

## P-Ch 60V Fast Switching MOSFETs



- ★ Super Low Gate Charge
- ★ 100% EAS Guaranteed
- ★ Green Device Available
- ★ Excellent CdV/dt effect decline
- ★ Advanced high cell density Trench technology

## Product Summary

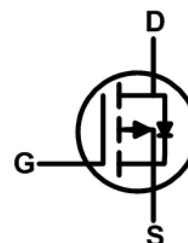
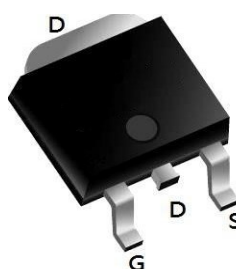
| BVDSS | RDSON | ID   |
|-------|-------|------|
| -60V  | 100mΩ | -10A |

## Description

The XR10P06 is the high cell density trenched P-ch MOSFETs, which provide excellent RDSON and gate charge for most of the synchronous buck converter applications.

The XR10P06 meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved.

## TO252-3L Pin Configuration



## Absolute Maximum Ratings

| Symbol                      | Parameter                                   | Rating     | Units            |
|-----------------------------|---------------------------------------------|------------|------------------|
| $V_{DS}$                    | Drain-Source Voltage                        | -60        | V                |
| $V_{GS}$                    | Gate-Source Voltage                         | $\pm 20$   | V                |
| $I_D@T_C=25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ -10V^1$ | -10        | A                |
| $I_D@T_C=100^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ -10V^1$ | -6.8       | A                |
| $I_D@T_A=25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ -10V^1$ | -3.5       | A                |
| $I_D@T_A=70^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ -10V^1$ | -2.8       | A                |
| $I_{DM}$                    | Pulsed Drain Current <sup>2</sup>           | -25        | A                |
| EAS                         | Single Pulse Avalanche Energy <sup>3</sup>  | 20         | mJ               |
| $I_{AS}$                    | Avalanche Current                           | -20        | A                |
| $P_D@T_C=25^\circ\text{C}$  | Total Power Dissipation <sup>4</sup>        | 25         | W                |
| $P_D@T_A=25^\circ\text{C}$  | Total Power Dissipation <sup>4</sup>        | 2          | W                |
| $T_{STG}$                   | Storage Temperature Range                   | -55 to 150 | $^\circ\text{C}$ |
| $T_J$                       | Operating Junction Temperature Range        | -55 to 150 | $^\circ\text{C}$ |

## Thermal Data

| Symbol          | Parameter                                        | Typ. | Max. | Unit               |
|-----------------|--------------------------------------------------|------|------|--------------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 62   | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 5    | $^\circ\text{C/W}$ |

## P-Ch 60V Fast Switching MOSFETs

Electrical Characteristics ( $T_J=25^\circ\text{C}$ , unless otherwise noted)

