

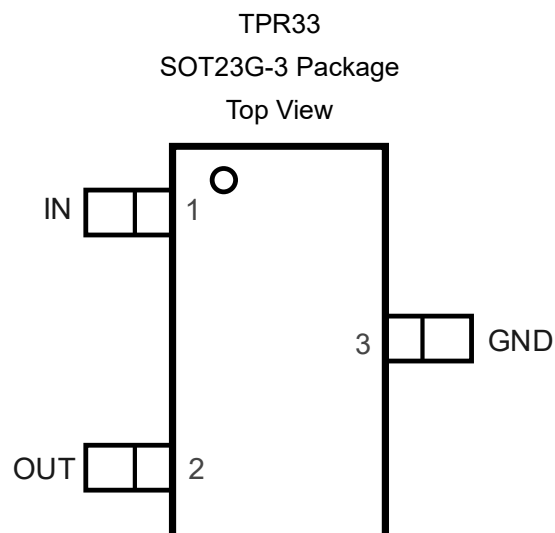
## Features

- Fixed Output Voltage:
  - 1.25 V, 2.048 V, 2.5 V, 3 V, 3.3 V, 4.096 V
- High Initial Accuracy and Low Temperature Coefficient
  - Max 0.15%
  - 30 ppm/°C
- Operation Temperature Range: -40°C to 125°C
- Output Noise: 50  $\mu$ Vpp of TPR3325
- Quiescent Current: 180  $\mu$ A
- Stable with 0.1- $\mu$ F to 10- $\mu$ F Capacitive Loads
- Package Option:
  - SOT23G-3

## Applications

- Power
- Instrumentation
- Industry

## Pin Configuration



## Description

The TPR33 is a voltage reference with guaranteed temperature stability over the entire operating temperature range. The temperature range is extended from -40 °C to +125 °C.

## Product Family Table

| Order Number | Output Voltage (V) | Package  |
|--------------|--------------------|----------|
| TPR3312-S3TR | 1.25               | SOT23G-3 |
| TPR3320-S3TR | 2.048              | SOT23G-3 |
| TPR3325-S3TR | 2.5                | SOT23G-3 |
| TPR3330-S3TR | 3                  | SOT23G-3 |
| TPR3333-S3TR | 3.3                | SOT23G-3 |
| TPR3340-S3TR | 4.096              | SOT23G-3 |

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## Revision History

| Revision  | Notes  |
|-----------|--|
| Rev.Pre.0 | Pre-Release version.   |
| Rev.Pre.1 | Updated Limit.   |
| Rev.Pre.2 | Updated Voltage Output.  |
| Rev.A.0   | Initial Version.   |
| Rev.A.1   | 1. Added Tape and Reel Information.<br>2. Added common condition in electrical characteristics: $V_S = 5\text{ V}$ . |
| Rev.A.2   | Updated ESD Rating.  |
| Rev.A.3   | 1. Added typical value of Long-term stability.<br>2. Corrected test conditions in Electrical Characteristics table.  |
| Rev.A.4   | Removed QFN1.5X1.5-8 Package.  |

## Specifications

### Absolute Maximum Ratings

| Parameter        |                                     | Min  | Max | Unit |
|------------------|-------------------------------------|------|-----|------|
| V <sub>IN</sub>  | Supply Voltage                      | -0.3 | 6.9 | V    |
| T <sub>J</sub>   | Junction Temperature Range          | -40  | 150 | °C   |
| T <sub>A</sub>   | Operating Temperature Range         | -40  | 125 | °C   |
| T <sub>STG</sub> | Storage Temperature Range           | -65  | 150 | °C   |
| T <sub>L</sub>   | Lead Temperature (Soldering 10 sec) |      | 260 | °C   |

