Supertex inc.

N-Channel Enhancement-Mode Vertical DMOS FETs

Ordering Information

BV$_{DSS}$/ BV$_{DGS}$	R$_{DS(ON)}$ (max)	I$_{D(ON)}$ (min)	Order Number / Package			
			TO-3	**TO-39**	**TO-220**	**Dice**[†]
350V	2.5Ω	3A	VN0335N1	VN0335N2	VN0335N5	VN0335ND
400V	2.5Ω	3A	VN0340N1	VN0340N2	VN0340N5	VN0340ND

[†] MIL visual screening available

High Reliability Devices

See pages 5-4 and 5-5 for MILITARY STANDARD Process Flows and Ordering Information.

Features

☐ Free from secondary breakdown

☐ Low power drive requirement

☐ Ease of paralleling

☐ Low C$_{ISS}$ and fast switching speeds

☐ Excellent thermal stability

☐ Integral Source-Drain diode

☐ High input impedance and high gain

☐ Complementary N- and P-channel devices

Applications

☐ Motor control

☐ Converters

☐ Amplifiers

☐ Switches

☐ Power supply circuits

☐ Drivers (relays, hammers, solenoids, lamps, memories, displays, bipolar transistors, etc.)

Absolute Maximum Ratings

|	
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
Soldering Temperature*	300°C

* Distance of 1.6 mm from case for 10 seconds.

Advanced DMOS Technology

These enhancement-mode (normally-off) transistors utilize a vertical DMOS structure and Supertex's well-proven silicon-gate manufacturing process. This combination produces devices 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, these devices are free from thermal runaway and thermally-induced secondary breakdown.

Supertex 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 Options

TO-39

TO-220

TO-3

Note: See package outline section for discrete pinout.
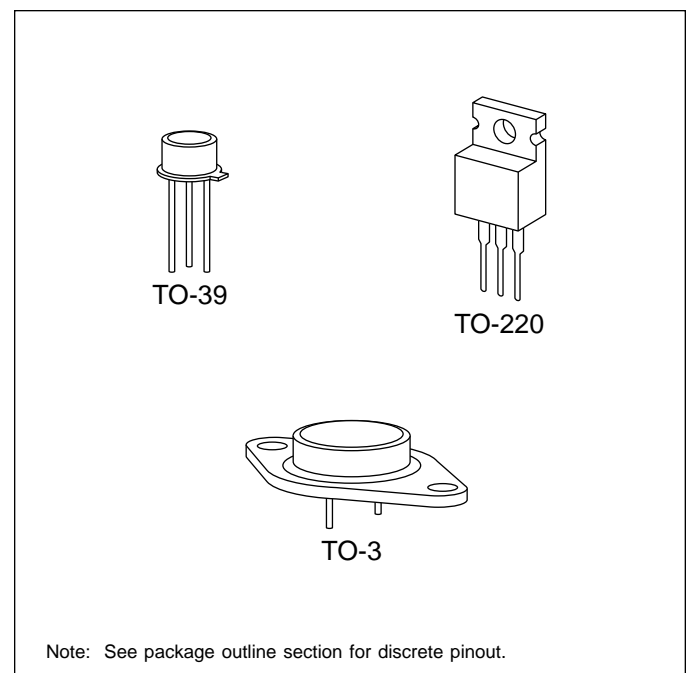
Thermal Characteristics

Package	I$_D$ (continuous)*	I$_D$ (pulsed)	Power Dissipation @ T$_C$ = 25°C	θ_{ja} °C/W	θ_{jc} °C/W	I$_{DR}$*	I$_{DRM}$
TO-3	3.5A	8.0A	100W	30	1.25	3.5A	8.0A
TO-39	1.0A	7.0A	6W	125	20.8	1.0A	7.0A
TO-220	2.1A	8.0A	50W	40	2.5	2.1A	8.0A

* I$_D$ (continuous) is limited by max rated T$_j$.

