

**05NM60**

Preliminary

**Power MOSFET****0.5A, 600V N-CHANNEL  
SUPER-JUNCTION MOSFET****DESCRIPTION**

The UTC **05NM60** is an Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

**FEATURES**

\*  $R_{DS(on)} \leq 8.8 \Omega$  @  $V_{GS}=10V$ ,  $I_D=0.25A$

\* High breakdown voltage

**ORDERING INFORMATION**

| Order Number  |               | Package | Pin Assignment |   |   | Packing   |
|---------------|---------------|---------|----------------|---|---|-----------|
| Lead Free     | Halogen Free  |         | 1              | 2 | 3 |           |
| 05NM60L-AA3-R | 05NM60G-AA3-R | SOT-223 | G              | D | S | Tape Reel |
| 05NM60L-AB3-R | 05NM60G-AB3-R | SOT-89  | G              | D | S | Tape Reel |
| 05NM60L-AE3-R | 05NM60G-AE3-R | SOT-23  | G              | S | D | Tape Reel |
| 05NM60L-T92-B | 05NM60G-T92-B | TO-92   | G              | D | S | Tape Box  |
| 05NM60L-T92-K | 05NM60G-T92-K | TO-92   | G              | D | S | Bulk      |

Note: Pin Assignment: G: Gate D: Drain S: Source

|                                                                                         |                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>05NM60G-AA3-R</p> <p>(1) Packing Type<br/>(2) Package Type<br/>(3) Green Package</p> | <p>(1) R: Tape Reel, B: Tape Box, K: Bulk<br/>(2) AA3: SOT-223, AB3: SOT-89, AE3: SOT-23<br/>T92: TO-92<br/>(3) G: Halogen Free and Lead Free, L: Lead Free</p> |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|

**MARKING**

|                                                                      |                                                                     |
|----------------------------------------------------------------------|---------------------------------------------------------------------|
| <p>SOT-223</p> <p>L: Lead Free<br/>G: Halogen Free<br/>Date Code</p> | <p>SOT-89</p> <p>Date Code<br/>L: Lead Free<br/>G: Halogen Free</p> |
| <p>SOT-23</p>                                                        | <p>TO-92</p> <p>L: Lead Free<br/>G: Halogen Free<br/>Date Code</p>  |

■ **ABSOLUTE MAXIMUM RATINGS** ( $T_C=25^{\circ}\text{C}$ , unless otherwise specified)

| PARAMETER                 |                 | SYMBOL           | RATINGS    | UNIT               |
|---------------------------|-----------------|------------------|------------|--------------------|
| Drain-Source Voltage      |                 | $V_{\text{DSS}}$ | 600        | V                  |
| Gate-Source Voltage       |                 | $V_{\text{GSS}}$ | $\pm 30$   | V                  |
| Drain Current             | Continuous      | $I_{\text{D}}$   | 0.5        | A                  |
|                           | Pulsed (Note 2) | $I_{\text{DM}}$  | 2.0        | A                  |
| Power Dissipation         | SOT-223         | $P_{\text{D}}$   | 3.5        | W                  |
|                           | SOT-89          |                  | 1.8        | W                  |
|                           | SOT-23          |                  | 1.4        | W                  |
|                           | TO-92           |                  | 2.8        | W                  |
| Junction Temperature      |                 | $T_{\text{J}}$   | +150       | $^{\circ}\text{C}$ |
| Storage Temperature Range |                 | $T_{\text{STG}}$ | -55 ~ +150 | $^{\circ}\text{C}$ |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating: Pulse width limited by maximum junction temperature.

■ **THERMAL DATA**

| PARAMETER           |         | SYMBOL               | RATINGS | UNIT                 |
|---------------------|---------|----------------------|---------|----------------------|
| Junction to Ambient | SOT-223 | $\theta_{\text{JA}}$ | 150     | $^{\circ}\text{C/W}$ |
|                     | SOT-89  |                      | 180     |                      |
|                     | SOT-23  |                      | 325     |                      |
|                     | TO-92   |                      | 160     |                      |
| Junction to Case    | SOT-223 | $\theta_{\text{JC}}$ | 35.7    | $^{\circ}\text{C/W}$ |
|                     | SOT-89  |                      | 69      |                      |
|                     | SOT-23  |                      | 89      |                      |
|                     | TO-92   |                      | 44.6    |                      |