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

### ESD, Electrostatic Discharge Protection

| Symbol | Parameter                | Condition                             | Minimum Level | Unit |
|--------|--------------------------|---------------------------------------|---------------|------|
| HBM    | Human Body Model ESD     | ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup> | ±4            | kV   |
| CDM    | Charged Device Model ESD | ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup> | ±1.5          | kV   |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### Recommended Operating Conditions

| Parameter       |                            | Min | Max | Unit |
|-----------------|----------------------------|-----|-----|------|
| V <sub>IN</sub> | Supply Voltage             | 2.1 | 5.5 | V    |
| T <sub>J</sub>  | Junction Temperature Range | -40 | 125 | °C   |

### Thermal Information

| Package Type | θ <sub>JA</sub> | θ <sub>JC</sub> | Unit |
|--------------|-----------------|-----------------|------|
| SOT23G-3     | 250             | 81              | °C/W |

**Electrical Characteristics**

 All test conditions:  $V_{IN} = 5\text{ V}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise noted.

| Symbol         | Parameter            | Conditions          | Min   | Typ   | Max  | Unit            |
|----------------|----------------------|---------------------|-------|-------|------|-----------------|
| <b>TPR3312</b> |                      |                     |       |       |      |                 |
| $V_{OUT}$      | Output Voltage       |                     |       | 1.25  |      | V               |
|                | Initial Accuracy     |                     | -0.15 |       | 0.15 | %               |
|                | Output Voltage Noise | f = 0.1 Hz to 10 Hz |       | 25    |      | $\mu\text{Vpp}$ |
| <b>TPR3320</b> |                      |                     |       |       |      |                 |
| $V_{OUT}$      | Output Voltage       |                     |       | 2.048 |      | V               |
|                | Initial Accuracy     |                     | -0.15 |       | 0.15 | %               |
|                | Output Voltage Noise | f = 0.1 Hz to 10 Hz |       | 40    |      | $\mu\text{Vpp}$ |
| <b>TPR3325</b> |                      |                     |       |       |      |                 |
| $V_{OUT}$      | Output Voltage       |                     |       | 2.5   |      | V               |
|                | Initial Accuracy     |                     | -0.15 |       | 0.15 | %               |
|                | Output Voltage Noise | f = 0.1 Hz to 10 Hz |       | 50    |      | $\mu\text{Vpp}$ |
| <b>TPR3330</b> |                      |                     |       |       |      |                 |
| $V_{OUT}$      | Output Voltage       |                     |       | 3.0   |      | V               |
|                | Initial Accuracy     |                     | -0.15 |       | 0.15 | %               |
|                | Output Voltage Noise | f = 0.1 Hz to 10 Hz |       | 60    |      | $\mu\text{Vpp}$ |
| <b>TPR3333</b> |                      |                     |       |       |      |                 |
| $V_{OUT}$      | Output Voltage       |                     |       | 3.3   |      | V               |
|                | Initial Accuracy     |                     | -0.15 |       | 0.15 | %               |
|                | Output Voltage Noise | f = 0.1 Hz to 10 Hz |       | 66    |      | $\mu\text{Vpp}$ |
| <b>TPR3340</b> |                      |                     |       |       |      |                 |
| $V_{OUT}$      | Output Voltage       |                     |       | 4.096 |      | V               |
|                | Initial Accuracy     |                     | -0.15 |       | 0.15 | %               |
|                | Output Voltage Noise | f = 0.1 Hz to 10 Hz |       | 80    |      | $\mu\text{Vpp}$ |

