Technical Reference Note

Embedded Power for
Business-Critical Continuity

LPS100-M Series

150 Watts (forced air)
100 Watts (convection)

ITE / Medical

Total Power:	80-150 Watts
Input Voltage:	90-264 Vac
	120-300 Vdc
# of Outputs:	Single

RoHS 2002/95/EC

Special Features

- Medical and ITE safeties
- Active power factor correction
- 2" x 4" footprint
- Less than 1U high
- EN61000-3-2 compliant
- Remote sense
- Power fail
- Adjustable main output
- Built-in Class B EMI filter
- Overvoltage protection
- Overload protection
- Thermal overload protection
- Isolated 12V Fan output
- 2 year warranty

Safety

TUV:	60950 / 60601-1
UL:	60950 / 60601-1
CSA:	60950 / 60601-1
NEMKO:	60950 / 60691-1
AUSTEL:	60950 / 60601-1
CB:	Certificate and report
CE:	Mark (LVD)

Product Descriptions

The LPS100-M series features a universal 90-264 Vac input – enabling it to be used anywhere in the world – and is also capable of operating from a 120-300 Vdc input. The power supply produces a tightly regulated main output, together with an isolated 12 Vdc fan output; the latter is rated at 1 A, while the main output can deliver up to 100W continuously with convection cooling, or up to 150W continuously with 30 CFM forced air cooling. The main output can be adjusted over the range +/-10% over nominal set output voltage, and remote sense facilities are provided to compensate for a drop of up to 0.5 V 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 275 µA, and the main output has a hold-up time of 16 ms minimum when the supply is fed with a 120 Vac input and is delivering 150 watts of output power.

LPS100-M series power supplies are comprehensively protected against overvoltage, overtemperature 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 0 to +50 degrees Celsius without de-rating and can cold-start from temperatures as low as -20 degrees Celsius. Operation between 50 and 70 degrees Celsius, the output should be derated by 2.5 percent per degree.

EMERSON Network Power

Model Numbers

Standard	Output Voltage	Minimum Load	Maximum Load Convection Cooling ($I_{O,maxCC}$)	Maximum Load Forced Air 30CFM ($I_{O,maxFA}$)	Peak Load[1]
LPS102-M	5V	0A	16A	24A	30A
LPS103-M	12V	0A	8.3A	12.5A	14A
LPS104-M	15V	0A	6.7A	10A	11A
LPS105-M	24V	0A	4.2A	6.3A	7A
LPS108-M	48V	0A	2.1A	3.1A	3.5A
LPS109-M	54V	0A	1.85A	2.8A	3.1A

Note 1 - Peak current lasting <30 seconds with a maximum 10% duty cycle

Options

None

Absolute Maximum Ratings

Stress in excess of those listed in the "Absolute Maximum Ratings" may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply's reliability.

Table 1. Absolute Maximum Ratings:

Parameter	Model	Symbol	Min	Typ	Max	Unit
Input Voltage:						
AC continuous operation	All models	$V_{IN,AC}$	90	-	264	Vac
DC continuous operation	All models	$V_{IN,DC}$	120	-	300	Vdc
Maximum Output Power (Main + Fan) Convection continuous operation	LPS102-M	$P_{O,maxCC}$	-	-	80	W
	LPS103-M		-	-	100	
	LPS104-M		-	-	100	
	LPS105-M		-	-	100	
	LPS108-M		-	-	100	
	LPS109-M		-	-	100	
Maximum Output Power (main + fan) Force air continuous operation - 30CFM	LPS102-M	$P_{O,maxFA}$	-	-	120	W
	LPS103-M		-	-	150	
	LPS104-M		-	-	150	
	LPS105-M		-	-	150	
	LPS108-M		-	-	150	
	LPS109-M		-	-	150	
Isolation Voltage						
Input to outputs	All models		-	-	4000	Vac
Input to safety ground	All models		-	-	1500	Vac
Outputs to safety ground	All models		-	-	500	Vdc
Main output to FAN output	All models		-	-	100	Vdc
Ambient Operating Temperature	All models	T_A	0	-	+70[1]	ºC
Cold Start-up Temperature	All models	T_{ST}	-20	-	-	ºC
Storage Temperature	All models	T_{STG}	-40	-	+85	ºC
Humidity (non-condensing)						
Operating	All models		10	-	90	%
Non-operating	All models		10	-	95	%
Altitude						
Operating	All models		-500	-	13,000[2]	feet
Non-operating	All models		-1,000	-	50,000	feet

Note 1 - Derate each output at 2.5% per degree C from 50ºC to 70ºC
Note 2 - Derate maximum operating temperature by 1ºC per 1,000 feet above 13,000 feet

Electrical Specifications

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}	47	50/60	440	Hz
Operating Input Voltage, DC		All	$V_{IN,DC}$	120	-	300	Vdc
Maximum steady state Input Current		$V_{IN,AC}$ = 90V_{AC} $V_{IN,AC}$ = 170V_{AC}	$I_{IN,max}$	- -	- -	2.2 1.2	Aac
No Load Input Current (V_O = nominal, I_O = 0, I_{FAN} = 0)		$V_{IN,AC}$ = 90V_{AC} $V_{IN,AC}$ = 264V_{AC}	$I_{IN,no\text{-}load}$	- -	- -	80 100	mAac
Harmonic Line Currents		All	THD	Per EN61000-3-2			
Power Factor		I_O = 0.5 to 1 x $I_{O,maxFA}$ $V_{IN,AC}$ = 115Vac	PF	0.97	-	-	
Startup Surge Current (Inrush) @ 25°C		$V_{IN,AC}$ = 230V_{AC}	$I_{IN,surge}$	-	-	50	A_{PK}
Input Fuse		Internal, L and N F2A5, 250V, Type 392		-	-	2.5	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 = $I_{O,maxFA}$	$V_{IN,AC\text{-}stop}$	75	-	83	Vac
Input DC Low Line Start-up Voltage		I_O = $I_{O,maxFA}$	$V_{IN,DC\text{-}start}$	110	-	119	Vdc
Input DC Undervoltage Lockout Voltage		I_O = $I_{O,maxFA}$	$V_{IN,DC\text{-}stop}$	100	-	106	Vdc
No Load Input Power (V_O = nominal, I_O = 0, I_{FAN} = 0)		$V_{IN,AC}$ = 115/230V_{AC}	$P_{IN,no\text{-}load}$	-	-	6	W
PFC Switching Frequency		All	$f_{SW,PFC}$	45	-	270	kHz
Buck Switching Frequency		All	$f_{SW,Buck}$	70	-	88	kHz
DCDC Switching Frequency		All	$f_{SW,DC\text{-}DC}$	117	-	143	kHz
Efficiency (T_A = 25°C, forced air cooling)	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	$V_{IN,AC}$ = 230Vac I_O = 0.75 * $I_{O,maxFA}$, I_{FAN} = 0	η	- - - - - -	84 90 90 90 91 91	- - - - - -	%

Input Specifications con't

Table 2 con't. Input Specifications:

Parameter		Conditions	Symbol	Min	Typ	Max	Unit
Hold Up Time		$V_{IN,AC}$ = 115Vac $P_O = P_{O,maxFA}$	$t_{Hold-Up}$	-	-	10	mSec
Turn On Delay		$V_{IN,AC}$ = 90Vac $P_O = P_{O,maxFA}$	$t_{Turn-On}$	-	-	2.5	Sec
Leakage Current to safety ground	All models	(V_{IN} = 264Vac, f_{IN} = 50/60 Hz)	$I_{IN,leakage}$	-	-	275	µA
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	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	Inclusive of set point, line, load temperature change, warm-up drift and cross regulation	V_O	4.90 11.76 14.70 23.52 47.04 52.92	5.00 12.00 15.00 24.00 48.00 54.00	5.10 12.24 15.30 24.48 48.96 55.08	V
	All models		V_{FAN}	10.2	12.0	13.8	
Output Ripple, pk-pk	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor	V_O	- - - - - -	- - - - - -	50 120 150 240 480 540	mV_{PK-PK}
	All models		V_{FAN}	-	-	240	
Convection Output Current, continuous	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	Convection cooling	$I_{O,maxCC}$	0 0 0 0 0 0	- - - - -	16 8.3 6.7 4.2 2.1 1.85	A
	All models		$I_{FAN,maxCC}$	0	-	0.5	
Maximum Convection Output Power, continuous	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	Main output + fan output	$P_{O,maxCC}$	- - - - - -	- - - - - -	80 100 100 100 100 100	W
Force Air Output Current, continuous	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	30 CFM force air cooling	$I_{O,maxFA}$	0 0 0 0 0 0	- - - - -	24 12.5 10 6.3 3.1 2.8	A
	All models		$I_{FAN,maxFA}$	0	-	1.0	
Maximum Force air Output Power, continuous	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	Main output + fan output, 30 CFM	$P_{O,maxFA}$	- - - - - -	- - - - - -	120 150 150 150 150 150	W

Output Specifications con't

Table 3. Output Specifications, con't

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Output Current, peak	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	Maximum duration <30 seconds, maximum duty cycle <10%	$I_{O,peak}$	- - - - - -	- - - - - -	30 14 11 7 3.5 3.1	A
Output Adjust Range	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	$V_{IN,AC}$ = 115V_{AC} I_O = 50% of $I_{O,maxFA}$ I_{FAN} = 0 Monitor V_O at SK2	V_O	4.5 10.8 13.5 21.6 43.2 48.6	- - - - - -	5.5 13.2 16.5 26.4 52.8 59.4	V
V_O Capacitive Load		Startup	-	0	-	330	µF/A
V_O Dynamic Response - Peak Deviation	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	50% (50% to 100% of $I_{O,maxFA}$) load change Slew rate = 1A/µs Output capacitance = 100µF/A	±%V_O	- - - - - -	- - - - - -	5 5 5 2 2 2	%
V_O Dynamic Response - Setting Time	All models	50% (50% to 100% of $I_{O,maxFA}$) load change Slew rate = 1A/µs Output capacitance = 100µF/A	t_s	-	-	500	µSec
V_O Turn On Overshoot	LPS102-M LPS103-M LPS104-M LPS105-M LPS108-M LPS109-M	I_O = 0, I_{FAN} = 0	V_O	- - - - - -	- - - - - -	5.15 12.36 15.45 24.72 49.44 55.62	V
V_O Long Term Stability	All models	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	125	-	150	%
V_O Over Current Protection		All	%I_O	110	-	160	%
Over Temperature Protection		All		Auto Recovery			
Short Circuit Protection		All		Auto Recovery			

LPS102-M Performance Curves

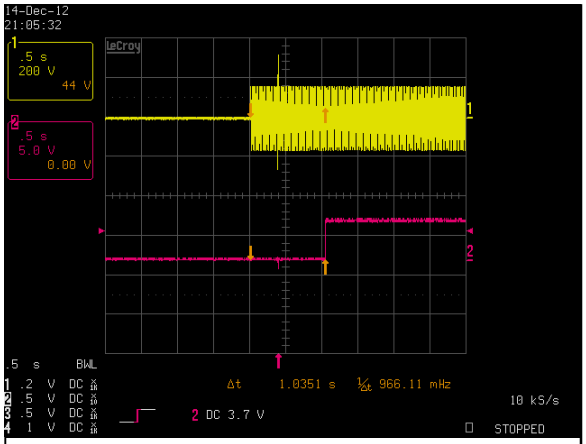


Figure 1: LPS102-M Turn-on delay
Vin = 115Vac Load: Io = 24A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

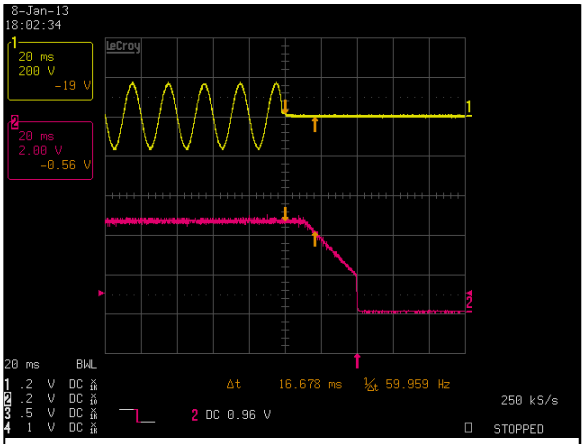


Figure 2: LPS102-M Hold-up Time (time to decay)
Vin = 115Vac Load: Io = 24A, IFAN = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

