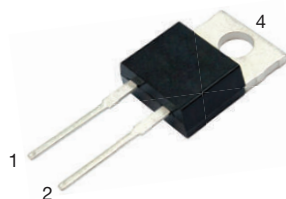
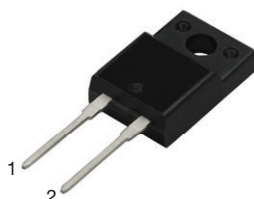
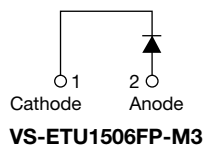
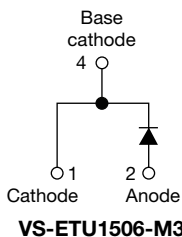


# Ultra Fast Rectifier, 15 A FRED Pt®


**TO-220AC 2L**

**TO-220 FullPAK 2L**


## FEATURES

- Low forward voltage drop
- Ultrafast soft recovery time
- 175 °C operating junction temperature
- Low leakage current
- Fully isolated package ( $V_{INS} = 2500 V_{RMS}$ )
- True 2 pin package
- Designed and qualified according to JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

## DESCRIPTION

State of the art, ultralow  $V_F$ , soft-switching ultrafast rectifiers optimized for Discontinuous (Critical) Mode (DCM) Power Factor Correction (PFC).

The minimized conduction loss, optimized stored charge and low recovery current minimized the switching losses and reduce over dissipation in the switching element and snubbers.

The device is also intended for use as a freewheeling diode in power supplies and other power switching applications.

## APPLICATIONS

AC/DC SMPS 70 W to 400 W

e.g. laptop and printer AC adaptors, desktop PC, TV and monitor, games units and DVD AC/DC power supplies.

## PRIMARY CHARACTERISTICS

| Package               | TO-220AC 2L, TO-220FullPAK 2L |
|-----------------------|-------------------------------|
| $I_{F(AV)}$           | 15 A                          |
| $V_R$                 | 600 V                         |
| $V_F$ at $I_F$        | 1.1 V                         |
| $t_{rr}$ (typ.)       | 24 ns                         |
| $T_J$ max.            | 175 °C                        |
| Circuit configuration | Single                        |

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL         | TEST CONDITIONS       | VALUES      | UNITS |
|---------------------------------------------|----------------|-----------------------|-------------|-------|
| Peak repetitive reverse voltage             | $V_{RRM}$      |                       | 600         | V     |
| Average rectified forward current in DC     | $I_{F(AV)}$    | $T_C = 151\text{ °C}$ | 15          | A     |
| FullPAK                                     |                | $T_C = 103\text{ °C}$ |             |       |
| Non-repetitive peak surge current           | $I_{FSM}$      | $T_J = 25\text{ °C}$  | 160         |       |
| Operating junction and storage temperatures | $T_J, T_{Stg}$ |                       | -65 to +175 | °C    |

## ELECTRICAL SPECIFICATIONS ( $T_J = 25\text{ °C}$ unless otherwise specified)

| PARAMETER                           | SYMBOL        | TEST CONDITIONS                              | MIN. | TYP. | MAX. | UNITS   |
|-------------------------------------|---------------|----------------------------------------------|------|------|------|---------|
| Breakdown voltage, blocking voltage | $V_{BR}, V_R$ | $I_R = 100\text{ }\mu A$                     | 600  | -    | -    | V       |
| Forward voltage                     | $V_F$         | $I_F = 15\text{ A}$                          | -    | 1.35 | 1.9  |         |
|                                     |               | $I_F = 15\text{ A}, T_J = 150\text{ °C}$     | -    | 1.1  | 1.3  |         |
| Reverse leakage current             | $I_R$         | $V_R = V_R$ rated                            | -    | 0.01 | 15   | $\mu A$ |
|                                     |               | $T_J = 150\text{ °C}, V_R = V_R$ rated       | -    | 20   | 200  |         |
| Junction capacitance                | $C_T$         | $V_R = 600\text{ V}$                         | -    | 12   | -    | pF      |
| Series inductance                   | $L_S$         | Measured lead to lead 5 mm from package body | -    | 8    | -    | nH      |

