SL POWER NCF250 SERIES

250 W Single Output Medical Grade - CF Rated*

Medical

PRODUCT DESCRIPTION

Advanced Energy's SL Power NCF250 series are 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 and also offer a 5 kV defibrillator withstand. NCF250 series power supplies provide up to 250 W of output power with air flow and a universal input voltage of 85 to 264 VAC. All models have output overvoltage, short circuit and overload protection and a 2.4 x 5.0 x 1.6 inch form factor.

AT A GLANCE

Total Power

250 W

Input Voltage

85 to 264 VAC

# of Outputs

Single

SPECIAL FEATURES

- 5 kV Defibrillator Withstand
- Up to 250 W with Air Flow
- Up to 175 W Convection Cooled
- 2.4"W x 5.0"L x 1.6"H Size
- Universal Input 85 to 264 VAC
- Meets Class B Emissions Levels
- 7+ Years Electrolytic Capacitor Life
- Meets IEC60601-1-2 4th Edition EMC
- Less than 10 µA Leakage Current
- Class I Input
- RoHS Compliant
- REACH Compliant
- 3 Years Warranty

SAFETY

- IEC/UL/cUL/EN60601-1, 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	Output Current (w/air)[1]	Output Power (w/air)[1]	Output Current (Convection)	Output Power (Convection)	Regulation	Ripple and Noise (pk-pk)
NCF250S12K	12V	19.1A	230W	12.1A	145W	±2%	120mV
NCF250S15K[2]	15V	15.3A	230W	10.3A	155W	±2%	150mV
NCF250S24K	24V	10.4A	250W	7.3A	175W	±2%	240mV
NCF250S48K	48V	5.2A	250W	3.6A	175W	±2%	480mV

Note 1 - 400LFM airflow 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
Maximum Output Power (convection)	NCF250S12K NCF250S15K NCF250S24K NCF250S48K	$P_{O,maxCC}$	- - - -	- - - -	145 155 175 175	W
Maximum Output Power (forced air - 400LFM)	NCF250S12K NCF250S15K NCF250S24K NCF250S48K	$P_{O,maxFA}$	- - - -	- - - -	230 230 250 250	W
No Load Input Power (V_O = OFF, I_{SB} = 0)	All	$P_{IN,\ no\text{-}load}$	-	-	7	W
Isolation Voltage Input to output (2 x MOPP) Input to ground (1 x MOPP) Output to ground (1 x MOPP)	 All Models All Models All Models		 - - -	 - - -	 4000 1500 1500	 VAC VAC VAC
Defibrillator Pulse Withstand	All Models				5000	V
Ambient Operating Temperature	All Models	T_A	-20	-	+70[1]	°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

Note 1 - Derate output power linearly from 50°C to 70°C, 50% load at 70°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	$V_{IN,AC}$	85	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	$I_{IN,max}$	-	-	2.6 1.3	A A
Startup Surge Current (Inrush)	$V_{IN,AC}$ = 264VAC Cold start	$I_{IN,surge}$	-	-	75	A_{PK}
Operating Efficiency @ 25°C	$I_O = I_{O,max}$ $V_{IN,AC}$ = 230VAC	η	90	-	-	%
Input Fuse	Internal, L and N 250VAC		-	-	6.3	A
PFC Switching Frequency	All	$f_{SW,PFC}$	30		125	kHz
Hold Up Time (Main Output)	$V_{IN,AC}$ = 100VAC P_O = 212W (85% $I_{O,max}$) P_O = 170W	$t_{Hold-Up}$	16 20	- -	- -	ms
Hold Up Time ($5V_{SB}$ Output)	$V_{IN,AC}$ = 100VAC	$t_{Hold-Up}$	30	-	-	ms
Turn On Delay (Main Output)	$V_{IN,AC}$ = 115VAC $P_O = P_{O,max}$	$t_{Turn-On}$	-	-	1000	ms
Turn On Delay ($5V_{SB}$ Output)	$V_{IN,AC}$ = 115VAC	$t_{Turn-On}$	-	-	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
Line Regulation		All	$\pm\%V_O$	-	-	1	%
Load Regulation		Main Output Standby Output	$\pm\%V_O$ $\pm\%V_{SB}$	- -	- -	2 3	% %
Total Regulation		All	$\pm\%V_O$	-	-	5	%
Initial Set Point Tolerance		All	$\pm\%V_O$	-	-	1	%
Capacitive Load		All	I_O	-	-	1000	uF
Output Adjust Range		All	$\pm\%V_O$	-	-	5	%
Output Voltage	NCF250S12K NCF250S15K NCF250S24K NCF250S48K	All	V_O	- - - -	12 15 24 48	- - - -	V
	All models		V_{SB}	-	5	-	V
Convection Output Current	NCF250S12K NCF250S15K NCF250S24K NCF250S48K	Convection cooling	I_O	0 0 0 0	- - - -	12.1 10.3 7.3 3.6	A
	All models		I_{SB}	0	-	1	A
Convection Output Power	NCF250S12K NCF250S15K NCF250S24K NCF250S48K	Convection cooling	P_O	- - - -	- - - -	145 155 175 175	W
Forced Air Output Current	NCF250S12K NCF250S15K NCF250S24K NCF250S48K	400 LFM forced air cooling	I_O	0 0 0 0	- - - -	19.1 15.3 10.4 5.2	A
	All models		I_{SB}	0	-	1	A
Forced Air Output Power	NCF250S12K NCF250S15K NCF250S24K NCF250S48K	400 LFM forced air cooling	P_O	- - - -	- - - -	230 230 250 250	W
Minimum Load		All	P_O	-	-	0	W
Output Ripple and Noise, pk-pk	All models	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF low ESR capacitor, 20MHz bandwidth	$\pm\%V_O$ $\pm\%V_{SB}$	- -	- -	1 75	% mVp-p

SECTION 2 ELECTRICAL SPECIFICATIONS

2.3 Output Specifications

Table 3. Output Specifications						
Parameter	**Condition**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
V_O Transient Response Peak Deviation Setting time	50% load change from 25% to 100% of $I_{O,max}$ $\Delta i/\Delta t$<0.2 A/µs	$\pm\%V_O$ $T_{Setting}$	- -	- -	3.5 500	% µs
V_O Turn On Overshoot	All	$\pm\%V_O$	-	-	5	%
V_O Turn Off Overshoot	All	$\pm\%V_O$	-	-	1	%
V_O Over Voltage Protection[1]	Latch off	$\%V_O$	110	-	140	%
V_O Over Current Protection	Hiccup Mode, Auto Recovery	$\%I_O$	110	-	180	%
Over Temperature Protection	All		Auto Recovery			
Short Circuit Protection	All		Hiccup Mode, Auto Recovery			

Note 1 - Due to the voltage limit of the output capacitor, the maximum output voltage of 12V model is 16Vdc, the maximum output voltage of 48V model is 63Vdc.

