

Two Pair, N- and P-Channel Enhancement-Mode MOSFET with Drain-Diodes

Features

- ▶ High voltage Vertical DMOS technology
- ▶ Integrated drain output high voltage diodes
- ▶ Integrated gate-to-source resistor
- ▶ Integrated gate-to-source Zener diode
- ▶ Low threshold, Low on-resistance
- ▶ Low input & output capacitance
- ▶ Fast switching speeds
- ▶ Electrically isolated N- and P-MOSFET pairs

Applications

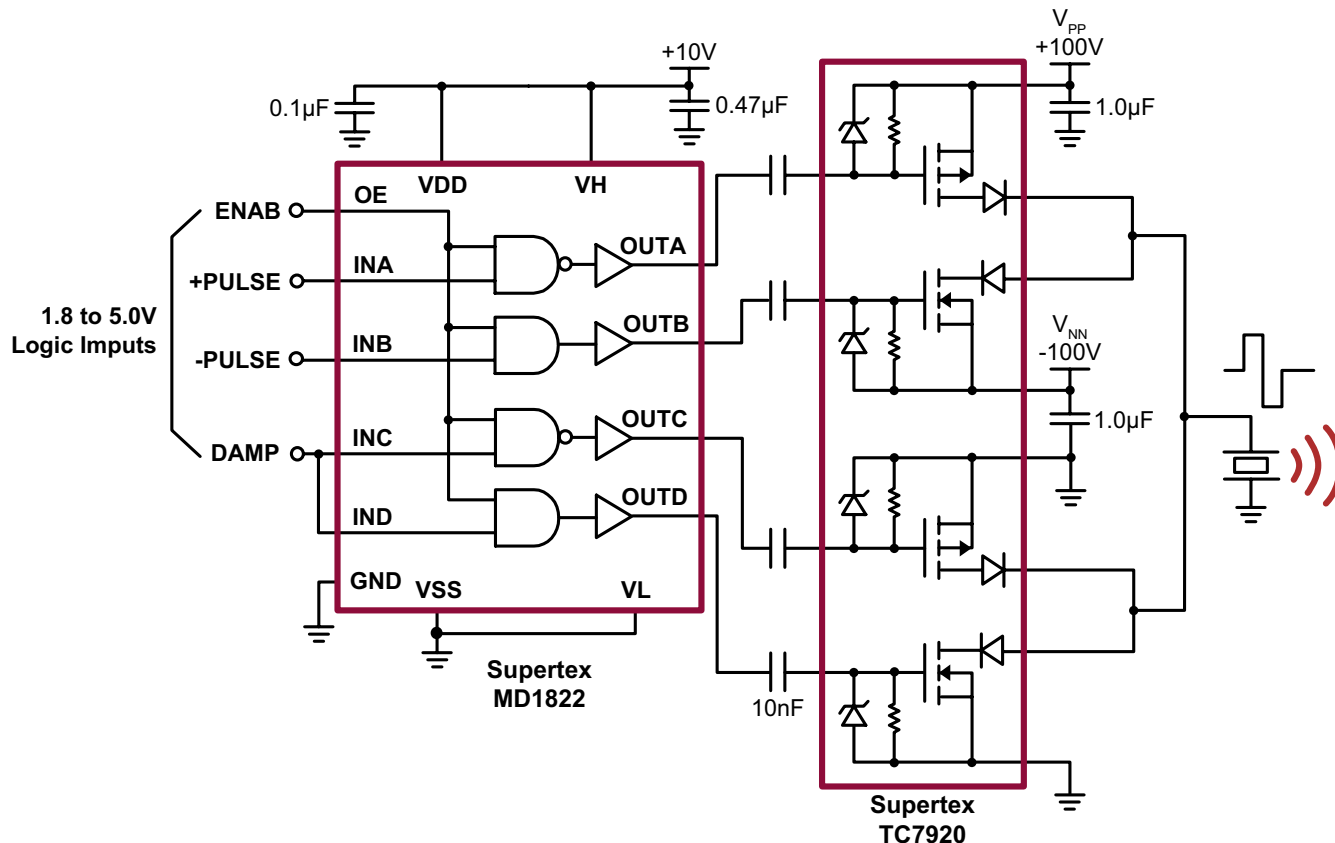
- ▶ High voltage pulsers
- ▶ Amplifiers
- ▶ Buffers
- ▶ Piezoelectric transducer drivers
- ▶ General purpose line drivers
- ▶ Logic level interfaces