**DYNAMIC RECOVERY CHARACTERISTICS** ( $T_J = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

| PARAMETER               | SYMBOL    | TEST CONDITIONS                                                                     | MIN. | TYP. | MAX. | UNITS |
|-------------------------|-----------|-------------------------------------------------------------------------------------|------|------|------|-------|
| Reverse recovery time   | $t_{rr}$  | $I_F = 1\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$     | -    | 24   | 28   | ns    |
|                         |           | $I_F = 15\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$    | -    | 36   | 47   |       |
|                         |           | $T_J = 25\text{ }^{\circ}\text{C}$                                                  | -    | 40   | -    |       |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                                 | -    | 87   | -    |       |
| Peak recovery current   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                  | -    | 5    | -    | A     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                                 | -    | 9    | -    |       |
| Reverse recovery charge | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$                                                  | -    | 107  | -    | nC    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                                 | -    | 430  | -    |       |
| Reverse recovery time   | $t_{rr}$  | $I_F = 15\text{ A}$<br>$di_F/dt = 800\text{ A}/\mu\text{s}$<br>$V_R = 390\text{ V}$ | -    | 53   | -    | ns    |
| Peak recovery current   | $I_{RRM}$ |                                                                                     | -    | 25   | -    | A     |
| Reverse recovery charge | $Q_{rr}$  |                                                                                     | -    | 730  | -    | nC    |

**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                        | SYMBOL         | TEST CONDITIONS                            | MIN.      | TYP. | MAX.       | UNITS                       |
|--------------------------------------------------|----------------|--------------------------------------------|-----------|------|------------|-----------------------------|
| Maximum junction and storage temperature range   | $T_J, T_{Stg}$ |                                            | -65       | -    | 175        | $^{\circ}\text{C}$          |
| Thermal resistance, junction to case<br>FULL-PAK | $R_{thJC}$     |                                            | -         | 1.2  | 1.4        | $^{\circ}\text{C}/\text{W}$ |
|                                                  |                |                                            | -         | 3.7  | 4.3        |                             |
| Thermal resistance, junction to ambient          | $R_{thJA}$     | Typical socket mount                       | -         | -    | 70         |                             |
| Typical thermal resistance, case to heatsink     | $R_{thCS}$     | Mounting surface, flat, smooth and greased | -         | 0.5  | -          |                             |
| Weight                                           |                |                                            | -         | 2    | -          | g                           |
|                                                  |                |                                            | -         | 0.07 | -          | oz.                         |
| Mounting torque                                  |                |                                            | 6<br>(5)  | -    | 12<br>(10) | kgf · cm<br>(lbf · in)      |
| Marking device                                   |                | Case style TO-220AC 2L                     | ETU1506   |      |            |                             |
|                                                  |                | Case style TO-220 FullPAK 2L               | ETU1506FP |      |            |                             |

