Features

- High Input Impedance
- Low Input Capacitance
- Fast Switching Speeds
- Low On-Resistance
- Free from Secondary Breakdown
- Low Input and Output Leakage

Applications

- Normally-On Switches
- Solid-State Relays
- Converters
- Constant-Current Sources
- Power Supply Circuits
- Telecommunication Switches

General Description

The DN3525 is a low-threshold Depletion-mode (normally-on) transistor that uses an advanced vertical DMOS structure and a well-proven silicon gate manufacturing process. This combination produces a device with the power handling capabilities of bipolar transistors and the high input impedance and positive temperature coefficient inherent in MOS devices. Characteristic of all MOS structures, this device is free from thermal runaway and thermally induced secondary breakdown.

Microchip’s vertical DMOS FETs are ideally suited to a wide range of switching and amplifying applications where high breakdown voltage, high input impedance, low input capacitance and fast switching speeds are desired.

Package Type

See Table 3-1 for pin information.
1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym.</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-to-Source Breakdown Voltage</td>
<td>BVDSX</td>
<td>250</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>VGS = –5V, ID = 100 µA</td>
</tr>
<tr>
<td>Gate-to-Source Off Voltage</td>
<td>VGS(OFF)</td>
<td>–1.5</td>
<td>—</td>
<td>–3.5</td>
<td>V</td>
<td>VDS = 15V, ID = 1 mA</td>
</tr>
<tr>
<td>Change in VGS(OFF) with Temperature</td>
<td>ΔVGS(OFF)</td>
<td>—</td>
<td>—</td>
<td>–4.5</td>
<td>mV/°C</td>
<td>VDS = 15V, ID = 1 mA (Note 1)</td>
</tr>
<tr>
<td>Gate Body Leakage Current</td>
<td>IGSS</td>
<td>—</td>
<td>—</td>
<td>100 nA</td>
<td>nA</td>
<td>VGS = ±20 V, VDS = 0V</td>
</tr>
<tr>
<td>Drain-to-Source Leakage Current</td>
<td>ID(OFF)</td>
<td>—</td>
<td>—</td>
<td>1 µA</td>
<td>µA</td>
<td>VDS = Maximum rating, VGS = –5V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
<td></td>
<td>VDS = 0.8 Maximum rating, VGS = –5V, TA = 125°C (Note 1)</td>
</tr>
<tr>
<td>Saturated Drain-to-Source Current</td>
<td>IDSS</td>
<td>300</td>
<td>—</td>
<td>—</td>
<td>mA</td>
<td>VGS = 0V, VDS = 15V</td>
</tr>
<tr>
<td>Static Drain-to-Source On-State Resistance</td>
<td>RDS(ON)</td>
<td>—</td>
<td>—</td>
<td>6</td>
<td>Ω</td>
<td>VGS = 0V, ID = 200 mA</td>
</tr>
<tr>
<td>Change in RDS(ON) with Temperature</td>
<td>ΔRDS(ON)</td>
<td>—</td>
<td>—</td>
<td>1.1</td>
<td>%/°C</td>
<td>VGS = 0V, ID = 200 mA (Note 1)</td>
</tr>
</tbody>
</table>

† Notice: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: TA = 25°C unless otherwise specified. All DC parameters are 100% tested at 25°C unless otherwise stated. Pulse test: 300 µs pulse, 2% duty cycle

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym.</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-to-Source Breakdown Voltage</td>
<td>BVDSX</td>
<td>250</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>VGS = –5V, ID = 100 µA</td>
</tr>
<tr>
<td>Gate-to-Source Off Voltage</td>
<td>VGS(OFF)</td>
<td>–1.5</td>
<td>—</td>
<td>–3.5</td>
<td>V</td>
<td>VDS = 15V, ID = 1 mA</td>
</tr>
<tr>
<td>Change in VGS(OFF) with Temperature</td>
<td>ΔVGS(OFF)</td>
<td>—</td>
<td>—</td>
<td>–4.5</td>
<td>mV/°C</td>
<td>VDS = 15V, ID = 1 mA (Note 1)</td>
</tr>
<tr>
<td>Gate Body Leakage Current</td>
<td>IGSS</td>
<td>—</td>
<td>—</td>
<td>100 nA</td>
<td>nA</td>
<td>VGS = ±20 V, VDS = 0V</td>
</tr>
<tr>
<td>Drain-to-Source Leakage Current</td>
<td>ID(OFF)</td>
<td>—</td>
<td>—</td>
<td>1 µA</td>
<td>µA</td>
<td>VDS = Maximum rating, VGS = –5V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
<td></td>
<td>VDS = 0.8 Maximum rating, VGS = –5V, TA = 125°C (Note 1)</td>
</tr>
<tr>
<td>Saturated Drain-to-Source Current</td>
<td>IDSS</td>
<td>300</td>
<td>—</td>
<td>—</td>
<td>mA</td>
<td>VGS = 0V, VDS = 15V</td>
</tr>
<tr>
<td>Static Drain-to-Source On-State Resistance</td>
<td>RDS(ON)</td>
<td>—</td>
<td>—</td>
<td>6</td>
<td>Ω</td>
<td>VGS = 0V, ID = 200 mA</td>
</tr>
<tr>
<td>Change in RDS(ON) with Temperature</td>
<td>ΔRDS(ON)</td>
<td>—</td>
<td>—</td>
<td>1.1</td>
<td>%/°C</td>
<td>VGS = 0V, ID = 200 mA (Note 1)</td>
</tr>
</tbody>
</table>

