

**LEVEL VI**  
EFFICIENCY  
EMI & EMC



 **RoHS**

**VI**

**CE**



## Features

- Meets DoE Efficiency Level VI Requirements
  - No load input power
  - Average Efficiency
- Up to 90W of AC-DC Power
- Universal Input 90-264Vac Input Range
- IP22 Rated Enclosure
- Meets “Heavy Industrial” Levels of EN61000 EMC Requirements
- Meets EN55011/CISPR11, FCC Part 15.109 Class B Conducted & Radiated Emissions, with 6db margin
- Approved to EN/IEC/UL60950-1, 2<sup>nd</sup> Edition, Am. 2
- E-cap life of >7 years
- 3 Year Warranty
- RoHS/REACH Compliant

## Description

A high performance AC to DC external power supply family designed for test & measurement and industrial applications. Fully compliant with Efficiency Level VI requirements per U.S. Dept. of Energy, and also compliant to the Heavy Industrial levels of various EN61000-4-x standards for EMC. The TE90 series models also meet Class B conducted and radiated EMI per FCC Part 15, EN55022, CISPR22, with margin. Designed to allow easy integration with test and measurement equipment and other industrial applications.

## Model Selection

| Model Number | Volts | Output Current | Output Power | Ripple & Noise <sup>1</sup> | Line Regulation | Load Regulation | Output Cable & Connector                                | Input Configuration                       |
|--------------|-------|----------------|--------------|-----------------------------|-----------------|-----------------|---------------------------------------------------------|-------------------------------------------|
| TE90A1251F01 | 12.0V | 7.50A          | 90W          | 120mV pk-pk                 | ±1%             | ±5%             | 6 pin Molex Type <sup>2</sup>                           | Class I Desktop, IEC60320 C14 Receptacle  |
| TE90A1503F01 | 15.0V | 6.00A          | 90W          | 150mV pk-pk                 | ±1%             | ±5%             | 2.5 x 5.5 x 9.5mm Straight Barrel Type, center positive |                                           |
| TE90A1803F01 | 18.0V | 5.00A          | 90W          | 180mV pk-pk                 | ±1%             | ±5%             |                                                         |                                           |
| TE90A2403F01 | 24.0V | 3.75A          | 90W          | 240mV pk-pk                 | ±1%             | ±5%             |                                                         | Class II Desktop, IEC60320 C8 Receptacle  |
| TE90A1251N01 | 12.0V | 7.50A          | 90W          | 120mV pk-pk                 | ±1%             | ±5%             | 6 pin Molex Type <sup>2</sup>                           |                                           |
| TE90A1503N01 | 15.0V | 6.00A          | 90W          | 150mV pk-pk                 | ±1%             | ±5%             | 2.5 x 5.5 x 9.5mm Straight Barrel Type, center positive |                                           |
| TE90A1803N01 | 18.0V | 5.00A          | 90W          | 180mV pk-pk                 | ±1%             | ±5%             |                                                         | Class II Desktop, IEC60320 C18 Receptacle |
| TE90A2403N01 | 24.0V | 3.75A          | 90W          | 240mV pk-pk                 | ±1%             | ±5%             |                                                         |                                           |
| TE90A1251Q01 | 12.0V | 7.50A          | 90W          | 120mV pk-pk                 | ±1%             | ±5%             | 6 pin Molex Type <sup>2</sup>                           |                                           |
| TE90A1503Q01 | 15.0V | 6.00A          | 90W          | 150mV pk-pk                 | ±1%             | ±5%             | 2.5 x 5.5 x 9.5mm Straight Barrel Type, center positive |                                           |
| TE90A1803Q01 | 18.0V | 5.00A          | 90W          | 180mV pk-pk                 | ±1%             | ±5%             |                                                         |                                           |
| TE90A2403Q01 | 24.0V | 3.75A          | 90W          | 240mV pk-pk                 | ±1%             | ±5%             |                                                         |                                           |

Notes: 1. Measured at the output connector, with noise probe directly across output and load, terminated with 0.1μF ceramic and 47μF low ESR capacitors.

