

## Features

- N-Channel  
30V/5.6A,  
 $R_{DS(ON)} = 15m\Omega (Typ.) @ V_{GS}=10V$   
 $R_{DS(ON)} = 23m\Omega (Typ.) @ V_{GS}=4.5V$
- P-Channel  
-30V/-3.9A,  
 $R_{DS(ON)} = 36m\Omega (Typ.) @ V_{GS}=-10V$   
 $R_{DS(ON)} = 50m\Omega (Typ.) @ V_{GS}=-4.5V$
- Very low on-resistance
- Fast Switching

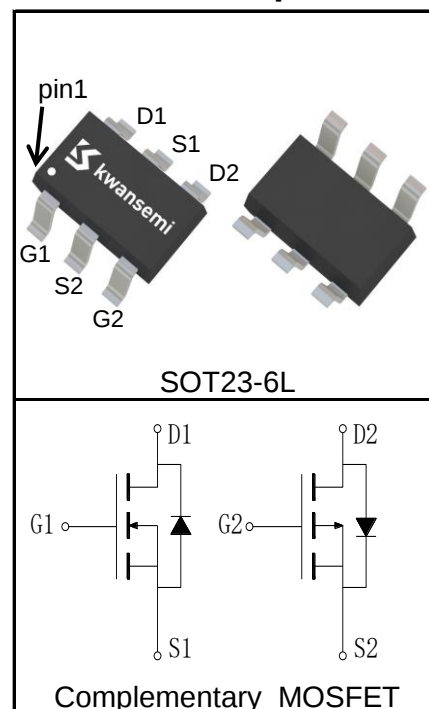
## Applications

- BLDC Motor Driver



Halogen-Free

## Pin Description



## Absolute Maximum Ratings

| Symbol                                                                 | Parameter                                    | N-Channel              | P-Channel  | Unit               |
|------------------------------------------------------------------------|----------------------------------------------|------------------------|------------|--------------------|
| <b>Common Ratings</b> ( $T_A=25^\circ\text{C}$ Unless Otherwise Noted) |                                              |                        |            |                    |
| $V_{DSS}$                                                              | Drain-Source Voltage                         | 30                     | -30        | V                  |
| $V_{GSS}$                                                              | Gate-Source Voltage                          | $\pm 20$               | $\pm 20$   |                    |
| $T_{Jmax}$                                                             | Maximum Junction Temperature                 | 150                    | 150        | $^\circ\text{C}$   |
| $T_J, T_{STG}$                                                         | Operating and Storage Temperature Range      | -55 to 150             | -55 to 150 | $^\circ\text{C}$   |
| $I_S$                                                                  | Diode Continuous Forward Current             | $T_A=25^\circ\text{C}$ |            | A                  |
|                                                                        |                                              | 1.2                    | -1.1       |                    |
| <b>Mounted on Large Heat Sink</b>                                      |                                              |                        |            |                    |
| $I_{DP}^{(1)}$                                                         | Pulse Drain Current                          | $T_A=25^\circ\text{C}$ |            | A                  |
|                                                                        |                                              | 22                     | -15        |                    |
| $I_D^{(2)}$                                                            | Continuous Drain Current( $V_{GS}=\pm 10V$ ) | $T_A=25^\circ\text{C}$ |            | A                  |
|                                                                        |                                              | 5.6                    | -3.9       |                    |
| $P_D$                                                                  | Maximum Power Dissipation                    | $T_A=25^\circ\text{C}$ |            | W                  |
|                                                                        |                                              | 1                      | 1          |                    |
| $P_D$                                                                  | Maximum Power Dissipation                    | $T_A=70^\circ\text{C}$ |            | W                  |
|                                                                        |                                              | 0.64                   | 0.64       |                    |
| $R_{\theta JL}$                                                        | Thermal Resistance-Junction to Lead          | 80                     | 80         | $^\circ\text{C/W}$ |
| $R_{\theta JA}^{(3)}$                                                  | Thermal Resistance-Junction to Ambient       | 125                    | 125        | $^\circ\text{C/W}$ |
| <b>Drain-Source Avalanche Ratings</b>                                  |                                              |                        |            |                    |
| $E_{AS}^{(4)}$                                                         | Avalanche Energy, Single Pulsed              | 20                     | 25         | mJ                 |

**Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$  Unless Otherwise Noted)

| Symbol                               | Parameter                        | Test Condition                                                              | Rating                                                                       |                       |       | Unit |    |     |
|--------------------------------------|----------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------|-------|------|----|-----|
|                                      |                                  |                                                                             | Min.                                                                         | Typ.                  | Max.  |      |    |     |
| Static Characteristics               |                                  |                                                                             |                                                                              |                       |       |      |    |     |
| BV <sub>DSS</sub>                    | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA                                 | N                                                                            | 30                    |       |      | V  |     |
|                                      |                                  | V <sub>GS</sub> =0V, I <sub>DS</sub> =-250μA                                | P                                                                            | -30                   |       |      |    |     |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V                                   | N                                                                            |                       |       | 1    | μA |     |
|                                      |                                  |                                                                             |                                                                              | T <sub>J</sub> =125°C |       |      |    | 30  |
|                                      |                                  | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V                                  | P                                                                            |                       |       | -1   |    |     |
|                                      |                                  |                                                                             |                                                                              | T <sub>J</sub> =125°C |       |      |    | -30 |
| V <sub>GS(th)</sub>                  | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA                   | N                                                                            | 1.1                   | 1.5   | 2.3  | V  |     |
|                                      |                                  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =-250μA                  | P                                                                            | -1.1                  | -1.5  | -2.3 |    |     |
| I <sub>GSS</sub>                     | Gate Leakage Current             | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                  | N                                                                            |                       |       | ±100 | nA |     |
|                                      |                                  | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                  | P                                                                            |                       |       | ±100 |    |     |
| R <sub>DS(ON)</sub> <sup>⑤</sup>     | Drain-Source On-state Resistance | V <sub>GS</sub> =10V, I <sub>DS</sub> =3A                                   | N                                                                            |                       | 15    | 20   | mΩ |     |
|                                      |                                  | V <sub>GS</sub> =-10V, I <sub>DS</sub> =-3A                                 | P                                                                            |                       | 36    | 45   |    |     |
|                                      |                                  | V <sub>GS</sub> =4.5V, I <sub>DS</sub> =2A                                  | N                                                                            |                       | 23    | 30   |    |     |
|                                      |                                  | V <sub>GS</sub> =-4.5V, I <sub>DS</sub> =-2A                                | P                                                                            |                       | 50    | 65   |    |     |
| Diode Characteristics                |                                  |                                                                             |                                                                              |                       |       |      |    |     |
| V <sub>SD</sub> <sup>⑤</sup>         | Diode Forward Voltage            | I <sub>SD</sub> =3A, V <sub>GS</sub> =0V                                    | N                                                                            |                       | 0.82  | 1.2  | V  |     |
|                                      |                                  | I <sub>SD</sub> =-3A, V <sub>GS</sub> =0V                                   | P                                                                            |                       | -0.85 | -1.2 |    |     |
| t <sub>rr</sub>                      | Reverse Recovery Time            | N-Channel<br>I <sub>SD</sub> =3A, dI <sub>SD</sub> /dt=100A/μs              | N                                                                            |                       | 15    |      | ns |     |
|                                      |                                  |                                                                             | P                                                                            |                       | 17    |      |    |     |
| Q <sub>rr</sub>                      | Reverse Recovery Charge          | P-Channel<br>I <sub>SD</sub> =-3A, dI <sub>SD</sub> /dt=-100A/μs            | N                                                                            |                       | 12    |      | nC |     |
|                                      |                                  |                                                                             | P                                                                            |                       | 8     |      |    |     |
| Dynamic Characteristics <sup>⑥</sup> |                                  |                                                                             |                                                                              |                       |       |      |    |     |
| R <sub>G</sub>                       | Gate Resistance                  | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz                            | N                                                                            |                       | 3.2   |      | Ω  |     |
|                                      |                                  |                                                                             | P                                                                            |                       | 9     |      |    |     |
| C <sub>iss</sub>                     | Input Capacitance                | N-Channel<br>V <sub>GS</sub> =0V, V <sub>DS</sub> =15V,<br>Frequency=1.0MHz | N                                                                            |                       | 480   |      | pF |     |
|                                      |                                  |                                                                             | P                                                                            |                       | 635   |      |    |     |
| C <sub>oss</sub>                     | Output Capacitance               |                                                                             | N                                                                            |                       | 65    |      |    |     |
|                                      |                                  |                                                                             | P                                                                            |                       | 70    |      |    |     |
| C <sub>rss</sub>                     | Reverse Transfer Capacitance     |                                                                             | P-Channel<br>V <sub>GS</sub> =0V, V <sub>DS</sub> =-15V,<br>Frequency=1.0MHz | N                     |       | 55   |    |     |
|                                      |                                  |                                                                             |                                                                              | P                     |       | 65   |    |     |

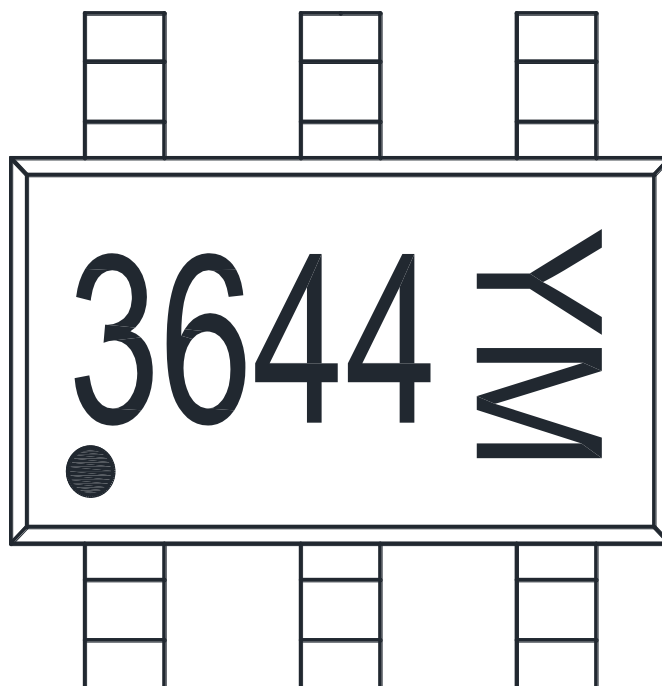
**Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$  Unless Otherwise Noted)

| Symbol                                   | Parameter          | Test Condition                                                                                       | Rating              |                                                                                                          |      | Unit |    |
|------------------------------------------|--------------------|------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------|------|------|----|
|                                          |                    |                                                                                                      | Min.                | Typ.                                                                                                     | Max. |      |    |
| Dynamic Characteristics <sup>⑥</sup>     |                    |                                                                                                      |                     |                                                                                                          |      |      |    |
| t <sub>d(ON)</sub>                       | Turn-on Delay Time | N-Channel<br>V <sub>DD</sub> =15V, I <sub>DS</sub> =3A,<br>V <sub>GEN</sub> =10V, R <sub>G</sub> =3Ω | N                   |                                                                                                          | 13   | ns   |    |
| t <sub>r</sub>                           | Turn-on Rise Time  |                                                                                                      | P                   |                                                                                                          | 10   |      |    |
|                                          |                    |                                                                                                      | N                   |                                                                                                          | 11   |      |    |
|                                          |                    |                                                                                                      | P                   |                                                                                                          | 7    |      |    |
|                                          |                    | t <sub>d(OFF)</sub>                                                                                  | Turn-off Delay Time | P-Channel<br>V <sub>DD</sub> =-15V, I <sub>DS</sub> =-3A,<br>V <sub>GEN</sub> = -10V, R <sub>G</sub> =3Ω | N    |      |    |
| P                                        |                    |                                                                                                      |                     | 23                                                                                                       |      |      |    |
| t <sub>f</sub>                           | Turn-off Fall Time |                                                                                                      |                     | N                                                                                                        |      |      | 16 |
|                                          |                    |                                                                                                      |                     | P                                                                                                        |      |      | 9  |
| Gate Charge Characteristics <sup>⑥</sup> |                    |                                                                                                      |                     |                                                                                                          |      |      |    |
| Q <sub>g</sub>                           | Total Gate Charge  | N-Channel<br>V <sub>DS</sub> =15V, V <sub>GS</sub> =10V,<br>I <sub>DS</sub> =3A                      | N                   |                                                                                                          | 9.8  | nC   |    |
| Q <sub>gs</sub>                          | Gate-Source Charge |                                                                                                      | P                   |                                                                                                          | 10.4 |      |    |
|                                          |                    | P-Channel<br>V <sub>DS</sub> =-15V, V <sub>GS</sub> = -10V,<br>I <sub>DS</sub> =-3A                  | N                   |                                                                                                          | 1.3  |      |    |
|                                          |                    |                                                                                                      | P                   |                                                                                                          | 1.5  |      |    |
|                                          |                    |                                                                                                      | Q <sub>gd</sub>     | Gate-Drain Charge                                                                                        | N    |      |    |
| P                                        |                    |                                                                                                      |                     |                                                                                                          | 2.3  |      |    |

