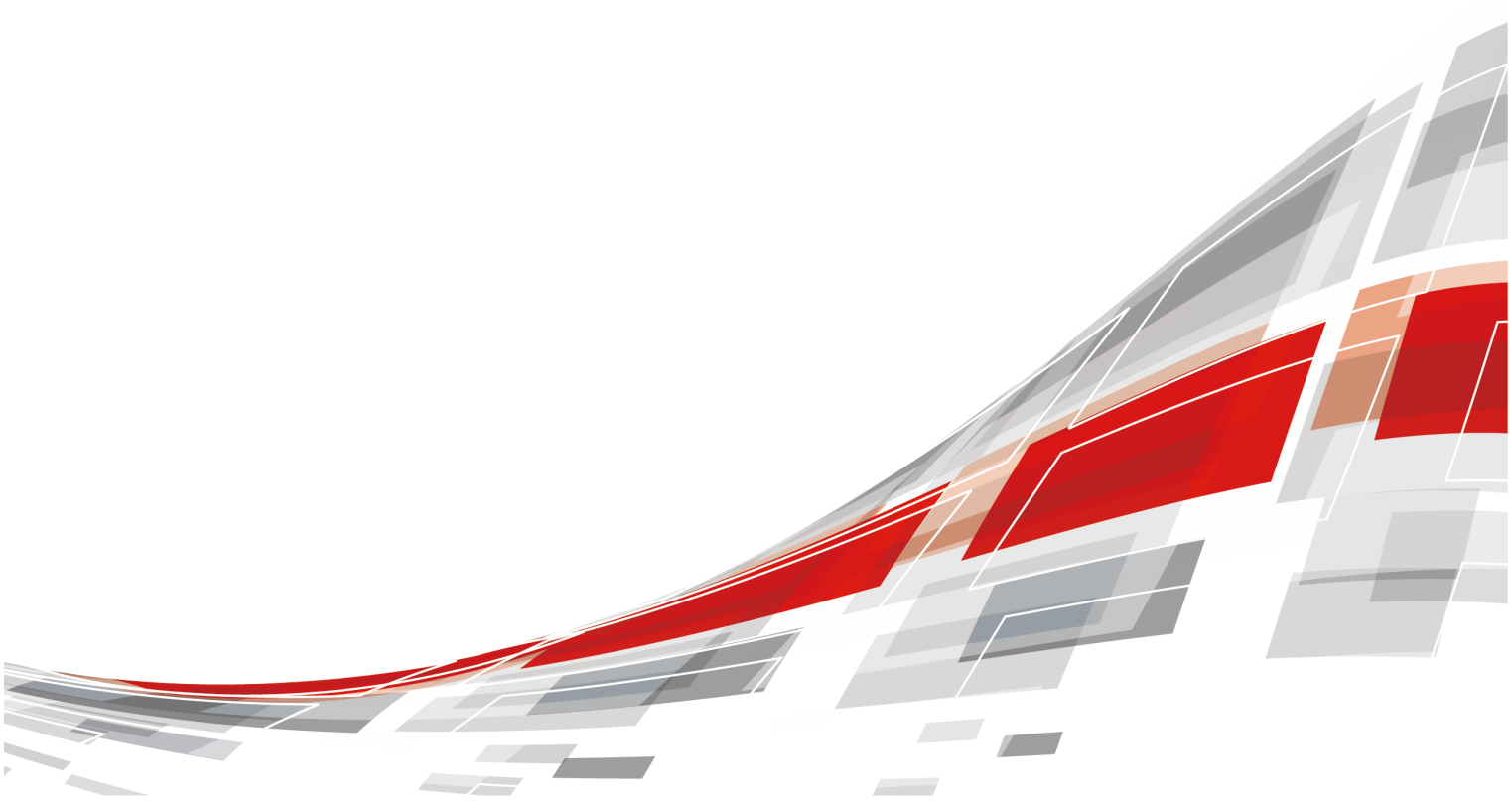
PAC900S12-T1 PSU

Technical Manual

Issue 01

Date 2026-01-20



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About This Document

Purpose

This document describes pins of the PAC900S12-T1 PSU and their application, as well as relevant heat dissipation and storage requirements in detail.

The figures provided in this document are for reference only.

Intended Audience

This document is intended for pre-sales engineers.

Symbol Conventions

The symbols that may be found in this document are defined as follows:

Symbol	Description
DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.
NOTE	Supplements the important information in the main text. NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.

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1 Safety Precautions

1.1 General Safety

1.2 Personnel Requirements

1.3 Electrical Safety

1.1 General Safety

Statement

Before installing, operating, and maintaining the device, read this document and observe all the safety instructions on the device and in this document.

The "NOTICE", "CAUTION", "WARNING", and "DANGER" statements in this document do not cover all the safety instructions. They are only supplements to the safety instructions. xFusion will not be liable for any consequence caused by the violation of general safety requirements or design, production, and usage safety standards.

Ensure that the PSU is used in environments that meet its design specifications. Otherwise, the PSU may become faulty, and the resulting malfunction, component damage, personal injuries, or property damage are not covered by the warranty.

Follow local laws and regulations when installing, operating, and maintaining the PSU. The safety instructions in this document are only supplements to local laws and regulations.

xFusion will not be liable for any consequences of the following circumstances:

- Although the device has passed security and compatibility tests, the radio frequency and magnetic fields emitted from the device may have a negative impact on the operation of other electronic devices. The device may affect normal operation of implanted medical appliances or personal medical appliances, such as pacemakers, cochlear implants, and hearing aids. If such appliances are used, consult the appliance manufacturer about the restrictions for using this device.
- Operation beyond the conditions specified in this document.

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- Installation or use in environments which are not specified in relevant international or national standards.
- Unauthorized modifications to the product or software code or removal of the product.
- Failure to follow the operation instructions and safety precautions on the product and in this document.
- Equipment damage due to force majeure, such as earthquakes, fire, and storms.
- Damage caused during transportation by the customer.
- Storage conditions that do not meet the requirements specified in this document.
- Do not drop, squeeze, or pierce the PSU. Protect the PSU from external high pressure to prevent internal short circuits and overheating.
- Do not disassemble, refit, or insert foreign objects into the PSU, or expose the PSU to water or other liquids, so as to avoid short circuits, overheating, fire, or electric shocks.
- Use the PSU at a temperature ranging from 5°C to 55°C (41°F to 131°F) and store the PSU at a temperature ranging from –40°C to +85°C (-40°F to +185°F).
- Do not expose the PSU to heat sources such as direct sunlight, radiators, microwave ovens, ovens, or water heaters.
- If the PSU is damaged, cracked, or wet, stop using it. Continuing to use it in such conditions may lead to electric shocks, short circuits, or fire.
- Dispose of the PSU in accordance with local regulations. Do not dispose of it as normal household waste. Follow local regulations on disposal of the PSU and its accessories, and support proper collection and recycling.
- Keep the PSU dry. Do not use the PSU in a dusty or damp place. Otherwise, the PSU may be faulty. Do not splash water on the PSU. Keep the PSU far away from fire sources. Do not ignite the PSU.

⚠ WARNING

In a household scenario, operation of this device may cause wireless interference.

Personal Safety

- Do not alter, disassemble, or remove the shell of the PSU.
- If there is a probability of personal injury or PSU damage during operations on the PSU, immediately stop the operations, report the case to the supervisor, and take feasible protective measures.
- Before the installation is completed or confirmed by professionals, do not power on the PSU.

1.2 Personnel Requirements

- Personnel who plan to install, operate or maintain the PSU must receive thorough training, understand all necessary safety precautions, and be able to correctly perform all operations.
- During the installation, operation, and maintenance of the PSU, no collision or drop is allowed.

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- During the secondary assembly of the PSU, do not introduce conductive foreign objects.

1.3 Electrical Safety

Operation Requirements

WARNING

Failure to follow the operating procedures may cause personal injury or even death.

- Only qualified personnel are allowed to perform operations to prevent electric shocks.
- Before installing or removing the PSU, disconnect the upstream power supply to the PSU.
- Before powering on the PSU, ensure that the PSU cables are correctly connected.
- Before making electrical connections, disconnect the upstream power supply to the PSU if people may contact energized components.
- Do not open, alter, or repair the product as the voltage inside the product is high.
- To ensure safety, connect the shell ground and the device ground reliably. When installing the device, install the PGND cable first. When uninstalling the device, remove the PGND cable last.
- Do not operate the PSU with wet hands. Otherwise, electric shocks may occur.
- The voltage between the L or N terminal of the PSU and the PE terminal cannot exceed 318 V AC.
- If any damage or fault occurs during installation or operation, power off the PSU immediately and return it to the manufacturer for inspection or repair.
- In case of emergency, remove the power plug from the power outlet to completely cut off the power supply.
- If the PSU has multiple inputs, disconnect all the inputs to completely power it off before operating the PSU.

ESD

- When installing, operating, and maintaining the PSU, comply with the ESD protection regulations and wear the ESD clothing, gloves, and wrist strap.
- When holding the PSU, hold its edge without touching any components. Do not touch the components with your bare hands.
- Package the removed PSU with ESD packaging materials before storing or transporting it.

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2 Product Overview

The PAC900S12-T1 supports AC input of 90 V to 264 V and HVDC input of 180 V to 300 V. The PSU provides one output and supports three output modes (MV12, SV12 and MV6). The rated output power of MV12 is 900 W, and the rated output power of SV12 is 420 W, and the rated ouput power of MV6 is 60 W.

The power supply is hot-swappable and has the current sharing function. It can be used in parallel in 1+1 or 2+2 mode, and supports active/standby N+R mode. The operating temperature ranges from 0°C to 55°C (32°F to 131°F). The PSU is equipped with a housing and fan module, with forced air cooling for heat dissipation.

The power supply has the functions of input over/under voltage protection, output overvoltage protection, output overcurrent/short circuit protection, overtemperature protection, input fault alarm, and output fault alarm.

The power supply features I^2C communication for reporting the manufacturer, power supply model, and version information. It incorporates black box recording and supports online firmware upgrade on both original and secondary sides. The entire power supply is designed in strict accordance with safety regulations and meets the safety standards of information technology equipment. The final product should obtain certifications of NRTL, TÜV, CCC, CB, and CE.

Figure 2-1 PAC900S12-T1



Model Naming Convention

P	AC	900	S	12	_	T	1
1	2	3	4	5		6	7

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No.	Description	No.	Description
1	Embedded power	2	AC input
3	Output power: 900 W	4	Single output
5	Output voltage: 12 V DC	6	Titanium energy efficiency certification
7	Serial number	-	-

Features

- Efficiency: ≥96.0% (T_A=25°C (77°F); V_{in}=230 V AC; P_{out}=450 W; without fan).
- D x W x H: 183.0 mm x 68.0 mm x 39.0 mm (7.20 in. x 2.68 in. x 1.54 in.).
- Weight: < 2 kg
- Supports input protection for overvoltage and undervoltage. Supports output protection for overvoltage, overcurrent, short circuit, and overtemperature.
- I^2C for controlling, programming, and monitoring.
- AC: NRTL, TÜV, CB, CE, and CCC certification.
- 240 HVDC: NRTL, TÜV, CCC, CB, and CE certification.
- 80 PLUS titanium energy efficiency certification.
- IEC 62368-1 and GB 4943.1 compliant.
- RoHS6 compliant.
- 2002/95/EC compliant.

Application Scenario

Servers

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3 Product Structure Overview

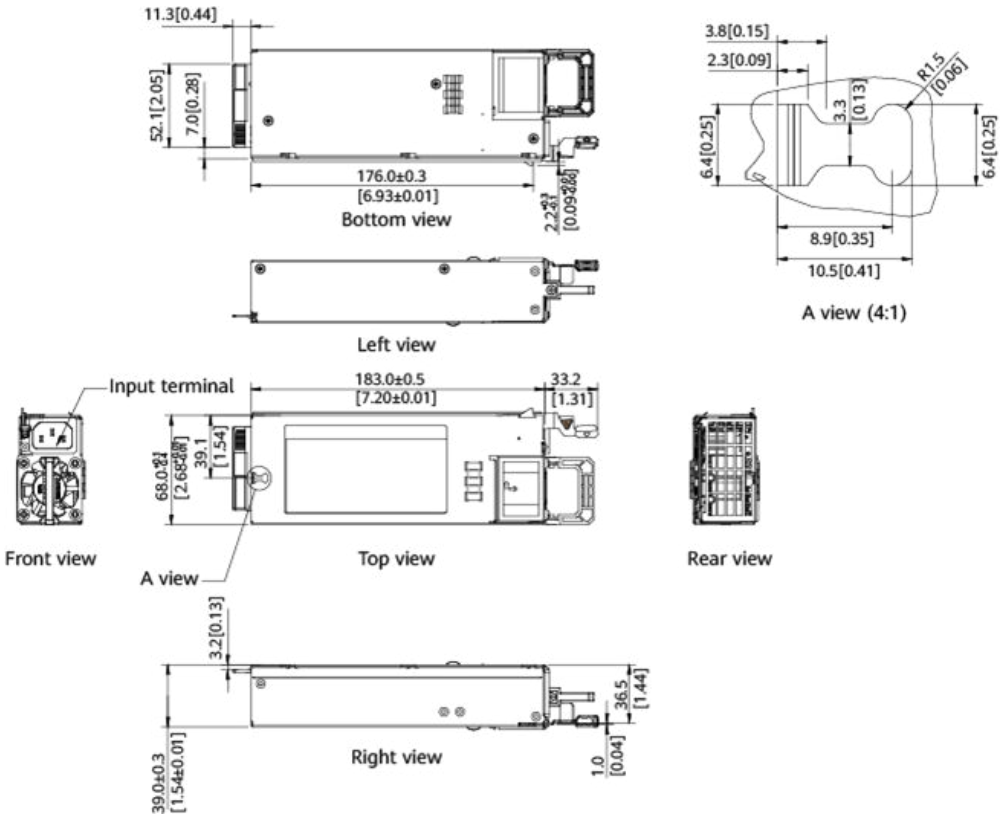
3.1 Dimension

3.2 External Ports

3.1 Dimension

Dimension (D x W x H): 183.0 mm x 68.0 mm x 39 mm (7.20 in. x 2.68 in. x 1.54 in.).

Figure 3-1 Dimension



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3.2 External Ports

Figure 3-2 Output connector (top view)

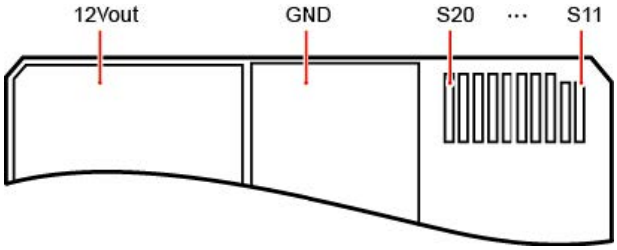


Figure 3-3 Output connector (bottom view)

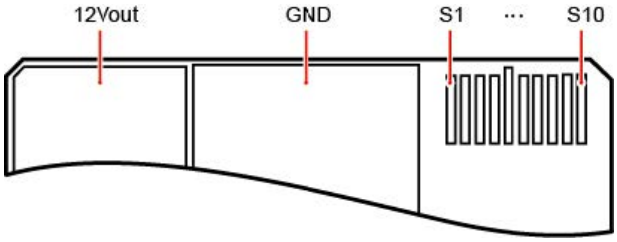


Table 3-1 Output connector pin definitions

Pin	Name	Description	Type
P1-P6, P21-P28	V12	PSU 12 V main output	Output
P7-P20	RTN	PSU output GND	Output
S20	PS_OPOK	Signal for indicating whether the main output is normal	Output
S19	PS_IPOK	Signal for indicating whether the input is normal	Output
S18	IPOK Link	Signal for indicating whether the input of the redundant PSU is normal	Input
S17	SMART_ON	Signal for waking up the cold standby power mode	Input/Output
S16	SHLFBB_SF1	Reserved	-

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Pin	Name	Description	Type
S15	INSTALLED54#	Reserved	-
S14	IP Present	SV12 control signal	Input
S13	PSON 12V#	MV12 remote on/off control signal	Input
S12	INSTALLED#	PSU installation signal	Input
S11	PRESENT#	PSU presence signal	Output
S10	I-MON	Current sharing signal	Input/output
S9	EFUSEV	System E-Fuse voltage	Input
S8	CYC_PWR#	Power supply cycle power	Input
S7	PS_INTR#	PSU alarm interruption signal	Output
S6	SDA	Data cable	Input/output
S5	I2C Sig GND	I^2C signal ground	Output
S4	SCL	Clock cable	Input/output
S3	ADD2	Address cable 2	Input
S2	ADD1	Address cable 1	Input
S1	ADD0	Address cable 0	Input

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4 Schematic Diagram

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5 Electrical Specifications

5.1 Environmental Characteristics
5.2 Input Characteristics
5.3 Output Characteristics
5.4 Efficiency Characteristics
5.5 Protection Characteristics

5.1 Environmental Characteristics

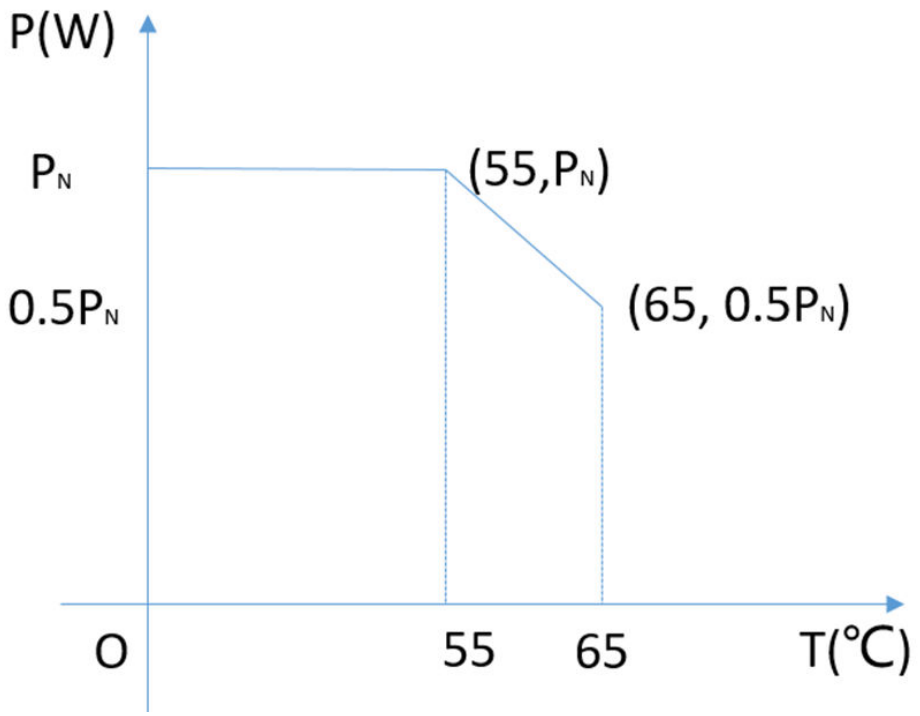
Table 5-1 Environmental parameters

Parameter	Min.	Typical Value	Max.	Unit	Remarks
Operating temperature	0	25	55	℃	• The PSU is able to start at –10°C (14°F), but there are no requirements on the PSU performance. • The power of the power supply is derated at 55°C (131°F) to 65°C (149°F) according to Figure 1. • When the temperature is 65°C (149°F), the PSU can run reliably at half load for a long period of time.
Storage temperature	-40	25	85	℃	-
Relative humidity	5	-	95	%	Non-condensing. The PSU can work properly.

