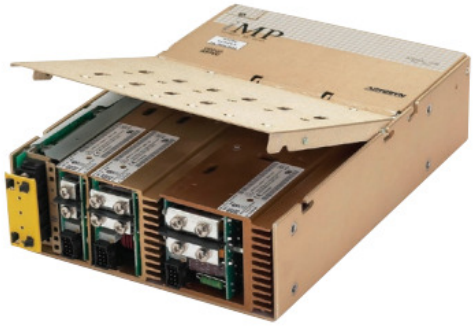
Your Power House
VP ELECTRONIQUE

Technical Reference Note

iMP Series

Up to1500 Watts
Intelligent MP series

Total Power: Up to 1500 Watts
Input Voltage: 85-264 Vac
120-300 Vdc
# of Outputs: Up to 21



Special Features

- Full medical EN60601 approval
- Intelligent I^2C control
- Voltage adjustment on all outputs (manual or I^2C)
- Configurable input and output OK signals and indicators
- Configurable inhibit/enable
- Configurable output UP/DOWN Sequencing
- Configurable current limit (foldback or constant current)
- High power density (8.8 W/cu-in)
- Intelligent fan (speed control/fault status)
- Downloadable GUI from website
- Customer provided air option
- Up controlled PFC input with active inrush protection
- I^2C monitor of voltage, current and temperature
- Programmable voltage, current limit, inhibit/enable through I^2C
- Optional extended hold-up module (SEMI F47 compliance)
- Increased power density to 50% over standard MP
- External switching frequency sync input
- Optional conformal coating
- Industrial temp range (-40^{O}C to 70^{O}C)
- No preload required
- Industrial shock/vibration (>50G's)

Safety

UL60950/UL2601
CSA22.2 No. 234 Level 5
EN60950/EN60601-1
CE Mark to LVD
CB Certificate and report

Product Descriptions

The iMP series power supply is a configurable power supply with market-leading density and efficiency. It features a very wide 85 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. It has a power factor of 0.99 typical. The power supplies also feature active AC inrush control to automatically limit inrush current at turn-on to 40 A maximum.

The iMP series power supply can deliver up to 1500 Watts maximum from the iMP1 case. The power supply has a low profile 1U size and has a power density of more than 8.8 Watts per cubic inch. When fed with a 180 to 264 Vac input, the iMP series power supply can achieve a very high - 85% typical efficiency at full case load.

ARTESYN
An Advanced Energy Company

Ordering Information

iMPX*	-	3L0-1Q1-4LL0-ILL0	-	00	-	A	-	###
①		②		③		④		⑤

①	Case Size	Case Size (inch) where X = 4 = 2.5" x 5" x 10", 750 W - 1158 W, 5 Slots 8 = 2.5" x 7" x 10", 1000 W - 1200 W, 6 Slots 1 = 2.5" x 8" x 11", 1200 W - 1500 W, 7 Slots * Note: Add "E" after iMP4 to denote IEC input option. e.g. iMP4E (Not available on iMP8 or iMP1)
②	**3L0-1Q1-4LL0-ILL0** ---------- Option Code ---------- Voltage Code ---------- Module Code	Module Codes 1 = 210 W single O/P (1 Slot) 2 = 360 W single O/P (2 Slot) 3 = 750 W single O/P (3 Slot) 4 = 144 W dual O/P (1 Slot) 5 = 1500 W single O/P (4 Slot) 6 - 9 = future Voltage Codes See Output Module Voltage/Current table on page 4 Option Codes 0 = Standard 1 = Module enable 2 = Constant current 3 = 1 & 2 combined 4 = Set for use in standard (non-intelligent case) 5 = Shutdown mode for 1500 W 6 = 1 & 5 combined 7 - 9 = future
③	Case Option Codes (See detail on page 5)	First digit 0 - 9, A - Z code Second digit 0 - 9, C - E code
④	Software Code	Software code used for configuration change. "A" is standard
⑤	Hardware Code	Factory assembled for hardware of firmware mods

Ordering Note:

1. The cases and modules of both MP and iMP series can be interchanged to allow more flexibility. If intelligent modules are used with non-intelligent cases, a numeric code "4" is placed at the end of the module code (ex. 4LL0 becomes 4LL4)

2. USB to I2C module order code 73-769-001

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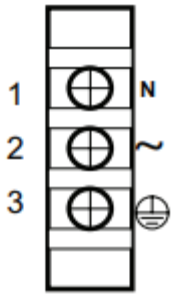
Case Size

Case	Max Output Power		Dimensions mm (inch)	Connections
	85-264 Vac	180-264 Vac		
iMP4 - 5 Slots	750 W	1158 W	63.5 x 127 x 254 (2.5" x 5" x 10")	IEC/ Terminal-Block
iMP8 - 6 Slots	1000 W	1200 W	63.5 x 177.8 x 254 (2.5" x 7" x 10")	Terminal-Block
iMP1 - 7 Slots	1200 W	1500 W	63.5 x 203.2 x 279.4 (2.5" x 8" x 11")	Terminal-Block

Case Input Type

Terminal Block (T)



IEC Connector C14 (C)

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Voltage Codes

Output Module Voltage/Current**											
Voltage	Voltage Code	Signal Output Module Code				Dual Output***		Triple Output			I²C Adjustment Ranges****
		1	2	3	5	4	4	-	-	-	
2.0	A	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	1.8 - 2.2
2.2	B	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	2.2 - 2.4
3.0	C	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	2.7 - 3.3
3.3	D	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	3.0 - 3.6
5.0	E	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	4.5 - 5.5
5.2	F	35 A	60 A	144 A	288 A	10 A	10 A	—	—	2 A	4.7 - 5.7
5.5	G	34 A	58 A	136 A	273 A	10 A	10 A	—	—	2 A	5.0 - 6.1
6.0	H	23 A	42 A	97.5 A	250 A	10 A*	10 A*	—	—	2 A	5.4 - 6.6
8.0	I	20 A	36 A	84.4 A	187.5 A	10 A	4 A	1 A	1 A	1 A	7.2 - 8.8
10.0	J	18 A	32 A	75 A	140 A	10 A	4 A	1 A	1 A	1 A	9.0 - 11.0
11.0	K	17 A	31 A	68 A	136.3 A	10 A	4 A	1 A	1 A	1 A	9.9 - 12.1
12.0	L	17 A	30 A	62.5 A	125 A	10 A	4 A	1 A	1 A	1 A	10.8 - 13.2
14.0	M	14 A	21 A	53.5 A	107 A	9 A	4 A	1 A	1 A	1 A	12.6 - 15.4
15.0	N	14 A	20 A	50 A	100 A	8 A	4 A	1 A	1 A	1 A	13.5 - 16.5
18.0	O	11 A	19 A	41.6 A	83.3 A	—	—	—	0.5 A	0.5 A	16.2 - 19.8
20.0	P	10.5 A	18 A	37.5 A	75 A	—	—	—	0.5 A	0.5 A	18.0 - 22.0
24.0	Q	8.5 A	15 A	30 A	62.5 A	4 A	2 A	—	0.5 A	0.5 A	21.6 - 26.4
28.0	R	6.7 A	11 A	26.8 A	53.5 A	3 A	2 A	—	0.5 A	0.5 A	25.2 - 30.8
30.0	S	6.5 A	11 A	25 A	50 A	—	—	—	—	—	27.0 - 33.0
33.0	T	6.2 A	10.9 A	22.7 A	35.8 A	—	—	—	—	—	29.7 - 36.3
36.0	U	5.8 A	10 A	20.8 A	35.8 A	—	—	—	—	—	32.4 - 39.6
42.0	V	4.2 A	7.5 A	16 A	35.7 A	—	—	—	—	—	37.8 - 46.2
48.0	W	4.0 A	7.5 A	15.6 A	31.2 A	—	—	—	—	—	43.2 - 52.8
54.0	X	3.7 A	6.0 A	13.9 A	27.7 A	—	—	—	—	—	48.6 - 59.4
60.0	Y	3.5 A	6.0 A	12.5 A	25 A	—	—	—	—	—	54.0 - 66.0
Contact Factory											
Special*	Z	35 A	60 A	150 A	300 A	—	10 A				2.3 - 2.6
Special*	Z	35 A	60 A	150 A	300 A	—	10 A				3.7 - 4.4
Special*	Z	20 A	36 A	80 A	140 A	—	8 A				6.7 - 7.1

Note:
*: Contact Factory for extended range down to 6 V.
**: Increments of current not shown can be achieved by paralleling modules (add currents of each module selected).
***: Total output power on dual model must not exceed 144 W.
****: For single output modules only. Green reference lines indicate physical module groupings

Case Option Code - First Digit （Parallel Code）

		Slot 5	Slot 4	Slot 3	Slot 2	Slot 1	iMP4 available slots
	Slot 6	Slot 5	Slot 4	Slot 3	Slot 2	Slot 1	iMP8 available slots
Slot 7	Slot 6	Slot 5	Slot 4	Slot 3	Slot 2	Slot 1	iMP1 available slots
7	6	5	4	3	2	1	
•	•	•	•	•	•	•	0 = no parallel
•	•	•	•	•	—		1 = 1&2
•	•	•	•	—		•	2 = 2&3
•	•	•	—		•	•	3 = 3&4
•	•	—		•	•	•	4 = 4&5
•	•	—	—	—	•	•	5 = 3&4&5
•	—		•	•	•	•	6 = 5&6
•	—	—	—	•	•	•	7 = 4&5&6
—		•	•	•	•	•	8 = 6&7
—		•	—		•	•	9 = 3&4 , 6&7
•	—		—		—		A = 1&2 , 3&4 , 5&6
•	•	—		—		•	C = 2&3 , 4&5
•	—		—		•	•	E = 3&4 , 5&6
—		—		—		•	F = 2&3 , 4&5 , 6&7

Case Option Code - Second Digit

Second digit

0 = No options

1 = Reverse air

3 = Global enable

4 = Fan idle with inhibit

5 = Opt 1 + Opt 3

6 = Opt 1 + Opt 4

7 = Opt 3 + Opt 4

8 = Opt 1 +3 +4

9 = RS485 73-544-002

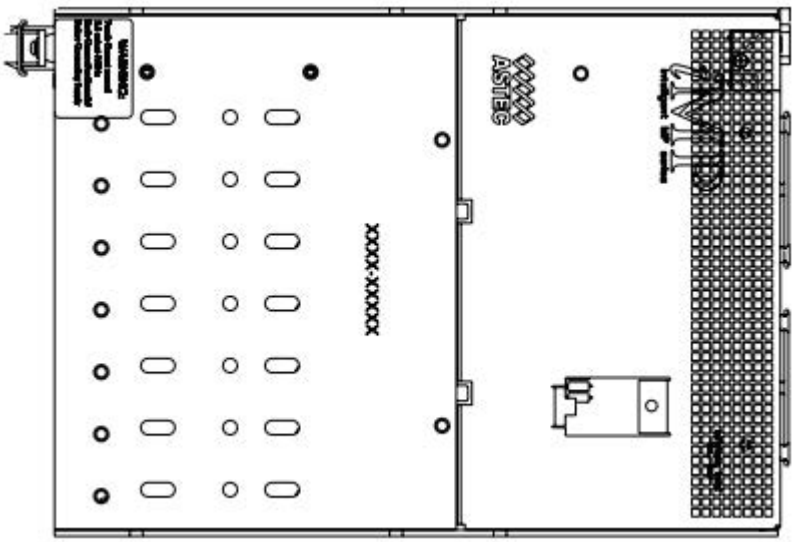
C = Opt 3 + Opt 9

D = CAN BUS 73-544-003

E = Opt 3 + Opt D

Normal Air Flow

Reverse Air Flow



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 (ITE)	All models	V_{IN}	85	-	264	Vac
AC continuous operation (Medical)			85	-	264	Vac
DC continuous operation (ITE)			120	-	350	Vdc
DC continuous operation (Medical)			120	-	300	Vdc
Maximum Output Power	iMP4	$P_{O,max}$	-	-	1158	W
	iMP8		-	-	1200	W
	iMP1		-	-	1500	W
Isolation Voltage						
Input to outputs[1]	All models	-	-	-	4000	Vac
Input to safety ground	All models	-	-	-	1500	Vac
Outputs to outputs	All models	-	-	-	500	Vdc
Outputs to safety ground	All models	-	-	-	400	Vdc
Ambient Operating Temperature						
Forward air[2]	All models	T_A	-40	-	70	^{O}C
Reverse air	All models	T_A	-40	-	40	^{O}C
Storage Temperature	All models	T_{STG}	-40	-	85	^{O}C
Humidity (non-condensing)						
Operating	All models		10	-	95	%
Non-operating	All models		10	-	95	%
Altitude						
Operating[3]	All models		-	-	10000	feet
Non-operating	All models		-	-	30000	feet

Note 1 - For 4000Vac hipot testing, all PE connection should be disconnected.
Note 2 - Derate each output 2.5% per degree from 50 ^{O}C to 70 ^{O}C. Cold start at -20 ^{O}C, allow 10 minutes warm-up before all outputs are with in specification. Reverse air to 40 ^{O}C maximum due to fan derating.
Note 3 - Derate linear to 50% from 10000 - 30000 feet.

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions/Case	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC	All	$V_{IN,AC}$	85	115/230	264	Vac
Operating Input Voltage, DC[1]	All	$V_{IN,DC}$	120	-	350/300	Vdc
Input AC Frequency[2]	All	$f_{IN,AC}$	47	50/60	63/440	Hz
Maximum Input Current ($I_O = I_{O,max}$, $I_{SB} = I_{SB,max}$)	iMP4 iMP8 iMP1	$I_{IN,max}$	- - -	14.0 15.0 18.0	- - -	A
Standby Input Current (V_O = Off, I_{SB} = 0 A)	iMP4 iMP8 iMP1	$I_{IN,standby}$	- - -	580 520 510	- - -	mA
Standby Input Power (V_O = Off, I_{SB} = 0 A)	iMP4 iMP8 iMP1	$P_{IN,standby}$	- - -	30 33 33	- - -	W
No Load Input Current (V_O = On, I_O = 0 A, I_{SB} = 0 A)	iMP4 iMP8 iMP1	I_{IN,no_load}	- - -	580 660 680	- - -	mA
Harmonic Line Currents	All	THD	Per EN61000-3-2			
Power Factor	$V_{IN,AC}$ = 115Vac $f_{IN,AC}$ = 47/63Hz $I_O = I_{O,max}$		-	0.99	-	
Inrush Current	$V_{IN,AC}$ = 264Vac		-	-	40	A_{PK}
Input Fuse	iMP4 iMP8 iMP1		- - -	- - -	16 20 25	A
Leakage Current to Earth Ground	$V_{IN,AC}$ = 240Vac $f_{IN,AC}$ = 50/60Hz		-	-	300	µA
PFC Switching Frequency	All	$f_{SW,PFC}$	50	-	90	KHz
Operating Efficiency @ 25 °C	$I_O = I_{O,max}$ $V_{IN,AC}$ = 180Vac to 264Vac	η	-	85	-	%
Global Inhibit/Enable		TTL, Logic “1” and Logic “0”				

Note 1 - Limited to 300 Vdc in medical applications.
Note 2 - iMP1 can support to 440Hz input for ITE only

Single Output Module Specifications

Table 3. Single Output Module Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	$\pm\%V_O$	-	1	-	%
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Output Voltage Adjustment Range[2]	All	$\pm\%V_O$	10	-	-	%
Margining	Single Output Module Only	$\pm\%V_O$	4	-	6	%
Output Ripple, pk-pk[3]	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	$\%V_O$	-	-	1	%
V_O Current Share Accuracy	50% to 100% $I_{O,max}$	$\%I_{O,max}$	-	-	5	%
V_O Minimum Current Share Loading		$\%I_{O,max}$	20	-	-	%
V_O Dynamic Response Peak Deviation[4] Settling Time	25% load change, slew rate = 1 A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 2 300	 % µSec
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\pm\%V_O$	-	-	0.1	%

Note 1 - 0.4% or 20 mV which is greater(0.4% or 21 mV for 750 W module, 1% for 1500 W module)
Note 2 - Full module adjustment range using I^2C, please refer to page 4
Note 3 - 1% or 50 mV which is greater
Note 4 - 2% or 100 mV which is greater, 5% for 1500W module

Dual Output Module Specifications

Table 4. Dual Output Module Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	$\pm\%V_O$	-	1	-	%
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Output Voltage Adjustment Range[2]	All	$\pm\%V_O$	10	-	-	%
Output Ripple, pk-pk[3]	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	$\%V_O$	-	-	1	%
V_O Current Share Accuracy	50% to 100% $I_{O,max}$	$\%I_{O,max}$	-	-	5	%
V_O Dynamic Response Peak Deviation[4] Settling Time	30% load change, slew rate = 1 A/µs	$\pm\%V_O$ t_s	- -	- -	2 300	% µSec
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\pm\%V_O$	-	-	0.1	%

Note 1 - 0.4% or 21 mV which is greater
Note 2 - Full module adjustment range using I^2C, please refer to page 4
Note 3 - 1% or 50 mV which is greater
Note 4 - 2% or 100 mV which is greater

