

# TPS1100, TPS1100Y SINGLE P-CHANNEL ENHANCEMENT-MODE MOSFETS

SLVS078C – DECEMBER 1993 – REVISED AUGUST 1995

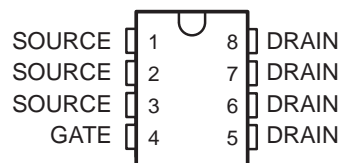
- Low  $r_{DS(on)}$  . . . 0.18  $\Omega$  Typ at  $V_{GS} = -10$  V
- 3 V Compatible
- Requires No External  $V_{CC}$
- TTL and CMOS Compatible Inputs
- $V_{GS(th)} = -1.5$  V Max
- Available in Ultrathin TSSOP Package (PW)
- ESD Protection Up to 2 kV Per MIL-STD-883C, Method 3015

## description

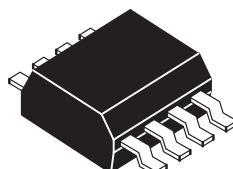
The TPS1100 is a single P-channel enhancement-mode MOSFET. The device has been optimized for 3-V or 5-V power distribution in battery-powered systems by means of Texas Instruments LinBiCMOS™ process. With a maximum  $V_{GS(th)}$  of  $-1.5$  V and an  $I_{DSS}$  of only  $0.5 \mu A$ , the TPS1100 is the ideal high-side switch for low-voltage, portable battery-management systems where maximizing battery life is a primary concern. The low  $r_{DS(on)}$  and excellent ac characteristics (rise time 10 ns typical) make the TPS1100 the logical choice for low-voltage switching applications such as power switches for pulse-width-modulated (PWM) controllers or motor/bridge drivers.

The ultrathin thin shrink small-outline package or TSSOP (PW) version with its smaller footprint and reduction in height fits in places where other P-channel MOSFETs cannot. The size advantage is especially important where board real estate is at a premium and height restrictions do not allow for a small-outline integrated circuit (SOIC) package.

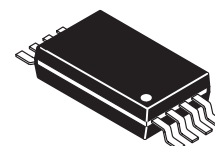
D OR PW PACKAGE  
(TOP VIEW)



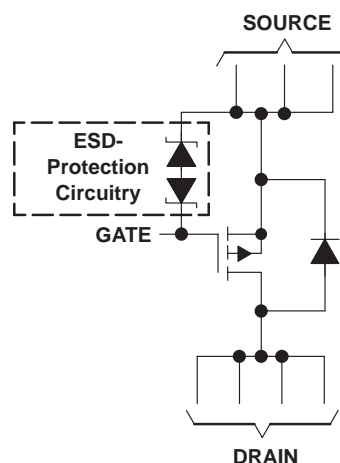
D PACKAGE



PW PACKAGE



## schematic



NOTE A: For all applications, all source pins should be connected and all drain pins should be connected.

## AVAILABLE OPTIONS

$T_A$	PACKAGED DEVICES		CHIP FORM (Y)
	SMALL OUTLINE (D)	PLASTIC DIP (P)	
$-40^\circ\text{C}$ to $85^\circ\text{C}$	TPS1100D	TPS1100PWLE	TPS1100Y

The D package is available taped and reeled. Add an R suffix to device type (e.g., TPS1100DR). The PW package is available only left-end taped and reeled (indicated by the LE suffix on the device type; e.g., TPS1100PWLE). The chip form is tested at  $25^\circ\text{C}$ .



Caution. This device contains circuits to protect its inputs and outputs against damage due to high static voltages or electrostatic fields. These circuits have been qualified to protect this device against electrostatic discharges (ESD) of up to 2 kV according to MIL-STD-883C, Method 3015; however, it is advised that precautions be taken to avoid application of any voltage higher than maximum-rated voltages to these high-impedance circuits.

