

| Parameter           | Rating | Units                |
|---------------------|--------|----------------------|
| Blocking Voltage    | 350    | $V_P$                |
| Load Current        | 120    | $mA_{rms} / mA_{DC}$ |
| On-Resistance (max) | 35     | $\Omega$             |

### Features

- 3750V<sub>rms</sub> Input/Output Isolation
- Low Drive Power Requirements (TTL/CMOS Compatible)
- FCC Compatible
- VDE Compatible
- No EMI/RFI Generation
- Small 8-Pin Package
- Surface Mount and Tape & Reel Version Available

### Applications

- Telecommunications
  - Telecom Switching
  - Tip/Ring Circuits
  - Modem Switching (Laptop, Notebook, Pocket Size)
  - Hook Switch
  - Dial Pulsing
  - Ground Start
  - Ringing Injection
- Instrumentation
- Multiplexers
- Data Acquisition
- Electronic Switching
- I/O Subsystems
- Meters (Watt-Hour, Water, Gas)
- Security
- Industrial Controls

### Description

The TS117 integrated circuit device combines a 350V normally open (1-Form-A) relay with an optocoupler in a single package. The relay uses optically coupled MOSFET technology to provide 3750V<sub>rms</sub> of input to output isolation.

Its optically coupled relay outputs, which use the patented OptoMOS architecture, are controlled by a highly efficient infrared LED.

The TS117 enables telecom circuit designers to combine two discrete functions in a single component that uses less space than traditional discrete component solutions.

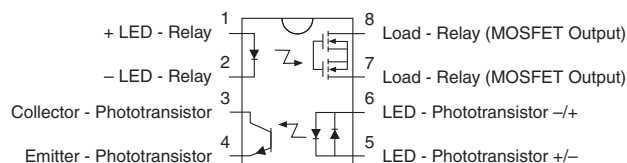
### Approvals

- UL Recognized Component: File E76270
- CSA Certified Component: Certificate 1175739
- EN 62368-1: TUV Certificate # B 082667 0008

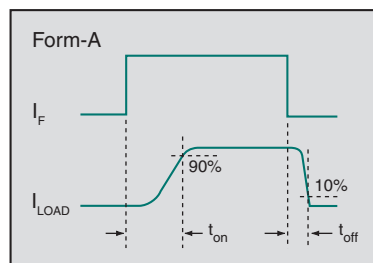
### Ordering Information

| Part #   | Description                     |
|----------|---------------------------------|
| TS117    | 8-Pin DIP (50/Tube)             |
| TS117S   | 8-Pin Surface Mount (50/Tube)   |
| TS117STR | 8-Pin Surface Mount (1000/Reel) |

### Pin Configuration



### Switching Characteristics of Normally Open Devices



### Absolute Maximum Ratings

| Parameter                                   | Ratings     | Units            |
|---------------------------------------------|-------------|------------------|
| Blocking Voltage                            | 350         | V <sub>P</sub>   |
| Input Power Dissipation <sup>1</sup>        | 150         | mW               |
| Input Control Current, Relay<br>Peak (10ms) | 50<br>1     | mA<br>A          |
| Input Control Current, Detector             | 100         | mA               |
| Reverse Input Voltage                       | 5           | V                |
| Total Power Dissipation <sup>2</sup>        | 800         | mW               |
| Isolation Voltage, Input to Output          | 3750        | V <sub>rms</sub> |
| Operational Temperature                     | -40 to +85  | °C               |
| Storage Temperature                         | -40 to +125 | °C               |

<sup>1</sup> Derate linearly 1.33 mW / °C

<sup>2</sup> Derate linearly 6.67 mW / °C

*Absolute Maximum Ratings are stress ratings. Stresses in excess of these ratings can cause permanent damage to the device. Functional operation of the device at conditions beyond those indicated in the operational sections of this data sheet is not implied. Absolute Maximum Ratings are at T<sub>A</sub>=25°C.*

*Unless otherwise specified, device characteristics are at T<sub>A</sub>=25°C.*

*Typical values are characteristic of the device at T<sub>A</sub>=25°C and are the result of engineering evaluations. They are provided for informational purposes only and are not part of the manufacturing testing requirements.*

