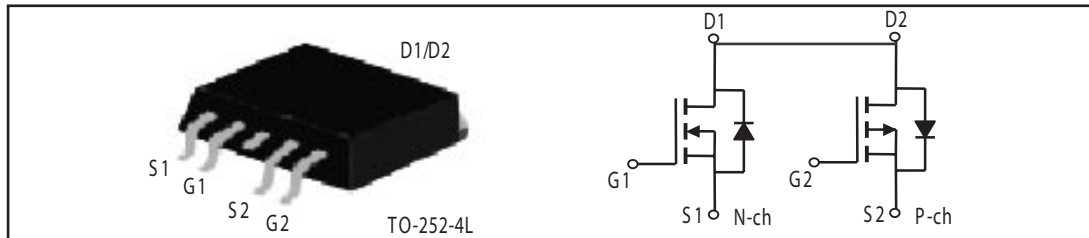




## Dual Enhancement Mode Field Effect Transistor ( N and P Channel)

| PRODUCT SUMMARY (N-Channel) |                |                                        |
|-----------------------------|----------------|----------------------------------------|
| V <sub>DSS</sub>            | I <sub>D</sub> | R <sub>DS(ON)</sub> ( m $\Omega$ ) Max |
| 40V                         | 11A            | 33 @ V <sub>GS</sub> = 10V             |
|                             |                | 45 @ V <sub>GS</sub> = 4.5V            |

| PRODUCT SUMMARY (P-Channel) |                |                                        |
|-----------------------------|----------------|----------------------------------------|
| V <sub>DSS</sub>            | I <sub>D</sub> | R <sub>DS(ON)</sub> ( m $\Omega$ ) Max |
| -40V                        | - 9A           | 45 @ V <sub>GS</sub> = -10V            |
|                             |                | 65 @ V <sub>GS</sub> = -4.5V           |



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

| Parameter                                        |                       | Symbol                            | N-Channel  | P-Channel | Unit |
|--------------------------------------------------|-----------------------|-----------------------------------|------------|-----------|------|
| Drain-Source Voltage                             |                       | V <sub>DS</sub>                   | 40         | -40       | V    |
| Gate-Source Voltage                              |                       | V <sub>GS</sub>                   | ±20        | ± 20      | V    |
| Drain Current-Continuous @ T <sub>c</sub>        | 25°C                  | I <sub>D</sub>                    | 11         | - 9       | A    |
|                                                  | 70°C                  |                                   | 9          | - 7       | A    |
| -Pulsed <sup>a</sup>                             |                       | I <sub>DM</sub>                   | 45         | -36       | A    |
| Drain-Source Diode Forward Current               |                       | I <sub>S</sub>                    | 7          | -6        | A    |
| Maximum Power Dissipation                        | T <sub>c</sub> = 25°C | P <sub>D</sub>                    | 11         |           | W    |
|                                                  | T <sub>c</sub> = 70°C |                                   | 7.7        |           |      |
| Operating Junction and Storage Temperature Range |                       | T <sub>J</sub> , T <sub>STG</sub> | -55 to 175 |           | °C   |

### THERMAL CHARACTERISTICS

|                                         |               |      |      |
|-----------------------------------------|---------------|------|------|
| Thermal Resistance, Junction-to-Case    | R $\theta$ JC | 13.6 | °C/W |
| Thermal Resistance, Junction-to-Ambient | R $\theta$ JA | 120  | °C/W |

# STU405DH

N-Channel ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C unless otherwise noted)

