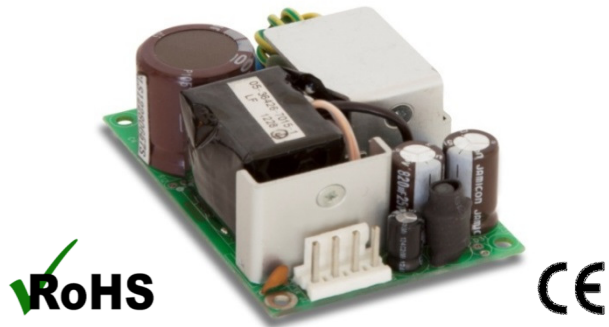


## Features



- Ultra Small size of 2" x 3" x 1"
- For 1U Applications
- 60W convection cooled
- Universal Input 90-264Vac
- Approved to IEC60601-1, 3<sup>rd</sup> Edition with 2 MOPP
- Level V Efficiency Compliant Models
- Less than 0.5W no-load Power Consumption
- 3 Year Warranty
- Optional LED indicator for power-on
- RoHS Compliant

## Description

The MB60S Series models provide a reliable power source in high power density in 2" x 3" x 1" package. Fully compliant to the applicable safety and EMC standards, these models will allow easy integration into many Medical applications. All 6 models are CE marked to low voltage directive and approved to Medical standards of IEC60601-1 3<sup>rd</sup> edition with 2 MOPP.

## Model Selection

Model Number	Volts	Output Current Convection Cooled	Output Power Convection Cooled	Ripple & Noise*	Total Regulation	OVP Threshold
MB60S12K	12V	4.58A	55W	120mV pk-pk	±2%	14.4-18Vdc
MB60S15K	15V	4.00A	60W	150mV pk-pk	±2%	18-22.5Vdc
MB60S18K	18V	3.33A	60W	180mV pk-pk	□2%	21-25.5Vdc
MB60S24K	24V	2.50A	60W	240mV pk-pk	±2%	28.8-36Vdc
MB60S36K**	36V	1.67A	60W	360mV pk-pk	±2%	42-47Vdc
MB60S48K	48V	1.25A	60W	480mV pk-pk	±2%	57.6-72Vdc

Notes:

\* At -20C, the noise and ripple is 2% of the output.

\*\* For product availability, please contact the factory

## Input Specifications

PARAMETER	SPECIFICATION	NOTES
AC Input Voltage:	90-264Vac, single phase	
AC Input Frequency:	47-63Hz	
AC Input Current:	120Vac: 1.4A, 240Vac: 0.75A	
Turn-on Input Voltage:	75V	Ramping Up
Turn-off Input Voltage:	65V	Ramping Down
Inrush Current:	40A maximum @ 0C	

<b>Leakage Current (Input–Earth):</b>	<275 $\mu$ A@264Vac, 60 Hz input, NC	IEC 60601-1 3 <sup>rd</sup> Ed – 8.7.3.c
<b>Leakage Current (Output–Earth):</b>	N/A	
<b>Leakage Current (Input-Output):</b>	<90 $\mu$ A@264Vac, 60 Hz input, NC	
<b>Input Fuses:</b>	F1, F2: 4A, 250VAC	Fuses provided on all models
<b>Efficiency</b>	Typical	Measured at 120Vac and full load
MB60S12K	83%	
MB60S15K	85%	
MB60S18K	85%	
MB60S24K	88%	24V, 36V, and 48V Models meet Level V requirement
MB60S36K	88%	
MB60S48K	88%	
<b>No Load Input Power:</b>	<0.5W	Meet Level V, standby Power Consumption
<b>Turn-on Time:</b>	<2 Seconds at 120Vac.	
<b>Hold-up Time:</b>	16mS minimum from loss of ac input at 120 Vac, full load.	55 Watts for 12V output

