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# EMH Dual Output Series



- 350 W Forced-Cooled Dual Output
- Industry Standard 4"x 6"x 1.43" Format
- IT & Medical (BF) Approvals
- 80 V – 275 VAC Operation
- Analog & PMBus Signals Options (EMH350)
- 5 V Standby
- Outputs upto 120 VDC
- 3 Year Warranty

The EMH350 Dual Output series provides two high current outputs in a industry standard 6" x 4" footprint. Available both in U channel and integrally cooled end fan versions the EMH dual series can be fitted into 1U and configured to provide single outputs upto 120 VDC.

All models feature two isolated outputs, plus an additional 12V/0.6A fan supply and 5V/2A standby supply complemented with a range of optional analogue, digital and PMBus signals and controls.

With safety approvals that cover both IEC60950 (IT) and IEC60601 BF (Medical) the EMH350 dual series is suitable for a wide range of industrial and medical applications including patient contact.

## Models & Ratings

Output Voltage V1	Output Current V1	Output Voltage V2	Output Current V2	Standby Supply	Fan Supply V3	Maximum Output Power	Model Number <sup>(1)</sup>
12 V	16.5 A	24 V	8.3 A	5.0 V/2.0 A	12 V/0.6 A	354 W	EMH350PD21-U
12 V	16.5 A	36 V	5.5 A	5.0 V/2.0 A	12 V/0.6 A	354 W	EMH350PD22-U
12 V	16.5 A	48 V	4.2 A	5.0 V/2.0 A	12 V/0.6 A	355 W	EMH350PD23-U
24 V	8.3 A	48 V	4.2 A	5.0 V/2.0 A	12 V/0.6 A	354 W	EMH350PD24-U
60 V	3.3 A	60 V	3.3 A	5.0 V/2.0 A	12 V/0.6 A	354 W	EMH350PD25-U

**Notes:**

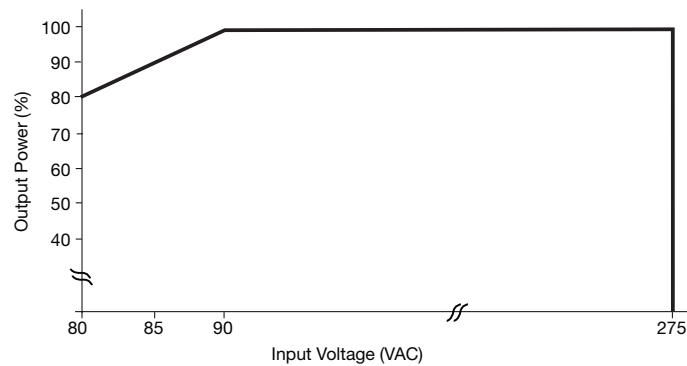
1. For integral end fan version, replace '-U' in model number with '- EF'
2. Output voltages to 120 VDC possible with series output connection contact sales.

## Input Characteristics

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Input Voltage - Operating	80	115/230	275	VAC	Derate output power < 90 VAC. See fig. 1
Input Frequency	47	50/60	63	Hz	
Power Factor		>0.9			EN61000-3-2 class A compliant
Input Current - No Load		0.05/0.03		A	115/230 VAC
Input Current - Full Load		3.6/1.8		A	115/230 VAC - EMH350
Inrush Current			40	A	230 VAC cold start, 25 °C
No Load Input Power		1.0		W	With output inhibit (via signal option)
Earth Leakage Current		90/160	250	µA	115/230 VAC/50 Hz (Typ.), 264 VAC/60 Hz (Max.)
Input Protection	F10 A/250 V internal fuse in both lines				