2.4 Derating Specifications

Ambient Temperature	12V Model		24V, 48V Model	
	90 to 264 VAC	85 VAC	90 to 264 VAC	85 VAC
50°C-Convection	145 W + 5 W (5V/1A)	137.7 W + 5W (5V/1A)	175 W + 5W (5V/1A)	166.3 W + 5W (5V/1A)
50°C-w/Airflow	230 W + 5 W (5V/1A)	218.5 W + 5W (5V/1A)	250 W + 5 W (5V/1A)	237.6 W + 5 W (5V/1A)
60°C-Convection	108.7 W + 5 W (5V/1A)	103.2 W + 5W (5V/1A)	131.2 W + 5 W (5V/1A)	124.6 W + 5 W (5V/1A)
60°C-w/Airflow	139.1 W + 5 W (5V/1A)	132.1 W + 5 W (5V/1A)	187.6 W + 5 W (5V/1A)	178.2 W + 5 W (5V/1A)
70°C-Convection	72.5 W + 2.5 W (5V/0.5A)	68.8 W + 2.5 W (5V/0.5A)	87.6 W + 2.5 W (5V/0.5A)	83.2 W + 2.5 W (5V/0.5A)
70°C-w/Airflow	115 W + 5 W (5V/1A)	109.2 W + 5 W (5V/1A)	125 W + 5 W (5V/1A)	118.7 W + 5 W (5V/1A)

Note - Contact Advanced Energy for availability of 15V output models.

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF250S12K Performance Curves

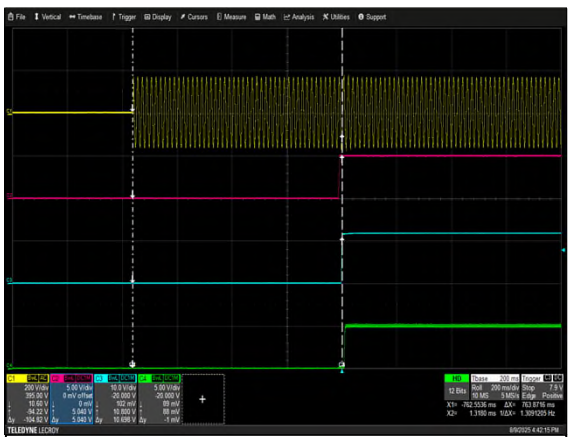


Figure 1: NCF250S12K Turn-On Delay via AC Mains
Vin = 115VAC Load: I_O = 19.1A I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_{SB} Ch 3: V_O Ch 4: DC_OK

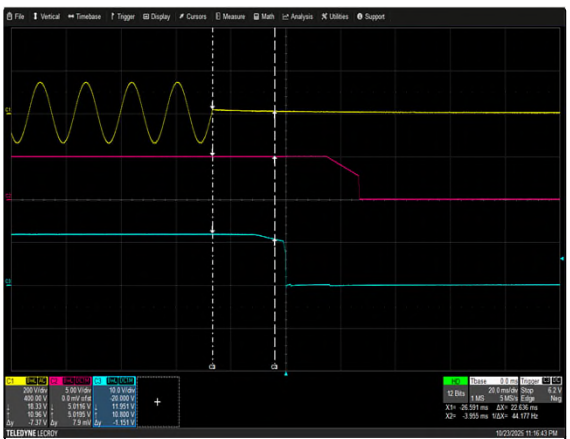


Figure 2: NCF250S12K Hold-Up Time
Vin = 100VAC Load: I_O = 16.3A (85% load) I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_{SB} Ch 3: V_O

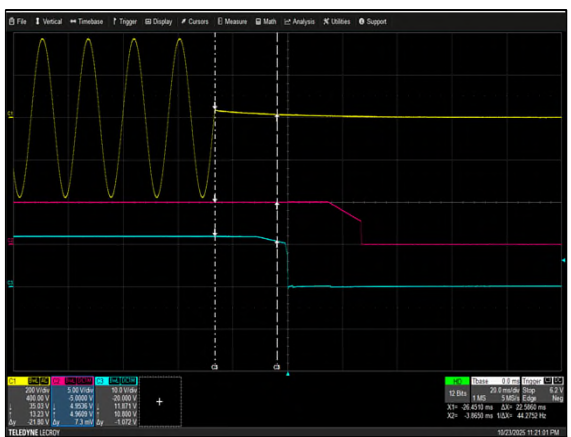


Figure 3: NCF250S12K Hold-Up Time
Vin = 264VAC Load: I_O = 16.3A (85% load) I_{SB} = 1A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O

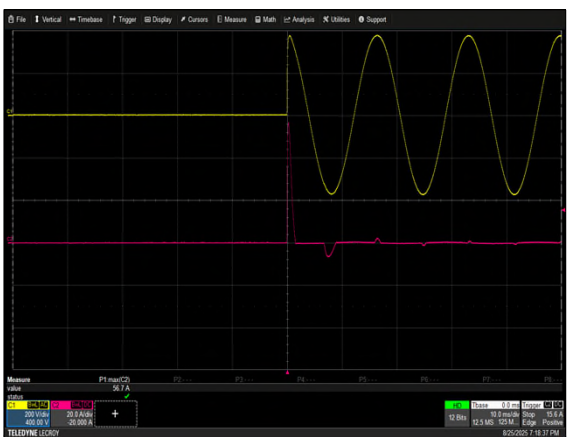


Figure 4: NCF250S12K Inrush Current
Vin = 264VAC Load: Io = 0A, Turn on at 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

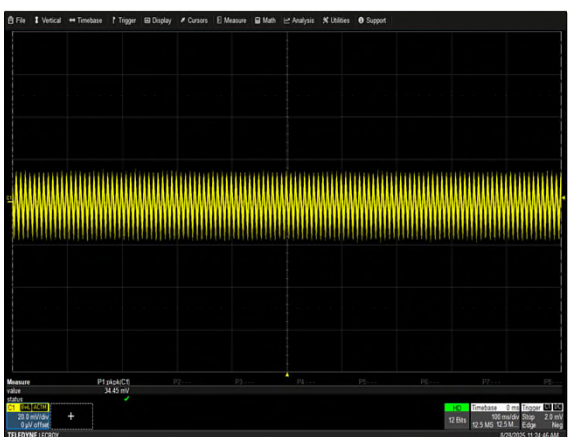


Figure 5: NCF250S12K Ripple and Noise Measurement
Vin = 230VAC Load: Io = 19.1A I_{SB} = 1A
Ch 1: V_O

Figure 6: NCF250S12K Output Voltage Startup Characteristic
Vin = 90VAC Load: Io = 19.1A I_{SB} = 1A
Ch 3: V_O Ch4: DC_OK

