

# Complementary MOSFET

## ELM51016CA-S

<http://www.elm-tech.com>

### General Description

ELM51016CA-S uses advanced trench technology to provide excellent  $R_{ds(on)}$  and low gate charge.

### Features

- | N-channel                              | P-channel                                |
|----------------------------------------|------------------------------------------|
| • $V_{ds}=20V$                         | • $V_{ds}=-20V$                          |
| • $I_d=0.6A$                           | • $I_d=-0.4A$                            |
| • $R_{ds(on)}=360m\Omega(V_{gs}=4.5V)$ | • $R_{ds(on)}=620m\Omega(V_{gs}=-4.5V)$  |
| • $R_{ds(on)}=420m\Omega(V_{gs}=2.5V)$ | • $R_{ds(on)}=860m\Omega(V_{gs}=-2.5V)$  |
| • $R_{ds(on)}=560m\Omega(V_{gs}=1.8V)$ | • $R_{ds(on)}=1450m\Omega(V_{gs}=-1.8V)$ |

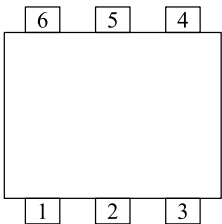
### Maximum Absolute Ratings

$T_a=25^{\circ}C$ . Unless otherwise noted.

| Parameter                                      |                   | Symbol    | N-ch (Max.) | P-ch (Max.) | Unit        |
|------------------------------------------------|-------------------|-----------|-------------|-------------|-------------|
| Drain-source voltage                           |                   | $V_{ds}$  | 20          | -20         | V           |
| Gate-source voltage                            |                   | $V_{gs}$  | $\pm 12$    | $\pm 12$    | V           |
| Continuous drain current( $T_j=150^{\circ}C$ ) | $T_a=25^{\circ}C$ | $I_d$     | 0.6         | -0.4        | A           |
|                                                | $T_a=70^{\circ}C$ |           | 0.4         | -0.2        |             |
| Pulsed drain current                           |                   | $I_{dm}$  | 1.0         | -1.0        | A           |
| Power dissipation                              | $T_c=25^{\circ}C$ | $P_d$     | 0.27        | 0.27        | W           |
|                                                | $T_c=70^{\circ}C$ |           | 0.16        | 0.16        |             |
| Operating junction temperature                 |                   | $T_j$     | -55 to 150  | -55 to 150  | $^{\circ}C$ |
| Storage temperature range                      |                   | $T_{stg}$ | -55 to 150  | -55 to 150  | $^{\circ}C$ |

### Pin configuration

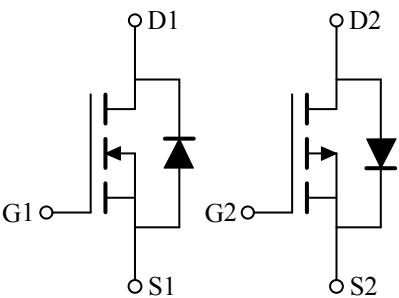
SOT-563(TOP VIEW)



| Pin No. | Pin name |
|---------|----------|
| 1       | SOURCE1  |
| 2       | GATE1    |
| 3       | DRAIN2   |
| 4       | SOURCE2  |
| 5       | GATE2    |
| 6       | DRAIN1   |

### Circuit

- N-ch
- P-ch



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### ■Electrical Characteristics (N-ch)

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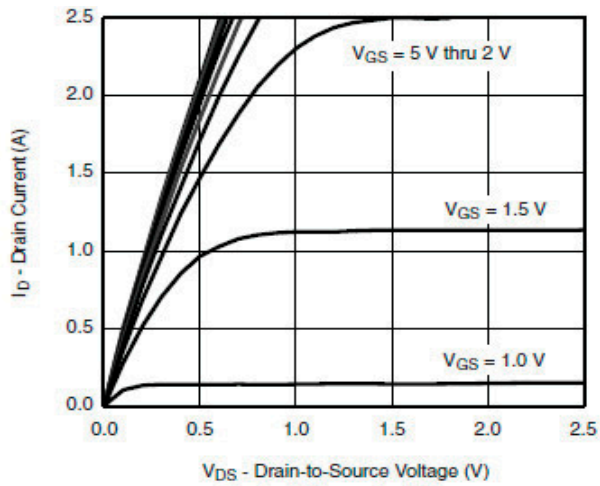
| Parameter                         | Symbol  | Conditions                                    | Min. | Typ. | Max. | Unit |
|-----------------------------------|---------|-----------------------------------------------|------|------|------|------|
| STATIC PARAMETERS                 |         |                                               |      |      |      |      |
| Drain-source breakdown voltage    | BVdss   | Id=250μA, Vgs=0V                              | 20   |      |      | V    |
| Zero gate voltage drain current   | Idss    | Vds=20V, Vgs=0V                               |      |      | 1    | μA   |
|                                   |         | Ta=85°C                                       |      |      | 5    |      |
| Gate-body leakage current         | Igss    | Vds=0V, Vgs=±12V                              |      |      | ±100 | nA   |
| Gate threshold voltage            | Vgs(th) | Vds=Vgs, Id=250μA                             | 0.4  |      | 1.0  | V    |
| On state drain current            | Id(on)  | Vgs=4.5V, Vds≥5V                              | 0.7  |      |      | A    |
| Static drain-source on-resistance | Rds(on) | Vgs=4.5V, Id=0.6A                             |      | 240  | 360  | mΩ   |
|                                   |         | Vgs=2.5V, Id=0.5A                             |      | 300  | 420  |      |
|                                   |         | Vgs=1.8V, Id=0.4A                             |      | 420  | 560  |      |
| Forward transconductance          | Gfs     | Vds=10V, Id=0.4A                              |      | 1    |      | S    |
| Diode forward voltage             | Vsd     | Is=0.15A, Vgs=0V                              |      | 0.8  | 1.2  | V    |
| Max.body-diode continuous current | Is      |                                               |      |      | 0.3  | A    |
| DYNAMIC PARAMETERS                |         |                                               |      |      |      |      |
| Input capacitance                 | Ciss    | Vgs=0V, Vds=10V, f=1MHz                       |      | 70   |      | pF   |
| Output capacitance                | Coss    |                                               |      | 20   |      | pF   |
| Reverse transfer capacitance      | Crss    |                                               |      | 8    |      | pF   |
| SWITCHING PARAMETERS              |         |                                               |      |      |      |      |
| Total gate charge                 | Qg      | Vgs=4.5V, Vds=10V, Id=0.6A                    |      | 1.06 | 1.38 | nC   |
| Gate-source charge                | Qgs     |                                               |      | 0.18 |      | nC   |
| Gate-drain charge                 | Qgd     |                                               |      | 0.32 |      | nC   |
| Turn-on delay time                | td(on)  | Vgs=4.5V, Vds=10V, Id=0.5A<br>RL=20Ω, Rgen=1Ω |      | 18   | 26   | ns   |
| Turn-on rise time                 | tr      |                                               |      | 20   | 28   | ns   |
| Turn-off delay time               | td(off) |                                               |      | 70   | 110  | ns   |
| Turn-off fall time                | tf      |                                               |      | 25   | 40   | ns   |

