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#### FGAF40N60UFD FAIRCHILD SEMICONDUCTOR IGBT FGAF40N60UFD Ultrafast IGBT **General Description** Features Fairchild's UFD series of Insulated Gate Bipolar Transistors JEW DESIG • High speed switching (IGBTs) provides low conduction and switching losses. Low saturation voltage : V<sub>CE(sat)</sub> The UFD series is designed for applications such as motor · High input impedance control and general inverters where high speed switching is • CO-PAK, IGBT with FRP rr = 50ns a required feature. **Applications** AC & DC motor controls, general purpose inverters, robotics, and s nti С PF ΤC GC Absolute Max num Ra. T<sub>C</sub> = 25°C unless othe wise noted JŚ Symbol Description FGAF40N60UFD Units V<sub>CES</sub> C-"rcto. ...er Volkage 600 V VGES Gate mitter Vollago ± 20 V Cri stor Current @ $T_{C} = 25^{\circ}C$ 40 А ю. Collector Current ⑦ T<sub>C</sub> = 100°C 20 А Pulsed Collector Current А 160 I<sub>CM</sub> ( Diode Continuou: Forward Current @ T<sub>C</sub> = 100°C ۱<sub>E</sub> 15 А Diode Maximum Forward Current 160 А PD Maxin.um Hower Dissipation @ $T_{C} = 25^{\circ}C$ 100 W Maximum Power Dissipation @ T<sub>C</sub> = 100°C W 40 Operating Junction Temperature -55 to +150 °C Storage Temperature Range °C T<sub>stg</sub> -55 to +150 Max mum Lead Temp. for Soldering °C 300 $T_L$ Purposes, 1/8" from Case for 5 Seconds Notes : (1) Repetitive rating : Pulse width limited by max. junction temperature **Thermal Characteristics** Symbol Parameter Max. Units Тур. °C/W R<sub>0JC</sub>(IGBT) 1.2 Thermal Resistance, Junction-to-Case --- $R_{\theta JC}(DIODE)$ °C/W Thermal Resistance, Junction-to-Case --2.6

Thermal Resistance, Junction-to-Ambient

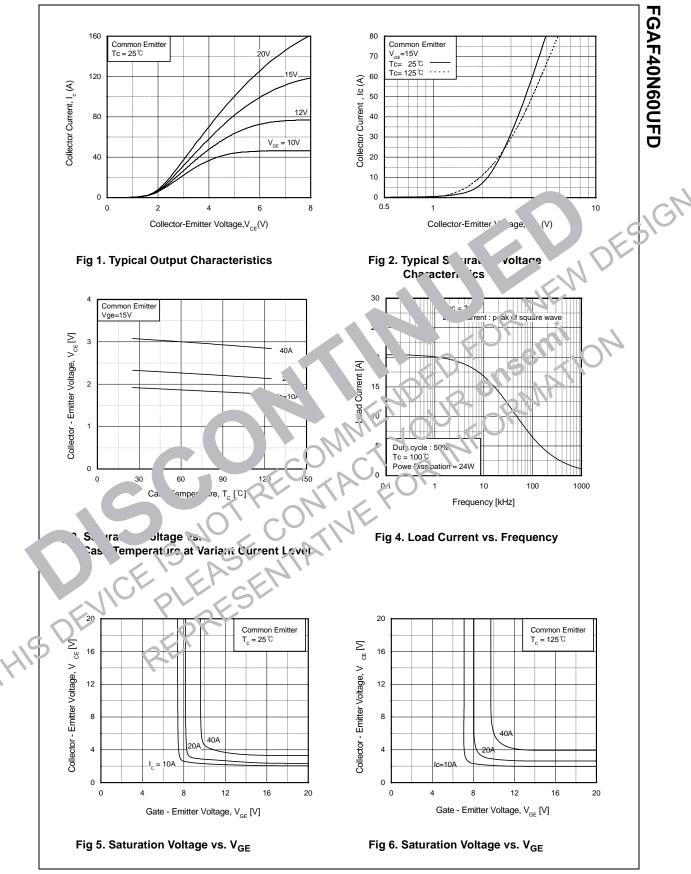
 $R_{\theta JA}$ 

°C/W

40

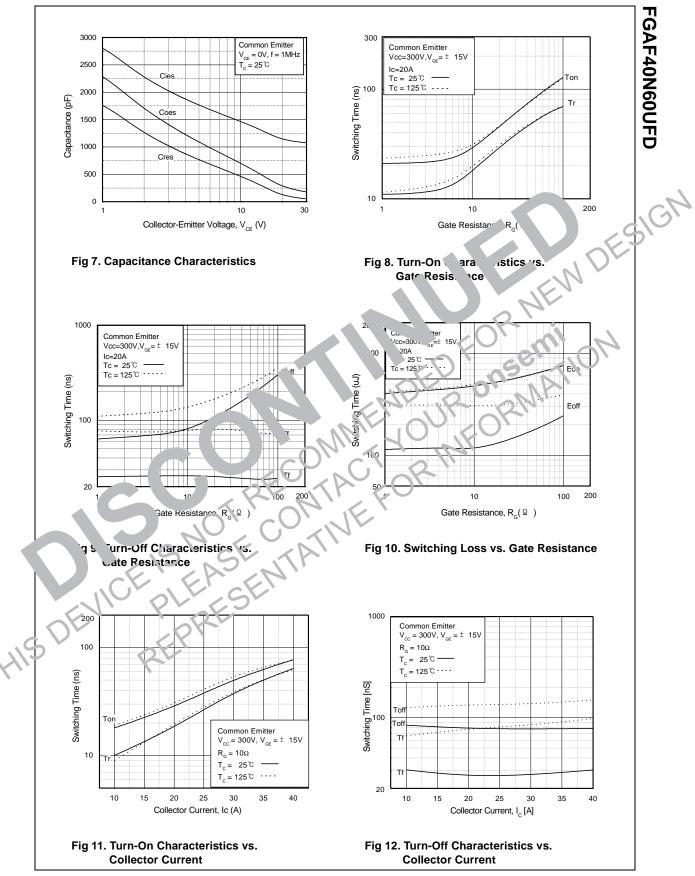
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$\begin{array}{cccccccccccccccccccccccccccccccccccc$		$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c} \Delta B_{VCES}' \\ \Delta T_J \\ V_{Oltage} \\ \Delta T_J \\ V_{Oltage} \\ Collector Cut-Off Current \\ V_{CE} \\ Collector Cut-Off Current \\ V_{CE} \\ Collector Cut-Off Current \\ V_{CE} \\ V_{CE}$		 <u>250</u> <u>±</u> 100 <u>+</u> 5 <u>-</u> 	V/°C uA nA V V V
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	BV <sub>CES</sub> AB <sub>VCES</sub> Collector-Emitter Breakdown Voltage AT_V <sub>GE</sub> = 0V, I <sub>C</sub> = 250uA600 $\Delta T_{a}$ VoltageTemperature Coefficient of Breakdown VoltageV <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA0.6 $\Delta C_{ES}$ Collector Cut-Off CurrentV <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0VI <sub>GES</sub> G-E Leakage CurrentV <sub>GE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0VOn CharacteristicsVCollector to EmitterI <sub>C</sub> = 20mA, V <sub>CE</sub> = V <sub>GE</sub> 3.55.1V <sub>CE(sall</sub> )Collector to EmitterI <sub>C</sub> = 20A, V <sub>GE</sub> = 15V2.5Saturation VoltageI <sub>C</sub> = 20N, V <sub>GE</sub> = 15V3.5Dynamic CharacteristicsCresReverse Transfer CapacitanceV <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V, f = 1MHz107CresReverse Transfer CapacitanceV <sub>CC</sub> 300 V, = 20A, R <sub>G</sub> = 102, V <sub>GE</sub> = 15V, i107Switching Characteristics3.5t <sub>4</sub> (off)Turn-On Delay Time t <sub>1</sub> 103t <sub>4</sub> (off)Turn-Off Bwitching Los103c <sub>1</sub> (off)Turn-On Delay Time t <sub>1</sub> 103t <sub>4</sub> (off)Turn-On Delay Time t <sub>1</sub> 103t <sub>4</sub> (off)Turn-On Delay Time t <sub>1</sub> 103t <sub>6</sub> (off)Turn-On Delay Time t <sub>1</sub> 103t <sub>6</sub> (off)Turn-On Delay Time t <sub>1</sub> 103t <sub>6</sub> (off)Turn-On Delay Time t <sub>1</sub> <td></td> <td> <u>250</u> <u>±</u>100 <u>+</u>5 <u>-</u> </td> <td>V/°C uA nA V V V</br></td>		 <u>250</u> <u>±</u> 100 <u>+</u> 5 <u>-</u> 	V/°C uA nA V V 
VCES/ J       Temperature Coefficient of Breakdown Voltage $V_{GE} = 0V, I_C = 1mA$ 0.6 $V/^{\circ}C$ SS       Collector Cut-Off Current $V_{CE} = V_{CES}, V_{CE} = 0V$ 250       uA         SS       G-E Leakage Current $V_{CE} = V_{GES}, V_{CE} = 0V$ ± 100       nA         Characteristics       E(th)       G-E Threshold Voltage       I_C = 20M, V_{CE} = 15V        2.6       V         Collector to Emitter       I_C = 20A, V_{GE} = 15V        2.6       V       V         Saturation Voltage       I_C = 30V, V_{GE} = 0V, I_C = 40A, V_{GE} = 15V        107 $PF$ $PE$ Output Capacitance $V_{CE} = 30V, V_{GE} = 0V,$ f = 1MHz        15 $PF$ $PF$ Nother Characteristics        15 $PF$ $PF$ $PF$ Reverse Transfer Capacitance $V_{CE} = 300, V_{GE} = 10V,$ runn-On Delay Time $PF$ </td <td><math display="block"> \begin{array}{c ccccccccccccccccccccccccccccccccccc</math></td> <td><math display="block"> \begin{array}{c c c c c c c c c c c c c c c c c c c </math></td> <td><math display="block"> \begin{array}{c cl} \Delta B_{VCES'} &amp; \mbox{Temperature Coefficient of Breakdown} \\ \Delta T_J &amp; \mbox{Votage} &amp; \mbox{V}_{GE} = 0V, I_C = 1mA &amp; &amp; 0.6 \\ \hline I_{CES} &amp; Collector Cut-Off Current &amp; V_{CE} = V_{CES}, V_{CE} = 0V &amp; &amp; \\ \hline I_{GES} &amp; G-E Leakage Current &amp; V_{GE} = V_{GES}, V_{CE} = 0V &amp; &amp; \\ \hline On Characteristics &amp; &amp;</math></td> <td></td> <td> <u>250</u> <u>±</u>100 <u>+</u>5 <u>-</u> </td> <td>V/°C uA nA V V V</td>	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c cl} \Delta B_{VCES'} & \mbox{Temperature Coefficient of Breakdown} \\ \Delta T_J & \mbox{Votage} & \mbox{V}_{GE} = 0V, I_C = 1mA & & 0.6 \\ \hline I_{CES} & Collector Cut-Off Current & V_{CE} = V_{CES}, V_{CE} = 0V & & \\ \hline I_{GES} & G-E Leakage Current & V_{GE} = V_{GES}, V_{CE} = 0V & & \\ \hline On Characteristics & & & & & & & & & & & & & & & & & & &$		 <u>250</u> <u>±</u> 100 <u>+</u> 5 <u>-</u> 	V/°C uA nA V V V
Voltage $V_{GE} = 0V, I_C = 1MA$ 0.6 $V^*C$ SS         Collector Cut-Off Current $V_{CE} = V_{GES}, V_{GE} = 0V$ 250         uA           SS         G-E Leakage Current $V_{CE} = V_{GES}, V_{CE} = 0V$ ±100         nA           n Characteristics         Ic = 20MA, $V_{CE} = V_{GE}$ 3.5         5.1         6.5         V           E(th)         G-E Threshold Voltage         Ic = 20MA, $V_{CE} = V_{GE}$ 3.5         5.1         6.5         V           E(sat)         Collector to Emitter         Ic = 20A, $V_{GE} = 15V$ 2.4         V           stauration Voltage         Ic = 40A, $V_{GE} = 15V$ 2.5         V           reside         Ic = 30V, $V_{GE} = 0V$ , for a stauration Voltage          1077 $pF$ stauration Voltage         V_{CE} = 30V, $V_{GE} = 0V$ , for a stauration Voltage          1077 $pF$ stauration Voltage         V_{CE} = 30V, $V_{GE} = 15V$ 1077 $pF$ stauration Voltage         V_{CC} 300, V_{CE} = 20A, R_G = 02,	NT_J       Voltage $V_{GE} = 0V, I_C = 1mA$ 0.6        V/C         CES       Collector Cut-Off Current $V_{CE} = V_{CES}, V_{CE} = 0V$ 250       uA         GES       G-E Leakage Current $V_{CE} = V_{CES}, V_{CE} = 0V$ $\pm 100$ nA         Dn Characteristics       //CE(sal)       G-E Threshold Voltage       I_C = 20mA, $V_{CE} = V_{GE}$ 3.5       5.1       6.5       V         Collector to Emitter       I_C = 20MA, $V_{CE} = V_{GE}$ 3.5       5.1       6.5       V         Cess       Collector to Emitter       I_C = 20A, $V_{GE} = 15V$ 2       V         Saturation Voltage       I_C = 40A, $V_{GE} = 15V$ 3.        V         Opnamic Characteristics       V_{CE} = 30V, $V_{GE} = 0V, f_C = 15V$ 3.        V         Output Capacitance $V_{CE} = 30V, V_{GE} = 0V, f_C = 15V$ 107 $pF$ Switching Characteristics        107        107 $pF$ Gres       Reverse Transfer Capacitance $V_{CE} = 300, V_{CE} = 20A, R_{C} = -20A, R_{C} = -25°C$ 10	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	         	250 ± 100	UA NA V V V
