



### Applications

- Medical and dental equipment
- Test and measurement
- Chemical analysis equipment
- Drug infusion equipment
- Peripherals

### Description

The ESM4 and ESM6 Series of modular AC-DC power supplies provide quick-turn-around, cost-effective power solutions for medical applications from 400 to 1000 watts. Low leakage currents, under 300  $\mu$ A (consult factory for leakage currents under 150  $\mu$ A), combined with conformance to IEC601-1 isolation and spacing requirements make these products ideal power sources for applications such as blood analyzers, DNA sequencers, and MRI and CAT scanners.

The ESM4 Series is available in 400 and 600 watt configurations, both providing up to eight outputs from 2.56" x 5" x 10.63" (65 x 127 x 270 mm) chassis. The ESM6 Series is available in 600 and 1000 watt versions, both providing up to twelve outputs from 2.56" x 7.36" x 10.63" (65 x 187 x 270 mm) packages. Five single-output and two dual-output modules can be configured in series or parallel to provide outputs from 1.45 to 58 VDC.

### Features

- EN60601-1, UL2601-1, IEC601-1 approved
- 12mm creepage
- Low leakage current <300  $\mu$ A
- Stackable for up to 2000W output power
- 1 to 12 isolated outputs with full user configurability
- Isolated bias supply voltage 5 V @ 50 mA
- Class B conducted emissions (ESM6)
- 400, 600, and 1000 Watts of output power
- Series and parallel capability
- EN61000-3-2 compliant
- Individual control signals on each module
- 2-year warranty

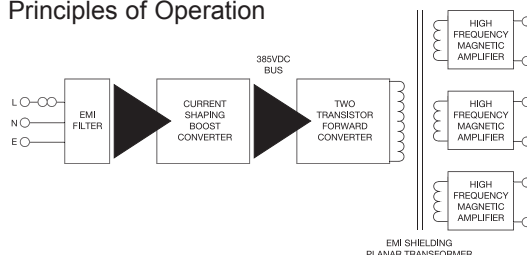
### Single-Output Module Selection

| Module    | No. of Slots | Nominal Voltage | Range         | I <sub>max</sub> |
|-----------|--------------|-----------------|---------------|------------------|
| Module 1  | 1            | 5 V             | 3 to 5.6 V    | 30 A             |
| Module 2  | 1            | 12 V            | 5 to 13 V     | 20 A             |
| Module 3  | 1            | 18 V            | 8 to 20 V     | 15 A             |
| Module 4  | 1            | 24 V            | 12 to 28 V    | 12 A             |
| Module 70 | 2            | 5 V             | 1.45 to 5.6 V | 80 A             |

### Dual-Output Module Selection

| Module   | No. of Slots | Nominal Voltage | Range      | I <sub>max</sub> |
|----------|--------------|-----------------|------------|------------------|
| Module 5 | 1            | 24 V            | 10 to 28 V | 3 A              |
|          |              | 24 V            | 10 to 28 V | 3 A              |
| Module 6 | 1            | 5 V             | 3 to 5.6 V | 10 A             |
|          |              | 24 V            | 10 to 28 V | 3 A              |

