

# NGTB40N120SWG

## 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

- $T_{Jmax} = 175^{\circ}C$
- Soft Fast Reverse Recovery Diode
- Optimized for High Speed Switching
- 10  $\mu s$  Short Circuit Capability
- These are Pb-Free Devices

### Typical Applications

- Welding

### ABSOLUTE MAXIMUM RATINGS

| Rating                                                                                           | Symbol    | Value                | Unit        |
|--------------------------------------------------------------------------------------------------|-----------|----------------------|-------------|
| Collector-emitter voltage                                                                        | $V_{CES}$ | 1200                 | V           |
| Collector current<br>@ $T_c = 25^{\circ}C$<br>@ $T_c = 100^{\circ}C$                             | $I_C$     | 80<br>40             | A           |
| Pulsed collector current, $T_{pulse}$<br>limited by $T_{Jmax}$                                   | $I_{CM}$  | 200                  | A           |
| Diode forward current<br>@ $T_c = 25^{\circ}C$<br>@ $T_c = 100^{\circ}C$                         | $I_F$     | 80<br>40             | A           |
| Diode pulsed current, $T_{pulse}$ limited<br>by $T_{Jmax}$                                       | $I_{FM}$  | 200                  | A           |
| Gate-emitter voltage<br>Transient gate-emitter voltage<br>( $T_{pulse} = 5 \mu s$ , $D < 0.10$ ) | $V_{GE}$  | $\pm 20$<br>$\pm 30$ | V           |
| Power Dissipation<br>@ $T_c = 25^{\circ}C$<br>@ $T_c = 100^{\circ}C$                             | $P_D$     | 535<br>267           | W           |
| Short Circuit Withstand Time<br>$V_{GE} = 15 V$ , $V_{CE} = 500 V$ , $T_J \leq 150^{\circ}C$     | $T_{SC}$  | 10                   | $\mu s$     |
| 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.



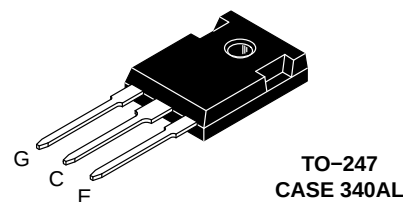
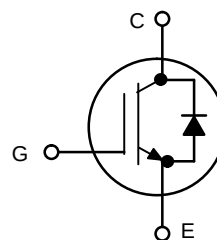
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40 A, 1200 V

$V_{CEsat} = 2.0 V$

$E_{off} = 1.10 mJ$



### MARKING DIAGRAM



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

### ORDERING INFORMATION

| Device        | Package             | Shipping        |
|---------------|---------------------|-----------------|
| NGTB40N120SWG | TO-247<br>(Pb-Free) | 30 Units / Rail |

# NGTB40N120SWG

## THERMAL CHARACTERISTICS

| Rating                                         | Symbol          | Value | Unit                 |
|------------------------------------------------|-----------------|-------|----------------------|
| Thermal resistance junction-to-case, for IGBT  | $R_{\theta JC}$ | 0.28  | $^{\circ}\text{C/W}$ |
| Thermal resistance junction-to-case, for Diode | $R_{\theta JC}$ | 0.5   | $^{\circ}\text{C/W}$ |
| Thermal resistance junction-to-ambient         | $R_{\theta JA}$ | 40    | $^{\circ}\text{C/W}$ |