2. Molex p/n 39-01-2060 or equivalent. See outline drawing for pinout information.

3. For Input Class I models: For AC GND connected to output common (-), insert a “B” in the part number where the “A” is located (TE90B1251F01).

4. All specifications are typical at nominal input, full load, at 25°C ambient unless noted.

## General Specifications

|                              |                                                                                                                                                                                                                                                                          |                                   |                                                                                                                                                                                                     |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AC Input</b>              | 100-240Vac, $\pm 10\%$ , 47-63Hz, 1 $\phi$                                                                                                                                                                                                                               | <b>Turn On Time</b>               | Less than 1 sec @115Vac, full load                                                                                                                                                                  |
| <b>Input Current</b>         | 115Vac: 1.2A, 230Vac: 0.6A                                                                                                                                                                                                                                               | <b>Hold-up Time</b>               | 20mS min., at full Load, 100Vac input                                                                                                                                                               |
| <b>Inrush Current</b>        | 264Vac, cold start: will not exceed 60A                                                                                                                                                                                                                                  | <b>Overtemperature Protection</b> | Will shutdown upon an over-temperature condition, auto-recovery.                                                                                                                                    |
| <b>Input Fuses</b>           | F1, F2: 5A, 250Vac fuses (line & neutral lines) provided on all models                                                                                                                                                                                                   | <b>Overload Protection</b>        | 130 to 180% of rating, Hiccup Mode                                                                                                                                                                  |
| <b>Earth Leakage Current</b> | Input-GND: <500 $\mu$ A@264Vac, 60Hz, NC<br>Output-GND: <4mA@264Vac, 60Hz, NC                                                                                                                                                                                            | <b>Short Circuit Protection</b>   | Hiccup Mode, auto recovery.                                                                                                                                                                         |
| <b>Efficiency</b>            | Meets US DoE Efficiency Level VI average efficiency levels                                                                                                                                                                                                               | <b>Overvoltage Protection</b>     | 130 to 150% of output voltage (max. 60V on 48V model), hiccup mode                                                                                                                                  |
| <b>Output Power</b>          | 90W continuous – See models chart for specific voltage model ratings.                                                                                                                                                                                                    | <b>Isolation</b>                  | Input-Output: 4000Vac<br>Input-Ground: 1500Vac<br>Output-Ground: 1500Vac                                                                                                                            |
| <b>No Load Input Power</b>   | <0.210W per DoE Efficiency Level VI Requirements                                                                                                                                                                                                                         | <b>Safety Standards</b>           | EN/CSA/UL/IEC 60950-1, 2nd Edition, Am 2                                                                                                                                                            |
| <b>Ripple and Noise</b>      | See models chart on pg 1.                                                                                                                                                                                                                                                | <b>Operating Temperature</b>      | -20°C to +70°C. Derate above 40°C.                                                                                                                                                                  |
| <b>Output Voltage</b>        | See models chart on pg 1.                                                                                                                                                                                                                                                | <b>Case Temperature</b>           | Case Temperatures are within regulatory guidelines. Care should be taken to avoid prolonged contact with skin or other heat sensitive surfaces.                                                     |
| <b>Transient Response</b>    | 500 $\mu$ S response time for return to within 0.5% of final value for any 50% load step over the range of 5% to 100% of rated load, $\Delta i/\Delta t < 0.2A/\mu$ S. Max. voltage deviation is $\pm 3.5\%$ .                                                           | <b>Temperature Derating</b>       | See Derating Chart                                                                                                                                                                                  |
| <b>E-Cap Life</b>            | >7 year life based on calculations at 115Vac/60Hz & 230Vac/50Hz, ambient 25°C at 24 hrs per day, 365 days/year, 6 power up cycles per day. (80% load on 12V model)                                                                                                       | <b>MTBF</b>                       | >500,000 hours, full load, 110 & 220Vac input, 25°C amb., per Telcordia 332 Issue 6.                                                                                                                |
| <b>Weight</b>                | 600g                                                                                                                                                                                                                                                                     | <b>Storage Temperature</b>        | -40°C to +85°C                                                                                                                                                                                      |
| <b>Safety Drop Test</b>      | 1.4m from table top to wooden platform, 6 faces.                                                                                                                                                                                                                         | <b>Altitude</b>                   | Operating: to 5000m (derate to TBD temp. above 3000m).<br>Non-operating: -500 to 40,000 ft.                                                                                                         |
| <b>Dimensions</b>            | W: 2.58" x L: 5.9" x H: 1.34"<br>W: 65.5mm x L: 150.5mm x H: 34mm                                                                                                                                                                                                        | <b>Relative Humidity</b>          | 5% to 95%, non-condensing                                                                                                                                                                           |
| <b>Vibration</b>             | Operating: 0.003g/Hz, 1.5grms overall, 3 axes, 10 min/axis, 1-500Hz.<br>Non-Oper.: random waveform, 3 minutes per axis, 3 axes and Sine waveform, Vib. frequency/acceleration: 10-500Hz/1g, sweep rate of 1 octave / minutes, Vibration time of 10 sweeps / axes, 3 axes | <b>Shock</b>                      | Operating: Half-sine, 20gpk, 10mS, 3 axes, 6 shocks total<br>Non-Operating: Half-sine waveform, impact acceleration of 100G, Pulse duration of 6 mS, Number of shocks: 3 for each of the three axis |