### Principles of Operation



**Specification** All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

### Output Specifications

|                         |                                                                                                         |                                               |
|-------------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Maximum power           | Input module B (for 4 slot only)<br>Input module C (for 4 & 6 slot)<br>Input module D (for 6 slot only) | 400 W<br>600 W<br>1000 W <sup>(1)</sup>       |
| Output adjustment       | (Note 2)                                                                                                | Multi-turn potentiometer                      |
| Line regulation         |                                                                                                         | ±0.1%                                         |
| Load regulation         | 50% load change                                                                                         | ±0.2%                                         |
| Cross regulation        |                                                                                                         | ±0.2% typ.                                    |
| Transient response      | (Note 3)                                                                                                | <10%, <0.5ms                                  |
| Temperature coefficient |                                                                                                         | ±0.02%/°C                                     |
| Ripple and noise        | (Note 4)                                                                                                | 1.0% or<br>100mV pk-pk                        |
| Overvoltage protection  |                                                                                                         | Standard on all outputs                       |
| Overcurrent protection  | (Note 5)                                                                                                | Individual current limit                      |
| Thermal protection      |                                                                                                         | Standard                                      |
| Mains failure signal    | Option 06 or 07                                                                                         | 5 ms warning                                  |
| Output isolation        | (Note 6)                                                                                                | Each single and dual<br>output fully floating |
| Margin                  | See application note for individual<br>module margin capabilities                                       |                                               |
| Minimum load            | (Note 7)                                                                                                | Zero                                          |
| Turn-on delay           | 90 VAC, full load                                                                                       | 900 ms max.                                   |
| Remote sense            | Single output modules only                                                                              | 0.5 V drop                                    |

### Input Specifications

|                       |                 |                                 |
|-----------------------|-----------------|---------------------------------|
| Input voltage range   | Universal input | 88 to 264 VAC<br>125 to 370 VDC |
| Input frequency range | (Note 8)        | 47Hz to 63 Hz                   |
| Inrush current        | 230 VAC @ 25°C  | 85A max.                        |
| Harmonic distortion   | (Power factor)  | EN61000-3-2                     |

### EMC Characteristics

|                                      |                                                |                    |
|--------------------------------------|------------------------------------------------|--------------------|
| Emissions:<br>Conducted              | EN55022, FCC<br>ESM4B & ESM4C<br>ESM6C & ESM6D | Level A<br>Level B |
| Immunity:<br>Electrostatic discharge | EN61000-4-2                                    | Level 4            |
| Radiated RFI                         | EN61000-4-3                                    | Level 3            |
| Fast transients - burst              | EN61000-4-4                                    | Level 3            |
| Input line surges                    | EN61000-4-5                                    | Class 3            |
| Conducted RFI                        | EN61000-4-6                                    | Level 3            |
| Voltage dips                         | EN61000-4-11                                   | Compliant          |

### General Specifications

|                         |                                                                 |                                 |
|-------------------------|-----------------------------------------------------------------|---------------------------------|
| Hold-up time            | (Note 9)                                                        | 20ms typ after loss of AC power |
| Efficiency              |                                                                 | 82% typ.                        |
| Isolation voltage       | Input/output<br>Input/chassis                                   | 4000 VAC<br>1500 VAC            |
| Switching frequency     |                                                                 | 200 kHz                         |
| Approvals and standards | (Note 11)<br>IEC601-1, UL60601-1<br>CAN/CSA-C22.2 No. 601-1-M90 |                                 |
| Leakage current         |                                                                 | <300 µA, 250 VAC, 60 Hz         |
| Weight                  | ESM4B, ESM4C<br>ESM6C, ESM6D                                    | 2.5 kg<br>3.5 kg                |
| Size                    | See mechanical specifications                                   |                                 |
| MTBF                    | See application note                                            | 400,000 hours                   |

