

# Three Level NPC Q2Pack Module

## NXH400N100H4Q2F2PG, NXH400N100H4Q2F2SG, NXH400N100H4Q2F2SG-R

This high-density, integrated power module combines high-performance IGBTs with rugged anti-parallel diodes.

### Features

- Extremely Efficient Trench with Field Stop Technology
- Low Switching Loss Reduces System Power Dissipation
- Module Design Offers High Power Density
- Low Inductive Layout
- Low Package Height
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Solar Inverters
- Uninterruptable Power Supplies Systems

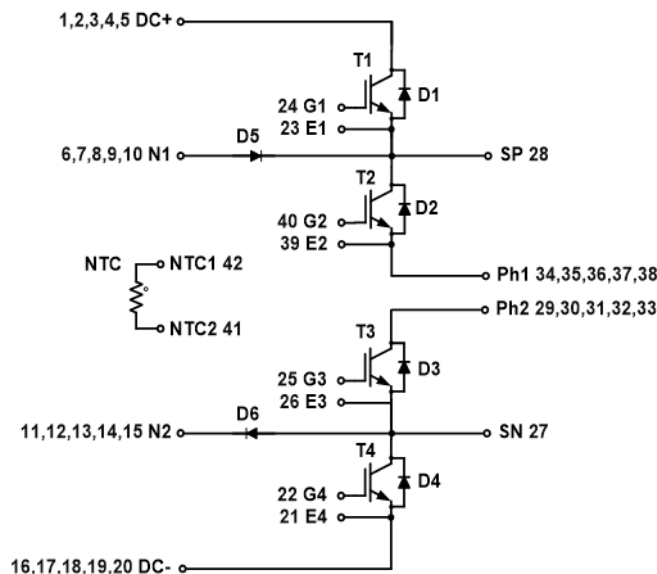
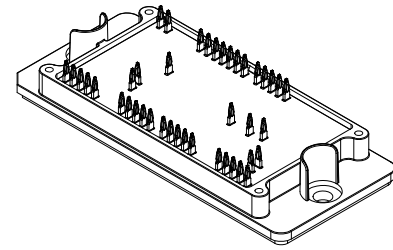
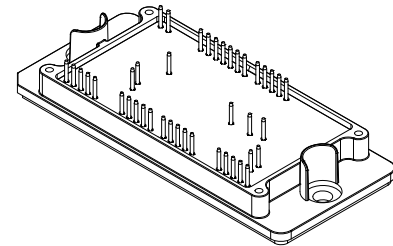


Figure 1. NXH400N100H4Q2F2PG/SG/SG-R Schematic Diagram

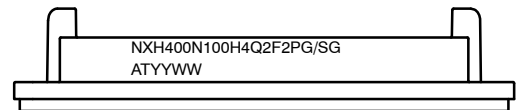


Q2PACK INPC PRESS FIT PINS  
PIM42, 93x47 (PRESSFIT)  
CASE 180BH



Q2PACK INPC SOLDER PINS  
PIM44, 93x47 (SOLDER PIN)  
CASE 180BS

### MARKING DIAGRAM



NXH400N100H4Q2F2PG/SG = Specific Device Code  
G = Pb-Free Package  
AT = Assembly & Test Site Code  
YYWW = Year and Work Week Code

### PIN CONNECTIONS

See details pin connections on page 2 of this data sheet.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

PIN CONNECTIONS

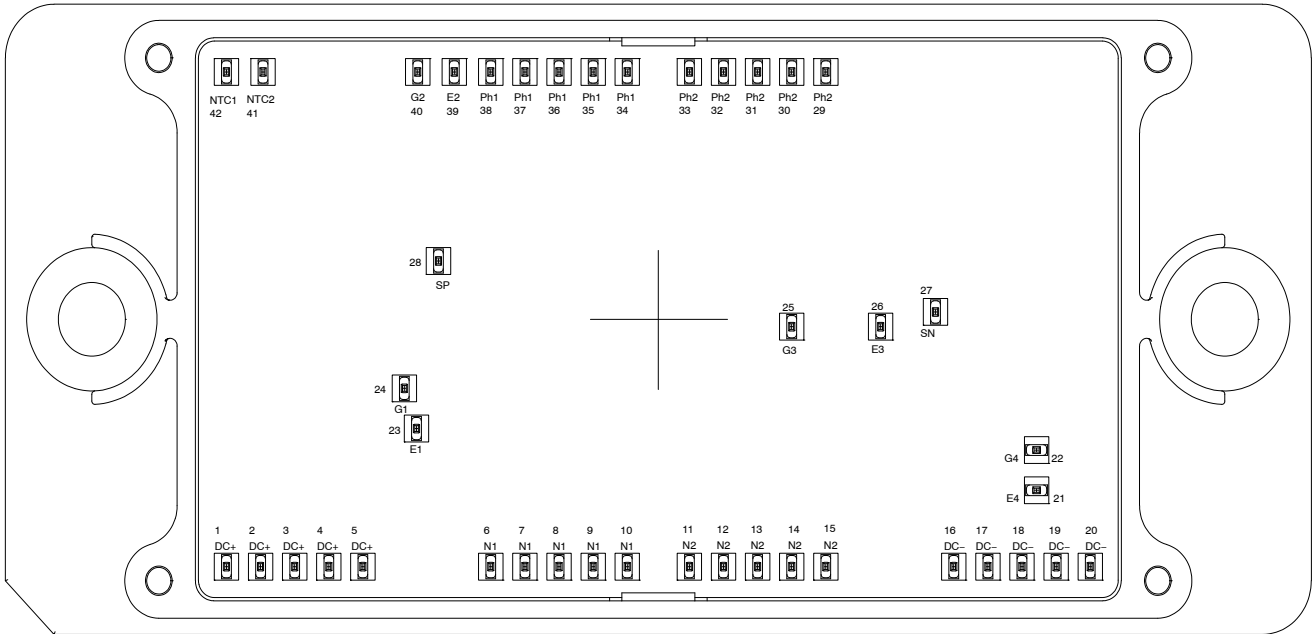


Figure 2. Pin Connections

**ABSOLUTE MAXIMUM RATINGS** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Rating | Symbol | Value | Unit |
|--------|--------|-------|------|
|--------|--------|-------|------|

**OUTER IGBT (T1, T4)**

|  |                |                |                  |
|--|----------------|----------------|------------------|
| Collector-Emitter Voltage  | $V_{CES}$      | 1000           | V                |
| Gate-Emitter Voltage<br>Positive Transient Gate-Emitter Voltage ( $T_{pulse} = 5 \mu\text{s}$ , $D < 0.10$ ) | $V_{GE}$       | $\pm 20$<br>30 | V                |
| Continuous Collector Current @ $T_C = 80^\circ\text{C}$  | $I_C$          | 409            | A                |
| Pulsed Peak Collector Current @ $T_C = 80^\circ\text{C}$ ( $T_J = 150^\circ\text{C}$ )                       | $I_{C(Pulse)}$ | 1227           | A                |
| Maximum Power Dissipation ( $T_J = 150^\circ\text{C}$ )  | $P_{tot}$      | 959            | W                |
| Minimum Operating Junction Temperature   | $T_{JMIN}$     | -40            | $^\circ\text{C}$ |
| Maximum Operating Junction Temperature   | $T_{JMAX}$     | 175            | $^\circ\text{C}$ |

**INNER IGBT (T2, T3)**

|  |                |                |                  |
|--|----------------|----------------|------------------|
| Collector-Emitter Voltage  | $V_{CES}$      | 1000           | V                |
| Gate-Emitter Voltage<br>Positive Transient Gate-Emitter Voltage ( $T_{pulse} = 5 \mu\text{s}$ , $D < 0.10$ ) | $V_{GE}$       | $\pm 20$<br>30 | V                |
| Continuous Collector Current @ $T_C = 80^\circ\text{C}$  | $I_C$          | 360            | A                |
| Pulsed Peak Collector Current @ $T_C = 80^\circ\text{C}$ ( $T_J = 150^\circ\text{C}$ )                       | $I_{C(Pulse)}$ | 1080           | A                |
| Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )  | $P_{tot}$      | 805            | W                |
| Minimum Operating Junction Temperature   | $T_{JMIN}$     | -40            | $^\circ\text{C}$ |
| Maximum Operating Junction Temperature   | $T_{JMAX}$     | 175            | $^\circ\text{C}$ |

**IGBT INVERSE DIODE (D1, D2, D3, D4)**

|   |           |      |   |
|---|-----------|------|---|
| Peak Repetitive Reverse Voltage                               | $V_{RRM}$ | 1000 | V |
| Continuous Forward Current @ $T_C = 80^\circ\text{C}$         | $I_F$     | 192  | A |
| Repetitive Peak Forward Current ( $T_J = 175^\circ\text{C}$ ) | $I_{FRM}$ | 576  | A |

# NXH400N100H4Q2F2PG, NXH400N100H4Q2F2SG, NXH400N100H4Q2F2SG-R

## ABSOLUTE MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

| Rating | Symbol | Value | Unit |
|--------|--------|-------|------|
|--------|--------|-------|------|

### IGBT INVERSE DIODE (D1, D2, D3, D4)

|   |                   |     |                  |
|---|-------------------|-----|------------------|
| Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ ) | $P_{\text{tot}}$  | 482 | W                |
| Minimum Operating Junction Temperature                  | $T_{\text{JMIN}}$ | -40 | $^\circ\text{C}$ |
| Maximum Operating Junction Temperature                  | $T_{\text{JMAX}}$ | 175 | $^\circ\text{C}$ |

### NEUTRAL POINT DIODE (D5, D6)

|   |                   |      |                  |
|---|-------------------|------|------------------|
| Peak Repetitive Reverse Voltage                               | $V_{\text{RRM}}$  | 1200 | V                |
| Continuous Forward Current @ $T_C = 80^\circ\text{C}$         | $I_F$             | 140  | A                |
| Repetitive Peak Forward Current ( $T_J = 175^\circ\text{C}$ ) | $I_{\text{FRM}}$  | 420  | A                |
| Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )       | $P_{\text{tot}}$  | 401  | W                |
| Minimum Operating Junction Temperature                        | $T_{\text{JMIN}}$ | -40  | $^\circ\text{C}$ |
| Maximum Operating Junction Temperature                        | $T_{\text{JMAX}}$ | 175  | $^\circ\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to [ELECTRICAL CHARACTERISTICS](#) and/or APPLICATION INFORMATION for Safe Operating parameters.