## Input Voltage - Derating Curve

Figure 1



## Output Characteristics

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Output Voltage - V1	12		120	VDC	See Models and Ratings table
Initial Set Accuracy			±1 V1, ±5 V2	%	50% load, 115/230 VAC
Output Voltage Adjustment	±10 V1			%	Via potentiometer & PMBus control, V2 will track
Minimum Load	0			A	
Start Up Delay		1		s	230 VAC full load (see fig. 2, 3 & 4.)
Hold Up Time		16		ms	115 VAC full load (see fig. 5.)
Drift			±0.2	%	After 20 min warm up
Line Regulation			±0.5	%	90-264 VAC
Load Regulation			±1 V1, ±5 V2	%	0-100% load, V2 EMH350 only
Cross Regulation					See regulation curves (see fig. 2-5)
Transient Response - V1			4	%	Recovery within 1% in less than 500 μs for a 50-75% and 75-50% load step
Over/Undershoot - V1		2		%	
Ripple & Noise			1	% pk-pk	20 MHz bandwidth (see fig. 6 & 7.)
Overvoltage Protection	115		140	%	Vnom DC.
Overload Protection	110		150	% W	Primary power limit V1 & V2 output power combined. (see fig. 6)
Short Circuit Protection					Continuous
Temperature Coefficient			0.05	%/°C	
Overtemperature Protection				°C	Fitted, auto recovery
Patient Leakage Current			100	μA	264 VAC/60 Hz

## Regulation Curves

Figure 2 - EMH350PD21

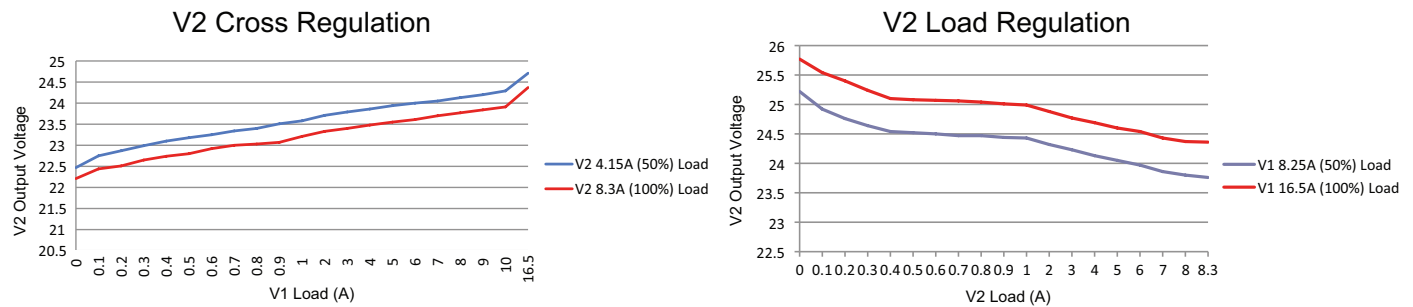
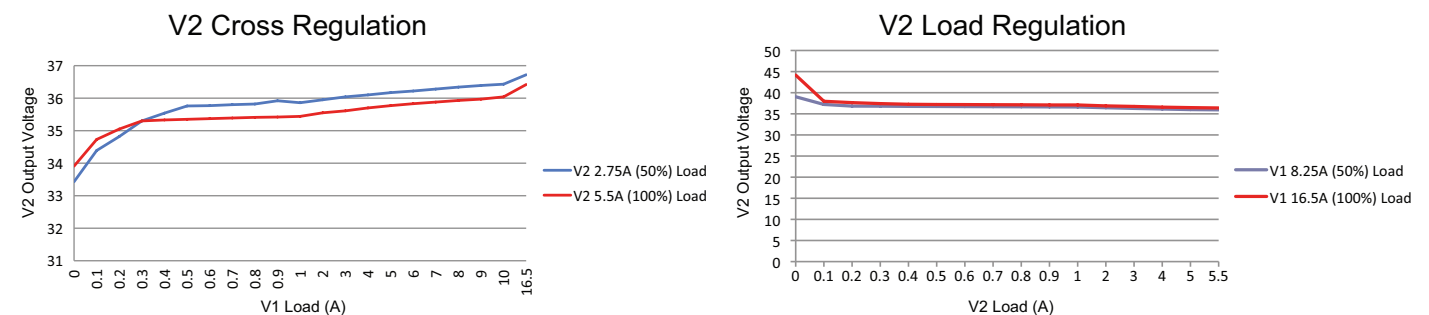


