

# N/P Channel MOSFET

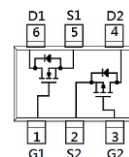
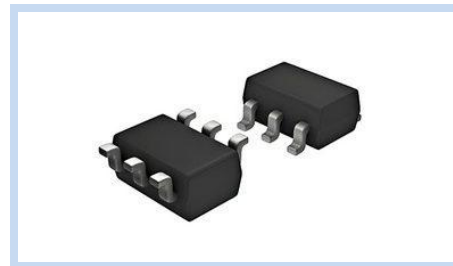
## 20V 1A 1.1W SOT-23-6 ESD

MFT2NP1A0S236E

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### FEATURE

- $R_{DS(ON)} < 400m\Omega$  at  $V_{GS}=4.5V$
- $R_{DS(ON)} < 500m\Omega$  at  $V_{GS}=2.5V$
- $R_{DS(ON)} < 700m\Omega$  at  $V_{GS}=1.8V$
- Advanced Trench Process Technology
- ESD Protected
- Application: Switch Load, PWM Application, etc.



### MECHANICAL DATA

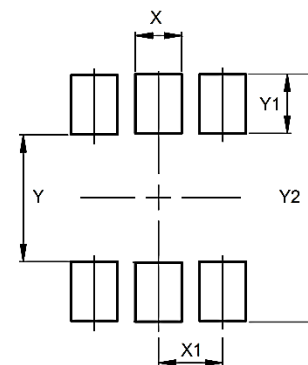
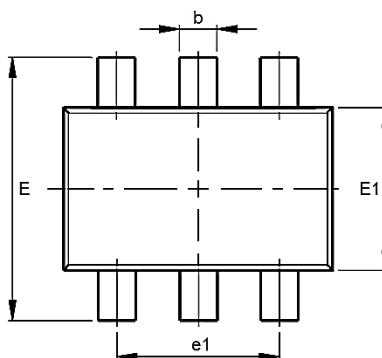
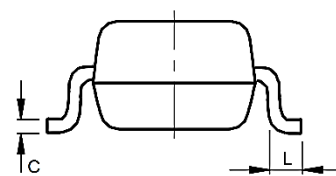
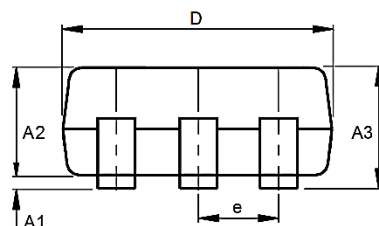
- Case: SOT-23-6 Package
- Terminals: Solderable per MIL-STD-750, Method 2026

### MAXIMUM RATINGS

Parameter	Symbol	Value		Unit
Drain-Source Voltage	$V_{DS}$	20	-20	V
Gate-Source Voltage	$V_{GS}$	$\pm 10$	$\pm 10$	V
Drain Current – Continuous	$I_D$	1.0	-1.0	A
Drain Current – Pulsed	$I_{DM}$	1.0	-2.0	A
Power Dissipation	$P_D$	1.1		W
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	114		$^{\circ}C/W$
Operating Junction and Storage Temperature	$T_J, T_{STG}$	-55~150		$^{\circ}C$

### DIMENSIONS

Item	Min (mm)	Max (mm)
A1	0.00	0.10
A2	1.00	1.20
A3	1.00	1.30
b	0.30	0.50
C	0.08	0.20
D	2.70	3.10
E	2.60	3.00
E1	1.50	1.70
e	0.95	
e1	1.70	2.10
L	0.30	0.60
X	0.80	
X1	0.95	
Y	1.10	
Y1	0.90	
Y2	2.90	



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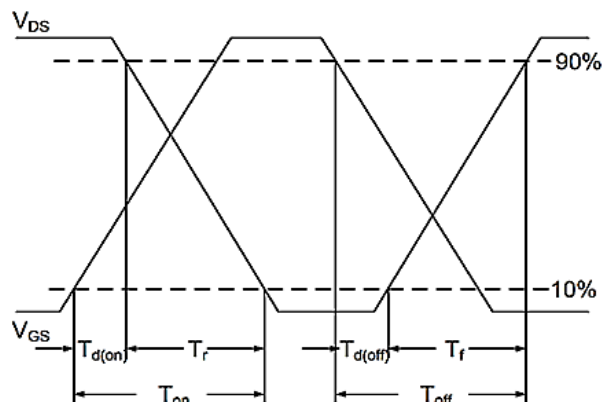
### ELECTRICAL CHARACTERISTICS - N-CH

