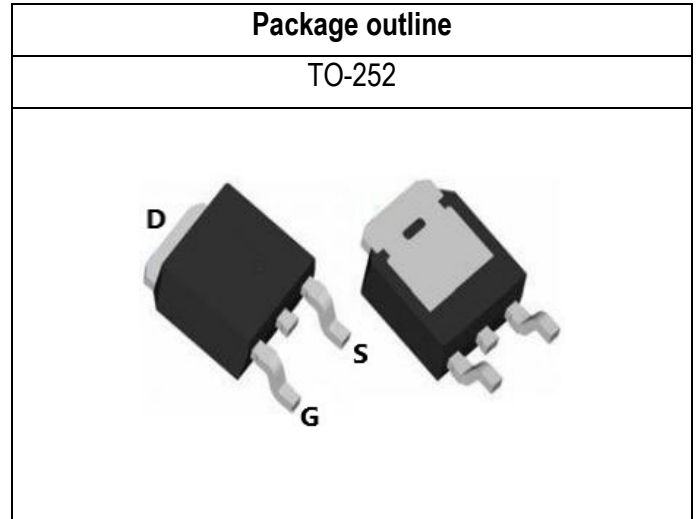


| Key parameter | N _{channel} | Unit |
|-----------------------------------|----------------------|------|
| V _{(BR)DSS} min. | 40 | V |
| R _{DS(ON)} max. VGS=10V | 6.7 | mΩ |
| R _{DS(ON)} max. VGS=4.5V | 9.6 | mΩ |
| V _{GS(TH)} Typ. | 1.7 | V |
| I _D | 95.3 | A |
| Q _g 10V Typ. | 19.9 | nC |
| C _{iss} Typ. | 930 | pF |
| E _{AS} | 19.2 | mJ |



Description

The DG40N20D uses double-gate structure of MOSFET to provide excellent electrical parameter. There is high speed switching capacity, low R_{DS(ON)} resistance, low gate charge and stable characteristics for these devices. Moreover, it is a helpful choose for raise efficiency or reduce consumption in circuit. These features combine to be an advantage design for use in wide variety of application including converter and inverter design.

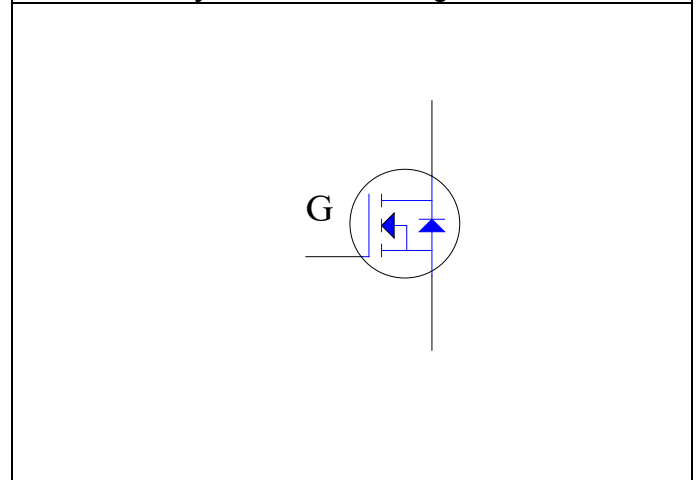
Features

- ◇ Fast switch capability
- ◇ Low R_{DS(ON)} resistance
- ◇ Low input capacitance
- ◇ Low Switching Loss
- ◇ Ruggedness commutation capability
- ◇ Pb-free lead plating; RoHS compliant

Potential application

- AC-DC adaptor
- DC-DC converter
- Quick Charger
- Electric tool application
- Motor/Fan driving application
- Synchronous Rectifier for Power Delivery

Symbol and Pin assignment



Order Information

| Item | Description |
|---------------------|--------------|
| 1. Order Code | DG40N20D |
| 2. Part Number | DG40N20D |
| 3. Package Type | TO-252 |
| 4. Package Code | D |
| 5. Packing Type | Tape & Reel |
| 6. Quantity in Pack | 2,500 |
| 7. RoHS Status | Halogen-Free |

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

| Parameter | | Symbol | Value | Unit |
|---|--|----------------|------------|---------------------|
| Drain-Source Voltage | | V_{DS} | 40 | V |
| Gate-Source Voltage | | V_{GS} | ± 20 | V |
| Drain Current-Continuous ^{Note 1} | $T_C=25^\circ\text{C}$ | I_D | 95.3 | A |
| | $T_C=100^\circ\text{C}$ | | 60.3 | A |
| Drain Current-Continuous ^{Note 2} | $T_A=25^\circ\text{C}$ | I_D | 16.8 | A |
| | $T_A=70^\circ\text{C}$ | | 13.5 | A |
| Drain Current-Pulsed ^{Note 3} | $T_A=25^\circ\text{C}$ | I_{DM} | 140 | A |
| Avalanche Current | | I_{AR} | 19.6 | A |
| Single Pulse Avalanche Energy ^{Note 4} | | E_{AS} | 19.2 | mJ |
| Maximum Power Dissipation | $T_C=25^\circ\text{C}$ | P_D | 97.6 | W |
| | $T_C=100^\circ\text{C}$ | | 39.0 | W |
| | $T_A=25^\circ\text{C}$ | | 3.0 | W |
| | $T_A=70^\circ\text{C}$ | | 1.9 | W |
| | Derate Factor Above $T_C=25^\circ\text{C}$ | | 0.78 | W/ $^\circ\text{C}$ |
| Max. Operating Junction Temperature | | T_J | 150 | $^\circ\text{C}$ |
| Operating and Storage Temperature Range | | T_J, T_{STG} | -55 to 150 | $^\circ\text{C}$ |

