Technical Reference Note

Embedded Power for Business-Critical Continuity

Preliminary

DS460S-3

460 Watts

Distributed Power System

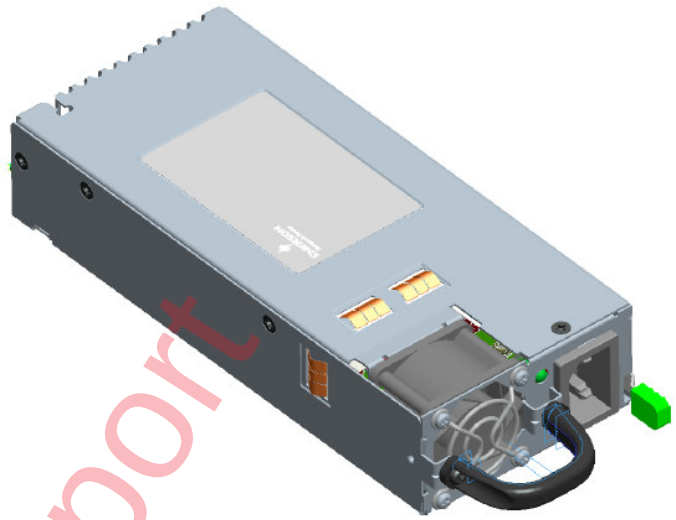
Total Power: 460 Watts
Input Voltage: 90-264 Vac
# of Outputs: Main + Standby

Special Features

- Active power factor correction
- EN61000-3-2 harmonic compliance
- Active AC inrush control
- 1U X 2U short form factor
- +12 Vdc Output
- +12 Vdc stand-by
- Hot plug operation
- N + 1 redundant
- Internal OR'ing fets
- Active current sharing
- Built-in cooling fan
- I2C communication interface bus
- PMBus compliant
- EERPOM for FRU data
- One year warranty

Safety

UL/cUL 60950 (UL Recognized)
NEMKO 60950
CB Certificate and report
CE Mark (LVD)



Product Descriptions

The DS460S-3 series high-efficiency bulk front-end power supply is intended for systems that use distributed power architectures. Rated at 460 watts, the DS460S-3 power supply generates a main payload output of 12 Vdc and an auxiliary output of 12 Vdc for powering standby circuitry. These power supplies are digitally programmable – they are equipped with an I2C interface and use the industry-standard PMBus™ communications protocol.

The DS460S-3 power supply is intended primarily for use in rack-mounting server type applications, such as data centers. The power supply uses an advanced power conversion topology to maximize efficiency and have exceptionally compact form factors; these models have a height of just 1.6 inches, which makes them ideal for use in 1U high rack-mounting equipment.

DS460S-3 power supply features a wide 90 to 264 Vac input voltage range and employs active power factor correction to minimize input harmonic current distortion and to ensure compliance with the international EN61000-3-2 standard – they have a power factor of 0.99 typical.

The supply has a 1U x 2U form factor – it measures only 7.75 inches in length, ideally suitable for length limited applications. When fed with a high line 230 Vac input, the DS460S-3 can achieve a very high – 92 percent typical conversion efficiency at 50 percent full load.

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Model Numbers

Standard	Output Voltage	Minimum Load	Maximum Load	Stand-By Supply	Air Flow Direction
DS460S-3	12.0 Vdc	1A	38.3A	12V @ 2.5A	Normal (DC Connector to Handle)
DS460S-3-001	12.0 Vdc	1A	38.3A	12V @ 2.5A	Reversed (Handle to DC Connector)

Options

None

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	$V_{I,AC}$	90	-	264	Vac
Maximum Output Power (Main + Stand-by)	All models	$P_{O,max}$	-	-	460	W
Isolation Voltage						
Input to outputs	All models		-	-	2500	Vac
Input to safety ground	All models		-	-	2500	Vac
Outputs to safety ground	All models		-	-	500	Vdc
Ambient Operating Temperature	All models	T_A	0	-	+50	ºC
Cold Start-up Temperature	All models	T_{ST}	-10	-	-	ºC
Storage Temperature	All models	T_{STG}	-40	-	+85	ºC
Humidity (non-condensing)						
Operating	All models		5	-	95	%
Non-operating	All models		5	-	95	%
Altitude						
Operating	All models		-	-	10,000[1]	feet
Non-operating	All models		-	-	50,000	feet

Note 1: Maximum ambient operating temperature linearly derated from 50ºC at 5,000 feet above sea level to 40ºC at 10,000 feet above sea level.

