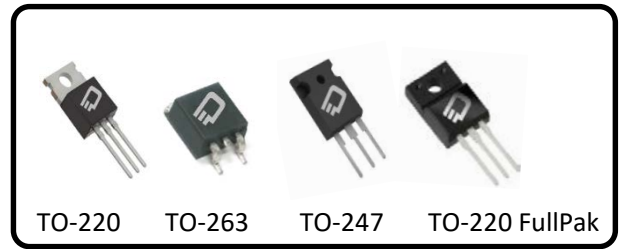


650V, 110mΩ, 32.6 A Super Junction Power MOSFET

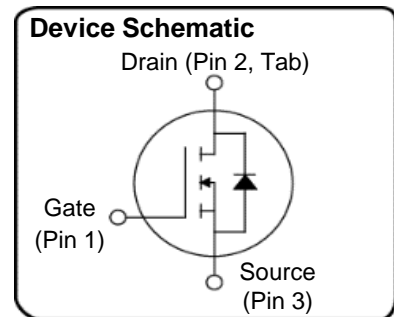
Ordering Information

| Part Number | Package Option |
|--------------|----------------|
| D3S110N65B-U | TO-220 |
| D3S110N65D-U | TO-247 |
| D3S110N65E-T | TO-263 |
| D3S110N65F-U | TO-220 FullPak |



Description

+FET™ is an advanced Super Junction Power MOSFET offering excellent efficiency through low $R_{DS(ON)}$ and low gate charge. +FET™ is a rugged device with precision charge balance implementation designed for demanding uses such as enterprise power computing power supplies, motor control, lighting and other challenging power conversion applications.



Features

- LOW $R_{DS(ON)}$
- FAST SWITCHING
- HIGH E_{AS}
- REL TEST SPEC: JESD-22
- HTRB >3000 HRS

Benefits

- LOW CONDUCTION LOSSES
- HIGH EFFICIENCY
- EXCELLENT AVALANCHE PERFORMANCE

Table 1 Key Performance Parameters

| Parameters | Value | Unit |
|-----------------------|-------|------|
| $V_{DS} @ T_{J \max}$ | 710 | V |
| $R_{DS(on),max}$ | <99 | mΩ |
| Q_g, typ | 56 | nC |
| $I_D @ 25C$ | 32.6 | A |
| Output Capacitance | 72 | pf |

Applications

- POWER FACTOR CORRECTION
- SERVER POWER SUPPLIES
- TELECOM POWER SUPPLIES
- INVERTERS
- MOTOR CONTROL

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| Electrical characteristics diagrams----- | 6 |
| Test Circuit & Waveform----- | 10 |
| Revision----- | 17 |

@ $T_J = 25^\circ\text{C}$, unless otherwise specified

Table 2 Maximum ratings

| Parameter | Symbol | Values | | | | Unit | Note/Test Condition |
|-----------------------------------|----------------|--------|------|----------------|-------|------------------|--|
| | | Min. | Typ. | Max | | | |
| | | | | 220, 263 & 247 | 220FP | | |
| Continuous drain current(1) | I_D | | | 32.6 | 15.5 | A | $T_C = 25^\circ\text{C}$ |
| | | | | 20.6 | 9.8 | | $T_C = 100^\circ\text{C}$ |
| Pulsed drain current(2) | $I_{D,pulse}$ | | | 131 | 61.9 | A | $T_C = 25^\circ\text{C}$ |
| Avalanche energy, single pulse | E_{AS} | | | 520 | 520 | mJ | $I_D=6.6\text{A}, V_{DD}=50\text{V}$ |
| Avalanche energy, repetitive | E_{AR} | | | 1.3 | 1.3 | mJ | $I_D=6.6\text{A}, V_{DD}=50\text{V}$ |
| Avalanche current, repetitive | I_{AR} | | | 6.6 | 6.6 | A | |
| MOSFET dv/dt ruggedness | dv/dt | | | 50 | 50 | V/ns | $V_{DS}=\dots 480\text{V}$ |
| Gate source voltage | V_{GS} | -30 | | 30 | 30 | V | static |
| | | -30 | | 30 | 30 | | AC (f > 1HZ) |
| Power dissipation for TO-220 | P_{tot} | | | 272 | 61 | W | $T_C = 25^\circ\text{C}$ |
| Operating and storage temperature | T_J, T_{stg} | -55 | | 150 | 150 | $^\circ\text{C}$ | |
| Mounting torque | | | | 60 | | Ncm | M3 and M3.5 screws |
| | | | | | 50 | | M3 screws |
| Continuous diode forward current | I_S | | | 32.6 | 15.5 | A | $T_C = 25^\circ\text{C}$ |
| Diode pulsed current | $I_{S,pulse}$ | | | 131 | 61.9 | A | $T_C = 25^\circ\text{C}$ |
| Reverse diode dv/dt(3) | dv/dt | | | 15 | 15 | V/ns | $V_{DS}=\dots 480\text{V}, I_{SD}<I_D$ $T_J = 25^\circ\text{C}$ |
| Maximum diode commutation speed | dif/dt | | | 500 | 500 | A/us | |

Table 3 Thermal characteristics

| Parameter | Symbol | Values | | | | Unit | Note/Test Condition |
|--|------------|--------|------|----------------|-------|---------------------------|-------------------------|
| | | Min. | Typ. | Max | | | |
| | | | | 220, 263 & 247 | 220FP | | |
| Thermal resistance, Junction-case | R_{thJC} | | | 0.5 | 2.25 | $^\circ\text{C}/\text{W}$ | |
| Thermal resistance, Junction-ambient | R_{thJA} | | | 43.4 | 46 | $^\circ\text{C}/\text{W}$ | Leaded |
| Soldering temperature, wavesoldering only allowed at leads | T_{sold} | | | 260 | 260 | $^\circ\text{C}$ | 1.6mm form case for 10s |

Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note/Test Condition |
|-----------------------------------|---------------|--------|------|------|------------|---|
| | | Min. | Typ. | Max. | | |
| Drain to source breakdown voltage | $V_{(BR)DSS}$ | 650 | | | V | $V_{GS}=0V, I_D=1mA$ |
| Gate threshold voltage | $V_{GS(TH)}$ | 2.3 | 3.2 | 4.5 | V | $V_{DS}=V_{GS}, I_D=194\mu A$ |
| Zero gate voltage drain current | I_{DSS} | | | 1 | uA | $V_{DS}=650V, V_{GS}=0V, T_J = 25^\circ C$ |
| | | | | 40 | | $V_{DS}=650V, V_{GS}=0V, T_J = 150^\circ C$ |
| Gate to source leakage current | I_{GSS} | | | 100 | nA | $V_{GS}=\pm 20V, V_{DS}=0V$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | | 100 | 110 | m Ω | $V_{GS}=10V, I_D=16.8A, T_J = 25^\circ C$ |
| | | | 255 | | m Ω | $V_{GS}=10V, I_D=16.8A, T_J = 150^\circ C$ |
| Gate resistance | R_G | | 1 | | Ω | Scaf-F |

Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note/Test Condition |
|--|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | C_{iss} | | 2222 | | pF | $V_{GS}=0V, V_{DS}=100V, f=1MHz$ |
| Output capacitance | C_{oss} | | 72 | | pF | |
| Reverse transfer capacitance | C_{rss} | | 13 | | pF | |
| Effective output capacitance, energy related 1 | $C_{o(er)}$ | | 105 | | pF | $V_{DS}=0\dots 480V, V_{GS}= 0V$ |
| Effective output capacitance, time related 2 | $C_{o(tr)}$ | | 331 | | pF | $I_D=constant, V_{DS}=0\dots 480V, V_{GS}= 0V$ |
| Turn on delay time | $t_{d(on)}$ | | 18 | | ns | $V_{DD}=400V, I_D=16.8A, R_G=1.0\Omega, V_{GS}=10V$ |
| Rising time | t_r | | 25 | | ns | |
| Turn off delay time | $t_{d(off)}$ | | 41 | | ns | |
| Fall time | t_f | | 22 | | ns | |