Sg       Collector Cut-Off Current $V_{CE} = V_{CES}, V_{GE} = 0V$ 250       uA         Sg       G-E Leakage Current $V_{GE} = V_{GES}, V_{CE} = 0V$ ± 100       nA         n Characteristics       I       G-E Threshold Voltage       I       C       200         ± 100       nA         n Characteristics       Collector to Emitter       I       C       200       V        200       V         G-E Threshold Voltage       I       C       200       V        200       V       V         Goldector to Emitter       I       C       200       V        200       V       V         Saturation Voltage       Input Capacitance       V       V       C       300        107 $pF$ es       Output Capacitance       V       V       C       300       V $a^{-1}$ $107$ $pF$ vitching Characteristics       V       V       C       300       V       - $a^{-1}$ $a^{-1}$ $a^{-1}$ $a^{-1}$ $a^{-1}$ $a^{-1}$ $a^{-1}$ <th< td=""><td>CES         Collector Cut-Off Current         <math>V_{CE} = V_{CES}, V_{GE} = 0V</math>           250         uA           GES         G-E Leakage Current         <math>V_{GE} = V_{GES}, V_{CE} = 0V</math>           ± 100         nA           Dn Characteristics         //GE(th)         G-E Threshold Voltage         <math>I_C = 20mA, V_{CE} = V_{GE}</math>         3.5         5.1         6.5         V           Collector to Emitter         <math>I_C = 20A, V_{GE} = 15V</math>          2         2         V           Cel(sat)         Saturation Voltage         <math>I_C = 20A, V_{GE} = 15V</math>          3          V           Opnamic Characteristics         Input Capacitance         <math>V_{CE} = 30V, V_{GE} = 0V, f = 1MHz</math>          107'          <math>pF</math>           Cres         Reverse Transfer Capacitance         <math>V_{CC} = 300, V_{GE} = 15V</math>          100'          <math>pF</math>           Switching Characteristics         <math>V_{CC} = 300, V_{GE} = 15V</math>          15'          <math>pF</math>           Gef         Tum-On Delay Time         <math>V_{CC} = 300, V, U_{C} = 20A, PG</math>          15'         <math>PG</math> <math>PG</math>          15'         <math>PG</math> <math>PG</math>          100'         <math>PG</math></td><td>Set         Collector Cut-Off Current         <math>V_{CE} = V_{CES}</math>, <math>V_{GE} = 0V</math>           250         uA           G=E         G=E Leakage Current         <math>V_{GE} = V_{GES}</math>, <math>V_{CE} = 0V</math>           ± 100         nA           On Characteristics         (GE(m)         G=E Threshold Voltage         <math>I_C = 20mA</math>, <math>V_{CE} = V_{GE}</math>         3.5         5.1         6.5         V           Collector to Emitter         <math>I_C = 20A</math>, <math>V_{GE} = 15V</math>          2.5         V         V           Saturation Voltage         <math>I_C = 20A</math>, <math>V_{GE} = 15V</math>          3.5         5.1         6.5         V           Celeset)         Collector to Emitter         <math>I_C = 20A</math>, <math>V_{GE} = 15V</math>          3.5          V           Oppamic Characteristics         <math>V_{CE} = 30V</math>, <math>V_{GE} = 0V</math>, <math>f = 10T'</math> <math>107''</math> <math>pF</math>           Switching Characteristics         <math>I_C = 10V</math>, <math>V_{GE} = 0V</math>, <math>I_C = 20A</math>, <math>R_G = -2, V_{GE} = 15V</math> <math>107''</math> <math>107''</math> <math>107''</math> <math>107'''</math> <math>107''''''''''''''''''''''''''''''''''''</math></td><td><math>l_{CES}</math>Collector Cut-Off Current<math>V_{CE} = V_{CES}, V_{GE} = 0V</math><math>l_{GES}</math>G-E Leakage Current<math>V_{GE} = V_{GES}, V_{CE} = 0V</math>On Characteristics<math>V_{GE}(th)</math>G-E Threshold Voltage<math>l_C = 20mA, V_{CE} = V_{GE}</math>3.55.1<math>V_{CE}(sat)</math>Collector to Emitter<math>l_C = 20A, V_{GE} = 15V</math>2.7Saturation Voltage<math>l_C = 20A, V_{GE} = 15V</math>2.7<math>V_{CE(sat)}</math>Collector to Emitter<math>l_C = 20A, V_{GE} = 15V</math>3.7Dynamic Characteristics<math>C_{res}</math>Input Capacitance<math>V_{CE} = 30V, V_{GE} = 0V, f = 10R, V_{CE} = 30V, V_{GE} = 0V, f = 10R, V_{CE} = 30V, V_{GE} = 15V, f = 10R, V_{CE} = 30V, V_{GE} = 15V, f = 10R, V_{CE} = 300, V_{GE} = 15V, f = 10R, V_{CE} = 300, V_{CE} = 20A, R_{G} = 0.2, V_{GE} = 15V, f = 10R, V_{CC} = 300, V_{CE} = 20A, R_{G} = 0.2, V_{GE} = 15V, f = 10R, f = 10R, V_{CC} = 300, V_{CE} = 20A, R_{G} = 0.2, V_{GE} = 15V, f = 10R, f = 10R, R_{G} = 0.02, V_{CE} = 10V, f = 300, V_{CE} = 20A, R_{G} = 0.02, V_{CE} = 300, V_{CE} = 20A, R_{G} = 0.02, V_{CE} = 50V, f = 0.02, R_{G} = 0.02, V_{CE} = 50V, f = 0.02, R_{G} = 0.02, V_{CE} = 50V, f = 0.02, R_{G} = 0.02, V_{CE} = 50V, f = 0.02, R_{G} = 50V, R_{G} = 1.02, R_{G} = 0.02, R_{G} = 1.02, R_{G} = 1.02, R_{G} = 1.02, R_{G} =</math></td><td> : .1 </td><td>± 100</td><td>NA V V V</td></th<>	CES         Collector Cut-Off Current $V_{CE} = V_{CES}, V_{GE} = 0V$ 250         uA           GES         G-E Leakage Current $V_{GE} = V_{GES}, V_{CE} = 0V$ ± 100         nA           Dn Characteristics         //GE(th)         G-E Threshold Voltage $I_C = 20mA, V_{CE} = V_{GE}$ 3.5         5.1         6.5         V           Collector to Emitter $I_C = 20A, V_{GE} = 15V$ 2         2         V           Cel(sat)         Saturation Voltage $I_C = 20A, V_{GE} = 15V$ 3          V           Opnamic Characteristics         Input Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107' $pF$ Cres         Reverse Transfer Capacitance $V_{CC} = 300, V_{GE} = 15V$ 100' $pF$ Switching Characteristics $V_{CC} = 300, V_{GE} = 15V$ 15' $pF$ Gef         Tum-On Delay Time $V_{CC} = 300, V, U_{C} = 20A, PG$ 15' $PG$ $PG$ 15' $PG$ $PG$ 100' $PG$	Set         Collector Cut-Off Current $V_{CE} = V_{CES}$ , $V_{GE} = 0V$ 250         uA           G=E         G=E Leakage Current $V_{GE} = V_{GES}$ , $V_{CE} = 0V$ ± 100         nA           On Characteristics         (GE(m)         G=E Threshold Voltage $I_C = 20mA$ , $V_{CE} = V_{GE}$ 3.5         5.1         6.5         V           Collector to Emitter $I_C = 20A$ , $V_{GE} = 15V$ 2.5         V         V           Saturation Voltage $I_C = 20A$ , $V_{GE} = 15V$ 3.5         5.1         6.5         V           Celeset)         Collector to Emitter $I_C = 20A$ , $V_{GE} = 15V$ 3.5          V           Oppamic Characteristics $V_{CE} = 30V$ , $V_{GE} = 0V$ , $f = 10T'$ $107''$ $pF$ Switching Characteristics $I_C = 10V$ , $V_{GE} = 0V$ , $I_C = 20A$ , $R_G = -2, V_{GE} = 15V$ $107''$ $107''$ $107''$ $107'''$ $107''''''''''''''''''''''''''''''''''''$	$l_{CES}$ Collector Cut-Off Current $V_{CE} = V_{CES}, V_{GE} = 0V$ $l_{GES}$ G-E Leakage Current $V_{GE} = V_{GES}, V_{CE} = 0V$ On Characteristics $V_{GE}(th)$ G-E Threshold Voltage $l_C = 20mA, V_{CE} = V_{GE}$ 3.55.1 $V_{CE}(sat)$ Collector to Emitter $l_C = 20A, V_{GE} = 15V$ 2.7Saturation Voltage $l_C = 20A, V_{GE} = 15V$ 2.7 $V_{CE(sat)}$ Collector to Emitter $l_C = 20A, V_{GE} = 15V$ 3.7Dynamic Characteristics $C_{res}$ Input Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 10R, V_{CE} = 30V, V_{GE} = 0V, f = 10R, V_{CE} = 30V, V_{GE} = 15V, f = 10R, V_{CE} = 30V, V_{GE} = 15V, f = 10R, V_{CE} = 300, V_{GE} = 15V, f = 10R, V_{CE} = 300, V_{CE} = 20A, R_{G} = 0.2, V_{GE} = 15V, f = 10R, V_{CC} = 300, V_{CE} = 20A, R_{G} = 0.2, V_{GE} = 15V, f = 10R, f = 10R, V_{CC} = 300, V_{CE} = 20A, R_{G} = 0.2, V_{GE} = 15V, f = 10R, f = 10R, R_{G} = 0.02, V_{CE} = 10V, f = 300, V_{CE} = 20A, R_{G} = 0.02, V_{CE} = 300, V_{CE} = 20A, R_{G} = 0.02, V_{CE} = 50V, f = 0.02, R_{G} = 0.02, V_{CE} = 50V, f = 0.02, R_{G} = 0.02, V_{CE} = 50V, f = 0.02, R_{G} = 0.02, V_{CE} = 50V, f = 0.02, R_{G} = 50V, R_{G} = 1.02, R_{G} = 0.02, R_{G} = 1.02, R_{G} = 1.02, R_{G} = 1.02, R_{G} =$	: .1 	± 100	NA V V V
