parameter	description
1	PS_1 Alarm	It displays the PS_1 DC Output Voltage status (ON/OFF).
2	PS_2 Alarm	It displays the PS_2 DC Output Voltage status (ON/OFF).
3	PS_3 Alarm	It displays the PS_3 DC Output Voltage status (ON/OFF).
4	FAN Rotation Speed_1 (Transformer Unit)	It displays the FAN Rotation Speed_1 (Transformer Unit) status (ON/OFF).
5	FAN Rotation Speed_2 (Transformer Unit)	It displays the FAN Rotation Speed_2 (Transformer Unit) status (ON/OFF).
6	FAN Rotation Speed (SSA Module)	It displays the FAN Rotation Speed (SSA Module) status (ON/OFF).
7	Communication Wire Error	It displays the Communication Wire Error status (ON/OFF).
8	FPGA Error Address_0	It displays the FPGA Response Error Address_0 status (ON/OFF).
9	Home button	By pressing the button, it switches to Information Display.
10	Page up button	By pressing the button, it switches to SSA Module_0 Status_4 Display.
11	Page down button	By pressing the button, it switches to SSA Module_0 Status_1 Display.



## 2.4. Protection Function

### 2.4.1. Interlock Control

Interlock Control works only with hardware without software. When Fault occurs, Interlock Control sets 24V Fault output to lower than 5VDC and shuts the PS control voltage down promptly. Those status can be seen via control interface. Fault information is latched, and also resettable by reset command.

Table 47: 24 V Fault State Definitions

No Fault State Voltage	24 VDC nominal	Range 10.0 – 31.2 VDC
No Fault State Current	Minimum 4.8 mA @10 VDC	Maximum 5.5 mA @31.2 VDC
Fault State	< 5 VDC	< 2.27 mA

### 2.4.2. Warning

In the SSA module, values are set for monitoring items such as current, voltage, temperature, etc. When the measured value exceeds the current value, the warning is notified. These status can be seen via control interface.



#### 3.1.1. Boot up / Reboot

- ① 120VAC Circuit Breaker On
- ② Self-Test
- ③ Configuration Parameter Write/Read-back
- ④ Operational Sequence

System will be initialized by changing the 120VAC Circuit Breaker status from Off to On.

Before the SSA becomes operable, PLC automatically performs the communication cable test and sets parameters to the Passed SSA modules. For the Failed SSA module, it will be processed as Warning without setting a parameter.

When receiving the reboot command, the system will be initialized from Self-Test again.

#### 3.1.2. Change parameter

- ① Operational Sequence
- ② Modbus/TCP command
- ③ Configuration Parameter Write/Read-back
- ④ Operational Sequence

To change parameters from Modbus/TCP, DC must be in Disable state. Any parameter change issued during the operation (DC is in Enable state) are ignored.

#### 3.1.3. Interlock

- ① Operational Sequence
- ② Interlock status happened
- ③ System shut-down
- ④ Fault Reset

When Interlock occurs, the system shuts down. Interlock information will be latched even after the factor of Interlock is removed. Interlock information is released by the Fault Reset command but the Fault Reset command is ignored when the factor of Interlock still exists.

#### 3.1.4. Warning

- ① Operational Sequence
- ② DC Enable command
- ③ Read Status
- ④ Warning status happened
- ⑤ Read Status with warning
- ⑥ Operational Sequence
- ⑦ DC Disable command

### ⑧ Fault Reset

When Warning occurs, the warning information can be read on Warning Monitor via Modbus/TCP. The SSA module continues to operate, but when a warning such as Thermostat etc. occurs, the SSA module stops.