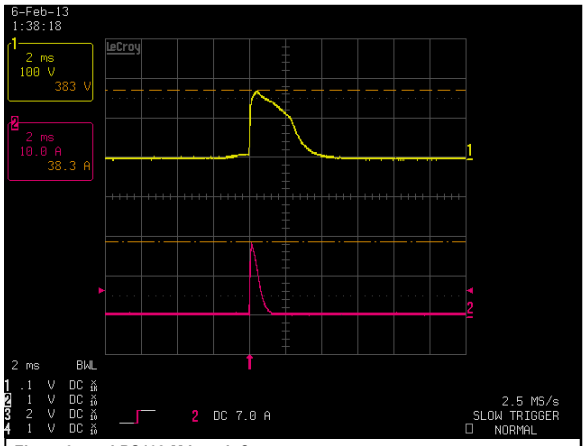


Figure 3: LPS102-M Inrush Current
Vin = 230Vac Load: Io = 0A, IFAN = 0A, Turn on Angle = 90 deg
Ch 1: AC Mains Ch 2: Io

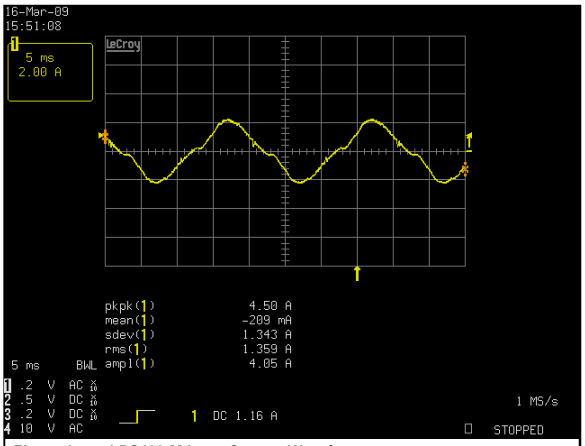


Figure 4: LPS102-M Input Current Waveform
Vin = 115Vac Load: Io = 24A, IFAN = 0A
Ch 1: IIN

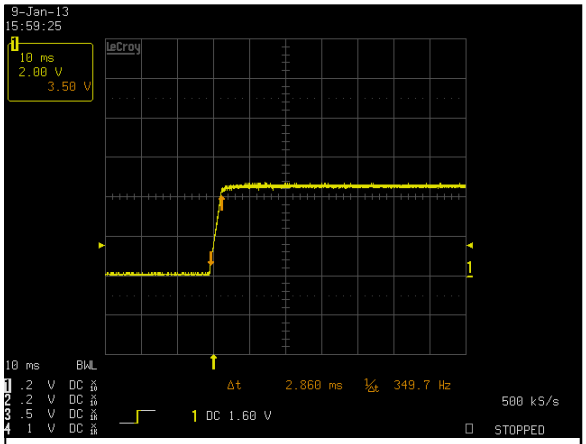


Figure 5: LPS102-M Output Voltage Startup Characteristic
Vin = 90Vac Load: Io = 24A, I_{FAN} = 0A, Output Capacitance = 330uF/A
Ch 1: Vo

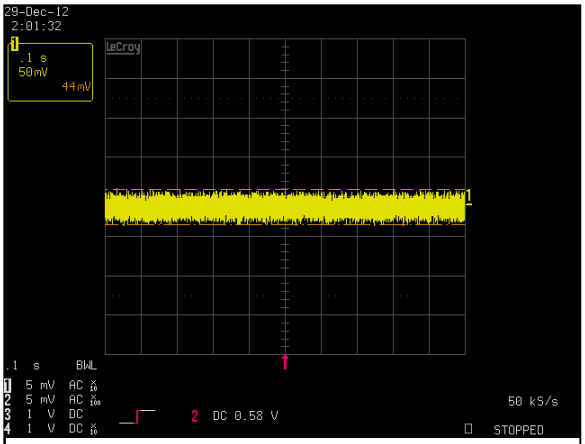


Figure 6: LPS102-M Ripple and Noise Measurement
Vin = 115Vac Load: Io = 24A, I_{FAN} = 0A
Ch 1: Vo

LPS102-M Performance Curves

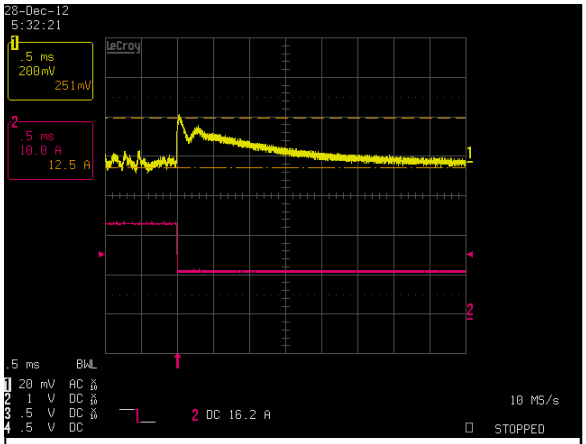


Figure 7: LPS102-M Transient Response – Vo Deviation (High to Low)
Vin = 115Vac Load: Io = 100% to 50% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

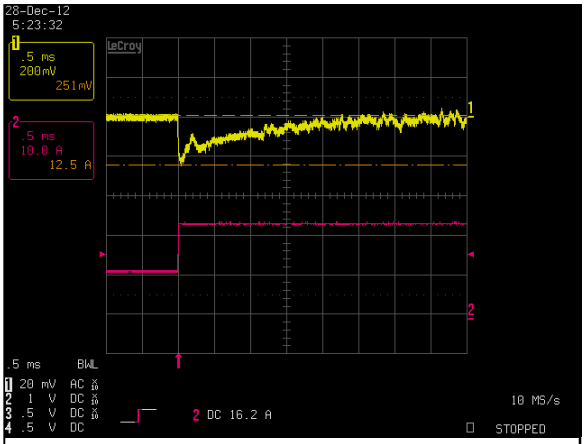


Figure 8: LPS102-M Transient Response – Vo Deviation (Low to High)
Vin = 115Vac Load: Io = 50% to 100% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

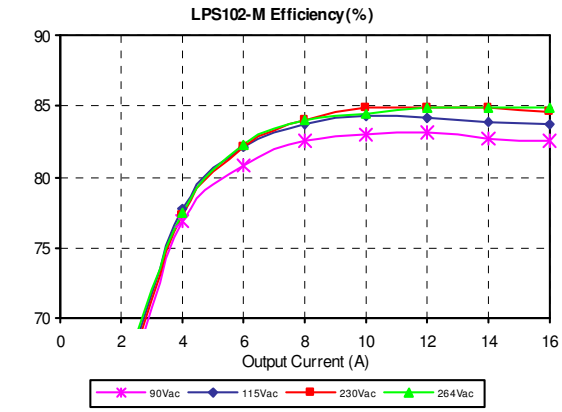


Figure 9: LPS102-M Efficiency Curves @ 25 degC, Convection Cool
Vin = 90 to 264Vac Load: Io = 0 to 16A, IFAN = 0A

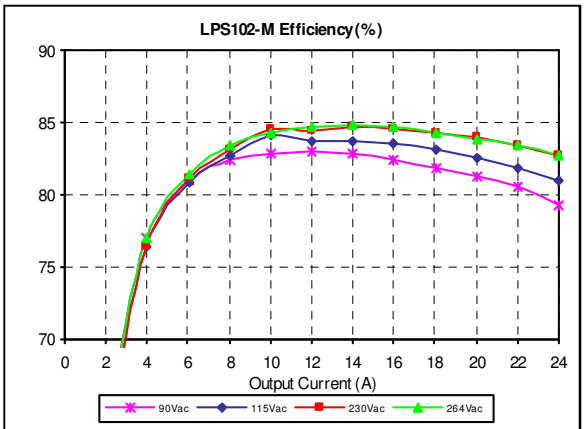


Figure 10: LPS102-M Efficiency Curves @ 25 degC, 30 CFM Forced Air
Vin = 90 to 264Vac Load: Io = 0 to 24A, IFAN = 0A

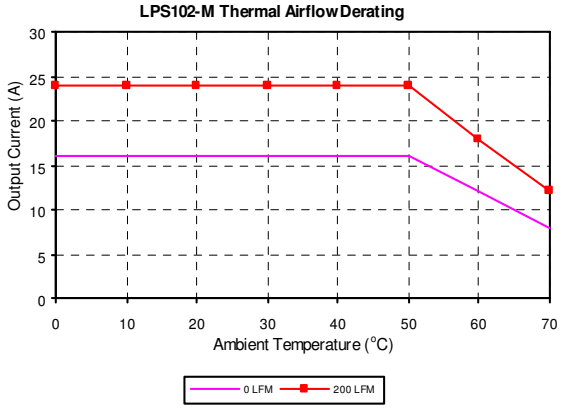


Figure 11: LPS102-M Derating Curves
Vin = 115Vac Load: Io = 0 to 24A, I_{FAN} = 0A

LPS103-M Performance Curves

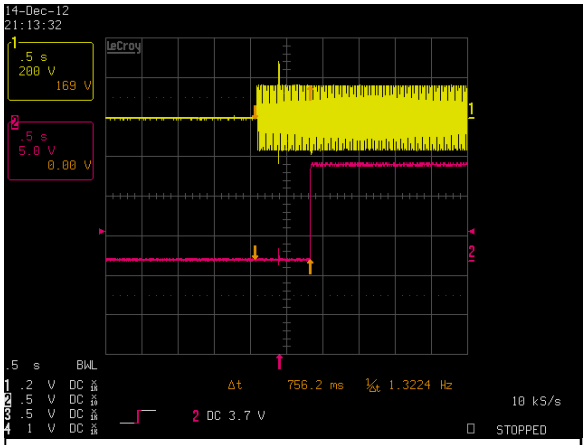


Figure 12: LPS103-M Turn-on delay
Vin = 115Vac Load: Io = 12.5A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch3: Power Fail

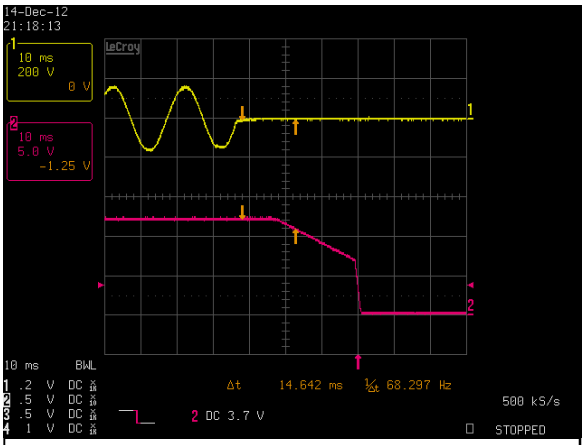


Figure 13: LPS103-M Hold-up Time (time to decay)
Vin = 115Vac Load: Io = 12.5A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

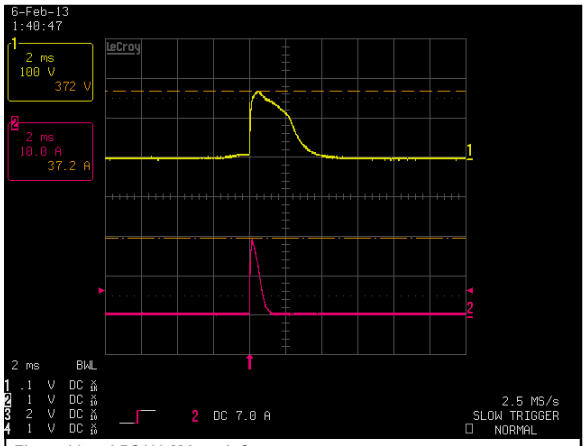


Figure 14: LPS103-M Inrush Current
Vin = 230Vac Load: Io = 0A, I_{FAN} = 0A, Turn on Angle = 90 deg
Ch 1: AC Mains Ch 2: Io

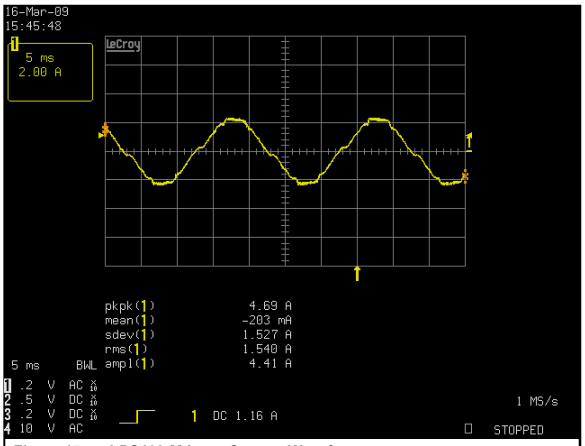


Figure 15: LPS103-M Input Current Waveform
Vin = 115Vac Load: Io = 12.5A, I_{FAN} = 0A
Ch 1: I_{IN}

