

CSV1300BP Series

1300 Watts Distributed Power System

Total Power: 1300 Watts
Input Voltage: 90-140 Vac
180-264 Vac
of Outputs: Main and Standby



Special Features

- 1300W output power
- 1U power supply
- Active Power Factor Correction
- EN61000-3-2 Harmonic compliance
- Inrush current control
- 80 Plus® Platinum efficiency
- N+N redundant
- Hot-pluggable
- Active current sharing
- PMBus™ compliant
- Conducted/Radiated EMI Class A
- RoHS compliant
- Two-year warranty

Safety

UL/cUL
CB Test Certificate
CE Mark
IEC 60950
KC
CCC/CQC
BSMI

Product Descriptions

The CSV1300BP series power supply features a very wide 90 to 140 Vac and 180 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 0.9 at 10% load.

The power supply employs a ultra high efficiency conversion topology, together with an innovative power transformer and rectifier construction that further improves power density and reduces interconnect power losses. Users have a choice of standard I²C or advanced PMBus™ communications. The control software runs under Windows on any standard PC, and uses a highly intuitive graphical user interface to simplify power supply set-up.

The CSV1300BP series can deliver up to 106.6 A from its main 12.2 Vdc payload output at high line input, and up to 2.5 A from its 12 Vdc auxiliary output. The form factor is 1U and can be used in single or in redundant configurations.

CSV1300BP series is compliant with 80plus Platinum Efficiency. Its efficiency is 94% at nominal high AC line with 50% full load.

Model Numbers

Standard	Output Voltage	Minimum Load ¹	Maximum Load	Standby Supply	Air Flow Direction
CSV1300BP-3	12.2Vdc	0A	106.6A	12.0Vdc@2.5A	Normal (DC connector to Handle)

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

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	$V_{IN,AC}$	90 180	- -	140 264	Vac Vac
Maximum Output Power $V_{IN,AC} = 90-140Vac$ $V_{IN,AC} = 180-264Vac$	All models	$P_{O,max}$	- -	- -	900 1300	W W
Isolation Voltage Input to output Input to safety ground	All models		- -	- -	3000 2138	Vac Vac
Ambient Operating Temperature	All models	T_A	5	-	+50	°C
Storage Temperature	All models	T_{STG}	-40	-	+60	°C
Humidity (non-condensing) Operating Non-operating	All models All models		8 5	- -	93 100	% %
Altitude ¹ Operating Non-operating	All models All models		- -	- -	10,000 50,000	feet feet
MTBF $T_A = 40^{\circ}C$ $I_O = 70\%I_{O,max}$ Nominal input	All models		-	-	500,000	Hours
Operating Life	All models		5	-	-	Years

Note 1 - PSU ambient temperature derated at 1°C per 600 feet above 3000 feet.

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC		$V_{IN,AC}$	90 180	110 220	140 264	Vac
Input AC Frequency		$f_{IN,AC}$	47	50/60	63	Hz
Maximum Input Current ¹ ($I_O = I_{O,max}$, $I_{SB} = I_{SB,max}$)	$V_{IN,AC} = 100Vac$	$I_{IN,max}$	-	-	11	A
No Load Input Current ($V_O = On$, $I_O = 0A$, $I_{SB} = 0A$)	$V_{IN,AC} = 90Vac$ $V_{IN,AC} = 180Vac$	$I_{IN,no-load}$	- -	110 170	- -	mA
No Load Input Power ($V_O = On$, $I_O = 0A$, $I_{SB} = 0A$)	$V_{IN,AC} = 90Vac$ $V_{IN,AC} = 180Vac$	$P_{IN,no-load}$	- -	5.8 5.7	- -	W
Standby Input Current ($V_O = Off$, $I_{SB} = 0A$)	$V_{IN,AC} = 90Vac$ $V_{IN,AC} = 180Vac$	$I_{IN,Standby}$	- -	100 171	- -	mA
Standby Input Power ($V_O = Off$, $I_{SB} = 0A$)	$V_{IN,AC} = 90Vac$ $V_{IN,AC} = 180Vac$	$P_{IN,Standby}$	- -	4.5 4.3	- -	W
Harmonic Line Currents	All	THD	Per EN 61000-3-2			
Power Factor	$I_O > 10\%I_{O,max}$	PF	0.9	-	-	
Startup Surge Current (Inrush) @ 25°C	$V_{IN,AC} = 264Vac$	$I_{IN,surge}$	-	-	30	Apk
Input Fuse	Internal, L, 5x20mm, Quick Acting 250Vdc		-	-	16	A
Leakage Current to earth ground	$V_{IN,AC} = 264Vac$ $f_{IN,AC} = 50Hz$		-	-	0.8	mA
Operating Efficiency @ 25°C	$V_{IN,AC} = 230Vac$ $f_{IN,AC} = 50Hz$ $I_O = 50\%I_{O,max}$	η	94	-	-	%
System Stability						
	Phase Margin		45	-	-	Ø
	Gain Margin		-10	-	-	dB

Note 1 - Output power should be reduced to limit input current at 10A for countries who will not allow >10A at 100Vac.

Output Specifications

Table 3. Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Voltage	All	V_O	12.1	12.2	12.3	Vdc
		V_{SB}	11.4	12.0	12.6	
Output Regulation	Inclusive of set-point, temperature change, warm-up drift and dynamic load	V_O	11.6	12.2	12.8	Vdc
		V_{SB}	11.4	12.0	12.6	
Output Ripple, pk-pk	Measure with a 0.1 μ F ceramic capacitor in parallel with a 10 μ F tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	120	mV _{PK-PK}
		V_{SB}	-	-	120	
Output Current	All	I_O	1 ¹	-	106.6 ²	A
	All	I_{SB}	0	-	2.5	
V_O Current Share Accuracy	30% - 100% $I_{O,max}$	% I_O	-	10	-	%
Load Capacitance	Start up	V_O	1000	-	20000	μ F
		V_{SB}	50		500	μ F
V_O Dynamic Response ³ Peak Deviation	30% load change, slew rate = 0.5A/ μ s	V_O	11.6	-	12.8	Vdc

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

Note 2 - 106.6A is for the high line input voltage range 180-264Vac. The maximum current is 73.8A for low line input 90-140Vac.

Note 3 - Allowable output voltage variation due to a 33A peak load change starting anywhere from 4.5A to 48A at a slew rate of 0.5A/ μ s. Minimum allowable output capacitance of 1000 μ F during test.

Load changes from minimum to maximum or maximum to minimum may cause output voltage to go out of regulation but will not cause the power supply to shut down.

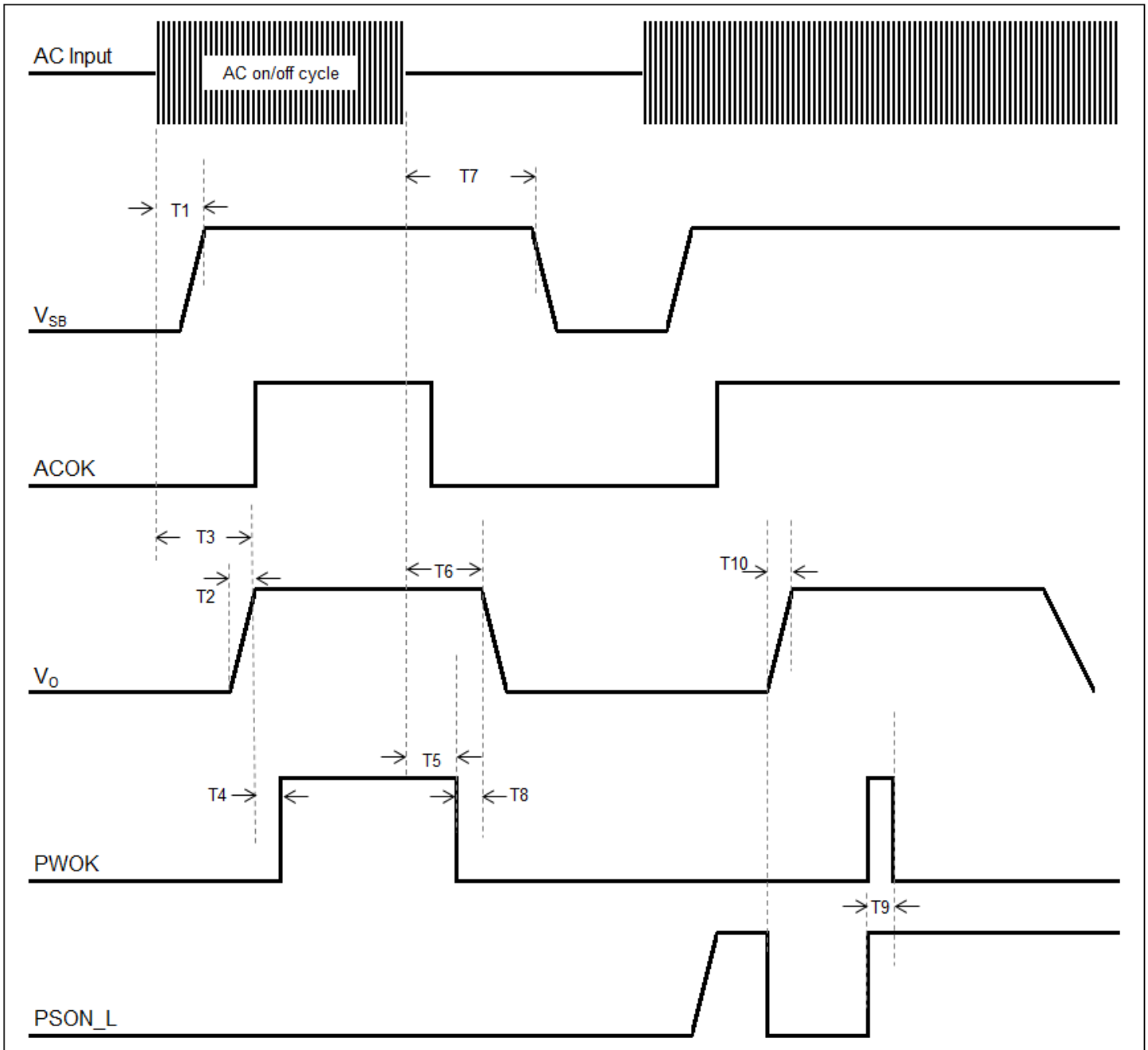
System Timing Specifications

Table 4. System Timing Specifications:

Label	Parameter	Min	Typ	Max	Unit
T1	Delay from AC being applied to V_{SB} being within regulation	-	-	2500	mSec
T2	Rise time of output voltage going from 10% to 90% of the nominal regulation	1	-	70	mSec
T3	Delay from AC being applied to main output being within regulation	-	-	3000	mSec
T4	Delay from output voltages within regulation limits to PWOK assertion	180		220	mSec
T5	Delay from ACOK going low to deassertion of PWOK	6			mSec
T6	Delay from loss of AC to main output being within regulation	12	-	-	mSec
T7	Delay from loss of AC to standby output being within regulation	50	-	1000	mSec
T8	Delay from deassertion of PWOK to output falling out of regulation	2	-	-	mSec
T9	Delay from deassertion of PSON to deassertion of PWOK	-	-	1	mSec
T10	Delay from PSON assertion to output being within regulation	-	-	100	mSec

System Timing Specifications

System Timing Diagram:



CSV1300BP-3 Performance Curves

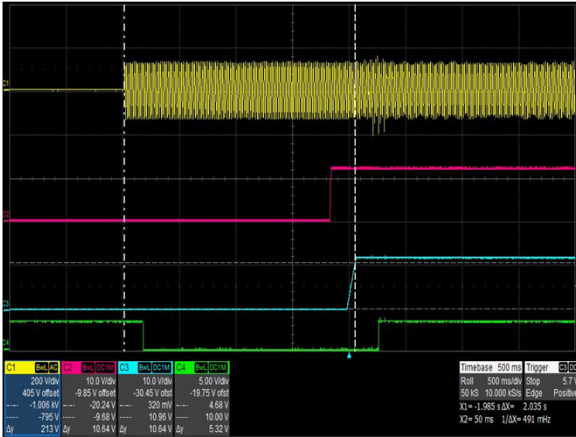


Figure 1: CSV1300BP-3 Turn-on delay via AC Mains - Vin = 90Vac
 Full Load: $I_o = 73.8A$, $I_{SB} = 2.5A$
 Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_o Ch 4: PWOK



Figure 2: CSV1300BP-3 Turn-on delay via PS_ON - Vin = 90Vac
 Full Load: $I_o = 73.8A$, $I_{SB} = 2.5A$
 Ch 1: AC Mains Ch 2: PS_ON Ch 3: V_o Ch 4: PWOK



Figure 3: CSV1300BP-3 Hold-up Time - Vin = 90Vac / 63Hz / 0°
 Full Load: $I_o = 73.8A$, $I_{SB} = 2.5A$
 Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_o Ch 4: PWOK

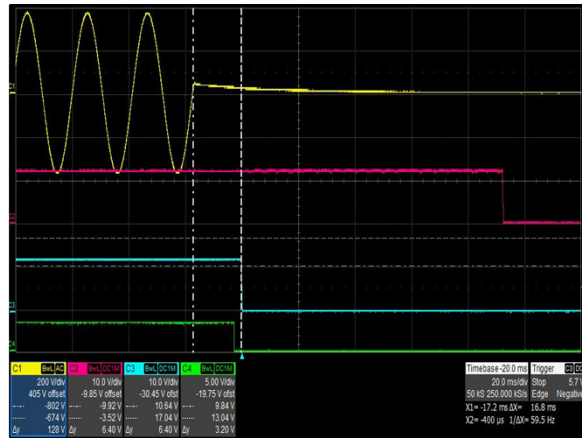


Figure 4: CSV1300BP-3 Hold-up time - Vin = 264Vac / 47Hz / 0°
 Full Load: $I_o = 106.6A$, $I_{SB} = 2.5A$
 Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_o Ch 4: PWOK

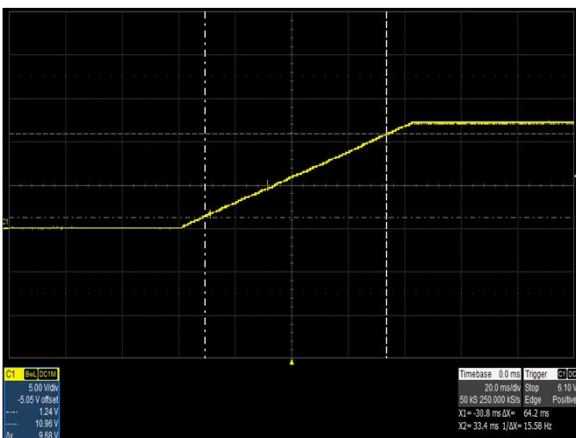


Figure 5: CSV1300BP-3 Output Voltage Startup Characteristic - Vin = 90Vac
 Full Load: $I_o = 73.8A$, $I_{SB} = 2.5A$
 Ch 1: V_o

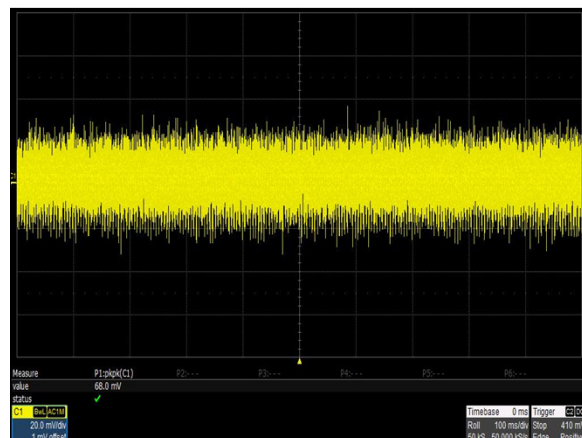


Figure 6: CSV1300BP-3 Ripple and Noise Measurement - Vin = 90Vac
 Full Load: $I_o = 73.8A$, $I_{SB} = 2.5A$
 Ch 1: V_o

CSV1300BP-3 Performance Curves



Figure 7: CSV1300BP-3 Turn Off Characteristic via PSRON
 Full Load: $I_o = 106.6A$, $I_{SB} = 2.5A$
 Ch 1: PSRON Ch 2: Vo Ch 3: PWOK



Figure 8: CSV1300BP-3 Turn Off Characteristic via PSKILL
 Full Load: $I_o = 106.6A$, $I_{SB} = 2.5A$
 Ch 1: PSKILL Ch 2: Vo Ch 3: PWOK

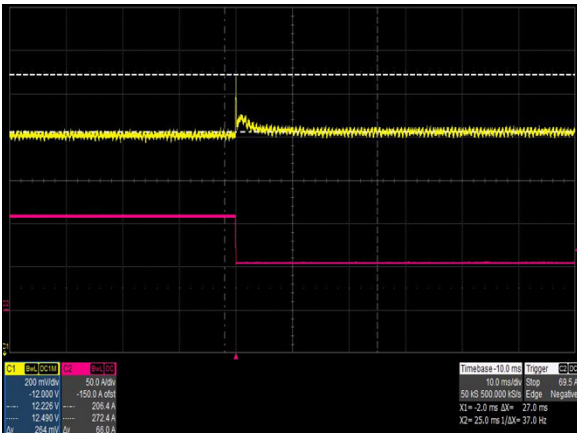


Figure 9: CSV1300BP-3 Transient Response - Vo Deviation (high to low)
 100% to 50% load change, $0.5A/\mu S$ slew rate, $V_{in} = 230Vac$
 Ch 1: Vo Ch 2: Io

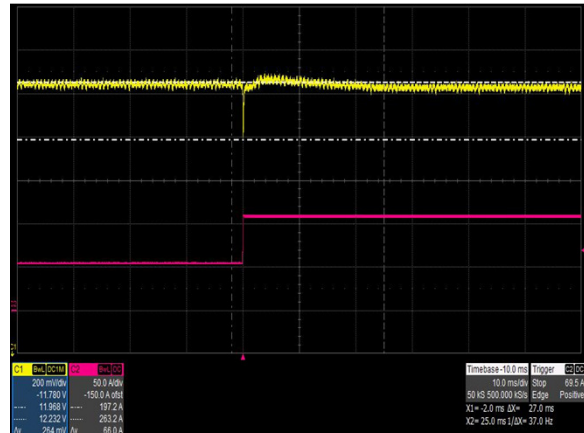


Figure 10: CSV1300BP-3 Transient Response - Vo Deviation (low to high)
 50% to 100% load change, $0.5A/\mu S$ slew rate, $V_{in} = 230Vac$
 Ch 1: Vo Ch 2: Io

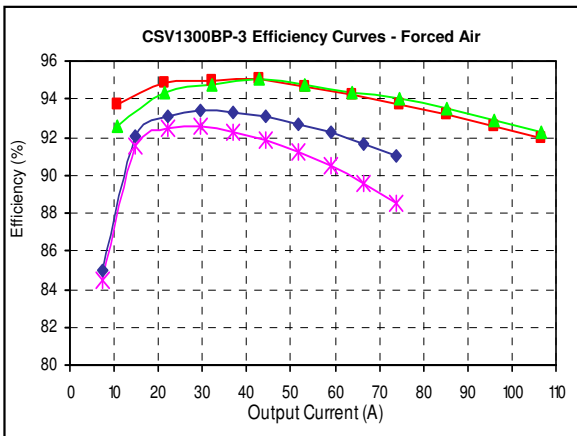


Figure 11: CSV1300BP-3 Efficiency Curves @ 25 °C
 Loading: $I_{o_main} = 10\% I_{o_max}$ increment to $106.6A$, $I_{SB} = 2.5A$

Protection Function Specification

Input Fusing

CSV1300BP series is equipped with an internal non user serviceable 16A High Breaking Capacity (Ceramic Tube) 250Vdc fuse to IEC 60127 for fault protection on L lines input.

Over Voltage Protection (OVP)

The power supply latches off during output overvoltage with the AC line recycled to reset the latch. +12V V_{SB} is auto-recovered after removing OVP limit.

Parameter	Min	Nom	Max	Unit
V_O Output Overvoltage	13.8	/	/	Vdc
V_{SB} Output Overvoltage	13.8	/	/	Vdc

Over Current Protection (OCP)

The power supply has current limit to prevent the outputs from exceeding the values shown in table below. If the current limits are exceeded, the power supply latches off. The latch can be cleared by toggling the PSON signal or by an AC power interruption. The power supply will not shut down if the over-current conditions does not last for more than 50ms. The power supply will not be damaged from repeated power cycling in this condition. The OCP mode of the +12V V_{SB} is hiccup.

