

## Descriptions

This is 500V 13A N-Channel Enhancement Mode Power MOSFET in a TO-220/TO-220F package

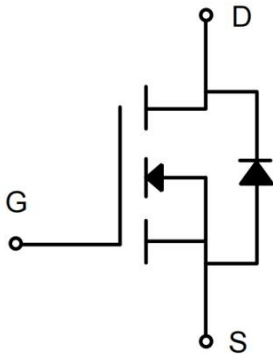
## Features

- Typ.RDS(on)=0.35Ω@VGS=10V
- 100% avalanche tested
- RoHS Compliant

## Applications

- SMPS
- Charger
- DC-DC

## Equivalent Circuit



## Pinning

**TO-220**



**TO-220F**



## Absolute Maximum Ratings (TC=25°C)

| Parameter                                   | Symbol       | CT13N50RA | CT13N50FA | Unit |
|---------------------------------------------|--------------|-----------|-----------|------|
| Drain-source voltage                        | $V_{DS}$     | 500       |           | V    |
| Gate-source voltage                         | $V_{GS}$     | $\pm 30$  |           | V    |
| Continuous drain current                    | $I_D$        | 13        |           | A    |
| Pulsed drain current <sup>1</sup>           | $I_{DM}$     | 52        |           | A    |
| Avalanche energy, single pulse <sup>2</sup> | $E_{AS}$     | 720       |           | mJ   |
| Power dissipation                           | $P_D$        | 150       | 41        | W    |
| Derate above 25°C                           |              | 1.2       | 0.33      | W/°C |
| Operating junction temperature              | $T_J$        | -55~150   |           | °C   |
| Storage temperature                         | $T_{stg}$    | -55~150   |           | °C   |
| Continuous diode forward current            | $I_S$        | 13        |           | A    |
| Diode pulse current <sup>1</sup>            | $I_{Spulse}$ | 52        |           | A    |

## Thermal Characteristic

| Parameter                             | Symbol          | CT13N50RA | CT13N50FA | Unit |
|---------------------------------------|-----------------|-----------|-----------|------|
| Thermal resistance,junction-to-case   | $R_{\theta JC}$ | 0.83      | 3         | °C/W |
| Thermalresistance,junction-to-ambient | $R_{\theta JA}$ | 62.5      | 62.5      | °C/W |

## Electrical Characteristics

| Parameter                           | Symbol  | Test Condition    | Test Condition | Min | Typ  | Max  | Unit |
|-------------------------------------|---------|-------------------|----------------|-----|------|------|------|
| Drain-source break down voltage     | BVDSS   | ID=250μA, VGS=0V  | TC=25°C        | 500 | -    | -    | V    |
| Gate threshold voltage              | VGS(th) | ID=250μA, VDS=VGS | TJ=25°C        | 2.0 | -    | 4.0  | V    |
| Drain-source leakage current        | DSS     | VDS=500V, VGS=0V  | TJ=25°C        | -   | -    | 1    | μA   |
| Gate-source leakage current,forward |         | VDS=400V, VGS=0V  | TJ=125°C       | -   | -    | 100  | μA   |
| Gate-source leakage current,forward | IGSSF   | VDS=0V, VGS=30V   | TJ=25°C        | -   | -    | 100  | nA   |
| Gate-source leakage current,reverse | IGSSR   | VDS=0V, VGS=-30V  | TJ=25°C        | -   | -    | -100 | nA   |
| Drain-source on-state resistance    | RDS(ON) | VGS=10V, ID=6.5A  | TJ=25°C        | -   | 0.35 | 0.48 | Ω    |

## Dynamic Characteristics of MOSFET (TC=25°C)

| Parameter                         | Symbol | Test Condition          | Min | Typ  | Max | Unit |
|-----------------------------------|--------|-------------------------|-----|------|-----|------|
| Input capacitance                 | Ciss   | f=1MHz, VDS=25V, VGS=0V | -   | 1978 | -   | pF   |
| Output capacitance                | Coss   |                         | -   | 185  | -   | pF   |
| Reverse transfer capacitance      | Crss   | VDD=120V                | -   | 9    | -   | pF   |
| Gate to source charge             | Qgs    | ID=13A                  | -   | 10   | -   | nC   |
| Gate to drain charge <sup>3</sup> | Qgd    | VGS= 0 to10V            | -   | 9    | -   | nC   |
| Total gate charge <sup>3</sup>    | Qg     |                         | -   | 34   | -   | nC   |

