

# NCE20ED135T

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### 1350V, 20A, Trench FS IGBT

#### Features

- Trench FS( Field Stop) IGBT
- High speed switching
- Low saturation voltage:  $V_{CE(sat)}=2.0V@I_C=20A$
- High input impedance

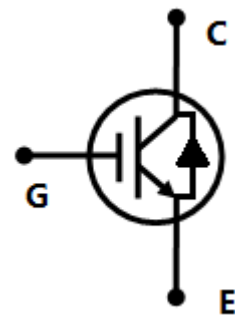


#### Applications

- Inductive heating, Microwave oven, Inverter, UPS, etc.
- Soft switching applications

#### General Description

Using advanced Trench field stop technology, NCE's 1350V IGBTs offers superior conduction and switching performances, and easy parallel operation with exceptional avalanche ruggedness. This device is designed for soft switching applications.



### Absolute Maximum Ratings

| Symbol      | Description                                                            | Ratings     | Units       |
|-------------|------------------------------------------------------------------------|-------------|-------------|
| $V_{CES}$   | Collector to Emitter Voltage                                           | 1350        | V           |
| $V_{GES}$   | Gate to Emitter Voltage                                                | +/-30       | V           |
| $I_C$       | Continuous Collector Current @ $T_C=25^{\circ}C$                       | 40          | A           |
|             | Continuous Collector Current @ $T_C=100^{\circ}C$                      | 20          | A           |
| $I_{CM}(1)$ | Pulsed Collector Current                                               | 60          | A           |
| $I_F$       | Diode Continuous Forward Current @ $T_C=100^{\circ}C$                  | 20          |             |
| $I_{FM}$    | Diode Maximum Forward Current                                          | 60          | A           |
| $P_D$       | Maximum Power Dissipation @ $T_C=25^{\circ}C$                          | 340         | W           |
|             | Maximum Power Dissipation @ $T_C=100^{\circ}C$                         | 170         | W           |
| $T_J$       | Operating Junction Temperature                                         | -55 to +150 | $^{\circ}C$ |
| $T_{stg}$   | Storage Temperature Range                                              | -55 to +150 | $^{\circ}C$ |
| $T_L$       | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5seconds | 260         | $^{\circ}C$ |

#### Notes:

1. Repetitive rating, Pulse width limited by max. junction temperature

## Thermal Characteristics

| Symbol           | Parameter                               | Typ. | Max. | Units         |
|------------------|-----------------------------------------|------|------|---------------|
| $R_{\square JC}$ | Thermal Resistance, Junction to Case    | -    | 0.37 | $^{\circ}C/W$ |
| $R_{JA}$         | Thermal Resistance, Junction to Ambient | -    | 40   | $^{\circ}C/W$ |