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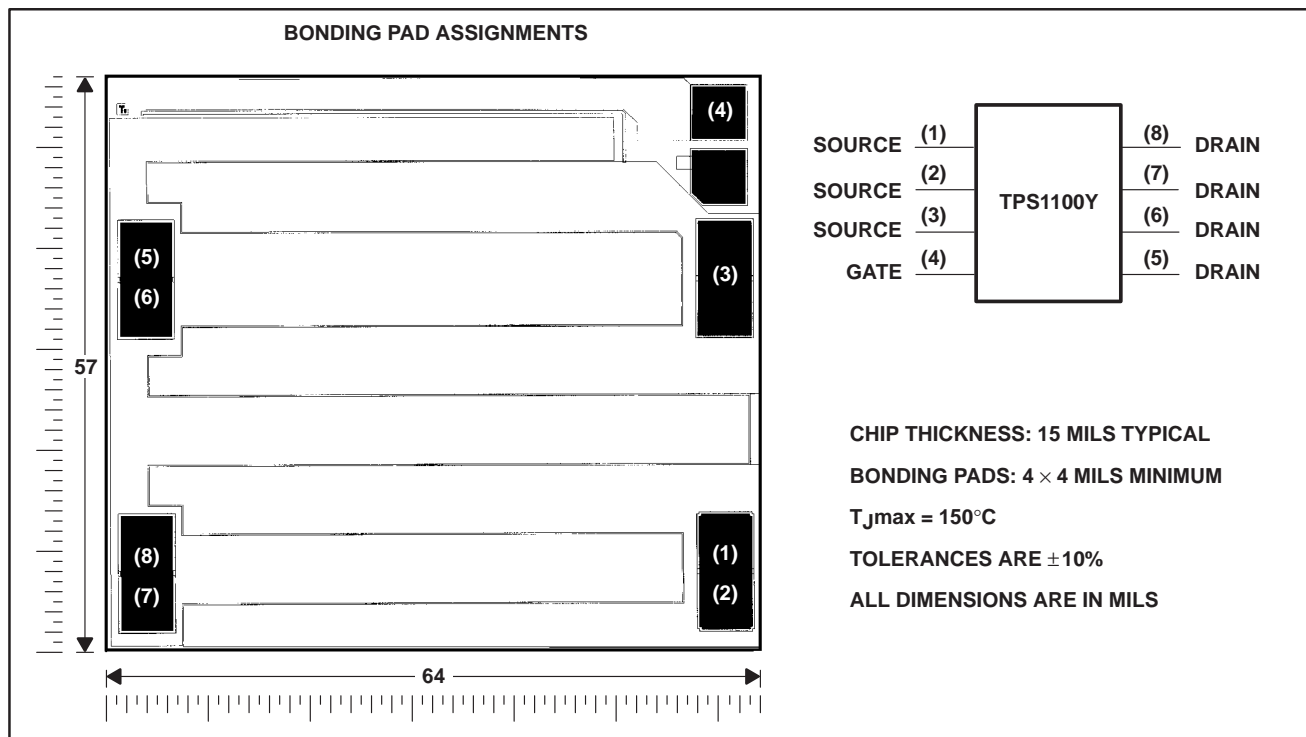
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## description (continued)

Such applications include notebook computers, personal digital assistants (PDAs), cellular telephones, and PCMCIA cards. For existing designs, the D-packaged version has a pinout common with other p-channel MOSFETs in SOIC packages.

## TPS1100Y chip information

This chip, when properly assembled, displays characteristics similar to the TPS1100. Thermal compression or ultrasonic bonding may be used on the doped aluminum bonding pads. The chips may be mounted with conductive epoxy or a gold-silicon preform.



