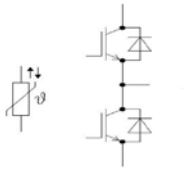
# High Speed IGBT in Trench and Fieldstop Technology



Equivalent circuit

## Features:

- 1200V 450A, VCE(sat) =2.1V@25°C
- High RBSOA capability
- Trench/FS technology
- Low reverse-recovery losses
- High SC capability

## Applications:

- Motor drives
- Solar applications
- UPS systems
- Commercial electric vehicles
- Three-level applications

## Mechanical Features:

- High power and thermal cycling capability
- Maximum junction temperature 175℃
- High power density
- PressFIT contact technology
- Isolated base plate

## Key Performance and Package Parameters

| Type | $V_{CES}$ | $I_{Cnom}$ | $V_{CEsat}$, $T_{vj}$=25°C | $T_{vjmax}$ | Marking |
|---|---|---|---|---|---|
| PM450T2120HS1 | 1200V | 450A | 2.1V | 175°C | PM450T2120HS1 |

## IGBT Inverter

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

| Parameter | Symbols | Value | Units |
|---|---|---|---|
| Collector-emitter voltage | $V_{CES}$ | 1200 | V |
| Continuous DC collector current $T_C$= 100°C | $I_C$ | 450 | A |
| Pulsed collector current Note *1 | $I_{CP}$ | 900 | A |
| Diode forward current | $I_F$ | 450 | A |
| Gate-emitter peak voltage | $V_{GES}$ | ±30 | V |
| Repetitive peak forward current | $I_{FRM}$ | 900 | A |
| Operating junction temperature | $T_{vj}$ | -40 ~ +150 | ℃ |
| Storage temperature | $T_{stg}$ | -40 ~ +125 | ℃ |

Note *1 : Pulse width limited by $T_{vjmax}$.

## IGBT, Inverter
## Characteristic Values at $T_{vj}$=25°C (unless otherwise specified)

| Parameter | Symbols | Conditions | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $I_C$=450A, $V_{GE}$=15V, $T_{vj}$=25°C | | - | 2.1 | 2.6 | V |
| | | $I_C$=450A, $V_{GE}$=15V, $T_{vj}$=125°C | | - | 2.49 | - | |
| | | $I_C$=450A, $V_{GE}$=15V, $T_{vj}$=150°C | | - | 2.58 | - | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$=9.8mA, $V_{CE}$=$V_{GE}$, $T_{vj}$=25°C | | 5.7 | 6.2 | 6.7 | V |
| Internal gate resistor | $R_{Gint}$ | $T_{vj}$=25°C | | - | 1.4 | - | Ω |
| Collector-emitter leakage current | $I_{CES}$ | $V_{CE}$=1200V, $V_{GE}$=0V, $T_{vj}$=25°C | | - | - | 200 | uA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$=0V, V=20V $T_{vj}$=25°C | | - | - | ±300 | nA |
| Input capacitance | $C_{ies}$ | f=1MHz, $V_{CE}$=25V, $V_{GE}$=0V | | - | 106 | - | nF |
| Reverse transfer capacitance | $C_{res}$ | f=1MHz, $V_{CE}$=25V, $V_{GE}$=0V | | - | 880 | - | pF |
| Gate charge | $Q_G$ | $V_{CC}$= 600V, $V_{GE}$= 15V | | - | 2270 | - | nC |
| Turn-on delay time, Inductive load | $t_{d(on)}$ | $V_{CC}$=600V<br>$I_C$=450A<br>$V_{GE}$=15V<br>$R_G$=20Ω | $T_{vj}$=25°C | - | 1.09 | - | µs |
| | | | $T_{vj}$=125°C | - | 0.99 | - | |
| | | | $T_{vj}$=150°C | - | 0.99 | - | |
| Rise time, inductive load | $t_r$ | | $T_{vj}$=25°C | - | 0.50 | - | µs |
| | | | $T_{vj}$=125°C | - | 0.51 | - | |
| | | | $T_{vj}$=150°C | - | 0.52 | - | |
| Turn-off delay time,inductive load | $t_{d(off)}$ | | $T_{vj}$=25°C | - | 1.48 | - | µs |
| | | | $T_{vj}$=125°C | - | 1.57 | - | |
| | | | $T_{vj}$=150°C | - | 1.59 | - | |
| Fall time, inductive load | $t_f$ | | $T_{vj}$=25°C | - | 0.11 | - | µs |
| | | | $T_{vj}$=125°C | - | 0.11 | - | |
| | | | $T_{vj}$=150°C | - | 0.12 | - | |
| Turn-on switching Loss | $E_{on}$ | | $T_{vj}$=25°C | - | 132.49 | - | mJ |
| | | | $T_{vj}$=125°C | - | 161.69 | - | |
| | | | $T_{vj}$=150°C | - | 169.26 | - | |
| Turn-off switching loss | $E_{off}$ | | $T_{vj}$=25°C | - | 59.69 | - | mJ |
| | | | $T_{vj}$=125°C | - | 66.74 | - | |
| | | | $T_{vj}$=150°C | - | 67.86 | - | |
| SC data | $I_{SC}$ | $V_{CC}$= 600V<br>$R_G$= 20Ω<br>$V_{GE}$≤ 15V<br>$V_{CEmax}$=$V_{CE}$-$L_{SCE}$*di/dt | $t_P$≤ 10µs<br>$T_{vj}$=150°C | - | 1800 | - | A |