Parameter	Min	Nom	Max	Unit
V_O Output Over current				
$V_{IN,AC} = 90-140Vac$	73.8	/	95.9	A
$V_{IN,AC} = 180-264Vac$	106.6	/	138.6	A
V_{SB} Output Over current	3.85	/	3.95	A

Over Temperature Protection (OTP)

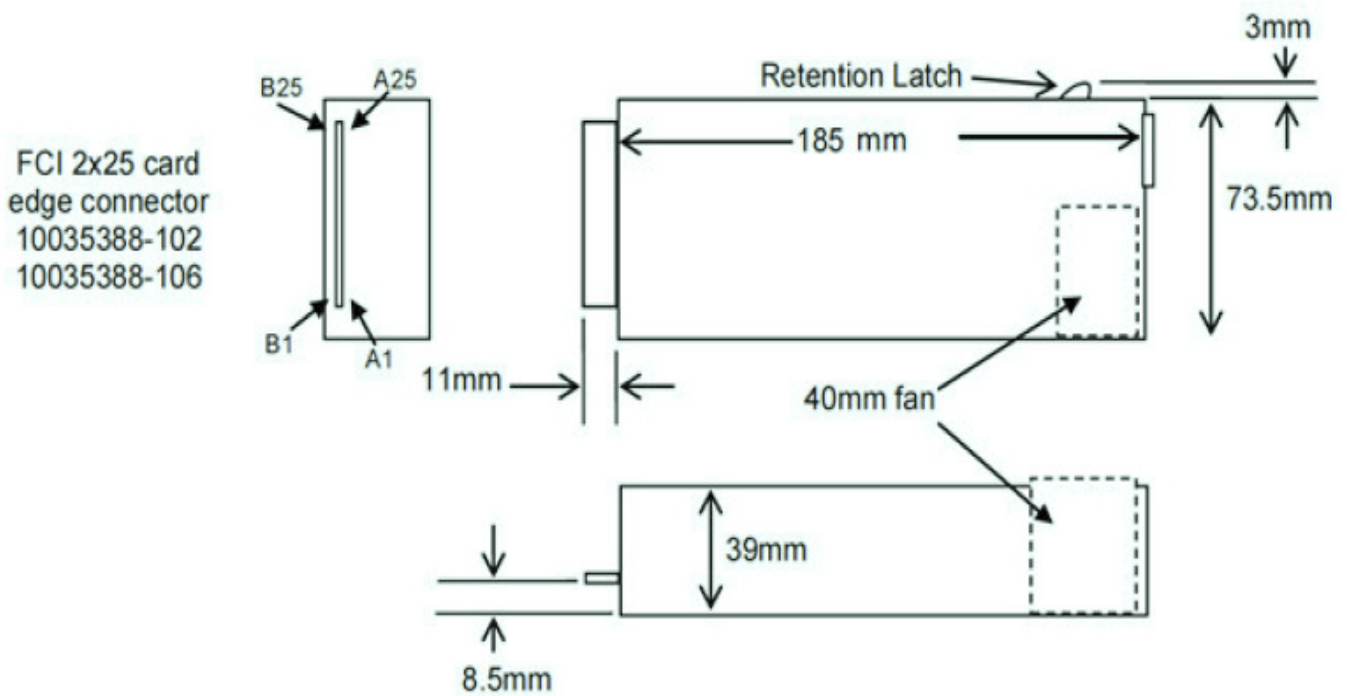
The power supply is internally protected against over temperature conditions. When the OTP limit is reached, the output latches off except standby. Reset can be done by recycling the AC input or PSON.

The power supply provides a temperature warning to the system whenever there is an impending over-temperature shut down. This will be through the OT_WARN bit of the STATUS_TEMPERATURE command. The power supply will not shut down for 30 seconds after setting the OT_WARN bit. If the over-temperature persists after 30 seconds, the power supply will set the THERMAL FAULT bit of STATUS_MFR_SPECIFIC command, and OT_FAULT bit of STATUS_TEMPERATURE command, and then shuts down.

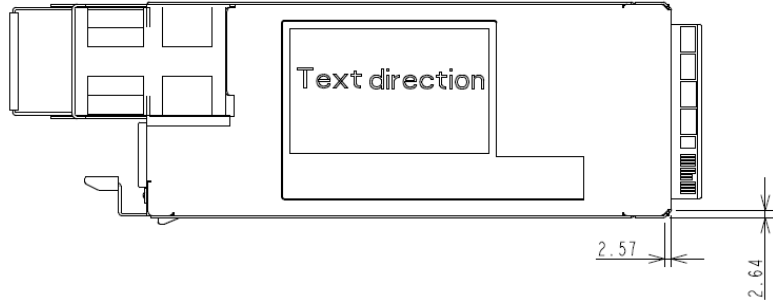
Mechanical Specifications

Mechanical Outlines (Unit:mm)

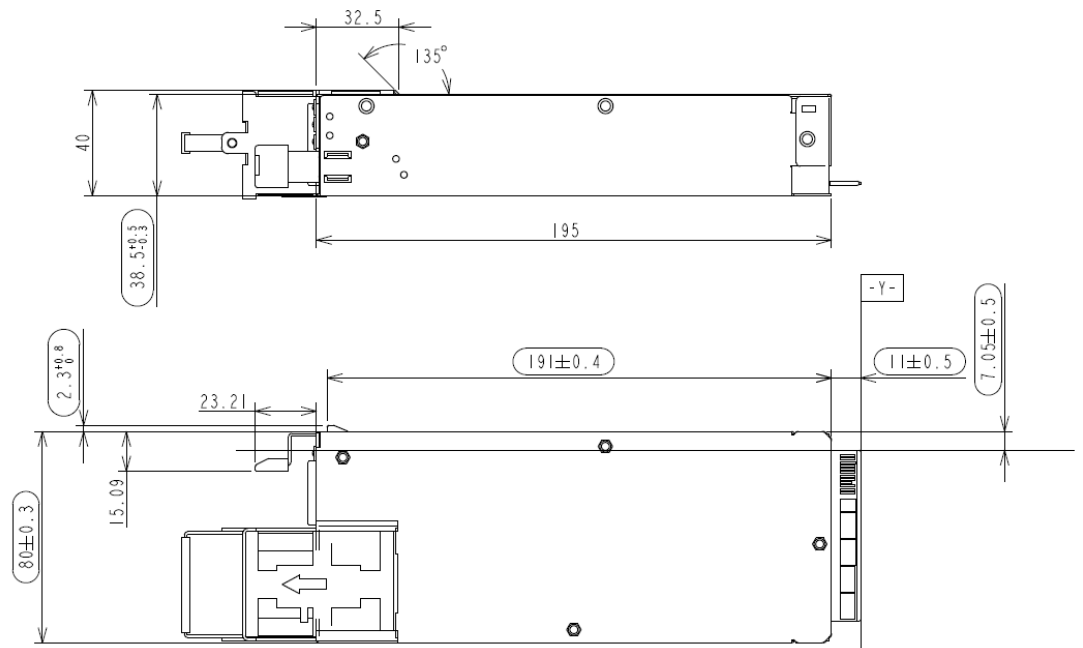
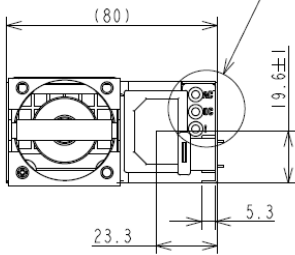
The power supply contains a single 40mm fan with normal airflow direction or reversed airflow direction. The power supply has an identical card edge output that interfaces with a 2x25 card edge connector in the system. The AC plugs directly into the external face of the power supply. Refer to the following figure. All dimensions are nominal.



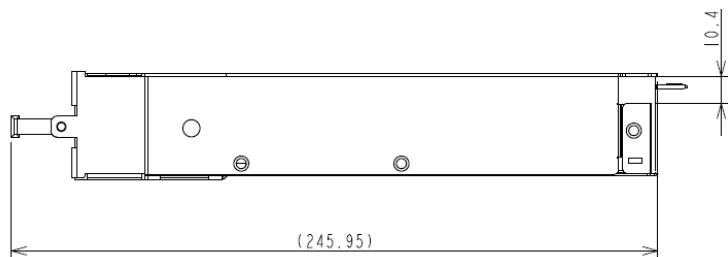
Detailed Mechanical (Unit: mm)



SEE DETAIL A



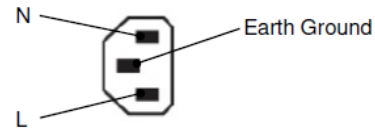
DETAIL A
 SCALE 5.000



Connector Definitions

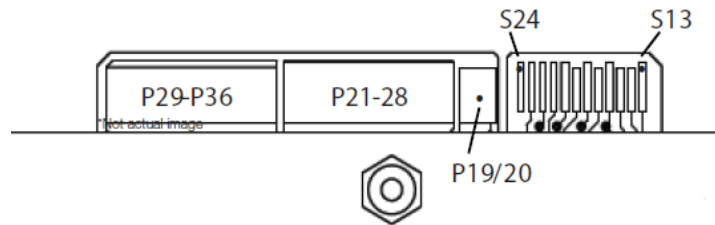
AC Input Connector

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



Output Connector – Power Blades

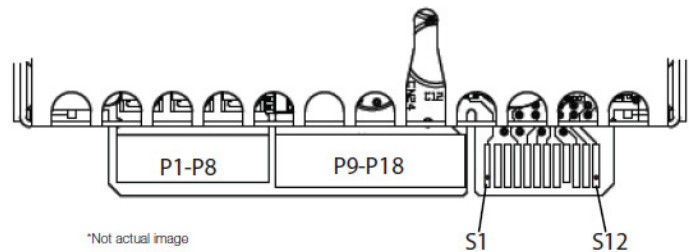
- P1-P8 – + Main Output (V_O)
- P9-P10 – Return (RTN)
- P19-P20 – $12V_{SB}$ (VSB)
- P21-P28 – Return (RTN)
- P29-P36 – + Main Output (V_O)



Power Supply Output Card Edge (Top Side)

Output Connector – Control Signals

- S1 – Reserved
- S2 – Reserved
- S3 – +Vsense
- S4 – PSKILL
- S5 – Reserved
- S6 – DC_GOOD/PWOK
- S7 – PRESENT
- S8 – SMBALERT#
- S9 – ISHARE
- S10 – RETURN
- S11 – SDA
- S12 – SCL
- S13 – SMBus_RESET#
- S14 – Reserved
- S15 – ADDRESS
- S16 – Reserved
- S17 – PSON_L
- S18 – EPOW#/ACOK
- S19 – FFS#
- S20 – Throttle#
- S21 – Reserved
- S22 – -Vsense
- S23 – Reserved
- S24 – Reserved



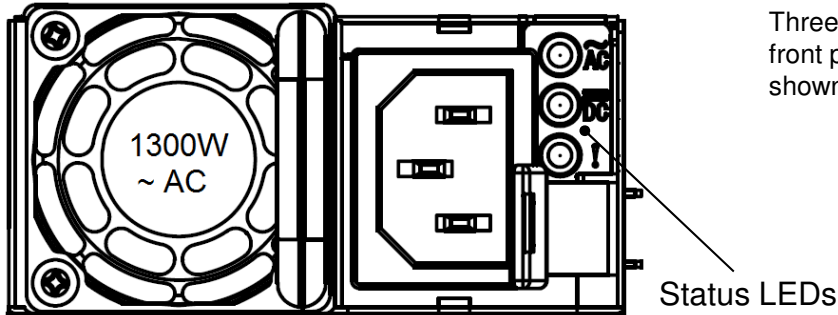
Power Supply Output Card Edge (Bottom Side)

Power / Signal Mating Connectors and Pin Types

Table 5. Mating Connectors for CSV1300BP series:

Reference	On Power Supply	Mating Connector or Equivalent
AC Input Connector	IEC320-C14	IEC320-C13
Output Connector	Card-edge	FCI Amphenol HPCE 10122238-320424FLF

LED indicator Definition



Three bi-color (green/yellow) LEDs at the power supply front provide status signal. The status LED conditions is shown on the below table.