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Parameter	Min.	Typical Value	Max.	Unit	Remarks
Altitude	-60	-	5000	m	According to CCC, it can work at an altitude of 5000 m (16404.2 ft.). When the PSU is not working, it can be placed at an altitude of 15,000 m (49212.6 ft.).
Atmospheric pressure	61	-	106	kPa	The PSU meets the atmospheric pressure at an altitude of 4000 m (13123.36 ft.).
Low atmospheric pressure	-	-	4000	-	• Low-pressure test at 4000 m or 13,123.36 ft (Acceptance criteria: at rated voltage of 230 V AC). • When the altitude ranges from 1800 m to 4000 m (5905.51 ft. to 13,123.36 ft.), the highest operating temperature decreases by 1°C (1.8°F) for every increase of 220 m (721.78 ft.). • Altitude storage test: Not powered-on during low-pressure storage test at 15,000 m (49,212.60 ft.) (tested at -8±°C or 17.6°F)

Figure 5-1 Derating curve of output power with temperature



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5.2 Input Characteristics

Table 5-2 Power input features

Parameter	Unit	Min.	Typical Value	Max.	Remarks
AC input voltage	V AC	90	-	264	-
Rated AC input voltage	V AC	100	230	240	-
240 HVDC input voltage	V DC	180	240	300	● The PSU operates normally under both input polarity conditions: L line is connected to (+), the N line is connected to (-), or the L line is connected to (-), and the N line is connected to (+). Safety certification shall be verified only under the L line connected to (+) and the N line connected to (-). ● The nameplate shows the 240 V DC. ● Before delivery, the HVDC test (240 V DC) must be performed on the PSU to ensure that it works properly at 240 V DC.
AC input frequency	Hz	47	50/60	63	-
THDi (MV12)	%	-	-	-	T_A = 25℃ (77℉), V_{in} = 208 V AC (60 Hz) or 230 V AC (50 Hz), no requirement when load is less than 10% load
		-	-	20	T_A = 25°C (77°F), V_{in} = 208 V AC (60 Hz) or 230 V AC (50 Hz), 10% load
		-	-	10	T_A = 25°C (77°F), V_{in} = 208 V AC (60 Hz) or 230 V AC (50 Hz), 20% load
		-	-	8	T_A = 25°C (77°F), V_{in} = 208 V AC (60 Hz) or 230 V AC (50 Hz), ≥ 30% load

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Parameter	Unit	Min.	Typical Value	Max.	Remarks
		-	-	5	T_A = 25°C (77°F), V_{in} = 208 V AC (60 Hz) or 230 V AC (50 Hz), ≥ 50% load
		-			
THDv	%	-	-	10	The PSU can work properly
Power factor (MV12)	-	0.94	-	-	T_A = 25°C (77°F), V_{in} = 208 V AC (60 Hz), 230 V AC (50 Hz), or 240 V AC (60 Hz), 10% load
	-	0.96	-	-	T_A = 25°C (77°F), V_{in} = 208 V AC (60 Hz), 230 V AC (50 Hz), or 240 V AC (60 Hz), 20% load
	-	0.99	-	-	T_A = 25°C (77°F), V_{in} = 208 V AC (60 Hz), 230 V AC (50 Hz), or 240 V AC (60 Hz), 50% load
Maximum AC input current	A	-	-	5	V_{in} = 200 V AC input at 100% load
Maximum HVDC input current	A	-	-	5	V_{in} = 240 V DC at 100% load
AC input DC bias	mA	-	-	50	Rated input (230 V AC), full load range (take the average value of the parallel test)
Input inrush current	A	-	-	30	ETSI 300 132-3 compliant
Input soft start current (FF feature)	A	-	-	-	Not required
AC input mode	• Supports single-phase three-wire input, that is, 220 V AC single-phase input. • Supports 110 V AC dual-live-wire input. The L and N lines must be connected in series. The connection is shown in **Figure 5-4**.				
Standby power (T_A=25℃)	W	-	-	1	V_{in} = 115 V AC/230 V AC/240 V DC. The fan, output, and PFC are shut down. The PSU works in deep sleep mode (parallel mode).

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Parameter	Unit	Min.	Typical Value	Max.	Remarks
	W	-	-	8	In cold backup scenarios, the standby server is evaluated. V_{in} = 115 V AC/230 V AC/240 V DC. I_{out} = 0 A, the fan works at the lowest rotational speed, and the PSU is in active/cold standby state (parallel mode and MV12 output mode).
Harmonic current	-	-	-	-	Meets the test requirements of class A equipment (TA = 25°C), IEC 61000-3-2, as shown in **Figure 5-2**.
Input overcurrent or short circuit protection	-	-	-	-	If an internal fault occurs in the PSU, the upstream C32 circuit breaker is not allowed to trip.

Figure 5-2 Inrush current standard diagram of ETSI EN 300 132-3

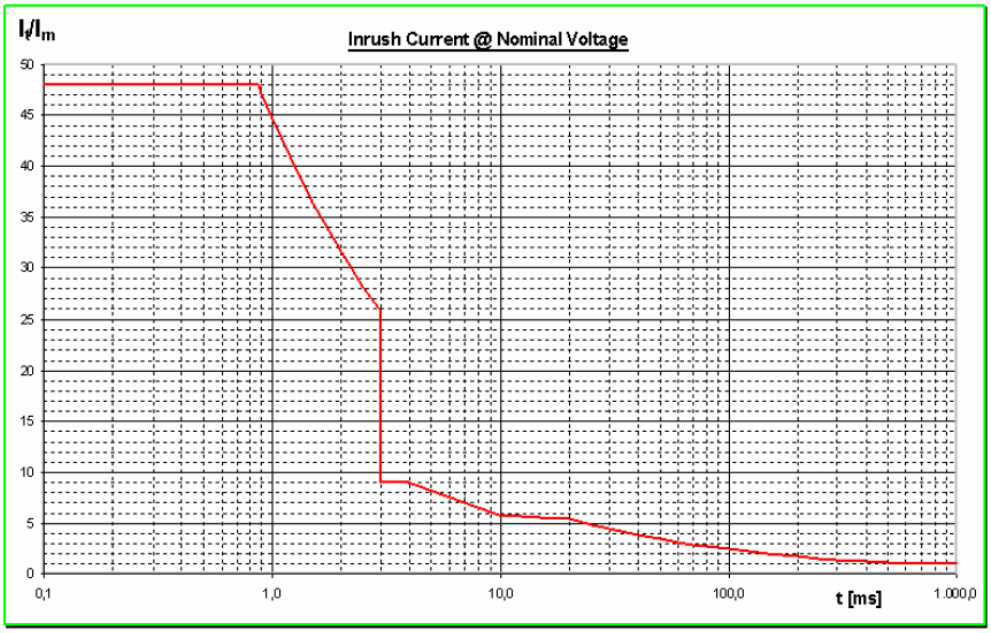


Figure 2: Maximum inrush current ratio characteristics for equipment at nominal voltage and maximum load

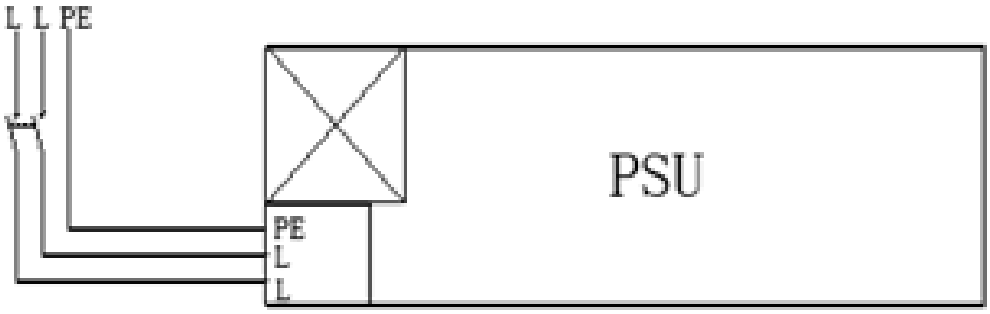
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Figure 5-3 Harmonic current requirements for Class A equipment testing

Tableau 1 – Limites pour les appareils de classe A

Rang harmonique n	Courant harmonique maximal autorisé A
Harmoniques impairs	
3	2,30
5	1,14
7	0,77
9	0,40
11	0,33
13	0,21
$15 \leq n \leq 39$	$0,15\ \frac{15}{n}$
Harmoniques pairs	
2	1,08
4	0,43
6	0,30
$8 \leq n \leq 40$	$0,23\ \frac{8}{n}$

Figure 5-4 Dual-live wire input



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5.3 Output Characteristics

Table 5-3 Output characteristics

Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
Number of outputs	-	-	-	1	-	The power supply has a single output, with three output modes: MV12 (output 12 V), MV6 (output 7.6 V), and SV12 (output 12 V). ● When PSON12V# is at high level, the PSU is in MV6 output mode. ● When PSON12V# is at low level, the PSU is in MV12 output mode. When the PSON12V# signal is at low level, the following working states are presented by the IP PRESENT: ● IP Present signal at high level, the PSU in MV12 output mode. ● IP Present signal at low level, the PSU in SV12 output mode. The power indicator blinks green at 1 Hz. ● IP Present signal detection validity time ≥ 25 ms, power filter time ≥ 10 ms, switching delay ≤ 200 ms (including the detection time).
Output power	MV12	-	-	900	W	176V AC~264V AC\180V DC~300V DC
		-	-	450		90V AC~176V AC
	SV12	-	-	420		**Same as above**
	MV6	-	-	60		**Same as above**
Output voltage setpoint	MV12/ SV12	12.27	12.30	12.33	V DC	T_A = 25°C, rated input (230 V AC/240 V DC) I_{out} = 3 A
	MV6	7.3	7.6	7.9		

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Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
Output voltage	MV12/ SV12	11.7	-	12.60	V DC	From no load to full load.
	MV6	6.4	7.6	8.20		From no load to full load. The output voltage ranges from 6.0 V DC to 8.2 V DC during the insertion or removal.
Output current	MV12	3	-	75	A	90V AC-264V AC\180V DC-300V DC maximum power ≤ 900 W
	SV12	0.4	-	35		5 W output at minimum load current.
	MV6	0.8	-	10		5 W output at minimum load current.
Energy efficiency certification	-	-	-	Titanium	-	Comply with 80 PLUS titanium certification. (230 V AC test; if the test cannot be sent, the titanium certification capability must be obtained, and the internal self-test report and GSTC energy efficiency report must be accepted.)
Source regulation rate	-	-	-	±1	%	-
Output ripple and noise (peak to peak)	MV12	-	-	120	mV	Output power ≤900 W with a minimum capacitive load of 540μF solid capacitor. Acceptance criteria require the minimum load current ≥ 3 A. Test method: The test end is equipped with a 10 μF capacitor and a 0.1 μF ceramic capacitor, and the oscilloscope bandwidth is 20 MHz

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Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
Output ripple and noise (peak to peak)	SV12	-	-	360	mV	The output power is less than or equal to 540 W, and the minimum capacitive 270 μF solid capacitor is added. Acceptance criteria require the minimum load current ≥ 1 A. Test method: The test end is equipped with a 10 μF capacitor and a 0.1 μF ceramic capacitor, and the oscilloscope bandwidth is 20 MHz
Output ripple and noise (peak to peak)	MV6	-	-	360	mV	The output power is less than or equal to 60 W, with the minimum capacitive load of 270 μF solid capacitor. Acceptance criteria require the minimum load current ≥ 1 A. Test method: The test end is equipped with a 10 μF capacitor and a 0.1 μF ceramic capacitor, and the oscilloscope bandwidth is 20 MHz
Dynamic overshoot amplitude	MV12	11.6	-	12.6	V	Current change rate: 0.5 A/μs, the period is 10 ms (CCDHT1=5 ms, CCDHT2=5 ms) at 25%–50%–25% or 50%–75%–50% load
		11.4	-	12.8	V	Current change rate: 2.5 A/μs, T=10 ms (CCDHT1 = 5 ms, CCDHT2 = 5 ms) at 50%–100%–50% load
	SV12	11.6	-	12.6	V	Current change rate: 0.5 A/μs, T = 10 ms (CCDHT1 = 5 ms, CCDHT2 = 5 ms); load: 25%–50%–25%; 50%–75%–50%
	MV6	6.0	-	8.2	V	Current change rate: 0.5 A/μs, T=10 ms (CCDHT1 = 5 ms, CCDHT2 = 5 ms); load: 5%–100%
Transient impact power overshoot (MV12)	-	11.4	-	12.8	V	Current change rate: 0.5 A/μs, T = 1010 ms (CCDHT1 = 1,000 ms, CCDHT2 = 10 ms); load: 65%–130%–65%

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Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
Overshoot at turn-on (MV12)	-	-	-	±5	%	It is required to start at -10 degrees, but performance is not required, and performance must be guaranteed at 0 to 55 degrees.
Temperature coefficient	-	-	-	±0.02	%/℃	Rated output voltage, rated output current, and full range of working temperature
Current share imbalance	-	-	-	±5	%	50%–100% load. (In MV12 mode, the imbalanced load of the PSU with 50% to 100% rated output current should not exceed ±5% of the rated DC output current of one PSU).
		-	-	±10	%	200 W at 50% load. (In MV12 mode, the imbalanced load of the PSU with 200 W to 50% rated output current should not exceed ±10% of the rated DC output current of one PSU).
		-	-	Not required	%	A single power supply is less than 200 W.
		1+1 and 2+2 parallel, current sharing formula: δn=[(In-I) /I]*100% In the formula: ● **In** indicates the output current value of each tested power supply ● **I** indicates the average of the total load of *N* power supplies				
External capacitance	MV12	540	-	22000	uF	Full temperature range.
	SV12	270	-	1000		
	MV6	270	-	1000		
Hot swap	MV12	11.4	-	12.6	V	The backplane voltage cannot exceed the dynamic specifications of the power supply during the insertion and removal process. The voltage of the busbar during the insertion and removal of the MV12 cannot be lower than 11.4 V. When the load is greater than 80%, the

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Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
	MV6	6.0	-	8.20		time when the busbar voltage is at least 11 V and lower than 11.4 V is not more than 100 μs.

5.4 Efficiency Characteristics

Table 5-4 Efficiency Characteristics

Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
Output efficiency	MV12	91.5	-	-	%	T_A = 25°C (77°F), V_{in} = 230 V AC, P_{out} = 90 W, without a fan.
		94	-	-		T_A = 25°C (77°F), V_{in} = 230 V AC, P_{out} = 180 W, without a fan.
		96	-	-		T_A = 25°C (77°F), V_{in} = 230 V AC, P_{out} = 450 W, without a fan.
		93	-	-		T_A = 25°C (77°F), V_{in} = 230 V AC, P_{out} = 900 W, without a fan.
	MV6	70	-	-	%	T_A = 25°C (77°F), V_{in} = 230 V AC/240 V DC, I_{out} =8A, without a fan.

5.5 Protection Characteristics

Table 5-5 AC input protection characteristics

Parameter	Min.	Typical Value	Max.	Unit	Remarks
Input overvoltage protection threshold	280	-	-	V AC	Self-recovery

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Parameter	Min.	Typical Value	Max.	Unit	Remarks
Input overvoltage recovery threshold	275	-	-	V AC	Hysteresis ≥ 5 V (During recovery, the PSU cannot start in the hysteresis range).
Input undervoltage protection threshold	-	-	85	V AC	Self-recovery
Input undervoltage recovery threshold	-	-	90	V AC	Hysteresis ≥ 5 V (During recovery, the PSU cannot start in the hysteresis range).
PFC overvoltage protection	Yes			-	PFC overvoltage does not damage the bus capacitor (excluding damage caused by input overvoltage).

Table 5-6 HVDC (240 V) input protection characteristics

Parameter	Min.	Typical Value	Max.	Unit	Remarks
Input overvoltage protection threshold	310	-	-	V DC	Self-recovery
Input overvoltage recovery threshold	305	-	-	V DC	Hysteresis ≥ 5 V (During recovery, the PSU cannot start in the hysteresis range).
Input undervoltage protection threshold	-	-	175	V DC	Self-recovery

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Parameter	Min.	Typical Value	Max.	Unit	Remarks
Input undervoltage recovery threshold	-	-	180	V DC	Hysteresis ≥ 5 V (During recovery, the PSU cannot start in the hysteresis range).
PFC overvoltage protection	Yes			-	PFC overvoltage does not damage the bus capacitor (excluding damage caused by input overvoltage).

Table 5-7 Output protection characteristics

Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
Output overvoltage protection threshold	MV12	13	-	15	V DC	Latch off.
	MV6	13	-	15	V DC	Latch off. In the MV6 mode, if the PSU loop is detected to be open, protection is triggered directly without having to reach the MV6 overvoltage protection threshold.
	SV12	13	-	15	V DC	Latch off.
Output overcurrent/ short-circuit protection threshold	MV12 output overcurrent	110	-	130	%	100 ms minumum, latch off.
		130	-	150		4 ms minimum, latch off.
	MV12 output short-circuit	150	-	-		500 μs maximum, latch off.

