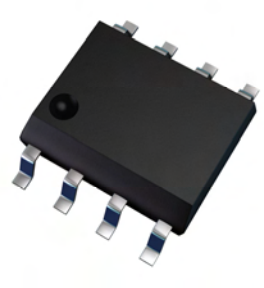
# ZXMHC3F381N8

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

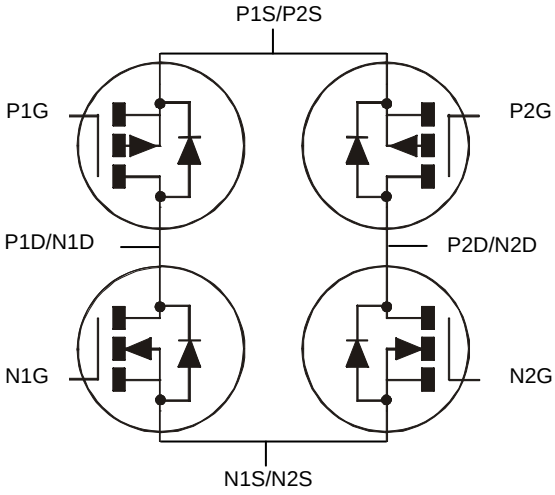
### Summary

| Device | $V_{(BR)DSS}$ | $Q_G$ | $R_{DS(on)}$ | $I_D$ $T_A$= 25°C |
|---|---|---|---|---|
| N-CH | 30V | 9.0nC | 33mΩ @ $V_{GS}$= 10V | 5.0A |
| | | | 60mΩ @ $V_{GS}$= 4.5V | 3.9A |
| P-CH | -30V | 12.7nC | 55mΩ @ $V_{GS}$= -10V | -4.1A |
| | | | 80mΩ @ $V_{GS}$= -4.5V | -3.3A |



### Description

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




### Features

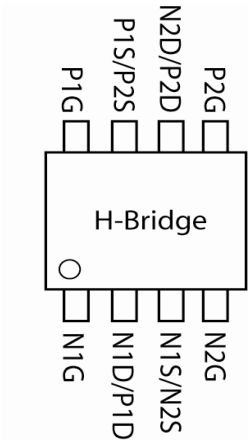
- 2 x N + 2 x P channels in a SOIC package
- Low voltage ($V_{GS}$ = 4.5 V) gate drive

### 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 | $V_{GS}$ | ±20 | ±20 | V |
| Continuous Drain current @ $V_{GS}$= 10V; $T_A$=25°C (b) | $I_D$ | 4.98 | -4.13 | A |
| @ $V_{GS}$= 10V; $T_A$=70°C (b) | | 3.98 | -3.31 | |
| @ $V_{GS}$= 10V; $T_A$=25°C (a) | | 3.98 | -3.36 | |
| @ $V_{GS}$= 10V; $T_L$=25°C (f) | | 4.17 | -3.51 | |
| Pulsed Drain current @ $V_{GS}$= 10V; $T_A$=25°C (c) | $I_{DM}$ | 22.9 | -19.6 | A |
| Continuous Source current (Body diode) at $T_A$=25°C (b) | $I_S$ | 2.0 | -2.0 | A |
| Pulsed Source current (Body diode) at $T_A$=25°C (c) | $I_{SM}$ | 22.9 | -19.6 | A |
| Power dissipation at $T_A$=25°C (a) | $P_D$ | 0.87 | | W |
| Linear derating factor | | 6.94 | | mW/°C |
| Power dissipation at $T_A$=25°C (b) | $P_D$ | 1.35 | | W |
| Linear derating factor | | 10.9 | | mW/°C |
| Power dissipation at $T_L$=25°C (f) | $P_D$ | 0.95 | 0.98 | W |
| Linear derating factor | | 7.63 | 7.81 | mW/°C |
| Operating and storage temperature range | $T_j$, $T_{stg}$ | -55 to 150 | | °C |

## Thermal resistance

| Parameter | Symbol | Value | | Unit |
|---|---|---|---|---|
| Junction to ambient (a) | $R_{\theta JA}$ | 144 | | °C/W |
| Junction to ambient (b) | $R_{\theta JA}$ | 92 | | °C/W |
| Junction to ambient (d) | $R_{\theta JA}$ | 106 | | °C/W |
| Junction to ambient (e) | $R_{\theta JA}$ | 254 | | °C/W |
| Junction to lead (f) | $R_{\theta JL}$ | 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 ≤ 10 sec.