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF250S12K Performance Curves

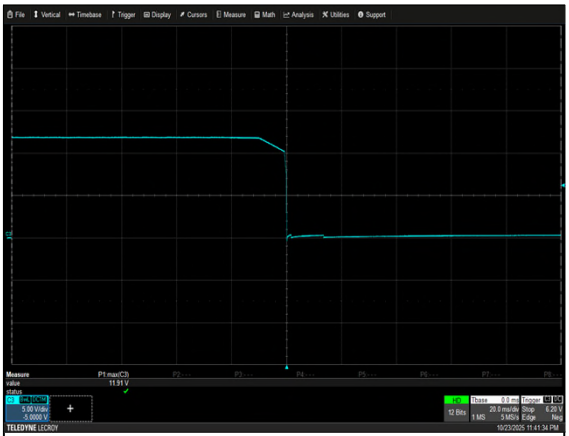


Figure 7: NCF250S12K Turn Off Characteristic
Vin = 90VAC Load: Io = 19.1A I_{SB} = 1A
Ch 3: V_O

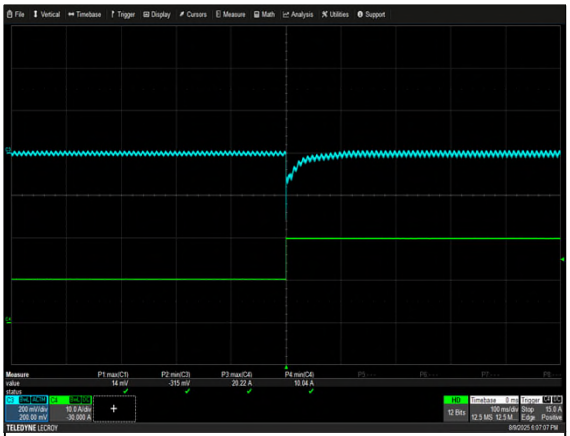


Figure 8: NCF250S12K Transient Response - V_O Deviation
50% to 100% load change 0.2A/µS slew rate, Vin = 230VAC
Ch 3: V_O Ch4: I_O

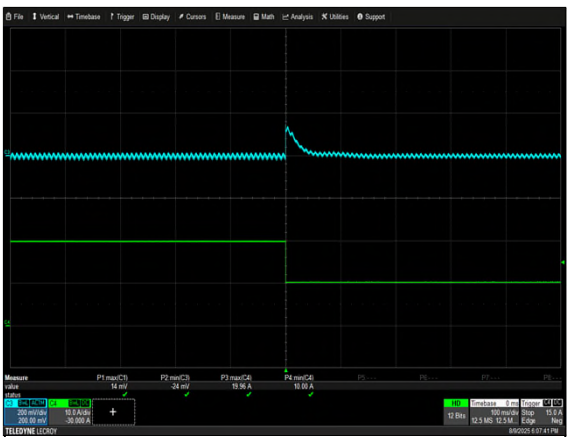


Figure 9: NCF250S12K Transient Response - V_O Deviation
100% to 50% load change 0.2A/µS slew rate, Vin = 230VAC
Ch 3: V_O Ch 4: I_O

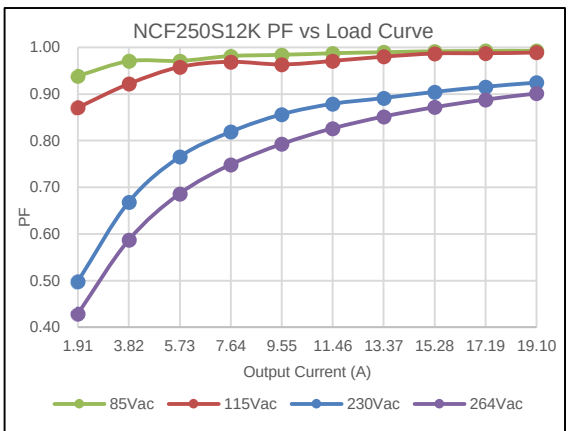


Figure 10: NCF250S12K PF vs Load Curve

Loading: I_{o_main} = 10% $I_{o,max}$ to $I_{o,max}$

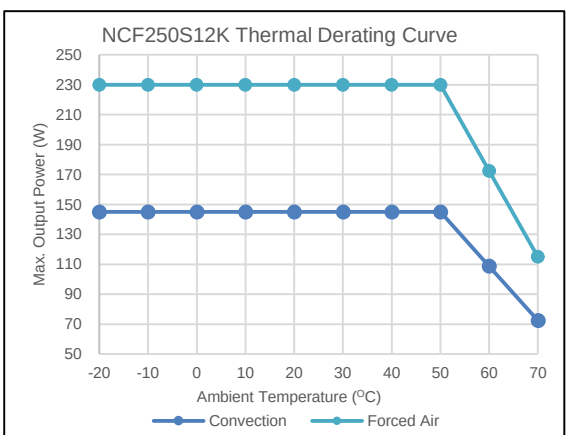


Figure 11: NCF250S12K Thermal Derating Curves

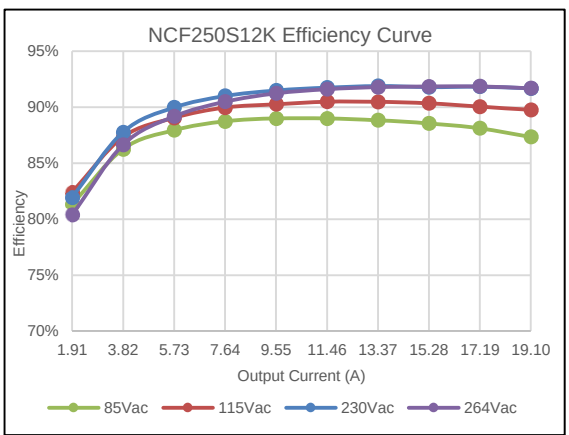


Figure 12: NCF250S12K Efficiency Curve @ 25°C

Loading: I_{o_main} = 10% $I_{o,max}$ to $I_{o,max}$

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF250S24K Performance Curves

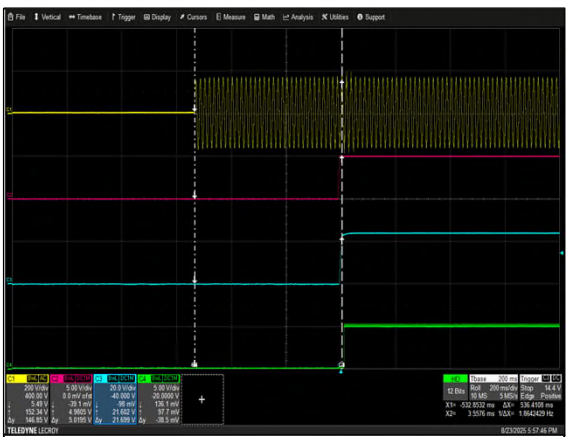


Figure 13: NCF250S24K Turn-On Delay via AC Mains
Vin = 115VAC Load: I_O = 10.4A I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_{SB} Ch 3: V_O Ch 4: DC_OK

