

N And P-Channel Enhancement Mode MOSFET

Description

The NP4606 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications.

General Features

◆ N-channel:

$V_{DS} = 30V, I_D = 6.9A$

$R_{DS(ON)} = 13.5m\Omega$ (typical) @ $V_{GS} = 10V$

$R_{DS(ON)} = 17.5m\Omega$ (typical) @ $V_{GS} = 4.5V$

P-Channel:

$V_{DS} = -30V, I_D = -6A$

$R_{DS(ON)} = 35m\Omega$ (typical) @ $V_{GS} = -10V$

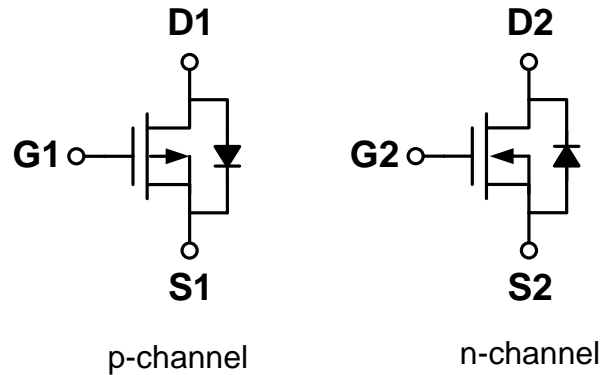
$R_{DS(ON)} = 49m\Omega$ (typical) @ $V_{GS} = -4.5V$

- ◆ Excellent gate charge x $R_{DS(ON)}$ product(FOM)
- ◆ Very low on-resistance $R_{DS(ON)}$
- ◆ 150 °C operating temperature
- ◆ Pb-free lead plating
- ◆ 100% UIS tested

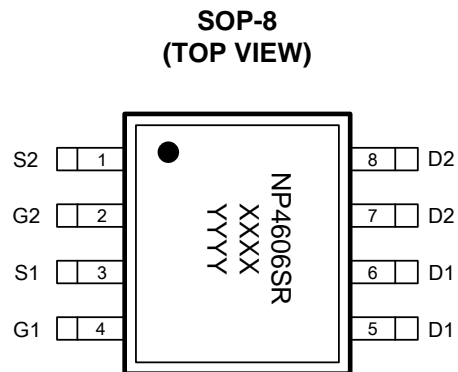
Application

- ◆ DC/DC Converter
- ◆ Ideal for high-frequency switching and synchronous rectification

Schematic diagram



Marking and pin assignment



Note: XXXX is the date code, YYYY is the wafer lot number.

Package

SOP-8

Ordering Information

| Part Number | Storage Temperature | Package | Devices Per Reel |
|-------------|---------------------|---------|------------------|
| NP4606SR | -55°C to +150°C | SOP-8 | 3000 |

Absolute Maximum Ratings (TA=25°C unless otherwise noted)

| Parameter | Symbol | Limit | | Unit |
|---------------------------|----------|-------|-----|------|
| | | N | P | |
| Drain-source voltage | V_{DS} | 30 | -30 | V |
| Gate-source voltage | V_{GS} | ±20 | ±20 | V |
| Maximum power dissipation | P_D | 2.0 | 2.0 | W |

| | | | | | |
|---|------------------------|------------------|---------|---------|----|
| Operating junction Temperature range | | T_j | -55—150 | -55—150 | °C |
| Drain Current-Continuous (Silicon Limited) | $T_A=25^\circ\text{C}$ | I_D | 6 | -6 | A |
| | $T_A=75^\circ\text{C}$ | | 5 | -5 | |
| Pulsed Drain Current (Package Limited) | | I_{DM} | 30 | -30 | A |
| Avalanche Current ^C | | I_{AS}, I_{AR} | 10 | 23 | A |
| Avalanche energy $L=0.1\text{mH}^C$ | | E_{AS}, E_{AR} | 5 | 26 | mJ |
| Power Dissipation ^B | $T_A=25^\circ\text{C}$ | P_D | 2 | 2 | W |
| | $T_A=75^\circ\text{C}$ | | 1.3 | 1.3 | |
| Junction and Storage Temperature Range | | T_J, T_{STG} | -55—150 | | °C |

N-Channel Electrical Characteristics ($T_J=25^\circ\text{C}$ unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|----------------------------------|--------------|--|-----|------|-----------|---------------|
| OFF Characteristics | | | | | | |
| Drain-source breakdown voltage | BV_{DSS} | $V_{GS}=0V, I_D=250\mu\text{A}$ | 30 | - | - | V |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=30V, V_{GS}=0V$ | - | - | 1 | μA |
| Gate-body leakage | I_{GSS} | $V_{DS}=0V, V_{GS}=\pm 20V$ | - | - | ± 100 | nA |
| ON Characteristics | | | | | | |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu\text{A}$ | 1.0 | 1.55 | 3.0 | V |
| Drain-source on-state resistance | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=6A$ | - | 13.5 | 20 | m Ω |
| | | $V_{GS}=4.5V, I_D=5A$ | - | 17.2 | 28 | |
| Forward transconductance | g_{fs} | $V_{DS}=5V, I_D=6A$ | - | 15 | - | S |
| Dynamic Characteristics | | | | | | |
| Input capacitance | C_{ISS} | $V_{DS}=15V, V_{GS}=0V$ $f=1.0\text{MHz}$ | - | 255 | 310 | pF |
| Output capacitance | C_{OSS} | | - | 45 | 60 | |
| Reverse transfer capacitance | C_{RSS} | | - | 35 | 50 | |
| Gate resistance | R_g | $V_{GS}=0V, V_{DS}=0V,$ $f=1.0\text{MHz}$ | - | 3.3 | 4.9 | Ω |
| Switching Characteristics | | | | | | |
| Turn-on delay time | $t_{D(ON)}$ | $V_{DS}=15V$ $V_{GS}=10V$ $R_L=2.5\Omega$ $R_{GEN}=3\Omega$ | - | 4.5 | - | ns |
| Rise time | t_r | | - | 2.5 | - | |
| Turn-off delay time | $t_{D(OFF)}$ | | - | 14.5 | - | |
| Fall time | t_f | | - | 3.5 | - | |
| Total gate charge | Q_g | $V_{DS}=15V, I_D=6A$ $V_{GS}=10V$ | - | 5.2 | - | nC |
| Gate-source charge | Q_{gs} | | - | 2.5 | - | |
| Gate-drain charge | Q_{gd} | | - | 1 | - | |