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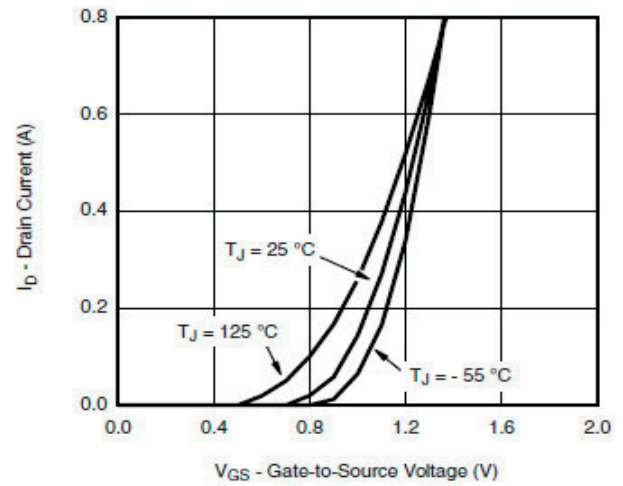
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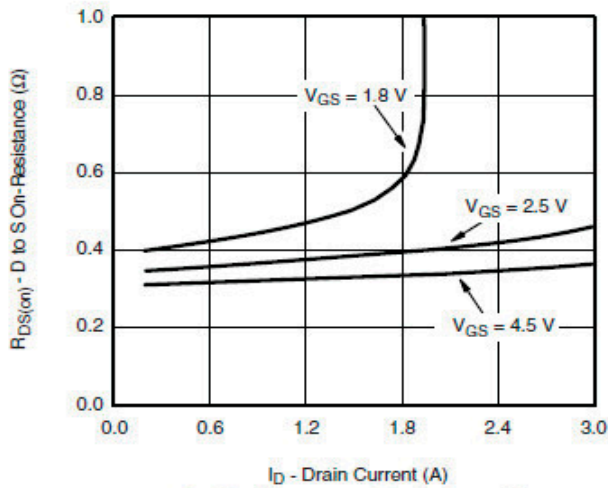
## ■ Typical Electrical and Thermal Characteristics (N-ch)



