



# FGD3N60LSD

## IGBT

### Features

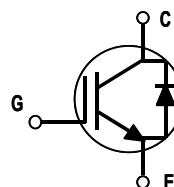
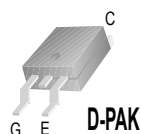
- High Current Capability
- Very Low Saturation Voltage :  $V_{CE(sat)} = 1.2 \text{ V @ } I_C = 3 \text{ A}$
- High Input Impedance

### Applications

- HID Lamp Applications
- Piezo Fuel Injection Applications

### Description

Fairchild's Insulated Gate Bipolar Transistors (IGBTs) provide very low conduction losses. The device is designed for applications where very low On-Voltage Drop is a required feature.



### Absolute Maximum Ratings

| Symbol      | Description                                                             | FGD3N60LSD  | Units               |
|-------------|-------------------------------------------------------------------------|-------------|---------------------|
| $V_{CES}$   | Collector-Emitter Voltage                                               | 600         | V                   |
| $V_{GES}$   | Gate-Emitter Voltage                                                    | $\pm 25$    | V                   |
| $I_C$       | Collector Current @ $T_C = 25^\circ\text{C}$                            | 6           | A                   |
|             | Collector Current @ $T_C = 100^\circ\text{C}$                           | 3           | A                   |
| $I_{CM(1)}$ | Pulsed Collector Current (1)                                            | 25          | A                   |
| $I_F$       | Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$            | 3           | A                   |
| $I_{FM}$    | Diode Maximum Forward Current                                           | 25          | A                   |
| $P_D$       | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$                    | 40          | W                   |
|             | Derating Factor                                                         | 0.32        | W/ $^\circ\text{C}$ |
| $T_J$       | Operating Junction Temperature                                          | -55 to +150 | $^\circ\text{C}$    |
| $T_{stg}$   | Storage Temperature Range                                               | -55 to +150 | $^\circ\text{C}$    |
| $T_L$       | Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 Seconds | 250         | $^\circ\text{C}$    |

Notes :

(1) Repetitive rating : Pulse width limited by max. junction temperature

### Thermal Characteristics

| Symbol                 | Parameter                                               | Typ. | Max. | Units              |
|------------------------|---------------------------------------------------------|------|------|--------------------|
| $R_{\theta JC}$ (IGBT) | Thermal Resistance, Junction-to-Case                    | --   | 3.1  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$        | Thermal Resistance, Junction-to-Ambient (PCB Mount) (2) | --   | 100  | $^\circ\text{C/W}$ |

Notes :

(2) Mounted on 1" square PCB (FR4 or G-10 Material)

## Package Marking and Ordering Information

| Device Marking | Device       | Package | Reel Size | Tape Width | Quantity |
|----------------|--------------|---------|-----------|------------|----------|
| FGD3N60LSD     | FGD3N60LSDTM | D-PAK   | 380mm     | 16mm       | 2500     |

