

# ON Semiconductor

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ON Semiconductor®

## FDC6301N

### Dual N-Channel , Digital FET

#### General Description

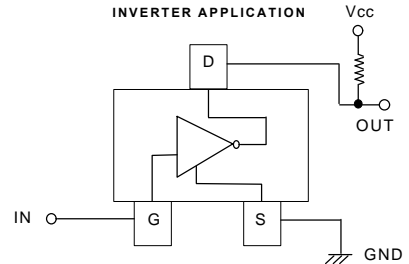
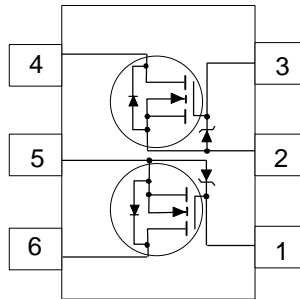
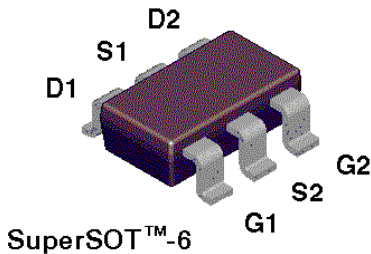
These dual N-Channel logic level enhancement mode field effect transistors are produced using ON Semiconductor's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance. This device has been designed especially for low voltage applications as a replacement for digital transistors. Since bias resistors are not required, these N-Channel FET's can replace several digital transistors, with a variety of bias resistors.

#### 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.  $V_{GS(th)} < 1.5V.$
- Gate-Source Zener for ESD ruggedness. >6kV Human Body Model.



Mark: .301



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

Symbol	Parameter	FDC6301N	Units
$V_{DSS}, V_{CC}$	Drain-Source Voltage, Power Supply Voltage	25	V
$V_{GSS}, V_{IN}$	Gate-Source Voltage, $V_{IN}$	- 0.5 to +8	V
$I_D, I_{OUT}$	Drain/Output Current - Continuous - Pulsed	0.22	A
		0.5	
$P_D$	Maximum Power Dissipation (Note 1a) (Note 1b)	0.9	W
		0.7	
$T_J, T_{STG}$	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

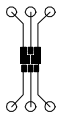
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	140	$^\circ C/W$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	60	$^\circ C/W$

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

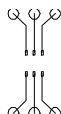
Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	25			V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		25		$\text{mV}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
				$T_J = 55^\circ\text{C}$	10	$\mu\text{A}$
$I_{GSS}$	Gate - Body Leakage Current	$V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$			100	nA
<b>ON CHARACTERISTICS (Note 2)</b>						
$\Delta V_{GS(th)}/\Delta T_J$	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	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	0.65	0.85	1.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 2.7\text{ V}, I_D = 0.2\text{ A}$		3.8	5	$\Omega$
			$T_J = 125^\circ\text{C}$	6.3	9	
		$V_{GS} = 4.5\text{ V}, I_D = 0.4\text{ A}$		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	$V_{DS} = 5\text{ V}, I_D = 0.4\text{ A}$		0.25		S
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		9.5		pF
$C_{oss}$	Output Capacitance			6		pF
$C_{rss}$	Reverse Transfer Capacitance			1.3		pF
<b>SWITCHING CHARACTERISTICS (Note 2)</b>						
$t_{D(on)}$	Turn - On Delay Time	$V_{DD} = 6\text{ V}, I_D = 0.5\text{ A},$ $V_{GS} = 4.5\text{ V}, R_{GEN} = 50\ \Omega$		5	10	ns
$t_r$	Turn - On Rise Time			4.5	10	ns
$t_{D(off)}$	Turn - Off Delay Time			4	8	ns
$t_f$	Turn - Off Fall Time			3.2	7	ns
$Q_g$	Total Gate Charge	$V_{DS} = 5\text{ V}, I_D = 0.2\text{ A},$ $V_{GS} = 4.5\text{ V}$		0.49	0.7	nC
$Q_{gs}$	Gate-Source Charge			0.22		nC
$Q_{gd}$	Gate-Drain Charge			0.07		nC
<b>Inverter Electrical Characteristics (<math>T_A = 25^\circ\text{C}</math> unless otherwise noted)</b>						
$I_{O(off)}$	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	$V_I = 2.7\text{ V}, I_O = 0.2\text{ A}$		3.8	5	$\Omega$

**Notes:**

- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.  $R_{\theta JA}$  shown below for single device operation on FR-4 in still air.



a.  $140^\circ\text{C}/\text{W}$  on a  $0.125\text{ in}^2$  pad of 2oz copper.



b.  $180^\circ\text{C}/\text{W}$  on a  $0.005\text{ in}^2$  pad of 2oz copper.

