



TE Family of External Power Supplies DoE Level VI Compliant Product Application Note

AN-P002

Overview

The SL Power TE family of external power supplies are designed to provide high power conversion efficiency, meeting the U.S. Department of Energy (DoE) Level VI efficiency and No Load power consumption requirement. In addition, this model family has enhanced Electromagnetic Compatibility (EMC) features offering heavy industrial Electrostatic Discharge (ESD), AC mains surge and RF immunity, resulting in a more robust and reliable product. The TE model's AC mains emissions comply with FCC & EN55022 class B levels with margin and output emissions for differential ripple and common mode voltage and current have been reduced to minimize system level Electromagnetic Interference (EMI) and system circuit interference.

Standard Model Configurations

The TE Family of external supplies are available in a wide variety of configurations allowing the end user to select a configuration that best suits their product needs. Options include Wall mounted supplies with fixed and interchangeable input blade options in 10, 20, 30 & 40 watt model families. Desktop supplies are available in 10, 20, 30, 40, 60, 90, 120, & 220 watt model families. Standard output voltages available are in 5, 6, 7.5, 9, 12, 15, 18, 24, & 48 volts (consult data sheet for availability by model family). For other voltages, consult the factory for availability.

Wall mount supplies have Class II inputs (no input earth ground connection). Desktop models are available with Class I (input earth ground connection) and Class II (no input earth ground connection) versions. Standard Class I desktop models have a floating output, however they can be ordered with the input ground connected to DC return.

Model Number Configuration

Model Number Configuration						
<u>TE</u>	<u>90</u>	<u>A</u>	<u>12</u>	<u>03</u>	<u>F</u>	<u>01</u>
<u>Model Configuration:</u>	"01" = Standard. "02" and higher indicates a modified model.					
<u>Input Connector:</u>	"F" = IEC320 C14 grounded, class I. Other options available. See Table 2 below.					
<u>Output Connector:</u>	Options from "02" thru "74", see separate list. "03" Connector is standard.					
<u>Output Voltage:</u>	"12" = 12Vdc, "15" = 15Vdc, etc.					
<u>AC Ground</u>	"A" = Floating output; "B" = AC Ground connected to output return (-). Other grounding options available - consult factory.					
<u>Configuration:</u>	"10" = 12W, "30" = 30W, "90" = 90W, "240" = 240W					
<u>Output Power:</u>						
<u>Product Family:</u>	"TE" = Test & Measurement External					

Table 1. Model number configuration detail.

Model

Standard supplies have a floating output where the DC output is isolated from the AC input ("A" Version). Desktop models with the Class I grounded input ("F" input option, see Table 2) can be ordered with the input ground connected to the DC return ("B" version). Additional options for bringing the input ground to the output connector are available, consult factory for options.

Input options:

AC Input Options							
Desktop			Wall-Plug				
IEC320 - C14 Class I Grounded (F)	IEC320 - C18 Class II Ungrounded (Q)	IEC320 - C8 Class II "Shaver" (N)	N. America Japan Interchangeable (B)	N. America Japan Fixed (C)	Europe Fixed (M)	United Kingdom Fixed (G)	Australia Fixed (H)

TABLE 2. Input types.

Output connector options:

Standard models have a 2.5, x 5.5 x 9.5mm straight barrel plug connector (Ault#3) center positive, models with higher output current ratings have a 6 pin Molex Minifit 39-01-2060 or equivalent (pins 1,3 (+), pins 3, 6 (-)). Other options are available, table 3 lists popular options, additional options or custom connectors can be accommodated (consult factory for availability).

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

TABLE 3. Output connector options.

Extended Temperature operation:

The TE family will start up at -40°C, however a warm-up period is needed before all parameters are within published specifications is required. It should be noted that the output voltage ripple will be considerably ($\sim 5x - 10x$) higher at this low temperature, but will decrease as the power adapter warms up. There will be some self-heating of the output capacitors, which will reduce the output voltage ripple and self-heating will diminish.

Operation above +40°C is possible with derating. Typical derating is linear to ~50% load from +40°C to +70°C, but does vary between models. Review the derating curve for the specific model of interest. For operation above 70°C, consult the factory.

