

# 2N7012, 2N7013

N-Channel Enhancement Mode Transistors

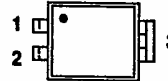
T-39-05

4-PIN DIP  
(Similar to TO-250)

TOP VIEW

## PRODUCT SUMMARY

| PART NUMBER | $V_{(BR)DSS}$<br>(V) | $r_{DS(ON)}$<br>( $\Omega$ ) | $I_D$<br>(A) |
|-------------|----------------------|------------------------------|--------------|
| 2N7012      | 60                   | 0.35                         | 1.2          |
| 2N7013      | 40                   | 0.35                         | 1.2          |



1 GATE  
2 SOURCE  
3 DRAIN

## ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ Unless Otherwise Noted)

| PARAMETERS/TEST CONDITIONS                                 | SYMBOL                    | LIMITS     |          | UNITS            |
|--|---------------------------|------------|----------|------------------|
|  |                           | 2N7012     | 2N7013   |                  |
| Drain-Source Voltage                                       | $V_{DS}$                  | 60         | 40       | V                |
| Gate-Source Voltage  | $V_{GS}$                  | $\pm 20$   | $\pm 20$ |                  |
| Continuous Drain Current                                   | $T_A = 25^\circ\text{C}$  | 1.2        | 1.2      | A                |
|  | $T_A = 100^\circ\text{C}$ | 0.80       | 0.80     |                  |
| Pulsed Drain Current <sup>1</sup>                          | $I_{DM}$                  | 10         | 10       |                  |
| Power Dissipation  | $T_A = 25^\circ\text{C}$  | 1.0        | 1.0      | W                |
|  | $T_A = 100^\circ\text{C}$ | 0.4        | 0.4      |                  |
| Operating Junction & Storage Temperature Range             | $T_J, T_{stg}$            | -55 to 150 |          | $^\circ\text{C}$ |
| Lead Temperature ( <sup>1/16"</sup> from case for 10 sec.) | $T_L$                     | 300        |          |                  |

4

## THERMAL RESISTANCE RATINGS

| THERMAL RESISTANCE  | SYMBOL          | TYPICAL | MAXIMUM | UNITS |
|---------------------|-----------------|---------|---------|-------|
| Junction-to-Ambient | $R_{\theta JA}$ |         | 120     | K/W   |

<sup>1</sup>Pulse width limited by maximum junction temperature.

# 2N7012, 2N7013



T-39-05

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C Unless Otherwise Noted)

