

# 60N40P7

## 主要参数 MAIN CHARACTERISTICS

|                           |              |
|---------------------------|--------------|
| $I_D$                     | 60A          |
| $V_{DS}$                  | 400V         |
| $R_{ds(on)} (V_{GS}=10V)$ | 60m $\Omega$ |

### 用途

- 负载开关
- 脉宽调制
- 电源管理

### APPLICATIONS

- Load Switch
- PWM Application
- Power Management

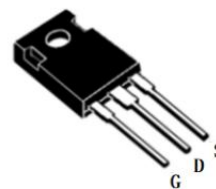
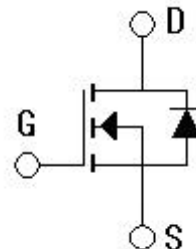
### 产品特性

- 先进沟槽技术
- 符合环保标准
- 产品无卤素
- 湿敏等级3级

### FEATURES

- Advanced Trench Technology
- RoHS and Reach Compliant
- Halogen and Antimony Free
- Moisture Sensitivity Level 3

## 封装 Package



TO-247

## 产品中有毒有害物质或元素的名称及含量

| 部件名称   | 有害物质或元素                                                                                                                                   |           |           |                 |               |                 |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----------------|---------------|-----------------|
|        | 铅<br>(Pb)                                                                                                                                 | 汞<br>(Hg) | 镉<br>(Cd) | 六价铬<br>(Cr(VI)) | 多溴联苯<br>(PBB) | 多溴二苯醚<br>(PBDE) |
| (含量要求) | ≤0.1%                                                                                                                                     | ≤0.1%     | ≤0.01%    | ≤0.1%           | ≤0.1%         | ≤0.1%           |
| 引线框    | ○                                                                                                                                         | ○         | ○         | ○               | ○             | ○               |
| 塑封树脂   | ○                                                                                                                                         | ○         | ○         | ○               | ○             | ○               |
| 管芯     | ○                                                                                                                                         | ○         | ○         | ○               | ○             | ○               |
| 内引线    | ○                                                                                                                                         | ○         | ○         | ○               | ○             | ○               |
| 焊料     | ×                                                                                                                                         | ○         | ○         | ○               | ○             | ○               |
| 说明     | <p>○: 表示该元素的含量在 SJ/T11363-2006 标准的限量要求以下。</p> <p>×: 表示该元素的含量超出 SJ/T11363-2006 标准的限量要求。</p> <p>目前产品的焊料中含有铅 (Pb) 成分, 但属于欧盟 RoHS 指令豁免范围。</p> |           |           |                 |               |                 |

绝对最大额定值 **ABSOLUTE RATINGS** ( $T_c=25^{\circ}\text{C}$ )

| 项 目<br>Parameter                                            | 符 号<br>Symbol                                              | 数 值<br>Value  | 单 位<br>Unit        |
|-------------------------------------------------------------|------------------------------------------------------------|---------------|--------------------|
| 最高漏极-源极直流电压<br>Drain-Source Voltage                         | $V_{DS}$                                                   | 400           | V                  |
| 连续漏极电流<br>Drain Current-continuous                          | $I_D$<br>$T=25^{\circ}\text{C}$<br>$T=100^{\circ}\text{C}$ | 60<br>36      | A                  |
| 最大脉冲漏极电流<br>Drain Current – pulse <sup>Note 1</sup>         | $I_{DM}$                                                   | 240           | A                  |
| 最高栅源电压<br>Gate-Source Voltage                               | $V_{GS}$                                                   | $\pm 30$      | V                  |
| 单脉冲雪崩能量<br>Single Pulsed Avalanche Energy <sup>Note 1</sup> | $E_{AS}$                                                   | 1380          | mJ                 |
| 耗散功率<br>Power Dissipation                                   | $P_D$<br>$T_c=25^{\circ}\text{C}$                          | 325           | W                  |
| 最高结温及存储温度<br>Operating and Storage Temperature Range        | $T_J, T_{STG}$                                             | $-55\sim+150$ | $^{\circ}\text{C}$ |

