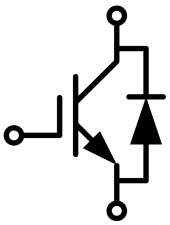
# IGBT Discrete with Anti-Parallel Diode

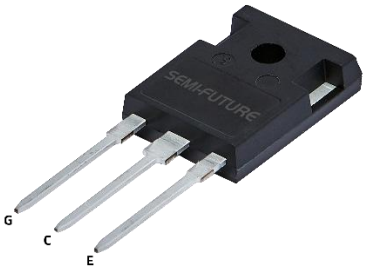
**电气特性/ Features and Benefits:**

- 1200V 沟槽栅/场终止工艺
  1200V Trench with Field Stop Technology
- 低开关损耗
  Low switching losses
- Vcesat 正温度系数
  Vcesat with positive Temperature Coefficient



**典型应用/ Applications:**

- 储能逆变器
  Energy storage inverter
- 不间断电源
  Uninterruptible power supplies
- 光伏逆变器
  Solar inverters




$V_{CES}$ =1200V，$I_{C\ nom}$ =50A / $I_{CRM}$ =150A

**关键性能和程序参数 / Key Performance And Package Parameters**

| Type | $V_{CE}$ | $I_C$ | VCEsat, $T_{vj}$=25°C | $T_{vjmax}$ | Package |
|---|---|---|---|---|---|
| SD50R12A6HS | 1200V | 50A | 2.15V | 175°C | TO-247-3L |

## 双极晶体管/IGBT

**最大额定值 / Maximum Ratings**

| Parameter | Conditions | Symbol | Value | Unit |
|---|---|---|---|---|
| 集电极-发射极电压<br>Collector-Emitter Voltage | $T_{vj}$=25°C | $V_{CES}$ | 1200 | V |
| 连续集电极直流电流<br>Continuous DC collector current | $T_C$=80°C, $T_{vj\ max}$=175°C | $I_{C\ nom}$ | 50 | A |

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|---|---|---|---|---|
| 集电极重复峰值电流<br>Repetitive peak collector current | $t_P$=1 ms | $I_{CRM}$ | 150 | A |
| 栅极-发射极电压<br>Gate emitter voltage | $t_p$ ≤0.5μs, D<0.001 | $V_{GE}$ | ±20<br>+30 | V |
| 短路时间<br>Short-circuit withstand time | $V_{CC}$ ≤ 600 V, $V_{GE}$ = 15 V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj}$ = 150 °C | $t_{SC}$ | 10 | μs |
| 总功率损耗<br>Total power dissipation | $T_C$ =25°C, $T_{vj\ max}$ =175°C<br>$T_C$ =100°C, $T_{vj\ max}$ =175°C | $P_{tot}$ | 900<br>500 | W |
| 在开关状态下温度<br>Temperature under switching conditions | | $T_{vj\ op}$ | -40…+175 | ℃ |
| 储存温度<br>Storage temperature | | $T_{stg}$ | -40…+150 | ℃ |

## 热特性 / Thermal Characteristics

| Parameter | Conditions | Symbol | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| IGBT 热阻，结-壳<br>IGBT thermal resistance, junction - case | | $R_{th(j-C)}$ | | 0.138 | | K/W |
| 二极管热阻，结-壳<br>Diode thermal resistance, junction - case | | $R_{th(j-C)}$ | | 0.393 | | K/W |

## 特征值 / Characteristic Values

| Parameter | Conditions | | Symbol | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| 击穿电压<br>Collector-emitter breakdown voltage | VGE=0V, Ic=0.25mA | | $V_{(BR)CES}$ | 1200 | | | V |
| 集电极-发射极饱和电压<br>Collector-Emitter saturation Voltage | $V_{GE}$=15V, $I_C$=50A<br>$V_{GE}$=15V, $I_C$=50A<br>$V_{GE}$=15V, $I_C$=50A | $T_{vj}$=25°C<br>$T_{vj}$=150°C<br>$T_{vj}$=175°C | $V_{CEsat}$ | | 2.15<br>2.80<br>2.91 | 2.40 | |
| 栅极-发射极阈值电压<br>Gate-Emitter threshold Voltage | $I_C$=0.4mA, $V_{GE}$=$V_{CE}$ | $T_{vj}$=25°C | $V_{GE(th)}$ | 4.9 | 5.5 | 6.1 | |
| 跨导<br>Transconductance | $V_{CE}$=20V，$I_C$=50A | | $G_{fs}$ | | 30 | | S |