| PARAMETER  | SYMBOL           | TEST CONDITIONS      | TYP   | LIMITS |          | UNIT    |
|--|------------------|----------------------|---|--------|----------|---------|
|  |                  |                      |   | MIN    | MAX      |         |
| <b>STATIC</b>  |                  |                      |   |        |          |         |
| Drain-Source Breakdown Voltage   | 2N7012<br>2N7013 | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA  |        | 60<br>40 | V       |
| Gate Threshold Voltage   |                  | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1000 μA  |        | 2.0      | 4.0     |
| Gate-Body Leakage  |                  | I <sub>GSS</sub>     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V  |        |          | ±100 nA |
| Zero Gate Voltage Drain Current  |                  | I <sub>DSS</sub>     | V <sub>DS</sub> = V <sub>(BR)DSS</sub> , V <sub>GS</sub> = 0 V  |        |          | 250 μA  |
|  |                  |                      | V <sub>DS</sub> = 0.8 × V <sub>(BR)DSS</sub> , V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125°C                            |        |          | 1000    |
| On-State Drain Current <sup>1</sup>  |                  | I <sub>D(on)</sub>   | V <sub>DS</sub> = 2 V, V <sub>GS</sub> = 10 V   |        | 1.2      | A       |
| Drain-Source On-State Resistance <sup>1</sup>                                |                  | r <sub>DS(on)</sub>  | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.0 A  | 0.3    |          | 0.35 Ω  |
|  |                  |                      | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.0 A, T <sub>J</sub> = 125°C  | 0.55   |          | 0.64    |
| Forward Transconductance <sup>1</sup>  |                  | g <sub>fs</sub>      | V <sub>DS</sub> = 15 V, I <sub>D</sub> = 1.0 A  | 1.5    | 1.2      | S       |
| <b>DYNAMIC</b>   |                  |                      |   |        |          |         |
| Input Capacitance  |                  | C <sub>iss</sub>     | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 25 V, f = 1 MHz  | 220    |          | 300 pF  |
| Output Capacitance   |                  | C <sub>oss</sub>     |   | 120    |          | 200     |
| Reverse Transfer Capacitance   |                  | C <sub>rss</sub>     |   | 30     |          | 100     |
| Total Gate Charge <sup>2</sup>   |                  | Q <sub>g</sub>       | V <sub>DS</sub> = 0.8 × V <sub>(BR)DSS</sub> , V <sub>GS</sub> = 10 V, I <sub>D</sub> = 15 A                            | 4.8    |          | 6.0 nC  |
| Gate-Source Charge <sup>2</sup>  |                  | Q <sub>gs</sub>      |   | 1      |          |         |
| Gate-Drain Charge <sup>2</sup>   |                  | Q <sub>gd</sub>      |   | 2      |          |         |
| Turn-On Delay Time <sup>2</sup>  |                  | t <sub>d(on)</sub>   | V <sub>DD</sub> = 30 V, R <sub>L</sub> = 25 Ω<br>I <sub>D</sub> ≈ 1.2 A, V <sub>GEN</sub> = 10 V, R <sub>G</sub> = 25 Ω | 7      |          | 20 ns   |
| Rise Time <sup>2</sup>   |                  | t <sub>r</sub>       |   | 13     |          | 30      |
| Turn-Off Delay Time <sup>2</sup>   |                  | t <sub>d(off)</sub>  |   | 18     |          | 30      |
| Fall Time <sup>2</sup>   |                  | t <sub>f</sub>       |   | 13     |          | 25      |
| <b>SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS (T<sub>A</sub> = 25°C)</b> |                  |                      |   |        |          |         |
| Continuous Current   |                  | I <sub>S</sub>       |   |        |          | 1.2 A   |
| Pulsed Current <sup>3</sup>  |                  | I <sub>SM</sub>      |   |        |          | 10      |
| Forward Voltage <sup>1</sup>   |                  | V <sub>SD</sub>      | I <sub>F</sub> = I <sub>S</sub> , V <sub>GS</sub> = 0 V   |        |          | 1.6 V   |
| Reverse Recovery Time  |                  | t <sub>rr</sub>      | I <sub>F</sub> = I <sub>S</sub> , di <sub>F</sub> /dt = 100 A/μs  | 45     |          | ns      |
| Reverse Recovery Charge  |                  | Q <sub>rr</sub>      |   | 0.6    |          | μC      |

<sup>1</sup>Pulse test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%.

<sup>2</sup>Independent of operating temperature.

<sup>3</sup>Pulse width limited by maximum junction temperature.

T-39.05

Figure 1. Output Characteristics

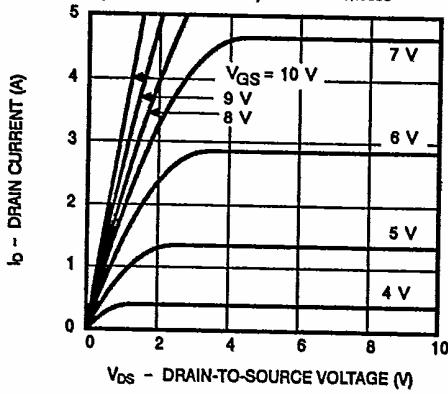


Figure 2. Transfer Characteristics

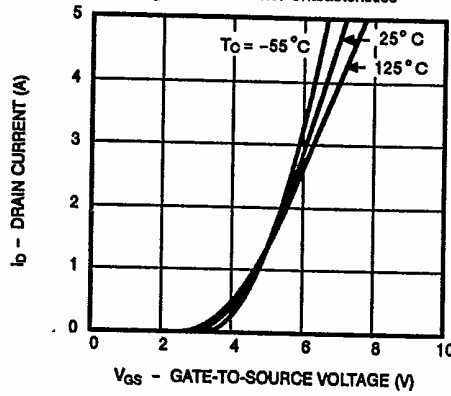


Figure 3. Transconductance

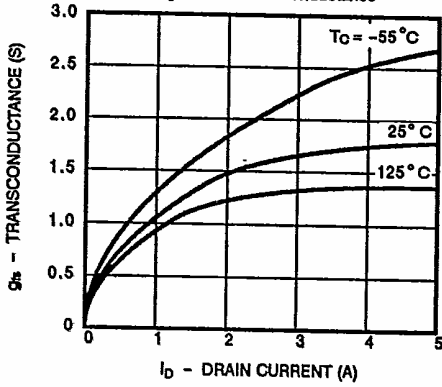
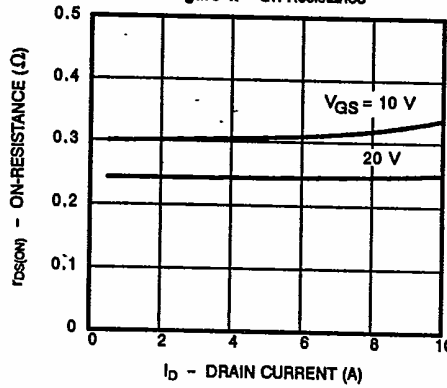