Thermal Resistance Ratings

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--------------------------------------|-------------------|------------------------|------|------|-------|---------------------------|
| Thermal resistance, Junction-Case | $R_{\theta JC-N}$ | Please refer to Note 5 | - | - | 1.28 | $^\circ\text{C}/\text{W}$ |
| Thermal resistance, Junction-Ambient | $R_{\theta JA-N}$ | Please refer to Note 5 | - | - | 40.81 | $^\circ\text{C}/\text{W}$ |

Notes:

- Limited by silicon chip capability and $R_{\theta JC-N}$ junction-to-case thermal resistance.
- The maximum current rating is limited by package and $R_{\theta JA-N}$ junction-to-ambient thermal resistance.
- Must be ensure junction temperature does not exceed 150-degree C. (Pulse Width $\leq 380\mu\text{s}$, Duty $\leq 2\%$)
- Limited by T_{Jmax} , starting $T_J=25^\circ\text{C}$, $L=0.1\text{mH}$, $R_g=25\Omega$, $I_D=19.6\text{A}$, $V_{GS}=10\text{V}$.
- The value of thermal resistance is measured with the single device put on cooling plate under a still air environment temperature is 25 degree C based on JEDEC standard JESD51-14 and JESD51-2a. Thermal resistance obtained depends on the user's specific board design and given application.

Electrical Characteristics (T_J=25°C unless otherwise noted)

| STATIC CHARACTERISTICS | | | | | | |
|---------------------------------|----------------------|--|------|------|------|------|
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
| Drain-Source Breakdown Voltage | V _{(BR)DSS} | V _{GS} =0V, I _{DS} =250μA | 40 | - | - | V |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} =40V, V _{GS} =0V | - | - | 1 | μA |
| | | V _{DS} =40V, V _{GS} =0V, T _J =125°C | - | - | 10 | μA |
| Gate-Body Leakage | I _{GSS} | V _{GS} =±20V, V _{DS} =0V | - | - | ±100 | nA |

