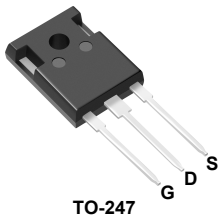
# WTM20N65VF/VMP

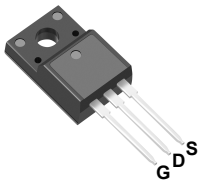
**670V N-Channel MOSFET**

## Features

- 20A, 670V, RDS(on) = 350mΩ @VGS = 10 V
- Low gate charge ( typical 40nC)
- Low Crss ( typical 5.7pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



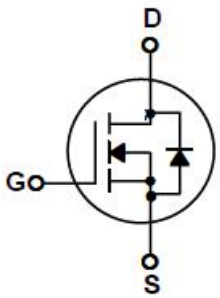

TO-247




TO-220F

## General Description

This Power MOSFET is produced by WPM using its own advanced planar stripe DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.These devices are well suited for high efficiency switched mode power supplies, active power factor correction based on half bridge topology.




| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | 670 | V |
| $I_D$ | Drain Current - Continuous (TC= 25°C) | 20 | A |
| | - Continuous (TC= 100°C) | 13* | A |
| $I_{DM}$ | Drain Current - Pulsed (Note 1) | 80* | A |
| $V_{GSS}$ | Gate-Source Voltage | ± 30 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | 403 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | 20 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | 66 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 5 | V/ns |
| $P_D$ | Power Dissipation (TC = 25°C)TO-220F | 35.0 | W |
| | TO-247 | 178 | W |
| $T_j$ , $T_{stg}$ | Operating and Storage Temperature Range | -55 to +150 | °C |
| $T_L$ | Maximum lead temperature for soldering purposes,1/8" from case for 5 seconds | 300 | °C |

* Drain current limited by maximum junction temperature

## Thermal Characteristics

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 3.47 | °C/W |
| $R_{\theta JS}$ | Thermal Resistance, Case-to-Sink Typ. | -- | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 42.2 | °C/W |

## Electrical Characteristics TC = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA | 670 | | | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | | 0.60 | | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 670 V, $V_{GS}$ = 0 V | | | 1 | μA |
| | | $V_{DS}$ = 400 V, TC = 125°C | | | 10 | μA |
| $I_{GSSF}$ | Gate-Body Leakage Current, Forward | $V_{GS}$ = 30 V, $V_{DS}$ = 0 V | | | 100 | nA |
| $I_{GSSR}$ | Gate-Body Leakage Current, Reverse | $V_{GS}$ = -30 V, $V_{DS}$ = 0 V | | | -100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_D$ =250 uA | 3.0 | | 5.0 | V |
| $R_{DS(On)}$ | Drain-Source On-state Resistance | $V_{GS}$=10 V, $I_D$ =10 A, $T_J$ = 25°C | | 350 | 440 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 10 A (Note 4) | | 18 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | 2289 | | pF |
| $C_{oss}$ | Output Capacitance | | | 277 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 5.7 | | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn On Delay Time | $V_{DD}$ = 335 V, ID = 20 A, $R_G$ = 25 Ω (Note 4, 5) | | 38 | | ns |
| $t_r$ | Rising Time | | | 52 | | ns |
| $t_{d(off)}$ | Turn Off Delay Time | | | 87 | | ns |
| $t_f$ | Fall Time | | | 45 | | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 335 V, ID = 20 A, $V_{GS}$ = 10 V (Note 4, 5) | | 40 | | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 15 | | nC |
| $Q_{gd}$ | Gate-Drain Charge | | | 12 | | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | | | 20 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | | | 80 | A |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$= 0 V, $I_S$ = 20 A | | | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_S$ = 20 A, $dI_F$ / dt = 100 A/μs Note 4) | | 484 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 6.5 | | μC |

**Notes:**
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L =2.0 mH, IAS = 20A, VDD = 50V, RG = 25Ω, Starting TJ = 25°C
3. ISD≤20A, di/dt ≤200A/us, VDD ≤ BVDSS, Starting TJ = 25°C
4. Pulse Test : Pulse width ≤ 300us, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Characteristics

