



## N-Channel Depletion-Mode Vertical DMOS FETs

### 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
- ▶ Linear amplifiers
- ▶ Constant current sources
- ▶ Power supply circuits
- ▶ Telecom

### General Description

The Supertex DN2540 is a low threshold depletion mode (normally-on) transistor utilizing an advanced vertical DMOS structure and Supertex's well-proven silicon-gate manufacturing process. This combination produces a device with the power handling capabilities of bipolar transistors and with 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.

Supertex'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.

### Ordering Information

| Device | Package Options |            |                         | $BV_{DSX}/BV_{DGX}$<br>(V) | $R_{DS(ON)}$<br>max<br>( $\Omega$ ) | $I_{DSS}$<br>min<br>(mA) |
|--------|-----------------|------------|-------------------------|----------------------------|-------------------------------------|--------------------------|
|        | TO-92           | TO-220     | TO-243AA <sup>(1)</sup> |                            |                                     |                          |
| DN2540 | DN2540N3-G      | DN2540N5-G | DN2540N8-G              | 400                        | 25                                  | 150                      |

-G indicates package is RoHS compliant ("Green")

(1) Same as SOT-89.



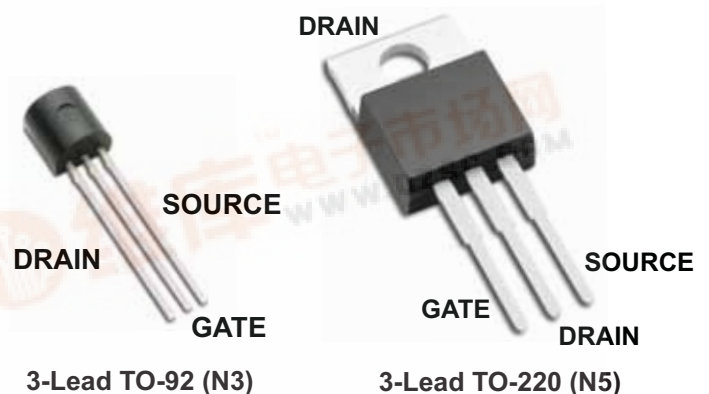
### Absolute Maximum Ratings

| Parameter                         | Value                             |
|-----------------------------------|-----------------------------------|
| Drain-to-source voltage           | $BV_{DSX}$                        |
| Drain-to-gate voltage             | $BV_{DGX}$                        |
| Gate-to-source voltage            | $\pm 20V$                         |
| Operating and storage temperature | $-55^{\circ}C$ to $+150^{\circ}C$ |
| Soldering temperature*            | $300^{\circ}C$                    |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. Continuous operation of the device at the absolute rating level may affect device reliability. All voltages are referenced to device ground.

\*Distance of 1.6mm from case for 10 seconds.

### Pin Configurations



3-Lead TO-243AA (N8)



## Product Marking



YY = Year Sealed  
WW = Week Sealed  
\_\_\_\_\_ = "Green" Packaging

3-Lead TO-92 (N3)



L = Lot Number  
YY = Year Sealed  
WW = Week Sealed  
\_\_\_\_\_ = "Green" Packaging

3-Lead TO-220 (N5)



W = Code for week sealed

3-Lead TO-243AA (N8)

## Thermal Characteristics

| Package  | $I_D$<br>(continuous) <sup>(1)</sup><br>(mA) | $I_D$<br>(pulsed)<br>(mA) | Power Dissipation<br>@ $T_c = 25^\circ\text{C}$<br>(W) | $\theta_{jc}$<br>( $^\circ\text{C/W}$ ) | $\theta_{ja}$<br>( $^\circ\text{C/W}$ ) | $I_{DR}^{(1)}$<br>(mA) | $I_{DRM}$<br>(mA) |
|----------|----------------------------------------------|---------------------------|--------------------------------------------------------|-----------------------------------------|-----------------------------------------|------------------------|-------------------|
| TO-92    | 120                                          | 500                       | 1.0                                                    | 125                                     | 170                                     | 120                    | 500               |
| TO-220   | 500                                          | 500                       | 15                                                     | 8.3                                     | 70                                      | 500                    | 500               |
| TO-243AA | 170                                          | 500                       | 1.6 <sup>(2)</sup>                                     | 15                                      | 78 <sup>(2)</sup>                       | 170                    | 500               |

### Notes:

- (1)  $I_D$  (continuous) is limited by max rated  $T_j$   
(2) Mounted on FR5 board, 25mm x 25mm x 1.57mm.

