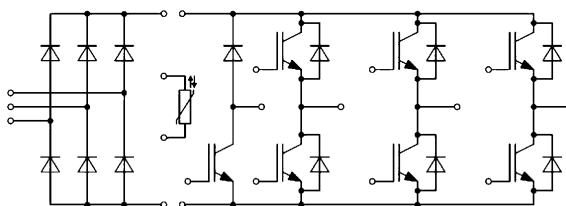


## High Speed IGBT in Trench and Fieldstop Technology



### Features:

- 1200V 100A,  $V_{CE(sat)} = 1.7V @ 25^{\circ}C$
- High RBSOA capability
- Trench/FS technology
- Low reverse-recovery losses
- High SC capability

### Applications:

- Motor drives
- Servo drives
- Auxiliary inverters
- Uninterruptible power supply

### Mechanical Features:

- High power and thermal cycling capability
- Maximum junction temperature  $175^{\circ}C$
- High power density
- PressFIT contact technology
- Isolated base plate

### Key Performance and Package Parameters

| Type          | $V_{CES}$ | $I_{Cnom}$ | $V_{CEsat}, T_{vj}=25^{\circ}C$ | $T_{vjmax}$    | Marking       |
|---------------|-----------|------------|---------------------------------|----------------|---------------|
| PM100T6120XS1 | 1200V     | 100A       | 1.7V                            | $175^{\circ}C$ | PM100T6120XS1 |

### IGBT/FRD Inverter

#### Maximum Rated Values at $T_{vj}=25^{\circ}C$ (unless otherwise specified)

| Parameter                                            | Symbols   | Value           | Units       |
|------------------------------------------------------|-----------|-----------------|-------------|
| Collector-emitter voltage                            | $V_{CES}$ | 1200            | V           |
| Continuous DC collector current $T_c = 100^{\circ}C$ | $I_C$     | 100             | A           |
| Pulsed collector current $t_p = 1ms$                 | $I_{cp}$  | 200             | A           |
| Diode forward current                                | $I_F$     | 100             | A           |
| Gate-emitter peak voltage                            | $V_{GES}$ | $\pm 30$        | V           |
| Repetitive peak forward current                      | $I_{FRM}$ | 200             | A           |
| Operating junction temperature                       | $T_{vj}$  | $-40 \sim +150$ | $^{\circ}C$ |
| Storage temperature                                  | $T_{stg}$ | $-40 \sim +125$ | $^{\circ}C$ |

## Diode, Rectifier

| Parameter                                                      | Symbols   | Value | Units           |
|----------------------------------------------------------------|-----------|-------|-----------------|
| Repetitive peak reverse voltage                                | $V_{RRM}$ | 1600  | V               |
| Average output current 50Hz/60Hz, sine wave                    | $I_o$     | 100   | A               |
| Surge forward current $V_R=0V$ $t_p=10ms$ $T_{vj}=45^{\circ}C$ | $I_{FSM}$ | 900   | A               |
| $I_{zt}$ -Value $V_R=0V$ $t_p=10ms$ $T_{vj}=45^{\circ}C$       | $I_{zt}$  | 5000  | A <sub>2s</sub> |

## IGBT, Brake

| Parameter                               | Symbols   | Value    | Units |
|-----------------------------------------|-----------|----------|-------|
| Collector-emitter voltage               | $V_{CES}$ | 1200     | V     |
| Gate-Emitter voltage                    | $V_{GES}$ | $\pm 30$ | A     |
| DC collector current $T_c=100^{\circ}C$ | $I_c$     | 50       | A     |
| Pulsed collector current $t_p=1ms$      | $I_{CP}$  | 100      | A     |

## Diode, Brake

| Parameter                                 | Symbols   | Value | Units |
|-------------------------------------------|-----------|-------|-------|
| Repetitive peak reverse voltage           | $V_{RRM}$ | 1200  | V     |
| Diode continuous forward current          | $I_F$     | 30    | A     |
| Repetitive peak forward current $t_p=1ms$ | $I_{FRM}$ | 60    | A     |