### Electrical Characteristics: Relay Section

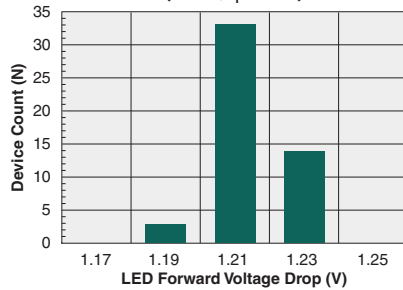
| Parameter                           | Conditions                               | Symbol            | Min | Typ | Max  | Units                                |
|-------------------------------------|------------------------------------------|-------------------|-----|-----|------|--------------------------------------|
| <b>Output Characteristics</b>       |                                          |                   |     |     |      |                                      |
| Load Current                        |                                          |                   |     |     |      |                                      |
| Continuous                          | -                                        | I <sub>L</sub>    | -   | -   | 120  | mA <sub>rms</sub> / mA <sub>DC</sub> |
| Peak                                | t=10ms                                   | I <sub>LPK</sub>  | -   | -   | ±350 | mA <sub>p</sub>                      |
| On-Resistance                       | I <sub>L</sub> =120mA                    | R <sub>ON</sub>   | -   | 23  | 35   | Ω                                    |
| Off-State Leakage Current           | V <sub>L</sub> =350V                     | I <sub>LEAK</sub> | -   | -   | 1    | μA                                   |
| Switching Speeds                    |                                          |                   |     |     |      |                                      |
| Turn-On                             | I <sub>F</sub> =5mA, V <sub>L</sub> =10V | t <sub>on</sub>   | -   | -   | 3    | ms                                   |
| Turn-Off                            |                                          | t <sub>off</sub>  | -   | -   | 3    | ms                                   |
| Output Capacitance                  | V <sub>L</sub> =50V, f=1MHz              | C <sub>OUT</sub>  | -   | 25  | -    | pF                                   |
| <b>Input Characteristics</b>        |                                          |                   |     |     |      |                                      |
| Input Control Current to Activate   | I <sub>L</sub> =120mA                    | I <sub>F</sub>    | -   | -   | 2    | mA                                   |
| Input Control Current to Deactivate | -                                        | I <sub>F</sub>    | 0.4 | 0.7 | -    | mA                                   |
| Input Voltage Drop                  | I <sub>F</sub> =5mA                      | V <sub>F</sub>    | 0.9 | 1.2 | 1.4  | V                                    |
| Reverse Input Current               | V <sub>R</sub> =5V                       | I <sub>R</sub>    | -   | -   | 10   | μA                                   |
| <b>Common Characteristics</b>       |                                          |                   |     |     |      |                                      |
| Input to Output Capacitance         | -                                        | C <sub>IO</sub>   | -   | 3   | -    | pF                                   |

### Electrical Characteristics: Detector Section

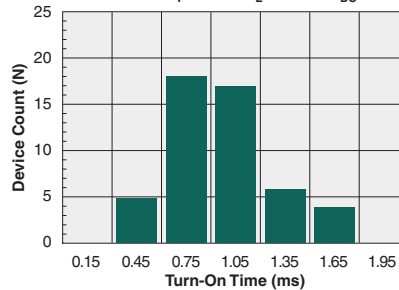
| Parameter                            | Conditions                                 | Symbol            | Min  | Typ | Max | Units            |
|--------------------------------------|--------------------------------------------|-------------------|------|-----|-----|------------------|
| <b>Output Characteristics</b>        |                                            |                   |      |     |     |                  |
| Phototransistor Blocking Voltage     | I <sub>C</sub> =10μA                       | BV <sub>CEO</sub> | 20   | 50  | -   | V                |
| Phototransistor Dark Current         | V <sub>CE</sub> =5V, I <sub>F</sub> =0mA   | I <sub>CEO</sub>  | -    | 50  | 500 | nA               |
| Saturation Voltage                   | I <sub>C</sub> =2mA, I <sub>F</sub> =16mA  | V <sub>SAT</sub>  | -    | 0.3 | 0.5 | V                |
| Current Transfer Ratio               | I <sub>F</sub> =6mA, V <sub>CE</sub> =0.5V | CTR               | 33   | 100 | -   | %                |
| <b>Input Characteristics</b>         |                                            |                   |      |     |     |                  |
| Input Control Current                | I <sub>C</sub> =2mA, V <sub>CE</sub> =0.5V | I <sub>F</sub>    | -    | 2   | 6   | mA               |
| Input Voltage Drop                   | I <sub>F</sub> =5mA                        | V <sub>F</sub>    | 0.9  | 1.2 | 1.4 | V                |
| Input Current (Detector Must be Off) | I <sub>C</sub> =1μA, V <sub>CE</sub> =5V   | I <sub>F</sub>    | 5    | 25  | -   | μA               |
| Isolation, Input to Output           | -                                          | V <sub>IO</sub>   | 3750 | -   | -   | V <sub>rms</sub> |