## 3.2. FPGA Flowchart

### 3.2.1. Controller Unit

#### ● Standby

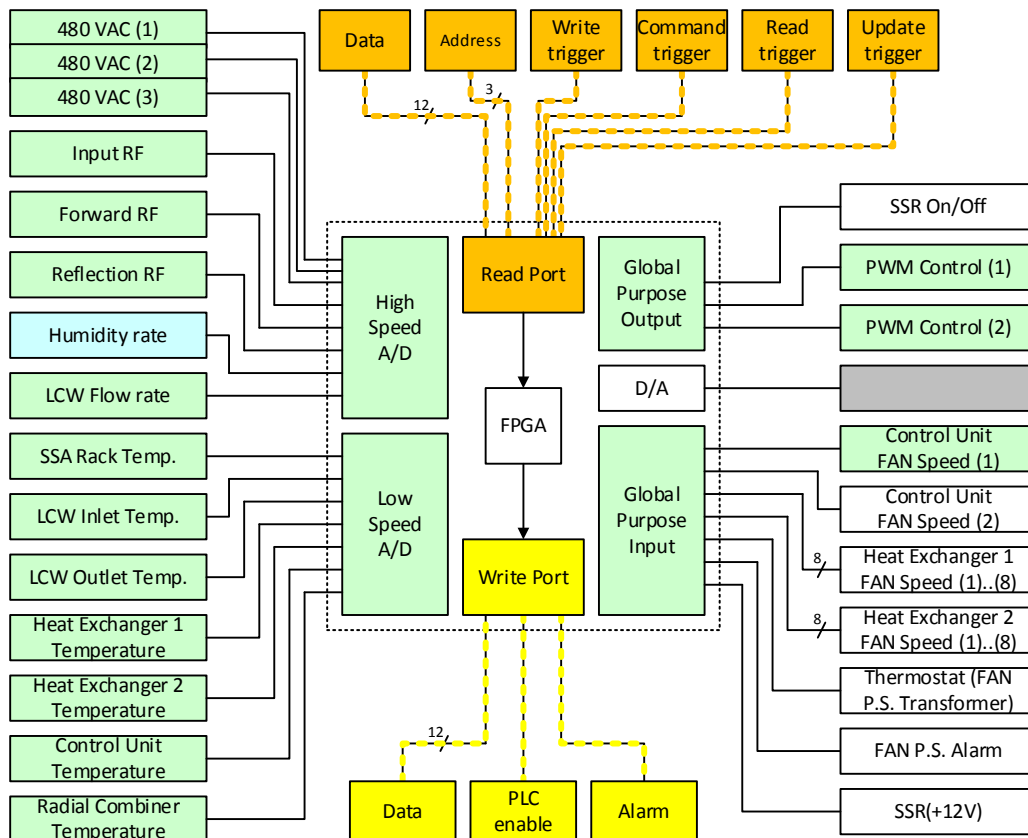


Fig. 36: Controller FPGA (Standby)

- ① Self-Test
- ② Configuration parameter
- ③ Start monitoring and FAN control

When receiving the communication cable test from the PLC to the **Read Port** after turning on the power, it sends the communication cable test from **Write Port** to PLC. Then, it receives each parameter setting from PLC, starts each status monitoring by **High Speed A/D**, **Low Speed A/D**, **Global Purpose Input**, and performs FAN speed control by **PWM Control**.



●

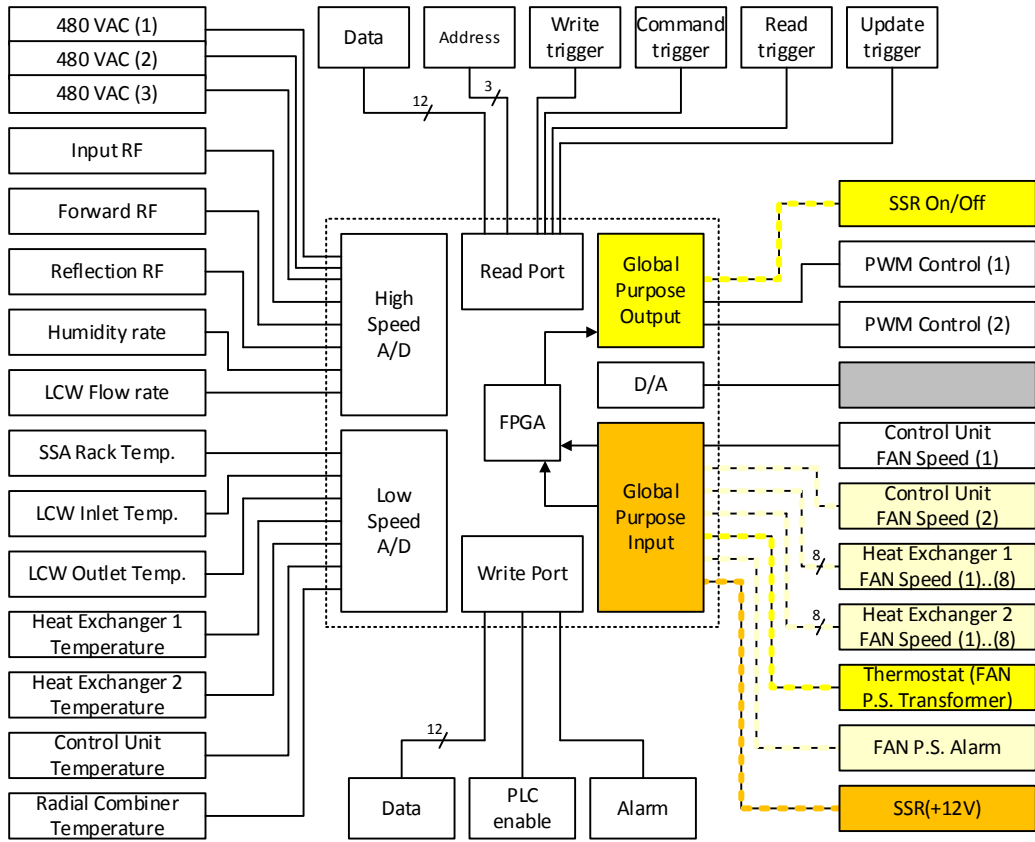


Fig. 37: Controller FPGA (SSR On)

