TDK·Lambda

Configurable Power Supplies

Edition 1 | 2010

Innovating Reliable Power

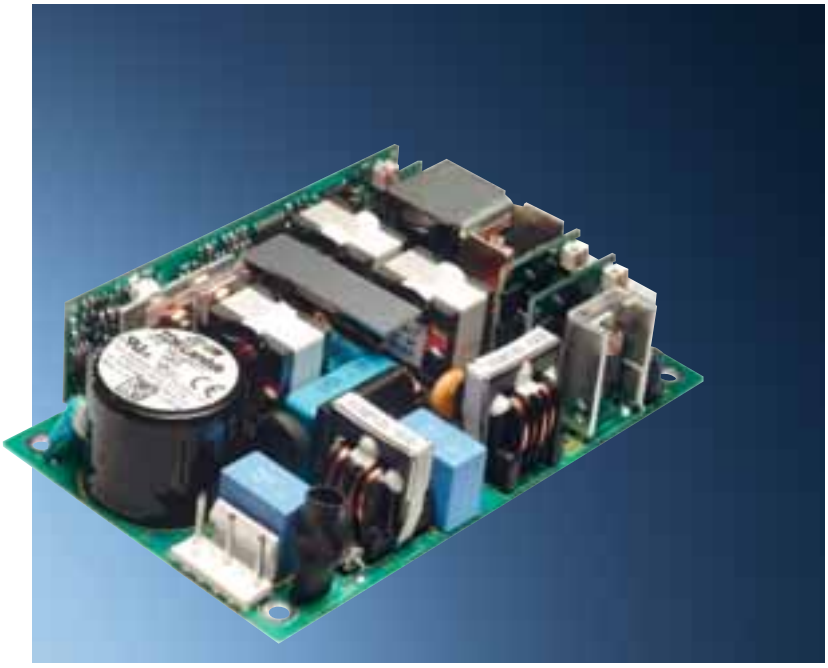

Innovating Reliable Power

TDK·Lambda

Contents

NV-Power medical

180 / 200 W



Highlights

- Reinforced isolation for IEC60601-1
- Low earth leakage and class B EMC
- Medical approval
- High efficiency
- High power density (9.3 W/in^3)
- Up to 3 outputs
- No minimum load
- Fits 1 U applications
- 3 years warranty
- Temperature controlled fan option
- Low profile
- Minimises heat in system
- Less space

Input Specifications

Input voltage	90 – 264 V AC (100 – 240 V AC nominal)
Input frequency	45 – 63 Hz
Input harmonics	EN61000-3-2 compliant
Inrush current	<40 A at 25 °C and 264 V AC, (cold start)
Input fuse	Fast acting (not user accessible)
Earth leakage current	123 µA max. at 120 V AC (60 Hz) 257 µA max. at 240 V AC (60 Hz) Worst case leakage current is less than 300 µA at 264 V AC, 63 Hz (normal condition, 500 µA Single Fault Condition)
Power factor	0.97 typical

Quick Selector

preferred configurations

Model	Ch1	Ch3	Ch4
NV1-1T000-M	12 V / 15 A	–	–
NV1-1G000-M	24 V / 7.5 A	–	–
NV1-3G0TT-M	24 V / 7.5 A	12 V / 5 A	–12 V / 1 A
NV1-3G0FF-M	24 V / 7.5 A	15 V / 5 A	–15 V / 1 A

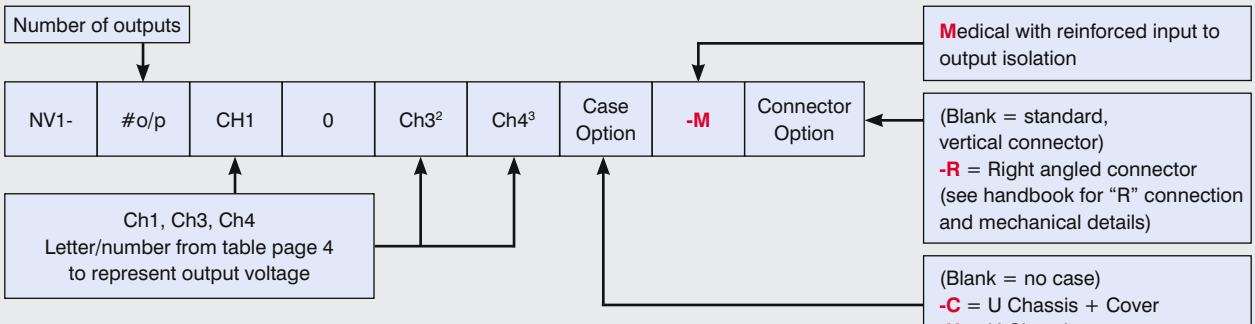
Above units available on rapid delivery. Additional variants available “Build to Order” – see below.

Available Outputs

Channel 1	Adjustment range	Channel 2	Channel 3[1]	Adjustment range	Channel 4[2]	Adjustment range
T 12 V / 15 A **F** 15 V / 12 A	12 – 15 V[3] 12 – 15 V[4]	not available	**T** 12 V / 5 A **F** 15 V / 5 A **G** 24 V / 2.5 A **0** Omit	12 – 15 V 12 – 15 V 18 – 24 V	**T** –12 V / 1 A **F** –15 V / 1 A **3HP** +3.3 V / 2 A[6] **5HP** +5 V / 2 A[6] **TH** –12 V / 2 A[6] **FH** –15 V / 2 A[6] **0H** Fan supply only **0** Omit	fixed fixed fixed fixed fixed fixed
G 24 V / 7.5 A	24 – 28 V[5]					

Notes: 1 Follow letters in red by “Y“ for negative output channel 3.
2 Follow letters in red by “P“ for positive output channel 4.
3 12 – 12.5 V if 24 V channel 3 fitted.
4 14.5 – 15 V if 24 V channel 3 fitted.
5 24 – 26 V if 24 V channel 3 fitted.
6 1.5 A max. if fitted with “-F“ option.

How to create a Product Code



1 Needs 0H, 3H, 5H, TH or FH type channel 4. **The fan speed is temperature dependent, ensuring optimum cooling and lowest audible noise.**

2 For Negative Output Channel 4, follow chosen letter by "Y". For example, TY channel 2 = –12 V / 5 A

3 For Positive Output Channel 4, follow chosen letter by 'P'. For example, TP channel 4 = +12V / 1A

Confirm availability of created product code with the factory.

Output Specifications

		Notes
Remote sense	yes	Channel 1 – max. 0.5 V total line drop
Total regulation	1 %	Including line (for 90 – 264 V AC input change), Load (for 0 – 100 % load change) and Cross (for 0 – 100 % load change on any other output) regulation
Ripple & noise	1 %	(or 50 mV if higher) Pk-Pk, using EIAJ test method 20 MHz bandwidth
Voltage accuracy	±1 %	±4 % for Channel 4 with "T" or "F" type outputs, +4 % / –3 % for all other Ch 3
Turn on time	1.5 s max.	at 90 V AC & 100 % rated output power
Efficiency	up to 90 %	configuration dependent
Hold-up	16 ms min.	at 90 V AC
Minimum load	none	on any output
Transient response	<4 %	of set voltage for 50 % load change (in 50 µs within the range 25 – 100 % load)
Recovery	<500 µs	for recovery to 1 % of set voltage
Short circuit protection	yes	
Over temperature protection	yes	
Over voltage protection	yes	See application notes for details
Ch1 good signal	yes	Provides a Logic "low" signal after output is within 90 % (±5 %) of nominal
Peak output power	200 W	Single output units. Average output power must not exceed 180 W over any 5 minute period

Isolation

Input to output	**reinforced**	**4 kV AC type tested to 4 kV AC (equivalent to 5.7 kV DC), production tested to 4.3 kV DC**		
Input to earth	**basic**	**2.3 kV DC**	**Output to earth**	**200 V DC**

Environment

Temperature	0 °C to 50 °C operational, – 40 °C to 85 °C storage (max. 12 months). Full load with either "-F" option fitted or 2 m/s air blown from input to output
Convection rating	See application note for details
Derating	50 °C to 65 °C derate each output by 2.5 % per °C
Low temperature start-up	– 20 °C
Humidity	5 – 95 % RH non condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11ms (±0.5 msec), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987 Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1,9
Altitude	3,000 metres operational
Pollution	Degree 2, Material group 3b

Immunity EN61000-6-2: 2001

				Criteria
Electrostatic discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV Not applicable to open frame units	A
Electromagnetic field	EN61000-4-3	Level 3	12 V/m	A
Fast / Burst transient	EN61000-4-4	Level 4	tested to 4.4 kV	A
Surge immunity	EN61000-4-5	Level 3	Common mode to 2.2 kV Differential mode to 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A/m	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption	A

Emissions EN61000-6-3: 2001

Radiated electric field	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B (2005) see application note for details
Conducted emissions	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B (2005)
Conducted harmonics	EN61000-3-2	Class A
Flicker	EN61000-3-3	Compliant – d_{max} only

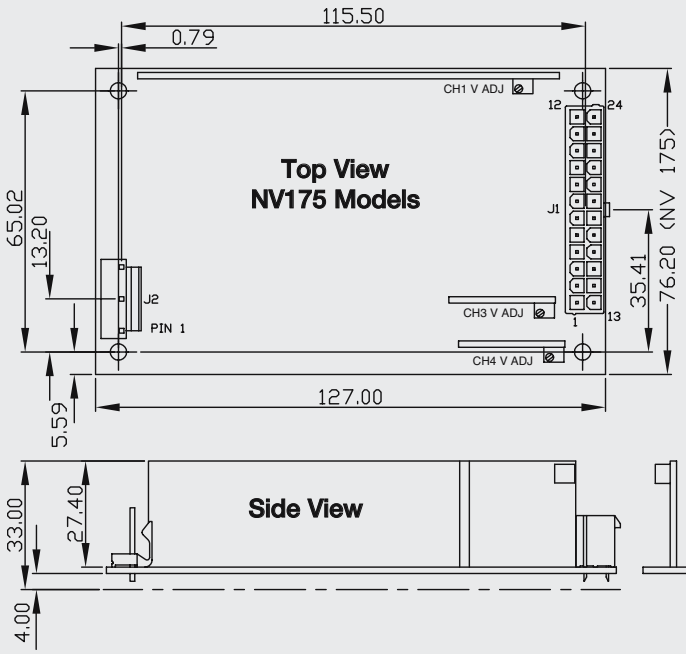
Safety Approvals

	Date	Amendments
EN60950-1	2006	
UL60950-1	2007	
CSA22.2 No 60950-1	2003	
IEC60950-1*	2005	
EN61010-1	2001	
IEC61010-1*	2001	

	Date	Amendments
IEC60601-1*	1988	A1, A2
EN60601-1	1990	A1, A2, A13
UL60601-1	2003	with revisions 2006
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

* CB certificate and report available on request.
Check with factory for status of approvals.

Outline & Connection Drawings



MATING PARTS (MOLEX OR EQUIVALENT)

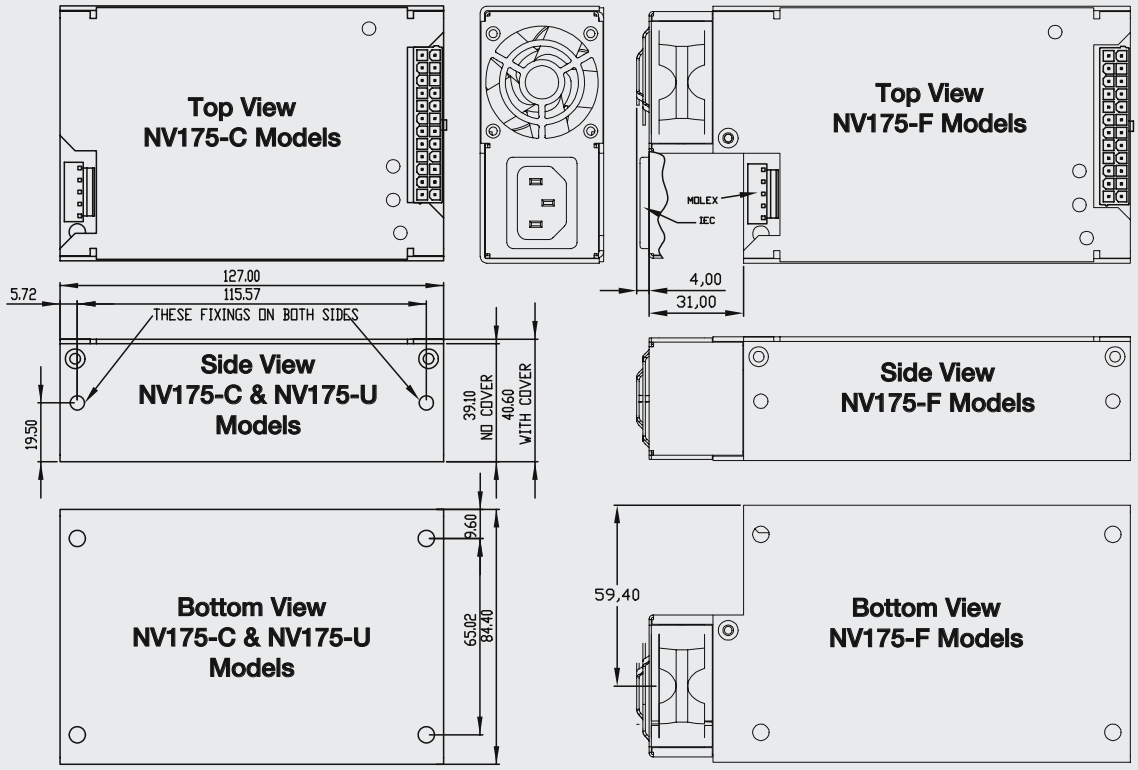
CONN	HOUSING	PINS
J1	39-01-2245	44476-3112
J2	09-50-8051	08-52-0113

J1

PIN	FUNCTION	PIN	FUNCTION
12	STANDBY +Ve	24	Do not connect
11	Do not connect	23	Do not connect
10	CH1 OUTPUT	22	CH1 POWER GOOD
9	CH1 OUTPUT	21	CH1 OUTPUT
8	CH1 OUTPUT	20	CH1 OUTPUT
7	+SENSE CH1	19	-SENSE CH1
6	0V COMMON	18	0V COMMON
5	0V COMMON	17	0V COMMON
4	Do not connect	16	0V COMMON
3	Do not connect	15	Do not connect
2	Do not connect	14	Do not connect
1	CH3 OUTPUT	13	CH4 OUTPUT

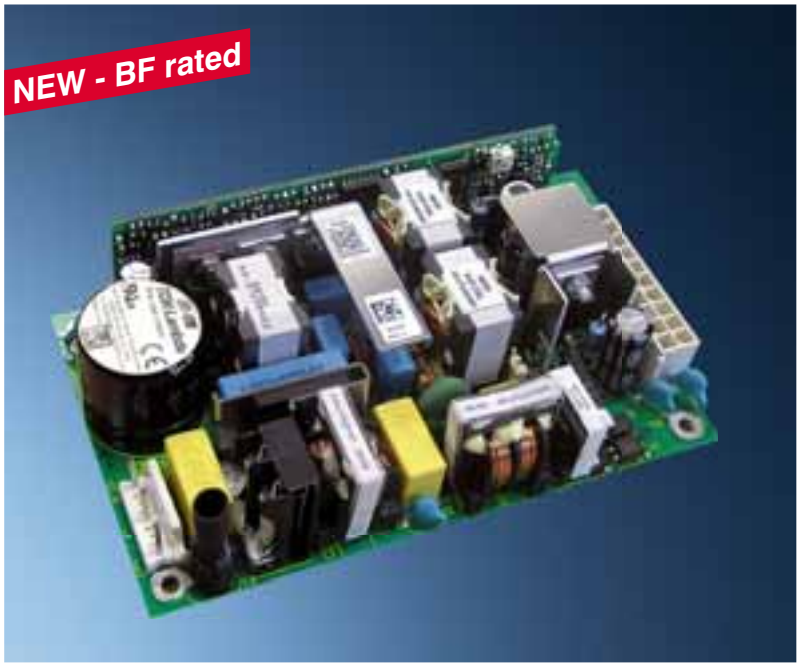
J2

PIN	FUNCTION
1	EARTH
2	NOT CONNECTED
3	LIVE
4	NOT CONNECTED
5	NEUTRAL



Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

NVM-Power medical — 180 W



Highlights

- Medical approval for BF applications
- Reinforced input to output Isolation for IEC60601
- Very low earth leakage and class B EMC
- Below 1 W standby power
- 5” x 3” footprint
- Standby supply and remote on/off
- High efficiency & high power density (9.3 W/in^3)
- No minimum load
- Fits 1U applications
- 3 years warranty

Input Specifications

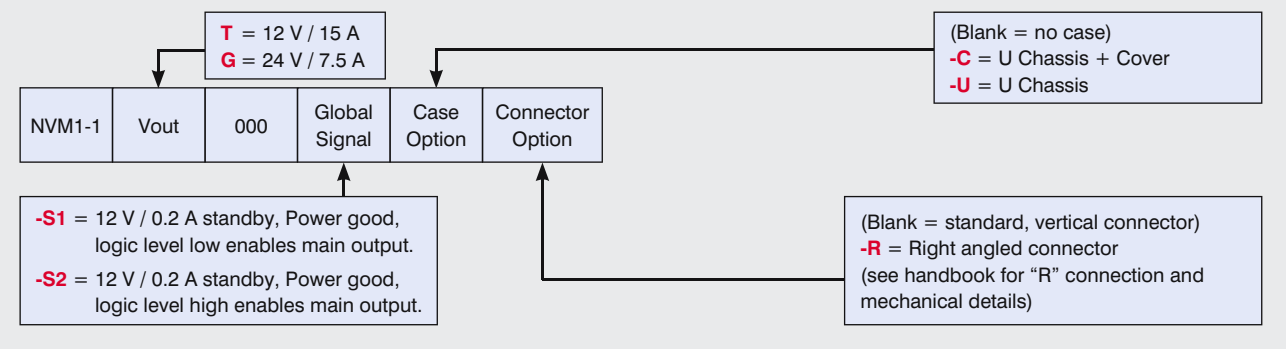
Input voltage	90 – 264 V AC (100 – 240 V AC nominal)
Input frequency	45 – 63 Hz
Input harmonics	EN61000-3-2 compliant
Inrush current	<40 A at 25 °C and 264 V AC, (cold start)
Input fuse	Dual Fused, Fast acting (not user accessible)
Earth leakage current	80 µA max at 120 V AC (60 Hz), 170 µA max at 240 V AC (60 Hz). Worst case leakage current is less than 200 µA at 264 V AC, 63 Hz (normal condition, =330 µA Single Fault Condition)
Power factor	0.97 typical

Quick Selector

preferred configurations

Model	Ch1	Standby	Remote on/off
NVM1-1T000-S1	12 V / 15 A	12 V / 0.2 A	TTL high / OC to inhibit
NVM1-1G000-S1	24 V / 7.5 A		

How to create a Product Code



Confirm availability of created product code with the factory.

Output Specifications

		Notes
Remote sense	yes	Channel 1 – max. 0.5 V total line drop
Total regulation	1 %	Including line (for 90 – 264 V AC input change) and Load (for 0 – 100 % load change)
Ripple & noise	1 %	(or 50 mV if higher) Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage accuracy	±1 %	
Turn on time	1.5 s max.	at 90 V AC & 100 % rated output power
Efficiency	up to 90 %	
Hold-up	16 ms min.	at 90 V AC
Minimum load	none	on any output
Transient response	<4 %	of set voltage for 50 % load change (in 50 µs within the range 25 – 100 % load)
Recovery	<500 µs	for recovery to 1 % of set voltage
Short circuit protection	yes	
Over temperature protection	yes	
Over voltage protection	yes	120 – 135 % of Vout. Remove AC for 10 seconds then reapply to restart unit
Power good signal (J1, pin 12)	yes	'S1' and 'S2' type global signals. Logic 'High' signal indicates ac supply is good and output 1 is within regulation. Provides minimum 4 ms AC fail warning.

Isolation

Input to output	reinforced	4.5 kV AC type tested to 4.5 kV AC (equivalent to 6.3 kV DC), production tested to 4.3 kV DC		
Input to earth	basic	1.5 kV AC, 2.3 kV DC	Output to earth	1.5 kV AC

Environment

Temperature	0 °C to 50 °C operational, – 40 °C to 85 °C storage (max. 12 months). Full load, with 1.5m/s air blown from input to output (approximately 10CFM)
Convection rating	See application note for details
Derating	50 °C to 70 °C derate each output by 2.5 % per °C with 2.0 m/s air blown from input to output
Low temperature start-up	– 20 °C
Humidity	5 – 95 % RH non condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11ms (±0.5 msec), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987 Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1,9
Altitude	5,000 metres operational (3,000 metres for IEC/EN/UL60601-1)
Pollution	Degree 2, Material group 3b

Immunity EN61000-6-2: 2001

				Criteria
Electrostatic discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV Not applicable to open frame units	A
Electromagnetic field	EN61000-4-3	Level 3	12 V/m	A
Fast / Burst transient	EN61000-4-4	Level 4	tested to 4.4 kV	A
Surge immunity	EN61000-4-5	Level 3	Common mode to 2.2 kV Differential mode to 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A/m	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption	A

Emissions EN61000-6-3:2001, EN60601-1-2:2001

Radiated electric field	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B (2005) see application note for details
Conducted emissions	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B (2005)
Conducted harmonics	EN61000-3-2	Class A
Flicker	EN61000-3-3	Compliant – d_{max} only

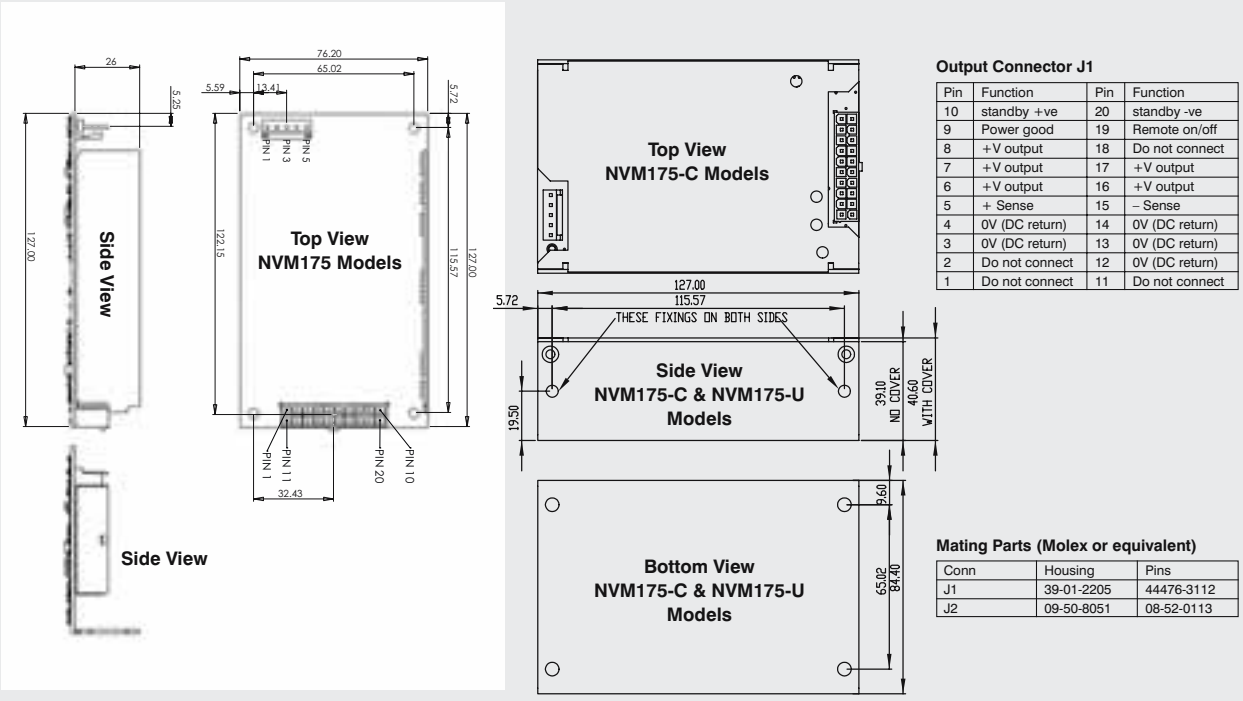
Safety Approvals

	Date	Amendments
EN60950-1	2006	
UL60950-1	2007	
CSA22.2 No 60950-1	2003	
IEC60950-1*	2005	

	Date	Amendments
IEC60601-1*	1988	A1, A2
EN60601-1	1990	A1, A2, A13
UL60601-1	2003	with revisions 2006
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

* CB certificate and report available on request. Check with factory for status of approvals.

