

***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-

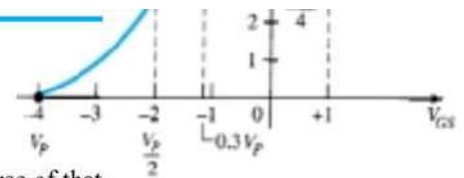


Figure 5.27 Transfer characteristics for an *n*-channel depletion-type MOSFET with $I_{DSS} = 10$ mA and $V_P = -4$ V.

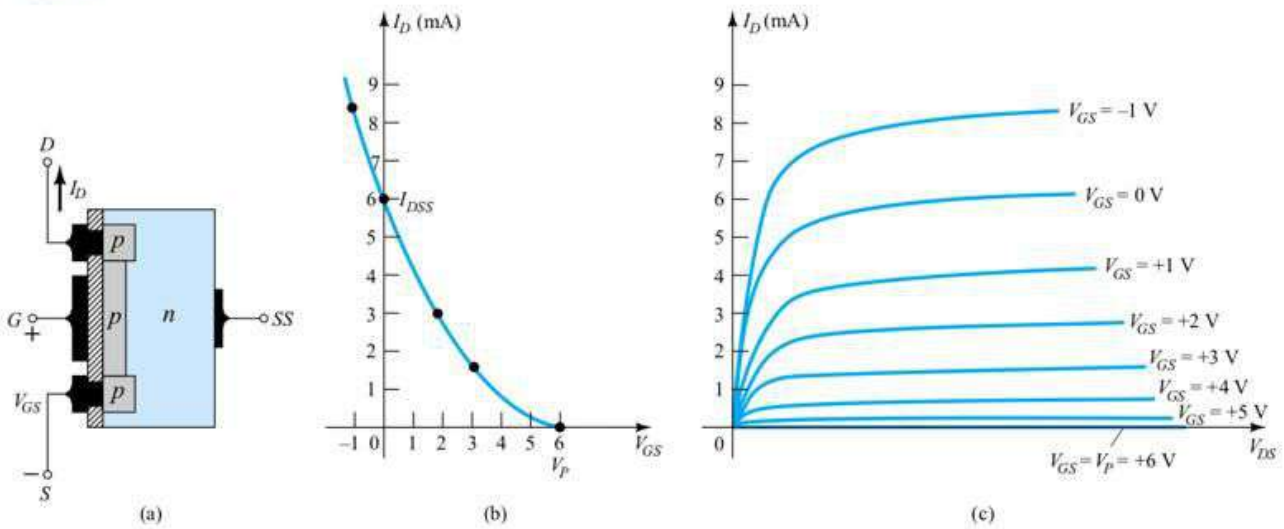
I_{DSS}/V_P 

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

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.

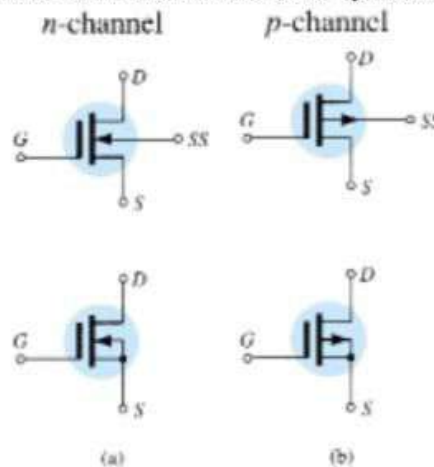
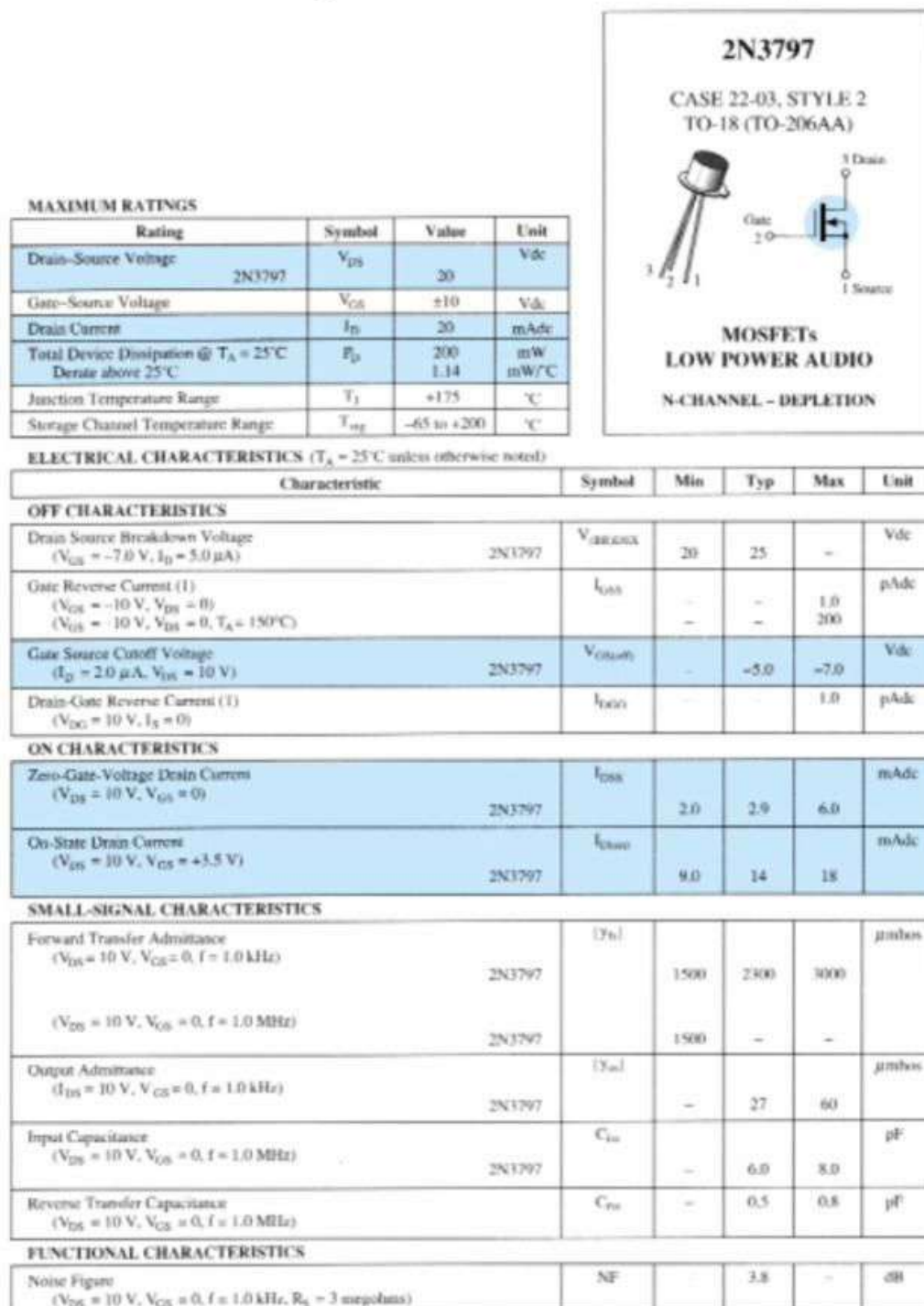


Figure 5.29 Graphic symbols for (a) *n*-channel depletion-type MOSFETs and (b) *p*-channel depletion-type MOSFETs.

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 MOSFET 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-



(1) 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.