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

## Typical Electrical Characteristics

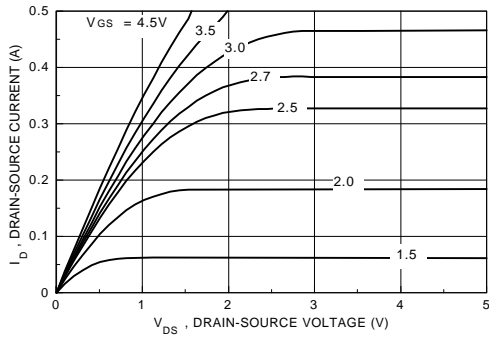


Figure 1. On-Region Characteristics.

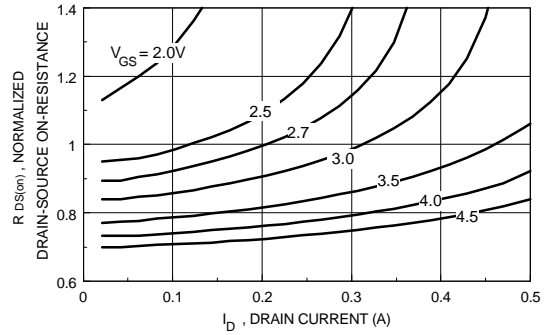


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

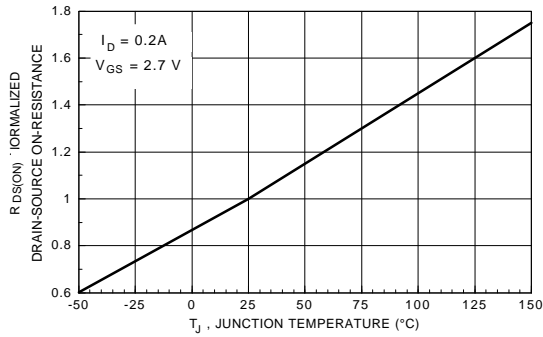


Figure 3. On-Resistance Variation with Temperature.

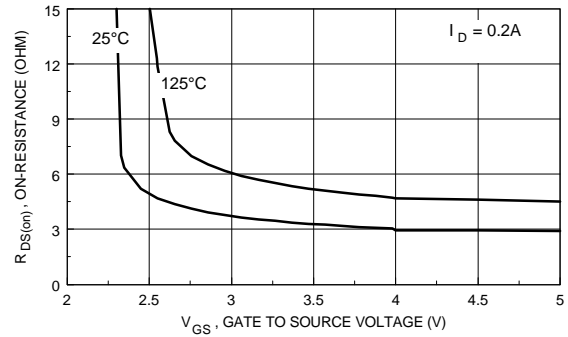


Figure 4. On Resistance Variation with Gate-To-Source Voltage.

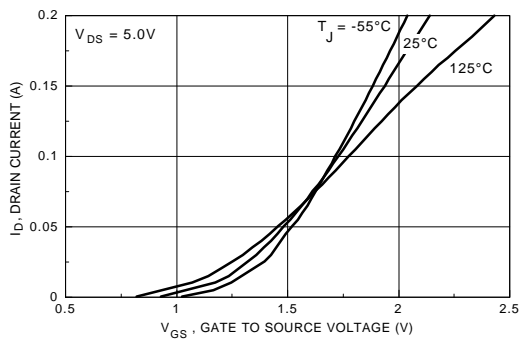


Figure 5. Transfer Characteristics.

