



Product Specification

# **XR160 Series**

**160-Watt AC to DC**

**Power Supplies**

**Document No. 703590 Rev 03-10-20**

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# 1.

# Introduction

## 1.1 Introduction

This specification covers the design and performance characteristics of an open frame single-phase (3 wire) universal input, power factor corrected, single or multiple-output, 160-watt switching mode power supply. It includes information regarding the mechanical details, cooling requirements, connector configurations, electrical and signal specifications, and environmental ranges for storage and operation of the power supply. It describes all AC-input XR160 models as listed in Tables 7-1 and 7-2.

The XR160-1ATX, XR160-7ATX and XR160-8ATX are multiple-output power supplies. These models meet the output requirements of Intel ATX/ATX12V Power Supply Design Guide (Version 2.03). They include a 5-volt standby output, as well as a Remote Enable input to disable the main outputs.

All models of the XR160 Series can be used as standalone power supplies while models XR160-05 CS through XR160-56 CS can also be used in redundant or N+1 configurations with up to 4 units connected in parallel. Lettering shown in square brackets indicate optional features or similar models (ex.: [CS] indicates that an active current-sharing feature is available on this model while [ATX] and [RE] indicates this model is available with a remote enable input for the main outputs). See Tables 7-1 and 7-2 for a list of available options.



Figure 1 XR160 (models differ slightly)

## 1.2 Agency Compliance






<b>Safety</b>	<b>Complies with Standard</b>	<b>Remarks</b>
United States	UL 60950-1 Second Edition UL 62368-1 Second Edition (Information Technology Equipment)	Leakage Current Hi-pot – 2121vdc for 1 second
Canada	CAN/CSA-C22.2 No. 60950-1 (2007) Second Edition	
EU Council	2006/95/EC (August 2007)	Low Voltage Directive
International	IEC 60950-1 (2005) Second Edition IEC 62368-1 (2014) Second Edition	
<b>EMC</b>	<b>Complies with Standard</b>	<b>Remarks</b>
United States	FCC part 15, subpart B	Conducted emissions Limits per CISPR 22 Class B Tested to ANSI C63.4: 2003
EU Council	2004/108/EC	EMC Directive
International	EN 61204-3 (refers to the following) EN 55022 Class B  EN 55024 (refers to the following) EN 61000-3-2 Class D  EN 61000-3-3 EN 61000-4-3 EN 61000-4-4 EN 61000-4-5 EN 61000-4-6 EN 61000-4-11	Low Voltage Power Supplies – DC Output  Conducted emissions Limits per CISPR 22 Class B  Immunity  Harmonic Current Emissions (Power Factor Correction – PFC)  Voltage Fluctuations & Flicker  Radiated Susceptibility  Fast Transient/Burst Immunity  Power Mains Surge Immunity  RF Immunity  Voltage Dips, Short Interruptions
<b>Reduction of Hazardous Substances (RoHS)</b>	<b>Complies with Standard</b>	<b>Remarks</b>
EU Council	2002/95/EC 2011/65/EU	RoHS Directive RoHS 2 Directive
<b>Marks of Conformance</b>		
United States & Canada	 (Underwriters Laboratories File E211115)	
Europe		
EU Council		
RoHS	 	

Table 1-1 Agency Compliance

# 2.

# AC Input

## 2.1 Input Line Requirements

The following table defines the voltage and frequency requirements for the AC line inputs to the XR160 power supply. The XR160 is capable of supplying full rated power in continuous operation throughout the specified ranges of voltages and frequencies. The power supply will automatically recover from AC power loss and is capable of starting under maximum load at the minimum AC input voltage described below.

Parameter	Minimum	Nominal	Maximum
RMS Input Voltage	90 VAC	100–240 VAC	264 VAC
RMS Input Current	–	–	2.2 A @ 100 V 1.0 A @ 240 V
Input Frequency	47 Hz	50/60 Hz	63 Hz

Table 2-1 XR160 AC Input Parameters

## 2.2 Input Over Current Protection

The XR160 series incorporates a primary AC line fuse for input over current protection and to meet product safety requirements as outlined in Section 1.2.

## 2.3 Inrush Current Limiting

The cold start inrush current is limited to 33 A peak at 115 VAC. Repetitive ON/OFF cycling of the AC input voltage shall not damage the power supply or cause the input fuse to fail.

## 2.4 Low Input Voltage

The application of an input voltage below the minimums specified in Table 2-1 shall not cause damage to the power supply.

## 2.5 Leakage Current

The leakage current from AC line or AC Neutral inputs to Earth Ground at 240 VAC, 50Hz is less than 1 mA.

# 3.

# DC Outputs

## 3.1 Output Voltage Regulation

The DC output voltages shall remain within the Minimum and Maximum limits of Table 3-1 when measured at the power supply connector under all specified line, load and environmental conditions contained herein. The main output (V1) in the single output models (-05 thru -56V) and the 12-volt auxiliary outputs are both galvanic isolated from each other and chassis (Safety ground). Refer to Section 3.3.2.

Model *	Output	Rated Voltage	Regulation	Minimum (VDC)	Nominal (VDC)	Maximum (VDC)	Remote Sense (* except ATX)
XR160-1[ATX]	V1	+3.3	±3%	3.201	3.300	3.399	V1/RTN
	V2	+5	±4%	4.848	5.050	5.252	V2*/RTN
	V3	+12	±5%	11.400	12.000	12.600	RTN
	V4	-12	±5%	-11.400	-12.000	-12.600	
	V5 †	+5V <sub>standby</sub>	±5%	4.750	5.000	5.250	
XR160-7[ATX]	V1	+2.5	±3%	2.425	2.500	2.575	V1/RTN
	V2	+5	±4%	4.848	5.050	5.252	V2*/RTN
	V3	+12	±5%	11.400	12.000	12.600	RTN
	V4	-12	±5%	-11.400	-12.000	-12.600	
	V5 †	+5V <sub>standby</sub>	±5%	4.750	5.000	5.250	
XR160-8[ATX]	V1	none					
	V2	+5	±5%	4.848	5.050	5.252	V2*/RTN
	V3	+12	±5%	11.400	12.000	12.600	RTN
	V4	-12	±5%	-11.400	-12.000	-12.600	
	V5 †	+5V <sub>standby</sub>	±5%	4.750	5.000	5.250	
XR160-XX [CS] [RE] XX: 05, 07, 08	V1	+5, +7, +8	±3%	Less 3%	5.00, 7.00, 8.00	Plus 3%	V1/RTN
	V2	+12V <sub>aux</sub>	±5%	11.400	12.000	12.600	
	RE models only	V3	+5V <sub>standby</sub>	±5%	4.750	5.000	5.250
XR160-XX [CS] [RE] 12 ≤ XX ≤ 56	V1	XX volts	±3%	Less 3%	XX.000	Plus 3%	V1/RTN
	V2	+/-12V <sub>aux</sub>	±5%	11.400	12.000	12.600	
	RE models only	V3	+5V <sub>standby</sub>	±5%	4.750	5.000	5.250

\* See Tables 7-1 and 7-2 for lists of all available models

† ATX models only

Table 3-1 XR160 Output Voltage Specifications for all AC-input Models



## 3.2 No Load Operation

The power supply will operate with reduced output voltage regulation of +/-10% with all outputs unloaded. This no load condition will not damage the XR160 or cause a hazardous condition, however the Power-Good signal may not go true with less than a 5-watt load. The power supply will remain stable and operate normally after application of loads.

**CAUTION**

*Remove AC power prior to installing or removing secondary loads.*

## 3.3 Output Current/Power

The maximum available output power is always a function of the cooling airflow and temperature. The total output power is reduced when unrestricted natural convection cooling (no fan) is used at an ambient temperature of 50°C or less (see Sections 3.3.1 and 3.3.2). No output will exceed 240VA under any of overload or short circuit condition including single component fault conditions as described by IEC 60950.

### 3.3.1 Output Loading for Models XR160-1[ATX], -7[ATX], -8[ATX]

The maximum combined output power of V1 through V4 is limited to 160 watts with 10 CFM of forced air-cooling at no more than 50°C. The combined output power of V1 and V2 is further limited to 100 watts. The V5 output is limited to 5 watts under the same conditions (total of 165 watts possible).