Triple Output Module Specifications

Table 5. Triple Output Module Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	$\pm\%V_O$	-	1	-	%
Output Regulation	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	4	%
Output Voltage Adjustment Range[1]	All	$\pm\%V_O$	10	-	-	%
Output Ripple, pk-pk[2]	Measure with a 0.1 µF ceramic capacitor in parallel with a 10 µF tantalum capacitor, 0 to 20 MHz bandwidth	$\%V_O$	-	-	1	%
V_O Dynamic Response Peak Deviation[3] Settling Time	30% load change, slew rate = 1 A/µs	$\pm\%V_O$ t_s	- -	- -	2 300	% µSec
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\pm\%V_O$	-	-	0.1	%

Note 1 - Full module adjustment range using I^2C, please refer to page 4
Note 2 - 1% or 50 mV which is greater
Note 3 - 2% or 100 mV which is greater

System Timing Specifications

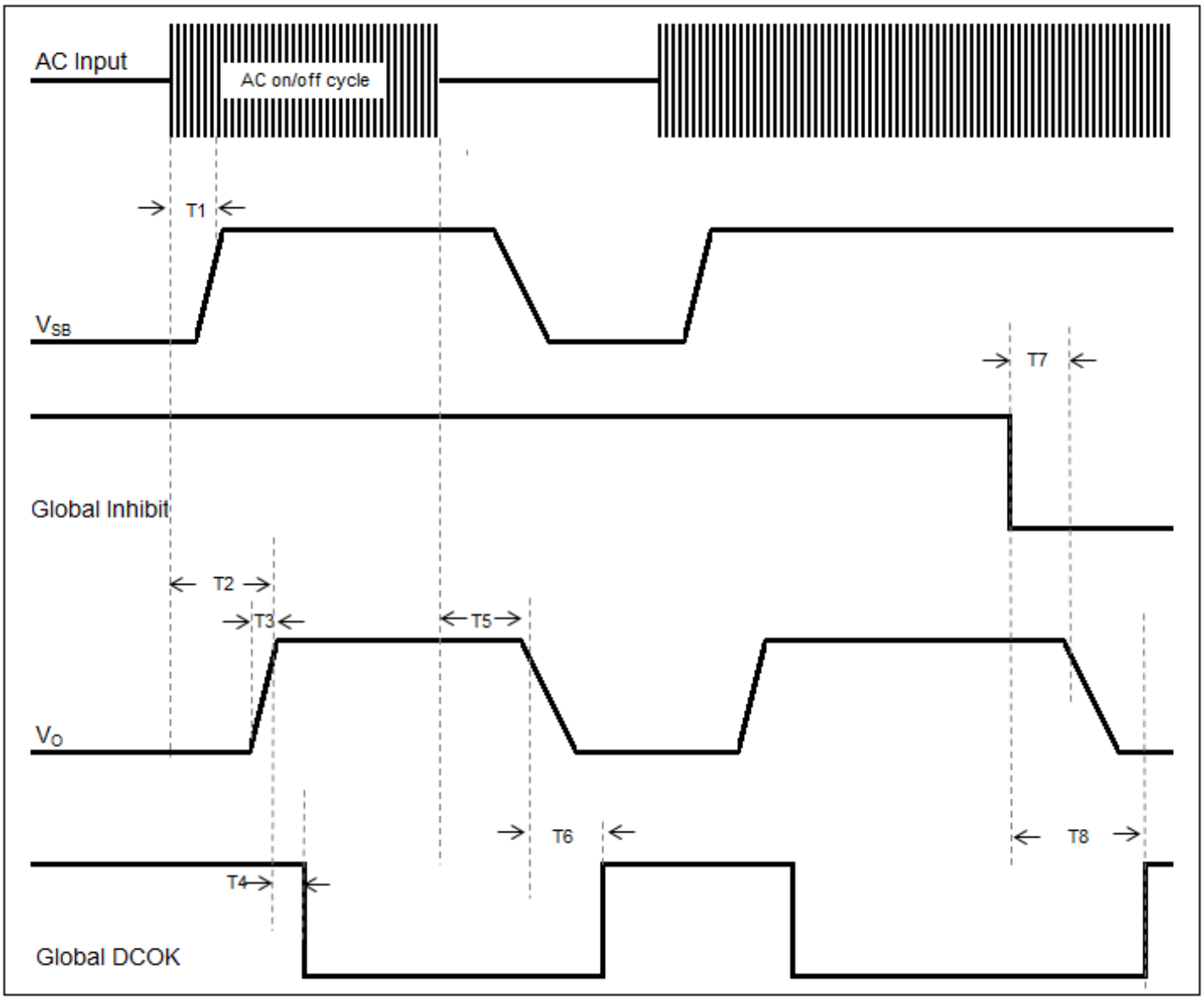
Table 6. System Timing Specifications:

Label	Parameter	Min	Typ	Max	Unit
T1	Delay from AC being applied to V_{SB} being within regulation	-	-	1000	mSec
T2	Delay from AC being applied to all output voltages being within regulation.	-	-	2000	mSec
T3	Rise up time from main output from 10% to 90% of normal output voltage	-	-	50	mSec
T4	Delay from output voltages within regulation limits to Global DC OK asserted low	10	-	1000	mSec
T5	Delay from loss of AC input to main output drop to 90% normal output voltage (Hold up time)	20[1]	-	-	mSec
T6	Delay from main output drop to 90% normal output voltage to Global DCOK being asserted high	-	25	-	mSec
T7	Delay from Global Inhibit asserted low to main output drop to 90% normal output voltage	-	10	-	mSec
T8	Delay from Global Inhibit asserted low to Global DCOK being asserted high	-	20	-	mSec

Note: 1. 20 ms minimum (independent of input Vac) addition 34 ms holdover storage with optional HUP module (SEMI F47 compatible). For iMP4 15 ms (low-line input), 10 ms (high-line input).

System Timing Specifications

Figure 1. System Timing Diagram:



iMP4 Case Performance Curves

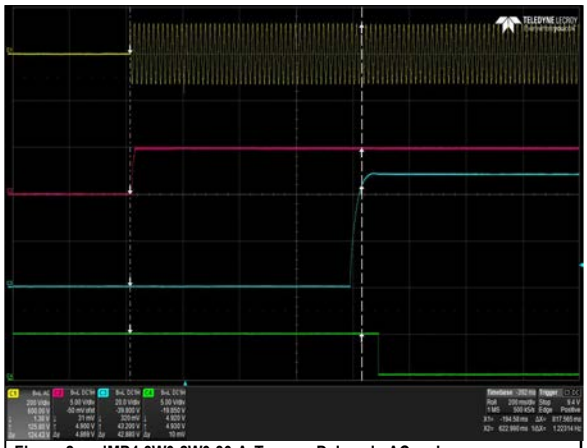


Figure 2: iMP4-3W0-2W0-30-A Turn-on Delay via AC mains
V_{IN} = 90 Vac, I_O = 15.6 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

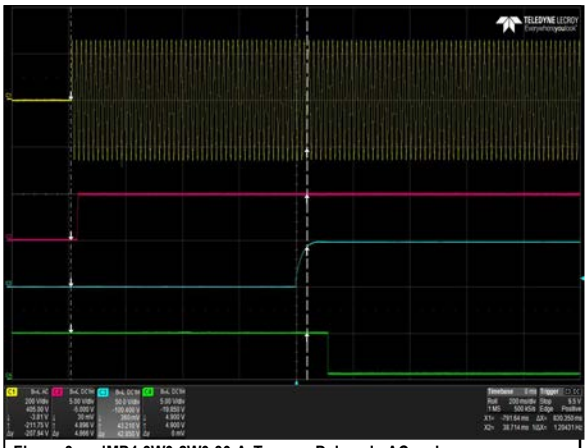


Figure 3: iMP4-3W0-2W0-30-A Turn-on Delay via AC mains
V_{IN} = 180 Vac, I_O = 24 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

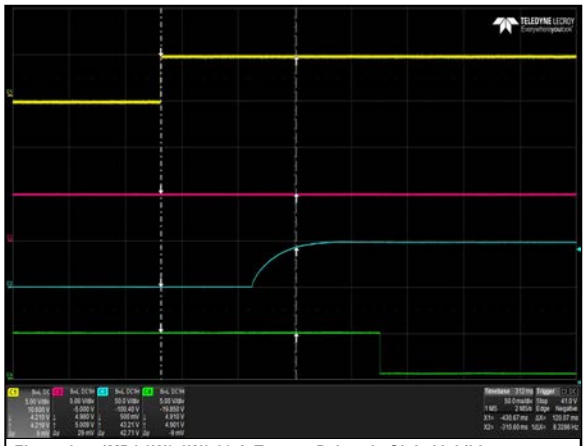


Figure 4: iMP4-3W0-2W0-30-A Turn-on Delay via Global Inhibit
V_{IN} = 90 Vac, I_O = 15.6 A, I_{SB} = 1 A
Ch 1: Global Inhibit Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

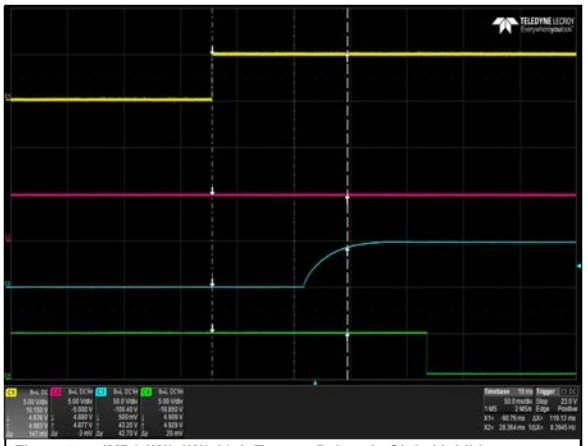


Figure 5: iMP4-3W0-2W0-30-A Turn-on Delay via Global Inhibit
V_{IN} = 180 Vac, I_O = 24 A, I_{SB} = 1 A
Ch 1: Global Inhibit Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

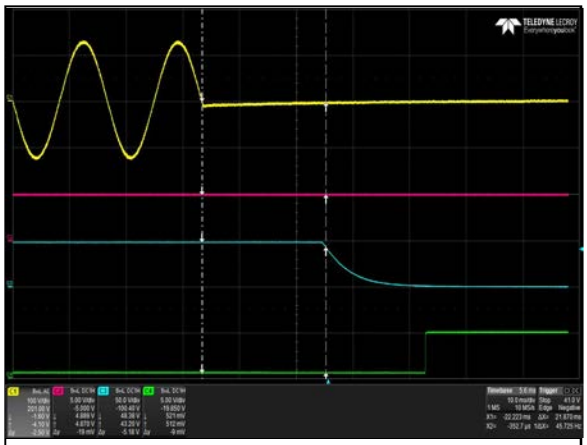


Figure 6: iMP4-3W0-2W0-30-A Hold Up Time
V_{IN} = 90 Vac, I_O = 15.6 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

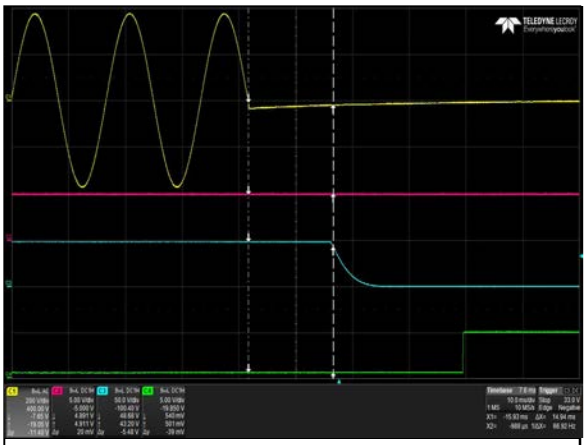


Figure 7: iMP4-3W0-2W0-30-A Hold Up Time
V_{IN} = 264 Vac, I_O = 24 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

iMP4 Case Performance Curves

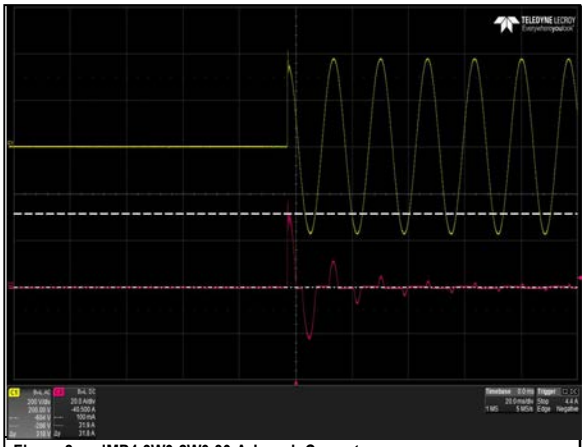


Figure 8: iMP4-3W0-2W0-30-A Inrush Current
V_{IN} = 264 Vac, No load
Ch 1: AC Mains Ch2: I_{IN}

Figure 9: iMP4-3W0-2W0-30-A Input Current
V_{IN} = 90 Vac, I_O = 15.6 A, I_{SB} = 1 A
Ch 1: I_{IN}

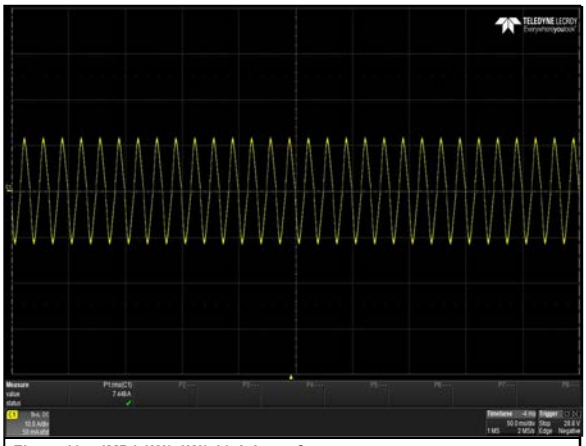


Figure 10: iMP4-3W0-2W0-30-A Input Current
V_{IN} = 180 Vac, I_O = 24 A, I_{SB} = 1 A
Ch 1: I_{IN}

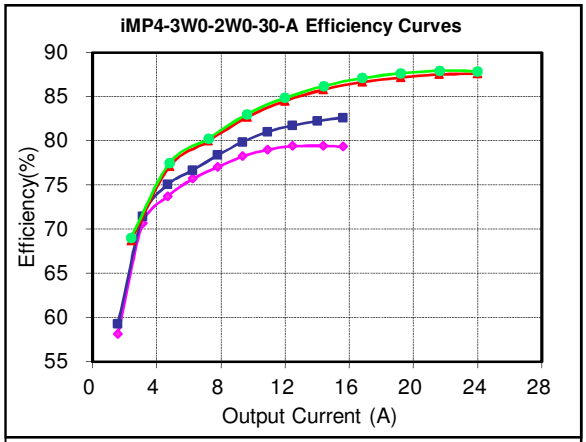


Figure 11: iMP4-3W0-2W0-30-A Efficiency Curves @ 25 degC
----- 90 Vac ----- 115 Vac ----- 230 Vac ----- 264 Vac
Loading: I_O = 10% increment to 24 A, I_{SB} = 0 A

iMP8 Case Performance Curves

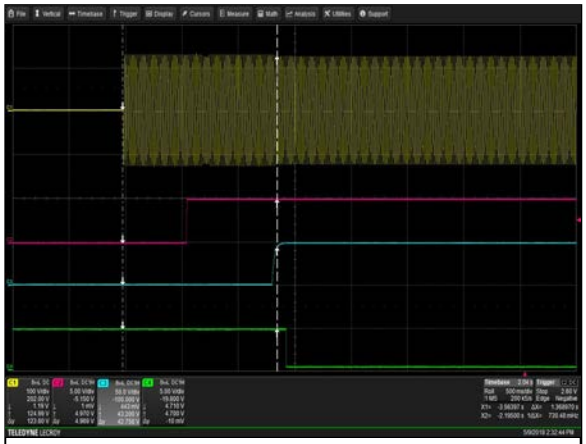


Figure 12: iMP8-3W0-3W0-30-A Turn-on Delay via AC mains
V_{IN} = 90 Vac, I_O = 20.83 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

Figure 13: iMP8-3W0-3W0-30-A Turn-on Delay via AC mains
V_{IN} = 180 Vac, I_O = 25A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

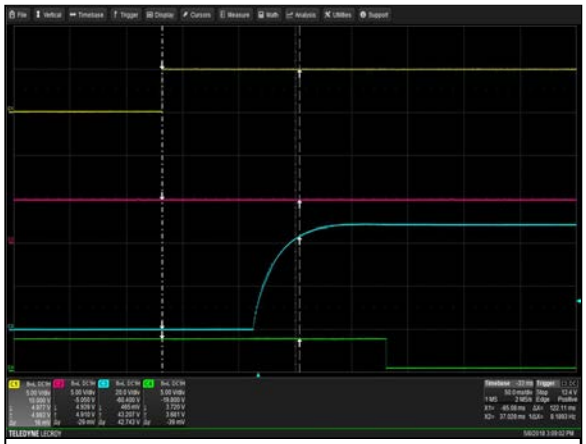


Figure 14: iMP8-3W0-3W0-30-A Turn-on Delay via Global Inhibit
V_{IN} = 90 Vac, I_O = 20.83 A, I_{SB} = 1 A
Ch 1: Global Inhibit Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

