



**2N7000**  
**2N7002**

**N-CHANNEL 60V - 1.8Ω - 0.35A SOT23-3L - TO-92**  
**STripFET™II MOSFET**

| TYPE   | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|--------|------------------|---------------------|----------------|
| 2N7000 | 60 V             | < 5 Ω (@ 10V)       | 0.35 A         |
| 2N7002 | 60 V             | < 5 Ω (@ 10V)       | 0.20 A         |

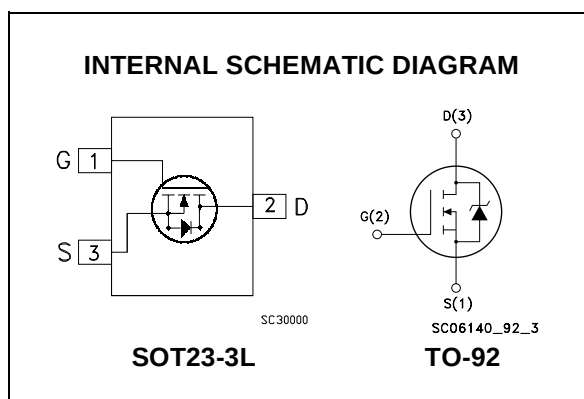
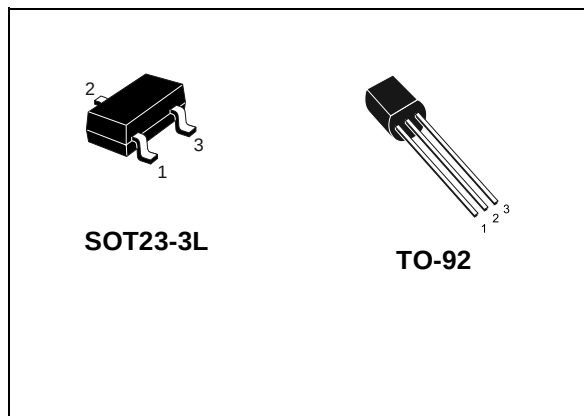
- TYPICAL R<sub>DS(on)</sub> = 1.8Ω @10V
- LOW Q<sub>g</sub>
- LOW THRESHOLD DRIVE

#### DESCRIPTION

This MOSFET is the second generation of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

#### APPLICATIONS

- HIGH SWITCHING APPLICATIONS



#### ORDER CODE

| PART NUMBER | MARKING | PACKAGE  | PACKAGING   |
|-------------|---------|----------|-------------|
| 2N7000      | 2N7000G | TO-92    | BULK        |
| 2N7002      | ST2N    | SOT23-3L | TAPE & REEL |

## 2N7000 - 2N7002

### ABSOLUTE MAXIMUM RATINGS

| Symbol            | Parameter                                              | Value    |          | Unit |
|-------------------|--------------------------------------------------------|----------|----------|------|
|                   |                                                        | TO-92    | STO23-3L |      |
| $V_{DS}$          | Drain-source Voltage ( $V_{GS} = 0$ )                  | 60       |          | V    |
| $V_{DGR}$         | Drain-gate Voltage ( $R_{GS} = 20\text{ k}\Omega$ )    | 60       |          | V    |
| $V_{GS}$          | Gate- source Voltage                                   | $\pm 18$ |          | V    |
| $I_D$             | Drain Current (continuous) at $T_C = 25^\circ\text{C}$ | 0.35     | 0.25     | A    |
| $I_{DM}(\bullet)$ | Drain Current (pulsed)                                 | 1.4      | 1        | A    |
| $P_{TOT}$         | Total Dissipation at $T_C = 25^\circ\text{C}$          | 1        | 0.35     | W    |