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC	All	$V_{I,AC}$	90	115/230	264	Vac
Input Vac Source Frequency	All	$f_{I,AC}$	47	50/60	63	Hz
Maximum Input Current ($I_O = I_{O,max}$, $I_{VSB} = I_{VSB,Max}$)	$V_{I,AC} = 100V_{AC}$ $V_{I,AC} = 180V_{AC}$	$I_{I,max}$	- -	- -	6.0 3.0	Aac
No Load Input Power (V_O = on, V_{SB} = on, $I_O = 0$, $I_{SB} = 0$)	$V_{I,AC} = 115V_{AC}$ $V_{I,AC} = 230V_{AC}$	$P_{I,no-load}$	- -	- -	7.0 7.0	W
Harmonic Line Currents	All	THD	Per EN61000-3-2			
Power Factor	$I_O = I_{O,max}$ $V_{I,AC} = 240Vac$	PF	0.97	-	-	
Startup Surge Current (Inrush) @ 25°C	$V_{I,AC} = 230V_{AC}$	$I_{IN,surge}$	-	-	30	A_{PK}
Input Fuse	Internal, L line 250V, Fast-Acting		-	-	10	A
Input AC Low Line Start-up Voltage	$I_O = I_{O,max}$	$V_{I,AC-start}$	???	-	???	Vac
Input AC Undervoltage Lockout Voltage	$I_O = I_{O,max}$	$V_{I,AC-stop}$	???	-	???	Vac
PFC Switching Frequency	All	$f_{SW,PFC}$	???	-	???	kHz
DCDC Switching Frequency	All	$f_{SW,DC-DC}$	???	-	115	kHz
Stand-By Output Switching Frequency	All	$f_{SW,VSB}$	???	-	???	kHz
Operating Efficiency @ 25°C	$V_{I,AC} = 230$ Vac $I_O = 0.5\ I_{O,max}$, $I_{VSB} = 0$	η	-	92	-	%
Hold Up Time	$V_{I,AC} = 115$ Vac $P_O = P_{O,maxFA}$	$t_{Hold-Up}$	10	-	-	mSec
Leakage Current to safety ground	($V_{I,AC} = 240Vac$, f_I = 50/60 Hz)	$I_{I,leakage}$	-	-	1.0	mA

Output Specifications

Table 3. Output Specifications:

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Output Voltage Set points		I_O = 1A	V_O	12.27	12.30	12.33	Vdc
		I_{VSB} = 0.1A	V_{VSB}	11.40	12.00	12.6	
Output Static Regulation		Measure at mating connector	V_O	11.85	12.3	12.45	Vdc
			V_{VSB}	11.40	12.00	12.6	
Output Ripple, pk-pk		Measured over a bandwidth of 0Hz to 20MHz	V_O	-	-	120	mV_{PK-PK}
			V_{VSB}	-	-	120	
Output Current		Single supply N = 1	I_O	1	-	38.2	A
			I_{VSB}	0	-	2.5	
		Dual supplies N = 1+1	I_O	2	-	68.9	
			I_{VSB}	0	-	2.5	
Dynamic Response	Peak Deviation	50% load change, maximum 0.5A/µSec slew rate, Inclusive of the static load regulation	V_O	11.60	-	12.60	%
			V_{VSB}	10.80	-	13.20	
	Setting Time		All	-	-	100	µSec
Max number of parallel units		In same chassis		-	-	4	unit
Output Capacitance:		Unconditionally Stable	V_O	2,200	-	22,000	µF
			V_{VSB}	200	-	1,000	