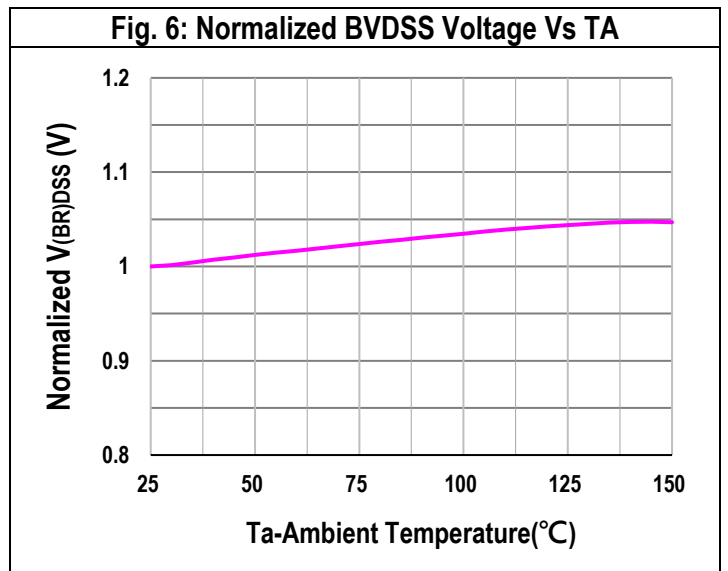
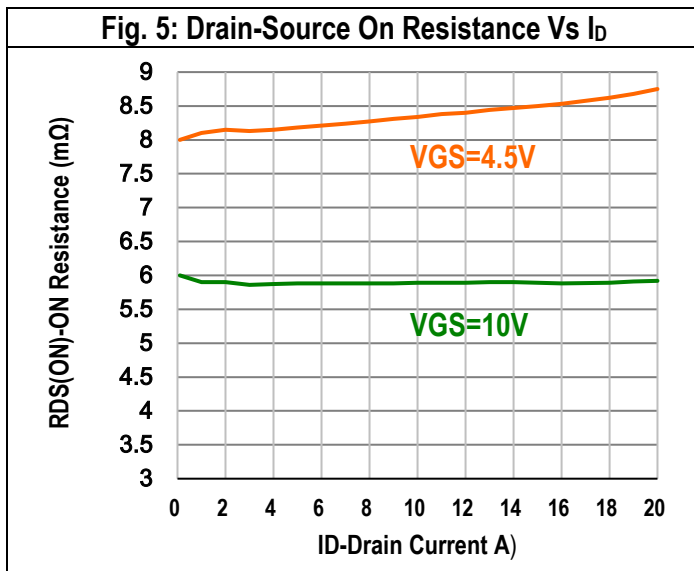
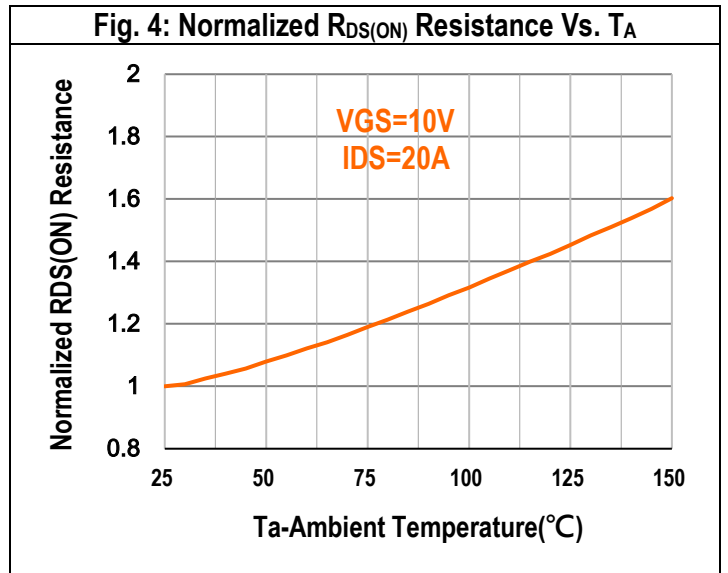
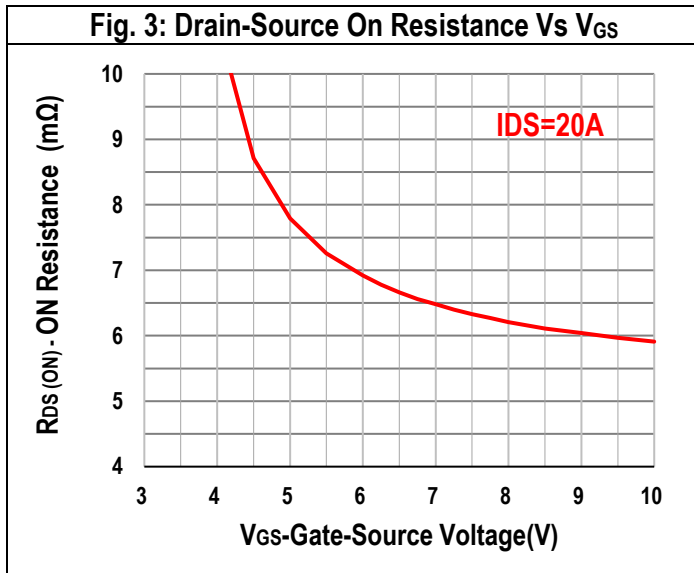
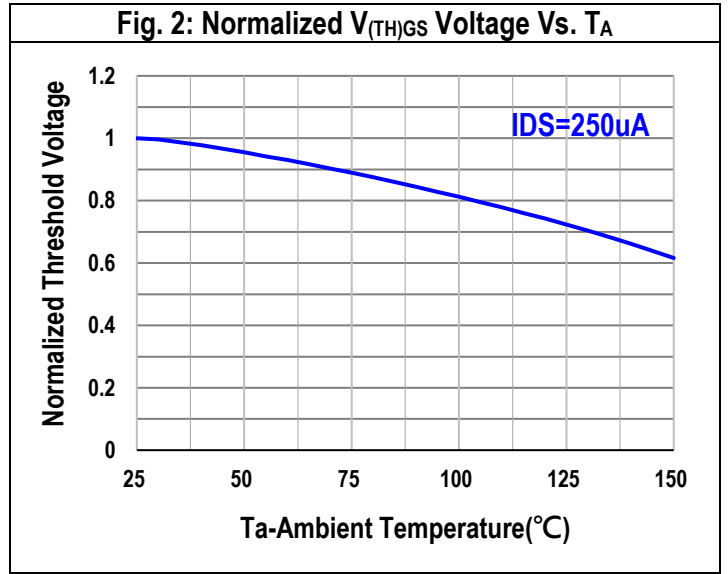
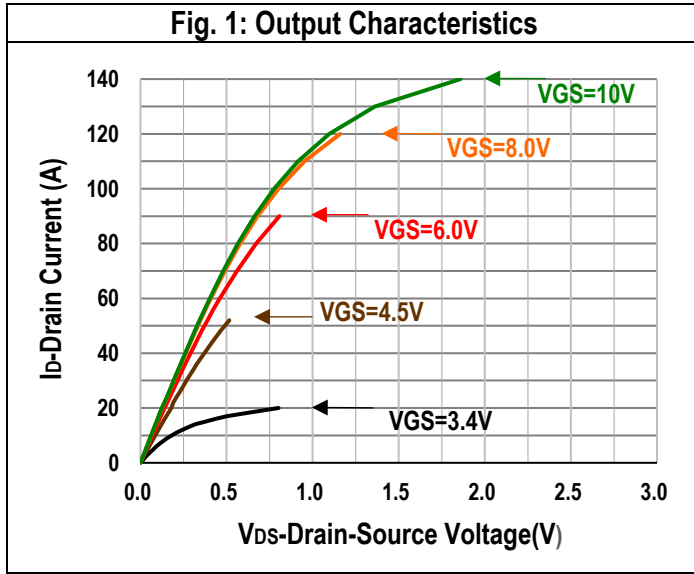
| STATIC CHARACTERISTICS | | | | | | |
|----------------------------------|---------------------|---|------|------|------|------|
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
| Gate Threshold Voltage | V _{GS(TH)} | V _{DS} =V _{GS} , I _{DS} =250μA | 1.4 | 1.7 | 2.0 | V |
| Drain-Source On-State Resistance | R _{DS(ON)} | V _{GS} =10V, I _{DS} =20A | - | 5.9 | 6.7 | mΩ |
| | | V _{GS} =4.5V, I _{DS} =15A | - | 8.4 | 9.6 | mΩ |
| Gate Resistance | R _g | V _{GS} =0V, V _{DS} =0V, f=1MHz | - | 2.4 | - | Ω |
| Forward Transconductance | g _{fs} | V _{DS} =5V, I _{DS} =15A | - | 15 | - | S |