( $\bullet$ )Pulse width limited by safe operating area

### THERMAL DATA

|                    |                                                       | TO-92       | SOT23-3L  |                    |
|--------------------|-------------------------------------------------------|-------------|-----------|--------------------|
| $R_{thj-amb}$      | Thermal Resistance Junction-ambient Max               | 125         | 357.1 (*) | $^\circ\text{C/W}$ |
| $T_J$<br>$T_{stg}$ | Operating Junction Temperature<br>Storage Temperature | - 55 to 150 |           | $^\circ\text{C}$   |

(\*) DEVICE MOUNTED ON A PCB AREA OF  $1\text{cm}^2$

### ON/OFF

| Symbol        | Parameter                                        | Test Conditions                                                                                 | Min. | Typ.     | Max.      | Unit                           |
|---------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------|------|----------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$                                                   | 60   |          |           | V                              |
| $I_{DSS}$     | Zero Gate Voltage Drain Current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max Rating}$<br>$V_{DS} = \text{Max Rating}$ , $T_C = 125^\circ\text{C}$        |      |          | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body Leakage Current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 18\text{ V}$                                                                      |      |          | $\pm 100$ | nA                             |
| $V_{GS(th)}$  | Gate Threshold Voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                              | 1    | 2.1      | 3         | V                              |
| $R_{DS(on)}$  | Static Drain-source On Resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 0.5\text{ A}$<br>$V_{GS} = 4.5\text{ V}$ , $I_D = 0.5\text{ A}$ |      | 1.8<br>2 | 5<br>5.3  | $\Omega$<br>$\Omega$           |

**ELECTRICAL CHARACTERISTICS** ( $T_{CASE} = 25\text{ }^{\circ}\text{C}$  UNLESS OTHERWISE SPECIFIED)  
**DYNAMIC**

| Symbol                              | Parameter                                                               | Test Conditions                                            | Min. | Typ.          | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------|------|---------------|------|----------------|
| $g_{fs}$ (1)                        | Forward Transconductance                                                | $V_{DS} = 10\text{ V}$ , $I_D = 0.5\text{ A}$              |      | 0.6           |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$ |      | 43<br>20<br>6 |      | pF<br>pF<br>pF |

**SWITCHING ON**

| Symbol                        | Parameter                                                    | Test Conditions                                                                                                              | Min. | Typ.              | Max. | Unit           |
|-------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------|-------------------|------|----------------|
| $t_{d(on)}$<br>$t_r$          | Turn-on Delay Time<br>Rise Time                              | $V_{DD} = 30\text{ V}$ , $I_D = 0.5\text{ A}$<br>$R_G = 4.7\Omega$ , $V_{GS} = 4.5\text{ V}$<br>(see test circuit, Figure 1) |      | 5<br>15           |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD} = 30\text{ V}$ , $I_D = 1\text{ A}$ ,<br>$V_{GS} = 5\text{ V}$<br>(see test circuit, Figure 2)                       |      | 1.4<br>0.8<br>0.5 | 2    | nC<br>nC<br>nC |

**SWITCHING OFF**

| Symbol                | Parameter                        | Test Conditions                                                                                                                | Min. | Typ.   | Max. | Unit     |
|-----------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------|--------|------|----------|
| $t_{d(off)}$<br>$t_f$ | Turn-Off Delay Time<br>Fall Time | $V_{DD} = 30\text{ V}$ , $I_D = 0.5\text{ A}$ ,<br>$R_G = 4.7\Omega$ , $V_{GS} = 4.5\text{ V}$<br>(see test circuit, Figure 1) |      | 7<br>8 |      | ns<br>ns |