Table 6 Gate charge characteristics

| Parameter | Symbol | Values | | | Unit | Note/Test Condition |
|----------------------|---------------|--------|------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Total gate charge | Q_g | | 56 | | nC | $V_{DD}=480V, V_{GS}=0 \text{ to } 10V, I_D=16.8A$ |
| Gate-source charge | Q_{gs} | | 14 | | nC | |
| Gate-drain charge | Q_{gd} | | 23 | | nC | |
| Gate plateau voltage | $V_{plateau}$ | | 5.0 | | V | |

Table 7 Reverse diode characteristics

| Parameter | Symbol | Values | | | Unit | Note/Test Condition |
|-------------------------------|-----------|--------|------|------|------|---|
| | | Min | Typ | Max | | |
| Diode forward voltage | V_{SD} | | 0.87 | 0.96 | V | $I_F=33.6A, V_{GS}=0V, T_J = 25^{\circ}C$ |
| Reverse recovery time | t_{rr} | | 452 | | ns | $I_F=33.6A, dI_F/dt=100A/us$ |
| Reverse recovery charge | Q_{rr} | | 8.0 | | uC | |
| Peak reverse recovery current | I_{rrm} | | 36 | | A | |

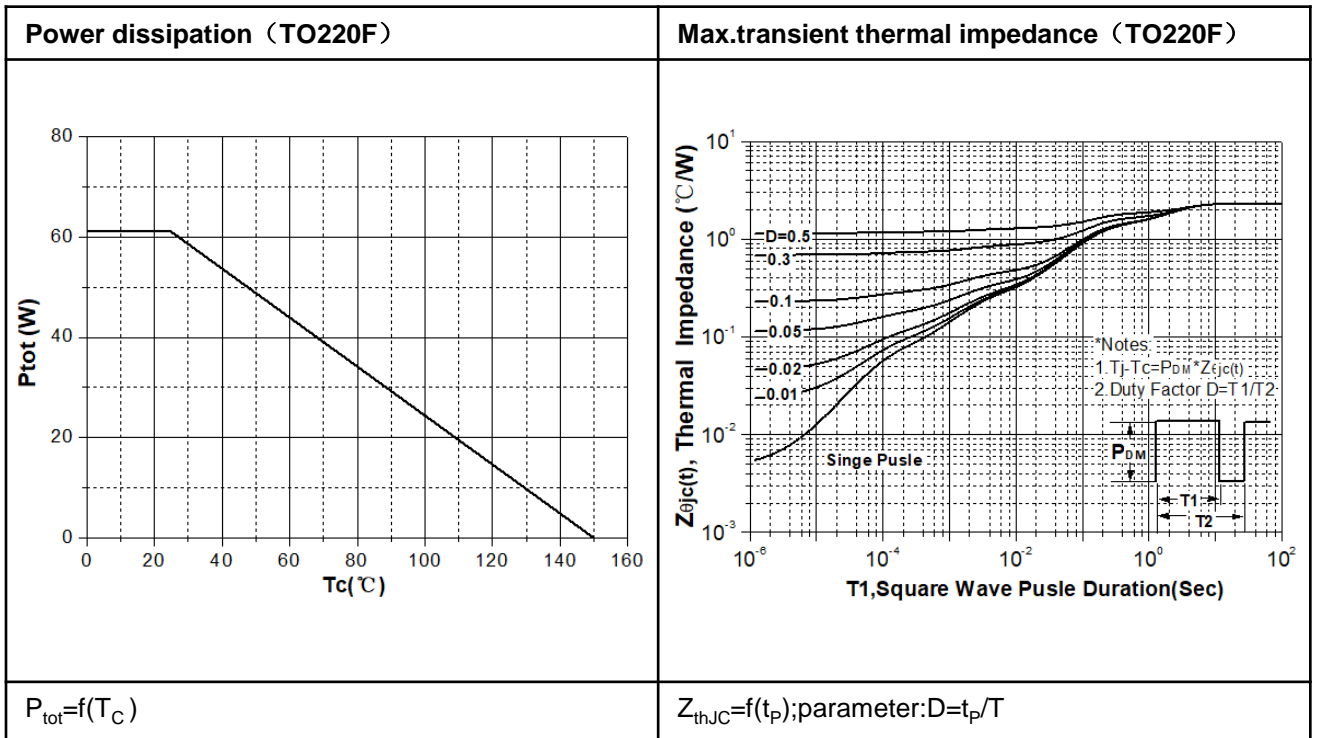
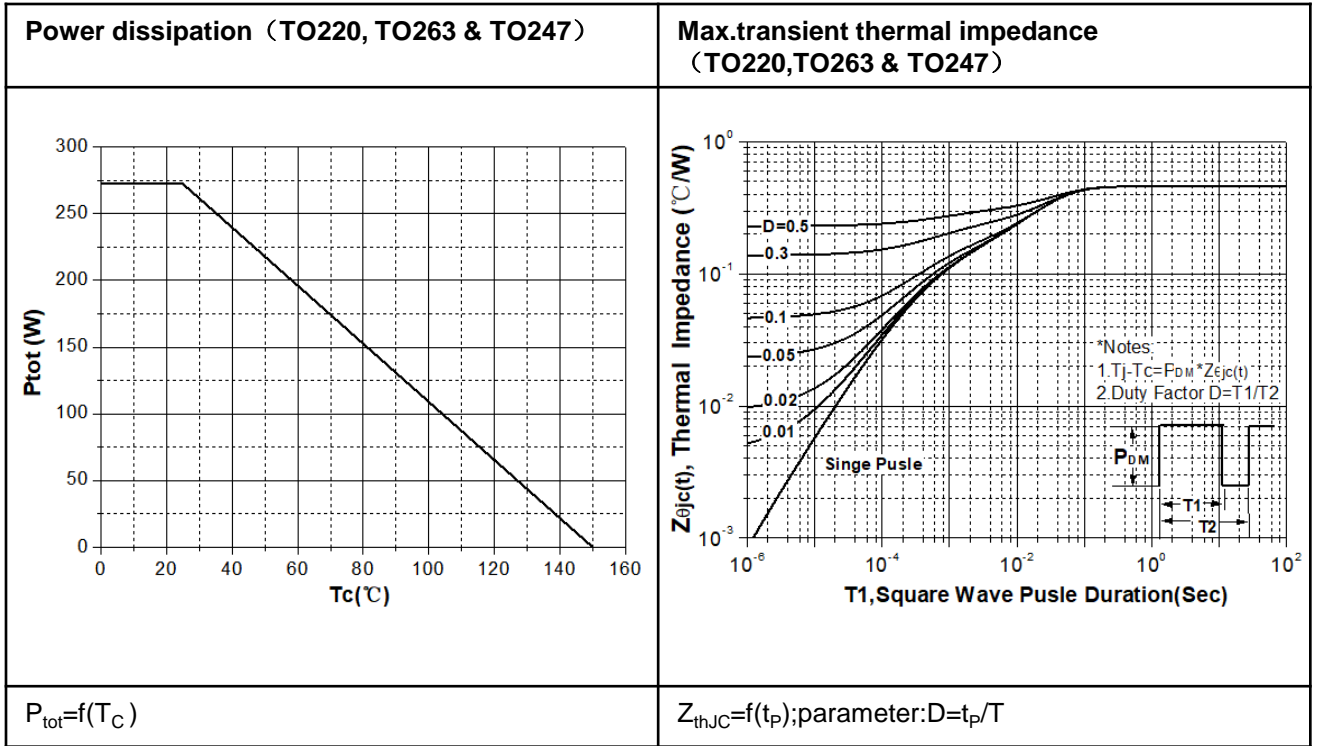
Table 8 Thermal Performance