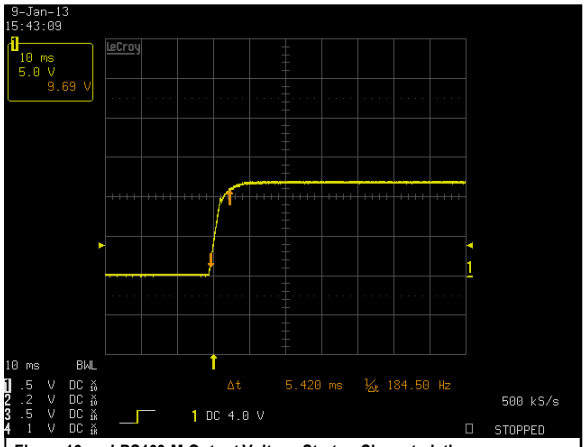


Figure 16: LPS103-M Output Voltage Startup Characteristic
Vin = 90Vac Load: Io = 12.5A, I_{FAN} = 0A, Output Capacitance = 330uF/A
Ch 1: Vo

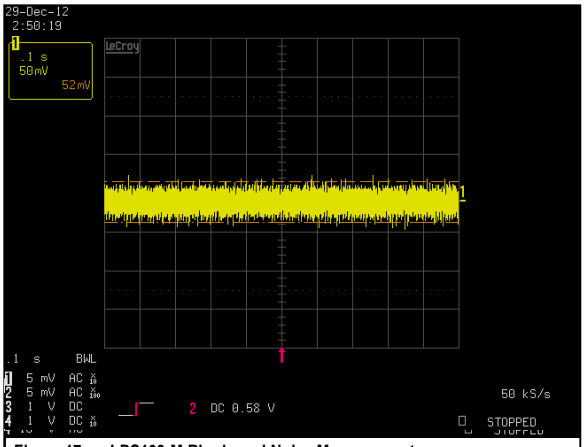


Figure 17: LPS103-M Ripple and Noise Measurement
Vin = 115Vac Load: Io = 12.5A, I_{FAN} = 0A
Ch 1: Vo

LPS103-M Performance Curves

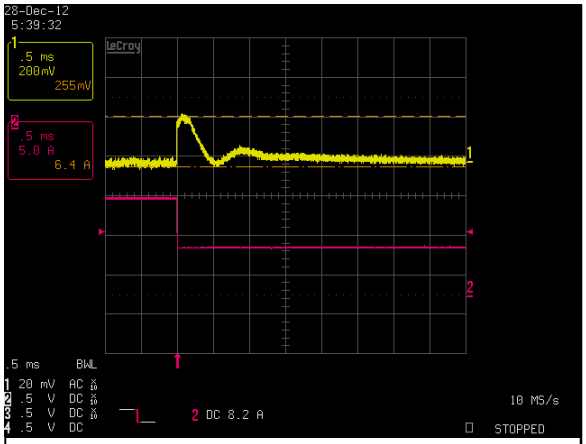


Figure 18: LPS103-M Transient Response – Vo Deviation (High to Low)
Vin = 115Vac Load: Io = 100% to 50% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

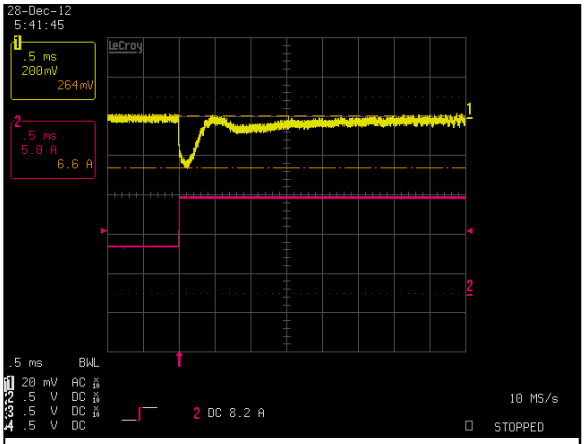


Figure 19: LPS103-M Transient Response – Vo Deviation (Low to High)
Vin = 115Vac Load: Io = 50% to 100% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

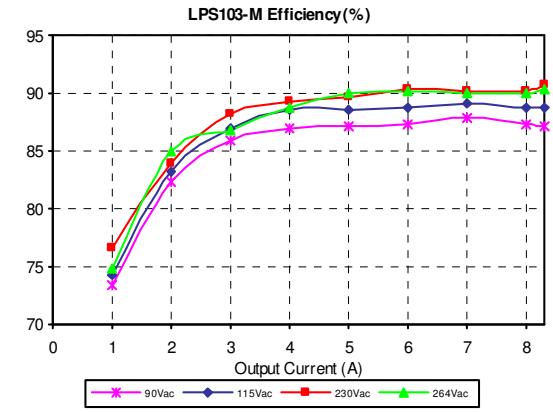


Figure 20: LPS103-M Efficiency Curves @ 25 degC, Convection Cool
Vin = 90 to 264Vac Load: Io = 0 to 8.3A, I_{FAN} = 0A

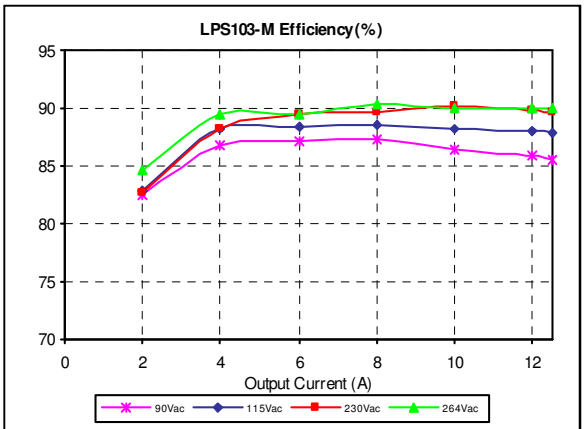


Figure 21: LPS103-M Efficiency Curves @ 25 degC, Forced Air Cool
Vin = 90 to 264Vac Load: Io = 0 to 12.5A, I_{FAN} = 0A

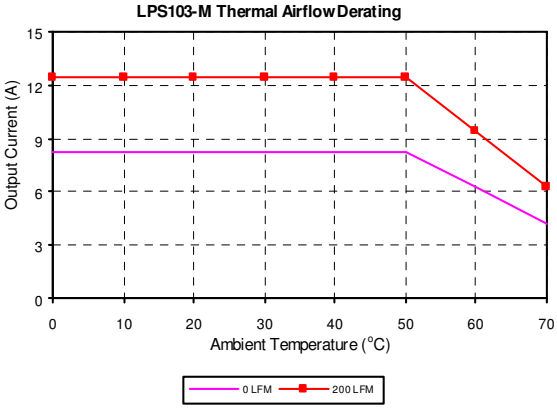


Figure 22: LPS103-M Derating Curves
Vin = 115Vac Load: Io = 0 to 12.5A, I_{FAN} = 0A

LPS104-M Performance Curves

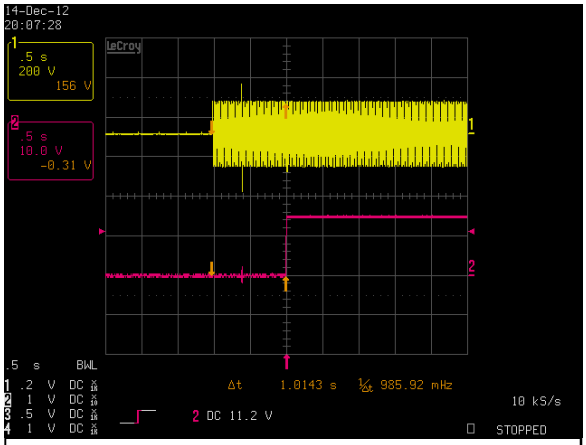


Figure 23: LPS104-M Turn-on delay
Vin = 115Vac Load: Io = 10A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

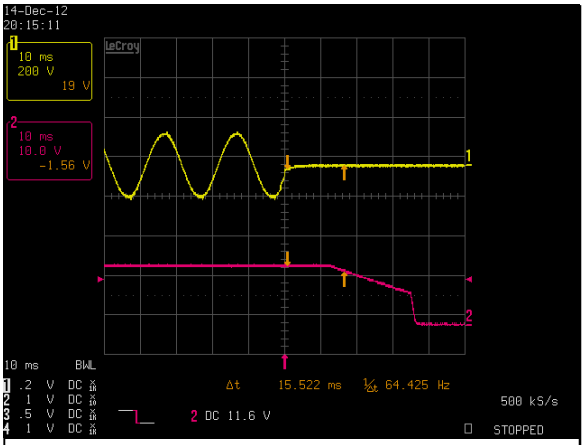


Figure 24: LPS104-M Hold-up Time (time to decay)
Vin = 115Vac Load: Io = 10A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

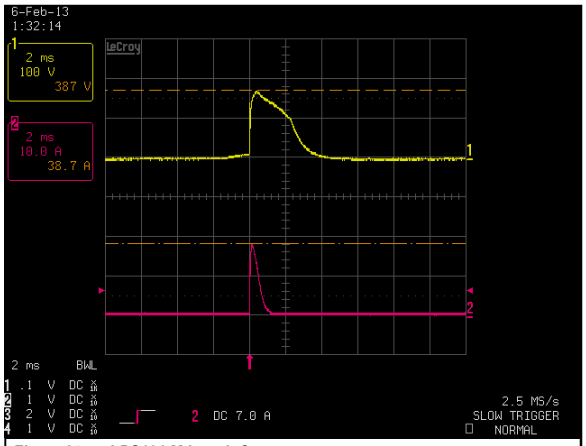


Figure 25: LPS104-M Inrush Current
Vin = 230Vac Load: Io = 0A, I_{FAN} = 0A, Turn on Angle = 90 deg
Ch 1: AC Mains Ch 2: Io

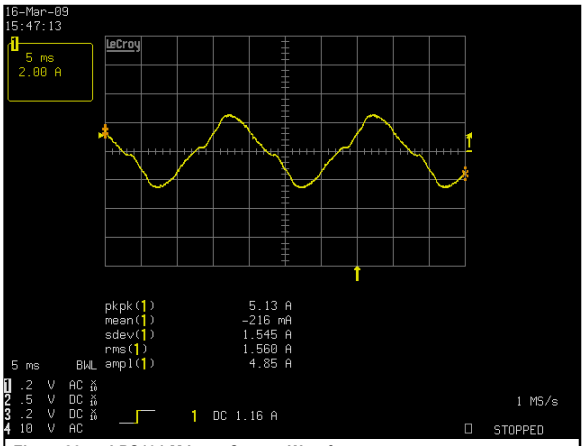


Figure 26: LPS104-M Input Current Waveform
Vin = 115Vac Load: Io =10A, I_{FAN} = 0A
Ch 1: I_{IN}

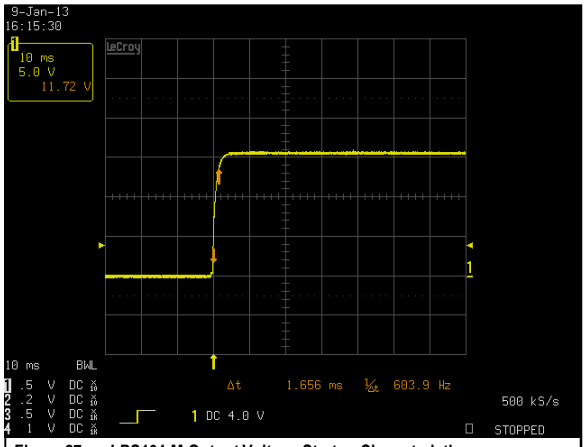


Figure 27: LPS104-M Output Voltage Startup Characteristic
Vin = 90Vac Load: Io = 10A, I_{FAN} = 0A, Output Capacitance = 330uF/A
Ch 1: Vo

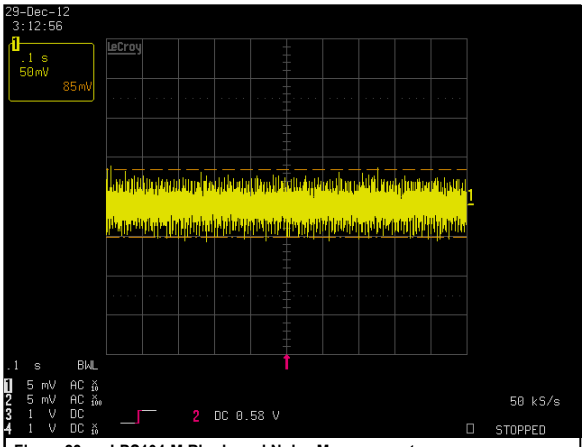


Figure 28: LPS104-M Ripple and Noise Measurement
Vin = 115Vac Load: Io = 10A, I_{FAN} = 0A
Ch 1: Vo