Outline & Connection Drawings



Output Connector J1

Pin	Function	Pin	Function
10	standby +ve	20	standby -ve
9	Power good	19	Remote on/off
8	+V output	18	Do not connect
7	+V output	17	+V output
6	+V output	16	+V output
5	+ Sense	15	– Sense
4	0V (DC return)	14	0V (DC return)
3	0V (DC return)	13	0V (DC return)
2	Do not connect	12	0V (DC return)
1	Do not connect	11	Do not connect

Mating Parts (Molex or equivalent)

Conn	Housing	Pins
J1	39-01-2205	44476-3112
J2	09-50-8051	08-52-0113

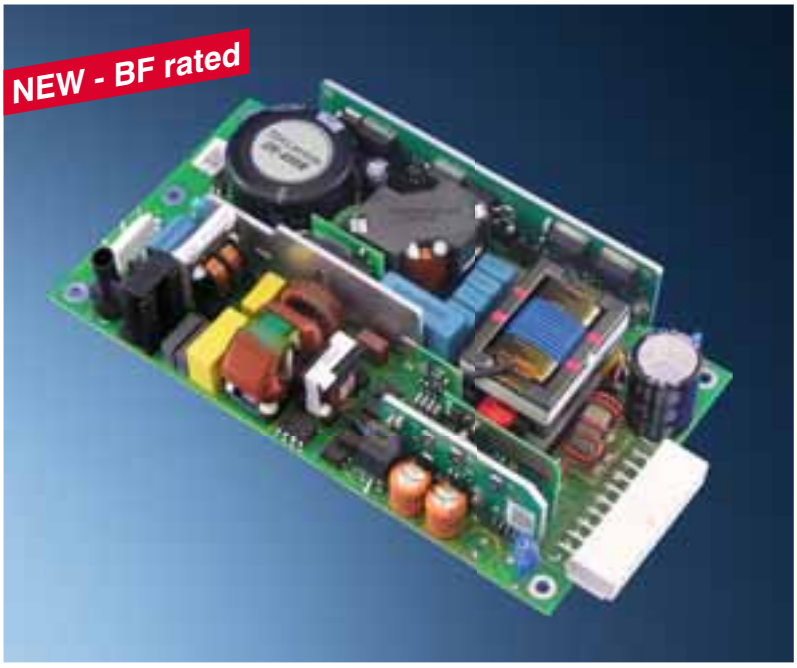
Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

EFE-300M / EFE-400M

300 / 400 W

Highlights

- Medical approval for BF applications
- High efficiency
- 300 W = 6 in x 3 in footprint,
  400 W = 6.5 in x 3.5 in
- 1 W standby (EFE400M only)
- High power density (up to 18 W/in^3)
- No minimum load
- Fits 1 U applications
- 3 years warranty



Input Specifications

Input voltage	90 – 264 V AC / 120 – 350 V DC
Input frequency	45 – 63 Hz (440 Hz with reduced PFC – consult factory)
Input harmonics	EN61000-3-2 compliant
Inrush current	<40 A at 25 °C and 230 V AC, (cold start) (meets EN61000-3-3)
Input fuse	Dual fuses (Live + Neutral) Fast acting (not user accessible)
Earth leakage current	123 µA at 120 V AC (60 Hz) 257 µA max. at 240 V AC (60 Hz). Worst case leakage current is less than 300 µA at 264 V AC, 63 Hz (normal condition, 0.5 mA Single Fault Condition)
Power factor	0.97 typical

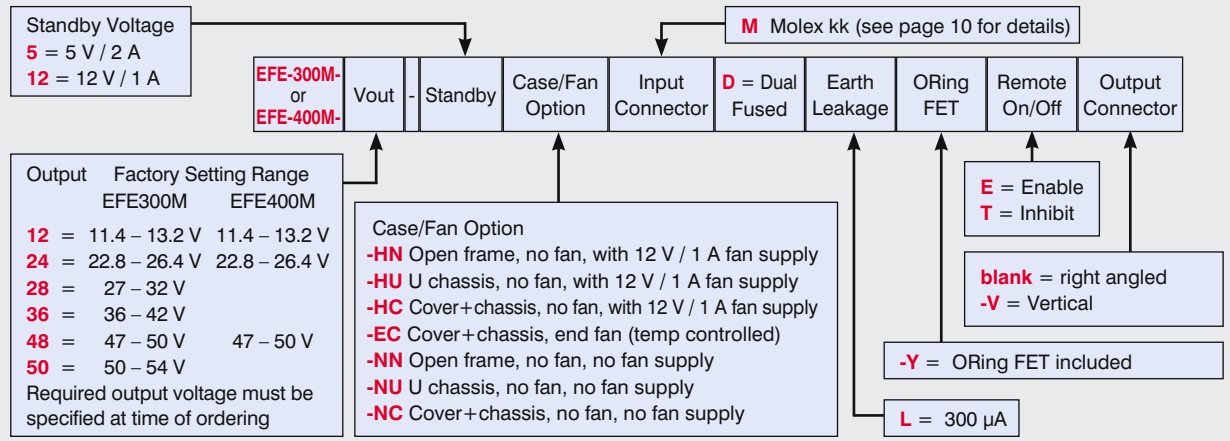
Quick Selector

preferred configurations

Output		Units without fan		Units with end fan
		Open Frame	Cover + Chassis	Cover + Chassis
12 V / 25 A	Description Order Code	EFE300M-12-5-HNMDL-YT U5Y0020	EFE300M-12-5-HCMDL-YT U5Y001Z	EFE300M-12-5-ECMDL-YT U5Y0031
12 V / 33.3 A	Description Order Code	EFE400M-12-5-HNMDL-YT U6Y001H	EFE400M-12-5-HCMDL-YT U6Y004L	EFE400M-12-5-ECMDL-YT U6Y007P
24 V / 12.5 A	Description Order Code	EFE300M-24-5-HNMDL-YT U5Y0053	EFE300M-24-5-HCMDL-YT U5Y0042	EFE300M-24-5-ECMDL-YT U5Y0064
24 V / 16.7 A	Description Order Code	EFE400M-24-5-HNMDL-YT U6Y002J	EFE400M-24-5-HCMDL-YT U6Y005M	EFE400M-24-5-ECMDL-YT U6Y008Q
48 V / 6.25 A	Description Order Code	EFE300M-48-5-HNMDL-YT U5Y0201	EFE300M-48-5-HCMDL-YT U5Y0223	EFE300M-48-5-ECMDL-YT U5Y0166
48 V / 8.3 A	Description Order Code	EFE400M-48-5-HNMDL-YT U6Y003K	EFE400M-48-5-HCMDL-YT U6Y006N	EFE400M-48-5-ECMDL-YT U6Y009R

Additional variants available “Build to Order” – see below.

How to create a Product Code



Confirm availability of created product code with the factory.

Output Specifications

	EFE300M	EFE400M	Notes
Output power	300 W	400 W	Continuous (including fan supply) or RMS (including Peak power)
Peak power	400 W	530 W	EFE300M – for 10 seconds. Outputs above 36 V, 350 W EFE400M – for 10 seconds. No peak power for outputs 47 V and above
Total regulation	better than 4 %		Including Line (for 90 – 264 V AC input change) and Load (for 0 – 100 % load change) and temperature (0 – 50 °C)
Ripple & noise	1.5 %		Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage setting accuracy	±1 %		at 50 % load
Turn on time	1.5 s max.		at 90 V AC & 100 % rated output power
Efficiency	90 %		typical. 87 % typical if Standby Supply is fully loaded
Hold-up	16 ms min.		typical at 90 V AC, 75 % load
Min load	none		
Transient response	<5 %		of set voltage for 50 % load change (in 50 µs within the range 25 – 100 % load)
Recovery	<1 ms		for recovery to 2 % of set voltage
Short circuit protection	yes		Auto recovery after removal of short circuit
Over temperature protection	yes		Primary – auto recovers, secondary – cycle power to restart
Over voltage protection	yes		Latching, need to cycle AC to restart unit
Fan supply	12 V / 1 A		Depending on “Case/Fan Option” selected

Global Signals

Remote on/off	Enable – TTL logic level low (relative to Standby 0V) enables channel 1 and fan supply Inhibit – TTL logic level low (relative to Standby 0V) inhibits channel 1 and fan supply
Standby supply	5 V / 2 A or 12 V / 1 A, isolated supply, not affected by remote on/off.
Power good	Logic high indicates AC supply is good and Ch1 is within regulation
ORing FET	Allows redundant connection of power supplies with no additional diodes required

Isolation

Input to output	reinforced	4 kV AC, 5.7 kV DC type tested to 4 kV AC (equivalent to 5.7 kV DC), production tested to 4.3 kV DC		
Input to earth	basic	1.5 kV AC, 2.3 kV DC	Output to earth	1.5 kV AC

Environment

Temperature	0 °C to 50 °C operational, – 40 °C to 70 °C storage (max. 12 months). Full load, with 2 m/s air blown from input to output (approximately 10CFM)
Convection rating	tbc.
Derating	50 °C to 70 °C derate each output by 2.5 % per °C
Low temperature start-up	– 20 °C
Humidity	5 – 95 % RH non condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11ms (±0.5 msec), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987. Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1,9
Altitude	–200 to 3,000 metres operational (–200 to 5,000 m storage/transportation)
Pollution	Degree 2, Material group 3b

Immunity EN61000-6-2: 2005

				Criteria
Electrostatic discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV Not applicable to open frame units	A
Electromagnetic field	EN61000-4-3	Level 3	12 V/m	A
Fast / Burst transient	EN61000-4-4	Level 4	AC input tested to 4.4kV DC output tested to 2.2kV	A
Surge immunity	EN61000-4-5	Level 3	Common mode – 2.2 kV, Differential – 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A/m	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption Criteria B for 1 cycle interruption	A
Ring Wave	EN61000-4-12	Level 3	Common mode – 2.2 kV, Differential – 1.1 kV	A
Voltage Fluctuations	EN61000-4-14	Class 3		A

Emissions EN61000-6-3: 2007, EN60601-1-2: 2001

Radiated electric field	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B see application note for details
Conducted emissions	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B
Conducted harmonics	EN61000-3-2	Class A, Class C (at 100 W and above)
Flicker	EN61000-3-3	Compliant – d_{max} only

Safety Approvals

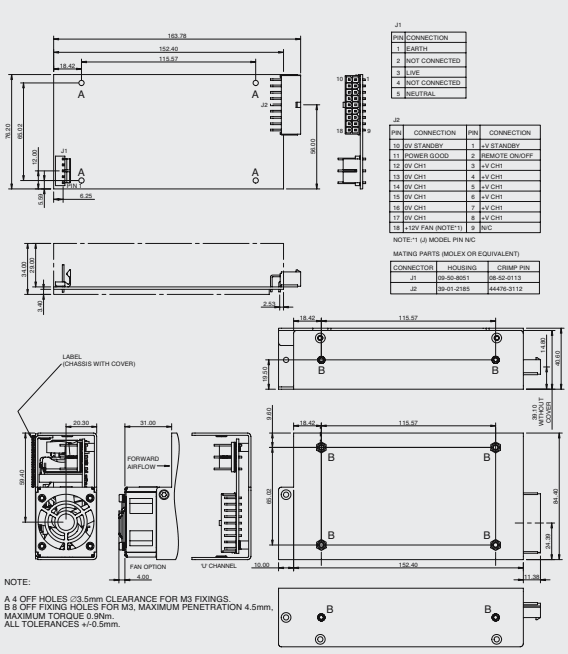
	Edition / Date	Amendments
EN60950-1	Edition 2 - 2006	
UL60950-1	Edition 2 - 2007	
EN61010-1	Edition 2 - 2001	
EN60601-1	Edition 2 - 1990	A1, A2, A13
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

	Edition / Date	Amendments
IEC60950-1*	Edition 2 - 2005	
CSA22.2 No. 60950-1	Edition 2 - 2007	
IEC61010-1*	Edition 2 - 2001	
IEC60601-1*	Edition 2 - 1988	A1, A2
UL/CSA60601-1	Edition 2 - 2003	With Revisions 2006

* CB certificate and report available on request. Check with factory for status of approvals.

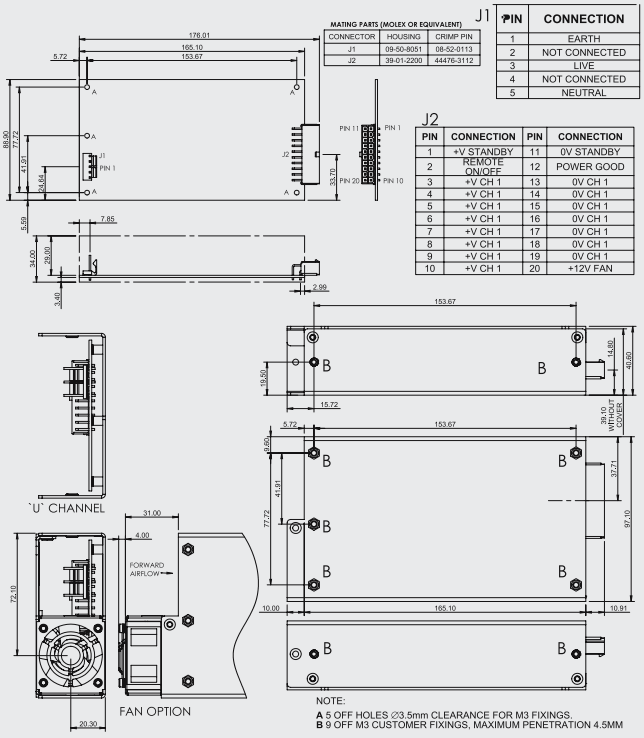
Outline & Connection Drawings

EFE-300M (not -V version)



Note connection details and outline drawings for -V (vertical) connector are different. (See handbook for details)

EFE-400M (not -V version)

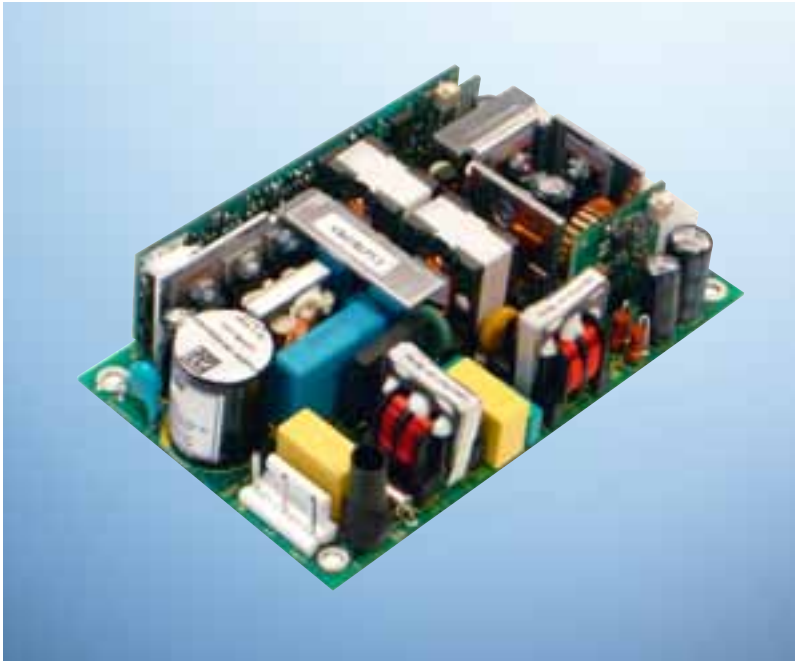


Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

NV-Power 100 W

Highlights

- High efficiency
- Minimises heat in system
- Low profile
- Fits 1 U applications
- 3 years warranty
- High power density
- Less space



Input Specifications

Input voltage	90 – 264 V AC / 120 – 350 V DC
Input frequency	45 – 63 Hz (440 Hz with reduced PFC – consult factory)
Input harmonics	EN61000-3-2 compliant
Inrush current	<40 A at 25 °C and 264 V AC, (cold start)
Input fuse	Time delay (not user accessible)
Earth leakage current	123 µA typical at 120 V AC (60 Hz), 257 µA typical at 240 V AC (60 Hz)
Power factor	0.97 typical

Quick Selector

preferred configurations

Model	Ch1	Ch2	Ch3	Ch4
NVA1-453TT	5 V / 10 A	3.3 V / 8 A	12 V / 3 A	–12 V / 1 A
NVA1-453FF	5 V / 10 A	3.3 V / 8 A	15 V / 3 A	–15 V / 1 A
NVA1-4G5TT	24 V / 4 A	5 V / 5 A	12 V / 3 A	–12 V / 1 A
NVA1-4G5FF	24 V / 4 A	5 V / 5 A	15 V / 3 A	–15 V / 1 A

Additional variants available “Build to Order” – see page 12.

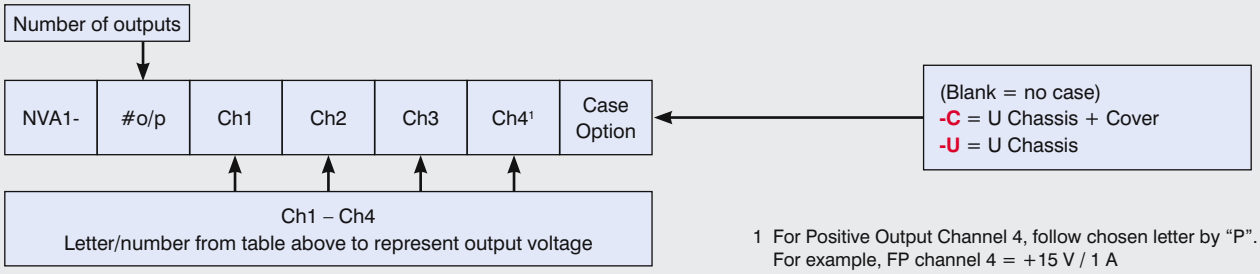
Available Outputs

Channel 1	Adjustment range	Channel 2	Adjustment range	Channel 3	Adjustment range	Channel 4[2]	Adjustment range
5 5 V / 10 A[1]	4.75 – 5.25 V	**3** 3.3 V / 8 A	3.14 – 3.46 V	**T** 12 V / 3 A **F** 15 V / 3 A **G** 24.5 V / 1.5 A	fixed fixed fixed	**T** –12 V / 1 A[3] **F** –15 V / 1 A[3]	fixed fixed
G 24 V / 4 A	23 – 25 V	**5** 5 V / 5 A	3.3 – 5.5 V	**T** 12 V / 3 A **F** 15 V / 3 A	fixed fixed	**T** –12 V / 1 A **F** –15 V / 1 A	fixed fixed

Notes: 1 5 V Ch1 / 3.3 V, Ch2 combined power must not exceed 60 W
2 Follow characters in red by “P“ for positive channel 4
3 If channel 3 = 24.5 V (G), channel 4 must be “P”

Other output options are available, please contact factory with your requirements.

How to create a Product Code



1 For Positive Output Channel 4, follow chosen letter by "P". For example, FP channel 4 = +15 V / 1 A

Confirm availability of created product code with the factory.

Output Specifications

		Notes
Remote sense	yes	Channels 1 & 2 – max. 0.5 V total line drop.
Total regulation	1 %	Including line (for 90 – 264 V AC input change), Load (for 0 – 100 % load change) and Cross (for 0 – 100 % load change on any other output) regulation. (5 % for channels 3 & 4)
Ripple & noise	1 %	(or 50 mV if higher) Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage accuracy	±1 %	±5 % for channels 3 & 4 (with channel 1 set to nominal voltage)
Turn on time	1.5 s max.	at 90 V AC & 100 % rated output power
Efficiency	up to 90 %	configuration dependent
Hold-up	16 ms min.	at 90 V AC
Min load	none	on any output. (For models with 12V or 15V Ch3, a load ≥ 1A is required on Ch3 to keep it in full regulation when Ch1+Ch2 output power ≥ 50 W)
Transient response	<4 %	of set voltage for 50 % load change (in 50 µs within the range 25 – 100 % load)
Recovery	<500 µs	for recovery to 1 % of set voltage
Short circuit protection	yes	
Over temperature protection	yes	
Over voltage protection	yes	See application notes for details
Ch1 good signal	optional	Contact factory for details

Isolation

Input to output	reinforced	4.3 kV DC		
Input to earth	basic	2.3 kV DC	Output to earth	200 V DC

Environment

Temperature	0 °C to 50 °C operational, –40 °C to 85 °C storage (max. 12 months). Full load with 2 m/s air blown from input to output (approximately 10CFM)
Convection rating	50 W at 50 °C. Max 50 % output current on any output. See application note for details
Derating	50 °C to 70 °C derate each output by 2.5 % per °C
Low temperature start-up	–20 °C
Humidity	5 – 95 % RH non condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11ms (±0.5 msec), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987 Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1,9
Altitude	–200 to 3,000 metres operational (–200 to 5,000 m storage/transportation)
Pollution	Degree 2, Material group 3b

Immunity EN61000-6-2: 2001

				Criteria
Electrostatic discharge	EN61000-4-2	Level 3	Air discharge 8 kV Contact discharge 4 kV Not applicable to open frame units	A
Electromagnetic field	EN61000-4-3	Level 3	12 V/m	A
Fast / Burst transient	EN61000-4-4	Level 4	tested to 4.4 kV	A
Surge Immunity	EN61000-4-5	Level 3	Common mode to 2.2 kV Differential mode to 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A/m	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption	A

Emissions EN61000-6-3: 2001, EN60601-1-2: 2001

Radiated electric field	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B see application note for details
Conducted emissions	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B
Conducted harmonics	EN61000-3-2	Class A
Flicker	EN61000-3-3	Compliant – d_{max} only

Safety Approvals

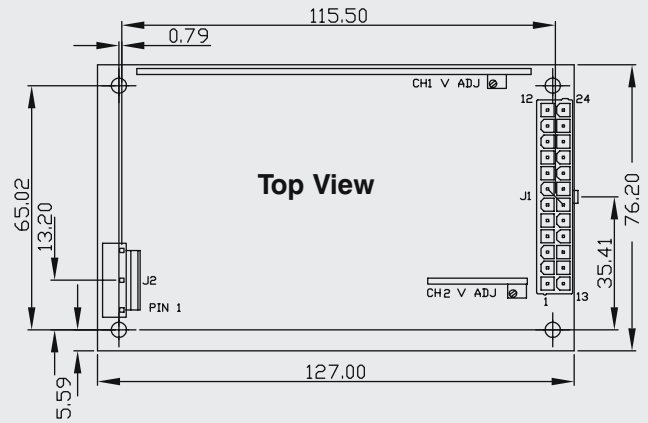
	Date	Amendments
EN60950-1	2006	
UL60950-1	2007	
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

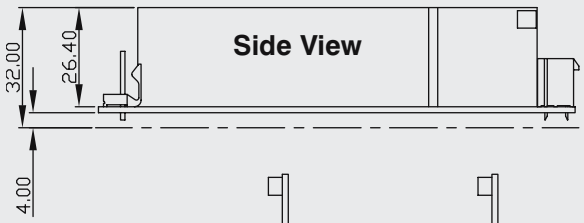
	Date	Amendments
CSA 22.2 No. 60950-1	2003	
IEC60950-1*	2005	

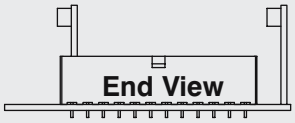
* CB certificate and report available on request.

Check with factory for status of approvals.