| Symbol                       | Parameter                                      | Conditions                                          | Min. | Typ.   | Max.      | Unit                |
|------------------------------|------------------------------------------------|-----------------------------------------------------|------|--------|-----------|---------------------|
| $BV_{DSS}$                   | Drain-Source Breakdown Voltage                 | $V_{GS}=0V, I_D=-250\mu A$                          | -60  | ---    | ---       | V                   |
| $\Delta BV_{DSS}/\Delta T_J$ | $BV_{DSS}$ Temperature Coefficient             | Reference to $25^\circ\text{C}$ , $I_D=-1\text{mA}$ | ---  | -0.049 | ---       | $V/^\circ\text{C}$  |
| $R_{DS(ON)}$                 | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=-10V, I_D=-8A$                              | ---  | 100    | 140       | $m\Omega$           |
|                              |                                                | $V_{GS}=-4.5V, I_D=-6A$                             | ---  | 115    | 190       |                     |
| $V_{GS(th)}$                 | Gate Threshold Voltage                         | $V_{GS}=V_{DS}, I_D=-250\mu A$                      | -1.0 | ---    | -2.5      | V                   |
| $\Delta V_{GS(th)}$          | $V_{GS(th)}$ Temperature Coefficient           |                                                     | ---  | 5.42   | ---       | $mV/^\circ\text{C}$ |
| $I_{DSS}$                    | Drain-Source Leakage Current                   | $V_{DS}=-48V, V_{GS}=0V, T_J=25^\circ\text{C}$      | ---  | ---    | 1         | $\mu A$             |
|                              |                                                | $V_{DS}=-48V, V_{GS}=0V, T_J=150^\circ\text{C}$     | ---  | ---    | 5         |                     |
| $I_{GSS}$                    | Gate-Source Leakage Current                    | $V_{GS}=\pm 20V, V_{DS}=0V$                         | ---  | ---    | $\pm 100$ | nA                  |
| gfs                          | Forward Transconductance                       | $V_{DS}=-5V, I_D=-5A$                               | ---  | 5.8    | ---       | S                   |
| $Q_g$                        | Total Gate Charge (-4.5V)                      | $V_{DS}=-20V, V_{GS}=-4.5V, I_D=-5A$                | ---  | 5.85   | ---       | nC                  |
| $Q_{gs}$                     | Gate-Source Charge                             |                                                     | ---  | 2.9    | ---       |                     |
| $Q_{gd}$                     | Gate-Drain Charge                              |                                                     | ---  | 1.8    | ---       |                     |
| $T_{d(on)}$                  | Turn-On Delay Time                             | $V_{DD}=-12V, V_{GS}=-10V, R_G=3.3\Omega, I_D=-5A$  | ---  | 10     | ---       | ns                  |
| $T_r$                        | Rise Time                                      |                                                     | ---  | 17     | ---       |                     |
| $T_{d(off)}$                 | Turn-Off Delay Time                            |                                                     | ---  | 22     | ---       |                     |
| $T_f$                        | Fall Time                                      |                                                     | ---  | 21     | ---       |                     |
| $C_{iss}$                    | Input Capacitance                              | $V_{DS}=-15V, V_{GS}=0V, F=1\text{MHz}$             | ---  | 715    | ---       | pF                  |
| $C_{oss}$                    | Output Capacitance                             |                                                     | ---  | 51     | ---       |                     |
| $C_{rss}$                    | Reverse Transfer Capacitance                   |                                                     | ---  | 34     | ---       |                     |

## Diode Characteristics

| Symbol   | Parameter                                | Conditions                                        | Min. | Typ. | Max. | Unit |
|----------|------------------------------------------|---------------------------------------------------|------|------|------|------|
| $I_S$    | Continuous Source Current <sup>1,5</sup> | $V_G=V_D=0V$ , Force Current                      | ---  | ---  | -10  | A    |
| $I_{SM}$ | Pulsed Source Current <sup>2,5</sup>     |                                                   | ---  | ---  | -24  | A    |
| $V_{SD}$ | Diode Forward Voltage <sup>2</sup>       | $V_{GS}=0V, I_S=-1A, T_J=25^\circ\text{C}$        | ---  | ---  | -1.2 | V    |
| $t_{rr}$ | Reverse Recovery Time                    | $I_F=-8A, dI/dt=100A/\mu s, T_J=25^\circ\text{C}$ | ---  | 10.2 | ---  | nS   |
| $Q_{rr}$ | Reverse Recovery Charge                  |                                                   | ---  | 5.4  | ---  | nC   |

Note :

1. The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
2. The data tested by pulsed, pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
3. The EAS data shows Max. rating. The test condition is  $V_{DD}=-25V, V_{GS}=-10V, L=0.1mH, I_{AS}=-15A$
4. The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
5. The data is theoretically the same as  $I_D$  and  $I_{DM}$ , in real applications, should be limited by total power dissipation.