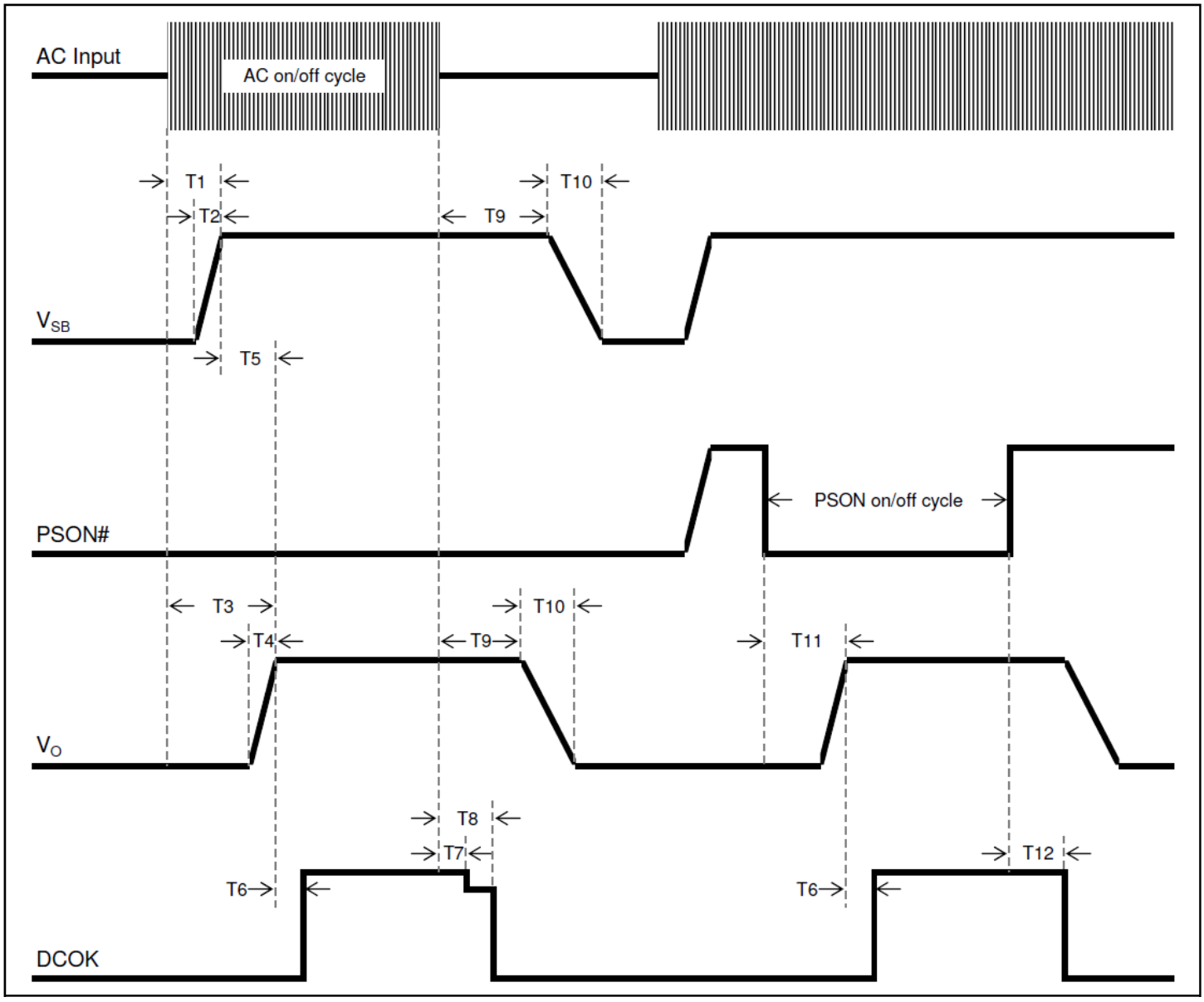
System Timing Specifications

Table 4. System Timing Specifications:

Label	Parameter	Min	Typ	Max	Unit
T1	AC input on to V_{VSB} in regulation after AC has been removed for more than 5 seconds	800	-	1,300	mSec
T2	V_{VSB} rise time, 0V to V_{VSB} in regulation	10	-	30	mSec
T3	AC input on to V_O in regulation with PSON# asserted low	1,000	-	1,500	mSec
T4	V_O rise time, 0V to V_O in regulation	10	-	30	mSec
T5	V_{VSB} in regulation to V_O in regulation at AC input turn on with PSON# low	50	-	300	mSec
T6	V_O in regulation to DCOK high	50	-	100	mSec
T7	Delay from AC input off to DCOK mid level	0	-	4	mSec
T8	AC input off to PSOK low at 460W output power	10	-	-	mSec
	AC input off to PSOK low at 230W output power	20	-	-	mSec
	AC input off to PSOK low at 115W output power	30	-	-	mSec
	AC input off to PSOK low at 57.5W output power	40	-	-	mSec
T9	AC input off to V_O or V_{VSB} out of regulation at 460W output power at 90Vac input	10	-	-	mSec
	AC input off to V_O or V_{VSB} out of regulation at 230W output power at 90Vac input	20	-	-	mSec
	AC input off to V_O or V_{VSB} out of regulation at 115W output power at 90Vac input	30	-	-	mSec
	AC input off to V_O or V_{SB} out of regulation at 57.5W output power at 90Vac input	40	-	-	mSec
T10	V_O or V_{VSB} falling from 90% nominal to <0.3V ($V_O \geq 1A$, $V_{VSB} \geq 0.1A$)	-	-	500	mSec
T11	PSON# low to V_O in regulation when AC has been present for more than 5 seconds	10	-	30	mSec
T12	Delay from PSON# high to DCOK low	-	-	50	mSec