## Thermal resistance

| Parameter | Symbols | Value | | | Units |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| Thermal resistance,per IGBT junction to case | $R_{th(j-c)}$ | - | - | 0.09 | K/W |
| Thermal resistance, per diodes junction to case | $R_{th(j-c)}$ | - | - | 0.14 | |

## Diode Inverter (unless otherwise specified)

| Parameter | Symbols | Conditions | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Forward voltage | $V_F$ | $I_F$=450A, $V_{GE}$=0V | $T_{vj}$=25°C | - | 1.90 | - | V |
| | | | $T_{vj}$=125°C | - | 1.60 | - | |
| | | | $T_{vj}$=150°C | - | 1.54 | - | |
| Recovery charge | $Q_r$ | $I_F$=450A,$V_R$=600V -di$_F$/dt= 1000A/us, $V_{GE}$= -15V | $T_{vj}$=25°C | - | 10.90 | - | µC |
| | | | $T_{vj}$=125°C | - | 41.77 | - | |
| | | | $T_{vj}$=150°C | - | 52.48 | - | |
| Reverse recovery energy | $E_{rec}$ | $I_F$=450A,$V_R$=600V -di$_F$/dt=1000A/us $V_{GE}$= -15V | $T_{vj}$=25°C | - | 4.57 | - | mJ |
| | | | $T_{vj}$=125°C | - | 10.98 | - | |
| | | | $T_{vj}$=150°C | - | 13.65 | - | |

## Module

| Parameter | Symbols | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| Isolation voltage | $V_{ISOL}$ | f=50Hz, t=1min, RMS | - | 2700 | - | V |
| Material of module base plat | | | - | Cu | - | |
| Internal isolation | | | - | $Al_2O_3$ | - | |
| Creepage distance | $d_{Creep}$ | Terminal to heatsink | - | 29.0 | - | mm |
| | | Terminal to terminal | - | 23.0 | - | |
| Clearance | $d_{Clear}$ | Terminal to heatsink | - | 23.0 | - | mm |
| | | Terminal to terminal | - | 11.0 | - | |
| Comparative tracking index | CTI | | - | 200 | - | |

| Parameter | Symbols | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Stray inductance module | $L_{sCE}$ | | - | 35 | - | nH |
| Terminal connection torque | M | Screw M6 | 3.0 | - | 6.0 | Nm |
| Mounting torque for module mounting | M | Screw M6 | 3.0 | - | 6.0 | Nm |
| Weight | G | | - | 322 | - | g |

