LPS360-M

360 Watts (forced air)
240 Watts (convection)

ITE / Medical

Total Power: 200-360 Watts
Input Voltage: 90-264 Vac
120-300 Vdc
# of Outputs: Single Main
Main Output: 12/15/24/ 36/48Vdc

Special Features

- Medical and ITE safeties
- Active power factor correction
- 3" x 5" footprint
- Less than 1U high
- EN61000-3-2 compliant
- Remote sense
- Power fail
- Adjustable main output
- Level B Conducted EMI – Class I or Class II inputs
- Overvoltage protection
- Overload protection
- Thermal overload protection
- 12V Fan output
- LPX200 enclosure kit available
- 5V Standby output
- Remote Inhibit
- PMBus™ commands
- Digital I^{2}C interface
- Class I and II approved
- Dual AC fuses
- Suitable for BF Type applications

Safety

TUV:	60950 / 60601-1
UL:	60950 / 60601-1
cULus:	60950 / 60691-1
CB:	Certificate and report
CE:	Mark for LVD and EMC
CCC:	Approval

RoHS 6/6 COMPLIANT

PMBus Power Management Defined.

Product Descriptions

The LPS360-M series power supply features a universal 90-264Vac input and also could operate from 120Vdc to 300Vdc input. The power supply produces a tightly regulated main output, together with an 12Vdc fan output. The main output can deliver up to 240W continuously with convection cooling, or up to 360W continuously with 400LFM forced air cooling. The 12V and 24V output models could be adjusted over the range +15%/-0% over nominal set output voltage. The 15V and 48V output models could be adjusted over the range +10%/-5% over nominal set output voltage. The 36V output models could be adjusted over the range +0%/-15% over nominal set output voltage. Remote sense facilities are provided to compensate for a drop of up to 0.5V between the output terminals and the load.

Active power factor correction is employed to minimize input harmonic current distortion and ensure compliance with the international EN61000-3-2 standard. The power supply has a maximum safety-ground leakage current of 300µA, and the main output has a hold-up time of 20 ms minimum when the supply is fed with a 220Vac input and is delivering 240Watts of output power.

LPS360-M series power supply is comprehensively protected against overvoltage, over temperature and short-circuit conditions, and feature a power fail signal for remote monitoring purposes which will change state at least 6 ms before the main output loses regulation. The power supplies have a full load ambient operating temperature range of -20 ^{O}C to +50 ^{O}C without derating at 400LFM. Operation between 50 ^{O}C and 70 ^{O}C, the output should be derated by 2.5 percent per ^{O}C. When the loading on Standby output is ≤ 1A, the power supply could startup at -40 ^{O}C. When the loading on Standby output is $>$ 1A, the LPS360-M series power supply could startup at -30 ^{O}C.

Model Numbers

Standard	Output Voltage	Minimum Load	Maximum Load Convection Cooling	Maximum Load Forced Air 400LFM	Peak Load[1]
LPS363-M	12V	0A	20A	30A	39A
LPS364-M	15V	0A	16A	24A	31A
LPS365-M	24V	0A	10A	15A	19.5A
LPS366-M	36V	0A	6.25A[2]	11.25A[2]	14.62A
LPS368-M	48V	0A	5A	7.5A	9.75A

Note 1 - Peak current lasting <3 seconds
2 - LPS366-M is limited to the lower of the applicable power rating or current rating, which results in lowest power

Options

1.Enclosure Kit: LPX200

2.The Artesyn Connector Kit for J3,J4,J5,J6: 70-841-029

3.The Artesyn Digital connector kit: 73-769-005 (Including 73-841-030 and 73-769-001 per below)

4. I^2C Mating Connector with cable: 73-841-030

5. USB to I^2C Adapter with USB cable: 73-769-001

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 DC continuous operation	 All Models All Models	 $V_{IN,AC}$ $V_{IN,DC}$	 90 120	 - -	 264 300	 Vac Vdc
Maximum Output Power (Main + Fan) Convection continuous operation	All Models	$P_{O,maxCC}$	-	-	240	W
Maximum Output Power (Main + Fan) Force air continuous operation – 400LFM	All Models	$P_{O,maxFA}$	-	-	360	W
Isolation Voltage Input to outputs Input to safety ground Outputs to output ground Main output to safety ground	 All Models All Models All Models All Models		 - - - -	 - - - -	 4000 1500 100 1500	 Vac Vac Vdc Vac
Ambient Operating Temperature	All Models	T_A	-20	-	+70[1]	^{O}C
Cold Start-up Temperature	All Models	T_{ST}	-30/-40[2]	-	-	^{O}C
Storage Temperature	All Models	T_{STG}	-40	-	+85	^{O}C
Humidity (non-condensing) Operating Non-operating	 All Models All Models		 10 10	 - -	 90 95	 % %
Altitude Operating Non-operating	 All Models All Models		 -200 -300	 - -	 5,000 16,000	 Meters Meters

Note 1 - Derate each output at 2.5% per ^{O}C from 50 ^{O}C to 70 ^{O}C
Note 2 - -40 ^{O}C startup if Standby output ≤ 1A (any valid load on main output); -30 ^{O}C startup if Standby output > 1A (any valid load on main output)

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC	All	$V_{IN,AC}$	90	115/230	264	Vac
Input AC Frequency	All	$f_{IN,AC}$	47	50/60	63	Hz
Operating Input Voltage, DC	All	$V_{IN,DC}$	120	-	300	Vdc
Maximum Input Current ($I_O = I_{O,maxFA}$, $I_{SB} = I_{SB,maxFA}$)	$V_{IN,AC}$ = 90Vac	$I_{IN,max}$	-	-	5	A_{PK}
No Load Input Current (V_O = ON, I_O = 0, I_{FAN} = 0)	$V_{IN,AC}$ = 90Vac $V_{IN,AC}$ = 264Vac	$I_{IN,no\text{-}load}$	- -	- -	100 250	mA
No Load Input Power (V_O = ON, I_O = 0, I_{FAN} = 0)	$V_{IN,AC}$ = 115/230Vac	$P_{IN,no\text{-}load}$	-	-	2.5	W
Harmonic Line Currents	All	THD	Per EN61000-3-2			
Power Factor	$I_O = I_{O,maxFA}$ $V_{IN,AC}$ = 115Vac	PF	-	0.99	-	
Startup Surge Current (Inrush) @ 25 ^{O}C	$V_{IN,AC}$ = 230Vac	$I_{IN,surge}$	-	-	50	A_{PK}
Input Fuse	Internal, L and N 500Vdc/500Vac		-	-	8	A
Input AC Low Line Start-up Voltage	$I_O = I_{O,maxFA}$	$V_{IN,AC\text{-}start}$	84	-	89	Vac
Input AC Undervoltage Lockout Voltage	$I_O = I_{O,maxFA}$	$V_{IN,AC\text{-}stop}$	70	-	80	Vac
Input DC Low Line Start-up Voltage	$I_O = I_{O,maxFA}$	$V_{IN,DC\text{-}start}$	118	-	125	Vdc
Input DC Undervoltage Lockout Voltage	$I_O = I_{O,maxFA}$	$V_{IN,DC\text{-}stop}$	110	-	115	Vdc
PFC Switching Frequency	All	$f_{SW,PFC}$	-	72	-	KHz
Efficiency @ 25 ^{O}C	$V_{IN,AC}$ = 230Vac $I_O = I_{O,maxFA}$	η	-	93	-	%

Input Specifications

Table 2. Input Specifications con't:

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Hold Up Time	$V_{IN,AC}$ = 220Vac P_O = 240W	$t_{Hold\text{-}Up}$	20	-	-	mSec
	$V_{IN,AC}$ = 220Vac P_O = 360W	$t_{Hold\text{-}Up}$	12	-	-	mSec
Turn On Delay	$V_{IN,AC}$ = 90Vac P_O = $P_{O,max}$	$t_{Turn\text{-}On}$	-	-	2	Sec
Leakage Current to safety ground	(V_{IN} = 132Vac, $f_{IN,AC}$ = 50/60 Hz)	$I_{IN,leakage}$	-	-	150	uA
	(V_{IN} = 264Vac, $f_{IN,AC}$ = 50/60 Hz)	$I_{IN,leakage}$	-	-	300	uA
System Stability Phase Margin Gain Margin	330µF/A Capacitive Load		45 10		- -	Ø dB

Output Specifications

Table 3. Output Specifications:

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Output Regulation		Inclusive of setpoint, line, load temperature change, warm-up drift and cross regulation	$\%V_O$	-2.0	-	+2.0	%
			$\%V_{SB}$	-5.0	-	+5.0	
			$\%V_{FAN}$	-5.0	-	+5.0	
Output Adjust Range[1]	LPS363-M LPS364-M LPS365-M LPS366-M LPS368-M	$I_O = 0$	$\%V_O$	-0 -5 -0 -15 -5	- - - -	+15 +10 +15 +0 +10	%
Output Ripple, pk-pk	LPS363-M LPS364-M LPS365-M LPS366-M LPS368-M	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor	V_O	- - - - -	- - - - -	120 150 240 360 480	mV_{PK-PK}
	All Models		V_{SB}	-	-	50	
			V_{FAN}	-	-	120	
Convection Output Current, continuous	LPS363-M LPS364-M LPS365-M LPS366-M LPS368-M	Convection cooling	$I_{O,maxCC}$	- - - - -	- - - - -	20 16 10 6.25 5	A
	All Models		$I_{SB,maxCC}$	-	-	1	
			$I_{FAN,maxCC}$	-	-	0.5	
Force Air Output Current, continuous	LPS363-M LPS364-M LPS365-M LPS366-M LPS368-M	400 LFM force air cooling	$I_{O,maxFA}$	- - - - -	- - - - -	30 24 15 11.25 7.5	A
	All Models		$I_{SB,maxFA}$	-	-	2	
			$I_{FAN,maxFA}$	-	-	1	
Output Current, peak	LPS363-M LPS364-M LPS365-M LPS366-M LPS368-M	Maximum duration of 30 seconds with maximum duty cycle of 10%	$I_{O,peak}$	- - - -	- - - -	39 31 19.5 14.62 9.75	A
V_O Turn On Overshoot[2]	All Models	$I_O = 0, I_{SB}=0, I_{FAN} = 0$	V_O	-	-	3	%V

Note 1 - The adjust pot shown on page 23
2 - The worst case overshoot is less than $3\%V_o$ or 150mV

Output Specifications con't

Table 3. Output Specifications con't:

Parameter		Condition	Symbol	Min	Typ	Max	Unit
V_O Dynamic Response - Peak Deviation	LPS363-M	50% (50% to 100% of $I_{O,maxFA}$) load change Slew rate = 1A/µS Output capacitance = 100µF/A	±%V_O	-	-	3	%
	Other Models			-	-	4	
V_O Dynamic Response - Setting Time		50% (50% to 100% of $I_{O,maxFA}$) load change Slew rate = 1A/µs Output capacitance = 100µF/A	t_s	-	-	500	µSec
Maximum Convection Output Power, continuous		Main output + fan output + Standby output	$P_{O,maxCC}$	-	-	240	W
Maximum Force air Output Power, continuous		Main output + fan output + Standby output , 400LFM	$P_{O,maxFA}$	-	-	360	W
V_O Capacitive Load		Start up	-	0	-	330	µF/A
V_O Long Term Stability		Max change over 24 hours after thermal equilibrium (30 mins)	±%V_O	-	-	1.0	%
V_O Over Voltage Protection		Latch off (AC recycle to reset)	%V_O	115	-	150	%
V_O Over Current Protection		All	%I_O	110	-	160	%
Over Temperature Protection		All		Auto Recovery			
Short Circuit Protection		All		Auto Recovery			
DCDC Switching Frequency		All	$f_{SW,DC-DC}$	70	-	130	KHz
Remote Sense, + and -		Maximum compensation at each output line	V_{SENSE}	-	-	500	mV

LPS363-M Performance Curves

Figure 1: LPS363-M Turn-on delay
V_{IN} = 90Vac Load: I_O = 30A, I_{SB}= 1A
Ch 1: V_{IN} Ch 2: V_O Ch3: V_{SB} Ch4:Power Fail