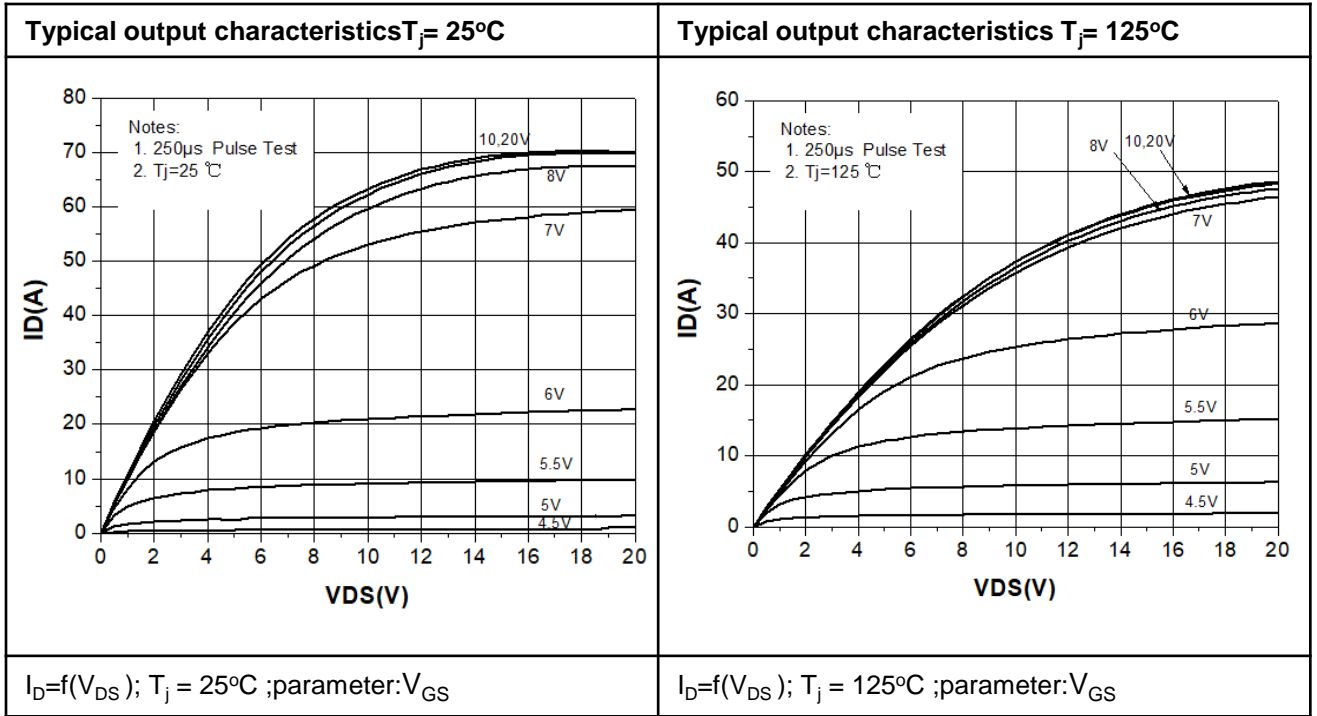
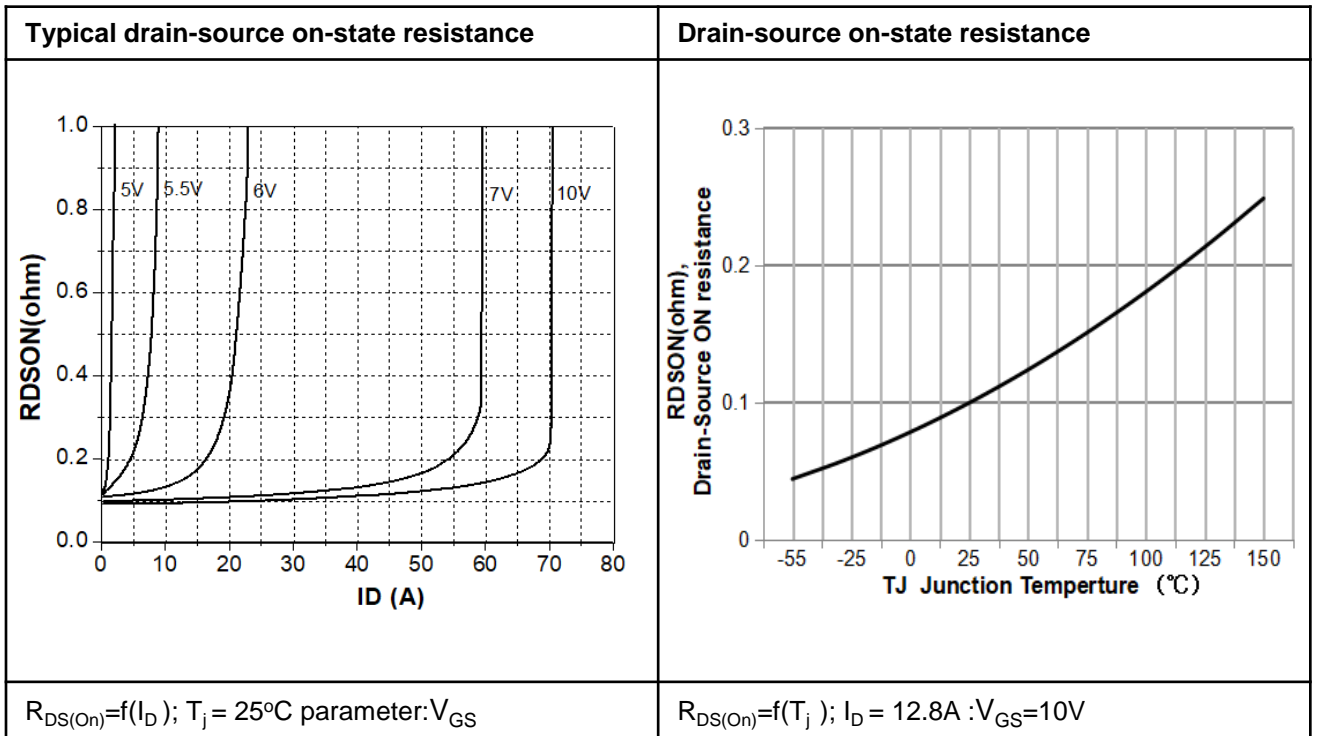
Table 9 Output Characteristics