Output	Remarks	Rated V1 Output	Minimum Load	Maximum Load	Maximum Watts/Output
V1	-1[ATX], -7[ATX] (No V1 on -8[ATX])	+3.3 V / +2.5 V	0.0 A	15.0 A	49.5 / 37.5
V2		+5 V	1.0 A	20.0 A	100
V3		+12 V	0.0 A	6.0 A	72
V4		-12 V	0.0 A	1.0 A	12
V5	ATX Models Only	+5 V <sub>standby</sub>	0.0 A	1.0 A	5

**Table 3-2 XR160-1[ATX], -7[ATX], -8[ATX]: Individual Min/Max Load Currents**

With unrestricted natural convection cooling (see Section 3.4), the maximum combined output power of V1 through V4 is limited to 70 watts while the +5V standby output is limited to 0.5A (total of 72.5 watts possible).

### **3.3.2 Output Loading for Models XR160-05 [CS] [RE] through XR160-56 [CS] [RE]**

The output currents listed in this section require 10 CFM of forced air-cooling at no more than 50°C. The total output of 160-watts is reduced to 115-watts with unrestricted natural convection cooling (see Section 3.4) except for the XR160-05 through XR160-08, which are reduced to 70-watts.

These single-output models (XR160-XX [CS] [RE] where [CS] means with or without current sharing and [RE] means with or without the remote enabled feature) all have an auxiliary 12V output (V2, 12V AUX) that is typically used to drive a cooling fan. The load on this V2 output can vary from 0 to 1.0 amps and does not affect the Power-Good or PS\_OK signals. Its load power detracts from the 160-watts otherwise available to the V1 load. On the XR160-05 thru XR160-08 models, the negative side of the V2 output is connected to the common ground "DC RETURN". The main output (V1) in the single output models (-12 thru -56V) and the 12-volt auxiliary outputs are both galvanic isolated from each other and chassis (Safety ground). Thus, they can be used as either a positive or negative supply.

The signals on J3: DC Return, Current Share, PG and PS\_OK are all with reference to the negative rail of the V1 Main output. Connecting the "+" voltage lead to ground or customer's return will yield a negative voltage on the "-" leads.

<b>Model</b>	<b>Rated V1 Output</b>	<b>Minimum Power-Good Load (5W) *</b>	<b>Maximum Continuous Load *</b>
XR160-05 [CS] [RE]	5 V	1.00 A	32.0 A
XR160-07 [CS] [RE]	7 V	0.72 A	22.8 A
XR160-08 [CS] [RE]	8 V	0.63 A	20.0 A
XR160-12 [CS] [RE]	12 V	0.40 A	13.3 A
XR160-15 [CS] [RE]	15 V	0.33 A	10.7 A
XR160-19 [CS] [RE]	19 V	0.26 A	8.42 A
XR160-24 [CS] [RE]	24 V	0.20 A	6.67 A
XR160-28 [CS] [RE]	28 V	0.18 A	5.71 A
XR160-30 [CS] [RE]	30 V	0.17 A	5.33 A
XR160-48 [CS] [RE]	48 V	0.11 A	3.33 A
XR160-51 [CS] [RE]	51 V	0.10 A	3.14 A
XR160-54 [CS] [RE]	54 V	0.09 A	2.96 A
XR160-56 [CS] [RE]	56 V	0.09 A	2.86 A

\* Minimum load needed for the Power-Good signal to go true (high) and the PS\_OK signal to go low

\* Assuming no load on V2 output & that cooling requirements are met

**Table 3-3 Min/Max Load Currents XR160-05 [CS] [RE] thru XR160-56 [CS] [RE]**

## 3.4 Cooling

The power supply can be used under certain output loading conditions in natural convection cooling or with forced air-cooling. The XR160 may be mounted in any attitude.

### 3.4.1 Unrestricted Convection Cooling

The maximum continuous output rating of all DC outputs combined is reduced under natural convection cooling with a maximum ambient temperature of 50°C (see Sections 3.3.1 through 3.3.2). On the XR160-1[ATX], -7[ATX] models, the sum of the V1 and V2 outputs must not exceed 40-watts. On the XR160-8[ATX] models, the V2 output must not exceed 40-watts.

### 3.4.2 Forced Air Cooling

The maximum continuous rating of all DC outputs combined is 160-watts with a minimum of 10 CFM of forced-air cooling at a maximum of 50°C. On the XR160-1[ATX] and -7[ATX] models, the sum of the V1 and V2 outputs must not exceed 100-watts. On the XR160-8[ATX] models, the V2 output must not exceed 100-watts. Airflow must be in the same plane as the circuit board (impinging on any side of the XR160).

### 3.4.3 High Temperature Derating

The XR160 can be operated at elevated temperatures by derating the total maximum output power (or current) by 2.5%/°C from 50°C to 70°C (see Figure 3-1).

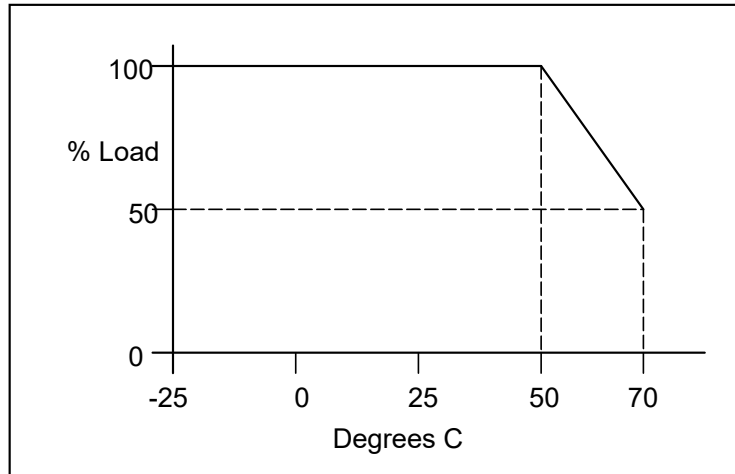


Figure 3-1 XR160 Output Power vs. Ambient Temperature Envelope

## 3.5 Output Ripple/Noise

Output ripple voltage and noise are defined as periodic or random signals over a frequency band of 10 Hz to 20 MHz. Measurements are to be made with an oscilloscope with at least 20 MHz bandwidth. Outputs should be bypassed at the connector with a 0.1  $\mu$ F ceramic disk capacitor and a 10  $\mu$ F tantalum capacitor to simulate system loading (see Figure 3-2). Ripple and noise shall not exceed the limits specified in the following tables.

### 3.5.1 Ripple/Noise Limits: XR160-1[ATX], -7[ATX], -8[ATX]

The ripple voltage of the outputs is measured at the pins of the mating connector. Ripple and noise shall not exceed the limits specified in Table 3-4 under any condition of line voltage and frequency specified in Section 2.1 and DC loading specified in Section 3.3.1.

Output	Voltage	Maximum Ripple+Noise (peak-to-peak)
V1 (-1[ATX] and -7[ATX] only)	+3.3 / +2.5 V	50 mV
V2	+5 V	50 mV
V3	+12 V	120 mV
V4	-12 V	120 mV
V5 (ATX models only)	+5 V <sub>standby</sub>	50 mV

Table 3-4 Ripple Voltage: XR160-1[ATX], -7[ATX], -8 [ATX] versions

**3.5.2 Ripple/Noise Limits: XR160-05 [CS] [RE] through XR160-56 [CS] [RE]**

The ripple voltage of the outputs is measured at the pins of the mating connector. Ripple and noise shall not exceed the limits specified in Table 3-5 under any condition of line voltage and frequency specified in Section 2.1 and DC loading specified in Section 3.3.2.