RELAY PERFORMANCE DATA\*

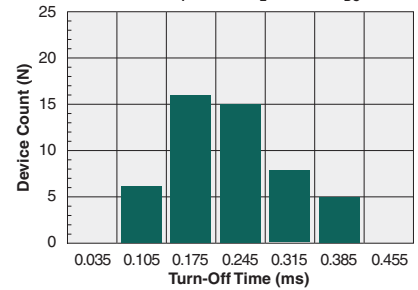
Typical LED Forward Voltage Drop  
(N=50,  $I_F=5\text{mA}$ )



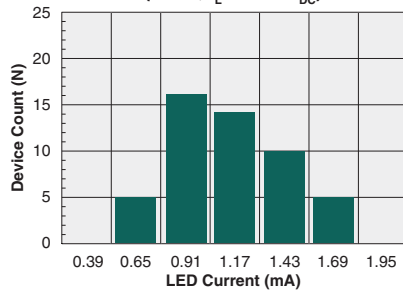
Typical Turn-On Time  
(N=50,  $I_F=2\text{mA}$ ,  $I_L=120\text{mA}_{DC}$ )



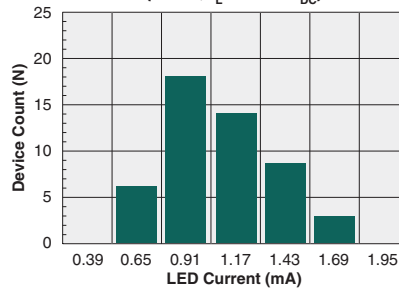
Typical Turn-Off Time  
(N=50,  $I_F=2\text{mA}$ ,  $I_L=120\text{mA}_{DC}$ )



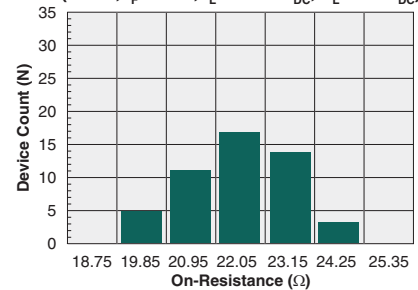
Typical  $I_F$  for Switch Operation  
(N=50,  $I_L=120\text{mA}_{DC}$ )



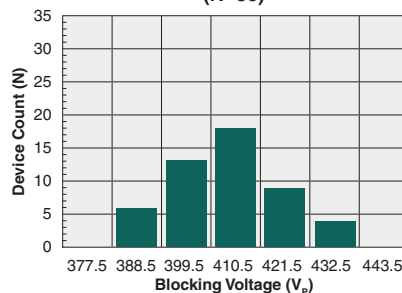
Typical  $I_F$  for Switch Dropout  
(N=50,  $I_L=120\text{mA}_{DC}$ )



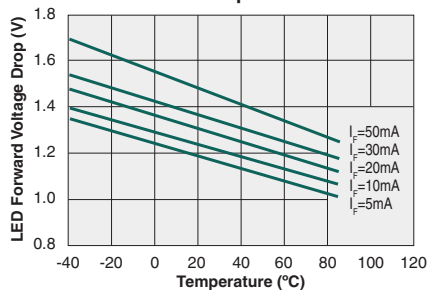
Typical On-Resistance Distribution  
(N=50,  $I_F=2\text{mA}$ ,  $I_L=120\text{mA}_{DC}$ ,  $V_L=350\text{V}_{DC}$ )



