

## 650V 40A Trench and Field Stop IGBT

JJT40N65UE

### Key performance:

- $V_{CE}=650V$
- $I_C=40A@T_C=100^{\circ}C$
- $V_{CE(sat)}=1.9V$

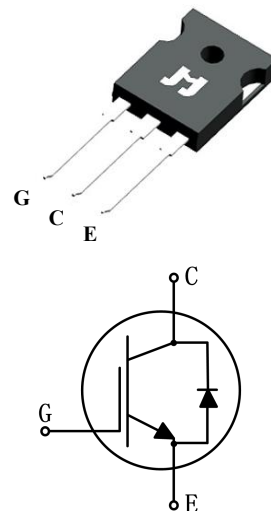
TO-247

### Features:

- Trench and field-stop technology.
- Easy parallel switching capability.

### Benefits:

- High efficiency for inverters.
- High ruggedness performance.
- RoHS compliant.



### Applications:

- PFC applications
- Welding machines

### Package parameters

| Type       | Marking | Package | Packaging Method |
|------------|---------|---------|------------------|
| JJT40N65UE | T4065UE | TO-247  | Tube             |

## Maximum ratings

| Symbol    | Parameter                                                    | Values      | Unit             |
|-----------|--------------------------------------------------------------|-------------|------------------|
| $V_{CES}$ | Collector-emitter voltage                                    | 650         | V                |
| $V_{GES}$ | Gate-emitter voltage                                         | $\pm 20$    | V                |
| $I_C$     | Continuous collector current ( $T_C=25^\circ\text{C}$ )      | 80          | A                |
|           | Continuous collector current ( $T_C=100^\circ\text{C}$ )     | 40          | A                |
| $I_{CM}$  | Pulsed collector current, $t_p$ limited by $T_{vjmax}$       | 160         | A                |
| $I_F$     | Diode continuous forward current ( $T_C=100^\circ\text{C}$ ) | 40          | A                |
| $I_{FM}$  | Diode maximum current, $t_p$ limited by $T_{vjmax}$          | 160         | A                |
| $P_{tot}$ | Power dissipation ( $T_C=25^\circ\text{C}$ )                 | 300         | W                |
|           | Power dissipation ( $T_C=100^\circ\text{C}$ )                | 150         | W                |
| $T_{vj}$  | Operating junction temperature range                         | -40 to +175 | $^\circ\text{C}$ |
| $T_{stg}$ | Storage temperature range                                    | -55 to +150 | $^\circ\text{C}$ |

## Thermal characteristics

| Symbol        | Parameter                                      | Values |      | Unit |
|---------------|------------------------------------------------|--------|------|------|
|               |                                                | Typ.   | Max. |      |
| $R_{th(j-c)}$ | Thermal resistance, junction to case for IGBT  | -      | 0.5  | K/ W |
| $R_{th(j-c)}$ | Thermal resistance, junction to case for Diode | -      | 0.9  | K/ W |
| $R_{th(j-a)}$ | Thermal resistance, junction to ambient        | -      | 40   | K/ W |

**Electrical characteristics of IGBT** ( $T_{vj}=25^{\circ}\text{C}$  unless otherwise specified)

**Static characteristics**

| Symbol        | Parameter                            | Test condition                                                  | Values |      |      | Unit          |
|---------------|--------------------------------------|-----------------------------------------------------------------|--------|------|------|---------------|
|               |                                      |                                                                 | Min.   | Typ. | Max. |               |
| $BV_{CES}$    | Collector-emitter breakdown voltage  | $V_{GE}=0\text{V}, I_C=250\mu\text{A}$                          | 650    | -    | -    | V             |
| $I_{CES}$     | Collector-emitter leakage current    | $V_{CE}=650\text{V}, V_{GE}=0\text{V}$                          | -      | -    | 50   | $\mu\text{A}$ |
| $I_{GES}$     | Gate leakage current, forward        | $V_{GE}=20\text{V}, V_{CE}=0\text{V}$                           | -      | -    | 100  | nA            |
|               | Gate leakage current, reverse        | $V_{GE}=-20\text{V}, V_{CE}=0\text{V}$                          | -      | -    | -100 | nA            |
| $V_{GE(th)}$  | Gate-emitter threshold voltage       | $V_{GE}=V_{CE}, I_C=1\text{mA}$                                 | 4.0    | 5.0  | 6.0  | V             |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}=15\text{V}, I_C=40\text{A}$                             | -      | 1.9  | -    | V             |
|               |                                      | $V_{GE}=15\text{V}, I_C=40\text{A}, T_{vj}=175^{\circ}\text{C}$ | -      | 2.6  | -    | V             |