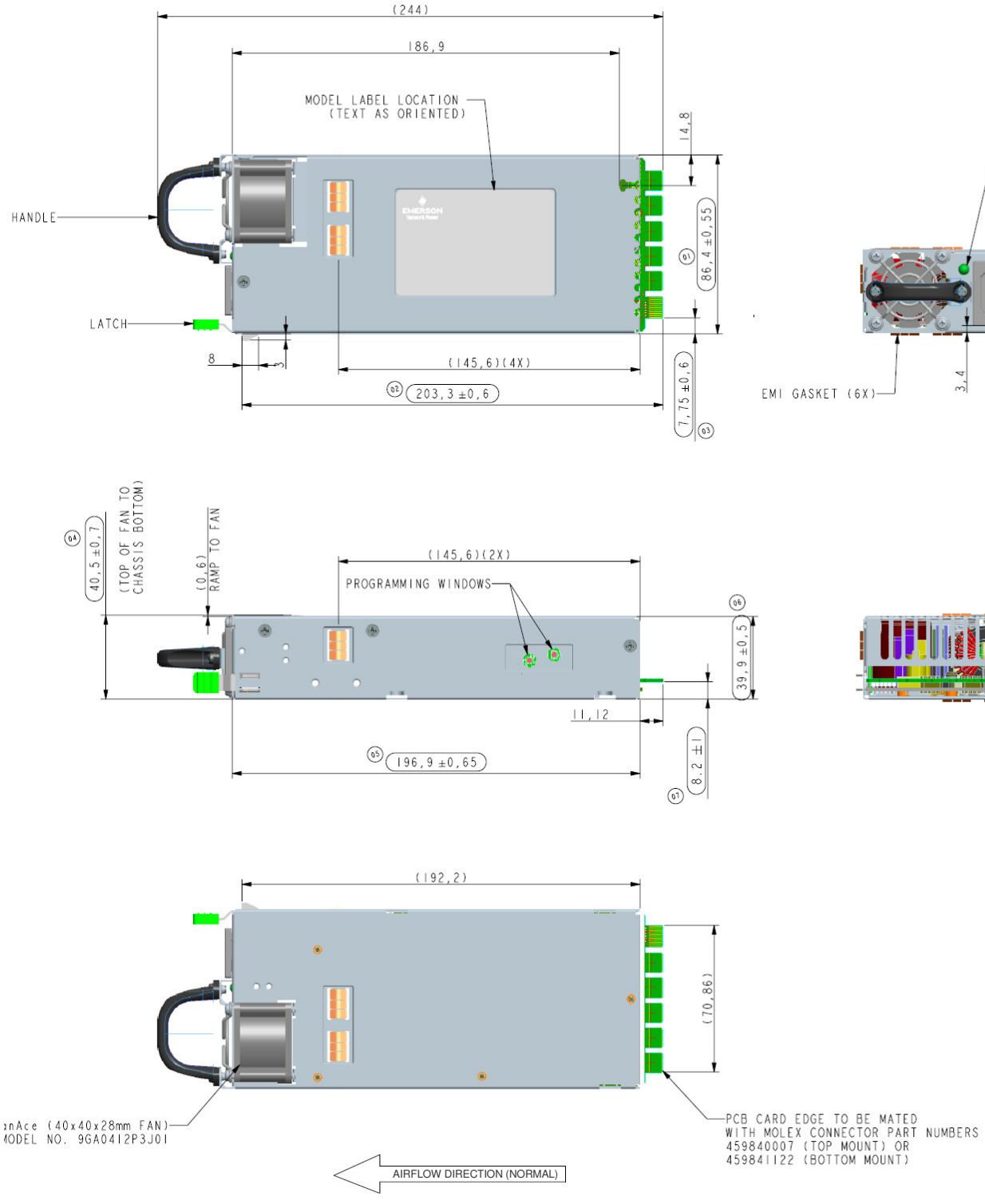
System Timing Specifications

Figure 1. System Timing Diagram:



Mechanical Specifications

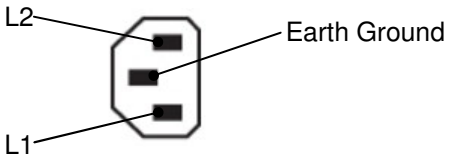
Mechanical Outlines



Connector Definitions

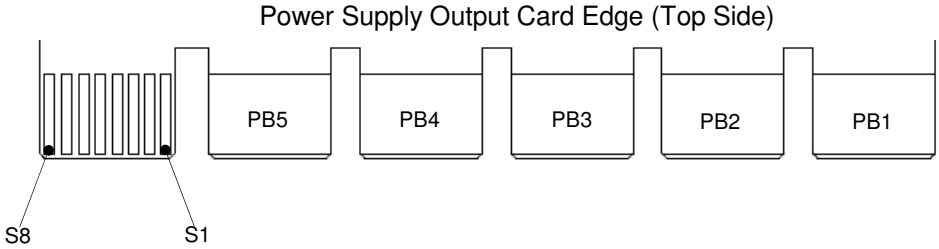
AC Input Connector

Pin 1 – Line
Pin 2 – Neutral
Pin 3 – Earth Ground



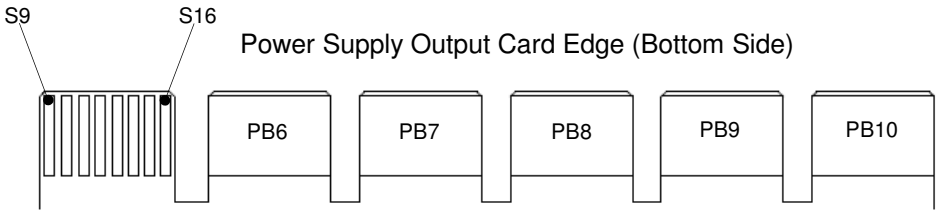
Output Connector – Power Blades

PB1 – V_O
PB2 – V_O
PB3 – V_O
PB4 – RTN
PB5 – RTN
PB6 – RTN
PB7 – RTN
PB8 – RTN
PB9 – V_O
PB10 – V_O



Output Connector – Signal Pins

S1 – VSB
S2 – VSB
S3 – Reserved
S4 – PS INTERRUPT
S5 – PS PRESENT
S6 – PSOK
S7 – I-MON
S8 – PSON#
S9 – SCL
S10 – SDA
S11 – GND
S12 – ADD0
S13 – ADD1
S14 – ADD2
S15 – RTN
S16 – RTN



Power / Signal Mating Connectors and Pin Types

Table 5. Mating Connectors for DS460S-3 series

Reference	On Power Supply	Mating Connector or Equivalent
AC Input Connector	IEC320-C13	IEC320-C14
Output Connector	PCB card edge (0.062”)	Molex 459840007 (top mount)
		Molex 459841122 (bottom mount)

