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# TIL111M, TIL117M, MOC8100M General Purpose 6-Pin Phototransistor Optocouplers

## Features

- UL Recognized (File # E90700)
- VDE Recognized (File #102497 for white package)
  - Add Option V (e.g., TIL111VM)

## Applications

- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs
- Appliance Sensor Systems
- Industrial Controls

## General Description

The MOC8100M, TIL111M, and TIL117M optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a 6-pin dual in-line package.

## Schematic

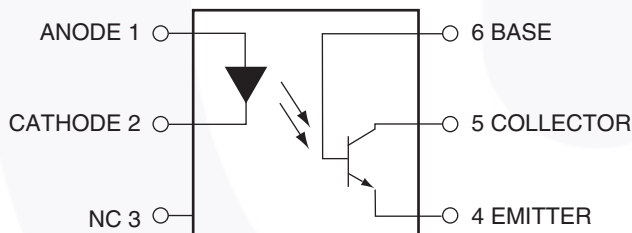


Figure 1. Schematic

## Package Outlines

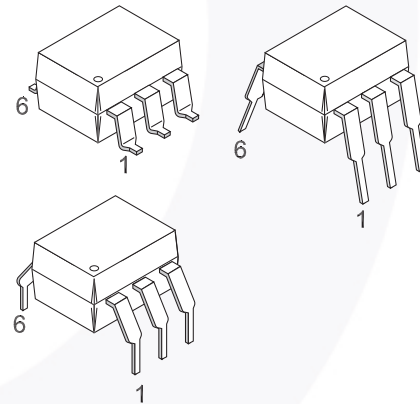


Figure 2. Package Outlines

## Safety and Insulation Ratings

As per IEC60747-5-2. This optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1 For Rated Mains Voltage < 150 V <sub>RMS</sub>		I-IV		
	For Rated Mains Voltage < 300 V <sub>RMS</sub>		I-IV		
	Climatic Classification		55/100/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index	175			
V <sub>PR</sub>	Input to Output Test Voltage, Method b, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC	1594			
	Input to Output Test Voltage, Method a, V <sub>IORM</sub> × 1.5 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 60 s, Partial Discharge < 5 pC	1275			
V <sub>IORM</sub>	Maximum Working Insulation Voltage	850			V <sub>peak</sub>
V <sub>IOTM</sub>	Highest Allowable Over Voltage	6000			V <sub>peak</sub>
	External Creepage	7			mm
	External Clearance	7			mm
	Insulation Thickness	0.5			mm
R <sub>IO</sub>	Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V	10 <sup>9</sup>			Ω

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Device	Value	Units
<b>Total Device</b>				
T <sub>STG</sub>	Storage Temperature	All	-40 to +150	°C
T <sub>OPR</sub>	Operating Temperature	All	-40 to +100	°C
T <sub>SOL</sub>	Lead Solder Temperature	All	260 for 10 sec	°C
P <sub>D</sub>	Total Device Power Dissipation @ T <sub>A</sub> = 25°C Derate Above 25°C	All	250	mW
			2.94	mW/°C
<b>Emitter</b>				
I <sub>F</sub>	DC/Average Forward Input Current	All	60	mA
V <sub>R</sub>	Reverse Input Voltage	TIL111M	3	V
		MOC8100M, TIL117M	6	
I <sub>F(pk)</sub>	Forward Current – Peak (300 μs, 2% Duty Cycle)	All	3	A
P <sub>D</sub>	LED Power Dissipation @ T <sub>A</sub> = 25°C Derate Above 25°C	All	120	mW
			1.41	mW/°C
<b>Detector</b>				
V <sub>CEO</sub>	Collector-Emitter Voltage	All	30	V
V <sub>CBO</sub>	Collector-Base Voltage	All	70	V
V <sub>ECO</sub>	Emitter-Collector Voltage	TIL111M, TIL117M	7	V
V <sub>EBO</sub>	Emitter-Base Voltage	All	7	
P <sub>D</sub>	Detector Power Dissipation @ T <sub>A</sub> = 25°C Derate Above 25°C	All	150	mW
			1.76	mW/°C

## Electrical Characteristics

$T_A = 25^\circ\text{C}$  unless otherwise specified.

