

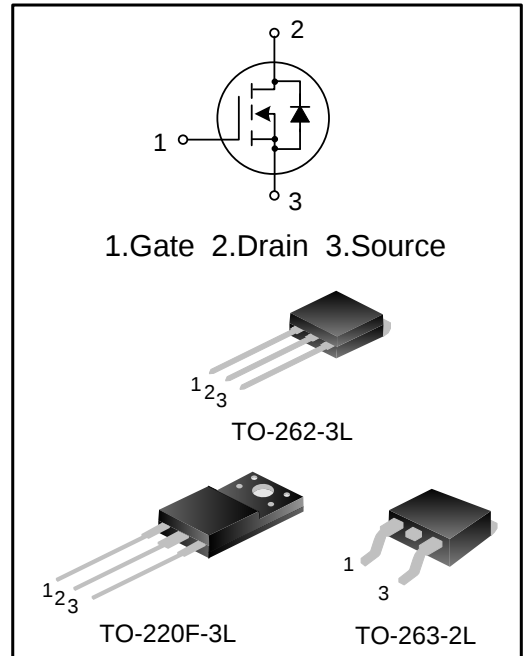
## 12A, 600V N-CHANNEL MOSFET

### GENERAL DESCRIPTION

SVF12N60F/S/K is an N-channel enhancement mode power MOS field effect transistor which is produced using Silan proprietary F-Cell™ structure VDMOS technology. The improved process and cell structure have been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are widely used in AC-DC power supplies, DC-DC converters and H-bridge PWM motor drivers.

### FEATURES

- 12A, 600V,  $R_{DS(on)}(typ.)=0.58\Omega@V_{GS}=10V$
- Low gate charge
- Low  $C_{rss}$
- Fast switching
- Improved  $dv/dt$  capability



### ORDERING INFORMATION

| Part No.    | Package    | Marking   | Hazardous Substance Control | Packing Type |
|-------------|------------|-----------|-----------------------------|--------------|
| SVF12N60F   | TO-220F-3L | SVF12N60F | Pb free                     | Tube         |
| SVF12N60S   | TO-263-2L  | SVF12N60S | Halogen free                | Tube         |
| SVF12N60STR | TO-263-2L  | SVF12N60S | Halogen free                | Tape&Reel    |
| SVF12N60K   | TO-262-3L  | SVF12N60K | Pb free                     | Tube         |

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub>=25°C UNLESS OTHERWISE NOTED)

| Characteristics                         |                       | Symbol           | Ratings   |           |           | Unit |
|-----------------------------------------|-----------------------|------------------|-----------|-----------|-----------|------|
|                                         |                       |                  | SVF12N60F | SVF12N60S | SVF12N60K |      |
| Drain-Source Voltage                    |                       | V <sub>DS</sub>  | 600       |           |           | V    |
| Gate-Source Voltage                     |                       | V <sub>GS</sub>  | ±30       |           |           | V    |
| Drain Current                           | T <sub>C</sub> =25°C  | I <sub>D</sub>   | 12        |           |           | A    |
|                                         | T <sub>C</sub> =100°C |                  | 7.6       |           |           |      |
| Drain Current Pulsed                    |                       | I <sub>DM</sub>  | 48        |           |           | A    |
| Power Dissipation(T <sub>C</sub> =25°C) |                       | P <sub>D</sub>   | 51        | 180       | 213       | W    |
| -Derate above 25°C                      |                       |                  | 0.41      | 1.44      | 1.7       | W/°C |
| Single Pulsed Avalanche Energy (Note 1) |                       | E <sub>AS</sub>  | 798       |           |           | mJ   |
| Reverse Diode dv/dt (Note 2)            |                       | dv/dt            | 4.5       |           |           | V/ns |
| MOSFET dv/dt Ruggedness (Note 3)        |                       | dv/dt            | 50        |           |           | V/ns |
| Operation Junction Temperature Range    |                       | T <sub>J</sub>   | -55~+150  |           |           | °C   |
| Storage Temperature Range               |                       | T <sub>stg</sub> | -55~+150  |           |           | °C   |