Outline & Connection Drawings







J2

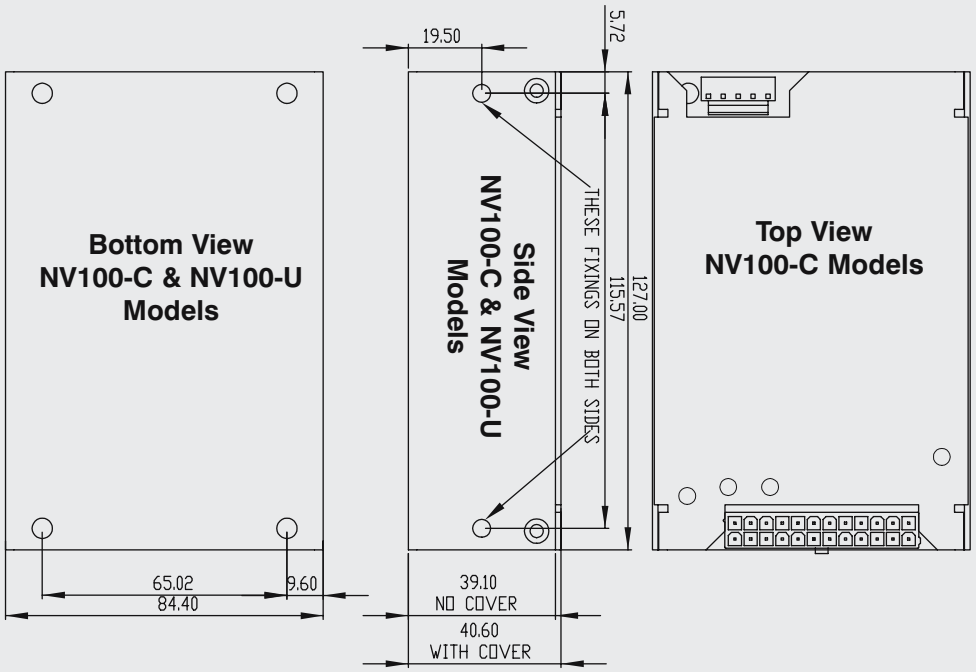
PIN	FUNCTION
1	EARTH
2	NOT CONNECTED
3	LIVE
4	NOT CONNECTED
5	NEUTRAL

J1

PIN	FUNCTION	PIN	FUNCTION
12	NOT CONNECTED	24	NOT CONNECTED
11	NOT CONNECTED	23	NOT CONNECTED
10	CH1 OUTPUT	22	CH1 POWER GOOD
9	CH1 OUTPUT	21	CH1 OUTPUT
8	CH1 OUTPUT	20	CH1 OUTPUT
7	+SENSE CH1	19	-SENSE CH1
6	0V COMMON	18	0V COMMON
5	0V COMMON	17	0V COMMON
4	CH2 OUTPUT	16	0V COMMON
3	CH2 OUTPUT	15	CH2 OUTPUT
2	+SENSE CH2	14	-SENSE CH2
1	CH3 OUTPUT	13	CH4 OUTPUT

MATING PARTS (MOLEX OR EQUIVALENT)

CONN	HOUSING	PINS
J1	39-01-2245	44476-3112
J2	09-50-8051	08-52-0113



Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

NV-Power

175 / 180 / 200 W

Highlights

- High efficiency
- Low profile
- High power density (9.3 W/in³)
- Up to 5 outputs
- Medical approval
- 3 years warranty
- Minimises heat in system
- Fits 1 U applications
- Less space
- Temperature controlled fan option
- No minimum load

Input Specifications

Input voltage	90 – 264 V AC / 120 – 350 V DC
Input frequency	47 – 63 Hz (440 Hz with reduced PFC – consult factory)
Input harmonics	EN61000-3-2 compliant
Inrush current	<40 A at 25 °C and 264 V AC, (cold start)
Input fuse	Fast acting (not user accessible)
Earth leakage current	123 µA max. at 120 V AC (60 Hz) 257 µA max. at 240 V AC (60 Hz) Worst case leakage current is less than 300 µA at 264 V AC, 63 Hz (normal condition, 500 µA Single Fault Condition)
Power factor	0.97 typical

Quick Selector

preferred configurations

Model	Ch1	Ch2	Ch3	Ch4	Ch5	Global option[1]
NV1-1T000	12 V / 15 A					No
NV1-1G000	24 V / 7.5 A					No
NV1-453TT	5 V / 25 A	3.3 V / 15 A	12 V / 5 A	–12 V / 1 A		No
NV1-453TT-N3	5 V / 25 A	3.3 V / 15 A	12 V / 5 A	–12 V / 1 A	5 V / 2 A	ATX (-N3)
NV1-453FF	5 V / 25 A	3.3 V / 15 A	15 V / 5 A	–15 V / 1 A		No
NV1-453FF-N3	5 V / 25 A	3.3 V / 15 A	15 V / 5 A	–15 V / 1 A	5 V / 2 A	ATX (-N3)
NV1-4G5TT	24 V / 7.5 A	5 V / 8 A	12 V / 5 A	–12 V / 1 A		No
NV1-4G5TT-N3	24 V / 7.5 A	5 V / 8 A	12 V / 5 A	–12 V / 1 A	5 V / 2 A	ATX (-N3)
NV1-4G5FF	24 V / 7.5 A	5 V / 8 A	15 V / 5 A	–15 V / 1 A		No
NV1-4G5FF-N3	24 V / 7.5 A	5 V / 8 A	15 V / 5 A	–15 V / 1 A	5 V / 2 A	ATX (-N3)

[1] see page 17 for details of global option.

Above units available on rapid delivery. See over for additional variants available “Build to Order”.

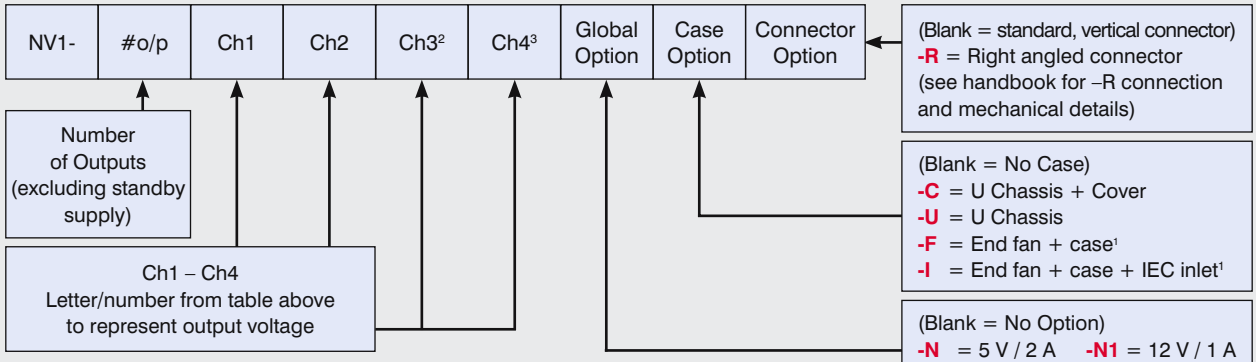
Available Outputs

Channel 1	Adj. range	Channel 2[1]	Adj. range	Channel 3[3]	Adj. range	Channel 4[4]	Adj. range
5 5 V / 25 A[2]	5 – 5.5 V	**1** 1.8 V / 15 A **2** 2.7 V / 15 A **3** 3.3 V / 15 A **0** Omit	0.9 – 2.5 V 2.5 – 3.3 V 2.5 – 3.3 V	**T** 12 V / 5 A **F** 15 V / 5 A **G** 24 V / 2.5 A **0** Omit	12 – 15 V 12 – 15 V 18 – 24 V	**T** –12 V / 1 A **F** –15 V / 1 A **3H** –3.3 V / 2 A[9] **5H** –5 V / 2 A[9] **TH** –12 V / 2 A[9] **FH** –15 V / 2 A[9] **OH** Fan supply only **0** Omit	fixed fixed fixed fixed fixed fixed fixed
T 12 V / 15 A **F** 15 V / 12 A	12 – 15 V[5] 12 – 15 V[6]	**5** 5 V / 10 A[10] **0** Omit	3.3 – 5.5 V				
G 24 V / 7.5 A	24 – 28 V[7]	**5** 5 V / 8 A[8] **0** Omit	3.3 – 5.5 V				

1 1.8 V, 2.7 V, 3.3 V channel 2 only available with 5 V Channel 1
5 V / 10 A channel 2 only available with 12 V or 15 V Channel 1
5 V / 8 A channel 2 only available with 24 V Channel 1.
2 Maximum combined output current from Ch1 & Ch2 = 25 A
Models with 5 V channel 1 are limited to 175 W output power.
3 Follow letters in red by "Y" for negative output channel 3.
4 Follow letters in red by "P" for positive output channel 4.
5 12 – 12.5 V if 24 V channel 3 fitted.
6 14.5 – 15 V if 24 V channel 3 fitted.
7 24 – 24.5 V if 5 V channel 2 fitted
24 – 26 V if 24 V channel 3 fitted.
8 7A max. with "-F" or "-I" option.
9 1.5 A max with "-F" or "-I" option.
10 9 A max with "-F" or "-I"option.

Other output options are available, please contact factory with your requirements.

How to create a Product Code



1 Needs 0H, 3H, 5H, TH or FH type channel 4. **The fan speed is temperature dependent, ensuring optimum cooling and lowest audible noise.**
2 For Negative Output Channel 3, follow chosen letter by "Y". For example, TY channel 3 = –12 V / 5 A
3 For Positive Output Channel 4, follow chosen letter by "P". For example, TP channel 4 = +12 V / 1 A

Confirm availability of created product code with the factory.

Output Specifications

		Notes
Remote sense	yes	Channels 1 & 2 – max. 0.5 V total line drop.
Total regulation	1 %	Including Line (for 90 – 264 V AC input change), Load (for 0 – 100 % load change) and Cross (for 0 – 100 % load change on any other output) regulation
Ripple & noise	1 %	(or 50 mV if higher) Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage accuracy	±1 %	±4 % for channel 4 with "T" or "F" type outputs, +4 %/–3 % for all other Ch 4
Turn on time	1.5 s max.	at 90 V AC & 100 % rated output power
Efficiency	up to 90 %	configuration dependent
Hold-up	16 ms min.	at 90 V AC
Minimum load	none	on any output
Transient response	<4 %	of set voltage for 50 % load change (in 50 µs within the range 25 – 100 % load)
Recovery	<500 µs	for recovery to 1 % of set voltage
Short circuit protection	yes	
Over temperature protection	yes	
Over voltage protection	yes	See application notes for details
Ch1 good signal	yes	Provides a logic "low" signal after output is within 90 % (±5 %) of nominal
Peak output power	200 W	Single output units with 12 V, 15 V or 24 V (T, F or G). Average output power must not exceed 180 W over any 5 minute period

Isolation

Input to output	reinforced	4.3 kV DC		
Input to earth	basic	2.3 kV DC	Output to earth	200 V DC

Global Signals -N1 and -N2 Option Models

Remote on/off	TTL logic level high inhibits all outputs (except standby)
Power good	Open collector output (referenced to PSU 0 V). Turns on to indicate AC supply is good and output 1 is within regulation.
Standby supply	Isolated supply, not affected by remote on/off -N Option = 5 V / 2 A (2.5 A peak) -N1 Option = 12 V / 1 A -N2 Option = 13.5 V / 1 A

See application note for details.

Global Signals -N3 and -N4 Option Models

ATX power good	Logic high indicates AC supply is good and output 1 is within regulation
Standby supply	Common 0 V with power supply. Not affected by ATX remote on/off -N3 Option = 5 V / 2 A -N4 Option = 12 V / 1 A

Environment

Temperature	0 °C to 50 °C operational, –40 °C to 85 °C storage (max. 12 months) Full load with either "-F" option fitted or 2 m/s air blown from input to output
Convection rating	See application note for details
Derating	50 °C to 70 °C derate each output by 2.5 % per °C
Low temperature start-up	–20 °C
Humidity	5 – 95 % RH non condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11ms (±0.5 msec), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987 Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1,9
Altitude	3,000 metres operational
Pollution	Degree 2, Material group 3b

Immunity EN61000-6-2: 2001

				Criteria
Electrostatic Discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV Not applicable to open frame units	A
Electromagnetic field	EN61000-4-3	Level 3	12 V/m	A
Fast / Burst transient	EN61000-4-4	Level 4	tested to 4.4 kV	A
Surge immunity	EN61000-4-5	Level 3	Common mode to 2.2 kV Differential mode to 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A/m	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption	A

Emissions EN61000-6-3: 2001

Radiated electric field	EN55022	(as per CISPR.22) Class A, Class B. See application note for details.
Conducted emissions	EN55022	Class B (as per CISPR.22)
Conducted harmonics	EN61000-3-2	Compliant
Flicker	EN61000-3-3	Compliant

Safety Approvals

	Date	Amendments
EN60950-1	2006	
UL60950-1	2007	
CSA22.2 No 60950-1	2003	
IEC60950-1*	2005	
EN61010-1	2001	

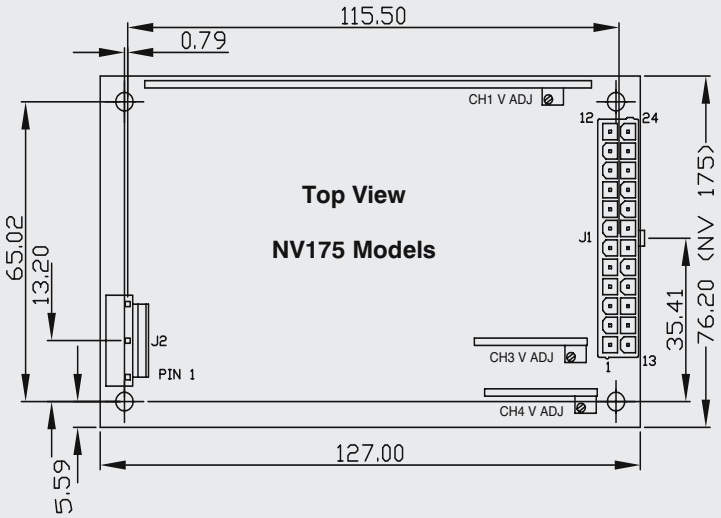
	Date	Amendments
IEC61010-1*	2001	
IEC60601-1*	1988	A1, A2
EN60601-1	1990	A1, A2, A13
UL60601-1	2003	with revisions 2006
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

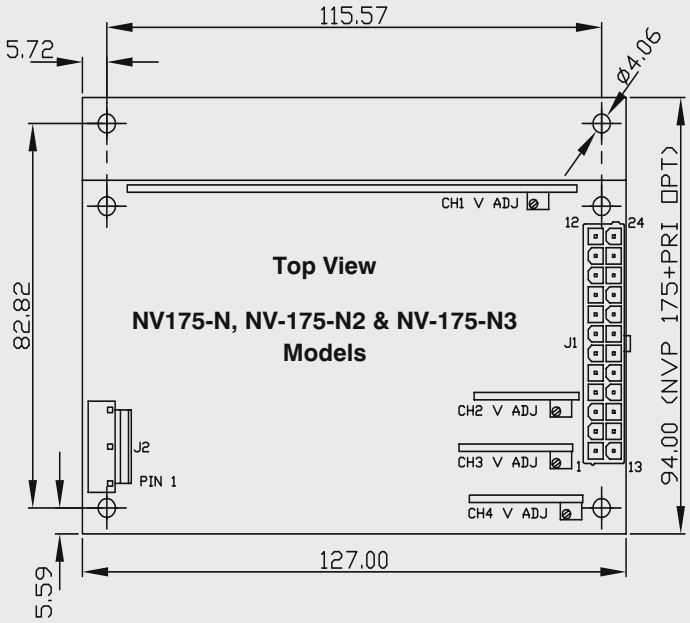
* CB certificate and report available on request.

Check with factory for status of approvals.

Outline & Connection Drawings

All drawings relate to both 175 W and 180 W versions





J2

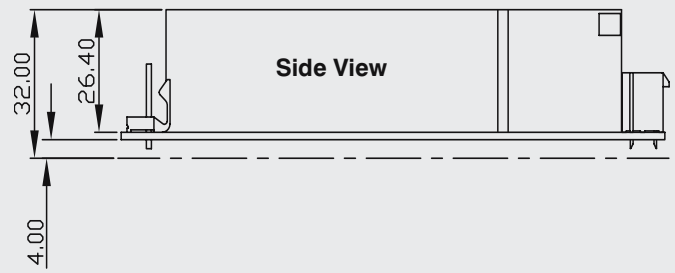
PIN	FUNCTION
1	EARTH
2	NOT CONNECTED
3	LIVE
4	NOT CONNECTED
5	NEUTRAL

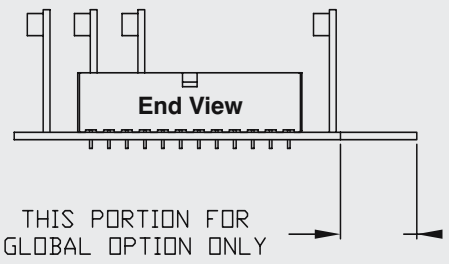
J1

PIN	FUNCTION	PIN	FUNCTION
12	STANDBY +Ve	24	Do not connect
11	Do not connect	23	Do not connect
10	CH1 OUTPUT	22	CH1 POWER GOOD
9	CH1 OUTPUT	21	CH1 OUTPUT
8	CH1 OUTPUT	20	CH1 OUTPUT
7	+SENSE CH1	19	-SENSE CH1
6	0V COMMON	18	0V COMMON
5	0V COMMON	17	0V COMMON
4	Do not connect	16	0V COMMON
3	Do not connect	15	Do not connect
2	Do not connect	14	Do not connect
1	CH3 OUTPUT	13	CH4 OUTPUT

MATING PARTS (MOLEX OR EQUIVALENT)

CONN	HOUSING	PINS
J1	39-01-2245	44476-3112
J2	09-50-8051	08-52-0113

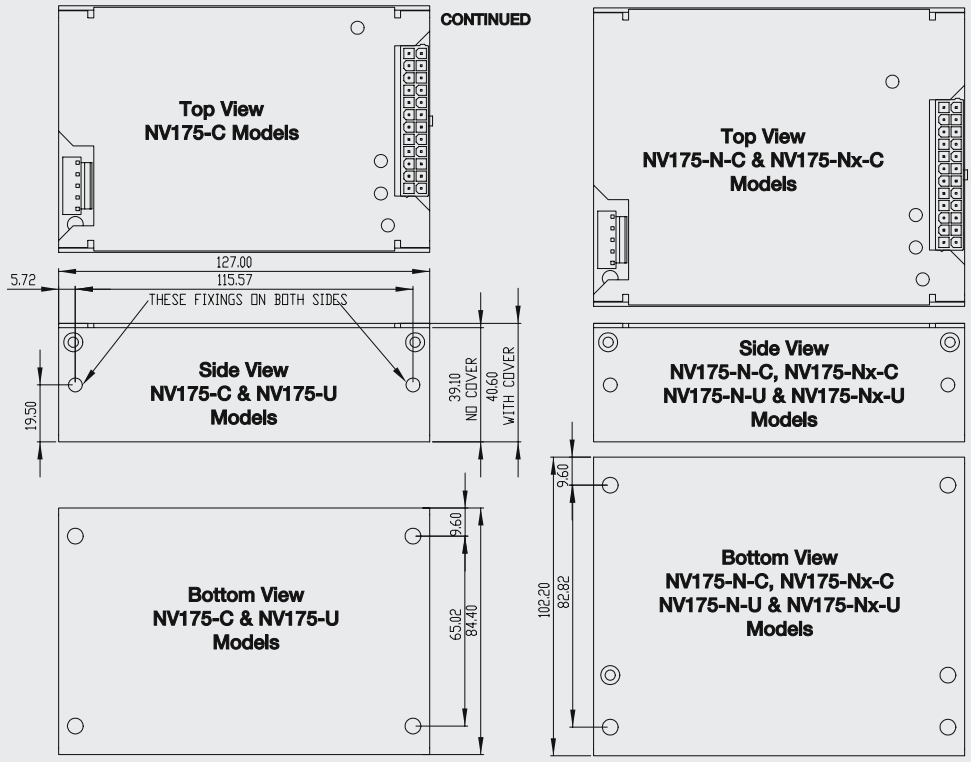




Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

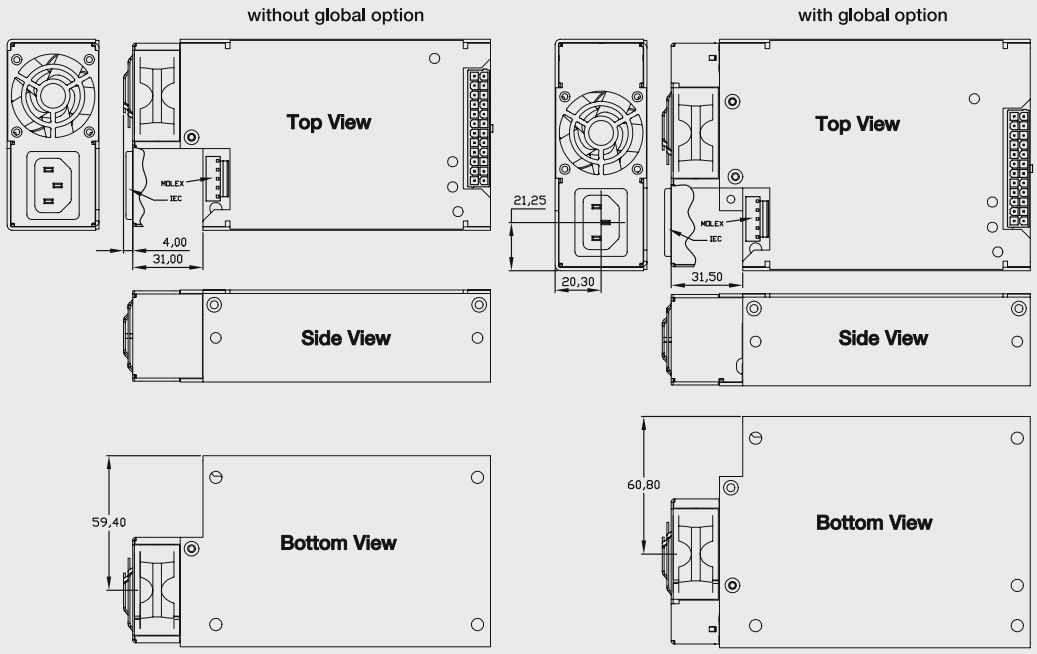
Outline & Connection Drawings

All drawings relate to both 175 W and 180 W versions



NV-175 units with fan (-F / -I)

All drawings relate to both 175 W and 180 W versions



Other dimensions same as cases without fans (above)

Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

Highlights

- High efficiency
- High power density (8.3 W/in³)
- Up to 5 outputs
- No minimum load
- Fits 1 U applications
- Medical approval
- 3 years warranty
- Temperature controlled fan option

Input Specifications

Input voltage	90 – 264 V AC / 120 – 350 V DC (below 100 V AC input, derate by 3 W per V)
Input harmonics	EN61000-3-2 compliant
Input fuse	6.3 A, Fast acting (not user accessible)
Input frequency	45 – 63 Hz (440 Hz with reduced PFC – consult factory)
Inrush current	15 A (typical) at 20 °C and 264 V AC, (cold start)
Power factor	0.97 typical
Earth leakage current	123 µA max. at 120 V AC (60 Hz), 257 µA max. at 240 V AC (60 Hz). Worst case leakage current is less than 300 µA at 264 V AC, 63 Hz (normal condition, 500 µA Single Fault Condition)

Quick Selector

preferred configurations

Model	Ch1	Ch2	Ch3	Ch4	Ch5	Global option[1]
NVA3-453TT	5 V / 40 A	3.3 V / 15 A	12 V / 5 A	–12 V / 1 A	–	no
NVA3-453TT-N3	5 V / 40 A	3.3 V / 15 A	12 V / 5 A	–12 V / 1 A	5 V / 2 A	ATX (-N3)
NVA3-350TT	5 V / 40 A	–	12 V / 5 A	–12 V / 1 A	–	no
NVA3-350TT-N3	5 V / 40 A	–	12 V / 5 A	–12 V / 1 A	5 V / 2 A	ATX (-N3)
NVA3-453FF	5 V / 40 A	3.3 V / 15 A	15 V / 5 A	–15 V / 1 A	–	no
NVA3-453FF-N3	5 V / 40 A	3.3 V / 15 A	15 V / 5 A	–15 V / 1 A	5 V / 2 A	ATX (-N3)
NVA3-350FF	5 V / 40 A	–	15 V / 5 A	–15 V / 1 A	–	no
NVA3-350FF-N3	5 V / 40 A	–	15 V / 5 A	–15 V / 1 A	5 V / 2 A	ATX (-N3)

Above units available on rapid delivery. See over for additional variants available “Build to Order”.

