

# NGTB45N60S2WG

## IGBT - Inverter Welding

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Trench construction, and provides superior performance in demanding switching applications, offering both low on state voltage and minimal switching loss. The IGBT is well suited for welding applications. Incorporated into the device is a soft and fast co-packaged free wheeling diode with a low forward voltage.

### Features

- Low Switching Loss Reduces System Power Dissipation
- $T_{Jmax} = 175^{\circ}C$
- Soft, Fast Free Wheeling Diode
- This is a Pb-Free Device

### Typical Applications

- Welding

### ABSOLUTE MAXIMUM RATINGS

| Rating                                                                                      | Symbol    | Value                | Unit        |
|---------------------------------------------------------------------------------------------|-----------|----------------------|-------------|
| Collector-emitter voltage                                                                   | $V_{CES}$ | 600                  | V           |
| Collector current<br>@ $T_c = 25^{\circ}C$<br>@ $T_c = 100^{\circ}C$                        | $I_C$     | 90<br>45             | A           |
| Pulsed collector current, $T_{pulse}$<br>limited by $T_{Jmax}$                              | $I_{CM}$  | 180                  | A           |
| Diode forward current<br>@ $T_c = 25^{\circ}C$<br>@ $T_c = 100^{\circ}C$                    | $I_F$     | 90<br>45             | A           |
| Diode pulsed current, $T_{pulse}$ limited<br>by $T_{Jmax}$                                  | $I_{FM}$  | 180                  | A           |
| Gate-emitter voltage<br>Transient Gate Emitter Voltage<br>( $t_p = 5 \mu s$ , $D < 0.010$ ) | $V_{GE}$  | $\pm 20$<br>$\pm 30$ | V           |
| Power Dissipation<br>@ $T_c = 25^{\circ}C$<br>@ $T_c = 100^{\circ}C$                        | $P_D$     | 300<br>150           | W           |
| Operating junction temperature<br>range                                                     | $T_J$     | $-55$ to $+175$      | $^{\circ}C$ |
| Storage temperature range                                                                   | $T_{stg}$ | $-55$ to $+175$      | $^{\circ}C$ |
| Lead temperature for soldering, 1/8"<br>from case for 5 seconds                             | $T_{SLD}$ | 260                  | $^{\circ}C$ |

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.



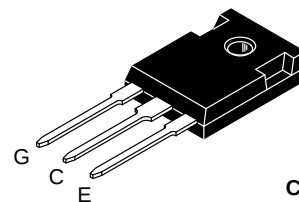
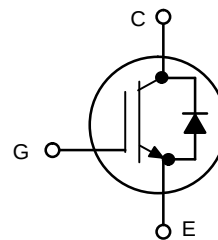
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45 A, 600 V

$V_{CEsat} = 2.0$  V

$E_{off} = 0.36$  mJ



TO-247  
CASE 340AL

### MARKING DIAGRAM



A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

| Device        | Package             | Shipping        |
|---------------|---------------------|-----------------|
| NGTB45N60S2WG | TO-247<br>(Pb-Free) | 30 Units / Rail |

# NGTB45N60S2WG

## THERMAL CHARACTERISTICS

| Rating                                         | Symbol          | Value | Unit |
|------------------------------------------------|-----------------|-------|------|
| Thermal resistance junction-to-case, for IGBT  | $R_{\theta JC}$ | 0.50  | °C/W |
| Thermal resistance junction-to-case, for Diode | $R_{\theta JC}$ | 1.46  | °C/W |
| Thermal resistance junction-to-ambient         | $R_{\theta JA}$ | 40    | °C/W |

