

### Product Summary

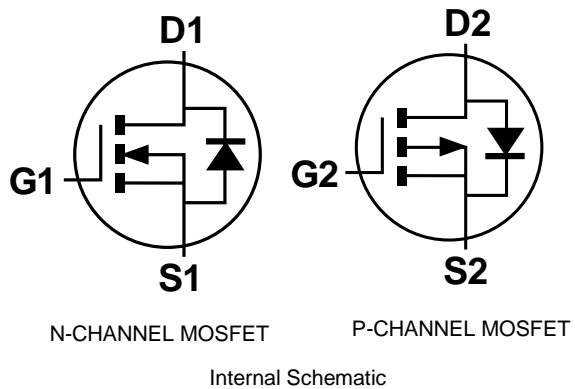
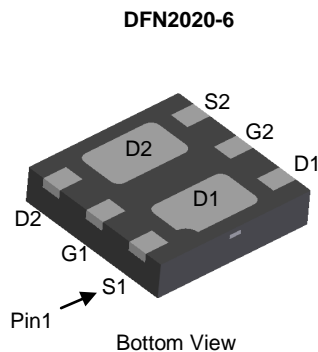
Device	$V_{(BR)DSS}$	$R_{DS(ON)}$ Max	$I_D$ Max $T_A = +25^\circ\text{C}$
Q1 N-Channel	12V	29m $\Omega$ @ $V_{GS} = 4.5\text{V}$	5.6A
		34m $\Omega$ @ $V_{GS} = 2.5\text{V}$	5.1A
		44m $\Omega$ @ $V_{GS} = 1.8\text{V}$	4.5A
		65m $\Omega$ @ $V_{GS} = 1.5\text{V}$	3.7A
Q2 P-Channel	-12V	61m $\Omega$ @ $V_{GS} = -4.5\text{V}$	-3.8A
		81m $\Omega$ @ $V_{GS} = -2.5\text{V}$	-3.3A
		115m $\Omega$ @ $V_{GS} = -1.8\text{V}$	-2.8A
		170m $\Omega$ @ $V_{GS} = -1.5\text{V}$	-2.3A

### Description

This MOSFET is designed to minimize the on-state resistance ( $R_{DS(ON)}$ ), yet maintain superior switching performance, making it ideal for high efficiency power management applications.

### Applications

- Loadswitch
- Power Management Functions
- Portable Power Adaptors



### Features

- Low On-Resistance
- Low Input Capacitance
- Low Profile, 0.6mm Max Height
- **Totally Lead-Free & Fully RoHS Compliant**
- **Halogen and Antimony Free. "Green" Device**
- **Qualified to AEC-Q101 Standards for High Reliability**

### Mechanical Data

- Case: DFN2020-6
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish NiPdAu over Copper leadframe. Solderable per MIL-STD-202, Method 208 <sup>(E4)</sup>
- Terminals Connections: See Diagram Below
- Weight: 0.0065 grams (Approximate)

### Package Marking and Ordering Information

Device	Device Marking	Device Package	Reel Size	Tape width	Quantity
LM2D5PN01	2903/K9C4	DFN2020-6	-	-	3000 units

## Maximum Ratings (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic			Symbol	Q1 N-Channel	Q2 P-Channel	Units
Drain-Source Voltage			V <sub>DSS</sub>	12	-12	V
Gate-Source Voltage			V <sub>GSS</sub>	±8	±8	V
Continuous Drain Current (Note 5) V <sub>GS</sub> = 4.5V	Steady State	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	5.6 4.4	-3.8 -3.0	A
	t < 5s	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	7.2 5.8	-5.0 -4.0	A
Maximum Continuous Body Diode Forward Current (Note 5)			I <sub>S</sub>	1	-1	A
Pulsed Drain Current (10µs Pulse, Duty Cycle = 1%)			I <sub>DM</sub>	20	-15	A

## Thermal Characteristics

Characteristic		Symbol	Value	Units
Total Power Dissipation (Note 5)	Steady State	P <sub>D</sub>	1.4	W
	t < 5s		2.2	
Thermal Resistance, Junction to Ambient (Note 5)	Steady State	R <sub>θJA</sub>	92	°C/W
	t < 5s		55	
Thermal Resistance, Junction to Case (Note 5)		R <sub>θJC</sub>	30	
Operating and Storage Temperature Range		T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C

Note: 5. Device mounted on 1" x 1" FR-4 PCB with high coverage 2oz. copper, single sided.