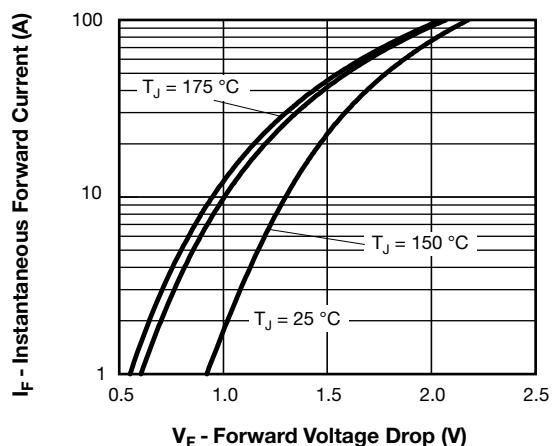


Fig. 1 - Typical Forward Voltage Drop Characteristics

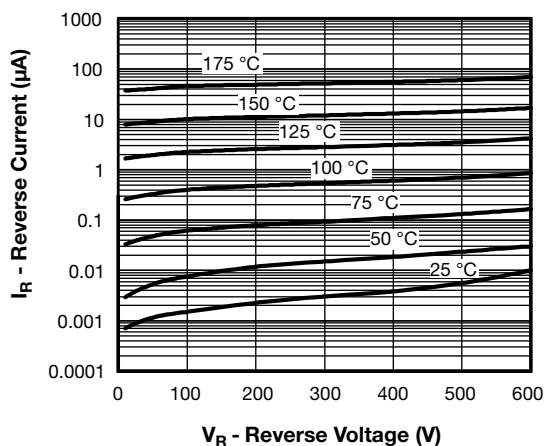


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