**Electrical Characteristics (Continued)**

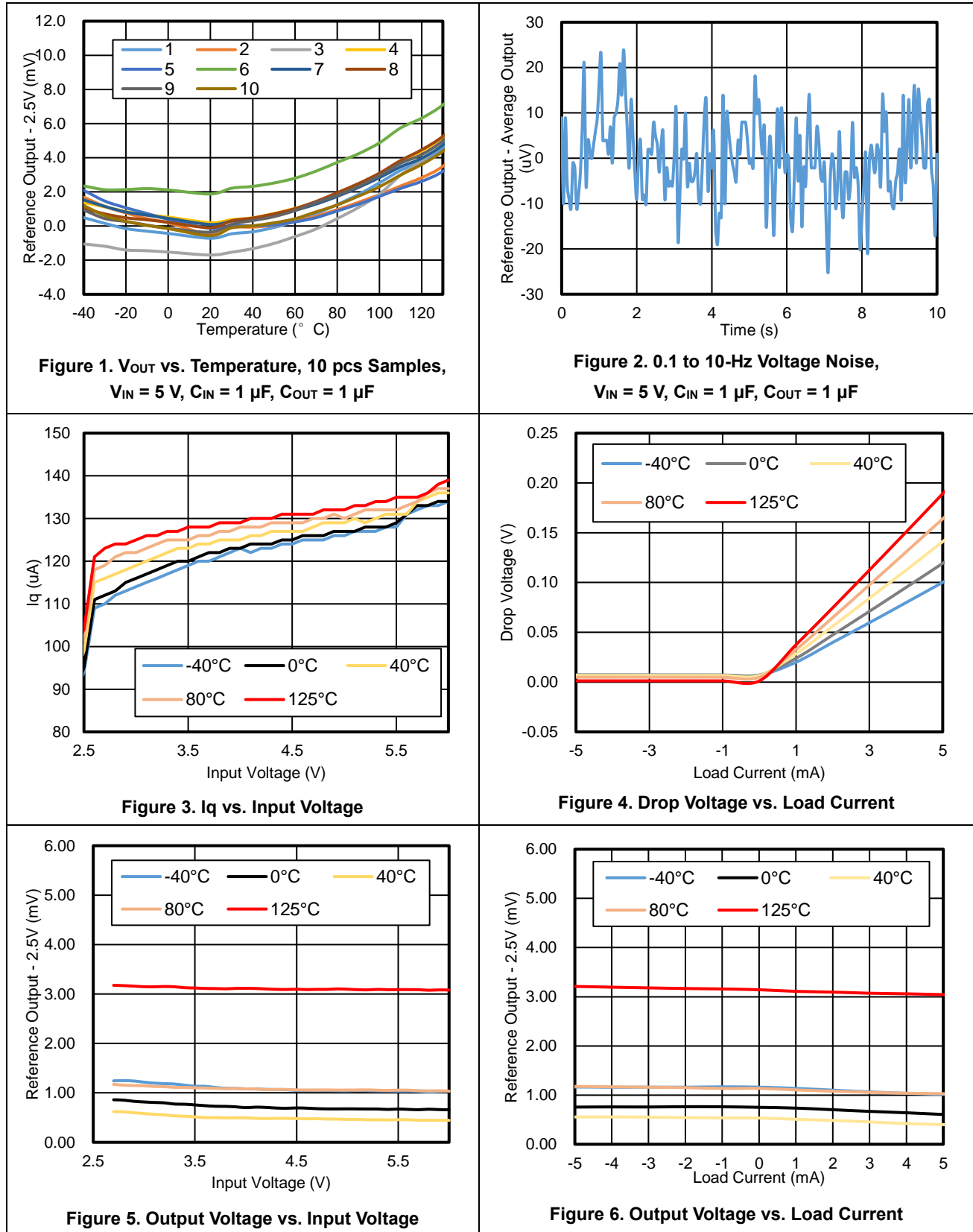
 All test conditions:  $V_{IN} = 5\text{ V}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise noted.

