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## IRLS640A

### N-Channel Logic Level A-FET

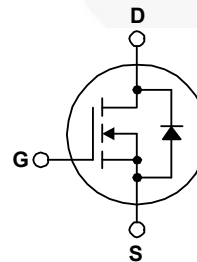
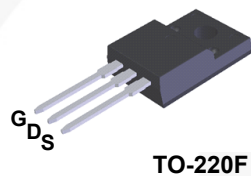
200 V, 9.8 A, 180 mΩ

#### Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar, DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switching DC/DC converters, switch mode power supplies, DC-AC converters for uninterrupted power supply and motor control.

#### Features

- 9.8 A, 200 V,  $R_{DS(on)} = 180 \text{ m}\Omega @ V_{GS} = 5 \text{ V}$
- Low Gate Charge (Typ. 40 nC)
- Low Crss (Typ. 95 pF)
- Fast Switching
- 100% Avalanche Tested
- Improved dv/dt Capability
- Logic-Level Gate Drive



#### Absolute Maximum Ratings

| Symbol         | Characteristic   | Value        | Units |
|----------------|--|--------------|-------|
| $V_{DSS}$      | Drain-to-Source Voltage  | 200          | V     |
| $I_D$          | Continuous Drain Current ( $T_C=25^\circ\text{C}$ )                      | 9.8          | A     |
|                | Continuous Drain Current ( $T_C=100^\circ\text{C}$ )                     | 6.2          |       |
| $I_{DM}$       | Drain Current-Pulsed <sup>①</sup>  | 63           | A     |
| $V_{GS}$       | Gate-to-Source Voltage   | $\pm 20$     | V     |
| $E_{AS}$       | Single Pulsed Avalanche Energy <sup>②</sup>                              | 64           | mJ    |
| $I_{AR}$       | Avalanche Current <sup>①</sup>   | 18           | A     |
| $E_{AR}$       | Repetitive Avalanche Energy <sup>①</sup>                                 | 4.0          | mJ    |
| dv/dt          | Peak Diode Recovery dv/dt <sup>③</sup>                                   | 5            | V/ns  |
| $P_D$          | Total Power Dissipation ( $T_C=25^\circ\text{C}$ )                       | 40           | W     |
|                | Linear Derating Factor   | 0.32         |       |
| $T_J, T_{STG}$ | Operating Junction and Storage Temperature Range                         | - 55 to +150 | °C    |
| $T_L$          | Maximum Lead Temp. for Soldering Purposes, 1/8 " from case for 5-seconds | 300          |       |

#### Thermal Resistance

| Symbol          | Characteristic      | Typ. | Max. | Units |
|-----------------|---------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case    | --   | 3.13 | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient | --   | 62.5 |       |

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|-------------|----------|---------|----------------|-----------|------------|----------|
| IRLS640A    | IRLS640A | TO-220F | Tube           | N/A       | N/A        | 50 units |

