

## FDV301N Digital FET , N-Channel

### General Description

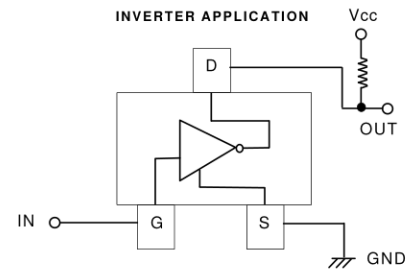
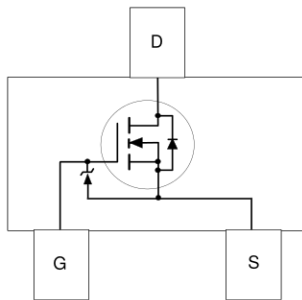
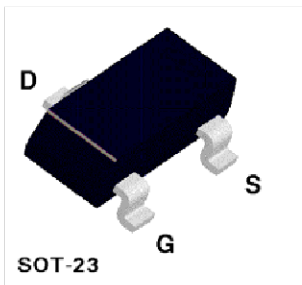
This N-Channel logic level enhancement mode field effect transistor is produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance. This device has been designed especially for low voltage applications as a replacement for digital transistors. Since bias resistors are not required, this one N-channel FET can replace several different digital transistors, with different bias resistor values.

### Features

- 25 V, 0.22 A continuous, 0.5 A Peak.  
 $R_{DS(ON)} = 5 \Omega @ V_{GS} = 2.7 V$   
 $R_{DS(ON)} = 4 \Omega @ V_{GS} = 4.5 V.$
- Very low level gate drive requirements allowing direct operation in 3V circuits.  $V_{GS(th)} < 1.06V.$
- Gate-Source Zener for ESD ruggedness. >6kV Human Body Model
- Replace multiple NPN digital transistors with one DMOS FET.



Mark:301



### Absolute Maximum Ratings $T_A = 25^\circ C$ unless other wise noted

| Symbol            | Parameter                                                                       | FDV301N    | Units      |
|-------------------|---------------------------------------------------------------------------------|------------|------------|
| $V_{DSS}, V_{CC}$ | Drain-Source Voltage, Power Supply Voltage                                      | 25         | V          |
| $V_{GSS}, V_I$    | Gate-Source Voltage, $V_{IN}$                                                   | 8          | V          |
| $I_D, I_O$        | Drain/Output Current - Continuous                                               | 0.22       | A          |
|                   |                                                                                 | 0.5        |            |
| $P_D$             | Maximum Power Dissipation                                                       | 0.35       | W          |
| $T_J, T_{STG}$    | Operating and Storage Temperature Range                                         | -55 to 150 | $^\circ C$ |
| ESD               | Electrostatic Discharge Rating MIL-STD-883D Human Body Model (100pf / 1500 Ohm) | 6.0        | kV         |

### THERMAL CHARACTERISTICS

|                 |                                         |     |              |
|-----------------|-----------------------------------------|-----|--------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 357 | $^\circ C/W$ |
|-----------------|-----------------------------------------|-----|--------------|

### Inverter Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol       | Parameter                         | Conditions                                   | Min | Typ | Max | Units         |
|--------------|-----------------------------------|----------------------------------------------|-----|-----|-----|---------------|
| $I_{O(off)}$ | Zero Input Voltage Output Current | $V_{CC} = 20\text{ V}, V_I = 0\text{ V}$     |     |     | 1   | $\mu\text{A}$ |
| $V_{I(off)}$ | Input Voltage                     | $V_{CC} = 5\text{ V}, I_O = 10\ \mu\text{A}$ |     |     | 0.5 | V             |
| $V_{I(on)}$  |                                   | $V_O = 0.3\text{ V}, I_O = 0.005\text{ A}$   | 1   |     |     | V             |
| $R_{O(on)}$  | Output to Ground Resistance       | $V_I = 2.7\text{ V}, I_O = 0.2\text{ A}$     |     | 4   | 5   | $\Omega$      |

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|--------|-----------|------------|-----|-----|-----|-------|
|--------|-----------|------------|-----|-----|-----|-------|