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Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
	SV12 output overcurrent	50	-	-	A	100 ms minumum, the PSU enters the MV12 mode after it experienced overcurrent in SV12 mode. The green indicator blinks at 1 Hz.
	SV12 output short-circuit	50	-	-		500 µs maximum, latch off.
	MV6 output overcurrent	11	-	15	A	100 ms minumum, the PSU outputs in MV12 mode after it experienced overcurrent in MV6 mode. The green indicator blinks at 1 Hz.
	MV6 output short-circuit	15	-	-		500 µs maximum, latch off.

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Parameter	Output	Min.	Typical Value	Max.	Unit	Remarks
Overtemperature protection	-	65	-	-	℃	● In the normal input range, the PSU can be protected against overtemperature and shut down only when the ambient temperature is higher than 65°C. Overtemperature protection can be automatically restored. The hysteresis for restoration must be greater than 5°C. ● The environment protection threshold of the PSU must be set to 65°C (149°F) or higher. ● If the PSU experiences overtemperature in MV12 or SV12 mode (even if PSON12V# is still at low level), it will be output based on MV6 mode. When the temperature restores to normal and the PSON12V# signal is at low level, the PSU can enter MV12 (IP Present signal is at high level) or SV12 (IP Present signal is at low level) mode. ● If the PSU experiences overtemperature in MV6 mode, it will shut down output. When the temperature restores to normal, the PSU restores to MV6 mode first (even if PSON12V# is still at low level), and then restores to MV12 mode if the PSON12V# signal is at low level. ● The hysteresis for restoration must be greater than 5°C.

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6 Parallel Operation

Current Sharing Design Requirements

- Supports 1+1/2+2. Test current sharing only in MV12 mode.
- The total load at startup in parallel operation scenarios should be less than the rated load of a single PSU.
- When PSUs work in 1+1 or 2+2 redundancy, if one of the PSUs works in MV6 mode and other PSUs work in MV12 mode, the PSUs should work properly without affecting each other.
- In scenarios where different PSUs are not installed together, the I-MON signals of the two PSUs should not affect the normal operation of the PSUs when they are directly connected.
- Test current sharing imbalance only in the normal temperature condition.

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7 Hot Swap

In the backup scenario, the voltage fluctuation range during hot-plug operations: MV12 maintains 11.4 V to 12.6 V.

There are several ways to plug and unplug:

1. PSU hot swap without AC power applied (The PSU does not work before the plugging or unplugging.)
   - AC power unplugging: The AC power is disconnected from the power module, and then the module is physically removed from the system.
   - AC insertion: The PSU is inserted into the system without power applied. Then, power is applied after the insertion.

   Requirements should be met in both AC input and 240 HV DC input scenarios.
2. PSU hot swap through the management system:
   - Extraction: The management processor removes the PSU by turning off the PSON12V#.
   - Insertion: After a PSU is inserted into the system, the system processor queries the system status (ON or OFF) and turns on the PSON12V# signal to enable the PSU to work in main route operation mode.
3. PSU hot swap with AC power applied:

   PSU hot swap with AC power applied (The AC/240 HVDC is valid before being plugged-in and unplugged.)
   - Unplug: The PSU is removed from the system with power on.
   - Plug-in: The PSU (AC/240 HVDC already works) is inserted into the system, and the system can start immediately.

   Remarks: Hot-swapping or electrical safety interlock with power cable.

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8 Energy Saving Feature

8.1 Active/Hot Standby Power Supply

8.2 Deep Sleep Function

8.3 Cold Standby Energy Saving

8.1 Active/Hot Standby Power Supply

In MV12 mode, the power supply works in parallel. The system sets bit7 of register CEh (PS_Control) to 1, and then adjusts the output voltage of one power supply to the standby power supply voltage through 21h VOUT_COMMAND. The standby power supply reduces its output voltage and disables the current sharing function.

The PSU with an output setting voltage of 12.3 V is the active PSU (only MV12 supports hot standby).

Table 8-1 Active/Standby power supply characteristics

Parameter	Min.	Typical Value	Max.	Unit	Remarks
12 V output voltage of the standby PSU	11.7	-	-	V	TA = 25°C
No-load power consumption of the standby PSU	-	-	10	W	• 1+1 power supply scenario: For the active/standby power supply with rated input of 115 V AC/230 V AC/240 V DC (AC+AC, AC+HVDC, HVDC+HVDC), the total input power is less than 75% of the rated output power of a single PSU and the input power

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Parameter	Min.	Typical Value	Max.	Unit	Remarks
	-	-	10	W	consumption of each standby PSU is lower than 10 W. ● 2+2 power supply scenario: For the active/standby power supply with rated input of 115 V AC/230 V AC/240 V DC (AC+AC, AC +HVDC, HVDC+HVDC), the total input power is less than 75% of the rated output power of two PSUs and the input power consumption of each standby PSU is lower than 10 W.
Busbar voltage in fault mode	11.4	-	-	V	In 1+1 active/standby power supply scenarios (AC+AC, AC +HVDC, or HVDC +HVDC), if one of the PSUs powers off and experiences a fault (such as input power failure, input undervoltage, input overvoltage, fan fault, overtemperature, output overvoltage, or hot swap), the busbar 12 V voltage cannot be lower than 11.4 V.
	11.4	-	-	V	2+2 active/standby power supply scenario (AC+AC, AC +HVDC, or HVDC+HVDC): The 12 V mains voltage of the backplane bus cannot be lower than 11.4 V if any of the following faults occurs. ● One power input fails (2+2 backup, one power input for two PSUs). ● One of the PSUs experienced a fault (such as input undervoltage, input overvoltage, fan fault, overtemperature, output overvoltage, or hot swap).

In 1+1 mode, PSUs work in active/standby N+R mode. When the total load is less than or equal to 80% of the rated load of a single PSU, the standby PSU does not

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carry loads in stable state. When the total load is 80%–100% of the rated load of a single PSU, the load rate of the active PSU to the standby PSU does not exceed 6:1.

Table 8-2 N+R power supply specifications

Parameter		Min.	Typical Value	Max.	Unit	Remarks
Input inrush current for active/ standby switchover	20ms	-	-	150% rated input current	A	In 1+1 scenarios, the input voltage of the active PSU is 220 V/50 Hz, and that of the standby PSU is 230 V/ 50 Hz. The 2+2 scenario is not assessed. The total load is tested between 50% and 100% of the load of a single PSU.
	100ms	-	-	130% rated input current		
Output dynamics		11.4	-	13.3	V	During the switchover of active/standby PSUs due to input power failure, the output voltage must range from 11.4 V to 13.3 V. (The output voltage is allowed to drop at the μs level, but the time when the voltage ranges from 11 V to 11.4 V cannot exceed 100 μs.) When the load rate is greater than 80%, the output ripple is not evaluated. The active/ standby switchover caused by other faults cannot cause system exceptions during the test.

8.2 Deep Sleep Function

The power supply supports the deep sleep function. The system can set bitB of CEh (PS_Control) to 1 to enable the power supply to enter the deep sleep mode (parallel/ system test).

8.3 Cold Standby Energy Saving

In a redundancy system, cold standby mode is supported in PSU 1+1 scenarios when the output mode is MV12. The 1+1/2+2 modes support cold backup mode.

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The PSU can enter cold standby mode if all of the following conditions are met:

- The system sends a D0h 0x01h command to set one of the PSUs as the active PSU (SMART_ON changes to high level).
- The system sends the D0h 0X02/0X03/0X04 to the other PSU and detects that SMART_ON is high.

The cold standby PSU exits cold standby mode if any of the following conditions is met:

- The system sends D0h 0X00 command.
- The single-chip microcomputer of the PSU restarts.
- The I^2C communication of the PSU is abnormal.
- The 12 V output of the active PSU is faulty, such as input power failure, input overvoltage/ undervoltage, output overvoltage/overcurrent/undervoltage (<11.8 V), overtemperature, and fan fault, which causes SMART_ON to change to low level.
- The PSON12V# signal changes from low level to high level, and the INSTALLED# signal changes from low level to high level.
- The load power is greater than the maximum power supported by cold standby.

The active PSU exits cold standby mode if any of the following conditions is met:

- The system sends D0h 0X00 command.
- The single-chip microcomputer of the PSU restarts.
- The I2C communication of the PSU is abnormal.
- The 12 V output of the active PSU is faulty, such as input power failure, input overvoltage/ undervoltage, output overvoltage/overcurrent/undervoltage (lower than 11.8 V), overtemperature, and fan fault.
- The PSON12V# signal changes from low level to high level, and the INSTALLED# signal changes from low level to high level.

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Table 8-3 Busbar voltage when the active PSU is faulty in cold standby mode

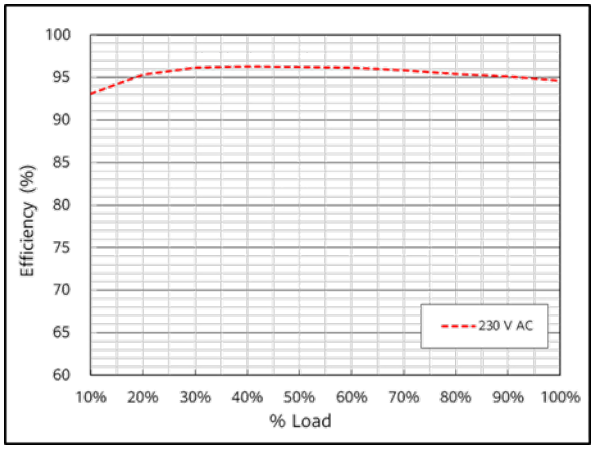
Parameter	Unit	Min.	Typical Value	Max.	Remarks
Busbar voltage in fault mode	V	11.4	-	-	In 1+1 active/standby power supply scenarios (AC+AC, AC+HVDC, HVDC+HVDC), if any PSU experiences a power failure, which causes a fault (excluding ORing-FET internal short circuit), the 12 V busbar voltage must be at least 11.4 V (full load range).
Power consumption of standby PSU	W	-	-	8	Input voltage: 115 V AC/230 V AC/240 V DC

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9 Characteristic Curves

Conditions: T_A = 25°C (77°F) unless otherwise specified.

Figure 9-1 Efficiency curve



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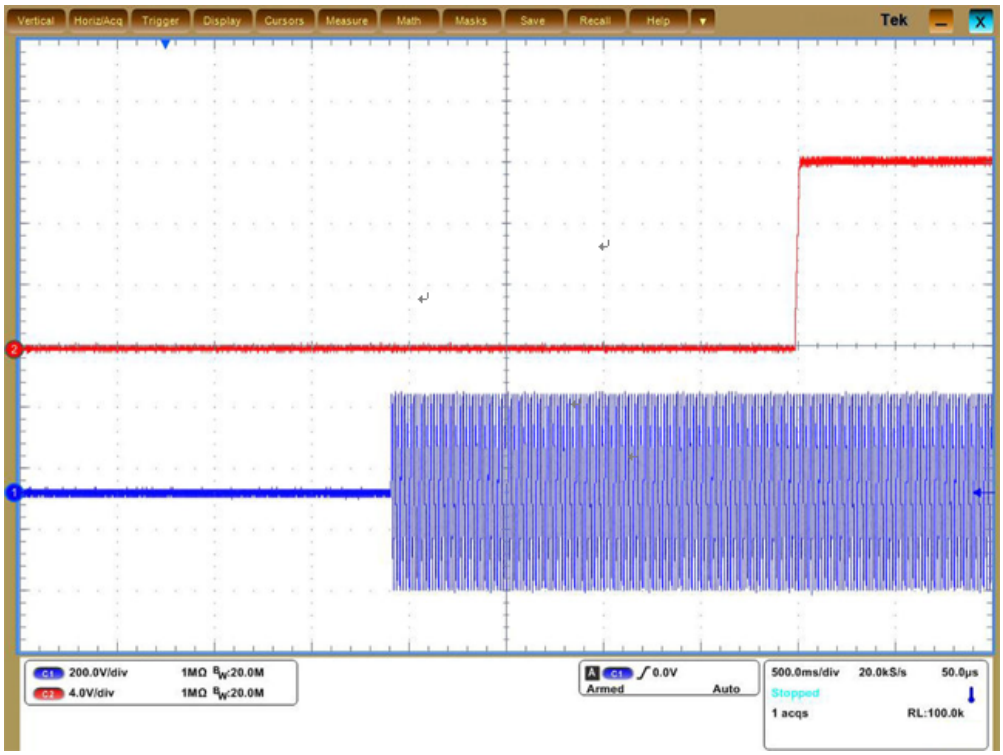
10 Typical Waveforms

10.1 Power-On/Power-Off Waveforms
10.2 Output Voltage Dynamic Response
10.3 Output Voltage Ripple

10.1 Power-On/Power-Off Waveforms

Conditions: T_A = 25°C (77°F) unless otherwise specified.

Figure 10-1 AC input power-on (Vin=220 V AC, Vout=12.30 V)



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Figure 10-2 AC input power off (Vin=220 V AC, Vout=12.30 V)

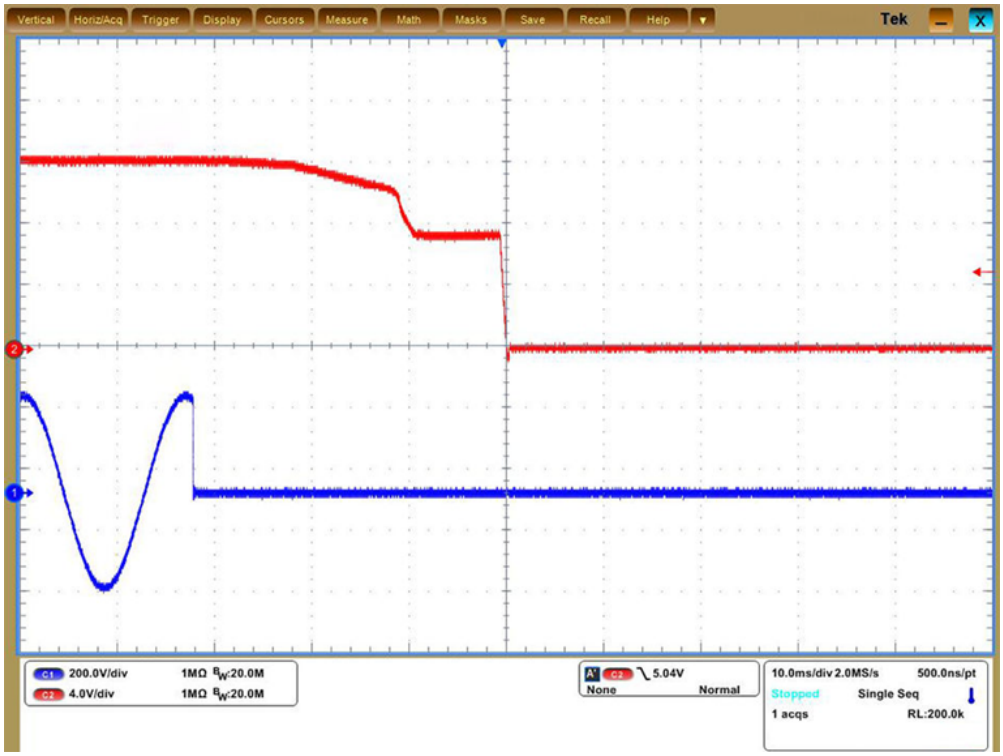
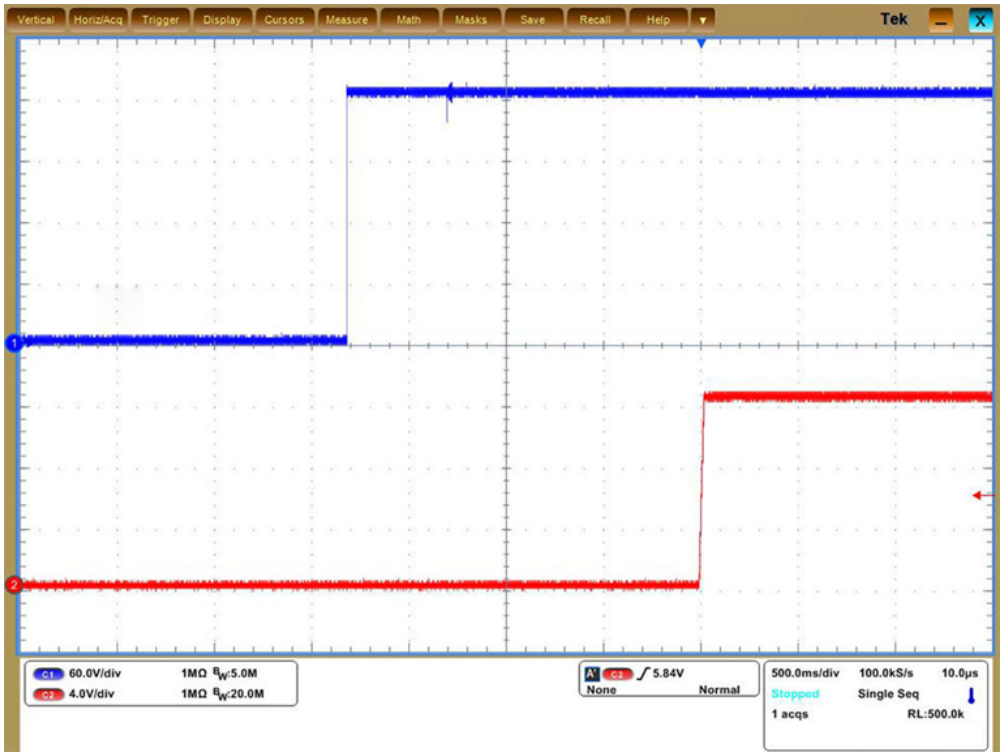
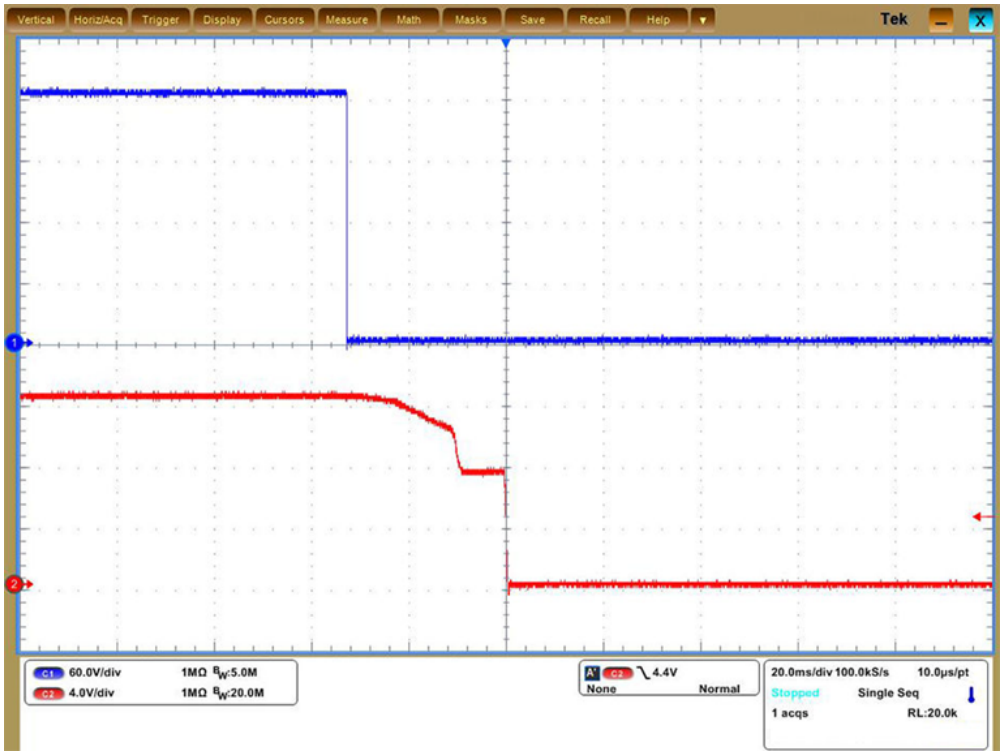


Figure 10-3 DC input power-on (Vin=240 V DC, Vout=12.30 V)



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Figure 10-4 DC input power-on (V_{in}=240 V DC, V_{out}=12.30 V)



10.2 Output Voltage Dynamic Response

Conditions: T_A = 25°C (77°F) unless otherwise specified.