### Individual Component Characteristics

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit	
<b>Emitter</b>								
$V_F$	Input Forward Voltage	$I_F = 16\text{ mA}$	$T_A = 25^\circ\text{C}$	TIL111M		1.2	1.4	V
		$I_F = 10\text{ mA}$ for MOC8100M, $I_F = 16\text{ mA}$ for TIL117M	$T_A = 0^\circ\text{C to } 70^\circ\text{C}$	MOC8100M, TIL117M		1.2	1.4	
			$T_A = -55^\circ\text{C}$			1.32		
			$T_A = +100^\circ\text{C}$			1.10		
$I_R$	Reverse Leakage Current	$V_R = 3.0\text{ V}$	TIL111M, TIL117M			0.001	10	$\mu\text{A}$
		$V_R = 6.0\text{ V}$	MOC8100M			0.001	10	$\mu\text{A}$
<b>Detector</b>								
$BV_{CEO}$	Collector-Emitter Breakdown Voltage	$I_C = 1.0\text{ mA}, I_F = 0$		All	30	100		V
$BV_{CBO}$	Collector-Base Breakdown Voltage	$I_C = 10\text{ }\mu\text{A}, I_F = 0$		All	70	120		V
$BV_{EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10\text{ }\mu\text{A}, I_F = 0$		All	7	10		V
$BV_{ECO}$	Emitter-Collector Breakdown Voltage	$I_F = 100\text{ }\mu\text{A}, I_F = 0$		TIL111M, TIL117M	7	10		V
$I_{CEO}$	Collector-Emitter Dark Current	$V_{CE} = 10\text{ V}, I_F = 0$		TIL111M, TIL117M		1	50	nA
		$V_{CE} = 5\text{ V}, T_A = 25^\circ\text{C}$		MOC8100M		0.5	25	nA
		$V_{CE} = 30\text{ V}, I_F = 0, T_A = 70^\circ\text{C}$		TIL117M, MOC8100M		0.2	50	$\mu\text{A}$
$I_{CBO}$	Collector-Base Dark Current	$V_{CB} = 10\text{ V}$		TIL111M, TIL117M			20	nA
		$V_{CB} = 5\text{ V}$		MOC8100M			10	nA
$C_{CE}$	Capacitance	$V_{CE} = 0\text{ V}, f = 1\text{ MHz}$		All		8		pF

\*All Typical values at  $T_A = 25^\circ\text{C}$

**Electrical Characteristics** (Continued) $T_A = 25^\circ\text{C}$  unless otherwise specified.**Transfer Characteristics**

Symbol	Parameter	Test Conditions	Device	Min	Typ*	Max	Unit
<b>DC Characteristics</b>							
$CTR_{CE}$	Current Transfer Ratio, Collector to Emitter	$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$	TIL117M	50			%
		$I_F = 1\text{ mA}, V_{CE} = 5\text{ V}$	MOC8100M	50			%
		$I_F = 1\text{ mA}, V_{CE} = 5\text{ V}, T_A = 0^\circ\text{C to } +70^\circ\text{C}$		30			
$I_{C(ON)}$	On-State Collector Current (Phototransistor Operation)	$I_F = 16\text{ mA}, V_{CE} = 0.4\text{ V}$	TIL111M	2			mA
	On-State Collector Current (Photodiode Operation)	$I_F = 16\text{ mA}, V_{CB} = 0.4\text{ V}$		7			$\mu\text{A}$
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage	$I_C = 500\text{ }\mu\text{A}, I_F = 10\text{ mA}$	TIL117M			0.4	V
		$I_C = 2\text{ mA}, I_F = 16\text{ mA}$	TIL111M			0.4	
		$I_C = 100\text{ }\mu\text{A}, I_F = 1\text{ mA}$	MOC8100M			0.5	
<b>AC Characteristics</b>							
$c_{ON}$	Turn-On Time	$I_C = 2\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\text{ }\Omega$ (Fig. 13)	MOC8100M			20	$\mu\text{s}$
			TIL117M			10	
$c_{OFF}$	Turn-Off Time		MOC8100M			20	$\mu\text{s}$
			TIL117M			10	
$t_r$	Rise Time		MOC8100M		2		$\mu\text{s}$
$t_f$	Fall Time		TIL117M		2		
$t_r$	Rise Time (Phototransistor Operation)	$I_{C(ON)} = 2\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\text{ }\Omega$ (Fig. 13)	TIL111M			10	$\mu\text{s}$
$t_f$	Fall Time (Phototransistor Operation)						

**Isolation Characteristics**

Symbol	Characteristic	Test Conditions	Min.	Typ.*	Max.	Units
$V_{ISO}$	Input-Output Isolation Voltage	$f = 60\text{ Hz}, t = 1\text{ s}$	7500			$V_{AC(PK)}$
$R_{ISO}$	Isolation Resistance	$V_{I-O} = 500\text{ V}_{DC}$	$10^{11}$			$\Omega$
$C_{ISO}$	Isolation Capacitance	$V_{I-O} = 0, f = 1\text{ MHz}$		0.2		pF

\*All Typical values at  $T_A = 25^\circ\text{C}$ .