# TPS1100, TPS1100Y

## SINGLE P-CHANNEL ENHANCEMENT-MODE MOSFETS

SLVS078C – DECEMBER 1993 – REVISED AUGUST 1995

### absolute maximum ratings over operating free-air temperature (unless otherwise noted)†

				UNIT	
Drain-to-source voltage, $V_{DS}$			-15	V	
Gate-to-source voltage, $V_{GS}$			2 or -15	V	
Continuous drain current ( $T_J = 150^\circ\text{C}$ ), $I_D^\ddagger$	$V_{GS} = -2.7\text{ V}$	D package	$T_A = 25^\circ\text{C}$	$\pm 0.41$	A
			$T_A = 125^\circ\text{C}$	$\pm 0.28$	
		PW package	$T_A = 25^\circ\text{C}$	$\pm 0.4$	
			$T_A = 125^\circ\text{C}$	$\pm 0.23$	
	$V_{GS} = -3\text{ V}$	D package	$T_A = 25^\circ\text{C}$	$\pm 0.6$	
			$T_A = 125^\circ\text{C}$	$\pm 0.33$	
		PW package	$T_A = 25^\circ\text{C}$	$\pm 0.53$	
			$T_A = 125^\circ\text{C}$	$\pm 0.27$	
	$V_{GS} = -4.5\text{ V}$	D package	$T_A = 25^\circ\text{C}$	$\pm 1$	
			$T_A = 125^\circ\text{C}$	$\pm 0.47$	
		PW package	$T_A = 25^\circ\text{C}$	$\pm 0.81$	
			$T_A = 125^\circ\text{C}$	$\pm 0.37$	
$V_{GS} = -10\text{ V}$	D package	$T_A = 25^\circ\text{C}$	$\pm 1.6$		
		$T_A = 125^\circ\text{C}$	$\pm 0.72$		
	PW package	$T_A = 25^\circ\text{C}$	$\pm 1.27$		
		$T_A = 125^\circ\text{C}$	$\pm 0.58$		
Pulsed drain current, $I_D^\ddagger$			$T_A = 25^\circ\text{C}$	$\pm 7$	A
Continuous source current (diode conduction), $I_S$			$T_A = 25^\circ\text{C}$	-1	A
Storage temperature range, $T_{stg}$				-55 to 150	$^\circ\text{C}$
Operating junction temperature range, $T_J$				-40 to 150	$^\circ\text{C}$
Operating free-air temperature range, $T_A$				-40 to 125	$^\circ\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds				260	$^\circ\text{C}$

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

‡ Maximum values are calculated using a derating factor based on  $R_{\theta JA} = 158^\circ\text{C}/\text{W}$  for the D package and  $R_{\theta JA} = 248^\circ\text{C}/\text{W}$  for the PW package. These devices are mounted on a FR4 board with no special thermal considerations.

**DISSIPATION RATING TABLE**

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR‡ ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D	791 mW	6.33 mW/ $^\circ\text{C}$	506 mW	411 mW	158 mW
PW	504 mW	4.03 mW/ $^\circ\text{C}$	323 mW	262 mW	101 mW

‡ Maximum values are calculated using a derating factor based on  $R_{\theta JA} = 158^\circ\text{C}/\text{W}$  for the D package and  $R_{\theta JA} = 248^\circ\text{C}/\text{W}$  for the PW package. These devices are mounted on an FR4 board with no special thermal considerations when tested.



# TPS1100, TPS1100Y SINGLE P-CHANNEL ENHANCEMENT-MODE MOSFETS

SLVS078C – DECEMBER 1993 – REVISED AUGUST 1995

## electrical characteristics at $T_J = 25^\circ\text{C}$ (unless otherwise noted)

### static

PARAMETER	TEST CONDITIONS	TPS1100			TPS1100Y			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$V_{GS(th)}$ Gate-to-source threshold voltage	$V_{DS} = V_{GS}$ , $I_D = -250 \mu\text{A}$	-1	-1.25	-1.50	-1.25			V
$V_{SD}$ Source-to-drain voltage (diode-forward voltage) <sup>†</sup>	$I_S = -1 \text{ A}$ , $V_{GS} = 0 \text{ V}$		-0.9		-0.9			V
$I_{GSS}$ Reverse gate current, drain short circuited to source	$V_{DS} = 0 \text{ V}$ , $V_{GS} = -12 \text{ V}$			$\pm 100$				nA
$I_{DSS}$ Zero-gate-voltage drain current	$V_{DS} = -12 \text{ V}$ , $V_{GS} = 0 \text{ V}$	$T_J = 25^\circ\text{C}$		-0.5				$\mu\text{A}$
		$T_J = 125^\circ\text{C}$		-10				
$r_{DS(on)}$ Static drain-to-source on-state resistance <sup>†</sup>	$V_{GS} = -10 \text{ V}$	$I_D = -1.5 \text{ A}$		180		180	m $\Omega$	
	$V_{GS} = -4.5 \text{ V}$	$I_D = -0.5 \text{ A}$		291	400	291		
	$V_{GS} = -3 \text{ V}$	$I_D = -0.2 \text{ A}$		476	700	476		
	$V_{GS} = -2.7 \text{ V}$	$I_D = -0.2 \text{ A}$		606	850	606		
$g_{fs}$ Forward transconductance <sup>†</sup>	$V_{DS} = -10 \text{ V}$ , $I_D = -2 \text{ A}$		2.5		2.5		S	