Proper Use

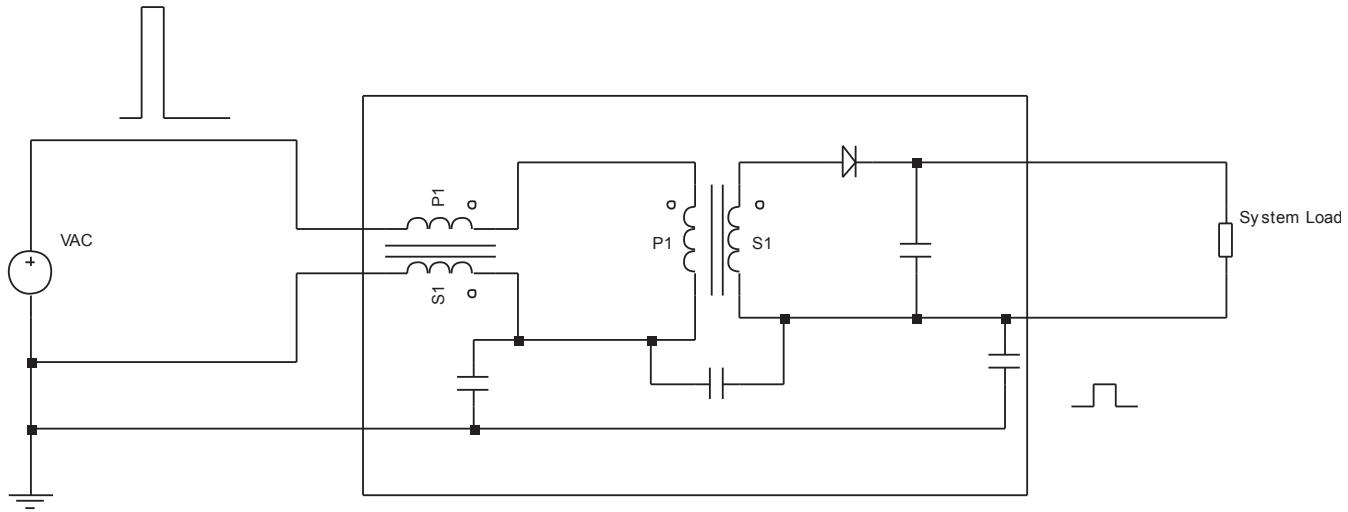
The external power supplies have high power conversion efficiency however they do rely on convection cooling to the surround environment (air) to prevent overheating or excessive internal and external surface temperatures. Therefore, adequate access to ambient air is necessary to ensure proper thermal performance of the power supply.

- Do not cover the power supply with blankets, clothing, pillows, or any other poor thermal conductor.
- Do not immerse the power supply in any liquid. The TE family is IP22 rated (ingress protection). It is protected against dripping water when tilted up to 15° (Test duration: 10 minutes. (Water equivalent to 3 mm rainfall per minute). Consult IEC standard 60529 for specific details of IP protection.
- Avoid dropping the power supply on hard surfaces
- Avoid impacting the case of the power supply with any hard object
- Avoid damage to the output cable (insulation damage, improper bending or folding of the cable)
- Use the proper Input cord (desktop version) for the power supply
- Use a proper mating connector for connection to the output of the power supply with good connections to avoid efficiency loss and voltage drops
- Do not place adapter on body parts. This is not considered an “applied part.” Surface temperature increases with increased ambient temperature and loading.

System Design Considerations**Adapter AC Input type selection:**

- **Class I AC input:** This type has a three-wire input with the AC earth ground connection and provides a path to a stable reference (earth) to help minimize output common mode noise and electromagnetic interference (EMI) and immunity. Generally, this type of AC input has better performance where output electrical noise interference must be kept to a minimum. However, the availability of power sources with a ground connection may be limited or not guaranteed, and in this case, power supplies specifically designed for AC inputs without ground should be selected. Also, with a class I AC input, it is possible to provide a reference

point for the load (user system) through the power supply to be ground reference for EMI and EMC performance improvements. In some applications, this is a must and provides a path to ground for ESD as well as reducing the amount of AC mains surges and electrical fast transients from reaching the load. Connecting the output to earth ground eliminates the output common mode noise.