1 See page 22 for details of global option.

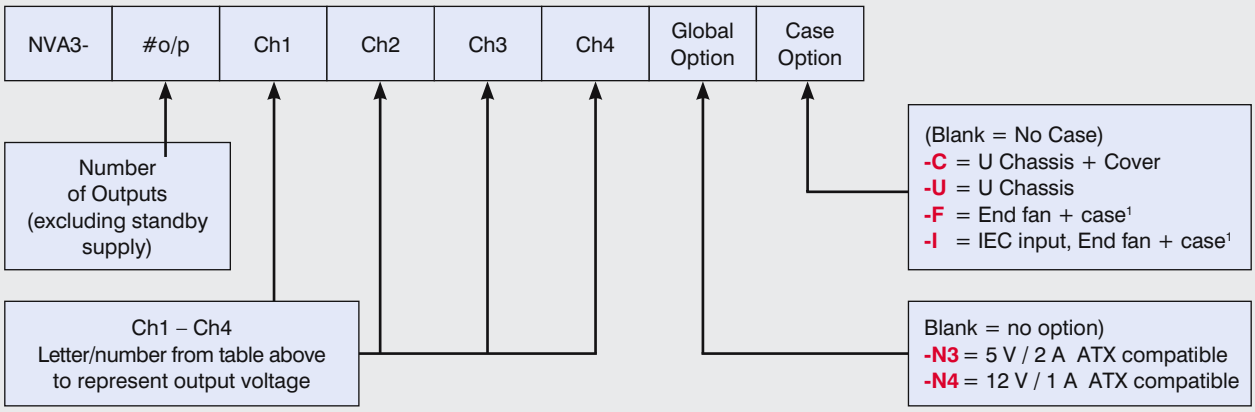
Available Outputs

Channel 1	Adj. range[5]	Channel 2[1]	Adj. range[5]	Channel 3	Adj. range[5]	Channel 4[3]	Adj. range
5 5 V / 40 A[2]	5 – 5.5 V	**1** 1.8 V / 15 A **2** 2.7 V / 15 A **3** 3.3 V / 15 A **2H** 2.7 V / 24 A **3H** 3.3 V / 24 A **0** Omit	0.9 – 2.5 V 2.5 – 3.8 V 2.5 – 3.8 V 2.5 – 3.8 V 2.5 – 3.8 V	**T** 12 V / 5 A[4] **TH** 12 V / 8 A[6] **F** 15 V / 4 A[4] **FH** 15 V / 6.4 A[6] **G** 24 V / 2.5 A **0** Omit	12 – 15 V 12 – 15 V 12 – 15 V 12 – 15 V 18 – 24 V	**3H** –3.3 V / 2 A[8] **5H** –5 V / 2 A[8] **TH** –12 V / 2 A[8] **FH** –15 V / 2 A[8] **OH** Fan supply only **0** Omit	Fixed Fixed Fixed Fixed Fixed Fixed
T 12 V / 25 A	12 – 13 V	**5** 5 V / 10 A **5H** 5 V / 16 A **0** Omit	3.3 – 5.5 V 3.3 – 5.5 V				
G 24 V / 12.5 A	24 – 28 V[7]	**5** 5 V / 8 A **5H** 5 V / 12.5 A **T** 12 V / 10 A **F** 15 V / 10 A **0** Omit	5 – 5.5 V 5 – 5.5 V 12 – 15.5 V 12 – 15.5 V				

1 1, 2, 3, 2H & 3H channel 2 only available with 5 V channel 1.
5 V / 10 A channel 2 only available with 12 or 15 V channel 1
5 V / 8 A channel 2 only available with 24 V channel 1.
2 Maximum combined output current from Ch1 & Ch2 = 40 A.
3 Follow letters in red by "P" for positive output channel 4.
4 60 W max output power.
5 Max voltage at the output (includes remote sense).
6 96 W max output power.
7 24 – 24.5 V if 5 V channel 2 fitted, 24 – 26 V if 24 V channel 3 fitted.
8 1.5 A max if fitted with "-F" option.

Other output options are available, please contact factory with your requirements.

How to create a Product Code



Note: 1 Needs 0H, 3H, 5H, TH or FH type channel 4.
The fan speed is temperature dependent, ensuring optimum cooling and lowest audible noise.

Confirm availability of created product code with the factory.

Output Specifications

Remote sense	yes	Channels 1 & 2 – max. 0.5 V total line drop.
Total regulation	1.5 %	For channels 1, 2 and 3 (2.5 % for channel 4) Including Line (for 90 – 264 V AC input change), Load (for 0 – 100 % load change) and Cross (for 0 – 100 % load change on any other output) regulation
Ripple & noise	1 %	(or 50 mV if higher) Pk-Pk, using EIAJ test method & 20 MHz bandwidth 1.5 % for units with 5 V Channel 1
Voltage accuracy	±1 %	±5 % for Channel 4
Turn on time	1.5 s max.	at 90 V AC & 100 % rated output power
Efficiency	up to 90 %	configuration dependent
Hold-up	16 ms min.	at 90 V AC
Min. load	none	on any output
Transient response	<5 %	of set voltage for 40 % load change (in 50 µs within the range 25 – 100 % load)
Recovery	<500 µs	for recovery to 1 % of set voltage
Short circuit protection	yes	
Over temperature protection	yes	
Over voltage protection	yes	See application notes for details
Ch1 good signal	yes	Provides a logic "low" signal after channel 1 output is within 90 % (±5 %) of nominal
Output power	300 W	Total output power from all outputs (including standby supply)

Global Signals -N3 and -N4 Option Models

ATX remote on/off	TTL logic level high or open circuit will inhibit all outputs (except Standby)
ATX power good	Logic high indicates AC supply is good and output 1 is within regulation
Standby supply	Common 0 V with power supply. Not affected by ATX remote on/off -N3 Option = 5 V / 2 A -N4 Option = 12 V / 1 A

Isolation

Input to output	reinforced	4.3 kV DC Note: Basic for IEC/EN/UL/CSA60601-1		
Input to earth	basic	2.25 kV DC	Output to earth	200 V DC

Environment

Temperature	0 °C to 50 °C operational, – 40 °C to 85 °C storage (max. 12 months) Full load with either "-F" option fitted or 2 m/s air blown from input to output
Derating	50 °C to 70 °C derate each output by 2.5 % per °C
Low temperature start-up	– 20 °C
Humidity	5 – 95 % RH non condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11 ms (±0.5 msec), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987 Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1,9
Altitude	3,000 metres operational
Pollution	Degree 2, Material group 3

Immunity EN61000-6-2: 2005, EN60601-1-2: 2001

				Criteria
Electrostatic discharge	EN61000-4-2	Level 3	Air discharge 8 kV Contact discharge 4 kV Not applicable to open frame units	A
Electromagnetic field	EN61000-4-3	Level 3	12 V/m	A
Fast / Burst transient (AC input)	EN61000-4-4	Level 4	tested to 4.4 kV	A
Fast / Burst transient (DC output)	EN61000-4-4	Level 4	tested to 2.2 kV	A
Surge immunity	EN61000-4-5	Level 3	Common mode to 2.2 kV Differential mode to 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A/m	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption	A
Voltage fluctuations	EN61000-4-14	Class 3	for 100 – 240 V nominal	A

Emissions EN61000-6-3: 2001, EN60601-1-2: 2001

Radiated electric field	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B see application note for details
Conducted emissions	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B
Conducted harmonics	EN61000-3-2	Class A
Flicker	EN61000-3-3	Compliant – d_{max} only

Safety Approvals

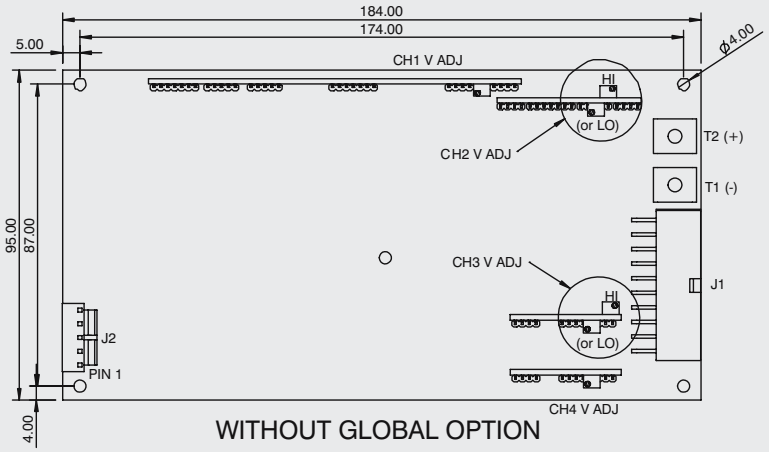
	Date	Amendments
EN60950-1	2006	
UL60950-1	2007	
CSA22.2 No 60950-1	2003	
IEC60950-1*	2005	
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

	Date	Amendments
EN61010-1	2001	
IEC61010-1*	2001	
IEC60601-1*	1988	A1, A2
EN60601-1	1990	A1, A2, A13
UL60601-1	2003	with revisions 2006

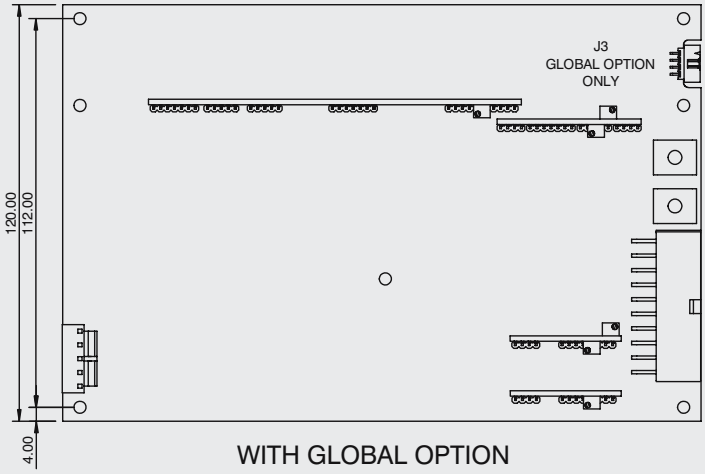
* CB certificate and report available on request.

Check with factory for status of approvals.

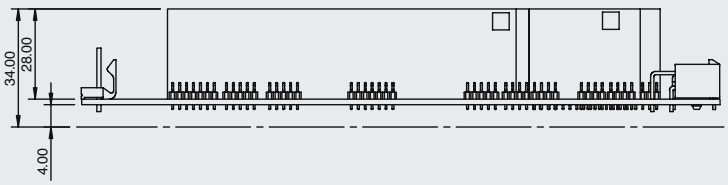
Outline & Connection Drawings

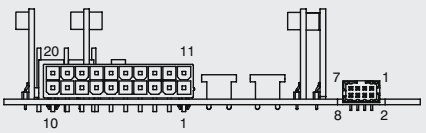


WITHOUT GLOBAL OPTION



WITH GLOBAL OPTION





J2

PIN	CONNECTION
1	EARTH
2	NOT CONNECTED
3	LIVE
4	NOT CONNECTED
5	NEUTRAL

J1

PIN	CONNECTION	PIN	CONNECTION
11	0V COMMON	1	0V COMMON
12	0V COMMON	2	0V COMMON
13	CH2 +Ve	3	CH2 +Ve
14	CH2 +Ve	4	CH2 +Ve
15	+SENSE CH1	5	-SENSE CH1
16	+SENSE CH2	6	-SENSE CH2
17	CH1 GOOD	7	N/C
18	CH3 +Ve	8	CH3 +Ve
19	0V COMMON	9	0V COMMON
20	CH4 O/P	10	CH4 O/P

T1 & T2 (SEE TOP LEFT)

J3 (GLOBAL OPTION ONLY)

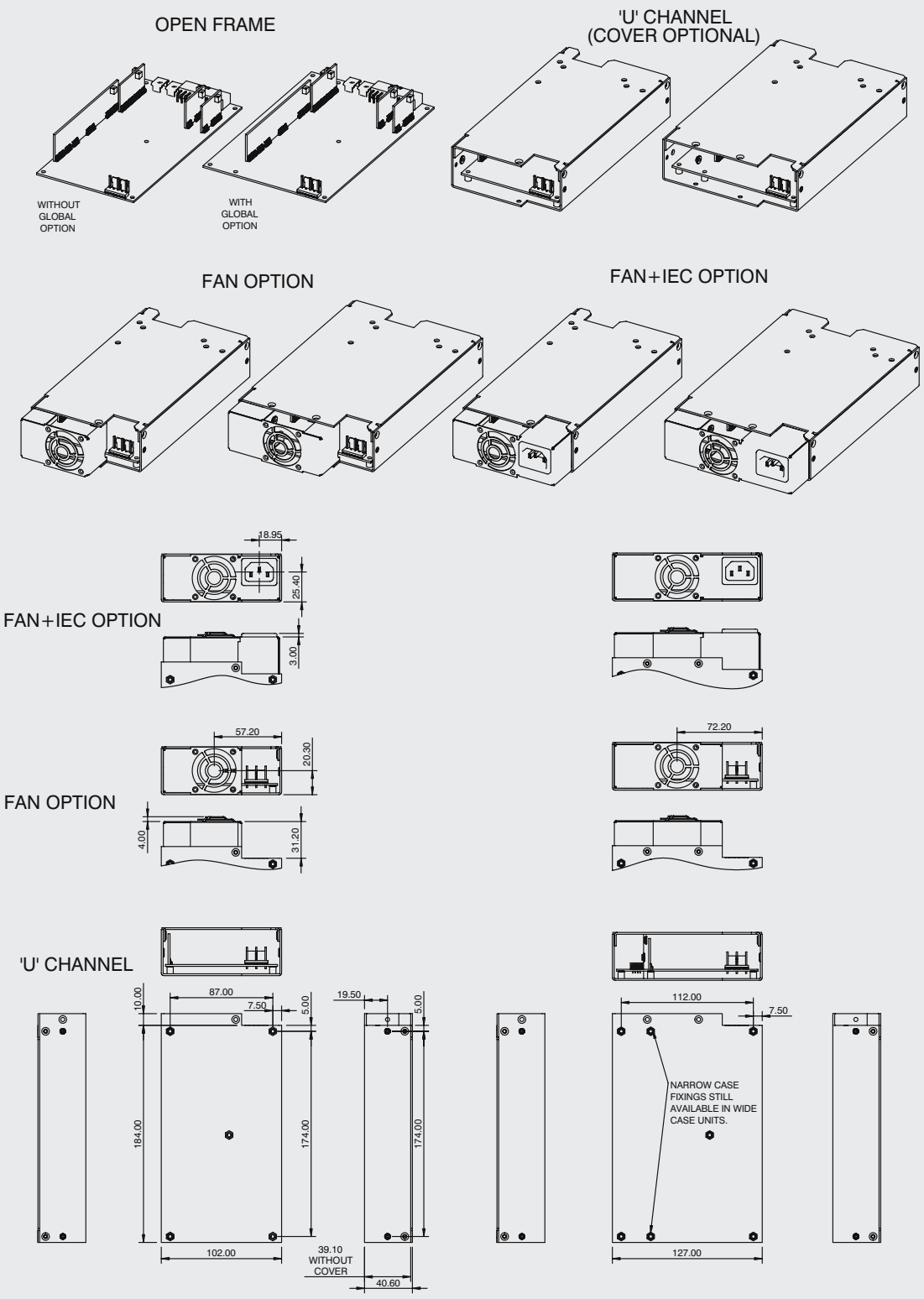
PIN	CONNECTION	PIN	CONNECTION
1	STANDBY -Ve	5	N/C
2	STANDBY +Ve	6	N/C
3	STANDBY -Ve	7	POWER GOOD
4	STANDBY +Ve	8	REM ON/OFF

MATING PARTS (MOLEX OR EQUIVALENT)

CONNECTOR	HOUSING	CRIMP PIN
J1	39-01-2205	44476-3112
J2	09-50-8051	08-52-0113
J3	51110-0860	50394
T1 & T2	N/A	TAG 19073-0165

Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

Outline & Connection Drawings



Other dimensions same as cases without fans (above)

Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

NV-Power 350 … 1150 W

Highlights

- High efficiency
- High power density (up to 19 W/in³)
- High peak power rating
- Up to 8 outputs (6 for NV-350)
- No minimum load
- Fits 1 U applications
- Medical approval
- 3 years warranty

Input Specifications

Input voltage	90 – 264 V AC		
Input frequency	47 – 63 Hz (up to 440 Hz with reduced PFC)		
Input harmonics	EN61000-3-2 compliant		
Inrush current	NV-350 <15 A	NV-700 <40 A	at 25 °C and 264 V AC (cold start)
Input fuse	NV-350 6.3 A	NV-700 16 A	250 V AC HBC Fast Acting (not user accessible)
Power factor	0.97 typical		
Leakage current	130 µA max. at 120 V AC (60 Hz), 260 µA max. at 240 V AC (60 Hz). Worst case leakage current is less than 300 µA at 264 V AC, 63 Hz (Normal Condition, <500 µA Single Fault Condition)		

Dual Output Modules

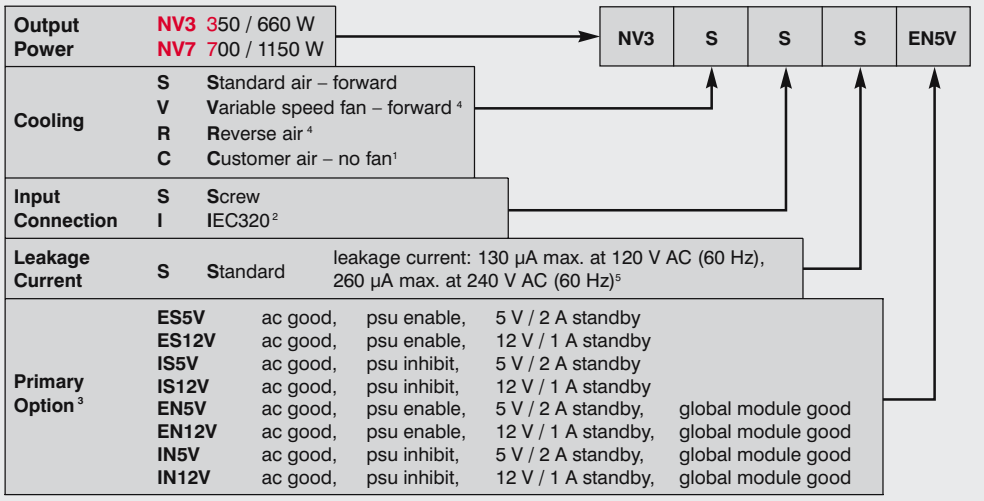
Module		Output 1		Output 2		Max Power
Code	Slots	Voltage range	Current	Voltage range	Current	
DA	1[8]	12 V (fixed)	3 A	–12 V (fixed)	1 A	48 W
DB	2	3.2 – 3.6 V	25 A	3.3 – 5.5 V 7 – 15 V 24 – 32 V	10 A 5 A 2 A	55 W 60 W 50 W
DB	2	4.75 – 5.5 V	25 A	3.3 – 5.5 V 7 – 15 V 24 – 32 V	10 A 5 A 2 A	55 W 60 W 50 W
DB	2	5.5 – 6.5 V	25 A	3.3 – 6.0 V	10 A	55 W
DB	2	12 – 15 V	13 A[1]	3.3 – 5.5 V 7 – 15 V 24 – 32 V	10 A 5 A 2 A	55 W 60 W 50 W
DB	2	24 – 28 V	7 A[2]	3.3 – 5.5 V 7 – 15 V 24 – 32 V	10 A 5 A 2 A	55 W 60 W 50 W

Single Output Modules

Module		Voltage range	Current	
Code	Slots		Continuous	Peak
B	2	3.2 – 3.6 V 4.75 – 5.5 V 7 – 9 V	40 A 40 A[3] 22.5 A[4]	40 A 40 A[3] 22.5 A[4]
BH	2	12 – 15.5 V 24 – 28 V	20 A[5] 10 A[6]	20 A[5] 10 A[6]
C	3	12 – 13.2 V 15 – 16.5 V 24 – 26.4 V 27 – 32 V	37.5 A[7] 30 A[7] 18.75 A[7] 16.6 A[7]	50 A[7] 37.5 A[7] 25 A[7] 19.7 A[7]
CM	3	24 – 26.4 V	18.75 A[7]	25 A[7]
CC	6	24 – 26.4 V 30 – 33 V 48 – 52.8 V 54 – 63 V	37.5 A[9] 30 A[9] 18.75 A[9] 16.6 A[9]	50 A[9] 37.5 A[9] 25 A[9] 19.7 A[9]
CCM	6	48 – 52.8	18.75 A[9]	25 A[9]

Notes
1 derate linearly from 13 A at 12.5 V to 10 A at 15.5 V
2 derate linearly from 7 A at 25 V to 6 A at 28 V
3 for NV3 – derate linearly from 40 A at 5.2 V to 36 A at 5.5 V
for NV7 – derate linearly from 40 A at 5 V to 36 A at 5.5 V
4 derate linearly from 22.5 A at 8 V to 20 A at 9 V
5 for NV3 – derate linearly from 20 A at 13.2 V to 16.5 A at 15.5 V
for NV7 – derate linearly from 20 A at 12.5 V to 15.5 A at 15.5 V
6 for NV3 – derate linearly from 10 A at 25.7 V to 8.5 A at 28 V
for NV7 – derate linearly from 10 A at 24 V to 8.5 A at 28 V
7 for NV3, 400 W max
for NV7, 600 W peak for up to 10 sec, 450 W average
8 only one per power supply
9 for NV7 only, 1200 W peak for up to 10 sec, 900 W average

NV-350 / NV-700 Configuring



Notes
1 Thermocoupled sample recommended to ensure adequate cooling – consult sales
2 Not with customer air Cooling
3 The Primary Option uses 1 slot
4 Not with NV7 (variable speed fan standard on NV7). Recommended for new designs for NV-350
5 Worst case leakage current is less than 300 µA at 264 V AC, 63 Hz Normal Condition (<500 µA Single Fault Condition)

The extensive range of output modules and options make it possible to achieve almost any combination of Volts and Amps.You can create your own NV-350 or NV-700 configuration online at **www.nv-power.com**. This method checks your configuration and offers the optimum solution. Alternatively, you can do this manually by using the guide below.

1. Calculate total output power to ensure power requirements are within 350 W or 1150 W, then select required Cooling, Connection and Controls/Signals from the table above.
2. Select Output Modules from the Module Tables below ensuring that no more that 6 slots (NV-350) or 8 slots (NV-700) in total are used.

