

## 200V, 70A N-CHANNEL POWER MOSFET

### GENERAL DESCRIPTION

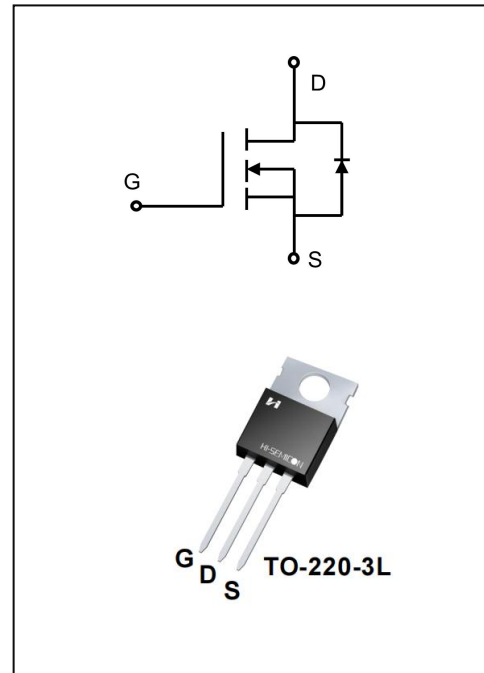
The SGP20HR24T uses advanced SGT technology and design to provide excellent  $R_{DS(on)}$  with low gate charge. It can be used in a wide variety applications.

### Features

- ◆  $V_{DS}=200V$ ,  $I_D=70A$
- ◆  $R_{DS(on)}$   
TYP:  $19.5m\Omega$  @  $V_{GS}=10V$

### Applications

- ◆ Motor control and drive
- ◆ Battery management System
- ◆ UPS (Uninterruptible Power Supplies)



### ORDERING INFORMATION

| Part No.   | Package   | Marking    | Material | Packing |
|------------|-----------|------------|----------|---------|
| SGP20HR24T | TO-220-3L | SGP20HR24T | Pb Free  | Tube    |

**ABSOLUTE MAXIMUM RATINGS** (T<sub>J</sub>=25°C unless otherwise noted)

| Characteristics                                                               | Symbol           | Ratings                | Unit |
|-------------------------------------------------------------------------------|------------------|------------------------|------|
| Drain-Source Voltage                                                          | V <sub>DS</sub>  | 200                    | V    |
| Gate-Source Voltage                                                           | V <sub>GS</sub>  | ±20                    | V    |
| Drain Current                                                                 | I <sub>D</sub>   | T <sub>C</sub> = 25°C  | A    |
|                                                                               |                  | T <sub>C</sub> = 100°C |      |
| Drain Current Pulsed(Note 1)                                                  | I <sub>DM</sub>  | 280                    | A    |
| Power Dissipation(T <sub>C</sub> =25°C)                                       | P <sub>D</sub>   | 208                    | W    |
| Single Pulsed Avalanche Energy (Note 2)                                       | E <sub>AS</sub>  | 420                    | mJ   |
| Operation Junction Temperature Range                                          | T <sub>J</sub>   | -55~+150               | °C   |
| Storage Temperature Range                                                     | T <sub>stg</sub> | -55~+150               | °C   |
| Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | TL               | 260                    | °C   |

**THERMAL CHARACTERISTICS**

| Characteristics                         | Symbol           | MAX  | Unit |
|-----------------------------------------|------------------|------|------|
| Thermal Resistance, Junction-to-Case    | R <sub>θJC</sub> | 0.6  | °C/W |
| Thermal Resistance, Junction-to-Ambient | R <sub>θJA</sub> | 62.5 | °C/W |