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|---|---|---|---|---|---|---|---|
| 内部栅极电阻<br>Internal gate resistor | $T_{vj}$ = 25 °C | | $R_{Gint}$ | | 2.3 | | Ω |
| 输入电容<br>Input capacitance | f=1 00KHZ, $V_{CE}$=25V, $V_{GE}$=0V | $T_{vj}$=25°C | $C_{ies}$ | | 3.12 | | nF |
| 输出电容<br>Output capacitance | | | $C_{oes}$ | | 0.24 | | |
| 反向传输电容<br>Reverse transfer capacitance | | | $C_{res}$ | | 0.12 | | |
| 门极电荷<br>Gate charge | $I_C$ =50A, $V_{GE}$ =15V,<br>$V_{CE}$ =960V | $T_{vj}$=25°C | $Q_G$ | | 300 | | μC |
| 集电极-发射极截止电流<br>Collector-emitter cut-off current | $V_{CE}$=1200V, $V_{GE}$=0V | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $I_{CES}$ | | <br>3000 | 1 | μA |
| 栅极-发射极漏电流<br>Gate-emitter leakage current | $V_{CE}$=0V, $V_{GE}$=20V | $T_{vj}$=25°C | $I_{GES}$ | | | 100 | nA |
| 开通延迟时间<br>Turn-on delay time | $I_C$=50A, $V_{CE}$=600V<br>$V_{GE}$=±15V, $R_G$=10Ω<br>(电感负载) / (inductive load) | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $t_{d\,on}$ | | 57<br>50 | | ns |
| 上升时间<br>Rise time | $I_C$=50A, $V_{CE}$=600V<br>$V_{GE}$=±15V, $R_G$=10Ω<br>(电感负载) / (inductive load) | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $t_r$ | | 134<br>69 | | |
| 关断延迟时间<br>Turn-off delay time | $I_C$=50A, $V_{CE}$=600V<br>$V_{GE}$=±15V, $R_G$=10Ω<br>(电感负载) / (inductive load) | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $t_{d\,off}$ | | 156<br>237 | | |
| 下降时间<br>Fall time | $I_C$=50A, $V_{CE}$=600V<br>$V_{GE}$=±15V, $R_G$=10Ω<br>(电感负载) / (inductive load) | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $t_f$ | | 136<br>160 | | |
| 开通损耗能量（每脉冲）<br>Turn-on energy loss per pulse | $I_C$=50A, $V_{CE}$=600V<br>$V_{GE}$=±15V, $R_G$=10Ω<br>di/dt = 340 A/μs<br>($T_{vj}$ = 175 °C) | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $E_{on}$ | | 6.50<br>10.0 | | mJ |
| 关断损耗能量（每脉冲）<br>Turn-off energy loss per pulse | $I_C$=50A, $V_{CE}$=600V<br>$V_{GE}$=±15V, $R_G$=10Ω<br>dv/dt = 5700 V/μs<br>($T_{vj}$ = 175 °C) | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $E_{off}$ | | 2.20<br>3.70 | | mJ |

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## 二极管/Diode

### 最大额定值 / Maximum Ratings

| Parameter | Conditions | Symbol | Value | Unit |
|---|---|---|---|---|
| 反向重复峰值电压<br>Repetitive peak reverse Voltage | $T_{vj}$=25°C | $V_{RRM}$ | 1200 | V |
| 连续正向直流电流<br>Continuous DC forward current | $T_C$=100°C, $T_{vj\ max}$=175°C | $I_F$ | 30 | A |
| 正向重复峰值电流<br>Repetitive peak forward current | $t_p$=1ms | $I_{FRM}$ | 100 | A |
| $I^2t$ 值<br>$I^2t$-value | $t_p$=10ms，sin180°，$T_j$=125°C | $I^2t$ | 310 | A |