All specifications are typical at nominal input, full load, at 25°C ambient unless noted.

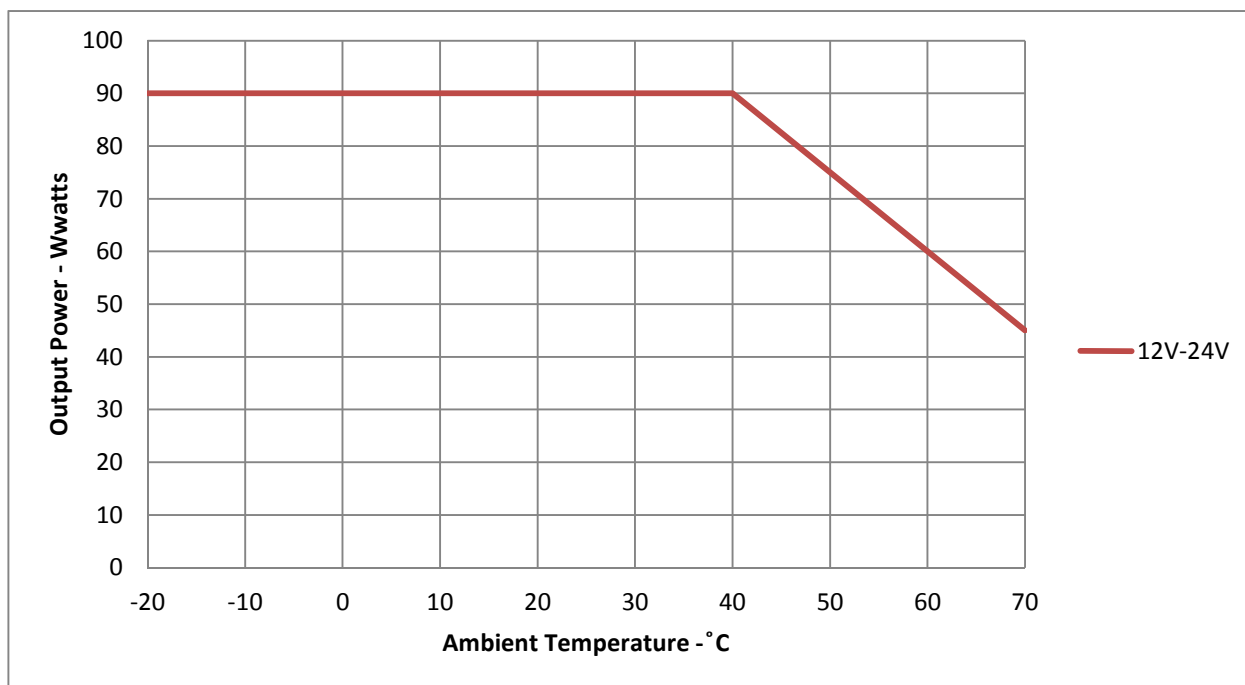
## EMI/EMC Compliance

|                                                                    |                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Conducted Emissions:</b>                                        | EN55011/CISPR22 Class B, FCC Part 15.107, Class B: 6db margin typ, at 115 and 230Vac                                                                                                                                                                          |
| <b>Radiated Emissions:</b>                                         | EN55022/CISPR22 Class B, FCC Part 15.109, Class B: 3db margin typ, at 115 and 230Vac                                                                                                                                                                          |
| <b>Common Mode Noise:</b>                                          | High Frequency (100kHz-20MHz): <40mA pk-pk                                                                                                                                                                                                                    |
| <b>Electro-Static Discharge (ESD) Immunity on Power ports:</b>     | EN55024/IEC61000-4-2, Level 4: +/- 8kV contact, +/- 15kV air, Criteria A                                                                                                                                                                                      |
| <b>Radiated RF EM Fields Susceptibility</b>                        | EN55022/EN61000-4-3, 10V/m, 80MHz-2.7GHz, 80% AM at 1kHz                                                                                                                                                                                                      |
| <b>Electrical Fast Transients (EFT) /Bursts:</b>                   | EN55024/IEC61000-4-4, Level 4, +/- 4kV, 100Khz rep rate, 40A, Criteria A                                                                                                                                                                                      |