## Electrical Characteristics of the IGBT T<sub>C</sub> = 25°C unless otherwise noted

| Symbol                                          | Parameter                                    | Test Conditions                                                                                                                    | Min. | Typ. | Max.  | Units |
|-------------------------------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------|------|-------|-------|
| Off Characteristics                             |                                              |                                                                                                                                    |      |      |       |       |
| BV <sub>CES</sub>                               | Collector-Emitter Breakdown Voltage          | V <sub>GE</sub> = 0V, I <sub>C</sub> = 250uA                                                                                       | 600  | --   | --    | V     |
| ΔB <sub>V</sub> <sub>CES</sub> /ΔT <sub>J</sub> | Temperature Coefficient of Breakdown Voltage | V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA                                                                                         | --   | 0.6  | --    | V/°C  |
| I <sub>CES</sub>                                | Collector Cut-Off Current                    | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V                                                                          | --   | --   | 250   | uA    |
| I <sub>GES</sub>                                | G-E Leakage Current                          | V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V                                                                          | --   | --   | ± 100 | nA    |
| On Characteristics                              |                                              |                                                                                                                                    |      |      |       |       |
| V <sub>GE(th)</sub>                             | G-E Threshold Voltage                        | I <sub>C</sub> = 3mA, V <sub>CE</sub> = V <sub>GE</sub>                                                                            | 2.5  | 3.2  | 5.0   | V     |
| V <sub>CE(sat)</sub>                            | Collector to Emitter Saturation Voltage      | I <sub>C</sub> = 3A, V <sub>GE</sub> = 10V                                                                                         | --   | 1.2  | 1.5   | V     |
|                                                 |                                              | I <sub>C</sub> = 6A, V <sub>GE</sub> = 10V                                                                                         | --   | 1.8  | --    | V     |
| Dynamic Characteristics                         |                                              |                                                                                                                                    |      |      |       |       |
| C <sub>ies</sub>                                | Input Capacitance                            | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz                                                                              | --   | 185  | --    | pF    |
| C <sub>oes</sub>                                | Output Capacitance                           |                                                                                                                                    | --   | 20   | --    | pF    |
| C <sub>res</sub>                                | Reverse Transfer Capacitance                 |                                                                                                                                    | --   | 5.5  | --    | pF    |
| Switching Characteristics                       |                                              |                                                                                                                                    |      |      |       |       |
| t <sub>d(on)</sub>                              | Turn-On Delay Time                           | V <sub>CC</sub> = 480 V, I <sub>C</sub> = 3A, R <sub>G</sub> = 470Ω, V <sub>GE</sub> = 10V, Inductive Load, T <sub>C</sub> = 25°C  | --   | 40   | --    | ns    |
| t <sub>r</sub>                                  | Rise Time                                    |                                                                                                                                    | --   | 40   | --    | ns    |
| t <sub>d(off)</sub>                             | Turn-Off Delay Time                          |                                                                                                                                    | --   | 600  | --    | ns    |
| t <sub>f</sub>                                  | Fall Time                                    |                                                                                                                                    | --   | 600  | --    | ns    |
| E <sub>on</sub>                                 | Turn-On Switching Loss                       |                                                                                                                                    | --   | 250  | --    | uJ    |
| E <sub>off</sub>                                | Turn-Off Switching Loss                      |                                                                                                                                    | --   | 1.00 | --    | mJ    |
| E <sub>ts</sub>                                 | Total Switching Loss                         |                                                                                                                                    | --   | 1.25 | --    | mJ    |
| t <sub>d(on)</sub>                              | Turn-On Delay Time                           | V <sub>CC</sub> = 480 V, I <sub>C</sub> = 3A, R <sub>G</sub> = 470Ω, V <sub>GE</sub> = 10V, Inductive Load, T <sub>C</sub> = 125°C | --   | 40   | --    | ns    |
| t <sub>r</sub>                                  | Rise Time                                    |                                                                                                                                    | --   | 45   | --    | ns    |
| t <sub>d(off)</sub>                             | Turn-Off Delay Time                          |                                                                                                                                    | --   | 620  | --    | ns    |
| t <sub>f</sub>                                  | Fall Time                                    |                                                                                                                                    | --   | 800  | --    | ns    |
| E <sub>on</sub>                                 | Turn-On Switching Loss                       |                                                                                                                                    | --   | 300  | --    | uJ    |
| E <sub>off</sub>                                | Turn-Off Switching Loss                      |                                                                                                                                    | --   | 1.9  | --    | mJ    |
| E <sub>ts</sub>                                 | Total Switching Loss                         |                                                                                                                                    | --   | 2.2  | --    | mJ    |
| Q <sub>g</sub>                                  | Total Gate Charge                            | V <sub>CE</sub> = 480 V, I <sub>C</sub> = 3A, V <sub>GE</sub> = 10V                                                                | --   | 12.5 | --    | nC    |
| Q <sub>ge</sub>                                 | Gate-Emitter Charge                          |                                                                                                                                    | --   | 2.8  | --    | nC    |
| Q <sub>gc</sub>                                 | Gate-Collector Charge                        |                                                                                                                                    | --   | 4.9  | --    | nC    |
| L <sub>e</sub>                                  | Internal Emitter Inductance                  | Measured 5mm from PKG                                                                                                              | --   | 7.5  | --    | nH    |