- Notes:
- ① Pulse width limited by safe operating area.
  - ② Calculated continuous current based on maximum allowable junction temperature.
  - ③ When mounted on 1 inch square copper board,  $t \leq 10\text{sec}$ . The value in any given application depends on the user's specific board design.
  - ④ Limited by  $T_{Jmax}$ . Starting  $T_J = 25^{\circ}\text{C}$ , N Channel:  $I_{ASmax} = 9\text{A}$ ,  $L = 0.5\text{mH}$ ,  $V_{DD} = 20\text{V}$ ,  $R_G = 25\Omega$ ,  $V_{GS} = 10\text{V}$ , Part not recommended for use above this value. P-Channel:  $I_{ASmax} = -10\text{A}$ ,  $L = 0.5\text{mH}$ ,  $V_{DD} = -20\text{V}$ ,  $R_G = 25\Omega$ ,  $V_{GS} = -10\text{V}$ , Part not recommended for use above this value.
  - ⑤ Pulse test; Pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
  - ⑥ Guaranteed by design, not subject to production testing.

## Ordering and Marking Information

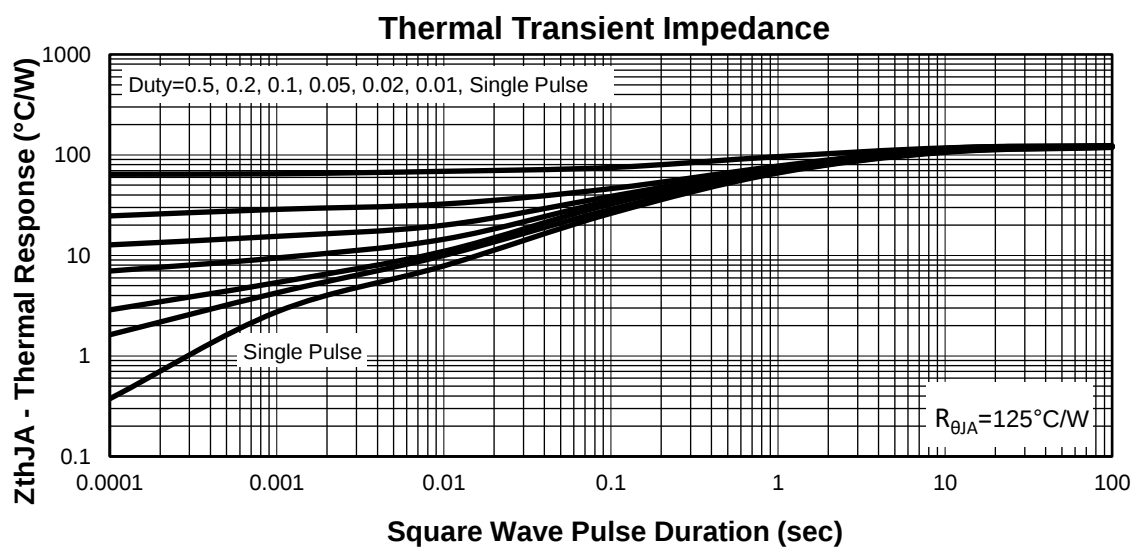
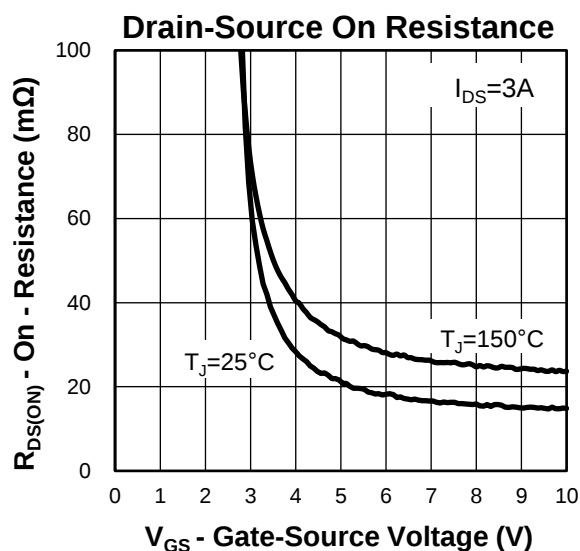
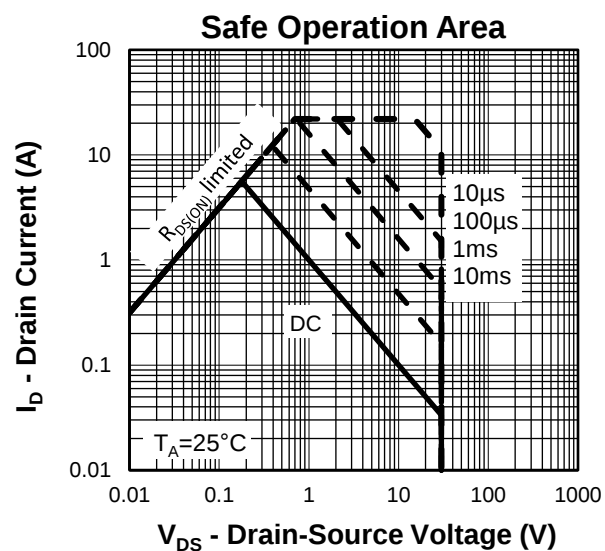
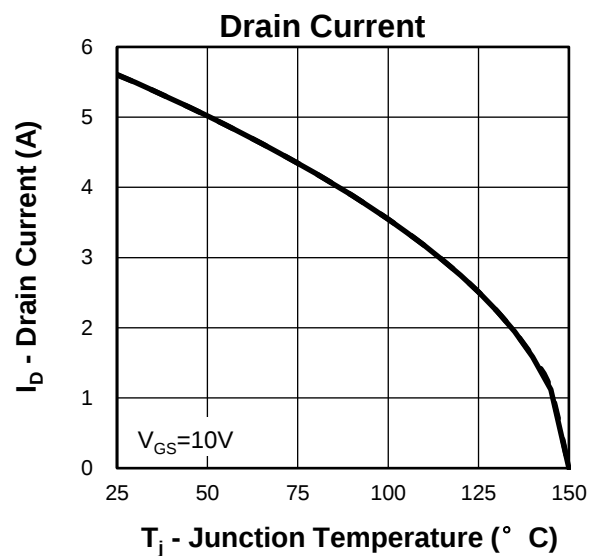
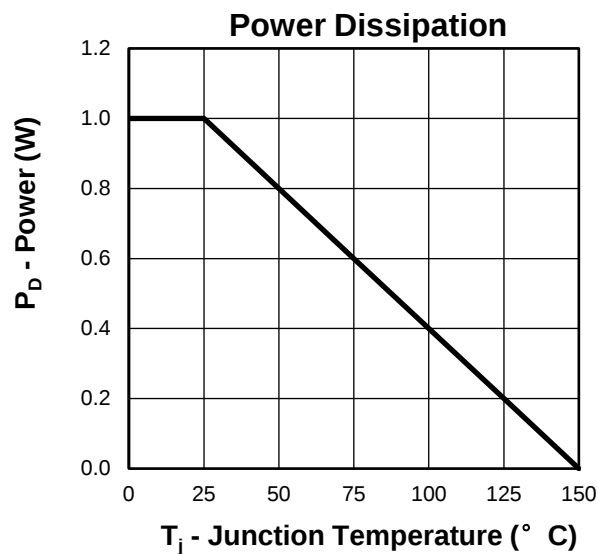
| Device    | Package  | Packaging | Quantity | Reel Size | Tape width |
|-----------|----------|-----------|----------|-----------|------------|
| KS3644EA6 | SOT23-6L | Tape&Reel | 3000     | 7"        | 8mm        |