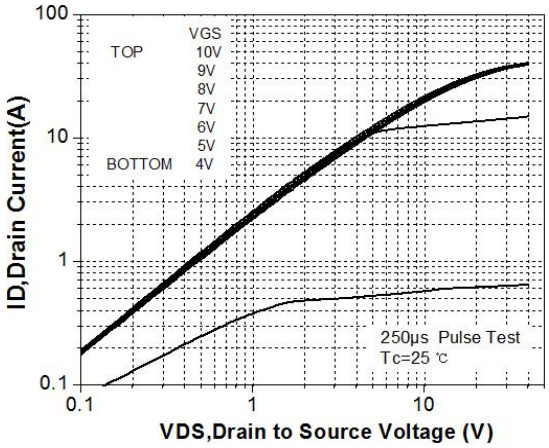



Figure 1. On-Region Characteristics

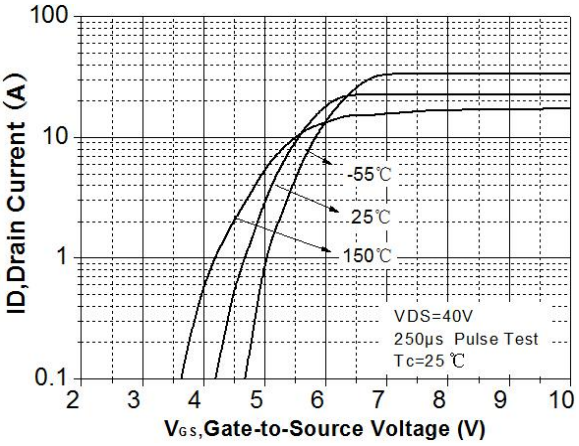



Figure 2. Transfer Characteristics

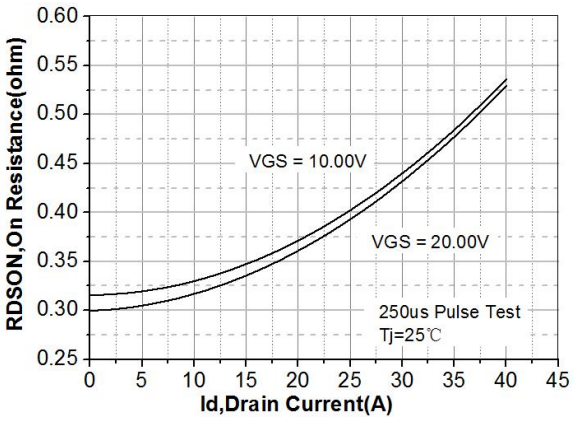



Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

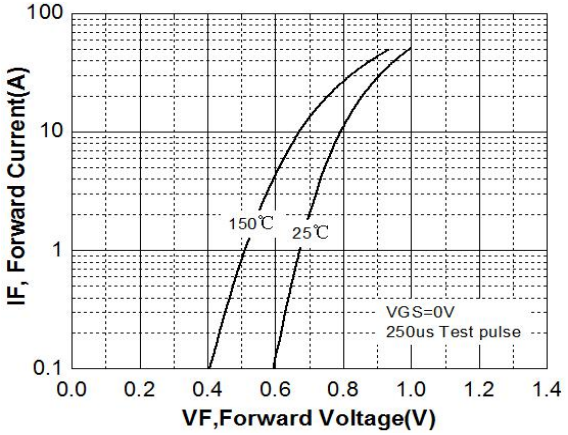



Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

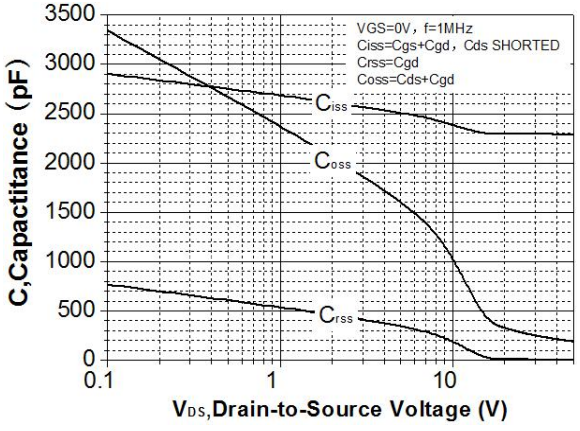



Figure 5. Capacitance Characteristics

