$V_{BR(CES)}$ = 500 V, I_C = 20 A
N-channel Ignition IGBT
DGU5020GR

Data Sheet

Description

The DGU5020GR is 500 V IGBT with Zener diodes and gate resistors, and achieves an ignition coil drive circuit without an external clamped circuit. The IGBT has low saturation characteristic, and can improve the efficiency of the circuit.

Features

- AEC-Q101 Qualified
- Bare Lead Frame: Pb-free (RoHS Compliant)
- Built-in Zener Diodes
- Built-in Gate Resistors
- Low Saturation Voltage

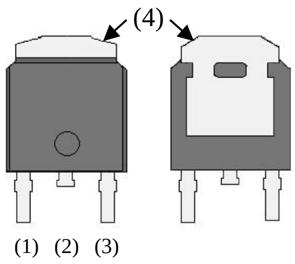
- $V_{(BR)CES}$ -- 500 V
- I_C -- 20 A
- $V_{CE(SAT)}$ ----------- 1.15 V typ. (V_{GE} = 4.5 V, I_C = 10 A)

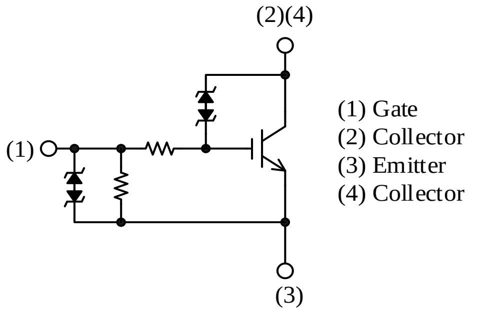
Applications

- Ignition Coil Driver Circuits

Packages

TO252-2L



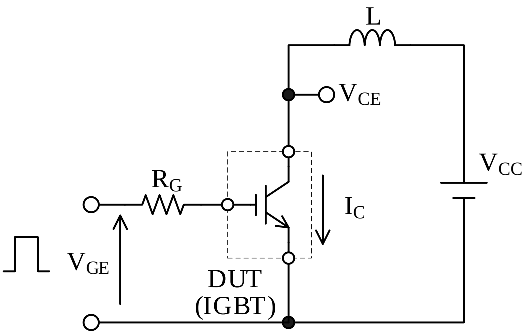


Not to scale

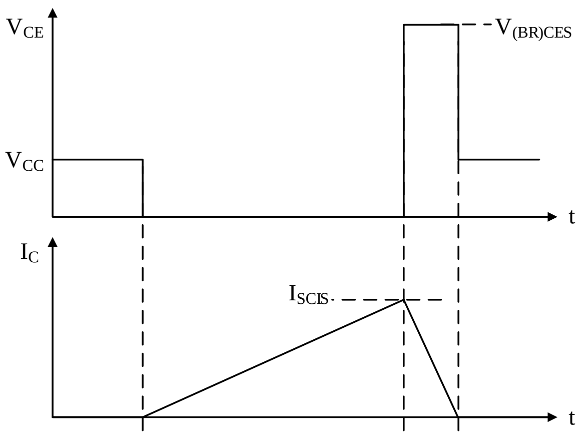
Absolute Maximum Ratings

Unless otherwise specified, T_A = 25 °C.

Parameter	Symbol	Conditions	Rating	Unit
Collector-to-Emitter Voltage	V_{CE}		$V_{(BR)CES}$	V
Gate-to-Emitter Voltage	V_{GE}		±10	V
Continuous Collector Current	I_C	T_C = 25 °C	20	A
Power Dissipation	P_D	T_C = 25 °C	172	W
Self-clamped Inductive Switching Energy	E_{SCIS}	See Figure 1 and Equation (1). V_{CC} = 14 V, V_{GE} = 5 V, L = 1.36 mH, R_G = 1 kΩ	280	mJ
Self-clamped Inductive Switching Current	I_{SCIS}		20	A
Reverse Avalanche Energy	$E_{AS(R)}$	L = 6 mH	2000	mJ
Operating Junction Temperature	T_J		−40 to 175	°C
Storage Temperature	T_{STG}		−40 to 175	°C



(a) Test Circuit



(b) Waveform

Figure 1. Self-clamped Inductive Switching Energy Test

$$E_{SCIS} = \frac{1}{2} \times L \times I_{SCIS}{}^2 \times \frac{V_{(BR)CES}}{V_{(BR)CES} - V_{CC}} \quad (1)$$

Electrical Characteristics

Unless otherwise specified, T_A = 25 °C.