## Switching Characteristics of MOSFET (TC=25°C)

| Parameter           | Symbol | Test Condition                            | Min | Typ | Max | Unit |
|---------------------|--------|-------------------------------------------|-----|-----|-----|------|
| Turn-on delay time  | td on  | VDS=250V, ID=13A,<br>RG=10Ω, VGS=0 to 10V | -   | 14  | -   | ns   |
| Rise time           | tr     |                                           | -   | 11  | -   | ns   |
| Turn-off delay time | td off |                                           | -   | 39  | -   | ns   |
| Fall time           | tf     |                                           | -   | 18  | -   | ns   |

## Characteristics of Body Diode (TC=25°C)

| Parameter                | Symbol | Test Condition                             | Min | Typ | Max | Unit |
|--------------------------|--------|--------------------------------------------|-----|-----|-----|------|
| Forward voltage          | VSD    | ISD=13A, VGS=0V                            | -   | -   | 1.5 | V    |
| Reverse recovery time    | trr    | VDS=250V, IS=13A, VGS=0V<br>-di/dt=100A/μs | -   | 274 | -   | ns   |
| Reverse recovery current | Irr    |                                            | -   | 18  | -   | A    |
| Recovery charge          | Qrr    |                                            | -   | 2.5 | -   | μC   |

Notes:

1. Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)} = 150^{\circ}\text{C}$ .
2. The  $E_{AS}$  data shows Max. rating . The test condition is  $V_{DD} = 50\text{V}$ ,  $V_{GS} = 10\text{V}$ ,  $L = 10\text{mH}$ ,  $I_{AS} = 12\text{A}$ ,  $T_c = 25^{\circ}\text{C}$ .
3. The data tested by pulsed , pulse width  $\leq 300\mu\text{s}$  , duty cycle  $\leq 2\%$ .

