

# MJ N-Channel Enhancement Mode Power MOSFET

## Description

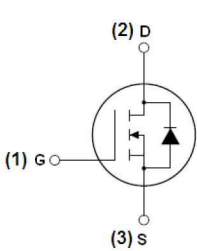
The MJ6020AL uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.

## General Features

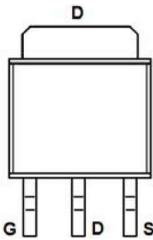
- ◆  $V_{DS} = 60V, I_D = 20A$   
 $R_{DS(ON)} < 35m\Omega @ V_{GS} = 10V$   
 $R_{DS(ON)} < 40m\Omega @ V_{GS} = 4.5V$
- ◆ High density cell design for ultra low  $R_{dson}$
- ◆ Fully characterized avalanche voltage and current
- ◆ Good stability and uniformity with high  $E_{AS}$
- ◆ Excellent package for good heat dissipation
- ◆ Special process technology for high ESD capability

## Application

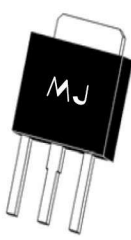
- ◆ Power switching application
- ◆ Hard switched and high frequency circuits
- ◆ Uninterruptible power supply



Schematic diagram



Marking and pin assignment



TO-251S top view

100% UIS TESTED! 100%  $\Delta V_{ds}$  TESTED!

## Package Marking and Ordering Information

| Device Marking | Device   | Device Package | Reel Size | Tape width | Quantity |
|----------------|----------|----------------|-----------|------------|----------|
| MJ6020AL       | MJ6020AL | TO-251S        | -         | -          | -        |

## Absolute Maximum Ratings ( $T_c = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

| Parameter   | Symbol                       | Limit      | Unit                  |
|---|------------------------------|------------|-----------------------|
| Drain-Source Voltage                                    | $V_{DS}$                     | 60         | V                     |
| Gate-Source Voltage                                     | $V_{GS}$                     | $\pm 20$   | V                     |
| Drain Current-Continuous                                | $I_D$                        | 20         | A                     |
| Drain Current-Continuous( $T_c = 100^{\circ}\text{C}$ ) | $I_{D(100^{\circ}\text{C})}$ | 14         | A                     |
| Pulsed Drain Current                                    | $I_{DM}$                     | 60         | A                     |
| Maximum Power Dissipation                               | $P_D$                        | 45         | W                     |
| Derating factor   |                              | 0.3        | W/ $^{\circ}\text{C}$ |
| Single pulse avalanche energy <sup>(Note 5)</sup>       | $E_{AS}$                     | 72         | mJ                    |
| Operating Junction and Storage Temperature Range        | $T_J, T_{STG}$               | -55 To 175 | $^{\circ}\text{C}$    |

## Thermal Characteristic

|  |                 |     |                      |
|--|-----------------|-----|----------------------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 3.3 | $^{\circ}\text{C/W}$ |
|--|-----------------|-----|----------------------|

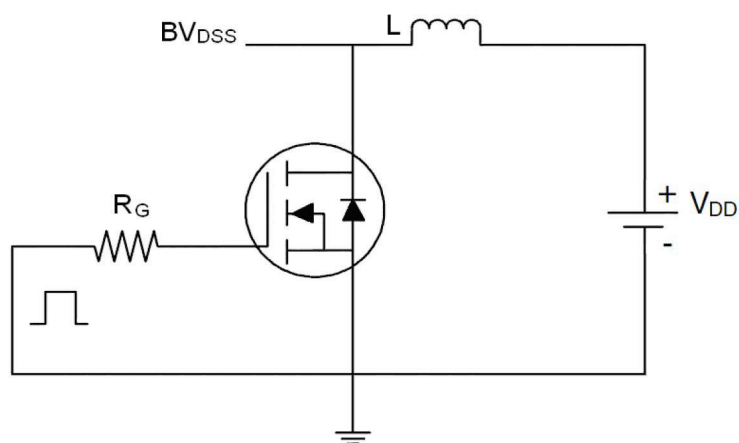
Electrical Characteristics (Tc =25°Cunless otherwise noted)