| Symbol  | Parameter   | Conditions  | Min  | Typ | Max | Unit                  |        |
|---|---|---|--|-----|-----|-----------------------|--------|
| <b>TPR3312, TPR3320, TPR3325, TPR3330, TPR3333, TPR3340, Power Supply</b>     |   |   |  |     |     |                       |        |
| $V_{IN}$  | Supply Voltage                                    | TPR3312   | 2.1  |     | 5.5 | V                     |        |
|   |   | All parts except TPR3312, $I_{LOAD} = \pm 1\text{ mA}$                                    | $V_{OUT} + 0.05$                                 |     | 5.5 | V                     |        |
| $I_q$   | Quiescent Current                                 |   |  |     | 180 | $\mu\text{A}$         |        |
|   |   | $T_A = -40$ to $125^\circ\text{C}$  |  |     | 215 | $\mu\text{A}$         |        |
|   | Minimum Dropout Voltage                           | $I_{LOAD} = \pm 1\text{ mA}$ ,<br>all parts except<br>TPR3312                             | $T_A = 25^\circ\text{C}$                         |     | 25  | 50                    | mV     |
|   |   |   | $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$    |     |     | 50                    | mV     |
|   |   |   | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ |     |     | 100                   | mV     |
|   |   | $I_{LOAD} = \pm 5\text{ mA}$ ,<br>all parts except<br>TPR3312                             | $T_A = 25^\circ\text{C}$                         |     |     | 200                   | mV     |
|   |   |   | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ |     |     | 250                   | mV     |
|   |   |   |  |     |     |                       |        |
| <b>TPR3312, TPR3320, TPR3325, TPR3330, TPR3333, TPR3340, Reference Output</b> |   |   |  |     |     |                       |        |
|   | Output Voltage<br>Temperature Drift               | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$   |  | 10  | 20  | ppm/ $^\circ\text{C}$ |        |
|   |   | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$  |  | 15  | 30  |                       |        |
|   | Line Regulation, TPR3312                          | $V_{IN} = 2.1$ to $5.5\text{ V}^{(1)}$  | -65  |     | 65  | ppm/V                 |        |
|   |   | $V_{IN} = 2.1$ to $5.5\text{ V}^{(1)}$ , $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | -85  |     | 85  | ppm/V                 |        |
|   | Line Regulation,<br>TPR33XX except for<br>TPR3312 | $V_{IN} = V_{OUT} + 300$<br>mV to $5.5\text{ V}$  |  | -50 |     | 50                    | ppm/V  |
|   |   |   | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | -70 |     | 70                    | ppm/V  |
|   | Load Regulation                                   | $V_{IN} = V_{OUT} + 300$<br>mV, $I_{LOAD} = -5$ to<br>$5\text{ mA}^{(1)}$                 |  | -20 |     | 20                    | ppm/mA |
|   |   |   | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | -30 |     | 30                    | ppm/mA |
|   | Long Term Stability                               | 0 to 1000 hours, $T_A = 25^\circ\text{C}$   |  | 200 |     | ppm                   |        |
|   |   | 1000 to 2000 hours, $T_A = 25^\circ\text{C}$  |  | 200 |     | ppm                   |        |
|   | Thermal Hysteresis                                |   |  | 80  |     | ppm                   |        |
| $I_{SC}$  | Short-circuit Current                             | Sourcing and sinking  |  | 50  |     | mA                    |        |
|   | Capacitive Load                                   |   | 0.1  |     | 10  | $\mu\text{F}$         |        |
|   | Turn-on Settling Time                             | To 0.1% with $C_L = 1\text{ }\mu\text{F}$   |  | 500 |     | $\mu\text{s}$         |        |

(1) The minimum supply voltage for the TPR3312 is 2.1 V.

Typical Performance Characteristics – TPR3325

All test conditions:  $T_A = +25^\circ\text{C}$ , unless otherwise noted.





### Typical Performance Characteristics – TPR3325 (Continued)

All test conditions:  $T_A = +25^\circ\text{C}$ , unless otherwise noted.

