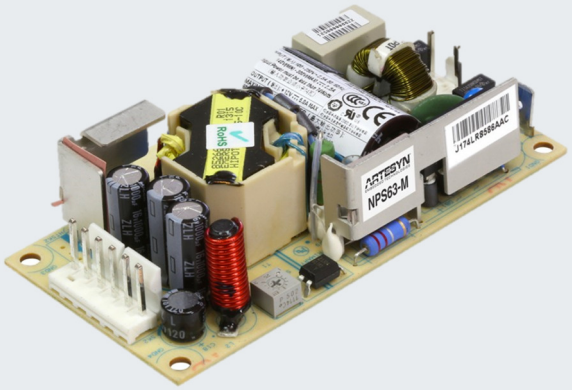
TECHNICAL REFERENCE NOTE

ARTESYN NPS60-M SERIES

60 W



PRODUCT DESCRIPTION

Advanced Energy's Artesyn NPS60-M series power supply features a universal 90 to 264 Vac input and also could operate from 127 to 300 Vdc input. The power supply produces a tightly regulated output, The output can deliver up to 60 W continuously with natural convection cooling (no additional rating for forced air). The output could be adjusted over the range +20%/-20% over nominal set output voltage. NPS60-M series power supply is comprehensively protected against overvoltage, over temperature and short-circuit conditions, The power supplies have a full load ambient operating temperature range of 0 ^{O}C to +50 ^{O}C without derating. Operation between 50 ^{O}C and 80 ^{O}C, the output should be derated by 2.5 percent per ^{O}C, the power supply could startup at -20 ^{O}C after a 30 minutes soak time.

AT A GLANCE

Total Power

60 W

Input Voltage

90 to 264 Vac

# of Outputs

Single

RoHS

SPECIAL FEATURES

- Medical and ITE safeties
- 2" x 4" footprint
- Less than 1U high
- Remote sense
- Overload and short circuit protection
- Adjustable output voltage
- High efficiency
- High MTBF
- Built-in EMI filter(CISPR 22 Class B)
- International efficiency level V, Energy Star 2.0 & CeC compliant (except NPS62-M)
- Less than 300mW no-load power consumption (Less than 500mW for NPS62-M)
- 0 ^{O}C to 80 ^{O}C
- Complies with EN61000-3-2
- UL Class I approved
- Class II approved(with Class A EMI)
- LPX100 enclosure kit available
- Dual AC fuses

SAFETY

TUV	62368-1 / 60601-1
UL	62368-1 / 60601-1
CSA	62368-1 / 60601-1
NEMKO	62368-1 / 60601-1
CB	Certificate and report
CE	Mark for LVD
CCC	Mark
UKCA	Mark

MODEL NUMBERS

Standard	Output Voltage	Minimum Load	Maximum Load	Peak Load[1]	Regulation[2]
NPS62-M	5 V	0 A	11 A	13 A	2%
NPS63-M	12 V	0 A	5 A	5.5 A	2%
NPS63-M-006[3]	12 V	0 A	5 A	5.5 A	2%
NPS64-M	15 V	0 A	4 A	4.4 A	2%
NPS65-M	24 V	0 A	2.5 A	2.75 A	2%

Note 1 - Peak current lasting <15 S with a maximum 10% duty cycle.
Note 2 - At 25 ^{O}C including initial tolerance, line voltage, load currents and output voltage adjusted to factory setting.
Note 3 - Compliant to level VI efficiency.

Options

None

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

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

Table 1. Absolute Maximum Ratings

Parameter	Model	Symbol	Min	Typ	Max	Unit
Input Voltage						
AC continuous operation	All Models	$V_{IN,AC}$	90	-	264	Vac
DC continuous operation	All Models	$V_{IN,DC}$	120	-	300	Vdc
Maximum Output Power (Main + Fan) Convection continuous operation	All Models	$P_{O,maxCC}$	-	-	60	W
Isolation Voltage						
Input to outputs	All Models		-	-	4000	Vac
Input to safety ground	All Models		-	-	1800	Vac
Ambient Operating Temperature	All Models	T_A	0	-	+80[1]	°C
Cold Start-up Temperature	All Models	T_{ST}	-30/-40[2]	-	-	°C
Storage Temperature	All Models	T_{STG}	-40	-	+85	°C
Humidity (non-condensing)						
Operating	All Models		10	-	90	%
Non-operating	All Models		10	-	95	%
Altitude						
Operating	All Models		-500	-	13000[3]	feet
Non-operating	All Models		-1000	-	50000	feet

Note 1 - Derate each output at 2.5% per °C from 50 °C to 80 °C
Note 2 - -40 °C startup if Standby output ≤ 1 A (any valid load on main output); -30 °C startup if Standby output > 1 A (any valid load on main output).
Note 3 - Derating 1 °C per 1000 feet above 10,000 feet.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications

Parameter	Condition	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	$V_{IN,DC}$	127	-	300	Vdc
Maximum Input Current	$V_{IN,AC}$ = 90 Vac	$I_{IN,max}$	-	-	1.5	A
No Load Input Power (V_O = ON, I_O = 0, I_{FAN} = 0)	All	$P_{IN,no-load}$	-	-	0.50 0.21 (-006)	W W
Harmonic Line Currents	All	THD	Per EN61000-3-2(for Class D)			
Startup Surge Current (Inrush) @ 25 °C	$V_{IN,AC}$ = 230 Vac	$I_{IN,surge}$	-	-	50	A_{PK}
Input Fuse	Internal, L and N 250 Vdc/250 Vac		-	-	2.5	A
Input AC Low Line Start-up Voltage	$I_O = I_{O,max}$	$V_{IN,AC-start}$	60	-	85	Vac
Input AC Undervoltage Lockout Voltage	$I_O = I_{O,max}$	$V_{IN,AC-stop}$	55	-	75	Vac
Input DC Low Line Start-up Voltage	$I_O = I_{O,max}$	$V_{IN,DC-start}$	70	-	85	Vdc
Input DC Undervoltage Lockout Voltage	$I_O = I_{O,max}$	$V_{IN,DC-stop}$	50	-	70	Vdc
Efficiency @ 25 °C	$V_{IN,AC}$ = 230 Vac $I_O = I_{O,max}$	η	-	87 80 (NPS62-M)	-	%
Hold Up Time	$V_{IN,AC}$ = 115 Vac	$t_{Hold-Up}$	10	-	-	mS
Turn On Delay	$V_{IN,AC}$ = 90 Vac $P_O = P_{O,max}$	$t_{Turn-On}$	-	-	2	S
Leakage Current to safety ground	(V_{IN} = 264 Vac, $f_{IN,AC}$ = 50/60 Hz)	$I_{IN,leakage}$	-	-	275	uA
System Stability Phase Margin Gain Margin	330 µF/A Capacitive Load		45 10		- -	Ø dB

ELECTRICAL SPECIFICATIONS

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	%
Output Adjust Range[1]		I_O = 0	$\%V_O$	-20	-	+20	%
Output Ripple, pk-pk	NPS62-M NPS63-M NPS63-M-006 NPS64-M NPS65-M	Measure with a 0.1 µF ceramic capacitor in parallel with a 10 µF tantalum capacitor	V_O	- - - - -	- - - - -	50 120 120 150 240	mV_{PK-PK}
Output Current, continuous	NPS62-M NPS63-M NPS63-M-006 NPS64-M NPS65-M	Convection cooling	$I_{O,maxCC}$	- - - - -	- - - - -	11.0 5.0 5.0 4.0 2.5	A
Output Current, peak[2]	NPS62-M NPS63-M NPS63-M-006 NPS64-M NPS65-M	Maximum duration of 30 S with maximum duty cycle of 10%	$I_{O,peak}$	- - - - -	- - - - -	13.0 5.5 5.5 4.4 2.75	A
V_O Turn On Overshoot[3]	All Models	I_O = 0, I_{SB} = 0, I_{FAN} = 0	$\%V_O$	-	-	3	V
V_O Dynamic Response - Peak Deviation	NPS62-M NPS63-M NPS63-M-006 NPS64-M NPS65-M	50% (50% to 100% of $I_{O,maxFA}$) load change Slew rate = 1 A/µS Output capacitance = 100 µF/A	$\pm\%V_O$	- - - - -	- - - - -	5 5 5 2 2	%
V_O Dynamic Response - Setting Time		50% (50% to 100% of $I_{O,maxFA}$) load change Slew rate = 1 A/µs Output capacitance = 100 µF/A	t_s	-	-	500	µS
Maximum Convection Output Power		Main output	$P_{O,maxCC}$	-	-	60	W
V_O Capacitive Load		Start up	-	0	-	330	µF/A
V_O Long Term Stability	NPS62-M NPS63-M NPS63-M-006 NPS64-M NPS65-M	Max change over 24 hours after thermal equilibrium (30 mins)	$\pm\%V_O$	- - - - -	- - - - -	0.1 1.0 1.0 1.0 1.0	%
DCDC Switching Frequency		All	$f_{SW,DC-DC}$	70	-	100	KHz
Remote Sense, + and -		Maximum compensation at each output line	V_{SENSE}	-	-	400	mV

Note 1 - The adjust pot shown on page 21.
Note 2 - Peak current lasting<15 S with a maximum 10% duty cycle.
Note 3 - The worst case overshoot is less than 3%V_o or 150 mV.