**Dynamic characteristics**

| Symbol    | Parameter                    | Test condition                                                  | Values |      |      | Unit |
|-----------|------------------------------|-----------------------------------------------------------------|--------|------|------|------|
|           |                              |                                                                 | Min.   | Typ. | Max. |      |
| $C_{ies}$ | Input capacitance            | $V_{CE}=30\text{V}$<br>$V_{GE}=0\text{V}$<br>$f=1\text{MHz}$    | -      | 2480 | -    | pF   |
| $C_{oes}$ | Output capacitance           |                                                                 | -      | 95   | -    | pF   |
| $C_{res}$ | Reverse transfer capacitance |                                                                 | -      | 21   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{CC}=520\text{V}$<br>$V_{GE}=15\text{V}$<br>$I_C=40\text{A}$ | -      | 78   | -    | nC   |

## Switching characteristics

| Symbol       | Parameter              | Test condition                                                                                           | Values |      |      | Unit |
|--------------|------------------------|----------------------------------------------------------------------------------------------------------|--------|------|------|------|
|              |                        |                                                                                                          | Min.   | Typ. | Max. |      |
| $t_{d(on)}$  | Turn-on delay time     | $V_{CC}=400V$<br>$V_{GE}=0/15V$<br>$I_C=40A$<br>$R_G=10\Omega$<br>Inductive load                         | -      | 32   | -    | ns   |
| $t_r$        | Rise time              |                                                                                                          | -      | 55   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time    |                                                                                                          | -      | 106  | -    | ns   |
| $t_f$        | Fall time              |                                                                                                          | -      | 51   | -    | ns   |
| $E_{on}$     | Turn-on energy         |                                                                                                          | -      | 0.9  | -    | mJ   |
| $E_{off}$    | Turn-off energy        |                                                                                                          | -      | 0.5  | -    | mJ   |
| $E_{ts}$     | Total switching energy |                                                                                                          | -      | 1.4  | -    | mJ   |
| $t_{d(on)}$  | Turn-on delay time     | $V_{CC}=400V$<br>$V_{GE}=0/15V$<br>$I_C=40A$<br>$R_G=10\Omega$<br>Inductive load<br>$T_{vj}=175^\circ C$ | -      | 28   | -    | ns   |
| $t_r$        | Rise time              |                                                                                                          | -      | 52   | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time    |                                                                                                          | -      | 128  | -    | ns   |
| $t_f$        | Fall time              |                                                                                                          | -      | 75   | -    | ns   |
| $E_{on}$     | Turn-on energy         |                                                                                                          | -      | 1.4  | -    | mJ   |
| $E_{off}$    | Turn-off energy        |                                                                                                          | -      | 0.7  | -    | mJ   |
| $E_{ts}$     | Total switching energy |                                                                                                          | -      | 2.1  | -    | mJ   |

