

AP4506GEM-HF-VB Datasheet

N- and P-Channel 30 V (D-S) MOSFET

| PRODUCT SUMMARY | | | | |
|-----------------|---------------------|------------------------------------|---------------------------------|-----------------------|
| | V _{DS} (V) | R _{DS(on)} (Ω) | I _D (A) ^a | Q _g (Typ.) |
| N-Channel | 30 | 0.018 at V _{GS} = 10 V | 8 ^e | 6.2 |
| | | 0.020 at V _{GS} = 8 V | 8 ^e | |
| | | 0.024 at V _{GS} = 4.5 V | 8 ^e | |
| P-Channel | - 30 | 0.040 at V _{GS} = - 10 V | - 8 ^e | 18.5 |
| | | 0.044 at V _{GS} = - 8 V | - 8 ^e | |
| | | 0.050 at V _{GS} = - 4.5 V | - 7.5 | |

FEATURES

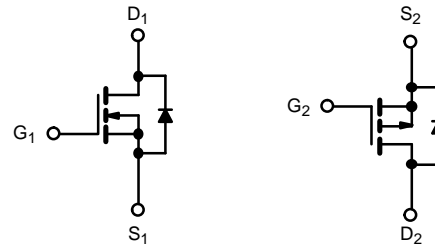
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET[®] Power MOSFET
- 100 % R_g and UIS Tested
- Compliant to RoHS Directive 2002/95/EC



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Motor Drive
- Mobile Power Bank



| ABSOLUTE MAXIMUM RATINGS (T _A = 25 °C, unless otherwise noted) | | | | | |
|---|-----------------------------------|------------------------|----------------------|-----------------------|-----------------------|
| Parameter | Symbol | N-Channel | P-Channel | Unit | |
| Drain-Source Voltage | V _{DS} | 30 | - 30 | V | |
| Gate-Source Voltage | V _{GS} | ± 20 | ± 20 | | |
| Continuous Drain Current (T _J = 150 °C) | I _D | T _C = 25 °C | 8 ^e | - 8 ^e | A |
| | | T _C = 70 °C | 6.8 | - 6.8 | |
| | | T _A = 25 °C | 6.8 ^{b, c} | - 6.6 ^{b, c} | |
| | | T _A = 70 °C | 5.4 ^{b, c} | - 5.3 ^{b, c} | |
| Pulsed Drain Current (10 μs Pulse Width) | I _{DM} | 40 | - 40 | A | |
| Source-Drain Current Diode Current | I _S | T _C = 25 °C | 2.6 | | - 2.6 |
| | | T _A = 25 °C | 1.6 ^{b, c} | | - 1.6 ^{b, c} |
| Pulsed Source-Drain Current | I _{SM} | 40 | - 40 | mJ | |
| Single Pulse Avalanche Current | I _{AS} | 10 | - 20 | | |
| Single Pulse Avalanche Energy | E _{AS} | 5 | 20 | W | |
| Maximum Power Dissipation | P _D | T _C = 25 °C | 3.1 | | 3.2 |
| | | T _C = 70 °C | 2 | | 2.1 |
| | | T _A = 25 °C | 2 ^{b, c} | | 2 ^{b, c} |
| | | T _A = 70 °C | 1.28 ^{b, c} | 1.28 ^{b, c} | |
| Operating Junction and Storage Temperature Range | T _J , T _{stg} | - 55 to 150 | | °C | |

| THERMAL RESISTANCE RATINGS | | | | | | | |
|---|-------------------|-----------|------|-----------|------|------|--|
| Parameter | Symbol | N-Channel | | P-Channel | | Unit | |
| | | Typ. | Max. | Typ. | Max. | | |
| Maximum Junction-to-Ambient ^{b, d} | R _{thJA} | 50 | 62.5 | 47 | 62.5 | °C/W | |
| Maximum Junction-to-Foot (Drain) | R _{thJF} | 30 | 40 | 29 | 38 | | |

Notes:

- a. Based on T_C = 25 °C.
- b. Surface mounted on 1" x 1" FR4 board.
- c. t = 10 s.
- d. Maximum under steady state conditions is 120 °C/W (n-channel) and 110 °C/W (p-channel).
- e. Package limited.