Condition	AC (Green)	DC (Green)	Fault (Yellow)
Output ON and OK	On	On	Off
Standby mode (input present, main output off) or zero output mode	Off	Blinking 1 Hz	Off
No input/input out of range	Off	Off	Off
OCP, or over-subscription fault, or OVP, or fan failure, or OTP	On	Off	On

Weight

The CSV1300BP series weight is 995g/2.19lbs.

Environmental Specifications

EMC Immunity

CSV1300BP series power supply is designed to meet the following EMC immunity specifications

Table 6. Environmental Specifications:

Document	Description
Class A of CISPR 22 (EN55022), FCC 47CFR15 Subpart B	Conducted and Radiated EMI Limits
IEC/EN 61000-3-2 Class A	Harmonics
IEC/EN 61000-3-3	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: 2010	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Radiated, radio-frequency, electromagnetic field immunity test performance criterion: A
IEC/EN 61000-4-4: 2010	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient/Burst Immunity Test. 1KV for AC power port, performance Criteria A
IEC/EN 61000-4-5: 2010	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – Surge Test. 2KV common mode and 1KV differential mode for AC ports, performance criteria A.
IEC/EN 61000-4-6	Conducted Immunity 150KHz - 80KHz, 10V _{RMS} , performance criteria A
EN61000-4-11	Voltage Dips and Sags >95% Reduction for 10mS Criteria B >95% Reduction for 500mS Criteria C 30% Reduction for 500mS Criteria A

Performance Criteria as defined by EN 55024.

Performance Criteria A: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below specified performance level during intended use of operation.

Performance Criteria B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below specified performance level during intended use of operation. Degradation of performance is allowed during the exposure to an electromagnetic phenomenon but no change of actual operating state is allowed.

Performance Criteria C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

Safety Certifications

The CSV1300BP 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.

Table 7. Safety Certifications for CSV1300BP series power supply system:

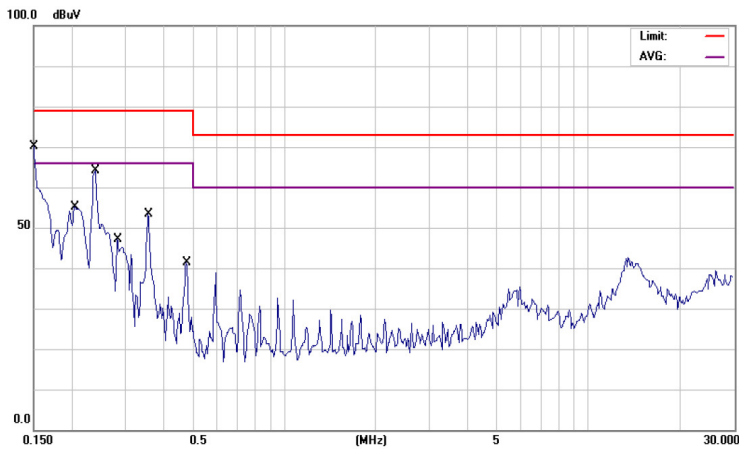
Document	Description
UL/cUL or CSA/NRTL	US and Canada Requirements
EN/IEC 60950	European Requirements
CB Certificate and Report	All CENELEC Countries
CHINA CCC Approval	China Requirements
CE Mark	LVD, ROHS, EMC
BSMI	Taiwan Requirements
KC	Korea Certification

EMI Emissions

The CSV1300BP series has been designed to comply with the Class A limits of EMI requirements of FCC Part 15 and CISPR 22 (EN55022) for emissions and relevant sections of EN55032: 2011 for immunity. The unit is enclosed inside a metal box, tested at 900W 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 CSV1300BP series power supplies have internal EMI filters to ensure the converters' conducted EMI levels comply with EN55032 (FCC Part 15) Class A limits. The EMI measurements are performed with resistive loads at maximum rated loading.

Sample of EN55022 Conducted EMI Measurement at 120Vac input.

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

Conducted EMI emission specifications of the CSV1300BP 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. 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 EN55032 Class A (FCC Part 15). Testing ac-dc 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 ac-dc convertors could pass. However, the standard also states that an attempt should be made to maximize the disturbance consistent with the typical application by varying the configuration of the test sample.

Operating Temperature

The CSV1300BP series power supplies will start and operate within stated specifications at an ambient temperature from 5°C to 50°C. The maximum operating temperature (50°C) is to be de-rated by 1°C per 600 feet above 3000 feet.

Forced Air Cooling

The CSV1300BP 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.

Storage and Shipping Temperature / Humidity

The CSV1300BP series power supplies can be stored or shipped at temperatures between -40°C to $+60^{\circ}\text{C}$ and relative humidity from 5% to 100% non-condensing.

Altitude

The CSV1300BP 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.

Humidity

The CSV1300BP series will operate within specifications when subjected to a relative humidity from 8% to 93% non-condensing. The CSV1300BP series can be stored in a relative humidity from 5% to 100% non-condensing.

Vibration

The CSV1300BP power supply will pass the following vibration specifications:

Non-Operating Random Vibration

Acceleration	1	gRMS
Frequency Range	2-200	Hz
Duration	15	mins
Direction	3 mutually perpendicular axis	

Operating Random Vibration

Acceleration	0.36in double amplitude displacement (5-17Hz) 0.55gRMS (17-199Hz) 0.25gRMS (200-500Hz)	
Frequency Range	5-500	Hz
Duration	30	mins
Direction	3 mutually perpendicular axis	

Shock

The CSV1300BP series power supply will pass the following vibration specifications:

Non-Operating Shock

Acceleration	50	G
Duration	17-22	msec
Pulse	Quasi-square pulse	
No. of Shock	1 shock on all 6 faces	

Power and Control Signal Descriptions

AC Input Connector

This connector supplies the AC Mains to the CSV1300BP series power supply.

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

Output Connector - Power Blades

These pins provide the main output and standby output for the CSV1300BP series. 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 CSV1300BP series power supply. The Main Output (V_O) is electrically isolated from the power supply chassis.

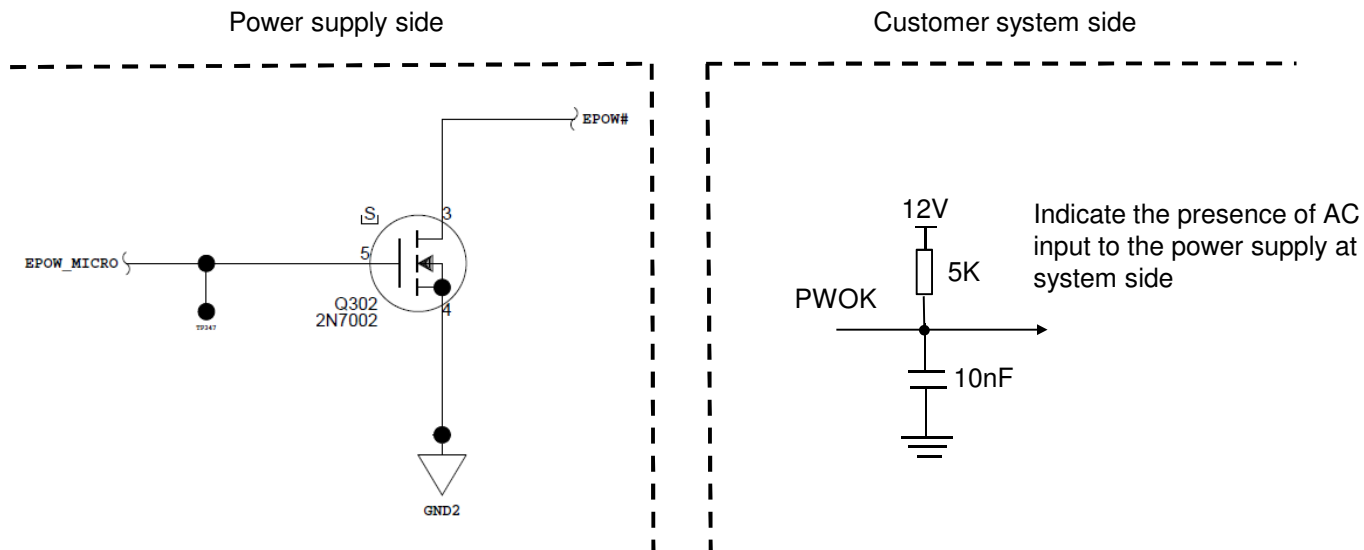
- P1-P8 – + Main Output (V_O)
- P9-P10 – Return (RTN)
- P19-P20 – $12V_{SB}$ (VSB)
- P21-P28 – Return (RTN)
- P29-P36 – + Main Output (V_O)

Output Connector - Control Signals

The CSV1300BP series contains a 24 pins control signal header providing an analogue control interface and I²C interface signal connections.