**Electrical characteristics of Diode** ( $T_{vj}=25^{\circ}\text{C}$  unless otherwise specified)

| Symbol    | Parameter                           | Test condition                                                                                              | Values |      |      | Unit |
|-----------|-------------------------------------|-------------------------------------------------------------------------------------------------------------|--------|------|------|------|
|           |                                     |                                                                                                             | Min.   | Typ. | Max. |      |
| $V_F$     | Diode forward voltage               | $I_F=40\text{A}$                                                                                            | -      | 2.4  | -    | V    |
|           |                                     | $I_F=40\text{A}, T_{vj}=175^{\circ}\text{C}$                                                                | -      | 1.7  | -    | V    |
| $t_{rr}$  | Diode reverse recovery time         | $V_R=400\text{V}$<br>$I_F=40\text{A}$<br>$di_F/dt=-950\text{A}/\mu\text{s}$                                 | -      | 68   | -    | ns   |
| $I_{rrm}$ | Diode peak reverse recovery current |                                                                                                             | -      | 15   | -    | A    |
| $Q_{rr}$  | Diode reverse recovery charge       |                                                                                                             | -      | 522  | -    | nC   |
| $t_{rr}$  | Diode reverse recovery time         | $V_R=400\text{V}$<br>$I_F=40\text{A}$<br>$di_F/dt=-950\text{A}/\mu\text{s}$<br>$T_{vj}=175^{\circ}\text{C}$ | -      | 106  | -    | ns   |
| $I_{rrm}$ | Diode peak reverse recovery current |                                                                                                             | -      | 24   | -    | A    |
| $Q_{rr}$  | Diode reverse recovery charge       |                                                                                                             | -      | 1423 | -    | nC   |

## Typical performance characteristics

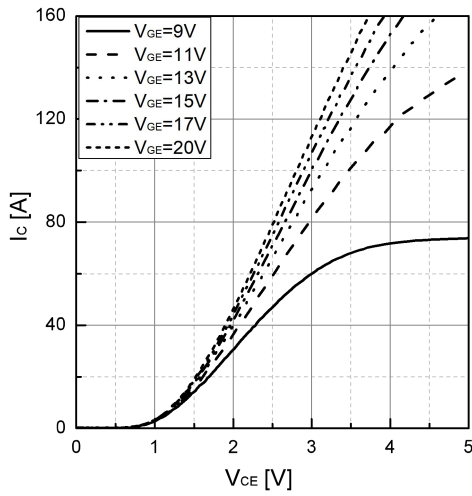


Fig 1. Typical output characteristic ( $T_{vj}=25^{\circ}\text{C}$ )

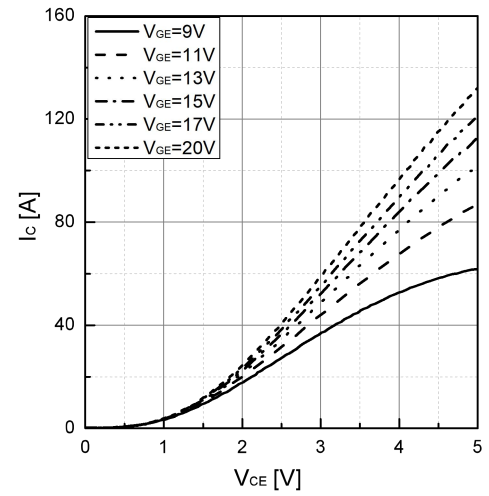


Fig 2. Typical output characteristic ( $T_{vj}=175^{\circ}\text{C}$ )

