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.
FGA20S140P
1400 V, 20 A Shorted-anode IGBT

Features
- High Speed Switching
- Low Saturation Voltage: $V_{CE(sat)} = 1.9$ V @ $I_C = 20$ A
- High Input Impedance
- RoHS Compliant

Applications
- Induction Heating, Microwave Oven

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 to Emitter Voltage</td>
<td>1400</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GES}$</td>
<td>Gate to Emitter Voltage</td>
<td>±25</td>
<td>V</td>
</tr>
<tr>
<td>$I_C$</td>
<td>Collector Current @ $T_C = 25^\circ$C</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td>$I_{CM(1)}$</td>
<td>Pulsed Collector Current</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>$I_F$</td>
<td>Diode Continuous Forward Current @ $T_C = 25^\circ$C</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td>$I_{FD}$</td>
<td>Diode Continuous Forward Current @ $T_C = 100^\circ$C</td>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Maximum Power Dissipation @ $T_C = 25^\circ$C</td>
<td>272</td>
<td>W</td>
</tr>
<tr>
<td>$P_{DM}$</td>
<td>Maximum Power Dissipation @ $T_C = 100^\circ$C</td>
<td>136</td>
<td>W</td>
</tr>
<tr>
<td>$T_J$</td>
<td>Operating Junction Temperature</td>
<td>-55 to +175</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>Storage Temperature Range</td>
<td>-55 to +175</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>
</tbody>
</table>

Thermal Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{jCj}$ (IGBT)</td>
<td>Thermal Resistance, Junction to Case</td>
<td>--</td>
<td>0.55</td>
<td>°C/W</td>
</tr>
<tr>
<td>$R_{jA}$</td>
<td>Thermal Resistance, Junction to Ambient</td>
<td>--</td>
<td>40</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Notes:
1: Limited by $T_{jmax}$
### Package Marking and Ordering Information

<table>
<thead>
<tr>
<th>Device Marking</th>
<th>Device</th>
<th>Package</th>
<th>Reel Size</th>
<th>Tape Width</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FGA20S140P</td>
<td>FGA20S140P</td>
<td>TO-3PN</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
</tbody>
</table>

### Electrical Characteristics of the IGBT  $T_C = 25^\circ\text{C}$ unless otherwise noted

#### Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit
---|----------|----------------|------|------|------|------

#### Off Characteristics

- **$I_{CES}$**: Collector Cut-Off Current  
  $V_{CE} = 1400$, $V_{GE} = 0V$  
  Min.: $1$ mA

- **$I_{GES}$**: G-E Leakage Current  
  $V_{GE} = V_{GES}$, $V_{CE} = 0V$  
  Min.: ±$500$ nA

#### On Characteristics

- **$V_{GE(th)}$**: G-E Threshold Voltage  
  $I_C = 20mA$, $V_{CE} = V_{GE}$  
  4.5 | 6.0 | 7.5 | V

- **$V_{CE(sat)}$**: Collector to Emitter Saturation Voltage  
  $I_C = 20A$, $V_{GE} = 15V$, $T_C = 25^\circ\text{C}$  
  Min.: $1.9$ V  
  Max.: $2.4$ V

  $I_C = 20A$, $V_{GE} = 15V$, $T_C = 125^\circ\text{C}$  
  Min.: $2.1$ V  
  Max.: $V$

  $I_C = 20A$, $V_{GE} = 15V$, $T_C = 175^\circ\text{C}$  
  Min.: $2.2$ V  
  Max.: $V$

- **$V_{FM}$**: Diode Forward Voltage  
  $I_F = 20A$, $T_C = 25^\circ\text{C}$  
  Min.: $1.7$ V  
  Max.: $2.4$ V

  $I_F = 20A$, $T_C = 175^\circ\text{C}$  
  Min.: $2.1$ V  
  Max.: $V$

#### Dynamic Characteristics

- **$C_{ies}$**: Input Capacitance  
  $V_{CE} = 30V$, $V_{GE} = 0V$, $f = 1\text{MHz}$  
  Min.: $1686$ pF

- **$C_{oes}$**: Output Capacitance  
  $I_C = 20mA$, $V_{CE} = V_{GE}$  
  Min.: $45$ pF

- **$C_{res}$**: Reverse Transfer Capacitance  
  $I_C = 20mA$, $V_{CE} = V_{GE}$  
  Min.: $32$ pF

#### Switching Characteristics

- **$t_d(on)$**: Turn-On Delay Time  
  $V_{CC} = 600V$, $I_C = 20A$, $R_G = 10\Omega$, $V_{GE} = 15V$, Resistive Load, $T_C = 25^\circ\text{C}$  
  Min.: $20$ ns