| SPECIFICATIONS (T _J = 25 °C, unless otherwise noted) | | | | | | | |
|---|--------------------------------------|---|------|-------------------|-------|-------|-------|
| Parameter | Symbol | Test Conditions | Min. | Typ. ^a | Max. | Unit | |
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V _{DS} | V _{GS} = 0 V, I _D = 250 μA | N-Ch | 30 | | | V |
| | | V _{GS} = 0 V, I _D = - 250 μA | P-Ch | - 30 | | | |
| V _{DS} Temperature Coefficient | ΔV _{DS} /T _J | I _D = 250 μA | N-Ch | | 40 | | mV/°C |
| | | I _D = - 250 μA | P-Ch | | - 34 | | |
| V _{GS(th)} Temperature Coefficient | ΔV _{GS(th)} /T _J | I _D = 250 μA | N-Ch | | - 4.1 | | |
| | | I _D = - 250 μA | P-Ch | | 5 | | |
| Gate Threshold Voltage | V _{GS(th)} | V _{DS} = V _{GS} , I _D = 250 μA | N-Ch | 1.0 | | 2.0 | V |
| | | V _{DS} = V _{GS} , I _D = - 250 μA | P-Ch | - 1.0 | | - 2.0 | |
| Gate-Body Leakage | I _{GSS} | V _{DS} = 0 V, V _{GS} = ± 12 V | N-Ch | | | ± 100 | nA |
| | | V _{DS} = 0 V, V _{GS} = ± 12 V | P-Ch | | | ± 100 | |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} = 30 V, V _{GS} = 0 V | N-Ch | | | 1 | μA |
| | | V _{DS} = - 30 V, V _{GS} = 0 V | P-Ch | | | - 1 | |
| | | V _{DS} = 30 V, V _{GS} = 0 V, T _J = 55 °C | N-Ch | | | 10 | |
| | | V _{DS} = - 30 V, V _{GS} = 0 V, T _J = 55 °C | P-Ch | | | - 10 | |
| On-State Drain Current ^b | I _{D(on)} | V _{DS} = 5 V, V _{GS} = 10 V | N-Ch | 20 | | | A |
| | | V _{DS} = - 5 V, V _{GS} = - 10 V | P-Ch | - 20 | | | |
| Drain-Source On-State Resistance ^b | R _{DS(on)} | V _{GS} = 10 V, I _D = 6.8 A | N-Ch | | 0.018 | | Ω |
| | | V _{GS} = - 10 V, I _D = - 8 A | P-Ch | | 0.040 | | |
| | | V _{GS} = 8 V, I _D = 6.7 A | N-Ch | | 0.020 | | |
| | | V _{GS} = - 8 V, I _D = - 6.5 A | P-Ch | | 0.044 | | |
| | | V _{GS} = 4.5 V, I _D = 6.6 A | N-Ch | | 0.024 | | |
| | | V _{GS} = - 4.5 V, I _D = - 5 A | P-Ch | | 0.050 | | |
| Forward Transconductance ^b | g _{fs} | V _{DS} = 15 V, I _D = 6.8 A | N-Ch | | 27 | | S |
| | | V _{DS} = - 15 V, I _D = - 6.7 A | P-Ch | | 25 | | |
| Dynamic^a | | | | | | | |
| Input Capacitance | C _{iss} | N-Channel V _{DS} = 20 V, V _{GS} = 0 V, f = 1 MHz | N-Ch | | 510 | | pF |
| Output Capacitance | C _{oss} | | P-Ch | | 620 | | |
| Reverse Transfer Capacitance | C _{rss} | P-Channel V _{DS} = - 20 V, V _{GS} = 0 V, f = 1 MHz | N-Ch | | 95 | | |
| | | | P-Ch | | 115 | | |
| Total Gate Charge | Q _g | V _{DS} = 20 V, V _{GS} = 10 V, I _D = 10 A | N-Ch | | 6 | 10 | nC |
| | | | P-Ch | | 41.5 | 63 | |
| | | V _{DS} = 20 V, V _{GS} = 4.5 V, I _D = 10 A | N-Ch | | 5.8 | 7 | |
| | | | P-Ch | | 16 | 22 | |
| Gate-Source Charge | Q _{gs} | P-Channel V _{DS} = - 20 V, V _{GS} = - 4.5 V, I _D = - 10 A | N-Ch | | 1.6 | | |
| Gate-Drain Charge | Q _{gd} | | P-Ch | | 4.3 | | |
| Gate Resistance | R _g | f = 1 MHz | N-Ch | 0.3 | 1.1 | 2.3 | Ω |
| | | | P-Ch | 1.2 | 5.7 | 9.6 | |