S       G-E Leakage Current $V_{GE} = V_{GES}$ , $V_{CE} = 0V$ $\pm 100$ nA         n Characteristics       Ic = 20mA, $V_{CE} = V_{GE}$ 3.5       5.1       6.5       V         E(th)       G-E Threshold Voltage       Ic = 20M, $V_{GE} = 15V$ 2.7       V         Collector to Emitter Saturation Voltage       Ic = 20A, $V_{GE} = 15V$ 2.7       V         main       Characteristics        V        3.7        V         main       Input Capacitance       V <sub>CC</sub> = 300 V, V <sub>GE</sub> = 0V, f = 1MHz        107 $V_{F}$ sise       Input Capacitance       V <sub>CC</sub> = 300 V, V <sub>GE</sub> = 0V, f = 1MHz        107 $V_{F}$ vitching Characteristics         107 $V_{F}$ $V_{C}$ 300 V, $V_{C}$ 107 $V_{F}$ witching Characteristics         107 $V_{F}$ $V_{C}$ 300 V, $V_{C}$ $V_{C}$ $V_{C}$ $V_{C}$ $V_{C}$ $V_{C}$	GES         G-E Leakage Current $V_{GE} = V_{GES}$ , $V_{CE} = 0V$ $\pm 100$ nA           On Characteristics $V_{GE}(h)$ G-E Threshold Voltage $I_C = 20nA$ , $V_{CE} = V_{GE}$ $3.5$ $5.1$ $6.5$ V           Callector to Emitter $I_C = 20A$ , $V_{GE} = 15V$ $2$ $V$ $V$ Staturation Voltage         Input Capacitance $V_{CE} = 30V$ , $V_{GE} = 15V$ $2$ $V$ Opnamic Characteristics $V_{CE} = 30V$ , $V_{GE} = 0V$ , $f = 1MHz$ $107$ $$ $pF$ Organic Characteristics $V_{CE} = 30V$ , $V_{GE} = 0V$ , $f = 1MHz$ $$ $107$ $$ $pF$ Switching Characteristics $V_{CC}$ $300$ , $V_{-} = 20A$ , $R_G = -12$ , $V_{GE} = 15V$ $$ $30$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $$ $107$ $107$	Bes         G-E Leakage Current $V_{GE} = V_{GES}, V_{CE} = 0V$ $\pm 100$ nA           On Characteristics         Ge(th)         G-E Threshold Voltage         I_C = 200A, V_{CE} = V_{GE}         3.5         5.1         6.5         V           Callector to Emitter Saturation Voltage         I_C = 20A, V_{GE} = 15V          2         V         V           Opposite         Collector to Emitter Saturation Voltage         V_CE = 30V, V_{GE} = 15V          2         V         V           Opposite         Characteristics         V         V         CE = 30V, V_{GE} = 0V, T          107'          V           Opposite         Output Capacitance         V         V         CE = 30V, V_{GE} = 0V, T          107'          PF           Switching Characteristics         V         V         CE = 30V, V_{GE} = 0V, T          3.5         100'         ns           Idef         Turn-On Delay Time         V         V         Ce = 300, V, V = 20A, R          3.5         100'         ns           Idef         Turn-Off Delay Time         V         V         Ce = 300, V, V = 20A, R          3.5         100'         nu J	loggs       G-E Leakage Current       VGE = VGES, VGE = 0V           On Characteristics       VGE(th)       G-E Threshold Voltage       Ic = 20MA, VGE = VGE       3.5       5.1         VGE(th)       G-E Threshold Voltage       Ic = 20MA, VGE = VGE       3.5       5.1         VCE(sat)       Collector to Emitter Saturation Voltage       Ic = 20A, VGE = 15V        2         Dynamic Characteristics       VCE = 30V, VGE = 0V, f = 107        107        107         Cres       Reverse Transfer Capacitance       VCE = 30V, VGE = 0V, f = 10HZ        107        700         Switching Characteristics       VGC 300, V, = 20A, RG = 15V        3.5       5.1         Switching Characteristics       VGC 300, V, = 20A, RG = 15V        3.5         td(off)       Turn-0ff Delay Time       VGC 300, V, = 20A, RG = 15V        3.5         Eon       Turn-0ff Switching Los       Inductive Load, T_G = 25°C        107         td(off)       Turn-0D Delay Time       VCG = 300, V, I_G = 28A, RG = 012, VGG = 5V        300        300        300        300        300        300        300	077 70 50	± 100	NA V V V
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dr Characteristics         VdE(th)       G-E Threshold Voltage       I_C = 20mA, V_{CE} = V_{GE}       3.5       5.1       6.5       V         VcE(sat)       Gollector to Emitter       I_C = 20A.       V_{GE} = 15V        2.7       5.1       6.5       V         Opposite       Ic = 40A.       V_{GE} = 15V        2.7       3.        V         Opposite       Input Capacitance       V_{CE} = 30V, V_{GE} = 0V, f = 1MHz        3.        V         Opposite       Reverse Transfer Capacitance       V_{CE} = 30V, V_{GE} = 0V, f = 1MHz        107        pF         Switching Characteristics       V       V       -       3.5       7.0       ->       pF         Switching Characteristics       V       V       V       -       3.5       7.0       pF         Switching Characteristics       V       V       -       20A, R_G = 2, V_{GE} = 15V, T_{C} = 35, 7.00       ns       ns         d(aft)       Turn-On Delay Time       V       V       -       3.5       7.00       ns         on       Turn-On Switching Los       V       -       3.0       -       1.30       -       1.30		On Characteristics       Ic = 20mA, V <sub>GE</sub> = V <sub>GE</sub> 3.5       5.1         V <sub>GE(th)</sub> G-E Threshold Voltage       Ic = 20A, V <sub>GE</sub> = 15V        2 model         V <sub>CE(sat)</sub> Saturation Voltage       Ic = 40A, V <sub>GE</sub> = 15V        3.5         Dynamic Characteristics         C <sub>res</sub> Input Capacitance       V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V, f = 10T        107         C <sub>res</sub> Reverse Transfer Capacitance       V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V, f = 10HHz        0.0         Switching Characteristics         t <sub>d(off)</sub> Tum-On Delay Time       V <sub>CC</sub> 300 V, = 20A, R <sub>G</sub> = 0.2, V <sub>GE</sub> = 15V        600         t <sub>d(off)</sub> Tum-Off Delay Time       V <sub>CC</sub> 300 V, = 20A, R <sub>G</sub> = 0.2, V <sub>GE</sub> = 15V        107         t <sub>d(off)</sub> Tum-Off Switching Los       Inductive Load, T <sub>C</sub> = 28A, T = 300        102         t <sub>d(off)</sub> Tum-Of Delay Time       V <sub>CC</sub> = 300 V, I <sub>C</sub> = 28A, T = 300        300         t <sub>d(off)</sub> Tum-Of Delay Time       V <sub>CC</sub> = 300 V, I <sub>C</sub> = 28A, T = 300        300         t <sub>d(off)</sub> Tum-Of Delay Time       V <sub>CC</sub> = 300 V, I <sub>C</sub> = 20A, T = 300        300         t <sub>d(off)</sub> Tum-Of S	)7 <sup>-</sup> 70 50		V V
E(th)G-E Threshold Voltage $I_C = 20mA, V_{CE} = V_{GE}$ 3.55.16.5VCollector to Emitter Saturation Voltage $I_C = 20A, V_{GE} = 15V$ 2.5V(mamic CharacteristicssInput Capacitance esOutput Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107' $pF$ sReverse Transfer Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107' $pF$ vitching Characteristicsm)Turn-On Delay Time Rise Time aff $V_{CC}$ 300 V, $= 20A, R_G = 0, V_{GE} = 15V, red15 n^{-2}redn/fTurn-Off Delay TimerV_{CC} 300 V, = 20A, R_G = 20^{\circ}C15 n^{-2}redn/fTurn-Off Delay TimerV_{CC} = 300 V, I_C = 20^{\circ}C1000redn/fTurn-On Switching Lossrred = 300 V, I_C = 20A, R_G = 15V, red11000redn/fTurn-On Delay TimerV_{CC} = 300 V, I_C = 20A, R_G = 15V, red11000redn/fTurn-On Delay TimerV_{CC} = 300 V, I_C = 20A, R_G = 15V, red110000redn/fTurn-On Suitching Losred = 300 V, I_C = 125^{\circ}C110000redn/fTurn-On Suitching Lossred = 300 V, I_C = 20A, red771500redn/fTurn-On Suitching Lossred = 300 V, I_C = 20A, red77150redn/fTurn-O Suitching Lossred Suitching Lo$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	)7 <sup>-</sup> 70 50		V V
