Advanced Energy®

ARTESYN
DS500SDC SERIES
500 Watts Distributed Power System

PRODUCT DESCRIPTION

Advanced Energy's Artesyn DS500SDC-3 series bulk front end DC-DC power supply accepts a wide range -36 to -72VDC input and provides a main 12V output plus a 12V standby output. It is rated at 500 watts. Housed in a 1U high rack-mounting enclosure with a short form factor that frees up system space, the DS500SDC-3 has a power density of 12 watts per cubic in. This series comes in two airflow versions — DC-connector to AC-connector and vice versa. The series is also in the same form factor and has the same output configuration as the DS500SPE-3.

AT A GLANCE

Total Power:

500 Watts

Input Voltage:

-36 to -72 Vdc

# of Outputs:

Main and Standby

SPECIAL FEATURES

- 1U power supply
- High-power and short form factor
- Active power factor correction
- High-density design: 12W/in^3
- Inrush current control
- Full digital control
- N+1 or N+N redundant
- Hot plug operation
- Active current sharing (10 to 100% load)
- PMBus compliant
- Compatible with Artesyn's Universal PMBus GUI
- Reverse airflow available
- Two years warranty

SAFETY

- UL/cUL
- DEMKO + CB Report
- EN60950
- CE Mark
- China CCC

TYPICAL APPLICATIONS

- Industrial

RoHS ✔

MODEL NUMBERS

Standard	Output Voltage	Minimum Load[1]	Maximum Load	Stand-By Supply	Air Flow Direction
DS500SDC-3	12.0Vdc	0A	41.6A	12Vdc@3A	Forward (DC Connector to Red Handle)
DS500SDC-3-001	12.0Vdc	0A	41.6A	12Vdc@3A	Reverse (Blue 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	**Models**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Input Voltage 　　　　DC continuous operation	All models	$V_{IN,DC}$	-36	-54	-72	Vdc
Maximum Output Power (Main + Stand-by)	All models	$P_{O,max}$	-	-	500	W
Isolation Voltage 　　　　Input to outputs 　　　　Input to safety ground	All models All models		- -	- -	3232 3232	Vdc Vdc
Ambient Operating Temperature	DS500SDC-3 DS500SDC-3-001	T_A	0 0	- -	+65[1] +55	^{O}C ^{O}C
Storage Temperature	All models	T_{STG}	-40	-	70	^{O}C
Humidity (non-condensing) 　　　　Operating 　　　　Non-operating	All models All models		20 10	- -	80 95	% %
Altitude 　　　　Operating 　　　　Non-operating	All models All models		- -	- -	10000[2] 50000	Feet Feet

Note 1 - DS500SDC-3: 500W from 0 to 50°C, withstand operation up to 65°C at 250W output power without damage.
　　　 DS500SDC-3-001: 500W from 0 to 40°C, withstand operation up to 55°C at 250W output power without damage.
Note 2 - Operating altitude up to 10000 feet, derated after 10000 feet, detail see page 23.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC	All	V_{DC}	-36	-54	-72	Vdc
Turn-on Voltage	All		-34	-	-36	Vdc
Turn-off Voltage	All		-33	-	-35	Vdc
Hysteresis between turn-on/turn-off	All		1	-	-	Vdc
Maximum Input Current	$V_{IN,DC}$ = -36Vdc		-	-	17.5	A
Startup Surge Current (Inrush) @ 25°C	All	$I_{IN,surge}$	-	-	55	Apk
Input Fuse	Quick Acting 30A, 170V		-	-	30	A
Operating Efficiency[1]	$V_{IN,DC}$ = -48Vdc I_O = 50% $I_{O,max}$	η	90	-	-	%
Standby Input Current (V_O = 0V, I_{SB} = 0A)	All	$I_{IN,standby}$	-	-	250	mA
Standby Input Power (V_O = 0V, I_{SB} = 0A)	All	$P_{IN,standby}$	-	-	15	W
No Load Input Current (V_O = On, I_O = 0A, I_{SB} = 0A)	All	$I_{IN,no-load}$	-	-	350	mA
System Stability Phase Margin Gain Margin			45 -	- -	- -10	Ø dB

Note 1 - Efficiency measurements done as per generalized test protocol for calculating energy efficiency of internal AC-DC and DC-DC power supplies.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Voltage	All	$\%V_O$	-0.2	-	+0.2	%
		$\%V_{SB}$	-1	-	+1	%
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	Vdc
Output Ripple, pk-pk	Measure with a 0.1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth. A resistor load is recommended. An additional 2000uF capacitor is needed on +12V for ripple/noise measurement	V_O	-	-	120	mV_{PK-PK}
		V_{SB}	-	-	120	mV_{PK-PK}
Output Current	All	I_O	2[1]	-	41.6	A
		I_{SB}	0.1	-	3	A
V_O Current Share Accuracy	50% to 100% I_O		-	-	6.8	$\%I_{O,max}$
Minimum Load for Current Sharing			10	-	-	$\%I_{O,max}$
Number of Parallel Units	Main output "ISHARE" connected		-	-	4	Units
Load Capacitance	Start up	V_O	2000	-	40000	uF
		V_{SB}	0	-	680	uF
V_O Dynamic Response Peak Deviation[1]	50% load change, slew rate = 1A/uS Minimum allowable output capacitance of 500uF during this test	$\%V_O$	-5	-	5	%
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\%V_O$	-0.2	-	0.2	%
MTBF	Telcordia SR232 at 40degC, nominal input, full load		200	-	-	KHour

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

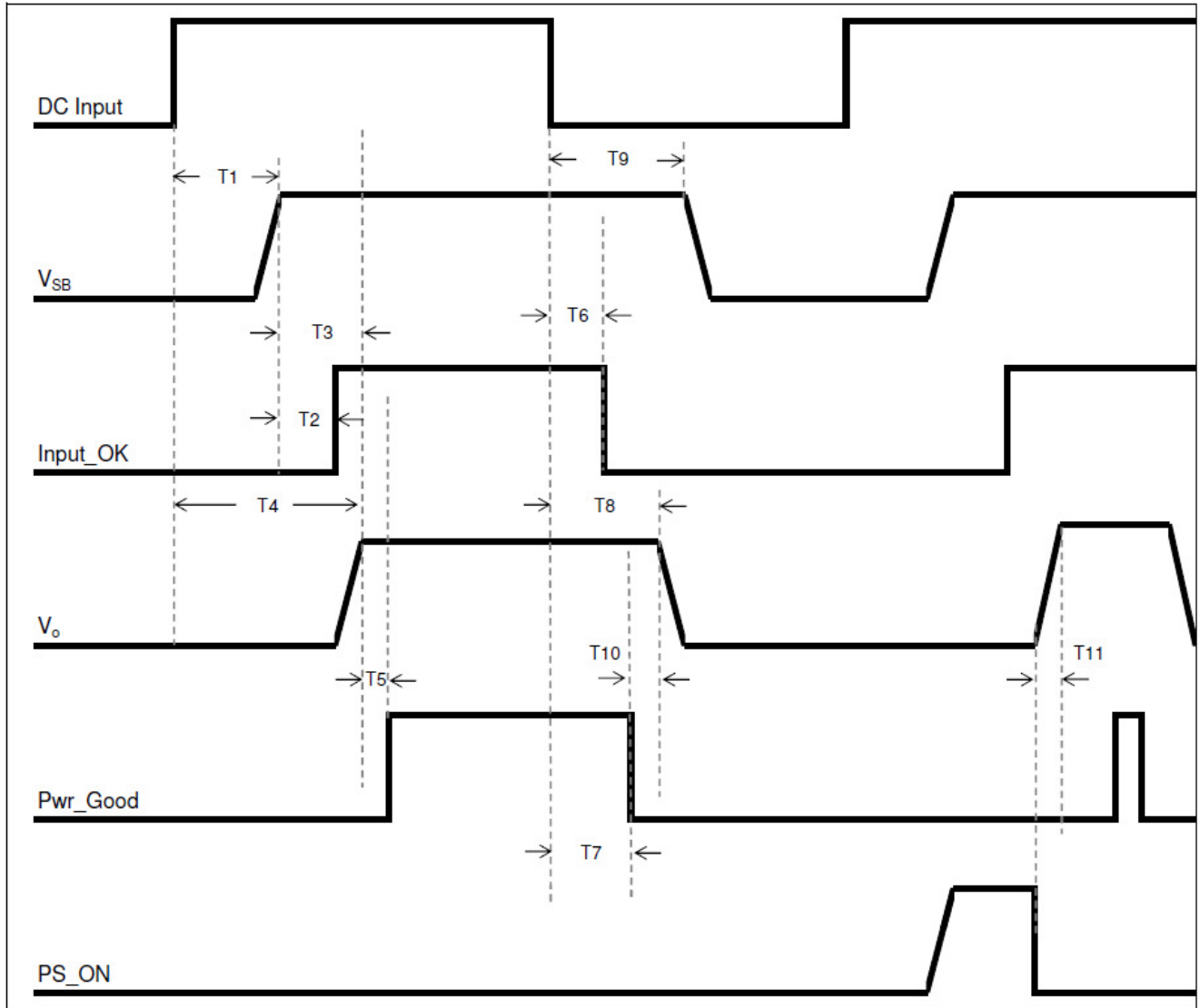# ELECTRICAL SPECIFICATIONS

System Timing Specifications

Table 4. System Timing Specifications				
Label	**Parameter**	**Min**	**Max**	**Unit**
T1	Delay from DC being applied to standby output being within regulation	20	1700	ms
T2	Delay from standby output to INPUT_OK assertion	See note below	20	ms
T3	Delay from standby output to main output voltage being within regulation	-	300	ms
T4	Delay from DC being applied to main output being within regulation	-	2200	ms
T5	Delay from output voltages within regulation limits to Pwr_Good asserted	100	1000	ms
T6	Delay from loss of DC to de-assertion of INPUT_OK	-	6	ms
T7	Delay from loss of DC to de-assertion of Pwr_Good	0.1	-	ms
T8	Delay from loss of DC to main output falling out of regulation	1	-	ms
T9	Delay from loss of DC to standby output falling out of regulation	150	-	ms
T10	Delay from deassertion of Pwr_Good to output falling out of regulation	1	-	ms
T11	Delay from PS_ON assertion to output being within regulation	-	350	ms

Note 1 - Tsb hold-up is measured with standby output loaded at 1A.
Note 2 - Tsb_INPUT_OK: INPUT_OK can assert earlier than the standby output.

