## DESCRIPTION

The MXD60N04 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a wide variety of applications.

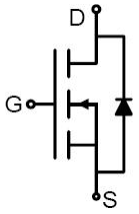
## GENERAL FEATURES

- VDS=40V, ID=68A
  $R_{DS(ON)}$(Typ.)=9.2mΩ @ VGS=4.5V
  $R_{DS(ON)}$(Typ.)=5.5mΩ @ VGS=10V
- High Power and current handing capability
- Lead free product is acquired
- Surface Mount Package

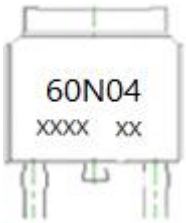
## APPLICATION

- PWM applications
- Load switch
- Power management

## PINOUT



Schematic diagram



Marking and pin Assignment


TO-252 top view

## ORDERING INFORMATION

| Device | Marking | StorageTemperature | Package | Devices Per Reel |
|---|---|---|---|---|
| MXD60N04 | 60N04 | -55°C to 175°C | TO-252 | 2500 |

## KEY PERFORMANCE PARAMETERS($T_A$=25°C unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage($V_{GS}$=0V) | $V_{DS}$ | 40 | V |
| Gate-Source Voltage($V_{DS}$=0V) | $V_{GS}$ | ±20 | V |
| Drain Current-Continuous($T_C$=25°C) | $I_D$ | 68 | A |
| Drain Current-Continuous($T_C$=100°C) | $I_D$ | 48 | A |
| Drain Current-Continuous@Current-Pulsed(Note 1) | $I_{DM(pluse)}$ | 272 | A |
| Maximum Power Dissipation($T_C$=25°C) | $P_D$ | 75 | W |
| Maximum Power Dissipation($T_C$=100°C) | $P_D$ | 37.5 | W |
| Single Pulse Avalanche Energy(Note 2) | $E_{AS}$ | 217.5 | mJ |
| Operating Junction and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to 175 | °C |

## THERMAL CHARACTERISTIC

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 2 | °C/W |

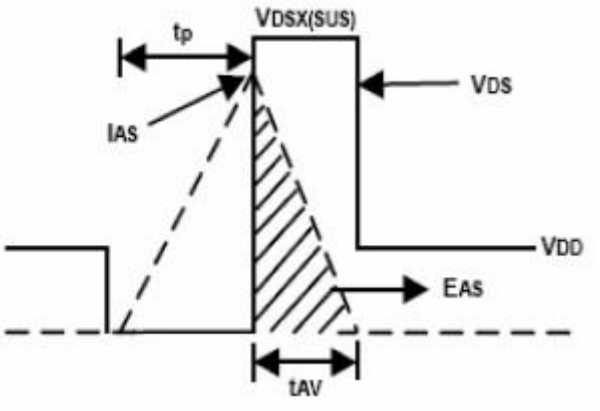
Note 1.Repetitive Rating: Pulse width limited by maximum junction temperature
Note 2.$E_{AS}$ condition:$T_J$=25°C,$V_{DD}$=15V,$V_G$=10V, $R_G$=25Ω