| Parameter                                     | Symbol              | Condition   | Min | Typ  | Max  | Unit |
|---|---------------------|---|-----|------|------|------|
| Off Characteristics                           |                     |   |     |      |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA   | 60  | -    | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =60V,V <sub>GS</sub> =0V  | -   | -    | 1    | μA   |
| Gate-Body Leakage Current                     | I <sub>GSS</sub>    | V <sub>DS</sub> =±20V,V <sub>DS</sub> =0V   | -   | -    | ±100 | nA   |
| On Characteristics <sup>(Note 3)</sup>        |                     |   |     |      |      |      |
| Gate Threshold Voltage                        | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =250μA   | 1.2 | 1.6  | 2.5  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =20A   | -   | 24   | 35   | mΩ   |
|   |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =20A  |     | 30   | 40   | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =5V,I <sub>D</sub> =5A  | 11  | -    | -    | S    |
| Dynamic Characteristics <sup>(Note 4)</sup>   |                     |   |     |      |      |      |
| Input Capacitance                             | C <sub>iss</sub>    | V <sub>DS</sub> =30V,V <sub>GS</sub> =0V<br>F=1.0MHz  | -   | 500  | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |   | -   | 60   | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |   | -   | 25   | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |   |     |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =30V,I <sub>D</sub> =2A,R <sub>L</sub> =6.7Ω<br>V <sub>GS</sub> =10V,R <sub>G</sub> =3Ω | -   | 5    | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |   | -   | 2.6  | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |   | -   | 16.1 | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |   | -   | 2.3  | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =30V,I <sub>D</sub> =4.5A<br>V <sub>GS</sub> =10V                                       | -   | 25   | -    | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |   | -   | 4.5  | -    | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |   | -   | 6.5  | -    | nC   |
| Drain-Source Diode Characteristics            |                     |   |     |      |      |      |
| Diode Forward Voltage <sup>(Note 3)</sup>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V,I <sub>S</sub> =20A   | -   | -    | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |   | -   | -    | 20   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> =25°C, I <sub>F</sub> =20A<br>di/dt=100A/μs <sup>(Note 3)</sup>                          | -   | 29   | -    | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     |   | -   | 49   | -    | nC   |
| Forward Turn-On Time                          | t <sub>on</sub>     | Intrinsic turn-on time is negligible(turn-on is dominated by LS+LD)                                     |     |      |      |      |

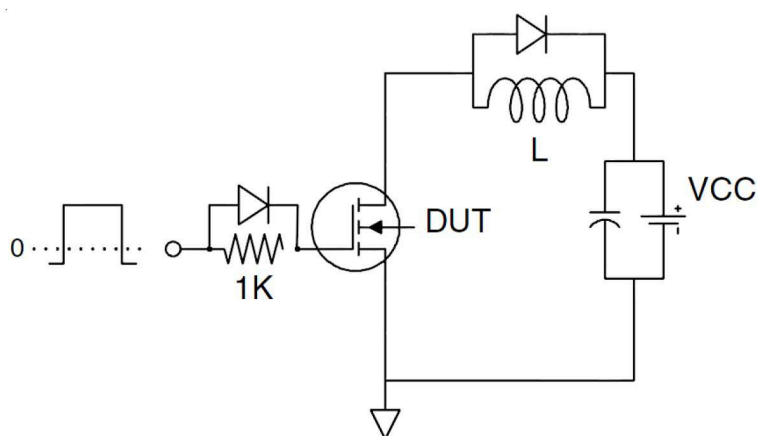
Notes:

- ① Repetitive Rating: Pulse width limited by maximum junction temperature.
- ② Surface Mounted on FR4 Board, t ≤ 10 sec.
- ③ Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
- ④ Guaranteed by design, not subject to production
- ⑤ EAS condition: T<sub>J</sub>=25°C, V<sub>DD</sub>=30V, V<sub>G</sub>=10V, L=0.5mH, R<sub>g</sub>=25Ω