## Module

| Parameter                                     | Symbols     | Value      | Units       |
|-----------------------------------------------|-------------|------------|-------------|
| Maximum junction temperature(inverter, brake) | $T_{vjmax}$ | 175        | $^{\circ}C$ |
| Maximum junction temperature(rectifier)       |             | 150        | $^{\circ}C$ |
| Operating junction temperature                | $T_{vj}$    | -40 ~ +150 | $^{\circ}C$ |
| Storage temperature                           | $T_{stg}$   | -40 ~ +125 | $^{\circ}C$ |
| Isolation voltage RMS, $f=50Hz$ , $t=1min$    | $V_{ISO}$   | 2500       | V           |

## Diode, Inverter

| Parameter                     | Symbols   | Conditions                                                                                                                                   | Value |                         |     | Unit    |
|-------------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------|-----|---------|
|                               |           |                                                                                                                                              | Min   | Typ                     | Max |         |
| Forward voltage               | $V_F$     | $I_F=100A$ , $V_{GE}=0V$<br>$T_{vj}=25^{\circ}C$<br>$T_{vj}=125^{\circ}C$<br>$T_{vj}=150^{\circ}C$                                           | -     | 1.49<br>1.38<br>1.36    | -   | V       |
| Recovery charge               | $Q_r$     | $I_F=100A$ , $V_R=600V$<br>$-di_F/dt=1100A/us$ ,<br>$V_{GE}= -15V$<br>$T_{vj}=25^{\circ}C$<br>$T_{vj}=125^{\circ}C$<br>$T_{vj}=150^{\circ}C$ | -     | 7.90<br>16.77<br>22.31  | -   | $\mu C$ |
| Reverse recovery energy       | $E_{rec}$ | $I_F=100A$ , $V_R=600V$<br>$-di_F/dt=1100A/us$<br>$V_{GE}= -15V$<br>$T_{vj}=25^{\circ}C$<br>$T_{vj}=125^{\circ}C$<br>$T_{vj}=150^{\circ}C$   | -     | 3.17<br>6.41<br>8.91    | -   | mJ      |
| Peak reverse recovery current | $I_{RM}$  | $I_F=100A$ , $V_R=600V$<br>$-di_F/dt=1100A/us$<br>$V_{GE}= -15V$<br>$T_{vj}=25^{\circ}C$<br>$T_{vj}=125^{\circ}C$<br>$T_{vj}=150^{\circ}C$   | -     | 60.81<br>71.25<br>89.43 | -   | A       |

**Diode, Rectifier**

| Parameter       | Symbols | Conditions                |                      | Value |      |     | Unit    |
|-----------------|---------|---------------------------|----------------------|-------|------|-----|---------|
|                 |         |                           |                      | Min   | Typ  | Max |         |
| Forward voltage | $V_F$   | $I_F=100A$ , $V_{GE}=0V$  | $T_{vj}=25^{\circ}C$ | -     | 1.20 | -   | V       |
| Reverse current | $I_R$   | $V_R=1600V$ , $V_{GE}=0V$ | $T_{vj}=25^{\circ}C$ | -     | 3.34 | -   | $\mu A$ |