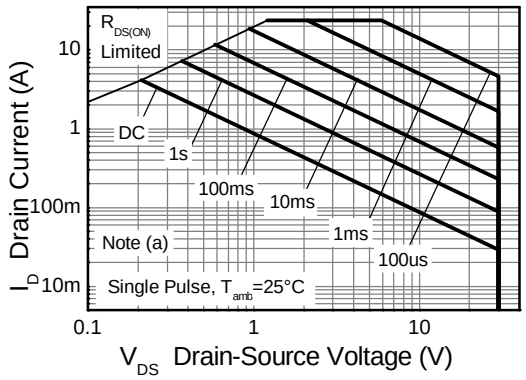
(c) Same as note (a), except the device is pulsed with D= 0.02 and pulse width 300 µs. The pulse current is limited by the maximum junction temperature.

(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.

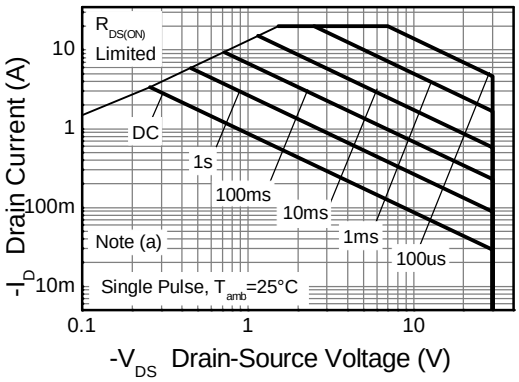
(e) For a device surface mounted on minimum copper 1.6mm FR4 PCB, in still air conditions; the device is measured when operating in a steady-state condition with one active die.

(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.