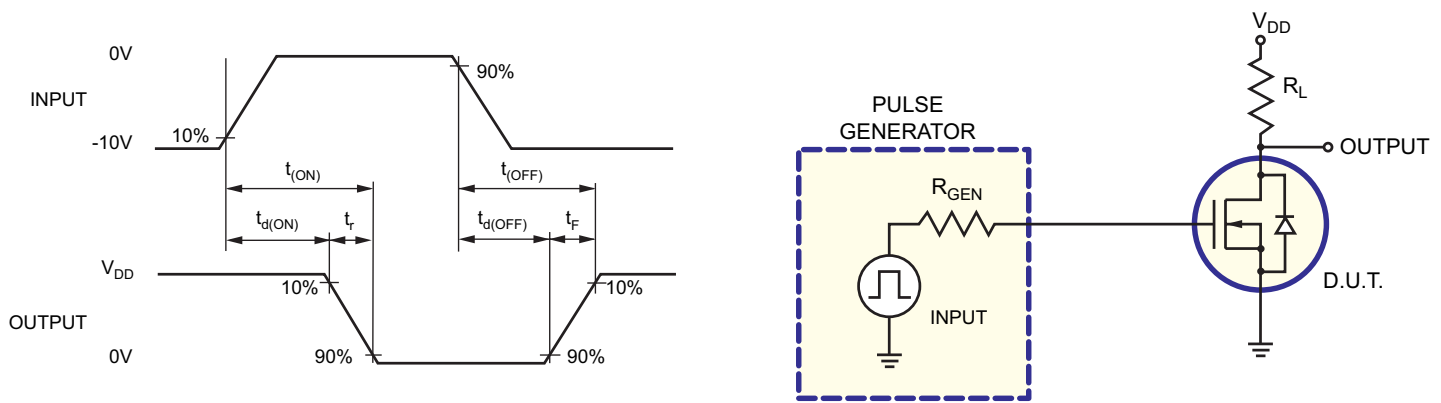
## Electrical Characteristics ( $T_A$ @ $25^\circ\text{C}$ unless otherwise specified)

| Sym                  | Parameter                                  | Min  | Typ | Max  | Units                | Conditions                                                                                |
|----------------------|--------------------------------------------|------|-----|------|----------------------|-------------------------------------------------------------------------------------------|
| $BV_{DSX}$           | Drain-to-source breakdown voltage          | 400  | -   | -    | V                    | $V_{GS} = -5.0\text{V}$ , $I_D = 100\mu\text{A}$                                          |
| $V_{GS(OFF)}$        | Gate-to-source OFF voltage                 | -1.5 | -   | -3.5 | V                    | $V_{DS} = 25\text{V}$ , $I_D = 10\mu\text{A}$                                             |
| $\Delta V_{GS(OFF)}$ | Change in $V_{GS(OFF)}$ with temperature   | -    | -   | 4.5  | mV/ $^\circ\text{C}$ | $V_{DS} = 25\text{V}$ , $I_D = 10\mu\text{A}$                                             |
| $I_{GSS}$            | Gate body leakage current                  | -    | -   | 100  | nA                   | $V_{GS} = \pm 20\text{V}$ , $V_{DS} = 0\text{V}$                                          |
| $I_{D(OFF)}$         | Drain-to-source leakage current            | -    | -   | 10   | $\mu\text{A}$        | $V_{DS} = \text{Max rating}$ , $V_{GS} = -10\text{V}$                                     |
|                      |                                            | -    | -   | 1.0  | mA                   | $V_{DS} = 0.8 \text{ Max Rating}$ ,<br>$V_{GS} = -10\text{V}$ , $T_A = 125^\circ\text{C}$ |
| $I_{DSS}$            | Saturated drain-to-source current          | 150  | -   | -    | mA                   | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$                                              |
| $R_{DS(ON)}$         | Static drain-to-source ON-state resistance | -    | 17  | 25   | $\Omega$             | $V_{GS} = 0\text{V}$ , $I_D = 120\text{mA}$                                               |
| $\Delta R_{DS(ON)}$  | Change in $R_{DS(ON)}$ with temperature    | -    | -   | 1.1  | %/ $^\circ\text{C}$  | $V_{GS} = 0\text{V}$ , $I_D = 120\text{mA}$                                               |
| $G_{FS}$             | Forward transconductance                   | -    | 325 | -    | mmho                 | $V_{DS} = 10\text{V}$ , $I_D = 100\text{mA}$                                              |
| $C_{ISS}$            | Input capacitance                          | -    | 200 | 300  | pF                   | $V_{GS} = -10\text{V}$ ,<br>$V_{DS} = 25\text{V}$ ,<br>$f = 1\text{MHz}$                  |
| $C_{OSS}$            | Common source output capacitance           | -    | 12  | 30   |                      |                                                                                           |
| $C_{RSS}$            | Reverse transfer capacitance               | -    | 1   | 5    |                      |                                                                                           |