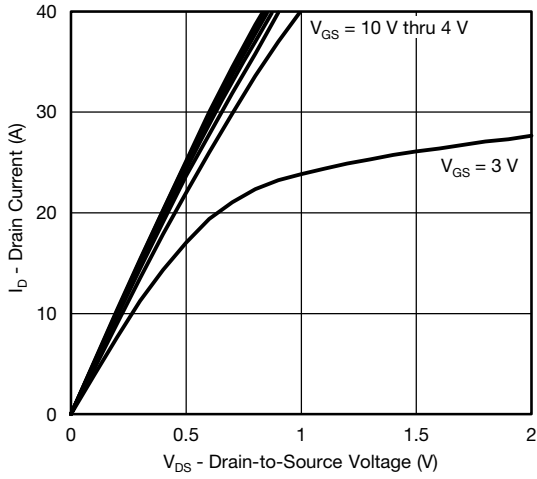
| SPECIFICATIONS (T _J = 25 °C, unless otherwise noted) | | | | | | | |
|---|---------------------|--|------|-------------------|-------|------|----|
| Parameter | Symbol | Test Conditions | Min. | Typ. ^a | Max. | Unit | |
| Dynamic^a | | | | | | | |
| Turn-On Delay Time | t _{d(on)} | N-Channel V _{DD} = 20 V, R _L = 3.7 Ω I _D ≅ 5.4 A, V _{GEN} = 10 V, R _g = 1 Ω P-Channel V _{DD} = -20 V, R _L = 2 Ω I _D ≅ -10 A, V _{GEN} = -10 V, R _g = 1 Ω | N-Ch | | 4 | 8 | ns |
| | | | P-Ch | | 10 | 16 | |
| Rise Time | t _r | | N-Ch | | 10 | 17 | |
| | | | P-Ch | | 9 | 15 | |
| Turn-Off Delay Time | t _{d(off)} | | N-Ch | | 16 | 22 | |
| | | | P-Ch | | 23 | 26 | |
| Fall Time | t _f | | N-Ch | | 5 | 9 | |
| | | | P-Ch | | 10 | 16 | |
| Turn-On Delay Time | t _{d(on)} | N-Channel V _{DD} = 20 V, R _L = 3.7 Ω I _D ≅ 5.4 A, V _{GEN} = 4.5 V, R _g = 1 Ω P-Channel V _{DD} = -20 V, R _L = 2 Ω I _D ≅ -10 A, V _{GEN} = -4.5 V, R _g = 1 Ω | N-Ch | | 10 | 16 | |
| | | | P-Ch | | 26 | 35 | |
| Rise Time | t _r | | N-Ch | | 11 | 20 | |
| | | | P-Ch | | 16 | 26 | |
| Turn-Off Delay Time | t _{d(off)} | | N-Ch | | 13 | 22 | |
| | | | P-Ch | | 16 | 26 | |
| Fall Time | t _f | | N-Ch | | 5 | 9 | |
| | | | P-Ch | | 16 | 26 | |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I _S | T _C = 25 °C | N-Ch | | | 2.6 | A |
| | | | P-Ch | | | -2.6 | |
| Pulse Diode Forward Current ^a | I _{SM} | | N-Ch | | | 40 | A |
| | | | P-Ch | | | -40 | |
| Body Diode Voltage | V _{SD} | I _S = 5.4 A | N-Ch | | 0.81 | 1.2 | V |
| | | I _S = -2 A | P-Ch | | -0.77 | -1.2 | |
| Body Diode Reverse Recovery Time | t _{rr} | N-Channel I _F = 5 A, dI/dt = 100 A/μs, T _J = 25 °C P-Channel I _F = -5 A, dI/dt = -100 A/μs, T _J = 25 °C | N-Ch | | 12 | 25 | ns |
| | | | P-Ch | | 31 | 57 | |
| Body Diode Reverse Recovery Charge | Q _{rr} | | N-Ch | | 10 | 17 | nC |
| | | | P-Ch | | 29 | 47 | |
| Reverse Recovery Fall Time | t _a | | N-Ch | | 10 | | ns |
| | | | P-Ch | | 13 | | |
| Reverse Recovery Rise Time | t _b | | N-Ch | | 7 | | ns |
| | | | P-Ch | | 23 | | |

Notes:

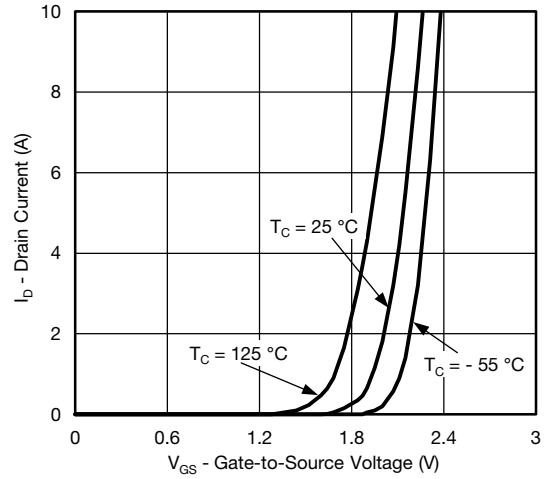
- a. Guaranteed by design, not subject to production testing.
- b. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.

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.

