

### Features

- Advanced trench technology
- High-speed switching
- Drive circuits can be simple
- Parallel use is easy
- RoHS compliant with Halogen-free
- Qualified to AEC-Q101 Standards

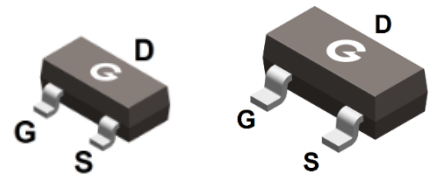
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### Typical Applications

- Power management in note book
- Switching application
- Battery powered system
- Load switch

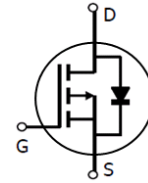
### Mechanical Data

- Case: SOT-23, SOT-23-3L
- Molding Compound: UL Flammability Classification Rating 94V-0
- Terminals: Matte tin-plated leads; solderability-per MIL-STD-202, Method 208



TBL3401  
SOT-23

TBL3401-3L  
SOT-23-3L



### Ordering Information

| Part Number | Package   | Shipping Quantity      | Marking Code |
|-------------|-----------|------------------------|--------------|
| TBL3401     | SOT-23    | 3000 pcs / Tape & Reel | 3401         |
| TBL3401-3L  | SOT-23-3L | 3000 pcs / Tape & Reel | 3401         |

### Maximum Ratings (@ T<sub>A</sub> = 25°C unless otherwise specified)

| Parameter                                                           | Symbol           | Value      | Unit |
|---------------------------------------------------------------------|------------------|------------|------|
| Drain-to-Source Voltage                                             | V <sub>DSS</sub> | -30        | V    |
| Gate-to-Source Voltage                                              | V <sub>GSS</sub> | ±12        | V    |
| Continuous Drain Current (T <sub>A</sub> = 25°C) *1                 | I <sub>D</sub>   | -4.1       | A    |
| Continuous Drain Current (T <sub>A</sub> = 70°C) *1                 |                  | -3.3       | A    |
| Pulsed Drain Current (t <sub>p</sub> = 10μs, T <sub>A</sub> = 25°C) | I <sub>DM</sub>  | -33        | A    |
| Single Pulse Avalanche Energy *3                                    | E <sub>AS</sub>  | 8          | mJ   |
| Power Dissipation (SOT-23, SOT-23-3L, T <sub>C</sub> = 25°C)        | P <sub>D</sub>   | 2.5        | W    |
| Power Dissipation (SOT-23, SOT-23-3L, T <sub>A</sub> = 25°C) *1     |                  | 1.25       | W    |
| Operating Junction Temperature Range                                | T <sub>J</sub>   | -55 ~ +150 | °C   |
| Storage Temperature Range                                           | T <sub>STG</sub> | -55 ~ +150 | °C   |

### Thermal Characteristics

| Parameter                                        | Symbol          | Min. | Typ. | Max. | Unit                 |
|--------------------------------------------------|-----------------|------|------|------|----------------------|
| Thermal Resistance Junction-to-Case              | $R_{\theta JC}$ | -    | 45   | 50   | $^{\circ}\text{C/W}$ |
| Thermal Resistance Junction-to-Air <sup>*1</sup> | $R_{\theta JA}$ | -    | 95   | 100  | $^{\circ}\text{C/W}$ |

