

## Six Pair, N- and P-Channel Enhancement-Mode MOSFET

### Features

- ▶ High voltage, vertical DMOS technology
- ▶ Integrated gate-to-source resistor
- ▶ Integrated gate-to-source Zener diode
- ▶ Typical peak output +/-3.5A at 50V
- ▶ Low threshold, low on-resistance
- ▶ Low input & output capacitance
- ▶ Fast switching speeds
- ▶ Electrically isolated N- and P-MOSFET pairs

### Applications

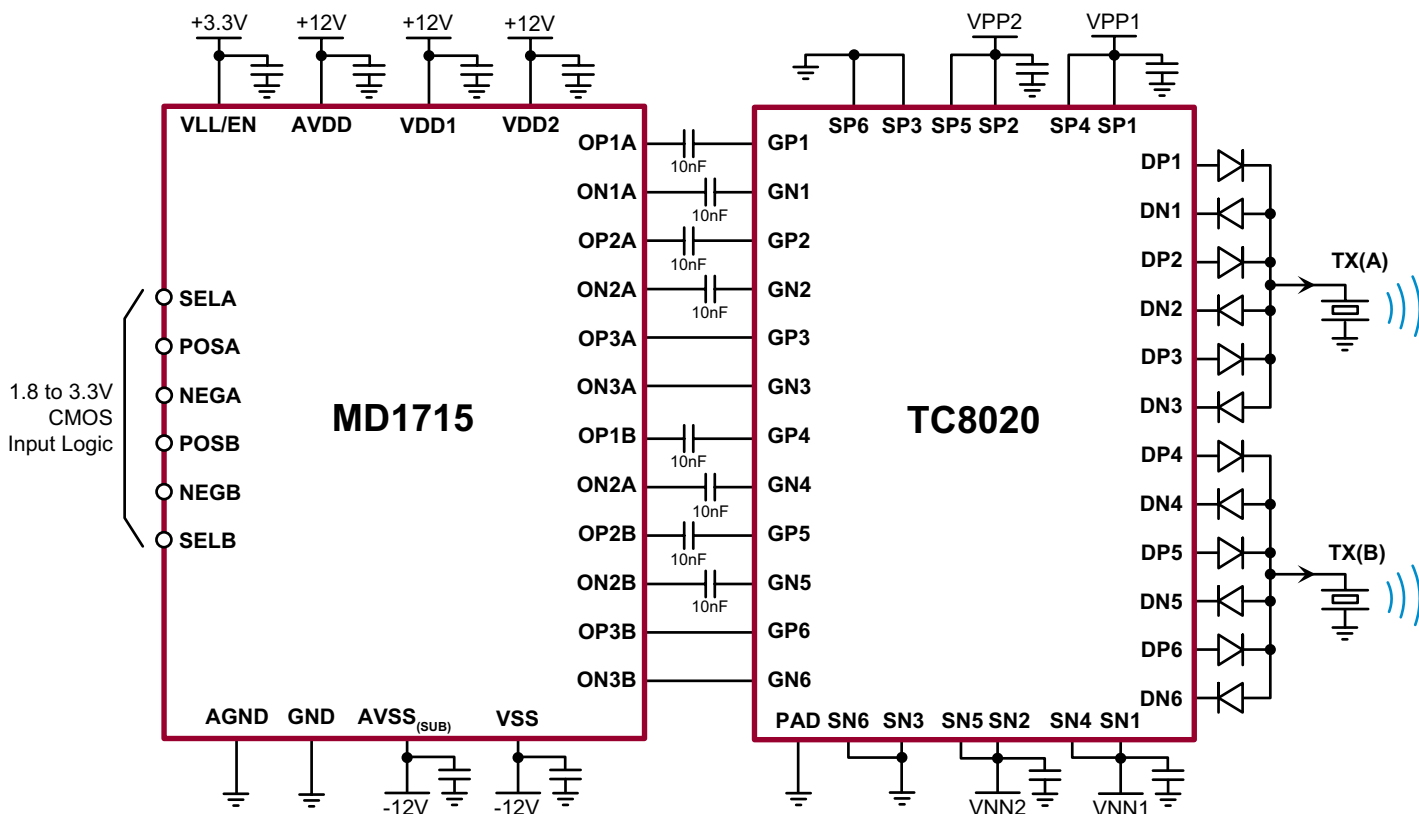
- ▶ High voltage pulsers
- ▶ Amplifiers
- ▶ Buffers
- ▶ Piezoelectric transducer drivers
- ▶ General purpose line drivers
- ▶ Logic level interfaces