Example – if you require 13 V 20 A:
a) select B as closest match for voltage & current and prefix with voltage eg. **13BH**
b) repeat for other outputs

This will create a complete product description eg. **NV3SSSES5V 13BH 12/15DB** which represents a three output NV-350 with Forward air cooling, Screw input terminals, standard leakage filter, ac good, PSU enable & 5 V / 2 A aux supply

Output 1 = 13 V / 20 A
Output 2 = 12 V / 13 A with screw terminals
Output 3 = 15 V / 4 A with screw terminals
Max. 350 W continuous output power

3. Contact TDK-Lambda to validate configuration and issue a part number.

Output Power

		90 – 115 V AC	115 – 150 V AC	150 – 180 V AC	180 – 264 V AC
NV-350	Continuous[6]	350 W	450 W	450 W	660 W
	Peak (10 s)[7]	400 W[1]	500 W[2]	500 W[2]	740 W[3]
NV-700	Continuous	700 W	700 W	1150 W	1150 W
	Peak (10 s)		850 W[4]	1150 W	1450 W[5]

1 350 W average 2 450 W average 3 600 W average 4 700 W average 5 1150 W average 6 250 W for reverse air 7 not for reverse air

Output

Voltage / current	See module tables	
Turn on time	1.5 s max.	at 90 V AC and 100 % rated output power
Rise time	<50 ms	to 90 % of voltage, monotonic rise above 10 %
Efficiency	up to 90 %	configuration dependent
Hold-up	16 ms min.	at 90 V AC and 100 % rated power (12 ms for NV-700 above 700 W output power)
Ripple and noise	<1 %	Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage accuracy	<1 %	of set voltage (DA module: +5/–1% for channel 1, +2/–3.5 % for channel 2)
Remote sense	yes	standard on single o/p + ch 1 of dual modules, max. 0.5 V total line drop (DA module: none)
Minimum load	no	on any output (DA module: 150 mA on channel 1)
Temperature coefficient	<0.02 %	of rated voltage per °C
Load regulation	<1 %	for 0 – 100 % load change (<2 % for channel 2, DA module: <3 %)
Line regulation	<0.1 %	for 90 – 264 V AC input change
Cross regulation	<0.1 %	for 100 % load change on any output (DA module: 0.2 % for channel 1, 3 % for channel 2)
Transient response	<4 %	of set voltage for 50 % load change
Recovery	500 µs	for recovery to 1 % of set voltage (DA module: 1000 µs)
Over voltage protection	yes	
Over current protection (singles)	110 – 150 %	of module current. Hiccup mode. Module primary side protected
Power Limit (duals)	110 – 150 %	of max. Power ch 1 + ch 2. Hiccub mode. Module primary side protected (DA module: 110 – 220 % for channel 1, 110 – 170 % for channel 2)
Short circuit protection	yes	
Over temperature protection	yes	cycle ac off/on to reset. Shut-down temperature varies according to ambient, output power & input voltage.

Signals – Standard

Ch1/Ch2 module good	Open collector output. “On” indicates output is within 90 % (±5 %) of nominal
Module inhibit	TTL logic high inhibits the output (both outputs for duals) of the module
Ch2 on/off (duals only)	TTL logic low inhibits output 2 of the module

All signals referenced to 0 V of channel

Global Interface Signals

with Primary Option

AC good collector AC good emitter	Uncommitted optocoupler. Turns on typically 5 ms after AC is good and off typically 5 ms before any channel falls below 95 % of nominal
Global module good collector Global module good emitter	Uncommitted optocoupler. Turns on typically 200 ms after all outputs are within 90 % (±5 %) of nominal and off typically 5 ms before any channel falls below 90 % (±5 %) of nominal. Do not connect for ES and IS type primary option.
EN/ES & IN/IS logic 0	TTL low enables (EN or ES) or inhibits (IN or IS) the entire psu including fan (except standby)
EN/ES & IN/IS logic 1	TTL high enables (EN or ES) or inhibits (IN or IS) the entire psu including fan (except standby)
Standby supply	5 V / 2 A (2.5 A peak) or 12 V / 1 A (1.2 A peak)

Isolation

Input to output	**reinforced**	**4 kV AC, 5.7 kV DC** type tested to 4 kV AC (equivalent to 5.7 kV DC), production tested to 4.3 kV DC		Units fitted with C and CC modules only
		4.3 kV DC Note: Basic for IEC/EN/UL/CSA60601-1		Units with any other module or primary option
Input to earth	**basic**	**2.3 kV DC**	**Output to earth**	**200 V DC**

Environment

Temperature	0 °C to 50 °C operational, –40 °C to 85 °C storage (max. 12 months)
Derating	50 °C[1] to 70 °C derate total output power and each output current by 2.5 % per °C
Low temperature start-up	–20 °C
Humidity	5 – 95 % RH non condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11 ms (±0.5 ms), half sine conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes
Altitude	3,000 metres operational (5,000 metres non-operational)
Pollution	Degree 2, Material group 3b

1 45 °C for NV7 with input voltage below 100 V AC.

Immunity EN61000-6-2: 2005, EN60601-1-2: 2001

				Criteria
Electrostatic discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV	A
Electromagnetic field	EN61000-4-3	Level 3	12 V/m	A
Fast / Burst transient (AC input)	EN61000-4-4	Level 4	tested to 4.4 kV	A
Fast / Burst transient (DC output)	EN61000-4-4	Level 4	tested to 2.2 kV	A
Surge immunity	EN61000-4-5	Level 3	Common mode to 2.2 kV Differential mode to 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A/m	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption	A
Voltage fluctuations	EN61000-4-14	Class 3	for 100 – 240 V nominal	A

Emissions EN61000-6-3: 2001, EN60601-1-2: 2001

Radiated electric field	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B see application note for details
Conducted emissions	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B
Conducted harmonics	EN61000-3-2	Class A
Flicker	EN61000-3-3	Compliant – d_{max} only

Safety Approvals

	Date	Amendments
EN60950-1	2006	
UL60950-1	2003	
CSA22.2 No 60950-1	2003	
IEC60950-1*	2005	
CE Mark	LV Directive 2006/95/EC(EN60950-1)	

	Date	Amendments
EN61010-1	2001	
IEC61010-1*	2001	
IEC60601-1*	1988	A1, A2
EN60601-1	1990	A1, A2, A13
UL60601-1	2003	with revisions 2006

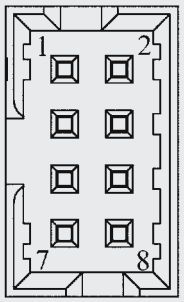
* CB certificate and report available on request.

Please check with Technical Sales for status of approvals.

Primary Option / DA Module

DA Module

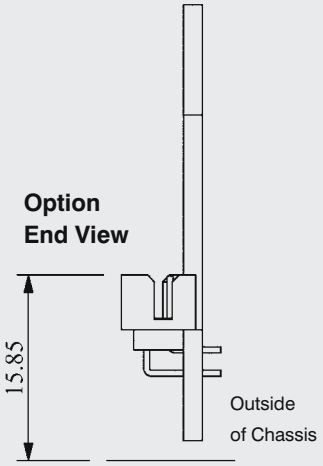
1 +12 V (channel 1)
2 +12 V (channel 1)
3 +12 V (channel 1)
4 0 V (common ch1 / ch2)
5 0 V (common ch1 / ch2)
6 0 V (common ch1 / ch2)
7 –12 V (channel 2)
8 –12 V (channel 2)



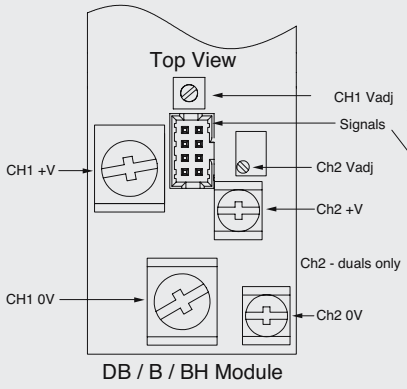
Primary Option

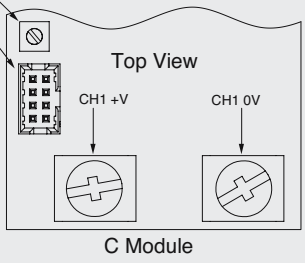
1 +V Standby
2 0 V Standby
3 EN/ES & IN/IS Logic 1
4 EN/ES & IN/IS Logic 0
5 Global Module Good Collector
6 Global Module Good Emitter
7 AC good Collector
8 AC good Emitter

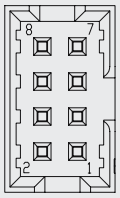
Housing: Molex 51110-0860
Crimp pin: 50394
Hand crimp tool: 69008-0959



Output Connections



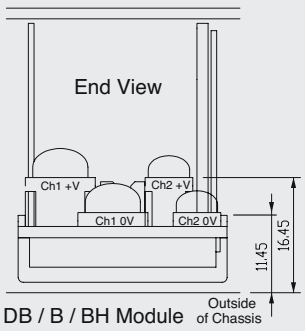


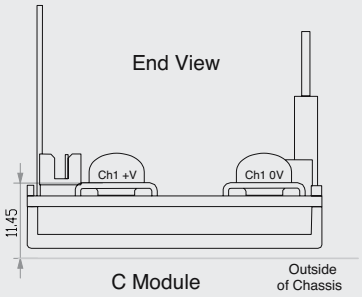


Signals

1 Ch2 0V
2 Ch2 Output Good
3 Ch2 On/Off
4 Module Inhibit
5 Ch1 0V
6 Ch1 Output Good
7 Ch1 Remote Sense -
8 Ch1 Remote Sense +

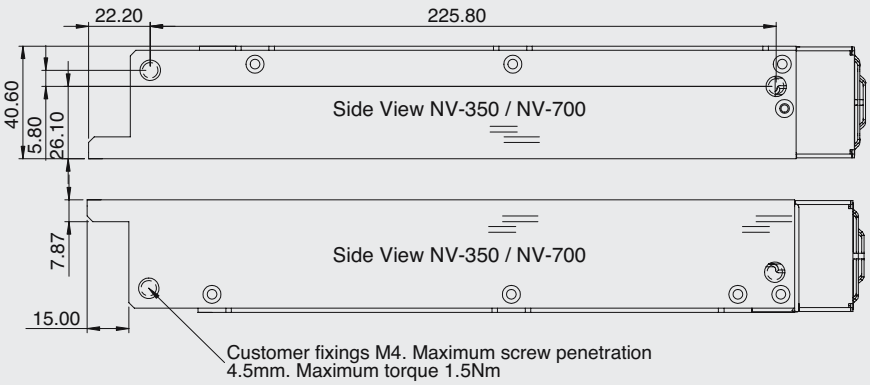
Housing: Molex 51110-0860
Crimp pin: 50394 Hand crimp tool: 69008-0959
Note: Do not connect pins 1-3 on single output modules



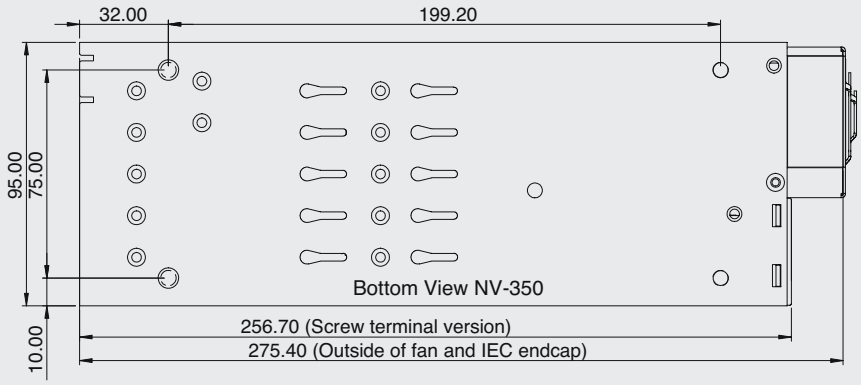


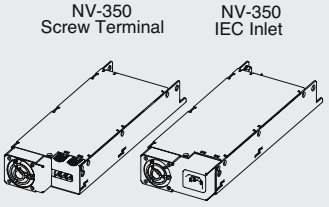
Connection Guidelines

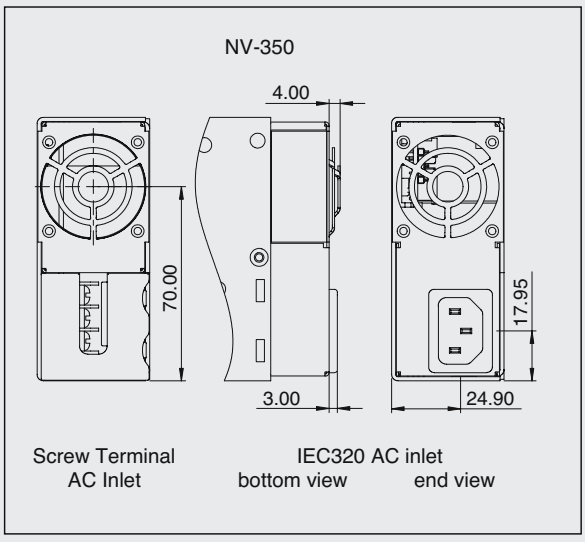
Ring Tags: Up to 50A, AMP PIDG terminals
Red: M3 36151, M4 320551, M5 130660
Blue: M3 320561, M4 320560, M5 130663
Yellow: M3 M4 320568, M5 130167
Crimp tool: 16900 Die set 169404

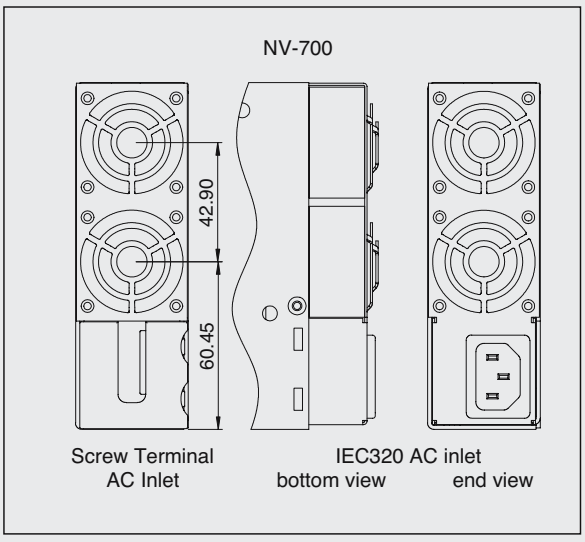


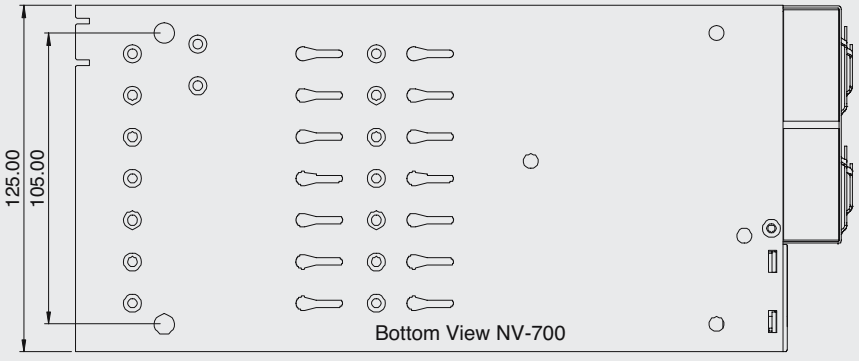
NOTES
1) Dimensions in mm
2) Tolerances:
Edge to edge/Edge to centre, +/-0.5
Centre to centre +/-0.2

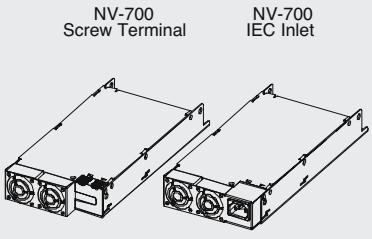












NV-Power FEP — 350 W

Highlights

- Designed for distributed power
- High efficiency
- Minimises heat in system
- Low profile
- Fits 1 U applications
- High power density (7.0 W/in^3)
- Less space
- Medical approval
- 3 years warranty

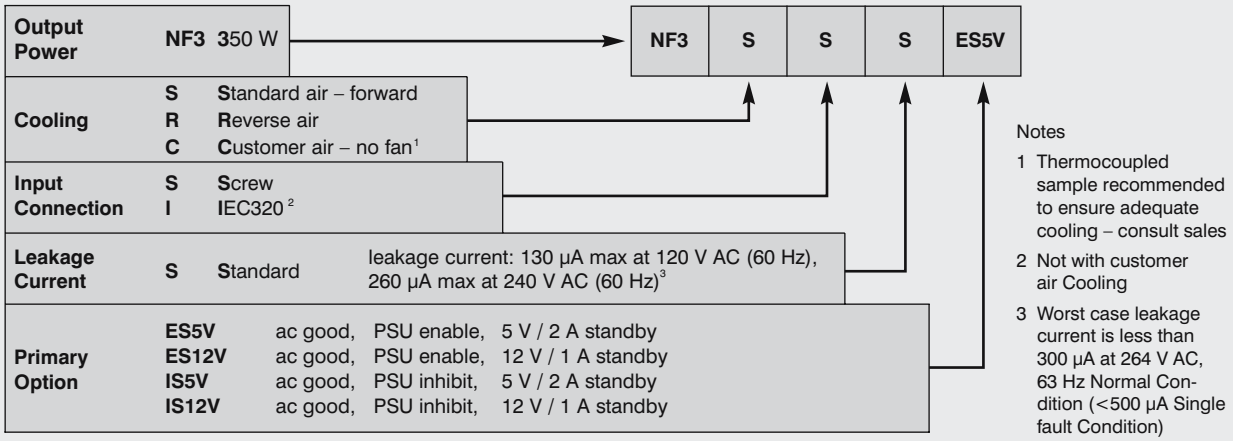
Input Specifications

Input voltage	90 – 264 V AC
Input frequency	47 – 63 Hz (up to 440 Hz with reduced PFC)
Input harmonics	EN61000-3-2 compliant
Inrush current	<15 A at 25 °C and 264 V AC (cold start)
Input fuse	6.3 A / 250 V AC HBC Fast Acting (not user accessible)
Power factor	0.97 typical
Leakage current	130 µA max. at 120 V AC (60 Hz), 260 µA max. at 240 V AC (60 Hz). Worst case leakage current is less than 300 µA at 264 V AC, 63 Hz Normal Condition (<500 µA Single fault condition)

Output Module (Type FE)

Output 1			Output 2			Total
Voltage range	Max. current	Max. power	Output voltage	Max. current	Max. power	Max. output power
11.5 – 13.2 V	29.2 A	350 W	12 V	2 A	24 W	350 W

NV-350-FEP Configuring



It is possible to create your own NV-350-FEP configuration online at **www.nv-power.com** or by using the guide above.

1. Select required Cooling, Connection and Controls/ Signals from the table above.
2. Select output required the Module Table below. Example – if you require 12 V 29 A: –
   a) select FE module and prefix with voltage eg **12FE**

This will create a complete product description eg **NF3SSSES5V 12FE** which represents a two output NV-350-FEP with Forward air, Screw i/p terminals, 300 µA Leakage, AC good, PSU enable & 5 V/2 A aux supply

Output 1 = 12 V / 29.2 A with screw terminals

Output 2 = 12 V / 2 A with screw terminals

Max. 350 W continuous output power

3. Contact TDK-Lambda to issue a part number.

Output Specifications

Voltage / current	See module tables	
Turn on time	1.5 s max.	at 90 V AC & 100 % rated output power
Rise time	<50 ms	to 90 % of voltage, monotonic rise above 10 %
Efficiency	90 %	typical
Hold-up	16 ms min.	at 90 V AC & 100 % rated power
Ripple & noise	<1 %	Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage accuracy	<1 %	of set voltage (±5 % for channel 2)
Remote sense	yes	Standard on single o/p + Ch1 of dual modules, max. 0.5 V total line drop
Minimum load	no	on any output
Temperature coefficient	<0.02 %	of rated voltage per °C
Total regulation	1 %	Including: Load Regulation for 0 – 100 % load change and Line Regulation for 90 – 264 V AC input change (2 % for channel 2)
Transient response	<4 %	of set voltage for 50 % load change
Recovery	500 µs	for recovery to 1 % of set voltage
Over voltage protection (Ch1)	15 – 16 V	
Over current protection (Ch1)	110 – 150 %	of rated current, hiccup mode. Module primary side protected
Short circuit protection	yes	
Over temperature protection	yes	Cycle AC off/on to reset. Shutdown temperature varies according to ambient, output power & input voltage

Signals – Standard

Ch1 good	Open collector output (emitter connected to Ch1 0 V). "On" indicates output is within 90 % (±5 %) of nominal
Ch1 remote sense –/+	Connections for remote sense. Up to 0.5 V total line drop can be compensated. If remote sense is not required, do not connect either "Sense –" or "Sense +"

Global Interface Signals

with Primary Option

AC good collector AC good emitter	Uncommitted optocoupler. Turns on typically 5 ms after AC is good and off typically 5 ms before any channel falls below 95 % of nominal
ES & IS logic 0	TTL low enables (ES) or inhibits (IS) the entire psu including fan (except standby)
ES & IS logic 1	TTL high enables (ES) or inhibits (IS) the entire psu including fan (except standby)
Standby supply	5 V / 2 A (2.5 A peak) or 12 V / 1 A (1.2 A peak)

Isolation

Input to output	**reinforced**	**4.3 kV DC Note: Basic for IEC/EN/UL/CSA60601-1**		
Input to earth	**basic**	**2.3 kV DC**	**Output to earth**	**200 V DC**

Environment

Temperature	0 to 50 °C operational, –40 °C to 85 °C storage (max. 12 months)
Derating	50 °C to 70 °C derate each output and total output power by 2.5 % per °C
Low temperature start-up	– 20 °C
Humidity	5 – 95 % RH non-condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11 ms (±0.5 ms), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes
Altitude	3,000 metres operational (15,000 metres non-operational)
Pollution	Degree 2, Material group 3b

Immunity EN61000-6-2: 2005, EN60601-1-2: 2001

				Criteria
Electrostatic discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV	A
Electromagnetic field	EN61000-4-3	Level 3	tested to 12 V/m	A
Fast / Burst transient (AC input)	EN61000-4-4	Level 4	tested to 4.4 kV	A
Fast / Burst transient (DC output)	EN61000-4-4	Level 4	tested to 2.2 kV	A
Surge immunity	EN61000-4-5	Level 3	Common mode to 2.2 kV Differential mode to 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	tested to 12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	tested to 30 A/m, 50 / 60 Hz	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption	A
Voltage fluctuations	EN61000-4-14	Class 3	for 100 – 240 V nominal	A

Emissions EN61000-6-3: 2001, EN60601-1-2: 2001

Radiated electric field	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B (2005) see application note for details
Conducted emissions	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B (2005)
Conducted harmonics	EN61000-3-2	Class A
Flicker	EN61000-3-3	Compliant – d_{max} only

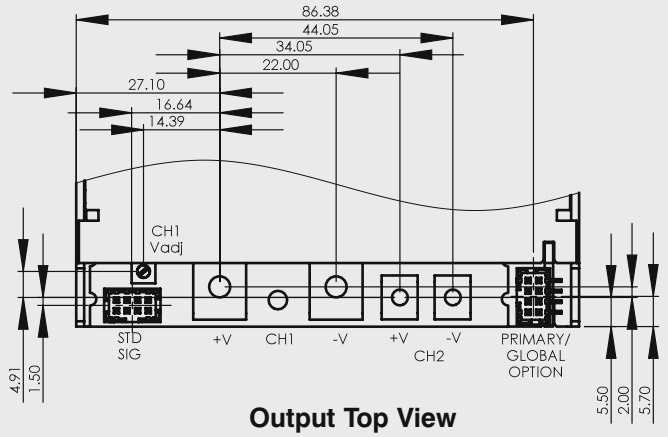
Safety Approvals

	Date	Amendments
EN60950-1	2006	
UL60950-1	2003	
CSA22.2 No 60950-1	2003	
IEC60950-1*	2005	
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

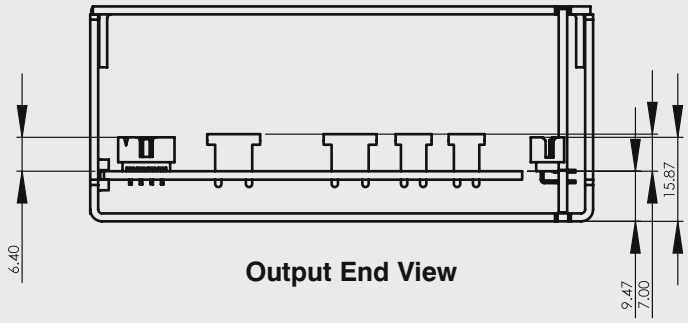
	Date	Amendments
EN61010-1	2001	
IEC61010-1*	2001	
IEC60601-1*	1988	A1, A2
EN60601-1	1990	A1, A2, A13
UL60601-1	2003	with revisions 2006

* CB certificate and report available on request.

