



# STP3020L

## N - CHANNEL 30V - 0.019Ω - 40A - TO-220 STripFET™ POWER MOSFET

| TYPE     | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|----------|------------------|---------------------|----------------|
| STP3020L | 30 V             | < 0.022 Ω           | 40 A           |

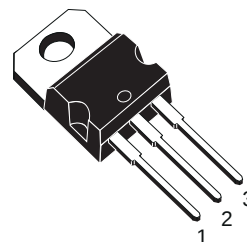
- TYPICAL R<sub>DS(on)</sub> = 0.019 Ω
- LOW GATE CHARGE A 100°C
- APPLICATION ORIENTED CHARACTERIZATION

### DESCRIPTION

This Power Mosfet is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

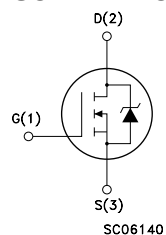
### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING SOLENOID AND RELAY DRIVERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- DC-AC & DC-AC CONVERTERS IN HIGH PERFORMANCE VRMS
- AUTOMOTIVE ENVIRONMENT (INJECTION, ABS, AIR-BAG, LAMPDRIVERS, Etc.)



TO-220

### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                             | Value      | Unit |
|---------------------|-------------------------------------------------------|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 30         | V    |
| V <sub>DGR</sub>    | Drain- gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 30         | V    |
| V <sub>GS</sub>     | Gate-source Voltage                                   | ± 20       | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 25 °C  | 40         | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C | 28         | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                | 160        | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C           | 80         | W    |
|                     | Derating Factor                                       | 0.53       | W/°C |
| T <sub>stg</sub>    | Storage Temperature                                   | -65 to 175 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                   | 175        | °C   |

(•) Pulse width limited by safe operating area

## THERMAL DATA

|                       |                                                |     |       |      |
|-----------------------|------------------------------------------------|-----|-------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case               | Max | 1.875 | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient            | Max | 62.5  | °C/W |
| R <sub>thc-sink</sub> | Thermal Resistance Case-sink                   | Typ | 0.5   | °C/W |
| T <sub>l</sub>        | Maximum Lead Temperature For Soldering Purpose |     | 300   | °C   |

ELECTRICAL CHARACTERISTICS (T<sub>case</sub> = 25 °C unless otherwise specified)

## OFF

| Symbol               | Parameter                                             | Test Conditions                                                                      | Min. | Typ. | Max.    | Unit     |
|----------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------|------|------|---------|----------|
| V <sub>(BR)DSS</sub> | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 μA V <sub>GS</sub> = 0                                          | 30   |      |         | V        |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0) | V <sub>DS</sub> = Max Rating<br>V <sub>DS</sub> = Max Rating T <sub>c</sub> = 125 °C |      |      | 1<br>10 | μA<br>μA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ± 20 V                                                             |      |      | ± 100   | nA       |

## ON (\*)

| Symbol              | Parameter                         | Test Conditions                                                                           | Min. | Typ.           | Max.           | Unit   |
|---------------------|-----------------------------------|-------------------------------------------------------------------------------------------|------|----------------|----------------|--------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> I <sub>D</sub> = 250 μA                                 | 1    |                | 2.5            | V      |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V I <sub>D</sub> = 20 A<br>V <sub>GS</sub> = 5V I <sub>D</sub> = 20 A |      | 0.019<br>0.033 | 0.022<br>0.038 | Ω<br>Ω |
| I <sub>D(on)</sub>  | On State Drain Current            | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub><br>V <sub>GS</sub> = 10 V   | 40   |                |                | A      |

## DYNAMIC

| Symbol                                                   | Parameter                                                               | Test Conditions                                                                     | Min. | Typ.               | Max. | Unit           |
|----------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|--------------------|------|----------------|
| g <sub>fs</sub> (*)                                      | Forward Transconductance                                                | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> I <sub>D</sub> = 20 A | 5    | 20                 |      | S              |
| C <sub>iss</sub><br>C <sub>oss</sub><br>C <sub>rss</sub> | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | V <sub>DS</sub> = 25 V f = 1 MHz V <sub>GS</sub> = 0                                |      | 1270<br>350<br>115 |      | pF<br>pF<br>pF |