## THERMAL CHARACTERISTICS

| Characteristics                         | Symbol           | Ratings   |           |           | Unit |
|-----------------------------------------|------------------|-----------|-----------|-----------|------|
|                                         |                  | SVF12N60F | SVF12N60S | SVF12N60K |      |
| Thermal Resistance, Junction-to-Case    | R <sub>θJC</sub> | 2.44      | 0.69      | 0.59      | °C/W |
| Thermal Resistance, Junction-to-Ambient | R <sub>θJA</sub> | 62.5      | 62.5      | 62.5      | °C/W |

## ELECTRICAL CHARACTERISTICS (T<sub>c</sub>=25°C UNLESS OTHERWISE NOTED)

| Characteristics                             | Symbol              | Test conditions                                                                                        | Min. | Typ. | Max. | Unit |
|---------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------|------|------|------|------|
| Drain -Source Breakdown Voltage             | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                                             | 600  | --   | --   | V    |
| Drain-Source Leakage Current                | I <sub>DSS</sub>    | V <sub>DS</sub> =600V, V <sub>GS</sub> =0V                                                             | --   | --   | 1.0  | μA   |
| Gate-Source Leakage Current                 | I <sub>GSS</sub>    | V <sub>GS</sub> =±30V, V <sub>DS</sub> =0V                                                             | --   | --   | ±100 | nA   |
| Gate Threshold Voltage                      | V <sub>GS(th)</sub> | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> =250μA                                              | 2.0  | --   | 4.0  | V    |
| Static Drain- Source<br>On State Resistance | R <sub>DS(on)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =6.0A                                                             | --   | 0.58 | 0.75 | Ω    |
| Input Capacitance                           | R <sub>g</sub>      | f=1.0MHz                                                                                               | --   | 4.2  | --   | Ω    |
| Input Capacitance                           | C <sub>iss</sub>    | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V,<br>f=1.0MHz                                                 | --   | 1367 | --   | pF   |
| Output Capacitance                          | C <sub>OSS</sub>    |                                                                                                        | --   | 152  | --   |      |
| Reverse Transfer Capacitance                | C <sub>rss</sub>    |                                                                                                        | --   | 14   | --   |      |
| Turn-on Delay Time                          | t <sub>d(on)</sub>  | V <sub>DD</sub> =300V, I <sub>D</sub> =12A,<br>V <sub>GS</sub> =10V, R <sub>G</sub> =24Ω<br>(Note 4,5) | --   | 24   | --   | ns   |
| Turn-on Rise Time                           | t <sub>r</sub>      |                                                                                                        | --   | 52   | --   |      |
| Turn-off Delay Time                         | t <sub>d(off)</sub> |                                                                                                        | --   | 88   | --   |      |
| Turn-off Fall Time                          | t <sub>f</sub>      |                                                                                                        | --   | 48   | --   |      |
| Total Gate Charge                           | Q <sub>g</sub>      | V <sub>DS</sub> =480V, I <sub>D</sub> =12A, V <sub>GS</sub> =10V<br>(Note 4,5)                         | --   | 34   | --   | nC   |
| Gate-Source Charge                          | Q <sub>gs</sub>     |                                                                                                        | --   | 7.6  | --   |      |
| Gate-Drain Charge                           | Q <sub>gd</sub>     |                                                                                                        | --   | 15   | --   |      |