| Parameter                              | Symbol              | Condition                                                                                            | Min | Typ <sup>c</sup> | Max  | Unit  |
|----------------------------------------|---------------------|------------------------------------------------------------------------------------------------------|-----|------------------|------|-------|
| OFF CHARACTERISTICS                    |                     |                                                                                                      |     |                  |      |       |
| Drain-Source Breakdown Voltage         | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =250uA                                                           | 40  |                  |      | V     |
| Zero Gate Voltage Drain Current        | I <sub>DSS</sub>    | V <sub>DS</sub> =32V, V <sub>GS</sub> =0V                                                            |     |                  | 1    | uA    |
| Gate-Body Leakage                      | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> = 0V                                                          |     |                  | ±100 | nA    |
| ON CHARACTERISTICS <sup>a</sup>        |                     |                                                                                                      |     |                  |      |       |
| Gate Threshold Voltage                 | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> = 250uA                                            | 1   | 1.5              | 3    | V     |
| Drain-Source On-State Resistance       | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =8A                                                             |     | 24               | 33   | m ohm |
|                                        |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> = 6A                                                           |     | 30               | 45   | m ohm |
| On-State Drain Current                 | I <sub>D(ON)</sub>  | V <sub>DS</sub> = 5V, V <sub>GS</sub> = 4.5V                                                         | 20  |                  |      | A     |
| Forward Transconductance               | g <sub>FS</sub>     | V <sub>DS</sub> = 10V, I <sub>D</sub> = 8A                                                           |     | 13.8             |      | S     |
| DYNAMIC CHARACTERISTICS <sup>b</sup>   |                     |                                                                                                      |     |                  |      |       |
| Input Capacitance                      | C <sub>ISS</sub>    | V <sub>DS</sub> =25V, V <sub>GS</sub> = 0V<br>f =1.0MHz                                              |     | 580              |      | pF    |
| Output Capacitance                     | C <sub>OSS</sub>    |                                                                                                      |     | 82               |      | pF    |
| Reverse Transfer Capacitance           | C <sub>RSS</sub>    |                                                                                                      |     | 50               |      | pF    |
| SWITCHING CHARACTERISTICS <sup>b</sup> |                     |                                                                                                      |     |                  |      |       |
| Turn-On Delay Time                     | t <sub>D(ON)</sub>  | V <sub>DD</sub> = 20V<br>I <sub>D</sub> = 1 A<br>V <sub>GS</sub> = 10V<br>R <sub>GEN</sub> = 3.3 ohm |     | 11               |      | ns    |
| Rise Time                              | t <sub>r</sub>      |                                                                                                      |     | 10.2             |      | ns    |
| Turn-Off Delay Time                    | t <sub>D(OFF)</sub> |                                                                                                      |     | 17.3             |      | ns    |
| Fall Time                              | t <sub>f</sub>      |                                                                                                      |     | 20               |      | ns    |
| Total Gate Charge                      | Q <sub>g</sub>      | V <sub>DS</sub> =28V, I <sub>D</sub> =8A,V <sub>GS</sub> =10V                                        |     | 11.3             |      | nC    |
|                                        |                     | V <sub>DS</sub> =28V, I <sub>D</sub> =8A,V <sub>GS</sub> =4.5V                                       |     | 5.8              |      | nC    |
| Gate-Source Charge                     | Q <sub>gs</sub>     | V <sub>DS</sub> =28V, I <sub>D</sub> = 8 A<br>V <sub>GS</sub> =10V                                   |     | 1.2              |      | nC    |
| Gate-Drain Charge                      | Q <sub>gd</sub>     |                                                                                                      |     | 2.9              |      | nC    |