| DYNAMIC CHARACTERISTICS | | | | | | |
|------------------------------|---------------------|--|------|------|------|------|
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
| Input Capacitance | C _{iss} | V _{DD} =40V, V _{DS} =20V, V _{GS} =0V, f=1MHz | - | 930 | - | pF |
| Output Capacitance | C _{oss} | V _{DD} =40V, V _{DS} =20V, V _{GS} =0V, f=1MHz | - | 369 | - | pF |
| Reverse Transfer Capacitance | C _{rss} | V _{DD} =40V, V _{DS} =20V, V _{GS} =0V, f=1MHz | - | 48.6 | - | pF |
| Turn-On Delay Time | T _{d(on)} | V _{DS} =20V, V _{GS} =10V, I _{DS} =20A, R _{GEN} =3Ω | - | 8.7 | - | nS |
| Rise Time | t _r | V _{DS} =20V, V _{GS} =10V, I _{DS} =20A, R _{GEN} =3Ω | - | 49.7 | - | nS |
| Turn-Off Delay Time | T _{d(off)} | V _{DS} =20V, V _{GS} =10V, I _{DS} =20A, R _{GEN} =3Ω | - | 24.0 | - | nS |
| Fall Time | t _f | V _{DS} =20V, V _{GS} =10V, I _{DS} =20A, R _{GEN} =3Ω | - | 49.6 | - | nS |

| GATE CHARGE CHARACTERISTICS | | | | | | |
|--|----------------------|---|------|------|------|------|
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
| Gate to Source Gate Charge | Q _{gs} | V _{DD} =20V, I _D =20A, V _{GS} =0 to 10V | - | 3.4 | - | nC |
| Gate charge at threshold | Q _{g(th)} | V _{DD} =20V, I _D =20A, V _{GS} =0 to 10V | - | 1.7 | - | nC |
| Gate to Drain Charge | Q _{gd} | V _{DD} =20V, I _D =20A, V _{GS} =0 to 10V | - | 5.4 | - | nC |
| Switching charge | Q _{SW} | V _{DD} =20V, I _D =20A, V _{GS} =0 to 10V | - | 7.0 | - | nC |
| Gate charge total | Q _{g 10V} | V _{DD} =20V, I _D =20A, V _{GS} =0 to 10V | - | 19.9 | - | nC |
| | Q _{g 4.5V} | V _{DD} =20V, I _D =20A, V _{GS} =0 to 4.5V | - | 10.1 | - | nC |
| Gate plateau voltage | V _{plateau} | V _{DD} =20V, I _D =20A, V _{GS} =0 to 10V | - | 3.4 | - | V |
| Gate charge total, sync. FET (Q _g - Q _{gd}) | Q _{g(sync)} | V _{DS} =0.1V, V _{GS} =0 to 10V | - | 14.5 | - | nC |

| DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS | | | | | | |
|--|-----------------|--|------|------|------|------|
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
| Body diode continuous forward current | I _S | T _C =25°C | - | - | 95.3 | A |
| Body diode pulse current | I _{SM} | T _C =25°C | - | - | 140 | A |
| Body diode forward voltage | V _{SD} | V _{GS} =0V, I _S =20A | - | 0.86 | 1.0 | V |
| Body diode reverse recovery time | t _{rr} | V _{DD} =20V, I _F =20A, di/dt=100A/μs | - | 17.5 | - | nS |
| Body diode reverse recovery charge | Q _{rr} | V _{DD} =20V, I _F =20A, di/dt=100A/μs | - | 4.7 | - | nC |
| Body diode peak reverse recovery charge | I _{rm} | V _{DD} =20V, I _F =20A, di/dt=100A/μs | - | 0.59 | - | A |

