



# SPN200N04

## N-Channel Enhancement Mode MOSFET

### DESCRIPTION

The SPN200N04 is the N-Channel enhancement mode power field effect transistors are produced using high cell density, DMOS trench technology. The SPN200N04 has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low  $R_{DS(ON)}$  and fast switching speed.

### FEATURES

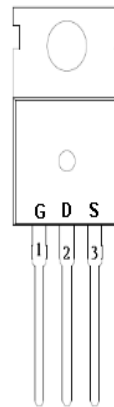
- ◆ 40V/200A,  $R_{DS(ON)}=1.6m\Omega@V_{GS}=10V$  for PPAK5x6-8L
- ◆ 40V/200A,  $R_{DS(ON)}=2.3m\Omega@V_{GS}=10V$  for TO-220
- ◆ Super high density cell design for extremely low  $R_{DS(ON)}$
- ◆ Exceptional on-resistance and maximum DC current capability
- ◆ TO-220 and PPAK5x6-8L package design

### APPLICATIONS

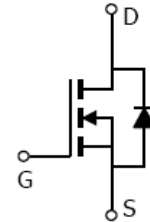
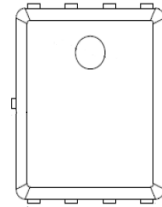
- High Frequency Synchronous Buck Converter
- DC/DC Power System
- Load Switch

### PIN CONFIGURATION

TO-220



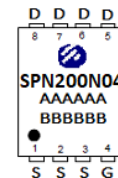
PPAK5x6-8L



### PART MARKING



A : Lot Code  
B : Date Code



A : Lot Code  
B : Date Code  
(YY/MM/DD)



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### PIN DESCRIPTION

#### TO-220

| Pin | Symbol | Description |
|-----|--------|-------------|
| 1   | G      | Gate        |
| 2   | D      | Drain       |
| 3   | S      | Source      |

#### PPAK5x6-8L

| Pin | Symbol | Description |
|-----|--------|-------------|
| 1   | S      | Source      |
| 2   | S      | Source      |
| 3   | S      | Source      |
| 4   | G      | Gate        |
| 5   | D      | Drain       |
| 6   | D      | Drain       |
| 7   | D      | Drain       |
| 8   | D      | Drain       |

### ORDERING INFORMATION

| Part Number      | Package    | Part Marking |
|------------------|------------|--------------|
| SPN200N04T220TGB | TO-220     | SPN200N04    |
| SPN200N04DN8RGB  | PPAK5x6-8L | SPN200N04    |

※ SPN200N04T220TGB : Tube ; Pb – Free ; Halogen - Free

※ SPN200N04DN8RGB : Tape Reel ; Pb – Free ; Halogen - Free



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### ABSOLUTE MAXIMUM RATINGS

( $T_A=25^{\circ}\text{C}$  Unless otherwise noted)

| Parameter                                   | Symbol          | Typical                   | Unit               |                             |
|---|-----------------|---------------------------|--------------------|-----------------------------|
| Drain-Source Voltage                        | $V_{DSS}$       | 40                        | V                  |                             |
| Gate -Source Voltage                        | $V_{GSS}$       | $\pm 20$                  | V                  |                             |
| Continuous Drain Current (Silicon Limited)  | $I_D$           | $T_C=25^{\circ}\text{C}$  | 200                | A                           |
|   |                 | $T_C=100^{\circ}\text{C}$ | 120                |                             |
| Pulsed Drain Current                        | $I_{DM}$        | 400                       | A                  |                             |
| Avalanche Current                           | $I_{AS}$        | 116                       | A                  |                             |
| Single Pulse Avalanche Energy               | $E_{AS}$        | 673                       | mJ                 |                             |
| Power Dissipation@ $T_C=25^{\circ}\text{C}$ | $P_D$           | TO-220                    | 104                | W                           |
|   |                 | PPAK5x6-8L                | 83                 |                             |
| Operating Junction Temperature              | $T_J$           | -55~150                   | $^{\circ}\text{C}$ |                             |
| Storage Temperature Range                   | $T_{STG}$       | -55~150                   | $^{\circ}\text{C}$ |                             |
| Thermal Resistance-Junction to Case         | $R_{\theta JC}$ | TO-220                    | 1.2                | $^{\circ}\text{C}/\text{W}$ |
|   |                 | PPAK5x6-8L                | 1.5                |                             |
| Thermal Resistance-Junction to Ambient      | $R_{\theta JA}$ | TO-220                    | 62                 | $^{\circ}\text{C}/\text{W}$ |
|   |                 | PPAK5x6-8L                | 55                 |                             |



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### ELECTRICAL CHARACTERISTICS