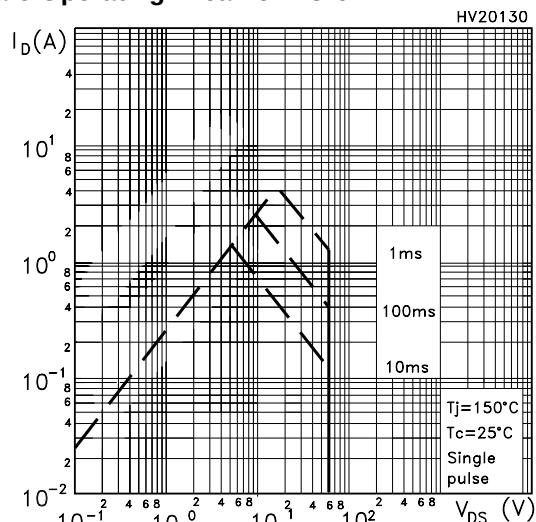
**SOURCE DRAIN DIODE**

| Symbol                            | Parameter                                                                    | Test Conditions                                                                                                                                      | Min. | Typ.            | Max.         | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------|--------------|---------------|
| $I_{SD}$<br>$I_{SDM}$ (2)         | Source-drain Current<br>Source-drain Current (pulsed)                        |                                                                                                                                                      |      |                 | 0.35<br>1.40 | A<br>A        |
| $V_{SD}$ (1)                      | Forward On Voltage                                                           | $I_{SD} = 1\text{ A}$ , $V_{GS} = 0$                                                                                                                 |      |                 | 1.2          | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 1\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 20\text{ V}$ , $T_j = 150^{\circ}\text{C}$<br>(see test circuit, Figure 3) |      | 32<br>25<br>1.6 |              | ns<br>nC<br>A |

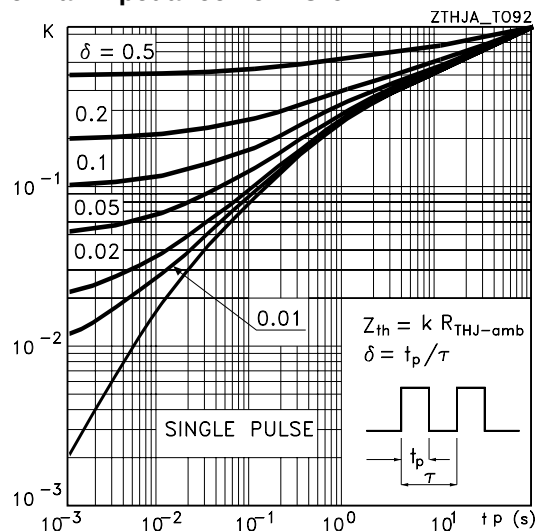
Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