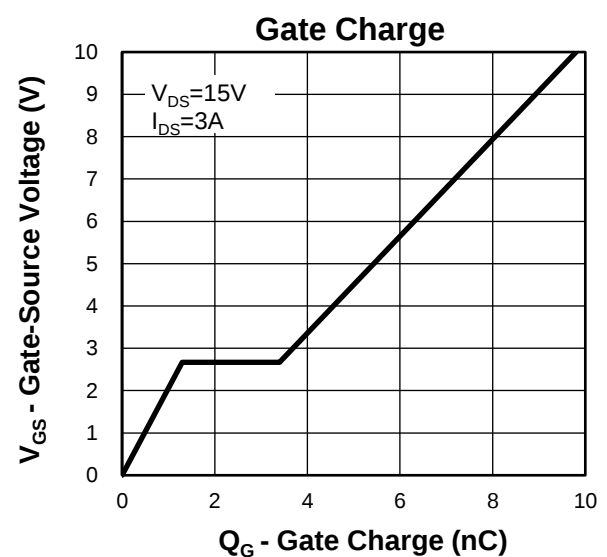
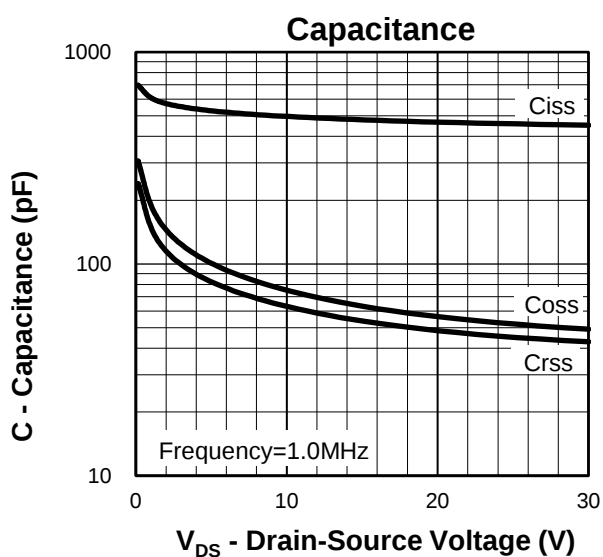
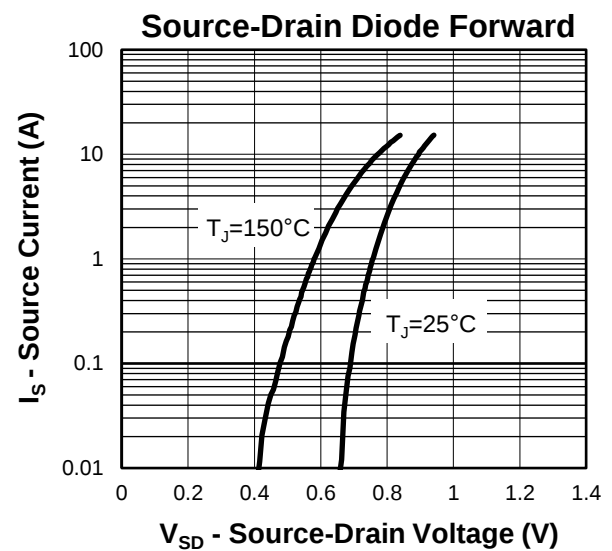
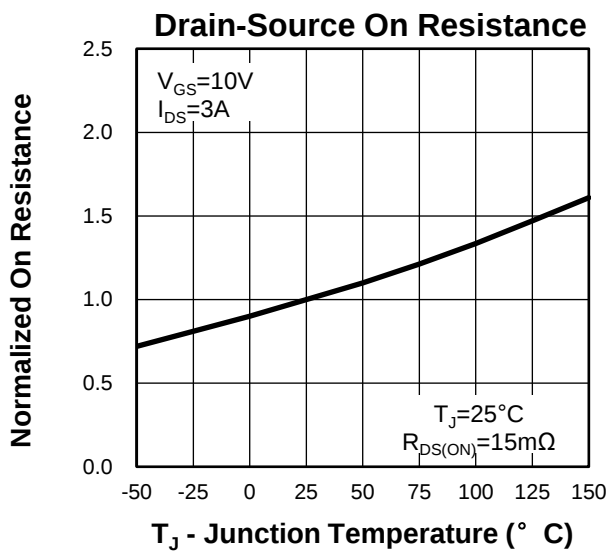
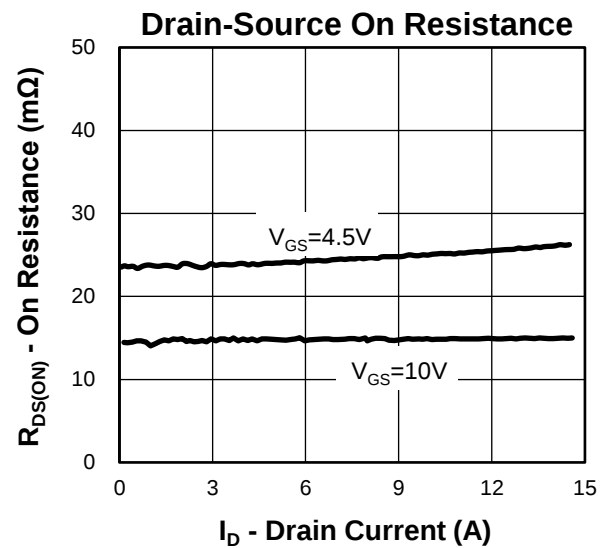
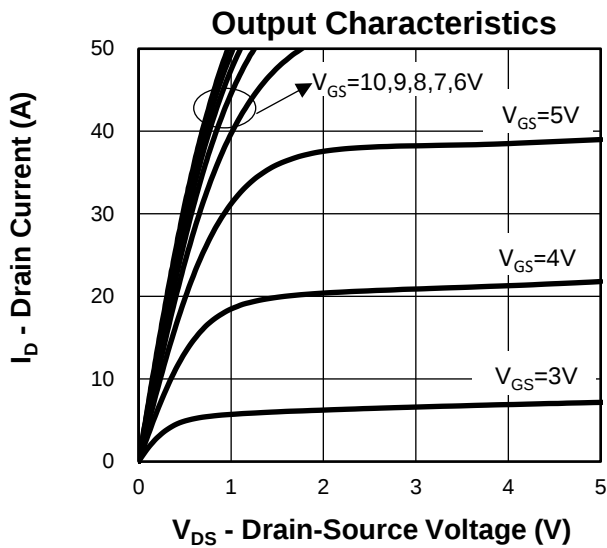
Y =Year,2017-A,2018-B,etc.