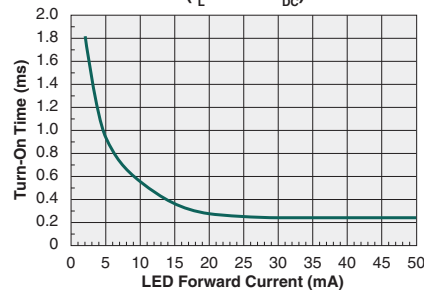
Typical Blocking Voltage Distribution  
(N=50)



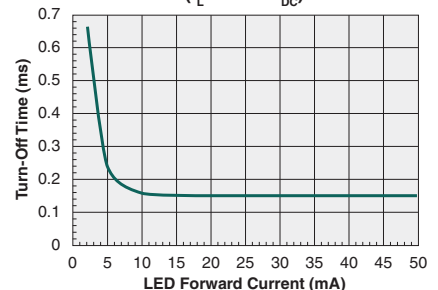
Typical LED Forward Voltage Drop  
vs. Temperature



Typical Turn-On Time  
vs. LED Forward Current  
( $I_L=120\text{mA}_{DC}$ )



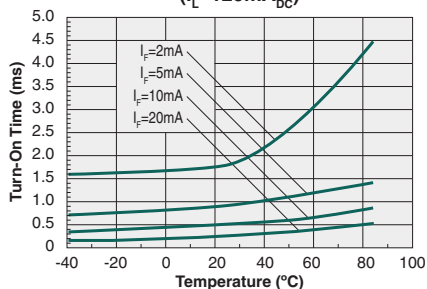
Typical Turn-Off Time  
vs. LED Forward Current  
( $I_L=120\text{mA}_{DC}$ )



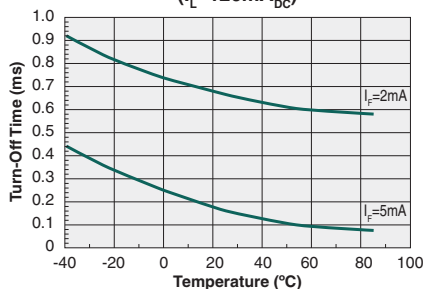
\*Unless otherwise noted, data presented in these graphs is typical of device operation at  $T_A=25^\circ\text{C}$ .

# RELAY PERFORMANCE DATA\*

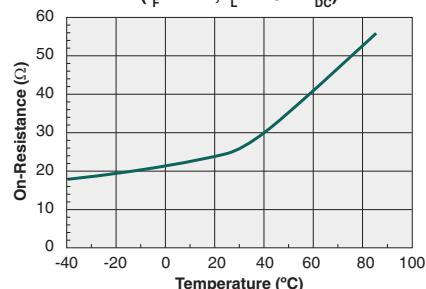
Typical Turn-On Time  
vs. Temperature  
( $I_L = 120\text{mA}_{\text{DC}}$ )



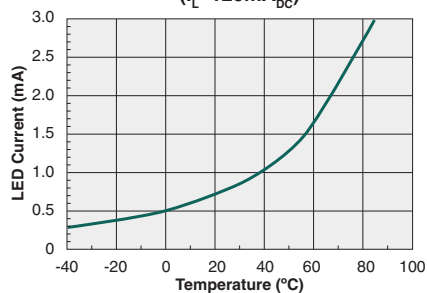
Typical Turn-Off Time  
vs. Temperature  
( $I_L = 120\text{mA}_{\text{DC}}$ )



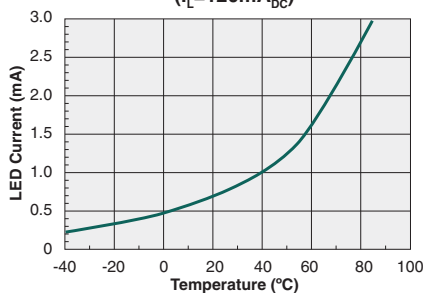
Typical On-Resistance  
vs. Temperature  
( $I_F = 2\text{mA}$ ,  $I_L = 120\text{mA}_{\text{DC}}$ )



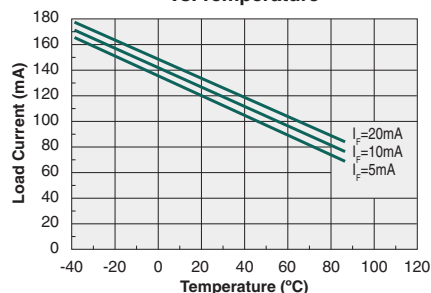
Typical  $I_F$  for Switch Operation  
vs. Temperature  
( $I_L = 120\text{mA}_{\text{DC}}$ )