## 电特性 ELECTRICAL CHARACTERISTICS

| 项 目<br>Parameter                                  | 符 号<br>Symbol | 测试条件<br>Tests conditions                  | 最小<br>Min | 典型<br>Typ | 最大<br>Max | 单位<br>Units |
|---------------------------------------------------|---------------|-------------------------------------------|-----------|-----------|-----------|-------------|
| <b>关态特性 Off –Characteristics</b>                  |               |                                           |           |           |           |             |
| 漏—源击穿电压<br>Drain-Source Voltage                   | $BV_{DSS}$    | $I_D=250\mu A, V_{GS}=0V, T_J=25^\circ C$ | 400       | -         | -         | V           |
| 零栅压下漏极漏电流<br>Zero Gate Voltage Drain Current      | $I_{DSS}$     | $V_{DS}=400V, V_{GS}=0V, T_C=25^\circ C$  | -         | -         | 10        | $\mu A$     |
| 正向栅极体漏电流<br>Gate-body leakage current,<br>forward | $I_{GSSF}$    | $V_{DS}=0V, V_{GS}=30V$                   | -         | -         | 100       | nA          |
| 反向栅极体漏电流<br>Gate-body leakage current,<br>reverse | $I_{GSSR}$    | $V_{DS}=0V, V_{GS}=-30V$                  | -         | -         | -100      | nA          |
| <b>通态特性 On-Characteristics</b>                    |               |                                           |           |           |           |             |
| 阈值电压<br>Gate Threshold Voltage                    | $V_{GS(th)}$  | $V_{DS} = V_{GS}, I_D=250\mu A$           | 2.4       | -         | 4.4       | V           |
| 静态导通电阻<br>Static Drain-Source<br>On-Resistance    | $R_{DS(ON)}$  | $V_{GS}=10V, I_D=30A$                     | -         | 60        | 68        | m $\Omega$  |
| <b>动态特性 Dynamic Characteristics</b>               |               |                                           |           |           |           |             |
| 输入电容<br>Input capacitance                         | $C_{iss}$     | $V_{DS}=25V,$<br>$V_{GS}=0V,$<br>$f=1MHz$ | -         | 9.0       | -         | nF          |
| 输出电容<br>Output capacitance                        | $C_{oss}$     |                                           | -         | 806       | -         | pF          |
| 反向传输电容<br>Reverse transfer capacitance            | $C_{rss}$     |                                           | -         | 25        | -         | pF          |

## 电特性 ELECTRICAL CHARACTERISTICS

| 开关特性 Switching Characteristics                                        |              |                                                      |   |     |     |          |
|-----------------------------------------------------------------------|--------------|------------------------------------------------------|---|-----|-----|----------|
| 延迟时间 Turn-On delay time                                               | $t_{d(on)}$  | $V_{DD}=200V, I_D=60A, R_G=25\Omega$<br>$V_{GS}=10V$ | - | 45  | -   | ns       |
| 上升时间 Turn-On rise time                                                | $t_r$        |                                                      | - | 96  | -   | ns       |
| 延迟时间 Turn-Off delay time                                              | $t_{d(off)}$ |                                                      | - | 75  | -   | ns       |
| 下降时间 Turn-Off Fall time                                               | $t_f$        |                                                      | - | 22  | -   | ns       |
| 栅极电荷总量 Total Gate Charge                                              | $Q_g$        | $V_{DS}=320V$ ,<br>$I_D=60A$<br>$V_{GS}=10V$         | - | 139 | -   | nC       |
| 栅-源电荷 Gate-Source charge                                              | $Q_{gs}$     |                                                      | - | 45  | -   | nC       |
| 栅-漏电荷 Gate-Drain charge                                               | $Q_{gd}$     |                                                      | - | 39  | -   | nC       |
| 栅极电阻 Gate Resistance                                                  | $R_g$        | $f=1MHz$                                             | - | 1.8 | -   | $\Omega$ |
| 漏-源二极管特性及最大额定值 Drain-Source Diode Characteristics and Maximum Ratings |              |                                                      |   |     |     |          |
| 正向压降<br>Drain-Source Diode Forward Voltage                            | $V_{SD}$     | $V_{GS}=0V, I_S=30A$                                 | - | -   | 1.4 | V        |
| 反向恢复时间<br>Reverse Recovery Time                                       | $T_{RR}$     | $V_{GS}=0V, I_S=60A$ ,<br>$di_F/dt=100A/\mu s$       | - | 126 | -   | ns       |
| 反向恢复电荷<br>Reverse Recovery Charge                                     | $Q_{RR}$     |                                                      | - | 0.6 | -   | $\mu C$  |