Output Connections



Output Top View

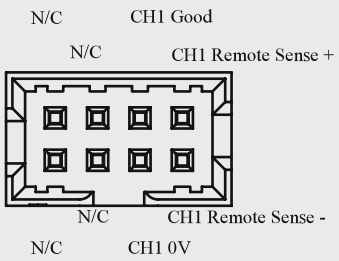


Output End View

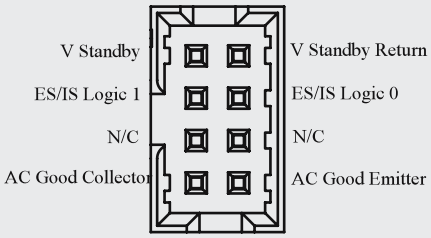
Connection Guidelines

Ring Tags: Up to 50A. AMP PIDG terminals
Red: M3 36151, M4 320551, M5 130660
Blue: M3 320561, M4 320560, M5 130663
Yellow: M4 320568, M5 130167
Crimp tool: 16900 Die set 169404

Standard Signals

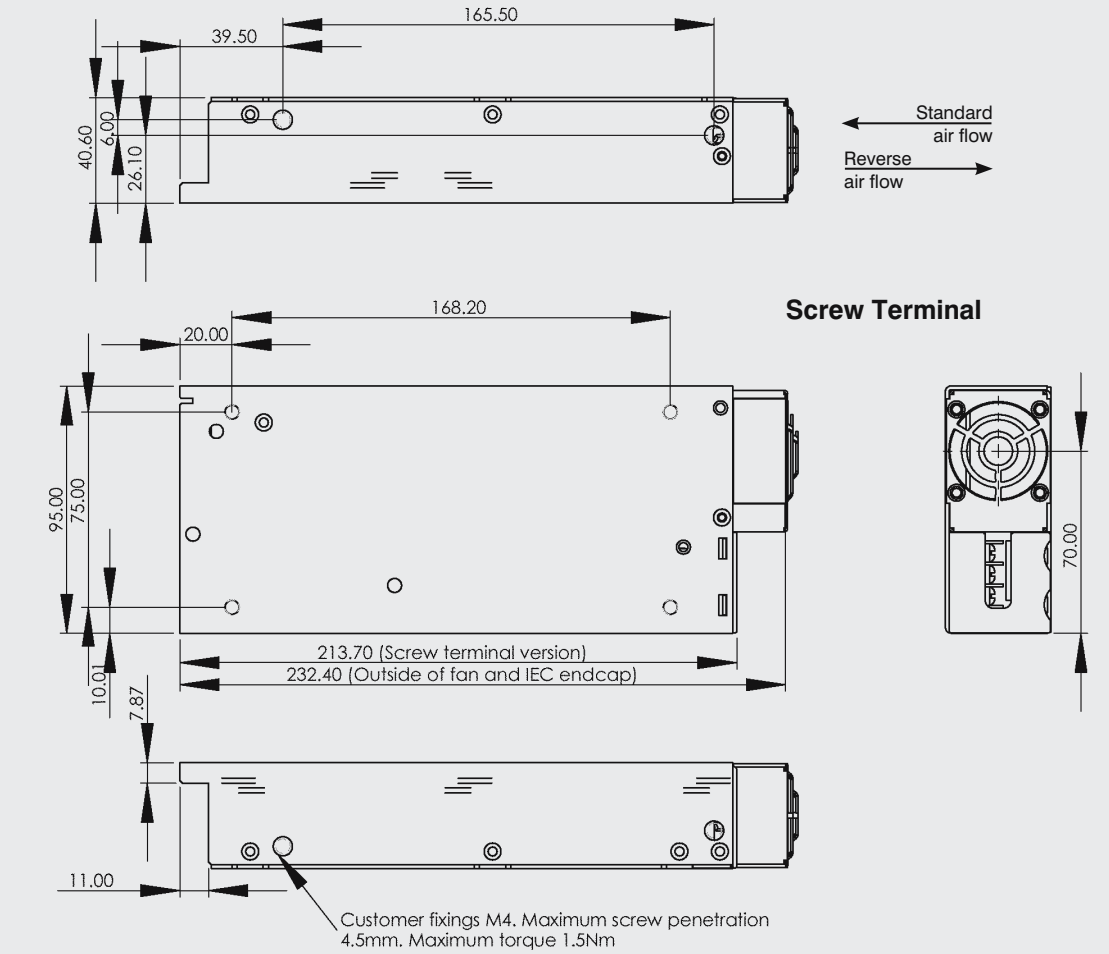


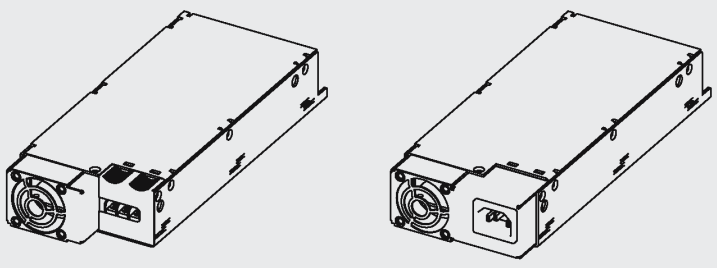
Primary/Global Option



Housing: Molex 51110-0860
Crimp pin: 50394
Hand crimp tool: 69008-0959

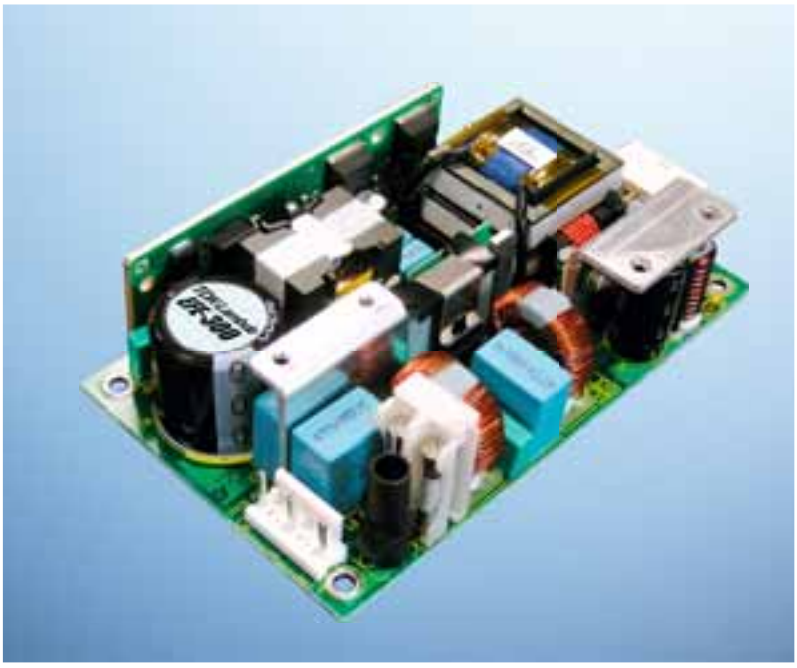
Outline & Connection Drawings





Notes: Tolerances Edge to edge / Edge to centre, ±0.5 mm, Centre to centre ±0.2 mm

EFE-300 / EFE-400 — 300 / 400 W



Highlights

- High efficiency
- 5 in x 3 in / 6 in x 3 in footprint
- High power density (up to 22 W/in^3)
- No minimum load
- Fits 1 U applications
- 400/530 W peak power for 10 seconds
- 3 years warranty

Input Specifications

Input voltage	90 – 264 V AC / 120 – 350 V DC
Input frequency	45 – 63 Hz (440 Hz with reduced PFC – consult factory)
Input harmonics	EN61000-3-2 compliant
Inrush current	<20 A for EFE300, <30 A for EFE400 at 25 °C and 230 V AC (cold start) (meets EN61000-3-3)
Input fuse	Dual fuses (Live + Neutral) Fast acting (not user accessible)
Earth leakage current	410 µA at 120 V AC (60 Hz), 858 µA max at 240 V AC (60 Hz), Worst case leakage current is less than 1.0 mA at 264 V AC, 63 Hz (normal condition, 1.8 mA Single Fault Condition)
Power factor	0.97 typical

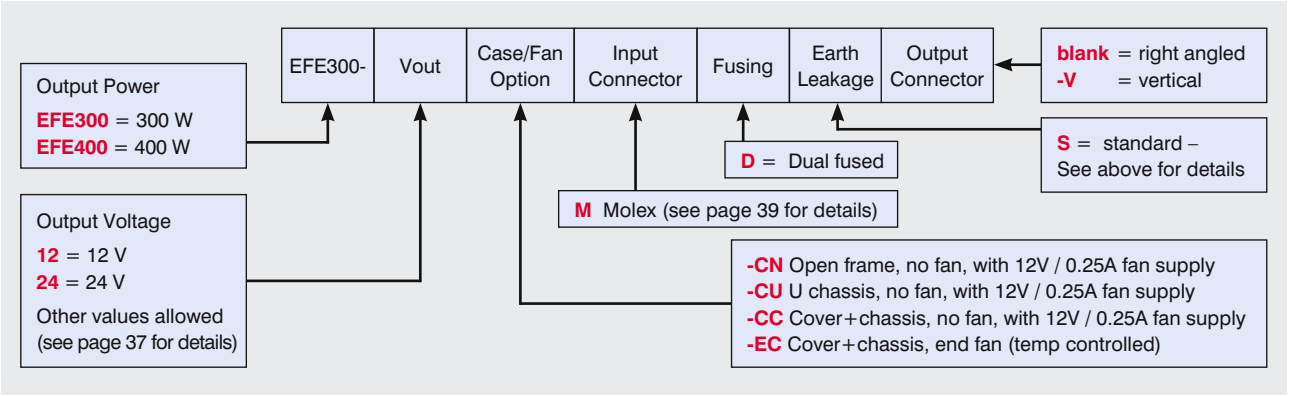
Quick Selector

preferred configurations

Output		Units without fan		Units with end fan
		Open Frame	Cover + Chassis	Cover + Chassis
12 V / 25 A	Description Order code	EFE300-12-CNMDS U2Y002G	EFE300-12-CCMDS U2Y001F	EFE300-12-ECMDS U2Y003H
24 V / 12.5 A	Description Order code	EFE300-24-CNMDS U2Y005K	EFE300-24-CCMDS U2Y004J	EFE300-24-ECMDS U2Y006L
12 V / 33.3 A	Description Order code	EFE400-12-CNMDS U4Y002H	EFE400-12-CCMDS U4Y001G	EFE400-12-ECMDS U4Y003J
24 V / 16.7 A	Description Order code	EFE400-24-CNMDS U4Y005L	EFE400-24-CCMDS U4Y004K	EFE400-24-ECMDS U4Y006M

Additional variants available “Build to Order” – see below.

How to create a Product Code



Confirm availability of created product code with the factory.

Output Specifications

	EFE-300	EFE-400	Notes
Output power	300 W	400 W	Continuous
Peak power	400 W	530 W	for 10 seconds (300 W RMS for EFE-300, 400 W RMS for EFE-400)
Total regulation	better than 4 %		Including Line (for 90 – 264 V AC input change) and Load (for 0 – 100 % load change)
Ripple & noise	1.5 %		Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage setting range	+10 % / –5 %		To be specified at time of ordering (chosen in "Output Voltage" part of product code)
Voltage setting accuracy	±1 %		at 50 % load
Turn on time	1.5 s typical		at 90 V AC & 100 % rated output power
Efficiency	90 %		typical
Hold-up	16 ms min.		typical at 90 V AC, 75 % load
Min load	none		
Transient response	<5 %		of set voltage for 50 % load change (in 50 µs within the range 25 – 100 % load)
Recovery	<1000 µs		for recovery to 2 % of set voltage
Short circuit protection	yes		Auto recovery after removal of short circuit
Over temperature protection	yes		Primary – auto recovers, secondary – cycle power to restart
Over voltage protection	yes		Latching, need to cycle AC to restart unit
Fan supply	12 V / 250 mA		Available if "no fan" is specified, otherwise used by PSU fan. No access to connector with -CC (cover + chassis)

Isolation

Input to output	**reinforced 3 kV**	**AC, 4.3 kV DC**		
Input to earth	**basic**	**1.5 kV AC, 2.3 kV DC**	**Output to earth**	**200 V DC**

Environment

Temperature	0 °C to 50 °C operational, –40 °C to 85 °C storage (max. 12 months). Full load with 2 m/s air blown from input to output
Derating	50 °C to 70 °C derate each output by 2.5 % per °C
Low temperature start-up	–20 °C
Humidity	5 – 95 % RH non-condensing
Shock	±3 x 30 g shocks in each plane, total 18 shocks 30 g shock = 11ms (±0.5 msec.), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987. Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1,9
Altitude	–200 to 3,000 metres operational (–200 to 5,000 metres storage/transportation)
Pollution	Degree 2, Material group 3b

Immunity EN61000-6-2: 2005

				Criteria
Electrostatic discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV Not applicable to open frame units	A
Electromagnetic field	EN61000-4-3	Level 3	12 V/m	A
Fast / Burst Transient	EN61000-4-4	Level 4	AC input tested to 4.4 kV DC output tested to 2.2 kV	A
Surge immunity	EN61000-4-5	Level 3	Common mode – 2.2 kV, Differential – 1.1 kV	A
Conducted RF immunity	EN61000-4-6	Level 3	12 V	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A/m	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	Criteria B for 5 sec. interruption EFE-300, criteria B for 1 cycle interruption	A
Ring Wave	EN61000-4-12	Level 3	Common mode – 2.2 kV, Differential – 1.1 kV	A
Voltage fluctuations	EN61000-4-14	Class 3		A

Emissions EN61000-6-3: 2007, EN60601-1-2: 2001

Radiated electric field	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B see application note for details
Conducted emissions	EN55011, EN55022	(as per CISPR.11/22) Class B, FCC47 part 15 subpart B
Conducted harmonics	EN61000-3-2	Class A
Flicker	EN61000-3-3	Compliant – d_{max} only

Safety Approvals

	Date	Amendments
EN60950-1	2006	
UL60950-1	2007	
EN61010-1	2001	
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

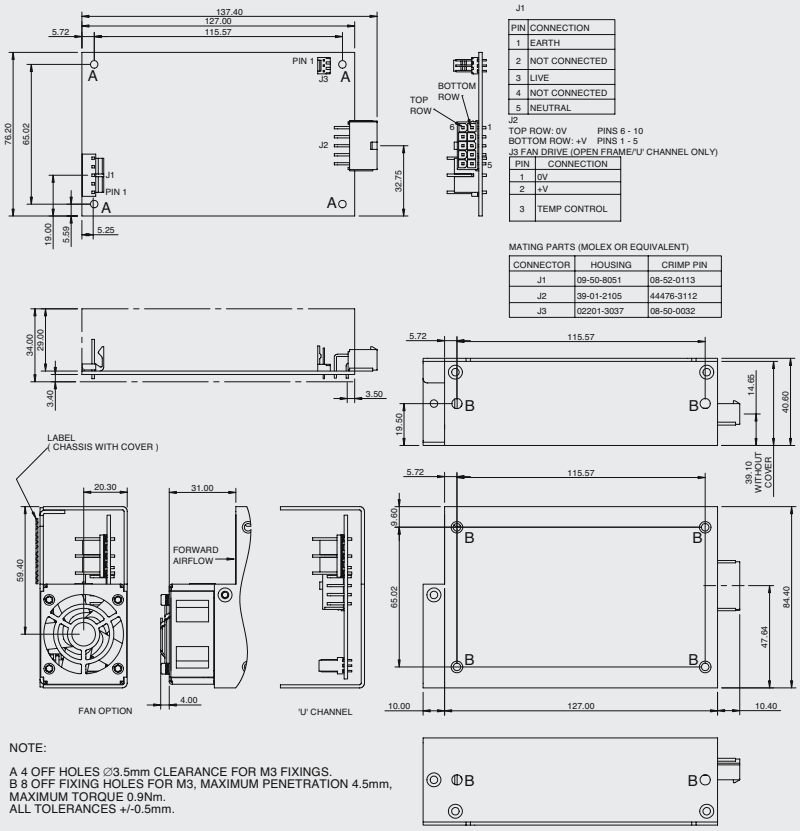
	Date	Amendments
IEC60950-1*	2005	
CSA 22.2 No. 60950-1	2007	
IEC61010-1*	2007	

* CB certificate and report available on request.

Check with factory for status of approvals.

Outline & Connection Drawings

EFE-300



J1

PIN	CONNECTION
1	EARTH
2	NOT CONNECTED
3	LIVE
4	NOT CONNECTED
5	NEUTRAL

J2
TOP ROW: 0V PINS 6 - 10
BOTTOM ROW: +V PINS 1 - 5
J3 FAN DRIVE (OPEN FRAME/'U' CHANNEL ONLY)

PIN	CONNECTION
1	0V
2	+V
3	TEMP CONTROL

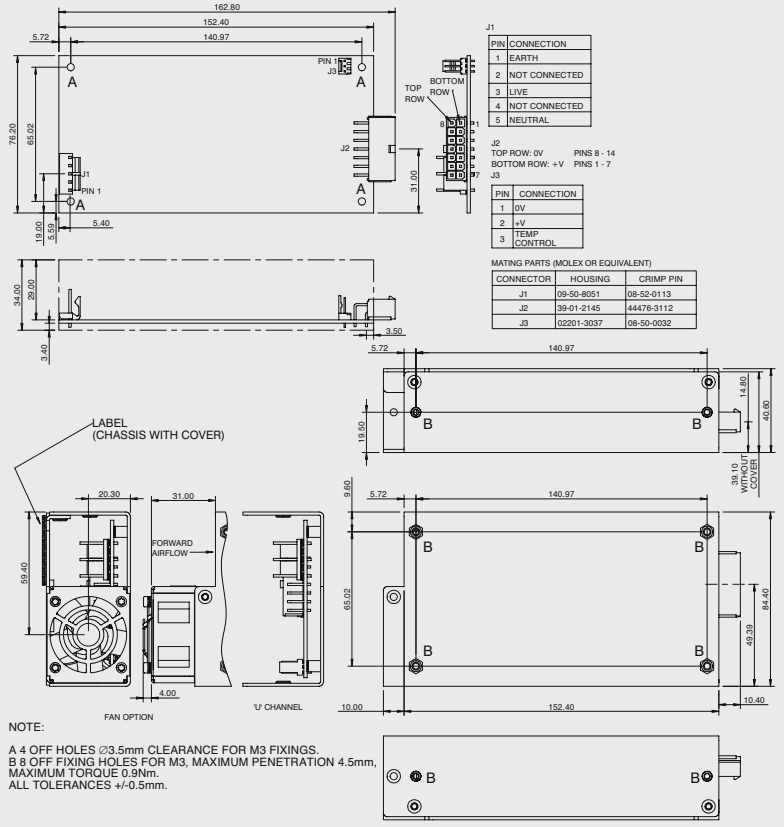
MATING PARTS (MOLEX OR EQUIVALENT)

CONNECTOR	HOUSING	CRIMP PIN
J1	09-50-8051	08-52-0113
J2	39-01-2105	44476-3112
J3	02201-3037	08-50-0032

NOTE:

A 4 OFF HOLES ∅3.5mm CLEARANCE FOR M3 FIXINGS.
B 8 OFF FIXING HOLES FOR M3, MAXIMUM PENETRATION 4.5mm, MAXIMUM TORQUE 0.9Nm.
ALL TOLERANCES +/-0.5mm.

EFE-400



J1

PIN	CONNECTION
1	EARTH
2	NOT CONNECTED
3	LIVE
4	NOT CONNECTED
5	NEUTRAL

J2
TOP ROW: 0V PINS 8 - 14
BOTTOM ROW: +V PINS 1 - 7
J3

PIN	CONNECTION
1	0V
2	+V
3	TEMP CONTROL

MATING PARTS (MOLEX OR EQUIVALENT)

CONNECTOR	HOUSING	CRIMP PIN
J1	09-50-8051	08-52-0113
J2	39-01-2145	44476-3112
J3	02201-3037	08-50-0032

NOTE:

A 4 OFF HOLES ∅3.5mm CLEARANCE FOR M3 FIXINGS.
B 8 OFF FIXING HOLES FOR M3, MAXIMUM PENETRATION 4.5mm, MAXIMUM TORQUE 0.9Nm.
ALL TOLERANCES +/-0.5mm.

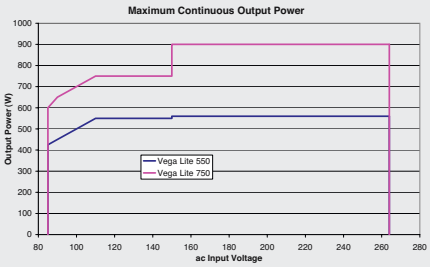
Notes: 1. All customer fixings M3 2. Maximum Penetration 4.5 mm 3. Maximum torque 0.9 Nm 4. All tolerances ±0.5 mm

VEGA Lite

550 … 900 W

Highlights

- Industry leading power density
- 1 to 11 outputs
- Voltages from 1.8 to 56 V
- Current up to 60 A
- Screw connection
- Worldwide approvals & CB report
- Medical approval option



Input Specifications

Voltage range	85 – 264 V AC
Frequency	47 – 63 Hz (440 Hz with reduced PFC – consult factory)
Inrush current	< 40 A at 25 °C and 264 V AC (cold start)
Fuse	16 A/250 V AC High Breaking Capacity, Fast Acting (not user accessible)
Leakage current	1.5 mA max. at 264 V AC & 63 Hz (medical version also available)
Power factor	0.99 typical

Output Specifications

Voltage / current	See module tables	
Turn on delay	1.5 s max.	at 90 V AC & 100 % rated output power
Rise time	<50 ms	to 90 % of voltage, monotonic rise above 10 %
Turn on overshoot	<5 % or 250 mV	Load type dependent, no overshoot with resistive load
Efficiency	75 %	typical at 230 V AC & 100 % rated power, configuration dependent
Hold-up	16 ms min.	at 100 V AC & 100 % rated output power
Ripple & noise	<1%	(or 50 mV if higher) Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage accuracy	<1 %	of set voltage
Remote sense	yes	Standard on single output modules, max. 0.75 V total line drop. Option for twin output modules
Minimum load	no	on any output
Temperature coefficient	<0.02 %	of rated voltage per °C
Load regulation	<0.5 % or 25 mV	for 0 – 100 % load change
Line regulation	<0.1 %	for 100 – 264 V AC input change
Cross regulation	<0.2 %	for 100 % load change on any other output
Transient response	<6 % or 300 mV	of set voltage for 50 % load change (above 25 % load)
Recovery	500 µs	for recovery to 1 % or 100 mV of set voltage
Over voltage protection	120 – 130 %	of set voltage for outputs >4.1 V (Tracking OVP)
	140 – 150 %	of set voltage for outputs <4.1 V (Tracking OVP)
	120 – 150 %	of max. rated output (Fixed OVP)
Over current protection	105 – 125 %	of rated current, constant current characteristic
Short circuit protection	<150 %	of rated current, when output voltage <1 %
Over temperature protection	yes	Shuts down all outputs and fan. Cycle AC off/on to reset[1, 2]

Notes 1: shutdown temp varies according to ambient, output power & input V 2: AC fail signal (if fitted) provides 5 ms warning of thermal shutdown

Output Voltages (Single Modules)

Module width (slots)								
Output voltage	1 Slot		1.5 Slots		2 Slots		3 Slots	
	Module	Current	Module	Current	Module	Current	Module	Current
1.8 V	1.8C1S	35 A	1.8D1LS	50 A	1.8E1S	60 A		
2 V	2C1S	35 A	2D1LS	50 A	2E1S	60 A		
3.3 V	3.3C1S	35 A	3.3D1LS	50 A	3.3E1S	60 A		
5 V	5L1S	35 A	5D1HS	50 A	5E2S	60 A		
6.5 V	6.5B2S	25 A	6.5D2S	45 A	6.5E2S	60 A		
12 V	12C3S	18 A	12D3S	24 A	12E3LS	40 A		
15 V	15C3S	18 A	15D3S	24 A	15E4S	30 A		
18 V	18C4S	14 A	18D4S	18 A	18E4S	30 A		
24 V	24C5S	10 A	24D5S	15 A	24E5HS	25 A		
28 V	28C5S	10 A	28D5S	15 A	28E5HS	25 A		
36 V	36HH5/4S	4.5 A			36BB4S	10 A		
48 V	48HH5/4S	4.5 A			48C5B4S	10 A	48DD5S	15 A