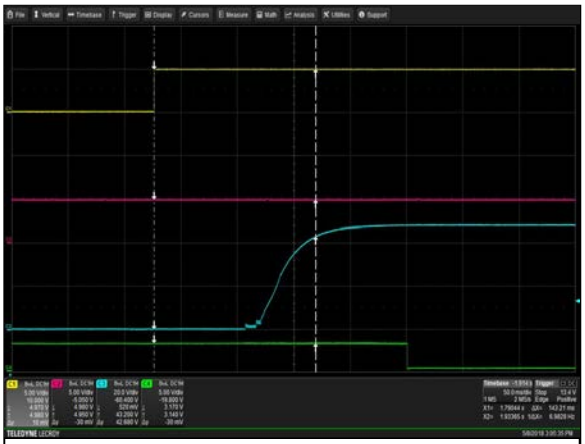


Figure 15: iMP8-3W0-3W0-30-A Turn-on Delay via Global Inhibit
V_{IN} = 180 Vac, I_O = 25 A, I_{SB} = 1 A
Ch 1: Global Inhibit Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

Figure 16: iMP8-3W0-3W0-30-A Hold Up Time
V_{IN} = 90 Vac, I_O = 20.83 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

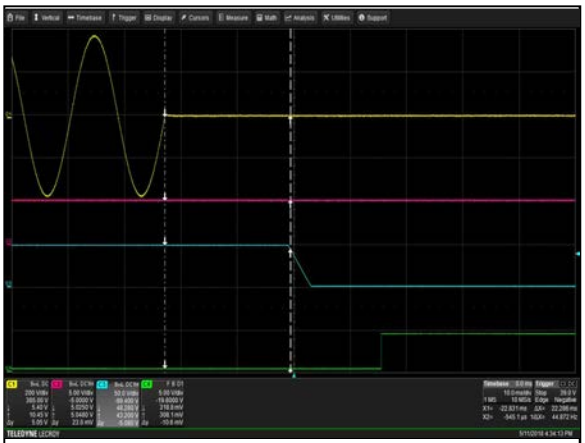


Figure 17: iMP8-3W0-3W0-30-A Hold Up Time
V_{IN} = 264 Vac, I_O = 25 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

iMP8 Case Performance Curves

Figure 18: iMP8-3W0-3W0-30-A Inrush Current
V_{IN} = 264 Vac, No load
Ch 1: AC Mains Ch2: I_{IN}

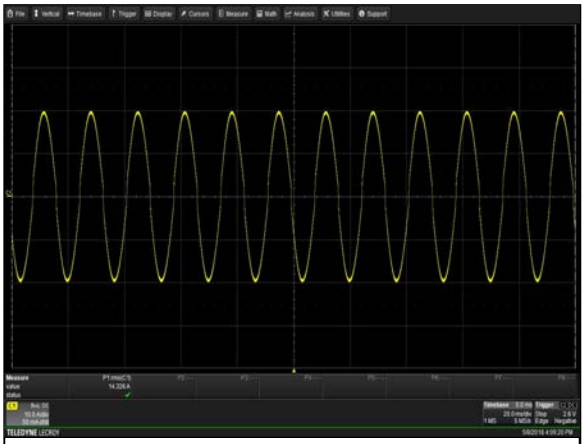


Figure 19: iMP8-3W0-3W0-30-A Input Current
V_{IN} = 90 Vac, I_O = 20.83 A, I_{SB} = 1 A
Ch 1: I_{IN}

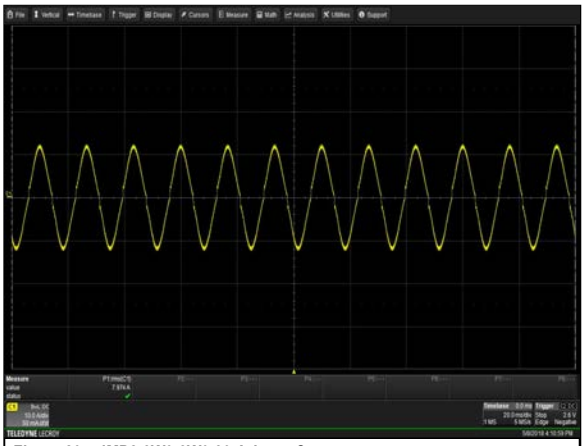


Figure 20: iMP8-3W0-3W0-30-A Input Current
V_{IN} = 180 Vac, I_O = 25 A, I_{SB} = 1 A
Ch 1: I_{IN}

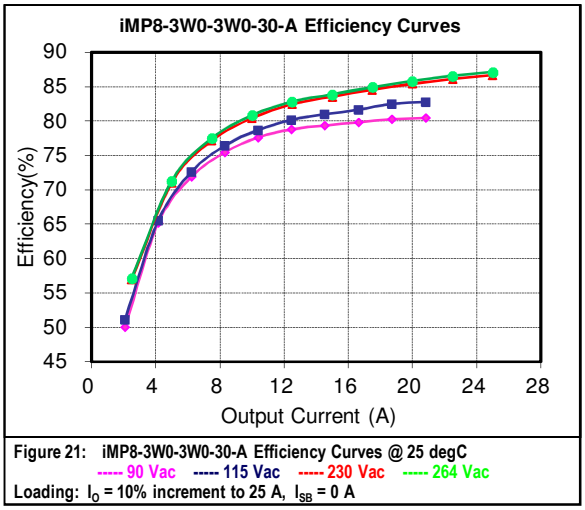


Figure 21: iMP8-3W0-3W0-30-A Efficiency Curves @ 25 degC
----- 90 Vac ----- 115 Vac ----- 230 Vac ----- 264 Vac
Loading: I_O = 10% increment to 25 A, I_{SB} = 0 A

iMP1 Case Performance Curves

Figure 22: iMP1-5W0-00-A Turn-on Delay via AC mains
V_{IN} = 90 Vac, I_O = 25 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

Figure 23: iMP1-5W0-00-A Turn-on Delay via AC mains
V_{IN} = 180 Vac, I_O = 31.25 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

Figure 24: iMP1-5W0-00-A Turn-on Delay via Global Inhibit
V_{IN} = 90 Vac, I_O = 25 A, I_{SB} = 1 A
Ch 1: Global Inhibit Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

Figure 25: iMP1-5W0-00-A Turn-on Delay via Global Inhibit
V_{IN} = 180 Vac, I_O = 31.25 A, I_{SB} = 1 A
Ch 1: Global Inhibit Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

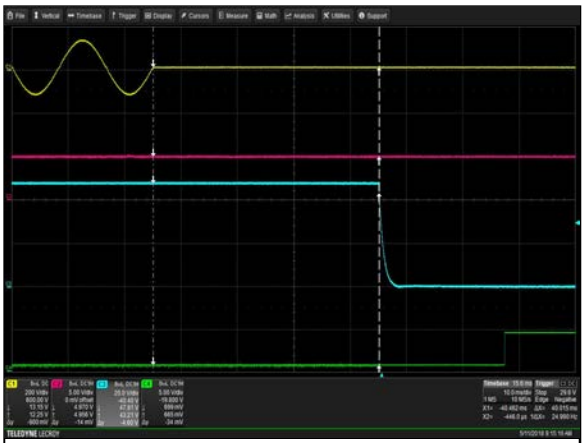


Figure 26: iMP1-5W0-00-A Hold Up Time
V_{IN} = 90 Vac, I_O = 25 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

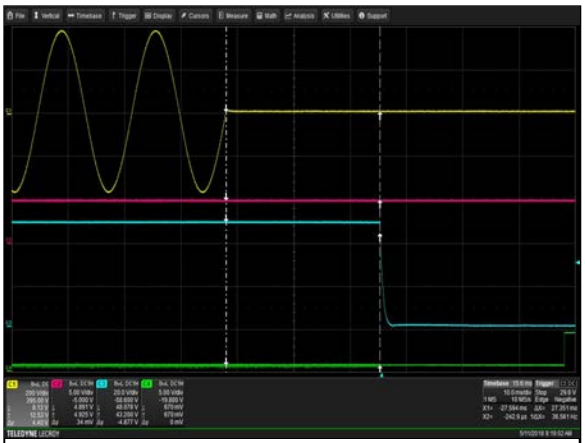


Figure 27: iMP1-5W0-00-A Hold Up Time
V_{IN} = 264 Vac, I_O = 31.25 A, I_{SB} = 1 A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

iMP1 Case Performance Curves

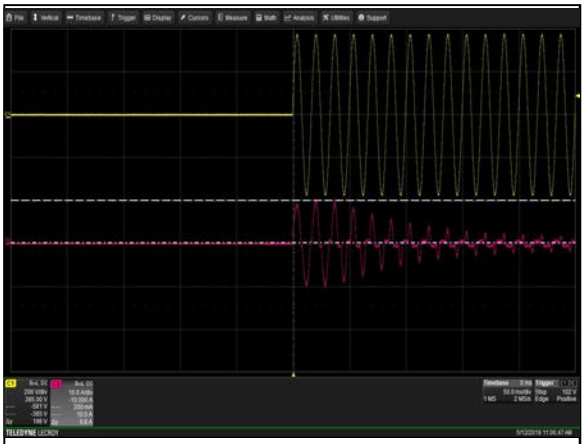


Figure 28: iMP1-5W0-00-A Inrush Current
V_{IN} = 264 Vac, No load
Ch 1: AC Mains Ch2: I_{IN}

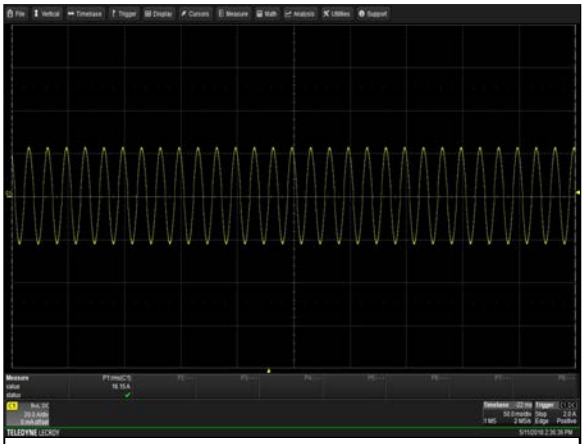


Figure 29: iMP1-5W0-00-A Input Current
V_{IN} = 90 Vac, I_O = 25 A, I_{SB} = 1 A
Ch 1: I_{IN}

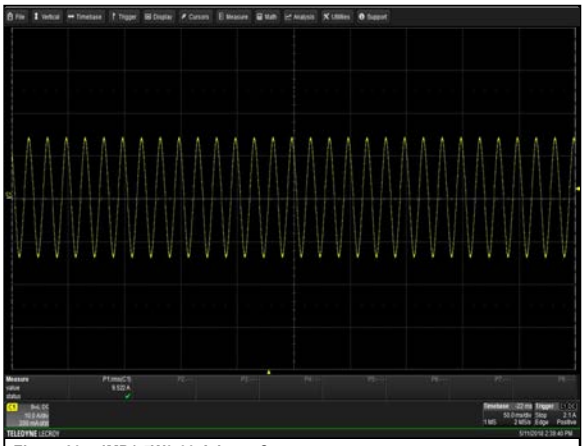


Figure 30: iMP1-5W0-00-A Input Current
V_{IN} = 180 Vac, I_O = 31.25 A, I_{SB} = 1 A
Ch 1: I_{IN}

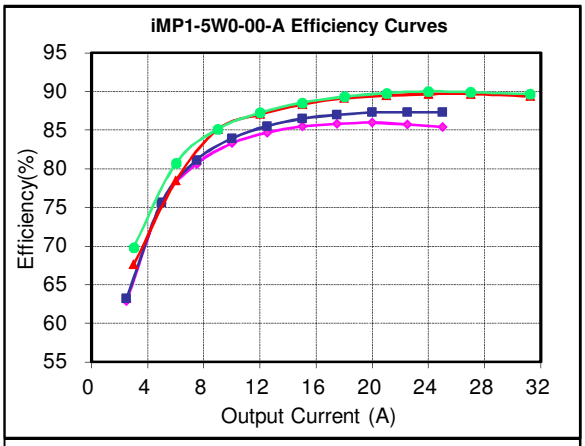


Figure 31: iMP1-5W0-00-A Efficiency Curves @ 25 degC
----- 90 Vac ----- 115 Vac ----- 230 Vac ----- 264 Vac
Loading: I_O = 10% increment to 31.25 A, I_{SB} = 0 A

210W 48V Module Performance Curves

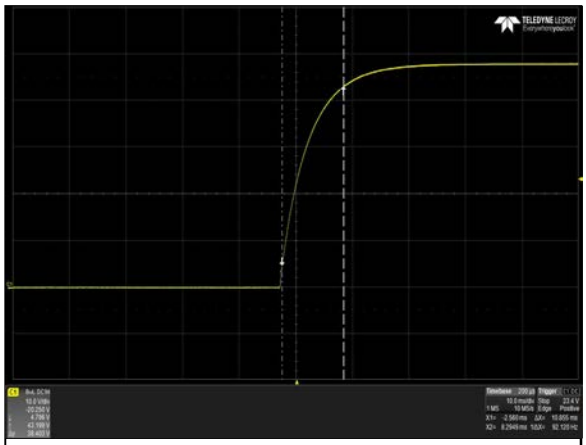


Figure 32: iMP4-1W0-00-A Output Voltage Startup Characteristic
Load: I_O = 4 A, V_{IN} = 230 Vac
Ch 1: V_O

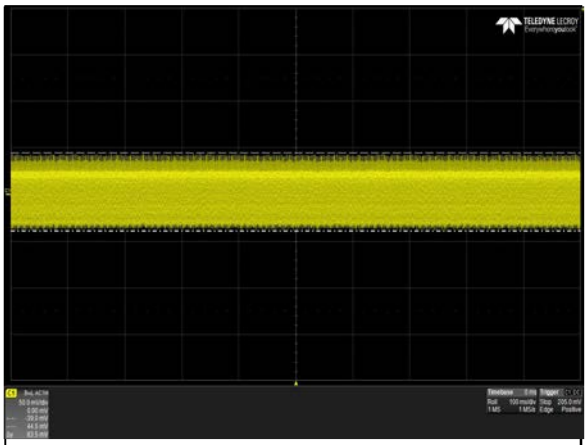


Figure 33: iMP4-1W0-00-A Ripple and Noise Measurement
Load: I_O = 4 A, V_{IN} = 230 Vac
Ch 1: V_O

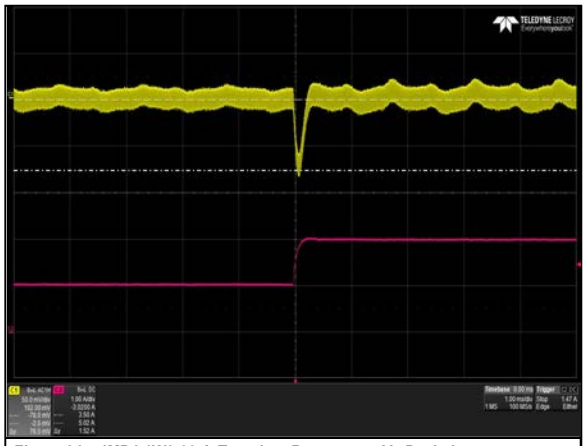


Figure 34: iMP4-1W0-00-A Transient Response – V_O Deviation
25% to 50% load change, 1 A/µS slew rate, V_{IN} = 230 Vac
Ch 1: V_O Ch 2: I_O

Figure 35: iMP4-1W0-00-A Transient Response – V_O Deviation
25% to 50% load change, 1 A/µS slew rate, V_{IN} = 230 Vac
Ch 1: V_O Ch 2: I_O

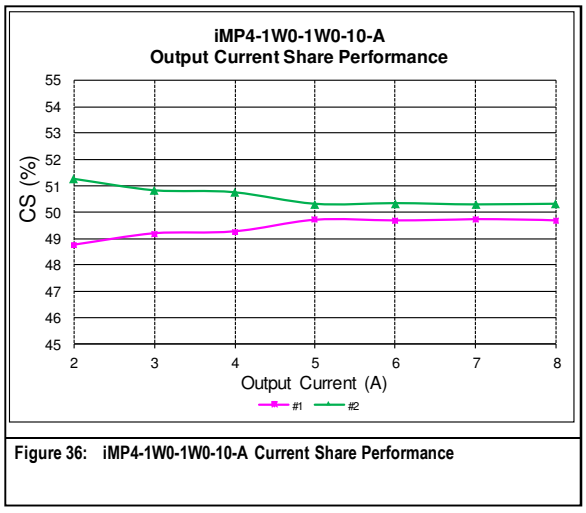


Figure 36: iMP4-1W0-1W0-10-A Current Share Performance

360W 48V Module Performance Curves

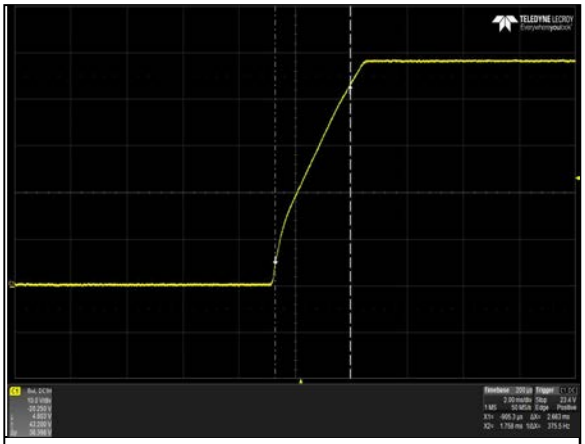


Figure 37: iMP4-2W0-00-A Output Voltage Startup Characteristic
Load: I_O = 7.5 A, V_{IN} = 230 Vac
Ch 1: V_O