- ① SSR (+12V) enable
- ② SSR On / Start monitoring (thermostat)
- ③ Start monitoring

When **SSR (+12V)** becomes enable, it turns ON the **Solid State Relay** and start monitoring **Thermostat** status. After the SSR becomes ON status, it starts monitoring each **FAN Speed**.

- SSR off

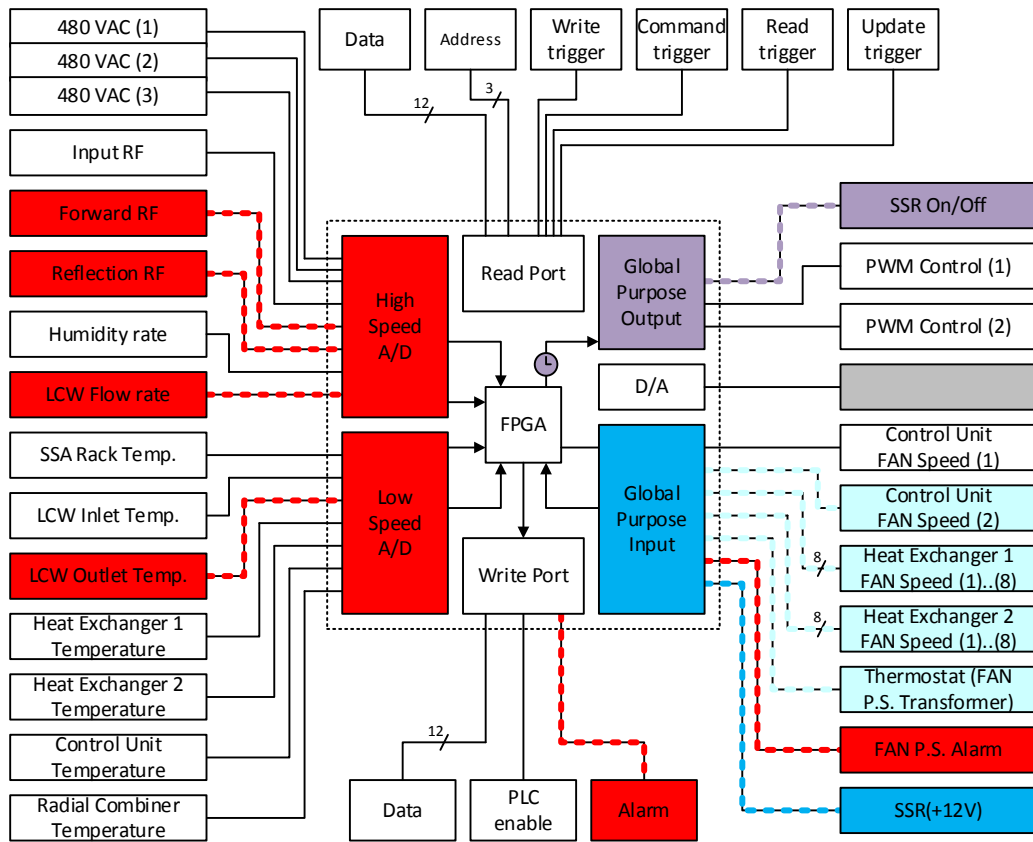


Fig. 38: Controller FPGA (SSR Off)

- ① SSR (+12V) disable / Interlock status happened
- ② SSR Off
- ③ Stop monitoring (FAN Speed)

When **SSR (+12V)** or Interlock status occurs, it turns **Solid State Relay** OFF. If it was in Interlock state, **Alarm** Line also gets enabled. After SSR becomes OFF status, it stops monitoring each **FAN Speed** and **Thermostat**. When Interlock status occurs, the fault information is kept as latched. That information is not reset in Interlock status, but can be reset after the Interlock status is released.