### General Description

The Supertex TC8020 consists of six pairs of high voltage, low threshold N- and P-channel MOSFETs in a 56-lead QFN package. All MOSFETs have integrated gate-to-source resistors and gate-to-source Zener diode clamps which are desired for high voltage pulser applications. The complimentary, high-speed, high voltage, gate-clamped N- and P-channel MOSFET pairs utilize 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 very low threshold voltage, high breakdown voltage, high input impedance, low input and output capacitance, and fast switching speeds are desired.

### Typical Application



### Ordering Information

Part Number	Package Option	Packing
TC8020K6-G	56-Lead QFN (8x8)	250/Tray

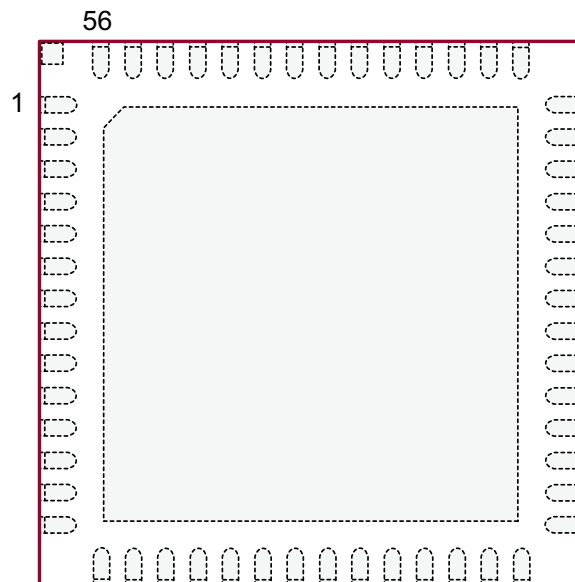
-G indicates package is RoHS compliant ('Green')



### Product Summary

$BV_{DSS}/BV_{DGS}$ (V)		$R_{DS(ON)}$ (max) ( $\Omega$ )	
N-Channel	P-Channel	N-Channel	P-Channel
200	-200	8.0	9.5

### Pin Configuration



56-Lead QFN (K6)  
Top View

### Absolute Maximum Ratings

Parameter	Value
Drain-to-source voltage	$BV_{DSS}$
Drain-to-gate voltage	$BV_{DGS}$
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.

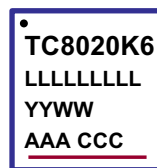
\* Distance of 1.6mm from case for 10 seconds.

### Thermal Characteristics

Package	$\theta_{ja}$
56-Lead QFN (K6)	27°C/W

Note:  
1.0oz, 4-layer, 3"x4" PCB

### Package Marking



- L = Lot Number
- YY = Year Sealed
- WW = Week Sealed
- A = Assembler ID
- C = Country of Origin
- \_\_\_ = "Green" Packaging

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

56-Lead QFN (K6)