<b>Model</b>	<b>Rated V1 Output</b>	<b>Maximum Ripple+Noise (peak-to-peak)</b>
XR160-05 [CS] [RE]	5 V	50 mV
XR160-07 CS [RE]	7 V	70 mV
XR160-08 CS [RE]	8 V	80 mV
XR160-12 [CS] [RE]	12 V	120 mV
XR160-15 [CS] [RE]	15 V	150 mV
XR160-19 CS [RE]	19 V	190 mV
XR160-24 [CS] [RE]	24 V	240 mV
XR160-28 [CS] [RE]	28 V	280 mV
XR160-30 [CS] [RE]	30 V	300 mV
XR160-48 [CS] [RE]	48 V	480 mV
XR160-51 CS [RE]	51 V	510 mV
XR160-54 [CS] [RE]	54 V	540 mV
XR160-56 [CS] [RE]	56 V	560 mV
All of the above	V2 (12V)	120 mV
RE models only	V3 +5 V <sub>standby</sub>	50 mV

**Table 3-5 Ripple Voltage: XR160-05 [CS] [RE] thru XR160-56 [CS] [RE]**

### 3.5.3 Ripple/Noise Test Setup

Figure 3-2 Ripple Noise Measurement Setup

## 3.6 Local and Remote Sensing

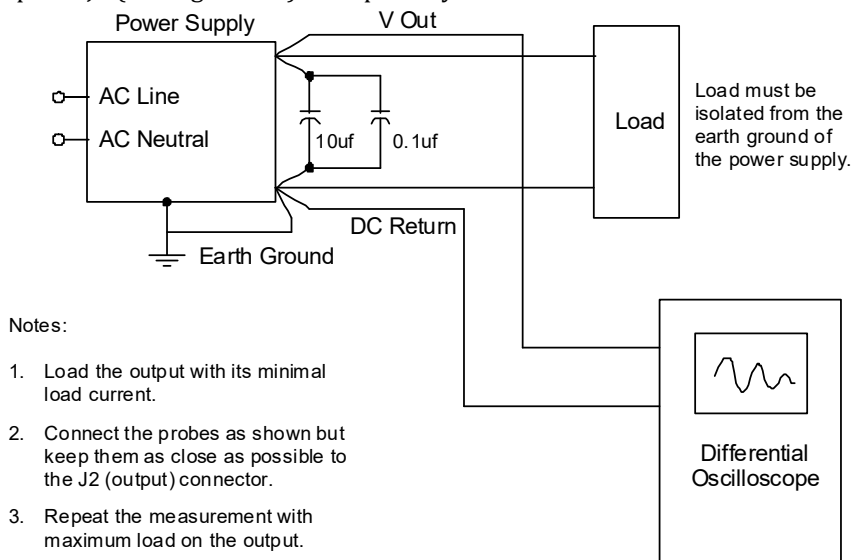
Remote sensing is provided to compensate for voltage drops in the V1 (+ Output) and DC RETURN connections to the load. All XR160-1, -7 and -8 models (both ATX & non-ATX) have an additional sense input of the V2 (+ Output). For every model, the 0V Sense input must always be connected to either one of the DC Return pins of the XR160 or the DC Return terminal at the load. Connecting it to the return side of the load will reduce the voltage drop in the external return wiring.

If the V1 Sense input is left open, the V1 output may not meet its load regulation specification. The V1 output will meet its load regulation specification when the V1 Sense pin is connected to one of the V1 output pins. Connecting the V1 Sense pin to the V1 output at the load will reduce the voltage drop in the external V1 wiring.

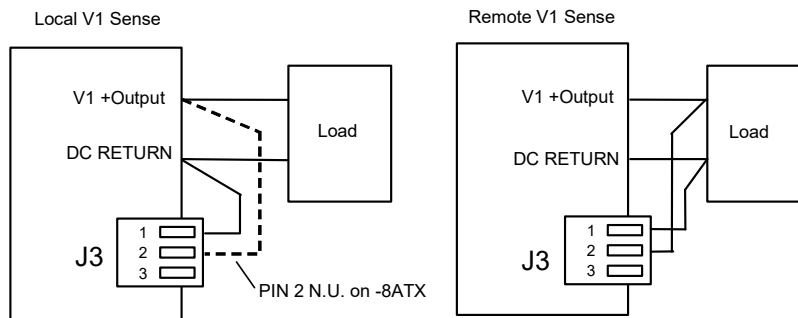
### 3.6.1 Local and Remote Sensing: XR160-1[ATX], -7[ATX], -8[ATX]

The V1 +Sense input need not be connected for the XR160-8[ATX], as it has no V1 output. The XR160-1[ATX] and XR160-7[ATX] can compensate for up to 0.2V drop in each side (+ Output and DC RETURN) of the V1 output. The +Sense on J3-1 affects only the V1 output while the -Sense on J3-2 affects V1, V2 and V3. Figure 3-3 shows the required and optional remote sensing connections. Note that on the ATX versions J3 has 5-pins instead of the 3-pins shown below, but pins 1 and 2 are still used for remote sense as shown in Figure 3-3. Refer to Table 4-8 for the pin definition of the XR160 connectors.

All XR160-1, -7 and -8 models (both ATX & non-ATX versions) have an additional +V2 sense pin at J4 (see Figure 4-3). This pin may be connected to +5V load to reduce the



voltage drop in the V2 load wiring. The +V2 sense input only affects V2 & V3 and does not affect the V1, V4 or V5 voltages.

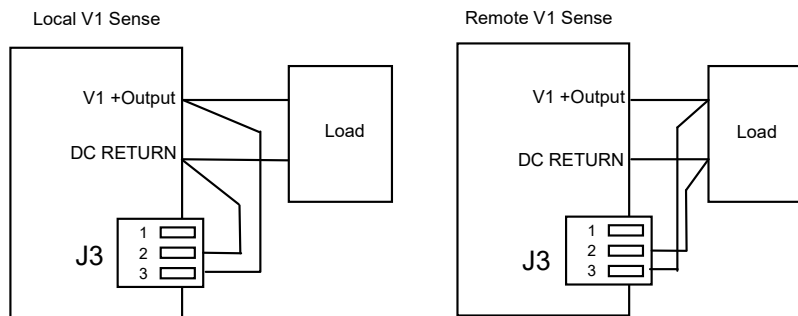


**Figure 3-3 Remote V1 Sensing: XR160-1[ATX], -7[ATX], -8[ATX]**

### 3.6.2 Local and Remote Sensing: XR160-05 [CS] [RE], XR160-07 CS [RE] and XR160-08 CS [RE]

Up to 0.2V in the return and 0.2V in the V1 connection may be compensated. Figure 3-4 shows the required and optional remote sensing connections. J3 actually has five pins but only the first three are shown below. Refer to Table 4-9 for the pin definition of the XR160 connectors.

This model contains an internal OR-ing MOSFET so that V1 output of multiple power supplies may be connected in parallel. Follow the same sense wiring for each paralleled supply as if it were a single supply.

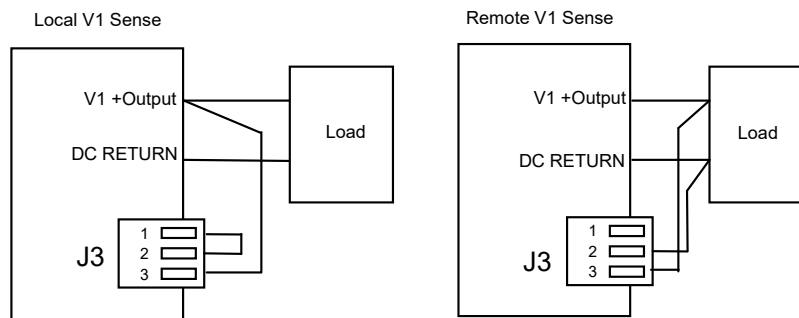


**Figure 3-4 Remote Sensing Wiring: XR160-05 [CS] [RE], XR160-07 CS [RE] and XR160-08 CS [RE]**

### 3.6.3 Local and Remote Sensing: XR160-12 [CS] [RE] thru XR160-56 [CS] [RE]

Up to 0.5V in the return and 0.5V in the V1 connection may be compensated. Figure 3-5 shows the required and optional remote sensing connections. J3 actually has five pins but only the first three are shown below. Refer to Figure 4-3 for the pin definition of the XR160 connectors. These models contain internal OR-ing diodes or OR-ing MOSFETs so

that V1 output of multiple power supplies may be connected in parallel. Follow the same sense wiring for each paralleled supply as if it were a single supply.



**Figure 3-5 Remote Sensing Wiring: XR160-12 [CS] [RE] through XR160-56 [CS] [RE]**

## 3.7 Parallel Operation

### 3.7.1 XR160-05 [CS] [RE], -07 CS [RE], -08 CS [RE] and XR160-12 [CS] [RE] through -56 [CS] [RE]

The V1 output of two XR160-xx [CS] [RE] power supplies may be connected directly in parallel to provide 1 + 1 output power. Each of these models has an optional built-in V1 output OR-ing diode (or MOSFET) and a single wire Current Share signal for active load-leveling parallel operation.