## Typical Performance Characteristics

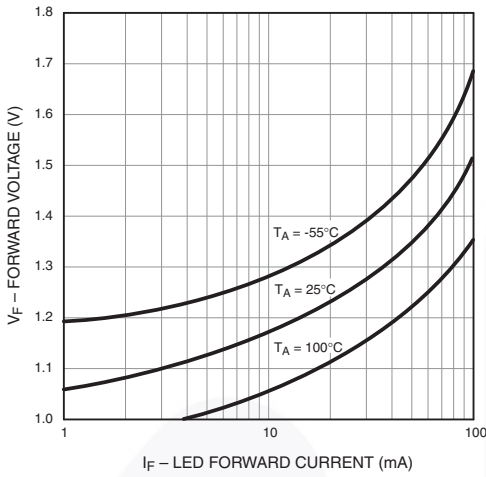


Figure 3. LED Forward Voltage vs. Forward Current

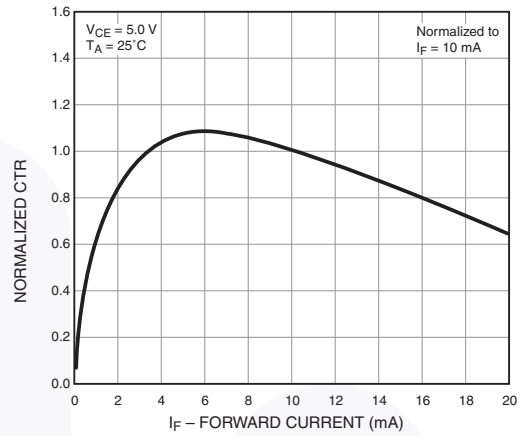


Figure 4. Normalized CTR vs. Forward Current

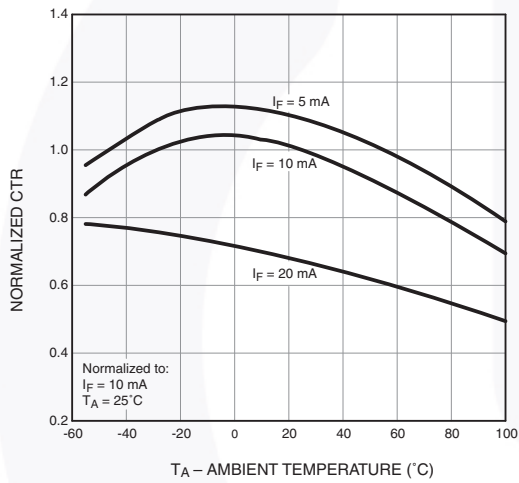


Figure 5. Normalized CTR vs. Ambient Temperature

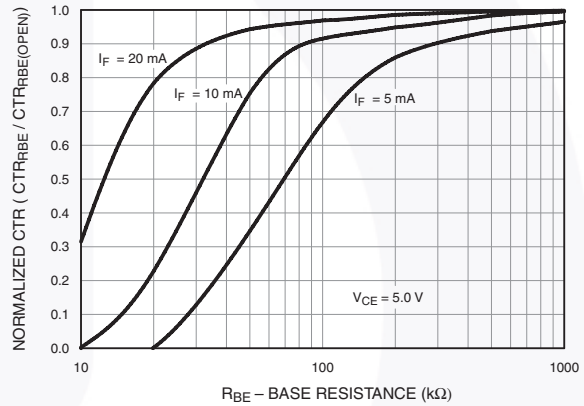


Figure 6. CTR vs. RBE (Unsaturated)

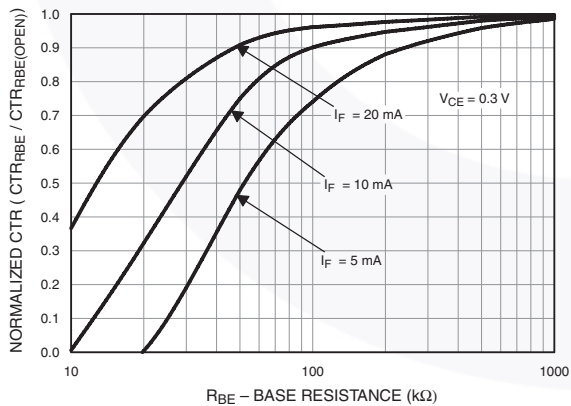


Figure 7. CTR vs. RBE (Saturated)