### 3.2.2. DA module

- Standby

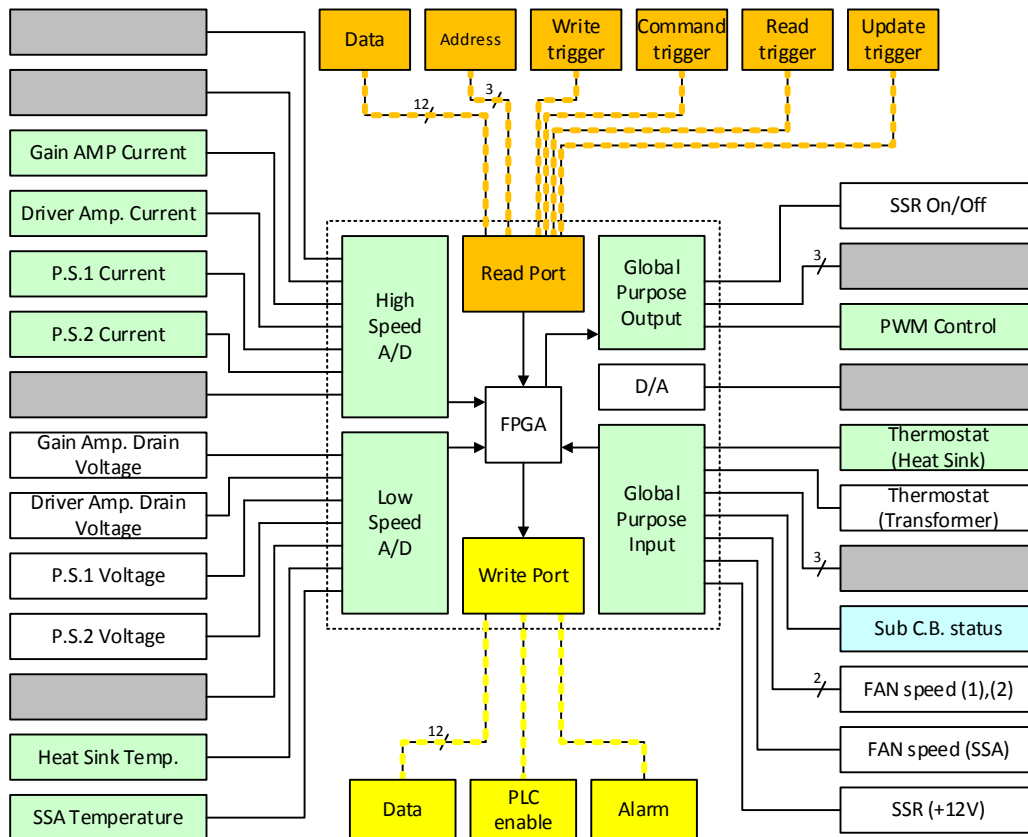


Fig. 39: DA module FPGA (Standby)

- ① Self-Test
- ② Configuration parameter
- ③ Start monitoring and FAN control

When receiving the communication cable test from PLC to **Read Port** after turning on the power, it sends the communication cable test from **Write Port** to PLC. Then, it receives each parameter setting from PLC, starts monitoring each status of **Amplifier Current**, **Power Supply Current**, **Temperature**, **Thermostat (Heat Sink)**, and perform FAN speed control by **PWM Control**.