Typical Operating Characteristics



Typical Operating Characteristics

Fig. 7: Typical Capacitance Variation Vs V_{DS}

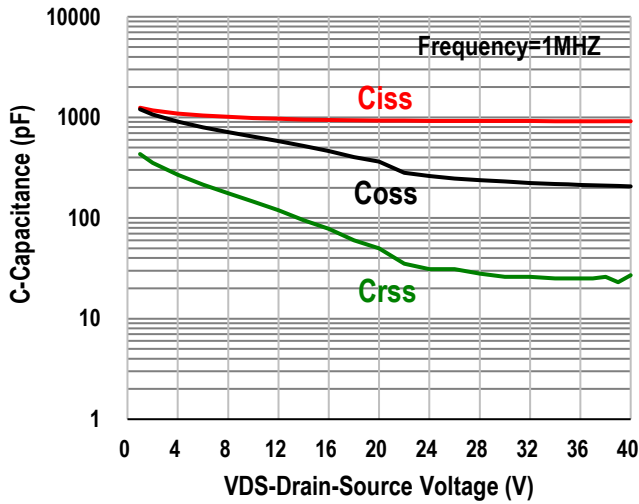


Fig. 8: Gate Charge Vs V_{GS}

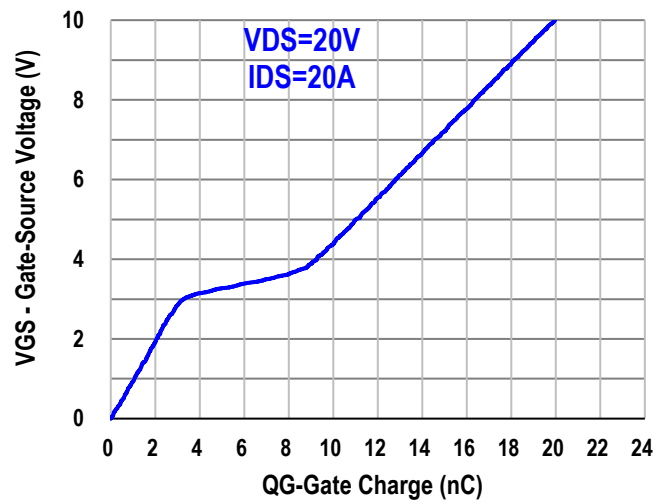


Fig. 9: Power Dissipation Vs. T_c

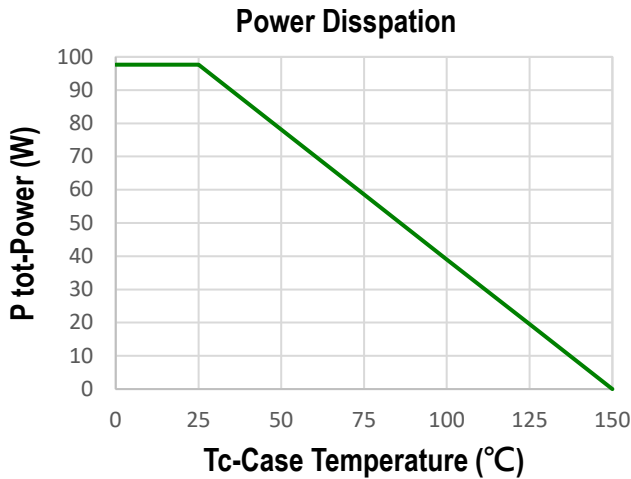


Fig. 10: Drain Current Vs. T_c

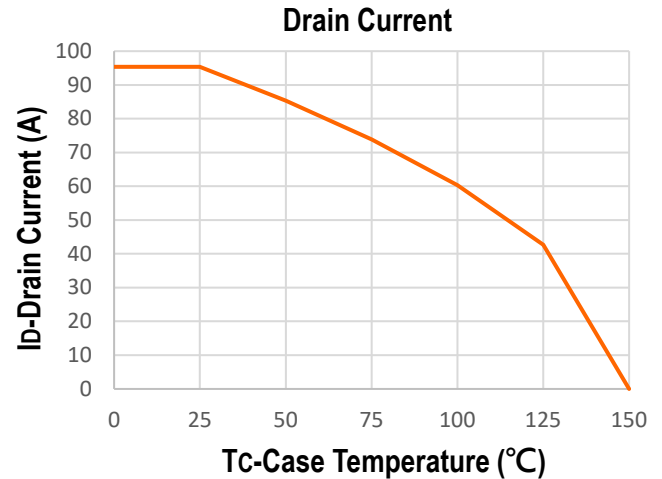


Fig. 11: Body Diode Forward Voltage Vs. I_s

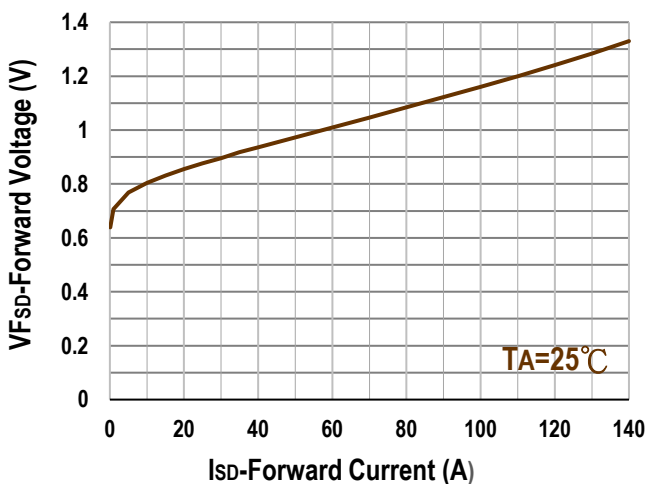
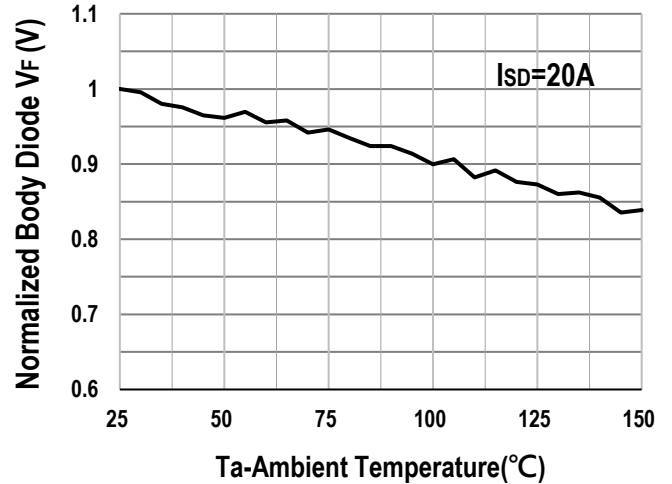