| <b>Surges, Line to Line (Diff Mode) and Line to GND (CMN Mode)</b> | EN55024/IEC61000-4-5, Level 4, +/-2kV DM, +/-4kV CM, Criteria A                                                                                                                                                                                               |
| <b>Conducted Disturbances induced by RF Fields</b>                 | EN55022/IEC61000-4-6, 10Vrms – Level 4, in ISM and amateur radio bands between 0.15Mhz and 80Mhz, 80% AM at 1KHz                                                                                                                                              |
| <b>Rated Power frequency magnetic fields</b>                       | EN55024/IEC1000-4-8, Level 4: 30 A/m, 50/60 Hz                                                                                                                                                                                                                |
| <b>Voltage Interruptions, Dips, Sags &amp; Surges</b>              | EN55024/IECEN61000-4-11:<br>--100% dip for 10 mS, at 0, 45, 90, 135, 180, 225, 270 and 315 degrees; 20mS at 0 degrees. Criteria A<br>--100% dip for 5000mS (250/300 cycles), Criteria B<br>--60% dip for 100mS, Criteria B<br>--30% dip for 500mS, Criteria A |
| <b>Harmonic Current Emissions</b>                                  | EN55011/EN61000-3-2, Class A                                                                                                                                                                                                                                  |
| <b>Flicker Test</b>                                                | EN61000-3-3                                                                                                                                                                                                                                                   |

