P-Channel 60-V (D-S) MOSFET
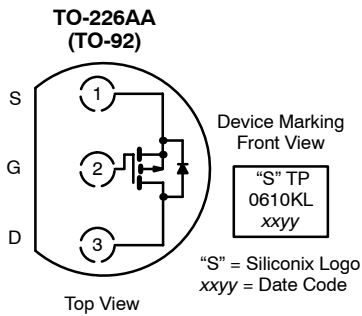
PRODUCT SUMMARY

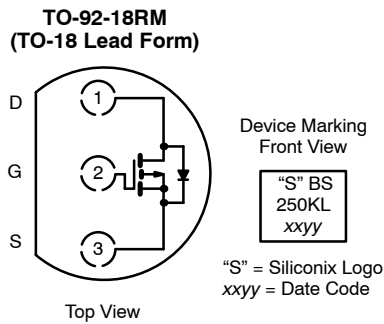| $V_{(BR)DSS(min)}$ (V)	$r_{DS(on)}$ (Ω)	$V_{GS(th)}$ (V)	I_D (A)
−60	6 @ V_{GS} = −10 V	−1 to −3.0	−0.27
	10 @ V_{GS} = −4.5 V		−0.21

FEATURES

- TrenchFET® Power MOSFET
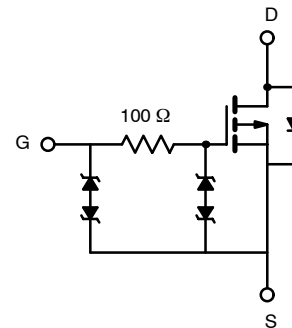- ESD Protected: 2000 V

APPLICATIONS

- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Power Supply, Converter Circuits
- Motor Control

TO-226AA (TO-92)

Device Marking
Front View

"S" TP
0610KL
xxyy

"S" = Siliconix Logo
xxyy = Date Code

Top View

Ordering Information: TP0610KL-TR1

TO-92-18RM (TO-18 Lead Form)

Device Marking
Front View

"S" BS
250KL
xxyy

"S" = Siliconix Logo
xxyy = Date Code

Top View

Ordering Information: BS250KL-TR1

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C UNLESS OTHERWISE NOTED)

Parameter		Symbol	Limit	Unit
Drain-Source Voltage		V_{DS}	−60	V
Gate-Source Voltage		V_{GS}	±20	
Continuous Drain Current	T_A = 25°C	I_D	−0.27	A
	T_A = 70°C		−0.22	
Pulse Drain Current[a]		I_{DM}	−1.0	
Power Dissipation	T_A = 25°C	P_D	0.8	W
	T_A = 70°C		0.51	
Maximum Junction-to-Ambient		R_{thJA}	156	°C/W
Operating Junction and Storage Temperature Range		T_J, T_{stg}	−55 to 150	°C

Notes
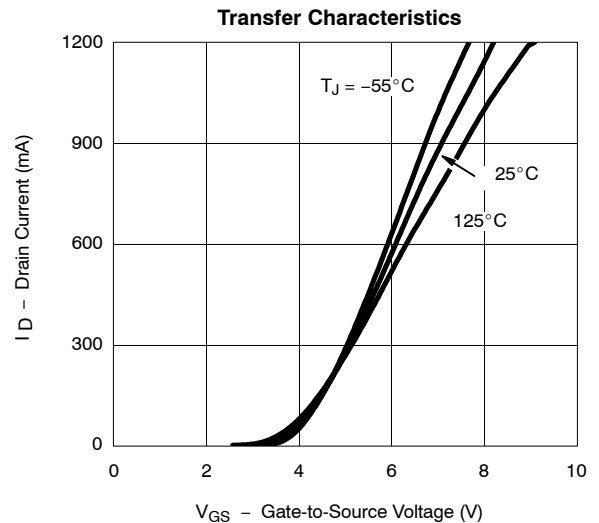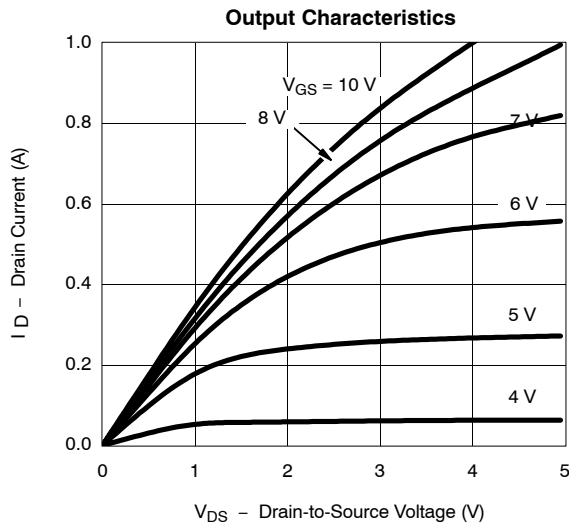a. Pulse width limited by maximum junction temperature.