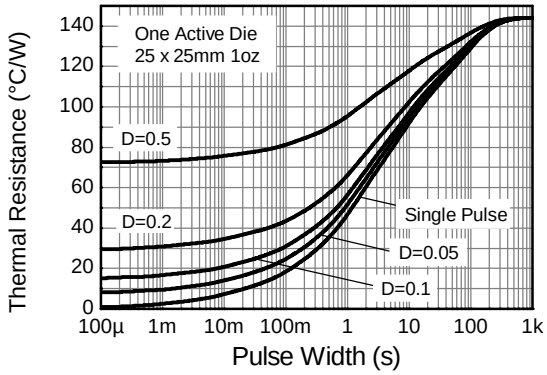
## Thermal characteristics



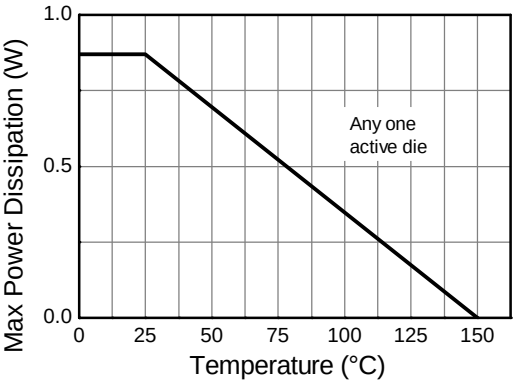

**N-channel Safe Operating Area**



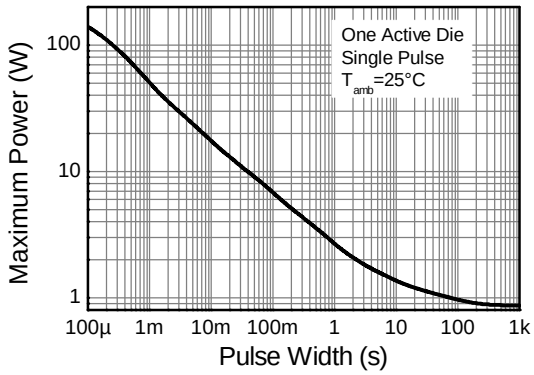

**P-channel Safe Operating Area**




**Transient Thermal Impedance**




**Derating Curve**




**Pulse Power Dissipation**

## N-channel electrical characteristics (at $T_{amb}$ = 25°C unless otherwise stated)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source breakdown voltage | $V_{(BR)DSS}$ | 30 | | | V | $I_D$ = 250μA, $V_{GS}$= 0V |
| Zero Gate voltage Drain current | $I_{DSS}$ | | | 0.5 | μA | $V_{DS}$= 30V, $V_{GS}$= 0V |
| Gate-Body leakage | $I_{GSS}$ | | | ±100 | nA | $V_{GS}$= ±20V, $V_{DS}$= 0V |
| Gate-Source threshold voltage | $V_{GS(th)}$ | 1.0 | | 3.0 | V | $I_D$= 250μA, $V_{DS}$= $V_{GS}$ |
| Static Drain-Source on-state resistance (a) | $R_{DS(on)}$ | | | 0.033<br>0.060 | Ω | $V_{GS}$= 10V, $I_D$= 5A<br>$V_{GS}$= 4.5V, $I_D$= 4A |
| Forward Transconductance (a) (c) | $g_{fs}$ | | 11.8 | | S | $V_{DS}$= 15V, $I_D$= 5A |
| **Dynamic** | | | | | | |
| **Capacitance** (c) | | | | | | |
| Input capacitance | $C_{iss}$ | | 430 | | pF | $V_{DS}$= 15V, $V_{GS}$= 0V<br>f= 1MHz |
| Output capacitance | $C_{oss}$ | | 101 | | pF | |
| Reverse transfer capacitance | $C_{rss}$ | | 56 | | pF | |
| **Switching** (b) (c) | | | | | | |
| Turn-on-delay time | $t_{d(on)}$ | | 2.5 | | ns | $V_{DD}$= 15V, $V_{GS}$= 10V<br>$I_D$= 1A<br>$R_G \cong 6\Omega$, |
| Rise time | $t_r$ | | 3.3 | | ns | |
| Turn-off delay time | $t_{d(off)}$ | | 11.5 | | ns | |
| Fall time | $t_f$ | | 6.3 | | ns | |
| **Gate charge** (c) | | | | | | |
| Total Gate charge | $Q_g$ | | 9.0 | | nC | $V_{DS}$=15V, $V_{GS}$= 10V<br>$I_D$= 5A |
| Gate-Source charge | $Q_{gs}$ | | 1.7 | | nC | |
| Gate-Drain charge | $Q_{gd}$ | | 2.0 | | nC | |
| **Source–Drain diode** | | | | | | |
| Diode forward voltage (a) | $V_{SD}$ | | 0.82 | 1.2 | V | $I_S$= 1.7A, $V_{GS}$= 0V |
| Reverse recovery time (c) | $t_{rr}$ | | 12 | | ns | $I_S$= 2.1A, di/dt= 100A/μs |
| Reverse recovery charge (c) | $Q_{rr}$ | | 4.9 | | nC | |

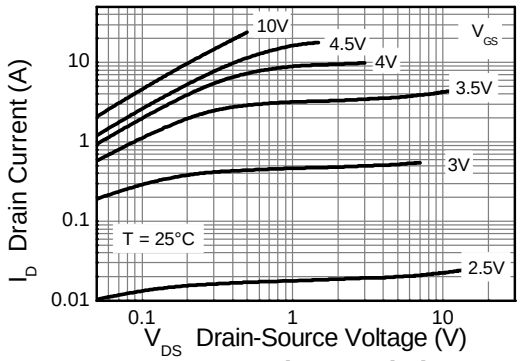
**NOTES:**

(a) Measured under pulsed conditions. Pulse width ≤ 300μs; duty cycle ≤ 2%.