## Electrical Characteristics Q1 N-Channel (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 6)</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	12	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
Zero Gate Voltage Drain Current T <sub>J</sub> = +25°C	I <sub>DSS</sub>	—	—	1.0	μA	V <sub>DS</sub> = 12V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	—	—	±100	nA	V <sub>GS</sub> = ±8V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS (Note 6)</b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	0.4	—	1	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
Static Drain-Source On-Resistance	R <sub>DS(ON)</sub>	—	17	29	mΩ	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 5A
		—	20	34		V <sub>GS</sub> = 2.5V, I <sub>D</sub> = 4.6A
		—	24	44		V <sub>GS</sub> = 1.8V, I <sub>D</sub> = 4.1A
		—	30	65		V <sub>GS</sub> = 1.5V, I <sub>D</sub> = 2A
Forward Transfer Admittance	Y <sub>fs</sub>	—	6.5	—	S	V <sub>DS</sub> = 10V, I <sub>D</sub> = 5A
Diode Forward Voltage	V <sub>SD</sub>	—	0.6	1.2	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 1A
<b>DYNAMIC CHARACTERISTICS (Note 7)</b>						
Input Capacitance	C <sub>iss</sub>	—	914	—	pF	V <sub>DS</sub> = 6V, V <sub>GS</sub> = 0V, f = 1.0MHz
Output Capacitance	C <sub>oss</sub>	—	132	—	pF	
Reverse Transfer Capacitance	C <sub>rss</sub>	—	119	—	pF	
Gate Resistance	R <sub>g</sub>	—	1.26	—	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1MHz
Total Gate Charge (V <sub>GS</sub> = 4.5V)	Q <sub>g</sub>	—	10.5	—	nC	V <sub>DS</sub> = 6V, I <sub>D</sub> = 6.5A
Total Gate Charge (V <sub>GS</sub> = 8V)		—	19.6	—	nC	
Gate-Source Charge	Q <sub>gs</sub>	—	1.2	—	nC	
Gate-Drain Charge	Q <sub>gd</sub>	—	1.6	—	nC	
Turn-On Delay Time	t <sub>D(on)</sub>	—	5.0	—	nS	
Turn-On Rise Time	t <sub>r</sub>	—	10.5	—	nS	V <sub>DD</sub> = 6V, V <sub>GS</sub> = 4.5V, R <sub>L</sub> = 1.2Ω, R <sub>G</sub> = 1Ω
Turn-Off Delay Time	t <sub>D(off)</sub>	—	16.6	—	nS	
Turn-Off Fall Time	t <sub>f</sub>	—	4.1	—	nS	

## Electrical Characteristics Q2 P-Channel (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 6)</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	-12	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA
Zero Gate Voltage Drain Current T <sub>J</sub> = +25°C	I <sub>DSS</sub>	—	—	-1.0	μA	V <sub>DS</sub> = -12V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	—	—	±100	nA	V <sub>GS</sub> = ±8V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS (Note 6)</b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	-0.4	—	-1	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA
Static Drain-Source On-Resistance	R <sub>DS(ON)</sub>	—	37	61	mΩ	V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -3.6A
		—	47	81		V <sub>GS</sub> = -2.5V, I <sub>D</sub> = -3.2A
		—	63	115		V <sub>GS</sub> = -1.8V, I <sub>D</sub> = -1A
		—	90	170		V <sub>GS</sub> = -1.5V, I <sub>D</sub> = -1A
Forward Transfer Admittance	Y <sub>fs</sub>	—	5.5	—	S	V <sub>DS</sub> = -10V, I <sub>D</sub> = -3.6A
Diode Forward Voltage	V <sub>SD</sub>	—	-0.65	-1.2	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = -1A
<b>DYNAMIC CHARACTERISTICS (Note 7)</b>						
Input Capacitance	C <sub>iss</sub>	—	915	—	pF	V <sub>DS</sub> = -6V, V <sub>GS</sub> = 0V, f = 1.0MHz
Output Capacitance	C <sub>oss</sub>	—	225	—	pF	
Reverse Transfer Capacitance	C <sub>rss</sub>	—	183	—	pF	
Gate Resistance	R <sub>g</sub>	—	56.9	—	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1MHz
Total Gate Charge (V <sub>GS</sub> = -4.5V)	Q <sub>g</sub>	—	10.7	—	nC	V <sub>DS</sub> = -6V, I <sub>D</sub> = -4.3A
Total Gate Charge (V <sub>GS</sub> = -8V)		—	17.9	—	nC	
Gate-Source Charge	Q <sub>gs</sub>	—	1.7	—	nC	
Gate-Drain Charge	Q <sub>gd</sub>	—	3.0	—	nC	
Turn-On Delay Time	t <sub>D(on)</sub>	—	5.7	—	nS	
Turn-On Rise Time	t <sub>r</sub>	—	11.5	—	nS	V <sub>DD</sub> = -6V, V <sub>GS</sub> = -4.5V, R <sub>L</sub> = 1.6Ω, R <sub>G</sub> = 1Ω
Turn-Off Delay Time	t <sub>D(off)</sub>	—	27.8	—	nS	
Turn-Off Fall Time	t <sub>f</sub>	—	26.4	—	nS	