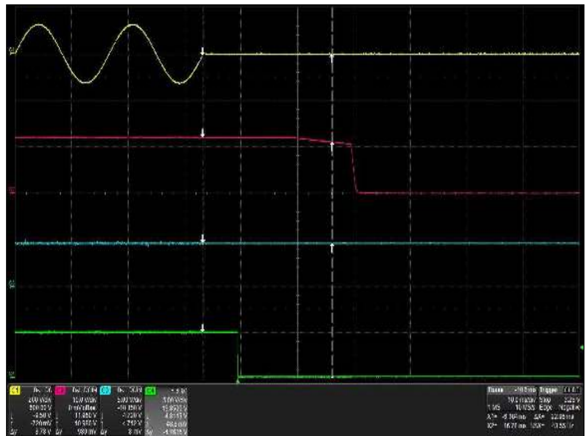


Figure 2: LPS363-M Hold-up Time (time to delay)
V_{IN} = 90Vac Load: I_O = 30A, I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_O Ch3: V_{SB} Ch4:Power Fail

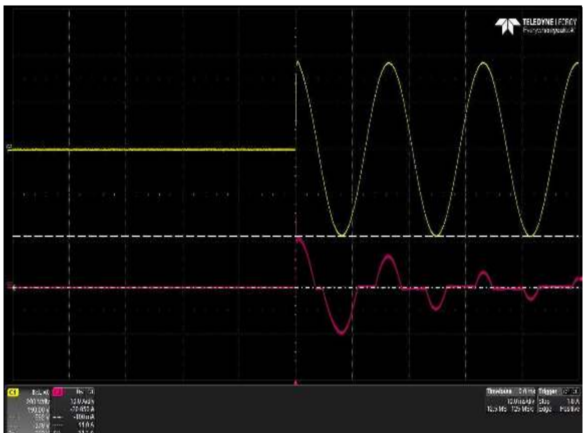


Figure 3: LPS363-M Inrush Current
V_{IN} = 264Vac Load: I_O = 0A, Turn on angle = 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

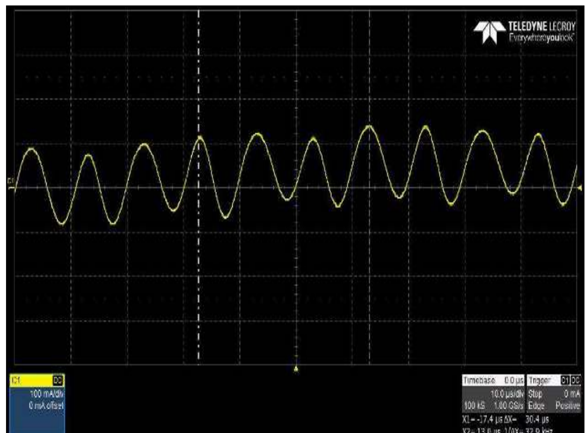


Figure 4: LPS363-M Input Current Ripple Waveform
V_{IN} = 220Vac Load: I_O = 30A
Ch 1: I_{IN}

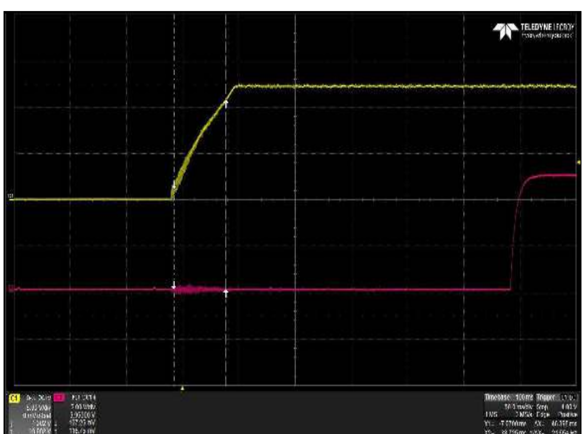


Figure 5: LPS363-M Output Voltage Startup Characteristic
V_{IN} = 90Vac Load: I_O = 30A, Output Capacitance = 330uF/A
Ch 1: V_O Ch 2: Power Fail

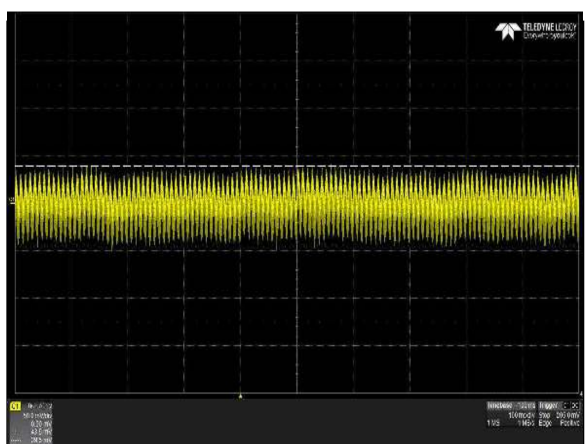


Figure 6: LPS363-M Ripple and Noise Measurement
V_{IN} = 115Vac Load: I_O = 30A,
Ch 1: V_O

LPS363-M Performance Curves

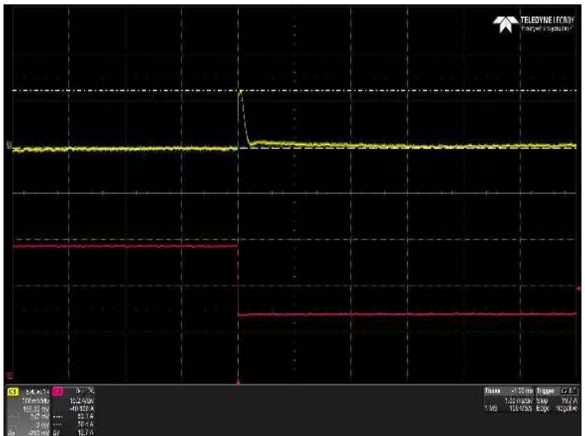


Figure 7: LPS363-M Transient Response – Vo Deviation (High to Low)
V_{IN} = 90Vac Load: I_O = 100% to 50% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

Figure 8: LPS363-M Transient Response – Vo Deviation (Low to High)
V_{IN} = 90Vac Load: I_O = 50% to 100% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

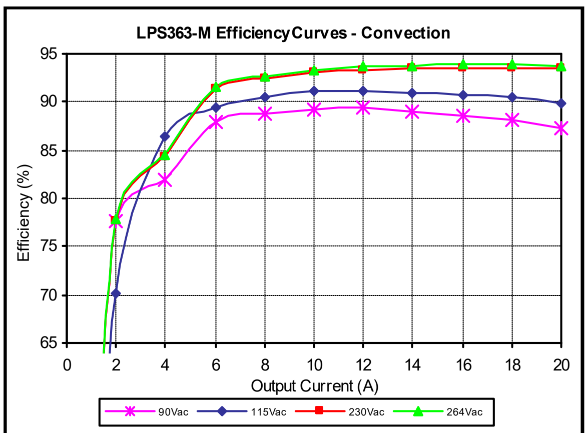


Figure 9: LPS363-M Efficiency Curves @ 25 degC, Convection Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 20A

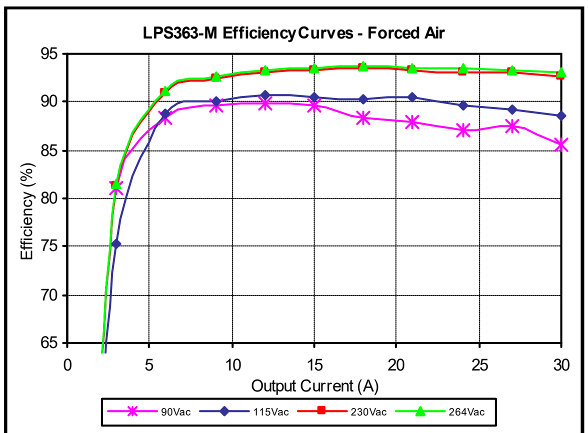


Figure 10: LPS363-M Efficiency Curves @ 25 degC, Forced Air Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 30A, Fan=400LFM

LPS364-M Performance Curves

Figure 11: LPS364-M Turn-on delay
V_{IN} = 90Vac Load: I_O = 24A, I_{SB}= 1A
Ch 1: V_{IN} Ch 2: V_O Ch3: V_{SB} Ch4:Power Fail

Figure 12: LPS364-M Hold-up Time (time to delay)
V_{IN} = 90Vac Load: I_O = 24A, I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_O Ch3: V_{SB} Ch4:Power Fail

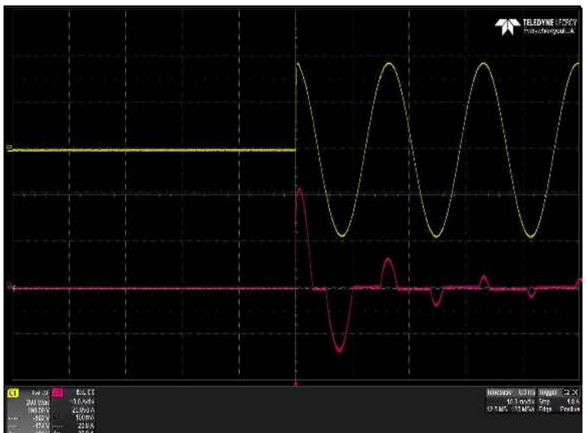


Figure 13: LPS364-M Inrush Current
V_{IN} = 264Vac Load: I_O = 0A, Turn on Angle = 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

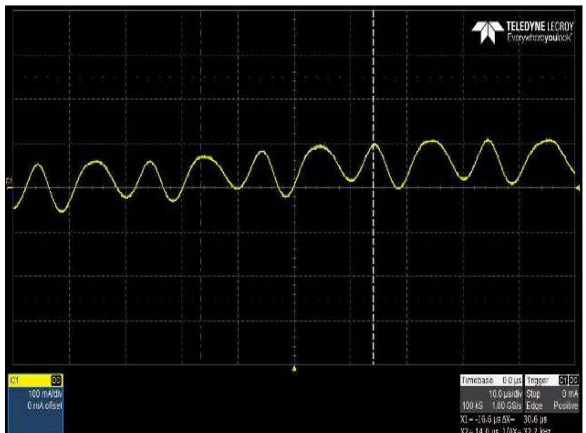


Figure 14: LPS364-M Input Current Ripple Waveform
V_{IN} = 220Vac Load: I_O = 24A
Ch 1: I_{IN}

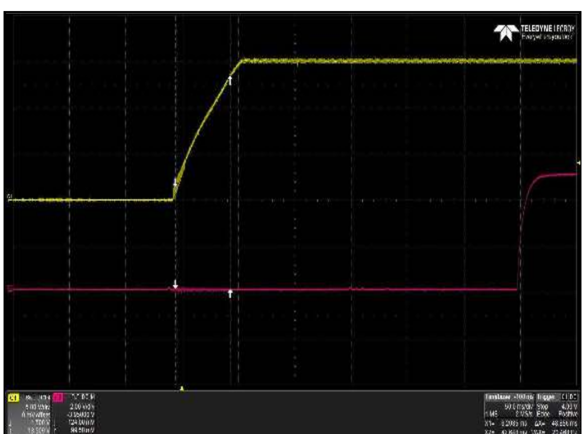


Figure 15: LPS364-M Output Voltage Startup Characteristic
V_{IN} = 90Vac Load: I_O = 24A, Output Capacitance = 330uF/A
Ch 1: V_O Ch2: Power Fail

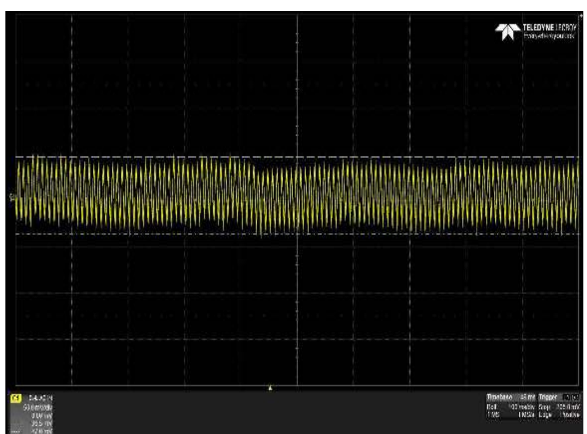


Figure 16: LPS364-M Ripple and Noise Measurement
V_{IN} = 115Vac Load: I_O = 24A
Ch 1: V_O