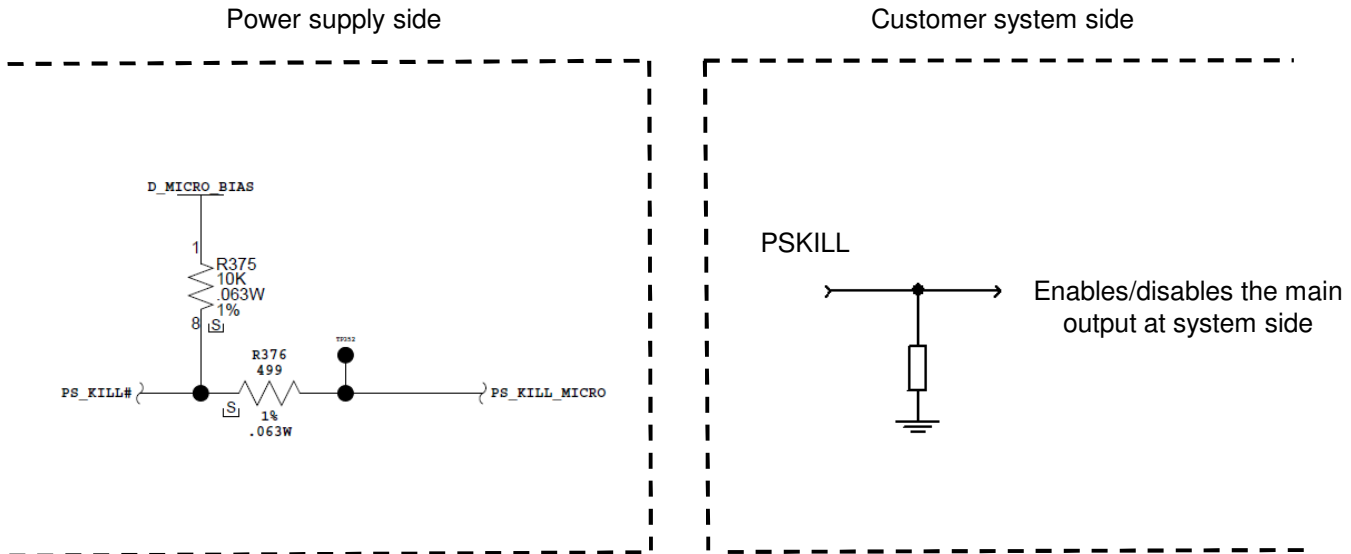
ACOK/EPOW - (Pin S18)

The ACOK is an active low open collector signal which is normally HIGH (>2.0V) whenever input AC voltage is within allowable limits. This signal will go LOW (<0.8V) when the input has gone below the operating limit. Pull-up on system side is required. A suitable decoupling capacitor connected to the return line is recommended on system side.



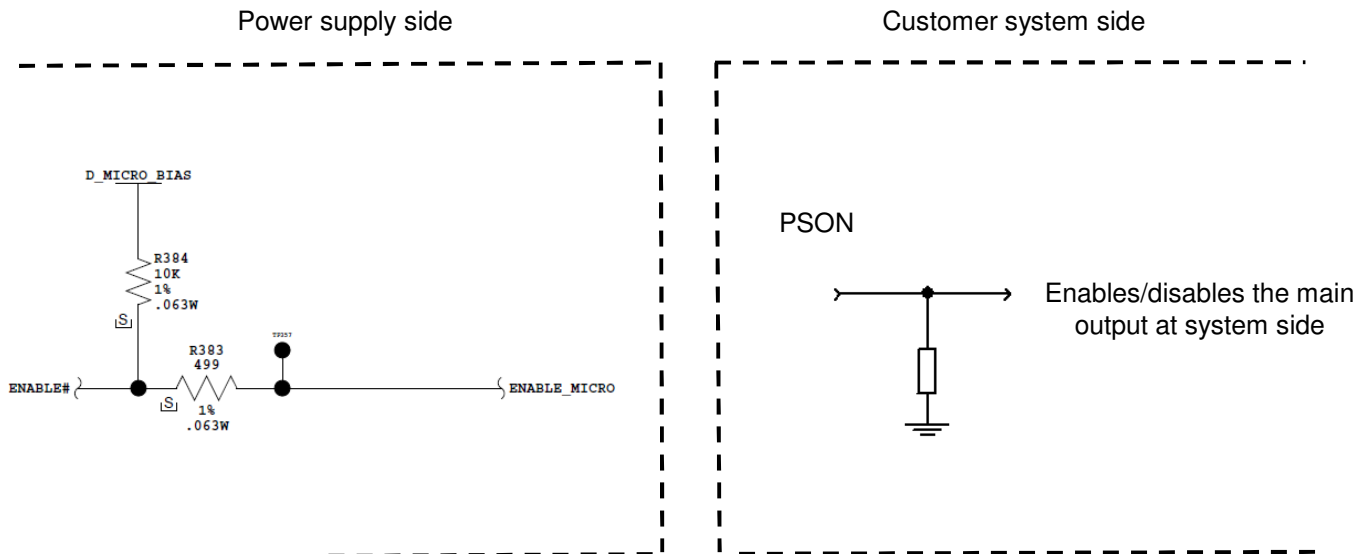
PSKILL - (Pin S4)

The PSKILL signal enables or disables the 12V main output of the power supply. When both the PSKILL and PSON signals are pulled low (<0.8V) by the system and ACOK/EPOW is high, the 12V main output will be enabled. The standby output is not affected by this signal.



PSON - (Pin S16)

This signal is active low, and enables or disables the 12V main output of the power supply. When both PSKILL and PSON signals are pulled low (<0.8V) by the system and ACOK/EPOW is high, the 12V main output will be enabled. The standby output is not affected by this signal.



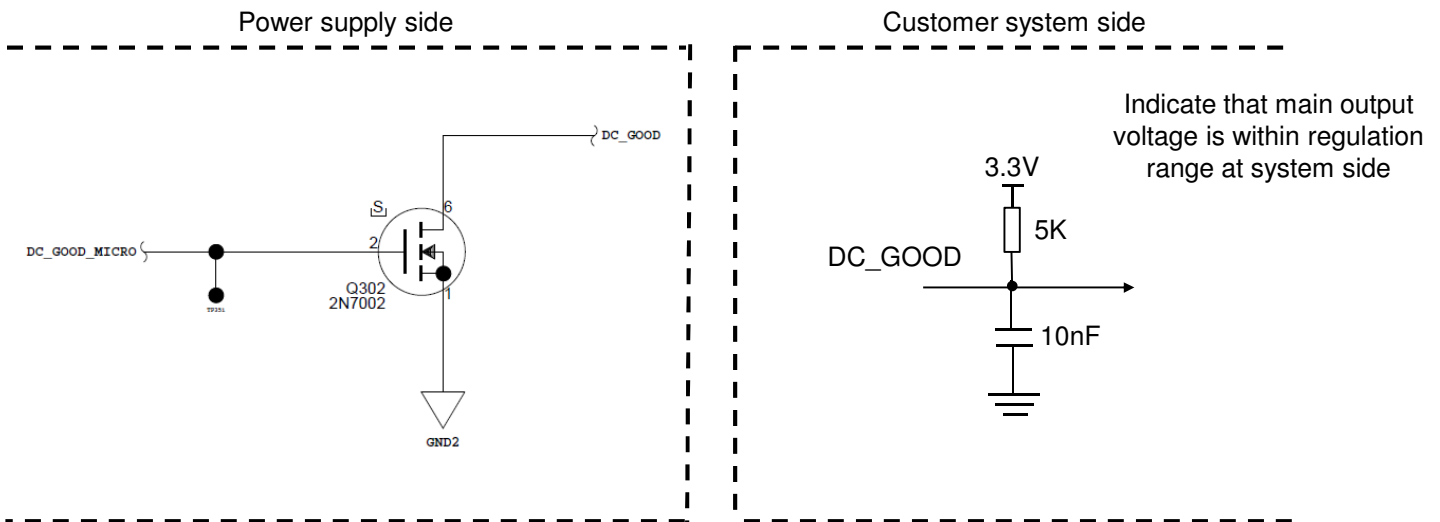
PWOK/DC_GOOD - (Pin S6)

An active high PWOK/DC_GOOD signal will be asserted, driven HIGH (>2,0V), by the power supply to indicate that the main output is valid and operating normally. A low state indicates that a fault in the power supply has occurred and the main output will shut down and latch off.

An over-temperature event causes this signal to go low 2ms before shut down of the main output.

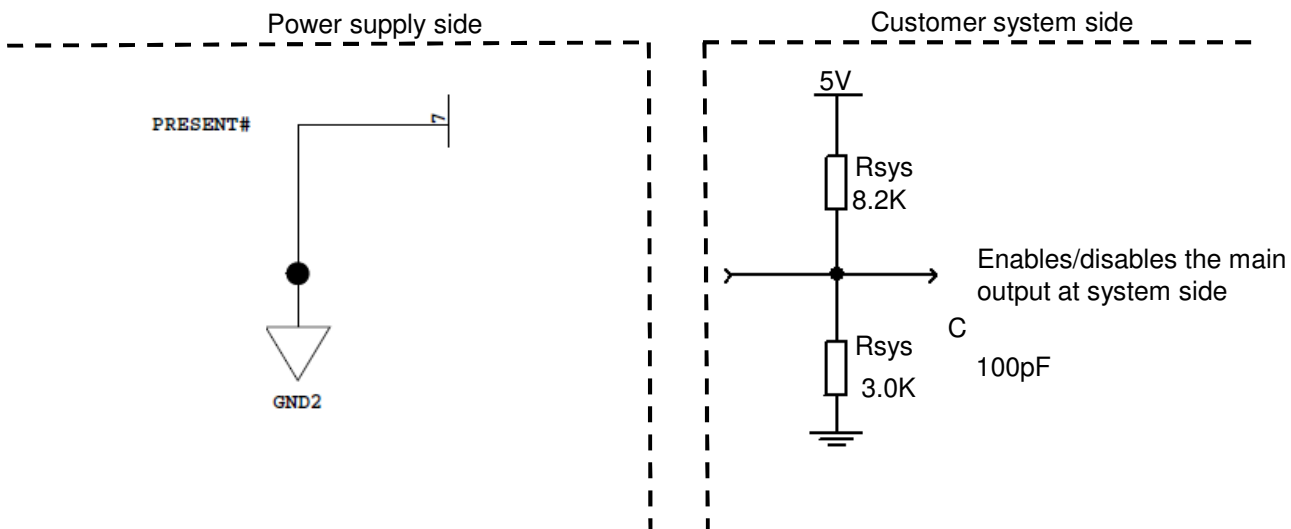
This signal doesn't have any pull-up in the power supply. Pull-up to 3.3V or 5V must be provided at the system side. A decoupling capacitor of at least 10nF at the system side is recommended.

This signal is active for Criteria A and B requirements during input sag and surge.



Present # - (Pin S7)

This active low signal can be used to sense PSUs physically present in the system. This signal pin is grounded inside the power supply. The host system must pull this signal by using a suitable pull-up to 3.3V or 5V on the system side.



SMBALERT# - (Pin S8)

SMBALERT# is an active low open collector signal from the power supply to indicate any change in the status of the power supply. A low signal indicates that one or more non-masked bits in any of the status registers has been set.

Assertion of this signal by the power supply only occurs when the main output is enabled. It stays deasserted in standby mode even when any bit in the status registers get set.