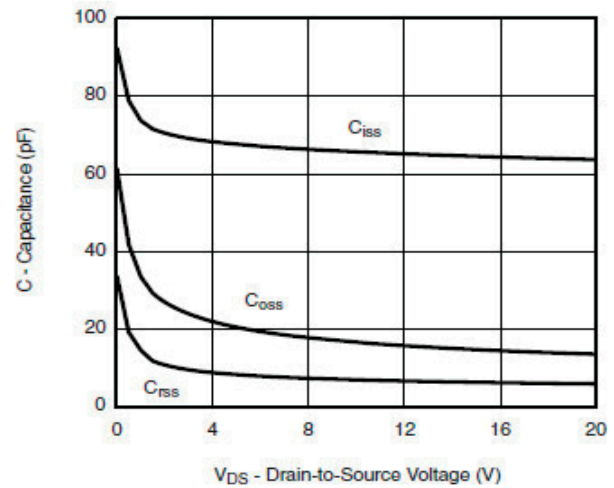
Output Characteristics



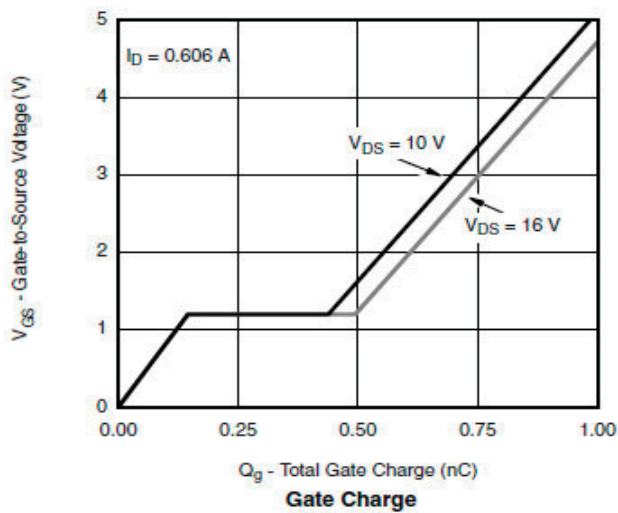
Transfer Characteristics



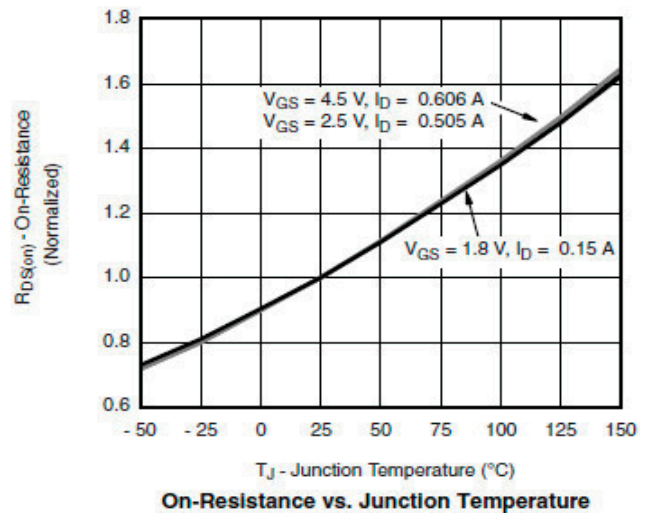
On-Resistance vs. Drain Current



Capacitance



Gate Charge

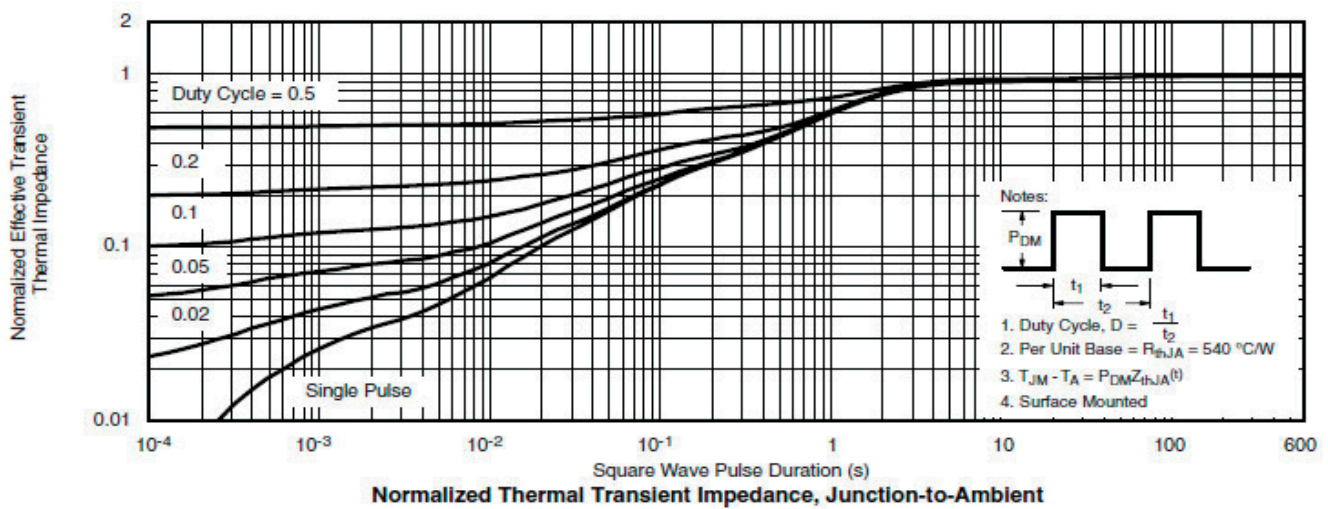
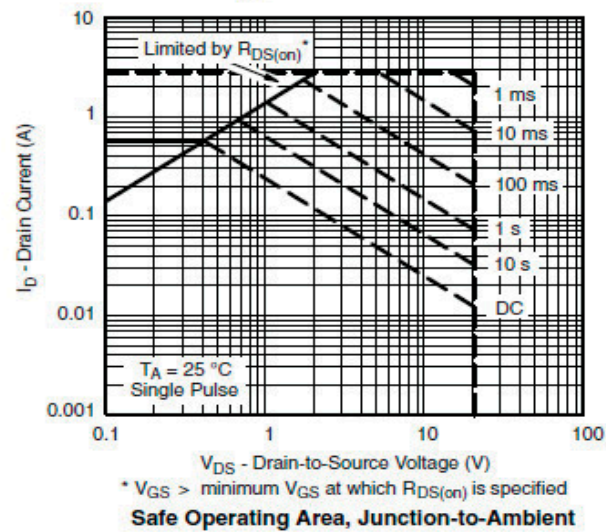
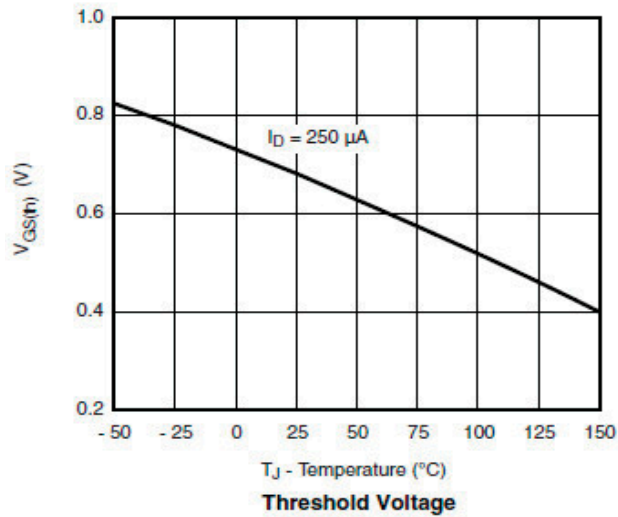
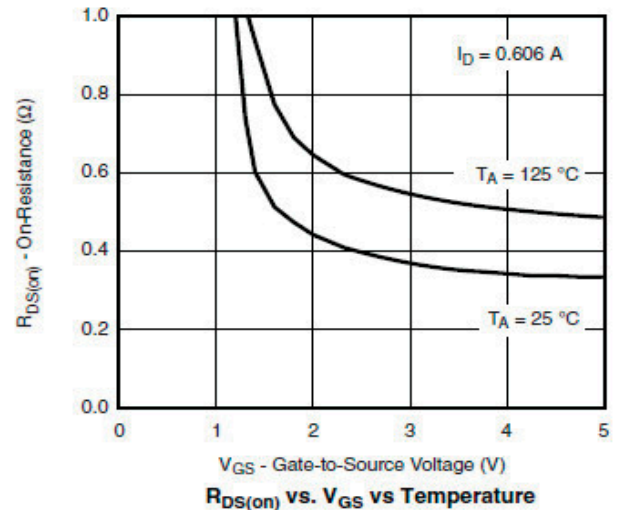
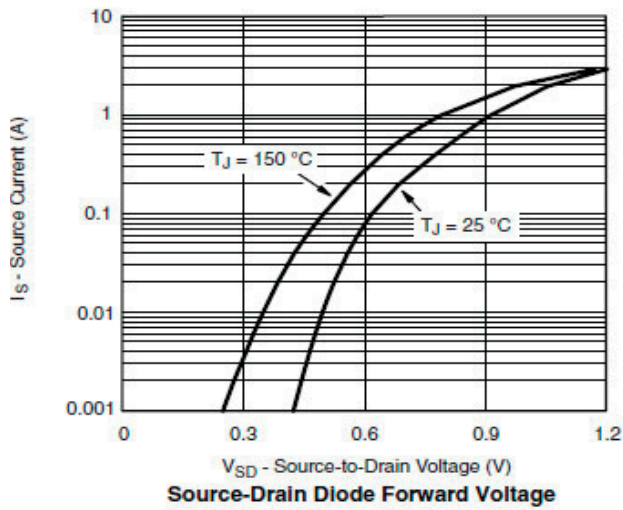