Off Characteristics	Conditions	Symbol	Min	Typ.	Max	Unit
Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	$BV_{DSS}$	20	--	--	V
Drain-Source Leakage Current	$V_{DS}=16V, V_{GS}=0V,$	$I_{DSS}$	--	--	1	$\mu A$
Gate-Source Leakage Current	$V_{GS}=\pm 8V, V_{DS}=0V$	$I_{GSS}$	--	--	$\pm 10$	$\mu A$
On Characteristics	Conditions	Symbol	Min	Typ.	Max	Unit
Static Drain-Source On-Resistance	$V_{GS}=4.5V, I_D=4.1A$	$R_{DS(ON)}$	--	--	400	m $\Omega$
	$V_{GS}=2.5V, I_D=2.8A$		--	--	500	
	$V_{GS}=1.8V, I_D=1.5A$		--	--	700	
Gate Threshold Voltage	$V_{GS}=V_{DS}, I_D=250\mu A$	$V_{GS(th)}$	0.3	--	1.1	V
Dynamic Characteristics	Conditions	Symbol	Min	Typ.	Max	Unit
Forward Transconductance	$V_{DS}=5V, I_D=0.5A$	$g_{FS}$	--	1.3	--	S
Total Gate Charge	$V_{DS}=10V, V_{GS}=2.5V, I_D=1A$	$Q_g$	--	0.6	--	nC
Gate-Source Charge			--	0.9	--	
Gate-Drain Charge		$V_{DS}=10V, V_{GS}=4.5V, I_D=1A$	$Q_{gd}$	--	0.1	
Turn-On Delay Time	$V_{DD}=10V, V_{GS}=4.5V, R_G=3.3\Omega, I_D=0.5A$	$T_{d(on)}$	--	1016	--	ns
Rise Time		$T_r$	--	168	--	
Turn-Off Delay Time		$T_{d(off)}$	--	762	--	
Fall Time		$T_f$	--	368	--	
Input Capacitance		$C_{iss}$	--	12	--	
Output Capacitance	$V_{DS}=10V, V_{GS}=0V, F=1MHz$	$C_{oss}$	--	12	--	
Reverse Transfer Capacitance		$C_{rss}$	--	5	--	
Drain-Source Body Diode	Conditions	Symbol	Min	Typ.	Max	Unit
Continuous Source Current	--	$I_S$	--	--	1	A
Diode Forward Voltage	$V_{GS}=0V, I_S=0.5A$	$V_{SD}$	--	--	1.2	V

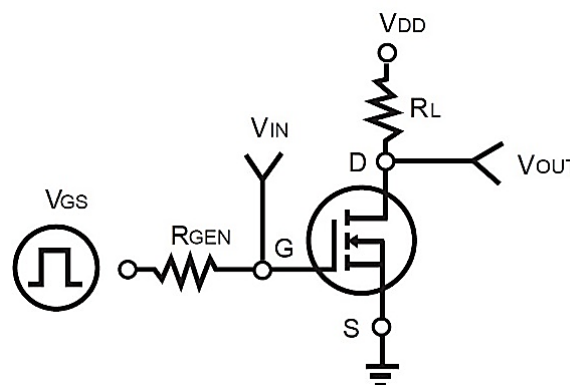
Note:

1. Pulse width  $\leq 100\mu s$ , duty cycle  $\leq 2\%$ .
2. Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)}=150^\circ C$ .
3. Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate.

Switching Time Waveform



Switching Test Circuit



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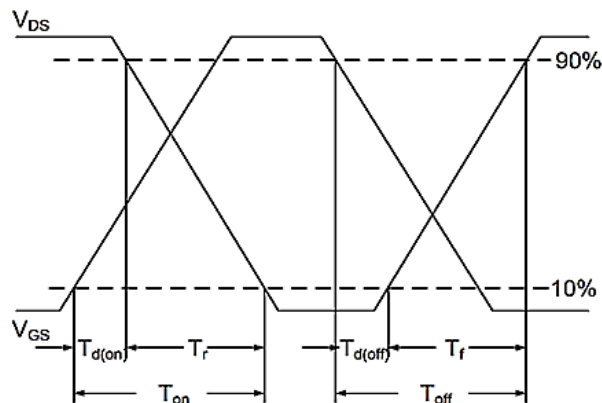
### ELECTRICAL CHARACTERISTICS - P-CH

