DS1600SPE-3

1600 Watts

Distributed Power System

Total Power: 800 - 1600 Watts
Input Voltage: 90 to 264 Vac
# of Outputs: Single Main

Special Features

- Active Power Factor Correction
- High-power and short form factor
- 80plus Platinum Efficiency
- 1U power supply
- High-density design: 40 W / in^3
- Inrush current control
- EN61000-3-2 Harmonic compliance
- N+1 or N+N Redundant
- Active current sharing (10 - 100% load)
- PMBus compliant
- Full digital control
- Compatible with Artesyn's Universal PMBus GUI
- Full digital control
- Two year warranty
- Reverse airflow option
- Class A + 6 dB margin Conducted/Radiated EMI
- ROHS

Safety

UL/cUL 60950 (UL Recognized)
DEMKO+ CB Report EN60950
EN60950
CE Mark
BSMI
China CQC

Product Descriptions

The DS1600SPE-3 power supply features a very wide 90 to 264 Vac input voltage range and employ active power factor correction to minimize input harmonic current distortion and to ensure compliance with the international EN61000-3-2 standard . The power supplies also feature active ac inrush current control, to automatically limit inrush current at turn-on to 55 A maximum.

The DS1600SPE-3 can deliver up to 133.3 A from its main +12 Vdc payload output, and up to 3.5 A from its +12 Vdc auxiliary output. The form factor is 1U and may be used in single or in redundant configurations.

DS1600SPE-3 has a power density of more than 40.0 Watts per cubic inch, and compliant 80plus Platinum Efficiency, its efficiency will be 94% at nominal high AC line with 50 percent full load.

DS1600SPE-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.

ARTESYN™
EMBEDDED TECHNOLOGIES

Model Numbers

Standard	Output Voltage	Minimum Load	Maximum Load	Standby Supply	Air Flow Direction
DS1600SPE-3	12.0Vdc	0A	133.3A	12V@3.5A	Forward (DC Connector to Handle)
DS1600SPE-3-001	12.0Vdc	0A	133.3A	12V@3.5A	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 + Stand-by) $V_{AC} \leq 180$Vac $V_{AC} > 180$Vac	All models	$P_{O,max}$	- -	- -	800 1600	W W
Isolation Voltage Input to outputs Input to safety ground	 All models All models		 - -	 - -	 3000 2113	 Vac Vac
Ambient Operating Temperature	All models	T_A	0	-	+50[1]	°C
Storage Temperature	All models	T_{STG}	-40	-	+70	°C
Humidity (non-condensing) Operating Non-operating	 All models All models		 20 10	 - -	 95 95	 % %
Altitude Operating Non-operating	 All models All models		 - -	 - -	 16,400[2] 50,000	 feet feet

Note 1 - DS1600SPE-3: 1600W from 0 to 50 °C, can operate up to 65°C at 2% derated power for every °C above 50°C.
DS1600SPE-3-001: 1600W from 0 to 40°C, can operate up to 60°C at 1% derated power for every °C above 40°C

Note 2 - Operating altitude up to 16,400 feet, derated after 10,000 feet, detail see page 19.

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC		V_{IAC}	90	115/230	264	Vac_{RMS}
Input Vac Source Frequency		f_{IAC}	47	50/60	63	Hz
Maximum Input Current ($I_O = I_{O,max}$, $I_{Vsb} = I_{Vsb,Max}$)	$V_{IAC} = 90V_{AC}$	$I_{I,max}$	-	-	10.5	A_{RMS}
Harmonic Line Currents	All	THD	Per IEC1000-3-2			
Power Factor	20% load and above		-	0.9	-	
Startup Surge Current (Inrush) @ 25°C	$V_{IAC} = 264V_{AC}$	$I_{I,surge}$	-	-	55	A_{PK}
Input Fuse	Internal,5x20mm, Quick Acting 16A, 250V		-	-	16	A
Leakage Current to earth ground	$V_{IAC} = 240V_{AC}$ $f_{IAC} = 50/60$ Hz		-	-	1.75	mA
Operating Efficiency	I_O =10% $I_{O,max}$ $V_{IAC} = 230V_{AC}$	η	-	-	89	%
	I_O =20% $I_{O,max}$ $V_{IAC} = 230V_{AC}$	η	-	-	93	%
	I_O =50% $I_{O,max}$ $V_{IAC} = 230V_{AC}$	η	-	-	94	%
	I_O =100% $I_{O,max}$ $V_{IAC} = 230V_{AC}$	η	-	-	91.5	%
	Efficiency measurements done as per Generalized Test Protocol for Calculating Energy Efficiency of Internal AC-DC and DC-DC Power Supplies					
System Stability: Phase Margin Gain Margin			45 -6	-	-	Ø dB

Output Specifications

Table 3. Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Voltage	All	$\pm\%V_O$	-0.2		+0.2	%
		$\pm\%V_{sb}$	-3		+3	%
Output Regulation	Inclusive of set-point, temperature change, warm-up drift and dynamic load	V_O	11.4	12.0	12.6	V
		V_{Vsb}	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	-	-	150	mV_{PK-PK}
		V_{Vsb}	-	-	150	
Output Current	$V_{AC} \leq$ 180Vac	I_O	2[1]	-	66.67	A
	$V_{AC} >$ 180Vac		2[1]		133.3	
	$90 \leq V_{IAC} \leq$ 264Vac	I_{Vsb}	0.1[1]	-	3.5	
V_O Current Share Accuracy	10% to 100% I_O		-6.65	-	6.65	A
Minimum Load for Current Sharing			10	-	-	$\%I_{O,max}$
Number of Parallel Units	Main Output Current Share connected		-	-	6	
V_O Load Capacitance	Start up	Vo	2250	-	14,000	µF
		V_{Vsb}	47	-	1000	µF
V_O Dynamic Response Peak Deviation	50% load change, slew rate = 1A/µs	$\pm\%V_O$	-	-	5	%
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\pm\%V_O$	-	-	0.2	%
MTBF	Telcordia Issue 2 Method 1, Case 3 at full load, 25° C		2		-	10^5 h

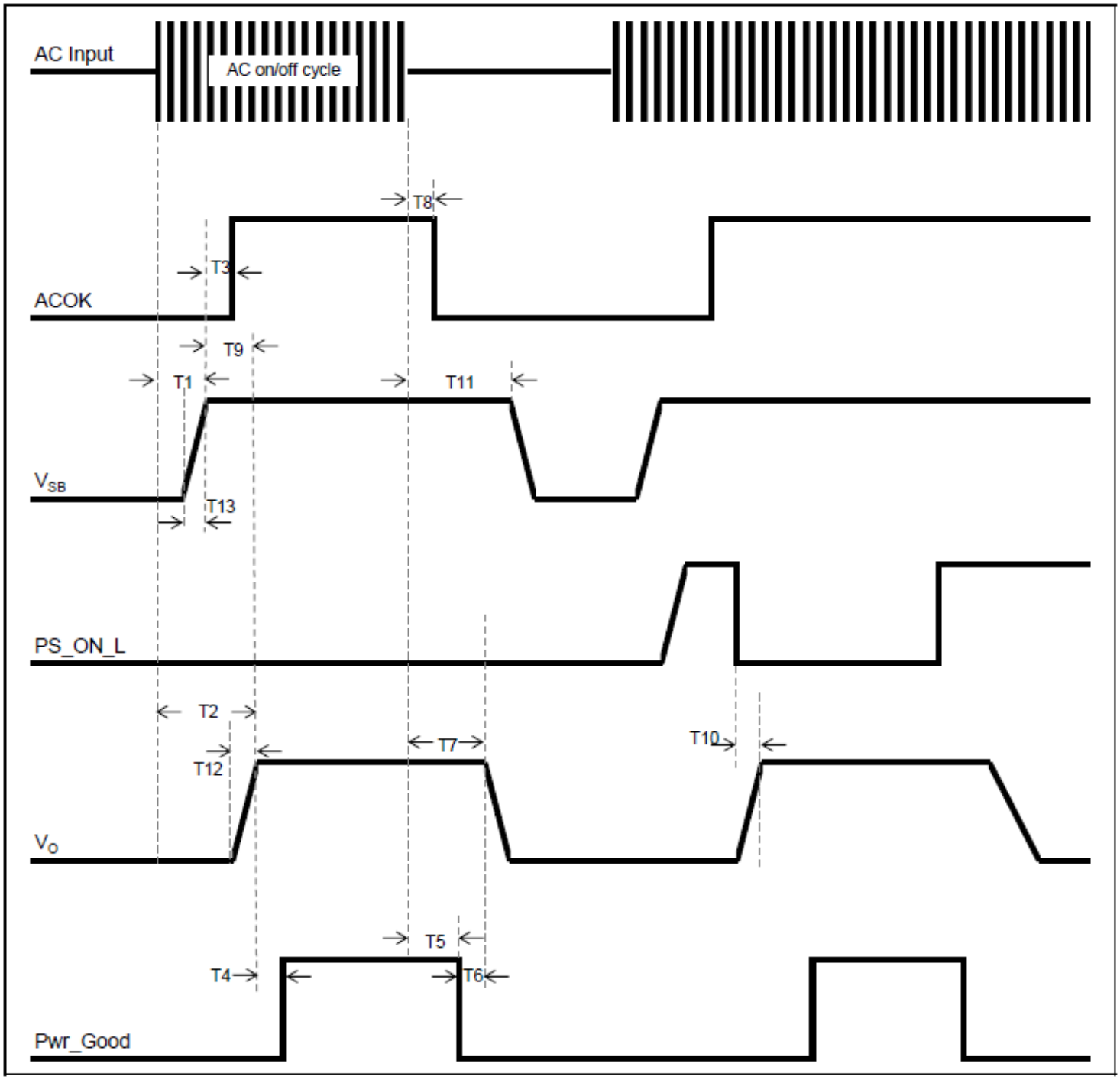
Note 1 - Minimum current for transient load response testing only. Unit is designed to operate and be within output regulation range at zero load.

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	20	-	2000	mSec
T2	Delay from AC being applied to main output voltages being within regulation.	-	-	2300	mSec
T3	Delay from Standby output to ACOK assertion	-	-	20	mSec
T4	Delay from output voltages within regulation limits to PWR_Good asserted.	100	-	1000	mSec
T5	Delay from loss of AC to deassertion of PWR_Good	10	-	-	mSec
T6	Delay from deassertion of PWR_Good to output voltages falling out of regulation.	1	-	-	mSec
T7	Delay from loss of AC to main output being within regulation	11	-	-	mSec
T8	Delay from loss of AC to assertion of ACOK	-	-	7	mSec
T9	Delay from Standby output to main output voltage being within regulation.	-	-	300	mSec
T10	Delay from PS_ON_L assertion to output voltages being within regulation.	-	-	350	mSec
T11	Delay from loss of AC to Standby output being within regulation.	150	-	-	mSec
T12	Output voltage rise time from the main output.	2	-	60	mSec
T13	Output voltage rise time from the standby output.	2	-	60	mSec

System Timing Specifications



DS1600SPE-3 Performance Curves

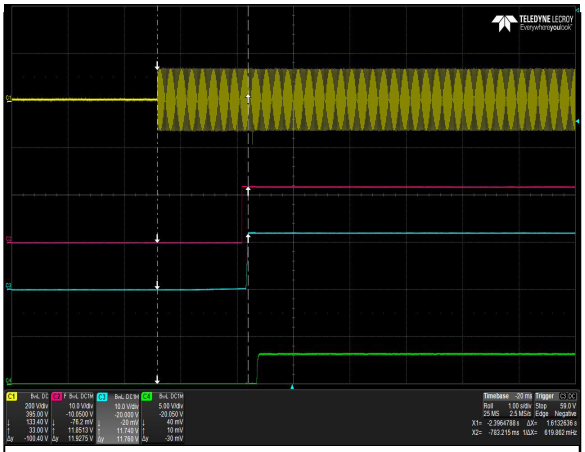


Figure 1: DS1600SPE-3 Turn-on delay via AC mains – Vin = 90Vac
Full Load: Io = 63.2A, Isb = 3.5A
Ch 1: AC Mains Ch 2: Vsb Ch 3: Vo Ch 4: Pwr_Good

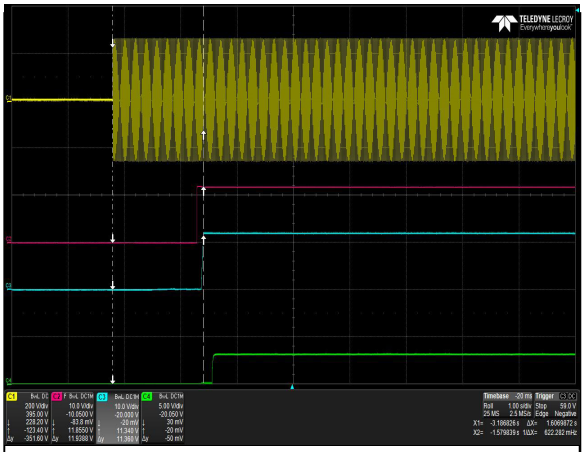


Figure 2: DS1600SPE-3 Turn-on delay via AC mains – Vin = 180Vac
Full Load: Io = 129.8A, Isb = 3.5A
Ch 1: AC Mains Ch 2: Vsb Ch 3: Vo Ch 4: Pwr_Good