## THERMAL AND INSULATION PROPERTIES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Rating | Symbol | Value | Unit |
|--------|--------|-------|------|
|--------|--------|-------|------|

### THERMAL PROPERTIES

|   |                   |            |                  |
|---|-------------------|------------|------------------|
| Operating Temperature under Switching Condition | $T_{\text{VJOP}}$ | -40 to 150 | $^\circ\text{C}$ |
| Storage Temperature Range                       | $T_{\text{stg}}$  | -40 to 125 | $^\circ\text{C}$ |

### INSULATION PROPERTIES

|   |                 |      |                  |
|---|-----------------|------|------------------|
| Isolation Test Voltage, $t = 2$ s, 50 Hz (Note 3) | $V_{\text{is}}$ | 4000 | $V_{\text{RMS}}$ |
| Creepage Distance                                 |                 | 12.7 | mm               |
| Comparative Tracking Index                        | CTI             | >600 |                  |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

2. Refer to [ELECTRICAL CHARACTERISTICS](#) and/or APPLICATION INFORMATION for Safe Operating parameters.
3. 4000  $V_{\text{ACRMS}}$  for 1 second duration is equivalent to 3333  $V_{\text{ACRMS}}$  for 1 minute duration.

# NXH400N100H4Q2F2PG, NXH400N100H4Q2F2SG, NXH400N100H4Q2F2SG-R

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

| Characteristic | Test Conditions | Symbol | Min | Typ | Max | Unit |
|----------------|-----------------|--------|-----|-----|-----|------|
|----------------|-----------------|--------|-----|-----|-----|------|

### OUTER IGBT (T1, T4) CHARACTERISTICS

|                                       |  |                      |     |       |       |     |
|---------------------------------------|--|----------------------|-----|-------|-------|-----|
| Collector-Emitter Cutoff Current      | V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1000 V  | I <sub>CES</sub>     | –   | –     | 500   | μA  |
| Collector-Emitter Saturation Voltage  | V <sub>GE</sub> = 15 V, I <sub>C</sub> = 400 A, T <sub>J</sub> = 25°C  | V <sub>CE(sat)</sub> | –   | 1.77  | 2.3   | V   |
|                                       | V <sub>GE</sub> = 15 V, I <sub>C</sub> = 400 A, T <sub>J</sub> = 150°C   |                      | –   | 2.11  | –     |     |
| Gate-Emitter Threshold Voltage        | V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 400 mA  | V <sub>GE(TH)</sub>  | 4.1 | 5.1   | 6.1   | V   |
| Gate Leakage Current                  | V <sub>GE</sub> = ±20 V, V <sub>CE</sub> = 0 V   | I <sub>GES</sub>     | –   | –     | ±2000 | nA  |
| Internal Gate Resistor                |  | R <sub>G</sub>       | –   | 1.44  | –     | Ω   |
| Turn-on Delay Time                    | T <sub>J</sub> = 25°C<br>V <sub>CE</sub> = 600 V, I <sub>C</sub> = 150 A<br>V <sub>GE</sub> = -8 V, 15 V, R <sub>Gon</sub> = 6 Ω,<br>R <sub>Goff</sub> = 11 Ω  | t <sub>d(on)</sub>   | –   | 151   | –     | ns  |
| Rise Time                             |  | t <sub>r</sub>       | –   | 35    | –     |     |
| Turn-off Delay Time                   |  | t <sub>d(off)</sub>  | –   | 551   | –     |     |
| Fall Time                             |  | t <sub>f</sub>       | –   | 68    | –     | μJ  |
| Turn-on Switching Loss per Pulse      |  | E <sub>on</sub>      | –   | 3270  | –     |     |
| Turn-off Switching Loss per Pulse     |  | E <sub>off</sub>     | –   | 5100  | –     |     |
| Turn-on Delay Time                    | T <sub>J</sub> = 125°C<br>V <sub>CE</sub> = 600 V, I <sub>C</sub> = 150 A<br>V <sub>GE</sub> = -8 V, 15 V, R <sub>Gon</sub> = 6 Ω,<br>R <sub>Goff</sub> = 11 Ω | t <sub>d(on)</sub>   | –   | 146   | –     | ns  |
| Rise Time                             |  | t <sub>r</sub>       | –   | 40    | –     |     |
| Turn-off Delay Time                   |  | t <sub>d(off)</sub>  | –   | 626   | –     |     |
| Fall Time                             |  | t <sub>f</sub>       | –   | 88    | –     | μJ  |
| Turn-on Switching Loss per Pulse      |  | E <sub>on</sub>      | –   | 4165  | –     |     |
| Turn-off Switching Loss per Pulse     |  | E <sub>off</sub>     | –   | 8420  | –     |     |
| Input Capacitance                     | V <sub>CE</sub> = 20 V, V <sub>GE</sub> = 0 V, f = 1 MHz   | C <sub>ies</sub>     | –   | 26093 | –     | pF  |
| Output Capacitance                    |  | C <sub>oes</sub>     | –   | 1012  | –     |     |
| Reverse Transfer Capacitance          |  | C <sub>res</sub>     | –   | 104   | –     |     |
| Total Gate Charge                     | V <sub>CE</sub> = 600 V, I <sub>C</sub> = 300 A,<br>V <sub>GE</sub> = -15 V~15 V   | Q <sub>g</sub>       | –   | 1304  | –     | nC  |
| Thermal Resistance – Chip-to-Heatsink | Thermal grease,<br>Thickness = 2.1 Mil ±2%<br>λ = 2.9 W/mK   | R <sub>thJH</sub>    | –   | 0.181 | –     | K/W |
| Thermal Resistance – Chip-to-Case     |  | R <sub>thJC</sub>    | –   | 0.073 | –     | K/W |

### NEUTRAL POINT DIODE (D5, D6) CHARACTERISTICS

|                                       |  |   |                   |       |       |      |
|---------------------------------------|--|---|-------------------|-------|-------|------|
| Diode Forward Voltage                 | I <sub>F</sub> = 100 A, T <sub>J</sub> = 25°C  | V <sub>F</sub>  | –                 | 1.50  | 1.85  | V    |
|                                       | I <sub>F</sub> = 100 A, T <sub>J</sub> = 150°C   |   | –                 | 2.07  | –     |      |
| Reverse Recovery Time                 | T <sub>J</sub> = 25°C<br>V <sub>CE</sub> = 600 V, I <sub>C</sub> = 150 A<br>V <sub>GE</sub> = -8 V, 15 V, R <sub>G</sub> = 6 Ω | t <sub>rr</sub>   | –                 | 19    | –     | ns   |
| Reverse Recovery Charge               |  | Q <sub>rr</sub>   | –                 | 229   | –     | nC   |
| Peak Reverse Recovery Current         |  | I <sub>RRM</sub>  | –                 | 19    | –     | A    |
| Peak Rate of Fall of Recovery Current |  | di/dt   | –                 | 6053  | –     | A/μs |
| Reverse Recovery Energy               |  | E <sub>rr</sub>   | –                 | 164   | –     | μJ   |
| Reverse Recovery Time                 |  | T <sub>J</sub> = 125°C<br>V <sub>CE</sub> = 600 V, I <sub>C</sub> = 150 A<br>V <sub>GE</sub> = -8 V, 15 V, R <sub>G</sub> = 6 Ω | t <sub>rr</sub>   | –     | 34    | –    |
| Reverse Recovery Charge               | Q <sub>rr</sub>  |   | –                 | 359   | –     | nC   |
| Peak Reverse Recovery Current         | I <sub>RRM</sub>   |   | –                 | 17    | –     | A    |
| Peak Rate of Fall of Recovery Current | di/dt  |   | –                 | 4621  | –     | A/μs |
| Reverse Recovery Energy               | E <sub>rr</sub>  |   | –                 | 211   | –     | μJ   |
| Thermal Resistance – Chip-to-Heatsink | Thermal grease,<br>Thickness = 2.1 Mil ±2%<br>λ = 2.9 W/mK   |   | R <sub>thJH</sub> | –     | 0.364 | –    |
| Thermal Resistance – Chip-to-Case     |  | R <sub>thJC</sub>   | –                 | 0.237 | –     | K/W  |

# NXH400N100H4Q2F2PG, NXH400N100H4Q2F2SG, NXH400N100H4Q2F2SG-R

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified) (continued)