### Electrical Characteristics (@ $T_A = 25^{\circ}\text{C}$ unless otherwise specified)

| Symbol                             | Parameter                       | Test Condition                                                                                    | Min. | Typ. | Max. | Unit |
|------------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------|------|------|------|------|
| Static Characteristics             |                                 |                                                                                                   |      |      |      |      |
| V <sub>DSS</sub>                   | Drain-Source Breakdown Voltage  | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA                                                     | -30  | -    | -    | V    |
| I <sub>DSS</sub>                   | Zero Gate Voltage Drain Current | V <sub>DS</sub> = -20V, V <sub>GS</sub> = 0V                                                      | -    | -    | -1   | μA   |
| I <sub>GSS</sub>                   | Gate-Body Leakage Current       | V <sub>GS</sub> = ±12V, V <sub>DS</sub> = 0V                                                      | -    | -    | ±100 | nA   |
| On Characteristics                 |                                 |                                                                                                   |      |      |      |      |
| R <sub>DS(ON)</sub>                | Drain-Source On-resistance *2   | V <sub>GS</sub> = -10V, I <sub>D</sub> = -4.2A                                                    | -    | 39   | 50   | mΩ   |
|                                    |                                 | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -4A                                                     | -    | 54   | 65   |      |
|                                    |                                 | V <sub>GS</sub> = -2.5V, I <sub>D</sub> = -1A                                                     | -    | 73   | 90   | mΩ   |
| V <sub>GS(TH)</sub>                | Gate Threshold Voltage          | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA                                       | -0.7 | -1.0 | -1.3 | V    |
| R <sub>G</sub>                     | Gate Resistance                 | V <sub>GS</sub> = 0V, f = 1MHz                                                                    | -    | 20   | -    | Ω    |
| Dynamic Characteristics            |                                 |                                                                                                   |      |      |      |      |
| C <sub>ISS</sub>                   | Input Capacitance               | V <sub>GS</sub> = 0V<br>V <sub>DS</sub> = -15V<br>f = 1.0MHz                                      | -    | 870  | -    | pF   |
| C <sub>OSS</sub>                   | Output Capacitance              |                                                                                                   | -    | 74   | -    |      |
| C <sub>RSS</sub>                   | Reverse Transfer Capacitance    |                                                                                                   | -    | 57   | -    |      |
| Switching Characteristics          |                                 |                                                                                                   |      |      |      |      |
| t <sub>d(ON)</sub>                 | Turn-on Delay Time *4           | V <sub>DD</sub> = -15V<br>V <sub>GS</sub> = -10V<br>R <sub>G</sub> = 6Ω<br>I <sub>D</sub> = -4.2A | -    | 7    | -    | ns   |
| t <sub>r</sub>                     | Turn-on Rise Time *4            |                                                                                                   | -    | 3    | -    |      |
| t <sub>d(OFF)</sub>                | Turn-Off Delay Time *4          |                                                                                                   | -    | 30   | -    |      |
| t <sub>f</sub>                     | Turn-Off Fall Time *4           |                                                                                                   | -    | 12   | -    |      |
| Q <sub>G</sub>                     | Total Gate-Charge               | V <sub>DD</sub> = -20V<br>V <sub>GS</sub> = -4.5V<br>I <sub>D</sub> = -3A                         | -    | 10.5 | -    | nC   |
| Q <sub>GS</sub>                    | Gate to Source Charge           |                                                                                                   | -    | 2.1  | -    |      |
| Q <sub>GD</sub>                    | Gate to Drain (Miller) Charge   |                                                                                                   | -    | 2.8  | -    |      |
| Source-Drain Diode Characteristics |                                 |                                                                                                   |      |      |      |      |
| V <sub>SD</sub>                    | Diode Forward Voltage *2        | I <sub>D</sub> = -1A, V <sub>GS</sub> = 0V                                                        | -    | -0.8 | -1   | V    |
| t <sub>rr</sub>                    | Reverse Recovery Time           | I <sub>SD</sub> = -3A, V <sub>GS</sub> = 0V                                                       | -    | 92   | -    | ns   |
| Q <sub>rr</sub>                    | Reverse Recovery Charge         | di/dt = 100A/μs                                                                                   | -    | 68   | -    | nC   |

Notes:

- The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper
- The data tested by pulsed, pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$
- The  $E_{AS}$  data shows Max. rating. The test condition is  $V_{DD} = -15\text{V}, V_{GS} = -10\text{V}, L = 0.1\text{mH}$
- Guaranteed by design, not subject to production

Ratings and Characteristics Curves (@  $T_A = 25^\circ\text{C}$  unless otherwise specified)

