

## ZXMHC3F381N8

### 30V SO8 Complementary enhancement mode MOSFET H-Bridge

#### Summary

| Device | $V_{(BR)DSS}$ | $Q_G$  | $R_{DS(on)}$                           | $I_D$<br>$T_A = 25^\circ\text{C}$ |
|--------|---------------|--------|----------------------------------------|-----------------------------------|
| N-CH   | 30V           | 9.0nC  | 33m $\Omega$ @ $V_{GS} = 10\text{V}$   | 5.0A                              |
|        |               |        | 60m $\Omega$ @ $V_{GS} = 4.5\text{V}$  | 3.9A                              |
| P-CH   | -30V          | 12.7nC | 55m $\Omega$ @ $V_{GS} = -10\text{V}$  | -4.1A                             |
|        |               |        | 80m $\Omega$ @ $V_{GS} = -4.5\text{V}$ | -3.3A                             |

#### Description

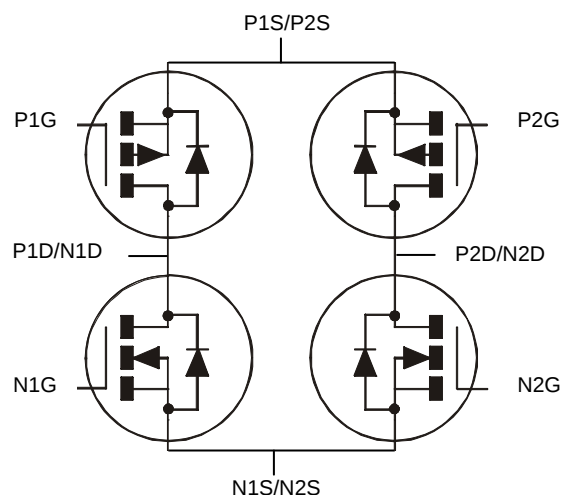
This new generation complementary MOSFET H-Bridge features low on-resistance achievable with low gate drive.

#### Features

- 2 x N + 2 x P channels in a SOIC package
- Low voltage ( $V_{GS} = 4.5\text{V}$ ) gate drive

#### Applications

- DC Motor control
- DC-AC Inverters

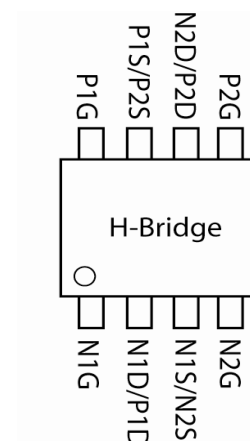


#### Ordering information

| Device         | Reel size (inches) | Tape width (mm) | Quantity per reel |
|----------------|--------------------|-----------------|-------------------|
| ZXMHC3F381N8TC | 13                 | 12              | 2,500             |

#### Device marking

ZXMHC  
3F381



**Absolute maximum ratings**

| Parameter                                                                                                                                                                                                                                             | Symbol         | N-channel                    | P-channel                        | Unit       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------|----------------------------------|------------|
| Drain-Source voltage                                                                                                                                                                                                                                  | $V_{DSS}$      | 30                           | -30                              | V          |
| Gate-Source voltage                                                                                                                                                                                                                                   | $V_{GS}$       | $\pm 20$                     | $\pm 20$                         | V          |
| Continuous Drain current @ $V_{GS} = 10V$ ; $T_A = 25^\circ C$ <sup>(b)</sup><br>@ $V_{GS} = 10V$ ; $T_A = 70^\circ C$ <sup>(b)</sup><br>@ $V_{GS} = 10V$ ; $T_A = 25^\circ C$ <sup>(a)</sup><br>@ $V_{GS} = 10V$ ; $T_L = 25^\circ C$ <sup>(f)</sup> | $I_D$          | 4.98<br>3.98<br>3.98<br>4.17 | -4.13<br>-3.31<br>-3.36<br>-3.51 | A          |
| Pulsed Drain current @ $V_{GS} = 10V$ ; $T_A = 25^\circ C$ <sup>(c)</sup>                                                                                                                                                                             | $I_{DM}$       | 22.9                         | -19.6                            | A          |
| Continuous Source current (Body diode) at $T_A = 25^\circ C$ <sup>(b)</sup>                                                                                                                                                                           | $I_S$          | 2.0                          | -2.0                             | A          |
| Pulsed Source current (Body diode) at $T_A = 25^\circ C$ <sup>(c)</sup>                                                                                                                                                                               | $I_{SM}$       | 22.9                         | -19.6                            | A          |
| Power dissipation at $T_A = 25^\circ C$ <sup>(a)</sup><br>Linear derating factor                                                                                                                                                                      | $P_D$          | 0.87<br>6.94                 |                                  | W<br>mW/°C |
| Power dissipation at $T_A = 25^\circ C$ <sup>(b)</sup><br>Linear derating factor                                                                                                                                                                      | $P_D$          | 1.35<br>10.9                 |                                  | W<br>mW/°C |
| Power dissipation at $T_L = 25^\circ C$ <sup>(f)</sup><br>Linear derating factor                                                                                                                                                                      | $P_D$          | 0.95<br>7.63                 | 0.98<br>7.81                     | W<br>mW/°C |
| Operating and storage temperature range                                                                                                                                                                                                               | $T_j, T_{stg}$ | -55 to 150                   |                                  | °C         |

