

D413A-VB Datasheet

P-Channel 40 V (D-S) MOSFET

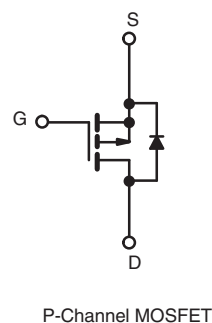
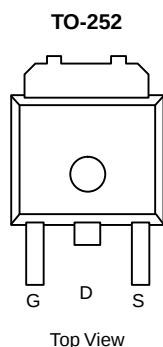
PRODUCT SUMMARY	
V_{DS} (V)	-40
$R_{DS(on)}$ (Ω) at $V_{GS} = -10$ V	0.012
$R_{DS(on)}$ (Ω) at $V_{GS} = -4.5$ V	0.015
I_D (A)	-50
Configuration	Single

FEATURES

- Trench power MOSFET
- Package with low thermal resistance
- 100 % R_g and UIS tested



RoHS
COMPLIANT
HALOGEN
FREE



ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		V_{DS}	-40	V
Gate-Source Voltage		V_{GS}	± 20	
Continuous Drain Current	$T_C = 25\text{ }^{\circ}\text{C}$ ^a	I_D	-50	A
	$T_C = 125\text{ }^{\circ}\text{C}$		-39	
Continuous Source Current (Diode Conduction) ^a		I_S	-50	
Pulsed Drain Current ^b		I_{DM}	-200	
Single Pulse Avalanche Current	$L = 0.1\text{ mH}$	I_{AS}	-40	
Single Pulse Avalanche Energy		E_{AS}	80	mJ
Maximum Power Dissipation ^b	$T_A = 25\text{ }^{\circ}\text{C}$	P_D	3	W
	$T_C = 25\text{ }^{\circ}\text{C}$		136	
	$T_C = 125\text{ }^{\circ}\text{C}$		45	
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	PCB Mount ^c	R_{thJA}	50	$^{\circ}\text{C/W}$
Junction-to-Case (Drain)		R_{thJC}	1.1	

Notes

- Package limited.
- Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
- When mounted on 1" square PCB (FR4 material).
- Parametric verification ongoing.

SPECIFICATIONS (T _C = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = -250 μA		-40	-	-	V
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = -250 μA		-1.0	-	-3.5	
Gate-Source Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{GS} = 0 V	V _{DS} = -40 V	-	-	-1	μA
		V _{GS} = 0 V	V _{DS} = -40 V, T _J = 125 °C	-	-	-50	
		V _{GS} = 0 V	V _{DS} = -40 V, T _J = 175 °C	-	-	-150	
On-State Drain Current ^a	I _{D(on)}	V _{GS} = -10 V	V _{DS} ≤ -5 V	-50	-	-	A
Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = -10 V	I _D = -17 A	-	0.012	-	Ω
		V _{GS} = -10 V	I _D = -10 A, T _J = 125 °C	-	0.017	-	
		V _{GS} = -10 V	I _D = -10 A, T _J = 175 °C	-	0.020	-	
		V _{GS} = -4.5 V	I _D = -14 A	-	0.015	-	
Forward Transconductance ^a	g _{fs}	V _{DS} = -15 V, I _D = -17 A		-	61	-	S
Dynamic ^b							
Input Capacitance	C _{iss}	V _{GS} = 0 V	V _{DS} = -25 V, f = 1 MHz	-	3000	-	pF
Output Capacitance	C _{oss}			-	508	635	
Reverse Transfer Capacitance	C _{rss}			-	352	440	
Total Gate Charge ^c	Q _g	V _{GS} = -10 V	V _{DS} = -30 V, I _D = -50 A	-	60	80	nC
Gate-Source Charge ^c	Q _{gs}			-	5.7	8.6	
Gate-Drain Charge ^c	Q _{gd}			-	14.7	22	
Gate Resistance	R _g	f = 1 MHz		1.5	3	4.5	Ω
Turn-On Delay Time ^c	t _{d(on)}	V _{DD} = -20 V, R _L = 0.4 Ω I _D ≅ -50 A, V _{GEN} = -10 V, R _g = 1 Ω		-	10	15	ns
Rise Time ^c	t _r			-	12	18	
Turn-Off Delay Time ^c	t _{d(off)}			-	40	60	
Fall Time ^c	t _f			-	16	24	
Source-Drain Diode Ratings and Characteristics ^b							
Pulsed Current ^a	I _{SM}			-	-	-200	A
Forward Voltage	V _{SD}	I _F = -50 A, V _{GS} = 0 V		-	-1	-1.5	V