Fig. 12: Body Diode Forward Voltage Vs. T_A



Typical Operating Characteristics

Fig. 13: Safe Operation Area

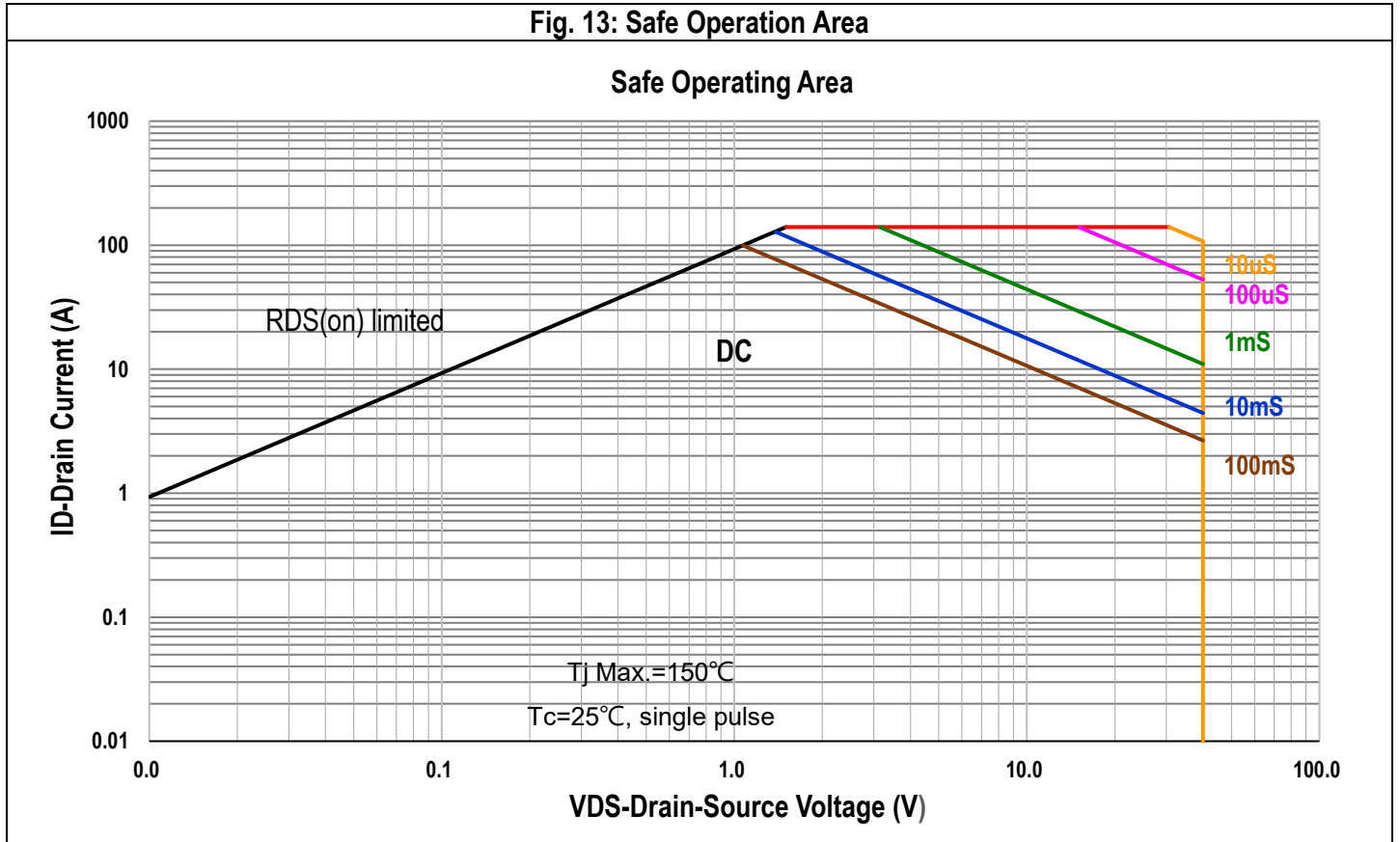
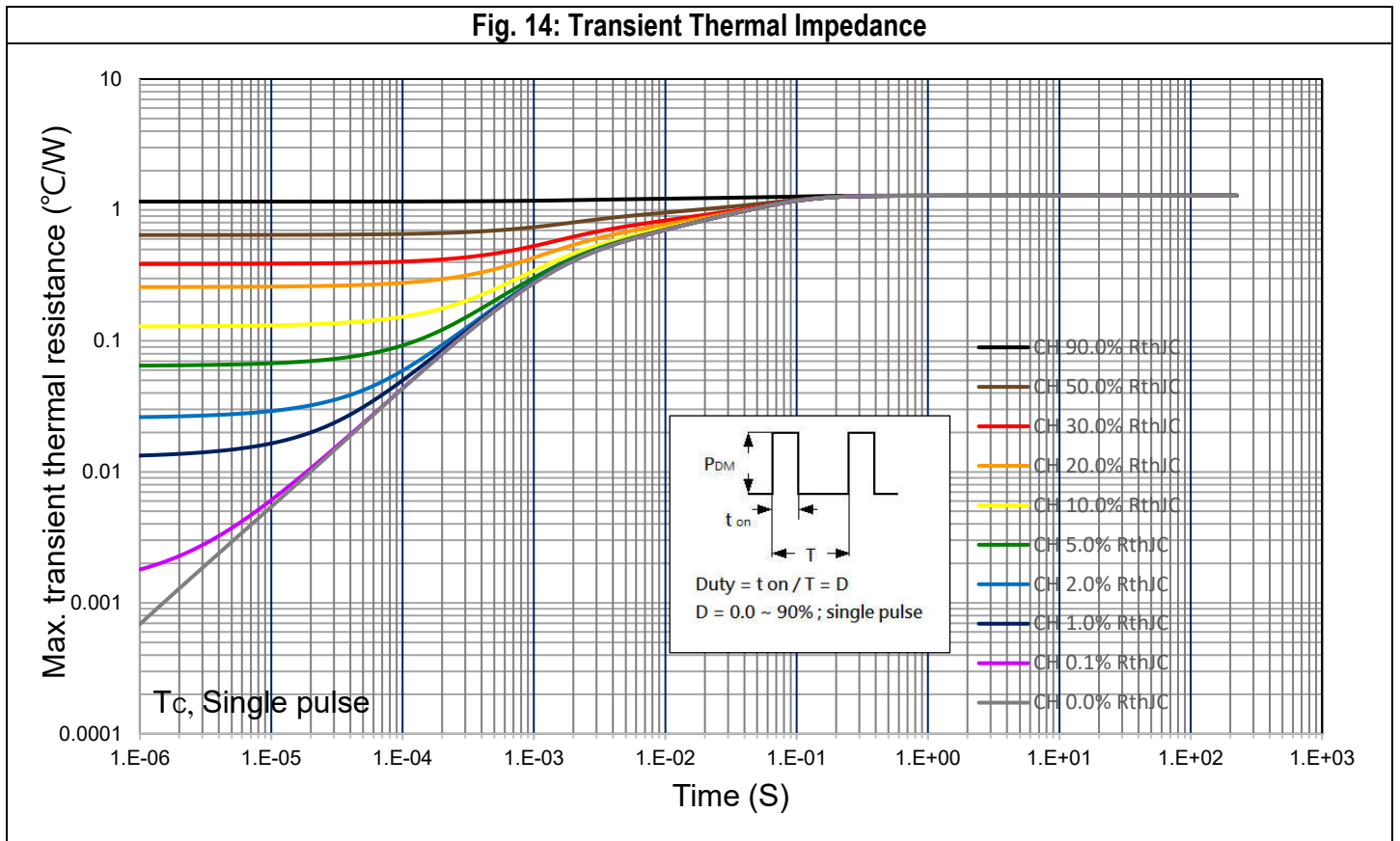
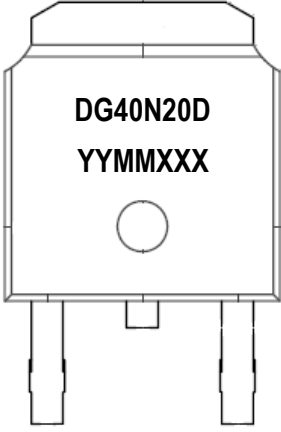