### DC Output Specifications

PARAMETER	SPECIFICATION	NOTES
<b>Output Power:</b>	60W continuous for operation from -10°C to 50°C 55 Watts for 12V output.	
<b>Cooling:</b>	Convection	
<b>Total Regulation:</b>	$\pm 2\%$ for all models	Total regulation is the maximum deviation from nominal voltage for all loading conditions
<b>Overload Protection:</b>	120% - 180% of rated output current value, Hiccup Mode	
<b>Short Circuit Protection:</b>	Short across the output terminals will not cause damage to the unit. Hiccup Mode	
<b>Overvoltage Protection:</b>	OVP firing reduces output voltage to <50% of nominal in <50mS. See chart for trip range	
<b>Overtemperature Protection:</b>	Automatic Power Shutdown at Tc = 155°C,	
<b>Minimum Load:</b>	No minimum load is required	
<b>Ripple and Noise:</b>	0.5% RMS, 1% pk-pk for all models.	20 MHz Bandwidth, differential mode. Measured with noise probe directly across output terminals, and load terminated with 0.1 $\mu$ F ceramic and 10 $\mu$ F low ESR capacitors
<b>Transient Response:</b>	500 $\mu$ s typ. response time for return to within 0.5% of final value for a 50% load change, $\Delta i/\Delta t < 0.2A/\mu s$ . Max. voltage deviation is 3.5%.	
<b>Overshoot:</b>	5% overshoot at turn-on, 5% overshoot at turn-off, under all conditions.	

### Safety Standard Compliance

Agency	CONDITIONS
UL	ANSI/AAMI ES60101:2005, 3 <sup>rd</sup> Edition
CSA	CAN/CSA-C22.2 No. 60601-1 (2008)
Demko	EN 60601-1:2006
CB Report	IEC 60601-1 (3 <sup>rd</sup> Edition)
Isolation Type:	B rated

### Isolation Specifications

PARAMETER	CONDITIONS	Rating	NOTES
Insulation Safety Rating:	Input to Ground	1 MOPP	
	Input to Output	2 MOPP	
	Output to Ground	Functional	
Electric Strength Test Voltage:	Input to Ground	1800Vac	
	Input to Output	4000Vac	
	Output to Ground	500Vac	

### Environmental Specifications

PARAMETER	SPECIFICATION	NOTES
Operating Temperature:	-10°C to +80°C	-40°C Startup guaranteed
Temperature Derating:	For Output Voltage ≥24V, derate output power to 50W @ 60C, 40 Watt @ 70C, and 20 Watts for 80C	<24V will derate to 40W at 60C, 30W at 70C, and 20W at 80C
Cooling:	Convection	
Storage Temperature:	-40°C to +85°C	
Altitude:	Operating: -500 to 3,000 meter Non-operating: -500 to 40,000 ft.	
Relative Humidity:	5% to 95%, non-condensing	
Shock:	Non-Operating: Half-sine, 40 gpk, 10mS, 3 axes, 6 shocks total	
Vibration:	Random vibration per MIL-STD-810E, Method 514.4, Cat. 1, Figure 514.4-1, 1 hr in each of three axes	

### Reliability Specifications

PARAMETER	SPECIFICATION	NOTES
MTBF:	700,000 hours, 25°C ambient, full load	Calculation is done based on Telcordia. Reports for each model is available
Warranty:	3 Years	Limited
HALT Data:	Per SL Power Halt procedure	Report is available