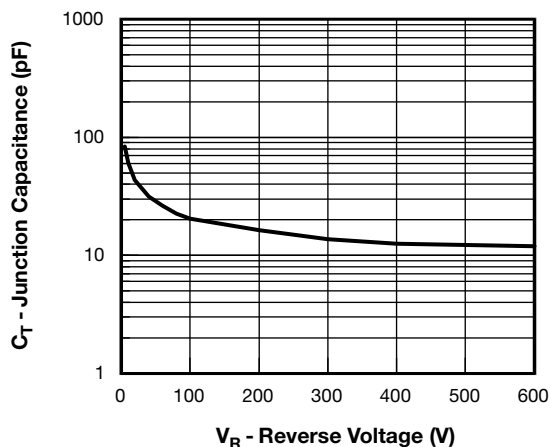
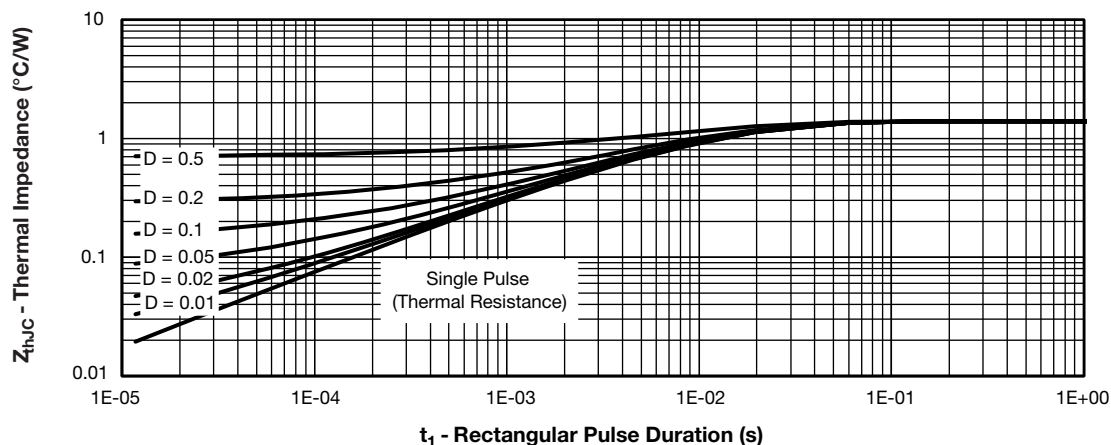


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

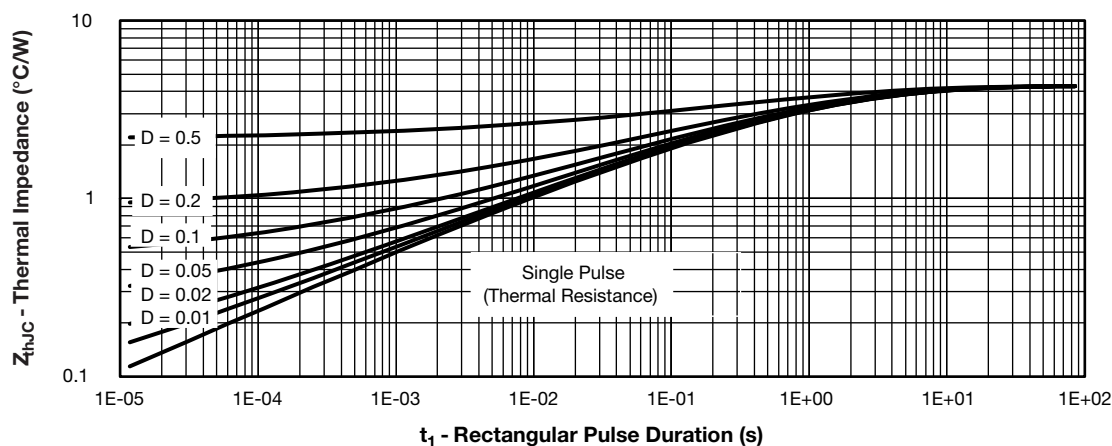
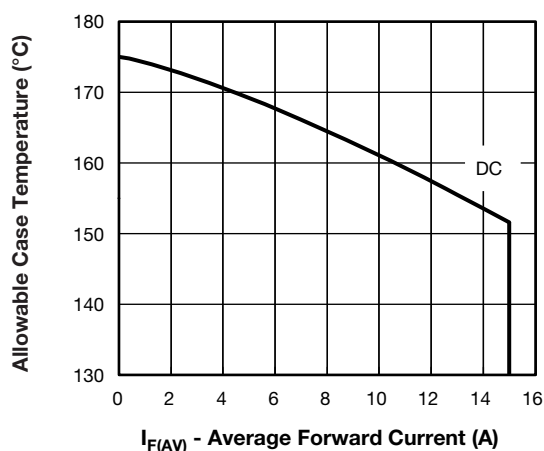