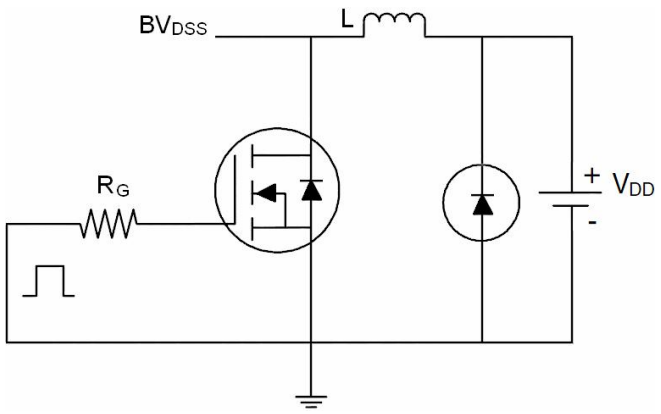
## ELECTRICAL CHARACTERISTICS($T_A$=25°C unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **On/Off Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V, $I_D$=250μA | 40 | 45 | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=40V, $V_{GS}$=0V | - | - | 1 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V, $V_{DS}$=0V | - | - | ±100 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=250μA | 1 | 1.5 | 2.5 | V |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=5V, $I_D$=15A | - | 29 | - | S |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=4.5V, $I_D$=20A | - | 9.2 | 15 | mΩ |
| | | $V_{GS}$=10V, $I_D$=20A | - | 5.5 | 7.4 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$=20V, $V_{GS}$=0V, F=1.0MHz | - | 1765 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 170 | - | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 136 | - | pF |
| Gate resistance | $R_g$ | $V_{GS}$=0V, $V_{DS}$=0V, F=1.0MHz | - | 1.2 | - | Ω |
| **Switching Characteristics** | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DS}$=20V, $R_L$=1Ω $V_{GS}$=10V,$R_{GEN}$=3Ω | - | 7 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 26 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 39 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 26 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=20V, $I_D$=20A, $V_{GS}$=10V | - | 40 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 5.2 | - | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 12.5 | - | nC |
| **Source-Drain Diode Characteristics** | | | | | | |
| Source-Drain Current(Body Diode) | $I_{SD}$ | | - | - | 68 | A |
| Forward On Voltage | $V_{SD}$ | $V_{GS}$=0V, $I_S$=20A | - | - | 1.2 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$=20A, dI/dt=100A/μs | - | 12.5 | - | nS |
| Reverse Recovery Charge | $Q_{rr}$ | | - | 5.1 | - | nC |