<sup>†</sup> Pulse test: pulse duration  $\leq 300 \mu\text{s}$ , duty cycle  $\leq 2\%$

### dynamic

PARAMETER	TEST CONDITIONS	TPS1100, TPS1100Y			UNIT
		MIN	TYP	MAX	
$Q_g$ Total gate charge	$V_{DS} = -10 \text{ V}$ , $V_{GS} = -10 \text{ V}$ , $I_D = -1 \text{ A}$		5.45		nC
$Q_{gs}$ Gate-to-source charge			0.87		
$Q_{gd}$ Gate-to-drain charge			1.4		
$t_{d(on)}$ Turn-on delay time	$V_{DD} = -10 \text{ V}$ , $R_L = 10 \Omega$ , $R_G = 6 \Omega$ , See Figures 1 and 2, $I_D = -1 \text{ A}$ ,		4.5		ns
$t_{d(off)}$ Turn-off delay time			13		ns
$t_r$ Rise time			10		ns
$t_f$ Fall time			2		
$t_{rr(SD)}$ Source-to-drain reverse recovery time		$I_F = 5.3 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$		16	



PARAMETER MEASUREMENT INFORMATION

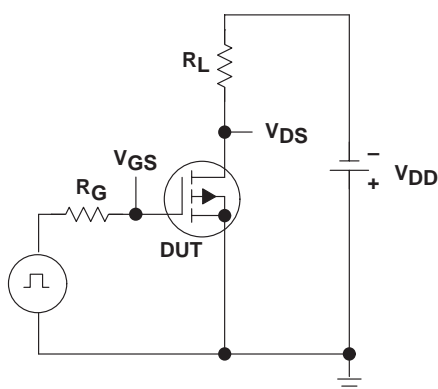


Figure 1. Switching-Time Test Circuit

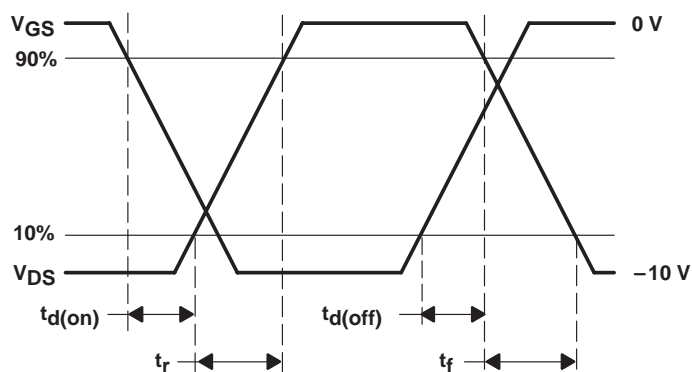


Figure 2. Switching-Time Waveforms

TYPICAL CHARACTERISTICS

Table of Graphs

		FIGURE
Drain current	vs Drain-to-source voltage	3
Drain current	vs Gate-to-source voltage	4
Static drain-to-source on-state resistance	vs Drain current	5
Capacitance	vs Drain-to-source voltage	6
Static drain-to-source on-state resistance (normalized)	vs Junction temperature	7
Source-to-drain diode current	vs Source-to-drain voltage	8
Static drain-to-source on-state resistance	vs Gate-to-source voltage	9
Gate-to-source threshold voltage	vs Junction temperature	10
Gate-to-source voltage	vs Gate charge	11

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SLVS078C – DECEMBER 1993 – REVISED AUGUST 1995