2. Pulse width limited by safe operating area.

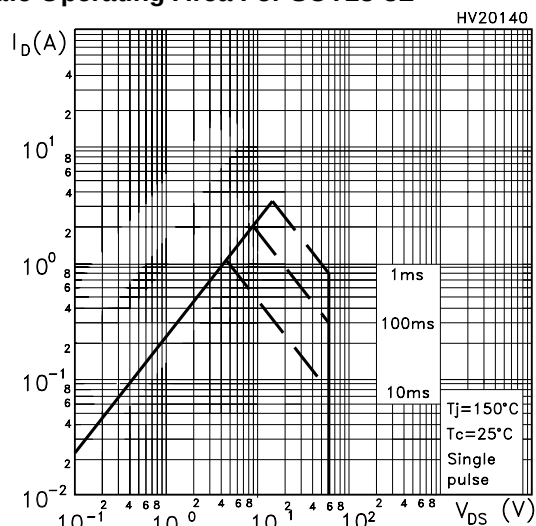
### Safe Operating Area For TO-92



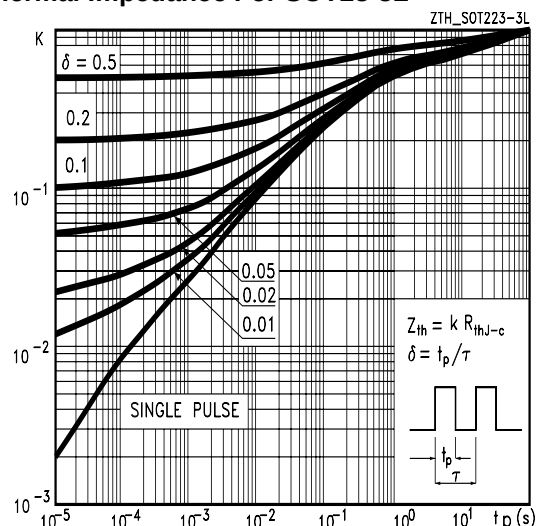
### Thermal Impedance For TO-92



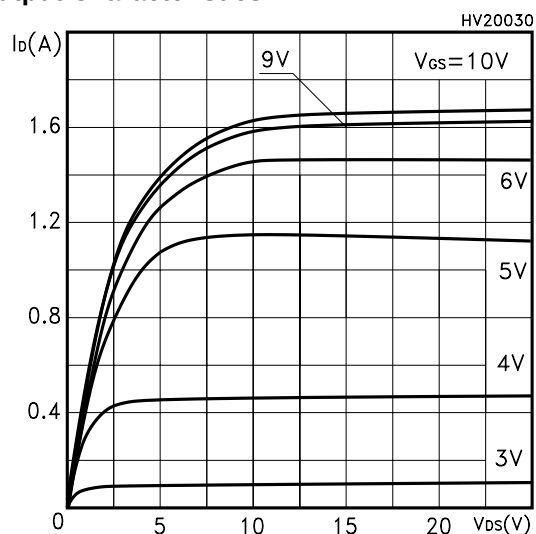
### Safe Operating Area For SOT23-3L



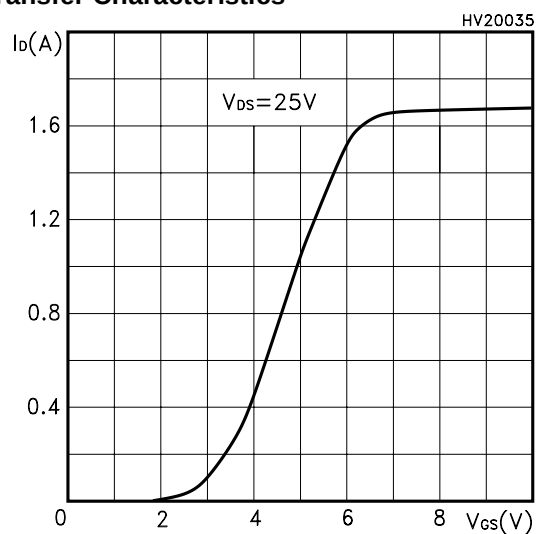