# STU405DH

P-Channel ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C unless otherwise noted)

| Parameter                              | Symbol              | Condition                                                                                              | Min | Typ <sup>c</sup> | Max  | Unit  |
|----------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------|-----|------------------|------|-------|
| OFF CHARACTERISTICS                    |                     |                                                                                                        |     |                  |      |       |
| Drain-Source Breakdown Voltage         | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =-250uA                                                            | -40 |                  |      | V     |
| Zero Gate Voltage Drain Current        | I <sub>DSS</sub>    | V <sub>DS</sub> =-32V, V <sub>GS</sub> =0V                                                             |     |                  | -1   | uA    |
| Gate-Body Leakage                      | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> = 0V                                                            |     |                  | ±100 | nA    |
| ON CHARACTERISTICS <sup>a</sup>        |                     |                                                                                                        |     |                  |      |       |
| Gate Threshold Voltage                 | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> = -250uA                                             | -1  | -1.7             | -3   | V     |
| Drain-Source On-State Resistance       | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> = -6A                                                            |     | 35               | 45   | m ohm |
|                                        |                     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> = -4A                                                           |     | 52               | 65   | m ohm |
| On-State Drain Current                 | I <sub>D(ON)</sub>  | V <sub>DS</sub> = -5V, V <sub>GS</sub> = -10V                                                          | -20 |                  |      | A     |
| Forward Transconductance               | g <sub>FS</sub>     | V <sub>DS</sub> = -10V, I <sub>D</sub> =-6A                                                            |     | 12               |      | S     |
| DYNAMIC CHARACTERISTICS <sup>b</sup>   |                     |                                                                                                        |     |                  |      |       |
| Input Capacitance                      | C <sub>ISS</sub>    | V <sub>DS</sub> =-25V, V <sub>GS</sub> = 0V<br>f =1.0MHz                                               |     | 980              |      | pF    |
| Output Capacitance                     | C <sub>OSS</sub>    |                                                                                                        |     | 135              |      | pF    |
| Reverse Transfer Capacitance           | C <sub>RSS</sub>    |                                                                                                        |     | 90               |      | pF    |
| SWITCHING CHARACTERISTICS <sup>b</sup> |                     |                                                                                                        |     |                  |      |       |
| Turn-On Delay Time                     | t <sub>D(ON)</sub>  | V <sub>DD</sub> = -20V<br>I <sub>D</sub> = -1A<br>V <sub>GS</sub> = -10V<br>R <sub>GEN</sub> = 3.3 ohm |     | 12               |      | ns    |
| Rise Time                              | t <sub>r</sub>      |                                                                                                        |     | 17               |      | ns    |
| Turn-Off Delay Time                    | t <sub>D(OFF)</sub> |                                                                                                        |     | 82               |      | ns    |
| Fall Time                              | t <sub>f</sub>      |                                                                                                        |     | 35               |      | ns    |
| Total Gate Charge                      | Q <sub>g</sub>      | V <sub>DS</sub> =-28V, I <sub>D</sub> =-6A,V <sub>GS</sub> =-10V                                       |     | 20.7             |      | nC    |
|                                        |                     | V <sub>DS</sub> =-28V, I <sub>D</sub> =-6A,V <sub>GS</sub> =-4.5V                                      |     | 11               |      | nC    |
| Gate-Source Charge                     | Q <sub>gs</sub>     | V <sub>DS</sub> =-28V, I <sub>D</sub> = -6 A                                                           |     | 1.5              |      | nC    |
| Gate-Drain Charge                      | Q <sub>gd</sub>     | V <sub>GS</sub> =-10V                                                                                  |     | 6.2              |      | nC    |

