30A, 50V, 0.040 Ohm, N-Channel Power MOSFET

This is an N-Channel enhancement mode silicon gate power field effect transistor designed for applications such as switching regulators, switching converters, motor drivers, relay drivers and drivers for high power bipolar switching transistors requiring high speed and low gate drive power. This type can be operated directly from integrated circuits.

Formerly developmental type TA9771.

Features

- 30A, 50V
- $r_{DS(ON)} = 0.040 \Omega$
- SOA is Power Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- Majority Carrier Device
- Related Literature
  - TB334 “Guidelines for Soldering Surface Mount Components to PC Boards”

Ordering Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE</th>
<th>BRAND</th>
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<tr>
<td>BUZ11</td>
<td>TO-220AB</td>
<td>BUZ11</td>
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NOTE: When ordering, use the entire part number.

Symbol

Packaging

JEDEC TO-220AB

SOURCE
DRAIN
GATE
DRAIN (FLANGE)
Absolute Maximum Ratings  \( T_C = 25^\circ C, \) Unless Otherwise Specified

- Drain to Source Breakdown Voltage (Note 1) \( V_{DS} \)
- Drain to Gate Voltage (Note 2) \( V_{DS} = 20\, \text{kV} \)
- Continuous Drain Current \( I_D \) \( T_C = 30^\circ C \)
- Pulsed Drain Current (Note 3) \( I_{DM} \)
- Gate to Source Voltage \( V_{GS} \)
- Maximum Power Dissipation \( P_D \)
- Linear Derating Factor \( 0.6 \, \text{W/}^\circ C \)
- Operating and Storage Temperature \( T_J, T_{STG} \) \(-55\) to \( 150^\circ C \)
- IEC Climatic Category - DIN IEC 68-1 55/150/56
- DIN Humidity Category - DIN 40040 \( E \)
- Maximum Power Dissipation \( P_D \)
- Gate to Source Voltage \( V_{GS} \)
- Source to Drain Diode Breakdown Voltage (Note 1) \( V_{DSM} \)
- Drain to Source On Resistance (Note 2) \( R_{DS(ON)} \)
- Forward Transconductance (Note 2) \( g_{FS} \)
- Turn-On Delay Time \( t_{(ON)} \)
- Rise Time \( t_r \)
- Turn-Off Delay Time \( t_{(OFF)} \)
- Fall Time \( t_f \)
- Input Capacitance \( C_{ISS} \)
- Output Capacitance \( C_{OSS} \)
- Reverse Transfer Capacitance \( C_{RSS} \)
- Thermal Resistance Junction to Case \( R_{JUC} \)
- Thermal Resistance Junction to Ambient \( R_{JUA} \)
- Leads at 0.063in (1.6mm) from Case for 10s
- Package Body for 10s, See Techbrief 334

CAUTION: Stresses above those listed in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:
1. \( T_J = 25^\circ C \) to \( 125^\circ C \).

Electrical Specifications  \( T_C = 25^\circ C, \) Unless Otherwise Specified

<table>
<thead>
<tr>
<th>PARAMETER</th>
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<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain to Source Breakdown Voltage</td>
<td>( BVDSS )</td>
<td>( I_D = 250\mu A, , V_{GS} = 0)</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>( V_{GS(TH)} )</td>
<td>( V_{GS} = V_{DS}, , I_D = 1mA ) (Figure 9)</td>
<td>2.1</td>
<td>3</td>
<td>4</td>
<td>V</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>( I_{DSS} )</td>
<td>( T_J = 25^\circ C, , V_{DS} = 50V, , V_{GS} = 0)</td>
<td>-</td>
<td>20</td>
<td>250</td>
<td>( \mu A )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( T_J = 125^\circ C, , V_{DS} = 50V, , V_{GS} = 0)</td>
<td>-</td>
<td>100</td>
<td>1000</td>
<td>( \mu A )</td>
</tr>
<tr>
<td>Gate to Source Leakage Current</td>
<td>( I_{GS} )</td>
<td>( V_{GS} = 20V, , V_{DS} = 0)</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>nA</td>
</tr>
<tr>
<td>Drain to Source On Resistance (Note 2)</td>
<td>( f_{DS(ON)} )</td>
<td>( I_D = 15A, , V_{GS} = 10V ) (Figure 8)</td>
<td>-</td>
<td>0.03</td>
<td>0.04</td>
<td>( \Omega )</td>
</tr>
<tr>
<td>Forward Transconductance (Note 2)</td>
<td>( g_{FS} )</td>
<td>( V_{DS} = 25V, , I_D = 15A ) (Figure 11)</td>
<td>4</td>
<td>8</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>Turn-On Delay Time</td>
<td>( t_{(ON)} )</td>
<td>( V_{CC} = 30V, , I_D = 3A, , V_{GS} = 10V, , R_{GS} = 50\Omega, , R_L = 10\Omega )</td>
<td>-</td>
<td>30</td>
<td>45</td>
<td>ns</td>
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<tr>
<td>Rise Time</td>
<td>( t_r )</td>
<td>( V_{DS} = 25V, , V_{GS} = 0V, , f = 1MHz ) (Figure 10)</td>
<td>-</td>
<td>70</td>
<td>110</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-Off Delay Time</td>
<td>( t_{(OFF)} )</td>
<td>( V_{DS} = 25V, , V_{GS} = 0V, , f = 1MHz ) (Figure 10)</td>
<td>-</td>
<td>180</td>
<td>230</td>
<td>ns</td>
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<tr>
<td>Fall Time</td>
<td>( t_f )</td>
<td>( V_{DS} = 25V, , V_{GS} = 0V, , f = 1MHz ) (Figure 10)</td>
<td>-</td>
<td>130</td>
<td>170</td>
<td>ns</td>
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<tr>
<td>Input Capacitance</td>
<td>( C_{ISS} )</td>
<td>( V_{DS} = 25V, , V_{GS} = 0V, , f = 1MHz ) (Figure 10)</td>
<td>-</td>
<td>1500</td>
<td>2000</td>
<td>pF</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>( C_{OSS} )</td>
<td>( V_{DS} = 25V, , V_{GS} = 0V, , f = 1MHz ) (Figure 10)</td>
<td>-</td>
<td>750</td>
<td>1100</td>
<td>pF</td>
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<tr>
<td>Reverse Transfer Capacitance</td>
<td>( C_{RSS} )</td>
<td>( V_{DS} = 25V, , V_{GS} = 0V, , f = 1MHz ) (Figure 10)</td>
<td>-</td>
<td>250</td>
<td>400</td>
<td>pF</td>
</tr>
<tr>
<td>Thermal Resistance Junction to Case</td>
<td>( R_{JUC} )</td>
<td>( T_J = 25^\circ C, , V_{DS} = 15A, , I_{DS} = 1mA ) (Figure 11)</td>
<td>-</td>
<td>1.67</td>
<td>-</td>
<td>( ^\circ C/W )</td>
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<tr>
<td>Thermal Resistance Junction to Ambient</td>
<td>( R_{JUA} )</td>
<td>( T_J = 25^\circ C, , V_{DS} = 15A, , I_{DS} = 1mA ) (Figure 11)</td>
<td>-</td>
<td>75</td>
<td>-</td>
<td>( ^\circ C/W )</td>
</tr>
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</table>