Figure 3 - EMH350PD22



## Regulation Curves

Figure 4 - EMH350PD23

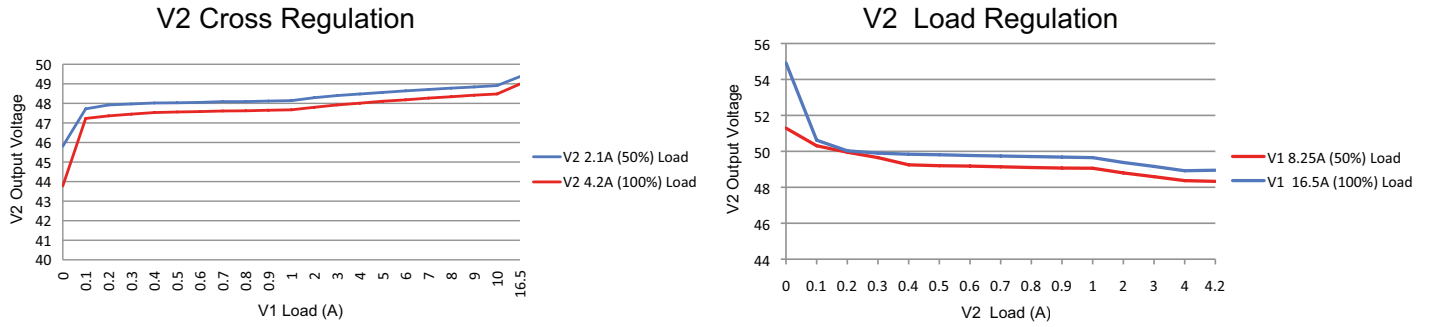
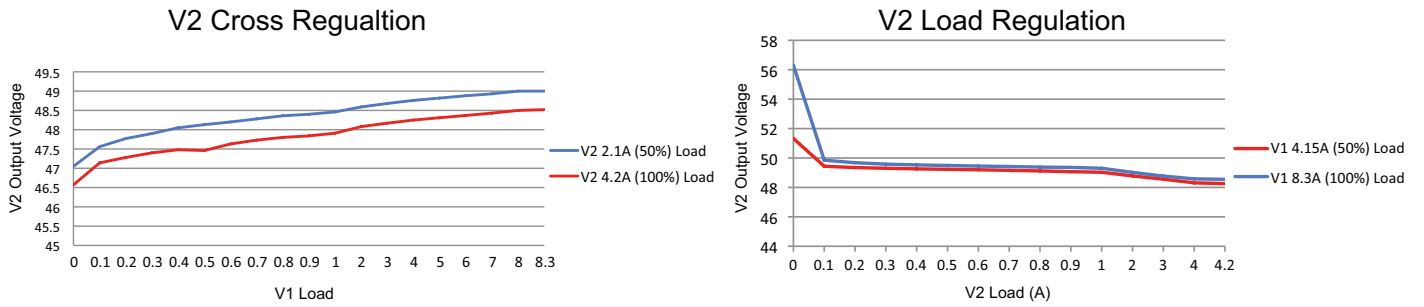
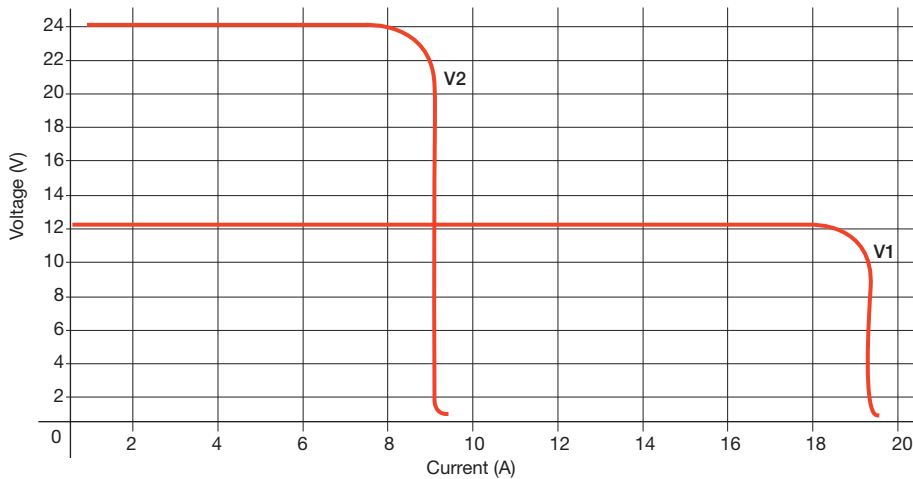