| Sym          | Parameter                  | Min | Typ | Max | Units | Conditions                                                 |
|--------------|----------------------------|-----|-----|-----|-------|------------------------------------------------------------|
| $t_{d(ON)}$  | Turn-ON delay time         | -   | -   | 10  | ns    | $V_{DD} = 25V,$<br>$I_D = 150mA,$<br>$R_{GEN} = 25\Omega,$ |
| $t_r$        | Rise time                  | -   | -   | 15  |       |                                                            |
| $t_{d(OFF)}$ | Turn-OFF delay time        | -   | -   | 15  |       |                                                            |
| $t_f$        | Fall time                  | -   | -   | 20  |       |                                                            |
| $V_{SD}$     | Diode forward voltage drop | -   | -   | 1.8 | V     | $V_{GS} = -10V, I_{SD} = 120mA$                            |
| $t_{rr}$     | Reverse recovery time      | -   | 800 | -   | ns    | $V_{GS} = -10V, I_{SD} = 1.0A$                             |

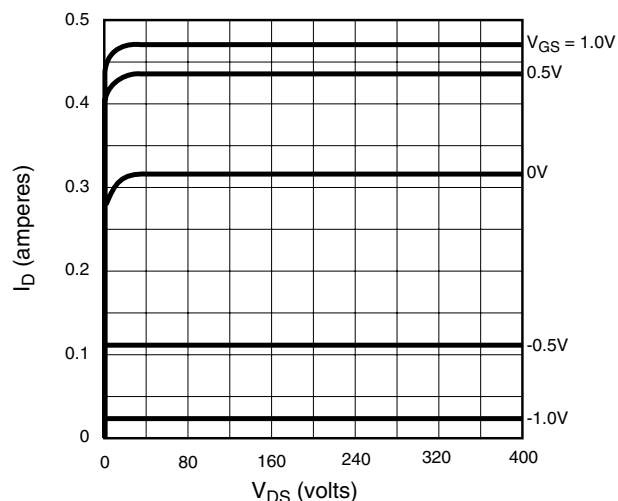
**Notes:**  
1.All D.C. parameters 100% tested at 25°C unless otherwise stated. (Pulse test: 300μs pulse, 2% duty cycle.)  
2.All A.C. parameters sample tested.

