

## N- and P-Channel 20V (D-S) Power MOSFET

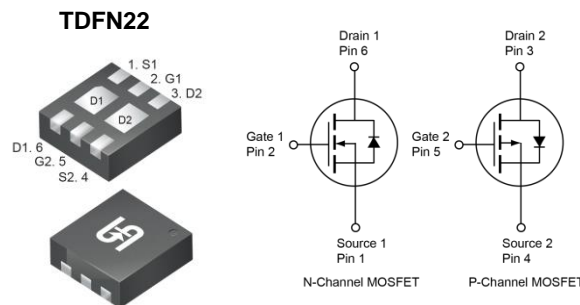
### FEATURES

- Low  $R_{DS(ON)}$  to minimize conductive losses
- Low gate charge for fast power switching
- Compliant to RoHS directive 2011/65/EU and in accordance to WEEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21

### APPLICATIONS

- Load Switch
- Power Management
- Portable Devices

KEY PERFORMANCE PARAMETERS			
PARAMETER	TYPE	VALUE	UNIT
$V_{DS}$	N-ch	20	V
	P-ch	-20	
$R_{DS(on)}$ (max)	N-ch	$V_{GS} = 4.5V$	30
		$V_{GS} = 2.5V$	36
		$V_{GS} = 1.8V$	42
	P-ch	$V_{GS} = -4.5V$	55
		$V_{GS} = -2.5V$	78
		$V_{GS} = -1.8V$	90
$Q_g$	N-ch	9.1	nC
	P-ch	9.8	



**Note:** MSL 3 (Moisture Sensitivity Level) per J-STD-020

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ C$ unless otherwise noted)				
PARAMETER	SYMBOL	N-ch	P-ch	UNIT
Drain-Source Voltage	$V_{DS}$	20	-20	V
Gate-Source Voltage	$V_{GS}$	$\pm 12$	$\pm 12$	V
Continuous Drain Current (Note 1)	$I_D$	$T_C = 25^\circ C$	11.6	-9
		$T_A = 25^\circ C$	6.4	-5
Pulsed Drain Current	$I_{DM}$	46.4	-36	A
Total Power Dissipation	$P_D$	$T_C = 25^\circ C$	6.25	6.25
		$T_C = 125^\circ C$	1.25	1.25
Total Power Dissipation	$P_D$	$T_A = 25^\circ C$	1.89	1.89
		$T_A = 125^\circ C$	0.38	0.38
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	- 55 to +150		$^\circ C$

THERMAL PERFORMANCE			
PARAMETER	SYMBOL	LIMIT	UNIT
Thermal Resistance – Junction to Case	$R_{\theta JC}$	20	$^\circ C/W$
Thermal Resistance – Junction to Ambient	$R_{\theta JA}$	66	

**Thermal Performance Note:**  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistances. The case-thermal reference is defined at the solder mounting surface of the drain pins.  $R_{\theta JA}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.

<b>ELECTRICAL SPECIFICATIONS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise noted)							
PARAMETER	CONDITIONS	SYMBOL	TYPE	MIN	TYP	MAX	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu\text{A}$	$BV_{DSS}$	N-ch	20	--	--	V
	$V_{GS} = 0V, I_D = -250\mu\text{A}$		P-ch	-20	--	--	
Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	$V_{GS(TH)}$	N-ch	0.5	0.8	1	V
	$V_{GS} = V_{DS}, I_D = -250\mu\text{A}$		P-ch	-0.45	-0.7	-1	
Gate-Source Leakage Current	$V_{GS} = \pm 12V, V_{DS} = 0V$	$I_{GSS}$	N-ch	--	--	$\pm 100$	nA
	$V_{GS} = \pm 12V, V_{DS} = 0V$		P-ch	--	--	$\pm 100$	
Drain-Source Leakage Current	$V_{GS} = 0V, V_{DS} = 20V$	$I_{DSS}$	N-ch	--	--	1	$\mu\text{A}$
	$V_{GS} = 0V, V_{DS} = 20V$ $T_J = 125^\circ\text{C}$			--	--	100	
	$V_{GS} = 0V, V_{DS} = -20V$		P-ch	--	--	-1	
	$V_{GS} = 0V, V_{DS} = -20V$ $T_J = 125^\circ\text{C}$			--	--	-100	
Drain-Source On-State Resistance <sup>(Note 2)</sup>	$V_{GS} = 4.5V, I_D = 6.4A$	$R_{DS(on)}$	N-ch	--	17	30	m $\Omega$
	$V_{GS} = 2.5V, I_D = 5.8A$			--	22	36	
	$V_{GS} = 1.8V, I_D = 5.4A$			--	32	42	
	$V_{GS} = -4.5V, I_D = -5A$		P-ch	--	48	55	
	$V_{GS} = -2.5V, I_D = -4.2A$			--	60	78	
	$V_{GS} = -1.8V, I_D = -3.9A$			--	78	90	
Forward Transconductance <sup>(Note 2)</sup>	$V_{DS} = 5V, I_D = 6.4A$	$g_{fs}$	N-ch	--	28	--	S
	$V_{DS} = -5V, I_D = -5A$		P-ch	--	15	--	
<b>Dynamic</b> <sup>(Note 3)</sup>							
Total Gate Charge	N-ch $V_{GS} = 4.5V,$ $V_{DS} = 10V, I_D = 6.4A$	$Q_g$	N-ch	--	9.1	--	nC
			P-ch	--	9.8	--	
Gate-Source Charge	P-ch	$Q_{gs}$	N-ch	--	1.3	--	
			P-ch	--	1.1	--	
Gate-Drain Charge	$V_{GS} = -4.5V,$ $V_{DS} = -10V, I_D = -5A$	$Q_{gd}$	N-ch	--	2.7	--	
			P-ch	--	2.7	--	
Input Capacitance	N-ch $V_{GS} = 0V, V_{DS} = 10V$	$C_{iss}$	N-ch	--	677	--	pF
			P-ch	--	744	--	
Output Capacitance	f = 1.0MHz P-ch	$C_{oss}$	N-ch	--	120	--	
			P-ch	--	106	--	
Reverse Transfer Capacitance	$V_{GS} = 0V, V_{DS} = -10V$ f = 1.0MHz	$C_{rss}$	N-ch	--	89	--	
			P-ch	--	97	--	
Gate Resistance	f = 1.0MHz	$R_g$	N-ch	--	3	--	$\Omega$
			P-ch	--	80	--	