Output Voltages (Twin Modules) – all 1 Slot Width

		Channel 1					
	Output voltage	5 V / 12 A	12 V / 10 A	15 V / 10 A	18 V / 5 A	24 V / 5 A	28 V / 5 A
Channel 2	1.8 V / 8 A	5/1.8H1H/1LS					
	2 V / 8 A	5/2H1H/1LS					
	3.3 V / 8 A	5/3.3H1H/1LS					
	5 V / 8 A		12/5H3/1HS	15/5H3/1HS	18/5H5/1HS	24/5H5/1HS	28/5H5/1HS
	12 V / 6 A	5/12H1H/1LS	12/12H3/3S	15/12H3/3S	18/12H5/3S	25/12H5/3S	28/12H5/3S
	15 V / 6 A	5/15H1H/1LS	12/15H3/3S	15/15H3/3S	18/15H5/3S	25/15H5/3S	28/15H5/3S
	18 V / 4.5 A				18/18H5/4S	24/18H5/4S	28/18H5/4S
	24 V / 4.5 A				18/24H5/4S	24/24H5/4S	28/24H5/4S

Output Voltages (Single Modules)

Module	Adjustment range (Volts)	Amps	Slots
C1S	1.8 – 3.4	35	1
D1LS	1.8 – 3.8	50	1.5
E1S	1.8 – 3.4	60	2
L1S	4.2 – 5.1	35	1
D2S	3.8 – 7.5	45	1.5
D1HS	3.9 – 5.1	50	1.5
E2S	3.8 – 7.5	60	2
B2S	5 – 8	25	1
C3S	9.1 – 15	18	1
D3S	8 – 15	24	1.5
E3LS	8 – 12.5	40	2
D4S	14 – 18	18	1.5
E4S	14 – 19	30	2
C4S	16.2 – 18	14	1
C5S	21.6 – 30	10	1
D5S	21 – 28	15	1.5
E5HS	24 – 28	25	2
HH5/4S	32.5 – 48	4.5	1
BB4S	32.6 – 40	10	2
C5B4S	43 – 49	10	2
DD5S	42 – 56	15	3

Twin Output Modules

Module	V1 Adjustment range (Volts)	Amps	V2 Adjustment range (Volts)	Amps	Slots
H1H/1LS	3.9 – 5.1	12	1.8 – 3.8	8	1
H1H/3S	3.9 – 5.1	12	9.1 – 16.2	6	1
H3/1HS	9.1 – 15.5	10	3.9 – 5.5	8	1
H3/3S	9.1 – 15.5	10	9.1 – 16.2	6	1
H5/1HS	16.2 – 28	5	3.9 – 5.5	8	1
H5/3S	16.2 – 28	5	9.1 – 16.2	6	1
H5/4S	16.2 – 28	5	16.3 – 24	4.5	1

Options – Single Output Modules*	
N	Output Inhibit, Module Good Current Sharing

Options – Twin Output Modules*	
N	Output Inhibit, Module Good, Remote Sense
R	Remote Sense Only

* see configuring guide

Isolation/Insulation

Isolation	Insulation	
Input to output	reinforced	4 kV AC, 5.7 kV DC
Input to earth	basic	2.3 kV DC

Isolation	Insulation	
Output to earth	operational	200 V DC
Output to output	operational	200 V DC

Environment

Temperature	0 °C to 65 °C operational, –40 °C to 85 °C storage (max. 12 months)
Derating	50 °C to 65 °C derate each output by 2.5 % per °C
Low temperature start-up	– 20 °C
Humidity	5 – 95 % RH non-condensing
Shock	±3 x 20 g shocks in each plane, total 18 shocks 20 g shock = 11 ms (±0.5 ms), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987 Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 – 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1,9
Altitude	5,000 m operational and non-operational
Pollution	Degree 2, Material group 3b
IP Rating	IP10

Immunity BS EN61000-6-2: 2001 (Industrial Environment)*

				Criteria
Electrostatic discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV	A
Electromagnetic field	EN61000-4-3	Level 3	10 V/m (tested to 12 V/m)	A
Fast / Burst transient	EN61000-4-4	Level 4	Input 4 kV, Outputs 2 kV tested at 5 kHz and 100 kHz	A
Surge immunity	EN61000-4-5	Level 3	Line to Line 1 kV (tested to 1.1 kV) Line to Earth 2 kV (tested to 2.2 kV)	A
Conducted RF immunity	EN61000-4-6	Level 3	10 V (tested to 12 V)	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A continuous	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3	B for 5 sec. interruptions	A

* Also complies with BS EN61000-6-1: 2001.

Emissions BS EN61000-6-3: 2001 (Residential, Commercial & Light Industrial Supply)*

Radiated electric field	EN55022	Class B (as per CISPR.22)	See application note for details. Only for “S” type leakage versions.
Conducted emissions	EN55022	Class B (as per CISPR.22)	Only for “S“ type leakage versions. “L” types meet Class A.
Conducted harmonics	EN61000-3-2	Compliant to Class A	
Flicker	EN61000-3-3	Compliant	

* Also complies with BS EN61000-6-4: 2001.

Safety Approvals

	Date	Amendments
EN60950-1	2006	
UL60950-1	2003	
CSA22.2 No 60950-1	2003	
IEC60950-1*	2005	
EN61010-1	2001	

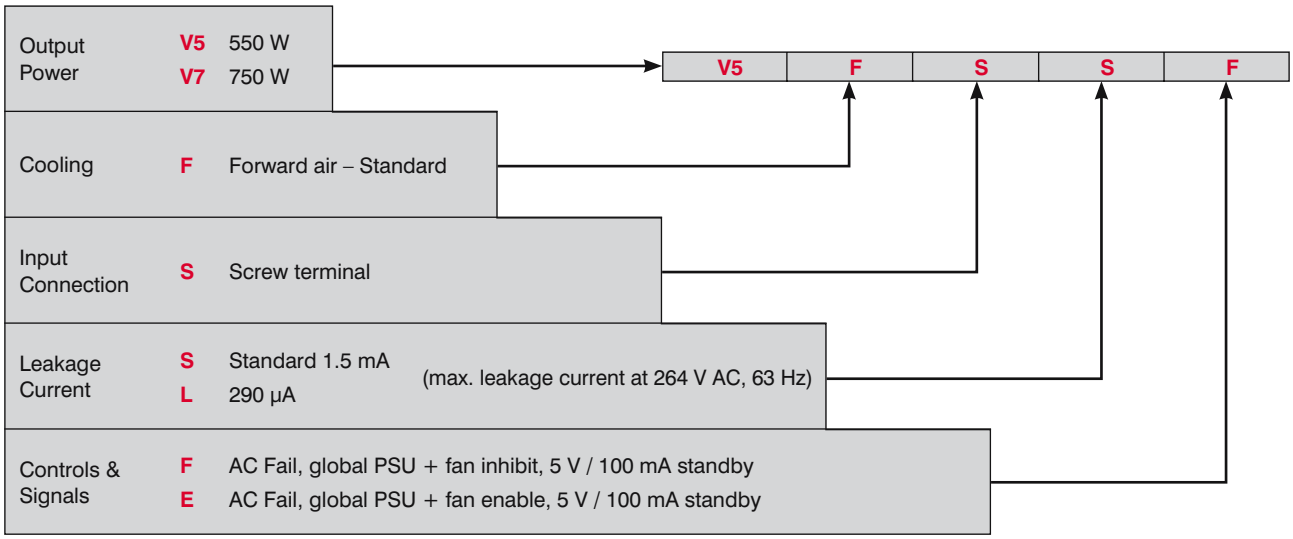
	Date	Amendments
IEC61010-1*	2001	Second Edition
IEC60601-1*	1988	A1, A2
EN60601-1[1]	1990	A1, A2, A13
UL60601-1[1]	2003	with revisions 2006
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

* CB certificate and report available on request. 1 Only for “L” type leakage variants. Check with Technical Sales for status of approvals.

The extensive range of output modules and options make it possible to achieve all popular combinations of Volts and Amps. The "online" configurator is the best way to achieve the optimum configuration, however you can also create your own VEGA configuration from this datasheet by using the guide below.

Web Configurator

1. Visit the TDK-Lambda website, select "VEGA Configurator" and follow the online instructions.
2. Enter your required Volts / Amps, and any additional functions (if required)
3. Enter preferred type of cooling, input connection, lower leakage current (if required) and controls & signal functions (if required)
4. Configurator will select the most suitable modules and options and give a unique part number.



Configuring from Datasheet

1. Calculate total output power to determine VEGA 550 W (560 W at 150 V AC and above) or 750 W (900 W at 150 V AC and above) and select converter, then select required cooling, connection, leakage current and controls/signals from the table above.
2. Select Output Modules and Options from the available Output Voltages Tables.

   Example – if you require 5 V / 18 A with output inhibit:
   a) select 5L1S as closest match for voltage and current
   b) add suffix N for output inhibit eg **5L1SN**
   c) repeat for other outputs

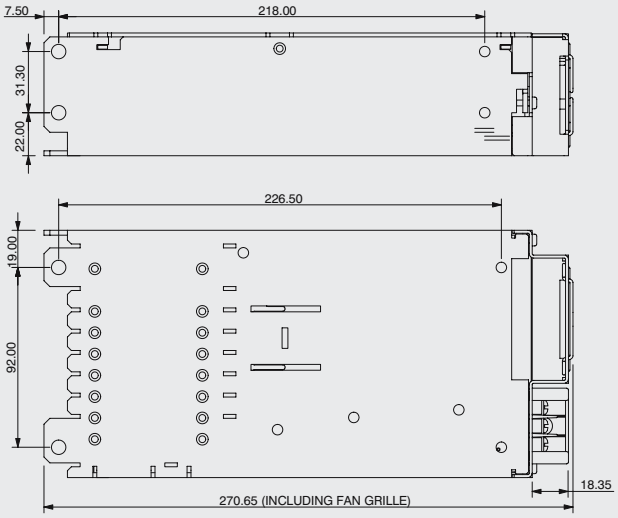
Ensure you do not select more than a total of 5 slots width of module.
This will create a complete product description eg:

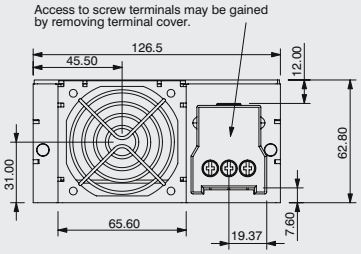
V5FSSF 5L1SN 12/12H3/3S 24C5S which represents a four output 550 W VEGA with Forward air, Screw input terminals, 1.5 mA Earth Leakage, AC Fail, Global Inhibit & 5 V / 100 mA aux supply.

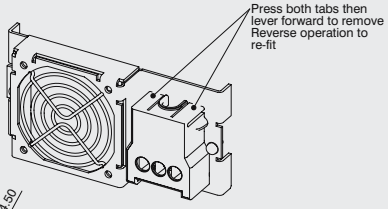
Output 1 = 5 V / 35 A with output inhibit, Module Good and Current Share option
Output 2 = 12 V / 10 A
Output 3 = 12 V / 6 A
Output 4 = 24 V / 10 A

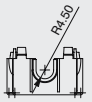
3. **Contact TDK-Lambda to validate configuration and issue a part number.**

Outline & Connection Drawings

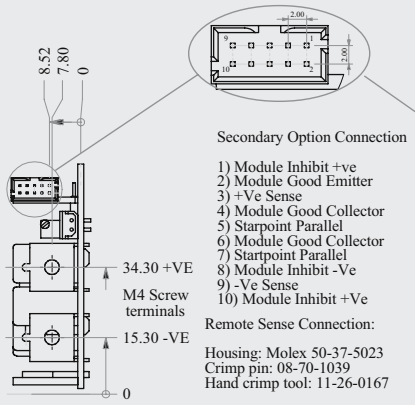




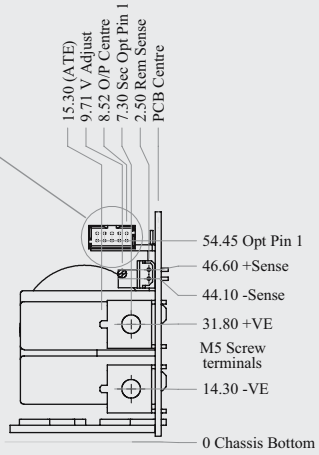




Screw Terminal Case
8 x M4 Customer fixings
Max thread penetration:- 4.5 mm



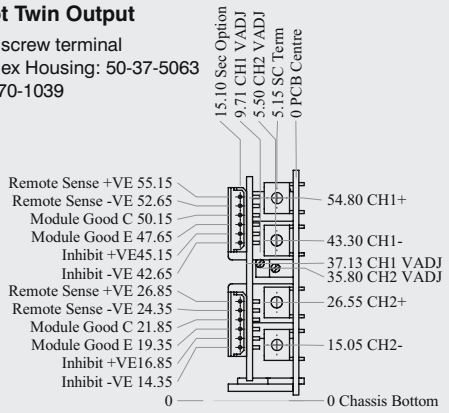
Dual Slot Single Output



Single Slot Single Output

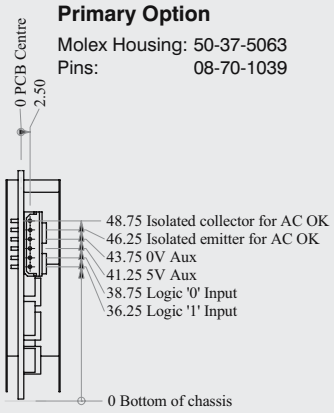
Single Slot Twin Output

Module: M3 screw terminal
Option: Molex Housing: 50-37-5063
Pins: 08-70-1039



Primary Option

Molex Housing: 50-37-5063
Pins: 08-70-1039



Highlights

- Industry leading flexibility
- Up to 11 outputs
- Voltages up to 62 V
- Current up to 114 A
- Screw, fast-on or IEC connection
- Worldwide approvals & CB report
- Medical approval option
- 3 years warranty
- AC or DC input versions

Input Specifications

	VEGA 450, 650 and 900	VEGA DC (450 W)
Input voltage	90 – 264 V AC 900 W version is 150 – 264 V AC only, 650 W below 150 V AC	34 – 75 V DC Derate linearly below 44 V to 340 W at 34 V
Input frequency	47 – 63 Hz (440 Hz with reduced PFC – consult factory)	DC only
Inrush current	<40 A at 25 °C and 264 V AC (cold start)	<40 A at 25 °C ETSI EN300132-2
Input fuse	16 A / 250 V AC HBC Fast Acting (not user accessible)	20 A Fast Acting (not user accessible)
Leakage current	1.5 mA max. at 264 V AC & 63 Hz	n/a
Lower leakage option	see configuring guide	n/a
Power factor	0.99 typical	n/a

Output Specifications

Voltage / current	See module tables	
Turn on delay	1.5 s max.	at 90 V AC (150 V AC for 900 W, 48 V DC for VEGA DC) & 100 % rated output power
Rise time	<50 ms	to 90 % of voltage, monotonic rise above 10 %
Turn on overshoot	<5 % or 250 mV	Load type dependent, no overshoot with resistive load
Efficiency	75 %	typical at 230 V AC (48 V DC for VEGA DC) & 100 % rated power, configuration dependent
Hold-up	16 ms min.	at 90 V AC (150 V AC for 900 W) & 100 % rated output power, 10 ms min. for VEGA DC
Ripple & noise	<1% or 50 mV	Pk-Pk, using EIAJ test method & 20 MHz bandwidth
Voltage accuracy	<1 %	of set voltage
Remote sense	yes	Standard on single output modules, max. 0.75 V total line drop. Option for twin output modules
Minimum load	no	on any output
Temperature coefficient	<0.02 %	of rated voltage per °C
Load regulation	<0.5 % or 25 mV	for 0 – 100 % load change
Line regulation	<0.1 %	for 90 – 264 V AC input change (34 – 75 V DC for VEGA DC)
Cross regulation	<0.2 %	for 100 % load change on any other output
Transient response recovery	<6 % or 300 mV	of set voltage for 50 % load change (above 25 % load)
	500 µs	for recovery to 1 % or 100 mV of set voltage

Output Specifications

Continuation

Over voltage protection	120 – 130 %	of set voltage for outputs >4.1 V (Tracking OVP)
	140 – 150 %	of set voltage for outputs <4.1 V (Tracking OVP)
	120 – 150 %	of max. rated output (Fixed OVP)
Over current protection	105 – 125 %	of rated current, constant current characteristic
Short circuit protection	<150 %	of rated current, when output voltage <1 %
Over temperature protection	yes	Shuts down all outputs and fan. Cycle AC off/on to reset[1,2]

Notes: 1. shutdown temp varies according to ambient, output power & input V 2. AC fail signal (if fitted) provides 5 ms warning of thermal shutdown

Output Voltages

Single output modules				Twin output modules					
Module	Adjustment range (Volts)	Amps	Slots	Module	V1 Adjustm. range (Volts)	Amps	V2 Adjustm. range (Volts)	Amps	Slots
B1L	1.8 – 3.8[e]	20	1	H1L/1L			1.8 – 3.8[n]	8	1
C1	1.8 – 4.1[e]	35	1	H1L/1H			3.9 – 5.5[d]	8	1
C1Y	1.8 – 4.1[e]	40	1	H1L/2	1.8 – 3.8[n]	12	5.6 – 9.0[f]	6	1
D1L	1.8 – 3.8	50	1.5	H1L/3			9.1 – 16.2[u]	6	1
E1	1.8 – 3.8[e]	60	2	H1L/4			16.3 – 25[p]	4.5	1
F1[a]	1.8 – 3.8	80	2	H1H/1L			1.8 – 3.8[n]	8	1
Z2	1.8 – 3.8[e]	95	3	H1H/1H			3.9 – 5.5[d]	8	1
Z3	1.8 – 3.8[e]	114	4	H1H/2	3.9 – 5.5[d]	12	5.6 – 9.0[f]	6	1
B1H	3.9 – 5.5[d]	20	1	H1H/3			9.1 – 16.2[u]	6	1
L1	4.2 – 5.5[d]	35	1	H1H/4			16.3 – 25[p]	4.5	1
D2	3.8 – 9.0[k]	45	1.5	H2/1L			1.8 – 3.8[n]	8	1
D1H	3.9 – 5.5[d]	50	1.5	H2/1H			3.9 – 5.5[d]	8	1
E2	3.8 – 8.0[k]	60	2	H2/2	5.6 – 9.0[f]	10	5.6 – 9.0[f]	6	1
Z18	4.2 – 5.5	66	2	H2/3			9.1 – 16.2[u]	6	1
F2[a]	3.8 – 8.0	75	2	H2/4			16.3 – 25[p]	4.5	1
Z4	3.9 – 5.5[d]	95	3	H3/1L			1.8 – 3.8[n]	8	1
Z6	3.9 – 5.5[d]	104	3.5	H3/1H			3.9 – 5.5[d]	8	1
B2	5.0 – 9.0[f]	25	1	H3/2	9.1 – 16.2[u]	10	5.6 – 9.0[f]	6	1
B3	9.1 – 16.2[g]	12	1	H3/3			9.1 – 16.2[u]	6	1
C3	9.1 – 16.2[g]	18	1	H3/4			16.3 – 25[p]	4.5	1
D3	8.0 – 16.5[g]	24	1.5	H5/1L			1.8 – 3.8[n]	8	1
E3L	8.0 – 13.9[l]	40	2	H5/1H			3.9 – 5.5[d]	8	1
Z7	8.0 – 16.5[g]	45	3	H5/2	16.2 – 28	5	5.6 – 9.0[f]	6	1
EE2	7.6 – 16.0[g]	45	4	H5/3			9.1 – 16.2[u]	6	1
D4	14 – 21.5[i]	18	1.5	H5/4			16.3 – 25[p]	4.5	1
E4	14 – 19.9[m]	30	2	Wide range programmable modules					
E3H	14 – 15	36	2	Module	Voltage range (Volts)	Amps	Slots	Select features from table below	
C4	16.3 – 21.5[i]	14	1						
CC3	18.2 – 32.4[j]	18	2	W2[a]	1.0 – 7.5	30	1		
E5L[v]	20 – 24	27	2	W5	0.5 – 32	8.5	1		
B5	21.6 – 31[h]	6	1						
C5	21.6 – 31[j]	10	1	follow by	F or T	Fixed or Tracking Overvoltage protection			
D5	21 – 28	15	1.5		F or S	Fast-on or Screw terminal			
E5H[v]	24 – 28	25	2		R or V	Resistance (0 – 32 kOhm)			
Z19[co]	24 – 28	36	3.5			Voltage (0 – 5 V) Programming			
HH5/3	25.3 – 44.2[b]	5	1			1 Inhibit, Fixed current limit			
DD4	28 – 43[s]	18	3		1, 2, 3	2 Inhibit, Programmable current limit (0 – 5 V)			
EE4[c]	28 – 38	22.5	4		or 4	3 Enable, Fixed current limit			
HH5/4	32.5 – 53[t]	4.5	1			4 Enable, Programmable current limit (0 – 5 V)			
BB4	32.6 – 43[q]	10	2	Follow non wide range modules by F (Fast-on) or S (Screw) terminal					
EE5L[co]	40 – 48	18	4	Options – Single output modules*					
C5B4	43 – 48	10	2	N	Output Inhibit, Module Good Current Sharing				
EE5H[co]	48 – 56	18	4	Options – Twin output modules*					
CC5	48.1 – 62[r]	10	2	N	Output Inhibit, Module Good, Remote Sense				
DD5	42 – 56	15	3	R	Remote Sense Only				

a) F1, F2 and W2 modules not for VEGA 900
b) 38 V max. for 900 W
c) Only available for VEGA 900
d) 5.1 V max. for 900 W
e) 3.4 V max. for 900 W
f) 8 V max. for 900 W
g) 15 V max. for 900 W
h) 28 V max. for 900 W
i) 18 V max. for 900 W
j) 30 V max. for 900 W
k) 7.5 V max. for 900 W
l) 12.5 V max. for 900 W
m) 19 V max. for 900 W
n) 3.4 V max. for 900 W
o) "N" option not available
p) 24 V max. for 900 W
q) 40 V max. for 900 W
r) 60 V max. for 900 W
s) 36 V max. for 900 W
t) 52 V max. for 900 W
u) 15.5 V max. for 900 W
v) "N" option not available if more than 1 E5 module fitted

* see configuring guide

Isolation/Insulation

Isolation	Insulation	
Input to output	reinforced	4 kV AC, 5.7 kV DC
Input to earth	basic	2.3 kV DC

Isolation	Insulation	
Output to earth	operational	200 V DC
Output to output	operational	200 V DC

Environment

Temperature	0 °C to 65 °C operational, –40 °C to 85 °C storage (max. 12 months)
Derating	50 °C to 65 °C derate each output by 2.5 % per °C (1.5 % per °C for VEGA DC)
Low temperature start-up	–20 °C
Humidity	5 – 95 % RH non-condensing
Shock	±3 x 20 g shocks in each plane, total 18 shocks 20 g shock = 11 ms (±0.5 ms), half sine Conforms to EN60068-2-27, EN60068-2-47, IEC68-2-27, IEC68-2-47, JIS C0041-1987 Conforms to MIL-STD-810E/F, Method 516.5, Pro I, IV, VI
Vibration	Single axis 10 - 500 Hz at 2 g (sweep and endurance at resonance) in all 3 planes Conforms to EN60068-2-6, IEC68-2-6 Conforms to MIL-STD-810E, Method 514.4, Pro I, Cat 1, 9
Altitude	5,000 metres operational / non operational (IEC inlet 3,000 m operational, 5,000 m non-operational)
Pollution	Degree 2, Material group 3
IP Rating	IP10