**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions                                                             | Min. | Typ. | Max. | Unit |
|-------------|--------------------|-----------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 15\text{ V}$ $I_D = 19\text{ A}$                                  |      | 28   |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\ \Omega$ $V_{GS} = 4.5\text{ V}$<br>(Resistive Load, see fig. 3) |      | 220  |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 24\text{ V}$ $I_D = 38\text{ A}$ $V_{GS} = 5\text{ V}$            |      | 21   | 29   | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                             |      | 9    |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                             |      | 11   |      | nC   |

**SWITCHING OFF**

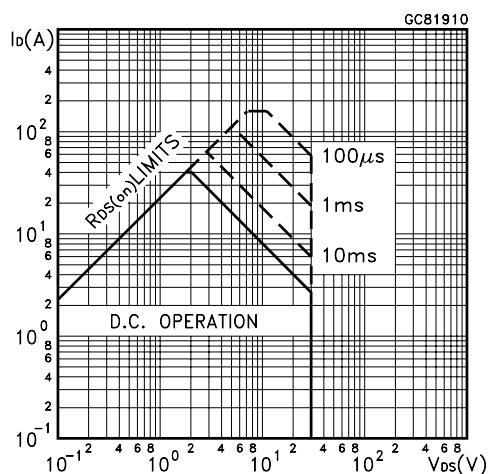
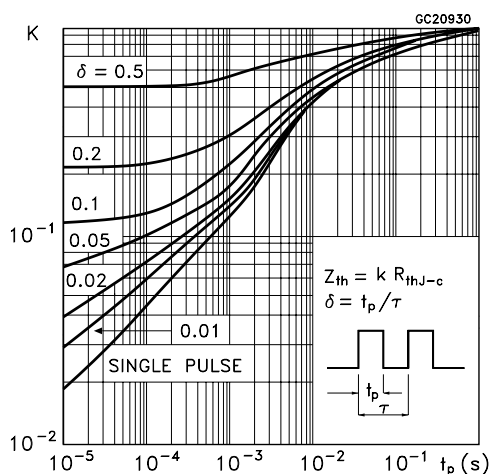
| Symbol        | Parameter             | Test Conditions                                                             | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|-----------------------------------------------------------------------------|------|------|------|------|
| $t_{d(off)}$  | Turn-off Delay Time   | $V_{DD} = 15\text{ V}$ $I_D = 19\text{ A}$                                  |      | 45   |      | ns   |
| $t_f$         | Fall Time             | $R_G = 4.7\ \Omega$ $V_{GS} = 4.5\text{ V}$<br>(Resistive Load, see fig. 3) |      | 35   |      | ns   |
| $t_{r(voff)}$ | Off-voltage Rise Time | $V_{DD} = 24\text{ V}$ $I_D = 38\text{ A}$                                  |      | 30   |      | ns   |
| $t_f$         | Fall Time             | $R_G = 4.7\ \Omega$ $V_{GS} = 4.5\text{ V}$                                 |      | 85   |      | ns   |
| $t_c$         | Cross-over Time       | (Inductive Load, see fig. 5)                                                |      | 125  |      | ns   |

