# PDFN 3333 Plastic-Encapsulate MOSFETS 7404

## N-Channel Enhancement Mode Power MOSFET

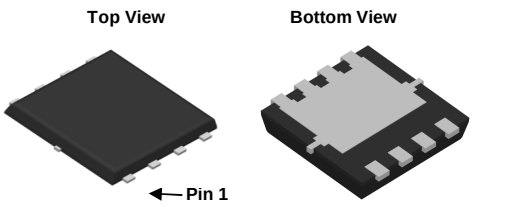
### Features

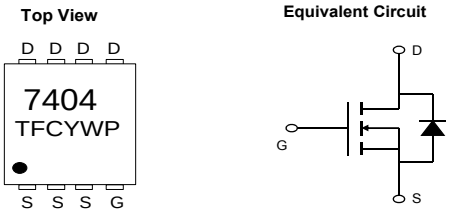
- 20V/40A,
  $R_{DS(ON)}$=3.4mΩ(Typ.)@$V_{GS}$=10V
  $R_{DS(ON)}$=4.5mΩ(Typ.)@$V_{GS}$=4.5V
- Super High Dense Cell Design
- Fast Switching Speed
- Low gate Charge
- 100% avalanche tested
- Lead Free and Green Devices Available

### Applications

- Switching Application Systems

DFN 3x3_EP




Y :year code W :week code

## Absolute Maximum Ratings

| Symbol | Parameter | | Rating | Unit |
|---|---|---|---|---|
| **Common Ratings** ($T_C$=25°C Unless Otherwise Noted) | | | | |
| $V_{DSS}$ | Drain-Source Voltage | | 20 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±12 | |
| $T_J$ | Maximum Junction Temperature | | 150 | °C |
| $T_{STG}$ | Storage Temperature Range | | -55 to 150 | °C |
| $I_S$ | Diode Continuous Forward Current | $T_C$=25°C | 30 | A |
| **Mounted on Large Heat Sink** | | | | |
| $I_{DP}$ ① | 300μs Pulse Drain Current Tested | $T_C$=25°C | 130 | A |
| $I_D$ ② | Continuous Drain Current@$T_C$($V_{GS}$=10V) | $T_C$=25°C | 40 | A |
| | Continuous Drain Current@$T_A$($V_{GS}$=10V) ③ | $T_A$=25°C | 20 | |
| $P_D$ | Maximum Power Dissipation@$T_C$ | $T_C$=25°C | 35 | W |
| | Maximum Power Dissipation@$T_A$ ③ | $T_A$=25°C | 3.1 | |

Notes:

①Pulse width limited by safe operating area.
②Calculated continuous current based on maximum allowable junction temperature.
③When mounted on 1 inch square copper board, t≤10sec.
④Limited by $T_{Jmax}$, $I_{AS}$ =13A, $V_{DD}$ = 18V, $R_G$ = 50Ω, Starting $T_J$ = 25°C.
⑤Pulse test;Pulse width≤300μs, duty cycle≤2%.
⑥Guaranteed by design, not subject to production testing.

| Symbol | Parameter | Rating | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance-Junction to Case | 4.2 | °C/W |
| $R_{\theta JA}$ ③ | Thermal Resistance-Junction to Ambient | 35 | °C/W |
| **Drain-Source Avalanche Ratings** | | | |
| $E_{AS}$ ④ | Avalanche Energy, Single Pulsed | 42 | mJ |

