

DS495SPE-3

495 Watts Distributed Power System

Total Power: 495 Watts
Input Voltage: 90 to 264Vac
of Outputs: Main and Standby



Special Features

- Active power factor correction
- High-power and short form factor
- 80plus platinum efficiency
- 1U power supply
- Inrush current control
- EN61000-3-2 harmonic compliant
- N+1 or N+N redundant
- Active current sharing (10 - 100% load)
- PMBus™ compliant
- Full digital control
- Compatible with Artesyn's Universal PMBus™ GUI
- Two-year warranty
- Reverse airflow option
- RoHS

Safety

UL/cUL
Demko+ CB Report
CE Mark
CCC
BSMI

Product Descriptions

The DS495SPE-3 power supply features a very wide 90 to 264Vac input voltage range and employs active power factor correction to minimize input harmonic current distortion and to ensure compliance with the international EN61000-3-2 standard. The power supply also features active AC inrush current control, to automatically limit inrush current at turn-on to 25A maximum.

The DS495SPE-3 can deliver up to 41.25A from its main +12Vdc payload output, and up to 3A from its +12Vdc auxiliary output. The form factor is 1U and can be used in single or in redundant configurations.

DS495SPE-3 is compliant with 80plus Platinum Efficiency. Its efficiency is 94% at nominal high AC line with 50% of full load.

DS495SPE-3 is equipped with an I²C interface available with industry-standard PMBus™ communications protocol. It also contains a memory device that is preprogrammed with data about the unit - including its type, serial number and date of manufacture - to facilitate replacement in the field.

Model Numbers

Standard	Output Voltage	Minimum Load	Maximum Load	Standby Supply	Air Flow Direction
DS495SPE-3	12.0Vdc	0A	41.25A	12Vdc@3A	Forward (DC Connector to Handle)
DS495SPE-3-001	12.0Vdc	0A	41.25A	12Vdc@3A	Reverse (Handle to DC Connector)

Options

None

Electrical Specifications

Absolute Maximum Ratings

Stress in excess of those listed in the “Absolute Maximum Ratings” may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply’s reliability.

Table 1. Absolute Maximum Ratings:

Parameter	Model	Symbol	Min	Typ	Max	Unit
Input Voltage AC continuous operation	All models	$V_{IN,AC}$	90	-	264	Vac
Maximum Output Power (Main + Standby)	All models	$P_{O,max}$	-	-	495	W
Isolation Voltage Input to output Input to safety ground	All models All models		- -	- -	3000 2020	Vac Vac
Ambient Operating Temperature	DS495SPE-3 DS495SPE-3-001	T_A T_A	0 0	- -	+65 ¹ +60 ¹	°C °C
Storage Temperature	All models	T_{STG}	-40	-	+70	°C
Humidity (non-condensing)	All models		10	-	95	%
Altitude Operating Non-operating	All models All models		- -	- -	16,400 ² 50,000	feet feet
MTBF ³	All models		900	-	-	kHrs
Operating Life ⁴	All models		5	-	-	Years

Note 1 - The power supply can provide derated output power above 55°C, detail see page 22.

Note 2 - Operating altitude up to 16,400 feet, derated after 10,000 feet, detail see page 23.

Note 3 - It is calculated under 55°C ambient temperature and 80% $I_{O,max}$, Telcordia Issue 3 Method 1, Case 3.

Note 4 - It is calculated under 55°C ambient temperature and 80% $I_{O,max}$.

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC	All	$V_{IN,AC}$	90	115/230	264	Vac
Input AC Frequency	All	$f_{IN,AC}$	47	50/60	63	Hz
Maximum Input Current ($I_O = I_{O,max}$, $I_{SB} = I_{SB,max}$)	$V_{IN,AC} = 90Vac$	$I_{IN,max}$	-	-	6.6	A
Standby Input Current ($V_O = Off$, $I_{SB} = 0A$)	All	$I_{IN,Standby}$	-	-	150	mA
Standby Input Power ($V_O = Off$, $I_{SB} = 0A$)	All	$P_{IN,Standby}$	-	-	4	W
No Load Input Current ($V_O = On$, $I_O = 0A$, $I_{SB} = 0A$)	All	$I_{IN,no-load}$	-	-	200	mA
Harmonic Line Currents ¹	All	THD	Per EN61000-3-2			
Power Factor	$V_{IN,AC} = 115/230Vac$ 20% load and above	PF	0.9	-	-	
Startup Surge Current (Inrush) @ 25°C	$V_{IN,AC} = 264Vac$	$I_{IN,surge}$	-	-	25	A
Input Fuse	Internal, 5x20mm, Quick Acting 16A, 250V		-	-	16	A
Leakage Current to Earth Ground	$V_{IN,AC} = 264Vac$ $f_{IN,AC} = 50/60Hz$		-	-	1	mA
Operating Efficiency ²	$V_{IN,AC} = 230Vac$ $I_O = 10\% I_{O,max}$	η	82	-	-	%
	$I_O = 20\% I_{O,max}$		90	-	-	%
	$I_O = 50\% I_{O,max}$		94	-	-	%
	$I_O = 100\% I_{O,max}$		91	-	-	%
System Stability	Phase Margin Gain Margin		45	-	-	Ø
			-	-	-6	dB

Note 1 - Harmonic line currents meet 10%THD from 50% to 100% load.

Note 2 - Power supply is certified for 80plus Platinum Efficiency level at 230Vac. The loading conditions are defined according to CSCI criteria.

Output Specifications

Table 3. Output Specifications:

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Factory Set Voltage	All	V_O	-0.2	-	+0.2	% V_O
		V_{SB}	-2.5	-	+2.5	% V_{SB}
Output Regulation	Inclusive of set-point, temperature change, warm-up drift and dynamic load	V_O	11.4	12.0	12.6	Vdc
		V_{SB}	11.4	12.0	12.6	
Output Ripple, pk-pk	Measure with a 0.1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	120	mV _{PK-PK}
		V_{SB}	-	-	120	
Output Current	All	I_O	2.0 ¹	-	41.25	A
		I_{SB}	0.1	-	3	
V_O Current Share Accuracy	10% to 100% $I_{O,max}$		-	-	5	% $I_{O,max}$
Minimum Load for Current Sharing			10	-	-	% $I_{O,max}$
Load Capacitance	Start up		-	-	38000	uF
			-	-	4700	
V_O Dynamic Response Peak Deviation	50% load change, slew rate = 1A/uS	V_O	-	-	5	±% V_O
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins) $V_{IN,AC} = 100/200Vac$	V_O	-	-	0.5	±% V_O

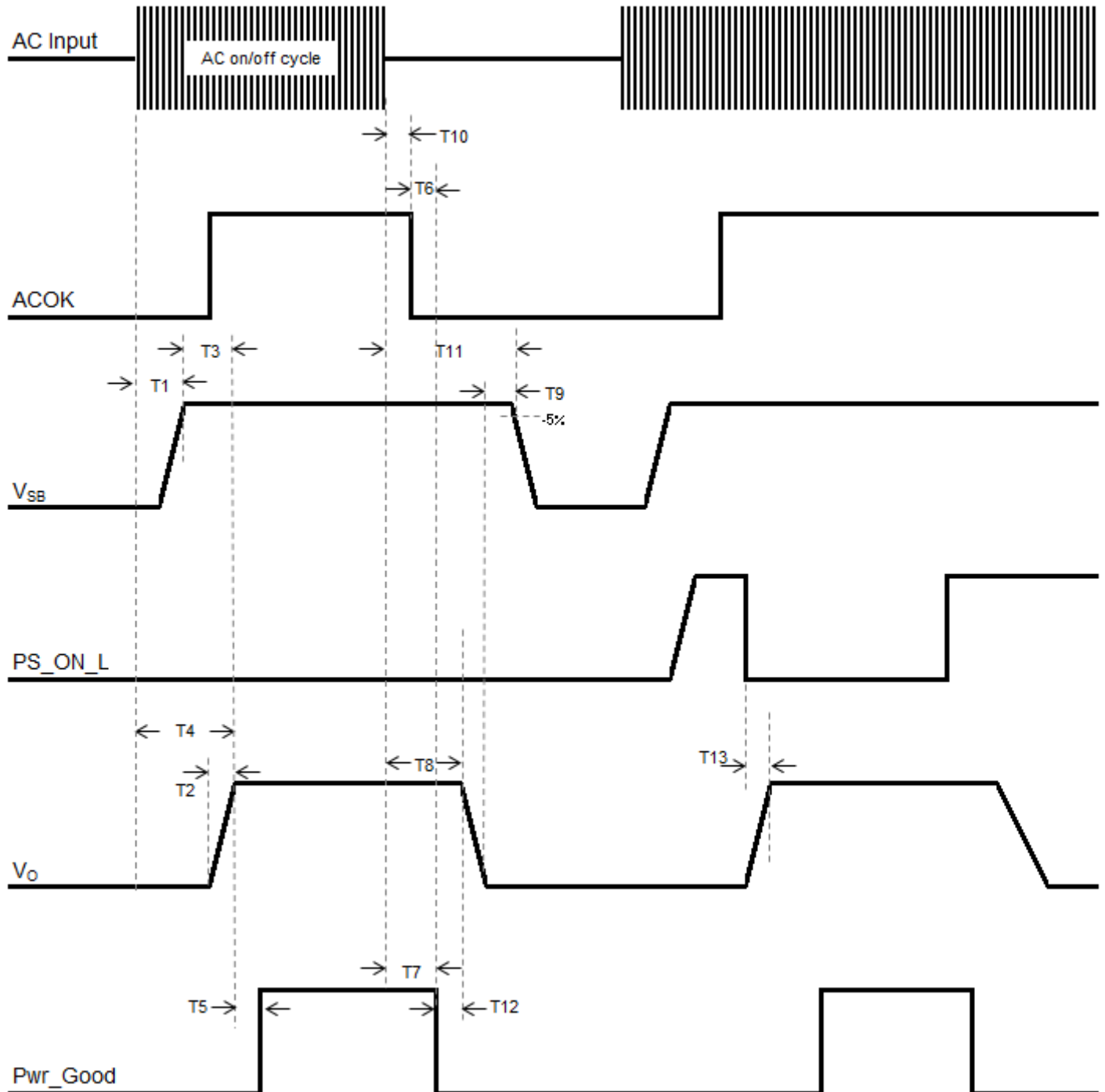
Note 1 - Minimum current for transient load response testing only. Unit is designed to operate and be within output regulation range at zero load.

System Timing Specifications

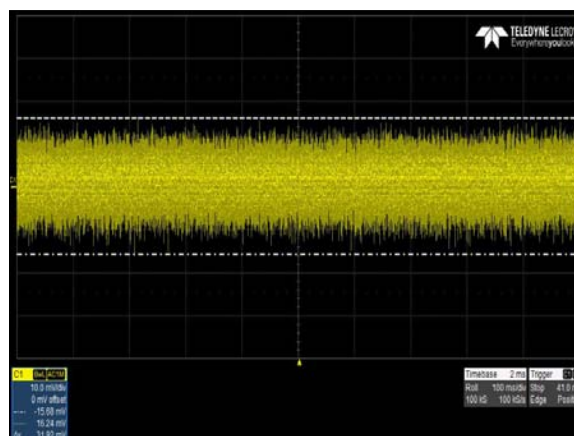
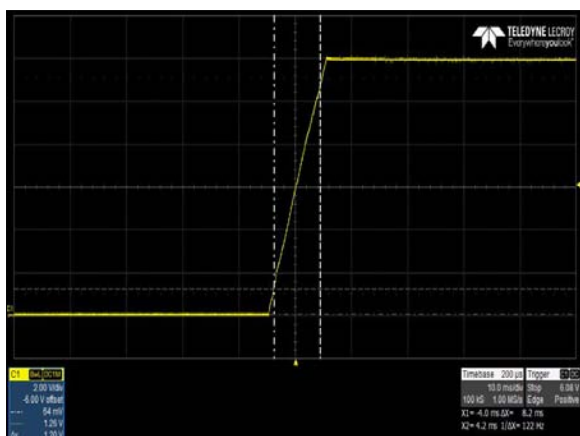
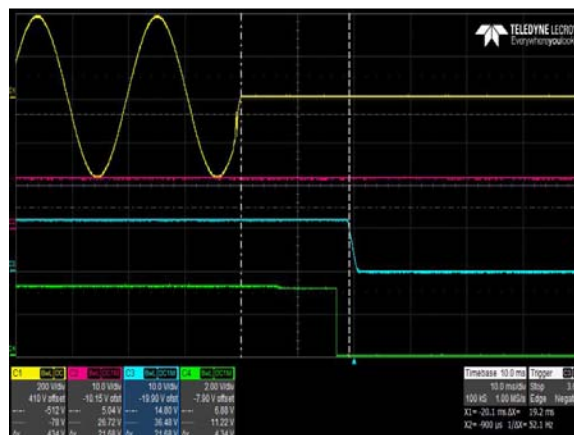
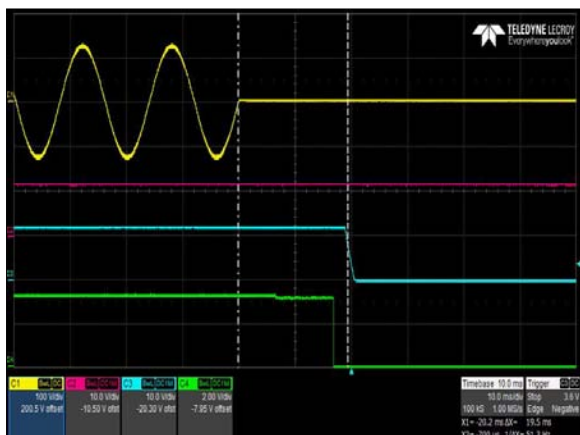
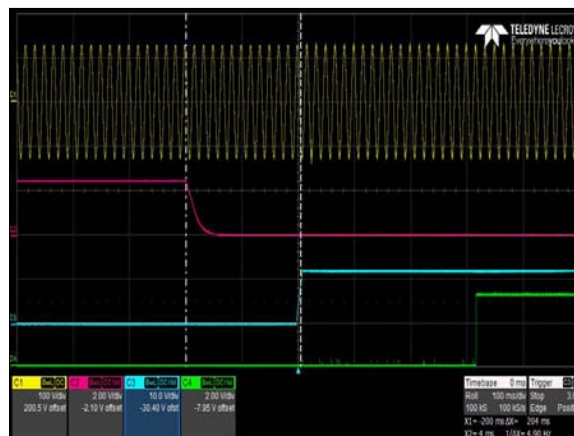
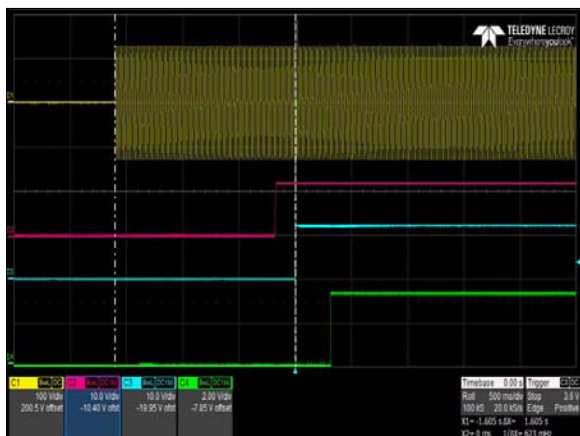
Table 4. System Timing Specifications:

Label	Parameter	Min	Typ	Max	Unit
T1	Delay from AC being applied to V_{SB} being within regulation	-	-	1700	mSec
T2	Output voltage rise time from 10% to 90% of the main output.	2	-	20	mSec
T3	Delay from Standby output to main output voltage being within regulation.	-	-	300	mSec
T4	Delay from AC being applied to main output voltages being within regulation.	-	-	2000	mSec
T5	Delay from output voltages within regulation limits to Pwr_Good asserted.	100	-	500	mSec
T6	Delay from deassertion of ACOK, due to AC loss, to the deassertion of PWOK	4	-	-	mSec
T7	Delay from loss of AC to deassertion of Pwr_Good	10	-	-	mSec
T8	Delay from loss of AC to main output being within regulation	11	-	-	mSec
T9	Delay from main output going <1V to Standby voltage falling out of regulation	5	-	-	mSec
T10	Delay from loss of AC to deassertion of ACOK	-	6	-	mSec
T11	Delay from loss of AC to Standby output being within regulation.	150	-	-	mSec
T12	Delay from deassertion of Pwr_Good to output voltages falling out of regulation.	1	-	-	mSec
T13	Delay from PS_ON_L assertion to output voltages being within regulation.	-	-	350	mSec

System Timing Specifications



DS495SPE-3 Performance Curves



DS495SPE-3 Performance Curves



Figure 7: DS495SPE-3 Turn Off Characteristic via PS_ON_L
Full Load: $I_O = 41.25A$
Ch 1: PS_ON_L Ch 2: V_O Ch 3: Pwr_Good

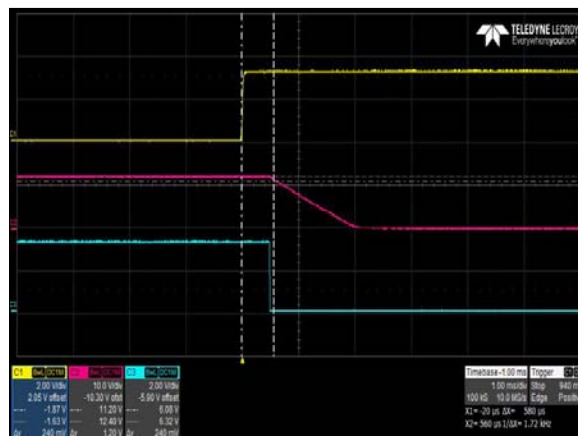


Figure 8: DS495SPE-3 Turn Off Characteristic via PS_KILL_L
Full Load: $I_O = 41.25A$
Ch 1: PS_KILL_L Ch 2: V_O Ch 3: Pwr_Good

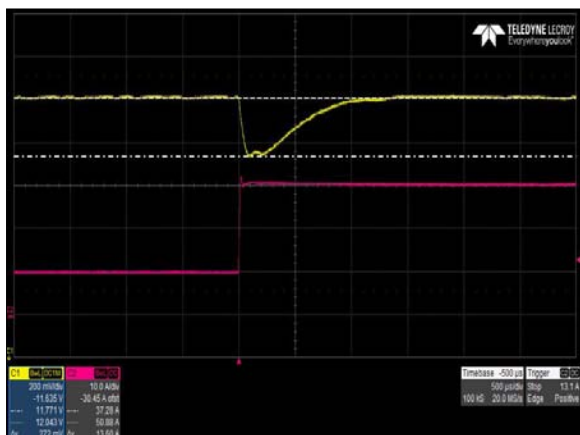


Figure 9: DS495SPE-3 Transient Response – V_O Deviation (low to high)
25% to 75% load change, $1A/uS$ slew rate, $V_{IN} = 230Vac$
Ch 1: V_O Ch 2: I_O Output capacitance=1000uF

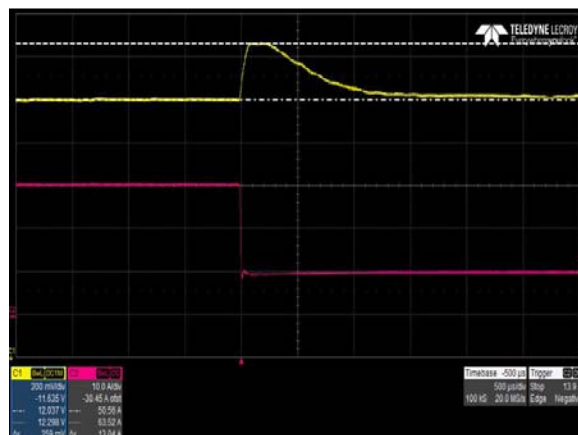


Figure 10: DS495SPE-3 Transient Response – V_O Deviation (high to low)
75% to 25% load change, $1A/uS$ slew rate, $V_{IN} = 230Vac$
Ch 1: V_O Ch 2: I_O Output capacitance=1000uF

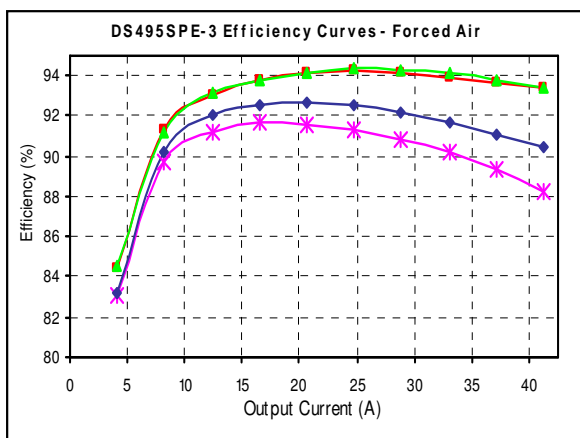


Figure 11: DS495SPE-3 Efficiency Curves @ 25 degC
—*— 90 Vac —◆— 115 Vac —■— 230 Vac —▲— 264 Vac
Loading: $I_O = 10\%$ increment to 41.25A

Protection Function Specification

Input Fusing

DS495SPE-3 series is equipped with an internal non user serviceable 16A Fast Acting 250Vac fuse to IEC 127 for fault protection in the L line input.

Over Voltage / Under Voltage Protection (OVP / UVP)

The power supply provides latch mode over and under voltage protection as defined by the output under voltage and output over voltage parameters for each output.

OVP

Parameter	Min	Nom	Max	Unit
V _O Output Overvoltage	13.5	/	15.0	V
V _{SB} Output Overvoltage	13.5	/	15.0	V

UVP

Parameter	Min	Nom	Max	Unit
V _O Output Undervoltage	10.0	/	10.5	V
V _{SB} Output Undervoltage	10.0	/	10.5	V

Over Current Protection (OCP)

DS495SPE-3 series includes internal current limit circuitry to prevent damage in the event of overload or short circuit. If the over-current is not more than 115% and does not last for more than 500 millisecond, the power supply continues to operate. Latch occurs when the over-current exceeds the conditions mentioned. If the overload is > 125% (+/-10% tolerance) of rated load, the power supply latches off immediately within 10ms. The latched state requires AC power / PS_ON_L recycling to restart the power supply. A fault in the main output does not cause the Standby Output to shut down.

The Standby has an OCP limit from 120% to 150% and auto-recover when the overload is removed. A fault in the Standby Output shuts down other outputs and auto-recovers when the overload on the Standby is removed.

Parameter	Min	Nom	Max	Unit
V _O Output Overcurrent	115	/	150	%I _{O,max}
V _{SB} Output Overcurrent	120	/	150	%I _{SB,max}

Short Circuit Protection (SCP)

The DS495SPE-3 power supply protects against a short circuit, which is defined as an impedance of 0.1 ohm or less, applied to any output during start-up or while running.

When the Standby output is shorted, the output goes into “hiccup mode”. When the Standby output attempts to restart, the maximum peak current from the Standby output is less than 20.0A peak. The maximum average current, taking into account the “hiccup” duty cycle, does not exceed the rated output current of the Standby.

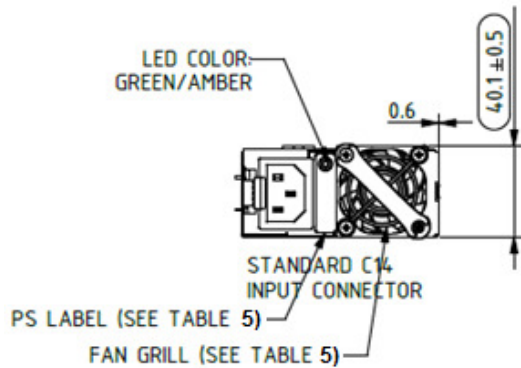
Over Temperature Protection (OTP)

The power supply is internally protected against over temperature conditions. When any of the sensing circuits have reached the OTP limit, all outputs, except Standby, shut down and remain off until the over-temperature condition no longer exist. Upon reaching the temperature recovery point, all outputs auto-recover.

Any OTP fault is reported in the PMBus™ status flag, without discriminating which OTP sensing circuit was triggered.

Mechanical Specifications

Mechanical Outlines (Unit: mm)



DS495SPE-3 (FORWARD FLOW) →
DS495SPE-3-001 (REVERSE FLOW) ←

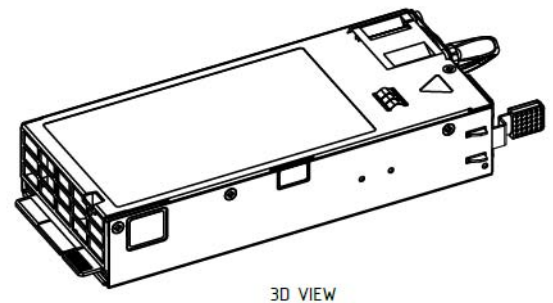
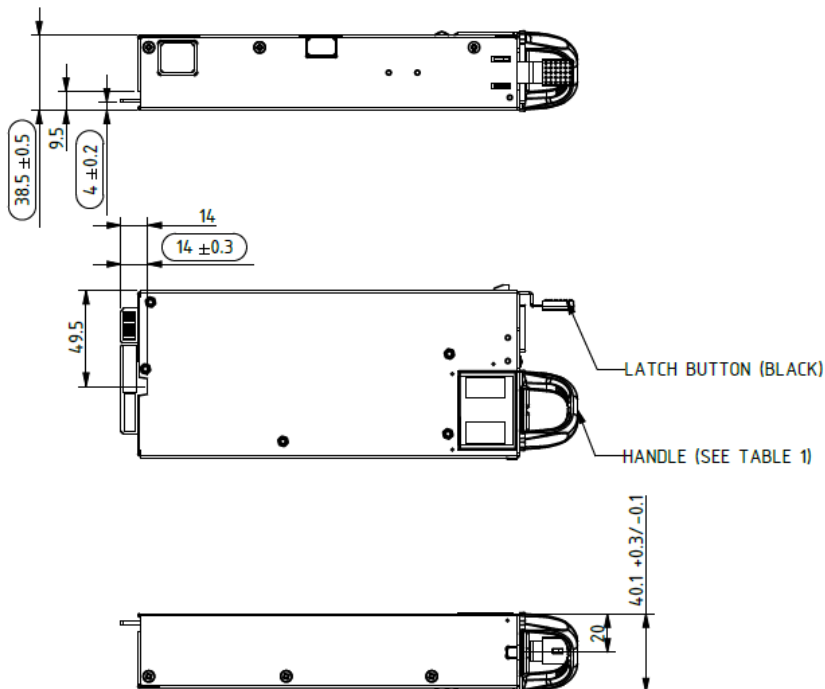
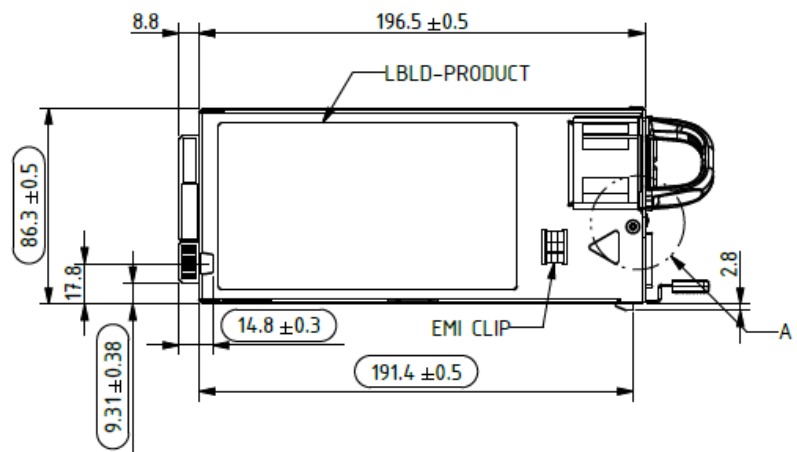
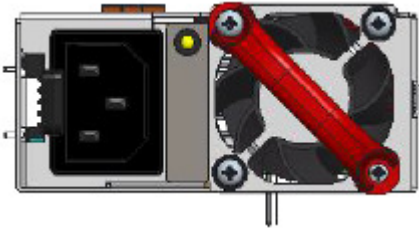
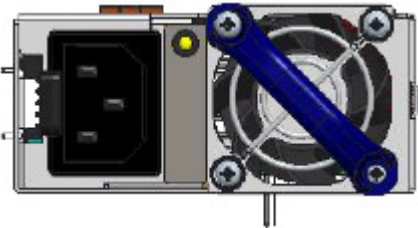