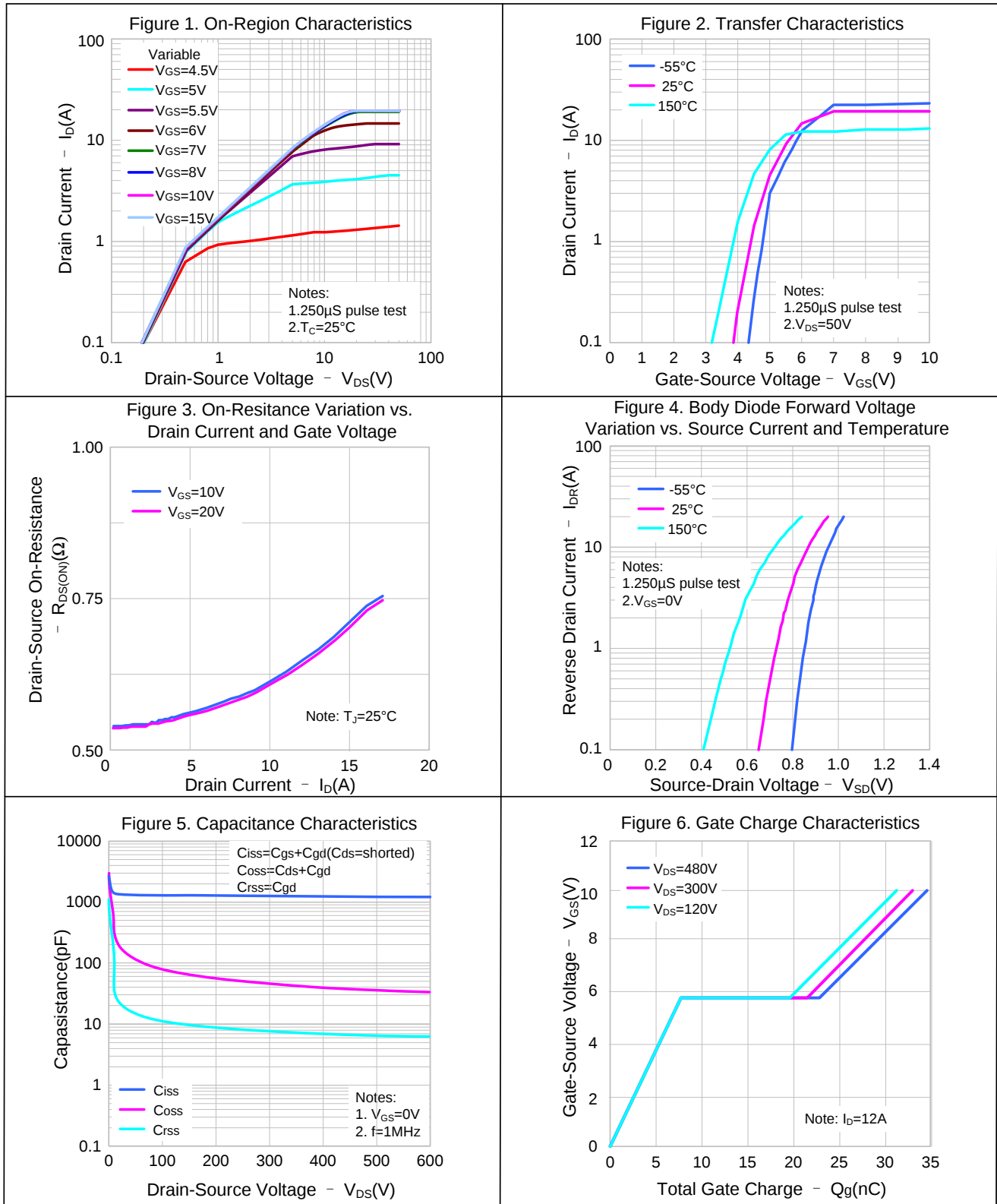
## SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

| Characteristics           | Symbol          | Test conditions                                      | Min. | Typ. | Max. | Unit |
|---------------------------|-----------------|------------------------------------------------------|------|------|------|------|
| Continuous Source Current | I <sub>S</sub>  | Integral Reverse p-n Junction<br>Diode in the MOSFET | --   | --   | 12   | A    |
| Pulsed Source Current     | I <sub>SM</sub> |                                                      | --   | --   | 48   |      |
| Diode Forward Voltage     | V <sub>SD</sub> | I <sub>S</sub> =12A, V <sub>GS</sub> =0V             | --   | --   | 1.3  | V    |
| Reverse Recovery Time     | T <sub>rr</sub> | I <sub>S</sub> =12A, V <sub>GS</sub> =0V,            | --   | 530  | --   | ns   |
| Reverse Recovery Charge   | Q <sub>rr</sub> | dI <sub>F</sub> /dt=100A/μS (Note 4)                 | --   | 4.8  | --   | μC   |

### Notes:

1. L=30Mh, I<sub>AS</sub>=6.7A, V<sub>DD</sub>=100V, R<sub>G</sub>=25Ω, starting temperature T<sub>J</sub>=25°C;
2. V<sub>DS</sub>=0~400V, I<sub>SD</sub>≤12A, T<sub>J</sub>=25°C;
3. V<sub>DS</sub>=0~480V;
4. Pulse Test: Pulse width ≤300μs, Duty cycle≤2%;
5. Essentially independent of operating temperature.

