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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor’s system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.
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°C
- Low Saturation Voltage: V_CE(sat) = 2.2 V @ I_C = 50 A
- Typical Fall Time: 261 ns at T_J = 125°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>
</tr>
</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°C</td>
<td>80</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Collector Current @ T_C = 100°C</td>
<td>50</td>
<td>A</td>
</tr>
<tr>
<td>I_CPM</td>
<td>Pulsed Collector Current</td>
<td>150</td>
<td>A</td>
</tr>
<tr>
<td>I_F</td>
<td>Diode Continuous Forward Current @ T_C = 25°C</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Diode Continuous Forward Current @ T_C = 100°C</td>
<td>30</td>
<td>A</td>
</tr>
<tr>
<td>I_FPM</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°C</td>
<td>10</td>
<td>us</td>
</tr>
<tr>
<td>P_D</td>
<td>Maximum Power Dissipation @ T_C = 25°C</td>
<td>250</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>Maximum Power Dissipation @ T_C = 100°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>°C</td>
</tr>
<tr>
<td>T_M</td>
<td>Storage Temperature Range</td>
<td>-55 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>T_L</td>
<td>Maximum Lead Temp. for Soldering Purposes, 1/8” from Case for 5 Seconds</td>
<td>300</td>
<td>°C</td>
</tr>
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</table>

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

Thermal Characteristics

<table>
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<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>°C/W</td>
</tr>
<tr>
<td>R_JUC(DIO)D</td>
<td>Thermal Resistance, Junction-to-Case</td>
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<td>1.0</td>
<td>°C/W</td>
</tr>
<tr>
<td>R_JUA</td>
<td>Thermal Resistance, Junction-to-Ambient</td>
<td>--</td>
<td>25</td>
<td>°C/W</td>
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### Electrical Characteristics of the IGBT $T_C = 25^\circ C$ unless otherwise noted

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<tr>
<th>Symbol</th>
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<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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<tr>
<td>$B_{V_{CES}}$</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>$\Delta B_{V_{CES}}/\Delta T_J$</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>V/$^\circ C$</td>
</tr>
<tr>
<td>$I_C$</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>$\pm 100$</td>
<td>nA</td>
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### On Characteristics

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<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
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<tr>
<td>$V_{GE(th)}$</td>
<td>G-E Threshold Voltage</td>
<td>$I_C = 50 mA, V_{GE} = V_{GE}$</td>
<td>5.0</td>
<td>6.0</td>
<td>8.5</td>
<td>V</td>
</tr>
<tr>
<td>$V_{CE(sat)}$</td>
<td>Collector to Emitter Saturation Voltage</td>
<td>$I_C = 50 A, V_{GE} = 15 V$</td>
<td>--</td>
<td>2.2</td>
<td>2.8</td>
<td>V</td>
</tr>
<tr>
<td>$I_C$</td>
<td>Collector Cut-Off Current</td>
<td>$V_{CE} = V_{CES}, V_{GE} = 0 V$</td>
<td>--</td>
<td>--</td>
<td>250</td>
<td>$\mu A$</td>
</tr>
<tr>
<td>$I_{CES}$</td>
<td>Collector Cut-Off Current</td>
<td>$V_{CE} = V_{CES}, V_{GE} = 0 V$</td>
<td>--</td>
<td>--</td>
<td>$\pm 100$</td>
<td>nA</td>
</tr>
<tr>
<td>$I_{C}$</td>
<td>Collector Cut-Off Current</td>
<td>$V_{CE} = V_{CES}, V_{GE} = 0 V$</td>
<td>--</td>
<td>--</td>
<td>250</td>
<td>$\mu A$</td>
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<tr>
<td>$I_{CES}$</td>
<td>Collector Cut-Off Current</td>
<td>$V_{CE} = V_{CES}, V_{GE} = 0 V$</td>
<td>--</td>
<td>--</td>
<td>$\pm 100$</td>
<td>nA</td>
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### Dynamic Characteristics