The host system need provide a pull-up to 3.3V or 5V at the system side.

a) Assertion Events

SMBALERT generally is asserted when:

- EPOW is asserted
- An over-temperature warning has occurred
- The load exceeded thresholds stated in Table 3
- Any non-masked status bit is asserted
- Any level-detected unmasked event has occurred

Whenever a level-detected unmasked even is present, SMBALERT will be asserted and continue to be asserted as long as the event is present.

b) Resetting

Clearing and resetting of SMBALERT is by:

- Clearing of STATUS bits that caused the assertion of the signal
- PSON or input recycling
- Masking the event with SMBALERT_MASK

c) SMBUS Behavior

The SMBALERT behavior for this power supply supports Intel's Node Manager. Refer to the flowchart in next page.

ISHARE (Current Share Bus) - (Pin S9)

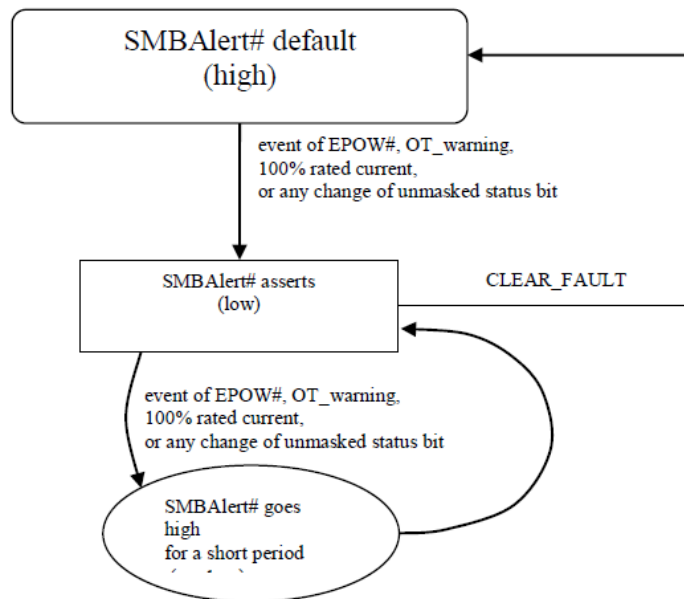
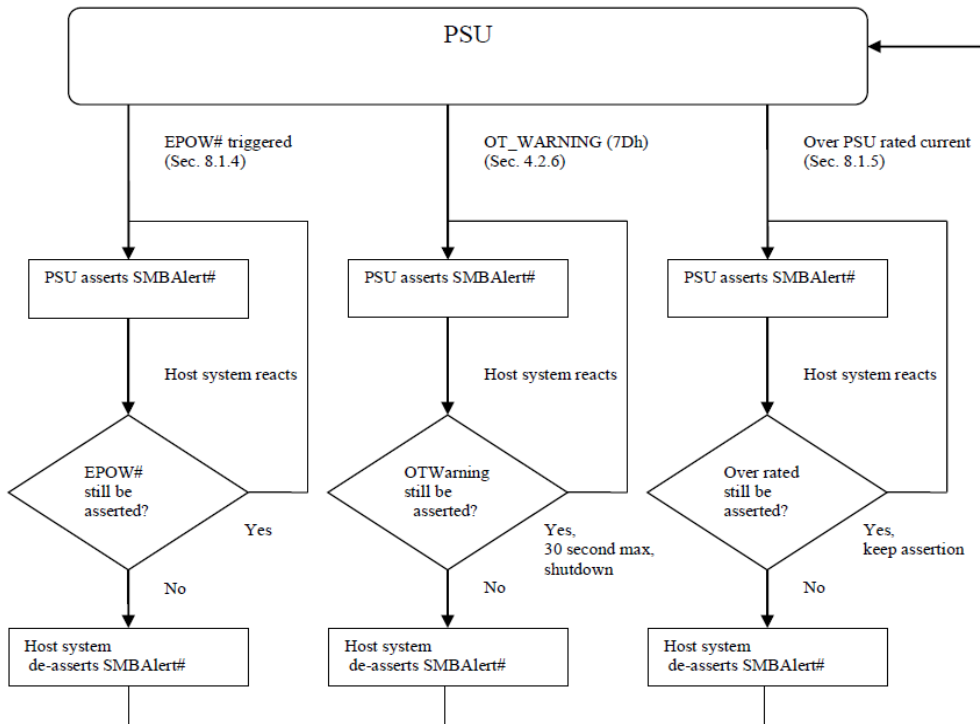
This signal is a bus which will allow two or more power supplies to share the system load current.

This signal will have a voltage which is directly proportional to supplied current. A linear slope from minimum load to full load is expected. The expected voltage levels are stated in Table 10.

SMBUS_RESET - (Pin S13)

SMBUS_RESET is an active low input signal to reset all SMBUS interfaces within the power supply. The system may drive this signal low between 1us to 500ms.

The power supply provides a pull-up to this signal. The host system will have an open collector device for this signal.



FFS_L (FAN FULL SPEED) - (Pin S19)

This is an active low input signal that drives the power supply fan to full speed. This signal also resets all input history and power data to zero at the falling edge of the FFS signal.

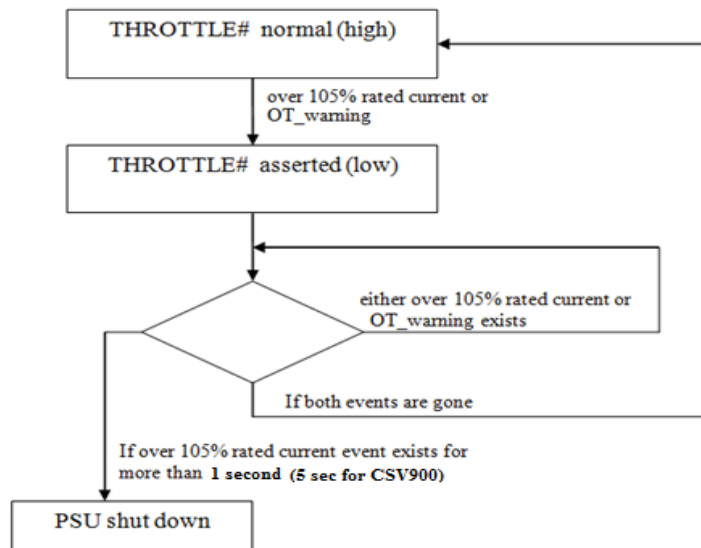
An internal pull-up to the auxiliary 3.3V or 5V is provided by the power supply. It is an open collector signal at the system side.

THROTTLE - (Pin S20)

THROTTLE is an active low open collector signal that indicates to the system host that it needs to reduce its power consumption or risk having a shutdown event. This signal is triggered by an oversubscription of the load beyond the maximum current rating or by an over-temperature warning. Upon assertion, this signal remains asserted until the system reduces the load it draws or the OT_WARNING status has been cleared. If the oversubscription of the load goes beyond 5sec, the power supply will shut down and flag the oversubscription fault bit.

Output current thresholds and timings are provided in below table.

The power supply doesn't have a pull-up for this signal. The host system must provide the pull-up to 3.3V or 5V at the system side.



Output Oversubscription (Slew rate not more than 0.5A/us)				
Conditions	Min	Nom	Max	Unit
Maximum absolute current, I_{MAX} *5 sec ride-through time before power supply is allowed to shut down if the load does not go below 70.1A	-	-	133.3	A
Threshold for THROTTLE# asserted (Ithrottle_Lo) *assertion delay of 1ms upon hitting the threshold	-	106.6	-	A
Threshold for THROTTLE# deasserted (Ithrottle_Hi) *deassertion delay of 1ms upon hitting the threshold	-	101.3	-	A

Communication Bus Descriptions

I²C Bus Signals

CSV1300BP series power supply contains enhanced monitor and control functions implemented via the I²C bus. The CSV1300BP series 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 100K Hz.

ADDRESS (I²C Address Signal) - (Pin S15)

ADDRESS is an analog signal to assign the serial bus 8-bit address. The power supply will attach a 40.2K ohm±1% resistor between 12Vaux and this signal pin. The host system has a 1% resistor between this signal pin and return, right at the power supply connector. The two resistors set up a voltage divider circuit that the power supply will use to determine the address. See table 8 for the power supply addresses.

SDA, SCL (I²C Data and Clock Signals) - (Pins S11, S12)

SDA and SCL are bi-directional serial bus lines for communication for SMBus devices in the power supply and the host system.

These pins for I²C communication must be pulled-up in the system. The power supply doesn't have internal pull-ups. These pins are recommended to be pulled-up in the system by an 2.2K ohm resistor to 3.3V and a 200pF decoupling capacitor at the system side.