Table 10 Drain Source Resistance


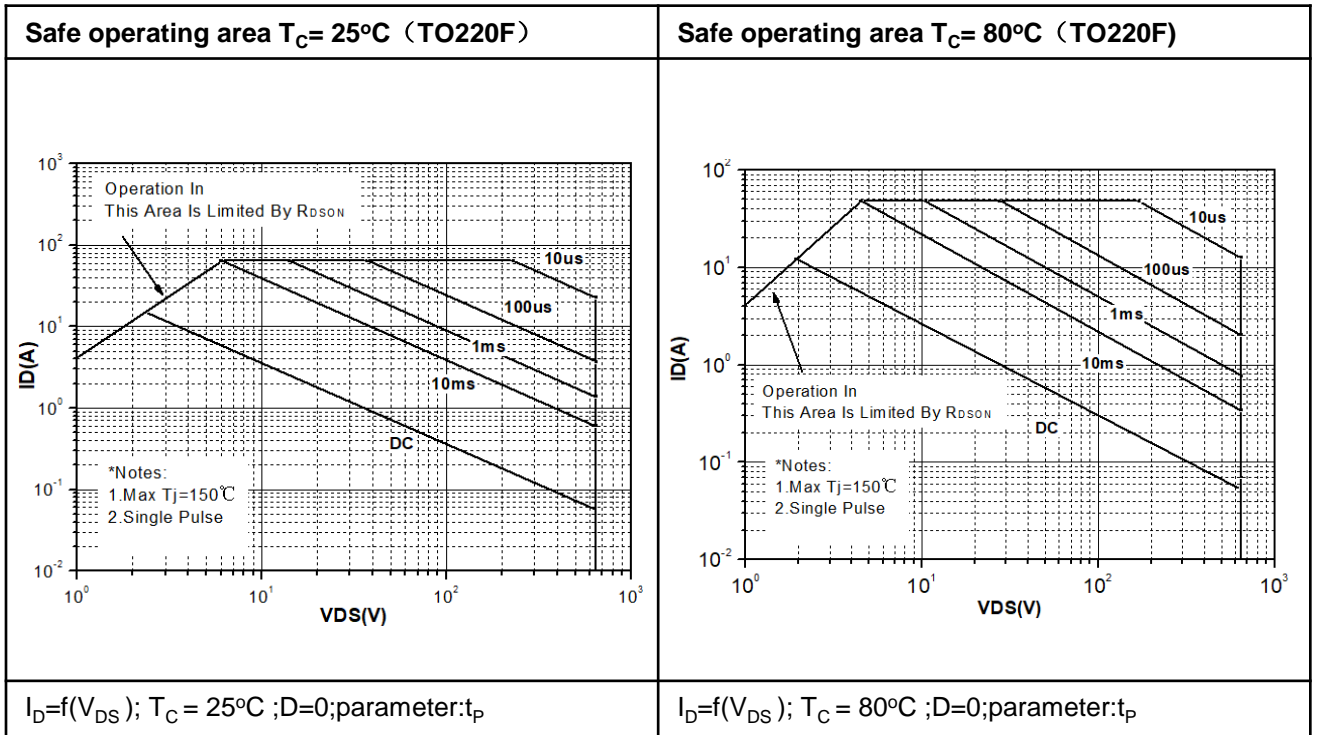
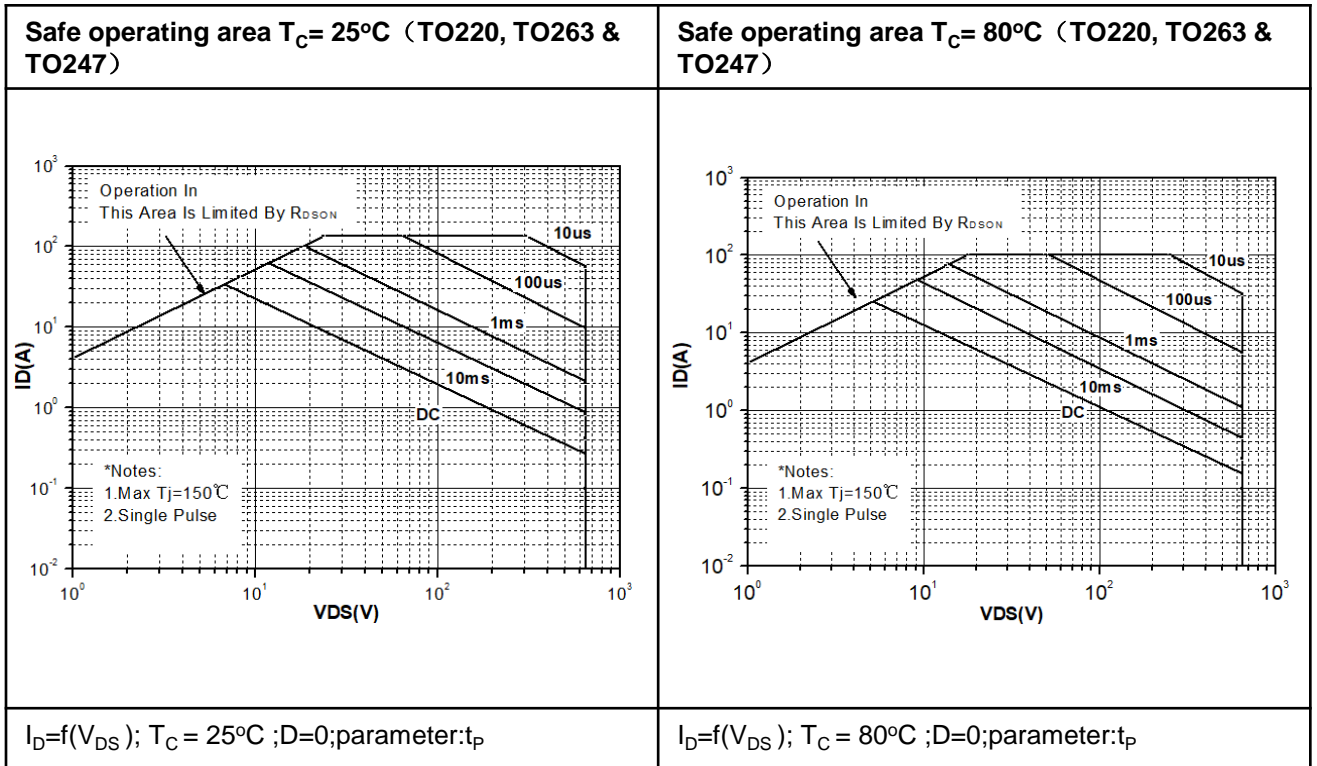
Table 11 Safe Operating Area