General Description

The Supertex TC7920 consists of two pairs of high voltage, low threshold N-channel and P-channel MOSFETs in a 12-Lead DFN package. All MOSFETs have integrated the output drain high voltage diodes, 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, these devices are 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 Circuit



Ordering Information

| Part Number | Package Option | Packing |
|-------------|----------------|-----------|
| TC7920K6-G | 12-Lead DFN | 3000/Reel |

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.

Typical Thermal Resistance

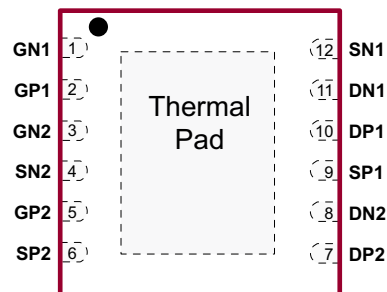
| Package | θ_{ja} |
|-------------|---------------|
| 12-Lead DFN | 42°C/W |

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

Product Summary

| BV_{DSS}/BV_{DGS} | | $R_{DS(ON)}$ (max) | |
|---------------------|-----------|--------------------|-----------|
| N-Channel | P-Channel | N-Channel | P-Channel |
| 200V | -200V | 7.0Ω | 8.0Ω |

Pin Configuration



12-Lead DFN
(top view)

Package Marking



Y = Last Digit of Year Sealed
W = Code for Week Sealed
L = Lot Number
— = "Green" Packaging

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

12-Lead DFN

Drain Output Diodes

| Sym | Parameter | Min | Typ | Max | Unit | Condition |
|----------|-----------------------|-----|------|-----|------|---|
| V_R | Breakdown voltage | 200 | - | - | V | $I_R = 100\mu A$ |
| VF | Forward voltage | - | 1.25 | - | V | $I_F = 100mA$ |
| I_{FM} | Park forward current | - | 3.0 | - | A | Pulse width = 1.0μs, D% = 1%, One diode |
| I_R | Reverse current | - | 1.0 | - | μA | $V_R = 100V, T_A = 25^\circ C$ |
| | | - | 100 | - | | $V_R = 100V, T_A = 125^\circ C$ |
| t_{tr} | Reverse recovery time | - | 1.0 | - | μs | $I_F = I_R = 10mA, I_{RR} = 1.0mA, R_L = 100\Omega$ |

Pin Description

| Pin # | Function | Description | Pin # | Function | Description |
|-------------|----------|---|-------|----------|----------------------|
| 1 | GN1 | Gate of N-MOSFET 1 | 7 | DP2 | Drain of P-MOSFET 2 |
| 2 | GP1 | Gate of P-MOSFET 1 | 8 | DN2 | Drain of N-MOSFET 2 |
| 3 | GN2 | Gate of N-MOSFET 2 | 9 | SP1 | Source of P-MOSFET 1 |
| 4 | SN2 | Source of N-MOSFET 2 | 10 | DP1 | Drain of P-MOSFET 1 |
| 5 | GP2 | Gate of P-MOSFET 2 | 11 | DN1 | Drain of N-MOSFET 1 |
| 6 | SP2 | Source of P-MOSFET 2 | 12 | SN1 | Source of N-MOSFET 1 |
| Thermal Pad | | Die attachment substrate, must be grounded externally | | | |

