ON Semiconductor®

# FGH40N60UF
## 600 V, 40 A Field Stop IGBT

### Features

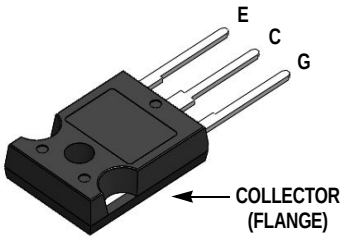
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.8 V @ $I_C$ = 40 A
- High Input Impedance
- Fast Switching
- RoHS Compliant

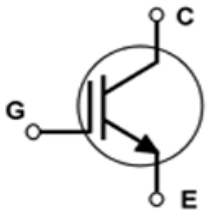
### Applications

- Solar Inverter, UPS, Welder, PFC

### General Description

Using novel field stop IGBT technology, ON Semicondcutor's field stop IGBTs offer the optimum performance for solar inverter, UPS, welder and PFC applications where low conduction and switch-ing losses are essential.




### Absolute Maximum Ratings

| Symbol | Description | | Ratings | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | | 600 | V |
| $V_{GES}$ | Gate to Emitter Voltage | | ±20 | V |
| | Transient Gate-to-Emitter Voltage | | ±30 | |
| $I_C$ | Collector Current | @ $T_C$ = 25°C | 80 | A |
| | Collector Current | @ $T_C$ = 100°C | 40 | A |
| $I_{CM\ (1)}$ | Pulsed Collector Current | @ $T_C$ = 25°C | 120 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 290 | W |
| | Maximum Power Dissipation | @ $T_C$ = 100°C | 116 | W |
| $T_J$ | Operating Junction Temperature | | -55 to +150 | °C |
| $T_{stg}$ | Storage Temperature Range | | -55 to +150 | °C |
| $T_L$ | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | | 300 | °C |

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

### Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$(IGBT) | Thermal Resistance, Junction to Case | - | 0.43 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | - | 40 | °C/W |

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FGH40N60UFTU | FGH40N60UF | TO-247 | Tube | N/A | N/A | 30 |

## Electrical Characteristics of the IGBT $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $V_{GE}$ = 0 V, $I_C$ = 250 μA | 600 | - | - | V |
| $\Delta BV_{CES}$ / $\Delta T_J$ | Temperature Coefficient of Breakdown Voltage | $V_{GE}$ = 0 V, $I_C$ = 250 μA | - | 0.6 | - | V/°C |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0 V | - | - | 250 | μA |
| $I_{GES}$ | G-E Leakage Current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0 V | - | - | ±400 | nA |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C$ = 250 μA, $V_{CE}$ = $V_{GE}$ | 4.0 | 5.0 | 6.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 40 A, $V_{GE}$ = 15 V | - | 1.8 | 2.4 | V |
| | | $I_C$ = 40 A, $V_{GE}$ = 15 V, $T_C$ = 125°C | - | 2.0 | - | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V, f = 1 MHz | - | 2110 | - | pF |
| $C_{oes}$ | Output Capacitance | | - | 200 | - | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | - | 60 | - | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 40 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 25°C | - | 24 | - | ns |
| $t_r$ | Rise Time | | - | 44 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 112 | - | ns |
| $t_f$ | Fall Time | | - | 30 | 60 | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 1.19 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.46 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 1.65 | - | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 40 A, $R_G$ = 10 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 125°C | - | 24 | - | ns |
| $t_r$ | Rise Time | | - | 45 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 120 | - | ns |
| $t_f$ | Fall Time | | - | 40 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 1.2 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.69 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 1.89 | - | mJ |
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 400 V, $I_C$ = 40 A, $V_{GE}$ = 15 V | - | 120 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | - | 14 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | - | 58 | - | nC |