**IGBT, Brake**

| Parameter                            | Symbols      | Conditions                                                                             |                                            | Value |      |           | Unit    |
|--------------------------------------|--------------|----------------------------------------------------------------------------------------|--------------------------------------------|-------|------|-----------|---------|
|                                      |              |                                                                                        |                                            | Min   | Typ  | Max       |         |
| Collector-emitter saturation voltage | $V_{CEsat}$  | $I_C=50A$ , $V_{GE}=15V$ , $T_{vj}=25^{\circ}C$                                        |                                            | -     | 2.1  | -         | V       |
| Collector-emitter leakage current    | $I_{CES}$    | $V_{CE}=1200V$ , $V_{GE}=0V$ , $T_{vj}=25^{\circ}C$                                    |                                            | -     | -    | 200       | $\mu A$ |
| Gate-emitter threshold voltage       | $V_{GE(th)}$ | $I_C=1.6mA$ , $V_{CE}=V_{GE}$ , $T_{vj}=25^{\circ}C$                                   |                                            | -     | 5.9  | -         | V       |
| Gate-emitter leakage current         | $I_{GES}$    | $V_{CE}=0V$ , $V=20V$ , $T_{vj}=25^{\circ}C$                                           |                                            | -     | -    | $\pm 300$ | nA      |
| Turn-on delay time , inductive load  | $t_{d(on)}$  | $V_{CC}= 600V$<br>$I_C= 50A$<br>$V_{GE}= 15V$<br>$R_G= 15\Omega$                       | $T_{vj}=25^{\circ}C$                       | -     | 0.23 | -         | $\mu s$ |
| Rise time , inductive load           | $t_r$        |                                                                                        | $T_{vj}=25^{\circ}C$                       | -     | 0.04 | -         | $\mu s$ |
| Turn-off delay time , inductive load | $t_{d(off)}$ |                                                                                        | $T_{vj}=25^{\circ}C$                       | -     | 0.36 | -         | $\mu s$ |
| Fall time , inductive load           | $t_f$        |                                                                                        | $T_{vj}=25^{\circ}C$                       | -     | 0.12 | -         | $\mu s$ |
| Turn-on switching loss               | $E_{on}$     |                                                                                        | $T_{vj}=25^{\circ}C$                       | -     | 5.49 | -         | $\mu s$ |
| Turn-off switching loss              | $E_{off}$    |                                                                                        | $T_{vj}=25^{\circ}C$                       | -     | 3.83 | -         | $\mu s$ |
| SC data                              | $I_{sc}$     | $V_{CC}= 600V$<br>$R_G= 20\Omega$<br>$V_{GE}\leq 15V$<br>$V_{CEmax}=V_{CE-LsCE}*di/dt$ | $t_p\leq 10\mu s$<br>$T_{vj}=150^{\circ}C$ | -     | 200  | -         | A       |