Figure 5 - EMH350PD24



## Overload Characteristics

Figure 6  
Typical Overload Characteristics

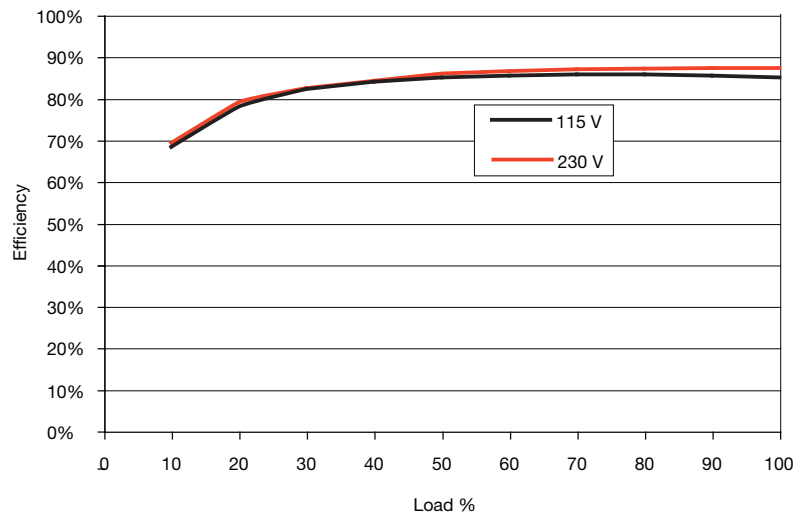


## General Specifications

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency		87		%	Full load (see fig. 7)
Isolation: Input to Output Input to Ground Output to Ground V1 to V2 Output	4000			VAC	
	1500				
	1500				
	80			VDC	
Switching Frequency		62-560 / 71 / 50-130		kHz	PFC / Main Converter / Standby Converter
Power Density			16.3	W/in <sup>3</sup>	
Mean Time Between Failure		400		kHrs	MIL-HDBK-217F, Notice 2 +25 °C GB
Weight		1.6 (730)		lbs (g)	U Models
		2.2 (1003)			EF Models

## Efficiency Versus Load

Figure 7  
EMH350PD21



## Environmental

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating Temperature	0		+70	°C	Derate linearly from +50 °C at 2.5%/°C to 50% at 70 °C. (See Thermal Considerations)
Storage Temperature	-40		+85	°C	
Cooling	16			CFM	Forced-cooled, see Thermal Considerations & Mechanical details
Humidity	5		95	%RH	Non-condensing
Operating Altitude			3048	m	
Shock					±3 x 30g shocks in each plane, total 18 shocks. 30g = 11ms (+/-0.5msec), half sine. Conforms to EN60068-2-27 & EN60068-2-47
Vibration					Single axis 10 - 500 Hz at 2g sweep and endurance at resonance in all 3 planes. Conforms to EN60068-2-6

## Electromagnetic Compatibility - Emissions

Phenomenon	Standard	Test Level	Criteria	Notes & Conditions
Conducted	EN55011/22	Class B		
Radiated	EN55011/22	Class A		AC input cable fitted with Würth Elektronik ferrite core (3 turns), Part No.742-700-56. See EMC report for details.
Voltage Fluctuations	EN61000-3-3			