**ELECTRICAL CHARACTERISTICS**

| Characteristics                          | Symbol              | Test conditions                                                                                        | Min. | Typ. | Max  | Unit |
|------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------|------|------|------|------|
| Off Characteristics                      |                     |                                                                                                        |      |      |      |      |
| Drain -Source Breakdown Voltage          | B <sub>VDSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                                             | 200  | --   | --   | V    |
| Drain-Source Leakage Current             | I <sub>DSS</sub>    | V <sub>DS</sub> =200V, V <sub>GS</sub> =0V                                                             | --   | --   | 1.0  | uA   |
| Gate-Source Leakage Current              | I <sub>GSS</sub>    | V <sub>GS</sub> =20V, V <sub>DS</sub> =0V                                                              | --   | --   | 100  | nA   |
| Gate-Source Leakage Current              | I <sub>GSS</sub>    | V <sub>GS</sub> =-20V, V <sub>DS</sub> =0V                                                             | --   | --   | -100 |      |
| On Characteristics                       |                     |                                                                                                        |      |      |      |      |
| Gate Threshold Voltage                   | V <sub>GS(th)</sub> | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> =250μA                                              | 3.0  | 3.9  | 5.0  | V    |
| Static Drain- Source On State Resistance | R <sub>DS(on)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =45A                                                              | --   | 19.5 | 24   | mΩ   |
| Dynamic Characteristics                  |                     |                                                                                                        |      |      |      |      |
| Gate Resistance                          | R <sub>g</sub>      | V <sub>GS</sub> =0V; f=1.0MHZ                                                                          | --   | 5.0  | --   | Ω    |
| Input Capacitance                        | C <sub>iss</sub>    | V <sub>DS</sub> =100V<br>V <sub>GS</sub> =0V<br>f=1.0MHZ                                               | --   | 2673 | --   | pF   |
| Output Capacitance                       | C <sub>oss</sub>    |                                                                                                        | --   | 232  | --   |      |
| Reverse Transfer Capacitance             | C <sub>rss</sub>    |                                                                                                        | --   | 9.7  | --   |      |
| Switching Characteristics                |                     |                                                                                                        |      |      |      |      |
| Turn-on Delay Time                       | t <sub>d(on)</sub>  | V <sub>DD</sub> =100V, V <sub>DS</sub> =10V<br>R <sub>G</sub> =2.5Ω, I <sub>D</sub> =45A<br>(Note 3.4) | --   | 21.5 | --   | ns   |
| Turn-on Rise Time                        | t <sub>r</sub>      |                                                                                                        | --   | 81.2 | --   |      |
| Turn-off Delay Time                      | t <sub>d(off)</sub> |                                                                                                        | --   | 32.6 | --   |      |
| Turn-off Fall Time                       | t <sub>f</sub>      |                                                                                                        | --   | 10.1 | --   |      |

|                    |          |                                                      |    |      |    |    |
|--------------------|----------|------------------------------------------------------|----|------|----|----|
| Total Gate Charge  | $Q_g$    | $V_{DS}=100V, I_D=45A$<br>$V_{GS}=10V$<br>(Note 3.4) | -- | 35.5 | -- | nC |
| Gate-Source Charge | $Q_{gs}$ |                                                      | -- | 20.7 | -- |    |
| Gate-Drain Charge  | $Q_{gd}$ |                                                      | -- | 4.3  | -- |    |

## SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

| Characteristics           | Symbol   | Test conditions                                   | Min. | Typ. | Max. | Unit |
|---------------------------|----------|---------------------------------------------------|------|------|------|------|
| Continuous Source Current | $I_S$    | Integral Reverse P-N Junction Diode in the MOSFET | --   | --   | 70   | A    |
| Pulsed Source Current     | $I_{SM}$ |                                                   | --   | --   | 280  |      |
| Diode Forward Voltage     | $V_{SD}$ | $I_S=45A, V_{GS}=0V$                              | --   | --   | 1.4  | V    |
| Reverse Recovery Time     | $T_{rr}$ | $I_F=45A, V_R=10V, dI_F/dt=100A/\mu S$            | --   | 128  | --   | ns   |
| Reverse Recovery Charge   | $Q_{rr}$ |                                                   | --   | 603  | --   | nC   |

1. Pulse width limited by maximum junction temperature
2.  $L=0.5mH, V_{DD}=100V, V_{GS}=10V, R_G=25\Omega$ , starting  $T_J=25^\circ$
3. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$
4. Essentially independent of operating temperature