● SSR On

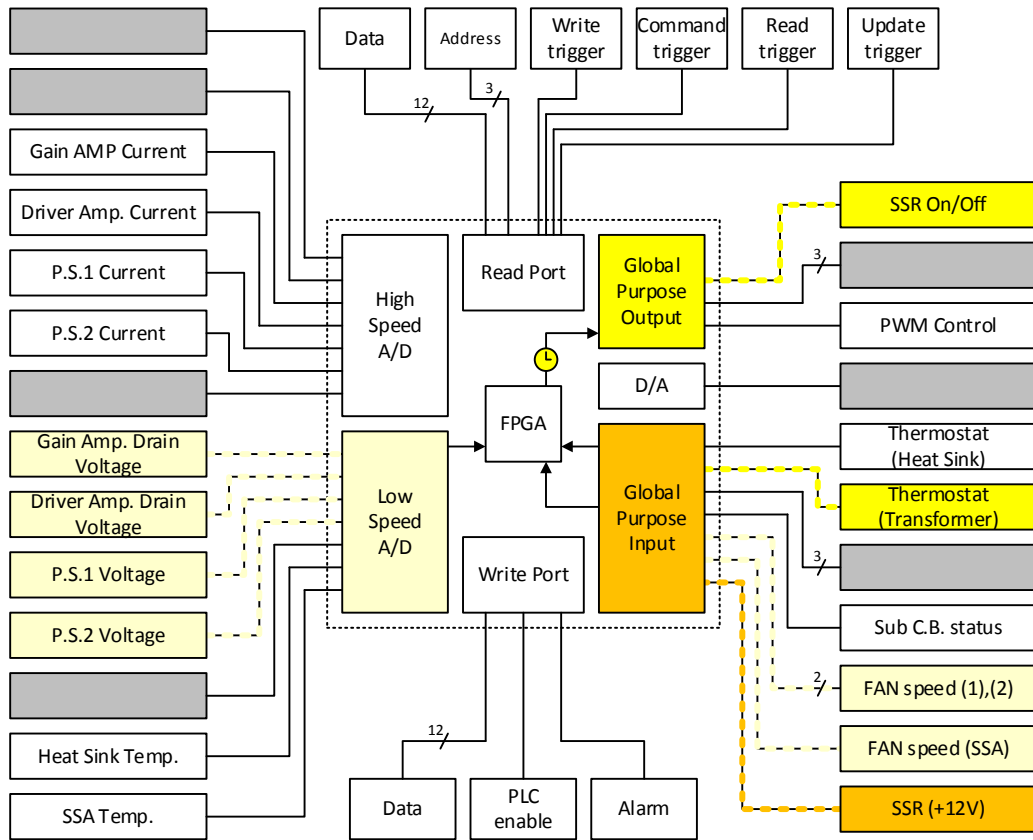


Fig. 40: DA module FPGA (SSR On)

- ① SSR (+12V) enable
- ② SSR On / Start monitoring (thermostat)
- ③ Start monitoring

When **SSR (+12V)** is enabled, **Solid State Relay** is turned ON and start monitoring **Thermostat (Trans.)** status. Monitoring of each FAN Speed, Amplifier Voltage, and Power Supply Voltage is started after Solid State Relay is turned ON.

- SSR Off

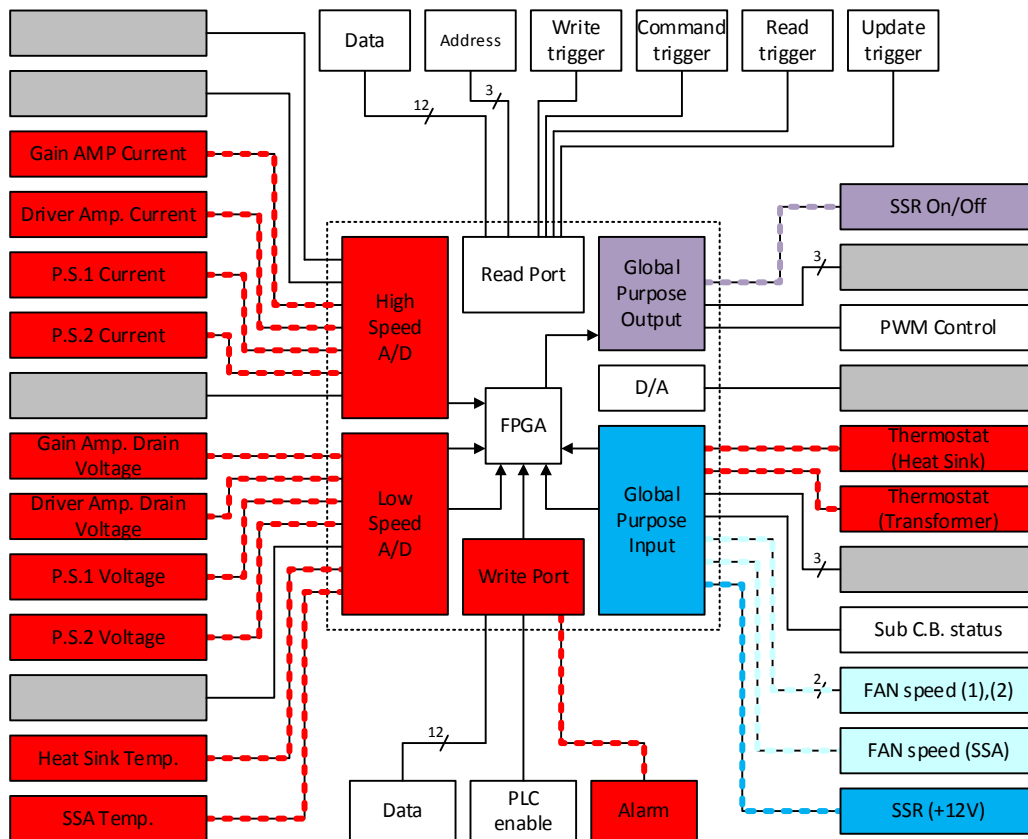


Fig. 41: DA module FPGA (SSR Off)

- ① SSR (+12V) disable / Warning status happened
- ② SSR Off
- ③ Stop monitoring (FAN Speed and Thermostat)

When **SSR (+12V)** disable status occurs or Warning status occurs or **Alarm** (Interlock) line becomes active, **Solid State Relay** is turned OFF. Monitoring of each **FAN Speed**, **Thermostat (Trans.)**, **Amplifier Voltage**, and **Power Supply Voltage** are stopped after **Solid State Relay** is turned OFF. When Warning status occurs, that information is Latched even after Warning status is released.

