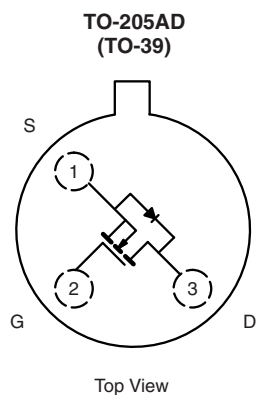


## N-Channel 60 V (D-S) MOSFET



### PRODUCT SUMMARY

|                                              |        |
|----------------------------------------------|--------|
| $V_{DS}$ (V)                                 | 60     |
| $R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = 10$ V | 3      |
| Configuration                                | Single |



### FEATURES

- Military Qualified
- Low On-Resistance: 1.3  $\Omega$
- Low Threshold: 1.7 V
- Low Input Capacitance: 35 pF
- Fast Switching Speed: 8 ns
- Low Input and Output Leakage

### BENEFITS

- Guaranteed Reliability
- Low Offset Voltage
- Low-Voltage Operation
- Easily Driven Without Buffer
- High-Speed Circuits
- Low Error Voltage

### APPLICATIONS

- Hi-Rel Systems
- Direct Logic-Level Interface: TTL/CMOS
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relays

### ORDERING INFORMATION

| PART         | PACKAGE             | DESCRIPTION/DSCC<br>PART NUMBER | VISHAY ORDERING<br>PART NUMBER |
|--------------|---------------------|---------------------------------|--------------------------------|
| 2N6660       | TO-205AD<br>(TO-39) | Commercial                      | 2N6660                         |
| 2N6660-2     |                     | Commercial, Lead (Pb)-free      | 2N6660-E3                      |
|              |                     | See -2 Flow Document            | 2N6660-2                       |
| 2N6660JANTX  |                     | JANTX2N6660 (std Au leads)      | 2N6660JTX02                    |
|              |                     | JANTX2N6660 (with solder)       | 2N6660JTXL02                   |
|              |                     | JANTX2N6660P (with PIND)        | 2N6660JTXP02                   |
| 2N6660JANTXV |                     | JANTXV2N6660 (std Au leads)     | 2N6660JTXV02                   |
|              |                     | JANTXV2N6660P (with PIND)       | 2N6660JTVP02                   |

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)

| PARAMETER                                            | SYMBOL         | LIMIT          | UNIT |
|------------------------------------------------------|----------------|----------------|------|
| Drain-Source Voltage                                 | $V_{DS}$       | 60             | V    |
| Gate-Source Voltage                                  | $V_{GS}$       | $\pm 20$       |      |
| Continuous Drain Current ( $T_J = 150$ °C)           | $I_D$          | $T_C = 25$ °C  | A    |
|                                                      |                | $T_C = 100$ °C |      |
| Pulsed Drain Current <sup>a</sup>                    | $I_{DM}$       | 3              |      |
| Maximum Power Dissipation                            | $P_D$          | $T_C = 25$ °C  | W    |
|                                                      |                | $T_A = 25$ °C  |      |
| Thermal Resistance, Junction-to-Ambient <sup>b</sup> | $R_{thJA}$     | 170            | °C/W |
| Thermal Resistance, Junction-to-Case                 | $R_{thJC}$     | 20             |      |
| Operating Junction and Storage Temperature Range     | $T_J, T_{stg}$ | - 55 to 150    | °C   |

#### Notes

- a. Pulse width limited by maximum junction temperature.  
b. Not required by military spec.