## 热特性 THERMAL CHARACTERISTIC

| 项 目<br>Parameter                                   | 符号<br>Symbol  | 值<br>Value | 单位<br>Unit    |
|----------------------------------------------------|---------------|------------|---------------|
| 结到管壳的热阻<br>Thermal Resistance, Junction to Case    | $R_{th(j-c)}$ | 0.43       | $^{\circ}C/W$ |
| 结到环境的热阻<br>Thermal Resistance, Junction-to-Ambient | $R_{th(j-A)}$ | 40         | $^{\circ}C/W$ |

## NOTES:

1. L = 0.5mH, VDD = 50V, RG=25 $\Omega$ , Starting at TJ = 25 $^{\circ}C$

## 特征曲线 ELECTRICAL CHARACTERISTICS

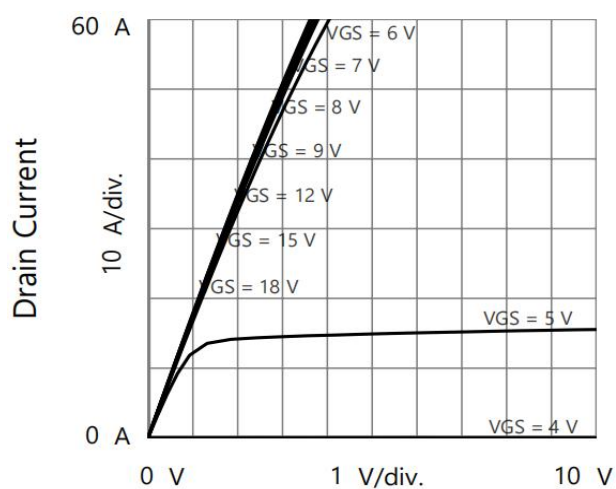


Fig1. Output characteristics  $T_J = 25^\circ\text{C}$

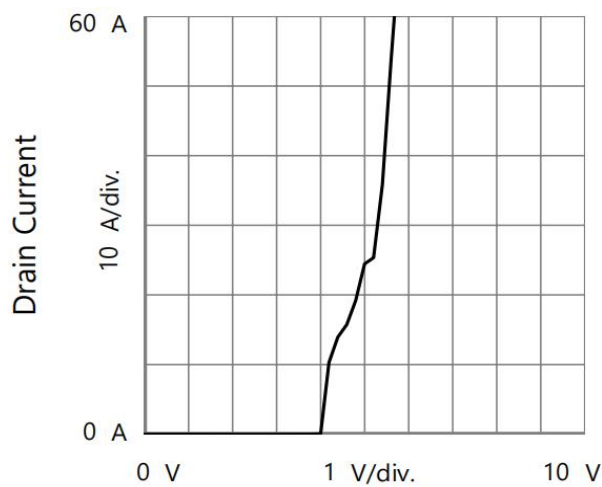


Fig2. Transfer characteristics