### 特征值 / Characteristic Values

| Parameter | Conditions | | Symbol | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| 正向电压<br>Forward Voltage | $I_F$=40A, $V_{GE}$=0V<br>$I_F$=40A, $V_{GE}$=0V<br>$I_F$=40A, $V_{GE}$=0V | $T_{vj}$=25°C<br>$T_{vj}$=150°C<br>$T_{vj}$=175°C | $V_F$ | | 1.82<br>1.60<br>1.54 | 2.40 | V |
| 反向恢复峰值电流<br>Peak reverse recovery current | $I_F$=50A,<br>-di$_F$/dt=350A/μs($T_{vj}$=175°C)<br>$V_R$=600V, $V_{GE}$=-15V | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $I_{RM}$ | | 10.3<br>30.0 | | A |
| 反向恢复电荷<br>Reverse Recovered charge | $I_F$=50A,<br>-di$_F$/dt=350A/μs($T_{vj}$=175°C)<br>$V_R$=600V, $V_{GE}$=-15V | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $Q_{rr}$ | | 3.69<br>11.8 | | μC |
| 反向恢复时间<br>Reverse Recovery Time | $I_F$=50A,<br>-di$_F$/dt=290A/μs($T_{vj}$=175°C)<br>$V_R$=600V, $V_{GE}$=-15V | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $t_{rr}$ | | 678<br>1120 | | ns |
| 反向恢复损耗（每脉冲）<br>Reverse recovered energy | $I_F$=50A,<br>-di$_F$/dt=290A/μs($T_{vj}$=175°C)<br>$V_R$=600V, $V_{GE}$=-15V | $T_{vj}$=25°C<br>$T_{vj}$=175°C | $E_{rec}$ | | 1.53<br>4.78 | | mJ |

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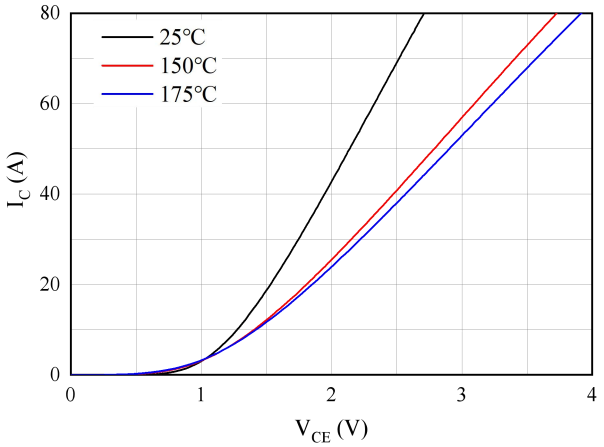



图 1. 典型输出特性 ($V_{GE}$=15V)
Figure 1. Typical output characteristics ($V_{GE}$=15V)

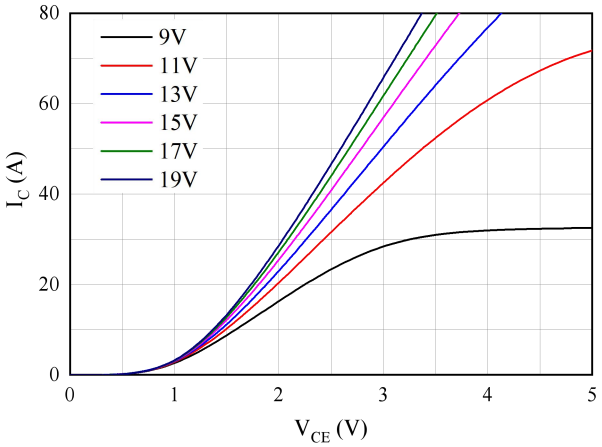



图 2. 典型输出特性 ($T_{vj}$=150℃)
Figure 2. Typical output characteristics ($T_{vj}$=150℃)