- **$t_r$**: Rise Time  
  $V_{CC} = 600V$, $I_C = 20A$, $R_G = 10\Omega$, $V_{GE} = 15V$, Resistive Load, $T_C = 25^\circ\text{C}$  
  Min.: $245$ ns

- **$t_d(off)$**: Turn-Off Delay Time  
  $V_{CC} = 600V$, $I_C = 20A$, $R_G = 10\Omega$, $V_{GE} = 15V$, Resistive Load, $T_C = 25^\circ\text{C}$  
  Min.: $400$ ns

- **$t_f$**: Fall Time  
  $V_{CC} = 600V$, $I_C = 20A$, $R_G = 10\Omega$, $V_{GE} = 15V$, Resistive Load, $T_C = 25^\circ\text{C}$  
  Min.: $130$ ns

- **$E_{on}$**: Turn-On Switching Loss  
  $V_{CC} = 600V$, $I_C = 20A$, $R_G = 10\Omega$, $V_{GE} = 15V$, Resistive Load, $T_C = 25^\circ\text{C}$  
  Min.: $0.76$ mJ

- **$E_{off}$**: Turn-Off Switching Loss  
  $V_{CC} = 600V$, $I_C = 20A$, $R_G = 10\Omega$, $V_{GE} = 15V$, Resistive Load, $T_C = 25^\circ\text{C}$  
  Min.: $0.56$ mJ

- **$E_{ts}$**: Total Switching Loss  
  $V_{CC} = 600V$, $I_C = 20A$, $R_G = 10\Omega$, $V_{GE} = 15V$, Resistive Load, $T_C = 25^\circ\text{C}$  
  Min.: $1.32$ mJ

- **$Q_g$**: Total Gate Charge  
  $V_{CE} = 600V$, $I_C = 20A$, $V_{GE} = 15V$  
  Min.: $203.5$ nC

- **$Q_{ge}$**: Gate to Emitter Charge  
  $V_{CE} = 600V$, $I_C = 20A$, $V_{GE} = 15V$  
  Min.: $10.8$ nC

- **$Q_{gc}$**: Gate to Collector Charge  
  $V_{CE} = 600V$, $I_C = 20A$, $V_{GE} = 15V$  
  Min.: $84.6$ nC
Typical Performance Characteristics

Figure 1. Typical Output Characteristics

![Graph showing typical output characteristics](image1)

Figure 2. Typical Saturation Voltage Characteristics

![Graph showing typical saturation voltage characteristics](image2)

Figure 3. Typical Saturation Voltage Characteristics

![Graph showing typical saturation voltage characteristics](image3)

Figure 4. Transfer Characteristics

![Graph showing transfer characteristics](image4)

Figure 5. Saturation Voltage vs. Case

![Graph showing saturation voltage vs. case](image5)

Figure 6. Saturation Voltage vs. Vge

![Graph showing saturation voltage vs. Vge](image6)
Typical Performance Characteristics

Figure 7. Saturation Voltage vs. Vge

Figure 8. Capacitance Characteristics

Figure 9. Gate Charge Characteristics

Figure 10. SOA Characteristics

Figure 11. Turn-On Characteristics vs Gate Resistance

Figure 12. Turn-off Characteristics vs Gate Resistance

Notes:
1. TC = 25°C
2. TJ = 175°C
3. Single Pulse

Collector-Emitter Voltage, VCE [V]
Gate-Emitter Voltage, VGE [V]
Capacitance [pF]
Collector-Emitter Voltage, VCE [V]
Gate Charge, Qg [nC]
Switching Time [ns]
Gate Resistance, Rg [Ω]
Typical Performance Characteristics

Figure 13. Turn-on Characteristics VS. Collector Current

Figure 14. Turn-off Characteristics VS. Collector Current

Figure 15. Switching Loss VS. Gate Resistance

Figure 16. Switching Loss VS. Gate Resistance

Figure 17. Turn off Switching SOA Characteristics

Figure 18. Forward Characteristics
Figure 19. Transient Thermal Impedance of IGBT

![Graph showing transient thermal impedance of IGBT](image)

- Duty Factor, $D = t_1/t_2$
- Peak $T_j = P_{dm} \times Z_{thjc} + T_C$

**Notes:**
- Single pulse
- Rectangular Pulse Duration [sec]
- Thermal Response [$Z_{thjc}$]
Mechanical Dimensions

Figure 20. TO-3P 3L - 3LD, T03, PLASTIC, EIAJ SC-65

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Dimensions in Millimeters
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<th>Product Status</th>
<th>Definition</th>
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</thead>
<tbody>
<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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