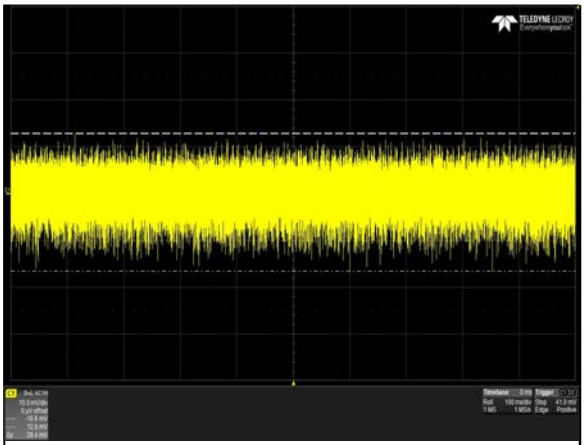


Figure 38: iMP4-2W0-00-A Ripple and Noise Measurement
Load: I_O = 7.5 A, Vin = 230 Vac
Ch 1: V_O

Figure 39: iMP4-2W0-00-A Transient Response – V_O Deviation
25% to 50% load change, 1 A/µS slew rate, V_{IN} = 230 Vac
Ch 1: V_O Ch 2: I_O

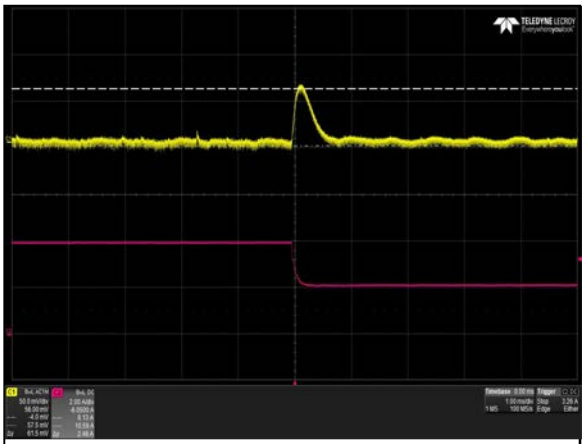


Figure 40: iMP4-2W0-00-A Transient Response – V_O Deviation
25% to 50% load change, 1 A/µS slew rate, V_{IN} = 230 Vac
Ch 1: V_O Ch 2: I_O

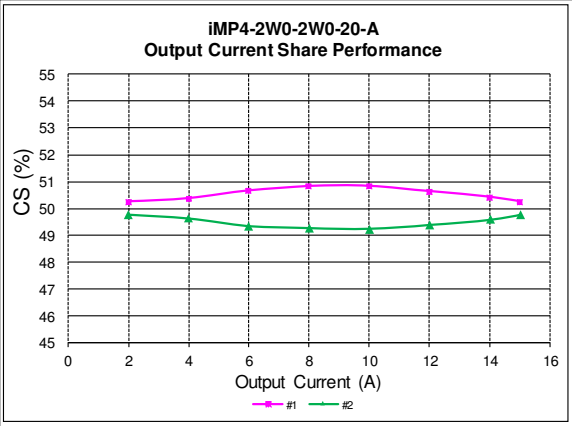


Figure 41: iMP4-2W0-2W0-20-A Current Share Performance

750W 48V Module Performance Curves

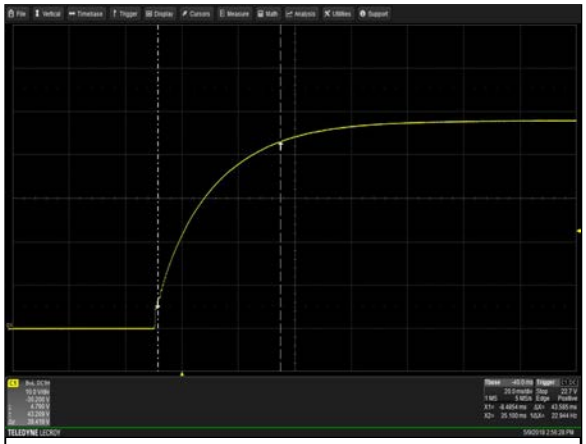


Figure 42: iMP8-3W0-00-A Output Voltage Startup Characteristic
Load: I_O = 15.625A, V_{IN} = 230 Vac
Ch 1: V_O

Figure 43: iMP8-3W0-00-A Ripple and Noise Measurement
Load: I_O = 15.625 A, Vin = 230 Vac
Ch 1: V_O

Figure 44: iMP8-3W0-00-A Transient Response – V_O Deviation
25% to 50% load change, 1 A/µS slew rate, V_{IN} = 230 Vac
Ch 1: V_O Ch 2: I_O

Figure 45: iMP8-3W0-00-A Transient Response – V_O Deviation
25% to 50% load change, 1 A/µS slew rate, V_{IN} = 230 Vac
Ch 1: V_O Ch 2: I_O

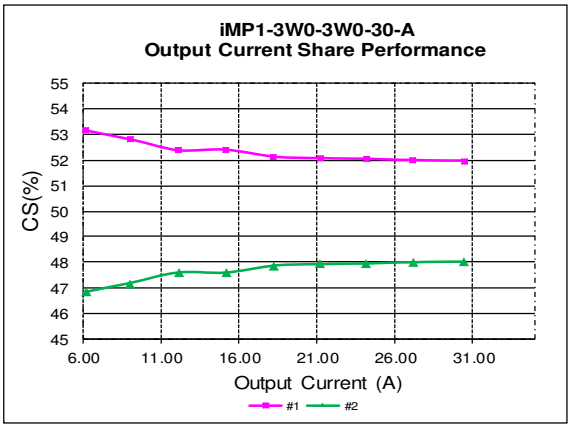


Figure 46: iMP1-3W0-3W0-30-A Current Share Performance

1500W 48V Module Performance Curves

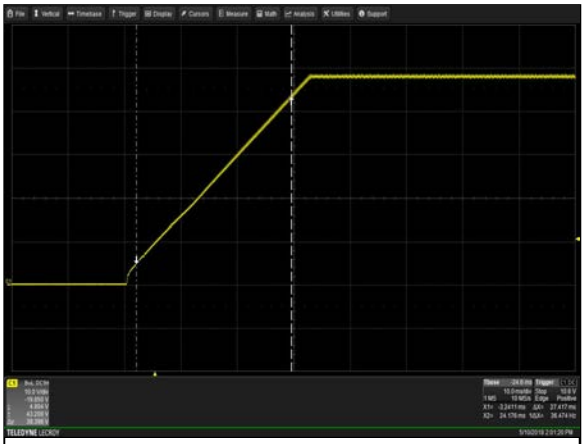


Figure 47: iMP1-5W0-00-A Output Voltage Startup Characteristic
Load: I_O = 31.25 A, V_{IN} = 230 Vac
Ch 1: V_O

Figure 48: iMP1-5W0-00-A Ripple and Noise Measurement
Load: I_O = 31.25 A, Vin = 230 Vac
Ch 1: V_O

Figure 49: iMP1-5W0-00-A Transient Response – V_O Deviation
70% to 100% load change, 1 A/µS slew rate, V_{IN} = 230 Vac
Ch 1: V_O Ch 2: I_O

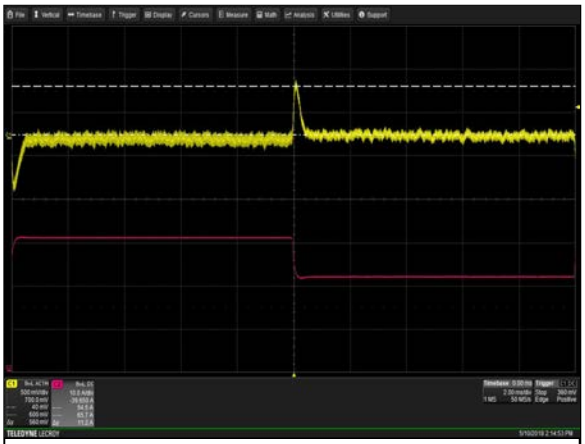


Figure 50: iMP1-5W0-00-A Transient Response – V_O Deviation
100% to 70% load change, 1 A/µS slew rate, V_{IN} = 230 Vac
Ch 1: V_O Ch 2: I_O

Protection Function Specification

Input Fusing

The iMP series power supply is equipped with an internal non user serviceable fast acting fuses for fault protection in both the L1 and L2 lines input. Please refer to the page 7 table 2 for the details.

Over Voltage Protection (OVP)

The iMP series power supply latches off during output overvoltage with the AC line recycled to reset the latch.

Parameter	Output Voltage	Min	Nom	Max	Unit
Single Output Module OVP	2 - 5.5 V 6 - 60 V	122 110	- -	134 120	$\%V_O$
Dual Output Module OVP	2 - 6 V 8 - 28 V	122 110	- -	134 120	$\%V_O$
Triple Output Module OVP	All	110	-	120	$\%V_{O,max}$

Over Current Protection (OCP)

The iMP series power supply includes internal current limit circuitry to prevent damage in the event of overload or short circuit. Recovery is automatic when the overload is removed. The customer could set the OCP mode to foldback (default setting) or constant current or shut down(1500 W module only).

Parameter	Min	Nom	Max	Unit
Single Output Module OCP	105	-	120	$\%I_O$
Dual Output Module OCP Main output of dual output module Aux output of dual output module	 105 105	 - -	 120 140	 $\%I_O$ $\%I_O$
Triple Output Module OCP	105	-	130	$\%I_O$

Short Circuit Protection (SCP)

The iMP series 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 is defined as impedance less than 0.1 ohm. Recovery is automatic upon removal of short.

Over Temperature Protection (OTP)

All outputs disabled when internal temp exceeds safe operating range. OTP trigger could be configured through iMP Gui and the OTP range could be set from 20 ^{O}C to 125 ^{O}C. An ACOK 5ms early warning signal is provided before the sync pulses go off. Recovery will be automatic

Mechanical Specifications

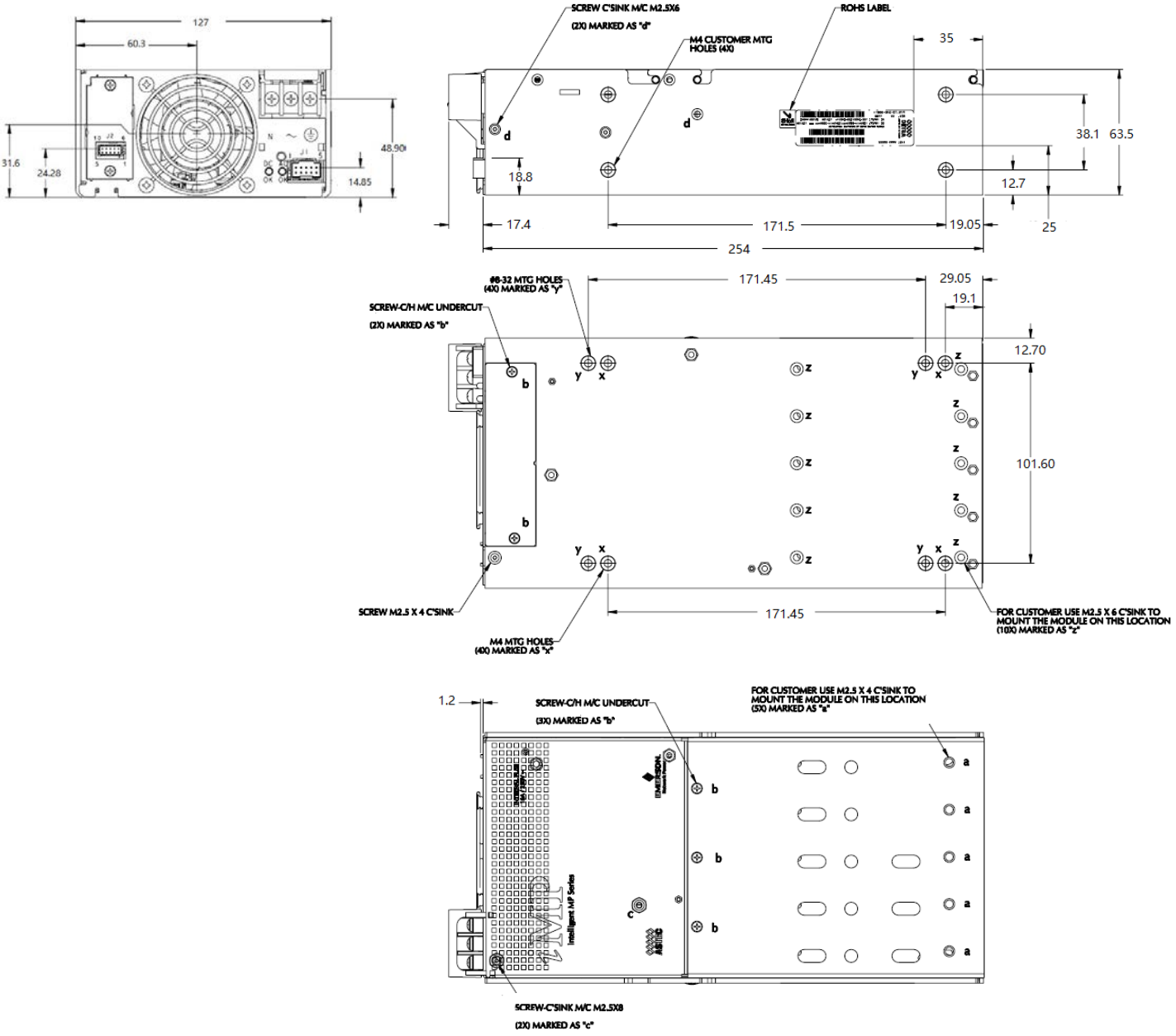
iMP Case Mechanical Outlines

iMP4 (750/1158 Watts Max)

Case Size: iMP4: 2.5” x 5.0” x 10.0” (63.5 mm x 127 mm x 254 mm)

Weight: 3 lbs (1.36 Kg)

Unit: mm



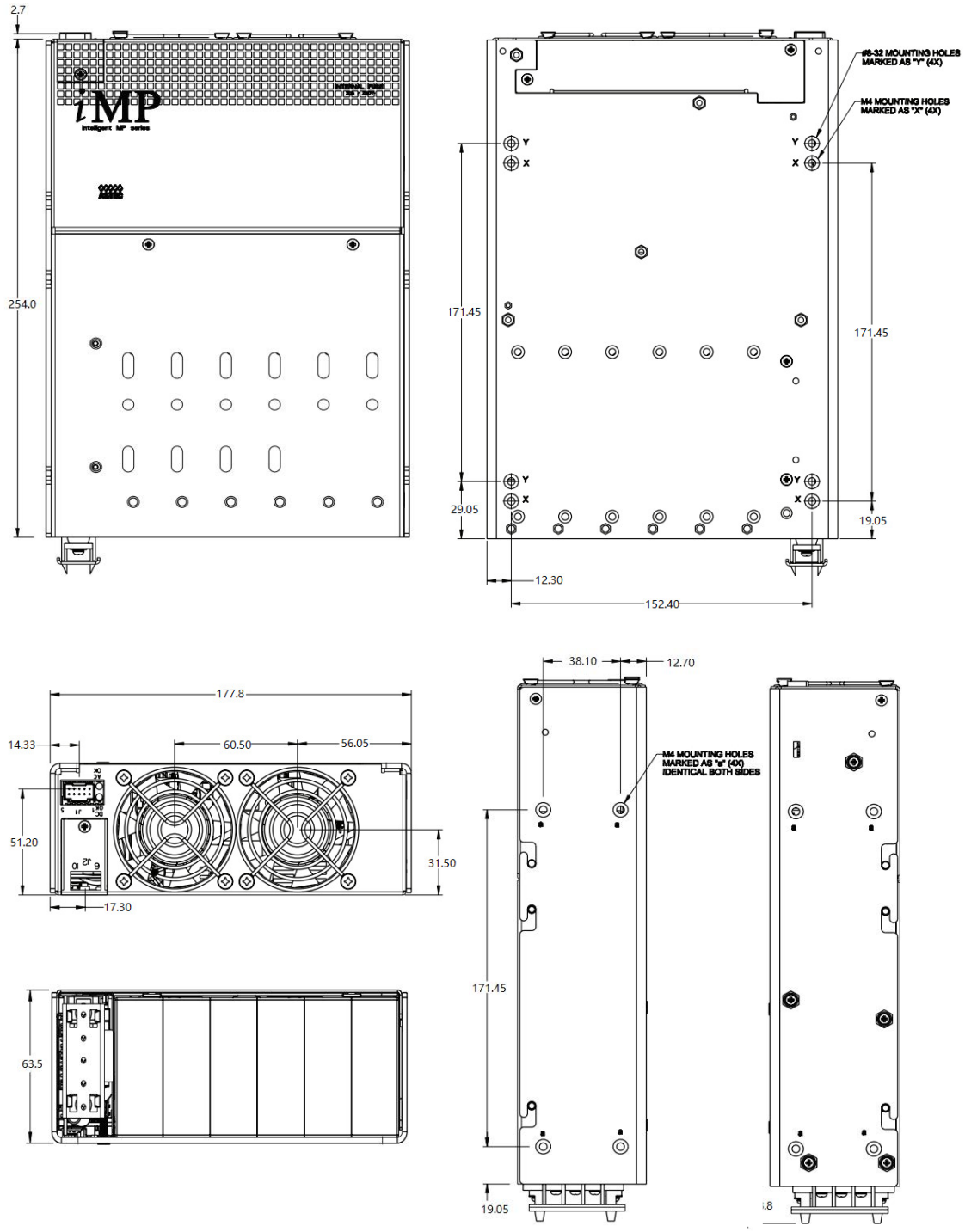
iMP Case Mechanical Outlines

iMP8 (1000/1200 Watts Max)