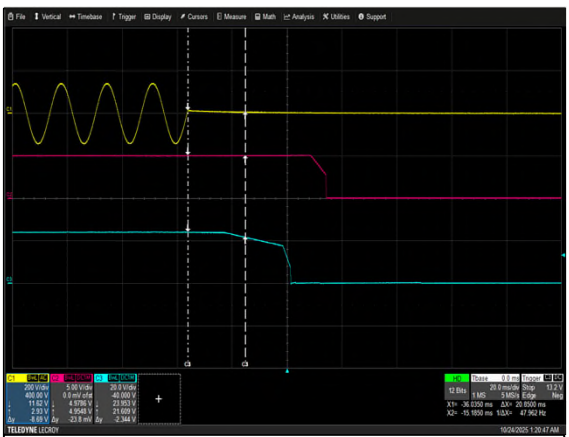


Figure 14: NCF250S24K Hold-Up Time
Vin = 100VAC Load: I_O = 8.84A (85% load) I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_{SB} Ch 3: V_O

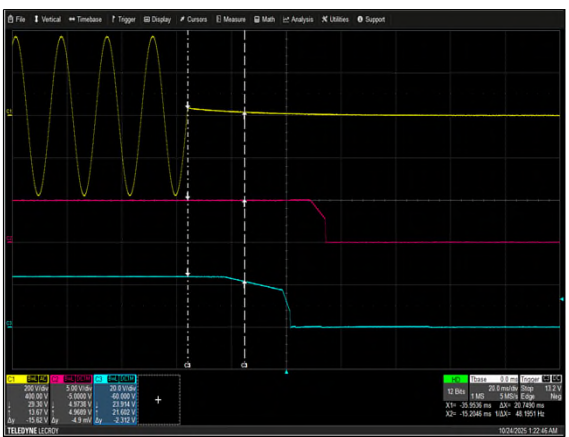


Figure 15: NCF250S24K Hold-Up Time
Vin = 264VAC Load: I_O = 8.84A (85% load) I_{SB} = 1A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O

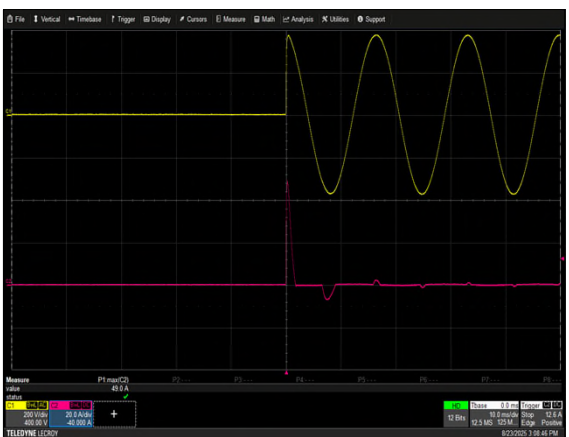


Figure 16: NCF250S24K Inrush Current
Vin = 264VAC Load: Io = 0A, Turn on at 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

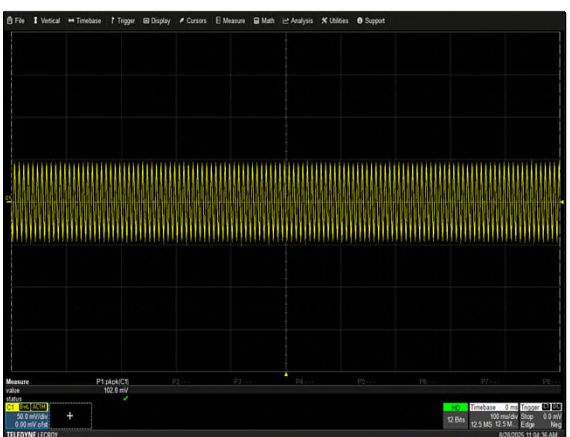


Figure 17: NCF250S24K Ripple and Noise Measurement
Vin = 230VAC Load: Io = 10.4A I_{SB} = 1A
Ch 1: V_O

Figure 18: NCF250S24K Output Voltage Startup Characteristic
Vin = 90VAC Load: Io = 10.4A I_{SB} = 1A
Ch 3: V_O Ch4: DC_OK

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF250S24K Performance Curves

Figure 19: NCF250S24K Turn Off Characteristic
Vin = 90VAC Load: Io = 10.4A I_{SB} = 1A
Ch 3: V_O

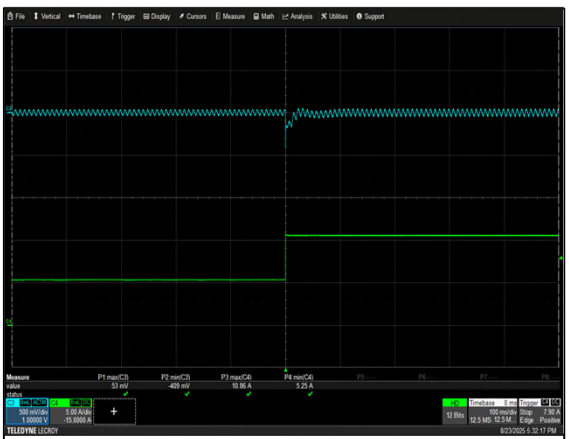


Figure 20: NCF250S24K Transient Response - V_O Deviation
50% to 100% load change 0.2A/µS slew rate, Vin = 230VAC
Ch 3: V_O Ch4: I_O

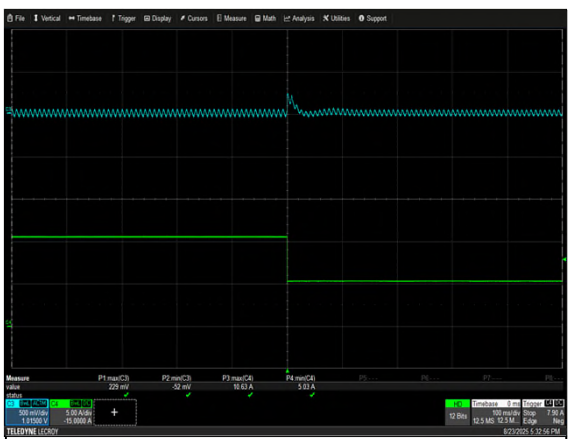


Figure 21: NCF250S24K Transient Response - V_O Deviation
100% to 50% load change 0.2A/µS slew rate, Vin = 230VAC
Ch 1: V_O Ch 2: I_O