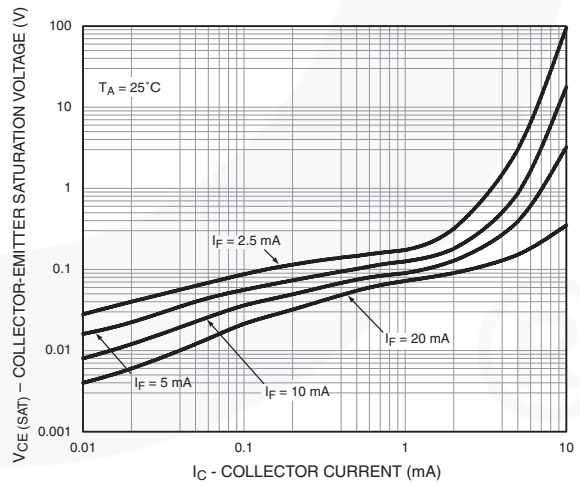


Figure 8. Collector-Emitter Saturation Voltage vs. Collector Current

Typical Performance Characteristics (Continued)

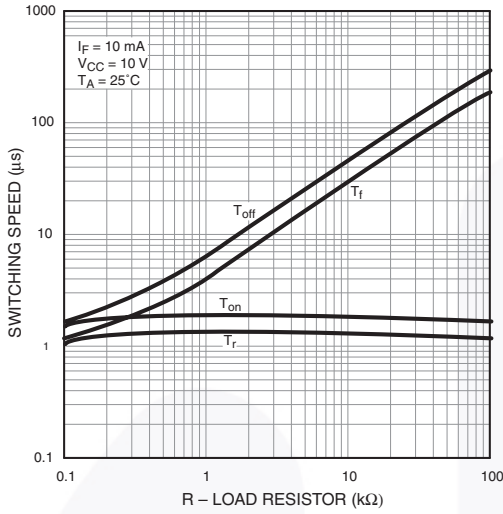


Figure 9. Switching Speed vs. Load Resistor

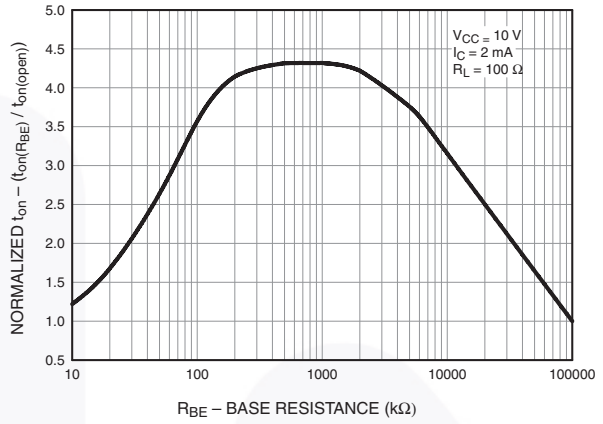


Figure 10. Normalized  $t_{on}$  vs.  $R_{BE}$

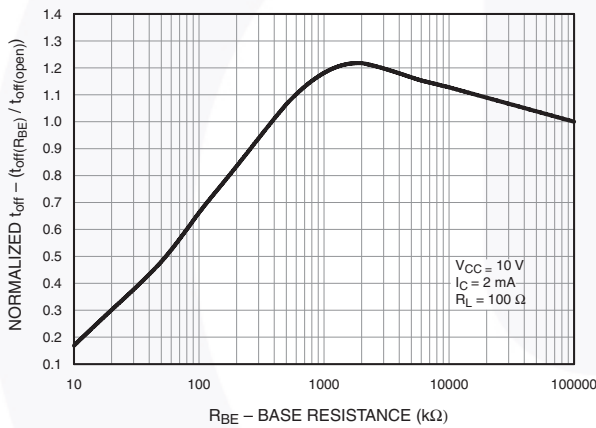