## Typical Performance Characteristics

Figure 1. Output Characteristics

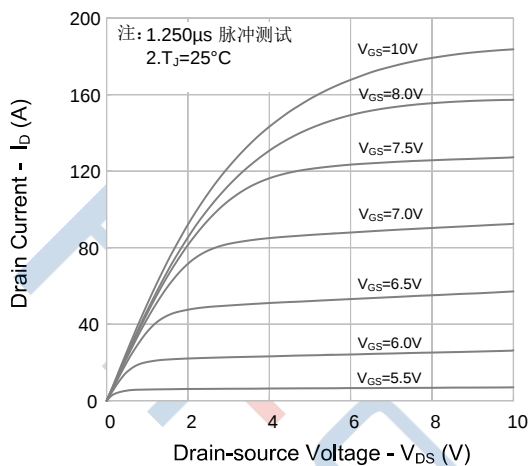


Figure 2. Transfer Characteristics

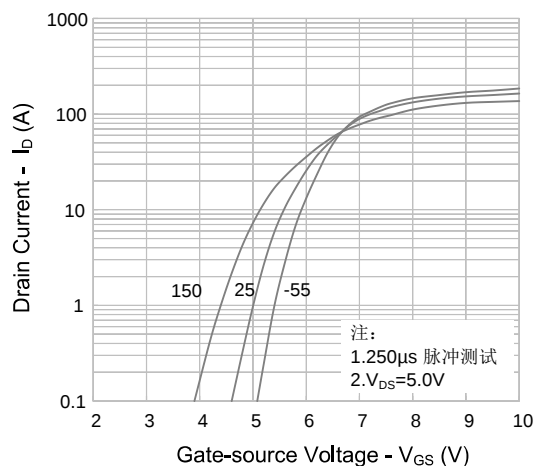


Figure 3. On-resistance vs. Drain Current

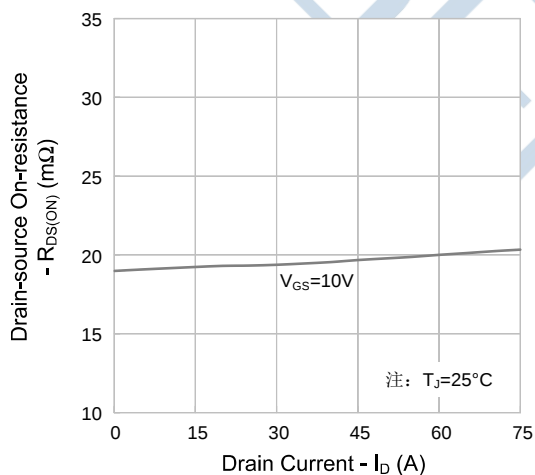


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

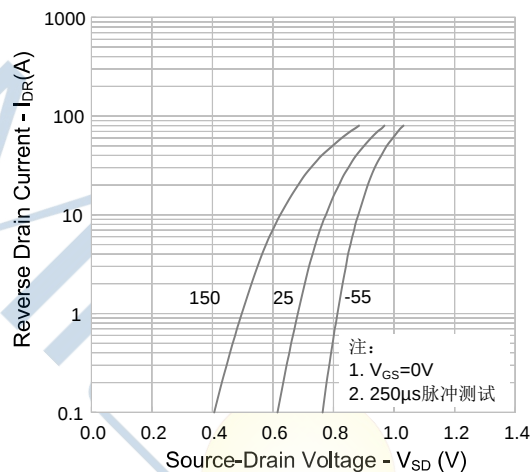


Figure 5. Capacitance Characteristics

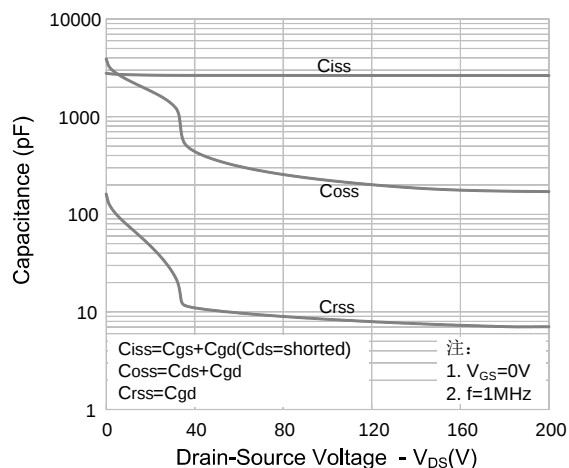
