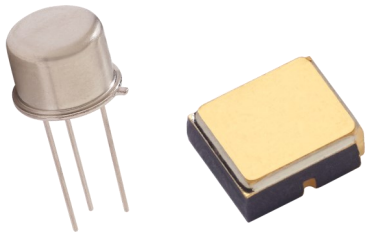
# 2N6660, 2N6661

## N Channel Power MOSFET

Rev. V2

### Features

- Available in JAN, JANTX, JANTXV and JANS per MIL-PRF-19500/547
- Features Low On-Resistance, Fast Switching Speed and Low Threshold
- Low Input Capacitance
- Ideal for Hi-Rel Solid-State Relays, Battery Operated Systems and Driver Applications for Relays, Solenoids, Lamps, Displays, Memories, etc.
- TO-39 (TO-205AD) and Surface Mount UB Package Types



### Electrical Characteristics ($T_A$ = 25°C unless otherwise noted)

| Parameter | Test Conditions | Symbol | Units | Min. | Max. |
|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $V_{DS}$ = 0, $I_G$ = 1.0 µA dc 2N6660, UB<br>$V_{DS}$ = 0, $I_G$ = 1.0 µA dc 2N6661, UB | $V_{DS}$ | V dc | 60<br>90 | — |
| Gate-Source Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 1 mA dc | $V_{GS\ (th)}$ | V dc | 0.8 | 2.0 |
| Gate Current | $V_{DS}$ = 0, $V_{GS}$ = ± 20V | $I_{GSS}$ | nA dc | — | ±100 |
| Zero Gate Voltage Drain Current | $V_{GS}$ = 0 V, $V_{DS}$ = 48 V dc 2N6660, UB<br>$V_{GS}$ = 0 V, $V_{DS}$ = 72 V dc 2N6661, UB | $I_{DSS}$ | µA dc | — | 1.0 |
| Drain-Source On-State Resistance | $V_{GS}$ = 10 V dc, $I_D$ = 1.0 A dc 2N6660, UB<br>$V_{GS}$ = 10 V dc, $I_D$ = 1.0 A dc 2N6661, UB | $r_{DS(on)}$ [1] | Ω | — | 3.0<br>4.0 |
| Drain-Source On-State Resistance | $V_{GS}$ = 5V, $I_D$ = 0.3A 2N6660, UB<br>$V_{GS}$ = 5V, $I_D$ = 0.3A 2N6661, UB | $r_{DS(on)}$ [2] | Ω | — | 5.0<br>5.3 |
| Forward Transconductance | $V_{DS}$ = $V_{GS}$ = 7.5V, $I_{D1}$ = 525 mA dc2N6660, UB<br>$V_{DS}$ = $V_{GS}$ = 7.5V, $I_{D2}$ = 475 mA dc 2N6661, UB | $g_{fs}$ | mS | 170 | — |
| Diode Forward Voltage | $I_S$ = 0.99 A, $V_{GS}$ = 0 V 2N6660, UB<br>$I_S$ = 0.86 A, $V_{GS}$ = 0 V 2N6661, UB | $V_{SD}$ | V (pk) | 0.7<br>0.7 | 1.6<br>1.4 |