Figure 11. Normalized  $t_{off}$  vs.  $R_{BE}$

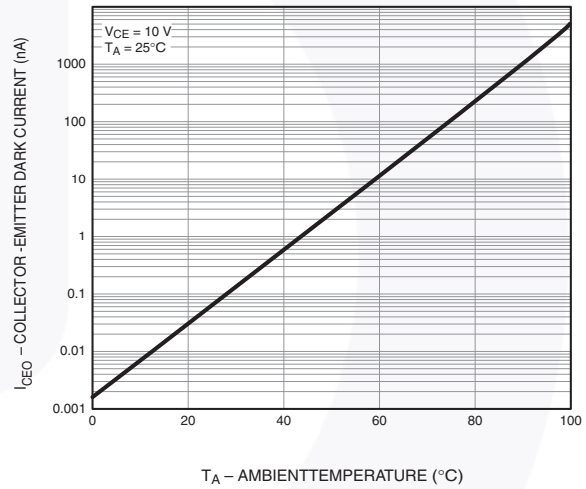


Figure 12. Dark Current vs. Ambient Temperature

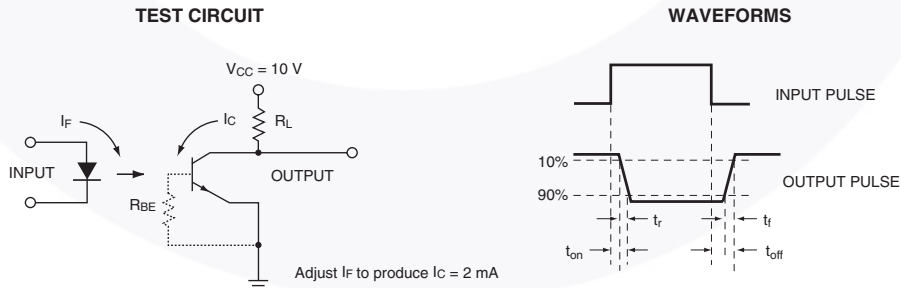


Figure 13. Switching Time Test Circuit and Waveforms



### Reflow Profile

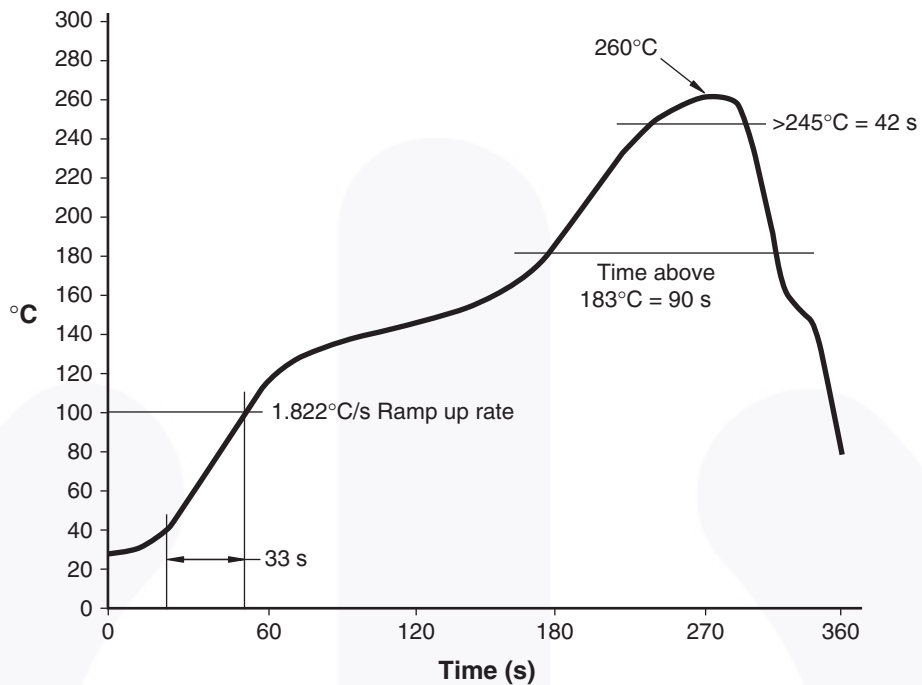
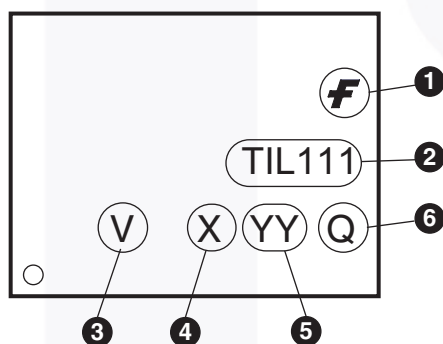