## Typical Characteristics

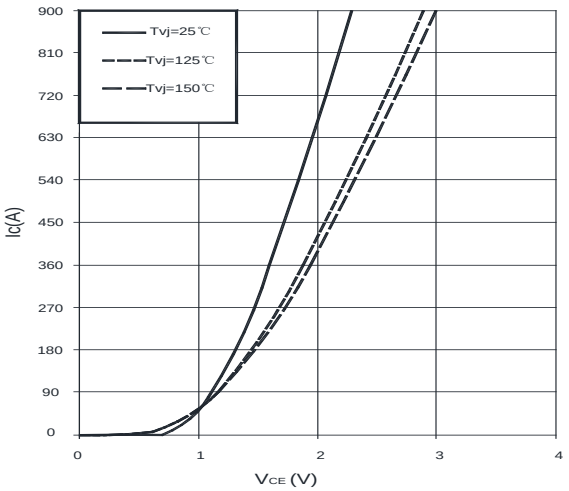



**Fig 1. Output characteristic (typical), IGBT, Inverter IGBT, Inverter $I_C$= f($V_{CE}$) $V_{GE}$= 15V**

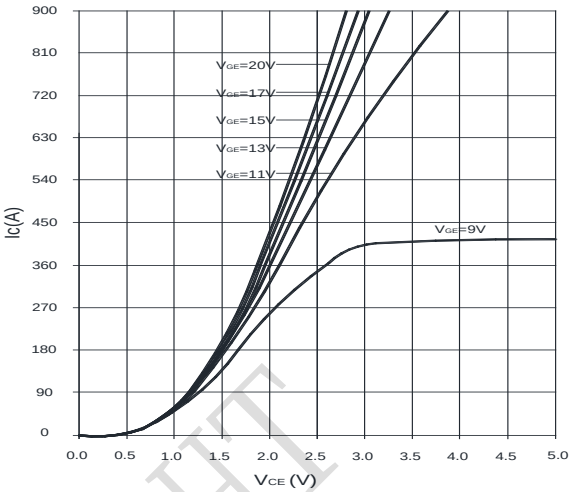



**Fig 2. Output characteristic (typical), $I_C$= f($V_{CE}$) $T_{vj}$= 150°C**

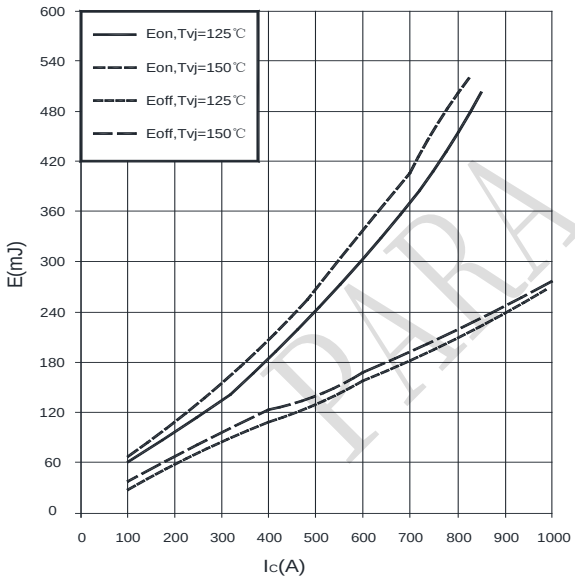



**Fig 3. Switching losses (typical), IGBT, Inverter E= f($I_C$) $R_{Goff}$= 20Ω, $R_{Gon}$=20Ω, $V_{GE}$= ±15V, $V_{CC}$= 600V**

