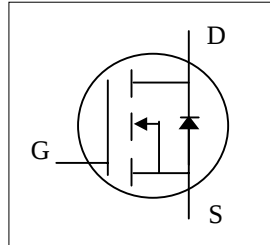
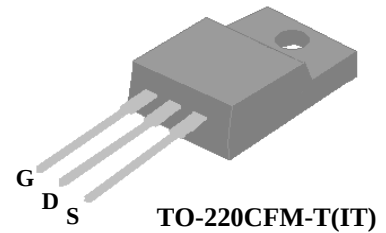


- ▼ 100%  $R_g$  & UIS Test
- ▼ Low  $t_{rr}$  /  $Q_{rr}$
- ▼ Simple Drive Requirement
- ▼ RoHS Compliant & Halogen-Free



|              |               |
|--------------|---------------|
| $BV_{DSS}$   | 600V          |
| $R_{DS(ON)}$ | 0.29 $\Omega$ |
| $I_D^{3,6}$  | 13.3A         |



## Description

XP60SA290D series are innovated design and silicon process technology to achieve the lowest possible on-resistance and fast switching performance. It provides the designer with an extreme efficient device for use in a wide range of power applications.

The TO-220CFM package is widely preferred for all commercial-industrial through hole applications. The mold compound provides a high isolation voltage capability and low thermal resistance between the tab and the external heat-sink.

## Absolute Maximum Ratings@ $T_j=25^\circ\text{C}$ (unless otherwise specified)

| Symbol                      | Parameter                                             | Rating     | Units            |
|-----------------------------|-------------------------------------------------------|------------|------------------|
| $V_{DS}$                    | Drain-Source Voltage                                  | 600        | V                |
| $V_{GS}$                    | Gate-Source Voltage                                   | $\pm 20$   | V                |
| $V_{GS}$                    | Gate-Source Voltage, AC ( $f > 1\text{Hz}$ )          | $\pm 30$   | V                |
| $I_D@T_C=25^\circ\text{C}$  | Drain Current, $V_{GS}$ @ $10V^{3,6}$                 | 13.3       | A                |
| $I_D@T_C=100^\circ\text{C}$ | Drain Current, $V_{GS}$ @ $10V^{3,6}$                 | 8.4        | A                |
| $I_{DM}$                    | Pulsed Drain Current <sup>1</sup>                     | 28         | A                |
| $dv/dt$                     | MOSFET $dv/dt$ Ruggedness ( $V_{DS} = 0 \dots 480V$ ) | 40         | V/ns             |
| $P_D@T_C=25^\circ\text{C}$  | Total Power Dissipation                               | 31.2       | W                |
| $P_D@T_A=25^\circ\text{C}$  | Total Power Dissipation                               | 1.92       | W                |
| $E_{AS}$                    | Single Pulse Avalanche Energy <sup>4</sup>            | 98         | mJ               |
| $dv/dt$                     | Peak Diode Recovery $dv/dt^5$                         | 15         | V/ns             |
| $T_{STG}$                   | Storage Temperature Range                             | -55 to 150 | $^\circ\text{C}$ |
| $T_J$                       | Operating Junction Temperature Range                  | -55 to 150 | $^\circ\text{C}$ |

## Thermal Data

| Symbol      | Parameter                                    | Value | Units                     |
|-------------|----------------------------------------------|-------|---------------------------|
| $R_{thj-c}$ | Maximum Thermal Resistance, Junction-case    | 4     | $^\circ\text{C}/\text{W}$ |
| $R_{thj-a}$ | Maximum Thermal Resistance, Junction-ambient | 65    | $^\circ\text{C}/\text{W}$ |