The V2 outputs may be connected together using OR-ing diodes and they are unaffected by the active current sharing of the V1 outputs.

#### 3.7.2 Current Sharing Connections

The Current Share signal (see Table 4-8) of each supply operating in parallel must be connected together. Power sharing does not require the 0V Sense signals be connected together, but the sharing accuracy may not meet published specification unless they are also connected together.

Power-Good signals may be externally wire OR-ed together, but this is not recommended, as a failing power supply will pull the signal low. They should be monitored individually by the user's system.

#### 3.7.3 Current Share Accuracy

When all the current share signals are connected together and all the 0V Sense signals are connected together, the load delivered by two supplies of the sharing supplies will not vary by more than 10% at full load.

#### 3.7.4 Transients

The output rise time and monotonic requirements of Section 6.1 may not be met where the load exceeds 160 watts, because of the difference in start-up times of the paralleled power supplies.



When the AC line to one of the parallel power supplies is disconnected or reconnected, or a power supply fails, the transient on the V1 output is within five (5) percent of nominal output voltage, although the output voltage may ramp to a new nominal voltage within the regulation band.

## **3.8 Output Protection**

There are three different output protection schemes designed to protect the load and the XR160 from component failures and extraordinary circumstances.

### **3.8.1 Over Temperature Protection**

If the XR160 is operated without adequate cooling, it will sense an over-temperature condition and shut itself down. It will not restart until it has cooled down to below its maximum operating temperature and the AC power is cycled off and back on.

### **3.8.2 V2 or V3 Outputs Over-Load Protection**

The V2 outputs of the XR160-05, -07, -08 and -12 through -56 are current limited at approximately 1.5A through a thermally protected linear regulator.

An overload on the V2 output should not affect the operation of the other outputs unless the V2 output power adds to already excessive output power, thereby causing over-power protection. The V2 output will resume normal operation when the over-load condition is removed.

### **3.8.3 Over-Power Protection**

Total output power in excess of approximately 190-watts will cause the XR160 to shut down all outputs except for the (+5Vstandby) output. The power supply will periodically attempt to restart until the over-load condition is removed.

Pulsating loads of 150% of the rated output can be sustained for 10-milliseconds provided the duty cycle does not exceed 10%. The total RMS power must still be limited to 160-watts.

### **3.8.4 Short Circuit Protection**

A short circuit is defined as an impedance of less than 0.1 ohms placed between DC RETURN and any output. A short circuit will cause no damage to the power supply, but will cause it to shutdown. The power supply will periodically attempt a restart until the short circuit condition is removed. After successfully restarting, the power supply will operate normally.

### **3.8.5 Over Voltage Protection**

No single fault is able to cause a sustained over voltage condition on any output. The following outputs have OVP sensing and will shut the supply down if the output reaches the OVP threshold. Following an OVP event, the XR160 will not restart until either AC power or remote on/off signal is cycled off and back on.

<b>Model</b>	<b>OVP Sensing on Outputs:</b>
XR160-1[ATX],-7[ATX]	V1, V2, V3
XR160-8[ATX]	V2, V3
XR160-XX [CS] [RE]	V1

**Table 3-6 OVP Protected Outputs by Model**

The XR160 will shut down under the following over voltage conditions:

<b>Rated Output Voltage</b>	<b>Minimum OVP Threshold</b>	<b>Nominal OVP Threshold</b>	<b>Maximum OVP Threshold</b>
2.5 V	2.87 V	3.15 V	3.44 V
3.3 V	3.76 V	4.2 V	4.9 V
5.0 V	5.74 V	6.3 V	6.88 V
7 V	7.88 V	8.7 V	9.63 V
8 V	9.00 V	10.0 V	11.0 V
12 V	13.5 V	15.0 V	16.5 V
15 V	16.9 V	18.8 V	20.6 V
19 V	21.4 V	23.8 V	26.1 V
24 V	27.0 V	30.0 V	33.0 V
28 V	31.5 V	35.0 V	33.5 V
30 V	33.8 V	37.5 V	41.3 V
48 V	54.0 V	58.0 V	66.0 V
51 V	57.4 V	63.8 V	70.1 V
54 V	60.8 V	64.8 V	74.3 V
56 V	63.0 V	70.0 V	77.0 V

**Table 3-7 Over Voltage Protection Limits by Rated Output Voltage**

### **3.9 Output Rise Time**

All output voltages shall rise from 10% to 90% of nominal output voltage (as specified in Table 3-1) within 0.2ms to 20ms. The output voltages waveform must be a monotonic ramp from 10% to 90% of final set-point within the regulation band under any loading conditions specified in the respective load current tables in Section 3.3.

For the purposes of this specification, a monotonic ramp is defined as always having a positive slope of from zero to 10 x Vout volts/millisecond. During any 5-millisecond portion of the ramp, its slope must be greater than 5% of its rated voltage per millisecond.

### **3.10 Overshoot At Turn On/Turn Off**

The output voltage overshoot upon the application or removal of the input mains voltage is less than 10% above the nominal voltage. No opposite polarity voltage is present on any output during turn on or turn off.

### **3.11 Output Transients**

The maximum output voltage transient caused by step load changes will not exceed the output voltage regulation limits by more than 5%. With an AC input as specified in Section 2.1, the power supply will remain stable when subjected to the load transients described below:

- Load changes between 75% and 100% on any output
- Load changing repetition of 50 to 333 cycles per second
- Transient load slew rate = 1.0 A/microsecond
- Capacitive loading per Table 3-8

### 3.12 Closed Loop Stability

The power supply is unconditionally stable under all line/load/transient load conditions including the capacitive loads specified in Table 3-8. The power supply shall exhibit a minimum of 45-degrees phase margin and 6 dB gain margin.

### 3.13 Capacitive Loading

The power supply will power up and operate normally with the capacitances listed in Table 3-8 simultaneously present on the outputs. Cap values are the same for [CS] and/or [RE] mode.

XR160-:	-1[ATX], -7[ATX], -8[ATX]	-05 thru -08	-12	-15 thru -19	-24 thru -30	-48 thru -56
<b>Output:</b>	have demonstrated starting and stability with the following capacitive loads					
+3.3 V / +2.5 V	6,000 $\mu$ F					
+5 V	10,000 $\mu$ F					
+5 V <sub>standby</sub> [RE]	100 $\mu$ F	100 $\mu$ F	100 $\mu$ F	100 $\mu$ F	100 $\mu$ F	100 $\mu$ F
+12 V	1,000 $\mu$ F					
V1 (Main Output)		10,000 $\mu$ F	4,000 $\mu$ F	3,000 $\mu$ F	2,000 $\mu$ F	500 $\mu$ F
12 V <sub>aux</sub>	350 $\mu$ F	350 $\mu$ F	350 $\mu$ F	350 $\mu$ F	350 $\mu$ F	350 $\mu$ F

**Table 3-8 XR160 Demonstrated Capacitive Loading**

# 4.

# General Specifications

## 4.1 Environmental

The XR160 meets or exceeds the following environmental specifications:

Parameter	Conditions	Specification	Remarks
Temperature	Operating	-25°C to 70°C	See cooling requirements
	Non-Operating	-40°C to 85°C	
Relative Humidity	Operating	95% Maximum	Non-Condensing
	Non-Operating	95% Maximum	Non-Condensing
Altitude	Operating	6,561 feet MSL Max.	2,000 meters
	Non-Operating	50,000 feet MSL Max.	15,240 meters
Vibration	No damage	2.4G RMS Maximum	5-500Hz, 10-min. each axis per MIL-PRF-28800F: 3.8.4.1 (Class 3,4)
		6.0G RMS Maximum	100-1,000Hz random, 10-min. vertical axis only
Mechanical Shock	No damage	30G half-sine, 11mS	Six shocks each axis per MIL-PRF-28800F: 4.5.5.4.1

Table 4-1 Environmental Specifications

## 4.2 Mean Time Between Failures

The MTBF for XR160 models are tested under the following conditions: Continuous operation at maximum output loading and worst case input line voltage with forced-air cooling at 25°C.