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Figure 10-5 Output voltage dynamic response (V_{in}=220 V AC; load: 25%–50%–25%; 0.5 A/μs; T=10ms; MV12)

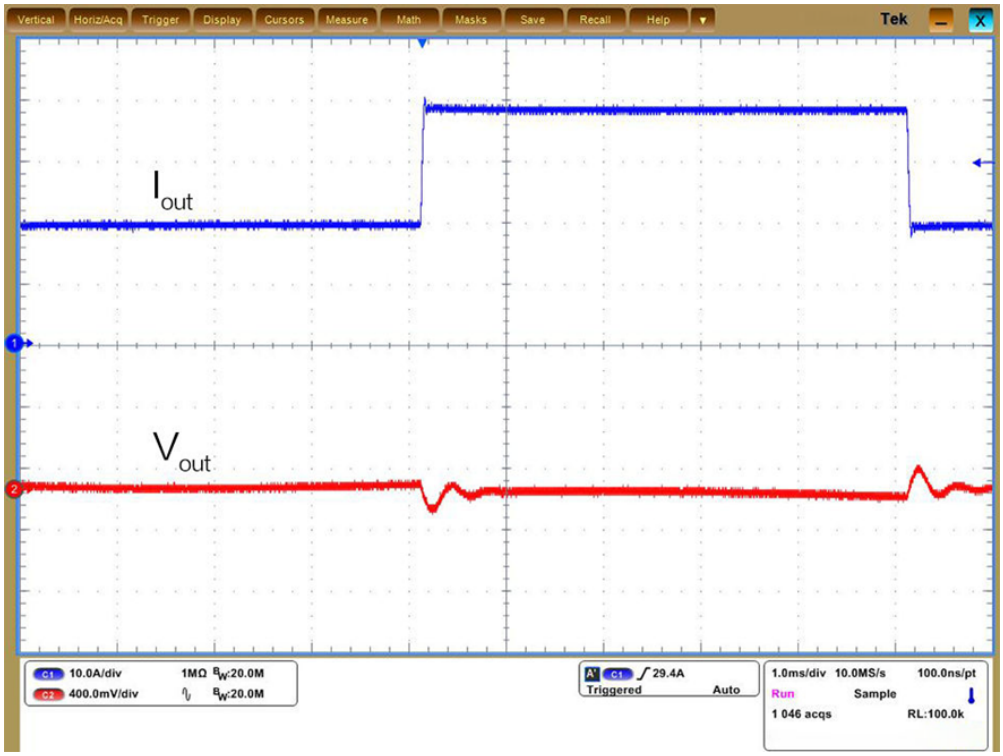
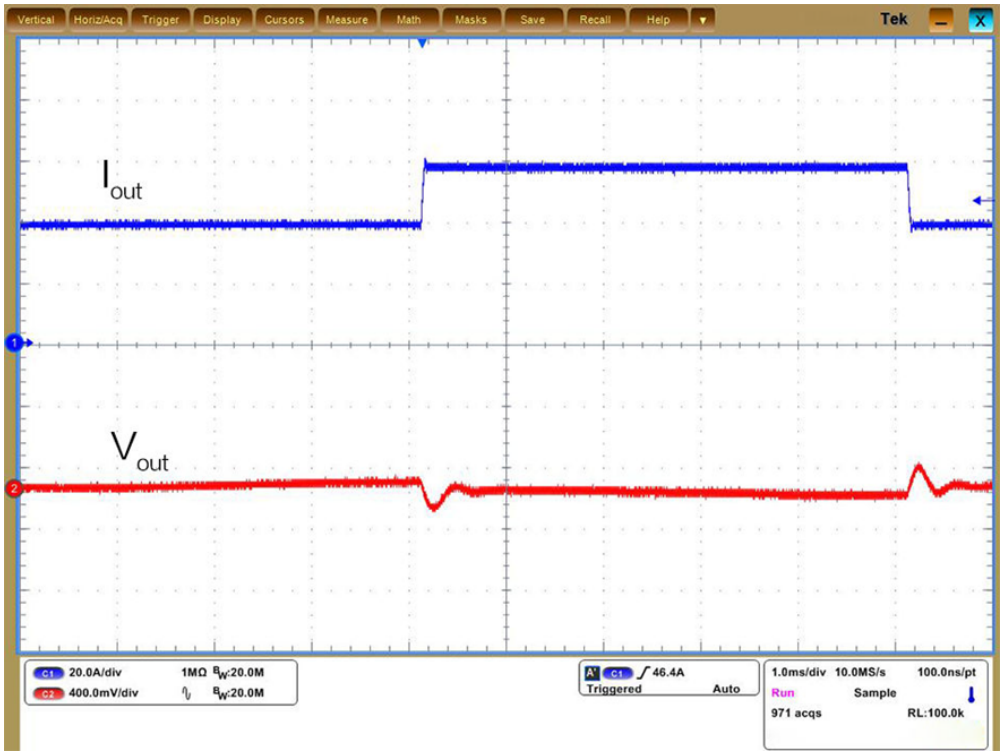


Figure 10-6 Output voltage dynamic response (V_{in}=220 V AC; load: 50%–75%–50%; 0.5 A/μs; T=10ms; MV12)



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Figure 10-7 Output voltage dynamic response (V_{in}=220 V AC; load: 50%–100%50%; 2.5 A/μs; T=10ms; MV12)

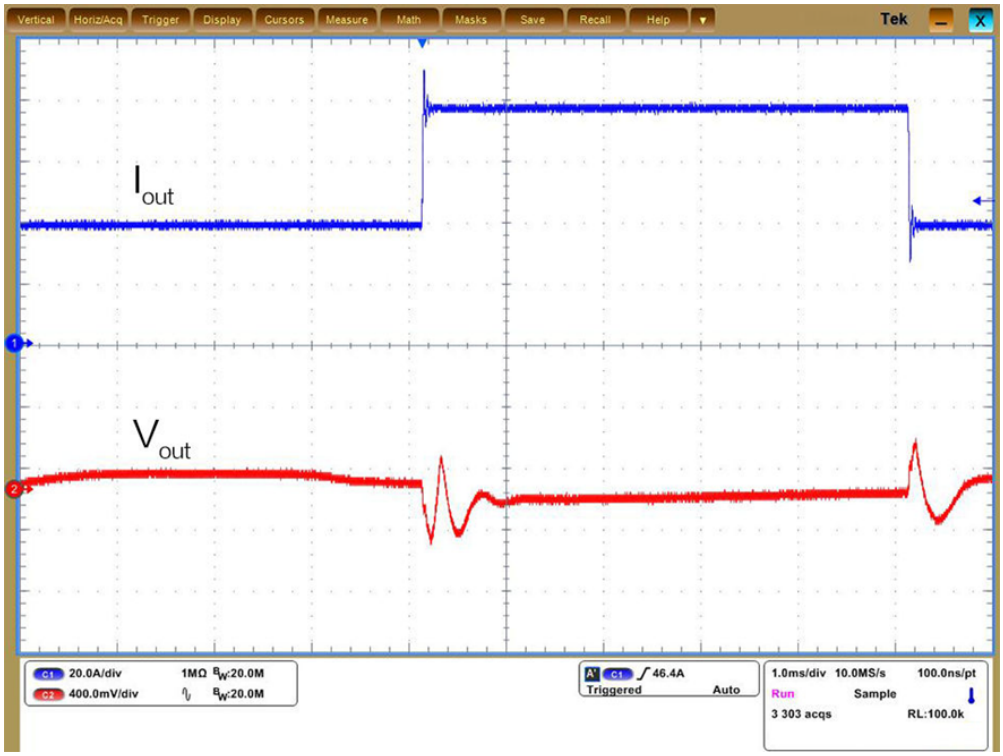
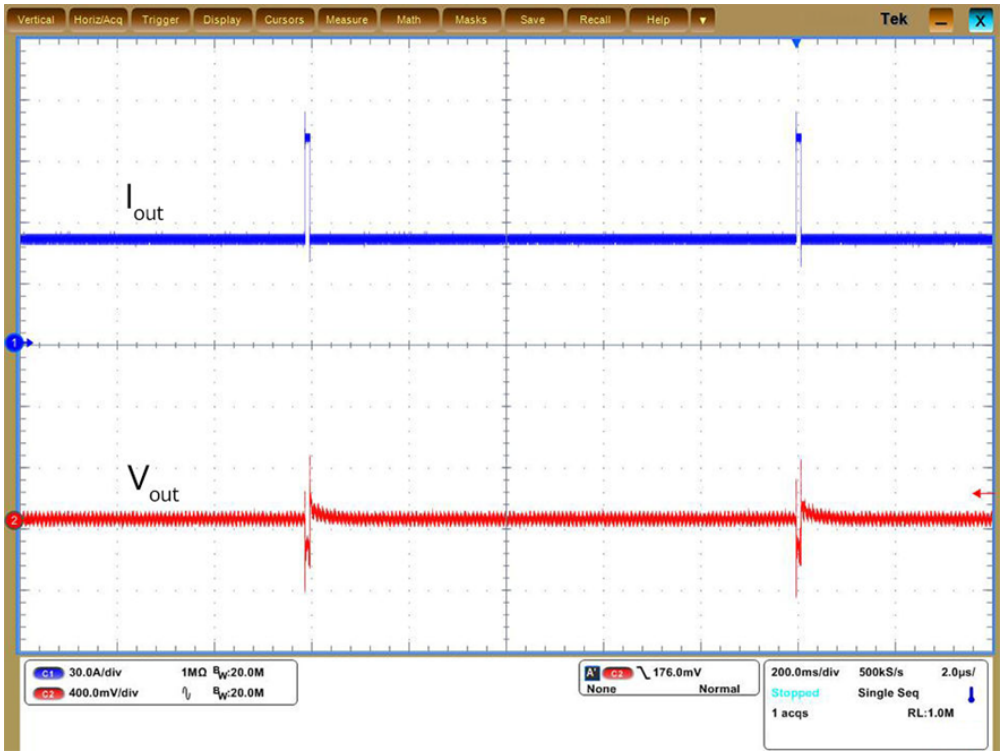


Figure 10-8 Output voltage dynamic response (V_{in}=220 V AC; load: 65%–130%–65%; 0.5 A/μs; T=10ms; MV12)



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Figure 10-9 Output voltage dynamic response (V_{in}=240 V DC; load: 25%–50%–25%; 0.5 A/μs; T=10ms; MV12)

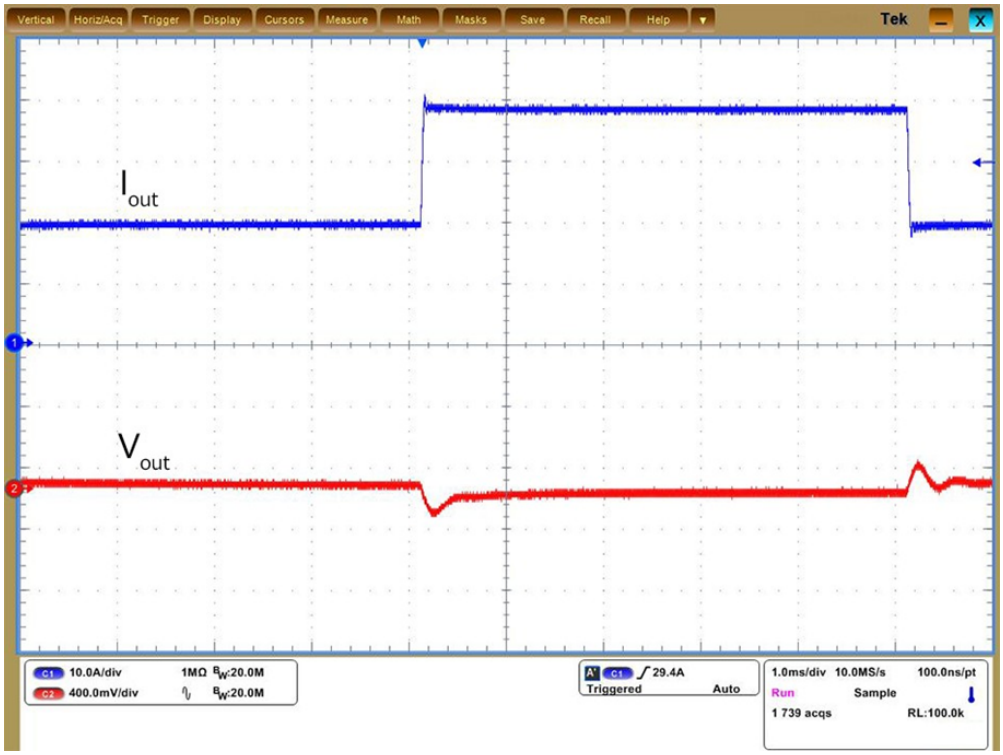
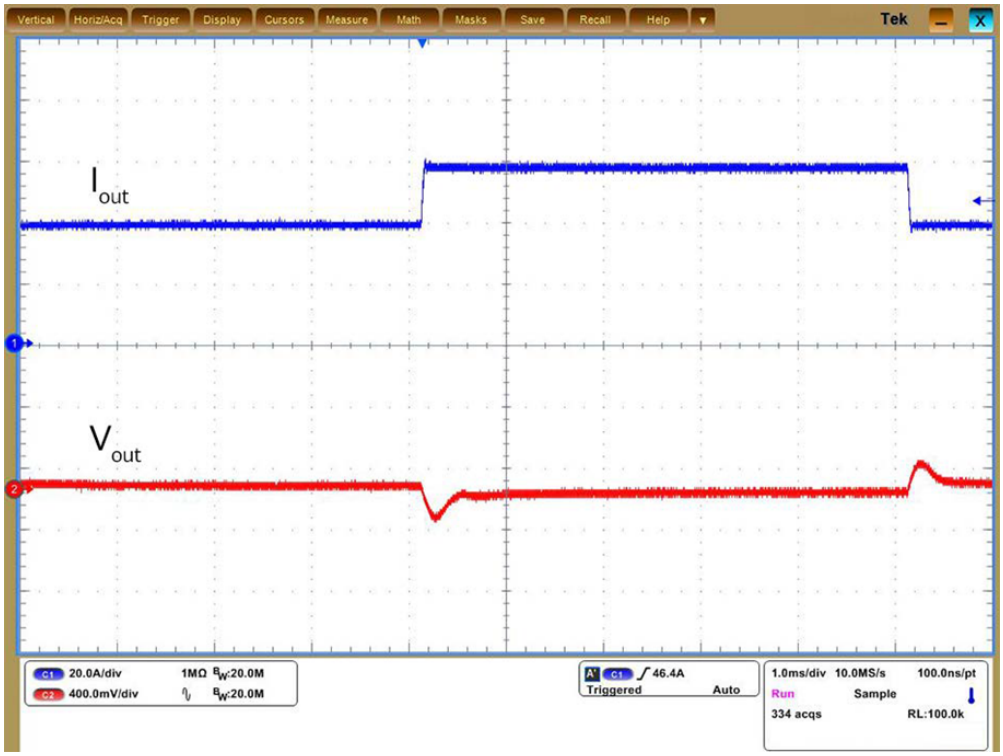


Figure 10-10 Output voltage dynamic response (V_{in}=240 V DC; load: 50%–75%–50%; 0.5 A/μs; T=10ms; MV12)



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Figure 10-11 Output voltage dynamic response (V_{in}=240 V DC; load: 50%–100%–50%; 2.5 A/μs; T=10ms; MV12)

