

# 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 and additional 12V/0.6A fan supply and 5V/2A standby supply complimented 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.



T H E X P E R T S I N P O W E R

## 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:

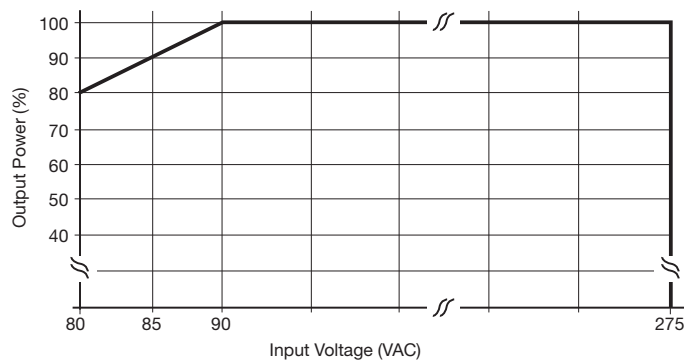
1. For integral end fan version, replace '-U' in model number with '- EF'
2. Output voltages to 120 VDC possible with series output connection contact sales.

## 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        |             |         | $\pm 1$ V1, $\pm 5$ V2 | %       | 50% load, 115/230 VAC                                                         |
| Output Voltage Adjustment   | $\pm 10$ 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                       |             |         | $\pm 0.2$              | %       | After 20 min warm up                                                          |
| Line Regulation             |             |         | $\pm 0.5$              | %       | 90-264 VAC                                                                    |
| Load Regulation             |             |         | $\pm 1$ V1, $\pm 5$ 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 $\mu$ s 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    |                                                                               |
| Overttemperature Protection |             |         |                        | °C      | Fitted, auto recovery                                                         |
| Patient Leakage Current     |             |         | 100                    | $\mu$ A | 264 VAC/60 Hz                                                                 |

## Regulation Curves

Figure 2 - EMH350PD21

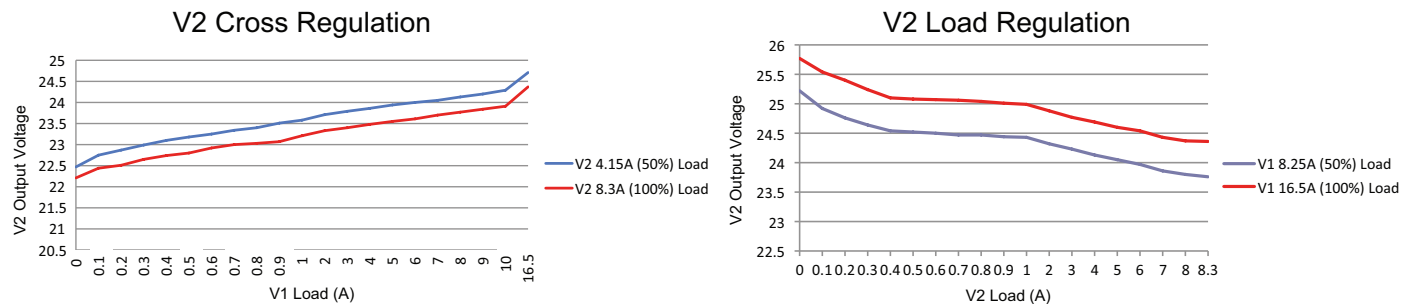
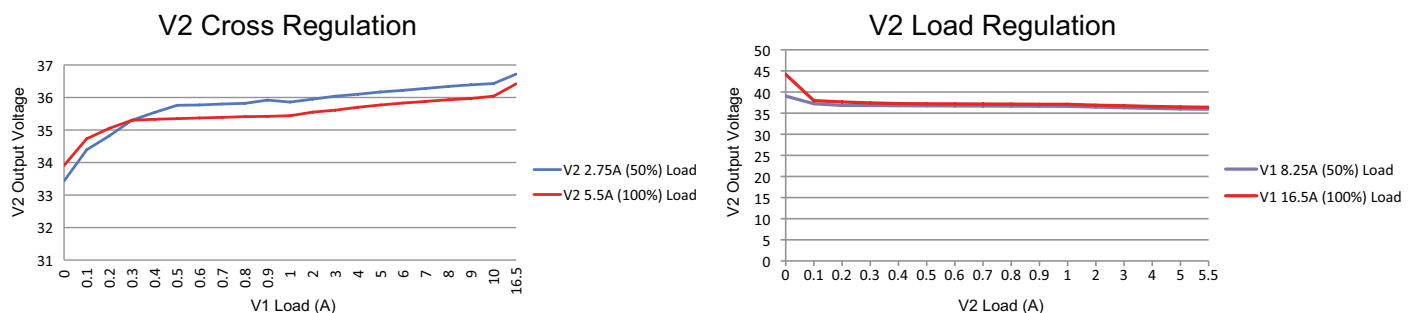