The XR160-1[ATX] and -7[ATX] models are rated at 609,000 hours while the XR160-8[ATX] is rated at 637,900 hours. The XR160-12 and 15 CS models are rated at 769,900 hours. The XR160-19 thru 56 CS models are rated at 784,100 hours. The XR160-05 thru -08 CS models are rated at 684,000 hours.

N2Power does not warrant the MTBF to be representative of any particular unit. The MTBF of the power supply is calculated with an 80% confidence level in accordance with Bellcore, SR-332, Issue 2. Actual failure rates vary from unit to unit.

## 4.3 Component Stress

The XR160 design followed these component-derating guidelines: semiconductor junction temperatures shall not exceed ninety (90) percent of manufacturer's rating with an ambient of 50°C. Inductor winding temperatures shall not exceed safety agency requirements. Capacitor case temperatures shall not exceed 95% of rated temperature. Resistor power dissipation derating is greater than 50%. Component voltage and current derating is greater than 10% at 50°C.

## 4.4 Labeling/Marking

The power supply is marked and labeled with the N2Power logo and part number, model number, input and output specifications, production code, appropriate safety agency logos, CE mark, patent number, and country of origin. A typical label is pictured below.

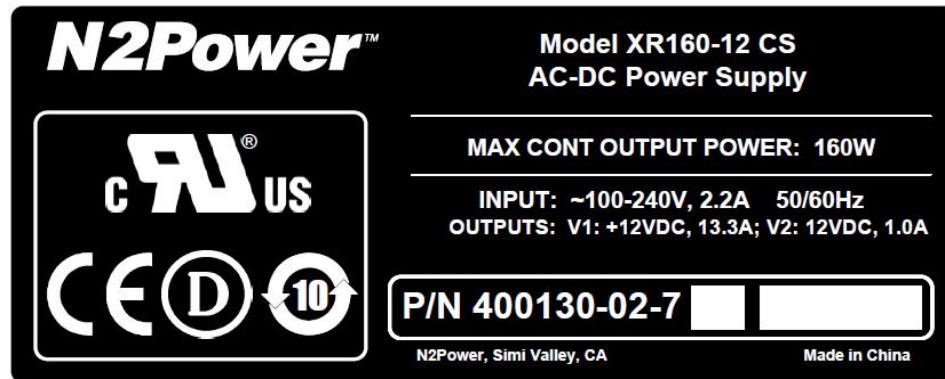


Figure 4-1 Sample XR Series Label

## 4.5 Weight

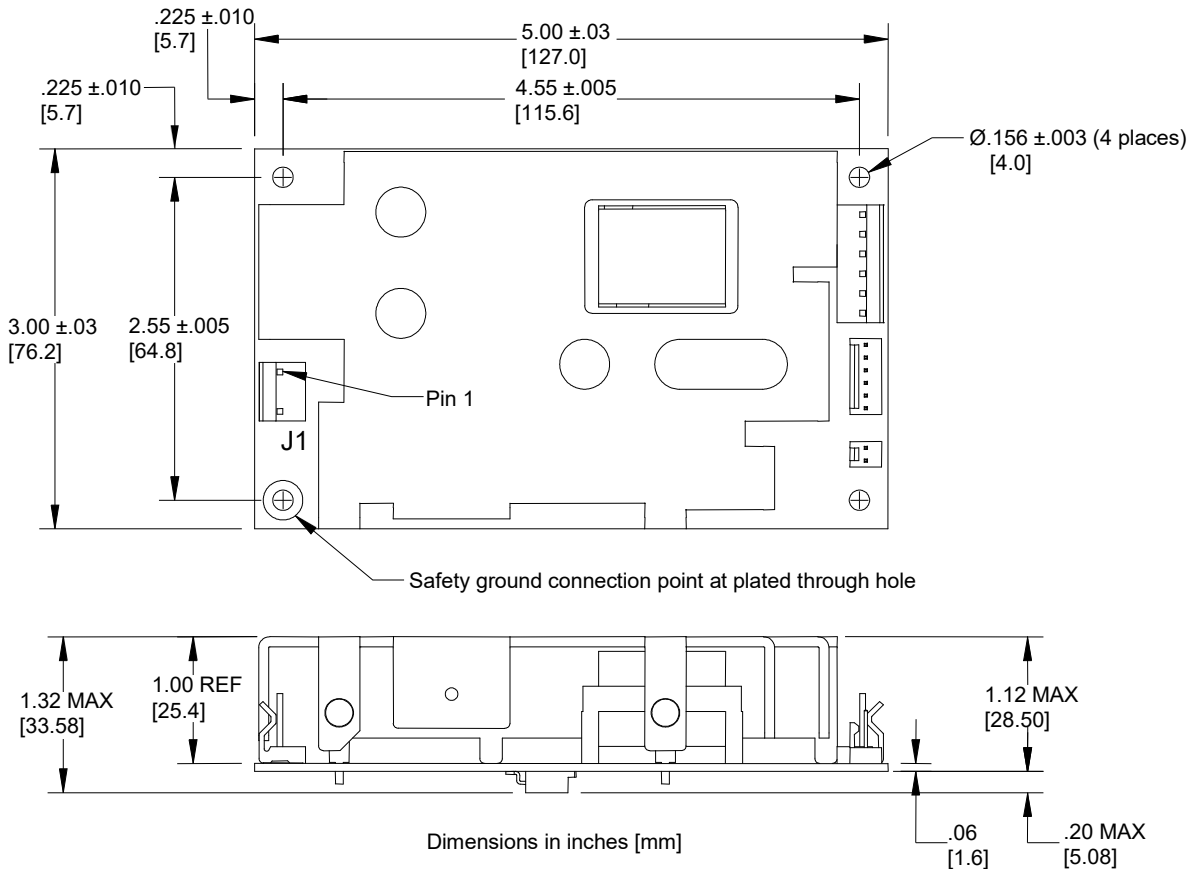
Model	Pounds	Ounces	Kilograms
XR160-1[ATX], -7[ATX]	0.73	11.7	0.331
XR160-8[ATX]	0.69	11.0	0.312
XR160-05 [CS] [RE], -07 CS [RE], -08 CS [RE]	0.69	11.0	0.312
XR160-12 [CS] [RE] thru -56 [CS] [RE]	0.65	10.4	0.295

Table 4-2 XR160 Weights

## 4.6 Mounting

The XR160 may be mounted in any attitude but must be mounted on all four corners. No. 6 or M3 mounting hardware should not exceed .282-inches (7.16-mm) in diameter for any lock washer, flat washer, standoff, screw head or other mounting hardware to avoid contact and maintain adequate safety agency spacing requirements with components or printed circuit board traces.

## 4.7 Physical Dimensions



Note: Recommended standoff size is .375" high and all mounting hardware should be less than .28" in diameter. A standoff less than .375" high is acceptable when a thin insulator, 0.4mm thick (polyester, fish paper or equivalent UL rated 94V-2 minimum) is placed between the XR160 and the mounting chassis (refer to applicable UL standard for clearance requirements).

**Figure 4-2 XR160 Dimensions**

## 4.8 Mating Connectors

The user must furnish all mating connectors. The mating connectors must meet the requirements of all applicable safety agencies (notably UL). Molex™ (Molex is a trademark of the Molex Corporation) did not change their part numbers when they took the lead out of their contacts. The Molex part numbers in this section should yield RoHS compliant contacts. The largest wire size accepted by each contact should be used for all power connections to help dissipate the heat generated by the resistive connections.

Note that the female contacts that mate to the power supply are only rated for 25-30 mating cycles. Excessive mating cycles causes dramatically increased terminal resistance and heating resulting in the eventual failure of the mating terminal and possibly the header on the power supply.

**CAUTION**

The pin-1 location differs amongst connector manufacturers. Sometimes pin-1 differs between the header (on the power supply) and the mating housing from the same manufacturer. Disregard the manufacturer's pin-1 location and follow only the pin-1 locations in Figure 4-3.

**4.8.1 AC Input Mating Connector (J1)**

The AC input connector to the XR160 is a 3-pin Molex™ (Molex is a trademark of the Molex Corporation) KK style header with 0.156" centers. The center pin is omitted to provide adequate insulation spacing. The Molex part numbers for the mating housing and crimp-style snap-in terminals are listed below. There may be equivalent connectors available from other manufacturers. The line side of the input should be connected to the pin closest to the mounting hole (see Figure 4-2).