## Electrical Characteristics ($T_C$=25°C Unless Otherwise Noted)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V, $I_{DS}$=250μA | 20 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=20V, $V_{GS}$=0V | | | 1 | μA |
| | | $T_J$=125°C | | | 30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_{DS}$=250μA | 1.1 | 1.35 | 2.0 | V |
| $I_{GSS}$ | Gate Leakage Current | $V_{GS}$=±12V, $V_{DS}$=0V | | | ±100 | nA |
| $R_{DS(ON)}$ ⑤ | Drain-Source On-state Resistance | $V_{GS}$=10V, $I_{DS}$=20A | | 3.40 | 4.50 | mΩ |
| | | $V_{GS}$=4.5V, $I_{DS}$=20A | | 4.50 | 5.90 | mΩ |
| **Diode Characteristics** | | | | | | |
| $V_{SD}$ ⑤ | Diode Forward Voltage | $I_{SD}$=20A, $V_{GS}$=0V | | | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$=20A, $dI_{SD}/dt$=100A/μs | | 17 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 38 | | nC |
| **Dynamic Characteristics** ⑥ | | | | | | |
| $R_G$ | Gate Resistance | $V_{GS}$=0V,$V_{DS}$=0V,F=1MHz | | 1.2 | | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=10V, Frequency=1.0MHz | | 3308 | | pF |
| $C_{oss}$ | Output Capacitance | | | 521 | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 350 | | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}$=10V, $R_L$=0.75Ω, $I_{DS}$=20A, $V_{GEN}$=10V, $R_G$=3Ω | | 8 | | ns |
| $t_r$ | Turn-on Rise Time | | | 9 | | |
| $t_{d(OFF)}$ | Turn-off Delay Time | | | 69 | | |
| $t_f$ | Turn-off Fall Time | | | 16 | | |
| **Gate Charge Characteristics** ⑥ | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$=10V, $V_{GS}$=10V, $I_{DS}$=20A | | 35 | | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 7 | | |
| $Q_{gd}$ | Gate-Drain Charge | | | 12.9 | | |

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

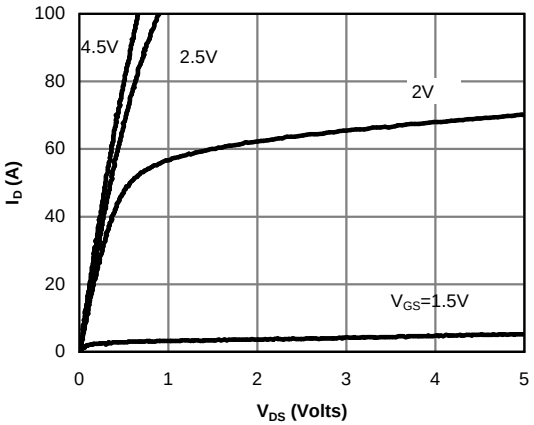



Fig 1: On-Region Characteristics (Note E)

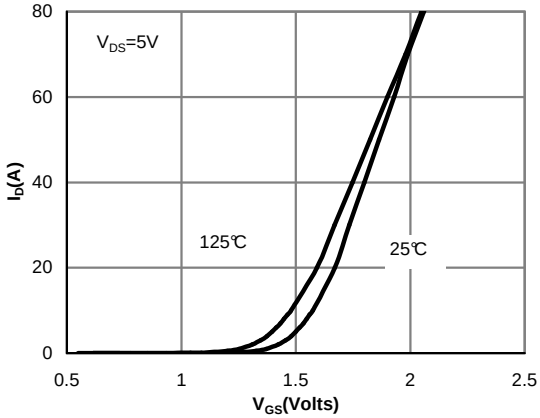



Figure 2: Transfer Characteristics (Note E)

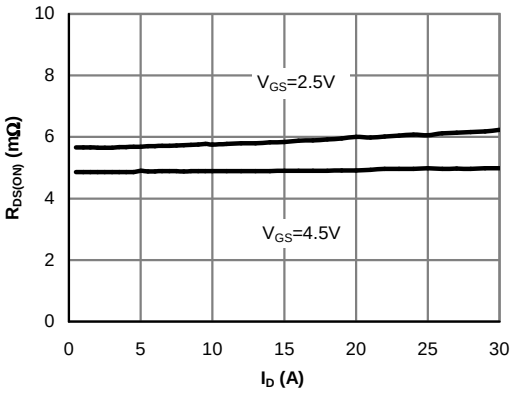



Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

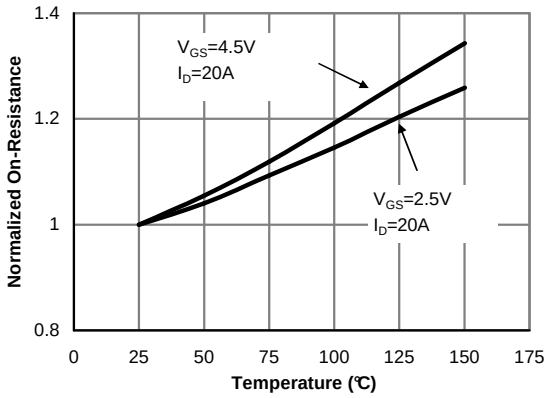



Figure 4: On-Resistance vs. Junction Temperature (Note E)