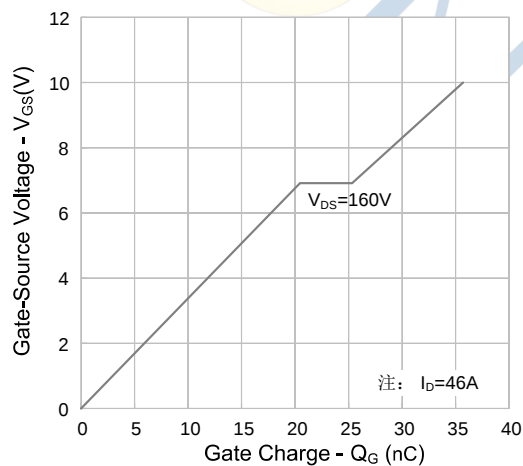


Figure 6. Gate Charge Characteristics



## Typical Performance Characteristics

Figure 7. Breakdown Voltage vs. Temperature Characteristics

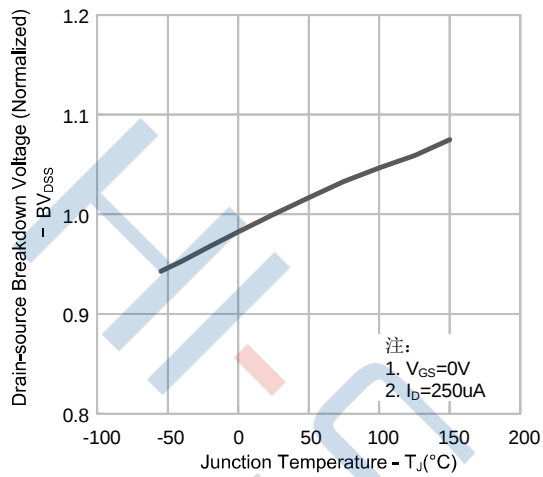


Figure 8. On-resistance vs. Temperature Characteristics

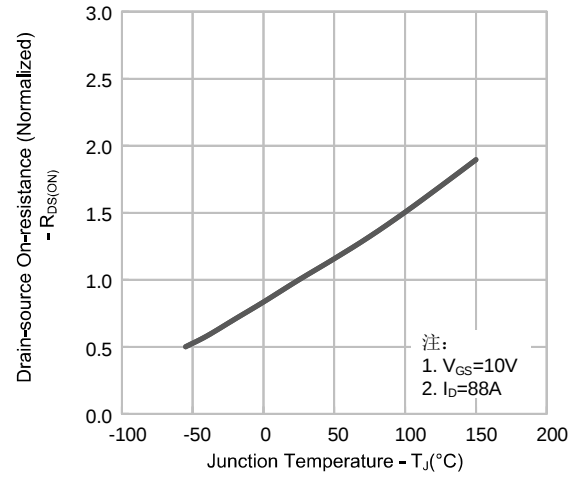
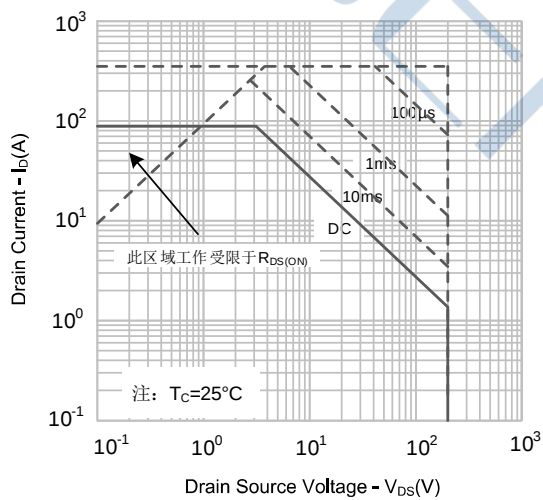
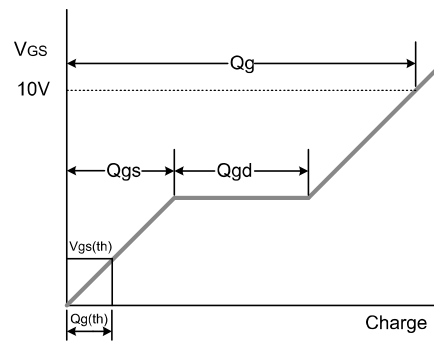
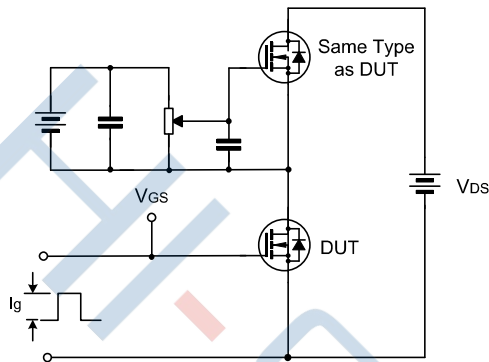