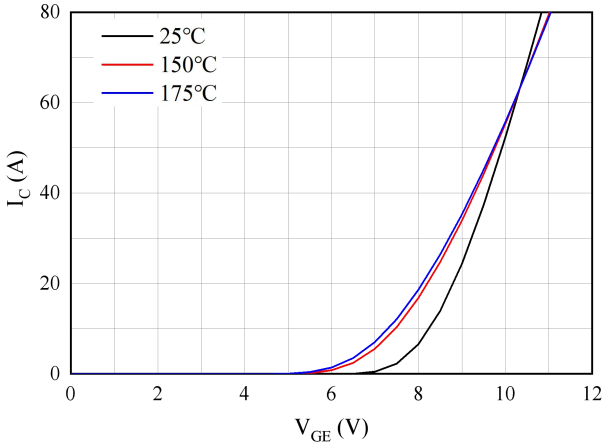



图 3. 典型传输特性($V_{CE}$=20V)
Figure 3. Typical transfer characteristic($V_{CE}$=20V)

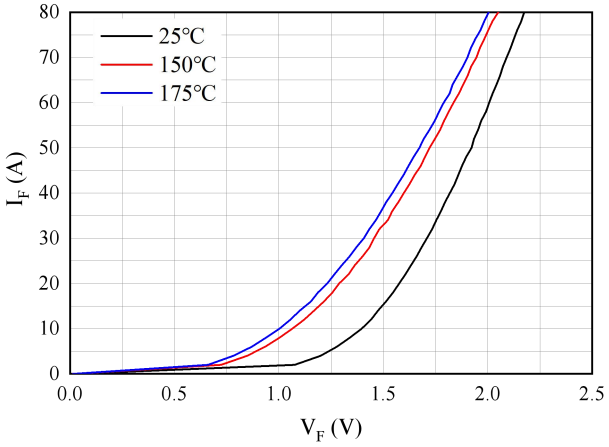



图 4. 正向偏压特性 二极管
Figure 4. Forward characteristic of Diode

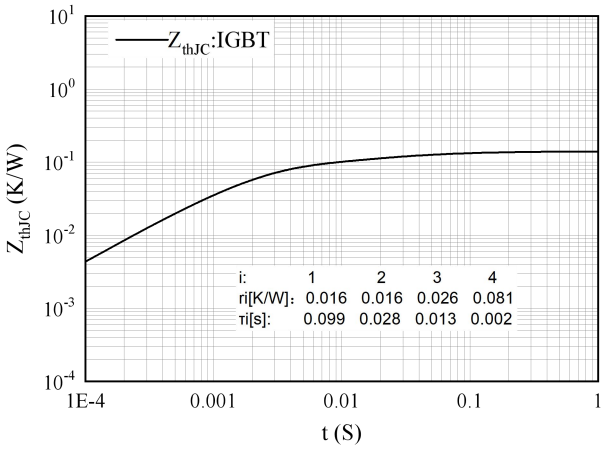



图 5. 瞬态热阻抗 IGBT
Figure 5. Transient thermal impedance IGBT, $Z_{thJC}$=f(t)

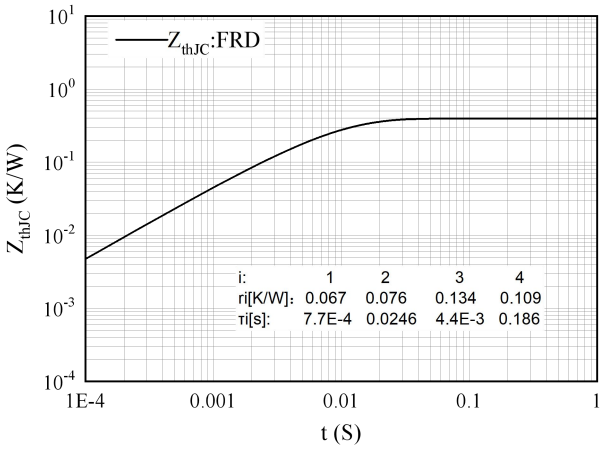



图 6. 瞬态热阻抗 FRD
Figure 6. Transient thermal impedance FRD, $Z_{thJC}$=f(t)