**TYPICAL CHARACTERISTICS**



**TYPICAL CHARACTERISTICS(CONTINUED)**

Figure 7. Breakdown Voltage Variation vs. Temperature

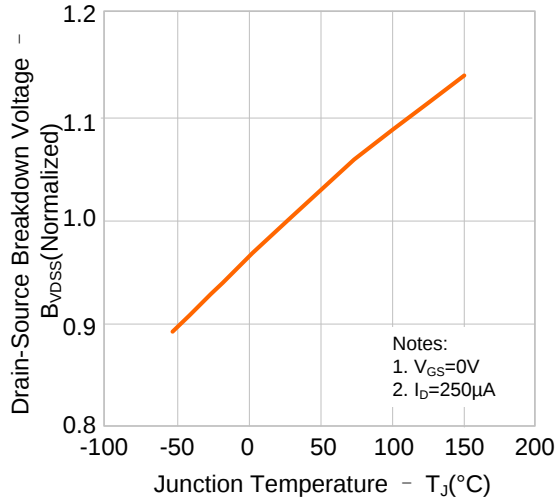


Figure 8. On-resistance Variation vs. Temperature

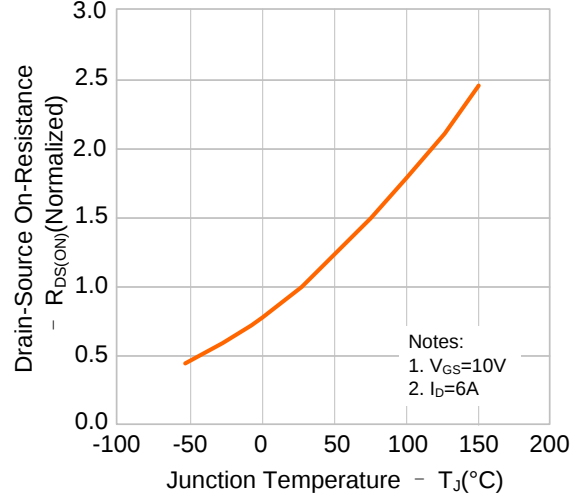


Figure 9-1. Max. Safe Operating Area(SVF12N60F)

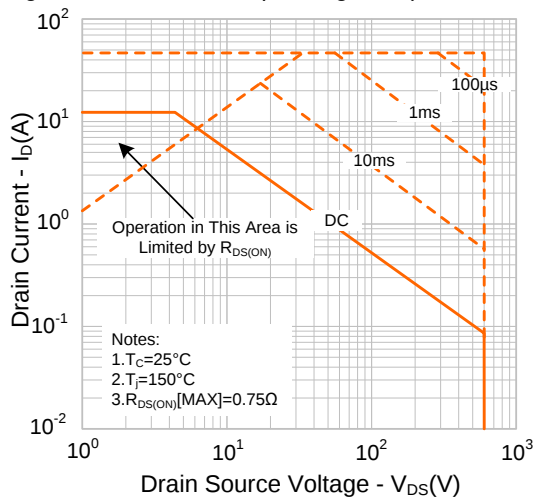


Figure 9-2. Max. Safe Operating Area(SVF12N60S)