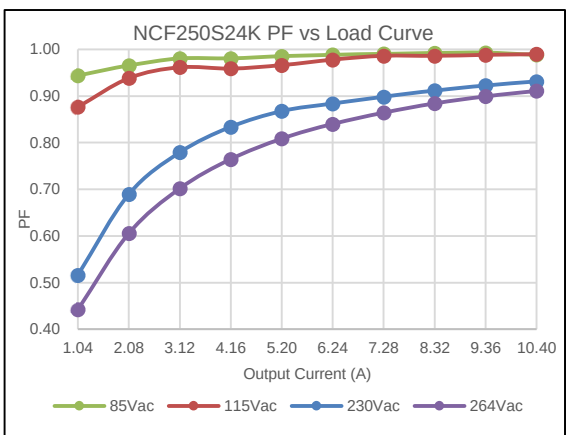


Figure 22: NCF250S24K PF vs Load Curve

Loading: I_{o_main} = 10% $I_{o,max}$ to $I_{o,max}$

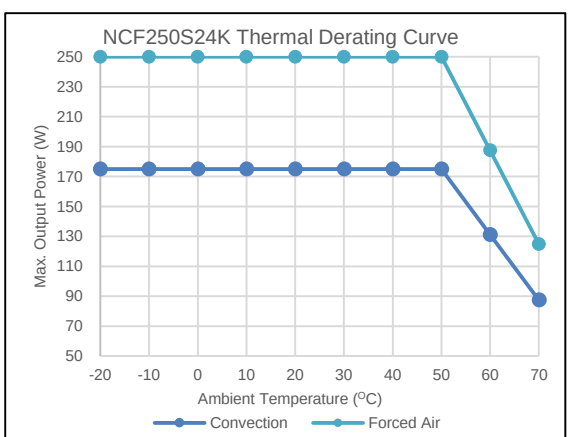


Figure 23: NCF250S24K Thermal Derating Curves

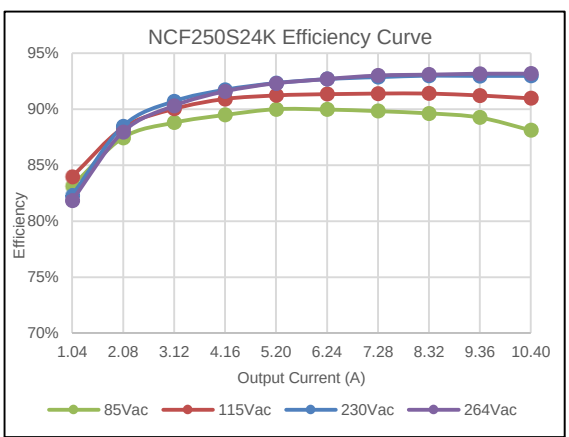


Figure 24: NCF250S24K Efficiency Curve @ 25°C

Loading: I_{o_main} = 10% $I_{o,max}$ to $I_{o,max}$

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF250S48K Performance Curves

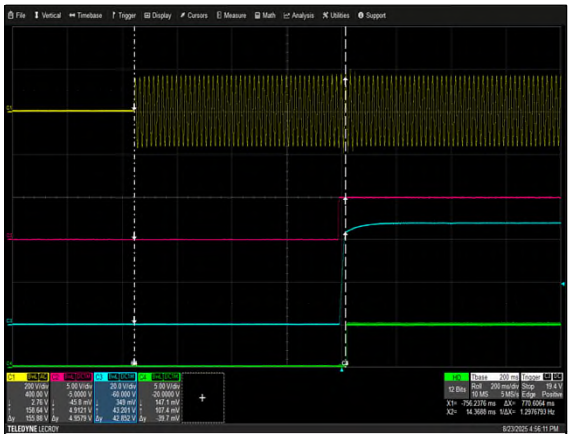


Figure 25: NCF250S48K Turn-On Delay via AC Mains
Vin = 115VAC Load: I_O = 5.2A I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_{SB} Ch 3: V_O Ch 4: DC_OK

Figure 26: NCF250S48K Hold-Up Time
Vin = 100VAC Load: I_O = 4.42A (85% load) I_{SB} = 1A
Ch 1: V_{IN} Ch 2: V_{SB} Ch 3: V_O

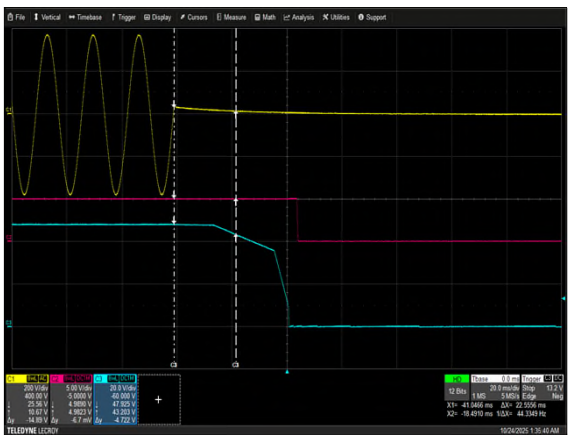


Figure 27: NCF250S48K Hold-Up Time
Vin = 264VAC Load: I_O = 4.42A (85% load) I_{SB} = 1A
Ch 1: AC Mains Ch 2: V_{SB} Ch 3: V_O

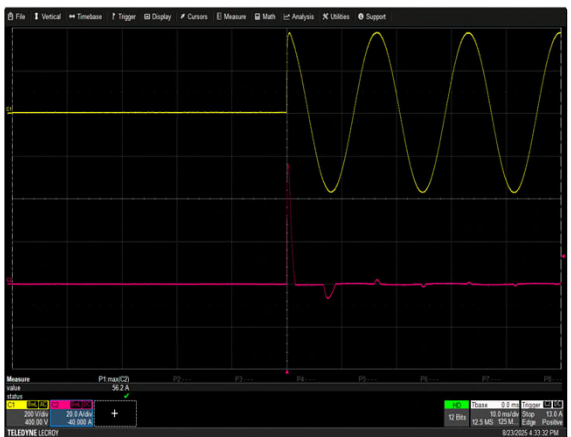


Figure 28: NCF250S48K Inrush Current
Vin = 264VAC Load: Io = 0A, Turn on at 90 deg
Ch 1: V_{IN} Ch 2: I_{IN}