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c} Ce[sat) \\ Ce[sat)$	$V_{CE(sat)}$ Collector to Emitter Saturation Voltage $I_C = 20A$ . $V_{GE} = 15V$ $$ $2 \le I_C = 40A$ . $V_{GE} = 15V$ $$ $2 \le I_C = 40A$ . $V_{GE} = 15V$ $$ $3.$ Dynamic Characteristics $C_{les}$ Input Capacitance $V_{CE} = 30V$ . $V_{GE} = 0V$ , f = 1MHz $$ $107$ $C_{oes}$ Output Capacitance $V_{CE} = 30V$ . $V_{GE} = 0V$ , f = 1MHz $$ $107$ $C_{res}$ Reverse Transfer Capacitance $V_{CE} = 30V$ . $V_{GE} = 0V$ , f = 1MHz $$ $107$ $Switching CharacteristicsV_{CC} = 300.V_{GE} = 15V.107t_{d(off)}Turn-On Delay TimeV_{CC} = 300.V_{CC} = 300.250t_{q}Fall TimeV_{CC} = 300.V_{CC} = 20A,T_{C} = 25^{\circ}C470t_{d(off)}Turn-On Delay TimeV_{CC} = 300.V_{CC} = 300.V_{C} = 300.300t_{q}Time.V_{CC} = 300.V_{CC} = 125^{\circ}C310t_{q}Time.V_{CC} = 300.V_{C} = 125^{\circ}C310t_{q}Time.V_{CE} = 300.V_{C} = 125^{\circ}C310t_{q}Time.V_{CE} = 300.V_{C} = 125^{\circ}C310t_{q}Time.V_{CE} = 100.V_{C} = 125^{\circ}C200t_{q}Gate-Eniter ChargeV_{CE} = 100.V_{CE} = 125^{\circ}C200t_{q}$	)7' / 0 50		V V
E(sat)       Saturation Voltage $I_C = 40A$ . $V_{GE} = 15V$ 3.        V         rmamic Characteristics       s       Input Capacitance $V_{CE} = 30V$ , $V_{GE} = 0V$ , $f = 1MHz$ $107^{\circ}$ $pF$ es       Output Capacitance $V_{CE} = 30V$ , $V_{GE} = 0V$ , $f = 1MHz$ $107^{\circ}$ $pF$ vitching Characteristics $107^{\circ}$ $pF$ $70^{\circ}$ $pF$ vitching Characteristics $15^{\circ}$ $1^{\circ}$	CE(sat)       Saturation Voltage $I_C = 40A$ , $V_{GE} = 15V$ 3.        V         Opnamic Characteristics $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107'        NF'         Cres       Reverse Transfer Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107'        NF'         Switching Characteristics $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107'        NF'         Ga(on)       Turn-On Delay Time $V_{CC}$ $000, V_{V} = 20A, R_G = 0, V, GE = 10V, V, GE = 20A, R_G = 0.2, V_{GE} = 10V, V, GE = 20A, R_G = 0.2, V_{GE} = 50V, V, GE = 300, V, I_C = 20A, R_G = 0.2, V_{GE} = 50V, V, GE = 300, V, I_C = 20A, V, GE = 10V, V, GE = 300, V, I_C = 20A, V, GE = 10V, V, GE = 20A, V, GE = 10V, V, GE = 20A, V, GE = 300, V, I_C = 20A, V, GE = 10V, V, GE = 20A, V, GE = 10V, V, GE = 20A, V, GE = 10V, V, GE = 10V, V, GE = 20A, V, GE = 10V, V, GE = 20A, V, GE = 20A, V, GE = 20A, V, GE = 20A, V, GE = 10V, V, GE = 20A, V, GE = 20A,$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	VCE(sat)       Saturation Voltage $I_C = 40A$ , $V_{GE} = 15V$ 3.         Dynamic Characteristics $V_{CE} = 30V, V_{GE} = 0V, f = 10T$ 107         Coes       Output Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 10HZ$ 107         Cres       Reverse Transfer Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 10HZ$ 107         Switching Characteristics $V_{CC} = 300V, V_{GE} = 0V, f = 10HZ$ 107         Switching Characteristics $V_{CC} = 300V, V_{GE} = 16V, f = 10HZ$ 107 $t_{d(off)}$ Turn-On Delay Time $V_{CC} = 300V, V_{GE} = 16V, f = 100, f = 25°C$ 107 $t_{d(off)}$ Turn-Off Switching Los       V_{CC} = 300V, I_C = 20A, f = 100, f = 25°C        100 $t_{d(off)}$ Turn-O Delay Time $V_{CC} = 300V, I_C = 20A, f = 100, f = 125°C$ 300        300 $t_{d(off)}$ Turn-O Delay Time $V_{CC} = 300V, I_C = 20A, f = 125°C$ 310        310        310        310        310        310        310        310        310        310	)7 /0 50		V
Imput Capacitance $V_{CE} = 30V$ , $V_{GE} = 0V$ , $ 107^{\circ}$ $107^{\circ}$ $107$	Outstation rotage $I_C = 401,  V_{GE} = 100$ $U_{C} = 100$ $U_{C} = 100$ Oppmanic Characteristics $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ $ 107$ $ pF$ Cres         Reverse Transfer Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ $ 107$ $ pF$ Switching Characteristics $T$ $T$ $107$ $ pF$ Switching Characteristics $V_{CC}$ $300 V, = 20A, R_G = 0, V_{GE} = 16V, V, S = 16V, V_{CC}$ $ 15$ $ 120$ $ns$ $d(off)$ Turn-Off Delay Time $V_{CC}$ $300 V, = 20A, R_G = 0, V_{GE} = 16V, V, S = 300 V, I_C = 20^{\circ}C$ $ 130$ $ns$ $and Turn-Off Switching Los          150  100 nductiv = Load, T_C = 25^{\circ}C  170  uJ and(off)         Turn-On Delay Time         V_{CC} = 300 V, I_C = 20A, R_G = 102^{\circ}C  110 200 ns and(off)         Turn-On Delay Time         V_{CC} = 300 V, I_C = 20A, R_G = 125^{\circ}C  110 200 ns $	Operation         Inc = 404, V_{GE} = 10V         U         U         U           Opnamic Characteristics $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107 $pF$ $C_{Oes}$ Output Capacitance $F = 1MHz$ 107 $pF$ $C_{Oes}$ Output Capacitance $F = 1MHz$ 107 $pF$ $C_{res}$ Reverse Transfer Capacitance $V_{CC} = 300, V_{GE} = 0V, f = 10V, f = 500, r = 000, r = 0$	Determinant of the systemDynamic Characteristics $C_{ies}$ Input Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 107$ $C_{cres}$ Reverse Transfer Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 10Hz$ $$ $C_{res}$ Reverse Transfer Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 10Hz$ $$ Switching Characteristics $V_{CC} = 300, V_{CE} = 20A, F = 15V, f = 10Hz$ $$ $$ $t_{(0n)}$ Turn-On Delay Time $V_{CC} = 300, V_{CE} = 20A, F = 15V, f = 100, F = 25°C$ $$ $$ $t_{d(off)}$ Turn-On Switching LosInductive Load, $T_{CE} = 25°C$ $$ $$ $t_{d(off)}$ Turn-Off Delay Time $V_{CC} = 300, V, I_{C} = 20A, F = 100, V_{CE} = 300, V_{CE} = 50V$ $$ $$ $t_{d(off)}$ Turn-Off Delay Time $V_{CC} = 300, V, I_{C} = 20A, F = 300, V_{CE} = 125°C$ $$ $$ $t_{d(off)}$ Turn-On Delay Time $V_{CE} = 300, V, I_{C} = 20A, F = 100, V_{CE} = 125°C$ $$ $$ $t_{d(off)}$ Turn-On S, J LossInductive Load, $T_{C} = 125°C$ $$ $$ $$ $t_{d(off)}$ Turn-On S, J LossInductive Load, $T_{C} = 20A, F_{C} = 125°C$ $$ $$ $t_{ge}$ Gate-Enritee ChargeV_{CE} = 300, V, I_{C} = 20A, F_{C} = 125°C $$ $$ $Q_{ge}$ Gate-Enritee ChargeMeasured 5mm from PKG $$ $$ $Q_{ge}$ Gate-Enritee ChargeMeasured 5mm from PKG $$ $$ $Q_{ge}$ Characteristics of DIODE $T_{C} = 25°C$ $$ $$ <td>07</td> <td></td> <td>~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~</td>	07		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
s       Input Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107 $pF$ $g_{S}$ Reverse Transfer Capacitance $r = 1MHz$ $r = 0, r = 10, r = $	Linguit Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ $107$ $107$ $107$ Cres         Reverse Transfer Capacitance $f = 1MHz$ $107$ $107$ $107$ Switching Characteristics $f = 1MHz$ $107$ $107$ $107$ $107$ Switching Characteristics $f = 1MHz$ $105$ $107$ $107$ $107$ Switching Characteristics $107$ $107$ $107$ $107$ $107$ Switching Characteristics $107$ $107$ $107$ $107$ $107$ Switching Characteristics $107$ $107$ $107$ $107$ $107$ Switching Los $V_{CC} = 300 V, V_{C} = 20A, R_{C} = -25°C$ $1730$ $103$ $103$ Switching Los $10730$ $1030$ $1030$ $1030$ $1030$ Switching Los $10730$ $1030$ $1030$ $1030$ $1030$ Switching Los $1030$ $1030$ $1030$ $1030$ $1030$ </td <td>Input Capacitance         <math>V_{CE} = 30V, V_{GE} = 0V, f = 1MHz</math> <math></math> <math>107^{\circ}</math> <math></math> <math>pF</math> <math>C_{res}</math>         Reverse Transfer Capacitance         <math></math> <math>107^{\circ}</math> <math></math> <math>pF</math> <math>C_{res}</math>         Reverse Transfer Capacitance         <math></math> <math>107^{\circ}</math> <math></math> <math>pF</math>           Switching Characteristics         <math></math> <math>15^{\circ}</math> <math></math> <math>pF</math> <math>d(off)</math>         Turn-On Delay Time         <math>V_{CC}</math> <math>300</math> <math></math> <math>15^{\circ}</math> <math></math> <math>ns</math> <math>fall</math>         Fall Time         <math>V_{CC}</math> <math>300</math> <math></math> <math>ns</math> <math>ns</math> <math>ns</math> <math>ns</math> <math>fort         Turn-On Switching Loss         <math>V_{CC} = 300</math> <math>V_{CE} = 20A, R_G = 02, V_{GE} = 15V</math> <math></math> <math>130^{\circ}</math> <math>nu</math> <math>fort         Turn-On Delay Time         <math>V_{CC} = 300</math> <math>V_{CE} = 20A, R_G = 02, V_{GE} = 5V</math> <math></math> <math>110^{\circ}</math> <math>0^{\circ}</math> <math>0^{\circ}</math><!