Case Size: iMP8: 2.5” x 7.0” x 10.0” (63.5 mm x 177.8 mm x 254 mm)

Weight: 4.1 lbs (1.86 Kg)

Unit: mm



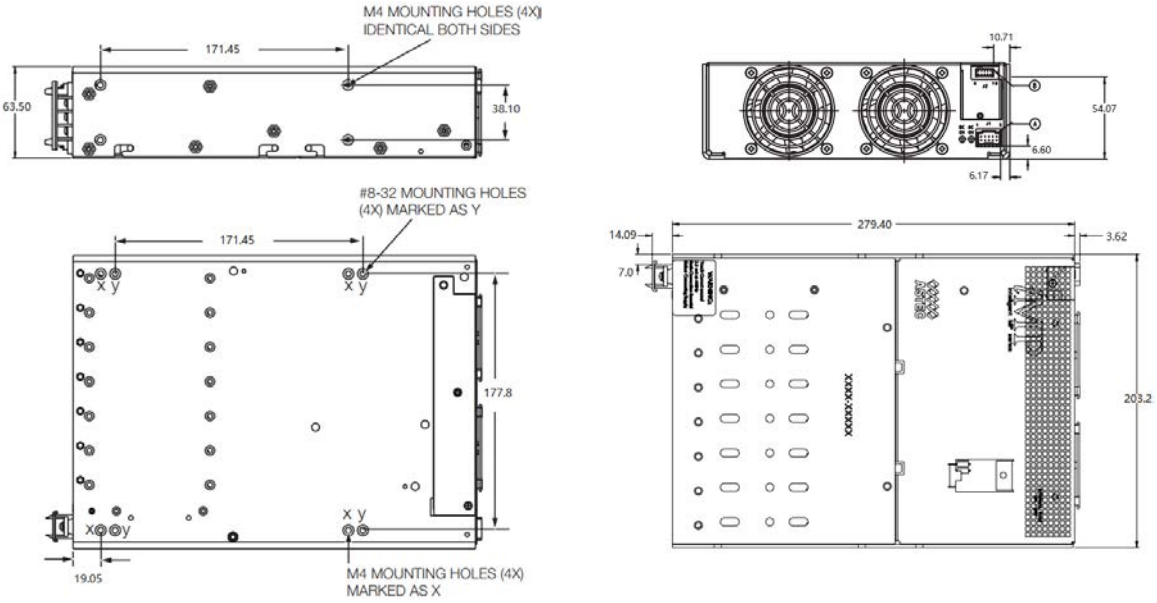
iMP Case Mechanical Outlines

iMP1 (1200/1500 Watts Max)

Case Size: iMP1: 2.5” x 8.0” x 11.0” (63.5 mm x 203.2 mm x 279.4 mm)

Weight: 5 lbs (2.27 Kg)

Unit: mm

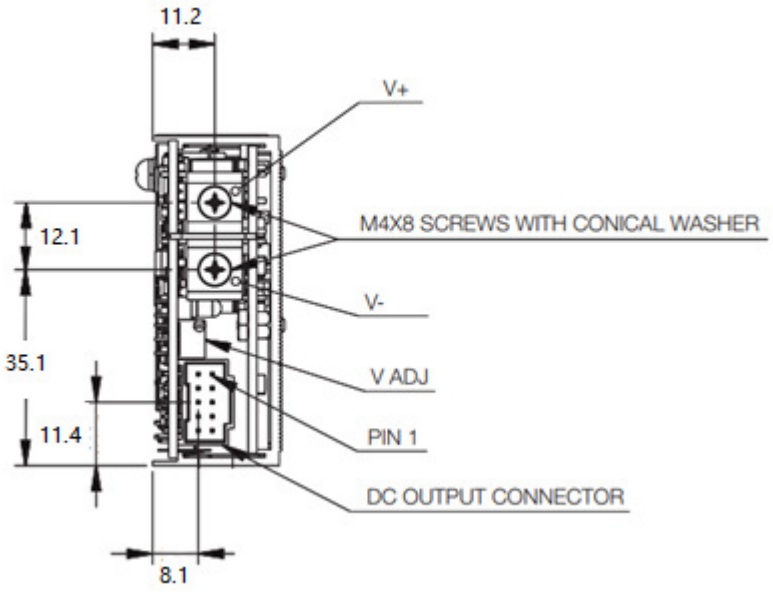


Single Output Module Mechanical Outlines

210 Watts

Weight: 0.6 lb (0.27 Kg)

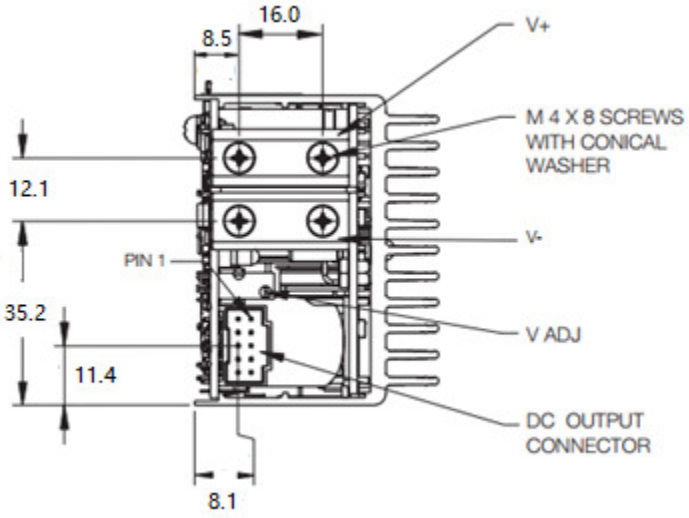
Unit: mm



360 Watts

Weight: 1 lb (0.45 Kg)

Unit: mm

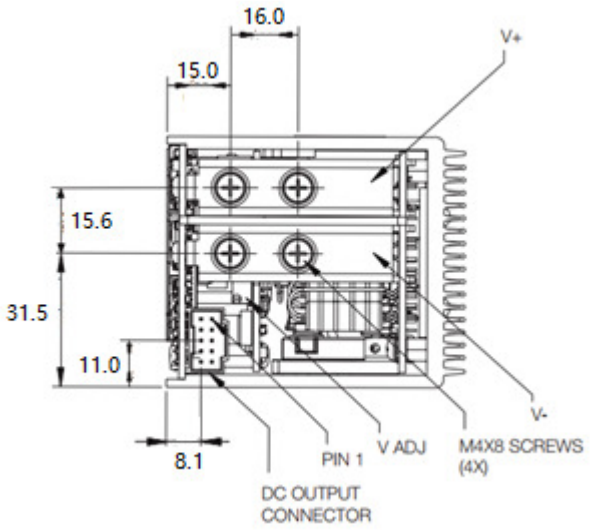


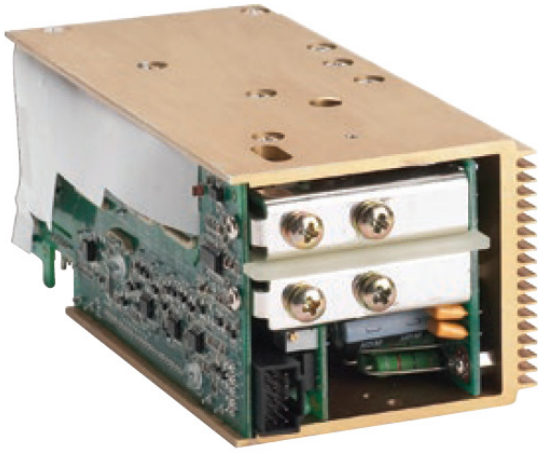
Single Output Module Mechanical Outlines

750 Watts

Weight: 1.6 lbs (0.73 Kg)

Unit: mm

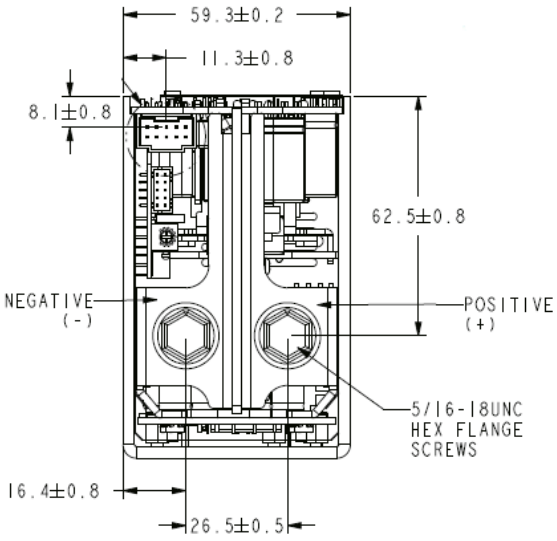


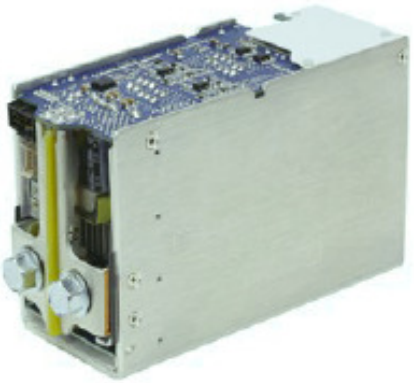


1500 Watts (2~5 V, 6~8 V)

Weight: 2 lbs (0.91 Kg)

Unit: mm



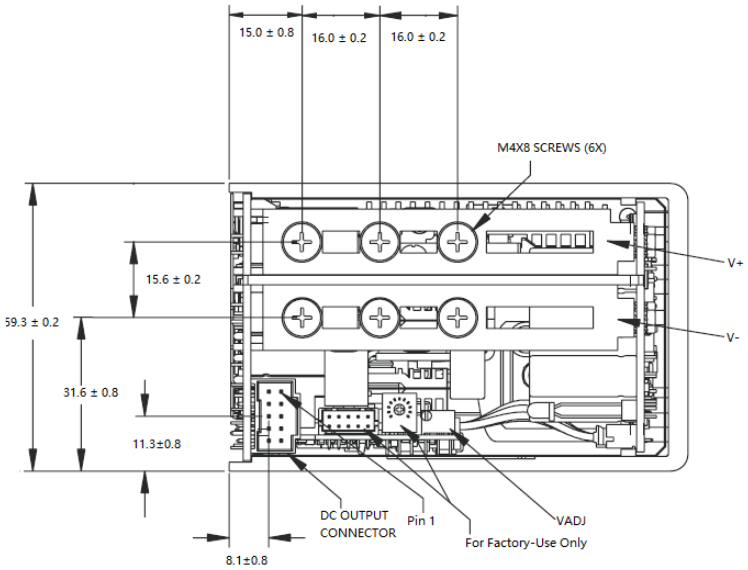


Single Output Module Mechanical Outlines

1500 Watts (10~60 V)

Weight: 2 lbs (0.91 Kg)

Unit: mm

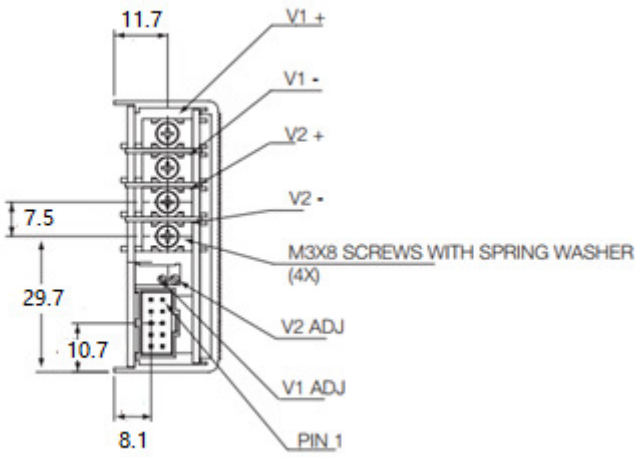


Dual Output Module Mechanical Outlines

144 Watts

Weight: 0.6 lb (0.27 Kg)

Unit: mm

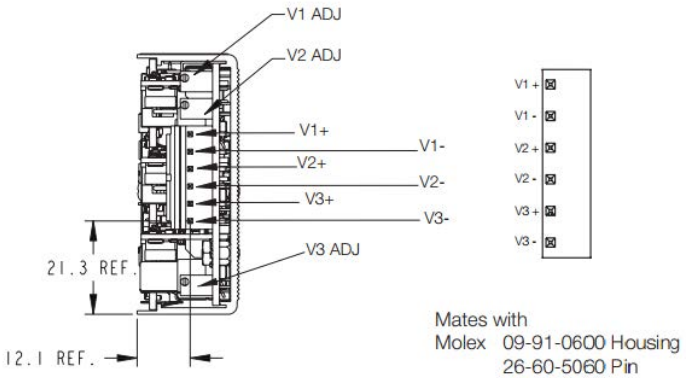


Triple Output Module Mechanical Outlines

36 Watts

Weight: 0.42 lb (0.19 Kg)

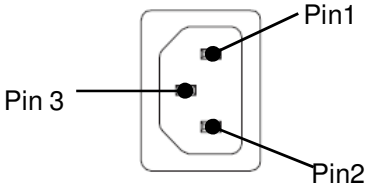
Unit: mm



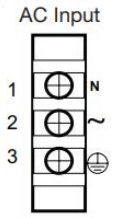
Connector Definitions - Case

AC Input Connector

Pin 1 – AC Neutral
Pin 2 – AC Line (hot)
Pin 3 – Chassis (earth) ground



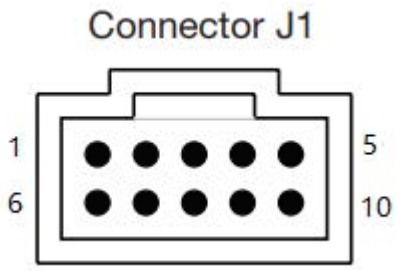
IEC Connector



Terminal Block

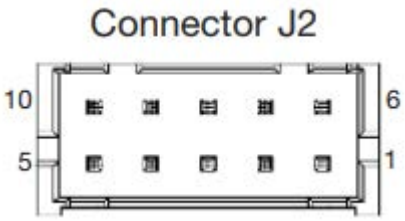
PFC Input Connector - J1

Pin 1 – Input AC OK - “emitter”
Pin 2 – Input AC OK - “collector”
Pin 3 – Global DC OK - “emitter”
Pin 4 – Global DC OK - “collector”
Pin 5 – External Sync
Pin 6 – Global inhibit/ optional enable logic “0”
Pin 7 – Global inhibit/ optional enable logic “1”
Pin 8 – Global inhibit/ optional enable return
Pin 9 – +5VSB housekeeping
Pin 10 – +5VSB housekeeping return



I²C Bus Output Connector - J2

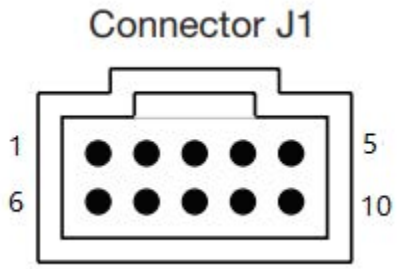
Pin 1 – No connection
Pin 2 – No connection
Pin 3 – No connection
Pin 4 – Serial clock signal (SCL)
Pin 5 – Serial data signal (SDA)
Pin 6 – Address bit 0 (A0)
Pin 7 – Address bit 1 (A1)
Pin 8 – Address bit 2 (A2)
Pin 9 – Secondary return (GND)
Pin 10 – 5 Vcc external bus (5 Vcc. Bus)



Connector Definitions - Single Output Module

J1 Control Connector

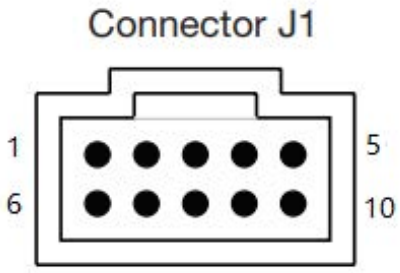
Pin 1 – + Remote Sense
Pin 2 – Remote Margin / V.Program
Pin 3 – Margin High
Pin 4 – - Remote Sense / Margin Low
Pin 5 – Spare
Pin 6 – Module, Isolated Inhibit
Pin 7 – Module Inhibit Return
Pin 8 – Current Share (SWP)
Pin 9 – Spare
Pin 10 – Spare



Connector Definitions - Dual Output Module

J1 Control Connector

Pin 1 – + Remote Sense
Pin 2 – Spare
Pin 3 – Spare
Pin 4 – - Remote Sense
Pin 5 – Spare
Pin 6 – Module, Isolated Inhibit
Pin 7 – Module Inhibit Return
Pin 8 – Current Share (Main output of Dual output)
Pin 9 – + Remote Sense V2
Pin 10 – - Remote Sense V2



Power / Signal Mating Connectors and Pin Types

Table 7. Mating Connectors for iMP (or equivalent):

Reference		Mating Connector or Equivalent
AC Input Connector	Terminal Block	Molex 19324-0003 Ring lug
	IEC Connector C14	IEC Connector C13
DC Output Connector	Single Output Module (210 W/360 W/750 W and 10.0 V~60.0 V/1500 W modules)	Molex 19141-0058 Spade lug
	Single Output Module (2.0 V~8.0 V /1500 W module)	Molex 19044-0168 Ring lug
	Dual Output Module	Molex 19324-0002 Ring lug
	Triple Output Module	Molex 09-91-0600 Housing Molex 26-60-5060 Pin
Case PFC Input Connector - J1		Molex 90142-0010 Housing Molex 90119-2110 Pin Artesyn Connector Kit Part No: 70-841-004
Case I^2C Bus Output Connector- J2		Landwin 2050S1000 Housing Landwin 2053T011V Pin or JST PHDR-10VS Housing JST SPHD-002T-P0.5 (28-24) JST SPHD-001T-P0.5 (26-22) Artesyn Connector Kit Part No: 70-841-023
Module Control Connector - J1		Molex 90142-0010 Housing Molex 90119-2110 Pin Artesyn Connector Kit Part No: 70-841-004

LED indicator definition

Two green LED's are placed on the case fan panel with status conditions are shown on the table below.

