# P-Channel Enhancement-Mode Vertical DMOS FET

## Features

- Free from secondary breakdown
- Low power drive requirement
- Ease of paralleling
- Low $C_{ISS}$ and fast switching speeds
- Excellent thermal stability
- Integral source-to-drain diode
- High input impedance and high gain

## Applications

- Motor controls
- Converters
- Amplifiers
- Switches
- Power supply circuits
- Drivers (relays, hammers, solenoids, lamps, memories, displays, bipolar transistors, etc.)

## General Description

The Supertex VP2110 is an enhancement-mode (normally-off) transistor that utilizes a 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 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 very low threshold voltage, high breakdown voltage, high input impedance, low input capacitance, and fast switching speeds are desired.

## Ordering Information

| Part Number | Package Option | Packing |
|---|---|---|
| VP2110K1-G | TO-236AB (SOT-23) | 3000/Reel |

*-G denotes a lead (Pb)-free / RoHS compliant package.*
*Contact factory for Wafer / Die availablity.*
*Devices in Wafer / Die form are lead (Pb)-free / RoHS compliant.*

## Product Summary

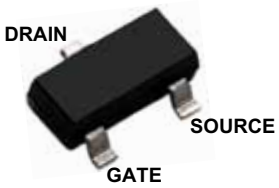
| $BV_{DSS}/BV_{DGS}$ | $R_{DS(ON)}$ (max) | $I_{D(ON}$ (min) |
|---|---|---|
| -100V | 12Ω | -500mA |

## Absolute Maximum Ratings

| Parameter | Value |
|---|---|
| Drain-to-source voltage | $BV_{DSS}$ |
| Drain-to-gate voltage | $BV_{DGS}$ |
| Gate-to-source voltage | ±20V |
| Operating and storage temperature | -55°C to +150°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.*

## Pin Configuration




**TO-236AB (SOT-23)**

## Typical Thermal Resistance

| Package | $\theta_{ja}$ |
|---|---|
| TO-236AB (SOT-23) | 203°C/W |

## Product Marking




W = Code for Week Sealed
____ = "Green" Packaging

*Package may or may not include the following marks: Si or*

**TO-236AB (SOT-23)**

## Thermal Characteristics

| Package | $I_D$ (continuous)† | $I_D$ (pulsed) | Power Dissipation @$T_A$ = 25°C | $I_{DR}$† | $I_{DRM}$ |
|---|---|---|---|---|---|
| TO-236AB (SOT-23) | -120mA | -400mA | 0.36W | -120mA | -400mA |

***Notes:***

† *$I_D$ (continuous) is limited by max rated $T_j$.*

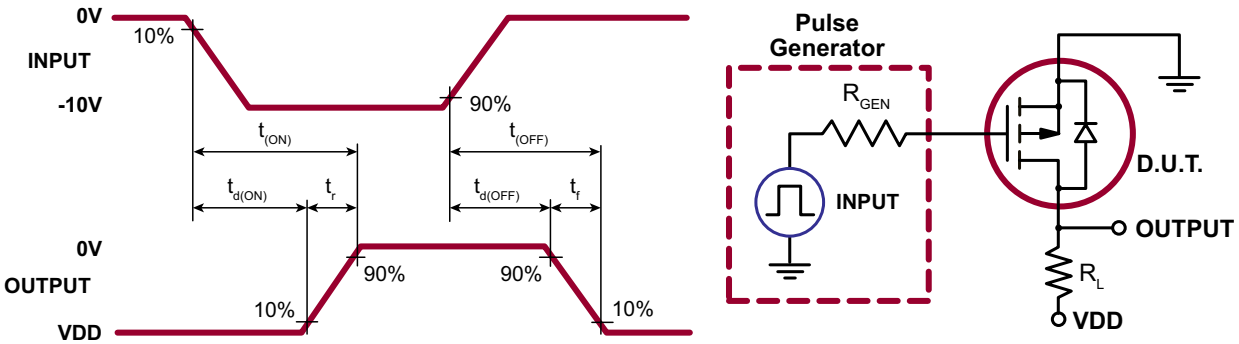
## Electrical Characteristics *($T_A$ = 25°C unless otherwise specified)*