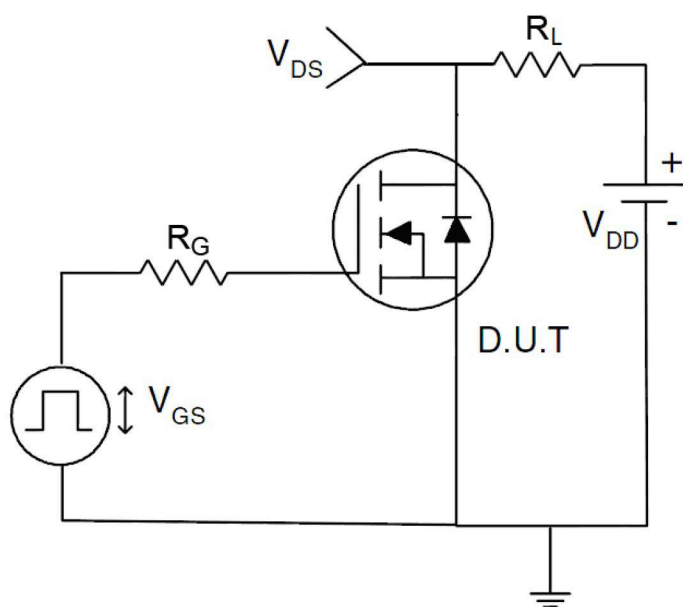
# Test circuit



EAS test Circuit

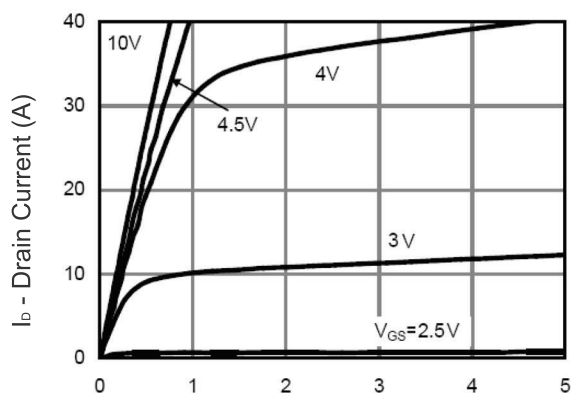


Gate charge test Circuit



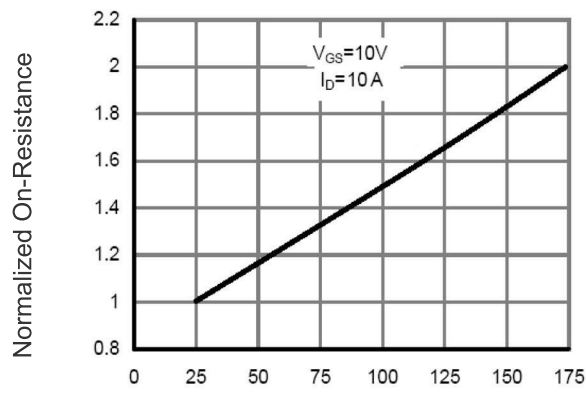
Switch Time Test Circuit

## Typical Electrical and Thermal Characteristics (Curves)



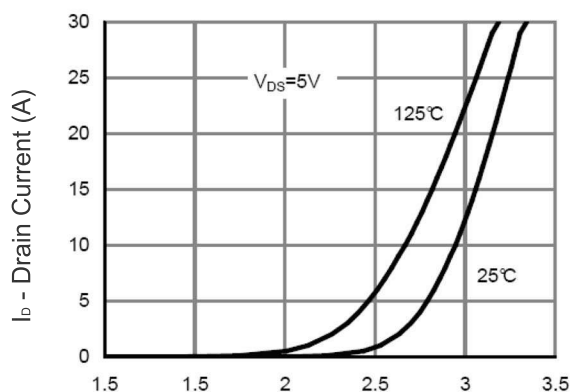
Vds Drain-Source Voltage (V)

Figure 1 Output Characteristics



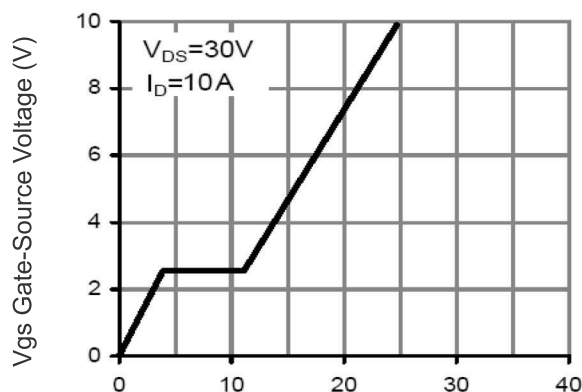
Tj -Junction Temperature(°C)

Figure 4 Rdson-Junction Temperature



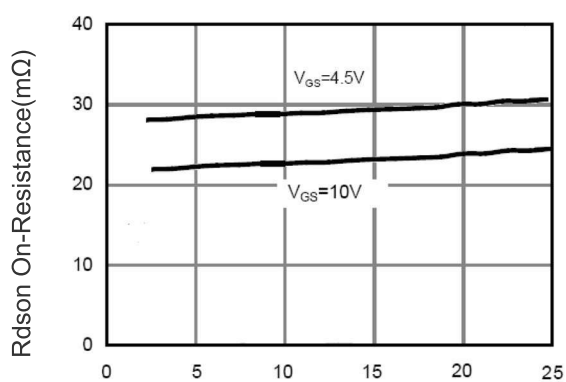
Vgs Gate-Source Voltage (V)