ELECTRICAL SPECIFICATIONS

NPS62-M Performance Curves

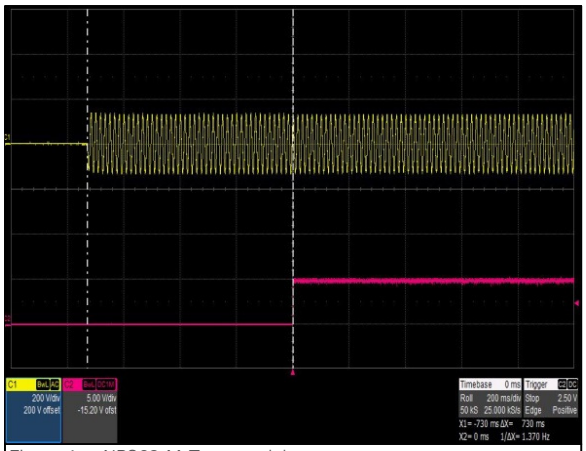


Figure 1: NPS62-M Turn-on delay
Vin = 90 Vac Load: Io = 11 A
Ch 1: V_{IN} Ch 2: Vo

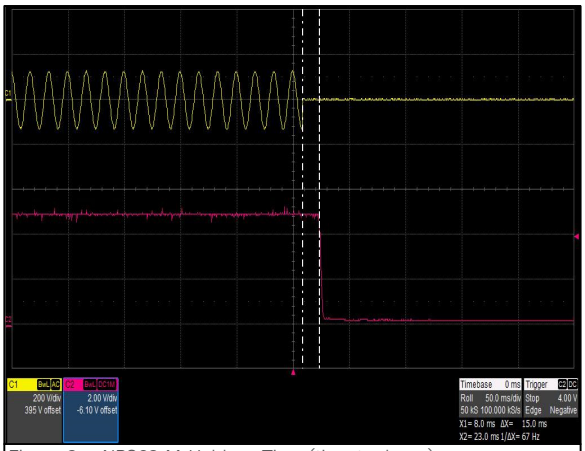


Figure 2: NPS62-M Hold-up Time (time to decay)
Vin = 90 Vac Load: Io = 11 A
Ch 1: V_{IN} Ch 2: Vo

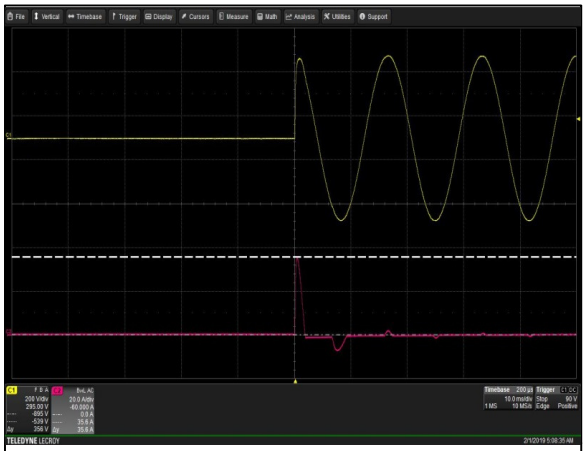


Figure 3: NPS62-M Inrush Current
Vin = 264 Vac Load: Io = 0 A, Turn on at 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

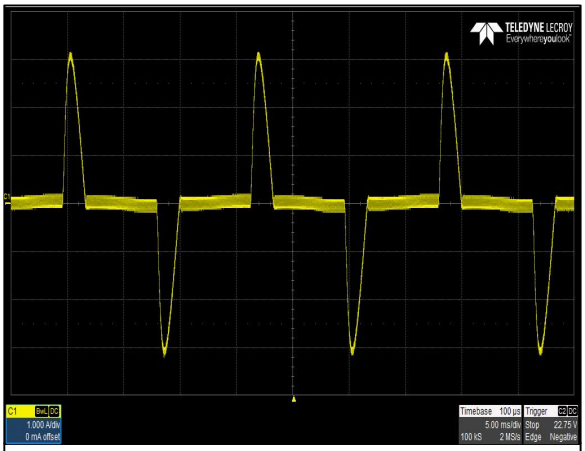


Figure 4: NPS62-M Input Current Waveform
Vin = 115 Vac Load: Io = 11 A
Ch 1: I_{IN}

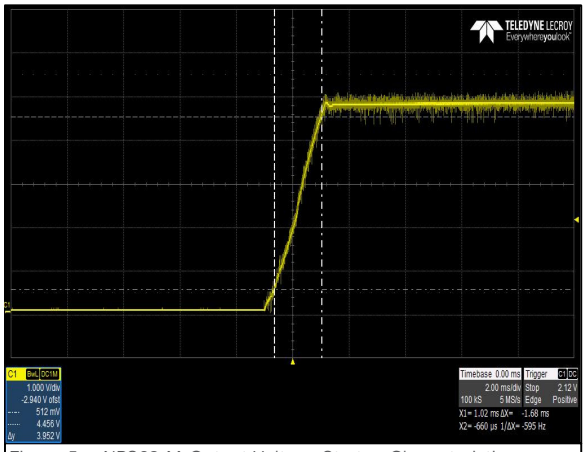


Figure 5: NPS62-M Output Voltage Startup Characteristic
Vin = 90 Vac Load: Io = 11 A
Ch 1: Vo Output Capacitance = 330 uF/A

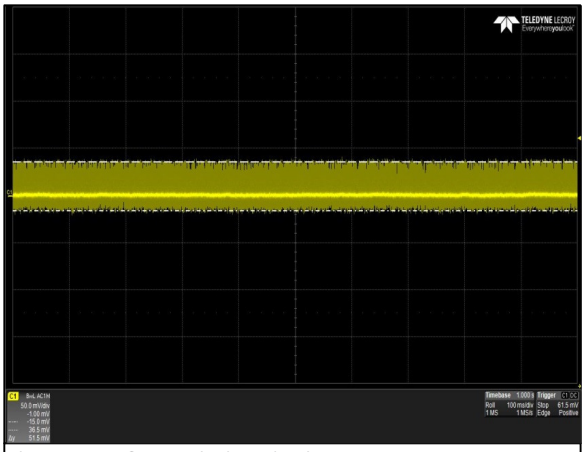


Figure 6: NPS62-M Ripple and Noise Measurement
Vin = 115 Vac Load: Io = 11 A
Ch 1: Vo

ELECTRICAL SPECIFICATIONS

NPS62-M Performance Curves

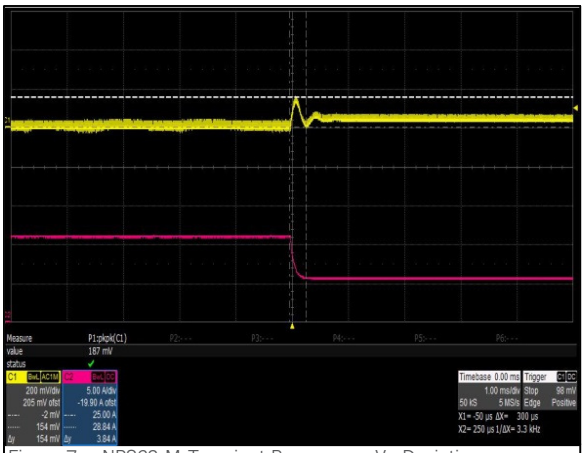


Figure 7: NPS62-M Transient Response – Vo Deviation
Vin = 230 Vac Load: Io = 100% to 50%, 1 A/us slew rate
Ch 1: Vo Ch 2: Io