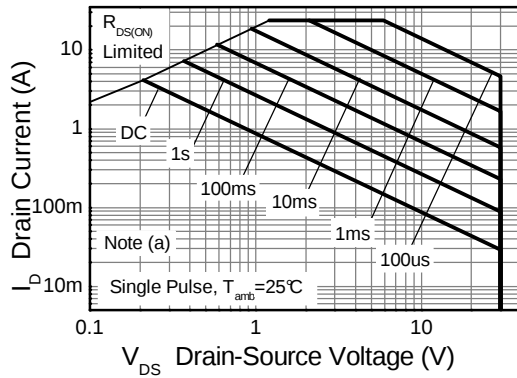
**Thermal resistance**

| Parameter                          | Symbol          | Value |     | Unit |
|------------------------------------|-----------------|-------|-----|------|
| Junction to ambient <sup>(a)</sup> | $R_{\theta JA}$ | 144   |     | °C/W |
| Junction to ambient <sup>(b)</sup> | $R_{\theta JA}$ | 92    |     | °C/W |
| Junction to ambient <sup>(d)</sup> | $R_{\theta JA}$ | 106   |     | °C/W |
| Junction to ambient <sup>(e)</sup> | $R_{\theta JA}$ | 254   |     | °C/W |
| Junction to lead <sup>(f)</sup>    | $R_{\theta JL}$ | 131   | 128 | °C/W |

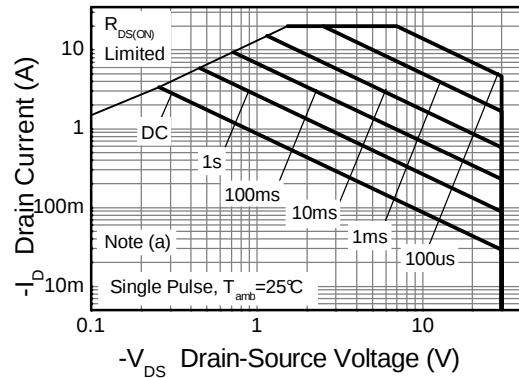
**NOTES:**

- (a) For a device surface mounted on 25mm x 25mm x 1.6mm FR4 PCB with high coverage of single sided 1oz copper, in still air conditions with the heat-sink split into two equal areas (one for each drain connection); the device is measured when operating in a steady-state condition with one active die.
- (b) Same as note (a), except the device is measured at  $t \leq 10$  sec.
- (c) Same as note (a), except the device is pulsed with  $D = 0.02$  and pulse width 300  $\mu s$ . The pulse current is limited by the maximum junction temperature.
- (d) For a device surface mounted on 50mm x 50mm x 1.6mm FR4 PCB with high coverage of single sided 2oz copper, in still air conditions with the heat-sink split into two equal areas (one for each drain connection); the device is measured when operating in a steady-state condition with one active die.
- (e) For a device surface mounted on minimum copper 1.6mm FR4 PCB, in still air conditions; the device is measured when operating in a steady-state condition with one active die.
- (f) Thermal resistance from junction to solder-point (at the end of the drain lead); the device is operating in a steady-state condition with one active die.