--</math--></math></math></td> <td>CiesInput Capacitance<math>V_{CE} = 30V, V_{GE} = 0V, f = 107, f = 107, f = 1017, f = 1017, f = 1011, f = </math></td> <td>70 50</td> <td></td> <td>- <u>p</u>r</td>	Input Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ $$ $107^{\circ}$ $$ $pF$ $C_{res}$ Reverse Transfer Capacitance $$ $107^{\circ}$ $$ $pF$ $C_{res}$ Reverse Transfer Capacitance $$ $107^{\circ}$ $$ $pF$ Switching Characteristics $$ $15^{\circ}$ $$ $pF$ $d(off)$ Turn-On Delay Time $V_{CC}$ $300$ $$ $15^{\circ}$ $$ $ns$ $fall$ Fall Time $V_{CC}$ $300$ $$ $ns$ $ns$ $ns$ $ns$ $fort         Turn-On Switching Loss         V_{CC} = 300 V_{CE} = 20A, R_G = 02, V_{GE} = 15V  130^{\circ} nu fort         Turn-On Delay Time         V_{CC} = 300 V_{CE} = 20A, R_G = 02, V_{GE} = 5V  110^{\circ} 0^{\circ} 0^{\circ}$	CiesInput Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 107, f = 107, f = 1017, f = 1017, f = 1011, f = $	70 50		- <u>p</u> r
s       Input Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107 $pF$ $g_{S}$ Reverse Transfer Capacitance $r = 1MHz$ $r = 0, r = 10, r = $	Input Capacitance $V_{CE} = 30V$ , $V_{GE} = 0V$ , f = 1MHz $$ $107'$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10''$ $$ $10'''$ $$ $10''''$ $$ $10''''''''''''''''''''''''''''''''''''$	Input Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 10T'$ $$ $10T'$ $$ $nF'$ $C_{res}$ Reverse Transfer Capacitance $F = 1MHz$ $$ $10T'$ $$ $nF'$ Switching Characteristics $$ $10T'$ $$ $nF'$ $$ $nF'$ Switching Characteristics $$ $15$ $$ $nF'$ $$ $nF'$ $M(off)$ Turn-On Delay Time $V_{CC}$ $30V, V_{=} = 20A, R_{G} = 02, V_{GE} = 16V, P_{G} = 35^{\circ}$ $$ $35$ $100$ $ns$ $fail Time          10T'  nS' 10V ns forf         Turn-On Switching Loss          10V_{CC} = 300^{\circ} V, I_{C} = 20^{\circ} C  100^{\circ} U  130^{\circ}   M(off)         Turn-On Delay Time         V_{CC} = 300^{\circ} V, I_{C} = 20A, R_{G} = 002, V_{GC} = 50^{\circ}  110^{\circ} 200^{\circ}  110^{\circ} 200^{\circ}  110^{\circ} 200^{\circ}   10^{\circ} 20^{\circ}  110^{\circ} 20^{\circ}  $	CiesInput Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 107$ 107 $C_{oes}$ Output Capacitance $V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$ 107 $C_{res}$ Reverse Transfer Capacitancef = 1MHz50Switching Characteristics $t_{(on)}$ Turn-On Delay Time15 $t_r$ Rise TimeV <sub>CC</sub> , 300 V, $v = 20A, R_G = 0, V_{GE} = 10V, 100, 000, 000, 000, 000, 000, 000,$	70 50		<b>P</b>
esOutput Capacitance $V_{CE} = 300$ , $V_{GE} = 501$ , $T_{GE} = 500$ , $T_{GE} = 15V$ , $T_{GE} = 500$ , $T_{GE} = 15V$ , $T_{GE} = 500$ , $T_{GE} = 200$ , $T_{GE}$	Coes         Output Capacitance $10E = 001, 10E = 01, 10$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	CoesOutput CapacitanceThe formulaThe formula $C_{res}$ Reverse Transfer Capacitance $f = 1MHz$ The formula $t_{(on)}$ Turn-On Delay Time $f = 1MHz$ $f = 1MHz$ $t_{(on)}$ Turn-On Delay Time $f = 1MHz$ $f = 10MHz$ $t_{(on)}$ Turn-On Delay Time $f = 10MHz$ $f = 10MHz$ $t_{(on)}$ Turn-On Delay Time $f = 10MHz$ $f = 10MHz$ $t_{(on)}$ Turn-Off Delay Time $V_{CC} = 300 V, f = 20A, R_G = 0.2, V_{GE} = 15V. Inductive Load, T_C = 25°Cf = 1000 V_{CC} = 100 V_{C$	70 50	<u>E</u>	-7C
esOutput Capacitance $V_{CE} = 300$ , $V_{GE} = 501$ , $T_{GE} = 500$ , $T_{GE} = 15V$ , $T_{GE} = 500$ , $T_{GE} = 15V$ , $T_{GE} = 500$ , $T_{GE} = 200$ , $T_{GE}$	Coes         Output Capacitance $10E = 001, 10E = 01, 10$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	CoesOutput CapacitanceThe formulaThe formula $C_{res}$ Reverse Transfer Capacitance $f = 1MHz$ The formula $t_{(on)}$ Turn-On Delay Time $f = 1MHz$ $f = 1MHz$ $t_{(on)}$ Turn-On Delay Time $f = 1MHz$ $f = 10MHz$ $t_{(on)}$ Turn-On Delay Time $f = 10MHz$ $f = 10MHz$ $t_{(on)}$ Turn-On Delay Time $f = 10MHz$ $f = 10MHz$ $t_{(on)}$ Turn-Off Delay Time $V_{CC} = 300 V, f = 20A, R_G = 0.2, V_{GE} = 15V. Inductive Load, T_C = 25°Cf = 1000 V_{CC} = 100 V_{C$	50		
Reverse Transfer Capacitance       50       -       pF         vitching Characteristics       -       15       -       pF         witching Characteristics       -       15       - $15$ - $15$ $m_1$ Turn-On Delay Time       V <sub>CC</sub> 300 V, $= 20A$ ,       - $15$ - $15$ $M_1$ Turn-Off Delay Time       V <sub>CC</sub> $300$ V, $= 20A$ ,       - $75$ $130$ ns $M_1$ Turn-On Switching Loss       Inductive Load, $T_C = 25°C$ - $470$ -       uJ $M_1$ Turn-On Delay Time       V <sub>CC</sub> = 300 V, I_C = 20A,       - $130$ - $uJ$ $M_1$ Turn-On Delay Time       V <sub>CC</sub> = 300 V, I_C = 20A,       - $110$ $200$ ns $M_1$ Turn-On S. $J$ Lose $J$ $I_C$ = $125°C$ - $80$ $250$ ns $M_1$ Turn-On S. $J$ Lose $I_C$	Cres         Reverse Transfer Capacitance         50 $-$ pF           Switching Characteristics          15         15         16         16         15         16         17         15         16         17         15         16         17         15         16         17         16         17         16         17         17         16         17         10 <th10< th=""> <th10< th="">         10</th10<></th10<>	Bres         Reverse Transfer Capacitance         50 $-$ pF           Switching Characteristics          Source $-$ 15 $   -$	Cress       Reverse Transfer Capacitance       50         Switching Characteristics			
Turn-On Delay Time        15       15       15       0       0       0       0       0       15       15       0       0       0       0       0       15       15       0       0       0       0       15       15       0       0       15       15       0       15       15       0       15       15       0       15       15       0       16       15       16       16       16       16       16       16       16       16	d(on)       Turn-On Delay Time        155       15	Turn-On Delay Time        15        16 $d(on)$ Turn-Off Delay Time $V_{CC}$ $300 V_{c} = 20A$ , $31$ $18$ $d(off)$ Turn-Off Delay Time $V_{CC}$ $300 V_{c} = 20A$ , $55$ $130$ ns $Gon$ Turn-On Switching Loss       Inductive Load, $T_{C} = 25°C$ $17V$ $130$ ns $Gon$ Turn-On Switching Lo       Inductive Load, $T_{C} = 25°C$ $17V$ $130$ ns $Goff$ Turn-On Delay Time $V_{CC} = 300 V_1 I_C = 20A$ , $1000$	td(on)Turn-On Delay Time15trRise TimeV <sub>CC</sub> 300 V, = 20A,85td(off)Turn-Off Delay TimeV <sub>CC</sub> 300 V, = 20A,85tfFall TimeV <sub>CC</sub> 300 V, = 20A,85EonTurn-On Switching Loss130100100EtsTotal Switching Lo130100100trRise Tim30130trRise Tim30100trRise Tim37100trTim-On Delay TimeV <sub>CC</sub> = 300 V, I <sub>C</sub> = 20A,110trTim-On S.J Loss80td(off)Turn-On S.J Loss800800td(off)Turn-On S.J Loss800800td(off)Turn-On S.J Loss800800td(off)Turn-On S.J Loss800800td(off)Switching Loss800800Ttalfthring Loss800800800QgGate-Enritter ChargeV <sub>CE</sub> = 300 V, I <sub>C</sub> = 20A,77200QgeGate-Enritter ChargeV <sub>CE</sub> = 15V200200QnnCale-Collector ChalgeMeasured 5mm from PKG14Electrical Character Stics of DIOD			pF