**IGBT, Inverter**  
**Characteristic Values (unless otherwise specified)**

| Parameter                            | Symbols             | Conditions                                                                                                                                                             |                                                                                                                                         | Value                                           |                         |             | Unit |   |
|--------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-------------------------|-------------|------|---|
|                                      |                     |                                                                                                                                                                        |                                                                                                                                         | Min                                             | Typ                     | Max         |      |   |
| Collector-emitter saturation voltage | V <sub>CEsat</sub>  | lc=100A, V <sub>GE</sub> =15V, T <sub>vj</sub> =25°C<br>lc=100A, V <sub>GE</sub> =15V, T <sub>vj</sub> =125°C<br>lc=100A, V <sub>GE</sub> =15V, T <sub>vj</sub> =150°C | -<br>-<br>-                                                                                                                             | 1.7<br>2.08<br>2.23                             | 2.2<br>-<br>-           | V           |      |   |
| Gate-emitter threshold voltage       | V <sub>GE(th)</sub> | lc=100mA, V <sub>CE</sub> =V <sub>GE</sub> , T <sub>vj</sub> =25°C                                                                                                     | 5.5                                                                                                                                     | 6.1                                             | 6.7                     | V           |      |   |
| Internal gate resistor               | R <sub>Gint</sub>   | T <sub>vj</sub> =25°C                                                                                                                                                  | -                                                                                                                                       | 3.88                                            | -                       | Ω           |      |   |
| Collector-emitter leakage current    | I <sub>CES</sub>    | V <sub>CE</sub> =1200V, V <sub>GE</sub> =0V, T <sub>vj</sub> =25°C                                                                                                     | -                                                                                                                                       | -                                               | 200                     | uA          |      |   |
| Gate-emitter leakage current         | I <sub>GES</sub>    | V <sub>CE</sub> =0V, V=20V, T <sub>vj</sub> =25°C                                                                                                                      | -                                                                                                                                       | -                                               | ±300                    | nA          |      |   |
| Input capacitance                    | C <sub>ies</sub>    | f=1MHz, V <sub>CE</sub> =25V, V <sub>GE</sub> =0V                                                                                                                      | -                                                                                                                                       | 21.20                                           | -                       | nF          |      |   |
| Reverse transfer capacitance         | C <sub>res</sub>    | f=1MHz, V <sub>CE</sub> =25V, V <sub>GE</sub> =0V                                                                                                                      | -                                                                                                                                       | 0.12                                            | -                       | nF          |      |   |
| Gate charge                          | Q <sub>G</sub>      | V <sub>CC</sub> = 600V, V <sub>GE</sub> = 15V                                                                                                                          | -                                                                                                                                       | 1.80                                            | -                       | nC          |      |   |
| Turn-on delay time , inductive load  | t <sub>d(on)</sub>  | V <sub>CC</sub> =600V<br>I <sub>C</sub> =100A<br>V <sub>GE</sub> =15V<br>R <sub>G</sub> =10Ω                                                                           | T <sub>vj</sub> =25°C<br>T <sub>vj</sub> =125°C<br>T <sub>vj</sub> =150°C                                                               | -<br>-<br>-                                     | 0.36<br>0.34<br>0.33    | -<br>-<br>- | μs   |   |
| Rise time , inductive load           | t <sub>r</sub>      |                                                                                                                                                                        | T <sub>vj</sub> =25°C<br>T <sub>vj</sub> =125°C<br>T <sub>vj</sub> =150°C                                                               | -<br>-<br>-                                     | 0.09<br>0.10<br>0.11    | -<br>-<br>- | μs   |   |
| Turn-off delay time , inductive load | t <sub>d(off)</sub> |                                                                                                                                                                        | T <sub>vj</sub> =25°C<br>T <sub>vj</sub> =125°C<br>T <sub>vj</sub> =150°C                                                               | -<br>-<br>-                                     | 0.39<br>0.41<br>0.44    | -<br>-<br>- | μs   |   |
| Fall time , inductive load           | t <sub>f</sub>      |                                                                                                                                                                        | T <sub>vj</sub> =25°C<br>T <sub>vj</sub> =125°C<br>T <sub>vj</sub> =150°C                                                               | -<br>-<br>-                                     | 0.08<br>0.10<br>0.15    | -<br>-<br>- | μs   |   |
| Turn-on switching loss               | E <sub>on</sub>     |                                                                                                                                                                        | T <sub>vj</sub> =25°C<br>T <sub>vj</sub> =125°C<br>T <sub>vj</sub> =150°C                                                               | -<br>-<br>-                                     | 12.92<br>16.08<br>21.09 | -<br>-<br>- | mJ   |   |
| Turn-off switching loss              | E <sub>off</sub>    |                                                                                                                                                                        | T <sub>vj</sub> =25°C<br>T <sub>vj</sub> =125°C<br>T <sub>vj</sub> =150°C                                                               | -<br>-<br>-                                     | 5.35<br>6.19<br>7.34    | -<br>-<br>- | mJ   |   |
| SC data                              | I <sub>SC</sub>     |                                                                                                                                                                        | V <sub>CC</sub> = 600V<br>R <sub>G</sub> = 20Ω<br>V <sub>GE</sub> ≤ 15V<br>V <sub>CEmax</sub> =V <sub>CE</sub> -L <sub>SC</sub> E*di/dt | t <sub>p</sub> ≤ 10μs<br>T <sub>vj</sub> =150°C | -                       | 400         | -    | A |

**Thermal resistance**

| Parameter                                          | Symbols       | Value |     |      | Units |
|----------------------------------------------------|---------------|-------|-----|------|-------|
|                                                    |               | Min   | Typ | Max  |       |
| Thermal resistance, inverter IGBT junction to case | $R_{th(j-c)}$ | -     | -   | 0.23 | K/W   |
| Thermal resistance, inverter FRD junction to case  | $R_{th(j-c)}$ | -     | -   | 0.44 |       |

**Diode , Brake****Characteristic Values at  $T_{vj}=25^{\circ}\text{C}$  (unless otherwise specified)**

| Parameter                     | Symbols   | Conditions                                                                                                                          | Value |       |     | Unit          |
|-------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-----|---------------|
|                               |           |                                                                                                                                     | Min   | Typ   | Max |               |
| Forward voltage               | $V_F$     | $I_F=30\text{A}$ , $V_{GE}=0\text{V}$<br>$T_{vj}=25^{\circ}\text{C}$                                                                | -     | 1.97  | -   | V             |
| Recovery charge               | $Q_r$     | $I_F=30\text{A}$ , $V_R=600\text{V}$<br>$-di_F/dt=357\text{A}/\mu\text{s}$ ,<br>$V_{GE}=-15\text{V}$<br>$T_{vj}=25^{\circ}\text{C}$ | -     | 0.25  | -   | $\mu\text{C}$ |
| Reverse recovery energy       | $E_{rec}$ | $I_F=30\text{A}$ , $V_R=600\text{V}$<br>$-di_F/dt=357\text{A}/\mu\text{s}$<br>$V_{GE}=-15\text{V}$<br>$T_{vj}=25^{\circ}\text{C}$   | -     | 0.01  | -   | mJ            |
| Peak reverse recovery current | $I_{RM}$  | $I_F=30\text{A}$ , $V_R=600\text{V}$<br>$-di_F/dt=357\text{A}/\mu\text{s}$<br>$V_{GE}=-15\text{V}$<br>$T_{vj}=25^{\circ}\text{C}$   | -     | 13.78 | -   | A             |