<b>ELECTRICAL SPECIFICATIONS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise noted)							
PARAMETER	CONDITIONS	SYMBOL	TYPE	MIN	TYP	MAX	UNIT
<b>Switching</b> (Note 3)							
Turn-On Delay Time	N-ch	$t_{d(on)}$	N-ch	--	8	--	ns
			P-ch	--	10	--	
Turn-On Rise Time	$V_{GS} = 4.5\text{V}, R_G = 2\Omega$ $V_{DS} = 10\text{V}, I_D = 6.4\text{A}$	$t_r$	N-ch	--	41	--	
			P-ch	--	34	--	
Turn-Off Delay Time	P-ch	$t_{d(off)}$	N-ch	--	25	--	
			P-ch	--	69	--	
Turn-Off Fall Time	$V_{DS} = -10\text{V}, I_D = -5\text{A}$	$t_f$	N-ch	--	30	--	
			P-ch	--	68	--	
<b>Source-Drain Diode</b>							
Forward Voltage (Note 2)	$V_{GS} = 0\text{V}, I_S = 6.4\text{A}$	$V_{SD}$	N-ch	--	0.7	--	V
	$V_{GS} = 0\text{V}, I_S = -5\text{A}$		P-ch	--	-0.8	--	
Reverse recovery Time	N-ch $I_S = 6.4\text{A},$ $dI/dt = 100\text{A}/\mu\text{s}$	$t_{rr}$	N-ch		22		nc
			P-ch		113		
Reverse Recovery Charge	P-ch $I_S = -5\text{A},$ $dI/dt = 100\text{A}/\mu\text{s}$	$Q_{rr}$	N-ch	--	6		nc
			P-ch	--	160		

**Notes:**

1. Silicon limited current only.
2. Pulse test: Pulse Width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
3. Switching time is essentially independent of operating temperature.