## Typical Performance Characteristics

**Figure 1. Typical Output Characteristics**

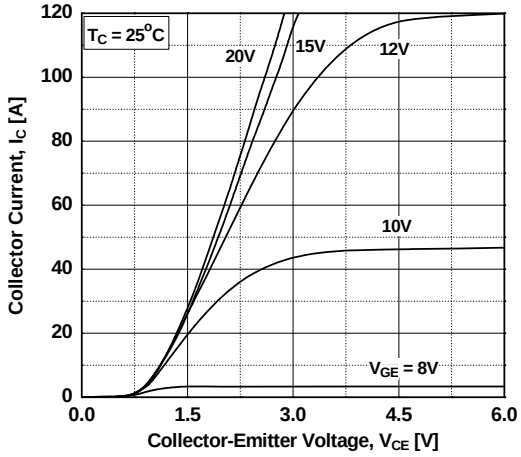



**Figure 2. Typical Output Characteristics**

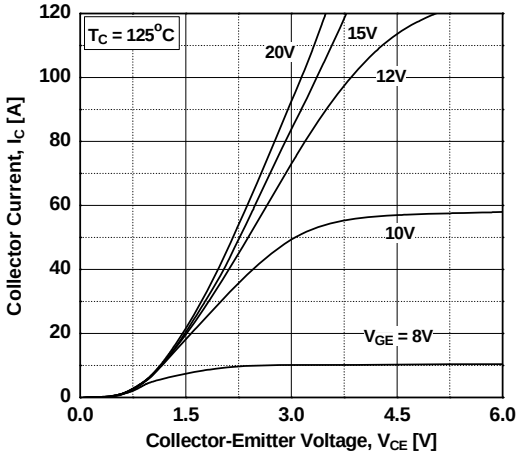



**Figure 3. Typical Saturation Voltage Characteristics**

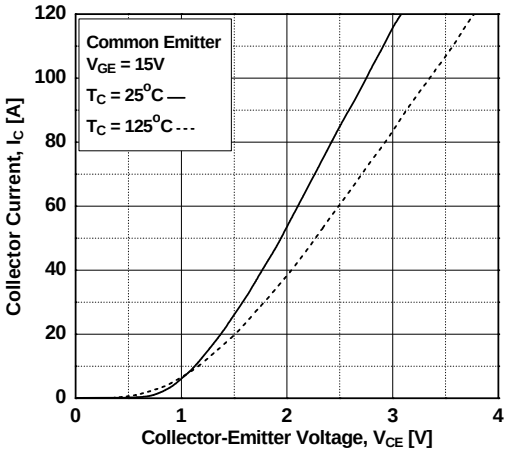



**Figure 4. Transfer Characteristics**

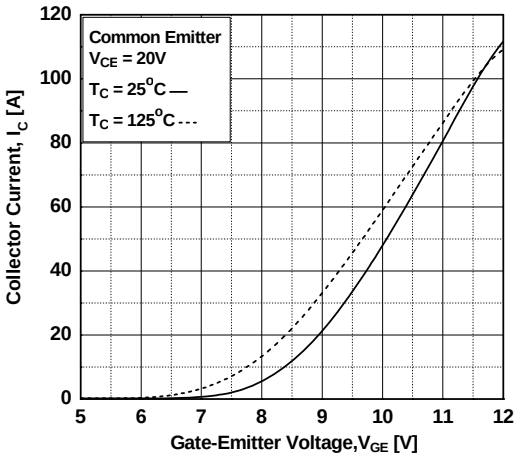



**Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level**

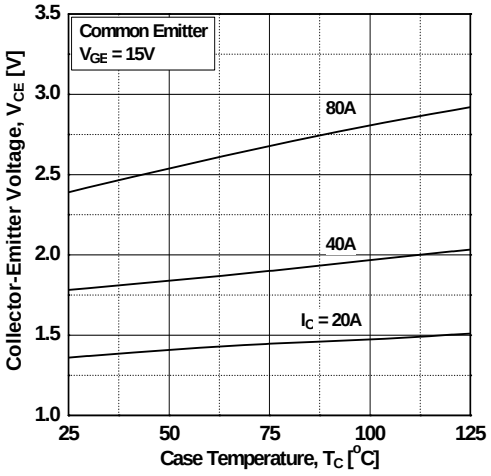
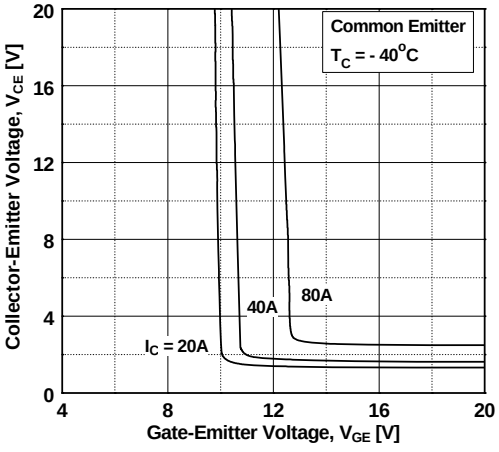
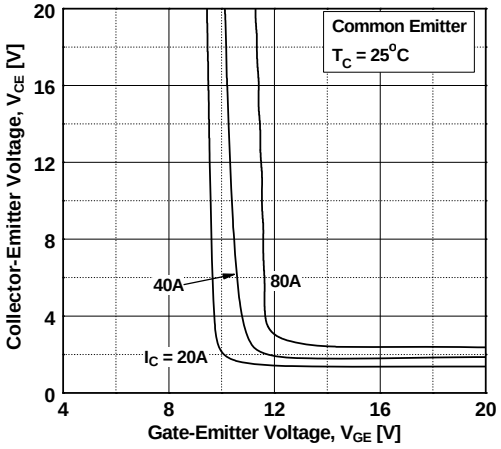



**Figure 6. Saturation Voltage vs. $V_{GE}$**

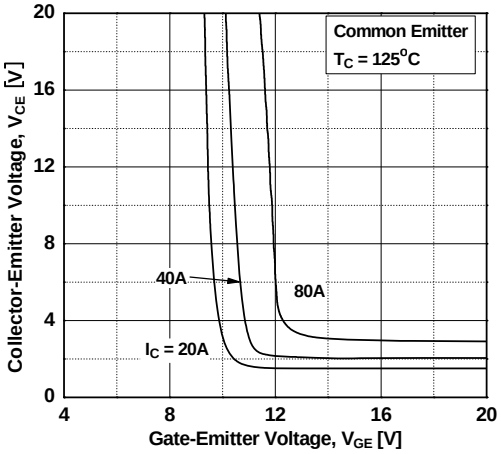


## Typical Performance Characteristics

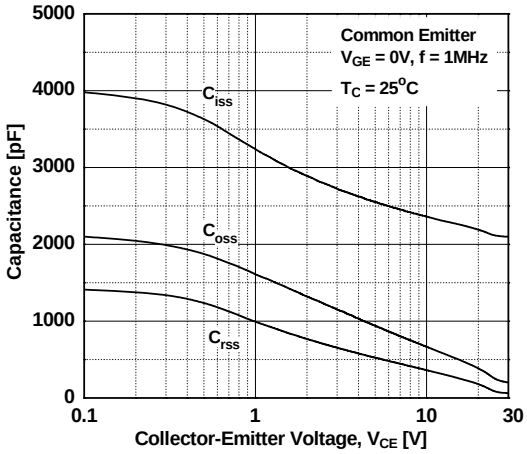
### Figure 7. Saturation Voltage vs. $V_{GE}$