### Environmental Specifications

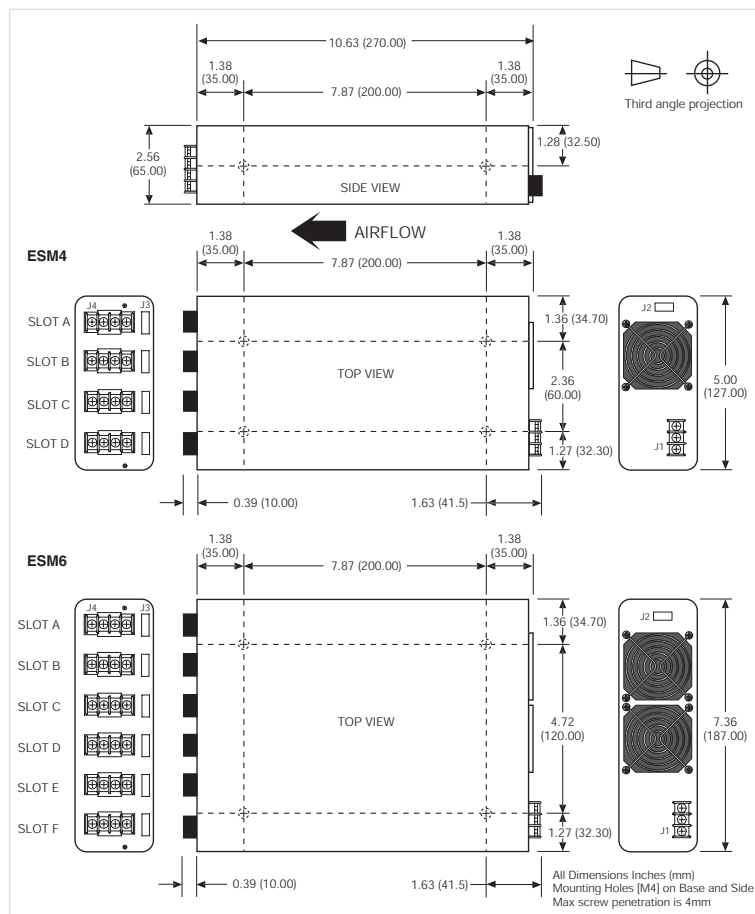
|                                               |                                                                             |                  |
|-----------------------------------------------|-----------------------------------------------------------------------------|------------------|
| Operating temperature<br>(See derating curve) | See application note<br>-20°C to +50°C<br>Derate 2.5% per °C<br>up to +70°C |                  |
| Storage temperature                           |                                                                             | -40°C to +85°C   |
| Relative humidity                             | Non-condensing                                                              | 5% to 95% RH     |
| Shock                                         | 3000 bumps, 10 G (16 ms) half sine                                          |                  |
| Vibration                                     |                                                                             | 10-200 Hz, 1.5 G |

### NOTES

- 1000 W peak power for 10 ms at low line. 800 W average power for input voltage less than 180 VAC.
- Outputs are user-adjustable or factory set to your requested voltage.
- 25% to 75% load change.
- Whichever is greater. 20 MHz bandwidth. (See application note for specification below 0°C).
- Straight line on all outputs. On Module 70 current limit adjustable from 50% to 110%. Optional foldback on Module 70 or contact factory for details see application note.

- 100V isolation between each output and 500 V to chassis.
- All outputs except Module 70, which has 5.0% minimum load for full specification.
- Contact factory for 400 Hz operation.
- For nominal output voltages and full load.
- The specifications contained in this data sheet are believed to be correct at time of publication. Specifications are subject to change without notice.
- This product is not intended for use as a standalone unit and must be installed by authorized personnel in order to maintain approvals.

## Mechanical Drawing

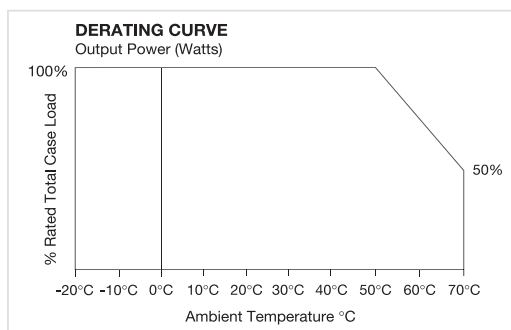


### Connectors:

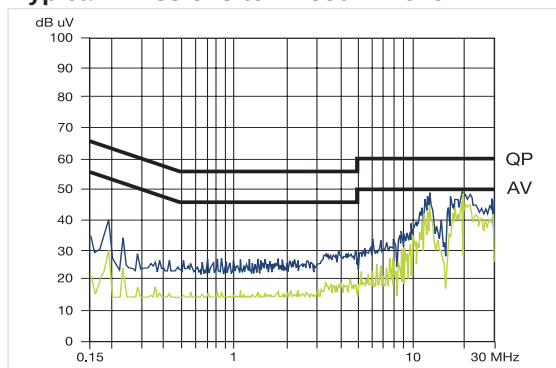
- J1 Line Input Connector
- J2 Options  
See application note for Pinout
- J3 Output Signals  
See application note for Pinout
- J4 Output Connector