Switching Waveforms and Test Circuit

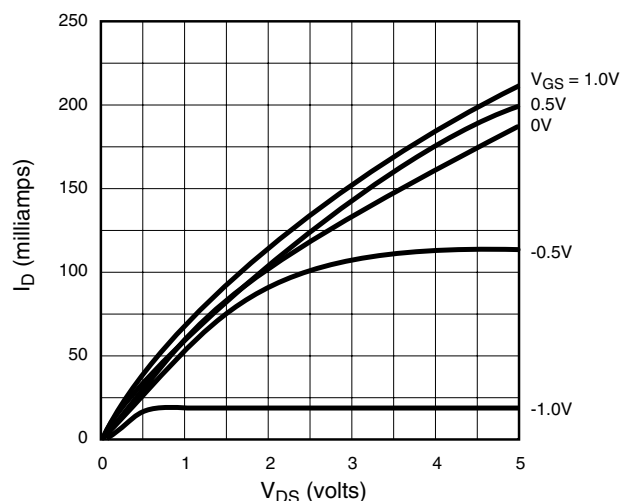


## Typical Performance Curves

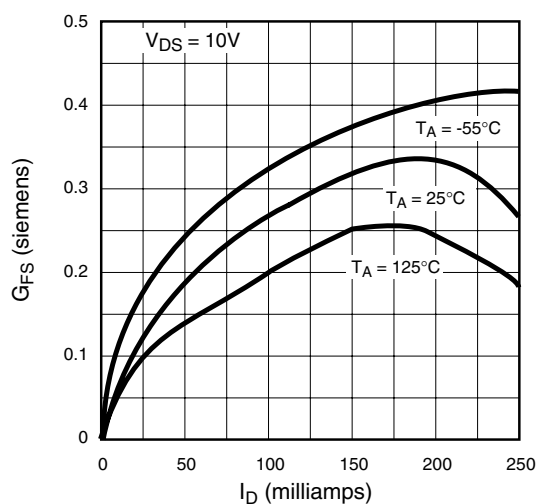
Output Characteristics



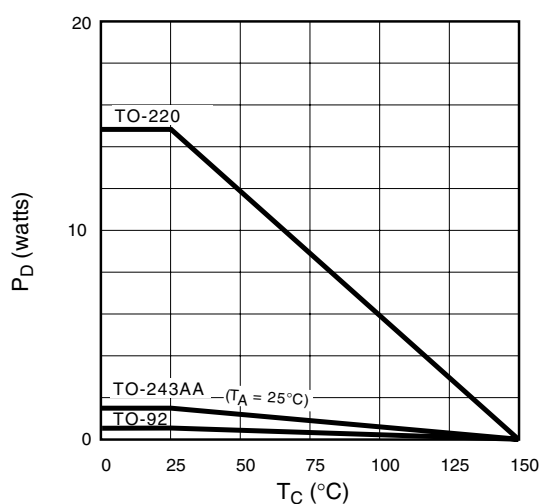
Saturation Characteristics



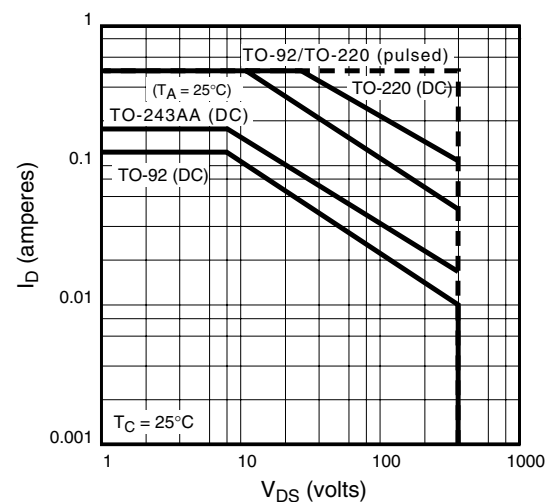
Transconductance vs. Drain Current



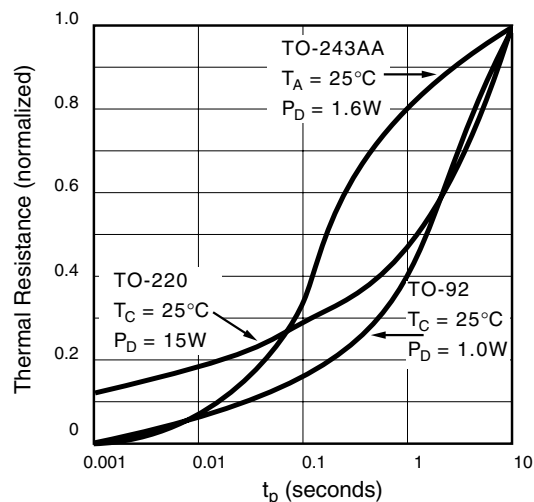
Power Dissipation vs. Ambient Temperature



