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µMP Series GEN II

Up to1800 Watts
Configurable

Total Power: Up to1800 Watts
Input Voltage: 85-264 Vac
120-300 Vdc
# of Outputs: Up to 12



Special Features

- Full Medical EN60601 approval
- PMBus monitor/control of input functions
- High efficiency
- Constant current limit protection
- High power density
  - µMP04:10.8 W / in^3
  - µMP10:15.1 W / in^3
  - µMP16:22.9 W / in^3
- Low Noise Intelligent fan (speed control/fault status),36% Reduction from GEN I
- Downloadable GUI from website
- Optional conformal coating
- Industrial temp range (-40 ^{O}C to 70 ^{O}C)
- No preload required
- Military STD Shock/Vibration (> 50G's)
- Low cost
- IEC, Terminal Block or Barrier Strip Input Connection Options
- Low profile 1U size
- Superior Aesthetics over GEN I

Safety

UL	UL60950-1/CSA22.2 No.60950-1/ ES60601-1/CSA22.2 No.60601-1
TUV	EN60950-1/EN60601-1
CB	Certificate and report
CE	LVD+RoHS
CQC	Approved
Medical	2*MOPP

Product Descriptions

The µMP series GEN II power supply is a configurable power supply with market-leading density and efficiency. It features a very wide 85 to 264Vac input voltage range and employs active power factor correction to minimize input harmonic current distortion and to ensure compliance with the international EN61000-3-2 standard – they have a power factor of 0.99 typical. The power supplies also feature active AC inrush control, to automatically limit inrush current at turn-on to 40A maximum.

The µMP series GEN II can deliver up to 1800 Watts maximum from the µMP16 case. The supply has a Low profile 1U size and has a power density of more than 22.9 watts per cubic inch. When fed with a 180 to 264 Vac input, the µMP Series GEN II can achieve a very high - 91% typical efficiency at full case load.

ARTESYN™
EMBEDDED TECHNOLOGIES

Ordering Information

µMPXY	-	SKW - S2E - S2Q - ILL - …	-	00	-	A	-	###
①		②		③		④		⑤

①	Case Type	Case Size where **X** = 04 = 1.57” x 3.5” x 10.0”, 400W - 600W, 4 Slots 10 = 1.57” x 5.0” x 10.0”, 1000W-1200W, 6 Slots 16 = 1.57” x 5.0” x 10.0”, 1200W-1800W**, 6 Slots ** See Input Derating table for µMP16 Input Type where **Y** = T = Terminal Block C = IEC Connector C14 S = Barrier Strip
②	Module / Voltage	Module Codes: S2 # = 200W Single O/P (1 slot) SK # = 1000W Single O/P (3 slot) I # # = 96W Dual O/P, Isolated GND (1 Slot) **# = Voltage Codes: See voltage code table**
③	Case Option Codes	**First digit** 0-9 = Parallel Code **Second Digit** 0 = Forward Air 1 = Reverse Air 2 = Not Used 3 = Global Enable 5 = Opt 1 + Opt 3
④	Software Code	Standard = A Modified Standards = factory assigned
⑤	Hardware Code	Standard = none Modified Standards = factory assigned

Case Size Line-Up

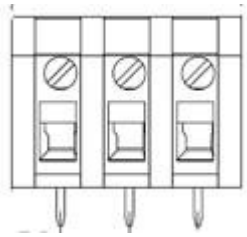
Case	Max Output Power		Dimensions mm (inch)	Connections	Max Continuous Current
	85-264Vac	180-264Vac			
µMP04 - 4 Slots	400W	600W	256.9 x 88.9 x 40.0 (10.11" x 3.5" x 1.57")	IEC Terminal-Block Barrier-Strip	9.91A
µMP10 - 6 Slots	1000W	1200W	256.9 x 127 x 40.0 (10.11" x 5.0" x 1.57")	IEC Terminal-Block Barrier-Strip	13.87A
µMP16 - 6 Slots	1000W	1800W	256.9 x 127 x 40.0 (10.11" x 5.0" x 1.57")	IEC Terminal-Block Barrier-Strip	13.87A

µMP16 Input Power Derating

Paramater	85-99Vac	100-140Vac	180-199Vac	200-264Vac
Designed For	1000W	1200W	1600W	1800W
Safety Label and Evaluation	1000W	1000W	1600W	1600W

Case Input Type

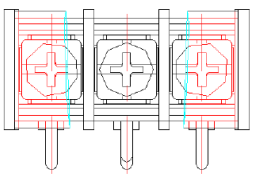
Terminal Block (T)



IEC Connector C14 (C)



Barrier Strip (S)



Voltage Codes

Standard Output Ratings									
Module Output Voltage Code		Signal Output				Dual Output			
		One Slot 240W Max	Three Slots 1000W Max	Module Group		One Slot 96W Max each output		Module Group	
Module Identification		S2 #	SK #	Output Range (V)		I # #		Output Range (V)	
Code (#)	Volts	Output Current				Output Current			
		V1 (A)	V1 (A)			V1 (A)	V2 (A)		
A	2.0	40.0	-	0.9 to 3.6	3V3 Module	NA		NA	
B	2.2	40.0	-			NA			
C	3.0	40.0	-			NA			
D	3.3	40.0	-			4.0	4.0	3.3 to 30.0	Dual ISO Module
E	5.0	36.0	-	3.2 to 6.0	5V Module	4.0	4.0		
F	5.2	34.0	-			4.0	4.0		
G	5.5	32.0	-			4.0	4.0		
H	6.0	30.0	84.0			4.0	4.0		
I	8.0	25.0	84.0	6.0 to 15.0	12V Module	4.0	4.0		
J	10.0	24.0	84.0			4.0	4.0		
K	11.0	22.0	84.0			4.0	4.0		
L	12.0	20.0	84.0			4.0	4.0		
M	14.0	17.0	71.4			4.0	4.0		
N	15.0	16.0	66.7			4.0	4.0		
O	18.0	13.0	42.0	12.0 to 30.0	24V Module	4.0	4.0		
P	20.0	12.0	42.0			4.0	4.0		
Q	24.0	10.0	42.0			4.0	4.0		
R	28.0	8.6	35.7			3.4	3.4		
S	30.0	8.0	33.3			3.2	3.2		
T	33.0	7	21.0	33.0 to 60.0	48V Module	NA		NA	
U	36.0	6.7	21.0			NA			
V	42.0	5.7	21.0			NA			
W	48.0	5.0	21.0			NA			
X	54.0	4.4	18.5			NA			
Y	60.0	4.0	16.7			NA			

* Note: For 1000W module, Output Voltages from 33.0-60.0V are available. Contact factory for availability of other output ranges

Parallel Codes (case option code - first digit)

Parallel Codes			
Code	Slots in Parallel	Code	Slots in Parallel
0	No module in parallel	9	1,2,3,4,5&6
1	1&2	A	1&2; 3&4
2	2&3	B	1,2&3; 4&5
3	3&4	C	1,2,3&4; 5&6
4	4&5	D	1&2; 3&4; 5&6
5	5&6	E	1,2&3; 4,5&6
6	1&2&3	H	3,4&5
7	1,2,3&4	J	3,4,5&6
8	1,2,3,4&5	K	4,5&6

Air Flow Direction (case option code - second digit)

0=Forward Air

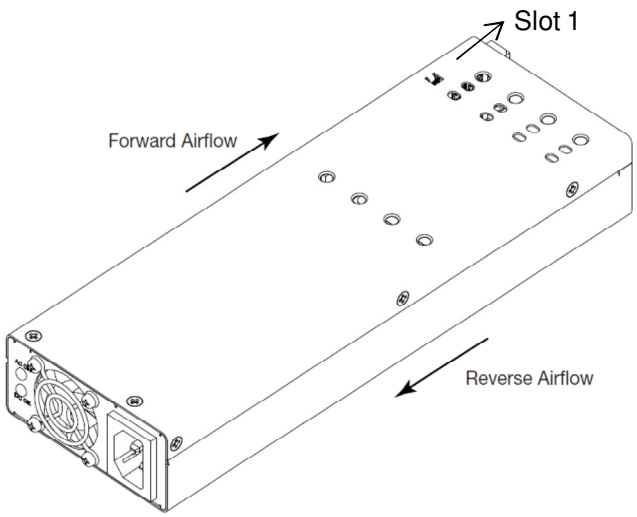
1=Reverse Air

2=Not Used

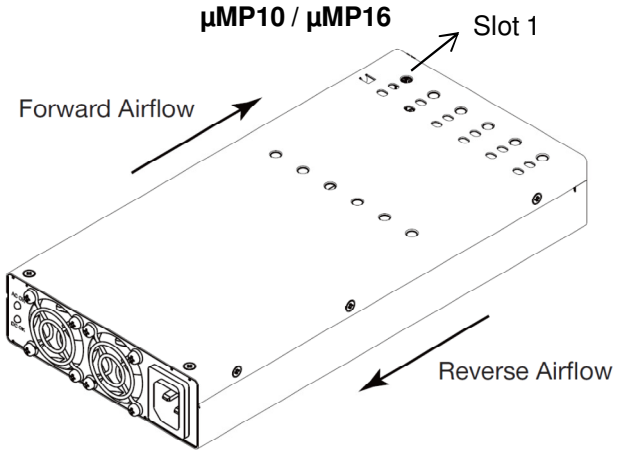
3= Global Enable

5=Opt 1+ Opt 3

µMP04



µMP10 / µMP16



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	$V_{IN,AC}$	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	µMP04	$P_{O,max}$	-	-	600	W
	µMP10	$P_{O,max}$	-	-	1200	W
	µMP16	$P_{O,max}$	-	-	1800	W
Isolation Voltage						
Input to outputs	All models	-	-	-	2550	Vdc
Input to safety ground	All models	-	-	-	2550	Vdc
Outputs to outputs	All models	-	-	-	500	Vdc
Outputs to safety ground	All models	-	-	-	500	Vdc
Ambient Operating Temperature						
Forward air	All models	T_A	-40[1]	-	70[1]	^{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	All models		-	-	30000[2]	feet
Non-operating	All models		-	-	30000	feet

Note 1 - Derate each output 2.5% per degree from 50^{O}C to 70^{O}C. Cold start soak -20^{O}C, allow 10 minutes warm-up before all outputs are with in specification. Reverse air to 40^{O}C Max due to fan derating.

Note 2 - 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	All	$V_{IN,DC}$	120	-	350/300	Vdc
Input AC Frequency	All	$f_{IN,AC}$	47	50/60	440	Hz
Maximum Input Current ($I_O = I_{O,max}$, $I_{SB} = I_{SB,max}$)	µMP04 µMP10 µMP16	$I_{IN,max}$	- - -	- - -	9.91 13.87 13.87	A_{RMS}
Standby Input Current (V_O=Off, I_{SB} = 0A)	µMP16	$I_{IN,standby}$	-	-	500	mA_{RMS}
Standby Input Power (V_O =Off, I_{SB} = 0A)	µMP10 µMP16	$P_{IN,standby}$	- - -	- - -	13 13	W
No Load Input Current (V_O =On, I_O = 0A, I_{SB} = 0A)	µMP16	I_{IN,no_load}	-	-	500	mA_{RMS}
Harmonic Line Currents	All	THD	Per EN61000-3-2			
Power Factor	All		-	0.99	-	
Inrush Current	$V_{IN,AC}$ = 264Vac		-	-	40	A_{PK}
Input Fuse	µMP04 µMP10 µMP16		- - -	- - -	10 16 16	A
Leakage Current to Earth Ground	$V_{IN,AC}$ = 240Vac $f_{IN,AC}$ = 50/60Hz		-	-	300[1]	µA
PFC Switching Frequency	All	$f_{SW,PFC}$	40	-	60	KHz
Operating Efficiency @ 25°C	$I_O = I_{O,max}$ $V_{IN,AC}$ = 180Vac to 264Vac	η	-	91	-	%
Global Inhibit/Enable		TTL, Logic “1” and Logic “0”; fan off when unit is inhibited				

Note 1 - Leakage current of standard uMP04 is >300uA. There is low leakage current version(<250uA) but EMI is level A.

132W - 3V3 Module Output Specifications (S2A, S2B, S2C, S2D)

Table 3. 3.3V Module Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	3.267	3.3	3.333	Vdc
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Margining High			3.432	-	3.498	Vdc
Margining Down			3.102	-	3.168	Vdc
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	50	mV_{PK-PK}
Output Current		I_O	-	-	40	A
V_O Current Share Accuracy	20% to 100% $I_{O,max}$		-	-	5	$\%I_{O,max}$
V_O Minimum Current Share Loading			20	-	-	$\%I_{O,max}$
Load Capacitance	Start up		-	-	2000	µF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 5 300	 % 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 30mV which ever is greater

180W - 5V Module Output Specifications (S2E, S2F, S2G, S2H)

Table 4. 5V Module Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	4.95	5.00	5.05	Vdc
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Margining High			5.2	-	5.3	Vdc
Margining Down			4.7	-	4.8	Vdc
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	50	mV_{PK-PK}
Output Current		I_O	-	-	36	A
V_O Current Share Accuracy	20% to 100% $I_{O,max}$		-	-	5	$\%I_{O,max}$
V_O Minimum Current Share Loading			20	-	-	$\%I_{O,max}$
Load Capacitance	Start up		-	-	2000	µF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 5 300	 % uSec
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 30mV which ever is greater

240W - 12V Module Output Specifications (S2I, S2J, S2K, S2L, S2M, S2N)

Table 5. 12V Module Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	11.88	12.00	12.12	Vdc
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Margining High			12.48	-	12.72	Vdc
Margining Down			11.28	-	11.52	Vdc
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	120	mV_{PK-PK}
Output Current		I_O	-	-	20	A
V_O Current Share Accuracy	20% to 100% $I_{O,max}$		-	-	5	$\%I_{O,max}$
V_O Minimum Current Share Loading			20	-	-	$\%I_{O,max}$
Load Capacitance	Start up		-	-	2000	µF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 5 300	 % uSec
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 30mV which ever is greater

240W - 24V Module Output Specifications (S2O, S2P, S2Q, S2R, S2S)

Table 6. 24V Module Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	23.76	24.00	24.24	V
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Margining High			24.96	-	25.44	V
Margining Down			22.56	-	23.04	V
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	240	mV_{PK-PK}
Output Current		I_O	-	-	10	A
V_O Current Share Accuracy	20% to 100% $I_{O,max}$		-	-	5	$\%I_{O,max}$
V_O Minimum Current Share Loading			20	-	-	$\%I_{O,max}$
Load Capacitance	Start up		-	-	2000	µF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	$\pm\%V_O$ t_s	- -	- -	5 300	% uSec
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 30mV which ever is greater

240W - 48V Module Output Specifications (S2T, S2U, S2V, S2W, S2X, S2Y)

Table 7. 48V Module Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	47.52	48.00	48.48	Vdc
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Margining High			49.92	-	50.88	Vdc
Margining Down			45.12	-	46.08	Vdc
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	480	mV_{PK-PK}
Output Current		I_O	-	-	5	A
V_O Current Share Accuracy	20% to 100% $I_{O,max}$		-	-	5	$\%I_{O,max}$
V_O Minimum Current Share Loading			20	-	-	$\%I_{O,max}$
Load Capacitance	Start up		-	-	2000	µF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 5 300	 % uSec
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 30mV which ever is greater