**Electrical Characteristics@T<sub>j</sub>=25°C(unless otherwise specified)**

| Symbol              | Parameter                                      | Test Conditions                                          | Min. | Typ. | Max. | Units |
|---------------------|------------------------------------------------|----------------------------------------------------------|------|------|------|-------|
| BV <sub>DSS</sub>   | Drain-Source Breakdown Voltage                 | V <sub>GS</sub> =0V, I <sub>D</sub> =250uA               | 600  | -    | -    | V     |
| R <sub>DS(ON)</sub> | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =10V, I <sub>D</sub> =5.8A               | -    | -    | 0.29 | Ω     |
| V <sub>GS(th)</sub> | Gate Threshold Voltage                         | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250uA | 2    | -    | 4    | V     |
| g <sub>fs</sub>     | Forward Transconductance                       | V <sub>DS</sub> =10V, I <sub>D</sub> =5.8A               | -    | 6.7  | -    | S     |
| I <sub>DSS</sub>    | Drain-Source Leakage Current                   | V <sub>DS</sub> =480V, V <sub>GS</sub> =0V               | -    | -    | 100  | uA    |
| I <sub>GSS</sub>    | Gate-Source Leakage                            | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V               | -    | -    | ±1   | uA    |
| Q <sub>g</sub>      | Total Gate Charge                              | I <sub>D</sub> =5A                                       | -    | 30   | 48   | nC    |
| Q <sub>gs</sub>     | Gate-Source Charge                             | V <sub>DS</sub> =480V                                    | -    | 7    | -    | nC    |
| Q <sub>gd</sub>     | Gate-Drain ("Miller") Charge                   | V <sub>GS</sub> =10V                                     | -    | 14   | -    | nC    |
| t <sub>d(on)</sub>  | Turn-on Delay Time                             | V <sub>DD</sub> =300V                                    | -    | 13   | -    | ns    |
| t <sub>r</sub>      | Rise Time                                      | I <sub>D</sub> =5A                                       | -    | 13   | -    | ns    |
| t <sub>d(off)</sub> | Turn-off Delay Time                            | R <sub>G</sub> =3.3Ω                                     | -    | 33   | -    | ns    |
| t <sub>f</sub>      | Fall Time                                      | V <sub>GS</sub> =10V                                     | -    | 8    | -    | ns    |
| C <sub>iss</sub>    | Input Capacitance                              | V <sub>GS</sub> =0V                                      | -    | 1020 | 1632 | pF    |
| C <sub>oss</sub>    | Output Capacitance                             | V <sub>DS</sub> =100V                                    | -    | 44   | -    | pF    |
| C <sub>rss</sub>    | Reverse Transfer Capacitance                   | f=1.0MHz                                                 | -    | 5    | -    | pF    |
| R <sub>g</sub>      | Gate Resistance                                | f=1.0MHz                                                 | -    | 3.3  | 6.6  | Ω     |

**Source-Drain Diode**

| Symbol          | Parameter                       | Test Conditions                           | Min. | Typ. | Max. | Units |
|-----------------|---------------------------------|-------------------------------------------|------|------|------|-------|
| V <sub>SD</sub> | Forward On Voltage <sup>2</sup> | I <sub>S</sub> =5.8A, V <sub>GS</sub> =0V | -    | 0.8  | -    | V     |
| t <sub>rr</sub> | Reverse Recovery Time           | I <sub>S</sub> =6.6A, V <sub>GS</sub> =0V | -    | 125  | -    | ns    |
| Q <sub>rr</sub> | Reverse Recovery Charge         | di/dt=100A/μs                             | -    | 770  | -    | nC    |

**Notes:**

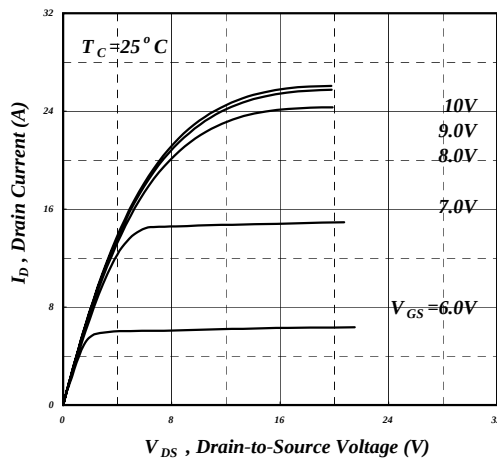
- 1.Pulse width limited by max. junction temperature.
- 2.Pulse test
- 3.Ensure that the junction temperature does not exceed T<sub>Jmax</sub>.
- 4.Starting T<sub>j</sub>=25°C , V<sub>DD</sub>=90V , L=100mH , R<sub>G</sub>=25Ω , V<sub>GS</sub>=10V
- 5.I<sub>SD</sub> ≤ I<sub>D</sub>, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, starting T<sub>J</sub> = 25°C
- 6.Limited by max. junction temperature. Maximum duty cycle D=0.75

THIS PRODUCT IS SENSITIVE TO ELECTROSTATIC DISCHARGE, PLEASE HANDLE WITH CAUTION.