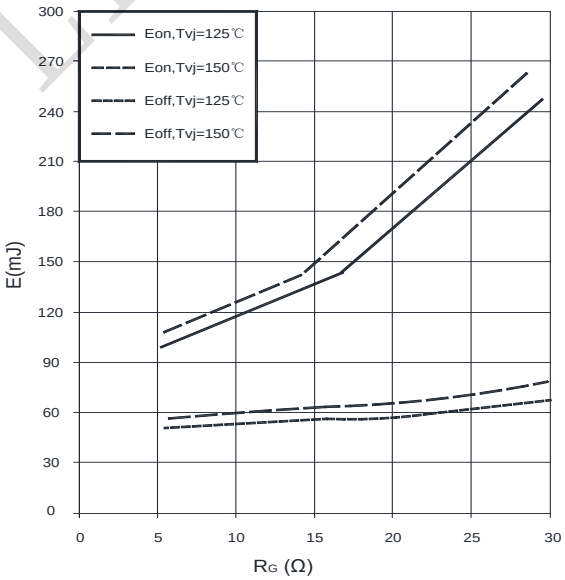



**Fig 4. Switching losses (typical), IGBT, Inverter E= f($R_G$) $V_{GE}$= 15V, $I_C$= 450A, $V_{CC}$= 600V**

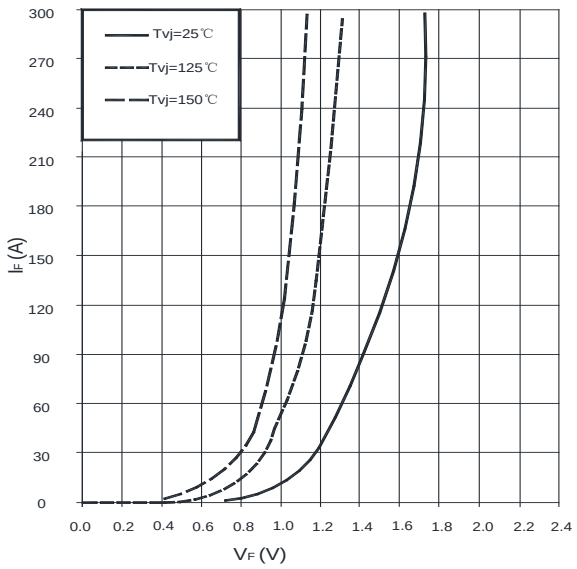



**Fig 5. Forward characteristic (typical), Diode, Inverter $I_F$= f($V_f$)**

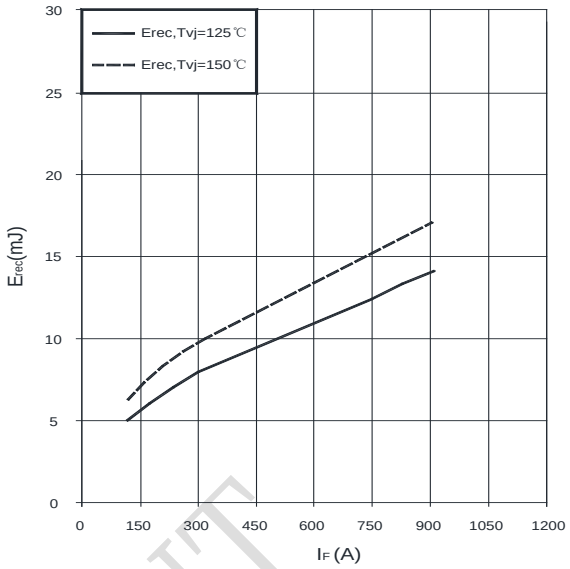



