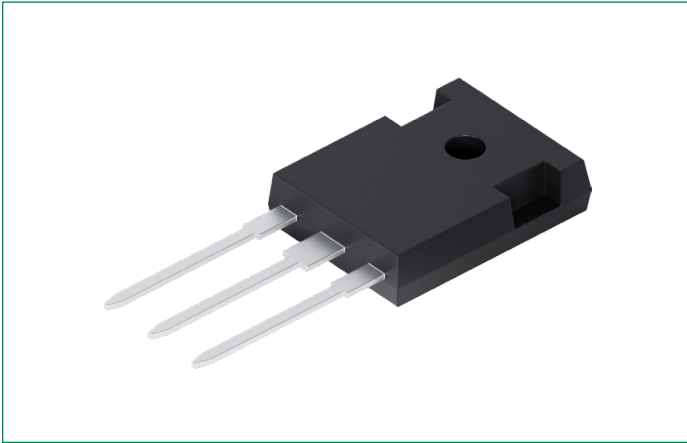


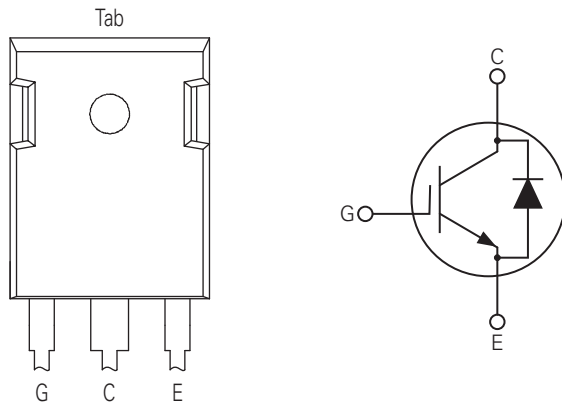
# IXYH30N120C4H1

## 1200 V, 30 A XPT™ Gen4 IGBT with Sonic Diode

Extreme Light Punch Through IGBT for 20–50 kHz Switching



**Pinout Diagram** (TO-247-3L)



**G:** Gate; **C:** Collector; **E:** Emitter; **Tab:** Collector

### Description:

Developed using our proprietary XPT™ thin-wafer technology and state-of-the-art Trench IGBT process, these devices feature reduced thermal resistance, low energy losses, fast switching, low tail current, and high current densities.

### Features & Benefits:

- Optimized for 20–50 kHz Switching
- Square RBSOA
- High Surge Current Capability
- International Standard Package
- Anti-Parallel Sonic Diode

### Applications:

- Power Inverters
- UPS
- Motor Drives
- SMPS
- PFC Circuits
- Battery Chargers
- Welding Machines

### Product Summary

| Characteristic | Value | Unit |
|----------------|-------|------|
| $V_{CES}$      | 1200  | V    |
| $I_{C110}$     | 30    | A    |
| $V_{CE(sat)}$  | 2.0   | V    |
| $t_{fi(typ)}$  | 53    | ns   |

## Maximum Ratings

| Symbol          | Characteristic                                                        | Conditions                                                                                                                                                       | Value      | Unit               |
|-----------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------|
| $V_{CES}$       | Collector-Emitter Voltage                                             | $T_{VJ} = 25\text{ }^{\circ}\text{C}$ to $175\text{ }^{\circ}\text{C}$                                                                                           | 1200       | V                  |
| $V_{GES}$       | Gate-Emitter Voltage                                                  | Continuous                                                                                                                                                       | $\pm 20$   | V                  |
| $V_{GEM}$       | Transient Gate-Emitter Voltage                                        | Transient                                                                                                                                                        | $\pm 30$   | V                  |
| $I_{C25}$       | Continuous Collector Current                                          | $T_C = 25\text{ }^{\circ}\text{C}$                                                                                                                               | 94         | A                  |
| $I_{C110}$      | Continuous Collector Current                                          | $T_C = 110\text{ }^{\circ}\text{C}$                                                                                                                              | 30         | A                  |
| $I_{F110}$      | Diode Forward Current                                                 | $T_C = 110\text{ }^{\circ}\text{C}$                                                                                                                              | 28         | A                  |
| $I_{CM}$        | Pulsed Collector Current                                              | $T_C = 25\text{ }^{\circ}\text{C}$ , 1 ms                                                                                                                        | 166        | A                  |
| SSOA<br>(RBSOA) | Switching Safe Operating Area<br>(Reverse Biased Safe Operating Area) | $V_{GE} = 15\text{ V}$ , $T_{VJ} = 115\text{ }^{\circ}\text{C}$ , $R_G = 5\text{ }\Omega$ ,<br>Clamped Inductive Load, $I_{CM} @ V_{CE} \leq 0.8 \times V_{CES}$ | 60         | A                  |
| $P_C$           | Collector Power Dissipation                                           | $T_C = 25\text{ }^{\circ}\text{C}$                                                                                                                               | 500        | W                  |
| $T_{VJ}$        | Virtual Junction Temperature                                          | –                                                                                                                                                                | –55 to 175 | $^{\circ}\text{C}$ |
| $T_{stg}$       | Storage Temperature                                                   | –                                                                                                                                                                | –55 to 175 | $^{\circ}\text{C}$ |
| $T_L$           | Lead Temperature for Soldering                                        | 1.6 mm (0.062 in.) from Case for 10 s                                                                                                                            | 300        | $^{\circ}\text{C}$ |
| $M_d$           | Mounting Torque                                                       | –                                                                                                                                                                | 1.13 / 10  | Nm/lb.in           |
| W               | Weight                                                                | –                                                                                                                                                                | 6          | g                  |