### Thermal Impedance For SOT23-3L



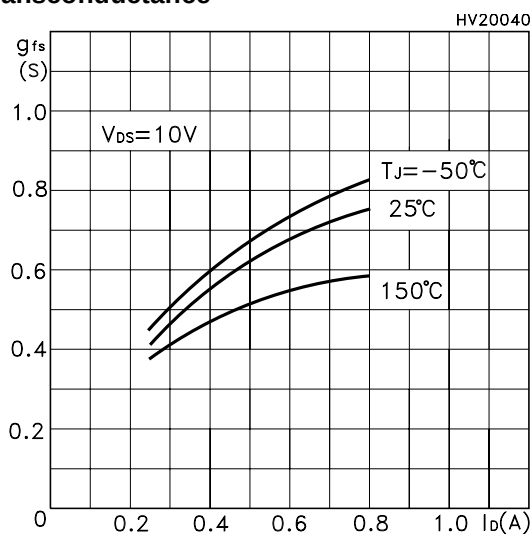
### Output Characteristics



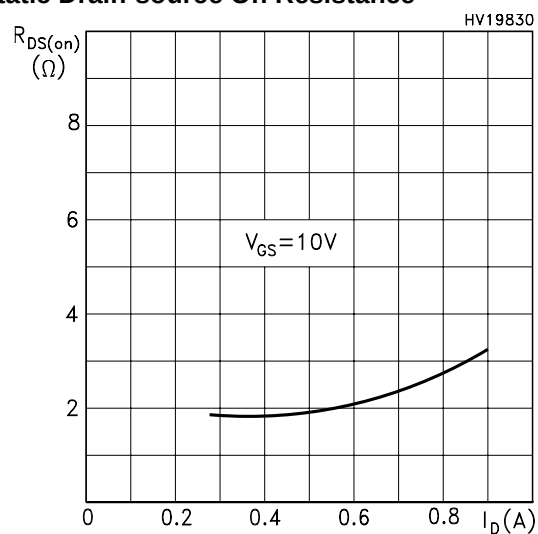
### Transfer Characteristics



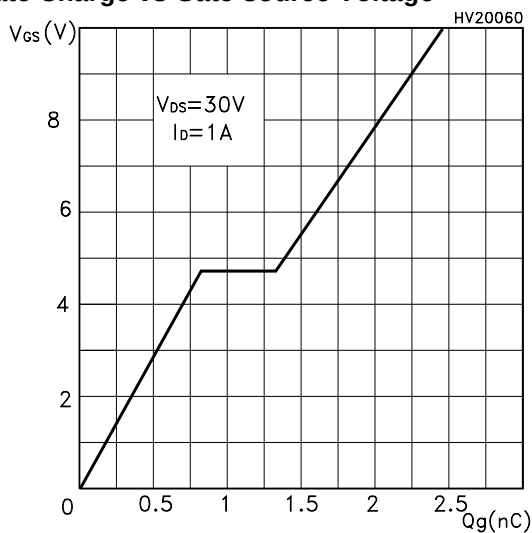
## Transconductance



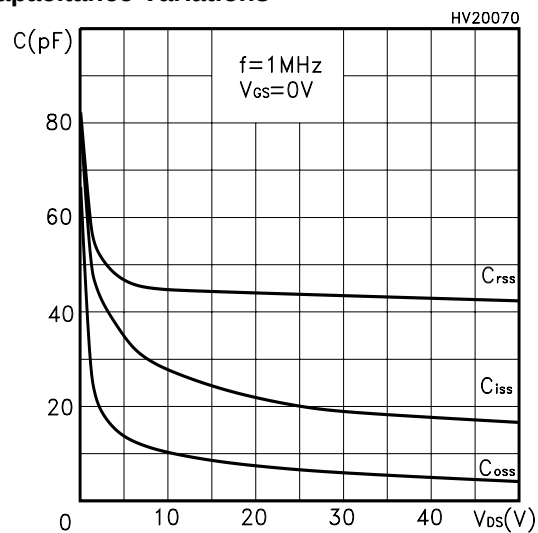
## Static Drain-source On Resistance



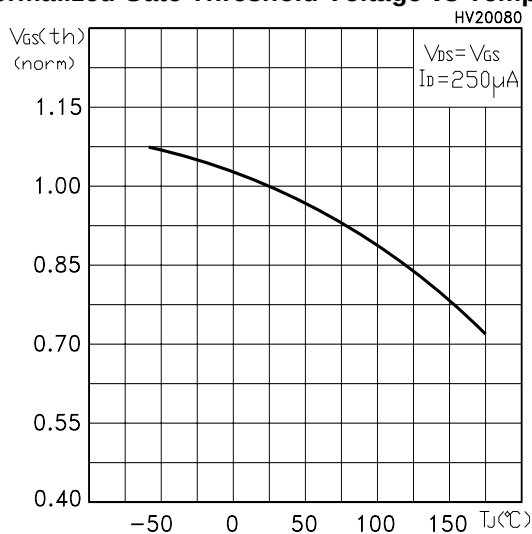