**Fig 6. Switching losses (typical), Diode, Inverter $E_{rec}$= f($I_F$) $R_{Gon}$= 20Ω,$V_{CC}$= 600V**

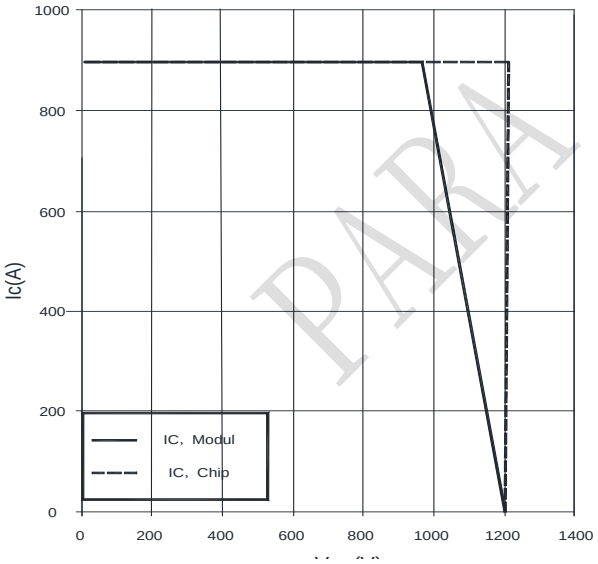
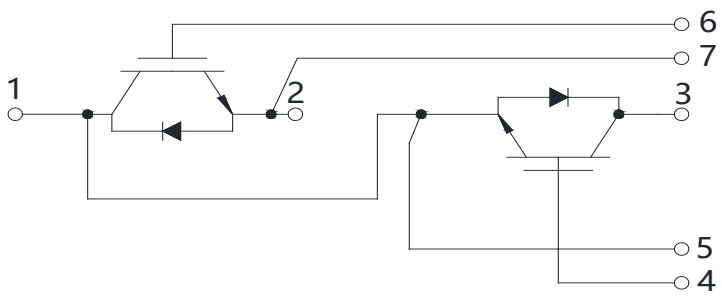
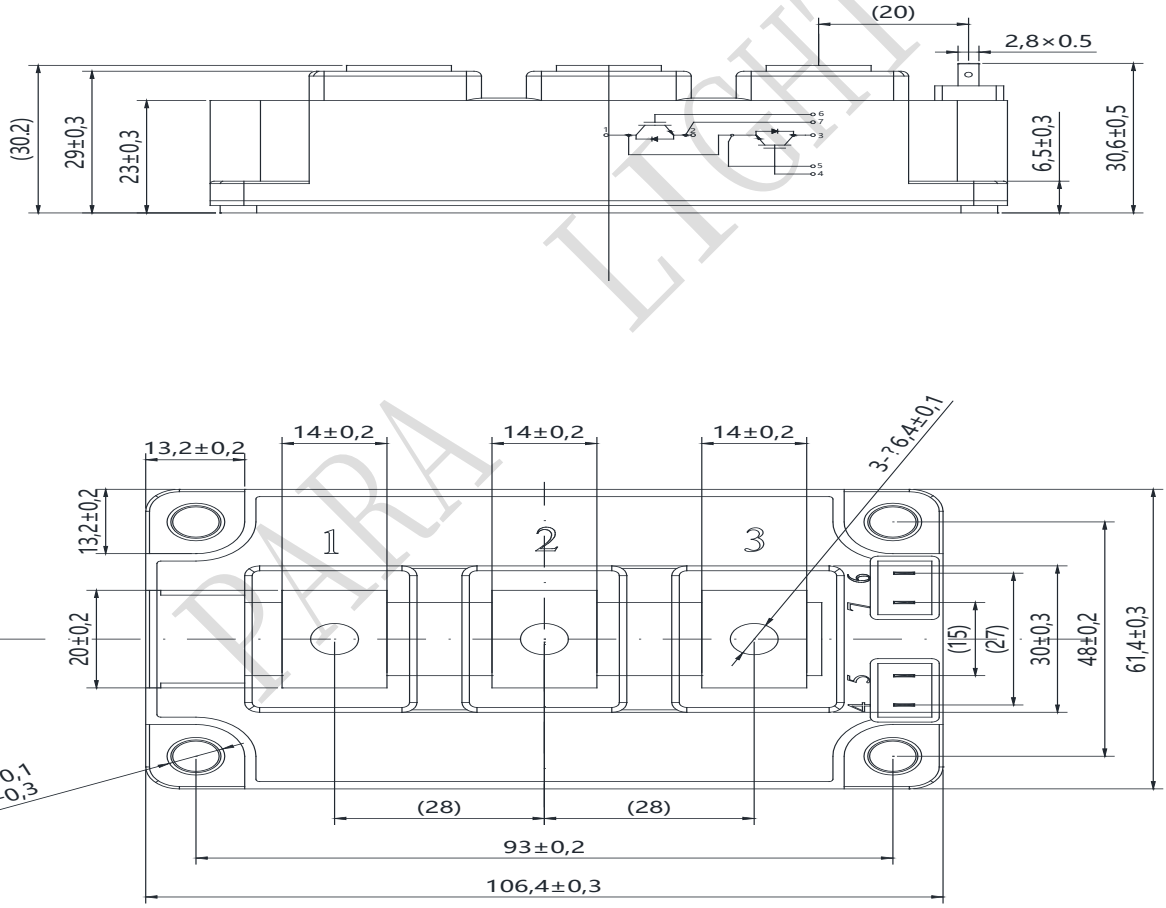



**Fig 7. Reverse bias safe operating area (RBSOA), IGBT, Inverter $I_C$= f($V_{CE}$) $R_{Goff}$= 20Ω, $V_{GE}$= ±15V, $T_{vj}$= 150°C**