## 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 | $V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$                                                                       | $V_{(BR)CES}$ | 1200   | –            | –         | V  |
| Collector-emitter saturation voltage                              | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}$<br>$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^{\circ}\text{C}$         | $V_{CEsat}$   | –<br>– | 2.00<br>2.40 | 2.40<br>– | V  |
| Gate-emitter threshold voltage                                    | $V_{GE} = V_{CE}, I_C = 400\text{ }\mu\text{A}$                                                                           | $V_{GE(th)}$  | 4.5    | 5.5          | 6.5       | V  |
| Collector-emitter cut-off current, gate-emitter short-circuited   | $V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$<br>$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 175^{\circ}\text{C}$ | $I_{CES}$     | –<br>– | –<br>–       | 0.1<br>2  | mA |
| Gate leakage current, collector-emitter short-circuited           | $V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$                                                                               | $I_{GES}$     | –      | –            | 200       | nA |

|                              |                                                                  |           |   |      |   |    |
|------------------------------|------------------------------------------------------------------|-----------|---|------|---|----|
| Input capacitance            | $V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$    | $C_{ies}$ | – | 7385 | – | pF |
| Output capacitance           |                                                                  | $C_{oes}$ | – | 230  | – |    |
| Reverse transfer capacitance |                                                                  | $C_{res}$ | – | 140  | – |    |
| Gate charge total            | $V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$ | $Q_g$     | – | 313  | – | nC |
| Gate to emitter charge       |                                                                  | $Q_{ge}$  | – | 61   | – |    |
| Gate to collector charge     |                                                                  | $Q_{gc}$  | – | 151  | – |    |

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

|                         |                                                                                                                                             |              |   |     |   |    |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|-----|---|----|
| Turn-on delay time      | $T_J = 25^{\circ}\text{C}$<br>$V_{CC} = 600\text{ V}, I_C = 40\text{ A}$<br>$R_g = 10\text{ }\Omega$<br>$V_{GE} = 0\text{ V/ }15\text{ V}$  | $t_{d(on)}$  | – | 116 | – | ns |
| Rise time               |                                                                                                                                             | $t_r$        | – | 42  | – |    |
| Turn-off delay time     |                                                                                                                                             | $t_{d(off)}$ | – | 286 | – |    |
| Fall time               |                                                                                                                                             | $t_f$        | – | 121 | – |    |
| Turn-on switching loss  |                                                                                                                                             | $E_{on}$     | – | 3.4 | – | mJ |
| Turn-off switching loss |                                                                                                                                             | $E_{off}$    | – | 1.1 | – |    |
| Total switching loss    |                                                                                                                                             | $E_{ts}$     | – | 4.5 | – |    |
| Turn-on delay time      | $T_J = 175^{\circ}\text{C}$<br>$V_{CC} = 600\text{ V}, I_C = 40\text{ A}$<br>$R_g = 10\text{ }\Omega$<br>$V_{GE} = 0\text{ V/ }15\text{ V}$ | $t_{d(on)}$  | – | 111 | – | ns |
| Rise time               |                                                                                                                                             | $t_r$        | – | 43  | – |    |
| Turn-off delay time     |                                                                                                                                             | $t_{d(off)}$ | – | 304 | – |    |
| Fall time               |                                                                                                                                             | $t_f$        | – | 260 | – |    |
| Turn-on switching loss  |                                                                                                                                             | $E_{on}$     | – | 4.4 | – | mJ |
| Turn-off switching loss |                                                                                                                                             | $E_{off}$    | – | 2.5 | – |    |
| Total switching loss    |                                                                                                                                             | $E_{ts}$     | – | 6.9 | – |    |

### DIODE CHARACTERISTIC

|                          |                                                                                                                 |           |        |              |           |               |
|--------------------------|-----------------------------------------------------------------------------------------------------------------|-----------|--------|--------------|-----------|---------------|
| Forward voltage          | $V_{GE} = 0\text{ V}, I_F = 40\text{ A}$<br>$V_{GE} = 0\text{ V}, I_F = 50\text{ A}, T_J = 175^{\circ}\text{C}$ | $V_F$     | –<br>– | 2.00<br>2.30 | 2.60<br>– | V             |
| Reverse recovery time    | $T_J = 25^{\circ}\text{C}$<br>$I_F = 40\text{ A}, V_R = 400\text{ V}$<br>$di_F/dt = 200\text{ A/}\mu\text{s}$   | $t_{rr}$  | –      | 240          | –         | ns            |
| Reverse recovery charge  |                                                                                                                 | $Q_{rr}$  | –      | 2.5          | –         | $\mu\text{C}$ |
| Reverse recovery current |                                                                                                                 | $I_{rrm}$ | –      | 18           | –         | 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.