**Module**

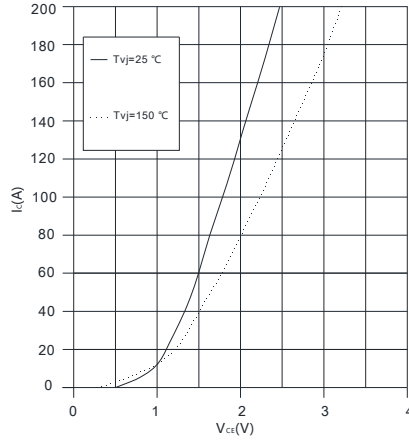
| Parameter                    | Symbols     | Conditions           | Value |                         |   | Unit |
|------------------------------|-------------|----------------------|-------|-------------------------|---|------|
| Material of module base plat |             |                      | -     | Cu                      | - |      |
| Internal isolation           |             |                      | -     | $\text{Al}_2\text{O}_3$ | - |      |
| Creepage distance            | $d_{Creep}$ | Terminal to terminal | -     | 10.0                    | - | mm   |
| Clearance                    | $d_{Clear}$ | Terminal to terminal | -     | 7.5                     | - | mm   |
| Comparative tracking index   | CTI         |                      | -     | 200                     | - |      |

| Parameter                              | Symbols       | Conditions                            | Value |      |     | Unit       |
|----------------------------------------|---------------|---------------------------------------|-------|------|-----|------------|
|                                        |               |                                       | Min   | Typ  | Max |            |
| Stray inductance module                | $L_{sCE}$     |                                       | -     | 35.2 | -   | nH         |
| Module lead resistance ,terminals-chip | $R_{CC'+EE'}$ | $T_C=25^{\circ}\text{C}$ , Per switch | -     | 4.3  | -   | m $\Omega$ |
| Mounting torque for module mounting    | M             | Screw M5                              | 3.0   |      | 6.0 | Nm         |
| Weight                                 | G             |                                       | -     | 300  | -   | g          |

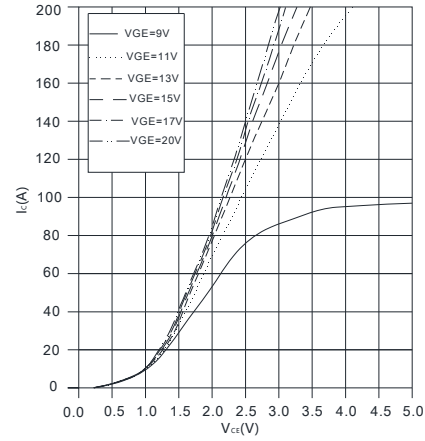
**NTC Characteristics**

| Parameter              | Symbols      | Conditions                                             | Value |      |     | Unit       |
|------------------------|--------------|--------------------------------------------------------|-------|------|-----|------------|
|                        |              |                                                        | Min   | Typ  | Max |            |
| Rated resistance       | $R_{25}$     | $T_{NTC}=25^{\circ}\text{C}$                           | -     | 5.0  | -   | K $\Omega$ |
| Deviation of $R_{100}$ | $\Delta R/R$ | $T_{NTC}=100^{\circ}\text{C}$ , $R_{100}=493\Omega$    | -5    | -    | 5   | %          |
| Power dissipation      | $P_{25}$     |                                                        | -     | -    | 20  | mW         |
| B-value                | $B_{25/50}$  | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$  | -     | 3388 | -   | K          |
| B-value                | $B_{25/80}$  | $R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$  | -     | 3454 | -   | K          |
| B-value                | $B_{25/100}$ | $R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$ | -     | 3485 | -   | K          |