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

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

### STATIC CHARACTERISTIC

|                                                                   |                                                                                                                       |               |        |            |          |    |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|---------------|--------|------------|----------|----|
| Collector-emitter breakdown voltage, gate-emitter short-circuited | $V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$                                                                   | $V_{(BR)CES}$ | 600    | –          | –        | V  |
| Collector-emitter saturation voltage                              | $V_{GE} = 15\text{ V}, I_C = 45\text{ A}$<br>$V_{GE} = 15\text{ V}, I_C = 45\text{ A}, T_J = 175^\circ\text{C}$       | $V_{CEsat}$   | –<br>– | 2.0<br>2.5 | 2.3<br>– | V  |
| Gate-emitter threshold voltage                                    | $V_{GE} = V_{CE}, I_C = 150\text{ }\mu\text{A}$                                                                       | $V_{GE(th)}$  | 4.5    | 5.5        | 6.5      | V  |
| Collector-emitter cut-off current, gate-emitter short-circuited   | $V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$<br>$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 175^\circ\text{C}$ | $I_{CES}$     | –<br>– | –<br>–     | 0.2<br>2 | mA |
| Gate leakage current, collector-emitter short-circuited           | $V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$                                                                           | $I_{GES}$     | –      | –          | 100      | nA |

### DYNAMIC CHARACTERISTIC

|                              |                                                                  |           |   |      |   |    |
|------------------------------|------------------------------------------------------------------|-----------|---|------|---|----|
| Input capacitance            | $V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$    | $C_{ies}$ | – | 3200 | – | pF |
| Output capacitance           |                                                                  | $C_{oes}$ | – | 130  | – |    |
| Reverse transfer capacitance |                                                                  | $C_{res}$ | – | 85   | – |    |
| Gate charge total            | $V_{CE} = 480\text{ V}, I_C = 45\text{ A}, V_{GE} = 15\text{ V}$ | $Q_g$     | – | 135  | – | nC |
| Gate to emitter charge       |                                                                  | $Q_{ge}$  | – | 27   | – |    |
| Gate to collector charge     |                                                                  | $Q_{gc}$  | – | 67   | – |    |

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

|                         |                                                                                                                                          |              |   |      |   |    |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|------|---|----|
| Turn-off delay time     | $T_J = 25^\circ\text{C}$<br>$V_{CC} = 400\text{ V}, I_C = 45\text{ A}$<br>$R_g = 10\text{ }\Omega$<br>$V_{GE} = 0\text{ V}/15\text{ V}$  | $t_{d(off)}$ | – | 151  | – | ns |
| Fall time               |                                                                                                                                          | $t_f$        | – | 55   | – |    |
| Turn-off switching loss |                                                                                                                                          | $E_{off}$    | – | 0.36 | – |    |
| Turn-off delay time     | $T_J = 150^\circ\text{C}$<br>$V_{CC} = 400\text{ V}, I_C = 45\text{ A}$<br>$R_g = 10\text{ }\Omega$<br>$V_{GE} = 0\text{ V}/15\text{ V}$ | $t_{d(off)}$ | – | 154  | – | ns |
| Fall time               |                                                                                                                                          | $t_f$        | – | 78   | – |    |
| Turn-off switching loss |                                                                                                                                          | $E_{off}$    | – | 0.69 | – |    |

### DIODE CHARACTERISTIC

|                          |                                                                                                               |           |        |            |          |    |
|--------------------------|---------------------------------------------------------------------------------------------------------------|-----------|--------|------------|----------|----|
| Forward voltage          | $V_{GE} = 0\text{ V}, I_F = 45\text{ A}$<br>$V_{GE} = 0\text{ V}, I_F = 45\text{ A}, T_J = 175^\circ\text{C}$ | $V_F$     | –<br>– | 1.2<br>1.2 | 1.4<br>– | V  |
| Reverse recovery time    | $T_J = 25^\circ\text{C}$<br>$I_F = 45\text{ A}, V_R = 200\text{ V}$<br>$di_F/dt = 200\text{ A}/\mu\text{s}$   | $t_{rr}$  | –      | 498        | –        | ns |
| Reverse recovery charge  |                                                                                                               | $Q_{rr}$  | –      | 9400       | –        | nc |
| Reverse recovery current |                                                                                                               | $I_{rrm}$ | –      | 36         | –        | A  |

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.