Off Characteristics	Conditions	Symbol	Min	Typ.	Max	Unit	
Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=-250\mu A$	$BV_{DSS}$	-20	--	--	V	
Drain-Source Leakage Current	$V_{DS}=-16V, V_{GS}=0V$	$I_{DSS}$	--	--	-1	$\mu A$	
Gate-Source Leakage Current	$V_{GS}=\pm 8V, V_{DS}=0V$	$I_{GSS}$	--	--	$\pm 10$	$\mu A$	
On Characteristics	Conditions	Symbol	Min	Typ.	Max	Unit	
Static Drain-Source On-Resistance	$V_{GS}=-4.5V, I_D=-3.1A$	$R_{DS(ON)}$	--	--	700	m $\Omega$	
	$V_{GS}=-2.5V, I_D=-2.0A$		--	--	1100		
	$V_{GS}=-1.8V, I_D=-1.1A$		--	--	1400		
Gate Threshold Voltage	$V_{GS}=V_{DS}, I_D=-250\mu A$	$V_{GS(th)}$	-0.3	--	-1.0	V	
Dynamic Characteristics	Conditions	Symbol	Min	Typ.	Max	Unit	
Forward Transconductance	$V_{DS}=-5V, I_D=0.5A$	$g_{FS}$	--	0.9	--	S	
Total Gate Charge	$V_{DS}=-10V, V_{GS}=-2.5V, I_D=-0.5A$	$Q_g$	--	0.45	--	nC	
Gate-Source Charge			$Q_{gs}$	--	0.2		--
Gate-Drain Charge			$Q_{gd}$	--	0.1		--
Turn-On Delay Time	$V_{DD}=-10V, V_{GS}=-4.5V, R_G=3.9\Omega, I_D=-0.5A$	$T_{d(on)}$	--	258	--	ns	
Rise Time		$T_r$	--	764	--		
Turn-Off Delay Time		$T_{d(off)}$	--	1216	--		
Fall Time		$T_f$	--	1847	--		
Input Capacitance	$V_{DS}=-10V, V_{GS}=0V, F=1MHz$	$C_{iss}$	--	32	--	pF	
Output Capacitance		$C_{oss}$	--	6.9	--		
Reverse Transfer Capacitance		$C_{rss}$	--	5	--		
Drain-Source Body Diode	Conditions	Symbol	Min	Typ.	Max	Unit	
Continuous Source Current	--	$I_S$	--	--	-1	A	
Diode Forward Voltage	$V_{GS}=0V, I_S=-0.5A$	$V_{SD}$	--	--	-1.2	V	

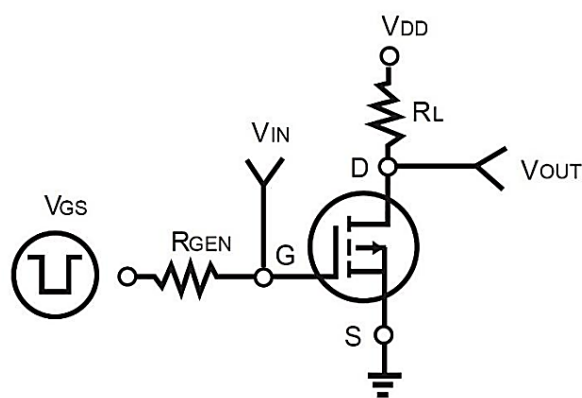
Note:

1. Pulse width  $\leq 100\mu s$ , duty cycle  $\leq 2\%$ .
2. Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)}=150^\circ C$ .
3. Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate.