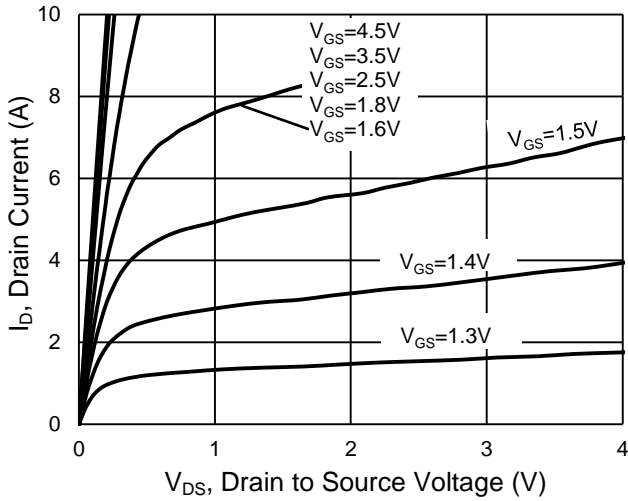
**ORDERING INFORMATION**

PART NO.	PACKAGE	PACKING
TSM2537CQ RFG	TDFN22	3,000pcs / 7" Reel

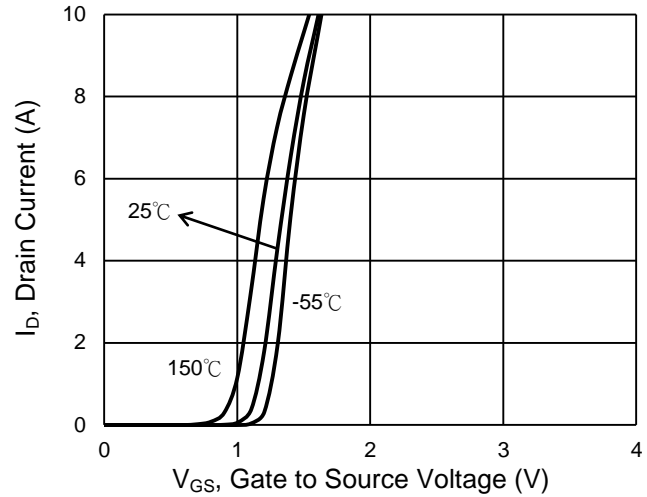
**CHARACTERISTICS CURVES (N-Channel)**

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

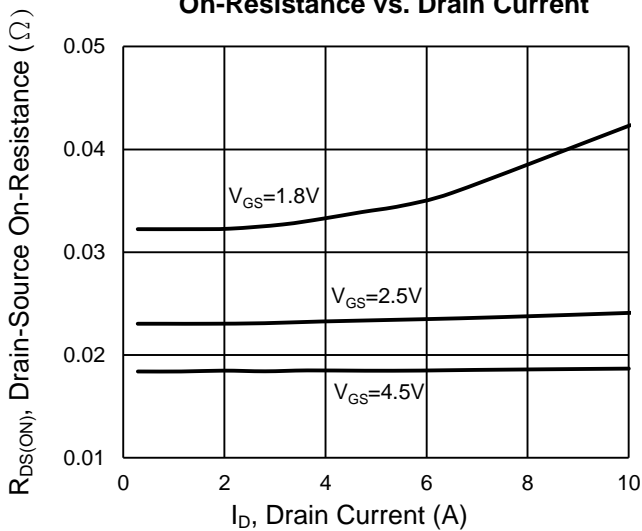
**Output Characteristics**



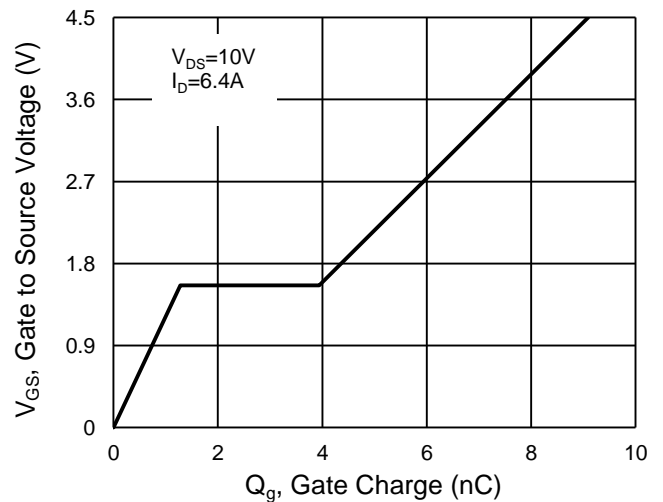
**Transfer Characteristics**



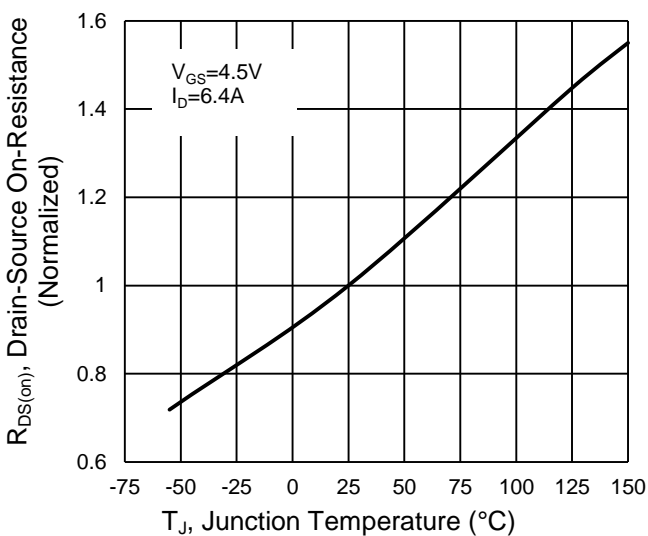