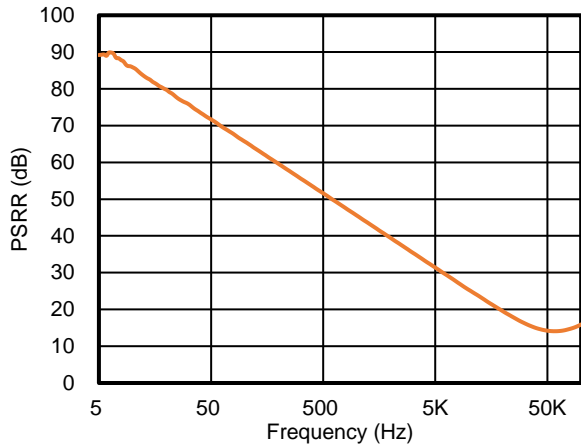


Figure 7. PSRR vs. Frequency

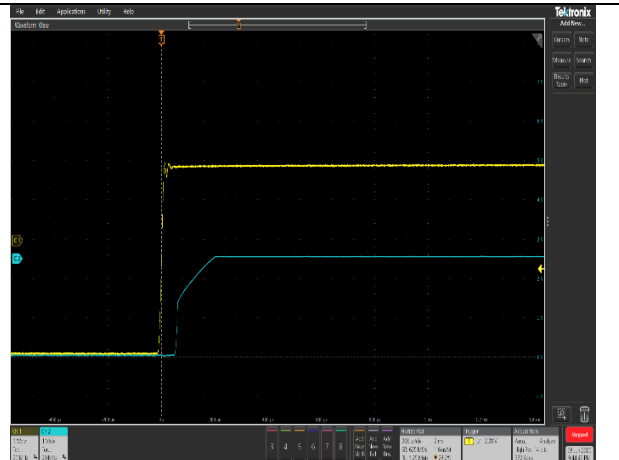


Figure 8. Step Response,  $V_{IN} = 5\text{ V}$ ,  $C_{IN} = 1\ \mu\text{F}$ ,  $C_{OUT} = 0.1\ \mu\text{F}$ ,  $200\ \mu\text{s/div}$

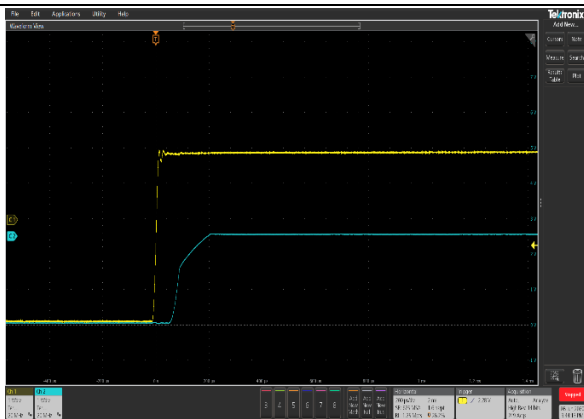


Figure 9. Step Response,  $V_{IN} = 5\text{ V}$ ,  $C_{IN} = 1\ \mu\text{F}$ ,  $C_{OUT} = 1\ \mu\text{F}$ ,  $200\ \mu\text{s/div}$

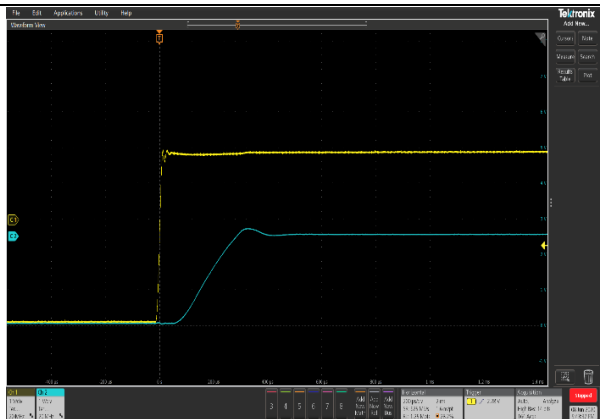


Figure 10. Step Response,  $V_{IN} = 5\text{ V}$ ,  $V_{IN} = 5\text{ V}$ ,  $C_{IN} = 1\ \mu\text{F}$ ,  $C_{OUT} = 10\ \mu\text{F}$ ,  $200\ \mu\text{s/div}$



