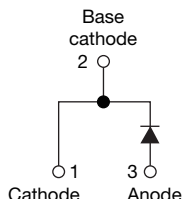


## Ultrafast Rectifier, 30 A FRED Pt®



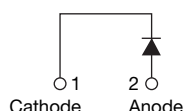
2L TO-220AC



VS-ETU3006-M3



2L TO-220 FULL-PAK



VS-ETU3006FP-M3

### 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
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition
- Designed and qualified according to JEDEC-JESD47



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

### DESCRIPTION

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.

### PRODUCT SUMMARY

|                 |                          |
|-----------------|--------------------------|
| Package         | 2L TO-220AC, 2L TO-220FP |
| $I_{F(AV)}$     | 30 A                     |
| $V_R$           | 600 V                    |
| $V_F$ at $I_F$  | 2 V                      |
| $t_{rr}$ (typ.) | 30 ns                    |
| $T_J$ max.      | 175 °C                   |
| Diode variation | Single die               |

### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL         | TEST CONDITIONS       | VALUES      | UNITS |
|---------------------------------------------|----------------|-----------------------|-------------|-------|
| Peak repetitive reverse voltage             | $V_{RRM}$      |                       | 600         | V     |
| Average rectified forward current in DC     | $I_{F(AV)}$    | $T_C = 130\text{ °C}$ | 30          | A     |
| FULL-PAK                                    |                | $T_C = 72\text{ °C}$  |             |       |
| Non-repetitive peak surge current           | $I_{FSM}$      | $T_J = 25\text{ °C}$  | 200         |       |
| 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 | $V_{BR}, V_R$ | $I_R = 100\text{ }\mu\text{A}$               | 600  | -    | -    | V             |
| Forward voltage                     | $V_F$         | $I_F = 30\text{ A}$                          | -    | 1.4  | 2.0  |               |
|                                     |               | $I_F = 30\text{ A}, T_J = 150\text{ °C}$     | -    | 1.15 | 1.35 |               |
| Reverse leakage current             | $I_R$         | $V_R = V_R$ rated                            | -    | 0.02 | 30   | $\mu\text{A}$ |
|                                     |               | $T_J = 150\text{ °C}, V_R = V_R$ rated       | -    | 30   | 250  |               |
| Junction capacitance                | $C_T$         | $V_R = 600\text{ V}$                         | -    | 20   | -    | pF            |
| Series inductance                   | $L_S$         | Measured lead to lead 5 mm from package body | -    | 8    | -    | nH            |

| <b>DYNAMIC RECOVERY CHARACTERISTICS</b> ( $T_J = 25\text{ °C}$ unless otherwise specified) |           |                                                                                |      |      |      |       |
|--------------------------------------------------------------------------------------------|-----------|--------------------------------------------------------------------------------|------|------|------|-------|
| PARAMETER                                                                                  | SYMBOL    | TEST CONDITIONS                                                                | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time                                                                      | $t_{rr}$  | $I_F = 1\text{ A}$ , $di_F/dt = 50\text{ A/}\mu\text{s}$ , $V_R = 30\text{ V}$ | -    | 30   | 45   | ns    |
|                                                                                            |           | $T_J = 25\text{ °C}$                                                           | -    | 45   | -    |       |
|                                                                                            |           | $T_J = 125\text{ °C}$                                                          | -    | 100  | -    |       |
| Peak recovery current                                                                      | $I_{RRM}$ | $T_J = 25\text{ °C}$                                                           | -    | 5.6  | -    | A     |
|                                                                                            |           | $T_J = 125\text{ °C}$                                                          | -    | 10   | -    |       |
| Reverse recovery charge                                                                    | $Q_{rr}$  | $T_J = 25\text{ °C}$                                                           | -    | 127  | -    | nC    |
|                                                                                            |           | $T_J = 125\text{ °C}$                                                          | -    | 580  | -    |       |