LPS104-M Performance Curves

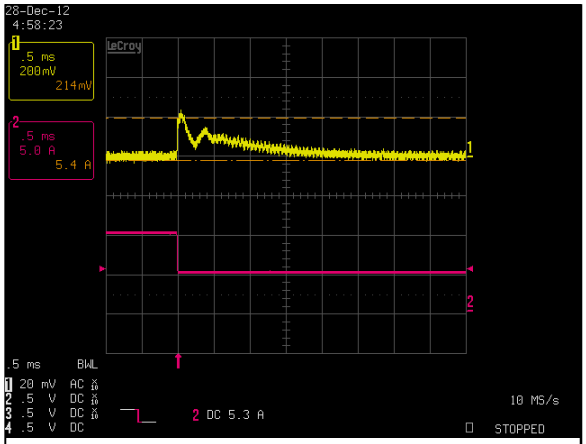


Figure 29: LPS104-M Transient Response – Vo Deviation (High to Low)
Vin = 115Vac Load: Io = 100% to 50% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

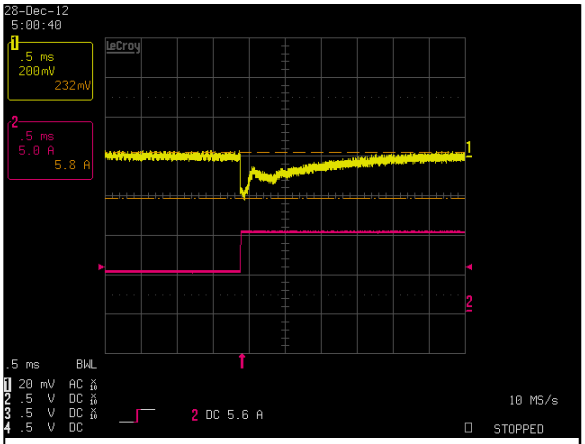


Figure 30: LPS104-M Transient Response – Vo Deviation (Low to High)
Vin = 115Vac Load: Io = 50% to 100% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

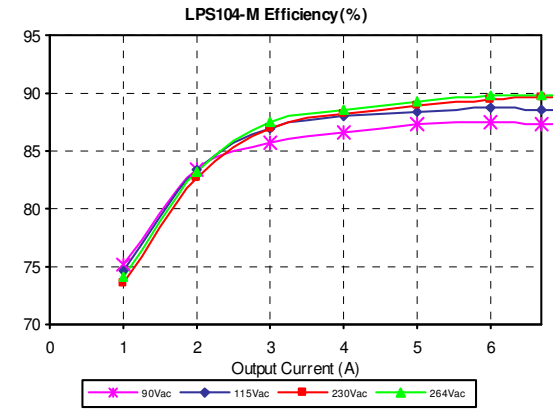


Figure 31: LPS104-M Efficiency Curves @ 25 degC, Convection Cool
Vin = 90 to 264Vac Load: Io = 0 to 6.7A, I_{FAN} = 0A

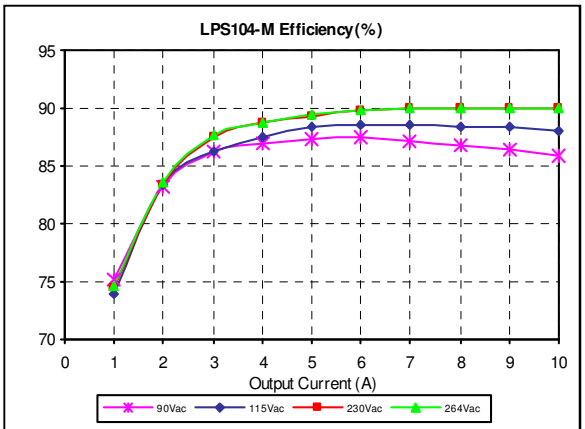


Figure 32: LPS104-M Efficiency Curves @ 25 degC, 30 CFM Forced Air
Vin = 90 to 264Vac Load: Io = 0 to 10A, I_{FAN} = 0A

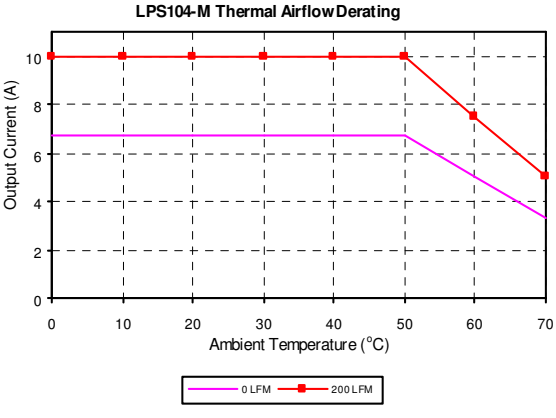


Figure 33: LPS104-M Derating Curves
Vin = 115Vac Load: Io = 0 to 10A, I_{FAN} = 0A

LPS105-M Performance Curves

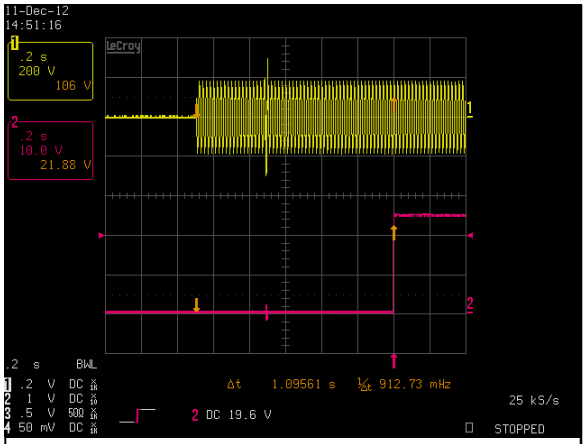


Figure 34: LPS105-M Turn-on delay
Vin = 115Vac Load: Io = 6.3A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

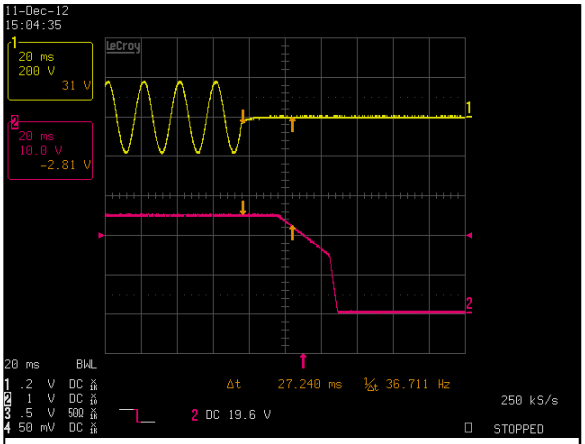


Figure 35: LPS105-M Hold-up Time (time to decay)
Vin = 115Vac Load: Io = 6.3A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

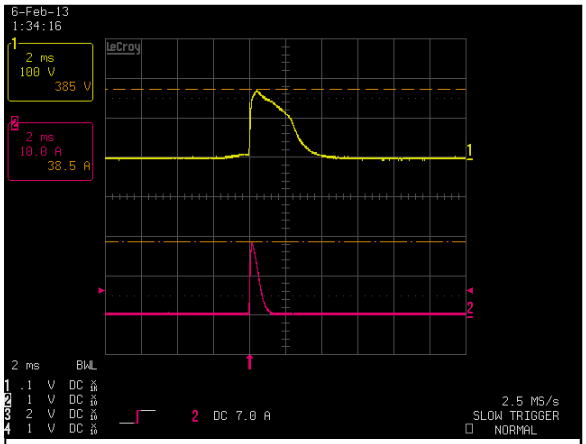


Figure 36: LPS105-M Inrush Current
Vin = 230Vac Load: Io = 0A, I_{FAN} = 0A, Turn on Angle = 90 deg
Ch 1: AC Mains Ch 2: Io

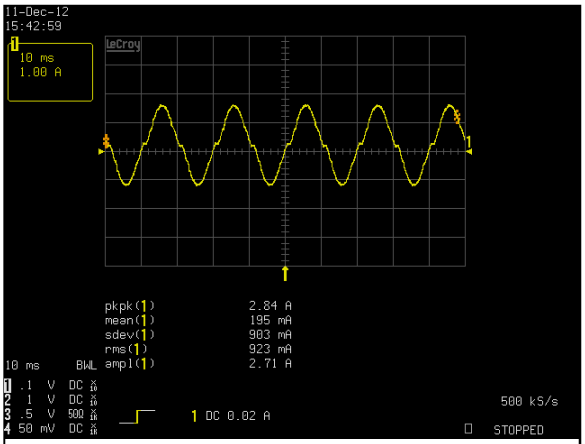


Figure 37: LPS105-M Input Current Waveform
Vin = 115Vac Load: Io = 6.3A, I_{FAN} = 0A
Ch 1: I_{IN}

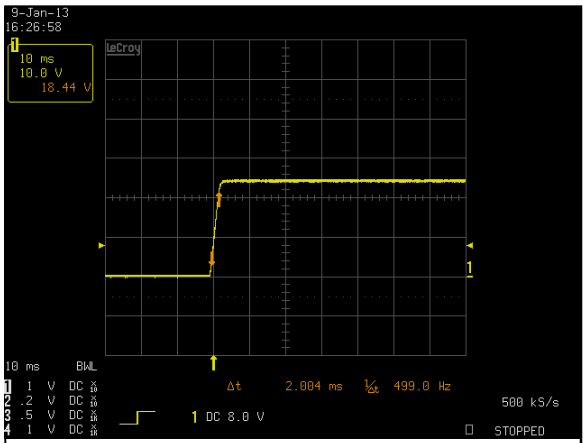


Figure 38: LPS105-M Output Voltage Startup Characteristic
Vin = 90Vac Load: Io = 6.3A, I_{FAN} = 0A, Output Capacitance = 330uF/A
Ch 1: Vo

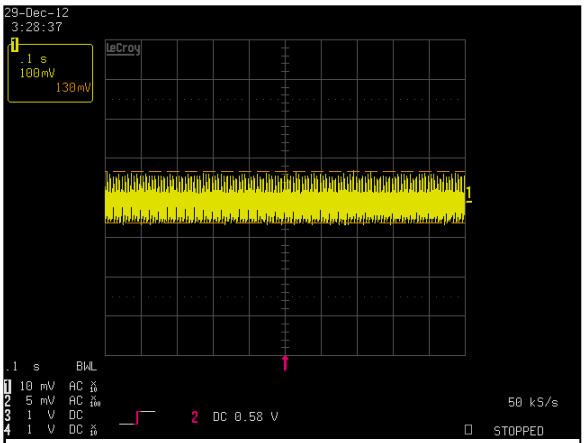


Figure 39: LPS105-M Ripple and Noise Measurement
Vin = 115Vac Load: Io = 6.3A, I_{FAN} = 0A
Ch 1: Vo

LPS105-M Performance Curves

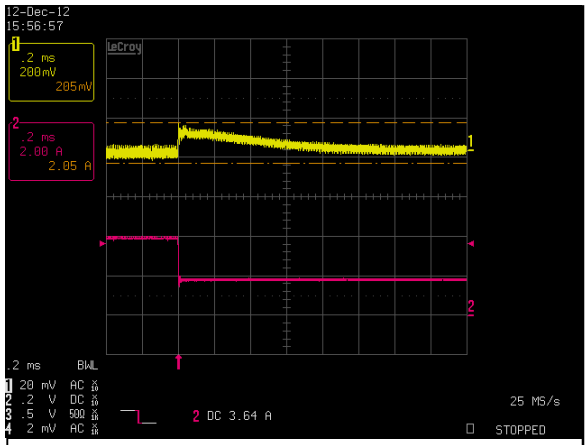


Figure 40: LPS105-M Transient Response – Vo Deviation (High to Low)
Vin = 115Vac Load: Io = 100% to 50% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

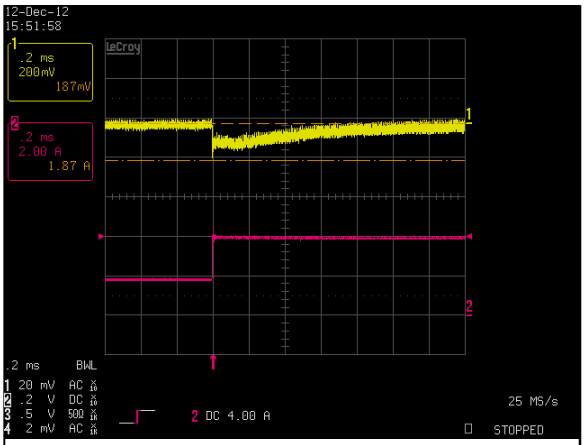


Figure 41: LPS105-M Transient Response – Vo Deviation (Low to High)
Vin = 115Vac Load: Io = 50% to 100% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