## Electrical Characteristics

| Parameter | Test Conditions | Symbol | Units | Min. | Max. |
|---|---|---|---|---|---|
| **Dynamic Characteristics** | | | | | |
| Static, Drain-Source On State Resistance | $V_{GS}$ = 10 V dc; $I_D$ = 1.0 A dc; $T_C$ = +125°C<br>2N6660, UB<br>2N6661, UB | $r_{DS(on)3}$ | Ω | — | <br>5.6<br>7.5 |
| Drain Current | $T_C$ = +125°C; $V_{GS}$ = 0 V<br>$V_{DS}$ = 48 V 2N6660, UB<br>$V_{DS}$ = 72 V 2N6661, UB | $I_{DSS2}$ | µA | — | 100 |
| Small-Signal, Common-Source Short Circuit Reverse Transfer Capacitance | $V_{DS}$ = 25 V dc, $V_{GS}$ = 0 V; f = 1MHz | $C_{rss}$ | pF | — | 10 |
| Small-Signal, Common-Source Short Circuit Input Capacitance | $V_{DS}$ = 25 V dc; $V_{GS}$ = 0 V; f = 1.0 MHz | $C_{iss}$ | pF | — | 50 |
| Small-Signal, Common-Source Short Circuit Output Capacitance | $V_{DS}$ = 25 V dc; $V_{GS}$ = 0 V; f = 1.0 MHz | $C_{oss}$ | pF | — | 40 |

| Parameter | Test Conditions | Symbol | Units | Min. | Max. |
|---|---|---|---|---|---|
| **Switching Characteristics** | | | | | |
| Turn-On Delay Time | $R_{GS}$ = 23Ω, $R_L$ = 23Ω, $V_{GEN}$ = 10 V<br>$V_{DD}$ = 25 V dc; $I_D$ = 1 A dc | $t_{d(on)}$ | ns | — | 10 |
| Turn-Off Delay Time | $R_{GS}$ = 23Ω, $R_L$ = 23Ω, $V_{GEN}$ = 10 V<br>$V_{DD}$ = 25 V dc; $I_D$ = 1 A dc | $t_{d(off)}$ | ns | — | 10 |

## Absolute Maximum Ratings ($T_A$ = +25°C unless otherwise noted)

| Ratings | Symbol | Value |
|---|---|---|
| Gate-Source Voltage | $V_{GS}$ | ± 20 V dc |
| Drain-Source Voltage | $V_{DS}$ | 2N6660, UB 60 V dc<br>2N6661, UB 90 V dc |
| Drain-Gate Voltage | $V_{DGR}$ | 2N6660, UB 60 V dc<br>2N6661, UB 90 V dc |
| Continuous Drain-Current | $I_{D1}$ (3) | 2N6660, UB 0.99 A dc<br>2N6661, UB 0.86 A dc |
| Continuous Drain-Current<br>$T_C$ = +100°C | $I_{D2}$ (3) | 2N6660, UB 0.62 A dc<br>2N6661, UB 0.54 A dc |
| Source Current | $I_S$ | 2N6660, UB -0.99 A dc<br>2N6661, UB -0.86 A dc |
| Peak Drain Current | $I_{DM}$ | 3 A (pk) |
| Maximum Power Dissipation (TO-39)<br>@ $T_C$= 25°C(1)<br>@ $T_A$ = 25°C | $P_T$ | 6.25 W<br>725 mW |
| Maximum Power Dissipation (UB)<br>@ $T_C$= 25°C(1)<br>@ $T_A$ = 25°C | $P_T$ | 2.5 W<br>570 mW |
| Junction & Storage Temperature Range | $T_J$ and $T_{STG}$ | -65°C to +150°C |
| Thermal Resistance, Junction to Case<br>Thermal Resistance, Junction to Case (UB) | $R_{\theta JC}$ | 20°C/W<br>40°C/W |

(1) Derate linearly 0.05 W/°C for $T_C$ > +25°C
(2) $R_{GS}$ ≤ 1 M ohm
(3) The following formula derives the maximum theoretical $I_D$ limit. $I_D$ is limited by package and internal construction.

$$I_D = \sqrt{\frac{T_{JM} - T_C}{(R_{\theta JC}) \times (R_{DS}(on) \text{ at } T_{JM})}}$$