## Electrical Characteristic Curve

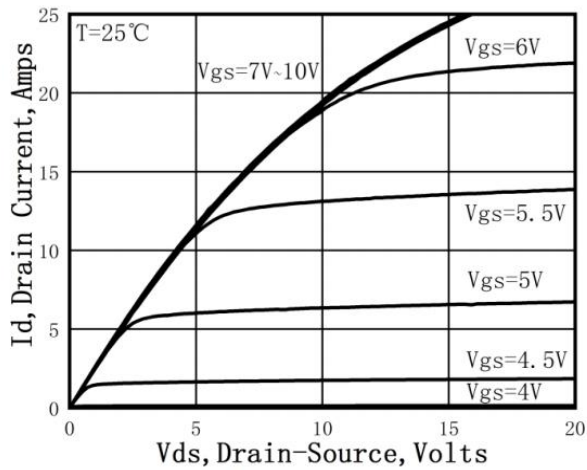


Figure 1. On-Region Characteristics

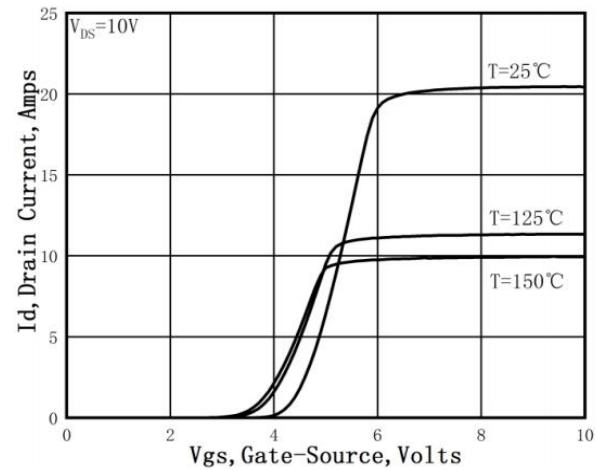


Figure 2. Transfer Characteristics

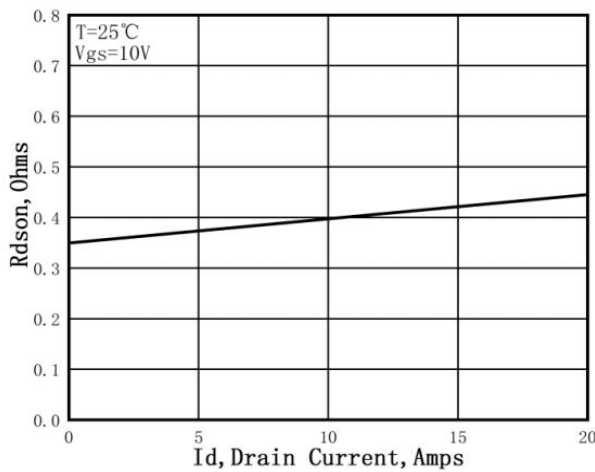


Figure 3. Static Drain-Source On Resistance

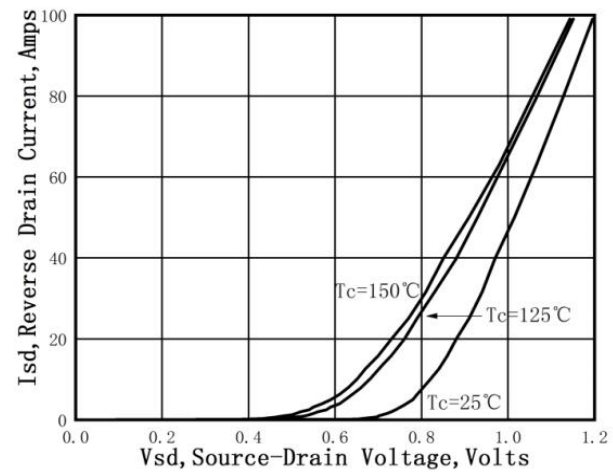
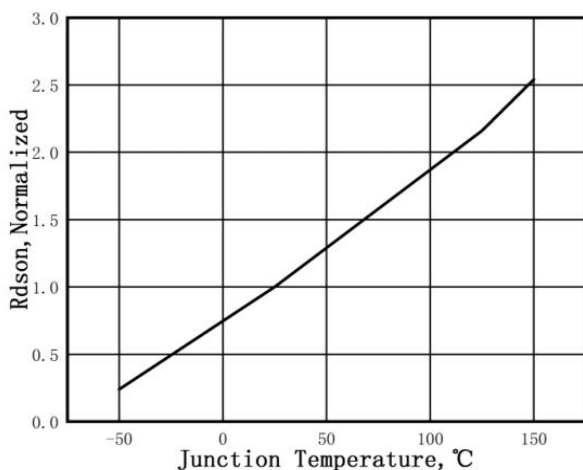
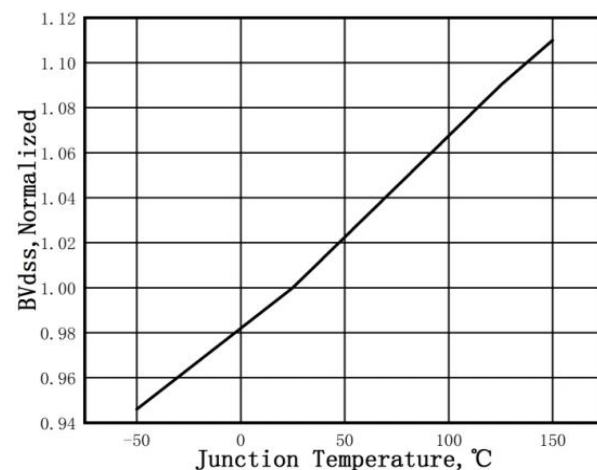


Figure 4. Typical Body Diode Transfer Characteristics

Figure 5. Normalized  $R_{DS(on)}$  vs. TemperatureFigure 6. Normalized  $BV_{DSS}$  vs. Temperature