1000W - 12V Module Output Specifications (SKH,SKI, SKJ, SKK, SKL, SKM, SKN)

Table 8. 12V Module Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	11.88	12.00	12.12	Vdc
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Margining High			12.48	-	12.72	Vdc
Margining Down			11.28	-	11.52	Vdc
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	120	mV_{PK-PK}
Output Current		I_O	-	-	84	A
V_O Current Share Accuracy	20% to 100% $I_{O,max}$		-	-	5	$\%I_{O,max}$
V_O Minimum Current Share Loading			20	-	-	$\%I_{O,max}$
Load Capacitance	Start up		-	-	2000	µF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 5 300	 % uSec
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 30mV which ever is greater

1000W - 24V Module Output Specifications (SKO, SKP, SKQ, SKR, SKS)

Table 9. 24V Module Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	23.76	24.00	24.24	Vdc
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Margining High			12.48	-	12.72	Vdc
Margining Down			11.28	-	11.52	Vdc
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	240	mV_{PK-PK}
Output Current		I_O	-	-	42	A
V_O Current Share Accuracy	20% to 100% $I_{O,max}$		-	-	5	$\%I_{O,max}$
V_O Minimum Current Share Loading			20	-	-	$\%I_{O,max}$
Load Capacitance	Start up		-	-	2000	uF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 5 300	 % uSec
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 30mV which ever is greater

1000W - 48V Module Output Specifications (SKT, SKU, SKV, SKW, SKX, SKY)

Table 10. 48V Module Output Specifications: -

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	47.52	48.00	48.48	Vdc
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Margining High			49.92	-	50.88	Vdc
Margining Down			45.12	-	46.08	Vdc
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	480	mV_{PK-PK}
Output Current		I_O	-	-	21	A
V_O Current Share Accuracy	20% to 100% $I_{O,max}$		-	-	5	$\%I_{O,max}$
V_O Minimum Current Share Loading			20	-	-	$\%I_{O,max}$
Load Capacitance	Start up		-	-	2000	uF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 5 300	 % uSec
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 30mV which ever is greater

96W/96W - Dual ISO Module Output Specifications (I##)[1]

Table 11. 3.3-28V Module Output Specifications:

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	V_O	-	-	1	%
Output Regulation[2]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	1	%
Output Current		I_O	-	-	4	A
Load Capacitance	Start up		-	-	2000	µF
V_O Dynamic Response Peak Deviation Settling Time	50% load change, slew rate = 1A/µs	 $\pm\%V_O$ t_s	 - -	 - -	 5 300	 % uSec
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\pm\%V_O$	-	-	0.1	%

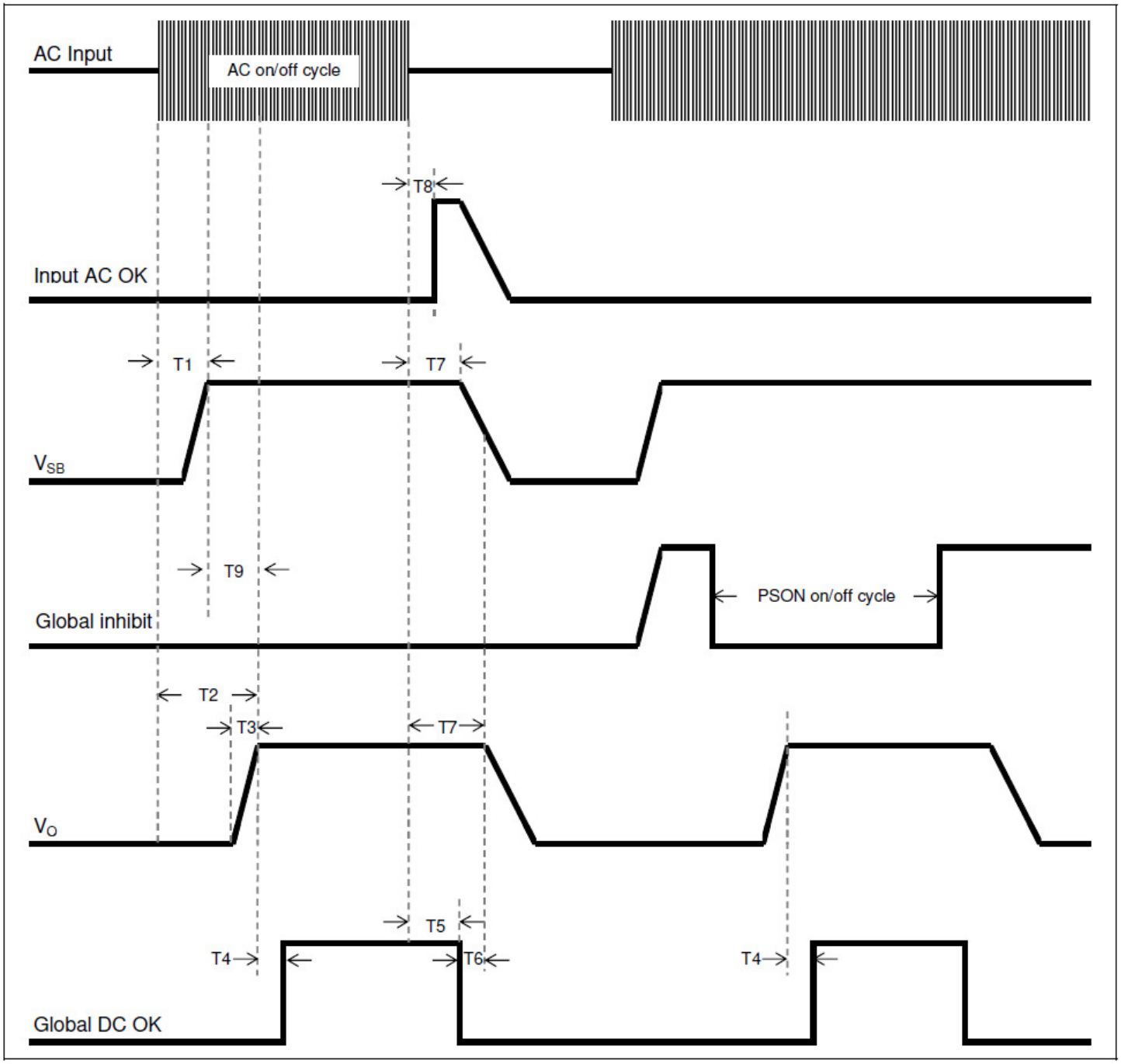
Note 1 - ## see voltage codes in page 4
Note 2 - 0.4% or 30 mV which ever is greater

System Timing Specifications

Table 12. System Timing Specifications:

Label	Parameter	Min	Typ	Max	Unit
T1	Delay from AC being applied to V_{SB} being within regulation	-	-	1500	mSec
T2	Delay from AC being applied to output voltages being within regulation.	-	-	2000	mSec
T3	V_O rise time, 10%V_O to V_O in regulation	-	-	50	mSec
T4	Delay from output voltages within regulation limits to Global DC OK asserted high. Measured from last module going to regulation to Global DC OK assertion	-	-	20	mSec
T5	Delay from loss of AC to de-assertion of Global DC OK	15	-	-	mSec
T6	Delay from Global DC OK de-asserted to output voltages dropping out of regulation limits.	1			mSec
T7	Hold up time - time all output voltages, including V_{SB}, stay within regulation after loss of AC.	16.7	-	-	mSec
T8	Delay from loss of AC input to Input AC OK going to high.	-	-	5	mSec
T9	Delay from V_{SB} being within regulation to output voltages being within regulation.	50	-	2000	mSec

System Timing Specifications



µMP16 Case Performance Curves

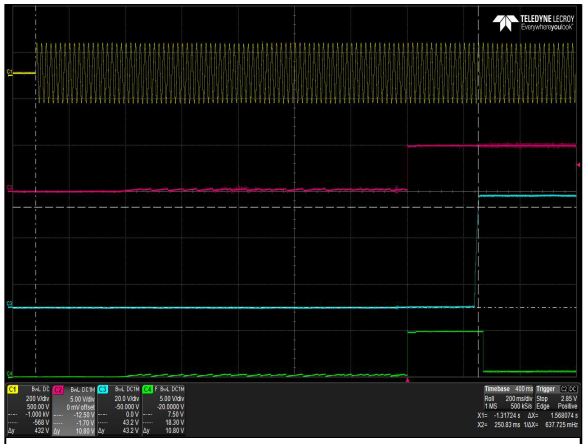


Figure 1: µMP16T-S2W-00-A Turn-on delay via AC mains – Vin = 90Vac
Full Load: I_O = 5A , I_{SB} = 2A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

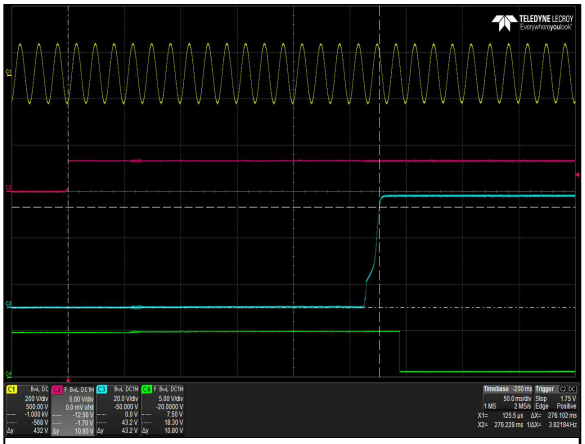


Figure 2: µMP16T-S2W-00-A Turn-on delay via Global inhibit – Vin = 90Vac
Full Load: I_O = 5A, I_{SB} = 2A
Ch 1: AC Mains Ch 2: Global inhibit Ch 3: V_O Ch 4: Global DC OK

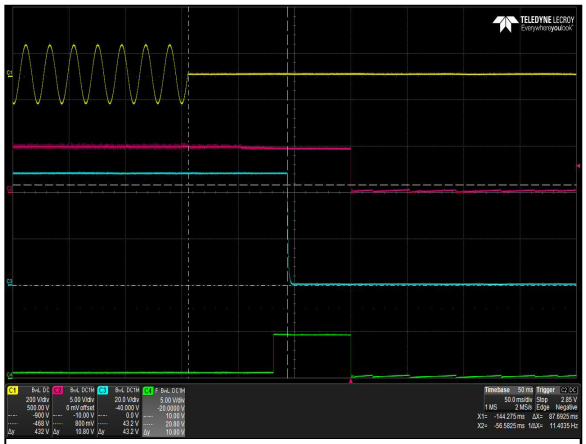


Figure 3: µMP16T-S2W-00-A Hold-up Time - Vin = 90Vac / 63Hz / 0°
Full Load: I_O = 5A, I_{SB}= 2A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

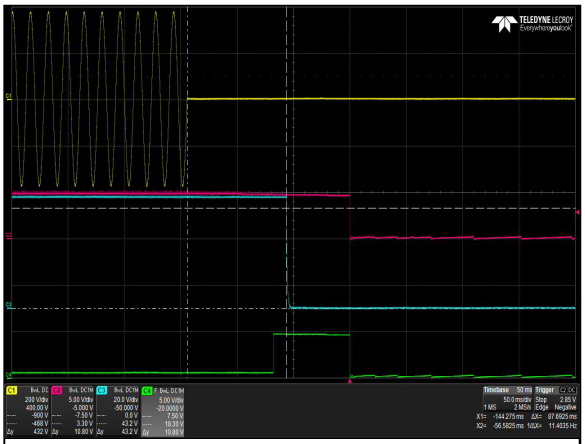


Figure 4: µMP16T-S2W-00-A Hold-up time - Vin = 264Vac / 47Hz / 0°
Full Load: I_O = 5A, I_{SB} = 2A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DC OK

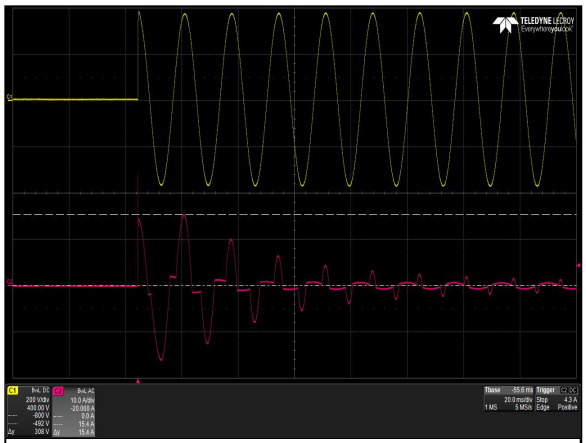


Figure 5: µMP16T-S2W-00-A Start up Inrush Current - Vin = 264Vac
Full Load: Io = 5A , Isb = 2A, Turn On Phase = 90deg
Ch 1: V_{IN} Ch 2: I_{IN}

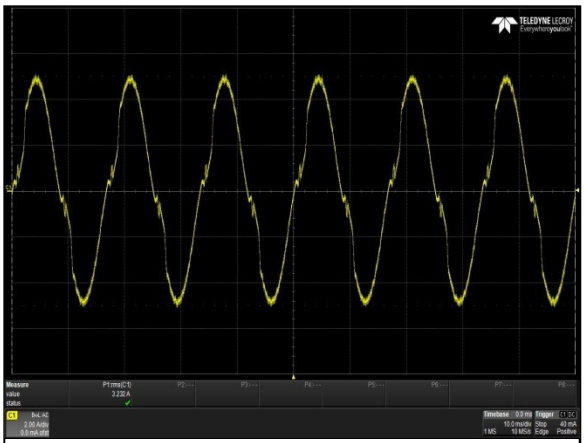


Figure 6: µMP16T-S2W-00-A Input Current Waveform - Vin = 90Vac
Full Load: I_O = 5A, I_{SB} = 2A
Ch 1: I_{IN}

µMP16 Case Performance Curves

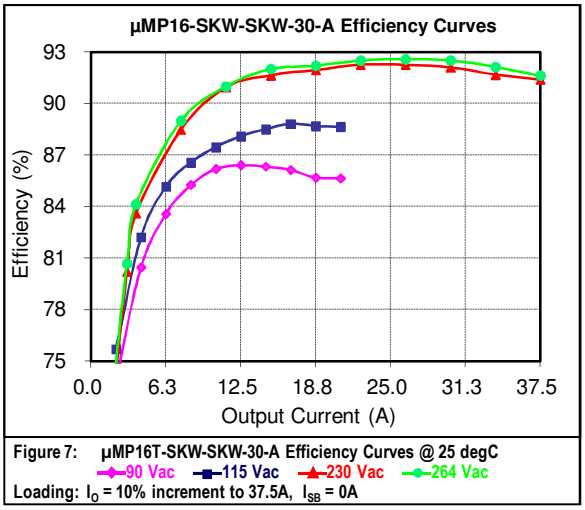


Figure 7: µMP16T-SKW-SKW-30-A Efficiency Curves @ 25 degC
90 Vac 115 Vac 230 Vac 264 Vac
Loading: I_O = 10% increment to 37.5A, I_{SB} = 0A