## TYPICAL CHARACTERISTICS

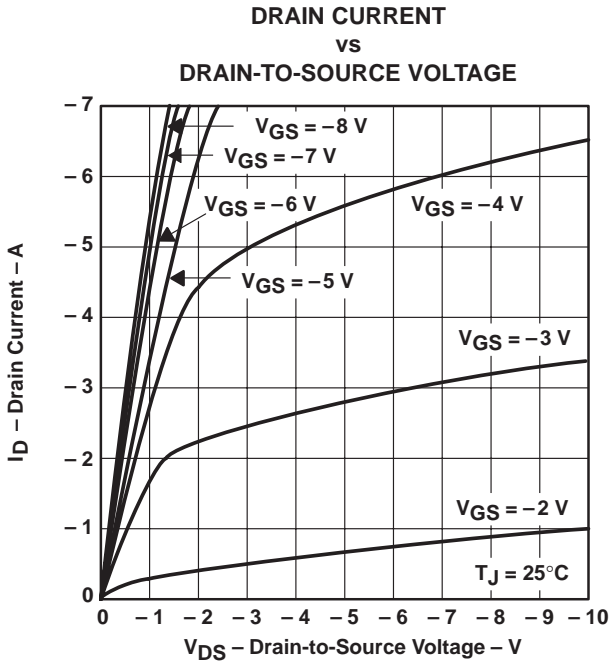


Figure 3

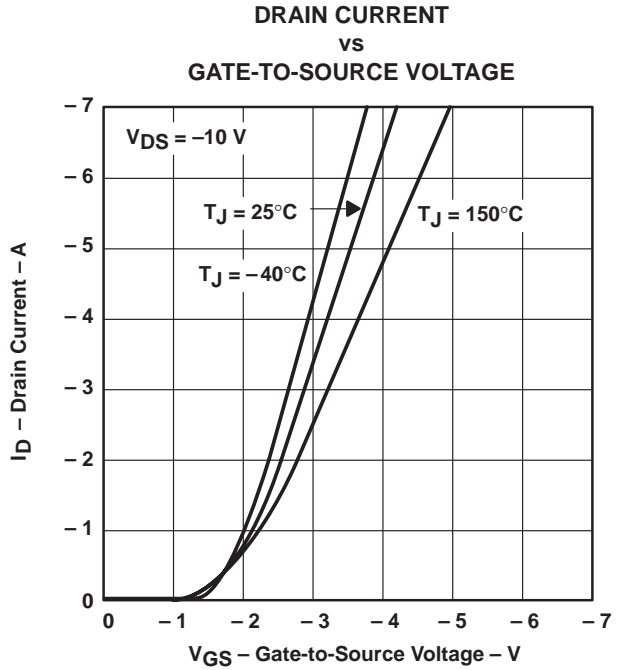


Figure 4

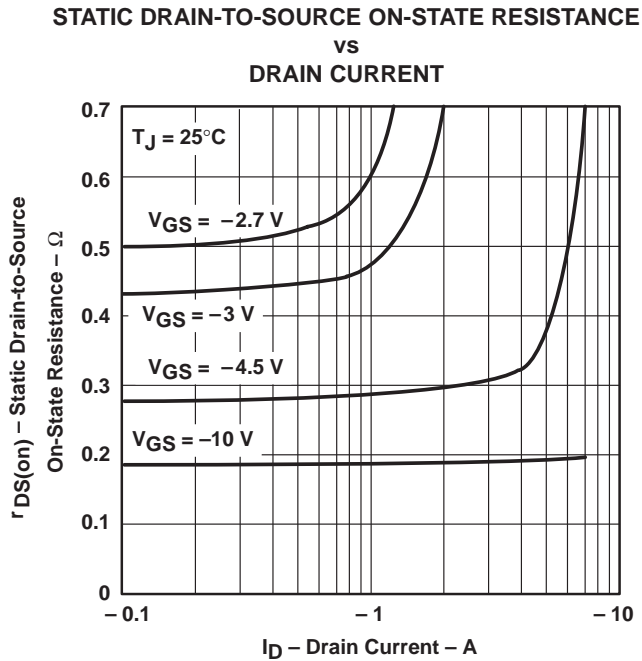
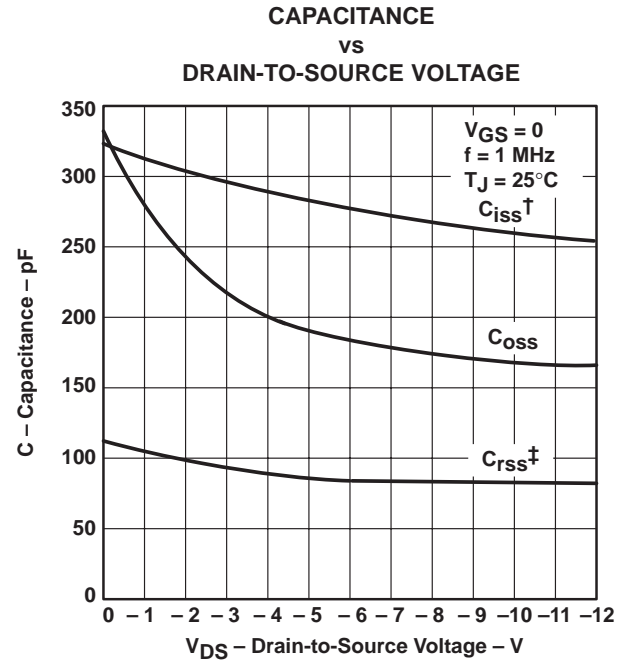


