

Description

The LCE P60T12A uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of $R_{DS(ON)}$ and Q_g . This device is ideal for high-frequency switching and synchronous rectification.

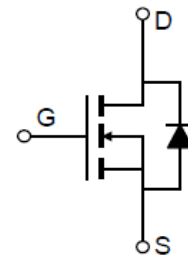
General Features

- $V_{DS} = 60V, I_D = 120A$
- $R_{DS(ON)} < 4.0m\Omega @ V_{GS} = 10V$ (Typ: 3.5m Ω)
- $R_{DS(ON)} < 5.0m\Omega @ V_{GS} = 4.5V$ (Typ: 4.0m Ω)
- Excellent gate charge x $R_{DS(on)}$ product
- Very low on-resistance $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

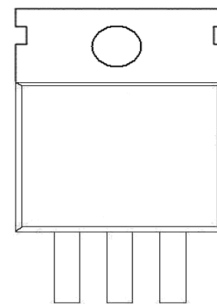
Application

- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

100% UIS TESTED!
100% ΔV_{ds} TESTED!



Schematic diagram



Marking and pin assignment



TO-220-3L top view

Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|----------------|-------------|----------------|-----------|------------|----------|
| NCEP60T12A | LCE P60T12A | TO-220-3L | - | - | - |

Absolute Maximum Ratings ($T_C = 25^\circ C$ unless otherwise noted)

| Parameter | Symbol | Limit | Unit |
|---|--------------------|------------|---------------|
| Drain-Source Voltage | V_{DS} | 60 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | V |
| Drain Current-Continuous (Silicon Limited) | I_D | 120 | A |
| Drain Current-Continuous ($T_C = 100^\circ C$) | $I_D(100^\circ C)$ | 100 | A |
| Pulsed Drain Current | I_{DM} | 480 | A |
| Maximum Power Dissipation | P_D | 180 | W |
| Derating factor | | 1.2 | W/ $^\circ C$ |
| Single pulse avalanche energy ^(Note 5) | E_{AS} | 500 | mJ |
| Operating Junction and Storage Temperature Range | T_J, T_{STG} | -55 To 175 | $^\circ C$ |

Thermal Characteristic

| | | | |
|--|-----------------|------|---------------|
| Thermal Resistance, Junction-to-Case ^(Note 2) | $R_{\theta JC}$ | 0.83 | $^{\circ}C/W$ |
|--|-----------------|------|---------------|

Electrical Characteristics ($T_C=25^{\circ}C$ unless otherwise noted)

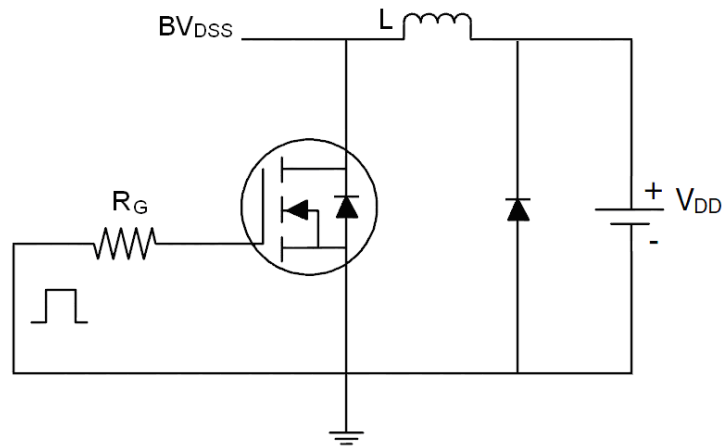
| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|--|--------------|--|-----|------|-----------|------------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=250\mu A$ | 60 | | - | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=60V, V_{GS}=0V$ | - | - | 1 | μA |
| Gate-Body Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | - | - | ± 100 | nA |
| On Characteristics ^(Note 3) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$ | 1.0 | 1.7 | 2.4 | V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=60A$ | - | 3.5 | 4.0 | m Ω |
| | | $V_{GS}=4.5V, I_D=60A$ | - | 4.0 | 5.0 | m Ω |
| Forward Transconductance | g_{FS} | $V_{DS}=10V, I_D=60A$ | 40 | - | - | S |
| Dynamic Characteristics ^(Note 4) | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS}=30V, V_{GS}=0V,$ $F=1.0MHz$ | - | 4000 | - | PF |
| Output Capacitance | C_{oss} | | - | 680 | - | PF |
| Reverse Transfer Capacitance | C_{rss} | | - | 23 | - | PF |
| Switching Characteristics ^(Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=30V, I_D=60A$ $V_{GS}=10V, R_G=4.7\Omega$ | - | 11 | - | nS |
| Turn-on Rise Time | t_r | | - | 5 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 56 | - | nS |
| Turn-Off Fall Time | t_f | | - | 12 | - | nS |
| Total Gate Charge | Q_g | $V_{DS}=30V, I_D=60A,$ $V_{GS}=10V$ | - | 67 | | nC |
| Gate-Source Charge | Q_{gs} | | - | 12 | | nC |
| Gate-Drain Charge | Q_{gd} | | - | 8.5 | | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage ^(Note 3) | V_{SD} | $V_{GS}=0V, I_S=120A$ | - | | 1.2 | V |
| Diode Forward Current ^(Note 2) | I_S | | - | - | 120 | A |
| Reverse Recovery Time | t_{rr} | $T_J = 25^{\circ}C, I_F = I_S$ $di/dt = 100A/\mu s$ ^(Note 3) | - | 48 | | nS |
| Reverse Recovery Charge | Q_{rr} | | - | 60 | | nC |