**SOURCE DRAIN DIODE**

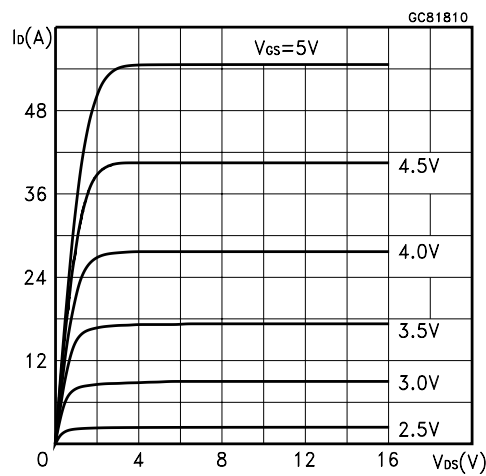
| Symbol             | Parameter                     | Test Conditions                                                                                                                                     | Min. | Typ. | Max. | Unit |
|--------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$           | Source-drain Current          |                                                                                                                                                     |      |      | 40   | A    |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) |                                                                                                                                                     |      |      | 160  | A    |
| $V_{SD} (*)$       | Forward On Voltage            | $I_{SD} = 40\text{ A}$ $V_{GS} = 0$                                                                                                                 |      |      | 1.5  | V    |
| $t_{rr}$           | Reverse Recovery Time         | $I_{SD} = 38\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 15\text{ V}$ $T_J = 150\text{ }^\circ\text{C}$<br>(see test circuit, fig. 5) |      | 45   |      | ns   |
| $Q_{rr}$           | Reverse Recovery Charge       |                                                                                                                                                     |      | 60   |      | nC   |
| $I_{RRM}$          | Reverse Recovery Current      |                                                                                                                                                     |      | 2.5  |      | A    |

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

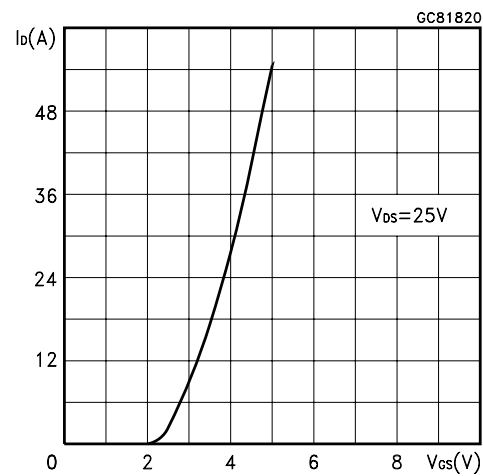
(\bullet) Pulse width limited by safe operating area