Switching Time Waveform

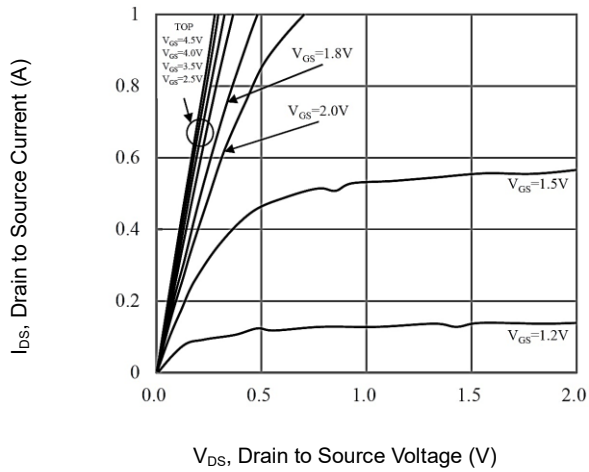


Switching Test Circuit

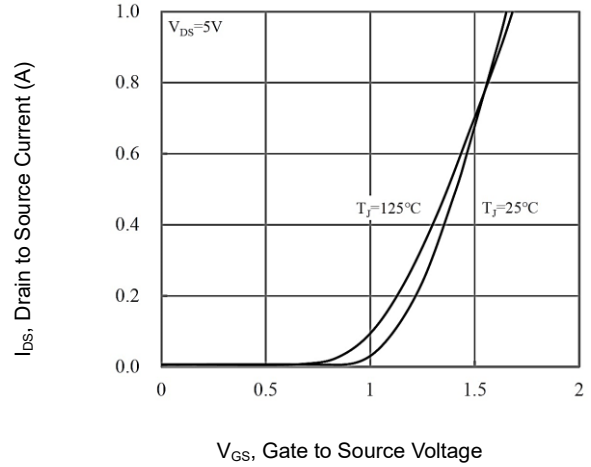


**N-CH CHARACTERISTIC CURVES**

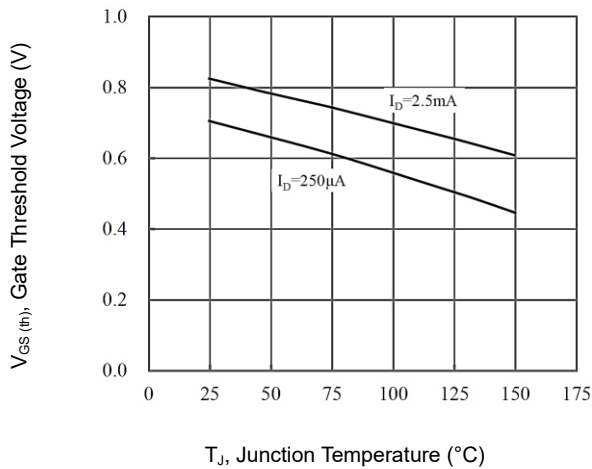
**On-Region Characteristics**



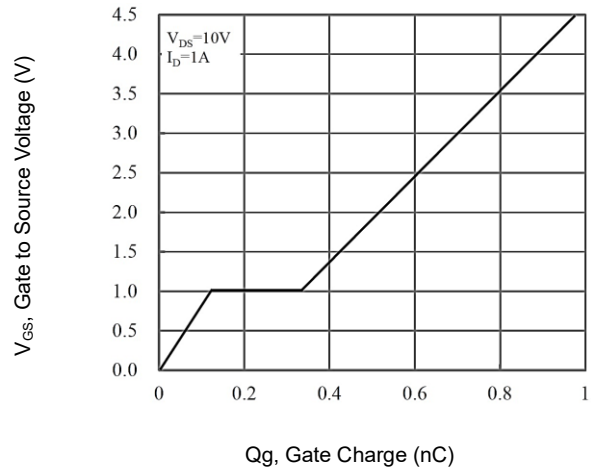
**Transfer Characteristics**



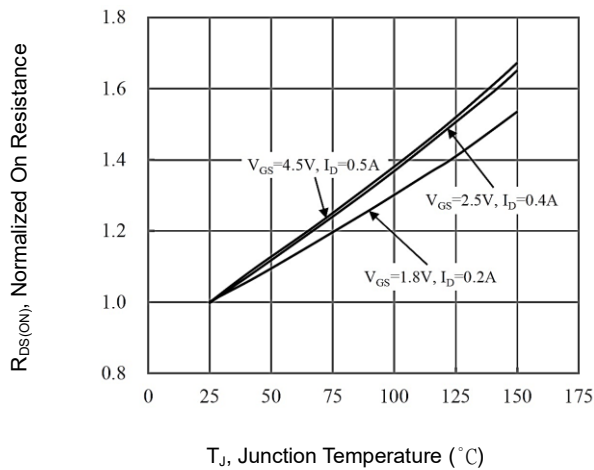
**Threshold Voltage Variance vs. Temperature**