Notes:

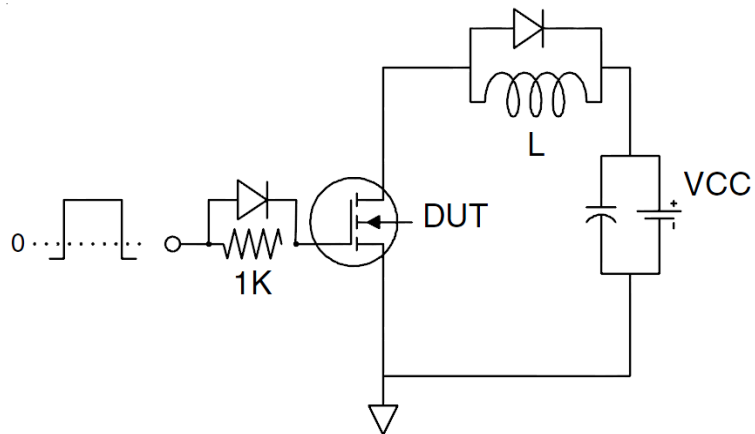
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production
5. EAS condition : $T_J=25^{\circ}C, V_{DD}=30V, V_G=10V, L=0.5mH, R_G=25\Omega$

Test Circuit

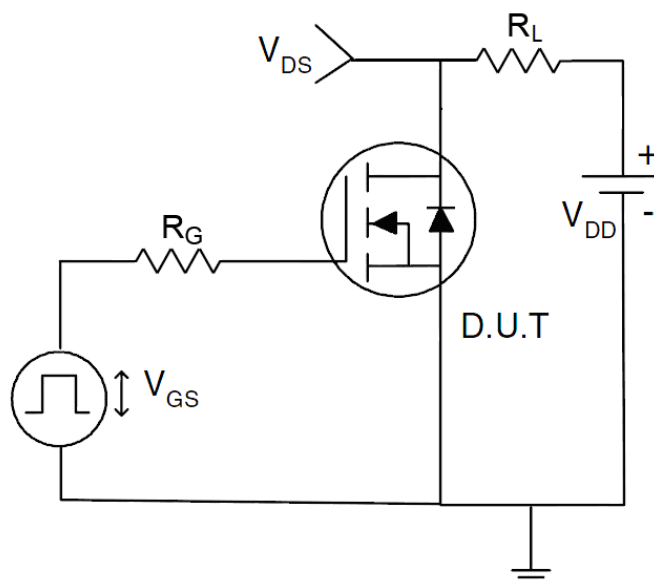
1) E_{AS} test Circuit



2) Gate charge test Circuit



3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics

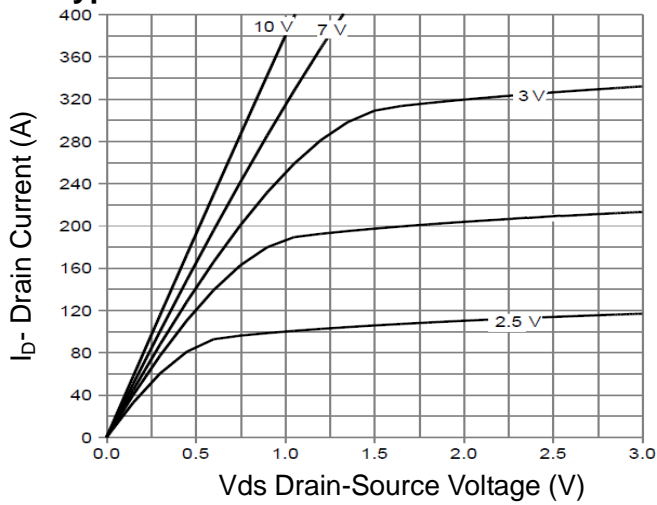