**On-Resistance vs. Drain Current**



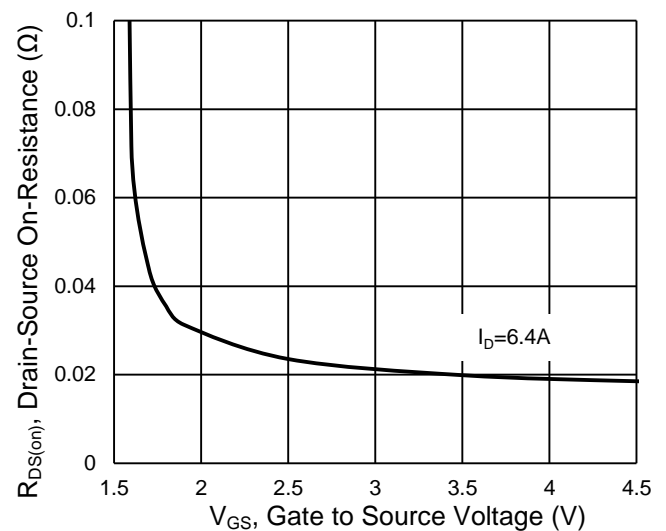
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**



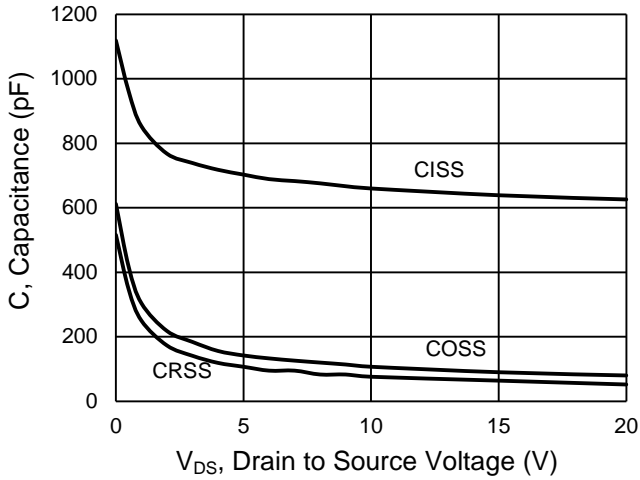
**On-Resistance vs. Gate-Source Voltage**



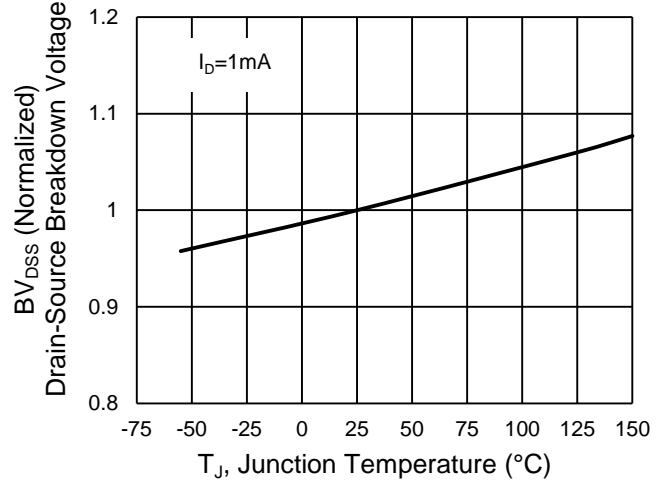
**CHARACTERISTICS CURVES (N-Channel)**

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

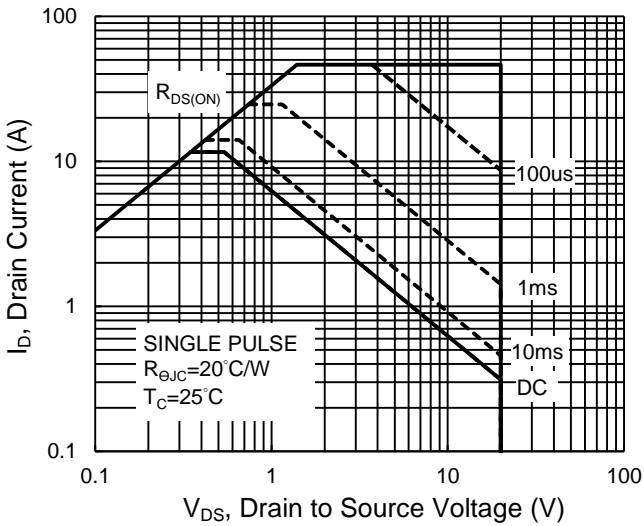
**Capacitance vs. Drain-Source Voltage**



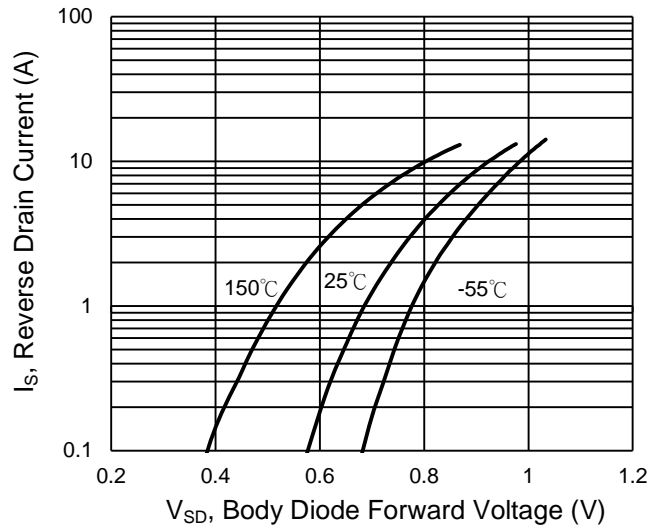
**$BV_{DSS}$  vs. Junction Temperature**



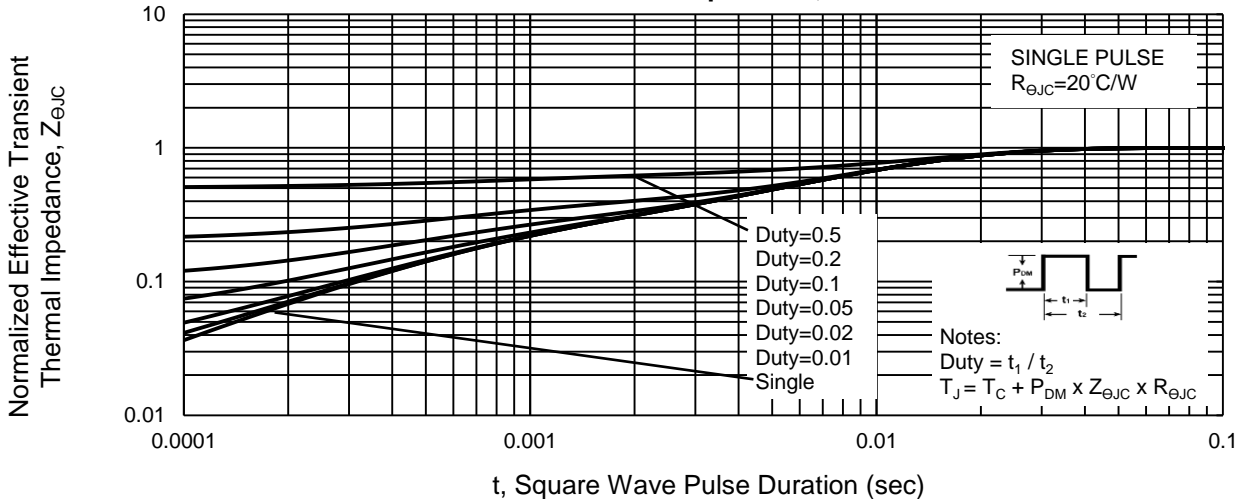
**Maximum Safe Operating Area, Junction-to-Case**



**Source-Drain Diode Forward Current vs. Voltage**



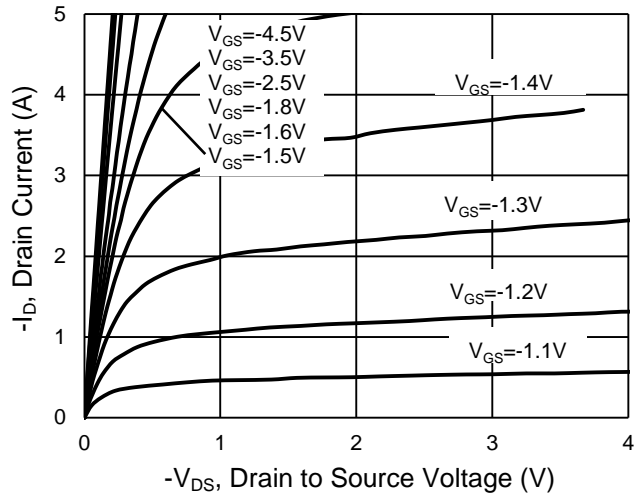
**Normalized Thermal Transient Impedance, Junction-to-Case**



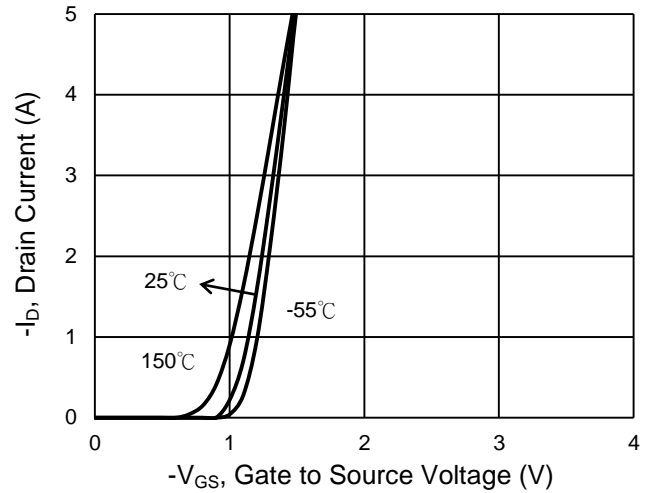
**CHARACTERISTICS CURVES (P-Channel)**

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

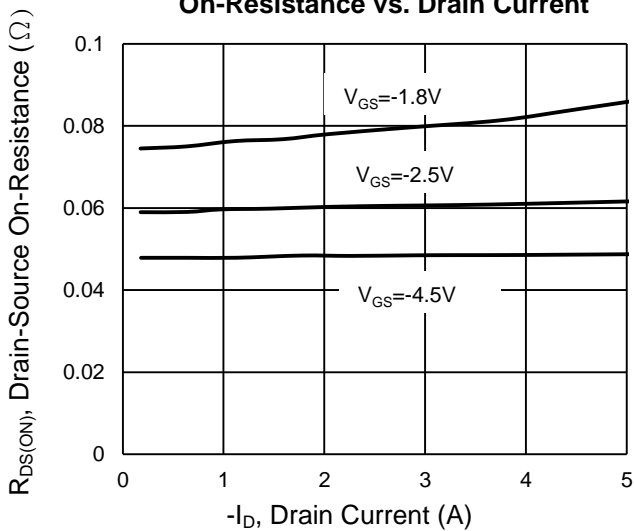
**Output Characteristics**



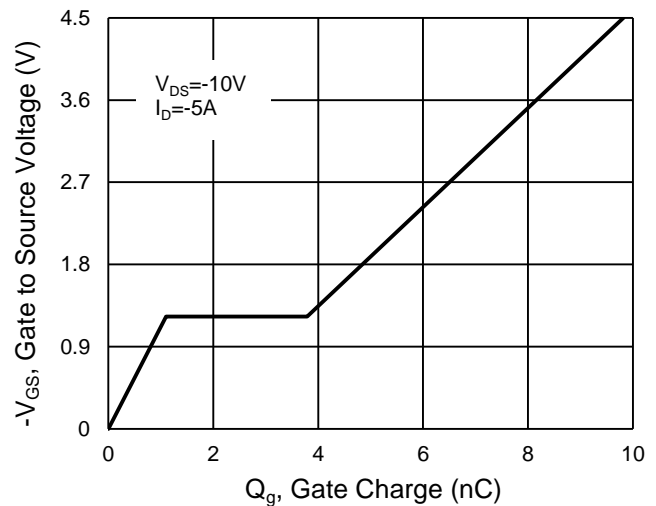
**Transfer Characteristics**



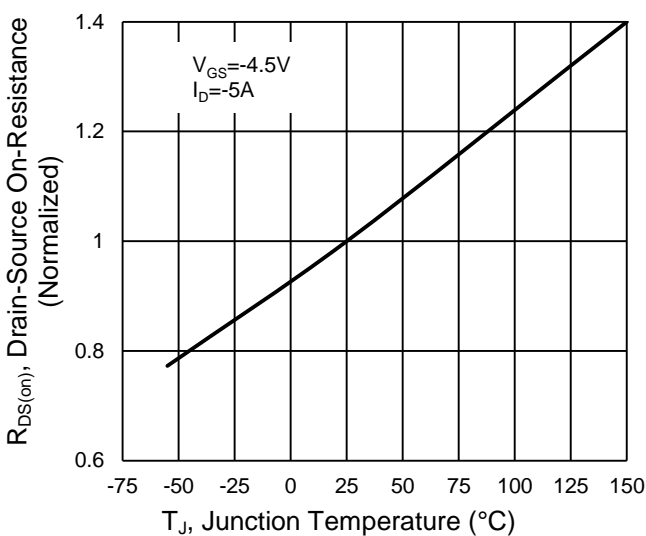
**On-Resistance vs. Drain Current**



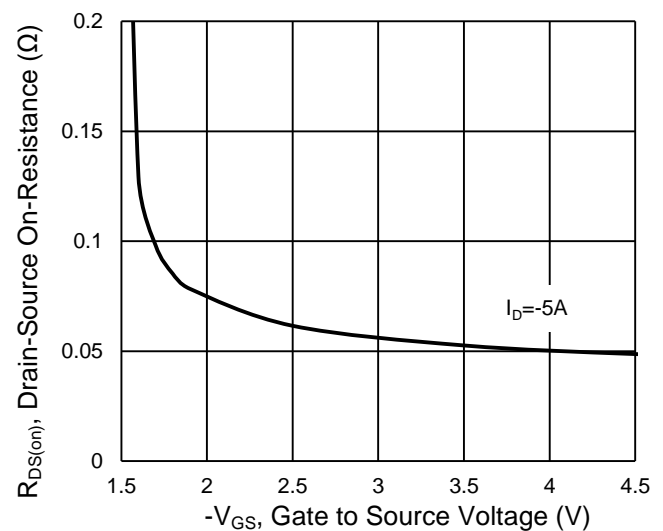
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**



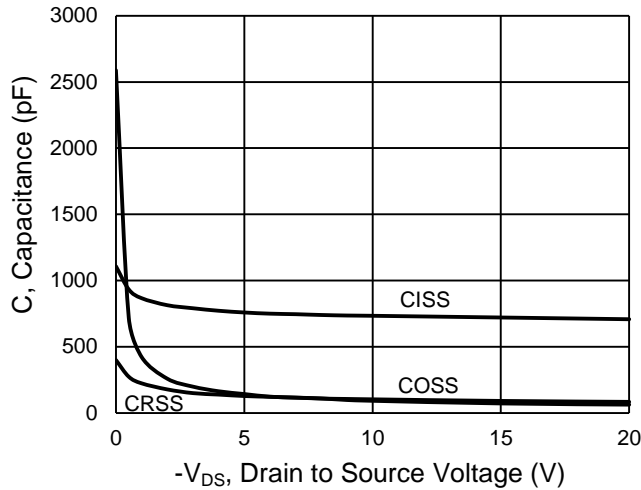
**On-Resistance vs. Gate-Source Voltage**



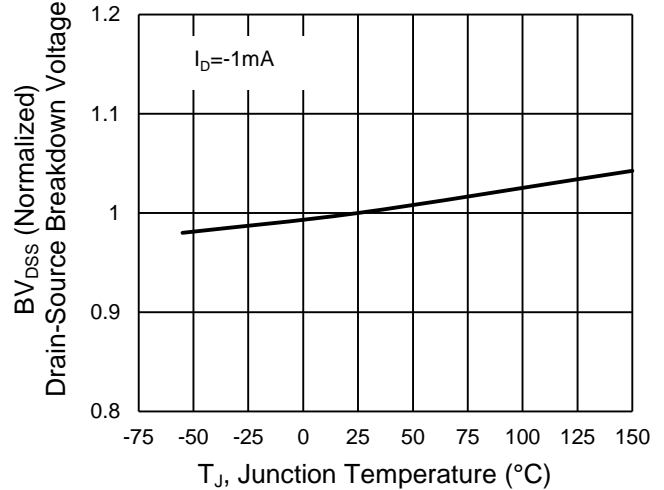
**CHARACTERISTICS CURVES (P-Channel)**

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

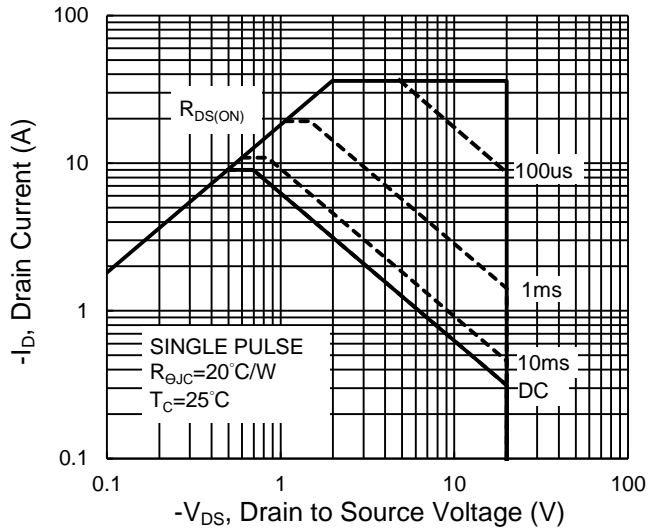
**Capacitance vs. Drain-Source Voltage**



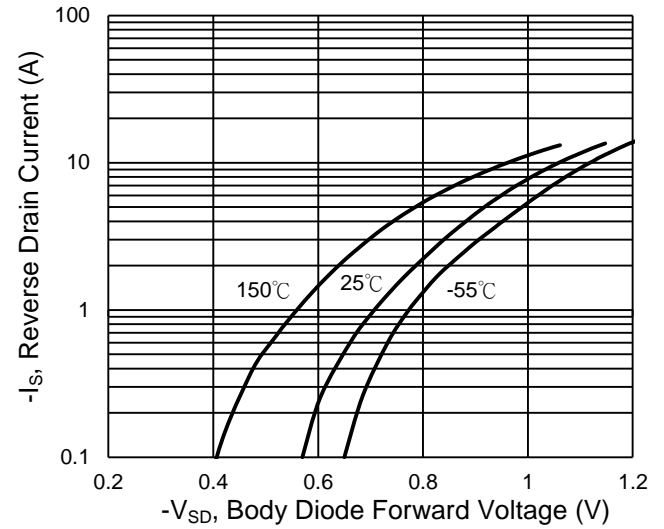
**$BV_{DSS}$  vs. Junction Temperature**