TYPICAL CHARACTERISTICS

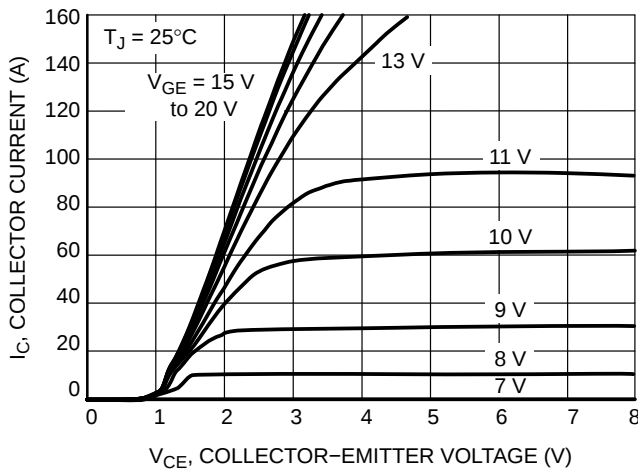


Figure 1. Output Characteristics

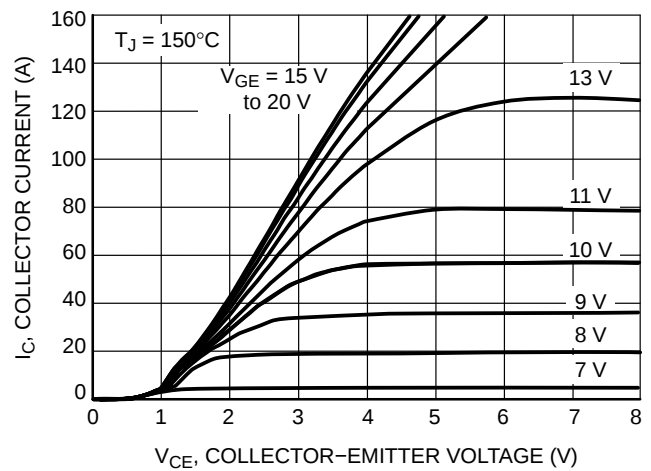


Figure 2. Output Characteristics

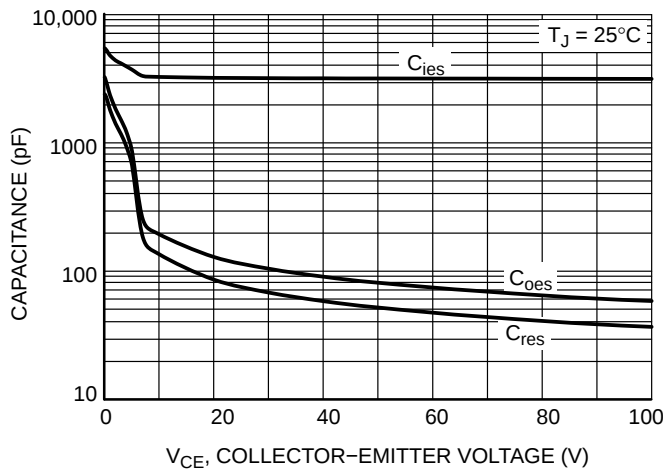


Figure 3. Typical Capacitance

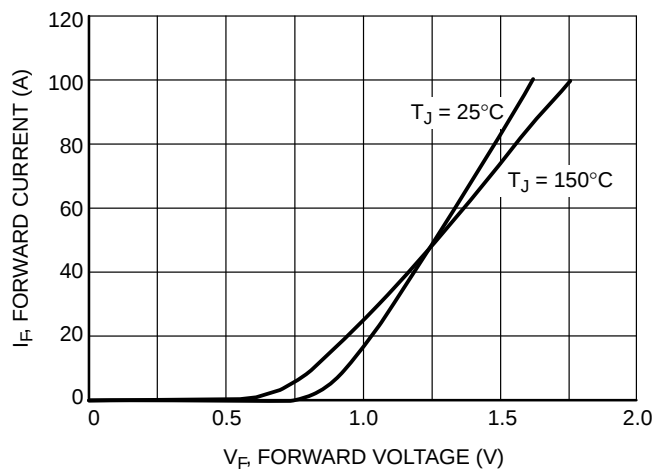