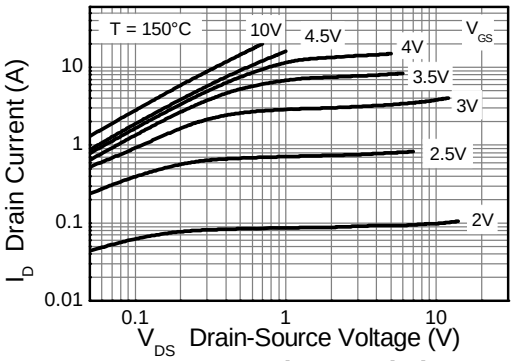
(b) Switching characteristics are independent of operating junction temperature.

(c) For design aid only, not subject to production testing

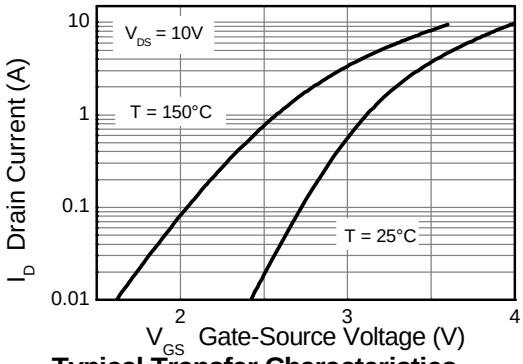
## N-channel typical characteristics



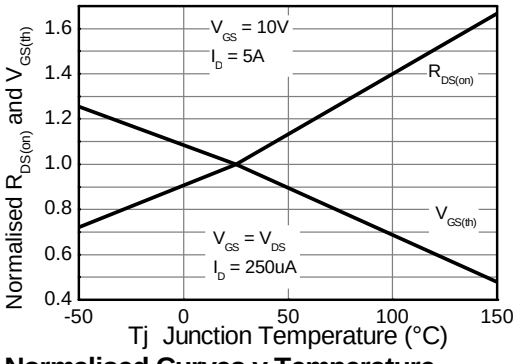

**Output Characteristics**



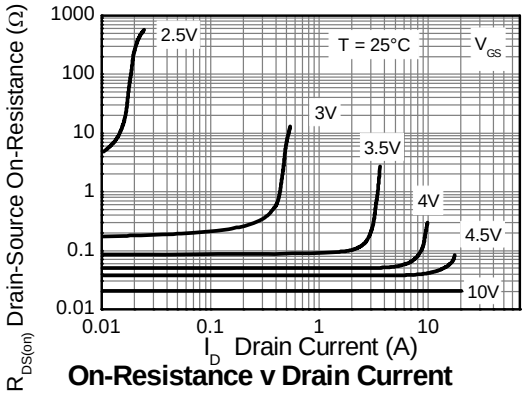

**Output Characteristics**



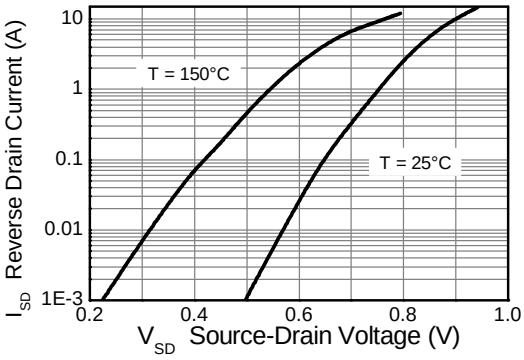

**Typical Transfer Characteristics**




**Normalised Curves v Temperature**

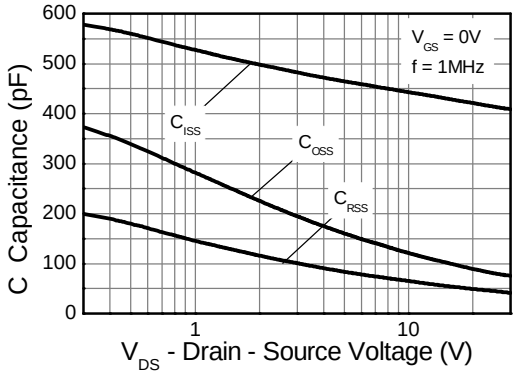



**On-Resistance v Drain Current**

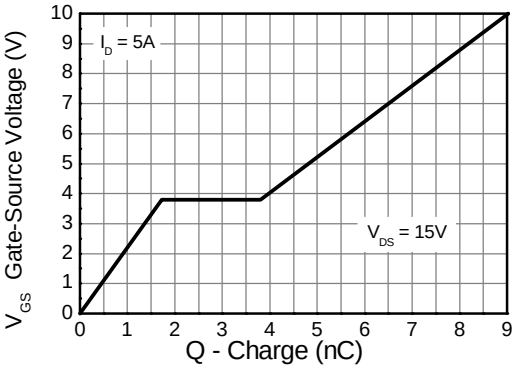



**Source-Drain Diode Forward Voltage**

## N-channel typical characteristics –continued

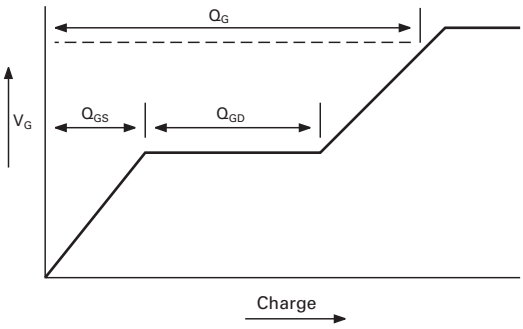



**Capacitance v Drain-Source Voltage**

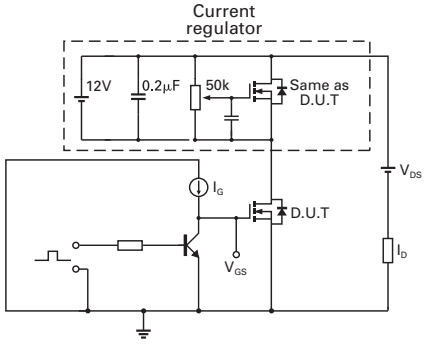



**Gate-Source Voltage v Gate Charge**

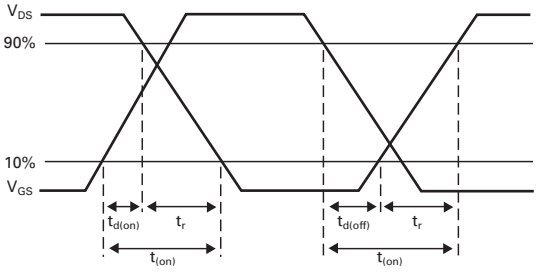
## Test circuits



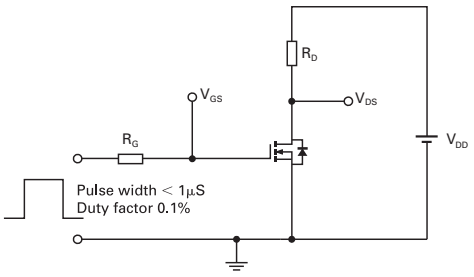