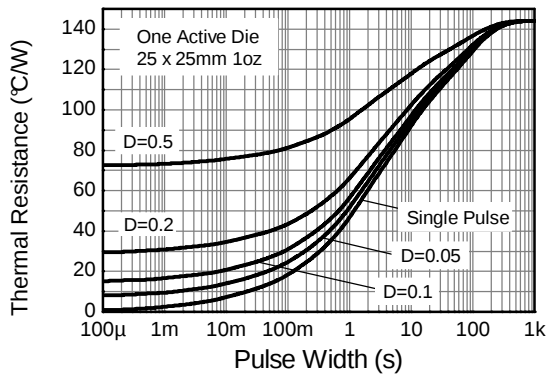
## Thermal characteristics



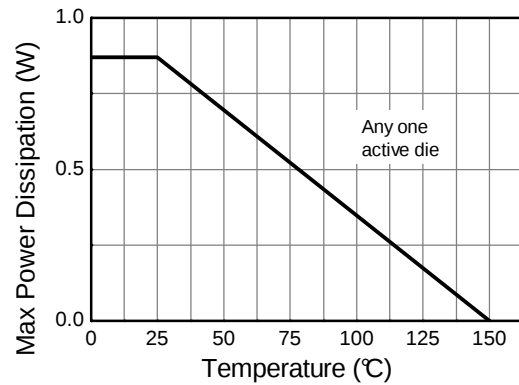
**N-channel Safe Operating Area**



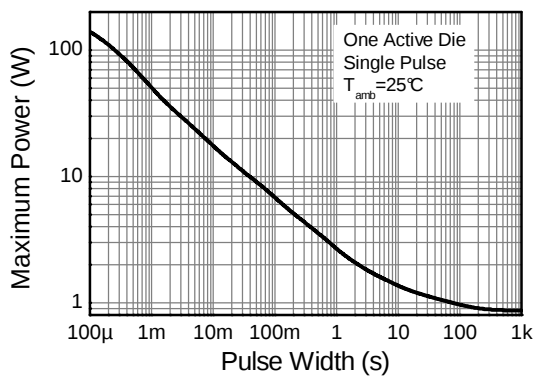
**P-channel Safe Operating Area**



**Transient Thermal Impedance**



**Derating Curve**



**Pulse Power Dissipation**

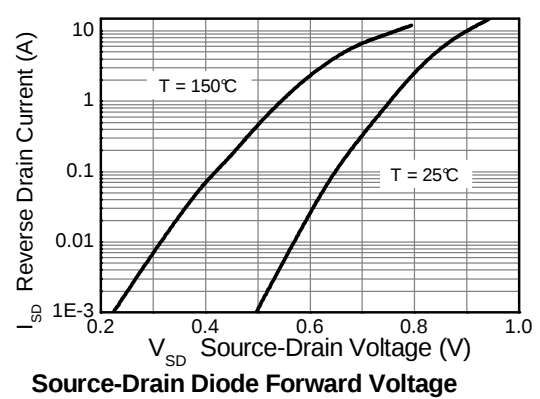
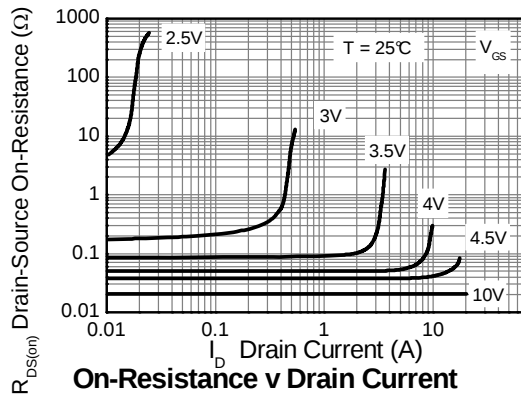
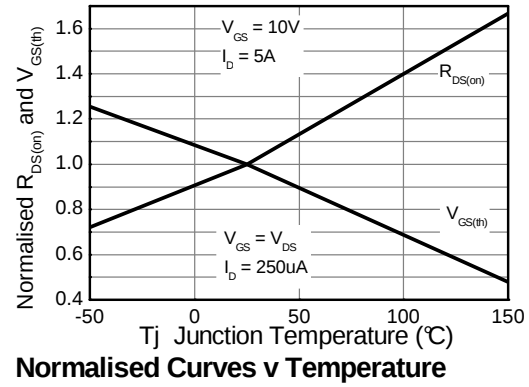
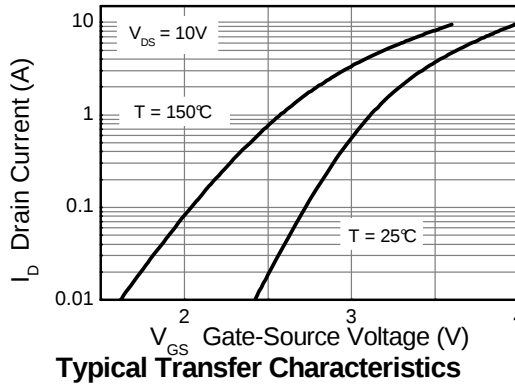
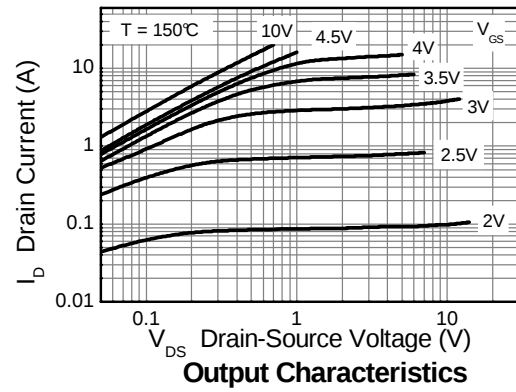
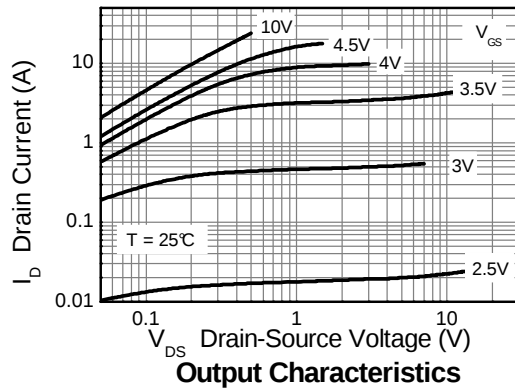
**N-channel electrical characteristics (at  $T_{amb} = 25^{\circ}\text{C}$  unless otherwise stated)**