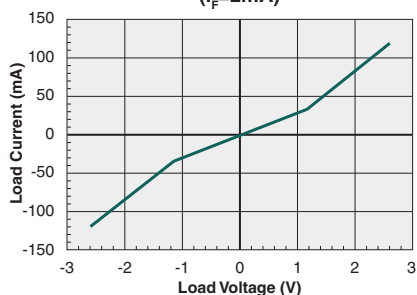
Typical  $I_F$  for Switch Dropout  
vs. Temperature  
( $I_L = 120\text{mA}_{\text{DC}}$ )



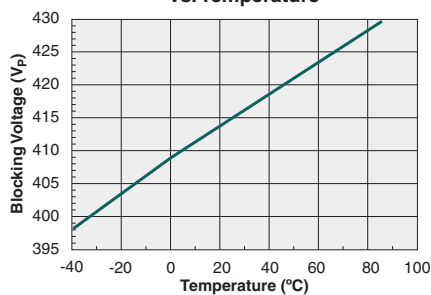
Maximum Load Current  
vs. Temperature



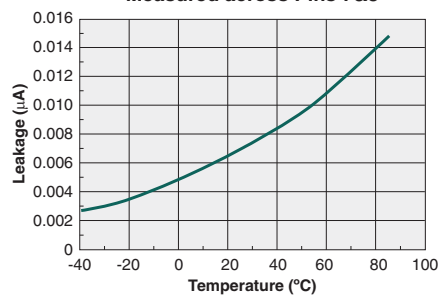
Typical Load Current  
vs. Load Voltage  
( $I_F = 2\text{mA}$ )



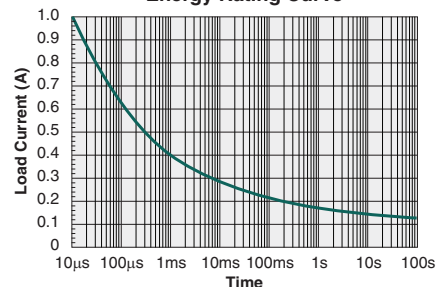
Typical Blocking Voltage  
vs. Temperature



Typical Leakage vs. Temperature  
Measured across Pins 7&8

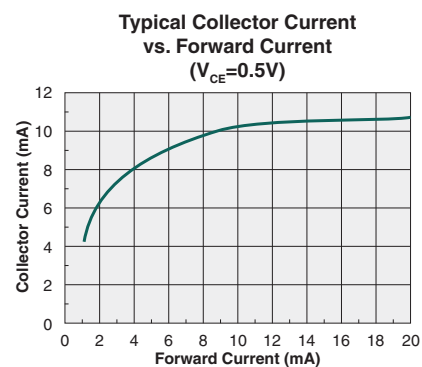
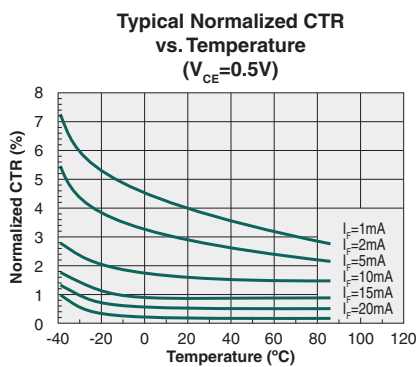
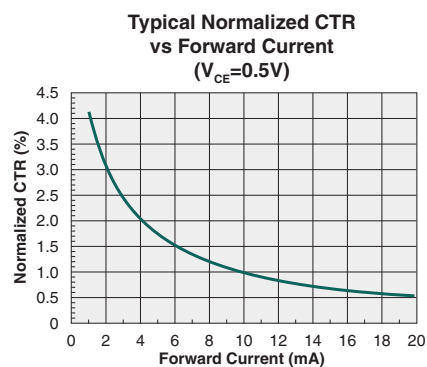


Energy Rating Curve



\*Unless otherwise noted, data presented in these graphs is typical of device operation at  $T_A = 25^\circ\text{C}$ .