ELECTRICAL SPECIFICATIONS

System Timing Diagram

ELECTRICAL SPECIFICATIONS

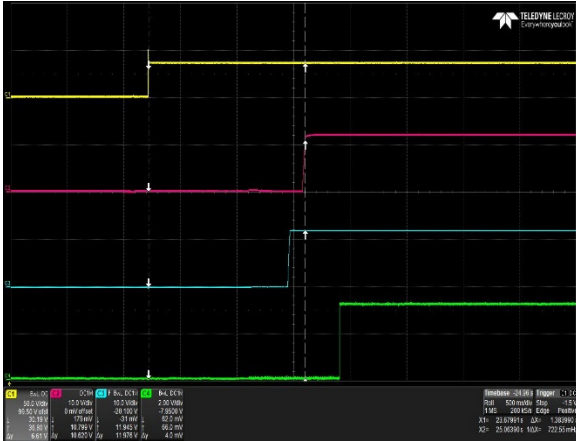## DS500SDC-3 Performance Curves

Figure 1: DS500SDC-3 Turn-On Delay via DC Mains
Vin = -36Vdc   Load: I$_O$ = 41.6A   I$_{SB}$ = 3A
Ch 1: DC Mains   Ch 2: V$_O$ Ch 3: V$_{SB}$ Ch 4: Pwr_Good

Figure 2: DS500SDC-3 Turn-On Delay via PS_ON
Vin = -36Vdc   Load: I$_O$ = 41.6A   I$_{SB}$ = 3A
Ch 1: DC Mains   Ch 2: V$_O$ Ch 3: PS_ON   Ch 4: Pwr_Good

Figure 3: DS500SDC-3 Hold-up Time
Vin = -36Vdc   Load: Io = 41.6A   I$_{SB}$ = 3A
Ch 1: DC Mains   Ch 2: V$_O$ Ch 3: V$_{SB}$ Ch 4: Pwr_Good

Figure 4: DS500SDC-3 Hold-up Time
Vin = -72Vdc   Load: Io = 41.6A   I$_{SB}$ = 3A
Ch 1: DC Mains   Ch 2: V$_O$ Ch 3: V$_{SB}$ Ch 4: Pwr_Good
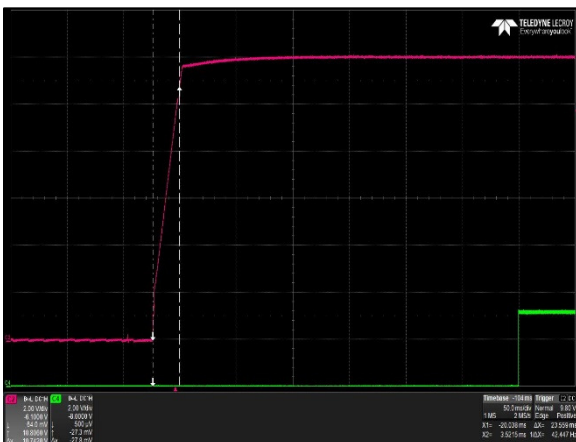

Figure 5: DS500SDC-3 Output Voltage Startup Characteristic
Vin = -36Vdc   Load: Io = 41.6A   I$_{SB}$ = 3A
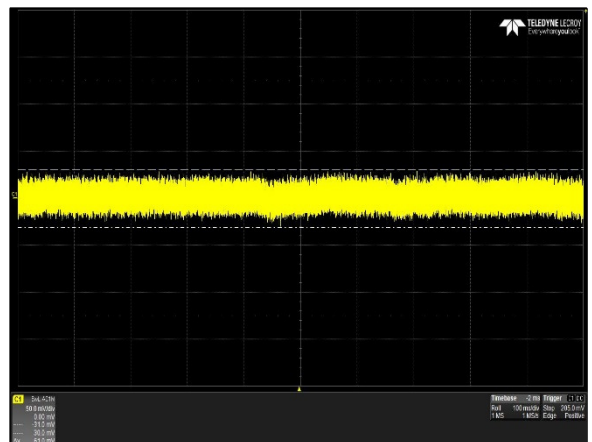Ch 2: V$_O$ Ch 4: Pwr_Good

Figure 6: DS500SDC-3 Ripple and Noise Measurement
Vin = -54Vac   Load: Io = 41.6A   I$_{SB}$ = 3A
Ch 1: V$_O$

ELECTRICAL SPECIFICATIONS

DS500SDC-3 Performance Curves

Figure 7:   DS500SDC-3 Turn Off Characteristic via PS_ON
                  Load: I_O = 41.6A I_{SB} = 3A
Ch 1: V_O Ch 2: PS_ON_L   Ch 3: Pwr_Good
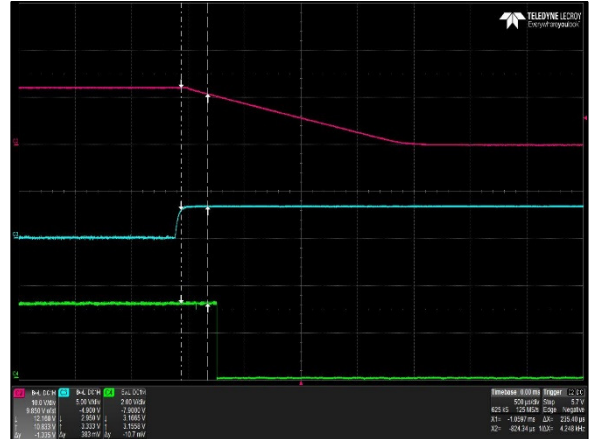

Figure 8:   DS500SDC-3 Turn Off Characteristic via PS_KILL
                  Load: I_O = 41.6A I_{SB} = 3A
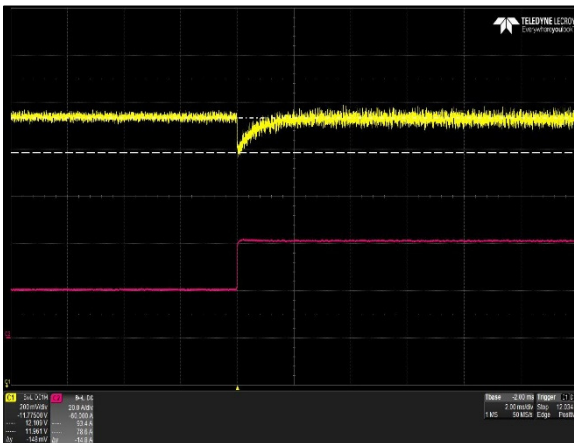Ch 1: V_O Ch 2: PS_KILL   Ch 3: Pwr_Good

Figure 9:   DS500SDC-3 Transient Response - V_O Deviation
50% to 100% load change   1A/uS slew rate   Vin = -54Vdc
Ch 1: V_O Ch 2: I_O Output capacitance = 1000uF
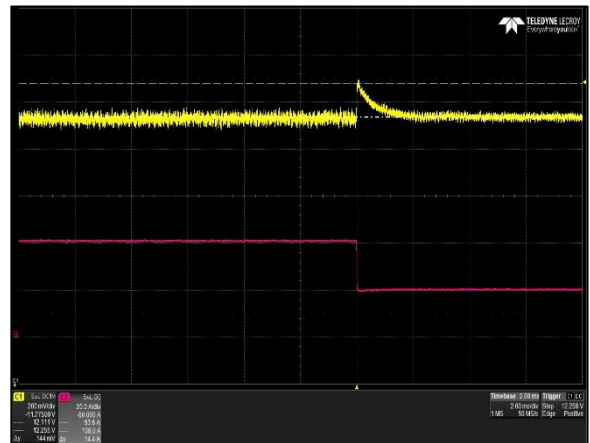

Figure 10:   DS500SDC-3 Transient Response - V_O Deviation
100% to 50% load change   1A/uS slew rate   Vin = -54Vdc
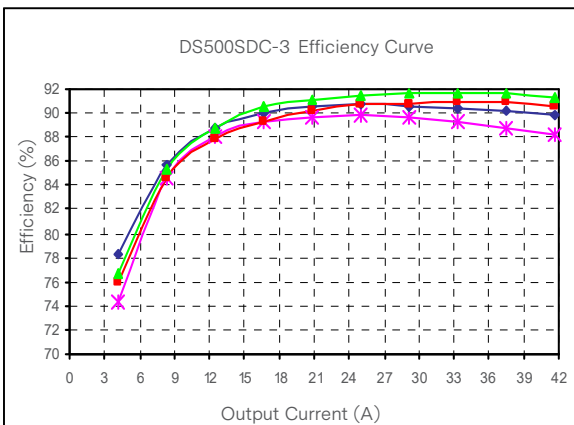Ch 1: V_O Ch 2: I_O Output capacitance = 1000uF

Figure 11:   DS500SDC-3 Efficiency Curve @ 25°C
—✳— -36Vdc   —◆— -48Vdc   —■— -54Vdc   —▲— -72Vdc
Loading: 5% increment to 41.6A, I_{SB} = 3A

ELECTRICAL SPECIFICATIONS

Protection Function Specifications

Input Fuse

DS500SDC-3 series are equipped with an internal non-user serviceable 30A Fast Acting 170Vac fuse for fault protection in 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. A fault on the main output will not cause the standby output to shutdown.

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 Under-voltage	10.5	/	11.0	V
3.3 V_{SB} Output Under-voltage	10.5	/	11.0	V

Over Current Protection (OCP)

DS500SDC-3 series include 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 500ms or less, and if it is less than or equal to 120% 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 DC power / PS_ON 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%-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	120	/	150	$\%I_{O,max}$
V_{SB} Output Overvoltage	120	/	150	$\%I_{SB,max}$

ELECTRICAL SPECIFICATIONS

Short Circuit Protection (SCP)

The DS500SDC-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 0.1 ohm or less.

When the Stand-by output is shorted, the output may try to auto recover. When the Stand-By output attempts to restart, the maximum peak current from the output must be less than 20A.
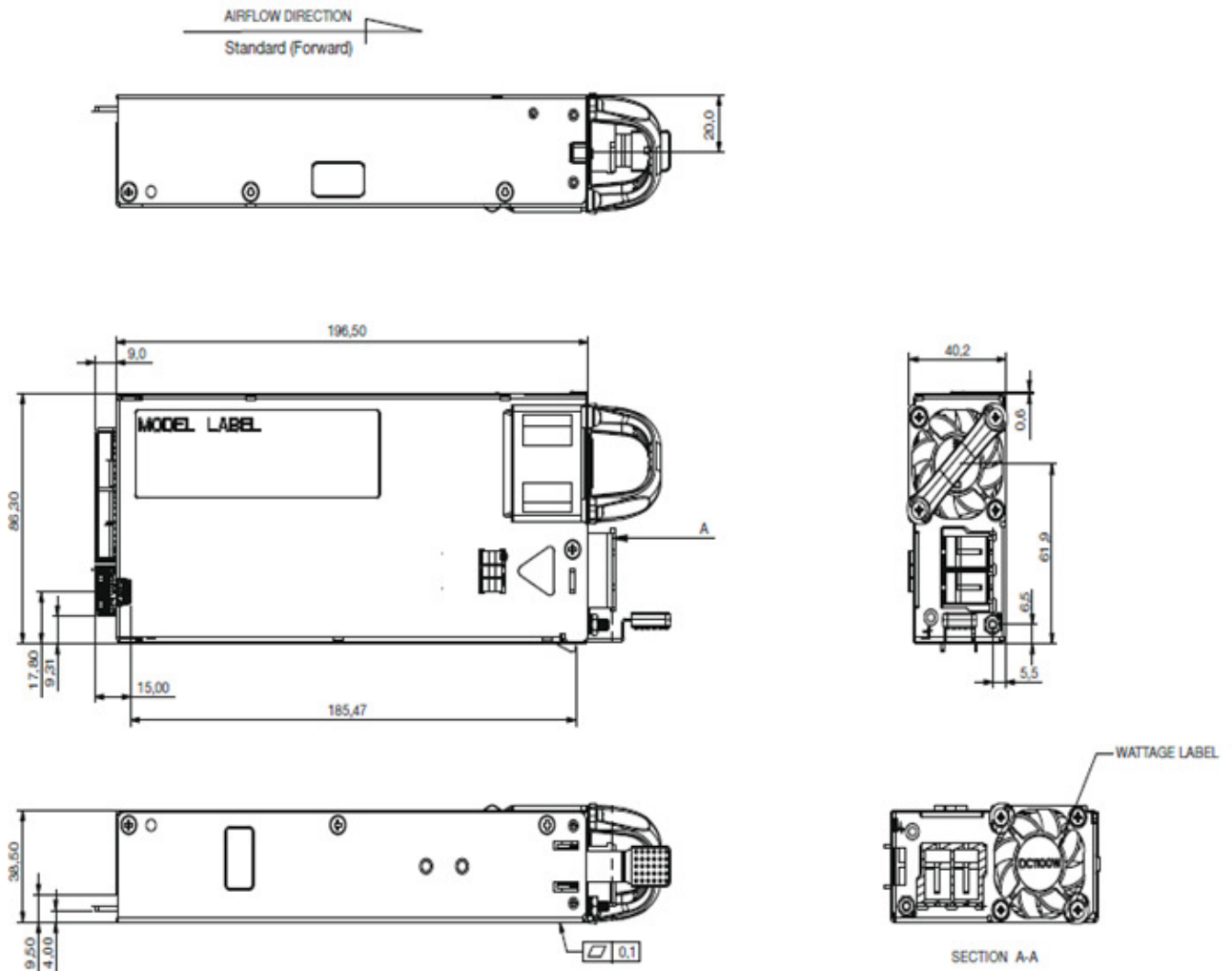
Over Temperature Protection (OTP)