| Parameter                                              | Symbol               | Min. | Typ. | Max.           | Unit | Conditions                                                                                  |
|--------------------------------------------------------|----------------------|------|------|----------------|------|---------------------------------------------------------------------------------------------|
| Static                                                 |                      |      |      |                |      |                                                                                             |
| Drain-Source breakdown voltage                         | V <sub>(BR)DSS</sub> | 30   |      |                | V    | I <sub>D</sub> = 250μA, V <sub>GS</sub> = 0V                                                |
| Zero Gate voltage Drain current                        | I <sub>DSS</sub>     |      |      | 0.5            | μA   | V <sub>DS</sub> = 30V, V <sub>GS</sub> = 0V                                                 |
| Gate-Body leakage                                      | I <sub>GSS</sub>     |      |      | ±100           | nA   | V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V                                                |
| Gate-Source threshold voltage                          | V <sub>GS(th)</sub>  | 1.0  |      | 3.0            | V    | I <sub>D</sub> = 250μA, V <sub>DS</sub> = V <sub>GS</sub>                                   |
| Static Drain-Source on-state resistance <sup>(a)</sup> | R <sub>DS(on)</sub>  |      |      | 0.033<br>0.060 | Ω    | V <sub>GS</sub> = 10V, I <sub>D</sub> = 5A<br>V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 4A   |
| Forward Transconductance <sup>(a) (c)</sup>            | g <sub>fs</sub>      |      | 11.8 |                | S    | V <sub>DS</sub> = 15V, I <sub>D</sub> = 5A                                                  |
| Dynamic                                                |                      |      |      |                |      |                                                                                             |
| Capacitance <sup>(c)</sup>                             |                      |      |      |                |      |                                                                                             |
| Input capacitance                                      | C <sub>iss</sub>     |      | 430  |                | pF   | V <sub>DS</sub> = 15V, V <sub>GS</sub> = 0V<br>f= 1MHz                                      |
| Output capacitance                                     | C <sub>oss</sub>     |      | 101  |                | pF   |                                                                                             |
| Reverse transfer capacitance                           | C <sub>rss</sub>     |      | 56   |                | pF   |                                                                                             |
| Switching <sup>(b) (c)</sup>                           |                      |      |      |                |      |                                                                                             |
| Turn-on-delay time                                     | t <sub>d(on)</sub>   |      | 2.5  |                | ns   | V <sub>DD</sub> = 15V, V <sub>GS</sub> = 10V<br>I <sub>D</sub> = 1A<br>R <sub>G</sub> ≅ 6Ω, |
| Rise time                                              | t <sub>r</sub>       |      | 3.3  |                | ns   |                                                                                             |
| Turn-off delay time                                    | t <sub>d(off)</sub>  |      | 11.5 |                | ns   |                                                                                             |
| Fall time                                              | t <sub>f</sub>       |      | 6.3  |                | ns   |                                                                                             |
| Gate charge <sup>(c)</sup>                             |                      |      |      |                |      |                                                                                             |
| Total Gate charge                                      | Q <sub>g</sub>       |      | 9.0  |                | nC   | V <sub>DS</sub> =15V, V <sub>GS</sub> = 10V<br>I <sub>D</sub> = 5A                          |
| Gate-Source charge                                     | Q <sub>gs</sub>      |      | 1.7  |                | nC   |                                                                                             |
| Gate-Drain charge                                      | Q <sub>gd</sub>      |      | 2.0  |                | nC   |                                                                                             |
| Source–Drain diode                                     |                      |      |      |                |      |                                                                                             |
| Diode forward voltage <sup>(a)</sup>                   | V <sub>SD</sub>      |      | 0.82 | 1.2            | V    | I <sub>S</sub> = 1.7A, V <sub>GS</sub> = 0V                                                 |
| Reverse recovery time <sup>(c)</sup>                   | t <sub>rr</sub>      |      | 12   |                | ns   | I <sub>S</sub> = 2.1A, di/dt= 100A/μs                                                       |
| Reverse recovery charge <sup>(c)</sup>                 | Q <sub>rr</sub>      |      | 4.9  |                | nC   |                                                                                             |