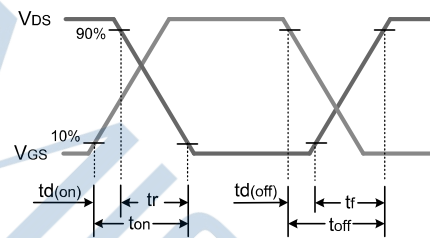
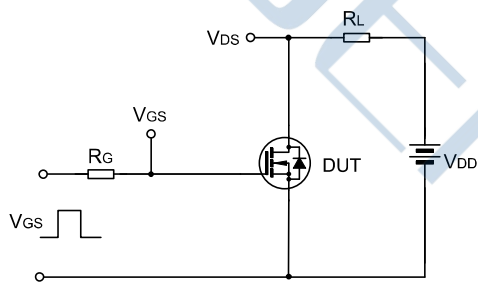
Figure 9. Max. Safe Operating Area



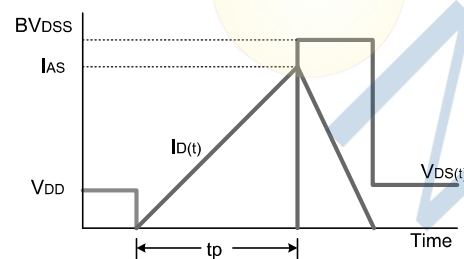
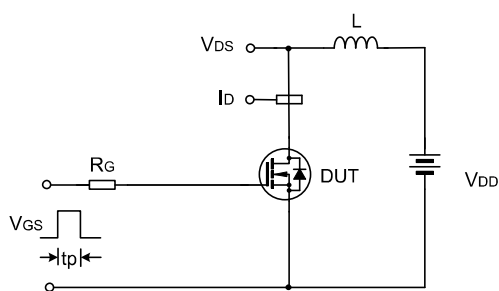
## Test Circuit