<table>
<tr><th>Parameter</th><th>Symbol</th><th colspan="2">Conditions</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th></tr>
<tr><td>Collector-to-Emitter Breakdown Voltage</td><td>$V_{(BR)CES}$</td><td colspan="2">I_C = 2 mA, V_{GE} = 0 V</td><td>475</td><td>500</td><td>525</td><td>V</td></tr>
<tr><td>Gate-to-Emitter Breakdown Voltage</td><td>$V_{(BR)GES}$</td><td colspan="2">I_G = ±1 mA, V_{CE} = 0 V</td><td>±10.0</td><td>±11.5</td><td>±13.0</td><td>V</td></tr>
<tr><td>Collector-to-Emitter Leakage Current</td><td>I_{CES}</td><td colspan="2">V_{CE} = 400 V, V_{GE} = 0 V</td><td>—</td><td>—</td><td>100</td><td>μA</td></tr>
<tr><td>Emitter-to-Collector Leakage Current</td><td>I_{ECS}</td><td colspan="2">V_{EC} = 24 V</td><td>—</td><td>—</td><td>1.0</td><td>mA</td></tr>
<tr><td>Gate-to-Emitter Leakage Current</td><td>I_{GES}</td><td colspan="2">V_{GE} = ±5 V</td><td>±89</td><td>±106</td><td>±132</td><td>μA</td></tr>
<tr><td>Gate Threshold Voltage</td><td>$V_{GE(TH)}$</td><td colspan="2">V_{CE} = 10 V, I_C = 1 mA</td><td>1.40</td><td>1.75</td><td>2.10</td><td>V</td></tr>
<tr><td rowspan="8">Collector-to-Emitter Saturation Voltage</td><td rowspan="8">$V_{CE(SAT)}$</td><td rowspan="4">T_J = 25 °C</td><td>V_{GE} = 3.5 V, I_C = 10 A</td><td>—</td><td>1.20</td><td>1.45</td><td>V</td></tr>
<tr><td>V_{GE} = 4.5 V, I_C = 10 A</td><td>—</td><td>1.15</td><td>1.40</td><td>V</td></tr>
<tr><td>V_{GE} = 4.5 V, I_C = 15 A</td><td>—</td><td>1.30</td><td>1.60</td><td>V</td></tr>
<tr><td>V_{GE} = 4.5 V, I_C = 20 A</td><td>—</td><td>1.45</td><td>1.75</td><td>V</td></tr>
<tr><td rowspan="4">T_J = 150 °C</td><td>V_{GE} = 3.5 V, I_C = 10 A</td><td>—</td><td>1.20</td><td>1.60</td><td>V</td></tr>
<tr><td>V_{GE} = 4.5 V, I_C = 10 A</td><td>—</td><td>1.20</td><td>1.45</td><td>V</td></tr>
<tr><td>V_{GE} = 4.5 V, I_C = 15 A</td><td>—</td><td>1.35</td><td>1.85</td><td>V</td></tr>
<tr><td>V_{GE} = 4.5 V, I_C = 20 A</td><td>—</td><td>1.65</td><td>2.20</td><td>V</td></tr>
<tr><td>Input Capacitance</td><td>C_{ies}</td><td colspan="2" rowspan="3">V_{CE} = 10 V,
V_{GE} = 0 V,
f = 1.0 MHz</td><td>—</td><td>1900</td><td>—</td><td>pF</td></tr>
<tr><td>Output Capacitance</td><td>C_{oes}</td><td>—</td><td>460</td><td>—</td><td>pF</td></tr>
<tr><td>Reverse Transfer Capacitance</td><td>C_{res}</td><td>—</td><td>160</td><td>—</td><td>pF</td></tr>
<tr><td>Turn-on Delay Time</td><td>$t_{d(ON)}$</td><td colspan="2" rowspan="2">Resistive load,
V_{CE} = 14 V, V_{GE} = 5 V,
R_G = 1 kΩ, R_L = 1 Ω;
see Figure 3</td><td>—</td><td>1.3</td><td>—</td><td>μs</td></tr>
<tr><td>Rise Time</td><td>t_r</td><td>—</td><td>3.8</td><td>—</td><td>μs</td></tr>
<tr><td>Turn-off Delay Time</td><td>$t_{d(OFF)}$</td><td colspan="2" rowspan="2">Inductive load,
V_{CE} = 300 V,
I_C = 10 A, V_{GE} = 5 V,
R_G = 1 kΩ, L = 2 mH;
see Figure 4</td><td>—</td><td>13.5</td><td>—</td><td>μs</td></tr>
<tr><td>Fall Time</td><td>t_f</td><td>—</td><td>2.7</td><td>—</td><td>μs</td></tr>
<tr><td>Internal Series Gate Resistor(1)</td><td>$R_{G(INT)}$</td><td colspan="2"></td><td>—</td><td>70</td><td>—</td><td>Ω</td></tr>
<tr><td>Internal Gate-to-Emitter Resistor (1)</td><td>$R_{GE(INT)}$</td><td colspan="2">T_J = −40 to 175 °C</td><td>37.6</td><td>47.0</td><td>61.1(2)</td><td>kΩ</td></tr>
</table>

(1) See Figure 2
(2) Guaranteed by design.