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 temperature 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.

MECHANICAL SPECIFICATIONS

Mechanical Outlines (Units: mm)

AIRFLOW DIRECTION
Standard (Forward)

20,0

196,50
9,0
MODEL LABEL
86,30
A
17,80
9,31
15,00
185,47

40,2
0,6
61,9
6,5
5,5

38,50
9,50
4,00
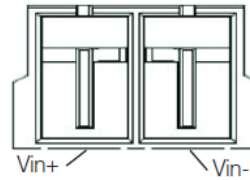0,1

WATTAGE LABEL
DC500W
SECTION A-A

MECHANICAL SPECIFICATIONS

Connector Definitions

DC Input Connector

Pin 1 – +Vin

Pin 2 – -Vin

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)

Output Connector - Control Signals

S1	–	PS_PRESENT
S2	–	Reserved
S3	–	Reserved
S4	–	Pwr_Good
S5	–	Input_OK (DC Input Present)
S6	–	RETURN
S7	–	ISHARE
S8	–	Reserved
S9	–	PS_INTERRUPT_L
S10	–	RETURN
S11	–	Reserved
S12	–	Reserved
S13	–	PS_ON
S14	–	PS_KILL
S15	–	Reserved
S16	–	RETURN
S17	–	SDA
S18	–	RETURN
S19	–	SCL
S20	–	RETURN
S21	–	REMOTE SENSE-
S22	–	RETURN
S23	–	REMOTE SENSE+
S24	–	Reserved

Power Supply Output Card Edge (Top Side)

Power Supply Output Card Edge (Bottom Side)
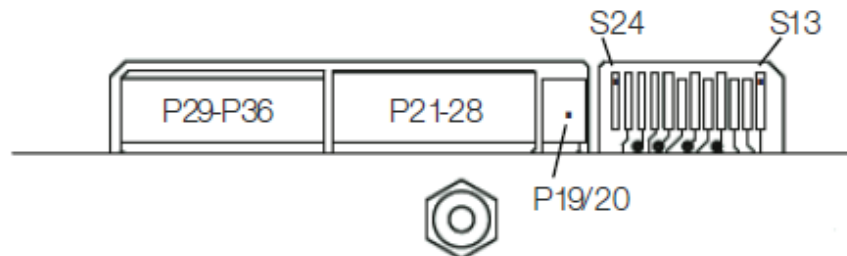
MECHANICAL SPECIFICATIONS

Power / Signal Mating Connectors and Pin Types

Table 5. Mating Connectors for DS500SDC-3 Series		
Reference	On Power Supply	Mating Connector or Equivalent
DC Input Connector	Molex 394210002	Molex 394250002
Output Connector	Card-edge	FCI 10107844-002LF or equivalent

MECHANICAL SPECIFICATIONS

LED Indicator Definitions
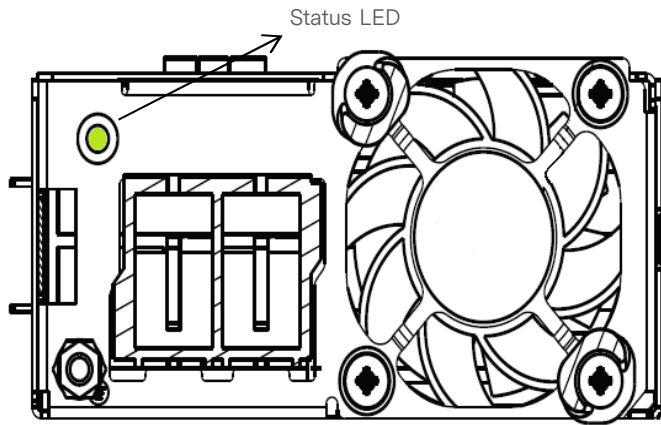
Status LED

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

Conditions	LED Status
No DC input to PSU	OFF
DC present, Standby output ON, Main output ON	SOLID GREEN
Standby mode and power supply failure	BLINKING AMBER

MECHANICAL SPECIFICATIONS

Weight

The DS500SDC-3 series power supply weight is 2.24lbs / 1014g maximum.

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

DS500SDC-3 series power supply is designed to meet the following EMC immunity specifications.

Table 6. Environmental Specifications	
Document	**Description**
FCC Part 15 Subpart J Class A,CISPR 22 / EN55032	Conducted and Radiated EMI Limits
IEC/EN61000-4-2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques - Electrostatic discharge immunity test: 8KV air, 4KV contact discharge. Performance - Criteria A
IEC/EN61000-4-4	Electromagnetic Compatibility (EMC) - Testing and measurement techniques - Electrical fast transient/burst immunity test: 1KV for AC power port. Performance - Criteria B 0.5KV for DC ports, I/O and signal ports. Performance - Criteria A
IEC/EN61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques - Surge test: 1KV common mode and 0.5KV differential mode for DC ports. Performance - Criteria B
EN55032	Information Technology Equipment - Immunity Characteristics, Limits and Method of Measurements

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The DS500SDC-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 DS500SDC-3 Series Power Supply		
Document	File #	Description
UL/cUL62368		US and Canada Requirements
D + CB Cert	DK-38993-A2-UL	(All CENELEC Countries)
CHINA CCC	2014010907716519	China Requirements
CE Mark	14756	
UKCA Mark		UK Requirements

ENVIRONMENTAL SPECIFICATIONS

EMI Emissions

The DS500SDC-3 series has been designed to comply with the Class A limits of EMI requirements of EN55032 (FCC Part 15) and CISPR 22 (EN55032) for emissions and relevant sections of EN61000 (IEC61000) for immunity. The unit is enclosed inside a metal box, tested at 500W using resistive load with cooling fan.

Conducted Emissions

The applicable standard for conducted emissions is EN55032 (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.
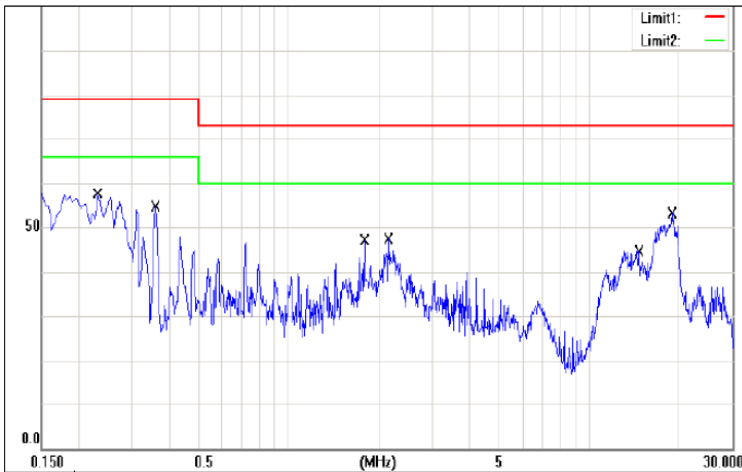
The DS500SDC-3 power supplies have internal EMI filters ensure the convertors' conducted EMI levels comply with EN55032 (FCC Part 15) Class A and EN55032 (CISPR 22) Class A limits. The EMI measurements are performed with resistive loads at maximum rated loading.

Sample of EN55032 Conducted EMI Measurement at 48Vdc input

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

Table 8. Conducted EMI Emission Specifications of The DS500SDC-3 Series Power Supply						
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

ENVIRONMENTAL SPECIFICATIONS

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 EN55032 Class A (FCC Part 15). Testing the convertors as a stand-alone component to the exact requirements of EN55032 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 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.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature

The DS500SDC-3 series power supplies will start and operate within stated specifications at an ambient temperature from $0^{O}C$ to $50^{O}C$ under all load conditions with internal fan.

Forced Air Cooling

The DS500SDC-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 minimum airflow provided by the power supply is 11CFM. The PSU must meet thermal requirements at this airflow at worst operating conditions, with a backpressure of 0.4 in of water.

The forward airflow direction will be from the DC connector end to the DC end of the power supply. The power supply is able to run continuously without overheating at 50% load and nominal line/temperature conditions at XX fan speed.

Additionally, the fan PWM duty cycle will be set to 100% once ambient temperature reaches 50 degrees C regardless of the output load.

Standby mode operation will not require airflow to cool the power supply at worst case conditions. However, if used in redundant mode operation and when the 12V main is present, fans are allowed to run regardless if any unit is in standby mode or have no DC input.

ENVIRONMENTAL SPECIFICATIONS

Storage and Shipping Temperature

The DS500SDC-3 series power supplies can be stored or shipped at temperatures between -40°C to +70°C and relative humidity from 10% to 95% non-condensing.

Altitude

The DS500SDC-3 series will operate within specifications at altitudes up to 10,000 feet above sea level. The power supply will not be damaged when stored at altitudes of up to 50,000 feet above sea level.

