NCF660 SERIES

660 W Single Output
Medical Grade - CF Rated*

Medical

PRODUCT DESCRIPTION

Advanced Energy's NCF660 CF rated medically approved AC-DC power supplies for critical medical applications needing low leakage current . They are available with a nominal main output of 12 V, 15 V, 24 V or 48 V. NCF660 series power supplies provide up to 660 W of output power with air flow. All models have output overvoltage, short circuit and overload protection and a 7 x 4 x 1.6 inch form factor.

AT A GLANCE

Total Power

660 W

Input Voltage

85 to 264 VAC

# of Outputs

Single

SPECIAL FEATURES

- 5 kV Defibrillator Withstand
- Up to 660 W With Air Flow
- Up to 440 W Convection Cooled
- 4" X 7" X 1.6" Size (W X L X H)
- Universal Input 85 to 264 VAC
- Meets Class B Emissions Levels
- 7+ Years Electrolytic Capacitor Life
- Meets EN60601-1-2 4th Edition EMC
- Less than 10uA Leakage Current
- Class I Input
- 3 Years Warranty
- ROHS Compliant
- REACH Compliant

SAFETY

- IEC/UL/cUL/EN 60601-1 Edition 3.2
- CF Rated*

* The NCF Series models are suitable for CF Rated applications as they provide the below features:
1. Clearance and creepage requirements between primary and ground for one MOPP, primary and secondary for two MOPP and secondary and ground for one MOPP.
2. Hi-pot tests between primary and ground, primary and secondary and secondary and ground.
3. Type CF patient leakage current <10 µA under normal condition and <50 µA under single fault condition.

Note: As the NCF series is classified as a component power supply, it cannot be declared an applied part, and therefore cannot be declared CF rated. However, the NCF Series has been evaluated for and meets the requirements related for use in CF applications.

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SECTION 1 MODEL NUMBERS

Model Number	Output Voltage	With Air Flow[1]		Convection		Terminations	
		Output Current	Output Power	Output Current	Output Power	Input	Output
NCF660S12K	12V	46.2A	560W	30.6A	370W	3 pin Molex Type Conn	Screw Terminals
NCF660S15K[2]	15V	37.0A	560W	24.5A	370W		
NCF660S24K	24V	27.2A	660W	18.2A	440W		
NCF660S48K	48V	13.6A	660W	9.1A	440W		

Note 1: 300 LFM airflow is required.
Note 2: Contact Advanced Energy for availability of 15V output models.

Options

None

Family Comparison

Model Number	Output Voltages	Maximum Output Power	Standby Output	Dimension
NCF150 series	12V, 15V, 19V, 24V, 48V	150W	5V @ 0.5A	4” x 2” x 1.26”
NCF250 Series	12V, 15V, 24V, 48V	250W	5V @ 1A	5” x 2.4” x 1.6”
NCF425 Series	12V, 24V, 48V	425W	5V @ 1A	6” x 3.5” x 1.5”
NCF660 Series	12V, 15V, 24V, 48V	660W	5V @ 1A	7” x 4” x 1.6”

SECTION 2 ELECTRICAL SPECIFICATIONS

2.1 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	$V_{IN,AC}$	85	-	264	VAC
Isolation Voltage Input to output Input to ground Output to ground	All Models		- - -	- - -	4000 1500 1500	VAC VAC VAC
Defibrillator Pulse Withstand	All Models				5000	V
Ambient Operating Temperature[1]	All Models	TA	-20	-	+70	°C
Storage Temperature	All Models	T_{STG}	-40	-	+85	°C
Humidity (non-condensing)	All Models		5	-	95	%
Altitude Operating Non-operating	 All Models All Models		 -500 -500	 - -	 5,000 12,192	 m m
Relative Humidity (non-condensing)	All Models		5		95	%

Note 1 - 5 minutes warm-up may be required at low operating temperature.
PSU performance derate above 50°C to 70°C (50% load at 70°C), and from 0°Cto -20°C.

SECTION 2 ELECTRICAL SPECIFICATIONS

2.2 Input Specifications

Table 2. Input Specifications

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC	All	$V_{IN,AC}$	80	115/230	264	VAC
Input AC Frequency	All	$f_{IN,AC}$	47	50/60	63	Hz
Maximum Steady State Input Current ($I_O = I_{O,max}$, $I_{SB} = I_{SB,Max}$)	$V_{IN,AC}$ = 115VAC $V_{IN,AC}$ = 230VAC	$I_{IN,max}$	- -	- -	7 3.5	A A
Standby Input Power (V_O Off, I_{SB} = 0, I_{FAN} = 0)	$V_{IN,AC}$ = 115/230VAC	$I_{IN,no-load}$	-	-	1	W
Startup Surge Current (Inrush)	Cold start	$I_{IN,surge}$	-	-	40	A
Input Fuse	Internal, L and N 250VAC		-	-	10	A
Switching Frequency	All	$f_{SW,PFC}$	30		125	kHz
Operating Efficiency @ 25°C	$I_O = I_{O,max}$ $V_{IN,AC}$ = 115/230VAC	η	90	-	-	%
Hold Up Time (Main Output)	$V_{IN,AC}$ = 100VAC	$t_{Hold-Up}$	16	- -	- -	ms
Hold Up Time ($5V_{SB}$ Output)	$V_{IN,AC}$ = 100VAC	$t_{Hold-Up}$	100	-	-	ms
Turn On Delay (Main Output)	$V_{IN,AC}$ = 115VAC $P_O = P_{O,max}$	$t_{Turn-On}$	-	-	1000	ms
Leakage Current (Type CF) - Typical PSU Performance						
Earth Leakage Current (Input to Earth) NC SFC	$V_{IN,AC}$ = 264VAC $f_{IN,AC}$ = 60Hz	$I_{IN,leakage}$	- -	- -	500 1000	µA µA
Patient Leakage Current (Input to Output) NC SFC	$V_{IN,AC}$ = 264VAC $f_{IN,AC}$ = 60Hz	$I_{IN,leakage}$	- -	- -	9 20	µA µA
Patient Leakage Current (Output to Earth) NC	$V_{IN,AC}$ = 264VAC $f_{IN,AC}$ = 60Hz	$I_{IN,leakage}$	-	-	50	µA
Leakage Current (Type CF) – IEC60601-1 Limits						
Earth Leakage Current (Input to Earth)[1] NC SFC	$V_{IN,AC}$ = 264VAC $f_{IN,AC}$ = 60Hz	$I_{IN,leakage}$	- -	- -	5 10	mA mA
Patient Leakage Current (Input to Output)[2] NC SFC	$V_{IN,AC}$ = 264VAC $f_{IN,AC}$ = 60Hz	$I_{IN,leakage}$	- -	- -	10 50	µA µA
Patient Leakage Current (Output to Earth)[3] NC	$V_{IN,AC}$ = 264VAC $f_{IN,AC}$ = 60Hz	$I_{IN,leakage}$	-	-	50	µA
Harmonic Line Currents	All	THD	Per EN61000-3-2			

Note 1 - Per IEC60601-1, Ed 3.2, Figure 13
Note 2 - Per IEC60601-1, Ed 3.2, Figure 15
Note 3 - Per IEC60601-1, Ed 3.2, Figure 16