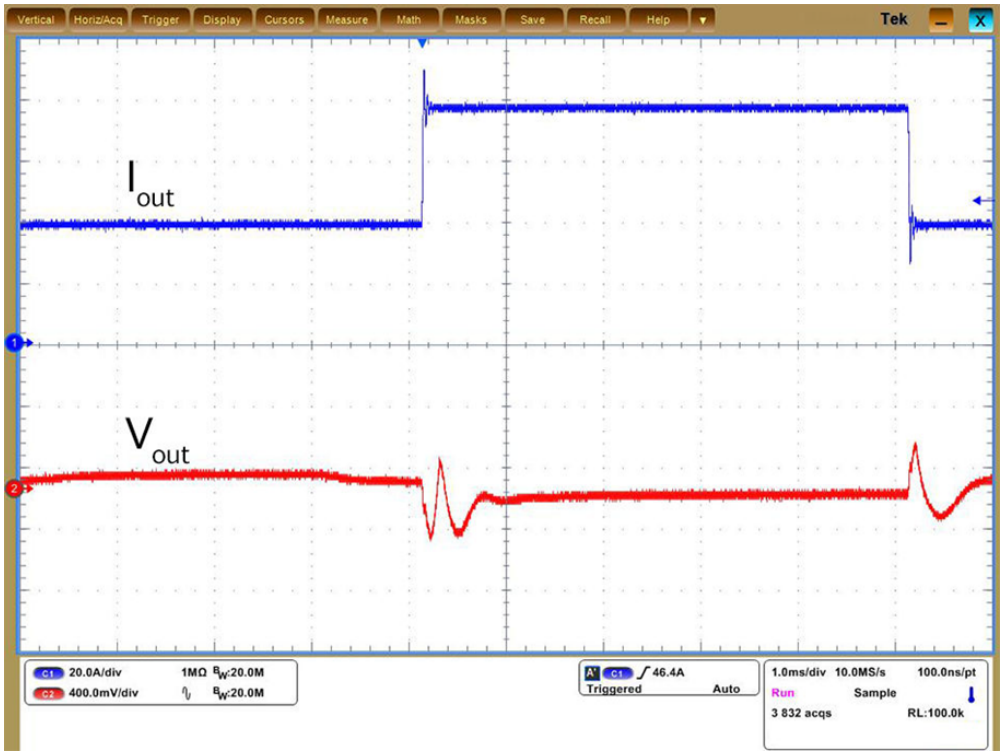
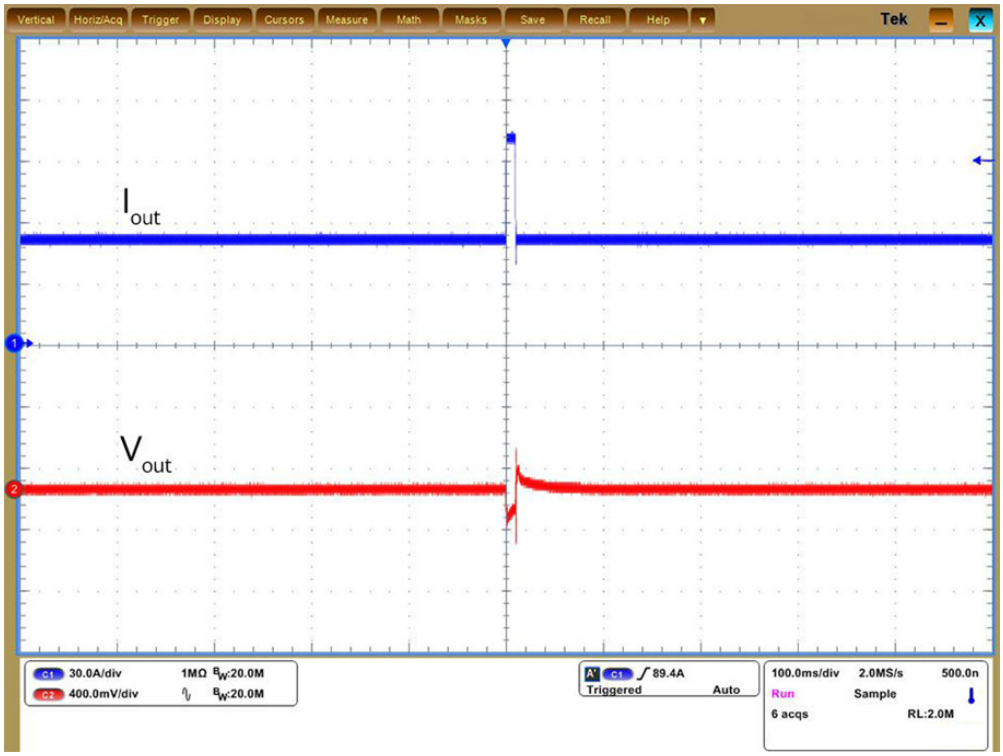


Figure 10-12 Output voltage dynamic response (V_{in}=240 V DC; load: 65%–130%–65%; 0.5 A/μs; T=10ms; MV12)

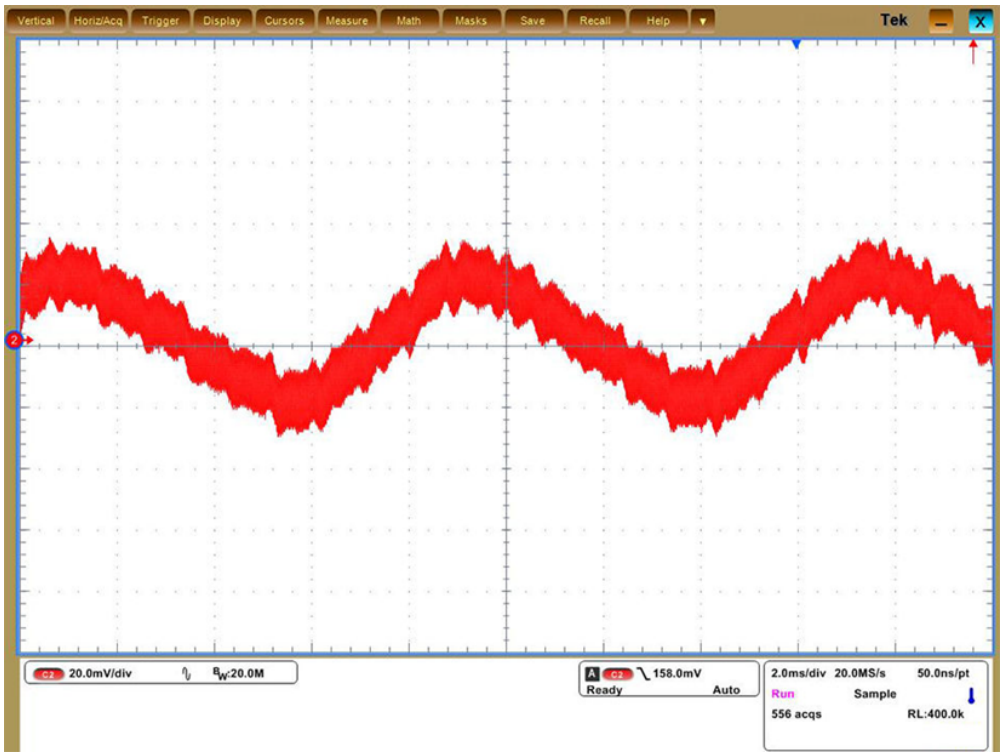


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10.3 Output Voltage Ripple

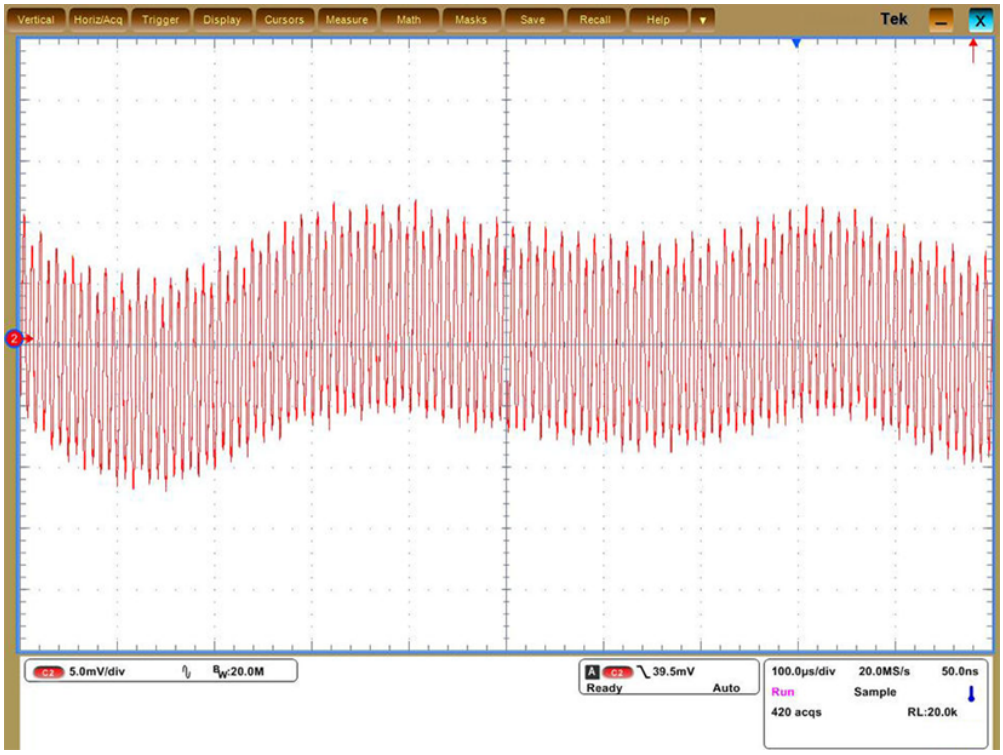
Conditions: T_A = 25°C (77°F) unless otherwise specified.

Figure 10-13 Output voltage ripple (V_{in}=220 V AC; 100% load; MV12)



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Figure 10-14 Output voltage ripple (V_{in}=240 V DC; 100% load; MV12)



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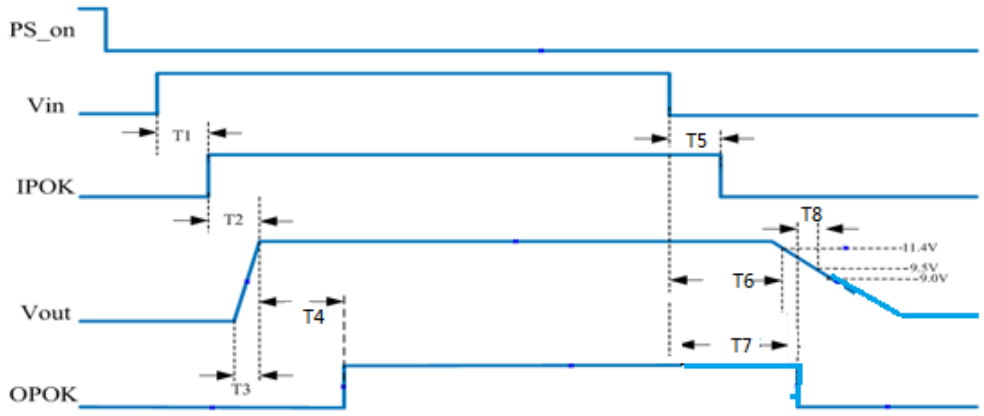
11 Control Signals

Signal noise (edge output connector): The peak voltage is less than 250 mV (20 MHz bandwidth).

11.1 Timing Requirement
11.2 ORing-FET
11.3 PSON12V#
11.4 PRESENT#
11.5 INSTALLED#
11.6 OPOK
11.7 IPOK
11.8 IPOK LINK
11.9 IP PRESENT
11.10 CYC_PWR#
11.11 I-MON
11.12 PS_INTR#
11.13 SCL and SDA
11.14 EFUSEV
11.15 SMART_ON

11.1 Timing Requirement

Figure 11-1 PSU timing diagram 1



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Figure 11-2 PSU timing diagram 2



Table 11-1 Time sequence requirements for output switch

Mark	Description	Min.	Max.	Unit
T1	Time from AC/DC input to when IPOK becomes high level	-	2000	ms
T2	Time from when IPOK becomes high level to when MV12 output to 11.4 V	-	500	ms
T3a	Time for MV6 output to increase from 10% to 90%	5	25	ms
T3b	Time for MV12 output to increase from 10% to 90%	5	25	ms
T4	Delay time for the OPOK to take effect (when MV12/MV6 increases to 90% to when OPOK is at high level)	50	100	ms
T5	IPOK failure delay time (from input outage to low IPOK signal, circuit breaker disconnection not considered, full load test conditions)	-	4	ms
T6	Output hold-up time (from input power failure during normal running to 11 V output, 100% load, DIP performance)	10	-	ms
T7	OPOK hold-up time (normal working input power failure to low OPOK signal, 100% load)	10	-	ms
	OPOK hold-up time (normal working input power failure to low OPOK signal, 50% load)	20	-	ms
	OPOK hold-up time (normal working input power failure to low OPOK signal, 25% load)	30	-	ms
	OPOK hold-up time (normal working input power failure to low OPOK signal, 12.5% load)	40	-	ms
T8	Duration from the time when the OPOK signal falls to 1.43 V to the time when the 12 V bus voltage drops to 9.5 V	200	-	uS
T10a	Duration from the time when the PSON12V# changes from high level to low level to the time when MV6 rises to MV12 mode	80	200	ms

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Mark	Description	Min.	Max.	Unit
T10b	Duration from MV6 to MV12 mode when MV6 OCP and MV12 OTP recover	2.1	3.3	s
T12	Time for MV12 drops to MV6 mode (with 24 W load)	80	200	ms

11.2 ORing-FET

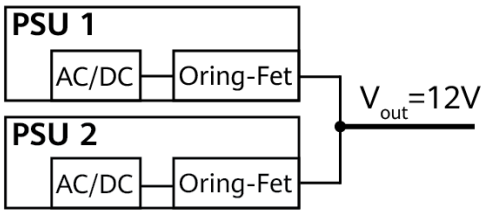
PSU side:

An ORing-FET failure isolation circuit needs to be added inside the PSU MV12 output. In the parallel scenario (1+1/2+2 backup), if one PSU experiences an internal fault, it should exit automatically to prevent the bus voltage output from being abnormal.

System side:

- Capacitance at the MV12 input side: The equivalent capacitance should be greater than the PSU's minimum capacitive load 540 μF multiplied by N (N is the number of PSUs configured in the system) and less than the PSU's maximum capacitive load 22000 μF.
- The MV12 load should be greater than the minimum PSU load 3 A and less than the rated load of the PSU

Figure 11-3 ORing-FET circuit



11.3 PSON12V#

The PSON12V# signal is an on/off signal that controls the PSU 12 V output remotely. If the PSON12V# signal is at low level and takes effect, the 12 V output of the PSU enters the active 12 V output mode. If the PSON12V# is at high level or left open, the MV12 output of the PSU enters MV6 output mode. The PSON12V# signal is valid only when the PSON12V# high level detection continues for at least 25 ms.

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Figure 11-4 PSON12V#

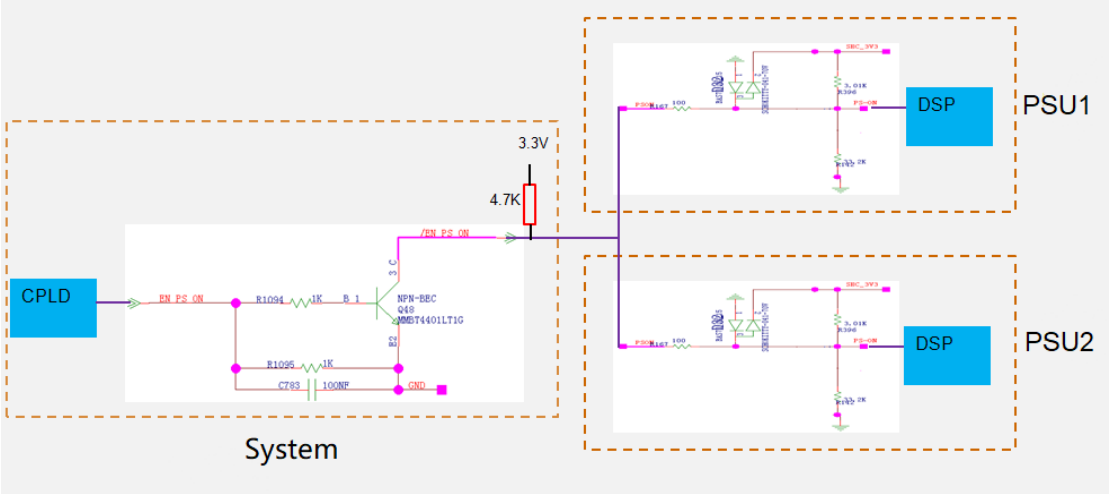


Table 11-2 PSON12V# signal characteristics

Signal Characteristics	
Signal type	PSU side: The signal is pulled up to the 3.3 V auxiliary power source inside the PSU through a pull-up resistor (reference value: 4.7 kilohm) System side: This signal is output by CPLD over the drive circuit and pulled up to 3.3 V by a 4.7 kilohm resistor.
PSON12V# = Low	MV12 output mode
PSON12V# = High/Open	MV6 output mode

Table 11-3 PSON12V# signal characteristics

PSON12V# Output	**Min.**	**Max.**
Low level voltage (main output enabled)	0 V	0.8 V
High level voltage (main output disabled)	2.0 V	3.465 V
Signal rise and fall time	-	200 µs

11.4 PRESENT#

The PRESENT# signal is used by the system to detect whether the PSU is present. The signal pin is required to be shorter than other pins on the PSU. The pin is grounded inside the PSU.

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Table 11-4 PRESENT# signal characteristics

Signal Characteristics	
Signal type	PSU side: The pin is directly grounded inside the PSU. System side: This signal is pulled up to 3.3 V by a 4.7-kilohm resistor and output to the system CPLD over a series resistor.
PRESENT# = Low	PSU is present.
PRESENT# = High	PSU is removed from the system.

11.5 INSTALLED#

The INSTALLED# signal is used by the PSU to determine whether it has been inserted into the system. The signal pin is required to be shorter than other pins on the PSU.

High level indicates that the PSU has not been inserted into the system and low level indicates that the PSU has been inserted into the system. When the INSTALLED# signal pin is left open, the PSU has no output. When inserted into the system, the PSU starts main output mode.

Table 11-5 INSTALLED# signal characteristics

Signal Characteristics	
Signal type	PSU side: The signal is pulled up to the 3.3 V auxiliary power source inside the PSU through a pull-up resistor (reference value: 4.7-kilohm) System side: This pin is grounded directly.
INSTALLED# = Low	PSU is inserted into the system.
INSTALLED# = High	PSU is not inserted into the system.

Table 11-6 INSATLLED# output

Signal type	Min.	Max.
Low level voltage (main output enabled)	0 V	0.8 V
High level voltage (main output disabled)	2.0 V	3.465 V
Signal rise and fall time	-	200 µs

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11.6 OPOK

The OPOK signal indicates whether the main output is normal.