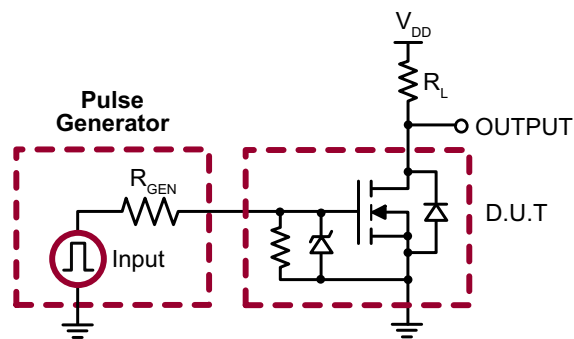
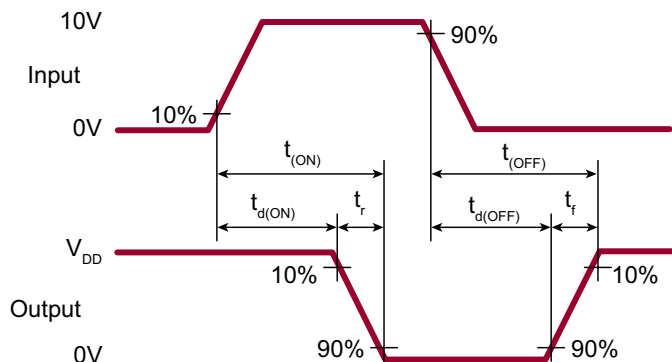
### N-Channel Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise specified)

Sym	Parameter	Min	Typ	Max	Units	Conditions
$BV_{DSS}$	Drain-to-source breakdown voltage	200	-	-	V	$V_{GS} = 0V, I_D = 1.0mA$
$V_{GS(th)}$	Gate threshold voltage	1.0	-	2.4	V	$V_{GS} = V_{DS}, I_D = 1.0mA$
$\Delta V_{GS(th)}$	Change in $V_{GS(th)}$ with temperature	-	-	-4.5	mV/°C	$V_{GS} = V_{DS}, I_D = 1.0mA$
$R_{GS}$	Gate-to-source shunt resistor	5.0	-	26	K $\Omega$	$I_{GS} = 100\mu A$
$VZ_{GS}$	Gate-to-source Zener voltage	13.2	-	25	V	$I_{GS} = 2.0mA$
$I_{DSS}$	Zero gate voltage drain current	-	-	10.0	$\mu A$	$V_{DS} = \text{Max rating}, V_{GS} = 0V$
		-	-	1.0	mA	$V_{DS} = 0.8 \text{ Max Rating}, V_{GS} = 0V, T_A = 125^\circ\text{C}$
$I_{D(ON)}$	On-state drain current	1.2	1.8	-	A	$V_{GS} = 4.5V, V_{DS} = 25V$
		2.0	3.2	-		$V_{GS} = 10V, V_{DS} = 25V$
$R_{DS(ON)}$	Static drain-to-source on-state resistance	-	6.0	9.0	$\Omega$	$V_{GS} = 4.5V, I_D = 150mA$
		-	5.3	8.0		$V_{GS} = 10V, I_D = 1.0A$
$\Delta R_{DS(ON)}$	Change in $R_{DS(ON)}$ with temperature	-	-	1.0	%/°C	$V_{GS} = 10V, I_D = 1.0A$
$G_{FS}$	Forward transconductance	400	-	-	mmho	$V_{DS} = 25V, I_D = 500mA$
$C_{ISS}$	Input capacitance	-	50	-	pF	$V_{GS} = 0V, V_{DS} = 25V, f = 1.0MHz$
$C_{OSS}$	Common source output capacitance	-	18	-		
$C_{RSS}$	Reverse transfer capacitance	-	7.0	-		
$t_{d(ON)}$	Turn-on delay time	-	-	10	ns	$V_{DD} = 25V, I_D = 500mA, R_{GEN} = 25\Omega$
$t_r$	Rise time	-	-	15		
$t_{d(OFF)}$	Turn-off delay time	-	-	20		
$t_f$	Fall time	-	-	15		
$V_{SD}$	Diode forward voltage drop	-	-	1.8	V	$V_{GS} = 0V, I_{SD} = 500mA$
$t_{rr}$	Reverse recovery time	-	300	-	ns	$V_{GS} = 0V, I_{SD} = 500mA$