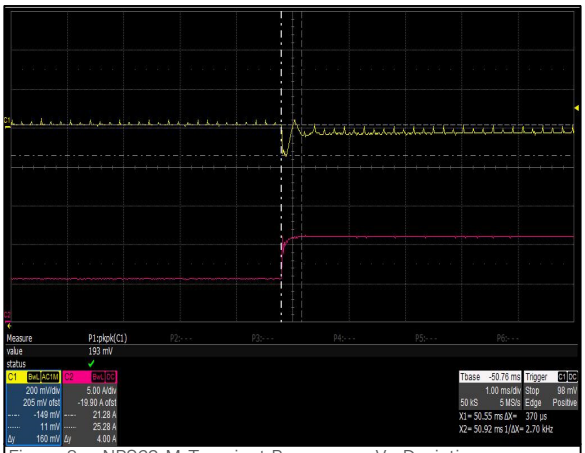


Figure 8: NPS62-M Transient Response – Vo Deviation
Vin = 230 Vac Load: Io = 50% to 100%, 1 A/us slew rate
Ch 1: Vo Ch 2: Io

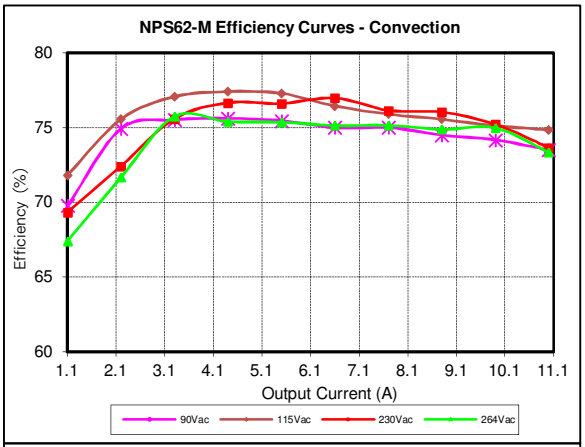


Figure 9: NPS62-M Efficiency Curves @ 25 degC
Convection Cooling
Vin = 90 to 264 Vac Load: Io = 0 to 11 A

ELECTRICAL SPECIFICATIONS

NPS63-M Performance Curves

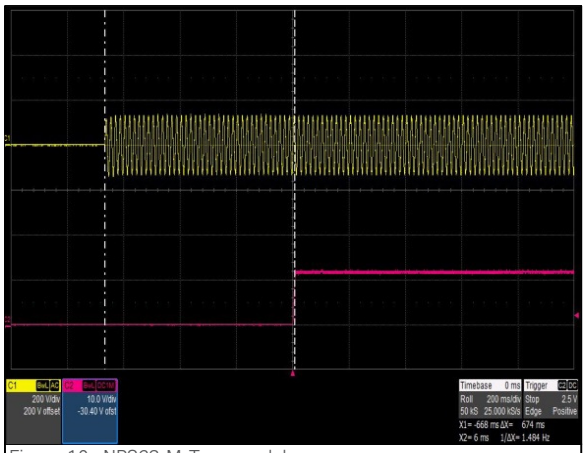


Figure 10: NPS63-M Turn-on delay
Vin = 90 Vac Load: Io = 5 A
Ch 1: V_{IN} Ch 2: Vo

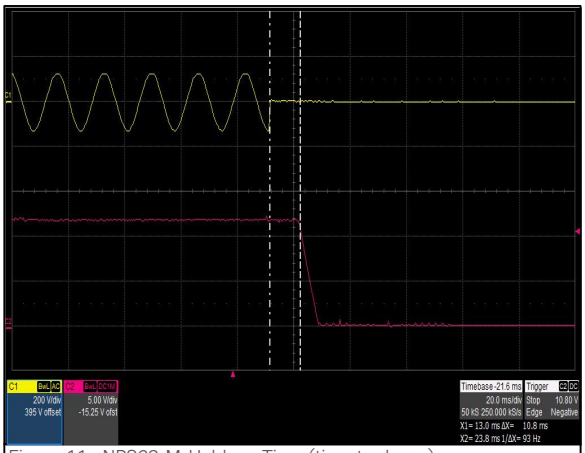


Figure 11: NPS63-M Hold-up Time (time to decay)
Vin = 90 Vac Load: Io = 5 A
Ch 1: V_{IN} Ch 2: Vo

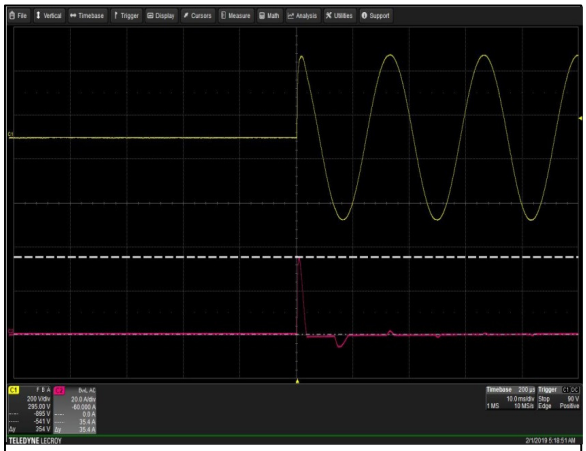


Figure 12: NPS63-M Inrush Current
Vin = 264 Vac Load: Io = 0 A, Turn on at 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

Figure 13: NPS63-M Input Current Waveform
Vin = 115 Vac Load: Io = 5 A
Ch 1: I_{IN}

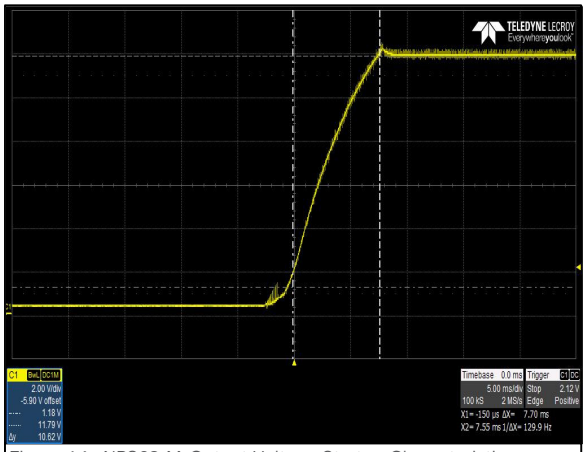


Figure 14: NPS63-M Output Voltage Startup Characteristic
Vin = 90 Vac Load: Io = 5 A
Ch 1: Vo Output Capacitance = 330 uF/A

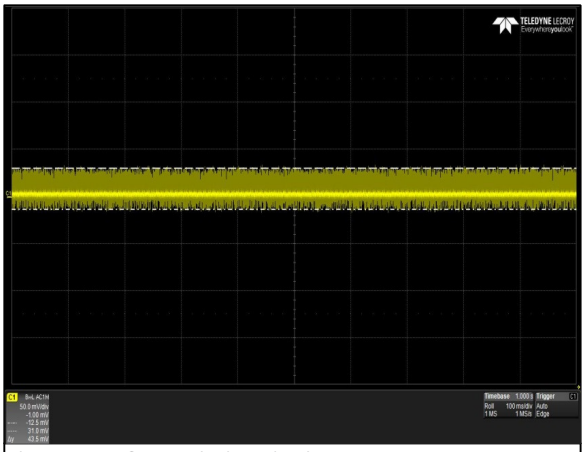


Figure 15: NPS63-M Ripple and Noise Measurement
Vin = 115 Vac Load: Io = 5 A
Ch 1: Vo