EMC Immunity

DS460S-3 series power supply is designed to meet the following EMC immunity specifications:

Table 6. Environmental Specifications:

Document	Description
IEC 61000-4-2	ESD up to 4 kV contact, 8kv discharge
IEC 61000-4-3	RFI 3V/m
IEC 61000-4-4	Electrical Fast Transients level 3 minimum
IEC 61000-4-5	Surge level 3 minimum
IEC 61000-4-6	Radio frequency common mode, Levels 3V (rms) Modulated AM 80%. 1 kHz, 150 ohm source imp.
IEC 61000-4-11	AC Input transients >95% 0.5 period 30% 25 period>95% 250 period
IEC 61000-3-2	Harmonic Distortion

Safety Certifications

The DS460S-3 series 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. The DS460S-3 series has been designed in accordance with EN60950-1 'Safety of Information Technology Equipment'. The series also conforms with the provisions of the European Council Low Voltage Directive 73/23/EEC (as amended by 93/68/EEC) to bear the CE Mark.

Note, appropriate safety certificates and approvals are available to download from our website www.powerconversion.com.

Table 7. Safety Certifications for DS460S-3 series power supply system

Document	Description
UL-60950-1 limited power clause latest edition	Safety of information Technology Equipment
CSA C22.2 60950-1 limited power clause latest edition	Safety of information Technology Equipment
European Community Safety (certified to EN60950, A11 May 1996)	Investigated and marketed by TUV
CB Certificate and Report	(All CENELEC Countries)
CE Mark	LVD

EMI Emissions

The DS460S-3 series has been designed to comply with the Class B 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 460W using resistive load with cooling fan.

Conducted Emissions

Table 8. Conducted EMI emission specifications of the DS460S-3 series

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC Part 15, class B	All	Margin	-	-	6	dB
VCCI Class II	All	Margin	-	-	6	dB
EN 60601-1-2: 2001	All	Margin	-	-	6	dB
CISPR 22 (EN55022) class B	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. The shielding effect provided by the system enclosure may bring the EMI level from Class A to Class B. 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’.

Power and Control Signal Descriptions

AC Input – IEC320 C14

This connector supplies the AC Mains to the DS460S-3 power supply.

Pin 1 - Line
Pin 2 - Neutral
Pin 3 - Earth Ground

Output Connector – Power Blades

These Power Blades provide the main output for the DS460S-3. The Vo and the TRN blades are the positive and negative rails, respectively, of the main output of the DS460S-3 power supply. The RTN rail is electrically connected to the power supply chassis.

PB1 - V_O
PB2 - V_O
PB3 - V_O
PB4 - RTN
PB5 - RTN
PB6 - RTN
PB7 - RTN
PB8 - RTN
PB9 - V_O
PB10 - V_O

Control Connector – Signal Pins

The DS460S-3 contains a 16 pins control signal header providing control signal interface and standby power interface.

VSB (StandBy Voltage) – (S1 & S2)

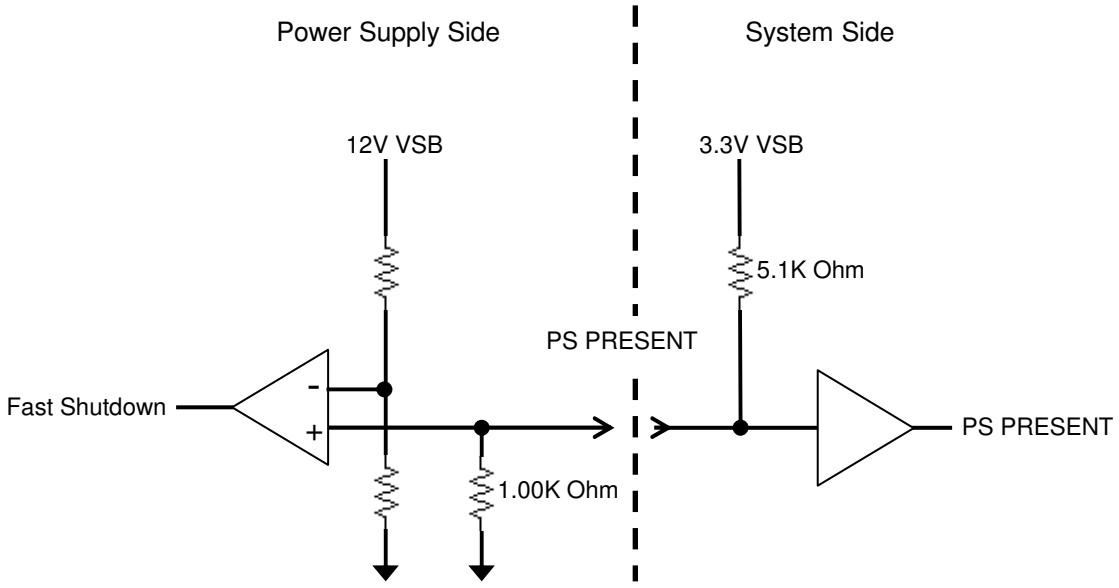
The DS460S-3 provides a regulated 12 volt 2.5 amp auxiliary output voltage to power critical circuitry that must remain active regardless of the on/off status of the power supply's main output. The VSB standby voltage is available whenever a valid AC input voltage is applied to the unit. The VSB output is independently short circuit protected and is referenced to the RTN pins (S15 & S16).

PS INTERRUPT – (S4)

The signal behavior in response to certain operating condition changes in the power supply as defined in the Firmware Specification section. This signal shall be pulled up to maximum 5V logic level external to the PS.

PS PRESENT (Power Supply Present) – (S5)

PS PRESENT signal is used to sense the number of power supplies in the system (operational or not) and provide hot plug insertion and removal functionality by controlling main outputs during hot plug insertion and removal by employing following circuitry. When the unit is removed from the system the fast shut down signal quickly turns OFF main outputs and discharges output capacitors. This signal is the shortest gold finger pin on the signal connector to allow for last make, first break configuration.



When the power supply is plugged into a system backplane, PS PRESENT is 0.54V +/-5% and the 12V output is enabled. When the power supply is removed, PS PRESENT on the power supply is ~0V and the 12V output is disabled.

When the power supply is plugged into the system backplane, PS PRESENT is pulled low (0.54V +/-5%) indicating a power supply is present. When the power supply is removed from the system, PS PRESENT on the system side is pull up to 3.3V (system side standby) indicating that no power supply is present.

PRESENT# SIGNAL CHARACTERISTICS

SIGNAL TYPE	Output From Power Supply, Pull-Up To 3.3VSB with 5.1k in System.	
PRESENT# = Low	Present	
PRESENT# = High	Not Present	
	MIN	MAX
Logic level low voltage	0V	0.6V
Logic level high voltage, Isink=50µA	1.0V	3.30V
12V Output enable threshold	350mV	
12V output disable threshold	150mV	250mV
Sink current, PRESENT# = low		1 mA
Signal transition time. Transition is defined as period during system insertion or removal as the Present pin makes or breaks contact with a powered system.		200usec

PSOK (Output OK Indicator) – (S6)

PSOK is a combined indicator of AC input and main 12V DC output. This is a three level signal to indicate different stages as follows.

AC not OK and DC not OK – Signal status shall be LOW (<0.6V)

AC OK and DC not OK – Signal status shall be LOW (<0.6V)

AC OK and DC OK – Signal status shall be HIGH (> 3.0V)

AC not OK and DC OK – Signal status shall be Middle Level (Between 2V and 2.5V)

DC OK threshold is defined as when the 12V output is greater than 11.5V.

DC not OK threshold is defined as when the 12V output is less than 11.4V and greater than 11.3V.

PSOK SIGNAL CHARACTERISTICS

SIGNAL TYPE	Output from power supply. Powered from12VSB output common to the system.	
PSOK = High	PS Good	
PSOK = Low	PS Not Good	
PSOK = MID	AC Bad, DC Good	
	MIN	MAX
Logic level low voltage	0V	0.6V
Logic level mid voltage	2.0V	2.5V
Logic level high voltage	3.0V	3.3V
Sink current, PSOK = low		1mA
Source current, PSOK = mid		200uA
Source current, PSOK = high		1mA
Signal rise and fall time		200usec

I-Mon (Current Monitor) – (S7)

I-Mon signal provides both the load sharing function (as a feedback for output regulation droop function) and 12V output current information. Signal characteristic is defined in below table.