## Gate Charge vs Gate-source Voltage



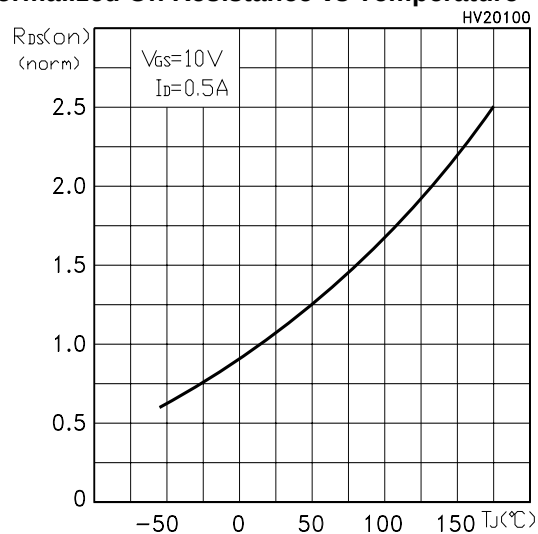
## Capacitance Variations



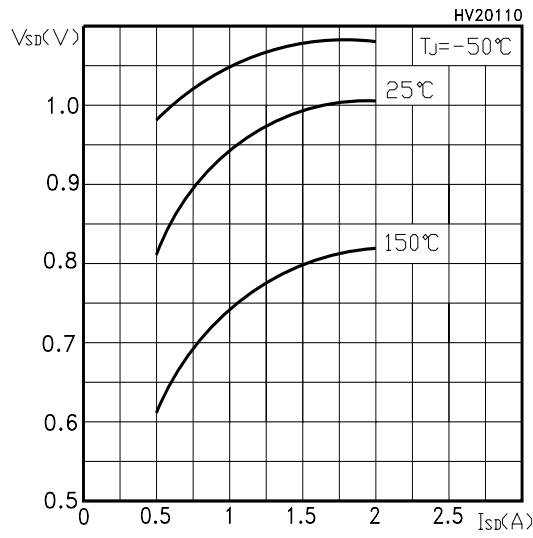
## Normalized Gate Threshold Voltage vs Temp.



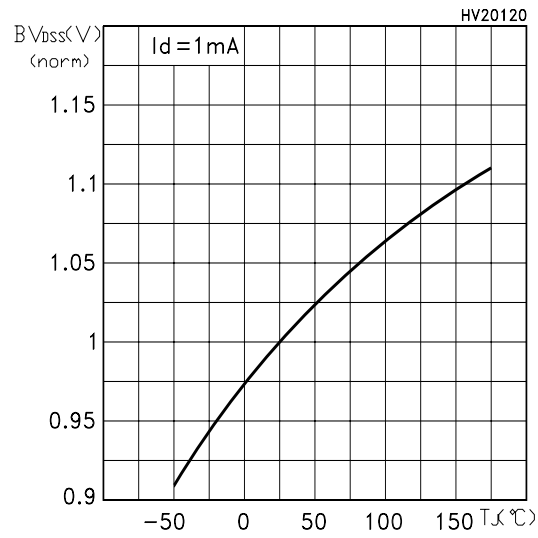
## Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics



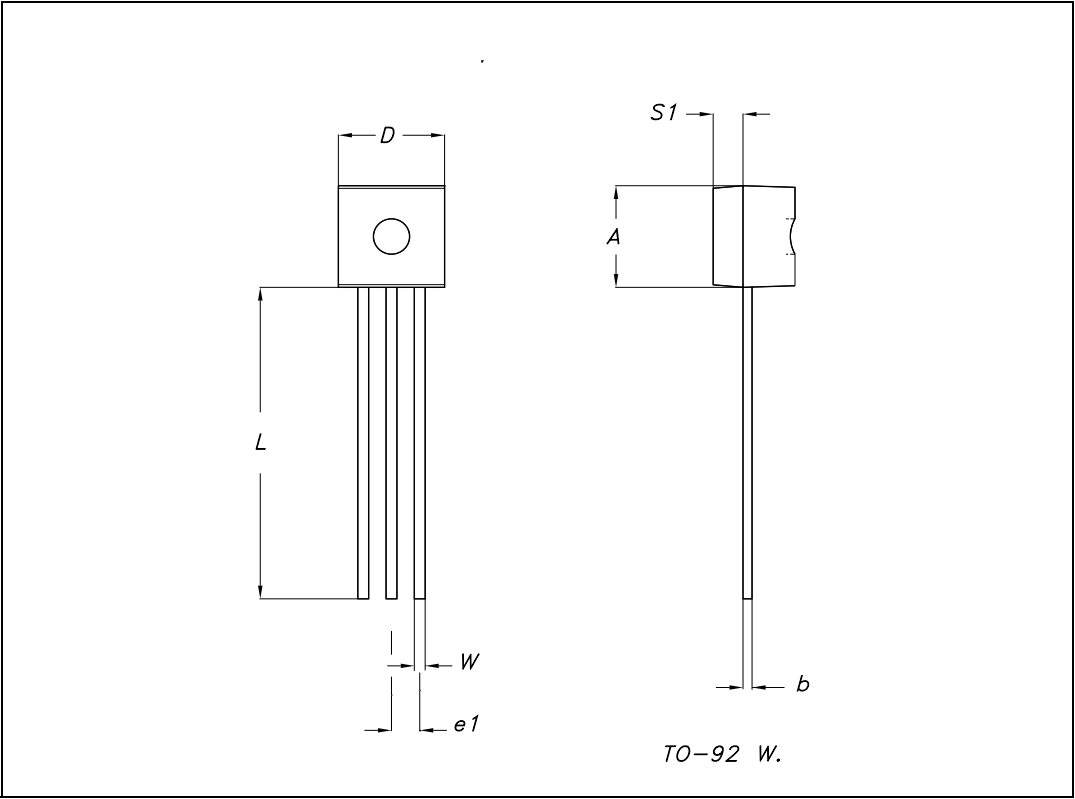
Normalized BVDSS vs Temperature





TO-92 MECHANICAL DATA

| DIM. | mm.   |     |       | inch  |      |       |
|------|-------|-----|-------|-------|------|-------|
|      | MIN.  | TYP | MAX.  | MIN.  | TYP. | MAX.  |
| A    | 4.38  |     | 4.78  | 0.17  |      | 0.188 |
| b    | 0.33  |     | 0.48  | 0.013 |      | 0.018 |
| D    | 4.43  |     | 4.83  | 0.174 |      | 0.190 |
| E    |       |     | 3.86  |       |      | 0.152 |
| e1   | 1.07  |     | 1.74  | 0.042 |      | 0.068 |
| L    | 14.07 |     | 14.87 | 0.553 |      | 0.585 |
| S1   | 0.92  |     | 1.12  | 0.036 |      | 0.044 |
| W    | 0.36  |     | 0.56  | 0.014 |      | 0.022 |
| V    |       | 4°  |       |       | 4°   |       |



SOT23-3L MECHANICAL DATA

| DIM. | mm.   |     |       | inch   |      |       |
|------|-------|-----|-------|--------|------|-------|
|      | MIN.  | TYP | MAX.  | MIN.   | TYP. | MAX.  |
| A    | 0.903 |     | 1.220 | 0.035  |      | 0.048 |
| A1   | 0.013 |     | 0.100 | 0.0005 |      | 0.004 |
| A2   | 0.890 |     | 1.120 | 0.035  |      | 0.044 |
| b    | 0.370 |     | 0.510 | 0.014  |      | 0.020 |
| C    | 0.085 |     | 0.180 | 0.003  |      | 0.007 |
| D    | 2.800 |     | 3.040 | 0.110  |      | 0.120 |
| E    | 2.100 |     | 2.64  | 0.082  |      | 0.104 |
| E1   | 1.200 |     | 1.400 | 0.047  |      | 0.055 |
| e    | 0.890 |     | 1.030 | 0.035  |      | 0.040 |
| e1   | 1.780 |     | 2.050 | 0.070  |      | 0.080 |
| L    | 0.400 |     | 0.600 | 0.015  |      | 0.023 |