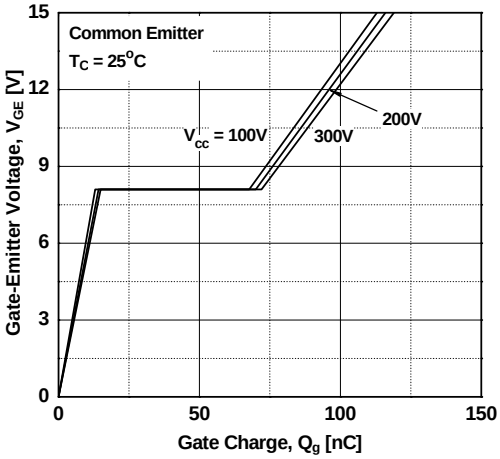

### Figure 8. Saturation Voltage vs. $V_{GE}$



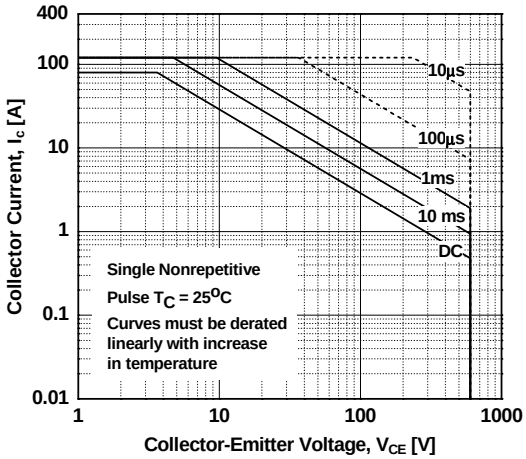

### Figure 9. Capacitance Characteristics



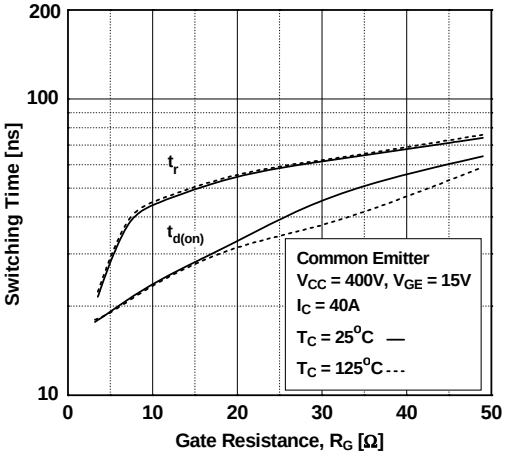

### Figure 10. Gate charge Characteristics




### Figure 11. SOA Characteristics




### Figure 12. Turn-on Characteristics vs. Gate Resistance



## Typical Performance Characteristics

**Figure 13. Turn-off Characteristics vs. Gate Resistance**

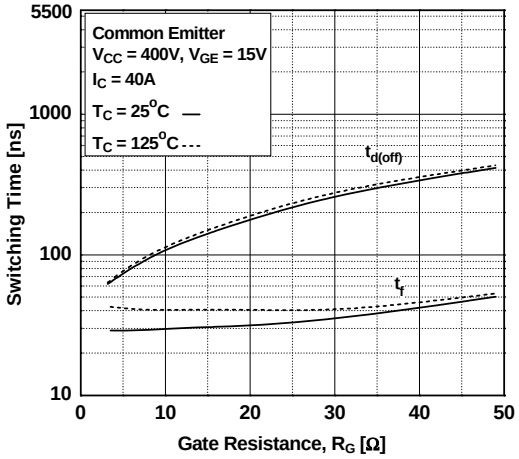



**Figure 14. Turn-on Characteristics vs. Collector Current**

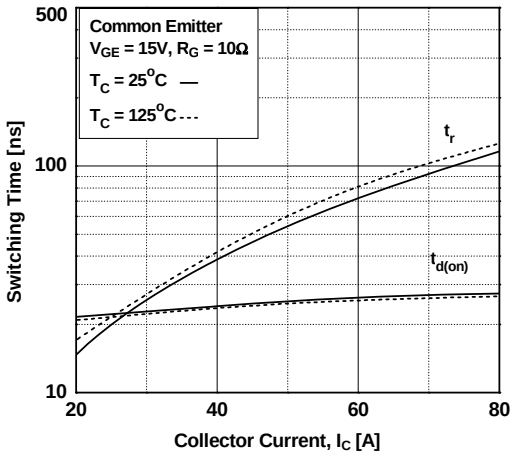