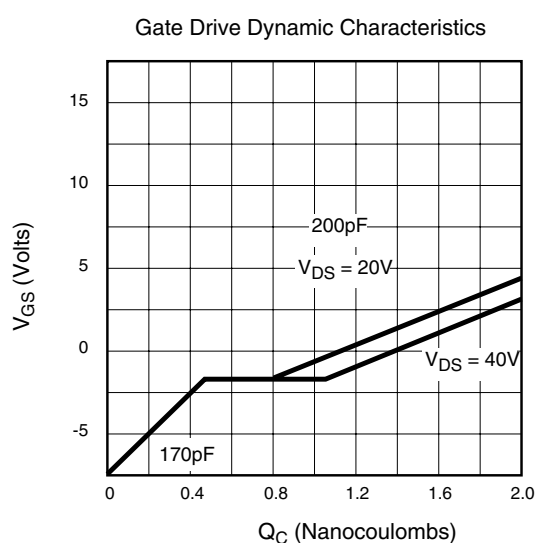
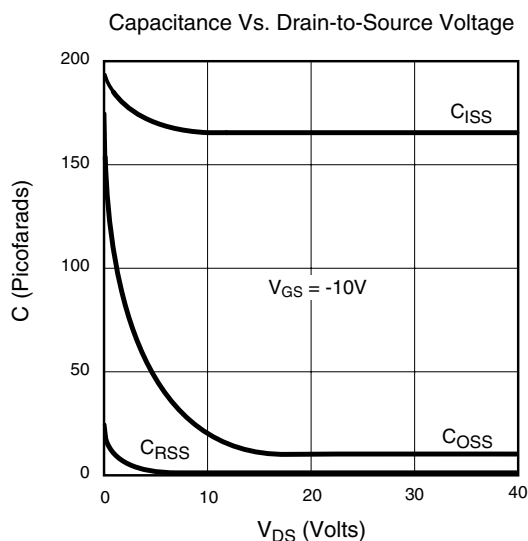
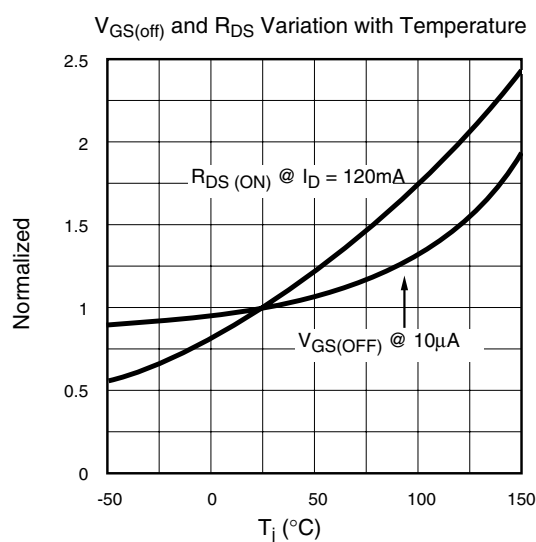
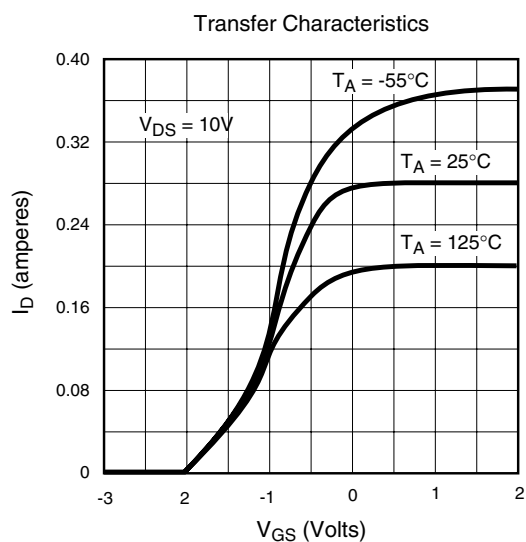
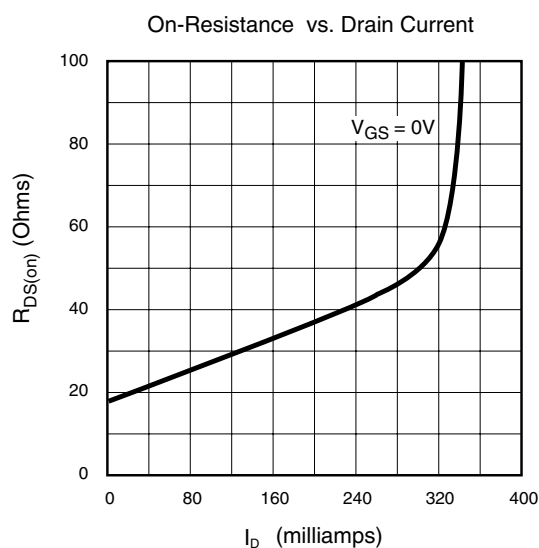
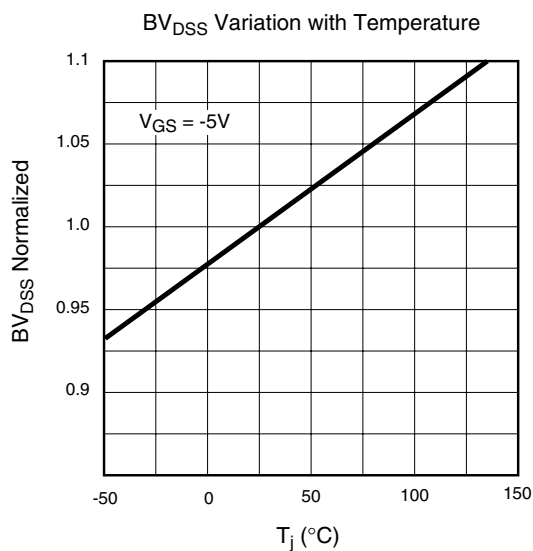
Maximum Rated Safe Operating Area