| Characteristic                             | Test Conditions  | Symbol        | Min | Typ   | Max        | Unit          |
|--|--|---------------|-----|-------|------------|---------------|
| <b>INNER IGBT (T2, T3) CHARACTERISTICS</b> |  |               |     |       |            |               |
| Collector-Emitter Cutoff Current           | $V_{GE} = 0\text{ V}, V_{CE} = 1000\text{ V}$  | $I_{CES}$     | –   | –     | 500        | $\mu\text{A}$ |
| Collector-Emitter Saturation Voltage       | $V_{GE} = 15\text{ V}, I_C = 400\text{ A}, T_J = 25^\circ\text{C}$   | $V_{CE(sat)}$ | –   | 1.77  | 2.3        | V             |
|  | $V_{GE} = 15\text{ V}, I_C = 400\text{ A}, T_J = 150^\circ\text{C}$  |               | –   | 2.11  | –          |               |
| Gate-Emitter Threshold Voltage             | $V_{GE} = V_{CE}, I_C = 400\text{ mA}$   | $V_{GE(TH)}$  | 4.1 | 5.1   | 6.1        | V             |
| Gate Leakage Current                       | $V_{GE} = \pm 20\text{ V}, V_{CE} = 0\text{ V}$  | $I_{GES}$     | –   | –     | $\pm 2000$ | nA            |
| Internal Gate Resistor                     |  | $R_G$         | –   | 1.44  | –          | $\Omega$      |
| Turn-on Delay Time                         | $T_J = 25^\circ\text{C}$<br>$V_{CE} = 600\text{ V}, I_C = 150\text{ A}$<br>$V_{GE} = -8\text{ V}, 15\text{ V}, R_{Gon} = 6\ \Omega,$<br>$R_{Goff} = 23\ \Omega$  | $t_{d(on)}$   | –   | 149   | –          | ns            |
| Rise Time                                  |  | $t_r$         | –   | 37    | –          |               |
| Turn-off Delay Time                        |  | $t_{d(off)}$  | –   | 882   | –          |               |
| Fall Time                                  |  | $t_f$         | –   | 35    | –          | $\mu\text{J}$ |
| Turn-on Switching Loss per Pulse           |  | $E_{on}$      | –   | 4970  | –          |               |
| Turn-off Switching Loss per Pulse          |  | $E_{off}$     | –   | 6010  | –          |               |
| Turn-on Delay Time                         | $T_J = 125^\circ\text{C}$<br>$V_{CE} = 600\text{ V}, I_C = 150\text{ A}$<br>$V_{GE} = -8\text{ V}, 15\text{ V}, R_{Gon} = 6\ \Omega,$<br>$R_{Goff} = 23\ \Omega$ | $t_{d(on)}$   | –   | 146   | –          | ns            |
| Rise Time                                  |  | $t_r$         | –   | 42    | –          |               |
| Turn-off Delay Time                        |  | $t_{d(off)}$  | –   | 977   | –          |               |
| Fall Time                                  |  | $t_f$         | –   | 12    | –          | $\mu\text{J}$ |
| Turn-on Switching Loss per Pulse           |  | $E_{on}$      | –   | 7790  | –          |               |
| Turn-off Switching Loss per Pulse          |  | $E_{off}$     | –   | 8530  | –          |               |
| Input Capacitance                          | $V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$  | $C_{ies}$     | –   | 26093 | –          | pF            |
| Output Capacitance                         |  | $C_{oes}$     | –   | 1012  | –          |               |
| Reverse Transfer Capacitance               |  | $C_{res}$     | –   | 104   | –          |               |
| Total Gate Charge                          | $V_{CE} = 600\text{ V}, I_C = 300\text{ A},$<br>$V_{GE} = 15\text{ V}$   | $Q_g$         | –   | 1304  | –          | nC            |
| Thermal Resistance – Chip-to-Heatsink      | Thermal grease,<br>Thickness = 2.1 Mil $\pm 2\%$<br>$\lambda = 2.9\text{ W/mK}$  | $R_{thJH}$    | –   | 0.207 | –          | K/W           |
| Thermal Resistance – Chip-to-Case          |  | $R_{thJC}$    | –   | 0.087 | –          | K/W           |

## IGBT INVERSE DIODE (D1, D2, D3, D4) CHARACTERISTICS

|                                       |   |  |            |       |       |                  |
|---------------------------------------|---|--|------------|-------|-------|------------------|
| Diode Forward Voltage                 | $I_F = 150\text{ A}, T_J = 25^\circ\text{C}$  | $V_F$  | –          | 2.0   | 2.6   | V                |
|                                       | $I_F = 150\text{ A}, T_J = 150^\circ\text{C}$   |  | –          | 1.77  | –     |                  |
| Reverse Recovery Time                 | $T_J = 25^\circ\text{C}$<br>$V_{CE} = 600\text{ V}, I_C = 150\text{ A}$<br>$V_{GE} = -8\text{ V}, 15\text{ V}, R_G = 6\ \Omega$ | $t_{rr}$   | –          | 105   | –     | ns               |
| Reverse Recovery Charge               |   | $Q_{rr}$   | –          | 4179  | –     | nC               |
| Peak Reverse Recovery Current         |   | $I_{RRM}$  | –          | 97    | –     | A                |
| Peak Rate of Fall of Recovery Current |   | $di/dt$  | –          | 4571  | –     | A/ $\mu\text{s}$ |
| Reverse Recovery Energy               |   | $E_{rr}$   | –          | 950   | –     | $\mu\text{J}$    |
| Reverse Recovery Time                 |   | $T_J = 125^\circ\text{C}$<br>$V_{CE} = 600\text{ V}, I_C = 150\text{ A}$<br>$V_{GE} = -8\text{ V}, 15\text{ V}, R_G = 6\ \Omega$ | $t_{rr}$   | –     | 179   | –                |
| Reverse Recovery Charge               | $Q_{rr}$  |  | –          | 11900 | –     | nC               |
| Peak Reverse Recovery Current         | $I_{RRM}$   |  | –          | 132   | –     | A                |
| Peak Rate of Fall of Recovery Current | $di/dt$   |  | –          | 4167  | –     | A/ $\mu\text{s}$ |
| Reverse Recovery Energy               | $E_{rr}$  |  | –          | 3750  | –     | $\mu\text{J}$    |
| Thermal Resistance – Chip-to-Heatsink | Thermal grease,<br>Thickness = 2.1 Mil $\pm 2\%$<br>$\lambda = 2.9\text{ W/mK}$   |  | $R_{thJH}$ | –     | 0.316 | –                |
| Thermal Resistance – Chip-to-Case     |   | $R_{thJC}$   | –          | 0.197 | –     | K/W              |

# NXH400N100H4Q2F2PG, NXH400N100H4Q2F2SG, NXH400N100H4Q2F2SG-R

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified) (continued)

| Characteristic | Test Conditions | Symbol | Min | Typ | Max | Unit |
|----------------|-----------------|--------|-----|-----|-----|------|
|----------------|-----------------|--------|-----|-----|-----|------|

### THERMISTOR CHARACTERISTICS

|                            |                                 |              |    |      |   |                  |
|----------------------------|---------------------------------|--------------|----|------|---|------------------|
| Nominal Resistance         | $T = 25^\circ\text{C}$          | $R_{25}$     | –  | 22   | – | $\text{k}\Omega$ |
| Nominal Resistance         | $T = 100^\circ\text{C}$         | $R_{100}$    | –  | 1486 | – | $\Omega$         |
| Deviation of $R_{25}$      |                                 | $\Delta R/R$ | -5 | –    | 5 | %                |
| Power Dissipation          |                                 | $P_D$        | –  | 200  | – | mW               |
| Power Dissipation Constant |                                 |              | –  | 2    | – | mW/K             |
| B-value                    | B (25/50), tolerance $\pm 3\%$  |              | –  | 3950 | – | K                |
| B-value                    | B (25/100), tolerance $\pm 3\%$ |              | –  | 3998 | – | K                |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

### ORDERING INFORMATION

| Part Number  | Marking                                     | Package  | Shipping                |
|--|---|--|-------------------------|
| NXH400N100H4Q2F2PG<br>PRESS FIT PINS                       | NXH400N100H4Q2F2PG                          | PIM42, 93x47 (PRESSFIT)<br>(Pb-Free/Halide-Free)   | 12 Units / Blister Tray |
| NXH400N100H4Q2F2SG,<br>NXH400N100H4Q2F2SG-R<br>SOLDER PINS | NXH400N100H4Q2F2SG,<br>NXH400N100H4Q2F2SG-R | PIM44, 93x47 (SOLDER PIN)<br>(Pb-Free/Halide-Free) | 12 Units / Blister Tray |