Figure 4. Diode Forward Characteristics

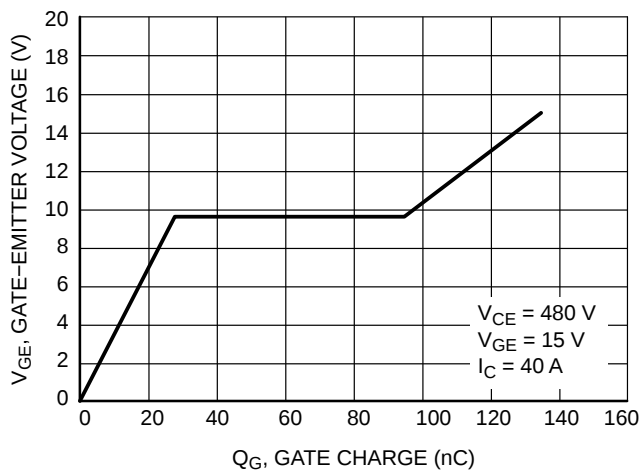


Figure 5. Typical Gate Charge

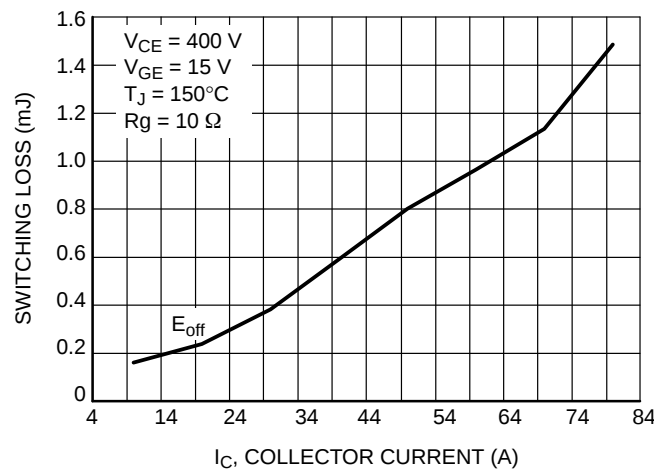


Figure 6. Switching Loss vs.  $I_C$

# NGTB45N60S2WG

## TYPICAL CHARACTERISTICS

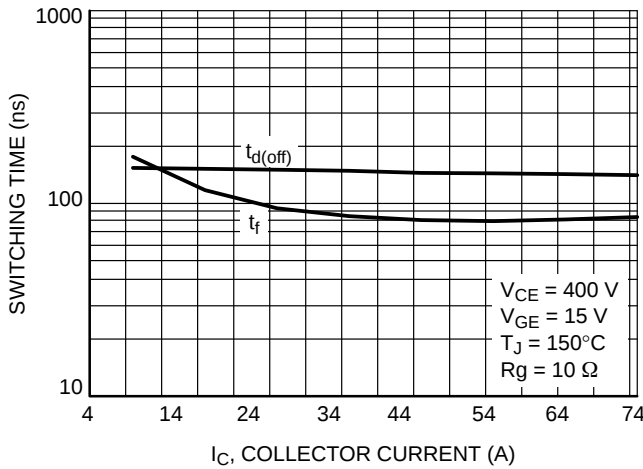