SECTION 2 ELECTRICAL SPECIFICATIONS

2.3 Output Specifications

Table 3. Output Specifications

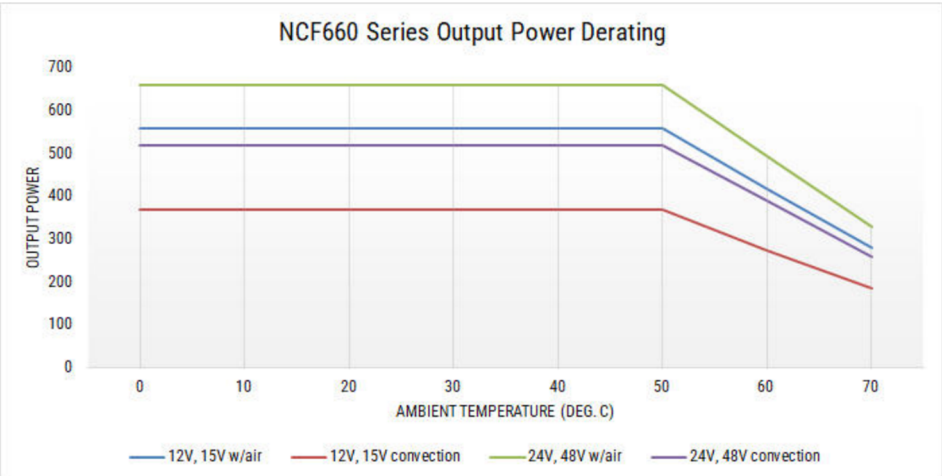
Parameter		Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Tolerance @ 25°C		$V_{IN,AC}$ = 115VAC I_O = 50% of $I_{O,max}$	V_O	-	±1	-	%
Line Regulation		All	V_O	-	±2	-	%
Load Regulation		All	V_O	-	±1	-	%
Total Regulation		Inclusive of set point, line, load temperature change, warm-up drift and cross regulation	V_O	-	±5	-	%
Output Adjust Range		All	V_O	-3	-	+5	%
Output Voltage	NCF660S12K NCF660S15K NCF660S24K NCF660S48K	All	V_O	- - - -	12.0 15.0 24.0 48.0	- - - -	V
	All models		V_{SB}	-	5.0	-	V
	All models		V_{FAN}	-	12.0	-	V
Convection Output Current	NCF660S12K NCF660S15K NCF660S24K NCF660S48K	Convection cooling	I_O	0 0 0 0	- - -	30.6 24.5 18.2 9.1	A
	All models		I_{SB}	0	-	2.0	A
	All models		I_{FAN}	0	-	1.0	A
Convection Output Power	NCF660S12K NCF660S15K NCF660S24K NCF660S48K	Convection cooling	P_O	- - - -	- - - -	370 370 440 440	W
Forced Air Output Current	NCF660S12K NCF660S15K NCF660S24K NCF660S48K	300 LFM forced air cooling	I_O	0 0 0 0	- - - -	46.2 37.0 27.2 13.6	A
	All models		I_{SB}	0	-	2.0	A
	All models		I_{FAN}	0	-	1.0	A
Forced Air Output Power	NCF660S12K NCF660S15K NCF660S24K NCF660S48K	300 LFM forced air cooling	P_O	- - - -	- - - -	560 560 660 660	W

SECTION 2 ELECTRICAL SPECIFICATIONS

Table 3. Output Specifications Con't						
Parameter	**Condition**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Load Capacitance	Startup		-	-	1000	µF
V_O Transient Response Peak Deviation Setting time	50% load change 25% to 100% of $I_{O,max}$ Slew rate = 0.2A/µs	±%V_O $T_{Setting}$	-	-	3.5 500	% µs
V_O Turn On Overshoot	All	±%V_O	-	-	5	%
V_O Turn Off Overshoot	All	±%V_O	-	-	1	%
Output Ripple, pk-pk	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF low ESR capacitor, 20MHz bandwidth	±%V_O	-	-	1	%
V_O Over Voltage Protection	Latch off I_O < 50% $I_{O,max}$	%V_O	115	-	155	%
V_O Over Current Protection	Hiccup mode	%I_O	110	-	160	%
Over Temperature Protection	Latch off	Auto Recovery				
Short Circuit Protection	All	Hiccup Mode				

Note - Unless otherwise noted, all parameters are specified at nominal input (115/230VAC), 25°C ambient operating temperature, no load to full rated output power, and nominal output voltage.

2.4 Power Derating Specifications



SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF660S12K Performance Curves

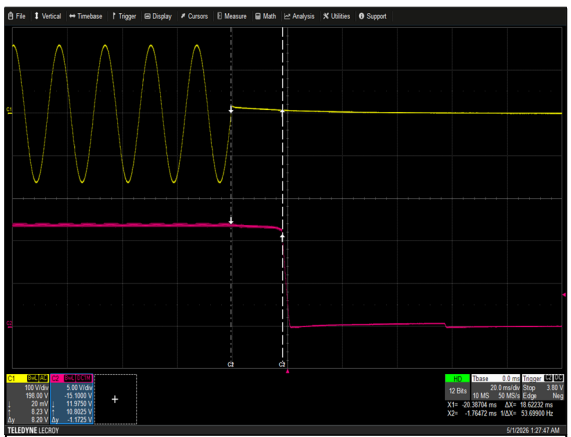


Figure 1: NCF660S12K Turn-on Delay
Vin = 115VAC Load: Io = 46.2A
Ch 1: V_{IN} Ch 2: Vo

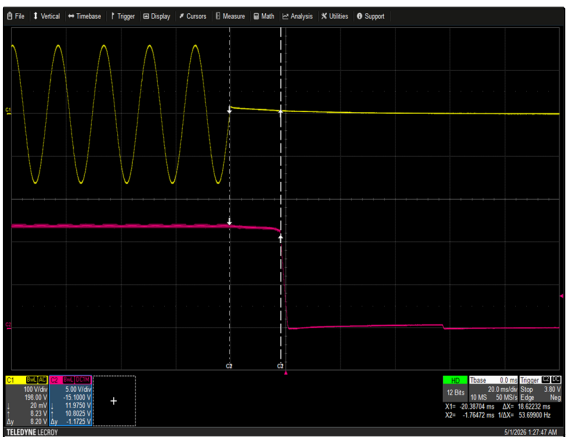


Figure 2: NCF660S12K Hold-up Time
Vin = 115VAC Load: Io = 46.2A
Ch 1: V_{IN} Ch 2: Vo

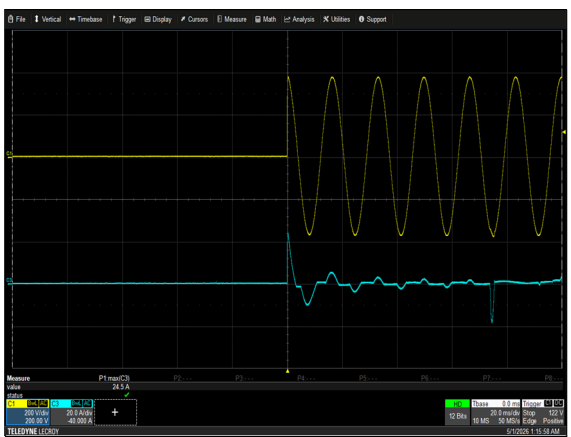


Figure 3: NCF660S12K Inrush Current
Vin = 264VAC Load: Io = 0A, Turn on at 90 deg
Ch 1: V_{IN} Ch 3: I_{IN}

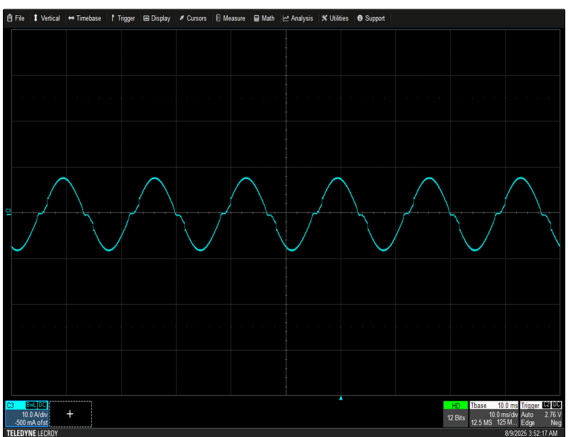


Figure 4: NCF660S12K Input Current Waveform
Vin = 115VAC Load: Io = 46.2A
Ch 3: I_{IN}