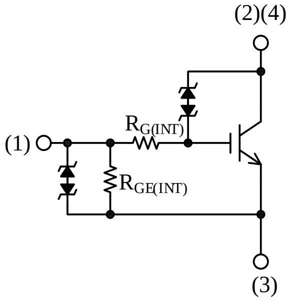


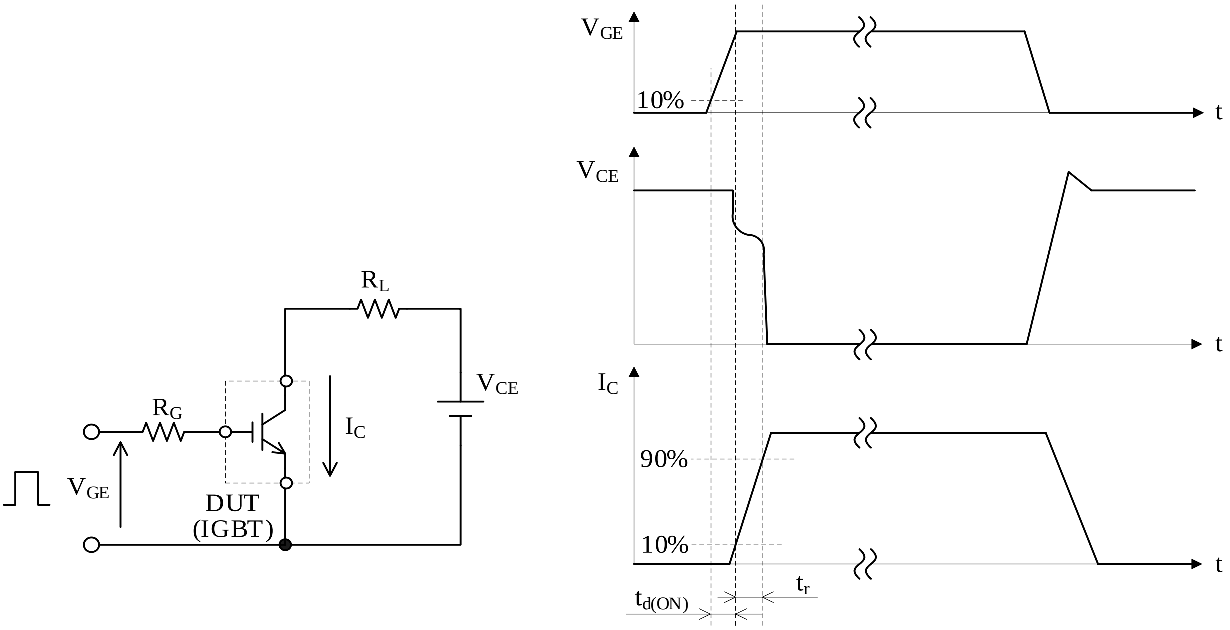
Figure 2. Internal Gate Resistor

Thermal Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$		—	—	0.87	°C/W

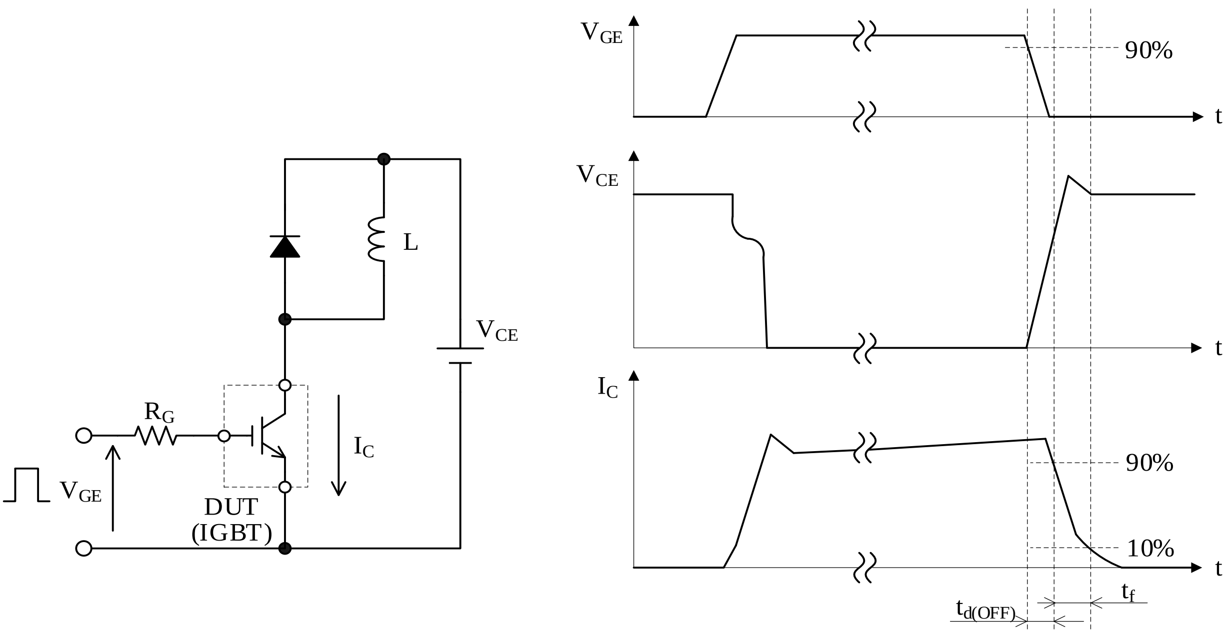
Mechanical Characteristics

Parameter	Conditions	Min.	Typ.	Max.	Unit
Package Weight		—	0.32	—	g



(a) Test Circuit (b) Waveform

Figure 3. Switching Time Test in Resistive Load



(a) Test Circuit (b) Waveform

Figure 4. Switching Time Test in Inductive Load