## Electrical Characteristics ( $T_C=25^\circ\text{C}$ unless otherwise specified)

| Symbol                 | Characteristic                          | Min. | Typ. | Max. | Units               | Test Condition  |
|------------------------|---|------|------|------|---------------------|---|
| $BV_{DSS}$             | Drain-Source Breakdown Voltage          | 200  | --   | --   | V                   | $V_{GS}=0V, I_D=250\mu A$   |
| $\Delta BV/\Delta T_J$ | Breakdown Voltage Temp. Coeff.          | --   | 0.17 | --   | V/ $^\circ\text{C}$ | $I_D=250\mu A$ <b>See Fig 7</b>   |
| $V_{GS(th)}$           | Gate Threshold Voltage                  | 1.0  | --   | 2.0  | V                   | $V_{DS}=V_{GS}, I_D=250\mu A$   |
| $I_{GSS}$              | Gate-Source Leakage, Forward            | --   | --   | 100  | nA                  | $V_{GS}=20V$  |
|                        | Gate-Source Leakage, Reverse            | --   | --   | -100 |                     | $V_{GS}=-20V$   |
| $I_{DSS}$              | Drain-to-Source Leakage Current         | --   | --   | 10   | $\mu A$             | $V_{DS}=200V$   |
|                        |   | --   | --   | 100  |                     | $V_{DS}=160V, T_C=125^\circ\text{C}$  |
| $R_{DS(on)}$           | Static Drain-Source On-State Resistance | --   | --   | 0.18 | $\Omega$            | $V_{GS}=5V, I_D=4.9A$ ④   |
| $g_{fs}$               | Forward Transconductance                | --   | 13.3 | --   | S                   | $V_{DS}=40V, I_D=4.9A$ ④  |
| $C_{iss}$              | Input Capacitance                       | --   | 1310 | 1705 | pF                  | $V_{GS}=0V, V_{DS}=25V, f=1\text{MHz}$<br><b>See Fig 5</b>                  |
| $C_{oss}$              | Output Capacitance                      | --   | 200  | 250  |                     |   |
| $C_{rss}$              | Reverse Transfer Capacitance            | --   | 95   | 120  |                     |   |
| $t_{d(on)}$            | Turn-On Delay Time                      | --   | 11   | 30   | ns                  | $V_{DD}=100V, I_D=18A,$<br>$R_G=4.6\Omega$<br><b>See Fig 13</b> ④ ⑤         |
| $t_r$                  | Rise Time                               | --   | 8    | 25   |                     |   |
| $t_{d(off)}$           | Turn-Off Delay Time                     | --   | 46   | 100  |                     |   |
| $t_f$                  | Fall Time                               | --   | 15   | 40   |                     |   |
| $Q_g$                  | Total Gate Charge                       | --   | 40   | 56   | nC                  | $V_{DS}=160V, V_{GS}=5V,$<br>$I_D=18A$<br><b>See Fig 6 &amp; Fig 12</b> ④ ⑤ |
| $Q_{gs}$               | Gate-Source Charge                      | --   | 6.8  | --   |                     |   |
| $Q_{gd}$               | Gate-Drain("Miller") Charge             | --   | 18.6 | --   |                     |   |

## Source-Drain Diode Ratings and Characteristics

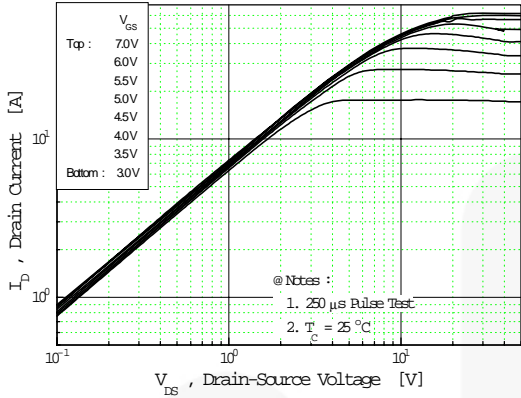
| Symbol   | Characteristic            | Min. | Typ. | Max. | Units   | Test Condition                              |
|----------|---------------------------|------|------|------|---------|---|
| $I_S$    | Continuous Source Current | --   | --   | 18   | A       | Integral reverse pn-diode in the MOSFET     |
| $I_{SM}$ | Pulsed-Source Current ①   | --   | --   | 63   |         |   |
| $V_{SD}$ | Diode Forward Voltage ④   | --   | --   | 1.5  | V       | $T_J=25^\circ\text{C}, I_S=9.8A, V_{GS}=0V$ |
| $t_{rr}$ | Reverse Recovery Time     | --   | 224  | --   | ns      | $T_J=25^\circ\text{C}, I_F=18A$             |
| $Q_{rr}$ | Reverse Recovery Charge   | --   | 1.55 | --   | $\mu C$ | $di_F/dt=100A/\mu s$ ④                      |

### Notes ;

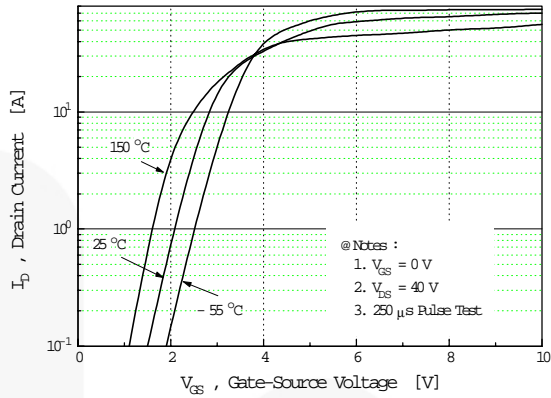
- ① Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature
- ②  $L=1\text{mH}, I_{AS}=9.8A, V_{DD}=50V, R_G=27\Omega$ , Starting  $T_J=25^\circ\text{C}$
- ③  $I_{SD}\leq 18A, di/dt\leq 260A/\mu s, V_{DD}\leq BV_{DSS}$ , Starting  $T_J=25^\circ\text{C}$
- ④ Pulse Test : Pulse Width =  $250\mu s$ , Duty Cycle  $\leq 2\%$
- ⑤ Essentially Independent of Operating Temperature