| <b>THERMAL - MECHANICAL SPECIFICATIONS</b>       |                |                                            |           |      |            |                        |
|--------------------------------------------------|----------------|--------------------------------------------|-----------|------|------------|------------------------|
| PARAMETER                                        | SYMBOL         | TEST CONDITIONS                            | MIN.      | TYP. | MAX.       | UNITS                  |
| Maximum junction and storage temperature range   | $T_J, T_{Stg}$ |                                            | - 65      | -    | 175        | °C                     |
| Thermal resistance, junction to case<br>FULL-PAK | $R_{thJC}$     |                                            | -         | 0.84 | 1.3        | °C/W                   |
|                                                  |                |                                            | -         | 3.2  | 3.8        |                        |
| 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 2L TO-220AC                     | ETU3006   |      |            |                        |
|                                                  |                | Case style 2L TO-220 FULL-PAK              | ETU3006FP |      |            |                        |

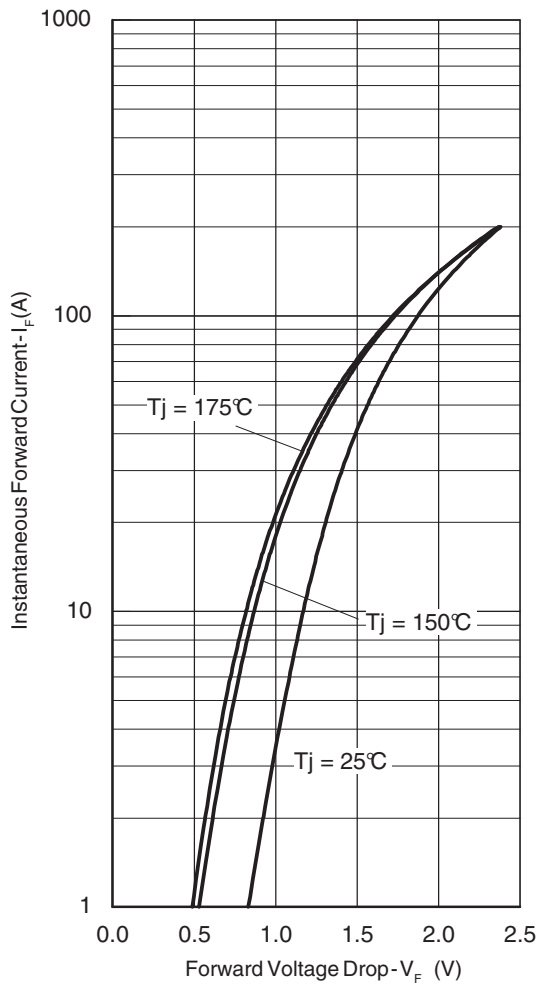


Fig. 1 - Typical Forward Voltage Drop Characteristics

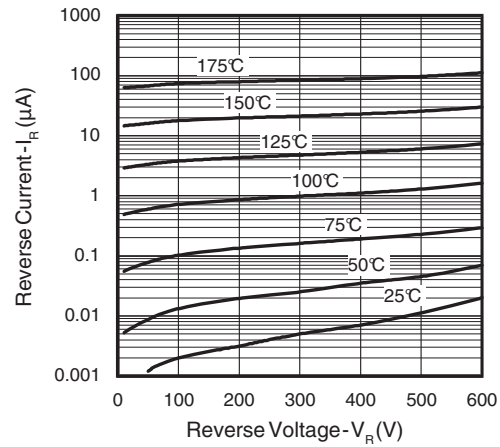


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

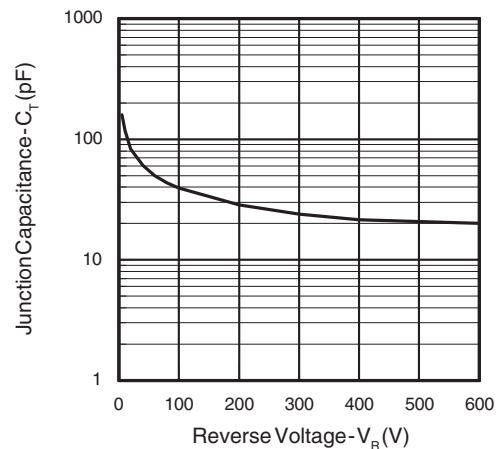


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

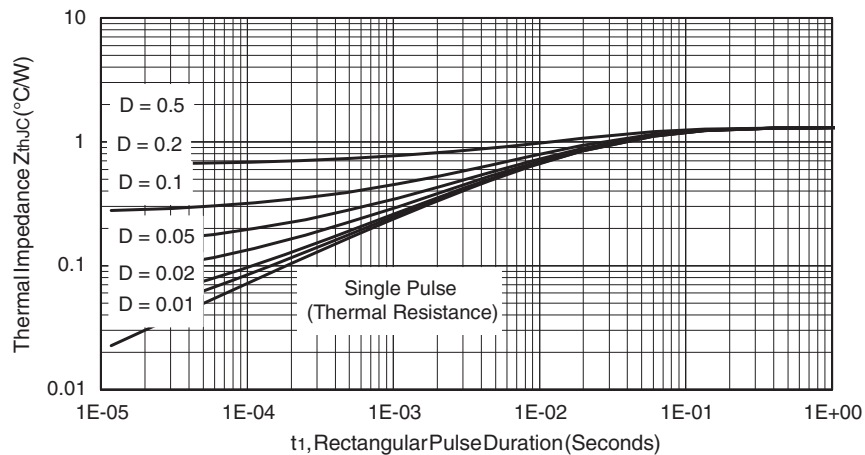


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

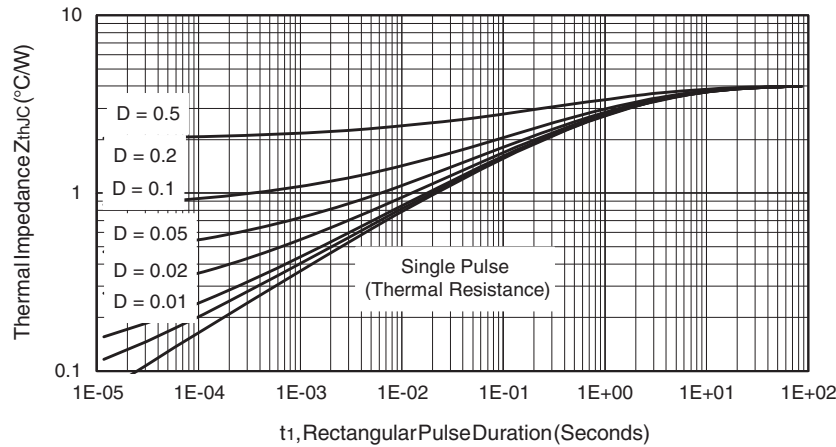


Fig. 5 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (FULL-PAK)

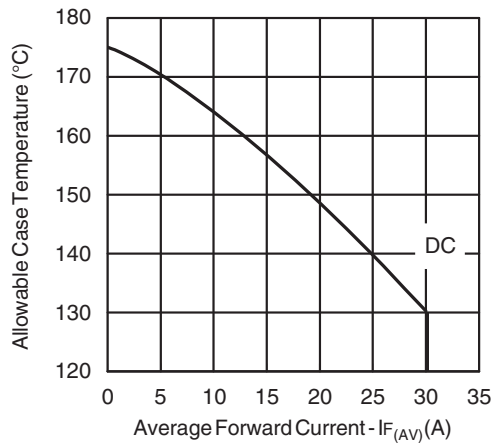


Fig. 6 - Maximum Allowable Case Temperature vs. Average Forward Current

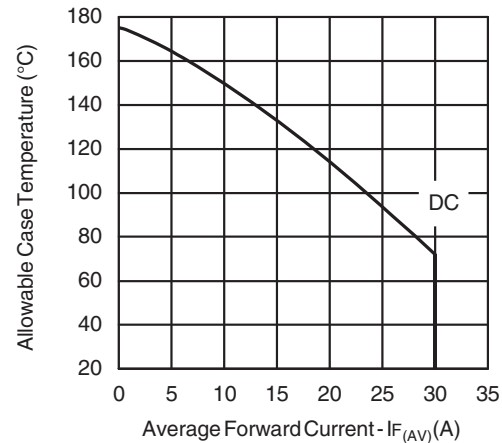


Fig. 7 - Maximum Allowable Case Temperature vs. Average Forward Current (FULL-PAK)