<b>J1</b>	<b>Molex P/N</b>
Connector Circuits (pins)	2 of 3
Mating Housing	09-50-8031
Rated Contact Current	7.0 A
Crimp Terminal (tin)	08-50-0106
Rated Wire Size	AWG 18 or 20

**Table 4-3 J1 Mating Connector**



#### 4.8.2 DC Output Connector (J2)

The DC output connector is a Molex KK style header with 0.156” centers. The Molex part numbers for the mating housing and crimp-style snap-in terminals are listed below. There may be equivalent connectors available from other manufacturers.

J2	XR160-1[ATX], -7[ATX], -8[ATX]	XR160-05 [CS] [RE], -07 CS [RE], -08 CS [RE]	XR160-xx [CS] [RE]
Connector Circuits (pins)	14	6 (Terminal Strip)	6
Mating Housing	09-50-8141	Stripped and tinned wire	09-50-8061
Crimp Terminal (tin)	08-52-0071	N/A	08-50-0106
Rated Wire Size	AWG 18 or 20	AWG 12 max.	AWG 18 or 20

Table 4-4 J2 Mating Connectors

#### 4.8.3 Remote Sense / PG Connector (J3)

The Remote Sense/PG connector on the XR160 is a Molex KK style header with 0.100” centers. The Molex part numbers for the mating housing and crimp-style snap-in terminals are listed below. There may be equivalent connectors available from other manufacturers.

J3	XR160-1, -7, -8	XR160-1ATX, -7ATX, -8ATX, XR160-05 [CS], -07 CS, -08 CS	XR160-xx [CS]
Connector Circuits (pins)	3	5	6
Mating Housing	22-01-3037	22-01-3057	22-01-3067
Crimp Terminal (tin, 2.5A)	08-52-0123	08-52-0123	08-52-0123
Rated Wire Size	AWG 22 to 30	AWG 22 to 30	AWG 22 to 30

\* For XR160-1, -7, -8 models only, the Molex 22-01-3037 housing is recommended and not an equivalent from another manufacturer.

Table 4-5 J3 Remote Sense/PG Mating Connectors

#### 4.8.4 Remote Enable Connector (J3)

The Remote Enable connector on the XR160 is a Molex KK style header with 0.100” centers. The Molex part numbers for the mating housing and crimp-style snap-in terminals are listed below. There may be equivalent connectors available from other manufacturers.

<b>J3</b>	<b>XR160-05 [CS] RE, -07 CS RE, -08 CS RE</b>	<b>XR160-xx [CS] RE</b>
Connector Circuits (pins)	8	8
Mating Housing	22-01-3087	22-01-3087
Crimp Terminal (tin, 2.5A)	08-52-0123	08-52-0123
Rated Wire Size	AWG 22 to 30	AWG 22 to 30

**Table 4-6 J3 Remote Enable Mating Connectors**

**4.8.5 J4 Connector: 12V Aux or V2 Sense** (see Table 4-8 & Table 4-9)

The 12V AUX or V2 Sense connector (see Table 4-7) is a 2-pin header with 0.100” centers. The part numbers for the mating housing and crimp-style snap-in terminals are listed below. There may be equivalent connectors available from other manufacturers.

<b>J4</b>	<b>All Models except ATX</b>
Connector Circuits (pins)	2
Mating Housing	Molex P/N 22-01-3027
Crimp Terminal (tin, 2.5A)	Molex 08-52-0123
Rated Wire Size	AWG 22 to 30

**Table 4-7 J4 Mating Connectors**

**4.9 Output Grounding**

The DC RETURN signal may be connected to the power supply chassis ground (safety ground) at the plated through mounting hole near the input connector.

## 4.10 Signal Pin Definitions

- There are three general output connector configurations for the XR160 Series
- Identical signal names are connected together on all connectors
- The V2 output (12V aux) is floating only on models XR160-12 through -56
- The safety ground connection is provided by the mounting screw near J1
- Refer to Figure 4-3 for connector and pin-1 locations
- Refer to Table 6-1 for signal level definitions

Pin	XR160-1[ATX], -7[ATX]	XR160-8[ATX]
J1-1	AC Neutral	AC Neutral
J1-2	No Pin	No Pin
J1-3	AC Line	AC Line
J2-1	V4 (-12V Output)	V4 (-12V Output)
J2-2	V3 (+12V Output)	V3 (+12V Output)
J2-3	V1 (+2.5/+3.3V Output)	V3 (+12V Output)
J2-4	V1 (+2.5/+3.3V Output)	V3 (+12V Output)
J2-5	V1 (+2.5/+3.3V Output)	V3 (+12V Output)
J2-6	DC RETURN (0V)	DC RETURN (0V)
J2-7	DC RETURN (0V)	DC RETURN (0V)
J2-8	DC RETURN (0V)	DC RETURN (0V)
J2-9	DC RETURN (0V)	DC RETURN (0V)
J2-10	DC RETURN (0V)	DC RETURN (0V)
J2-11	V2 (+5V Output)	V2 (+5V Output)
J2-12	V2 (+5V Output)	V2 (+5V Output)
J2-13	V2 (+5V Output)	V2 (+5V Output)
J2-14	V2 (+5V Output)	V2 (+5V Output)
J3-1	0V Sense (-)	0V Sense (-)
J3-2	V1 Sense (+)	Not Used
J3-3	Power-Good	Power-Good
J3-4	PS_ON/	PS_ON/
J3-5	+5 V <sub>standby</sub>	+5 V <sub>standby</sub>

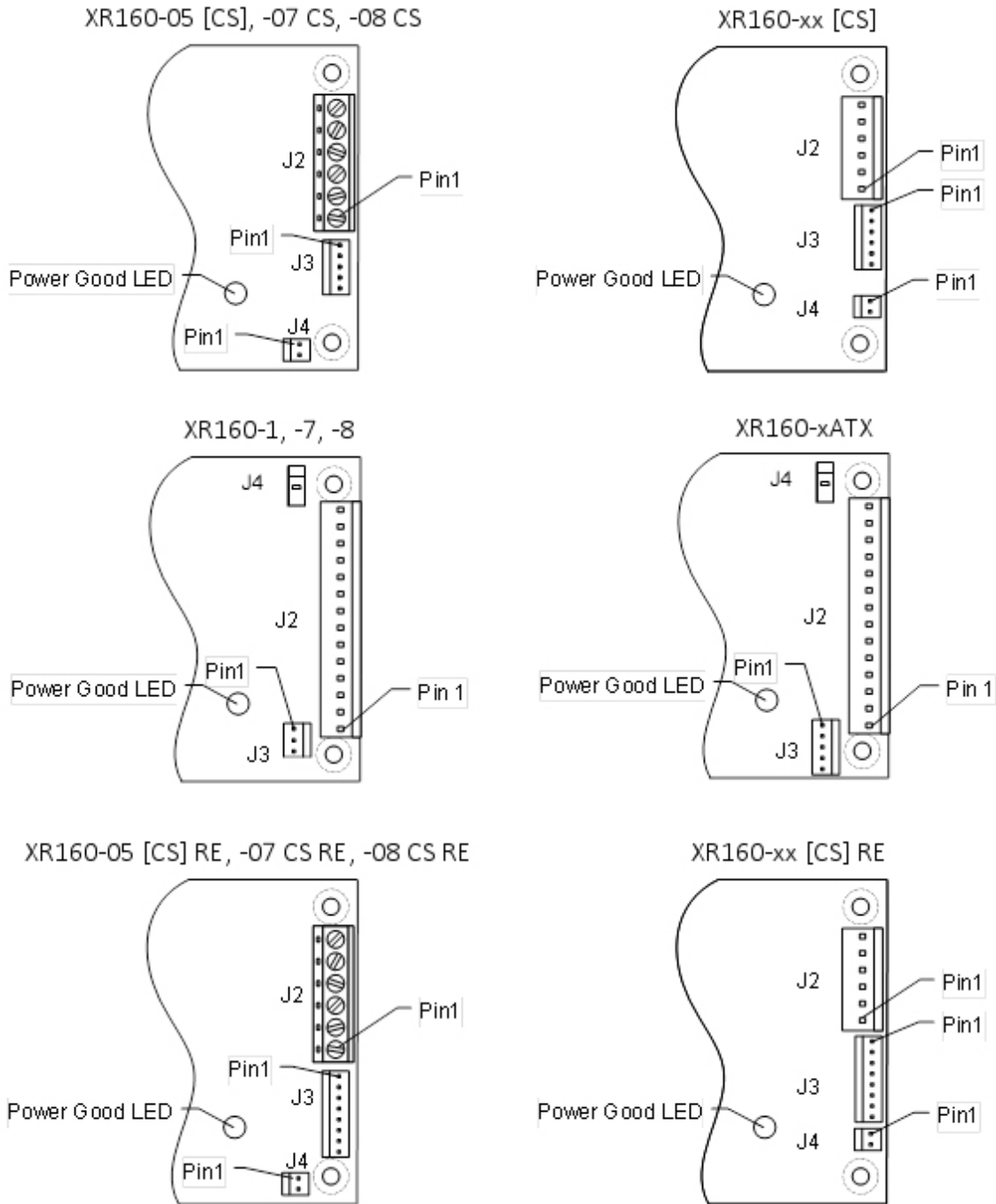
**Table 4-8 XR160 Signal Pin Definitions (Part A)**