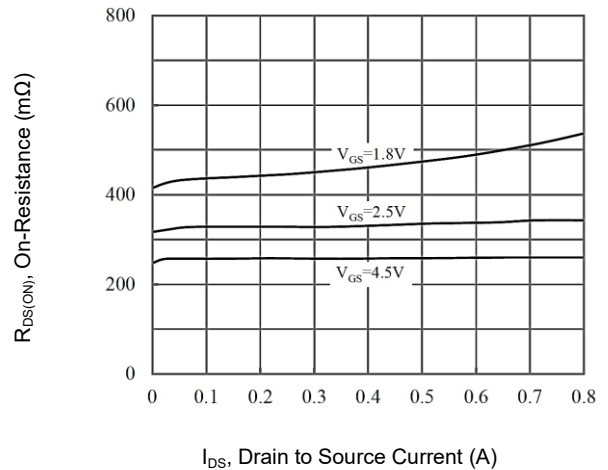
**Gate Charge Waveform**



**Normalized On-Resistance vs. Junction Temperature**



**On-Resistance vs. Drain Current**



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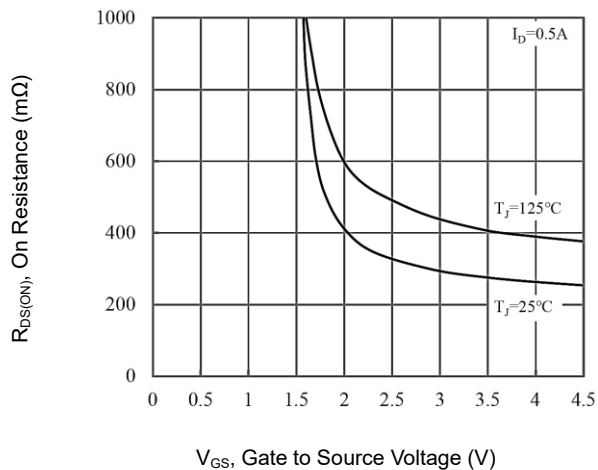
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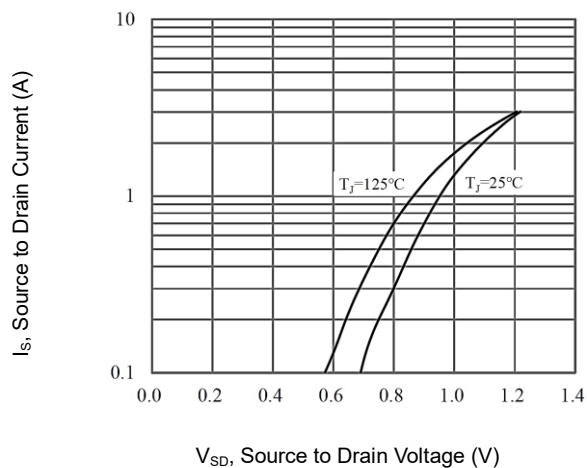
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### N-CH CHARACTERISTIC CURVES