Turn-On Delay Time        15       15       15       0       0       0       0       0       15       15       0       0       0       0       0       15       15       0       0       0       0       15       15       0       0       15       15       0       15       15       0       15       15       0       15       15       0       16       15       16       16       16       16       16       16       16       16	d(on)       Turn-On Delay Time        155       10       0       15       16       15	Turn-On Delay Time        15       15       16       16       16       16       16       16       16       16       16       16       16       17       16       17       10       10       10       10       10       10       10       10       10       10       10       10       10	$t_{d(on)}$ Turn-On Delay Time15 $t_r$ Rise TimeV <sub>CC</sub> 300 V, = 20A,85 $t_{d(off)}$ Turn-Off Delay TimeV <sub>CC</sub> 300 V, = 20A,85 $t_i$ Fall TimeV <sub>CC</sub> 300 V, = 20A,85 $E_{on}$ Turn-On Switching Loss130160160 $E_{ts}$ Total Switching Los13017130 $t_t$ Rise Tim30130 $t_t$ Rise Tim30130 $t_t$ Rise Tim30130 $t_t$ Rise Tim30100 $t_t$ Rise Tim30100 $t_t$ Tim On S.J Loss100 $t_f$ Tim On S.J Loss800100 $t_f$ Tim On S.J Loss800800 $t_f$ Junicoling Loss800800800 $t_f$ Junicoling Loss800800800 $Q_g$ Total Gate ChargeV <sub>CE</sub> = 300 V, I <sub>C</sub> = 20A,7777 $Q_g$ Gate-Enriter ChargeV <sub>CE</sub> = 300 V, I <sub>C</sub> = 20A,77200 $Q_{on}$ Gate-Collector ChargeV <sub>CE</sub> = 15V200200 $Q_{on}$ Gate-Collector ChargeMeasured 5mm from PKG14Enc			
Rise Time        31        15         off)       Turn-Off Delay Time $V_{CC}$ 300 V, $J = 20A$ , $rs_3$ $rs_5$ </td <td><math>r_r</math>       Rise Time        <math>3^{+}</math> <math>1^{+}</math> <math>r_f</math>       Fall Time       <math>V_{CC}</math> <math>300</math>       V, <math>= 20A</math>,        <math>r.5</math> <math>r.5</math>&lt;</td> <td>Rise Time      </td> <td>trRise Time3 t<math>t_{d(off)}</math>Turn-Off Delay Time<math>V_{CC}</math><math>300 V_{c}</math><math>= 20A, R_G = 0, V_{GE} = 15V, R_G = 0, V_{GE} = 25°C</math><math>470</math><math>E_{off}</math>Turn-Off Switching Lor<math>600</math><math>600</math><math>t_{d(off)}</math>Turn-On Delay Tin<math>30</math><math>600</math><math>t_r</math>Rise Tim<math>30</math><math>100</math><math>t_r</math>Rise Tim<math>30</math><math>110</math><math>t_f</math>Tim-O Delay TimeV_{CC} = 300 V, I_C = 20A,<math>110</math><math>t_f</math>TimR_G = 0, Q, V_{GC} = 5V<math>800</math><math>t_f</math>Tim On S.J Loss<math>810</math><math>C_{off}</math>Jun-O Switching Loss<math>810</math><math>t_f</math>Tim On S.J Loss<math>800</math><math>C_{off}</math>Jun-O Switching Loss<math>800</math><math>800</math><math>C_{off}</math>Jun-O Switching Loss<math>810</math><math>C_{off}</math>Jun C Switching Loss<math>810</math><math>C_{off}</math>Jun C Switching Loss<math>77</math><math>770</math><math>Q_{ge}</math>Gate-Emitter ChargeV_{CE} = 300 V, I_C = 20A, V_{CE} = 20A, V_{CE} = 15V<math>Q_{or}</math>Gate-ChargeNeasured 5mm from PKG14Etectrical Charactel Stics of DIODE<math>T_{c} = 25°C</math>14Total SymbolParam</td> <td></td> <td></td> <td></td>	$r_r$ Rise Time $3^{+}$ $1^{+}$ $r_f$ Fall Time $V_{CC}$ $300$ V, $= 20A$ , $r.5$ <	Rise Time	trRise Time3 t $t_{d(off)}$ Turn-Off Delay Time $V_{CC}$ $300 V_{c}$ $= 20A, R_G = 0, V_{GE} = 15V, R_G = 0, V_{GE} = 25°C$ $470$ $E_{off}$ Turn-Off Switching Lor $600$ $600$ $t_{d(off)}$ Turn-On Delay Tin $30$ $600$ $t_r$ Rise Tim $30$ $100$ $t_r$ Rise Tim $30$ $110$ $t_f$ Tim-O Delay TimeV_{CC} = 300 V, I_C = 20A, $110$ $t_f$ TimR_G = 0, Q, V_{GC} = 5V $800$ $t_f$ Tim On S.J Loss $810$ $C_{off}$ Jun-O Switching Loss $810$ $t_f$ Tim On S.J Loss $800$ $C_{off}$ Jun-O Switching Loss $800$ $800$ $C_{off}$ Jun-O Switching Loss $810$ $C_{off}$ Jun C Switching Loss $810$ $C_{off}$ Jun C Switching Loss $77$ $770$ $Q_{ge}$ Gate-Emitter ChargeV_{CE} = 300 V, I_C = 20A, V_{CE} = 20A, V_{CE} = 15V $Q_{or}$ Gate-ChargeNeasured 5mm from PKG14Etectrical Charactel Stics of DIODE $T_{c} = 25°C$ 14Total SymbolParam			
Turn-Off Delay Time $V_{CC}$ $300 V_{V} = 20A$ , $r_{5}$ $130$ ns         Fall Time       Turn-On Switching Loss       Inductive Load, $T_{C} = 25^{\circ}C$ $470$ uJ         f       Turn-Off Switching Lo $130$ ns        uJ         f       Turn-On Delay Tin $600$ 1000       uJ         on)       Turn-On Delay Tin $30$ ns         Rise Tim $300 V_{CC} = 300 V_{V} I_{C} = 20A$ , $110$ $200$ ns         f       Turn-O Delay Time $V_{CC} = 300 V_{V} I_{C} = 20A$ , $110$ $200$ ns         f       Turn-O Delay Time $V_{CC} = 300 V_{V} I_{C} = 20A$ , $110$ $200$ ns         f       Time $T_{C} = 300 V_{V} I_{C} = 125^{\circ}C$ $810$ $1200$ uJ         f       Int-C       Switching Loss $810$ $1200$ uJ         f       Int-C       Switching Loss $810$ $1200$ uJ         f       Int-C       Switching Loss <td>Image: dom final system       V<sub>CC</sub>       300 V, <math>= 20A</math>, <math>R_G = 0, V_{GE} = 15V</math>, <math>R_G = 0, V_{GE} = 15V</math>       Image: respective system       Image: respecies system       Image: respecie</td> <td>Image: diagram of the second state of the second state</td> <td><math>t_{d(off)}</math>Turn-Off Delay Time<math>V_{CC} 300 V_{v} = 20A_{v}</math>r5<math>t_{f}</math>Fall Time<math>V_{CC} 300 V_{v} = 20A_{v}</math>75<math>E_{on}</math>Turn-On Switching LossInductive Load, <math>T_{C} = 25^{\circ}C</math>77<math>E_{ts}</math>Total Switching Lor600<math>t_{(on)}</math>Turn-On Delay Time30<math>t_{r}</math>Rise Tim30<math>t_{d(off)}</math>Turn-O Delay Time30<math>t_{r}</math>Rise Tim30<math>t_{d(off)}</math>Turn-O Delay TimeV<sub>CC</sub> = 300 V, I<sub>C</sub> = 2CA,<math>t_{d(off)}</math>Turn-O S.y Loss80<math>E_{on}</math>Turn-O S.y Loss80<math>C_{off}</math>Switching Loss80<math>C_{off}</math>Switching Loss810<math>Q_{g}</math>Total Gate Charge<math>V_{CE} = 300 V, I_C = 20A,</math>77<math>Q_{ge}</math>Gate-Emitter Charge<math>V_{CE} = 300 V, I_C = 20A,</math>20<math>Q_{or}</math>Cale-Collector ChaligeV<sub>CE</sub> = 15V20<math>V_{GE} = 15V</math>2025<math>Q_{or}</math>Cale-Collector ChaligeMeasured 5mm from PKG<math>V_{CE} = 25^{\circ}C</math> unless otherwise notedT_{C} = 25^{\circ}C14Etectrical Characteristics of DIODETest ConditionsMin.TypeTest ConditionsMin.TypeTotal Querteristics of DIODETest 25^{\circ}C<td></td><td></td><td></td></td>	Image: dom final system       V <sub>CC</sub> 300 V, $= 20A$ , $R_G = 0, V_{GE} = 15V$ Image: respective system       Image: respecies system       Image: respecie	Image: diagram of the second state	$t_{d(off)}$ Turn-Off Delay Time $V_{CC} 300 V_{v} = 20A_{v}$ r5 $t_{f}$ Fall Time $V_{CC} 300 V_{v} = 20A_{v}$ 75 $E_{on}$ Turn-On Switching LossInductive Load, $T_{C} = 25^{\circ}C$ 77 $E_{ts}$ Total Switching Lor600 $t_{(on)}$ Turn-On Delay Time30 $t_{r}$ Rise Tim30 $t_{d(off)}$ Turn-O Delay Time30 $t_{r}$ Rise Tim30 $t_{d(off)}$ Turn-O Delay TimeV <sub>CC</sub> = 300 V, I <sub>C</sub> = 2CA, $t_{d(off)}$ Turn-O S.y Loss80 $E_{on}$ Turn-O S.y Loss80 $C_{off}$ Switching Loss80 $C_{off}$ Switching Loss810 $Q_{g}$ Total Gate Charge $V_{CE} = 300 V, I_C = 20A,$ 77 $Q_{ge}$ Gate-Emitter Charge $V_{CE} = 300 V, I_C = 20A,$ 20 $Q_{or}$ Cale-Collector ChaligeV <sub>CE</sub> = 15V20 $V_{GE} = 15V$ 2025 $Q_{or}$ Cale-Collector ChaligeMeasured 5mm from PKG $V_{CE} = 25^{\circ}C$ unless otherwise notedT_{C} = 25^{\circ}C14Etectrical Characteristics of DIODETest ConditionsMin.TypeTest ConditionsMin.TypeTotal Querteristics of DIODETest 25^{\circ}C <td></td> <td></td> <td></td>			