Figure 11-5 OPOK signal connection

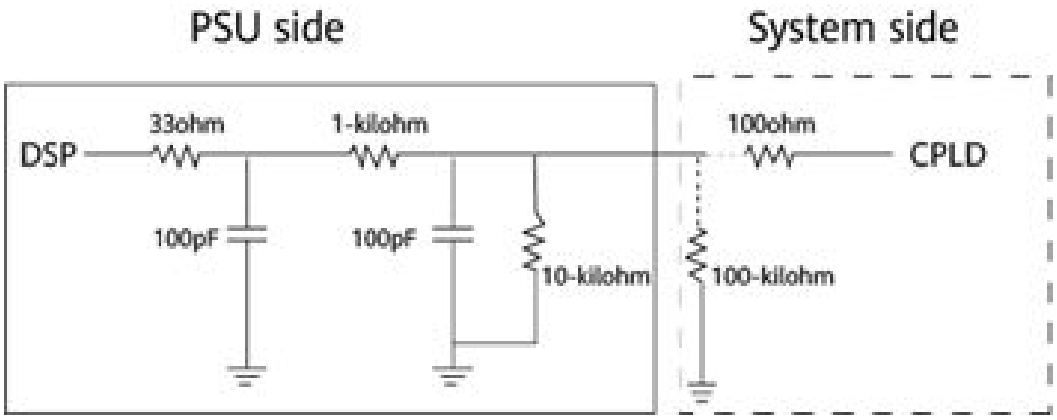


Table 11-7 OPOK signal characteristics

Signal Characteristics	
Signal type	PSU side: The DSP is output to the edge connector after RC filtering. System side: Pulled down to GND by a 100-kilohm resistor and connected to the system CPLD over a 100-ohm series resistor.
OPOK = High	The main output is normal.
OPOK = Low	The main output is abnormal.

Table 11-8 OPOK output

Signal type	Min.	Max.
Low level voltage	0 V	0.6 V
High level voltage	2.2 V	3.465 V
Signal rise and fall time	-	200 μs

11.7 IPOK

The IPOK signal is used to detect whether the PSU input is normal. High level indicates that the input is normal, and low level indicates that the input is abnormal.

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Figure 11-6 IPOK signal connection

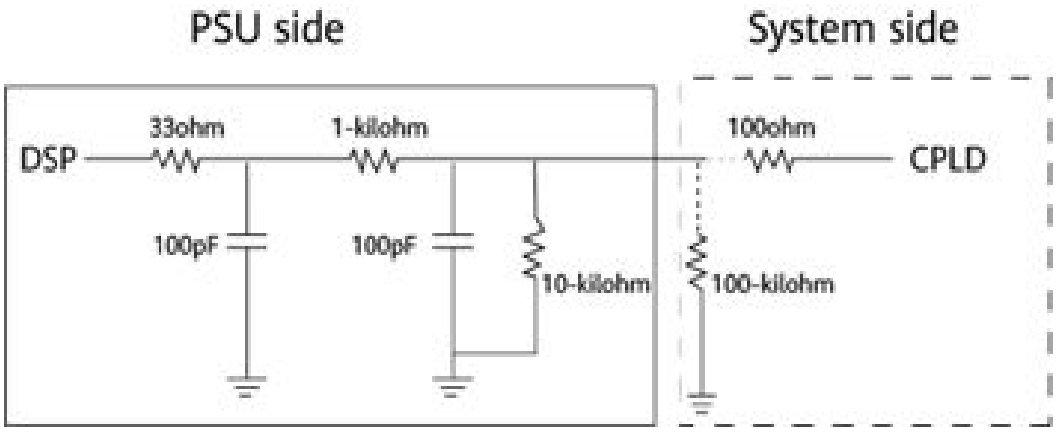


Table 11-9 IPOK signal characteristics

Signal Characteristics	
Signal type	PSU side: The power is output after RC filtering. System side: Pulled down to GND by a 100-kilohm resistor and connected to the system CPLD over a 100-ohm series resistor.
IPOK = High	The input is normal. (90 V AC<V_{in}<264 V AC; 180 V DC<V_{in}<300 V DC).
IPOK = Low	The input is abnormal (after AC or DC input undervoltage/overvoltage protection).

Table 11-10 IPOK output

Signal type	Min.	Max.
Low level voltage	0 V	0.6 V
High level voltage	2.2 V	3.465 V
Signal rise and fall time	-	200 μs

11.8 IPOK LINK

The IPOK LINK signal is sent by the system to the PSU. It indicates that at least one PSU is present in the system and its input is normal.

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Table 11-11 IPOK LINK signal characteristics

Signal Characteristics	
Signal type (PSU output signal)	PSU side: This signal is pulled up to the 3.3 V auxiliary power source inside the PSU by a 2.49-kilohm resistor. System side: This signal is output by CPLD over the drive circuit and pulled up to 3.3 V by a 4.7-kilohm resistor.
IPOK LINK = High	The standby power supply input is normal.
IPOK LINK = Low	The standby power supply input is abnormal.

Table 11-12 IPOK LINK Output

Signal type	Min.	Max.
Low level voltage	0 V	0.6 V
High level voltage	2.2 V	3.465 V
Signal rise and fall time	-	200 μs

11.9 IP PRESENT

IP PRESENT signal controls the switching between SV12 mode and MV12 mode.

- When PSON12V# is low, the following features are met:
  - The IP PRESENT signal is high. After the IP PRESENT signal is valid, the power supply outputs normal MV12 voltage.
  - The IP Present signal is low. After the IP Present signal is valid, the power supply is low-power SV12 output. In this case, the overcurrent point of the power supply is designed to be greater than or equal to 50 A at the OCP point.
- When the PSON12V# signal is high, the power supply maintains the MV12 output mode, which is not affected by the change of the IP Present signal.

  PSU side: This signal is pulled up to the 3.3 V auxiliary power source inside the PSU through a pull-up resistor (reference value: 4.75-kilohm).

  System side: This signal is output by CPLD over the drive circuit and pulled up to 3.3 V by a 4.7-kilohm resistor.

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Table 11-13 IP PRESENT# signal characteristics

Signal Characteristics	
Signal type	PSU side: This signal is pulled up to the 3.3 V auxiliary power source inside the PSU through a pull-up resistor (reference value: 4.75-kilohm). System side: This signal is output by CPLD over the drive circuit and pulled up to 3.3 V by a 4.7-kilohm resistor.
IP PRESENT# = High	MV12 output mode
IP PRESENT# = Low	SV12 output mode

Table 11-14 IP PRESENT output

Signal type	Min.	Max.
Low level voltage	0 V	0.6 V
High level voltage	2.0 V	3.465 V
Signal rise and fall time	-	200 μs

11.10 CYC_PWR#

The CYC_PWR signal is sent to PSUs by the system to shut down or restore the 12 V main output of the PSU.

- The signal is valid if the CYC_PWR# signal is at low level for 100–150ms. The PSU shuts down after the delay time (configurable) and then starts after the restart time (configurable).
- The CYC_PWR# signal is invalid if both the OPOK and CYC_PWR# signals are low level.
- The signal is invalid if the CYC_PWR# signal is at low level for less than 100ms.
- The CYC_PWR# signal is invalid when a PSU is during delay shutdown or restarting. The CYC_PWR# signal is valid after the OPOK signal becomes high level.

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Table 11-15 CYC_PWR# signal characteristics

Signal Characteristics	
Signal type	PSU side: This signal is pulled up to the 3.3 V auxiliary power source inside the PSU through a pull-up resistor (reference value: 2.49-kilohm). System side: This signal is output by CPLD over the drive circuit and pulled up to 3.3 V by a 4.7-kilohm resistor.
CYC_PWR# = High	The PSU does not act.
CYC_PWR# = Low	The PSU enters power supply cycle power mode.

Table 11-16 CYC_PWR output

Signal type	Min.	Max.
Low level voltage	0 V	0.8 V
High level voltage	2.0 V	3.465 V
Signal rise and fall time	-	200 μs

11.11 I-MON

This signal is a 12 V current sharing signal and is connected to the system backplane.

PSU side: Internal current sharing bus

System side: The backplane directly connects the I-MON signals of all PSUs together.

11.12 PS_INTR#

The PS_INTR# signal indicates PSU I^2C alarm interruption.

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Figure 11-7 PS_INTR# signal connection

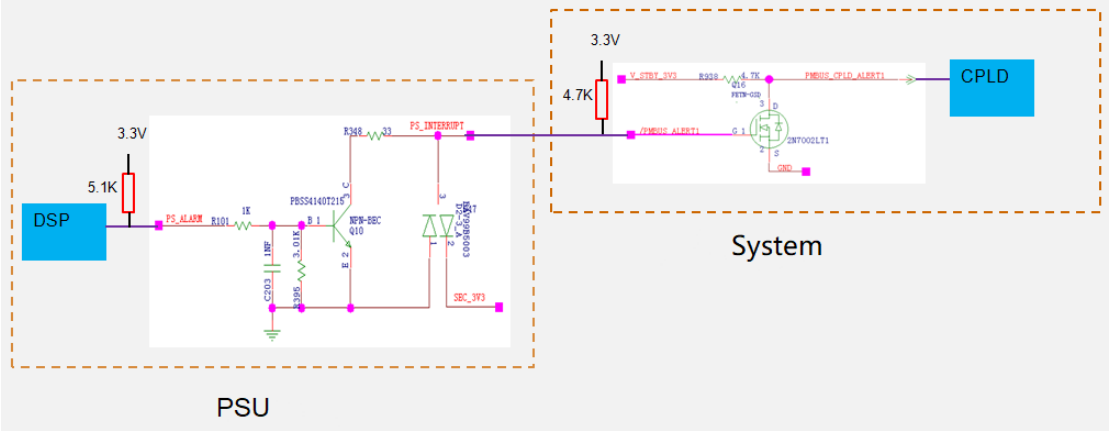


Table 11-17 PS_INTR# signal characteristics

Signal Characteristics	
Signal type	PSU side: Output over the drive circuit, no pull-up on the PSU side. System side: Pulled up to 3.3 V level and then reversely sent to the system over the MOS transistor.
PS_INTR# = High	The power supply is working properly
PS_INTR# = Low	Power supply alarm

Table 11-18 PS_INTR output

Signal type	Min.	Max.
Low level voltage	0 V	0.6 V
High level voltage	2.2 V	3.465 V

11.13 SCL and SDA

The I2C serial clock line (SCL) and the serial data line (SDA) occupy two signal pins of the output connector.

PSU side:

- Interconnection in the PSU: SCL and SDA must be pulled up to 3.3 V by a 20-kilohm (reference value) resistor.
- The supply voltage source for the secondary-side MCU is generated from the PSU auxiliary power supply and 12 V at the system side at the same time.
- When power is supplied from the system side, there should be a fuse or an overcurrent or short circuit protection circuit.

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- Capacitors on the SCL and SDA circuit are no more than 66 pF.

System side:

SCL and SDA are pulled up to 3.3 V level by a 3-kilohm to 10-kilohm equivalent resistor.

11.14 EFUSEV

The system samples the input current of the main service load branch (12 V), converts the current to a linear voltage analog signal, and sends the signal to the EFUSEV pin of the PSU. If the value of EFUSEV is greater than 1.0 V, the main service of the system is working. In this case, the PSU cannot enable deep sleep and automatic PFC shutdown. If the value of EFUSEV is less than 0.8 V, the main service of the system is powered off or does not work. In this case, the PSU can enable deep sleep and automatic PFC shutdown.

Table 11-19 EFUSEV signal characteristics

Signal Characteristics	
Signal type	PSU side: Send to the PSU DSP by a 100-ohm series resistor. System side: ● If this function is enabled, the system sends the voltage analog signal of the main service circuit to the PSU, or CPLD outputs this signal over the drive circuit and this signal is pulled up to 3.3 V level by a 4.7-kilohm resistor. ● If this function is disabled, this signal is pulled up to 3.3 V level by a 4.7-kilohm resistor.
EFUSEV = High	Disable deep sleep and automatic PFC shutdown.
EFUSEV = Low	Enable deep sleep and automatic PFC shutdown.

Table 11-20 EFUSEV output

EFUSEV Output	**Min.**	**Max.**
Low level voltage	0 V	0.8 V
High level voltage	1.0 V	3.465 V

11.15 SMART_ON

The SMART_ON signal is used to wake up a cold-standby PSU (low level by default).

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- Set an active PSU: The system sets one of the PSUs to be the active PSU (by sending the **D0h 0x01** command). The active PSU sets the SMART_ON signal to high level.
- Set a standby PSU: The system sends a standby PSU command (**D0h 0x02/0x03/0x04**). The standby PSU enters cold standby mode. (Two conditions that the standby PSU enter the cold standby mode must be met. 1. The SMART_ON signal is at high level. 2. The system sends the **D0h 0x02/0x03/0x04** command.)
- Wake up the standby PSU: When the host is faulty, the active PSU sets the SMART_ON signal to low level to wake up the standby PSU.

NOTE

The mixed insertion of this signal will cause other PSUs to work abnormally.

Table 11-21 SMART_ON signal characteristics

Signal Characteristics	
Signal type	System side: The SMART_ON signals of all PSU backplanes are connected together through the cables.
SMART_ON = High	The PSU enters cold standby mode.
SMART_ON = Low	The PSU exits from cold standby mode.

Table 11-22 SMART_ON output

SMART_ON Output	**Min.**	**Max.**
Low level voltage	0 V	0.8 V
High level voltage	2.0 V	3.6 V

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12 Communication

12.1 Signal Characteristics
12.2 Data Link Layer Protocol
12.3 Network Layer Protocol
12.4 Application Layer Protocol
12.5 Supply Retention

12.1 Signal Characteristics

Table 12-1 PMBus detection precision

Parameter	Type	Min.	Typical Value	Max.	Unit	Remarks
Input voltage detection precision	-	-2	-	2	V	V_{in}=220 V AC/230 V AC
Input power detection precision	Non-standby mode	-	20	-	W	V_{in}=230 V AC/270 V DC, MV12, T_A=25℃–35℃ (77°F–95°F), P_{in}≤20 W
		-10	-	10	W	V_{in}=230 V AC/270 V DC, MV12, T_A=25℃–35℃ (77°F–95°F), 20 W<P_{in}<100 W
		-5	-	5	%	V_{in}=230 V AC/270 V DC, MV12, T_A=25°C–35°C (77°F–95°F), 100 W≤P_{in}<200 W

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Parameter	Type	Min.	Typical Value	Max.	Unit	Remarks
		-3	-	3	%	V_{in}=230 V AC/270 V DC, MV12, T_A=25°C–35°C (77°F–95°F), P_{in}≥200 W
	Standby mode	-	5	-	W	V_{in}=230 V AC/270 V DC, MV12, T_A=25℃–35℃ (77°F–95°F), P_{in}≤5 W
		-10	-	10	W	V_{in}=230 V AC/270 V DC, MV12, T_A=25℃–35℃ (77°F–95°F), 5 W<P_{in}<100 W
		-5%	-	5%	-	V_{in}=230 V AC/270 V DC, MV12, T_A=25℃–35℃ (77°F–95°F), 100 W≤P_{in}<200 W
		-3%	-	3%	-	V_{in}=230 V AC/270 V DC, MV12, T_A=25℃–35℃ (77°F–95°F), P_{in}≥200 W
Output power detection precision	Running PSU	-10	-	10	W	Minimum load > 2 A, V_{in} = 230 V AC/ 270 V DC, MV12, T_A = 25°C–35°C (77°F–95°F); P_{out} < 100 W
		-5	-	5	%	Minimum load > 2 A, V_{in} = 230 V AC/ 270 V DC, MV12, T_A = 25°C–35°C (77°F–95°F); P_{out} ≥ 100 W

12.2 Data Link Layer Protocol

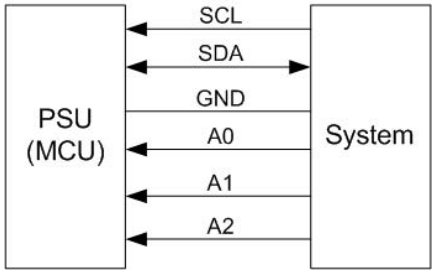
The link layer uses the PMBus V1.2 protocol and complies with *PMBus_Specification_Part_I_Rev_1-2_20100906* and *PMBus_Specification_Part_II_Rev_1-2_20100906*.

12.2.1 I2C Signal

The PSU includes a main control unit (MCU) used for monitoring and an electrically erasable programmable read only memory (EEPROM) of 256 bytes used for storing fault records. The PSU can use the EEPROM in the MCU to store fault records. The system sends commands to the MCU over the I2C bus to read fault records from the PSU. **Figure 12-1** shows the I2C interface communication diagram.

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Figure 12-1 I2C interface



SCL and SDA are the serial clock signal and the serial data signal of the I2C interface.

PSU side:	System side:
• SCL and SDA must be pulled up to 3.3 V by a 20-kilohm resistor. • The voltage source must be generated by the auxiliary power source and system-side 12 V bus that supplies power to the secondary MCU at the same time. • When power is supplied from the system side, the fuse or overcurrent/short-circuit protection circuit must be used. • The capacitance on the SCL and SDA in the PSU cannot exceed 66 pF.	The voltage of SCL and SDA is pulled up to 3.3 V by increasing the resistance by 3-10 kilohm.

12.2.2 I2C Address

Addresses A2, A1, and A0 are allocated to a PSU.

PSU side:

- Interconnection in the PSU: A2, A1, and A0 must be pulled up to the internal voltage source through a 10-kilohm (reference value) resistor. The voltage source must be the voltage source that supplies power to the secondary MCU. The voltage source is supplied by the internal auxiliary power source, which is generated by the PSU and system-side 12 V bus at the same time.
- When power is supplied from the system side, the fuse or overcurrent/short-circuit protection circuit must be used.

System side:

If this signal is connected to GND through a 300-ohm resistor, the address bit is 0. If this signal is left open, the address bit is 1.

The I2C addresses of the PSU from high to low are A2, A1, and A0. See **Table 12-2** for details.