Notes: 6. Short duration pulse test used to minimize self-heating effect.  
7. Guaranteed by design. Not subject to product testing.

## Q1 N-CHANNEL

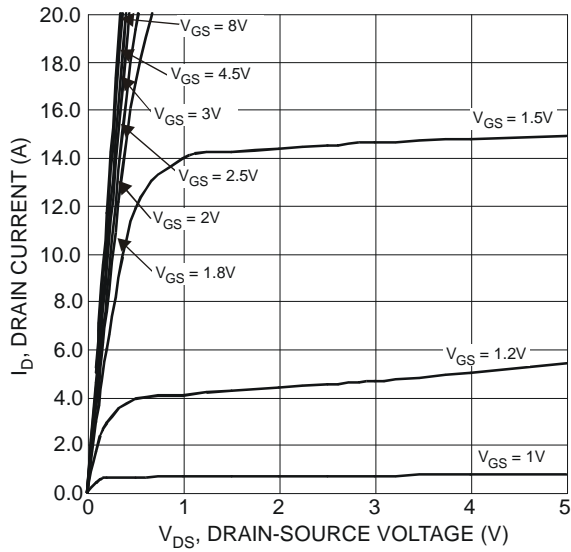


Figure 1 Typical Output Characteristics

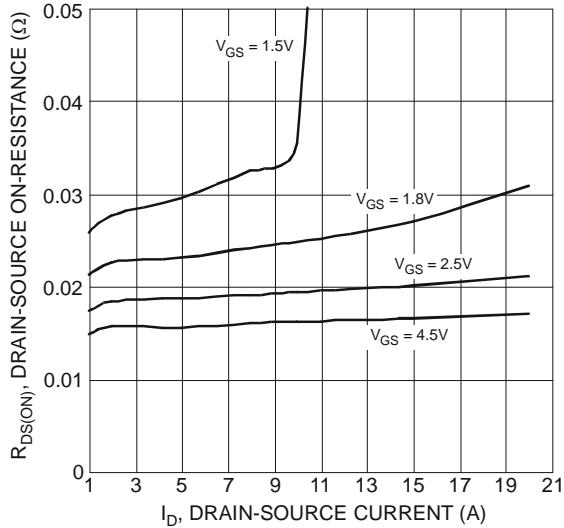


Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

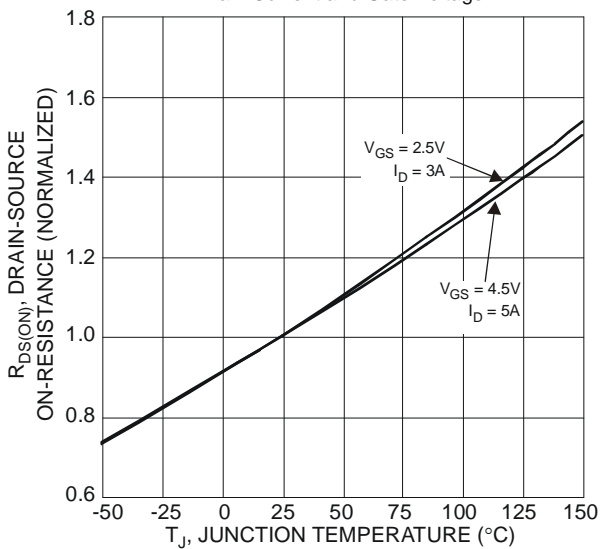


Figure 5 On-Resistance Variation with Temperature