**Electrical Characteristics of DIODE**  $T_C = 25^\circ\text{C}$  unless otherwise noted

| Symbol                 | Parameter                           | Test Conditions                                                  |                        | Min.                          | Typ.                  | Max. | Units |
|------------------------|-------------------------------------|------------------------------------------------------------------|------------------------|-------------------------------|-----------------------|------|-------|
| V <sub>FM</sub>        | Diode Forward Voltage               | I <sub>F</sub> = 3A                                              | T <sub>C</sub> = 25°C  | --                            | 1.5                   | 1.9  | V     |
|                        |                                     |                                                                  | T <sub>C</sub> = 100°C | --                            | 1.55                  | --   |       |
| t <sub>rr</sub>        | Diode Reverse Recovery Time         | I <sub>F</sub> = 3A,<br>di/dt = 100A/us<br>V <sub>R</sub> = 200V | T <sub>C</sub> = 25°C  | --                            | 234                   | --   | ns    |
| I <sub>rr</sub>        | Diode Peak Reverse Recovery Current |                                                                  | T <sub>C</sub> = 100°C | --                            | --                    | --   |       |
|                        |                                     |                                                                  | T <sub>C</sub> = 25°C  | --                            | 2.64                  | --   | A     |
|                        |                                     |                                                                  | T <sub>C</sub> = 100°C | --                            | --                    | --   |       |
|                        |                                     |                                                                  | Q <sub>rr</sub>        | Diode Reverse Recovery Charge | T <sub>C</sub> = 25°C | --   | 309   |
| T <sub>C</sub> = 100°C | --                                  |                                                                  |                        |                               | --                    | --   |       |