ELECTRICAL SPECIFICATIONS

NPS63-M Performance Curves

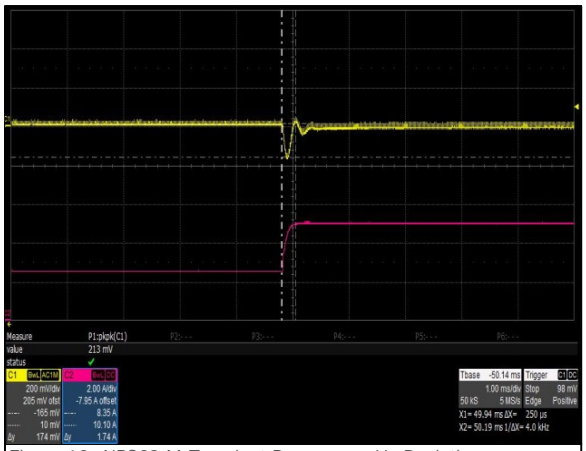


Figure 16: NPS63-M Transient Response – Vo Deviation
Vin = 230 Vac Load: Io = 100% to 50%, 1 A/us slew rate
Ch 1: Vo Ch 2: Io

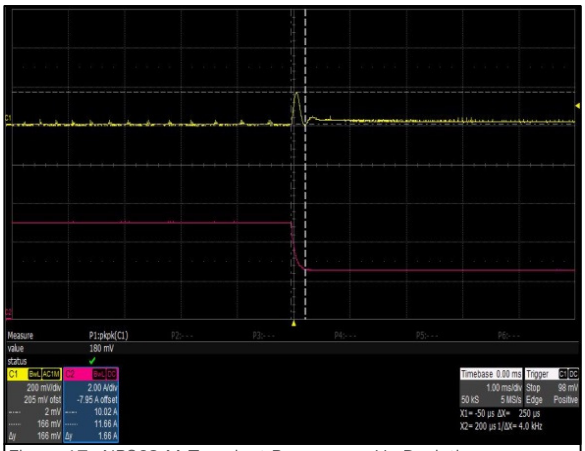


Figure 17: NPS63-M Transient Response – Vo Deviation
Vin = 230 Vac Load: Io = 50% to 100%, 1 A/us slew rate
Ch 1: Vo Ch 2: Io

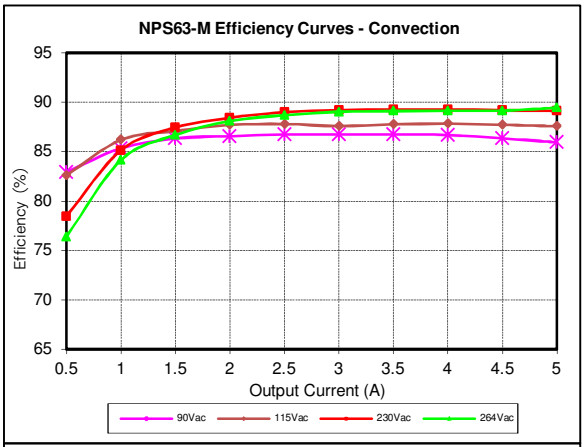


Figure 18: NPS63-M Efficiency Curves @ 25 degC
Convection Cooling
Vin = 90 to 264 Vac Load: Io = 0 to 5 A

ELECTRICAL SPECIFICATIONS

NPS64-M Performance Curves

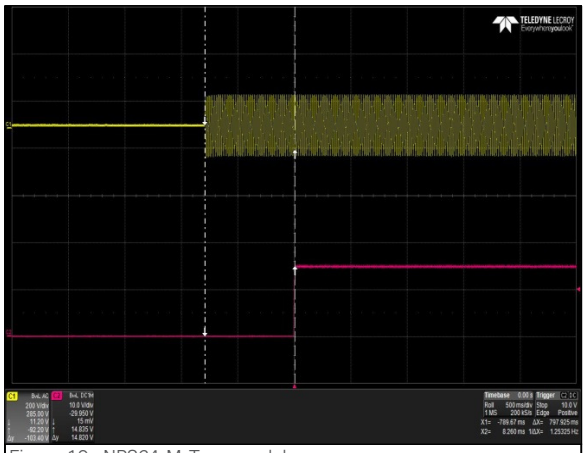


Figure 19: NPS64-M Turn-on delay
Vin = 90 Vac Load: Io = 4 A
Ch 1: V_{IN} Ch 2: Vo

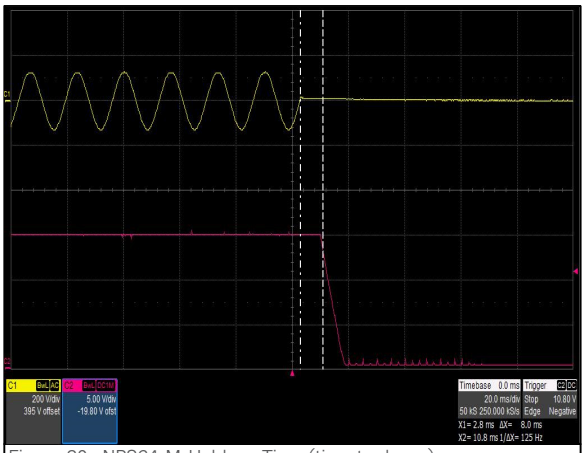


Figure 20: NPS64-M Hold-up Time (time to decay)
Vin = 90 Vac Load: Io = 4 A
Ch 1: V_{IN} Ch 2: Vo

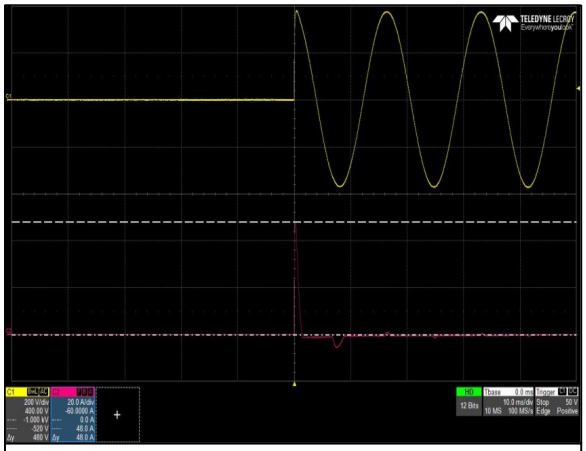


Figure 21: NPS64-M Inrush Current
Vin = 264 Vac Load: Io = 0 A, Turn on at 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

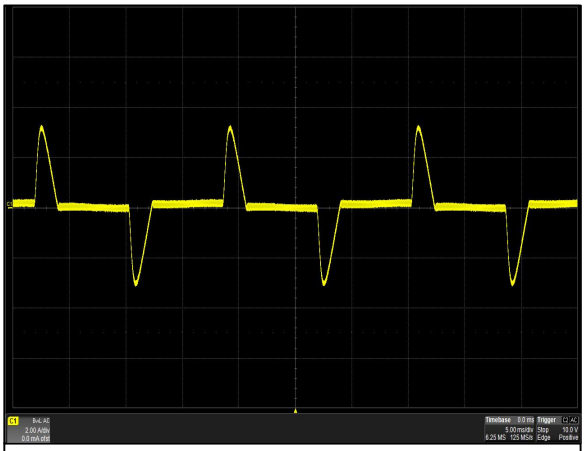


Figure 22: NPS64-M Input Current Waveform
Vin = 115 Vac Load: Io = 4 A
Ch 1: I_{IN}

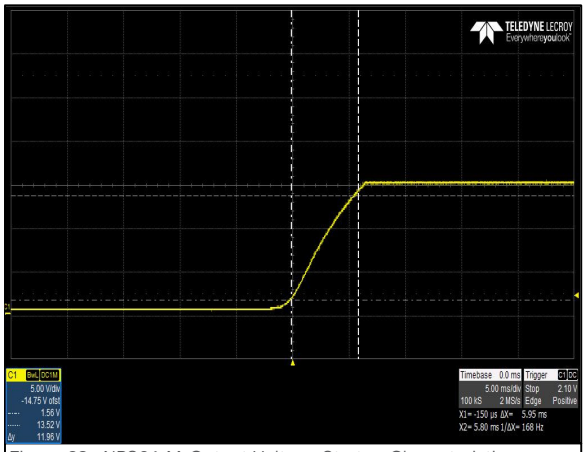


Figure 23: NPS64-M Output Voltage Startup Characteristic
Vin = 90 Vac Load: Io = 4 A
Ch 1: Vo Output Capacitance = 330 uF/A