## Electrical Characteristic Curve

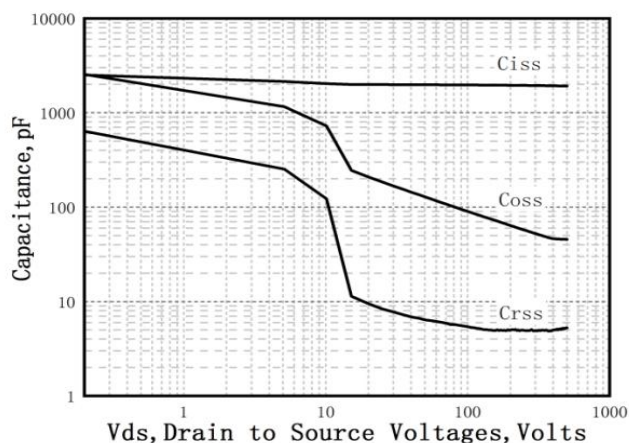


Figure 7. Capacitance Characteristics

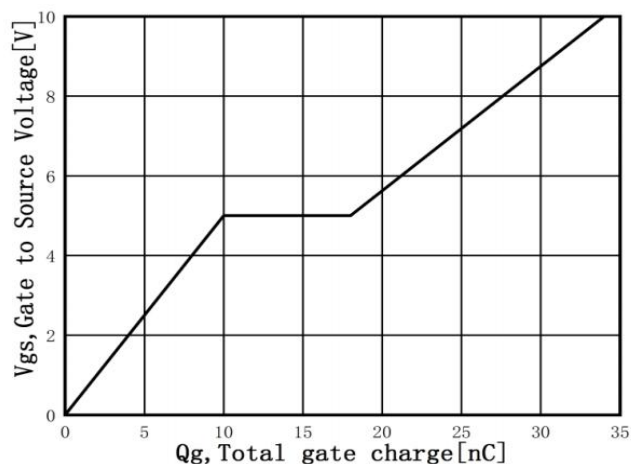


Figure 8. Gate Charge Characteristics

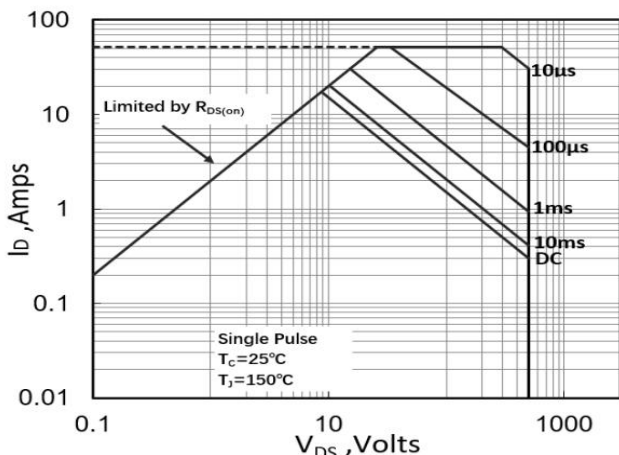


Figure 9. Maximum Safe Operating Area (TO-220)

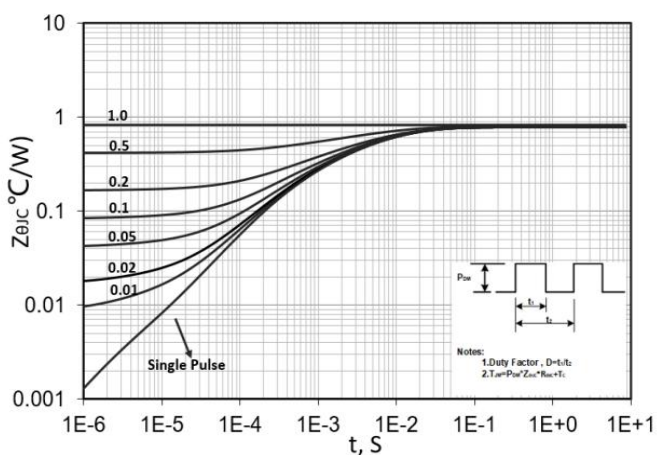


Figure 10. Transient Thermal Response Curve (TO-220)