## Thermal Characteristics

| Symbol       | Characteristic                             | Conditions | Value |      |      | Unit |
|--------------|--------------------------------------------|------------|-------|------|------|------|
|              |                                            |            | Min.  | Typ. | Max. |      |
| $R_{th, JC}$ | Thermal Resistance, junction-to-case, IGBT | –          | –     | –    | 0.30 | K/W  |
| $R_{th, CS}$ | Thermal Resistance, case-to-heat sink      | –          | –     | 21   | –    | K/W  |

## Electrical Characteristics – Static ( $T_{VJ} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

| Symbol        | Characteristic                                    | Conditions                                                                            | Value |      |           | Unit          |
|---------------|---------------------------------------------------|---------------------------------------------------------------------------------------|-------|------|-----------|---------------|
|               |                                                   |                                                                                       | Min.  | Typ. | Max.      |               |
| $BV_{CES}$    | Collector-Emitter Breakdown Voltage               | $I_C = 250\text{ }\mu\text{A}$ , $V_{GE} = 0\text{ V}$                                | 1200  | –    | –         | V             |
| $V_{GE(th)}$  | Gate-Emitter Threshold Voltage                    | $I_C = 250\text{ }\mu\text{A}$ , $V_{CE} = V_{GE}$                                    | 4.0   | –    | 6.5       | V             |
| $I_{GES}$     | Gate-Emitter Leakage Current                      | $V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$                                    | –     | –    | $\pm 100$ | nA            |
| $I_{CES}$     | Zero Gate Voltage Collector Current               | $V_{CE} = V_{CES}$ , $V_{GE} = 0\text{ V}$                                            | –     | –    | 50        | $\mu\text{A}$ |
|               |                                                   | $V_{CE} = V_{CES}$ , $V_{GE} = 0\text{ V}$ , $T_{VJ} = 125\text{ }^{\circ}\text{C}$   | –     | –    | 5         | mA            |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage <sup>1</sup> | $I_C = 25\text{ A}$ , $V_{GE} = 15\text{ V}$                                          | –     | 2.0  | 2.4       | V             |
|               |                                                   | $I_C = 25\text{ A}$ , $V_{GE} = 15\text{ V}$ , $T_{VJ} = 150\text{ }^{\circ}\text{C}$ | –     | 2.4  | –         | V             |

**Note 1:** Pulse test,  $t \leq 300\text{ }\mu\text{s}$ , duty cycle,  $d \leq 2\%$

**Electrical Characteristics – Dynamic** ( $T_{VJ} = 25^{\circ}\text{C}$  unless otherwise specified)

| Symbol       | Characteristic                   | Conditions                                                                                                                       |                                        | Value |      |      | Unit |  |
|--------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-------|------|------|------|--|
|              |                                  |                                                                                                                                  |                                        | Min.  | Typ. | Max. |      |  |
| $g_{fs}$     | Transconductance <sup>1</sup>    | $I_C = 25\text{ A}, V_{CE} = 10\text{ V}$                                                                                        |                                        | 9.0   | 15.5 | –    | S    |  |
| $C_{ies}$    | Input Capacitance                | $V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 1\text{ MHz}$                                                                    |                                        | –     | 1150 | –    | pF   |  |
| $C_{oes}$    | Output Capacitance               |                                                                                                                                  |                                        | –     | 110  | –    |      |  |
| $C_{res}$    | Reverse Transfer Capacitance     |                                                                                                                                  |                                        | –     | 40   | –    |      |  |
| $Q_{g(on)}$  | Total Gate Charge                | $V_{GE} = 15\text{ V}, V_{CE} = 0.5 \times V_{CES},$<br>$I_C = 25\text{ A}$                                                      |                                        | –     | 57   | –    | nC   |  |
| $Q_{ge}$     | Gate-Emitter Charge              |                                                                                                                                  |                                        | –     | 10   | –    |      |  |
| $Q_{gc}$     | Gate-Collector Charge            |                                                                                                                                  |                                        | –     | 26   | –    |      |  |
| $t_{d(on)}$  | Turn-on Delay Time <sup>2</sup>  | Inductive Load,<br>$V_{GE} = 15\text{ V},$<br>$V_{CE} = 0.8 \times V_{CES},$<br>$I_C = 25\text{ A},$<br>$R_{G(ext)} = 5\ \Omega$ | $T_{VJ} = 25\text{ }^{\circ}\text{C}$  | –     | 18   | –    | ns   |  |
|              |                                  |                                                                                                                                  | $T_{VJ} = 125\text{ }^{\circ}\text{C}$ | –     | 16   | –    |      |  |
| $t_{ri}$     | Turn-on Rise Time <sup>2</sup>   |                                                                                                                                  | $T_{VJ} = 25\text{ }^{\circ}\text{C}$  | –     | 58   | –    | ns   |  |
|              |                                  |                                                                                                                                  | $T_{VJ} = 125\text{ }^{\circ}\text{C}$ | –     | 40   | –    |      |  |
| $E_{on}$     | Turn-on Energy <sup>2</sup>      |                                                                                                                                  | $T_{VJ} = 25\text{ }^{\circ}\text{C}$  | –     | 4.8  | –    | mJ   |  |
|              |                                  |                                                                                                                                  | $T_{VJ} = 125\text{ }^{\circ}\text{C}$ | –     | 5.6  | –    |      |  |
| $t_{d(off)}$ | Turn-off Delay Time <sup>2</sup> |                                                                                                                                  | $T_{VJ} = 25\text{ }^{\circ}\text{C}$  | –     | 205  | –    | ns   |  |
|              |                                  |                                                                                                                                  | $T_{VJ} = 125\text{ }^{\circ}\text{C}$ | –     | 260  | –    |      |  |
| $t_{fi}$     | Turn-off Fall Time <sup>2</sup>  |                                                                                                                                  | $T_{VJ} = 25\text{ }^{\circ}\text{C}$  | –     | 53   | –    | ns   |  |
|              |                                  |                                                                                                                                  | $T_{VJ} = 125\text{ }^{\circ}\text{C}$ | –     | 100  | –    |      |  |
| $E_{off}$    | Turn-off Energy <sup>2</sup>     |                                                                                                                                  | $T_{VJ} = 25\text{ }^{\circ}\text{C}$  | –     | 1.5  | –    | mJ   |  |
|              |                                  |                                                                                                                                  | $T_{VJ} = 125\text{ }^{\circ}\text{C}$ | –     | 2.7  | –    |      |  |