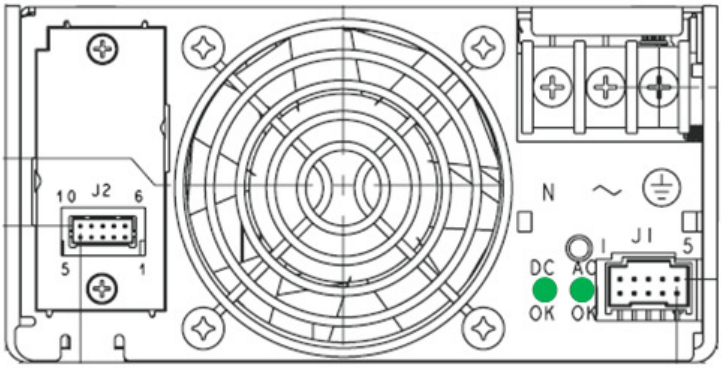


Table 8. LED indicator definition:

Condition	Case AC OK LED Status	Case DC OK LED Status
AC Present, Outputs Inhibits (Case Global Inhibit)	ON	Blinking
AC Present, Outputs Inhibited (Module Isolated Inhibit)	ON	OFF
AC Present, Outputs Enabled	ON	ON
Output OCP/OVP/Fan Fault	ON	OFF
AC Not Present	OFF	OFF

Environmental Specifications

EMC Immunity

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

Table 9. Environmental Specifications:

Document	Description
FCC Part 15 Subpart J Class B/ EN55022, Level B	Conducted and Radiated EMI Limits
EN61000-3-2	Harmonics
EN61000-3-3	Voltage Fluctuations
EN 61000-4-2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – Electrostatic discharge immunity test. +/-15 KV air, +/-8 KV contact discharge, performance Criteria B
EN 61000-4-4	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient/Burst Immunity Test. 2 KV for AC power port, 1.0 KV for DC ports, I/O and signal ports performance Criteria B
EN 61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – 2 KV common mode and 1KV differential mode for AC ports and 0.5kV differential mode for DC power, I/O and signal ports, performance criteria B.
EN 61000-4-11	Electromagnetic Compatibility (EMC) - Testing and measurement techniques : Voltage Dips and Interruptions: 30% reduction for 500 mS- Criteria B>95% reduction for 10mS, Criteria A, >95% reduction for 5000 mS, Criteria C
EN55024	Information Technology Equipment-Immunity Characteristics, Limits and Method of Measurements

Safety Certifications

The iMP 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 10. Safety Certifications for iMP series power supply system:

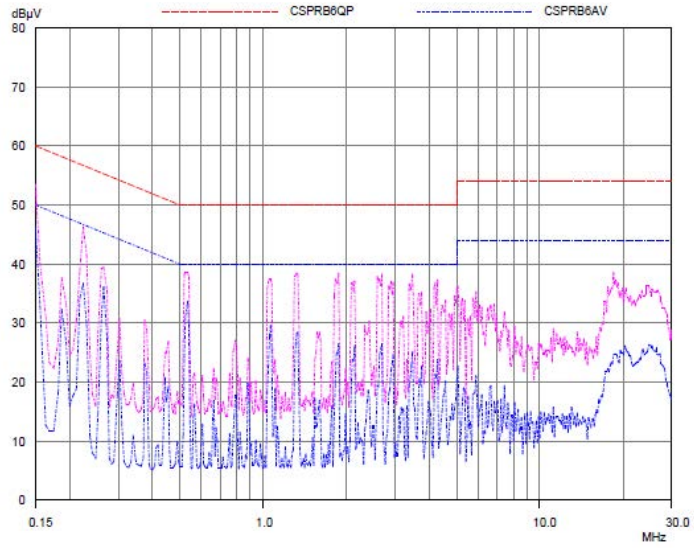
Document	File #	Description
UL 60950 2nd Edition	E186249-A155-UL-X3	US ITE Requirements
CSA 22.2 No. 60950-1-07 2nd Edition	2400643	Canadian ITE Requirements
IEC60950-1 2nd Edition CB Certificate	DK-44012-UL	International ITE Requirements
EN60950 2nd Edition	Z2 15 03 13890 02209	International ITE Requirements
EN60601-1	211-400876-000	European Medical Requirements
IEC60601-1	SG-MD-00499	International Medical Requirements
ANSI/AAMI ES60601-1 (2005 + C1:09 + A2:10 + A1:12), CAN/CSA-C22.2 No. 60601-1 (2014)	E182560-V4-S6	US Medical Requirement
CE (LVD+RoHS), EN60950-1	16336	European Requirements

EMI Emissions

The iMP series power supply 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 for immunity.

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 iMP series power supply has internal EMI filters ensure the convertors' conducted EMI levels comply with EN55022 (FCC Part 15) Class B and EN55022 (CISPR 22) Class B limits. The EMI measurements are performed with resistive loads at maximum rated loading.

Sample of EN55022 Conducted EMI Measurement at 120 Vac input and 1100 W R-load

Note: Blue Line refers to Artesyn Quasi Peak margin, which is 3 dB below the CISPR international limit. Red Line refers to the Artesyn Average margin, which is 3 dB below the CISPR international limit.

Conducted Emissions

Table 11. Conducted EMI emission specifications of the iMP series power supply:

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC Part 15, class B	All	Margin	3	-	-	dB
CISPR 22 (EN55022) class B	All	Margin	3	-	-	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 B (FCC Part 15). Testing ac-dc convertors as a stand-alone component to the exact requirements of EN55022 can be difficult, because the standard calls for 1m leads to be attached to the input and outputs and aligned such as to maximize the disturbance. In such a set-up, it is possible to form a perfect dipole antenna that very few ac-dc convertors could pass. However, the standard also states that 'an attempt should be made to maximize the disturbance consistent with the typical application by varying the configuration of the test sample.

Operating Temperature

The iMP series power supply will start-up at -20 ^{O}C and could operate from -40 ^{O}C to 50 ^{O}C with full load after 30 min warm up period. It could provide derated output power from 50 ^{O}C up to 70 ^{O}C ambient temperature derate each output 2.5% per degree from 50 ^{O}C to 70 ^{O}C.

Forced Air Cooling

The iMP series power supply includes 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. There are 1 fan in iMP04 case and 2 fans in iMP8 and iMP1 case. The standard direction of airflow is from the fan side through the power supply with exhaust on the output side of the power supply. Reverse airflow option is required with 600 W derated total output power.

Fan speed is controlled by thermal sensors in case and modules. In the event of a fan fault condition, the unit will protect by latching off. AC input or Global Inhibit must be recycled to turn the unit back on after a fan fault condition.

Storage and Shipping Temperature / Humidity

The iMP series power supply can be stored or shipped at temperatures between -40 ^{O}C to +85 ^{O}C and relative humidity from 5% to 95% non-condensing.

Altitude

The iMP series power supply will operate within specifications at altitudes up to 10,000 feet above sea level. Linear to 50% output from 10,000 feet to 30,000 feet. The power supply will not be damaged when stored at altitudes of up to 30,000 feet above sea level.

Humidity

The iMP series power supply will operate within specifications when subjected to a relative humidity from 10% to 95% non-condensing. The iMP series power supply can be stored in a relative humidity from 10% to 95% non-condensing.

Vibration

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

Non-Operating Random Vibration

Acceleration	6.07		gRMS
Frequency Range	10-2000		Hz
Duration	30		mins
Direction	3 mutually perpendicular axis		
PSD Profile	**FREQ**	**SLOPE dB/oct**	**PSD g^2/Hz**
	10 Hz	---	0.005 g^2/Hz
	20 Hz	---	0.01 g^2/Hz
	80 Hz	---	0.04 g^2/Hz
	350 Hz	---	0.04 g^2/Hz
	2000 Hz	---	0.007 g^2/Hz

Operating Random Vibration

Acceleration	4.22		gRMS
Frequency Range	10-500		Hz
Duration	30		mins
Direction	3 mutually perpendicular axis		
PSD Profile	**FREQ**	**SLOPE dB/oct**	**PSD g^2/Hz**
	10 Hz	---	0.002 g^2/Hz
	350 Hz	---	0.04 g^2/Hz
	500 Hz	---	0.0198 g^2/Hz

Shock

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

Non-Operating Half-Sine Shock

Acceleration	30	G
Duration	26	msec
Pulse	Half-Sine	
No. of Shock	1 shock on each of 6 faces	

Operating Half-Sine Shock

Acceleration	40	G
Duration	6	msec
Pulse	Half-Sine	
No. of Shock	1 shock on each of 6 faces	

Power and Control Signal Descriptions

AC Input Connector

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

Pin 1 - AC neutral
Pin 2 - AC line (hot)
Pin 3 - Chassis (earth) ground

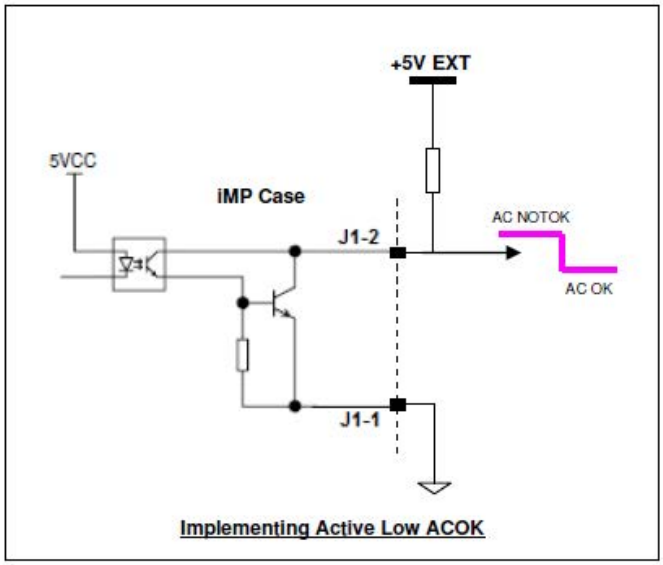
iMP Case - PFC Input Connector (J1)

Input AC OK - "collector" / Input AC OK - "emitter"- (pins 1,2)

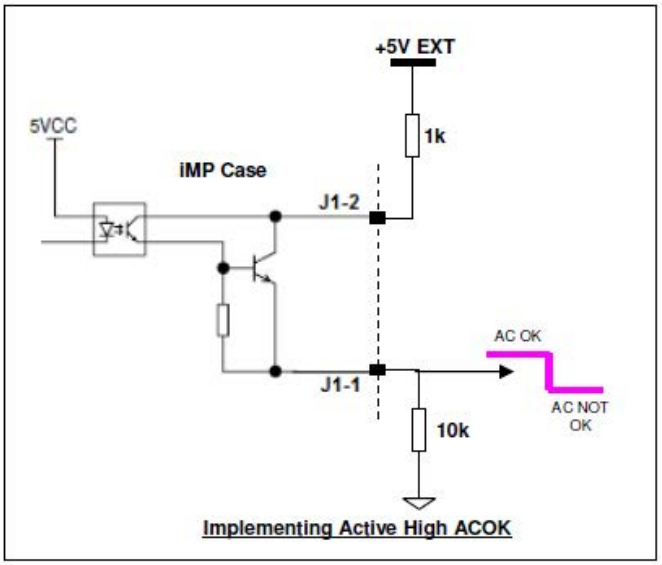
Input ACOK - "Collector" and Input ACOK - "Emitter" are output of an uncommitted bipolar junction transistor, there is an internal 470 ohm resistor in series with the collector of the transistor for current limiting. AC is OK when the transistor is On. AC is not OK when the transistor is Off. A green LED is provided in the iMP Case as visual indicator of the status of ACOK signal.

Sink Current: 50 mA max, 5 ms minimum warning time.

Recommended circuit configuration for AC_OK Signal:



Implementing Active Low ACOK



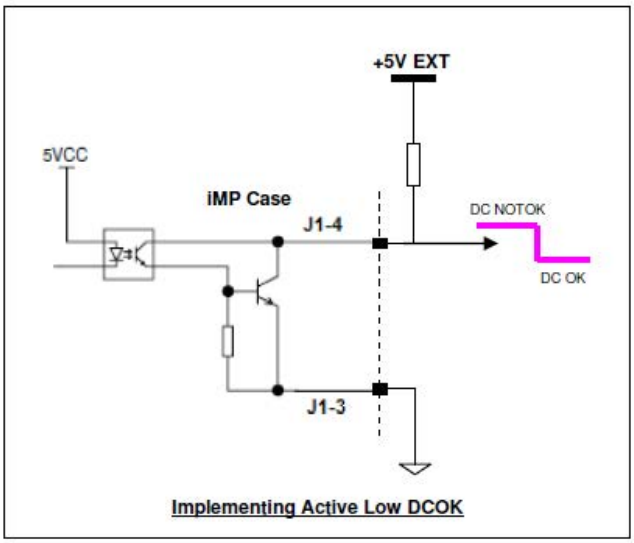
Implementing Active High ACOK

Global DC OK - "collector" /Global DC OK - "emitter" - (pins 3,4)

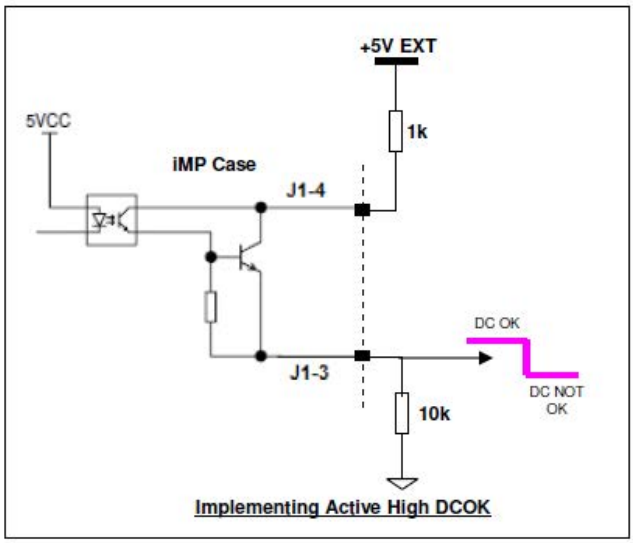
DCOK - "Emitter" (pin 8) and DCOK - "Collector" (pin9) signal functions as DC OK signal. These signals are connected to an uncommitted transistor. When all modules outputs are OK, the transistor is On. When any output of modules is not OK, the transistor is Off. This isolated DC OK signal logic low level is < 1.1 V and logic high level > 4.7 V.

Max Sink current is 50 mA. Recommended supply voltage is 5 V.

Recommended circuit configuration for DC_OK Signal:



Implementing Active Low DCOK



Implementing Active High DCOK

External Sync - (pin 5)

An input pin use used to synchronize connected DC-DC output modules for better EMI response, apply an external clock frequency of 500 kHz +/-20% (5 V amplitude) to synchronize connected DC-DC output modules. Since the switching frequency of the module will follow the sync signal frequency, this can be use to adjust the switching frequency of the modules within allowable range. Note the effective switching frequency in the module is half of the External Sync input frequency.