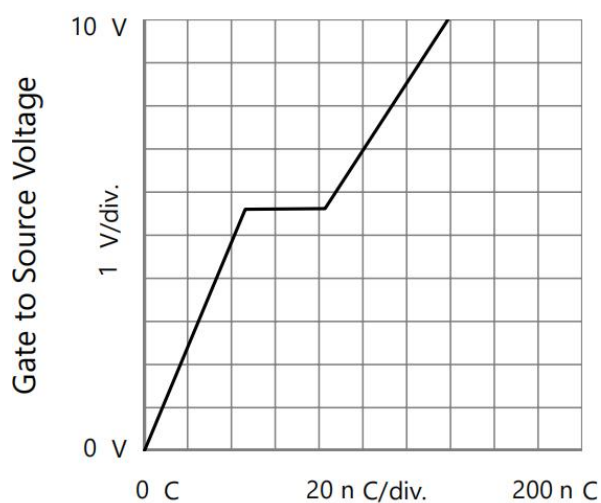


Fig3. Gate charge characteristics

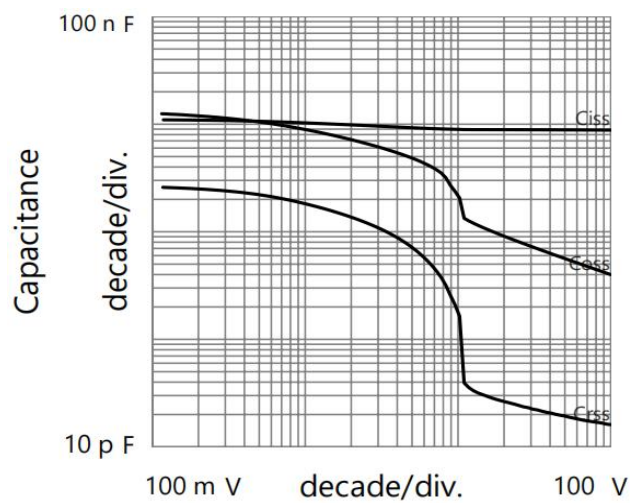


Fig 4. Capacitance Characteristics

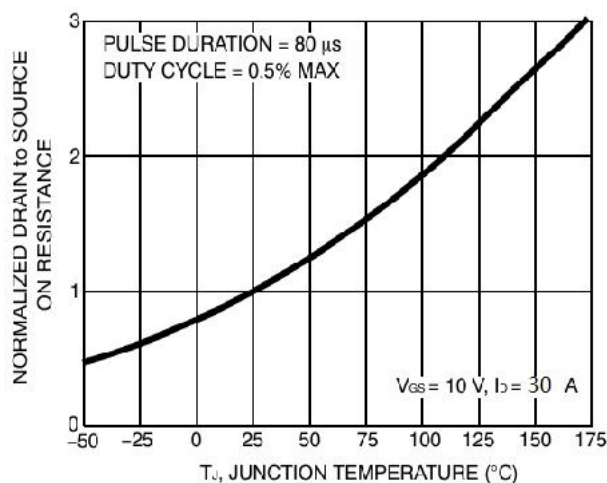


Fig 5.  $R_{DS(ON)}$  vs junction temperature

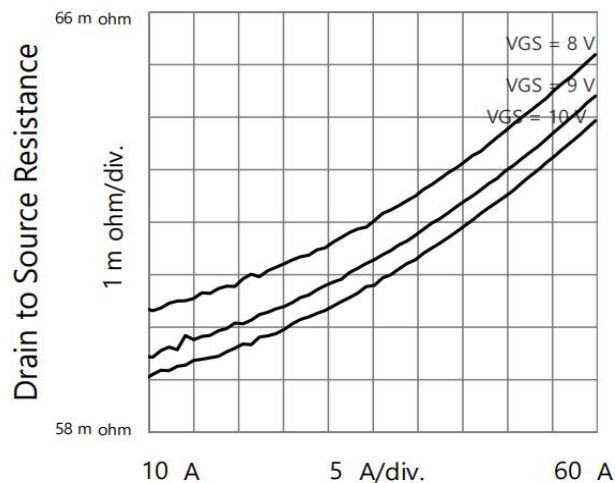


Fig 6.  $I_D$  VS  $R_{DSon}$

## 特征曲线 ELECTRICAL CHARACTERISTICS

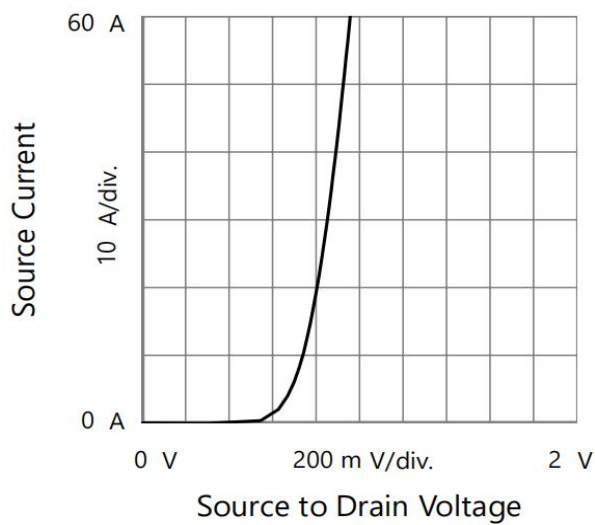


Fig 7 . Forward characteristics of reverse diode

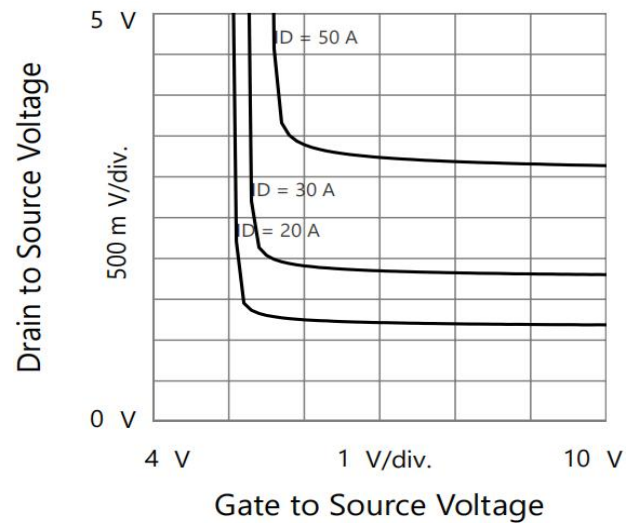


Fig 8 .Drain to Source Voltage vs. Gate to Source Voltage

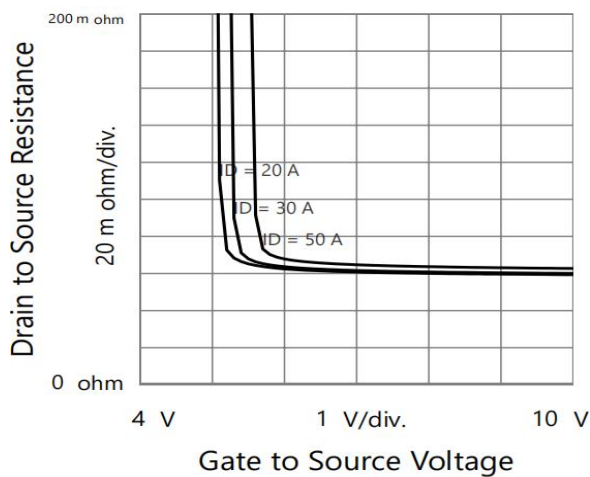


Fig 9 .Drain to Source Resistance vs. Gate to Source Voltage

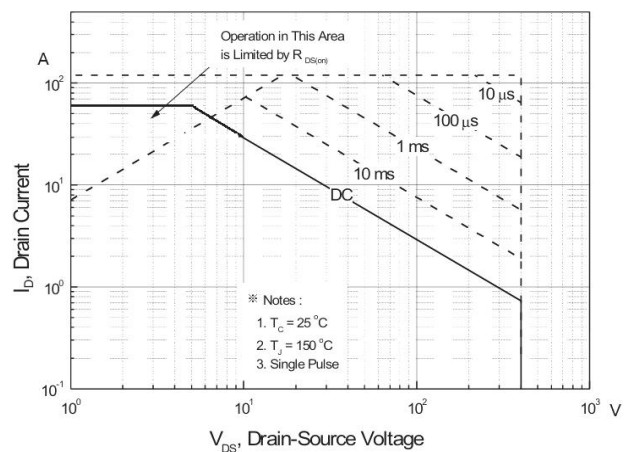