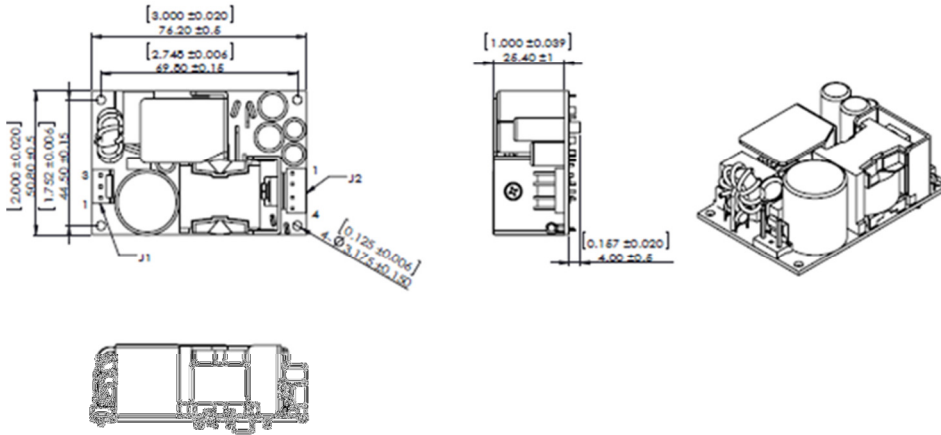
### EMI/EMC Compliance

PARAMETER	SPECIFICATION	NOTES
Conducted Emissions:	EN55011/22 Class B; FCC Part 15	
Radiated Emissions:	EN55011/22 Class A; FCC Part 15	
Harmonic Current Emissions	EN61000-3-2, Class A	
Voltage Fluctuations & Flicker	EN61000-3-3	
Static Discharge Immunity:	EN61000-4-2 6kV contact, 8kV air, Criteria A	Performance criteria are defined as following:  A – Normal performance during and after the test B – Temporary degradation, self-recoverable C – Temporary degradation, operator intervention required to recover the operation
RF Field Susceptability	EN61000-4-3 (3V/m), Criteria A	
Fast Transients/Bursts	EN61000-4-4 (PS: 2kV-40A, other lines 1kV-20A), Criteria B	
Surge Susceptability	EN61000-4-5, Installation Class 3 (1kV diff. mode, 2kV common mode), Criteria A	
Conducted RF Susceptability	EN61000-4-6 (3Vrms), Criteria A	
Power Frequency Magnetic Field Test	EN61000-4-8 (3A/m), Criteria A	
Voltage Sags & Surges	EN61000-4-11, 95% dip/0.5 cycle (Criteria A), 60%/5cycles (Criteria B), 30%/25 cycles (Criteria A).	

#### Notes:

1. Specifications subject to change without notice.
2. Specifications are for convection rating at factory settings with 115Vac input and 25°C ambient unless otherwise stated.

## Mechanical Drawing



## Connector Information

Input Connector J100	DC Output Connector J2	Ground (FG)
PIN 1) AC LINE PIN 2) EMPTY PIN 3) AC NEUTRAL	PIN 1) +Vout PIN 3) -Vout PIN 2) +Vout PIN 4) -Vout	19-30258-0187 (Keystone 1285) (Zierick 895)(.187*0.020)
Mating Connector: Tyco/AMP 640250-3 Pins = 770461-1	Mating Connector: AMP 640250-4 Pins = 770461-1	Mating Connector Molex 19002-0005

1. Mounting holes should be connected together for EMI purpose
2. FG is safety ground connection
3. This power supply requires mounting on metal standoffs 0.20" (5mm) in height

**Characteristic Curves**

**Output vs. Temperature**

-40C start up. At -20C, the supply meet its full spec except ripple & noise might be increased from 1% to 2% of the output voltage

55W convection cooled, derating output power to 30W at 70°C for outputs 12V and 15V

60W convection cooled, derating output power to 50W at 60°C and 40W at 70°C for Output Voltages ≥ 24V