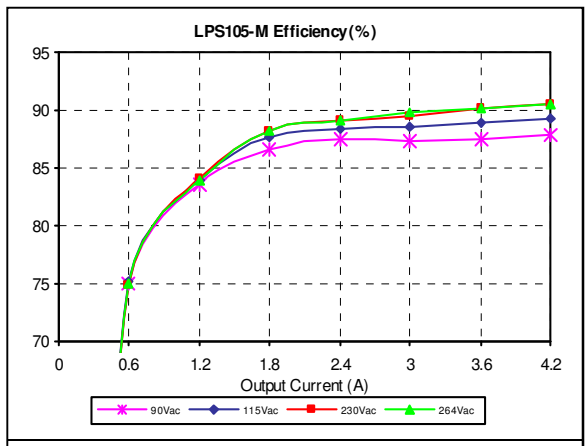


Figure 42: LPS105-M Efficiency Curves @ 25 degC, Convection Cool
Vin = 90 to 264Vac Load: Io = 0 to 4.2A, I_{FAN} = 0A

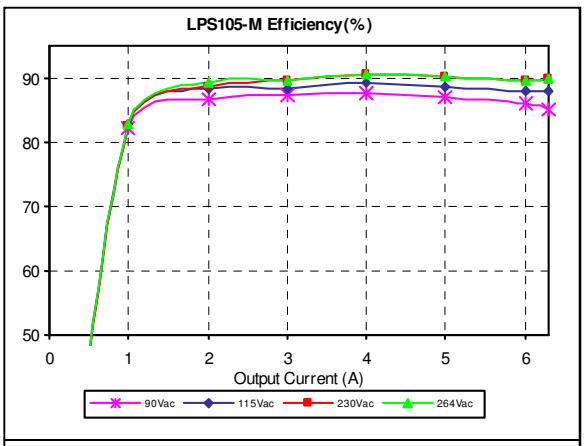


Figure 43: LPS105-M Efficiency Curves @ 25 degC, 30 CFM Forced Air
Vin = 90 to 264Vac Load: Io = 0 to 6.3A, I_{FAN} = 0A

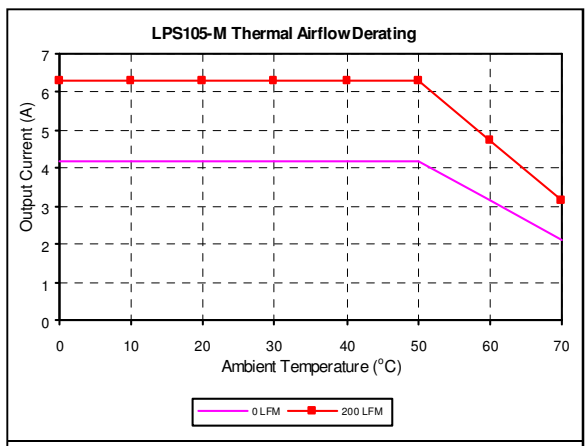


Figure 44: LPS105-M Derating Curves
Vin = 115Vac Load: Io = 0 to 6.3A, I_{FAN} = 0A

LPS108-M Performance Curves

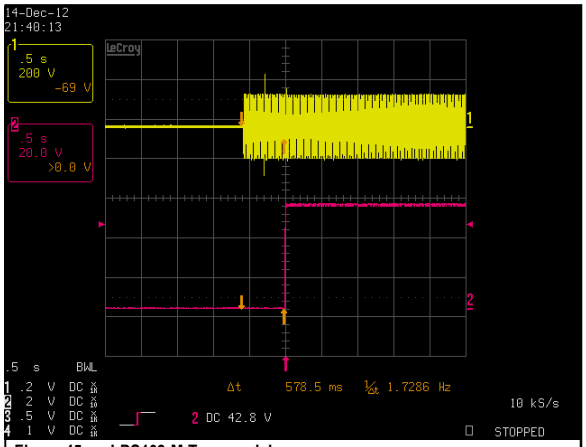


Figure 45: LPS108-M Turn-on delay
Vin = 115Vac Load: Io = 3.1A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

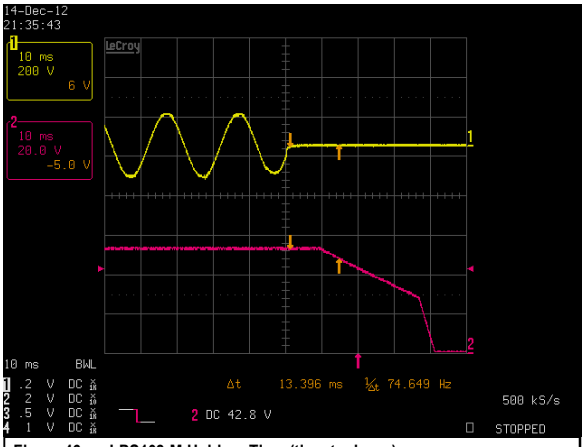


Figure 46: LPS108-M Hold-up Time (time to decay)
Vin = 115Vac Load: Io = 3.1A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo Ch 3: Power Fail

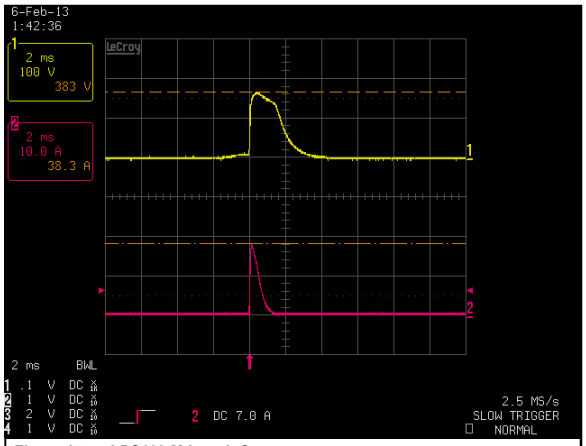


Figure 47: LPS108-M Inrush Current
Vin = 230Vac Load: Io = 0A, I_{FAN} = 0A, Turn on Angle = 90 deg
Ch 1: AC Mains Ch 2: Io

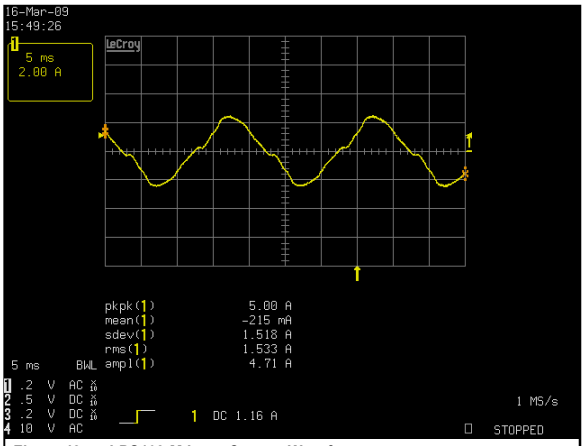


Figure 48: LPS108-M Input Current Waveform
Vin = 115Vac Load: Io = 3.1A, I_{FAN} = 0A
Ch 1: I_{IN}

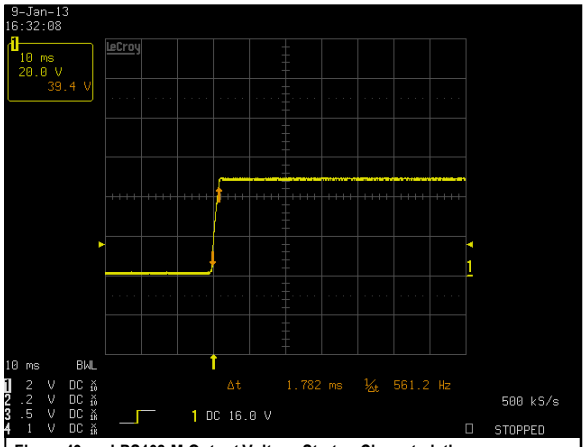


Figure 49: LPS108-M Output Voltage Startup Characteristic
Vin = 90Vac Load: Io = 3.1A, I_{FAN} = 0A, Output Capacitance = 330uF/A
Ch 1: Vo

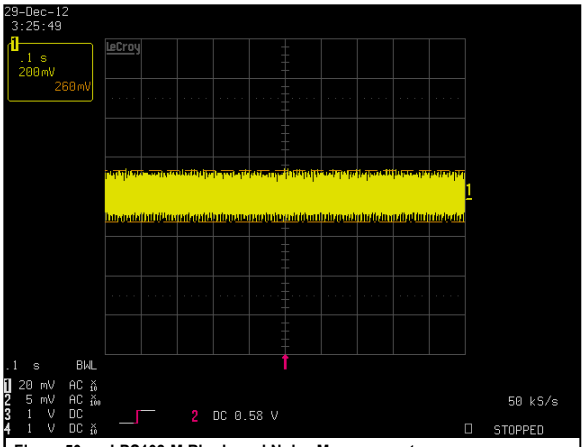


Figure 50: LPS108-M Ripple and Noise Measurement
Vin = 115Vac Load: Io = 3.1A, I_{FAN} = 0A
Ch 1: Vo

LPS108-M Performance Curves

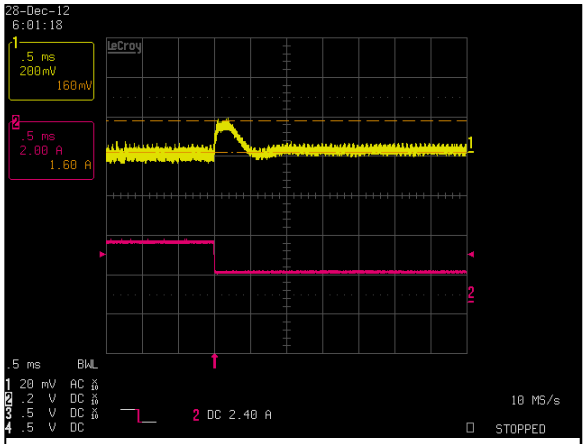


Figure 51: LPS108-M Transient Response – Vo Deviation (High to Low)
Vin = 115Vac Load: Io = 100% to 50% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

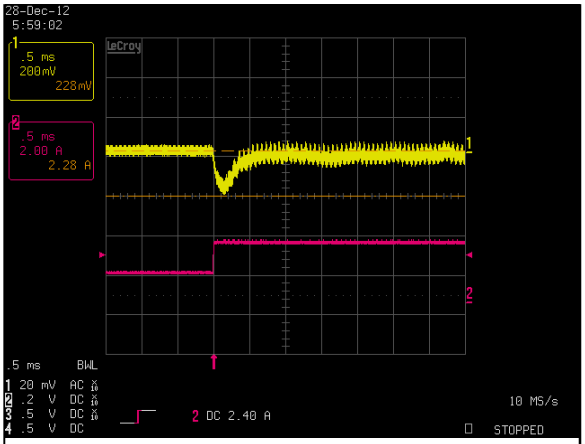


Figure 52: LPS108-M Transient Response – Vo Deviation (Low to High)
Vin = 115Vac Load: Io = 50% to 100% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

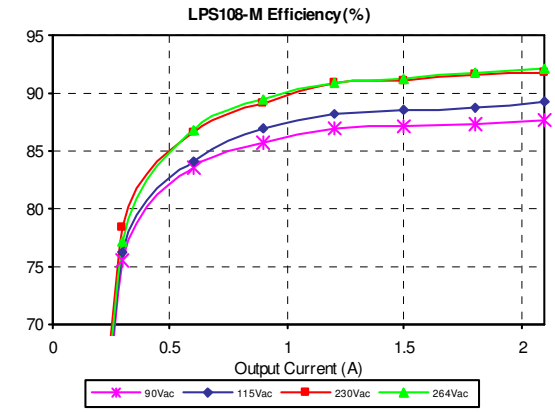


Figure 53: LPS108-M Efficiency Curves @ 25 degC, Convection Cool
Vin = 90 to 264Vac Load: Io = 0 to 2.1A, I_{FAN} = 0A

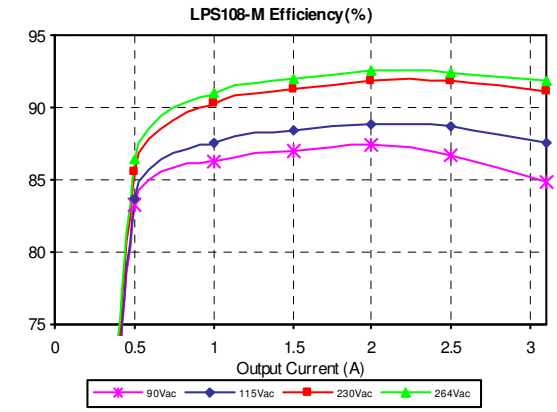


Figure 54: LPS108-M Efficiency Curves @ 25 degC, 30 CFM Forced Air
Vin = 90 to 264Vac Load: Io = 0 to 3.1A, I_{FAN} = 0A