On-Resistance vs. Junction Temperature

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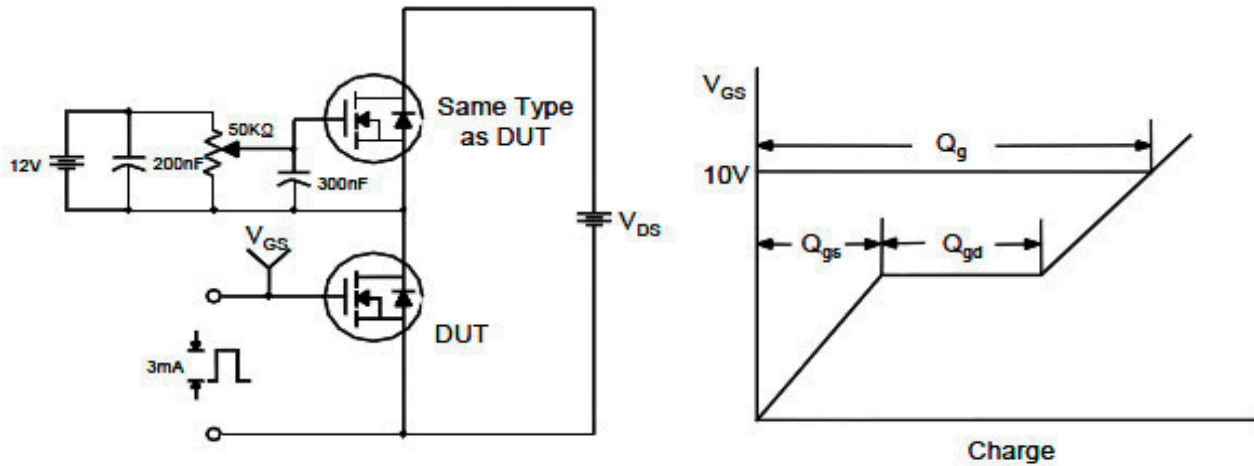
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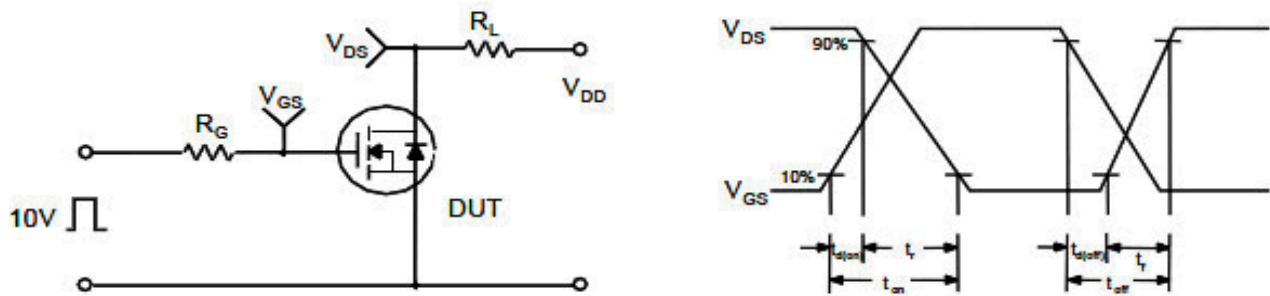
<http://www.elm-tech.com>