20W convection cooled at 80C

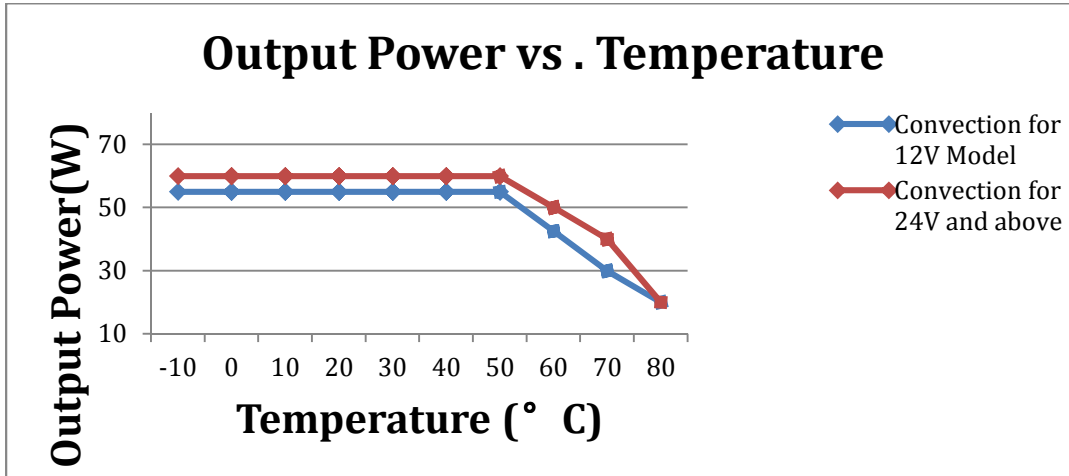


Fig.1

**Efficiency vs. Loading**

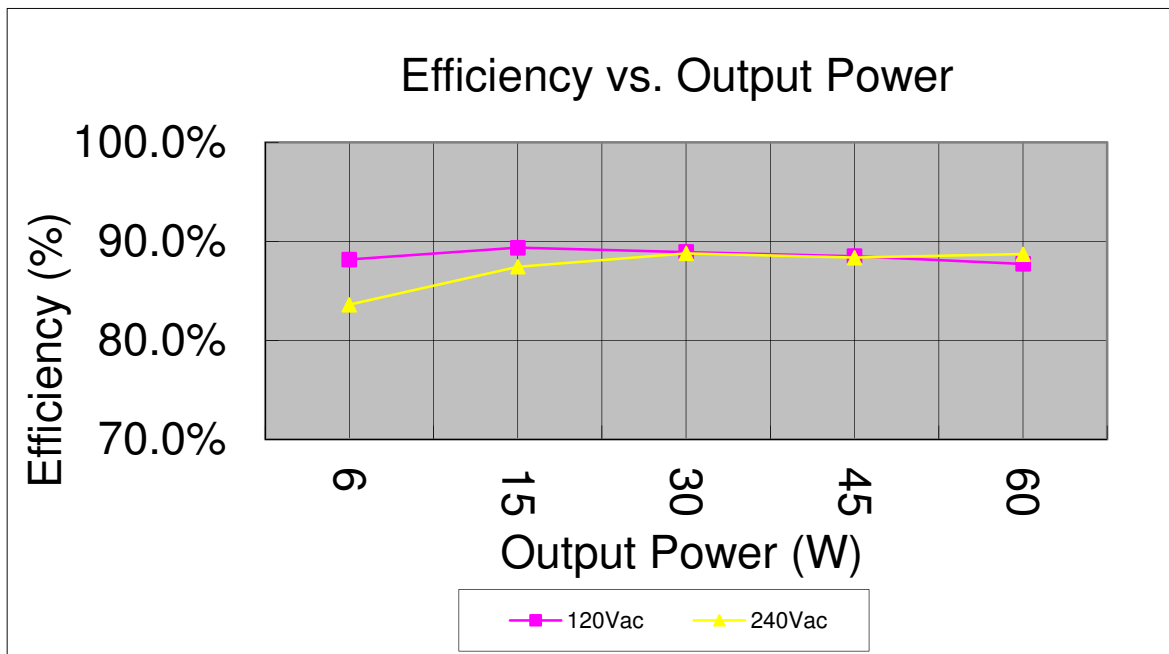
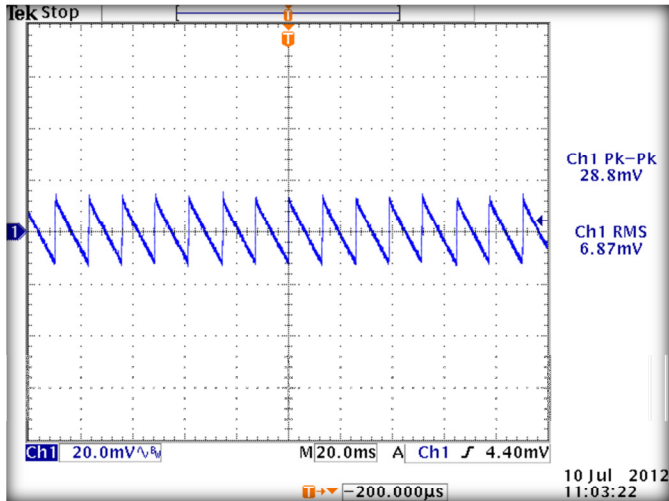