### 3.2.3. SSA module

- Standby

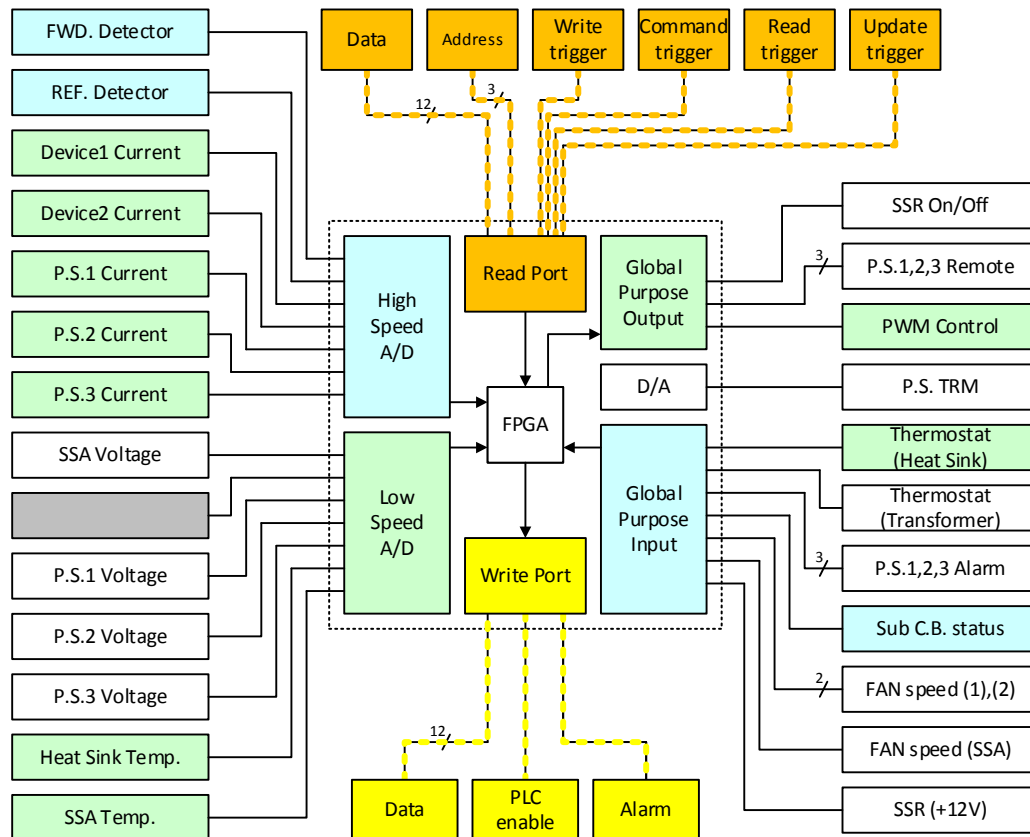


Fig. 42: SSA module FPGA (Standby)

- ① Self-Test
- ② Configuration parameter
- ③ Start monitoring and FAN control

When receiving the communication cable test from the PLC to the **Read Port** after turning on the power, it sends the communication cable test from **Write Port** to PLC. Then, it receives each parameter setting from PLC, starts each status monitoring of **Device Current**, **Power Supply Current**, **Temperature**, **Thermostat (Heat Sink)**, and performs FAN speed control by **PWM Control**.