240W 12V Module Performance Curves

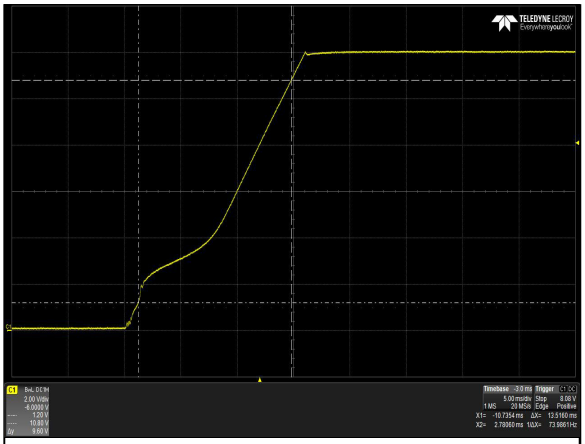


Figure 8: µMP16T-S2L-00- A Output Voltage Startup Characteristic
Load: I_O= 20A
Ch 1: V_O

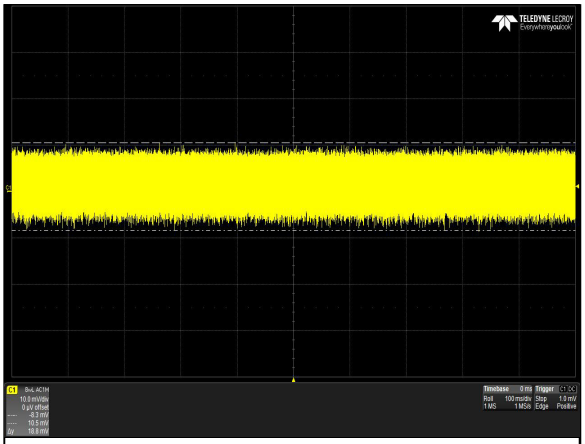


Figure 9: Ripple and Noise Measurement
Load: I_O = 20A
Ch 1: V_O

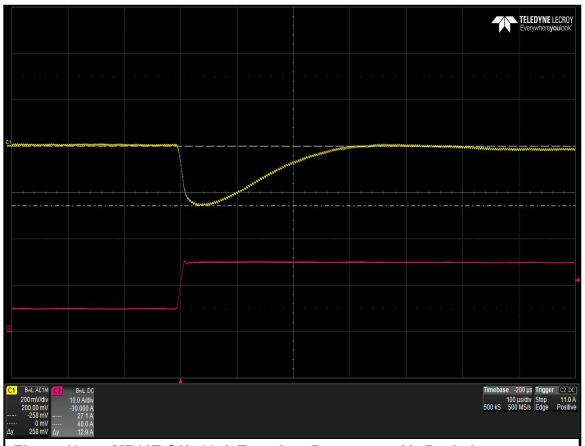


Figure 10: µMP16T-S2L-00-A Transient Response – V_O Deviation
25% to 75% load change, 1A/uS slew rate
Ch 1: V_O Ch 2: I_O

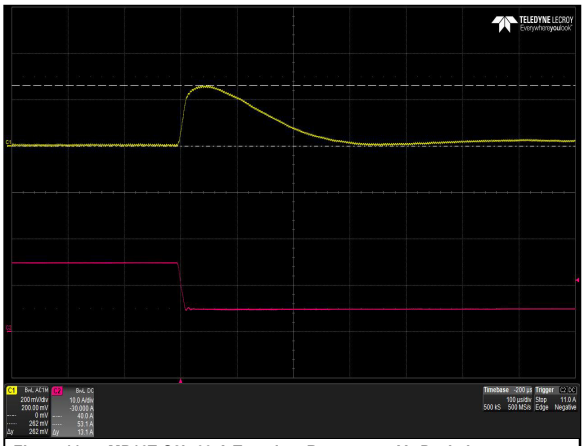


Figure 11: µMP16T-S2L-00-A Transient Response – V_O Deviation
75% to 25% load change, 1A/uS slew rate,
Ch 1: V_O Ch 2: I_O

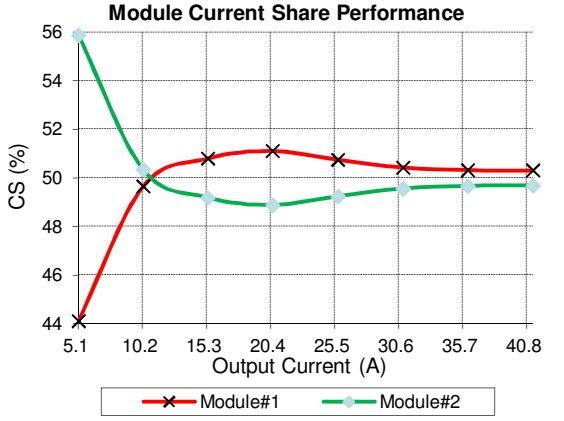


Figure 12: µMP16T-S2L-S2L-10-A Current Share Performance

1000W 48V Module Performance Curves

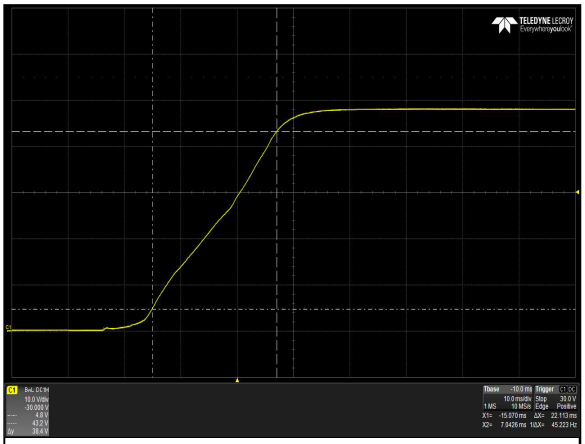


Figure 13: µMP16-SKW-00-A Output Voltage Startup Characteristic
Load: I_O = 20.8A
Ch 1: V_O

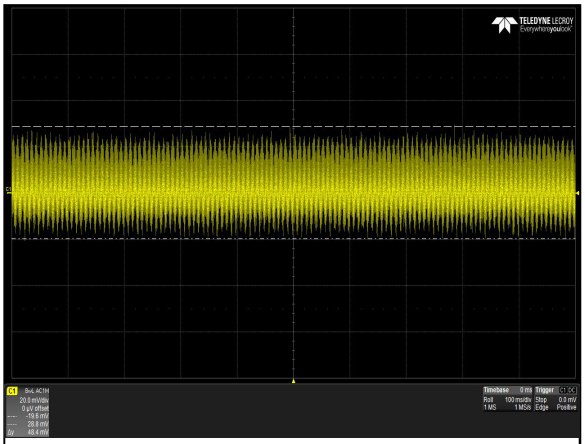


Figure 14: µMP16-SKW-00-A Ripple and Noise Measurement
Load: I_O = 20.8A
Ch 1: V_O

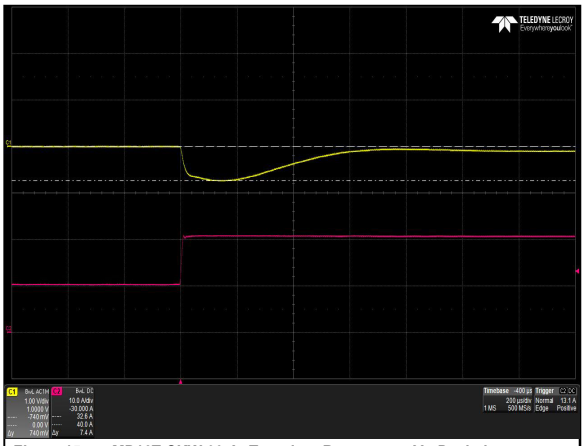


Figure 15: µMP16T-SKW-00-A Transient Response – Vo Deviation
50% to 100% load change, 1A/uS slew rate
Ch 1: V_O Ch 2: I_O

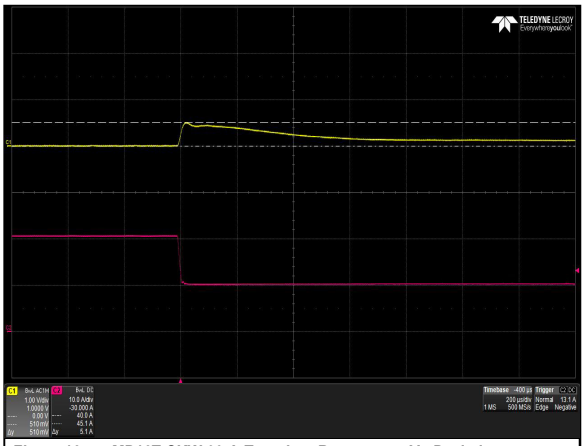


Figure 16: µMP16T-SKW-00-A Transient Response – Vo Deviation
100% to 50% load change, 1A/uS slew rate
Ch 1: V_O Ch 2: I_O

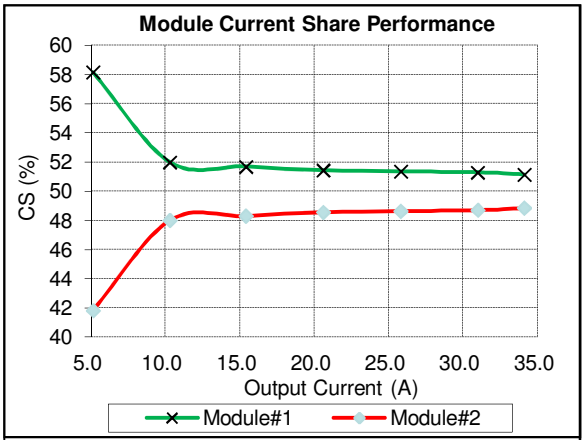


Figure 17: µMP16T-SKW-SKW-30-A Current Share Performance

96W Dual ISO Module Performance Curves

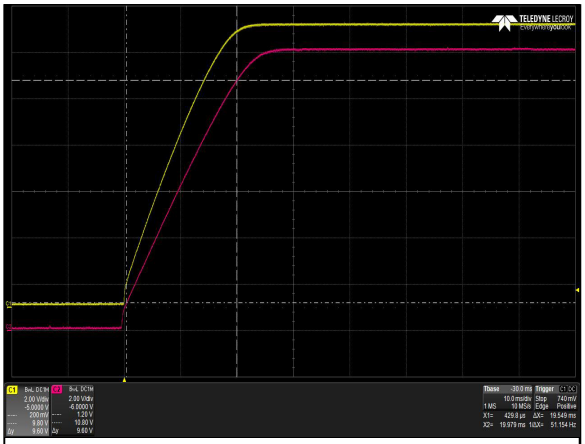


Figure 18: µMP16T-ILL-00-A Output Voltage Startup Characteristic
Load: I_{O1} = 4A, I_{O2} = 4A
Ch 1: V_{O1} Ch 2: V_{O2}

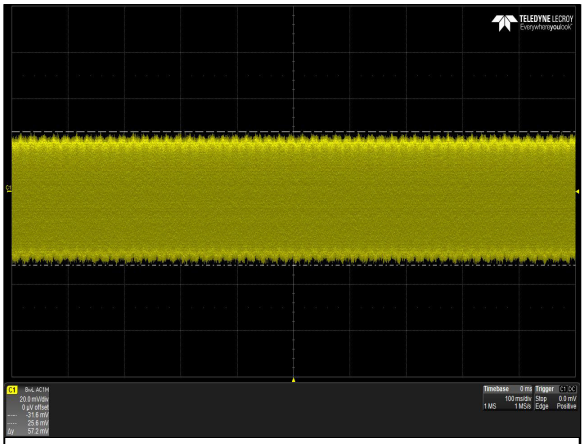


Figure 19: µMP16T-ILL-00-A Ripple and Noise Measurement
Load: I_{O1} = 4A
Ch 1: V_{O1}

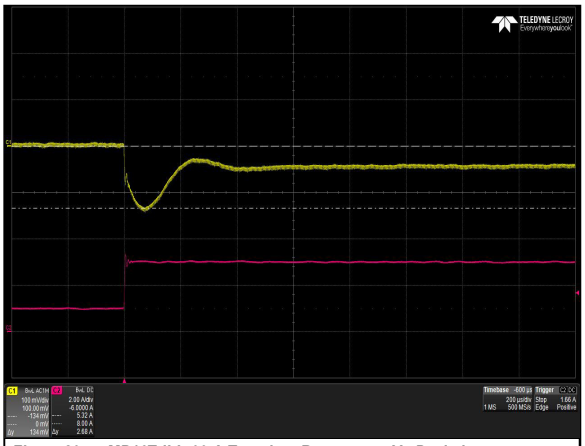


Figure 20: µMP16T-ILL-00-A Transient Response – Vo Deviation
25% to 75% load change, 1A/ µS slew rate, Co = 470uF
Ch 1: V_{O1} Ch 2: I_{O1}

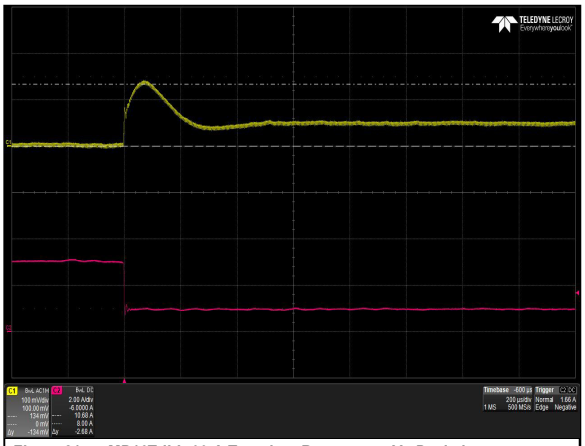


Figure 21: µMP16T-ILL-00-A Transient Response – Vo Deviation
75% to 25% load change, 1A/ µS slew rate, Co = 470uF
Ch 1: V_{O1} Ch 2: I_{O1}

Protection Function Specification

Input Fusing

µMP Series is equipped with an internal non user serviceable 16A (TLAG) 250 Vac fuse for µMP10/µMP16, 10A (TLAG) 250V for µMP04 for fault protection in both the L1 and L2 lines input.

Over Voltage Protection (OVP)

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

OVP

Parameter	Min	Nom	Max	Unit
3.3 V Module				
0.9 V Output Overvoltage	-	-	2.00	V
3.3 V Output Overvoltage	-	-	5.96	V
3.6 V Output Overvoltage	-	-	6.31	V
5 V Module				
3.2 V Output Overvoltage	-	-	5.76	V
5 V Output Overvoltage	-	-	9.00	V
6 V Output Overvoltage	-	-	10.80	V
12 V Module				
6 V Output Overvoltage	-	-	10.80	V
12 V Output Overvoltage	-	-	15.60	V
15 V Output Overvoltage	-	-	19.50	V
24 V Module				
12 V Output Overvoltage	-	-	15.60	V
24 V Output Overvoltage	-	-	31.20	V
30 V Output Overvoltage	-	-	39.00	V
48 V Module				
28 V Output Overvoltage	-	-	36.40	V
48 V Output Overvoltage	-	-	62.40	V
60 V Output Overvoltage	-	-	78.00	V

Over Current Protection (OCP)

µMP series includes internal current limit circuitry to prevent damage in the event of overload or short circuit. Recovery is automatic when the overload is removed, it is constant current type.