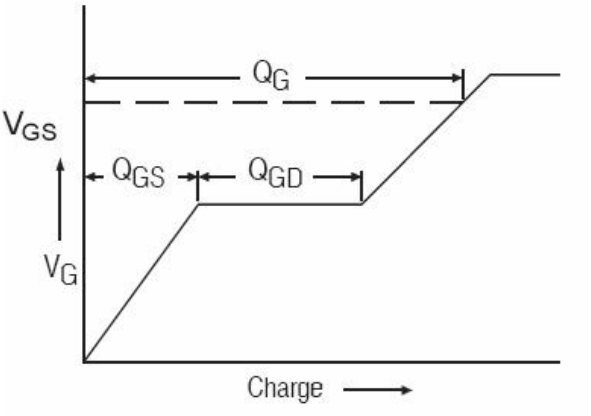
## TEST CIRCUIT

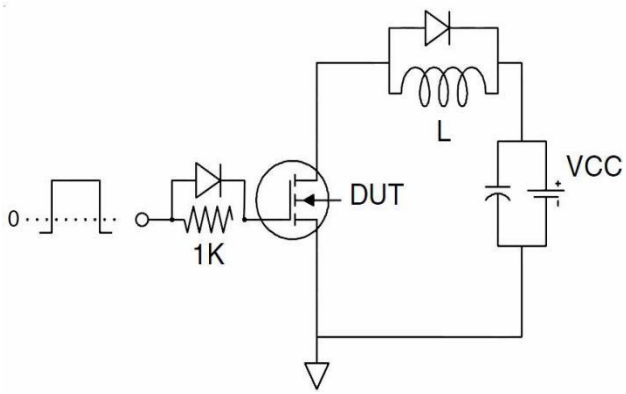
### 1) $E_{AS}$ Test Circuits



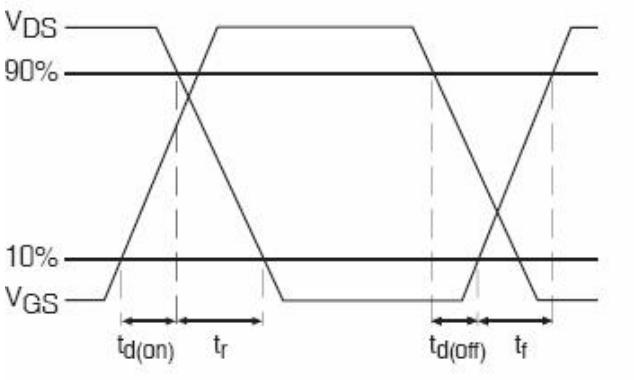



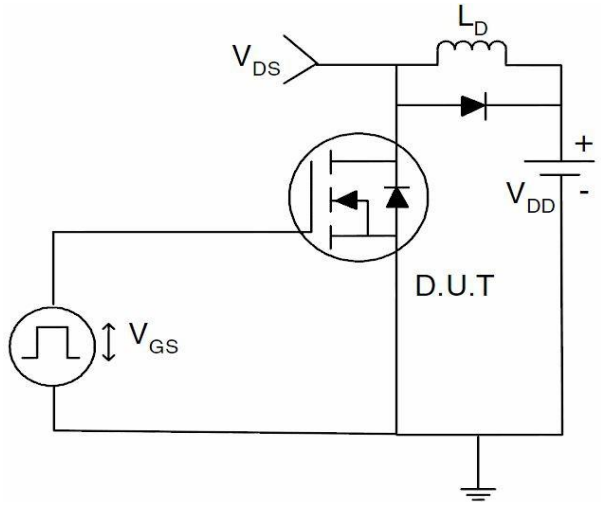

### 2) Gate Charge Test Circuit




### 3) Switch Time Test Circuit



## TYPICAL PERFORMANCE CHARACTERISTICS

**Figure1. Output Characteristics**

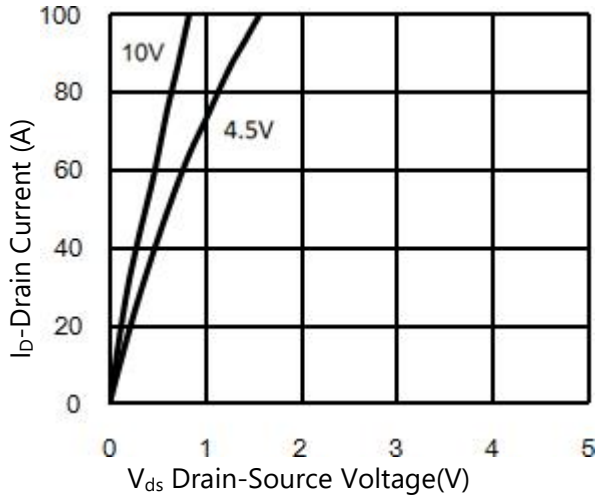