**Safe Operating Area****Thermal Impedance**

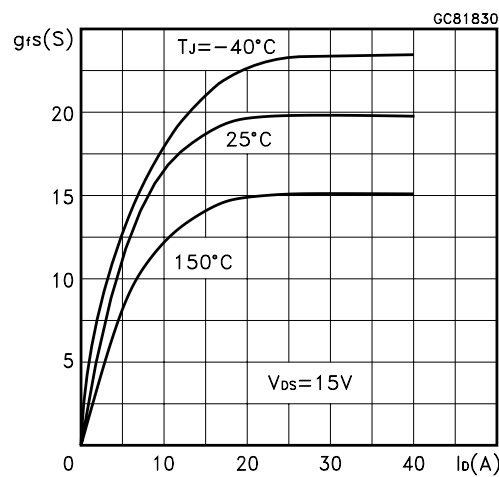
Output Characteristics



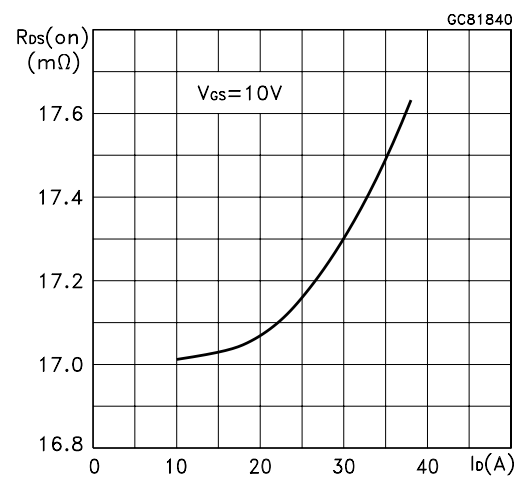
Transfer Characteristics



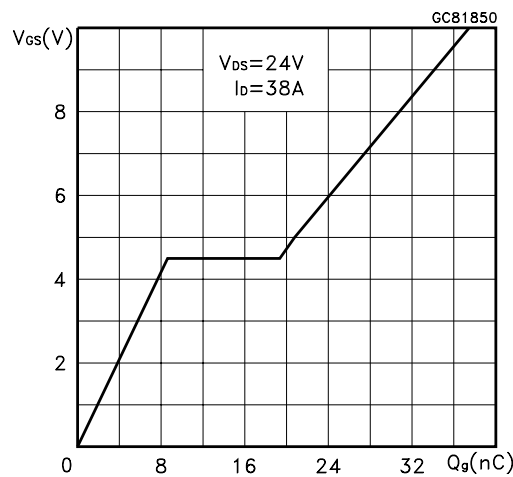
Transconductance



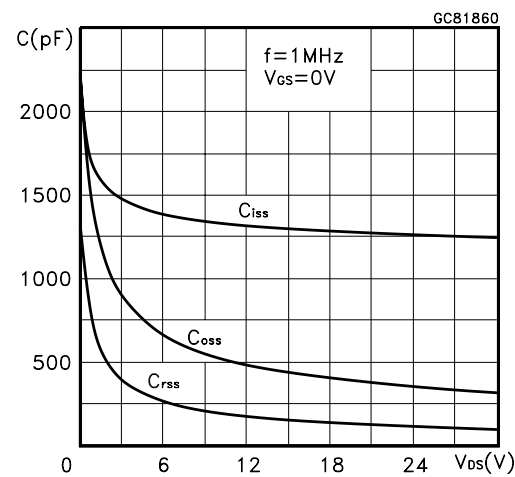
Static Drain-source On Resistance



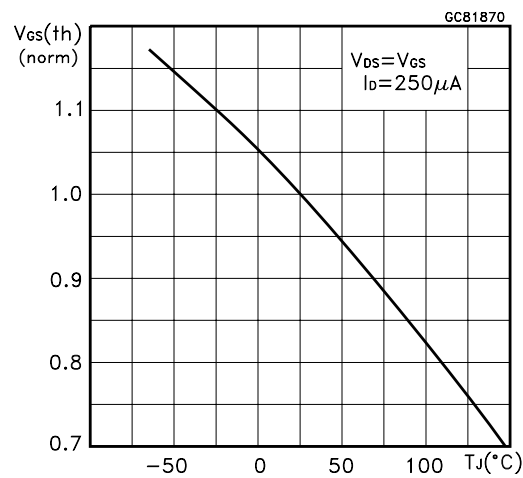
Gate Charge vs Gate-source Voltage



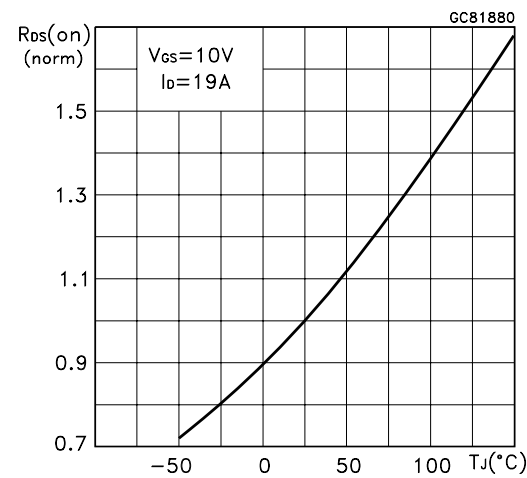
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