Figure 7. Switching Time vs.  $I_C$

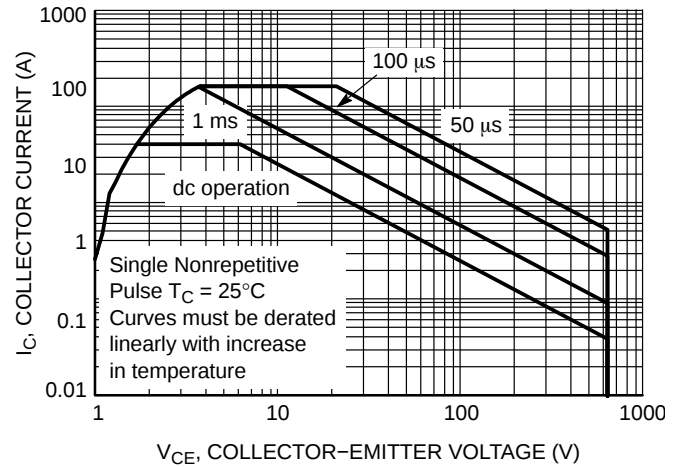


Figure 8. Safe Operating Area

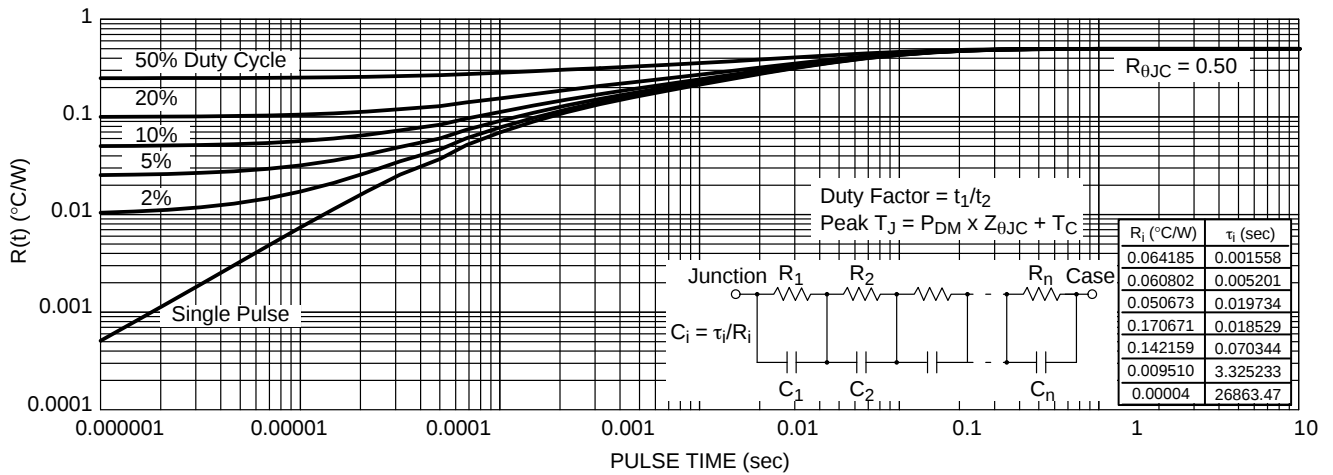


Figure 9. IGBT Transient Thermal Impedance

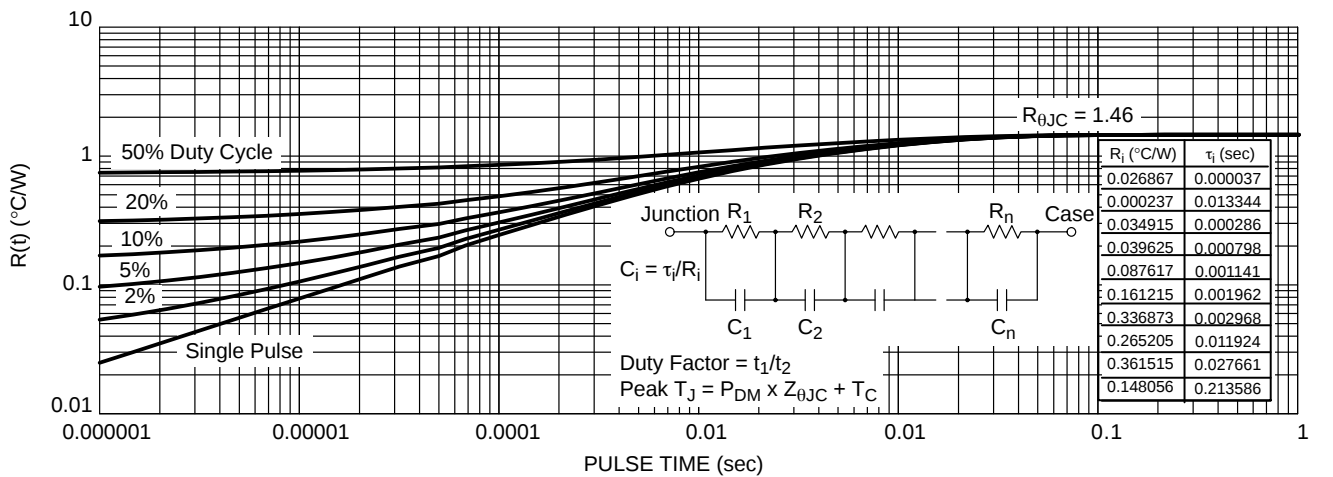
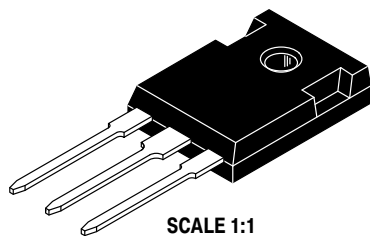