LPS364-M Performance Curves

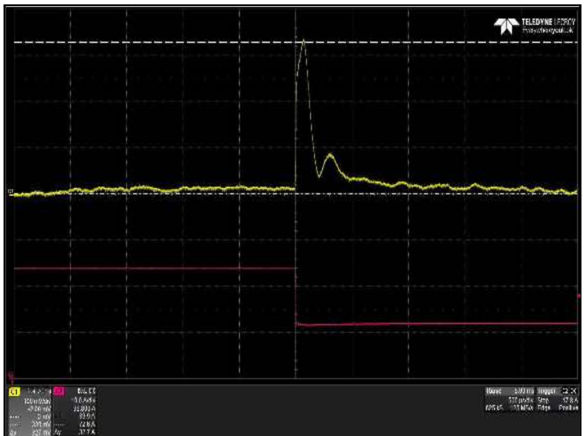


Figure 17: LPS364-M Transient Response – Vo Deviation (High to Low)
V_{IN} = 90Vac Load: I_O = 100% to 50% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

Figure 18: LPS364-M Transient Response – Vo Deviation (Low to High)
V_{IN} = 90Vac Load: I_O = 50% to 100% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

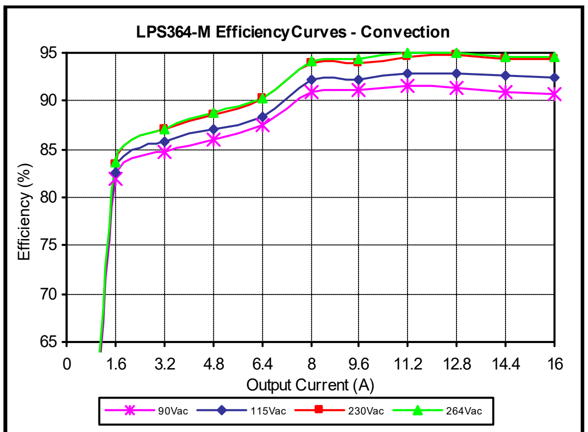


Figure 19: LPS364-M Efficiency Curves @ 25 degC, Convection Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 16A

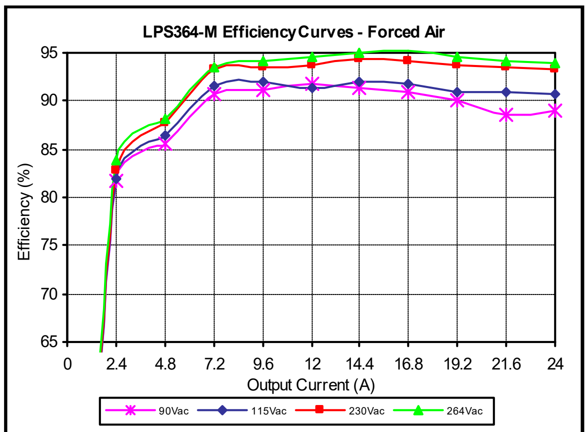


Figure 20: LPS363-M Efficiency Curves @ 25 degC, Forced Air Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 24A, Fan=400LFM

LPS365-M Performance Curves

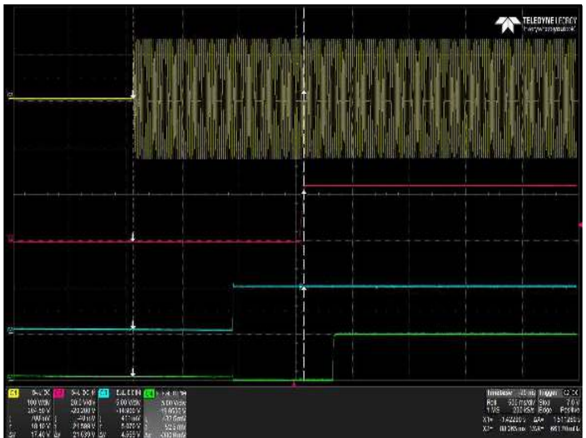


Figure 21: LPS365-M Turn-on delay
V_{IN} = 90Vac Load: I_O = 15A, I_{SB}= 1A
Ch 1: V_{IN} Ch 2: V_O Ch3: V_{SB} Ch4:Power Fail

Figure 22: LPS365-M Hold-up Time (time to delay)
V_{IN} = 90Vac Load: I_O = 15A, I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_O Ch3: V_{SB} Ch4:Power Fail

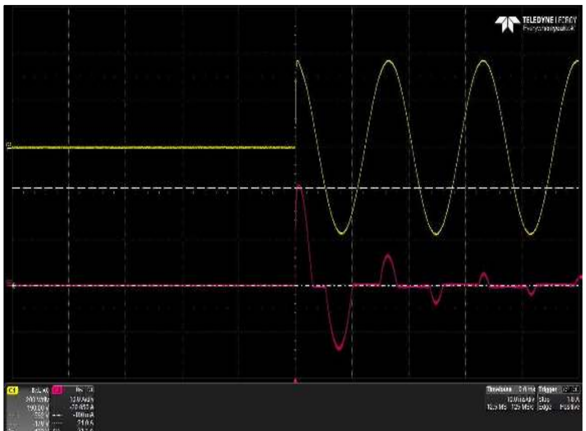


Figure 23: LPS365-M Inrush Current
V_{IN} = 264Vac Load: I_O = 0A, Turn on Angle = 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

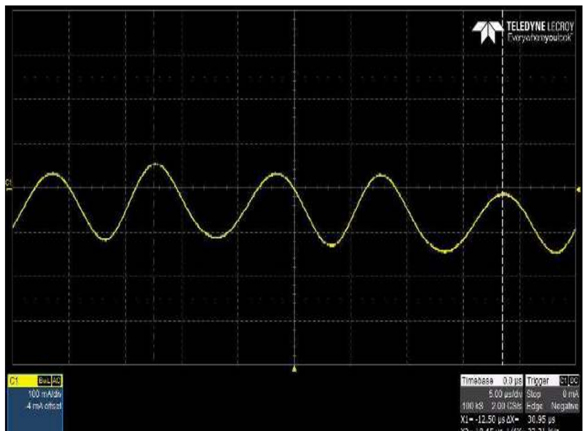


Figure 24: LPS365-M Input Current Ripple Waveform
V_{IN} = 220Vac Load: I_O = 15A
Ch 1: I_{IN}

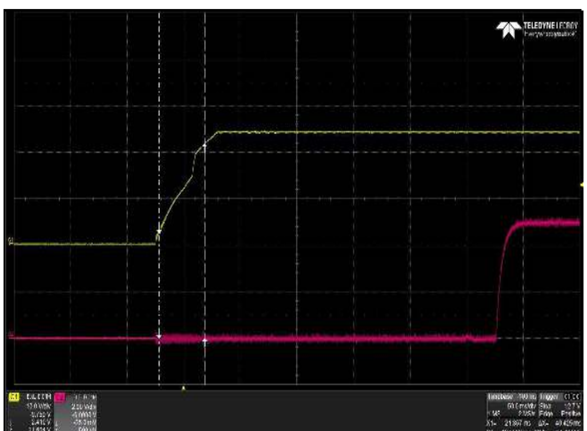


Figure 25: LPS365-M Output Voltage Startup Characteristic
V_{IN} = 90Vac Load: I_O = 15A, Output Capacitance = 330uF/A
Ch 1: V_O Ch2: Power Fail

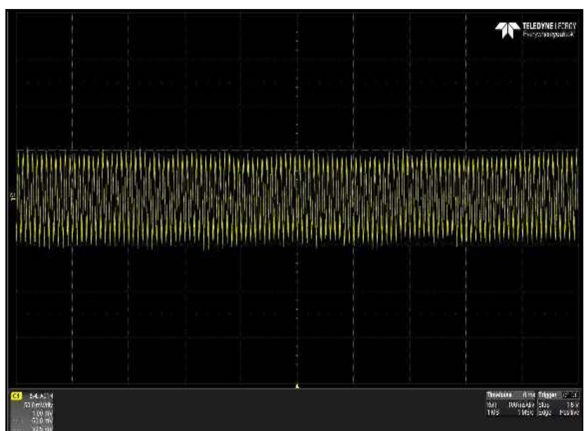


Figure 26: LPS365-M Ripple and Noise Measurement
V_{IN} = 90Vac Load: I_O = 15A
Ch 1: V_O

LPS365-M Performance Curves

Figure 27: LPS365-M Transient Response – Vo Deviation (High to Low)
V_{IN} = 90Vac Load: I_O = 100% to 50% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

Figure 28: LPS365-M Transient Response – Vo Deviation (Low to High)
V_{IN} = 90Vac Load: I_O = 50% to 100% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

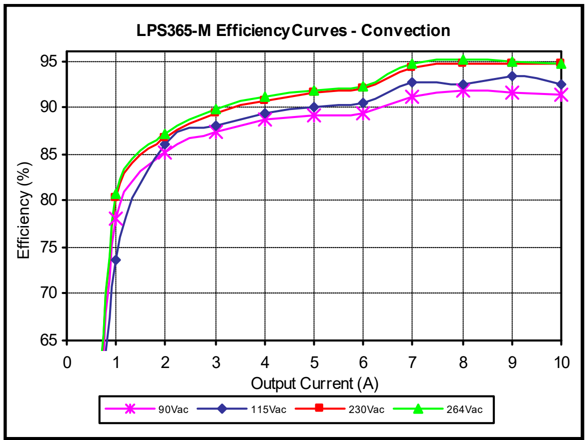


Figure 29: LPS365-M Efficiency Curves @ 25 degC, Convection Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 10A

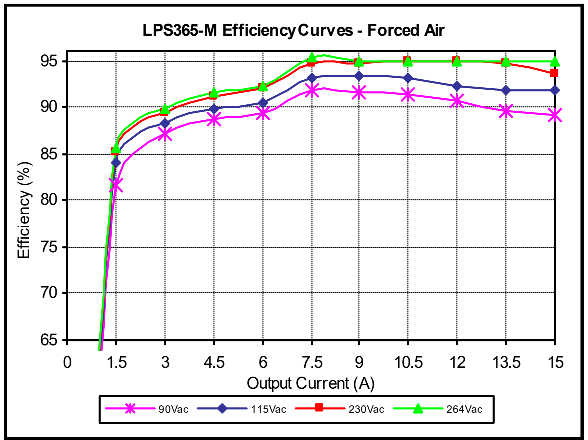


Figure 30: LPS365-M Efficiency Curves @ 25 degC, Forced Air Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 15A, Fan=400LFM

LPS366-M Performance Curves

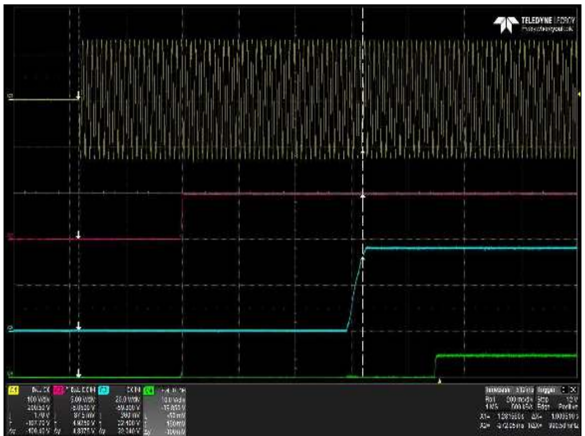


Figure 31: LPS366-M Turn-on delay
V_{IN} = 90Vac Load: I_O = 10A, I_{SB}= 1A
Ch 1: V_{IN} Ch 2: V_{SB} Ch3: V_O Ch4:Power Fail

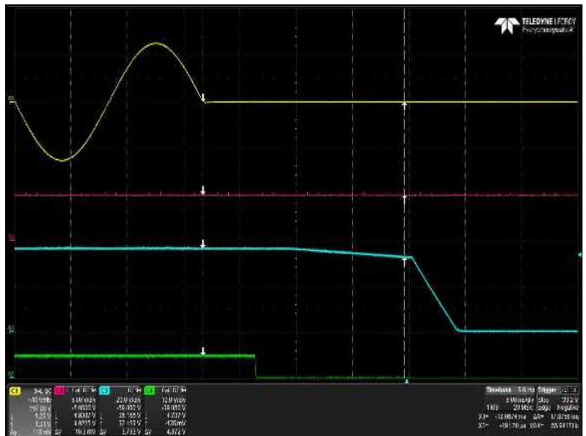


Figure 32: LPS366-M Hold-up Time (time to delay)
V_{IN} = 90Vac Load: I_O = 10A, I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_{SB} Ch3: V_O Ch4:Power Fail