| Sym | Parameter | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source breakdown voltage | -100 | - | - | V | $V_{GS}$ = 0V, $I_D$ = -1.0mA |
| $V_{GS(th)}$ | Gate threshold voltage | -1.5 | - | -3.5 | V | $V_{GS}$ = $V_{DS}$, $I_D$= -1.0mA |
| $\Delta V_{GS(th)}$ | Change in $V_{GS(th)}$ with temperature | - | 5.8 | 6.5 | mV/°C | $V_{GS}$ = $V_{DS}$, $I_D$= -1.0mA |
| $I_{GSS}$ | Gate body leakage | - | -1.0 | -100 | nA | $V_{GS}$ = ± 20V, $V_{DS}$ = 0V |
| $I_{DSS}$ | Zero Gate voltage Drain current | - | - | -10 | µA | $V_{GS}$ = 0V, $V_{DS}$ = Max Rating |
| | | - | - | -1.0 | mA | $V_{DS}$ = 0.8 Max Rating, $V_{GS}$ = 0V, $T_A$ = 125°C |
| $I_{D(ON)}$ | On-state Drain current | -0.5 | -1.0 | - | A | $V_{GS}$ = -10V, $V_{DS}$ = -25V |
| $R_{DS(ON)}$ | Static Drain-to-Source on-state resistance | - | 11 | 15 | Ω | $V_{GS}$ = -5.0V, $I_D$ = -100mA |
| | | - | 9.0 | 12 | | $V_{GS}$ = -10V, $I_D$ = -500mA |
| $\Delta R_{DS(ON)}$ | Change in $R_{DS(ON)}$ with temperature | - | 0.55 | 1.0 | %/°C | $V_{GS}$ = -10V, $I_D$ = -500mA |
| $G_{FS}$ | Forward transductance | 150 | 200 | - | mmho | $V_{DS}$ = -25V, $I_D$ = -500mA |
| $C_{ISS}$ | Input capacitance | - | 45 | 60 | pF | $V_{GS}$ = 0V, $V_{DS}$ = -25V, f = 1.0MHz |
| $C_{OSS}$ | Common Source output capacitance | - | 22 | 30 | | |
| $C_{RSS}$ | Reverse transfer capacitance | - | 3.0 | 8.0 | | |
| $t_{d(ON)}$ | Turn-on delay time | - | 4.0 | 5.0 | ns | $V_{DD}$ = -25V, $I_D$ = -500mA, $R_{GEN}$ = 25Ω |
| $t_r$ | Rise time | - | 5.0 | 8.0 | | |
| $t_{d(OFF)}$ | Turn-off delay time | - | 5.0 | 9.0 | | |
| $t_f$ | Fall time | - | 4.0 | 8.0 | | |
| $V_{SD}$ | Diode forward voltage drop | - | -1.2 | -2.0 | V | $V_{GS}$ = 0V, $I_{SD}$ = -500mA |
| $t_{rr}$ | Reverse recovery time | - | 400 | - | ns | $V_{GS}$ = 0V, $I_{SD}$ = -500mA |

***Notes:***

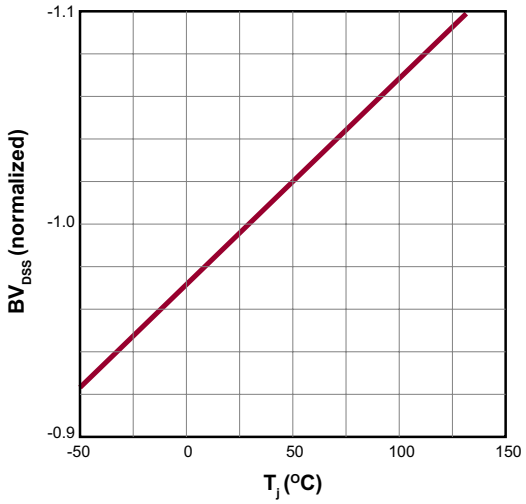
1. *All D.C. parameters 100% tested at 25°C unless otherwise stated. (Pulse test: 300µs pulse, 2% duty cycle.)*
2. *All A.C. parameters sample tested.*