Fig. 14: Transient Thermal Impedance

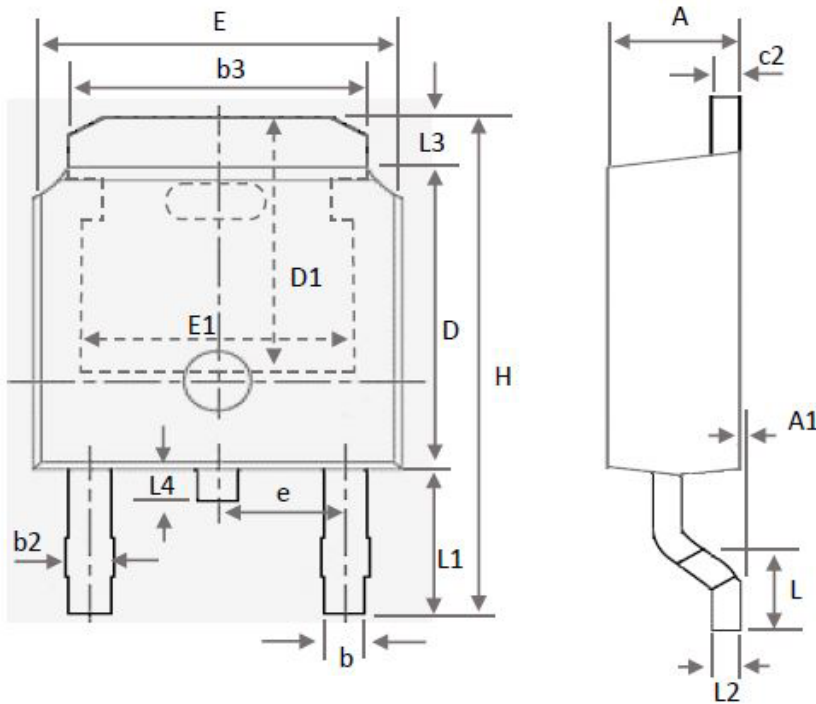


Marking Information

| TO-252 (D) | Marking Rule |
|---|---|
| <p>Laser Marking</p>  <p>The diagram shows a TO-252 (D) MOSFET package. On the top surface, there is a laser marking consisting of two lines of text: 'DG40N20D' on the top line and 'YYMMXXX' on the bottom line. Below the text is a small circular mark. The package has three leads extending from the bottom.</p> | <p><u>Line 1</u> : Device DG40N20D</p> <p><u>Line 2</u> : Date Code YYMMXXX</p> <p>YY : Year Code MM : Month Code XXX : Serial Number</p> |

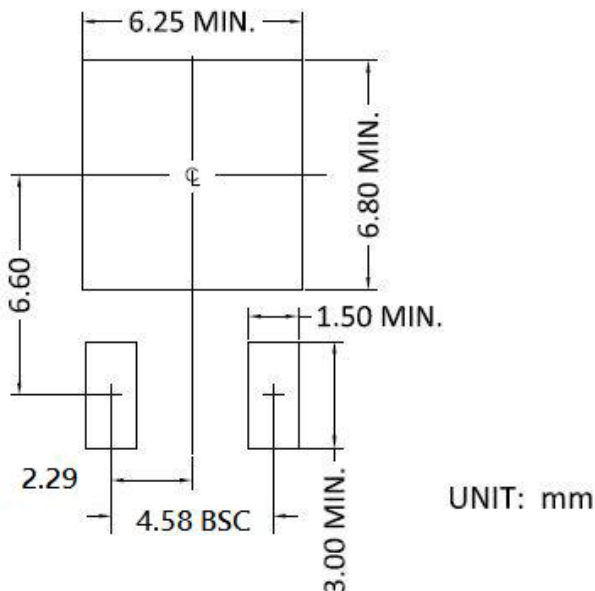
Package of Dimension

Package type: TO-252



| Symbol | Min | Nor | Max |
|--------|------------|------|-------|
| E | 6.35 | 6.54 | 6.731 |
| L | 1.40 | 1.59 | 1.78 |
| L1 | 2.743 Ref. | | |
| L2 | 0.508 BSC | | |
| L3 | 0.89 | 1.08 | 1.27 |
| L4 | 0.60 | 0.81 | 1.01 |
| D | 5.97 | 6.10 | 6.223 |
| H | 9.40 | 9.91 | 10.41 |
| b | 0.64 | 0.77 | 0.89 |
| b2 | 0.76 | 0.95 | 1.14 |
| b3 | 4.95 | 5.21 | 5.46 |
| e | 2.286 BSC | | |
| A | 2.18 | 2.29 | 2.39 |
| A1 | 0.00 | 0.07 | 0.13 |
| c2 | 0.46 | 0.68 | 0.89 |
| D1 | 5.21 | - | - |
| E1 | 4.32 | - | - |

Land pattern (Footprint)



Note 1: Land pattern (Footprint) design is for reference only.