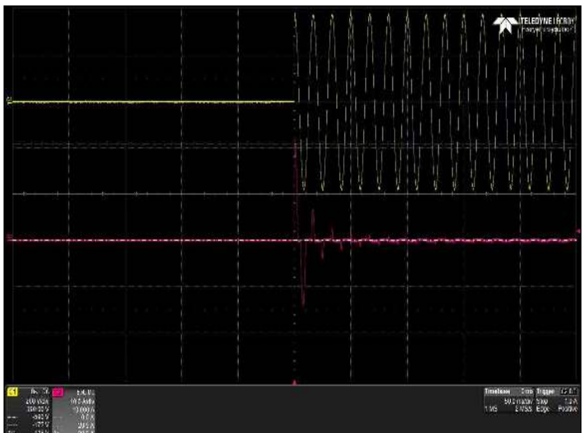


Figure 33: LPS366-M Inrush Current
V_{IN} = 264Vac Load: I_O = 0A, Turn on Angle = 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

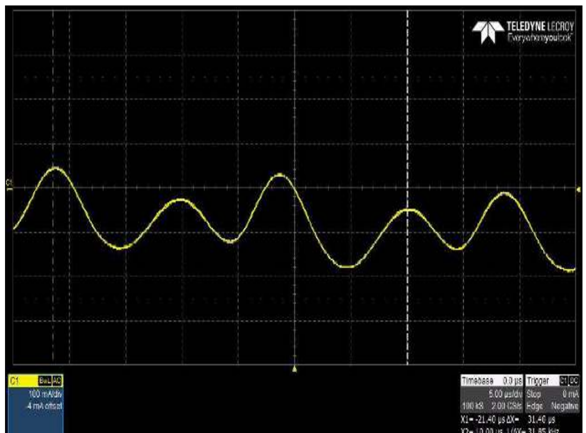


Figure 34: LPS366-M Input Current Ripple Waveform
V_{IN} = 220Vac Load: I_O = 10A
Ch 1: I_{IN}

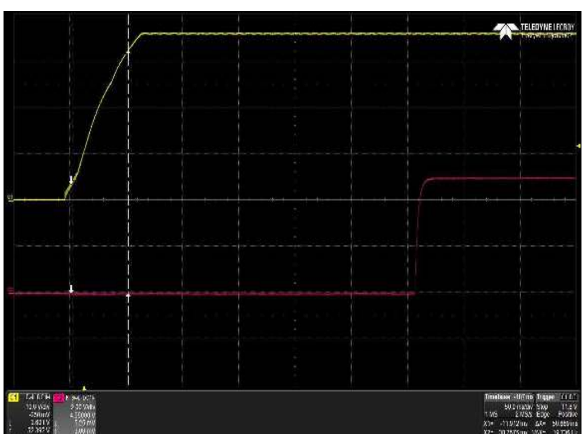


Figure 35: LPS366-M Output Voltage Startup Characteristic
V_{IN} = 90Vac Load: I_O = 10A, Output Capacitance = 330uF/A
Ch 1: V_O Ch2: Power Fail

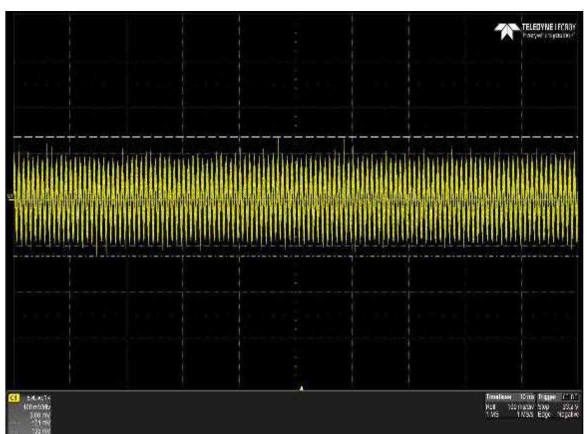


Figure 36: LPS366-M Ripple and Noise Measurement
V_{IN} = 90Vac Load: I_O = 10A
Ch 1: V_O

LPS366-M Performance Curves

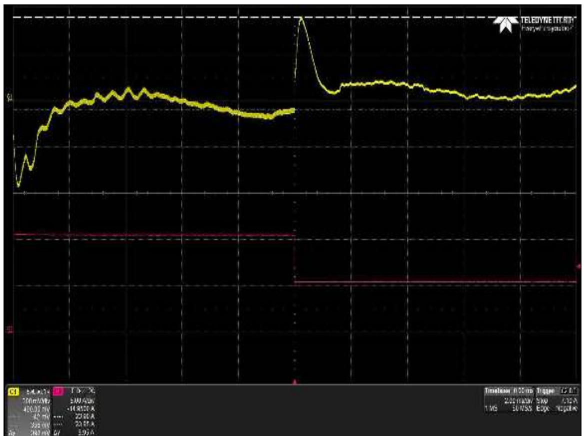


Figure 37: LPS366-M Transient Response – Vo Deviation (High to Low)
V_{IN} = 90Vac Load: I_O = 100% to 50% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

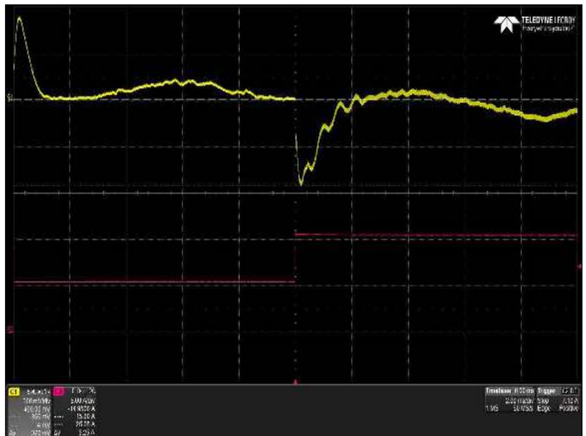


Figure 38: LPS366-M Transient Response – Vo Deviation (Low to High)
V_{IN} = 90Vac Load: I_O = 50% to 100% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

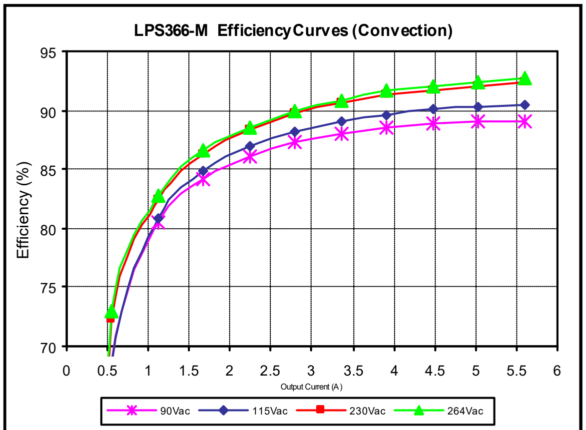


Figure 39: LPS366-M Efficiency Curves @ 25 degC, Convection Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 5.6A

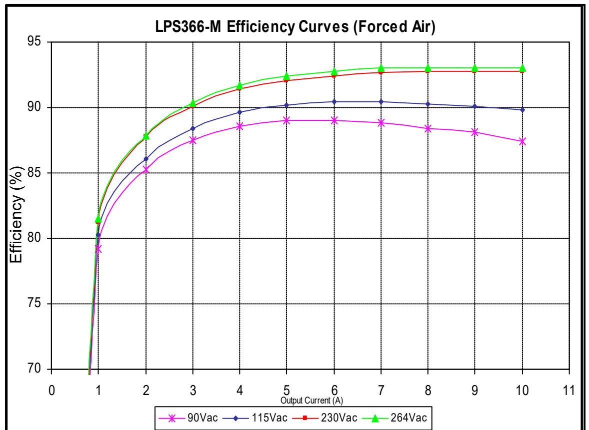


Figure 40: LPS366-M Efficiency Curves @ 25 degC, Forced Air Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 10A, Fan=400LFM

LPS368-M Performance Curves

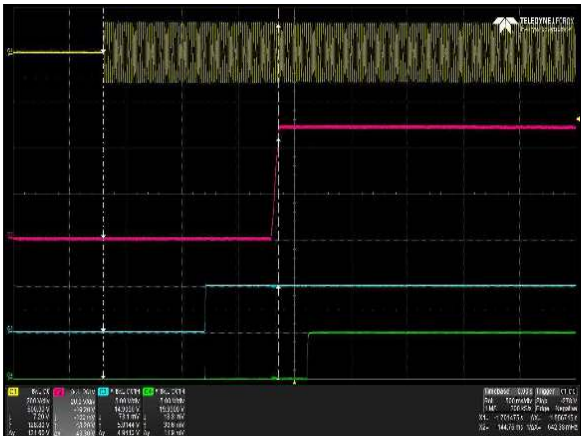


Figure 41: LPS368-M Turn-on delay
V_{IN} = 90Vac Load: I_O = 7.5A, I_{SB}= 1A
Ch 1: V_{IN} Ch 2: V_O Ch3: V_{SB} Ch4:Power Fail

Figure 42: LPS368-M Hold-up Time (time to delay)
V_{IN} = 90Vac Load: I_O = 7.5A, I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_O Ch3: V_{SB} Ch4:Power Fail

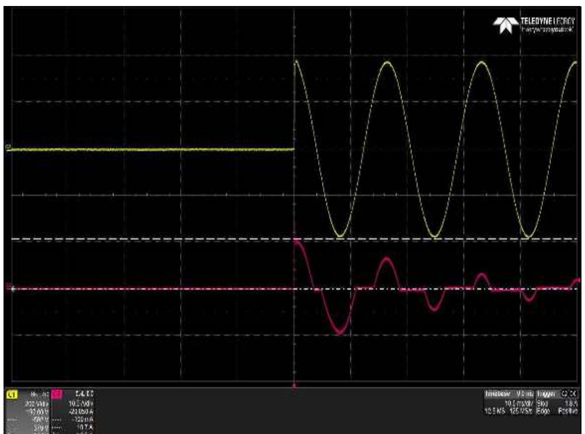


Figure 43: LPS368-M Inrush Current
V_{IN} = 264Vac Load: I_O = 0A, Turn on Angle = 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

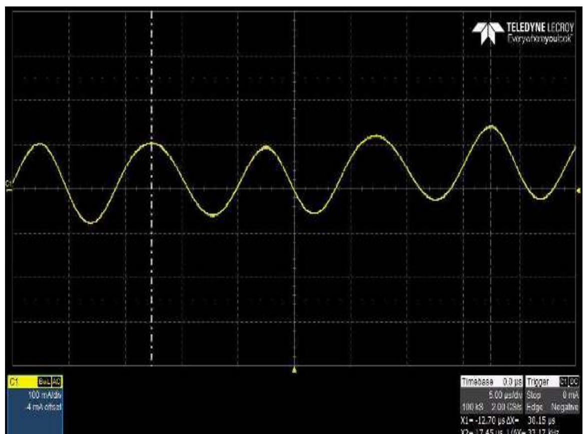


Figure 44: LPS368-M Input Current Ripple Waveform
V_{IN} = 220Vac Load: I_O = 7.5A
Ch 1: I_{IN}

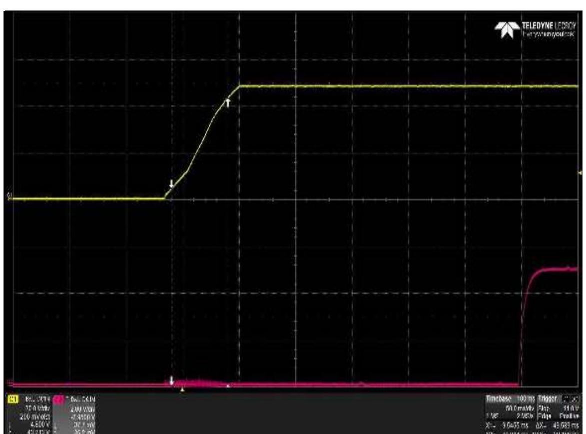


Figure 45: LPS368-M Output Voltage Startup Characteristic
V_{IN} = 90Vac Load: I_O = 7.5A, Output Capacitance = 330uF/A
Ch 1: V_O Ch2: Power Fail