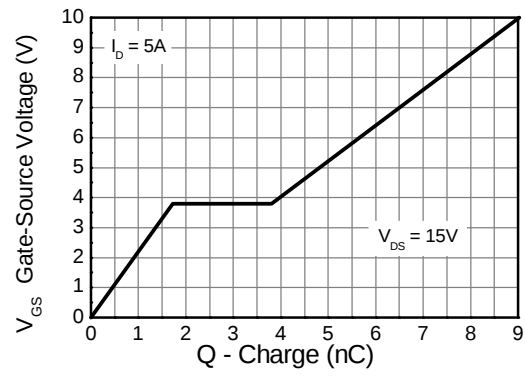
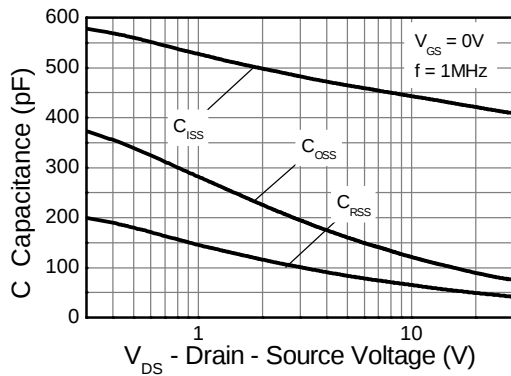
**NOTES:**

- (a) Measured under pulsed conditions. Pulse width  $\leq 300\mu\text{s}$ ; duty cycle  $\leq 2\%$ .  
(b) Switching characteristics are independent of operating junction temperature.  
(c) For design aid only, not subject to production testing

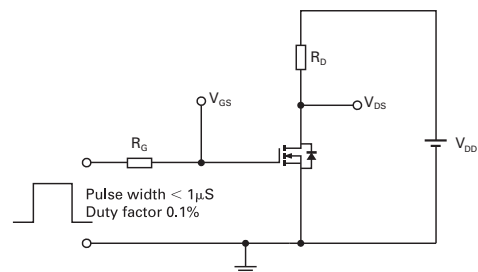
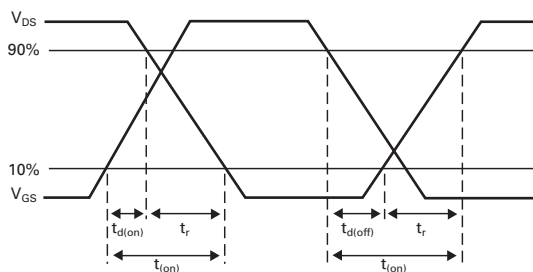
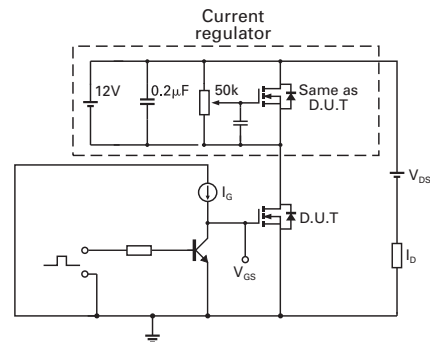
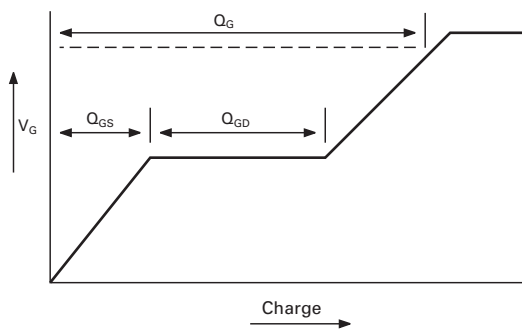
## N-channel typical characteristics