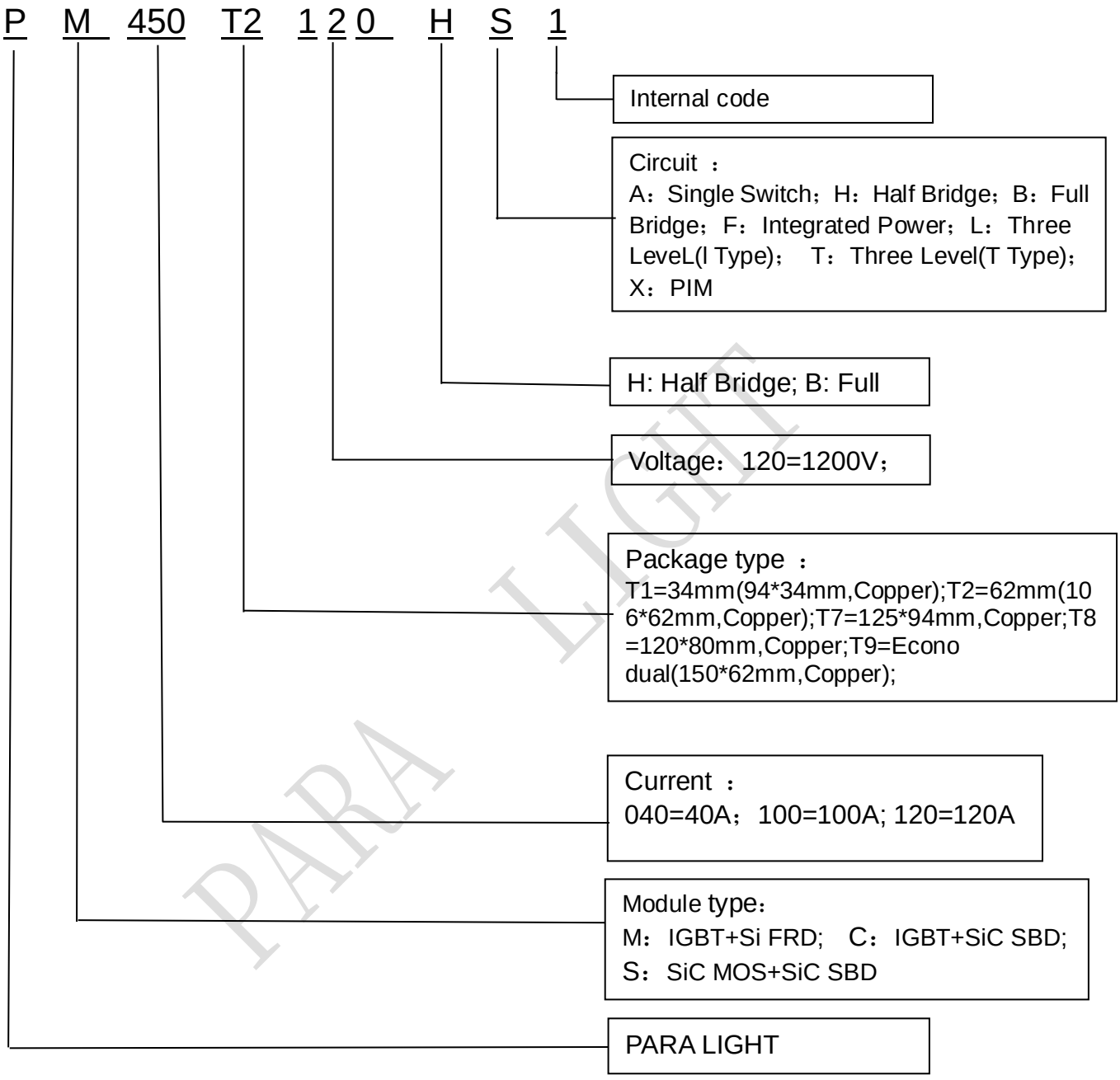
**Circuit_diagram_headline**




**Package outline**



**PART NO. SYSTEM :**



## Revision history

### Document revision history

| Date | Version | Changes |
|---|---|---|
| 2024.09.28 | A / 0 | First release. |
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