(TA=25°C Unless otherwise noted)

| Parameter                              | Symbol        | Conditions   | Min. | Typ  | Max.      | Unit |
|--|---------------|--|------|------|-----------|------|
| <b>Static</b>                          |               |  |      |      |           |      |
| Drain-Source Breakdown Voltage         | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=250\mu A$                                  | 40   |      |           | V    |
| Gate Threshold Voltage                 | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=250\mu A$                              | 2.0  | 2.8  | 4.0       | V    |
| Gate Leakage Current                   | $I_{GSS}$     | $V_{DS}=0V, V_{GS}=\pm 20V$                                |      |      | $\pm 100$ | nA   |
| Zero Gate Voltage Drain Current        | $I_{DSS}$     | $V_{DS}=32V, V_{GS}=0V$                                    |      |      | 1         | uA   |
|  |               | $V_{DS}=32V, V_{GS}=0V, T_J=55^\circ C$                    |      |      | 5         |      |
| On-State Drain Current                 | $I_{D(on)}$   | $V_{DS}\geq 5V, V_{GS}=10V$                                |      |      | 100       | A    |
| Drain-Source On-Resistance, TO220      | $R_{DS(on)}$  | $V_{GS}=10V, I_D=20A$                                      |      | 2.1  | 2.3       | mΩ   |
| Drain-Source On-Resistance, PPAK5x6-8L |               |  |      | 1.4  | 1.6       |      |
| Gate Resistance                        | $R_g$         | $V_{DS}=V_{GS}=0V, f=1MHz$                                 |      | 1.2  |           | Ω    |
| Diode Forward Voltage                  | $V_{SD}$      | $I_S=1A, V_{GS}=0V$  |      |      | 1.2       | V    |
| <b>Dynamic</b>                         |               |  |      |      |           |      |
| Total Gate Charge                      | $Q_g$         | $V_{DS}=20V, V_{GS}=10V$<br>$I_D=20A$                      |      | 108  |           | nC   |
| Gate-Source Charge                     | $Q_{gs}$      |  |      | 25.4 |           |      |
| Gate-Drain Charge                      | $Q_{gd}$      |  |      | 26.8 |           |      |
| Input Capacitance                      | $C_{iss}$     | $V_{DS}=20V, V_{GS}=0V$<br>$f=1MHz$                        |      | 6601 |           | pF   |
| Output Capacitance                     | $C_{oss}$     |  |      | 2073 |           |      |
| Reverse Transfer Capacitance           | $C_{rss}$     |  |      | 248  |           |      |
| Turn-On Time                           | $t_{d(on)}$   | $V_{DD}=20V,$<br>$I_D=20A, V_{GEN}=10V$<br>$R_G=1.5\Omega$ |      | 20   |           | nS   |
|  | $t_r$         |  |      | 145  |           |      |
| Turn-Off Time                          | $t_{d(off)}$  |  |      | 55   |           |      |
|  | $t_f$         |  |      | 18   |           |      |