Figure 5



$$\dagger C_{iss} = C_{gs} + C_{gd} + C_{ds(\text{shorted})}$$

$$\ddagger C_{rss} = C_{gd}, C_{oss} = C_{ds} + \frac{C_{gs} C_{gd}}{C_{gs} + C_{gd}} \approx C_{ds} + C_{gd}$$

Figure 6



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TYPICAL CHARACTERISTICS

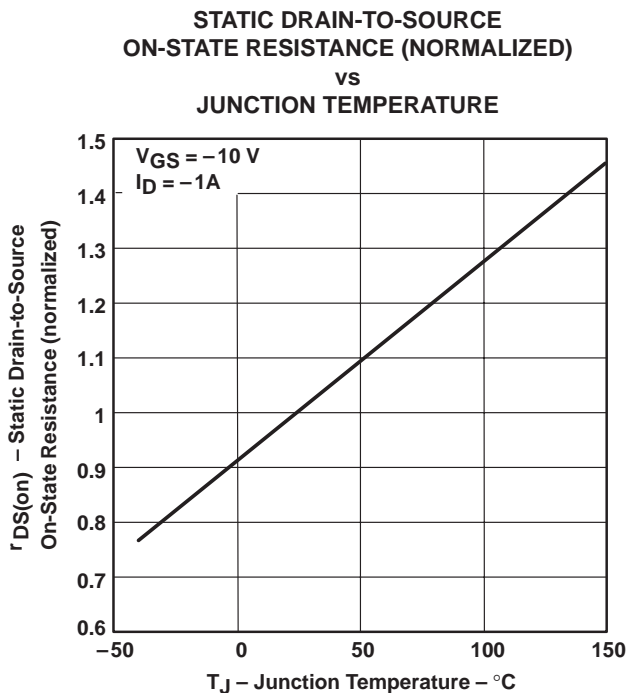


Figure 7

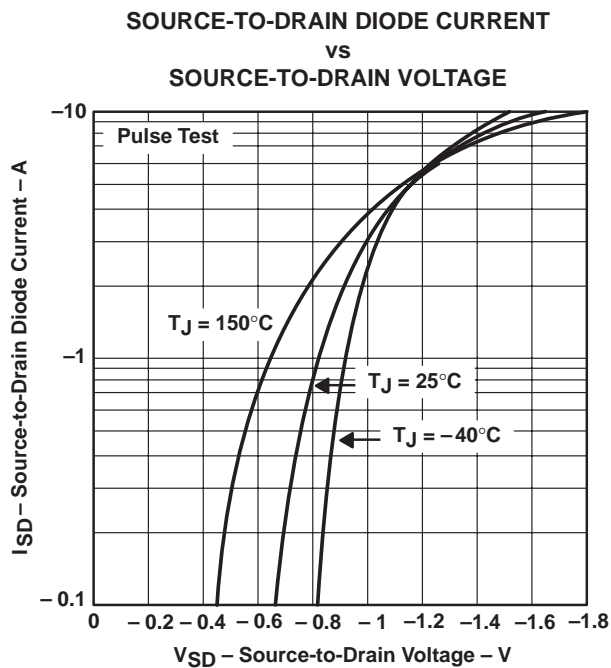


Figure 8