Parameter	Min	Nom	Max	Unit
3.3 V Module				
0.9 V Output Over Current	105	130	160	%
3.3 V Output Over Current	105	130	160	%
3.6 V Output Over Current	105	130	160	%
5 V Module				
3.2 V Output Over Current	105	130	160	%
5 V Output Over Current	105	130	160	%
6 V Output Over Current	105	130	160	%
12 V Module				
6 V Output Over Current	105	130	160	%
12 V Output Over Current	105	130	160	%
15 V Output Over Current	105	130	160	%
24 V Module				
12 V Output Over Current	105	130	160	%
24 V Output Over Current	105	130	160	%
30 V Output Over Current	105	130	160	%
48 V Module				
28 V Output Over Current	105	130	200	%
48 V Output Over Current	105	130	160	%
60 V Output Over Current	105	130	200	%

Short Circuit Protection (SCP)

The µMP series power supply will withstand a continuous short circuit with no permanent damage, applied to its main output during start-up or while running.

Over Temperature Protection (OTP)

The µMP series power supply is internally protected against over temperature conditions. When the OT circuit is activated, the power supply output will disable. Recovery type will be auto recovery with temperature hysteresis.

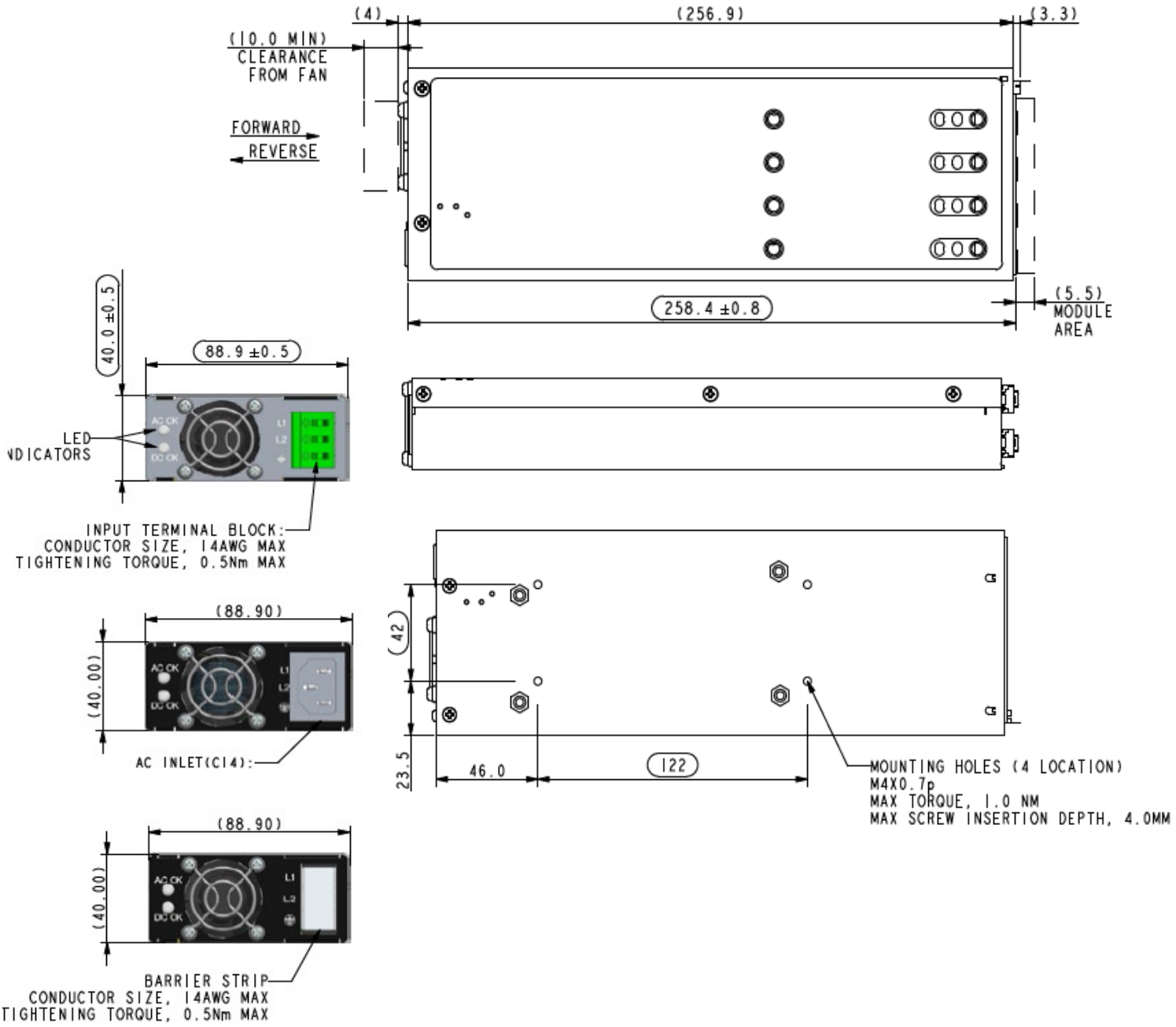
Mechanical Specifications

µMP Series Mechanical Outlines

µMP04 (400/600 Watts Max)

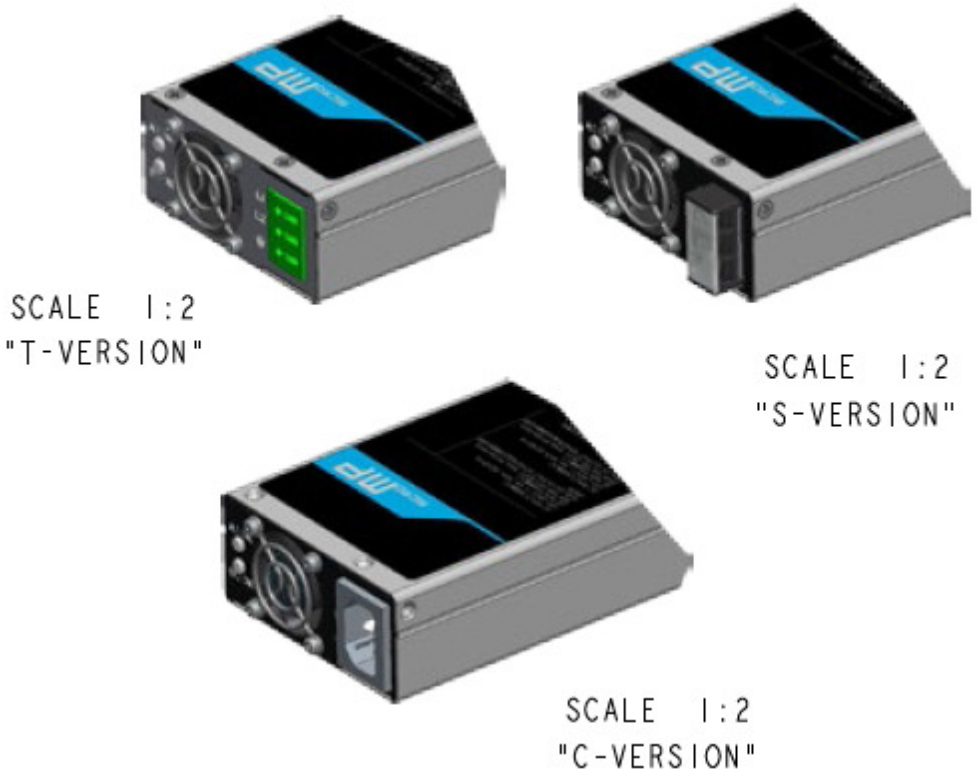
Case Size: µMP04: 10.11” x 3.5” x 1.57” (256.9 mm x 88.9 mm x 40.0 mm)

Weight: µMP04 Case: 1.96 lbs(731.55g)

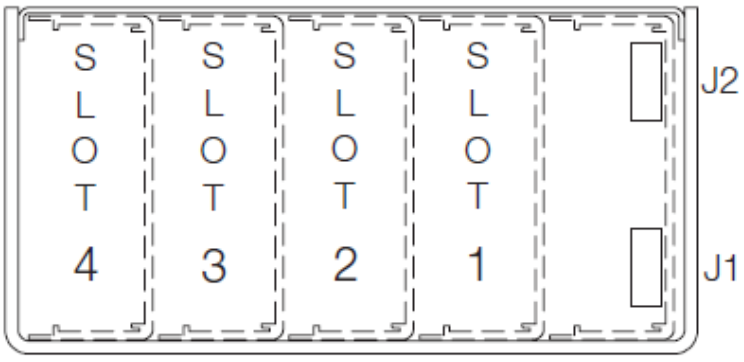


µMP Series Mechanical Outlines

Case Input Types:



Module Slot Location:



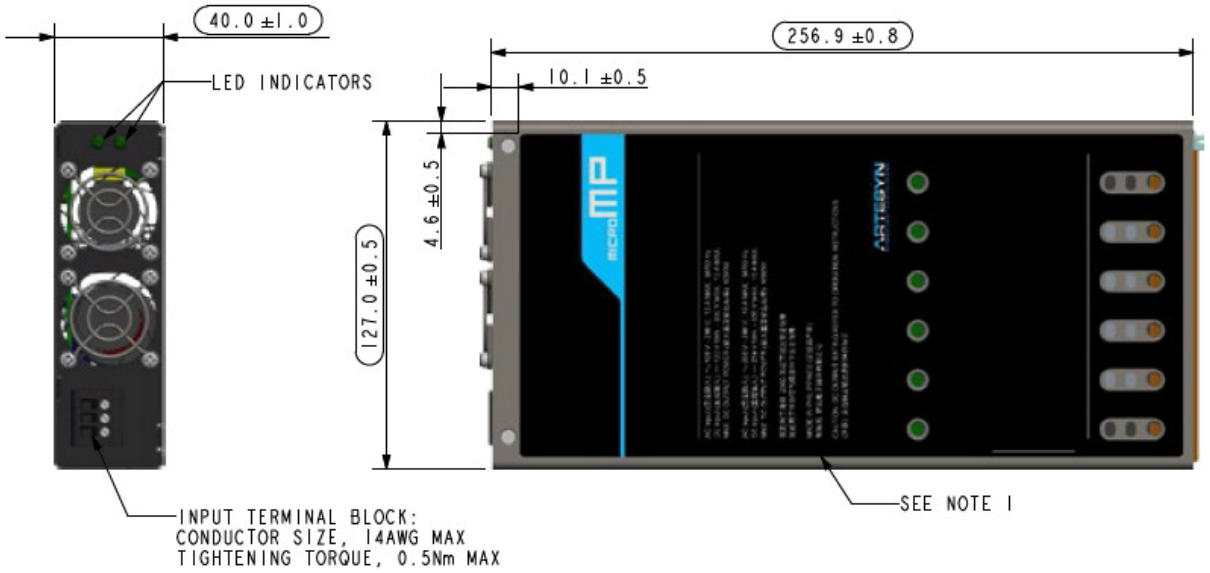
µMP Series Mechanical Outlines

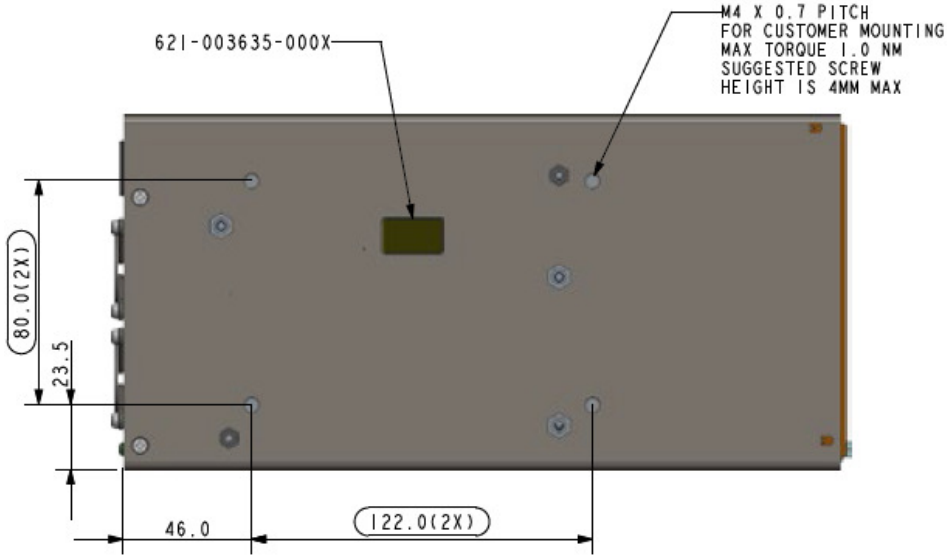
µMP10 (1000/1200 Watts Max)

µMP16 (1200/1800 Watts Max)

Case Size: µMP10/16: 10.11” x 5” x 1.57” (256.9 mm x 127 mm x 40.0 mm)

Weight: µMP10/16 Case: 2.78 lbs (1037.6g)





µMP Series Mechanical Outlines

Case Input Types:

"C" VERSION



SCALE 1:2

"T" VERSION



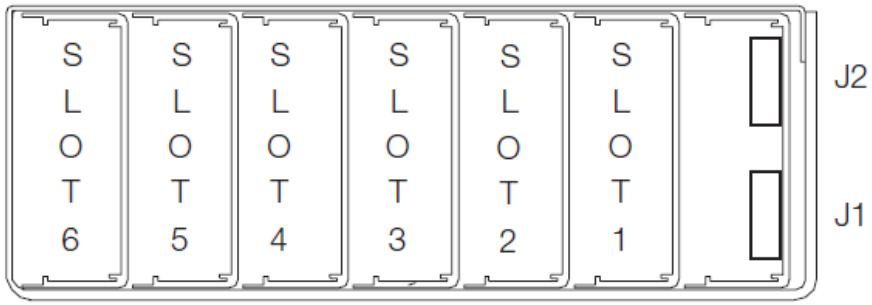
SCALE 1:2

"S" VERSION



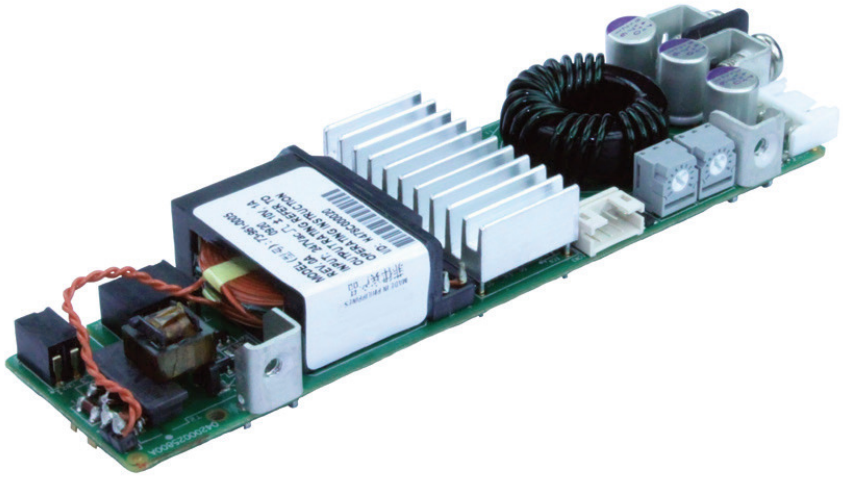
SCALE (1:2)