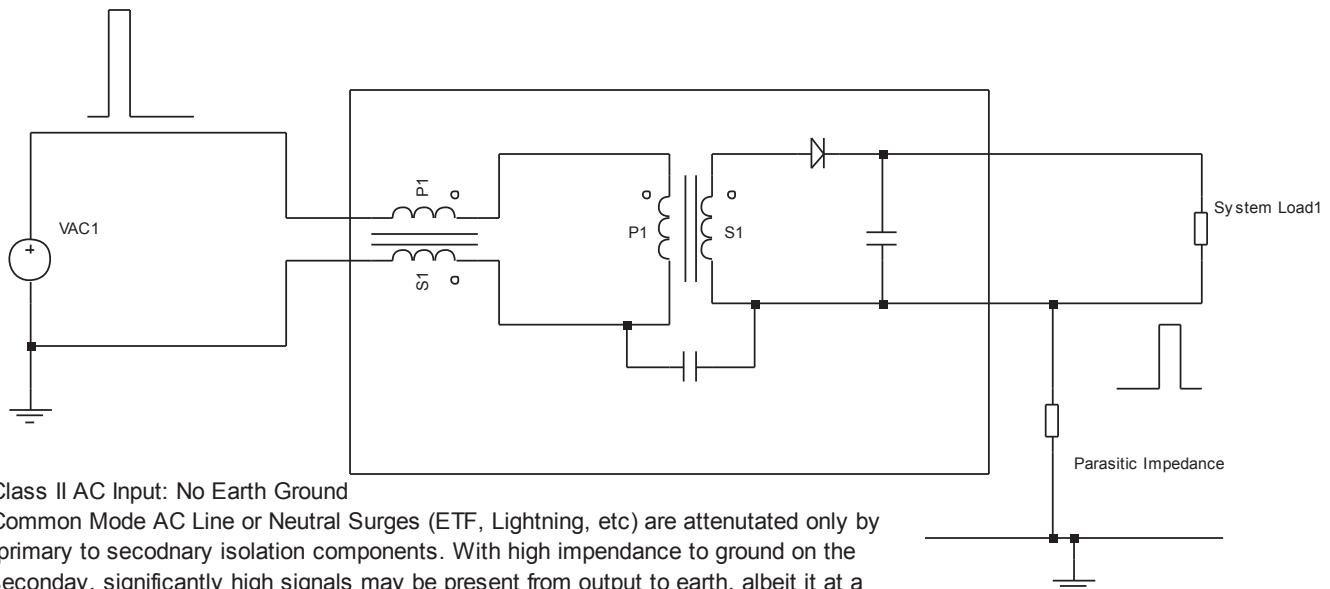


Class I AC Input: Includes Earth Ground
Common Mode AC Line or Neutral Surges (ETF, Lightning, etc) are attenuated by primary and secondary side impedances (capacitors, surge protectors).

FIGURE 1: Simplified schematic of a Class I AC input showing parasitic and real component paths for noise sources to propagate to the “isolated” secondary output resulting in common and differential mode noise.

In the model number configuration table (see Table 1), output connection to AC input ground is defined. This is only available on input connector configuration F which has the AC earth ground pin.

- **Class II AC input:** this type has as two wire input without an earth ground connection. This is a popular input configuration due to its wider market appeal. In order to safely function without an earth ground (protective earth) the insulation scheme is more complex and has double or reinforced insulation to comply with safety agency standards. However, there will likely be higher output common mode noise because there is no internal reference to earth ground to by-pass noise coupled to the output by the parasitic capacitive and inductive elements in the power supply.



Class II AC Input: No Earth Ground

Common Mode AC Line or Neutral Surges (ETF, Lightning, etc) are attenuated only by primary to secondary isolation components. With high impedance to ground on the secondary, significantly high signals may be present from output to earth, albeit it at a high impedance and hence low current/power noise source.

Figure 2: Simplified Schematic of a Class II AC input showing parasitic and real component paths for noise sources to propagate to the “isolated” secondary output resulting in common and differential mode noise.

- **Common mode noise** is an electrical signal that appears between either output and earth ground or chassis ground. This comes about due to parasitic capacitance and inductive coupling in the power supply that couples electrical energy from the primary to the secondary, or from the secondary to earth ground. Although the coupling is minimized by design and construction, it cannot easily be eliminated. Be aware of any special needs in the application for low common mode noise. The Class I AC input models have lower common mode noise in general and in some case, where the output can be connected to AC/earth ground, it can be virtually eliminated.

Summary

The TE family is available in hundreds of standard configurations; thousands of configurations are possible with available connector and cable options allowing the end user to select a supply that will meet their application requirements without compromise. The supplies are designed to meet the demanding requirements of Test & Measurement and Industrial applications. Key performance features include:

- **Meets DoE Efficiency Level VI Requirements**

- No load input power
 - Average Efficiency

- **Universal Input 90-264Vac Input Range for worldwide use**

- **IP22 Rated Enclosure**

- Meets "Heavy Industrial" Levels of EN61000-4-x EMC Requirements
 - Meets EN55022/CISPR22, FCC Part 15.109 Class B Conducted & Radiated Emissions, with 6db and 3dB margin respectively.
 - Common Mode Noise (high freq.) less than 20mApp
 - Approved to EN/IEC/UL60950-1, 2nd Edition, Am. 2
 - E-cap life of >7 years
 - >500K Hours MTBF
 - 3-Year Warranty
 - RoHS/REACH Compliant

For more detailed performance and power related application notes, see the model specific (TE10/20, TE30/40, TE60 and TE90 watt) application notes.

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