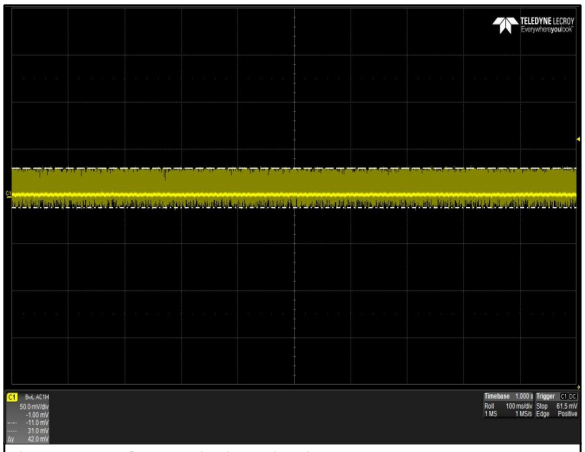


Figure 24: NPS64-M Ripple and Noise Measurement
Vin = 115 Vac Load: Io = 4 A
Ch 1: Vo

ELECTRICAL SPECIFICATIONS

NPS64-M Performance Curves

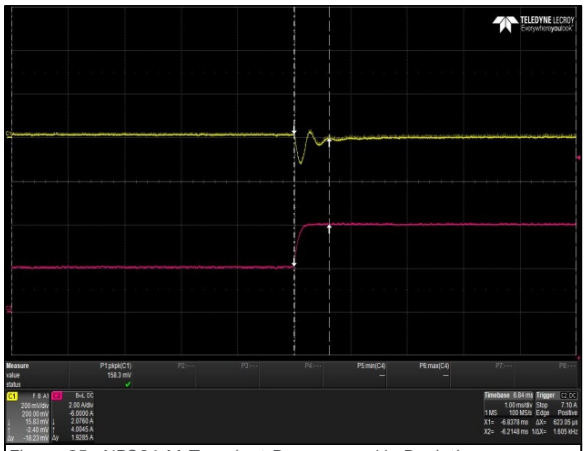


Figure 25: NPS64-M Transient Response – Vo Deviation
Vin = 230 Vac Load: Io = 100% to 50%, 1 A/us slew rate
Ch 1: Vo Ch 2: Io

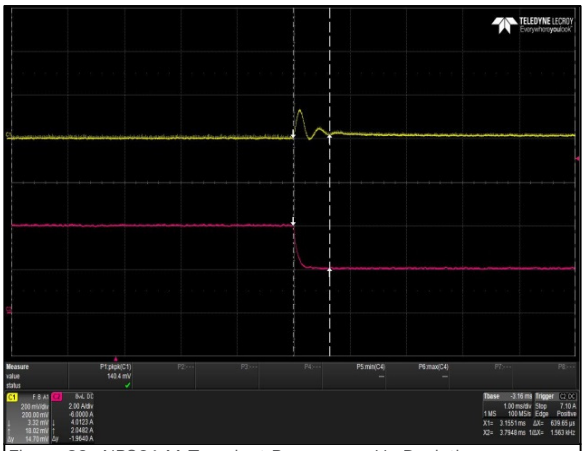


Figure 26: NPS64-M Transient Response – Vo Deviation
Vin = 230 Vac Load: Io = 50% to 100%, 1 A/us slew rate
Ch 1: Vo Ch 2: Io

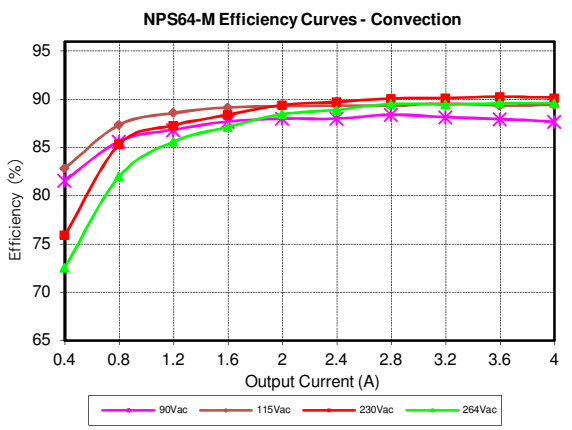


Figure 27: NPS64-M Efficiency Curves @ 25 degC
Convection Cooling
Vin = 90 to 264 Vac Load: Io = 0 to 4 A

ELECTRICAL SPECIFICATIONS

NPS65-M Performance Curves

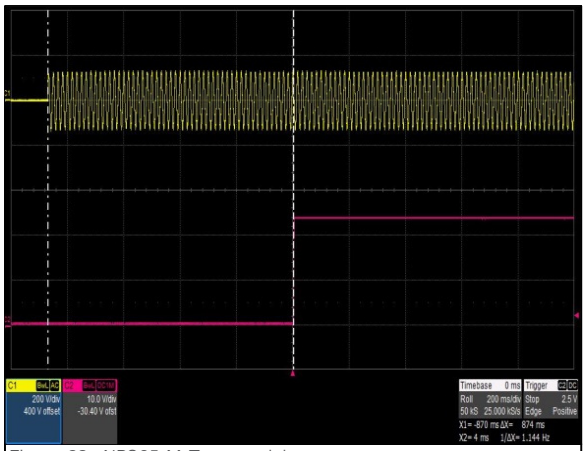


Figure 28: NPS65-M Turn-on delay
Vin = 90 Vac Load: Io = 2.5 A
Ch 1: V_{IN} Ch 2: Vo

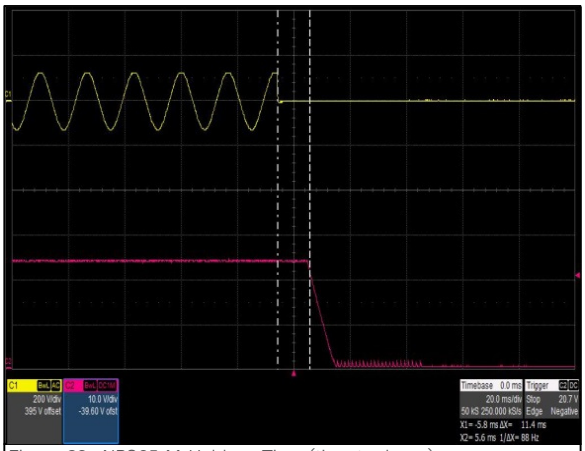


Figure 29: NPS65-M Hold-up Time (time to decay)
Vin = 90 Vac Load: Io = 2.5 A
Ch 1: V_{IN} Ch 2: Vo

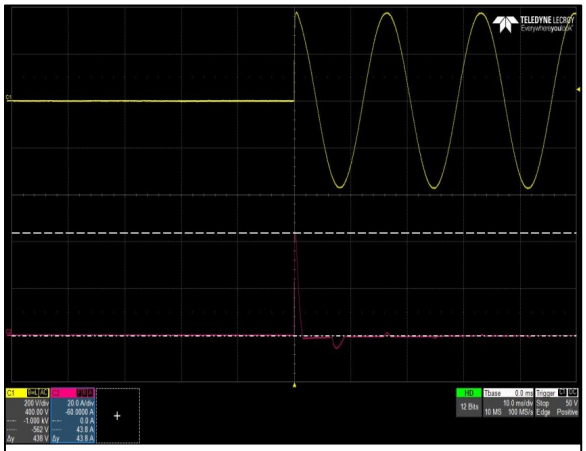


Figure 30: NPS65-M Inrush Current
Vin = 264 Vac Load: Io = 0 A, Turn on at 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

Figure 31: NPS65-M Input Current Waveform
Vin = 115 Vac Load: Io = 2.5 A
Ch 1: I_{IN}

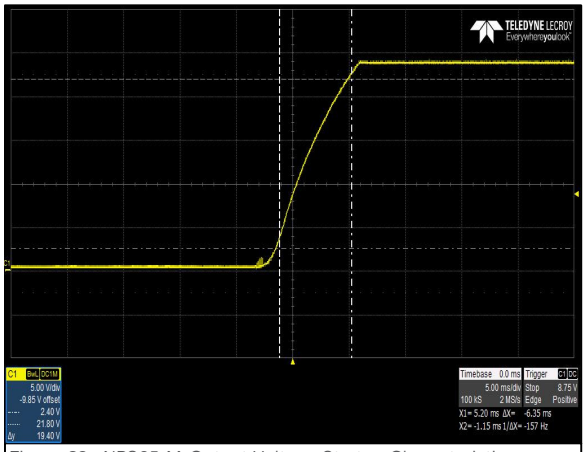


Figure 32: NPS65-M Output Voltage Startup Characteristic
Vin = 90 Vac Load: Io = 2.5 A
Ch 1: Vo Output Capacitance = 330 uF/A