M =Month,Jan-1,Feb-2,....Sep-9,Oct-A,Nov-B,Dec-C.

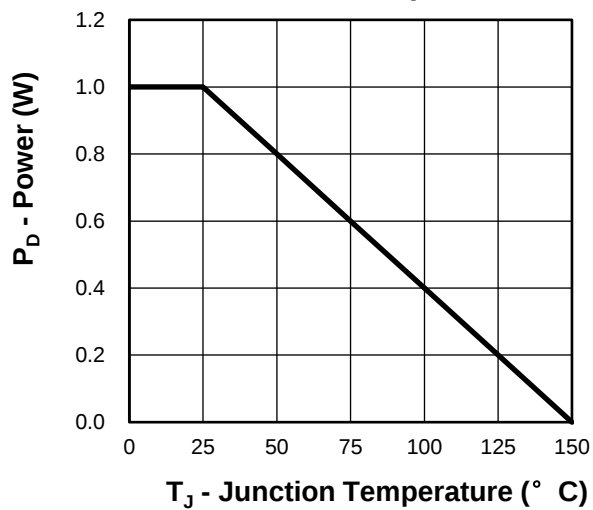
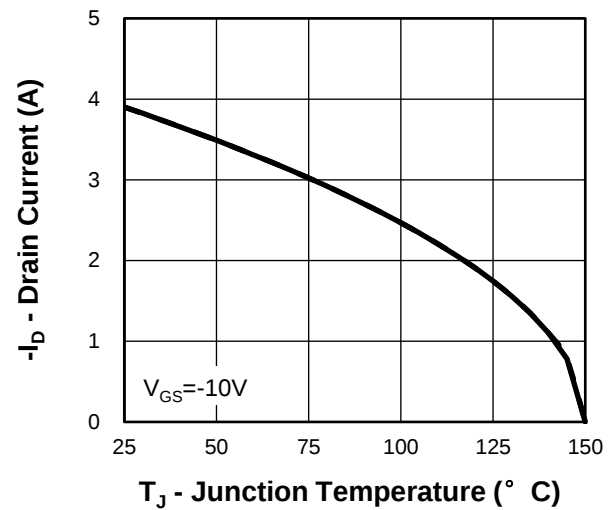
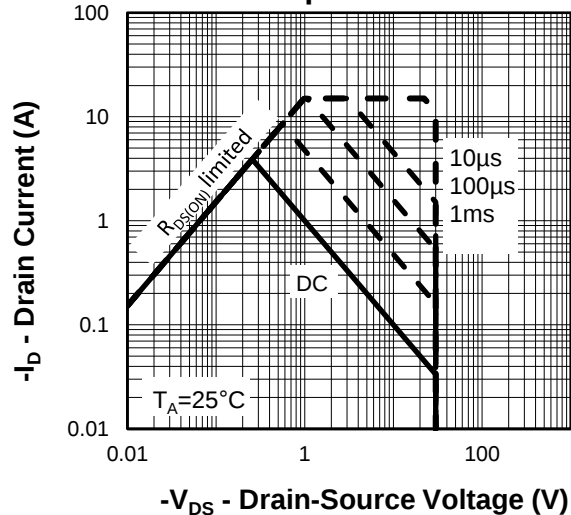
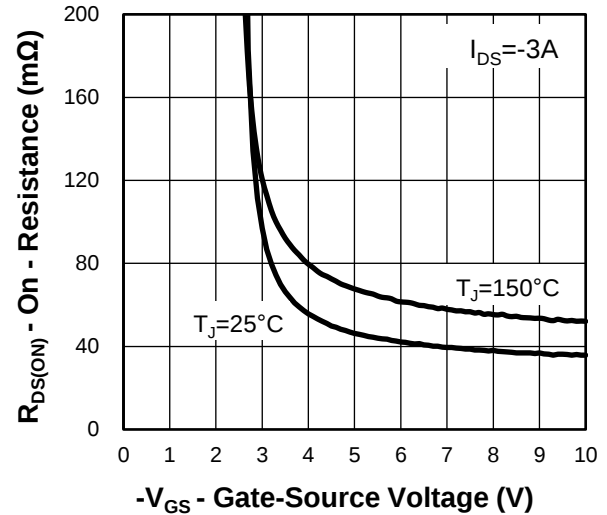
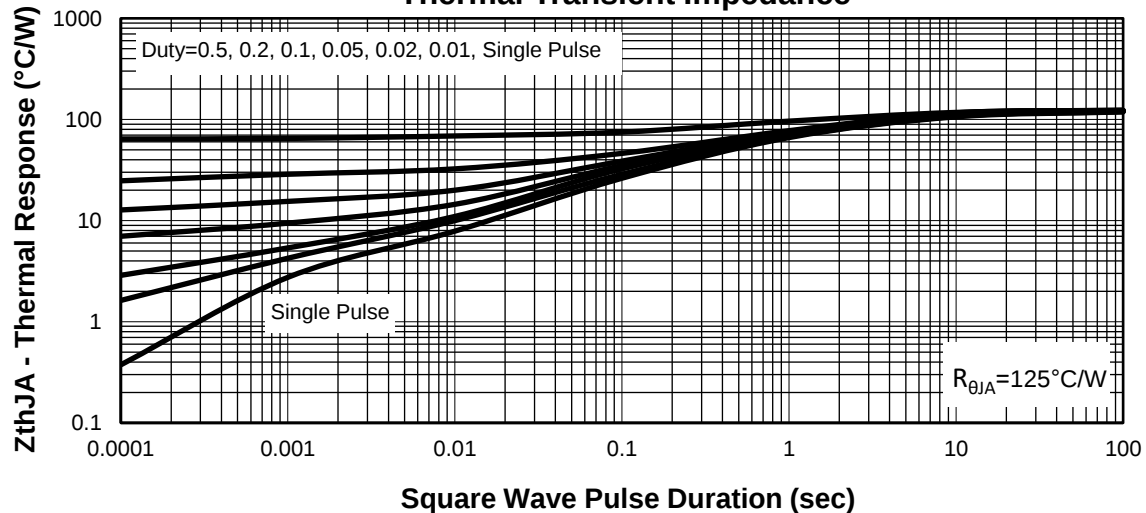
## Typical Characteristics(N-Channel)