Thermal Characteristics

| | | | |
|--|-------------|-----|------|
| Thermal Resistance junction-to ambient | $R_{th JA}$ | 100 | °C/W |
|--|-------------|-----|------|

N-Channel: Typical Electrical And Thermal Characteristics

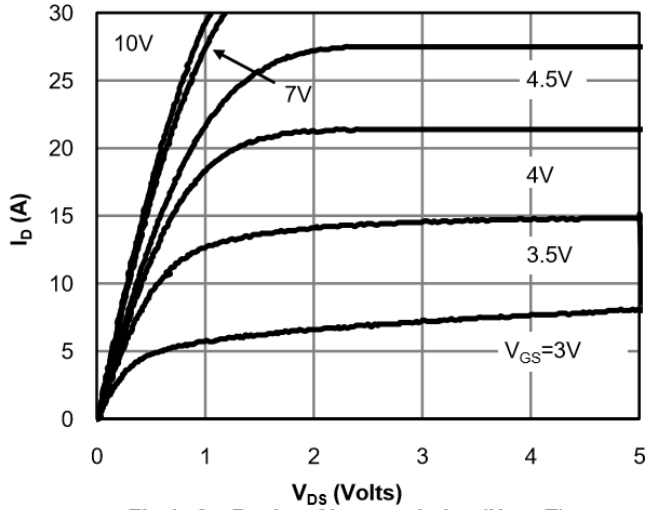


Fig 1: On-Region Characteristics (Note E)

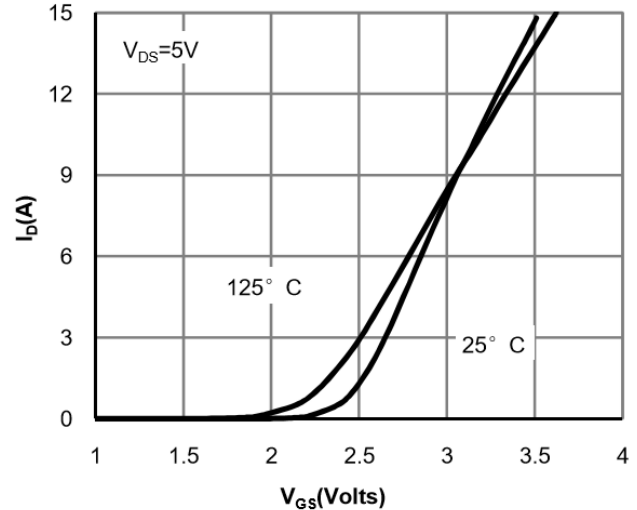


Figure 2: Transfer Characteristics (Note E)

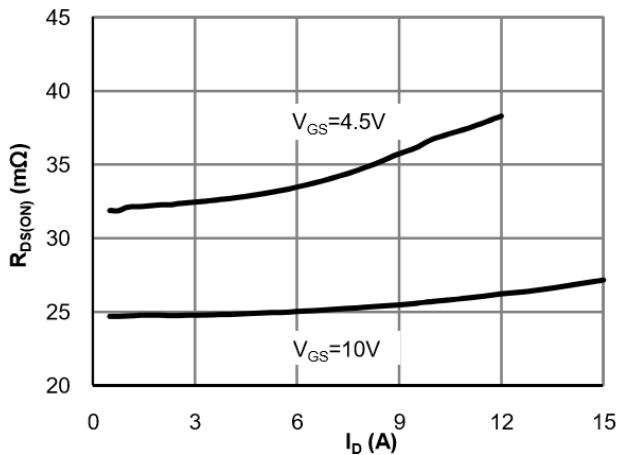


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

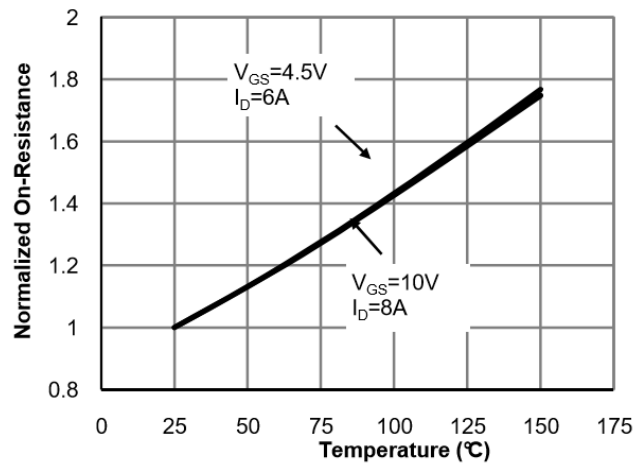


Figure 4: On-Resistance vs. Junction Temperature (Note E)