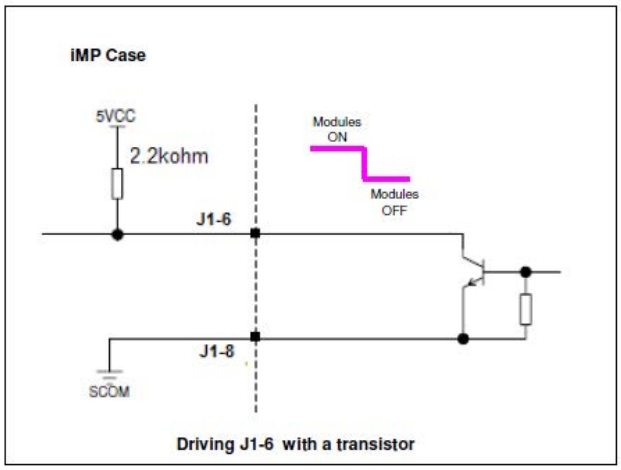
Global inhibit/optional enable logic "0" (DEFAULT) - (pin 6)

This signal is a TTL input to a microcontroller inside the iMP case, an internal 2.2 Kohm resistor is connected between this pin and internal 5 V supply to make the signal initially HIGH.

Enable Logic "0" (DEFAULT setting), active High is the default Logic when Global Enable Option is NOT selected.

When pin is left open or pull HIGH (2 V - 5 V), the modules are ON and can be disable/enable by PMBus operation command. The Modules set to Module Option Code 1 'Module Enable mode' will remain OFF until enable by its Module Inhibit Pin.

When the pin is pull LOW (< 0.8 V) the modules will turn OFF, the PMBus OPERATION COMMAND alone cannot enable the modules.

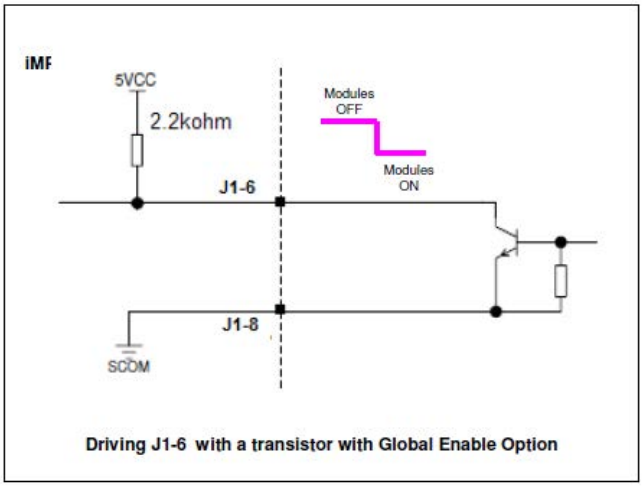


Driving J1-6 with a transistor

The logic of the signal is reverse when Case Option Code 3 - 'Global Enable option' is selected'.

When the pin is left open or pull HIGH (2 V - 5 V), all the Modules are OFF, the PMBus OPERATION COMMAND alone cannot enable the modules.

When pin is pull LOW (< 0.8 V), the Modules are ON and can be disable/enable by PMBus OPERATION COMMAND. The Modules set to Module Option Code 1 'Module Enable mode' will remain OFF enable by its Module Inhibit pin.



Driving J1-6 with a transistor with Global Enable Option

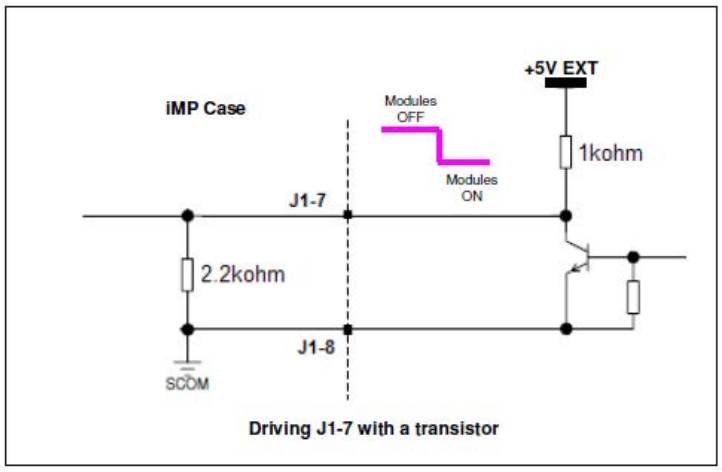
Global inhibit/optional enable logic "1" (DEFAULT) - (pin 7)

This pin is a TTL input to a microcontroller inside the iMP case, an internal 2.2 Kohm resistor is connected between this pin and ground to make the signal initially LOW.

Logic "1" (Default), active LOW is the default Logic when 'Global Enable Option' is NOT selected. Upon application of correct AC input all the modules are ON except the modules set to Module Option code 1 'Module Enable mode'.

When pin is left open or pull LOW (< 0.8 V), the modules are ON and can be disable/enable by PMBus operation command. The Modules set to Module Option Code 1 'Module Enable mode' will remain OFF until enable by its Module Inhibit pin.

When pin is pull HIGH (> 2 V- 5 V), the installed modules will turn OFF, the PMBus OPERATION Command alone cannot enable the modules. The 5V standby output can be used as external supply to drive pin 7.



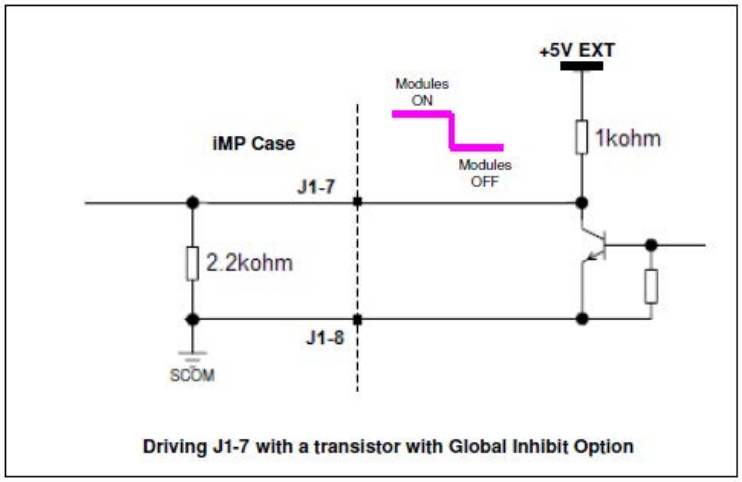
Driving J1-7 with a transistor

The logic of the signal is reverse when Case Option Code3 - 'Global Enable option' is selected.

When pin is left open or pull LOW (< 0.8 V) all the Modules are OFF, the PMBus OPERATION Command alone cannot enable the modules.

When pin is pull HIGH (> 2 V - 5 V), the Modules will turn ON and can be disable/enable by PMBus OPERATION COMMAND. The modules set to Module Option Code 1 'Module Enable mode' will remain OFF until enable by its Module Inhibit pin. The 5 V standby output can be used to drive this pin.

Note: pin 6 and pin 7 are independent signals, both signals must assume the correct logic levels to turn ON the modules.



Driving J1-7 with a transistor with Global Inhibit Option

Global inhibit/optional enable return - (pin 8)

Ground reference for Global Enable/Optional Enable. This pin is electrically connected to pin 10 - +5 VSB housekeeping return.

+5VSB housekeeping - (pin 9)

+5VSB housekeeping is the standby output of the power supply rated 5 V / 1 A. This output is available every time the input AC voltage to the power supply is within 85Vac - 264Vac. This output is not affected by Global Inhibit function.

+5VSB housekeeping return - (pin 10)

The ground reference of +5VSB housekeeping, this ground is not connected to the chassis of the power supply.

iMP Case - I²C Bus Signal Connector (J2)

No Connection - (pins 1, 2, 3)

Serial clock signal(SCL) and Serial data signal(SDA) - (pins 4,5)

Please refer to “Communication Bus Descriptions” section.

Address bit 0 (A0) , Address bit 1 (A1), Address bit 2 (A2) - (pins 6,7,8)

Please refer to “Communication Bus Descriptions” section.

Secondary return (GND) - (pin 9)

Ground Reference for the signals of J2 connector. This pin is electrical connected to +5VSB housekeeping return of J1 connector.

5 Vcc external bus (5 VCC. BUS) - (pin 10)

This pin is an input to the iMP Case, applying 5V to this signal will provide external power to the I2C devices - EEPROM and Microcontroller. The pin can be used to enable the I2C communication using external power supply and allow reading of manufacturing from a non-working PSU without powering the supply. Do not supply voltage > 5.5 V to prevent damaging the I2C devices.

iMP Single Output Module - Control Connector (J1)

+ Remote Sense , - Remote Sense - (pin 1, 4)

Remote sense of the output modules use to compensate up to 500 mV of cable drop.

Connect the - Remote Sense and + Remote Sense to output 'V-' and 'V+' respectively at the point of load to compensate up to 500 mV of voltage drop along the power cables, note that compensating too much voltage drop can cause overvoltage and latch the output. Leaving the remote sense floating will not cause the module to malfunction.

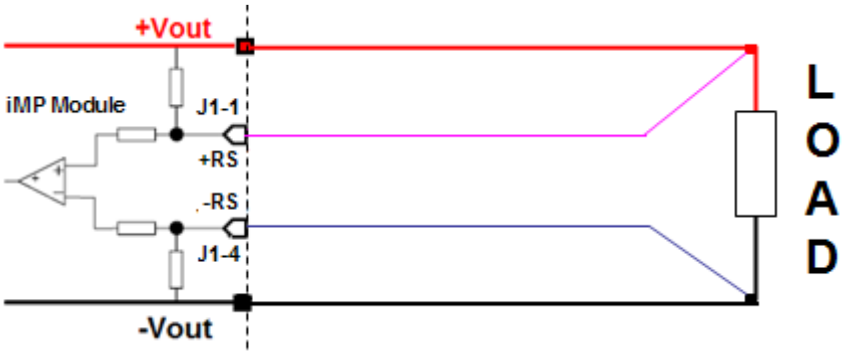


Figure 51. Typical Implementation of remote sensing

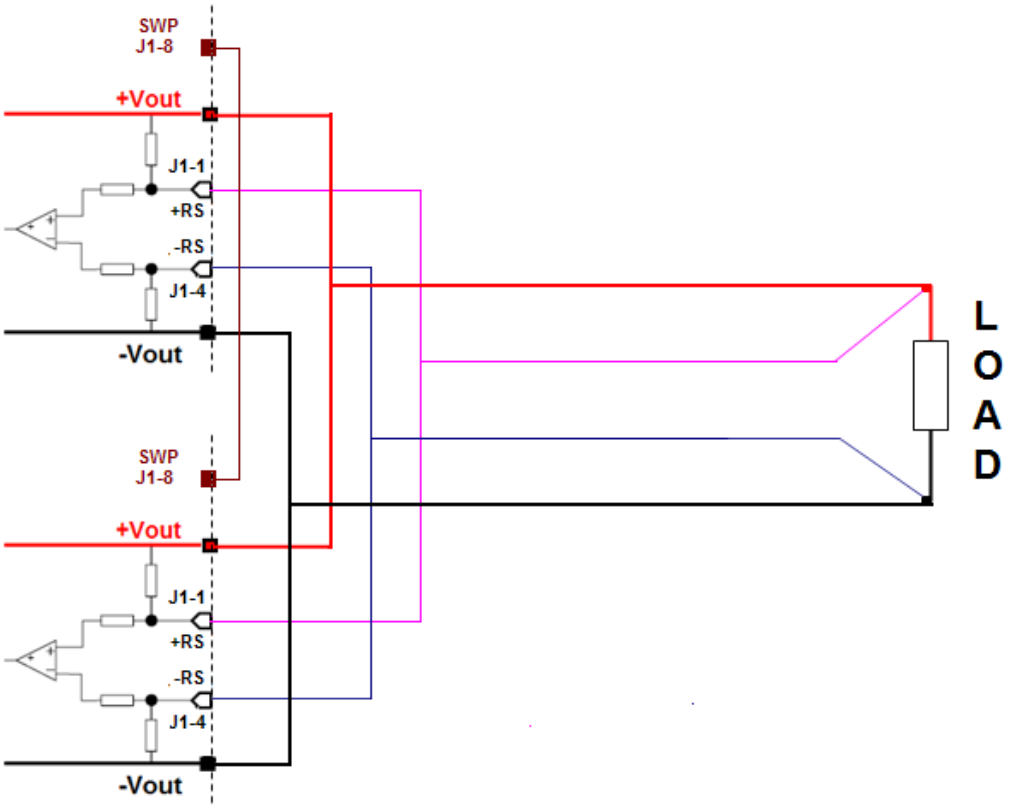


Figure 52. Remote sensing with modules in parallel

Remote Margin / V. Program, Margin High, Margin Low - (pin 2, 3, 4)

Used to remotely adjust the output voltage regulation by +/- 4% - 6%.

Connect Remote Margin (pin 2) to Margin High (pin 3) to increase output voltage by 4% - 6% of the rated output.

Connect Remote Margin (pin 2) to Margin Low (pin 4) to reduce the output voltage by 4% - 6%.

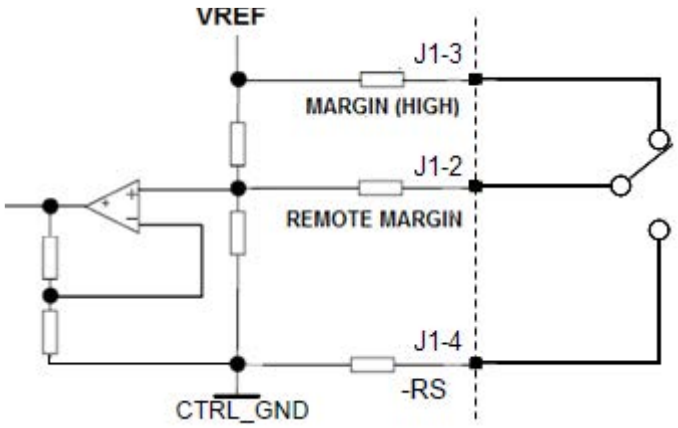


Figure 53. Remote margining using Single Pole

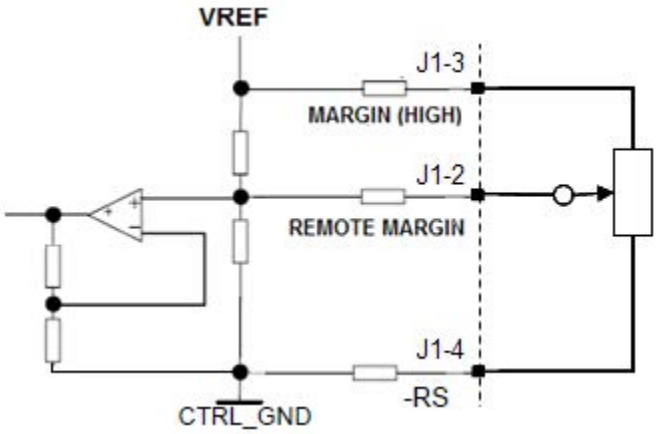


Figure 54. Remote margining using a potentiometer

Module, Isolated Inhibit , Module Inhibit Return - (pin 6, 7)

Module, Isolated Inhibit (pin 6) and Module Inhibit Return (pin 7) use to remotely enable/disable the module, apply 5 V across the Module ISO Inhibit and Module Inhibit Return to disable the module.

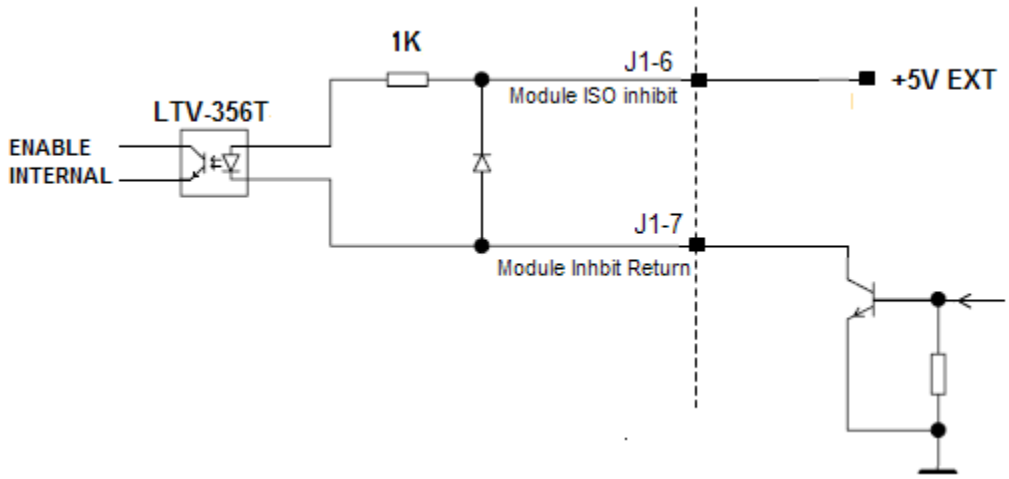


Figure 55. Driving with 5V external supply and bipolar transistor

Current Share (SWP) - (pin 8)

Current Share (pin 8) is an input/output signal of the module, when multiple modules are connected in parallel the Current Share Pins of each of the parallel modules must be connected together to achieve low error current sharing. Since, the output voltage of Current Share signal is proportional to the actual output current the pin can be used as output current monitor, the pin will have 6 V nominal output at full rated load. For illustration, refer to figure in “Remote Sensing with module in parallel”.

iMP Dual Output Module - Control Connector (J1)

+ Remote Sense , -Remote Sense - (pin 1, 4)

Remote Sense of the output modules use to compensate up to 500 mV of cable drop.

Pin 1 (+ Remote Sense) and Pin 4 (- Remote Sense) are the pair of main output V1 for the dual output module.

Pin 9 (+ Remote Sense V2) and Pin 10 (- Remote Sense V2) is the pair of remote sense for slave output V2 of the dual output module.

Module, Isolated Inhibit , Module Inhibit Return - (pin 6, 7)

Refer to page 49. The Module Inhibit enable/disable both outputs.

Current Share (SWP) - (pin 8)

Refer to page 49. The current share could work on main output of dual output module.

Communication Bus Descriptions

I²C Bus Signals Connector - J2

The iMP series power supply contains enhanced monitor and control functions implemented via the I²C bus. The µMP 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 5V supply or from an external power source connected to the StandBy Output (ie: accessing an unpowered power supply as long as the StandBy Output of another power supply connected in parallel is on).

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

Note: PMBus™ functionality can be accessed only when the PSU is powered-up.

Guaranteed communication I²C speed is 100KHz.

Serial clock signal(SCL) and Serial data signal(SDA) - (pins 4,5)

These are pins for I2C communication are internally pulled up to internal 5 V supply with a 2 Kohm resistor; a current source pull-up can also be used. If multiple units are used inside a system, the 5 V housekeeping supply of each unit must be connected in parallel in the system, otherwise, the SCL and SDA bus will be pulled low by the unit without AC power.

Address bit 0 (A0) , Address bit 1 (A1), Address bit 2 (A2) - (pins 6,7,8)

Multiple configured iMP power supplies can be used in a single system, the power supplies can have parallel outputs or providing multiple outputs. The iMP case has three address pins allowing the system to assign different addresses to multiple PSUs used within the system. The I2C devices inside the iMP case are EEPROM to store FRU data and microcontroller for PMBus. The table on page 54 listed all the possible addresses of the two I2C devices inside the PSU. Pull the address pin to secondary return (COM) to set the address to “0” or High (or open) to set it the address to “1”.

I²C Bus Communication Interval

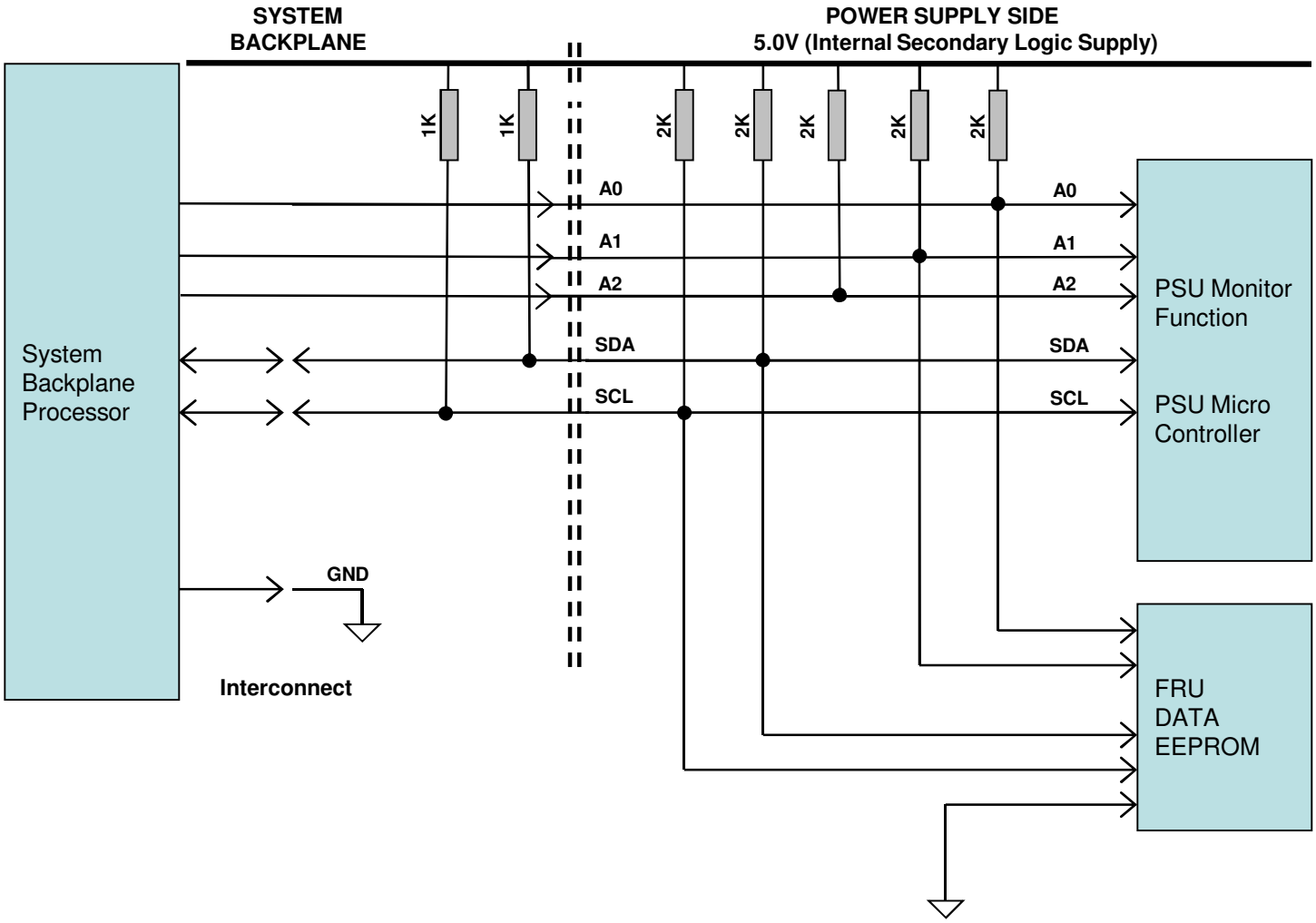
The interval between two consecutive I²C communications to the power supply should be at least 50ms to ensure proper monitoring functionality.

I²C Bus Signal Integrity

The noise on the I²C bus (SDA, SCL lines) due to the power supply will be less than 400 mV peak-to-peak. This noise measurement should be made with an oscilloscope bandwidth limited to 100 MHz. Measurements should be make at the power supply output connector with 1 Kohm resistors pulled up to StandBy Output and 20 pf ceramic capacitors to StandBy Output return.

The noise on the address lines A0 and A1 will be less than 100 mV peak-to-peak. This noise measurement should be made at the power supply output connector.

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):

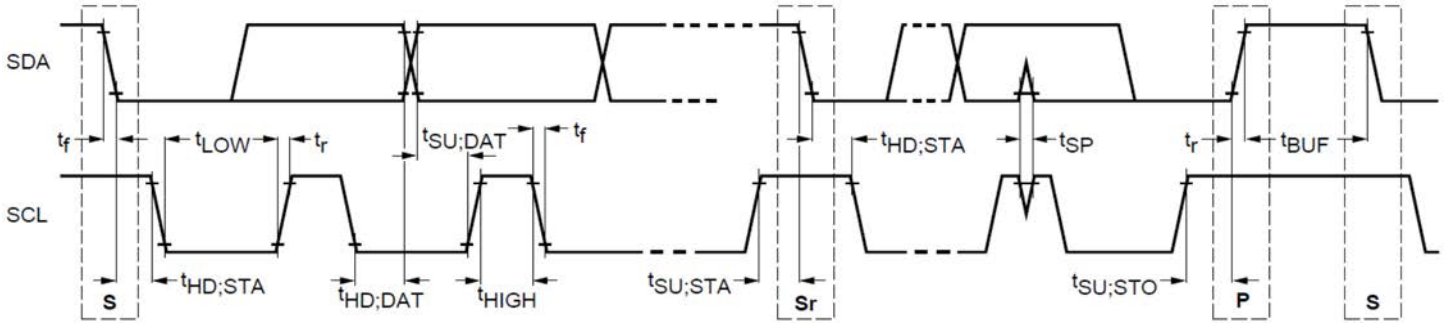
Parameter	Condition	Symbol	Min	Typ	Max	Unit
SDA, SCL internal pull-up resistor		R_{int}	-	2	-	Kohm
SDA, SCL internal bus capacitance		C_{int}	-	0	-	pF
Recommended external pull-up resistor		R_{ext}	-	1	-	Kohm

Logic Levels

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

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

Timings



Parameter	Symbol	Standard-Mode Specs		Actual Measured		Unit
		Min	Max			
SCL Clock Frequency	f_{SCL}	0	100	98.9		KHz
Hold time (repeated) START condition	$t_{HD;STA}$	4.0	-	4.88		µS
LOW period of SCL clock	t_{LOW}	4.7	-	15.03		µS
HIGH period of SCL clock	t_{HIGH}	4.0	-	4.42		µS
Setup time for repeated START condition	$t_{SU;STA}$	4.7	-	4.87		µS
Data hold time	$t_{HD;DAT}$	0	3.45	0.41		µS
Data setup time	$t_{SU;DAT}$	250	-	4824		nS
Rise time	t_r	-	1000	SCL = 496	SDA = 696	nS
Fall time	t_f	-	300	SCL = 136	SDA = 272	nS
Setup time for STOP condition	$t_{SU;STO}$	4.0	-	5.88		µS
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	31.06*		µS

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

Device Addressing

Multiple configured iMP power supplies can be used in a single system, the power supplies can have parallel outputs or providing multiple outputs. The iMP CASE has three address pins allowing the system to assign different addresses to multiple PSUs used within the system. The I2C devices inside the iMP-CASE are EEPROM to store FRU data and microcontroller for PMBus. The table below listed all the possible addresses of the two I2C devices inside the PSU. Pull the address pin to Secondary return (COM) to set the address to “0” or High (or open) to set it the address to “1”.

PSU Slot	Slot ID Bits			PMBus™ Address	EEPROM (FRU) Read Address
	A0	A1	A2		
1	0	0	0	0x30	0xA0
2	0	0	1	0x32	0xA2
3	0	1	0	0x34	0xA4
4	0	1	1	0x36	0xA6
5	1	0	0	0x38	0xA8
6	1	0	1	0x3A	0xAA
7	1	1	0	0x3C	0xAC
8	1	1	1	0x3E*	0xAE

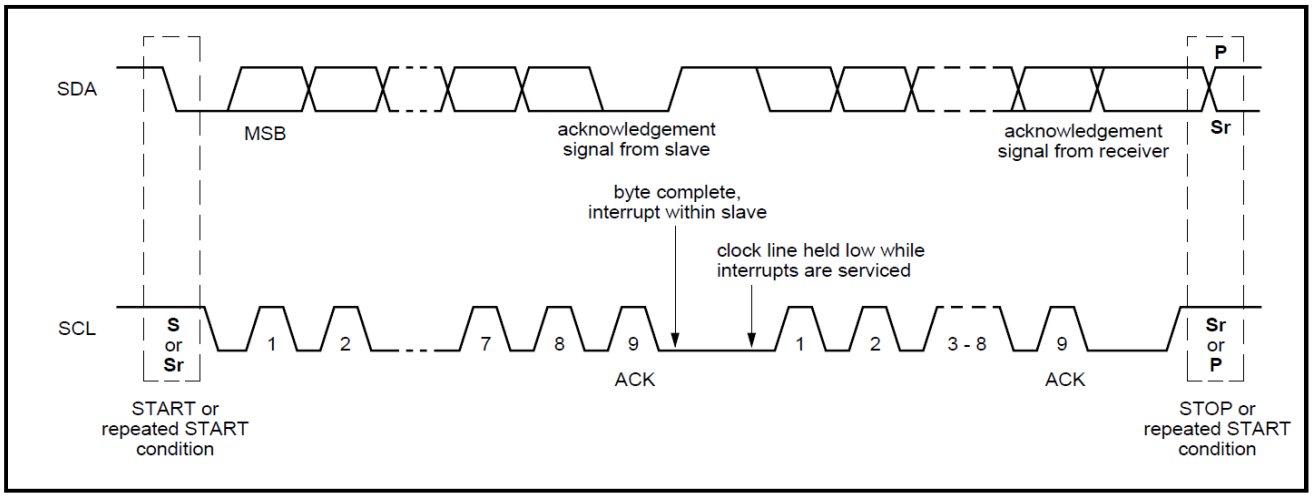
* Default PMBus™ address when A0, A1, A2 are left open.

I²C Clock Synchronization

The iMP series power supply might apply clock stretching. An addressed slave power supply may hold the clock line (SCL) low after receiving (or sending) a byte, indicating that it is not yet ready to process more data. The system master that is communicating with the power supply will attempt to raise the clock to transfer the next bit, but must verify that the clock line was actually raised. If the power supply is clock stretching, the clock line will still be low (because the connections are open-drain).

The maximum clock low timeout for iMP series power supply is 37 ms.

The maximum transaction timeout condition for clock stretching for iMP series power supply is 100 ms.



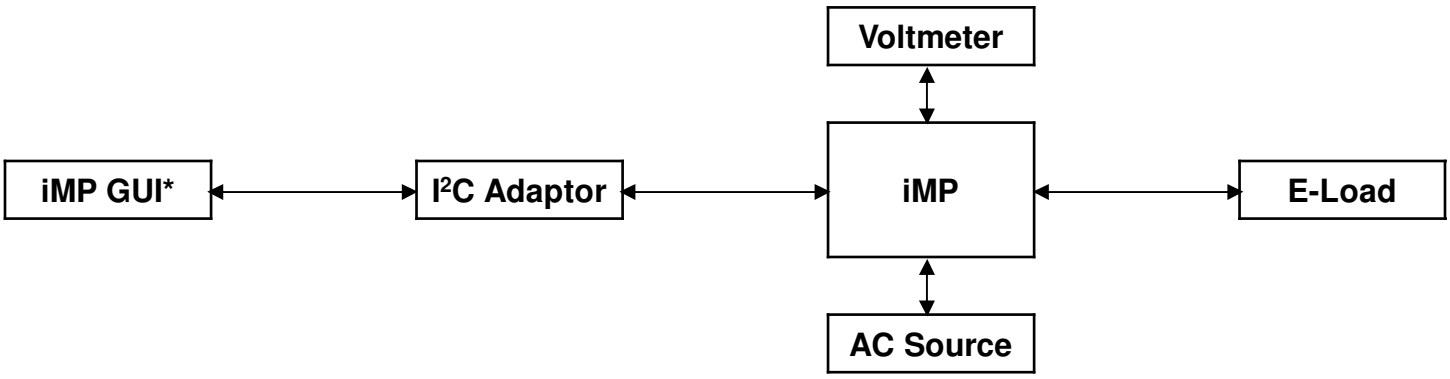
PMBus™ Interface Support

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

iMP Series PMBus™ General Instructions

Equipment Setup

The following is typical I²C communication setup:



PMBus™ Writing Instructions

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

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

Levels: 00h – Enable writing to all writeable commands

20h – Disables write except 10h, 01h, 00h, 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

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

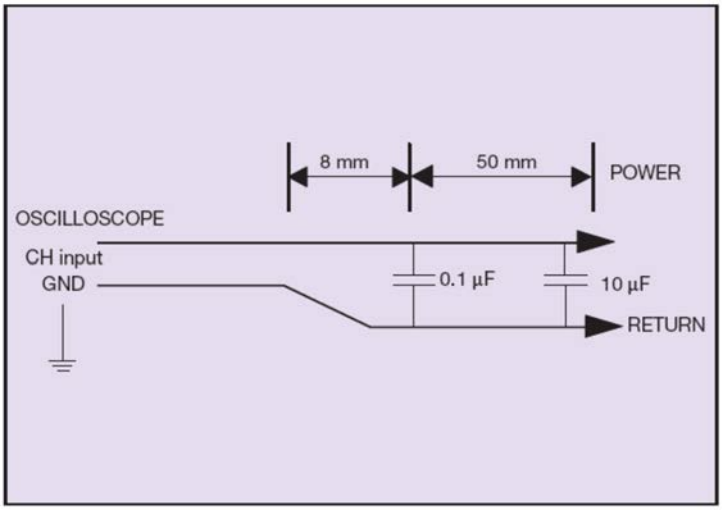
Note:

* Please refer to “iMP Software” for iMP Gui function.

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 iMP series. When measuring output ripple and noise, a scope jack in parallel with a 0.1 uF ceramic chip capacitor, and a 10 uF aluminum electrolytic capacitor should be used. Oscilloscope should be set to 20 MHz bandwidth for this measurement.



Record of Revision and Changes

Issue	Date	Description	Originators
1.0	02.06.2018	First Issue	L.Lee
1.1	06.12.2018	Update IMP1, IMP8, 750W and 1500W module performance curve	L.Lee
1.2	07.20.2020	Update input frequency for IMP1	L.Lee
1.3	09.21.2020	Update the SDA/SCL description	L.Lee

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