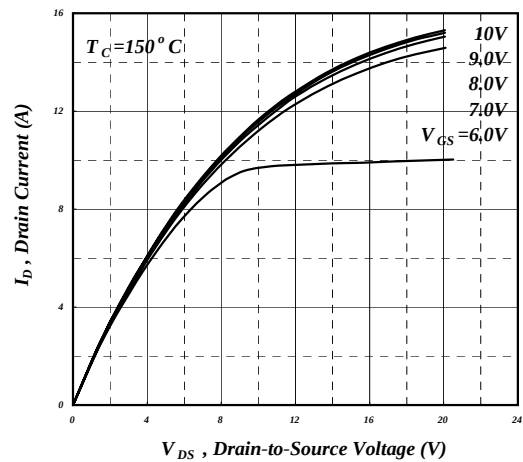
USE OF THIS PRODUCT AS A CRITICAL COMPONENT IN LIFE SUPPORT, AUTOMOTIVE OR OTHER SIMILAR SYSTEMS IS NOT AUTHORIZED.

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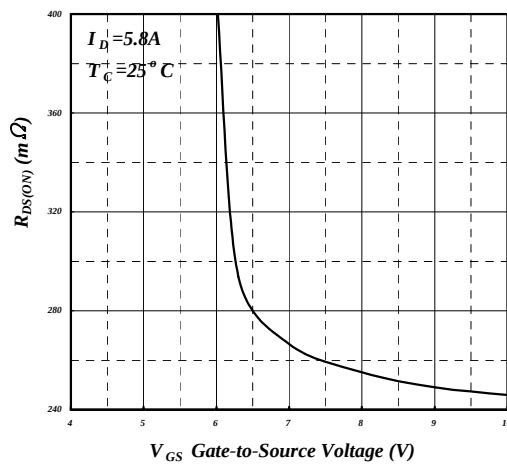
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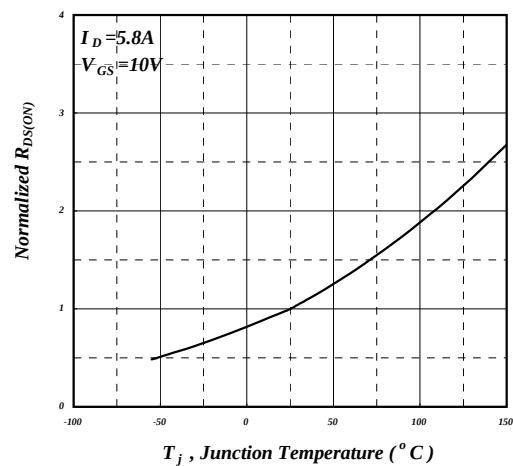
**Fig 1. Typical Output Characteristics**



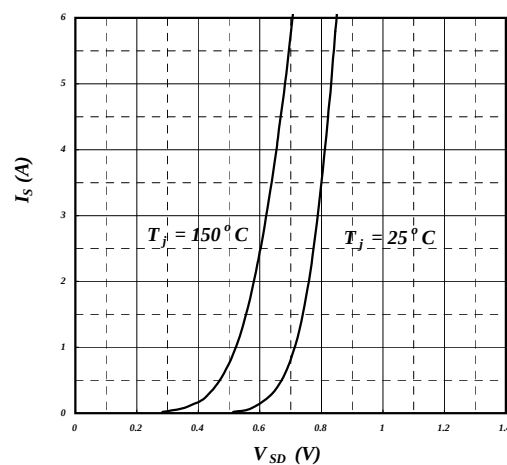
**Fig 2. Typical Output Characteristics**



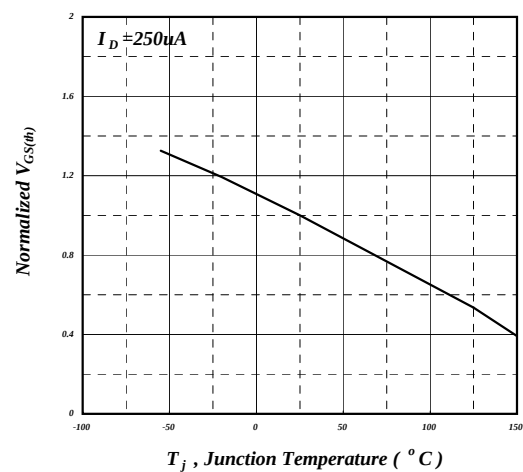
**Fig 3. On-Resistance v.s. Gate Voltage**



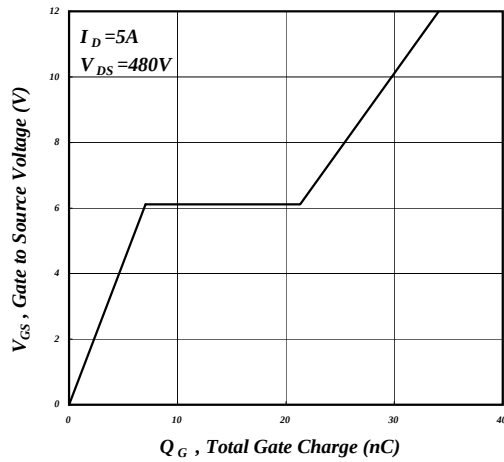
**Fig 4. Normalized On-Resistance  
v.s. Junction Temperature**



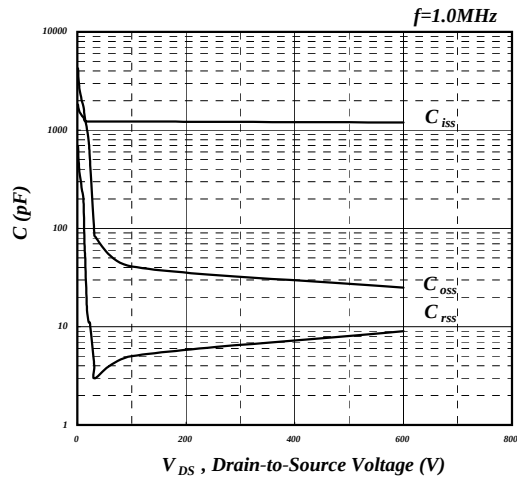
**Fig 5. Forward Characteristic of  
Reverse Diode**



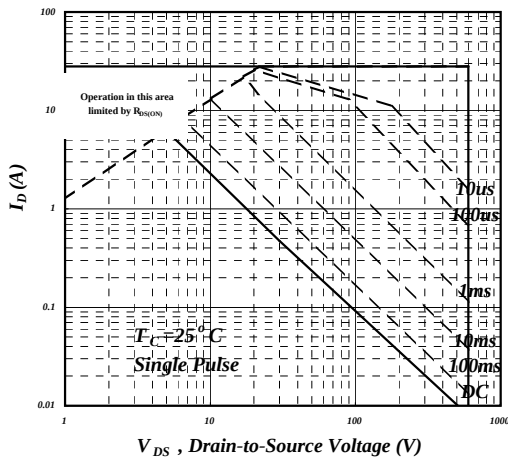
**Fig 6. Gate Threshold Voltage v.s.  
Junction Temperature**



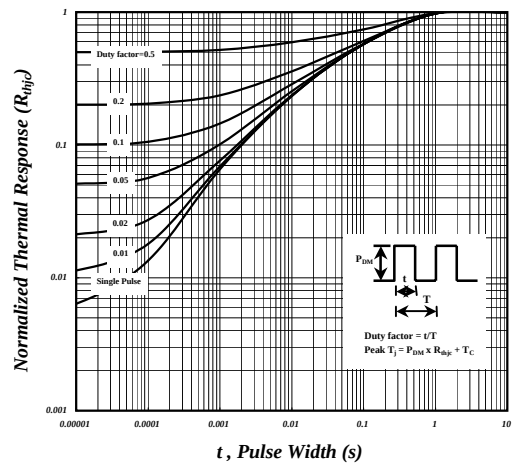
**Fig 7. Gate Charge Characteristics**



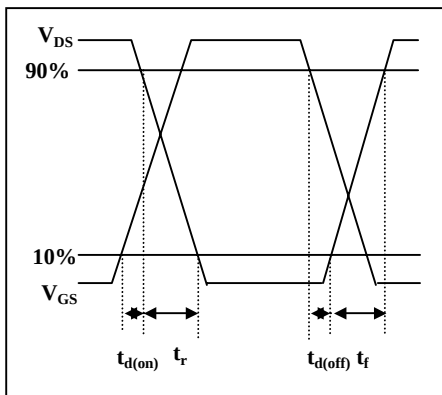
**Fig 8. Typical Capacitance Characteristics**



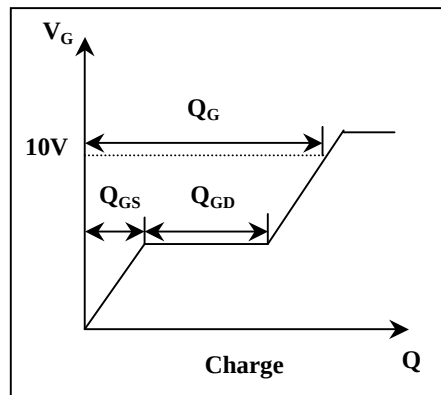
**Fig 9. Maximum Safe Operating Area**



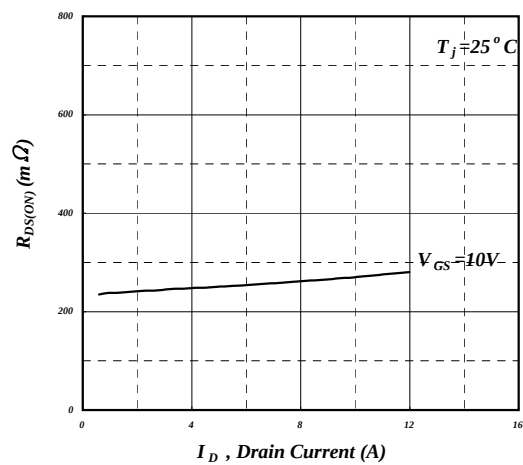
**Fig10. Effective Transient Thermal Impedance**



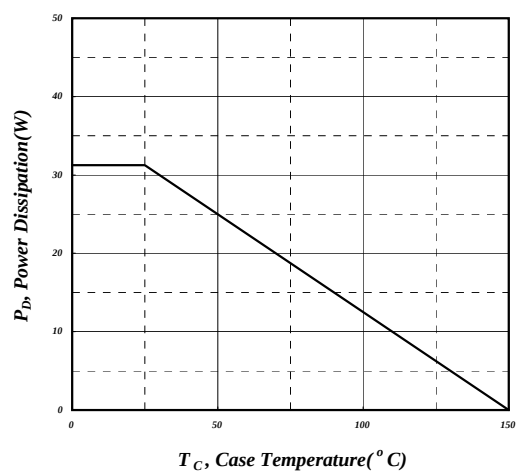
**Fig 11. Switching Time Waveform**



**Fig 12. Gate Charge Waveform**

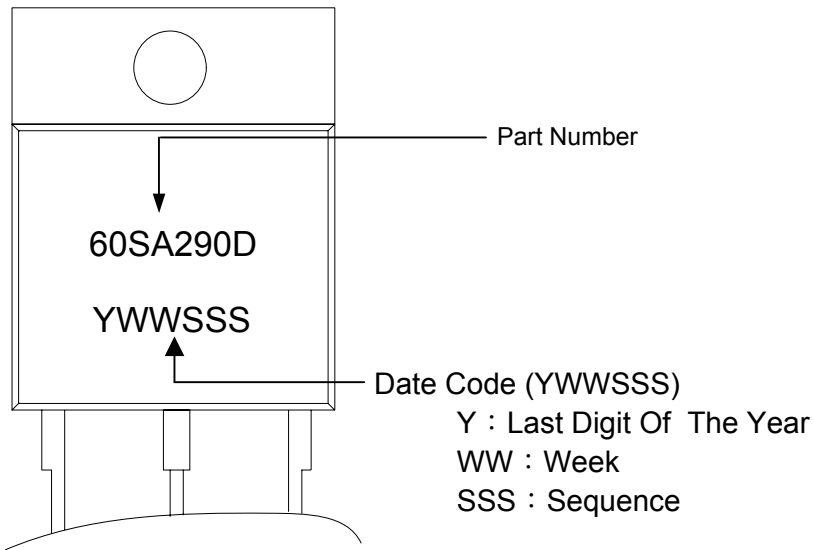


**Fig 13. Typ. Drain-Source on State Resistance**

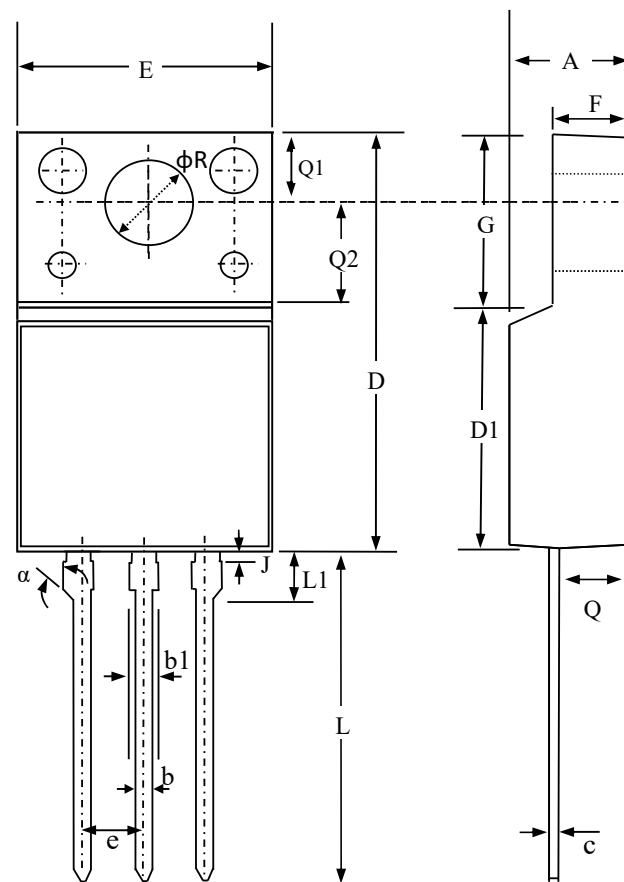


**Fig 14. Total Power Dissipation**

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**MARKING INFORMATION**

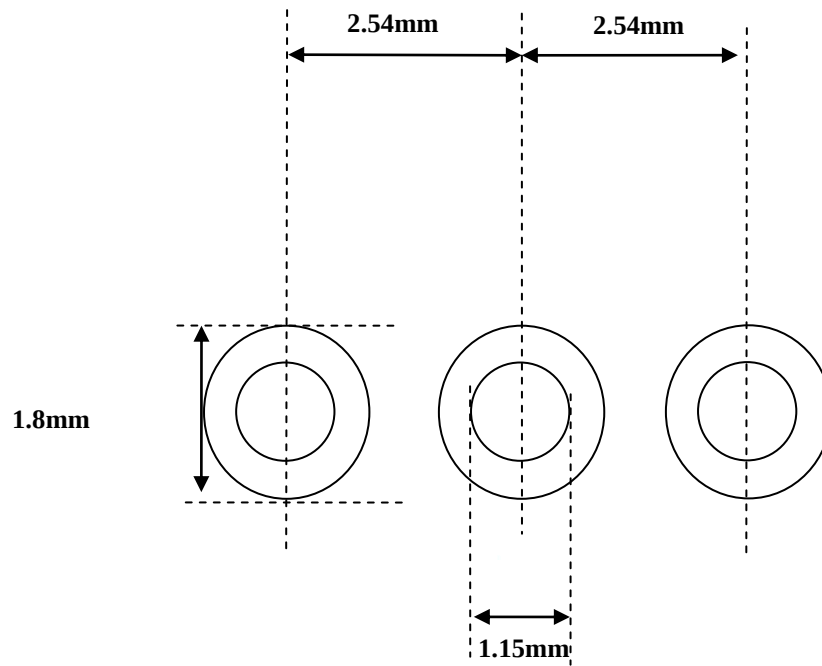
## Package Outline : TO-220CFM-T



| SYMBOLS   | Millimeters |       |       |
|-----------|-------------|-------|-------|
|           | MIN         | NOM   | MAX   |
| <b>A</b>  | 4.30        | 4.50  | 4.70  |
| <b>b</b>  | 0.54        | 0.69  | 0.84  |
| <b>b1</b> | 0.99        | 1.14  | 1.29  |
| <b>c</b>  | 0.45        | 0.62  | 0.79  |
| <b>D</b>  | 14.70       | 15.00 | 15.30 |
| <b>D1</b> | 8.5 Ref.    |       |       |
| <b>e</b>  | 2.54 Ref.   |       |       |
| <b>E</b>  | 9.70        | 10.00 | 10.30 |
| <b>F</b>  | 2.50        | 2.70  | 2.90  |
| <b>G</b>  | 6.30        | 6.70  | 7.10  |
| <b>L</b>  | 12.50       | 13.00 | 13.50 |
| <b>L1</b> | 1.80        | 2.30  | 2.80  |
| <b>J</b>  | 0.10        | 0.20  | --    |
| <b>Q</b>  | 2.50        | 2.60  | 2.90  |
| <b>Q1</b> | 2.90        | 3.10  | 3.30  |
| <b>Q2</b> | 3.5 Ref.    |       |       |
| <b>φR</b> | 3.00        | 3.20  | 3.40  |
| <b>α</b>  | 45° Ref.    |       |       |

- 1.All dimension are in millimeters.
- 2.Dimension does not include burrs and mold flash/protrusions.
- 3.The outline schematic is not to scale and slightly different from the actual product appearance.

**TO-220CFM-T FOOTPRINT :**



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