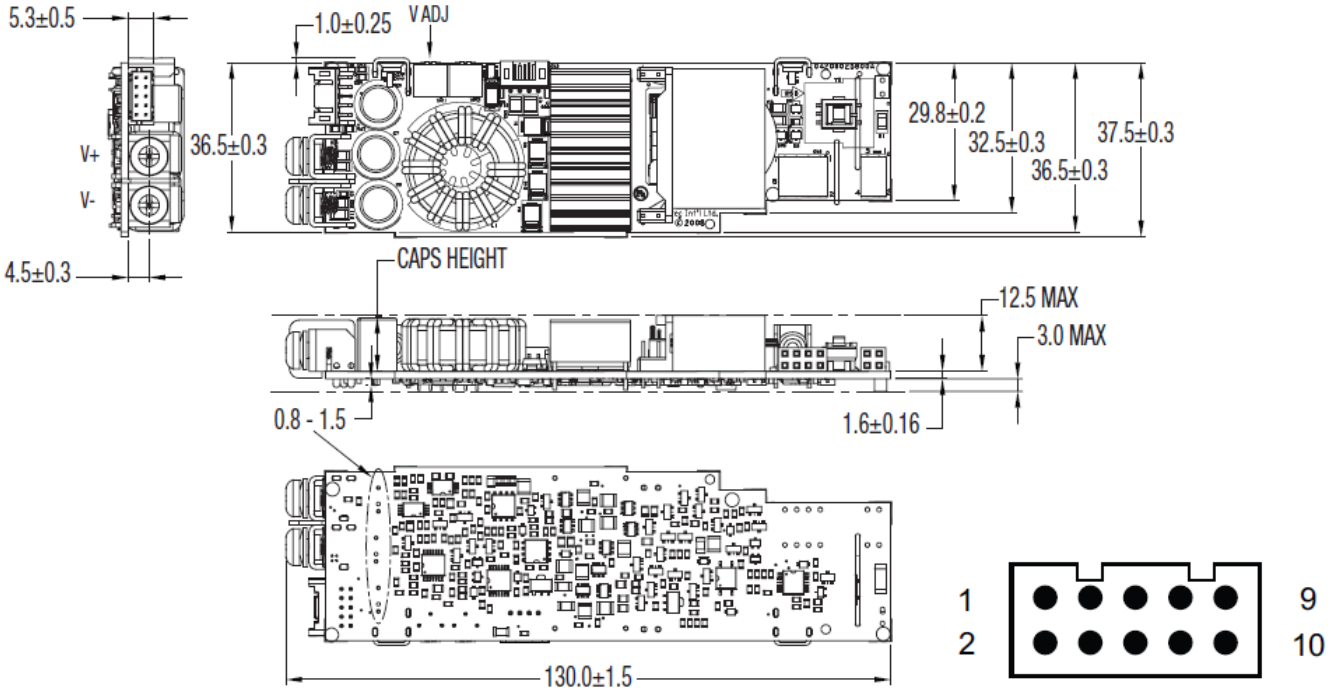
Module Slot Location:



S2 Module Mechanical Outlines

Weight: 200W Single O/P: 0.22lb (82.1g)

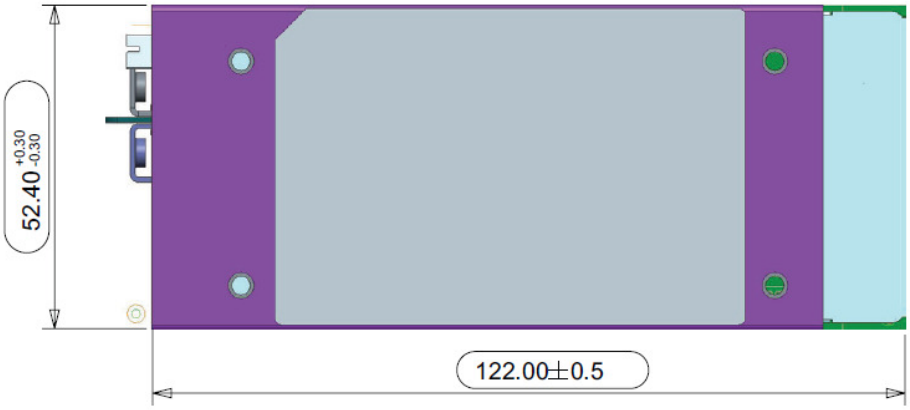


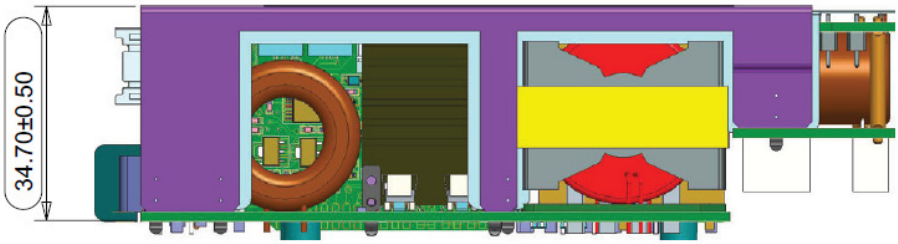


SK Module Mechanical Outlines

1000 W



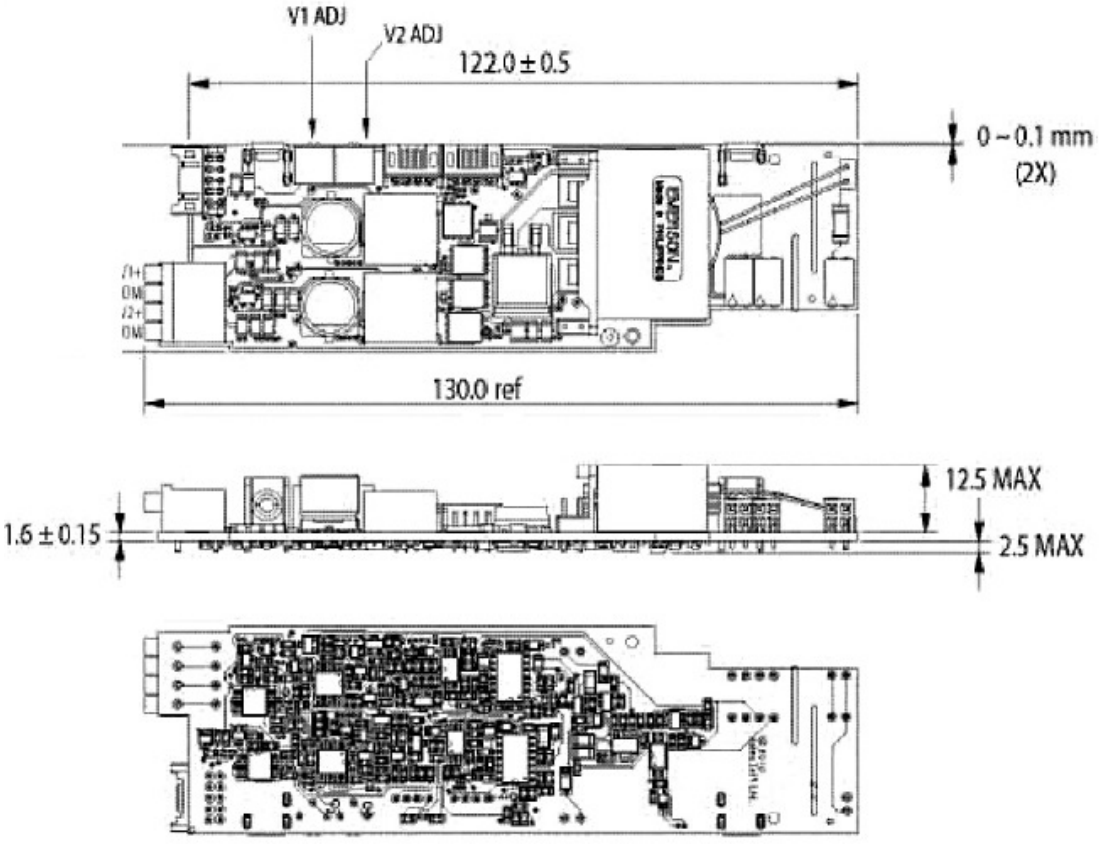




Dual Module Mechanical Outlines

Weight: Dual O/P:0.16lb (59.7g)

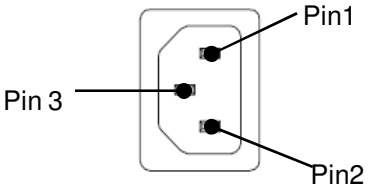




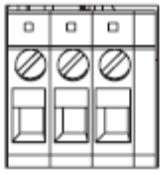
Connector Definitions - Case

AC Input Connector

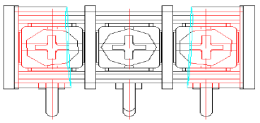
Pin 1 – AC Neutral
Pin 2 – AC Line(hot)
Pin 3 – Chassis(earth) ground



IEC Connector



Terminal Block

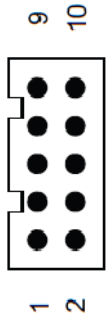


Barrier Strip

Case Control Signal 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 – Spare
Pin 6 – Global inhibit/optional enable logic “1”
Pin 7 – Global inhibit/optional enable logic “0”
Pin 8 – Global inhibit/optional enable return
Pin 9 – +5VSB housekeeping
Pin 10 – +5VSB housekeeping return

J1&J2

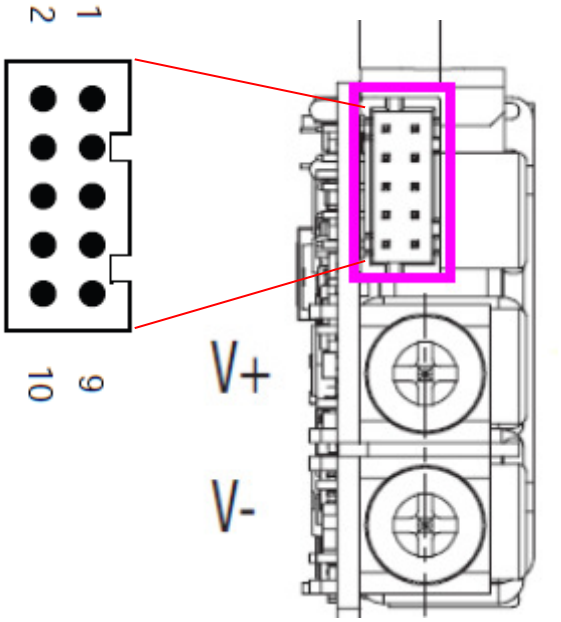


Case I2C Bus Signal Connector- J2

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



Connector Definitions - S2# & SK# Module



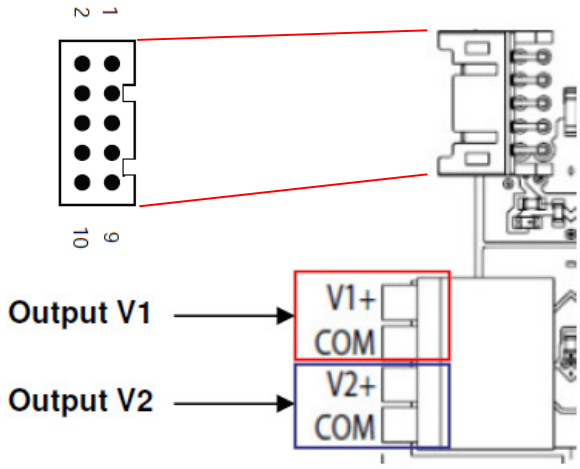
Main Output Terminals

V+ – Positive Output
V- – Negative Output

DC Output Control Signal Connector

Pin 1 – No connection
Pin 2 – No connection
Pin 3 – Current share
Pin 4 – Module inhibit return
Pin 5 – Module ISO inhibit
Pin 6 – SCOM
Pin 7 – -RMT sense
Pin 8 – Margin
Pin 9 – Remote margin / V prog.
Pin 10 – +RMT sense

Connector Definitions - I## Module



Main Output Terminals

V1+ – V1 Positive Output
Com – V1 Negative Output
V2+ – V2 Positive Output
Com – V2 Negative Output

DC Output Control Signal Connector

Pin 1 – -RMT sense V2
Pin 2 – +RMT sense V2
Pin 3 – No connection
Pin 4 – Module inhibit rtn
Pin 5 – Module ISO inhibit
Pin 6 – SCOM
Pin 7 – -RMT sense V1
Pin 8 – No connection
Pin 9 – No connection
Pin 10 – +RMT sense V1

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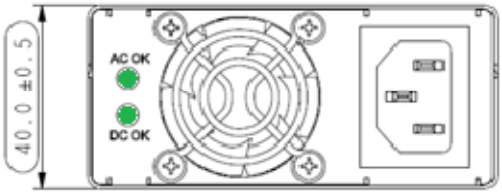
Power / Signal Mating Connectors and Pin Types

Table 4. Mating Connectors for µMP (or equivalent)

Reference	Mating Connector or Equivalent
AC Input (IEC Connector C14)	IEC Connector C13
DC Output (Barr)	Molex 19141-0058/0063 or 19099/0048 Spade lug based on Cable Ampacity/AWG
Case Control Signal Connector - J1	Landwin 2050S1000 (housing) Landwin 2053T011V (pins) or JST PHDR-10VS(housing) JST SPHD-002T-P0.5(28-24)(pins) JST SPHD-001T-P0.5(26-22)
Case I2C Bus Signal Connector- J2	Landwin 2050S1000 (housing) Landwin 2053T011V (pins) or JST PHDR-10VS(housing) JST SPHD-002T-P0.5(28-24)(pins) JST SPHD-001T-P0.5(26-22)
DC Output Control Signal Connector	Landwin 2050S1000 (housing) Landwin 2053T011V (pins) or JST PHDR-10VS(housing) JST SPHD-002T-P0.5(28-24)(pins) JST SPHD-001T-P0.5(26-22)

Note: The Artesyn Connector Kit for J1,J2 and DC Output Control Signal Connector is 70-841-023

LED indicator Definition



Two (green/off) LEDs are placed on the case fan panel with status conditions are shown on the table below. Each module will have a green LED indicating basic output operation (not driven by DCOK)

Condition	Case AC OK LED Status	Case DC OK LED Status	Module LED Status
V_{SB} = ON, V_O = OFF, AC Input = ON	Green	Blinking	OFF
V_{SB} = ON, V_O = ON	Green	Green	Green
V_O = OCP /OVP/SCP	Green	OFF	OFF
FAN_FAULT / OTP / V_{SB} = OCP	Green	OFF	OFF
AC Not Present	OFF	OFF	OFF

Environmental Specifications

EMC Immunity

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

Table 6. 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
IEC/EN 61000-4-2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – Electrostatic discharge immunity test. Level 3, performance Criteria B, otherwise, +/-8KV air, +/-6KV contact discharge for non-standard test points,
IEC/EN 61000-4-3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Radiated, radio-frequency, electromagnetic field immunity test. Level 3,Criteria A, Designed to Meet.
IEC/EN 61000-4-4	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient/Burst Immunity, Level 4, performance Criteria B
IEC/EN 61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – Surge, 2KV common mode and 2KV differential mode, performance criteria A.
IEC/EN 61000-4-11	Electromagnetic Compatibility (EMC) - Testing and measurement techniques : Voltage Dips and Interruptions: 30% reduction for 500ms-Criteria B>95% reduction for 10mS, Criteria A, >95% reduction for 5000mS, Criteria C
EN55024	Information Technology Equipment-Immunity Characteristics, Limits and Method of Measurements

Safety Certifications

The µMP 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 µMP series power supply system

Document	File #	Description
UL 60950-1/CAN/CSA C22.2 No. 60950-1	E186249-A273-UL-X3	US and Canada Requirements
ANSI/AAMI ES60601-1 CAN/CSA-C22.2 No. 60601-1	E182560-A116-UL-X1	Medical Requirements
EN60950-1	E186249-A273-CB-1	European Requirements.
EN60601-1		European Requirements and Medical Requirements
EN60950 Deviations		International Requirements
CB Certificate and Report	DK-39327-A2-UL	(All CENELEC Countries)
CHINA CQC Approval		China Requirements

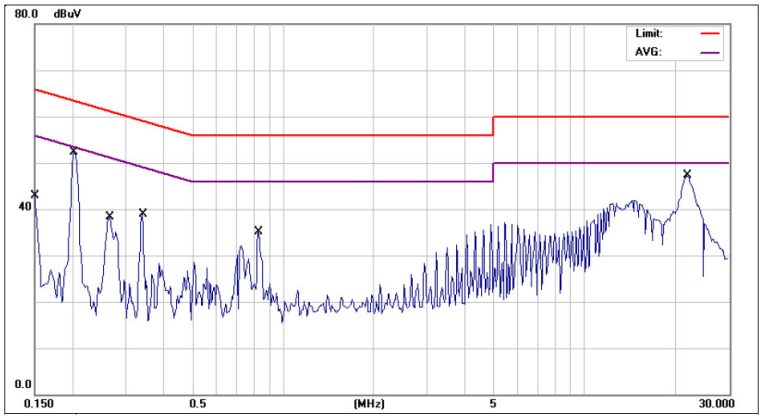
EMI Emissions

The µMP series has been designed to comply with the Class B limits of EMI requirements of EN55022 (FCC Part 15) and CISPR 22 (EN55022) for emissions and relevant sections of EN61000 (IEC 61000) for immunity.