# STU405DH

ELECTRICAL CHARACTERISTICS ( $T_A=25^{\circ}\text{C}$  unless otherwise noted)

| Parameter                                       | Symbol   | Condition                          | Min  | Typ <sup>c</sup> | Max  | Unit |
|-------------------------------------------------|----------|------------------------------------|------|------------------|------|------|
| DRAIN-SOURCE DIODE CHARACTERISTICS <sup>b</sup> |          |                                    |      |                  |      |      |
| Diode Forward Voltage                           | $V_{SD}$ | $V_{GS}=0\text{V}, I_S=7\text{A}$  | N-Ch | 0.98             | 1.2  | V    |
|                                                 |          | $V_{GS}=0\text{V}, I_S=-6\text{A}$ | P-Ch | -0.9             | -1.2 |      |

Notes

a. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

b. Guaranteed by design, not subject to production testing.

N-Channel

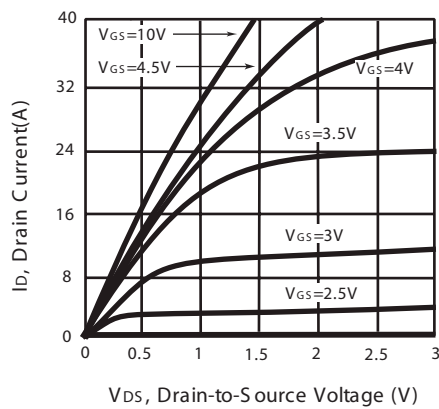


Figure 1. Output Characteristics

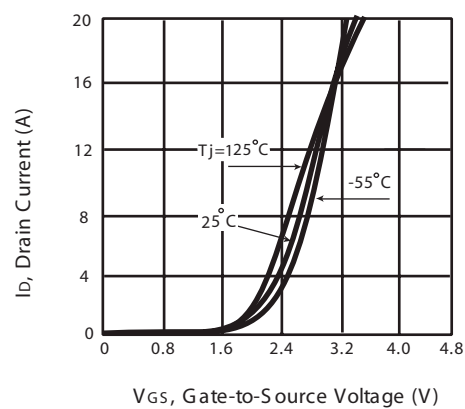


Figure 2. Transfer Characteristics

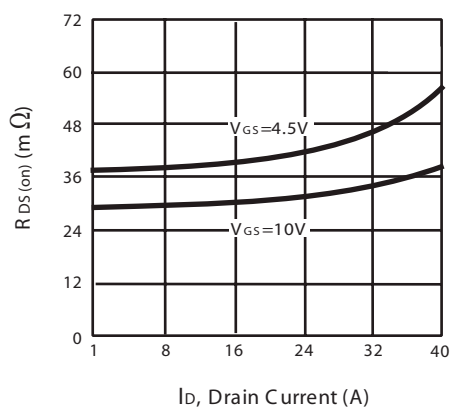


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

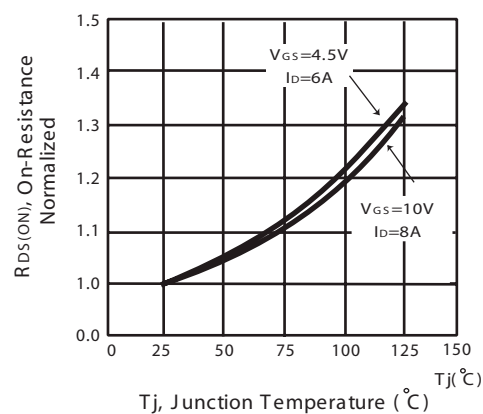


Figure 4. On-Resistance Variation with Drain Current and Temperature

# STU405DH

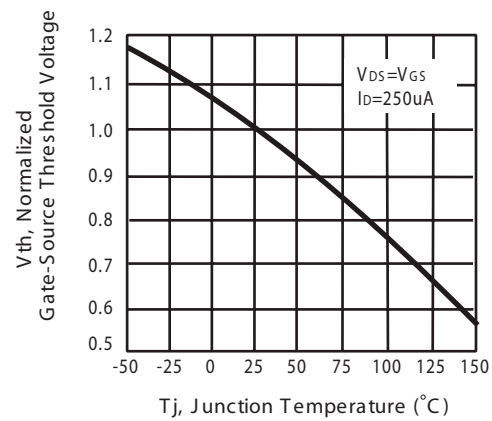


Figure 5. Gate Threshold Variation with Temperature

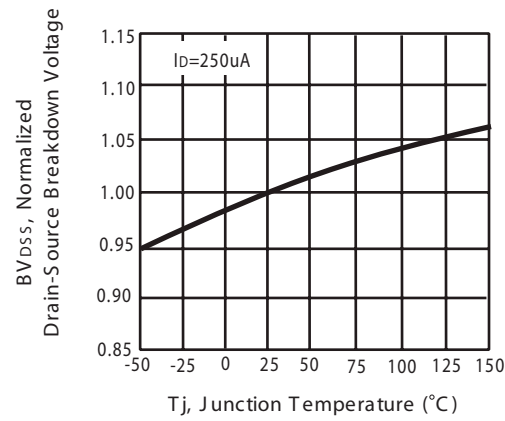


Figure 6. Breakdown Voltage Variation with Temperature

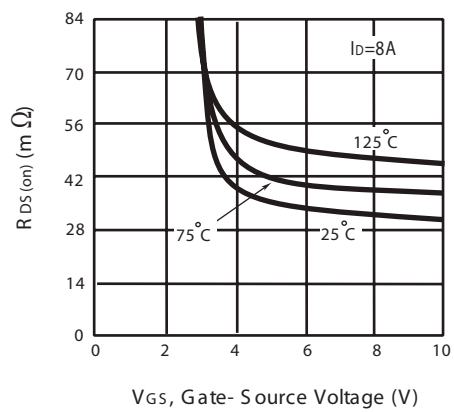


Figure 7. On-Resistance vs. Gate-Source Voltage

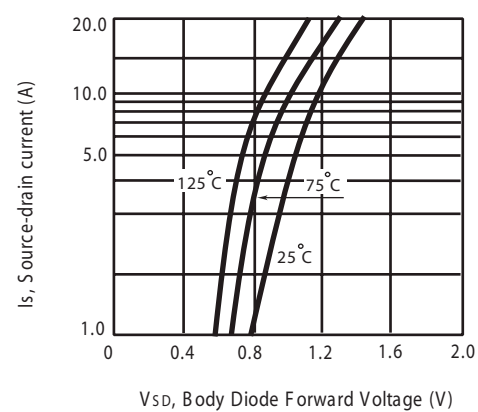
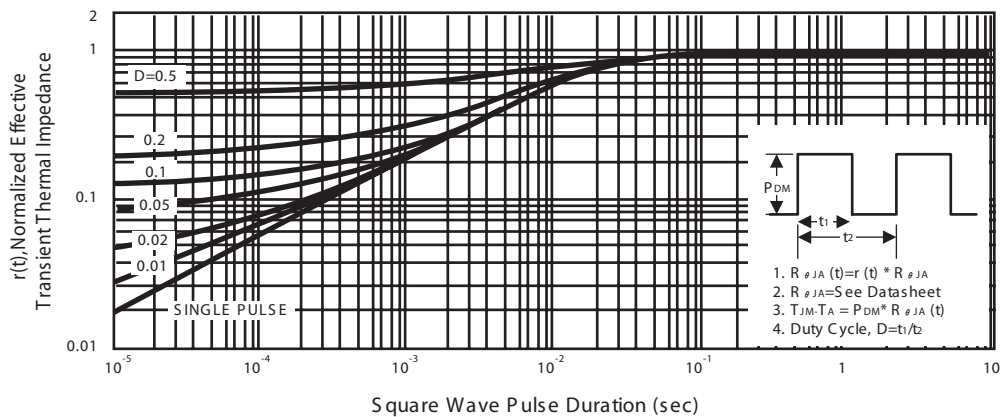
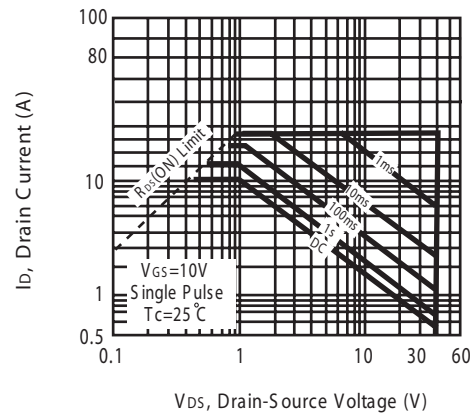
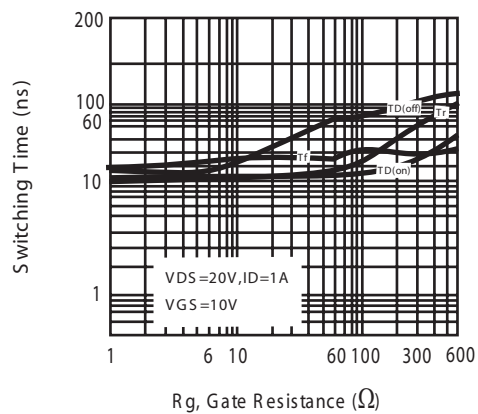
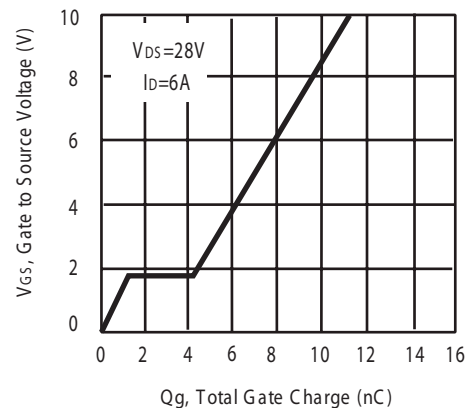
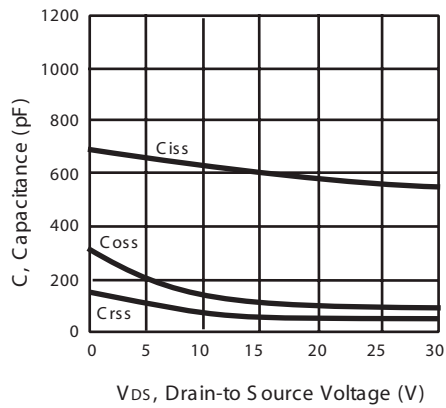


