SGL50N60RUFD
600 V, 50 A Short Circuit Rated IGBT

General Description
Fairchild’s RUFD series of Insulated Gate Bipolar Transistors (IGBTs) provide low conduction and switching losses as well as short circuit ruggedness. The RUFD series is designed for applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short circuit ruggedness is a required feature.

Features
- 50 A, 600 V, $T_C = 100^\circ C$
- Low Saturation Voltage: $V_{CE(sat)} = 2.2 V$ @ $I_C = 50 A$
- Typical Fall Time . . . . . . . . .261ns at $T_J = 125^\circ C$
- High Speed Switching
- High Input Impedance
- Short Circuit Rating

Applications
Motor Control, UPS, General Inverter.

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Ratings</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>$V_{CES}$</td>
<td>Collector-Emitter Voltage</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GES}$</td>
<td>Gate-Emitter Voltage</td>
<td>± 20</td>
<td>V</td>
</tr>
<tr>
<td>$I_C$</td>
<td>Collector Current @ $T_C = 25^\circ C$</td>
<td>80</td>
<td>A</td>
</tr>
<tr>
<td>$I_{CM(1)}$</td>
<td>Collector Current @ $T_C = 100^\circ C$</td>
<td>50</td>
<td>A</td>
</tr>
<tr>
<td>$I_F$</td>
<td>Pulsed Collector Current</td>
<td>150</td>
<td>A</td>
</tr>
<tr>
<td>$I_{FM}$</td>
<td>Diode Continuous Forward Current @ $T_C = 25^\circ C$</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>$I_{FM}$</td>
<td>Diode Continuous Forward Current @ $T_C = 100^\circ C$</td>
<td>30</td>
<td>A</td>
</tr>
<tr>
<td>$I_{FM}$</td>
<td>Diode Maximum Forward Current</td>
<td>90</td>
<td>A</td>
</tr>
<tr>
<td>$T_{SC}$</td>
<td>Short Circuit Withstand Time @ $T_C = 100^\circ C$</td>
<td>10</td>
<td>us</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Maximum Power Dissipation @ $T_C = 25^\circ C$</td>
<td>250</td>
<td>W</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Maximum Power Dissipation @ $T_C = 100^\circ C$</td>
<td>100</td>
<td>W</td>
</tr>
<tr>
<td>$T_J$</td>
<td>Operating Junction Temperature</td>
<td>-55 to +150</td>
<td>^\circ C</td>
</tr>
<tr>
<td>$T_{SR}$</td>
<td>Storage Temperature Range</td>
<td>-55 to +150</td>
<td>^\circ C</td>
</tr>
<tr>
<td>$T_L$</td>
<td>Maximum Lead Temp. for Soldering Purposes, 1/8&quot; from Case for 5 Seconds</td>
<td>300</td>
<td>^\circ C</td>
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</tbody>
</table>

Notes:
(1) Repetitive rating: Pulse width limited by max. junction temperature

Thermal Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>$R_{JUC(IGBT)}$</td>
<td>Thermal Resistance, Junction-to-Case</td>
<td>--</td>
<td>0.5</td>
<td>^\circ C/W</td>
</tr>
<tr>
<td>$R_{JUC(DIODE)}$</td>
<td>Thermal Resistance, Junction-to-Case</td>
<td>--</td>
<td>1.0</td>
<td>^\circ C/W</td>
</tr>
<tr>
<td>$R_{JUA}$</td>
<td>Thermal Resistance, Junction-to-Ambient</td>
<td>--</td>
<td>25</td>
<td>^\circ C/W</td>
</tr>
</tbody>
</table>
## Electrical Characteristics of the IGBT