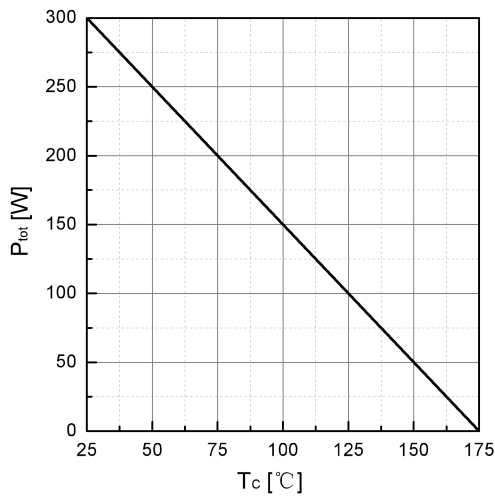


Fig 3. Power dissipation as a function of  $T_c$

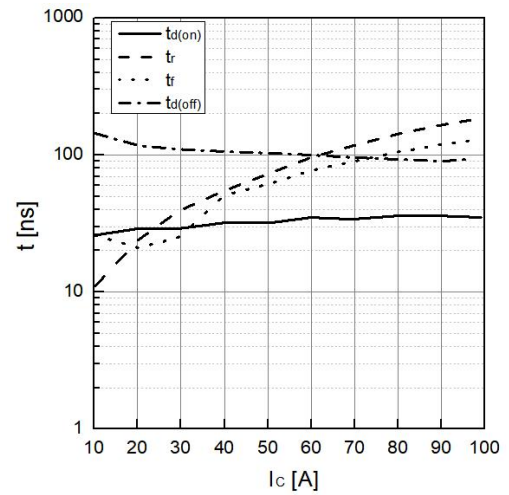


Fig 4. Typical switching time as a function of  $I_c$

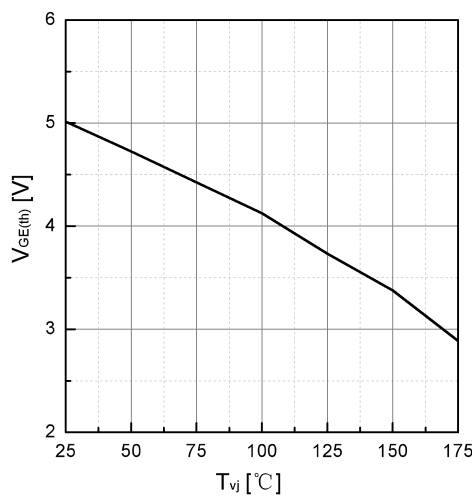


Fig 5. Typical  $V_{GE(th)}$  as a function of  $T_{vj}$

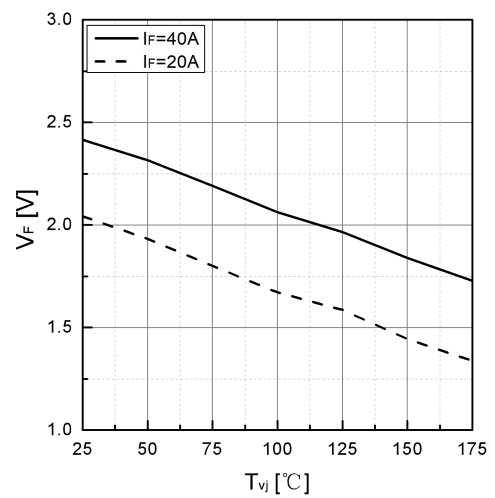


Fig 6. Typical  $V_F$  as a function of  $T_{vj}$

## Typical performance characteristics

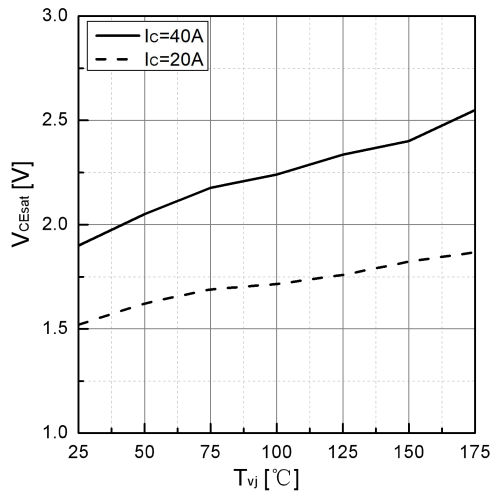


Fig 7. Typical  $V_{CEsat}$  as a function of  $T_{vj}$

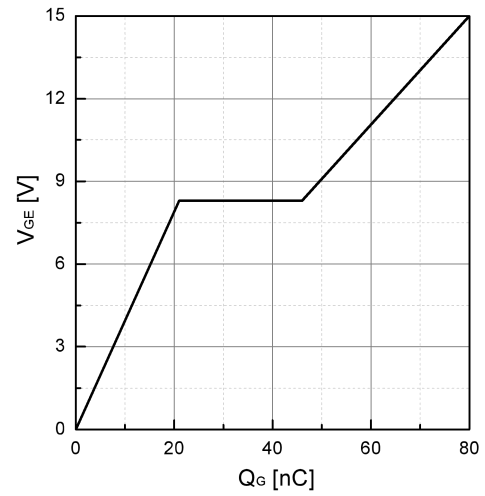


Fig 8. Typical Gate charge