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND NEUTRAL POINT DIODE

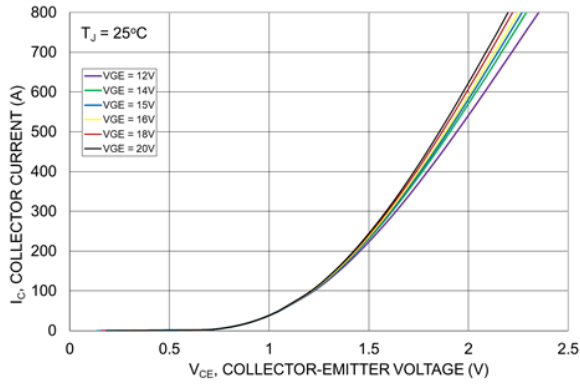


Figure 3. Typical Output Characteristics – Inner IGBT

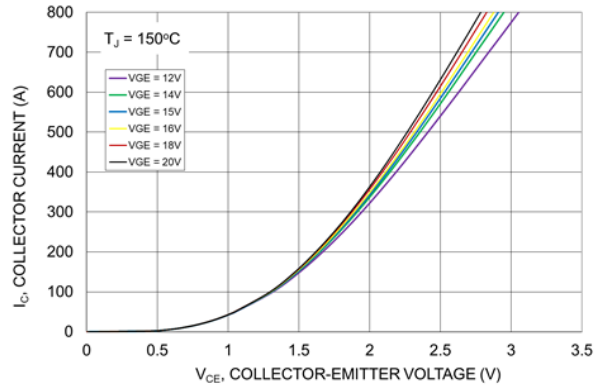


Figure 4. Typical Output Characteristics – Inner IGBT

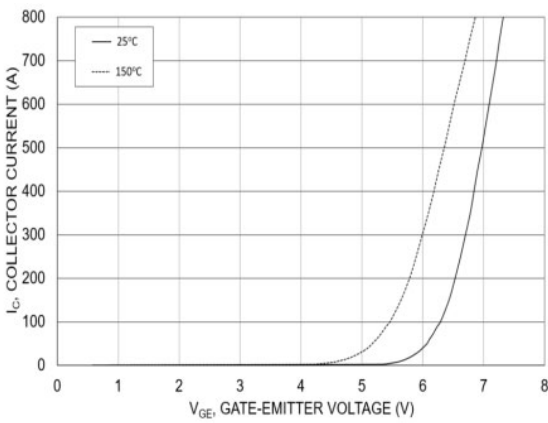


Figure 5. Transfer Characteristics – Inner IGBT

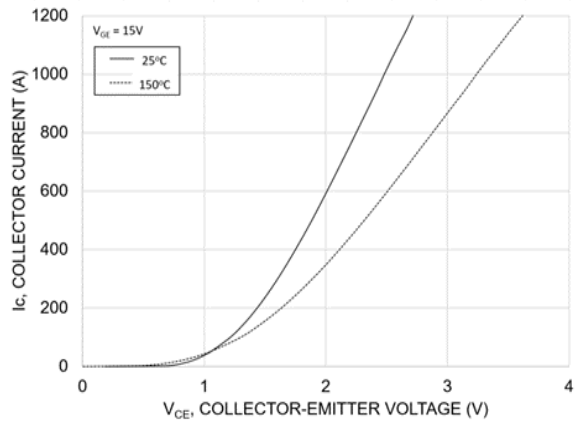


Figure 6. Saturation Voltage Characteristic

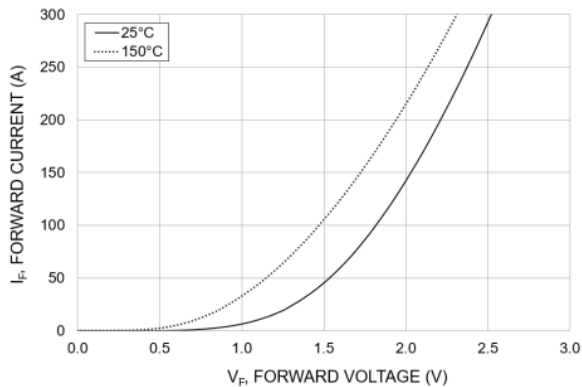


Figure 7. Inverse Diode Forward Characteristics

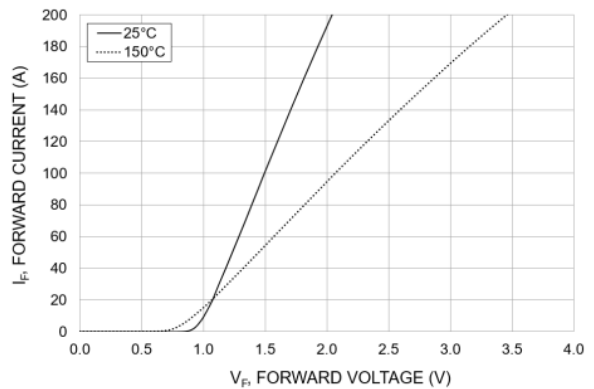


Figure 8. Buck Diode Forward Characteristics

TYPICAL CHARACTERISTICS – OUTER IGBT

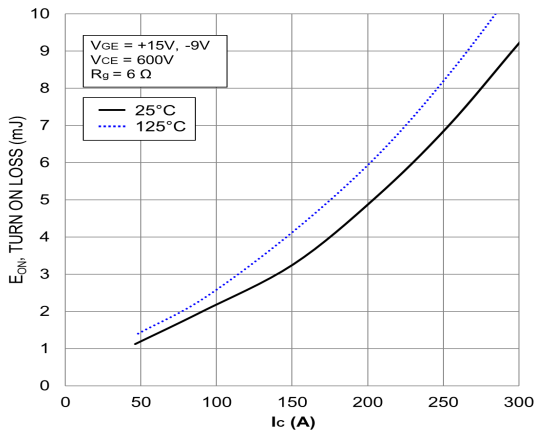


Figure 9. Typical Turn ON Loss vs. IC

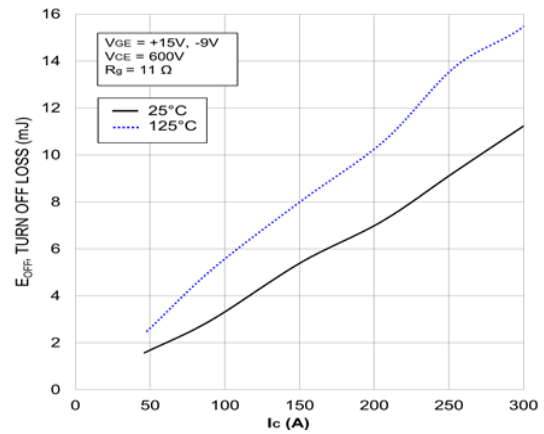


Figure 10. Typical Turn OFF Loss vs. IC

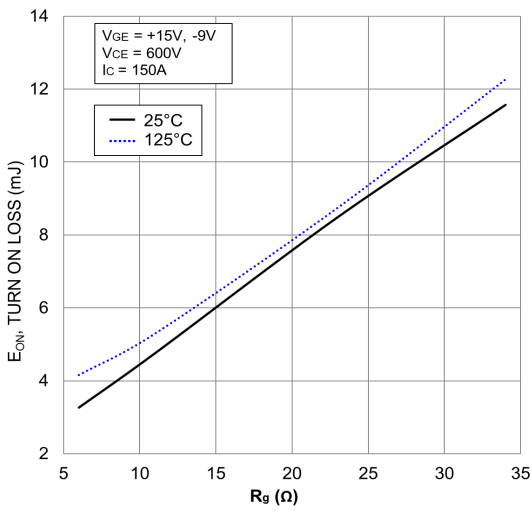


Figure 11. Typical Turn On Loss vs.  $R_g$

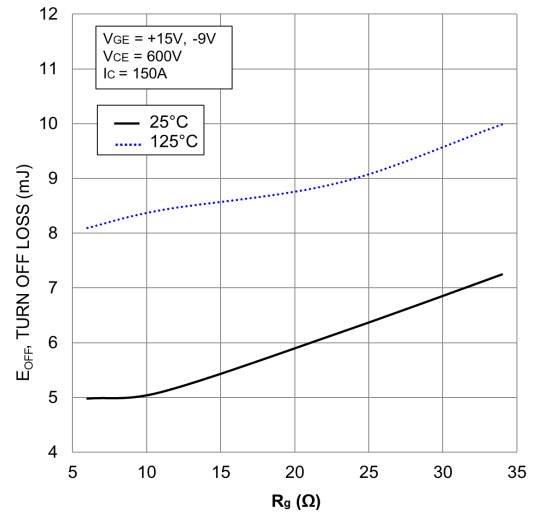


Figure 12. Typical Turn Off Loss vs.  $R_g$

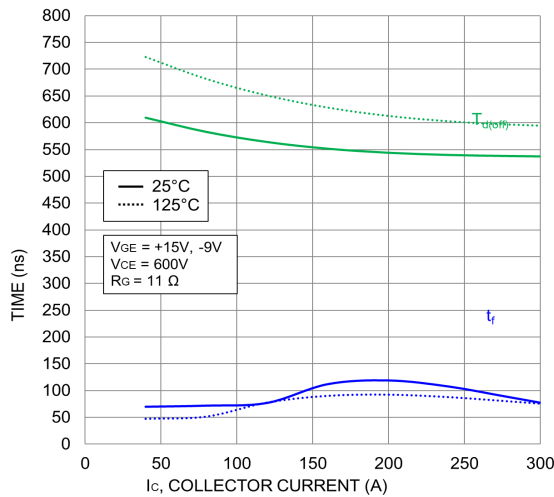


Figure 13. Typical Turn-Off Switching Time vs. IC

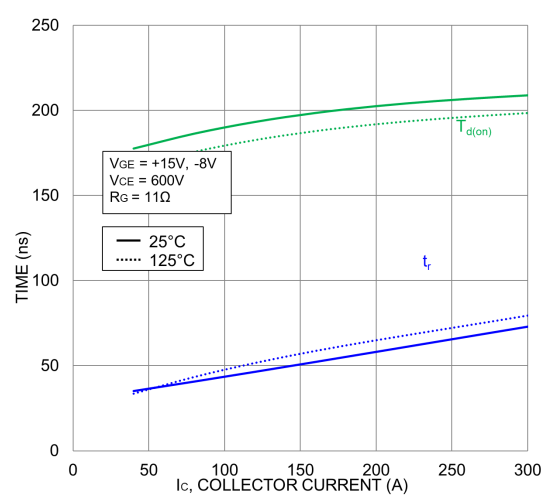


Figure 14. Typical Turn-On Switching Time vs. IC



TYPICAL CHARACTERISTICS – OUTER IGBT (continued)