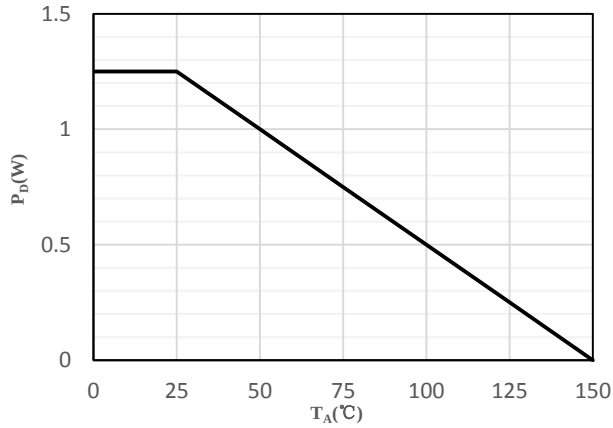


Fig 1 Power Dissipation

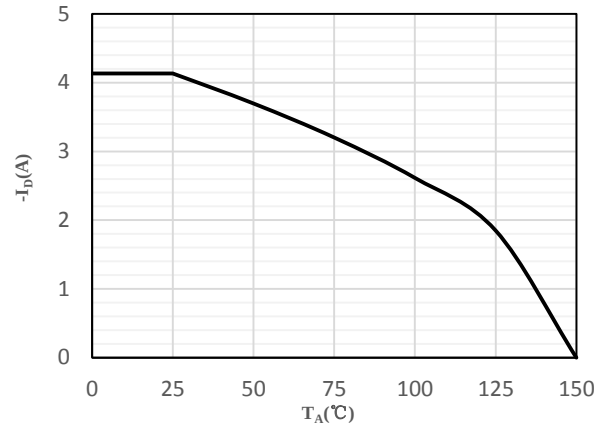


Fig 2 Drain Current

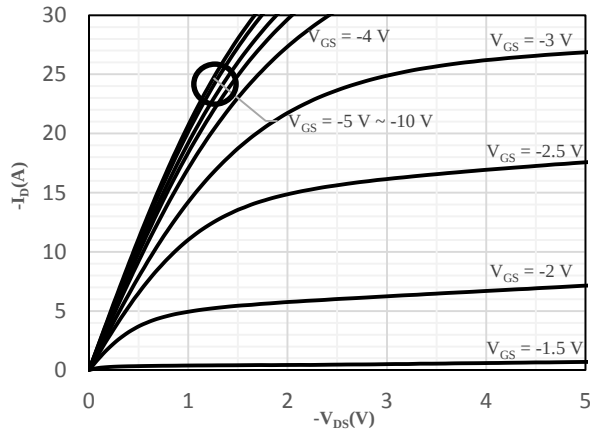


Fig 3 Typical Output Characteristics

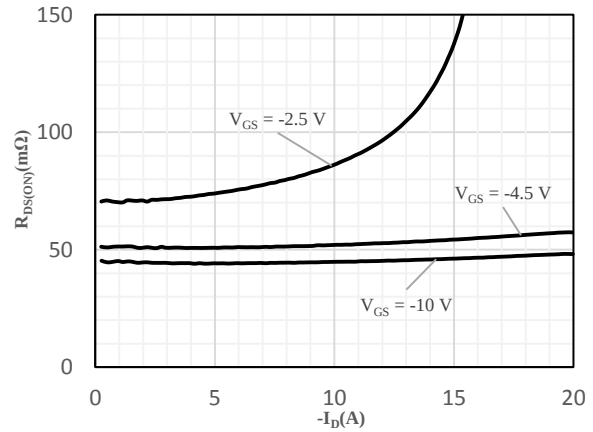


Fig 4 On-Resistance vs. Drain Current  
and Gate Voltage

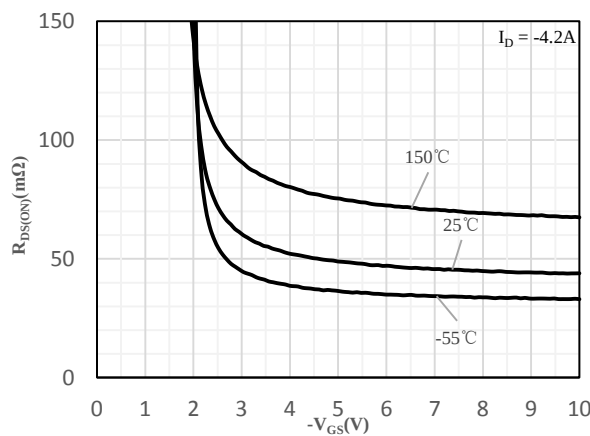


Fig 5 On-Resistance vs. Gate-Source Voltage

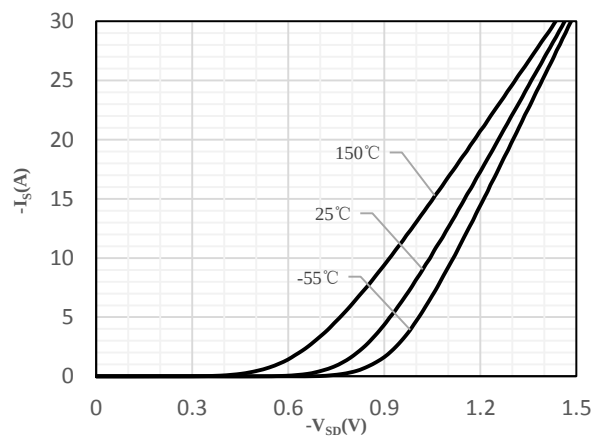


Fig 6 Body-Diode Characteristics

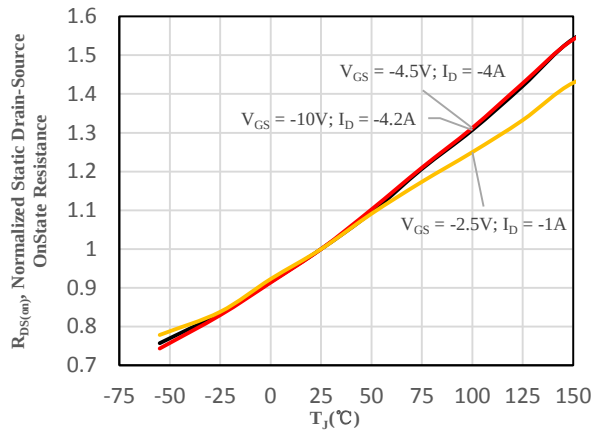