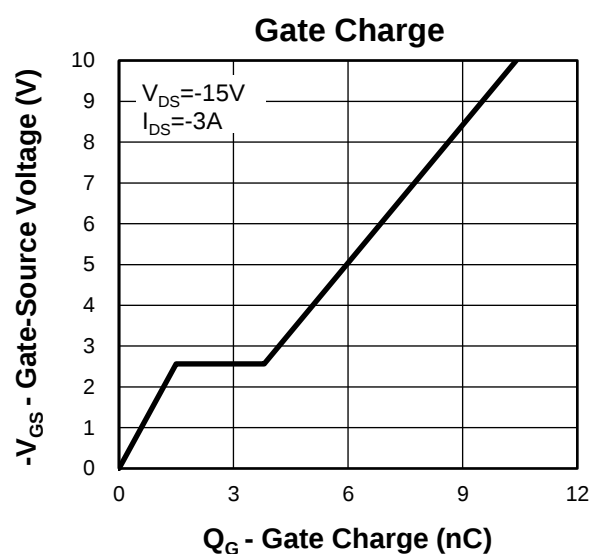
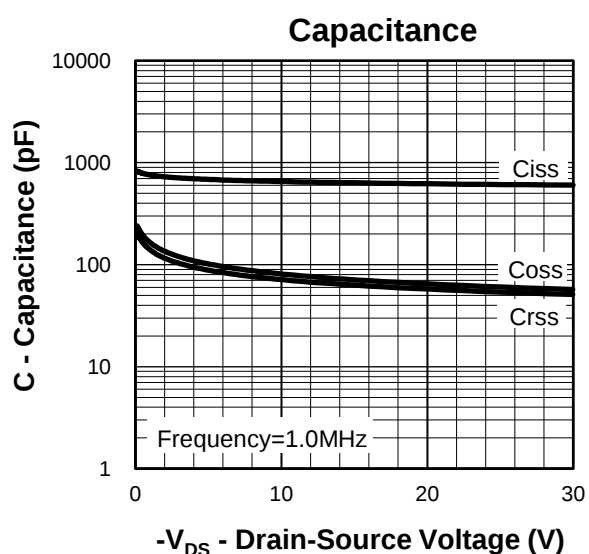
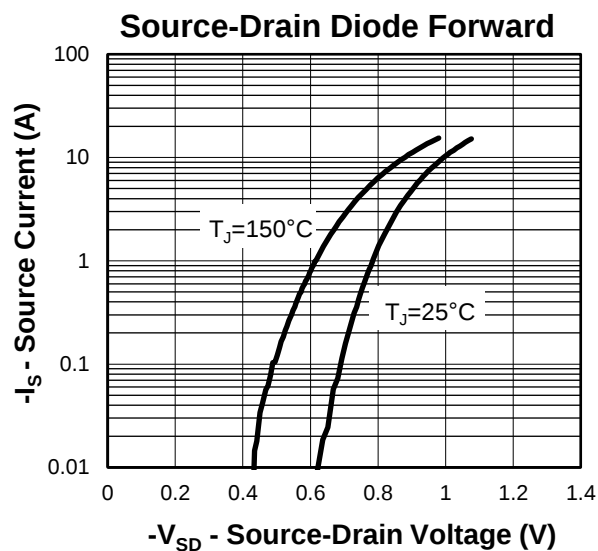
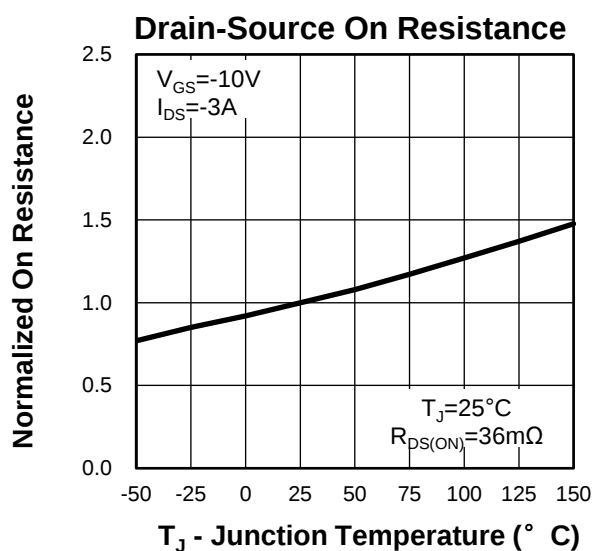
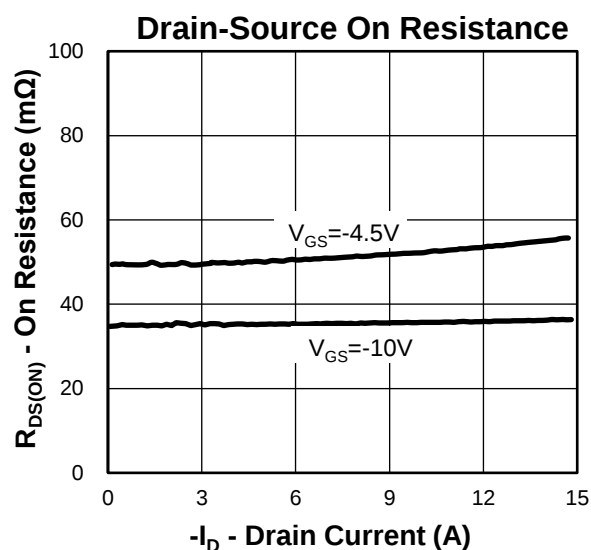
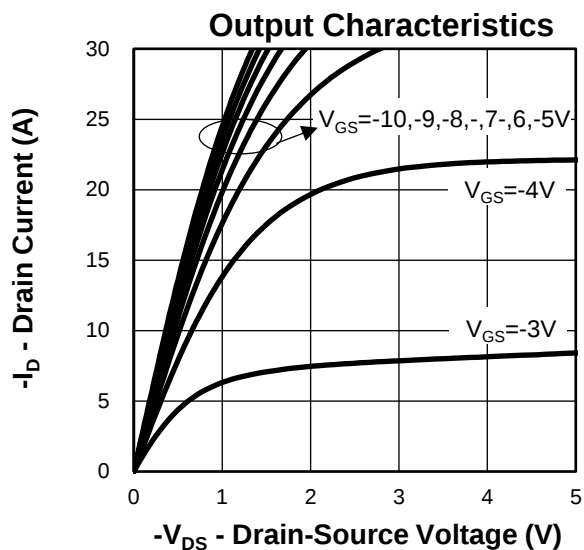
## Typical Characteristics(N-Channel)



