

## U413-VB Datasheet

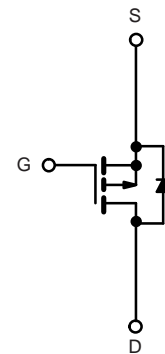
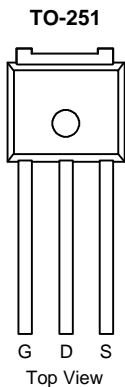
### P-Channel 40 V (D-S) MOSFET

#### PRODUCT SUMMARY

$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A) <sup>a</sup>
- 40	0.010 at $V_{GS} = - 10$ V	$\pm 55$
	0.014 at $V_{GS} = - 4.5$ V	$\pm 54$

#### FEATURES

- Compliant to RoHS Directive 2002/95/EC



P-Channel MOSFET

#### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Limit	Unit
Gate-Source Voltage	$V_{GS}$	$\pm 40$	V
Continuous Drain Current ( $T_J = 175\text{ }^\circ\text{C}$ )	$I_D$	$- 55^a$	A
		$- 52$	
Pulsed Drain Current	$I_{DM}$	$- 220$	
Avalanche Current	$I_{AR}$	$- 60$	
Repetitive Avalanche Energy <sup>b</sup>	$E_{AR}$	180	mJ
Power Dissipation	$P_D$	45	W
		3.75	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	$- 55$ to $175$	$^\circ\text{C}$

#### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Limit	Unit
Junction-to-Ambient	$R_{thJA}$	40	$^\circ\text{C/W}$
		62.5	
Junction-to-Case	$R_{thJC}$	0.8	

Notes:

- Package limited.
- Duty cycle  $\leq 1\%$ .
- When mounted on 1" square PCB (FR-4 material).
- See SOA curve for voltage derating.

\* Pb containing terminations are not RoHS compliant, exemptions may apply.

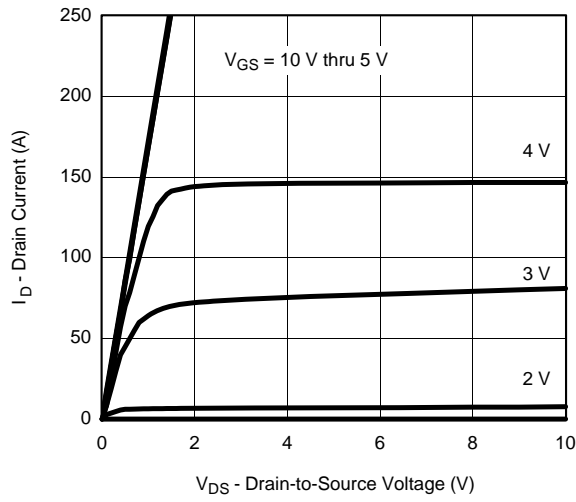
SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = - 250 μA	- 40			V
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = - 250 μA	- 1.0		- 2.5	
Gate-Body Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V			± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = - 40 V, V <sub>GS</sub> = 0 V			- 1	μA
		V <sub>DS</sub> = - 40 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C			- 50	
		V <sub>DS</sub> = - 40 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 175 °C			- 250	
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> = - 5 V, V <sub>GS</sub> = - 10 V	- 120			A
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 30 A		0.010		Ω
		V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 30 A, T <sub>J</sub> = 125 °C		0.016		
		V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 30 A, T <sub>J</sub> = 175 °C		0.023		
		V <sub>GS</sub> = - 4.5 V, I <sub>D</sub> = - 20 A		0.014		
Forward Transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = - 15 V, I <sub>D</sub> = - 75 A	20			S
Dynamic <sup>b</sup>						
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = - 25 V, f = 1 MHz		3000		pF
Output Capacitance	C <sub>oss</sub>			620		
Reversen Transfer Capacitance	C <sub>rss</sub>			315		
Total Gate Charge <sup>c</sup>	Q <sub>g</sub>	V <sub>DS</sub> = - 15 V, V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 75 A		160		nC
Gate-Source Charge <sup>c</sup>	Q <sub>gs</sub>			32		
Gate-Drain Charge <sup>c</sup>	Q <sub>gd</sub>			30		
Turn-On Delay Time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = - 15 V, R <sub>L</sub> = 0.2 Ω I <sub>D</sub> ≐ - 75 A, V <sub>GEN</sub> = - 10 V, R <sub>g</sub> = 2.5 Ω		25	40	ns
Rise Time <sup>c</sup>	t <sub>r</sub>			225	360	
Turn-Off Delay Time <sup>c</sup>	t <sub>d(off)</sub>			150	240	
Fall Time <sup>c</sup>	t <sub>f</sub>			210	340	
Source-Drain Diode Ratings and Characteristics <sup>b</sup> (T <sub>C</sub> = 25 °C)						
Continuous Current	I <sub>S</sub>			- 220		A
Pulsed Current	I <sub>SM</sub>				- 240	
Forward Voltage <sup>a</sup>	V <sub>SD</sub>	I <sub>F</sub> = - 75 A, V <sub>GS</sub> = 0 V		- 1.2	- 1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = - 75 A, dI/dt = 100 A/μs		55	100	ns
Peak Reverse Recovery Current	I <sub>RM(REC)</sub>			2.5	5	A
Reverse Recovery Charge	Q <sub>rr</sub>			0.07	0.25	μC