DETECTOR PERFORMANCE DATA\*



\*Unless otherwise noted, data presented in these graphs is typical of device operation at  $T_A = 25^\circ C$ .

## Manufacturing Information

### Moisture Sensitivity



All plastic encapsulated semiconductor packages are susceptible to moisture ingress. Littelfuse classifies its plastic encapsulated devices for moisture sensitivity according to the latest version of the joint industry standard, **IPC/JEDEC J-STD-020**, in force at the time of product evaluation. We test all of our products to the maximum conditions set forth in the standard, and guarantee proper operation of our devices when handled according to the limitations and information in that standard as well as to any limitations set forth in the information or standards referenced below.

Failure to adhere to the warnings or limitations as established by the listed specifications could result in reduced product performance, reduction of operable life, and/or reduction of overall reliability.

This product carries a **Moisture Sensitivity Level (MSL)** classification as shown below, and should be handled according to the requirements of the latest version of the joint industry standard **IPC/JEDEC J-STD-033**.

| Device | Moisture Sensitivity Level (MSL) Classification |
|--------|-------------------------------------------------|
| TS117S | MSL 1                                           |

### ESD Sensitivity



This product is ESD Sensitive, and should be handled according to the industry standard **JESD-625**.

### Soldering Profiles

Provided in the table below is the **IPC/JEDEC J-STD-020** Classification Temperature ( $T_C$ ) and the maximum total dwell time ( $t_p$ ) in all reflow processes that the body temperature of these surface mount devices may be ( $T_C - 5$ )°C or greater. The device's body temperature must not exceed the Classification Temperature at any time during reflow soldering processes.

| Device | Classification Temperature ( $T_C$ ) | Dwell Time ( $t_p$ ) | Max Reflow Cycles |
|--------|--------------------------------------|----------------------|-------------------|
| TS117S | 250°C                                | 30 seconds           | 3                 |

For through-hole devices, the maximum pin temperature and maximum dwell time through all solder waves is provided in the table below. Dwell time is the interval beginning when the pins are initially immersed into the solder wave until they exit the solder wave. For multiple waves, the dwell time is from entering the first wave until exiting the last wave. During this time, pin temperatures must not exceed the maximum temperature given in the table below. Body temperature of the device must not exceed the limit shown in the table below at any time during the soldering process.

| Device | Maximum Pin Temperature | Maximum Body Temperature | Maximum Dwell Time | Wave Cycles |
|--------|-------------------------|--------------------------|--------------------|-------------|
| TS117  | 260°C                   | 250°C                    | 10 seconds*        | 1           |

\*Total cumulative duration of all waves.

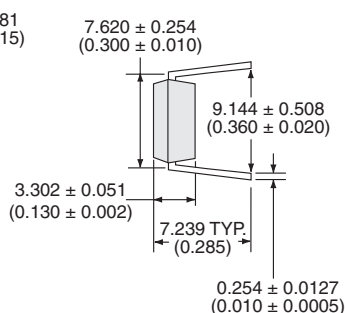
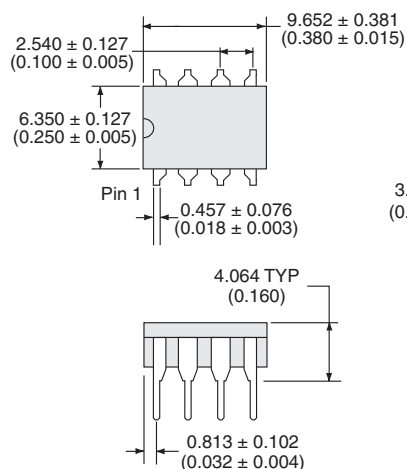
### Board Wash

Littelfuse recommends the use of no-clean flux formulations. Board washing to reduce or remove flux residue following the solder reflow process is acceptable provided proper precautions are taken to prevent damage to the device. These precautions include but are not limited to using a low pressure wash and providing a follow up bake cycle sufficient to remove any moisture trapped within the device due to the washing process. Due to the variability of the wash parameters used to clean the board, determination of the bake temperature and duration necessary to remove the moisture trapped within the package is the responsibility of the user (assembler). Cleaning or drying methods that employ ultrasonic energy may damage the device and should not be used. Additionally, the device must not be exposed to halide flux or solvents.