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<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>$C_{i_{ds}}$</td>
<td>Input Capacitance</td>
<td>$V_{CE}=30 \text{ V}, V_{GE}=0 \text{ V}, f=1 \text{ MHz}$</td>
<td>--</td>
<td>3311</td>
<td>--</td>
<td>pF</td>
</tr>
<tr>
<td>$C_{o_{es}}$</td>
<td>Output Capacitance</td>
<td>$V_{CE}=30 \text{ V}, V_{GE}=0 \text{ V}, f=1 \text{ MHz}$</td>
<td>--</td>
<td>399</td>
<td>--</td>
<td>pF</td>
</tr>
<tr>
<td>$C_{r_{es}}$</td>
<td>Reverse Transfer Capacitance</td>
<td>$V_{CE}=30 \text{ V}, V_{GE}=0 \text{ V}, f=1 \text{ MHz}$</td>
<td>--</td>
<td>139</td>
<td>--</td>
<td>pF</td>
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### Switching Characteristics

<table>
<thead>
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<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{on}$</td>
<td>Turn-On Delay Time</td>
<td>$V_{CC} = 300 \text{ V}, I_C = 50 \text{ A}$</td>
<td>--</td>
<td>26</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>$t_r$</td>
<td>Rise Time</td>
<td>$V_{CC} = 300 \text{ V}, I_C = 50 \text{ A}$</td>
<td>--</td>
<td>89</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>$t_{off}$</td>
<td>Turn-Off Delay Time</td>
<td>$V_{CC} = 300 \text{ V}, I_C = 50 \text{ A}$</td>
<td>--</td>
<td>66</td>
<td>100</td>
<td>ns</td>
</tr>
<tr>
<td>$t_f$</td>
<td>Fall Time</td>
<td>$V_{CC} = 300 \text{ V}, I_C = 50 \text{ A}$</td>
<td>--</td>
<td>118</td>
<td>200</td>
<td>ns</td>
</tr>
<tr>
<td>$E_{on}$</td>
<td>Turn-On Switching Loss</td>
<td>$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$</td>
<td>--</td>
<td>1.68</td>
<td>--</td>
<td>mJ</td>
</tr>
<tr>
<td>$E_{off}$</td>
<td>Turn-Off Switching Loss</td>
<td>$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$</td>
<td>--</td>
<td>1.03</td>
<td>--</td>
<td>mJ</td>
</tr>
<tr>
<td>$E_{s}$</td>
<td>Total Switching Loss</td>
<td>$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$</td>
<td>--</td>
<td>2.71</td>
<td>3.8</td>
<td>mJ</td>
</tr>
<tr>
<td>$t_{on}$</td>
<td>Turn-On Delay Time</td>
<td>$V_{CC} = 300 \text{ V}, I_C = 50 \text{ A}$</td>
<td>--</td>
<td>28</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>$t_r$</td>
<td>Rise Time</td>
<td>$V_{CC} = 300 \text{ V}, I_C = 50 \text{ A}$</td>
<td>--</td>
<td>91</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>$t_{off}$</td>
<td>Turn-Off Delay Time</td>
<td>$V_{CC} = 300 \text{ V}, I_C = 50 \text{ A}$</td>
<td>--</td>
<td>68</td>
<td>110</td>
<td>ns</td>
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<tr>
<td>$E_{on}$</td>
<td>Turn-On Switching Loss</td>
<td>$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$</td>
<td>--</td>
<td>261</td>
<td>400</td>
<td>ns</td>
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<tr>
<td>$E_{off}$</td>
<td>Turn-Off Switching Loss</td>
<td>$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$</td>
<td>--</td>
<td>1.7</td>
<td>--</td>
<td>mJ</td>
</tr>
<tr>
<td>$E_{s}$</td>
<td>Total Switching Loss</td>
<td>$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$</td>
<td>--</td>
<td>4.01</td>
<td>5.62</td>
<td>mJ</td>
</tr>
<tr>
<td>$T_{sc}$</td>
<td>Short Circuit Withstand Time</td>
<td>$V_{CC} = 300 \text{ V}, V_{GE} = 15 \text{ V}$</td>
<td>10</td>
<td>--</td>
<td>--</td>
<td>us</td>
</tr>
<tr>
<td>$Q_g$</td>
<td>Total Gate Charge</td>
<td>$V_{CE} = 300 \text{ V}, I_C = 50 \text{ A}$</td>
<td>--</td>
<td>145</td>
<td>210</td>
<td>nC</td>
</tr>
<tr>
<td>$Q_{ge}$</td>
<td>Gate-Emitter Charge</td>
<td>$V_{CE} = 300 \text{ V}, V_{GE} = 15 \text{ V}$</td>
<td>--</td>
<td>25</td>
<td>35</td>
<td>nC</td>
</tr>
<tr>
<td>$Q_{gc}$</td>
<td>Gate-Collector Charge</td>
<td>$V_{CE} = 300 \text{ V}, V_{GE} = 15 \text{ V}$</td>
<td>--</td>
<td>70</td>
<td>100</td>
<td>nC</td>
</tr>
<tr>
<td>$L_e$</td>
<td>Internal Emitter Inductance</td>
<td>Measured 5mm from PKG</td>
<td>--</td>
<td>18</td>
<td>--</td>
<td>nH</td>
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</tbody>
</table>