SPECIFICATIONS (T_A = 25°C UNLESS OTHERWISE NOTED)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Static						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = –10 μA	–60			V
Gate-Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = –250 μA	–1	–2.1	–3.0	
Gate-Body Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ±20 V			±10	μA
		V_{DS} = 0 V, V_{GS} = ±10 V			±200	nA
		V_{DS} = 0 V, V_{GS} = ±10 V, T_J = 85°C			±500	
		V_{DS} = 0 V, V_{GS} = ±5 V			±100	
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = –60 V, V_{GS} = 0 V			–1	μA
		V_{DS} = –60 V, V_{GS} = 0 V, T_J = 55°C			–10	
On-State Drain Current[a]	$I_{D(on)}$	V_{DS} = –10 V, V_{GS} = –4.5 V	–50			mA
		V_{DS} = –10 V, V_{GS} = –10 V	–600			
Drain-Source On-Resistance[a]	$r_{DS(on)}$	V_{GS} = –4.5 V, I_D = –25 mA		5.5	10	Ω
		V_{GS} = –10 V, I_D = –500 mA		3.1	6	
		V_{GS} = –10 V, I_D = –500 mA, T_J = 125°C		4.7	9	
Forward Transconductance[a]	g_{fs}	V_{DS} = –10 V, I_D = –100 mA		180		mS
Diode Forward Voltage[a]	V_{SD}	I_S = –200 mA, V_{GS} = 0 V		–0.9	–1.4	V
Dynamic[b]						
Total Gate Charge	Q_g	V_{DS} = –30 V, V_{GS} = –15 V, I_D ≅ –500 mA		1.7	3	nC
Gate-Source Charge	Q_{gs}			0.26		
Gate-Drain Charge	Q_{gd}			0.46		
Gate Resistance	R_g			285		Ω
Turn-On Time	$t_{d(on)}$	V_{DD} = –25 V, R_L = 150 Ω I_D ≅ –150 mA, V_{GEN} = –10 V R_g = 10 Ω		2.4	5	ns
	t_r			15.5	25	
Turn-Off Time	$t_{d(off)}$			21	35	
	t_f			12.5	20	

Notes
a. Pulse test: PW ≤ 300 ms duty cycle ≤ 2%.
b. Guaranteed by design, not subject to production testing.