Figure 11. Load Transient,  $\pm 5\text{ mA}$ ,  $V_{IN} = 5\text{ V}$ ,  $C_{IN} = 1\ \mu\text{F}$ ,  $C_{OUT} = 1\ \mu\text{F}$ ,  $50\text{ mV/div}$



Figure 12. Load Transient,  $\pm 5\text{ mA}$ ,  $V_{IN} = 2.8\text{ V}$ ,  $C_{IN} = 1\ \mu\text{F}$ ,  $C_{OUT} = 1\ \mu\text{F}$ ,  $50\text{ mV/div}$

### Typical Performance Characteristics – TPR3325 (Continued)

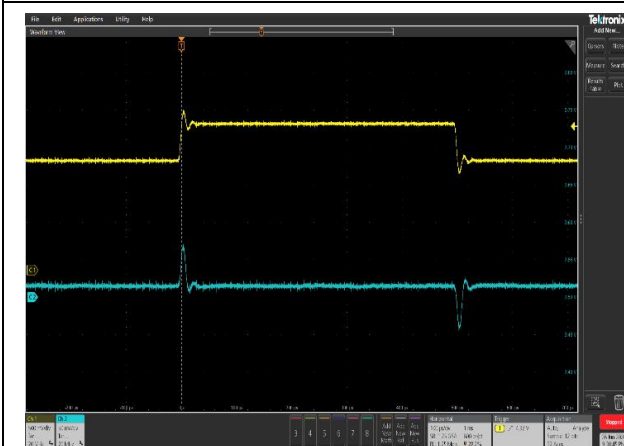
All test conditions:  $T_A = +25^\circ\text{C}$ , unless otherwise noted.



**Figure 13. Load Transient,  $\pm 2$  mA,  $V_{IN} = 5$  V,  
 $C_{IN} = 1 \mu\text{F}$ ,  $C_{OUT} = 1 \mu\text{F}$ , 20 mV/div**