| SPECIFICATIONS (T <sub>A</sub> = 25 °C, unless otherwise noted) |                     |                                                                      |                                   |        |                   |       |      |
|-----------------------------------------------------------------|---------------------|----------------------------------------------------------------------|-----------------------------------|--------|-------------------|-------|------|
| PARAMETER                                                       | SYMBOL              | TEST CONDITIONS                                                      |                                   | LIMITS |                   |       | UNIT |
|                                                                 |                     |                                                                      |                                   | MIN.   | TYP. <sup>a</sup> | MAX.  |      |
| Static                                                          |                     |                                                                      |                                   |        |                   |       |      |
| Drain-Source Breakdown Voltage                                  | V <sub>DS</sub>     | V <sub>DS</sub> = 0 V, I <sub>D</sub> = 10 μA                        |                                   | 60     | 75                | -     | V    |
| Gate-Source Threshold Voltage                                   | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1 mA            |                                   | 0.8    | 1.7               | 2     |      |
|                                                                 |                     | T <sub>C</sub> = - 55 °C                                             |                                   | -      | -                 | 2.5   |      |
|                                                                 |                     | T <sub>C</sub> = 125 °C                                              |                                   | 0.3    | -                 | -     |      |
| Gate-Body Leakage                                               | I <sub>GSS</sub>    | V <sub>GS</sub> = ± 20 V                                             | V <sub>DS</sub> = 0 V             | -      | -                 | ± 100 | nA   |
|                                                                 |                     |                                                                      | T <sub>C</sub> = 125 °C           | -      | -                 | ± 500 |      |
| Zero Gate Voltage Drain Current                                 | I <sub>DSS</sub>    | V <sub>GS</sub> = 0 V                                                | V <sub>DS</sub> = 48 V            | -      | -                 | 1     | μA   |
|                                                                 |                     |                                                                      | T <sub>C</sub> = 125 °C           | -      | -                 | 100   |      |
| On-State Drain Current                                          | I <sub>D(on)</sub>  | V <sub>GS</sub> = 10 V                                               | V <sub>DS</sub> = 10 V            | -      | 2                 | -     | A    |
| Drain-Source On-State Resistance <sup>b</sup>                   | R <sub>DS(on)</sub> | V <sub>GS</sub> = 5 V                                                | I <sub>D</sub> = 0.3 A            | -      | 2                 | 5     | Ω    |
|                                                                 |                     | V <sub>GS</sub> = 10 V                                               | I <sub>D</sub> = 1 A              | -      | 1.3               | 3     |      |
|                                                                 |                     |                                                                      | T <sub>C</sub> = 125 °C           | -      | 2.4               | 5.6   |      |
| Forward Transconductance <sup>b</sup>                           | g <sub>fs</sub>     | V <sub>DS</sub> = 7.5 V, I <sub>D</sub> = 0.525 A                    |                                   | 170    | 350               | -     | mS   |
| Diode Forward Voltage                                           | V <sub>SD</sub>     | I <sub>S</sub> = 0.99 A, V <sub>GS</sub> = 0 V                       |                                   | 0.7    | 0.8               | 1.6   | V    |
| Dynamic                                                         |                     |                                                                      |                                   |        |                   |       |      |
| Input Capacitance                                               | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V                                                | V <sub>DS</sub> = 25 V, f = 1 MHz | -      | 35                | 50    | pF   |
| Output Capacitance                                              | C <sub>oss</sub>    |                                                                      |                                   | -      | 25                | 40    |      |
| Reverse Transfer Capacitance                                    | C <sub>rss</sub>    |                                                                      |                                   | -      | 7                 | 10    |      |
| Drain-Source Capacitance                                        | C <sub>ds</sub>     |                                                                      |                                   | -      | 30                | -     |      |
| Switching <sup>c</sup>                                          |                     |                                                                      |                                   |        |                   |       |      |
| Turn-On Time                                                    | t <sub>ON</sub>     | V <sub>DD</sub> = 25 V, R <sub>L</sub> = 23 Ω                        |                                   | -      | 8                 | 10    | ns   |
| Turn-Off Time                                                   | t <sub>OFF</sub>    | I <sub>D</sub> ≥ 1 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 25 Ω |                                   | -      | 8.5               | 10    |      |