Fig 7 Normalized On-Resistance vs. Junction Temperature

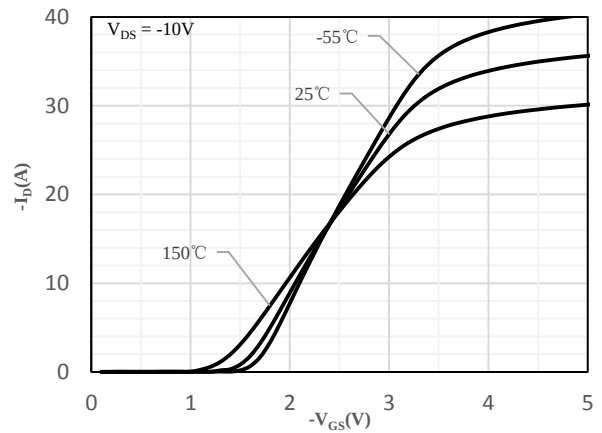


Fig 8 Transfer Characteristics

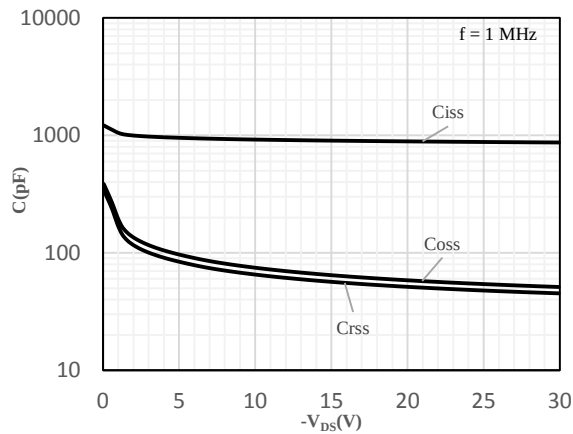


Fig 9 Capacitance Characteristics

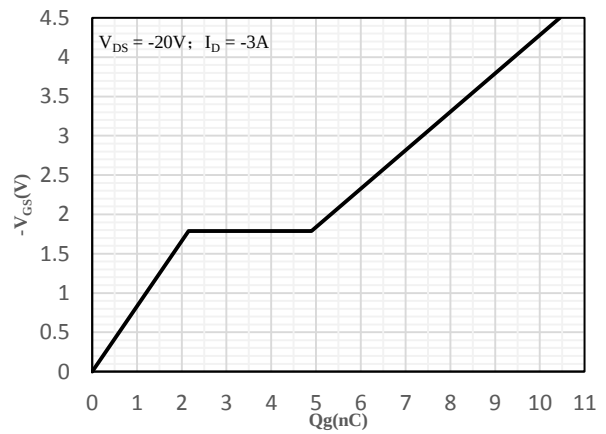


Fig 10 Gate-Charge Characteristics

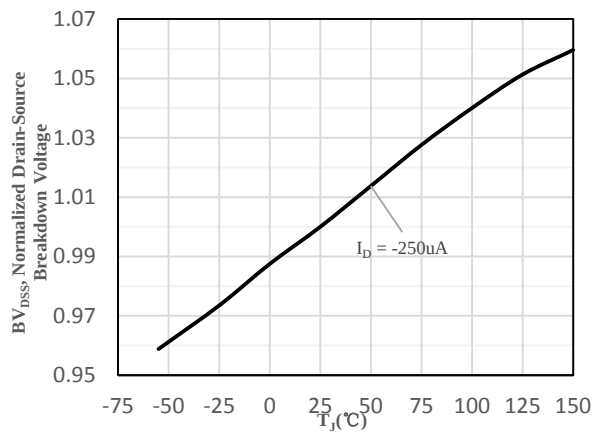


Fig 11 Normalized Breakdown Voltage vs. Junction Temperature

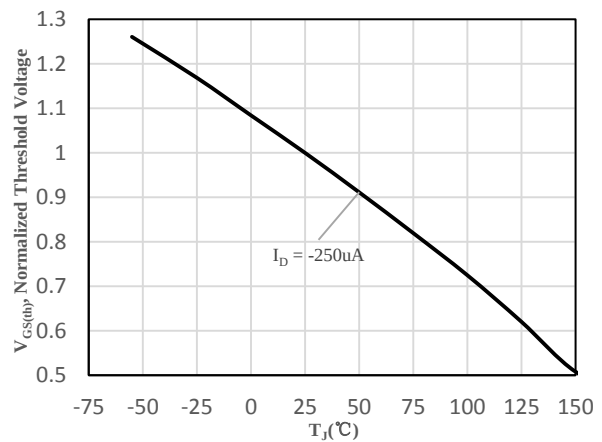


Fig 12 Normalized  $V_{GS(th)}$  vs. Junction Temperature

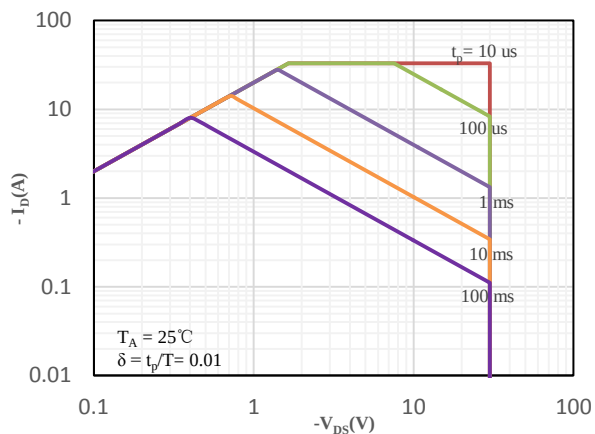