**TC = 25°C unless otherwise noted**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td><strong>Off Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(BV_{CES})</td>
<td>Collector-Emitter Breakdown Voltage</td>
<td>(V_{GE} = 0\ V,\ I_C = 250\ \mu A)</td>
<td>600</td>
<td>--</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>(\Delta B_{CES}/\Delta T_J)</td>
<td>Temperature Coefficient of Breakdown Voltage</td>
<td>(V_{GE} = 0\ V,\ I_C = 1\ mA)</td>
<td>--</td>
<td>0.6</td>
<td>--</td>
<td>(^{\circ})/C</td>
</tr>
<tr>
<td>(I_{CES})</td>
<td>Collector Cut-Off Current</td>
<td>(V_{GE} = V_{CES},\ V_{CE} = 0\ V)</td>
<td>--</td>
<td>--</td>
<td>250</td>
<td>(\mu A)</td>
</tr>
<tr>
<td>(I_{GES})</td>
<td>G-E Leakage Current</td>
<td>(V_{GE} = V_{GES},\ V_{CE} = 0\ V)</td>
<td>--</td>
<td>--</td>
<td>± 100</td>
<td>nA</td>
</tr>
</tbody>
</table>

| **On Characteristics** | | | | | | |
| \(V_{GE(th)}\) | G-E Threshold Voltage | \(I_C = 50\ mA,\ V_{GE} = V_{GE}\) | 5.0 | 6.0 | 8.5 | V |
| \(V_{CE(sat)}\) | Collector to Emitter Saturation Voltage | \(I_C = 50\ A,\ V_{GE} = 15\ V\) | -- | 2.2 | 2.8 | V |
| \(I_{CE} = 80\ A,\ V_{GE} = 15\ V\) | -- | 2.5 | -- | V |

| **Dynamic Characteristics** | | | | | | |
| \(C_{iss}\) | Input Capacitance | \(V_{CE} = 30\ V,\ V_{GE} = 0\ V,\ f = 1\ MHz\) | -- | 3311 | -- | pF |
| \(C_{oss}\) | Output Capacitance | \(V_{CE} = 30\ V,\ V_{GE} = 0\ V,\ f = 1\ MHz\) | -- | 399 | -- | pF |
| \(C_{tres}\) | Reverse Transfer Capacitance | \(V_{CE} = 30\ V,\ V_{GE} = 0\ V,\ f = 1\ MHz\) | -- | 139 | -- | pF |

| **Switching Characteristics** | | | | | | |
| \(t_{d(on)}\) | Turn-On Delay Time | \(V_{CC} = 300\ V,\ I_C = 50\ A,\ R_G = 5.9\ \Omega,\ V_{GE} = 15\ V,\ Inductive Load,\ T_C = 25\ ^{\circ}\) | -- | 26 | -- | ns |
| \(t_{f}\) | Rise Time | -- | 89 | -- | ns |
| \(t_{d(off)}\) | Turn-Off Delay Time | -- | 66 | 100 | ns |
| \(t_{f}\) | Fall Time | -- | 118 | 200 | ns |
| \(E_{on}\) | Turn-On Switching Loss | -- | 1.68 | -- | mJ |
| \(E_{off}\) | Turn-Off Switching Loss | -- | 1.03 | -- | mJ |
| \(E_{ts}\) | Total Switching Loss | -- | 2.71 | 3.8 | mJ |
| \(t_{d(on)}\) | Turn-On Delay Time | -- | 28 | -- | ns |
| \(t_{f}\) | Rise Time | -- | 91 | -- | ns |
| \(t_{d(off)}\) | Turn-Off Delay Time | -- | 68 | 110 | ns |
| \(t_{f}\) | Fall Time | -- | 261 | 400 | ns |
| \(E_{on}\) | Turn-On Switching Loss | -- | 1.7 | -- | mJ |
| \(E_{off}\) | Turn-Off Switching Loss | -- | 2.31 | -- | mJ |
| \(E_{ts}\) | Total Switching Loss | -- | 4.01 | 5.62 | mJ |
| \(T_{sc}\) | Short Circuit Withstand Time | \(V_{CC} = 300\ V,\ V_{GE} = 15\ V,\ @ T_C = 100\ ^{\circ}\) | 10 | -- | -- | us |
| \(Q_g\) | Total Gate Charge | \(V_{CE} = 300\ V,\ I_C = 50\ A,\ V_{GE} = 15\ V\) | -- | 145 | 210 | nC |
| \(Q_{ge}\) | Gate-Emitter Charge | \(V_{GE} = 15\ V\) | -- | 25 | 35 | nC |
| \(Q_{gc}\) | Gate-Collector Charge | -- | 70 | 100 | nC |
| \(L_e\) | Internal Emitter Inductance | Measured 5mm from PKG | -- | 18 | -- | nH |