## N-channel typical characteristics –continued



## Test circuits



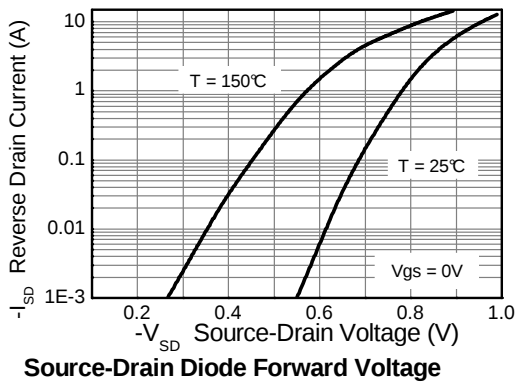
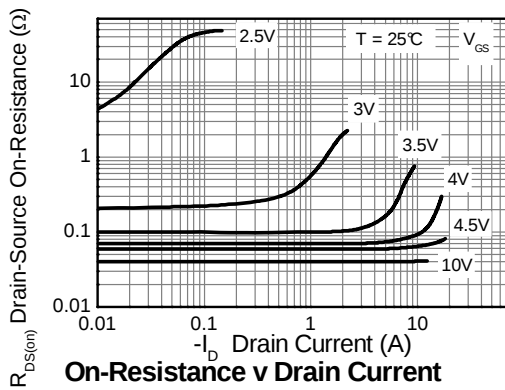
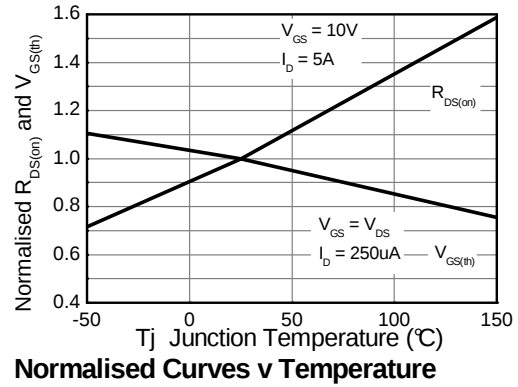
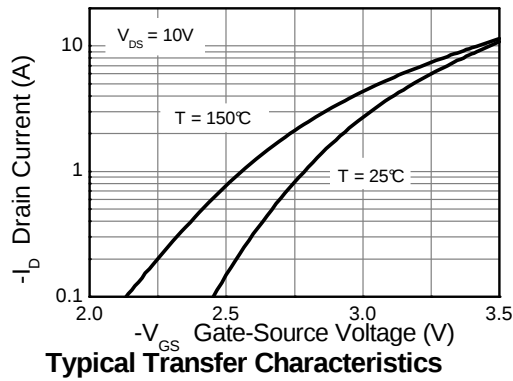
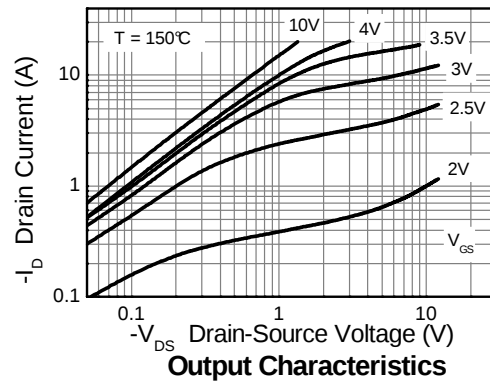
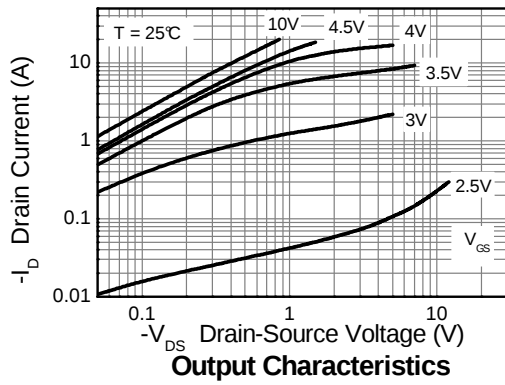
**P-channel electrical characteristics (at  $T_{amb} = 25^{\circ}\text{C}$  unless otherwise stated)**