**Notes:**

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

### N-Channel Switching Waveforms and Test Circuit



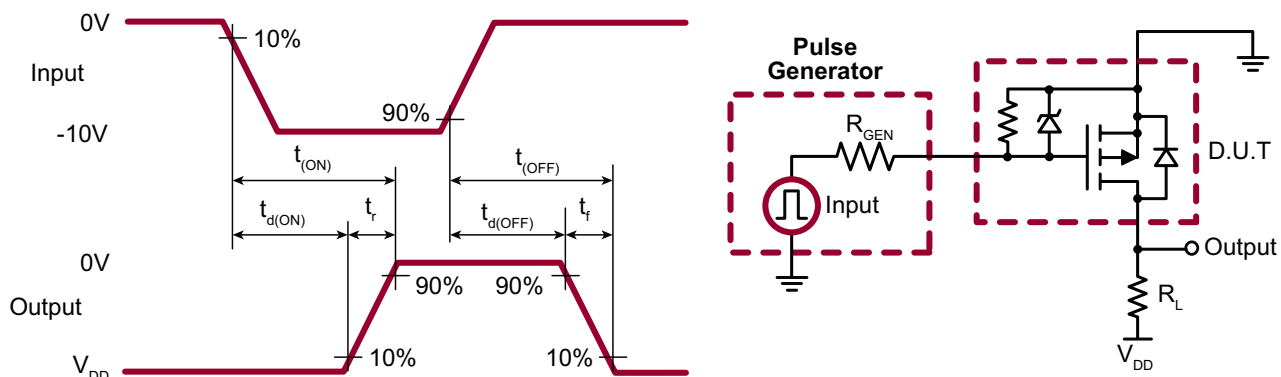
**P-Channel Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

Sym	Parameter	Min	Typ	Max	Units	Conditions
$BV_{DSS}$	Drain-to-source breakdown voltage	-200	-	-	V	$V_{GS} = 0V, I_D = -1.0mA$
$V_{GS(th)}$	Gate threshold voltage	-1.0	-	-2.4	V	$V_{GS} = V_{DS}, I_D = -1.0mA$
$\Delta V_{GS(th)}$	Change in $V_{GS(th)}$ with temperature	-	-	4.5	mV/°C	$V_{GS} = V_{DS}, I_D = -1.0mA$
$R_{GS}$	Gate-to-source shunt resistor	5.0	-	26	K $\Omega$	$I_{GS} = -100\mu A$
$VZ_{GS}$	Gate-to-source Zener voltage	-13.2	-	-24.0	V	$I_{GS} = -2.0mA$
$I_{DSS}$	Zero gate voltage drain current	-	-	-10	$\mu A$	$V_{DS} = \text{Max rating}, V_{GS} = 0V$
		-	-	-1.0	mA	$V_{DS} = 0.8 \text{ Max Rating}, V_{GS} = 0V, T_A = 125^\circ\text{C}$
$I_{D(ON)}$	On-state drain current	-0.80	-1.25	-	A	$V_{GS} = -4.5V, V_{DS} = -25V$
		-2.00	-2.80	-		$V_{GS} = -10V, V_{DS} = -25V$
$R_{DS(ON)}$	Static drain-to-source on-state resistance	-	7.0	10	$\Omega$	$V_{GS} = -4.5V, I_D = -150mA$
		-	6.5	9.5		$V_{GS} = -10V, I_D = -1.0A$
$\Delta R_{DS(ON)}$	Change in $R_{DS(ON)}$ with temperature	-	-	1.0	%/°C	$V_{GS} = -10V, I_D = -1.0A$
$G_{FS}$	Forward transconductance	400	-	-	mmho	$V_{DS} = -25V, I_D = -500mA$
$C_{ISS}$	Input capacitance	-	55	-	pF	$V_{GS} = 0V, V_{DS} = -25V, f = 1.0MHz$
$C_{OSS}$	Common source output capacitance	-	20	-		
$C_{RSS}$	Reverse transfer capacitance	-	8.0	-		
$t_{d(ON)}$	Turn-on delay time	-	-	10	ns	$V_{DD} = -25V, I_D = -1.0A, R_{GEN} = 25\Omega$
$t_r$	Rise time	-	-	15		
$t_{d(OFF)}$	Turn-off delay time	-	-	20		
$t_f$	Fall time	-	-	15		
$V_{SD}$	Diode forward voltage drop	-	-	-1.8	V	$V_{GS} = 0V, I_{SD} = -500mA$
$t_{rr}$	Reverse recovery time	-	300	-	ns	$V_{GS} = 0V, I_{SD} = -500mA$