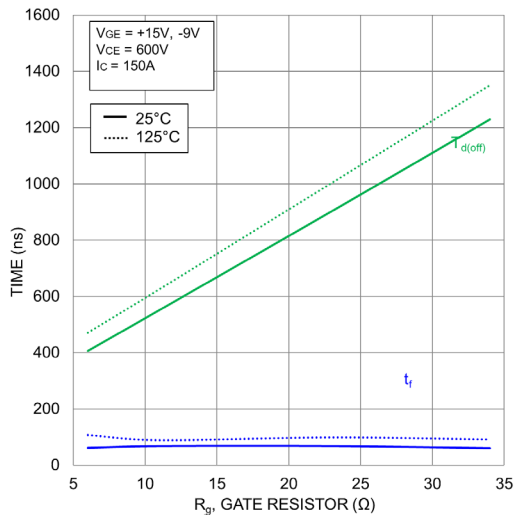


Figure 15. Typical Turn-Off Switching Time vs.  $R_g$

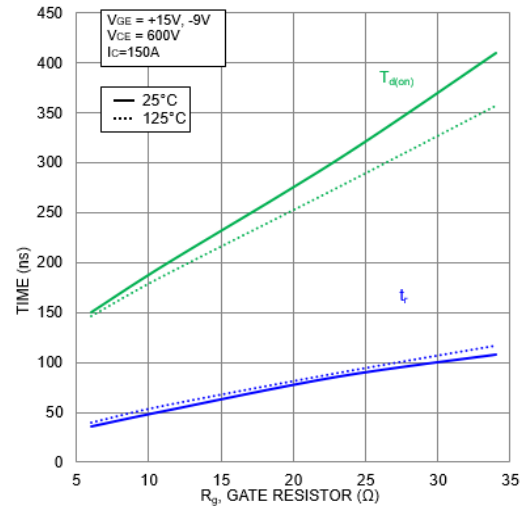


Figure 16. Typical Turn-On Switching Time vs.  $R_g$

TYPICAL CHARACTERISTICS – INNER IGBT

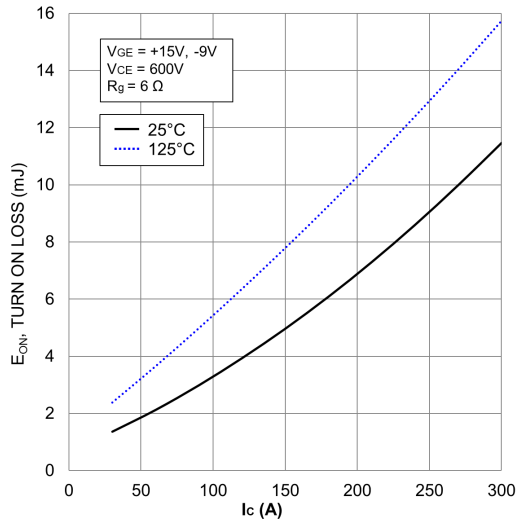


Figure 17. Typical Turn On Switching Time vs.  $I_C$

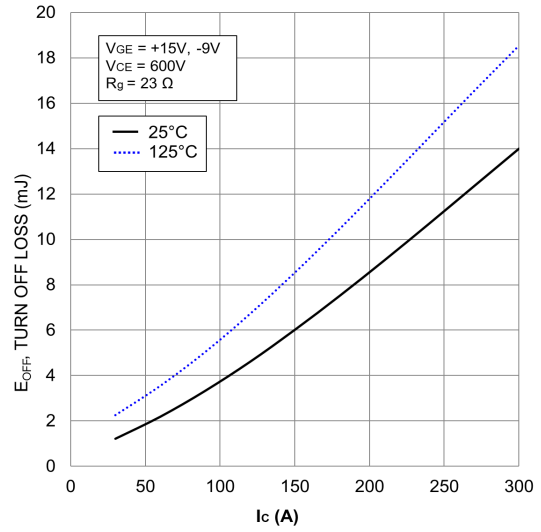


Figure 18. Typical Turn Off Switching Time vs.  $I_C$

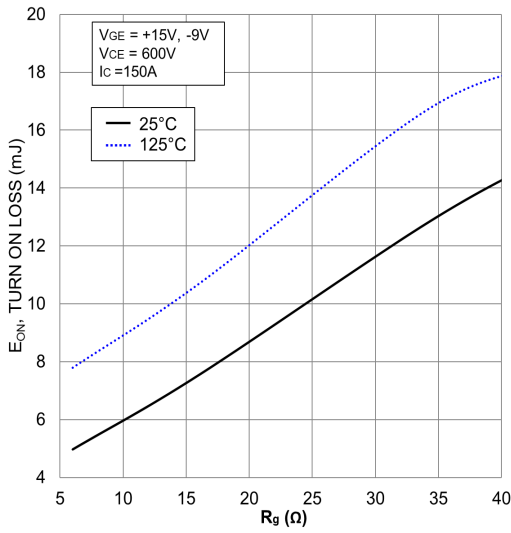


Figure 19. Typical Turn On Switching Time vs.  $R_G$

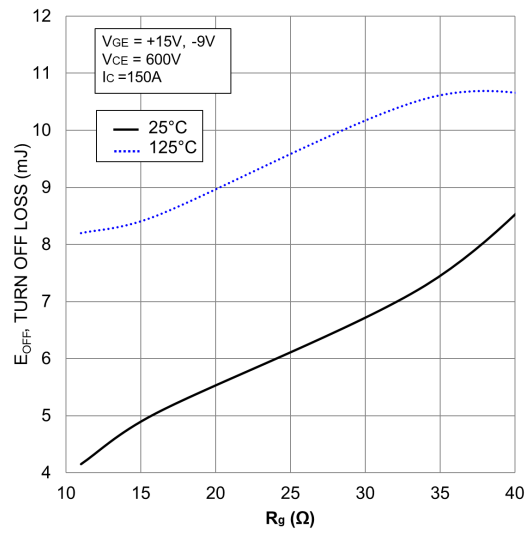


Figure 20. Typical Turn Off Switching Time vs.  $R_G$

TYPICAL CHARACTERISTICS – INNER IGBT (continued)