Fig 10 .Safe operating area

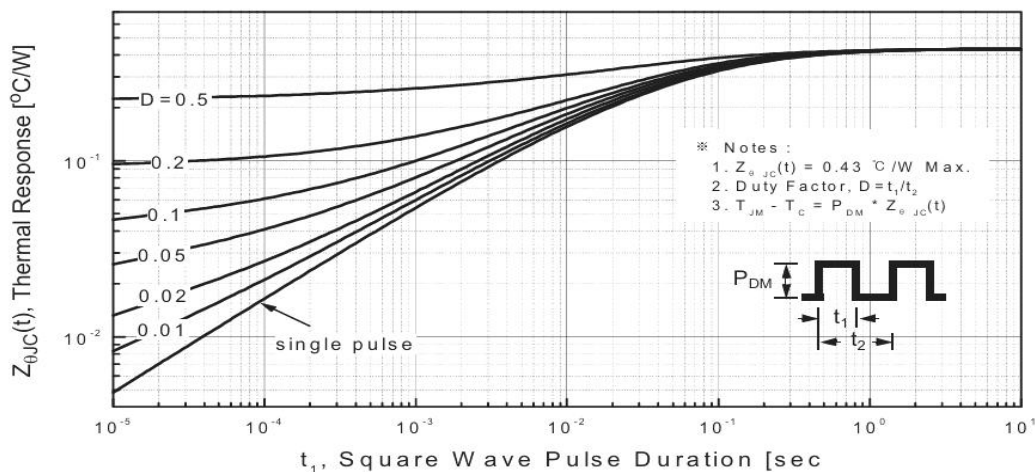
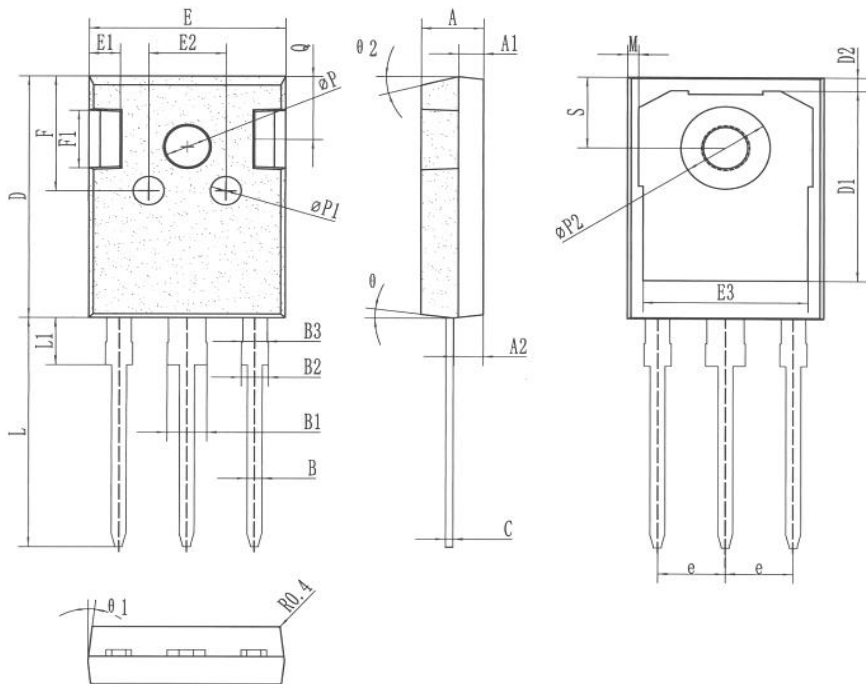


Fig 11 .Transient thermal impedance

外形尺寸 **PACKAGE MECHANICAL DATA**  
**TO-247**



COMMON DIMENSIONS

| SYMBOL | MM       |       |       |
|--------|----------|-------|-------|
|        | MIN      | NOM   | MAX   |
| A      | 4.90     | 5.00  | 5.10  |
| A1     | 1.90     | 2.00  | 2.10  |
| A2     | 2.30     | 2.40  | 2.50  |
| B      | 1.15     | 1.20  | 1.25  |
| B1     | 3.05     | 3.15  | 3.25  |
| B2     | 2.00     | 2.10  | 2.20  |
| B3     | 1.90     | 2.00  | 2.10  |
| C      | 0.55     | 0.60  | 0.65  |
| D      | 20.90    | 21.00 | 21.10 |
| D1     | 16.35    | 16.55 | 16.75 |
| D2     | 1.02     | 1.17  | 1.32  |
| E      | 15.70    | 15.80 | 15.90 |
| E1     | 2.40     | 2.50  | 2.60  |
| E2     | 6.10     | 6.20  | 6.30  |
| E3     | 13.10    | 13.30 | 13.50 |
| F      | 9.80     | 10.00 | 10.20 |
| F1     | 4.90     | 5.00  | 5.10  |
| e      | 5.44 BSC |       |       |
| L      | 19.72    | 19.92 | 20.12 |
| L1     | 3.90     | 4.10  | 4.30  |
| øP     | 3.50     | 3.60  | 3.70  |
| øP1    | 2.40     | 2.50  | 2.60  |
| øP2    | 7.10     | 7.20  | 7.30  |
| S      | 6.05     | 6.15  | 6.25  |
| M      | 0.45     | —     | 0.95  |
| Q      | 5.60     | 5.80  | 6.00  |
| ø      | 5°       | 7°    | 9°    |
| ø1     | 5°       | 7°    | 9°    |
| ø2     | 13°      | 15°   | 17°   |