Derating Curves

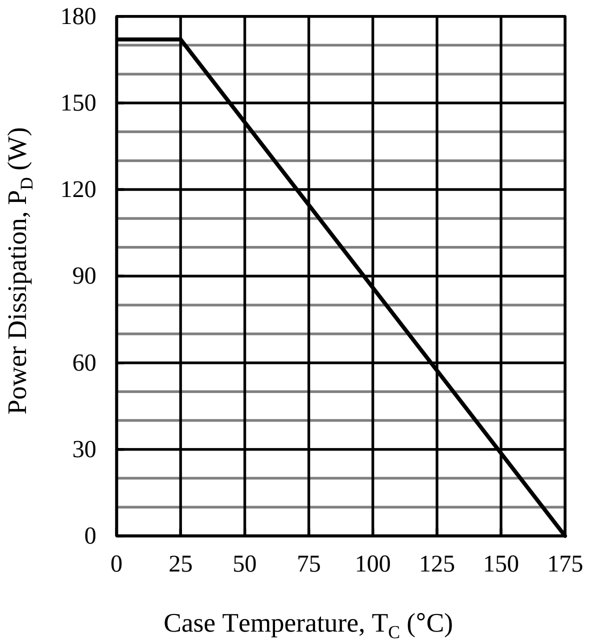


Figure 5. P_D vs. T_C

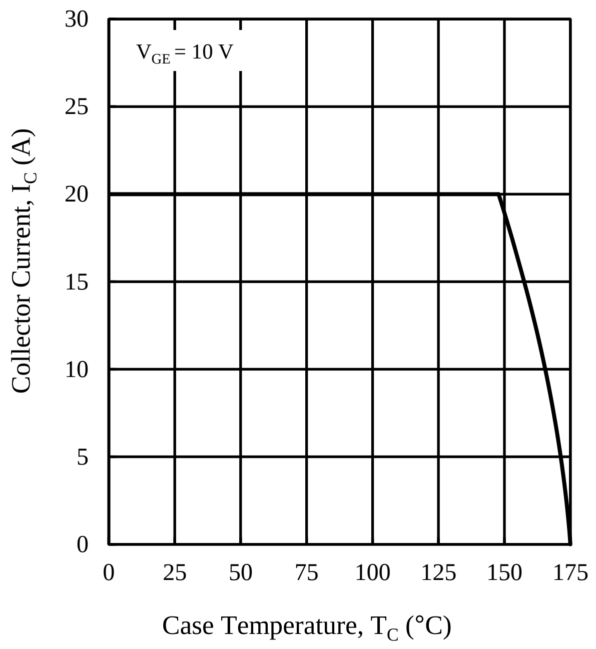


Figure 6. I_C vs. T_C (V_{GE} = 5 V)

Typical Characteristic Curves

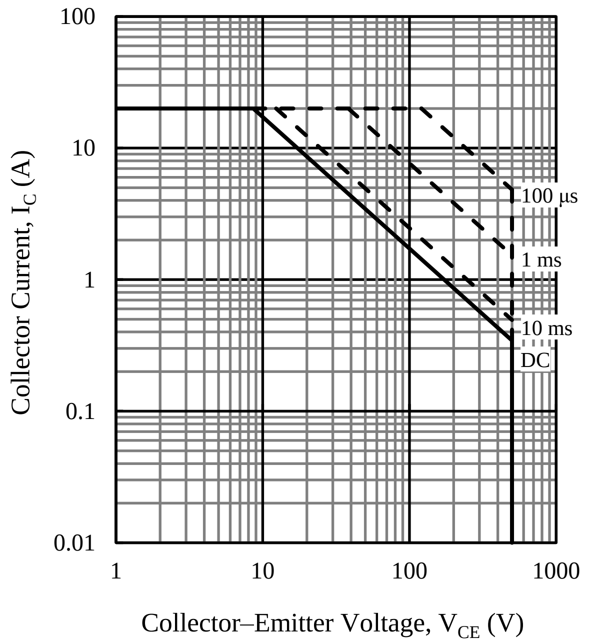


Figure 7. Safe Operating Area

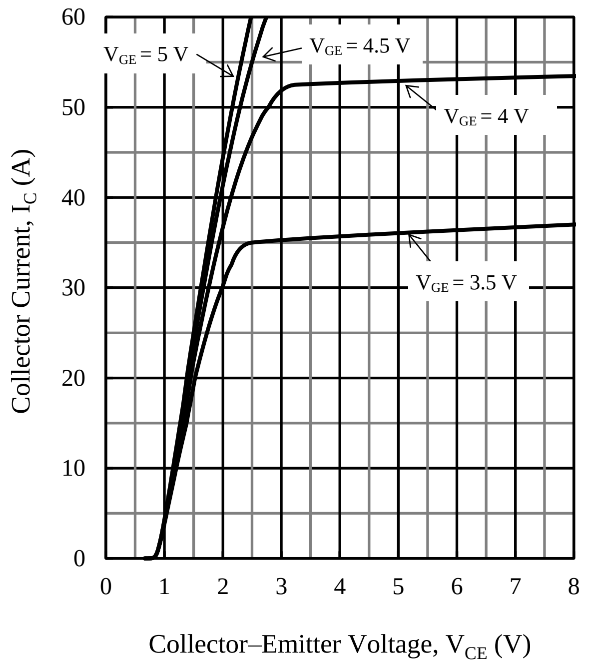


Figure 8. Typical Characteristics: I_C vs. V_{CE} (T_J = −40 °C)

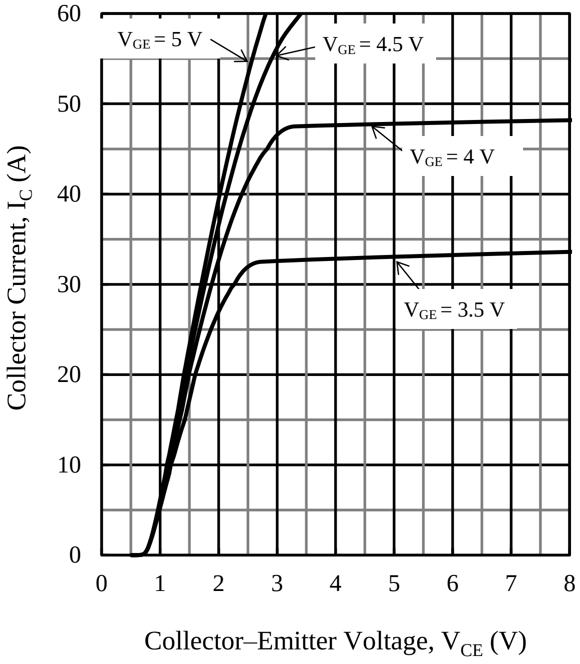


Figure 9. Typical Characteristics: I_C vs. V_{CE} (T_J = 25 °C)