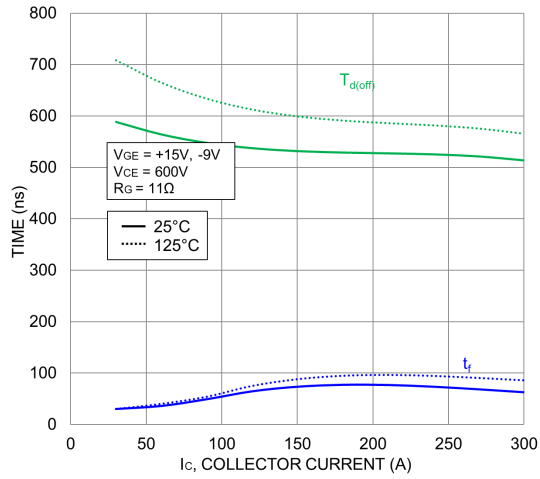


Figure 23. Typical Turn-Off Switching Time vs.  $I_c$

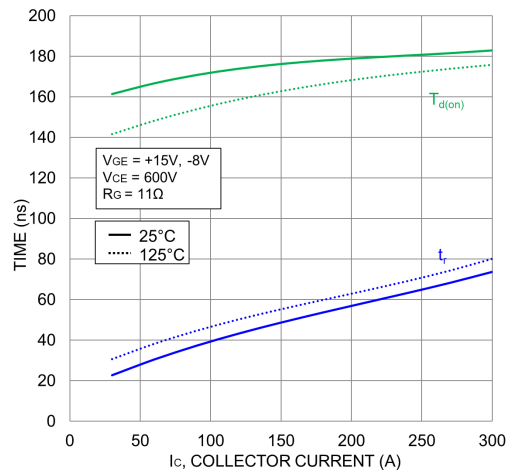


Figure 24. Typical Turn-On Switching Time vs.  $I_c$

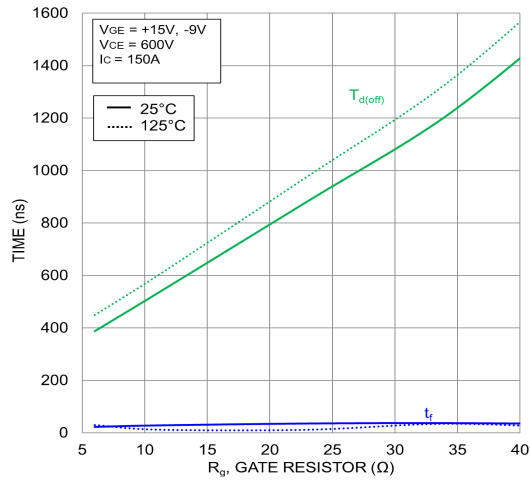


Figure 21. Typical Turn-Off Switching Time vs.  $R_g$

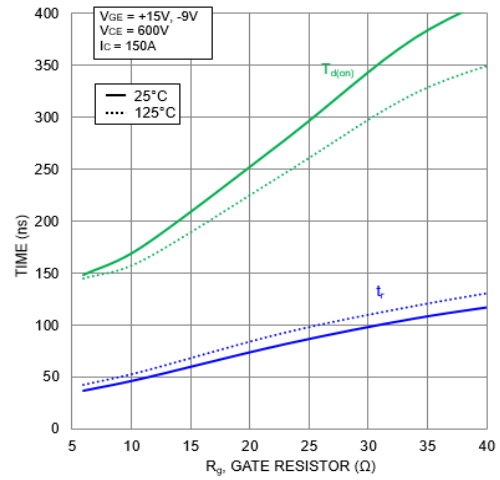


Figure 22. Typical Turn-On Switching Time vs.  $R_g$

TYPICAL SWITCHING CHARACTERISTICS – NEUTRAL POINT DIODE

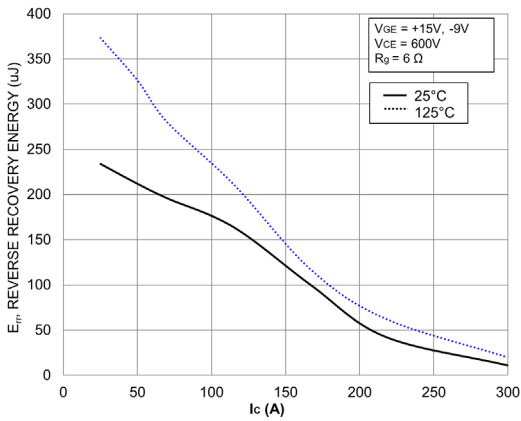


Figure 25. Typical Reverse Recovery Energy Loss vs.  $I_c$

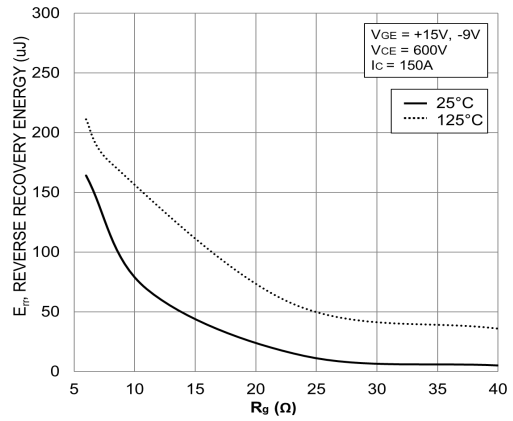


Figure 26. Typical Reverse Recovery Energy Loss vs.  $R_g$

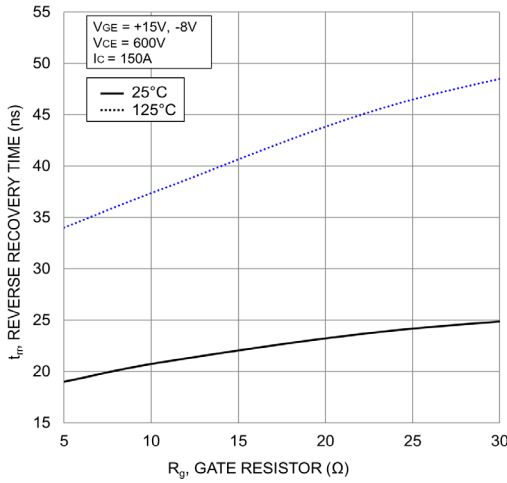


Figure 27. Typical Reverse Recovery Time vs.  $R_g$

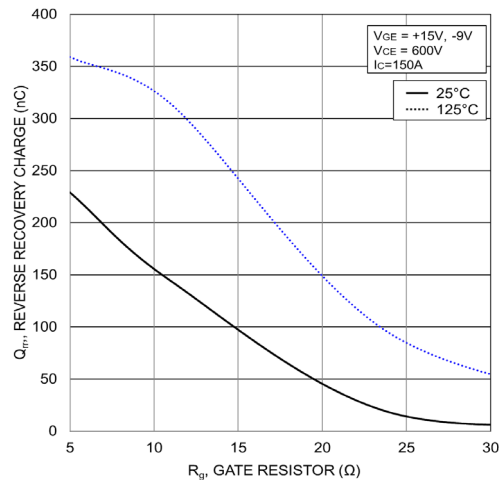


Figure 28. Typical Reverse Recovery Charge vs.  $R_g$

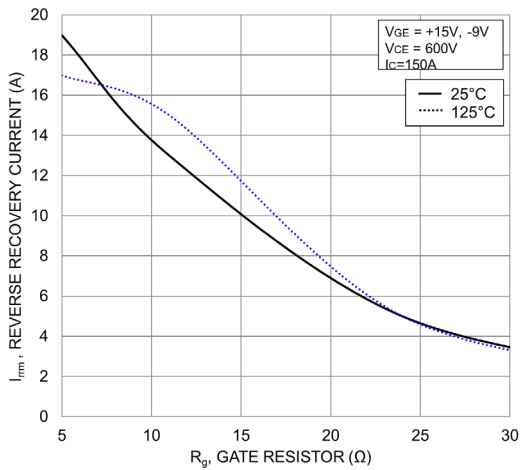


Figure 29. Typical Reverse Recovery Peak Current vs.  $R_g$

TYPICAL CHARACTERISTICS – INVERSE DIODE

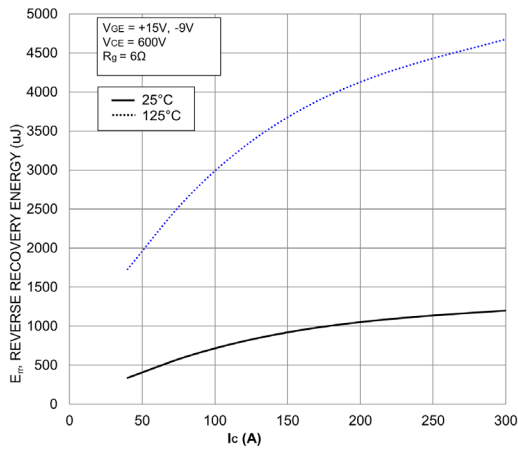


Figure 30. Typical Reverse Recovery Energy Loss vs.  $I_C$

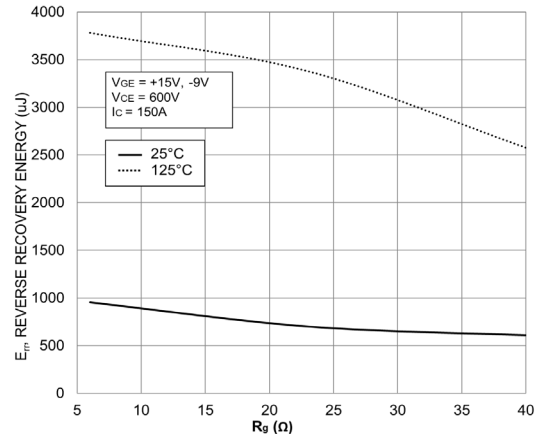


Figure 31. Typical Reverse Recovery Energy Loss vs.  $R_g$

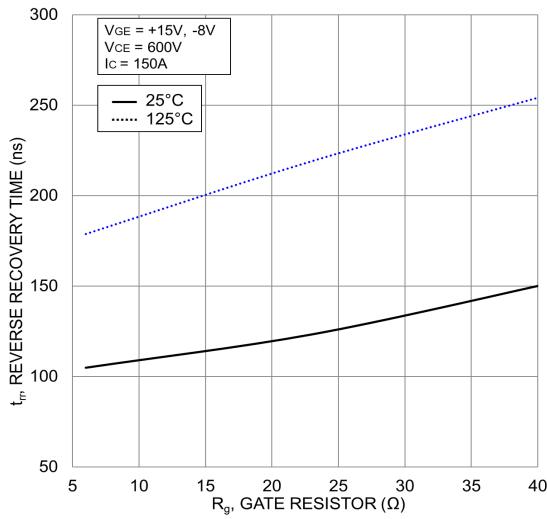


Figure 32. Typical Reverse Recovery Time vs.  $R_g$

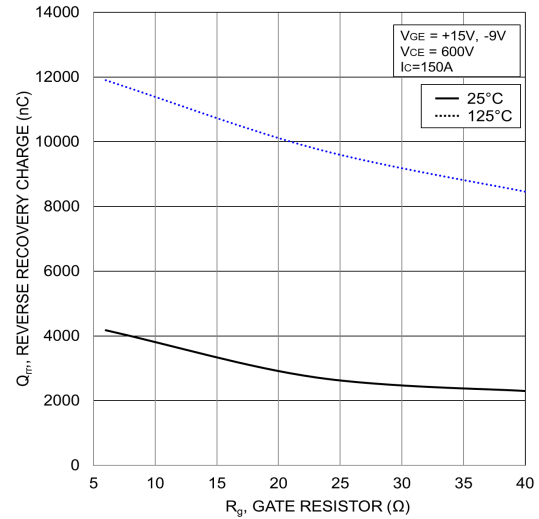


Figure 33. Typical Reverse Recovery Charge vs.  $R_g$

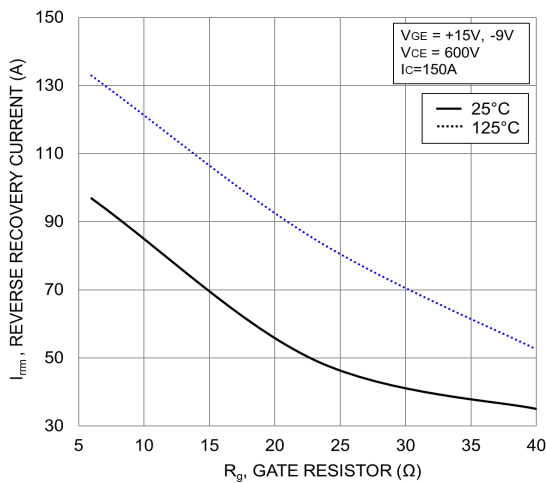


Figure 34. Typical Reverse Recovery Peak Current vs.  $R_g$

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND NEUTRAL POINT DIODE

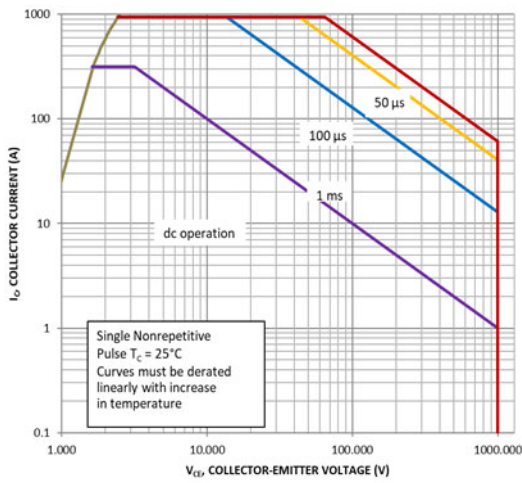


Figure 35. FBSOA – Outer IGBT

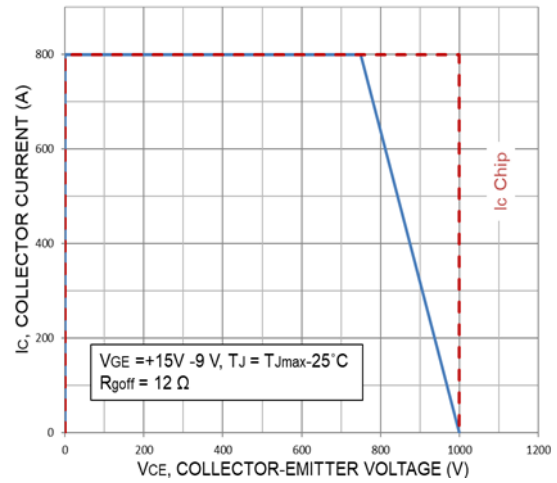


Figure 36. RBSOA – Outer IGBT

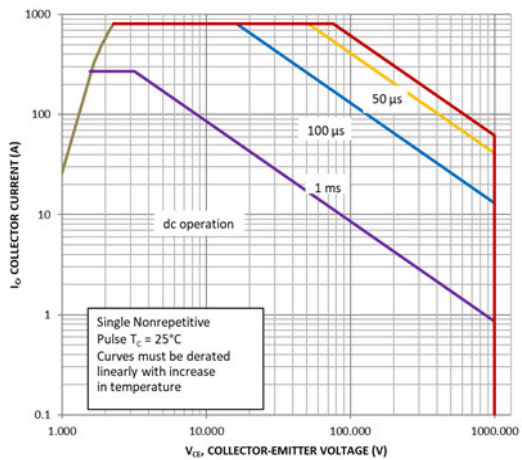


Figure 37. FBSOA – Inner IGBT

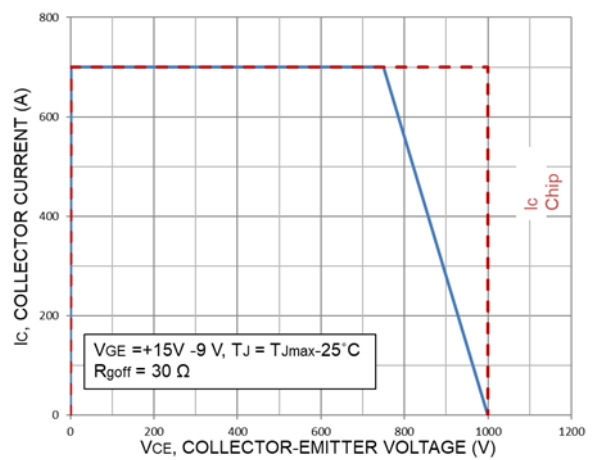


Figure 38. RBSOA – Inner IGBT

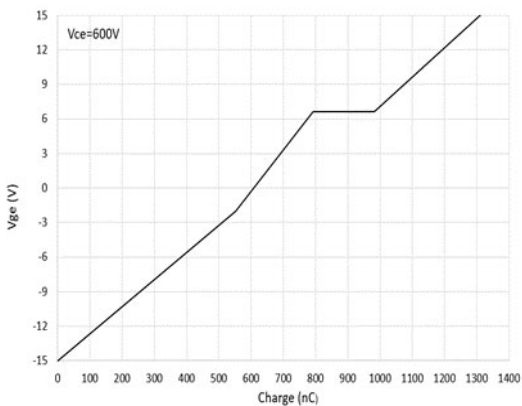


Figure 39. Gate Voltage vs. Gate Charge

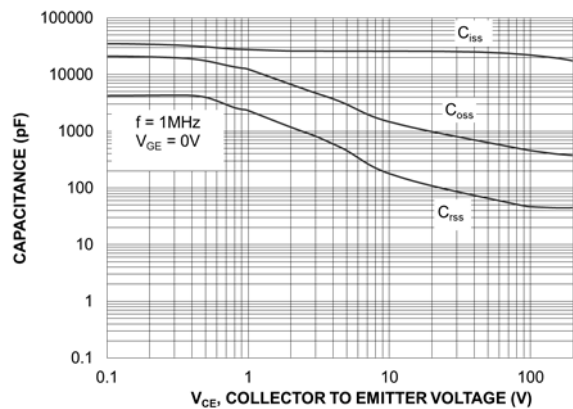


Figure 40. Capacitance Charge

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND NEUTRAL POINT DIODE (continued)