## ■ Test circuit and waveform (N-ch)

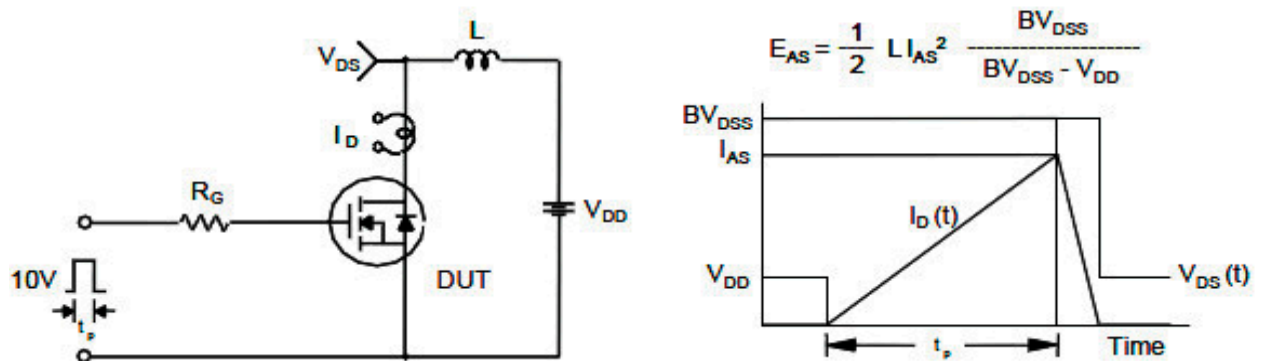
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



# Complementary MOSFET

## ELM51016CA-S

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### ■Electrical Characteristics (P-ch)

Ta=25°C. Unless otherwise noted.

| Parameter                          | Symbol  | Conditions                                          | Min. | Typ.  | Max.  | Unit |
|------------------------------------|---------|-----------------------------------------------------|------|-------|-------|------|
| STATIC PARAMETERS                  |         |                                                     |      |       |       |      |
| Drain-source breakdown voltage     | BVdss   | Id=-250μA, Vgs=0V                                   | -20  |       |       | V    |
| Zero gate voltage drain current    | Idss    | Vds=-20V, Vgs=0V                                    |      |       | -1    | μA   |
|                                    |         | Ta=85°C                                             |      |       | -5    |      |
| Gate-body leakage current          | Igss    | Vds=0V, Vgs=±12V                                    |      |       | ±100  | nA   |
| Gate threshold voltage             | Vgs(th) | Vds=Vgs, Id=-250μA                                  | -0.4 |       | -1.0  | V    |
| On state drain current             | Id(on)  | Vgs=-4.5V, Vds≥-5V                                  | -0.7 |       |       | A    |
| Static drain-source on-resistance  | Rds(on) | Vgs=-4.5V, Id=-0.4A                                 |      | 500   | 620   | mΩ   |
|                                    |         | Vgs=-2.5V, Id=-0.3A                                 |      | 700   | 860   |      |
|                                    |         | Vgs=-1.8V, Id=-0.2A                                 |      | 1000  | 1450  |      |
| Forward transconductance           | Gfs     | Vds=-10V, Id=-0.4A                                  |      | 1     |       | S    |
| Diode forward voltage              | Vsd     | Is=-0.15A, Vgs=0V                                   |      | -0.65 | -1.20 | V    |
| Max. body-diode continuous current | Is      |                                                     |      |       | -0.3  | A    |
| DYNAMIC PARAMETERS                 |         |                                                     |      |       |       |      |
| Input capacitance                  | Ciss    | Vgs=0V, Vds=-10V, f=1MHz                            |      | 70    | 100   | pF   |
| Output capacitance                 | Coss    |                                                     |      | 20    |       | pF   |
| Reverse transfer capacitance       | Crss    |                                                     |      | 10    |       | pF   |
| SWITCHING PARAMETERS               |         |                                                     |      |       |       |      |
| Total gate charge                  | Qg      | Vgs=-4.5V, Vds=-10V<br>Id=-0.25A                    |      | 1.0   | 1.3   | nC   |
| Gate-source charge                 | Qgs     |                                                     |      | 0.1   |       | nC   |
| Gate-drain charge                  | Qgd     |                                                     |      | 0.3   |       | nC   |
| Turn-on delay time                 | td(on)  | Vgs=-4.5V, Vds=-10V<br>Id=-0.2A, RL=30Ω<br>Rgen=10Ω |      | 10    | 15    | ns   |
| Turn-on rise time                  | tr      |                                                     |      | 10    | 15    | ns   |
| Turn-off delay time                | td(off) |                                                     |      | 40    | 60    | ns   |
| Turn-off fall time                 | tf      |                                                     |      | 30    | 50    | ns   |

