MBN1800F33F

Silicon N-channel IGBT 3300V F version

FEATURES
* Soft switching behavior, low switching loss & low conduction loss :
  * Soft low-injection punch-through
  * Advanced Trench High conductivity IGBT.
* Low driving power due to low input capacitance with trench MOS gate.
* Low noise recovery: Ultra soft fast recovery diode.
* High Current rate Package.
* Low Rth(j-c) & low stray inductance.
* RoHS
* High thermal fatigue durability: (delta Tc=70K, N>30,000cycles)

ABSOLUTE MAXIMUM RATINGS (Tc=25°C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector Emitter Voltage</td>
<td>VCES</td>
<td>V</td>
<td></td>
<td></td>
<td>3.3</td>
<td>VGE=3.300V, VGE=0V, Tj=25°C</td>
</tr>
<tr>
<td>Gate Emitter Voltage</td>
<td>VGES</td>
<td>V</td>
<td>≥20</td>
<td></td>
<td></td>
<td>VGE=3.300V, VGE=0V, Tj=150°C</td>
</tr>
<tr>
<td>Collector Current</td>
<td>IC</td>
<td>A</td>
<td>1,800</td>
<td></td>
<td></td>
<td>VGE=±20V, VGE=0V, Tj=25°C</td>
</tr>
<tr>
<td>Forward Current</td>
<td>IF</td>
<td>A</td>
<td>1,800</td>
<td></td>
<td></td>
<td>VGE=10V, Ic=180mA, Tj=25°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>TJ</td>
<td>°C</td>
<td>-50</td>
<td>~+150</td>
<td></td>
<td>TSS=55°C, Tj=25°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>TSS</td>
<td>°C</td>
<td>-55</td>
<td>~+150</td>
<td></td>
<td>TSS=55°C, Tj=25°C</td>
</tr>
<tr>
<td>Isolation Voltage</td>
<td>VIS</td>
<td>V</td>
<td></td>
<td></td>
<td>6.0</td>
<td>6,000(AC 1 minute)</td>
</tr>
<tr>
<td>Screw Torque</td>
<td>N Tomorrow (M4/M8)</td>
<td>N Tomorrow</td>
<td>2/15</td>
<td></td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>Mounting (M6)</td>
<td>N Tomorrow</td>
<td>N Tomorrow</td>
<td>6</td>
<td></td>
<td>(2)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1) Recommended Value 1.8±0.2/15°-N·m; (2) Recommended Value 5.5±0.5N·m

ELECTRICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector Emitter Cut-Off Current</td>
<td>IGE</td>
<td>mA</td>
<td>-</td>
<td>-</td>
<td>60</td>
<td>VCE=1800V, IC=0V, TJ=25°C</td>
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<tr>
<td>Gate Emitter Leakage Current</td>
<td>IGE</td>
<td>nA</td>
<td>-500</td>
<td>-</td>
<td>500</td>
<td>VCE=±20V, VCE=0V, Tj=25°C</td>
</tr>
<tr>
<td>Collector Emitter Saturation Voltage</td>
<td>VCESat</td>
<td>V</td>
<td>2.5</td>
<td>2.85</td>
<td>3.5</td>
<td>Ic=1800A, VGE=15V, Tj=150°C</td>
</tr>
<tr>
<td>Gate Emitter Threshold Voltage</td>
<td>VGE(th)</td>
<td>V</td>
<td>5.5</td>
<td>6.5</td>
<td>7.5</td>
<td>VCE=10V, Ic=1800mA, Tj=25°C</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>Ciss</td>
<td>nF</td>
<td>132</td>
<td></td>
<td></td>
<td>VCE=10V, VGE=0V, f=100kHz, Tj=25°C</td>
</tr>
<tr>
<td>Internal Gate Resistance</td>
<td>rgs</td>
<td>Ω</td>
<td>0.3</td>
<td></td>
<td></td>
<td>VCE=1800V, Ic=1800A</td>
</tr>
<tr>
<td>Rise Time</td>
<td>tR</td>
<td>μs</td>
<td></td>
<td></td>
<td></td>
<td>LS=80nH</td>
</tr>
<tr>
<td>Turn On Time</td>
<td>tON</td>
<td>μs</td>
<td>1.1</td>
<td></td>
<td></td>
<td>LS=80nH</td>
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<tr>
<td>Fall Time</td>
<td>tF</td>
<td>μs</td>
<td>1.8</td>
<td></td>
<td></td>
<td>Rs(on/off)=4.7Ω/5.6Ω (3)</td>
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<tr>
<td>Turn Off Time</td>
<td>tOFF</td>
<td>μs</td>
<td>4.0</td>
<td></td>
<td></td>
<td>VGE=±15V, TJ=150°C</td>
</tr>
<tr>
<td>Peak Forward Voltage Drop</td>
<td>VR</td>
<td>V</td>
<td>2.2</td>
<td>2.6</td>
<td>2.9</td>
<td>IF=1800A, VGE=0V, TJ=150°C</td>
</tr>
<tr>
<td>Reverse Recovery Time</td>
<td>tR</td>
<td>μs</td>
<td>0.7</td>
<td></td>
<td></td>
<td>VCE=1800V, IF=1800A, LS=80nH</td>
</tr>
<tr>
<td>Turn On Loss</td>
<td>Eon</td>
<td>J/P</td>
<td>3.7</td>
<td></td>
<td></td>
<td>Rs(on/off)=4.7Ω/5.6Ω (3)</td>
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<tr>
<td>Turn Off Loss</td>
<td>Eoff</td>
<td>J/P</td>
<td>3.3</td>
<td></td>
<td></td>
<td>Rs(on/off)=4.7Ω/5.6Ω (3)</td>
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<tr>
<td>Reverse Recovery Loss</td>
<td>Ee</td>
<td>J/P</td>
<td>2.4</td>
<td></td>
<td></td>
<td>Rs(on/off)=4.7Ω/5.6Ω (3)</td>
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<tr>
<td>Short Circuit Pulse Width</td>
<td>tsc</td>
<td>μs</td>
<td>10</td>
<td></td>
<td></td>
<td>VCE=2000V, LS=100nH</td>
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<tr>
<td>Stray inductance module</td>
<td>LSE</td>
<td>nH</td>
<td>7</td>
<td></td>
<td></td>
<td>Rs(on/off)=4.7Ω/5.6Ω</td>
</tr>
<tr>
<td>Thermal Impedance</td>
<td>Rth(I-c)</td>
<td>K/W</td>
<td>0.0067</td>
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<td></td>
<td>Junction to case</td>
</tr>
<tr>
<td>Contact Thermal Impedance</td>
<td>Rth(c-f)</td>
<td>K/W</td>
<td>0.012</td>
<td></td>
<td></td>
<td>Junction to case</td>
</tr>
<tr>
<td>PT value</td>
<td>tP</td>
<td>kA²s</td>
<td>1000</td>
<td></td>
<td></td>
<td>Tj=150°C, 10ms, V=0V, half-sinewave</td>
</tr>
</tbody>
</table>

Notes: (3) Rs value is a test condition value for evaluation, not recommended value.
  * Please determine the suitable Rs value by measuring switching behaviors.
  * Please contact our representatives at order.
  * For improvement, specifications are subject to change without notice.
  * For actual application, please confirm this spec sheet is the newest revision.
  * ELECTRICAL CHARACTERISTIC values according to IEC 60747–2 IEC 60747–9
STATISTICAL CHARACTERISTICS

Collector Current vs. Collector to Emitter Voltage

Collector to Emitter Voltage, VCE (V)
Collector Current, Ic (A)

VGE = 15V
Tc = 25°C

VGE = 9V
Tc = 150°C

VGE = 7V
Tc = 25°C

Forward Voltage of free-wheeling diode

Forward Voltage, VF (V)
Forward Current, IF (A)

VGE = 0V
Tj = 25°C

Tj = 150°C
**Dynamic Characteristics**

1. **Turn-on Loss vs. Collector Current**
   - **Conditions:**
     - $V_{cc}=1800\,\text{V}$
     - $R_{G(on)}=4.7\,\Omega$
     - $V_G=\pm15\,\text{V}$
     - $L_s=80\,\text{nH}$
     - $T_c=150\,\text{°C}$
   - **Equation:**
     \[ y = 2 \times 10^{-7} x^2 + 0.0016 x + 0.2825 \]

2. **Turn-off Loss vs. Collector Current**
   - **Conditions:**
     - $V_{cc}=1800\,\text{V}$
     - $R_{G(off)}=5.6\,\Omega$
     - $V_G=\pm15\,\text{V}$
     - $L_s=80\,\text{nH}$
     - $T_c=150\,\text{°C}$
   - **Equation:**
     \[ y = 6 \times 10^{-8} x^2 + 0.0015 x + 0.2995 \]