Table 5. Handle and fan for DS495SPE-3 series

DS495SPE-3 (Forward)	DS495SPE-3-001 (Reverse)
1. Red handle	1. Blue handle
2. No fan grill	2. With fan grill
	

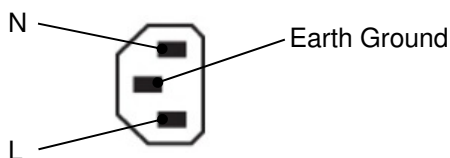
Recommended position for AC cord retention



Connector Definitions

AC Input Connector

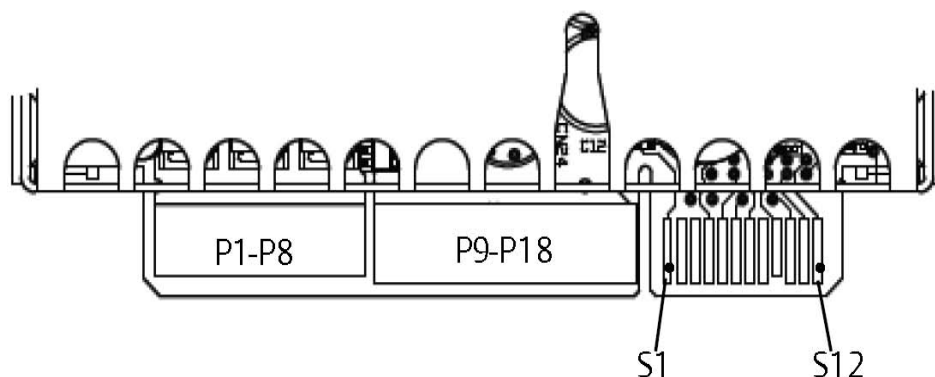
- Pin 1 – L
- Pin 2 – N
- Pin 3 – Earth Ground



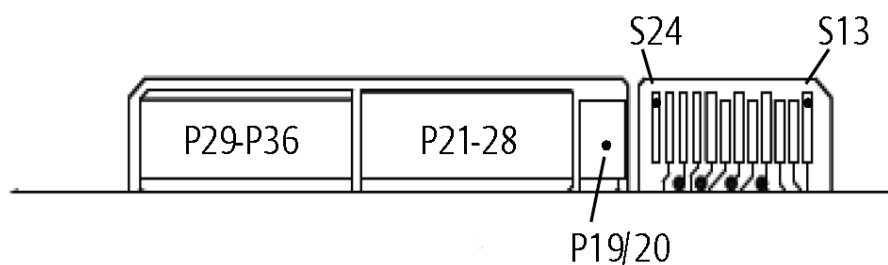
Output Connector – Power Blades

- P1-P8 – + Main Output (V_O)
- P9-P18 – Return
- P19-P20 – + Standby Output (V_{SB})
- P21-P28 – Return
- P29-P36 – + Main Output (V_O)

Power Supply Output Card Edge (Top Side)



Power Supply Output Card Edge (Bottom Side)



Output Connector – Control Signals

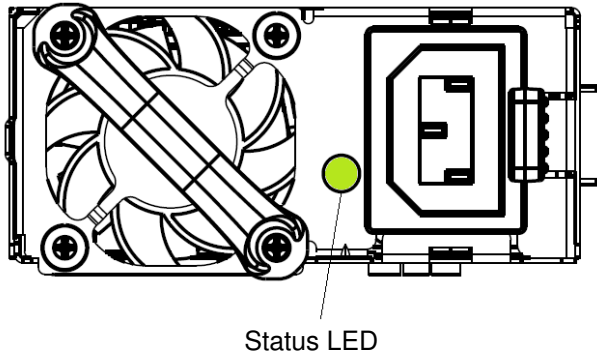
- S1 – PS PRESENT
- S2 – Reserved
- S3 – Reserved
- S4 – Pwr_Good(PWOK)
- S5 – ACOK (AC Input Present)
- S6 – RETURN
- S7 – ISHARE
- S8 – Reserved
- S9 – PS INTERRUPT_L
- S10 – RETURN
- S11 – Reserved
- S12 – Reserved
- S13 – PS_ON_L
- S14 – PS_KILL_L
- S15 – Reserved
- S16 – RETURN
- S17 – SDA
- S18 – RETURN
- S19 – SCL
- S20 – RETURN
- S21 – REMOTE SENSE-
- S22 – RETURN
- S23 – REMOTE SENSE+
- S24 – Reserved

Power / Signal Mating Connectors and Pin Types

Table 6. Mating Connectors for DS495SPE-3 series

Reference	On Power Supply	Mating Connector or Equivalent
AC Input Connector	IEC320-C14	IEC320-C13
Output Connector	Card-edge	FCI Power Blade 10107844-002LF or equivalent

LED indicator Definition



One bi-color (green/amber) LED at the power supply front provides status signal. The status LED conditions is shown on the below table.

Condition	LED Status
AC Input = ON, V_{SB} = ON, V_O = ON	Solid Green
AC Input = ON, V_{SB} = ON, V_O = OFF	Blinking Green, 2S on/1S off
V_O = OCP / OVP / OTP / FAN FAULT	Blinking Amber, 1S on/1S off
V_{SB} = OCP / OVP / OTP / FAN FAULT, V_O = OFF	Off
Power supply plugged into a live chassis, with no AC cord	Blinking Green, 2S on/1S off

Weight

The DS495SPE-3 series weight is 1.83 lbs / 830 g maximum.

Environmental Specifications

EMC Immunity

DS495SPE-3 series power supply is designed to meet the following EMC immunity specifications:

Table 7. Environmental Specifications:

Document	Description
FCC 47CFR 15 Subpart B / CISPR 22/ EN55022, Class A	Conducted and Radiated EMI Limits
EN61000-3-2	Harmonic Currents
EN61000-3-3	Voltage Fluctuations
IEC/EN 61000-4-2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – Electrostatic discharge immunity test. +/-15KV air, +/-8KV contact discharge, performance Criteria B
IEC/EN 61000-4-3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Radiated, radio-frequency, electromagnetic field immunity test, Criteria A
IEC/EN 61000-4-4	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient/Burst Immunity Test. 2KV for AC power port Criteria B, 0.5KV for DC ports, I/O and signal ports performance Criteria A.
IEC/EN 61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – 2KV common mode and 1KV differential mode for AC ports performance criteria B.
IEC/EN 61000-4-11	Electromagnetic Compatibility (EMC) - Testing and measurement techniques : Voltage Dips and Interruptions: >30% reduction for 500ms, Criteria C, >95% reduction for 10mS, Criteria A, >95% reduction for 500mS, Criteria C
EN55022	Information Technology Equipment-Immunity Characteristics, Limits and Method of Measurements

Safety Certifications

The DS495SPE-3 power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand alone product.

Table 8. Safety Certifications for DS495SPE-3 series power supply system .

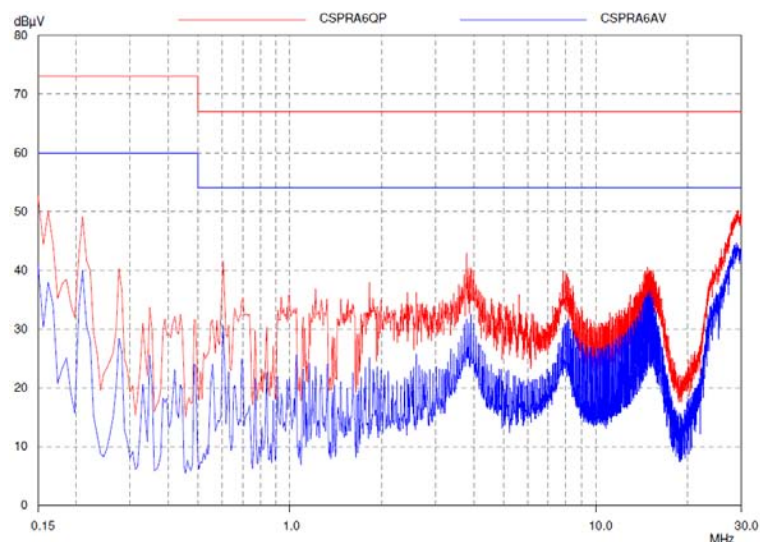
Document	File #	Description
UL 60950 No.	E186249-A256-UL-X6	US and Canada Requirements
EN60950	D-03244	European Requirements
CB Certificate and Report	DK-37859-UL	(All CENELEC Countries)
CHINA CCC Approval	2014010907690077	China Requirements
BSMI	CI333161602443	Taiwan Requirement
CE Mark	14133	

EMI Emissions

The DS495SPE-3 series has been designed to comply with the Class A limits of EMI requirements of EN55022 (FCC Part 15) and CISPR 22 (EN55022) for emissions and relevant sections of EN61000 (IEC 61000) for immunity. The unit is enclosed inside a metal box, tested at 495W using resistive load with cooling fan.

Conducted Emissions

The applicable standard for conducted emissions is EN55022 (FCC Part 15). Conducted noise can appear as both differential mode and common mode noise currents. Differential mode noise is measured between the two input lines, with the major components occurring at the supply fundamental switching frequency and its harmonics. Common mode noise, a contributor to both radiated emissions and input conducted emissions, is measured between the input lines and system ground and can be broadband in nature.



The DS495SPE-3 power supplies have internal EMI filters to ensure the convertors' conducted EMI levels comply with EN55022 (FCC Part 15) Class A and EN55022 (CISPR 22) Class A limits. The EMI measurements are performed with resistive loads at maximum rated loading.

Sample of EN55022 Conducted EMI Measurement at 110Vac input

Note: Red Line refers to Artesyn Quasi Peak margin, which is 6dB below the CISPR international limit. Blue Line refers to the Artesyn Average margin, which is 6dB below the CISPR international limit.

Conducted Emissions

Table 9. Conducted EMI emission specifications of the DS495SPE-3 series

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC Part 15, class A	All	Margin	-	-	6	dB
CISPR 22 (EN55022) class A	All	Margin	-	-	6	dB

Radiated Emissions

Unlike conducted EMI, radiated EMI performance in a system environment may differ drastically from that in a stand-alone power supply. It is thus recommended that radiated EMI is evaluated in a system environment. The applicable standard is EN55022 Class A (FCC Part 15). Testing AC-DC convertors as a stand-alone component to the exact requirements of EN55022 can be difficult, because the standard calls for 1m leads to be attached to the input and outputs and aligned such as to maximize the disturbance. In such a set-up, it is possible to form a perfect dipole antenna that very few AC-DC convertors could pass. However, the standard also states that an attempt should be made to maximize the disturbance consistent with the typical application by varying the configuration of the test sample.

Operating Temperature

The DS495SPE-3 series power supplies can start and operate within stated specifications at an ambient temperature from 0°C to 55°C under all load conditions with internal fan.

DS495SPE-3 can provide derated output power from 55°C up to 65°C ambient temperature max. DS495SPE-3-001 can provide derated output power from 55°C up to 60°C ambient temperature max.

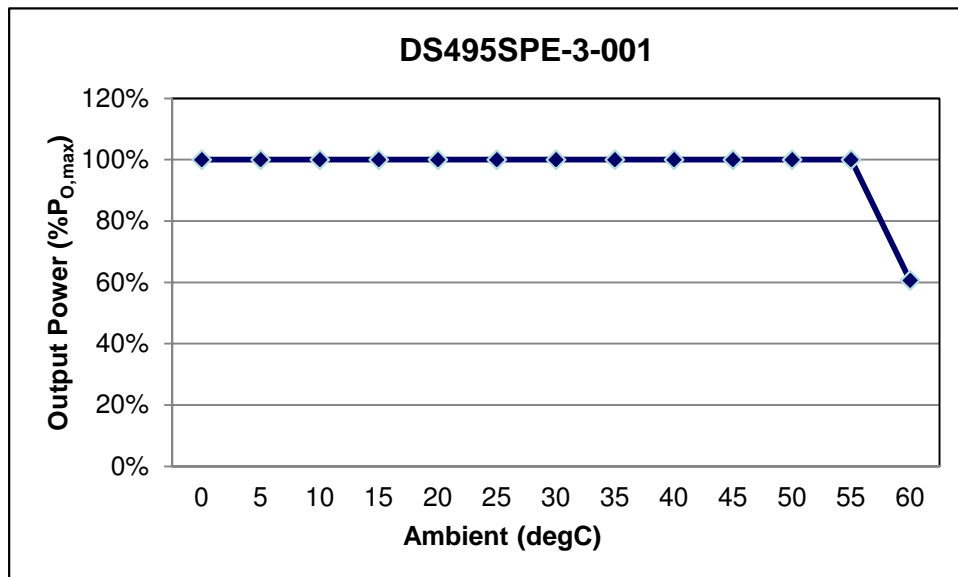
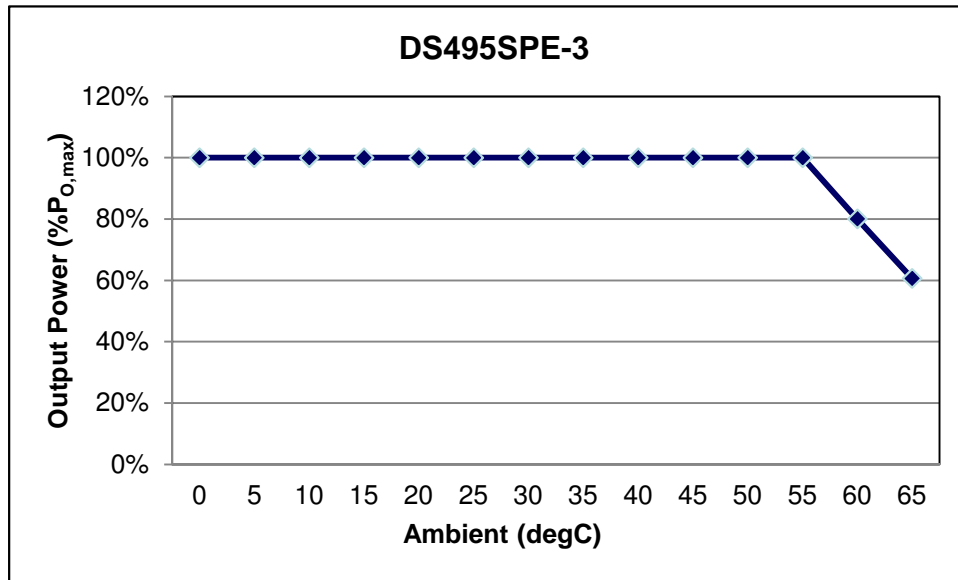
Forced Air Cooling

The DS495SPE-3 series power supplies include internal cooling fans as part of the power supply assembly to provide forced air-cooling to maintain and control temperature of devices and ambient temperature in the power supply to appropriate levels. The standard direction of airflow is from the DC connector end to the AC connector end of the power supply.