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## TYPICAL CHARACTERISTICS

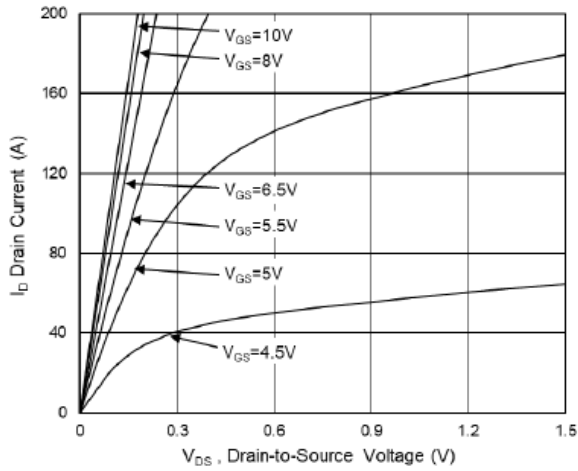


Fig.1 Typical Output Characteristics

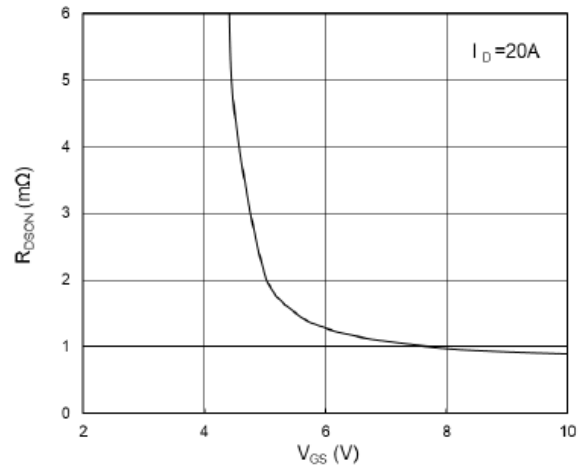


Fig.2 On-Resistance vs G-S Voltage

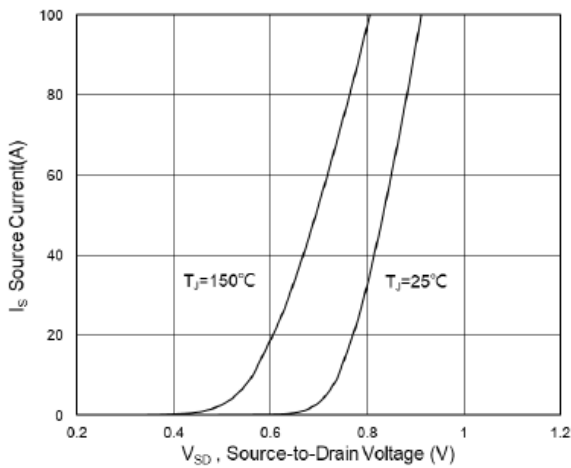


Fig.3 Source Drain Forward Characteristics

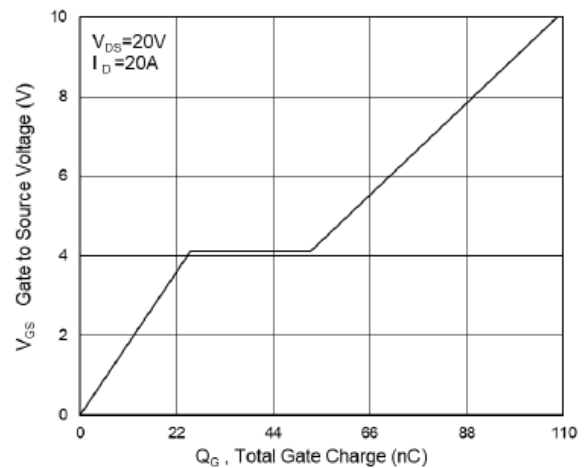


Fig.4 Gate-Charge Characteristics

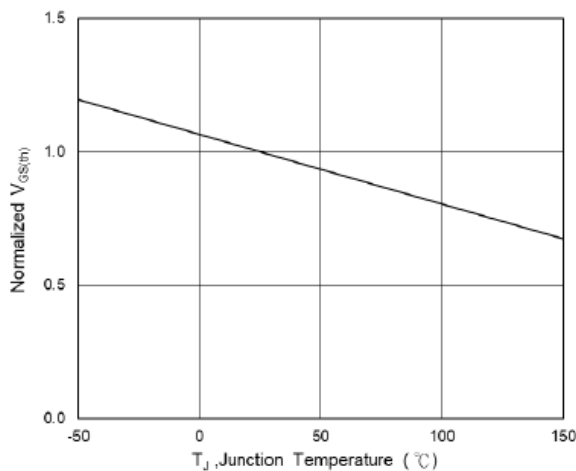


Fig.5 Normalized  $V_{GS(th)}$  vs  $T_J$

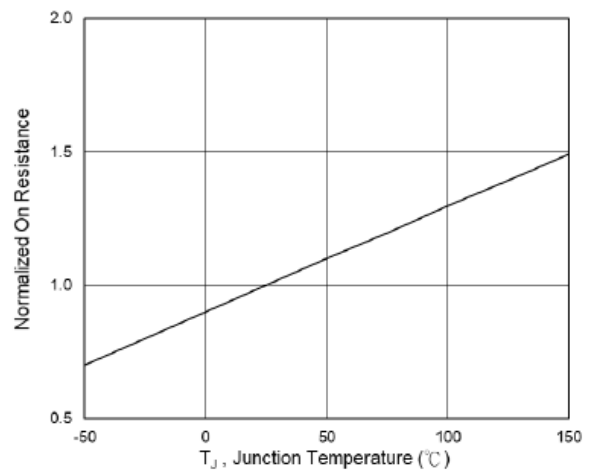


