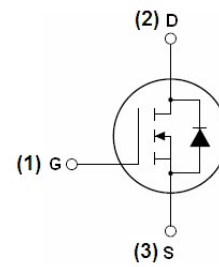


# AP9N20A

## N-Channel Power MOSFET

### Description

The AP9N20A uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.



Schematic diagram

### General Features

- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Low gate to drain charge to reduce switching losses

| $V_{DSS}$ | $R_{DS(ON)}$<br>@ 10V (typ) | $I_D$ |
|-----------|-----------------------------|-------|
| 200V      | 210m $\Omega$               | 9A    |



Marking and pin assignment

### Application

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply



TO-252

### Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$ unless otherwise noted)

| Parameter   | Symbol                   | Limit      | Unit             |
|---|--------------------------|------------|------------------|
| Drain-Source Voltage                                | $V_{DS}$                 | 200        | V                |
| Gate-Source Voltage                                 | $V_{GS}$                 | $\pm 20$   | V                |
| Drain Current-Continuous                            | $I_D$                    | 9          | A                |
| Drain Current-Continuous( $T_C=100^\circ\text{C}$ ) | $I_D(100^\circ\text{C})$ | 5.6        | A                |
| Pulsed Drain Current                                | $I_{DM}$                 | 20         | A                |
| Maximum Power Dissipation                           | $P_D$                    | 55         | W                |
| Operating Junction and Storage Temperature Range    | $T_J, T_{STG}$           | -55 To 150 | $^\circ\text{C}$ |

### Thermal Characteristic

|  |                 |     |                    |
|--|-----------------|-----|--------------------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 2.3 | $^\circ\text{C/W}$ |
|--|-----------------|-----|--------------------|

## N-Channel Power MOSFET

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

| Parameter                                 | Symbol       | Condition  | Min | Typ | Max       | Unit       |
|---|--------------|--|-----|-----|-----------|------------|
| <b>Off Characteristics</b>                |              |  |     |     |           |            |
| Drain-Source Breakdown Voltage            | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                                | 200 | 225 | -         | V          |
| Zero Gate Voltage Drain Current           | $I_{DSS}$    | $V_{DS}=200V, V_{GS}=0V$                                 | -   | -   | 1         | $\mu A$    |
| Gate-Body Leakage Current                 | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$                              | -   | -   | $\pm 100$ | nA         |
| <b>On Characteristics</b> (Note 3)        |              |  |     |     |           |            |
| Gate Threshold Voltage                    | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                            | 1   | 1.6 | 2.5       | V          |
| Drain-Source On-State Resistance          | $R_{DS(on)}$ | $V_{GS}=10V, I_D=4.5A$                                   | -   | 210 | 300       | m $\Omega$ |
| Forward Transconductance                  | $g_{FS}$     | $V_{DS}=25V, I_D=4.5A$                                   | 3   | -   | -         | S          |
| <b>Dynamic Characteristics</b> (Note 4)   |              |  |     |     |           |            |
| Input Capacitance                         | $C_{iss}$    | $V_{DS}=25V, V_{GS}=0V,$<br>$F=1.0MHz$                   |     | 540 |           | PF         |
| Output Capacitance                        | $C_{oss}$    |  |     | 90  |           | PF         |
| Reverse Transfer Capacitance              | $C_{rss}$    |  |     | 35  |           | PF         |
| <b>Switching Characteristics</b> (Note 4) |              |  |     |     |           |            |
| Turn-on Delay Time                        | $t_{d(on)}$  | $V_{DD}=100V, I_D=4.5A$<br>$V_{GS}=10V, R_{GEN}=5\Omega$ | -   | 6.4 | -         | nS         |
| Turn-on Rise Time                         | $t_r$        |  | -   | 11  | -         | nS         |
| Turn-Off Delay Time                       | $t_{d(off)}$ |  | -   | 20  | -         | nS         |
| Turn-Off Fall Time                        | $t_f$        |  | -   | 12  | -         | nS         |
| Total Gate Charge                         | $Q_g$        | $V_{DS}=160V, I_D=4.5A,$<br>$V_{GS}=10V$                 | -   | 16  | -         | nC         |
| Gate-Source Charge                        | $Q_{gs}$     |  | -   | 3.4 | -         | nC         |
| Gate-Drain Charge                         | $Q_{gd}$     |  | -   | 5.1 | -         | nC         |
| <b>Drain-Source Diode Characteristics</b> |              |  |     |     |           |            |
| Diode Forward Voltage (Note 3)            | $V_{SD}$     | $V_{GS}=0V, I_S=4.5A$                                    | -   | -   | 1.2       | V          |
| Diode Forward Current (Note 2)            | $I_S$        |  | -   | -   | 9         | A          |

## Notes:

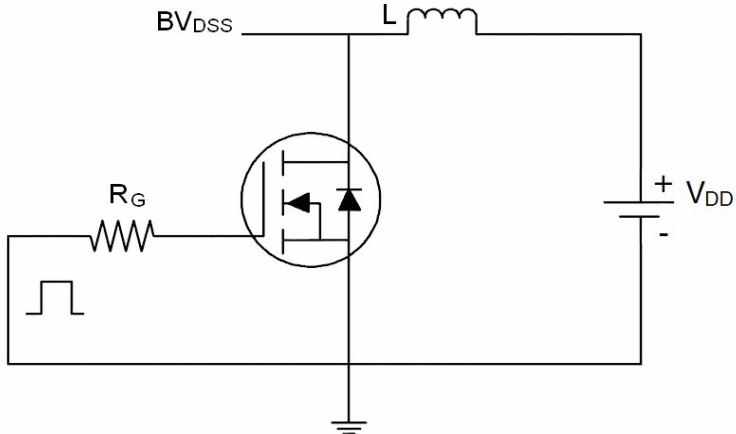
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

**AP9N20A**

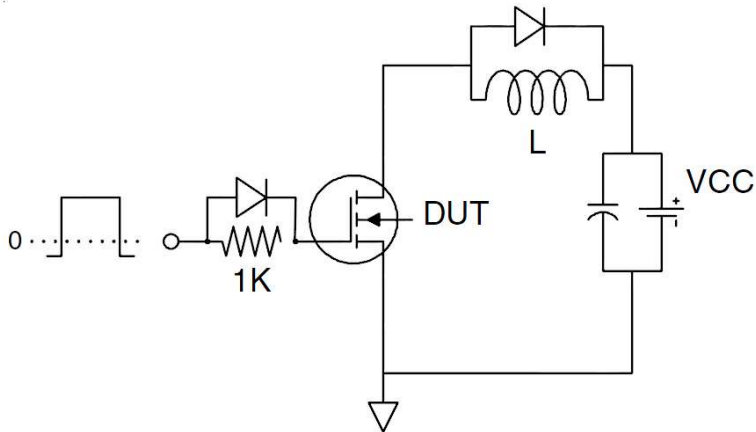
**N-Channel Power MOSFET**

**Test Circuit**

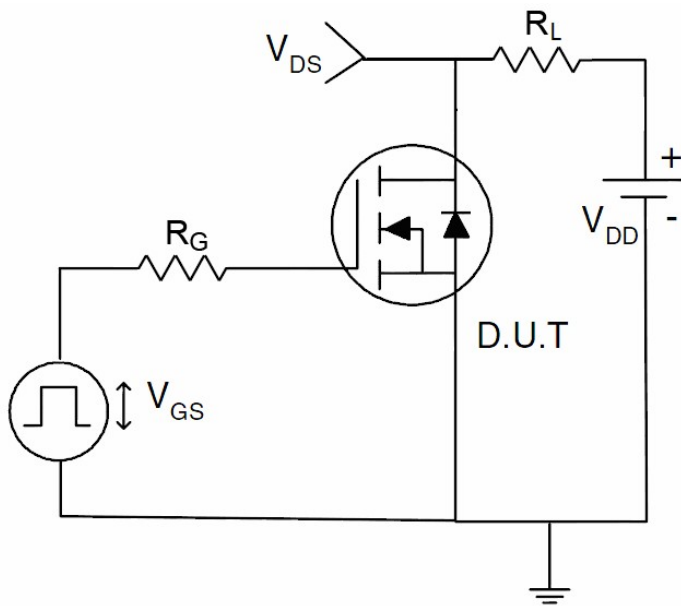
**1)  $E_{AS}$  test Circuit**



**2) Gate charge test Circuit**



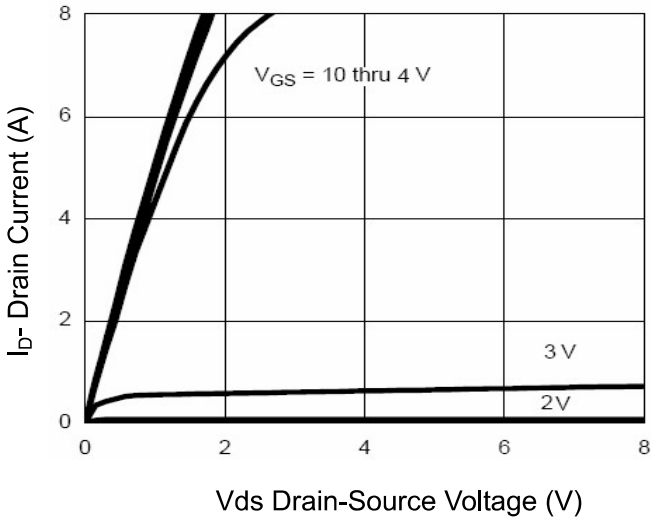
**3) Switch Time Test Circuit**



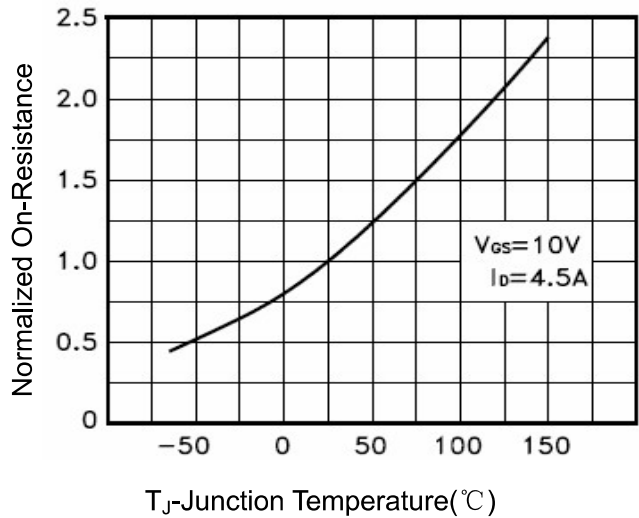
**AP9N20A**

**N-Channel Power MOSFET**

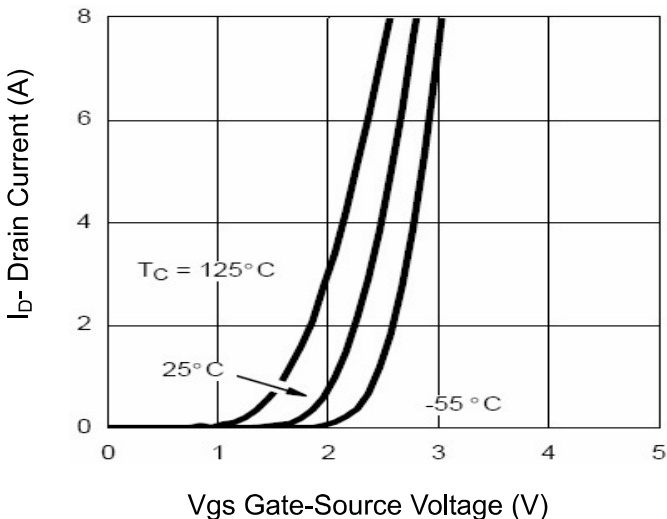
**Typical Electrical and Thermal Characteristics (Curves)**



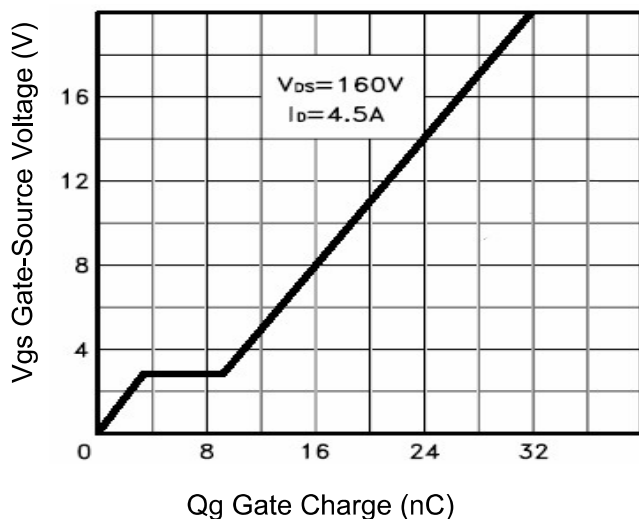
**Figure 1 Output Characteristics**



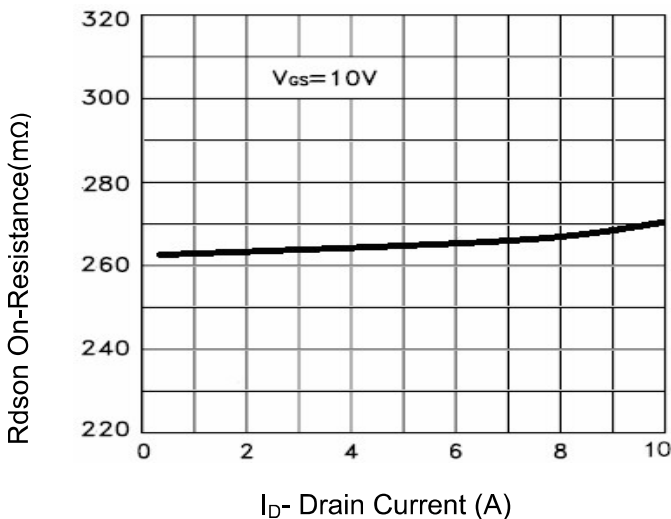
**Figure 4 Rdson-Junction Temperature**



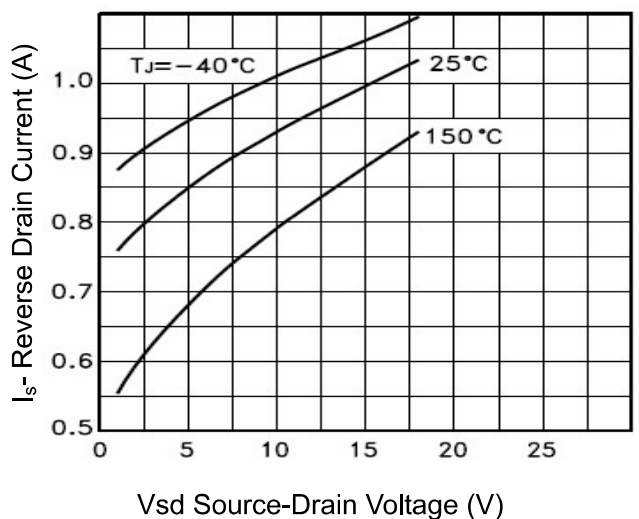
**Figure 2 Transfer Characteristics**



**Figure 5 Gate Charge**



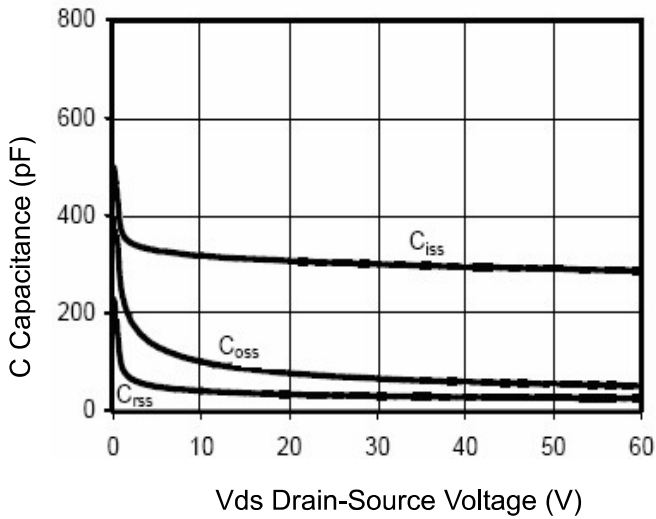
**Figure 3 Rdson- Drain Current**



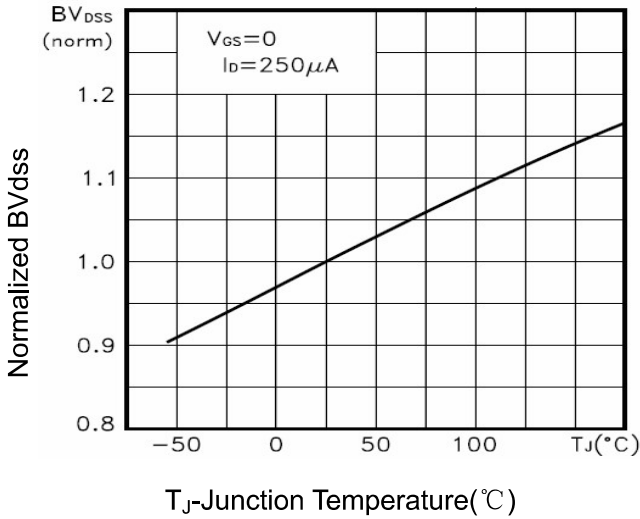
**Figure 6 Source- Drain Diode Forward**

**AP9N20A**

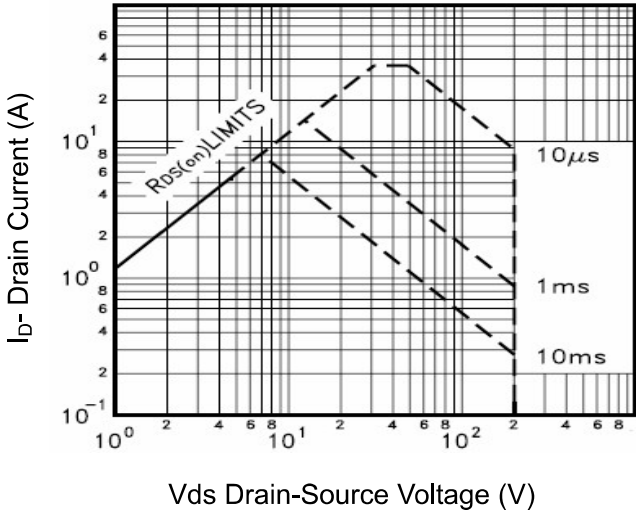
**N-Channel Power MOSFET**



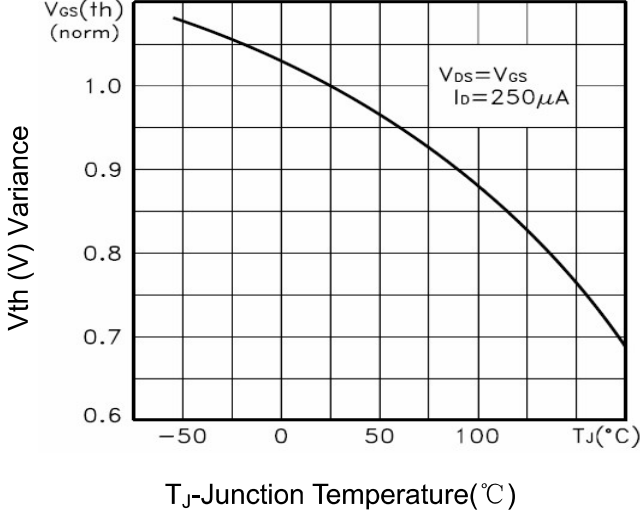
**Figure 7 Capacitance vs Vds**



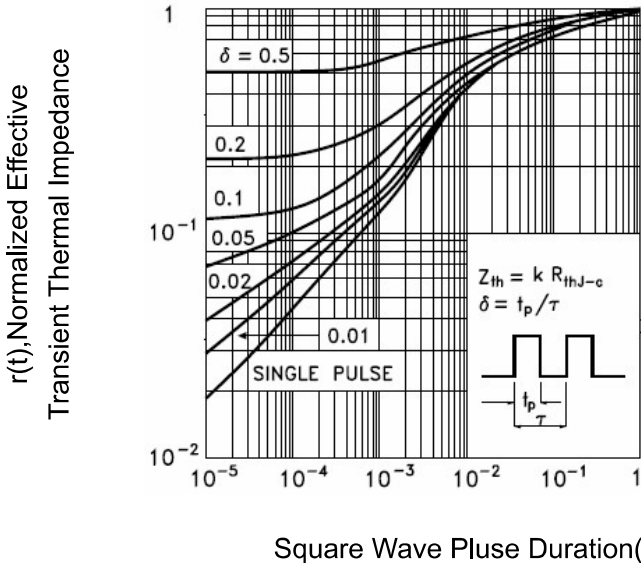
**Figure 9 BV<sub>DSS</sub> vs Junction Temperature**



**Figure 8 Safe Operation Area**



**Figure 10 V<sub>GS(th)</sub> vs Junction Temperature**

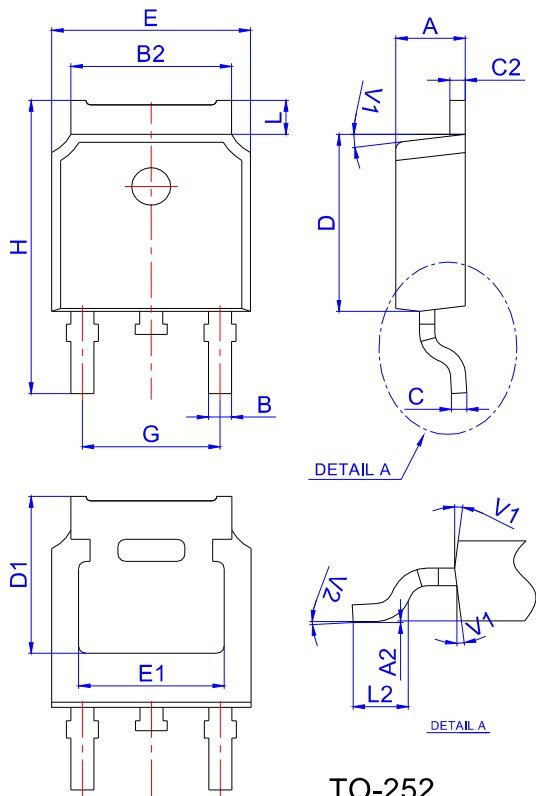


**Figure 11 Normalized Maximum Transient Thermal Impedance**

**AP9N20A**

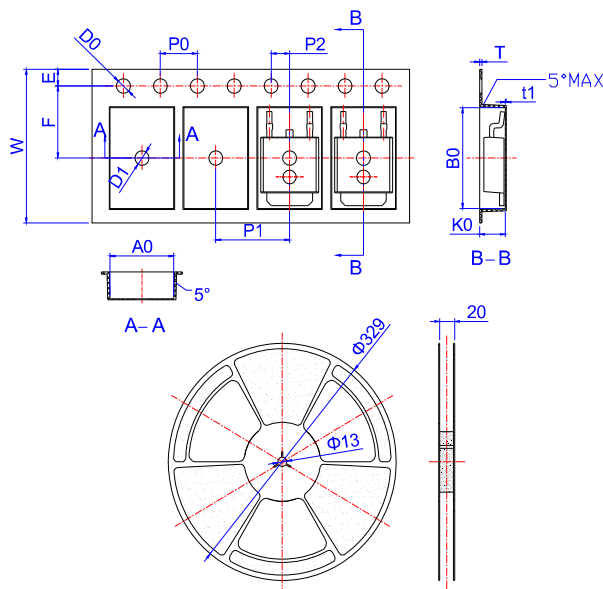
**N-Channel Power MOSFET**

**Package Mechanical Data-TO-252**



| 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-TO-252**



| 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 |