Electrical Characteristics (@ 25°C unless otherwise specified)

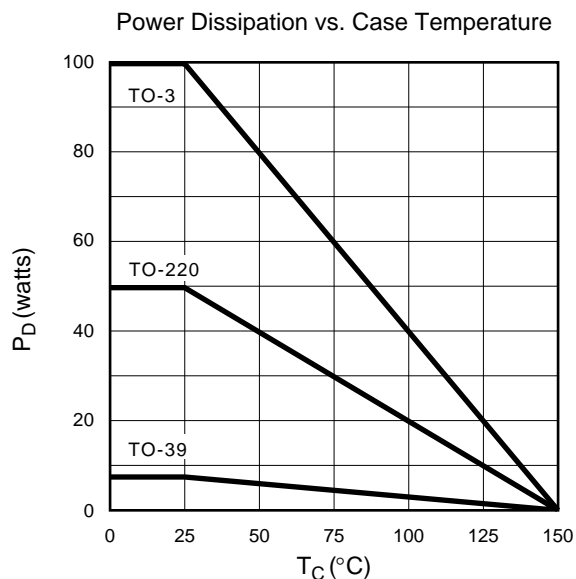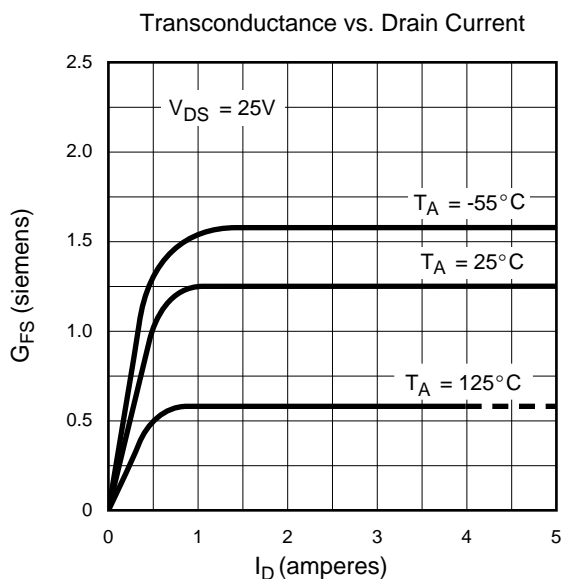| Symbol	Parameter		Min	Typ	Max	Unit	Conditions
BV$_{DSS}$	Drain-to-Source Breakdown Voltage	VN0340	400			V	V$_{GS}$ = 0, I$_D$ = 10mA
		VN0335	350				
V$_{GS(th)}$	Gate Threshold Voltage		2		4	V	V$_{GS}$ = V$_{DS}$, I$_D$ = 10mA
ΔV$_{GS(th)}$	Change in V$_{GS(th)}$ with Temperature			-4.8	-6.0	mV/°C	V$_{GS}$ = V$_{DS}$, I$_D$ = 10mA
I$_{GSS}$	Gate Body Leakage				100	nA	V$_{GS}$ = ±20V, V$_{DS}$ = 0
I$_{DSS}$	Zero Gate Voltage Drain Current				100	μA	V$_{GS}$ = 0, V$_{DS}$ = Max Rating
					2.0	mA	V$_{GS}$ = 0, V$_{DS}$ = 0.8 Max Rating T$_A$ = 125°C
I$_{D(ON)}$	ON-State Drain Current			5.0		A	V$_{GS}$ = 5V, V$_{DS}$ = 25V
			3.0	6.0			V$_{GS}$ = 10V, V$_{DS}$ = 25V
R$_{DS(ON)}$	Static Drain-to-Source ON-State Resistance			2.2		Ω	V$_{GS}$ = 5V, I$_D$ = 0.5A
				1.8	2.5		V$_{GS}$ = 10V, I$_D$ = 1A
ΔR$_{DS(th)}$	Change in R$_{DS(th)}$ with Temperature			1	2	%/°C	V$_{GS}$ = 10V, I$_D$ = 1A
G$_{FS}$	Forward Transconductance		1	1.25		℧	V$_{DS}$ = 25V, I$_D$ = 1A
C$_{ISS}$	Input Capacitance			550	650	pF	V$_{GS}$ = 0, V$_{DS}$ = 25V f = 1 MHz
C$_{OSS}$	Common Source Output Capacitance			75	125		
C$_{RSS}$	Reverse Transfer Capacitance			25	50		
t$_{d(ON)}$	Turn-ON Delay Time			12	20	ns	V$_{DD}$ = 25V, I$_D$ = 1A, R$_{GEN}$ = 10Ω
t$_r$	Rise Time			12	20		
t$_{d(OFF)}$	Turn-OFF Delay Time			65	100		
t$_f$	Fall Time			20	30		
V$_{SD}$	Diode Forward Voltage Drop			1.1	1.5	V	V$_{GS}$ = 0, I$_{SD}$ = 1A
t$_{rr}$	Reverse Recovery Time			450		ns	V$_{GS}$ = 0, I$_{SD}$ = 1A