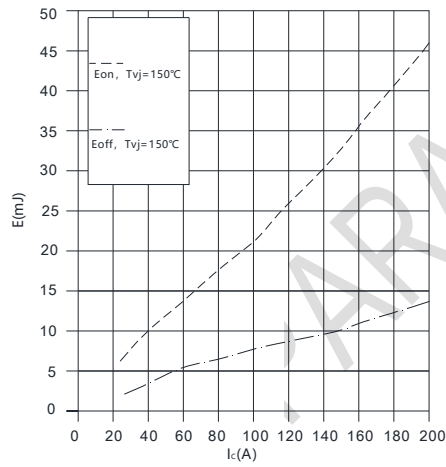
## Typical Characteristi



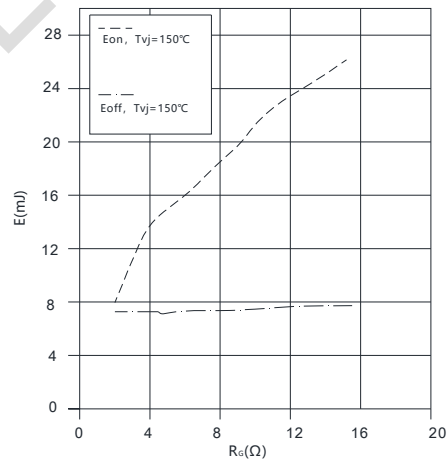
**Fig 1. Output characteristic (typical), IGBT, Inverter**  $I_c = f(V_{ce})$   $V_{GE} = 15V$



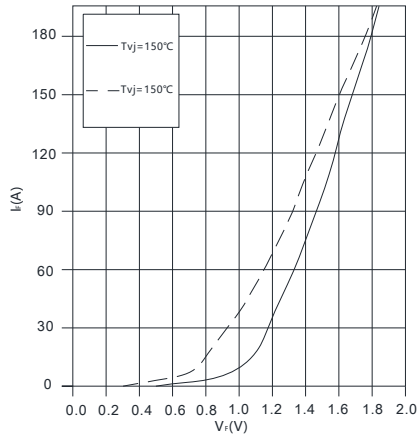
**Fig 2. Output characteristic (typical),  $I_c = f(V_{ce})$   $T_{vj} = 150^{\circ}C$**



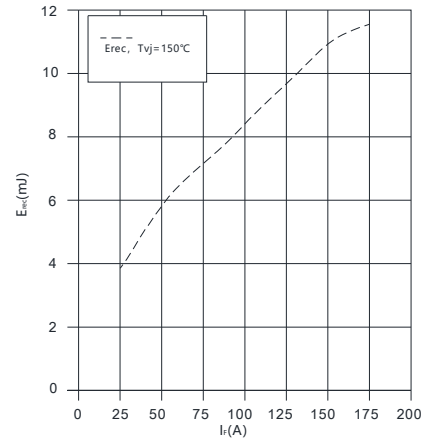
**Fig 3. Switching losses (typical), IGBT, Inverter**  $E = f(I_c)$   $R_{Goff} = 10\Omega$ ,  $R_{Gon} = 10\Omega$ ,  $V_{GE} = \pm 15V$ ,  $V_{CC} = 600V$



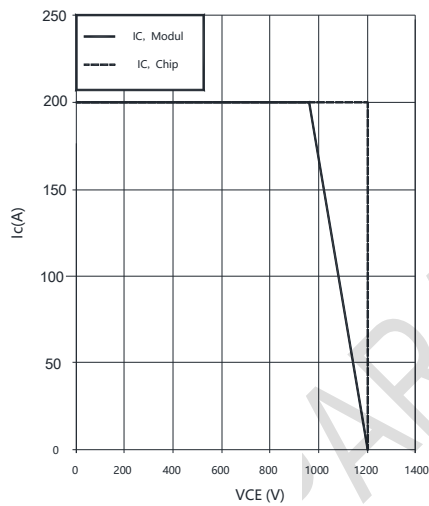
**Fig 4. Switching losses (typical), IGBT, Inverter**  $E = f(R_g)$   $V_{GE} = 15V$ ,  $I_c = 100A$ ,  $V_{CC} = 600V$