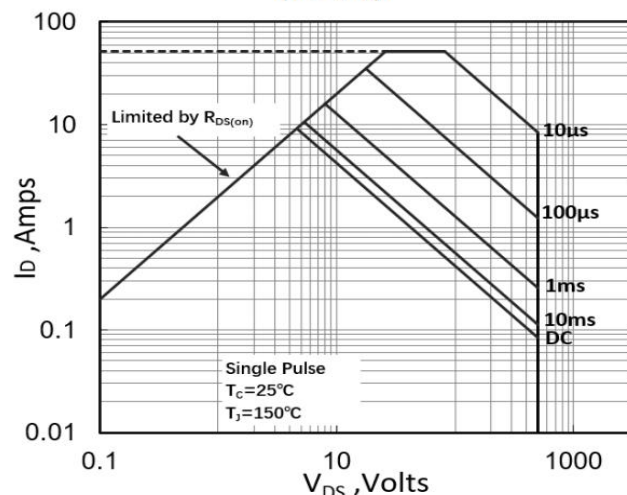


Figure 11. Maximum Safe Operating Area (TO-220F)

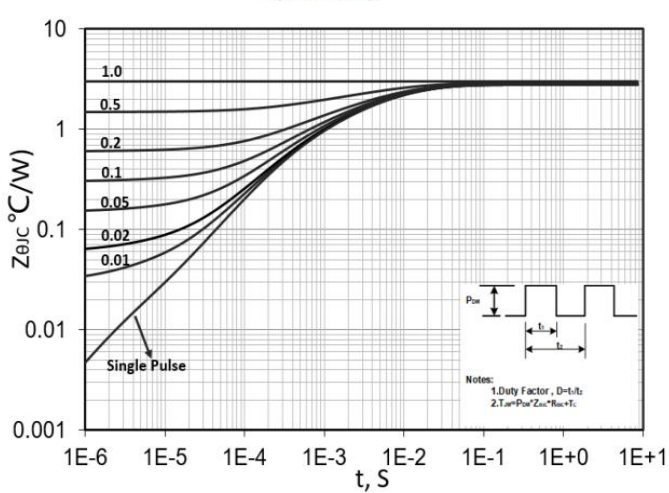
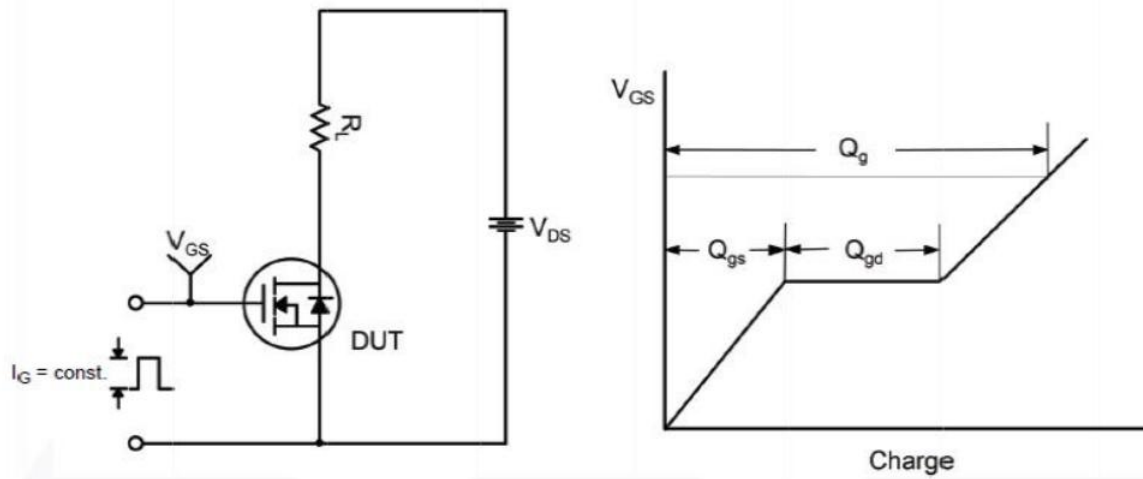