# NGTB40N120SWG

## TYPICAL CHARACTERISTICS

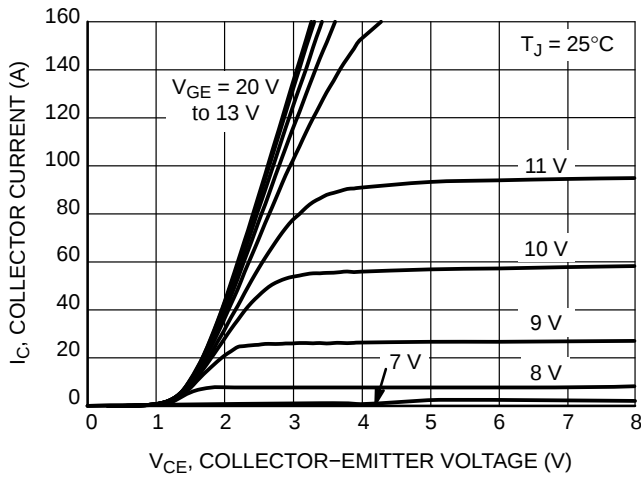


Figure 1. Output Characteristics

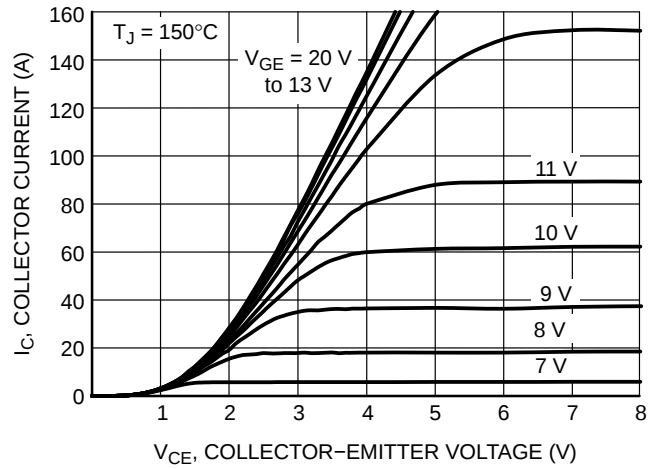


Figure 2. Output Characteristics