Gate Charge Test Circuit & Waveform

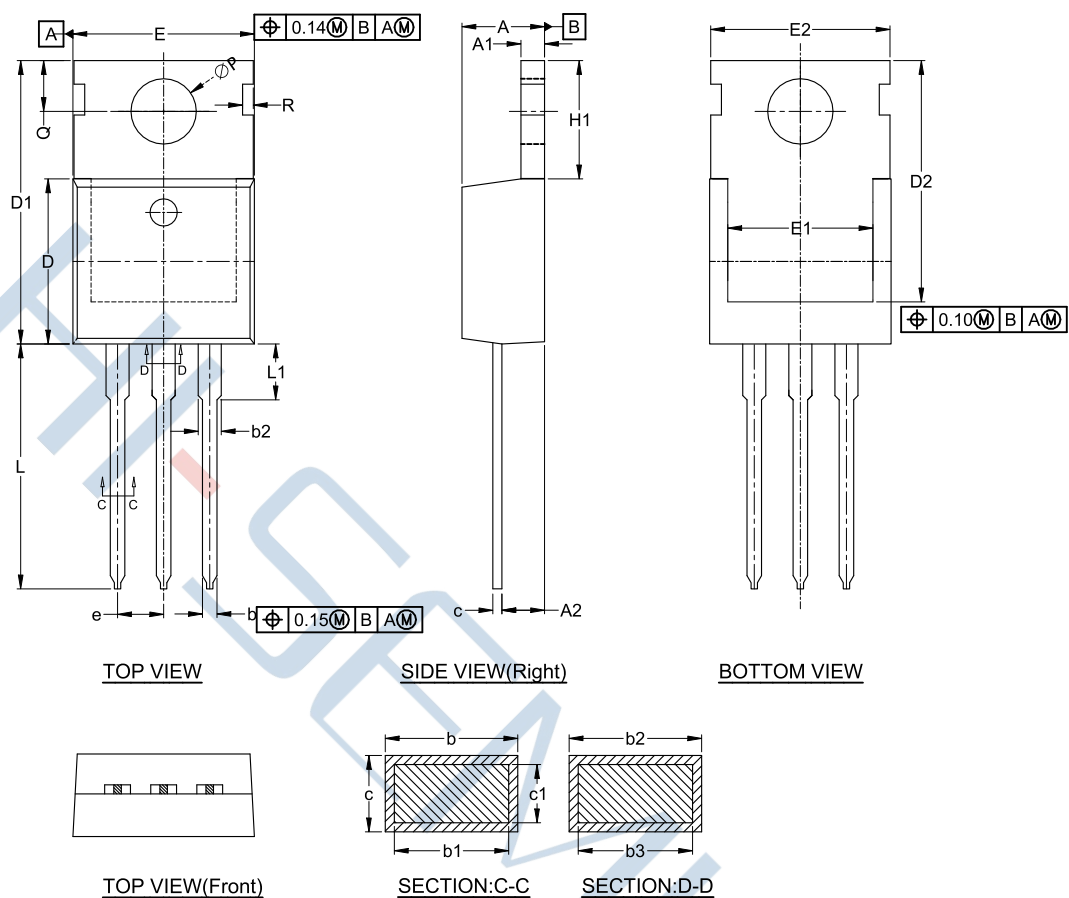


Resistive Switching Test Circuit & Waveform



Unclamped Inductive Switching Test Circuit & Waveform

# Package Dimensions of TO-220-3L



| DIM<br>SYMBOL | MIN.       | NOM.   | MAX.   |
|---------------|------------|--------|--------|
| A             | 4.450      | 4.550  | 4.650  |
| A1            | 1.240      | 1.340  | 1.440  |
| A2            | 2.250      | 2.350  | 2.450  |
| b             | 0.740      | 0.840  | 0.940  |
| b1            | 0.700      | 0.800  | 0.900  |
| b2            | 1.210      | 1.310  | 1.410  |
| b3            | 1.170      | 1.270  | 1.370  |
| c             | 0.440      | 0.540  | 0.640  |
| c1            | 0.400      | 0.500  | 0.600  |
| D             | 9.000      | 9.100  | 9.200  |
| D1            | 15.420     | 15.620 | 15.820 |
| D2            | 13.100     | 13.300 | 13.500 |
| E             | 9.900      | 10.000 | 10.100 |
| E1            | 7.800      | 8.000  | 8.200  |
| E2            | 9.680      | 9.880  | 10.080 |
| e             | 2.540 BSC. |        |        |
| H1            | 6.420      | 6.520  | 6.620  |
| L             | 13.300     | 13.500 | 13.700 |
| L1            | 2.880      | 3.080  | 3.280  |
| $\phi P$      | 3.500      | 3.600  | 3.700  |
| Q             | 2.600      | 2.800  | 3.000  |
| R             | 0.590 REF. |        |        |

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