**Figure2. Transfer Characteristics**

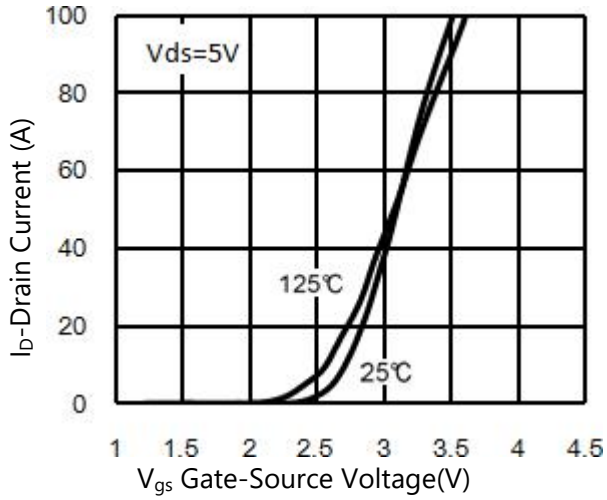



**Figure3. Power Dissipation**

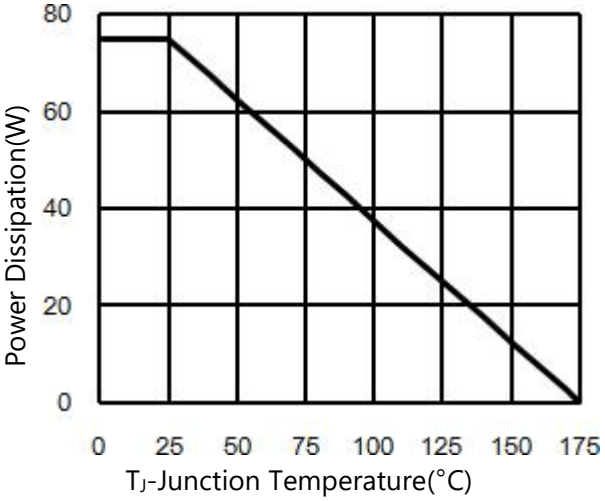



**Figure4. Drain Current**

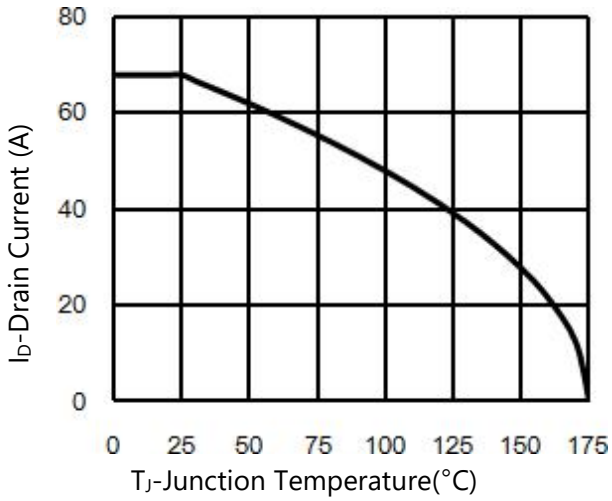



**Figure5. $V_{GS(th)}$ vs Junction Temperature**

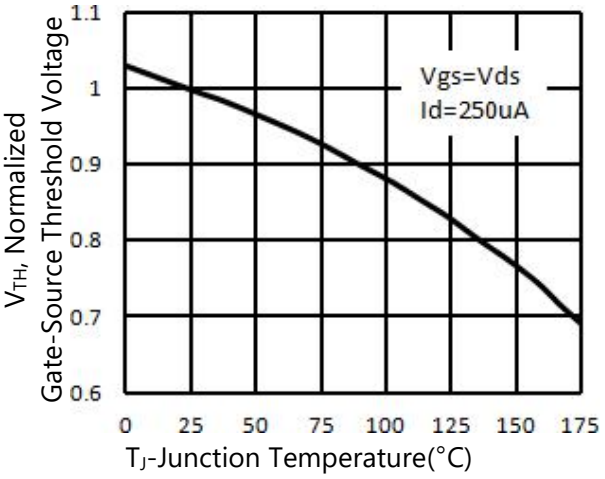
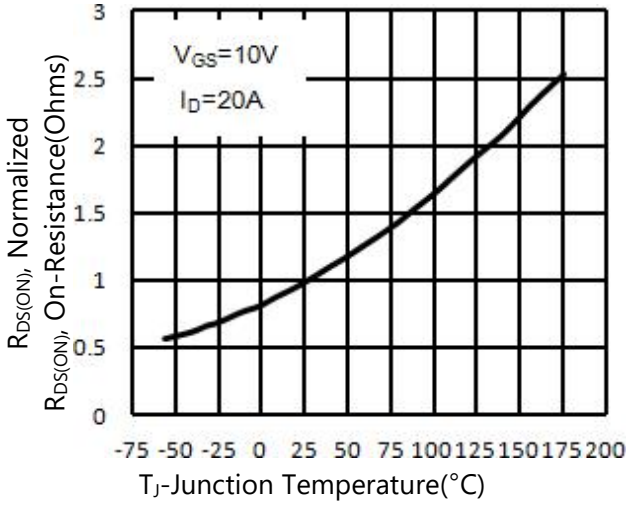