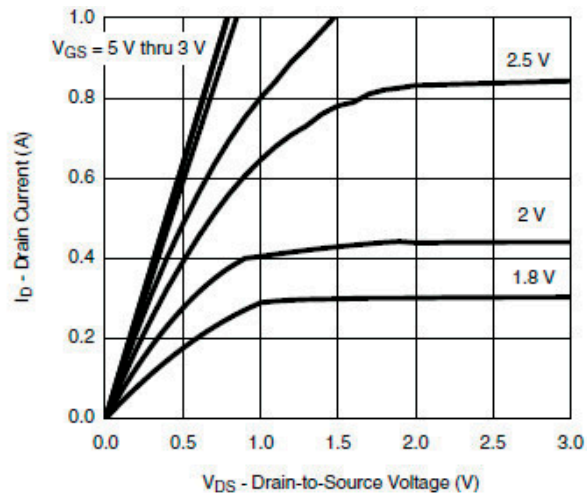


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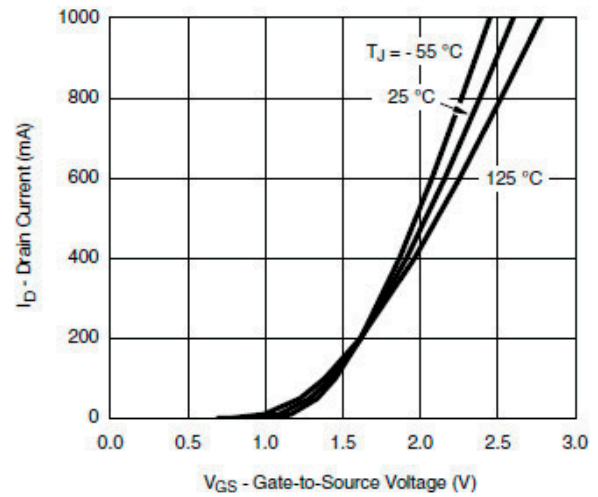
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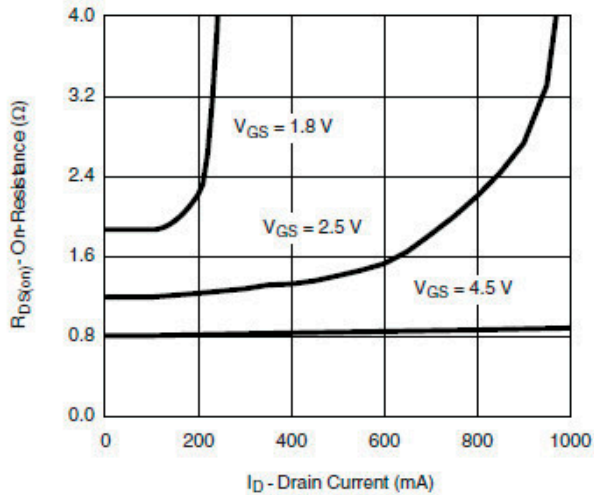
### ■ Typical Electrical and Thermal Characteristics (P-ch)