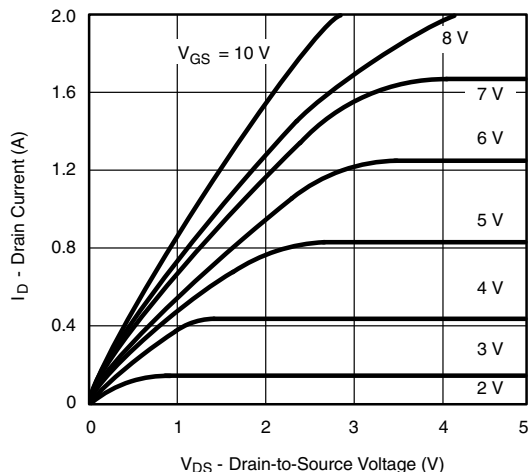
## Notes

- FOR DESIGN AID ONLY, not subject to production testing.
- Pulse test: PW ≤ 300 μs duty cycle ≤ 2 %.
- Switching time is essentially independent of operating temperature.

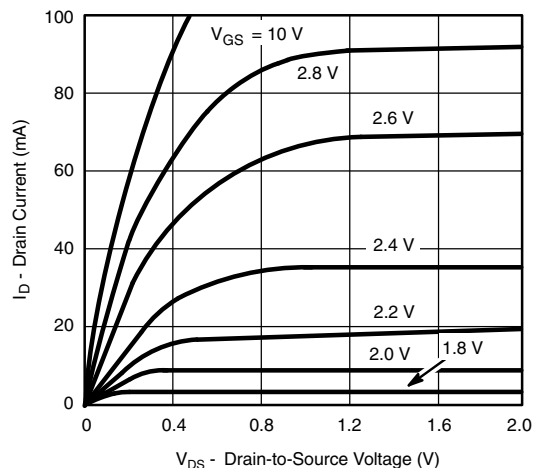
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



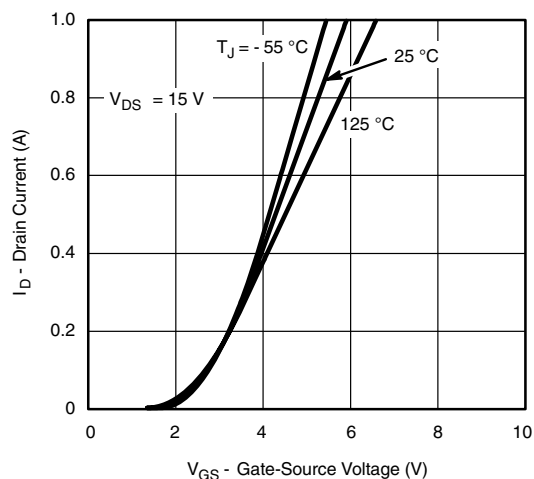
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