The cooling fan is a variable speed fan. In Standby mode power supply fan will operate at minimum speed to maintain component reliability at all load, line and ambient conditions. When 12V output is enabled, power supply fan will operate at minimum achievable fan speed. Power supply fan speed control algorithms will vary the speed so that the critical component temperatures do not exceed safe operating levels. Fans will be powered from voltage source inside the power supply and from system side voltage source.

Power Derating Curves

DS495SPE-3 series total output power will be derated according to the curve shown below.



Storage and Shipping Temperature

The DS495SPE-3 series power supply can be stored or shipped at temperatures between -40°C to +70°C.

Altitude

The DS495SPE-3 series will operate within specifications at altitudes up to 16,400 feet above sea level (ambient temperature derated to 45°C at 10,000 feet).

The power supply will not be damaged when stored at altitudes of up to 50,000 feet above sea level.

Humidity

Operating: Power supply will be designed to operate with no degradation of performance while operating in range of 10% RH to 95%RH non-condensing.

Non-Operating: Power supply will be designed to operate with no degradation of performance while operating in range of 10%RH to 95%RH non-condensing.

Vibration

The DS495SPE-3 series power supply will pass the following vibration specifications:

Non-Operating Random Vibration

Acceleration	3.12	gRMS
Frequency Range	5-500	Hz
Duration	15	mins
Direction	Rotating each axis (except front) on vertical vibration	
PSD Profile	<div> <div>FREQ</div> <div>5Hz</div> <div>20Hz</div> <div>500Hz</div> </div> <div> <div>SLOPE</div> <div>dB/oct</div> <div>0.002 g²/Hz</div> <div>0.020 g²/Hz</div> <div>0.020 g²/Hz</div> </div> <div> <div>PSD</div> <div>g²/Hz</div> </div>	

Operating Random Vibration

Acceleration	0.5	gRMS
Frequency Range	5-500	Hz
Duration	30	mins
Direction	Rotating each axis (except front) on vertical vibration	
PSD Profile	<div> <div>FREQ</div> <div>5Hz</div> <div>20Hz</div> <div>500Hz</div> </div> <div> <div>SLOPE</div> <div>dB/oct</div> <div>0.001 g²/Hz</div> <div>0.010 g²/Hz</div> <div>0.010 g²/Hz</div> </div> <div> <div>PSD</div> <div>g²/Hz</div> </div>	

Shock

The DS495SPE-3 power supply will pass the following shock specifications:

Non-Operating Half-Sine Shock

Acceleration	202	G
Duration	2	msec
Pulse	Half-Sine	
No. of Shock	3 shock on each of 6 faces	

Operating Half-Sine Shock

Acceleration	122	G
Duration	2	msec
Pulse	Half-Sine	
No. of Shock	3 shock on each of 6 faces except front	

Power and Control Signal Descriptions

AC Input Connector

This connector supplies the AC Mains to the DS495SPE-3 power supply.

- Pin 1 - L
- Pin 2 - N
- Pin 3 - Earth Ground

Output Connector – Power Blades

These pins provide the main output for the DS495SPE-3. The + Main Output (V_O) and the Main Output Return pins are the positive and negative rails, respectively, of the V_O main output of the DS495SPE-3 power supply. The Main Output Return is electrically not isolated from the power supply chassis.

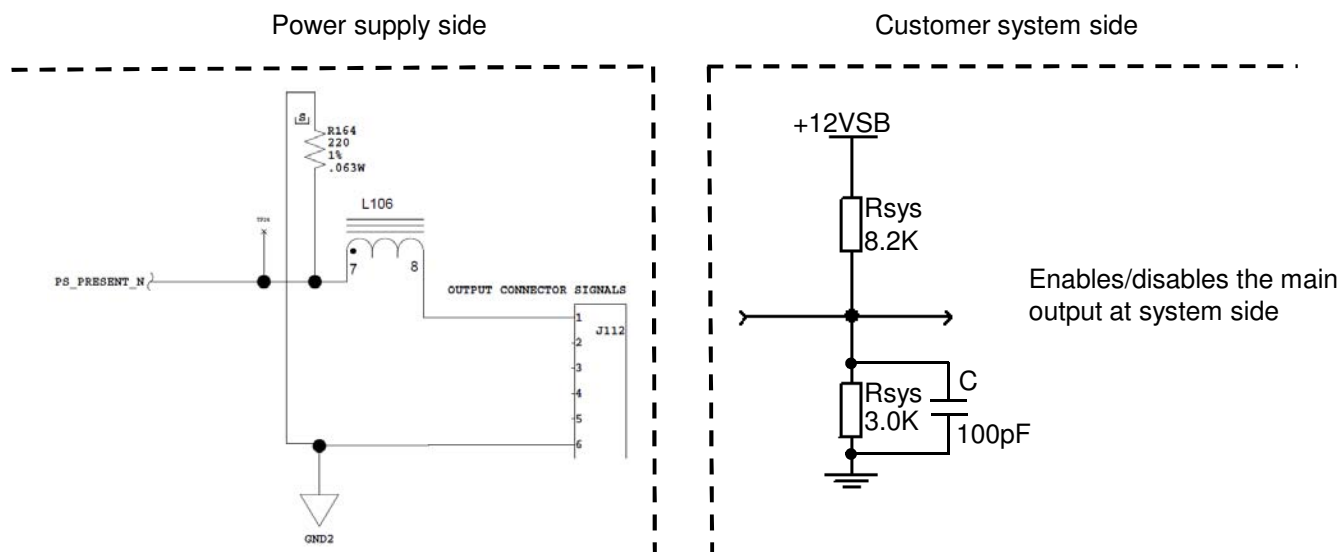
- P1-P8 - + Main Output (V_O)
- P9-P18 - Main Output Return
- P19-P20 - Standby Output (V_{SB})
- P21-P28 - Main Output / Standby Output Return
- P29-P36 - + Main Output (V_O)

Output Connector - Control Signals

The DS495SPE-3 series contains a 24 pins control signal header providing an analogue control interface and I²C interface signal connections.

PS_PRESENT – (pin S1)

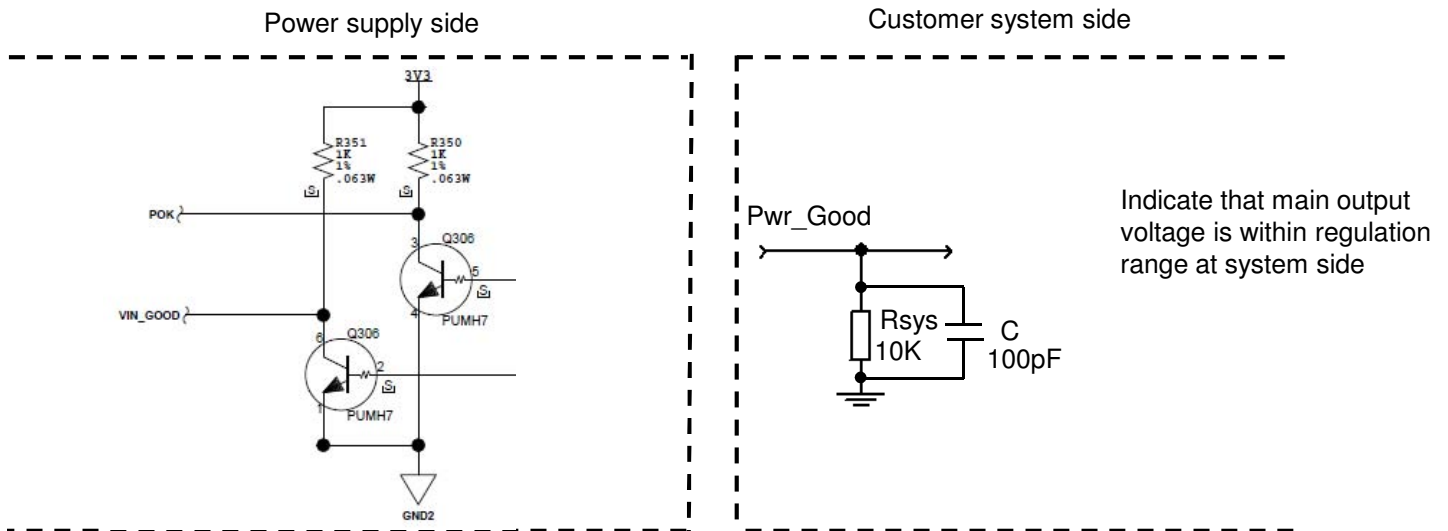
This signal pin is grounded to the Standby return via a 220ohm resistor inside the power supply. It can be used to sense the power supply is inserted in the system by using a suitable pull-up with noise filter capacitor. Recommended pull-up resistor to 12V Standby is 8.2K ohm with a 3.0K ohm pull-down to ground. A 100pF decoupling capacitor is also recommended.



Pwr_Good – (pin S4)

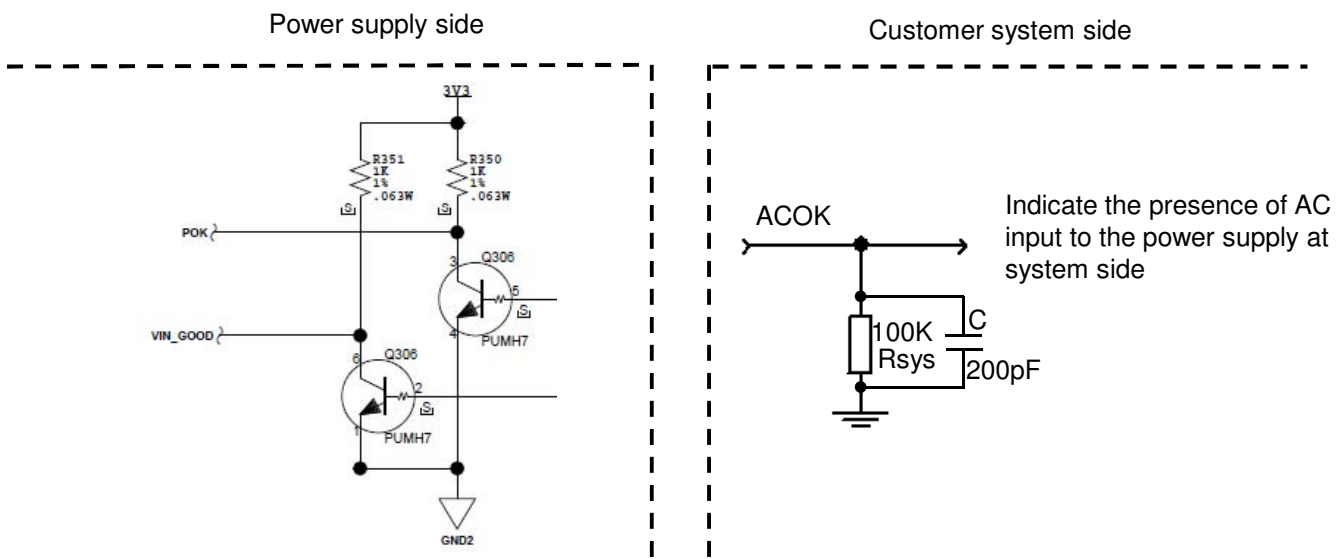
Signal used to indicate that main output voltage is within regulation range. The Pwr_Good signal will be driven HIGH (>2.0V) when the output voltage is valid and will be driven LOW (<0.4V) when the output falls below the under-voltage threshold. This signal also gives an advance warning when there is an impending power loss due to loss of AC input or system shutdown request.

This is an open collector/drain output. This pin is pulled high by a 1.0K ohm resistor connected to 3.3V inside the power supply. It is recommended that this pin is connected to a 100pF decoupling capacitor and pulled down by a 10K ohm resistor.



ACOK – (pin S5)

Signal used to indicate the presence of AC input to the power supply. A logic level HIGH (>2.0V) will indicate that the AC input to the power supply is within the operating range while a logic level LOW (0.4V) will indicate that AC has been lost. This is an open collector/drain output. This pin is pulled high by a 1.0K ohm resistor connected to 3.3V inside the power supply. It is recommended that this pin be connected to a 200pF decoupling capacitor and pulled down by a 100K ohm resistor.