Fall Time $R_G = \Omega, V_{GE} = 15V,$ $\cdot$ $35$ $100$ ns         n       Turn-On Switching Loss       Inductive Load, $T_C = 25^{\circ}C$ $$ $170$ $$ $uJ$ f       Turn-Off Switching Lo $$ $130$ $$ $uJ$ Total Switching Lo $$ $600$ $1000$ $uJ$ $m$ Turn-On Delay Time $$ $30$ $$ $ns$ $ff$ Turn-O Delay Time $V_{CC} = 300 \text{ V}, I_C = 20A,$ $$ $110$ $200$ $ns$ $ff$ Turn-O Delay Time $V_{CC} = 300 \text{ V}, I_C = 125^{\circ}C$ $$ $80$ $250$ $ns$ $ff$ Turn-O S. $J$ Lose $J$ -ductive Load, $T_C = 125^{\circ}C$ $$ $80$ $250$ $ns$ $ff$ Jun-C       Switching Loss $$ $810$ $1200$ $uJ$ $ff$ Jun-C       Switching Loss $$ $810$ $1200$ $uJ$ $ff$ Jun-C       Switching Loss $$ $77$ $150$ $nC$ $ff$ Jun-C       Switching Loss	f       Fall Time $R_G = Q, V_{GE} = 15V,$ 35 $100$ ns $c_{on}$ Turn-On Switching Loss       Inductive Load, $T_Q = 25^{\circ}C$ $4i^{\circ}$ $uJ$ $c_{off}$ Turn-Off Switching Los $600$ 1000 $uJ$ $t_{ts}$ Total Switching Los $600$ 1000 $uJ$ $t_{ts}$ Total Switching Los $30$ ns $d(on)$ Turn-On Delay Time $V_{CC} = 300 V, I_C = 20A,$ $110$ $200$ ns $d_{con}$ Turn-O Delay Time $V_{CC} = 300 V, I_C = 20A,$ $80$ $250$ ns $f_{con}$ Turn-O S, g Losc       Inductive Load, $T_C = 125^{\circ}C$ $810$ $1200$ $uJ$ $f_{con}$ $T_{con}C_{so}$ $V_{CE} = 300 V, I_C = 20A,$ $810$ $1200$ $uJ$ $f_{con}$ $Gate-Emitter Charge$ $V_{CC} = 15V$ $20$ $30$ $nC$	Fall Time $R_G = Q, V_{GE} = 15V,$	trFall Time $R_G = Q, V_{GE} = 15V,$ Inductive Load, $T_G = 25^{\circ}C$ 470EonTurn-On Switching LossInductive Load, $T_G = 25^{\circ}C$ 470EoffTurn-Off Switching Lo130EtsTotal Switching Lor600td(on)Turn-On Delay Time30t_Rise Tim37td(off)Turn-Or Delay TimeV <sub>CC</sub> = 300 V, I <sub>C</sub> = 20A,td(off)Turn-Or Delay TimeV <sub>CC</sub> = 300 V, I <sub>C</sub> = 20A,td(off)Turn-Or S.J LosstqTimeR_G = 002, V_Gr = 5VEonTurn-Or Switching Loss310ConTurn-Or S.J LossFoffun-C Switching Loss310TTal f utching Loss800Q_gTotal Gate ChargeV <sub>CE</sub> = 300 V, I <sub>C</sub> = 20A,Q_geGate-Emitter ChargeV <sub>CE</sub> = 300 V, I <sub>C</sub> = 20A,Q_grCate-Collector ChalgeV <sub>CE</sub> = 15V20Uniternal Emitter inductanceMeasured 5mm from PKG14Electrical Character stics of DIODET <sub>C</sub> = 25°C unless otherwise notedSymbolParameterTest ConditionsMin.Type			IS
n       Turn-On Switching Loss       Inductive Load, $T_c = 25^{\circ}C$ $47^{\circ}$ uJ         f       Turn-Off Switching Lo $130^{\circ}$ uJ         Total Switching Lo $600^{\circ}$ $1000^{\circ}$ uJ         m)       Turn-On Delay Time $30^{\circ}$ ns         fill       Turn-O Delay Time $V_{CC} = 300^{\circ}V, I_C = 20A,$ $110^{\circ}$ $20^{\circ}$ fift       Turn-O Delay Time $V_{CC} = 300^{\circ}V, I_C = 20A,$ $110^{\circ}$ $200^{\circ}$ fift       Turn-O S.       J Lose       Inductive Load, $T_C = 125^{\circ}C$ $80^{\circ}$ $250^{\circ}$ ns         f       Jini-C       Switching Loss       Inductive Load, $T_C = 125^{\circ}C$ $810^{\circ}$ $1200^{\circ}$ uJ         f       Jini-C       Switching Loss $810^{\circ}$ $1200^{\circ}$ $10^{\circ}$ f       Jini-C       Switching Loss $810^{\circ}$ $1200^{\circ}$ $10^{\circ}$ f       Jini-C       Switching Loss $77^{\circ}$ $150^{\circ}$ $$ $77^{\circ}$ $150^{\circ}$	Turn-On Switching Loss       Inductive Load, $T_C = 25^{\circ}C$ $1/V$ uJ $c_{off}$ Turn-Off Switching Lo $150$ $uJ$ $t_{ts}$ Total Switching Lo $600$ $1000$ $uJ$ $d(on)$ Turn-On Delay Time $30$ $ns$ $r_{r}$ Rise Tim $30$ $ns$ $d(off)$ Turn-O Delay Time $V_{CC} = 300 \text{ V}, \text{ I}_C = 20\text{ A},$ $110$ $200$ $ns$ $f_{c}$ Time On S. $g$ Losc       Inductive Load, $T_C = 125^{\circ}C$ $80$ $250$ $ns$ $f_{c}$ $un$ -C Switching Loss       Inductive Load, $T_C = 125^{\circ}C$ $810$ $1200$ $uJ$ $f_{c}$ $f_{c}$ $f_{c}$ $f_{c}$ $f_{c}$ $f_{c}$ $f_{c}$ $uJ$ $f_{c}$	Inductive Load, $T_C = 25^{\circ}C$ $I_{1/2}$ $uJ$ Inductive Load, $T_C = 125^{\circ}C$ $I_{1/2}$ $uJ$ $uJ$ Inductive Load, $T_C = 125^{\circ}C$ $I_{1/2}$ $uJ$ $uJ$ Inductive Load, $T_C = 125^{\circ}C$ $I_{1/2}$ $uJ$ $uJ$ Inductive Load, $T_C = 125^{\circ}C$	EonTurn-On Switching LossInductive Load, $T_{c} = 25^{\circ}C$ $476$ EoffTurn-Off Switching Lo130EtsTotal Switching Lo600 $t_{d(on)}$ Turn-On Delay Tin30 $t_r$ Rise Tim37 $t_{d(off)}$ Turn-Or Delay Time $V_{CC} = 300 \text{ V}, I_C = 20\text{ A},$ $t_{t}$ Tim $R_G = 0\Omega, V_{GC} = 5V$ 80 $E_{on}$ Turn-On S			ns
Image: definition of the system of the s	$\overline{off}$ Turn-Off Switching Lor        130        uJ $\overline{f_{ts}}$ Total Switching Lor        600       1000       uJ $\overline{f_{d(on)}}$ Turn-On Delay Time        30        ns $\overline{f_{r}}$ Time       V <sub>CC</sub> = 300 V, I <sub>C</sub> = 20A,        110       200       ns $\overline{f_{r}}$ Time       R <sub>G</sub> = 000, V <sub>GC</sub> = 5V        80       250       ns $\overline{f_{off}}$ Time On S.       g Losc        110       200       ns $\overline{f_{off}}$ Time On S.       g Losc        1310        uJ $\overline{f_{off}}$ Time On S.       g Losc        100, V <sub>GC</sub> = 125°C        810       1200       uJ $\overline{f_{off}}$ Trate Critching Loss        810       1200       uJ        810       1200       uJ $\overline{f_{off}}$ Gate-Emitter Charge       V <sub>CE</sub> = 300 V, I <sub>C</sub> = 20A,        77       150       nC $\overline{f_{off}}$ $\overline{f_{off}}$ $\overline{f_{off}}$ 20       30       nC $\overline{f_{off}}$ $\overline{f_{off}}$ <td>Image: Solution of the second system of</td> <td>Eoff GiffTurn-Off Switching Lo13C<math>E_{ts}</math>Total Switching Lo600<math>t_{d(on)}</math>Turn-On Delay Tin30<math>t_r</math>Rise Tim37<math>t_{d(off)}</math>Turn-On Delay Time<math>V_{CC} = 300 \text{ V}, I_C = 20.4,</math><math>t_f</math>TimR_G = 002, V_{Gr} = 5V<math>t_f</math>TimR_G = 002, V_{Gr} = 5V<math>E_{on}</math>Turn-On Sg LossInductive Load, <math>T_C = 125^{\circ}C</math><math>E_{off}</math>CSwitching Loss<math>T</math>Tal Ctching Loss810<math>Q_g</math>Total Gate Charge<math>v_{CE} = 300 \text{ V}, I_C = 20A,</math><math>Q_{ge}</math>Gate-Emitter Charge<math>v_{CE} = 300 \text{ V}, I_C = 20A,</math><math>Q_{ge}</math>Gate-Emitter Charge<math>v_{CE} = 300 \text{ V}, I_C = 20A,</math><math>Q_{ge}</math>Gate-Collector Charge<math>v_{CE} = 300 \text{ V}, I_C = 20A,</math><math>Q_{ge}</math>Gate-Collector ChargeVert and the matter inductance<math>Q_{ge}</math>Internal Emitter inductanceMeasured 5mm from PKG<math>Internal Emitter inductance<math>T_C = 25^{\circ}C</math> unless otherwise notedSymbolParameterTest ConditionsMin.Type</math></td> <td></td> <td>100</td> <td>ns</td>	Image: Solution of the second system of	Eoff GiffTurn-Off Switching Lo13C $E_{ts}$ Total Switching Lo600 $t_{d(on)}$ Turn-On Delay Tin30 $t_r$ Rise Tim37 $t_{d(off)}$ Turn-On Delay Time $V_{CC} = 300 \text{ V}, I_C = 20.4,$ $t_f$ TimR_G = 002, V_{Gr} = 5V $t_f$ TimR_G = 002, V_{Gr} = 5V $E_{on}$ Turn-On Sg LossInductive Load, $T_C = 125^{\circ}C$ $E_{off}$ CSwitching Loss $T$ Tal Ctching Loss810 $Q_g$ Total Gate Charge $v_{CE} = 300 \text{ V}, I_C = 20A,$ $Q_{ge}$ Gate-Emitter Charge $v_{CE} = 300 \text{ V}, I_C = 20A,$ $Q_{ge}$ Gate-Emitter Charge $v_{CE} = 300 \text{ V}, I_C = 20A,$ $Q_{ge}$ Gate-Collector Charge $v_{CE} = 300 \text{ V}, I_C = 20A,$ $Q_{ge}$ Gate-Collector ChargeVert and the matter inductance $Q_{ge}$ Internal Emitter inductanceMeasured 5mm from PKG $Internal Emitter inductanceT_C = 25^{\circ}C unless otherwise notedSymbolParameterTest ConditionsMin.Type$		100	ns
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c }\hline Turn-On Delay Tin & & 30 & & ns \\\hline Rise Tim & & & & \\\hline d(off) & Turn-O Delay Time & & & & \\\hline V_{CC} = 300 V, I_C = 20A, \\\hline R_G = 0\Omega, V_{GT} = 5V \\\hline r. & & 110 & 200 & ns \\\hline R_G = 0\Omega, V_{GT} = 5V \\\hline r. & & 110 & 200 & ns \\\hline r. & & 110 & 200 & ns \\\hline r. & & & 110 & 200 & ns \\\hline r. & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & & & \\\hline r. & & & & & \\\hline r. & & & & & \\\hline r. & & & & & & \\\hline r. & & & & \\\hline r. & & & & & \\ r. & & & & \\\hline r. & & & & $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $			uJ