**Note 1:** Pulse test,  $t \leq 300\ \mu\text{s}$ , duty cycle,  $d \leq 2\%$ **Note 2:** Switching times and energy losses may increase for higher  $V_{CE(clamp)}$ ,  $T_{VJ}$ , or  $R_G$ .**Reverse Sonic Diode** ( $T_{VJ} = 25^{\circ}\text{C}$  unless otherwise specified)

| Symbol       | Characteristic                       | Conditions                                                                                                                          | Value |      |      | Unit |
|--------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|              |                                      |                                                                                                                                     | Min.  | Typ. | Max. |      |
| $V_F$        | Diode Forward Voltage <sup>1</sup>   | $I_F = 30\text{ A}, V_{GE} = 0\text{ V}$                                                                                            | –     | 1.85 | 2.4  | V    |
|              |                                      | $I_F = 30\text{ A}, V_{GE} = 0\text{ V}, T_{VJ} = 150^{\circ}\text{C}$                                                              | –     | 2.15 | –    |      |
| $I_{RM}$     | Reverse Recovery Current             | $I_F = 30\text{ A}, V_{GE} = 0\text{ V}, T_{VJ} = 150^{\circ}\text{C}$<br>$-di_F/dt = 400\text{ A}/\mu\text{s}, V_R = 600\text{ V}$ | –     | 20   | –    | A    |
| $t_{rr}$     | Reverse Recovery Time                |                                                                                                                                     | –     | 310  | –    | ns   |
| $R_{th, JC}$ | Thermal Resistance, junction-to-case | –                                                                                                                                   | –     | –    | 0.52 | K/W  |