Figure 3 - EMH350PD22



## Regulation Curves

Figure 4 - EMH350PD23

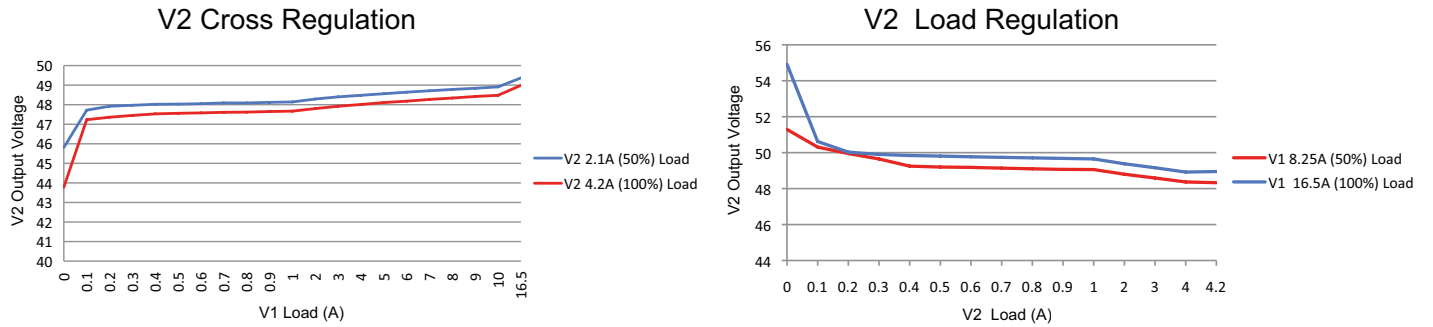
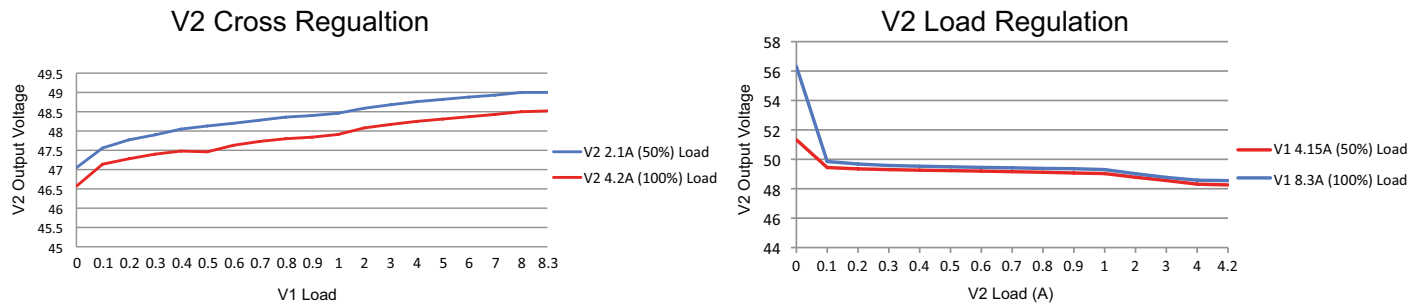
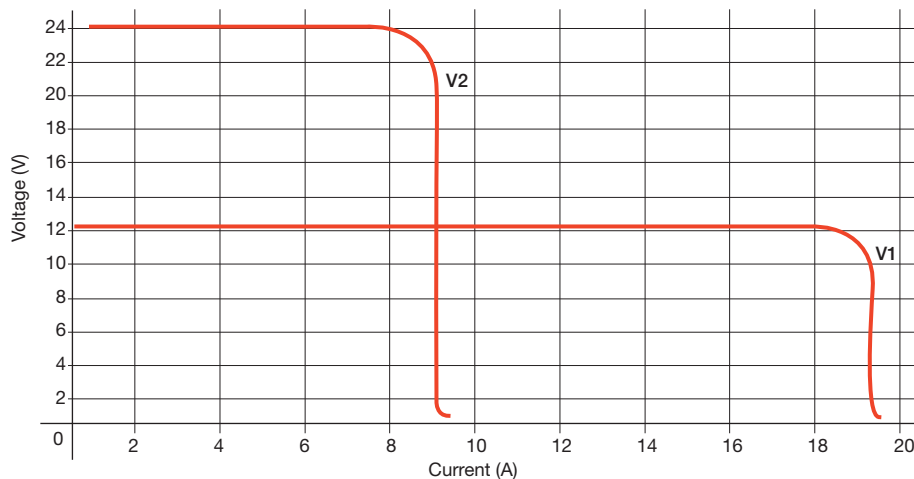