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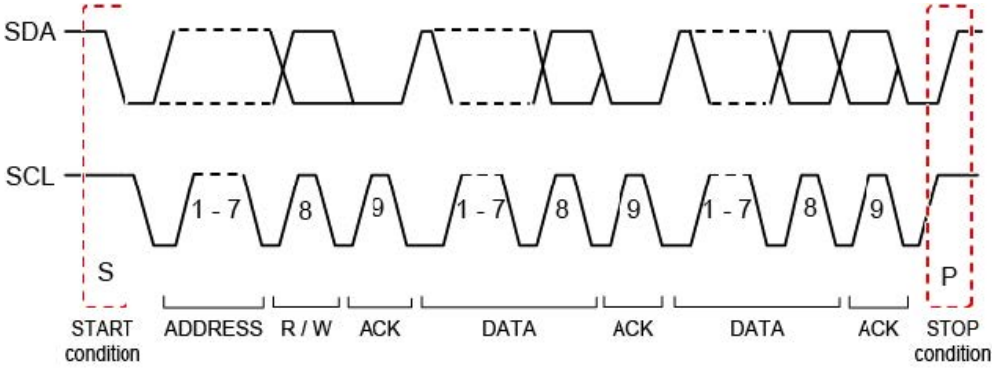
Table 12-2 I2C address

PSU A2/A1/A0	0/0/0	0/0/1	0/1/0	0/1/1	1/0/0	1/0/1	1/1/0	1/1/1
MCU	0xB0	0xB2	0xB4	0xB6	0xB8	0xBA	0xBC	0xBE

12.2.3 Data Transmission Mode

The I2C transmission standard is used. Data transmission rate is 100 Kbit/s. The timing definition of lower-layer signals, such as START, STOP, R/W, ADDRESS, ACK/NACK, bus arbitration, clock synchronization, and clock extension (except bus timeout), complies with PSMI. See **Figure 12-2** for the I2C data transmission mode.

Figure 12-2 I2C data transmission mode



12.2.4 Bus Timeout

The I2C program of the PSU is reset to 0 if the PSU detects that the SCL or SDA data line is held low for more than 300 ms.

12.3 Network Layer Protocol

12.3.1 Secondary Addressing Method

The PSU serves as the secondary device, and the PSU address is identified by the hardware and assigned in static mode. The primary device accesses secondary devices independently based on the secondary device addresses determined by the hardware

12.3.2 Data Packet Verification Mode

To ensure data integrity and accuracy during communication, the PSU uses the 8-bit CRC checksum mechanism.

The last byte of each sent and received communication is the CRC code of this signal.

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- When the primary device sends data to a secondary device, PEC (CRC) contains the address byte, read/write bit, command byte, and multiple pieces of data to be sent.
- The primary device obtains data from a secondary device: PEC (CRC) sent by the secondary device contains the address bytes obtained by the secondary device, read/write bits, command codes, and data bytes sent by the secondary device.

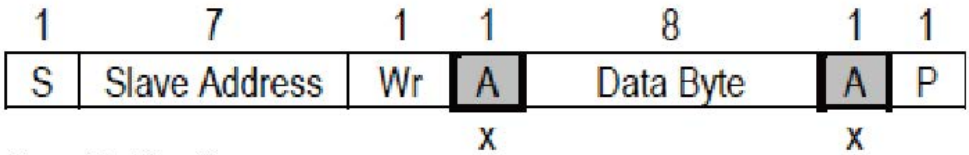


12.3.3 CRC Generation Rules

The generator polynomial is $x^8 + x^2 + x^1 + 1$, and the CRC code is 100000111.

12.3.4 Data Transmission

PMBus communication supports 10 data formats in total. All data formats adopt PEC verification.

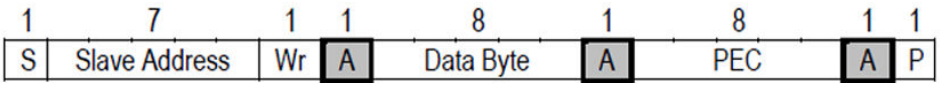


S: Start Condition
Sr: Repeated start condition
Rd: Read (bit value of 1)
Wr: Write (bit value of 0)
x: Shown under a field indicates that field is required to have the value of 'x'
A: Acknowledge (this bit position may be '0' for an ACK or '1' for a NACK)
P: Stop condition
PEC: Packet Error Code
...: Continuation of protocol

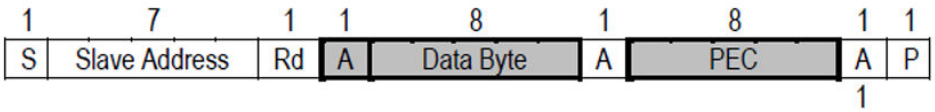
Master-to-Slave

Slave-to-Master

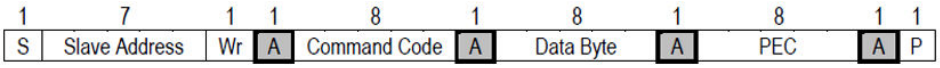
- Send Byte command and response.



- Receive Byte command and response.

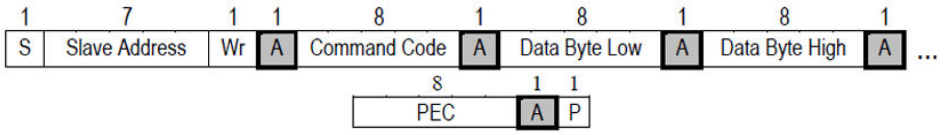


- Write Byte command and response.

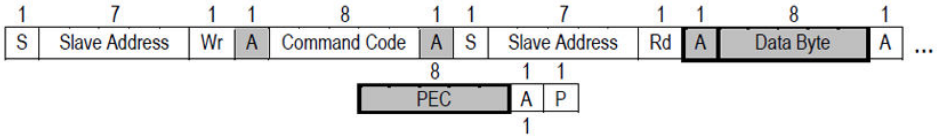


- Write Word command and response.

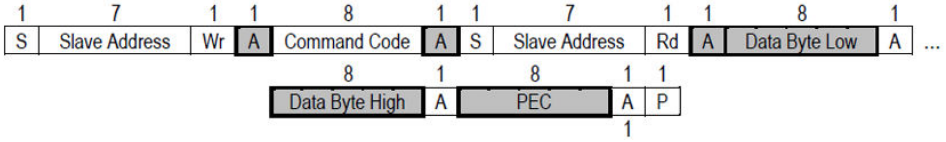
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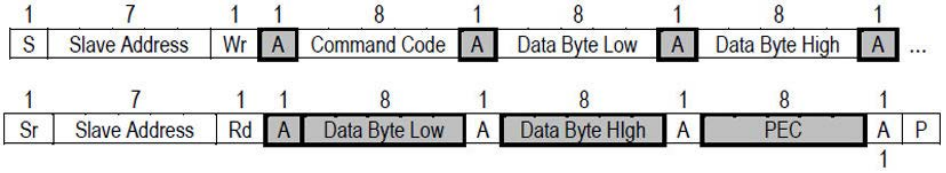
- Read Byte command and response.



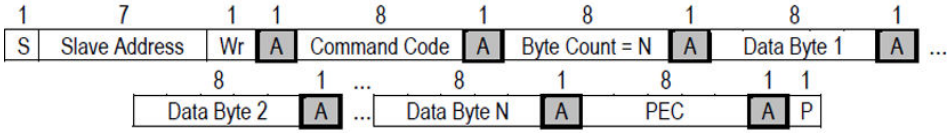
- Read Word command and response.



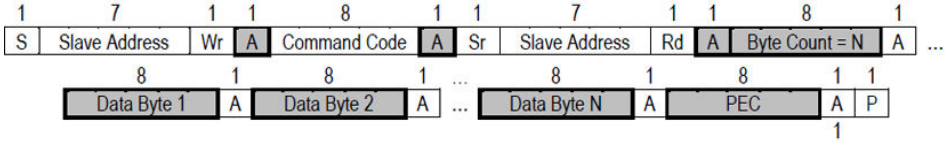
- Process Call command and response.



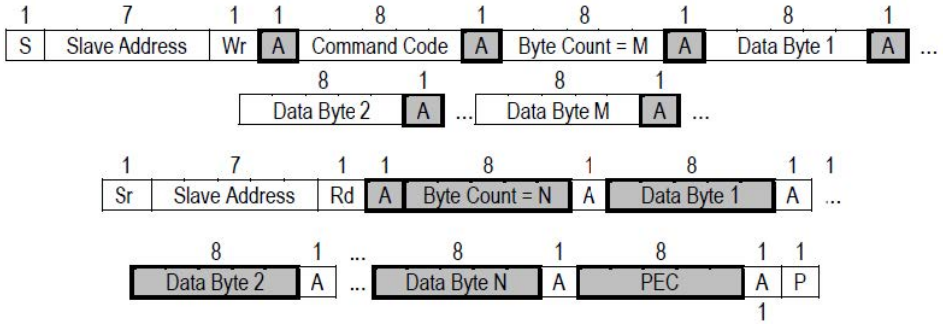
- Block Write command and response.



- Block Read command and response.



- Block Read – Block Write Process Call command and response.



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12.4 Application Layer Protocol

NOTE

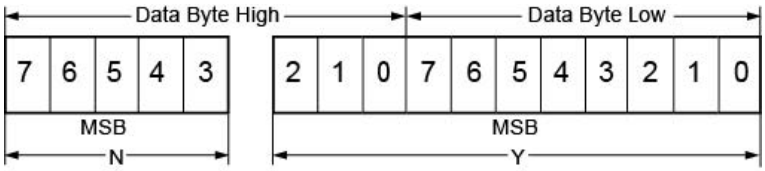
- The PMBus alarm is not latched. If a PSU is faulty, an alarm is reported. After the PSU fault is rectified, the alarm is automatically cleared.
- If the PSU is faulty, the system sends **CLEAR_FAULTS** to clear the alarm. If the alarm persists, the PSU continues to report the alarm.
- The **FAULT** alarm and the **WARNING** alarm are mutually exclusive.

12.4.1 Data Format

Linear 11 Data Format

The Linear 11 data format is a two-byte value with an 11-bit binary signed mantissa (two's complement) and a 5-bit binary signed exponent (two's complement), as shown in **Figure 1 Linear 11 data format**.

Figure 12-3 Linear 11 data format



The relationship between N, Y, and actual value X is given by the following equation:

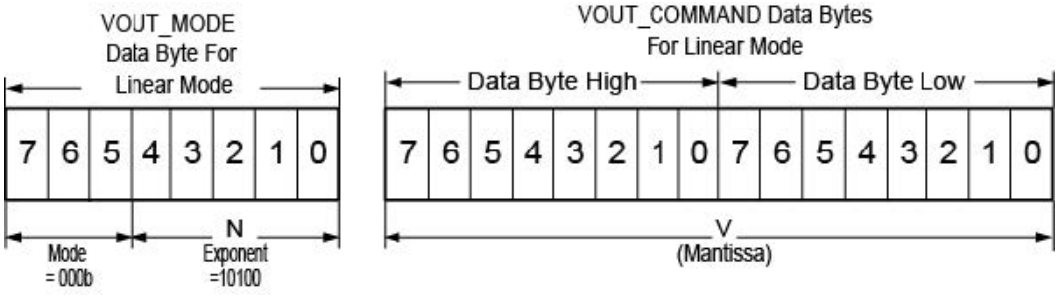
$X = Y \times 2^N$

- Where: Y is the 11-bit, binary signed mantissa (two's complement).
- N is the 5-bit, binary signed exponent (two's complement).

Linear 16 Data Format

The Linear 16 data format is a two-byte value with a 16-bit binary unsigned mantissa and a 5-bit binary signed exponent (two's complement), as shown in **Figure 12-4**.

Figure 12-4 Linear 16 data format



The output voltage is calculated as follows:

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Voltage = V x 2^N

- Where: Voltage is the output voltage value.
- V is the 16-bit unsigned integer.
- N is the 5-bit signed integer (two's complement), and N is –12.

12.4.2 Commands

Commands

Command ID	Command Name	Data Type	Data Format	Description
0x01	PMBUS_CMD_OPERATION	Read/ Write byte	HEX	Remote startup and shutdown ● 0x80: Start the PSU. ● 0x40: Soft shutdown. The PSOK time sequence meets the requirements. ● 0x00: Reset the PSU.
0x03	PMBUS_CMD_CLEAR_FAULTS	Write byte	HEX	Clearing faults; No parameter available; Sending the command with CRC and clearing the fault alarms after receiving the command.
0x20	PMBUS_CMD_VOUT_MODE	Read byte	HEX	Output mode
0x21	PMBUS_CMD_VOUT_CTRL	Read/ Write word	LINEAR 16 Q12	Output voltage configuration. In non-equipment mode, the voltage range must be 11.97 V to–12.35 V.
0x31	PMBUS_CMD_RATED_POUT	Read word	LINEAR 11	Maximum output power
0x3A	PMBUS_CMD_FAN_CONFIG	Read/ Write byte	HEX	Fan configuration; default value: 0xD0
0x3B	PMBUS_CMD_FAN_COMMAND	Read/ Write word	HEX	Fan speed setting
0x78	PMBUS_CMD_STATUS_BYTE	Read/ Write byte	HEX	Status single-byte
0x79	PMBUS_CMD_STATUS_WORD	Read/ Write word	HEX	Status dual-byte

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Command ID	Command Name	Data Type	Data Format	Description
0x7A	PMBUS_CMD_STATUS_VOUT	Read/ Write byte	HEX	Output voltage status
0x7B	PMBUS_CMD_STATUS_IOUT	Read/ Write byte	HEX	Output current status
0x7C	PMBUS_CMD_STATUS_INPUT	Read/ Write byte	HEX	Input status
0x7D	PMBUS_CMD_STATUS_TEMP	Read/ Write byte	HEX	Temperature status
0x7E	PMBUS_CMD_STATUS_CML	Read/ Write byte	HEX	CMD status
0x80	PMBUS_CMD_STATUS_MFR_SPECIFIC	Read/ Write byte	HEX	MFR status
0x81	PMBUS_CMD_STATUS_FANS	Read/ Write byte	HEX	Fan status
0x88	PMBUS_CMD_READ_VIN	Read word	LINEAR 11	Input voltage
0x89	PMBUS_CMD_READ_IIN	Read word	LINEAR 11	Input current
0x8B	PMBUS_CMD_READ_VOUT	Read word	LINEAR 16	Output voltage
0x8C	PMBUS_CMD_READ_IOUT	Read word	LINEAR 11	Output current
0x8D	PMBUS_CMD_READ_TEMPERATURE_1	Read word	LINEAR 11	Ambient temperature
0x8E	PMBUS_CMD_READ_TEMPERATURE_2	Read word	LINEAR 11	Primary side temperature (MOS1)
0x8F	PMBUS_CMD_READ_TEMPERATURE_3	Read word	LINEAR 11	Secondary side temperature (MOS1)
0x90	PMBUS_CMD_READ_FAN_SPEED	Read word	DEC	Fan speed
0x95	PMBUS_CMD_READ_FREQUENCY	Read word	LINEAR 11	PSU frequency

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Command ID	Command Name	Data Type	Data Format	Description
0x96	PMBUS_CMD_READ_POUT	Read word	LINEAR 11	Output power
0x97	PMBUS_CMD_READ_PIN	Read word	LINEAR 11	Input power
0x98	PMBUS_CMD_PMBUS_REVISION	Read byte	DEC	PMBus version
0x99	PMBUS_CMD_MFR_ID	Read block	ASCII	Vendor name
0x9A	PMBUS_CMD_MFR_MODEL	Read/ Write block	ASCII	PSU name
0x9B	PMBUS_CMD_HARD_VERSION	Read block	ASCII	Hardware version
0x9D	PMBUS_CMD_MFR_DATE	Read/ Write block	ASCII	Production date
0x9E	PMBUS_CMD_MFR_SERIAL	Read/ Write block	ASCII	Product SN
0xBD	PMBUS_CMD_E_LABLE_LENGTH	Read/ Write block	HEX	Length and frame length of the e-label
0xBE	PMBUS_CMD_E_LABLE_INDEX	Read/ Write word	DEC	E-label number
0xBF	PMBUS_CMD_E_LABLE_CONTENT	Read/ Write block	ASCII	E-label content
0xC0	PMBUS_CMD_POWER_CYCLE_TIME	Read/ Write word	DEC	Shutdown delay time ● Bits F–8: PSU shutdown delay time ● Bits 7–0: PSU shutdown time

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Command ID	Command Name	Data Type	Data Format	Description
0xC6	PMBUS_CMD_WARNING_COUNT1	Read/ Write word	DEC	Alarm counter 1; Writing 0x0000 clears the alarm and recounts the alarm. Writing other values does not take effect.
0xC7	PMBUS_CMD_WARNING_COUNT2	Read/ Write word	DEC	Alarm counter 2; Writing 0x0000 clears the alarm and recounts the alarm. Writing other values does not take effect.
0xC8	PMBUS_CMD_WARNING_COUNT3	Read/ Write word	DEC	Alarm counter 3; Writing 0x0000 clears the alarm and recounts the alarm. Writing other values does not take effect.
0xCC	PMBUS_CMD_MAX_VIN	Read/ Write word	LINEAR 11	Maximum input voltage; Writing 0x0000 clears the alarm, writing other values does not take effect.
0xCD	PMBUS_CMD_MAX_IIN	Read/ Write word	LINEAR 11	Maximum input current; Writing 0x0000 clears the alarm, writing other values does not take effect.
0xCE	PMBUS_CMD_PS_CONTROL	Read/ Write word	HEX	PSU control register; default value: 0x0000
0xCF	PMBUS_CMD_READ_POWER_TYPE	Read word	HEX	PSU types Currently, the PSU always reports 3, that is, AC & 240HVDC. The meanings of the data are as follows: ● 0: AC ● 1: 48 V DC ● 2: HVDC ● 3: AC & 240HVDC ● 4: AC & 240HVDC & 380HVDC