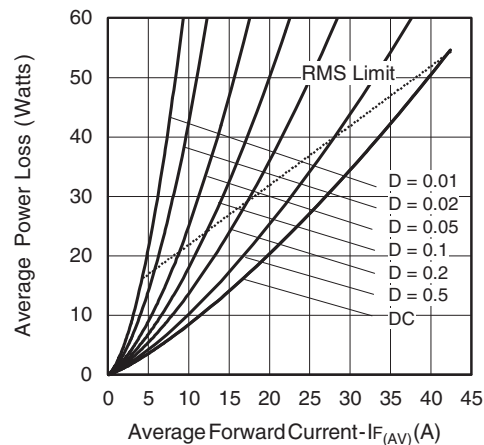


Fig. 8 - Forward Power Loss Characteristics

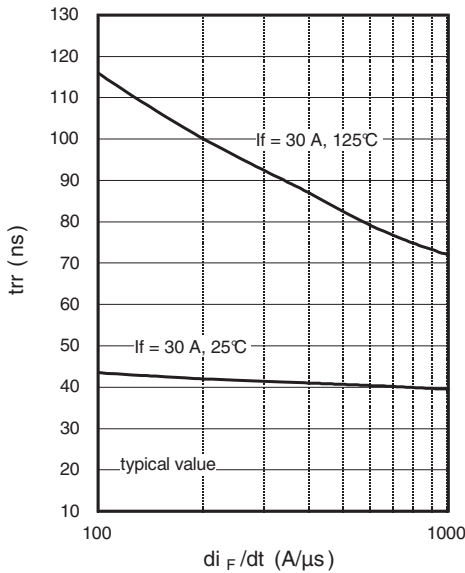


Fig. 9 - Typical Reverse Recovery vs.  $di_F/dt$

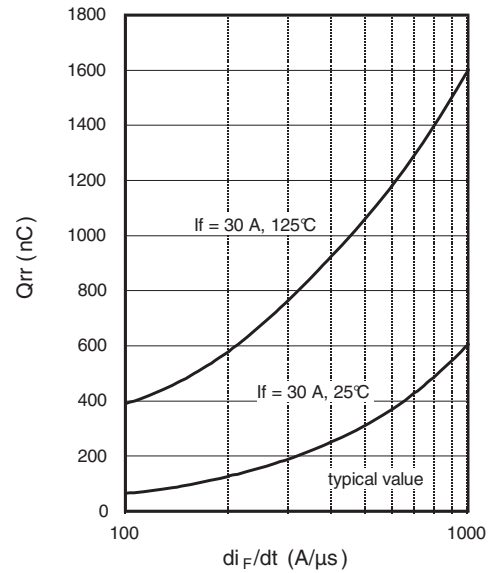


Fig. 10 - Typical Stored Charge vs.  $di_F/dt$

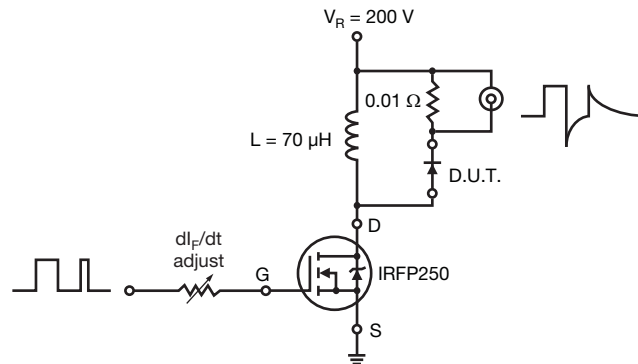
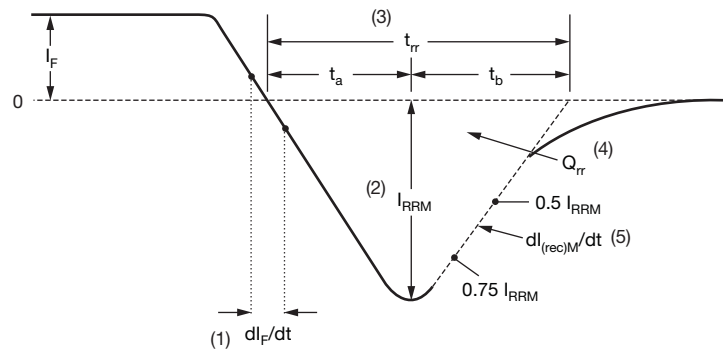