Figure 8. Body Diode Forward Voltage Variation with Source Current

# STU405DH



# STU405DH

## P-Channel

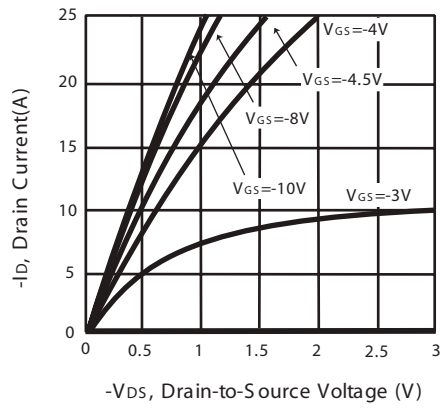


Figure 1. Output Characteristics

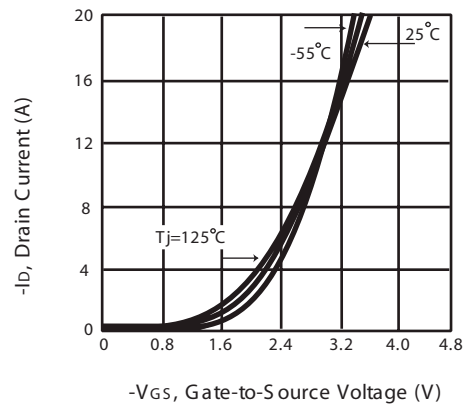


Figure 2. Transfer Characteristics

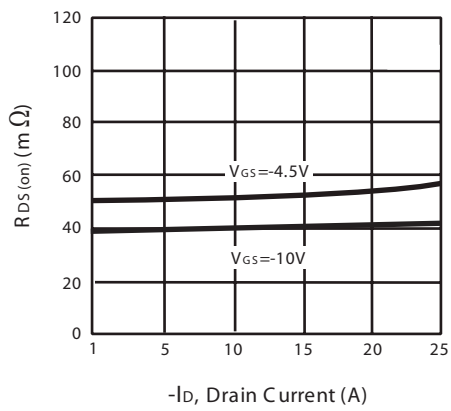


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

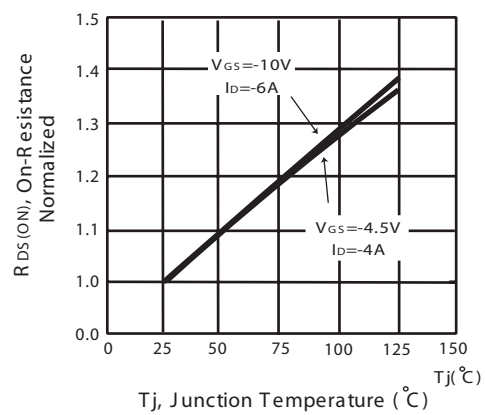


Figure 4. On-Resistance Variation with Drain Current and Temperature

# STU405DH

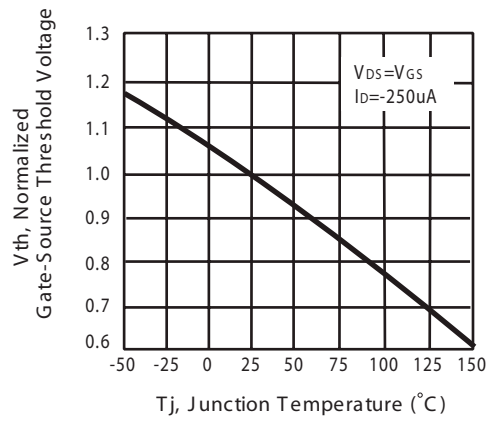