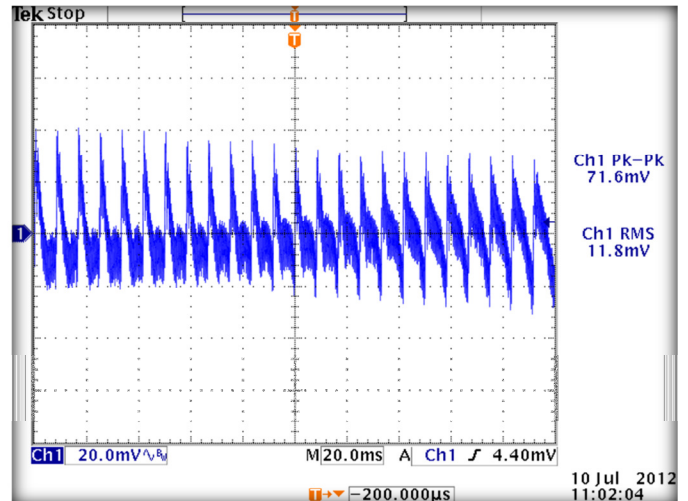
Fig.2

### Ripple & Noise

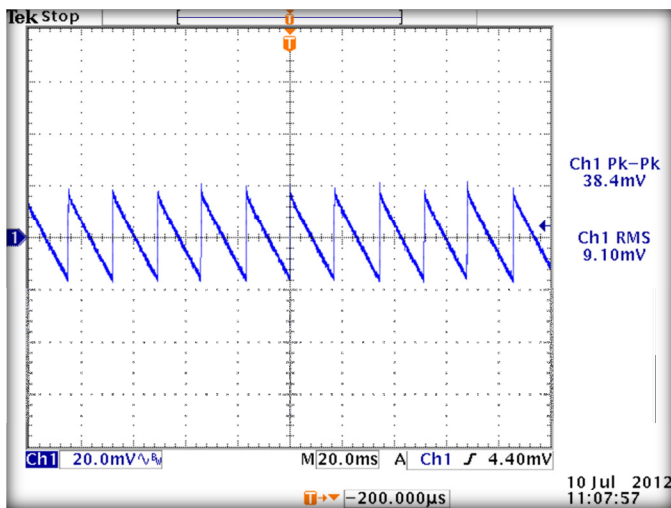
To verify that the output ripple and noise does not exceed the level specified in the product specification, measured using a scope probe socket with 0.1uF ceramic and a 10uF electrolytic capacitor connected in parallel across it, 20MHz BW.



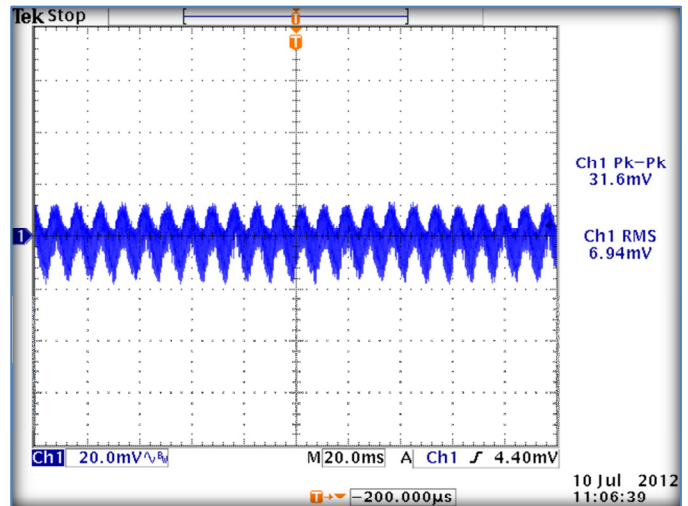
[24V OUT, NO LOAD, 90VAC, 60Hz](#)



[24V OUT, FULL LOAD, 90VAC, 60Hz](#)