Note 1: Specification is obtained by characterization and is not 100% tested.
**AC ELECTRICAL CHARACTERISTICS**

**Electrical Specifications:** $T_A = 25°C$ unless otherwise specified. Specification is obtained by characterization and is not 100% tested.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym.</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Transconductance</td>
<td>$G_{FS}$</td>
<td>225</td>
<td>—</td>
<td>—</td>
<td>mmho</td>
<td>$V_{DS} = 10V, I_D = 150 mA$</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>$C_{ISS}$</td>
<td>—</td>
<td>270</td>
<td>350</td>
<td>pF</td>
<td>$V_{GS} = -5V, V_{DS} = 25V, f = 1 MHz$</td>
</tr>
<tr>
<td>Common Source Output Capacitance</td>
<td>$C_{OSS}$</td>
<td>—</td>
<td>20</td>
<td>60</td>
<td>pF</td>
<td>$V_{DD} = 25V, I_D = 150 mA, R_{GEN} = 25Ω$</td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>$C_{RSS}$</td>
<td>—</td>
<td>5</td>
<td>20</td>
<td>pF</td>
<td>$V_{GS} = 0V to -10V$</td>
</tr>
<tr>
<td>Turn-On Delay Time</td>
<td>$t_{d(ON)}$</td>
<td>—</td>
<td>—</td>
<td>20</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_r$</td>
<td>—</td>
<td>—</td>
<td>25</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Turn-Off Delay Time</td>
<td>$t_{d(OFF)}$</td>
<td>—</td>
<td>—</td>
<td>25</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Fall Time</td>
<td>$t_f$</td>
<td>—</td>
<td>—</td>
<td>40</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

**DIODE PARAMETER**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym.</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode Forward Voltage Drop</td>
<td>$V_{SD}$</td>
<td>—</td>
<td>—</td>
<td>1.8</td>
<td>V</td>
<td>$V_{GS} = -5V, I_{SD} = 150 mA$ (Note 1)</td>
</tr>
<tr>
<td>Reverse Recovery Time</td>
<td>$t_{rr}$</td>
<td>—</td>
<td>800</td>
<td>—</td>
<td>ns</td>
<td>$V_{GS} = -5V, I_{SD} = 150 mA$ (Note 1)</td>
</tr>
</tbody>
</table>

**Note 1:** Unless otherwise stated, all DC parameters are 100% tested at 25°C. Pulse test: 300 µs pulse, 2% duty cycle.

**TEMPERATURE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym.</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE RANGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Ambient Temperature</td>
<td>$T_A$</td>
<td>−55</td>
<td>—</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$T_S$</td>
<td>−55</td>
<td>—</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

**PACKAGE THERMAL RESISTANCE**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym.</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-lead SOT-89</td>
<td></td>
<td>—</td>
<td>133</td>
<td>—</td>
<td>°C/W</td>
<td></td>
</tr>
</tbody>
</table>

**THERMAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th></th>
<th>$I_D$ (Note 1)</th>
<th></th>
<th>$I_D$ (Pulsed)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td></td>
<td>(Continuous)</td>
<td>(mA)</td>
<td>(Pulsed)</td>
<td>(A)</td>
<td></td>
</tr>
<tr>
<td>3-lead SOT-89</td>
<td></td>
<td>360</td>
<td>1</td>
<td>1.6</td>
<td>360</td>
<td>1</td>
</tr>
</tbody>
</table>

**Note 1:** $I_D$ (continuous) is limited by maximum $T_J$.

**Note 2:** Mounted on an FR4 board, 25 mm x 25 mm x 1.57 mm
2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g. outside specified power supply range) and therefore outside the warranted range.