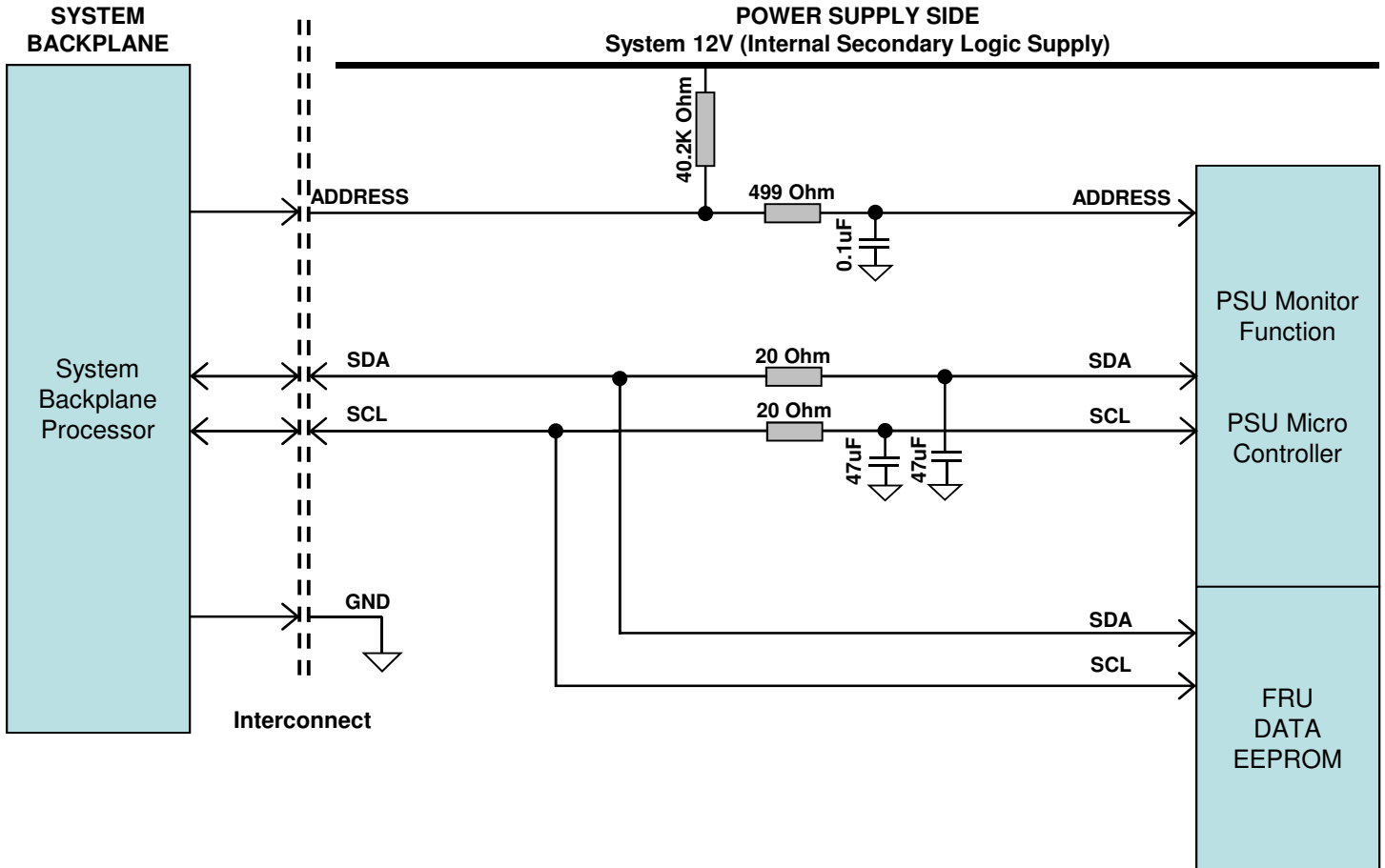
I²C Bus Communication Interval

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

I²C Bus Signal Integrity

The noise on the I²C bus (SDA, SCL lines) due to the power supply will be less than 300mV peak-to-peak. This noise measurement should be made with an oscilloscope bandwidth limited to 100MHz. Measurements should be made at the power supply output connector with 10K ohm resistors pulled up to Standby Output and 47pF ceramic capacitors to Standby Output Return.

I²C Bus Internal Implementation, Pull-ups and Bus Capacitances



I²C Bus - Recommended external pull-ups:

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

Parameter	Condition	Symbol	Min	Typ	Max	Unit
SDA, SCL internal pull-up resistor		R _{int}	No pull-up resistor			
SDA, SCL internal bus capacitance		C _{int}	-	47	-	uF
Recommended external pull-up resistor	1 PSU	R _{ext}	-	2.2	-	Kohm

Logic Levels

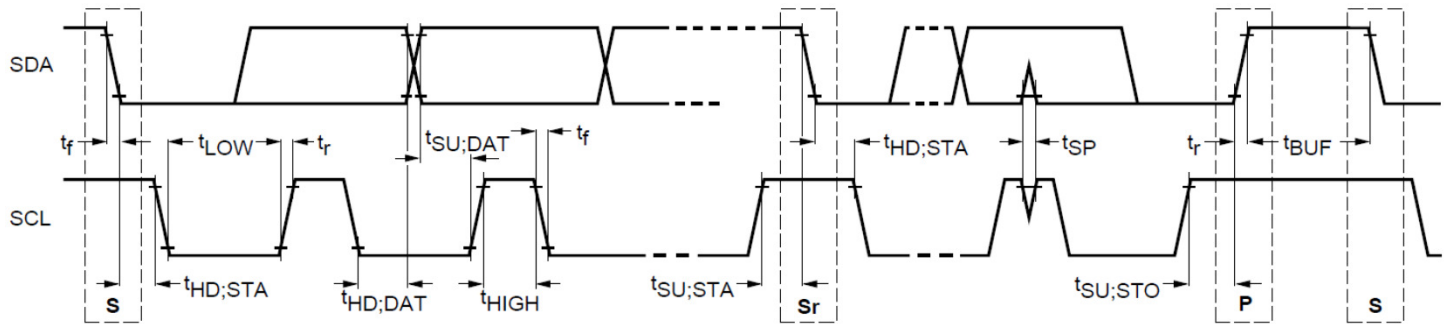
CSV1300BP series power supply I²C Communication Bus will respond to logic levels as per below:

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

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

**Note: Artesyn 73-769-001 I²C adapter was used.

Timings



Parameter	Symbol	Standard-Mode Specs		Actual Measured		Unit
		Min	Max			
SCL Clock Frequency	f_{SCL}	10	100	90.9		KHz
Hold time (repeated) START condition	$t_{HD;STA}$	4.0	-	4.74		μS
LOW period of SCL clock	t_{LOW}	4.7	-	4.86		μS
HIGH period of SCL clock	t_{HIGH}	4.0	50	4.84		μS
Setup time for repeated START condition	$t_{SU;STA}$	4.7	-	4.884		μS
Data hold time	$t_{HD;DAT}$	0	-	0.2416		μS
Data setup time	$t_{SU;DAT}$	250	-	4887		nS
Rise time	t_r	-	1000	SCL = 669.6	SDA = 710.4	nS
Fall time	t_f	-	300	SCL = 156.8	SDA = 146	nS
Setup time for STOP condition	$t_{SU;STO}$	4.0	-	5.02		μS
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	95***		μS

*** Note Artesyn 73-769-001 I²C adapter (USB-to-I²C) and Universal PMBus™ GUI software was used.

Device Addressing

The CSV1300BP power supply has a 40.2K ohm $\pm 1\%$ resistor pull-up to 12Vsb. The host system has a resistor from this pin to return right at the power supply connector. The voltage resulting from this divider determines the power supply address based on Table 8.

ADDRESS pin (Pin S15) is an analog signal to assign the serial bus 8-bit address.

Table 8: Device Addressing

Resistance ¹ (Ohms)	Resultant Voltage ² (V)	Address ³	
		Binary	Hex
Open	12.00	1101 0000	D0
280k	10.49	1101 0010	D2
121k	9.01	1101 0100	D4
68.1k	7.55	1101 0110	D6
40.2k	6.00	1101 1000	D8
23.7k	4.45	1101 1010	DA
13.3k	2.98	1101 1100	DC
5.76k	1.50	1101 1110	DE

Note 1 - Host system resistors, $\pm 1\%$ tolerance or better.

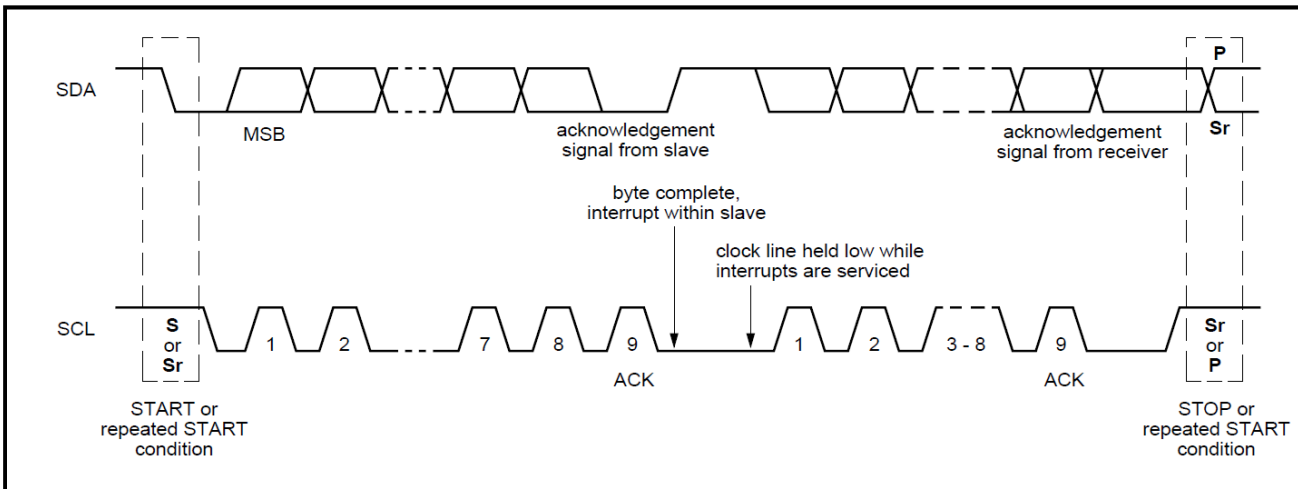
Note 2 - Based on average resistor and 12Vsb values.

Note 3 - The power supply must reply to commands sent with the 8-bit address.

I²C Clock Synchronization

The CSV1300BP series power supply apply clock stretching. An addressed slave power supply 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 CSV1300BP series is 100 microseconds.



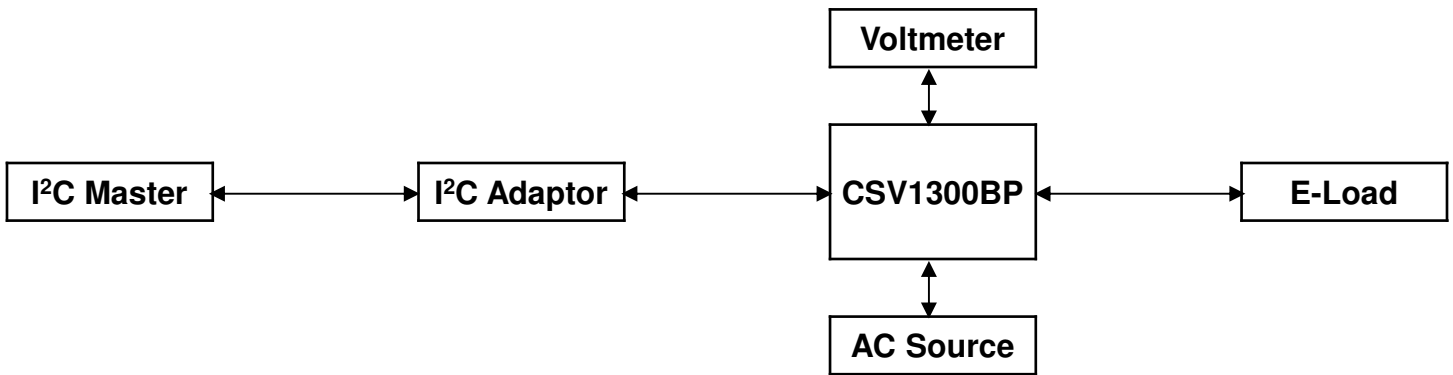
PMBus™ Interface Support

The CSV1300BP series is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I²C interface port.