**Note 1:** Pulse test,  $t \leq 300\ \mu\text{s}$ , duty cycle,  $d \leq 2\%$

## Characteristic Curves

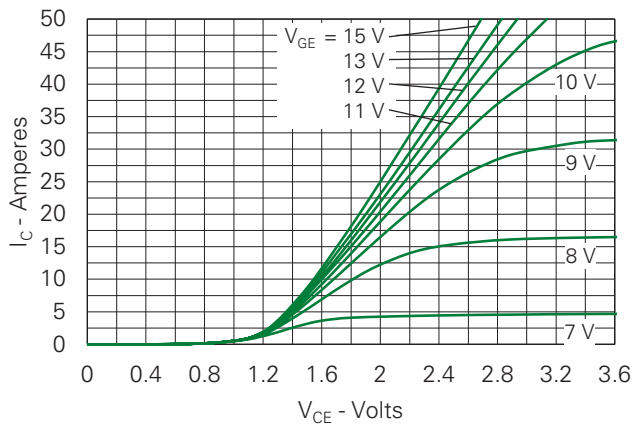
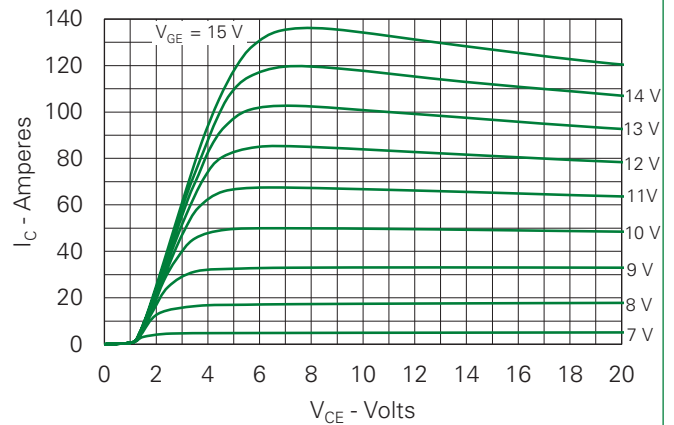
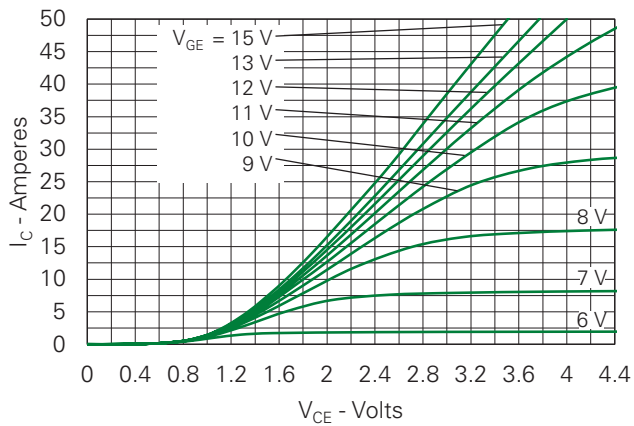
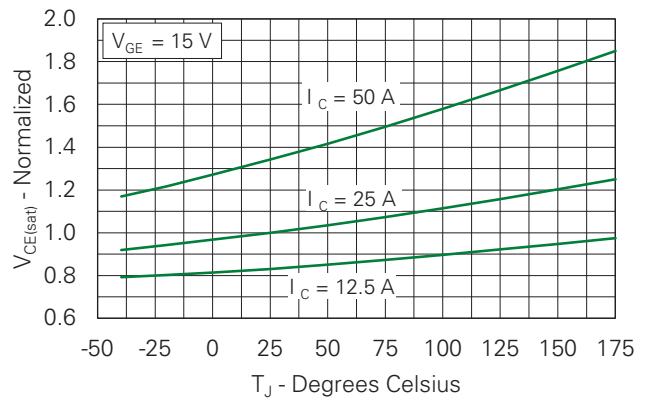
Fig. 1. Output Characteristics @  $T_{VJ} = 25\text{ }^{\circ}\text{C}$ Fig. 2. Extended Output Characteristics @  $T_{VJ} = 25\text{ }^{\circ}\text{C}$ Fig. 3. Output Characteristics @  $T_{VJ} = 150\text{ }^{\circ}\text{C}$ Fig. 4. Dependence of  $V_{CE(sat)}$  on Junction Temperature

Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

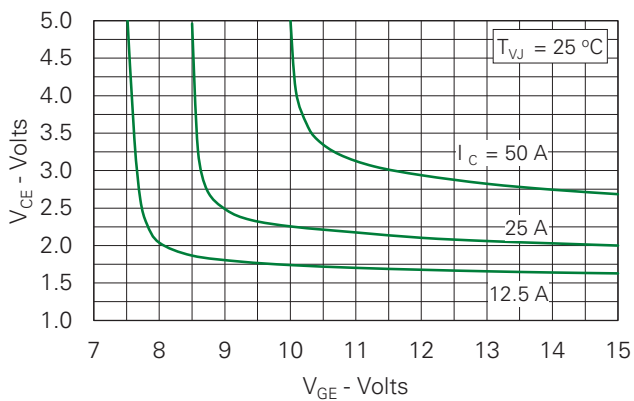


Fig. 6. Input Admittance

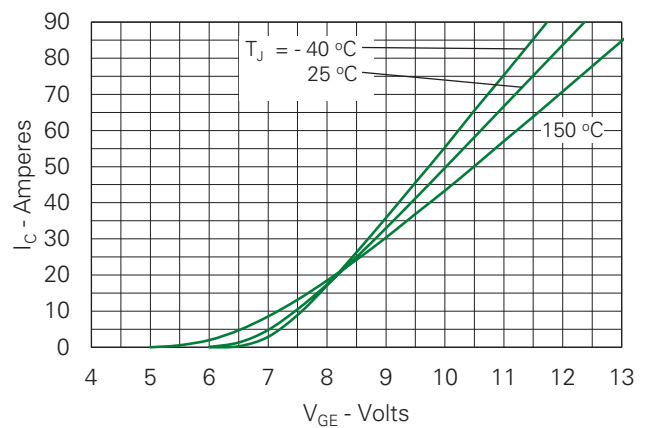


Fig. 7. Transconductance

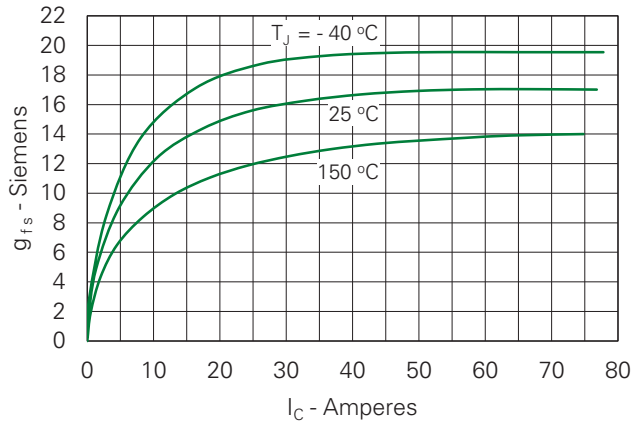


Fig. 8. Gate Charge

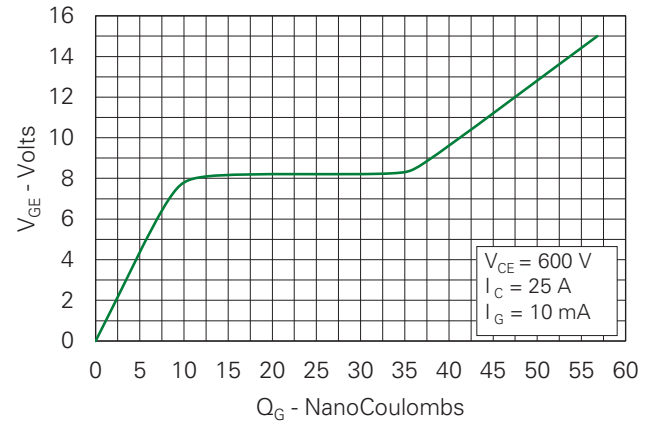


Fig. 9. Capacitance

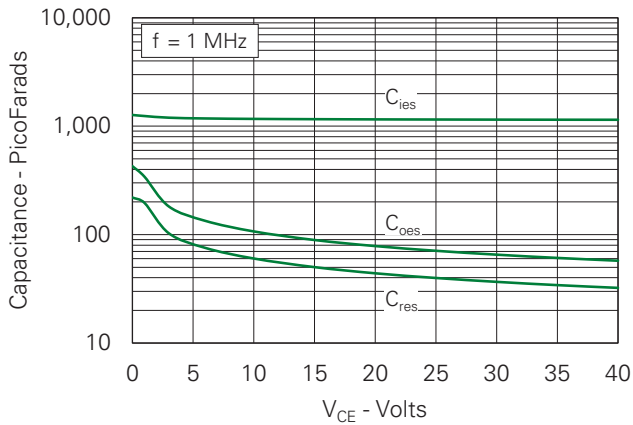


Fig. 10. Reverse-Bias Safe Operating Area

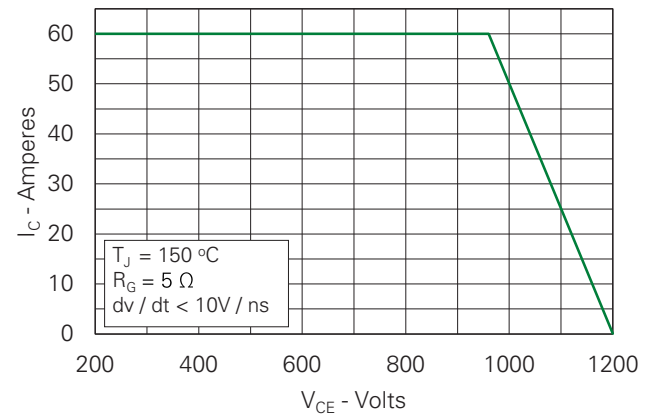


Fig. 11. Maximum Transient Thermal Impedance (IGBT)