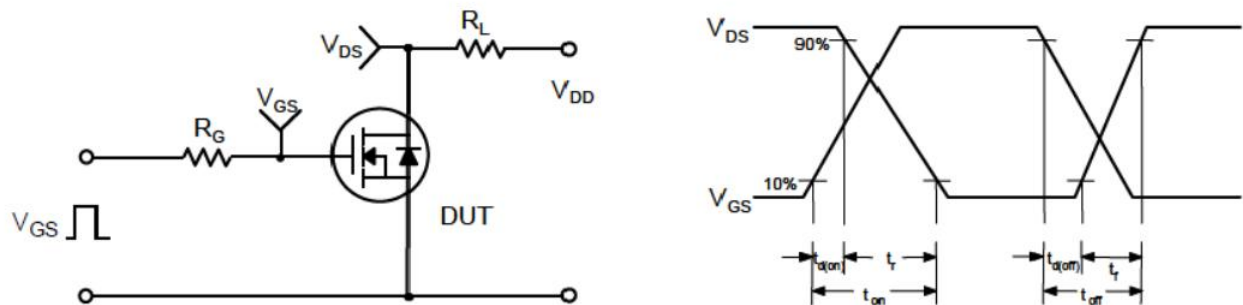
Figure 12. Transient Thermal Response Curve (TO-220F)

## Test Circuit

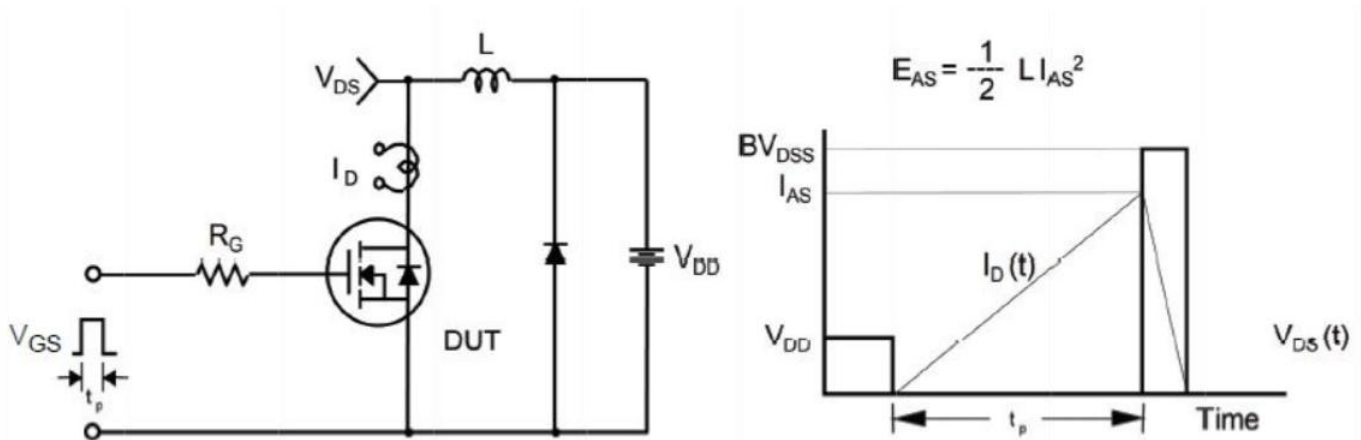
Gate Charge Test Circuit & Waveform



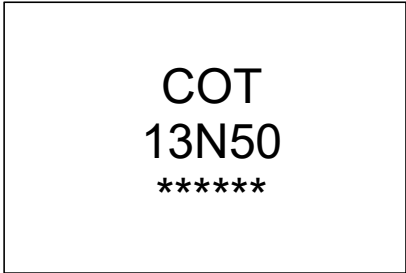
Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



Marking Information



Note:  
COT: Company Code  
13N50: Product Type.  
\*\*\*\*\*: \*: Inner Code \* : Year Code \*\*: Week Code \*\*: Lot Code.