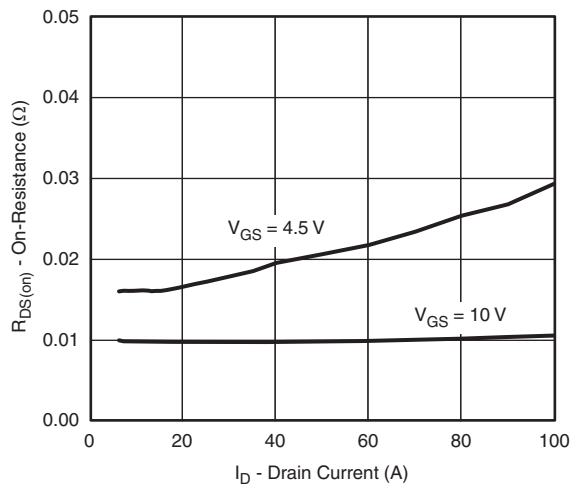
Notes

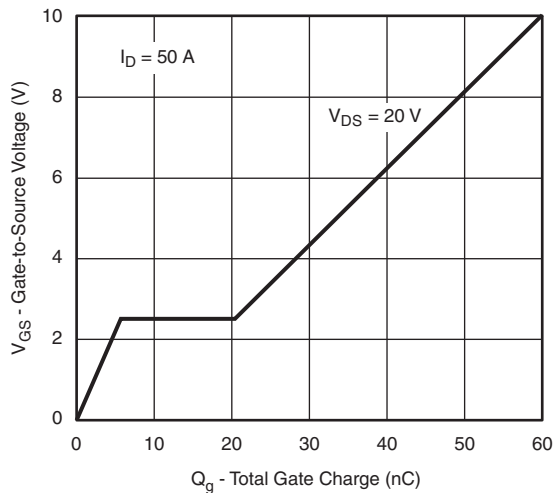
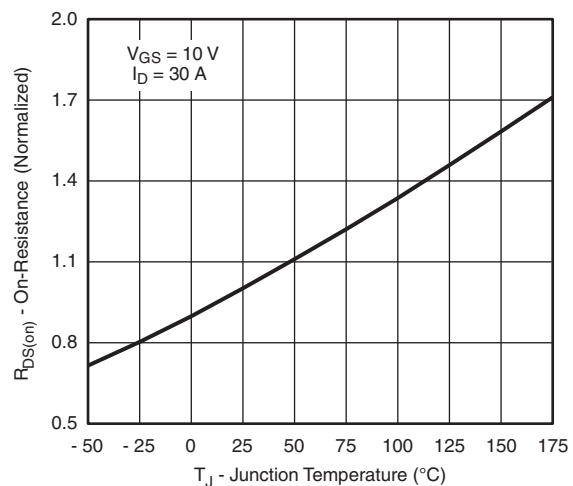
- a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
 b. Guaranteed by design, not subject to production testing.
 c. Independent of operating temperature.

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.

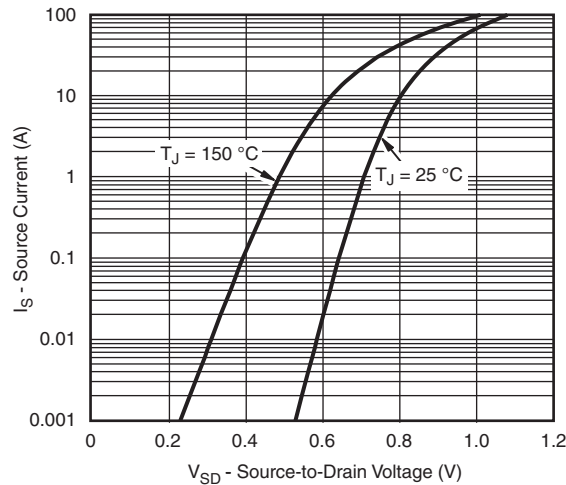
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Output Characteristics