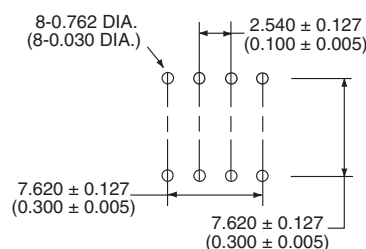


# Mechanical Dimensions

## TS117



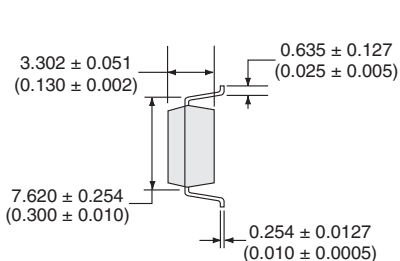
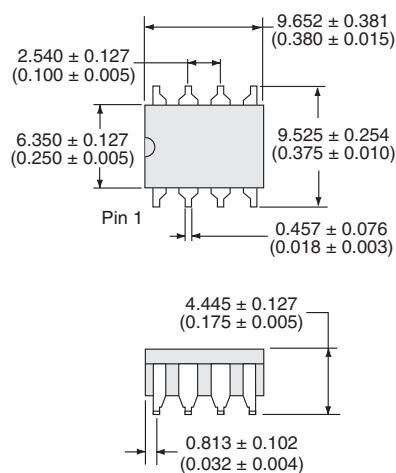
## PCB Hole Pattern



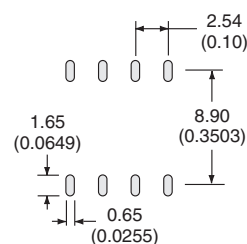
- Notes:
1. Controlling dimension: Inches
  2. Leadframe thickness does not include solder plating (1000μinches max)

Dimensions  
mm  
(inches)

## TS117S



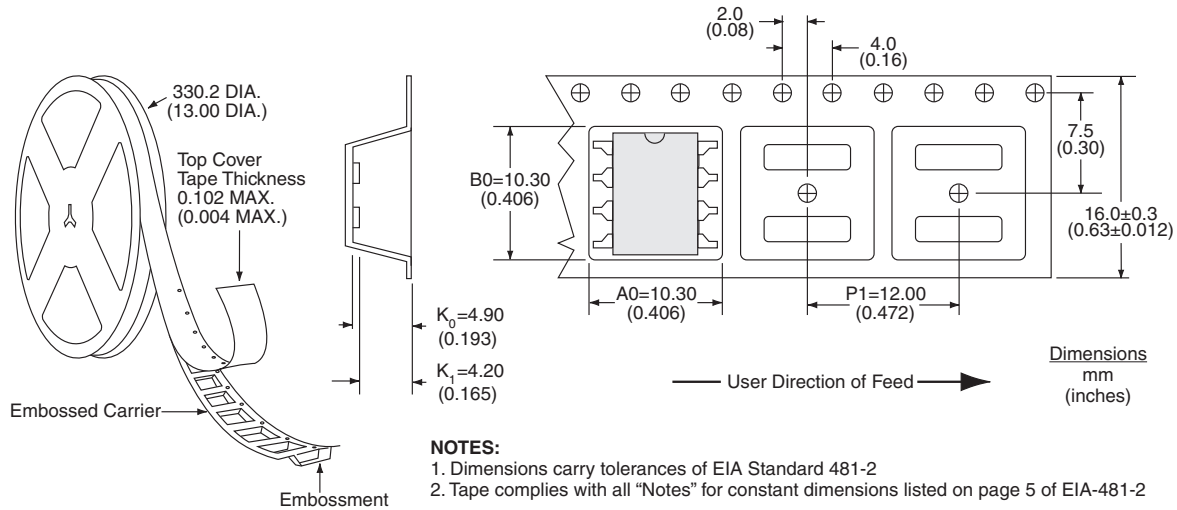
## PCB Land Pattern



- Notes:
1. Controlling dimension: Inches
  2. Coplanarity = 0.004" (0.102 mm) max
  3. Leadframe thickness does not include solder plating (1000μinches max)

Dimensions  
mm  
(inches)

## TS117STR Tape & Reel



For additional information please visit our website at: <http://www.littelfuse.com>