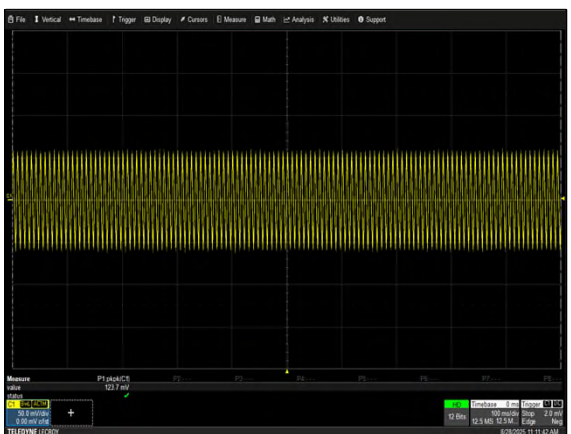


Figure 29: NCF250S48K Ripple and Noise Measurement
Vin = 230VAC Load: Io = 5.2A I_{SB} = 1A
Ch 1: V_O

Figure 30: NCF250S48K Output Voltage Startup Characteristic
Vin = 90VAC Load: Io = 5.2A I_{SB} = 1A
Ch 3: V_O Ch4: DC_OK

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 NCF250S48K Performance Curves

Figure 31: NCF250S48K Turn Off Characteristic
Vin = 90VAC Load: Io = 5.2A I_{SB} = 1A
Ch 3: V_O

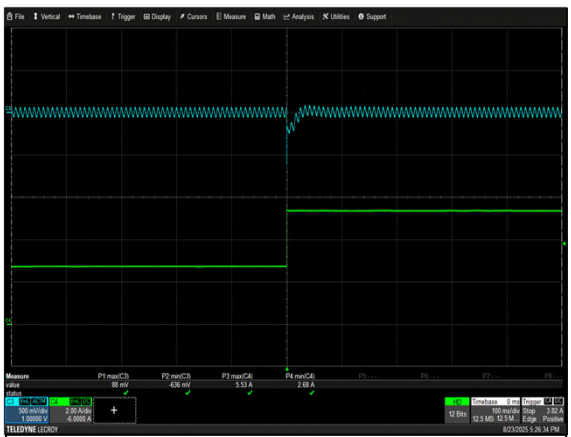


Figure 32: NCF250S48K Transient Response - V_O Deviation
50% to 100% load change 0.2A/µS slew rate, Vin = 230VAC
Ch 3: V_O Ch4: I_O

Figure 33: NCF250S48K Transient Response - V_O Deviation
100% to 50% load change 0.2A/µS slew rate, Vin = 230VAC
Ch 1: V_O Ch 2: I_O

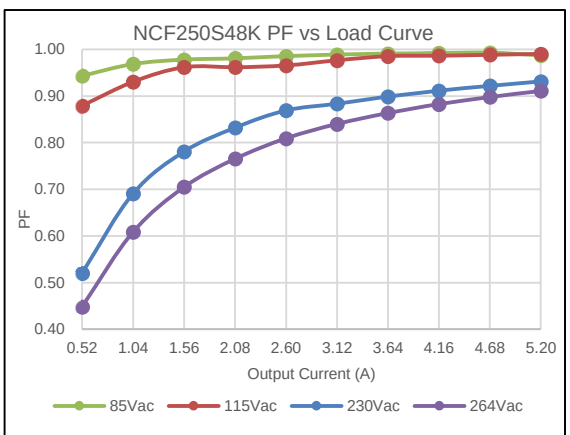


Figure 34: NCF250S48K PF vs Load Curve

Loading: I_{o_main} = 10% $I_{o,max}$ to $I_{o,max}$

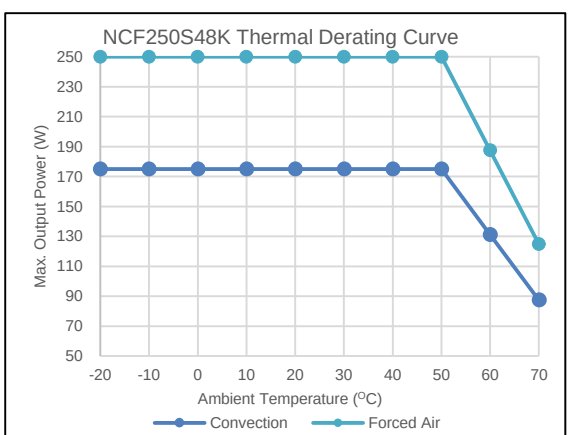


Figure 35: NCF250S12K Thermal Derating Curves

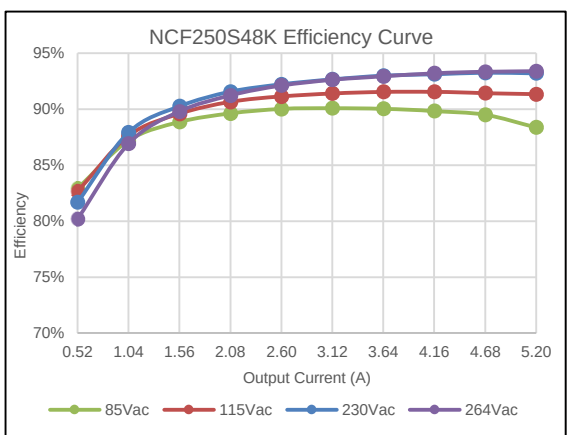


Figure 36: NCF250S48K Efficiency Curve @ 25°C

Loading: I_{o_main} = 10% $I_{o,max}$ to $I_{o,max}$

SECTION 2 ELECTRICAL SPECIFICATIONS

2.6 Protection Function Specifications

Input Fuse

NCF250 series power supply is equipped with internal non user serviceable 6.3 A, 250 VAC fuse for fault protection in both the line and neutral lines input.

Over Voltage Protection (OVP)

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

NCF250S12K

Parameter	Min	Typ	Max	Unit
V_O Output Overvoltage	13.2	/	16	V

NCF250S15K

Parameter	Min	Typ	Max	Unit
V_O Output Overvoltage	16.5	/	21	V

NCF250S24K

Parameter	Min	Typ	Max	Unit
V_O Output Overvoltage	26.4	/	33.6	V

NCF250S48K

Parameter	Min	Typ	Max	Unit
V_O Output Overvoltage	52.8	/	63	V

Short Circuit Protection (SCP)

The power supply will withstand a continuous short circuit with no permanent damage. The power supply will enter hiccup mode and 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 shut down during over-temperature condition and returns back to normal operation when the power supply is cooled down. The power supply might experience over-temperature conditions during a persistent overload on the output. Overload conditions can be caused by external faults. OTP might also be entered due to a loss of control of the environmental conditions, e.g. an increase in the converter's ambient temperature due to a failing fan or external cooling system etc.

SECTION 2 ELECTRICAL SPECIFICATIONS

Over Current Protection (OCP)

NCF250 series power supply includes internal current limit circuitry to prevent damage in the event of overload or short circuit. In the event of overloads, the output voltage may deviate from the regulation range but recovery is automatic when the load is reduced to be within specified limits.