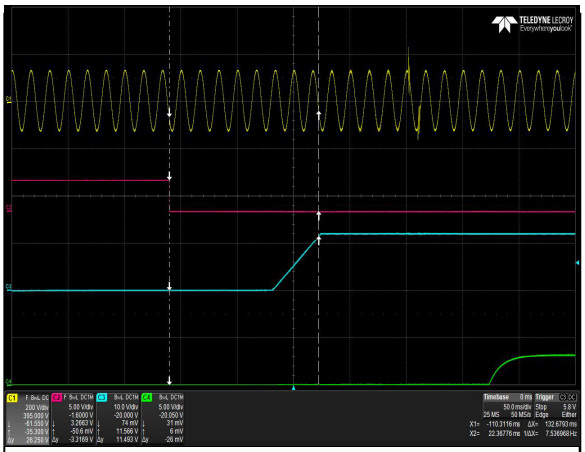


Figure 3: DS1600SPE-3 Turn-on delay via PS_ON_L – Vin = 90Vac
Full Load: Io = 63.2A, Isb = 3.5A
Ch 1: AC Mains Ch 2: PS_ON_L Ch 3: Vo Ch 4: Pwr_Good

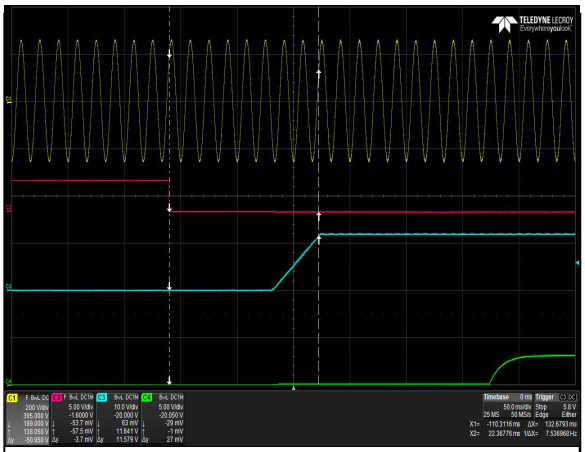


Figure 4: DS1600SPE-3 Turn-on delay via PS_ON_L – Vin = 180Vac
Full Load: Io = 129.8A, Isb = 3.5A
Ch 1: AC Mains Ch 2: PS_ON_L Ch 3: Vo Ch 4: Pwr_Good

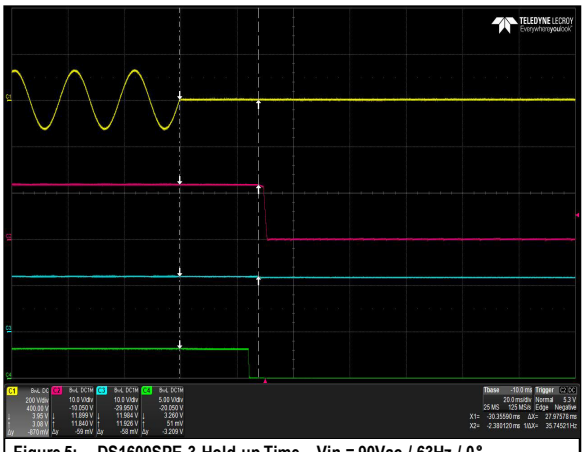


Figure 5: DS1600SPE-3 Hold-up Time – Vin = 90Vac / 63Hz / 0°
Full Load: Io = 63.2A, Isb = 3.5A
Ch 1: AC Mains Ch 2: Vo Ch 3: Vsb Ch 4: Pwr_Good

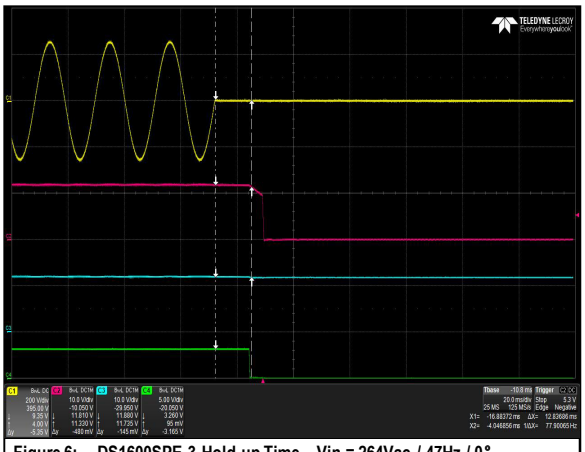


Figure 6: DS1600SPE-3 Hold-up Time – Vin = 264Vac / 47Hz / 0°
Full Load: Io = 129.8A, Isb = 3.5A
Ch 1: AC Mains Ch 2: Vo Ch 3: Vsb Ch 4: Pwr_Good

DS1600SPE-3 Performance Curves

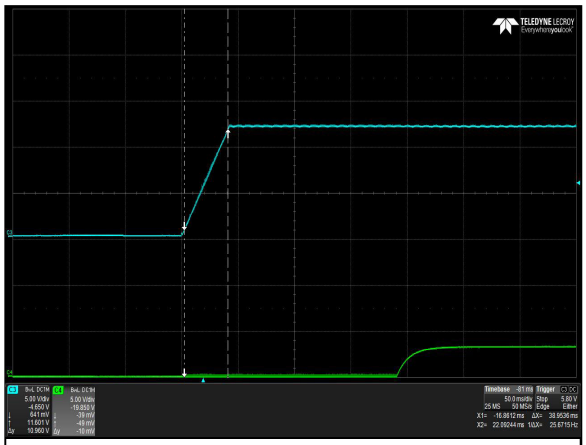


Figure 7: DS1600SPE-3 Output Voltage Startup – Vin = 90Vac
Full Load: Io = 63.2A, Isb = 3.5A
Ch 3: Vo Ch 4: Pwr_Good

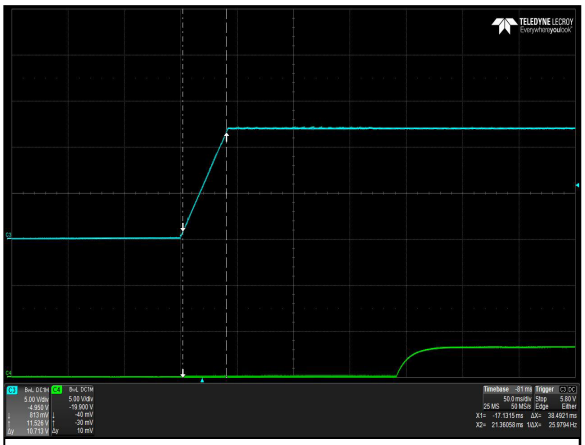


Figure 8: DS1600SPE-3 Output Voltage Startup – Vin = 180Vac
Full Load: Io = 129.8A, Isb = 3.5A
Ch 3: Vo Ch 4: Pwr_Good

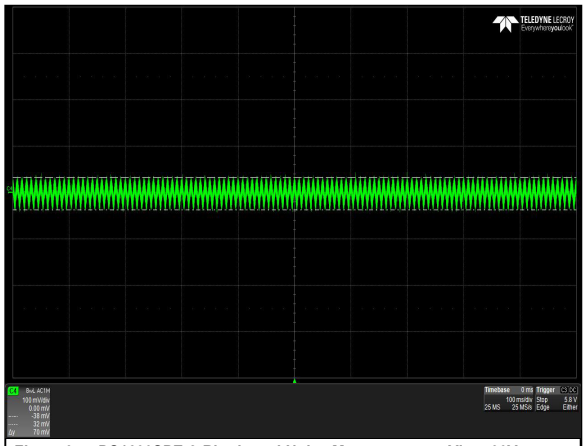


Figure 9: DS1600SPE-3 Ripple and Noise Measurement – Vin = 90Vac
Full Load: Io = 63.2A, Isb = 3.5A
Ch 4: Vo

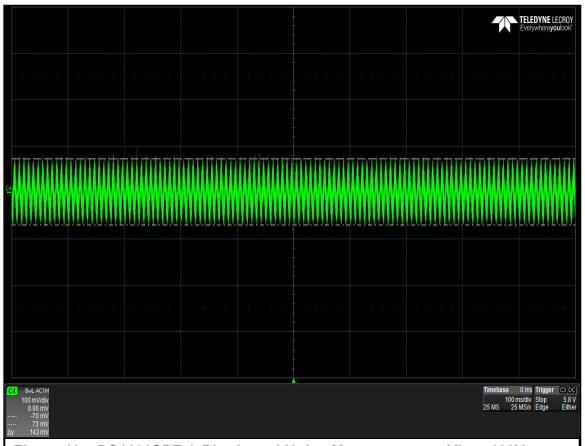


Figure 10: DS1600SPE-3 Ripple and Noise Measurement – Vin = 180Vac
Full Load: Io = 129.8A, Isb = 3A
Ch 4: Vo

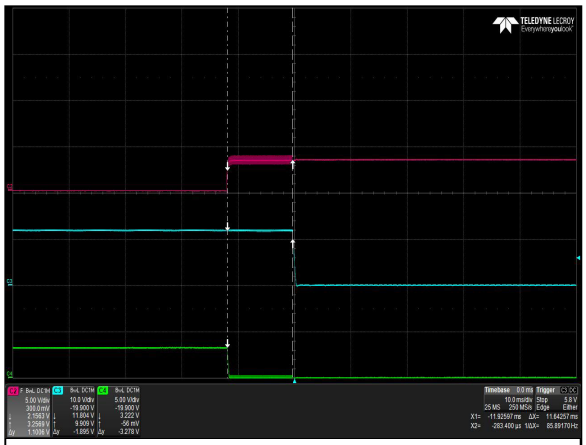


Figure 11: DS1600SPE-3 Turn Off Characteristic via PS_ON_L
Full Load: Io = Io = 129.8A, Isb = 3.5A
Ch 2: PS_ON_L Ch 3: Vo Ch 4: Pwr_Good

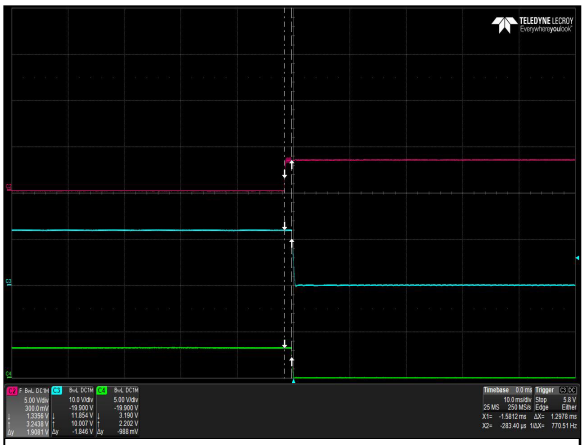


Figure 12: DS1600SPE-3 Turn Off Characteristic via PS_KILL_L
Full Load: Io = 129.8A, Isb = 3.5A
Ch 2: PS_KILL_L Ch 3: Vo Ch 4: Pwr_Good

DS1600SPE-3 Performance Curves

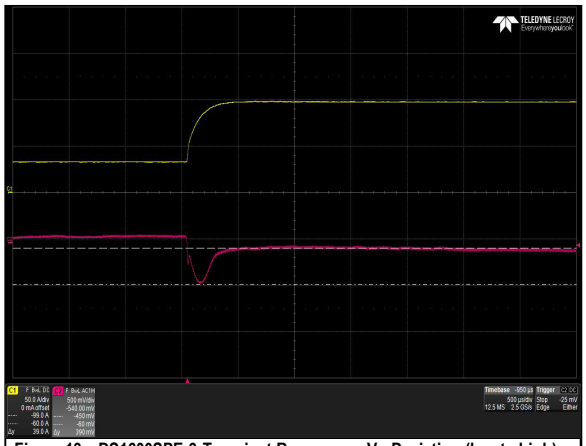


Figure 13: DS1600SPE-3 Transient Response – Vo Deviation (low to high) 25% to 75% load change, 1A/µS slew rate, Vin = 230Vac
Ch 1: Io Ch 2: Vo Output capacitance=2350µF

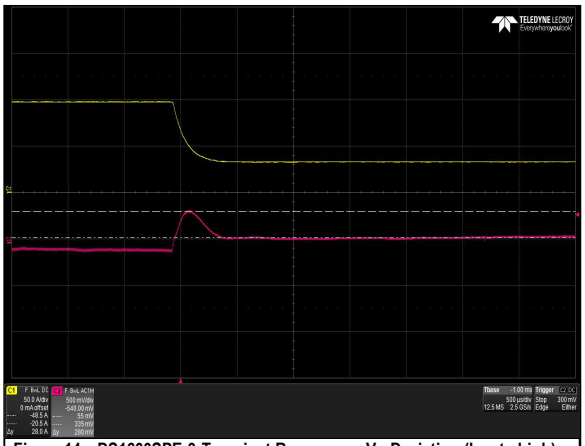


Figure 14: DS1600SPE-3 Transient Response – Vo Deviation (low to high) 25% to 75% load change, 1A/µS slew rate, Vin = 230Vac
Ch 1: Io Ch 2: Vo Output capacitance=2350µF

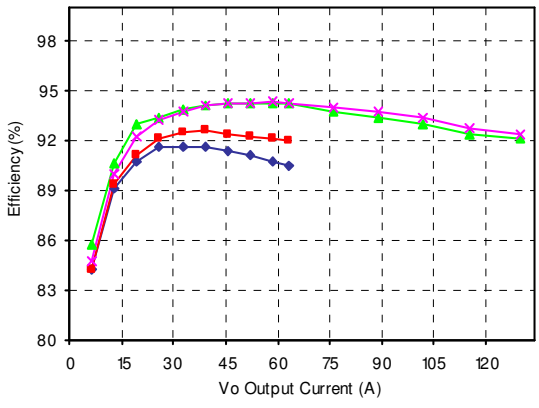


Figure 15: DS1600SPE-3 Efficiency Curves @ 25 degC,
90 Vac 120 Vac 230 Vac 264 Vac
Loading: Vo = 5% increment to 129.8A, 12VSB = 3.5A,

Protection Function Specification

Input Fusing

DS1600SPE-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 will provide latch mode over and under voltage protection as defined by the output under voltage and output over voltage parameters for each output. A fault on the main output and standby will not cause the standby output to shutdown.