#### OFF CHARACTERISTICS

|                              |                                     |                                                                         |    |    |     |                            |
|------------------------------|-------------------------------------|-------------------------------------------------------------------------|----|----|-----|----------------------------|
| $BV_{DSS}$                   | Drain-Source Breakdown Voltage      | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$                           | 25 |    |     | V                          |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | $I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$             |    | 25 |     | $\text{mV}/^\circ\text{C}$ |
| $I_{DSS}$                    | Zero Gate Voltage Drain Current     | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$<br>$T_J = 55^\circ\text{C}$ |    |    | 1   | $\mu\text{A}$              |
|                              |                                     |                                                                         |    |    | 10  | $\mu\text{A}$              |
| $I_{GSS}$                    | Gate - Body Leakage Current         | $V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$                              |    |    | 100 | nA                         |

#### ON CHARACTERISTICS (Note)

|                                |                                          |                                                                          |      |      |      |                            |
|--------------------------------|------------------------------------------|--------------------------------------------------------------------------|------|------|------|----------------------------|
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Temp. Coefficient | $I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$              |      | -2.1 |      | $\text{mV}/^\circ\text{C}$ |
| $V_{GS(th)}$                   | Gate Threshold Voltage                   | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$                                | 0.70 | 0.85 | 1.06 | V                          |
| $R_{DS(on)}$                   | Static Drain-Source On-Resistance        | $V_{GS} = 2.7\text{ V}, I_D = 0.2\text{ A}$<br>$T_J = 125^\circ\text{C}$ |      | 3.8  | 5    | $\Omega$                   |
|                                |                                          |                                                                          |      | 6.3  | 9    |                            |
|                                |                                          |                                                                          |      | 3.1  | 4    |                            |
| $I_{D(on)}$                    | On-State Drain Current                   | $V_{GS} = 2.7\text{ V}, V_{DS} = 5\text{ V}$                             | 0.2  |      |      | A                          |
| $g_{FS}$                       | Forward Transconductance                 | $V_{DS} = 5\text{ V}, I_D = 0.4\text{ A}$                                |      | 0.2  |      | S                          |

#### DYNAMIC CHARACTERISTICS

|           |                              |                                                                      |  |     |  |    |
|-----------|------------------------------|----------------------------------------------------------------------|--|-----|--|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$ |  | 9.5 |  | pF |
| $C_{oss}$ | Output Capacitance           |                                                                      |  | 6   |  | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                      |  | 1.3 |  | pF |

#### SWITCHING CHARACTERISTICS (Note)

|              |                       |                                                                                             |  |      |     |    |
|--------------|-----------------------|---------------------------------------------------------------------------------------------|--|------|-----|----|
| $t_{D(on)}$  | Turn - On Delay Time  | $V_{DD} = 6\text{ V}, I_D = 0.5\text{ A},$<br>$V_{GS} = 4.5\text{ V}, R_{GEN} = 50\ \Omega$ |  | 3.2  | 8   | ns |
| $t_r$        | Turn - On Rise Time   |                                                                                             |  | 6    | 15  | ns |
| $t_{D(off)}$ | Turn - Off Delay Time |                                                                                             |  | 3.5  | 8   | ns |
| $t_f$        | Turn - Off Fall Time  |                                                                                             |  | 3.5  | 8   | ns |
| $Q_g$        | Total Gate Charge     | $V_{DS} = 5\text{ V}, I_D = 0.2\text{ A},$<br>$V_{GS} = 4.5\text{ V}$                       |  | 0.49 | 0.7 | nC |
| $Q_{gs}$     | Gate-Source Charge    |                                                                                             |  | 0.22 |     | nC |
| $Q_{gd}$     | Gate-Drain Charge     |                                                                                             |  | 0.07 |     | nC |

#### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

|          |                                                       |                                                   |  |      |     |   |
|----------|-------------------------------------------------------|---------------------------------------------------|--|------|-----|---|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current |                                                   |  | 0.29 |     | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_S = 0.29\text{ A}$ (Note) |  | 0.8  | 1.2 | V |

Note:  
Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## Typical Electrical Characteristics

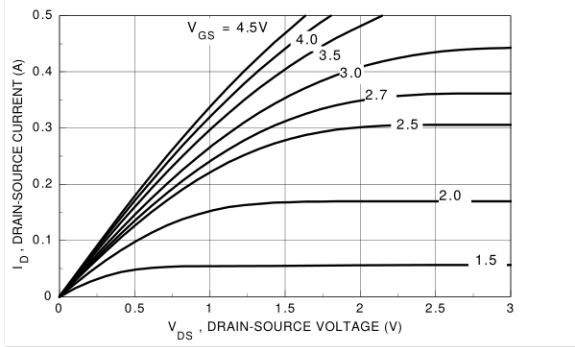


Figure 1. On-Region Characteristics.