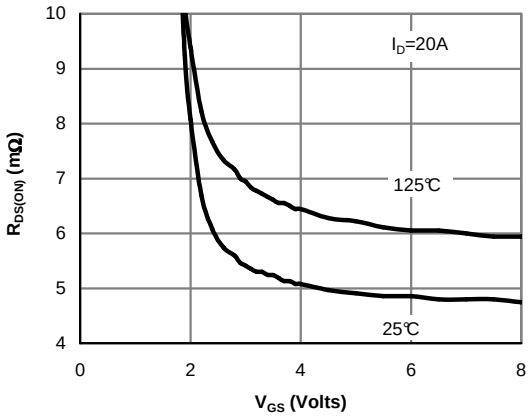



Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

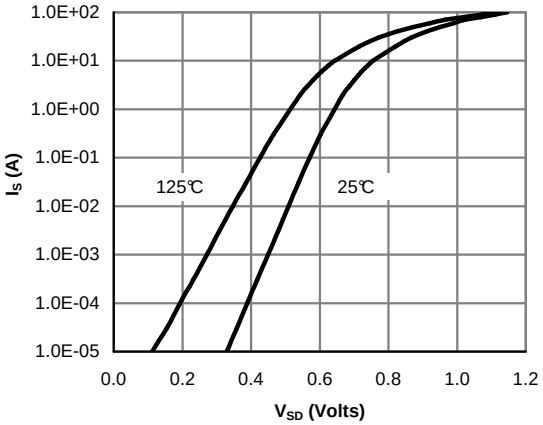



Figure 6: Body-Diode Characteristics (Note E)

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

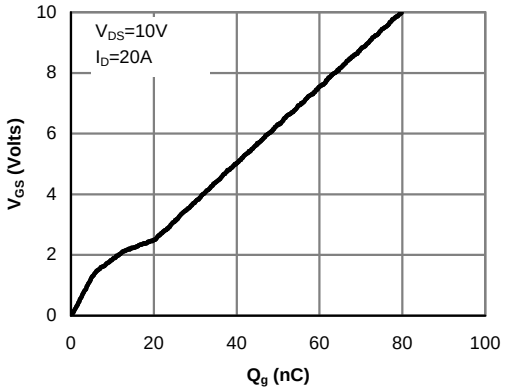



Figure 7: Gate-Charge Characteristics

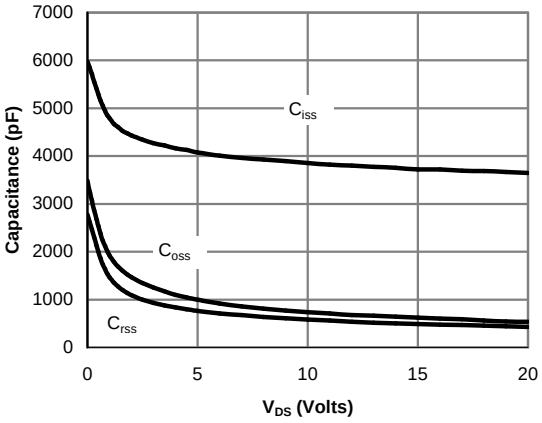



Figure 8: Capacitance Characteristics

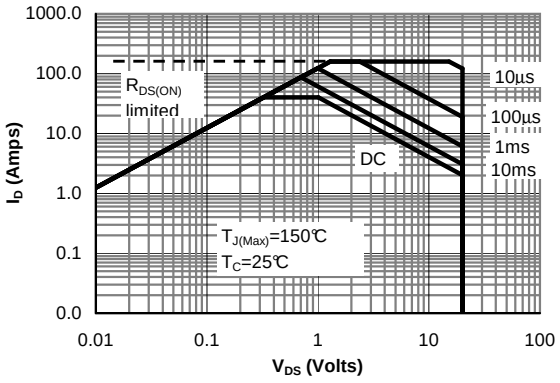



Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

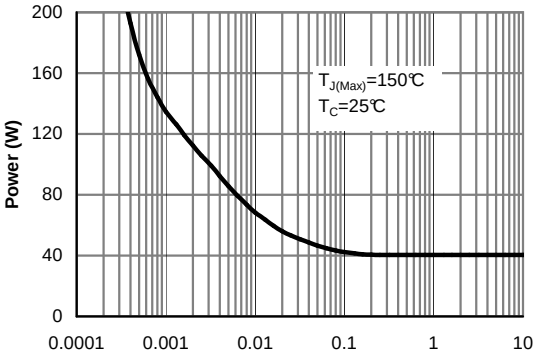



Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

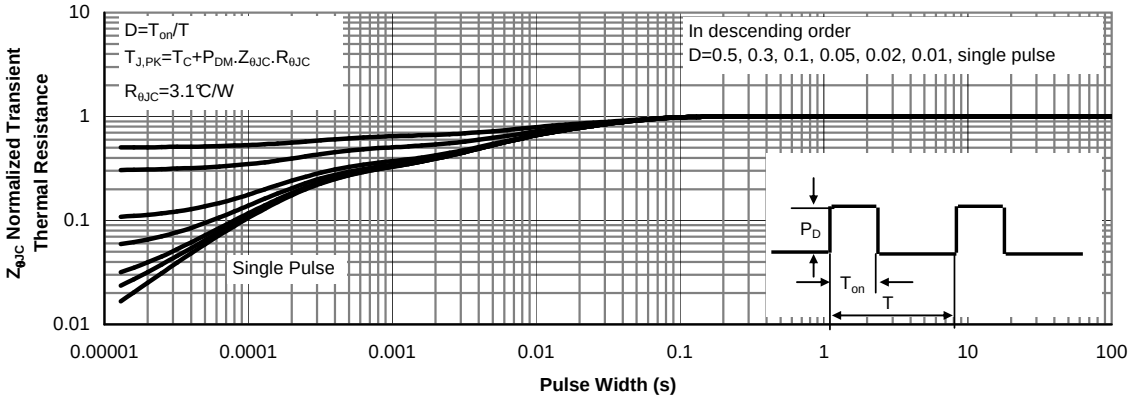



Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

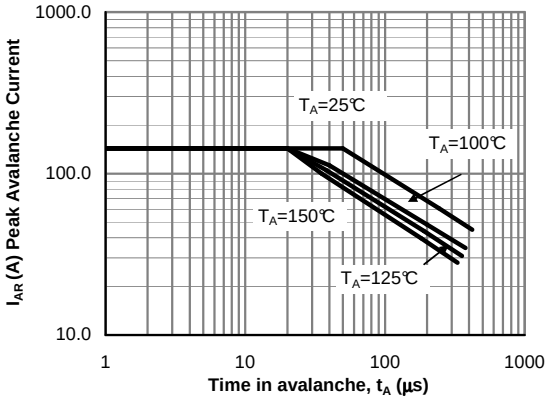



Figure 12: Single Pulse Avalanche capability (Note C)

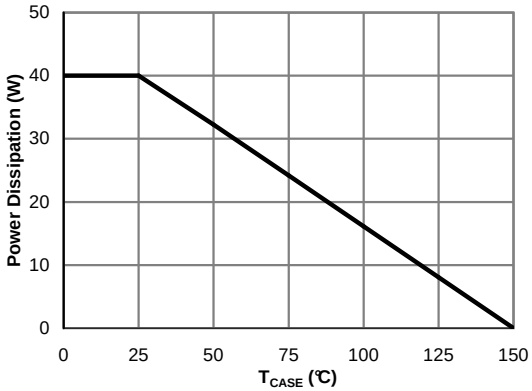



Figure 13: Power De-rating (Note F)