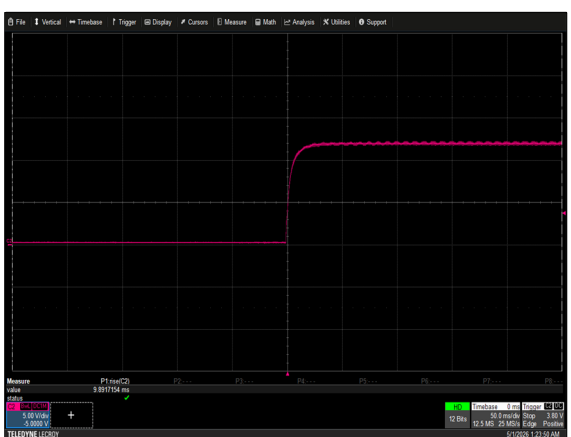


Figure 5: NCF660S12K Output Voltage Startup Characteristic
Vin = 115VAC Load: Io = 46.2A
Ch 2: Vo

Figure 6: NCF660S12K Ripple and Noise Measurement
Vin = 115VAC Load: Io = 46.2A
Ch 2: Vo

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF660S12K Performance Curves

Figure 7: NCF660S12K Transient Response - Vo Deviation
Vin = 115VAC Load: Io = 75% to 25%, 0.2A/µs slew rate
Ch 2: Vo Ch 3: Io

Figure 8: NCF660S12K Transient Response - Vo Deviation
Vin = 115VAC Load: Io = 25% to 75%, 0.2A/µs slew rate
Ch 2: Vo Ch 3: Io

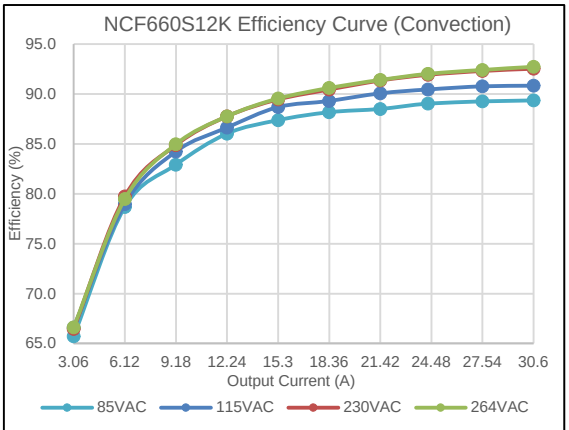


Figure 9: NCF660S12K Efficiency Curve @ 25°C (Convection)
Loading: I_{o_main} = 10%$I_{o,max}$ increment to $I_{o,max}$

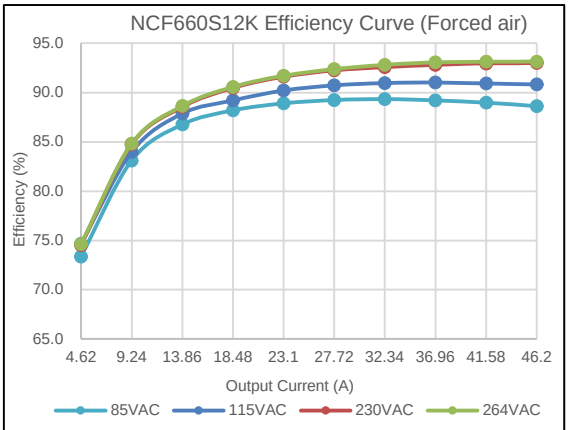


Figure 10: NCF660S12K Efficiency Curve @ 25°C (Forced air)
Loading: I_{o_main} = 10%$I_{o,max}$ increment to $I_{o,max}$

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2.5 NCF660S24K Performance Curves

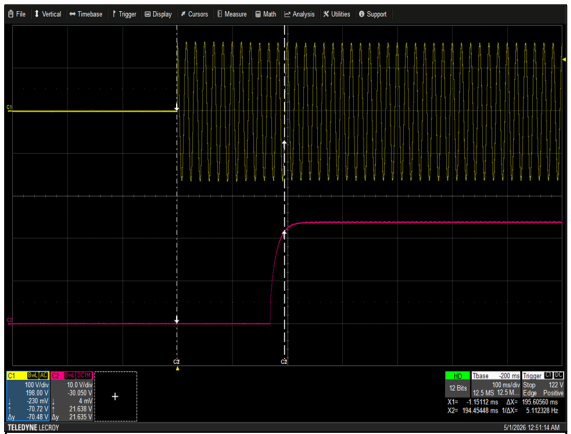

Figure 11: NCF660S24K Turn-on Delay
Vin = 115VAC Load: Io = 27.2A
Ch 1: V_{IN} Ch 2: Vo

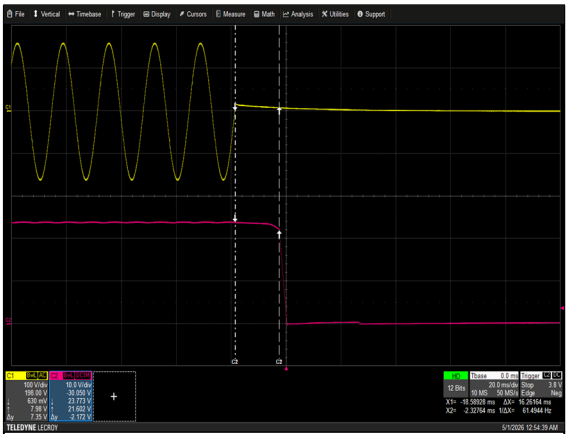

Figure 12: NCF660S24K Hold-up Time
Vin = 115VAC Load: Io = 27.2A
Ch 1: V_{IN} Ch 2: Vo

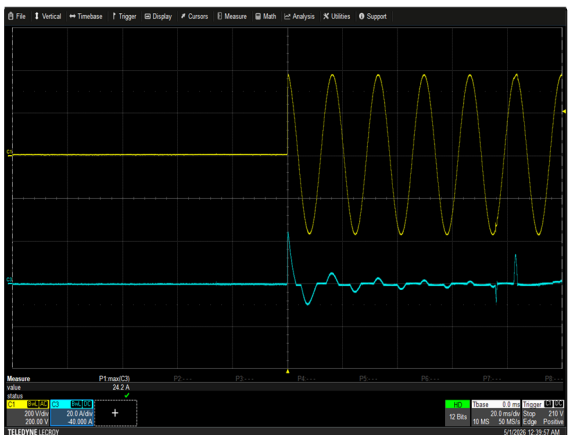

Figure 13: NCF660S24K Inrush Current
Vin = 264VAC Load: Io = 0A, Turn on at 90 deg
Ch 1: V_{IN} Ch 3: I_{IN}

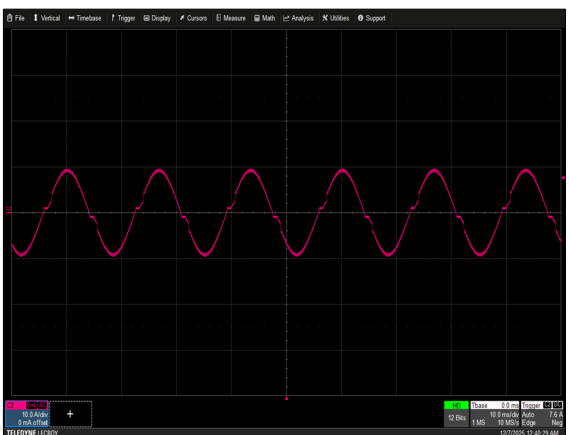

Figure 14: NCF660S24K Input Current Waveform
Vin = 115VAC Load: Io = 27.2A
Ch 2: I_{IN}