## Switching Waveforms and Test Circuit

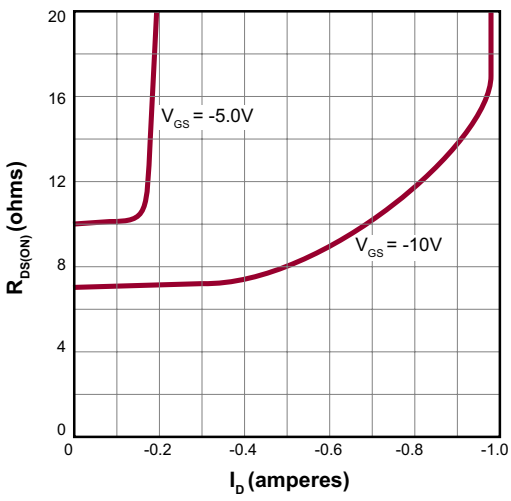


# Typical Performance Curves

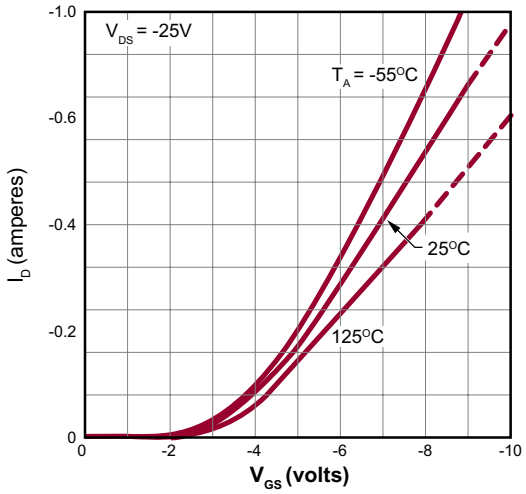
### $BV_{DSS}$ Variation with Temperature