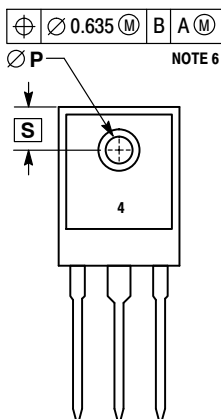
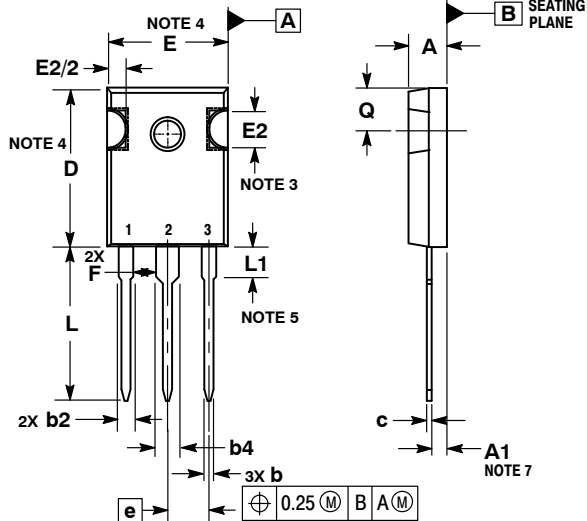
Figure 10. Diode Transient Thermal Impedance

TO-247  
CASE 340AL  
ISSUE D

DATE 17 MAR 2017



SCALE 1:1

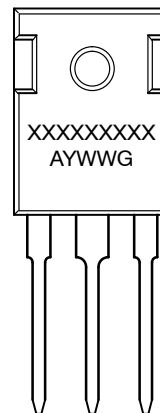


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. SLOT REQUIRED, NOTCH MAY BE ROUNDED.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
5. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.
6. ØP SHALL HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM DIAMETER OF 3.91.
7. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.

| MILLIMETERS |          |       |
|-------------|----------|-------|
| DIM         | MIN      | MAX   |
| A           | 4.70     | 5.30  |
| A1          | 2.20     | 2.60  |
| b           | 1.07     | 1.33  |
| b2          | 1.65     | 2.35  |
| b4          | 2.60     | 3.40  |
| c           | 0.45     | 0.68  |
| D           | 20.80    | 21.34 |
| E           | 15.50    | 16.25 |
| E2          | 4.32     | 5.49  |
| e           | 5.45 BSC |       |
| F           | 2.655    | ---   |
| L           | 19.80    | 20.80 |
| L1          | 3.81     | 4.32  |
| P           | 3.55     | 3.65  |
| Q           | 5.40     | 6.20  |
| S           | 6.15 BSC |       |

GENERIC  
MARKING DIAGRAM\*



XXXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*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.

|                  |             |                                                                                                                                                                                     |
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