OVP

Parameter	Min	Nom	Max	Unit
V_O Output Overvoltage	13.5	/	15.0	V
Standby Overvoltage	13.5	/	15.0	V

UVP

Parameter	Min	Nom	Max	Unit
V_O Output Undervoltage	10.5	/	11.0	V
Standby Undervoltage	10.0	/	11.0	V

Over Current Protection (OCP)

DS1600SPE-3 series includes internal current limit circuitry to prevent damage in the event of overload or short circuit. Recovery must be automatic when the overload is removed, if the overload lasts for 500 millisecond or less, and if it is less than or equal to 115% of rated load. If the overload is > 125% of rated load, the power supply will latch off immediately within 10ms. The latched state will require AC power / PS_ON_L recycling to restart the power supply. A fault in the main output will not cause the Standby output to shut down. No damage will result to the supply as the result of either short term or long term overloads of the outputs.

The standby output will have an OCP limit from 120% to 150% and will auto-recover when the overload is removed. A fault in the standby output will shutdown other outputs and will auto-recover as well when the overload on the standby is removed.

Parameter	Min	Nom	Max	Unit
V_O Output Overcurrent	115	/	150	$\%I_O$
Standby Overcurrent	120	/	150	$\%I_O$

Short Circuit Protection (SCP)

The DS1600SPE-3 power supply will withstand a continuous short circuit with no permanent damage, applied to its main output during start-up or while running. A short circuit is defined as an impedance on Vo of 0.04 ohms or less.

When the Standby output is shorted the output will go into “hiccup mode”. When the Standby output attempts to restart, the maximum peak current from the Standby output will be less than 20.0A peak. The maximum average current, taking into account the “hiccup” duty cycle, is less than rated output current.

Excessive peak currents due to the discharge of output capacitors are not controllable in the event of short circuit at the output.

Over Temperature Protection (OTP)

The power supply will be internally protected against over temperature conditions. There will be three over-temperature protection sensing - on the main output, the PFC circuit and on the standby output. When one of the sensing circuits has reached the OTP limit, all outputs, except standby, will shut down and will remain off until the over-temperature condition no longer exists. The standby output will shut down due to OTP only when the ambient temp has gone above 80degC. A suitable hysteresis point between the OTP threshold and the recovery point will be set to ensure there is no frequent on-off cycling of the outputs. The temperature recovery point will be set well-within the operating temperature range. Upon reaching the temperature recovery point, all outputs will auto-recover.

Any OTP fault will be reported in the PMBus status flag, without discriminating on which OTP sensing circuit was triggered.

Input Brown-out Protection

When the power supply is operating at high line input and at full load rating, the power supply can protect itself when the input voltage drops down to less than 180Vac. The power supply is dual-rated for input line so it will revert to the low-line over-current limit when the input line transitions to low line during brown-out testing.

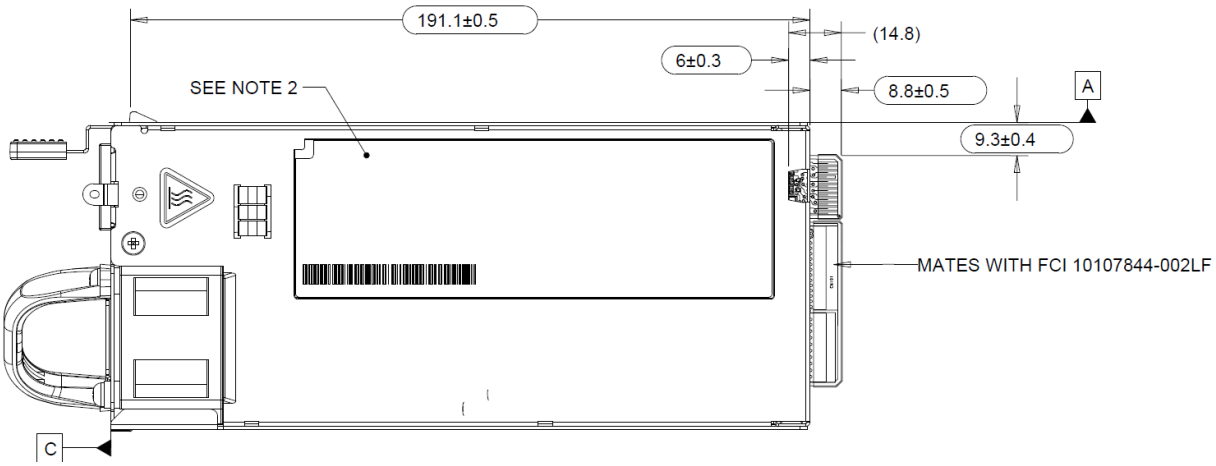
The latched state will require recycling AC power or PS_ON or an On/OFF command.

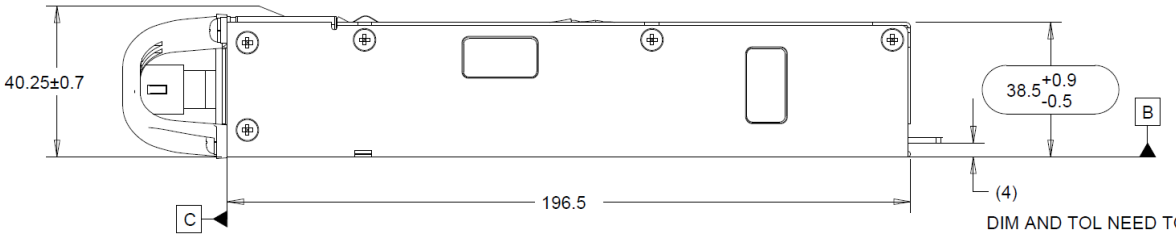
Fan Fault Protection

The power supply will be internally protected against fan fault conditions.

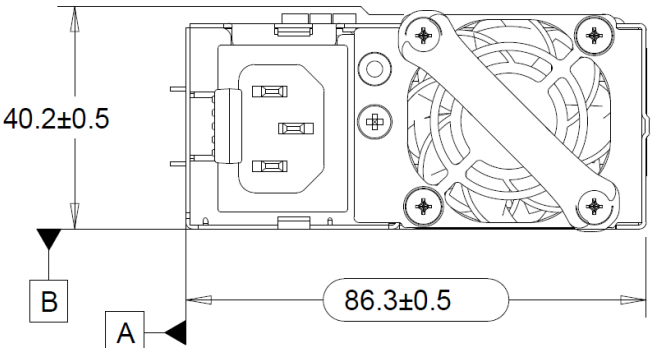
Mechanical Specifications

Mechanical Outlines





DIM AND TOL NEED TO BE HELD AT THE EDGE OF THE STANDOFF LOCATIONS ONLY.

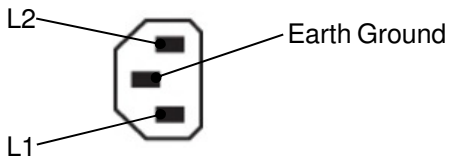


MODEL	AIRFLOW DIRECTION
DS1600SPE-3	FORWARD ←
DS1600SPE-3-001	REVERSE →
DS1600SPE-3-401	FORWARD ←

Connector Definitions

AC Input Connector

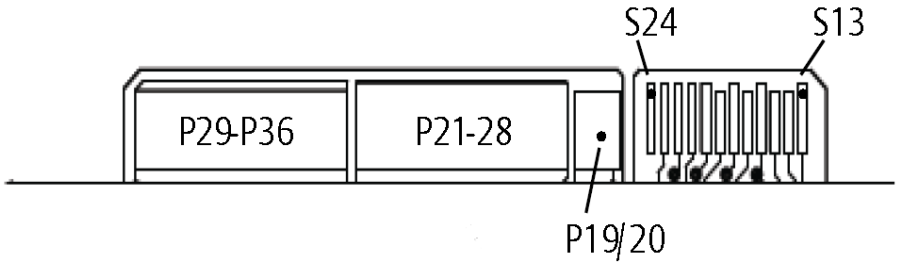
Pin 1 – L1
Pin 2 – L2
Pin 3 – Earth Ground



Output Connector – Power Blades

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

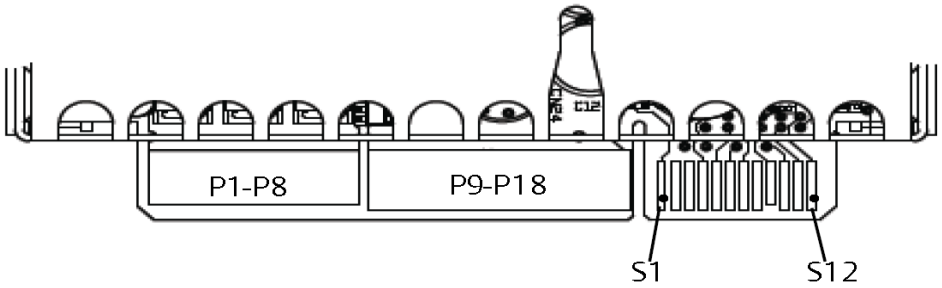
Power Supply Output Card Edge (Bottom Side)



Output Connector – Control Signals

S1 – PS_PRESENT
S2 – A1
S3 – A0
S4 – PWR_Good
S5 – ACOK (AC Input Present)
S6 – RETURN
S7 – I_SHARE
S8 – Reserved
S9 – PS_INTERRUPT_L
S10 – RETURN
S11 – Reserved
S12 – Reserved
S13 – PS_ON_L
S14 – PS_KILL_H
S15 – Reserved
S16 – RETURN
S17 – SDA
S18 – RETURN
S19 – SCL
S20 – RETURN
S21 – REMOTE SENSE-
S22 – RETURN
S23 – REMOTE SENSE+
S24 – A2

Power Supply Output Card Edge (Top Side)

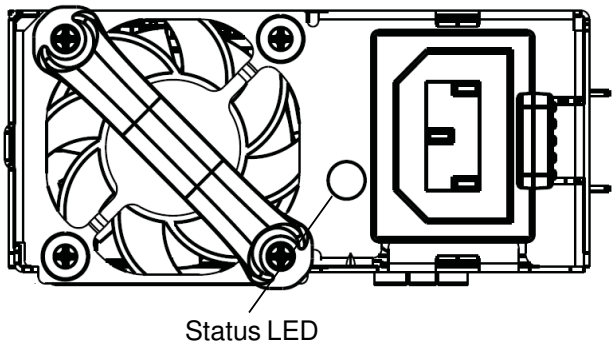


Power / Signal Mating Connectors and Pin Types

Table 5. Mating Connectors for DS1600SPE-3 series

Reference	On Power Supply	Mating Connector or Equivalent
AC Input Connector	IEC320-C13	IEC320-C14
Output Connector	Card-edge	FCI Power Blade 10107844-002LF Straight Pins
		FCI Power Blade 10115859-004LF Right Angle Pins

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 = OFF	Off
V_{SB} = ON, V_O = ON	Solid Green
V_{SB} = ON, V_O = OFF, AC Input = ON	Blinking Amber
V_O/V_{SB} = OCP / OVP / OTP / FAN FAULT	Blinking Amber

Weight

The DS1600SPE-3 series weight is 2.2 lbs / 1 kg maximum.

Environmental Specifications

EMC Immunity

DS1600SPE-3 series power supply is designed to meet the following EMC immunity specifications:

Table 6. Environmental Specifications:

Document	Description
FCC 47CFR 15 Subpart C/ ISPR 22/ B/ 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 C, >95% reduction for 500mS, Criteria C
EN55022	Information Technology Equipment-Immunity Characteristics, Limits and Method of Measurements

Safety Certifications

The DS1600SPE-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 7. Safety Certifications for DS1600SPE-3 series power supply system .

