

## P-Channel 20-V (D-S) MOSFET

PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A)	Q <sub>g</sub> (Typ.)
- 20	0.032 at V <sub>GS</sub> = - 4.5 V	- 7.1	16.5
	0.040 at V <sub>GS</sub> = - 2.5 V	- 6.4	
	0.053 at V <sub>GS</sub> = - 1.8 V	- 5.5	

### FEATURES

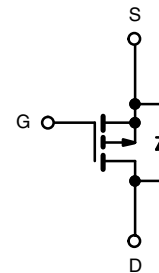
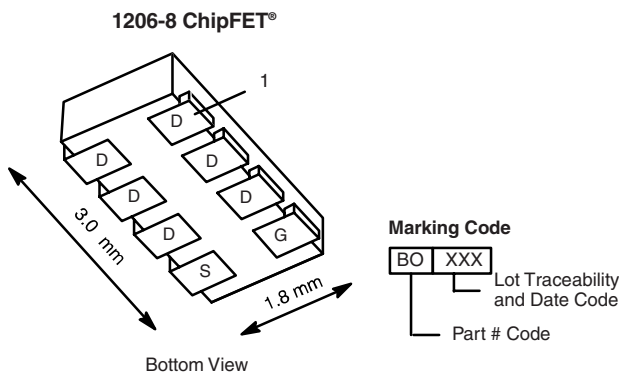
- Halogen-free According to IEC 61249-2-21 Available
- TrenchFET<sup>®</sup> Power MOSFET
- Ultra-Low On-Resistance
- Thermally Enhanced ChipFET<sup>®</sup> Package
- 40 % Smaller Footprint than TSOP-6



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### APPLICATIONS

- Load Switch, PA Switch, and Battery Switch for Portable Devices



P-Channel MOSFET

**Ordering Information:** Si5401DC-T1-E3 (Lead (Pb)-free)  
Si5401DC-T1-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted				
Parameter	Symbol	5 s	Steady State	Unit
Drain-Source Voltage	V <sub>DS</sub>	- 20		V
Gate-Source Voltage	V <sub>GS</sub>	± 8		
Continuous Drain Current (T <sub>J</sub> = 150 °C) <sup>a</sup>	I <sub>D</sub>	T <sub>A</sub> = 25 °C	- 7.1	- 5.2
		T <sub>A</sub> = 85 °C	- 5.1	- 3.7
Pulsed Drain Current	I <sub>DM</sub>	- 20		A
Continuous Source Current <sup>a</sup>	I <sub>S</sub>	- 2.1	- 1.1	
Maximum Power Dissipation <sup>a</sup>	P <sub>D</sub>	T <sub>A</sub> = 25 °C	2.5	1.3
		T <sub>A</sub> = 85 °C	1.3	0.7
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150		°C
Soldering Recommendations (Peak Temperature) <sup>b, c</sup>		260		

THERMAL RESISTANCE RATINGS					
Parameter	Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient <sup>a</sup>	R <sub>thJA</sub>	t ≤ 5 s	40	50	°C/W
		Steady State	80	95	
Maximum Junction-to-Foot (Drain)	R <sub>thJF</sub>	15	20		

Notes:

- Surface Mounted on 1" x 1" FR4 board.
- See Reliability Manual for profile. The ChipFET is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.
- Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.