Fig. 5 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (FullPAK)


Fig. 6 - Maximum Allowable Case Temperature vs. Average Forward Current

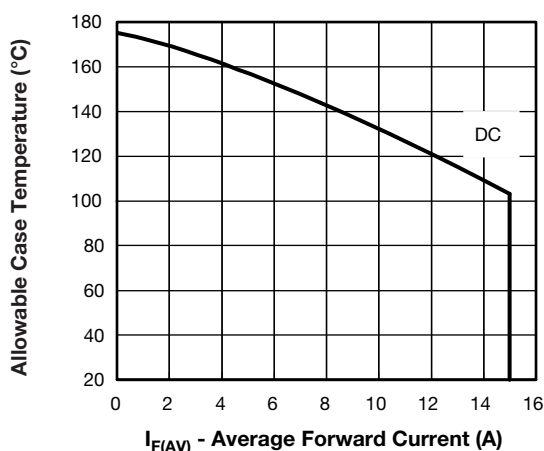


Fig. 7 - Maximum Allowable Case Temperature vs. Average Forward Current (FullPAK)

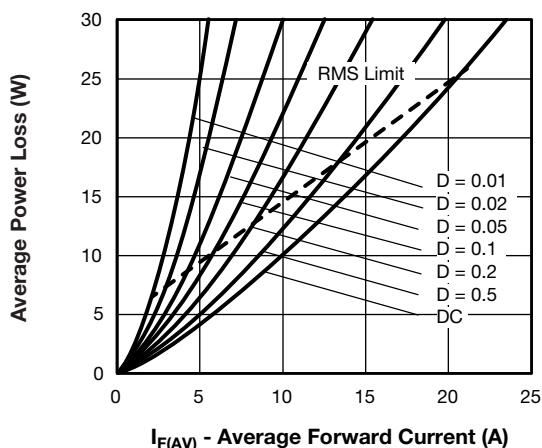


Fig. 8 - Forward Power Loss Characteristics

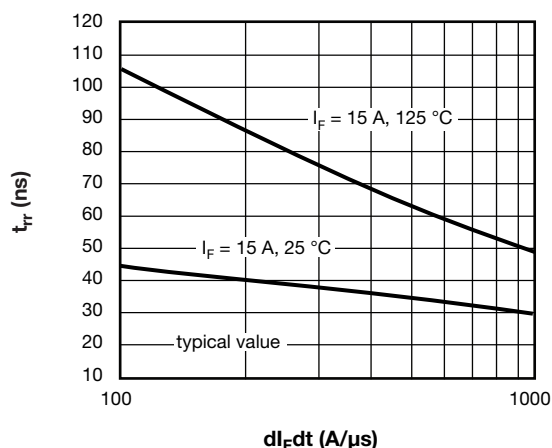
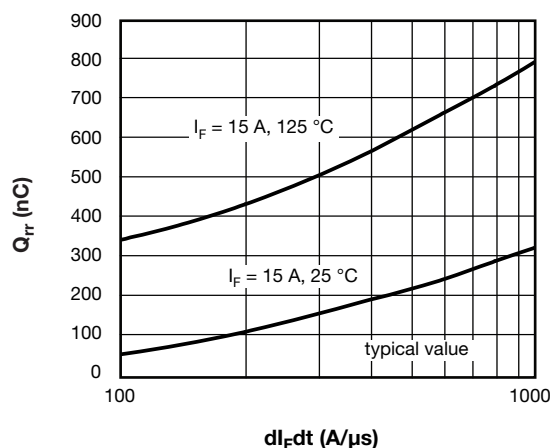
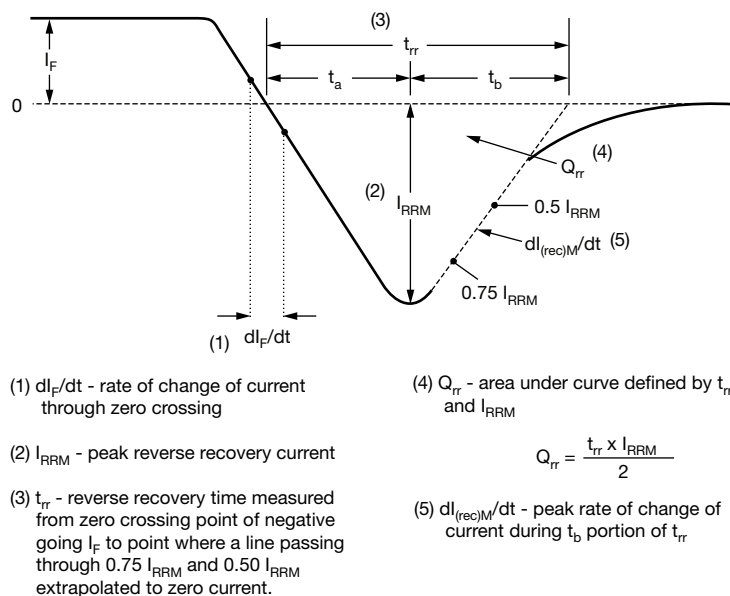

Fig. 9 - Typical Reverse Recovery vs.  $dI_F/dt$ 

Fig. 10 - Typical Stored Charge vs.  $dI_F/dt$ 


Fig. 11 - Reverse Recovery Waveform and Definitions

**ORDERING INFORMATION TABLE**

|             |                                                                                               |          |          |          |           |           |           |            |
|-------------|-----------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|------------|
| Device code | <b>VS-</b>                                                                                    | <b>E</b> | <b>T</b> | <b>U</b> | <b>15</b> | <b>06</b> | <b>FP</b> | <b>-M3</b> |
|             | ①                                                                                             | ②        | ③        | ④        | ⑤         | ⑥         | ⑦         | ⑧          |
| ①           | - Vishay Semiconductors product                                                               |          |          |          |           |           |           |            |
| ②           | - Circuit configuration:<br>E = single diode                                                  |          |          |          |           |           |           |            |
| ③           | - T = TO-220                                                                                  |          |          |          |           |           |           |            |
| ④           | - U = hyperfast recovery time                                                                 |          |          |          |           |           |           |            |
| ⑤           | - Current code: 15 = 15 A                                                                     |          |          |          |           |           |           |            |
| ⑥           | - Voltage code: 06 = 600 V                                                                    |          |          |          |           |           |           |            |
| ⑦           | - • None = TO-220<br>• FP = FullPAK                                                           |          |          |          |           |           |           |            |
| ⑧           | - Environmental digit:<br>-M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free |          |          |          |           |           |           |            |