<b>Pin</b>	<b>XR160-05 [CS], -07 CS, -08 CS</b>	<b>XR160-xx [CS]</b>
J1-1	AC Neutral	AC Neutral
J1-2	No Pin	No Pin
J1-3	AC Line	AC Line
J2-1	V1 (+5V Output)	V1 (+ Output)
J2-2	V1 (+5V Output)	V1 (+ Output)
J2-3	V1 (+5V Output)	V1 (+ Output)
J2-4	DC RETURN (0V)	DC RETURN (0V)
J2-5	DC RETURN (0V)	DC RETURN (0V)
J2-6	DC RETURN (0V)	DC RETURN (0V)
J3-1	Current Share	DC RETURN (0V)
J3-2	0V Sense (-)	0V Sense (-)
J3-3	V1 Sense (+)	V1 Sense (+)
J3-4	PS_OK	Current Share
J3-5	Power-Good	Power-Good
J3-6	No Pin	PS_OK
J4-1	+12V AUX (Fan)	V2 (+12V AUX)
J4-2	DC RETURN (0V)	V2 (-12V AUX)

**Table 4-9 XR160 Signal Pin Definitions (Part B)**

Pin	XR160-05 [CS] RE,	
	-07 CS RE, -08 CS RE	XR160-xx [CS] RE
J1-1	AC Neutral	AC Neutral
J1-2	No Pin	No Pin
J1-3	AC Line	AC Line
J2-1	V1 (+5V Output)	V1 (+ Output)
J2-2	V1 (+5V Output)	V1 (+ Output)
J2-3	V1 (+5V Output)	V1 (+ Output)
J2-4	DC RETURN (0V)	DC RETURN (0V)
J2-5	DC RETURN (0V)	DC RETURN (0V)
J2-6	DC RETURN (0V)	DC RETURN (0V)
J3-1	Current Share	DC RETURN (0V)
J3-2	0V Sense (-)	0V Sense (-)
J3-3	V1 Sense (+)	V1 Sense (+)
J3-4	PS_OK	Current Share
J3-5	Power-Good	Power-Good
J3-6	Remote Enable	PS_OK
J3-7	+5 V <sub>standby</sub>	Remote Enable
J3-8	DC RETURN (0V)	+5 V <sub>standby</sub>
J4-1	+12V AUX (Fan)	V2 (+12V AUX)
J4-2	DC RETURN (0V)	V2 (-12V AUX)

**Table 4-10 XR160 Signal Pin Definitions (Part C)**



**Figure 4-3 XR160 Output Connectors Layouts**

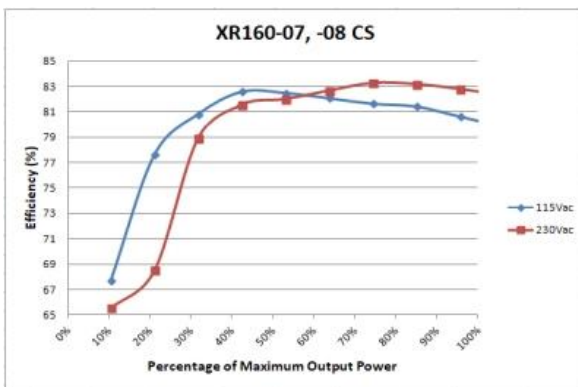
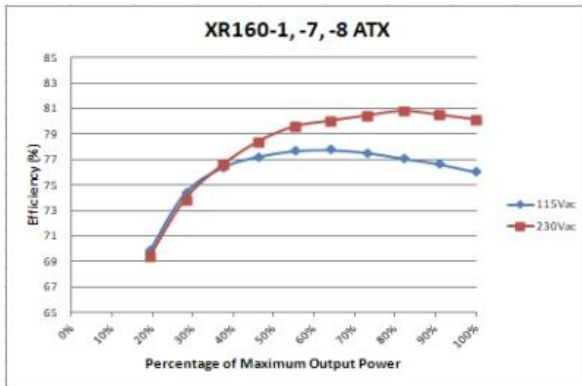
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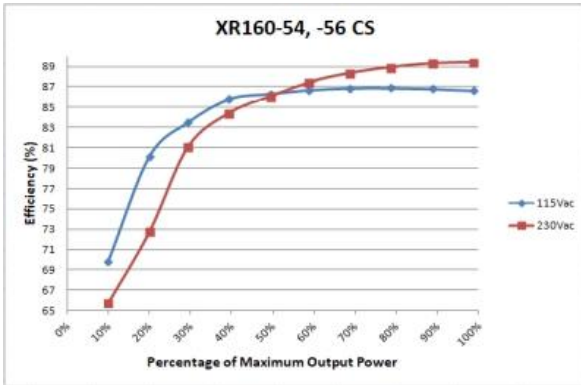
# Efficiency

The power supply will meet high efficiencies under defined loading conditions specified in Table 5-1 with a line voltage of 230VAC and 10 CFM of cooling air at 25°C. Efficiency curves are shown in the following diagrams. These charts are for Current Sharing (CS) models, removing the Or-ing diodes will increase the efficiency by approximately 2%. This is available as an option. Note that only some models are shown.

XR160:	-1[ATX], -7[ATX]	-8[ATX]	-05 [CS]	-07 [CS], -08 [CS]	-12 [CS]	-15 [CS]	-24 [CS]	-28 [CS], -30 [CS]	-48 [CS], -56 [CS]
Efficiency	82%	83%	84%	87%	86%	87%	87%	88%	89%
V1	0.10A	-	32 A	22.8 A	13.3 A	10.6A	6.6A	5.7A	3.3A
V2	20 A	15 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A	0.0 A
V3	4.0 A	6.0 A	0.0A	0.0A	0.0A	0.0A	0.0 A	0.0 A	0.0A
V4	1.0 A	1.0 A	-	-	-	-	-	-	-
V5	1.0 A	1.0 A							

Table 5-1 XR160 Output Currents at Rated Efficiency (See next page)





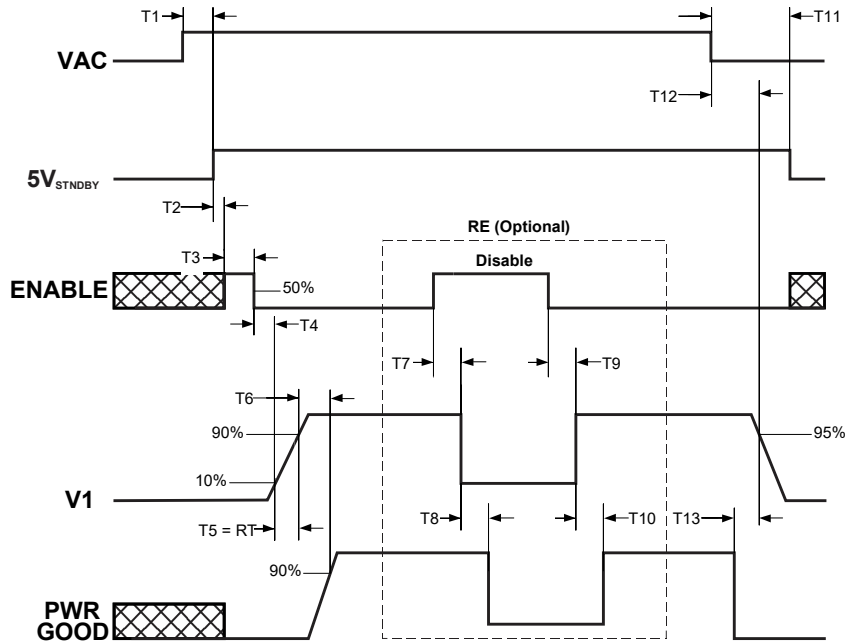


# 6.

# Timing and Control

## 6.1 Power Supply Timing

XR160-xx, xATX and RE Models



	Min	Max		Min	Max	
STBY TURN ON DELAY T1	75mS	800mS	T8	2mS	15mS	PG OFF DELAY
ENABLE DELAY T2		<5mS	T9		<3 secs	V1 ENABLE DELAY
ENABLE DELAY T3		<5mS	T10	2mS	15mS	PG ON DELAY
V1 DELAY T4		<60mS	T11	>35mS		5V STBY HOLD UP
OUTPUT RISETIME T5	2mS	19mS	T12	>22mS		OUTPUT HOLDUP
PG DELAY T6	30mS	200mS	T13	>2mS		EARLY WARNING
V1 DISABLE DELAY T7	2mS	15mS				