## Electromagnetic Compatibility - Immunity

Phenomenon	Standard	Test Level	Criteria	Notes & Conditions	
Low Voltage PSU EMC	EN61204-3	High severity level	as below		
Harmonic Current	EN61000-3-2	Class A			
Radiated	EN61000-4-3	3	A		
EFT	EN61000-4-4	3	A		
Surges	EN61000-4-5	Installation class 3	A		
Conducted	EN61000-4-6	3	A		
Dips and Interruptions	EN55024 (100 VAC)	Dip >95% (0 VAC), 8.3ms	B		
		Dip 30% (70 VAC), 416ms	B		
		Dip >95% (0 VAC), 4160ms	B		
	EN55024 (240 VAC)	Dip >95% (0 VAC), 10.0ms	B		
		Dip 30% (168 VAC), 500ms	B		
		Dip >95% (0 VAC), 5000ms	B		
	EN60601-1-2 (100 VAC)	Dip >95% (0 VAC), 10.0ms	A		
		Dip 60% (40 VAC), 100ms	A		Derate Output Power to 140 W
		Dip 30% (70 VAC), 500ms	A		
	EN60601-1-2 (240 VAC)	Dip >95% (0 VAC), 5000ms	B		
		Dip >95% (0 VAC), 10.0ms	A		
		Dip 60% (96 VAC), 100ms	A		
		Dip 30% (168 VAC), 500ms	A		
		Dip >95% (0 VAC), 5000ms	B		

## Safety Agency Approvals

Safety Agency	Safety Standard	Category
CB Report	UL, IEC60950-1:2005 Ed 2	Information Technology
UL	UL60950-1 (2007), CSA 22.2 No.60950-1-07 Ed 2	Information Technology
TUV	TUV, EN60950-1:2006	Information Technology
CE	LVD & RoHS	

Safety Agency	Safety Standard	Category
CB Report	IEC60601-1 Ed 3 Including Risk Management	Medical
UL	ANSI/AAMI ES 60601-1:2005 & CSA C22.2 No. 60601-1:08	Medical
TUV	EN60601-1:2006	Medical

Means of Protection		Category
Primary to Secondary	2 x MOPP (Means of Patient Protection)	IEC60601-1 Ed 3
Primary to Earth	1 x MOPP (Means of Patient Protection)	
Secondary to Earth	1 x MOPP (Means of Patient Protection)	

Equipment Protection Class	Safety Standard	Notes & Conditions
Class I & BF	IEC60950-1:2005 Ed 2 & IEC60601-1 Ed 3	See safety agency conditions of acceptability for details

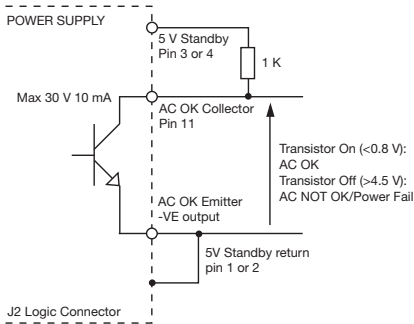
## Signals Description & Compatibility

Model	Functions							PMBus
	Remote Sense	Fan Supply	5 V Standby	AC OK/ Power Fail	Inhibit V1 & V Fan	Current Share	Variable Speed Fan Control	
EMH350PDxx-U	✓	✓	✓	✓	✓	✓		Contact Sales
EMH350PDxx-EF	✓	✓	✓	✓	✓	✓	✓	

Characteristic	Notes & Conditions
<b>Signals &amp; Control</b>	
Remote Sense	Compensates for 0.5 V total voltage drop
12 V Fan Supply (V3)	12 V/0.6 A supply, present when AC supplied, inhibit turns fan supply off.
5V Standby	5 V/2 A supply, always present when AC supplied
AC OK/Power Fail	AC OK is an open collector transistor, referenced to negative output, providing a minimum of 3 ms warning of loss of output regulation. The transistor is normally on when AC is healthy. See fig. 8.
Inhibit	The inhibit high pin should be pulled below 0.4 V to switch V1, V2 & V Fan (V3) off. Open circuit or 2-8 V maximum to switch the output on. See fig. 9.
Current Share	Connecting pin 9 (-01 & -02 models) of like voltage units (3 maximum) will force the current to share between the outputs. Units share current within 10% of each other at full load. See fig. 10.
Variable Speed Fan Control	Only available for -EF models. Varies the speed of the integral fans depending on input voltage, output power & ambient temperature within the unit.