Figure 14. Reflow Profile

## Ordering Information

Option	Order Entry Identifier (Example)	Description
No option	TIL111M	Standard Through-Hole Device
S	TIL111SM	Surface Mount Lead Bend
SR2	TIL111SR2M	Surface Mount; Tape and Reel
T	TIL111TM	0.4" Lead Spacing
V	TIL111VM	VDE 0884
TV	TIL111TVM	VDE 0884, 0.4" Lead Spacing
SV	TIL111SVM	VDE 0884, Surface Mount
SR2V	TIL111SR2VM	VDE 0884, Surface Mount, Tape and Reel

## Marking Information



Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One-digit year code, e.g., '3'
5	Two-digit work week ranging from '01' to '53'
6	Assembly package code

\*Note – Parts that do not have the 'V' option (see definition 3 above) that are marked with date code '325' or earlier are marked in portrait format.

### Carrier Tape Specification

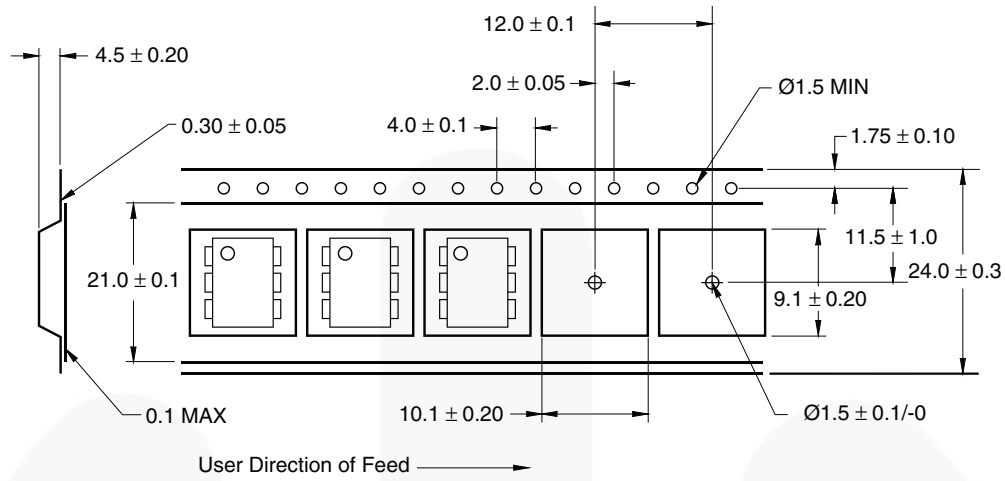


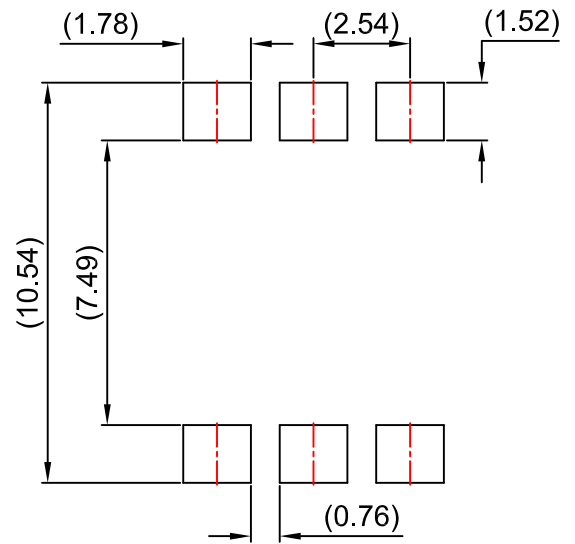
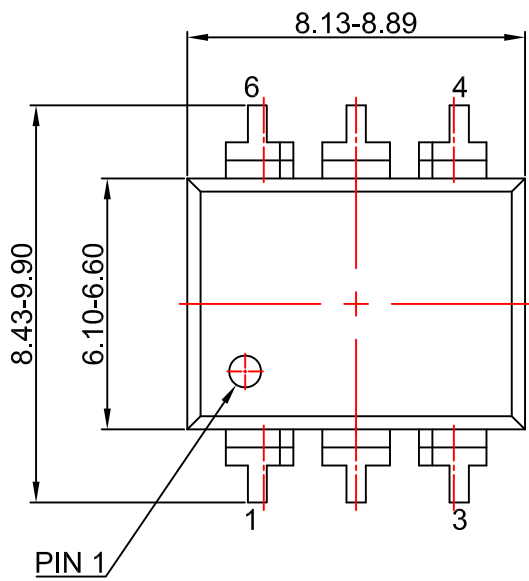
Figure 15. Carrier Tape Specification





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