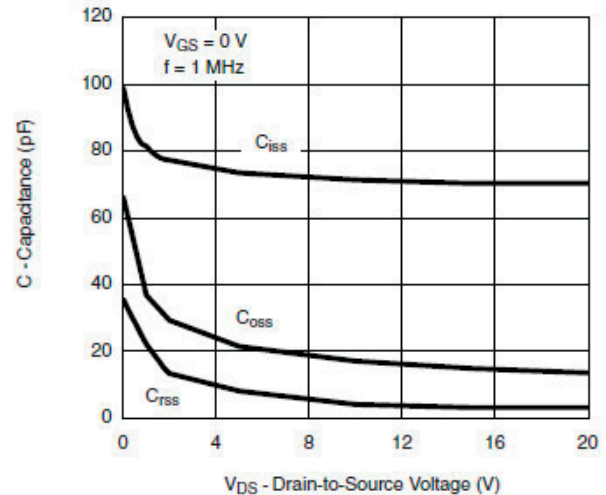
Output Characteristics



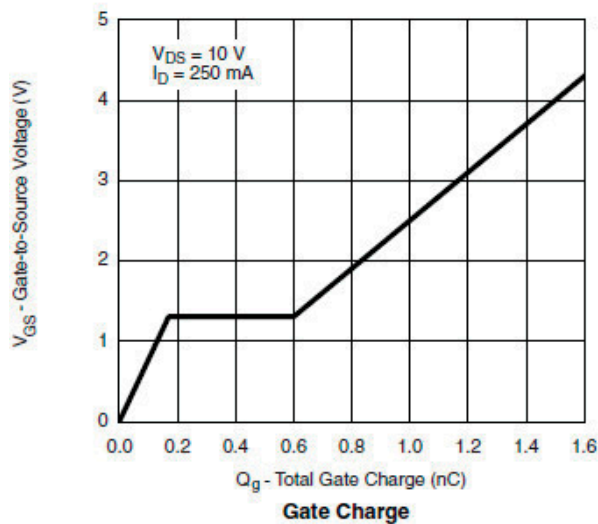
Transfer Characteristics



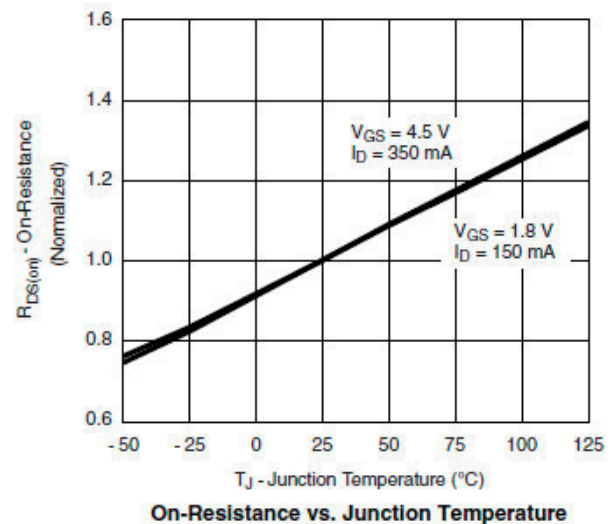
On-Resistance vs. Drain Current



Capacitance



Gate Charge

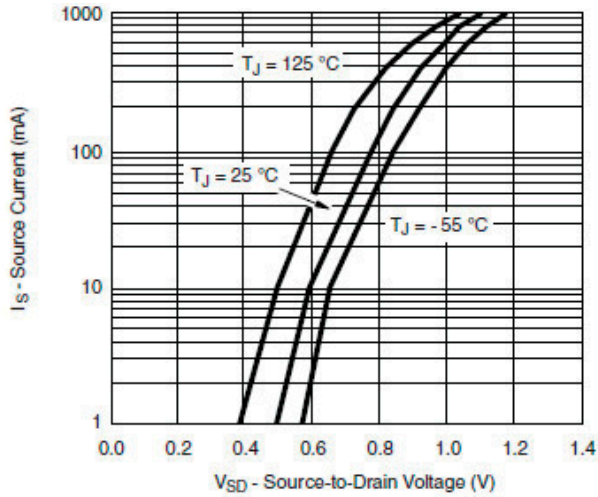


On-Resistance vs. Junction Temperature

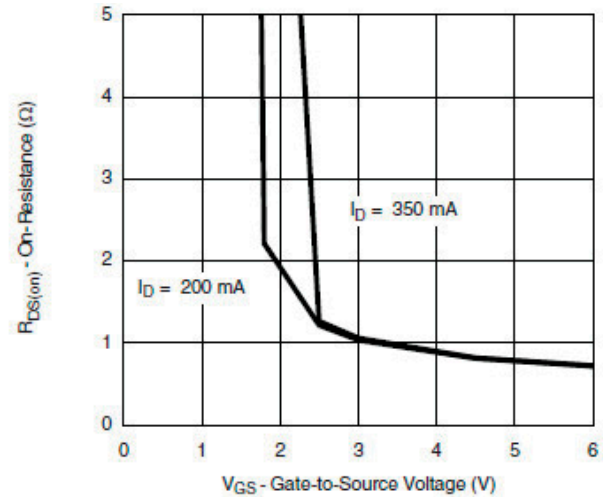
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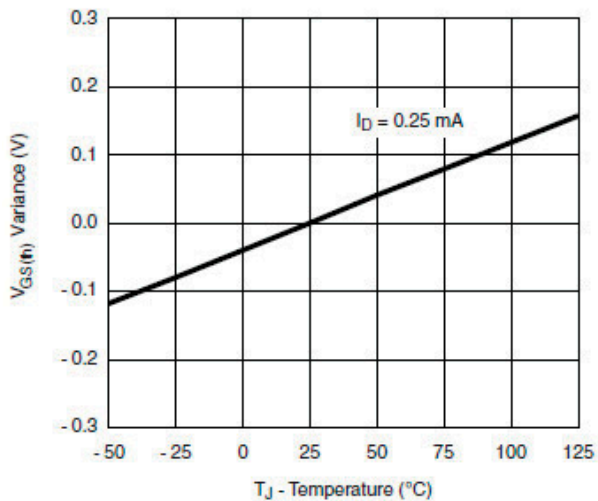
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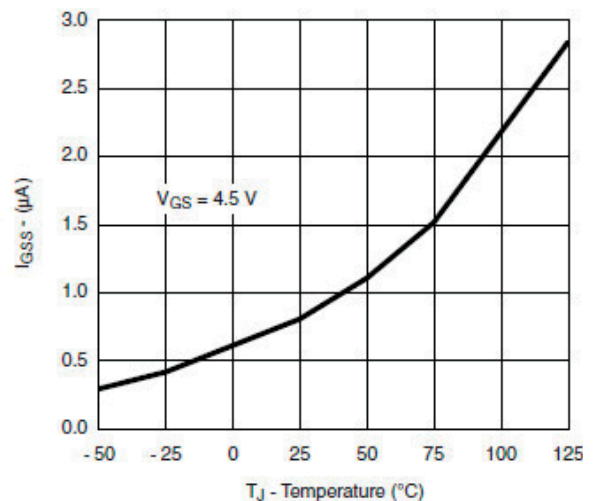
Source-Drain Diode Forward Voltage



