9A, 200V, 0.400 Ohm, N-Channel Power MOSFETs

These are N-Channel enhancement mode silicon gate power field effect transistors. They are advanced power MOSFETs designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. All of these power MOSFETs are designed for applications such as switching regulators, switching convertors, motor drivers, relay drivers, and drivers for high power bipolar switching transistors requiring high speed and low gate drive power. These types can be operated directly from integrated circuits.

Formerly developmental type TA17412.

Features

- 9A, 200V
- $r_{DS(ON)} = 0.400\Omega$
- Single Pulse Avalanche Energy Rated
- SOA is Power Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- 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>
</tr>
</thead>
<tbody>
<tr>
<td>IRF630</td>
<td>TO-220AB</td>
<td>IRF630</td>
</tr>
<tr>
<td>RF1S630SM</td>
<td>TO-263AB</td>
<td>RF1S630</td>
</tr>
</tbody>
</table>

NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-263AB variant in the tape and reel, i.e., RF1S630SM9A.

Symbol

Packaging

JEDEC TO-220AB

JEDEC TO-263AB
Absolute Maximum Ratings  $T_C = 25^\circ C$, Unless Otherwise Specified

- Drain to Source Voltage (Note 1)  $V_{DS} = 200 \text{ V}$
- Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1)  $V_{DS} = 200 \text{ V}$
- Continuous Drain Current  $I_D = 9 \text{ A}$
- Pulsed Drain Current (Note 3)  $I_{DM} = 36 \text{ A}$
- Gate to Source Voltage  $V_{GS} = \pm 20 \text{ V}$
- Maximum Power Dissipation  $P_D = 75 \text{ W}$
- Linear Derating Factor  $0.6 \text{ W/}^\circ C$
- Single Pulse Avalanche Energy Rating (Note 4)  $E_{AS} = 150 \text{ mJ}$
- Maximum Temperature for Soldering  $T_L = 300 \text{ }^\circ C$
- Package Body for 10s, See Techbrief 334  $T_{pkg} = 260 \text{ }^\circ C$

**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>
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<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<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>$I_D = 250\mu A$, $V_{GS} = 0\text{ V}$ (Figure 10)</td>
<td>200</td>
<td>-</td>
<td>-</td>
<td>\text{V}</td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>$V_{GS(TH)}$</td>
<td>$V_{DS} = 250\mu A$</td>
<td>2</td>
<td>-</td>
<td>4</td>
<td>\text{V}</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{DSS}$</td>
<td>$V_{DS} =$ Rated $BVDSS$, $V_{GS} = 0\text{ V}$</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>\text{mA}</td>
</tr>
<tr>
<td>On-State Drain Current (Note 2)</td>
<td>$I_{D(ON)}$</td>
<td>$V_{DS} &gt; I_{D(ON)} \times R_{DS(ON)MAX}$, $V_{GS} = 10\text{ V}$</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>\text{A}</td>
</tr>
<tr>
<td>Gate to Source Leakage Current</td>
<td>$I_{GSS}$</td>
<td>$V_{GS} = \pm 20\text{ V}$</td>
<td>-</td>
<td>-</td>
<td>$\pm 100$</td>
<td>\text{nA}</td>
</tr>
<tr>
<td>Drain to Source On Resistance (Note 2)</td>
<td>$R_{DS(ON)}$</td>
<td>$I_D = 5\text{ A}$, $V_{GS} = 10\text{ V}$ (Figure 8, 9)</td>
<td>-</td>
<td>0.25</td>
<td>0.4</td>
<td>\text{\Omega}</td>
</tr>
<tr>
<td>Forward Transconductance (Note 2)</td>
<td>$g_{fs}$</td>
<td>$V_{DS} &gt; I_{D(ON)} \times R_{DS(ON)MAX}$, $I_D = 5\text{ A}$ (Figure 12)</td>
<td>3</td>
<td>4.8</td>
<td>-</td>
<td>\text{S}</td>
</tr>
<tr>
<td>Turn-On Delay Time</td>
<td>$t_{d(ON)}$</td>
<td>$V_{DD} = 90\text{ V}$, $I_D = 9\text{ A}$, $R_{GS} = 9.1\text{ \Omega}$, $V_{GS} = 10\text{ V}$</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>\text{ns}</td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_r$</td>
<td>MOSFET Switching Times are Essentially Independent of Operating Temperature</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>\text{ns}</td>
</tr>
<tr>
<td>Turn-Off Delay Time</td>
<td>$t_{d(OFF)}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>\text{ns}</td>
</tr>
<tr>
<td>Fall Time</td>
<td>$t_f$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>40</td>
<td>\text{ns}</td>
</tr>
<tr>
<td>Total Gate Charge (Gate to Source + Gate to Drain)</td>
<td>$Q_g(TOT)$</td>
<td>$V_{GS} = 10\text{ V}$, $I_D = 9\text{ A}$, $V_{DS} = 0.8 \times$ Rated $BVDSS$, $I_{g(REF)} = 1.5\text{mA}$ (Figure 14)</td>
<td>-</td>
<td>19</td>
<td>30</td>
<td>\text{nC}</td>
</tr>
<tr>
<td>Gate to Source Charge</td>
<td>$Q_{gs}$</td>
<td>Gate Charge is Essentially Independent of Operating Temperature</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>\text{nC}</td>
</tr>
<tr>
<td>Gate to Drain “Miller” Charge</td>
<td>$Q_{gd}$</td>
<td>-</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>\text{nC}</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>$C_{ISS}$</td>
<td>$V_{DS} = 25\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1\text{MHz}$ (Figure 11)</td>
<td>-</td>
<td>600</td>
<td>-</td>
<td>\text{pF}</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>$C_{OSS}$</td>
<td>-</td>
<td>250</td>
<td>-</td>
<td>-</td>
<td>\text{pF}</td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>$C_{RSS}$</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>-</td>
<td>\text{pF}</td>
</tr>
<tr>
<td>Internal Drain Inductance</td>
<td>$L_D$</td>
<td>Measured From the Contact Screw on Tab to Center of Die</td>
<td>3.5</td>
<td>-</td>
<td>-</td>
<td>\text{nH}</td>
</tr>
<tr>
<td>Internal Source Inductance</td>
<td>$L_S$</td>
<td>Measured From the Source Lead, 6mm (0.25in) From Package to Center of Die</td>
<td>4.5</td>
<td>-</td>
<td>-</td>
<td>\text{nH}</td>
</tr>
<tr>
<td>Thermal Resistance Junction to Case</td>
<td>$R_{iJC}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.67</td>
<td>\text{\circ C/W}</td>
</tr>
<tr>
<td>Thermal Resistance Junction to Ambient</td>
<td>$R_{iJA}$</td>
<td>Free Air Operation</td>
<td>-</td>
<td>-</td>
<td>80</td>
<td>\text{\circ C/W}</td>
</tr>
</tbody>
</table>