## Electrical Characteristics $T_C=25^{\circ}C$

| Symbol                           | Parameter                               | Test Conditions                                                                                 | Min. | Typ. | Max.   | Units   |
|----------------------------------|-----------------------------------------|-------------------------------------------------------------------------------------------------|------|------|--------|---------|
| <b>Off Characteristics</b>       |                                         |                                                                                                 |      |      |        |         |
| $BV_{CES}$                       | Collector to Emitter Breakdown Voltage  | $V_{GE}=0V, I_C=1mA$                                                                            | 1350 | -    | -      | V       |
| $I_{CES}$                        | Collector Cut-Off Current               | $V_{CE}=1350V, V_{GE}=0V$                                                                       | -    | -    | 100    | $\mu A$ |
| $I_{GES}$                        | G-E Leakage Current                     | $V_{GE}=30V, V_{CE}=0V$                                                                         | -    | -    | +/-100 | nA      |
| <b>On Characteristics</b>        |                                         |                                                                                                 |      |      |        |         |
| $V_{GE(th)}$                     | G-E Threshold Voltage                   | $I_C=1mA, V_{CE}=V_{GE}$                                                                        | 5    |      | 7      | V       |
| $V_{CE(sat)}$                    | Collector to Emitter Saturation Voltage | $I_C=20A, V_{GE}=15V$<br>$T_C=25^{\circ}C$                                                      | -    | 1.7  | 2      | V       |
|                                  |                                         | $I_C=20A, V_{GE}=15V$<br>$T_C=125^{\circ}C$                                                     | -    | 2    | -      | V       |
| <b>Dynamic Characteristics</b>   |                                         |                                                                                                 |      |      |        |         |
| $C_{ies}$                        | Input Capacitance                       | $V_{CE}=30V, V_{GE}=0V,$<br>$f=1MHz$                                                            | -    | 2050 | -      | pF      |
| $C_{oes}$                        | Output Capacitance                      |                                                                                                 | -    | 70   | -      | pF      |
| $C_{res}$                        | Reverse Transfer Capacitance            |                                                                                                 | -    | 40   | -      | pF      |
| <b>Switching Characteristics</b> |                                         |                                                                                                 |      |      |        |         |
| $t_{d(off)}$                     | Turn-Off Delay Time                     | $V_{CC}=600V, I_C=20A,$<br>$R_G=10\Omega, V_{GE}=15V,$<br>Inductive Load,<br>$T_C=25^{\circ}C$  | -    | 190  | -      | ns      |
| $t_f$                            | Fall Time                               |                                                                                                 | -    | 100  |        | ns      |
| $E_{off}$                        | Turn-Off Switching Loss                 |                                                                                                 | -    | 0.9  |        | mJ      |
| $t_{d(off)}$                     | Turn-Off Delay Time                     | $V_{CC}=600V, I_C=20A,$<br>$R_G=10\Omega, V_{GE}=15V,$<br>Inductive Load,<br>$T_C=125^{\circ}C$ | -    | 200  |        | ns      |
| $t_f$                            | Fall Time                               |                                                                                                 | -    | 154  |        | ns      |
| $E_{off}$                        | Turn-Off Switching Loss                 |                                                                                                 | -    | 1.4  |        | mJ      |
| $Q_g$                            | Total Gate Charge                       | $V_{CC}=600V, I_C=20A,$<br>$V_{GE}=15V$                                                         | -    | 190  | 240    | nC      |
| $Q_{ge}$                         | Gate to Emitter Charge                  |                                                                                                 | -    | 15   | 23     | nC      |
| $Q_{gc}$                         | Gate to Collector Charge                |                                                                                                 | -    | 80   | 120    | nC      |
| <b>Diode Characteristics</b>     |                                         |                                                                                                 |      |      |        |         |
| $V_{FM}$                         | Forward Voltage                         | $I_F=20A, T_C=25^{\circ}C$                                                                      | -    | 1.8  | 2      | V       |
| $t_{rr}$                         | Reverse Recovery Time                   | $I_F=20A, di/dt=200A/us$<br>$T_C=25^{\circ}C$                                                   | -    | 235  | 350    | ns      |
| $I_{rr}$                         | Peak Reverse Recovery Current           |                                                                                                 | -    | 27   | 40     | A       |
| $Q_{rr}$                         | Reverse Recovery Charge                 |                                                                                                 | -    | 3130 | 4700   | $\mu C$ |