## Outline Drawing TO-205AD (TO-39)

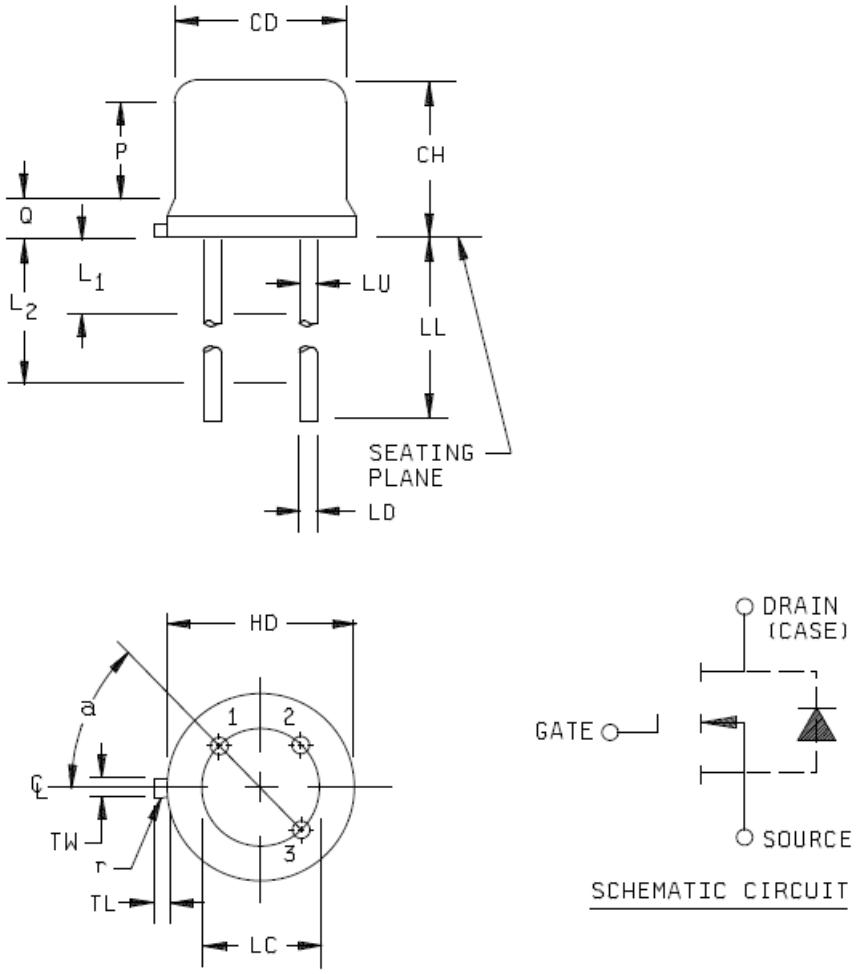



FIGURE 1. Physical dimensions (TO-205AD).