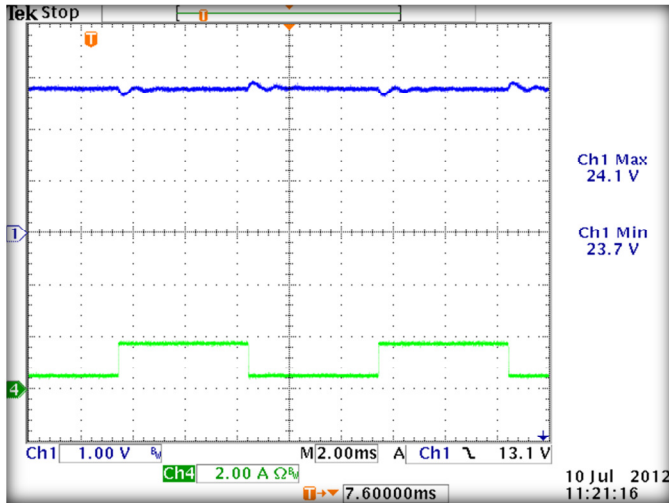
[24V OUT, NO LOAD, 264VAC, 50Hz](#)



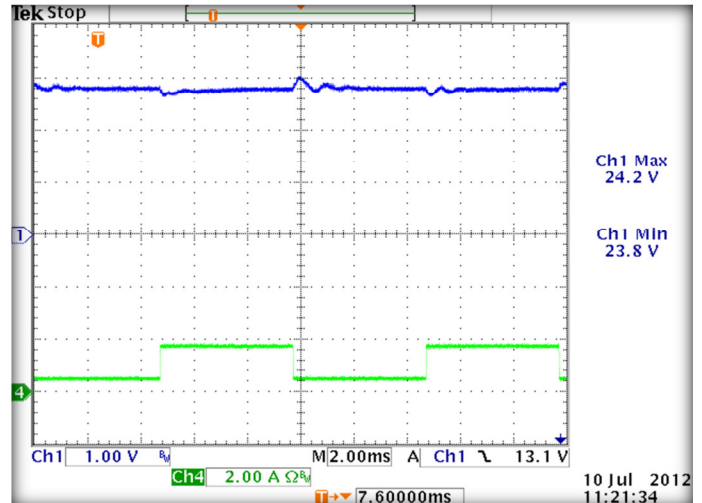
[24V OUT, FULL LOAD, 264VAC, 50Hz](#)

### Output Transient Response

50% load step within the regulation limits of minimum and maximum load,  $di/dt < 0.2A/\mu\text{Sec}$ . Recovery time not specified as there is no laps in regulation with a 50% Load Step. Maximum voltage deviation is 3.5%

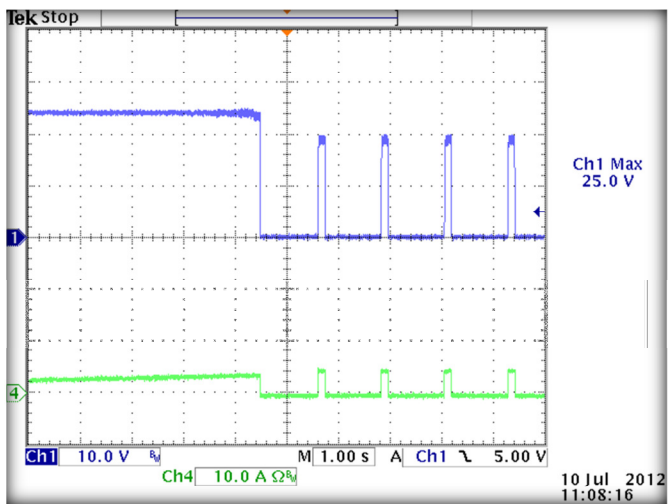


[24V OUT, 120VAC, 25% TO 75% LOAD STEP](#)

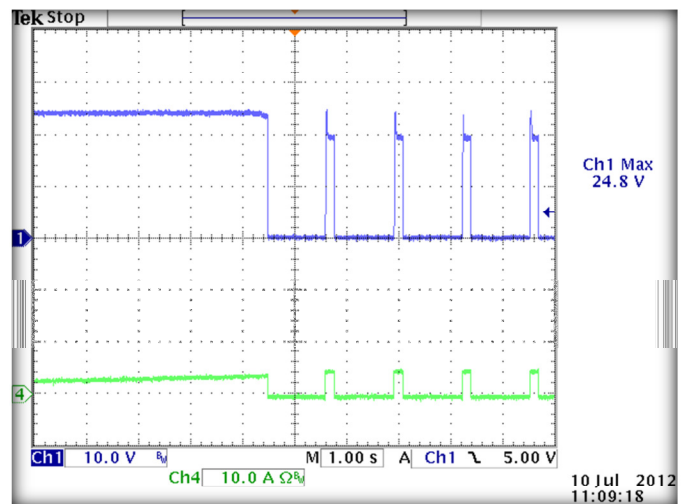


[24V OUT, 240VAC, 25% TO 75% LOAD STEP](#)