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

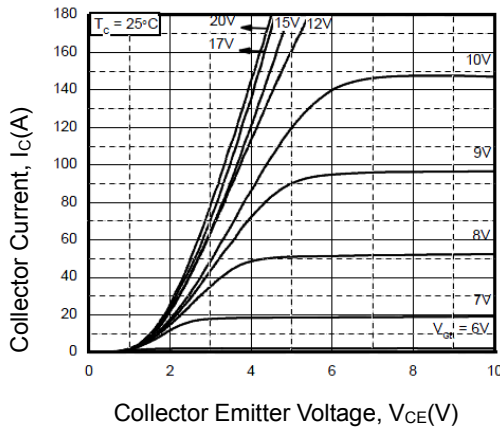


Figure 2. Typical Saturation Voltage Characteristics

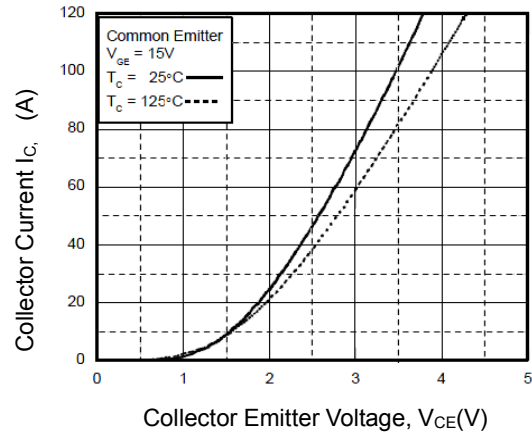


Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

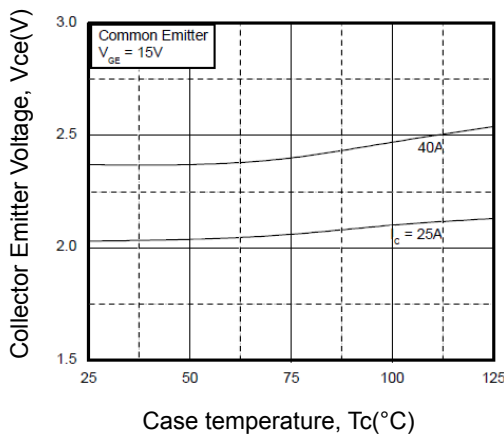


Figure 4. Saturation Voltage vs. Vge

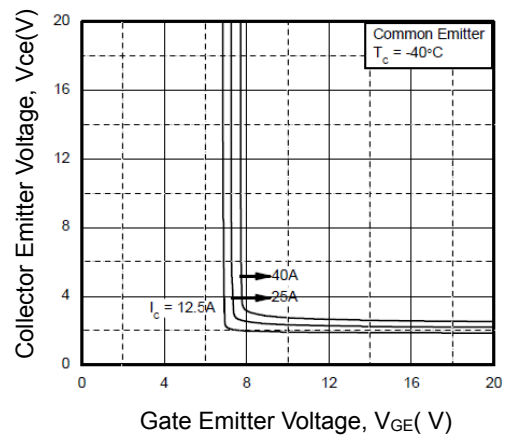


Figure 5. Saturation Voltage vs. Vge

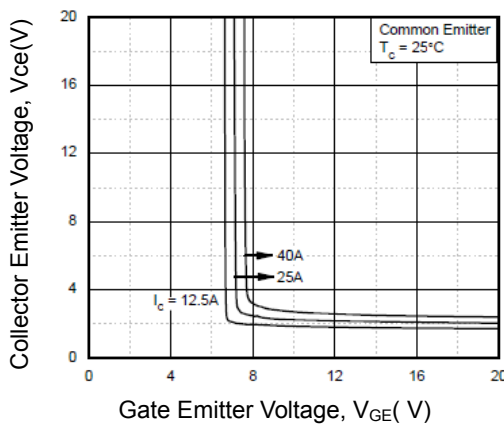
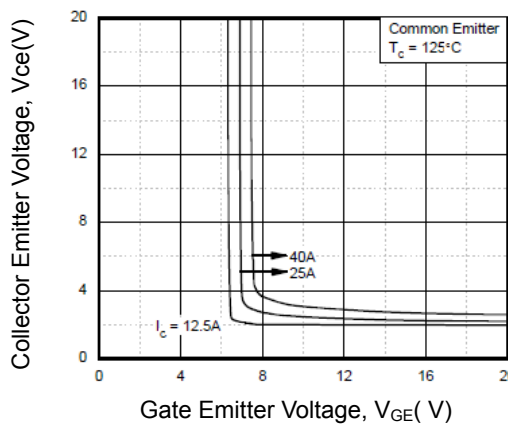