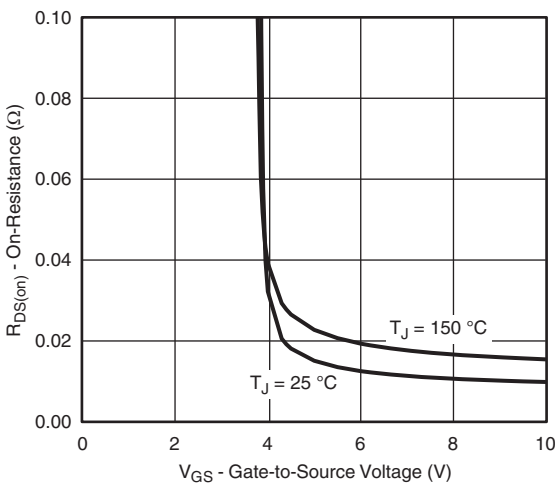
Transfer Characteristics

On-Resistance vs. Drain Current

Capacitance

Gate Charge

On-Resistance vs. Junction Temperature

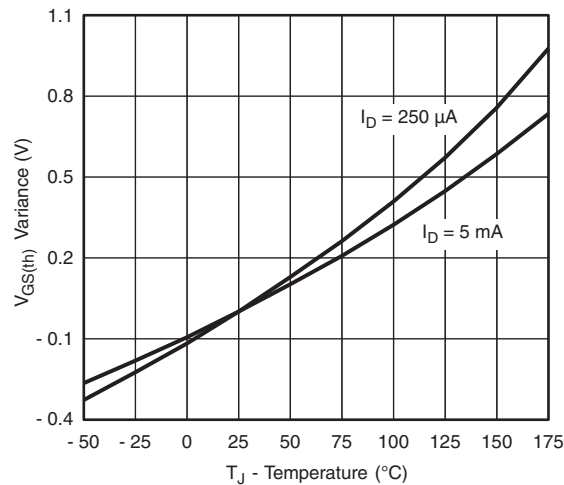
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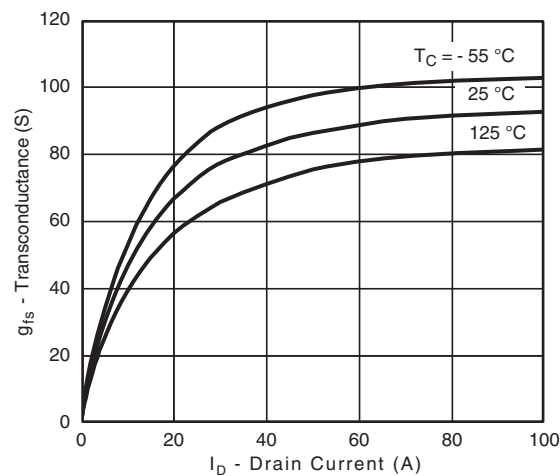
Source Drain Diode Forward Voltage



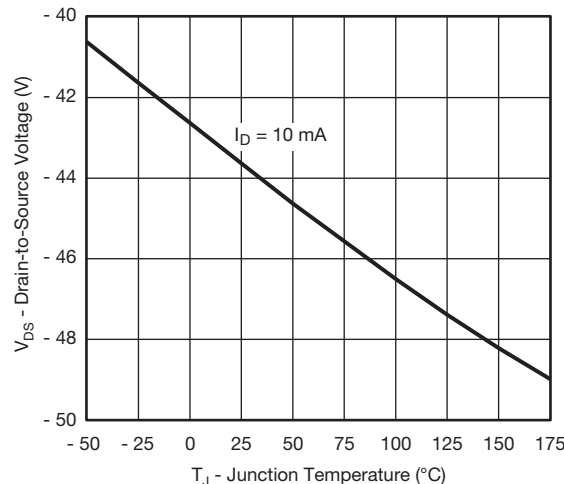
On-Resistance vs. Gate-to Source Voltage



Threshold Voltage



Transconductance



Drain Source Breakdown vs. Junction Temperature

Figure 10: Drain Current vs. Drain-to-Source Voltage (V_{DS}) for a Single Pulse

The graph shows the relationship between V_{DS} (x-axis, logarithmic scale from 0.01 V to 100 V) and I_D - Drain Current (A) (y-axis, logarithmic scale from 0.01 A to 100 A) for a single pulse at $T_C = 25^\circ\text{C}$.

The curves represent different pulse widths:

- 100 μs
- 1 ms
- 10 ms
- 100 ms
- 1 s, 10 s, DC

The limiting factors for the curves are:

- I_{DM} Limited (Solid line)
- Limited by $R_{DS(on)}$ (Dashed line)
- I_D Limited (Dotted line)
- BVDSS Limited (Dashed line)

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

Figure 10 is a log-log plot showing the Normalized Effective Transient Thermal Impedance (Y-axis, ranging from 0.01 to 2) versus the Square Wave Pulse Duration (s) (X-axis, ranging from 10^{-4} to 1). The plot displays curves for various duty cycles (0.5, 0.2, 0.1, 0.05, 0.02) and a single pulse. The curves show that the normalized effective transient thermal impedance increases with pulse duration and approaches a steady-state value of 1.0 for longer pulse durations. The duty cycle significantly influences the transient thermal impedance, with higher duty cycles resulting in higher impedance values for a given pulse duration.

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Normalized Thermal Transient Impedance, Junction-to-Ambient

Note

- The characteristics shown in the two graphs
 - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
 - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)
- are given for general guidelines only to enable the user to get a "ball park" indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

TO-252AA Case Outline



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.38	0.086	0.094
A1	-	0.127	-	0.005
b	0.64	0.88	0.025	0.035
b2	0.76	1.14	0.030	0.045
b3	4.95	5.46	0.195	0.215
C	0.46	0.61	0.018	0.024
C2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	4.10	-	0.161	-
E	6.35	6.73	0.250	0.265
E1	4.32	-	0.170	-
H	9.40	10.41	0.370	0.410
e	2.28 BSC		0.090 BSC	
e1	4.56 BSC		0.180 BSC	
L	1.40	1.78	0.055	0.070
L3	0.89	1.27	0.035	0.050
L4	-	1.02	-	0.040
L5	1.01	1.52	0.040	0.060
ECN: T13-0592-Rev. A, 02-Sep-13 DWG: 6019				

Note

- Dimension L3 is for reference only.

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads
Dimensions in Inches/(mm)

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