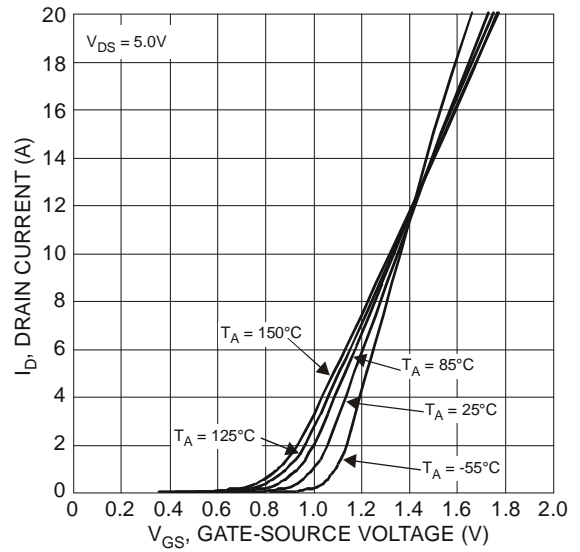


Figure 2 Typical Transfer Characteristics

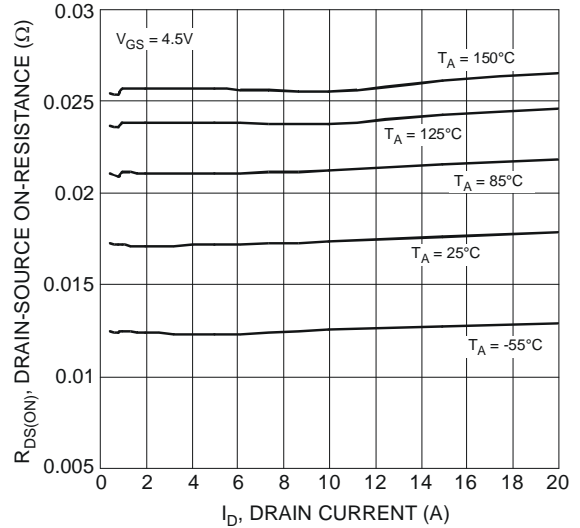


Figure 4 Typical On-Resistance vs. Drain Current and Temperature

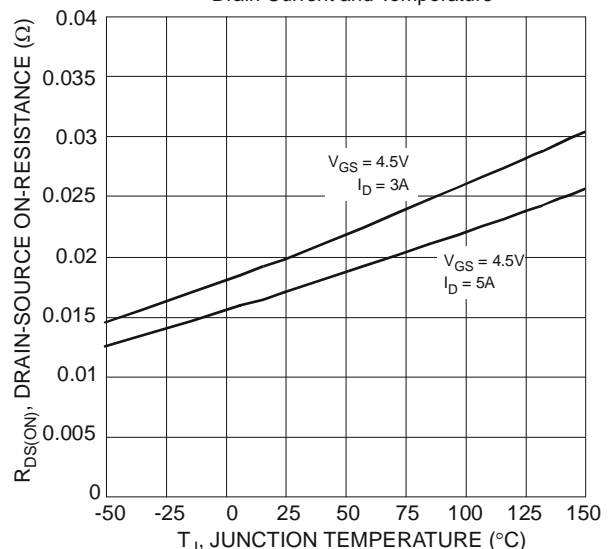


Figure 6 On-Resistance Variation with Temperature

## Q1 N-CHANNEL (Continued)

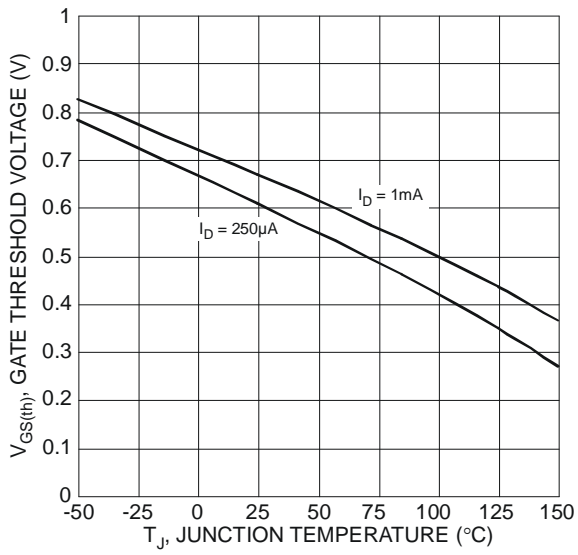


Figure 7 Gate Threshold Variation vs. Ambient Temperature