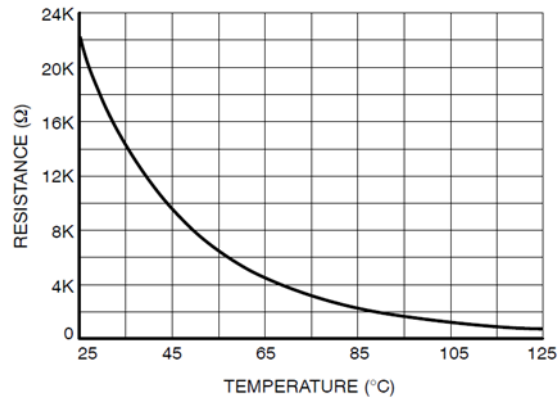


Figure 41. Thermistor Characteristics

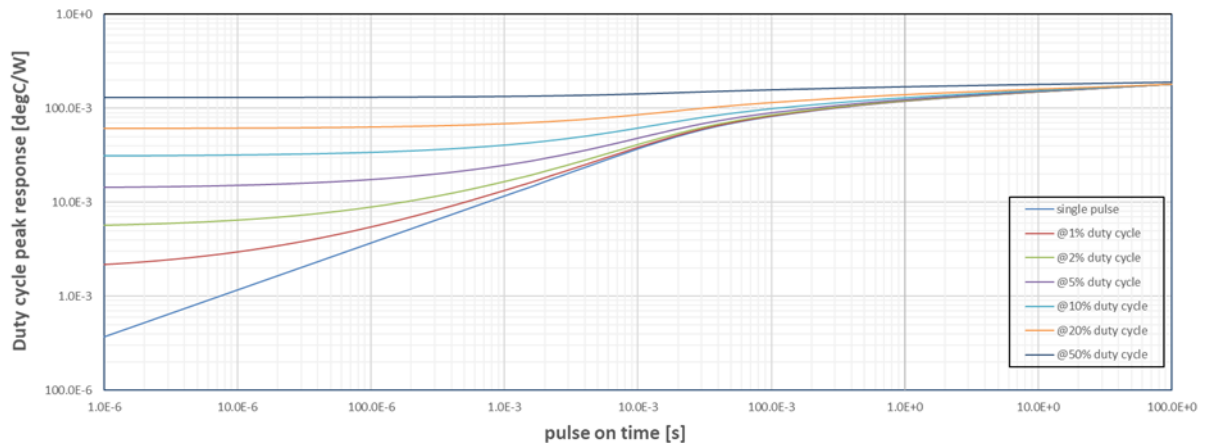


Figure 42. Transient Thermal Impedance – Outer IGBT

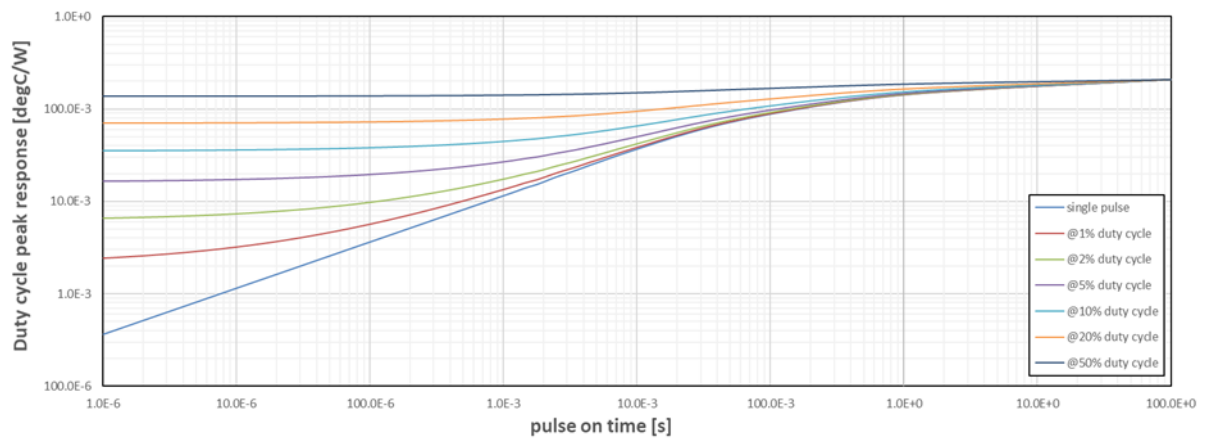


Figure 43. Transient Thermal Impedance – Inner IGBT

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND NEUTRAL POINT DIODE (continued)

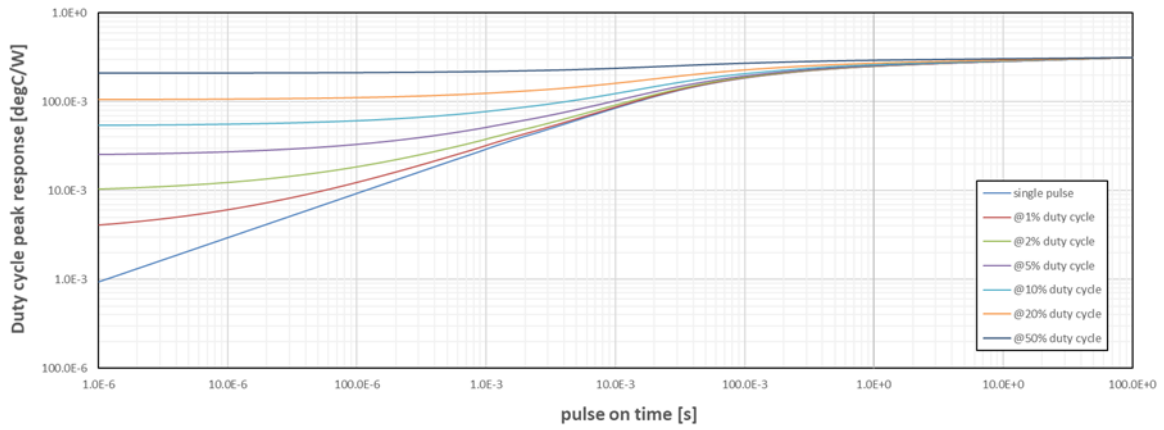


Figure 44. Transient Thermal Impedance – Inverse Diode

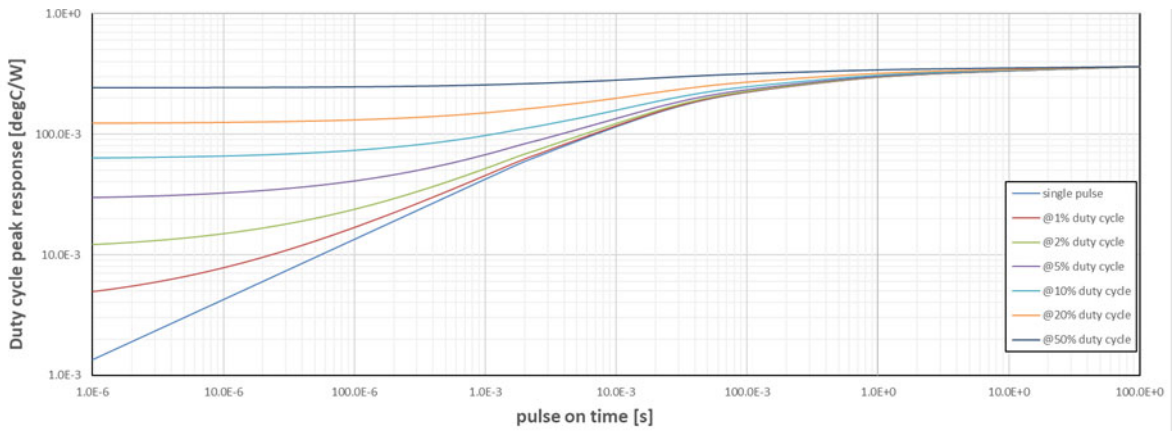


Figure 45. Transient Thermal Impedance – Neutral Point Diode



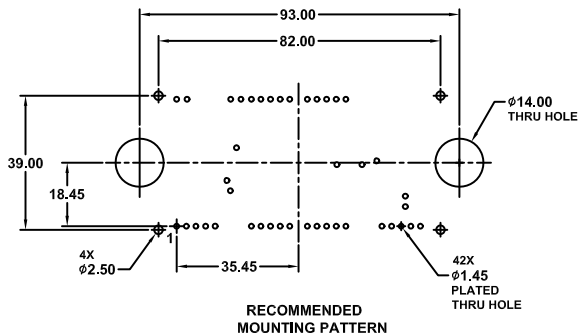
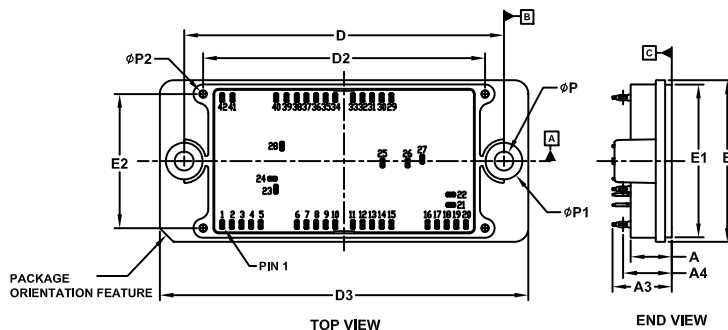
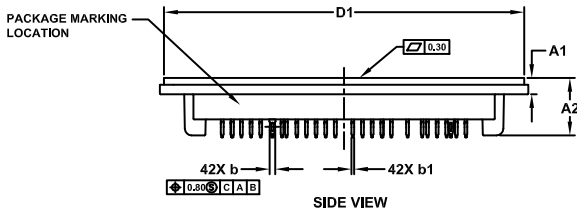
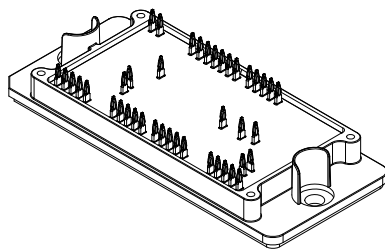
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