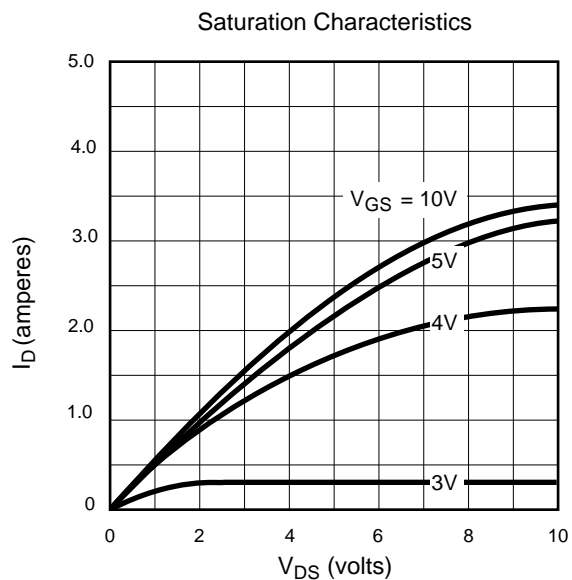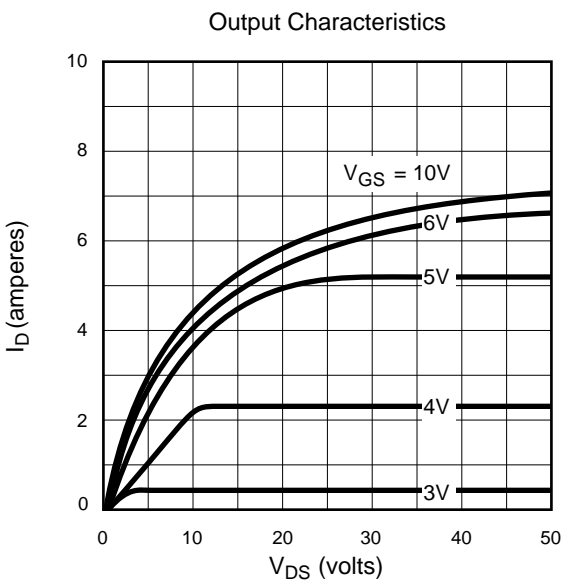**Notes:**