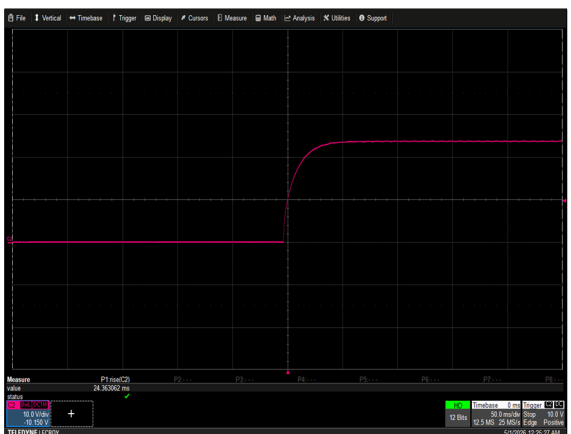

Figure 15: NCF660S24K Output Voltage Startup Characteristic
Vin = 115VAC Load: Io = 27.2A
Ch 2: Vo

Figure 16: NCF660S24K Ripple and Noise Measurement
Vin = 115VAC Load: Io = 27.2A
Ch 2: Vo

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF660S24K Performance Curves

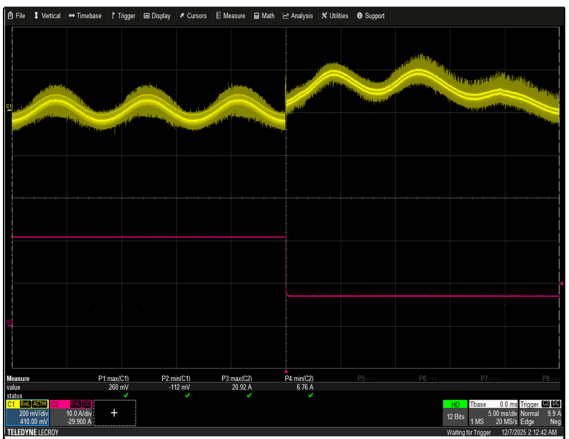

Figure 17: NCF660S24K Transient Response - Vo Deviation
Vin = 115VAC Load: Io = 75% to 25%, 0.2A/µs slew rate
Ch 1: Vo Ch 2: Io

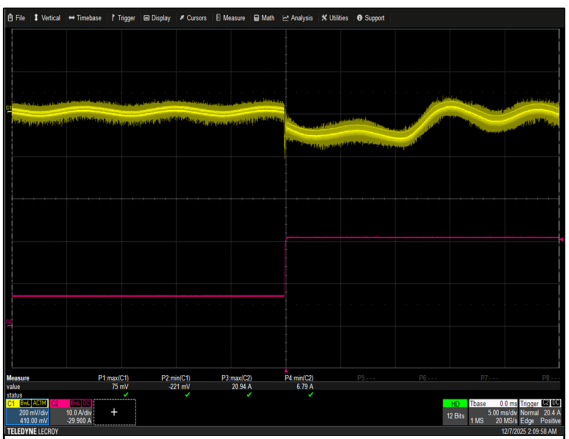

Figure 18: NCF660S24K Transient Response - Vo Deviation
Vin = 115VAC Load: Io = 25% to 75%, 0.2A/µs slew rate
Ch 1: Vo Ch 2: Io

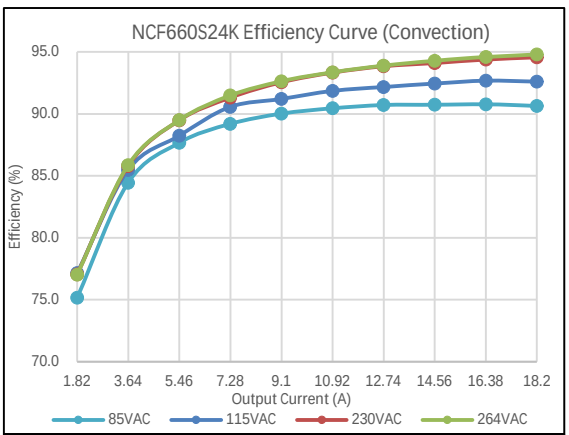

Figure 19: NCF660S24K Efficiency Curve @ 25°C (Convection)
Loading: I_{o_main} = 10%$I_{o,max}$ increment to $I_{o,max}$

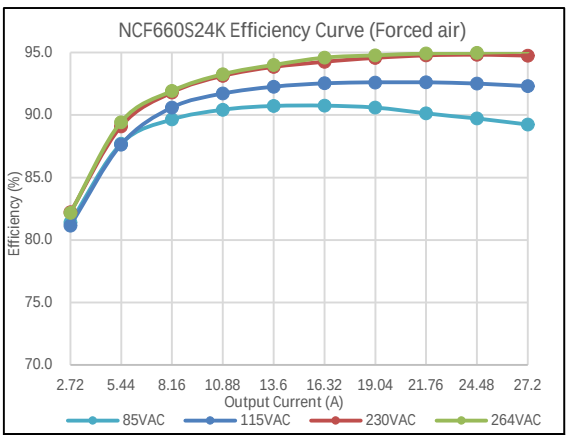

Figure 20: NCF660S24K Efficiency Curve @ 25°C (Forced air)
Loading: I_{o_main} = 10%$I_{o,max}$ increment to $I_{o,max}$

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2.5 NCF660S48K Performance Curves

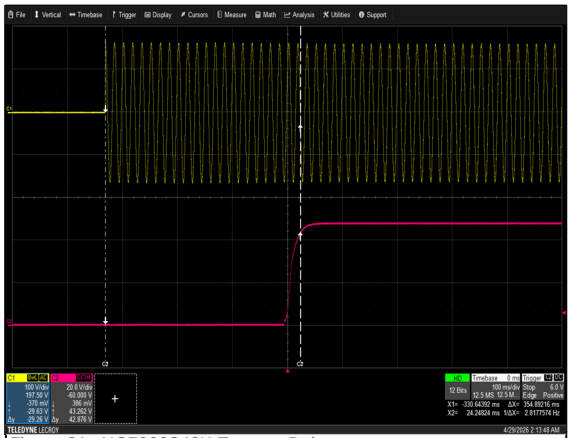


Figure 21: NCF660S48K Turn-on Delay
Vin = 115VAC Load: Io = 13.6A
Ch 1: V_{IN} Ch 2: Vo

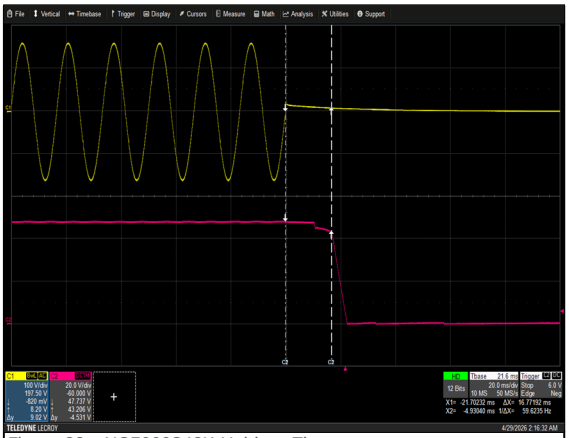


Figure 22: NCF660S48K Hold-up Time
Vin = 115VAC Load: Io = 13.6A
Ch 1: V_{IN} Ch 2: Vo