## P-Ch 60V Fast Switching MOSFETs

### P-Channel Typical Characteristics

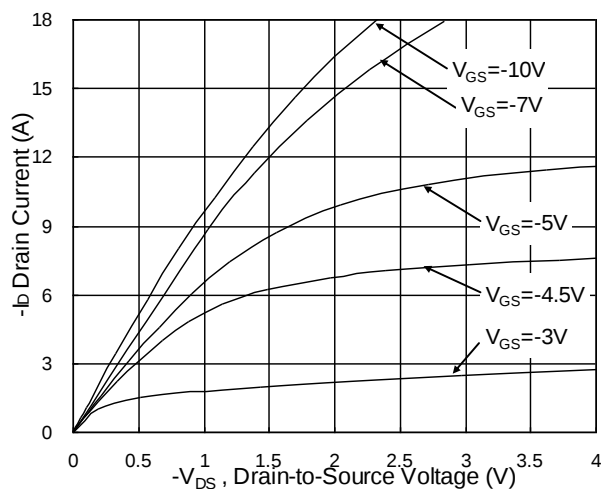


Fig.1 Typical Output Characteristics

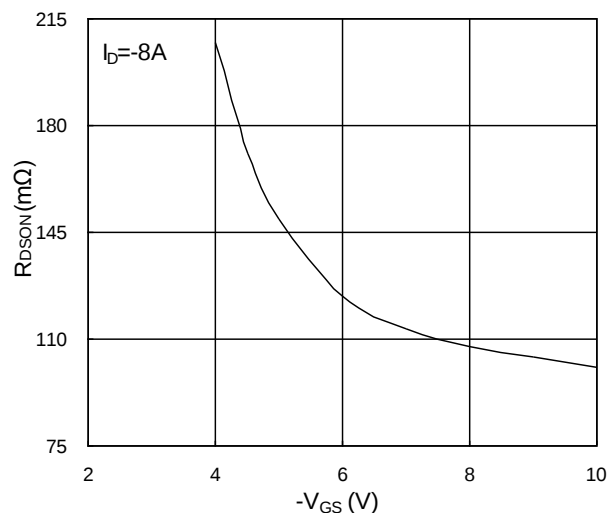


Fig.2 On-Resistance vs. G-S Voltage

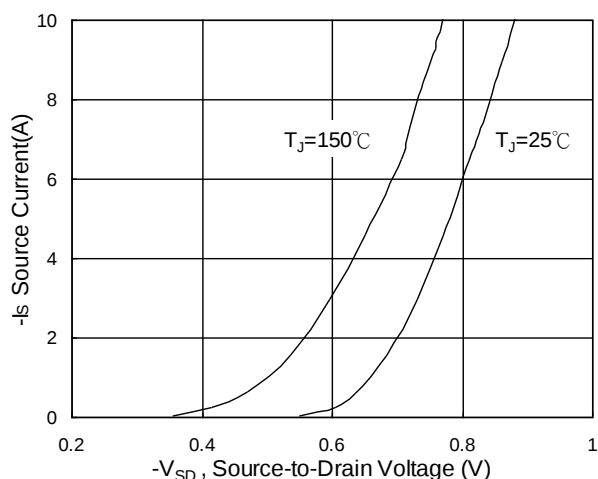


Fig.3 Forward Characteristics Of Reverse

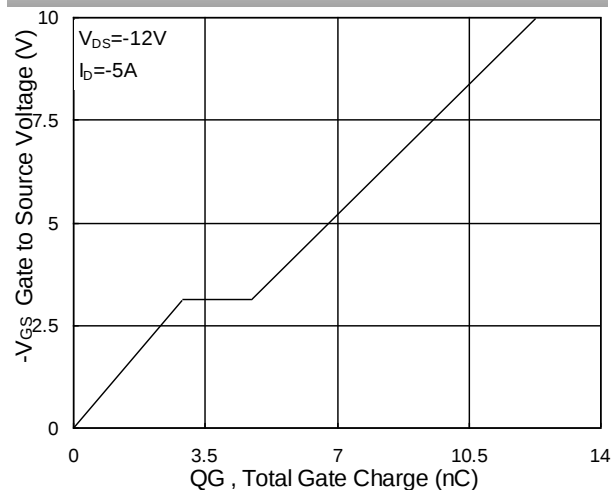


Fig.4 Gate-Charge Characteristics

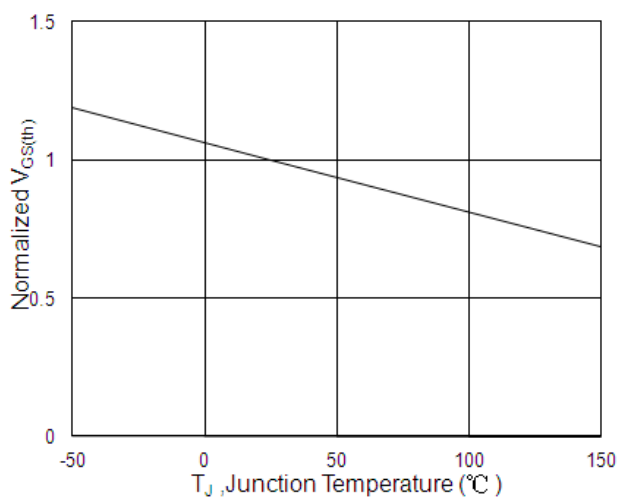


Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$

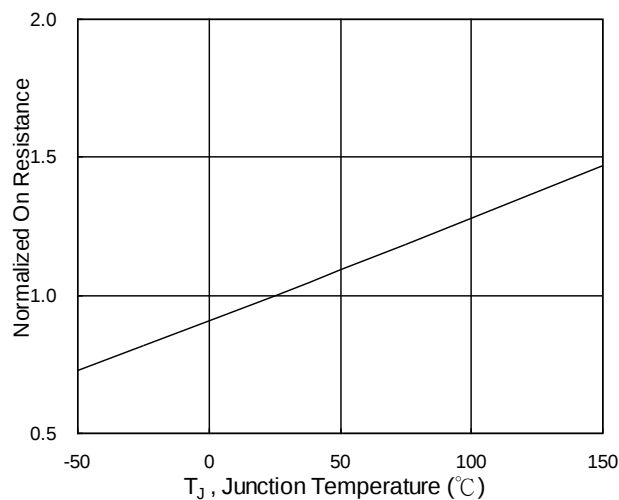


Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$

## P-Ch 60V Fast Switching MOSFETs

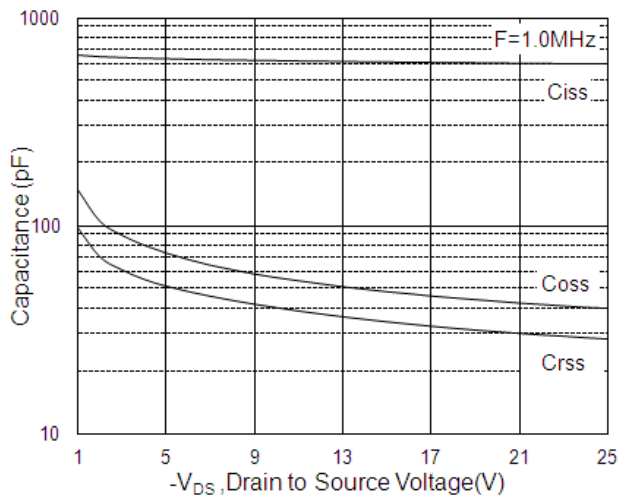


Fig.7 Capacitance

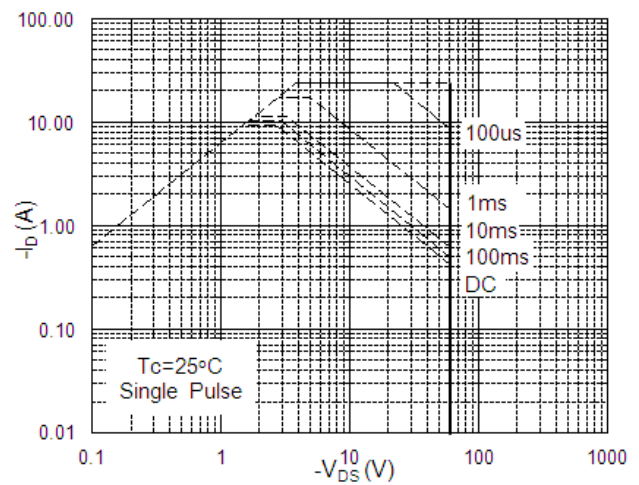


Fig.8 Safe Operating Area

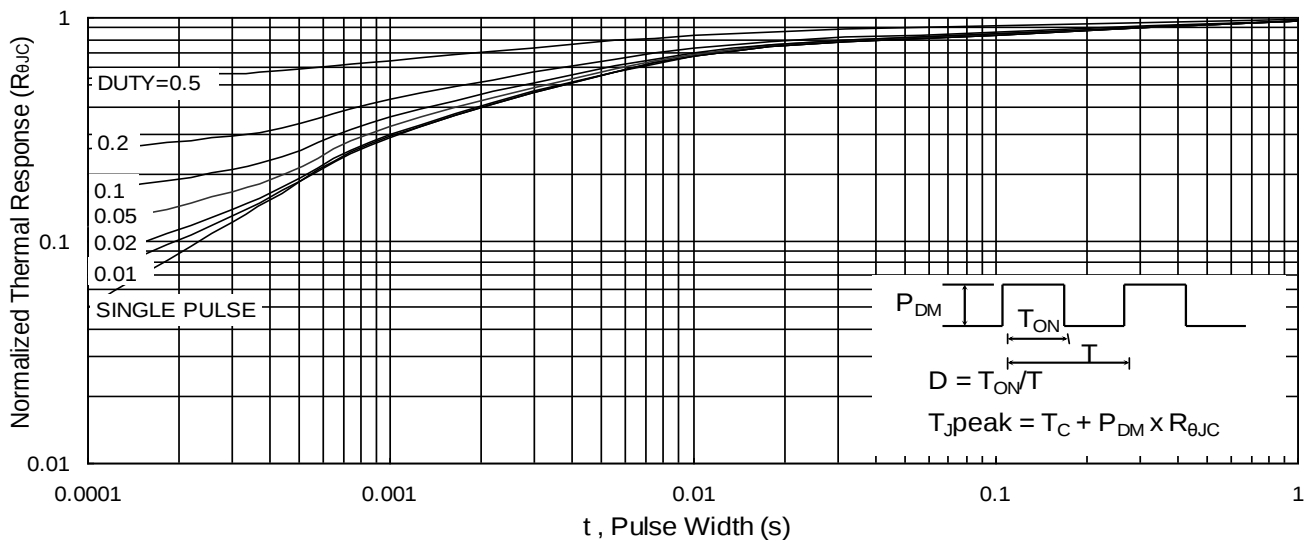


Fig.9 Normalized Maximum Transient Thermal Impedance

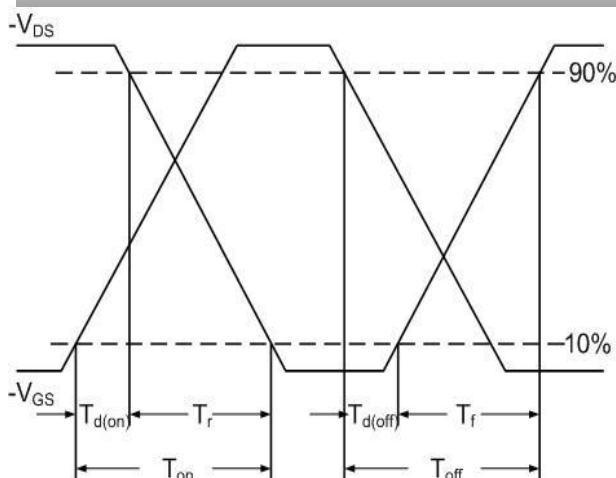


Fig.10 Switching Time Waveform

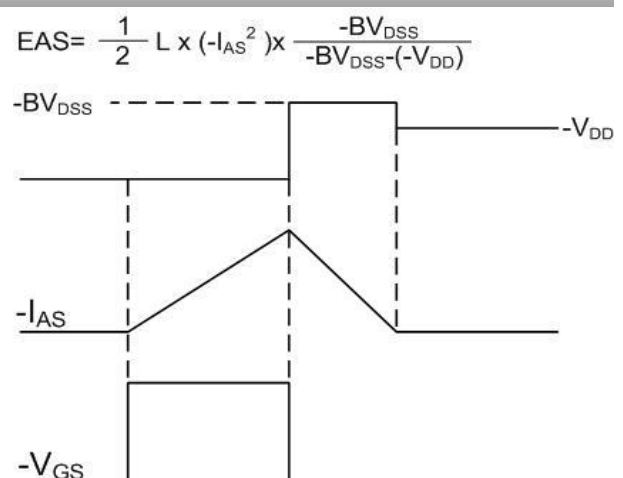
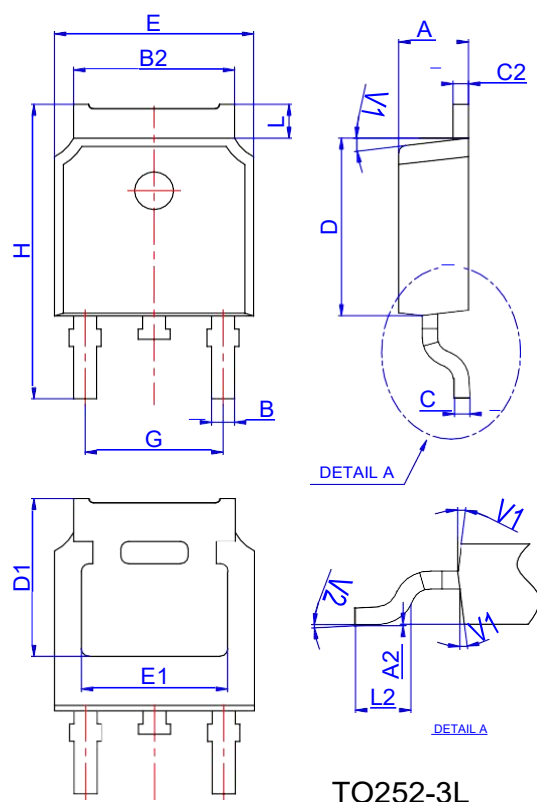


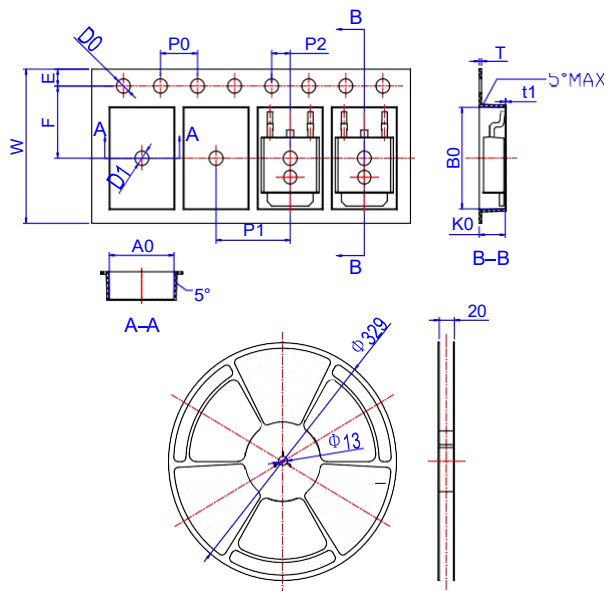
Fig.11 Unclamped Inductive Switching Waveform

### Package Mechanical Data TO252-3L



| Ref. | Dimensions  |      |       |          |      |       |
|------|-------------|------|-------|----------|------|-------|
|      | Millimeters |      |       | Inches   |      |       |
|      | Min.        | Typ. | Max.  | Min.     | Typ. | Max.  |
| A    | 2.10        |      | 2.50  | 0.083    |      | 0.098 |
| A2   | 0           |      | 0.10  | 0        |      | 0.004 |
| B    | 0.66        |      | 0.86  | 0.026    |      | 0.034 |
| B2   | 5.18        |      | 5.48  | 0.202    |      | 0.216 |
| C    | 0.40        |      | 0.60  | 0.016    |      | 0.024 |
| C2   | 0.44        |      | 0.58  | 0.017    |      | 0.023 |
| D    | 5.90        |      | 6.30  | 0.232    |      | 0.248 |
| D1   | 5.30REF     |      |       | 0.209REF |      |       |
| E    | 6.40        |      | 6.80  | 0.252    |      | 0.268 |
| E1   | 4.63        |      |       | 0.182    |      |       |
| G    | 4.47        |      | 4.67  | 0.176    |      | 0.184 |
| H    | 9.50        |      | 10.70 | 0.374    |      | 0.421 |
| L    | 1.09        |      | 1.21  | 0.043    |      | 0.048 |
| L2   | 1.35        |      | 1.65  | 0.053    |      | 0.065 |
| V1   |             | 7°   |       |          | 7°   |       |
| V2   | 0°          |      | 6°    | 0°       |      | 6°    |

### Reel Specification-TO252-3L



| Ref. | Dimensions  |       |       |        |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | Millimeters |       |       | Inches |       |       |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| W    | 15.90       | 16.00 | 16.10 | 0.626  | 0.630 | 0.634 |
| E    | 1.65        | 1.75  | 1.85  | 0.065  | 0.069 | 0.073 |
| F    | 7.40        | 7.50  | 7.60  | 0.291  | 0.295 | 0.299 |
| D0   | 1.40        | 1.50  | 1.60  | 0.055  | 0.059 | 0.063 |
| D1   | 1.40        | 1.50  | 1.60  | 0.055  | 0.059 | 0.063 |
| P0   | 3.90        | 4.00  | 4.10  | 0.154  | 0.157 | 0.161 |
| P1   | 7.90        | 8.00  | 8.10  | 0.311  | 0.315 | 0.319 |
| P2   | 1.90        | 2.00  | 2.10  | 0.075  | 0.079 | 0.083 |
| A0   | 6.85        | 6.90  | 7.00  | 0.270  | 0.271 | 0.276 |
| B0   | 10.45       | 10.50 | 10.60 | 0.411  | 0.413 | 0.417 |
| K0   | 2.68        | 2.78  | 2.88  | 0.105  | 0.109 | 0.113 |
| T    | 0.24        |       | 0.27  | 0.009  |       | 0.011 |
| t1   | 0.10        |       |       | 0.004  |       |       |
| 10P0 | 39.80       | 40.00 | 40.20 | 1.567  | 1.575 | 1.583 |