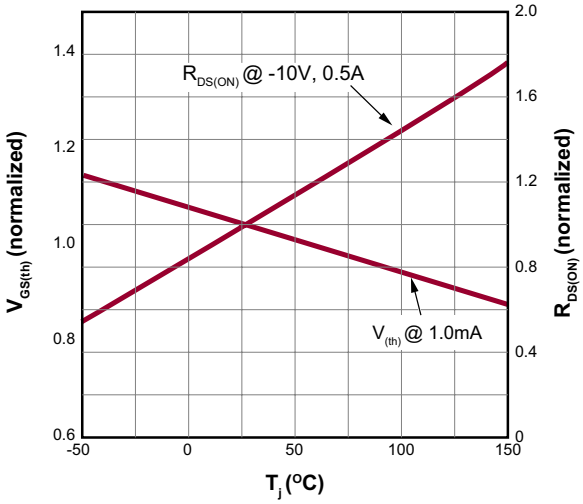

### On-Resistance vs. Drain Current



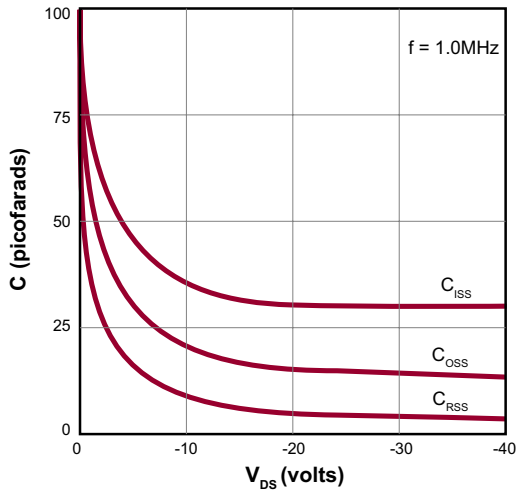

### Transfer Characteristics



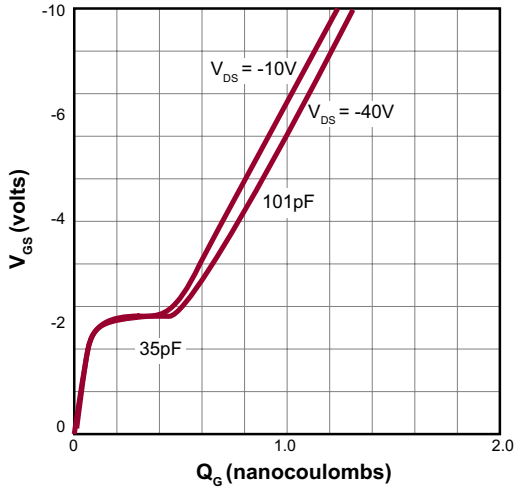

### $V_{(th)}$ and $R_{DS}$ Variation with Temperature




### Capacitance vs. Drain-to-Source Voltage

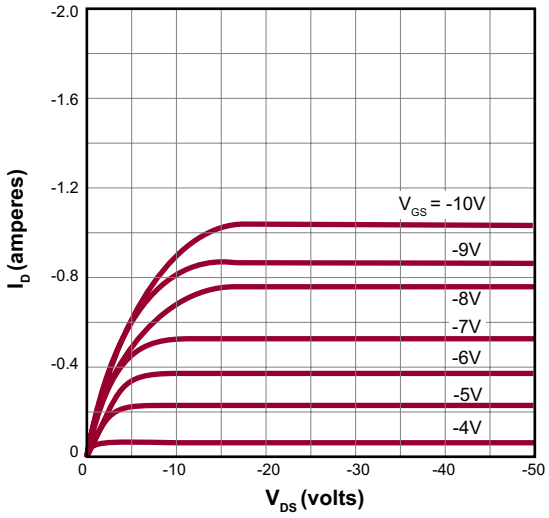



### Gate Drive Dynamic Characteristics

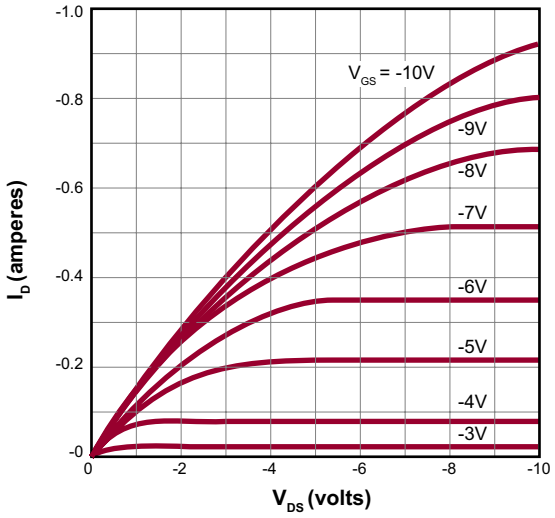


## Typical Performance Curves *(cont.)*

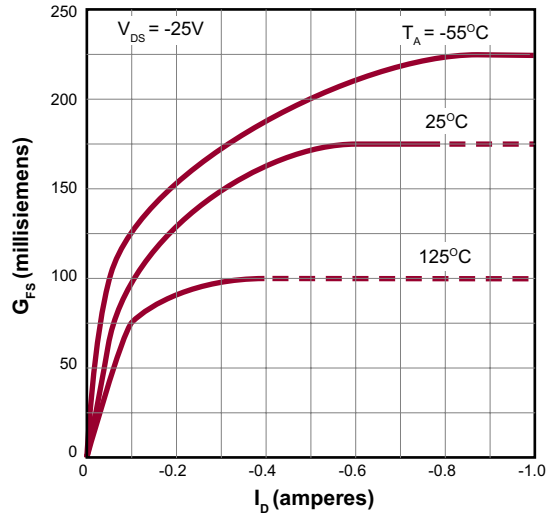
### Output Characteristics



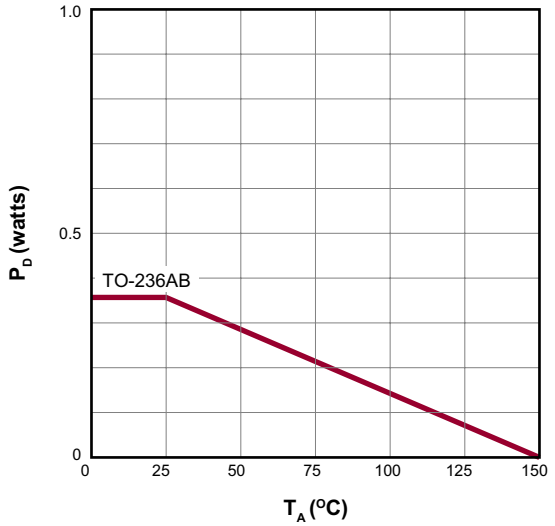

### Saturation Characteristics



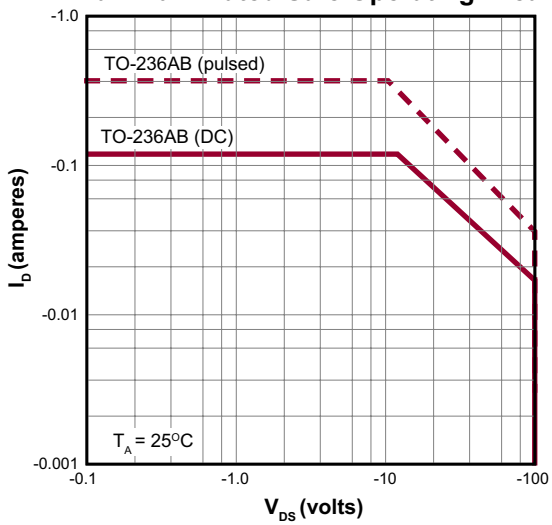

### Transconductance vs. Drain Current



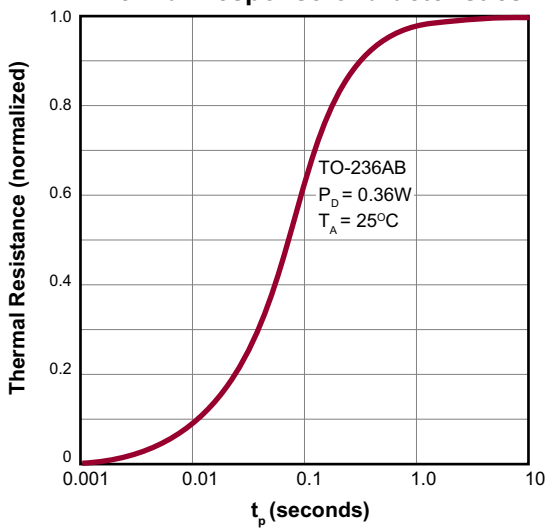

### Power Dissipation vs. Ambient Temperature




### Maximum Rated Safe Operating Area

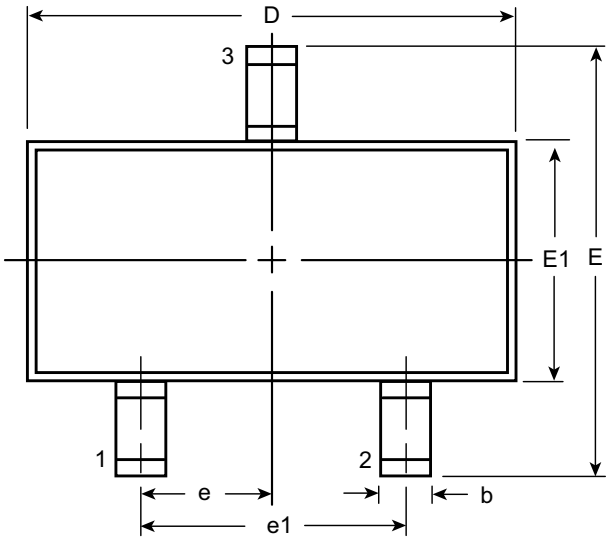



### Thermal Response Characteristics

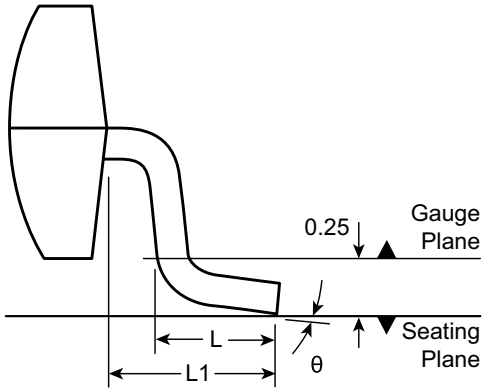