Figure 2 Transfer Characteristics



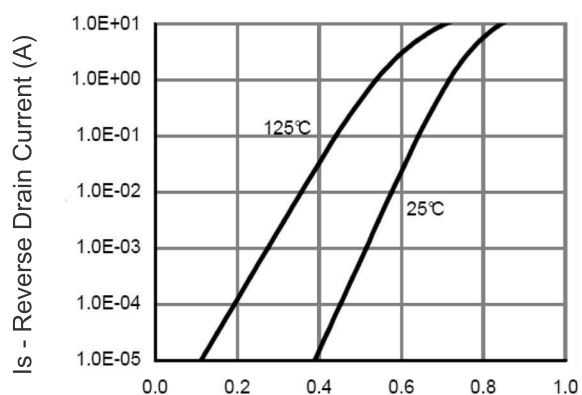
Qg Gate Charge (nC)

Figure 5 Gate Charge



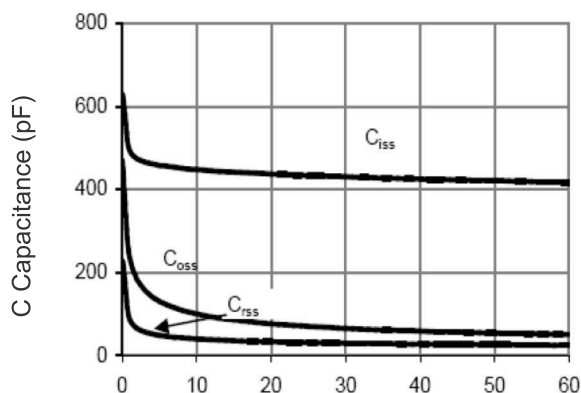
Id - Drain Current (A)

Figure 3 Rdson- Drain Current

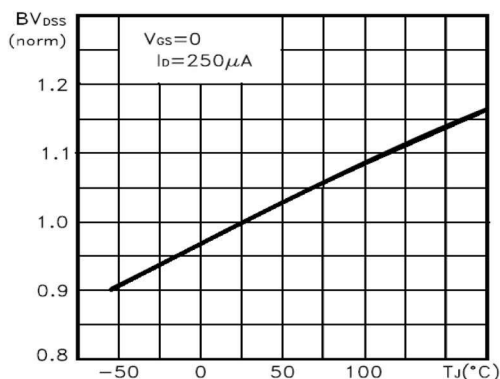


Vsd Source-Drain Voltage (V)

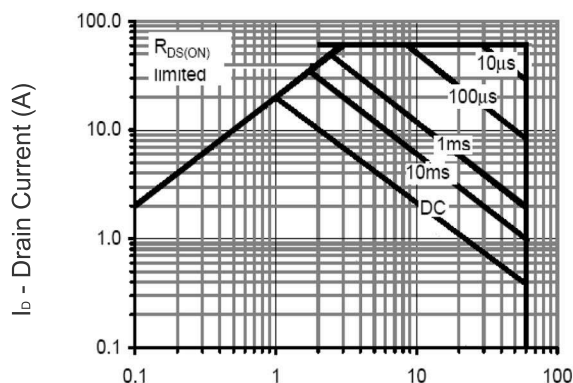
Figure 6 Source- Drain Diode Forward



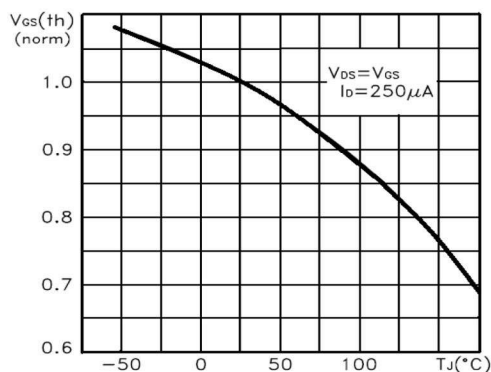
Vds Drain-Source Voltage (V)  
Figure 7 Capacitance vs Vds



TJ -Junction Temperature(°C)  
Figure 9 BV<sub>DSS</sub> vs Junction Temperature



Vds Drain-Source Voltage (V)  
Figure 8 Safe Operation Area



TJ -Junction Temperature(°C)  
Figure 10 V<sub>GS(th)</sub> vs Junction Temperature