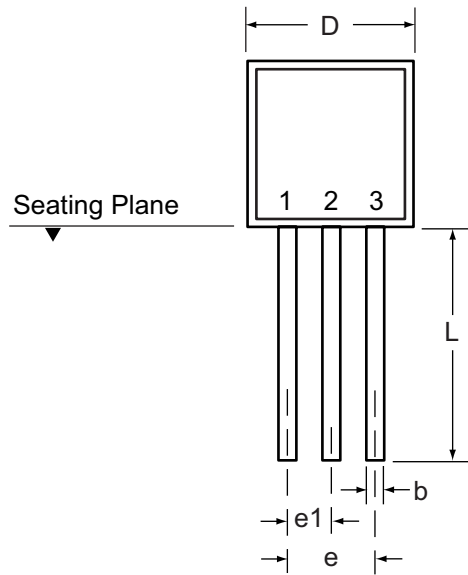
Thermal Response Characteristics



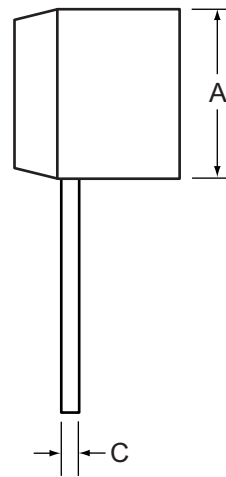
## Typical Performance Curves (cont.)



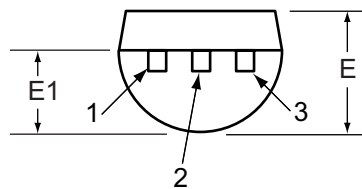
### 3-Lead TO-92 Package Outline (N3)