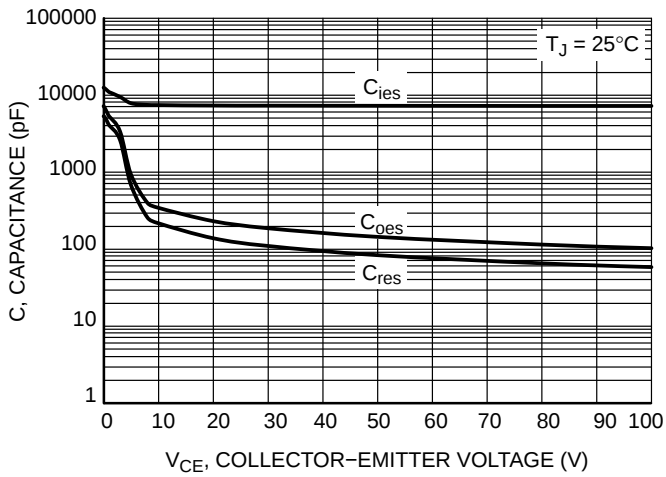


Figure 3. Typical Capacitance

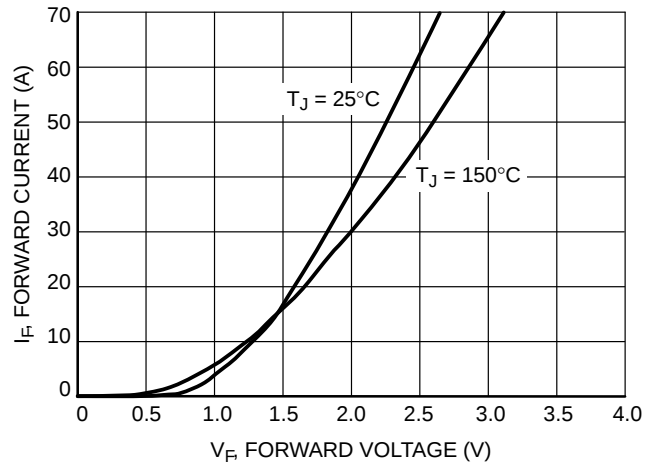


Figure 4. Diode Forward Characteristics

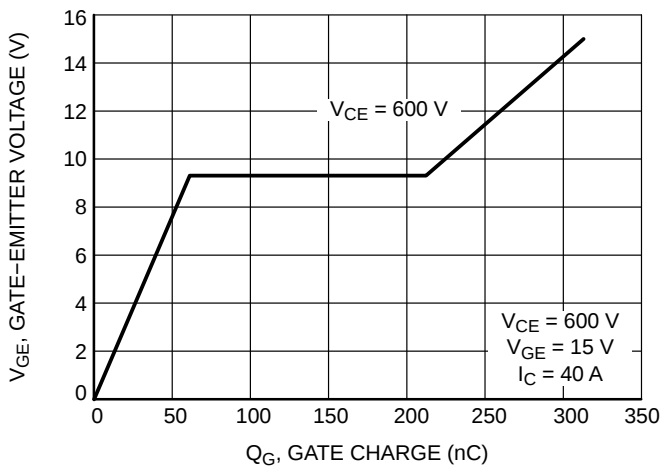


Figure 5. Typical Gate Charge