## Typical Characteristics

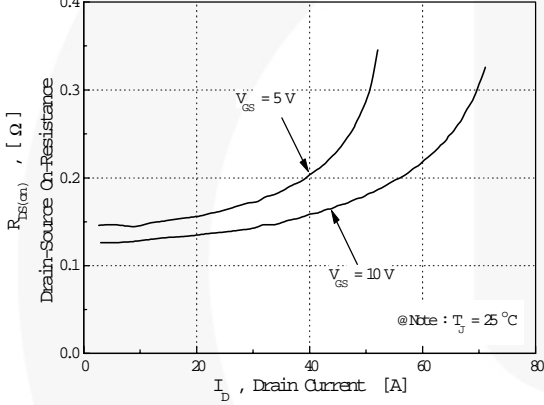
**Fig 1. Output Characteristics**



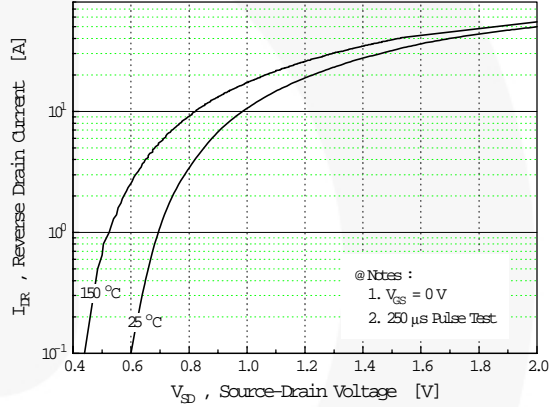
**Fig 2. Transfer Characteristics**



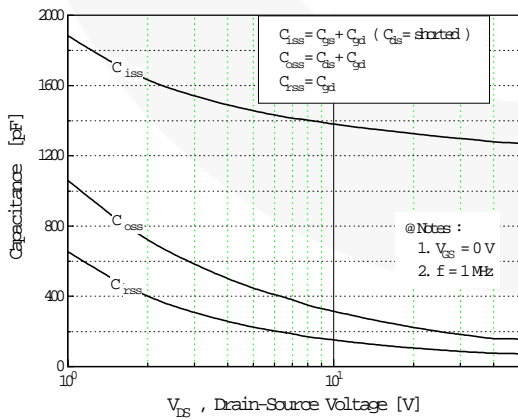
**Fig 3. On-Resistance vs. Drain Current**



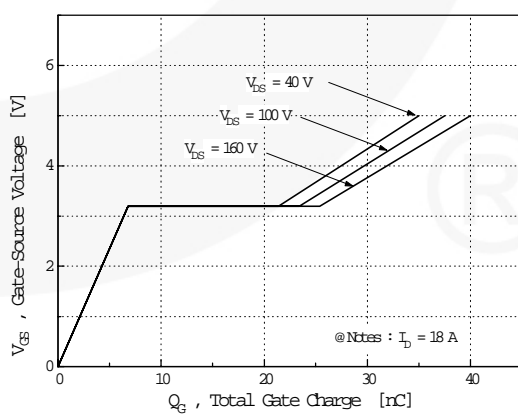
**Fig 4. Source-Drain Diode Forward Voltage**



**Fig 5. Capacitance vs. Drain-Source Voltage**



**Fig 6. Gate Charge vs. Gate-Source Voltage**



Typical Characteristics (continued)