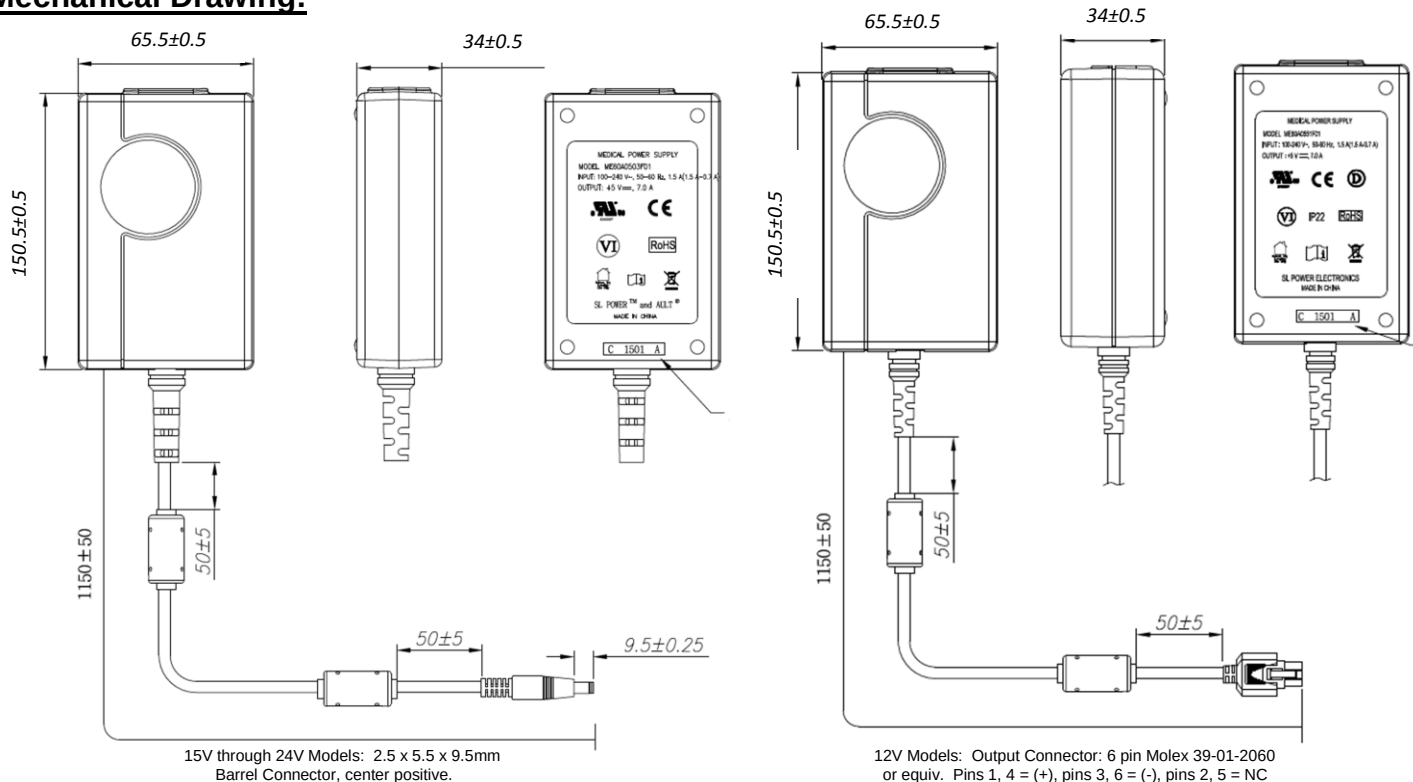
**Notes:** Performance criteria are based on EN55024. According to the standards, performance criteria are defined as following:

- A – Normal performance during and after the test
- B – Temporary degradation, self-recoverable
- C – Temporary degradation, operator intervention required to recover the operation
- D – Permanent damage

## Derating Chart:



## Mechanical Drawing:



- Notes:**
- 1) All dimensions in mm.
  - 2) The unit should not be covered or enclosed to protect against excessive case temperature rise.

## Connector Information

Standard models include a 2.5 x 5.5 x 9.5mm straight barrel type connector (Ault #3), center positive. (#51 for the 12V models). Other standard options are listed below. The "03" in the standard model number is replaced by the applicable digits below:

| Connector No. | Description                                                                    | Connector No. | Description                                                                         |
|---------------|--------------------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------|
| 02            | 2.1 x 5.5 x 9.5mm straight barrel plug - Center Positive                       | 44            | 2.1 x 5.5 x 9.5mm straight barrel plug, locking - Center Positive                   |
| 03            | 2.5 x 5.5 x 9.5mm straight barrel plug - Center Positive (Standard Models)     | 45            | 2.5 x 5.5 x 9.5mm straight barrel plug, locking - Center Positive                   |
| 12            | 5 pin DIN-180 male connector (Pins 3, 5 = (+), pins 1, 2, 4 = (-))             | 48            | 3 pin Snap n Lock, Kycon Kpp-3P or equivalent (Pin 1 = (+), pin 2 = (-))            |
| 22            | 6 pin DIN male connector (Pins 1, 2 = (+), pins 4, 5 = (-))                    | 49            | 4 pin Snap n Lock, Kycon Kpp-4P or equivalent (Pins 1, 3 = (+), pins 2, 4 = (-))    |
| 23            | 8 pin DIN male connector (Pins 3, 7 = (+), pins 1, 4, 6, 8 = (-), shell = FG)) | 51            | 6 pin Minifit - Molex 39-01-2060 or equivalent (Pins 1, 4 = (+), pins 3, 6 = (-))   |
| 32            | 9 pin "D" type, female (Pin 8 = (+), pin 5 = (-), all others = NC)             | 65            | Stripped and Tinned Leads                                                           |
| 33            | 2.5 x 5.5 x 12.5mm straight barrel plug - Center Positive                      | 70            | 2.1 x 5.5 x 11mm right angle barrel plug (high retention) - Center Positive         |
| 40            | 2.1 x 5.5 x 9.5mm right angle barrel plug (high retention) - Center Positive   | 71            | 2.5 x 5.5 x 11mm right angle barrel plug (high retention) - Center Positive         |
| 41            | 2.5 x 5.5 x 9.5mm right angle barrel plug (high retention) - Center Positive   | 72            | 2.1 x 5.5 x 9.5mm straight barrel plug (high retention, no spark) - Center Positive |
| 42            | 2.1 x 5.5 x 11mm straight barrel plug (high retention) - Center Positive       | 73            | 2.5 x 5.5 x 9.5mm straight barrel plug (high retention, no spark) - Center Positive |
| 43            | 2.5 x 5.5 x 11mm straight barrel plug (high retention) - Center Positive       | 74            | EIAJ#5 style connector - Center Positive                                            |

**Efficiency Level VI Information:**

| Single-Voltage External AC-DC Power Supply, Basic-Voltage |                                                                       |                                   |
|-----------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------|
| Nameplate Output Power ( $P_{out}$ )                      | Minimum Average Efficiency in Active Mode<br>(expressed as a decimal) | Maximum Power in No-Load Mode [W] |
| $P_{out} \leq 1 \text{ W}$                                | $\geq 0.5 \times P_{out} + 0.16$                                      | $\leq 0.100$                      |
| $1 \text{ W} < P_{out} \leq 49 \text{ W}$                 | $\geq 0.071 \times \ln(P_{out}) - 0.0014 \times P_{out} + 0.67$       | $\leq 0.100$                      |
| $49 \text{ W} < P_{out} \leq 250 \text{ W}$               | $\geq 0.880$                                                          | $\leq 0.210$                      |
| $P_{out} > 250 \text{ W}$                                 | $\geq 0.875$                                                          | $\leq 0.500$                      |
| Single-Voltage External AC-DC Power Supply, Low-Voltage   |                                                                       |                                   |
| Nameplate Output Power ( $P_{out}$ )                      | Minimum Average Efficiency in Active Mode<br>(expressed as a decimal) | Maximum Power in No-Load Mode [W] |
| $P_{out} \leq 1 \text{ W}$                                | $\geq 0.517 \times P_{out} + 0.087$                                   | $\leq 0.100$                      |
| $1 \text{ W} < P_{out} \leq 49 \text{ W}$                 | $\geq 0.0834 \times \ln(P_{out}) - 0.0014 \times P_{out} + 0.609$     | $\leq 0.100$                      |
| $49 \text{ W} < P_{out} \leq 250 \text{ W}$               | $\geq 0.870$                                                          | $\leq 0.210$                      |
| $P_{out} > 250 \text{ W}$                                 | $\geq 0.875$                                                          | $\leq 0.500$                      |

..... TE90A Series

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