	Notes	Min	Max	Altitude	System Back Pressure
DS500SDC-3	500W load	0°C	50°C	6,000 ft	0.4" H20
	500W load	0°C	40°C	10,000 ft	0.5" H20
	375W load	0°C	55°C	10,000 ft	0.5" H20
	250W load	0°C	65°C	10,000 ft	0.5" H20
DS500SDC-3-001	500W load	0°C	40°C	6,000 ft	0.4" H20
	500W load	0°C	30°C	10,000 ft	0.4" H20
	375W load	0°C	45°C	10,000 ft	0.5" H20
	250W load	0°C	55°C	10,000 ft	0.5" H20

Humidity

Operating: Power supply will be designed to operate with no degradation of performance while operating in range of 20%RH to 80%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 DS500SDC-3 series power supply will pass the following vibration specifications:

Non-Operating Random Vibration

Acceleration	2.21		gRMS
Frequency Range	5 - 500		Hz
Duration	90		Mins
Direction	Rotating each axis on vertical vibration		
PSD Profile	FREQ (Hz)	SLOPE (db/oct)	PSD (g²/Hz)
	5	/	0.001
	20	/	0.010
	500	/	0.010

ENVIRONMENTAL SPECIFICATIONS

Operating Random Vibration

Acceleration	3.12		gRMS
Frequency Range	5 - 500		Hz
Duration	90		Mins
Direction	Rotating each axis on vertical vibration		
PSD Profile	FREQ (Hz)	SLOPE (db/oct)	PSD (g²/Hz)
	5	/	0.002
	20	/	0.020
	500	/	0.020

Shock

The DS500SDC-3 power supply will pass the following shock specifications:

Non-Operating Half-Sine Shock

Acceleration	30	G
Duration	18	mSec
Pulse	Half-sine	
Number of Shock	3 shocks on each of 6 faces	

Operating Half-Sine Shock

Acceleration	15	G
Duration	11	mSec
Pulse	Half-sine	
Number of Shock	3 shocks in each of 6 faces	

POWER AND CONTROL SIGNAL DESCRIPTIONS

DC Input Connector

This connector supplies the DC mains to the DS500SDC-3 power supply.

Pin1 – +Vin
Pin2 – -Vin

Output Connector – Power Blades

These pins provide the main output for the DS500SDC-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 DS500SDC-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 (V_{SB})
P21-P28   – Main Output / Standby Output Return
P29-P36   – + Main Output (V_O)

Output Connector – Control Signals

The DS500SDC-3 series power supply contains a 24 pins control signal header analogy control interface, standby power and i²C interface signal connections.

PS_PRESENT - (Pin S1)

This signal pin is grounded inside the power supply. It can be used to sense PSU seated by using a suitable pull-up to standby bus with a noise filter capacitor connected to SB return.

Pwr_Good / PWOK - (Pin S4)

A power good signal will be asserted, driven HIGH (>2,0V), by the power supply to indicate that all outputs are valid. If any of the outputs falls below the UVP threshold, then this output will be driven LOW (<0.4V). This signal has 1K pull-up resistor connected to standby bus before oring device inside PSU. Timing requirements for this signal is given in table 4.

Note: For proper power supply operation, it is recommended to provide separate PSON signal to each unit using suitable circuit capable to sink 6mA max current when connected in parallel configuration. Also note that PSU has 1K internal pull-up, hence no additional pull-up required by system.

Power supply side   Customer system side

Indicate that main output voltage is within regulation range at system side
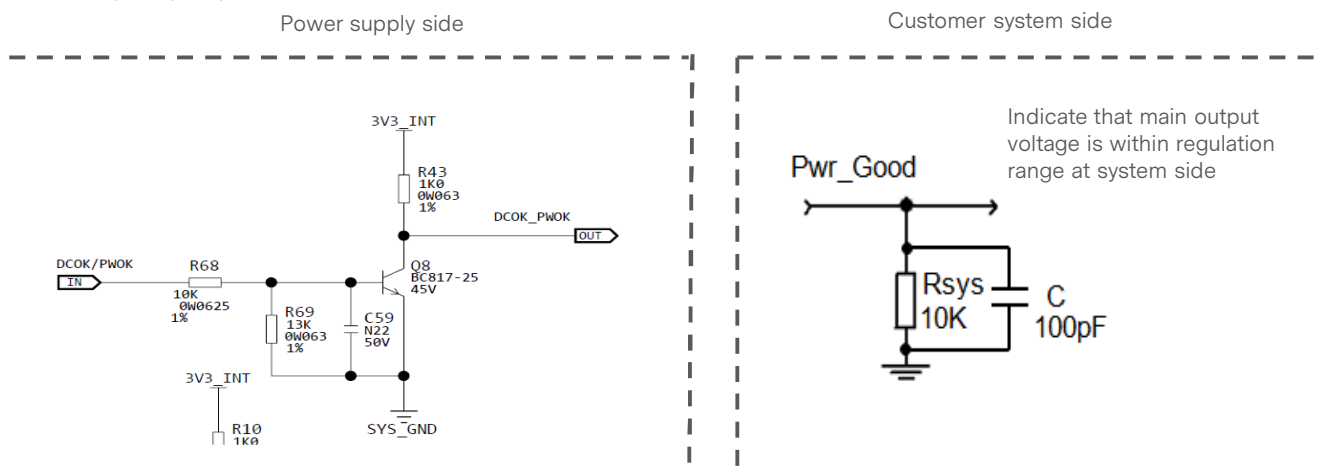
POWER AND CONTROL SIGNAL DESCRIPTIONS

INPUT_OK (DC Input Present) - (Pin S5)

The INPUT_OK is an open collector signal which is normally HIGH (>2.0V) whenever input DC voltage is within allowable limits. This signal will go LOW (<0.4V) within 0.1ms from loss of DC. Power supply has internal 1Kohm /pull-up resistor to internal 3.3V bias. Additional pull-up on system side may be added but current-limited to 0.7mA. Suitable noise filter capacitor connected to standby return line is recommended on system side.
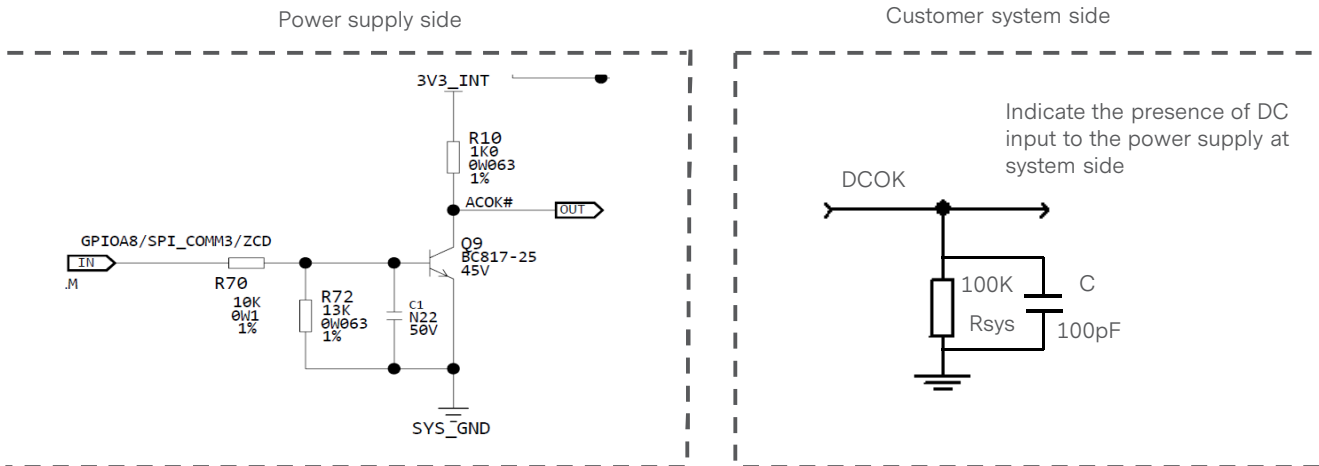
ISHARE (Current Share Bus) - (Pin S7)

This signal is a bus which will allow two or more power supplies to share the system load current.
This signal will have a voltage which is directly proportional to supplied current. A linear slope from minimum load to full load is expected.

PS_ON (REMOTE ON/OFF) - (Pin S13)

This signal enables or disables the 12V main output of the power supply. When this signal is pulled to <0.8V by the system, the 12V main output will be enabled. The signal can source a maximum of 1mA in this state. Pulling this signal to >2.0V will shutdown the main output. This signal can be pulled high to 3.3V maximum. The standby output is not affected by this signal. This function is supported through PMbus, please refer to PMbus command for more details.
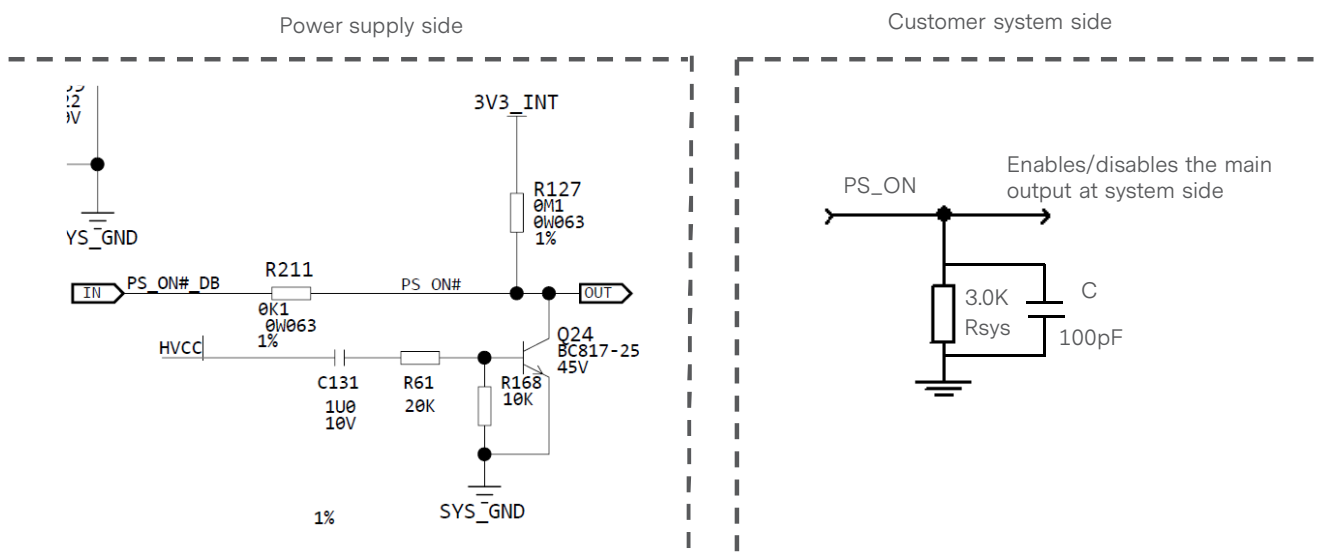
POWER AND CONTROL SIGNAL DESCRIPTIONS

PS_KILL - (Pin S14)

This signal has the shortest pin in the output connector. It functions as the first break / last mate pin, thus, supports how-swap capability. 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 will be enabled. The signal can source a maximum of 1.2mA in this state. When this signal is opened by the power supply removal from the system, the main output will shut down within 100us.