Figure 1 Output Characteristics

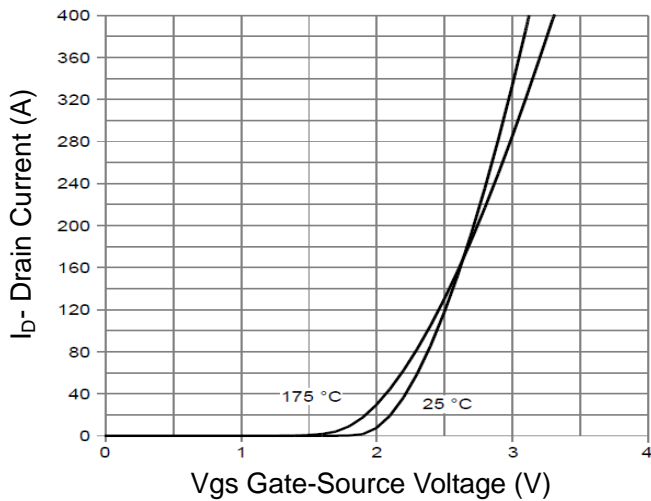


Figure 2 Transfer Characteristics

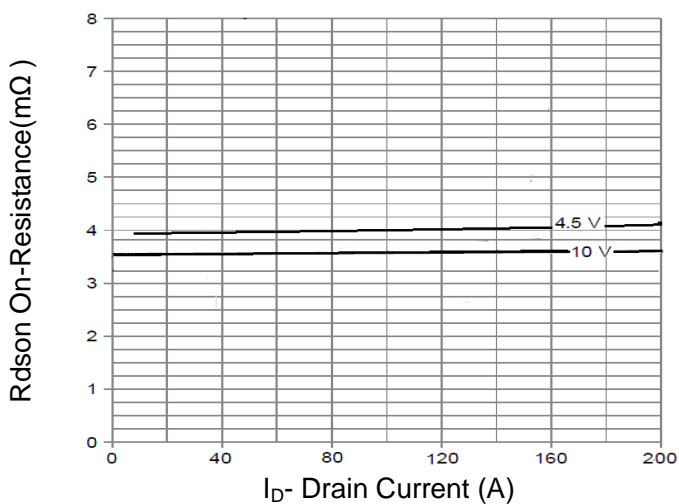


Figure 3 $R_{DS(on)}$ - Drain Current

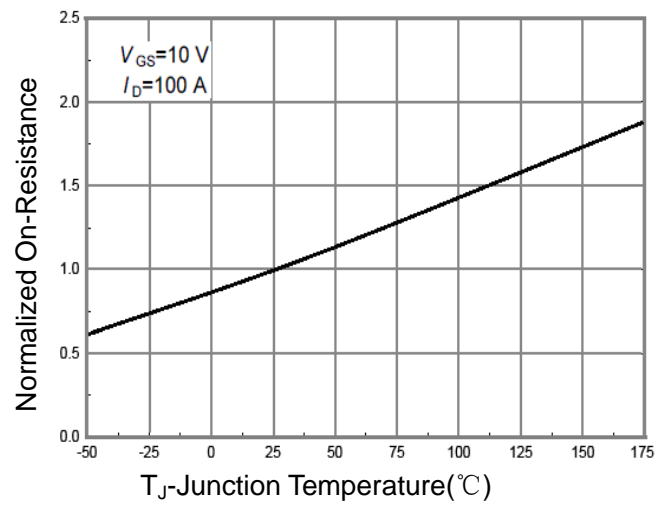


Figure 4 $R_{DS(on)}$ -Junction Temperature

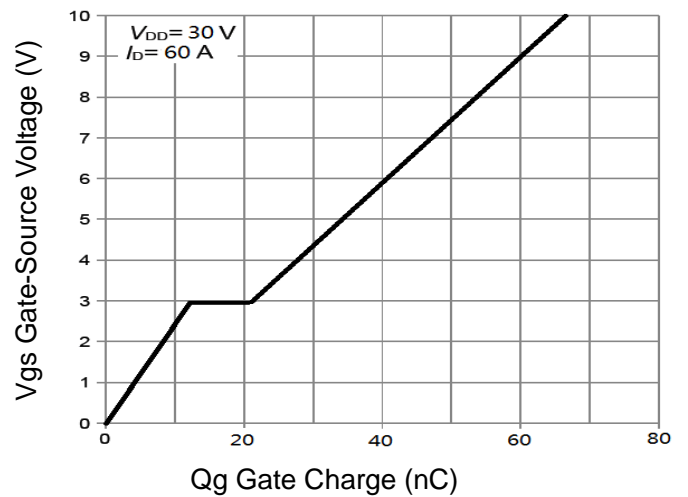


Figure 5 Gate Charge

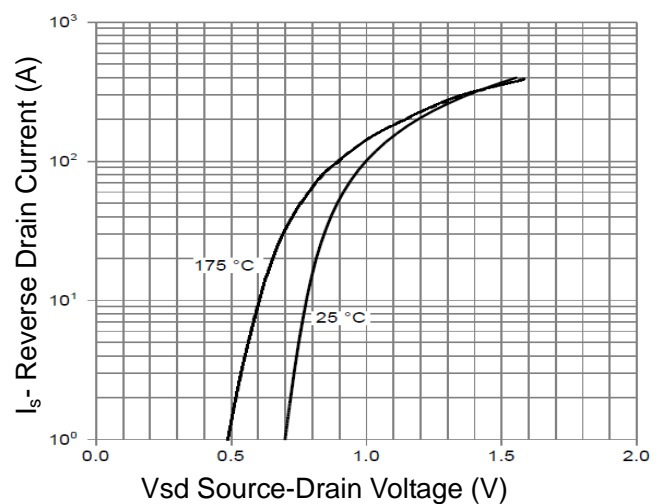