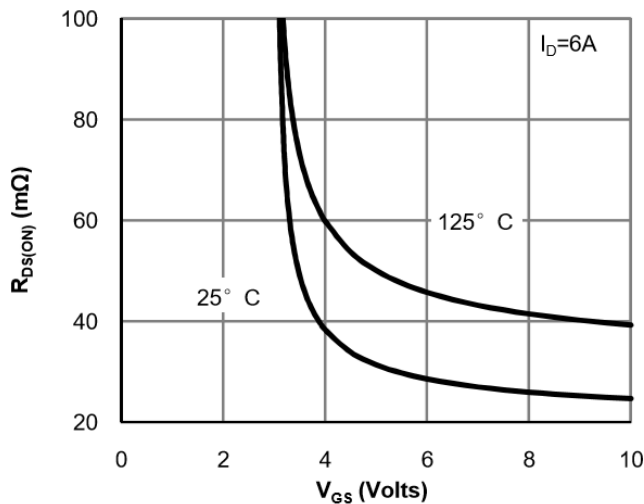


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

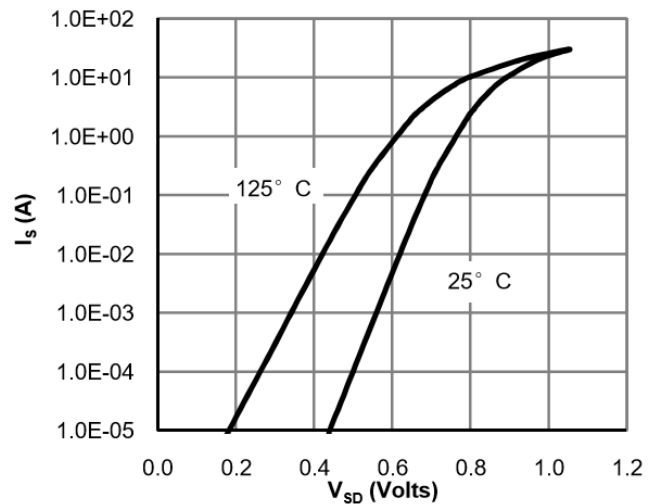


Figure 6: Body-Diode Characteristics (Note E)