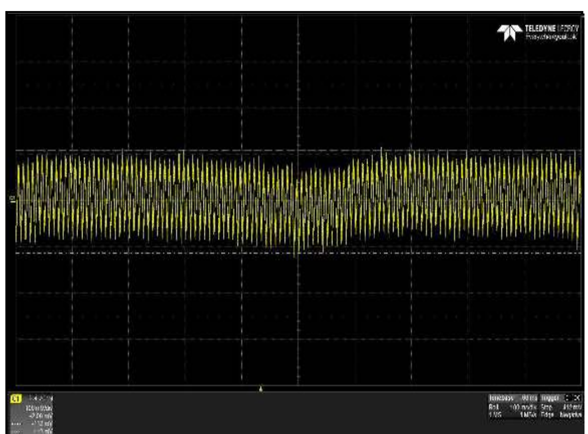


Figure 46: LPS368-M Ripple and Noise Measurement
V_{IN} = 90Vac Load: I_O = 7.5A
Ch 1: V_O

LPS368-M Performance Curves

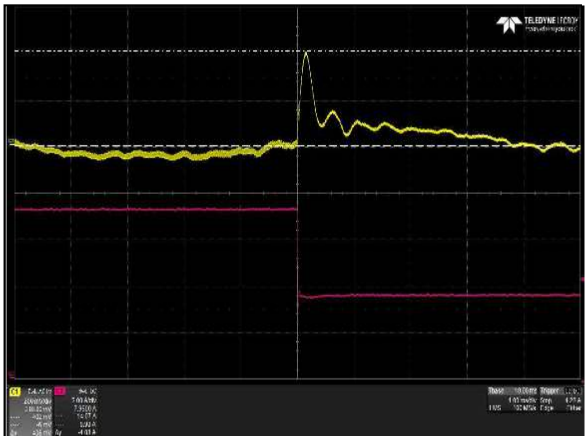


Figure 47: LPS368-M Transient Response – Vo Deviation (High to Low)
V_{IN} = 90Vac Load: I_O = 100% to 50% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

Figure 48: LPS368-M Transient Response – Vo Deviation (Low to High)
V_{IN} = 90Vac Load: I_O = 50% to 100% load change, 1A/us slew rate
Ch 1: V_O Ch 2: I_O

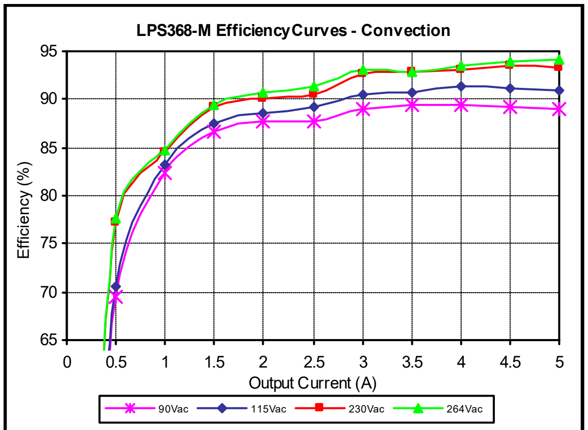


Figure 49: LPS368-M Efficiency Curves @ 25 degC, Convection Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 5.6A

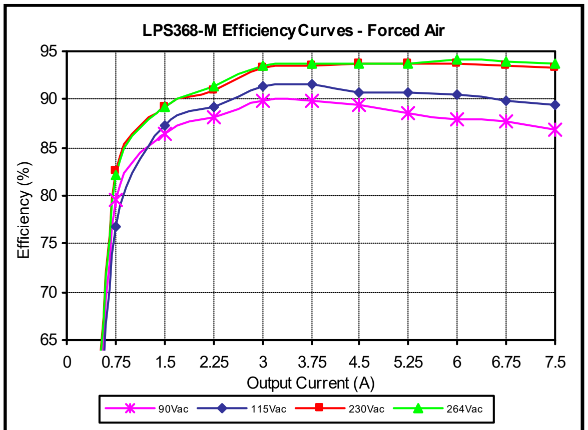


Figure 50: LPS368-M Efficiency Curves @ 25 degC, Forced Air Cool
V_{IN} = 90 to 264Vac Load: I_O = 0 to 7.5A, Fan=400LFM

Protective Function Specifications

Input Fusing

Protective Fuse is provided on the “Line” and “Neutral” side of the primary line of each power supply. 500Vdc/500Vac and 8A rated.

Over Voltage Protection (OVP)

The LPS360-M series power supply main output will latch off during output overvoltage with the AC line recycled to reset the latch.

LPS360-M

Parameter	Min	Nom	Max	Unit
V_O Output Overvoltage	130%	/	150%	V_O

Over Current Protection (OCP)

The LPS360-M series power supply includes internal current limit circuitry to prevent damage in the event of overload or short circuit. The OCP mode is hiccup. Recovery is automatic when the overload is removed.

LPS360-M

Parameter	Min	Nom	Max	Unit
V_O Output Overcurrent	110	/	160	$\%I_{O,max}$

Short Circuit Protection (SCP)

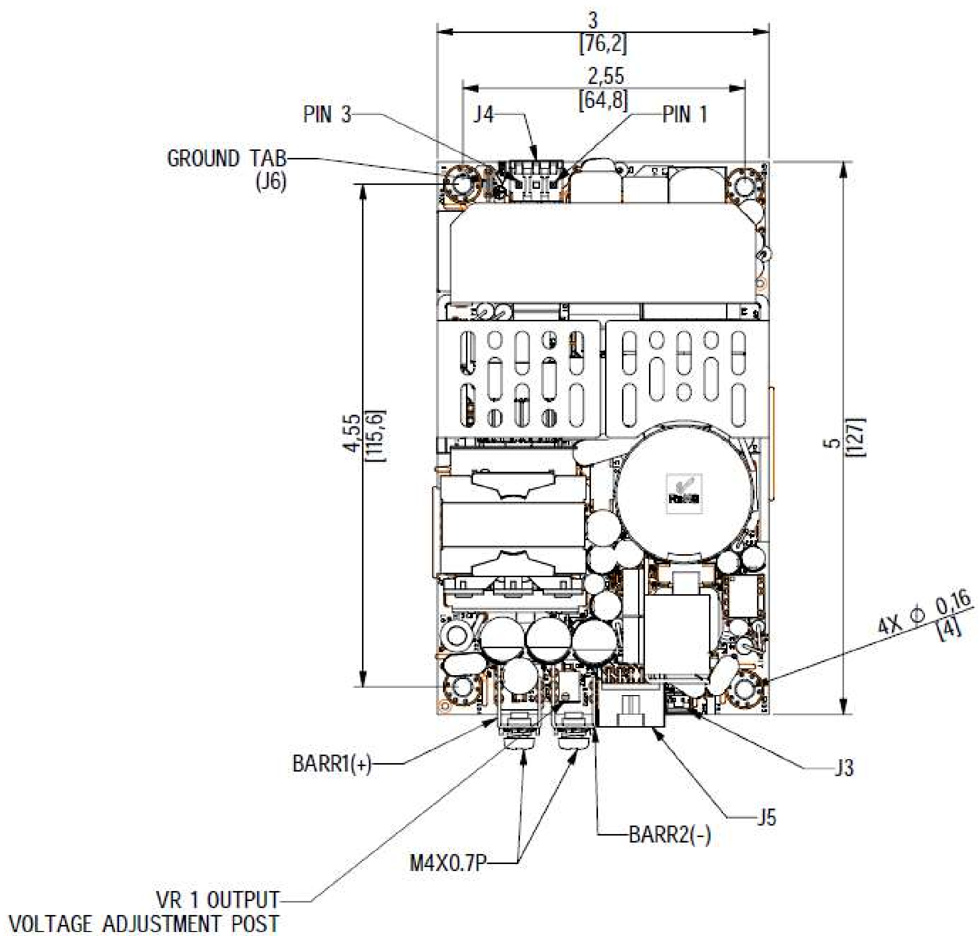
The power supply will withstand a continuous short circuit with no permanent damage. The power supply will automatically restart when the short circuit is removed. A short is defines as impedance less than 50 milliohms. The SCP mode is hiccup.

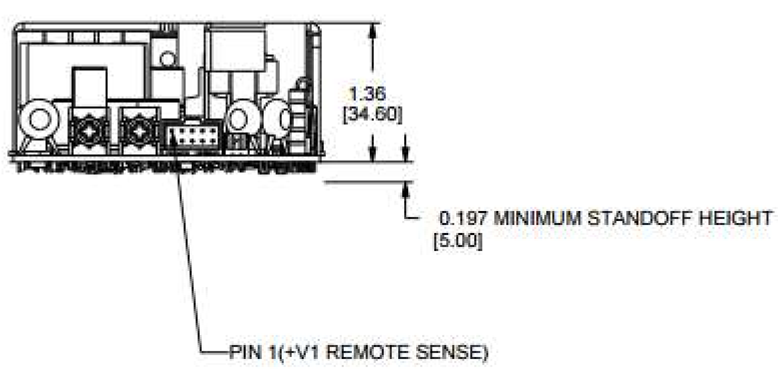
Over Temperature Protection (OTP)

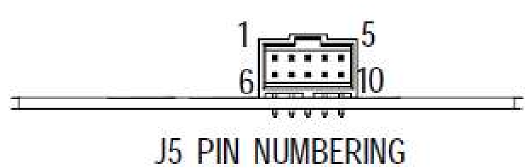
The power supply will shut down during over-temperature condition and return back to normal operation when the power supply is cooled down. The LPS360-M series power supply might experience over-temperature conditions during a persistent overload on the output. Overload conditions can be caused by external faults. OTP might also be entered due to a loss of control of the environmental conditions e.g. an increase in the converter’s ambient temperature due to a failing fan or external cooling system etc. The latch option can be a mod, as it requires firmware update.

Mechanical Specifications

Mechanical Drawing (Dimensioning and Mounting Locations)



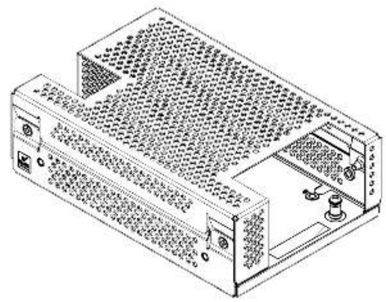


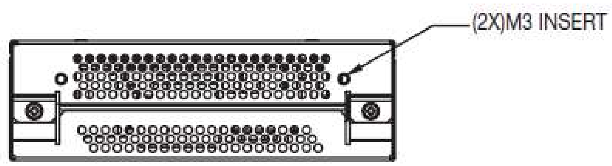


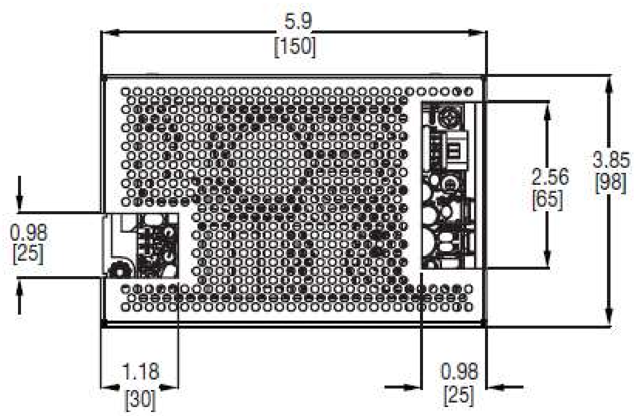
Note: All dimensions in inches (mm), tolerance is 0.02" (±0.5mm)

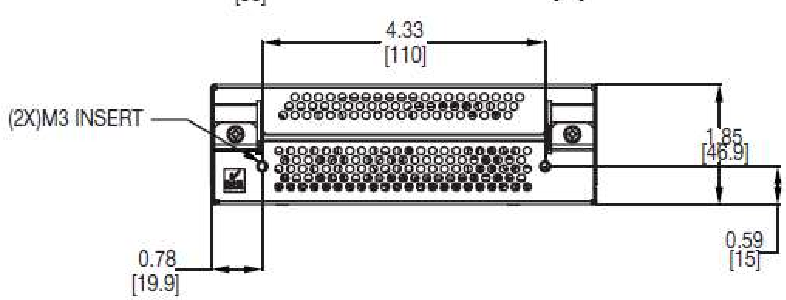
Mechanical Drawing (Enclosure Kit)