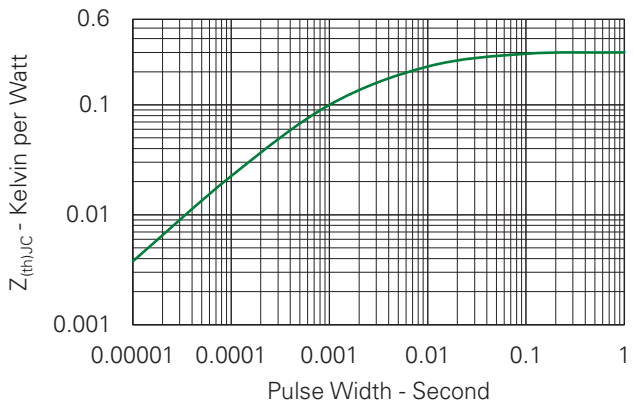


Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance

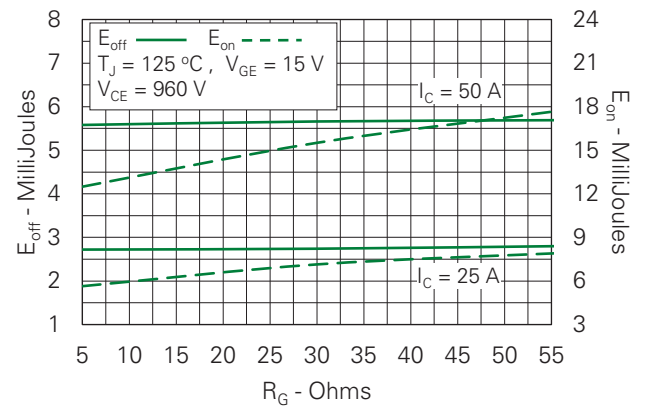


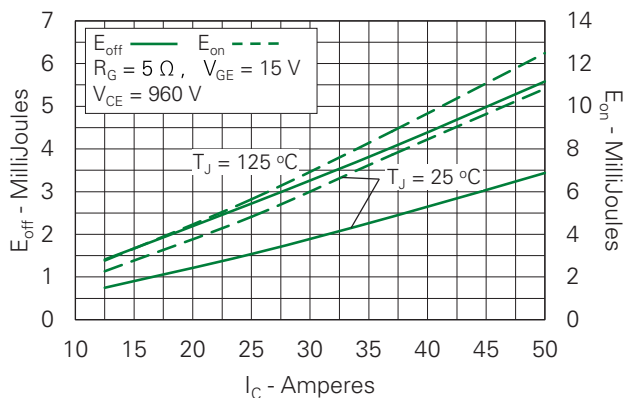
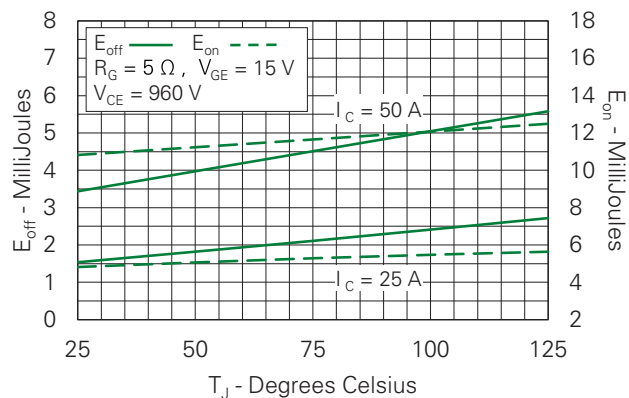
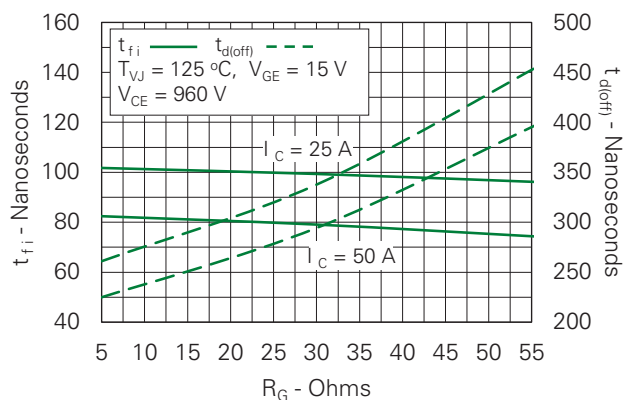
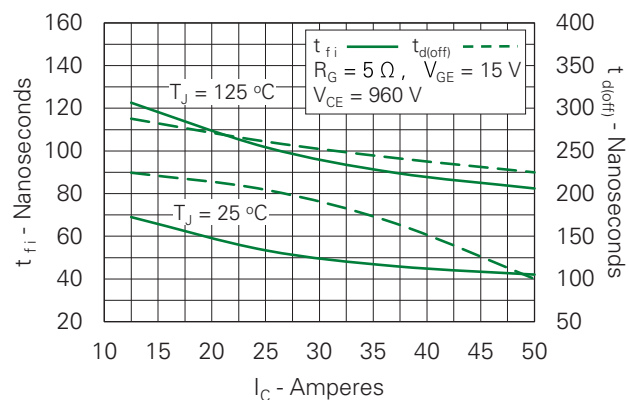
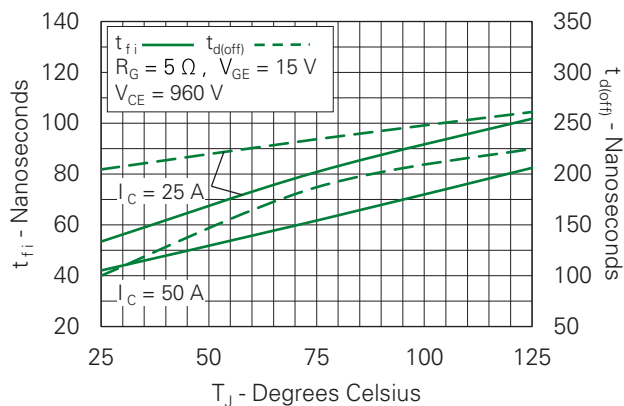
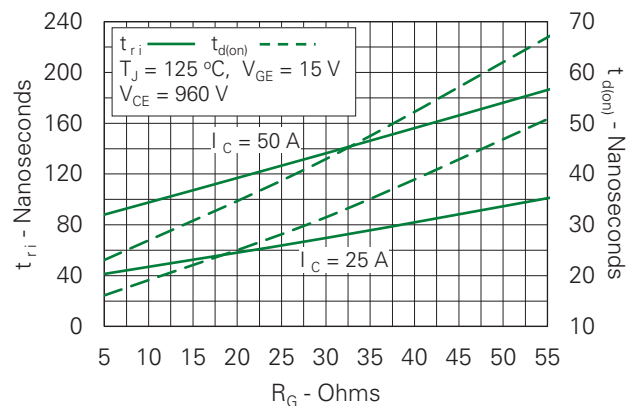
**Fig. 13. Inductive Switching Energy Loss vs. Collector Current****Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature****Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance****Fig. 16. Inductive Turn-off Switching Times vs. Collector Current****Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature****Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