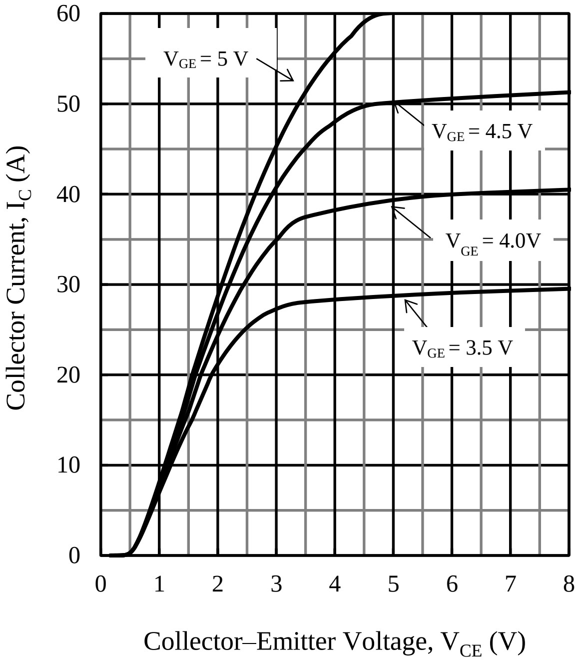


Figure 10. Typical Characteristics: I_C vs. V_{CE} (T_J = 175 °C)

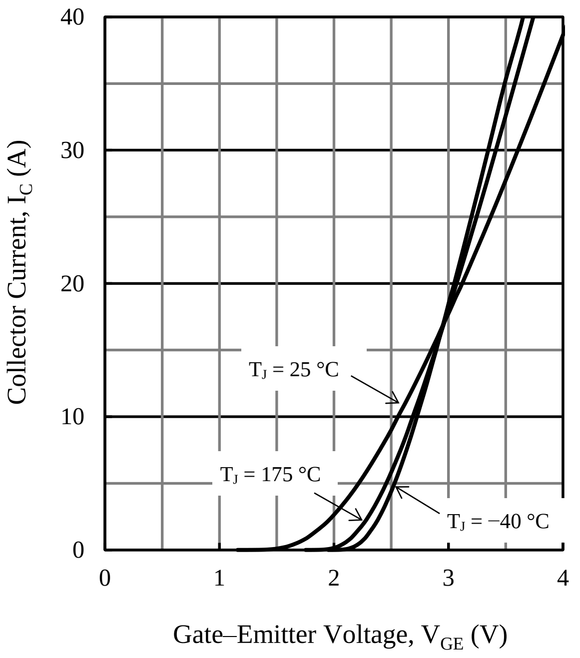


Figure 11. Typical Characteristics: I_C vs. V_{GE} (V_{CE} = 5 V)

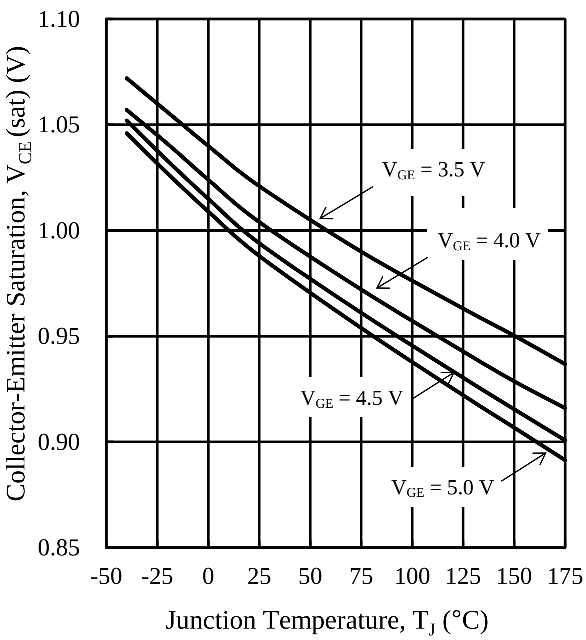


Figure 12. Typical Characteristics: $V_{CE(SAT)}$ vs. T_J (I_C = 6 A)

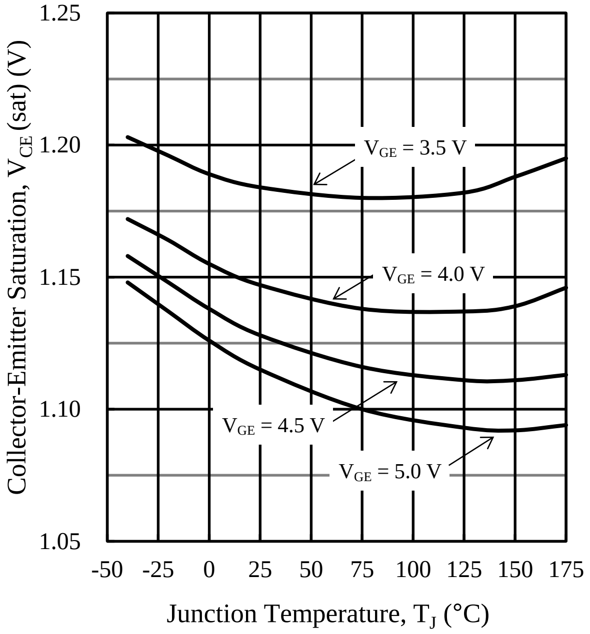


Figure 13. Typical Characteristics: $V_{CE(SAT)}$ vs. T_J (I_C = 10 A)