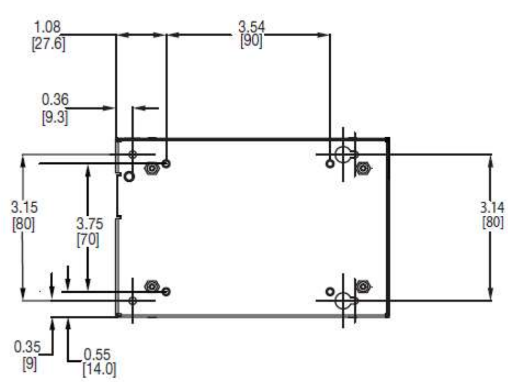
Part number for the Enclosure Kit is LPX200



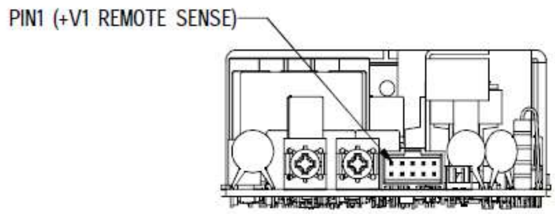








Connector Definitions



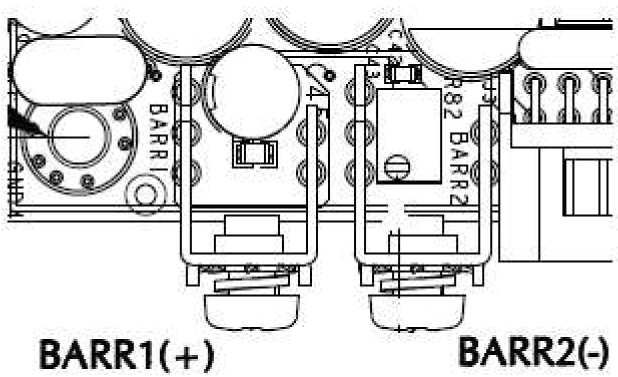
AC Input Connector – J4

Pin 1 – Line

Pin 3 – Neutral

AC GND – J6

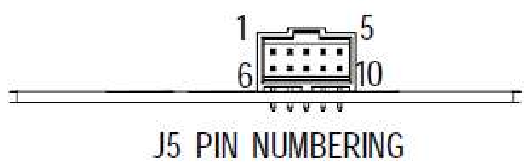
Output Connector – Barr



Barr1 – Main Output +

Barr2 – Main Output Common

Control Signal Header – J5



Pin 1 – +V1 Remote Sense

Pin 2 – - V1 Remote Sense

Pin 3 – +5V Standby

Pin 4 – +5V Standby Return

Pin 5 – +Power Fail

Pin 6 – Forced Air Operation

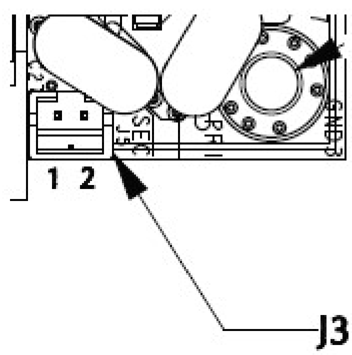
Pin 7 – Inhibit

Pin 8 – GND

Pin 9 – SDA

Pin 10 – SCL

12V Fan Supply Header – J3



Pin 1 – +12V V_{FAN}

Pin 2 – FAN Return[1]

Note 1 - FAN Return is isolated from the main Output Return

Power / Signal Mating Connectors and Pin Types

Table 4. Mating Connectors for LPS360-M (or equivalent)

Reference	Mating Connector or Equivalent
AC Input (J4)	Molex 09-50-3031 (housing) Molex 08-52-0072 (pins)
AC GND (J6)	Molex 01-90020001
DC Output (Barr)	Molex 19141-0058/0063 or 19099/0048 Spade lug based on Cable Ampacity/AWG
Control Signals (J5)	Molex 90142-0010 (housing) Molex 90119-2110 (pins)
Fan Output (J3)	Molex 51065-0200 (housing) Molex 50212-8100 (pins)

Note:

1.The Artesyn Connector Kit for J3,J4,J5,J6: 70-841-029

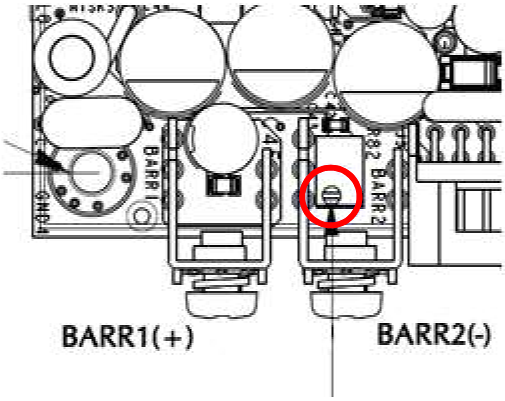
2.The Artesyn Digital connector kit: 73-769-005 (Including 73-841-030 and 73-769-001 per below)

3. I^2C Mating Connector with cable: 73-841-030

4. USB to I^2C Adapter with USB cable: 73-769-001

Potentiometer Definitions

VR1- Vo Output Adjust.



VR1 - Output
Voltage Adjustment
Potentiometer

Weight

The LPS360-M series power supply typical weight is 0.88lbs/0.4kg.

Environmental Specifications

EMC Immunity

LPS360-M series power supply is designed to meet the following EMC immunity specifications:

Table 5. Environmental Specifications:

Document	Description
EN60601-1-2: 2001	
EN 55022	Conducted Level B and Radiated Level B (stand alone)
IEC 61000-4-2	ESD up to 4kV contact, 8kV discharge
IEC 61000-4-3	RFI 3V/m, criteria A
IEC 61000-4-4	Electrical Fast Transients level 3 minimum, criteria A
IEC 61000-4-5	Surge level 3 minimum, Criteria B.
IEC 61000-4-6	Radio frequency common mode, Levels 3V (rms) Modulated AM 80%, 1 kHz, 150 ohm source impedance, criteria A
IEC 61000-4-8	Power Frequency Magnetic Immunity, 1 A/m
IEC 61000-4-11	AC Input transients Condition — Criteria >95% dip, 0.5 period — A 60% dip, 5.0 periods — B (A when Vin >160 VAC) 30% dip, 25 periods — A >95% dip, 5 Sec — B
IEC 61000-3-2	Harmonic Distortion
FCC Part 15, Subpart J, Class B	Conducted & radiated[1] emissions
CISPR22 (EN55022), Class B	Conducted & radiated[1] emissions

Note 1 - To be tested with system enclosure

Safety Certifications

The LPS360-M series power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand alone product.

The LPS360-M series power supply has been designed in accordance with following safety standards. Appropriate safety certificates and approvals are available to download from our website www.artesyn.com.

Table 6. Safety Certifications for LPS360-M

Document	File #	Description
ES60601-1	E182560-V4-S14	Safety of Technology Equipment
UL-60950-1 (2nd Edition)/ EN60950-1	E186249-A276-CB-1	US and Canada Requirements
CSA -C22.2 No. 601601-1(2008)	E182560-A117-UL-X1	Medical Equipment.
EN60601-1/A1:2013	211-500076-100	European Community Safety investigated and marketed by TUV or VDE
TUV-SUD CB Cert	SG-MD-00527M1	
CE Mark	17131	LVD&EMC
CCC	C-00401-Z1603QD-00987	China Approval

LPS360-M series power supply maintains basic insulation (1xMOPP) between secondary and earth and with the enclosure floating, protection Class II safety clearance requirement will still be met.

EMI Emissions

The LPS360-M 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 (IEC 61000) for immunity.

Conducted Emissions

Radio Frequency Interference

The power supply is tested under worst case conditions or AC input voltage, frequency and load conditions. The power supply will meet the following requirements with 6 dB margin across the frequency range; when tested on a wooden bench. This will be met with the output common floating or connected to ground. Additionally for single models the positive output connected to ground (operated as a negative output).

Table 7. Conducted EMI emission specifications of the LPS360-M

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

Radiated Emissions

For appliance IEC protection Class I operation, LPS360-M series power supply meet Class A and B conducted and radiated EMI with the LPX200 metal enclosure.

For appliance IEC protection Class II operation with earth Ground Tap floating, connect the primary and secondary y-caps for improved EMI response.

Operating Temperature

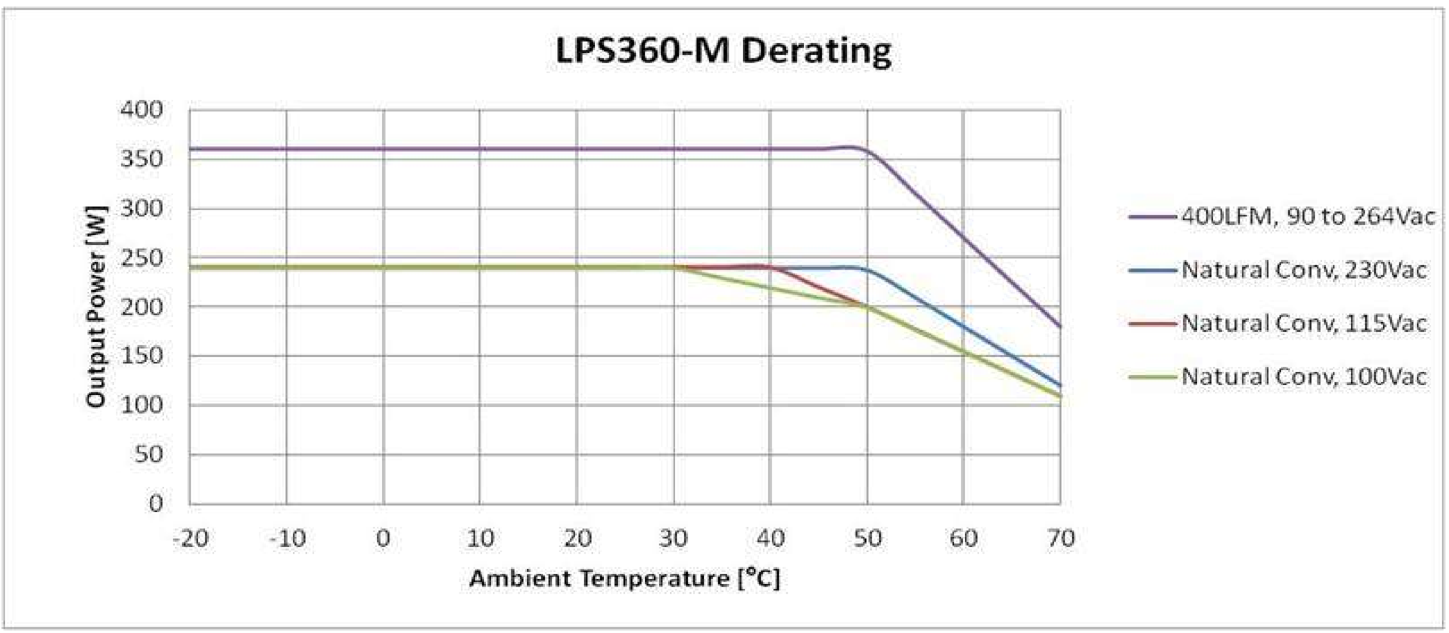
The LPS360-M series power supplies will start and operate within stated specifications at an ambient temperature from -20 ^{O}C to 50 ^{O}C under all load conditions with 400LFM of cooling air (see below derating curves for other amount of air flow and orientation. Derate output current and power by 2.5% per degree above 50 ^{O}C. Maximum operating ambient temperature is 70 ^{O}C (which implies a 50% derating at max 70 ^{O}C ambient).

Under convection cooling condition, the maximum output power derates linearly from 240-200 Watts. When input voltage is 100Vac, the LPS360-M series power supply will derate from 30 ^{O}C. When the input voltage is 115Vac, the power supply will derate from 40 ^{O}C. When the voltage is 230Vac, the power supply will derate from 50 ^{O}C.

When the loading on Standby output is ≤ 1A, the LPS360-M series power supply could startup at -40 ^{O}C. When the loading on Standby output is ＞ 1A, the power supply could startup at -30 ^{O}C.

Derating Curves

Both the ambient operating temperature and the method of cooling will limit the maximum power available from the LPS360-M series power supply.



Forced Air Cooling

The LPS360-M series power supply will provide 360W output with 400LFM of forced air cooling for ambient temperature up to 50 ^{O}C. Above 50 ^{O}C, it will require a derating of 2.5% output power per ^{O}C for operation up to 70 ^{O}C.

Forced Air Cooling set up:

Pins 6 and 8 of J5 need to be connected together

Load = 100% of forced air load (360W)

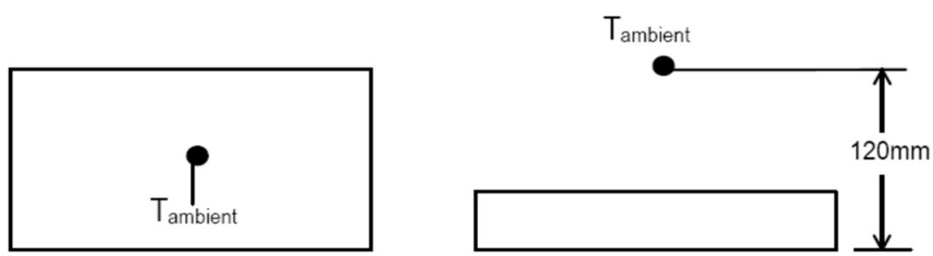
Cooling Fan: Use one cooling fan with 400LFM air flow rating blowing lengthwise or sideways.

Natural Convection Cooling

The LPS360-M series power supply will provide up to 200-240W output power under natural convection condition for ambient temperature up to 50 ^{O}C. Above 50 ^{O}C, it will require a derating of 2.5% output power per ^{O}C for operation up to 70 ^{O}C.

Natural convection cooling defined as power supply unit mounting on flat surface with bottom of the power supply down and open top unrestricted setting (see diagram below). Other mounting orientation might produce different derating and should be evaluated.

For convection cooling, pin 6 of control connector J5 should be left unconnected, the LPM360-M series power supply will provide up to 240W load output.



Storage and Shipping Temperature / Humidity

The LPS360-M series power supply 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 LPS360-M series power supply will operate within specifications at altitudes up to 5,000 meters above sea level. The power supply will not be damaged when stored at altitudes of up to 16,000 meters above sea level.

Humidity

The LPS360-M series power supply will operate within specifications when subjected to a relative humidity from 10% to 90% non-condensing. The LPS360-M series power supply can be stored in a relative humidity from 10% to 95% non-condensing.

Vibration

The LPS360-M series power supply will pass the following vibration specifications:

Non-Operating Random Vibration

Acceleration	2.7		gRMS
Frequency Range	10-2000		Hz
Duration	20		mins
Direction	3 mutually perpendicular axis		
PSD Profile	**FREQ**	**SLOPE dB/oct**	**PSD g^2/Hz**
	10-190 Hz	---	0.01 g^2/Hz
	190-210 Hz	-31.213dB/oct	---
	210-2000 Hz	---	0.003 g^2/Hz

Operating Random Vibration

Acceleration	1.0		gRMS
Frequency Range	10-500		Hz
Duration	20		mins
Direction	3 mutually perpendicular axis		
PSD Profile	**FREQ**	**SLOPE dB/oct**	**PSD g^2/Hz**
	10-500 Hz	---	0.002 g^2/Hz

Shock

The LPS360-M series power supply will pass the following vibration specifications:

Non-Operating Half-Sine Shock

Acceleration	30	G
Duration	18	msec
Pulse	Half-Sine	
No. of Shock	3 shock on each of 6 faces	

Operating Half-Sine Shock

Acceleration	4	G
Duration	22	msec
Pulse	Half-Sine	
No. of Shock	3 shock on each of 6 faces	

Power / Control Signal Interface Descriptions

AC Input (J4)

This connector supplies the VIN to the LPS360-M series power supply.

Pin 1 - Neutral

Pin 3 - Line

AC Ground (J6)

This tab connector is the safety ground connection and should be connected to AC input earth ground.

GND - Earth Ground (Safety Ground)

Main Output (Barr)

These terminals provide the main output for the LPS360-M series power supply. The V_O and the Output Return terminals are the positive and negative rails, respectively of the main output of the LPS360-M series power supply. The Main Output is electrically isolated from the Earth Ground and can be operated as a positive or negative output.

Barr-1 - Main Output +

Barr-2 - Main Output common

Vo Output voltage adjustment

The main output of LPS363-M and LPS365-M can be adjusted by 0%~+15% from its nominal output voltage. The main output of LPS364-M and LPS368-M can be adjust by -5%~+10% from its nominal output voltage. The main output of LPS366-M can be adjusted by -15%~0% from its nominal output voltage. The adjustment potentiometer is VR1.

12V Fan Supply (J3)

The LPS360-M series power supply contains an isolated 12V output for powering a cooling fan or as an aux power source. This 12V Fan Supply is provided in a 2 pin header connector SK5.

Pin 1 - +12V V_{FAN}

Pin 2 - FAN Return

Control Signals (J5)

The LPS360-M series power supply contains a 10 pins control signal header providing control interface.

+Remote Sense, -Remote Sense (Remote Sensing) – (J5 – Pin 1 and Pin 2)

The main output of LPS360-M series power supply is equipped with a Remote Sensing capability that will compensate for a voltage drop of up to a 0.5V between the output terminals of the supply and the sensed voltage point (load). This feature is implemented by connecting the +V1 Remote Sense (pin 1) and the -V1 Remote Sense (pin 2) terminals to the positive and negative rails of the main output, respectively, at a location that is near to the load. Care should be taken in the routing of the sense lines as any noise sources or additional filtering components introduced into the voltage rail may affect the stability of the power supply. The LPS360-M series power supply will operate appropriately without the sense lines connected.

The power supply is protected against damage caused by inadvertent reverse connection of the Remote Sense lines.

Remote sensing has no effect on the +5V Standby output and +12V V_{FAN} output.

+5V Standby Output, Standby Output Return – (J5 – Pin 3 and Pin 4)

5V Standby Output rated at 2A with forced air cooling and 1A for convection cooled. If this output is shorted it will shut down the main converter.

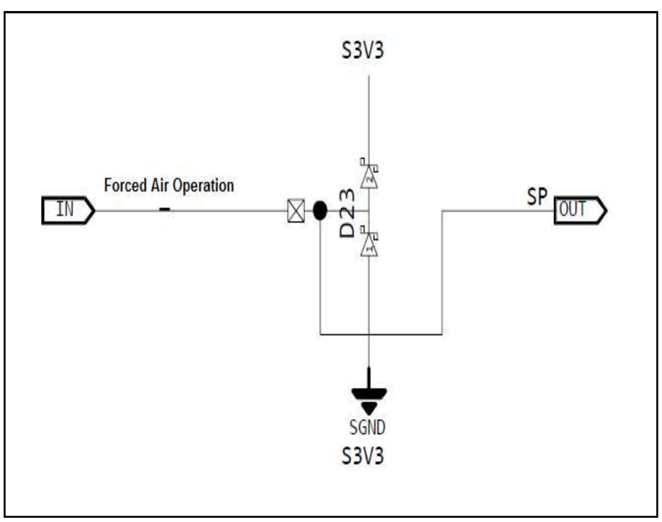
Forced Air Operation – (J5 – Pin 6)

For forced air operation, connect Pin 6 to Pin 8 of J5. If these two pins are not connected, for the protection of the unit, the power is constrained to the convection rated power (200-240W).

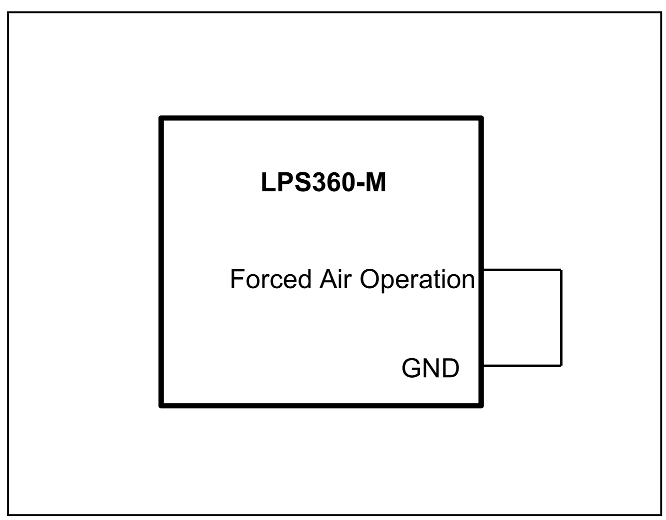
To protect the operation of the LPS360-M, users must select the cooling method and set this pin accordingly.

For forced air cooling, this pin (pin 6) must be shorted to GND or pin 8. This sets the maximum output power to 360W. With this setting, in the event the unit does not receive the required airflow, the OTP will trigger.

For convection cooling, this pin (pin 6) must left open (default), and the maximum output power is set to 240W. Loading more than 240W under this setting might trigger OCP (over current protection)



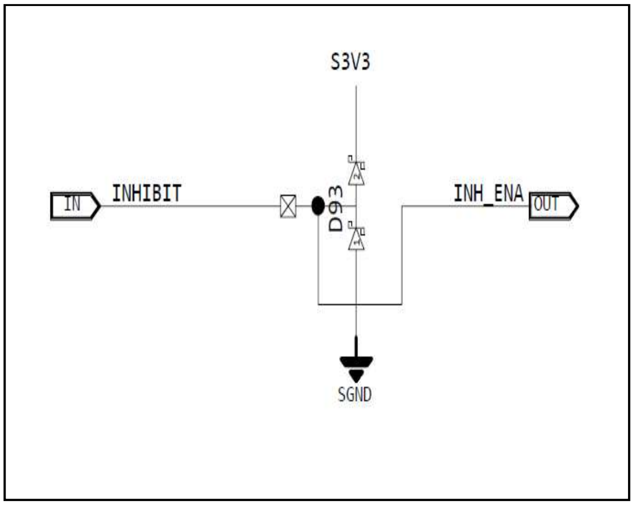
Forced Air Operation signal circuit diagram
(Inside of LPS360-M Series Power Supply)



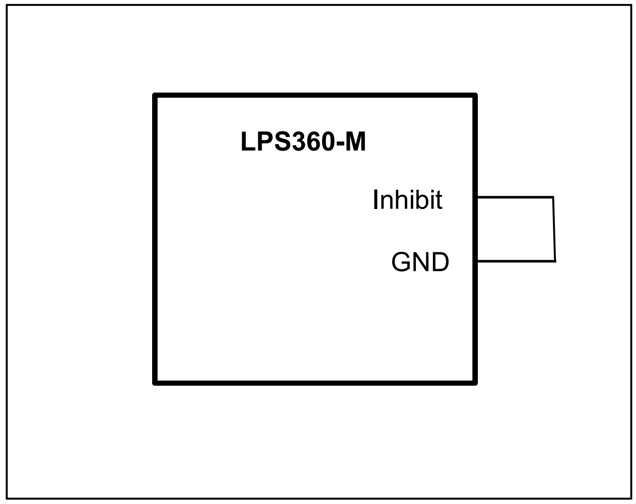
Forced Air Operation connection
(Outside of LPS360-M Series Power Supply)

Inhibit – (J5 – Pin 7)

Remote inhibit will require Pin 7 of J5 to be grounded. Low voltage will also inhibit the power supply. Low is <0.8V and high is ≥ 2.0V, source current 1mA maximum. Left the inhibit pin open will enable the power supply.