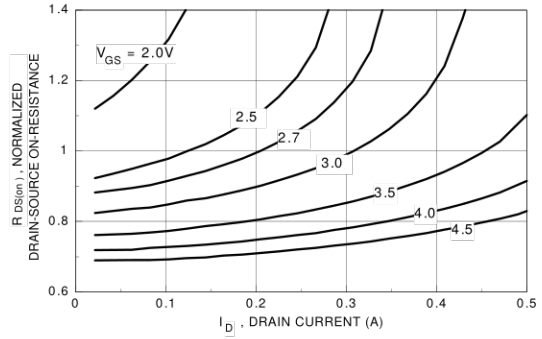


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

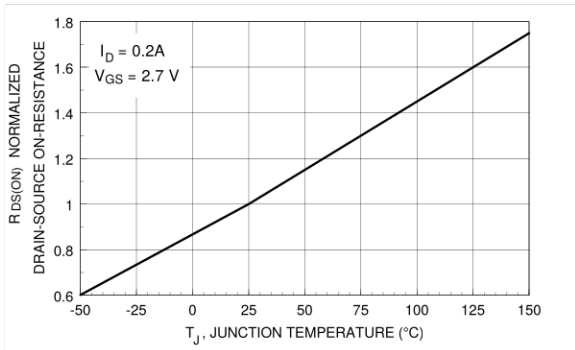


Figure 3. On-Resistance Variation with Temperature.

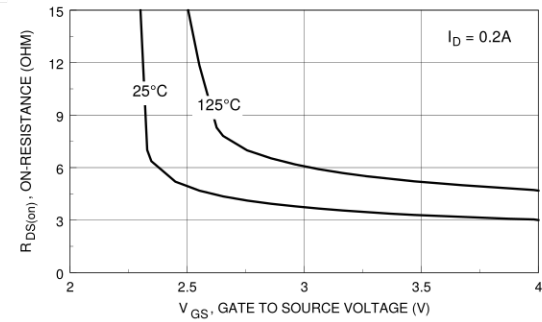


Figure 4. On Resistance Variation with Gate-To-Source Voltage.

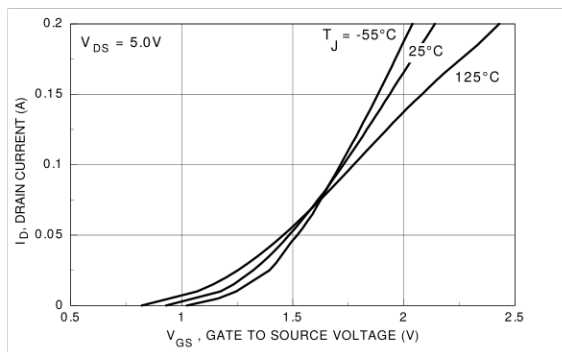


Figure 5. Transfer Characteristics.

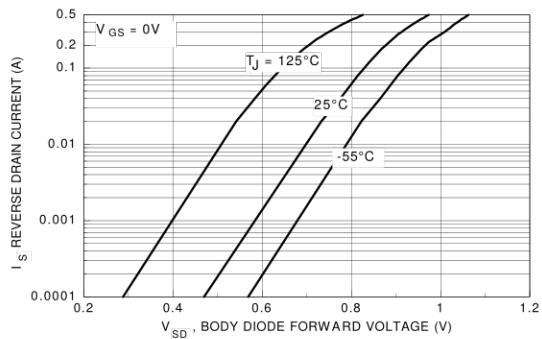


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

## Typical Electrical And Thermal Characteristics

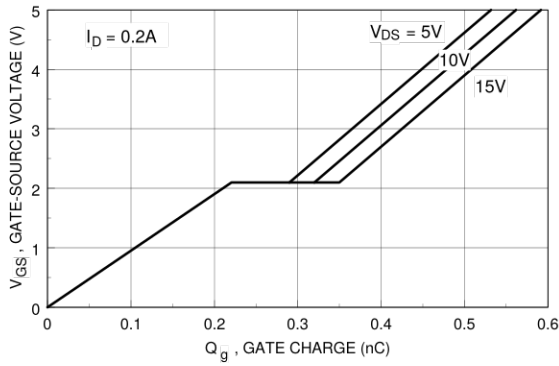


Figure 7. Gate Charge Characteristics.