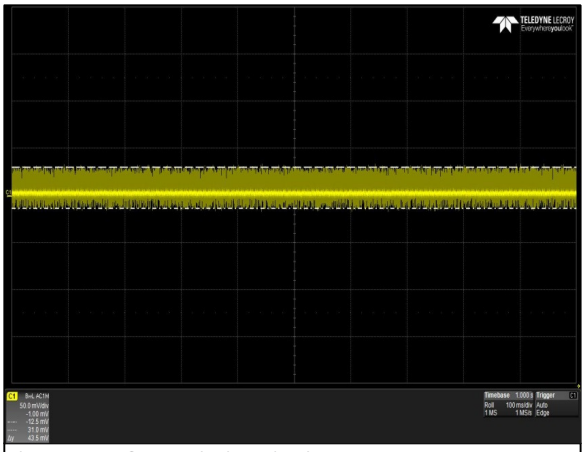


Figure 33: NPS65-M Ripple and Noise Measurement
Vin = 115 Vac Load: Io = 2.5 A
Ch 1: Vo

ELECTRICAL SPECIFICATIONS

NPS65-M Performance Curves

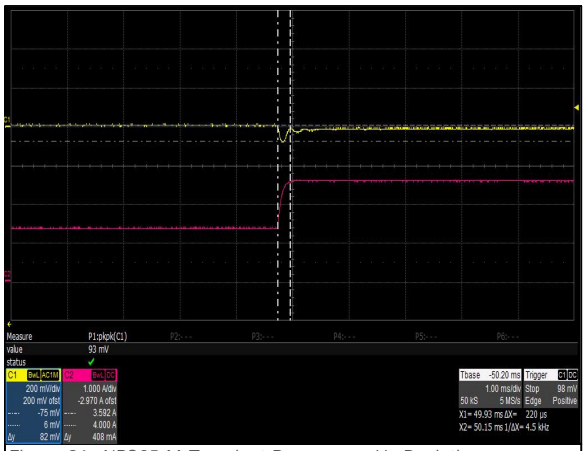


Figure 34: NPS65-M Transient Response – Vo Deviation
Vin = 230 Vac Load: Io = 100% to 50%, 1 A/us slew rate
Ch 1: Vo Ch 2: Io

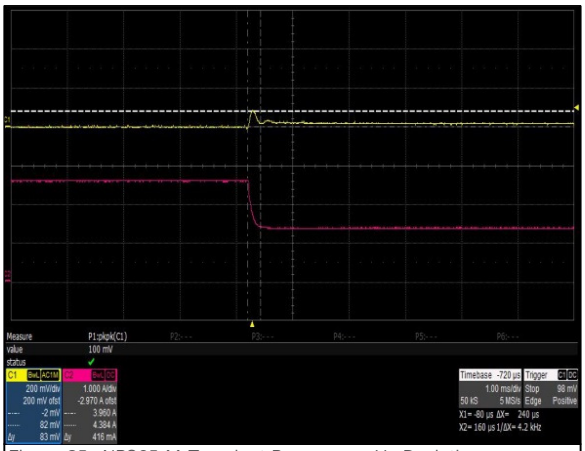


Figure 35: NPS65-M Transient Response – Vo Deviation
Vin = 230 Vac Load: Io = 50% to 100%, 1 A/us slew rate
Ch 1: Vo Ch 2: Io

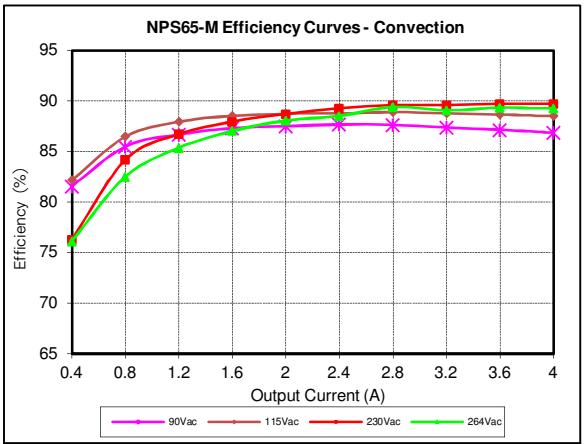


Figure 36: NPS65-M Efficiency Curves @ 25 degC
Convection Cooling
Vin = 90 to 264 Vac Load: Io = 0 to 2.5 A

ELECTRICAL SPECIFICATIONS

Protection Function Specifications

Input Fuse

Protective fuse is provided on the “Line” and “Neutral” side of the primary line of each power supply. 250 V and 2.5 A rated.

Over Voltage Protection (OVP)

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

Parameter	Min	Typ	Max	Unit
V_O Output Overvoltage	130%	/	150%	Vo

Over Current Protection (OCP)

The NPS60-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.

NPS62-M

Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent	26.4	/	38.4	A

NPS63-M

Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent	13.7	/	18.0	A

NPS64-M

Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent	11.0	/	16.0	A

NPS65-M

Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent	6.9	/	10.0	A

NPS69-M

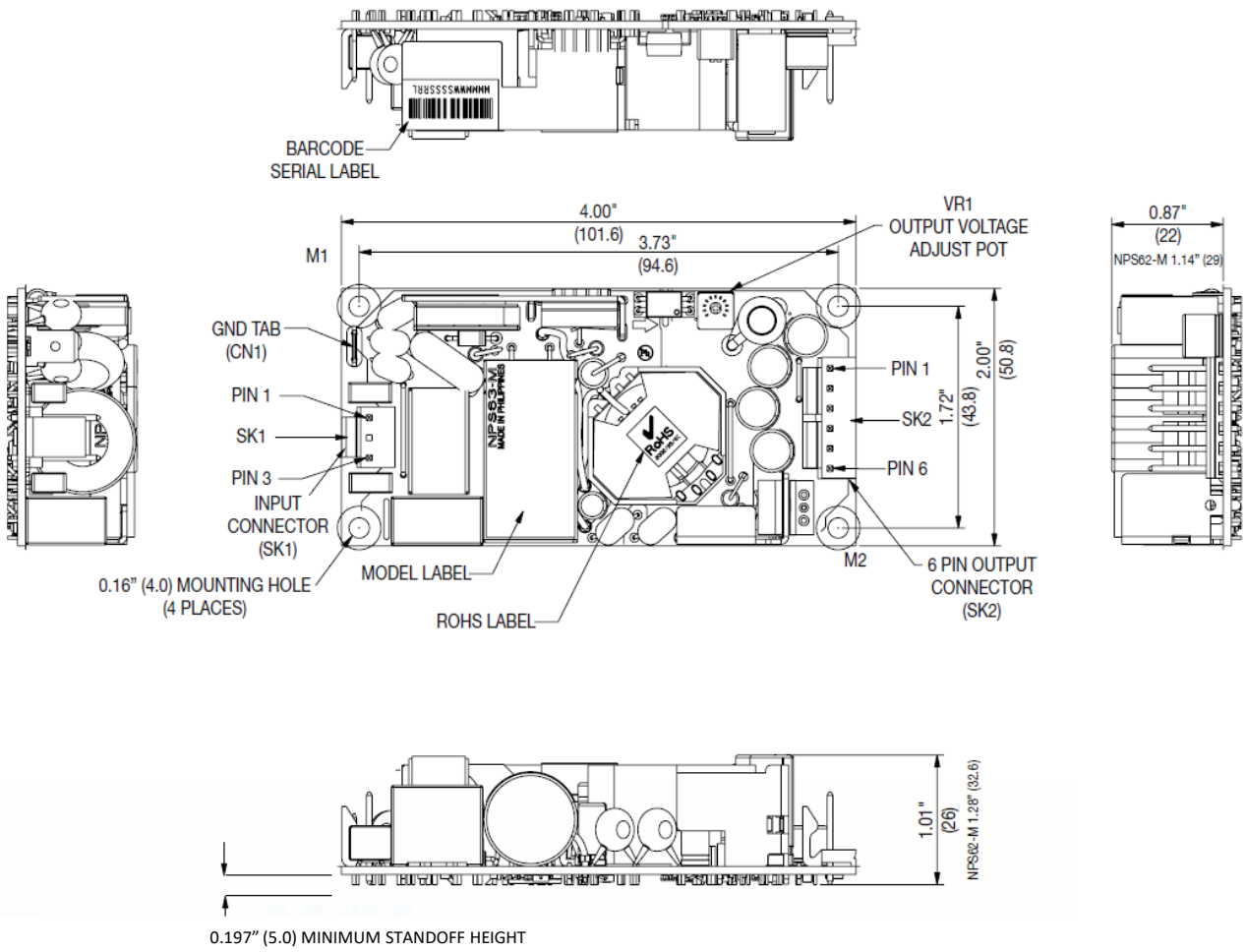
Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent	3.4	/	5.0	A

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.