Inhibit signal circuit diagram
(Inside of LPS360-M Series Power Supply)



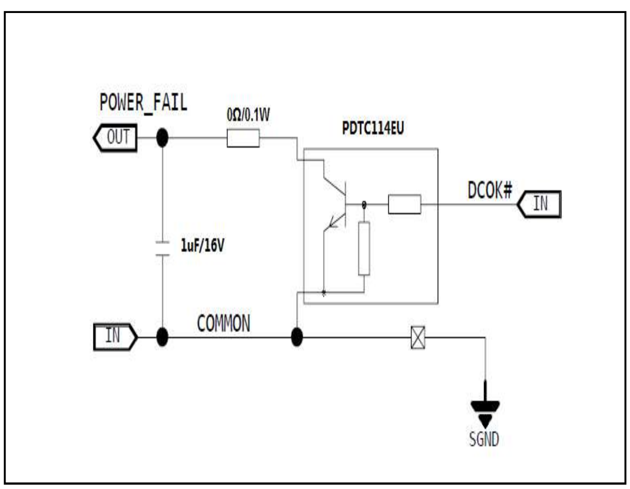
Inhibit the power supply connection
(Outside of LPS360-M Series Power Supply)

SDA, SCL and GND – (J5 – Pin 8, Pin 9 and Pin 10)

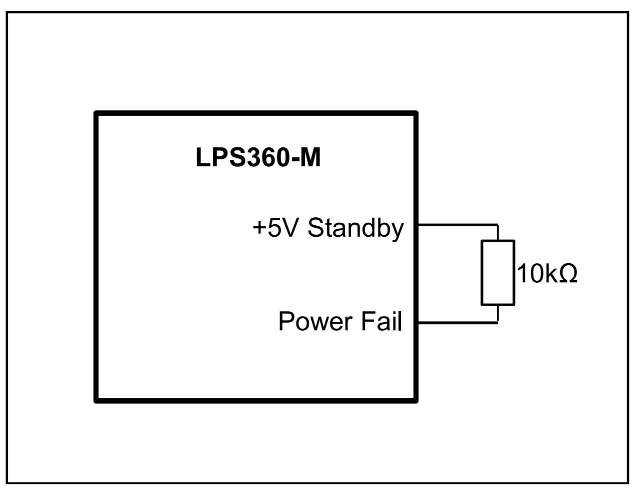
Please refer to “Communication Bus Descriptions” section.

Power Fail – (J5 – Pin 5)

Power Fail is an open collector output capable of sinking 10mA maximum at 0.5Vdc. This signal is referenced to GND. Add a pull-up resistor (10K) to Standby Output or other voltage rail (12V max) for the Power Fail signal.



Power Fail signal circuit diagram
(Inside of LPS360-M Series Power Supply)



Power Fail signal circuit diagram
(Outside of LPS360-M Series Power Supply)

Power Fail signal timing diagram

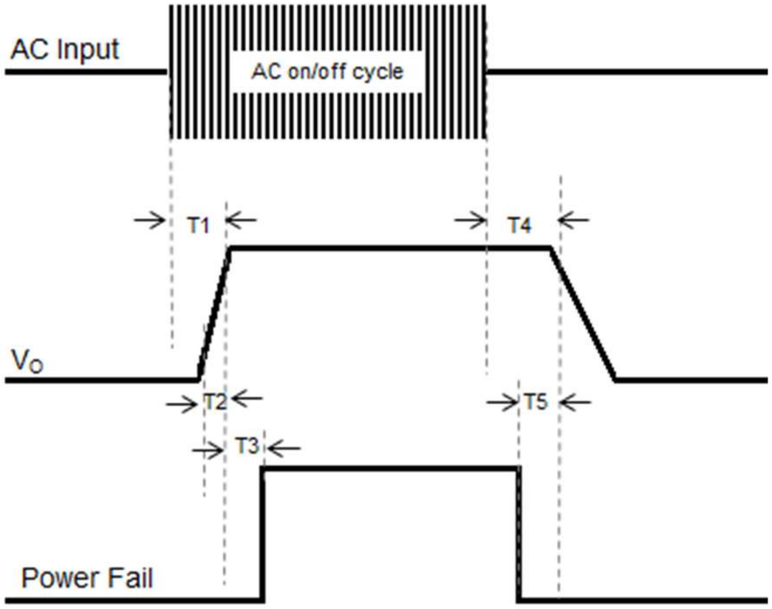


Table 8. Power Fail signal timing Specifications:

Label	Parameter	Min	Typ	Max	Unit
T1	Turn on delay - Delay from AC being applied to output voltages being within regulation with Power Fail asserted low.	-	-	2	Sec
T2	Rise up time – total time from 10%V_O to 90%V_O	5	-	55	mSec
T3	Delay from 90%V_O to Power Fail asserted high.	100	-	500	mSec
T4	Hold up time - time all output voltages, including V_{SB}, stay within regulation after loss of AC.	20	-	-	mSec
T5	Delay from Power Fail de-asserted to output voltages dropping out of regulation limits.	6	-	-	mSec

Communication Bus Descriptions

I^2C Bus Signals

The LPS360-M series power supply contains a Digital I^2C interface and controls functions implemented via the I^2C bus. The LPS360-M series power supply I^2C functionality (PMBus™) can be accessed via the control connector signals.

Note: PMBus™ functionality can be accessed only when the PSU is powered-up.
Guaranteed communication I^2C speed is 15 to 50 KHz.

SDA, SCL (I^2C Data and Clock Signals) – (J5-Pin9, J5-Pin10)

SCL: Serial clock signal; SDA: Serial data signal (bi-directional). The SCL pin and SDA pin are pulled up inside of the LPS360-M series power supply.

I^2C Bus Communication Interval

The interval between two consecutive I^2C communications to the power supply should be at least 50ms to ensure proper monitoring functionality.

Device Addressing

Slave device address is 0XB0.

I²C Clock Synchronization

The LPS360-M 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).

Clock Low Timeout

The PSU monitors the state of SDA and SCL lines. Whenever the SDA or SCL line gets stuck to a low level for more than 25 msec the PMBus interface will be reset and reinitialized after 2 msec. This will reset the internal state machine of the PMBus interface.

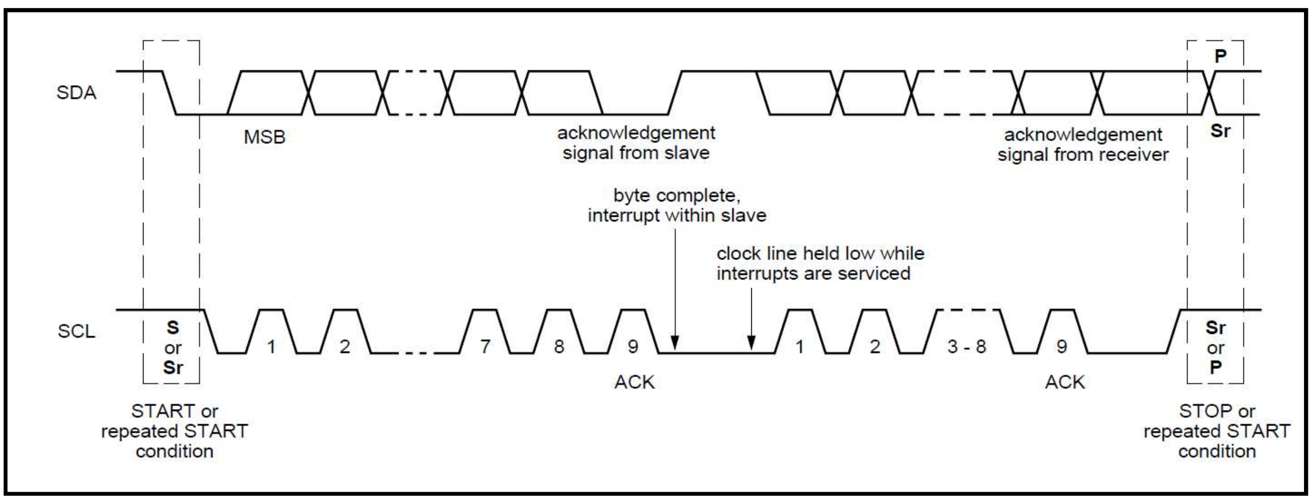
The purpose of this timeout and reset is to be able to release the bus if ever the PSU is holding one of the lines caused by signaling anomalies in the bus.

Note that the reset is only for the PMBus interface. No other PSU functionality will be affected.

Transaction Timeout

If a transaction is not completed within 100msec a transaction timeout will occur. The timeout will cause the internal state machine of the PMBus interface to reset.

This transaction timeout is particularly useful for system with multi masters. In case a master device fails in the middle of a transaction, this timeout enables the PSU to be ready to accept another transaction from another master.



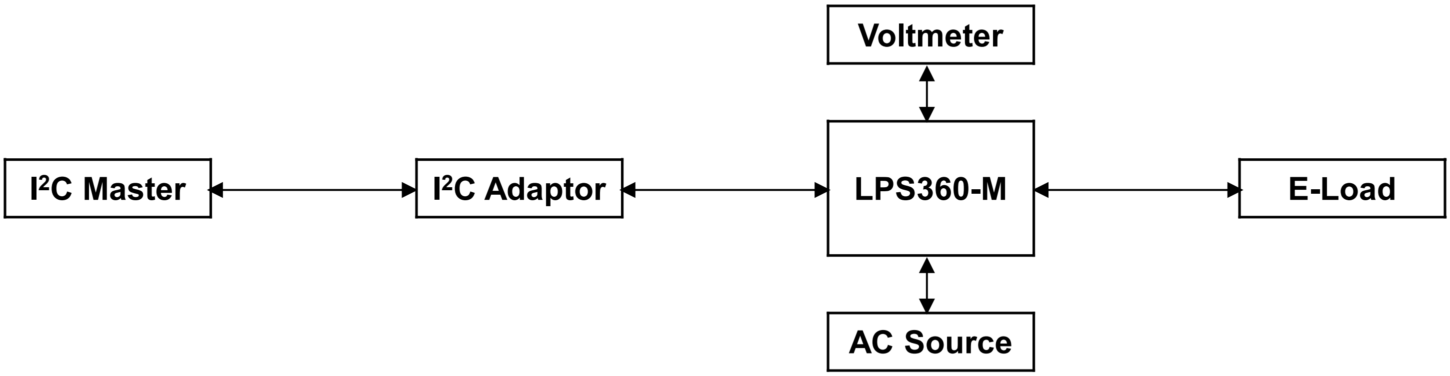
PMBus^{TM} Interface Support

The LPS360-M series power supply is compliant with the industry standard PMBus^{TM} protocol for monitoring and control of the power supply via the I^2C interface port. The I^2C Kit part number is 73-769-005.

LPS360-M PMBus^{TM} General Instructions

Equipment Setup

The following is typical I^2C communication setup:



LPS360-M Support PMBus™ Command List

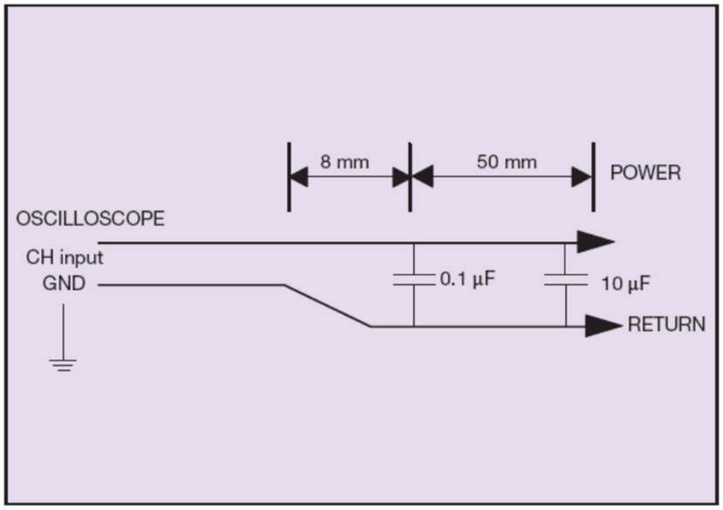
The LPS360-M is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I^2C interface port.

LPS360-M Supported PMBus™ Command List:

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
78h	STATUS_BYTE	00	R	1	Bd	
79h	STATUS_WORD	0000	R	2	Bd	
8Bh	READ_VOUT	-	R	2	Linear	Returns the actual, measured voltage in Volts.
8Ch	READ_IOUT	-	R	2	Linear	Returns the output current in amperes.
9Ah	MFR_MODEL	-	BR	15	ASCII	Manufacturers Model number, ASCII format
9Eh	MFR_Serial	-	BR	13	ASCII	Unit serial number, ASCII format.
E1h	FW_SEC_VERSION	-	BR	8	ASCII	

Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the LPS360-M. When measuring output ripple and noise, a scope jack in parallel with a 0.1uF 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	10.29.2015	First Issue	L. Lee
1.1	11.17.2015	Update the inrush current waveform	L. Lee
1.2	12.02.2015	Update the control signal details	L. Lee
1.3	12.11.2015	Update the efficiency typical data and Leakage current data	L. Lee
1.4	08.24.2016	Update the OCP part error	K. Wang
1.5	03.30.2017	Update the LPS366-M Data	L. Lee
1.6	07.25.2019	Update the OVP and T5 timing data	L. Lee
1.7	09.02.2019	Update the I2C Clock Frequency	K. Wang
1.8	11.21.2019	Update the EMC surge part	K. Wang

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