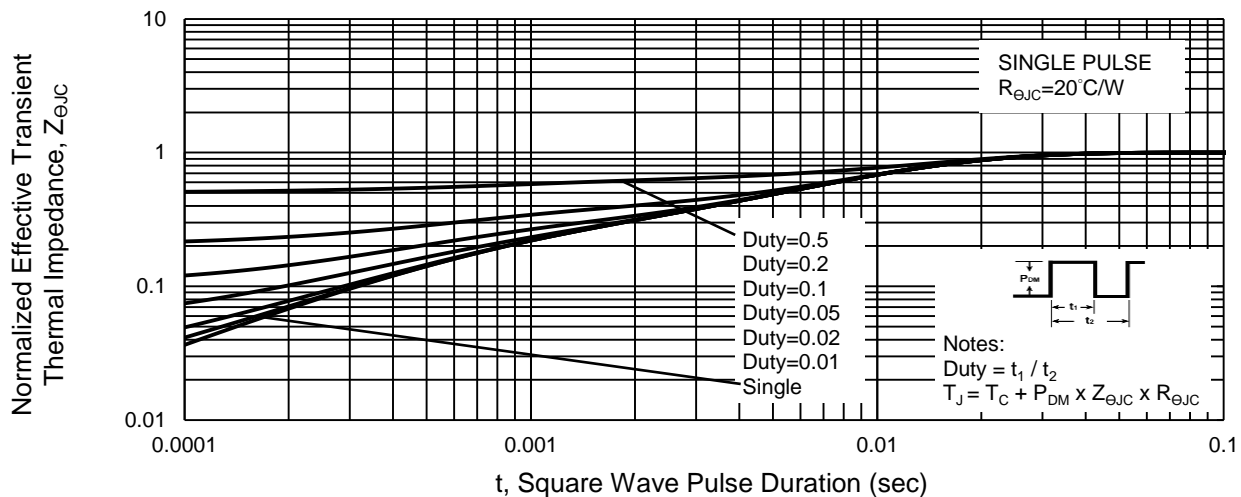
**Maximum Safe Operating Area, Junction-to-Case**



**Source-Drain Diode Forward Current vs. Voltage**

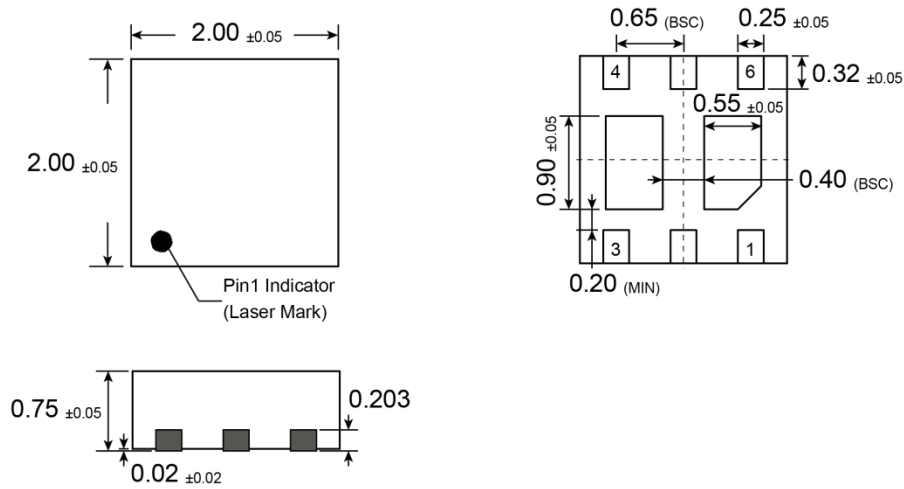


**Normalized Thermal Transient Impedance, Junction-to-Case**

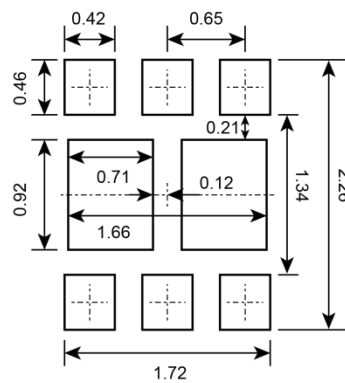


**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

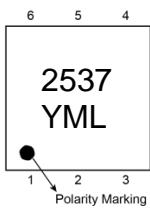
**TDFN22**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



- Y** = Year Code
- M** = Month Code for Halogen Free
  - O** =Jan    **P** =Feb    **Q** =Mar    **R** =Apr
  - S** =May    **T** =Jun    **U** =Jul    **V** =Aug
  - W** =Sep    **X** =Oct    **Y** =Nov    **Z** =Dec
- L** = Lot Code (1~9, A~Z)



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