Power supply side   Customer system side
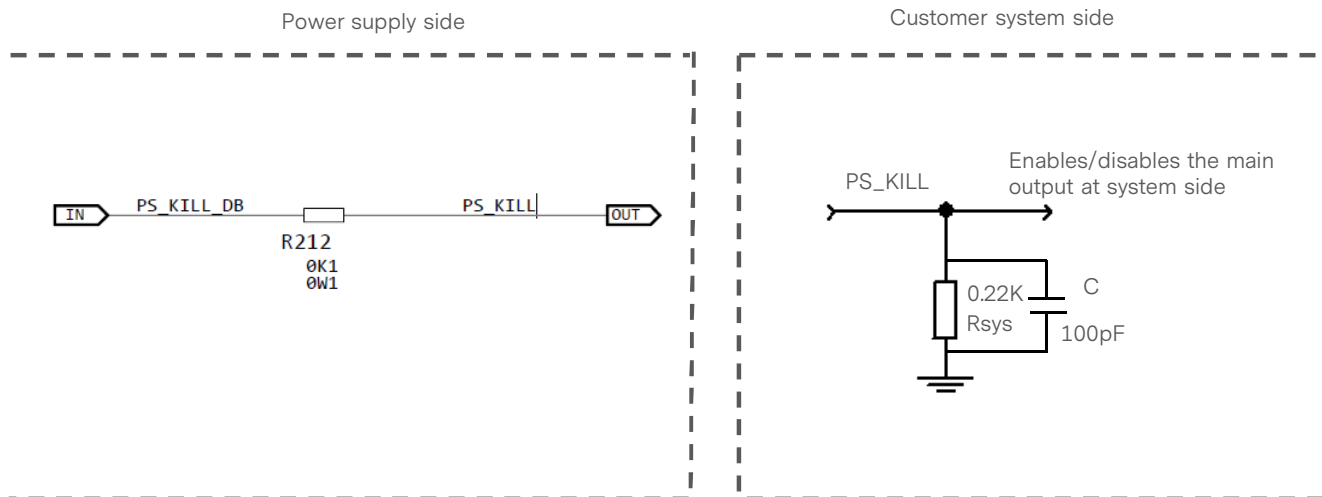
REMOTE SENSE + and REMOTE SENSE- - (Pins S21, S23)

The main output of the DS500SDC-3 is equipped with a remote sensing capability that will compensate for a power path drop around the entire loop of 100 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 DS500SDC-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 DS500SDC-3 power supply contains enhanced monitor and control functions implemented via the I²C bus. The DS500SDC-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 DC source connected.

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

SDA, SCL and PS INTERRUPT (Alert#)

Pins for I²C communication is pulled-up in the system by 1Kohm resistor to a 3V3 supply.

If units are connected in parallel or redundant mode, the stand-by output must be capable of maintaining supply to the power supply controller such that I²C communication is not lost even without an DC supply in one power supply.

If these pins are pulled up to the stand-by output created from the main output using a step-down, non-isolated DC/DC provided within the end system, the ground of the stand-by output and main output are connected together.

PS INTERRUPT is used to send a signal to the system that a fault in the PSU occurred. The pin is normally high; it is asserted (goes low) when a fault occurs. The conditions where in the signal is de-asserted (goes back to high) are: (1) DC recycle, (2) PSON recycle and (3) issuance of a CLEAR_FAULTS PMBus command.

I²C Bus Communication Interval

The interval between two consecutive I²C communications to the power supply will be at least 15ms to ensure proper monitoring functionality or after the PS INTERRUPT signal is sent to the system. PS INTERRUPT signal is an optional feature and is allowed to float if this pin function is not used.

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 across all operating conditions. This noise measurement should be made with an oscilloscope bandwidth limited to 100MHz. Measurements is made at the power supply output connector using up to 47pf ceramic capacitor to power supply standby return.

Packet Error Checking

Packet Error Checking must support a CRC-8 error checking byte calculated on all the message bytes (including addresses and read/write bits). The PSU must be prepared to accept the slave transfer with or without PEC. A "Packet Error Check Failed" on bit XX of the STATUS_CML register will be set if a PEC byte is not correct.

The PEC must be supported according to SMBus specifications.

Communication Bus Descriptions

I²C Bus Internal Implementation, Pull-ups and Bus Capacitances
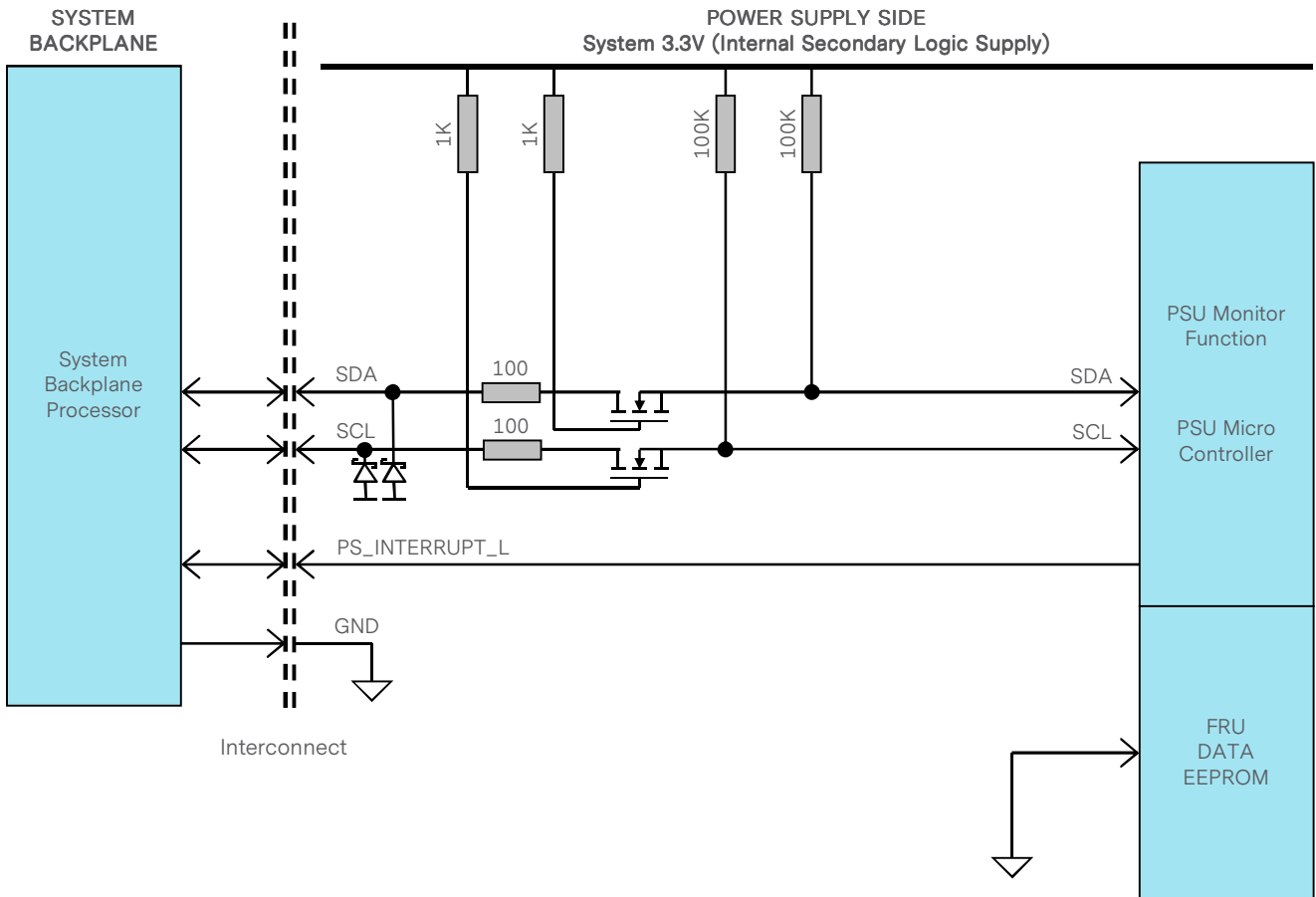
I²C Bus - Recommended external pull-ups

Electrical and interface specifications of I²C signals (referenced to standby output return pin, unless otherwise indicated):

Parameter	Condition	Symbol	Min	Type	Max	Unit
SDA, SCL Internal Pull-up Resistor		R_{int}	-	100	-	Kohm
SDA, SCL Internal Bus Capacitance		C_{int}	-	100	-	pF
Recommended External Pull-up Resistor	1 to 4 PSU	R_{ext}	-	2.2	-	Kohm

COMMUNICATION BUS DESCRIPTIONS

Logic Levels

DS500SDC-3 series power supply I^{2}C communication bus will respond to logic levels as per below:

Logic High: 3.3V nominal (Spec is 2.1V to 5.5V)**
Logic Low: 500mV nominal (Spec is 800mV max)**

Timings
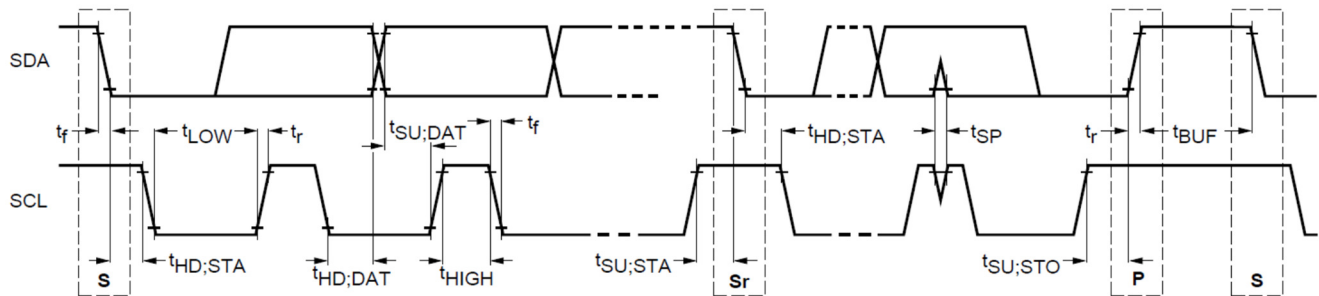
Parameter	Symbol	Standard-Mode Specs		Actual Measured		Unit
		Min	Max			
SCL clock frequency	f_{SCL}	0	100	99.8		KHz
Hold time (repeated) START condition	$t_{HD;STA}$	4.0	-	4.46		uS
LOW period of SCL clock	t_{LOW}	4.7	-	14.3		uS
HIGH period of SCL clock	t_{HIGH}	4.0	50	4.15		uS
Setup time for repeated START condition	$t_{SU;STA}$	4.7	-	5		uS
Data hold time	$t_{HD;DAT}$	0	3.45	0.26		uS
Data setup time	$t_{SU;DAT}$	250	-	4356		nS
Rise time	t_r	-	1000	SCL = 433.6	SDA = 520.8	nS
Fall time	t_f	-	300	SCL = 125	SDA = 148	nS
Setup time for STOP condition	$t_{SU;STO}$	4.0	-	6.7		uS
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	62.1		mS

COMMUNICATION BUS DESCRIPTIONS

Device Addressing

The DS500SDC-3 has a fixed I^2C 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 I^2C switcher or I^2C expander. Contact Artesyn for the demo and application note of I^2C switcher or I^2C expander.