Figure 5. Gate Threshold Variation with Temperature

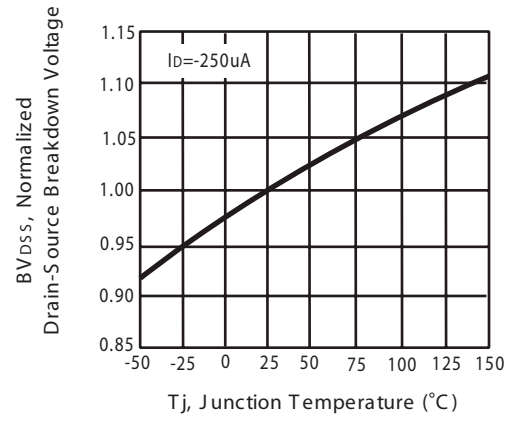


Figure 6. Breakdown Voltage Variation with Temperature

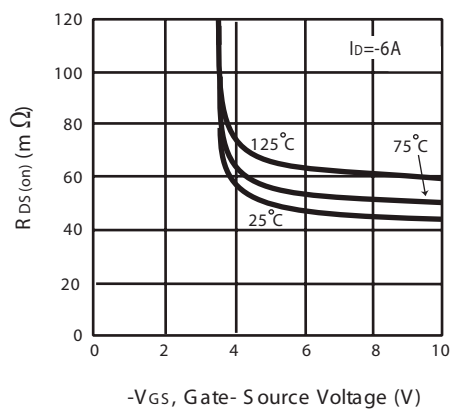


Figure 7. On-Resistance vs. Gate-Source Voltage

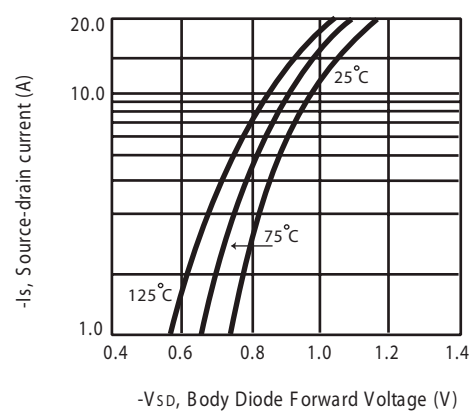
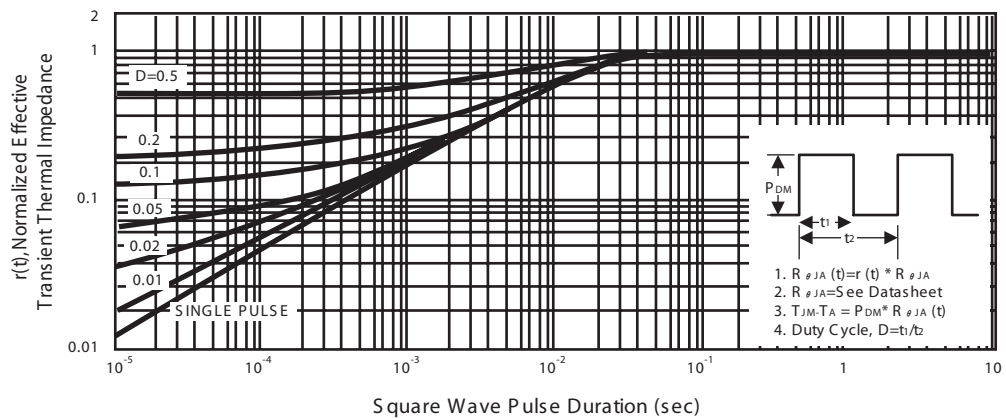
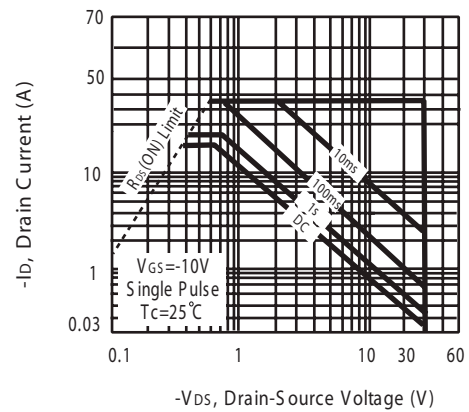
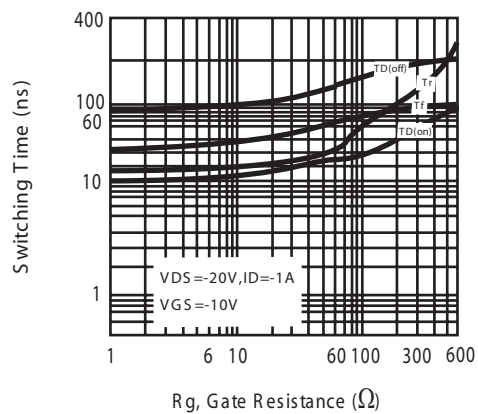
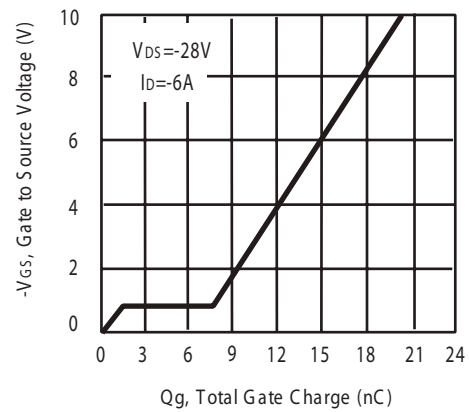
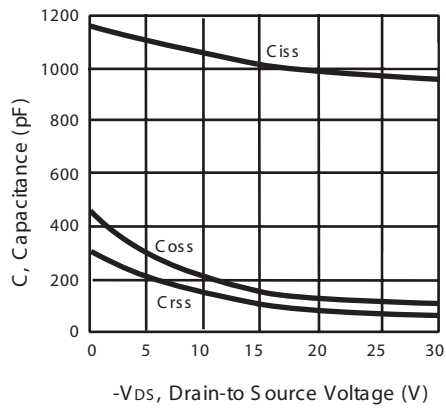