I-MONITOR OUTPUT CHARACTERISTIC

ITEM	DESCRIPTION	MIN	NOMINAL	MAX	UNITS
V_{share}; I_{out}= 45.96A	Voltage of load monitor bus.	3.88	4.00	4.12	V
V_{share}; I_{out}= 38.3A	Voltage of load monitor bus.	3.23	3.33	3.43	V
V_{share}; I_{out}= 22.98A	Voltage of load monitor bus.	1.94	2.00	2.06	V
V_{share}; I_{out}= 9.19A	Voltage of load monitor bus.	0.76	0.8	0.84	V
V_{share}; I_{out}= 2.3A	Voltage of load monitor bus.	0.16	0.2	0.24	V
V_{share}; I_{out}= 0A	Voltage of load monitor bus.	-0.2	0	0.2	V
$\Delta V_{share}/\Delta I_{out}$; I_{out}>0.5A	Slope of load monitor bus voltage with changing load.		4 / I_{outmax}		V / A
I_{share} sink; V_{share}=4V	Amount of current the load monitor bus output from each power supply sinks.			0.25	mA
I_{share} source; V_{share}=4V	Amount of current the load monitor bus output from each power supply sources.	2.0			mA
$T_{repsonse}$	Delay from output current transition to I-monitor signal change			500	usec

PSON# (Power Supply ON) – (S8)

PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the main 12V DC output. When this signal is not pulled low by the system, or left open, the 12V output is turned off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply. Refer to below On/Off Timing for timing diagram. When in off or standby condition, the main 12V DC output will be less than 50mV with respect to output return.

PSON# SIGNAL CHARACTERISTIC

SIGANL TYPE	Accepts an open collector/drain input from the system. Pull-up internal to the power supply.	
PSON# = Low	ON	
PSON# = Open	OFF(Not installed in the system)	
PSON# = High	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	0.8V
Logic level high (power supply OFF)	2.0V	3.30V
Source current, Vpson = low		1mA
Signal rise and fall time		200usec

SCL, SDA (I2C Serial Clock and Data) – (S9 & S10)

I2C Serial Clock (SCL) signal and the Serial Data (SDA) signals are used to communicate power supply status with end use system as defined in the Firmware Specification section. Both pins are bi-directional and are used to form a serial I2C bus. These signals are pulled up to 5V logic level internal to the PS through separate 20KΩ resistors. Capacitance on each signal internal to the Power Supply is less than 150pF.

The end user system should also provide 3.3KΩ to 10KΩ pull-up resistors for the SDA and SCL lines to 5Vsb or an appropriate VCC derived from 12V VSB. If system side of the I2C Bus is pulled up to a voltage lower than 5V, then level shifting/isolation circuits must be placed between the PS side and the system side of the bus.

GND (I2C Signal Ground) – (S11)

Ground reference for I2C signals SCL and SDA

ADD0, ADD1, ADD2 (PS Address lines A0, A1, A2) – (S12, S13 & S14)

Address pins ADD0, ADD1 and ADD2 are used by end use system to allocate unit address to a power supply in particular slot position. These lines are pulled up to 5V logic level internal to the PS. The end user system must pull these lines low via 300Ω or less or leave it floating to assign the I2C address of the power supply.

Power supply FRU device address is configured per the table below:

Device Address Locations						
	PS1	PS2	PS3	PS4	PS5	PS6
PDB addressing A2/A1/A0	0/0/0	0/0/1	0/1/0	1/0/0	1/0/1	1/1/0
Power supply FRU device	0xA0	0xA2	0xA4	0xA8	0xAA	0xAC

RTN (Output Return) – (S15 & S16)

Power return for the standby voltage VSB, electrically connected to the main V_O 12VDC output return RTN of the power blades.

Americas
5810 Van Allen Way
Carlsbad, CA 92008
USA
Telephone: +1 (760) 930 4600
Facsimile: +1 (760) 930 0698

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2 Wing Yip Street
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