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

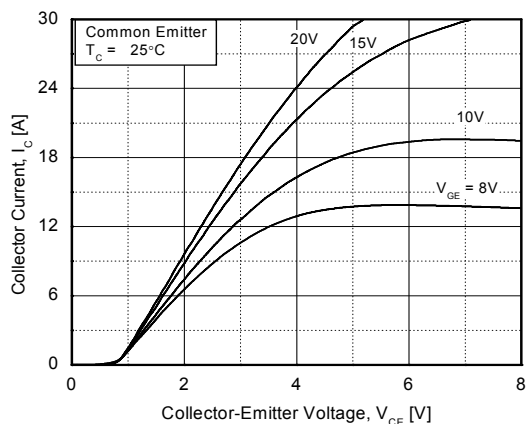


Figure 2. Typical Output Characteristics

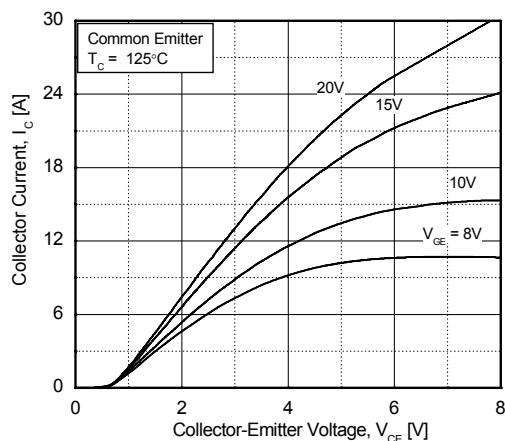


Figure 3. Typical Output Characteristics

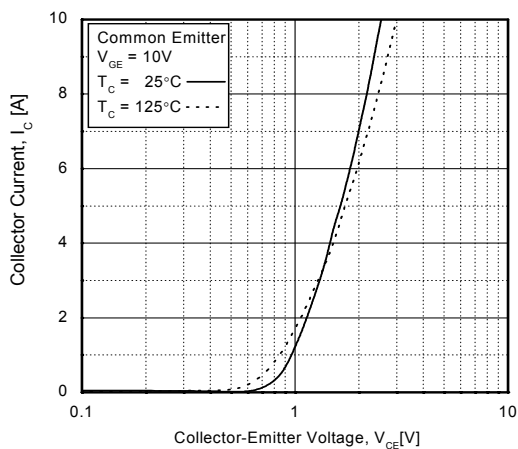


Figure 4. Transfer Characteristics

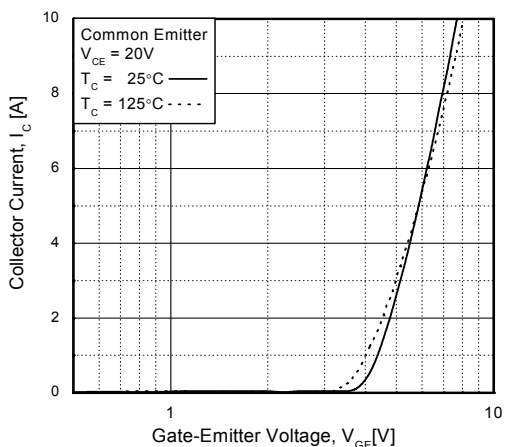


Figure 5. Saturation Voltage vs. Case

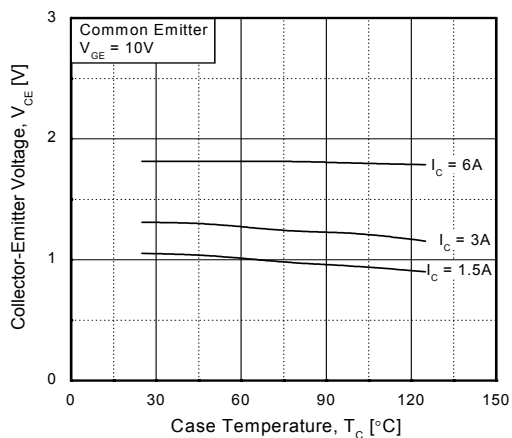
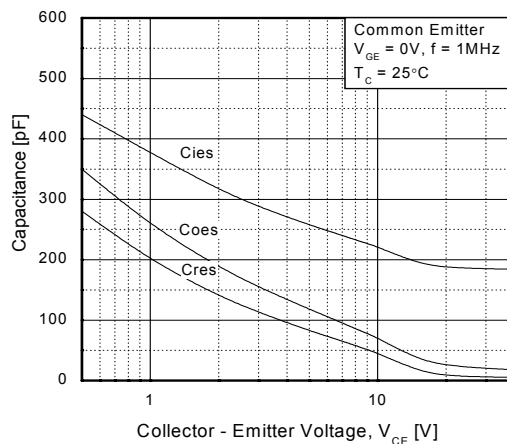