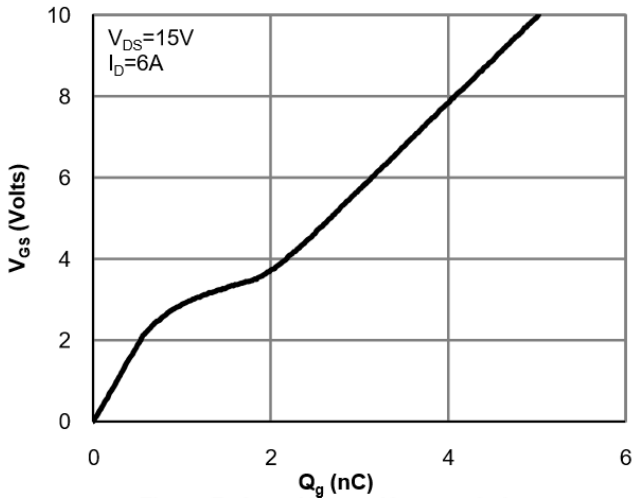


Figure 7: Gate-Charge Characteristics

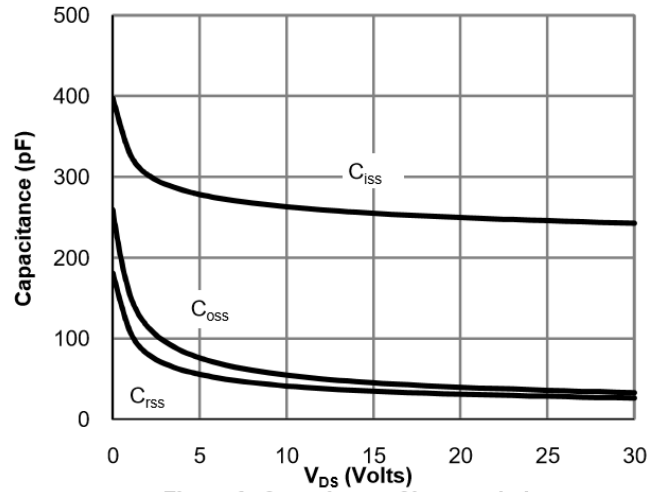


Figure 8: Capacitance Characteristics

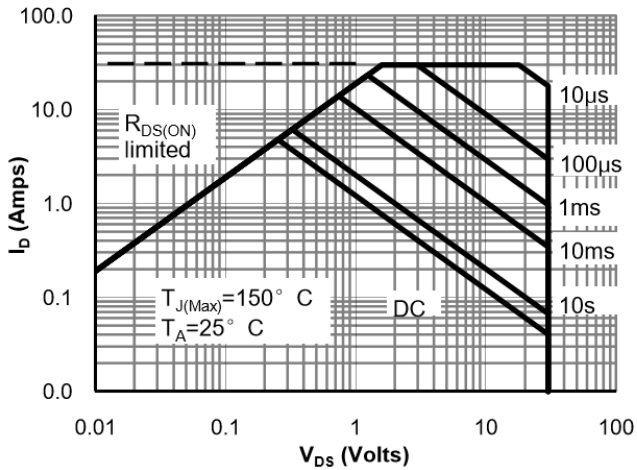


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

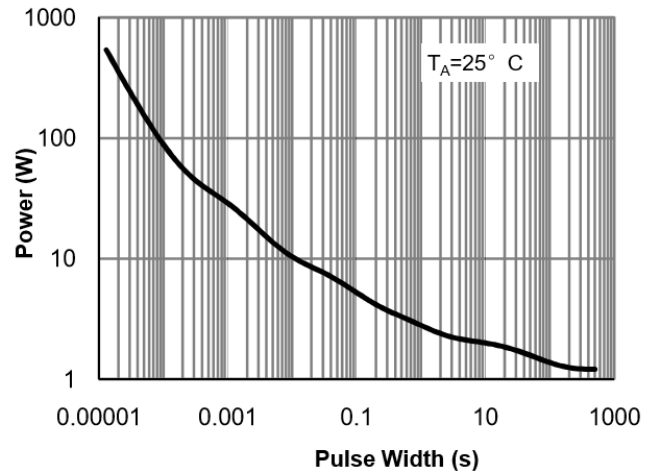


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

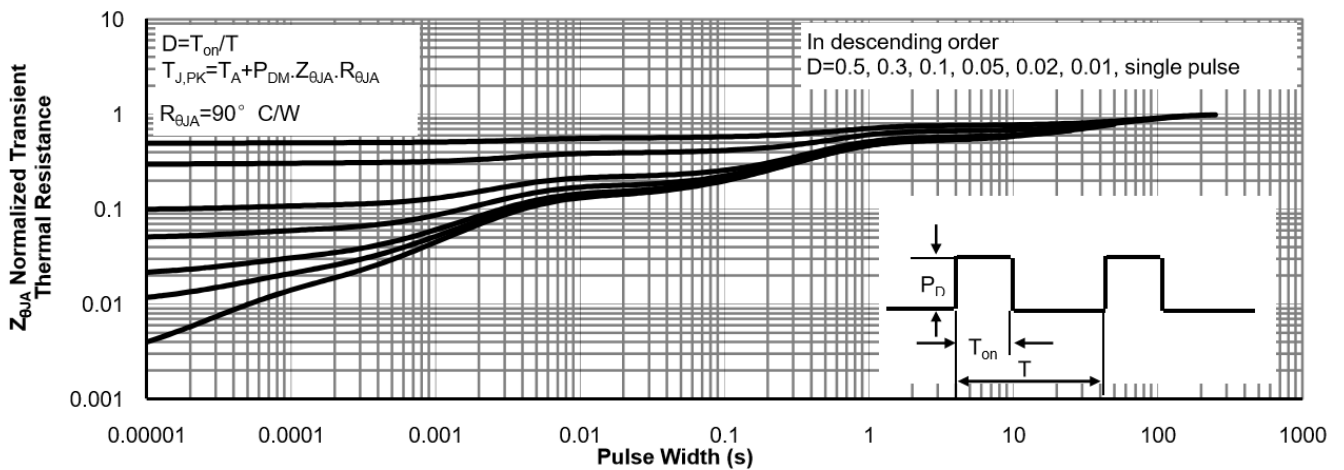
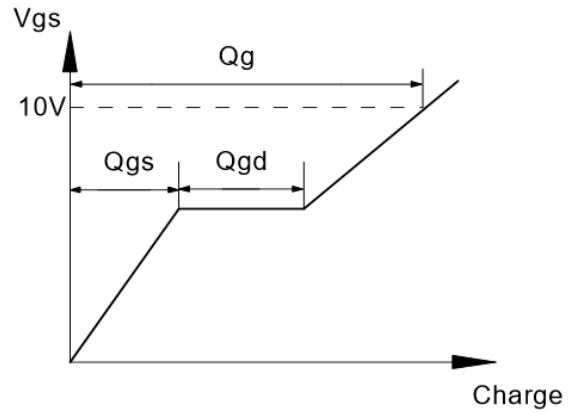
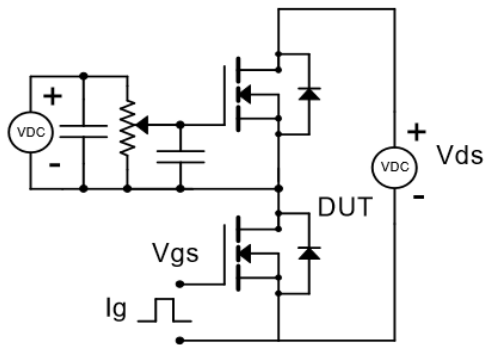
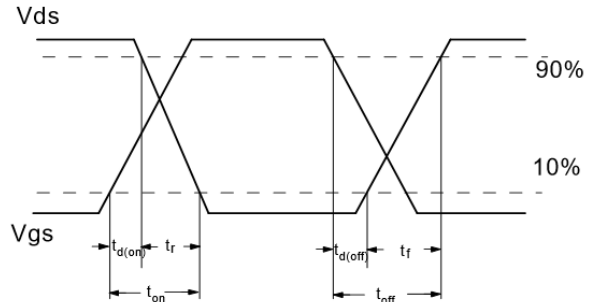
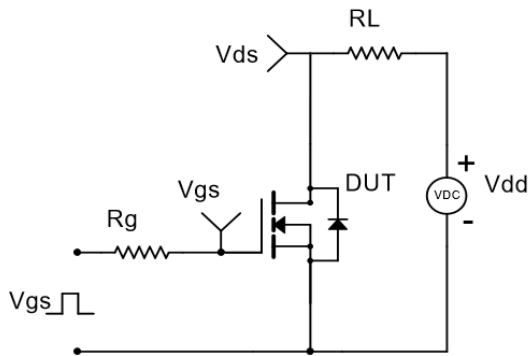


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

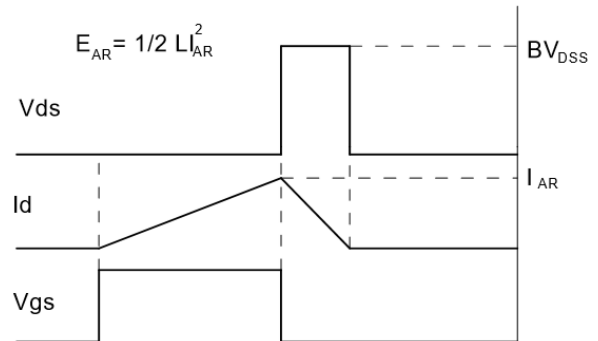
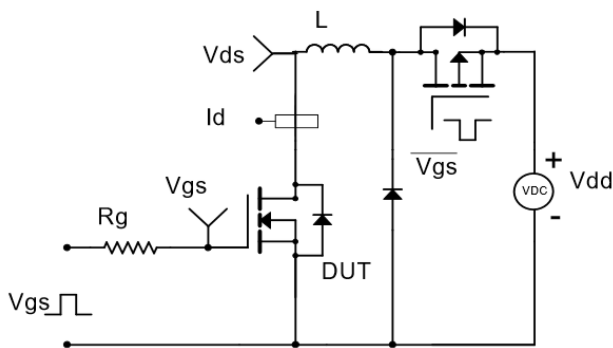
Gate Charge Test Circuit & Waveform