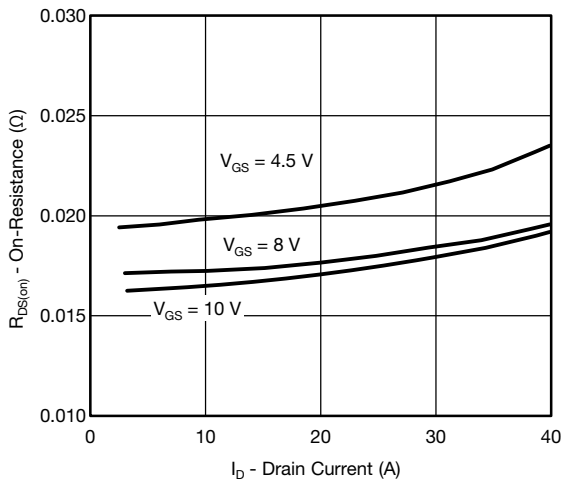
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Output Characteristics



Transfer Characteristics



On-Resistance vs. Drain Current and Gate Voltage



Capacitance



Gate Charge



On-Resistance vs. Junction Temperature

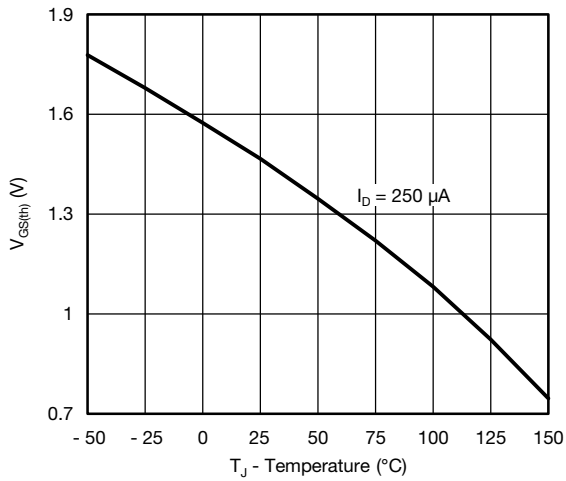
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Source-Drain Diode Forward Voltage



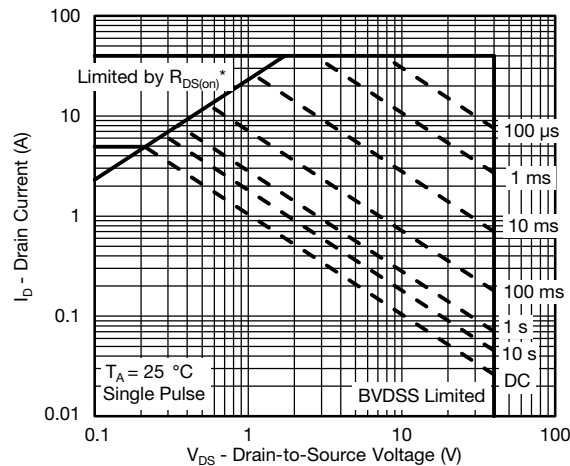
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage

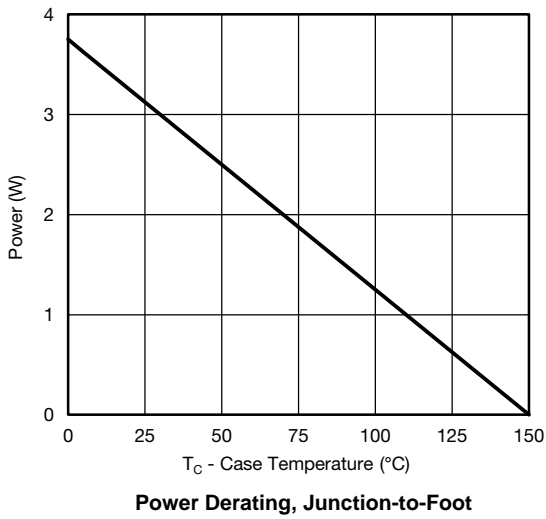
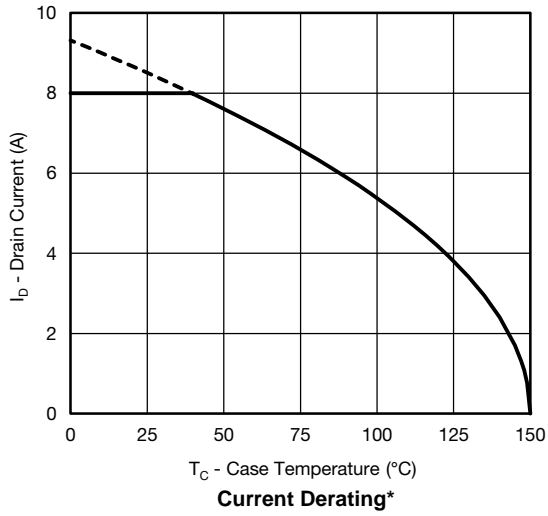