| Parameter                                              | Symbol               | Min. | Typ.  | Max.           | Unit | Conditions                                                                                    |
|--------------------------------------------------------|----------------------|------|-------|----------------|------|-----------------------------------------------------------------------------------------------|
| Static                                                 |                      |      |       |                |      |                                                                                               |
| Drain-Source breakdown voltage                         | V <sub>(BR)DSS</sub> | -30  |       |                | V    | I <sub>D</sub> = -250μA, V <sub>GS</sub> = 0V                                                 |
| Zero Gate voltage Drain current                        | I <sub>DSS</sub>     |      |       | -0.5           | μA   | V <sub>DS</sub> = -30V, V <sub>GS</sub> = 0V                                                  |
| Gate-Body leakage                                      | I <sub>GSS</sub>     |      |       | ±100           | nA   | V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V                                                  |
| Gate-Source threshold voltage                          | V <sub>GS(th)</sub>  | -1.0 |       | -3.0           | V    | I <sub>D</sub> = -250μA, V <sub>DS</sub> = V <sub>GS</sub>                                    |
| Static Drain-Source on-state resistance <sup>(a)</sup> | R <sub>DS(on)</sub>  |      |       | 0.055<br>0.080 | Ω    | V <sub>GS</sub> = -10V, I <sub>D</sub> = -5A<br>V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -4A |
| Forward Transconductance <sup>(a) (c)</sup>            | g <sub>fs</sub>      |      | 14    |                | S    | V <sub>DS</sub> = -15V, I <sub>D</sub> = -5A                                                  |
| Dynamic                                                |                      |      |       |                |      |                                                                                               |
| Capacitance <sup>(c)</sup>                             |                      |      |       |                |      |                                                                                               |
| Input capacitance                                      | C <sub>iss</sub>     |      | 670   |                | pF   | V <sub>DS</sub> = -15V, V <sub>GS</sub> = 0V<br>f= 1MHz                                       |
| Output capacitance                                     | C <sub>oss</sub>     |      | 126   |                | pF   |                                                                                               |
| Reverse transfer capacitance                           | C <sub>rss</sub>     |      | 70    |                | pF   |                                                                                               |
| Switching <sup>(b) (c)</sup>                           |                      |      |       |                |      |                                                                                               |
| Turn-on-delay time                                     | t <sub>d(on)</sub>   |      | 1.9   |                | ns   | V <sub>DD</sub> = -15V, V <sub>GS</sub> = -10V<br>I <sub>D</sub> = -1A<br>R <sub>G</sub> ≅ 6Ω |
| Rise time                                              | t <sub>r</sub>       |      | 3.0   |                | ns   |                                                                                               |
| Turn-off delay time                                    | t <sub>d(off)</sub>  |      | 30    |                | ns   |                                                                                               |
| Fall time                                              | t <sub>f</sub>       |      | 21    |                | ns   |                                                                                               |
| Gate charge <sup>(c)</sup>                             |                      |      |       |                |      |                                                                                               |
| Total Gate charge                                      | Q <sub>g</sub>       |      | 12.7  |                | nC   | V <sub>DS</sub> = -15V, V <sub>GS</sub> = -10V<br>I <sub>D</sub> = -5A                        |
| Gate-Source charge                                     | Q <sub>gs</sub>      |      | 2.0   |                | nC   |                                                                                               |
| Gate-Drain charge                                      | Q <sub>gd</sub>      |      | 2.4   |                | nC   |                                                                                               |
| Source–Drain diode                                     |                      |      |       |                |      |                                                                                               |
| Diode forward voltage <sup>(a)</sup>                   | V <sub>SD</sub>      |      | -0.82 | -1.2           | V    | I <sub>S</sub> = -1.7A, V <sub>GS</sub> = 0V                                                  |
| Reverse recovery time <sup>(c)</sup>                   | t <sub>rr</sub>      |      | 16.5  |                | ns   | I <sub>S</sub> = -2.1A, di/dt= 100A/μs                                                        |
| Reverse recovery charge <sup>(c)</sup>                 | Q <sub>rr</sub>      |      | 11.5  |                | nC   |                                                                                               |

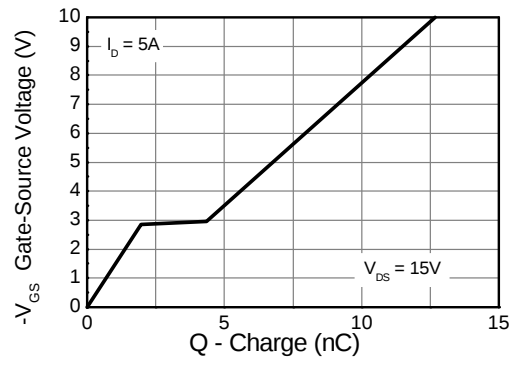
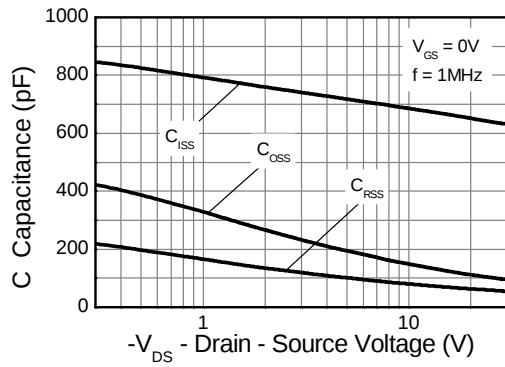
**NOTES:**

- (a) Measured under pulsed conditions. Pulse width  $\leq 300\mu\text{s}$ ; duty cycle  $\leq 2\%$ .  
 (b) Switching characteristics are independent of operating junction temperature.  
 (c) For design aid only, not subject to production testing