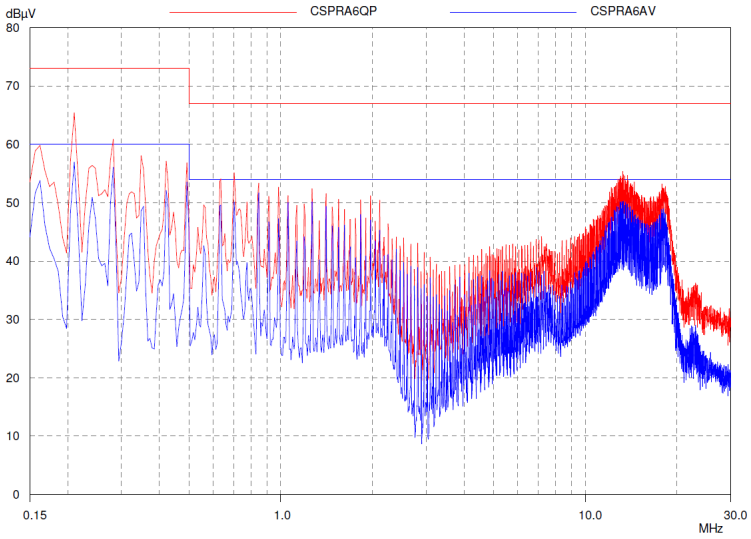
Document	File #	Description
UL 60950 No.		US and Canada Requirements
CSA 22.2 No. 60950-1		Information Technology Equipment - Safety - Part 1: General Requirements (Bi-National standard, with UL 60950-1)
EN60950		European Requirements
EN60950 Deviations		International Requirements
CB Certificate and Report		(All CENELEC Countries)
CHINA CQC Approval		China Requirements
BSMI		Taiwan Requirement

EMI Emissions

The DS1600SPE-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 1600W 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 DS1600SPE-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 Emerson Quasi Peak margin, which is 6dB below the CISPR international limit. Blue Line refers to the Emerson Average margin, which is 6dB below the CISPR international limit.

Conducted Emissions

Table 8. Conducted EMI emission specifications of the DS1600SPE-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 be 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.

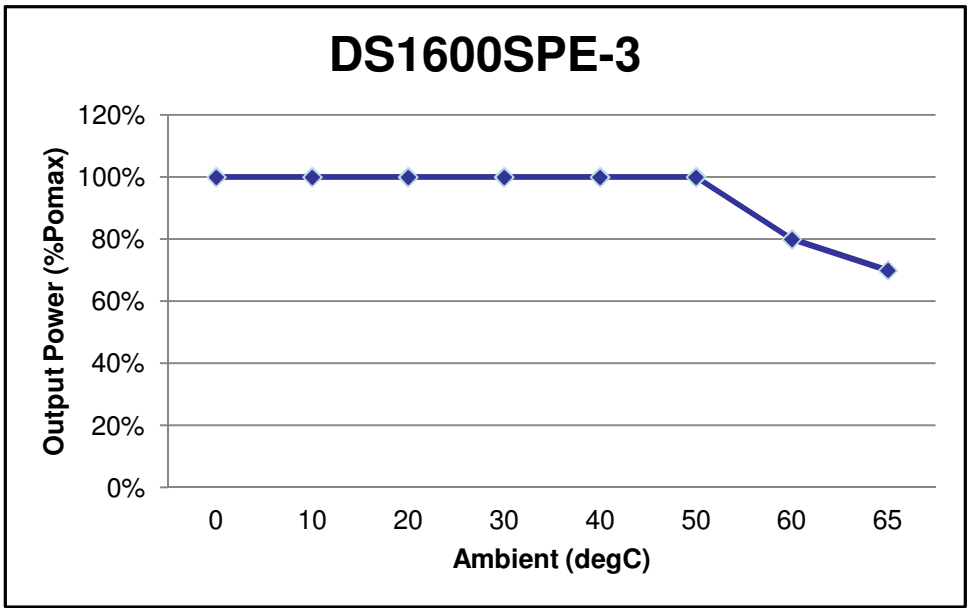
Forced Air Cooling

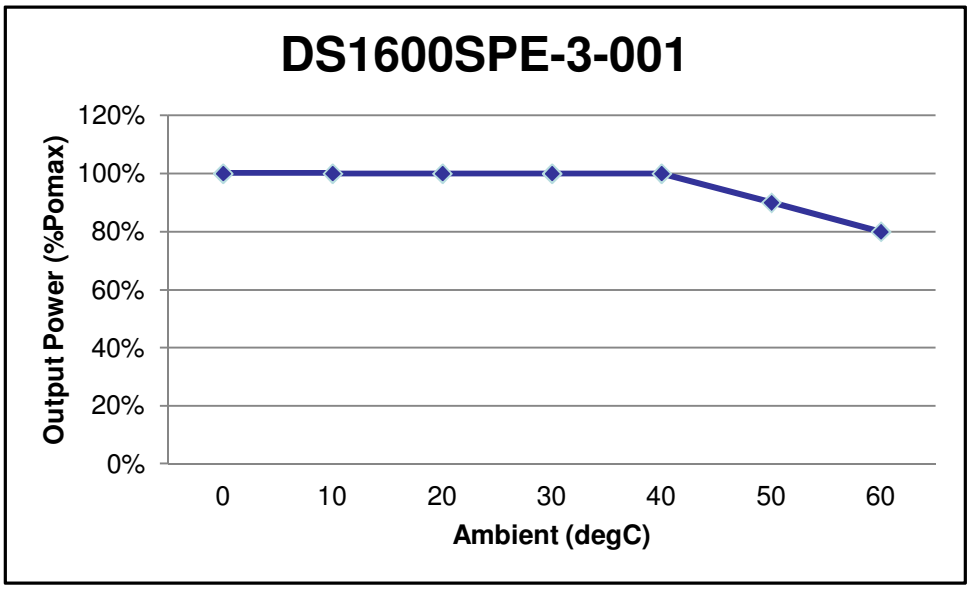
The DS1600SPE-3 series power supplies included internal cooling fans as part of the power supply assembly to provide forced air-cooling to maintain and control temperature of devices and ambient temperature in the power supply to appropriate levels. The standard direction of airflow is from the DC connector 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

DS1600SPE-3 series total output power will be derated according to the curve shown below. All models can provide derated output power from 50degC up to 65deg C ambient temperature max.





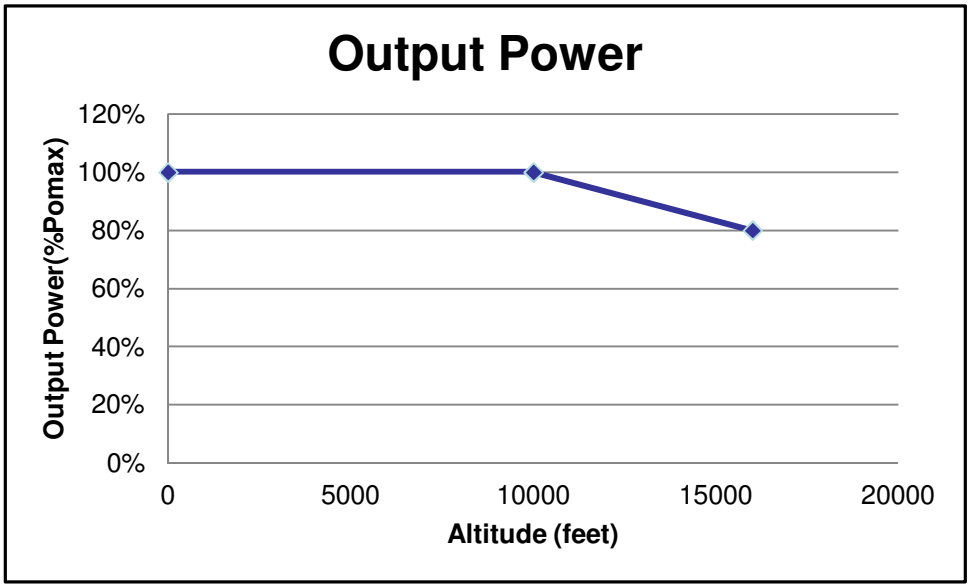
Storage and Shipping Temperature / Humidity

The DS1600SPE-3 series power supplies can be stored or shipped at temperatures between –40 ºC to +70 ºC and relative humidity from 10% to 95% non-condensing.

Altitude

The DS1600SPE-3 series will operate within specifications at altitudes up to 16,400 feet above sea level. The power supply will not be damaged when stored at altitudes of up to 50,000 feet above sea level.

When Altitude come up to 16400 feet of see level, (ambient temperature derated to 40 degrees C at 10,000 feet) , power derates to 80% load at 50°C or 100% load at 35°C.



Humidity

Operating: Power supply will be designed to operate with no degradation of performance while operating in range of 20% 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-95%RH non-condensing.

Vibration

The DS1600SPE-3 series power supply will pass the following vibration specifications:

Non-Operating Random Vibration

Acceleration	2.21	gRMS
Frequency Range	5-500	Hz
Duration	30	mins
Direction	Rotating each axis on vertical vibration	
PSD Profile	**FREQ** / **SLOPE dB/oct** / **PSD g^2/Hz** 5 Hz / 0.001 g^2/Hz 20Hz / 0.010 g^2/Hz 500 Hz / 0.010 g^2/Hz	

Acceleration	3.12	gRMS
Frequency Range	5-500	Hz
Duration	30	mins
Direction	Rotating each axis on vertical vibration	
PSD Profile	**FREQ** / **SLOPE dB/oct** / **PSD g^2/Hz** 5 Hz / 0.002 g^2/Hz 20Hz / 0.020 g^2/Hz 500 Hz / 0.020 g^2/Hz	

Shock

The DS1600SPE-3 power supply will pass the following vibration specifications:

Non-Operating Half-Sine Shock

Acceleration	30	G
Duration	18	msec
Pulse	Half-Sine	
No. of Shock	3 shock on each of 6 faces	

Power and Control Signal Descriptions

AC Input Connector

This connector supplies the AC Mains to the DS1600SPE-3 power supply.

Pin 1 - L1
Pin 2 - L2
Pin 3 - Earth Ground

Output Connector – Power Blades

These pins provide the main output for the DS1600SPE-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 DS1600SPE-3 power supply. The Main Output (V_O) is electrically isolated from the power supply chassis.

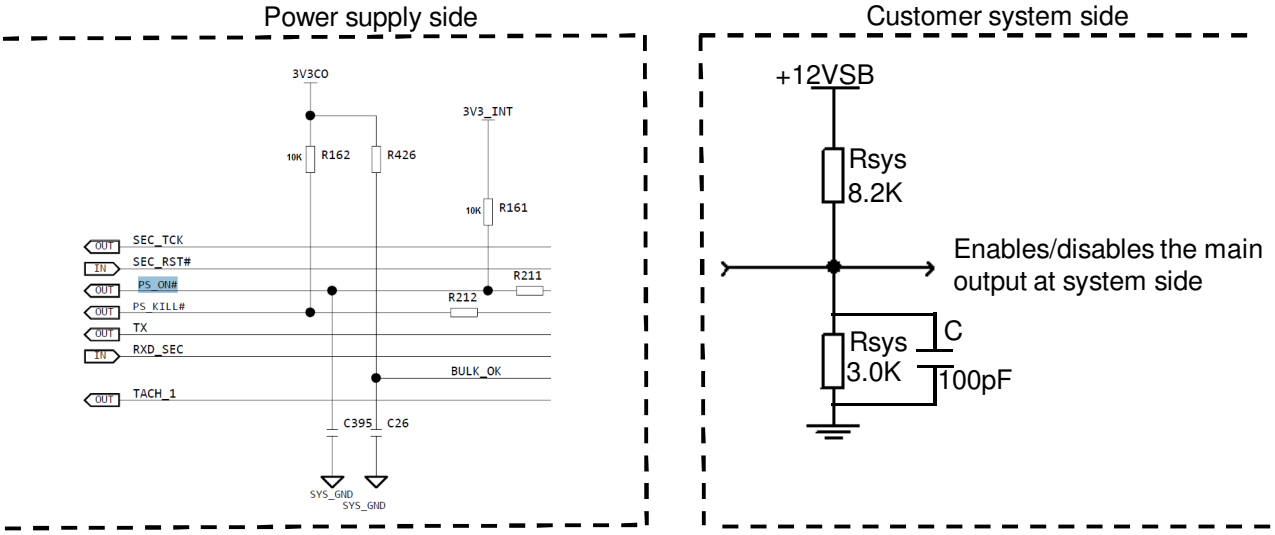
P1-P8 - + Main Output (V_O)
P9-P18 - Main Output Return
P19-P20 - Standby Output (Vsb)
P21-P28 - + Main Output / Standby Return
P29-P36 - + Main Output (V_O)

Output Connector - Control Signals

The DS1600SPE-3 series contains a 24 pins control signal header providing an analogue control interface, Standby power and I^2C interface signal connections.

PS_ON_L – (pin S13)

This signal input pin controls the normal turning ON and Off of the Main Output of the DS1600SPE-3 power supply. The power supply main output (V_O) will be enabled when this signal is pulled low, below 0.8 V. The Power supply output (except Vsb output) will be disabled when this input is driven higher than 2.0 V, or left open circuited. Recommended pull-up resistor to 12 Vsb is 8.2 k with a 3.0 k pull-down to ground. A 100 pF decoupling capacitor is also recommended.



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

The main output of the DS1600SPE-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 DS1600SPE-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 (Vsb).

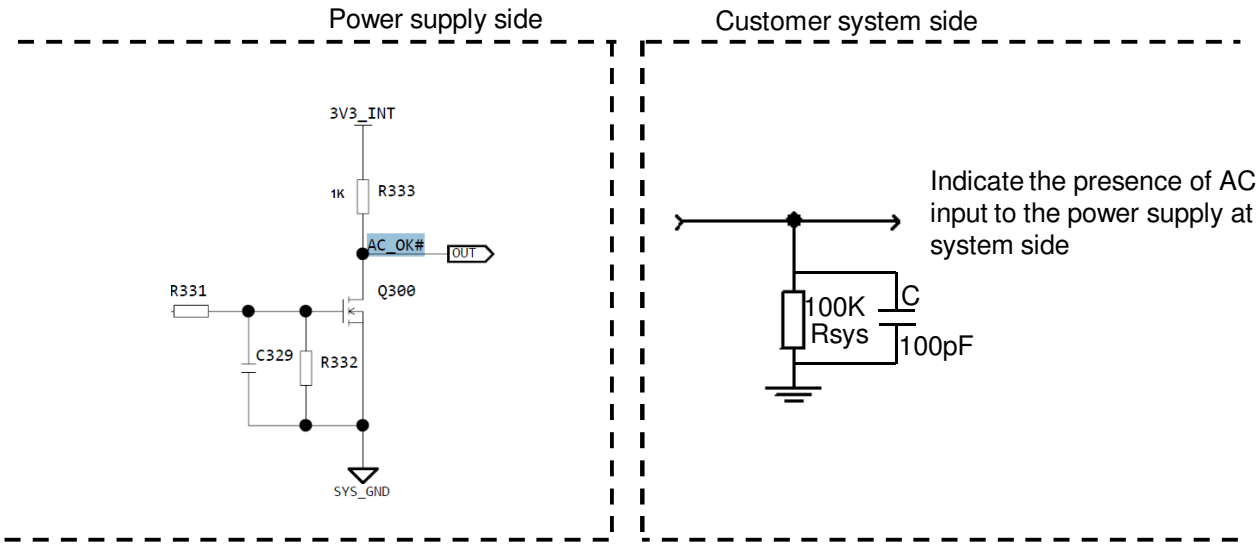
12V Main output and Standby output return lines are connected together inside PSU and connected to PSU chassis directly. It is recommended to connect 12V return to system chassis on end system application for better common mode noise.

Standby Output, Standby Output Return – (pins P19-P12, P21-P28)

The DS1600SPE-3 provides a regulated 12 volt 3 amp auxiliary output voltage to power critical circuitry that must remain active regardless of the on/off status of the power supply's main output. The Standby Output (Vsb) voltage is available whenever a valid AC input voltage is applied to the unit. The Standby Output is independently short circuit protected and is referenced to the Standby Output Return pins (P21-P28).

ACOK – (pin S5)

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



I_SHARE – (pin S7)

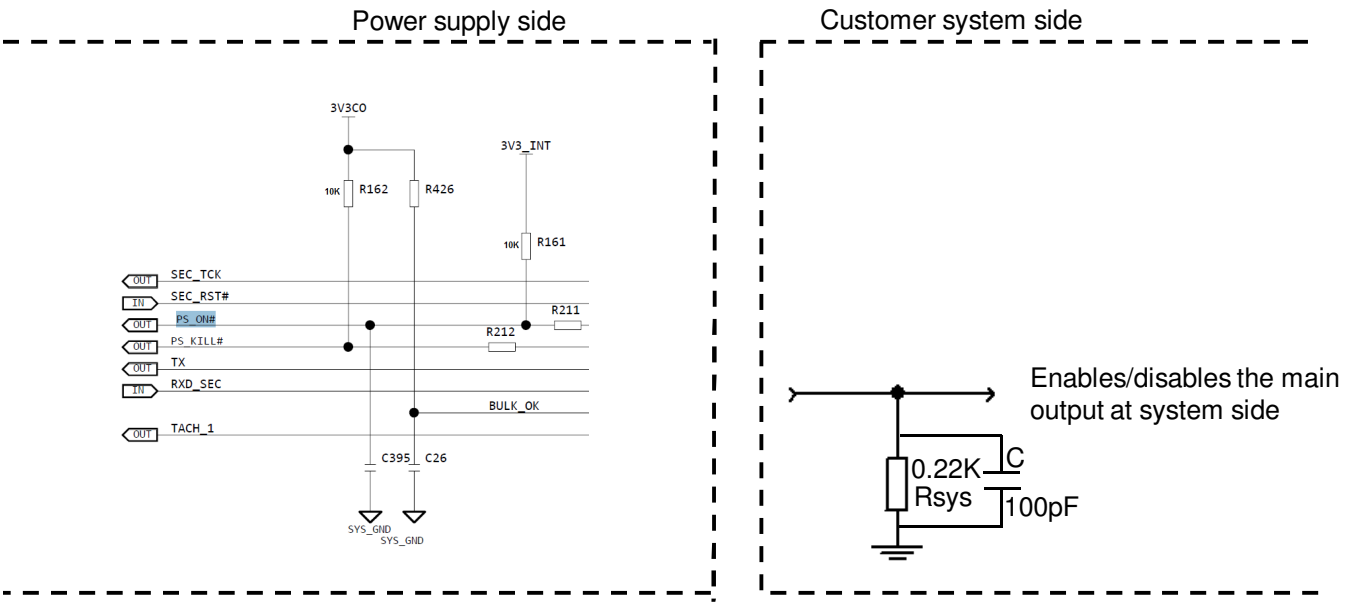
The DS1600SPE-3 supports active current sharing through a single wire connection between the power supplies. This input/output signal pin allows two or more power supplies to share the main output load current to increase the overall power capability or to operate the units in a N+N configuration for redundancy purposes.

The voltage of this signal will be a linear slope from no load to full load. At 66.6A output when two supplies are running in parallel must be between 3.85 and 4.15V. At 133.3A output when two supplies are running in parallel must be between 7.75 and 8.25V.

All outputs with active current sharing 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: If the maximum rated output current of an output is 100A, then the difference between half of total load and supplies' current cannot be greater than +-2A/100%, +-2A/50%, +-2A /25% and +-2A/10% load. The current share loop should be activated when the output current exceed 10% of total load.

PS_KILL_H – (pin S14)

First break/Last Mate active LOW signal which enables/disables the main output. This signal will have to be pulled to ground at the system side with a 220ohm resistor. A 100pF decoupling capacitor is also recommended (Standby output will remain on).



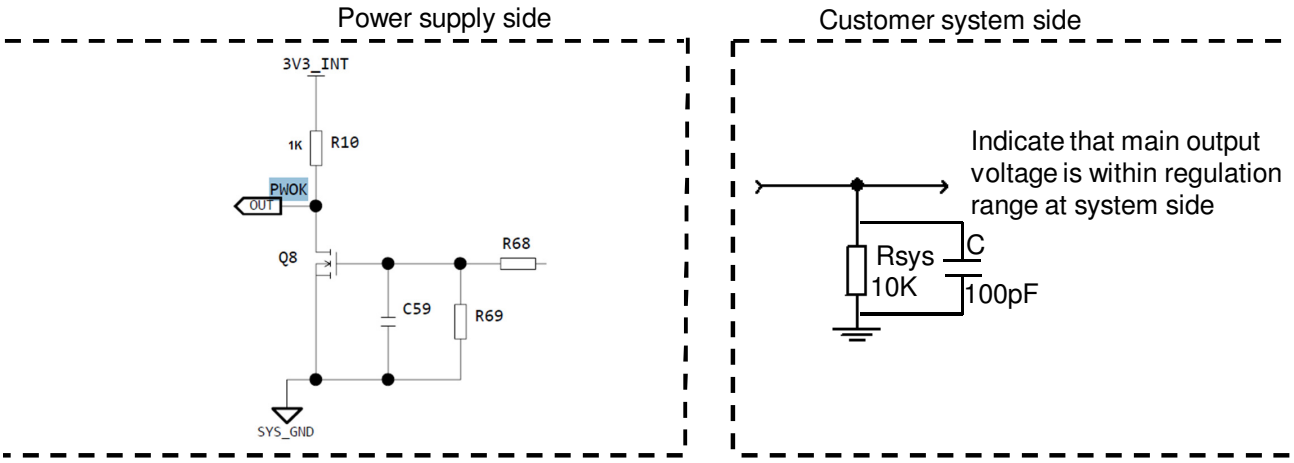
SDA, SCL and S_INTERRUPT_L – (pins S17, S19, S9)

Please refer to "Communication Bus Descriptions" section.

PWR_Good – (pin S4)

Signal used to indicate that main output voltage is within regulation range. The PWR_Good signal will be driven HIGH when the output voltage is valid and will be driven LOW 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 1.0kohm resistor connected to 3.3V inside the power supply. It is recommended that this pin be connected to a 100pF decoupling capacitor and pulled down by a 10kohm resistor.



PS_PRESENT – (pin S1)

Signal used to indicate to the system that a power supply is inserted in the power bay. This pin is shorted to the Standby return in the power supply. Recommended pull-up resistor to 12Vsb is 8.2k with a 3.0k pull-down to ground. A 100pF decoupling capacitor is also recommended.

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

Please refer to “Communication Bus Descriptions” section.

A0, A1 and A2– (pins S2, S3 and S24)

Please refer to “Communication Bus Descriptions” section.

Communication Bus Descriptions

I²C Bus Signals

The DS1600SPE-3 power supply contains enhanced monitor and control functions implemented via the I²C bus. The DS1600SPE-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 (ie: 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 100KHz.

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

I²C serial data and clock bus - these pins are internally pulled up to internal 3.3V supply with a 100K resistor. 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.

Refer to the communication interface specifications for more details

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 12Vsb is 8.2k with a 3.0k pull-down to ground. A 200pF decoupling capacitor is also recommended.

A0, A1 and A2 (I²C Address) – (pin S2, S3 and S24)

These three input pins are the address lines A0, A1 and A2 to indicate the slot position the power supply occupies in the power bay and define the power supply addresses for FRU data and PMBus™ data communication. This allows the system to assign different addresses for each power supply. During I²C communication between system and power supplies, the system will be the master and power supplies will be slave.

They are internally pulled up to internal 3.3V supply with a 2.2K resistor.

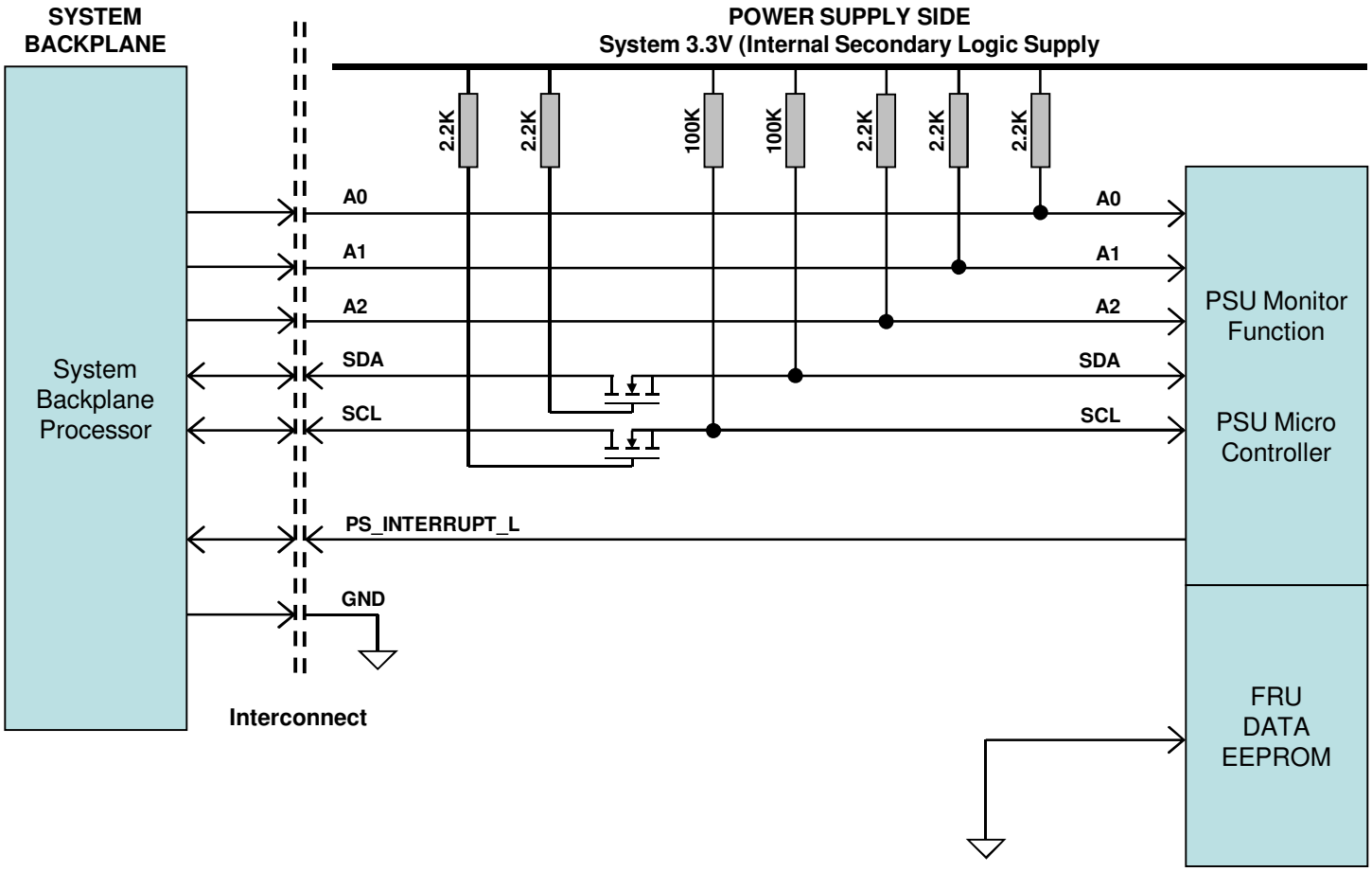
I²C Bus Communication Interval

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 400mV peak-to-peak. This noise measurement should be made with an oscilloscope bandwidth limited to 100MHz. Measurements should be make at the power supply output connector with 2.2K ohm resistors pulled up to Standby Output and 100pf 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):

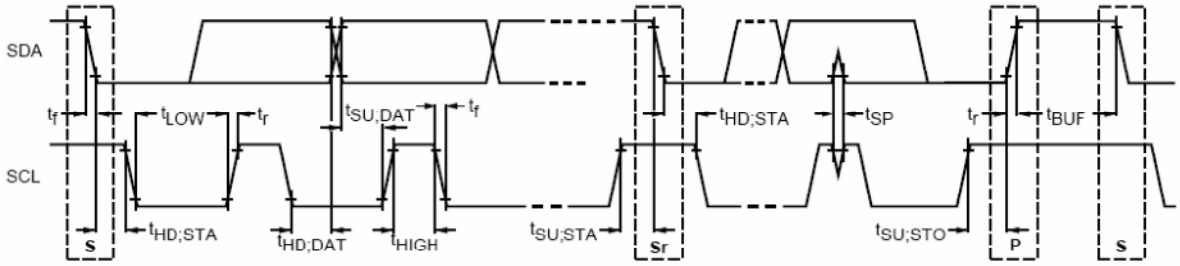
Parameter	Condition	Symbol	Min	Typ	Max	Unit
SDA, SCL internal pull-up resistor		R_{int}	-	100	-	Kohm
Recommended external pull-up resistor	1 PSU	R_{int}	-	2.2	-	Kohm
		C_{int}	-	200	-	pF
	6 PSU	R_{int}	-	0.37	-	Kohm
A0,A1,A2 internal pull-up resistor	1 PSU	R_{int}	-	2.2	-	Kohm
A0,A1,A2 internal bus capacitance	1 PSU	C_{int}	-	200	-	pF
Recommended external pull-down resistor	1 PSU	R_{ext}	-	220	-	ohm
Recommended external pull-down capacitance	1 PSU	C_{ext}	-	100	-	pF

Logic Levels

DS1600SPE-3 series power supply I2C Communication Bus will respond to logic levels as per below:

Logic High: 5.1V Nominal (Specs is 2.1V to 5.5V)**
Logic Low: 500mV nominal (Specs is 800mV max)**

Timings



Parameter	Symbol	Standard-Mode Soecs		Actual		Unit
		Min	Max			
SCL Clock Frequency	f_{SCL}	0	100	100		KHz
Hold time (repeated) START condition	$t_{HD;STA}$	4.0	-	4.9		us
LOW period of SCL clock	t_{LOW}	4.7	-	5.3		us
HIGH period of SCL clock	t_{HIGH}	4.0	-	4.1		us
Setup time for repeated START condition	$t_{SU;STA}$	4.7	-	20.4		us
Data hold time	$t_{HD;DAT}$	0	3.45	1.7		us
Data setup time	$t_{SU;DAT}$	250	-	4688		ns
Rise time	t_r	-	1000	SCL = 961	SDA = 811	ns
Fall time	t_f	-	300	SCL = 125	SDA = 211	ns
Setup time for STOP condition	$t_{SU;STO}$	4.0	-	6.9		us
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	62.1		msec

Device Addressing

The DS1600SPE-3 series will respond to supported commands on the I²C bus that are addressed according to pins A2, A1 and A0 pins of output connector.

Address pins are held HIGH by default via pulled up to internal 3.3V (5V)supply with a 2.2K resistor. To set the address as "0", the corresponding address line should be pulled down to logic ground level. Below tables show the address of the power supply with A0, A1 and A2 pins set to either "0" or "1".

PSU Slot	Slot ID Bits			PMBus™ Address(W/R)	EEPROM (FRU) Address (W/R)
	A2	A1	A0		
1	0	0	0	0xB0/0xB1	0xA0/0xA1
2	0	0	1	0xB2/0xB2	0xA2/0xA2
3	0	1	0	0xB4/0xB5	0xA4/0xA5
4	0	1	1	0xB6/ 0xB7	0xA6/ 0xA7
5	1	0	0	0xB8/0xB9	0xA8/0xA9
6	1	0	1	0xBA/0xBB	0xAA/0xAB
7	1	1	0	0xBC/ 0xBD	0xAC/ 0xAD
8	1	1	1	0xBE/ 0xBF*	0xAE/ 0xAF*

* Default PMBus™ address when A0, A1 and A2 are left open

Reporting Functions

The power supply will have enhanced monitor and control functions implemented via the I2C bus. This will use the SDA and SCL pins. The power supply monitor will operate 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	±5%	
Input power	±5W at <125W	±1.25%	
Output voltage	±2%		
Output current	±1.2 A error for DS1600SPE[1]	±3%	
Temperature	±5 degC on the operating range		
E_{IN}	±15% from 10% to 20% load	±5%	
Fan speed	±250 RPM		

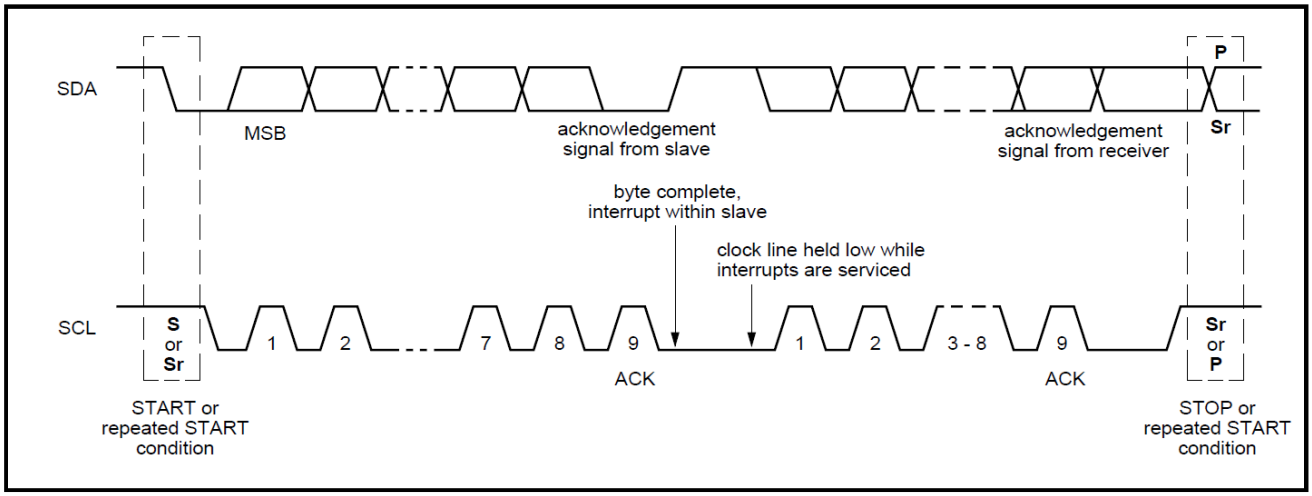
PMBus	Yes
Remote ON/OFF	Yes

Note1 - reporting error shall not be more than 2A when the load is below 5%

I²C Clock Synchronization

The DS1600SPE-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 DS1600SPE-3 is 100 microsecond.



FRU (EEPROM) Data

The FRU (Field Replaceable Unit) data format is compliant with the Intel IPMI v1.0 specification.

The DS1600SPE-3 uses 1 page of EEPROM for FRU purpose. A page of EEPROM contains up to 256 byte-sized data locations.

Where: OFFSET - The OFFSET denotes the address in decimal format of a particular data byte within DS1600SPE-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.

DS1600SPE-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**	216	D8
2	02	**CHASSIS INFO AREA OFFSET**	8	08
3	03	**BOARD INFO AREA OFFSET**	0	00
4	04	**PRODUCT INFO AREA OFFSET**	5	05
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))	209	D1
		CHASSIS INFO AREA(32 BYTES) This area will be filled by the Mfg. Diag. or by the OS if used		
8	08	**FORMAT VERSION NUMBER** 7:4 - Reserved, write as 0000b 3:0 - Format Version Number = 1h for this specification	1	01
9	09	**CHASSIS INFO AREA LENGTH** in multiple of 8 bytes	4	04
10	0A	**CHASSIS TYPE** (Default value is 0.)	0	00
11	0B	**CHASSIS PART NUMBER** Type/Length CAh (if used) 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** CFH (if used) Type = “ASCII+LATIN1” = (11)b Length = 15 Bytes = (001111)b	207	CF
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		0	00
31	1F		0	00
32	20		0	00

DS1600SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
33	21	CHASSIS SERIAL NUMBER BYTES, Default value is 0.	0	00
34	22		0	00
35	23		0	00
36	24		0	00
37	25		0	00
38	26	**End Tag** (0C1h if used)	193	C1
39	27	**CHKSUM** (Zero CHKSUM if used)	161	A1
		PRODUCT INFORMATION AREA, 64 BYTES		
40	28	**FORMAT VERSION NUMBER** (Product Info Area) 7:4 - Reserved, write as 0000b 3:0 - Format Version Number = 1h for this specification	1	01
41	29	**PRODUCT INFO AREA LENGTH** (In multiples of 8 bytes)	8	08
42	2A	**Language (English)**	25	19
43	2B	**MANUFACTURER NAME TYPE / LENGTH** (0C5H) 7:6 - (11)b, 8-Bit ASCII+Latin 1, 5:0 – (000101)b, 5-Byte Allocation	199	C7
		MANUFACTURER'S NAME 5 byte sequence		
44	2C	"A"= 41h	65	41
45	2D	"R"= 52h	82	52
46	2E	T"= 54h	84	54
47	2F	"E"= 45h	69	45
48	30	"S"= 53h	83	53
49	31	"Y"= 59h	89	59
50	32	"N"= 4Eh	78	4E
51	33	**PRODUCT NAME** Type/Length (CCH) Type = "ASCII+LATIN1" = (11)b Length = 15 Bytes = (001111)b	207	CF
52	34	**PRODUCT NAME BYTES** (5 Byte sequence)	68	44
53	35		83	53
54	36	"D"	49	31
55	37	"S"	54	36
56	38	"1"	48	30
57	39	"6"	48	30
58	3A	"0"	83	53
59	3B	"0"	80	50
60	3C	"S"	69	45
61	3D	"P"	45	2D
62	3E	"E"	51	33
63	3F	"D"	32	20
64	40	"-"	32	20
65	41	"3"	32	20
66	42		32	20
67	43	**PRODUCT PART/MODEL NUMBER** Type/Length (CFH) Type = "ASCII+LATIN1" = (11)b Length = 15 Bytes = (001111)b	207	CF
68	44	**PRODUCT PART/MODEL NUMBER BYTES**	68	44
69	45	"D"	83	53
70	46	"S"	49	31
71	47	"1"	54	36
72	48	"6"	48	30
73	49	"0"	48	30
74	4A	"0"	83	53
75	4B	"S"	80	50
76	4C	"P"	69	45
77	4D	"E"	45	2D
78	4E	"D"	51	33
79	4F	"-"	32	20
80	50	"3"	32	20
81	51		32	20
82	52		32	20

DS1600SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
83	53	**PRODUCT VERSION NUMBER** Type/Length (C2h) Type = "ASCII+LATIN1" = (11)b Length = 2 bytes = (000010)b	194	C2
		PRODUCT VERSION NUMBER BYTES Refer to Section 1.2 Product Revision History in latest IPS		
84	54	"A"	65	41
85	55	"A"	65	41
		PRODUCT SERIAL NUMBER Type/Length		
86	56	Type = "ASCII+LATIN1" = (11)b Length = 13 bytes = (001101)b	205	CD
		PRODUCT SERIAL NUMBER BYTES Model ID = DS1600SPE-3 / K369		
87	57	"K"	75	4B
88	58	"3"	51	33
89	59	"6"	54	36
90	5A	"9"	57	39
		MANUFACTURING YEAR AND WEEK CODE		
91	5B	"W"=57h (Per Unit)	87	57
92	5C	"W"=57h (Per Unit)	87	57
		UNIQUE SERIAL NUMBER "SSSS"		
93	5D	"S" = 53 (Per Unit)	83	53
94	5E	"S" = 53 (Per Unit)	83	53
95	5F	"S" = 53 (Per Unit)	83	53
96	60	"S" = 53 (Per Unit)	83	53
		MODEL REVISION, Astec Model Rev, See Latest Model Rev in IPS Sec 1.2		
97	61	"A"	65	41
98	62	"A"	65	41
99	63	**MANUFACTURING LOCATION** "Z" for "Zhonshan, China" In Decimal = 090 In Hex = 5AH	90	5A
100	64	End Tag	193	C1
101	65	**PAD (reserved), Default value is 0.**	0	00
102	66		0	00
		ZERO CHECK SUM (256 – (Sum of bytes 40 to 102)) Per Unit		
103	67	Zero Check Sum :Should follow check sum calculation as per IPMI v1.1 specs	187	BB
Multi Record Area, 88 Bytes				
		Power Supply Record Header		
104	68	Record type = 00 for Power supply	0	00
105	69	End of List /Record Format Version Number	2	02
106	6A	Record Length of Power Supply Record	24	18
107	6B	Record CHECKSUM of Power Supply Record (Zero CHECKSUM) (256-(sum of bytes 109 to 132)	23	17
108	6C	Header CHECKSUM of Power Supply Record Header (Zero CHECKSUM) (256-(sum of bytes 104 to 107)	207	CF
Power Supply Record				
		Overall Capacity of the Power Supply 2 Bytes Sequence 1600W = 0640H		
109	6D	In Decimal = 64, 06	64	40
110	6E	In Hex = 40H, 06H	06	06

DS1600SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
		Peak VA, 1834W = 072AH		
111	6F	2 Bytes Sequence	42	2A
112	70	In Decimal = 42, 07 In Hex = 2AH, 07H	07	07
		Inrush Current, 55A		
113	71	In Decimal = 055 In Hex = 37H	55	37
		Inrush Interval, 10mS		
114	72	In Decimal = 010 In Hex = 0AH	10	0A
		Low End Input Voltage Range 1(10mV), (90V / 10mV) 9000 = 2328H 2 Bytes Sequence		
115	73	In Decimal = 040, 035	40	28
116	74	In Hex = 28H, 23H	35	23
		High End Input Voltage Range 1(10mV), (264V/10mV) 26400= 6720H 2 Bytes Sequence		
117	75	In Decimal = 032, 103	32	20
118	76	In Hex = 20H, 67H	103	67
		Low End Input Voltage Range 2(10mV)		
119	77	Not Applicable	0	00
120	78	(Autoswitch)	0	00
		High End Input Voltage Range 2(10mV)		
121	79	Not Applicable	0	00
122	7A	(Autoswitch)	0	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,** 1 indicates function supported and a 0 indicates function not supported. Bits 7-5: RESERVED, WRITE AS 000B Bit 5: PMBUS capable or not. 1 if Supported 0 if not. BIT = 1 Bit 4: Tachometer Pulses Per Rotation / Predictive Fail Polarity BIT = 0 Bit 3: Hot Swap / Redundancy Support BIT = 1 Bit 2: Auto switch Support BIT = 1 Bit 1: Power Factor Correction Support BIT = 1 Bit 0: Predictive Fail Support BIT = 0	46	2E
		Peak Wattage Capacity and Holdup Time 2 Bytes Sequence		
127	7F	1600W = 0640H	64	40
128	80	10ms = 0BH	166	A6
129	81	**Combined Wattage,** Not Applicable	0	00
130	82	Byte 1: 0000 0000	0	00
131	83	0000 0000 Byte 2 and Byte 3: 00H, 00H 3 Bytes Sequence	0	00
		Predictive Fail Tachometer Lower Threshold, Not Applicable.		
132	84	Predictive Failure is not Supported.	0	00
		12V DC OUTPUT RECORD HEADER		
133	85	Record type = 01 for DC Output Record	1	01
134	86	End of List /Record Format Version Number for 12V DC Output Record	2	02
135	87	Record Length of 12V DC Output Record	13	0D
136	88	Record CHECKSUM of 12V DC Output Record (Zero CHECKSUM) (256-(sum of bytes 138 to 150)	184	B6
137	89	Header CHECKSUM of 12V DC Output Record Header (Zero CHECKSUM) (256-(sum of bytes 1313to 136)	56	36

DS1600SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
		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
		Nominal Voltage (10mV), (12V / 10mV) 1200 = 04B0H 2 Bytes Sequence		
139 140	8B 8C	In Decimal: 176, 004 In Hex: B0H, 04H	176 4	B0 04
		Maximum Negative Voltage Deviation (10mV), 1140 = 0474H 2 Bytes Sequence		
141 142	8D 8C	In Decimal: 116, 004 In Hex: 74H, 04H	116 4	74 04
		Maximum Positive Voltage Deviation (10mV), 1260 =04ECH 2 Bytes Sequence		
143 144	8F 90	In Decimal: 236, 004 In Hex: ECH, 04H	236 4	EC 04
		Ripple and Noise pk-pk (mV), 150 = 96H 2 Bytes Sequence		
145 146	91 92	In Decimal: 150, 000 In Hex: 96H, 00H	120 0	78 00
		Minimum Current Draw (10mA), 0200 = 00C8H 2 Bytes Sequence		
147 148	93 94	In Decimal: 050, 000 In Hex: 32H, 00H	200 0	C8 00
		Maximum Current Draw (10mA), 6250 = 3415H		
149 150	95 96	In Decimal: 21, 52 In Hex: 15H, 34H	21 52	15 34
		Vsb 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	2	02
153	99	Record Length of 3V3SB Output Record	13	0D
154	9A	Record CHECKSUM of 3V3SB Output Record (Zero CHECKSUM) (256-(sum of bytes 156 to 168)	179	B3
155	9B	Header CHECKSUM of 3V3SB Output Record Header (Zero CHECKSUM) (256-(sum of bytes 151 to 154)	61	3D
156	9C	**Output Information,** 002 = 02H Bit 7: Standby Information = 1B Bits 6-4: Reserved, Write as 000B Bits 3-0: Output Number 2 = 010B	130	82
		Nominal Voltage (10mV), (12V / 10mV) 1200 = 04B0H 2 Bytes Sequence		
157 158	9D 9E	In Decimal: 176, 004 In Hex: B0H, 04H	176 4	B0 04
		Maximum Negative Voltage Deviation (10mV), 1140 = 0474H 2 Bytes Sequence		
159 160	9F A0	In Decimal: 116, 004 In Hex: 74H, 04H	116 4	74 04
		Maximum Positive Voltage Deviation (10mV), 1260 =04ECH 2 Bytes Sequence		
161 162	A1 A2	In Decimal: 236, 004 In Hex: ECH, 04H	236 4	EC 04
		Ripple and Noise pk-pk (mV), 120 = 78H 2 Bytes Sequence		
163 164	A3 A4	In Decimal: 120, 000 In Hex: 78H, 00H	120 0	78 00

DS1600SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
		Minimum Current Draw (10mA), (0.1A / 10mA) 10 = 000AH		
		2 Bytes Sequence		
165	A5	In Decimal: 010, 000	10	0A
166	A6	In Hex: 0AH, 00H	0	00
		Maximum Current Draw (10mA), (3.5A / 10mA) 350 = 015EH		
		2 Bytes Sequence		
167	A7	In Decimal: 94, 001	94	5E
168	A8	In Hex: 5EH, 01H	1	01
		OEM RECORD HEADER		
169	A9	Record type = C0H for OEM Record	192	C0
170	AA	End of List /Record Format Version Number for 3.3Vsb output Record	130	82
171	AB	Record Length of OEM Record	42	2A
172	AC	Record CHECKSUM of OEM Record (Zero CHECKSUM)	0	00
173	AD	Header CHECKSUM of OEM Record Header (Zero CHECKSUM)	148	94
		(256-(sum of bytes 169to 172)		
		OEM RECORD		
174	AE	**Manufacturer ID** (3 bytes, Default is 0)	0	00
175	AF	RESERVED	0	00
176	B0	RESERVED	0	00
177	B1	RESERVED	0	00
178	B2	RESERVED	0	00
179	B3	RESERVED	0	00
180	B4	RESERVED	0	00
181	B5	RESERVED	0	00
182	B6	RESERVED	0	00
183	B7	RESERVED	0	00
184	B8	RESERVED	0	00
185	B9	RESERVED	0	00
186	BA	RESERVED	0	00
187	BB	PAD (reserved), Default value is 0.	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

DS1600SPE-3 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
		INTERNAL USE AREA, 40 BYTES		
216	D8	RESERVED, Default value is 0.	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
235	EB		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	Zero CHECKSUM of Internal Use Area (if used). Default Value=0	0	00

DS1600SPE-3-001 FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
52	34	**PRODUCT NAME BYTES** (5 Byte sequence)	68	44
53	35	"D"	83	53
54	36	"S"	49	31
55	37	"1"	54	36
56	38	"6"	48	30
57	39	"0"	48	30
58	3A	"0"	83	53
59	3B	"S"	80	50
60	3C	"P"	69	45
61	3D	"E"	45	2D
62	3E	"D"	51	33
63	3F	"-"	45	2D
64	40	"3"	48	30
65	41	"-"	48	30
66	42	"0"	49	31
		"0"		
		"1"		
67	43	**PRODUCT PART/MODEL NUMBER** Type/Length (CFH) Type = "ASCII+LATIN1" = (11)b Length = 15 Bytes = (001111)b	207	CF
68	44	**PRODUCT PART/MODEL NUMBER BYTES**	68	44
69	45	"D"	83	53
70	46	"S"	49	31
71	47	"1"	54	36
72	48	"6"	48	30
73	49	"0"	48	30
74	4A	"0"	83	53
75	4B	"S"	80	50
76	4C	"P"	69	45
77	4D	"E"	45	2D
78	4E	"D"	51	33
79	4F	"-"	45	2D
80	50	"3"	48	30
81	51	"-"	48	30
82	52	"0"	49	31
		"0"		
		"1"		

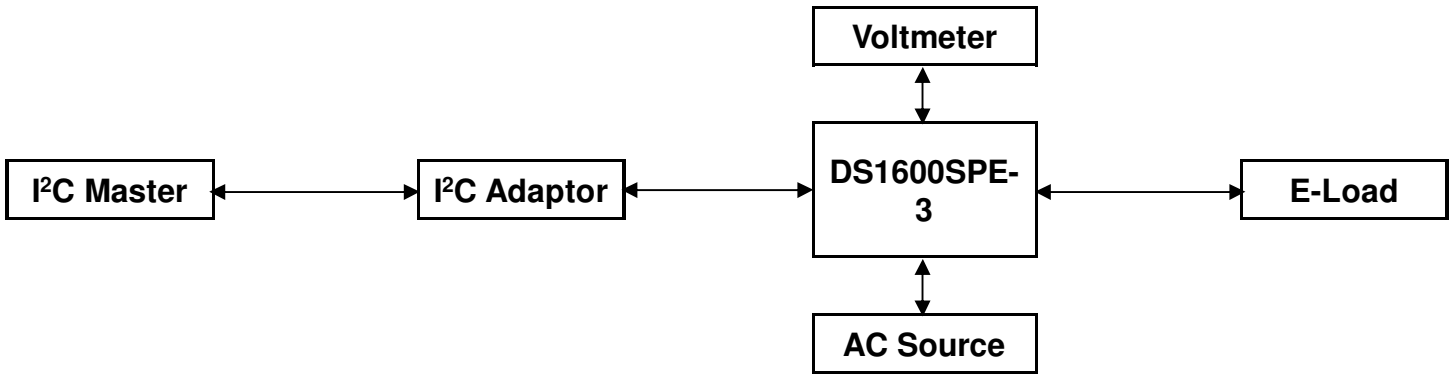
PMBus™ Interface Support

The DS1600SPE-3 is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I²C interface port.

DS1600SPE-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 commends

20h – Disables write except 10h, 01h, 00h, 02h and 21h commands

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

80h – Disable write except 0x00h

To save changes on the USER PMBus™ Table:

Use send byte command: 15h STORE_USER_ALL

To save changes on the DEFAULT PMBus™ Table:

Use send byte command: 11h STORE_DEFAULT_ALL

Wait for 5 seconds, turn-off the PSU, wait for another 5 seconds before turning it on.

DS1600SPE-3 Series Support PMBus™ Command List

The DS1600SPE-3 is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the i²C interface port.

DS1600SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
00h	Page	00	R	1		
01h	OPERATION	80h	R/W	1		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	10b				00 – Immediate Turn OFF (No Sequencing) 01 – Soft Turn OFF (With Sequencing) 10 – PSU ON
	b5:4	00b				
	b3:2	00b				
	b1:0	00b				Reserved
02h	ON_OFF_CONFIG	1C	R/W	1		Configures the combination of CONTROL pin and serial communication commands needed to turn the Unit ON/OFF.
	b7:5	000				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	FF	S			
10h	WRITE_PROTECT	00	R/W	1		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.
15h	STORE_USER_ALL	-	S	0		Copies the Operating memory table to the matching USER non-volatile memory.
19h	CAPABILITY	90	R	1		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	00000				Reserved
20h	VOUT_MODE	17	R	1		Specifies the mode and parameters of Output Voltage related Data Formats

DS1600SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	
21h	VOUT_COMMAND	1800	R/W	2	Linear	Sets the Output Voltage Reference Vout command sends discreet value to change or trim output voltage. Valid range is 11.4 tp 12.6V.
24h	VOUT_MAX	1933	R	2	Linear	Read Only (12.6V)
30h	COEFFICIENTS	-	BR	6		use to retrieve the m, b and R coefficients, needed for DIRECT data format
	byte 1:2					mlow Byte, m high byte
	byte 3:4					b low Byte, b high byte
	byte 5					R byte
35h	VIN_ON	EAC0	R	2	Linear	Sets the value of input, in volts, at which the unit should start. ACGOOD 88Vac
36h	VIN_OFF	EA98	R	2	Linear	Sets the value of input, in volts, at which the unit should stop power conversion. ACBAD 83Vac
3Ah	FAN_ CONFIG_1_2	90	R	1		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	1C33	R/W	2	Linear	Sets Output Over voltage threshold. (14.1V) Valid Range: 12.6 to 15.5 V
41h	VOUT_OV_FAULT_RESPONSE	80	R	1		Unit Latches OFF. Resets on PSON or CONTROL pin recycle or AC recycle.
42h	VOUT_OV_WARN_LIMIT	1999	R/W	2	Linear	Sets Over-voltage Warning threshold. (12.8V)
43h	VOUT_UV_WARN_LIMIT	1666	R/W	2	Linear	Sets Under-voltage Warning threshold. (11.2V)
44h	VOUT_UV_FAULT_LIMIT	1599	R/W	2	Linear	Sets Under-voltage Fault threshold. (10.8V)
45h	VOUT_UV_FAULT_RESPONSE	80	R	1		Turn PSU OFF
46h	IOUT_OC_FAULT_LIMIT	F280	R	2	Linear	Sets the Over current threshold in Amps. (160A) Valid Range: 150 to 166.7 A
47h	IOUT_OC_FAULT_RESPONSE	C0	R	1		OCP ride through. If OCP persists.
4Ah	IOUT_OC_WARN_LIMIT	F258	R	2	Linear	Sets the Over Current Warning threshold in Amps. (150A) Valid Range: 150 to 166.7 A
4Fh	OT_FAULT_LIMIT	EBC0	R/W	2	Linear	Secondary ambient temperature Fault threshold, in degree C. (120degC), Valid Range: 51 to 125 deg C
50h	OT_FAULT_RESPONSE	78	R	1		Turn PSU OFF and will retry indefinitely. Supported enable/disable of protection and recoverability.
51h	OT_WARN_LIMIT	EB98	R	2	Linear	Secondary ambient temperature warning threshold, in degree C. Operating limit (115 degC) Valid Range: 51 to 125 deg C

DS1600SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	
55h	VIN_OV_FAULT_LIMIT	FA26	R	2	Linear	Sets input over-voltage threshold. (275Vac) Valid Range: 264 to 300 Vac
56h	VIN_OV_FAULT_RESPONSE	F8	R	1		
57h	VIN_OV_WARN_LIMIT	???				Default: 270 Vac Valid Range: 264 to 300 Vac
58h	VIN_UV_WARN_LIMIT	EAB8	R	2	Linear	Default: 87 Vac Valid Rang: 70 to 90 Vac
59h	VIN_UV_FAULT_LIMIT	EA98	R	2	Linear	Default: 83 Vac Valid Rang: 70 to 90 Vac
5Ah	VIN_UV_FAULT_RESPONSE	F8	R	1		
5Eh	POWER_GOOD_ON	16CC	R	2	Linear	Sets the threshold by which the Power Good Default: 11.4 V Valid Range: 11.4 to 12.6 V
5Fh	POWER_GOOD_OFF	1666	R	2	Linear	Sets the threshold by which the Power Good Default: 11.2 V Valid Range <= 11.4 V
60h	TON_DELAY	EB20	R	2	Linear	Sets the time (sec), from start condition (Power ON) until the output starts to rise. (2.1sec max) Default=100ms
61h	TON_RISE	E280	R	2	Linear	Sets the time (ms), for the output rises from 0 to regulation. (50ms max) Default=40ms
63h	TON_MAX_FAULT_RESPONSE	80				
64h	TOFF_DELAY	C200	R	2	Linear	Sets the time (ms), from a stop condition (Power OFF) until the output starts to drop (converter OFF). Default: 2.2 S Valid Range: 2 to 2.5 S
6Ah	POUT_OP_WARN_LIMIT					Default: 1600 W Valid Rang: 1600 to 1920 W
78h	STATUS_BYTE	-	R	1		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	-	R	2		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 – UKNOWN					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.

DS1600SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	
7Ah	STATUS_VOUT	-	R	1		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 that the highest permissible voltage.
	b2					TON_MAX_FAULT
	b1					TOFF_MAX Warning. Not supported
	b0					Not supported.
7Bh	STATUS_IOUT	00	R	1		Output Current related faults and warnings
	b7					IOUT Over current Fault
	b6					IOUT Over current And Low Voltage shutdown Fault
	b5					IOUT Overcurrent Warning
	b4					IOUT Undercurrent Fault
	b3					Current Share Fault
	b2					Power Limiting
	b1					POUT Overpower Fault
	b0					POUT Overpower Warning
7Ch	STATUS_INPUT	-	R	1		Input related faults and warnings
	b7					VIN Overvoltage Fault
	b6					VIN Overvoltage Warning
	b5					VIN Undervoltage Warning
	b4					VIN Undervoltage Fault
	b3					Unit is OFF for insufficient Input Voltage
	b2					IIN Overcurrent Fault
	b1					IIN Overcurrent Warning
	b0					PIN Overpower Warning
7Dh	STATUS_TEMPERATURE	-	R	1		Temperature related faults and warnings
	b7					Overtemperature Fault
	b6					Overtemperature Warning
	b5					Undertemperature Warning
	b4					Undertemperature Fault
	b3:0					Reserved
7Eh	STATUS_CML	-	R	1		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

DS1600SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	
80h	STATUS_MFR_SPECIFIC	-	R	1		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	1		
	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_VIN	-	R	2	Linear	Returns the accumulated input power over time
87h	READ_EOUT	-	R	2	Linear	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
8Ah	READ_VCAP	-	R	2	Linear	Returns Bulk Capacitor voltage in Volts
8Bh	READ_VOUT	-	R	2	Direct	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	PSU's inter hot spot temperature typically that of the main output rall heat sink. Format is Linear-11
8Eh	READ_TEMPERATURE_2	-	R	2	Linear	PSU's system-side air inlet or internal ambient temperature . Format is Linear-11.
8Fh	READ_TEMPERATURE_3	-	R	2	Linear	PSU's chassis-side air exhaust temperature. Format is Linear-11.
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		Reads the PMBus revision number
	b7:5	0001				Part 1 Revision 0000 – Revision 1.0 0001 – Revision 1.1
	b4:0	0001				Part 2 Revision 0000 – Revision 1.0 0001 – Revision 1.1
99h	MFR_ID	"ARTESYN"	BR, ASCII	7		Abbrev or symbol of manufacturers name. ASCII (EMERSON)
9Ah	MFR_MODEL	"DS1600SPE-3"	BR, ASCII			Manufacturers Model number, ASCII format
9Bh	MFR_REVISION	"AA"	BR, ASCII	2		Manufacturers, revision number, ASCII format
9Ch	MFR_LOCATION	"China"	BR, ASCII			Manufacturers facility, ASCII format
9Dh	MFR_Date	"WW"	BR	6		Manufacture Date, ASCII format structure : YYMMDD
9Eh	MFR_DATE	"K369WWSSSSAAZ	BR	13		Unit serial number, ASCII format.
A0h	MFR_VIN_MIN	EADO	R	2	Linear	Minimum Input Voltage (90Vac)
A1h	MFR_VIN_MAX	FA10	R	2	Linear	Maximum Input Voltage (264Vac)
A2h	MFR_IIN_MAX	D280	R	2	Linear	Maximum Input Current (10A)
A3	MFR_PIN_MAX	-			Linear	Maximum Input Power (1780W)
A4h	MFR_VOUT_MIN	16CC	R	2	Linear	Minimum Output Voltage Regulation Window. (11.4V)

DS1600SPE-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	
A5h	MFR_VOUT_MAX	1933	R	2	Linear	Maximum Output Voltage. Regulation Window (12.6V)
A6h	MFR_IOUT_MAX	-	R	2	Linear	Maximum Output Current (133.3A)
A7h	MFR_POUT_MAX	-	R	2	Linear	Maximum Output Power (1600W)
A8h	MFR_TAMBIENT_MAX	E320	R	2	Linear	Maximum Operating Ambient Temperature (Secondary Ambient) (50 degC)
A9h	MFR_TAMBIENT_MIN	000A	R	2	Linear	Minimum Operating Ambient Temperature (Secondary Ambient) (0 degC)
AAh	MFR_EFFICIENCY_LL		R	14		Default: 115 V, 160 W, 89 %, 400 W, 91.5%, 800 W, 89%
ABh	MFR_EFFICIENCY_HL		R	14		Default: 230 V, 320 W, 93 %, 800 W, 94 %, 1600W, 92 %
B0h	USER_DATA_00		R/W			
E0h	FW_PRI_VERSION		R	8	ASCII	
E1h	FW_SEC_VERSION		R	8	ASCII	
F0	PMBUS_IMP_SPEC_REVISION	AC	R	2		
F1h	ISP_UNLOCK_CODE		R/W	4		
F2h	ISP_CTRL_CMD		R/W	1		
F3h	ISP_STATUS_BYTE		R	1		
F4h	ISP_FLASH_ADDR		R/W	4		
F5h	ISP_FLASH_DATA.		R/W	4		

Current Sharing

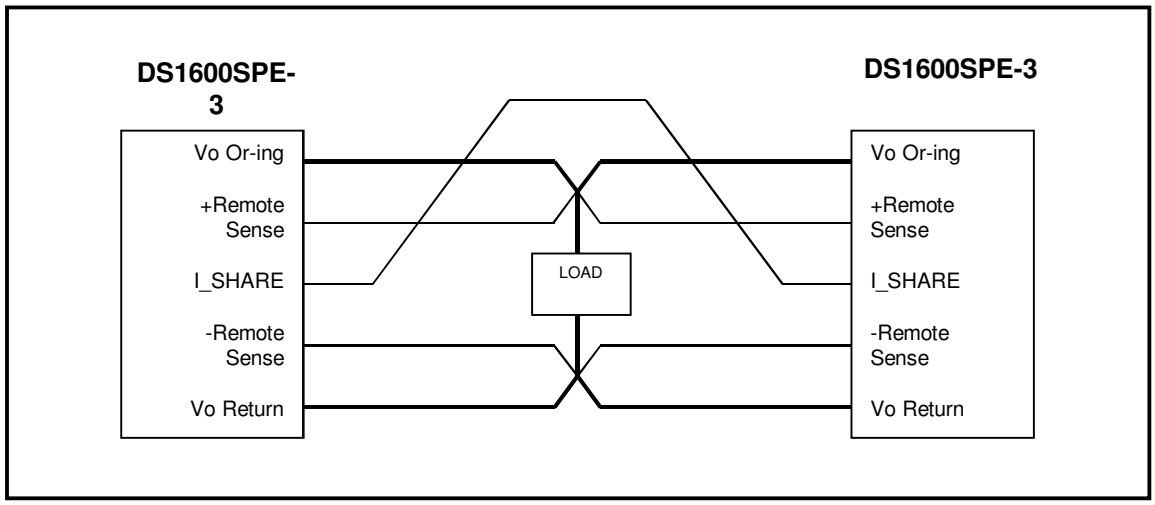
The DS1600SPE-3 series' main output V_O is equipped with current sharing capability. This will allow up to 6 power supplies to be connected in parallel for higher power application. Current share accuracy is typically 5% of full load. When supplying light loads between 10% and 100% of its rated load, the power supplies will share within 5% accuracy. Below 10% total loading, there is no guarantee of output current sharing.

The current sharing has been tested with a distribution impedance of about 200 micro-ohm.

Redundancy / Fault Tolerance

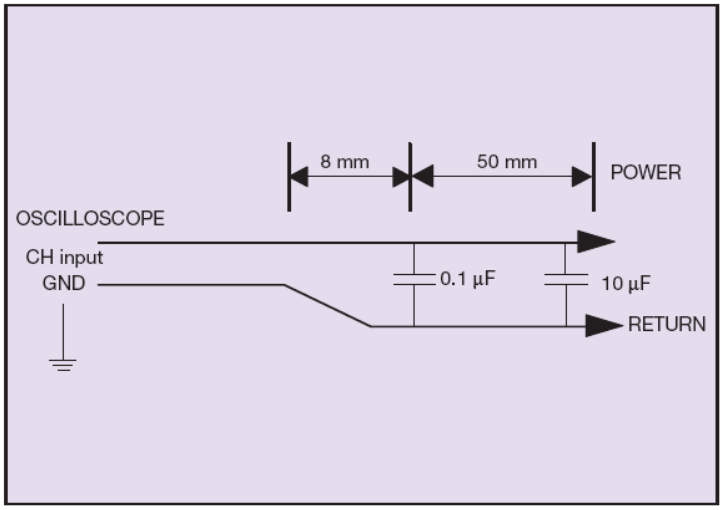
The DS1600SPE-3 series power supplies must be able to current share with 2(1+1) up to 4(2+2) or 6(3+3) power supplies in parallel and operate in a hot swap/redundant N+N configuration where N=1, 2, or 3. The 12Vsb outputs of the power supplies are connected together in the system so that a failure or 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 DS1600SPE-3 Series. When measuring output ripple and noise, a scope jack in parallel with a 0.1uF ceramic chip capacitor, and a 10 uF aluminum electrolytic capacitor should be used. Oscilloscope should be set to 20 MHz bandwidth for this measurement.



WORLDWIDE OFFICES

Americas
2900 S.Diablo Way
Tempe, AZ 85282
USA
+1 888 412 7832

Europe (UK)
Waterfront Business Park
Merry Hill, Dudley
West Midlands, DY5 1LX
United Kingdom
+44 (0) 1384 842 211

Asia (HK)
14/F, Lu Plaza
2 Wing Yip Street
Kwun Tong, Kowloon
Hong Kong
+852 2176 3333

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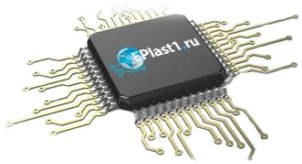

Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.