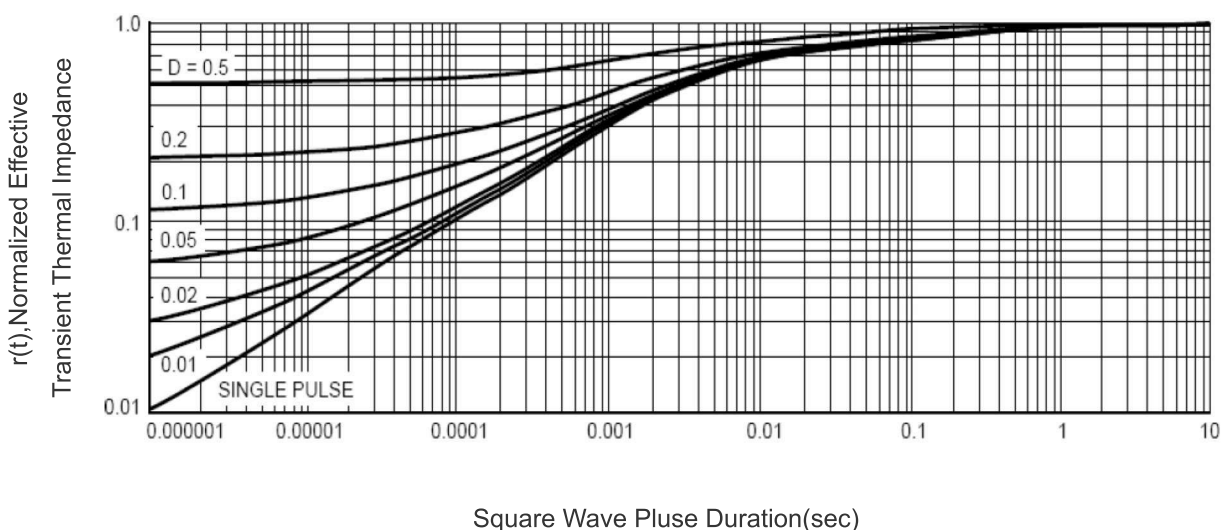
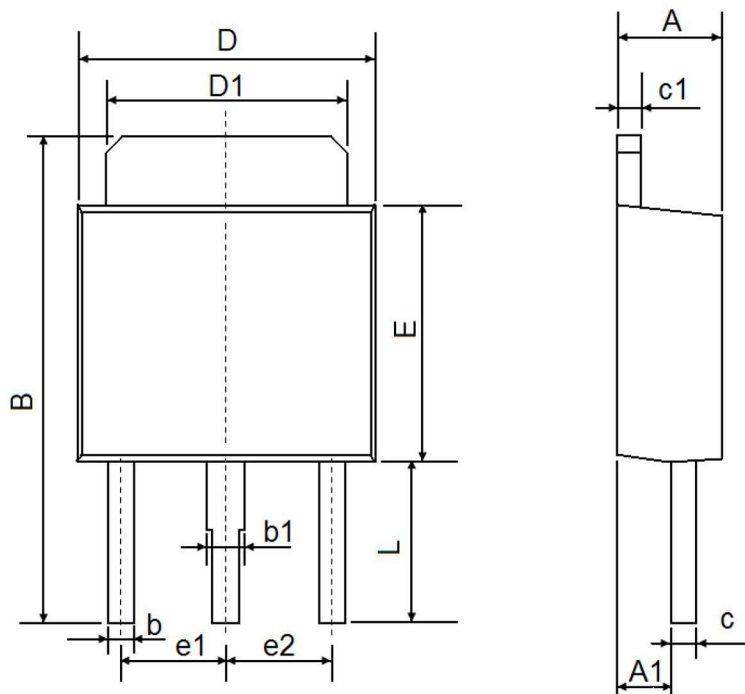


Figure 11 Normalized Maximum Transient Thermal Impedance

# TO-251S Package Information



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 2.250                     | 2.350  | 0.089                | 0.093 |
| A1     | 1.150                     | 1.250  | 0.045                | 0.049 |
| B      | 10.200                    | 10.800 | 0.402                | 0.425 |
| b      | 0.550                     | 0.650  | 0.022                | 0.026 |
| b1     | 0.750                     | 0.850  | 0.030                | 0.033 |
| c      | 0.480                     | 0.540  | 0.019                | 0.021 |
| c1     | 0.480                     | 0.540  | 0.019                | 0.021 |
| D      | 6.400                     | 6.600  | 0.252                | 0.260 |
| D1     | 5.250                     | 5.350  | 0.207                | 0.211 |
| E      | 5.400                     | 5.600  | 0.213                | 0.220 |
| e1     | 2.300 TYP                 |        | 0.091 TYP            |       |
| e2     | 2.300 TYP                 |        | 0.091 TYP            |       |
| L      | 3.300                     | 3.700  | 0.130                | 0.146 |

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