**Fig 5. Forward characteristic (typical), Diode, Inverter  $I_f = f(V_f)$**

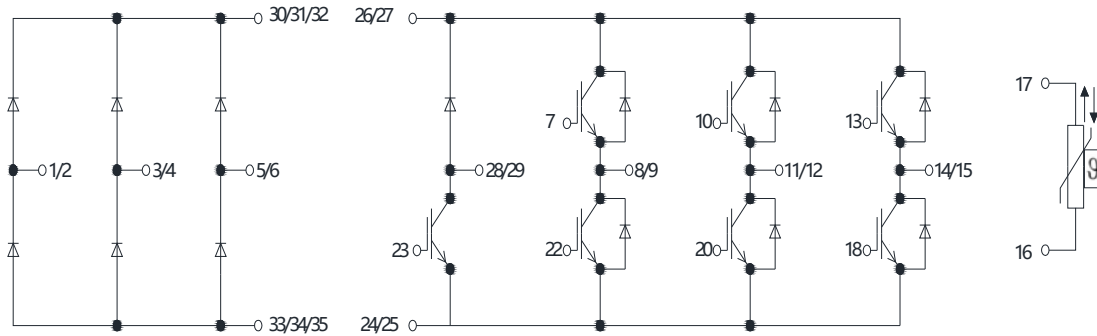


**Fig 6. Switching losses (typical), Diode, Inverter  $E_{rec} = f(I_f)$   $R_{Gon} = 10\Omega$ ,  $V_{cc} = 600V$**

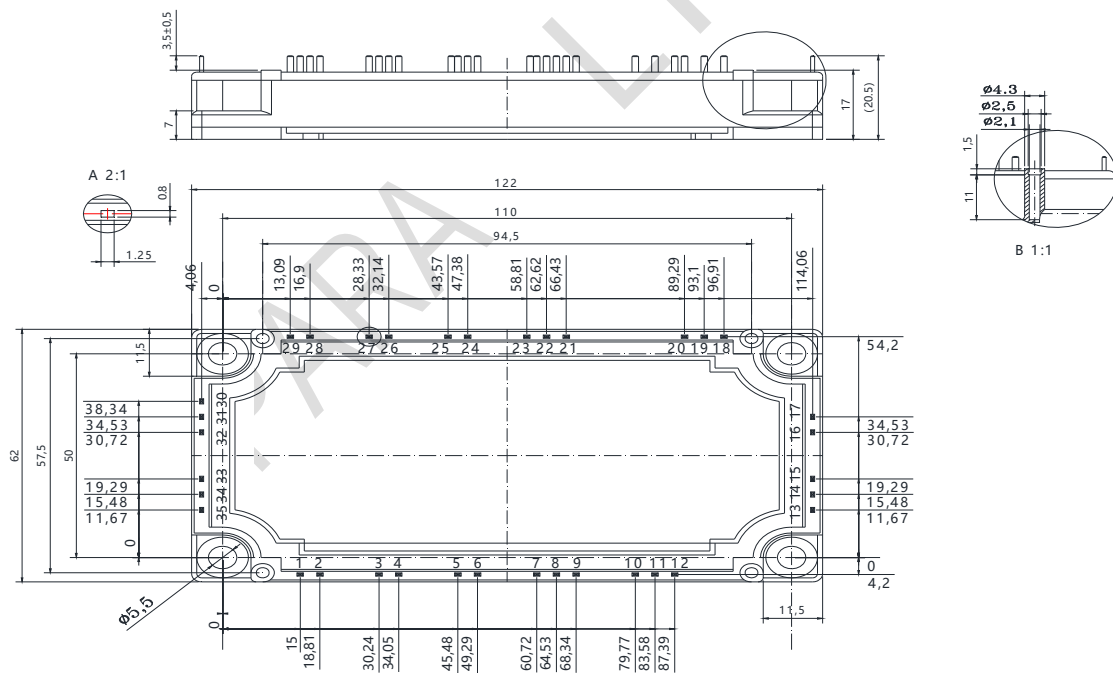


**Fig 7. Reverse bias safe operating area (RBSOA), IGBT, Inverter  $I_c = f(V_{CE})$   $R_{Goff} = 10\Omega$ ,  $V_{GE} = \pm 15V$ ,  $T_{vj} = 150^\circ\text{C}$**