Rise Tim $37$ ns $M_{ff}$ Turn-Or Delay Time $V_{CC} = 300 \text{ V}, \text{ I}_{C} = 20\text{ A},$ $110$ $200$ ns         Tim $R_G = 0\Omega, \text{ V}_{G_T} = 5\text{ V}$ $80$ $250$ ns         Turn-On S. $J$ Loss $V_{CC} = 300 \text{ V}, \text{ I}_C = 125^{\circ}\text{C}$ $80$ $250$ ns         Turn-On S. $J$ Loss $V_{CC} = 300 \text{ V}, \text{ I}_C = 125^{\circ}\text{C}$ $80$ $250$ ns         Total Gate Charge $V_{CE} = 300 \text{ V}, \text{ I}_C = 20\text{ A},$ $77$ $150$ nC         Gate-En titler Charge $V_{CE} = 300 \text{ V}, \text{ I}_C = 20\text{ A},$ $77$ $150$ nC	Rise Tim $37$ ns         d(off)       Turn-O       Delay Time $V_{CC} = 300 \text{ V}, \text{ I}_{C} = 20\text{ A},$ 110       200       ns         f       Tim $R_G = 10\Omega, \text{ V}_{GC} = 50$ 80       250       ns         for       Turn-O       Suitching Loss        110       200       ns         for       Turn-O       Switching Loss        110       200       ns         for       Trial Cutching Loss        110       200       ns $Q_g$ Total Gate Charge $v_{CE} = 300 \text{ V}, \text{ I}_C = 20A,$ 77       150       nC $Q_{ge}$ Gate-Emitter Charge $v_{CE} = 15V$ 20       30       nC	Rise Tim        37        ns $d(off)$ Turn-Op Delay Time $V_{CC} = 300 \text{ V}, I_C = 20 \text{ A},$ 110       200       ns $G(off)$ Time Op S.       g Lose        110       200       ns $Goff$ Turn-Op S.       g Lose        110       200       ns $Goff$ Turn-Op S.       g Lose        110       200       ns $Goff$ The Op S.       g Lose        110       200       ns $Goff$ The Op S.       g Lose        110       200       ns $Goff$ The Op S.       g Lose        110       200       ns $Goff$ The Op S.       g Lose        125°C        10        uJ $Goff$ The If Atching Loss        810       1200       uJ        810       1200       uJ $Goge$ Gate-Emitter Charge       V <sub>CE</sub> = 300 V, I <sub>C</sub> = 20A,        20       30       nC $Gogef$ Cale-Collector Charge        25	trRise Tim37 $t_{d(off)}$ Turn-Or Delay Time $V_{CC} = 300 V, I_C = 20A,$ 110 $t_{f}$ Time $R_G = 0\Omega, V_{GC} = 5V$ 80 $E_{on}$ Turn-On S	00	1000	uJ
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Turn-O       Delay Time $V_{CC} = 300 \text{ V}, \text{ I}_{C} = 20\text{ A},$ 110       200       ns         f       Time $R_G = 0\Omega2, \text{ V}_{GT} = 5\text{ V}$ 80       250       ns $\overline{c}_{on}$ Turn-O       S. $g$ Loss $110$ 200       ns $\overline{c}_{onf}$ Turn-O       Switching Loss $110$ 200       ns $\overline{c}_{off}$ un-C       Switching Loss $110$ 200       ns $\overline{c}_{off}$ un-C       Switching Loss $310$ $uJ$ $\overline{c}_{off}$ Itching Loss $810$ $1200$ $uJ$ $\overline{c}_{gg}$ Total Gate Charge $V_{CE} = 300 \text{ V}, \text{ I}_C = 20A,$ $77$ $150$ nC $\overline{c}_{gg}$ Gate-Emitter Charge $V_{CE} = 15 \text{ V}$ $20$ $30$ nC	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	t_d(off)Turn-ODelay Time $V_{CC} = 30^{\circ} V, I_C = 20A,$ 110 $t_f$ Time $R_G = 0\Omega, V_{GC} = 5V$ 80 $E_{on}$ Turn-On S	30		ns
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Turn On S.       y Loss       Inductive Load, $T_C = 125^{\circ}C$ 500        uJ         f       Jin-C       Switching Loss        310        uJ         T tal C litching Loss        810       1200       uJ         Total Gate Charge $v_{CE} = 300 \text{ V}, I_C = 20A,$ 77       150       nC         Cate En liter Charge $v_{CE} = 300 \text{ V}, I_C = 20A,$ 20       30       nC	$a_{on}$ Turn On S. $g$ LoscInductive Load, $T_C = 125^{\circ}C$ $500$ $uJ$ $a_{off}$ $a_{off}$ C. Switching Loss $$ $310$ $$ $uJ$ $T_{ral}$ $a_{ral}$ $c_{ral}$ $a_{ral}$ $1200$ $uJ$ $a_{g}$ Total Gate Charge $v_{CE} = 300 \text{ V}, I_C = 20A,$ $$ $77$ $150$ $nC$ $a_{ge}$ Gate-Emitter Charge $v_{CE} = 15V$ $$ $20$ $30$ $nC$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	EonTurn On S.y LoscInductive Load, $T_C = 125^{\circ}C$ 500EoffInn-O. Switching LossInductive Load, $T_C = 125^{\circ}C$ 310QTrial Cutching LossInductive Load, $T_C = 20A$ ,Inductive Load, $T_C = 20A$ ,810QGate-Enritter Charge $V_{CE} = 300 \text{ V}, I_C = 20A$ ,Inductive Load, $T_C = 20A$ ,77QGate-Enritter Charge $V_{CE} = 15V$ Internal Emitter InductanceMeasured 5mm from PKG14Electrical Characteristics of DIODET <sub>C</sub> = 25°C unless otherwise notedSymbolParameterTest ConditionsMin.Type	10		ns
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T tal C litching Loss      310      UJ       T tal C litching Loss      810     1200     UJ       Total Gate Charge     vcE = 300 V, Ic = 20A,      77     150     nC	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Eoff       Import Switching Loss        310 $Q_g$ Trial full charge        810 $Q_g$ Total Gate Charge $v_{CE} = 300 \text{ V}, I_C = 20 \text{ A},$ 20 $Q_{gr}$ Gate-Emitter Charge $v_{CE} = 15 \text{ V}$ 20 $Q_{gr}$ Calco-Collector Charge       Measured 5mm from PKG        14         Electrical Character Stics of DIODE $T_c = 25^{\circ}\text{C}$ unless otherwise noted         Symbol       Parameter       Test Conditions       Min.       Type	00		uJ
T tal ftching Loss          810         1200         uJ           Total Gate Charge         vce = 300 V, Ic = 20A,          77         150         nC           Gate-En itter Charge         vce = 300 V, Ic = 20A,          70         30         nC	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	10		uJ
$v_{CE} = 300 \text{ V}, \text{ I}_{C} = 20\text{ A},$	$v_{CE} = 300 \text{ V}, I_C = 20\text{ A},$ $v_{CE} = 300 \text{ V}, I_C = 20\text{ A},$ $v_{CE} = 15\text{ V}$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$Q_{ge}$ Gate-Envitter Charge $V_{CE} = 300 \text{ V}, I_C = 20\text{ A}, V_{GE} = 15\text{ V}$ 20 $Q_{gr}$ Gate-Collector Charge $V_{GE} = 15\text{ V}$ 25         Internal Emvitter inductance       Measured 5mm from PKG        14         Electrical Character stics of DIODE $T_c = 25^{\circ}C$ unless otherwise noted       Symbol       Parameter       Test Conditions       Min.       Type         Tc = 25^{\circ}C        14	10		
	$z_{ge} = -20$ 30 HC	$\frac{V_{\text{ge}}}{V_{\text{GE}}} = \frac{V_{\text{GE}} + 11000000000000000000000000000000000$	$u_{ge}$ Gate Environment of ange $V_{GE} = 15V$ $$ $20$ $Q_{or}$ Cate-Collector Chalge $V_{GE} = 15V$ $$ $25$ Internal Emitter inductance       Measured 5mm from PKG $$ $14$ Exerctrical Characteristics of DIODE $T_c = 25^{\circ}C$ unless otherwise noted       Min.       Type         Symbol       Parameter       Test Conditions       Min.       Type	77	150	nC
		Dor Gale-Collector Chalge 25 40 nC	Qgr     Cale-Collector Chalge     Oge     Oge <thoge< th=""> <thoge< th="">     Oge     <thoge< th=""></thoge<></thoge<></thoge<>	20		
Galo-Collector Chalge 25 40 nC	$Q_{0r}$ (-a.c-Collector Charge 25 40 nC	Internal Emitter inductance Measured 5mm from PKG 14 nH	Symbol       Tc = 25°C unless otherwise noted         Symbol       Parameter       Test Conditions       Min.       Type         Tc = 25°C        14	25	40	
Internal Emitter inductance Measured 5mm from PKG 14 nH	A listing of Factors of A Management From Streep DKO		SymbolParameterTest ConditionsMin.Type $T_c = 25^{\circ}C$ 1.4	4		nH
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ctrical Characteristics of DIODE T <sub>c</sub> = 25°C unless otherwise noted	ZVI Profes	netrical Characteristics of DIODE Tc = 25°C unless otherwise noted	V Diada Valtage $I_{c} = 25^{\circ}C$ 1.4	yp.	Max.	Units
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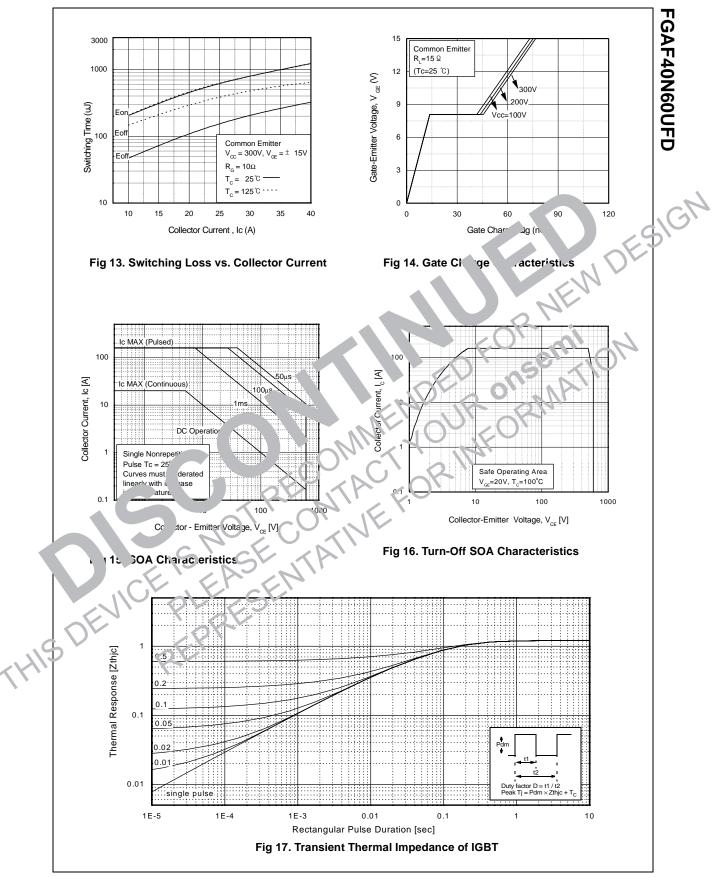
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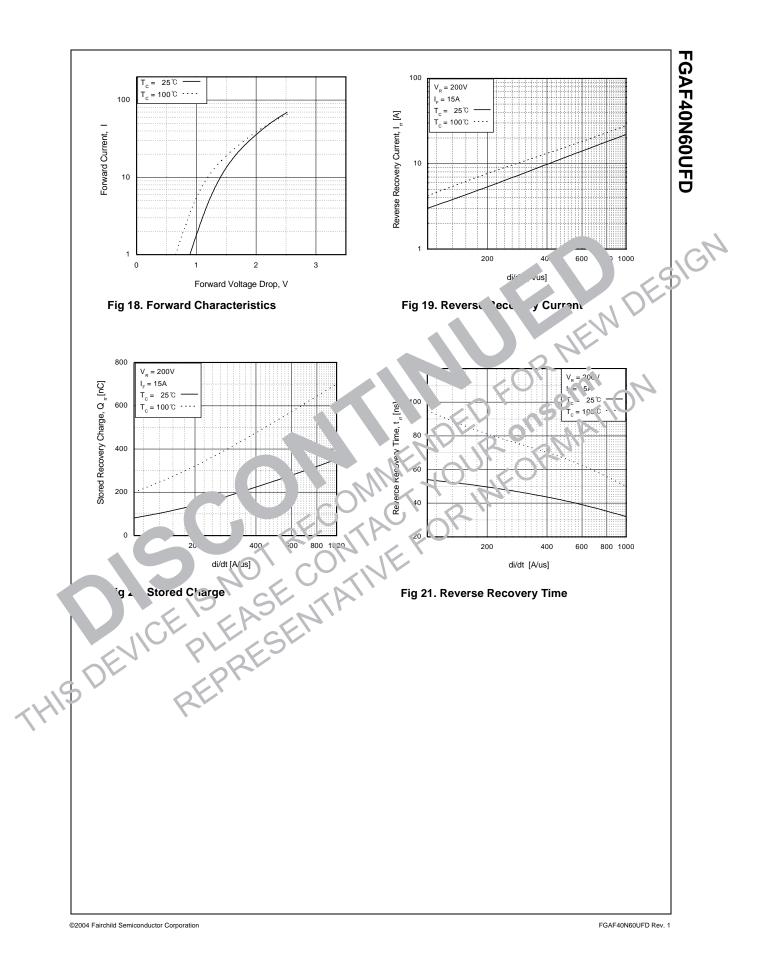


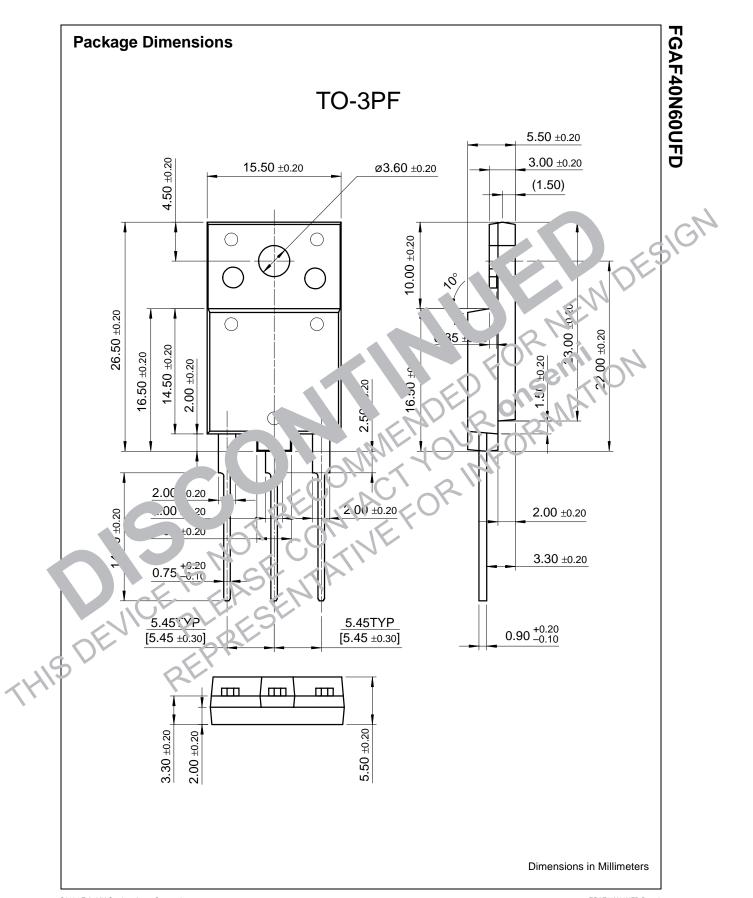
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