**Front View**



**Side View**



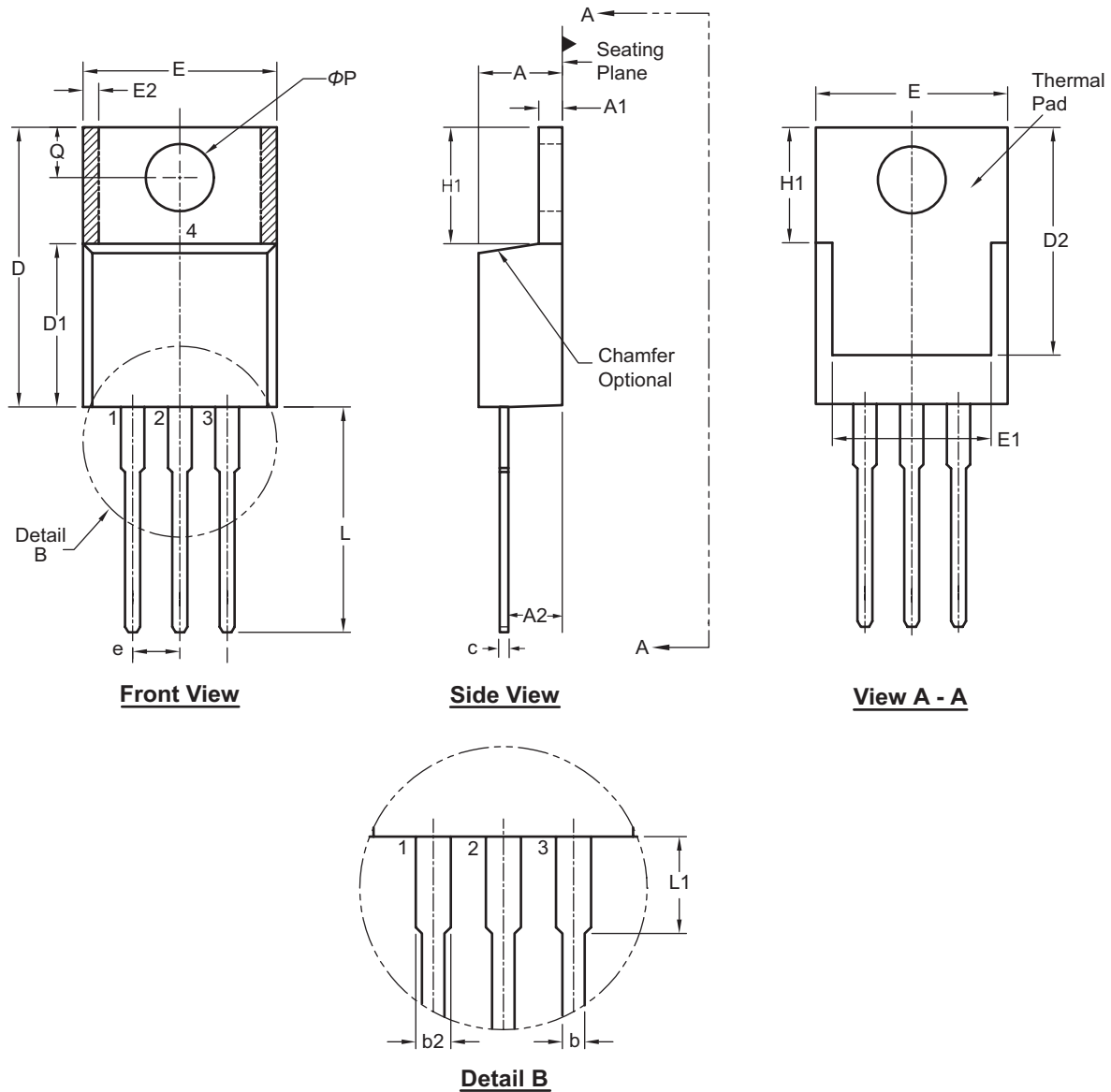
**Bottom View**

| Symbol                |     | A    | b    | C    | D    | E    | E1   | e    | e1   | L    |
|-----------------------|-----|------|------|------|------|------|------|------|------|------|
| Dimension<br>(inches) | MIN | .170 | .014 | .014 | .175 | .125 | .080 | .095 | .045 | .500 |
|                       | NOM | -    | -    | -    | -    | -    | -    | -    | -    | -    |
|                       | MAX | .210 | .022 | .022 | .205 | .165 | .105 | .105 | .055 | -    |