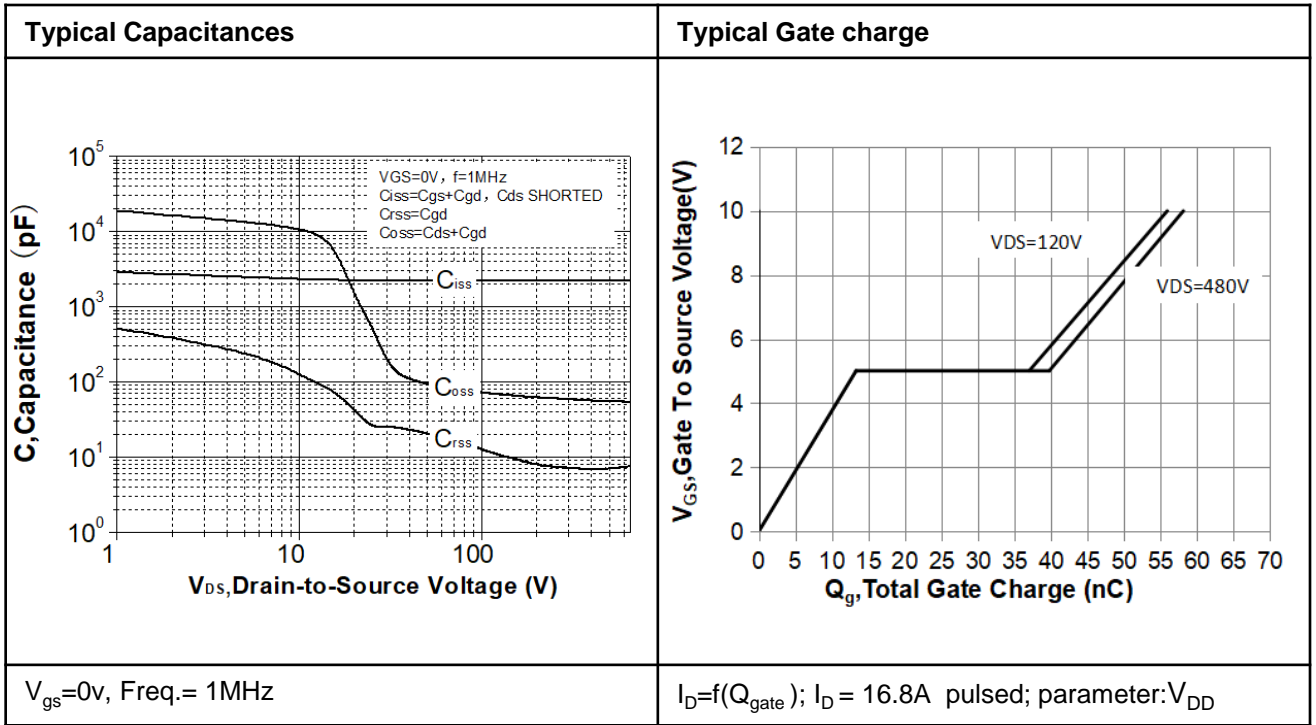
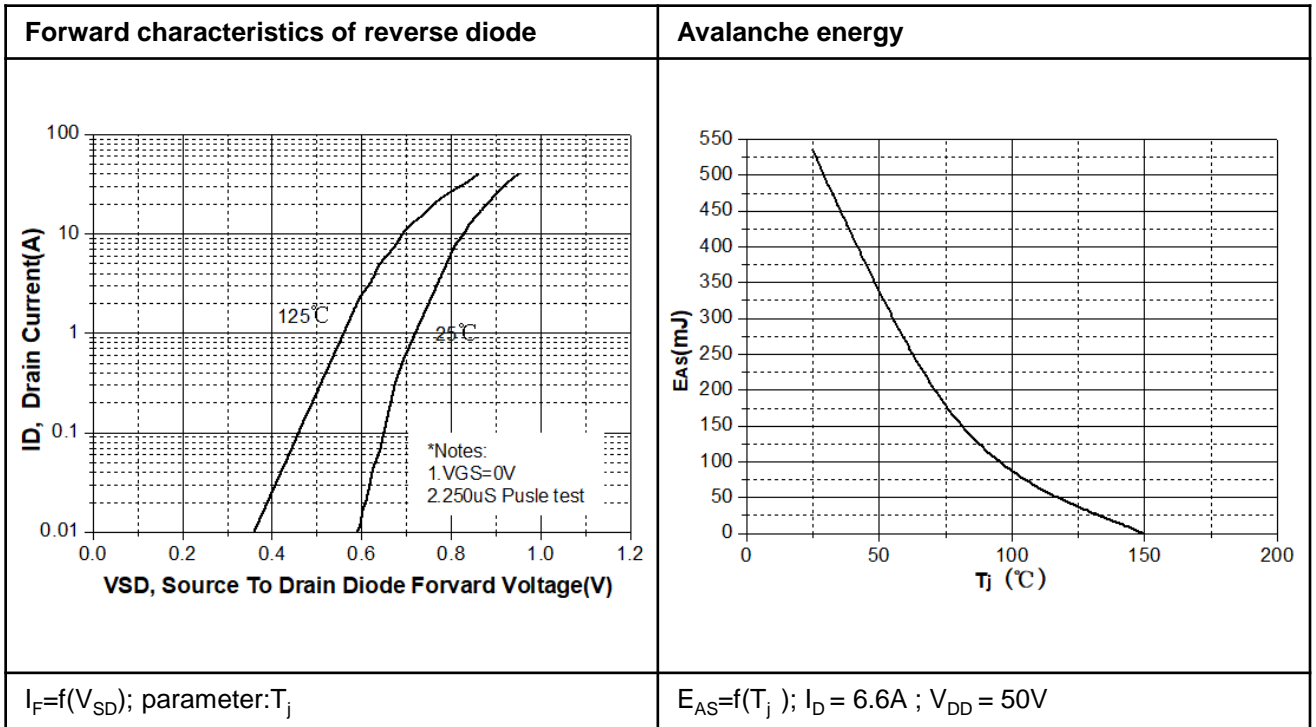
Table 12 Capacitances and Gate Charge

Table 13 Diode Characteristics and Avalanche Energy


Table 14 Breakdown Voltage and Transfer Characteristics

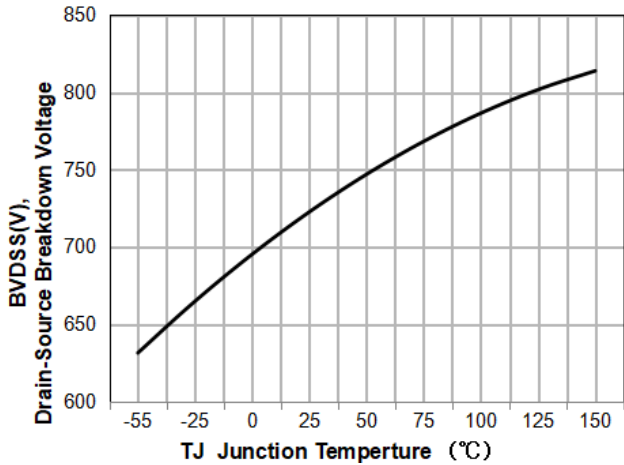
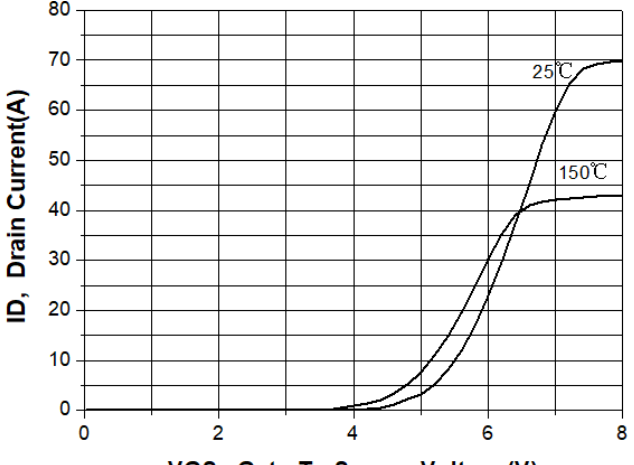
| Drain-source breakdown voltage | Transfer Characteristics |
|---|---|
|  <p>The graph shows the Drain-Source Breakdown Voltage (BV_{DSS}) in Volts (V) on the y-axis (ranging from 600 to 850) versus the TJ Junction Temperature in degrees Celsius (°C) on the x-axis (ranging from -55 to 150). The curve shows a positive correlation, starting at approximately 630V at -55°C and rising to about 815V at 150°C.</p> |  <p>The graph shows the Drain Current (ID) in Amperes (A) on the y-axis (ranging from 0 to 80) versus the Gate-To-Source Voltage (V_{GS}) in Volts (V) on the x-axis (ranging from 0 to 8). Two curves are shown for different temperatures: 25°C and 150°C. The 25°C curve shows a higher drain current for a given gate voltage compared to the 150°C curve, indicating a decrease in transconductance with increasing temperature.</p> |
| $V_{BR(DSS)} = f(T_j); I_D = 1\text{mA}$ | $I_D = f(V_{GS}); V_{DS} > 2 I_D R_{DS(On)max}; \text{parameter: } T_j$ |