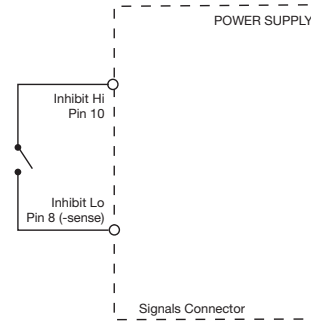
### AC OK Power Fail

Figure 8



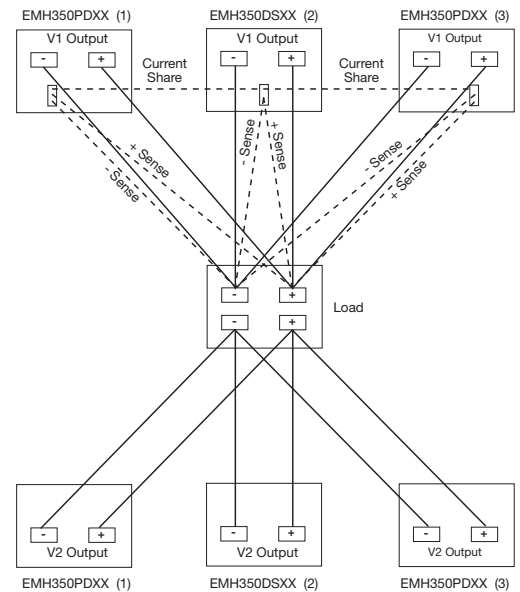
### Inhibit

Figure 9



### Parallel & Current Share

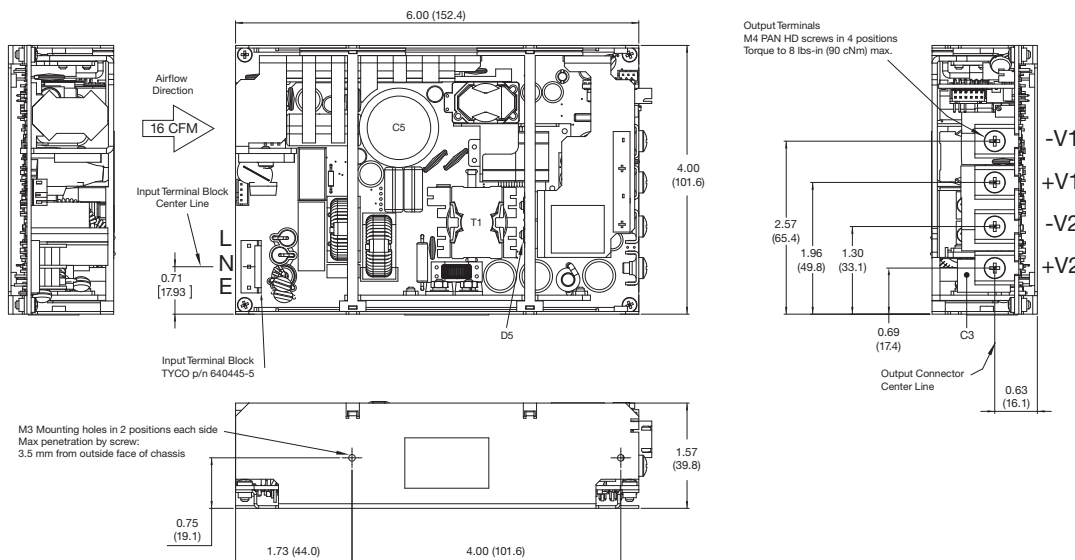
Figure 10





# Mechanical Details

## EMH350PDxx-U



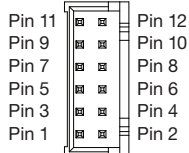
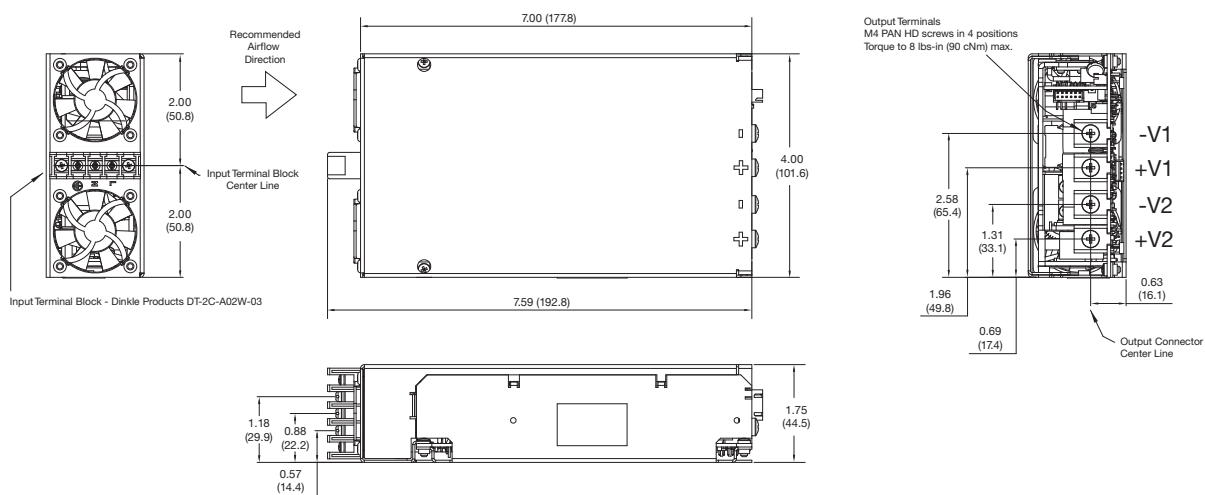
Output Connector	
CON 2	+V1
CON 3	-V1

Input Connector CON 1 TYCO part # 640445-5	
1	Line
3	Neutral
5	Earth

Pins 2 & 4 removed  
Mates with Tyco SL-156 Series Connector

## EMH350PDxx-EF



Pin Connections			
Pin	Function	Pin	Function
1	-VE Standby	7	V1 +VE Sense
2	-VE Standby	8	V1 -VE Sense
3	+VE Standby	9	Current Share
4	+VE Standby	10	Inhibit
5	Fan +VE	11	Power Fail
6	Fan -VE	12	Not Connected

Signals Connector - 12 WAY 2mm PITCH p/n JST S12B-PHDSS  
Mating HALF - p/n JST PHDR-12VS  
Contact - 26-22 AWG p/n JST SPHD-001T-P0.5

### Notes

1. Dimensions shown in inches (mm).  
Tolerance: ±0.02 (±0.5)

2. Weight: U channel: 1.6 lb (730 g),  
End Fan: 2.2 lbs (1003 g)

## Thermal Considerationse (U Channel Versions)

In order to ensure safe operation of the PSU in the end-use equipment, the temperature of the components listed in the table below must not be exceeded. Temperature should be monitored using K type thermocouples placed on the hottest part of the component (out of any direct air flow). See Mechanical Details for component locations.

Temperature Measurements (Ambient ≤ 50 °C)	
Component	Max Temperature °C
D5 case	120 °C
C5	105 °C
C3	105 °C
T1 coil	120 °C

## Service Life (U Channel Versions)

The estimated service life of the EMH Dual Series is determined by the cooling arrangements and load conditions experienced in the end application. Due to the uncertain nature of the end application this estimated service life is based on the actual measured temperature of a key capacitor within the product when installed in the end application.

The graph below expresses the estimated lifetime for a given component temperature and assumes continuous operation at this temperature.

## Estimated Service Life vs Component Temperature