Figure 6 Source- Drain Diode Forward

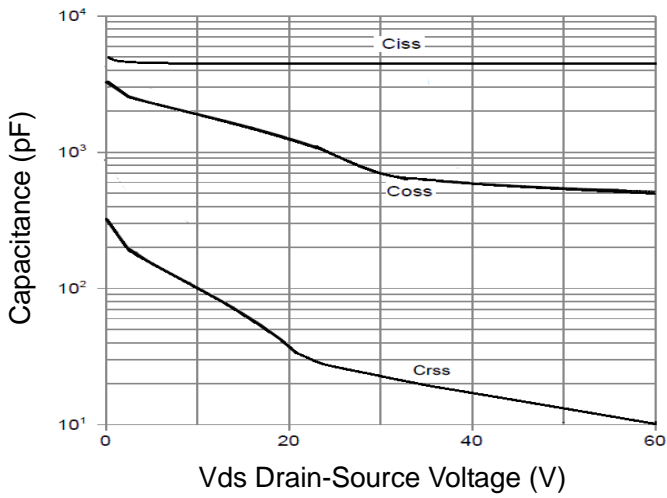


Figure 7 Capacitance vs Vds

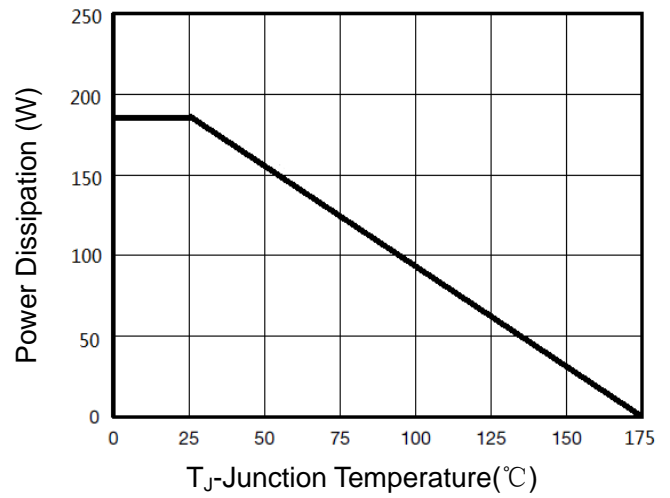


Figure 9 Power De-rating

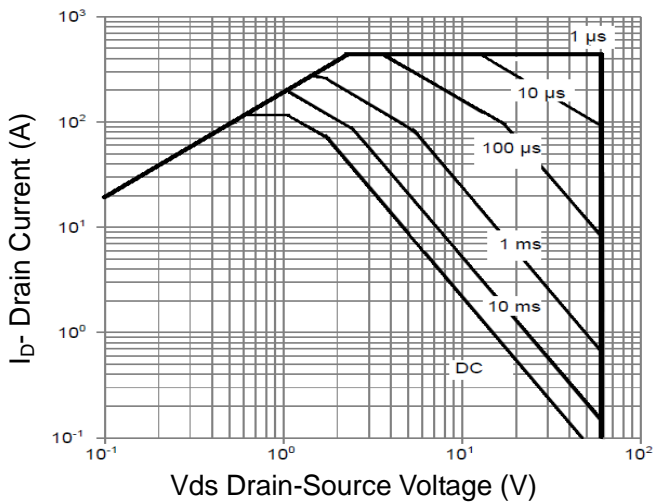


Figure 8 Safe Operation Area

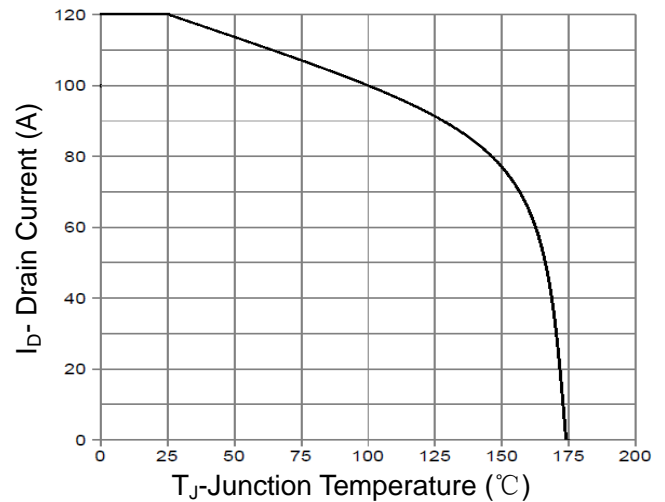


Figure 10 Current De-rating

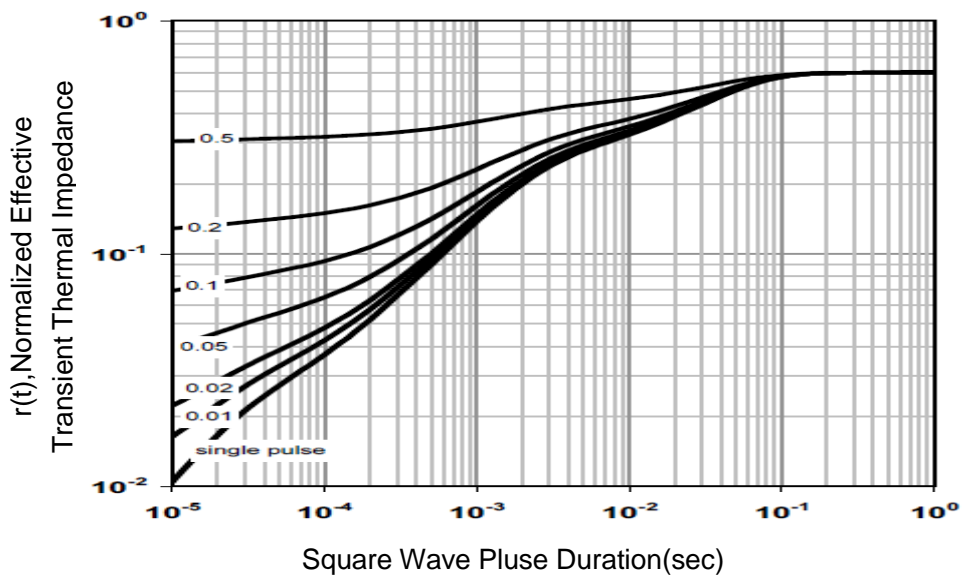
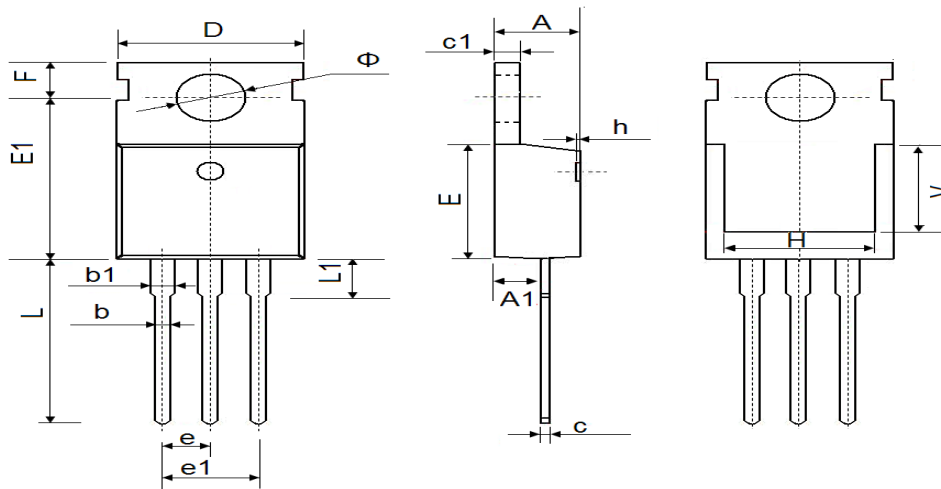