Single Pulse Power, Junction-to-Ambient



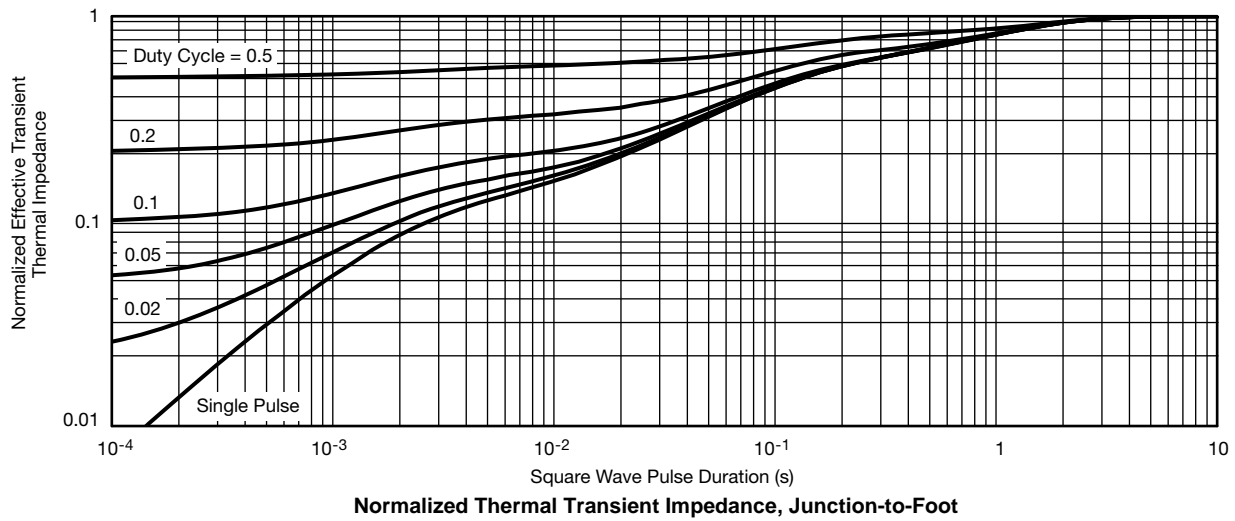
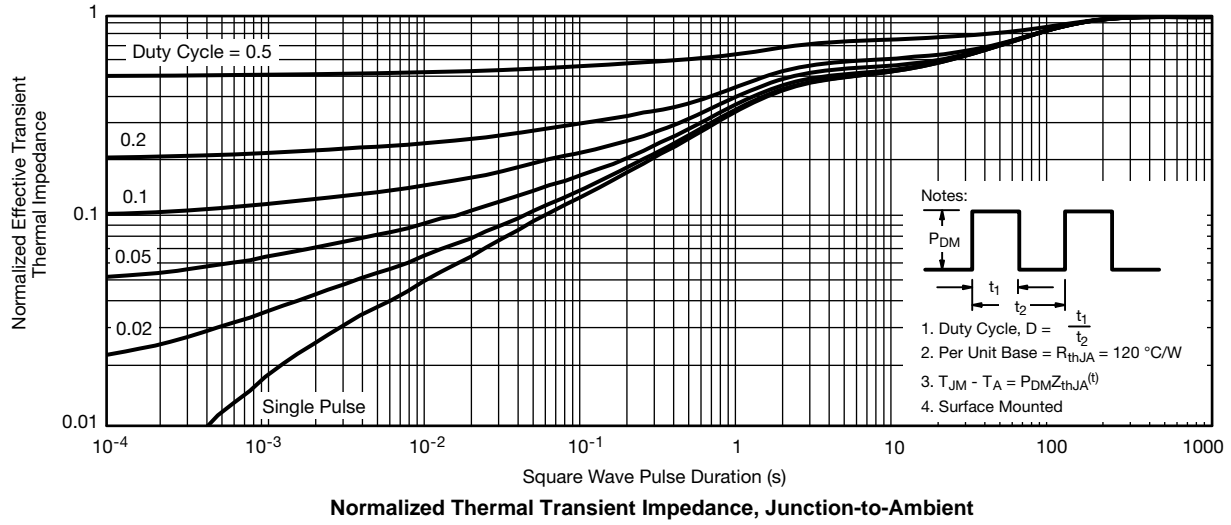
Safe Operating Area, Junction-to-Ambient