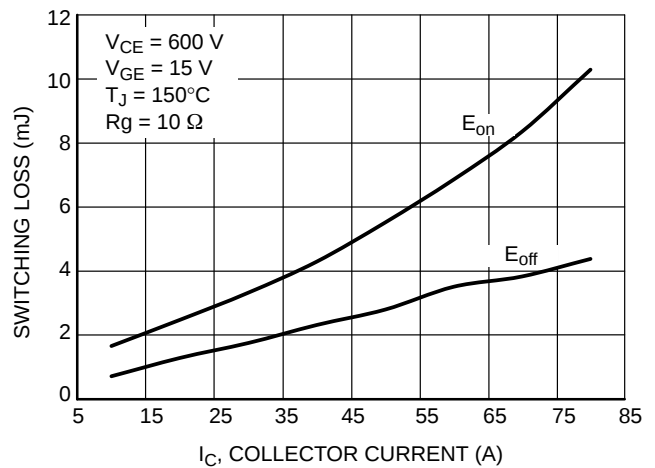
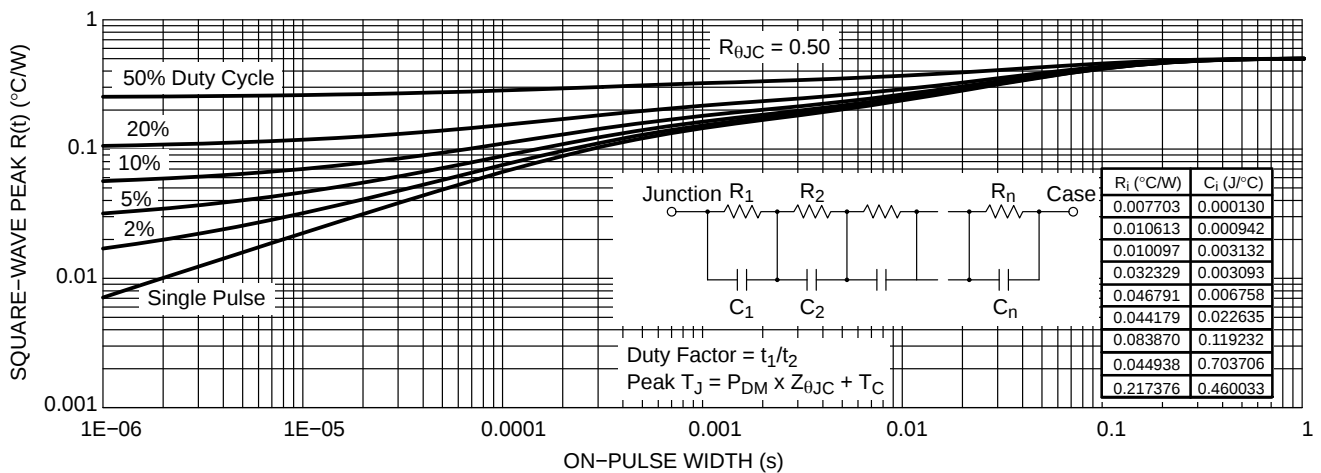
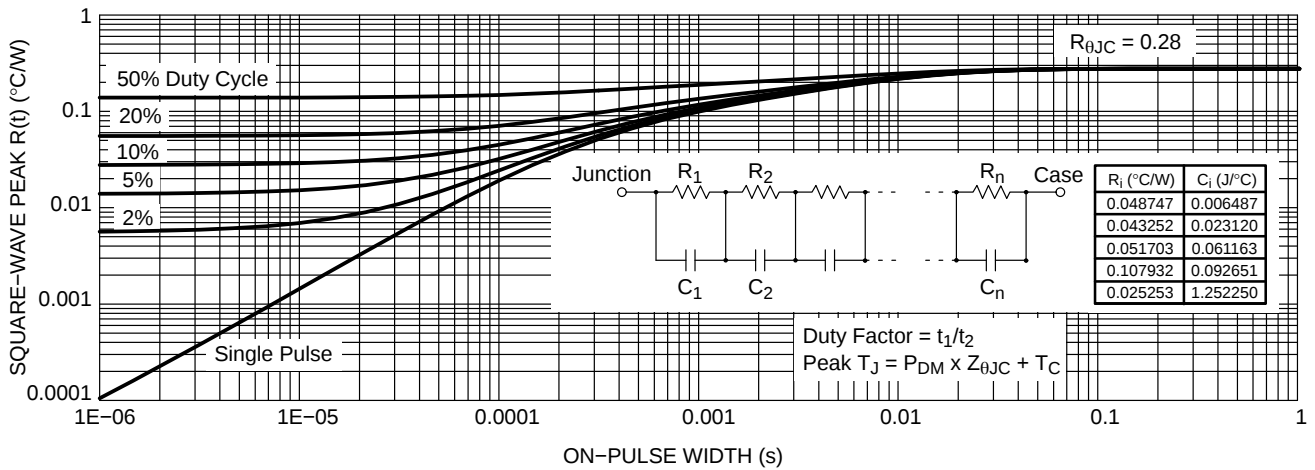
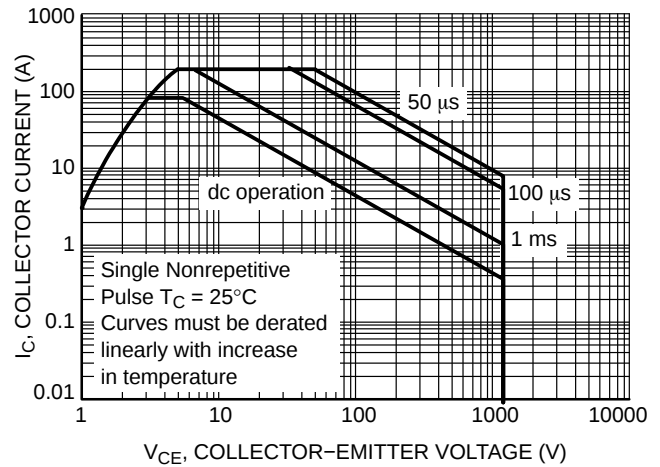
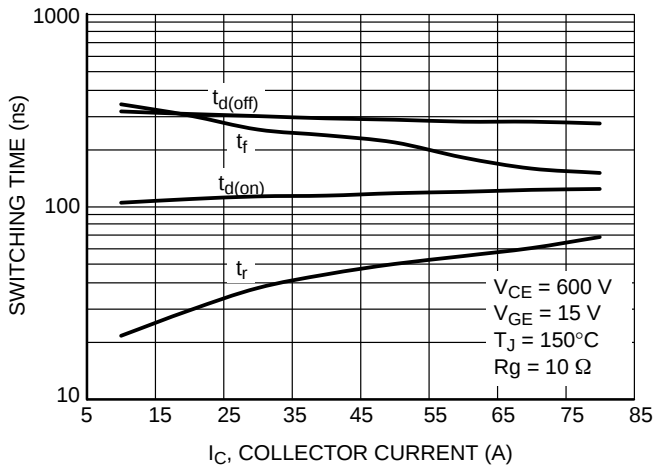