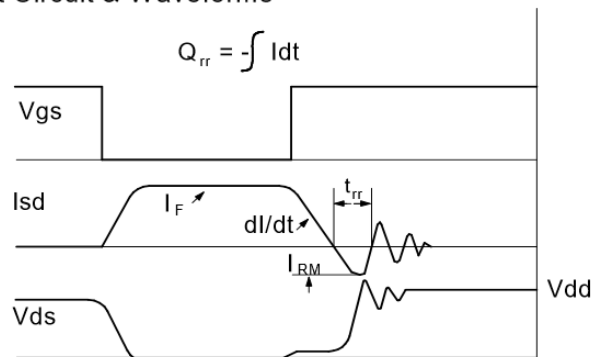
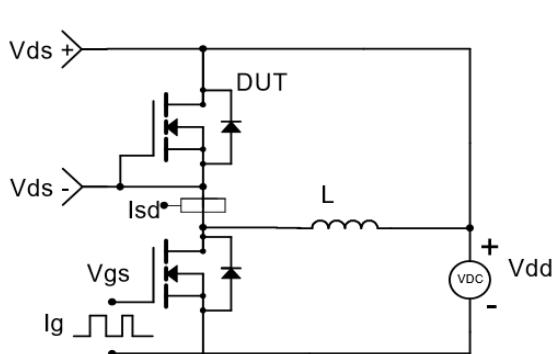
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



P-Channel Electrical Characteristics ($T_J=25^{\circ}\text{C}$ unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|----------------------------------|--------------|--|------|-------|-----------|------------|
| OFF Characteristics | | | | | | |
| Drain-source breakdown voltage | BV_{DSS} | $V_{GS}=0V, I_D=-250\mu A$ | -30 | - | - | V |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=-30V, V_{GS}=0V$ | - | - | -1 | μA |
| Gate-body leakage | I_{GSS} | $V_{DS}=0V, V_{GS}=\pm 20V$ | - | - | ± 100 | nA |
| ON Characteristics | | | | | | |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-250\mu A$ | -0.8 | -1.32 | -2 | V |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=-10V, I_D=-6A$ | - | 35 | 45 | m Ω |
| | | $V_{GS}=-4.5V, I_D=-5A$ | - | 49 | 60 | |
| Forward transconductance | gfs | $V_{DS}=-5V, I_D=-6A$ | - | 18 | - | S |
| Dynamic Characteristics | | | | | | |
| Input capacitance | C_{ISS} | $V_{DS}=-15V, V_{GS}=0V$ $f=1.0\text{MHz}$ | - | 760 | - | pF |
| Output capacitance | C_{OSS} | | - | 140 | - | |
| Reverse transfer capacitance | C_{RSS} | | - | 95 | - | |
| Gate resistance | R_g | $V_{GS}=0V, V_{DS}=0V,$ $f=1.0\text{MHz}$ | - | 3.2 | 5 | Ω |
| Switching Characteristics | | | | | | |
| Turn-on delay time | $t_{D(ON)}$ | $V_{DS}=-15V$ $V_{GS}=-10V$ $R_L=2.3\Omega$ $R_{GEN}=3\Omega$ | - | 8 | - | ns |
| Rise time | t_r | | - | 6 | - | |
| Turn-off delay time | $t_{D(OFF)}$ | | - | 17 | - | |
| Fall time | t_f | | - | 5 | - | |
| Total gate charge | Q_g | $V_{DS}=-15V, I_D=-6A$ $V_{GS}=-10V$ | - | 13.6 | - | nC |
| Gate-source charge | Q_{gs} | | - | 2.5 | - | |
| Gate-drain charge | Q_{gd} | | - | 3.2 | - | |

P-Channel: Typical Electrical And Thermal Characteristics

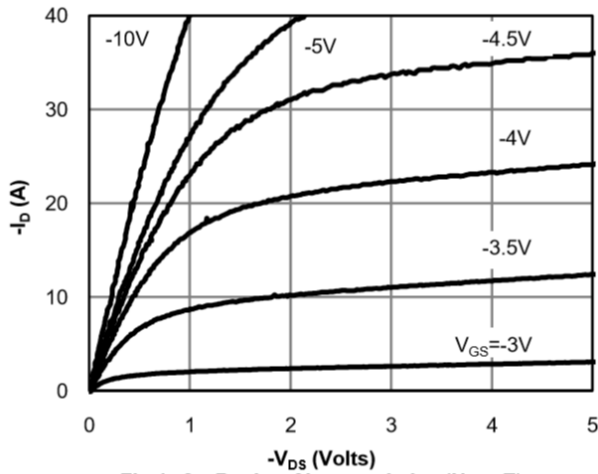


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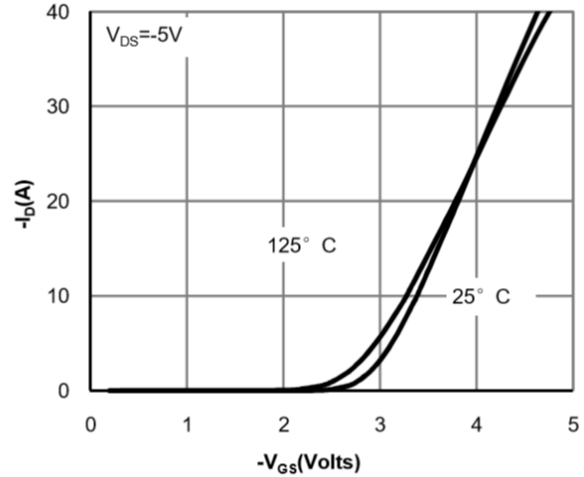


Figure 2: Transfer Characteristics (Note E)