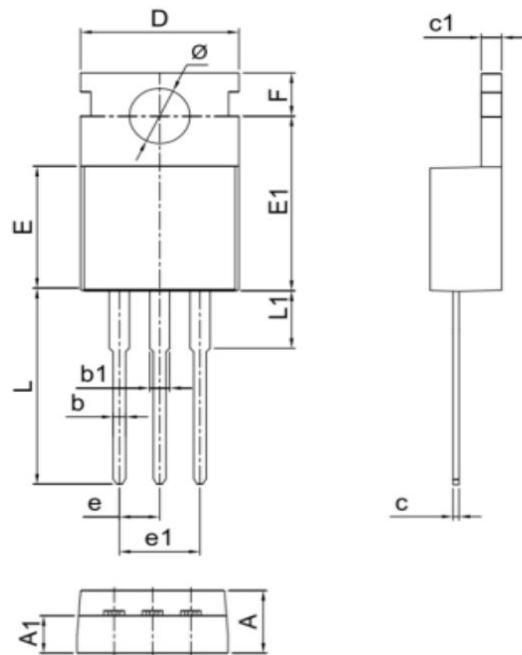
Ordering Information

| Part      | Package | Marking | Packing method |
|-----------|---------|---------|----------------|
| CT13N50RA | TO-220  | 13N50   | Tube           |
| CT13N50FA | TO-220F | 13N50   | Tube           |



Mechanical Dimensions

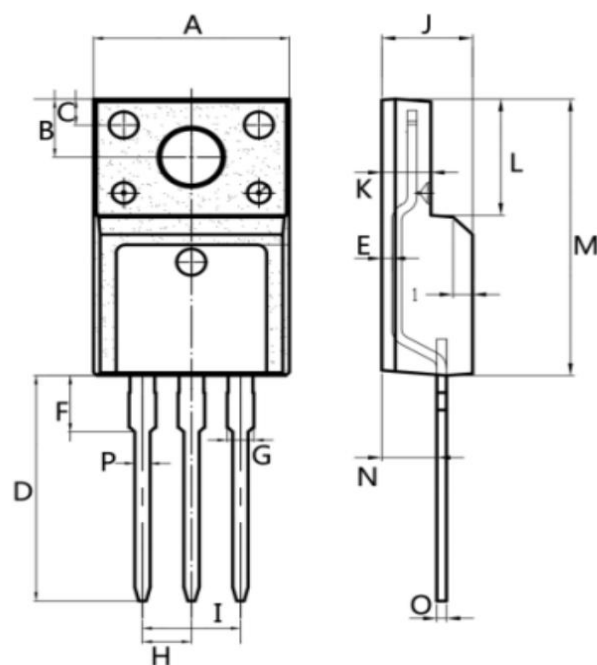
Mechanical Dimensions for TO-220



COMMON DIMENSIONS

| SYMBOL | MM    |       |
|--------|-------|-------|
|        | MIN   | MAX   |
| A      | 4.30  | 4.70  |
| A1     | 2.30  | 2.82  |
| b      | 0.70  | 0.94  |
| b1     | 1.17  | 1.41  |
| c      | 0.30  | 0.64  |
| c1     | 1.17  | 1.44  |
| D      | 9.70  | 10.20 |
| E      | 8.50  | 9.30  |
| E1     | 12.00 | 12.50 |
| e      | 2.44  | 2.64  |
| e1     | 4.88  | 5.26  |
| F      | 2.60  | 2.94  |
| L      | 13.00 | 14.00 |
| L1     | 3.385 | 4.20  |
| Ø      | 3.74  | 3.95  |

Mechanical Dimensions for TO-220F



COMMON DIMENSIONS

| SYMBOL | MM    |       |
|--------|-------|-------|
|        | MIN   | MAX   |
| A      | 9.95  | 10.36 |
| B      | 2.95  | 3.55  |
| C      | 1.25  | 1.6   |
| D      | 12.64 | 13.5  |
| E      | 0.40  | 0.60  |
| F      | 2.80  | 3.80  |
| G      | 1.14  | 1.58  |
| H      | 2.44  | 2.64  |
| I      | 4.88  | 5.26  |
| J      | 4.50  | 4.90  |
| K      | 2.34  | 2.80  |
| L      | 6.48  | 6.90  |
| M      | 15.40 | 16.07 |
| N      | 2.66  | 3.50  |
| O      | 0.40  | 0.64  |
| P      | 0.70  | 0.94  |