*Drawings not to scale.*

DN2540

## 3-Lead TO-220 (Power Package) Package Outline (N5)

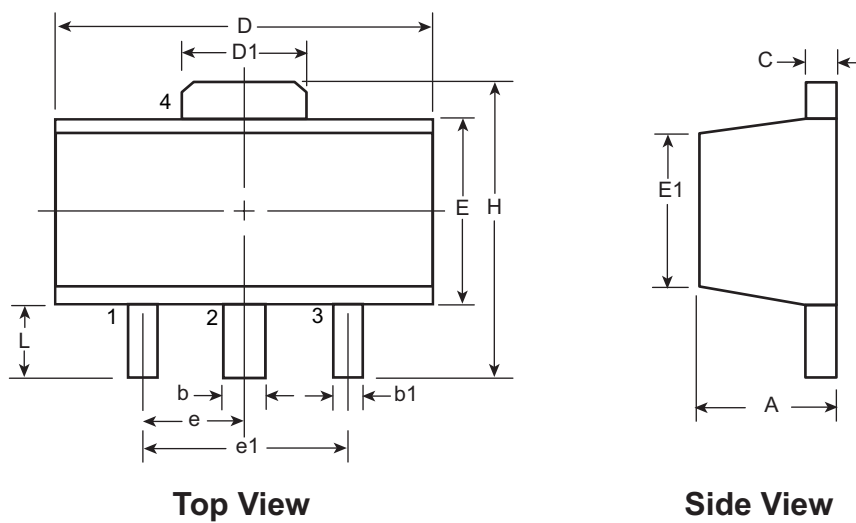


| Symbol             | A   | A1   | A2   | b    | b2   | c    | D    | D1   | D2   | E    | E1   | E2   | e        | H1   | L    | L1   | Q    | ΦP   |
|--------------------|-----|------|------|------|------|------|------|------|------|------|------|------|----------|------|------|------|------|------|
| Dimension (inches) | MIN | .140 | .020 | .080 | .015 | .045 | .014 | .560 | .330 | .480 | .380 | .270 | -        | .230 | .500 | -    | .100 | .139 |
|                    | NOM | -    | -    | -    | .027 | .057 | -    | -    | -    | -    | -    | -    | .100 BSC | -    | -    | -    | -    | -    |
|                    | MAX | .190 | .055 | .115 | .040 | .070 | .024 | .650 | .355 | .507 | .420 | .350 | .030     | .270 | .580 | .250 | .135 | .161 |

JEDEC Registration TO-220, Variation AB, Issue K, April 2002.

Drawings not to scale.

## 3-Lead TO-243AA (SOT-89) Package Outline (N8)



| Symbol             |     | A    | b    | b1   | C    | D    | D1   | E    | E1   | e           | e1          | H    | L    |
|--------------------|-----|------|------|------|------|------|------|------|------|-------------|-------------|------|------|
| Dimensions<br>(mm) | MIN | 1.40 | 0.44 | 0.36 | 0.35 | 4.40 | 1.62 | 2.29 | 2.13 | 1.50<br>BSC | 3.00<br>BSC | 3.94 | 0.89 |
|                    | NOM | -    | -    | -    | -    | -    | -    | -    | -    |             |             | -    | -    |
|                    | MAX | 1.60 | 0.56 | 0.48 | 0.44 | 4.60 | 1.83 | 2.60 | 2.29 |             |             | 4.25 | 1.20 |

JEDEC Registration TO-243, Variation AA, Issue C, July 1986.

**Drawings not to scale.**

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to <http://www.supertex.com/packaging.html>.)

**Supertex inc.** does not recommend the use of its products in life support applications, and will not knowingly sell its products for use in such applications, unless it receives an adequate "product liability indemnification insurance agreement". **Supertex** does not assume responsibility for use of devices described and limits its liability to the replacement of the devices determined defective due to workmanship. No responsibility is assumed for possible omissions or inaccuracies. Circuitry and specifications are subject to change without notice. For the latest product specifications, refer to the **Supertex** website: <http://www.supertex.com>.