3. **Reverse Recovery Loss vs. Collector Current**
   - **Conditions:**
     - $V_{cc}=1800\,\text{V}$
     - $R_{G(on)}=4.7\,\Omega$
     - $V_G=\pm15\,\text{V}$
     - $L_s=80\,\text{nH}$
     - $T_c=150\,\text{°C}$
   - **Equation:**
     \[ y = -1 \times 10^{-7} x^2 + 0.0014 x + 0.5581 \]

4. **Switching Time vs. Collector Current**
   - **Conditions:**
     - $V_{cc}=1800\,\text{V}$
     - $R_{G(on/off)}=4.7\,\Omega/5.6\,\Omega$
     - $V_G=\pm15\,\text{V}$
     - $L_s=80\,\text{nH}$
     - $T_c=150\,\text{°C}$
   - **Equation:**
     \[ y = 2E-07 x^2 + 0.0015 x + 0.2995 \]
IGBT MODULE

MBN1800F33F

**Turn-on Loss vs. Gate Resistance**

- Conditions:
  - Vcc=1800V
  - IC=1800A
  - VG=±15V
  - Ls=80nH
  - Tc=150°C
  - Inductive Load

**Turn-off Loss vs. Gate Resistance**

- Conditions:
  - Vcc=1800V
  - IC=1800A
  - VG=±15V
  - Ls=80nH
  - Tc=150°C
  - Inductive Load

**Reverse Recovery Loss vs. Gate Resistance**

- Conditions:
  - Vcc=1800V
  - IC=1800A
  - VG=±15V
  - Ls=80nH
  - Tc=150°C
  - Inductive Load
**IGBT MODULE**

**MBN1800F33F**

### Capacitance vs. Collector to Emitter Voltage

- **Conditions:**
  - $T_j=25^\circ C$
  - $f=100$ kHz

- **Graph:**
  - $C_{ies}$, $C_{oes}$, $C_{res}$ (nF)
  - Collector to Emitter Voltage, $V_{CE}$ (V)

### QG-VGE Curve

- **Conditions:**
  - $L_s=80$ nH, $V_{CC}=1800$ V,
  - $I_{C}=1800$ A, $V_{GE}=\pm 15$ V, $T_j=25^\circ C$

### Safe Operating Area

- **Reverse bias safe operation area (RBSOA)**
  - $V_{CC} \leq 2200$ V, $I_C \leq 3600$ A,
  - $R_{G(off)} \geq 5.6 \Omega$, $V_{GE}=\pm15$ V,
  - $-50^\circ C \leq T_j \leq 150^\circ C$, $L_s \leq 80$ nH,
  - on pulse width $\geq 10$ us

- **Reverse recovery safe operation area (RRSOA)**
  - $V_{CC} \leq 2200$ V, $I_F \leq 3600$ A,
  - $\frac{dI}{dt} \leq 11$ kA/us,
  - $-50^\circ C \leq T_j \leq 150^\circ C$
  - $L_s \leq 80$ nH,
  - on pulse width $\geq 10$ us

**TYPICAL**

**Pmax=3.6MW**
TRANSIENT THERMAL IMPEDANCE

 transient thermal impedance : $Z_{th(j-c)}$ (K/W)

### Curve approximation model

$\sum Z_{th[n]}(1 - \exp(-t/\tau_{th[n]}))$

<table>
<thead>
<tr>
<th>$n$</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_{th[n]}$</td>
<td>0.003</td>
<td>0.03</td>
<td>0.1</td>
<td>0.3</td>
<td>sec</td>
</tr>
<tr>
<td>$Z_{th[n,IGBT]}$</td>
<td>1.36E-03</td>
<td>7.88E-04</td>
<td>4.11E-03</td>
<td>4.49E-04</td>
<td>K/W</td>
</tr>
<tr>
<td>$Z_{th[n,Diode]}$</td>
<td>2.26E-03</td>
<td>1.62E-03</td>
<td>6.71E-03</td>
<td>1.41E-03</td>
<td>K/W</td>
</tr>
</tbody>
</table>

Maximum FWD

IGBT

Transient Thermal Impedance Curve
**Fig. 1 Outline Drawings**

**Fig. 2 Circuit diagram**
For inquiries relating to the products, please contact nearest overseas representatives that is located “Inquiry” portion on the top page of a home page.

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