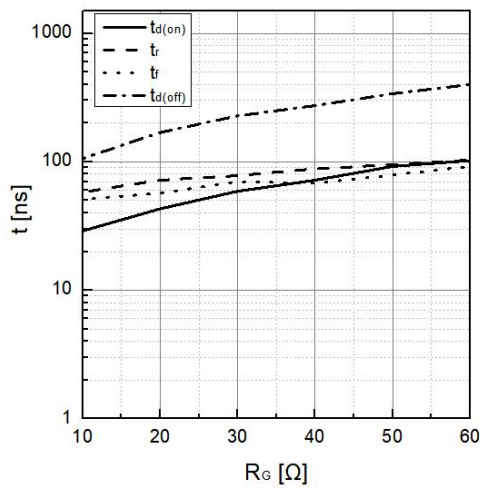


Fig 9. Typical switching times as a function of  $R_G$

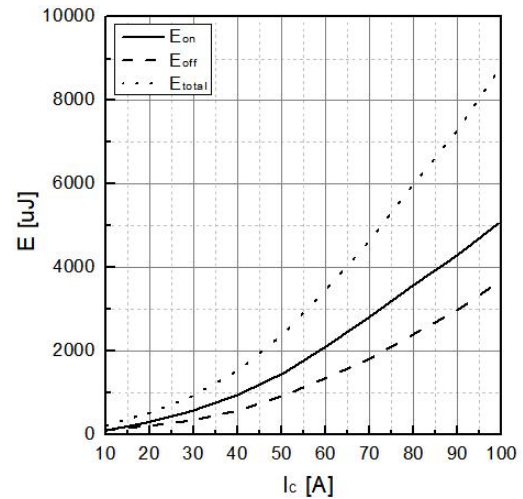


Fig 10. Typical switching energy losses as a function of  $I_C$

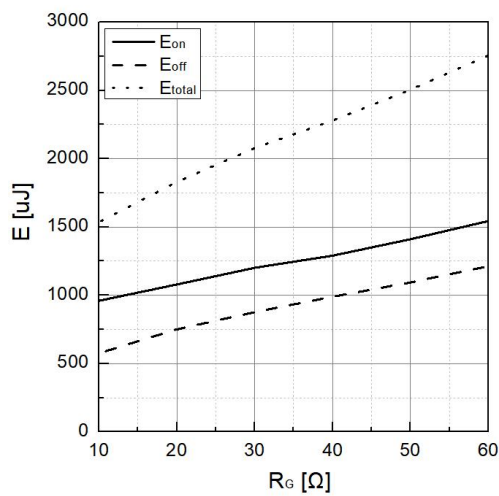


Fig 11. Typical switching energy losses as a function of  $R_G$

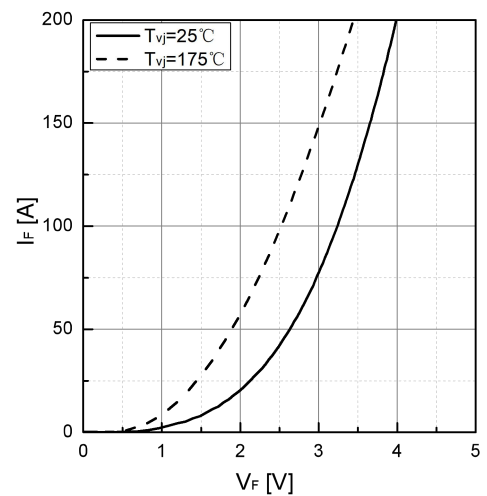


Fig 12. Typical  $I_F$  as a function of  $V_F$

## Typical performance characteristics

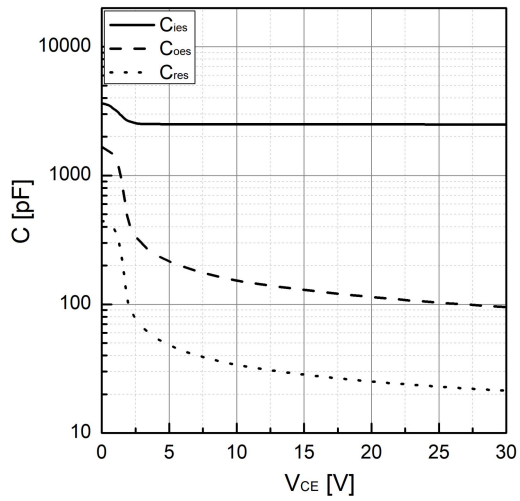


Fig 13. Typical capacitance as a function of  $V_{CE}$   
( $f=1\text{MHz}$ ,  $V_{GE}=0\text{V}$ )