Figure 6. Saturation Voltage vs. Vge



## Typical Performance Characteristics (Continued)

Figure 7. Capacitance Characteristics

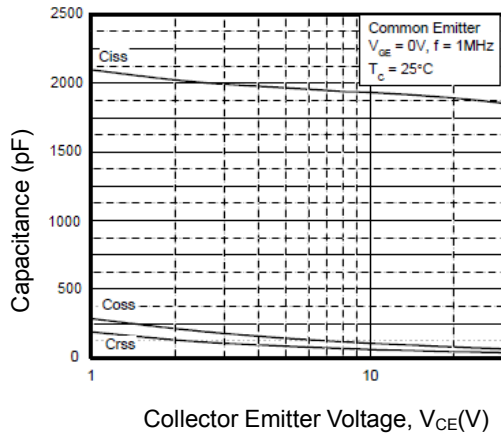


Figure 9. Turn-off Characteristics vs. Gate Resistance

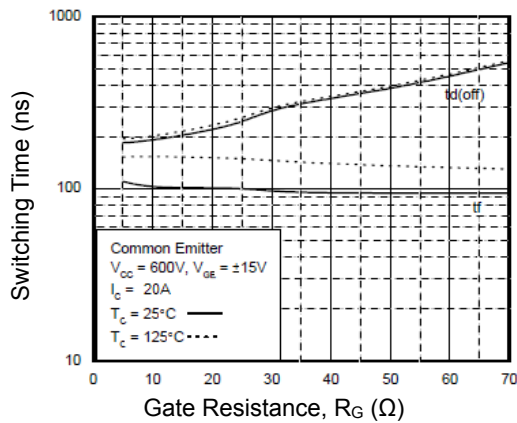


Figure 11. Turn-on Characteristics vs. Collector Current

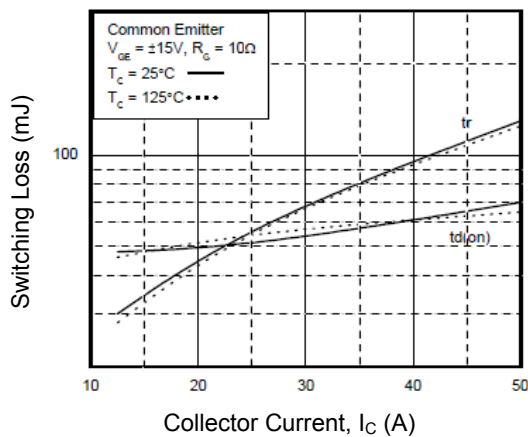


Figure 8. Turn-on Characteristics vs. Gate Resistance

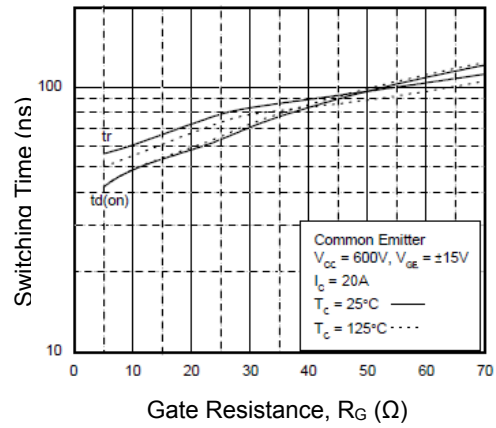


Figure 10. Switching Loss vs. Gate Resistance

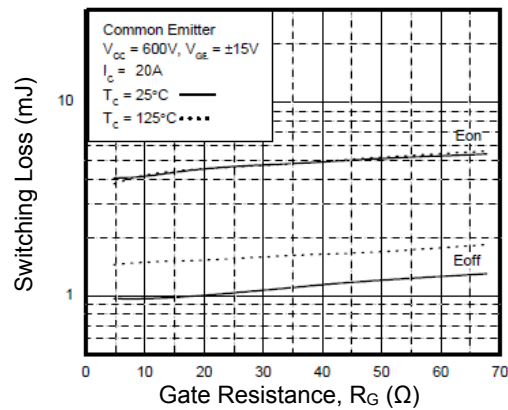
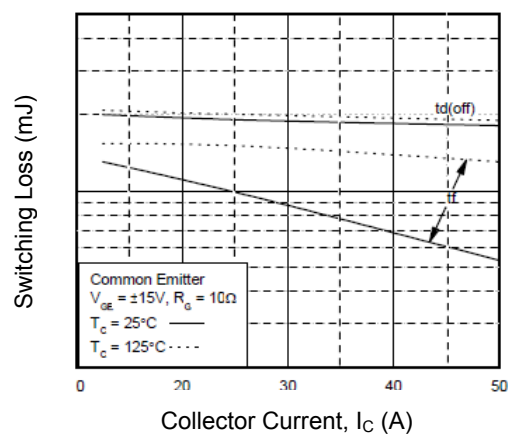