µMP16 is tested at 1200W at low line and >100Vac input, and 1800W at high line>200Vac input using resistive load.

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 µMP16 power supplies have internal EMI filters to 2 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 100Vac input

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

Conducted Emissions

Table 8. Conducted EMI emission specifications of the µMP series

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC Part 15, class B	All	Margin	-	-	6	dB
CISPR 22 (EN55022) class B	All	Margin	-	-	6	dB

Radiated Emissions

Unlike conducted EMI, radiated EMI performance in a system environment may differ drastically from that in a stand-alone power supply. The shielding effect provided by the system enclosure may bring the EMI level from Class A to Class B. It is thus recommended that radiated EMI be evaluated in a system environment. The applicable standard is EN55022 Class 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 µMP series power supplies will start and operate within stated specifications at an ambient temperature from -40 ^{O}C to 70 ^{O}C under all load conditions with internal fan. Derate each output 2.5% per degree from 50 ^{O}C to 70 ^{O}C. Cold start at -20 ^{O}C, allow 10 min warm-up before all outputs are within specification. Reverse air to 40 ^{O}C max due to fan derating.

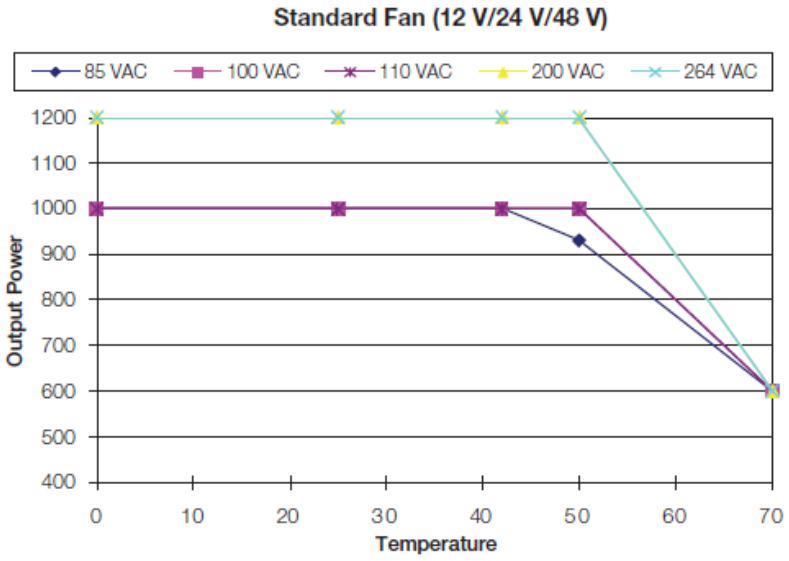
Forced Air Cooling

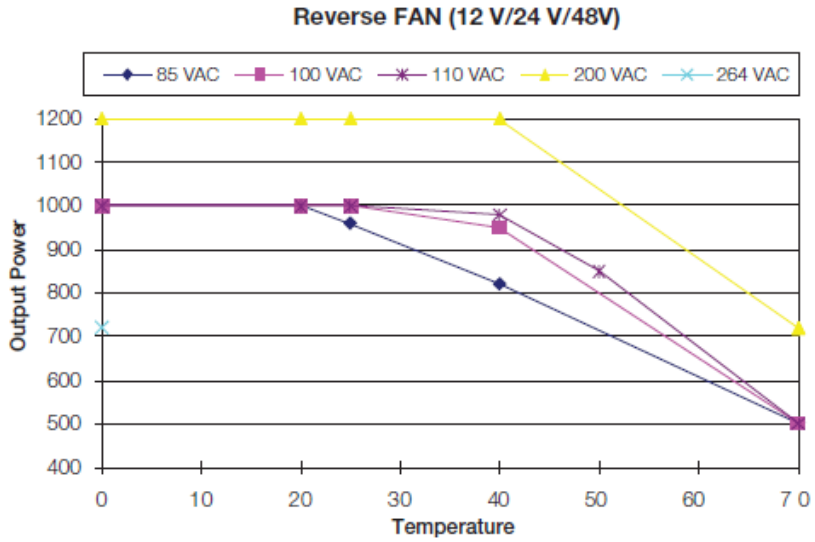
The µMP series power supplies include internal cooling fans as part of the power supply assembly to provide forced air-cooling to maintain and control temperature of devices and ambient temperature in the power supply to appropriate levels. There are 1 fan in µMP04 case and 2 fans in µMP10/16 case. The 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 some derating allowed. Allow 40 ^{O}C max ambient for reverse airflow.

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.

Power Derating Curves

µMP series can operate up to a maximum ambient temperature of 70 ^{O}C with derating, below is the µMP10 derating curves.





Storage and Shipping Temperature / Humidity

The µMP series power supplies can be stored or shipped at temperatures between -40 ^{O}C to +85 ^{O}C and relative humidity from 10% to 95% non-condensing.

Altitude

The µMP series will operate within specifications at altitudes up to 10,000 feet above sea level. The power supply will derate linear to 50% from 10,000 to 30,000 feet above sea level.

Humidity

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

Vibration

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

Non-Operating Random Vibration

Acceleration	50		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
	80-350 Hz	---	0.04 g^2/Hz
	2000 Hz	---	0.007 g^2/Hz

Operating Random Vibration

Acceleration	50		gRMS
Frequency Range	10-500		Hz
Duration	30		mins
Direction	3 mutually perpendicular axis		
PSD Profile	**FREQ**	**SLOPE dB/oct**	**PSD g^2/Hz**
	10-350Hz	---	0.04 g^2/Hz
	500 Hz	---	0.0198 g^2/Hz

Shock

The µMP 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	3 shock on each of 6 faces	

Operating Half-Sine Shock

Acceleration	40	G
Duration	6	msec
Pulse	Half-Sine	
No. of Shock	3 shock on each of 6 faces	

Power and Control Signal Descriptions

AC Input Connector

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

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

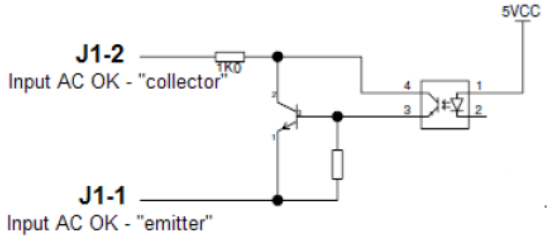
Case Control Signal Connector - J1

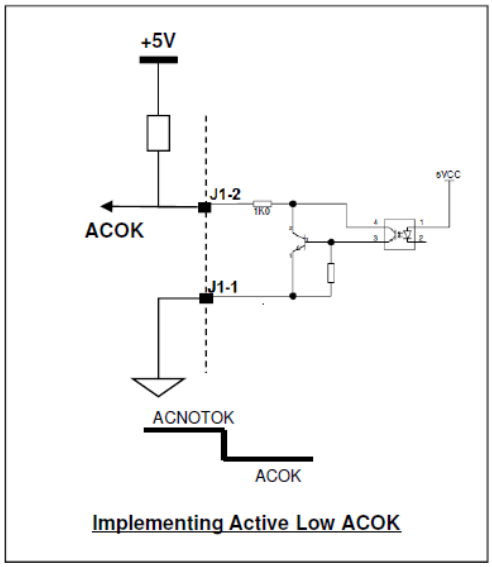
The µMP series contain a 10 pins control signal header providing an analogue control interface, standby power and I^2C interface signal connections.

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

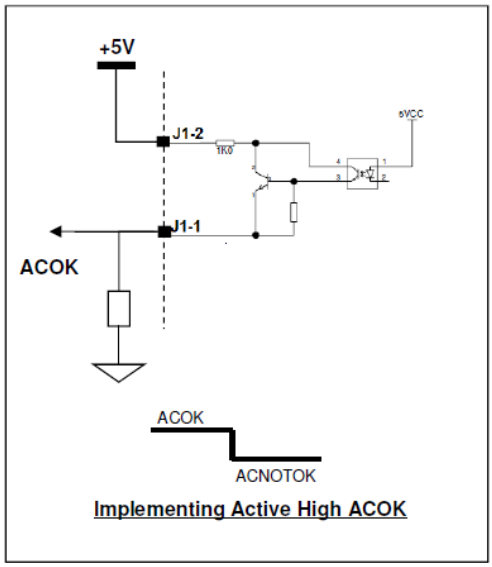
Input ACOK - "collector" and Input ACOK - "emitter" are output of an uncommitted bipolar junction transistor, there is an internal 1K ohm resistor in series with the collector of the transistor for current limiting. The transistor shall turn ON when the Input Mains level is Good >85Vac, it shall turn OFF when input voltage is <80Vac. Sink current: 50mA maximum, 5ms minimum warning time.

A green LED is provided in the µMP case as visual indicator of the status of ACOK signal.





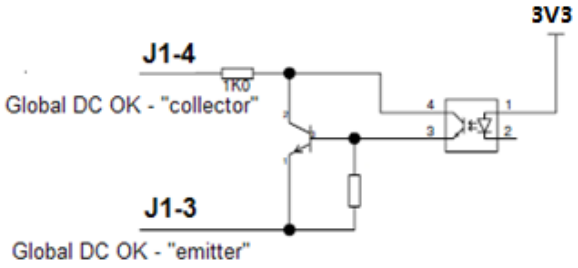
Implementing Active Low ACOK

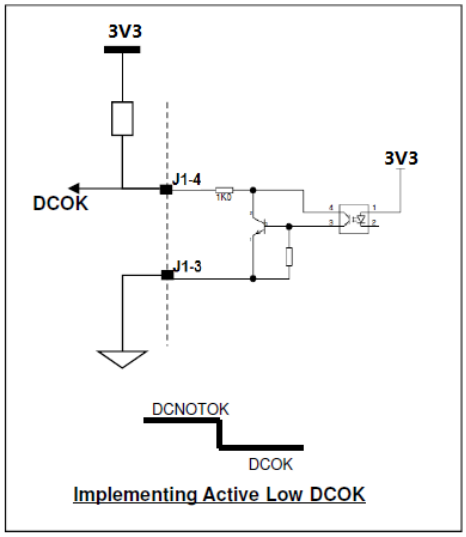


Implementing Active High ACOK

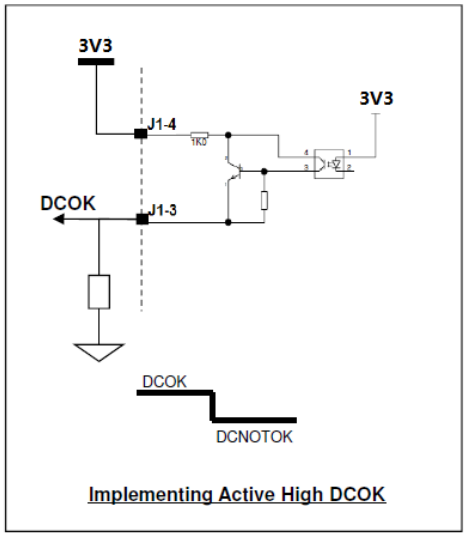
Global DC OK - “collector” /Global DC OK - “emitter” - (pins 3,4)

Global DCOK - “collector” and Global DCOK - “emitter” are output signal of uncommitted bipolar junction transistor, there is an internal 1K ohm resistor in series with the collector of the transistor for current limiting. The transistor shall turn ON when the DC output of ALL modules have good regulation, otherwise it will turn OFF. A green LED is provided as a visual indicator of the DCOK status. Sink current: 50mA max.





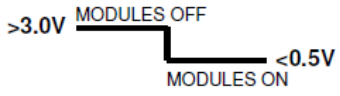
Implementing Active Low DCOK



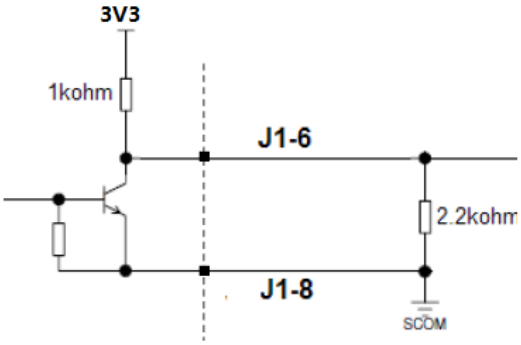
Implementing Active High DCOK

Global inhibit/optional enable logic “1” - (pin 6)

Global inhibit/optional enable logic “1”(default setting). Active low, when pin is left open or pulled Low, all the modules are ON. Pulling the pin to logic level Hi (>3V- 4V) will turn OFF all the modules of the power supply. There is an internal 2.2K ohm resistor pulling the signal to ground to make the level low when pin is left floating.