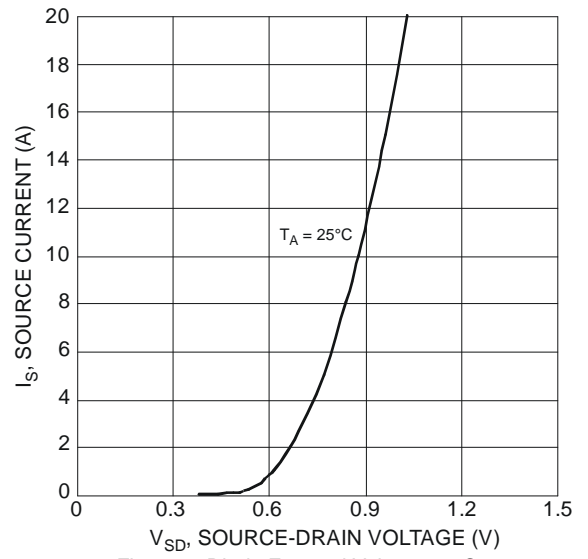


Figure 8 Diode Forward Voltage vs. Current

## Q2 P-CHANNEL

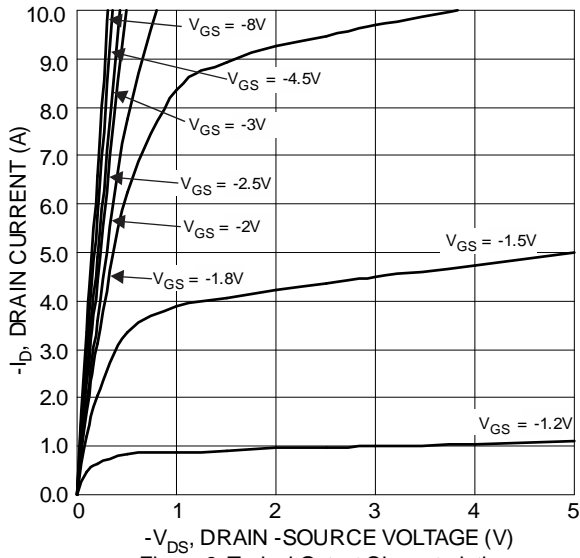


Figure 9 Typical Output Characteristics

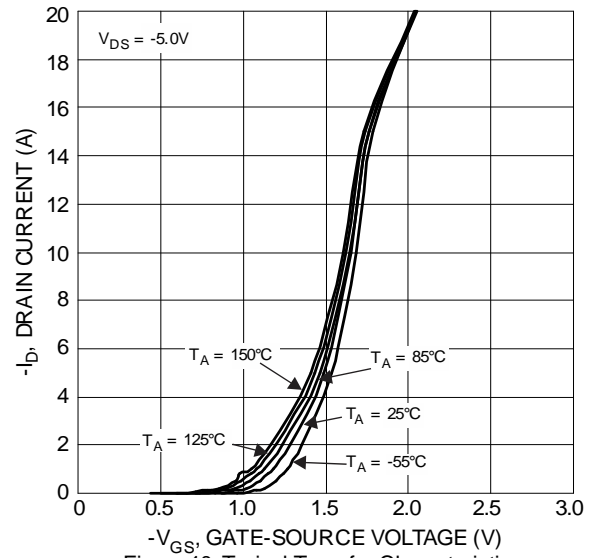


Figure 10 Typical Transfer Characteristics

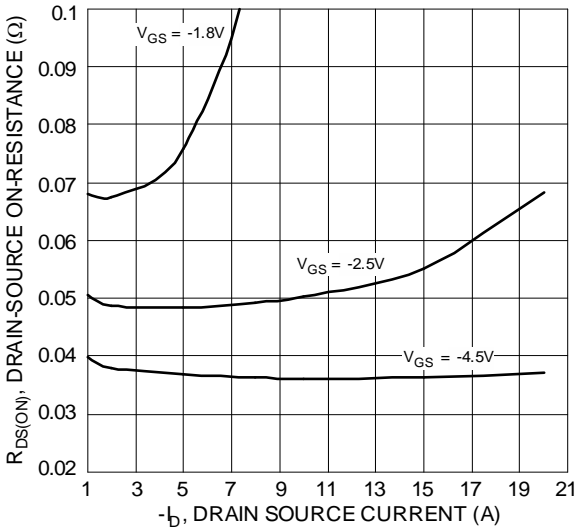


Figure 11 Typical On-Resistance vs. Drain Current and Gate Voltage

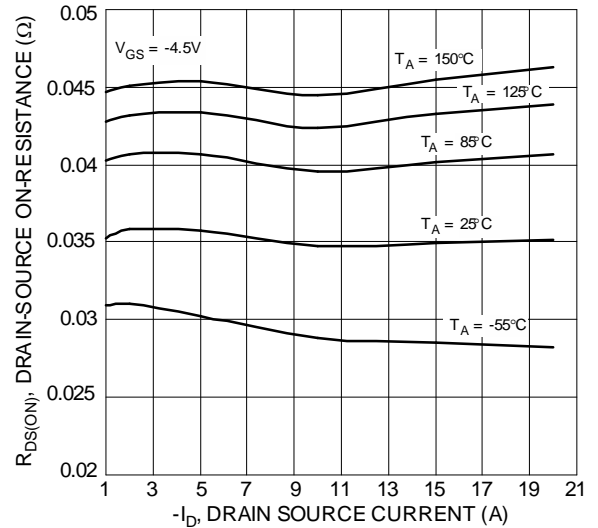