● SSR On

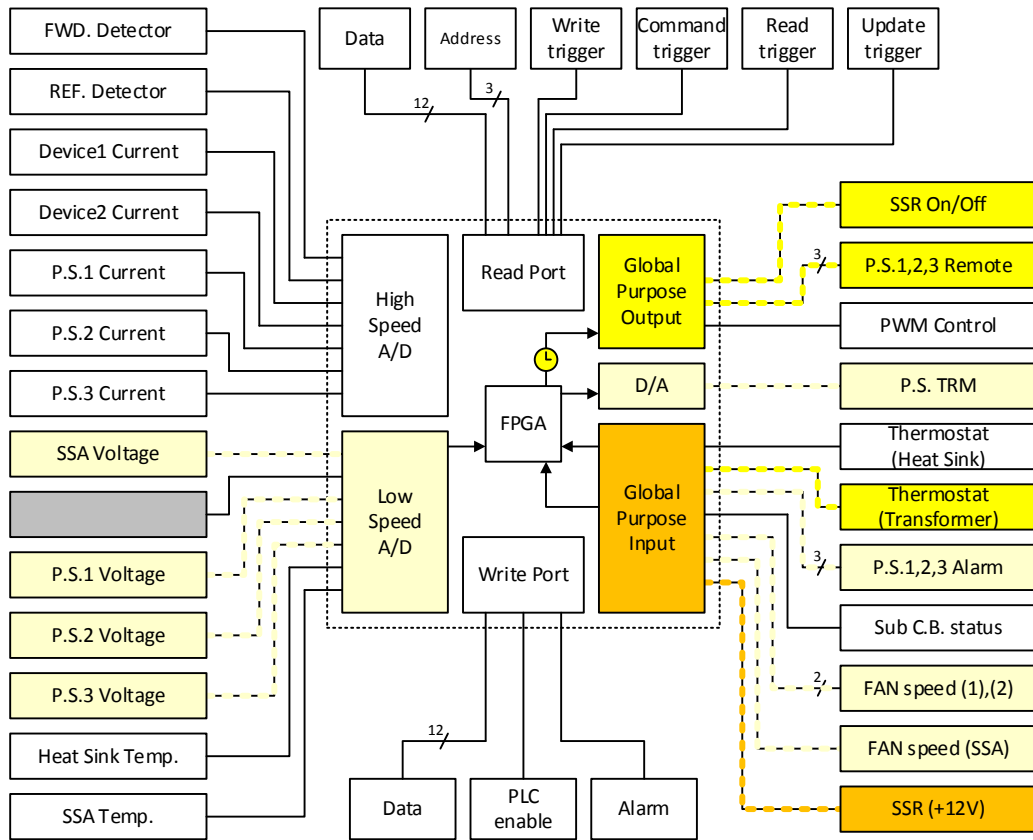


Fig. 43: SSA module FPGA (SSR On)

- ① SSR (+12V) enable
- ② SSR On / Start monitoring (thermostat)
- ③ Start monitoring / Step up P.S. TRM voltage

When **SSR (+12V)** is enabled, **Power Supply Remote** and **Solid State Relay** are turned ON and start monitoring **Thermostat (Trans.)** status. Monitoring of each **FAN Speed**, **Amplifier Voltage**, **Power Supply Voltage**, and **Power Supply Alarm** is started after **Power Supply Remote** and **Solid State Relay** are turned ON. Then voltage of **Power Supply TRM** is increased gradually.

● SSR Off

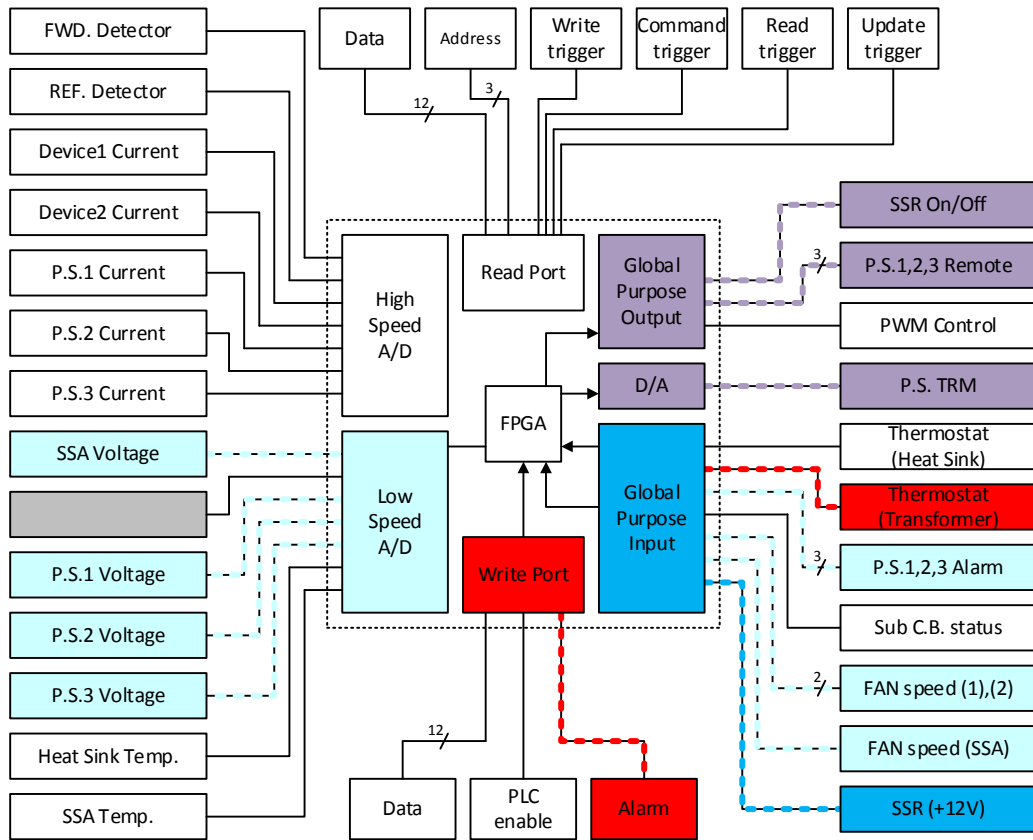


Fig. 44: SSA module FPGA (SSR Off)