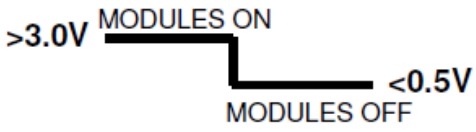
Logic signal at Pin J1-6



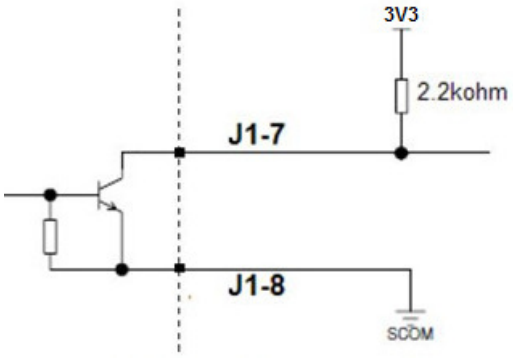
Driving J1-6 with a transistor

Global inhibit/optional enable logic "0" - (pin 7) - For µMP 10/16

Enable logic "0" (default setting). Active high - when pin is left open or pulled high, all the PSU modules are ON. Pulling pin 7 to <0.5V will turn OFF all the modules. There is an internal 2.2K ohm resistor pulling the signal to internal 3.3V supply to make the level high when pin is left floating.



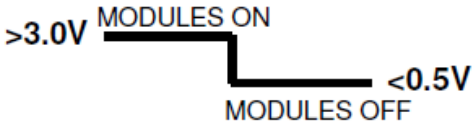
Logic signal at Pin J1-7

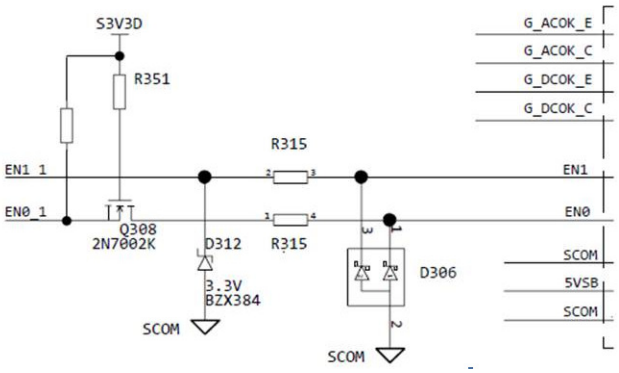


Driving J1-7 with a transistor

Global inhibit/optional enable logic "0" - (pin 7) - For µMP 04

Enable logic "0" (default setting). Active high - when pin is left open or pulled high, all the PSU modules are ON. Pulling pin 7 to <0.5V will turn OFF all the modules. There is no internal pull up to 3.3V for EN0 on µMP04. Instead level shifter is implemented for EN0 on µMP04. If EN0 pin is left floating, you will measure 3.3V on the pin.





Advantage of the level shifter will allow customer to drive EN0 flexibly.

a) Gate of 3.3V circuit

b) Gate of 5V circuit

c) Comparator/Op-amp output of 12V circuit

d) OC(Open Collector as you shown in your diagram

e) Other output or gate that will not exceed the derating of the level shifter

Note: Pin 6 and pin 7 are independent signals, both signals must assume the correct logic to turn ON the modules. By default, Pin 6 is low(when pin is floating) and pin 7 is high(when pin is floating) and all modules are ON; change the logic state of either pins to turn the output modules OFF.

Note:Case option code 3 "Global Enable" reverses the modules ON/OFF status described above.

Global inhibit/optional enable return - (pin 8)

This pin is ground reference for global enable/optional enable. It is electrically connected to pin 10 (+5VSB housekeeping Return).

+5VSB housekeeping - (pin 9)

This pin is the standby output of the power supply rated 5V/1A. This output is available everytime 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.

Case I²C Bus Signal Connector- J2

5Vcc bus - (pin 1)

This pin is an input to the µMP case, supplying 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 to allow reading of manufacturing from a non-working PSU without powering the supply. Do not supply voltage >5.5V to prevent damaging the I2C devices.

Secondary return (COM) - (pin 3)

Ground reference for the signals of J2 connector. This pin is electrical connected to pin 10(+5V V_{SB} housekeeping return of J1 connector) .

SDA, SCL (I²C Data and Clock Signals) - (pins 2,4)

Please refer to “Communication Bus Descriptions” section.

A2, A1,A0 (I²C Address BIT 2, BIT1, BIT0 Signals) - (pins 5,7,9)

Please refer to “Communication Bus Descriptions” section.

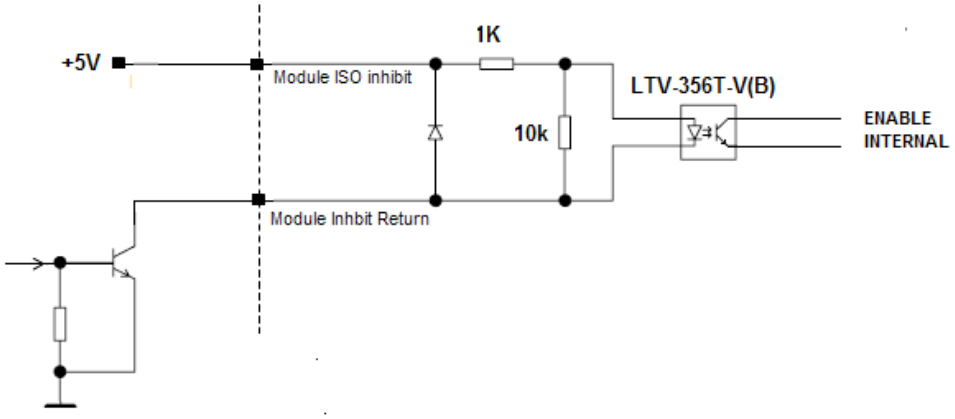
DC Output Control Signal Connector

Current Share - (pin 3)

Current share pin 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 equal current sharing. Failure to connect the current sharing pin while the output of the modules are in parallel connection can cause one or more of the modules to sink current from the other parallel modules and fail. 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 6V nominal output at full rated load.

Module Inhibit Return and Module ISO Inhibit - (pins 4,5)

Isolated Inhibit input signals use to remotely enable/disable the module, apply 5V across the Module ISO Inhibit and Module Inhibit Return to disable the module. This pin driving the diode side of an optocoupler to drive the internal enable signal, an internal 1K ohm is in series with the diode.

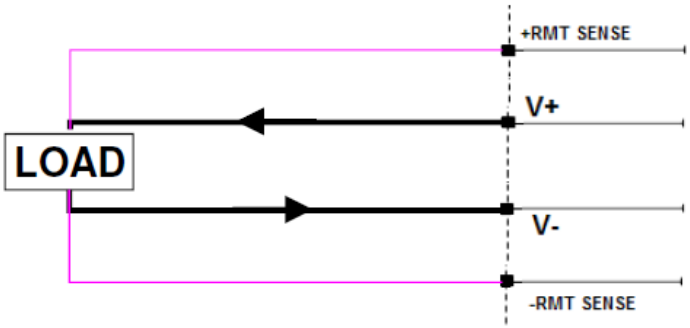


SCOM - (pin 6)

Ground Reference of the output module, this is connected to 'V-' output of the module.

- RMT sense/+RMT sense - (pins 7,10)

Remote sense of the output modules use to compensate up to 500mV of cable drop. Connect the -RMT sense and +RMT sense to the output 'V-' and 'V+' respectively at the point of load to compensate up to 500mV of voltage drop along the power lines.

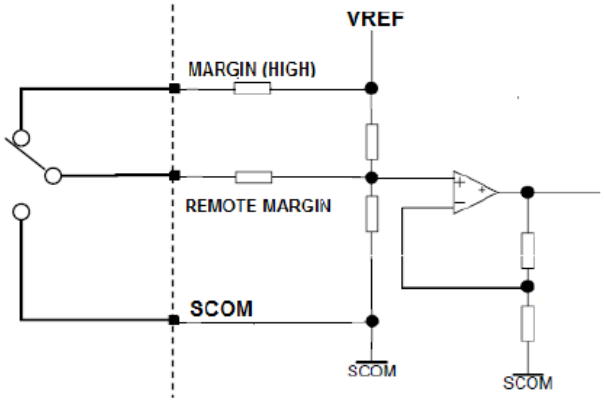


µMP Module

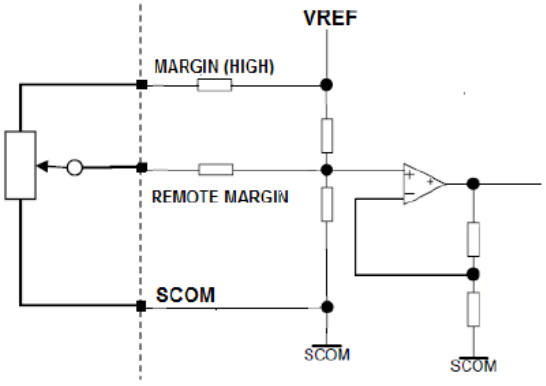
Margin and Remote margin/V prog - (pins 8,9)

Used to remotely adjust the output voltage regulation to 95% (Margin Low) or 105% (Margin High). Connect Remote margin (Pin 9) to Margin (Pin 8) to adjust voltage output level to 105% of the rated output. Connect Remote margin (Pin9) to SCOM (Pin 6) to adjust the voltage output level to 95% of the rated.

Remote margining using Single Pole Center Off switch to achieve 3 possible voltage level



Remote margining using a potentiometer to get voltage adjustment range between 95% -105% of nominal rating.



DC Output Control Signal Connector- I## Module

-RMT sense V2 / +RMT sense V2 - (pins 1,2)

Remote sense for output V2, can compensate up to 500mV cable drop. Connect the -RMT sense V2 and +RMT sense V2 to the output 'V2 COM' and 'V2+' respectively at the point of load to compensate up to 500mV of voltage drop along the power lines.

Module Inhibit Return and Module ISO Inhibit - (pins 4,5)

Refer to page 51. The Module Inhibit enable/disable both outputs.

SCOM - (pin 6)

Ground Reference of the output module, this is connected to COM of output V2.

-RMT sense V1 / +RMT sense V1 - (pins 7,10)

Remote sense for output V1, can compensate up to 500mV cable drop. Connect the -RMT sense V1 and +RMT sense V1 to the output 'V1 COM ' and 'V1+' respectively at the point of load to compensate up to 500mV of voltage drop along the power lines.

Communication Bus Descriptions

I²C Bus Signals - J2

The µMP 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.

SDA, SCL (I²C Data and Clock Signals) - (pins 2, 4)

These are pins for I2C communication and must be pulled-up in the system by 20K ohm resistor to 3.3V housekeeping; a current source pull-up can also be used. If multiple units are used inside a system, the 3.3V housekeeping 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.

A0, A1,A2 (I²C Address BIT 0, BIT1 Signals) - (pins 5,7,9)

Multiple configured µMP power supplies can be used in a single system, the power supplies can have parallel outputs or providing multiple outputs. The µMP case has three address pins allowing the system to assign different addresses to multiple PSUs used within the system. The I2C devices inside the µMP 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”.

I²C Bus Communication Interval

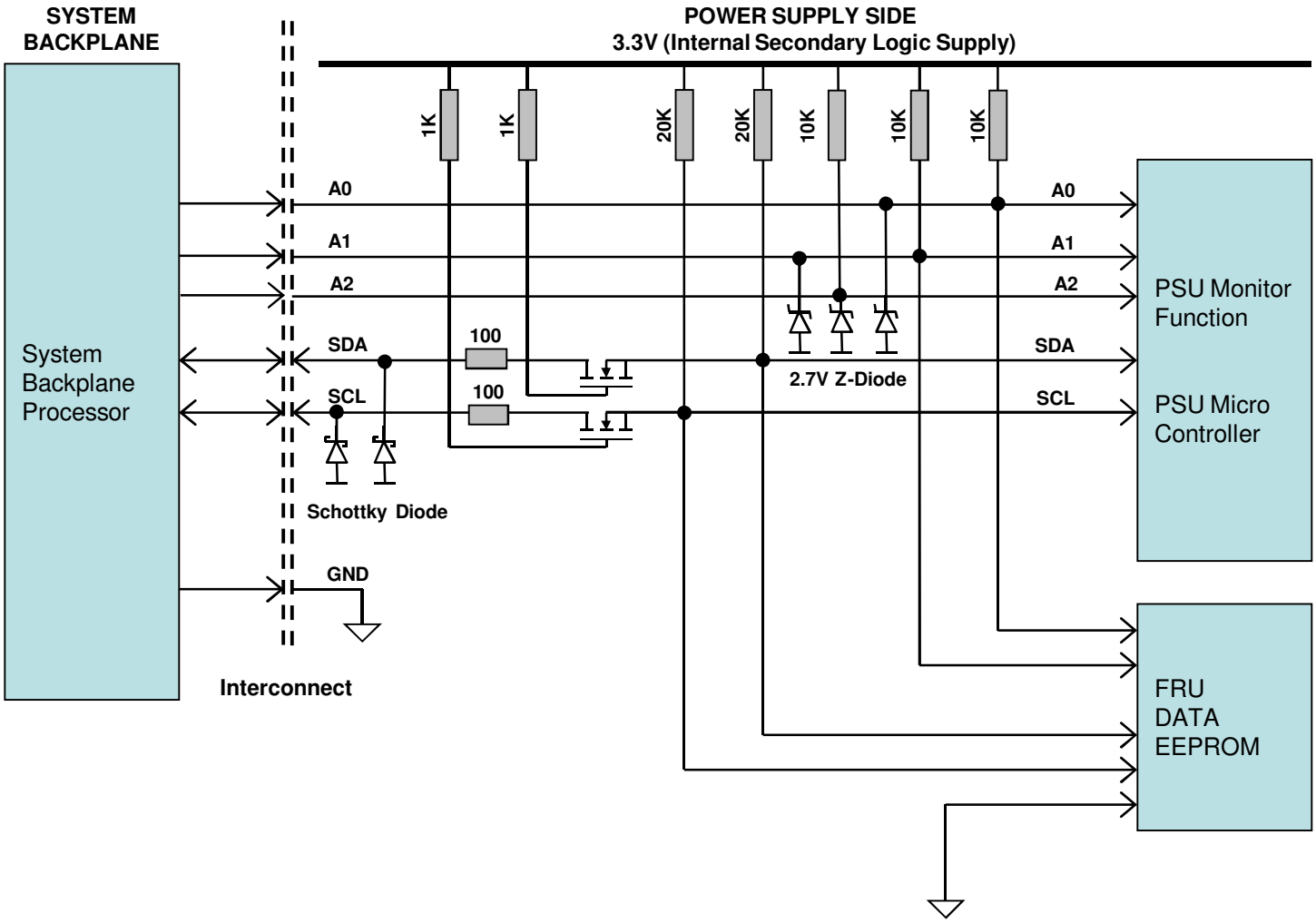
The interval between two consecutive I²C communications to the power supply should be at least 50ms to ensure proper monitoring functionality.

I²C Bus Signal Integrity

The noise on the I²C bus (SDA, SCL lines) due to the power supply will be less than 500mV peak-to-peak. This noise measurement should be made with an oscilloscope bandwidth limited to 100MHz. Measurements should be make at the power supply output connector with 2.2K ohm resistors pulled up to StandBy Output and 20pf ceramic capacitors to StandBy Output Return.