Figure 12. Turn-Off Characteristics vs. Collector Current



## Typical Performance Characteristics (Continued)

Figure 13. Switching Loss vs. Collector Current

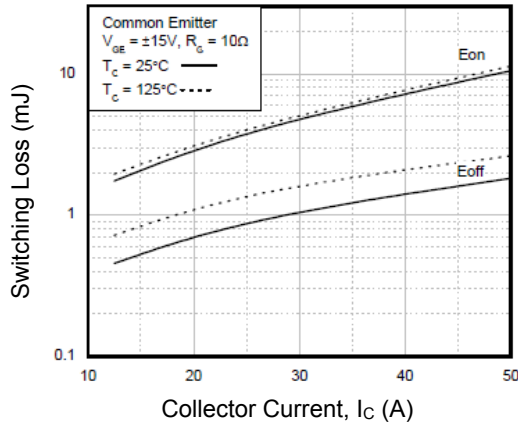


Figure 14. Gate Charge Characteristics

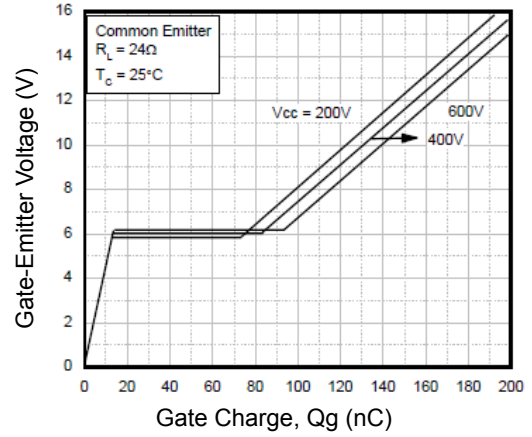


Figure 15. SOA Characteristics

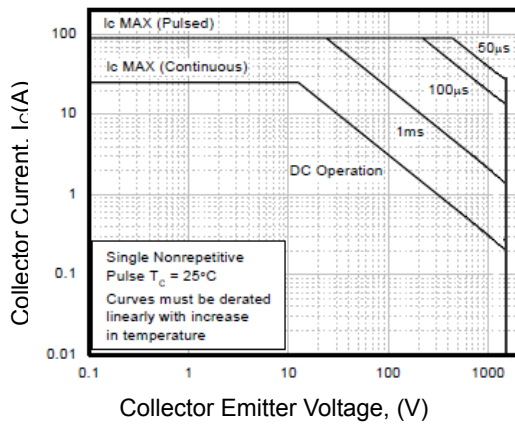


Figure 16. Turn-Off SOA

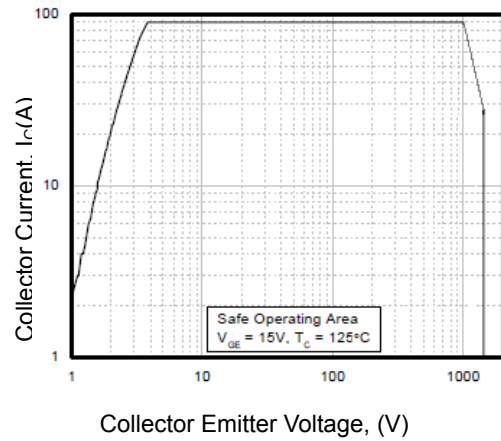
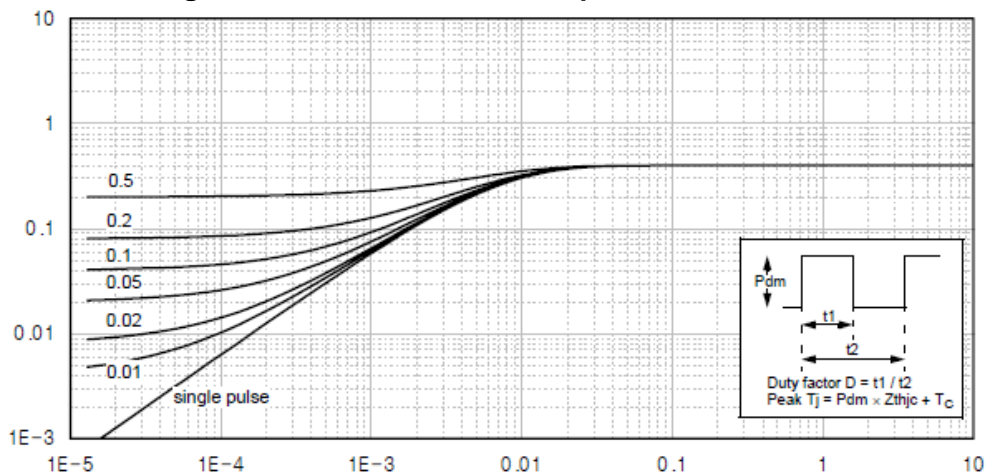
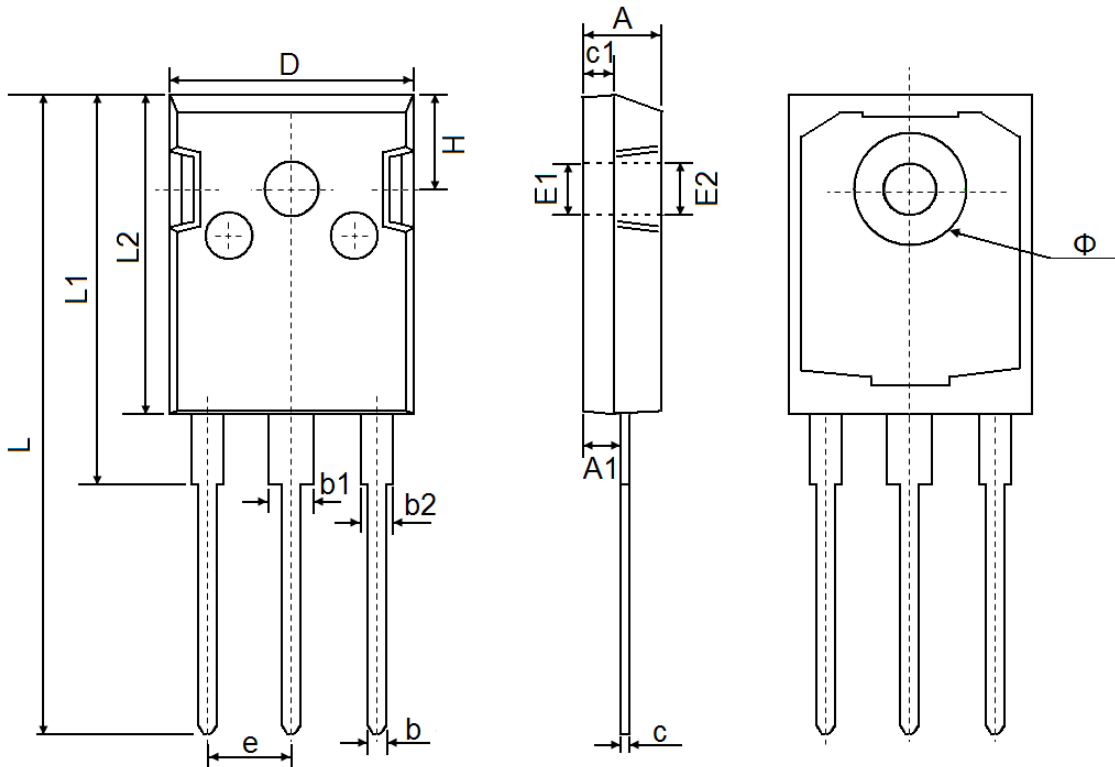


Figure 17. Transient Thermal Impedance of IGBT



## TO-247 Package Information



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 4.850                     | 5.150  | 0.191                | 0.200 |
| A1     | 2.200                     | 2.600  | 0.087                | 0.102 |
| b      | 1.000                     | 1.400  | 0.039                | 0.055 |
| b1     | 2.800                     | 3.200  | 0.110                | 0.126 |
| b2     | 1.800                     | 2.200  | 0.071                | 0.087 |
| c      | 0.500                     | 0.700  | 0.020                | 0.028 |
| c1     | 1.900                     | 2.100  | 0.075                | 0.083 |
| D      | 15.450                    | 15.750 | 0.608                | 0.620 |
| E1     | 3.500 REF                 |        | 0.138 REF            |       |
| E2     | 3.600 REF                 |        | 0.142 REF            |       |
| L      | 40.900                    | 41.300 | 1.610                | 1.626 |
| L1     | 24.800                    | 25.100 | 0.976                | 0.988 |
| L2     | 20.300                    | 20.600 | 0.799                | 0.811 |
| Φ      | 7.100                     | 7.300  | 0.280                | 0.287 |
| e      | 5.450 TYP                 |        | 0.215 TYP            |       |
| H      | 5.980 REF                 |        | 0.235 REF            |       |



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