Figure 6-1 XR160 Timing Diagram

## **6.2 Power-Good Signal, PS\_OK Signal, PS\_ON/Input and Remote Enable Input**

### **6.2.1 Power-Good (PG)**

The Power-Good Signal provides a high logic level to indicate that sufficient time has expired for the DC outputs to be within their regulation limits and that sufficient mains energy is stored by the power supply to ensure continuous power operation within specification for the duration of the hold-up time. When the AC mains power is removed for a period longer than 20ms, the Power-Good (PG) Signal transitions to a low logic level. PG Signal is active low with two TL331 outputs in parallel with a single 2.2K resistor tied to 5 V<sub>standby</sub>. The Power-Good signal is driven by open-drain channel MOSFET transistors. XR160-1, -7 and -8 models add a TTL compatible pull-up resistor on just the Power Good output. The electrical specifications for the Power-Good output are described in Table 6-1.

### **6.2.2 PS\_OK**

The PS\_OK signal is the logical complement of the Power-Good signal and is driven by an open-drain MOSFET transistor. The electrical specifications for the PS\_OK output are described in Table 6-1.

### **6.2.3 PS\_ON/**

On the ATX versions, the V1 through V4 outputs are enabled whenever the PS\_ON/ input (J3 pin-4) is grounded to DC RETURN (or J3 pin-1). Opening the PS\_ON/ input will disable the four outputs leaving only the +5V<sub>standby</sub> output and cause the Power-Good output to go false. The PS\_ON/ input has an internal 10K-ohm pull-up resistor connected to +5 V<sub>standby</sub>.

### **6.2.4 Remote Enable**

Similar to PS\_ON/ input on ATX versions, V1 and V2 outputs of RE versions are enabled whenever Remote Enable pin (J3 pin-6 for XR160-05 [CS] RE, -07 CS RE, -08 CS RE and J3 pin-7 for XR160-xx [CS] RE) is grounded to DC RETURN. Opening the Remote Enable input will disable the two outputs leaving only the +5V<sub>standby</sub> output and cause the Power-Good output to go false. The Remote Enable input has an internal 10K-ohm pull-up resistor connected to +5 V<sub>standby</sub>.

Signal Type	+5VDC, TTL Compatible
Low Logic Levels	<0.4V when sinking 4mA
High Logic Levels	Open Collector Output (see text above)
Power-Good output	High true (open) when conditions described above are met
Power-Good Delay	Less than 200mS after V1 outputs reaches regulation
Power Down Warning	>2 mS before V1 reaches minimum regulated output
Rise Time	<200 μS from 10% to 90% point.
PS_OK Output	Logical complement of Power-Good signal. Open drain MOSFET output with a 2.2K pull-up resistor
PS_ON/ (input)	Operate < 0.8V, Standby > 2.0V, Load: 10 K pull-up to +5 V
Remote Enable (input)	Operate < 0.8V, Standby > 2.0V, Load: 10 K pull-up to +5 V

**Table 6-1 XR160 Status Signal Specifications**

### 6.3 Power-Good LED

A green LED on all models illuminates whenever the Power-Good signal is true (high). See Figure 4-3 for the LED location near the output connector. At turn off, V2 is clamped via a diode to +5V output to insure 2.5 / 3.3V never exceed 5V output by 0.6V during turn-off.

### 6.4 Power Sequencing: XR160-1[ATX] and XR160-7[ATX]

The +12V and +5V output voltages are equal to or greater than the V1 (+2.5V or +3.3V) output voltage at all times during power up and normal operation. The time between the +5V output reaching minimum in-regulation voltage and the V1 output reaching minimum in-regulation voltage shall be less than 20 milliseconds. At turnoff, V1 is clamped via a diode to +5V output and not to exceed 0.6V.

### 6.5 Voltage Hold-Up Time

The power supply will maintain output regulation per Table 3-1 despite a loss of input power at 100VAC/50Hz and 230VAC/47Hz at maximum continuous output load for a minimum of 22 milliseconds. The Power-Good and PS\_OK signals provide a minimum 2mS early warning of impending loss of output power.

# 7.

# Ordering Information

The following table provides the N2Power part numbers that should appear on your purchase order and will appear on any N2Power correspondence:

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**XR160 Models without active current sharing**

---

<b>Model Number</b>	<b>V1</b>	<b>P/N</b>
XR160-1ATX	3.3	400125-02-7
XR160-7ATX	2.5	400126-02-5
XR160-8ATX	N/A	400127-02-3
XR160-1	3.3	400125-01-9
XR160-7	2.5	400126-01-7
XR160-8	N/A	400127-01-5
XR160-05	5	400140-01-8
XR160-12	12	400130-01-9
XR160-15	15	400131-01-7
XR160-24	24	400133-01-3
XR160-28	28	400134-01-1
XR160-30	30	400135-01-8
XR160-48	48	400136-01-6
XR160-54	54	400138-01-2
XR160-56	56	400139-01-0

---

**XR160 Models with active current sharing**

---

<b>Model Number</b>	<b>V1</b>	<b>P/N</b>
XR160-05 CS	5	400140-02-6
XR160-07 CS	7	400141-01-6
XR160-08 CS	8	400142-01-4
XR160-12 CS	12	400130-02-7
XR160-15 CS	15	400131-02-5
XR160-19 CS	19	400132-01-5
XR160-24 CS	24	400133-02-1
XR160-28 CS	28	400134-02-9
XR160-30 CS	30	400135-02-6
XR160-48 CS	48	400136-02-4
XR160-51 CS	51	400137-01-4
XR160-54 CS	54	400138-02-0
XR160-56 CS	56	400139-02-8

**Table 7-1 XR160 Model and Part Numbers**

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**XR160 RE Models without active current sharing**

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<b>Model Number</b>	<b>V1</b>	<b>P/N</b>
XR160-05 RE	5	400140-03-4
XR160-12 RE	12	400130-03-5
XR160-15 RE	15	400131-03-3
XR160-24 RE	24	400133-03-9
XR160-28 RE	28	400134-03-7
XR160-30 RE	30	400135-03-4
XR160-48 RE	48	400136-03-2
XR160-54 RE	54	400138-03-8
XR160-56 RE	56	400139-03-6

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**XR160 RE Models with active current sharing**

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<b>Model Number</b>	<b>V1</b>	<b>P/N</b>
XR160-05 CS RE	5	400140-04-2
XR160-07 CS RE	7	400141-02-4
XR160-08 CS RE	8	400142-02-2
XR160-12 CS RE	12	400130-04-3
XR160-15 CS RE	15	400131-04-1
XR160-19 CS RE	19	400132-02-3
XR160-24 CS RE	24	400133-04-7
XR160-28 CS RE	28	400134-04-5
XR160-30 CS RE	30	400135-04-2
XR160-48 CS RE	48	400136-04-0
XR160-51 CS RE	51	400137-02-2
XR160-54 CS RE	54	400138-04-6
XR160-56 CS RE	56	400139-04-4

**Table 7-2 XR160 RE Model and Part Numbers**

For warranty information refer to [www.n2power.com](http://www.n2power.com)

All XR160 power supplies are RoHS compliant.

Direct all questions, orders or requests for quotation as follows:

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