N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

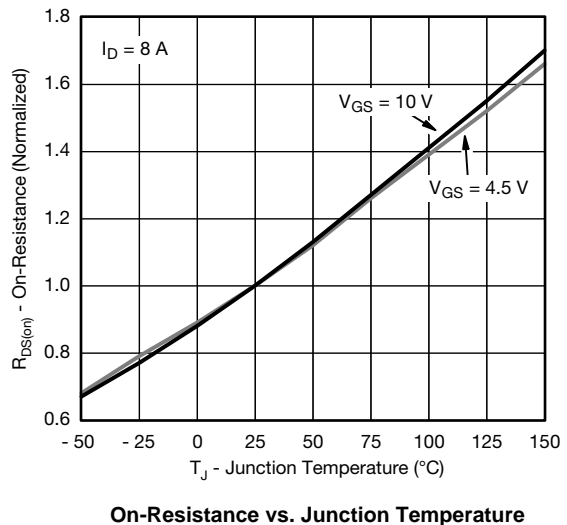
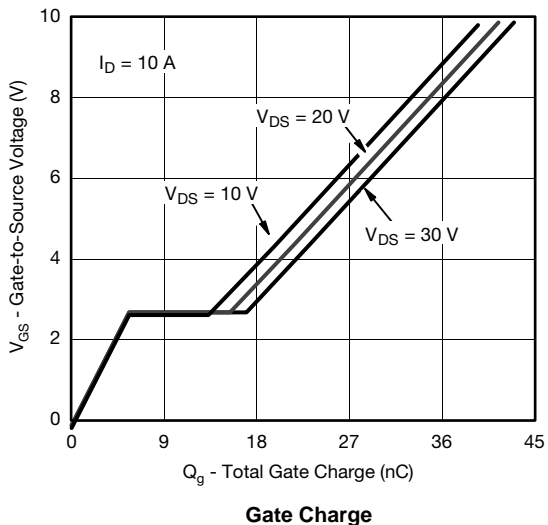
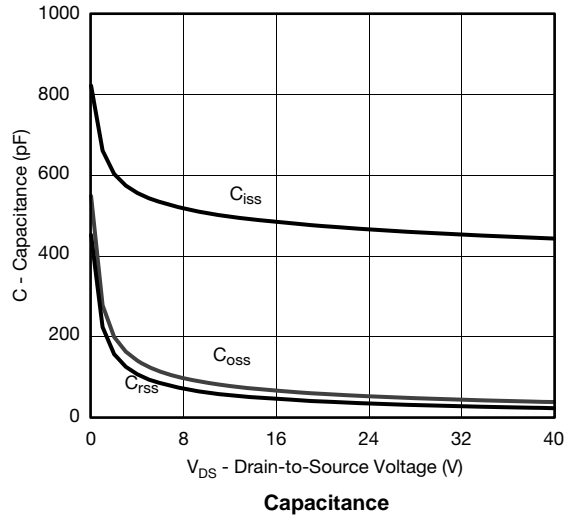
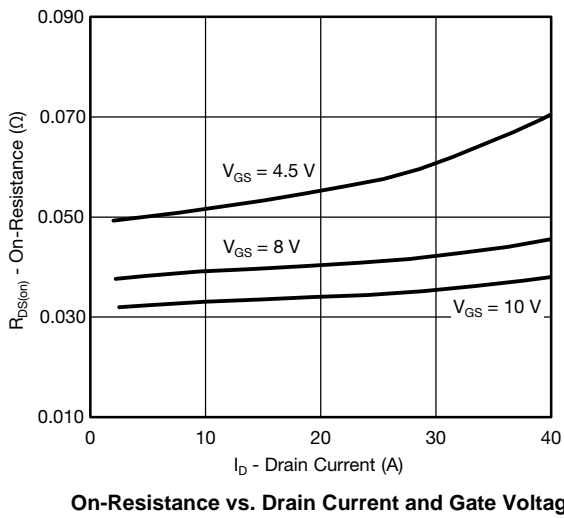
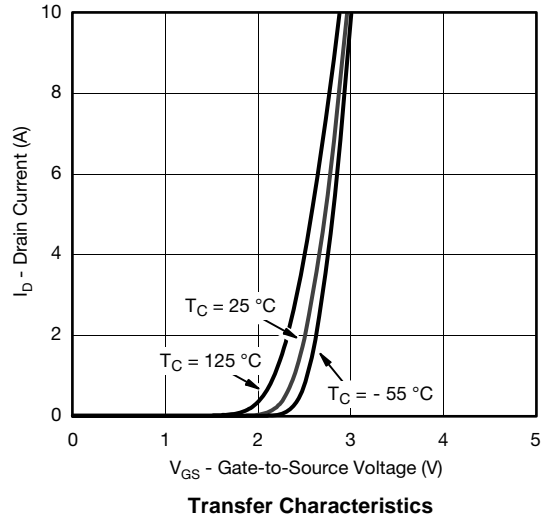
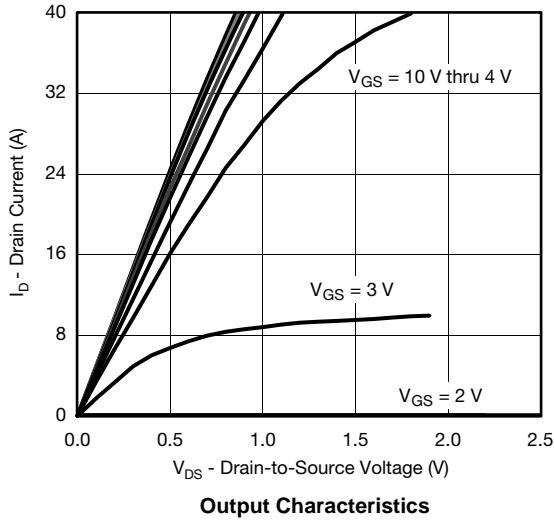