**Figure 15. Turn-off Characteristics vs. Collector Current**

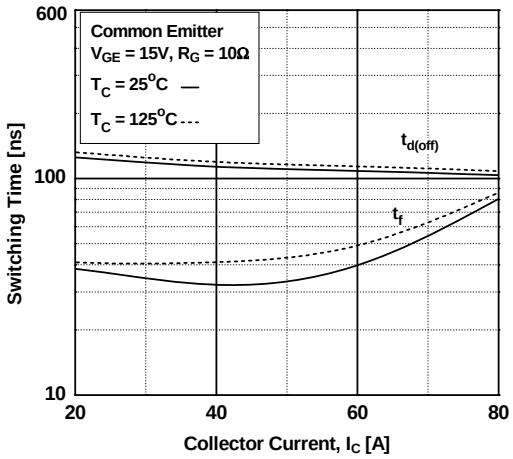



**Figure 16. Switching Loss vs. Gate Resistance**

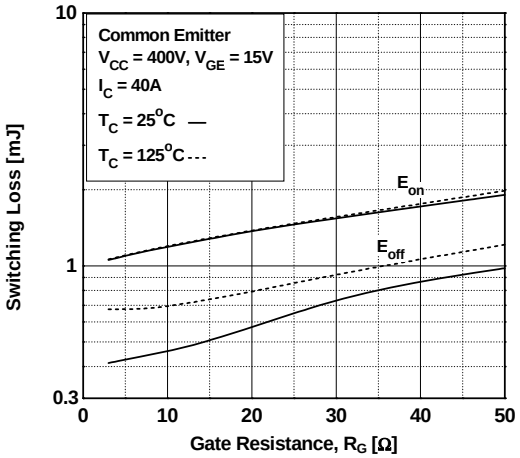



**Figure 17. Switching Loss vs. Collector Current**

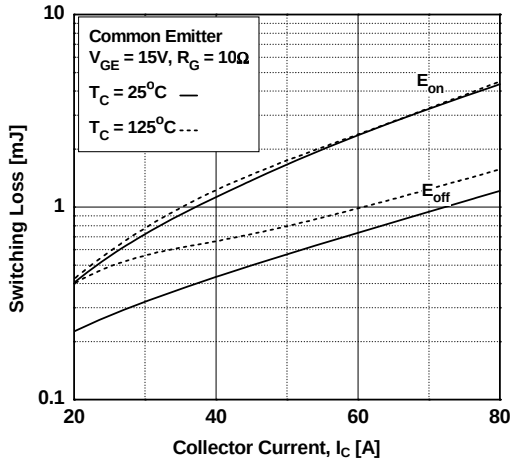
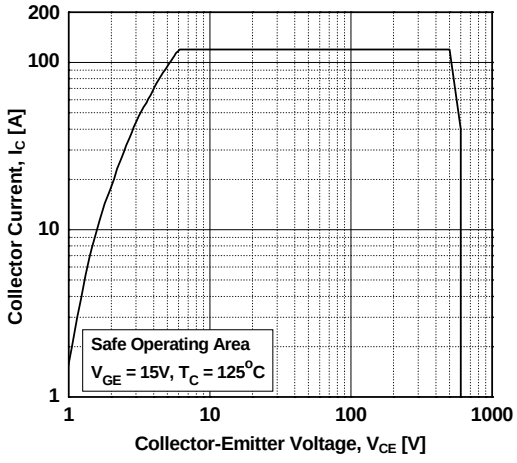
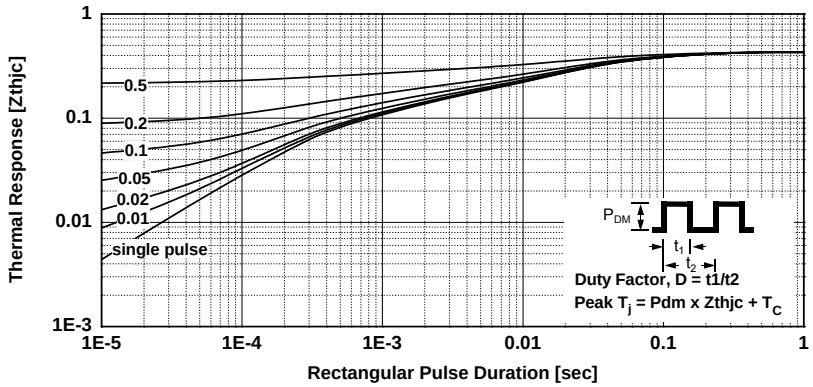



**Figure 18. Turn off Switching SOA Characteristics**



## Typical Performance Characteristics

**Figure 19.Transient Thermal Impedance of IGBT**



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