# 3-Lead TO-236AB (SOT-23) Package Outline (K1)

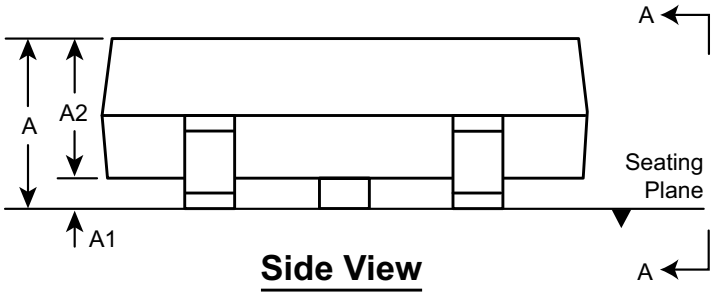
***2.90x1.30mm body, 1.12mm height (max), 1.90mm pitch***



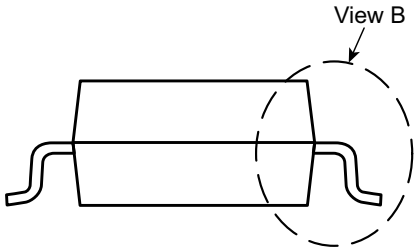

**Top View**




**View B**




**Side View**




**View A - A**

| Symbol | | A | A1 | A2 | b | D | E | E1 | e | e1 | L | L1 | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dimension (mm) | MIN | 0.89 | 0.01 | 0.88 | 0.30 | 2.80 | 2.10 | 1.20 | 0.95 BSC | 1.90 BSC | 0.20† | 0.54 REF | 0° |
| | NOM | - | - | 0.95 | - | 2.90 | - | 1.30 | | | 0.50 | | - |
| | MAX | 1.12 | 0.10 | 1.02 | 0.50 | 3.04 | 2.64 | 1.40 | | | 0.60 | | 8° |

*JEDEC Registration TO-236, Variation AB, Issue H, Jan. 1999.*
*† This dimension differs from the JEDEC drawing.*
***Drawings not to scale.***
***Supertex Doc.#:*** *DSPD-3TO236ABK1, Version C041309.*

*(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.)*

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