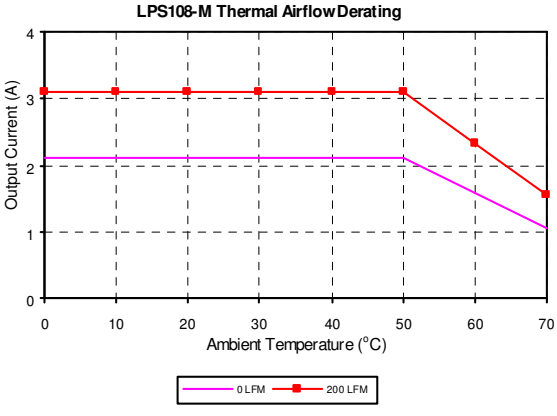


Figure 55: LPS108-M Derating Curves
Vin = 115Vac Load: Io = 0 to 3.1A, I_{FAN} = 0A

LPS109-M Performance Curves

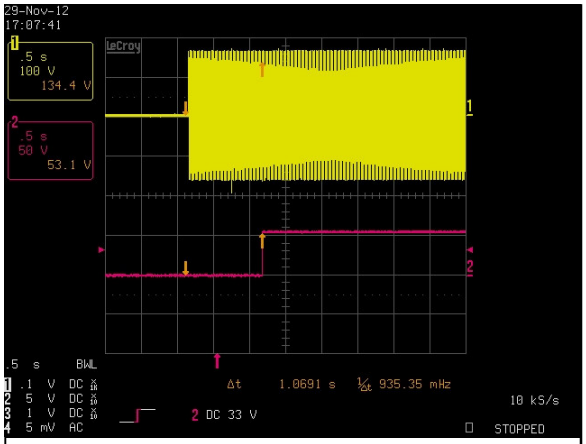


Figure 56: LPS109-M Turn-on delay
Vin = 115Vac Load: Io = 2.8A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo

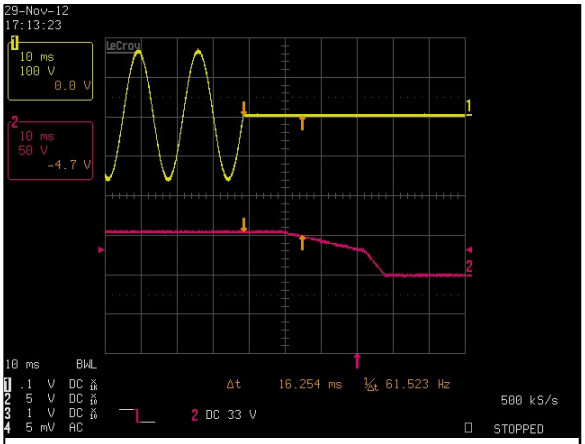


Figure 57: LPS109-M Hold-up Time (time to decay)
Vin = 115Vac Load: Io = 2.8A, I_{FAN} = 0A
Ch 1: AC Mains Ch 2: Vo

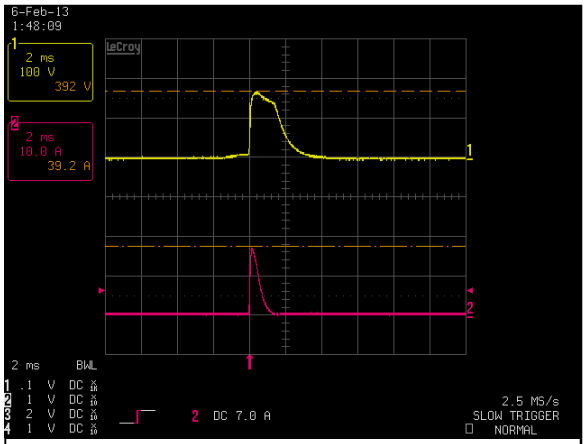


Figure 58: LPS109-M Inrush Current
Vin = 230Vac Load: Io = 0A, I_{FAN} = 0A, Turn on Angle = 90 deg
Ch 1: AC Mains Ch 2: Io

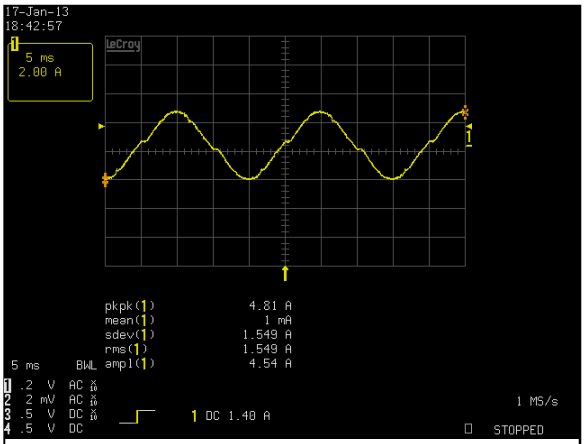


Figure 59: LPS109-M Input Current Waveform
Vin = 115Vac Load: Io = 2.8A, I_{FAN} = 0A
Ch 1: I_{IN}

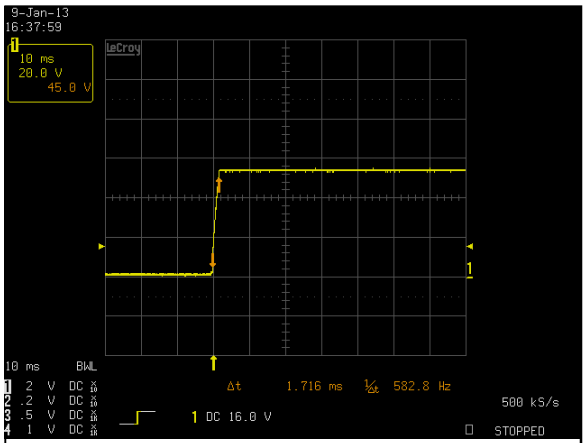


Figure 60: LPS109-M Output Voltage Startup Characteristic
Vin = 90Vac Load: Io = 2.8A, I_{FAN} = 0A, Output Capacitance = 330uF/A
Ch 1: Vo

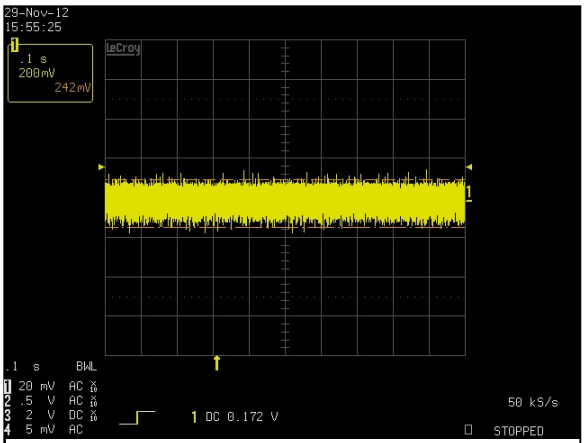


Figure 61: LPS109-M Ripple and Noise Measurement
Vin = 115Vac Load: Io = 2.8A, I_{FAN} = 0A
Ch 1: Vo

LPS109-M Performance Curves

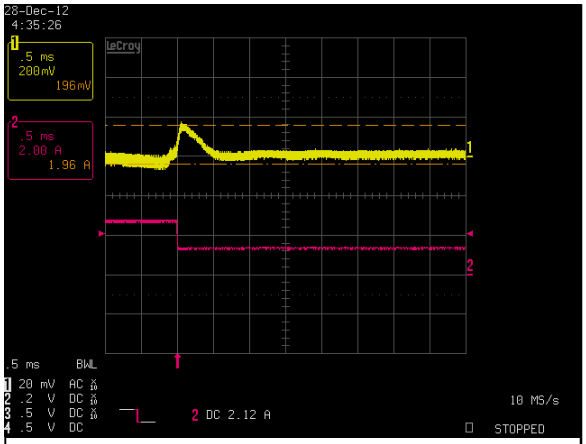


Figure 62: LPS109-M Transient Response – Vo Deviation (High to Low)
Vin = 115Vac Load: Io = 100% to 50% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

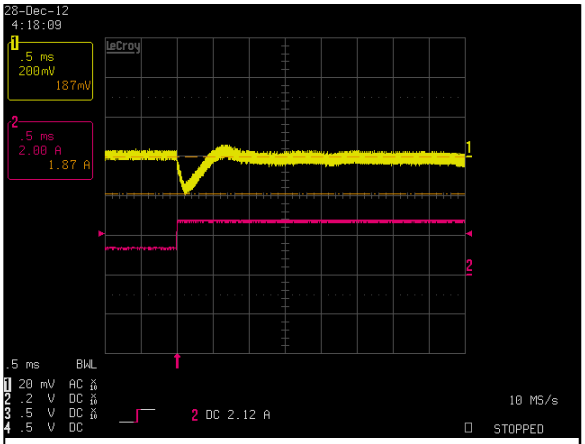


Figure 63: LPS109-M Transient Response – Vo Deviation (Low to High)
Vin = 115Vac Load: Io = 50% to 100% load change, 1A/us slew rate
Ch 1: Vo Ch 2: Io

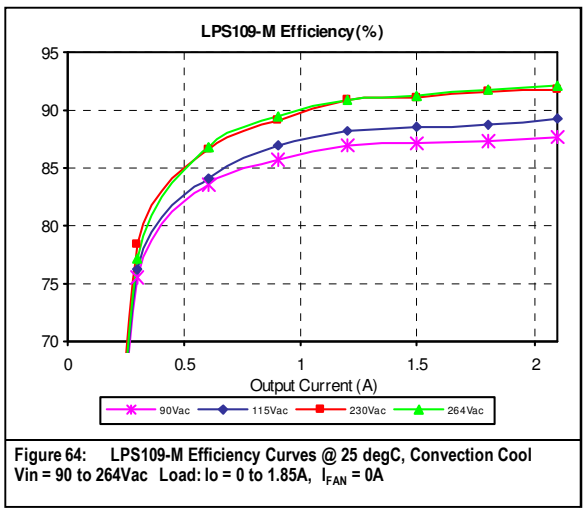


Figure 64: LPS109-M Efficiency Curves @ 25 degC, Convection Cool
Vin = 90 to 264Vac Load: Io = 0 to 1.85A, I_{FAN} = 0A

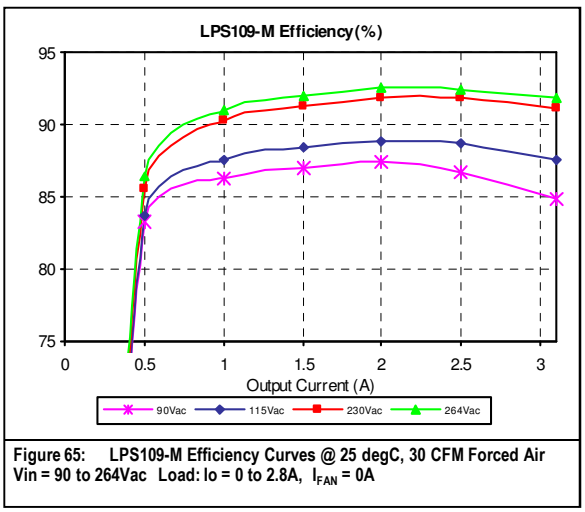


Figure 65: LPS109-M Efficiency Curves @ 25 degC, 30 CFM Forced Air
Vin = 90 to 264Vac Load: Io = 0 to 2.8A, I_{FAN} = 0A

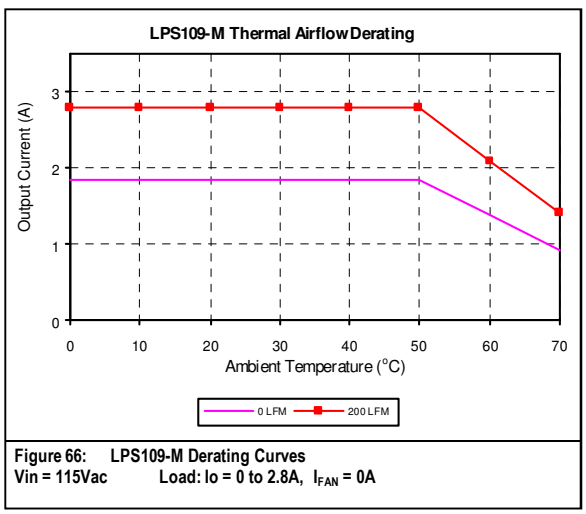


Figure 66: LPS109-M Derating Curves
Vin = 115Vac Load: Io = 0 to 2.8A, I_{FAN} = 0A

Protective Function Specifications

Input Fusing

LPS100-M series power supply is equipped with an internal non user serviceable 2.5 A, 250 Vac, type 392 fuse for fault protection in both the 'line' and 'neutral' lines input.