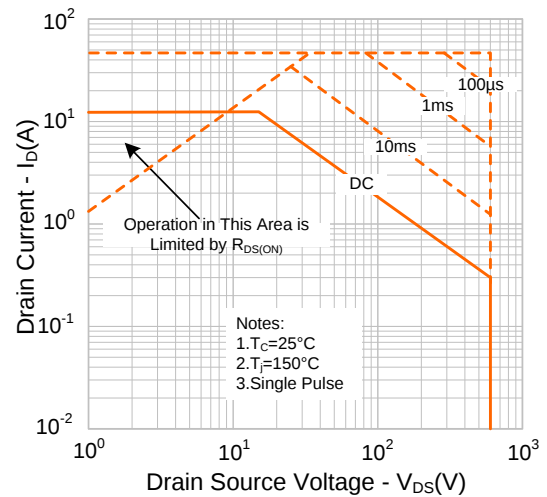


Figure 9-3. Max. Safe Operating Area(SVF12N60K)

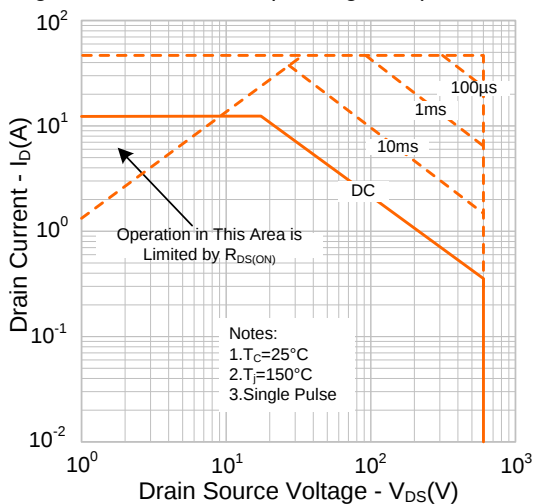
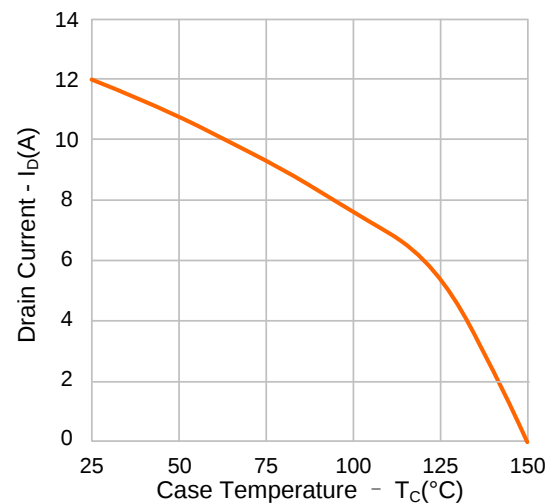
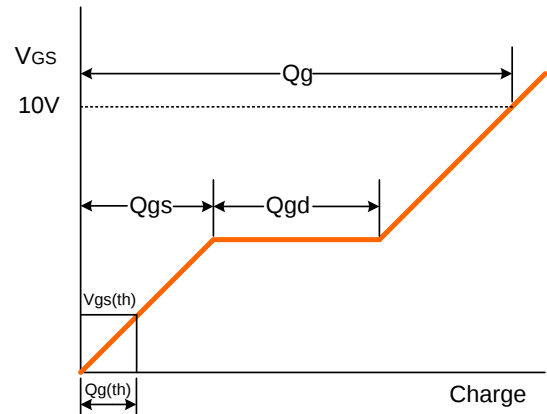
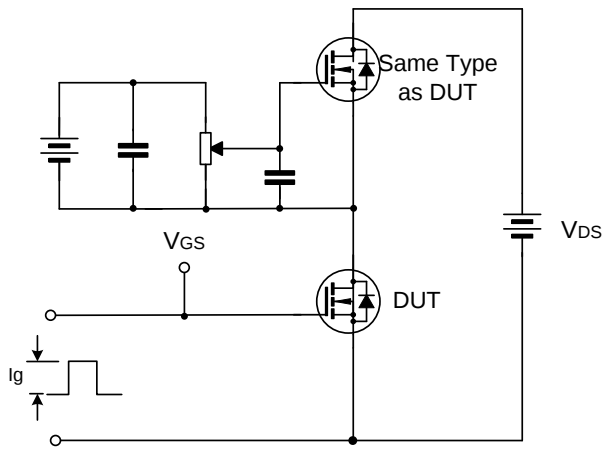