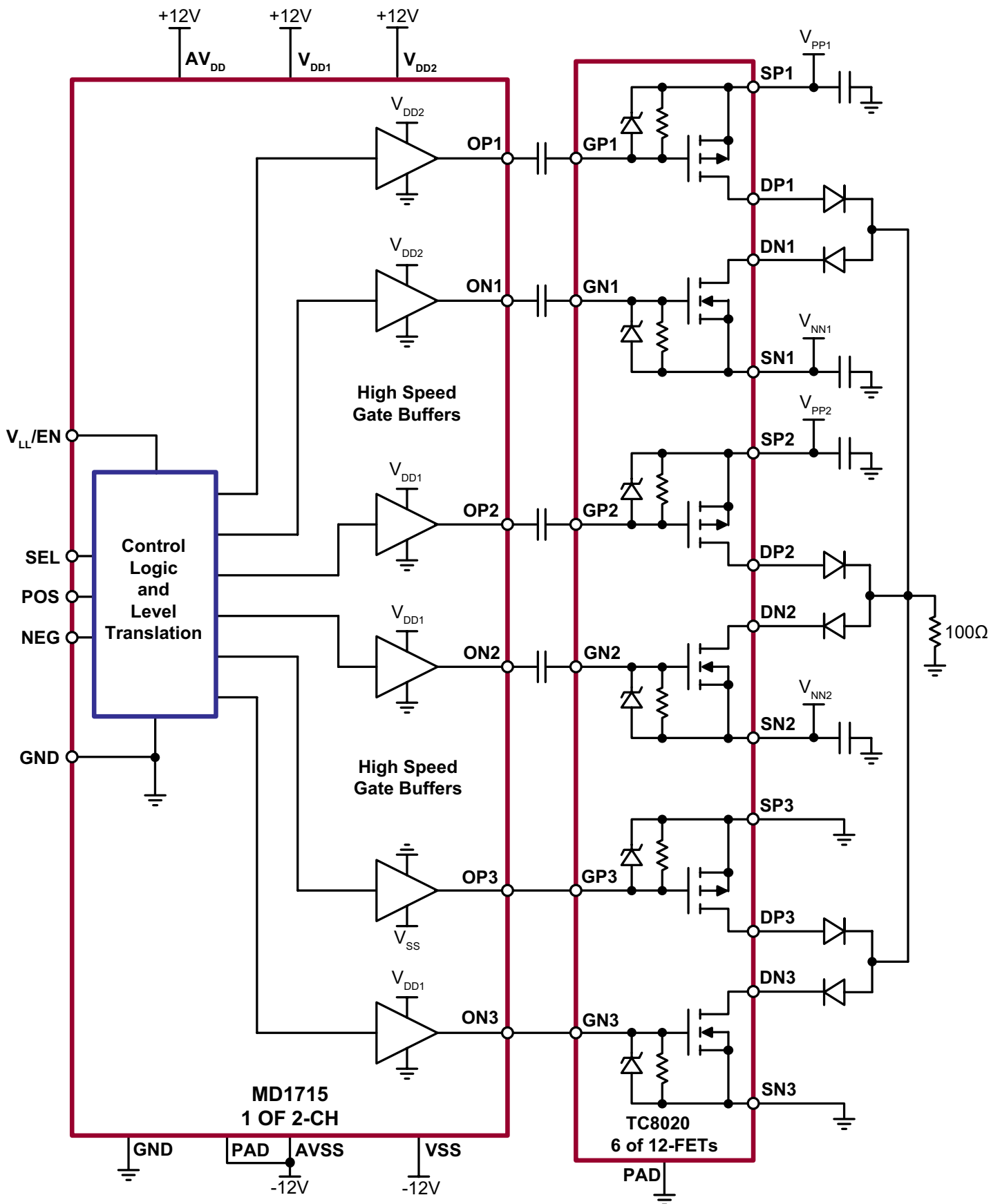
**Notes:**

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