NCF250S12K

Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent with Convection Cooling	13.31	/	21.78	A
V_O Output Overcurrent with 400LFM Forced Air	21.01	/	34.38	A

NCF250S15K

Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent with Convection Cooling	11.33	/	18.54	A
V_O Output Overcurrent with 400LFM Forced Air	16.83	/	27.54	A

NCF250S24K

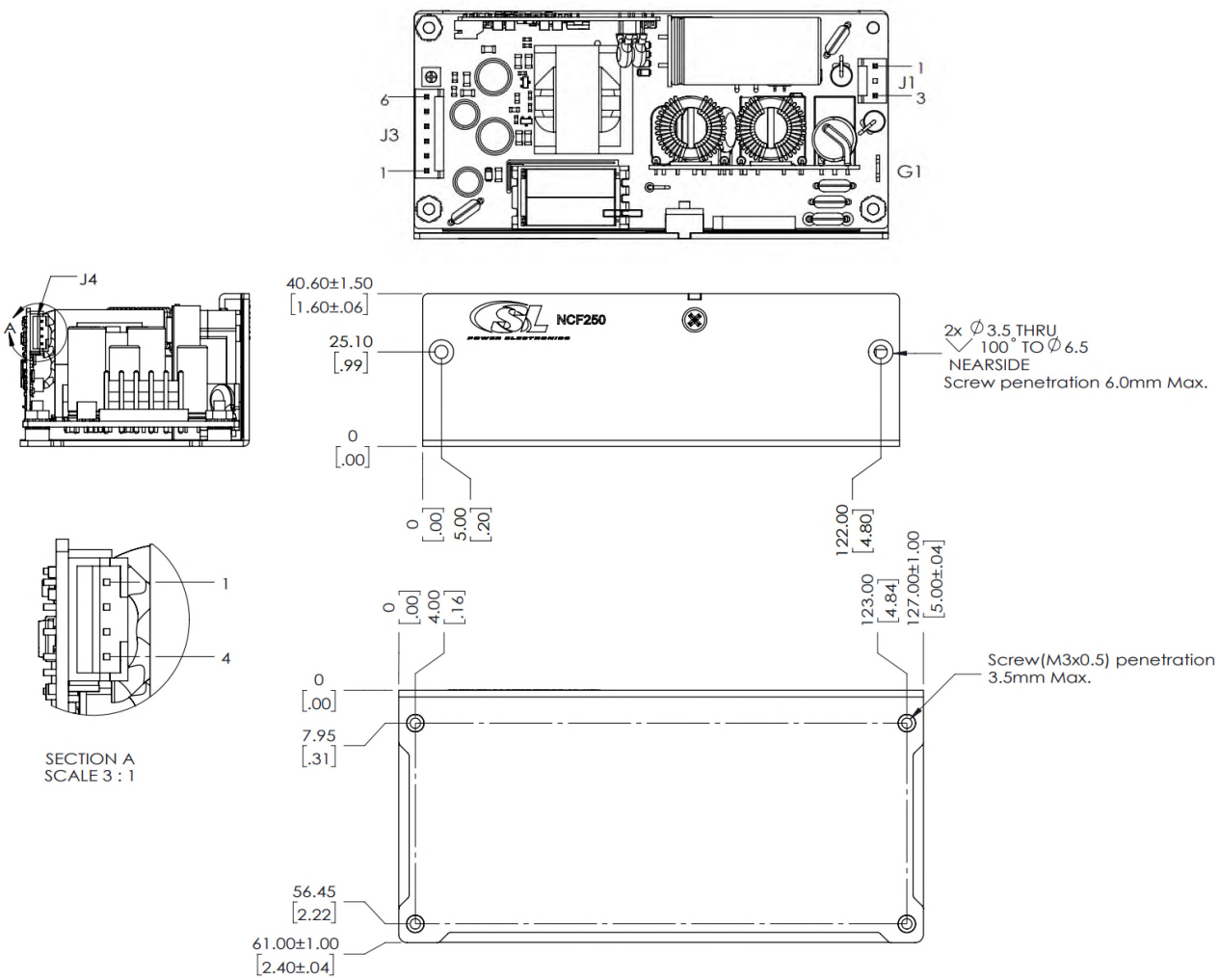
Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent with Convection Cooling	8.03	/	13.14	A
V_O Output Overcurrent with 400LFM Forced Air	11.44	/	18.72	A

NCF250S48K

Parameter	Min	Typ	Max	Unit
V_O Output Overcurrent with Convection Cooling	3.96	/	6.48	A
V_O Output Overcurrent with 400LFM Forced Air	5.72	/	9.36	A

SECTION 3 MECHANICAL SPECIFICATIONS

3.1 Mechanical Outlines (Dimensions and Mounting Locations)



Note 1 - All dimensions in mm (inches).

Note 2 - The NCF250 series dimensions is 2.4" x 5.0" x 1.6".

Note 3 - Weight: 290 g.

SECTION 3 MECHANICAL SPECIFICATIONS

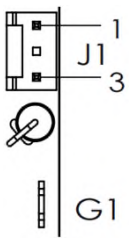
3.2 Connector Definitions

AC Input Connector – J1

Pin 1 - AC Neutral

Pin 3 - AC Line

G1 - GND



DC Output Connector – J3

Pin 1 - Return

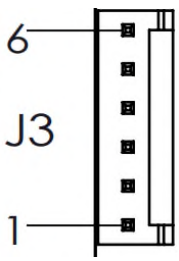
Pin 2 - Return

Pin 3 - Return

Pin 4 - +Vout

Pin 5 - +Vout

Pin 6 - +Vout



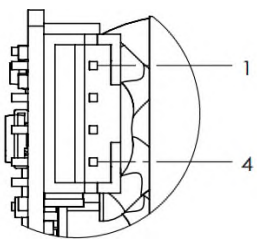
Signal Connector – J4

Pin 1 - 5V Standby

Pin 2 - GND

Pin 3 - Inhibit

Pin 4 - DC_OK



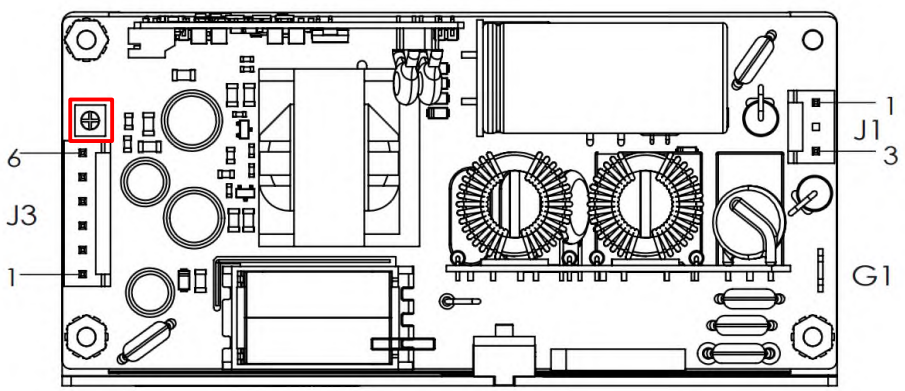
SECTION 3 MECHANICAL SPECIFICATIONS

3.3 Power / Signal Mating Connectors and Pin Types

Table 4. Mating Connectors for NCF250 Series		
Reference	Connector PN	Mating Connector and Pins
Input Connector (J1)	TE# 640445-3 (middle pin removed)	AMP P/N 640250-3. Pins: 640252-1
DC Output Connector (J3)	TE# 640445-6	AMP P/N 640250-6. Pins: 640252-1
G1 (GND)	0.187 quick disconnect terminal	-