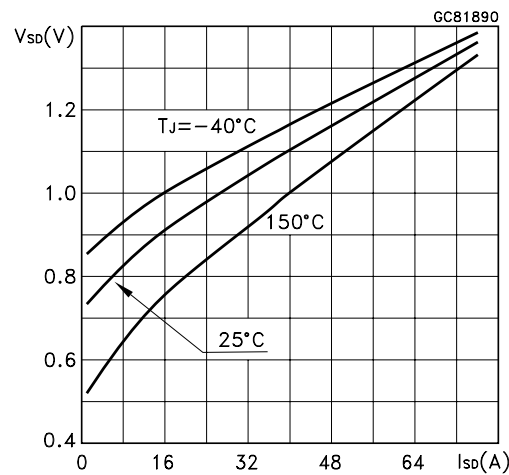


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform



Fig. 3: Switching Times Test Circuits For Resistive Load



Fig. 4: Gate Charge test Circuit

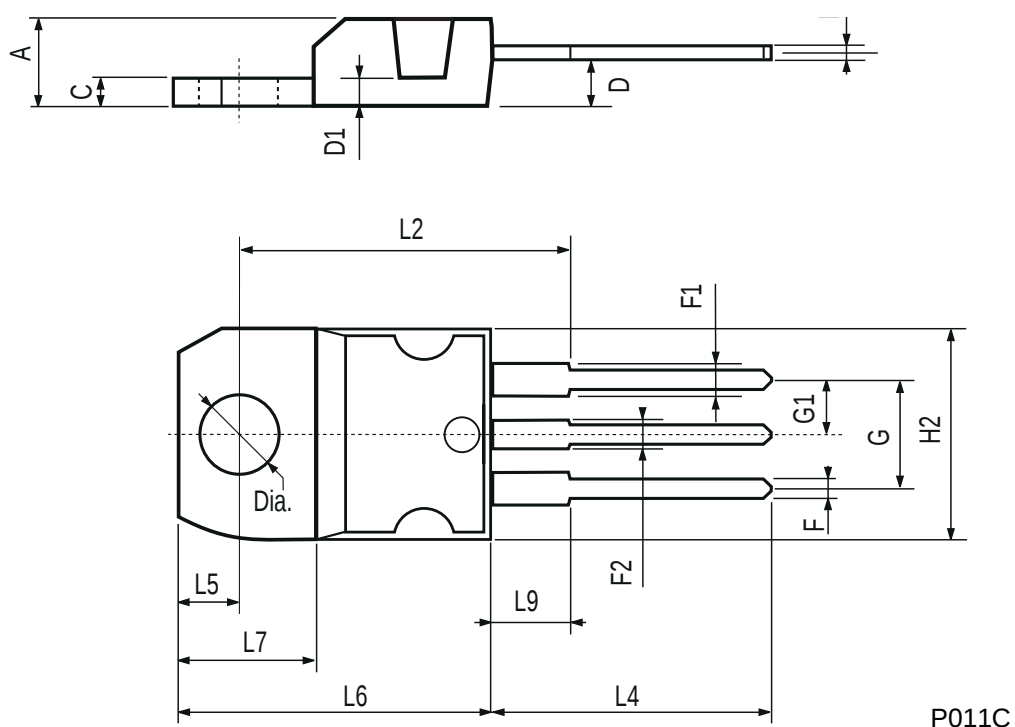


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



## TO-220 MECHANICAL DATA

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |      | 4.60  | 0.173 |       | 0.181 |
| C    | 1.23  |      | 1.32  | 0.048 |       | 0.051 |
| D    | 2.40  |      | 2.72  | 0.094 |       | 0.107 |
| D1   |       | 1.27 |       |       | 0.050 |       |
| E    | 0.49  |      | 0.70  | 0.019 |       | 0.027 |
| F    | 0.61  |      | 0.88  | 0.024 |       | 0.034 |
| F1   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| F2   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| G    | 4.95  |      | 5.15  | 0.194 |       | 0.203 |
| G1   | 2.4   |      | 2.7   | 0.094 |       | 0.106 |
| H2   | 10.0  |      | 10.40 | 0.393 |       | 0.409 |
| L2   |       | 16.4 |       |       | 0.645 |       |
| L4   | 13.0  |      | 14.0  | 0.511 |       | 0.551 |
| L5   | 2.65  |      | 2.95  | 0.104 |       | 0.116 |
| L6   | 15.25 |      | 15.75 | 0.600 |       | 0.620 |
| L7   | 6.2   |      | 6.6   | 0.244 |       | 0.260 |
| L9   | 3.5   |      | 3.93  | 0.137 |       | 0.154 |
| DIA. | 3.75  |      | 3.85  | 0.147 |       | 0.151 |



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