## Typical Characteristics(P-Channel)

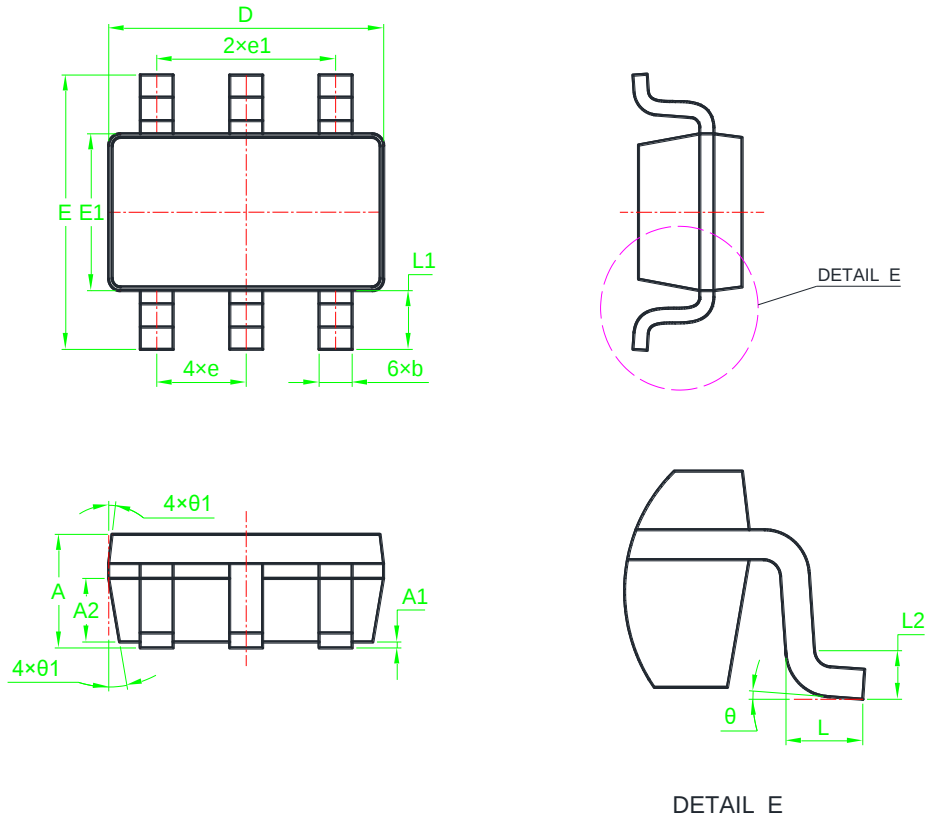
**Power Dissipation**

**Drain Current**

**Safe Operation Area**

**Drain-Source On Resistance**

**Thermal Transient Impedance**


## Typical Characteristics(P-Channel)



## Package Information

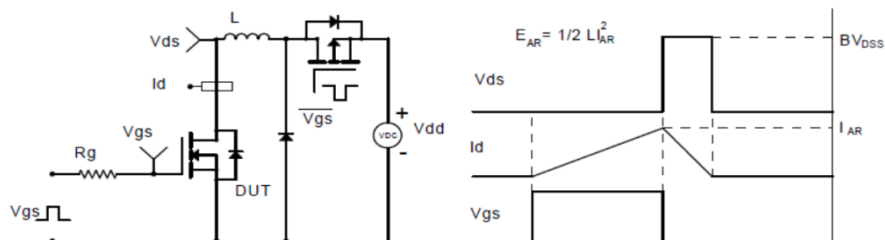
### SOT23-6L



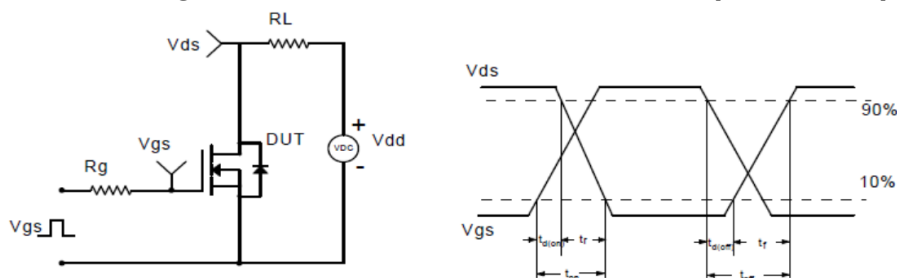
| SYMBOL | MM   |      |      | INCH  |       |       | SYMBOL | MM       |      |      | INCH     |       |       |
|--------|------|------|------|-------|-------|-------|--------|----------|------|------|----------|-------|-------|
|        | MIN  | NOM  | MAX  | MIN   | NOM   | MAX   |        | MIN      | NOM  | MAX  | MIN      | NOM   | MAX   |
| A      | 1.05 | 1.15 | 1.25 | 0.041 | 0.045 | 0.049 | e      | 0.95BSC  |      |      | 0.037BSC |       |       |
| A1     | 0.01 | *    | 0.10 | 0.000 | *     | 0.004 | e1     | 1.9BSC   |      |      | 0.075BSC |       |       |
| A2     | 1.05 | 1.10 | 1.15 | 0.041 | 0.043 | 0.045 | L      | 0.30     | 0.45 | 0.60 | 0.012    | 0.018 | 0.024 |
| b      | 0.30 | 0.40 | 0.50 | 0.012 | 0.016 | 0.020 | L1     | 0.6REF   |      |      | 0.024REF |       |       |
| D      | 2.82 | 2.92 | 3.02 | 0.111 | 0.115 | 0.119 | L2     | 0.254BSC |      |      | 0.01BSC  |       |       |
| E      | 2.65 | 2.80 | 2.95 | 0.104 | 0.110 | 0.116 | θ      | 0°       | *    | 8°   | 0°       | *     | 8°    |
| E1     | 1.50 | 1.60 | 1.70 | 0.059 | 0.063 | 0.067 | θ1     | 0°       | *    | 10°  | 0°       | *     | 10°   |

Note: Dimensions do not inclusive burrs and mold flash.