**Basic gate charge waveform**




**Gate charge test circuit**




**Switching time waveforms**




**Switching time test circuit**

## P-channel electrical characteristics (at $T_{amb}$ = 25°C unless otherwise stated)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source breakdown voltage | $V_{(BR)DSS}$ | -30 | | | V | $I_D$ = -250μA, $V_{GS}$= 0V |
| Zero Gate voltage Drain current | $I_{DSS}$ | | | -0.5 | μA | $V_{DS}$= -30V, $V_{GS}$= 0V |
| Gate-Body leakage | $I_{GSS}$ | | | ±100 | nA | $V_{GS}$= ±20V, $V_{DS}$= 0V |
| Gate-Source threshold voltage | $V_{GS(th)}$ | -1.0 | | -3.0 | V | $I_D$= -250μA, $V_{DS}$= $V_{GS}$ |
| Static Drain-Source on-state resistance (a) | $R_{DS(on)}$ | | | 0.055<br>0.080 | Ω | $V_{GS}$= -10V, $I_D$= -5A<br>$V_{GS}$= -4.5V, $I_D$= -4A |
| Forward Transconductance (a) (c) | $g_{fs}$ | | 14 | | S | $V_{DS}$= -15V, $I_D$= -5A |
| **Dynamic** | | | | | | |
| **Capacitance** (c) | | | | | | |
| Input capacitance | $C_{iss}$ | | 670 | | pF | $V_{DS}$= -15V, $V_{GS}$= 0V<br>f= 1MHz |
| Output capacitance | $C_{oss}$ | | 126 | | pF | |
| Reverse transfer capacitance | $C_{rss}$ | | 70 | | pF | |