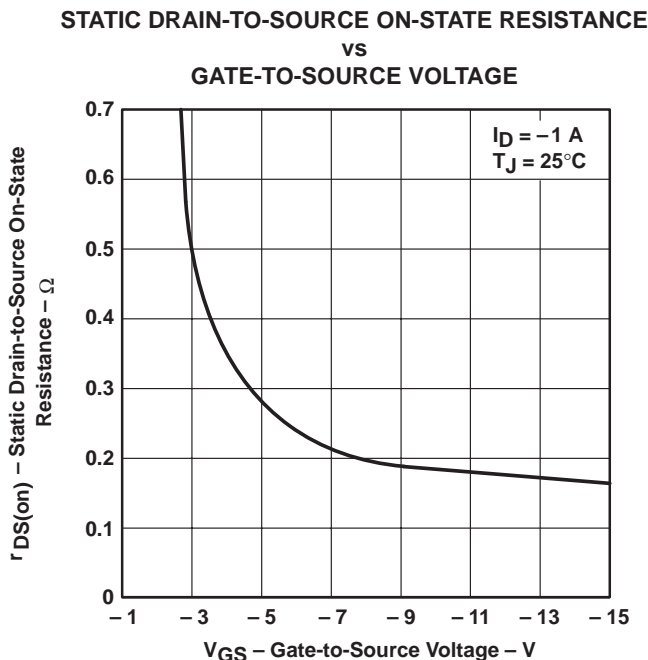


Figure 9

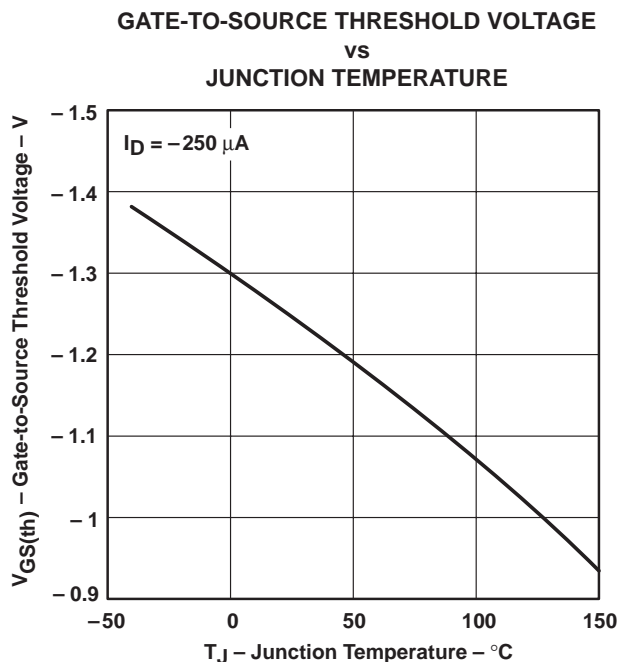


Figure 10

# TPS1100, TPS1100Y SINGLE P-CHANNEL ENHANCEMENT-MODE MOSFETS

SLVS078C – DECEMBER 1993 – REVISED AUGUST 1995

## TYPICAL CHARACTERISTICS

GATE-TO-SOURCE VOLTAGE  
vs  
GATE CHARGE

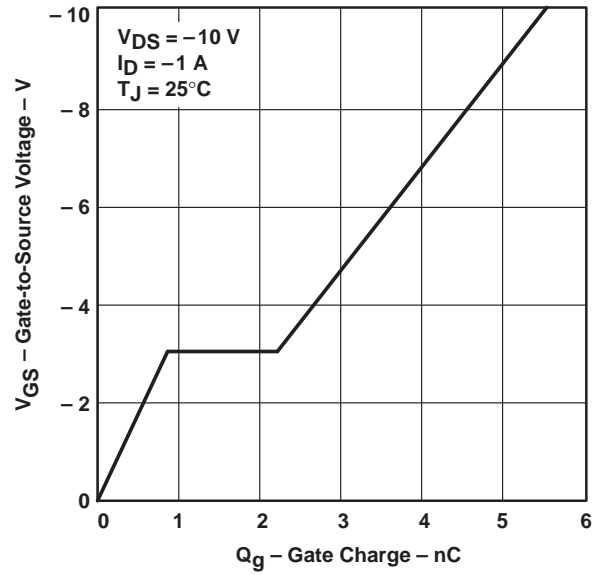
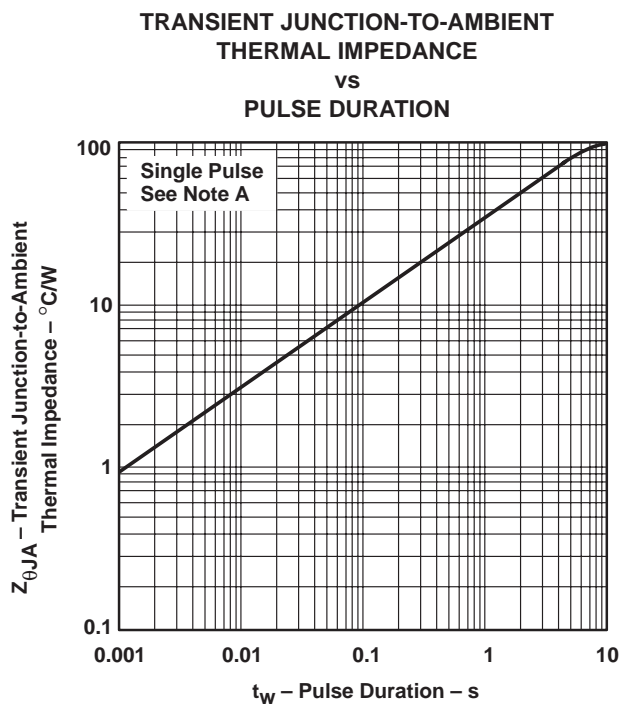