Figure 10. Maximum Drain Current vs. Case Temperature

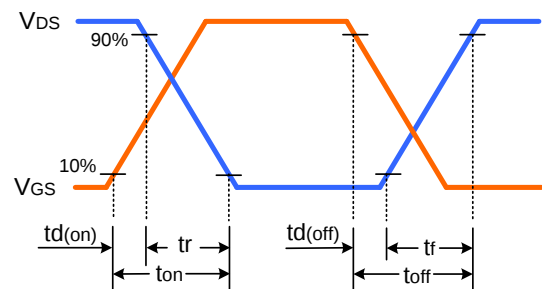
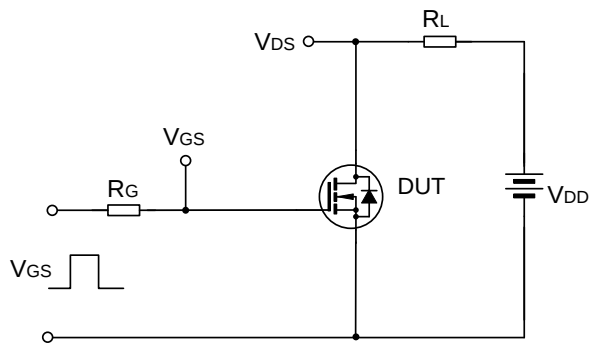


**TYPICAL TEST CIRCUIT**

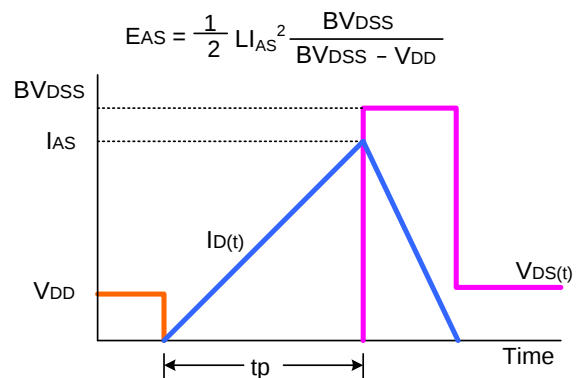
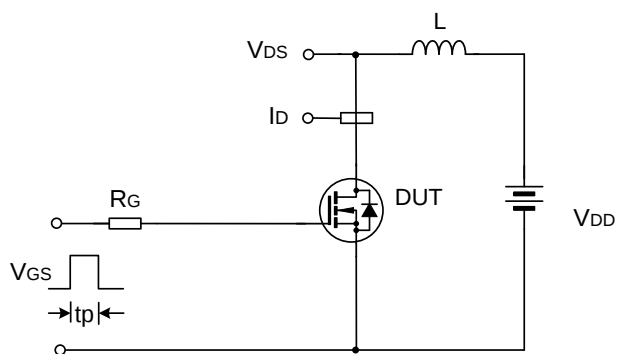
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveform



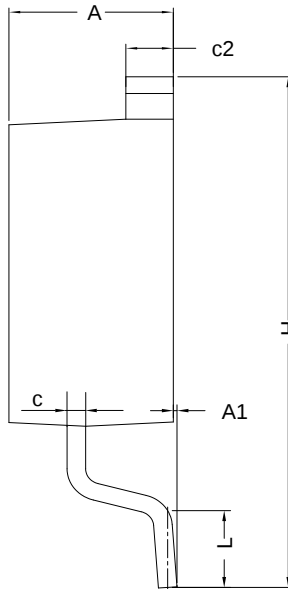
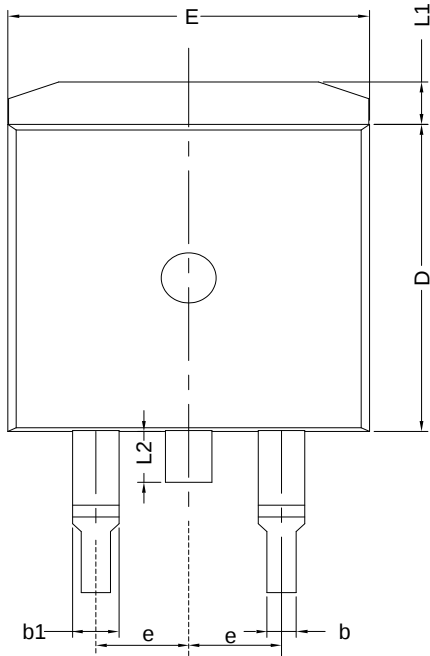
Unclamped Inductive Switching Test Circuit & Waveform