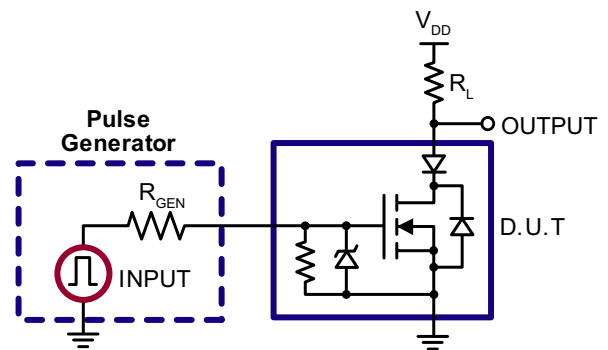
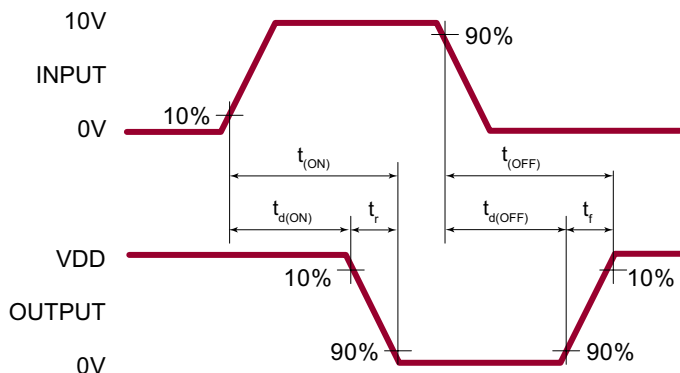
N-Channel Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise specified)

| Sym | Parameter | Min | Typ | Max | Units | Conditions |
|---------------------|--|------|-----|------|------------|---|
| BV_{DSS} | Drain-to-source breakdown voltage | 200 | - | - | V | $V_{GS} = 0V, I_D = 2.0mA$ |
| $V_{GS(th)}$ | 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 | 10 | - | 50 | K Ω | $I_{GS} = 100\mu A$ |
| VZ_{GS} | Gate-to-source Zener voltage | 13.2 | - | 25 | V | $I_{GS} = 2.0mA$ |
| I_{DSS} | Zero gate voltage drain current | - | - | 10.0 | μA | $V_{DS} = \text{Max rating}, V_{GS} = 0V$ |
| | | - | - | 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 | 0.9 | - | - | A | $V_{GS} = 5.0V, V_{DS} = 25V$ |
| | | 2.0 | - | - | | $V_{GS} = 10V, V_{DS} = 50V$ |
| $R_{DS(ON)}$ | Static drain-to-source on-state resistance | - | - | 13 | Ω | $V_{GS} = 5.0V, I_D = 150mA$ |
| | | - | - | 10 | | $V_{GS} = 10V, I_D = 1.0A$ |
| $\Delta R_{DS(ON)}$ | Change in $R_{DS(ON)}$ with temperature | - | - | 1.0 | %/°C | $V_{GS} = 5.0V, I_D = 150mA$ |
| G_{FS} | Forward transconductance | 300 | - | - | mmho | $V_{DS} = 25V, I_D = 500mA$ |
| C_{ISS} | Input capacitance | - | 52 | - | pF | $V_{GS} = 0V, V_{DS} = 25V, f = 1.0MHz$ |
| C_{OSS} | Common source output capacitance | - | 6.9 | - | | |
| C_{RSS} | Reverse transfer capacitance | - | 1.3 | - | | |
| $t_{d(ON)}$ | 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 μs pulse, 2% duty cycle.)
2. All A.C. parameters sample tested.