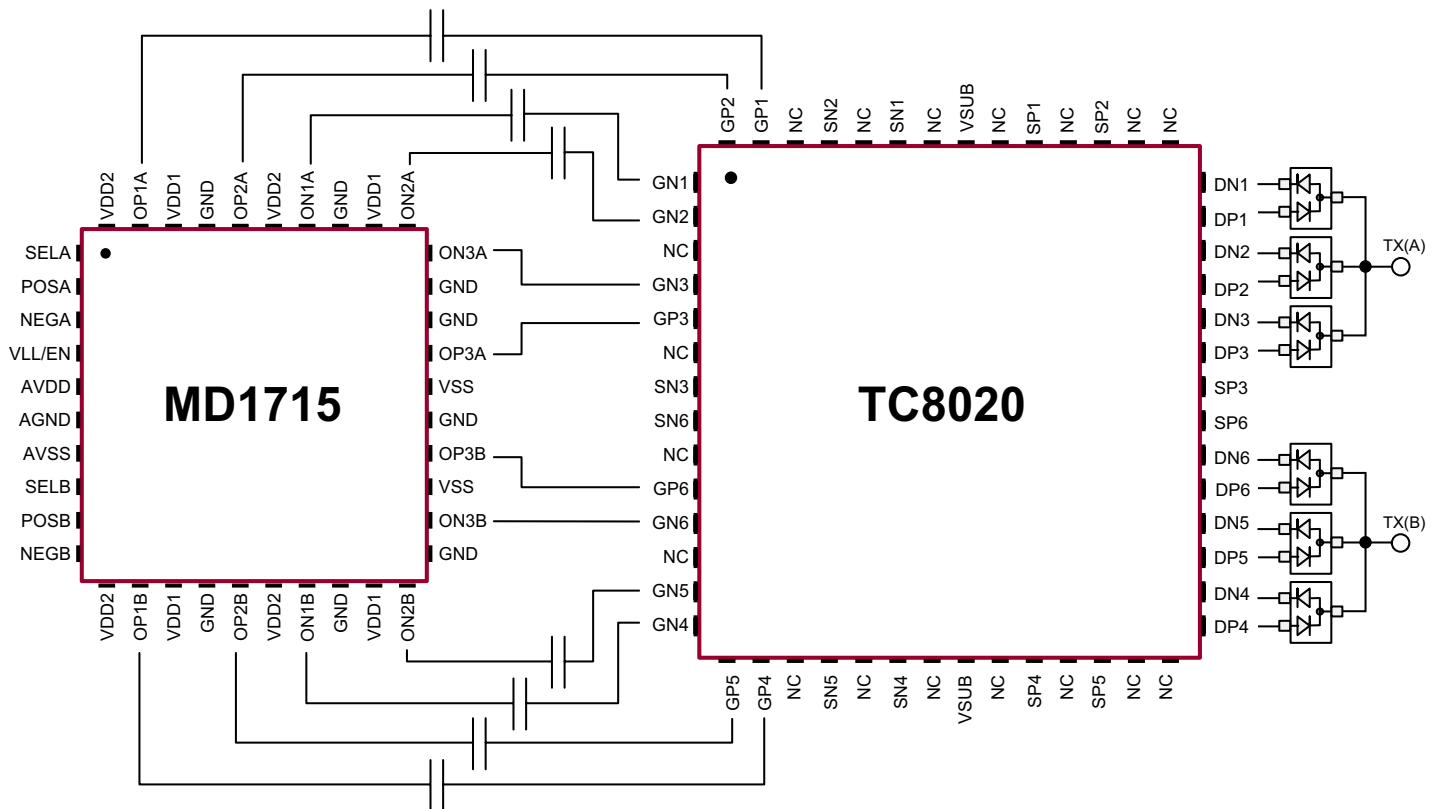
**P-Channel Switching Waveforms and Test Circuit**