* The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



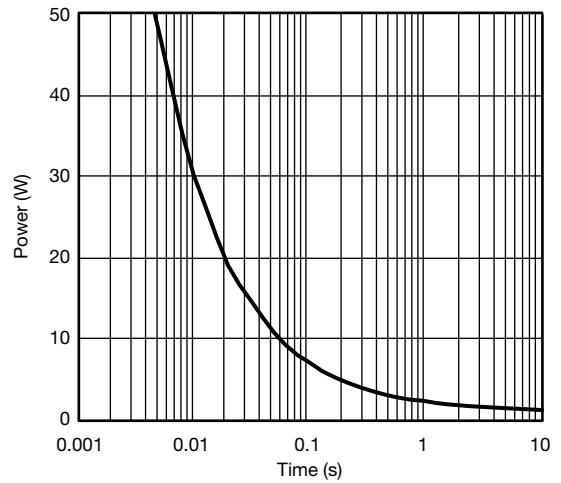
Source-Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage

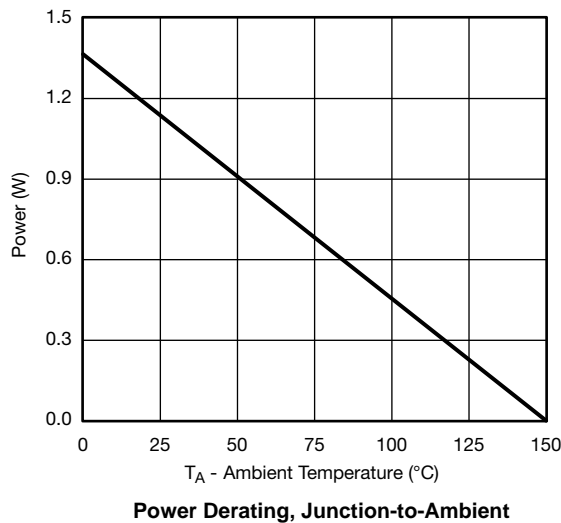
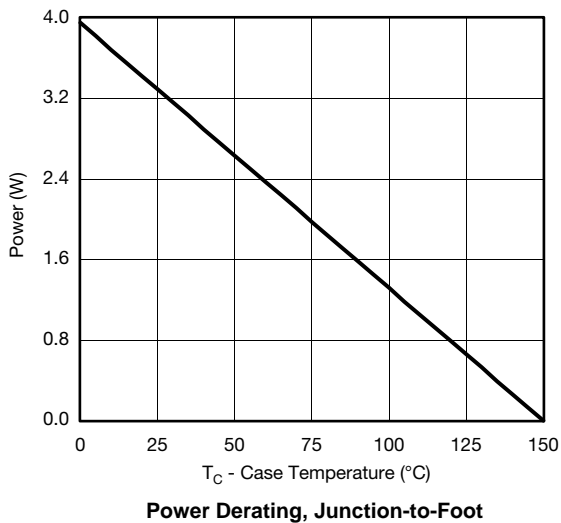
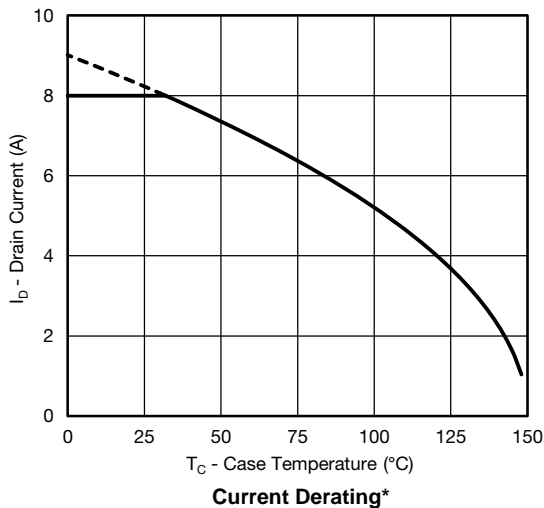