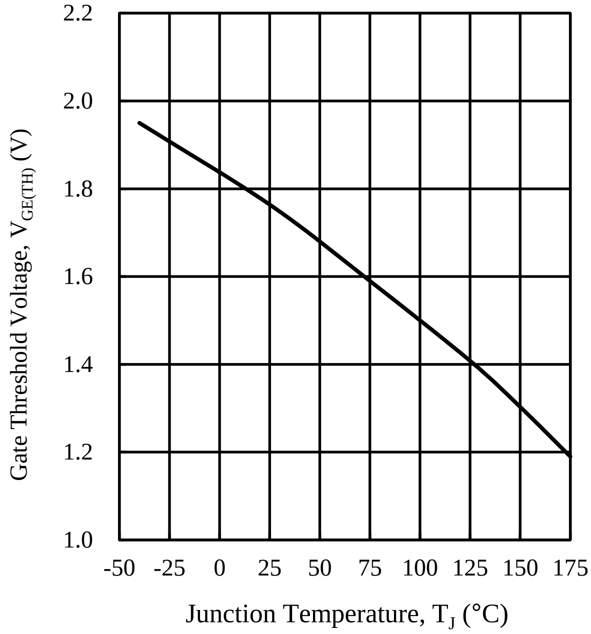


Figure 14. Typical Characteristics: $V_{GE(TH)}$ vs. T_J (V_{CE} = 10 V, I_C = 1 mA)

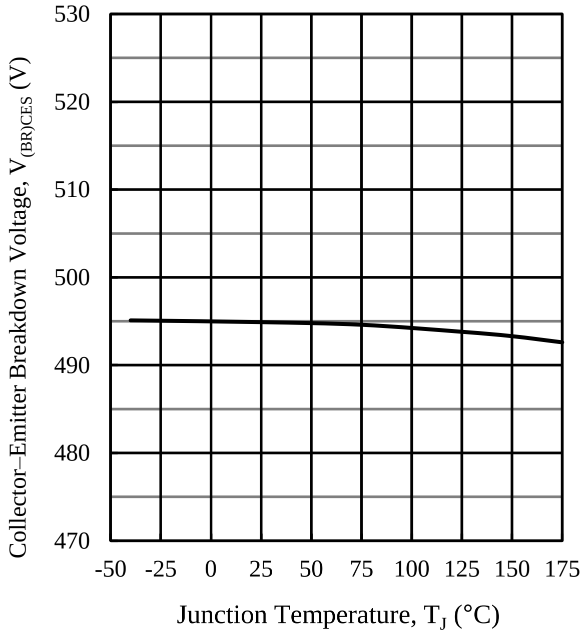


Figure 15. Typical Characteristics: $V_{(BR)CES}$ vs. T_J (V_{GE} = 0 V, I_C = 2 mA)