- ① SSR (+12V) disable / Warning status happened
- ② SSR Off and P.S. Remote off and P.S. TRM shut off
- ③ Stop monitoring (FAN Speed and Thermostat) / Shut off P.S. TRM voltage

When **SSR (+12V)** disable status occurs or **Thermostat (Trans.)** (Warning) occurs or **Alarm** (Interlock) line becomes active, **Power Supply Remote** and **Solid State Relay** are turned OFF. Monitoring of each **FAN Speed**, **Thermostat (Trans.)**, **Amplifier Voltage**, **Power Supply Voltage**, and **Power Supply Alarm** are stopped after **Power Supply Remote** and **Solid State Relay** are turned OFF. Then, voltage of **Power Supply TRM** is decreased to +0V. When Warning status occurs, that information is Latched even after Warning status is released.



- P.S. Remote off

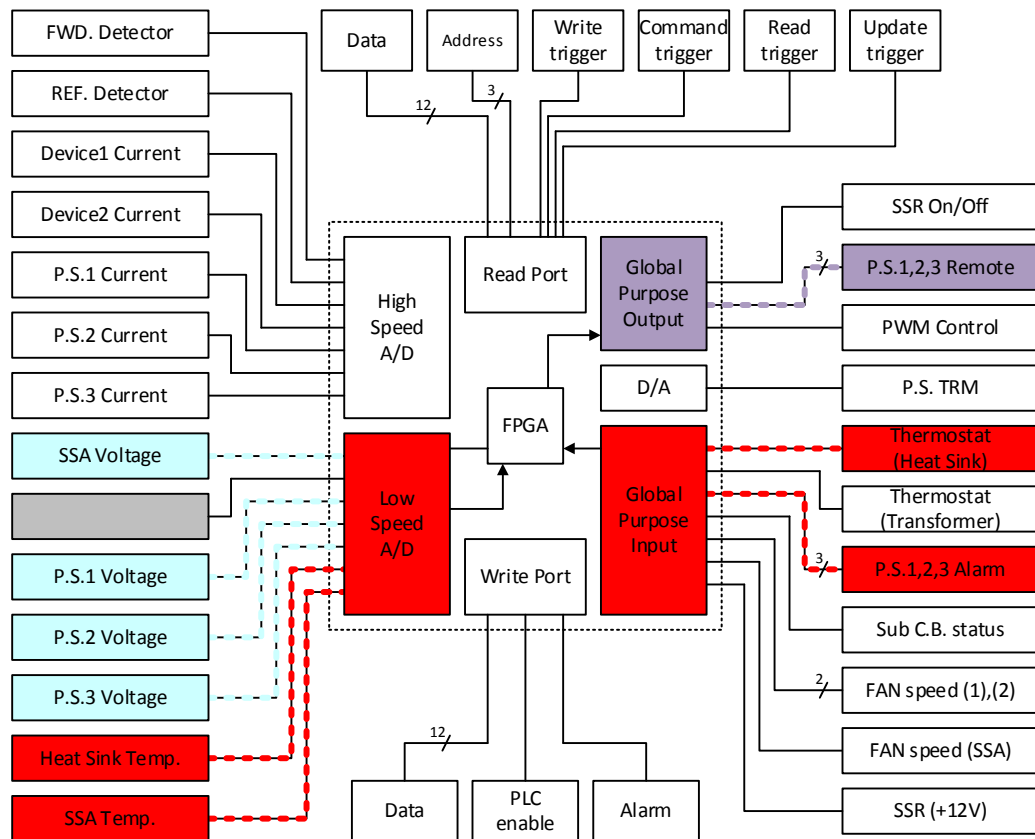


Fig. 45: SSA module FPGA (P.S. Remote off)

- ① Warning status happened
- ② P.S. Remote disable

When Warning of **Thermostat (Heat Sink)**, **Power Supply Alarm**, or each **Temperature** occurs, **Power Supply Remote** is turned OFF. Monitoring of **Amplifier Voltage**, **Power Supply Voltage**, and **Power Supply Alarm** are stopped after **Power Supply Remote** is turned OFF. When Warning status occurs, that information is Latched even after Warning status is released.