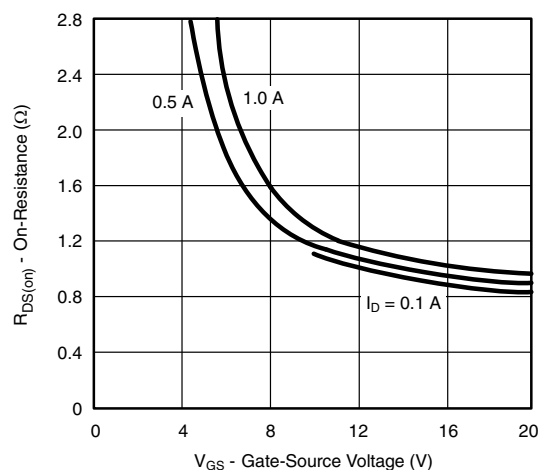
Ohmic Region Characteristics



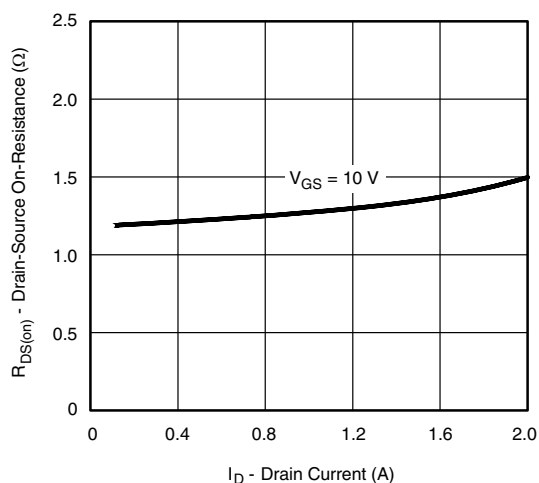
Output Characteristics for Low Gate Drive



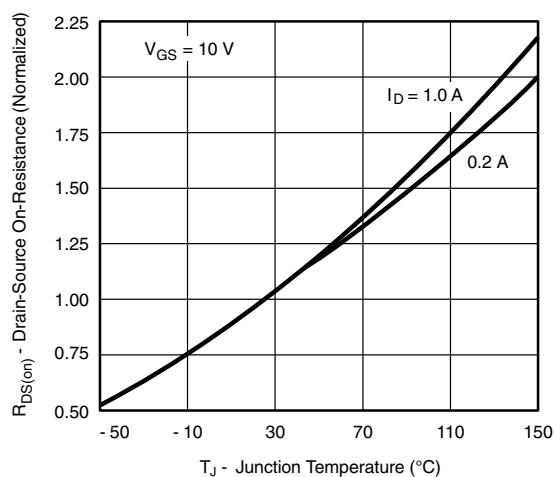
Transfer Characteristics



On-Resistance vs. Gate-to-Source Voltage



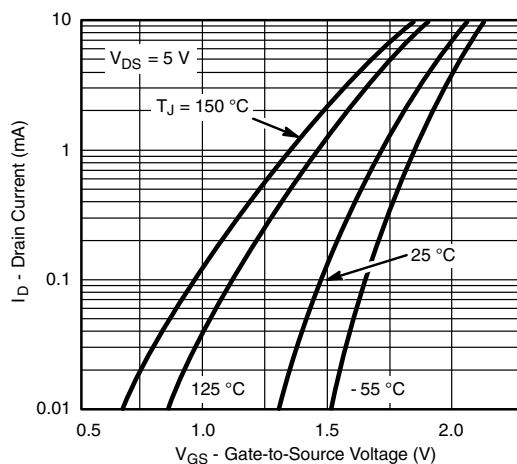
On-Resistance vs. Drain Current



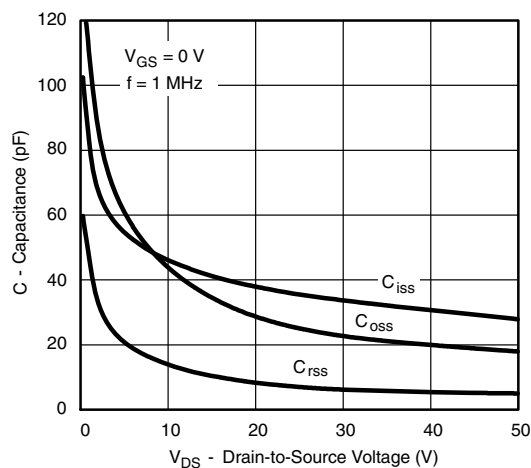
Normalized On-Resistance vs. Junction Temperature



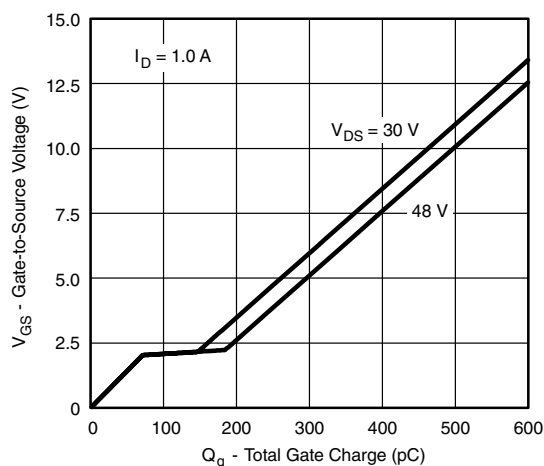
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