N-Channel Switching Waveforms and Test Circuit



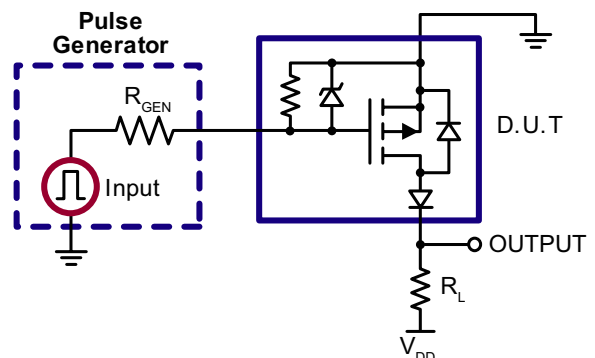
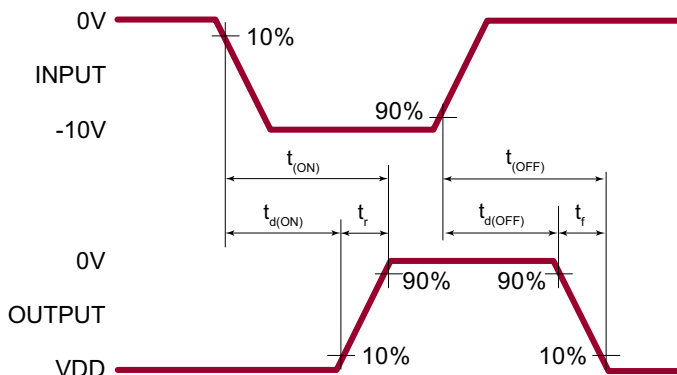
P-Channel Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise specified)

| Sym | Parameter | Min | Typ | Max | Units | Conditions |
|---------------------|--|------|-----|------|------------|---|
| BV_{DSS} | Drain-to-source breakdown voltage | -200 | - | - | V | $V_{GS} = 0V, I_D = -2.0mA$ |
| $V_{GS(th)}$ | 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 | 10 | - | 50 | K Ω | $I_{GS} = 100\mu A$ |
| VZ_{GS} | Gate-to-source Zener voltage | 13.2 | - | 25 | V | $I_{GS} = -2.0mA$ |
| I_{DSS} | Zero gate voltage drain current | - | - | -10 | μA | $V_{DS} = \text{Max rating}, V_{GS} = 0V$ |
| | | - | - | -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 | -0.7 | - | - | A | $V_{GS} = -5.0V, V_{DS} = -25V$ |
| | | -2.0 | - | - | | $V_{GS} = -10V, V_{DS} = -50V$ |
| $R_{DS(ON)}$ | Static drain-to-source on-state resistance | - | - | 15 | Ω | $V_{GS} = -5.0V, I_D = -150mA$ |
| | | - | - | 12 | | $V_{GS} = -10V, I_D = -1.0A$ |
| $\Delta R_{DS(ON)}$ | Change in $R_{DS(ON)}$ with temperature | - | - | 1.0 | %/°C | $V_{GS} = -10V, I_D = -200mA$ |
| G_{FS} | Forward transconductance | 300 | - | - | mmho | $V_{DS} = -25V, I_D = -500mA$ |
| C_{ISS} | Input capacitance | - | 54 | - | pF | $V_{GS} = 0V, V_{DS} = -25V, f = 1.0MHz$ |
| C_{OSS} | Common source output capacitance | - | 7.5 | - | | |
| C_{RSS} | Reverse transfer capacitance | - | 2.6 | - | | |
| $t_{d(ON)}$ | 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:

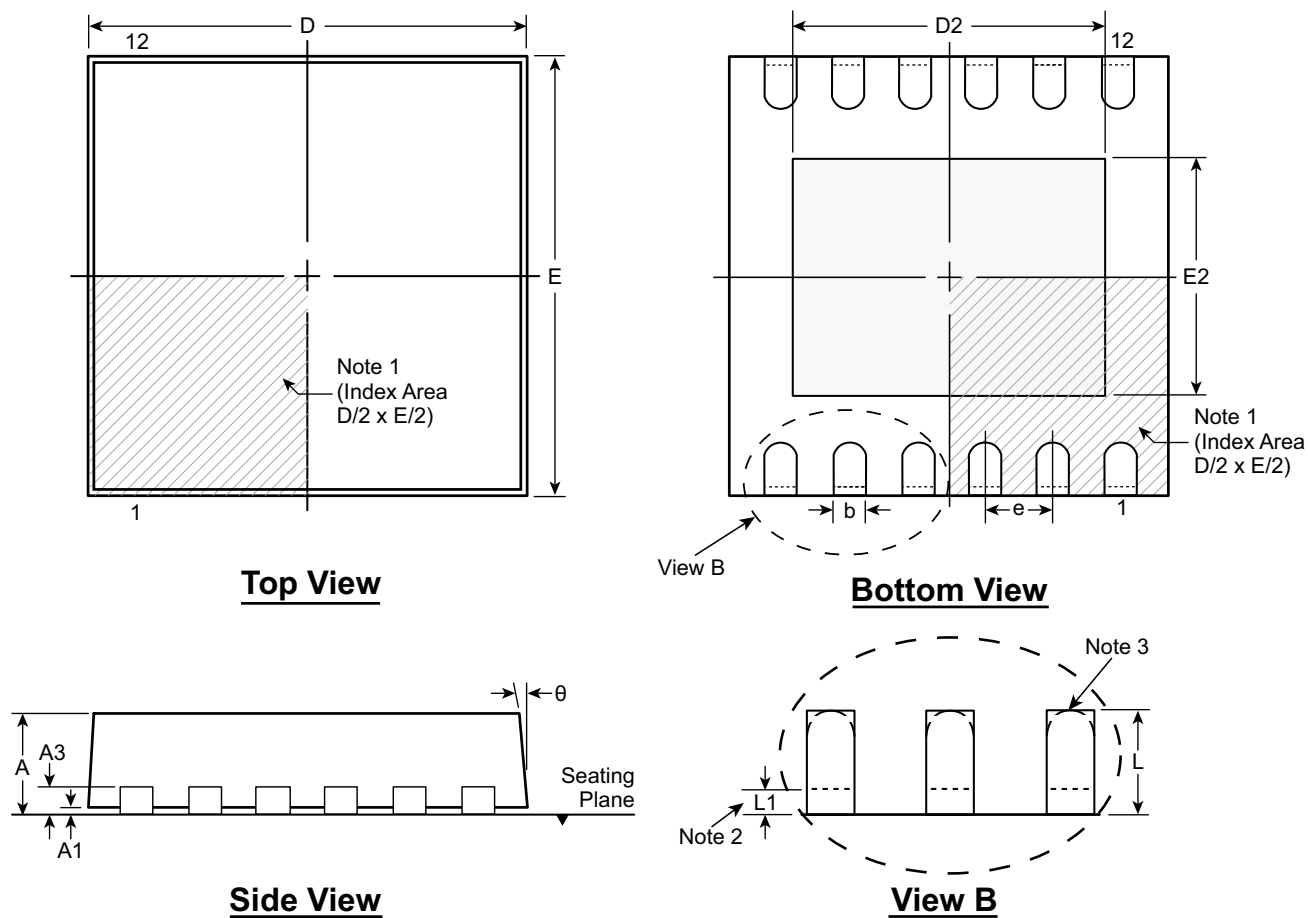
1. All D.C. parameters 100% tested at 25°C unless otherwise stated. (Pulse test: 300 μs pulse, 2% duty cycle.)
2. All A.C. parameters sample tested.

P-Channel Switching Waveforms and Test Circuit



12-Lead DFN Package Outline (K6)

4.00x4.00mm body, 1.00mm height (max), 0.50mm pitch



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 | 3.85 | 3.19 | 3.85 | 2.29 | 0.50 BSC | 0.30 | 0.00 | 0° |
| | NOM | 0.90 | 0.02 | | 0.25 | 4.00 | 3.34 | 4.00 | 2.44 | | 0.40 | - | - |
| | MAX | 1.00 | 0.05 | | 0.30 | 4.15 | 3.44 | 4.15 | 2.54 | | 0.50 | 0.15 | 14° |

Drawings not to scale.

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(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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[DMN1006UCA6-7](#) [DMN16M9UCA6-7](#)