Fig. 11 - Reverse Recovery Parameter Test Circuit



(1)  $di_F/dt$  - rate of change of current through zero crossing

(2)  $I_{RRM}$  - peak reverse recovery current

(3)  $t_{rr}$  - reverse recovery time measured from zero crossing point of negative going  $I_F$  to point where a line passing through  $0.75 I_{RRM}$  and  $0.50 I_{RRM}$  extrapolated to zero current.

(4)  $Q_{rr}$  - area under curve defined by  $t_{rr}$  and  $I_{RRM}$

$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

(5)  $dl_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

Fig. 12 - Reverse Recovery Waveform and Definitions

# VS-ETU3006-M3, VS-ETU3006FP-M3

Vishay Semiconductors Ultrafast Rectifier, 30 A FRED Pt®



## ORDERING INFORMATION TABLE

|             |     |   |   |   |    |    |    |     |
|-------------|-----|---|---|---|----|----|----|-----|
| Device code | VS- | E | T | U | 30 | 06 | FP | -M3 |
|             | 1   | 2 | 3 | 4 | 5  | 6  | 7  | 8   |

- 1** - Vishay Semiconductors product
- 2** - Circuit configuration:  
E = Single diode
- 3** - T = TO-220
- 4** - U = Hyperfast recovery time
- 5** - Current code: 30 = 30 A
- 6** - Voltage code: 06 = 600 V
- 7** -
  - None = TO-220
  - FP = FULL-PAK
- 8** - Environmental digit:  
-M3 = Halogen-free, RoHS compliant and terminations lead (Pb)-free

| ORDERING INFORMATION (Example) |                   |                        |                         |
|--------------------------------|-------------------|------------------------|-------------------------|
| PREFERRED P/N                  | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
| VS-ETU3006-M3                  | 50                | 1000                   | Antistatic plastic tube |
| VS-ETU3006FP-M3                | 50                | 1000                   | Antistatic plastic tube |

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

### True 2 Pin TO-220

**DIMENSIONS** in millimeters and inches



| SYMBOL                        | MILLIMETERS |       | INCHES    |       |
|-------------------------------|-------------|-------|-----------|-------|
|                               | MIN.        | MAX.  | MIN.      | MAX.  |
| A                             | 4.32        | 4.57  | 0.170     | 0.180 |
| 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                             | 14.99       | 15.49 | 0.590     | 0.610 |
| E                             | 10.04       | 10.41 | 0.395     | 0.410 |
| e                             | 5.08 BSC    |       | 0.200 BSC |       |
| F                             | 1.22        | 1.37  | 0.048     | 0.054 |
| H <sub>1</sub>                | 5.97        | 6.47  | 0.235     | 0.255 |
| J <sub>1</sub>                | 2.54        | 2.79  | 0.100     | 0.110 |
| L                             | 13.47       | 13.97 | 0.530     | 0.550 |
| L <sub>1</sub> <sup>(1)</sup> | 3.31        | 3.81  | 0.130     | 0.150 |
| Ø P                           | 3.79        | 3.88  | 0.149     | 0.153 |
| Q                             | 2.60        | 2.84  | 0.102     | 0.112 |

#### Notes

<sup>(1)</sup> Lead dimension and finish uncontrolled in L<sub>1</sub>

- These dimensions are within allowable dimensions of JEDEC TO-220AB rev. J outline dated 3-24-87
- Controlling dimension: Inch

## 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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