Note: Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

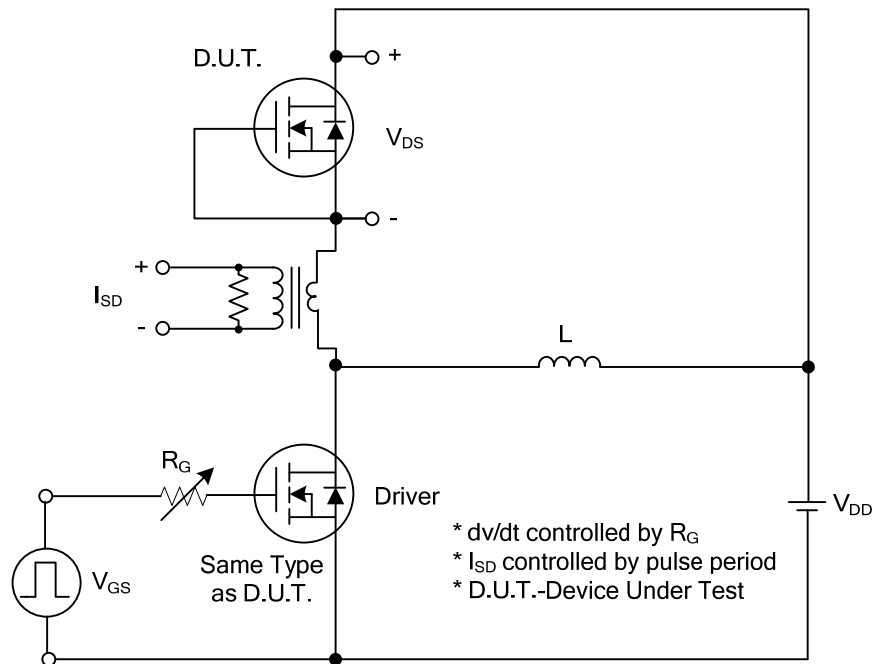
■ **ELECTRICAL CHARACTERISTICS** ( $T_J=25^{\circ}\text{C}$ , unless otherwise specified)

| PARAMETER                                       |         | SYMBOL              | TEST CONDITIONS                                                                                    | MIN | TYP | MAX  | UNIT |
|-------------------------------------------------|---------|---------------------|----------------------------------------------------------------------------------------------------|-----|-----|------|------|
| OFF CHARACTERISTICS                             |         |                     |                                                                                                    |     |     |      |      |
| Drain-Source Breakdown Voltage                  |         | BV <sub>DSS</sub>   | I <sub>D</sub> =250μA, V <sub>GS</sub> =0V                                                         | 600 |     |      | V    |
| Drain-Source Leakage Current                    |         | I <sub>DSS</sub>    | V <sub>DS</sub> =600V, V <sub>GS</sub> =0V                                                         |     |     | 10   | μA   |
| Gate-Source Leakage Current                     | Forward | I <sub>GSS</sub>    | V <sub>GS</sub> =+30V, V <sub>DS</sub> =0V                                                         |     |     | +100 | nA   |
|                                                 | Reverse |                     | V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V                                                         |     |     | -100 | nA   |
| ON CHARACTERISTICS                              |         |                     |                                                                                                    |     |     |      |      |
| Gate Threshold Voltage                          |         | V <sub>GS(TH)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                           | 2.5 |     | 4.5  | V    |
| Static Drain-Source On-State Resistance         |         | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =0.25A                                                        |     |     | 8.8  | Ω    |
| DYNAMIC PARAMETERS                              |         |                     |                                                                                                    |     |     |      |      |
| Input Capacitance                               |         | C <sub>ISS</sub>    | V <sub>GS</sub> =0V, V <sub>DS</sub> =50V, f=1.0MHz                                                |     | 36  |      | pF   |
| Output Capacitance                              |         | C <sub>OSS</sub>    |                                                                                                    |     | 17  |      | pF   |
| Reverse Transfer Capacitance                    |         | C <sub>RSS</sub>    |                                                                                                    |     | 3.7 |      | pF   |
| SWITCHING PARAMETERS                            |         |                     |                                                                                                    |     |     |      |      |
| Total Gate Charge (Note 1)                      |         | Q <sub>G</sub>      | V <sub>DS</sub> =480V, V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A, (Note 1, 2)                     |     | 10  |      | nC   |
| Gate to Source Charge                           |         | Q <sub>GS</sub>     |                                                                                                    |     | 5   |      | nC   |
| Gate to Drain Charge                            |         | Q <sub>GD</sub>     |                                                                                                    |     | 2   |      | nC   |
| Turn-ON Delay Time (Note 1)                     |         | t <sub>D(ON)</sub>  | V <sub>DS</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A, R <sub>G</sub> =25Ω (Note 1, 2) |     | 4   |      | ns   |
| Rise Time                                       |         | t <sub>R</sub>      |                                                                                                    |     | 18  |      | ns   |
| Turn-OFF Delay Time                             |         | t <sub>D(OFF)</sub> |                                                                                                    |     | 8   |      | ns   |
| Fall-Time                                       |         | t <sub>F</sub>      |                                                                                                    |     | 10  |      | ns   |
| SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS |         |                     |                                                                                                    |     |     |      |      |
| Maximum Body-Diode Continuous Current           |         | I <sub>S</sub>      |                                                                                                    |     |     | 0.5  | A    |
| Maximum Body-Diode Pulsed Current               |         | I <sub>SM</sub>     |                                                                                                    |     |     | 2.0  | A    |
| Drain-Source Diode Forward Voltage (Note 1)     |         | V <sub>SD</sub>     | I <sub>S</sub> =0.5A, V <sub>GS</sub> =0V                                                          |     |     | 1.4  | V    |
| Reverse Recovery Time (Note 1)                  |         | t <sub>rr</sub>     | I <sub>S</sub> =0.5A , V <sub>GS</sub> =0V                                                         |     | 120 |      | ns   |
| Reverse Recovery Charge                         |         | Q <sub>rr</sub>     | di/dt=100A/μs                                                                                      |     | 200 |      | nC   |