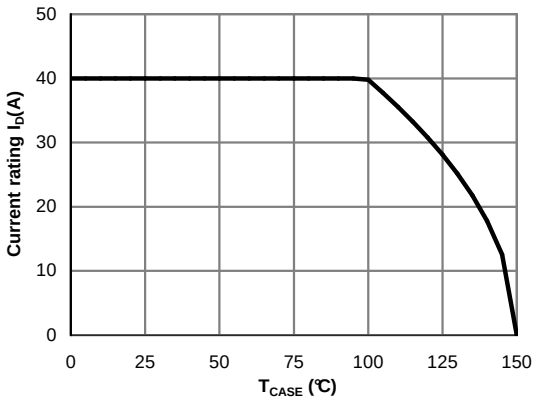



Figure 14: Current De-rating (Note F)

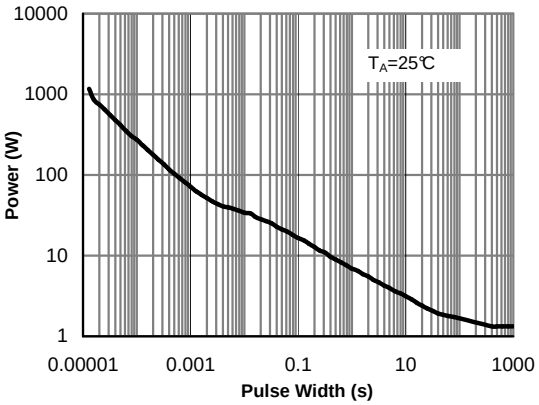



Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note H)

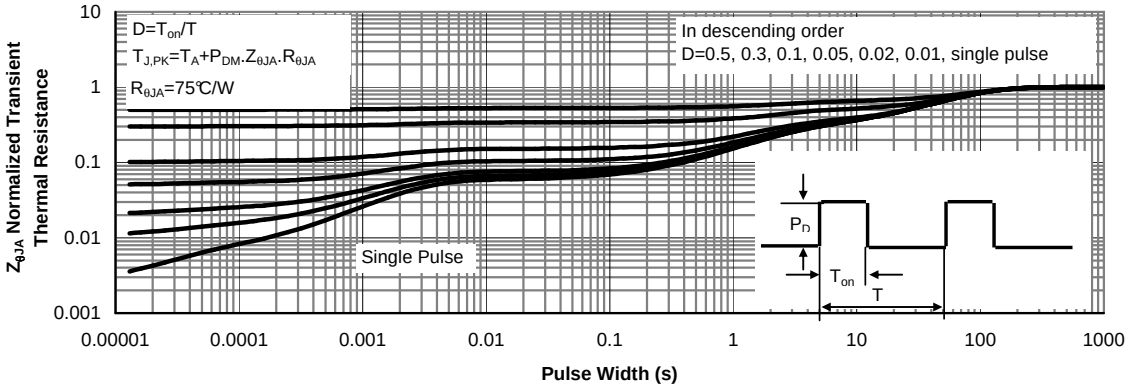
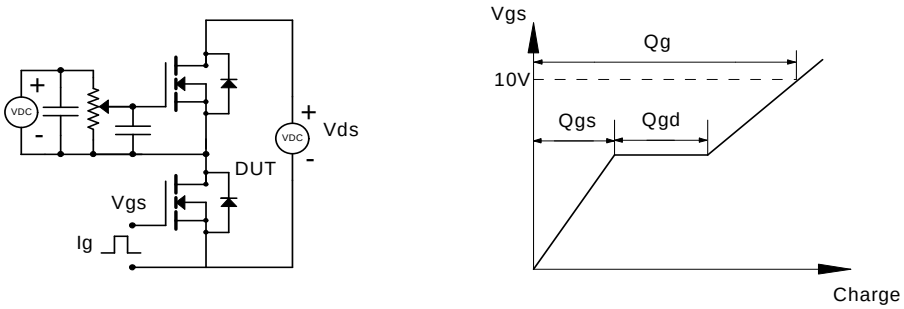
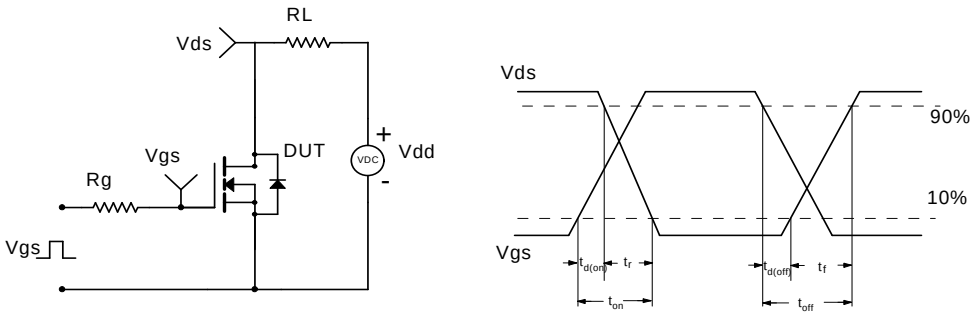