Single Pulse Power, Junction-to-Ambient



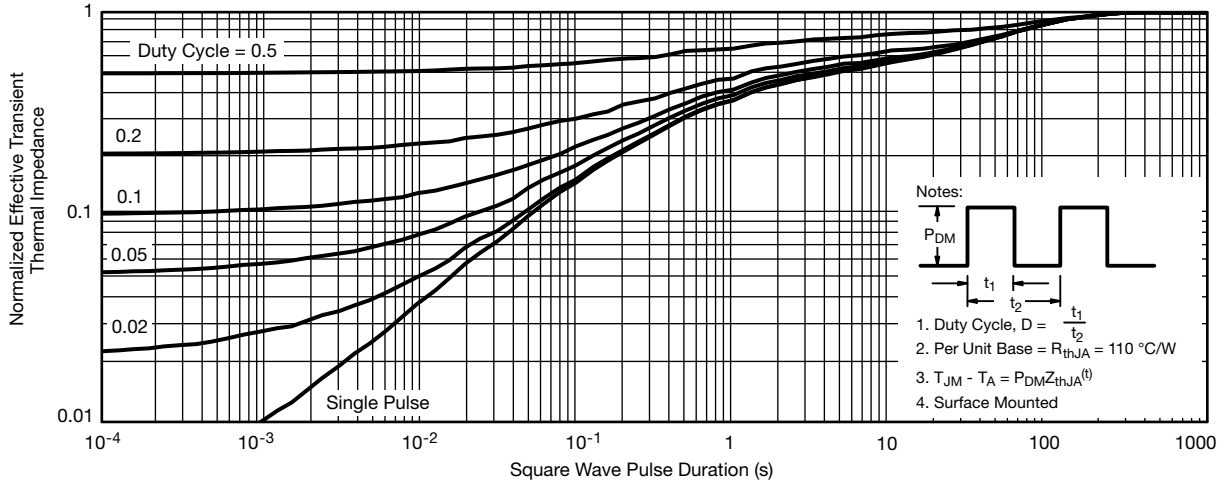
Safe Operating Area, Junction-to-Ambient

P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

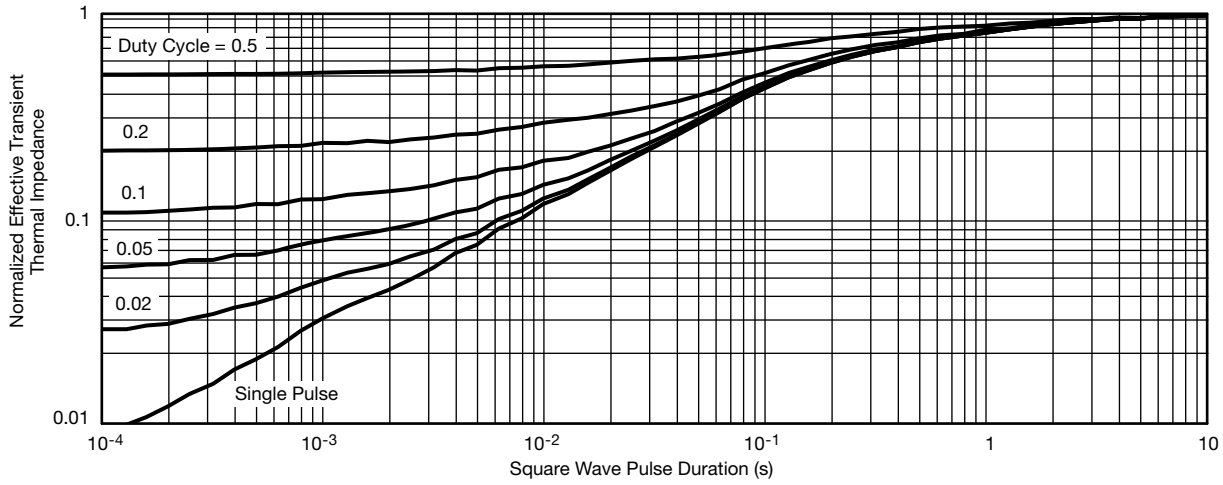


* The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Foot

SOIC (NARROW): 8-LEAD

JEDEC Part Number: MS-012



| DIM | MILLIMETERS | | INCHES | |
|--------------------------------|-------------|------|-----------|-------|
| | Min | Max | Min | Max |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| A ₁ | 0.10 | 0.20 | 0.004 | 0.008 |
| B | 0.35 | 0.51 | 0.014 | 0.020 |
| C | 0.19 | 0.25 | 0.0075 | 0.010 |
| D | 4.80 | 5.00 | 0.189 | 0.196 |
| E | 3.80 | 4.00 | 0.150 | 0.157 |
| e | 1.27 BSC | | 0.050 BSC | |
| H | 5.80 | 6.20 | 0.228 | 0.244 |
| h | 0.25 | 0.50 | 0.010 | 0.020 |
| L | 0.50 | 0.93 | 0.020 | 0.037 |
| q | 0° | 8° | 0° | 8° |
| S | 0.44 | 0.64 | 0.018 | 0.026 |
| ECN: C-06527-Rev. I, 11-Sep-06 | | | | |
| DWG: 5498 | | | | |

RECOMMENDED MINIMUM PADS FOR SO-8



Recommended Minimum Pads
Dimensions in Inches/(mm)

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