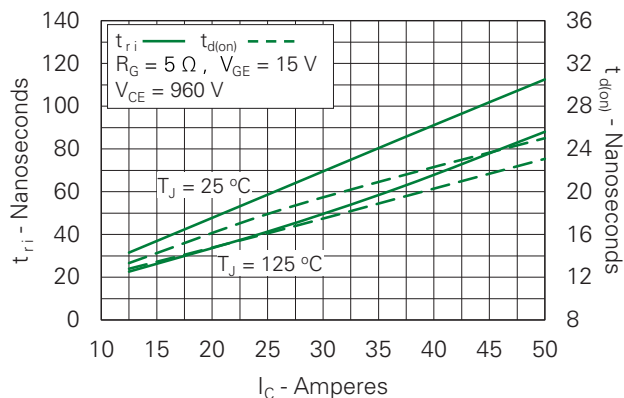
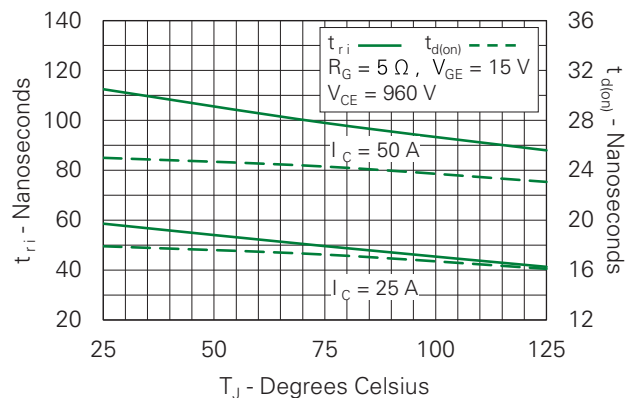
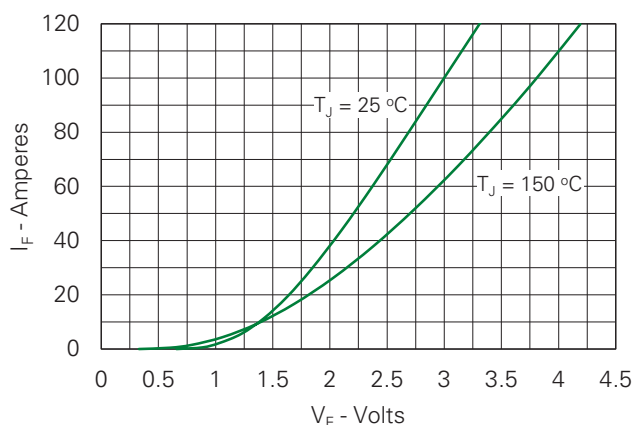
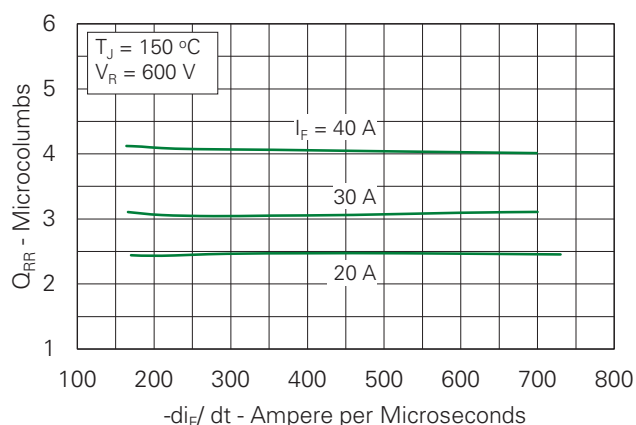
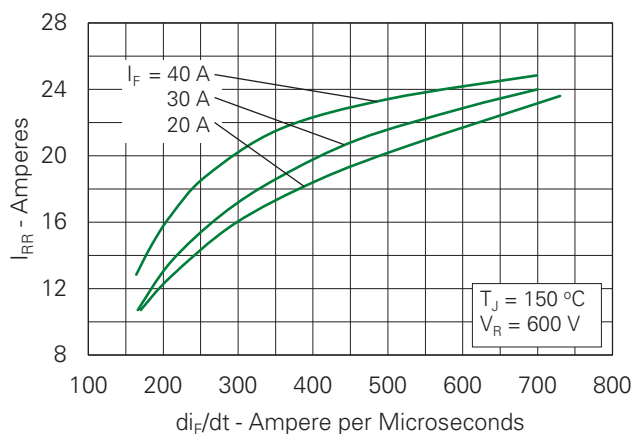
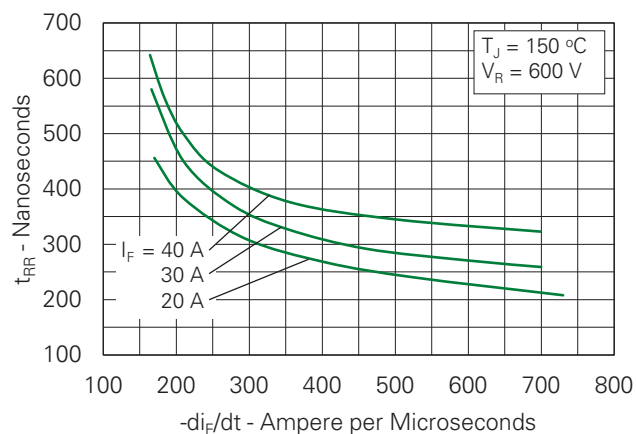
**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current****Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature****Fig. 21. Diode Forward Characteristics****Fig. 22. Reverse Recovery Charge vs.  $-di_F/dt$** **Fig. 23. Reverse Recovery Current vs.  $-di_F/dt$** **Fig. 24. Reverse Recovery Time vs.  $-di_F/dt$** 