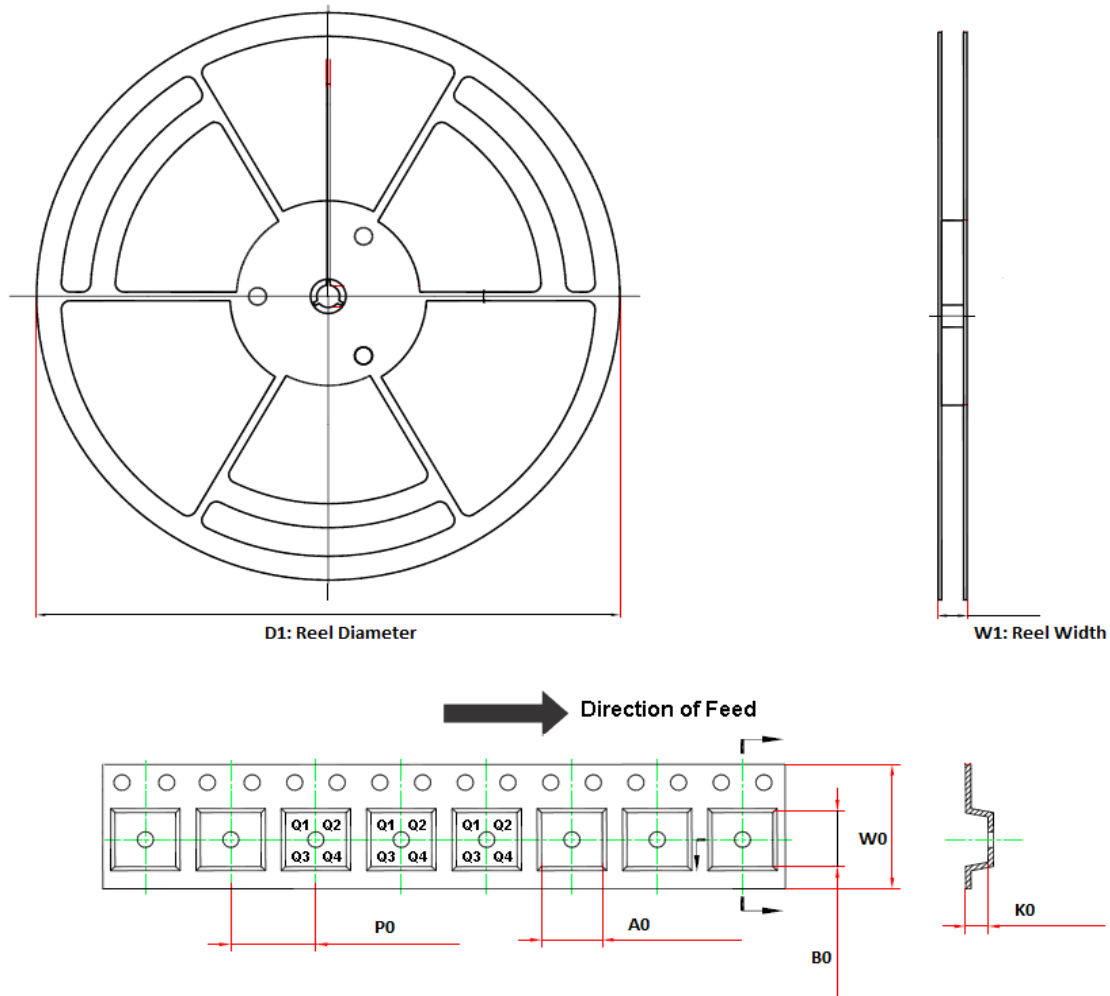


**Figure 14. Load Transient,  $\pm 2$  mA,  $V_{IN} = 2.8$  V,  
 $C_{IN} = 1 \mu\text{F}$ ,  $C_{OUT} = 1 \mu\text{F}$ , 20 mV/div**