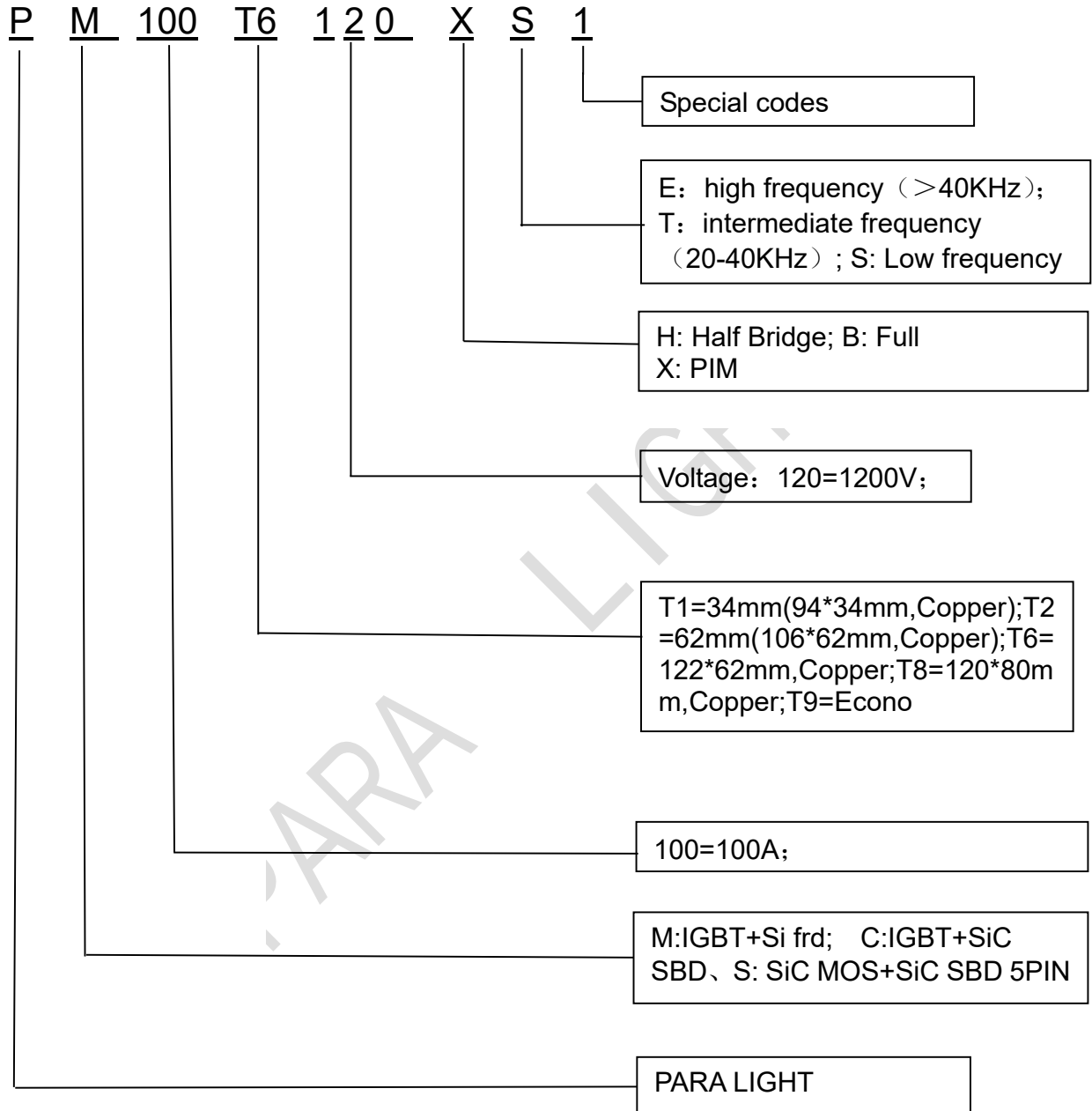
### Circuit\_diagram\_headline



### Package outline



**PART NO. SYSTEM :**



## Revision history

### Document revision history

| Date       | Version | Changes        |
|------------|---------|----------------|
| 2024.09.24 | A / 0   | First release. |
|            |         |                |
|            |         |                |
|            |         |                |
|            |         |                |