MECHANICAL SPECIFICATIONS

Mechanical Outlines (Dimensioning and Mounting Locations)

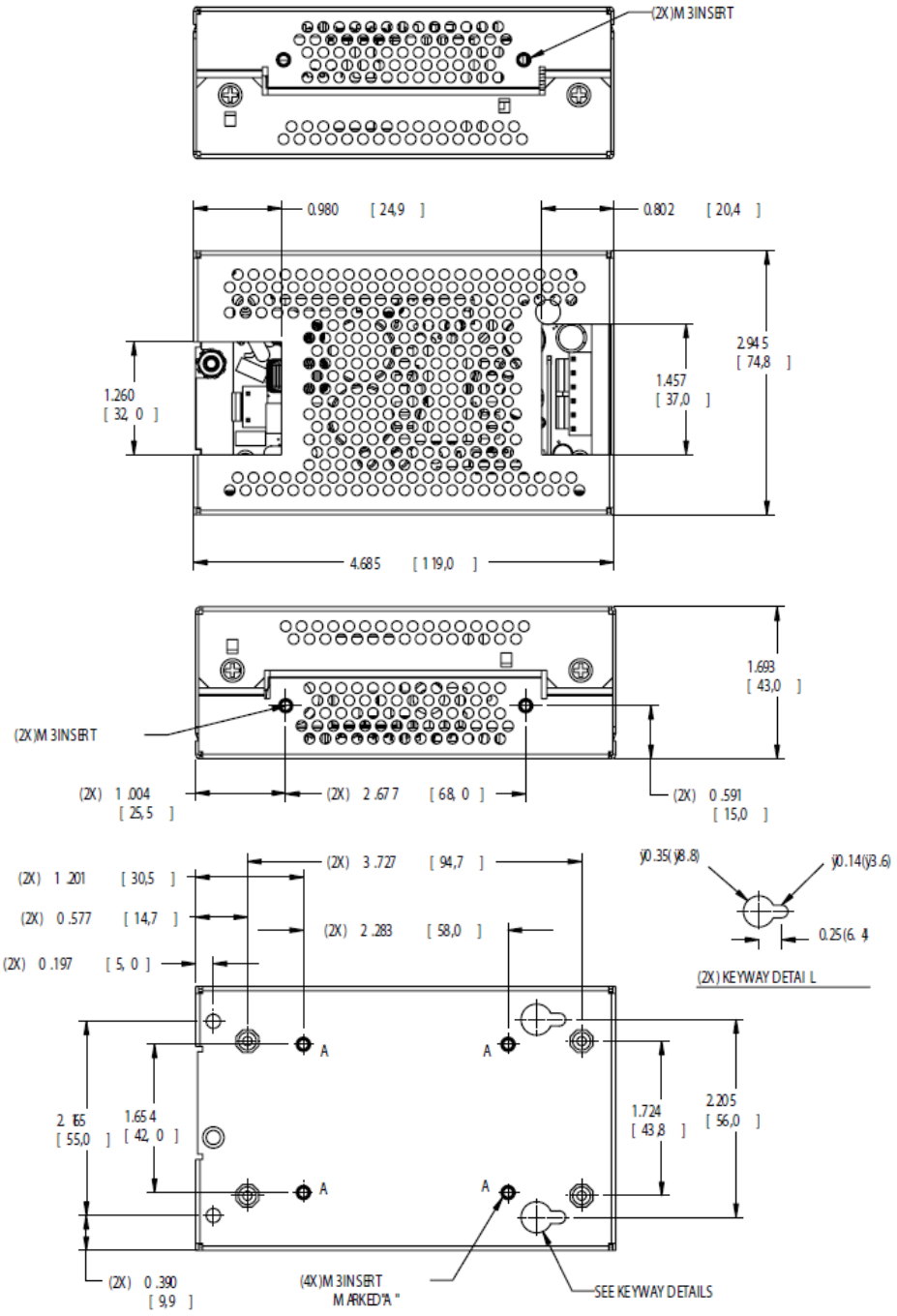


- All dimensions in inches [mm], tolerance is +/-0.02" [0.5 mm]

MECHANICAL SPECIFICATIONS

Mechanical Outlines (Enclosure Kit)

Part number for the Enclosure Kit is LPX100



- All dimensions in inches [mm], tolerance is +/-0.02" [0.5 mm]

MECHANICAL SPECIFICATIONS

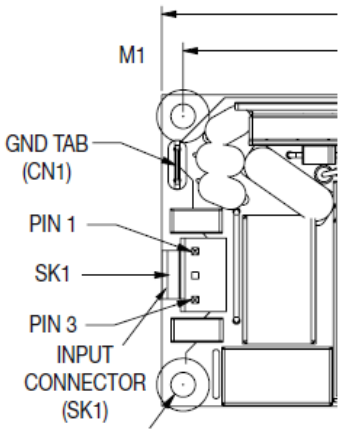
Connector Definitions

AC Input Connector – SK1

Pin 1 - Neutral

Pin 3 - Line

GND – CN1



Output Connector – SK2

Pin 1 - +5V

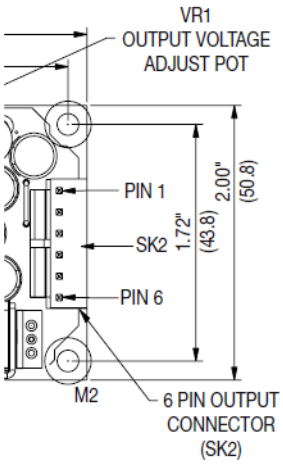
Pin 2 - +5V

Pin 3 - Output Return

Pin 4 - Output Return

Pin 5 - -Sense

Pin 6 - +Sense



MECHANICAL SPECIFICATIONS

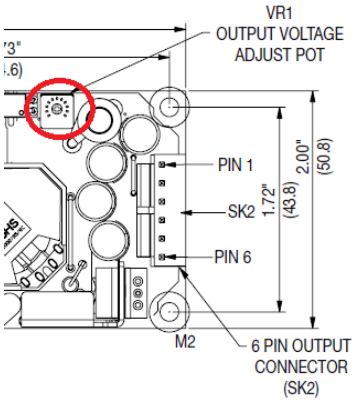
Power / Signal Mating Connectors and Pin Types

Table 4. Mating Connectors for NPS60-M Series	
Reference	**Mating Connector or Equivalent**
AC Input (SK1)	Molex 09-50-8031 (USA) 09-93-0300 (UK) PINS: 08-52-0113
AC GND (CN1)	Molex 01-90020001
DC Output (SK2)	Molex 09-50-8061 (USA) 09-93-0600 (UK) PINS: 08-52-0113

NPS60-M connector kit can be ordered separately. Connector Kit #: 70-841-006.

Potentiometer Definitions

VR1 – Main output voltage adjustment



MECHANICAL SPECIFICATIONS

Weight

The NPS60-M series weight is 0.26 lb / 118 g maximum.

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

NPS60-M series power supply is designed to meet the following EMC immunity specifications.

Table 5. Environmental Specifications

Document	Description
EN60601-1-2: 2001	FCC Rules and Regulations Part 15, Subpart J, Class B, for conducted and Class B with a ground plane for radiated interference (with 6 dB margin). VCCI Class II
EN55032	Conducted Level B and Radiated Level B (stand alone)
IEC 61000-4-2	ESD up to 4 kV contact, 8 kV discharge
IEC 61000-4-3	RFI 3 V/m, criteria A
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 3 V (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[1] 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 S — B
ANSI 62.4	Ringwave Test 3 KV at 200 A

Note 1 – For conditions where Criteria A cannot be met, characterize the boundary condition(Line and/or Load) where Criteria A becomes Criteria B.