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Command ID	Command Name	Data Type	Data Format	Description
0xD0	PMBUS_CMD_SMART_ON_CONFIG	Read/ Write byte	HEX	Cold standby configuration command
0xD4	PMBUS_CMD_SET_PSALERT	Read/ Write byte	HEX	Forcible alarm command. ● Write 0x20 to forcibly interrupt the signal alarm. ● Write 0x00 to clear the software control and restore the PSU normal control. ● Writing other values is invalid.
0xD6	PMBUS_CMD_MAX_PIN	Read/ Write word	LINEAR 11	Maximum input power
0xD7	PMBUS_CMD_MAX_POUT	Read/ Write word	LINEAR 11	Maximum output power
0xD8	PMBUS_CMD_MAX_TEMP_MONITOR	Read/ Write word	LINEAR 11	Maximum temperature of the PSU air intake vent
0xDB	PMBUS_CMD_MAX_12V_IOUT	Read/ Write word	LINEAR 11	Maximum output current
0xDE	PMBUS_CMD_READ_PART_NUMBER	Read/ Write block	ASCII	xFusion number
0xDF	PMBUS_CMD_READ_INPUT_TYPE	Read word	HEX	Input voltage type PSU real-time input status: ● 0: no input or input voltage abnormal ● 1: AC input ● 2: HVDC ● 3: low-voltage DC (no such input is available)
0xE0	PMBUS_CMD_WRITE_EVENT_INDEX	Write byte	DEC	Black box No.
0xE0	PMBUS_CMD_READ_EVENT_LOG	Read block	HEX	Black box content

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Command ID	Command Name	Data Type	Data Format	Description
0xE1	PMBUS_CMD_WRITE_EVENT_LOG	Write word	HEX	Writing logs
0xE4	PMBUS_CMD_DCDC_SOFT_VER	Read word	HEX	DCDC software version
0xE7	PMBUS_CMD_PFC_SOFT_VER	Read word	HEX	DCDC software version
0xED	PMBUS_CMD_LED_CTRL	Read/ Write byte	HEX	LED control If bit 0 and bit 1 are written to 1 at the same time, the command is invalid. ● Bit 7: 1 indicates active PSU control (the indicator is valid), and 0 indicates PSU automatic control. ● Bit 1: 1 indicates that the orange LED indicator is on, and 0 indicates that it is off. ● Bit 0: 1 indicates that the green LED indicator is on, and 0 indicates that it is off.
0xEE	PMBUS_CMD_LOAD_SHARE_SCALE	Read/ Write byte	DEC	Coefficient of proportionality for current sharing, default value: 1. Value range: 1 to 8. For example, 1 indicates 1:1 and 4 indicates 1:4.
0xFA	PMBUS_CMD_UPDATE_TIME	Write block	TIME	Time serving
0xFB	PMBUS_CMD_LOAD_PARAM	Read block	HEX	Load parameters
0xFC	PMBUS_CMD_LOAD_START	Read/ Write word	HEX	Load commands
0xFD	PMBUS_CMD_LOAD_DATA	Write block	HEX	Load data

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12.4.3 Command Descriptions

PMBUS_CMD_STATUS_BYTE (0x78)

Bit Address	Command Name
7	Reserved
6	Reserved
5	VOUT_OV_FAULT
4	IOUT_OC_FAULT
3	VIN_UV_FAULT
2	TEMPERATURE
1	CML
0	Reserved

PMBUS_CMD_STATUS_WORD (0x79)

Bit Address	Command Name
(Low) 7	Reserved
6	Reserved
5	VOUT_OV_FAULT
4	IOUT_OC_FAULT
3	VIN_UV_FAULT
2	TEMPERATURE
1	CML
0	Reserved
(High) 7	VOUT
6	IOUT/POUT
5	INPUT
4	MFR_SPECIFIC
3	Reserved
2	FANS
1	Reserved
0	Reserved

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PMBUS_CMD_STATUS_VOUT (0x7A)

Bit Address	Command Name
7	VOUT_OV_FAULT
6	VOUT_OV_WARNING
5	VOUT_UV_WARNING
4	VOUT_UV_FAULT
3	Reserved
2	Reserved
1	Reserved
0	Reserved

PMBUS_CMD_STATUS_IOUT (0x7B)

Bit Address	Command Name
7	IOUT_OC_FAULT
6	Reserved
5	IOUT_OC_WARNING
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	Reserved

PMBUS_CMD_STATUS_ INPUT (0x7C)

Bit Address	Command Name
7	VIN_OV_FAULT
6	VIN_OV_WARNING
5	VIN_UV_WARNING
4	VIN_UV_FAULT
3	Reserved
2	Reserved

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Bit Address	Command Name
1	Reserved
0	Reserved

PMBUS_CMD_STATUS_TEMP (0x7D)

Bit Address	Command Name
7	OT_FAULT
6	OT_WARNING
5	Reserved
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	Reserved

PMBUS_CMD_STATUS_FANS (0x81)

Bit Address	Command Name
7	Fan 1 Fault
6	Reserved
5	Fan 1 Warning
4	Reserved
3	Fan 1 Speed Override
2	Reserved
1	Reserved
0	Reserved

PMBUS_CMD_STATUS_CML (0x7E)

Bit Address	Command Name
7	Reserved

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Bit Address	Command Name
6	Reserved
5	Packet Error Check Failed
4	Memory Fault Detected
3	Processor Fault Detected
2	Reserved
1	Other Communication Fault
0	Reserved

PMBUS_CMD_MFR_SPECIFIC (0x80)

Bit Address	Command Name
7	PSON12V#
6	INSTALLED#
5	IPOK
4	OPOK
3	OPERATION OFF
2	SET Interrupt
1	PFC ENABLED
0	PFC BUS UV

12.4.4 Online Upgrade

Both the primary and secondary sides of the PSU support online upgrade.

12.4.5 Black Box Function

The PSU has 440-byte space for storing fault logs. The PSU provides a read channel for external systems by the **Read Event Log** command.

12.4.5.1 Runtime Counter

The total runtime is the sum of the time when the PSU works properly (OPOK is normal), is presented in the unit of seconds, and occupies four bytes.

12.4.5.2 Event Log Update

The PSU maintains a circular event log of the last ten records. Before saving the event log, the PSU shall set the event update flag in the event log to 1. Each log shall

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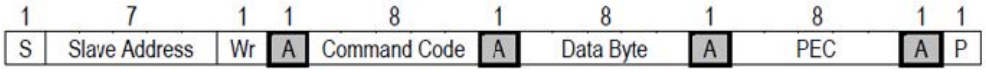
start with an event number followed by a 4-byte runtime (measured in seconds). The total runtime must be updated before the log is saved.

The PSU abnormality alarm status, input voltage, input current, output voltage, output current, temperature, fan speed, maximum input voltage, maximum output current, PS control, and other information will be stored in the fault record register. No output due to the hot swap, the switch PSU output operation and the **CYC_PWR** issued by the system cannot be saved by the PSU fault record function. Faults including input power failure, input overvoltage, input undervoltage, output overvoltage, output overcurrent/short-circuit, overtemperature, fan fault, and PSU damage will be stored. If a new fault is the same as the latest record in the event log, this fault will not be stored. That is, two consecutive same faults cannot exist in the fault record.

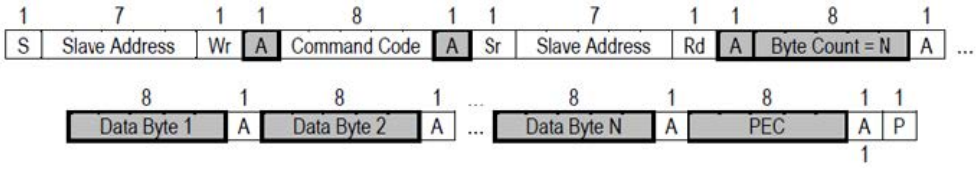
The runtime counter shall be updated every time an event occurs regardless of whether the event is written into the event log. When there are more than 10 events, the 11th event shall overwrite the 1st event, the 12th event shall overwrite the 2nd event, and so on.

12.4.5.3 Format of Reading Logs

- Write Byte Index (0–10)



- Read Block (N = 40)



12.5 Supply Retention

If the power supply works in parallel and one power supply has no input, the system must be able to communicate with the power supply.

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13 Heat Dissipation Requirements and Fan Control

The PSU supports forcible air cooling for heat dissipation. The PSU uses 40 mm (1.57 in.) x 40 mm (1.57 in.) fans. The power supply heats up in the exhaust mode, with air intake from the rear and air exhaust from the front (the output connector is the rear, and the input is the front).

Heat Dissipation Requirements

The fan should meet the following requirements:

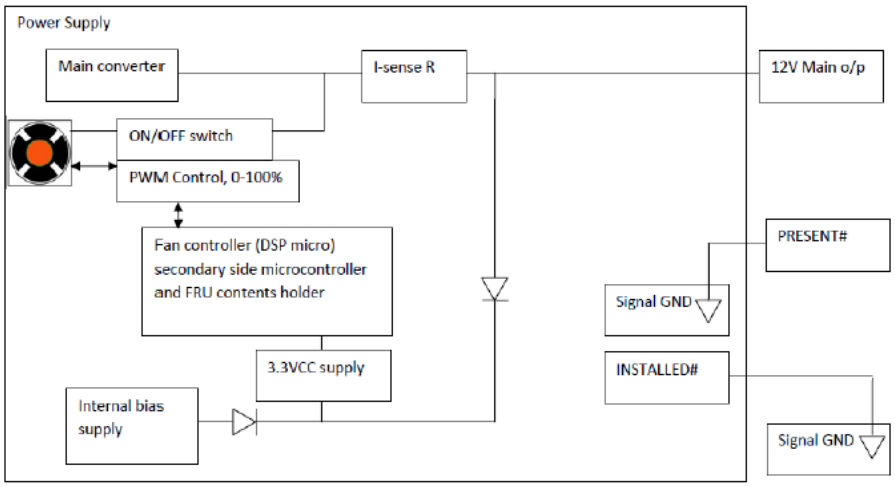
- In MV6 mode, the PSU will not trigger overtemperature protection when the fan works at the lowest speed.
- When the PSU is in MV12 mode, the fan operates at the required rotational speed. Ensure that overtemperature protection will not be triggered.
- The fan cannot stop rotating in the case of reverse power supply.
- Before overtemperature protection, the fan must operate at full speed.
- When the temperature at the air intake vent of the PSU reaches 45°C (113°F), the fan speed can be adjusted.

Fan Power Supply Mode

- The fan obtains power from the output bus. A fan fault cannot cause a system alarm or reset. The bus voltage must be greater than or equal to 11.0 V and the time when the bus voltage is lower than 11.4 V must not exceed 100 μs.
- The fan should be isolated if a fault occurs.
- The system can deliver a command to turn off the fan.

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Figure 13-1 Fan power supply circuit (for reference)



Noise Requirements

Air Intake Vent Temperature	Maximum Value	Test Method	Remarks
25°C (77°F)	50 dB (sound pressure level)	Tested at 1 m (39.37 in.) away from the PSU at 40% load	The noise sensor should face the air exhaust vent of the fan.

Fan Protection

- If PSUs are connected in parallel and one of the fans or the power supply circuit is short- circuited or open-circuited, the 12 V and 6 V routes of the system backplane should not exceed the normal dynamic change voltage restriction specifications. The system operation should not be affected.
- The fan fault detection circuit can report a fault only when it detects a fan or fan circuit fault and the fault lasts for over 20s.
- A fan fault can be rectified.

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14 Indicator on the Panel

The power supply of the indicator is the same as that of the secondary side MCU. The **Figure 14-1** shows the position of the indicator on the panel.

Figure 14-1 Indicators on the power module panel

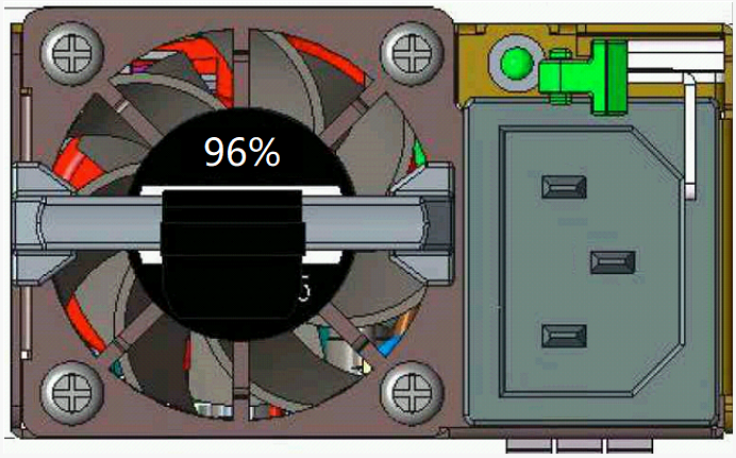


Table 14-1 Indicators on the power module panel

Indicator	Status	Description
Indicator	Steady green	The input and mains MV12 output are normal.

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Indicator	Status	Description
	Blinking green at 1 Hz	● The input is normal, and the PSU shuts down MV12 output due to the INSTALLED# signal. ● The input is normal. The PSU enters MV6 mode because the PSON12V# signal is at high level. ● The input is normal. After the MV6 is overcurrent, the power supply enters the MV12 mode. ● Input overvoltage or undervoltage occurs. ● The standby PSU is in cold standby mode. ● The PSU enters deep sleep mode. ● In low power mode, the PSON12V# and IP PRESENT signals are at low level and the PSU enters the SV12 mode. ● After the PSU enters MV12 mode due to overcurrent in SV12 mode, the green indicator blinks at 1 Hz.
	Steady orange	The input is normal. There is no output due to overtemperature protection, output overcurrent/short circuit, output overvoltage, short-circuit protection, or component failure (excluding failure of all components).
	Off	No input.
	Blinking green at 4 Hz	Online loading.

Table 14-2 Panel indicator luminance

Indicator	Meaning	Luminance Range
Green	Normal	>36cd/m2, <350cd/m2
Orange	Normal	>36cd/m2, <350cd/m2

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15 Product Storage, and Transportation

Storage Requirements

The product must be stored in a dry and well-ventilated warehouse where the temperature ranges from –40°C to +85°C (-40°F to +185°F), the relative humidity is not greater than 80%, and no corrosive gas exists.

Transportation Requirements

During transportation, the product must be securely placed in a packing case. The packing case must comply with related international standards and be printed with marks such as "Handle with care" and "Keep dry". The packing case containing the product can be transported by any means. The packing case must be protected against rains, snows, and mechanical impact during transportation.

Enclosure Protection

Table 15-1 Enclosure protection level

Item	Requirement
Enclosure protection level	IP20 (normal maintenance surface)

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A EMC Requirements

The power supply must be able to work with the whole system and pass the EMC test of the certification body. The specific specifications of the power supply are as follows.

Table A-1 AC&240 HVDC EMC requirements

Parameter	Conditions	Criterion
Conducted emission (CE)	6 dB margin	EN 55032, class A
Radiated emission (RE)	6 dB margin	EN 55032, class A
	6 dB margin, 30 MHz–1 GHz	FCC Part15, class A
ESD	Contact: 6 kV, air: 8 kV, Criterion B Contact: 8 kV, air: 15 kV, Criterion C	IEC61000-4-2
EFT	±2kV	IEC 61000-4-4, criterion B
RS	10 V/m, 80 MHz to 6 GHz	IEC 61000-4-3, criterion A
CS	10 V, 10 kHz–80 MHz	IEC 61000-4-6, criterion A
Surge	AC input surge: ● Differential mode: ±2.5 kV for L to N (1.2/50 μs, 2-ohm) ● Common mode: ±2.5 kV for L to PE, N to PE, and L and N to PE (1.2/50 μs, 12-ohm)	IEC 61000-4-5, criterion B
	HVDC input surge: ● Differential mode: ±2 kV for P to N (1.2/50 μs, 2-ohm) ● Common mode: ±2 kV for P to PE, N to PE, and P and N to PE (1.2/50 μs, 12-ohm)	IEC 61000-4-5, criterion B

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Parameter	Conditions	Criterion
Voltage fluctuation and flicker (for AC input only)	Voltage fluctuation and flicker limit of class A products	IEC61000-3-3
Current harmonics emission (for AC input only)	Harmonic current limit of class A products	IEC61000-3-2
Power magnetic susceptibility (PMS)	30A/m	IEC 61000-4-8: 2001, criterion A
DIP (AC)	Fall to 0% UT, duration: 10 ms (single power supply full load)	IEC 61000-4-11, criterion A
	Fall to 0% UT, duration: 20 ms (single power supply half load, dual power supply full load)	IEC 61000-4-11, criterion A
	Dip to 70% UT, hold-up time: 500 ms	IEC 61000-4-11, criterion B
	Dip to 0% UT, hold-up time: 5,000 ms	IEC 61000-4-11, criterion C
DIP (HVDC)	Dip to 40% UT, hold-up time: 1 ms/3 ms/10 ms/30 ms/100 ms/300 ms/ 1,000 ms	IEC 61000-4-11, criterion B
	Dip to 70% UT, hold-up time: 1 ms/3 ms/10 ms/30 ms/100 ms/300 ms/ 1000 ms	IEC 61000-4-11, criterion B
	Dip to 0% UT, hold-up time: 1 ms/3 ms/10 ms/30 ms/100 ms/300 ms/ 1000 ms	IEC 61000-4-11, criterion B
	Dip to 80% UT, hold-up time: 100 ms/300 ms/1000 ms/ 3,000 ms/ 10,000 ms	IEC 61000-4-11, criterion A
	Dip to 120% UT, hold-up time: 100 ms/300 ms/1,000 ms/ 3,000 ms	IEC 61000-4-11, criterion A

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B Product Safety Testing

Dielectric Strength Testing

Gas discharge tubes with input to ground cannot be used in the circuit.

Table B-1 Dielectric Strength Testing

Test Item	Minimum Test Voltage	Test Duration	Leakage Current	Arching Determination
Input and PE	2500V DC	1 min	≤10mA	No breakdown or arcing.
	1500 V AC (Available 2121 V DC equivalent)	1 min	≤10mA	No breakdown or arcing.
Output and PE	The SGND of the 12 V output and the PE are short-circuited inside the PSU.			

Ground Continuity Testing

Table B-2 Grounding continuity test

Test Item	Maximum Test Voltage	Test Current	Maximum Resistance	Test Duration
PE input terminal and case	12 V	25 A	0.1 ohm	Until the readings are stable

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C Reliability

Table C-1 Reliability

Parameter	Min.	Typical Value	Max.	Unit	Remarks
Mean time between failures (MTBF)	-	500,000	-	Hours	Telcordia SR332, V_{in} = 230 V AC/240 V DC; rated load, T_A = 25°C(77°F)

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