## Outline Drawing TO-205AD (TO-39)

MIL-PRF-19500/547D

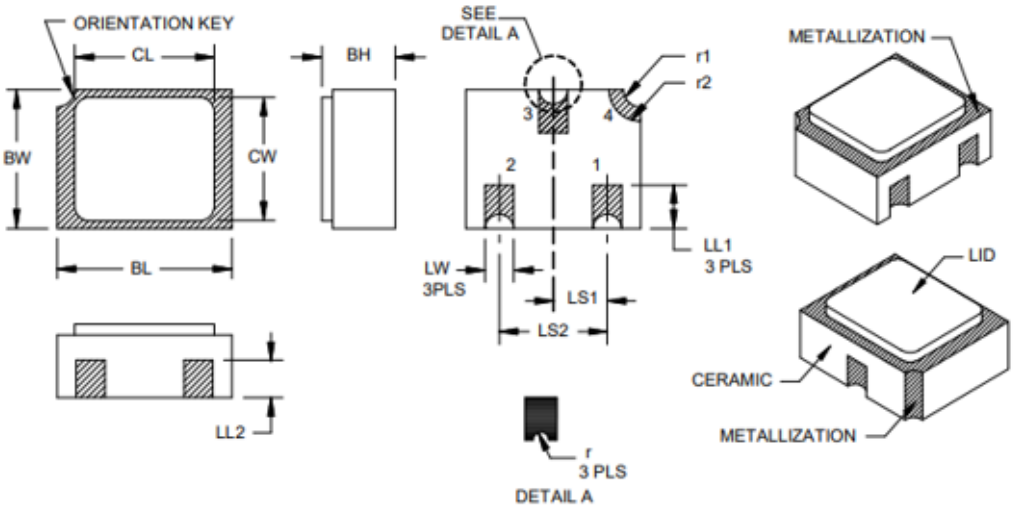
| Ltr | Dimensions | | | | Notes |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| CD | .305 | .335 | 7.75 | 8.51 | |
| CH | .240 | .260 | 6.10 | 6.60 | |
| HD | .335 | .370 | 8.51 | 9.40 | |
| TW | .028 | .034 | 0.71 | 0.86 | 2 |
| TL | .029 | .045 | 0.74 | 1.14 | 3 |
| LD | .016 | .021 | 0.41 | 0.53 | 7,8 |
| LL | .500 | .750 | 12.70 | 19.05 | 7,8 |
| LC | 0.200 TP | | 5.08 TP | | 6 |
| LU | .016 | .019 | 0.41 | 0.48 | 7,8 |
| $L_1$ | | .050 | | 1.27 | 7,8 |
| $L_2$ | .250 | | 6.35 | | 7,8 |
| P | .100 | | 2.54 | | 5 |
| Q | | .050 | | 1.27 | 4 |
| R | | .010 | | 0.25 | 9 |
| α | 45° TP | | 45° TP | | 6 |

NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. Beyond radius (r) maximum, TW shall be held for a minimum length of .011 inch (0.28 mm).
3. Dimension TL measured from maximum HD.
4. Outline in this zone is not controlled.
5. Dimension CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 +.001, -.000 inch (1.37 +0.03, -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
7. LU applies between $L_1$ and $L_2$. LD applies between $L_2$ and L minimum. Diameter is uncontrolled in $L_1$ and beyond LL minimum.
8. All three leads.
9. Radius (r) applies to both inside corners of tab.
10. Drain is electrically connected to the case.

FIGURE 1. Physical dimensions(TO-205AD) - Continued.

## Outline Drawing (UB)




| Symbol | Dimensions | | | | Notes |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| BL | .115 | .128 | 2.92 | 3.25 | |
| BW | .085 | .108 | 2.16 | 2.74 | |
| BH | .040 | .056 | 1.02 | 1.42 | 4 |
| BH | .055 | .069 | 1.40 | 1.75 | 5 |
| CL | | .128 | | 3.25 | |
| CW | | .108 | | 2.74 | |
| LL1 | .022 | .038 | 0.56 | 0.97 | 6 |

| Symbol | Dimensions | | | | Notes |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| LL2 | .009 | .036 | 0.23 | 0.89 | 6 |
| LS1 | .035 | .040 | 0.89 | 1.02 | |
| LS2 | .071 | .079 | 1.80 | 2.01 | |
| LW | .016 | .024 | 0.41 | 0.61 | 6 |
| r | | .008 | | 0.20 | |
| r1 | | .012 | | 0.30 | 7 |
| r2 | | .022 | | 0.56 | |

NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. Hatched areas on package denote metallized areas.
3. Pad 1 = Gate, 2 = Source, 3 = Drain, 4 = shielding connected to the lid (UB only) or lid braze ring (UBC only).
4. Dimension BH for UB packages with medal lid.
5. Dimension BH for UBC packages with ceramic lid.
6. Three places.
7. For design reference only.
8. In accordance with ASME Y14.5M, diameters are equivalent to Øx symbology.

FIGURE 2. Physical dimensions for UB and UBC style surface mount package.