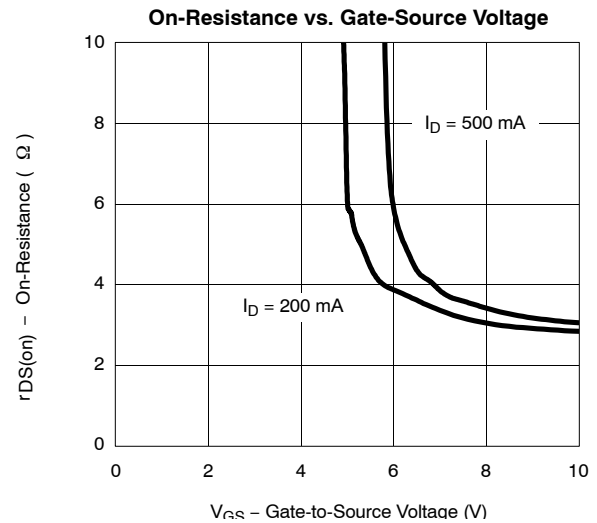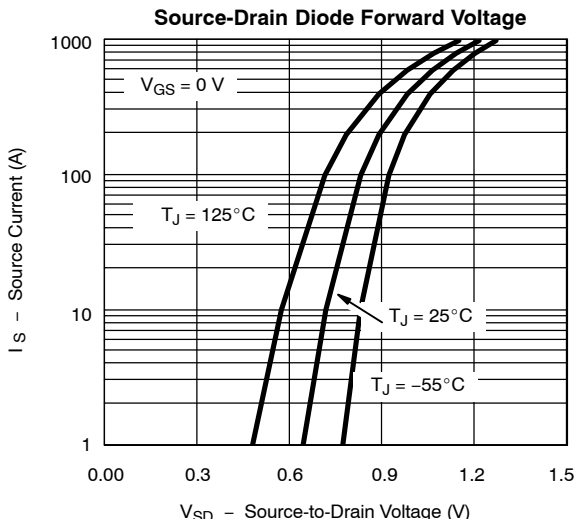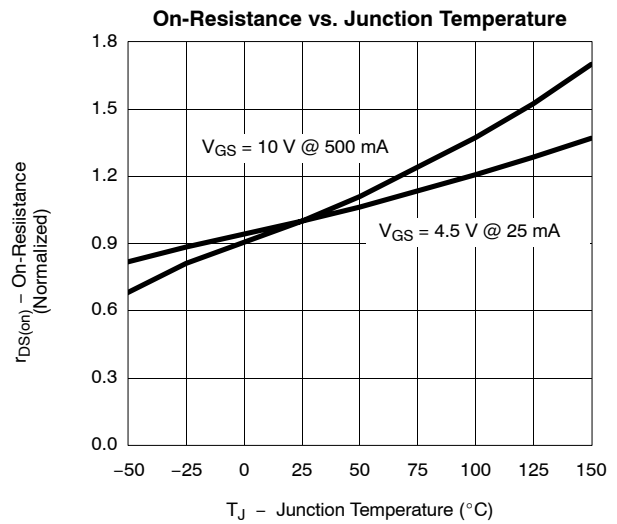## TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

For the following graphs, p-channel negative polarities for all voltage and current values are represented as positive values.

Output Characteristics

Transfer Characteristics

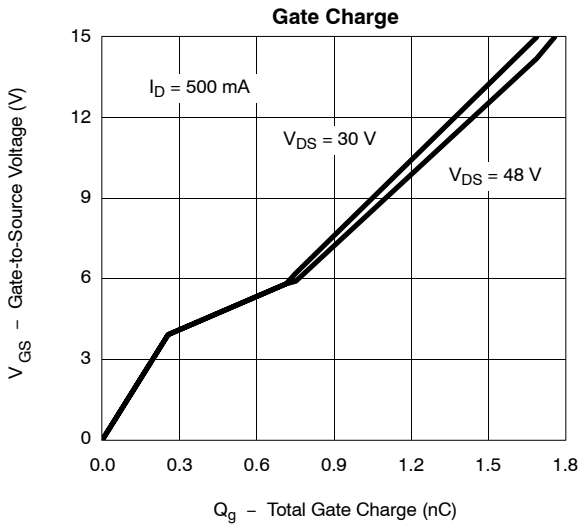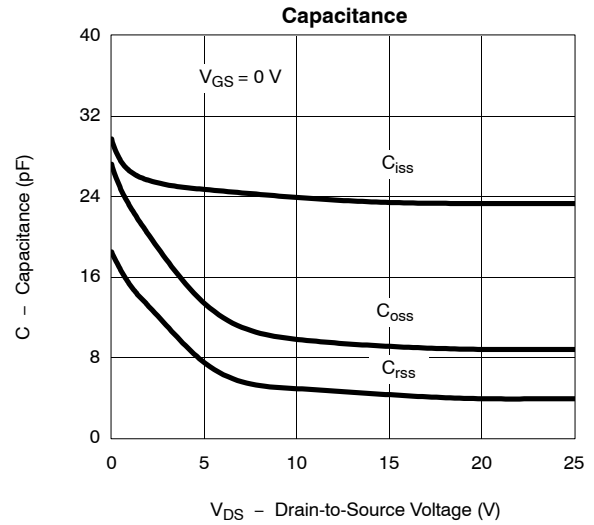## TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

For the following graphs, p-channel negative polarities for all voltage and current values are represented as positive values.