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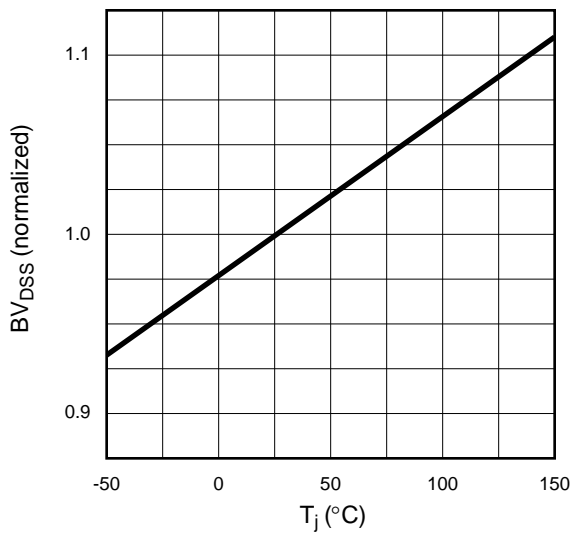2. All A.C. parameters sample tested.

Switching Waveforms and Test Circuit

Typical Performance Curves

Output Characteristics

I_D (amperes)

$V_{GS} = 10V$
6V
5V
4V
3V

V_{DS} (volts)

Saturation Characteristics

I_D (amperes)

$V_{GS} = 10V$
5V
4V
3V

V_{DS} (volts)

Transconductance vs. Drain Current

G_{FS} (siemens)

$V_{DS} = 25V$

$T_A = -55°C$
$T_A = 25°C$
$T_A = 125°C$

I_D (amperes)

Power Dissipation vs. Case Temperature

P_D (watts)

TO-3
TO-220
TO-39

T_C (°C)

Maximum Rated Safe Operating Area

I_D (amperes)

TO-220 (pulsed)
TO-3 (DC)
TO-220 (DC)
TO-39 (DC)
$T_C = 25°C$

V_{DS} (volts)

Thermal Response Characteristics

Thermal Resistance (normalized)

TO-220
$P_D = 50W$
$T_C = 25°C$

TO-3
$P_D = 100W$
$T_C = 25°C$

TO-39
$P_D = 6W$
$T_C = 25°C$

t_p (seconds)

8

Typical Performance Curves

BV$_{DSS}$ Variation with Temperature

BV$_{DSS}$ (normalized)

1.1

1.0

0.9

-50   0   50   100   150

T$_j$ (°C)

On-Resistance vs. Drain Current

R$_{DS(ON)}$ (ohms)

20

16

12

8

4

0

V$_{GS}$ = 5V

V$_{GS}$ = 10V

0   2   4   6   8   10

I$_D$ (amperes)
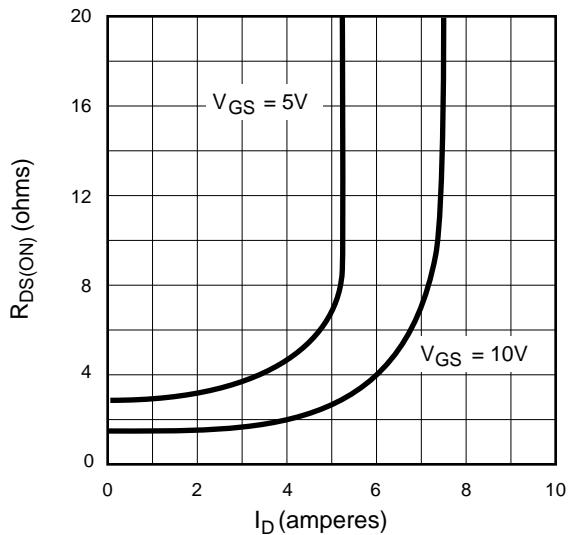
Transfer Characteristics

I$_D$ (amperes)