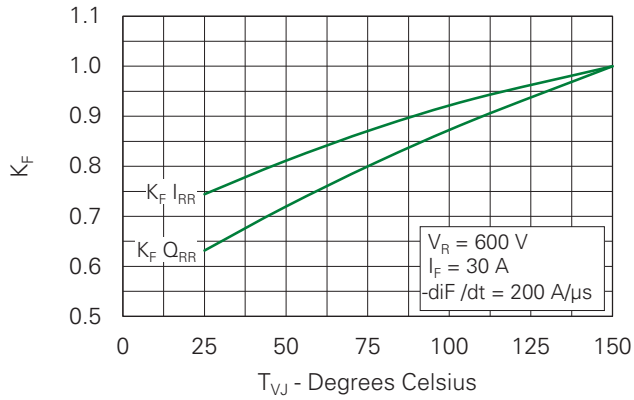
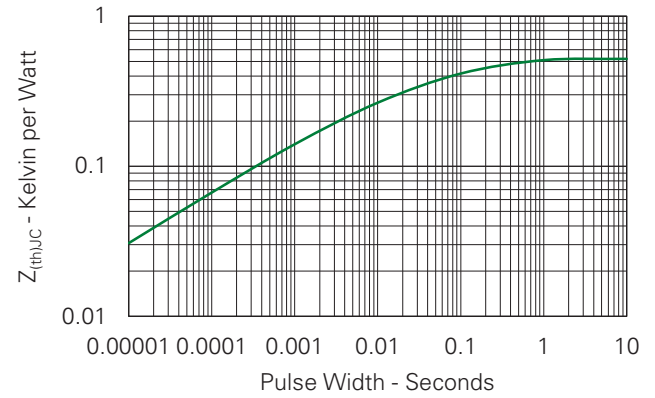
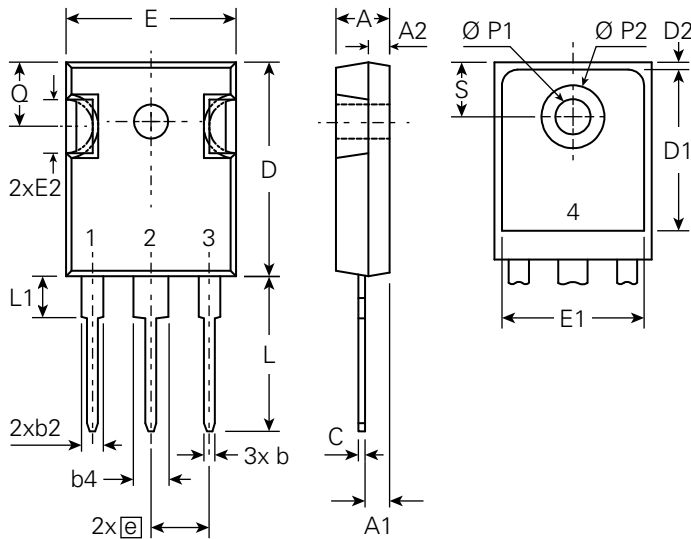
Fig. 25. Dynamic Parameters  $Q_{RR}$ ,  $I_{RR}$  vs. Junction Temperature

Fig. 26. Maximum Transient Thermal Impedance (Diode)



## Part Outline Drawing (TO-247-3L)



| Symbol           | Inches    |         |       | Millimeters |         |       |
|------------------|-----------|---------|-------|-------------|---------|-------|
|                  | Min.      | Typical | Max.  | Min.        | Typical | Max.  |
| A                | 0.185     | –       | 0.209 | 4.70        | –       | 5.30  |
| A1               | 0.087     | –       | 0.102 | 2.21        | –       | 2.59  |
| A2               | 0.059     | –       | 0.098 | 1.50        | –       | 2.49  |
| b                | 0.039     | –       | 0.055 | 0.99        | –       | 1.40  |
| b2               | 0.065     | –       | 0.094 | 1.65        | –       | 2.39  |
| b4               | 0.102     | –       | 0.135 | 2.59        | –       | 3.43  |
| C                | 0.015     | –       | 0.035 | 0.38        | –       | 0.89  |
| D                | 0.819     | –       | 0.844 | 20.79       | –       | 21.45 |
| D1               | 0.515     | –       | –     | 13.07       | –       | –     |
| D2               | 0.020     | –       | 0.053 | 0.51        | –       | 1.35  |
| E                | 0.609     | –       | 0.639 | 15.48       | –       | 16.24 |
| E1               | 0.530     | –       | –     | 13.45       | –       | –     |
| E2               | 0.170     | –       | 0.216 | 4.31        | –       | 5.48  |
| e                | 0.215 BSC |         |       | 5.45 BSC    |         |       |
| L                | 0.780     | –       | 0.799 | 19.80       | –       | 20.30 |
| L1               | –         | –       | 0.177 | –           | –       | 4.49  |
| $\varnothing P1$ | 0.140     | –       | 0.144 | 3.55        | –       | 3.65  |
| $\varnothing P2$ | –         | –       | 0.291 | –           | –       | 7.39  |
| Q                | 0.212     | –       | 0.244 | 5.38        | –       | 6.19  |
| S                | 0.242 BSC |         |       | 6.14 BSC    |         |       |

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