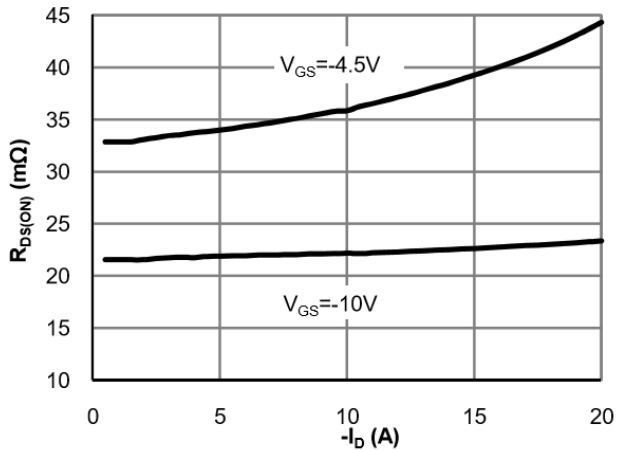


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

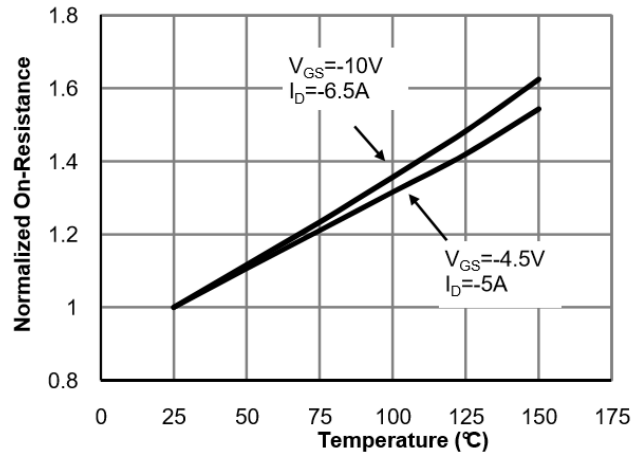


Figure 4: On-Resistance vs. Junction Temperature (Note E)

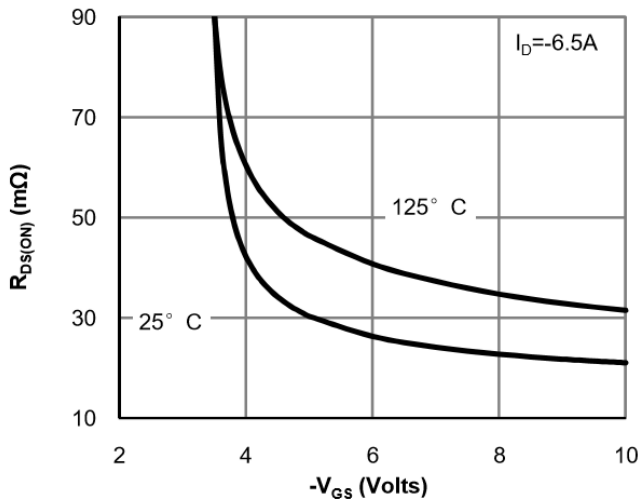


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

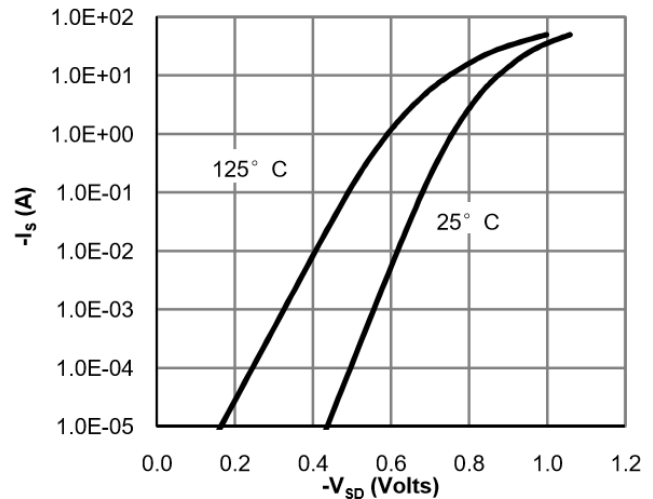


Figure 6: Body-Diode Characteristics (Note E)

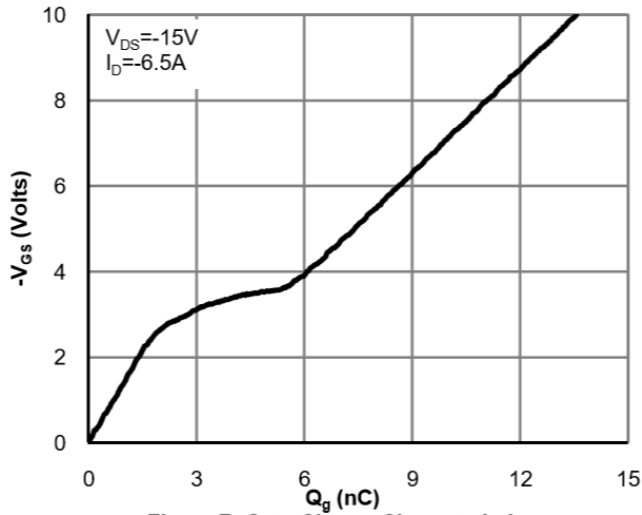


Figure 7: Gate-Charge Characteristics

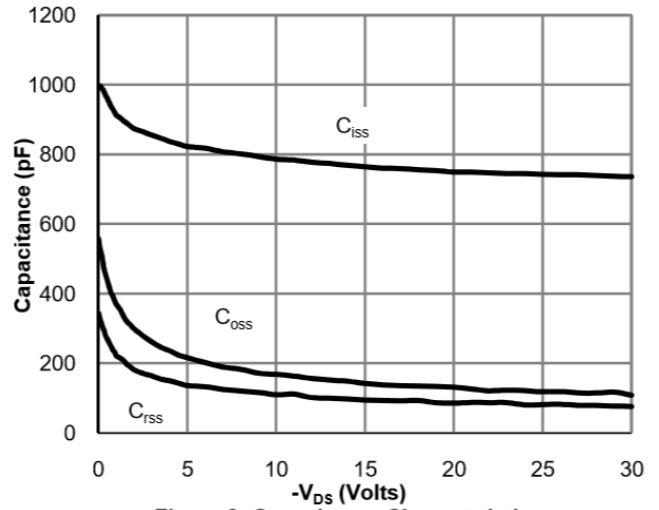


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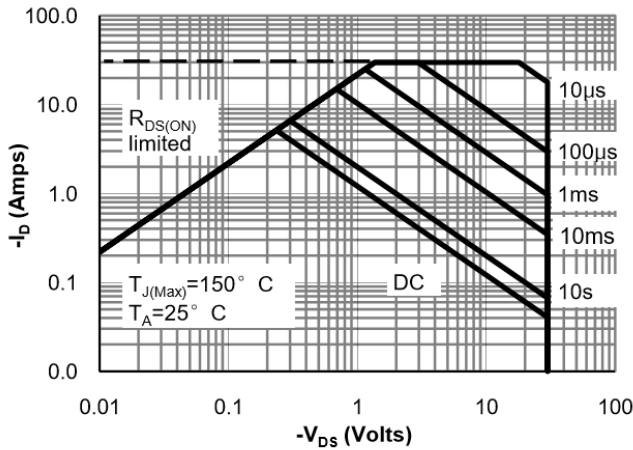