Notes:

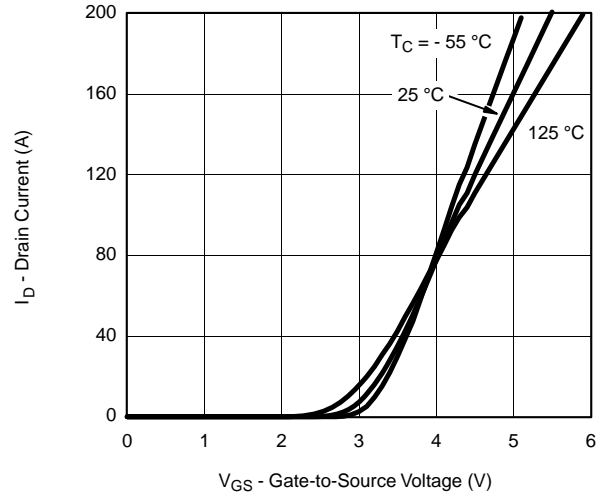
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.  
 c. Independent of operating temperature.

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 °C, unless otherwise noted)



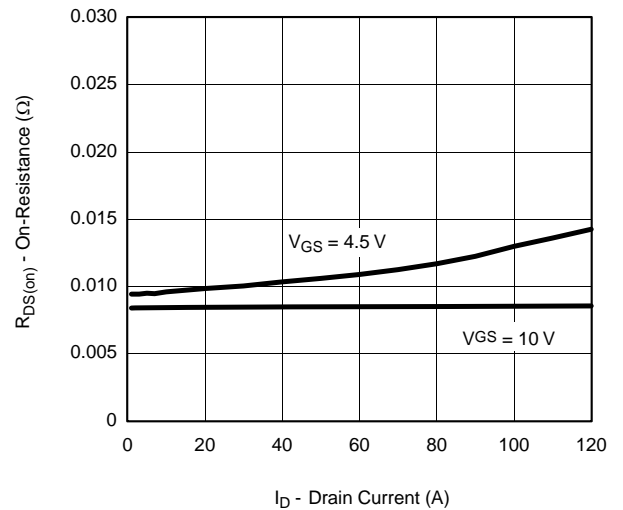