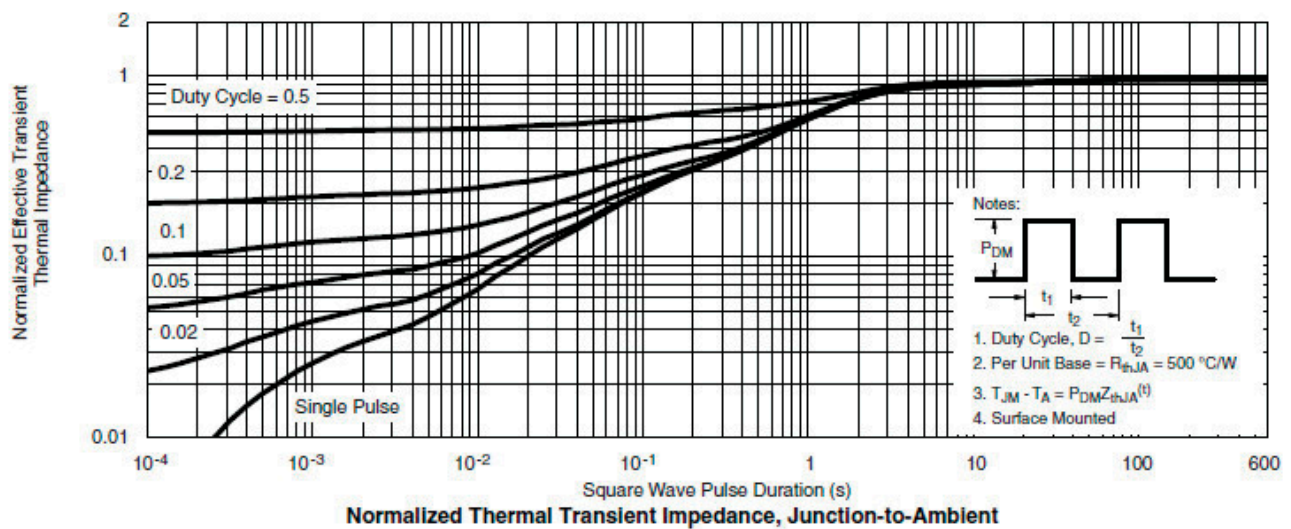
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage Variance vs. Temperature



$I_{GSS}$  vs. Temperature





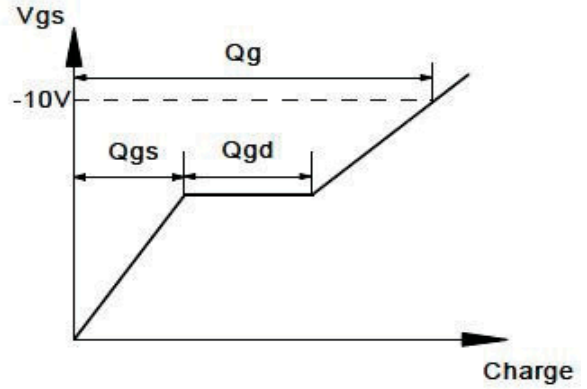
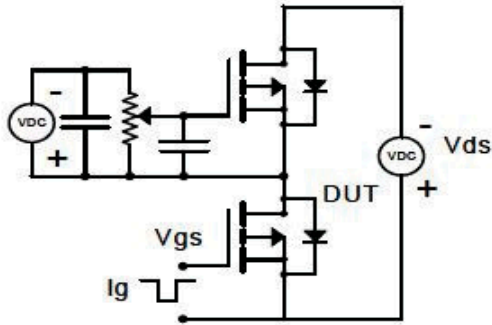
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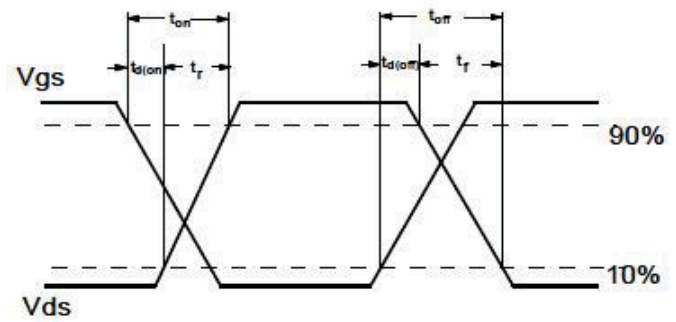
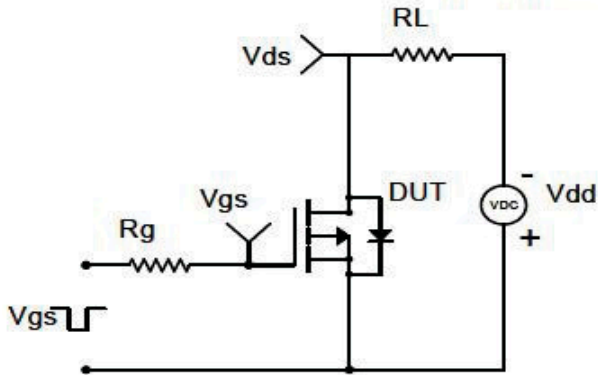
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## ■ Test circuit and waveform (P-ch)

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