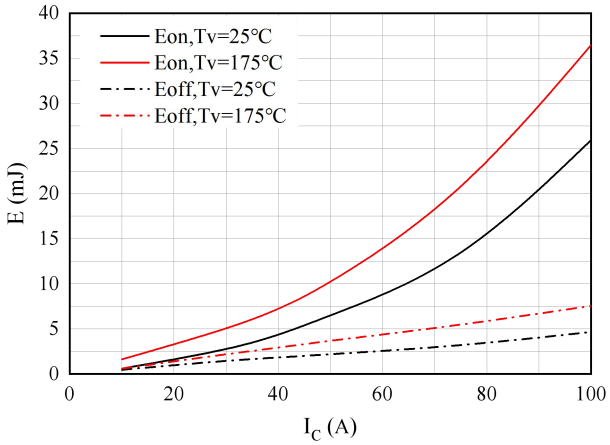



图 7. 开关损耗

Figure 7. Switching losses of IGBT

$V_{GE}$ =±15, $R_G$ =10Ω, $V_{CE}$ =600V

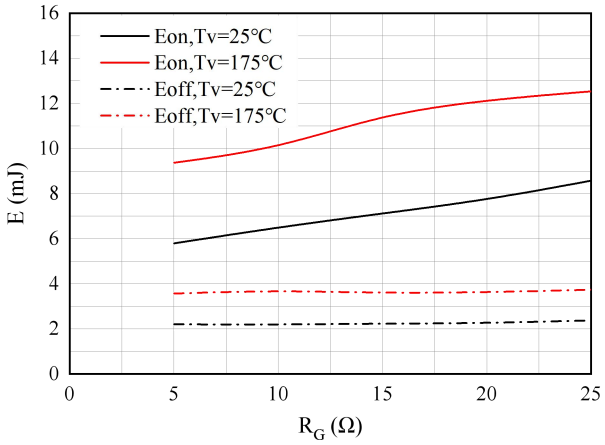



图 8. 开关损耗

Figure 8. Switching losses of IGBT

$V_{GE}$ =±15V, $I_C$ =50A, $V_{CE}$ =600V

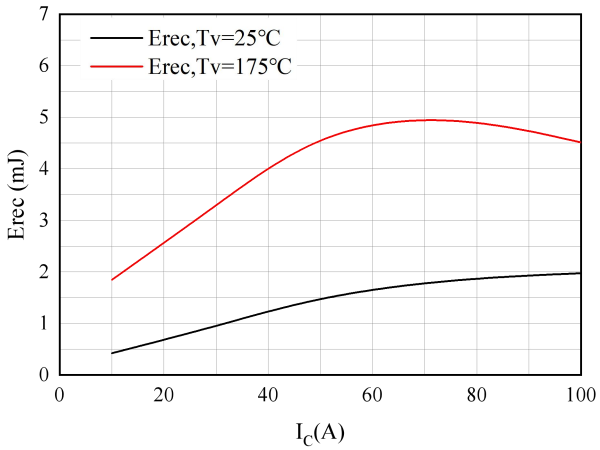



图 9. 开关损耗 二极管

Figure 9. Switching losses of Diode

$R_G$ =10Ω, $V_{CE}$ =600V

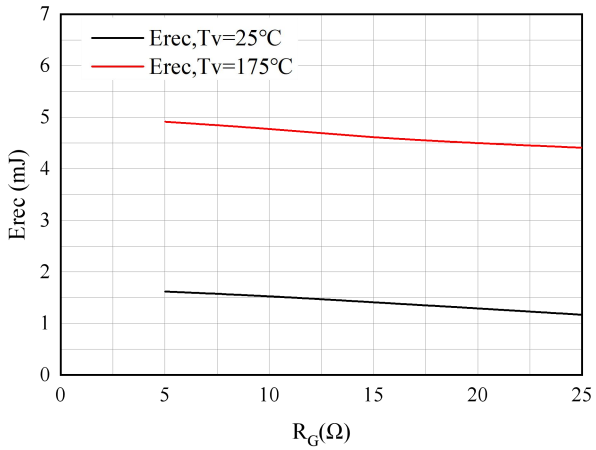



图 10. 开关损耗 二极管

Figure 10. Switching losses of Diode

$I_F$ =50A, $V_{CE}$ =600V

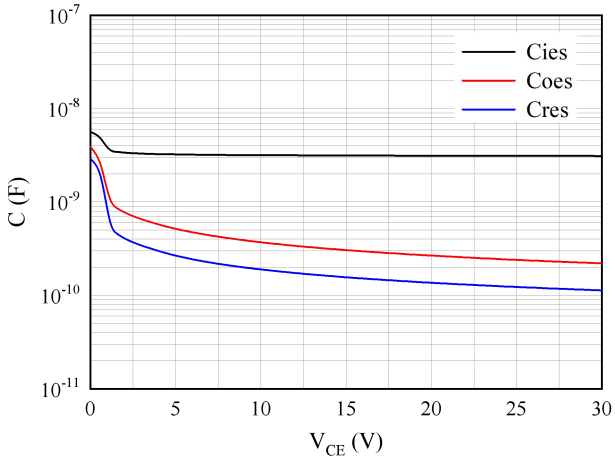
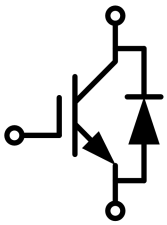


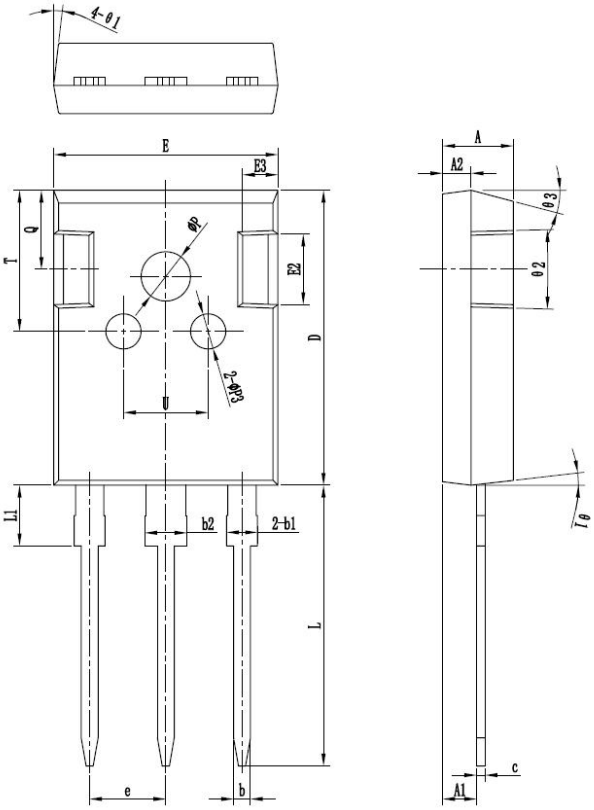

图 11. 电容特性

Figure 11. Capacitance characteristic

**接线图 / Circuit diagram**



**封装尺寸 / Package outlines**




| 符号 | 单位:mm | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| *A | 4.90 | 5.00 | 5.10 |