## Graphs

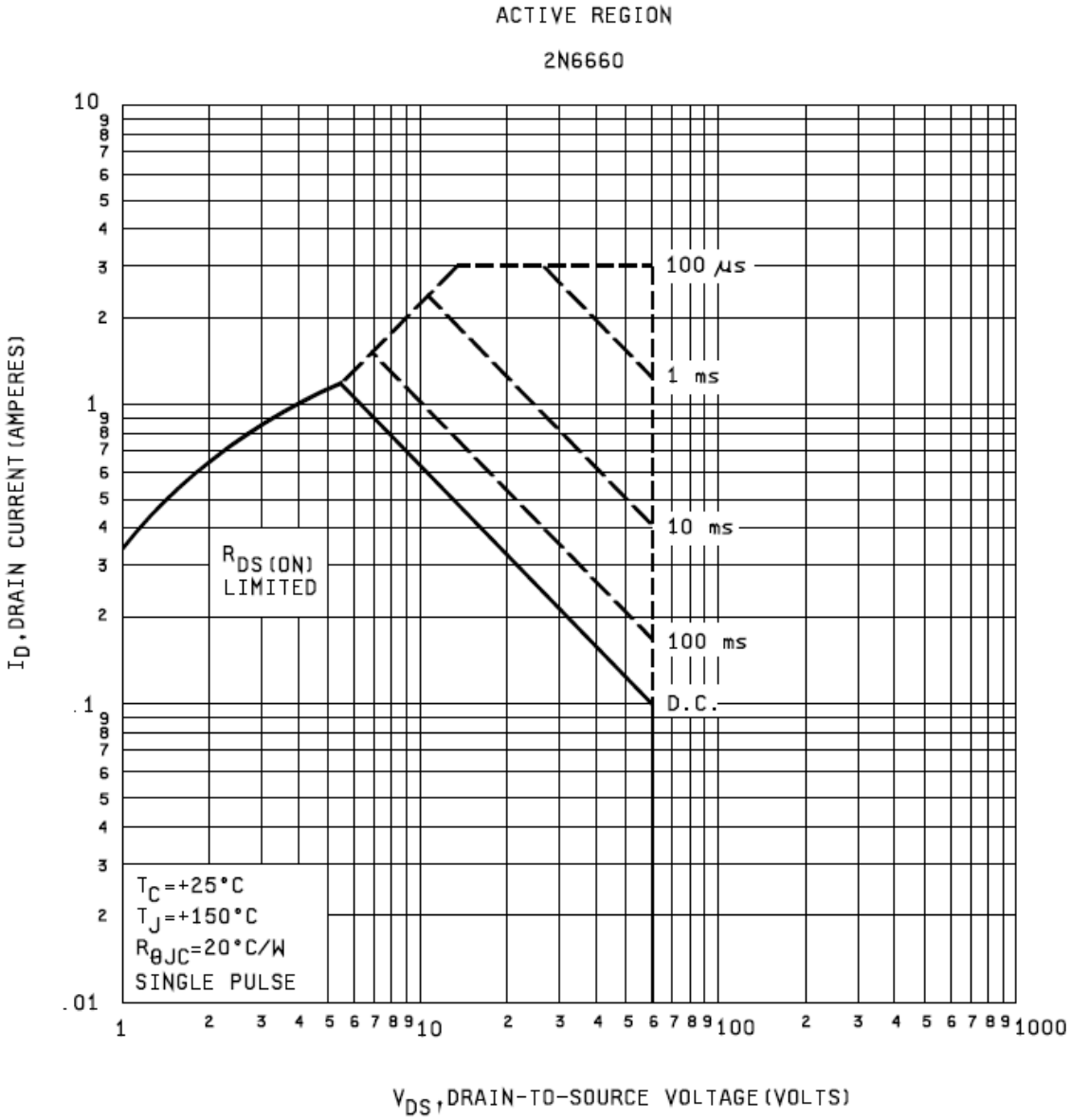



FIGURE 2. Maximum safe operating area.