Contact Advanced Energy for availability of a variant model supporting multiple addresses.

COMMUNICATION BUS DESCRIPTIONS

Reporting Functions

The power supply will have enhanced monitor and control functions implemented via the I^{2}C bus. This will use the SDA and SCL pins. The power supply monitor will operate as an I^{2}C slave device.

The accuracy of the report functions will be as follows:

Firmware Reporting And Monitoring				
Output loading	5% to 10%	10% to 20%	20% to 40%	40% to 100%
Input voltage	±5%			
Input current	0.8A fixed error	±0.55A fixed error		±4%
Input power	2.0W fixed error	±1.25W at <125W input		±1.25%
Output voltage	±2%			
Output current	±10%	±7%	±5%	±2%
Temperature	±5°C on the operating range			
E$_{IN}$	±20%	±15%	±5%	
Fan speed	±250RPM			

PMBus	Yes
Remote ON/OFF	Yes

Note - Reporting error will not be more than 1.5A when the load is below 8%.

COMMUNICATION BUS DESCRIPTIONS

I²C Clock Synchronization

The DS500SDC-3 power supply applies clock stretching. SMBus specifies a maximum clock low extension (clock stretching) for slave devices. Being a slave device, the product have a timeout mechanism that detects an extended time (longer than the maximum specified by SMBus) that the SDA or SCL is being held low within a PMBus transaction. If this timeout occurs, the slave I²C/SMBus internal state machine must be reset. Usually, this can be done by resetting and reinitializing. Ultimately, the objective is to be able to release the bus (i.e. in high impedance state) if it is the PMBus slave device pulling it low.

The power supply uses clock stretching. Clock stretching will not exceed SMBus maximum clock low timeout of 25msec.

The power supply has a command completion timeout of 100msec. That is, a single transaction (from START to STOP condition) must be finished within 100msec. Otherwise, the PSU will consider that command as an aborted command and restart its internal PMBus state machine to be able to accept a new transaction.
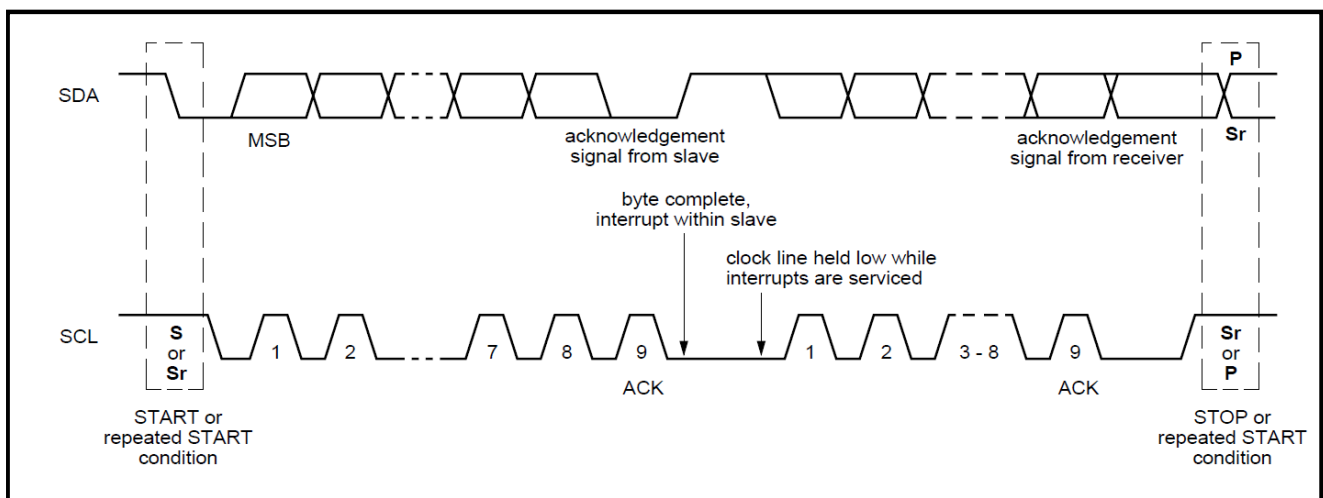
COMMUNICATION BUS DESCRIPTIONS

FRU (EEPROM) Data

The FRU (Field Replaceable Unit) data format is compliant with the Intel IPMI v1.0 specification. The DS500SDC-3 uses 1 page of EEPROM for FRU purpose. The one 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 DS500SDC-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.

DS500SDC-3 series FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
COMMON HEADER, 8 BYTES				
0	00	FORMAT VERSION NUMBER (Common Header)	1	01
1	01	INTERNAL USE AREA OFFSET (In multiples of 8 bytes)	27	1B
2	02	CHASSIS INFO AREA OFFSET (In multiples of 8 bytes)	1	01
3	03	BOARD INFO AREA OFFSET (Not Used)	0	00
4	04	PRODUCT INFO AREA OFFSET (In multiples of 8 bytes)	5	05
5	05	MULTI RECORD AREA OFFSET (In multiples of 8 bytes)	13	0D
6	06	PAD (reserved - always 00H)	0	00
7	07	ZERO CHECK SUM (256 - (Sum of bytes 000d to 006d))	209	D1
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.)	4	04
10	0A	CHASSIS TYPE (Default value is 0.)	0	00
11	0B	CHASSIS PART NUMBER Type/Length 10-byte allocation	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 15-byte allocation	0	00
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
33	21		0	00
34	22		0	00
35	23		0	00
36	24		0	00
37	25		0	00

COMMUNICATION BUS DESCRIPTIONS

DS500SDC-3 series FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
38	26	End Tag	193	C1
39	27	Zero Check Sum (256 – (Sum of bytes 008d to 038d))	161	A1
PRODUCT INFORMATION AREA, 72 BYTES				
40	28	**FORMAT VERSION NUMBER**	1	01
41	29	**PRODUCT INFO AREA LENGTH** (In multiples of 8 bytes)	10	0A
42	2A	**Language Code**	25	19
43	2B	**MANUFACTURER NAME TYPE/LENGTH,** 7-byte allocation = C7H	197	C5
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,** 15-byte allocation = CFH	207	CF
52	34	"D" = 44H	68	44
53	35	"S" = 53H	83	53
54	36	"5" = 35H	53	35
55	37	"0" = 30H	48	30
56	38	"0" = 30H	48	30
57	39	"S" = 53H	83	53
58	3A	"D" = 44H	68	44
59	3B	"C" = 43H	67	43
60	3C	"-" = 2DH	45	2D
61	3D	"3" = 33H	51	33
62	3E	Space	32	20
63	3F	Space	32	20
64	40	Space	32	20
65	41	Space	32	20
66	42	Space	32	20
67	43	**Product Part/Model Number Type/Length,** 15-byte allocation = CFH	207	CF
68	44	"D" = 44H	68	44
69	45	"S" = 53H	83	53
70	46	"5" = 35H	53	35
71	47	"0" = 30H	48	30
72	48	"0" = 30H	48	30
73	49	"S" = 83H	83	53
74	4A	"D" = 44H	68	44
75	4B	"C" = 43H	67	43
76	4C	"-" = 2DH	45	2D
77	4D	"3" = 33H	51	33
78	4E	Space	32	20
79	4F	Space	32	20
80	50	Space	32	20
81	51	Space	32	20
82	52	Space	32	20
83	53	**Product Version Number Type/Length,** 2-byte allocation = C2H	194	C2
84	54	"0" = 30H (Refer to iPro for latest revision)	48	30
85	55	"0" = 30H (Refer to iPro for latest revision)	48	30
86	56	**Product Serial Number Type/Length,** 13-byte allocation = CDH	205	CD

COMMUNICATION BUS DESCRIPTIONS

DS500SDC-3 series FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
86	56	**Product Serial Number Type/Length,** 13-byte allocation = CDH	205	CD
87	57	"L" = 4CH Product Serial Number: MODEL ID	76	4C
88	58	"1" = 31H	49	31
89	59	"0" = 30H	48	30
90	5A	"1" = 31H	49	31
91	5B	"W" MANUFACTURING YEAR AND WEEK CODE	87	57
92	5C	"W" MANUFACTURING YEAR AND WEEK CODE	87	57
93	5D	"S" UNIQUE SERIAL NUMBER	83	53
94	5E	"S" UNIQUE SERIAL NUMBER	83	53
95	5F	"S" UNIQUE SERIAL NUMBER	83	53
96	60	"S" UNIQUE SERIAL NUMBER	83	53
97	61	"R" MODEL REVISION (Refer to iPro for latest revision)	82	52
98	62	"R" MODEL REVISION (Refer to iPro for latest revision)	82	52
99	63	"P" = 50H, (For Laguna, Philippines) MANUFACTURING LOCATION	80	50
100	64	End of Fields Marker (0C1H)	193	C1
101	65	PAD (reserved - always 00H)	0	00
102	66	Zero Check Sum (256 - (Sum of bytes 040d to 102d))	0	00
103	67		203	CB
104	68	**Power Supply Record Header (72 bytes)** Record Type ID (0x00 = Power Supply Information)	0	00
105	69	**3-0: (0010)b, Record Format Version**	2	02
106	6A	**Record Length:** 24 bytes	24	18
107	6B	**Record Checksum** (Zero Checksum From 109d to 132d)	80	50
108	6C	**Header Checksum** (Zero Checksum From 104d to 107d)	150	96
109	6D	**Overall Capacity of the Power Supply,** 15-12: (0000)b, reserved	244	F4
110	6E	11-0: (000111110100)b, 500W = 01F4H	1	01
111	6F	**Peak VA (Watts)** 15-12: (0000)b, reserved	255	FF
112	70	11-0: FFFFH if not specified	255	FF
113	71	**Inrush Current (Amps)** 55Amps = 37H	55	37
114	72	**Inrush Interval (ms)** 10ms = 0AH	10	0A
118	76	**RESERVED**	00	00
115	73	**Low End Input Voltage Range 1**	16	10
116	74	36V = 3600 (x10mV) = 0FA0H	14	0E
117	75	**High End Input Voltage Range 1**	32	20
118	76	72V = 7200 (x10mV) = 1C20H	28	1C
119	77	**Low End Input Voltage Range 2**	0	00
120	78	Stored with LSB first then MSB.	0	00
121	79	**High End Input Voltage Range 2**	0	00
122	7A	Stored with LSB first then MSB.	0	00
123	7B	**Low End Input Frequency Range** 00H if DC input	0	00
124	7C	**High End Input Frequency Range** 00H if DC input	0	00
125	7D	**Input Dropout Tolerance in ms,** 1ms = 01H	1	01