The noise on the address lines A0 and A1 will be less than 100mV 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}	-	20	-	Kohm
SDA, SCL internal bus capacitance		C_{int}	-	0	-	pF
Recommended external pull-up resistor 1 PSU	1 PSU	R_{ext}	-	2.2K	-	ohm
	8 PSU		-	0.275K	-	ohm

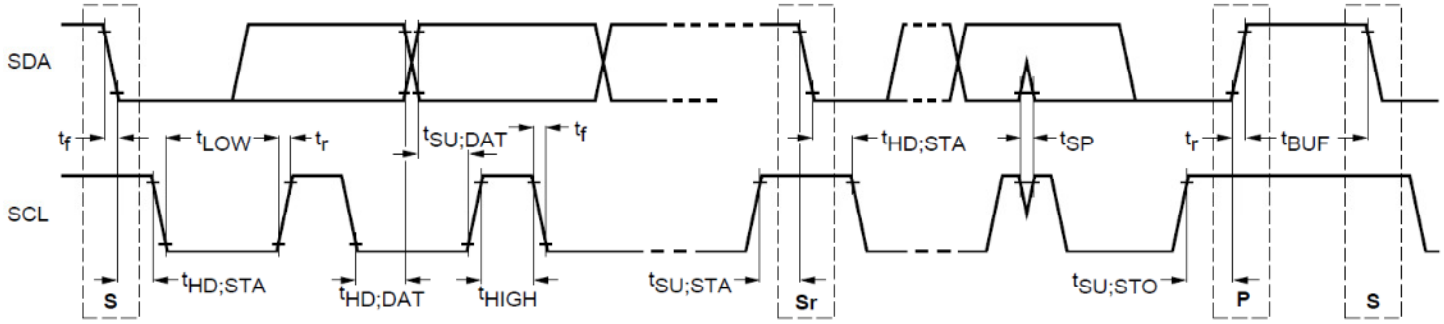
Logic Levels

µMP 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}	0	100	99		KHz
Hold time (repeated) START condition	$t_{HD;STA}$	4.0	-	4.68		µS
LOW period of SCL clock	t_{LOW}	4.7	-	14.8		µS
HIGH period of SCL clock	t_{HIGH}	4.0	-	4.1		µS
Setup time for repeated START condition	$t_{SU;STA}$	4.7	-	5.7		µS
Data hold time	$t_{HD;DAT}$	0	3.45	0.5		µS
Data setup time	$t_{SU;DAT}$	250	-	521		nS
Rise time	t_r	-	1000	SCL =896	SDA = 540	nS
Fall time	t_f	-	300	SCL = 132	SDA = 220	nS
Setup time for STOP condition	$t_{SU;STO}$	4.0	-	5.66		µS
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	31.06***		µS

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

Device Addressing

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

Address pins are held high by default via pulled up to internal 3.3V housekeeping with a 10K ohm resistor. To set the address as "0", the corresponding address line should be pulled down to logic ground level. Below tables show the address of the power supply with A0,A1 and A2 pins set to either "0" or "1".

PSU Slot	Slot ID Bits			PMBus™ Address	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

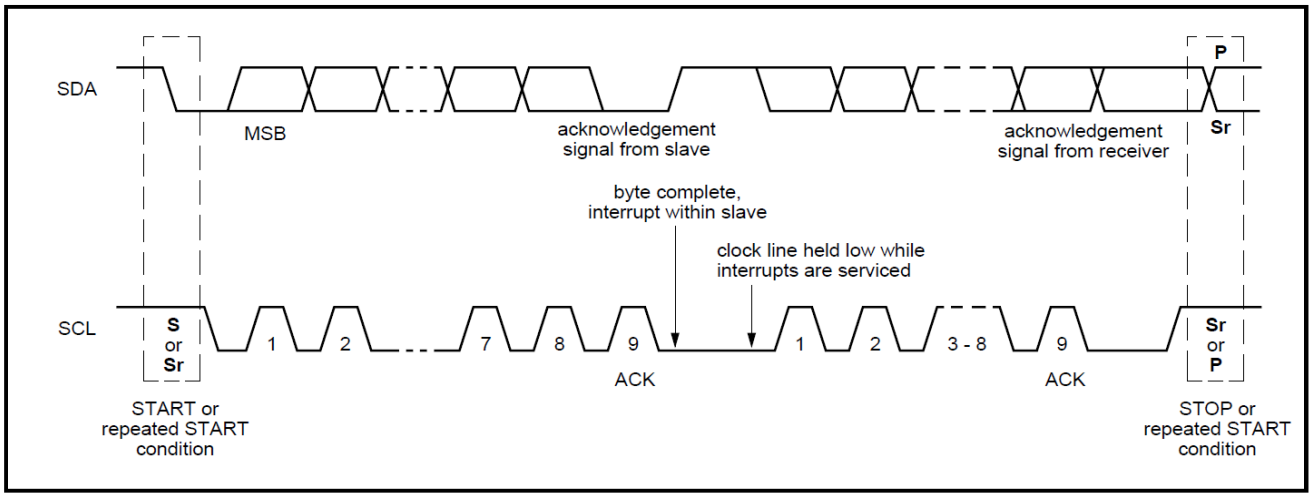
* Default PMBus™ address when A0, A1, A2 are left open.

I²C Clock Synchronization

The µMP 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 µMP is 25 millisecond.

The maximum transaction timeout condition for clock stretching for µMP is 100 millisecond.



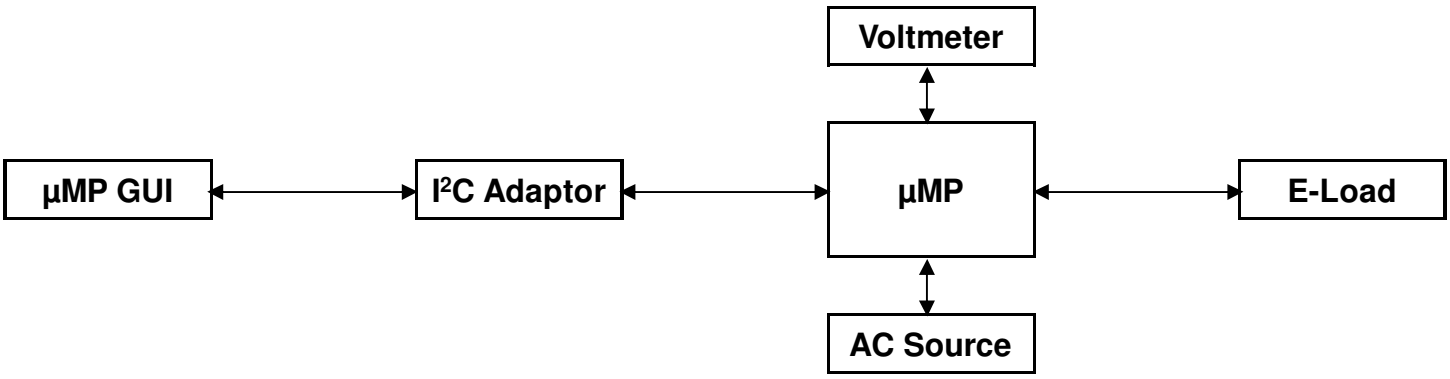
PMBus™ Interface Support

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

µMP 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

µMP Series Support PMBus™ Command List

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

µMP Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
00h	PAGE	00	R	1	Hex	
01h	OPERATION	80	R	1		Used to turn the unit ON/OFF
	b7:6	10b				
	b5:4	00b				
	b3:2	00b				
	b1:0	00b				Reserved
02h	ON_OFF_CONFIG	1E	R	1		
03h	CLEAR_FAULTS	0	S	0		
10h	WRITE_PROTECT	80	R/W	1		Used to Control Writing to the PMBus Device 80h - Disables write except 10h 40h – Disables write except 10h, 01h, 00h 20h – Disables write except 10h,01h,00h,02h 00 – Enables write to all writeable commands.
15h	STORE_USER_ALL	-	S	0		Copies the Operating memory table to the matching USER non-volatile memory.
19h	CAPABILITY	80	R	1		
35h	VIN_ON	-	R	2		Default: 82Vac
36h	VIN_OFF	-	R	2		Default: 75Vac
3Ah	FAN_ CONFIG_1_2	D5	R	1		Used to configure up to 2 fans associated with one PMBus device
3Bh	FAN_COMMAND_1	0	R/W	2	Direct	Default: 0RPM Valid Range: 0 – 32767RPM
50h	OT_FAULT_RESPONSE	78	R	1		Turn PSU OFF and will retry indefinitely
58h	VIN_UV_WARN_LIMIT	EA90	R	2	Linear	(82Vac)
59h	VIN_UV_FAULT_LIMIT	EA58	R	2	Linear	(75Vac)
5Ah	VIN_UV_FAULT_RESPONSE	F8	R	1		
78h	STATUS_BYTE	00	R	1		Returns the summary of critical faults
	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 Warning not listed in bits[7:1] has occurred.

µMP Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
79h	STATUS_WORD	0000	R	2		Summary of units Fault and warning status.
	b15 – VOUT					An output voltage fault or warning has occurred
	b14 – IOUT/POUT					An Output current or power fault or warning has occurred.
	b13 – INPUT					An input voltage, current or power fault or warning as occurred.
	b12 – MFR					A manufacturer specific fault or warning has occurred.
	b11 – Global DC OK					The Global DC OK signal is de-asserted
	b10 - FANS					A fan or airflow fault or warning has occurred.
	b9 – OTHER					A bit in STATUS_OTHER is set.
	b8 – UKNOWN					A fault type not given in bits [15:1] of the STATUS_WORD has been detected.
	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.
7Ch	STATUS_INPUT	00	R	1		Input related faults and warnings
	b7					VIN Overvoltage Fault
	b6					VIN Overvoltge Warning
	b5					VIN Undervoltage Warning
	b4					VIN Undervoltage Fault
	b3					Unit is OFF for insufficient Input Voltage
	b2					IIN Overcurrent Fault
	b1					IIN Overcurrent Warning
	b0					PIN overpower Warning
7Dh	STATUS_TEMPERATURE	00	R	1		Temperature related faults and warnings
	b7					Overtemperature Fault
	b6					Overtemperature Warning
	b5					Undertemperature Warning
	b4					Undertemperature Fault
	b3:0					reserved
7Eh	STATUS_CML	00	R	1		Communications, Logic and Memory
	b7					Invalid or unsupported Command Received
	b6					
	b5					Packet Error Check Failed
	b4					Memory Fault Detect, CRC Error
	b3					
	b2					
	b1					
	b0					

µMP Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
80h	STATUS_MFR_SPECIFIC	00	R	1		Manufacturer Status codes
	b7					Bulk OK, 1- Bulk is within range and is ready for use
	b6					Not Used
	b5					Not Used
	b4					Not Used
	b3					Not Uesd
	b2					Not Uesd
	b1					Standby Fault, 1 If there's a standby fault.
	b0					PS_ON Pin Status 1 – asserted, 0 - deasserted
81h	STATUS_FANS_1_2	00	R	1		
	b7					Fan 1 Fault
	b6					Fan 2 Fault
	b5					Fan 1 Warning
	b4					Fan 2 Warning
	b3					Fan_1 Speed Overridden
	b2					Fan_2 Speed Overridden
	b1					
	b0					
88h	READ_VIN	-	R	2	Linear	Returns input Voltage in Volts ac.
89h	READ_IIN	-	R	2	Linear	Returns input Current in Amperes
8Dh	READ_TEMPERATURE_1	-	R	2	Linear	Primary Hotspot
8Eh	READ_TEMPERATURE_2	-	R	2	Linear	Standby Hotspot
8Fh	READ_TEMPERATURE_3	-	R	2	Linear	Secondary Ambient
90h	READ_FAN_SPEED_1	-	R	2	Linear	Speed of Fan 1
91h	READ_FAN_SPEED_2	-	R	2	Linear	Speed of Fan 2
97h	READ_PIN	-	R	2	Linear	Returns the input power, in Watts.
98h	PMBUS_REVISION	22	B	1		Reads the PMBus revision number
99h	MFR_ID	"ARTESYN"	BR, ASCII	Varies		Abbrev or symbol of manufacturers name.
9Ah	MFR_MODEL	"µMP"	BR, ASCII	Varies		Manufacturers Model number, ASCII format
9Bh	MFR_REVISION	"AA"	BR, ASCII	Varies		Manufacturers, revision number, ASCII format
9Ch	MFR_LOCATION	Philippines"	BR, ASCII	Varies		Manufacturers facility, ASCII format
9Dh	MFR_Data	"xxxxxx"	BR	Varies		Manufacture Date, ASCII format structure : YYMMDD
9Eh	MFR_Serial	"xxxxxxxxxxxxx"	BR	Varies		Default: "K975YYWWSSSSSSAAP" for 73-954-0001C-G2 , "K974YYWWSSSSSSAAP" for 73-954-0001T-G2
A0h	MFR_VIN_MIN	EAA8	R	2	Linear	Minimum Input Voltage (85Vac)
A1h	MFR_VIN_MAX	FA10	R	2	Linear	Maximum Input Voltage (264Vac)
A2h	MFR_IIN_MAX	D340	R	2	Linear	Maximum Input Current (13A)
A7h	MFR_POUT_MAX	B20	R	2	Linear	Maximum Output Power (1200W)
A8h	MFR_TAMBIENT_MAX	F38D	R	2	Direct	Maximum Operating Ambient Temperature (Secondary Ambient) (70degC)
A9h	MFR_TAMBIENT_MIN	E580	R	2	Direct	Minimum Operating Ambient Temperature (Secondary Ambient) (-40degC)

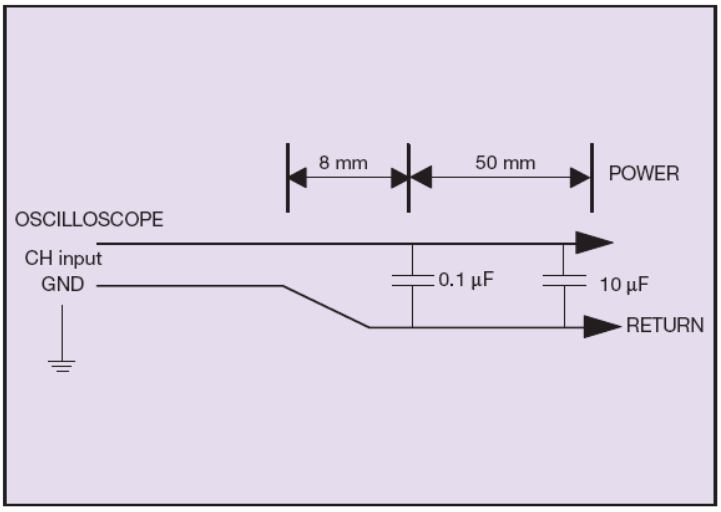
µMP Series Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
D6h	MODULE_EN_DELAY	0	BR	Varies	Linear	Default: 0 for all Modules
E0h	FW_PRI_VERSION	-	BR	8	ASCII	N/A
E1h	FW_SEC_VERSION	-	BR	8	ASCII	N/A
F1h	ISP_UNLOCK_CODE	-	BR/W	4	ASCII	00h,00h,00h,00h
F2h	ISP_CTRL_CMD	-	W	1	B	N/A
F3h	ISP_STATUS_BYTE	-	R	1	B	Varies
F4h	ISP_FLASH_ADDR	-	B	4	Raw Hex	Varies
F5h	ISP_FLASH_DATA	-	BR/W	4	Raw Hex	Varies

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



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