CSV1300BP Series PMBus™ General Instructions

Equipment Setup

The following is typical I²C communication setup:



CSV1300BP Series Support PMBus™ Command List

The CSV1300BP is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I²C interface port.

CSV1300BP Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value (HEX)	Access Type	Data Bytes	Data Format	Description
00h	Page		R/W	1	Hex	Only Read is supported
01h	OPERATION		R/W	1	Bitmapped	Used to turn the unit ON/OFF.
	b7:6					00 - Immediate Turn OFF 01 - Reserved 10 - PSU ON
	b5:0					Reserved
02h	ON_OFF_CONFIG	15	R/W	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	0				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	1				0 - Use programmed turn ON/OFF delay 1 - Turn OFF the output and stop transferring energy to the output as fast as possible.
03h	CLEAR_FAULTS	-	S			
05h	PAGE_PLUS_WRITE	-	BW	Varies		
06h	PAGE_PLUS_READ	-	BR/BW	Varies		
19h	CAPABILITY		R	1	Bitmapped	Provides a way for the hosts system to determine some key capabilities of a PMBus™ device.
	b7 - Packet Error Checking					0 - PEC not supported 1 - PEC supported
	b6 - Maximum Bus Speed					0 - Maximum supported bus speed, 100KHz 1 - Maximum supported bus speed, 400KHz
	b5 - SMBALERT#					0 - SMBus Alert Pin not supported 1 - SMBus Alert Pin supported
	b4:0					Reserved

CSV1300BP Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
1Ah	QUERY		BR/BW		N/A	Used to determine if the PSU supports a specific command; It should return the proper information about any commands listed
1Bh	SMBALERT_MASK		BR/BW		N/A	Used with STATUS_INPUT, STATUS_TEMPERATURE, STATUS_IOUT
20h	VOUT_MODE		R	1	Bitmapped	Specifies the mode and parameters of Output Voltage related Data Formats Exponent = 1Bh
30h	COEFFICIENTS		BW/BR	5	Hex	Use to retrieve the m, b and R coefficients, needed for DIRECT data format
	byte 5					R byte
	byte 4:3					b low Byte, b high byte
	byte 2:1					m low Byte, m high byte
3Ah	FAN_CONFIG_1_2		R	1	Bitmapped	
	B7					0 - No fan is installed in position 1 1 - Fan is installed in position 1
	B6					0 - Fan is commanded in RPM 1 - Fan is commanded is DC
	b5:4					00 - 1 pulse per revolution 01 - 2 pulse per revolution 10 - 3 pulse per revolution 11 - 4 pulse per revolution
	b3:0					Reserved
3Bh	FAN_COMMAND_1		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.
4Ah	IOUT_OC_WARNING_LIMIT		R	2	Linear	Sets the Over Current Warning Threshold in Amps.
51h	OT_WARN_LIMIT(Hot Spot)		R	2	Hex	Secondary ambient temperature warning threshold, in degree C.
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					An Output current or power fault or warning has occurred.
	b13 - INPUT					An input voltage, current or power fault or warning as occurred.
	b11 - POWER_GOOD#					The POWER_GOOD signal is de-asserted
	b10 - FANS					A fan or airflow fault or warning has occurred.
	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.	

CSV1300BP Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
7Ah	STATUS_VOUT		R	1	Bitmapped	
	b7 - VOUT Over-Voltage Fault					Page 1
	b4 - VOUT Under-Voltage Fault					Page 1
7Bh	STATUS_IOUT		R	1	Bitmapped	
	b7 - IOUT Overcurrent Fault					IOUT Overcurrent Fault
	b5 - IOUT Overcurrent Warning					IOUT Overcurrent Warning
	b1 - POUT_OP_FAULT					POUT_OP_FAULT
7Ch	b0 - POUT_OP_WARNING					POUT_OP_WARNING
	STATUS_INPUT		R	1	Bitmapped	Input related faults and warnings
	b7 - VIN_OV_FAULT					VIN Over voltage Fault
	b5 - VIN_UV_WARNING					VIN Under voltage Warning
	b4 - VIN_UV_FAULT					VIN Under voltage Fault
	b3 - Unit Off For Low Input Voltage					Unit is OFF for insufficient Input Voltage
	b1 - IIN_OC_WARNING					IIN Overcurrent Warning
7Dh	b0 - PIN_OP_WARNING					PIN Overpower Warning
	STATUS_TEMPERATURE		R	1	Bitmapped	Temperature related faults and warnings
	b7 - Over temperature Fault					Over temperature Fault
	b6 - Over temperature Warning					Over temperature Warning
7Eh	STATUS_CML		R	1	Bitmapped	Communications, Logic and Memory
	b7 - Invalid/Unsupported command					Invalid or unsupported Command Received
	b6 - Invalid/Unsupported Data					Invalid Data
	b5 - Packet Error Check Failed					Packet Error Check Failed
80h	STATUS_MFR_SPECIFIC		R/W	1	Bitmapped	
	b7 - Current Share Warning					
	b6 - Standby output under-voltage or over-current fault					
	b5 - Output voltage over-current fault					
	b4 - Standby output over-voltage fault					
	b3 - Output voltage under-voltage fault					
	b2 - Output voltage over-voltage fault					
	b1 - Thermal fault					
81h	b0 - Fan fault					
	STATUS_FANS_1_2		R/W	1	Bitmapped	
	b7 - Fan1 Fault					Fan1 Fault
	b5 - Fan1 Warning					Fan1 Warning
86h	b3 - Fan1 Speed Overridden					Fan1 Speed Overridden
	Ein		BR	6	Direct	Returns the accumulated input power over time
87h	Eout		BR	6	Direct	Returns the accumulated output power over time

CSV1300BP Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
88h	READ_VIN		R	2	Linear	Returns input Voltage in Volts.
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 (Ambient)		R	2	Linear	Returns the ambient temperature in degree Celsius.
8Eh	READ_TEMPERATURE_2 (Hot Spot)		R	2	Linear	Returns the hot pot temperature in degree Celsius.
8Fh	READ_TEMPERATURE_3		R	2	Linear	
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		R	1	Linear	Reads the PMBus revision number
9Fh	APP_PROFILE_SUPPORT		BR		Linear	
A6h	MFR_IOUT_MAX		R	2	Linear	Maximum Output Current (106.6A)
A7h	MFR_POUT_MAX		R	2	Linear	Maximum Output Power (1300W)
C0h	MFR_MAX_TEMP_1 (Ambient)		R	2	Linear	Maximum ambient temperature
C1h	MFR_MAX_TEMP_2 (hot Spot)		R	2	Linear	Maximum hot sopt temperature
E1h	READ_PIN_AVG		R	2		

Application Notes

Current Sharing

The CSV1300BP 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 9.

The power supply may support up to 5+1 configuration. Current sharing below 30% load per unit is not required.

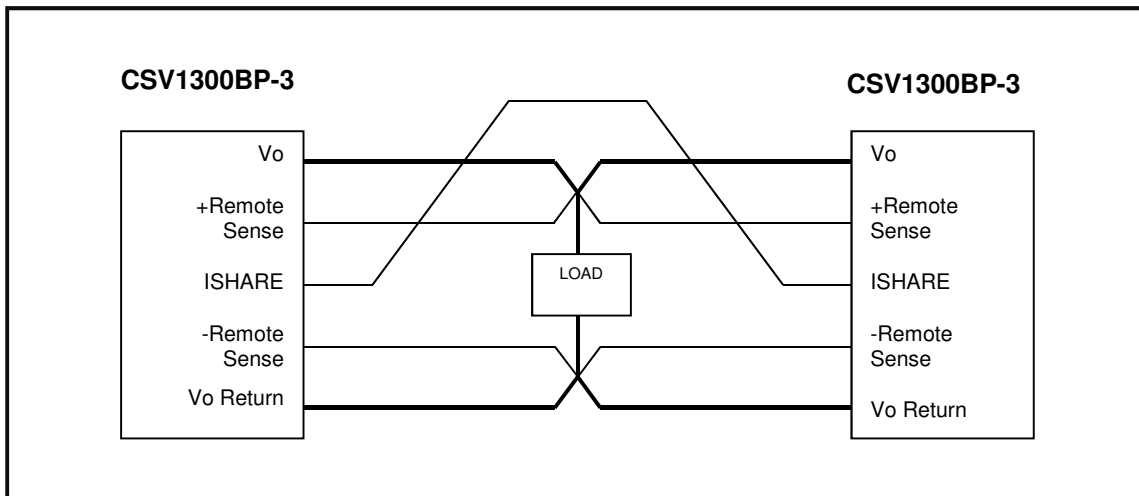


Table 9. Current Sharing Accuracy

Load (per power supply unit)	Max Difference between PSUs
30% - 100%	±10% of expected average from each

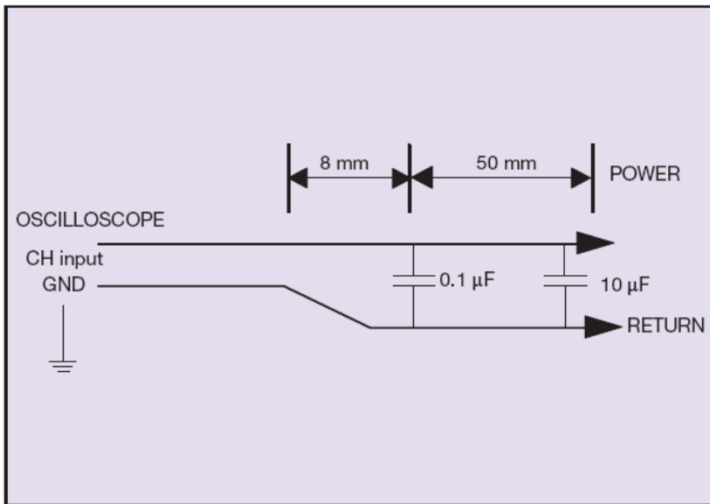
The current share signal I_{share} , is a DC signal that represents the load current that a power supply is providing. This voltage increases proportionately with the output load. The typical I_{share} voltage is specified in below Table 10.

Table 10. I_{share} Voltage

Load (per power supply unit)	Typical I_{share} Voltage
100%	5.0V
50%	2.5V
25%	1.25V

Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the CSV1300BP Series. When measuring output ripple and noise, a scope jack in parallel with a 0.1 μF ceramic chip capacitor, and a 10 μF aluminum electrolytic capacitor should be used. Oscilloscope should be set to 20MHz bandwidth for this measurement



Record of Revision and Changes

Issue	Date	Description	Originators
1.0	09.04.2018	First Issue	A. Zhang

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