On-Resistance vs. Drain Current

Capacitance

Gate Charge

On-Resistance vs. Junction Temperature

Source-Drain Diode Forward Voltage

On-Resistance vs. Gate-Source Voltage

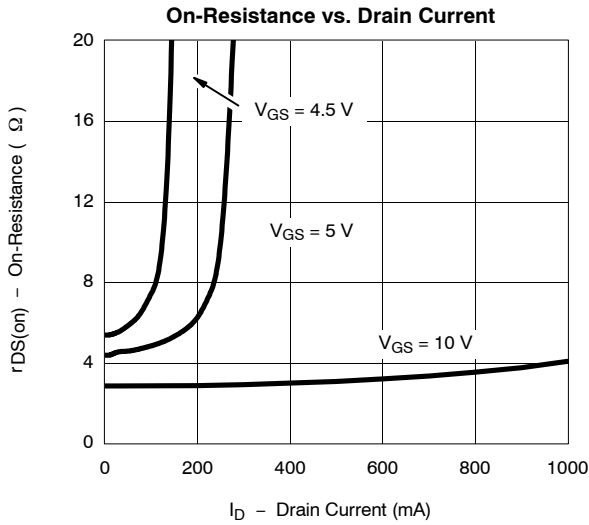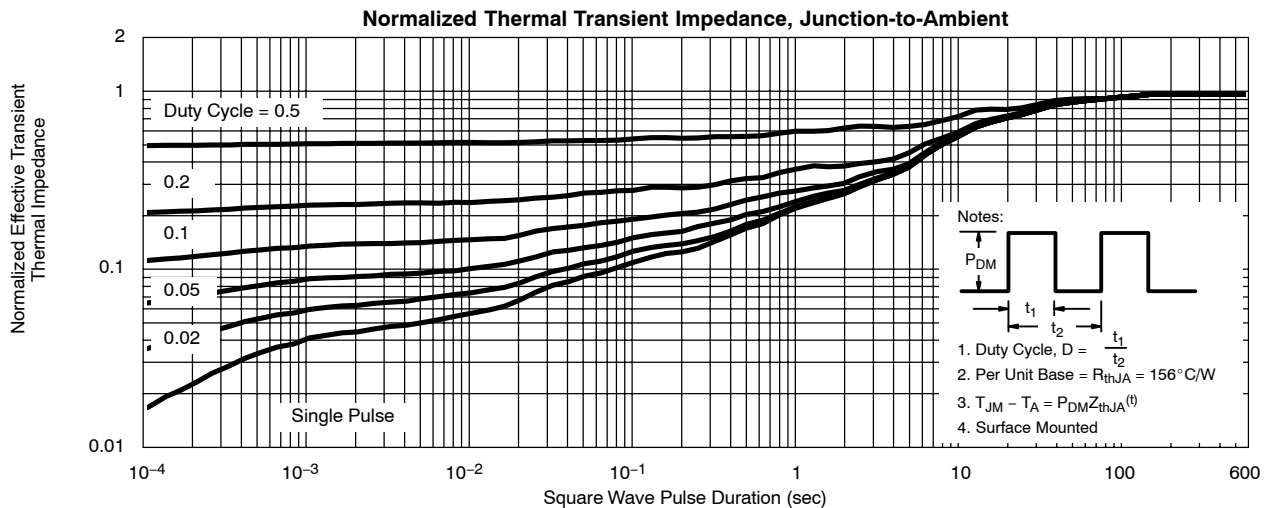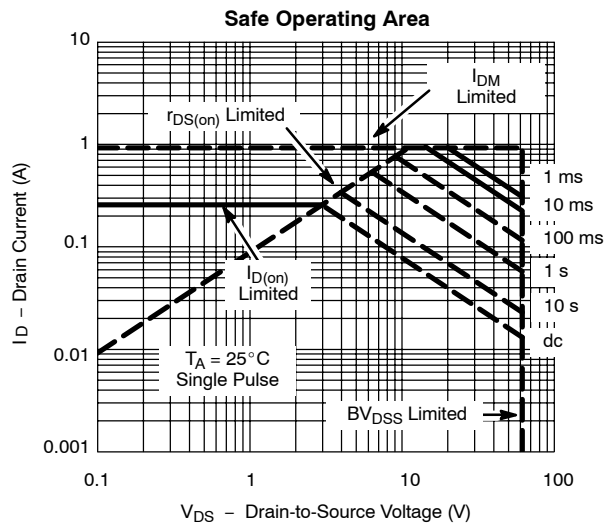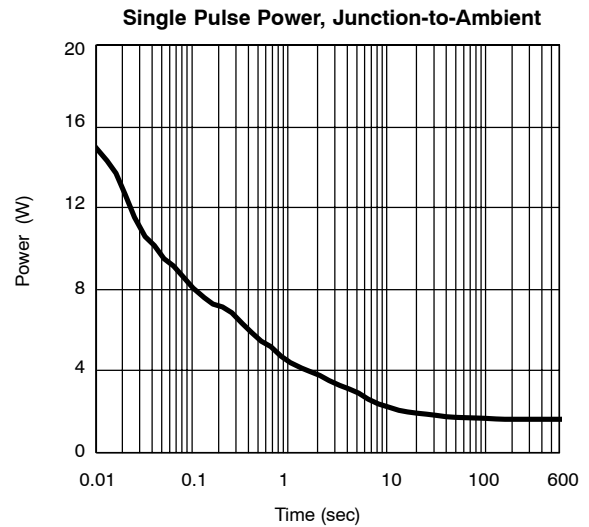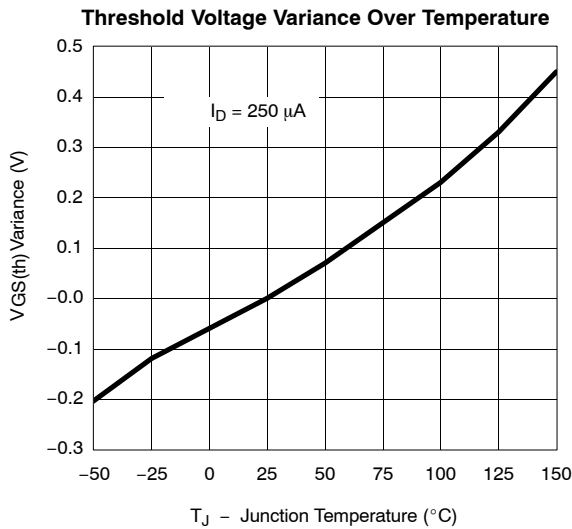## TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