Fig.6 Normalized  $R_{DS(on)}$  vs  $T_J$



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## TYPICAL CHARACTERISTICS

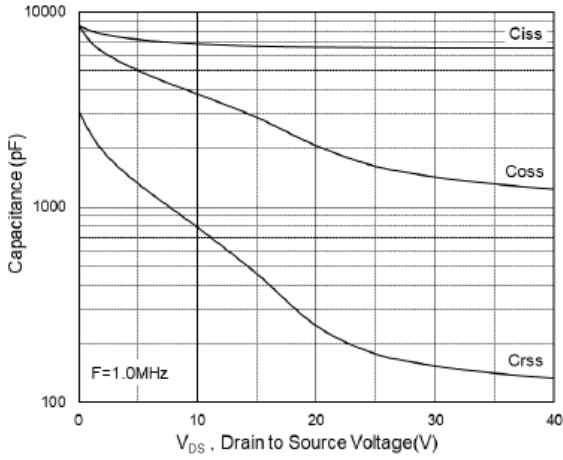


Fig.7 Capacitance

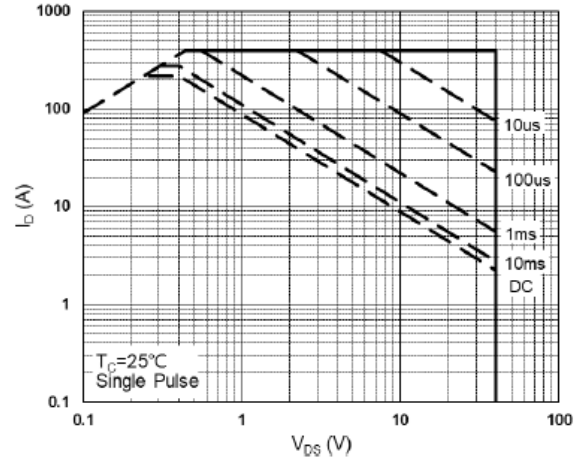


Fig.8 Safe Operating Area

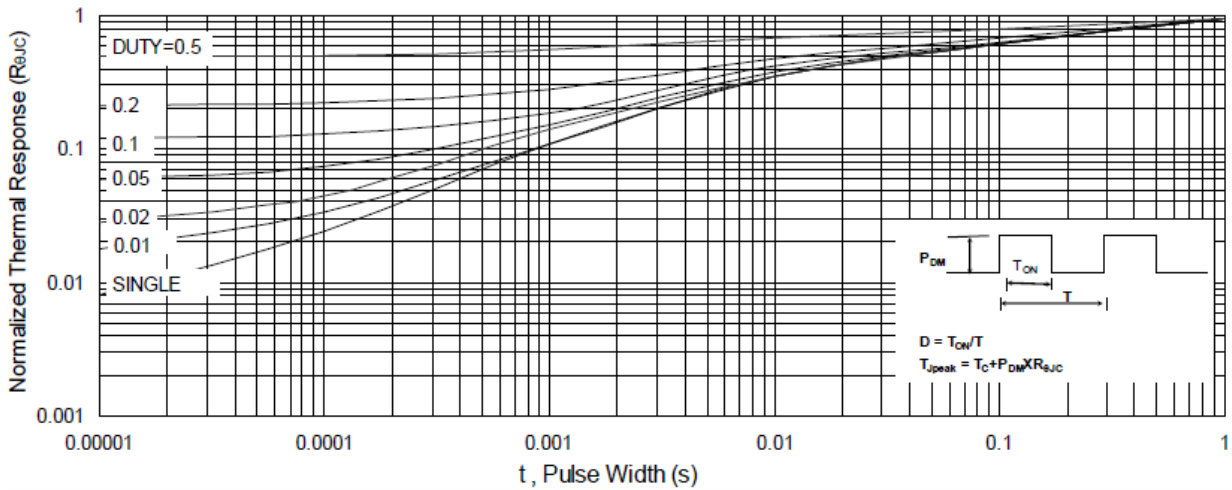


Fig.9 Normalized Maximum Transient Thermal Impedance

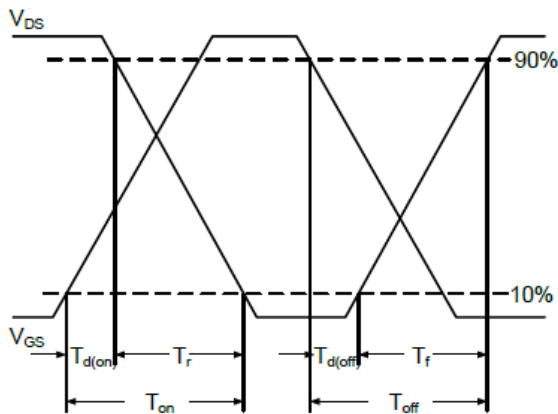


Fig.10 Switching Time Waveform

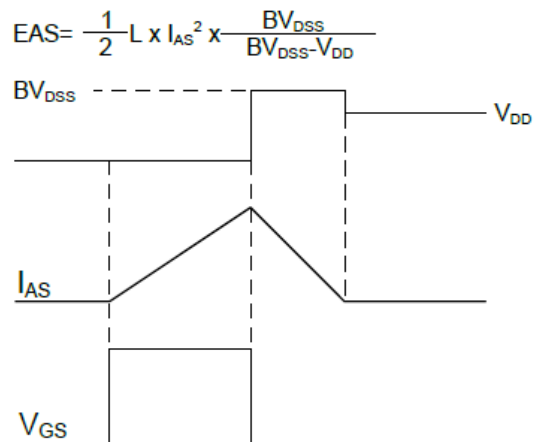


Fig.11 Unclamped Inductive Switching Waveform



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