Over Voltage Protection (OVP)

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

LPS102-M

Parameter	Min	Nom	Max	Unit
Vo Output Overvoltage	6.5	/	7.5	V

LPS103-M

Parameter	Min	Nom	Max	Unit
Vo Output Overvoltage	15.6	/	18.0	V

LPS104-M

Parameter	Min	Nom	Max	Unit
Vo Output Overvoltage	19.5	/	22.5	V

LPS105-M

Parameter	Min	Nom	Max	Unit
Vo Output Overvoltage	31.2	/	36.0	V

LPS108-M

Parameter	Min	Nom	Max	Unit
Vo Output Overvoltage	62.4	/	72.0	V

LPS109-M

Parameter	Min	Nom	Max	Unit
Vo Output Overvoltage	70.2	/	81.0	V

Over Current Protection (OCP)

LPS100-M series power supply includes internal current limit circuitry to prevent damage in the event of overload or short circuit. In the event of overloads, the output voltage may deviate from the regulation band but recovery is automatic when the load is reduced to within specified limits.

Over Current Protection (OCP)

LPS100-M series power supply includes internal current limit circuitry to prevent damage in the event of overload or short circuit. In the event of overloads, the output voltage may deviate from the regulation band but recovery is automatic when the load is reduced to within specified limits.

LPS102-M

Parameter	Min	Nom	Max	Unit
Vo Output Overcurrent	26.4	/	38.4	A

LPS103-M

Parameter	Min	Nom	Max	Unit
Vo Output Overcurrent	13.7	/	18.0	A

LPS104-M

Parameter	Min	Nom	Max	Unit
Vo Output Overcurrent	11.0	/	16.0	A

LPS105-M

Parameter	Min	Nom	Max	Unit
Vo Output Overcurrent	6.9	/	10.0	A

LPS108-M

Parameter	Min	Nom	Max	Unit
Vo Output Overcurrent	3.4	/	5.0	A

LPS109-M

Parameter	Min	Nom	Max	Unit
Vo Output Overcurrent	3.1	/	4.5	A

Short Circuit Protection (SCP)

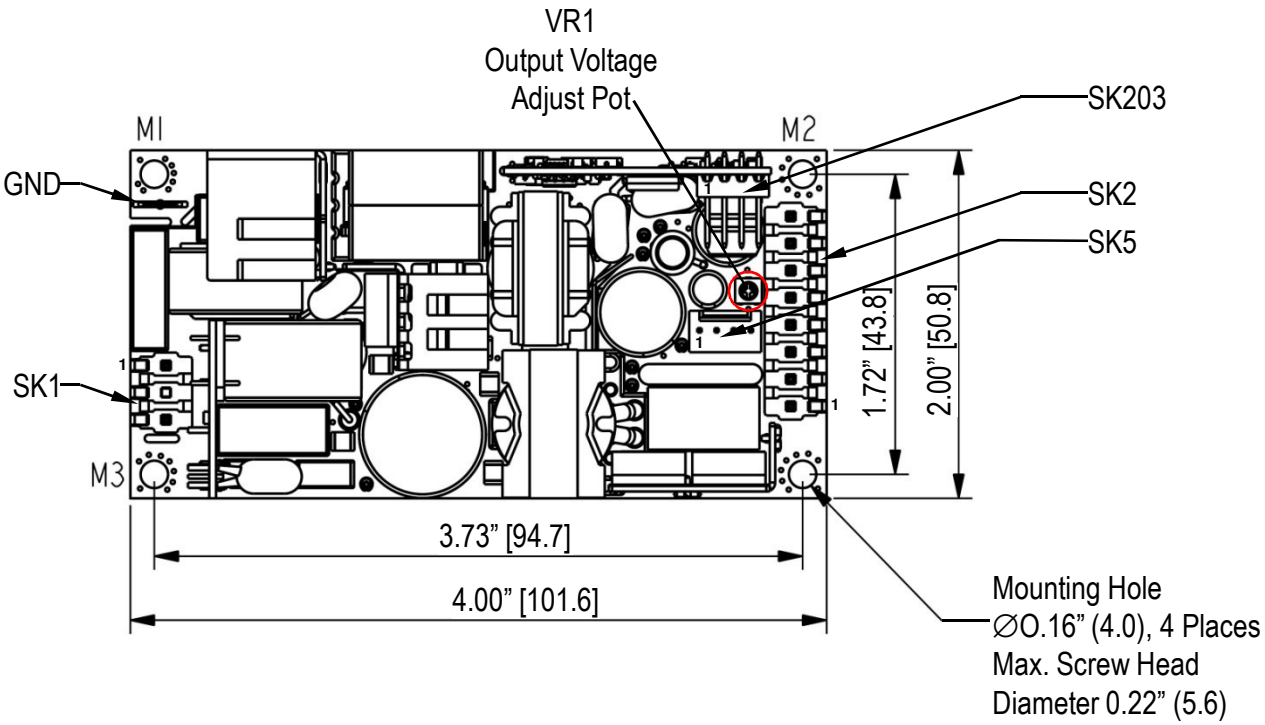
The power supply will withstand a continuous short circuit with no permanent damage. The power supply will automatically restart when the short circuit is removed. A short is defines as impedance less than 50 milliohms.

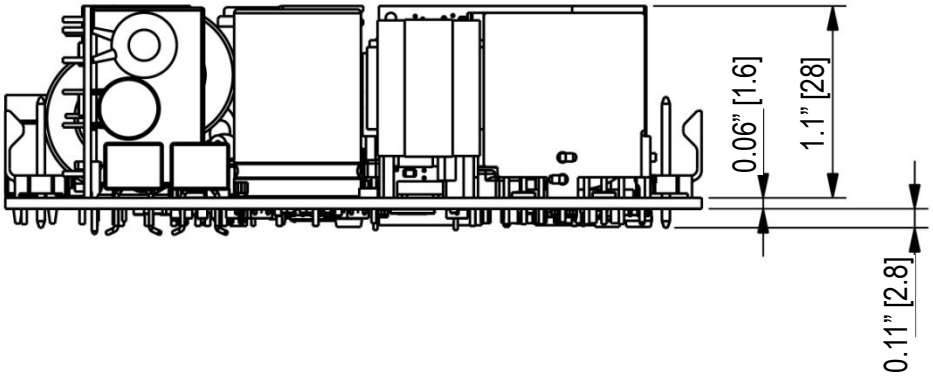
Over Temperature Protection (OTP)

The power supply latches off during over-temperature condition and returns back to normal operation when the power supply is cooled down. The LPS100-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.

Mechanical Specifications

Mechanical Drawing (Dimensioning and Mounting Locations)





- All dimensions in inches [mm], tolerance is +/-0.02" [0.5mm]
- Mounting holes M1 and M2 should be grounded for EMI purpose
- Mounting hole M1 is safety ground connection
- This power supply requires mounting on standoffs 0.20" [5.0mm] in height

Connector Definitions

AC Input Connector – SK1

Pin 1 – Neutral

Pin 3 – Line

Earth Ground – GND

Output Connector – SK2

Pin 1 – Output Return

Pin 2 – Output Return

Pin 3 – Output Return

Pin 4 – Output Return

Pin 5 – +Vo

Pin 6 – +Vo

Pin 7 – +Vo

Pin 8 – +Vo

12V Fan Supply Header – SK5

Pin 1 – +12V V_{FAN}

Pin 2 – +12V V_{FAN}

Pin 3 – FAN Return[1]

Pin 4 – FAN Return[1]

Control Signal Header – SK203

Pin 1 – Output Return

Pin 2 – Power Fail

Pin 3 – - Remote Sense

Pin 4 – + Remote Sense

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

Power / Signal Mating Connectors and Pin Types

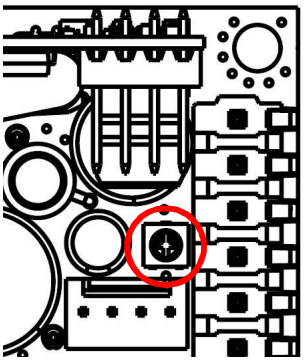
Table 4. Mating Connectors for LPS100-M series (or equivalent)

Reference	Vendor	Mating Connector or Equivalent	Mating Pins/Terminals or Equivalent
SK1	Molex	09-50-8031	08-52-0113
	Landwin	3060S0302	3360T011P
GND	Molex	01-90020001	
SK2	Molex	09-50-8081	08-52-0113
	Landwin	3060S0802	3360T011P
SK5	Molex	22-01-1042	08-70-0049
	Landwin	2510S04A0	2543T011P
SK203	Molex	35155-0400	08-70-0057
	Landwin	2640S04A0	2543T011P

LPS100-M connector kit can be ordered separately from Emerson. Use Connector Kit # 70-841-025 to order. Each LPS100-M connector kit contains the following:

- 1pcs Molex 09-50-8031 header housing for SK1
- 1pcs Molex 09-50-8081 header housing for SK2
- 12pcs Molex 08-52-0113 crimp pins for Molex 09-50-8031 and Molex 09-50-8081
- 1pcs Molex 01-90020001 insulated female lug for GND
- 1pcs Molex 22-01-1042 header housing for SK5
- 4pcs Molex 08-70-0049 crimp pins for Molex 22-01-1042
- 1pcs Molex 35155-0400 header housing for SK203
- 4pcs Molex 08-70-0057 crimp pins for Molex 35155-0400

Potentiometer Definitions



VR1- Vo Output adjust

Weight

The LPS100-M series weight is 0.44 lb. / 0.20 kg.

EMC Immunity

The LPS100-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 (stand alone) and Radiated Level B (in system)
IEC 61000-4-2	ESD up to 4kV contact, 8kV discharge
IEC 61000-4-3	RFI 3V/m
IEC 61000-4-4	Electrical Fast Transients level 3 minimum
IEC 61000-4-5	Surge level 3 minimum
IEC 61000-4-6	Radio frequency common mode, Levels 3V (rms) Modulated AM 80%, 1 kHz, 150 ohm source impedance
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 currents emission
FCC Part 15, Subpart J, Class B	Conducted & radiated[1] emissions
CISPR22 (EN55022), Class B	Conducted & radiated[1] emissions
IEC601-1 and International Electrotechnical Commission.	
EN60601	
CE Marking	LVD and EMC

Note 1 - to be tested with system enclosure

Safety Certifications

The LPS100-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 LPS100-M series has been designed in accordance with following safety standards. Appropriate safety certificates and approvals are available to download from our website www.powerconversion.com.

Table 6. Safety Certifications for LPS100-M series power supply

Document	Description
UL-60950-1 limited power clause latest edition	Safety of information Technology Equipment
UL-60601-1 (or latest)	Safety of Medical Electric Equipment.
CSA C22.2 60950-1 limited power clause latest edition	Safety of information Technology Equipment
CSA -C22.2 No. 601-1 M90	Medical Equipment.
European Community Safety (certified to EN60950-1/A11:2004)	European Community Safety investigated and marketed by TUV
EN60601-1/A2:1995 (partially)	European Community Safety investigated and marketed by TUV or VDE
CB Certificate and Report	(All CENELEC Countries)
CE Mark	LVD

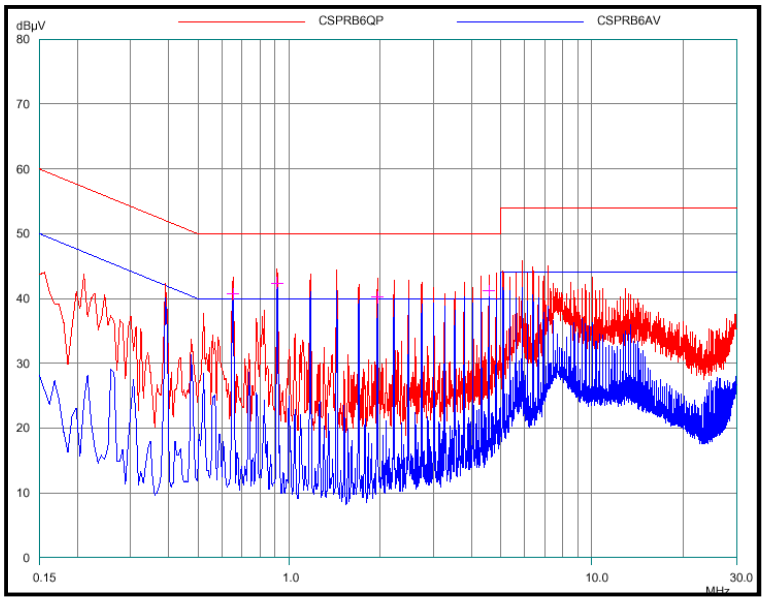
EMI Emissions

The LPS100-M series has been designed to comply with the Class B limits of EMI requirements of EN55022 (FCC Part 15) and CISPR 22 (EN55022) for emissions and relevant sections of EN61000 (IEC 61000) for immunity.

The unit is enclosed inside a metal box, tested at 150W using resistive load with cooling fan.