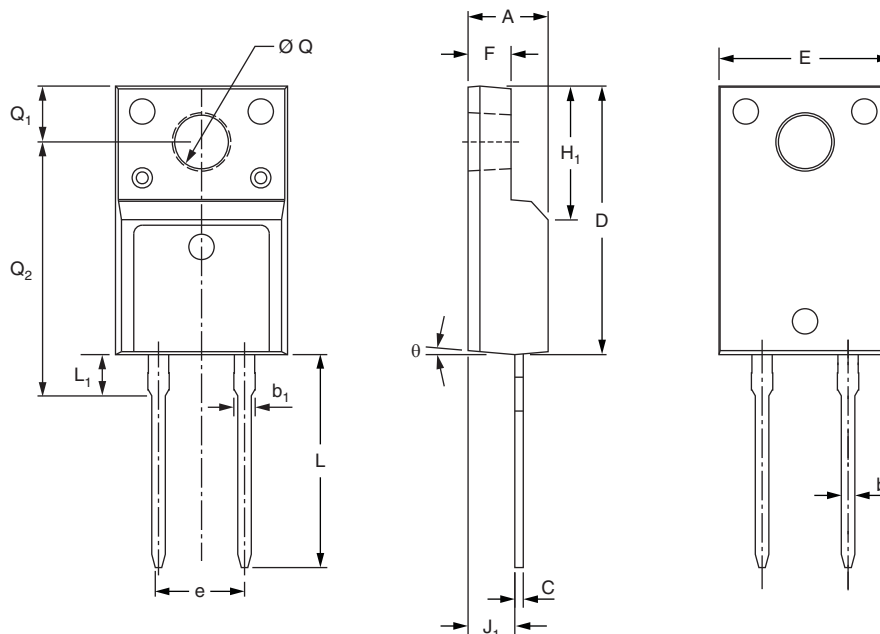
| <b>ORDERING INFORMATION</b> (Example) |                   |                        |                         |
|---------------------------------------|-------------------|------------------------|-------------------------|
| PREFERRED P/N                         | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
| VS-ETU1506-M3                         | 50                | 1000                   | Antistatic plastic tube |
| VS-ETU1506FP-M3                       | 50                | 1000                   | Antistatic plastic tube |

| <b>LINKS TO RELATED DOCUMENTS</b> |                   |                                                                        |
|-----------------------------------|-------------------|------------------------------------------------------------------------|
| Dimensions                        | TO-220AC 2L       | <a href="http://www.vishay.com/doc?95259">www.vishay.com/doc?95259</a> |
|                                   | TO-220 FullPAK 2L | <a href="http://www.vishay.com/doc?95260">www.vishay.com/doc?95260</a> |
| Part marking information          | TO-220AC 2L       | <a href="http://www.vishay.com/doc?95391">www.vishay.com/doc?95391</a> |
|                                   | TO-220 FullPAK 2L | <a href="http://www.vishay.com/doc?95392">www.vishay.com/doc?95392</a> |
| SPICE model                       | TO-220AC 2L       | <a href="http://www.vishay.com/doc?96130">www.vishay.com/doc?96130</a> |
|                                   | TO-220 FullPAK 2L | <a href="http://www.vishay.com/doc?96131">www.vishay.com/doc?96131</a> |



## True 2 Pin TO-220 FULL-PAK

**DIMENSIONS** in millimeters and inches



| SYMBOL         | MILLIMETERS  |       | INCHES        |       |
|----------------|--------------|-------|---------------|-------|
|                | MIN.         | MAX.  | MIN.          | MAX.  |
| A              | 4.53         | 4.93  | 0.178         | 0.194 |
| b              | 0.71         | 0.91  | 0.028         | 0.036 |
| b <sub>1</sub> | 1.15         | 1.39  | 0.045         | 0.055 |
| C              | 0.36         | 0.53  | 0.014         | 0.021 |
| D              | 15.67        | 16.07 | 0.617         | 0.633 |
| E              | 9.96         | 10.36 | 0.392         | 0.408 |
| e              | 5.08 typical |       | 0.200 typical |       |
| F              | 2.34         | 2.74  | 0.092         | 0.107 |
| H <sub>1</sub> | 6.50         | 6.90  | 0.256         | 0.272 |
| J <sub>1</sub> | 2.56         | 2.96  | 0.101         | 0.117 |
| L              | 12.78        | 13.18 | 0.503         | 0.519 |
| L <sub>1</sub> | 2.23         | 2.63  | 0.088         | 0.104 |
| Ø Q            | 2.98         | 3.38  | 0.117         | 0.133 |
| Q <sub>1</sub> | 3.10         | 3.50  | 0.122         | 0.138 |
| Q <sub>2</sub> | 14.80        | 15.20 | 0.583         | 0.598 |
| θ              | 0°           | 5°    | 0°            | 5°    |



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