Test Circuit



### Circuit Pin Layout



### Pin Description

Pin	Function	Description
1	GN1	Gate of N-MOSFET 1
2	GN2	Gate of N-MOSFET 2
3	NC	No Connection
4	GN3	Gate of N-MOSFET 3
5	GP3	Gate of P-MOSFET 3
6	NC	No Connection
7	SN3	Source of N-MOSFET 3
8	SN6	Source of N-MOSFET 6
9	NC	No Connection
10	GP6	Gate of P-MOSFET 6
11	GN6	Gate of N-MOSFET 6
12	NC	No Connection
13	GN5	Gate of N-MOSFET 5
14	GN4	Gate of N-MOSFET 4
15	GP5	Gate of P-MOSFET 5
16	GP4	Gate of P-MOSFET 4
17	NC	No Connection
18	SN5	Source of N-MOSFET 5

## Pin Description (cont.)

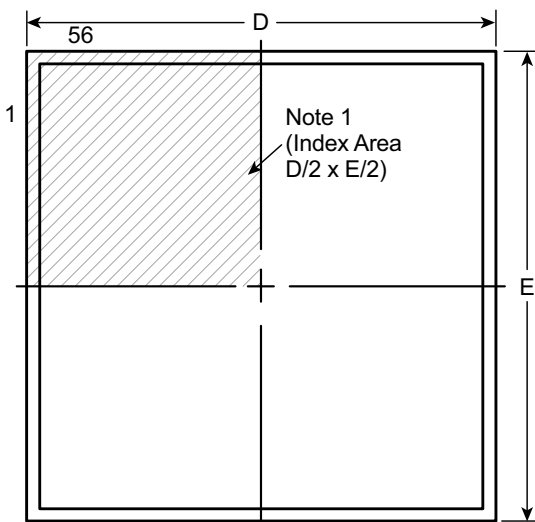
Pin	Function	Description
19	NC	No Connection
20	SN4	Source of N-MOSFET 4
21	NC	No Connection
22	VSUB	Die attachment substrate, must be grounded externally.
23	NC	No Connection
24	SP4	Source of P-MOSFET 4
25	NC	No Connection
26	SP5	Source of P-MOSFET 5
27	NC	No Connection
28	NC	No Connection
29	DP4	Drain of P-MOSFET 4
30	DN4	Drain of N-MOSFET 4
31	DP5	Drain of P-MOSFET 5
32	DN5	Drain of N-MOSFET 5
33	DP6	Drain of P-MOSFET 6
34	DN6	Drain of N-MOSFET 6
35	SP6	Source of P-MOSFET 6
36	SP3	Source of P-MOSFET 3
37	DP3	Drain of P-MOSFET 3
38	DN3	Drain of N-MOSFET 3
39	DP2	Drain of P-MOSFET 2
40	DN2	Drain of N-MOSFET 2
41	DP1	Drain of P-MOSFET 1
42	DN1	Drain of N-MOSFET 1
43	NC	No Connection
44	NC	No Connection
45	SP2	Source of P-MOSFET 2
46	NC	No Connection
47	SP1	Source of P-MOSFET 1
48	NC	No Connection
49	VSUB	Die attachment substrate, must be grounded externally.
50	NC	No Connection
51	SN1	Source of N-MOSFET 1
52	NC	No Connection
53	SN2	Source of N-MOSFET 2
54	NC	No Connection
55	GP1	Gate of P-MOSFET 1
56	GP2	Gate of P-MOSFET 2