Table 15 Diode Recovery Characteristic

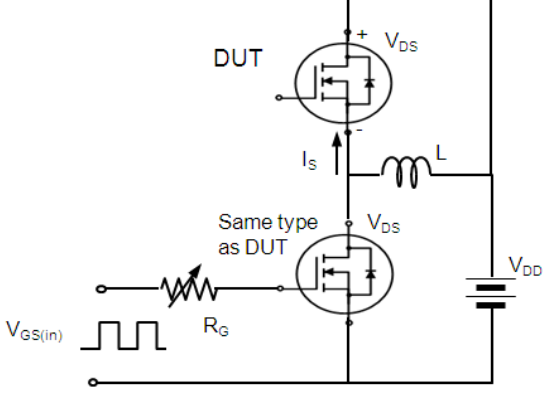
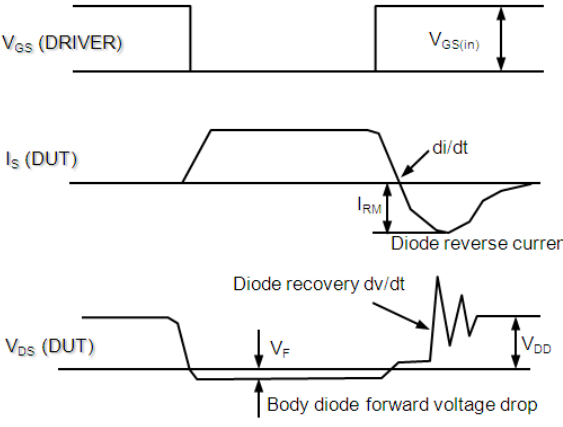
| Test Circuit For Diode Recovery | Test Waveform For Diode Recovery |
|--|--|
|  <p>*. dv/dt controlled by R_G *. I_S controlled by pulse period</p> |  |

Table 16 Switching Time Characteristic

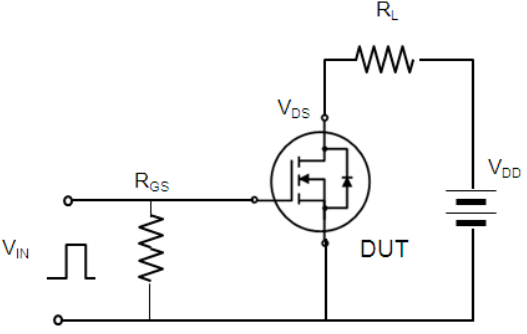
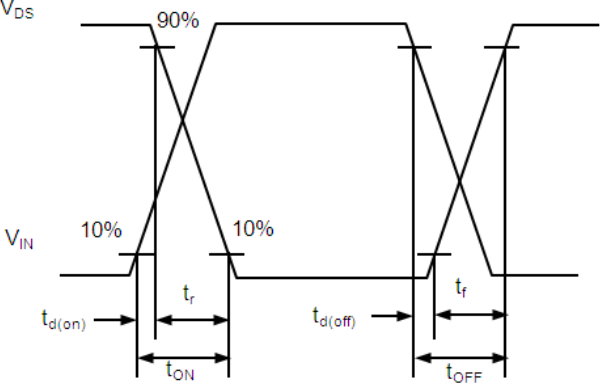
| Test Circuit for Switching Time | Test Waveform for Switching Time |
|---|--|
|  |  |