Note 2: Package body sizes exclude mold flash and burrs.

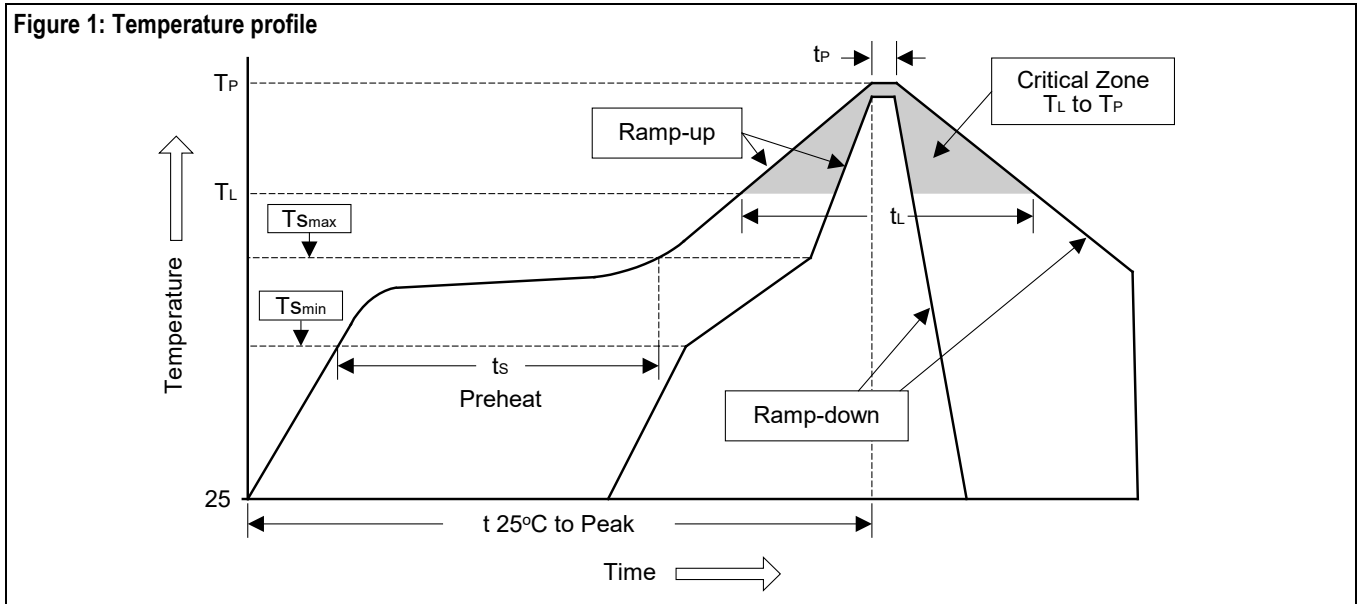
Note 3: Dimension is measured in gauge plane.

Note 4: Tolerance 0.1mm unless otherwise specified.

Appendix-A

Soldering Methods for Silicongear's Products (Just for SMD type of device)

- Storage environment: Temperature=10°C to 35°C Humidity=65%±15%
- Reflow soldering of surface-mount devices



| Profile Feature | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|--|-------------------------|------------------|
| Average ramp-up rate (T_L to T_P) | <3°C/sec | <3°C/sec |
| Preheat | | |
| - Temperature Min (T_{Smin}) | 100°C | 150°C |
| - Temperature Max (T_{Smax}) | 150°C | 200°C |
| - Time (min to max) (t_s) | 60 to 120 sec | 60 to 180 sec |
| T_{Smax} to T_L | | |
| - Ramp-up Rate | <3°C/sec | <3°C/sec |
| Time maintained above: | | |
| - Temperature (T_L) | 183°C | 217°C |
| - Time (t_L) | 60 to 150 sec | 60 to 150 sec |
| Peak Temperature (T_P) | 240°C +0/-5°C | 260°C +0/-5°C |
| Time within 5°C of actual Peak Temperature (t_p) | 10 to 30 sec | 20 to 40 sec |
| Ramp-down Rate | <6°C/sec | <6°C/sec |
| Time 25°C to Peak Temperature | <6 minutes | <8 minutes |

3. Flow (wave) soldering (solder dipping)

| Products | Peak Temperature | Dipping Time |
|------------------|------------------|--------------|
| Pb devices. | 245°C ±5°C | 5sec ±1sec |
| Pb-Free devices. | 260°C +0/-5°C | 5sec ±1sec |

Appendix-B

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Revision History

| Document Revision History | | | |
|---------------------------|-------------|----------|---|
| Device | Date | Revision | Description (major change from last revision) |
| DG40N02D | Sep-30-2024 | 01 | <ul style="list-style-type: none">- Release of first- Sample Lot N.o: R2J677 ; Date Code: 2211901- Parameter definition based on verified raw data of R&D dept.- This device is not classified under general product development, and no any record or information |
| | | | |