Figure 6. Switching Loss vs.  $I_C$

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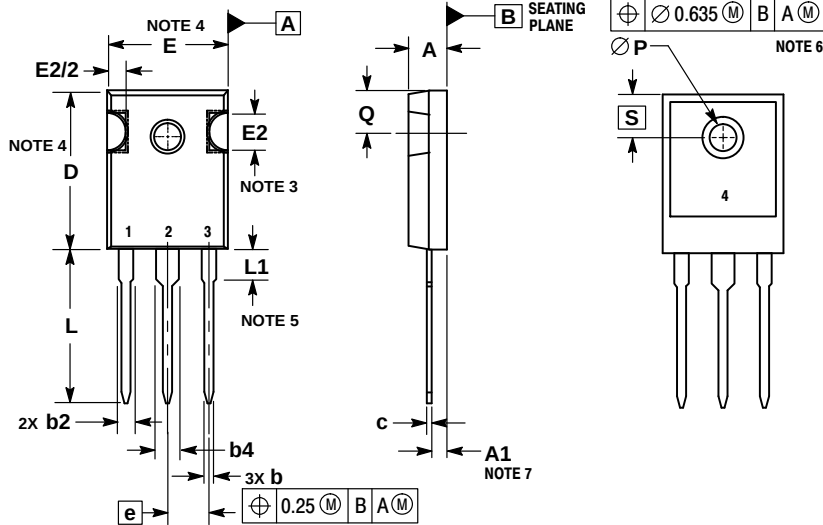
## TYPICAL CHARACTERISTICS



# NGTB40N120SWG

## PACKAGE DIMENSIONS

### TO-247 CASE 340AL ISSUE A



#### 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.  $\phi P$  SHALL HAVE A MAXIMUM DRAFT ANGLE OF  $1.5^\circ$  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.

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 4.70        | 5.30  |
| A1  | 2.20        | 2.60  |
| b   | 1.00        | 1.40  |
| b2  | 1.65        | 2.35  |
| b4  | 2.60        | 3.40  |
| c   | 0.40        | 0.80  |
| D   | 20.30       | 21.40 |
| E   | 15.50       | 16.25 |
| E2  | 4.32        | 5.49  |
| e   | 5.45 BSC    |       |
| L   | 19.80       | 20.80 |
| L1  | 3.50        | 4.50  |
| P   | 3.55        | 3.65  |
| Q   | 5.40        | 6.20  |
| S   | 6.15 BSC    |       |

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