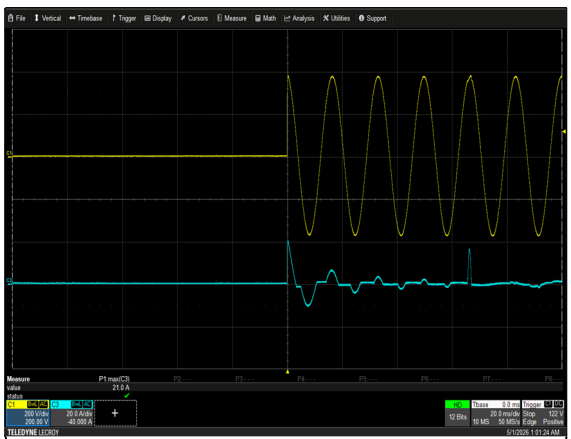


Figure 23: NCF660S48K Inrush Current
Vin = 264VAC Load: Io = 0A, Turn on at 90 deg
Ch 1: V_{IN} Ch 3: I_{IN}

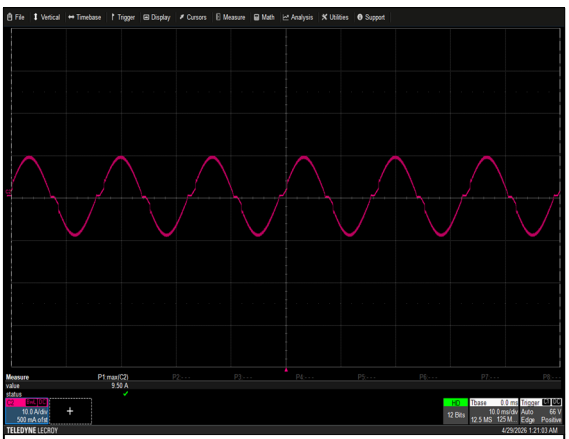


Figure 24: NCF660S48K Input Current Waveform
Vin = 115VAC Load: Io = 13.6A
Ch 2: I_{IN}

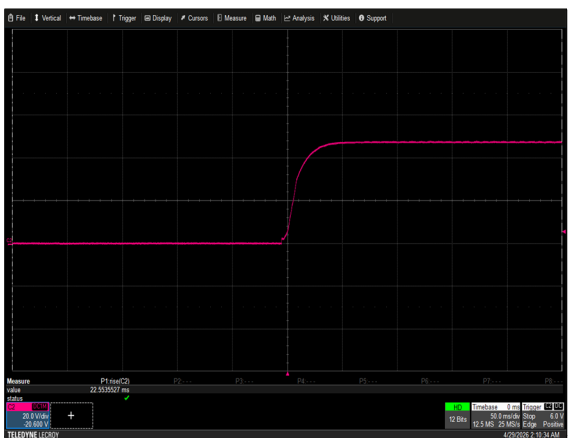


Figure 25: NCF660S48K Output Voltage Startup Characteristic
Vin = 115VAC Load: Io = 13.6A
Ch 2: Vo

Figure 26: NCF660S48K Ripple and Noise Measurement
Vin = 115VAC Load: Io = 13.6A
Ch 2: Vo

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF660S48K Performance Curves

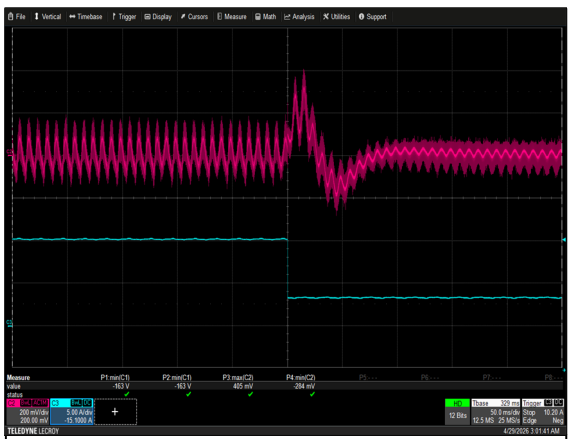


Figure 27: NCF660S48K Transient Response - Vo Deviation
Vin = 115VAC Load: Io = 75% to 25%, 0.2A/µs slew rate
Ch 2: Vo Ch 3: Io

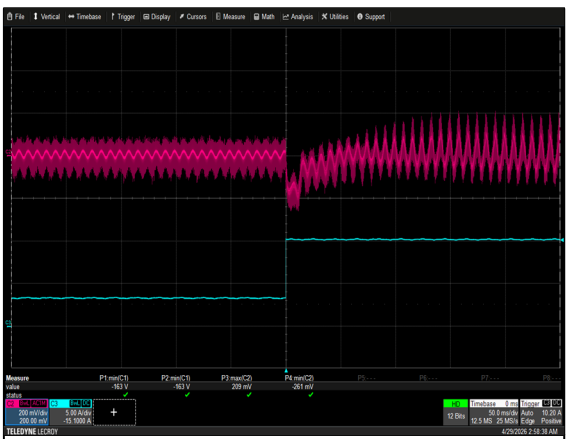


Figure 28: NCF660S48K Transient Response - Vo Deviation
Vin = 115VAC Load: Io = 25% to 75%, 0.2A/µs slew rate
Ch 2: Vo Ch 3: Io

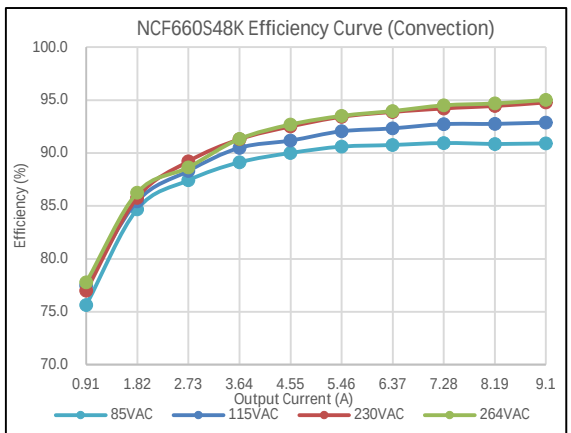


Figure 29: NCF660S48K Efficiency Curve @ 25°C (Convection)
Loading: I_{o_main} = 10%$I_{o,max}$ increment to $I_{o,max}$

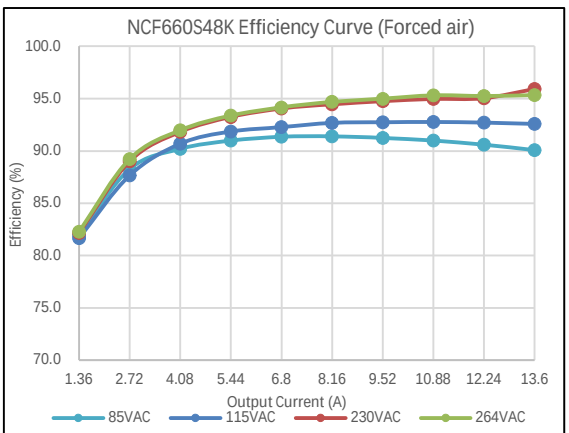


Figure 30: NCF660S48K Efficiency Curve @ 25°C (Forced air)
Loading: I_{o_main} = 10%$I_{o,max}$ increment to $I_{o,max}$

SECTION 2 ELECTRICAL SPECIFICATIONS

2.6 Protection Function Specifications

Input Fuse

The NCF660 series power supply is equipped with an internal non-user-serviceable 10 A, 250 VAC fuse for fault protection on both the line and neutral input lines.

Over Voltage Protection (OVP)

The power supply main output will latch off (less than 50% loading) during output overvoltage with the AC line recycled to reset the latch.

Parameter	Min	Typ	Max	Unit
V_O Output Overvoltage	115	/	155	%V_O

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 defined as impedance less than 50 milliohms.