Figure 8. Body Diode Forward Voltage Variation with Source Current



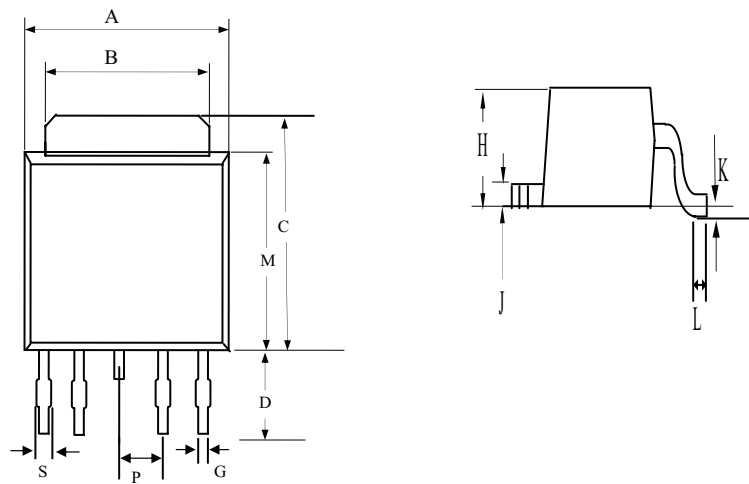
# STU405DH



# STU405DH

## PACKAGE OUTLINE DIMENSIONS

TO-252-4L

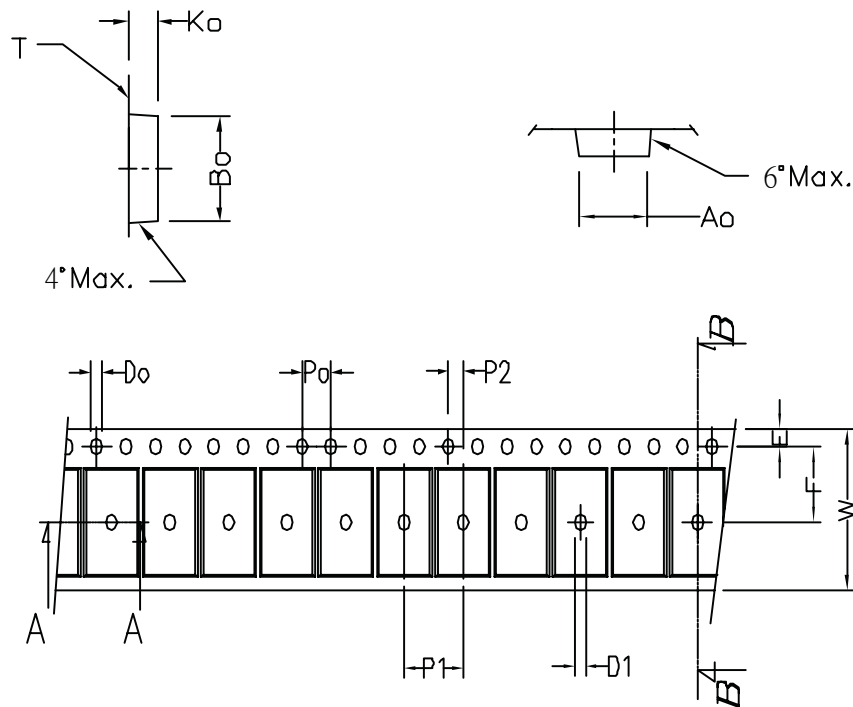


| REF . | Millimeters |       |
|-------|-------------|-------|
|       | MIN         | MAX   |
| A     | 6.40        | 6.80  |
| B     | 5.2         | 5.50  |
| C     | 6.80        | 10.20 |
| D     | 2.20        | 3.00  |
| P     | 1.27 REF.   |       |
| S     | 0.50        | 0.80  |
| G     | 0.40        | 0.60  |
| H     | 2.20        | 2.40  |
| J     | 0.45        | 0.60  |
| K     | 0           | 0.15  |
| L     | 0.90        | 1.50  |
| M     | 5.40        | 5.80  |

# STU405DH

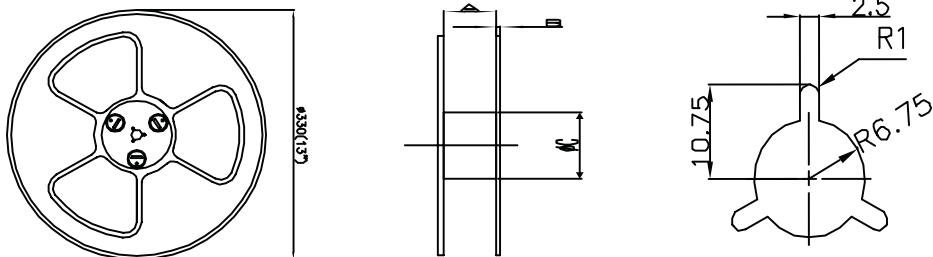
## TO-252-5L Tape and Reel Data

### TO-252-5L Carrier Tape



| symbol | $A_0$          | $B_0$           | $K_0$           | $P_0$          | $P_1$                | $P_2$          | $T$              |
|--------|----------------|-----------------|-----------------|----------------|----------------------|----------------|------------------|
| Spec   | $6.96 \pm 0.1$ | $10.49 \pm 0.1$ | $2.79 \pm 0.1$  | $4.0 \pm 0.1$  | $8.0 \pm 0.10$       | $2.0 \pm 0.05$ | $0.33 \pm 0.013$ |
| symbol | $E$            | $F$             | $D_0$           | $D_1$          | $W$                  | $10P_0$        |                  |
| Spec   | $1.75 \pm 0.1$ | $7.5 \pm 0.05$  | $1.55 \pm 0.05$ | $1.5 \pm 0.25$ | $16.0^{+0.3}_{-0.1}$ | $40.0 \pm 0.2$ |                  |

### TO-252-5L Reel



UNIT:mm

| Width of carrier tape | 8   | 12   | 16   | 24   | 32   | 44   | 56   |
|-----------------------|-----|------|------|------|------|------|------|
| $A \pm 0.1$           | 9.4 | 13.4 | 17.4 | 25.4 | 33.4 | 45.4 | 57.4 |
| $B$                   | 2.3 | 2.3  | 2.3  | 2.3  | 2.3  | 2.3  | 2.3  |
| $\phi C$              | 100 | 100  | 100  | 100  | 100  | 100  | 100  |