**Figure 15. Line Transient, 500 mV Step,  
 $C_{IN} = 1 \mu\text{F}$ ,  $C_{OUT} = 1 \mu\text{F}$ , 50 mV/div**

### Tape and Reel Information

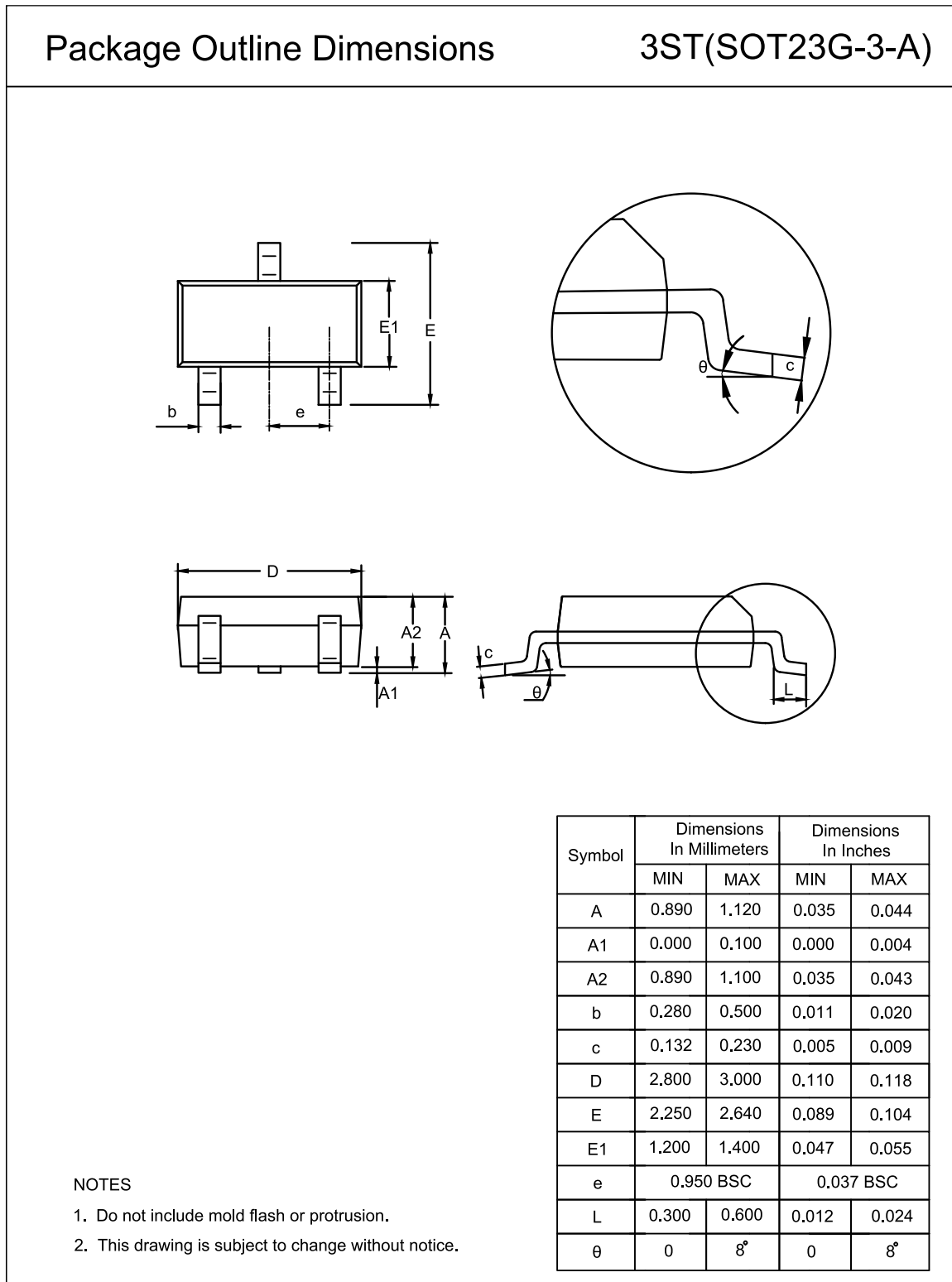


| Order Number | Package  | D1 (mm) | W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | W0 (mm) | Pin1 Quadrant |
|--------------|----------|---------|---------|---------|---------|---------|---------|---------|---------------|
| TPR33xx-S3TR | SOT23G-3 | 178     | 12.1    | 3.15    | 2.77    | 1.22    | 4.0     | 8.0     | Q3            |

(1) Output voltage, xx = 12 to 40.

Package Outline Dimensions

SOT23G-3



**Order Information**

| Order Number | Operating Temperature Range | Package  | Marking Information | MSL  | Transport Media, Quantity | Eco Plan |
|--------------|-----------------------------|----------|---------------------|------|---------------------------|----------|
| TPR3312-S3TR | -40 to 125°C                | SOT23G-3 | R3A                 | MSL3 | 3,000                     | Green    |
| TPR3320-S3TR | -40 to 125°C                | SOT23G-3 | R3B                 | MSL3 | 3,000                     | Green    |
| TPR3325-S3TR | -40 to 125°C                | SOT23G-3 | R3C                 | MSL3 | 3,000                     | Green    |
| TPR3330-S3TR | -40 to 125°C                | SOT23G-3 | R3D                 | MSL3 | 3,000                     | Green    |
| TPR3333-S3TR | -40 to 125°C                | SOT23G-3 | R3E                 | MSL3 | 3,000                     | Green    |
| TPR3340-S3TR | -40 to 125°C                | SOT23G-3 | R3F                 | MSL3 | 3,000                     | Green    |

(1) Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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