Over Temperature Protection (OTP)

The power supply will be internally protected against over temperature conditions. When the OTP circuit is activated, the power supply will shut off and require AC recycle to reset once the OTP condition is gone.

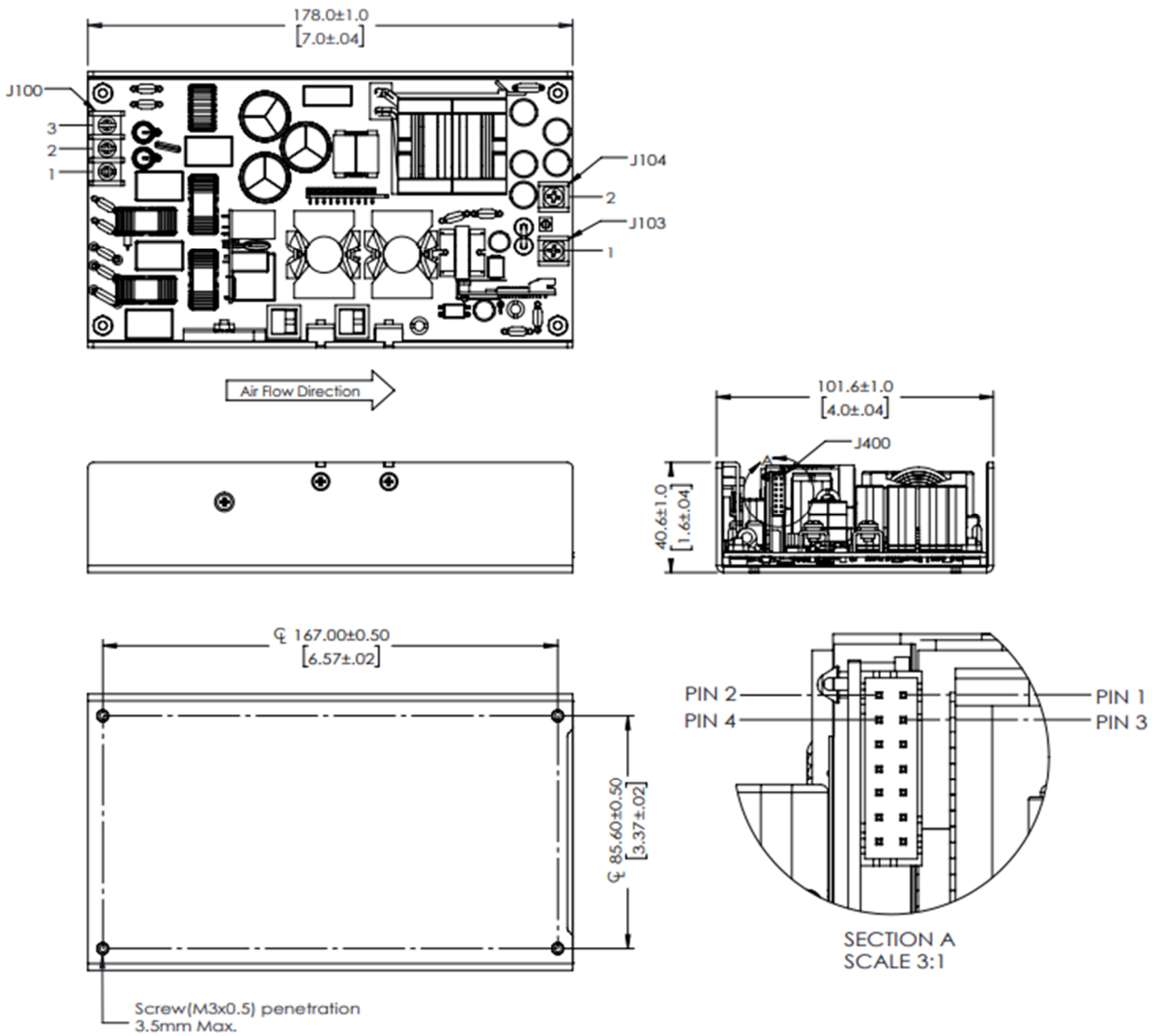
Over Current Protection (OCP)

The NCF660 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 over current protection mode is hiccup mode for the NCF660 series.

Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent (forced air)	110	/	160	%I_O,max

SECTION 3 MECHANICAL SPECIFICATIONS

3.1 Mechanical Outlines (Dimensions and Mounting Locations)



Note 1 - All dimensions in mm (inches).

Note 2 - The NCF660 series weight is 830g.

Note 3 - The NCF660 series dimensions is 4” x 7” x 1.6”.

SECTION 3 MECHANICAL SPECIFICATIONS

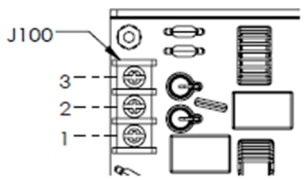
3.2 Connector Definitions

AC Input Connector - J100

Pin 1 - AC Line

Pin 2 - AC Neutral

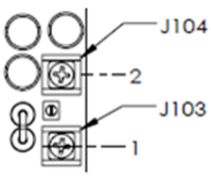
Pin 3 - Ground



Output Connector - J103, J104

J103 - +Vout

J104 - Output Return



Signal Header - J400

Pin 1 - Return

Pin 2 - Spare

Pin 3 - + Remote Sense

Pin 4 - Return

Pin 5 - Spare

Pin 6 - PWR_GOOD

Pin 7 - Spare

Pin 8 - ON_OFF

Pin 9 - Spare

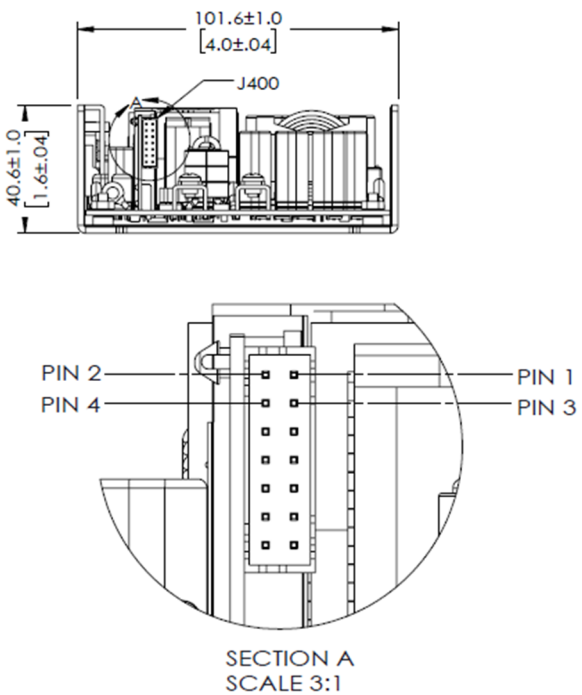
Pin 10 - Spare

Pin 11 - Return

Pin 12 - Spare

Pin 13 - 5VSB

Pin 14 - 5VSB



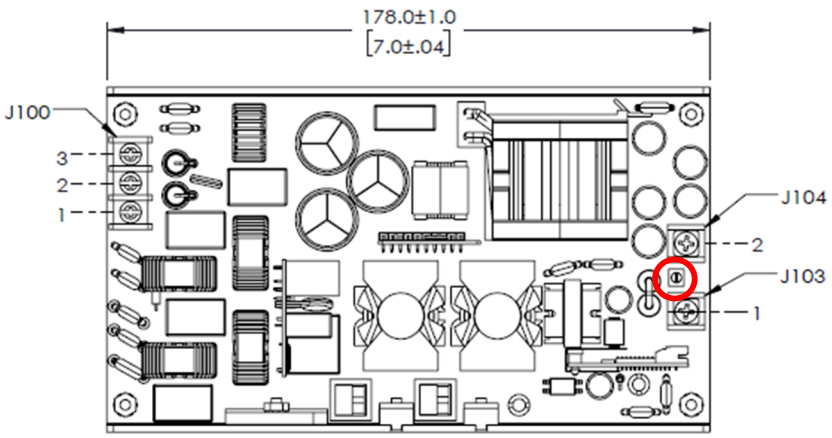
SECTION 3 MECHANICAL SPECIFICATIONS

3.3 Power / Signal Mating Connectors and Pin Types

Table 4. Mating Connectors for NCF660 Series			
Reference	**Vendor**	**Mating Connector or Equivalent**	**Mating Pins or Equivalent**
J100	Molex	19141-0052/0053	/
J103/J104	Molex	19141-0058/0063/0065/0059/0064/0066	/
J400	Landwin	2050S1400 or JST PHDR-14VS	2053T021N

3.4 Potentiometer Definitions

Main output voltage adjustment



SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.1 EMC Immunity

NCF660 series power supply is designed to meet the following EMC immunity specifications.