Figure 12 Typical On-Resistance vs. Drain Current and Temperature

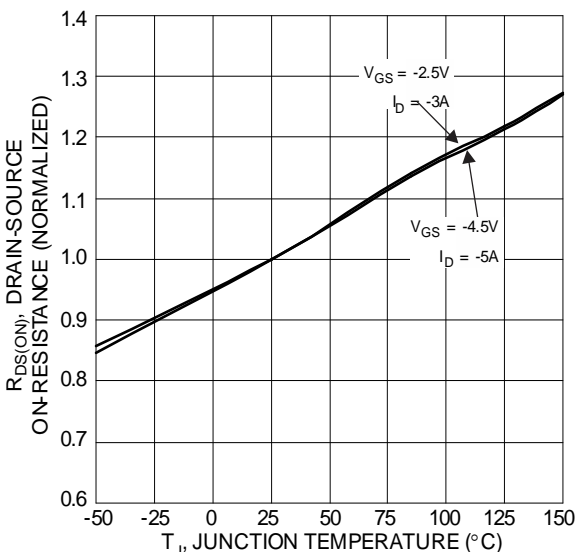


Figure 13 On-Resistance Variation with Temperature

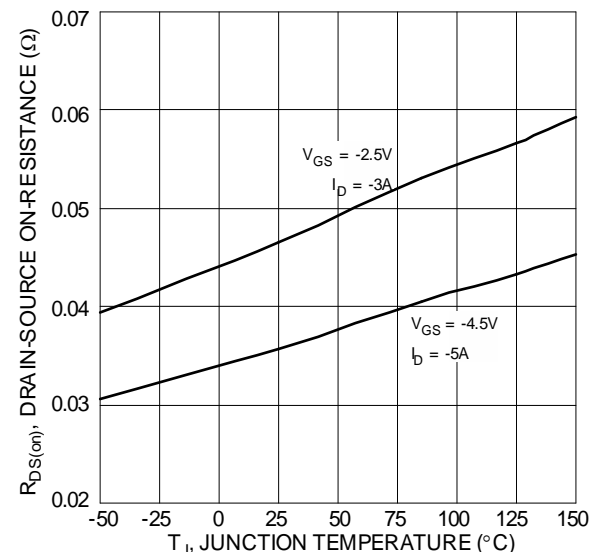


Figure 14 On-Resistance Variation with Temperature

## Q2 P-CHANNEL (Continued)

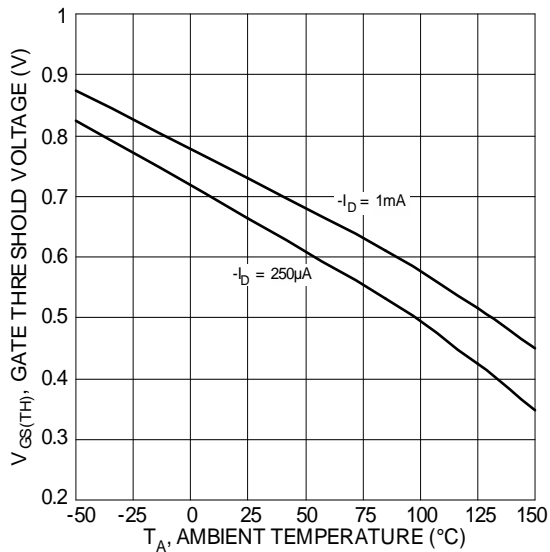


Figure 15 Gate Threshold Variation vs. Ambient Temperature

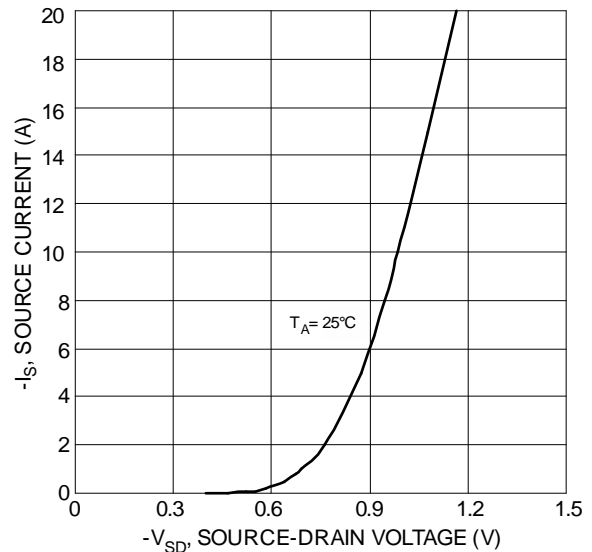