### Output Overload Characteristic



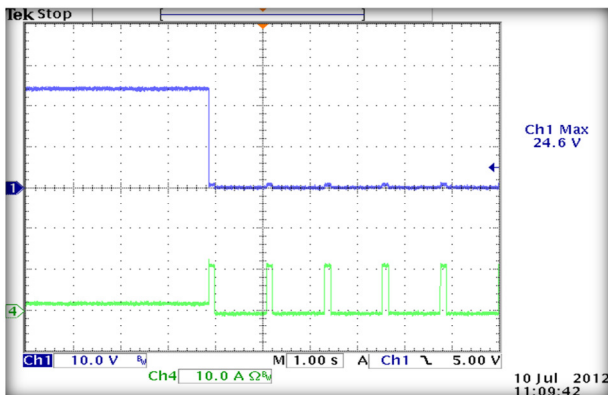
[24V OUT, 90VAC](#)



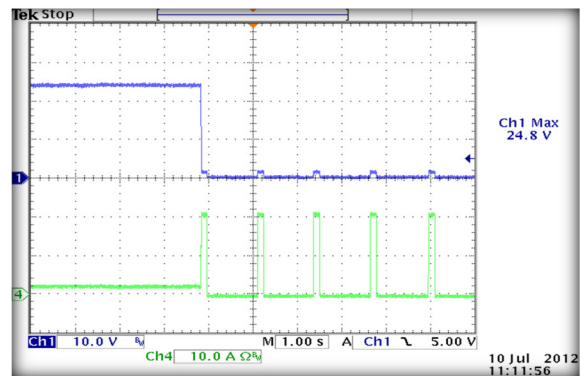
[24V OUT, 264VAC](#)

### Short Circuit Protection

Supply shall protect itself against Short Circuit conditions. No damage will occur if the output is shorted.



[24V OUT, 264VAC](#)

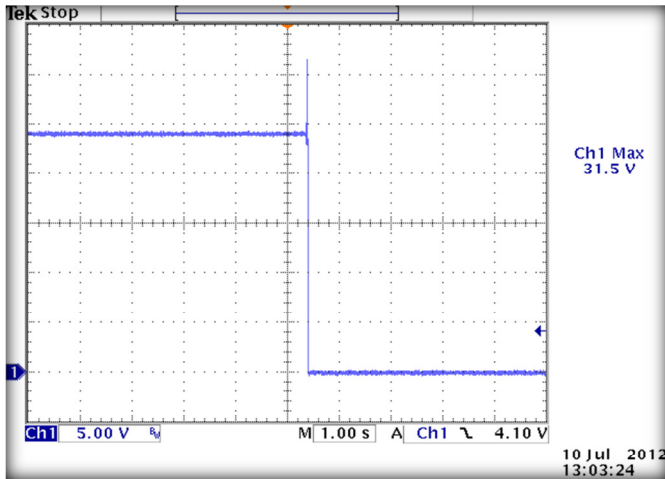


[24V OUT, 90VAC](#)

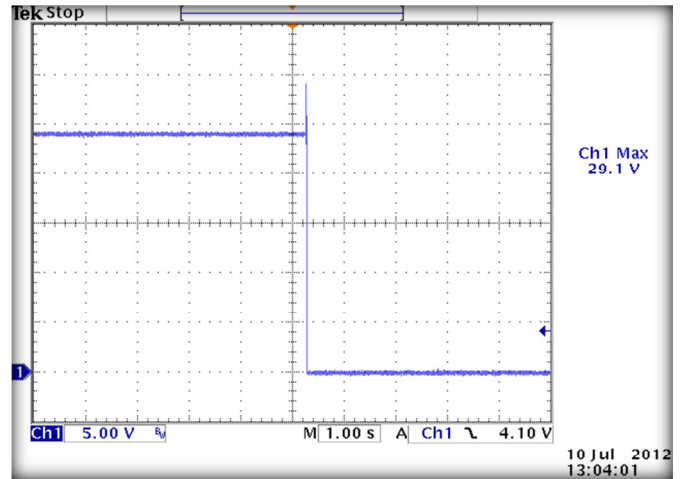


### Overvoltage Protection

OVP firing reduces output voltage to <50% of nominal in <50ms. See models chart for trip ranges.