## Electrical Characteristics of DIODE

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<table>
<thead>
<tr>
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<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{FM})</td>
<td>Diode Forward Voltage</td>
<td>(I_F = 30\ A)</td>
<td>(T_C = 25^{\circ})</td>
<td>1.9</td>
<td>2.8</td>
<td>V</td>
</tr>
<tr>
<td>(t_{rr})</td>
<td>Diode Reverse Recovery Time</td>
<td>(I_F = 30\ A)</td>
<td>(T_C = 25^{\circ})</td>
<td>70</td>
<td>100</td>
<td>ns</td>
</tr>
<tr>
<td>(I_{rr})</td>
<td>Diode Peak Reverse Recovery Current</td>
<td>(I_F = 30\ A,\ \frac{dI_F}{dt} = 200\ \text{A/\mu s})</td>
<td>(T_C = 25^{\circ})</td>
<td>6</td>
<td>7.8</td>
<td>A</td>
</tr>
<tr>
<td>(Q_{rr})</td>
<td>Diode Reverse Recovery Charge</td>
<td>(T_C = 25^{\circ})</td>
<td>200</td>
<td>360</td>
<td>nC</td>
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</tr>
</tbody>
</table>

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SGL50N60RUFD Rev. C1
SGL50N60RUFD — 600 V, 50 A Short Circuit Rated IGBT

Fig 1. Typical Output Characteristics

Fig 2. Typical Saturation Voltage Characteristics

Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

Fig 4. Load Current vs. Frequency

Fig 5. Saturation Voltage vs. V\textsubscript{GE}

Fig 6. Saturation Voltage vs. V\textsubscript{GE}
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Fig 7. Capacitance Characteristics

Fig 8. Turn-On Characteristics vs. Gate Resistance

Fig 9. Turn-Off Characteristics vs. Gate Resistance

Fig 10. Switching Loss vs. Gate Resistance

Fig 11. Turn-On Characteristics vs. Collector Current

Fig 12. Turn-Off Characteristics vs. Collector Current
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Fig 13. Switching Loss vs. Collector Current

Fig 14. Gate Charge Characteristics

Fig 15. SOA Characteristics

Fig 16. Turn-Off SOA Characteristics

Fig 17. Transient Thermal Impedance of IGBT
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**Fig 18. Forward Characteristics**

**Fig 19. Reverse Recovery Current**

**Fig 20. Stored Charge**

**Fig 21. Reverse Recovery Time**
Mechanical Dimensions

NOTE:
A. PACKAGE REFERENCE: JEDEC TO264 VARIATION AA
B. ALL DIMENSIONS ARE IN MILLIMETERS
C. OUT OF JEDEC STANDARD VALUE
D. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994
E. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS
F. THIS PACKAGE IS INTENDED ONLY FOR "F"S PKG CODE AF
G. DRAWING FILE NAME: TO264A03REV1

Figure 22. TO-264 3L - 3LD; TO264; MOLDED; JEDEC VARIATION AA

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MicroPak2™
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TINYOPTO™
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Definition of Terms

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<tr>
<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
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<tr>
<td>Advance Information</td>
<td>Formative / In Design</td>
<td>Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
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