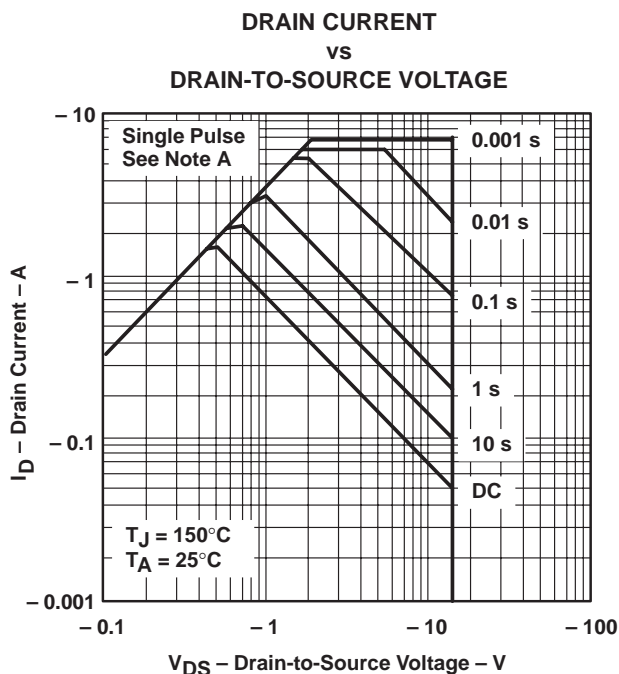


Figure 11



THERMAL INFORMATION



NOTE A: Values are for the D package and are FR4-board mounted only.

APPLICATION INFORMATION

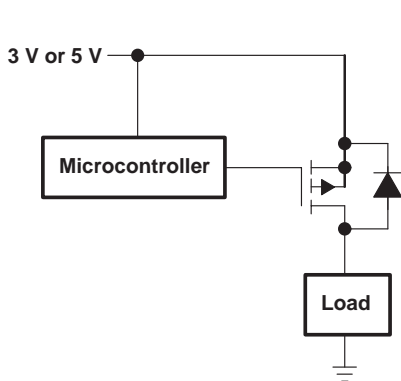


Figure 14. Notebook Load Management

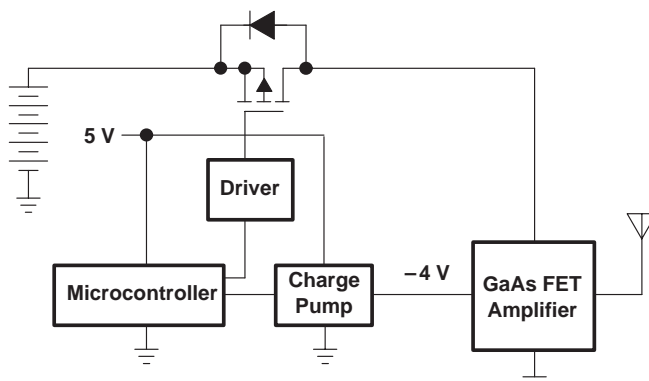


Figure 15. Cellular Phone Output Drive

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