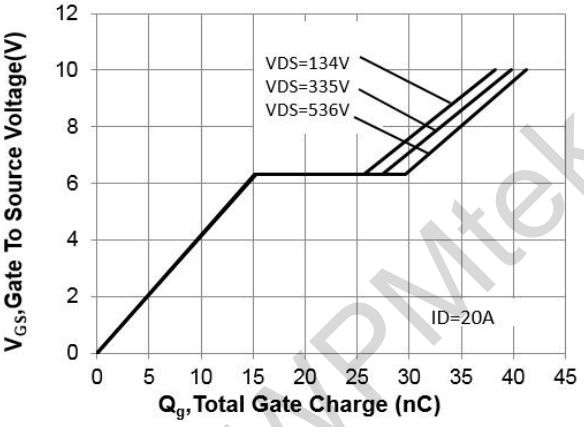



Figure 6. Gate Charge Characteristics

## Typical Characteristics (Continued)

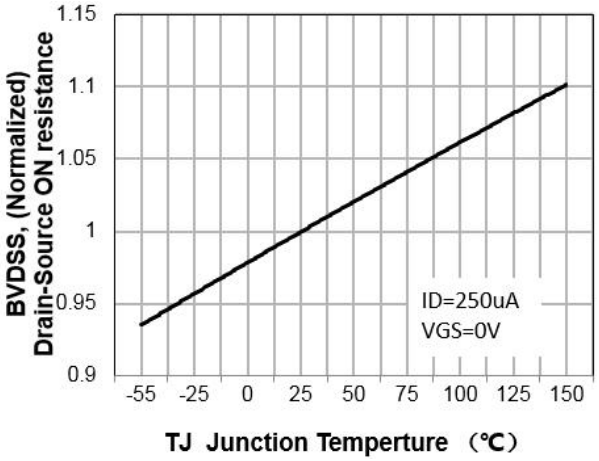



Figure 7. Breakdown Voltage Variation vs Temperature

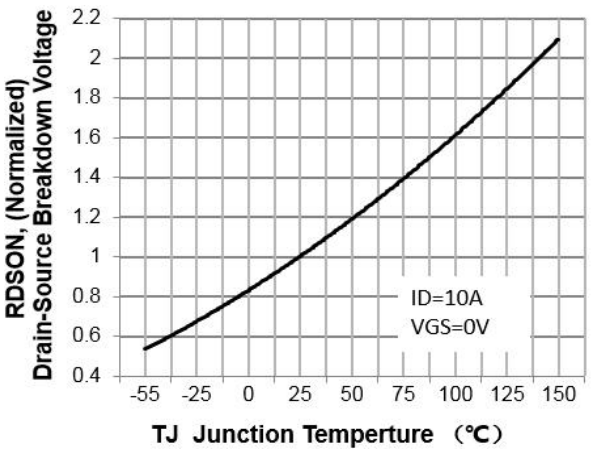



Figure 8. On-Resistance Variation vs Temperature

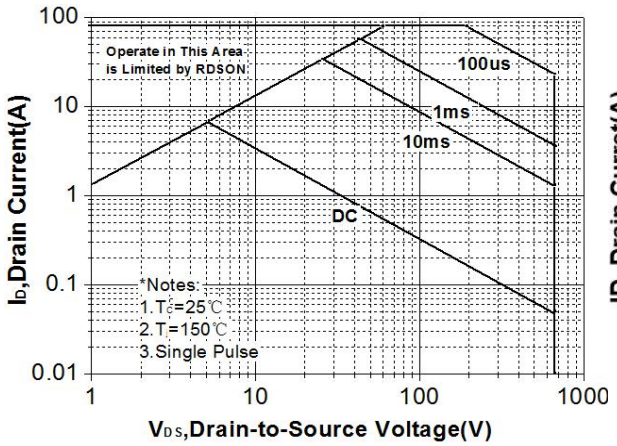



Figure 9. Maximum Safe Operating Area

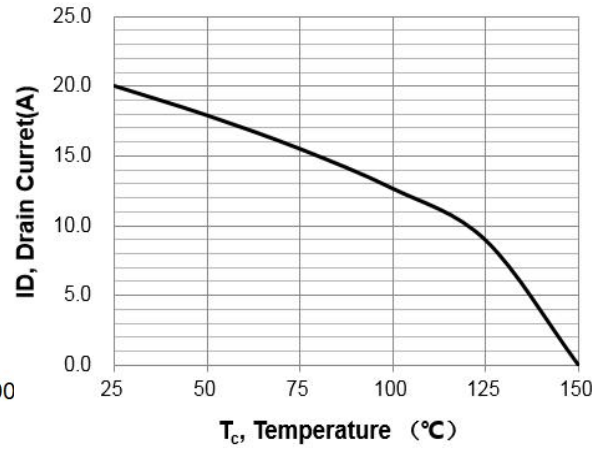



Figure 10. Maximum Drain Current vs Case Temperature