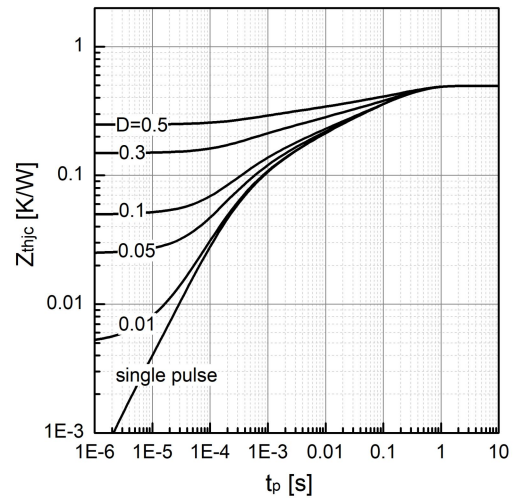
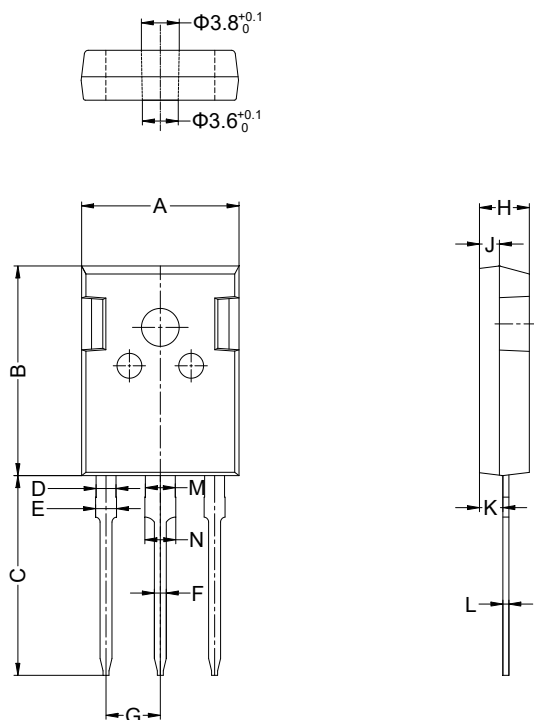


Fig 14. Transient thermal impedance of IGBT

## Package dimension

TO-247



| Ref. | Dimensions  |       |       |        |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | Millimeters |       |       | Inches |       |       |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| A    | 15.50       | 15.80 | 16.10 | 0.610  | 0.622 | 0.634 |
| B    | 20.80       | 21.00 | 21.20 | 0.819  | 0.827 | 0.835 |
| C    | 19.70       | 20.00 | 20.30 | 0.776  | 0.787 | 0.799 |
| D    | 1.80        | 2.00  | 2.20  | 0.071  | 0.079 | 0.087 |
| E    | 1.90        | 2.10  | 2.30  | 0.075  | 0.083 | 0.091 |
| F    | 1.00        | 1.20  | 1.40  | 0.039  | 0.047 | 0.055 |
| G    | 5.25        | -     | 5.65  | 0.207  | -     | 0.222 |
| H    | 4.80        | 5.00  | 5.20  | 0.189  | 0.197 | 0.205 |
| J    | 1.90        | 2.00  | 2.10  | 0.075  | 0.079 | 0.083 |
| K    | 2.20        | 2.35  | 2.50  | 0.087  | 0.093 | 0.098 |
| L    | 0.41        | 0.60  | 0.79  | 0.016  | 0.024 | 0.031 |
| M    | 2.80        | 3.00  | 3.20  | 0.110  | 0.118 | 0.126 |
| N    | 2.90        | 3.10  | 3.30  | 0.114  | 0.122 | 0.130 |

## Revision history

| Date       | Revision | Changes                  |
|------------|----------|--------------------------|
| 2023-11-20 | Rev 1.0  | Release of the datasheet |
| 2024-04-17 | Rev 1.1  | Update                   |
| 2024-05-17 | Rev 1.2  | Update                   |

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