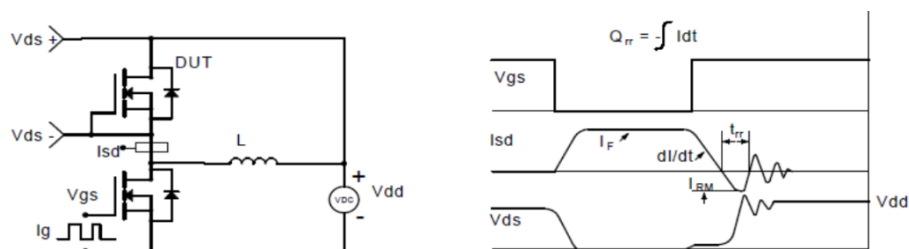
### Avalanche Test Circuit and Waveforms(N-Channel)



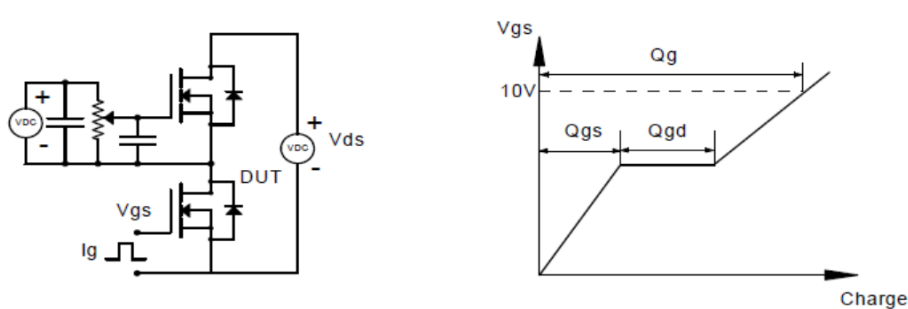
### Switching Time Test Circuit and Waveforms(N-Channel)



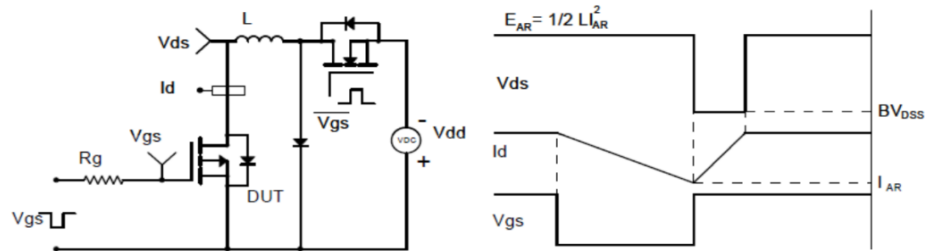
### Diode Recovery Test Circuit and Waveforms(N-Channel)



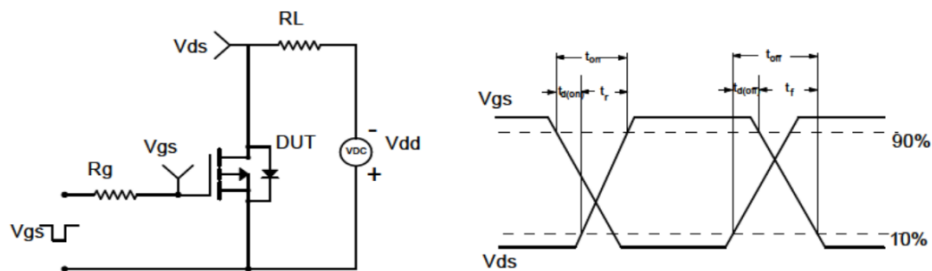
### Gate Charge Test Circuit and Waveform(N-Channel)



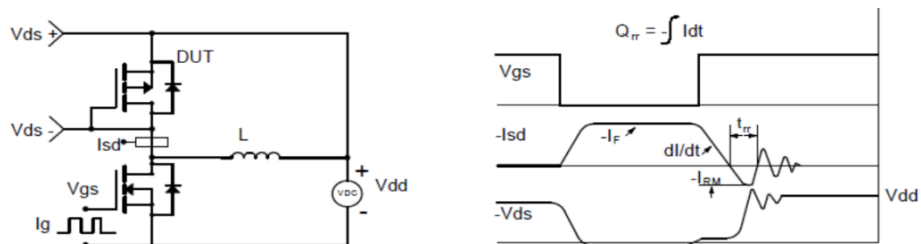
### Avalanche Test Circuit and Waveforms(P-Channel)



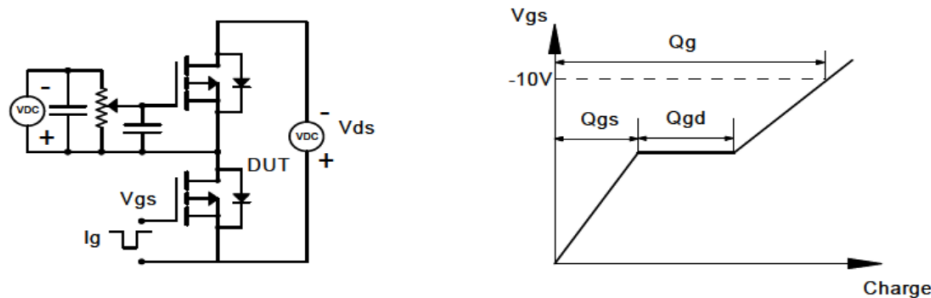
### Switching Time Test Circuit and Waveforms(P-Channel)



### Diode Recovery Test Circuit and Waveforms(P-Channel)



### Gate Charge Test Circuit and Waveform(P-Channel)



## Customer Service

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