| **Switching** (b) (c) | | | | | | |
| Turn-on-delay time | $t_{d(on)}$ | | 1.9 | | ns | $V_{DD}$= -15V, $V_{GS}$= -10V<br>$I_D$= -1A<br>$R_G \cong 6\Omega$ |
| Rise time | $t_r$ | | 3.0 | | ns | |
| Turn-off delay time | $t_{d(off)}$ | | 30 | | ns | |
| Fall time | $t_f$ | | 21 | | ns | |
| **Gate charge** (c) | | | | | | |
| Total Gate charge | $Q_g$ | | 12.7 | | nC | $V_{DS}$= -15V, $V_{GS}$= -10V<br>$I_D$= -5A |
| Gate-Source charge | $Q_{gs}$ | | 2.0 | | nC | |
| Gate-Drain charge | $Q_{gd}$ | | 2.4 | | nC | |
| **Source–Drain diode** | | | | | | |
| Diode forward voltage (a) | $V_{SD}$ | | -0.82 | -1.2 | V | $I_S$= -1.7A, $V_{GS}$= 0V |
| Reverse recovery time (c) | $t_{rr}$ | | 16.5 | | ns | $I_S$= -2.1A, di/dt= 100A/μs |
| Reverse recovery charge (c) | $Q_{rr}$ | | 11.5 | | nC | |

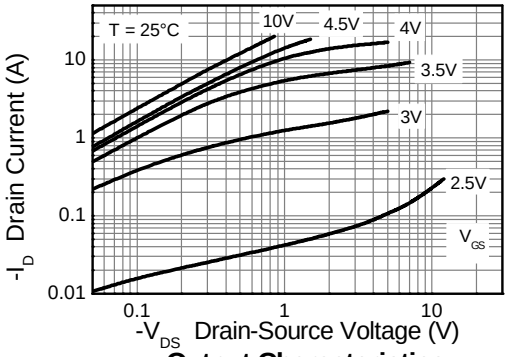
**NOTES:**

(a) Measured under pulsed conditions. Pulse width ≤ 300μs; duty cycle ≤ 2%.

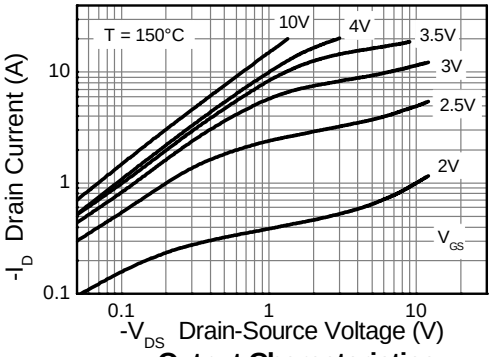
(b) Switching characteristics are independent of operating junction temperature.