## PACKAGE OUTLINE

TO-263-2L

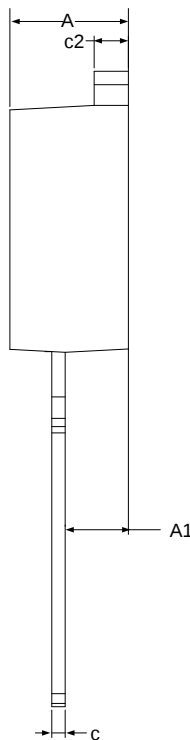
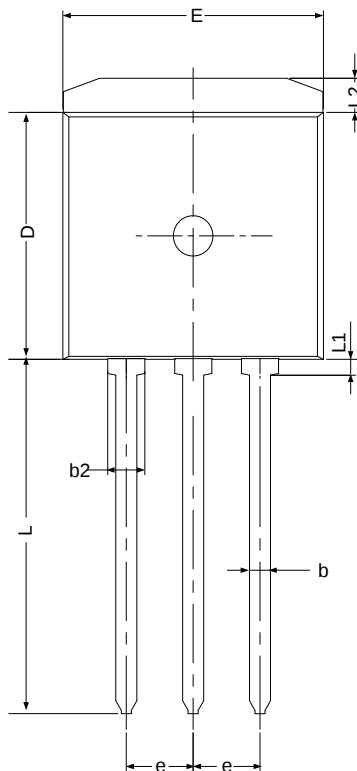
UNIT: mm



| SYMBOL | MILLIMETER |      |       |
|--------|------------|------|-------|
|        | MIN        | NOM  | MAX   |
| A      | 4.30       | 4.57 | 4.72  |
| A1     | 0          | 0.10 | 0.25  |
| b      | 0.71       | 0.81 | 0.91  |
| c      | 0.30       | —    | 0.60  |
| c2     | 1.17       | 1.27 | 1.37  |
| D      | 8.50       | —    | 9.35  |
| E      | 9.80       | —    | 10.45 |
| e      | 2.54BSC    |      |       |
| H      | 14.70      | —    | 15.75 |
| L      | 2.00       | 2.30 | 2.74  |
| L1     | 1.12       | 1.27 | 1.42  |
| L2     | —          | —    | 1.75  |