3.4 Potentiometer Definitions

Main output voltage adjustment



SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.1 EMC Immunity

NCF250 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	3db margin typ.
Radiated Emissions	EN55011/32, CISPR11/32, FCC Part 15.107	Class B, 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	B
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	3V/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/EN612.100-4-11: 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 70% load 100% dip for 20ms, 0 deg 100% dip for 5000ms (250/300 cycles) 60% dip for 100ms 30% dip for 500ms, 90% load 30% dip for 500ms, 100% load	B B A B B A B

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 NCF250 series power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand-alone product.

Table 6. Safety Certifications for NCF250 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°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

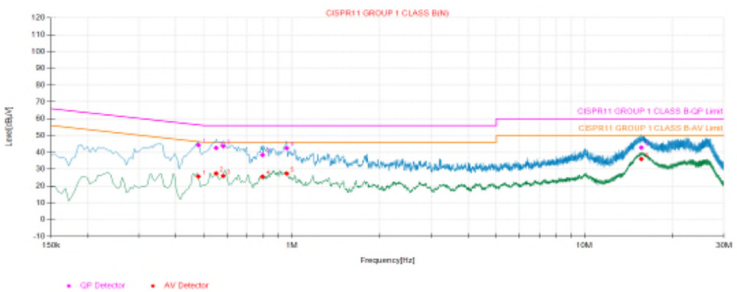
SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.3 EMI Emissions

The NCF250 series has been designed to comply with the Class B limits of EMI requirements of EN55032 (FCC Part 15) and CISPR 32 (EN55032) for emissions and relevant sections of EN61000 (IEC 61000) for immunity.

Conducted Emissions

The applicable standard for conducted emissions is EN55032 (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 NCF250 series power supply have internal EMI filters to ensure the convertor's conducted EMI levels comply with EN55032 (FCC Part 15) Class B and EN55032 (CISPR 32) Class B limits.

Sample of EN55032 Conducted EMI Measurement at 230VAC input tested at Neutral.

Conducted EMI emissions specifications of the NCF250 series:

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC Part 15, Class B	All	Margin	-	-	3	dB
CISPR11/32, 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 EN55032 Class B (FCC Part 15). Testing AC-DC convertors as a stand-alone component to the exact requirements of EN55032 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 NCF250 series power supply will start and operate at an ambient temperature from -20°C to 70°C. PSU performance will derate from 50°C to 70°C. PSU will derate output power linearly above 50°C to 50% rated output current at 70°C.

4.5 Storage and Shipping Temperature

The NCF250 series power supply can be stored or shipped at temperatures between -40°C and +85°C.

4.6 Altitude

The NCF250 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 NCF250 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 / minutes, 10 sweeps / axes

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

Acceleration	1.5 gRMS, 0.003 g^2/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

Non-Operating Half-Sine Shock

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

Operating Half-Sine Shock

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 (Using Telcordia SR-332, Issue 3 at 110V & 220V, for both 25°C and 50°C)
Warranty	3 Years
Temperature Cycling[1]	Power supply must 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 (115VAC/60Hz & 230VAC/50Hz, ambient 25°C at 24 hours per day, 365 days/year, 6 power up cycles per day.)
Life Cycle AC Power On / Off Test[1]	>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

Note 1 - Part of design verification tests.

SECTION 6 POWER AND CONTROL SIGNAL DESCRIPTIONS

6.1 AC Input (J1)

This connector supplies the AC Mains to the NCF250 series power supply.

Pin 1 - Neutral

Pin 3 - Line

6.2 Earth Ground (GND)

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

GND - Earth Ground (Safety Ground)

6.3 Main Output (J3)

These terminals provide the main output for the NCF250 series. The Vo and the Output Return terminals are the positive and negative rails, respectively of the main output of the NCF250 series power supply.

Pin 1 to 3 - Output Return

Pin 4 to 6 - Main Output

6.4 Signal Connector (J4)

The NCF250 series power supply contains a 4-pin signal connector, providing standby power, ON_OFF and Power Good function.

Standby Output, Standby Output Return (Pin 1, Pin2)

The NCF250 series 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.

Inhibit (Pin 3)

This pin controls the normal turning on and off of the main output of the NCF250 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.

DC_OK (Pin 4)

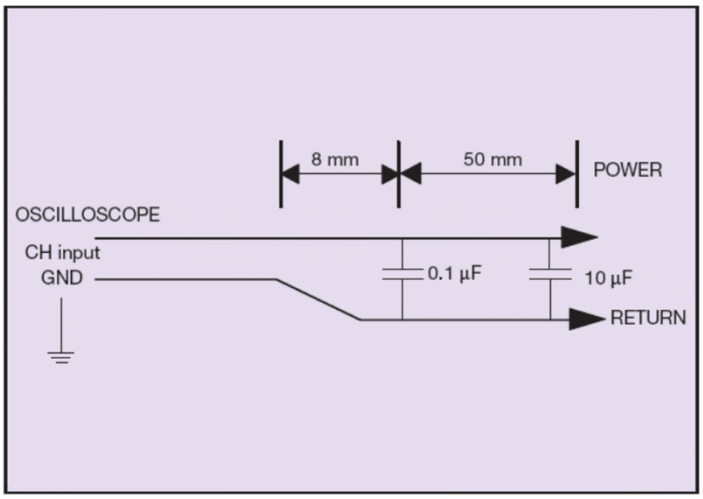
DC_OK signal will be high once the DC output rises to within the regulation (on turn-on), and go low if the DC output falls below the regulation range.

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

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 NCF250 series. When measuring output ripple and noise, a scope jack in parallel with a 0.1uF ceramic chip capacitor, and a 10uF tantalum capacitor will be used. Oscilloscope can be set to 20MHz bandwidth for this measurement.



SECTION 7 RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	03.10.26	First issue	L. Luo

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

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NCF250 Series - Rev. 03.24.26_#1.0