Figure 6. Capacitance Characteristics



## Typical Performance Characteristics (Continued)

Figure 7. Gate Charge

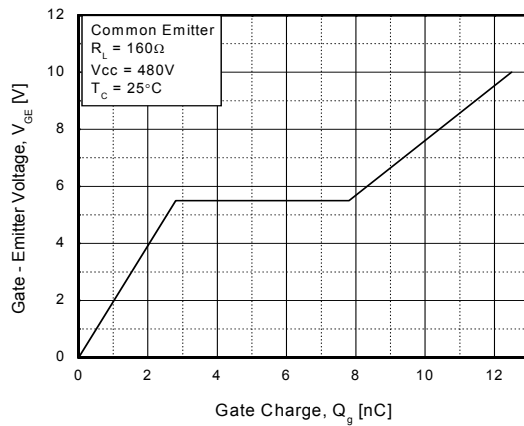


Figure 8. Turn-On Characteristics vs. Gate Resistance

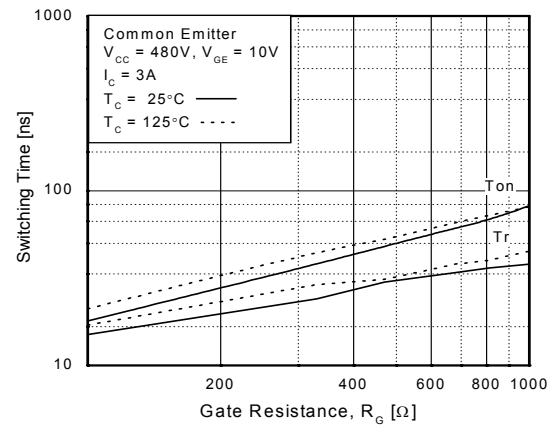


Figure 9. Turn-Off Characteristics vs. Gate Resistance

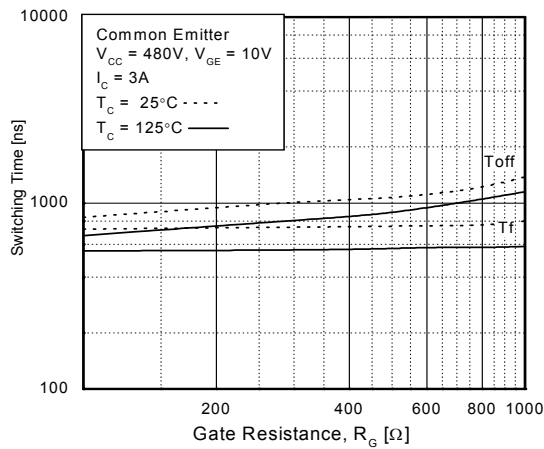


Figure 10. Switching Loss vs. Gate Resistance

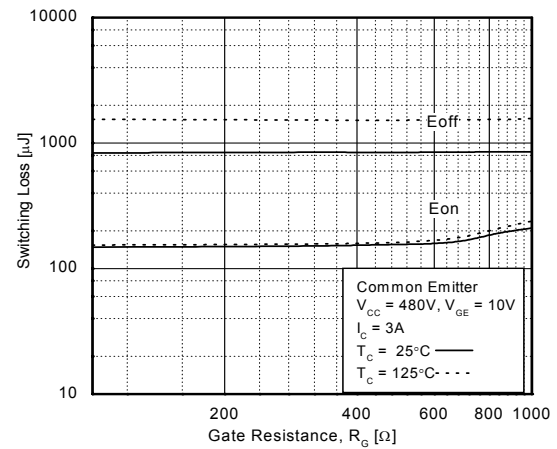


Figure 11. Turn-On Characteristics vs. Collector Current

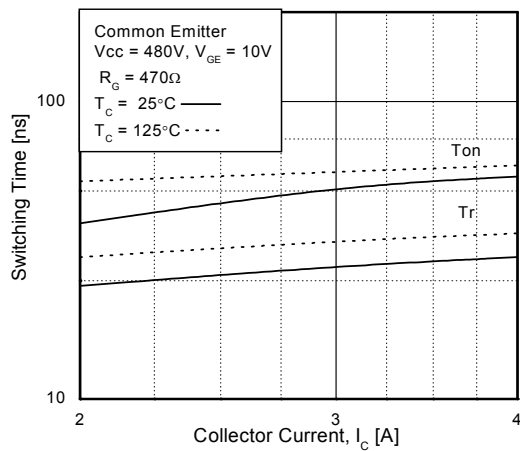
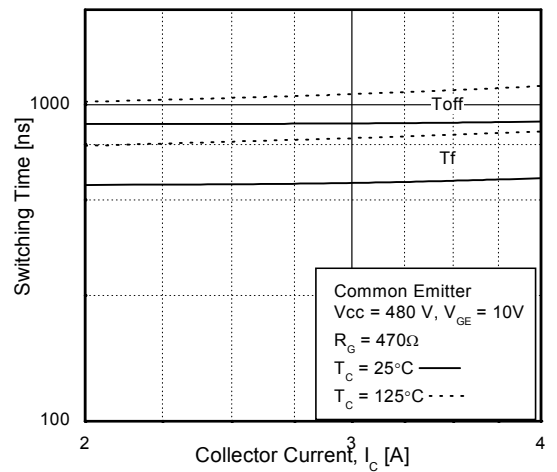