TO-262-3L

UNIT: mm

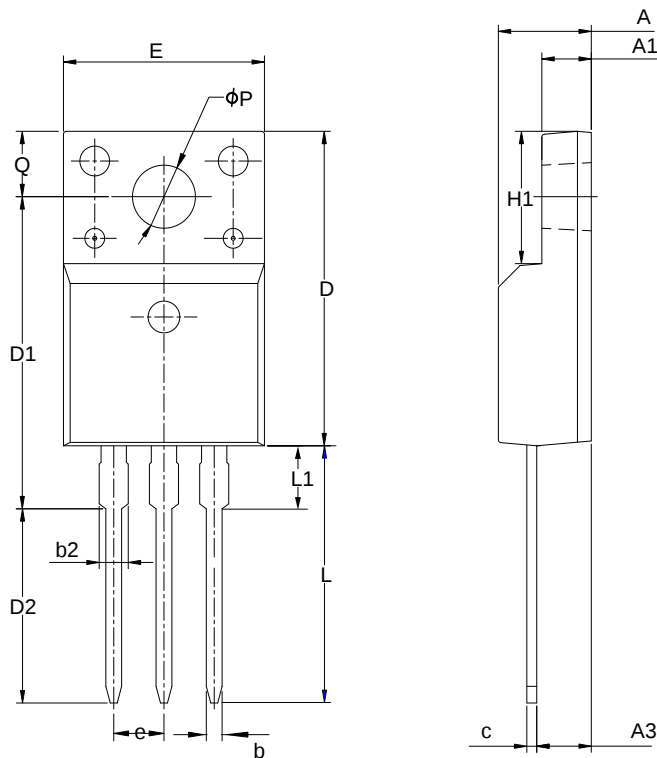


| SYMBOL | MILLIMETER |       |       |
|--------|------------|-------|-------|
|        | MIN        | NOM   | MAX   |
| A      | 4.30       | 4.50  | 4.70  |
| A1     | 2.20       | —     | 2.92  |
| b      | 0.71       | 0.80  | 0.90  |
| b2     | 1.20       | —     | 1.50  |
| c      | 0.34       | —     | 0.65  |
| c2     | 1.22       | 1.30  | 1.35  |
| D      | 8.38       | —     | 9.30  |
| E      | 9.80       | 10.16 | 10.54 |
| e      | 2.54 BSC   |       |       |
| L      | 12.80      | —     | 14.10 |
| L1     | —          | —     | 0.75  |
| L2     | 1.12       | —     | 1.42  |

**PACKAGE OUTLINE(CONTINUED)**

**TO-220F-3L**

**UNIT: mm**



| SYMBOL   | MILLIMETER |       |       |
|----------|------------|-------|-------|
|          | MIN        | NOM   | MAX   |
| A        | 4.42       | 4.70  | 5.02  |
| A1       | 2.30       | 2.54  | 2.80  |
| A3       | 2.50       | 2.76  | 3.10  |
| b        | 0.70       | 0.80  | 0.90  |
| b2       | —          | —     | 1.47  |
| c        | 0.35       | 0.50  | 0.65  |
| D        | 15.25      | 15.87 | 16.25 |
| D1       | 15.30      | 15.75 | 16.30 |
| D2       | 9.30       | 9.80  | 10.30 |
| E        | 9.73       | 10.16 | 10.36 |
| e        | 2.54BSC    |       |       |
| H1       | 6.40       | 6.68  | 7.00  |
| L        | 12.48      | 12.98 | 13.48 |
| L1       | —          | —     | 3.50  |
| $\phi P$ | 3.00       | 3.18  | 3.40  |
| Q        | 3.05       | 3.30  | 3.55  |

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|            |                                         |                |                                                               |
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Rev.: 2.7

## Revision History:

1. Update Update Electrical schematic and Typical Test circuit
  2. Delete NOMENCLATURE
  3. Update the template of the datasheet
- 

Rev.: 2.6

## Revision History:

1. Update Fig 5
  2. Add dv/dt and Rg
- 

Rev.: 2.5

## Revision History:

1. Update the package outline of TO-262-3L
- 

Rev.: 2.4

## Revision History:

1. Delete the package outline of TO-220-3L
- 

Rev.: 2.3

## Revision History:

1. Add another solid figure of TO-220-3L
  2. Update the package outline of TO-262-3L and TO-263-2L
- 

Rev.: 2.2

## Revision History:

1. Modify the Electrical characteristics
- 

Rev.: 2.1

## Revision History:

1. Modify the ordering information
  2. Modify the package information of TO-220-3L
- 

Rev.: 2.0

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## Revision History:

1. Modify the package information

Rev.: 1.9

## Revision History:

1. Modify the thermal characteristics

Rev.: 1.8

## Revision History:

1. Modify the ordering information

Rev.: 1.7

## Revision History:

1. Change the schematic diagram of MOS

Rev.: 1.6

## Revision History:

1. Modify "PACKAGE OUTLINE"

Rev.: 1.5

## Revision History:

1. Add the package of TO-262-3L

Rev.: 1.4

## Revision History:

1. Modify the typ. value of  $R_{DS(on)}$

Rev.: 1.3

## Revision History:

1. Modify the value of  $T_{rr}$  and  $Q_{rr}$
2. Modify the value of capacitance
3. Modify the figure 5

Rev.: 1.2

## Revision History:

1. Add the halogen free information of SVF12N60F

Rev.: 1.1

## Revision History:

1. Modify "PACKAGE OUTLINE"

Rev.: 1.0

## Revision History:

1. Original