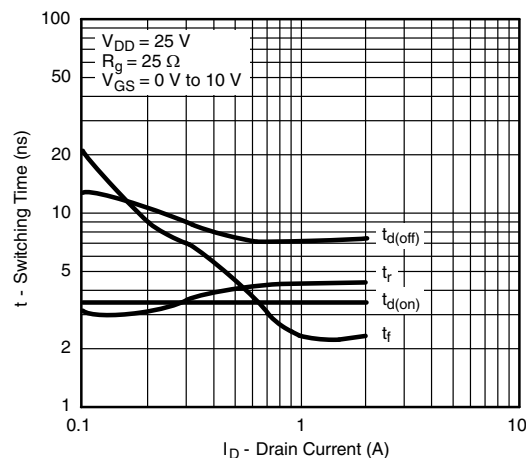
Threshold Region



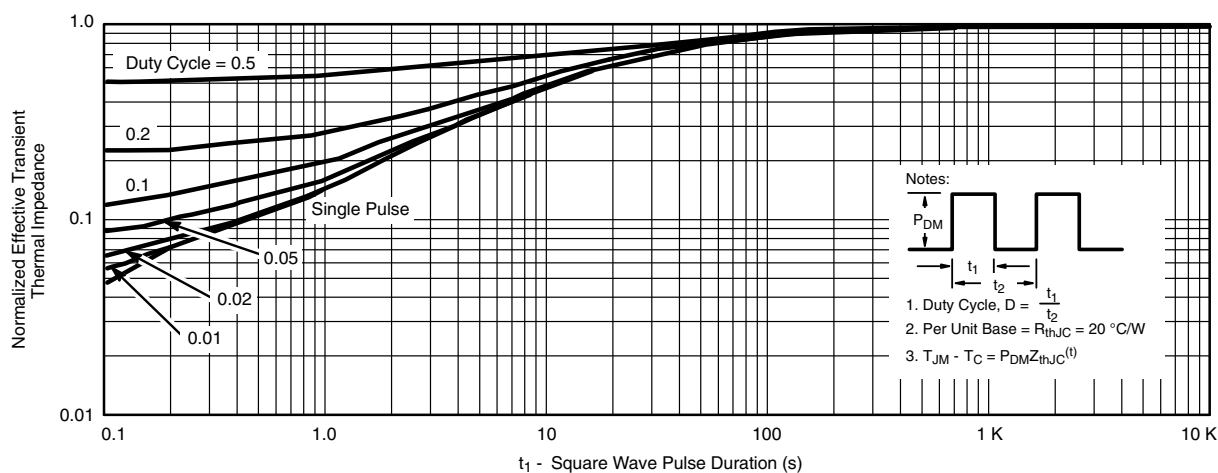
Capacitance



Gate Charge



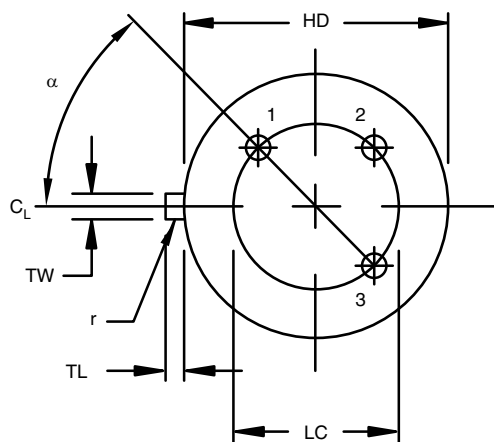
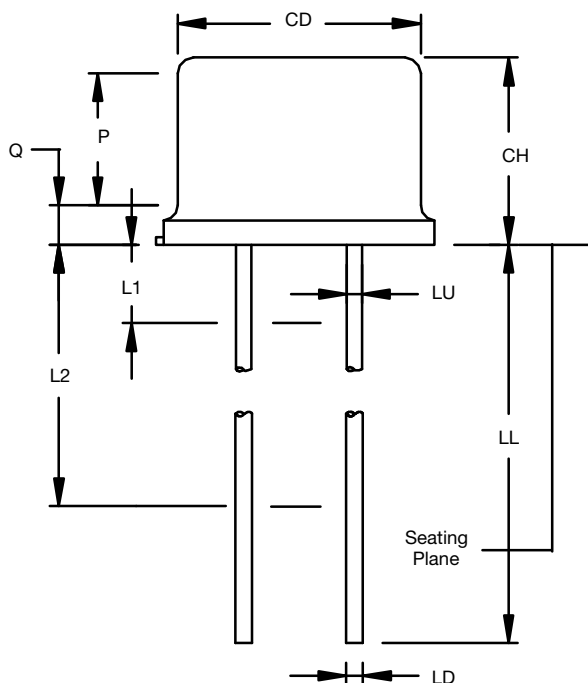
Load Condition Effects on Switching



Normalized Thermal Transient Impedance, Junction-to-Ambient

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## TO-205AD (TO-39 TALL LID)



| DIM.                            | INCHES   |       | MILLIMETERS |       |
|---------------------------------|----------|-------|-------------|-------|
|                                 | MIN.     | MAX.  | MIN.        | MAX.  |
| CD                              | 0.305    | 0.335 | 7.75        | 8.51  |
| CH                              | 0.240    | 0.260 | 6.10        | 6.60  |
| HD                              | 0.335    | 0.370 | 8.51        | 9.40  |
| LC <sup>(6)</sup>               | 0.200 TP |       | 5.08 TP     |       |
| LD <sup>(7)(8)</sup>            | 0.016    | 0.021 | 0.41        | 0.53  |
| LL <sup>(7)(8)</sup>            | 0.500    | 0.750 | 12.70       | 19.05 |
| LU <sup>(7)(8)</sup>            | 0.016    | 0.019 | 0.41        | 0.48  |
| L1 <sup>(7)(8)</sup>            | —        | 0.050 | —           | 1.27  |
| L2 <sup>(7)(8)</sup>            | 0.250    | —     | 6.35        | —     |
| P <sup>(5)</sup>                | 0.100    | —     | 2.54        | —     |
| Q <sup>(4)</sup>                | —        | 0.050 | —           | 1.27  |
| r <sup>(9)</sup>                | —        | 0.010 | —           | 0.25  |
| TL <sup>(3)</sup>               | 0.029    | 0.045 | 0.74        | 1.14  |
| TW <sup>(2)</sup>               | 0.028    | 0.034 | 0.71        | 0.86  |
| α <sup>(6)</sup>                | 45° TP   |       | 45° TP      |       |
| ECN: S15-1675-Rev. D, 27-Jul-15 |          |       |             |       |
| DWG: 5511                       |          |       |             |       |

### Notes

- (1) Dimensions are in inches. Metric equivalents are given for general information only.
- (2) Beyond radius (r) maximum, TW shall be held for a minimum length of 0.011" (0.028 mm).
- (3) Dimension TL measured from maximum HD.
- (4) Outline in this zone is not controlled.
- (5) Dimension CD shall not vary more than 0.010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
- (6) Leads at gauge plane 0.054" + 0.001", - 0.000" (1.37 mm + 0.03 mm, - 0.00 mm) below seating plane shall be within 0.007" (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
- (7) LU applies between L1 and L2, LD applies between L2 and L maximum. Diameter is uncontrolled in L1 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.



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