FIGURE 2-1: Output Characteristics.

FIGURE 2-2: Transconductance vs. Drain Current.

FIGURE 2-3: Maximum Rated Safe Operating Area.

FIGURE 2-4: Saturation Characteristics.

FIGURE 2-5: Power Dissipation vs. Ambient Temperature.

FIGURE 2-6: Thermal Response Characteristics.
FIGURE 2-7: \( \text{BV}_{DSV} \) Variation with Temperature.

FIGURE 2-8: Transfer Characteristics.

FIGURE 2-9: Capacitance vs. Drain-to-Source Voltage.

FIGURE 2-10: On-Resistance vs. Drain Current.

FIGURE 2-11: \( V_{GS(OFF)} \) and \( R_{DS(ON)} \) with Temperature.

FIGURE 2-12: Gate Drive Dynamic Characteristics.
3.0 PIN DESCRIPTION

Table 3-1 shows the description of pins in DN3525. Refer to Package Type for the location of pins.

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gate</td>
<td>Gate</td>
</tr>
<tr>
<td>2, 4</td>
<td>Drain</td>
<td>Drain</td>
</tr>
<tr>
<td>3</td>
<td>Source</td>
<td>Source</td>
</tr>
</tbody>
</table>
4.0 FUNCTIONAL DESCRIPTION

Figure 4-1 illustrates the switching waveforms and test circuit for DN3525.

**TABLE 4-1: PRODUCT SUMMARY**

<table>
<thead>
<tr>
<th>BVDSX/BVDGX (mA)</th>
<th>RDS(ON) (Maximum) (Ω)</th>
<th>IDSS (Minimum) (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>6</td>
<td>300</td>
</tr>
</tbody>
</table>
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

Legend:
- XX...X Product Code or Customer-specific information
- Y Year code (last digit of calendar year)
- YY Year code (last 2 digits of calendar year)
- WW Week code (week of January 1 is week '01')
- NNN Alphanumeric traceability code
- * This package is Pb-free. The Pb-free JEDEC designator (メディカル®) can be found on the outer packaging for this package.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for product code or customer-specific information. Package may or not include the corporate logo.
3-Lead TO-243AA (SOT-89) Package Outline (N8)

Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>A</th>
<th>b</th>
<th>b1</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>E1</th>
<th>e</th>
<th>e1</th>
<th>H</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN</td>
<td>1.40</td>
<td>0.44</td>
<td>0.36</td>
<td>0.35</td>
<td>4.40</td>
<td>1.62</td>
<td>2.29</td>
<td>2.00*</td>
<td>1.50</td>
<td>3.00</td>
<td>0.73*</td>
</tr>
<tr>
<td>NOM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MAX</td>
<td>1.60</td>
<td>0.56</td>
<td>0.48</td>
<td>0.44</td>
<td>4.60</td>
<td>1.83</td>
<td>2.60</td>
<td>2.29</td>
<td>4.25</td>
<td>1.20</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

† This dimension differs from the JEDEC drawing

Drawings not to scale.
APPENDIX A: REVISION HISTORY

Revision A (May 2018)

• Converted Supertex Doc# DSFP-DN3525 to Microchip DS20005705A
• Added a pin function table
• Changed the package marking format
• Made minor text changes throughout the document
# PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>XX</th>
<th>Package Options</th>
<th>Environmental</th>
<th>Media Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>DN3525</td>
<td>N-Channel Depletion-Mode Vertical DMOS FET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>N8</td>
<td>3-lead SOT-89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td>G</td>
<td>Lead (Pb)-free/RoHS-compliant Package</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media Type</td>
<td>(blank)</td>
<td>2000/Reel for an N8 Package</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example:**

a) DN3525N8-G: N-Channel Depletion-Mode Vertical DMOS FET, 3-lead SOT-89, 2000/Reel
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**Corporate Office**  
2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200  
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Tel: 408-436-4270

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Fax: 905-695-2078

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**China - Dongguan**  
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**China - Guangzhou**  
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**China - Hangzhou**  
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**China - Hong Kong SAR**  
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**China - Nanjing**  
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**China - Qingdao**  
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**China - Shanghai**  
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**China - Shenyang**  
Tel: 86-24-2334-2829

**China - Shenzhen**  
Tel: 86-755-8664-2200

**China - Suzhou**  
Tel: 86-186-6233-1526

**China - Wuhan**  
Tel: 86-27-5980-5300

**China - Xian**  
Tel: 86-29-8833-7252

**China - Xi’an**  
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