Conducted Emissions

The applicable standard for conducted emissions is EN55022 (FCC Part 15). Conducted noise can appear as both differential mode and common mode noise currents. Differential mode noise is measured between the two input lines, with the major components occurring at the supply fundamental switching frequency and its harmonics. Common mode noise, a contributor to both radiated emissions and input conducted emissions, is measured between the input lines and system ground and can be broadband in nature.



The LPS100-M series power supply have internal EMI filters to ensure the convertor's 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 under forced air convection at maximum rated loading.

Sample of EN55022 Conducted EMI Measurement at 100Vac input

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

Table 7. Conducted EMI emission specifications of the LPS100-M 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
EN 60601-1-2: 2001	All	Margin	-	-	6	dB
VCCI Class II	All	Margin	-	-	6	dB

Radiated Emissions

Unlike conducted EMI, radiated EMI performance in a system environment may differ drastically from that in a stand-alone power supply. The shielding effect provided by the system enclosure may bring the EMI level from Class A to Class B. It is thus recommended that radiated EMI be evaluated in a system environment. The applicable standard is EN55022 Class A (FCC Part 15). Testing ac-dc convertors as a stand-alone component to the exact requirements of EN55022 can be difficult, because the standard calls for 1m leads to be attached to the input and outputs and aligned such as to maximize the disturbance. In such a set-up, it is possible to form a perfect dipole antenna that very few ac-dc convertors could pass. However, the standard also states that 'an attempt should be made to maximize the disturbance consistent with the typical application by varying the configuration of the test sample'.

Environmental Specifications

The LPS100-M series power supply is designed to meet all of its specifications during any combination of operating ambient conditions and after exposure to any combination of non-operating ambient conditions specified in this section.

Table 8. Maximum Ambient Conditions:

Parameter	Model	Symbol	Min	Typ	Max	Unit
Ambient Operating Temperature	All	T_A	0	-	+70[1]	ºC
Cold Start-up Temperature	All	T_{ST}	-20	-	-	ºC
Storage Temperature	All	T_{STG}	-40	-	+85	ºC
Shock		Accordance to IEC 68-2-27 Three positive and negative pulses in each axis				
Operating	All	4G, half sine, 22mSec duration				
Non-operating	All	30G, half sine, 18mSec duration				
Vibration		Accordance to IEC 68-2-6 to levels IEC 721-3-2 Tested in three mutually perpendicular axes				
Operating	All	Random - 1.0g rms, 10-500Hz, 20 minutes/axis				
Non-operating	All	Sine - 1.0g rms, 10-500Hz, 15 minutes/axis Random - 2.7 g rms, 10-2000Hz, 20 minutes/axis				
MTBF Convection 25ºC	All	$V_{IN,AC}$ = 115Vac >200,000hrs $V_{IN,AC}$ = 230Vac >300,000hrs				
Forced air 25ºC	All	$V_{IN,AC}$ = 115Vac >400,000hrs $V_{IN,AC}$ = 230Vac >500,000hrs				

Note 1 - Derate each output at 2.5% per degree C from 50ºC to 70ºC

AC Input (SK1)

This connector supplies the AC Mains to the LPS100-M series power supply.

Pin 1 - Neutral

Pin 3 - Line

Earth Ground (GND)

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

GND – Earth Ground (Safety Ground)

Main Output (SK2)

These terminals provide the main output for the LPS100-M. The Vo and the Output Return terminals are the positive and negative rails, respectively of the main output of the LPS100-M series power supply. The Main Output is electrically isolated from the Earth Ground and can be operated as a positive or negative output.

Pin 1 to 4 – Output Return

Pin 5 to 8 – +Vo

Vo Output voltage adjustment

The main output of the LPS100-M series power supply can be adjusted by +/- 10% from its nominal output voltage via the potentiometer VR1. Since the 12V Fan Supply is not independently regulated (except on LPS102-M and LPS104-M), its output voltage may change according to Vo set point.

12V Fan Supply (SK5)

The LPS100-M series power supply contains an isolated 12V output for powering a cooling fan or as a aux power source. This 12V Fan Supply is provided in a 4 pin header connector SK5.

Pin 1 and 2 – +12V V_{FAN}

Pin 3 and 4 – FAN Return

Control Signals (SK203)

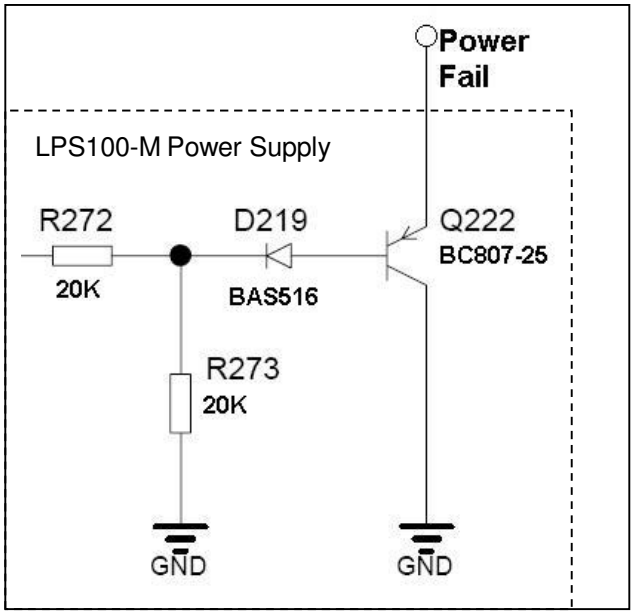
The LPS100-M series contains a 4 pins control signal header providing analogy control interface.

Output Return – (SK203 – Pin 1)

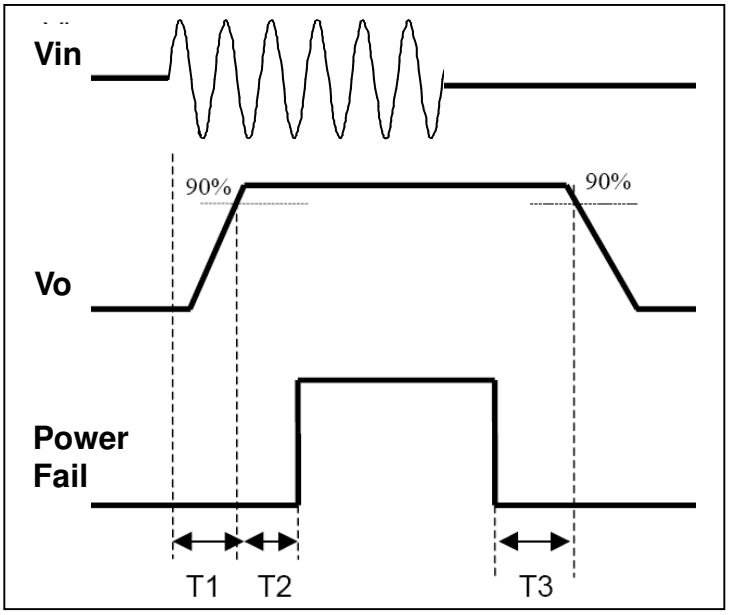
This pin is the control signal ground reference in the SK203 control header. It is electrically connected to the main output Vo Output Return.

Power Fail – (SK203 – Pin 2)

Power Fail is an open emitter output capable of sinking 10ma maximum at 0.9VDC. This signal is referenced to Output Return. Add a pull-up resistor (10K) to an external supply (12V max) for the Power Fail signal.



Power Fail signal output equivalent circuit



Power Fail signal timing diagram

Low to High Transition (Power OK)

Mains AC Application - Delay time measurement between the application of the Mains AC at the power supply input to the availability of the regulated Vo – T1 (Turn On Delay) and the delay time T2 to when Power Fail signal indicates output voltage Vo is OK. AC line should be considered at 0 degrees at time of initial application to the AC input.

High to Low Transition (Power Fail)

Loss of Main AC - The high to low transition of the Power Fail signal shall be an indication of the impending loss of Vo regulation due to a shutdown condition such as the loss of Mains AC, Overvoltage Protection or Over Temperature Protection. The AC line should be considered at 0 degrees at the time of removal from the power supply input.

Table 9. Timing specifications of the Power Fail signal:

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Turn On Delay	$V_{IN,AC}$ = 90 Vac $P_O = P_{O,maxFA}$	T1	-	-	2	Sec
Power OK Delay	$V_{IN,AC}$ = 115 Vac $P_O = P_{O,maxFA}$	T2	100	-	500	mSec
Power Fail Delay	$V_{IN,AC}$ = 115 Vac $P_O = P_{O,maxFA}$	T3	6	-	-	mSec

+Remote Sense, -Remote Sense (Remote Sensing) – (SK203 – Pin 3 and Pin 4)

The main output of the LPS100-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 Vo +Remote Sense (pin 4) and the Vo –Remote Sense (pin 3) 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 LPS100-M series power supply will operate appropriately without the sense lines connected; however it is recommended that the sense lines be connected directly to the main output terminals if remote sensing is not required.

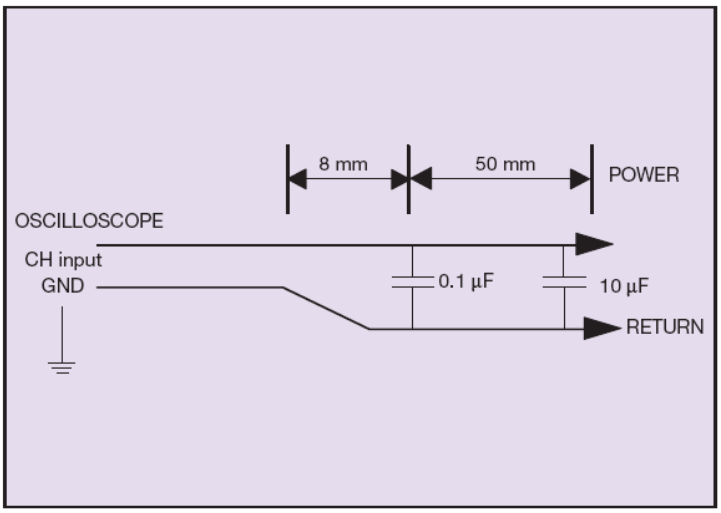
The power supply is protected against damage caused by inadvertent reverse connection of the Remote Sense lines.

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

Note: The maximum output voltage of the LPS100-M series power supply is limited to +10% above the nominal setting, trimming the main output above the nominal may limit the maximum amount of voltage sense compensation.

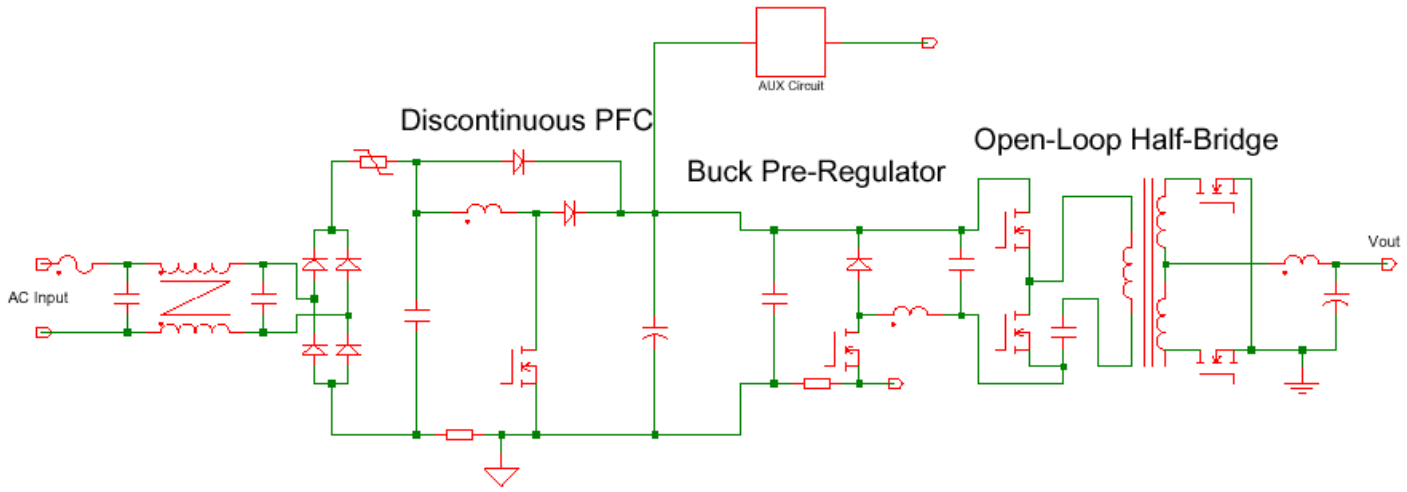
Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the LPS100-M Series. 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.



Block Diagram

Below is the block diagram of the LPS100-M series power supply.



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