Figure 12. Turn-Off Characteristics vs. Collector Current



## Typical Performance Characteristics (Continued)

Figure 13. Switching Loss vs. Collector Current

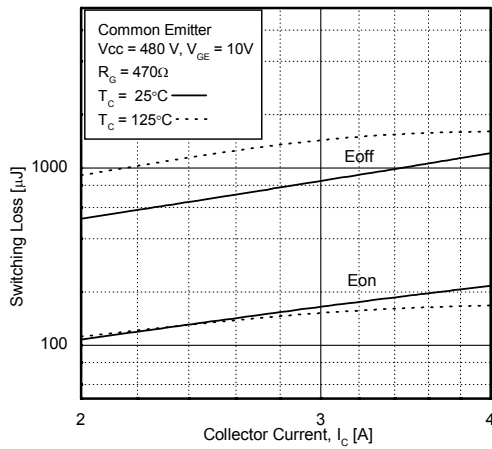


Figure 14. Forward Characteristics

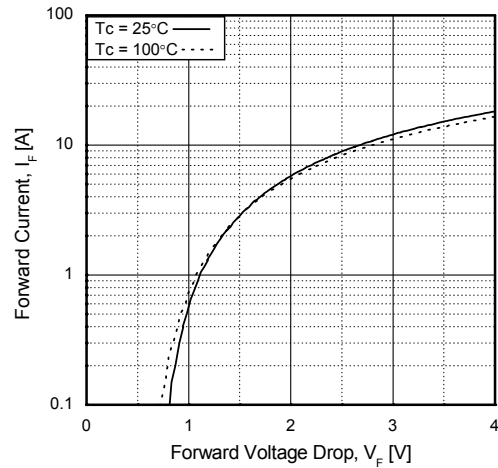


Figure 15. Forward Voltage Drop Vs Tj

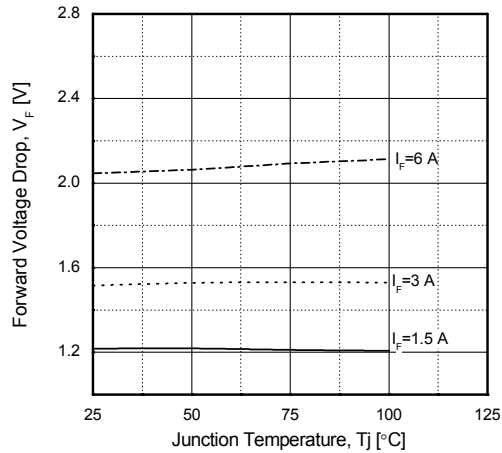


Figure 16. SOA Characteristics

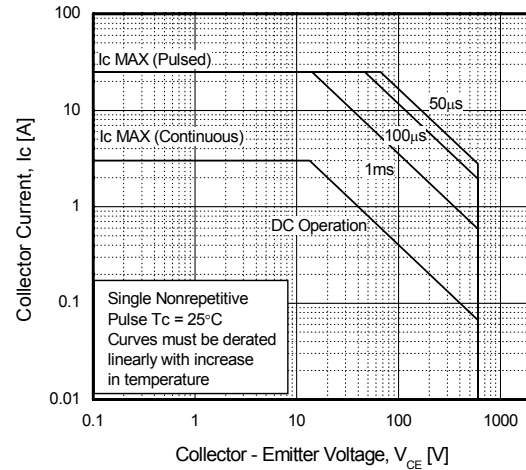
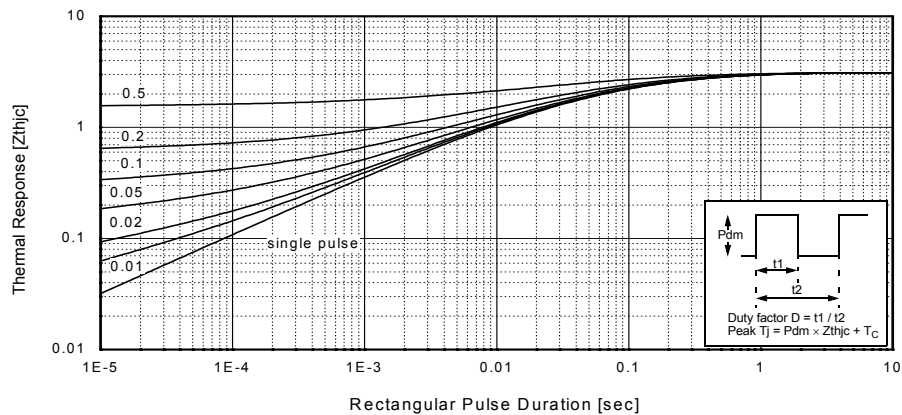


Figure 17. Transient Thermal Impedance of IGBT





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