### Electrical Characteristics of DIODE $T_C = 25^\circ C$ 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>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{FM}$</td>
<td>Diode Forward Voltage</td>
<td>$I_F = 30 A$</td>
<td>$T_C = 25^\circ C$</td>
<td>--</td>
<td>1.9</td>
<td>2.8</td>
</tr>
<tr>
<td>$t_{tr}$</td>
<td>Diode Reverse Recovery Time</td>
<td>$I_F = 30 A$</td>
<td>$T_C = 25^\circ C$</td>
<td>--</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>$I_{tr}$</td>
<td>Diode Peak Reverse Recovery Current</td>
<td>$I_F = 30 A$, $di/dt=200 A/\mu s$</td>
<td>$T_C = 25^\circ C$</td>
<td>--</td>
<td>6</td>
<td>7.8</td>
</tr>
<tr>
<td>$Q_{tr}$</td>
<td>Diode Reverse Recovery Charge</td>
<td></td>
<td>$T_C = 25^\circ C$</td>
<td>--</td>
<td>200</td>
<td>360</td>
</tr>
</tbody>
</table>

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SGL50N60RUFD Rev. C1 www.fairchildsemi.com
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_{GE}

Fig 6. Saturation Voltage vs. V_{GE}
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
SGL50N60RUFD — 600 V, 50 A Short Circuit Rated IGBT

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
**Fig 18. Forward Characteristics**

- **Forward Voltage Drop, \( V_{FM} \) [V]**
  - \( T_C = 25\,^\circ C \)
  - \( T_C = 100\,^\circ C \)

- **Forward Current, \( I_F \) [A]**
  - \( V_R = 200\,V \)
  - \( I_F = 30\,A \)
  - \( T_C = 25\,^\circ C \)
  - \( T_C = 100\,^\circ C \)

**Fig 19. Reverse Recovery Current**

- **Reverse Recovery Current, \( I_{rr} \) [A]**
  - \( V_R = 200\,V \)
  - \( I_F = 30\,A \)
  - \( T_C = 25\,^\circ C \)
  - \( T_C = 100\,^\circ C \)

**Fig 20. Stored Charge**

- **Stored Recovery Charge, \( Q_{rr} \) [nC]**
  - \( V_R = 200\,V \)
  - \( I_F = 30\,A \)
  - \( T_C = 25\,^\circ C \)
  - \( T_C = 100\,^\circ C \)

**Fig 21. Reverse Recovery Time**

- **Reverse Recovery Time, \( t_{rr} \) [ns]**
  - \( V_R = 200\,V \)
  - \( I_F = 30\,A \)
  - \( T_C = 25\,^\circ C \)
  - \( T_C = 100\,^\circ C \)
Figure 22. TO-264 3L - 3LD; TO264; MOLDED; JEDEC VARIATION AA

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ESBC™
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FETBench™
FPS™
FRFET®
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IntelliMAX™
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SuperSOT™-6
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PRODUCT STATUS DEFINITIONS
Definition of Terms

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<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
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<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>
</tr>
<tr>
<td>Preliminary</td>
<td>First Production</td>
<td>Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.</td>
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<tr>
<td>No Identification Needed</td>
<td>Full Production</td>
<td>Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.</td>
</tr>
<tr>
<td>Obsolete</td>
<td>Not In Production</td>
<td>Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.</td>
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