

## p-Channel Depletion-Type MOSFET

The construction of a p-channel depletion-type MOSFET is exactly the reverse of that appearing in Fig. 5.23. That is, there is now an n-type substrate and a p-type channel, as shown in Fig. 5.28a. The terminals remain as identified, but all the voltage polarities and the current directions are reversed, as shown in the same figure. The drain characteristics would appear exactly as in Fig. 5.25 but with  $V_{DS}$  having negative val-

Figure 5.27 Transfer characteristics for an n-channel depletion-type MOSFET with  $I_{DSS}=10$  mA and  $V_P=-4$  V.



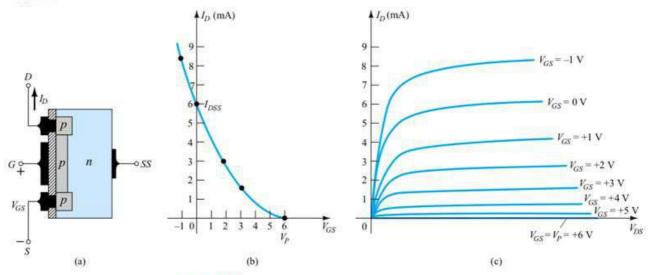


Figure 5.28 p-Channel depletion-type MOSFET with  $I_{DSS} = 6$  mA and  $V_P = +6$  V.

ues,  $I_D$  having positive values as indicated (since the defined direction is now reversed), and  $V_{GS}$  having the opposite polarities as shown in Fig. 5.28c. The reversal in  $V_{GS}$  will result in a mirror image (about the  $I_D$  axis) for the transfer characteristics as shown in Fig. 5.28b. In other words, the drain current will increase from cutoff at  $V_{GS} = V_P$  in the positive  $V_{GS}$  region to  $I_{DSS}$  and then continue to increase for increasingly negative values of  $V_{GS}$ . Shockley's equation is still applicable and requires simply placing the correct sign for both  $V_{GS}$  and  $V_P$  in the equation.

## Symbols, Specification Sheets, and Case Construction

The graphic symbols for an *n*- and *p*-channel depletion-type MOSFET are provided in Fig. 5.29. Note how the symbols chosen try to reflect the actual construction of the device. The lack of a direct connection (due to the gate insulation) between the gate and channel is represented by a space between the gate and the other terminals of the symbol. The vertical line representing the channel is connected between the drain and source and is "supported" by the substrate. Two symbols are provided for each type of channel to reflect the fact that in some cases the substrate is externally available while in others it is not. For most of the analysis to follow in Chapter 6, the substrate and source will be connected and the lower symbols will be employed.

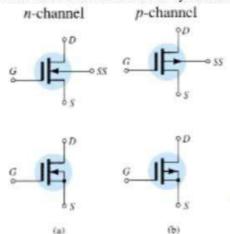


Figure 5.29 Graphic symbols for (a) *n*-channel depletion-type MOSFETs and (b) *p*-channel depletion-type MOSFETs.

The device appearing in Fig. 5.30 has three terminals, with the terminal identification appearing in the same figure. The specification sheet for a depletion-type MOS-FET is similar to that of a JFET. The levels of  $V_P$  and  $I_{DSS}$  are provided along with a list of maximum values and typical "on" and "off" characteristics. In addition, how-

## CASE 22-03, STYLE 2 TO-18 (TO-206AA) Gate 20 MOSFETS LOW POWER AUDIO N-CHANNEL - DEPLETION

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit Vdc Vdc	
Drain-Source Veitage 2N3797	V <sub>DS</sub>	20		
Gate-Source Voltage	Vos	±10		
Deals Current	In	20	mAde	
Total Device Dissipation @ T <sub>A</sub> = 25°C Device above 25°C	P <sub>D</sub>	200 1.14	mW/C	
Junction Temperature Runge	T <sub>3</sub>	+175	, 'C	
Storage Channel Temperature Range	Tog	-65 to +200	, 'C'	

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain Source Breakdown Voltage $(V_{GR} \approx -7.0 \text{ V}, T_D = 5.0 \mu\text{A})$	2N3797	V <sub>GROOM</sub> X	20	25	**	Vdc
Gate Reverse Current (1) (V <sub>CS</sub> = -10 V, V <sub>DS</sub> = 0) (V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 0, T <sub>A</sub> = 150°C)		Loss		(H)	1,0 200	pAde
Gate Source Cutoff Voltage (t <sub>D</sub> = 2.0 µA, V <sub>DS</sub> = 10 V)	2N3797	Votum	-	-5.0	-7.0	Vdc
Drain-Gate Reverse Current (1) (V <sub>DG</sub> = 30 V, I <sub>S</sub> = 0)		Inno			1.0	pAde
ON CHARACTERISTICS						
Zero-Gate-Voltage Desin Currens $(V_{DS}=10,V,V_{GS}=0)$	2N3797	IDSK	2.0	2.9	6.0	mAdc
On-State Drain Current (V <sub>GS</sub> = 10 V, V <sub>GS</sub> = +3.5 V)	2N3797	I <sub>Ohio</sub>	9,0	14	18	mAdc
SMALL-SIGNAL CHARACTERISTICS						
Forward Transfer Admittance $(V_{DS} = 10 \text{ V}, V_{CS} = 0, f = 1.0 \text{ kHz})$	2N3797	(Yell	1500	2300	3000	дэмбен
$(V_{DS} = 10 \ V, \ V_{CS} = 0, f = 1.0 \ MHz)$	2N3797		1500	-		
Output Admittance $(I_{DS}=10\ V,\ V_{CS}=0,\ f=1.0\ kHz)$	2N3797	l Yad	-	27	60	umbo
Imput Capacitance $(V_{DS}=10~V,~V_{CS}=0,~f=1.0~MHz) \label{eq:vDS}$	2N3797	Ciu		6.0	8.0	pF
Reverse Transfer Capacitation $(V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1.0 \text{ MHz})$		Cne	-	0,5	0.8	pf
FUNCTIONAL CHARACTERISTICS						
Noise Figure $(V_{DS}=\{0,V,V_{CS}=0,f\equiv1.0\text{ kHz},R_{S}=3\text{ megohns})$		NF		3.8	2	dB

This value of current includes both the FET leakage current as well as the leakage current associated with the test socket and fixture when measured under best attainable conditions.

Figure 5.30 2N3797 Motorola n-channel depletion-type MOSFET.