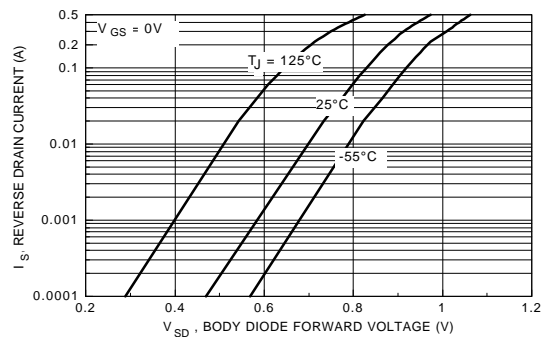


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

## Typical Electrical Characteristics (continued)

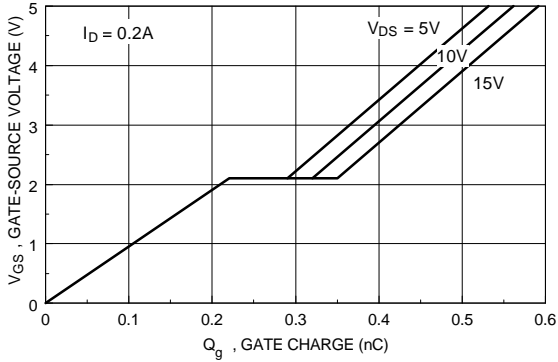


Figure 7. Gate Charge Characteristics.

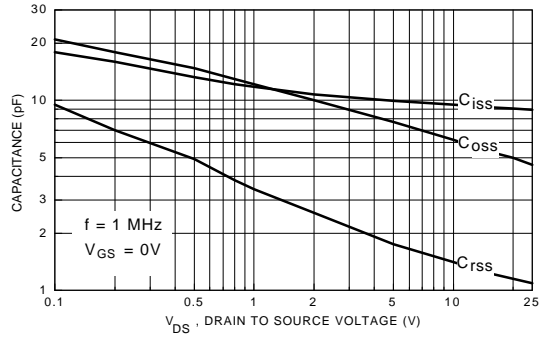


Figure 8. Capacitance Characteristics.

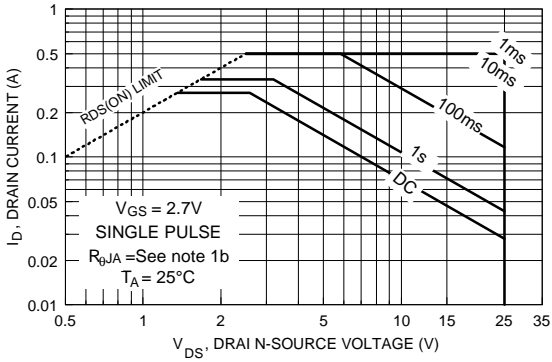


Figure 9. Maximum Safe Operating Area.

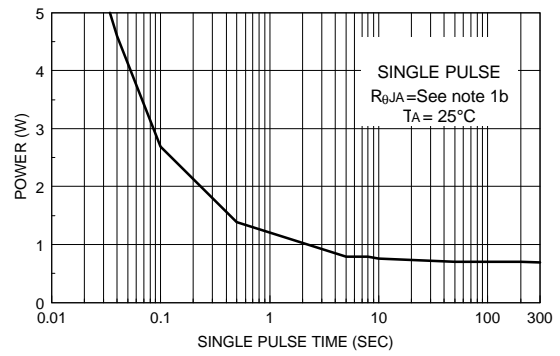


Figure 10. Single Pulse Maximum Power Dissipation.

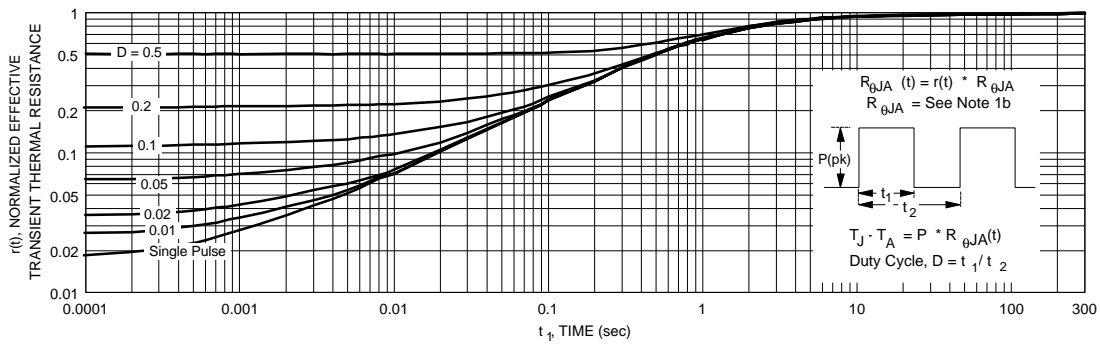


Figure 11. Transient Thermal Response Curve.

Note: Thermal characterization performed using the conditions described in note 1b. Transient thermal response will change depending on the circuit board design.

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