(c) For design aid only, not subject to production testing

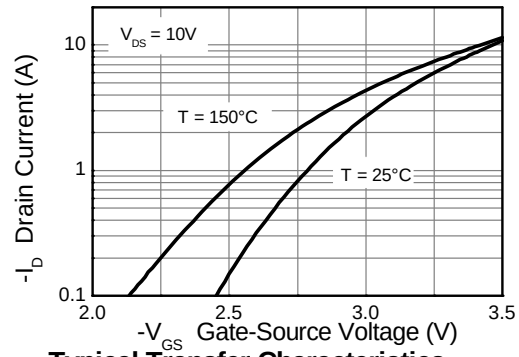
## P-channel typical characteristics



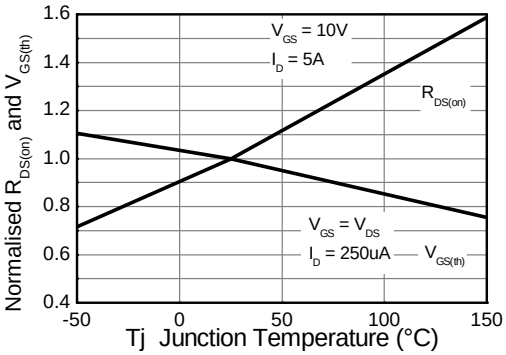

**Output Characteristics**



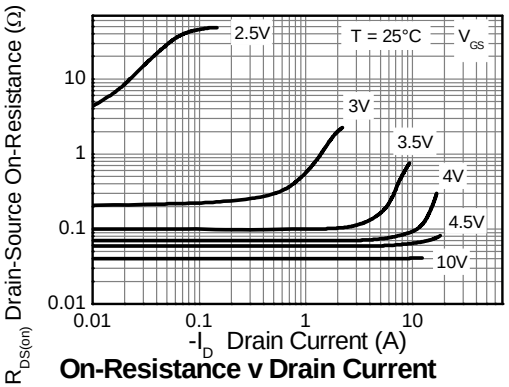

**Output Characteristics**



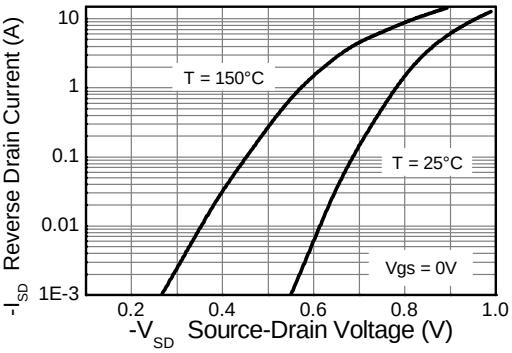

**Typical Transfer Characteristics**




**Normalised Curves v Temperature**

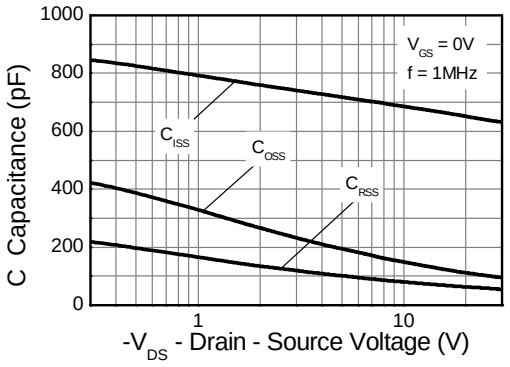



**On-Resistance v Drain Current**

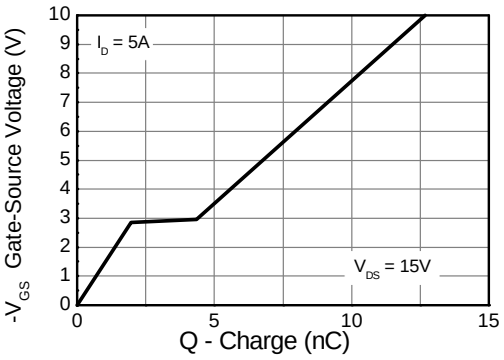



**Source-Drain Diode Forward Voltage**

## P-channel typical characteristics –continued

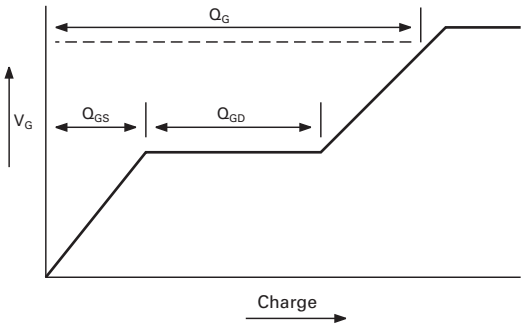