**Output Characteristics**



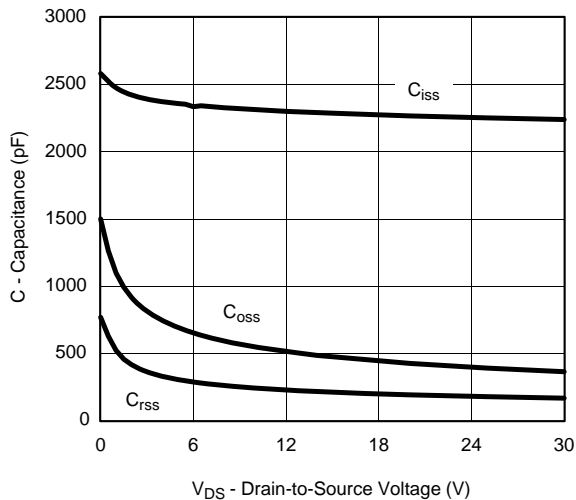
**Transfer Characteristics**



**Transconductance**



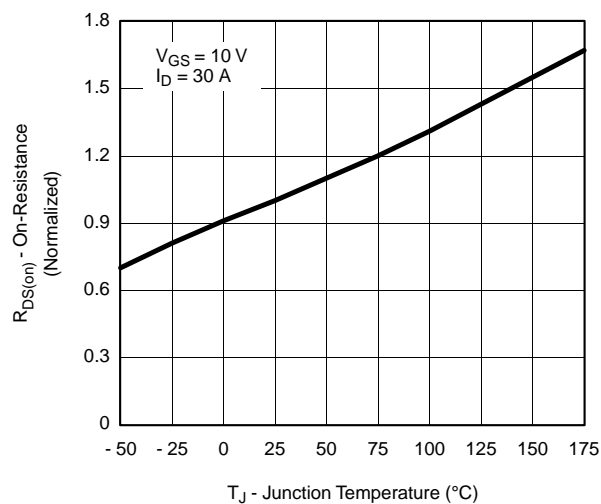
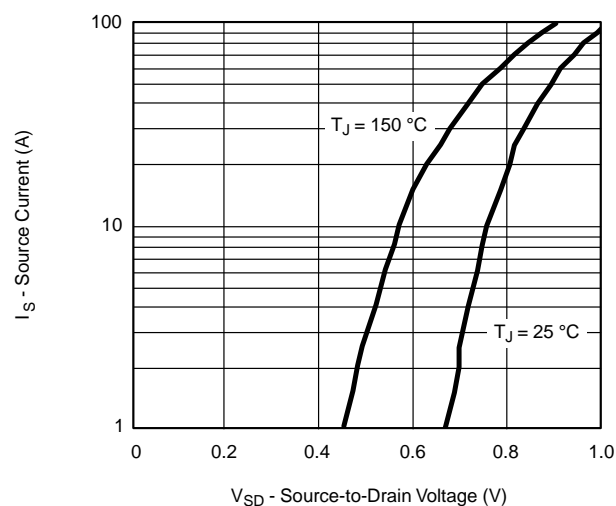
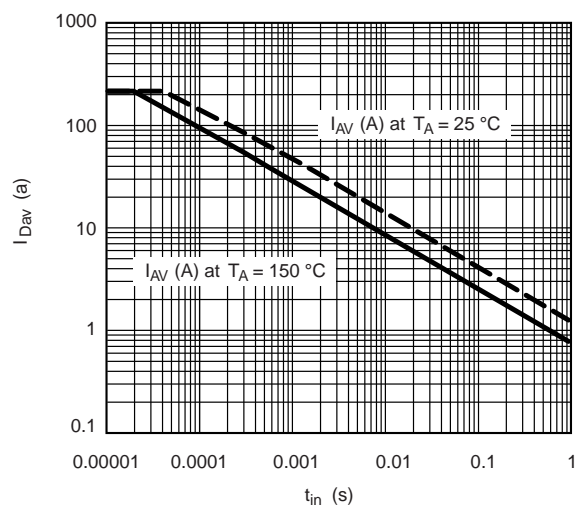
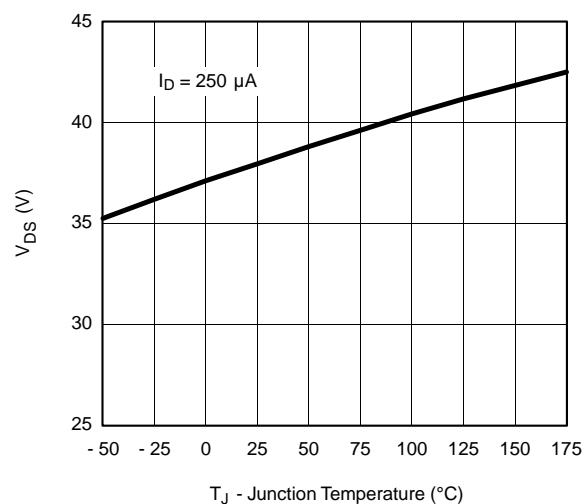
**On-Resistance vs. Drain Current**