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-220-3L Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.400 | 4.600 | 0.173 | 0.181 |
| A1 | 2.250 | 2.550 | 0.089 | 0.100 |
| b | 0.710 | 0.910 | 0.028 | 0.036 |
| b1 | 1.170 | 1.370 | 0.046 | 0.054 |
| c | 0.330 | 0.650 | 0.013 | 0.026 |
| c1 | 1.200 | 1.400 | 0.047 | 0.055 |
| D | 9.910 | 10.250 | 0.390 | 0.404 |
| E | 8.9500 | 9.750 | 0.352 | 0.384 |
| E1 | 12.650 | 12.950 | 0.498 | 0.510 |
| e | 2.540 TYP. | | 0.100 TYP. | |
| e1 | 4.980 | 5.180 | 0.196 | 0.204 |
| F | 2.650 | 2.950 | 0.104 | 0.116 |
| H | 7.900 | 8.100 | 0.311 | 0.319 |
| h | 0.000 | 0.300 | 0.000 | 0.012 |
| L | 12.900 | 13.400 | 0.508 | 0.528 |
| L1 | 2.850 | 3.250 | 0.112 | 0.128 |
| V | 7.500 REF. | | 0.295 REF. | |
| Φ | 3.400 | 3.800 | 0.134 | 0.150 |