Fig 7. Breakdown Voltage vs. Temperature

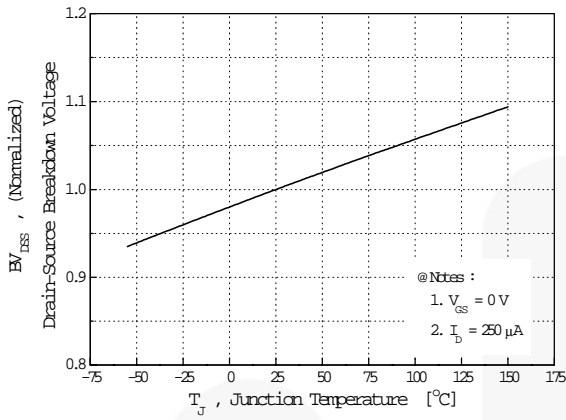


Fig 8. On-Resistance vs. Temperature

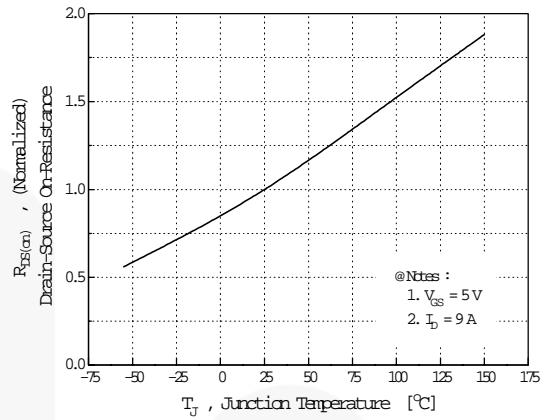


Fig 9. Max. Safe Operating Area

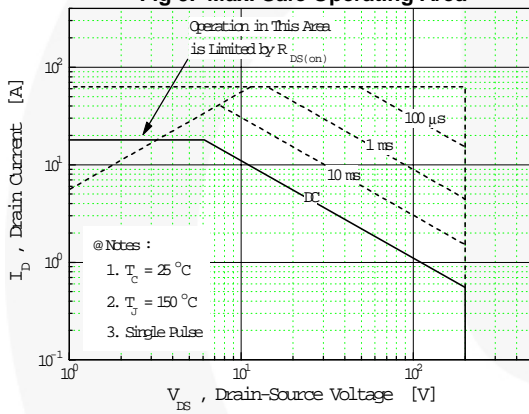


Fig 10. Max. Drain Current vs. Case Temperature

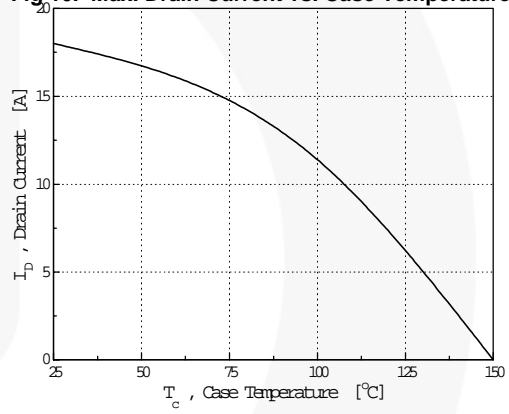


Fig 11. Thermal Response

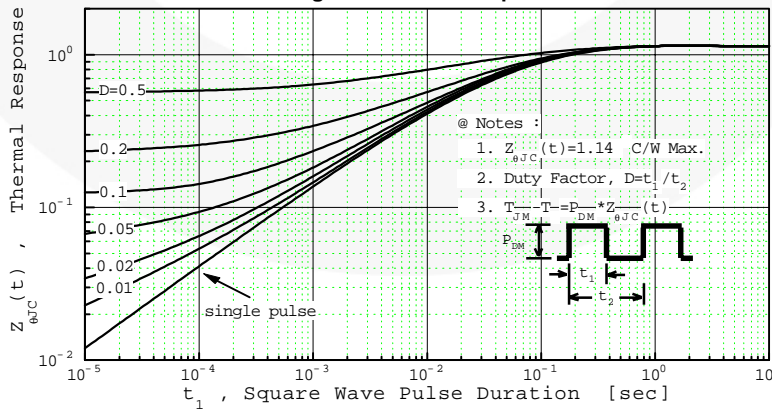




Figure 12. Gate Charge Test Circuit & Waveform



Figure 13. Resistive Switching Test Circuit & Waveforms

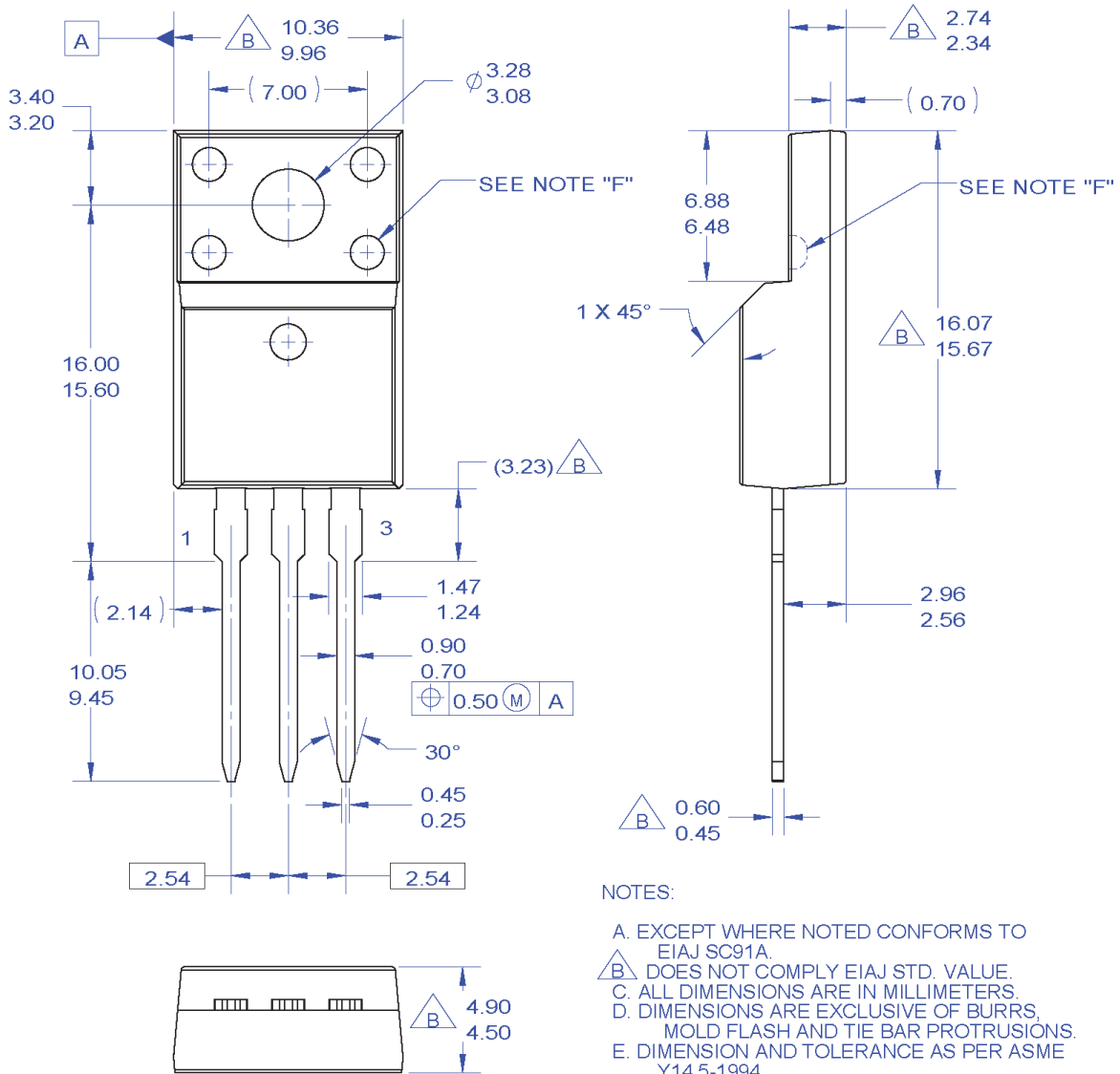


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms



Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

**Mechanical Dimensions**



**NOTES:**

- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- B. DOES NOT COMPLY EIAJ STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- F. OPTION 1 - WITH SUPPORT PIN HOLE.  
OPTION 2 - NO SUPPORT PIN HOLE.
- G. DRAWING FILE NAME: TO220M03REV3

**Figure 16. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead**

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