**PARAMETER**  $T_J = 25^\circ C$, Unless Otherwise Specified
Source to Drain Diode Specifications

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Source to Drain Current</td>
<td>$I_{SD}$</td>
<td>Modified MOSFET Symbol Showing the Integral Reverse P-N Junction Diode</td>
<td>-</td>
<td>-</td>
<td>9</td>
<td>A</td>
</tr>
<tr>
<td>Pulse Source to Drain Current (Note 3)</td>
<td>$I_{SDM}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>36</td>
<td>A</td>
</tr>
</tbody>
</table>

Source to Drain Diode Voltage (Note 2) $V_{SD}$ $T_J = 25^\circ C$, $I_{SD} = 9A$, $V_{GS} = 0V$ (Figure 13) | -   | -   | 2   | V    |

Reverse Recovery Time $t_{rr}$ $T_J = 150^\circ C$, $I_{SD} = 9A$, $dI_{SD}/dt = 100A/\mu s$ | -   | 450 | -   | ns   |

Reverse Recovery Charge $Q_{RR}$ $T_J = 150^\circ C$, $I_{SD} = 9A$, $dI_{SD}/dt = 100A/\mu s$ | -   | 3   | -   | $\mu C$ |

**NOTES:**
2. Pulse Test: Pulse width ≤ 300\(\mu s\), Duty Cycle ≤ 2%.
3. Repetitive rating: Pulse width limited by maximum junction temperature. See Transient Thermal Impedance curve (Figure 3).
4. $V_{DD} = 20V$, starting $T_J = 25^\circ C$, $L = 3.37mH$, $R_G = 50\Omega$, peak $I_{AS} = 9A$.

**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. NORMALIZED TRANSIENT THERMAL IMPEDANCE**
Typical Performance Curves  Unless Otherwise Specified  (Continued)

- **FIGURE 4. FORWARD BIAS SAFE OPERATING AREA**
  - Indicates safe operating area with limits marked.
  - OPERATION IN THIS AREA MAY BE LIMITED BY $r_{DS(ON)}$.
  - $T_J = MAX$ RATED, $T_C = 25^\circ C$.

- **FIGURE 5. OUTPUT CHARACTERISTICS**
  - PULSE DURATION = 80µs
  - DUTY CYCLE = 0.5% MAX
  - $V_GS = 10V$, $V_GS = 8V$, $V_GS = 7V$, $V_GS = 6V$, $V_GS = 5V$, $V_GS = 4V$.

- **FIGURE 6. SATURATION CHARACTERISTICS**
  - PULSE DURATION = 80µs
  - DUTY CYCLE = 0.5% MAX
  - $V_GS = 10V$, $V_GS = 9V$, $V_GS = 8V$, $V_GS = 7V$, $V_GS = 6V$.

- **FIGURE 7. TRANSFER CHARACTERISTICS**
  - PULSE DURATION = 80µs
  - DUTY CYCLE = 0.5% MAX
  - $V_GS = 10V$, $I_D = 5A$.

- **FIGURE 8. DRAIN TO SOURCE ON RESISTANCE vs GATE VOLTAGE AND DRAIN CURRENT**
  - Normalized data with pulse test conditions.
  - $V_GS = 10V$, $V_GS = 20V$.

- **FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE**
  - PULSE DURATION = 80µs
  - DUTY CYCLE = 0.5% MAX
  - $V_GS = 10V$, $I_D = 5A$.
Typical Performance Curves  Unless Otherwise Specified  (Continued)

**Figure 10. Normalized Drain to Source Breakdown Voltage vs Junction Temperature**

**Figure 11. Capacitance vs Drain to Source Voltage**

**Figure 12. Transconductance vs Drain Current**

**Figure 13. Source to Drain Diode Voltage**

**Figure 14. Gate to Source Voltage vs Gate Charge**
Test Circuits and Waveforms

**FIGURE 15. UNCLAMPED ENERGY TEST CIRCUIT**

**FIGURE 16. UNCLAMPED ENERGY WAVEFORMS**

**FIGURE 17. SWITCHING TIME TEST CIRCUIT**

**FIGURE 18. RESISTIVE SWITCHING WAVEFORMS**

**FIGURE 19. GATE CHARGE TEST CIRCUIT**

**FIGURE 20. GATE CHARGE WAVEFORMS**
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