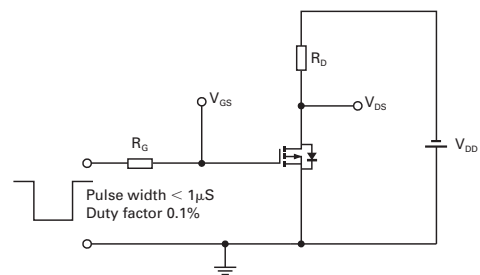
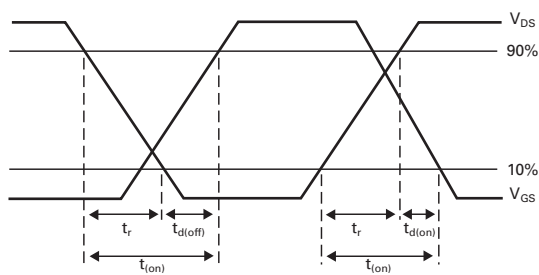
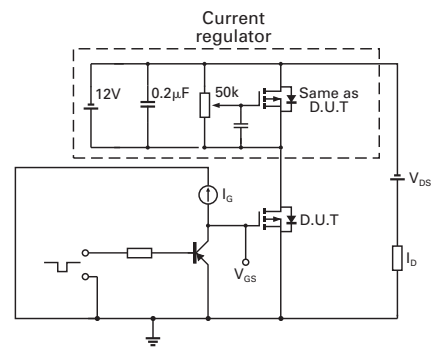
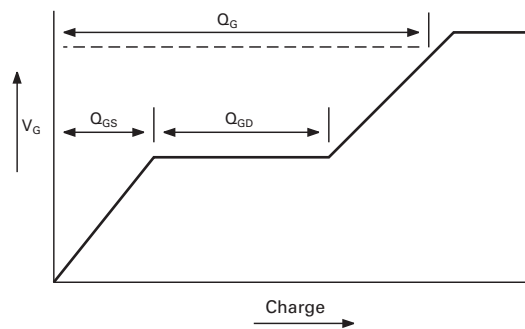
## P-channel typical characteristics



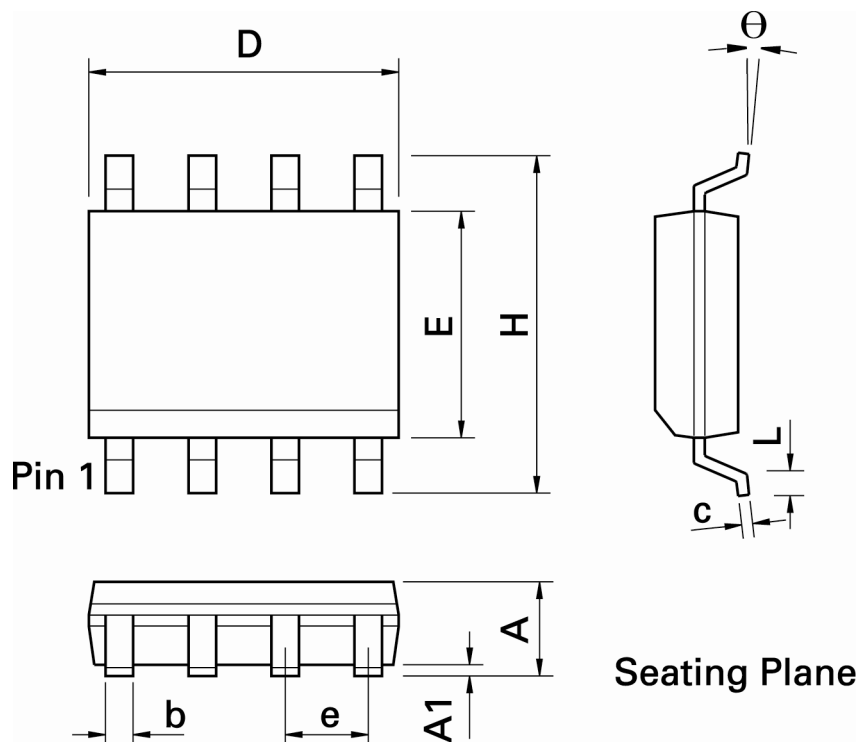
## P-channel typical characteristics –continued



## Test circuits



Packaging details - SO8



| DIM | Inches |       | Millimeters |      | DIM | Inches    |       | Millimeters |      |
|-----|--------|-------|-------------|------|-----|-----------|-------|-------------|------|
|     | Min.   | Max.  | Min.        | Max. |     | Min.      | Max.  | Min.        | Max. |
| A   | 0.053  | 0.069 | 1.35        | 1.75 | e   | 0.050 BSC |       | 1.27 BSC    |      |
| A1  | 0.004  | 0.010 | 0.10        | 0.25 | b   | 0.013     | 0.020 | 0.33        | 0.51 |
| D   | 0.189  | 0.197 | 4.80        | 5.00 | c   | 0.008     | 0.010 | 0.19        | 0.25 |
| H   | 0.228  | 0.244 | 5.80        | 6.20 | θ   | 0°        | 8°    | 0°          | 8°   |
| E   | 0.150  | 0.157 | 3.80        | 4.00 | -   | -         | -     | -           | -    |
| L   | 0.016  | 0.050 | 0.40        | 1.27 | -   | -         | -     | -           | -    |

**Note:** Controlling dimensions are in inches. Approximate dimensions are provided in millimeters

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1. are intended to implant into the body, or
2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

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