**Figure6. $R_{DS(ON)}$ vs Junction Temperature**



## TYPICAL PERFORMANCE CHARACTERISTICS

**Figure7. Gate Charge Waveforms**

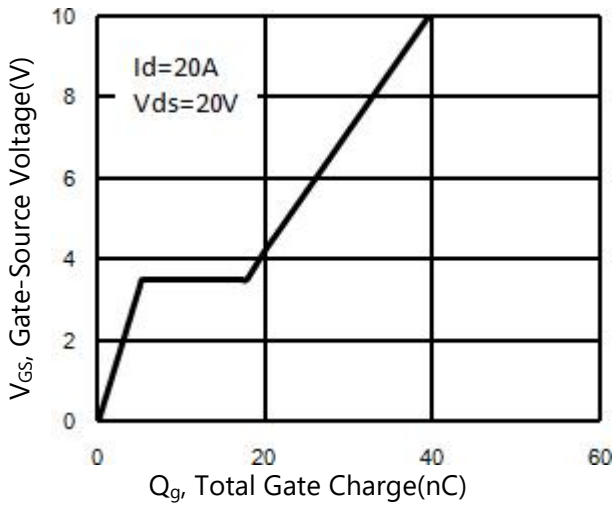



**Figure8. Capacitance**

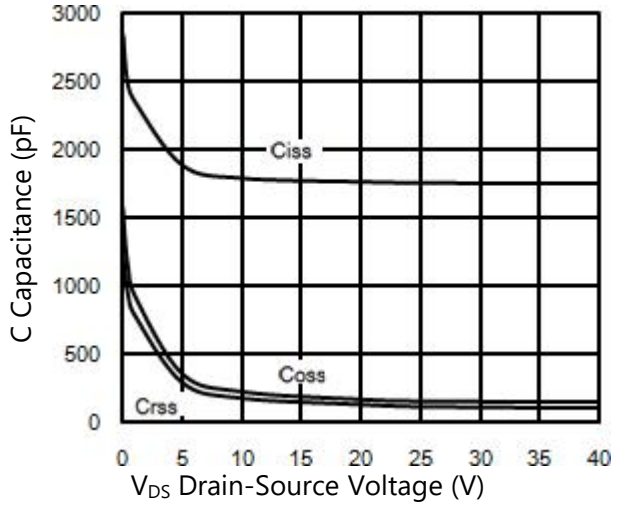



**Figure9. Source-Drain Diode Forward**

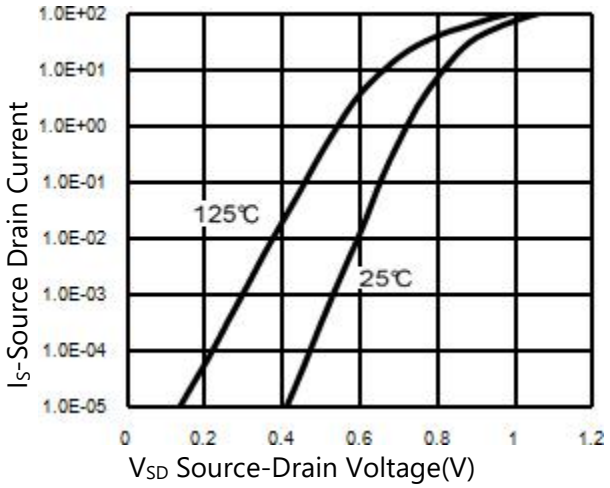
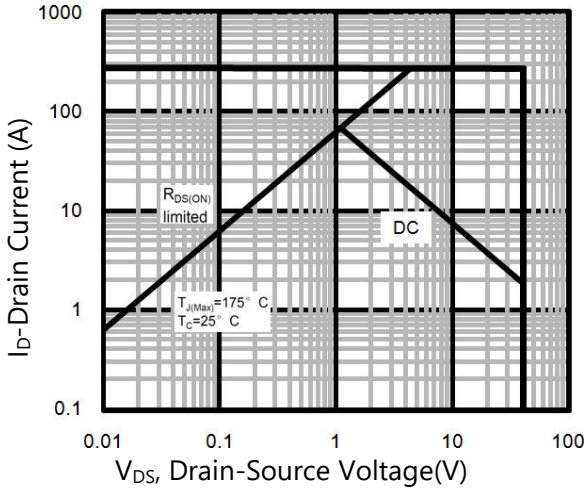
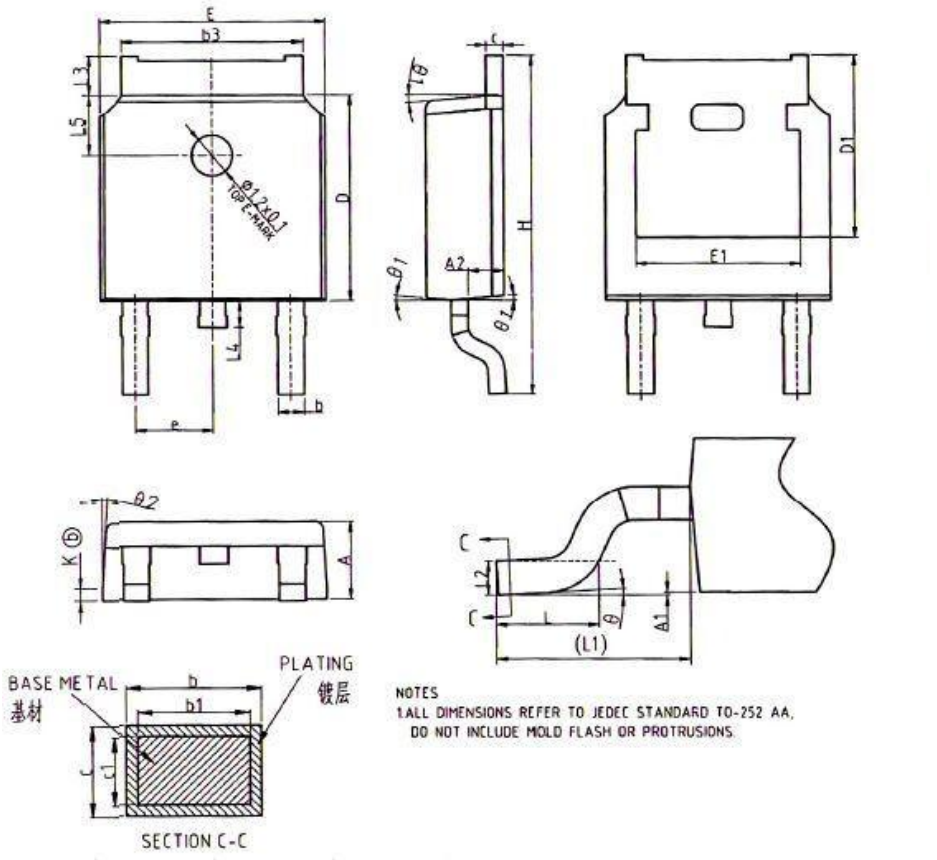



**Figure10. Safe Operating Area**



## PACKAGE INFORMATION

**TO-252**




| SYMBOL | COMMON DIMENSIONS IN MILLIMETERS | | | SYMBOL | COMMON DIMENSIONS IN MILLIMETERS | | |
|---|---|---|---|---|---|---|---|
| | MIN | NOM | MAX | | MIN | NOM | MAX |
| A | 2.20 | 2.30 | 2.38 | H | 9.90 | 10.10 | 10.30 |
| A1 | 0.00 | - | 0.10 | L | 1.40 | 1.50 | 1.70 |
| A2 | 0.97 | 1.07 | 1.17 | L1 | 2.90REF | | |
| b | 0.72 | 0.78 | 0.85 | L2 | 0.51BSC | | |
| b1 | 0.71 | 0.76 | 0.81 | L3 | 0.90 | - | 1.25 |
| b3 | 5.23 | 5.33 | 5.46 | L4 | 0.60 | 0.80 | 1.00 |
| c | 0.47 | 0.53 | 0.58 | L5 | 1.70 | 1.80 | 1.90 |
| c1 | 0.46 | 0.51 | 0.56 | θ | 0° | - | 8° |
| D | 6.00 | 6.10 | 6.20 | θ1 | 5° | 7° | 9° |
| D1 | 5.30REF | | | θ2 | 5° | 7° | 9° |
| E | 6.50 | 6.60 | 6.70 | K | 0.40REF | | |
| E1 | 4.70 | 4.83 | 4.92 | | | | |
| e | 2.286BSC | | | | | | |