## PIM42, 93x47 (PRESSFIT) CASE 180BH ISSUE O

DATE 06 AUG 2019

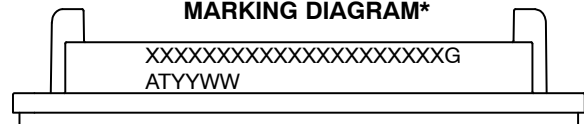


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS b AND b1 APPLY TO THE PLATED TERMINALS AND ARE MEASURED AT DIMENSION A4.
4. POSITION OF THE CENTER OF THE TERMINALS IS DETERMINED FROM DATUM B THE CENTER OF DIMENSION D, X DIRECTION, AND FROM DATUM A, Y DIRECTION. POSITIONAL TOLERANCE, AS NOTED IN DRAWING, APPLIES TO EACH TERMINAL IN BOTH DIRECTIONS.
5. PACKAGE MARKING IS LOCATED AS SHOWN ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES.

| DIM | MILLIMETERS |        |        | PIN POSITION |       | PIN POSITION |    |       |       |
|-----|-------------|--------|--------|--------------|-------|--------------|----|-------|-------|
|     | MIN.        | NOM.   | MAX.   | X            | Y     | PIN          | X  | Y     |       |
| A   | 11.70       | 12.00  | 12.30  | 1            | 0.00  | 0.00         | 22 | 66.50 | 8.70  |
| A1  | 4.40        | 4.70   | 5.00   | 2            | 2.80  | 0.00         | 23 | 15.60 | 10.30 |
| A2  | 16.40       | 16.70  | 17.00  | 3            | 5.60  | 0.00         | 24 | 14.60 | 13.30 |
| A3  | 16.90       | 17.30  | 17.70  | 4            | 8.40  | 0.00         | 25 | 46.60 | 17.90 |
| A4  | 13.97       | 14.18  | 14.39  | 5            | 11.20 | 0.00         | 26 | 53.90 | 17.90 |
| b   | 1.61        | 1.66   | 1.71   | 6            | 21.70 | 0.00         | 27 | 58.20 | 19.00 |
| b1  | 0.75        | 0.80   | 0.85   | 7            | 24.50 | 0.00         | 28 | 17.40 | 22.80 |
| D   | 92.90       | 93.00  | 93.10  | 8            | 27.30 | 0.00         | 29 | 49.20 | 36.90 |
| D1  | 104.45      | 104.75 | 105.05 | 9            | 30.10 | 0.00         | 30 | 46.40 | 36.90 |
| D2  | 81.80       | 82.00  | 82.20  | 10           | 32.90 | 0.00         | 31 | 43.60 | 36.90 |
| D3  | 106.90      | 107.20 | 107.50 | 11           | 38.00 | 0.00         | 32 | 40.80 | 36.90 |
| E   | 46.70       | 47.00  | 47.30  | 12           | 40.80 | 0.00         | 33 | 38.00 | 36.90 |
| E1  | 44.10       | 44.40  | 44.70  | 13           | 43.60 | 0.00         | 34 | 32.90 | 36.90 |
| E2  | 38.80       | 39.00  | 39.10  | 14           | 46.40 | 0.00         | 35 | 30.10 | 36.90 |
| P   | 5.40        | 5.50   | 5.60   | 15           | 49.20 | 0.00         | 36 | 27.30 | 36.90 |
| P1  | 10.60       | 10.70  | 10.80  | 16           | 59.70 | 0.00         | 37 | 24.50 | 36.90 |
| P2  | 1.80        | 2.00   | 2.20   | 17           | 62.50 | 0.00         | 38 | 21.70 | 36.90 |
|     |             |        |        | 18           | 65.30 | 0.00         | 39 | 18.70 | 36.90 |
|     |             |        |        | 19           | 68.10 | 0.00         | 40 | 15.70 | 36.90 |
|     |             |        |        | 20           | 70.90 | 0.00         | 41 | 3.00  | 36.90 |
|     |             |        |        | 21           | 66.50 | 5.70         | 42 | 0.00  | 36.90 |

### GENERIC MARKING DIAGRAM\*



XXXXX = Specific Device Code  
G = Pb-Free Package  
AT = Assembly & Test Site Code  
YYWW = Year and Work Week Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "μ", may or may not be present. Some products may not follow the Generic Marking.

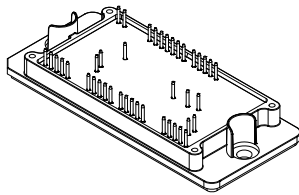
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| DESCRIPTION:     | PIM42 93X47 (PRESS FIT) | PAGE 1 OF 1  |

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# MECHANICAL CASE OUTLINE

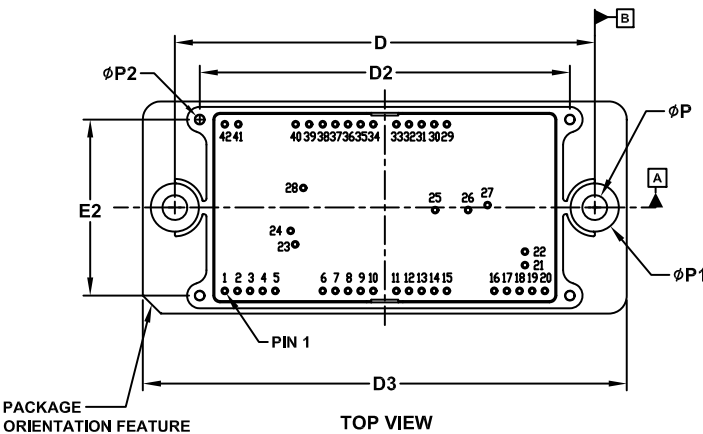
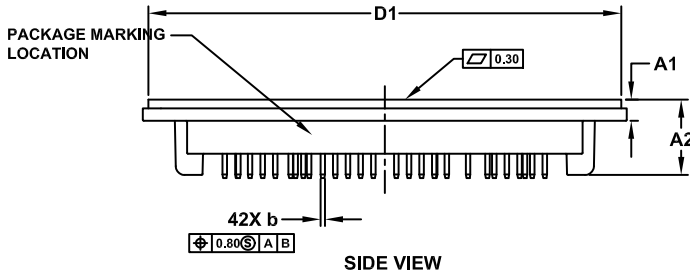
## PACKAGE DIMENSIONS

ON Semiconductor®



**PIM42, 93x47 (SOLDER PIN)**  
CASE 180BS  
ISSUE O

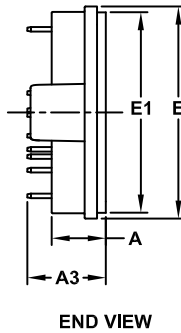
DATE 03 DEC 2019



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS b AND b1 APPLY TO THE PLATED TERMINALS AND ARE MEASURED AT DIMENSION A4.
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5. PACKAGE MARKING IS LOCATED AS SHOWN ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES.

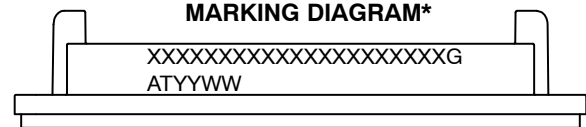
| DIM | MILLIMETERS |        |        |
|-----|-------------|--------|--------|
|     | MIN.        | NOM.   | MAX.   |
| A   | 11.70       | 12.00  | 12.30  |
| A1  | 4.40        | 4.70   | 5.00   |
| A2  | 16.40       | 16.70  | 17.00  |
| A3  | 16.80       | 17.20  | 17.60  |
| b   | 0.95        | 1.00   | 1.05   |
| D   | 92.90       | 93.00  | 93.10  |
| D1  | 104.45      | 104.75 | 105.05 |
| D2  | 81.80       | 82.00  | 82.20  |
| D3  | 106.90      | 107.20 | 107.50 |
| E   | 46.70       | 47.00  | 47.30  |
| E1  | 44.10       | 44.40  | 44.70  |
| E2  | 38.80       | 39.00  | 39.10  |
| P   | 5.40        | 5.50   | 5.60   |
| P1  | 10.60       | 10.70  | 10.80  |
| P2  | 1.80        | 2.00   | 2.20   |



**NOTE 4**

| PIN | PIN POSITION |      | PIN | PIN POSITION |       |
|-----|--------------|------|-----|--------------|-------|
|     | X            | Y    |     | X            | Y     |
| 1   | 0.00         | 0.00 | 22  | 66.50        | 8.70  |
| 2   | 2.80         | 0.00 | 23  | 15.60        | 10.30 |
| 3   | 5.60         | 0.00 | 24  | 14.60        | 13.30 |
| 4   | 8.40         | 0.00 | 25  | 46.60        | 17.90 |
| 5   | 11.20        | 0.00 | 26  | 53.90        | 17.90 |
| 6   | 21.70        | 0.00 | 27  | 58.20        | 19.00 |
| 7   | 24.50        | 0.00 | 28  | 17.40        | 22.80 |
| 8   | 27.30        | 0.00 | 29  | 49.20        | 36.90 |
| 9   | 30.10        | 0.00 | 30  | 46.40        | 36.90 |
| 10  | 32.90        | 0.00 | 31  | 43.60        | 36.90 |
| 11  | 38.00        | 0.00 | 32  | 40.80        | 36.90 |
| 12  | 40.80        | 0.00 | 33  | 38.00        | 36.90 |
| 13  | 43.60        | 0.00 | 34  | 32.90        | 36.90 |
| 14  | 46.40        | 0.00 | 35  | 30.10        | 36.90 |
| 15  | 49.20        | 0.00 | 36  | 27.30        | 36.90 |
| 16  | 59.70        | 0.00 | 37  | 24.50        | 36.90 |
| 17  | 62.50        | 0.00 | 38  | 21.70        | 36.90 |
| 18  | 65.30        | 0.00 | 39  | 18.70        | 36.90 |
| 19  | 68.10        | 0.00 | 40  | 15.70        | 36.90 |
| 20  | 70.90        | 0.00 | 41  | 3.00         | 36.90 |
| 21  | 66.50        | 5.70 | 42  | 0.00         | 36.90 |

**GENERIC MARKING DIAGRAM\***



XXXXX = Specific Device Code  
G = Pb-Free Package  
AT = Assembly & Test Site Code  
YYWW = Year and Work Week Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

|                         |                                 |  |
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| <b>DESCRIPTION:</b>     | <b>PIM42 93X47 (SOLDER PIN)</b> | <b>PAGE 1 OF 1</b>   |

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