Source to Drain Diode Specifications

<table>
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<tr>
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<tbody>
<tr>
<td>Continuous Source to Drain Current</td>
<td>( I_{SD} )</td>
<td>( T_C = 25^\circ C )</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Source to Drain Current</td>
<td>( I_{SDM} )</td>
<td>( T_C = 25^\circ C )</td>
<td>-</td>
<td>-</td>
<td>120</td>
<td>A</td>
</tr>
<tr>
<td>Source to Drain Diode Voltage</td>
<td>( V_{SD} )</td>
<td>( T_J = 25^\circ C, , I_{SD} = 60A, , V_{GS} = 0V )</td>
<td>-</td>
<td>1.7</td>
<td>2.6</td>
<td>V</td>
</tr>
<tr>
<td>Reverse Recovery Time</td>
<td>( t_{rr} )</td>
<td>( T_J = 25^\circ C, , I_{SD} = 60A, , dI_{SD}/dt = 100A/\mu s, , V_{HR} = 30V )</td>
<td>-</td>
<td>200</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>Reverse Recovery Charge</td>
<td>( Q_{RR} )</td>
<td>( T_J = 25^\circ C, , I_{SD} = 60A, , dI_{SD}/dt = 100A/\mu s, , V_{HR} = 30V )</td>
<td>-</td>
<td>0.25</td>
<td>-</td>
<td>( \mu C )</td>
</tr>
</tbody>
</table>

NOTES:
2. Pulse Test: Pulse width \( \leq 300\)ms, duty cycle \( \leq 2\% \).
3. Repetitive rating; pulse width limited by maximum junction temperature. See Transient Thermal Impedance curve (Figure 3).
Typical Performance Curves  Unless Otherwise Specified

FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

FIGURE 3. MAXIMUM TRANSIENT THERMAL IMPEDANCE

FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

FIGURE 5. OUTPUT CHARACTERISTICS
Typical Performance Curves  Unless Otherwise Specified  (Continued)

**FIGURE 6. TRANSFER CHARACTERISTICS**

**FIGURE 7. DRAIN TO SOURCE ON RESISTANCE vs GATE VOLTAGE AND DRAIN CURRENT**

**FIGURE 8. DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE**

**FIGURE 9. GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE**

**FIGURE 10. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE**

**FIGURE 11. TRANSCONDUCTANCE vs DRAIN CURRENT**
Typical Performance Curves  Unless Otherwise Specified  (Continued)

![Graph showing source to drain diode voltage](image1)

**FIGURE 12. SOURCE TO DRAIN DIODE VOLTAGE**

![Graph showing gate to source voltage vs gate charge](image2)

**FIGURE 13. GATE TO SOURCE VOLTAGE vs GATE CHARGE**

Test Circuits and Waveforms

![Switching time test circuit](image3)

**FIGURE 14. SWITCHING TIME TEST CIRCUIT**

![Resistive switching waveforms](image4)

**FIGURE 15. RESISTIVE SWITCHING WAVEFORMS**

![Gate charge test circuit](image5)

**FIGURE 16. GATE CHARGE TEST CIRCUIT**

![Gate charge waveforms](image6)

**FIGURE 17. GATE CHARGE WAVEFORMS**

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PRODUCT STATUS DEFINITIONS

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