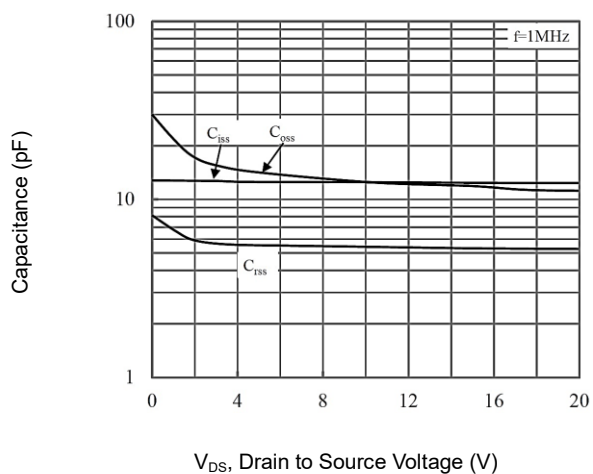
On-Resistance Variation with  $V_{GS}$



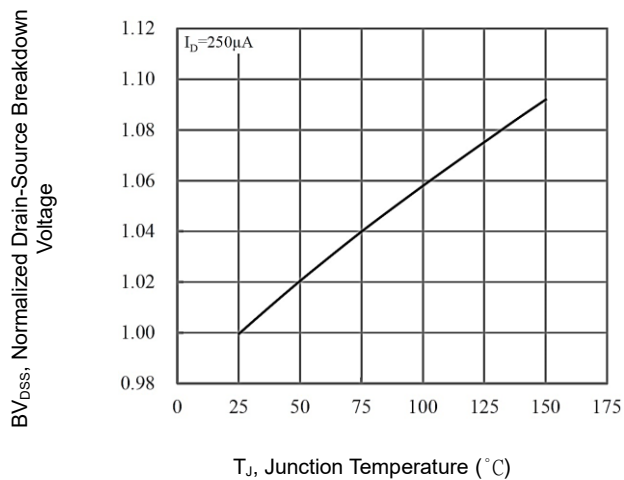
Body Diode Characteristics



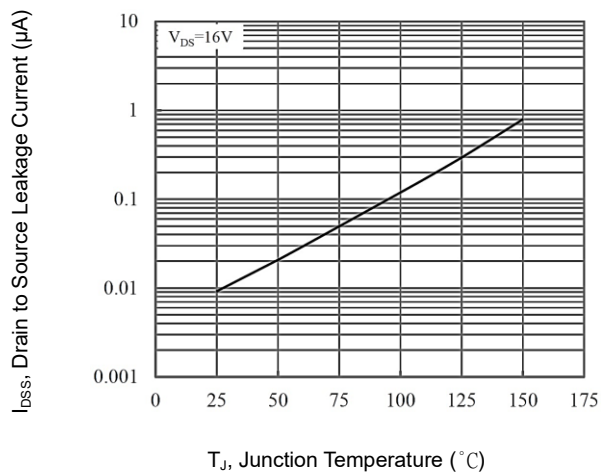
Capacitance vs. Drain-Source Voltage



Normalized Drain-Source Breakdown Voltage

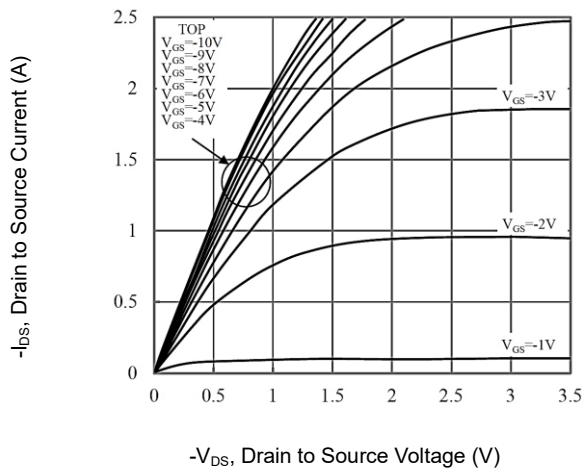


Drain-Source Leakage Current

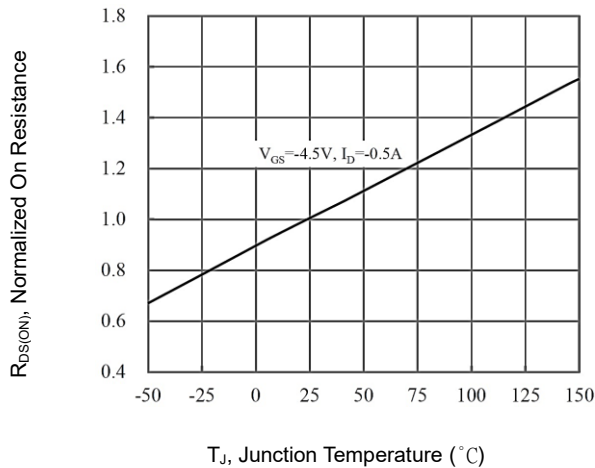


### P-CH CHARACTERISTIC CURVES

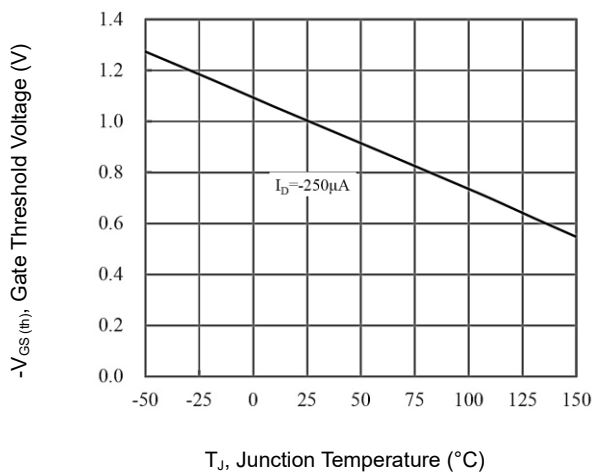