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

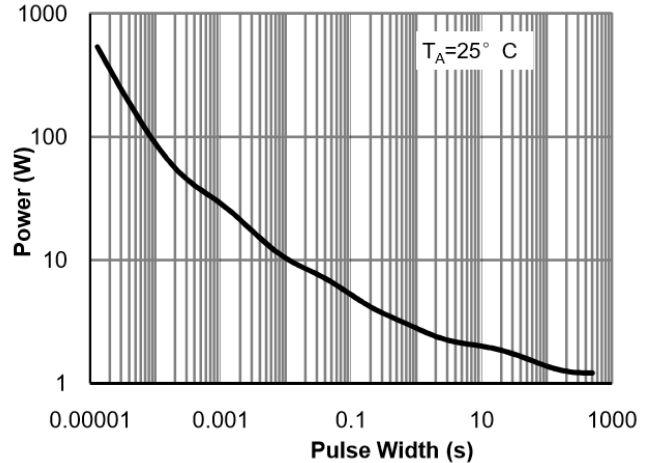


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

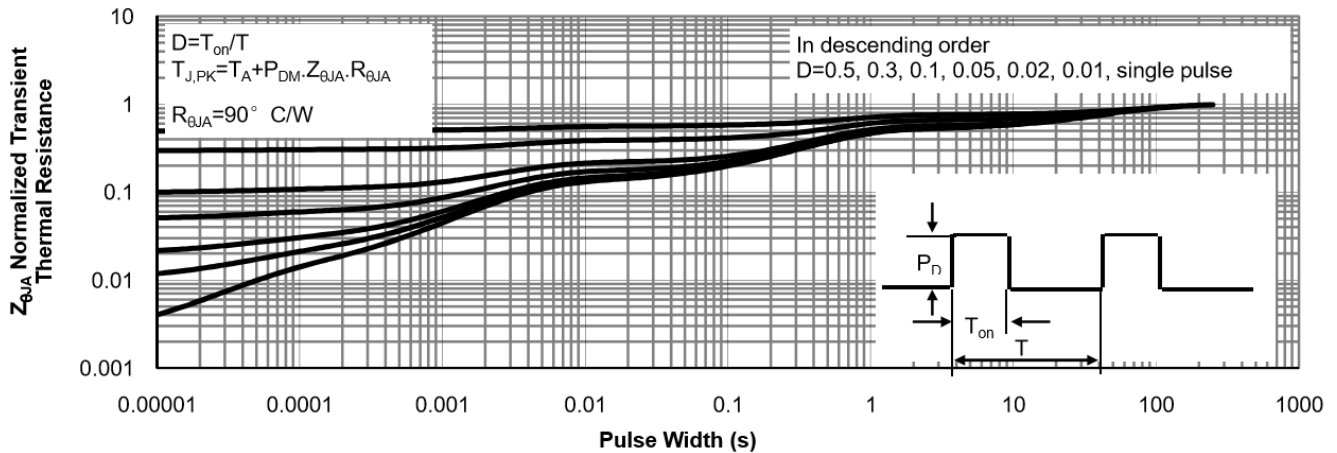
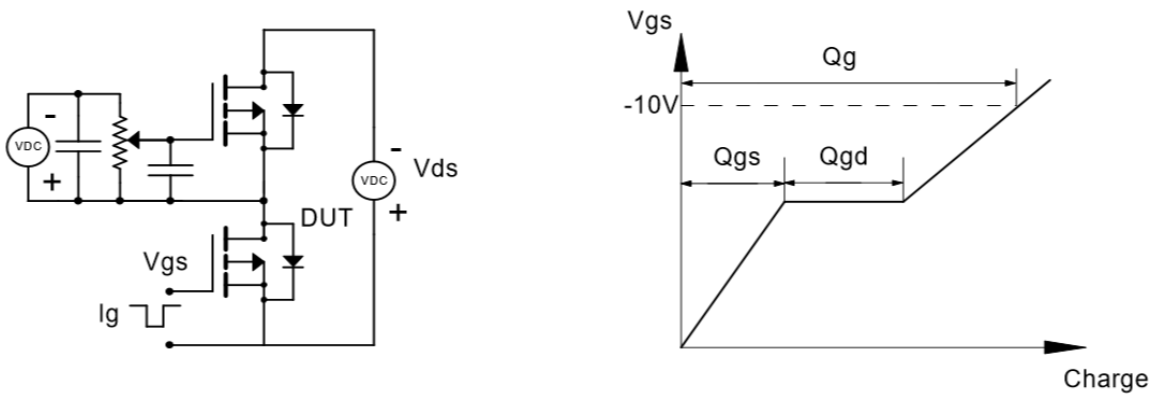
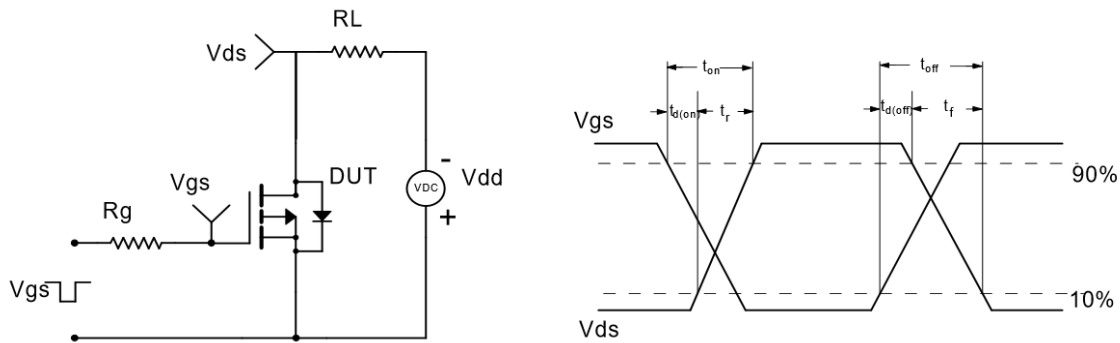