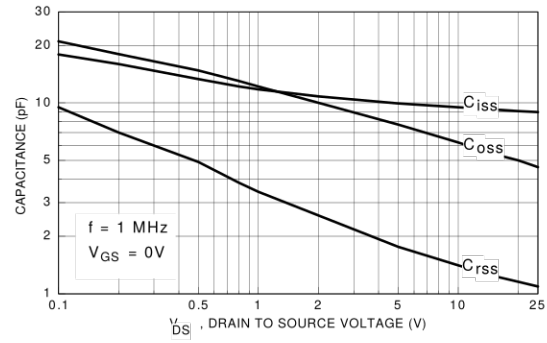


Figure 8. Capacitance Characteristics.

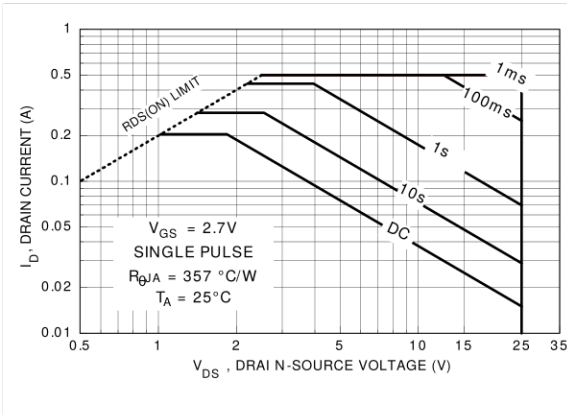


Figure 9. Maximum Safe Operating Area.

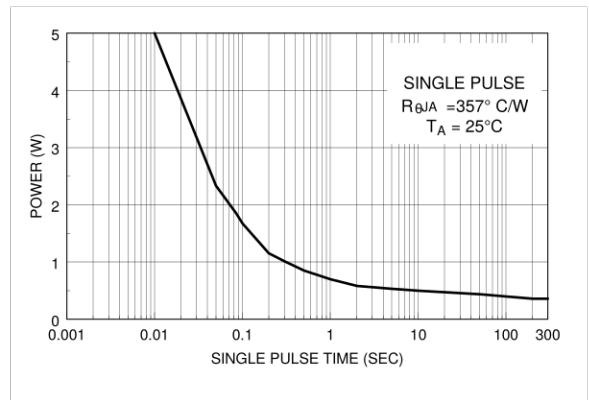


Figure 10. Single Pulse Maximum Power Dissipation.

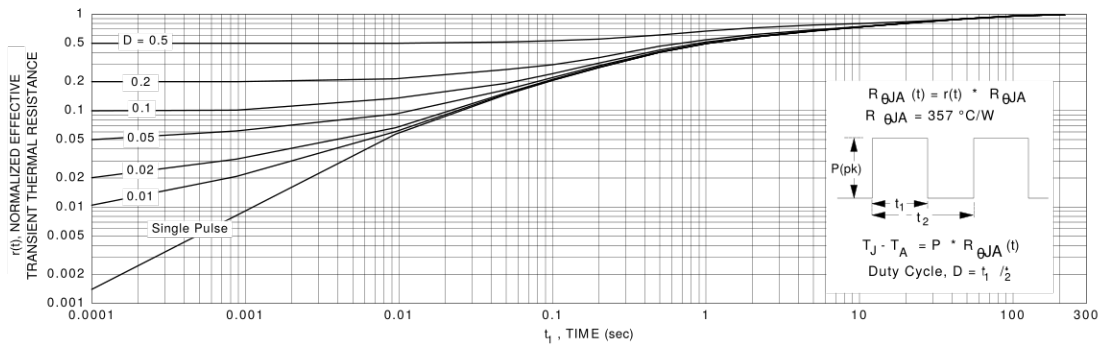







Figure 11. Transient Thermal Response Curve.



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| CTL™                                                                              | Gmax™                                                                               | Quiet Series™                                                                        | TinyLogic®           |
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