On-Region Characteristics



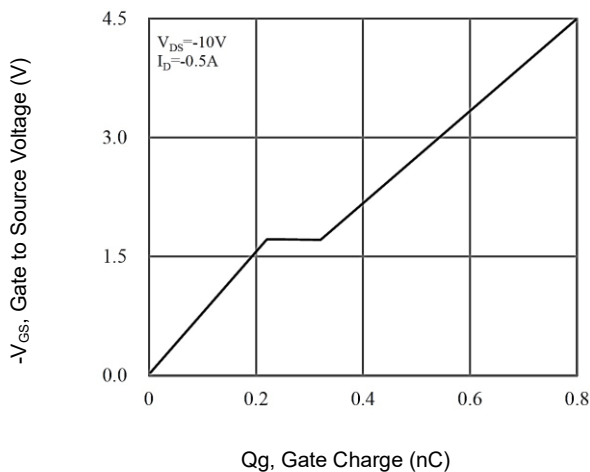
Normalized On-Resistance vs. Junction Temperature



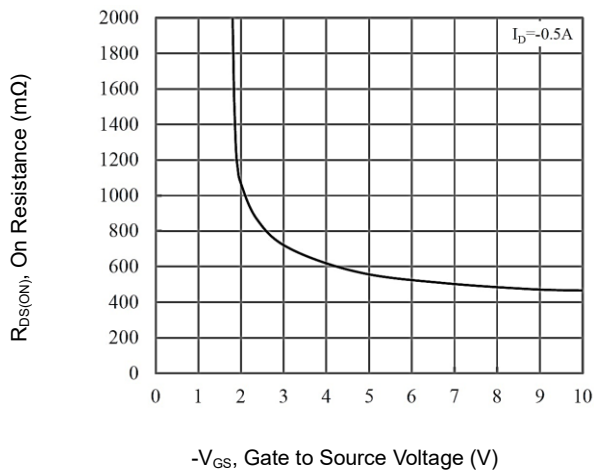
Threshold Voltage Variance vs. Temperature



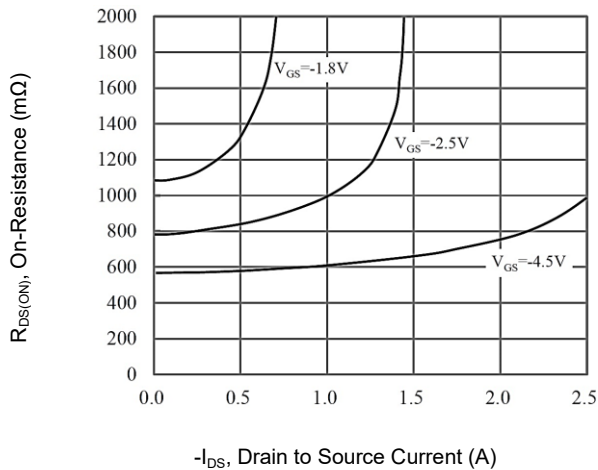
Gate Charge Waveform



On-Resistance Variation with  $V_{GS}$

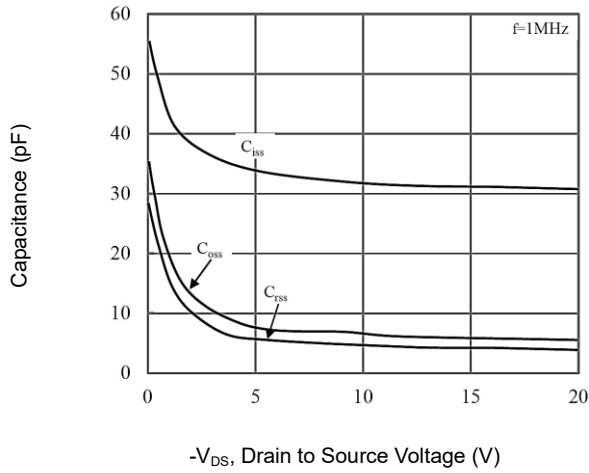


On-Resistance vs. Drain Current



**P-CH CHARACTERISTIC CURVES**

Capacitance vs. Drain-Source Voltage



Body Diode Characteristics