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

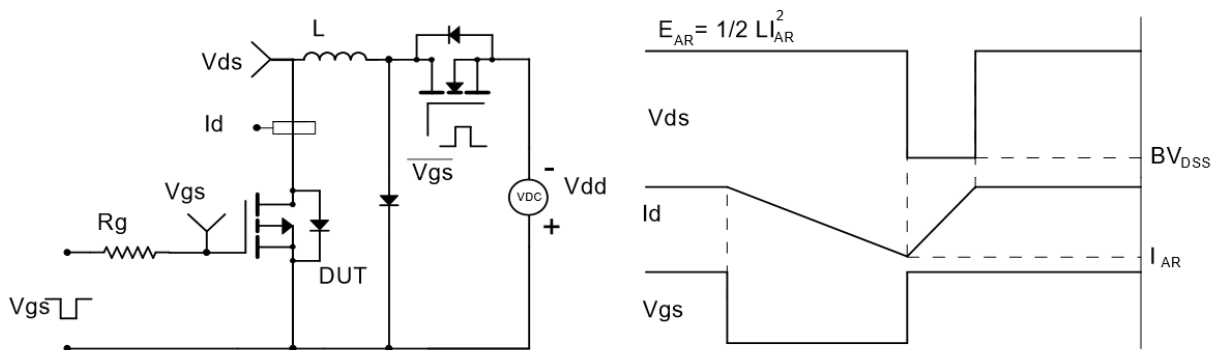
Gate Charge Test Circuit & Waveform



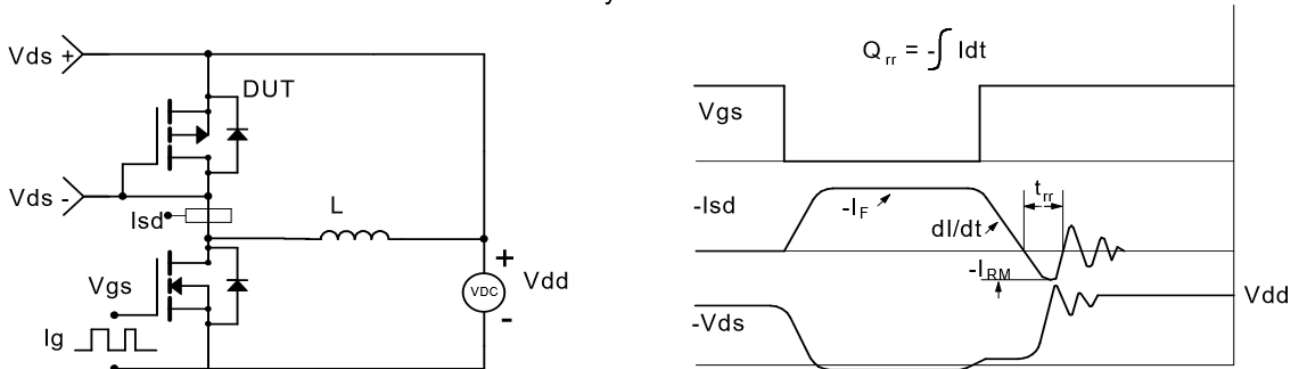
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

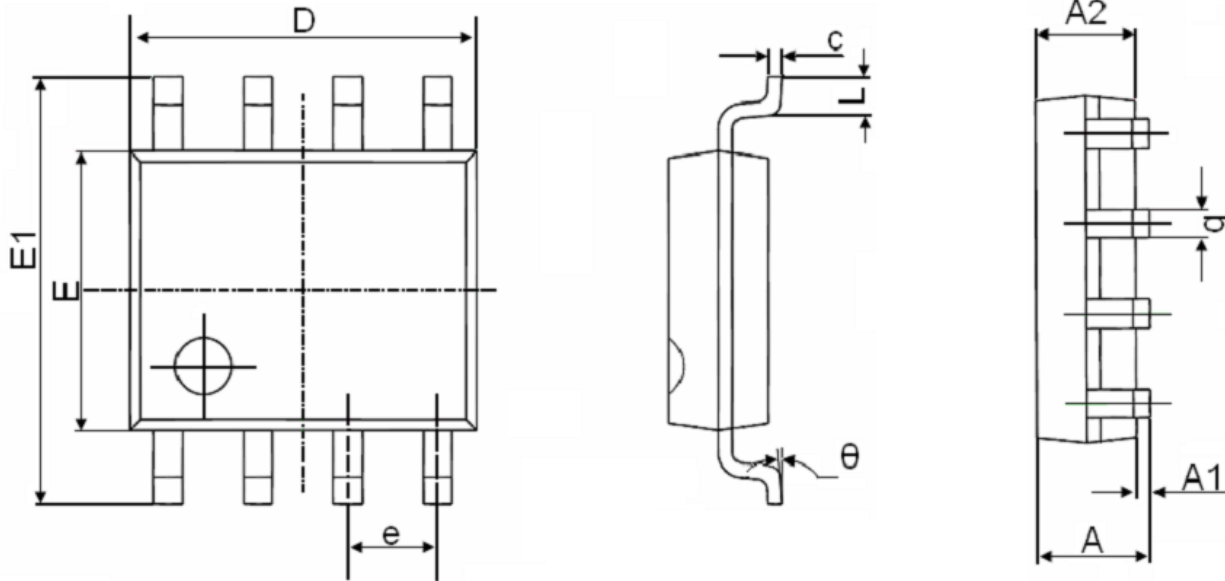


Diode Recovery Test Circuit & Waveforms



Package Information

- SOP-8



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.006 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.200 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.200 | 0.228 | 0.244 |
| e | 1.270(BSC) | | 0.050(BSC) | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |