

## Product Summary

Device	BV <sub>DSS</sub>	R <sub>DS(ON)</sub> Max	I <sub>D</sub> Max T <sub>A</sub> = +25°C
Q1	20V	0.99Ω @ V <sub>GS</sub> = 4.5V	450mA
		1.2Ω @ V <sub>GS</sub> = 2.5V	400mA
		1.8Ω @ V <sub>GS</sub> = 1.8V	330mA
		2.4Ω @ V <sub>GS</sub> = 1.5V	300mA
Q2	-20V	1.9Ω @ V <sub>GS</sub> = -4.5V	-310mA
		2.4Ω @ V <sub>GS</sub> = -2.5V	-280mA
		3.4Ω @ V <sub>GS</sub> = -1.8V	-240mA
		5Ω @ V <sub>GS</sub> = -1.5V	-180mA

## Features and Benefits

- Low On-Resistance
- Very Low Gate Threshold Voltage, 1.0V Max
- Low Input Capacitance
- Fast Switching Speed
- Ultra-Small Surface Mount Package 1mm x 1mm
- Low Package Profile, 0.45mm Maximum Package Height
- ESD Protected Gate
- **Totally Lead-Free & Fully RoHS Compliant (Note 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

## Description and Applications

This MOSFET is designed to meet the stringent requirements of Automotive applications. It is qualified to AEC-Q101, supported by a PPAP and is ideal for use in:

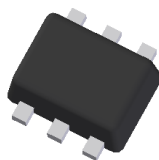
- General Purpose Interfacing Switch
- Power Management Functions
- Analog Switch

## Mechanical Data

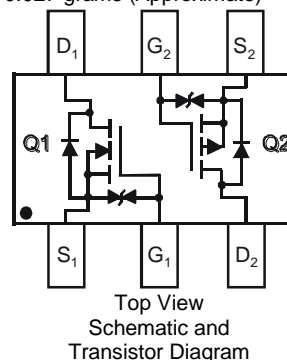
- Case: SOT963
- Case Material: Molded Plastic, "Green" Molding Compound.  
UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections Indicator: See Diagram
- Terminals: Finish — Matte Tin Annealed over Copper Leadframe.  
Solderable per MIL-STD-202, Method 208 **e3**
- Weight: 0.027 grams (Approximate)



SOT963



Top View

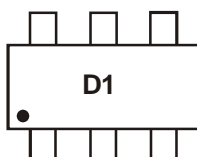


## Ordering Information (Note 5)

Part Number	Case	Packaging
DMC2990UDJQ-7	SOT963	10K/Tape & Reel
DMC2990UDJQ-7B	SOT963	10K/Tape & Reel

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. Automotive products are AEC-Q101 qualified and are PPAP capable. Refer to [http://www.diodes.com/product\\_compliance\\_definitions.html](http://www.diodes.com/product_compliance_definitions.html).
  5. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Marking Information



D1 = Product Type Marking Code

**Maximum Ratings Q1 N-CHANNEL** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic			Symbol	Value	Unit
Drain-Source Voltage			$V_{DSS}$	20	V
Gate-Source Voltage			$V_{GSS}$	$\pm 8$	V
Continuous Drain Current (Note 6) $V_{GS} = 4.5\text{V}$	Steady State	$T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$	$I_D$	450 350	mA
	t<5s	$T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$	$I_D$	520 410	mA
Continuous Drain Current (Note 6) $V_{GS} = 1.8\text{V}$	Steady State	$T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$	$I_D$	330 260	mA
	t<5s	$T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$	$I_D$	390 310	mA
Maximum Continuous Body Diode Forward Current (Note 6)			$I_S$	440	mA
Pulsed Drain Current (Note 7)			$I_{DM}$	800	mA

**Maximum Ratings Q2 P-CHANNEL** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic			Symbol	Value	Unit
Drain-Source Voltage			$V_{DSS}$	-20	V
Gate-Source Voltage			$V_{GSS}$	$\pm 8$	V
Continuous Drain Current (Note 6) $V_{GS} = -4.5\text{V}$	Steady State	$T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$	$I_D$	-310 -240	mA
	t<5s	$T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$	$I_D$	-360 -280	mA
Continuous Drain Current (Note 6) $V_{GS} = -1.8\text{V}$	Steady State	$T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$	$I_D$	-240 -190	mA
	t<5s	$T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$	$I_D$	-280 -220	mA
Maximum Continuous Body Diode Forward Current (Note 6)			$I_S$	-440	mA
Pulsed Drain Current (Note 7)			$I_{DM}$	-800	mA

**Thermal Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic		Symbol	Value	Unit
Total Power Dissipation (Note 6)		$P_D$	350	mW
Thermal Resistance, Junction to Ambient (Note 6)	Steady State	$R_{\theta JA}$	360	$^\circ\text{C/W}$
	t<5s		270	$^\circ\text{C/W}$
Operating and Storage Temperature Range		$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$

- Notes: 6. Device mounted on FR-4 PCB, with minimum recommended pad layout.  
7. Device mounted on minimum recommended pad layout test board, 10 $\mu\text{s}$  pulse duty cycle = 1%.

**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 8)</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	20	-	-	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	-	-	100	nA	V <sub>DS</sub> = 16V, V <sub>GS</sub> = 0V
		-	-	50		V <sub>DS</sub> = 5V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	-	-	±100	nA	V <sub>GS</sub> = ±5V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS (Note 8)</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	0.4	-	1.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
Static Drain-Source On-Resistance	R <sub>DS(ON)</sub>	-	0.60	0.99	Ω	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 100mA
		-	0.75	1.2		V <sub>GS</sub> = 2.5V, I <sub>D</sub> = 50mA
		-	0.90	1.8		V <sub>GS</sub> = 1.8V, I <sub>D</sub> = 20mA
		-	1.2	2.4		V <sub>GS</sub> = 1.5V, I <sub>D</sub> = 10mA
		-	2.0	-		V <sub>GS</sub> = 1.2V, I <sub>D</sub> = 1mA
Forward Transfer Admittance	Y <sub>fs</sub>	180	850	-	ms	V <sub>DS</sub> = 5V, I <sub>D</sub> = 125mA
Diode Forward Voltage	V <sub>SD</sub>	-	0.6	1.0	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 10mA
<b>DYNAMIC CHARACTERISTICS (Note 9)</b>						
Input Capacitance	C <sub>iSS</sub>	-	27.6	-	pF	V <sub>DS</sub> = 15V, V <sub>GS</sub> = 0V, f = 1.0MHz
Output Capacitance	C <sub>oSS</sub>	-	4.0	-	pF	
Reverse Transfer Capacitance	C <sub>rSS</sub>	-	2.8	-	pF	
Gate Resistance	R <sub>g</sub>	-	113	-	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1.0MHz
Total Gate Charge	Q <sub>g</sub>	-	0.5	-	nC	V <sub>GS</sub> = 4.5V, V <sub>DS</sub> = 10V, I <sub>D</sub> = 250mA
Gate-Source Charge	Q <sub>gs</sub>	-	0.07	-	nC	
Gate-Drain Charge	Q <sub>gd</sub>	-	0.07	-	nC	
Turn-On Delay Time	t <sub>D(ON)</sub>	-	4.0	-	ns	V <sub>DD</sub> = 15V, V <sub>GS</sub> = 4.5V, R <sub>L</sub> = 47Ω, R <sub>g</sub> = 2Ω, I <sub>D</sub> = 200mA
Turn-On Rise Time	t <sub>R</sub>	-	3.3	-	ns	
Turn-Off Delay Time	t <sub>D(OFF)</sub>	-	19.0	-	ns	
Turn-Off Fall Time	t <sub>F</sub>	-	6.4	-	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 8)</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	-20	-	-	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	-	-	100	nA	V <sub>DS</sub> = -16V, V <sub>GS</sub> = 0V
		-	-	50		V <sub>DS</sub> = -5V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	-	-	±100	nA	V <sub>GS</sub> = ±5V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS (Note 8)</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	-0.4	-	-1.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA
Static Drain-Source On-Resistance	R <sub>DS(ON)</sub>	-	1.2	1.9	Ω	V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -100mA
		-	1.5	2.4		V <sub>GS</sub> = -2.5V, I <sub>D</sub> = -50mA
		-	2.1	3.4		V <sub>GS</sub> = -1.8V, I <sub>D</sub> = -20mA
		-	2.5	5		V <sub>GS</sub> = -1.5V, I <sub>D</sub> = -10mA
		-	4.0	-		V <sub>GS</sub> = -1.2V, I <sub>D</sub> = -1mA
Forward Transfer Admittance	Y <sub>fs</sub>	100	450	-	ms	V <sub>DS</sub> = -5V, I <sub>D</sub> = -125mA
Diode Forward Voltage	V <sub>SD</sub>	-	-0.6	-1.0	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = -10mA
<b>DYNAMIC CHARACTERISTICS (Note 9)</b>						
Input Capacitance	C <sub>iSS</sub>	-	28.7	-	pF	V <sub>DS</sub> = -15V, V <sub>GS</sub> = 0V, f = 1.0MHz
Output Capacitance	C <sub>oSS</sub>	-	4.2	-	pF	
Reverse Transfer Capacitance	C <sub>rSS</sub>	-	2.9	-	pF	
Gate Resistance	R <sub>g</sub>	-	399	-	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1.0MHz
Total Gate Charge	Q <sub>g</sub>	-	0.4	-	nC	V <sub>GS</sub> = -4.5V, V <sub>DS</sub> = -10V, I <sub>D</sub> = -250mA
Gate-Source Charge	Q <sub>gs</sub>	-	0.08	-	nC	
Gate-Drain Charge	Q <sub>gd</sub>	-	0.06	-	nC	
Turn-On Delay Time	t <sub>D(ON)</sub>	-	5.8	-	ns	V <sub>DD</sub> = -15V, V <sub>GS</sub> = -4.5V, R <sub>g</sub> = 2Ω, I <sub>D</sub> = -200mA
Turn-On Rise Time	t <sub>R</sub>	-	5.7	-	ns	
Turn-Off Delay Time	t <sub>D(OFF)</sub>	-	31.1	-	ns	
Turn-Off Fall Time	t <sub>F</sub>	-	16.4	-	ns	

Notes: 8. Short duration pulse test used to minimize self-heating effect.  
9. Guaranteed by design. Not subject to product testing.

**Typical Characteristics - N-CHANNEL**

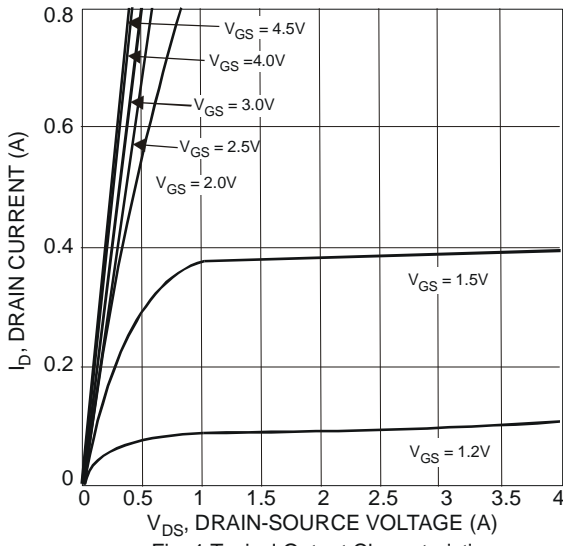


Fig. 1 Typical Output Characteristics

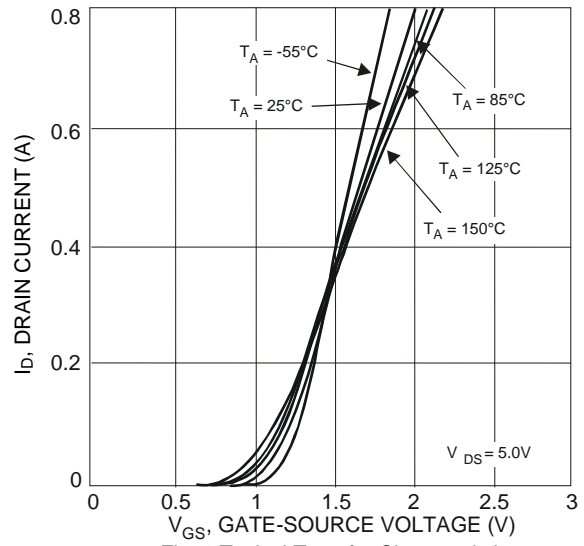


Fig. 2 Typical Transfer Characteristics

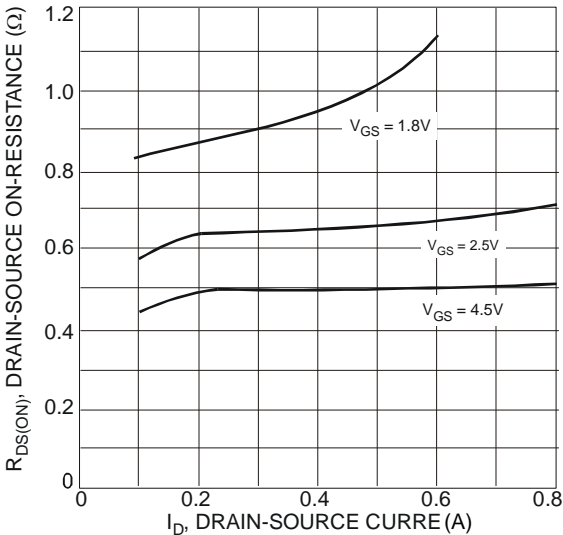


Fig. 3 Typical On-Resistance vs. Drain Current and Gate Voltage

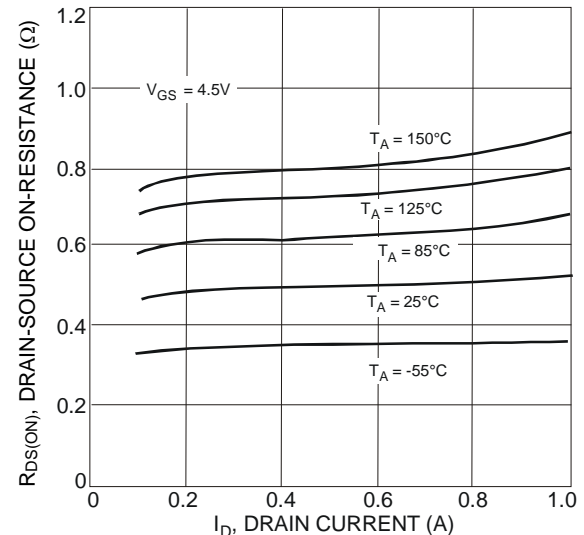


Fig. 4 Typical On-Resistance vs. Drain Current and Temperature

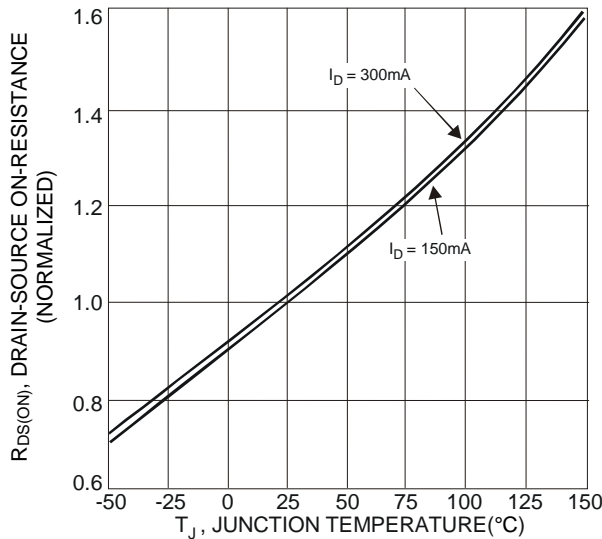


Fig. 5 On-Resistance Variation with Temperature

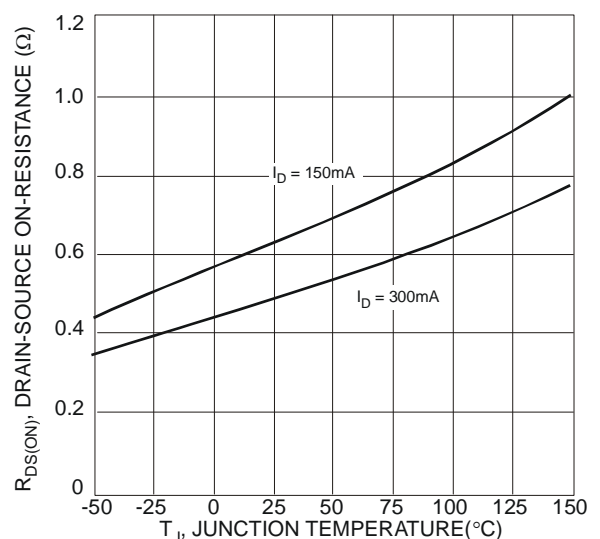


Fig. 6 On-Resistance Variation with Temperature

**Typical Characteristics - N-CHANNEL (Cont.)**

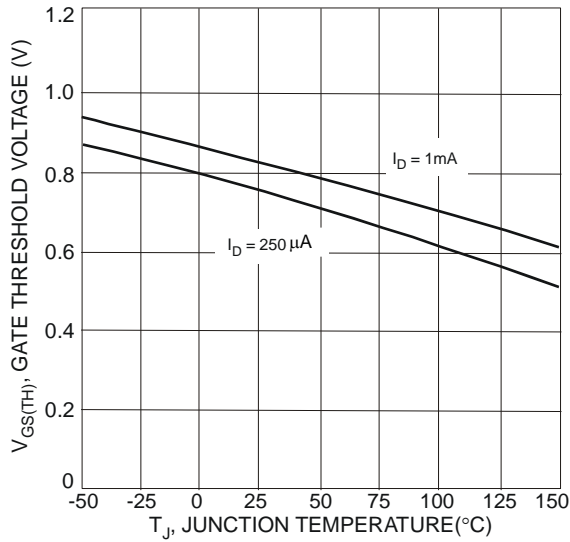


Fig. 7 Gate Threshold Variation vs. Ambient Temperature

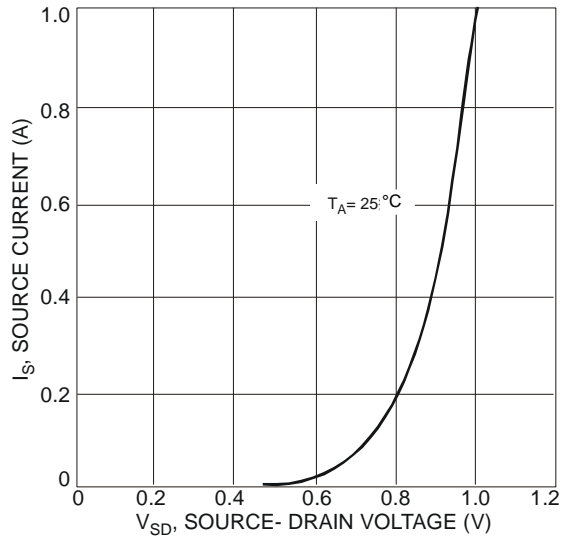


Fig. 8 Diodes Forward Voltage vs. Current

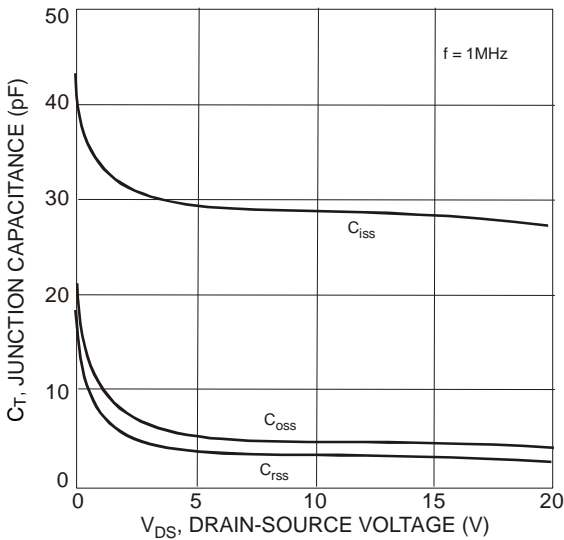


Fig. 9 Typical Junction Capacitance

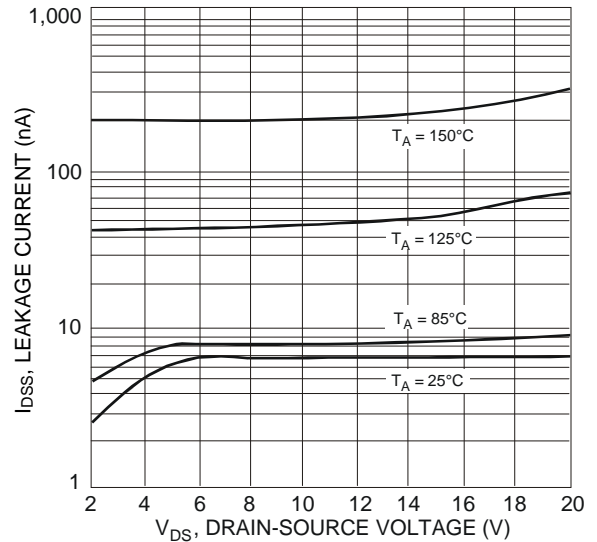


Fig. 10 Typical Drain-Source Leakage Current vs. Voltage

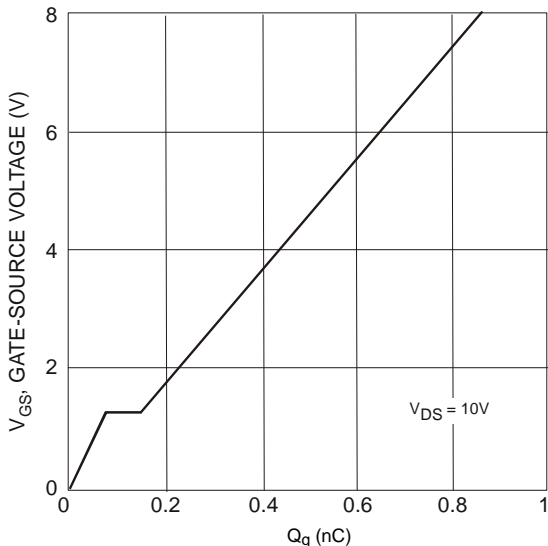


Fig. 11 Gate Charge Characteristics

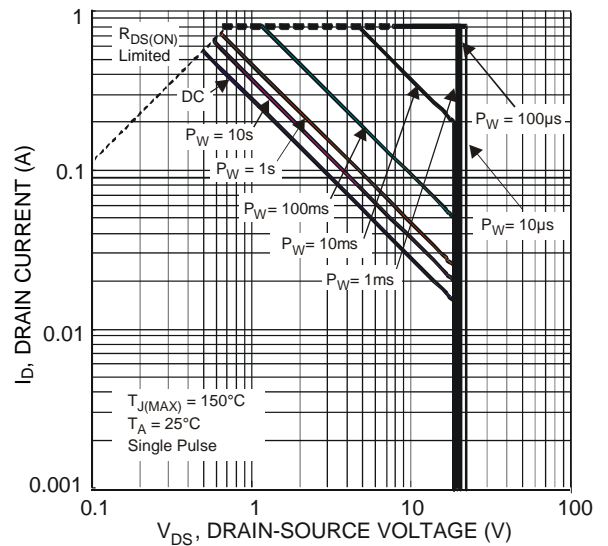


Fig. 12 SOA, Safe Operation Area

**Typical Characteristics - P-CHANNEL**

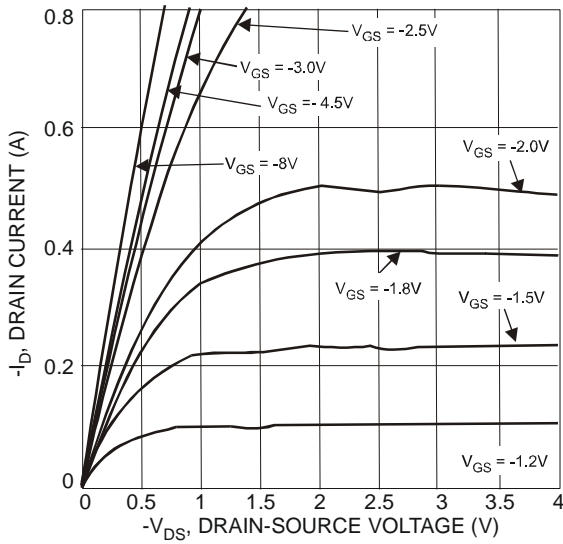


Fig. 13 Typical Output Characteristics

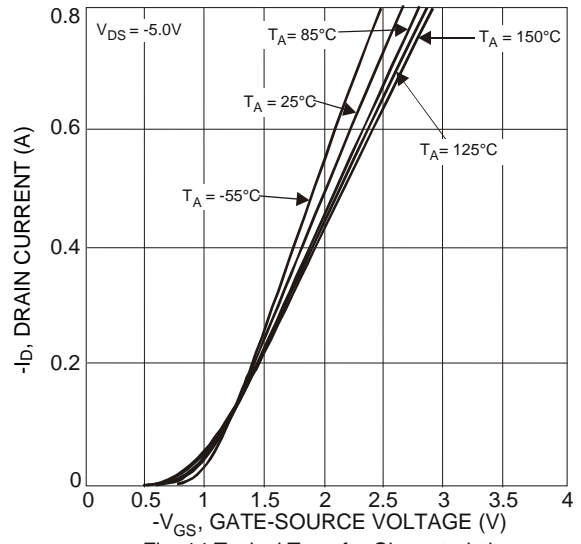


Fig. 14 Typical Transfer Characteristics

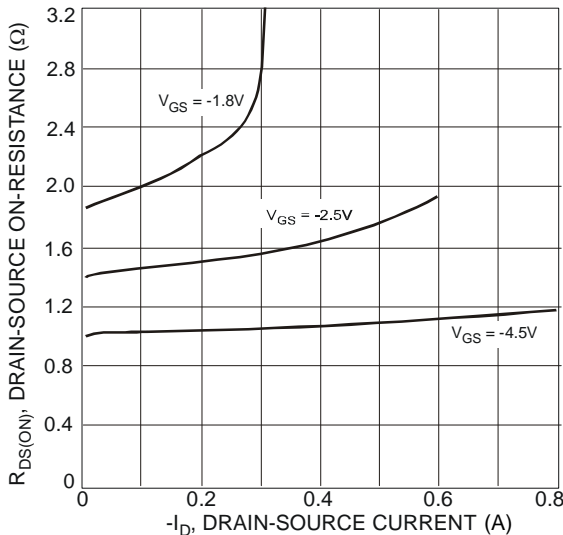


Fig. 15 Typical On-Resistance vs. Drain Current and Gate Voltage

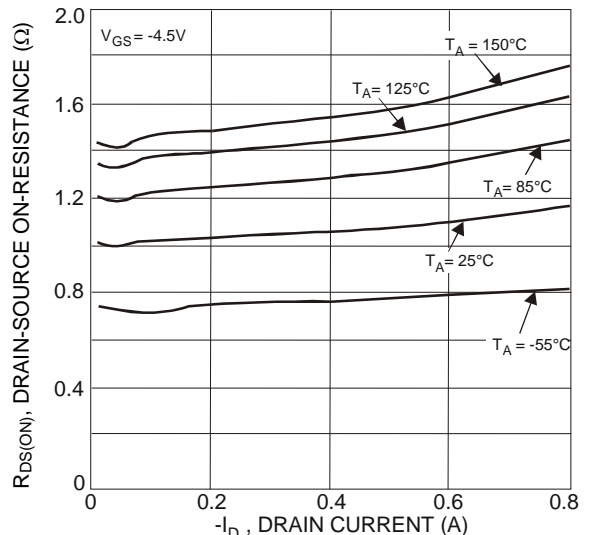


Fig. 16 Typical On-Resistance vs. Drain Current and Temperature

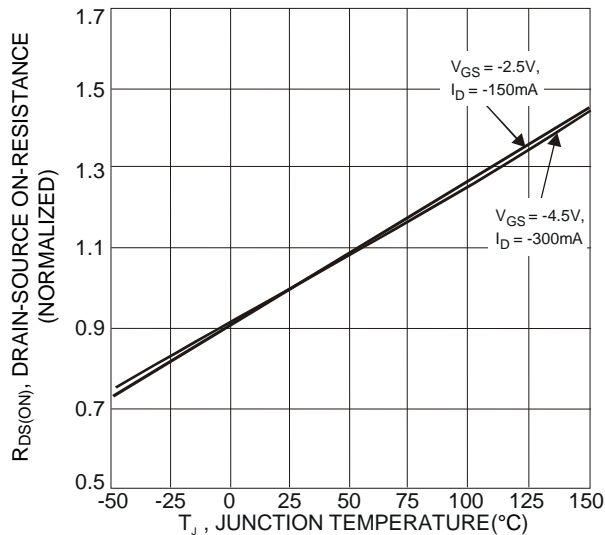


Fig. 17 On-Resistance Variation with Temperature

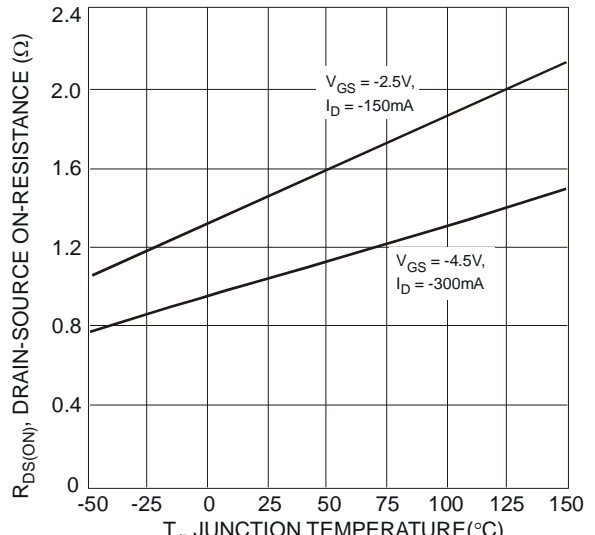


Fig. 18 On-Resistance Variation with Temperature

**Typical Characteristics - P-CHANNEL (Cont.)**

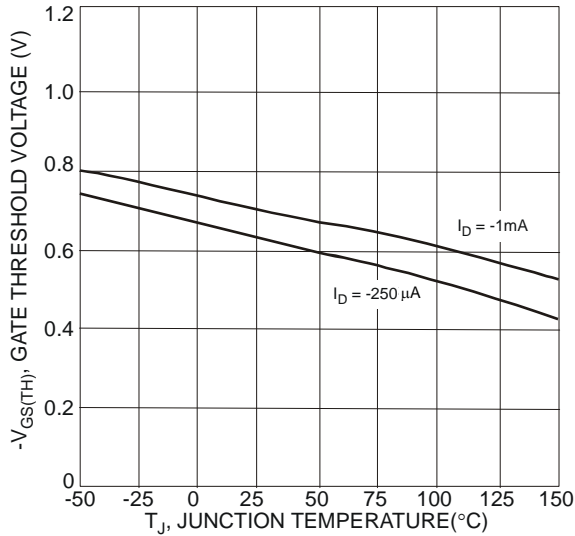


Fig. 19 Gate Threshold Variation vs. Ambient Temperature

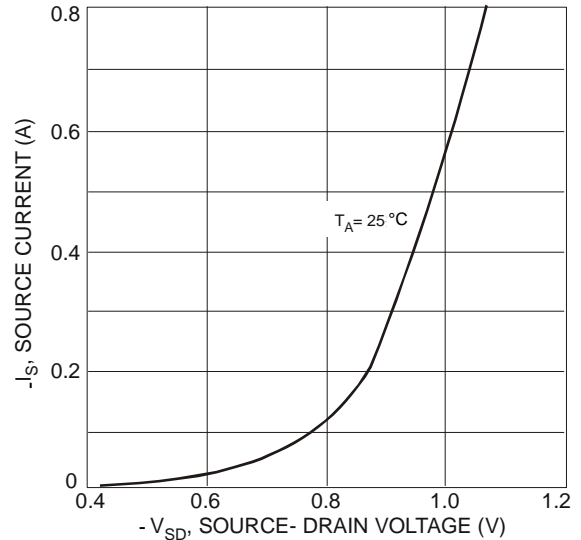


Fig. 20 Diodes Forward Voltage vs. Current

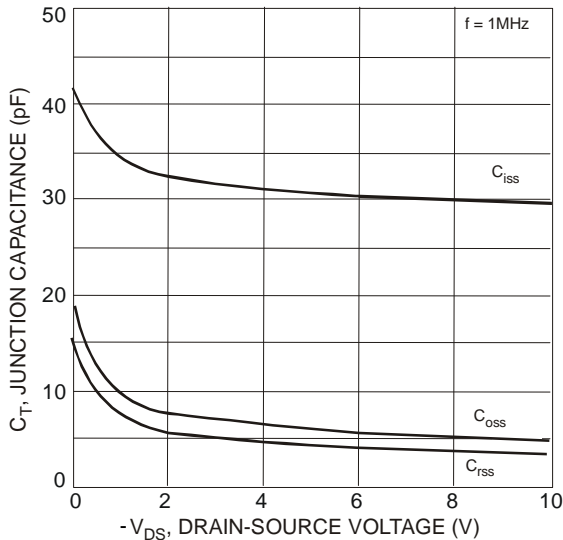


Fig. 21 Typical Junction Capacitance

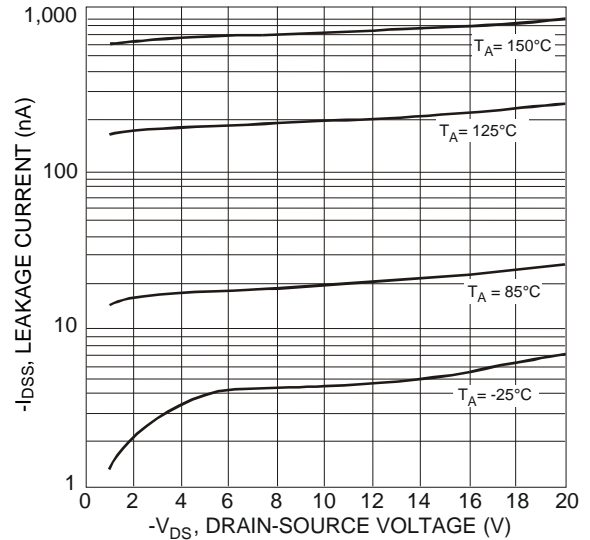


Fig. 22 Typical Leakage Current vs. Drain-Source Voltage

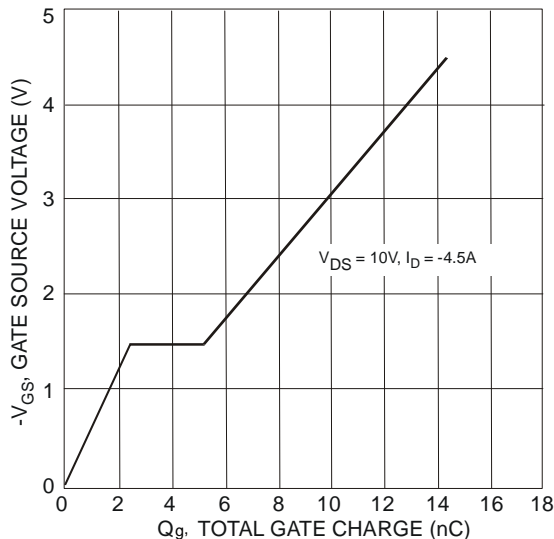


Fig. 23 Gate Charge Characteristics

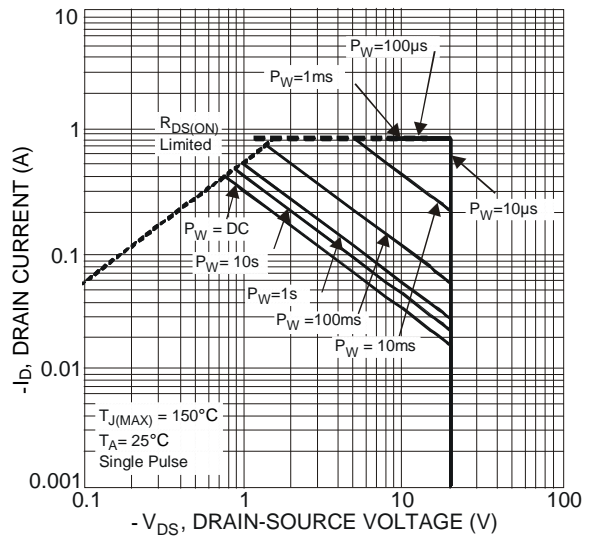
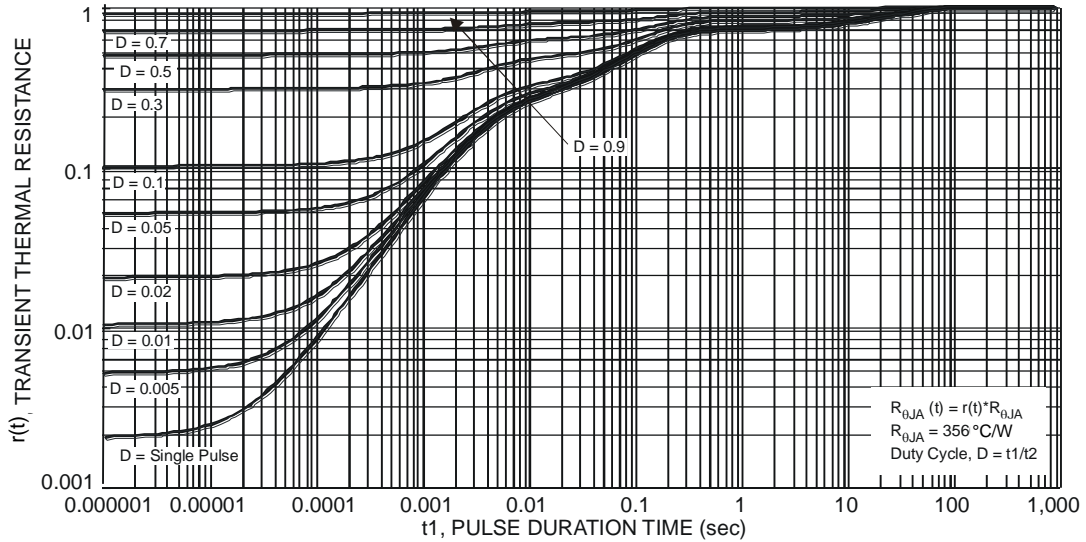


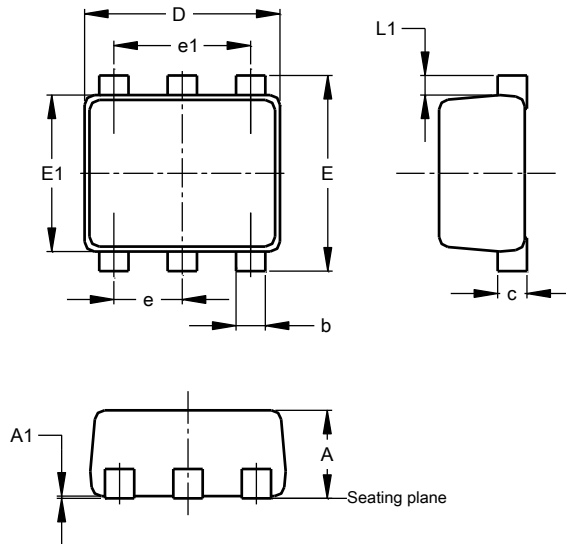
Fig. 24 SOA, Safe Operation Area



### Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

#### SOT963

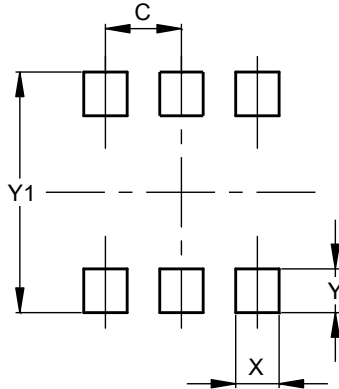


SOT963			
Dim	Min	Max	Typ
A	0.40	0.50	0.45
A1	0.00	0.05	--
b	0.10	0.20	0.15
c	0.120	0.180	0.150
D	0.95	1.05	1.00
E	0.95	1.05	1.00
E1	0.75	0.85	0.80
e	--	--	0.35
e1	--	--	0.70
L1	0.05	0.15	0.10
All Dimensions in mm			



## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.  
**SOT963**



Dimensions	Value (in mm)
C	0.350
X	0.200
Y	0.200
Y1	1.100

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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

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