### Accessories:

- Parallel Link
- Series Link
- "U" Link
- Mating Connector for options + Module 1-6 signals
- Mating Connector for Module 70 signals



## Typical Emissions to EN55022 Level B



### Single-Output Module Selection

| Module    | No. of Slots | Nominal Voltage | Range         | I <sub>max</sub> |
|-----------|--------------|-----------------|---------------|------------------|
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|          |              | 24 V            | 10 to 28 V | 3 A              |
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|          |              | 24 V            | 10 to 28 V | 3 A              |

### Output Signals

Output control signals are available on all output modules. (see application note)

#### Modules 1 to 6

- Power good signal
- Output inhibit signal
- Remote adjust (margin)

#### Module 70 Additional Features

- Adjustable Current Limit
- Foldback or Straight Line Current Limiting
- Bias Voltage
- Selectable Output Inhibit or Enable

Dual output modules:  
Output signals available on first [top] output only.

### Production Configuration:

Units are shipped with nominal output voltages unless special configuration is specified. Power-One can configure to your exact requirements through use of appropriate series and parallel busbars, and voltage adjustment to specific set points.

### ESP/ESM Standard Options

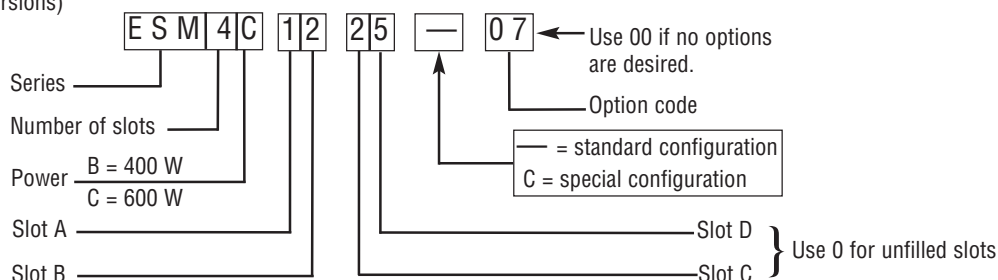
06 Mains Power Fail + Global Enable + Bias Supply Voltage

07 Mains Power Fail + Global Inhibit + Bias Supply Voltage

### How to Order ESM4

(Available in 400/600 Watt Versions)

**Note:** Calculate power requirements by summing output powers calculated at application output voltages.



### Specification of power supply detailed above:

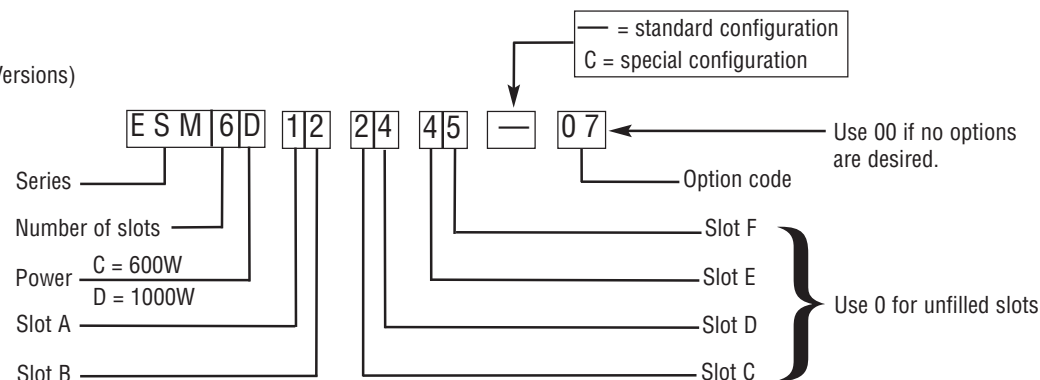
- 4-slot series
- Maximum output power: 600 W
- 5 V @ 30 A; 12 V @ 20 A; 24 V @ 3 A; 24 V @ 3 A
- Mains Power Fail signal + Logic Inhibit + Bias Supply Voltage

### How to Order ESM6

(Available in 600/1000 Watt Versions)

**Note:** Calculate power requirements by summing output powers calculated at application output voltages.

For ESM6D:  
Limit total power from slots A-C and D-F to 550W each.