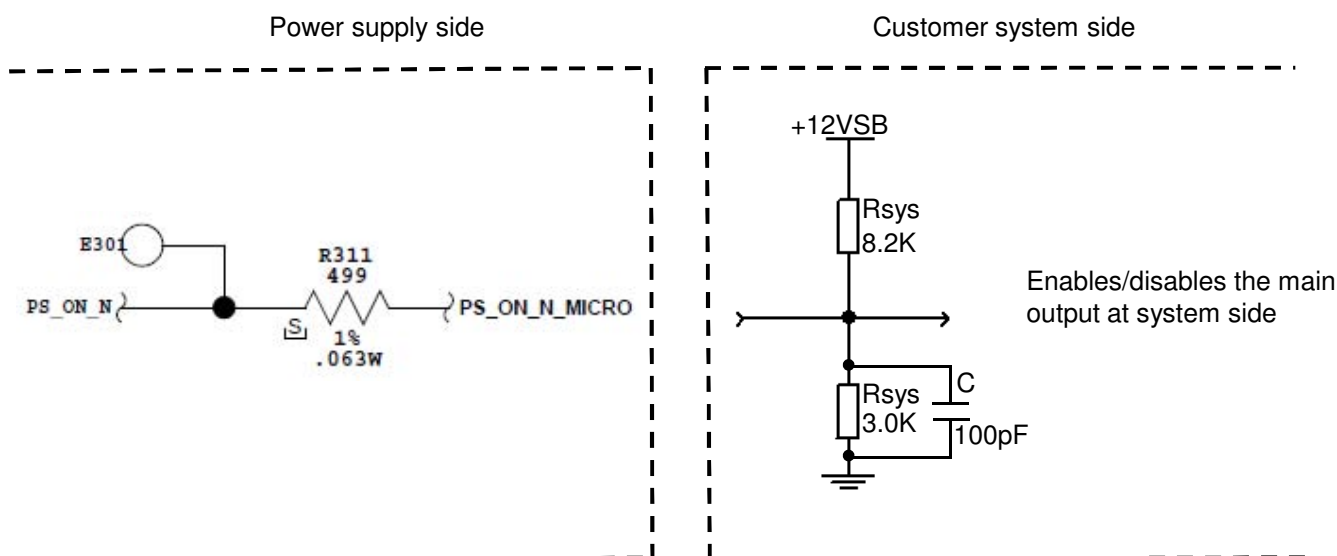
ISHARE – (pin S7)

The DS495SPE-3 supports active current sharing through a single wire connection between the power supplies. This input/output signal pin allows two or more power supplies to share the main output load current to increase the overall power capability or to operate the units in a N+M configuration for redundancy purposes.

All outputs of the DS495SPE-3 with ISHARE pins connected will share load current and the current share errors (CSE) are 4%, 8%, 16% and 40% of the average current at 100%, 50%, 25% and 10% rated load respectively. Example: When two DS495SPE-3 in parallel with ISHARE connected, then the difference between half of total load and supplies' current will not be greater than +/-1.65A at 100% load current (82.5A), +/-1.65A at 50% load current (41.25A), +/-1.65A at 25% load current (20.63A) and +/-1.65A at 10% load current (8.25A). The current share loop should be activated when the output current exceed 10% of total load current.

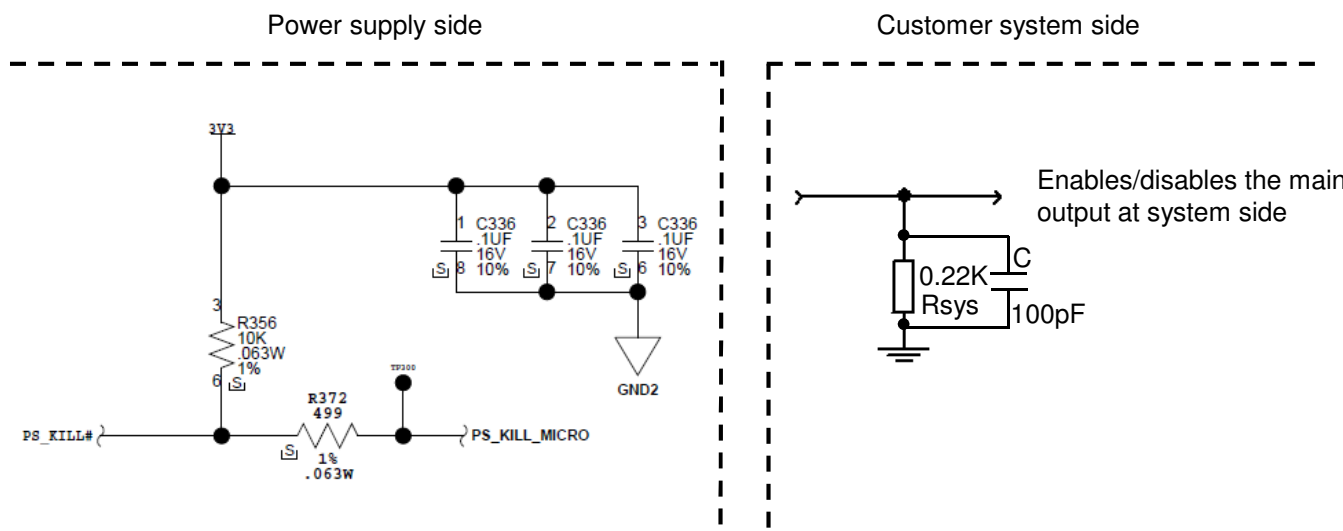
PS_ON_L – (pin S13)

This signal input pin controls the normal turning ON and Off of the Main Output of the DS495SPE-3 power supply. The power supply main output (V_O) will be enabled when this signal is pulled low (<0.8 V) by the system. The Power supply output (except V_{SB} output) will be disabled when this signal is pulled high (>2.0 V). This signal can be pulled high to 3.3V maximum. Recommended pull-up resistor to 12V V_{SB} is 8.2K ohm with a 3.0K ohm pull-down to ground. A 100pF decoupling capacitor is also recommended. For proper Power supply operation, it is recommended to provide separate PSON signal to each unit in a system.



PS_KILL_L – (pin S14)

This signal has the shortest pin in the output connector. It functions as the first break/ last mate. This enables or disables the 12V main output of the power supply. When this signal is shorted to ground by the system, the 12V main output is enabled. When this signal is opened by removal of the power supply from the system, the main output will shut down within 100uS. The recommended pull-down resistor is 220 ohm. A 100pF decoupling capacitor is also recommended. Standby output will remain on.



SDA, SCL and PS_INTERRUPT_L – (pin S17, S19 and S9)

Please refer to "Communication Bus Descriptions" section.

Main Output Remote Sense Return, Main Output Remote Sense – (pins S21, S23)

The main output of the DS495SPE-3 is equipped with a Remote Sensing capability that will compensate for a power path drop around the entire loop of 200 millivolt. This feature is implemented by connecting the Main Output Remote Sense (pin S23) and the Main Output Remote Sense Return (pin S21) to the positive and negative rails of the main output, respectively, at a location that is near to the load. Care should be taken in the routing of the sense lines as any noise sources or additional filtering components introduced into the voltage rail may affect the stability of the power supply. The DS495SPE-3 will operate appropriately without the sense lines connected; however it is recommended that the sense lines be connected directly to the main output terminals if remote sensing is not required. This remote sense circuit will not raise the power supply's output voltage to the OVP trip level. Main Output Remote Sense has no effect on the Standby Output (V_{SB}).

In the event of a failure of the remote sense lines, the output voltage should revert to the internal sense so as to limit the output voltage to less than 105% of the nominal.

Communication Bus Descriptions

I²C Bus Signals

The DS495SPE-3 power supply contains enhanced monitor and control functions implemented via the I²C bus. The DS495SPE-3 I²C functionality (PMBus™ and FRU data) can be accessed via the output connector control signals. The communication bus is powered either by the internal 3.3V supply or from an external power source connected to the Standby Output (i.e. accessing an unpowered power supply as long as the Standby Output of another power supply connected in parallel is on).

If units are connected in parallel or in redundant mode, the Standby Outputs must be connected together in the system. Otherwise, the I²C bus will not work properly when a unit is inserted into the system without the AC source connected.

Note: PMBus™ functionality can be accessed only when the PSU is powered-up.
Guaranteed communication I²C speed is 100K Hz.

SDA, SCL (I²C Data and Clock Signals) – (pins S17, S19)

I²C serial data and clock bus – there's no internal bias for these pins. These pins must be pulled-up in the system by an 2.2K ohm resistor to 3.3V and a 200pF decoupling capacitor at the system side.

PS_INTERRUPT_L – (pin S9)

PS_INTERRUPT_L is used to send a signal to the system that a fault in the power supply occurred. This signal is normally logic level HIGH. It will go to a LOW logic level when a fault bit has been set in the power supply's status register. This event can be triggered by faults such as OVP, OCP, OTP, and fan fault. This signal can be cleared by a CLEAR_FAULT command. Recommended pull-up resistor to 12V V_{SB} is 8.2K ohm with a 3.0K ohm pull-down to ground. A 200pF decoupling capacitor is also recommended.

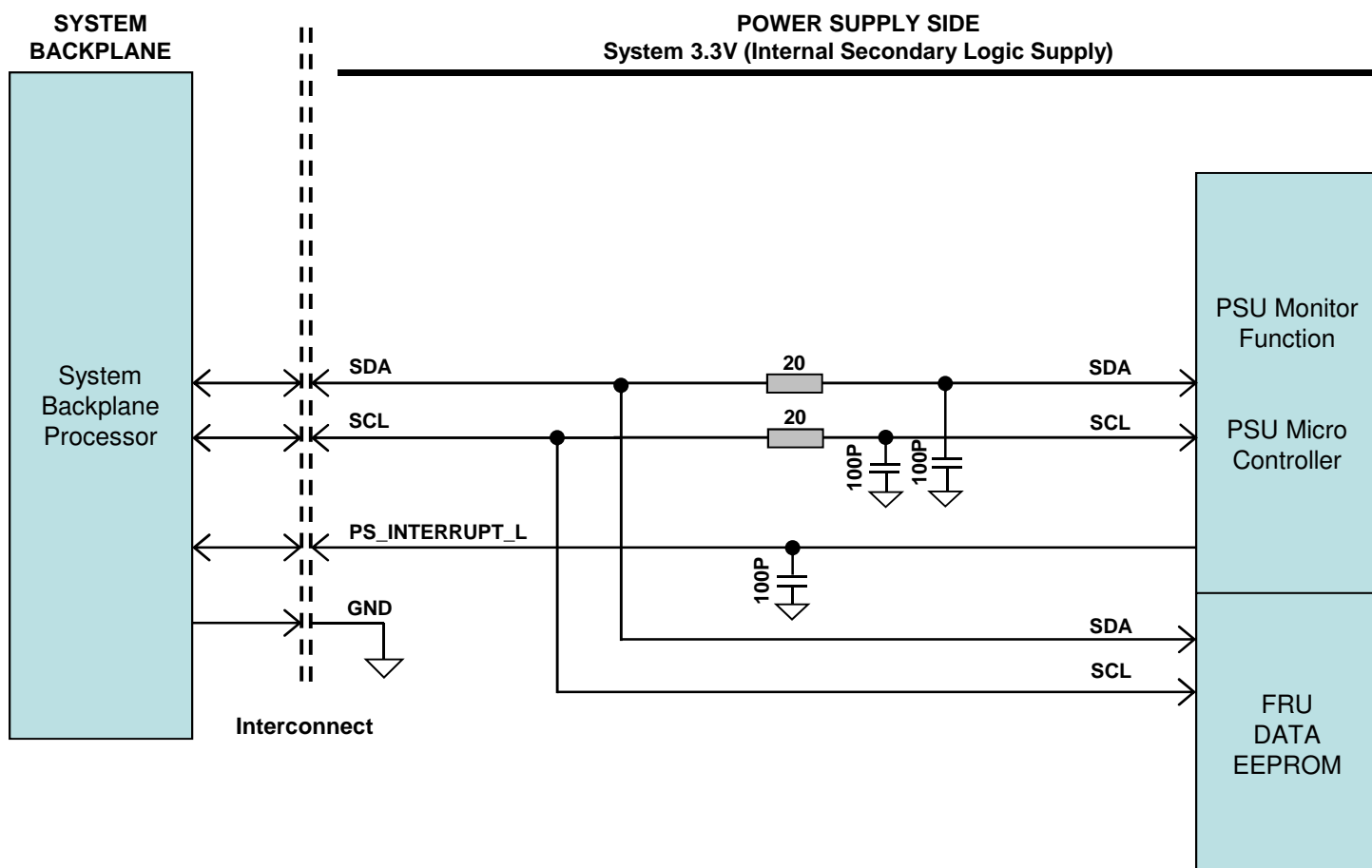
I²C Bus Communication Interval

The interval between two consecutive I²C communications to the power supply should be at least 15ms to ensure proper monitoring functionality.

I²C Bus Signal Integrity

The noise on the I²C bus (SDA, SCL lines) due to the power supply will be less than 300mV peak-to-peak. This noise measurement should be made with an oscilloscope bandwidth limited to 100MHz. Measurements should be made at the power supply output connector with 2.2K ohm resistors pulled up to Standby Output and 47pF ceramic capacitors to Standby Output Return.

I²C Bus Internal Implementation, Pull-ups and Bus Capacitances



I²C Bus - Recommended external pull-ups:

Electrical and Interface specifications of I²C signals (referenced to Standby Output Return pin, unless otherwise indicated):

Parameter	Condition	Symbol	Min	Typ	Max	Unit
SDA, SCL internal pull-up resistor		R_{int}	No pull-up resistor			
SDA, SCL recommended external bus capacitance		C_{ext}	-	200	-	pF
Recommended external pull-up resistor	1 PSU	R_{ext}	-	2.2	-	Kohm

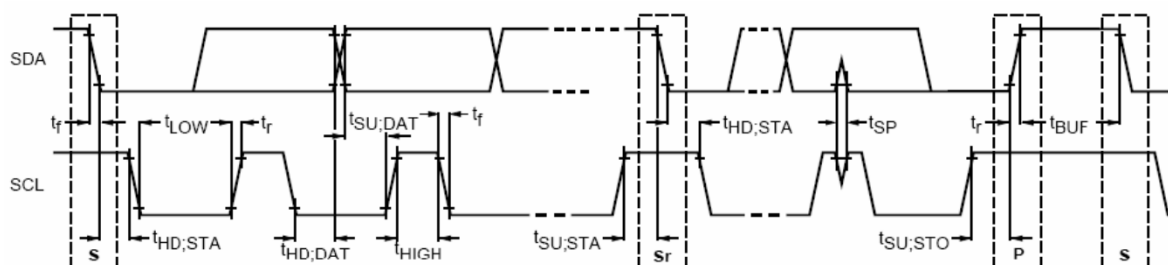
Logic Levels

DS495SPE-3 series power supply I²C Communication Bus will respond to logic levels as per below:

Logic High: 3.3V Nominal (Specs is 2.1V to 5.5V)**

Logic Low: 500mV nominal (Specs is 800mV max)**

Timings



Parameter	Symbol	Standard-Mode Specs		Actual		Unit
		Min	Max			
SCL Clock Frequency	f_{SCL}	0	100	100		KHz
Hold time (repeated) START condition	$t_{HD;STA}$	4.0	-	5.2		uS
LOW period of SCL clock	t_{LOW}	4.7	-	5.6		uS
HIGH period of SCL clock	t_{HIGH}	4.0	-	3.0		uS
Setup time for repeated START condition	$t_{SU;STA}$	4.7	-	4.8		uS
Data hold time	$t_{HD;DAT}$	0	3.45	0.8		uS
Data setup time	$t_{SU;DAT}$	250	-	4200		nS
Rise time	t_r	-	1000	SCL = 950	SDA = 1000	nS
Fall time	t_f	-	300	SCL = 160	SDA = 140	nS
Setup time for STOP condition	$t_{SU;STO}$	4.0	-	5.2		uS
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	31.4		mSec

Device Addressing

The DS495SPE-3 has a default I²C address 0xB0. This address has been set in the power supply side, there is no address bit accessible externally. In order to support multiple addresses, system side should use an I²C switcher or I²C expander. Contact Artesyn for the demo and application note of I²C switcher or I²C expander.

Contact Artesyn for availability of a variant model supporting multiple addresses.

Pull signaling pins S2, S3, and S24 at the system side to low for I²C addressing compatibility across all models in the short family of Front-end Bulk Power Series including the DS495SPE, DS750PED, DS1100PED and DS1600SPE.

Reporting Functions

The power supply is capable of monitoring and controlling functions implemented via the I²C bus. This will use the SDA and SCL pins. The power supply monitor operates as an I²C slave device.

The accuracy of the report functions will be as follows:

Firmware Reporting And Monitoring			
Output loading	5 to 20%	20 to 50%	50 to 100%
Input voltage	±5%		
Input current	±0.55A fixed error	±4%	
Input power	6.25W	5%	
Output voltage	±2%		
Output current	0.7A error, 1.5A for load<8%	±3%	
Temperature	±5 degC on the operating range		
E _{IN}	±15% from 10% to 20% load	±5%	
Fan speed	±250 RPM		

PMBus™	Yes
Remote ON/OFF	Yes

Note - Accuracy of input parameters applicable at nominal lines only.

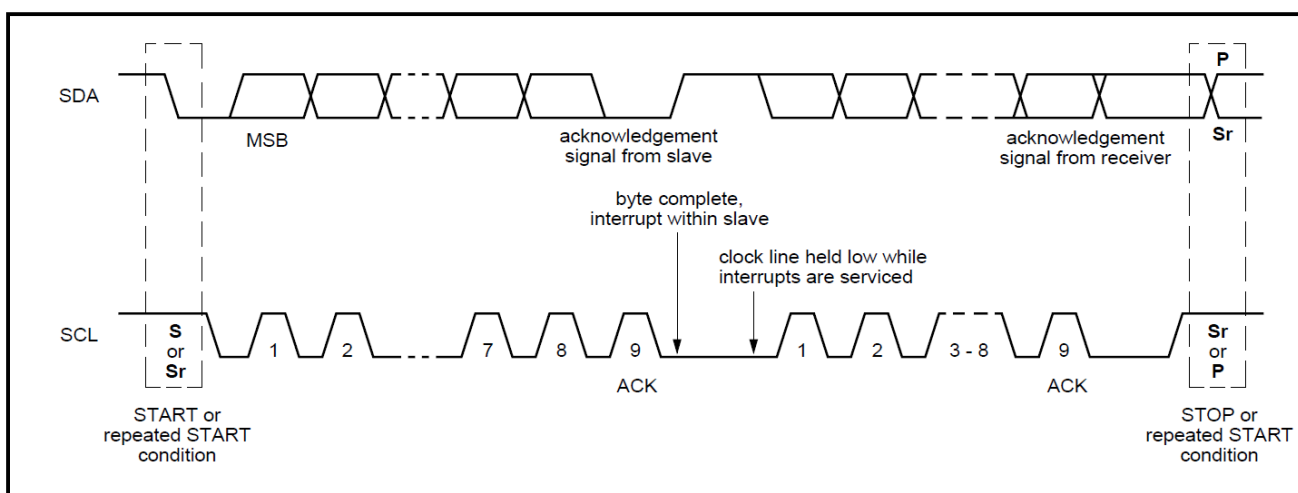
I²C Clock Synchronization

The DS495SPE-3 power supply might apply clock stretching. An addressed slave power supply may hold the clock line (SCL) low after receiving (or sending) a byte, indicating that it is not yet ready to process more data.

The system master that is communicating with the power supply will attempt to raise the clock to transfer the next bit, but must verify that the clock line was actually raised. If the power supply is clock stretching, the clock line will still be low (because the connections are open-drain).

The maximum time out condition for clock stretching for DS495SPE-3 is 25 millisecond.

The power supply has a command completion timeout of 100 millisecond. That is, a single transaction (from START to STOP condition) must be finished within 100 millisecond.



FRU (EEPROM) Data

The FRU (Field Replaceable Unit) data format is compliant with the Intel IPMI v1.0 specification. The DS495SPE-3 uses 1 page of EEPROM for FRU purpose. The one page of EEPROM contains up to 256 byte-sized data locations. By default, FRU Data is read-only.

Where: OFFSET - The OFFSET denotes the address in decimal format of a particular data byte within DS495SPE-3 EEPROM.

 VALUE - The VALUE details data written to a particular memory location of the EEPROM.

 DEFINITION - The contents DEFINITION refers to the definition of a particular data byte.

The FRU data storage and retrieval is performed using 0xB0 address and the following PMBus USER_DATA commands.

USER_DATA_00 (FRU_DATA_OFFSET) – Command code 0xB0

This command sets the offset address from which subsequent READ_FRU_DATA operations will commence. Writing to the FRU_DATA_OFFSET is performed using the block write protocol, as shown in the figure below:

S	Slave Addr / W	A	USER_DATA_00 Command Code	A	Byte Count = 2	A	Index LSB	A
---	----------------	---	------------------------------	---	----------------	---	--------------	---

...

Index MSB	A	PEC	A	P
--------------	---	-----	---	---

USER_DATA_01 (READ_FRU_DATA) – Command code 0xB1

This command is used to read the actual data in 16 byte blocks. By iterating the FRU_DATA_OFFSET, READ_FRU_DATA combination, all 256 bytes of the FRU image can be read.

Reading the FRU_DATA is performed using the block read protocol, as shown in the figure below:

S	Slave Addr / W	A	USER_DATA_01 Command Code	A
---	----------------	---	------------------------------	---

...

Sr	Slave Addr / Rd	A	Byte Count = 16	A	User Data Byte 1	A
----	-----------------	---	-----------------	---	---------------------	---

...

User Data Byte 2	A	...	User Data Byte N-1	A	User Data Byte N	A	PEC	N	P
---------------------	---	-----	-----------------------	---	---------------------	---	-----	---	---

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DS495SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
COMMON HEADER, 8 BYTES				
0	00	FORMAT VERSION NUMBER (Common Header) 7:4 - Reserved, write as 0000b 3:0 - Format Version Number = 1h for this specification	1	01
1	01	INTERNAL USE AREA OFFSET	22	16
2	02	CHASSIS INFO AREA OFFSET	1	01
3	03	BOARD INFO AREA OFFSET	0	00
4	04	PRODUCT INFO AREA OFFSET	4	04
5	05	MULTI RECORD AREA OFFSET	13	0D
6	06	PAD (reserved-Default value is 0.)	0	00
7	07	ZERO CHECK SUM (256 – (Sum of bytes 0 to 6))	215	D7
CHASSIS INFO AREA(24 BYTES)				
8	08	FORMAT VERSION NUMBER (Default value is 0.)	1	01
9	09	CHASSIS INFO AREA LENGTH (Default value is 0.)	3	03
10	0A	CHASSIS TYPE (Default value is 0.)	0	00
11	0B	CHASSIS PART NUMBER Type/Length Type = "ASCII+LATIN1" = (11)b Length = 10 Bytes = (001010)b	202	CA
12	0C	CHASSIS PART NUMBER BYTES (Default value is 0.)	0	00
13	0D		0	00
14	0E		0	00
15	0F		0	00
16	10		0	00
17	11		0	00
18	12		0	00
19	13		0	00
20	14		0	00
21	15		0	00
22	16	CHASSIS SERIAL NUMBER Type/Length Type = "ASCII+LATIN1" = (11)b Length = 7 Bytes = (000111)b	199	C7
23	17	CHASSIS SERIAL NUMBER BYTES , Default value is 0.	0	00
24	18		0	00
25	19		0	00
26	1A		0	00
27	1B		0	00
28	1C		0	00
29	1D		0	00
30	1E	End Tag (Default value is 0.)	193	C1
31	1F	ZERO CHECK SUM (From 8d to 30d if used.)	170	AA

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DS495SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
PRODUCT INFORMATION AREA, 72 BYTES				
32	20	FORMAT VERSION NUMBER	1	01
33	21	PRODUCT INFO AREA LENGTH (In multiples of 8 bytes)	9	09
34	22	Language	25	19
35	23	MANUFACTURER NAME Type/Length Type = "ASCII+LATIN1" = (11)b Length = 7 Bytes = (000111)b	199	C7
36	24	"A"= 41h	65	41
37	25	"R"= 52h	82	52
38	26	"T"= 54h	84	54
39	27	"E"= 45h	69	45
40	28	"S"= 53h	83	53
41	29	"Y"= 59h	89	59
42	2A	"N"= 4Eh	78	4E
43	2B	PRODUCT NAME Type/Length Type = "ASCII+LATIN1" = (11)b Length = 15 Bytes = (001111)b	207	CF
44	2C	"D"	68	44
45	2D	"S"	83	53
46	2E	"4"	52	34
47	2F	"9"	57	39
48	30	"5"	53	35
49	31	"S"	83	53
50	32	"P"	80	50
51	33	"E"	69	45
52	34	"_"	45	2D
53	35	"3"	51	33
54	36		xx	xx
55	37		xx	xx
56	38		xx	xx
57	39		xx	xx
58	3A		32	20
59	3B	PRODUCT PART/MODEL NUMBER Type/Length Type = "ASCII+LATIN1" = (11)b Length = 15 Bytes = (001111)b	207	CF
60	3C	"D"	68	44
61	3D	"S"	83	53
62	3E	"4"	52	34
63	3F	"9"	57	39
64	40	"5"	53	35
65	41	"S"	83	53
66	42	"P"	80	50
67	43	"E"	69	45
68	44	"_"	45	2D
69	45	"3"	51	33
70	46		xx	xx
71	47		xx	xx
72	48		xx	xx
73	49		xx	xx
74	4A		32	20
75	4B	PRODUCT VERSION NUMBER Type/Length Type = "ASCII+LATIN1" = (11)b Length = 2 Bytes = (000010)b	194	C2
76	4C	"0"	48	30
77	4D	"A" (Should track customer part revision in IPRO)	65	41
78	4E	PRODUCT SERIAL NUMBER Type/Length Type = "ASCII+LATIN1" = (11)b Length = 13 bytes = (001101)b	205	CD

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DS495SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
79	4F	Model ID. Per unit.	xx	xx
80	50		xx	xx
81	51		xx	xx
82	52		xx	xx
83	53	MANUFACTURING YEAR AND WEEK CODE "W"=57h (Per Unit)	87	57
84	54		87	57
		UNIQUE SERIAL NUMBER "SSSS"		
85	55	"S" = 53 (Per Unit)	83	53
86	56	"S" = 53 (Per Unit)	83	53
87	57	"S" = 53 (Per Unit)	83	53
88	58	"S" = 53 (Per Unit)	83	53
89	59	MODEL REVISION , Astec Model Rev, See Latest Model Rev in IPS Sec 1.2 "R"	82	52
90	5A		"R"	82
91	5B	MANUFACTURING LOCATION "P" for "Laguna, Philippines" In Decimal = 080 In Hex = 50H	80	50
92	5C	Product Serial Number: ASSET TAG (Default = 0)	0	00
93	5D	End of Fields Marker	193	C1
94	5E	PAD (reserved) (Default value is 0.)	0	00
95	5F		0	00
96	60		0	00
97	61		0	00
98	62		0	00
99	63		0	00
100	64		0	00
101	65		0	00
102	66		0	00
103	67	ZERO CHECK SUM (256 – (Sum of bytes 032 to 103)) Per Unit	xx	xx
Multi Record Area, 72 Bytes				
104	68	Power Supply Record Header Record type = 00 for Power supply End of List /Record Format Version Number Record Length of Power Supply Record Record CHECKSUM of Power Supply Record (Zero CHECKSUM) (256-(sum of bytes 109 to 132) Header CHECKSUM of Power Supply Record Header (Zero CHECKSUM) (256-(sum of bytes 104 to 107)	0	00
105	69		2	02
106	6A		24	18
107	6B		149	95
108	6C		81	51
Power Supply Record				
109	6D	Overall Capacity of the Power Supply 2 Bytes Sequence 495W = 01EFH In Decimal = 239, 1 In Hex = EFH, 01H	239	EF
110	6E		1	01
111	6F	Peak VA, FFFFH if not specified 2 Bytes Sequence In Decimal = 255, 255 In Hex = FFH, FFH	255	FF
112	70		255	FF
113	71	Inrush Current, 25A In Decimal = 25 In Hex = 19H	25	19
114	72	Inrush Interval, 0mS In Decimal = 00 In Hex = 00H	0	00

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DS495SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
115 116	73 74	Low End Input Voltage Range 1(10mV) , (90V / 10mV) 9000 = 2328H 2 Bytes Sequence In Decimal = 040, 035 In Hex = 28H, 23H	40 35	28 23
117 118	75 76	High End Input Voltage Range 1(10mV) , (264V/10mV) 26400= 6720H 2 Bytes Sequence In Decimal = 032, 103 In Hex = 20H, 67H	32 103	20 67
119 120	77 78	Low End Input Voltage Range 2(10mV) Not Applicable (Autoswitch)	0 0	00 00
121 122	79 7A	High End Input Voltage Range 2(10mV) Not Applicable (Autoswitch)	0 0	00 00
123	7B	Low End Input Frequency Range , 47Hz = 2FH	47	2F
124	7C	Low End Input Frequency Range , 63Hz = 3FH	63	3F
125	7D	AC Dropout Tolerance in ms , 10mS= 0AH	10	0A
126	7E	Binary Flags	26	1A
127 128	7F 80	Peak Wattage Capacity and Holdup Time , Not Specified	0 0	00 00
129 130 131	81 82 83	Combined Wattage Byte 1: 7:4 – Voltage1 3:0 – Voltage2 Byte 2 and Byte 3: Total Combined Wattage Stored with LSB first then MSB.	0 0 0	00 00 00
132	84	Predictive Fail Tachometer Lower Threshold , Not Applicable. Predictive Failure is not Supported.	0	00
12V DC OUTPUT RECORD HEADER				
133 134 135 136 137	85 86 87 88 89	Record type = 01 for DC Output Record End of List /Record Format Version Number for 12V DC Output Record Record Length of 12V DC Output Record Record CHECKSUM of 12V DC Output Record (Zero CHECKSUM) (256-(sum of bytes 138 to 150)) Header CHECKSUM of 12V DC Output Record Header (Zero CHECKSUM) (256-(sum of bytes 133 to 136))	1 2 13 12 228	01 02 0D 0C E4
12V OUTPUT RECORD				
138	8A	Output Information, 001 = 01H Bit 7: Standby Information = 0B Bits 6-4: Reserved, Write as 000B Bits 3-0: Output Number 1 = 001B	1	01
139 140	8B 8C	Nominal Voltage (10mV) , (12V / 10mV) 1200 = 04B0H 2 Bytes Sequence In Decimal: 176, 004 In Hex: B0H, 04H	176 4	B0 04
141 142	8D 8C	Maximum Negative Voltage Deviation (10mV) , 11.40V=1140 (x10mV) = 0474H 2 Bytes Sequence In Decimal: 116, 004 In Hex: 74H, 04H	116 4	74 04
143 144	8F 90	Maximum Positive Voltage Deviation (10mV) , 12.6V=1260 (x10mV) =04ECH 2 Bytes Sequence In Decimal: 236, 004 In Hex: ECH, 04H	236 4	EC 04
145 146	91 92	Ripple and Noise pk-pk (mV) , 120 = 0078H 2 Bytes Sequence In Decimal: 120, 000 In Hex: 78H, 00H	120 0	78 00

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DS495SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
147	93	Minimum Current Draw (10mA), 0050 = 0032H 2 Bytes Sequence In Decimal: 050, 000	50	32
148	94	In Hex: 32H, 00H	0	00
149	95	Maximum Current Draw (10mA), 4125 = 101DH In Decimal: 29, 16	29	1D
150	96	In Hex: 1DH, 10H	16	10
V_{SB} OUTPUT RECORD HEADER				
151	97	Record type = 01 for DC Output Record	1	01
152	98	End of List /Record Format Version Number for 3V3SB Output Record	130	82
153	99	Record Length of 3V3SB Output Record	13	0D
154	9A	Record CHECKSUM of 3V3SB Output Record (Zero CHECKSUM)	179	B3
155	9B	Header CHECKSUM of 3V3SB Output Record Header (Zero CHECKSUM) (256-(sum of bytes 156 to 168))	189	BD
156	9C	V_{SB} Output Information	130	82
157	9D	Nominal Voltage (10mV), (12V / 10mV) 1200 = 04B0H 2 Bytes Sequence In Decimal: 176, 004	176	B0
158	9E	In Hex: B0H, 04H	4	04
159	9F	Maximum Negative Voltage Deviation (10mV), 1140 = 0474H 2 Bytes Sequence In Decimal: 116, 004	116	74
160	A0	In Hex: 74H, 04H	4	04
161	A1	Maximum Positive Voltage Deviation (10mV), 1260 = 04ECH 2 Bytes Sequence In Decimal: 236, 004	236	EC
162	A2	In Hex: ECH, 04H	4	04
163	A3	Ripple and Noise pk-pk (mV), 120 = 78H 2 Bytes Sequence In Decimal: 120, 000	120	78
164	A4	In Hex: 78H, 00H	0	00
165	A5	Minimum Current Draw (10mA), (0.1A / 10mA) 10 = 000AH 2 Bytes Sequence In Decimal: 010, 000	10	0A
166	A6	In Hex: 0AH, 00H	0	00
167	A7	Maximum Current Draw (10mA), (3A / 10mA) 0300 = 012CH 2 Bytes Sequence In Decimal: 44, 001	44	2C
168	A8	In Hex: 2CH, 01H	1	01
169	A9	Reserved, Default value is 0.	0	00
170	AA		0	00
171	AB		0	00
172	AC		0	00
173	AD		0	00
174	AE		0	00
175	AF		0	00

Technical Reference Note

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DS495SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
INTERNAL USE AREA, 40 BYTES				
176	B0	Internal User Area	1	01
177	B1	RESERVED, Default value is 0.	0	00
178	B2		0	00
179	B3		0	00
180	B4		0	00
181	B5		0	00
182	B6		0	00
183	B7		0	00
184	B8		0	00
185	B9		0	00
186	BA		0	00
187	BB		0	00
188	BC		0	00
189	BD		0	00
190	BE		0	00
191	BF		0	00
192	C0		0	00
193	C1		0	00
194	C2		0	00
195	C3		0	00
196	C4		0	00
197	C5		0	00
198	C6		0	00
199	C7		0	00
200	C8		0	00
201	C9		0	00
202	CA		0	00
203	CB		0	00
204	CC		0	00
205	CD		0	00
206	CE		0	00
207	CF		0	00
208	D0		0	00
209	D1		0	00
210	D2		0	00
211	D3		0	00
212	D4		0	00
213	D5		0	00
214	D6		0	00
215	D7		0	00
216	D8		0	00
217	D9		0	00
218	DA		0	00
219	DB		0	00
220	DC		0	00
221	DD		0	00
222	DE		0	00
223	DF		0	00
224	E0		0	00
225	E1		0	00
226	E2		0	00
227	E3		0	00
228	E4		0	00
229	E5		0	00
230	E6		0	00
231	E7		0	00
232	E8		0	00
233	E9		0	00
234	EA		0	00

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DS495SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
235	EB	RESERVED, Default value is 0.	0	00
236	EC		0	00
237	ED		0	00
238	EE		0	00
239	EF		0	00
240	F0		0	00
241	F1		0	00
242	F2		0	00
243	F3		0	00
244	F4		0	00
245	F5		0	00
246	F6		0	00
247	F7		0	00
248	F8		0	00
249	F9		0	00
250	FA		0	00
251	FB		0	00
252	FC		0	00
253	FD		0	00
254	FE		0	00
255	FF		0	00

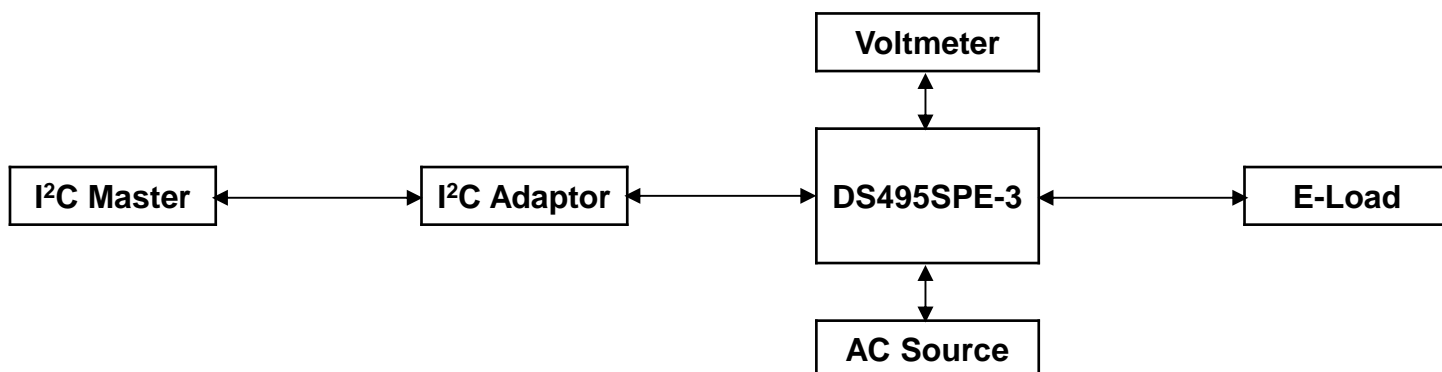
PMBus™ Interface Support

The DS495SPE-3 is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I²C interface port.

DS495SPE-3 Series PMBus™ General Instructions

Equipment Setup

The following is typical I²C communication setup:



PMBus™ Writing Instructions

When writing to any PMBus™ R/W registers, ALWAYS do the following:

Disable Write Protect (command 10h) by writing any of the following accordingly:

Levels: 00h – Enable writing to all writeable commands

20h – Disables write except 10h, 01h, 00h and 02h commands

40h – Disables write except 10h, 01h, and 00h commands

80h – Disable write except 0x00h

DS495SPE-3 Series Support PMBus™ Command List

The DS495SPE-3 is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I²C interface port.

DS495SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	Description
00h	Page	00	R/W	1	Hex	Valid input: 00h, 01h, FFh
01h	OPERATION	80	R/W	1	Bitmapped	Used to Turn the unit ON/OFF in conjunction with the input CONTROL pin. It is also used to set output to upper or lower Margin Voltages.
	b7:6					01 – Immediate Turn OFF (No Sequencing) 10 – PSU ON
	b5:4					
	b3:2					
	b1:0					Reserved
02h	ON_OFF_CONFIG	1C	R	1	Bitmapped	Configures the combination of CONTROL pin and serial communication commands needed to turn the Unit ON/OFF.
	b7:5					Reserved
	b4 – Enable CONTROL pin and Serial communication control.	1				0 – Unit powers up any time power is present regardless of the state of CONTROL pin. 1 – Unit powers up as dictated by CONTROL pin and OPERATION command (b3:0)
	b3 – Serial communication Control	1				0 – Unit Ignores ON/OFF portion of the OPERATION command. 1 – Enables Serial communication ON/OFF portion of OPERATION command. Requires CONTROL pin to be asserted for the unit to start and energize the output.
	b2 – Sets how the unit responds to CONTROL pin	1				0 – Unit ignores CONTROL pin. (ON/OFF controlled by OPERATION command). 1 – Unit requires CONTROL pin to be asserted to start the unit.
	b1 - CONTROL pin polarity	0				0 – Active Low (Pull Low to start the unit) 1 – Active high (Pull high to start the unit)
	b0 – CONTROL pin Action	0				0 – Use programmed turn ON/OFF delay 1 – Turn OFF the output and stop transferring energy to the output as fast as possible.
03h	CLEAR_FAULTS	-	S			
05h	PAGE_PLUS_WRITE	-	BW	Varies		
06h	PAGE_PLUS_READ	-	BR/BW	Varies		
10h	WRITE_PROTECT	00	R/W	1	Bitmapped	Used to Control Writing to the PMBus™ Device 80h - Disables write except 10h 40h – Disables write except 10h, 01h, 00h 20h – Disables write except 10h,01h,00h,02h and 21h commands 00 – Enables write to all writeable commands.

DS495SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	Description
19h	CAPABILITY	90	R	1	Bitmapped	Provides a way for the hosts system to determine some key capabilities of a PMBus™ device.
	b7 - Packet Error Checking	1				0 - PEC not supported 1 - PEC supported
	b6 - Maximum Bus Speed	0				0 - Maximum supported bus speed, 100KHz 1 - Maximum supported bus speed, 400KHz
	b5 - SMBALERT#	0				0 - SMBus Alert Pin not supported 1 - SMBus Alert Pin supported
	b4:0					Reserved
1Ah	QUERY	-	BR/BW	1	Bitmapped	
20h	VOUT_MODE	17	R	1	Bitmapped	Specifies the mode and parameters of Output Voltage related Data Formats
30h	COEFFICIENTS	-	BW	6	Hex	use to retrieve the m, b and R coefficients, needed for DIRECT data format
	byte 1:2					m low Byte, m high byte
	byte 3:4					b low Byte, b high byte
	byte 5					R byte
3Ah	FAN_CONFIG_1_2	90	R	1	Bitmapped	Read only to reflect setting of Fans
	b7	1				1 - Fan is installed in position 1 0 - No Fan is installed in position 1
	b6	0				1 - Fan is commanded in RPM 0 - Fan is commanded in DC
	b5:4	01				00 - 1 pulse per revolution 01 - 2 pulses per revolution 10 - 3 pulses per revolution 11 - 4 pulses per revolution
	b3	0				1 - Fan is installed in position 2 0 - No Fan is installed in position 2
	b2	0				1 - Fan is commanded in RPM 0 - Fan is commanded in DC
	b1:0	00				00 - 1 pulse per revolution 01 - 2 pulses per revolution 10 - 3 pulses per revolution 11 - 4 pulses per revolution
3Bh	FAN_COMMAND_1	0000	R/W	2	Linear	Adjusts the operation of the Fans. The device may override the command, if it requires higher value, to maintain proper device temperature. RPM Control - Commands Speeds from 0-65535 RPM. Duty cycle Control - Commands Speeds from 0 to 100%
40h	VOUT_OV_FAULT_LIMIT	1C80	R/W	2	Linear	Sets Output Over voltage threshold. (14.25V) Valid Range: 13.5 to 15.0V
44h	VOUT_UV_FAULT_LIMIT	1480	R/W	2	Linear	Sets Under-voltage Fault threshold. (10.25V) Valid Range: 10.0 to 10.5V
46h	IOUT_OC_FAULT_LIMIT	E998	R/W	2	Linear	Sets Overcurrent threshold in Amps. (51A) Valid Range: 10.32 to 58A
4Ah	IOUT_OC_WARN_LIMIT	F0A5	R/W	2	Linear	Sets Overcurrent Warning threshold. (41.25A) Valid Range: 9.82 to 51.56A
4Fh	OT_FAULT_LIMIT	007B	R/W	2	Linear	Secondary ambient temperature Fault threshold, in degree C. (123degC)

DS495SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	Description
51h	OT_WARN_LIMIT	006F	R/W	2	Linear	Secondary ambient temperature warning threshold, in degree C. Operating limit (111degC)
5Dh	IIN_OC_WARN_LIMIT	C9A6 (HL) CB4D (LL)	R	2	Linear	Default: 3.3A for high line (HL), 6.6A for low line (LL)
6Bh	PIN_OP_WARN_LIMIT		R	2	Linear	Default: 594W
78h	STATUS_BYTE	00	R	1	Bitmapped	Returns the summary of critical faults
	b7 – BUSY	-				Not supported
	b6 – OFF	-				Unit is OFF
	b5 – VOUT_OV	-				Output over-voltage fault has occurred
	b4 – IOUT_OC	-				Output over-current fault has occurred
	b3 – VIN_UV	-				An input under-voltage fault has occurred
	b2 – TEMPERATURE	-				A temperature fault or warning has occurred
	b1 – CML	-				A communication, memory or logic fault has occurred.
	b0 – NONE OF THE ABOVE	-				A Fault Warning not listed in bits[7:1] has occurred.
79h	STATUS_WORD	0000	R	2	Bitmapped	Summary of units Fault and warning status.
	b15 – VOUT					An output voltage fault or warning has occurred
	b14 – IOUT/POUT					An Output current or power fault or warning has occurred.
	b13 – INPUT					An input voltage, current or power fault or warning as occurred.
	b12 – MFR					A manufacturer specific fault or warning has occurred.
	b11 – POWER_GOOD#					The POWER_GOOD signal is de-asserted
	b10 – FANS					A fan or airflow fault or warning has occurred.
	b9 – OTHER					Not supported
	b8 – UNKNOWN					Not supported
	b7 – BUSY					A fault was declared because the device was busy and unable to respond.
	b6 – OFF					Unit is OFF
	b5 – VOUT_OV					Output over-voltage fault has occurred
	b4 – IOUT_OC					Output over-current fault has occurred
	b3 – VIN_UV					An input under-voltage fault has occurred
	b2 – TEMPERATURE					A temperature fault or warning has occurred
	b1 – CML					A communication, memory or logic fault has occurred.
	b0 – NONE_OF_THE_ABOVE					A fault or warning not listed in bits[7:1] of this byte has occurred.

DS495SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	Description
7Ah	STATUS_VOUT	00	R/W	1	Bitmapped	Output voltage related faults and warnings
	b7					VOUT Over-voltage Fault
	b6					VOUT Over-voltage warning
	b5					VOUT Under-voltage Warning
	b4					VOUT Under-voltage Fault
	b3					VOUT_MAX Warning, an attempt has been made to set output to a value higher than the highest permissible voltage. Not supported
	b2					TON_MAX_FAULT
	b1					TOFF_MAX Warning. Not supported
	b0					Not supported.
7Bh	STATUS_IOUT	00	R/W	1	Bitmapped	Output Current related faults and warnings
	b7					IOUT Over current Fault
	b6					IOUT Over current And Low Voltage shutdown Fault. Not supported
	b5					IOUT Overcurrent Warning
	b4					IOUT Undercurrent Fault. Not supported
	b3					Current Share Fault. Not supported
	b2					Power Limiting. Not supported
	b1					POUT Overpower Fault. Not supported
	b0					POUT Overpower Warning
7Ch	STATUS_INPUT	00	R/W	1	Bitmapped	Input related faults and warnings
	b7					VIN Overvoltage Fault
	b6					VIN Overvoltage Warning . Not supported
	b5					VIN Undervoltage Warning
	b4					VIN Undervoltage Fault
	b3					Unit is OFF for insufficient Input Voltage
	b2					IIN Overcurrent Fault . Not supported
	b1					IIN Overcurrent Warning . Not supported
	b0					PIN Overpower Warning . Not supported
7Dh	STATUS_TEMPERATURE	00	R/W	1	Bitmapped	Temperature related faults and warnings
	b7					Overtemperature Fault
	b6					Overtemperature Warning
	b5					Undertemperature Warning . Not supported
	b4					Undertemperature Fault . Not supported
	b3:0					Reserved
7Eh	STATUS_CML	00	R/W	1	Bitmapped	Communications, Logic and Memory
	b7					Invalid or unsupported Command Received
	b6					Invalid Data
	b5					Packet Error Check Failed
	b4					Memory Fault Detect, CRC Error
	b3					Not Supported
	b2					Not Supported
	b1					Not Supported
	b0					Not Supported

DS495SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	Description
7Fh	STATUS_OTHER	00	R/W	1	Bitmapped	Manufacturer Status codes
	b7					Not Used
	b6					Not Used
	b5					Not Used
	b4					Not Used
	b3					Not Uesd
	b2					Not Uesd
	b1					Not Uesd
	b0					MFR SPECIFIC FAULT. FOR Trouble shooting
81h	STATUS_FANS_1_2	00	R/W	1	Bitmapped	
	b7					Fan 1 Fault
	b6					Fan 2 Fault
	b5					Fan 1 Warning
	b4					Fan 2 Warning
	b3					Fan_1 Speed Overridden
	b2					Fan_2 Speed Overridden
	b1					Not Used
	b0					Not Used
86h	READ_EIN	-	R	2	Direct	Returns the accumulated input power over time
87h	READ_EOUT	-	R	2	Direct	Returns the accumulated output power over time
88h	READ_VIN	-	R	2	Linear	Returns input Voltage in Volts ac.
89h	READ_IIN	-	R	2	Linear	Returns input Current in Amperes
8Bh	READ_VOUT	-	R	2	Linear	Returns the actual, measured voltage in Volts.
8Ch	READ_IOUT	-	R	2	Linear	Returns the output current in amperes.
8Dh	READ_TEMPERATURE_1	-	R	2	Linear	Secondary side hotspot
8Eh	READ_TEMPERATURE_2	-	R	2	Linear	Secondary side ambient
8Fh	READ_TEMPERATURE_3	-	R	2	Linear	Primary side Ambient
90h	READ_FAN_SPEED_1	-	R	2	Linear	Speed of Fan 1
96h	READ_POUT	-	R	2	Linear	Returns the output power, in Watts.
97h	READ_PIN	-	R	2	Linear	Returns the input power, in Watts.
98h	PMBus™_REVISION	22	R	1	Bitmapped	Reads the PMBus™ revision number
	b7:4	0010				Part 1 Revision 0000 – Revision 1.0 0001 – Revision 1.1 0010 – Revision 1.2
	b3:0	0010				Part 2 Revision 0000 – Revision 1.0 0001 – Revision 1.1 0010 – Revision 1.2

DS495SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	Description
99h	MFR_ID	"ARTESYN"	BR	-	ASCII	Abbrev or symbol of manufacturers name. ASCII (artesyn)
9Ah	MFR_MODEL	"DS495SPE-3" "DS495SPE-3-001"	BR	15	ASCII	Manufacturers Model number, ASCII format "DS495SPE-3" for forward airflow version, "DS495SPE-3-001" for reverse airflow version
9Bh	MFR_REVISION	"0A"	BR/W	-	ASCII	Manufacturers, revision number, ASCII format
9Ch	MFR_LOCATION	"P"	BR/W	-	ASCII	Manufacturers facility, ASCII format
9Dh	MFR_Date	"WW"	BR/W	-	ASCII	Manufacture Date, ASCII format
9Eh	MFR_Serial Number	"K543WWSSS SRRP"	BR/W	-	ASCII	Unit serial number, ASCII format.
A0h	MFR_VIN_MIN	005A	R	2	Linear	Minimum Input Voltage (90Vac)
A1h	MFR_VIN_MAX	0108	R	2	Linear	Maximum Input Voltage (264Vac)
A2h	MFR_IIN_MAX	C9A6 (HL) CB4D (LL)	R	2	Linear	Maximum Input Current 3.3A for high line (HL), 6.6A for low line (LL)
A3h	MFR_PIN_MAX	0252	R	2	Linear	Maximum Input Power (594W)
A4h	MFR_VOUT_MIN	16CC	R	2	Linear	Minimum Output Voltage Regulation Window. (11.4V)
A5h	MFR_VOUT_MAX	1933	R	2	Linear	Maximum Output Voltage. Regulation Window (12.6V)
A6h	MFR_IOUT_MAX	E294	R	2	Linear	Maximum Output Current (41.25A)
A7h	MFR_POUT_MAX	01EF	R	2	Linear	Maximum Output Power (495W)
A8h	MFR_TAMBIENT_MAX	0037	R	2	Linear	Maximum Operating Ambient Temperature (Secondary Ambient) (55degC)
A9h	MFR_TAMBIENT_MIN	0000	R	2	Linear	Minimum Operating Ambient Temperature (Secondary Ambient) (0degC)
AAh	MFR EFFICIENCY_LL	-	BR	14	Linear	Default: 115V, 99W, 88 %, 247.5W, 91.5%, 495W, 89%
ABh	MFR EFFICIENCY_HL	-	BR	14	Linear	Default: 230V, 99W, 90 %, 247.5W, 94 %, 495W, 91 %
B0h	USER_DATA_00	-	BR/BW		Hex	
B1h	USER_DATA_01 (FRU_DATA)		BR/BW	16	Hex	
C0h	MAX_TEMP_1	006F	R	2	Linear	Default: 111degC
E0h	FW_PRI_VERSION	-	BR	8	ASCII	
E1h	FW_SEC_VERSION	-	BR	8	ASCII	

Application Notes

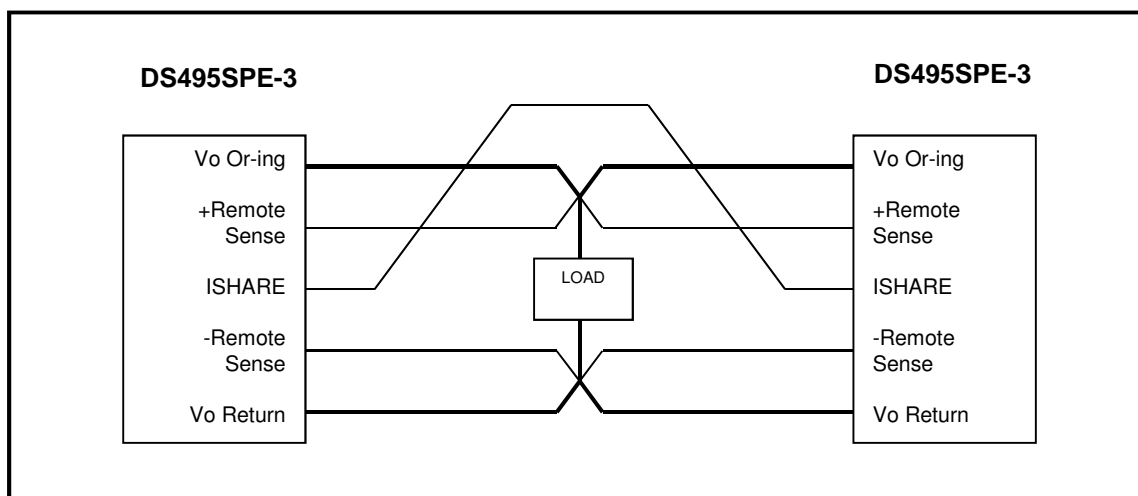
Current Sharing

The DS495SPE-3 series' main output V_O is equipped with current sharing capability. This will allow up to 4 power supplies to be connected in parallel for higher power application. Current share accuracy is typically 5% of full load. When supplying light loads between 10% and 100% of its rated load, the power supplies will share within 5% accuracy. Below 10% total loading, there is no guarantee of output current sharing.

Redundancy / Fault Tolerance

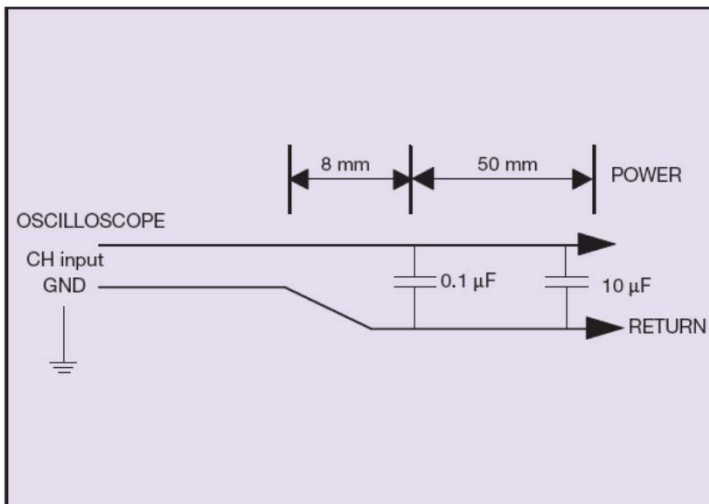
The DS495SPE-3 series is able to current share with 2 (1+1) up to 4 (2+2) power supplies in parallel and operate in a hot swap/redundant N+N configuration where N=1, 2, or 3. The 12V V_{SB} outputs of the power supplies are connected together in the system so that a failure or hot swap of a redundant power supply does not cause these outputs to go out of regulation in the system.

All power supply outputs will be designed for redundant mode operation. No internal failure in any power supply in this configuration should cause the bus voltage to fall below the regulation limits specified. All output voltages should stay within the regulation limits during cold swapping or hot swapping operation.



Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the DS495SPE-3 Series. When measuring output ripple and noise, a scope jack in parallel with a 0.1uF ceramic chip capacitor, and a 10uF aluminum electrolytic capacitor should be used. Oscilloscope should be set to 20MHz bandwidth for this measurement.



Record of Revision and Changes

Issue	Date	Description	Originators
1.0	09.12.2016	First Issue	A. Zhang
1.1	01.16.2018	Update the FRU Data	A. Zhang
1.2	02.27.2018	Update the PS_PRESENT signal	A. Zhang

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