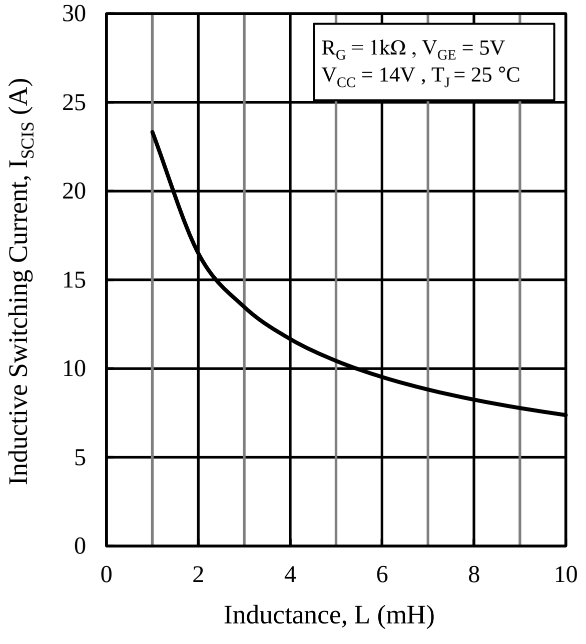


Figure 16. Typical Characteristics: I_{SCIS} vs. L

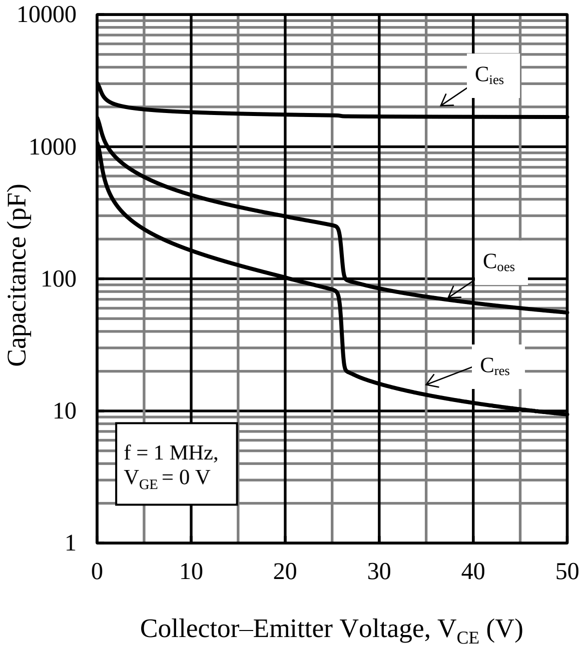


Figure 17. Typical Characteristics: Capacitance vs. V_{CE}

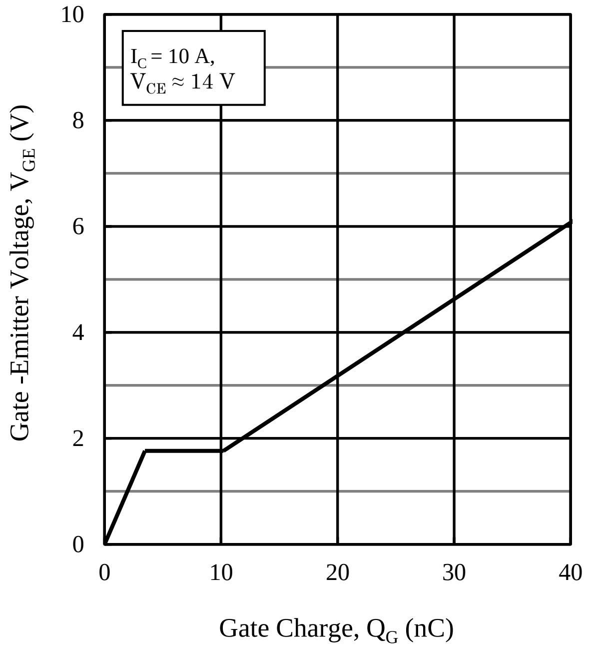


Figure 18. Typical Characteristics: V_{GE} vs. Q_G

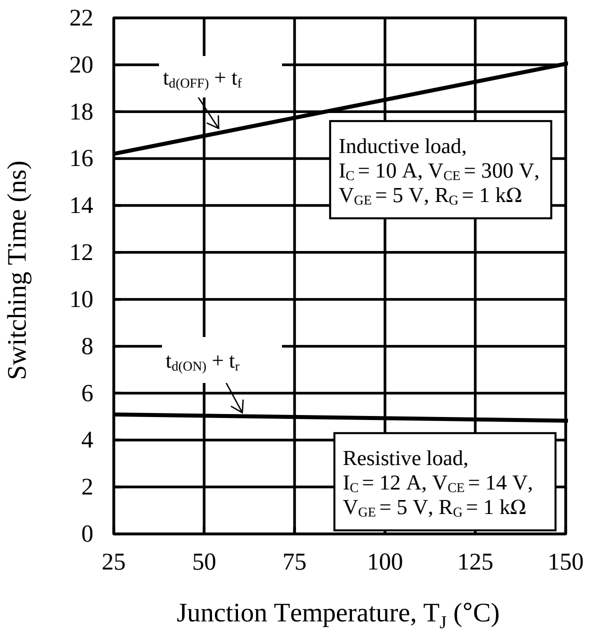


Figure 19. Typical Characteristics: Switching Time vs. T_J

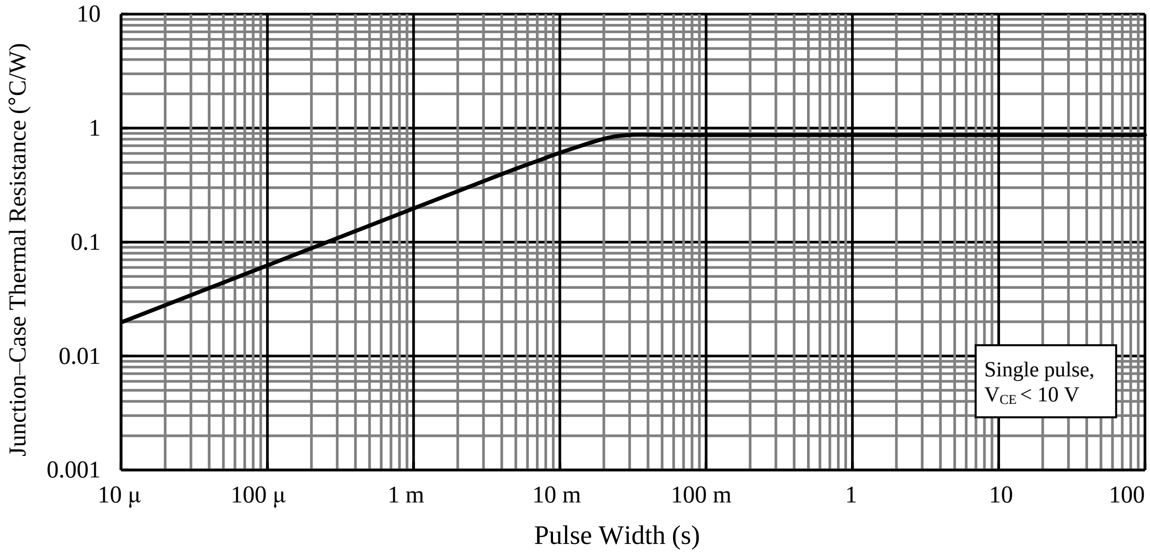
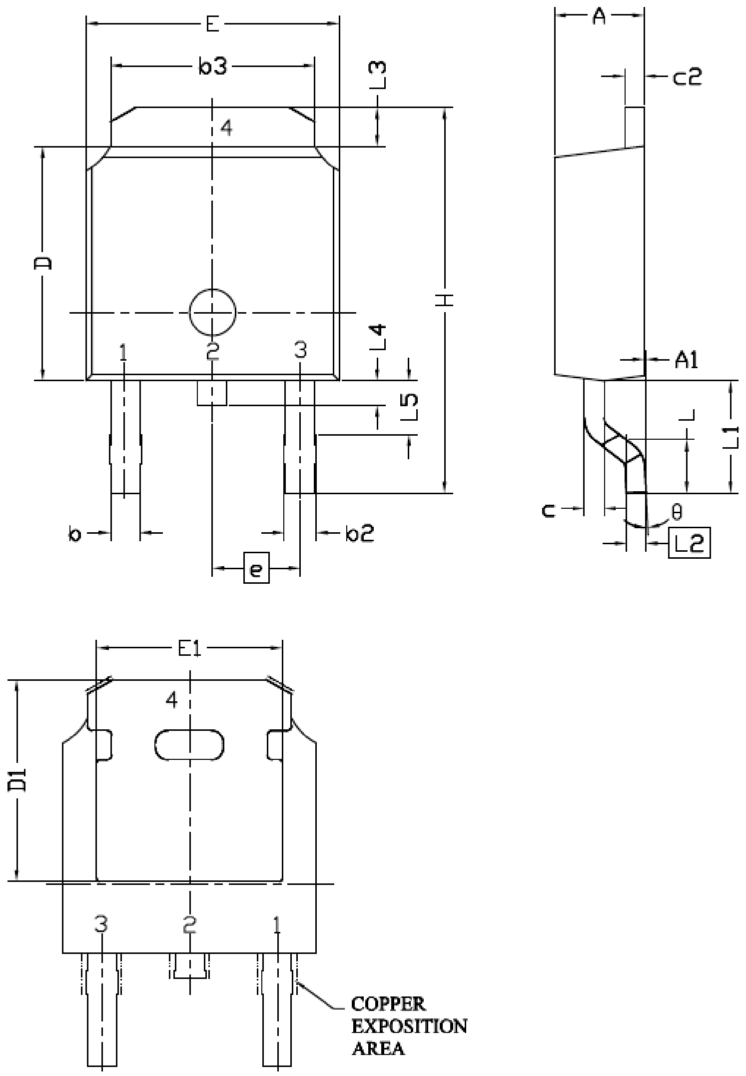