Figure 4. On-Resistance



4

Figure 5. Capacitance

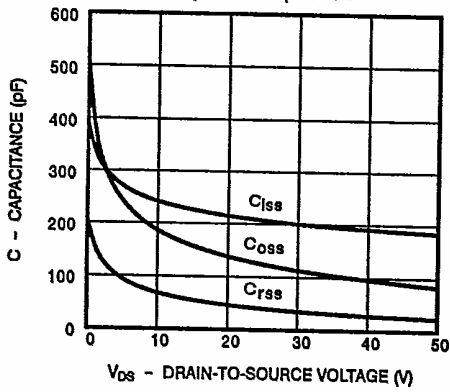
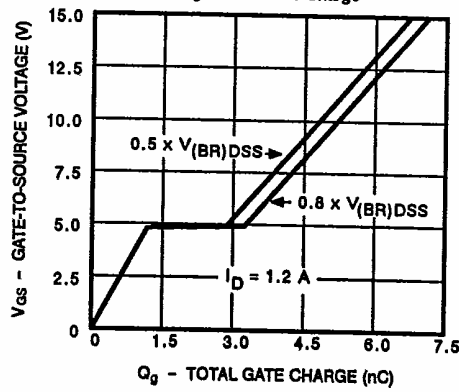


Figure 6. Gate Charge



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## TYPICAL CHARACTERISTICS (Cont'd)

T-39-05

Figure 7. On-Resistance vs. Junction Temperature

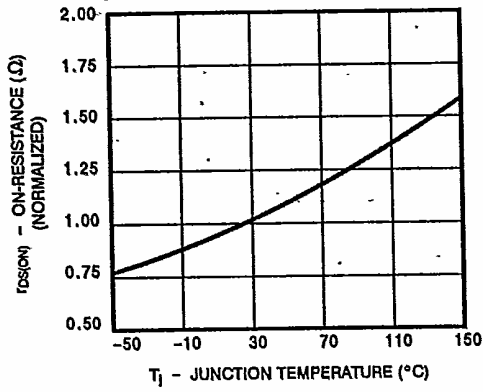
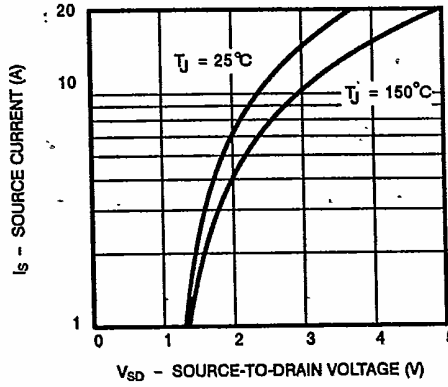


Figure 8: Source-Drain Diode Forward Voltage



## THERMAL RATINGS

Figure 9. Maximum Drain Current vs. Ambient Temperature

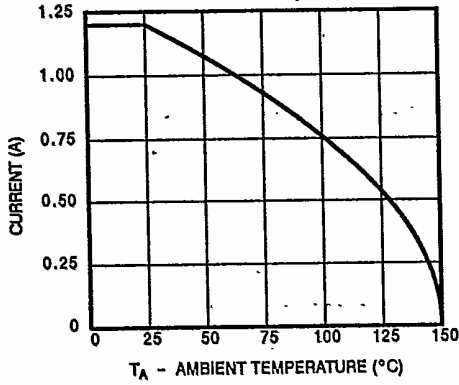
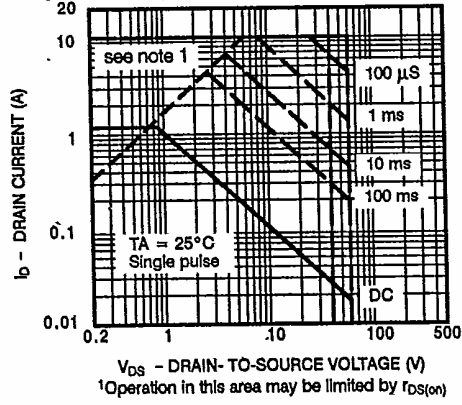


Figure 10. Safe Operating Area



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