**Capacitance v Drain-Source Voltage**

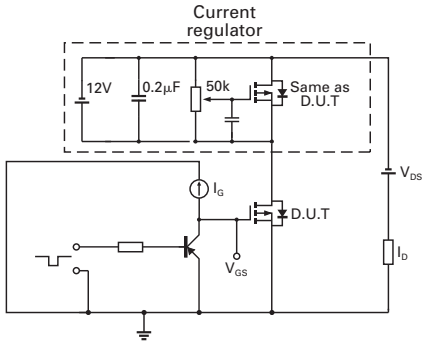



**Gate-Source Voltage v Gate Charge**

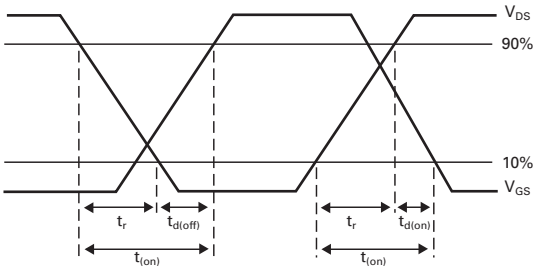
## Test circuits



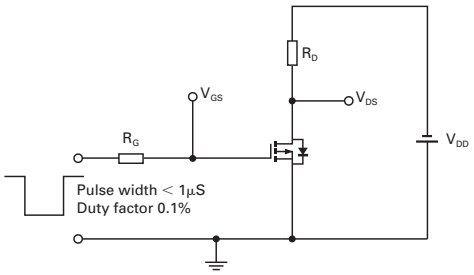

**Basic gate charge waveform**




**Gate charge test circuit**

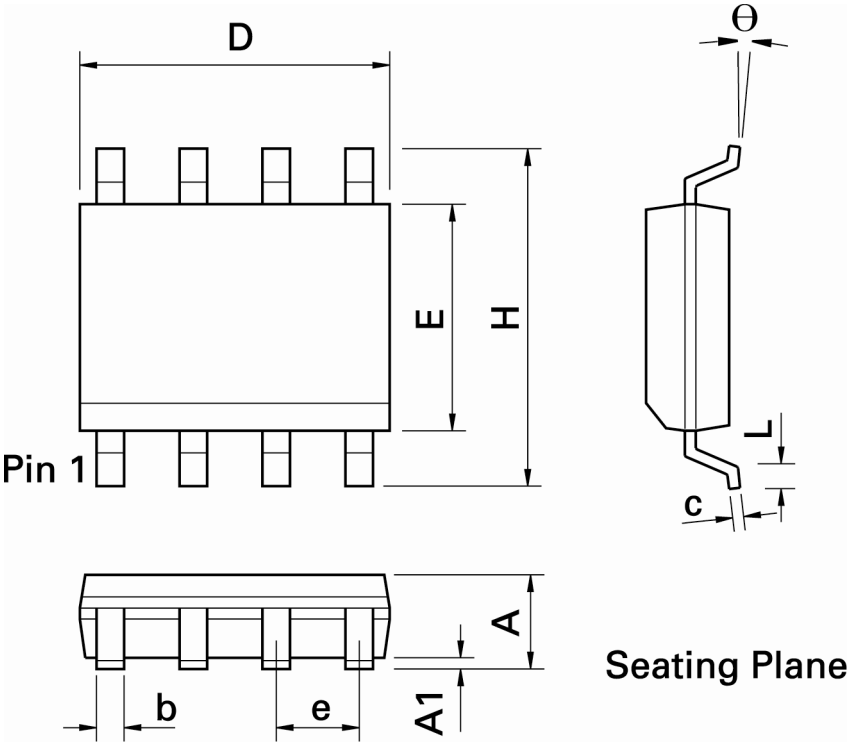



**Switching time waveforms**




**Switching time test circuit**

**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

**IMPORTANT NOTICE**

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