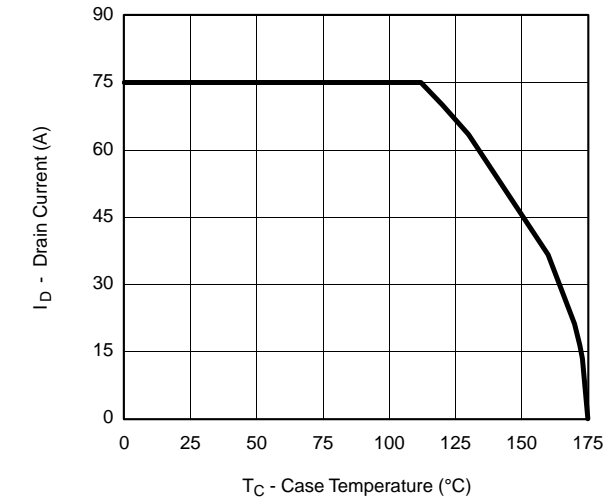
**Capacitance**



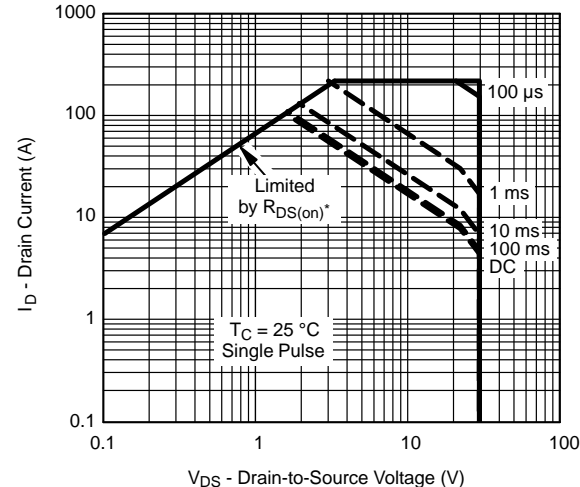
**Gate Charge**

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

**On-Resistance vs. Junction Temperature**

**Source-Drain Diode Forward Voltage**

**Avalanche Current vs. Time**

**Drain Source Breakdown  
vs. Junction Temperature**

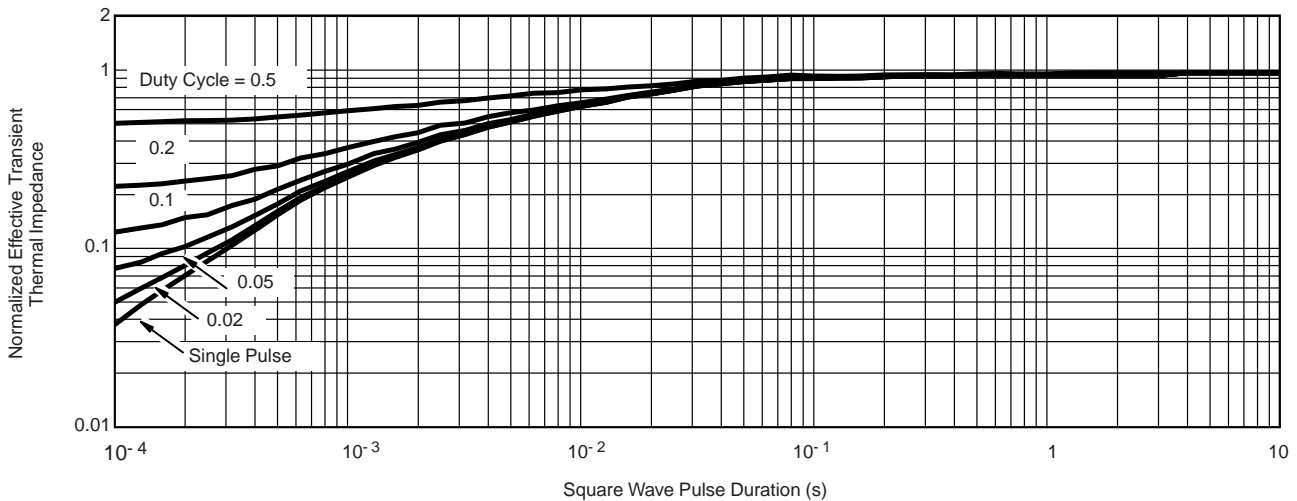
**THERMAL RATINGS**



**Maximum Avalanche and Drain Current  
vs. Case Temperature**

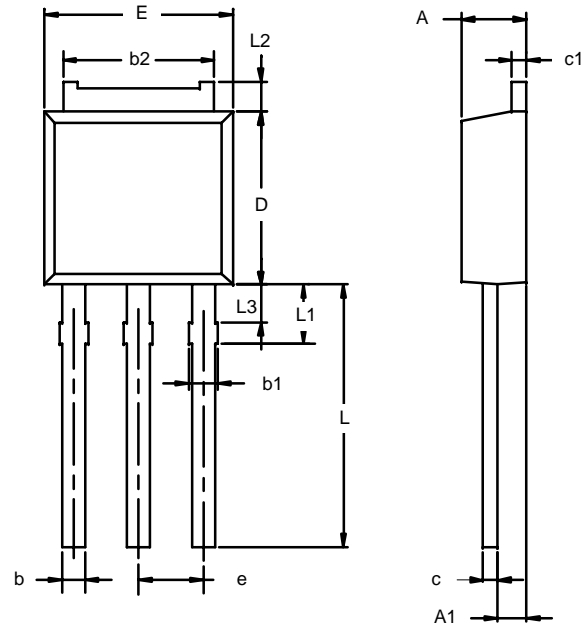


**\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified  
Safe Operating Area**



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

**TO-251AA (DPAK)**



Note: Dimension L3 is for reference only.

Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	2.21	2.38	0.087	0.094
A1	0.89	1.14	0.035	0.045
b	0.71	0.89	0.028	0.035
b1	0.76	1.14	0.030	0.045
b2	5.23	5.43	0.206	0.214
c	0.46	0.58	0.018	0.023
c1	0.46	0.58	0.018	0.023
D	5.97	6.22	0.235	0.245
E	6.48	6.73	0.255	0.265
e	2.28 BSC		0.090 BSC	
L	8.89	9.53	0.350	0.375
L1	1.91	2.28	0.075	0.090
L2	0.89	1.27	0.035	0.050
L3	1.15	1.52	0.045	0.060
ECN: S-03946—Rev. E, 09-Jul-01 DWG: 5346				

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