2.5

2.0

1.5

1.0

0.5

0

V$_{DS}$ = 25V

T$_A$ = -55°C   25°C

125°C

0   2   4   6   8   10

V$_{GS}$ (volts)
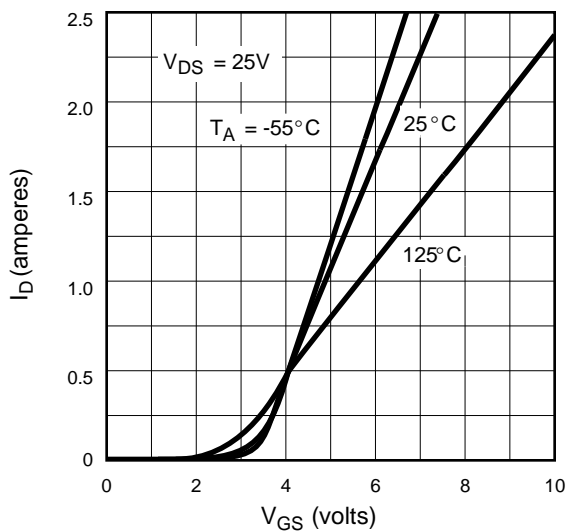
V$_{(th)}$ and R$_{DS}$ Variation with Temperature

V$_{GS(th)}$ (normalized)

1.4

1.2

1.0

0.8

0.6

R$_{DS(ON)}$ (normalized)

2.0

1.5

1.0

0.5

0

R$_{DS}$ @ 10V, 1A

V$_{(th)}$ @ 10mA

-50   0   50   100   150

T$_j$ (°C)
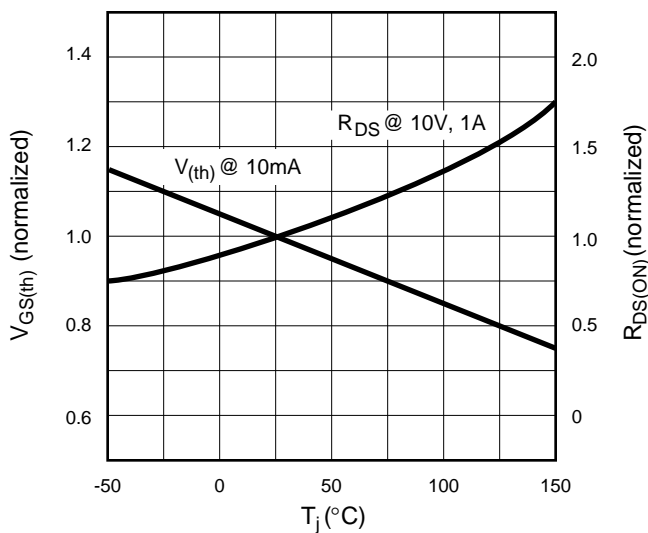
Capacitance vs. Drain-to-Source Voltage

C (picofarads)

1000

750

500

250

0

f = 1MHz

C$_{ISS}$

C$_{OSS}$

C$_{RSS}$

0   10   20   30   40

V$_{DS}$ (volts)
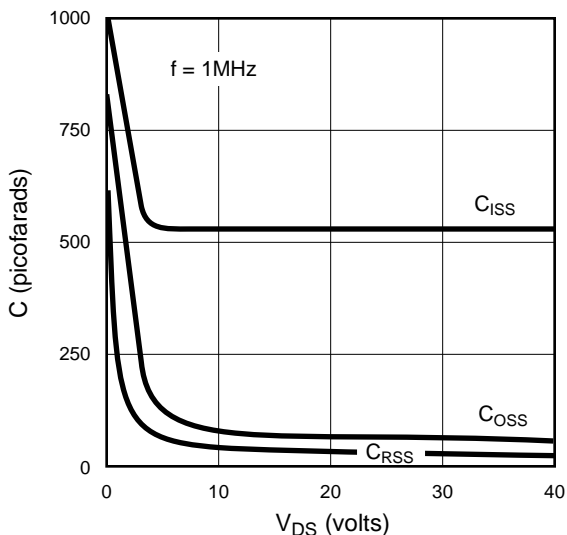
Gate Drive Dynamic Characteristics

V$_{GS}$ (volts)

10

8

6

4

2

0

V$_{DS}$ = 10V

1600 pF

V$_{DS}$ = 40V

600 pF

0   4   8   12   16   20

Q$_G$ (nanocoulombs)