**Note:**

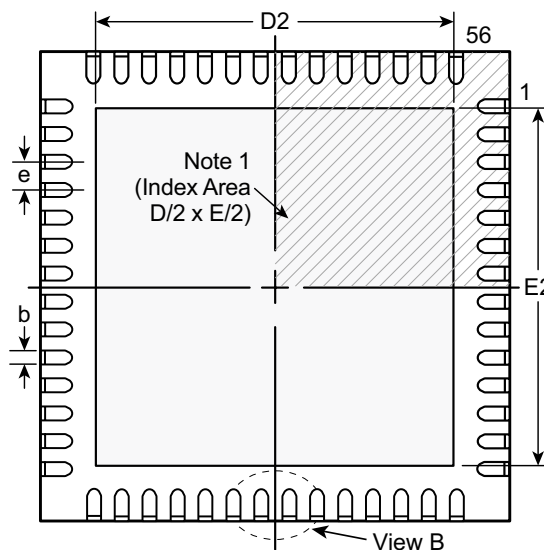
*Thermal Pad must be grounded externally.*

# 56-Lead QFN Package Outline (K6)

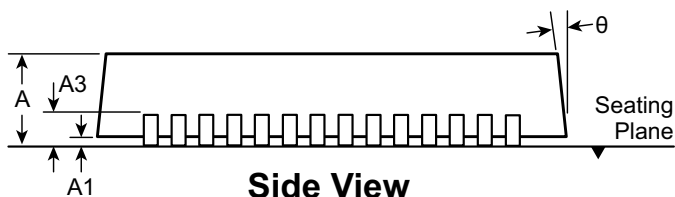
8.00x8.00mm body, 1.00mm height (max), 0.50mm pitch



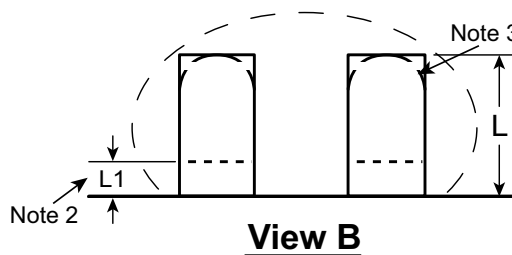
**Top View**



**Bottom View**



**Side View**



**View B**

**Notes:**

1. A Pin 1 identifier must be located in the index area indicated. The Pin 1 identifier can be: a molded mark/identifier; an embedded metal marker; or a printed indicator.
2. Depending on the method of manufacturing, a maximum of 0.15mm pullback (L1) may be present.
3. The inner tip of the lead may be either rounded or square.

Symbol	A	A1	A3	b	D	D2	E	E2	e	L	L1	θ	
Dimension (mm)	MIN	0.80	0.00	0.20 REF	0.18	7.85*	2.75	7.85*	2.75	0.50 BSC	0.30	0.00	0°
	NOM	0.90	0.02		0.25	8.00	5.70	8.00	5.70		0.40	-	-
	MAX	1.00	0.05		0.30	8.15*	6.70†	8.15*	6.70†		0.50	0.15	14°

JEDEC Registration MO-220, Variation VLLD-2, Issue K, June 2006.

\* This dimension is not specified in the JEDEC drawing.

† This dimension differs from the JEDEC drawing.

**Drawings are not to scale.**

**Supertex Doc.#:** DSPD-56QFNK68X8P050, Version A031010.

(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 them for use in such applications unless it receives an adequate "product liability indemnification insurance agreement." **Supertex inc.** 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 and inaccuracies. Circuitry and specifications are subject to change without notice. For the latest product specifications refer to the **Supertex inc.** (website: <http://www.supertex.com>)