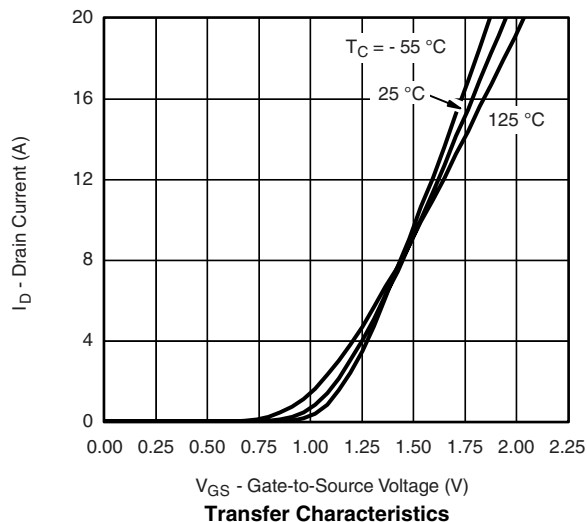
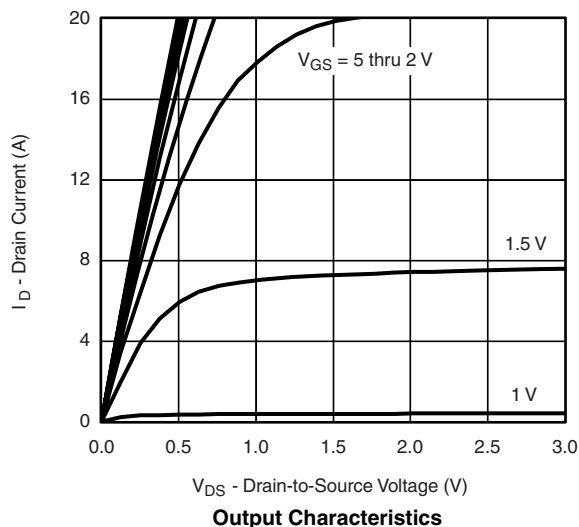
<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-0.40		-1.0	V
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$			-5	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	-20			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -5.2\text{ A}$		0.026	0.032	$\Omega$
		$V_{GS} = -2.5\text{ V}, I_D = -4.6\text{ A}$		0.033	0.040	
		$V_{GS} = -1.8\text{ V}, I_D = -1.9\text{ A}$		0.044	0.053	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -10\text{ V}, I_D = -5.2\text{ A}$		20		S
Diode Forward Voltage <sup>a</sup>	$V_{SD}$	$I_S = -1.1\text{ A}, V_{GS} = 0\text{ V}$		-0.8	-1.2	V
<b>Dynamic<sup>b</sup></b>						
Total Gate Charge	$Q_g$	$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -5.2\text{ A}$		16.5	25	nC
Gate-Source Charge	$Q_{gs}$		1.7			
Gate-Drain Charge	$Q_{gd}$		3.5			
Gate Resistance	$R_g$	$f = 1\text{ MHz}$		9		$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 10\text{ }\Omega$ $I_D \cong -1\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 6\text{ }\Omega$		10	15	ns
Rise Time	$t_r$		25	40		
Turn-Off Delay Time	$t_{d(off)}$		115	175		
Fall Time	$t_f$		70	105		
Source-Drain Reverse Recovery Time	$t_{rr}$	$I_F = -1.1\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}$		30	60	nC
Reverse Recovery Charge	$Q_{rr}$			140		

Notes:

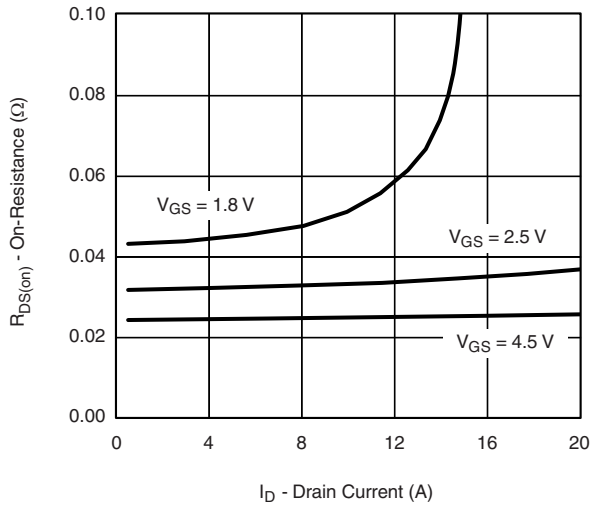
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

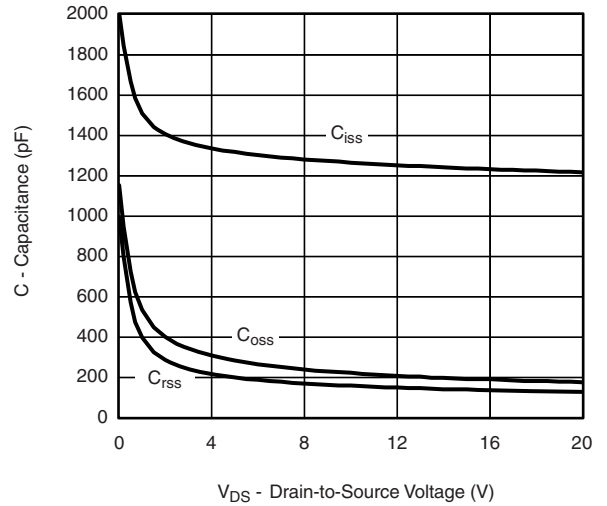
### TYPICAL CHARACTERISTICS $25\text{ }^\circ\text{C}$ , unless otherwise noted



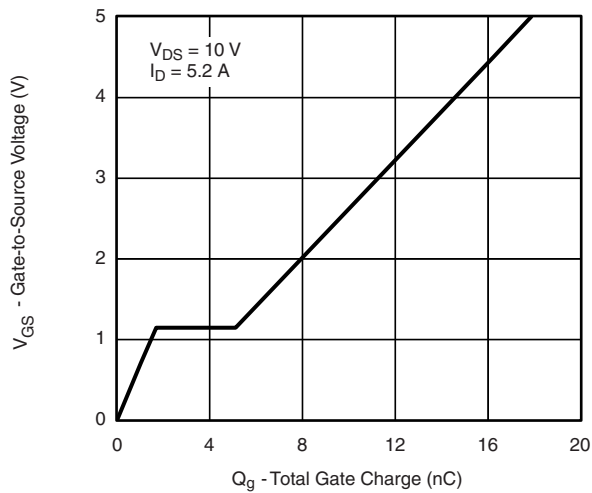
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



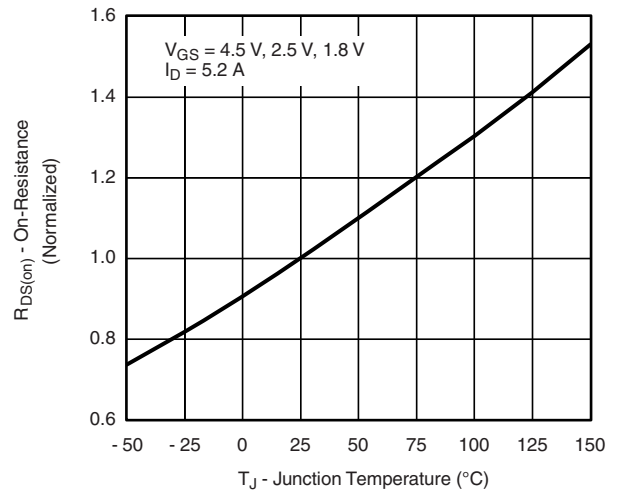
**On-Resistance vs. Drain Current**



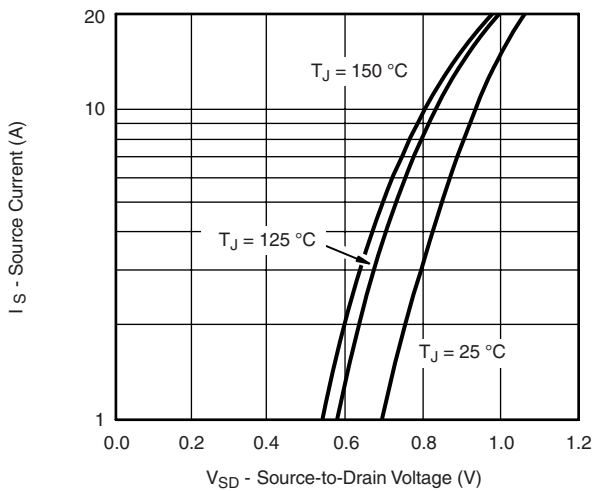
**Capacitance**



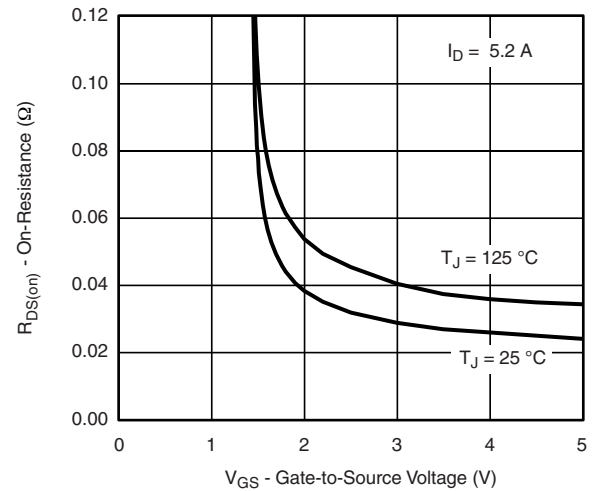
**Gate Charge**



**On-Resistance vs. Junction Temperature**

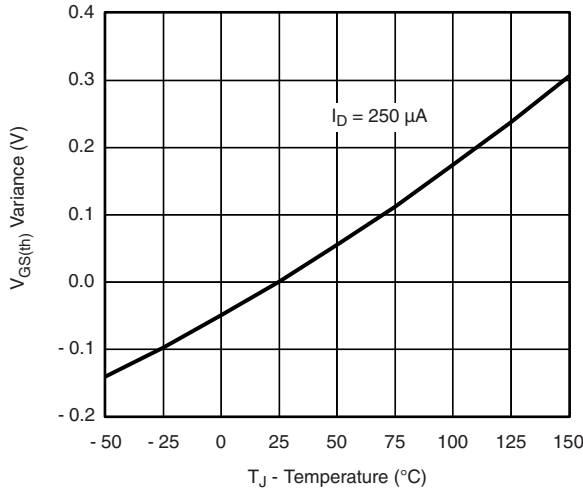


**Source-Drain Diode Forward Voltage**

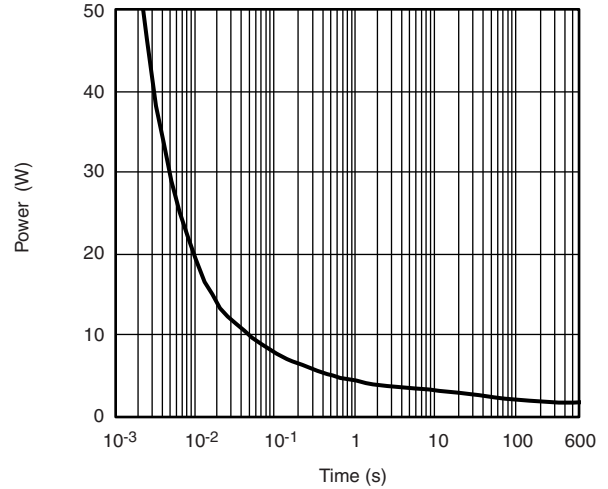


**On-Resistance vs. Gate-to-Source Voltage**

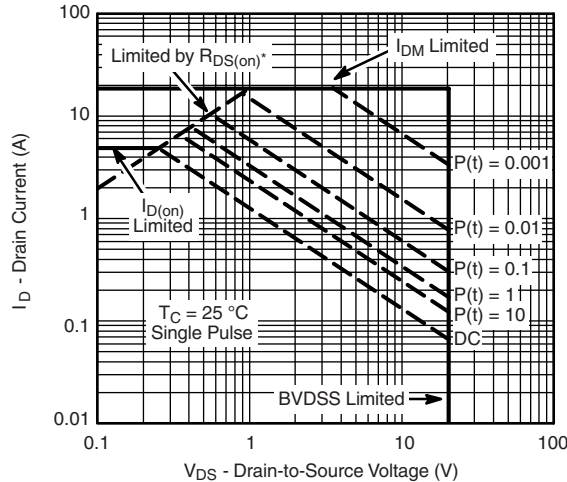
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



**Threshold Voltage**

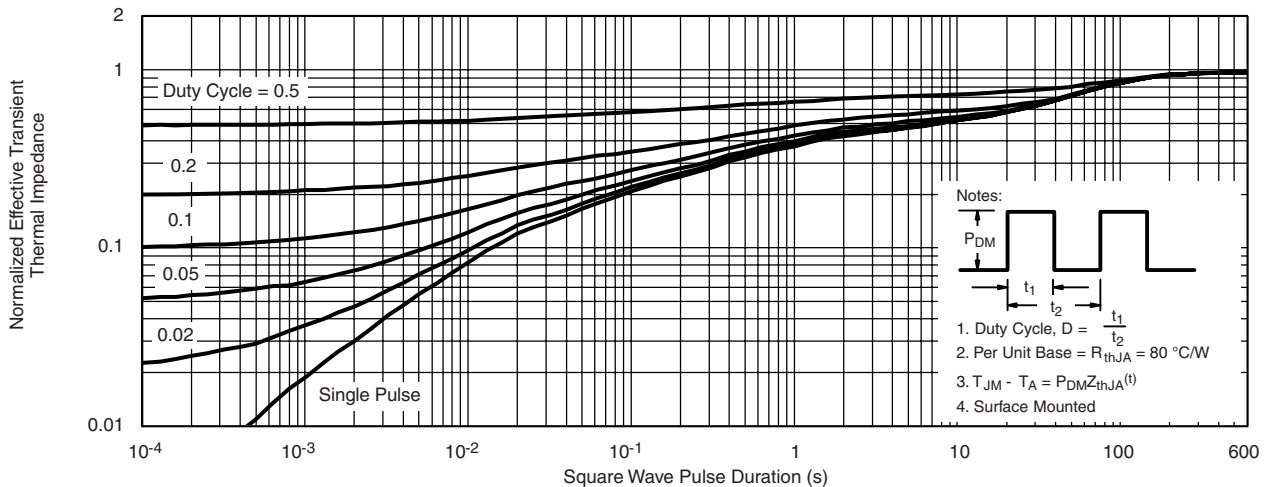


**Single Pulse Power**



\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

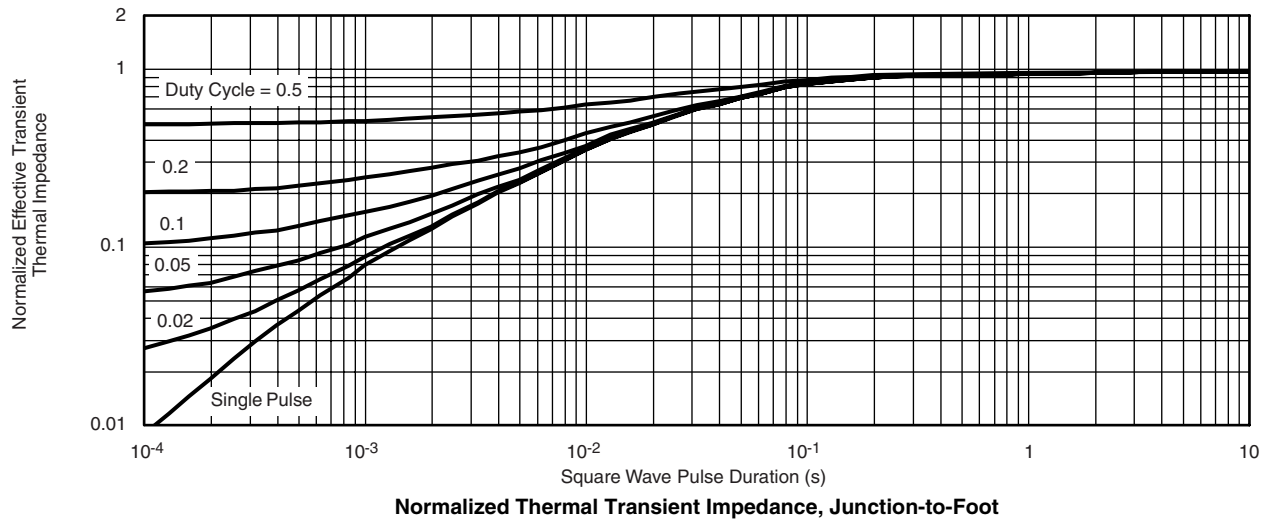
**Safe Operating Area**



**Normalized Thermal Transient Impedance, Junction-to-Ambient**



**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



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