Table 17 Gate Charge Characteristic

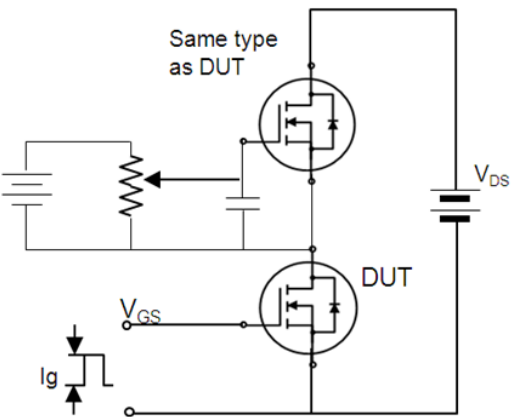
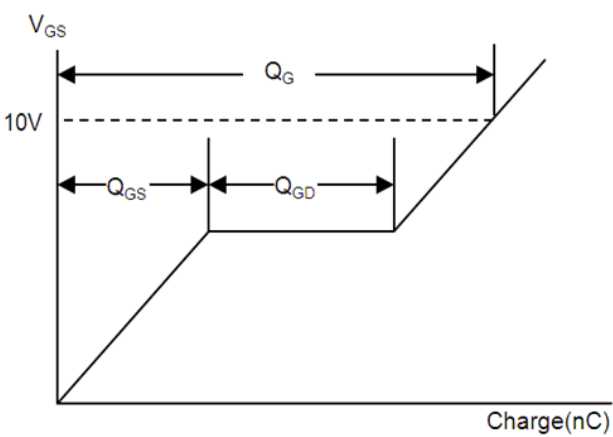
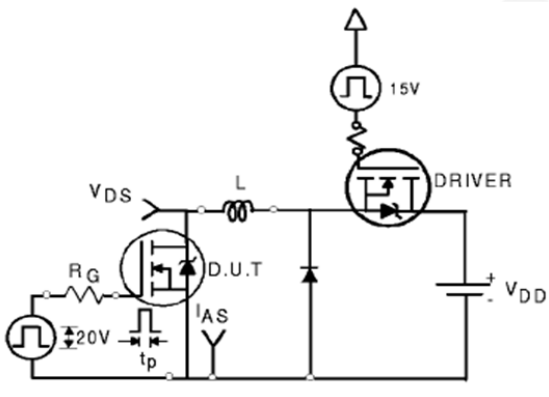
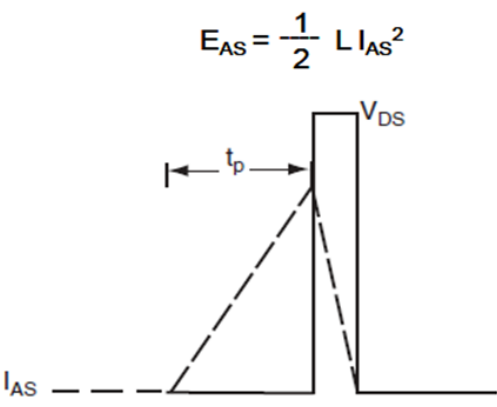
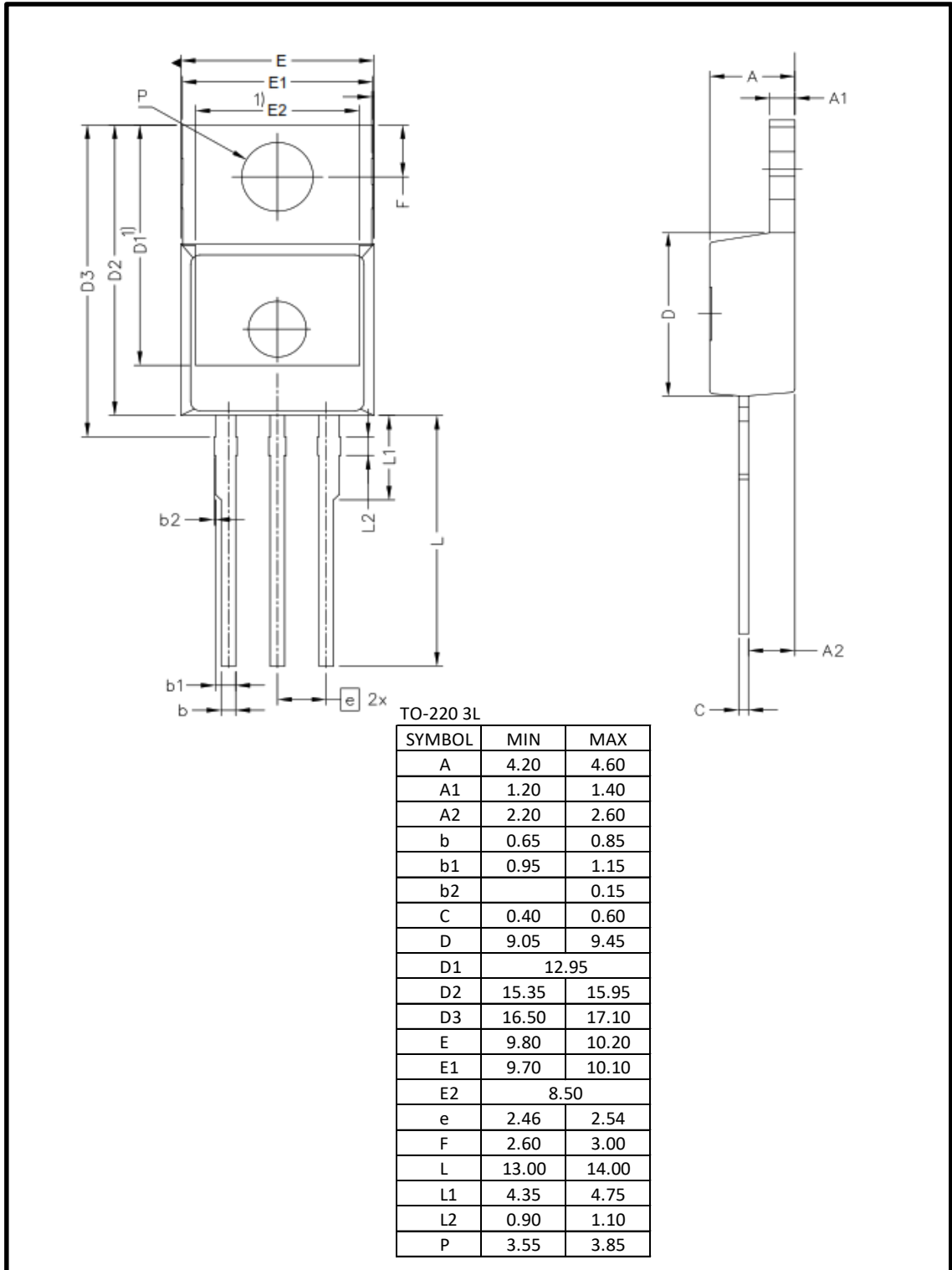
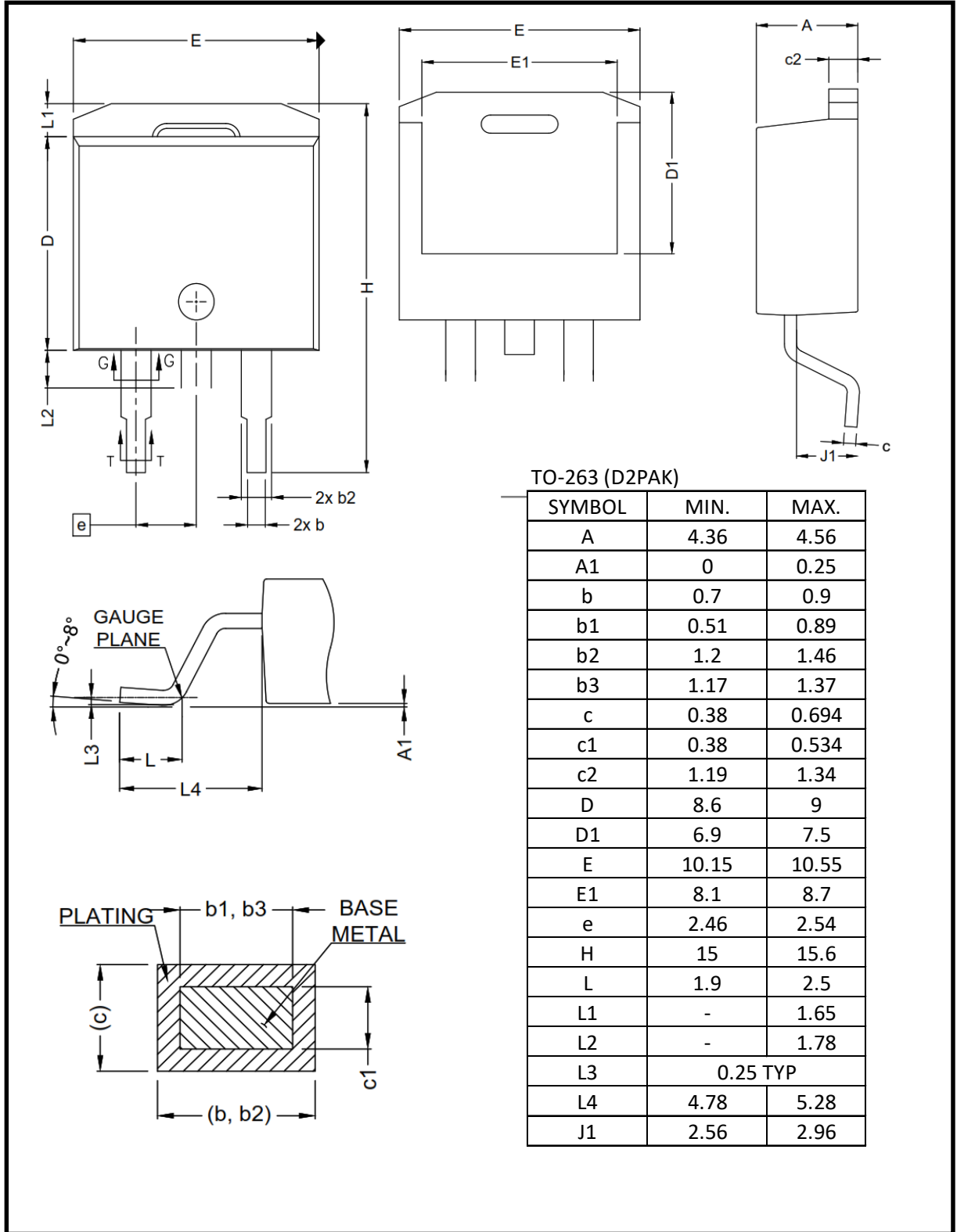
| Test Circuit For Gate Charge | Test Waveform For Gate Charge |
|---|--|
|  |  |

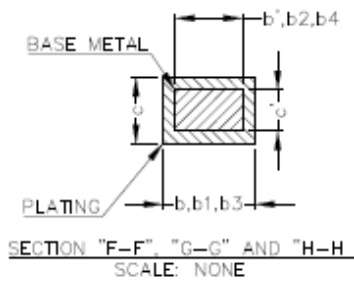
Table 18 Unclamped Inductive Characteristic

| Test Circuit For Unclamped Inductive | Test Waveform For Unclamped Inductive |
|--|--|
|  |  $E_{AS} = \frac{1}{2} L I_{AS}^2$ |