Advanced Energy

COMMUNICATION BUS DESCRIPTIONS

DS500SDC-3 series FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
127 128	7F 80	**Peak Wattage** 15-12: (0000)b, Hold Up Time in Seconds = 00H (Not Specified) 11-0: (000000000000)b, Peak Capacity in Watts = 00H (Not Specified)	244 1	F4 01
129 130 131	81 82 83	**Combined Wattage** Byte 1: Bits 7-4: Voltage1 Bits 3-0: Voltage2 Byte 2 and Byte 3: Total Combined Wattage	0 0 0	00 00 00
132	84	**Predictive Fail Tachometer Lower Threshold,** not applicable	0	00
133	85	**Record Type ID** (0x01 = DC Output)	1	01
134	86	**End of List / Record Format Version Number**	2	02
135	87	**Record Length:** 13 bytes	13	0D
136	88	**Record Checksum** (Zero Checksum From 138d to 150d)	20	14
137	89	**Header Checksum** (Zero Checksum From 133d to 136d)	220	DC
138	8A	**+12V Output Information**	1	01
139 140	8B 8C	**Nominal Voltage** 12.00V = 1200 (x10mV) = 04B0H	176 4	B0 04
135 136	87 88	**Low End Input Voltage Range 2 (10mV)** (Only one input range) Stored with LSB first then MSB	00 00	00 00
137 138	89 8A	**High End Input Voltage Range 2 (10mV)** (Only one input range) Stored with LSB first then MSB	00 00	00 00
139	8B	**Low End Input Frequency Range,** 00Hz = 00H	00	00
140	8C	**High End Input Frequency Range,** 00Hz = 00H	00	00
141 142	8D 8E	**Maximum Negative Voltage Deviation** 11.40V = 1140 (x10mV) = 0474H	116 4	74 04
143 144	8F 90	**Maximum Positive Voltage Deviation** 12.60V = 1260 (x10mV) = 04ECH	236 4	EC 04
145 146	91 92	**Ripple And Noise pk-pk 10Hz to 20MHz (mV)** 120mV = 0078H	120 0	78 00
147 148	93 94	**Minimum Current Draw (10mA)** 0000 = 0000H	0 0	00 00
149 150	95 96	**Maximum Current Draw (10mA)** 41.67A = 4167 (x10mA) = 1047H	71 16	47 10
151	97	**Record Type ID** (0x01 = DC Output)	1	01
152	98	**End of List / Record Format Version Number**	2	02
153	99	**Record Length:** 13 bytes	13	0D
154	9A	**Record Checksum** (Zero Checksum From 156d to 168d)	189	BD
155	9B	**Header Checksum** (Zero Checksum From 151d to 154d)	51	33
156	9C	**+12Vsb Output Information**	130	82
157 158	9D 9E	**Nominal Voltage** 12.00V = 1200 (x10mV) = 04B0H	176 4	B0 04
159 160	9F A0	**Maximum Negative Voltage Deviation** 11.40V = 1140 (x10mV) = 0474H	116 4	74 04
161 162	A1 A2	**Maximum Positive Voltage Deviation** 12.60V = 1260 (x10mV) = 04ECH	236 4	EC 04
163 164	A3 A4	**Ripple And Noise pk-pk 10Hz To 20MHz (mV)** 120mV = 0078DH	120 0	78 00
165 166	A5 A6	**Minimum Current Draw (10mA)** 0000 = 0000H	0 0	00 00

COMMUNICATION BUS DESCRIPTIONS

DS500SDC-3 series FRU (EEPROM) Data:

OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
167	A7	**Maximum Current Draw (10mA)**	44	2C
168	A8	3.00A = 0300 (x10mA) = 012CH	1	01
169	A9	**Record Type ID** (C0H = OEM Record)	192	C0
170	AA	**End of List / Record Format Version Number**	130	82
171	AB	**Record Length**	42	2A
172	AC	**Record Checksum** (Zero Checksum From 174d to 215d)	256	00
173	AD	**Header Checksum** (Zero Checksum From 169d to 172d)	148	94
174	AE	Reserved	0	00
175	AF		0	00
176	B0		0	00
177	B1		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	**Internal Use Area**	1	01
217	D9	Reserved	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

COMMUNICATION BUS DESCRIPTIONS

DS500SDC-3 series FRU (EEPROM) Data:

| OFFSET		DEFINITION	SPEC VALUE	
(DEC)	(HEX)	(REMARKS)	(DEC)	(HEX)
224	E0	Internal Use Area	0	00
225	E1	Reserved	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		0	00

PMBus™ SPECIFICATIONS

The DS500SDC-3 is compliant with the industry standard I²C protocol for monitoring and control of the power supply via the I²C interface port.

DS500SDC-3 Series I²C General Instructions

Equipment Setup

The following is typical I²C communication setup:
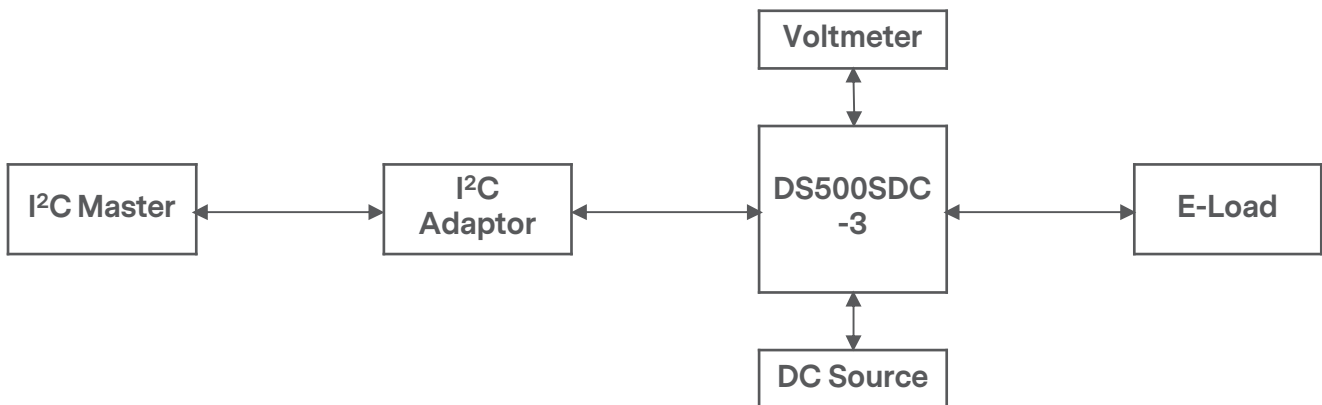
PMBus™ Writing Instructions

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, 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.

PMBus™ SPECIFICATIONS

The DS500SDC-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
01h	OPERATION	80	R/W	1	Bitmapped	Used to turn the unit ON/OFF in conjunction with the input PS_ON pin. It is also used to set output to upper or lower margin voltages.
	b7:6	10				01 - Soft Turn OFF (with sequencing) 10 - PSU ON
	b5:2	0000				
	b1:0	00				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	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	0	S			
10h	WRITE_PROTECT	80	R/W	1	Bitmapped	Used to control writing to the PMBus™ device. 80h - Disables write except 10h 40h - Disables write except 10h, 01h 20h - Disables write except 10h, 01h, 02h and 21h commands. 00h - Enables write to all writeable commands.
15h	STORE_USER_ALL		S	0		Copies the Operating memory table to the matching USER non-volatile memory.

PMBus™ SPECIFICATIONS

The DS500SDC-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	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	00000				Reserved
1Ah	QUERY		BR/W Process Call	2	Bitmapped	Varies
1Bh	SMB_ALERT_MASK		BR/W Process Call	2	Bitmapped	Varies
20h	VOUT_MODE	17	R	1	Bitmapped	Specifies the mode and parameters of output voltage related data formats.
21h	VOUT_COMMAND	1800	R/W	2	Linear	Sets the output voltage reference. Vout command sends discreet value to change or trim output voltage. The value acts as digital reference of the power supply after additional operations are performed (to make the representation compatible. Default: 12.00V Min: 11.4V Max: 12.6V) Affects OVP_WARNING and FAULT LIMIT, as well as POWER_GOOD_ON/OFF level.
24h	VOUT_MAX	1933	R	2	Linear	Read Only (12.6V)
30h	COEFFICIENTS		BR/W Process Call	6	Hex	m = 1, b = 0, R = 0
35h	VIN_ON	0023	R	2	Linear	Sets the value of input, in volts, at which the unit should start. (35V)
36h	VIN_OFF	0022	R	2	Linear	Sets the value of input, in volts, at which the unit should stop power conversion. (34V)
3Ah	FAN_ CONFIG_1_2	90	R	1	Bitmapped	Read only to reflect settings 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

PMBus™ SPECIFICATIONS

The DS500SDC-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
3Ah	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	0				00 - 1 pulse per revolution 01 - 2 pulses per revolution 10 - 3 pulses per revolution 11 - 4 pulses per revolution
3Bh	FAN_COMMAND_1 *(used by both fan 1 and 2)	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) Min: 13.5V Max: 15V
42h	VOUT_OV_WARN_LIMIT	1A00	R/W	2	Linear	Sets over-voltage warning threshold. (13V) Min: 12.6V Max: 13.4V
43h	VOUT_UV_WARN_LIMIT	1666	R/W	2	Linear	Sets under-voltage warning threshold. (11.2V) Min: 11.1V Max: 11.3V
44h	VOUT_UV_FAULT_LIMIT	1580	R/W	2	Linear	Sets under-voltage fault threshold. (10.75V) Min: 10.5V Max: 11V
45h	VOUT_UV_FAULT_RESPONSE	80	R	1	Bitmapped	Turn PSU OFF.
46h	IOUT_OC_FAULT_LIMIT	E318	R/W	2	Linear	Sets the over current threshold in Amps. (49.5A) Min: 10.4A Max: 49.5A
47h	IOUT_OC_FAULT_RESPONSE	C0	R	1	Bitmapped	OCP ride through. If OCP persists.
4Ah	IOUT_OC_WARN_LIMIT	E2D6	R/W	2	Linear	Sets the Over Current Warning threshold in Amps. (45.375A) Min: 10.4A Max: 47.84A
4Fh	OT_FAULT_LIMIT	EB20	R/W	2	Linear	Secondary ambient temperature fault threshold, in degree C. (100degC)
50h	OT_FAULT_RESPONSE	F8	R	1	Bitmapped	Turn PSU OFF and will retry indefinitely. Support enable/disable of protection and recoverability.
51h	OT_WARN_LIMIT	EAF8	R/W	2	Linear	Secondary ambient temperature warning threshold, in degree C. (95degC)
55h	VIN_OV_FAULT_LIMIT	AA00	R	2	Linear	Default: 85Vdc
56h	VIN_OV_FAULT_RESPONSE	C0	R	1	Bitmapped	
57h	VIN_OV_WARN_LIMIT	9600	R	2	Linear	Default: 75Vdc
58h	VIN_UV_WARN_LIMIT	4600	R	2	Linear	Default: 35Vdc
59h	VIN_UV_FAULT_LIMIT	3C00	R	2	Linear	Default: 30Vdc

PMBus™ SPECIFICATIONS

The DS500SDC-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
5Ah	VIN_UV_FAULT_RESPONSE	F8	R	1	Bitmapped	
5Eh	POWER_GOOD_ON	1600	R	2	Linear	Sets the threshold by which the power good signal is asserted. (11V)
5Fh	POWER_GOOD_OFF	1580	R	2	Linear	Sets the threshold by which the power good signal is de-asserted. (10.8V)
60h	TON_DELAY	EB20	R/W	2	Linear	Default: 100 msec Min: 0msec Max: 2200 msec
61h	TON_RISE	DBC0	R/W	2	Linear	Sets the time (ms), for the output rises from 0 to regulation. (30ms) Min: 0 Max: 50 msec
62h	TON_MAX_FAULT_LIMIT		R/W	2	Linear	Default: 2400mSec Min: 2200 msec Max: 2400 msec
63h	TON_MAX_FAULT_RESPONSE	C0	R	1	Bitmapped	
64h	TOFF_DELAY	1271	R/W	2	Linear	Sets the time (ms), from a stop condition (Power OFF) until the output starts to drop (converter OFF). (Default: 2500 msec Min: 0 Max: 2700 msec)
6Ah	POUT_OP_WARN_LIMIT		R/W	2	Linear	Default Value: 575 Valid Range: Min = 574W; Max = 575W
78h	STATUS_BYTE		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		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.