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The NPS60-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.

Table 6. Safety Certifications for NPS60-M Series Power Supply System

Standard	Description
CSA-C22.2	Safety of Medical Equipment
EN60601-1	European Community Safety investigated and marketed by TUV or VDE
UL62368-1	US and Canada Requirements
UL60601-1	US and Canada Medical Equipment.
CSA C22.2 No. 62368-1	Safety of information Technology Equipment, including electrical business equipment
UKCA Mark	European Requirements
CE Mark	LVD

ENVIRONMENTAL SPECIFICATIONS

EMI Emissions

The NPS60-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 60 W using resistive load with cooling fan.

Conducted Emissions

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).

Conducted EMI emissions specifications of the NPS60-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

Radiated Emissions

For appliance IEC protection Class I operation, NPS60-M series power supply meet Class A and B conducted and radiated EMI with the LPX100 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

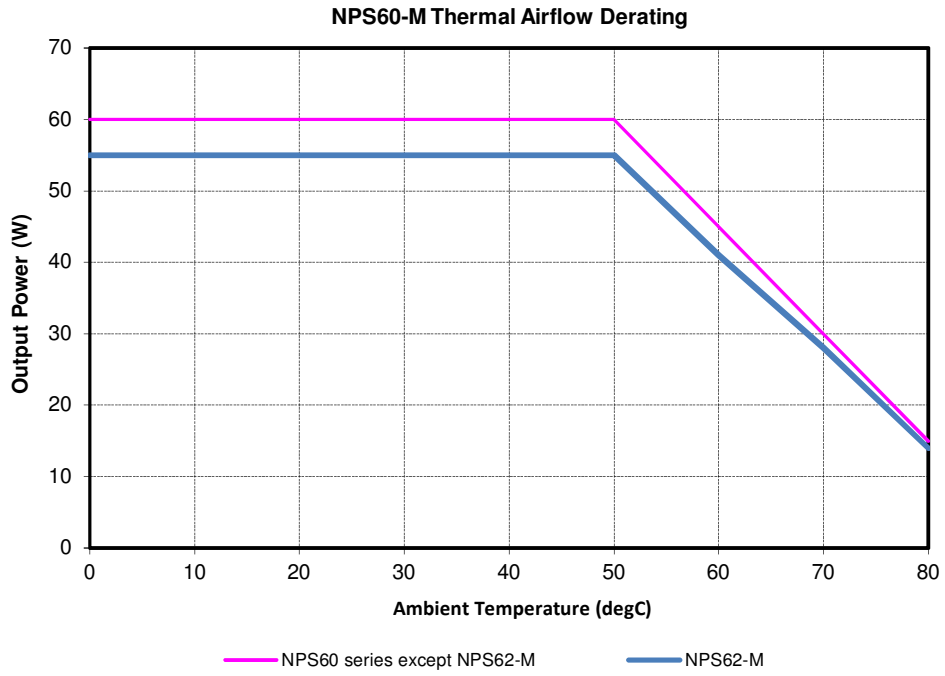
ENVIRONMENTAL SPECIFICATIONS

Operating Temperature

The NPS60-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. Derate output current and power by 2.5% per degree above 50 ^{O}C. Maximum operating ambient temperature is 80 ^{O}C (which implies a 50% derating at max 80 ^{O}C ambient). -20 ^{O}C start up after a 30 minutes soak time.

Derating Curves

The NPS60 series total output power is up to 60 W at 50 ^{O}C with convection cooling (no additional rating for farced air) for all models except NPS62-M where the total output power is up to 55 W at 50 ^{O}C with convection cooling.



ENVIRONMENTAL SPECIFICATIONS

Storage and Shipping Temperature / Humidity

The NPS60-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 NPS60-M series power supply will operate within specifications at altitudes -500 to 13000 feet above sea level, derating 1 ^{O}C per 1000 feet above 10,000 feet. Medical approval limited to a maximum altitude of 3000 meters. The power supply will not be damaged when stored at altitudes of up to 50000 feet above sea level.

Humidity

The NPS60-M series power supply will operate within specifications when subjected to a relative humidity from 10% to 90% non-condensing. The NPS60-M series power supply can be stored in a relative humidity from 10% to 95% non-condensing.

Vibration

The NPS60-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** 10-190 Hz 190-210 Hz 210-2000 Hz	**SLOPE** **dB/oct** --- -31.213dB/oct ---	**PSD** **g^2/Hz** 0.01 g^2/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** 10-500 Hz	**SLOPE** **dB/oct** ---	**PSD** **g^2/Hz** 0.002 g^2/Hz

ENVIRONMENTAL SPECIFICATIONS

Shock

The NPS60-M series power supply will pass the following vibration specifications:

Non-Operating Half-Sine Shock

Acceleration	2.7	G
Frequency Range	10-2000	Hz
Duration	20	mS
Pulse	Half-Sine	
No. of Shock	3 shock on each of 6 faces	

Operating Half-Sine Shock

Acceleration	1.0	G
Frequency Range	10-500	Hz
Duration	20	mS
Pulse	Half-Sine	
No. of Shock	3 shock on each of 6 faces	

POWER AND CONTROL SIGNAL DESCRIPTIONS

AC Input (SK1)

This connector supplies the AC Mains to the NPS60-M series power supply.

Pin 1 - Neutral

Pin 3 - Line

Earth Ground (CN1)

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

CN1 - Earth Ground (Safety Ground)

Main Output (SK2)

These terminals provide the main output for the NPS60-M series power supply. The Vo and the Output Return terminals are the positive and negative rails. The output is electrically isolated from the Earth Ground and can be operated as a positive or negative output.

SK2-1 and SK2-2 - Main Output+

SK2-3 and SK2-4 - Main Output common

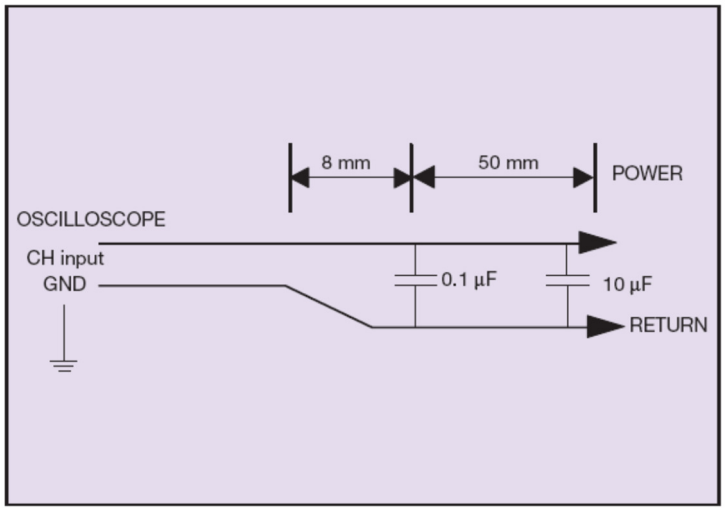
+Sense, -Sense - (SK2-6 and SK2-5)

The NPS60-M series power supply is provide remote sensing on the low voltage main output (single output models only). It will compensate for up to 400 mV in each load line (800 mV in total). There will be reverse sense (to their own output) and cross-charging protection which will not cause damage to the power supply. This will be accomplish by using PTC pull up and pull down resistors to the main output. The output will remain in regulation regardless of sense configuration. The sensed output will not change more than 1% between all sense configurations. The – remote sense will be common to both outputs. The maximum terminal voltage under any operational condition will not exceed the maximum specified adjustment range terminal voltage when the unit is operating with local sensing (+20%) provided the total output power does not exceed the maximum rating.

APPLICATION NOTES

Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the NPS60-M series. When measuring output ripple and noise, a scope jack in parallel with a 0.1 uF ceramic chip capacitor, and a 10 uF aluminum electrolytic capacitor should be used. Oscilloscope should be set to 20 MHz bandwidth for this measurement.



RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	06.10.2019	First Issue	K. Wang
1.1	04.27.2020	Update Derating Curve and an note typo	K. Wang
1.2	04.29.2020	Remove OTP spec	K. Wang
1.3	04.07.2021	Update isolation error	K. Wang
1.4	04.25.2022	Update UKCA safety mark	K. Ma

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Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

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NPS60-M - Rev.04.25.22_#1.4