For the following graphs, p-channel negative polarities for all voltage and current values are represented as positive values.

Threshold Voltage Variance Over Temperature

$I_D = 250 \ \mu A$

V GS(th) Variance (V)

T_J – Junction Temperature (°C)

Single Pulse Power, Junction-to-Ambient

Power (W)

Time (sec)

Safe Operating Area

$r_{DS(on)}$ Limited

I_{DM} Limited

1 ms
10 ms
100 ms
1 s
10 s
dc

$I_{D(on)}$ Limited

$T_A = 25°C$
Single Pulse

BV_{DSS} Limited

I_D – Drain Current (A)

V_{DS} – Drain-to-Source Voltage (V)

Normalized Thermal Transient Impedance, Junction-to-Ambient

Normalized Effective Transient Thermal Impedance

Duty Cycle = 0.5
0.2
0.1
0.05
0.02
Single Pulse

Notes:

P_{DM}

t_1

t_2

1. Duty Cycle, D = $\dfrac{t_1}{t_2}$
2. Per Unit Base = $R_{thJA} = 156°C/W$
3. $T_{JM} - T_A = P_{DM}Z_{thJA}^{(t)}$
4. Surface Mounted

Square Wave Pulse Duration (sec)

Disclaimer

All product specifications and data are subject to change without notice.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.