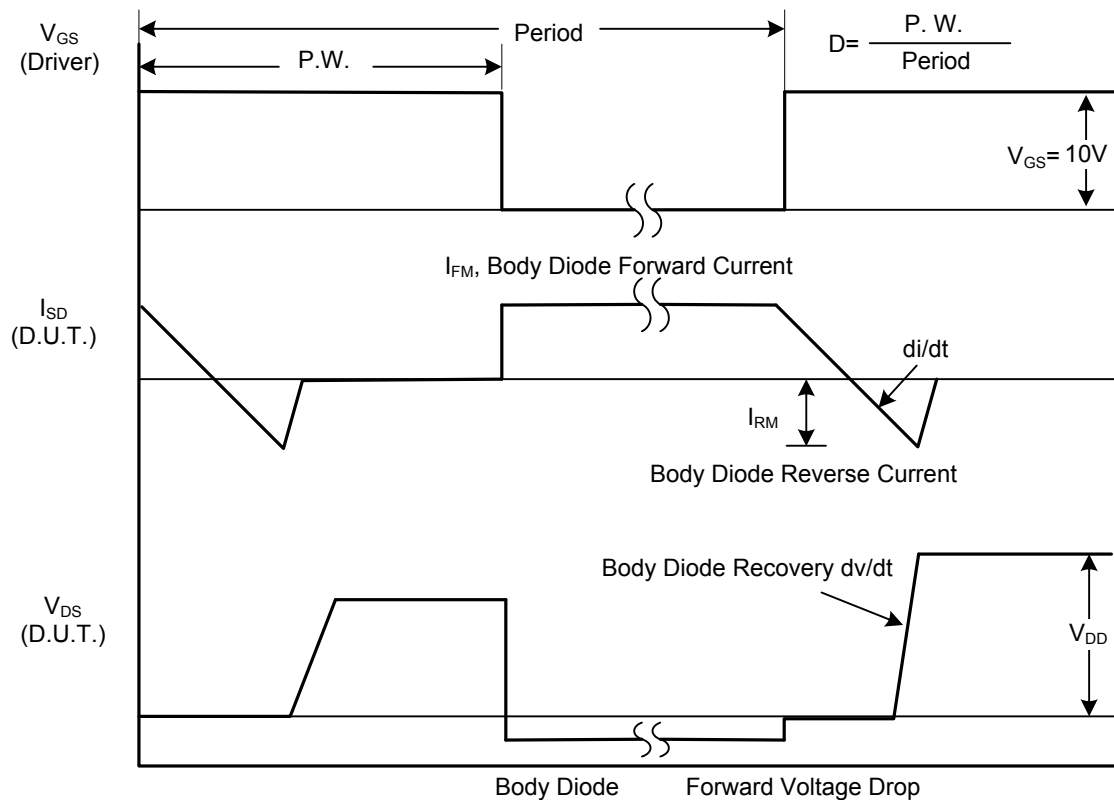
Notes: 1. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating temperature.