Table 5. Environmental Specifications

Test Items	Standard	Test Level	Criteria[1]
Conducted Emissions	EN55011/32, CISPR11/32, FCC Part 15.107	Class B, measured at 10%, 50%, and 100% load steps at 120 and 230 VAC	6db margin typ.
Radiated Emissions	EN55011/32, CISPR11/32, FCC Part 15.107	Class A, measured at 10%, 50%, and 100% load steps at 120 and 230 VAC	3db margin typ.
Harmonic Current Emissions	EN61000-3-2	100% load, 230VAC	A
Voltage Fluctuations & Flicker	IEC61000-3-3	-	-
Electro-Static Discharge (ESD) Immunity	EN55024/IEC61000-4-2 IEC60601-1-2, 4th Edition, Table 4	Level 4. +/- 8kV contact, +/- 15kV air	A
Radiated RF EM Fields Susceptibility	EN55022/EN61000-4-3 IEC60601-1-2, 4th Edition, Table 4	10V/m, 80MHz to 2.7GHz, 80% AM at 1kHz	A
Electrical Fast Transients (EFT) / Bursts	EN55024/IEC61000-4-4 IEC60601-1-2, 4th Edition, Table 5	Level 4. +/-4kV, 100kHz rep rate, 40A	A
Surges - Line to Line (DM) and Line to GND (CM)	EN55024/IEC61000-4-5 IEC60601-1-2, 4th Edition	Level 4. +/-2kV DM, +/-4kV CM	A
Conducted Disturbances Induced by RF Fields	EN55022/IEC61000-4-6 IEC60601-1-2, 4th Edition, Table 5	3.6V/m - Level 4, 0.15MHz to 80MHz; 12 V/m in ISM and amateur radio bands between 0.15 MHz and 80 MHz, 80% AM at 1KHz	-
Rated Power Frequency Magnetic Fields	EN55024/IEC1000-4-8 IEC60601-1-2, 4th Edition, Table 4	Level 4. 30A/m, 230VAC, 50/60 Hz	-
Voltage Interruptions, Dips, Sags & Surges[1]	EN55024/IEC/EN61000-4-11: IEC60601-1-2, 4th Edition, Table 5	100% dip for 10ms, at 0, 45, 90, 135, 180, 225, 270 and 315 degrees 100% load 100% dip for 20ms, 0 deg 60% load 100% dip for 20ms, 0 deg 100% dip for 5000ms (250/300 cycles) 60% dip for 100ms 30% dip for 500ms	 B A B B A

Note 1 - Performance criteria are based on EN55024. According to the standards, 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
D - Permanent damage

SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.2 Safety Certifications

The NCF660 series power supply is intended for inclusion in other equipment and the installer must ensure that it is 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 standalone product.

Table 6. Safety Certifications for NCF425 Series Power Supply

Standard	Agency	Description
UL60601-1-1, Ed.3.2 Complies with CF rated application requirements	UL	US Requirements
CAN/CSA-C22.2 No. 60601-1 Complies with CF rated application requirements	CSA	Canada Requirements
CB Certificate and Report Design to meet 5000m and 50^{O}C, 93% RH with 120 h (tropical standard) according to IEC60601-1-1, Ed.3.2 Complies with CF rated application requirements	-	All CENELEC Countries
CE Marking	-	LVD + RoHS

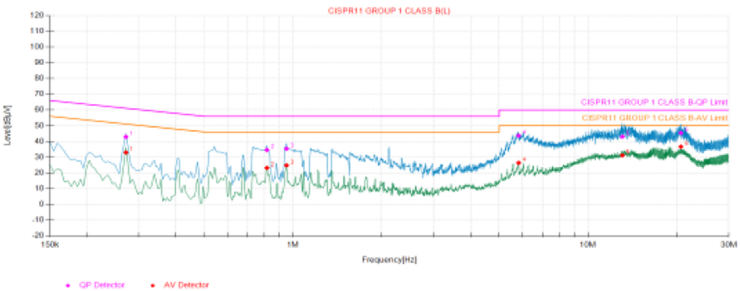
SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.3 EMI Emissions

The NCF660 series has been designed to comply with the Class B limits of EMI requirements of EN55011/32 (FCC Part 15) and CISPR 11/32 (EN55032) for emissions and relevant sections of EN61000 (IEC 61000) for immunity.

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 NCF660 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.

Sample of EN55022 Conducted EMI Measurement at 120VAC input tested at Line.

Conducted EMI emissions specifications of the NCF660 series:

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC Part 15, Class B	All	Margin	-	-	3	dB
CISPR11/15/32 Class B	All	Margin	-	-	3	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 B (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".

SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.4 Operating Temperature

The NCF660 series power supply will start and operate at an ambient temperature from -20°C to 70°C. PSU performance will derate above 50°C to 70°C, and from 0 to -20°C. 5 minutes warm-up may be required at low operating temperature. PSU will derate output power linearly above 50°C to 50% rated output at 70°C.

4.5 Storage and Shipping Temperature

The NCF660 series power supply can be stored or shipped at temperatures between -40°C and +85°C.

4.6 Altitude

The NCF660 series power supply will operate within specifications at altitudes from -500m to 5,000m above sea level. The power supply will not be damaged when stored at altitudes from -500m to 12,192m above sea level.

4.7 Humidity

The NCF660 series power supply will operate within specifications when subjected to a relative humidity from 5% to 95% non-condensing.

4.8 Vibration

Non-Operating Random Vibration (Per IEC 60068-2-64)

Acceleration	1.0 gRMS
Frequency Range	10 to 500 Hz
Direction	3 mutually perpendicular axis
Duration	3 minutes per axis
Sweep Rate	1 octave / min, 10 sweeps / axes

Operating Random Vibration (Per IEC 60068-2-64)

Acceleration	1.5 gRMS, 0.003 g²/Hz
Frequency Range	5 to 500 Hz
Direction	3 mutually perpendicular axis
Duration	10 minutes per axis

Transportation vibration:

Random vibration per MIL-STD-810E, Method 514.4, Cat. 1, Figure 514.4-1, 1 hr in each of three axes.

SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.9 Shock (Per IEC 60068-2-27)

Non-Operating Half-Sine Shock (Per IEC 60068-2-27)

Acceleration	50 g
Duration	6 ms
Pulse	Half-Sine
Number of Shock	3 shocks total

Operating Half-Sine Shock (Per IEC 60068-2-27)

Acceleration	20 g
Duration	10 ms
Pulse	Half-Sine
Number of Shock	6 shocks total

SECTION 5 RELIABILITY SPECIFICATIONS

Table 7. Reliability Specifications	
Parameter	**Specification**
MTBF	>500K hours, at 25°C (Using Telcordia SR-332, Issue 3 at 110V & 220V)
Warranty	3 Years
Temperature Cycling[1]	Power supply withstand 3 complete cycles alternating from -40°C to 80°C holding at 1 hour at each without going out of specification
E-Cap Lifetime	All specified E-Caps exceed 7-year life based on calculations at 25°C thermal environment.
Life Cycle AC Power On / Off Test	>10,000 Cycles for each of the following: 230VAC input with 100% load at 0.5 seconds on, 59.5 seconds off, and at 100VAC input at 10 seconds on, 50 seconds off
IPC 610 Class 2	This product shall be considered a class 3 product

Note 1 - Part of design verification tests.

SECTION 6 POWER AND CONTROL SIGNAL DESCRIPTIONS

6.1 AC Input (J100)

This connector supplies the AC Mains to the NCF660 series power supply.

Pin 1 - AC Line

Pin 2 - AC Neutral

Pin 3 - GND - Earth Ground (Safety Ground)

6.2 Main Output (J103, J104)

These terminals provide the main output for the NCF660. The +Vo and the Output Return terminals are the positive and negative rails, respectively of the main output of the NCF660 series power supply.

J103 - +Vo

J104 - Output return

6.3 Signal Connector (J400)

The NCF660 series contains a 14-pin signal header providing analog control interface and standby power.

Main Output Remote Sense - (Pin 3)

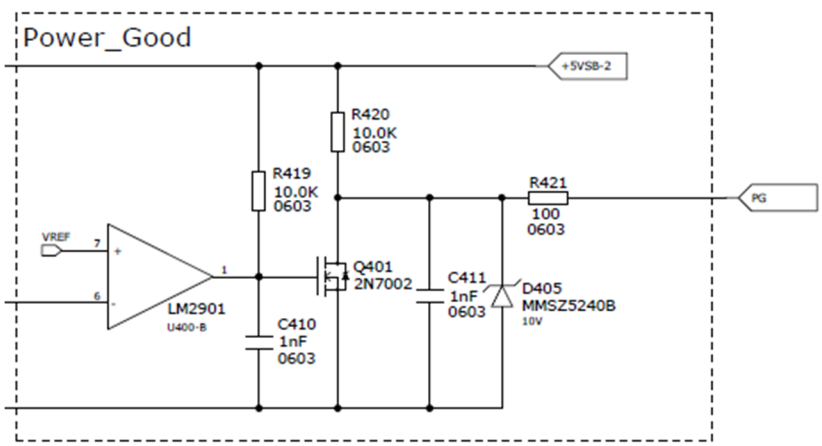
The main output of the NCF660 is equipped with a remote sensing capability that will compensate for a power path drop. This feature is implemented by connecting the main output remote sense (pin 3) to the positive rail of the main output at a location that is near the load. Care should be taken in the 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 NCF660 will operate appropriately without the sense line connected; however, it is recommended that the sense line be connected directly to the main output terminals if remote sensing is not required. This remote sense circuit will not raise the power supply's output voltage to the OVP trip level.

The main output remote sense does not affect the standby output (V_{SB}).

PWR_GOOD signal - (Pin 6)

PWR_GOOD signal will be high once the DC output rises to within the regulation (on turn-on), and go low if the DC output falls below the regulation range.

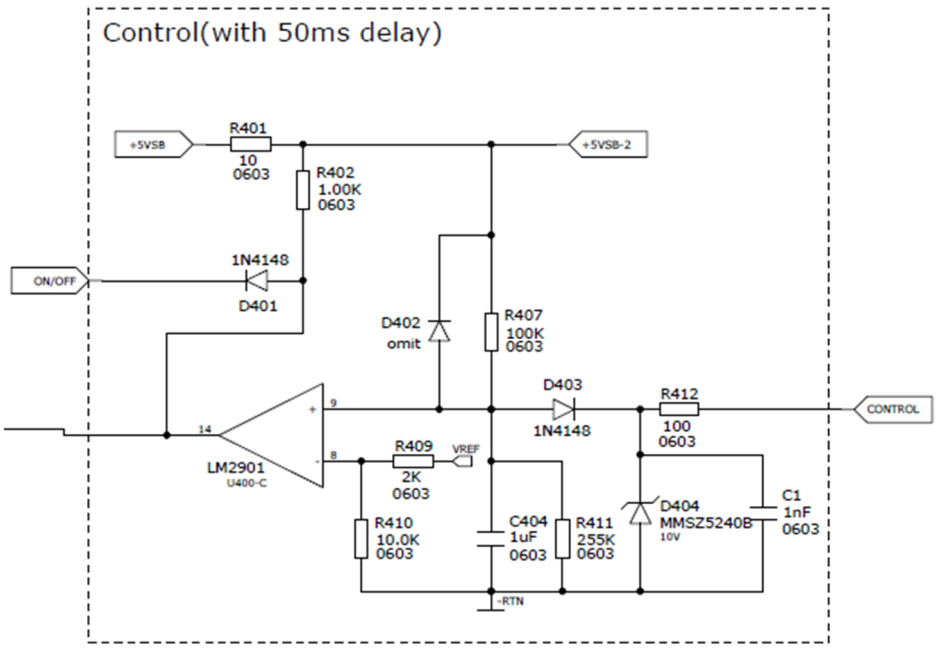
The PWR_GOOD is an output signal driven high by the power supply to indicate that all outputs are valid. If any of the power supply outputs fail below its regulation limits, this output will be driven low. The output signal is an open-drain output internally pulled up by the power supply to the internal standby supply.



SECTION 6 POWER AND CONTROL SIGNAL DESCRIPTIONS

ON_OFF Signal - (Pin 8)

This signal input pin controls the normal turning on and off of the main output of the NCF660 power supply. The power supply main output (V_O) will be enabled when this signal is pulled high or left open. The power supply output (except V_{SB} output) will be disabled when this input is pulled low.



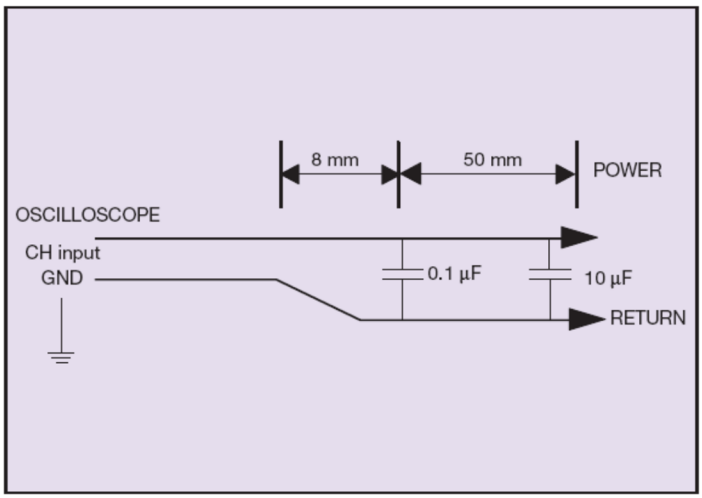
Standby Output, Standby Output Return - (Pins 13, 14)

The NCF660 provides a regulated 5V/1A standby output voltage to power critical circuitry that must remain active regardless of the on/off status of the power supply's main output. The standby output voltage is available whenever a valid AC input voltage is applied to the unit.

SECTION 7 APPLICATION NOTES

7.1 Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the NCF660 series. When measuring output ripple and noise, a scope jack in parallel with a 0.1µF ceramic chip capacitor and a 10µF tantalum capacitor will be used. Oscilloscope can be set to 20MHz bandwidth for this measurement.



RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	07.07.2026	First issue	Anna. Anayeti

Note - If you have any feedback for this document, feel free to contact kathy.wang@aei.com.

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