Figure 20. Transient Thermal Resistance Characteristics

Physical Dimensions

- **TO252-2L Package**

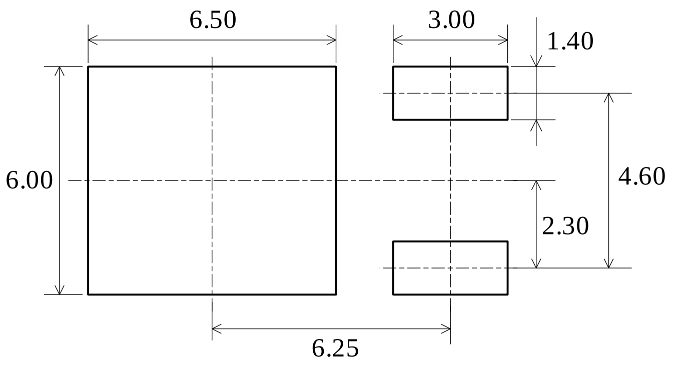


Symbol	Dimensional Requirements		
	Min.	Nom.	Max.
E	6.40	6.60	6.731
L	1.40	1.52	1.77
L1	2.743 Ref.		
L2	0.508 Bsc.		
L3	0.89	—	1.27
L4	0.64	—	1.01
L5	—	—	—
D	6.00	6.10	6.223
H	9.40	10.00	10.40
b	0.64	0.76	0.88
b2	0.77	0.84	1.14
b3	5.21	5.34	5.46
e	2.286 Bsc.		
A	2.20	2.30	2.38
A1	0	—	0.127
c	0.46	0.50	0.60
c2	0.46	0.50	0.58
D1	5.21	—	—
E1	4.40	—	—
θ	0°	—	10°

NOTES:

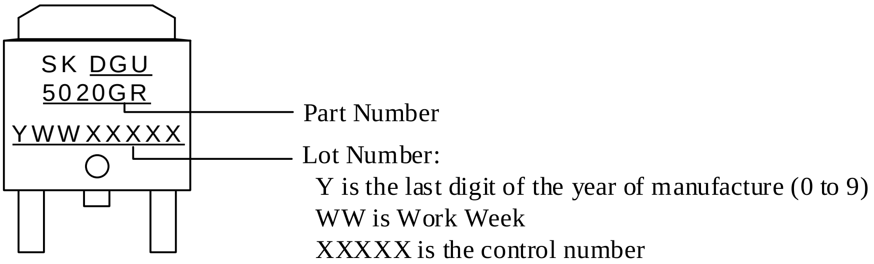
- Dimensions in millimeters
- All the dimensions exclude mold flashes.
- Bare lead frame: Pb-free (RoHS compliant)
- Moisture Sensitivity Level 1 (MSL 1)
- When soldering the products, it is required to minimize the working time within the following limits:
  Reflow
    Preheat: 150 °C to 200 °C / 60 s to 120 s
    Solder heating: 255 °C / 30 s, 3 times (260 °C peak)
  Soldering iron: 350 °C / 3.5 s, 1 time

- **TO252-2L Land Pattern Example**



Dimensions in millimeters

Marking Diagram



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DSGN-AEZ-16003