| *A1 | 2.31 | 2.41 | 2.51 |
| A2 | 1.90 | 2.00 | 2.10 |
| *b | 1.15 | 1.20 | 1.25 |
| *b1 | 1.95 | 2.10 | 2.25 |
| *b2 | 2.95 | 3.10 | 3.25 |
| *c | 0.55 | 0.60 | 0.65 |
| *D | 20.90 | 21.00 | 21.10 |
| D1 | 16.35 | 16.55 | 16.75 |
| D2 | 1.05 | 1.20 | 1.35 |
| *E | 15.70 | 15.80 | 15.90 |
| E1 | 13.10 | 13.25 | 13.40 |
| E2 | 4.90 | 5.00 | 5.10 |
| E3 | 2.40 | 2.50 | 2.60 |
| *e | 5.40 | 5.44 | 5.48 |
| *L | 19.80 | 19.92 | 20.10 |
| *L1 | - | - | 4.30 |
| *ΦP | 3.70 | 3.80 | 3.90 |
| *ΦP1 | 3.50 | 3.60 | 3.70 |
| ΦP2 | 7.00 | 7.20 | 7.40 |
| ΦP3 | 2.40 | 2.50 | 2.60 |
| Q | 5.60 | 5.80 | 6.00 |
| *S | 6.05 | 6.15 | 6.25 |
| T | 9.80 | 10.00 | 10.20 |
| U | 6.00 | 6.20 | 6.40 |
| θ1 | 5° | 7° | 9° |
| θ2 | 1° | 3° | 5° |
| θ3 | 13° | 15° | 17° |

*为关键管控尺寸

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