Figure 5 - EMH350PD24



## Overload Characteristics

Figure 6  
Typical Overload Characteristics

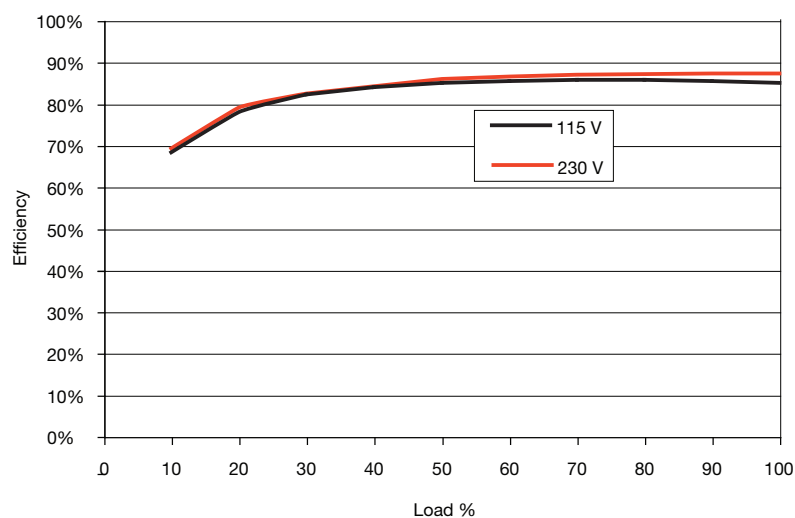


## General Specifications

| Characteristic                                                                       | Minimum | Typical              | Maximum | Units             | Notes & Conditions                       |
|--------------------------------------------------------------------------------------|---------|----------------------|---------|-------------------|------------------------------------------|
| Efficiency                                                                           |         | 87                   |         | %                 | Full load (see fig. 7)                   |
| Isolation: Input to Output<br>Input to Ground<br>Output to Ground<br>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<br>+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 (2 turns). 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<br>(100 VAC)     | Dip >95% (0 VAC), 8.3ms  | B        |                              |
|                        |                          | Dip 30% (70 VAC), 416ms  | B        |                              |
|                        |                          | Dip >95% (0 VAC), 4160ms | B        |                              |
|                        | EN55024<br>(240 VAC)     | Dip >95% (0 VAC), 10.0ms | B        |                              |
|                        |                          | Dip 30% (168 VAC), 500ms | B        |                              |
|                        |                          | Dip >95% (0 VAC), 5000ms | B        |                              |
|                        | EN60601-1-2<br>(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        |                              |
|                        |                          | Dip >95% (0 VAC), 5000ms | B        |                              |
|                        | EN60601-1-2<br>(240 VAC) | 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 |

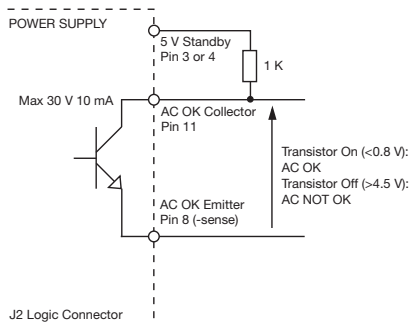
## Signals Description & Compatibility

| Model         | Functions    |            |             |                   |                    |               |                            |               |
|---------------|--------------|------------|-------------|-------------------|--------------------|---------------|----------------------------|---------------|
|               | Remote Sense | Fan Supply | 5 V Standby | AC OK/ Power Fail | Inhibit V1 & V Fan | Current Share | Variable Speed Fan Control | PMBus         |
| 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 sense, providing a minimum of 3 ms warning of loss of output regulation. The transistor is normally off when AC is healthy. See fig. 4. |
| Inhibit                      | The inhibit high pin should be pulled below 0.4 V to switch V1 & V Fan (V3) off. Open circuit or 2-8 V maximum to switch the output on. See fig. 5.                                                   |
| 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. 6.     |
| 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.                                                  |