## Graphs

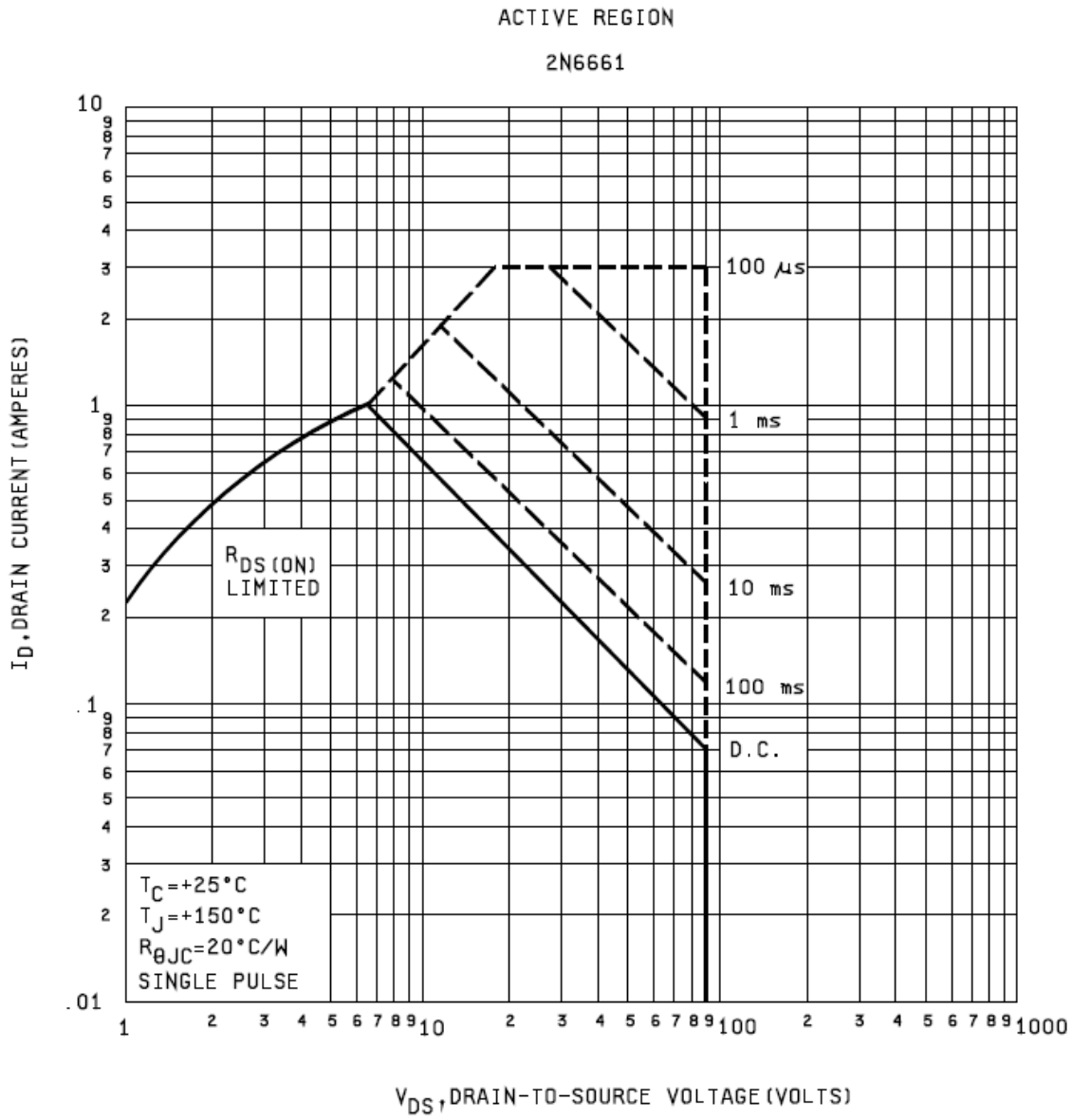



FIGURE 2. Maximum safe operating area - Continued.