Figure 16: Normalized Maximum Transient Thermal Impedance (Note H)

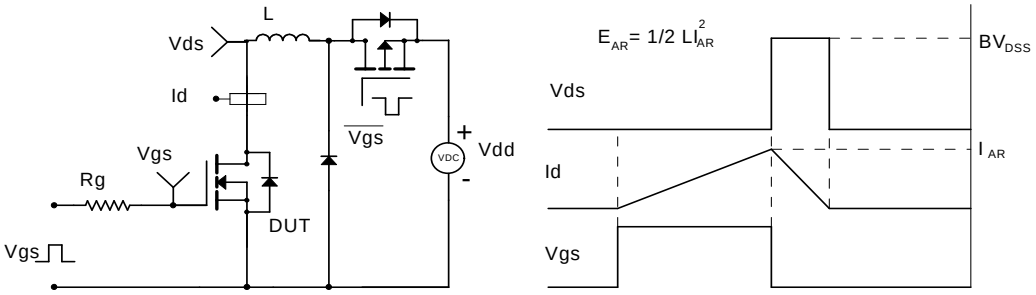
Gate Charge Test Circuit & Waveform



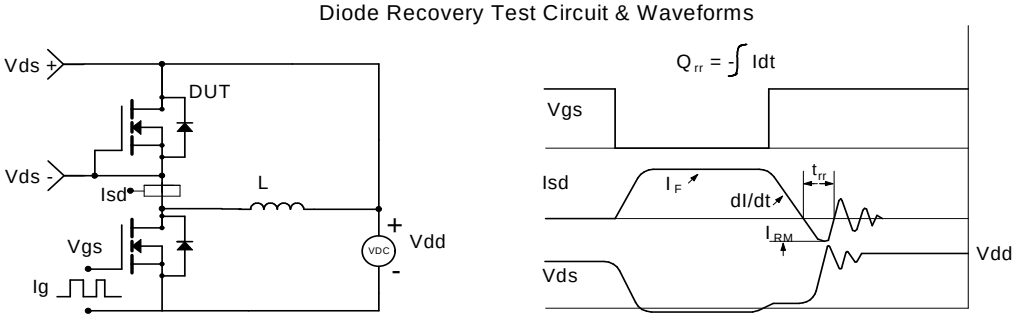

Resistive Switching Test Circuit & Waveforms




Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

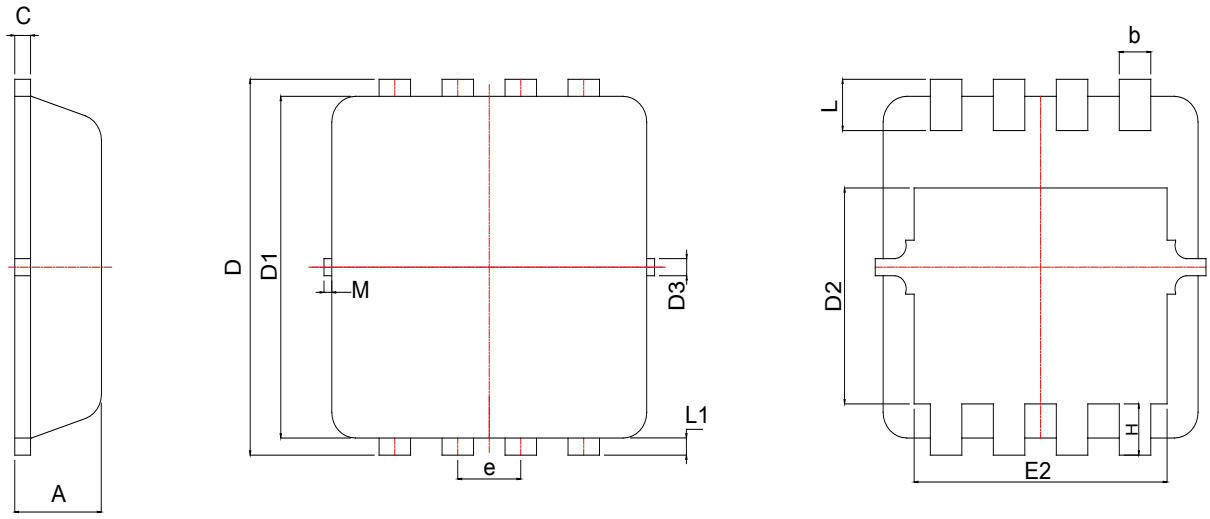


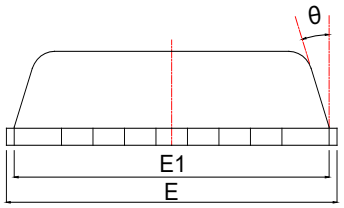

Diode Recovery Test Circuit & Waveforms

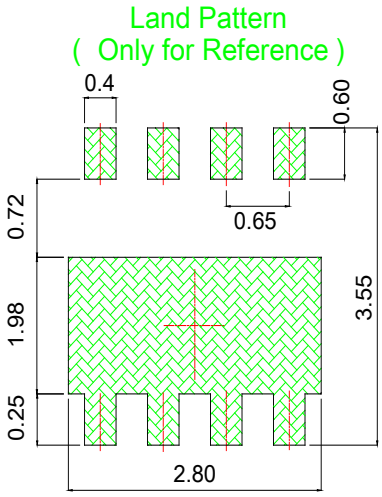


## Package Information

PDFN3333




| SYMBOL | MM | | | INCH | | | SYMBOL | MM | | | INCH | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MIN | NOM | MAX | MIN | NOM | MAX | | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.70 | 0.75 | 0.80 | 0.028 | 0.030 | 0.031 | E1 | 3.00 | 3.15 | 3.20 | 0.118 | 0.122 | 0.126 |
| b | 0.25 | 0.30 | 0.35 | 0.010 | 0.012 | 0.014 | E2 | 2.39 | 2.49 | 2.59 | 0.094 | 0.098 | 0.102 |
| c | 0.10 | 0.15 | 0.25 | 0.004 | 0.007 | 0.010 | e | 0.65BSC | | | 0.026BSC | | |
| D | 3.25 | 3.35 | 3.45 | 0.128 | 0.132 | 0.136 | H | 0.30 | 0.40 | 0.50 | 0.012 | 0.016 | 0.020 |
| D1 | 3.00 | 3.10 | 3.20 | 0.118 | 0.122 | 0.126 | L | 0.30 | 0.40 | 0.50 | 0.012 | 0.016 | 0.020 |
| D2 | 1.78 | 1.88 | 1.98 | 0.070 | 0.074 | 0.078 | L1 | * | 0.13 | * | * | 0.005 | * |
| D3 | * | 0.13 | * | * | 0.005 | * | θ | * | 10° | 12° | * | 10° | 12° |
| E | 3.20 | 3.30 | 3.40 | 0.126 | 0.130 | 0.134 | M | * | * | 0.15 | * | * | 0.006 |