PMBus™ SPECIFICATIONS

The DS500SDC-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
79h	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.
7Ah	STATUS_VOUT		R	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 Not supported.
	b2					TON_MAX_FAULT
	b1					TOFF_MAX warning. Not supported.
	b0					Not supported.
7Bh	STATUS_IOUT		R	1	Bitmapped	Output current related faults and warnings
	b7					IOUT overcurrent fault
	b6					IOUT overcurrent 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

PMBus™ SPECIFICATIONS

The DS500SDC-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
7Ch	STATUS_INPUT		R	1	Bitmapped	Input related faults and warnings
	b7					VIN overvoltage fault
	b6					VIN overvoltage warning Not supported.
	b5					VIN under-voltage warning
	b4					VIN under-voltage fault
	b3					Unit is OFF for insufficient input voltage.
	b2					IIN overcurrent fault
	b1					IIN overcurrent warning Not supported.
	b0					PIN overpower warning Not supported.
7Dh	STATUS_TEMPERATURE		R	1	Bitmapped	Temperature related faults and warnings
	b7					Over-temperature fault
	b6					Over-temperature warning
	b5					Under-temperature warning Not supported.
	b4					Under-temperature fault Not supported.
	b3:0					Reserved
7Eh	STATUS_CML		R	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.
80h	STATUS_MFR_SPECIFIC		R	1	Bitmapped	Manufacturer status codes
	b7					Not used
	b6					Not used
	b5					Not used
	b4					Not used
	b3					Not used
	b2					Not used
	b1					Not used
	b0					MFR SPECIFIC FAULT. For trouble shooting

PMBus™ SPECIFICATIONS

The DS500SDC-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
81h	STATUS_FANS_1_2		R	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	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
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	PFC HTSK_Temp_1 (Standard air mode uses this sensor for fan control)
8Eh	READ_TEMPERATURE_2		R	2	Linear	DCDC HTSK_Temp_2
8Fh	READ_TEMPERATURE_3		R	2	Linear	SEC Ambient_Temp_3 (Inside temperature. Reverse air mode uses this sensor for fan control)
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	22h	R	1		Reads the PMBus revision number.
99h	MFR_ID	41,52,54,45,53,59,4E	BR ASCII	7		Abbrev or symbol of manufacturers name. ASCII (ARTESYN)
9Ah	MFR_MODEL	44,53,35,30,30,53,44,43,2D,33	BR ASCII	13		Manufacturers model number, ASCII format (DS500SDC-3)
9Bh	MFR_REVISION		BR/W ASCII	3		Manufacturers, revision number, ASCII format.
9Ch	MFR_LOCATION	50,48,49,4C,49,50,50,49,4E,45,53	BR/W ASCII	11		Manufacturers facility, ASCII format. (PHILIPPINES)
9Dh	MFR_DATE		BR/W	8		Manufacture date, ASCII format Structure
9Eh	MFR_SERIAL		BR	16		Unit serial number, ASCII format.
A0h	MFR_VIN_MIN	0024	R	2	Linear	Minimum Input Voltage (36Vdc)
A1h	MFR_VIN_MAX	0048	R	2	Linear	Maximum Input Voltage (72Vdc)
A2h	MFR_IIN_MAX	DA00	R	2	Linear	Maximum Input Current (16A)
A3h	MFR_PIN_MAX	023F	R	2	Linear	Maximum Input Power (575W)

PMBus™ SPECIFICATIONS

The DS500SDC-3 Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
A4h	MFR_VOUT_MIN	16CD	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	E29A	R	2	Linear	Maximum Output Current. (41.625A)
A7h	MFR_POUT_MAX	FBE8	R	2	Linear	Maximum Output Power. (500W)
A8h	MFR_TAMBIENT_MAX	0032	R	2	Linear	Maximum Operating Ambient Temperature (Secondary Ambient) (50degC)
A9h	MFR_TAMBIENT_MIN	0000	R	2	Linear	Minimum Operating Ambient Temperature (Secondary Ambient) (0degC)
AAh	MFR_EFFICIENCY_LL		BR	14	Linear	Vin, %load, Eff., %Load, Eff., %load, eff.
ABh	MFR_EFFICIENCY_HL		BR	14	Linear	Vin, %load, Eff., %Load, Eff., %load, eff.
B0h	USER_DATA_00		BR/W Process Call	Varies		
E0h	FW_PRI_VERSION		BR	8	ASCII	
E1h	FW_SEC_VERSION		BR	8	ASCII	
E2h	CONFIG_UNLOCK_CODE		BR/W	4	ASCII	
E3h	CONFIG_CTRL_CMD		BR/W	1		
F1h	ISP_UNLOCK_CODE		BR/W	4		00h,00h,00h,00h
F2h	ISP_CTRL_CMD		R/W	1	Bitmapped	ISP Mode
F3h	ISP_STATUS_BYTE		R	1	Bitmapped	ISP Mode
F5h	ISP_FLASH_DATA		BR/W	Varies	Direct	ISP Mode

APPLICATION NOTES

Current Sharing

The DS500SDC-3 series' main output V_O is equipped with current sharing capability. When two or more power supplies are connected and operating in parallel, the sharing accuracy between units must be within the limits specified in the table below.

Load (per power supply unit)	Max
100%	+/-3.33A
50%	+/-3.33A
20%	+/-3.33A
<20%	+/-2.8A

The current sharing function will start when the total system load has reached 10% of the power supply rating.

The power supply can support up to 4 units in parallel. Any configuration to support more than this may be discussed separately.

The current share signal, Imon, is a DC signal and within the voltage range specified below. It is be capable of sinking 0.4mA and sourcing 4mA. The waveform for this signal will be provided to confirm stability during parallel mode operation.

Load (per power supply unit)	Min	Typ	Max
100%	7.75	8	8.25
50%	3.85	4	4.15

The current share signal may be disabled by shorting this pin to ground. The main output voltage should stay within regulation limits in this condition.
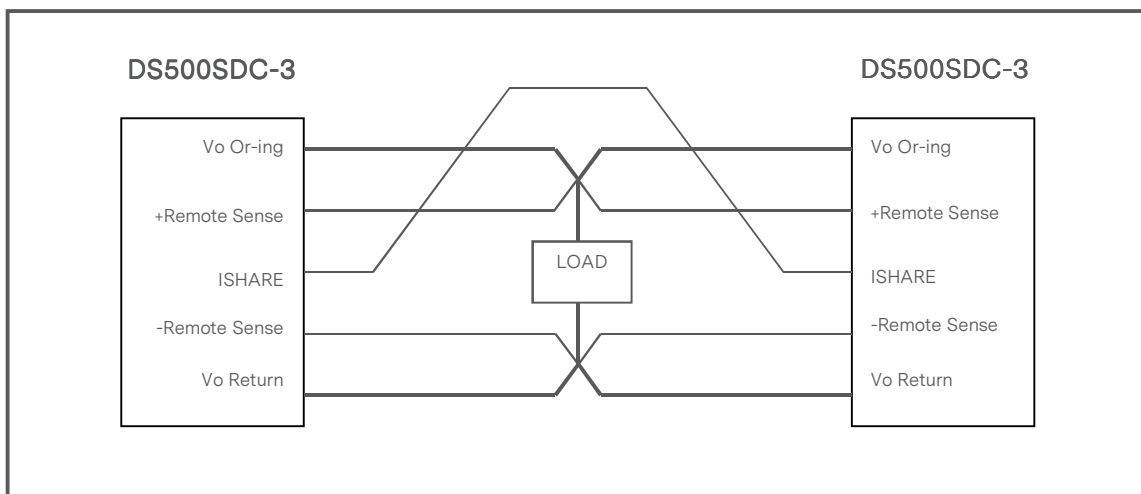
APPLICATION NOTES

Redundancy / Fault Tolerance

The DS500SDC-3 series power supplies is designed for redundant mode N+1 operation. No internal failure in any power supply in this configuration should cause the bus voltage and standby bus to fall below the regulation limits specified in table 3. All output voltages will stay within the regulation limits during swapping of the power supplies. Hot-swapping supplies will not cause any abnormal behavior of output performance to the system.

The power supply is support hot-swap operation, thus, any hot removal or hot insertion of power supplies will not cause damage to output pins due to arcing.

A single point failure will not cause failure of the system power while in redundant mode operation with more than 1 power supply installed in the system.

APPLICATION NOTES

Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the DS500SDC-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 200MHz bandwidth for this measurement. Measurement is be under all line, load and temperature conditions and is done with resistor loads rather than electronic loads.
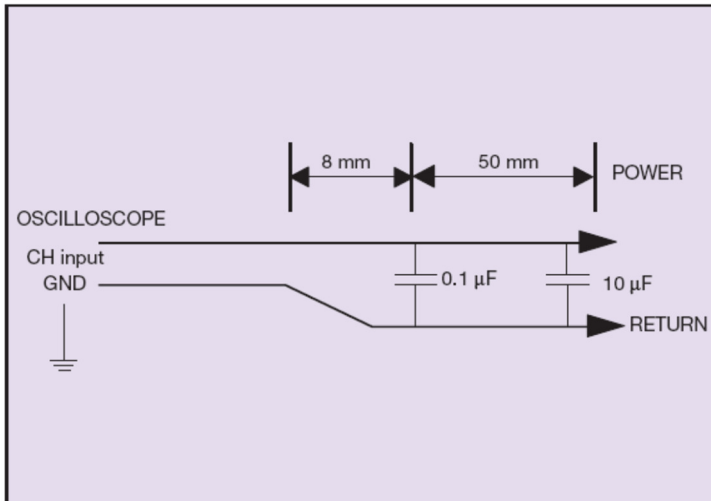
RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	12.11.2015	First issue	A. Li
1.1	01.26.2016	Update pull down resistor	K. Wang
1.2	03.04.2019	Update I^{2}C bus internal implementation	J. Ma
1.3	12.24.2019	Update PSON signal pull down resistor	K. Wang
1.4	11.20.2020	Update logic level	K. Wang
1.5	03.03.2021	Update cover and back cover	C. Liu
1.6	05.09.2022	Add UKCA Mark	C. Liu

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

PRECISION | POWER | PERFORMANCE

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DS500SDC-3 - Rev.05.09.22_#1.6