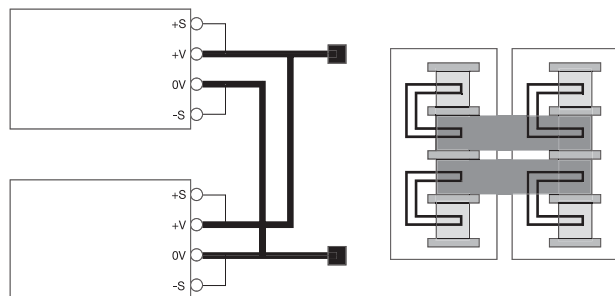


### Specification of power supply detailed above:

- 6-slot series
- Maximum output power: 1000W
- 5V @ 30A; 12V @ 20A; 12V @ 20A; 24V @ 12A; 24V @ 12A; 24V @ 3A; 24V @ 3A
- Mains Power Fail signal + Logic Inhibit + Bias Supply Voltage

## ESM Flexibility

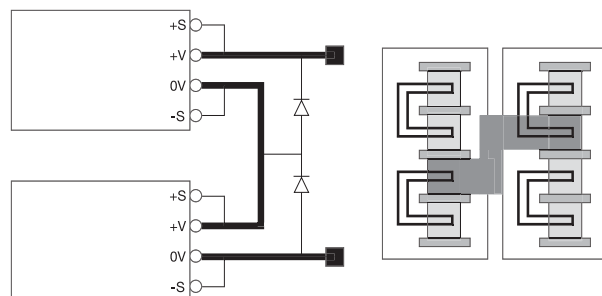
### Using Modules in Parallel



#### Notes:

Maximum current =  $(I_1 + I_2) \times .9$   
Use two parallel links

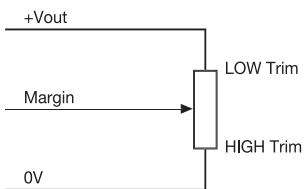
### Using Modules in Series



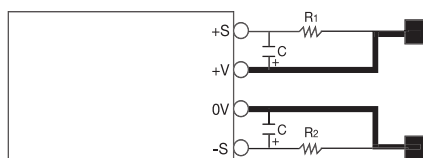
#### Notes:

Maximum voltage to chassis is 500V  
Use series link  
Reverse bias diodes may be required for certain applications, eg. large capacitive loads

### Remote Adjustment



### Remote Sensing

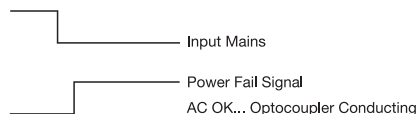


#### Notes:

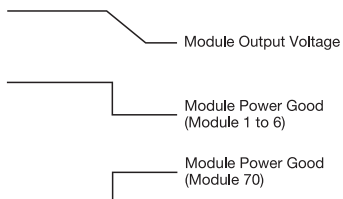
Where the sensing point is remote from the output of the power supply, to avoid spurious noise pick-up it may be necessary to:

- 1 Use twisted pair sense wires.
- 2 Use R C as shown ( $R_1 = 100\Omega$ ) ( $R_2 = 10\Omega$ ) ( $C = 22\mu F$ ).

### Mains Power Fail Signal



### Output Power Good Signal



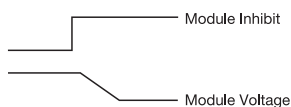
#### Notes:

See application note for full details.

### Global Inhibit (Reverse Logic for Global Enable)



### Module Inhibit



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