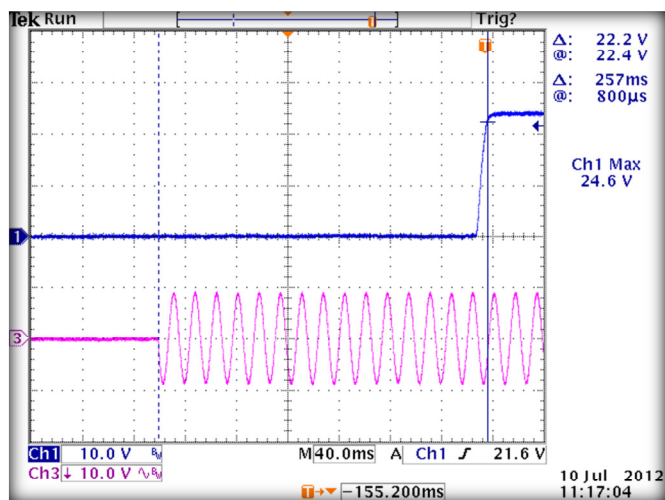


24V OUT, FULL LOAD, 90VAC, 60HZ

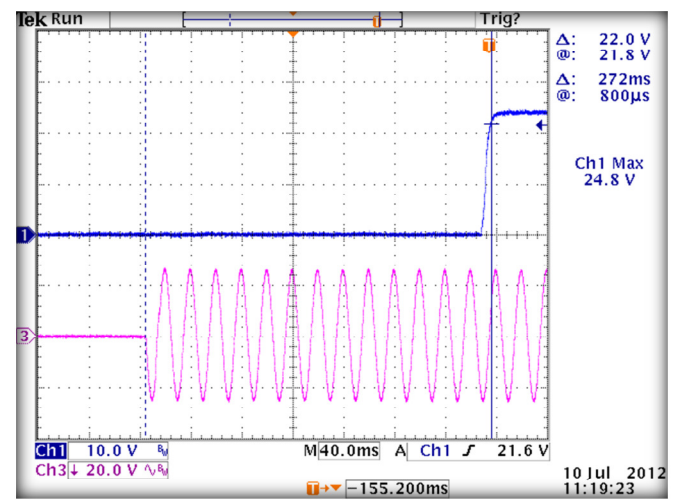


24V OUT, FULL LOAD, 264VAC, 50HZ

### Turn On Time

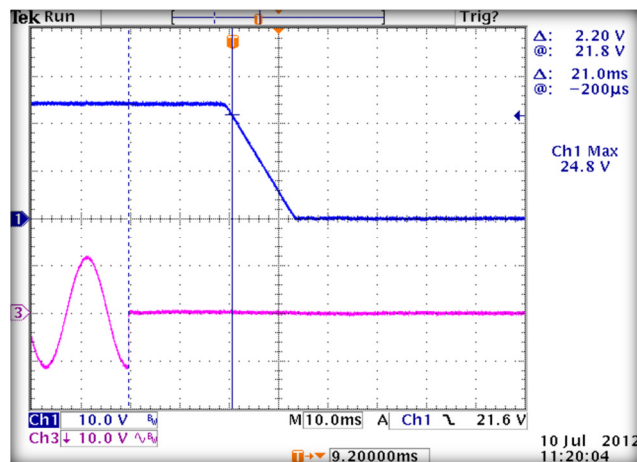


24V OUT, FULL LOAD, 90VAC, 60HZ



24V OUT, FULL LOAD, 264VAC, 50HZ

### Hold Up Time



24V OUT, FULL LOAD, 120VAC, 60HZ