## ■ TEST CIRCUITS AND WAVEFORMS

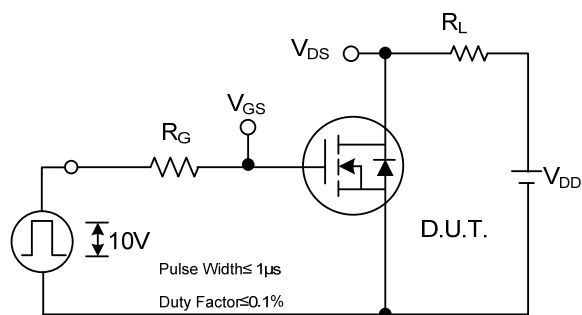


Peak Diode Recovery dv/dt Test Circuit

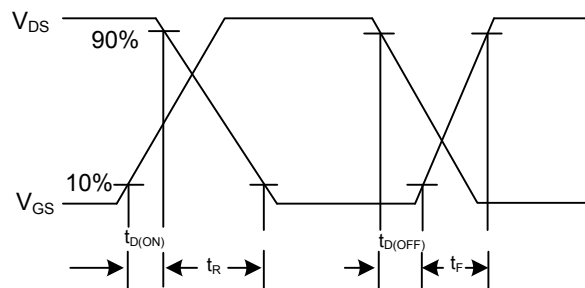


Peak Diode Recovery dv/dt Waveforms

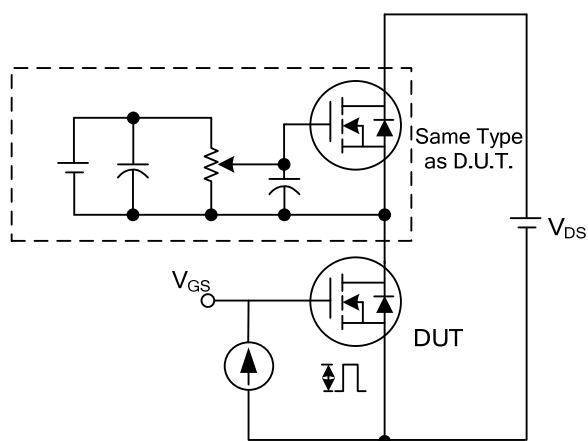
## ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



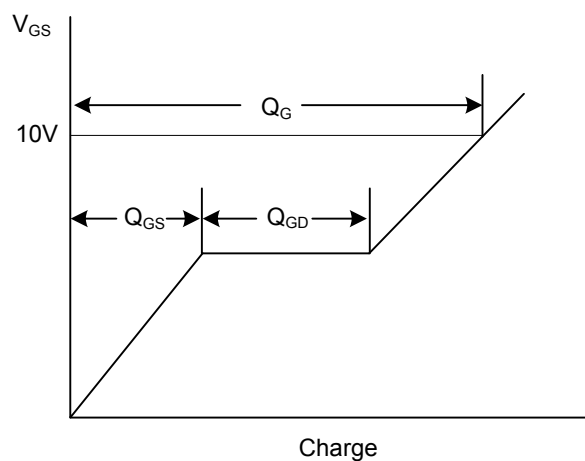
Switching Test Circuit



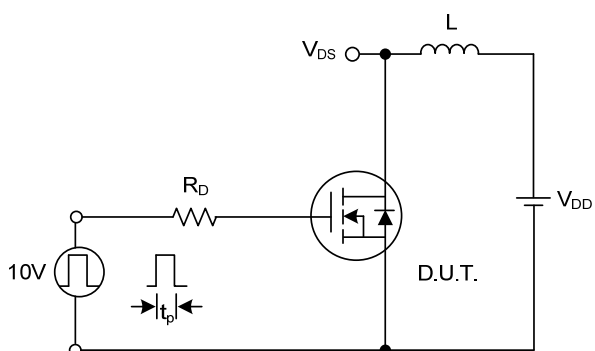
Switching Waveforms



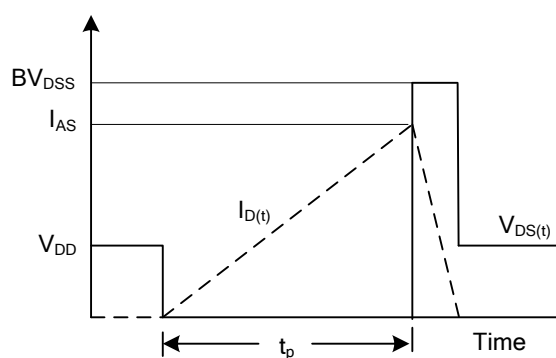
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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