Figure 16 Diode Forward Voltage vs. Current

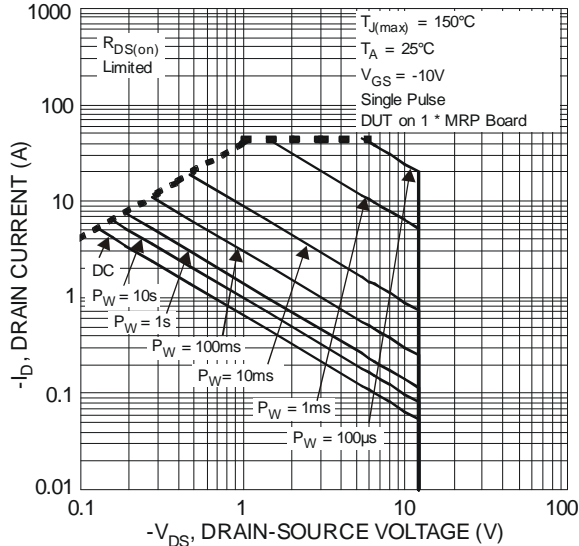


Figure 17 SOA, Safe Operation Area

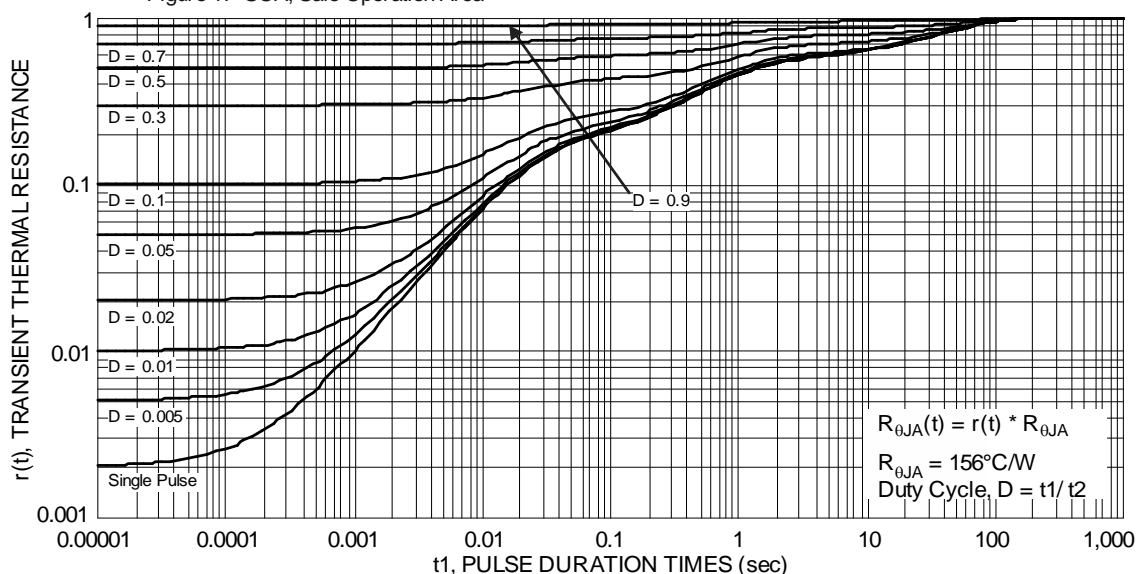


Figure 18 Transient Thermal Resistance

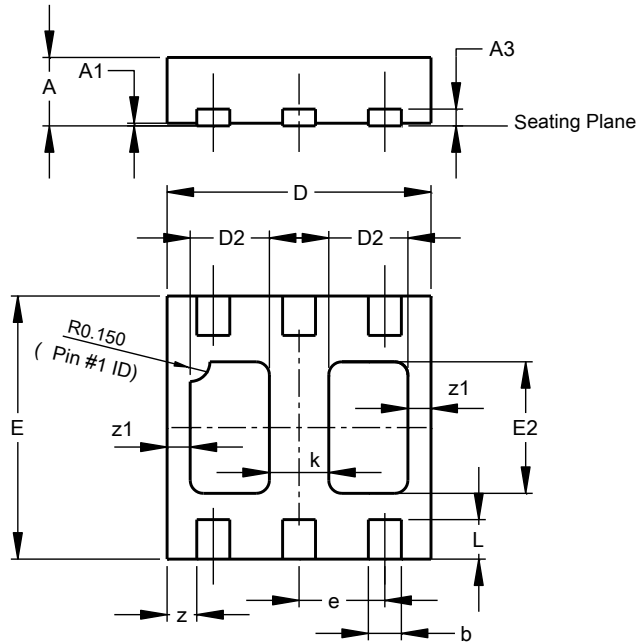
$$R_{\theta JA}(t) = r(t) * R_{\theta JA}$$

$$R_{\theta JA} = 156^{\circ}\text{C/W}$$

$$\text{Duty Cycle, } D = t1 / t2$$

## Package Outline Dimensions

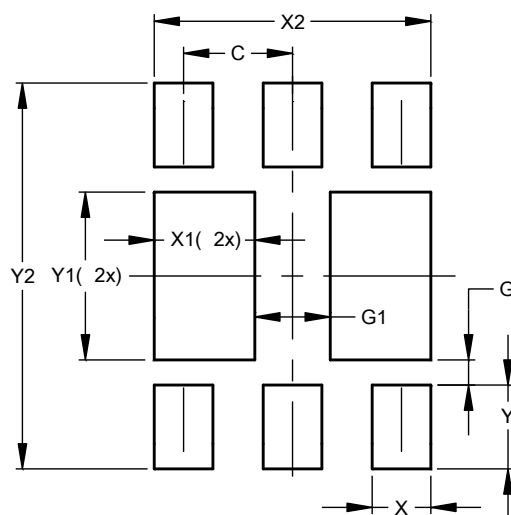
DFN2020-6



DFN2020-6			
Dim	Min	Max	Typ
A	0.545	0.605	0.575
A1	0.00	0.05	0.02
A3	-	-	0.13
b	0.20	0.30	0.25
D	1.95	2.075	2.00
D2	0.50	0.70	0.60
e	-	-	0.65
E	1.95	2.075	2.00
E2	0.90	1.10	1.00
k	-	-	0.45
L	0.25	0.35	0.30
z	-	-	0.225
z1	-	-	0.175
All Dimensions in mm			

## Suggested Pad Layout

DFN2020-6



Dimensions	Value (in mm)
C	0.650
G	0.150
G1	0.450
X	0.350
X1	0.600
X2	1.650
Y	0.500
Y1	1.000
Y2	2.300