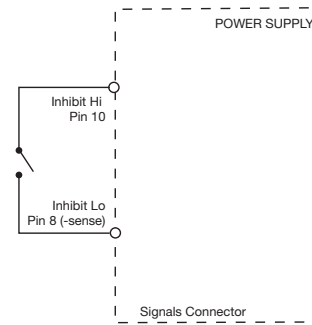
### AC OK Power Fail

Figure 8



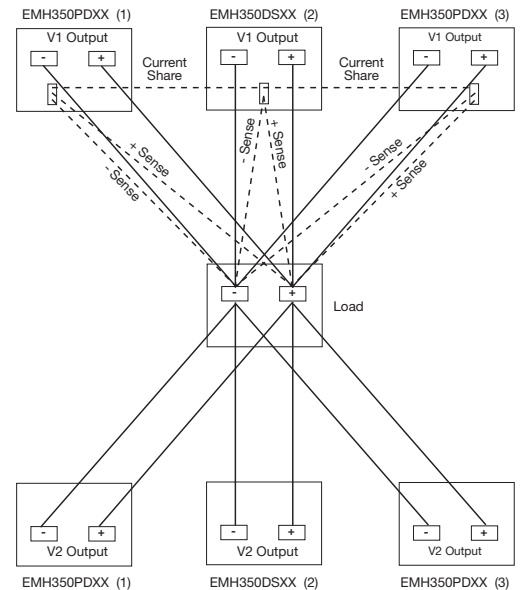
### Inhibit

Figure 9



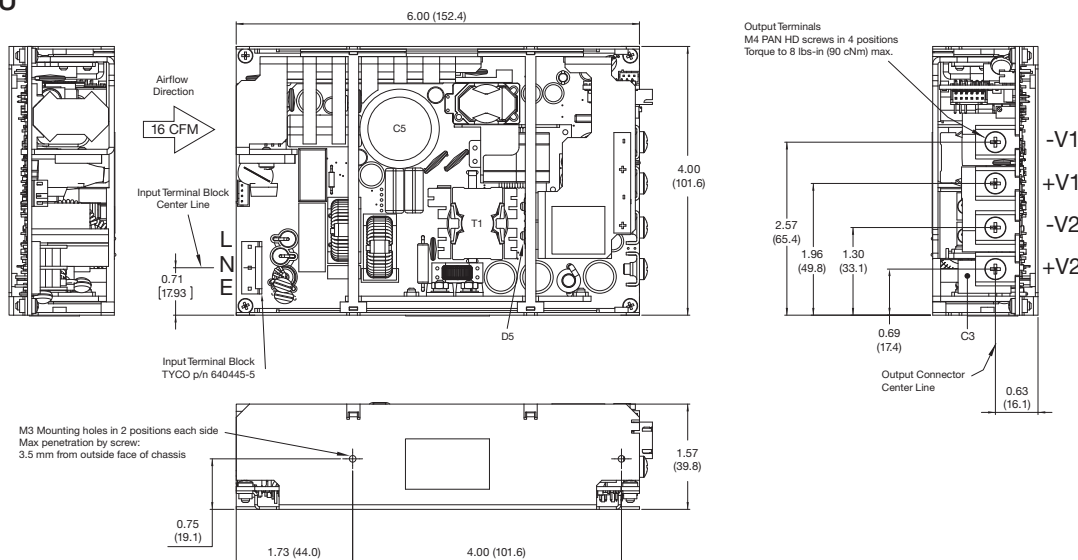
### Parallel & Current Share

Figure 10

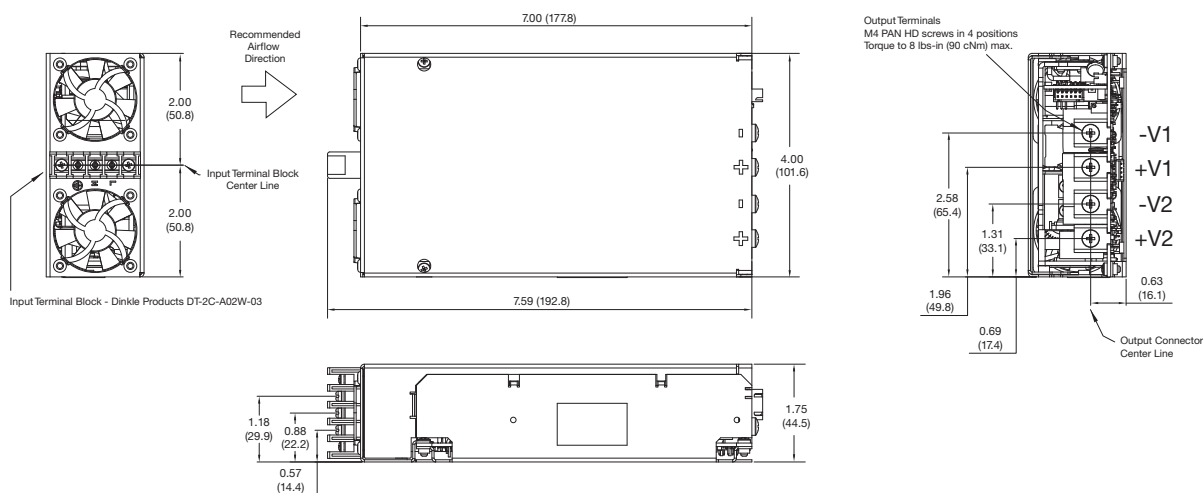


## Mechanical Details

### EMH350PDxx-U



### EMH350PDxx-EF



|        |  |        |
|--------|--|--------|
| Pin 11 |  | Pin 12 |
| Pin 9  |  | Pin 10 |
| Pin 7  |  | Pin 8  |
| Pin 5  |  | Pin 6  |
| Pin 3  |  | Pin 4  |
| Pin 1  |  | Pin 2  |

| 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:  $\pm 0.02$  ( $\pm 0.5$ )

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.

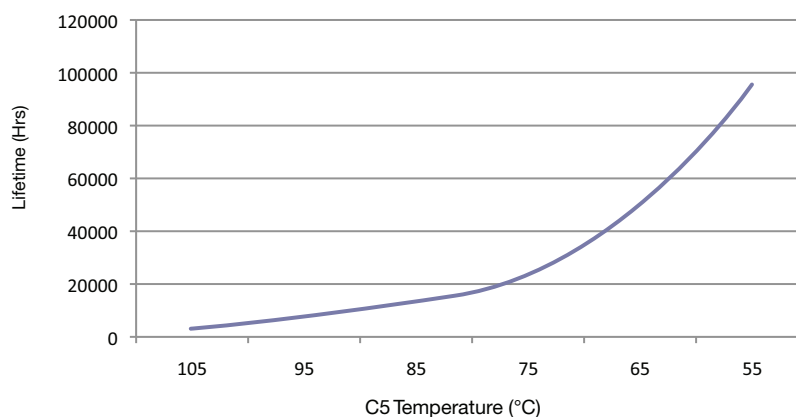
| Temperature Measurements (Ambient $\leq 50^{\circ}\text{C}$ ) |                                    |
|---------------------------------------------------------------|------------------------------------|
| Component                                                     | Max Temperature $^{\circ}\text{C}$ |
| D5 case                                                       | 120 $^{\circ}\text{C}$             |
| C5                                                            | 105 $^{\circ}\text{C}$             |
| C3                                                            | 105 $^{\circ}\text{C}$             |
| T1 coil                                                       | 120 $^{\circ}\text{C}$             |

## 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



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#### North American HQ

XP Power  
990 Benecia Avenue, Sunnyvale, CA 94085  
Phone : +1 (408) 732-7777  
Fax : +1 (408) 732-2002  
Email : [nasales@xppower.com](mailto:nasales@xppower.com)

#### European HQ

XP Power  
Horseshoe Park, Pangbourne, Berkshire, RG8 7JW, UK  
Phone : +44 (0)118 984 5515  
Fax : +44 (0)118 984 3423  
Email : [eusales@xppower.com](mailto:eusales@xppower.com)

#### German HQ

XP Power  
Auf der Höhe 2, D-28357 Bremen, Germany  
Phone : +49 (0)421 63 93 3 0  
Fax : +49 (0)421 63 93 3 10  
Email : [desales@xppower.com](mailto:desales@xppower.com)

#### Asian HQ

XP Power  
401 Commonwealth Drive, Haw Par Technocentre,  
Lobby B #02-02, Singapore 149598  
Phone : +65 6411 6900  
Fax : +65 6741 8730  
Email : [apsales@xppower.com](mailto:apsales@xppower.com)  
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