Immunity BS EN61000-6-2: 2001

Industrial Environment*

				Criteria
Electrostatic discharge	EN61000-4-2	Level 4	Air discharge 15 kV Contact discharge 8 kV	A
Electromagnetic field	EN61000-4-3	Level 3	10 V/m (tested to 12 V/m)	A
Fast / Burst transient	EN61000-4-4	Level 4, Level 3 for VEGA DC	Input 4 kV, (2 kV for VEGA DC) Outputs 2 kV, (1 kV for VEGA DC) tested at 5 kHz and 100 kHz	A
Surge immunity	EN61000-4-5	Level 3, Level 2 for VEGA DC	Line to Line 1 kV (tested to 1.1 kV) (0.5 kV, tested to 0.55 kV for VEGA DC) Line to Earth 2 kV (tested to 2.2 kV) (1 kV, tested to 1.1 kV for VEGA DC)	A
Conducted RF immunity	EN61000-4-6	Level 3	10 V (tested to 12 V)	A
Power frequency magnetic field	EN61000-4-8	Level 4	30 A continuous	A
Voltage dips, variations, interruptions	EN61000-4-11	Class 3 na – VEGA DC		A B for 5 s interruptions

*also complies with BS EN61000-6-4: 2001

Emissions BS EN61000-6-3: 2001

Residential, Commercial & Light Industrial Supply*

Radiated electric field	EN55022	Class B (as per CISPR.22) Class A for VEGA DC	See application note for details. Only for “S” type leakage versions
Conducted emissions	EN55022	Class B (as per CISPR.22) Class A for VEGA DC	Only for “S“ type leakage versions. “M” and “L” types meet Class A
Conducted harmonics	EN61000-3-2	Compliant to Class A	Not applicable to VEGA DC
Flicker	EN61000-3-3	Compliant	Not applicable to VEGA DC

*also complies with BS EN61000-6-4: 2001

Safety Approvals

	Date	Amendments
EN60950-1	2006	
UL60950-1	2003	
CSA22.2 No 60950-1	2003	
IEC60950-1*	2005	
EN61010-1	2001	

	Date	Amendments
IEC61010-1*	2001	Second Edition
IEC60601-1[1]*	1988	A1, A2
EN60601-1[1]	1990	A1, A2, A13
UL60601-1[1]	2003	with revisions 2006
CE Mark	LV Directive 2006/95/EC (EN60950-1)	

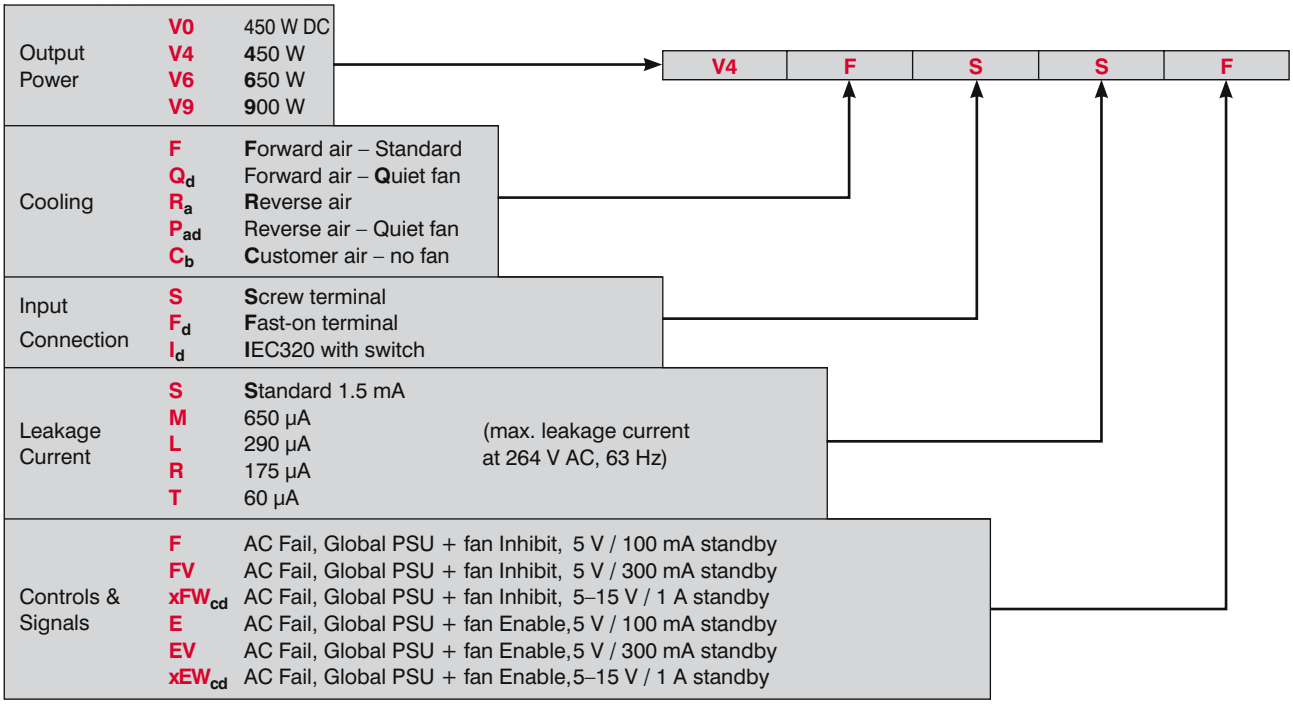
* CB certificate and report available on request.
Check with Technical Sales for status of approvals.

1 Only for L, R and T leakage variants. Not applicable to VEGA DC.

The extensive range of output modules and options make it possible to achieve almost any combination of Volts and Amps. The "online" configurator is the best way to achieve the optimum configuration, however you can also create your own VEGA configuration from this datasheet by using the guide below.

Web Configurator

1. Visit the TDK-Lambda website, select "VEGA Configurator" and follow the online instructions.
2. Enter your required Volts / Amps, type of output connection and any additional functions (if required).
3. Enter preferred type of cooling, input connection, lower leakage current (if required) and controls & signal functions (if required).
4. Configurator will select the most suitable modules and options and give a unique part number.



Notes: a) Not available for VEGA 900. b) Thermocoupled sample recommended to ensure adequate cooling – consult sales. c) xFW and xEW options increase leakage current by 90 µA. Replace "x" with required output voltage (5FW = 5 V aux supply). d) Not available for VEGA DC.

Configuring from Datasheet

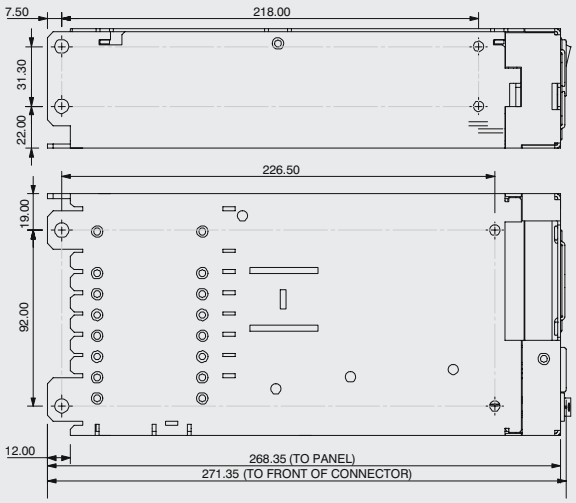
1. Calculate total output power to determine VEGA 450 W, 650 W or 900 W and select converter, then select required Cooling, Connection, Leakage Current and Controls / Signals from the table above.
2. Select Output Modules and Options from the Output Voltages tables.
   Example – if you require 5.2 V / 18 A with output inhibit:
   a) select B1H as closest match for voltage and current and prefix with voltage (eg **5.2B1H**)
   b) add suffix S or F for Screw or Fast-on connection (eg 5.2B1H**S**)
   c) add suffix N for output inhibit (eg 5.2B1HS**N**)
   d) repeat for other outputs

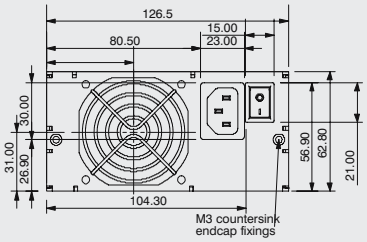
Ensure you do not select more than a total of 5 slots width of module. This will create a complete product description eg:

V5FSSF 5L1SN 12/12H3/3S 24C5S which represents a four output 650 W VEGA with Forward air, Screw input terminals, 1.5 mA Earth Leakage, AC Fail, Global Inhibit & 5 V / 100 mA aux supply with the following outputs:
Output 1 = 5 V / 35 A with output inhibit, Module Good and Current Share option
Output 2 = 12 V / 10 A
Output 3 = 12 V / 6 A
Output 4 = 24 V / 10 A

3. Contact TDK-Lambda to validate configuration and issue a part number.

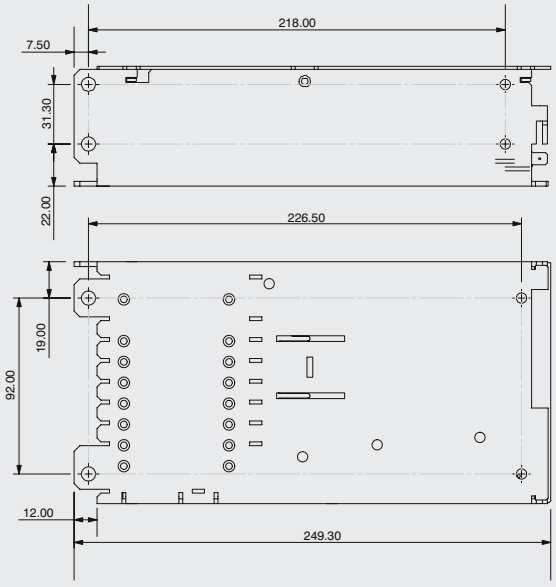
Outline & Connection Drawings

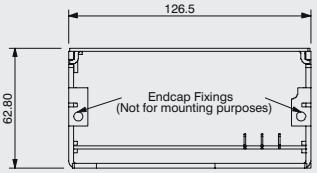




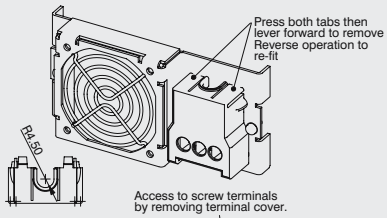
IEC-320 Connector Case

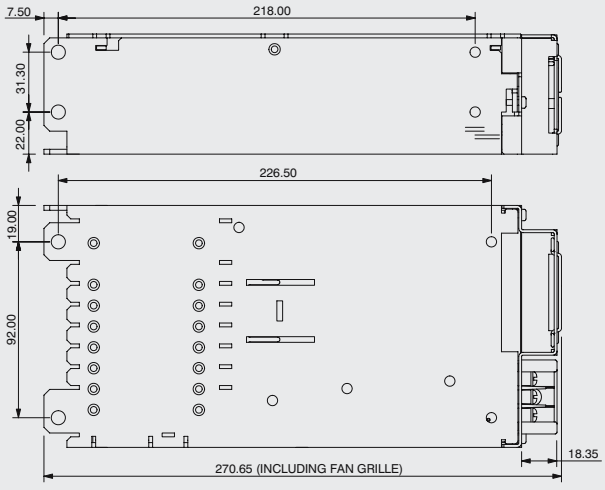
All versions have:
8 x M4 Customer fixings
Max thread penetration: 4.5 mm

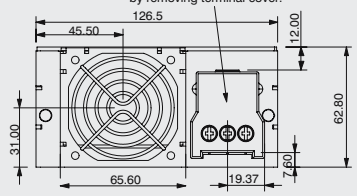




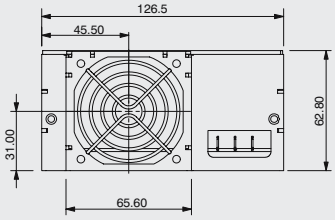
Customer Air Case (no fan)







Screw & Fast-on Terminal Case



ALPHA

1000 … 1500 W

Highlights

- 1 to 16 outputs
- Standard or configurable
- No minimum load
- Rapid connection
- Wide range input
- EN61000-3-2 compliant
- Class B conducted

Input Specifications

Input voltage range	ALPHA 1500: 150 – 264 V AC ALPHA 1000: 90 – 264 V AC
Frequency	47 to 63 Hz
Inrush current	< 50 A
Switching frequency – PFC – Forward converter	 100 kHz 200 kHz
Leakage current	1.1 mA (see options for lower leakage current)
Input protection	internal fuse
Thermal protection	standard

Output Specifications

Power	1000 to 1500 W
Voltage adjustment	Multi-turn potentiometer
Line regulation	< 0.5 %
Load regulation	< 2 % < 0.5 % (sense connected)
Remote sense	single o/p modules only
Ripple and noise (value peak to peak)	2 %
Overcurrent protection	standard
Overvoltage protection	standard

General

Efficiency	75 % typically
Voltage isolation	
Input-output Input-ground Output-ground	 3 kV RMS 1.5 kV RMS 500 V DC

Environment

Operating temperature	
Range	0 °C to +70 °C
Derating (typ)	50 °C – 70 °C derate 2.5 % / °C
Storage temperature	–40 °C to +70 °C
EMI	Curve A – conducted
Safety approvals	CB Certificated, IEC/EN60950, UL1950 CSA 22.2 No. 950 (all models)

Standard Electrical Specification – Standard Models

Model	Max.** power	Output N° 1		Output N° 2		Output N° 3		Output N° 4		Modules
	Watts	Volts	Amp.	Volts	Amp.	Volts	Amp.	Volts	Amp.	
CA1000-5A, 12F, 12F	1000 W	5 V	60 A	12 V	33 A	12 V	33 A			A, F, F
CA1000-12C, 5A, 3.3R, 12F	1000 W	5 V	60 A	3.3 V	60 A	12 V	33 A	12 V	16 A	C, A, R, F
CA1000-24G_PP, 24G_PP	1000 W	24 V	40 A*							G, G

* Modules in parallel.
** Total output power must not exceed: 1000 W for ALPHA 1000.
See next section for information on 1500 W models.

Configured Models

To meet your requirements it is possible to configure an ALPHA power supply using any of the standard ALPHA models and converters. 1500 W (CA1500) models can accommodate up to 8 slots and 1000 W (CA1000) models up to 7 slots. To ensure ALPHA meets your exact requirements please contact Technical Sales or visit our Website.

Single output modules				Twin output modules					
Module	Adjustment range (Volts)	Amps	Slots	Module	V1 Adjustm. range (Volts)	Amps	V2 Adjustm. range (Volts)	Amps	Slots
A	4.5 – 5.5	60	2	E	5 – 16	8	5 – 16	8	1
AA	4.5 – 6.2	60	2	EB	4.5 – 5.5	9	4.5 – 5.5	9	1
B	4.5 – 5.5	25	1	EQ	4.5 – 5.5	9	2.7 – 3.9	9	1
BB	4.5 – 6.5	25	1	H	18 – 32	5[c]	18 – 32	5[c]	1
C	5 – 16	16[a]	1	P	18 – 29	5	5 – 16	8	1
D	18 – 29	8	1						
F	9 – 15.5	33	2						
G	17.5 – 29	25	2						
J	30 – 48	10[b]	2						
K	18 – 29	15	2						
L	1.8 – 3.2	25	1						
M	5 – 16	8	1						
N	18 – 32	5[c]	1						
Q	2.7 – 3.9	25	1						
R	2.7 – 3.9	60	2						
S	2.5 – 5.7	85	2						
T	1.8 – 3.2	60	2						
U	10 – 21	16	1						
V	10 – 21	25	2						
W	4.5 – 5.5	15	1						
Z	4.5 – 5.5	25	1						

Note: a) 12 A max above 12 V b) Derate output current by 0.25 A / V above 40 V c) 1 A max above 29 V

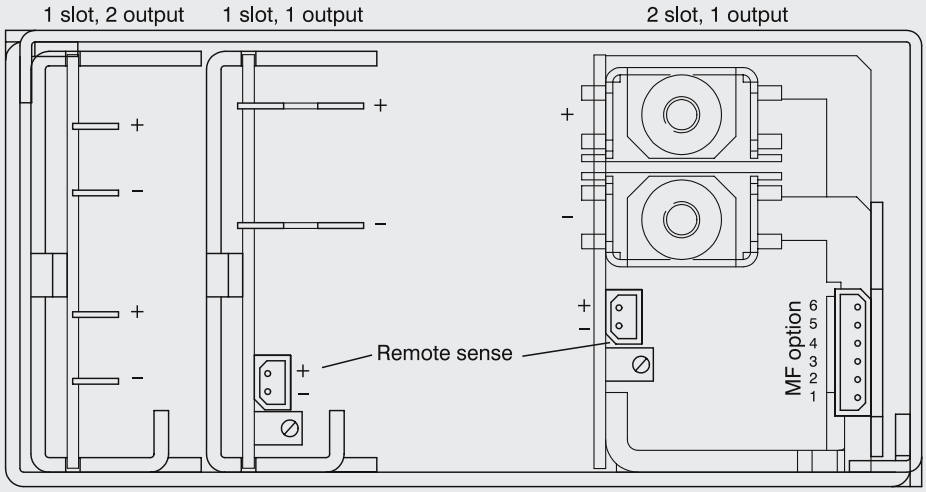
Options

Input Options
MF: AC Fail, Global inhibit,
5 V / 50 mA standby supply

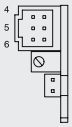
Low Leakage filter options
ML: 500 µA
LL: 240 µA
RL: 100 µA
TL: 50 µA

Output Options
IN: Output inhibit and output good signal
PP: Parallel outputs to increase current from one psu
PA: Current share and output good
(for N +1 redundant applications)
RP: Remote program (resistance)

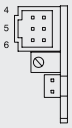
MF option connector

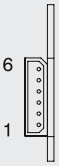


IN option
PIN 1: Not connected
PIN 2: Module Good
PIN 3: Inhibit
PIN 4: Not connected
PIN 5: – Power
PIN 6: – Power

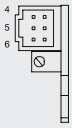


PA option
PIN 1: + Sense
PIN 2: Module good
PIN 3: Star point
PIN 4: – Sense
PIN 5: – Power
PIN 6: Star point

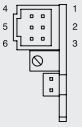




PP option
PIN 1: + Sense
PIN 2: Not connected
PIN 3: Not connected
PIN 4: – Sense
PIN 5: Not connected
PIN 6: Not connected

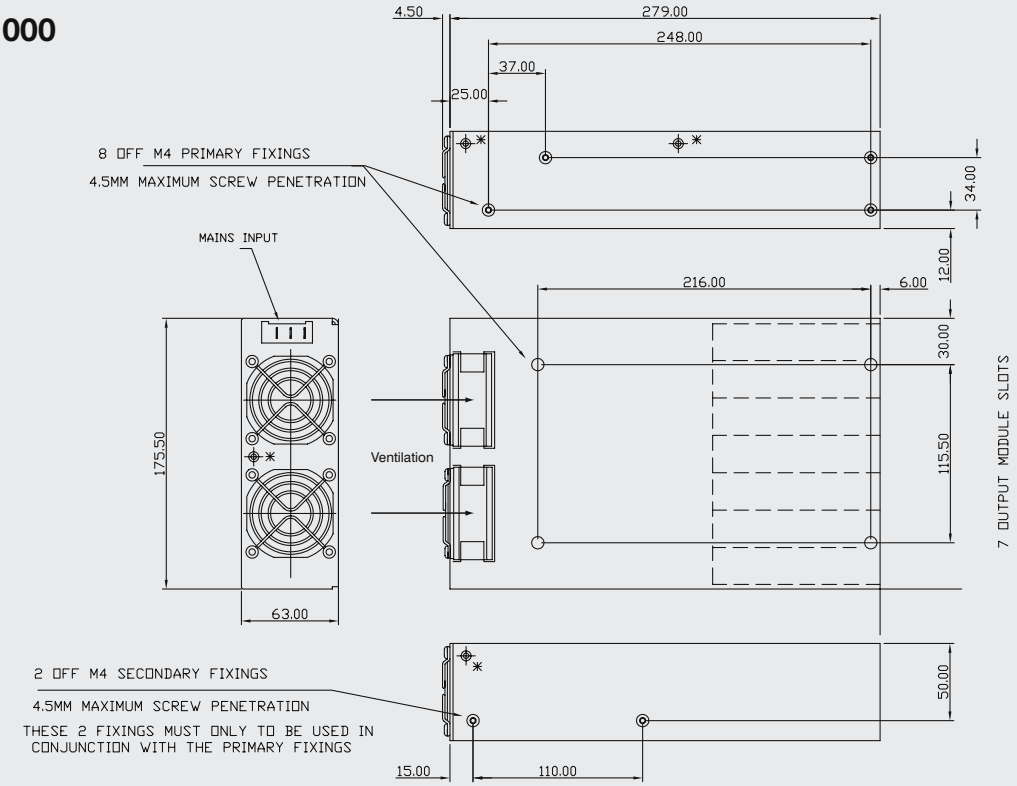


RP option
PIN 1: + Sense
PIN 2: – Sense
PIN 3: Control 2
PIN 4: Not connected
PIN 5: Control 1
PIN 6: Not connected

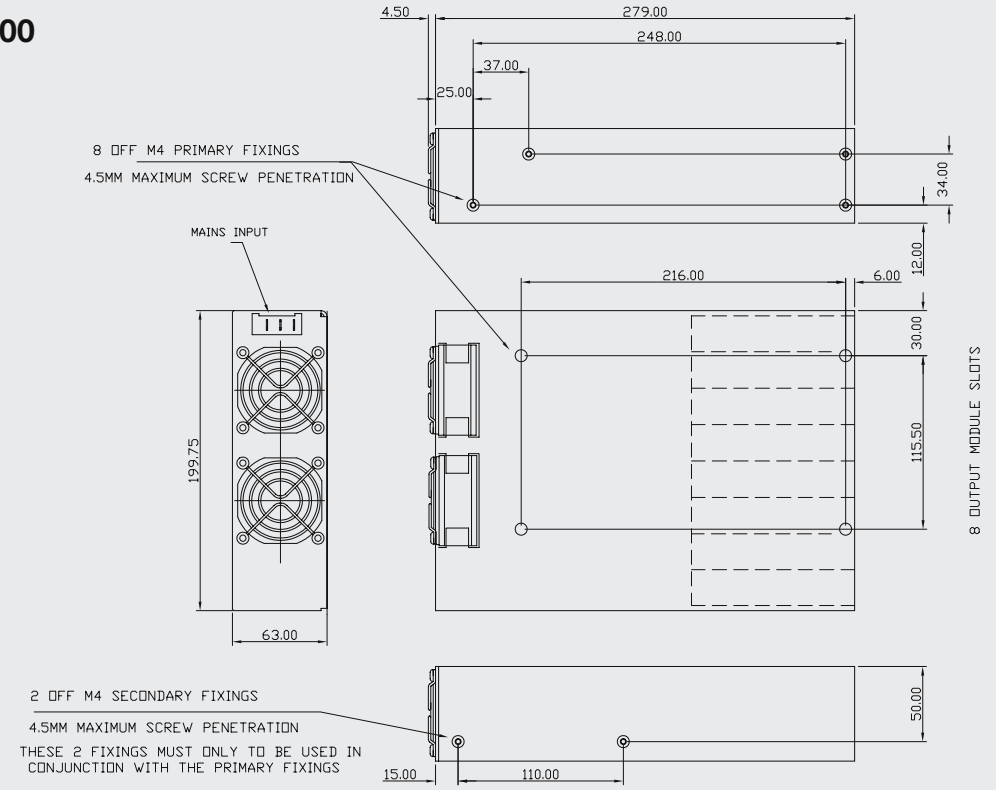


Outline & Connection Drawings

Alpha 1000



Alpha 1500



Innovating Reliable Power

TDK·Lambda

With production facilities in Asia, America and Europe, TDK-Lambda has positioned itself as one of the world's largest manufacturers of electronic power supplies. Boasting a comprehensive range of AC/DC power supplies, DC/DC converters and laboratory power devices ranging from 1.5 W to 15 kW, TDK-Lambda offers the right solution for a host of different applications.

"Power supply" to us is more than just an electronic device. It is the fundamental basis of the safety and reliability of our customers' products. This is why we support you with everything from design, EMC standards and safety certification to serial production, so that we are confident of offering you the best possible solution in every aspect.

More detailed information:

Visit our website and discover the many possibilities offered by TDK-Lambda. Browse through the latest product highlights and download our catalogues and documentation.

www.emea.tdk-lambda.com

TDK·Lambda

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