4a) TO-220


4b) TO-263

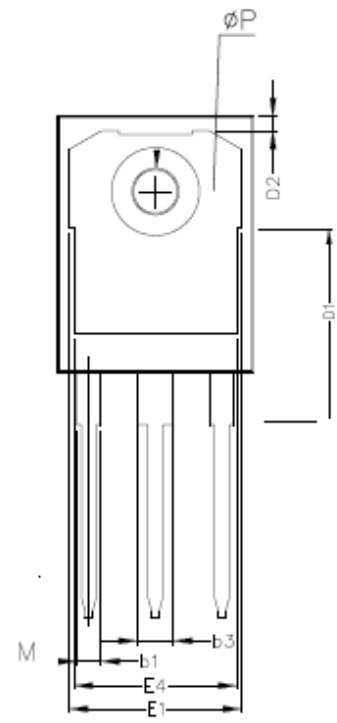
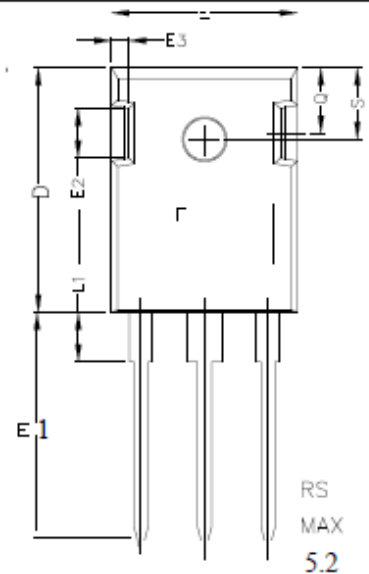
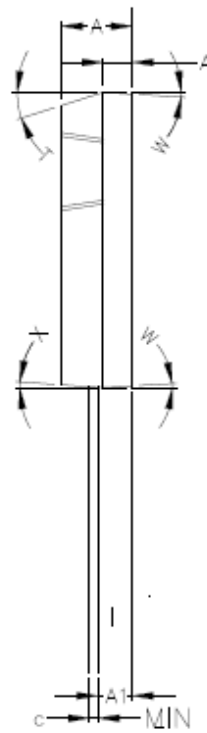


4c) TO-247


1. ALL METAL SURFACES: TIN PLATED, EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCING CONFIRM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
4. THIS DRAWING WILL MEET ALL DIMENSIONS REQUIREMENT OF JEDEC outlines TO-247 AD.

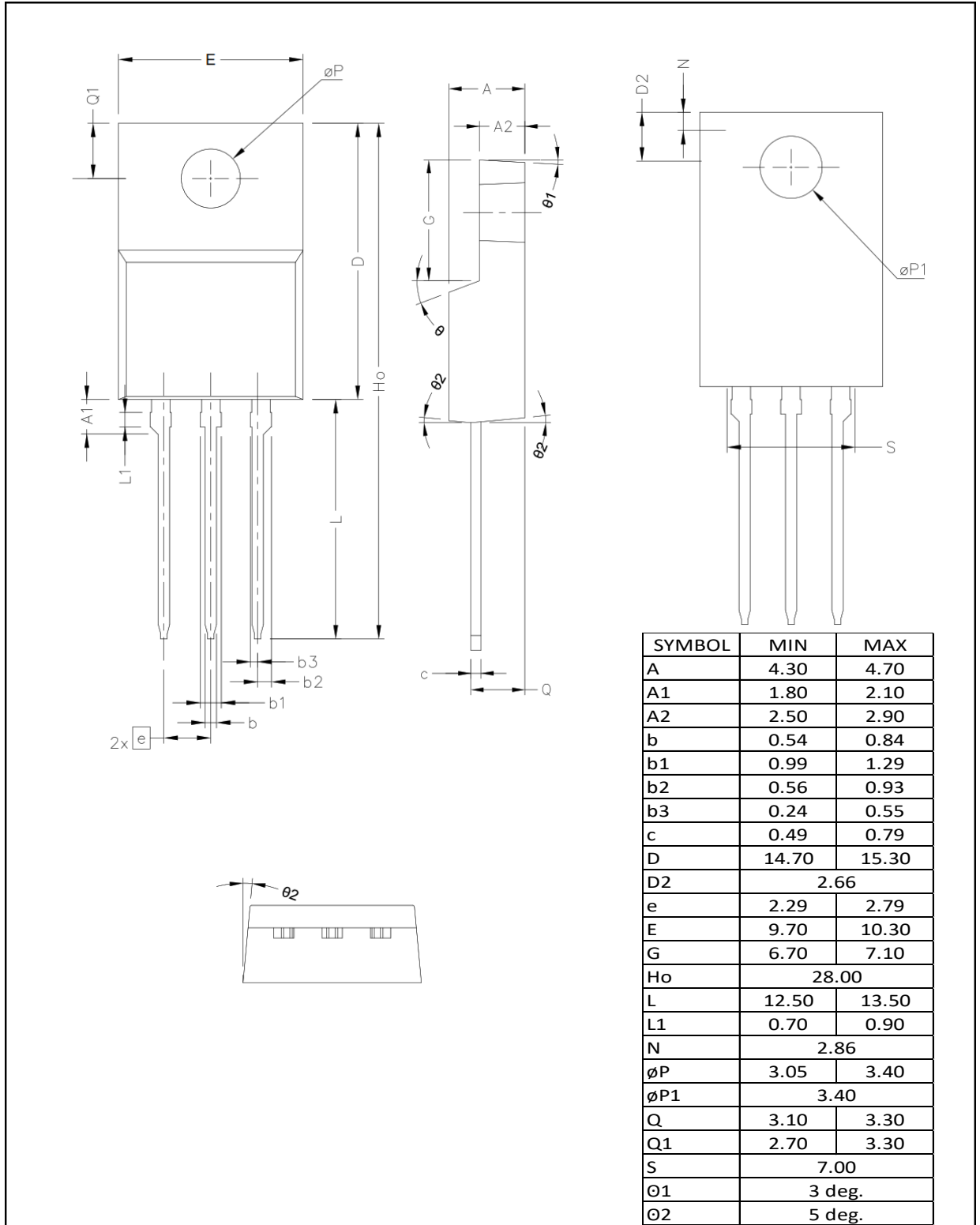
| SYM | MILLIMETERS | |
|-----|-------------|-------|
| | MIN | MAX |
| A | 4.83 | 5.21 |
| A1 | 2.29 | 2.54 |
| A2 | 1.91 | 2.16 |
| b' | 1.07 | 1.28 |
| b | 1.07 | 1.33 |
| b1 | 1.91 | 2.41 |
| b2 | 1.91 | 2.16 |
| b3 | 2.87 | 3.38 |
| b4 | 2.87 | 3.13 |
| c' | 0.55 | 0.65 |
| c | 0.55 | 0.68 |
| D | 20.80 | 21.10 |
| D1 | 16.25 | 17.65 |
| D2 | 0.95 | 1.25 |
| E | 15.75 | 16.13 |
| E1 | 13.10 | 14.15 |
| E2 | 3.68 | 5.10 |
| E3 | 1.00 | 1.90 |
| E4 | 12.38 | 13.43 |
| e | 5.44 BSC | |
| N | 3 | |
| L | 19.81 | 20.32 |
| L1 | 4.10 | 4.40 |
| øP | 3.51 | 3.65 |
| Q | 5.49 | 6.00 |
| S | 6.04 | 6.30 |
| T | 17.5° ref | |
| W | 3.5° ref. | |
| X | 4° ref | |

- 1 - GATE
- 2 - DRAIN (COLLECTOR)
- 3 - SOURCE (EMITTER)
- 4 - DRAIN (COLLECTOR)



1

4d) TO-220 FullPak



Revision History

| Revision | Release Date | Comments |
|----------|--------------|-------------------|
| 1.0 | 2-Jan 2019 | Initial Datasheet |


Resources

www.d3semi.com

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