Fig 13 Safe Operation Area

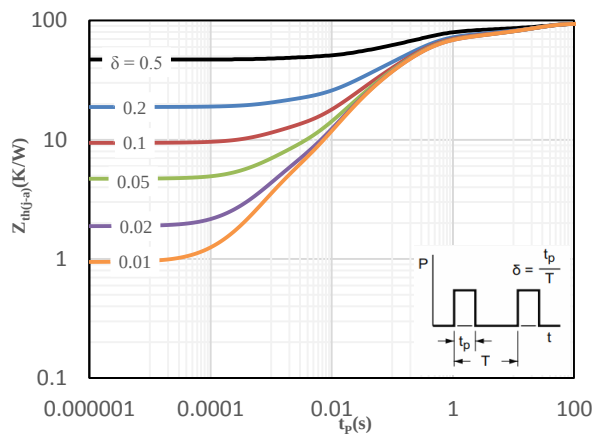
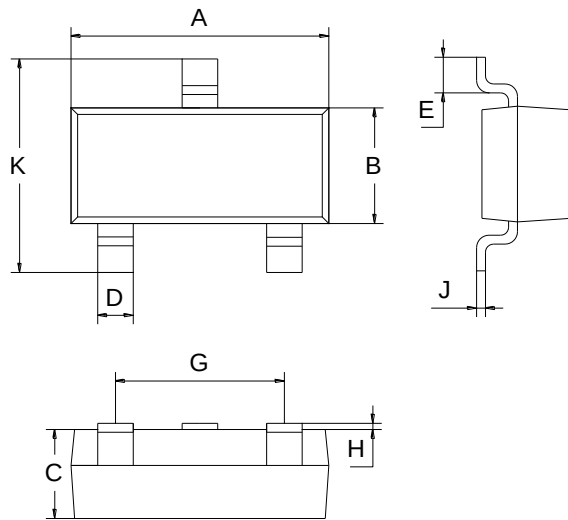
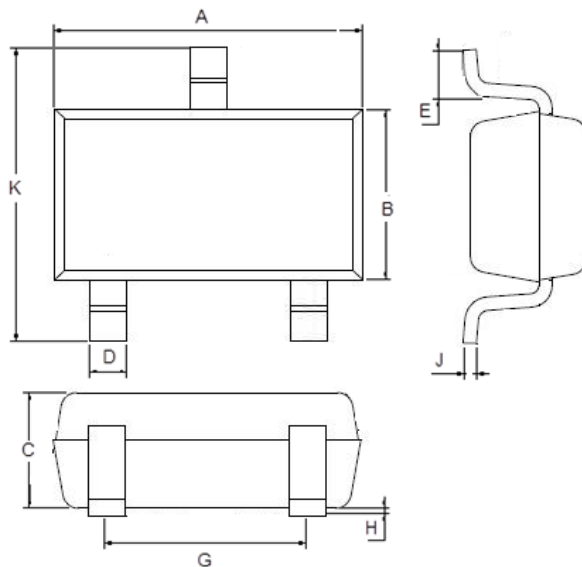


Fig 14 Maximum transient thermal impedance

**Package Outline Dimensions** (Unit: mm)



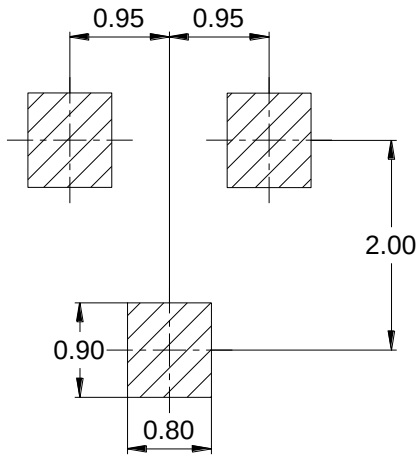
| SOT-23    |      |      |
|-----------|------|------|
| Dimension | Min. | Max. |
| A         | 2.70 | 3.10 |
| B         | 1.10 | 1.50 |
| C         | 0.90 | 1.10 |
| D         | 0.30 | 0.50 |
| E         | 0.35 | 0.48 |
| G         | 1.80 | 2.00 |
| H         | 0.02 | 0.10 |
| J         | 0.05 | 0.15 |
| K         | 2.20 | 2.60 |



| SOT-23-3L |      |      |
|-----------|------|------|
| Dimension | Min. | Max. |
| A         | 2.80 | 3.00 |
| B         | 1.50 | 1.70 |
| C         | 1.00 | 1.20 |
| D         | 0.35 | 0.45 |
| E         | 0.35 | 0.55 |
| G         | 1.80 | 2.00 |
| H         | 0.02 | 0.10 |
| J         | 0.10 | 0.20 |
| K         | 2.60 | 3.00 |

**Mounting Pad Layout** (Unit: mm)

**SOT-23**



**SOT-23-3L**