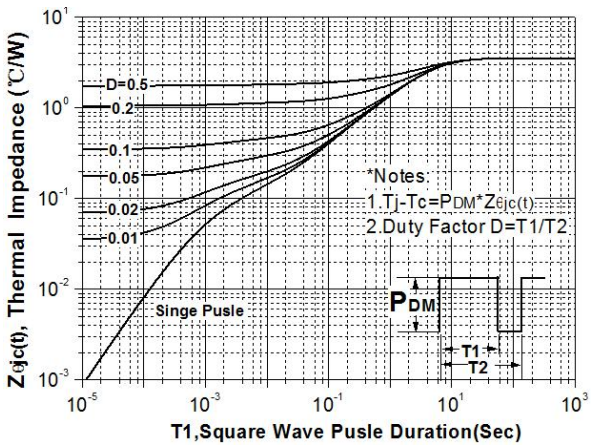
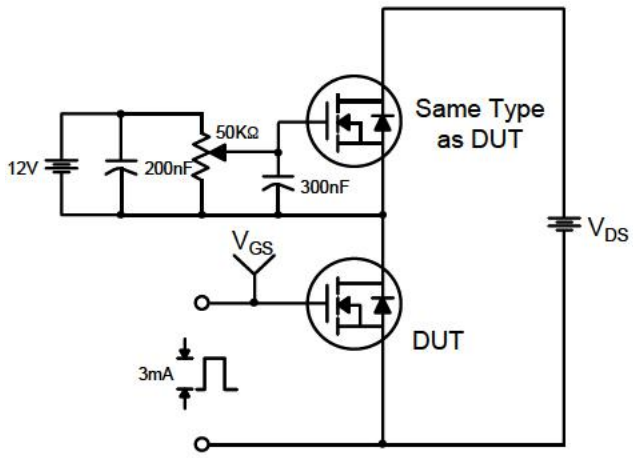
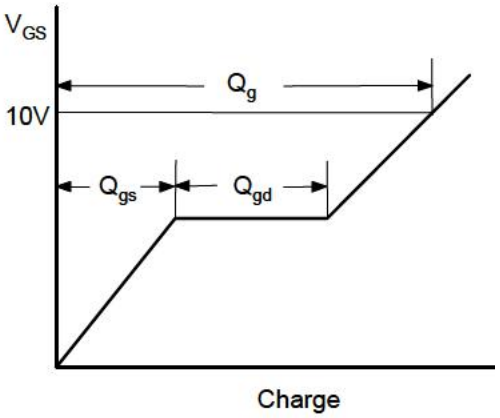


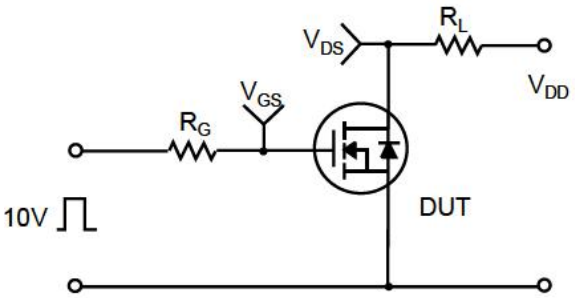

Figure 11. Transient Thermal Response Curve

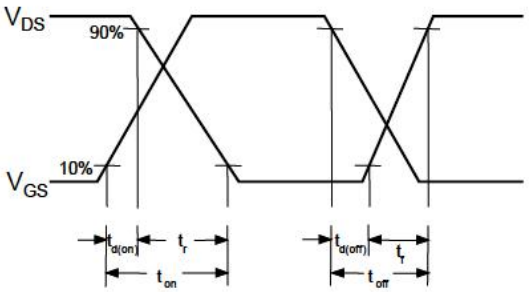
## Gate Charge Test Circuit & Waveform



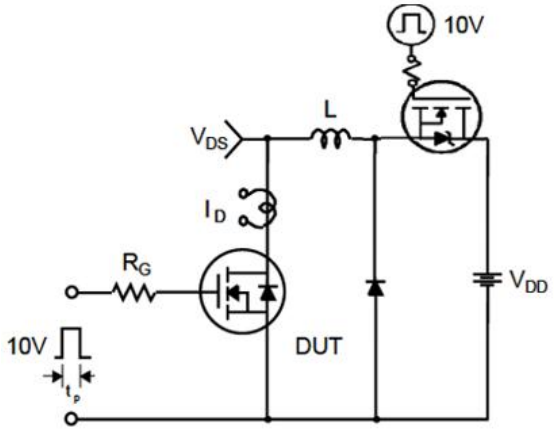



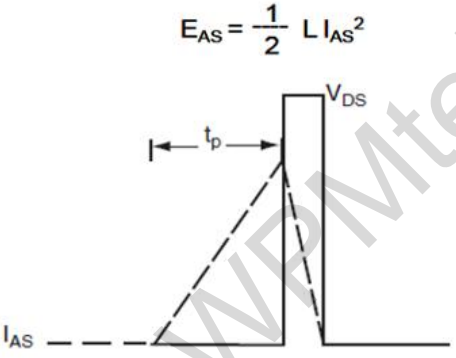

## Resistive Switching Test Circuit & Waveforms



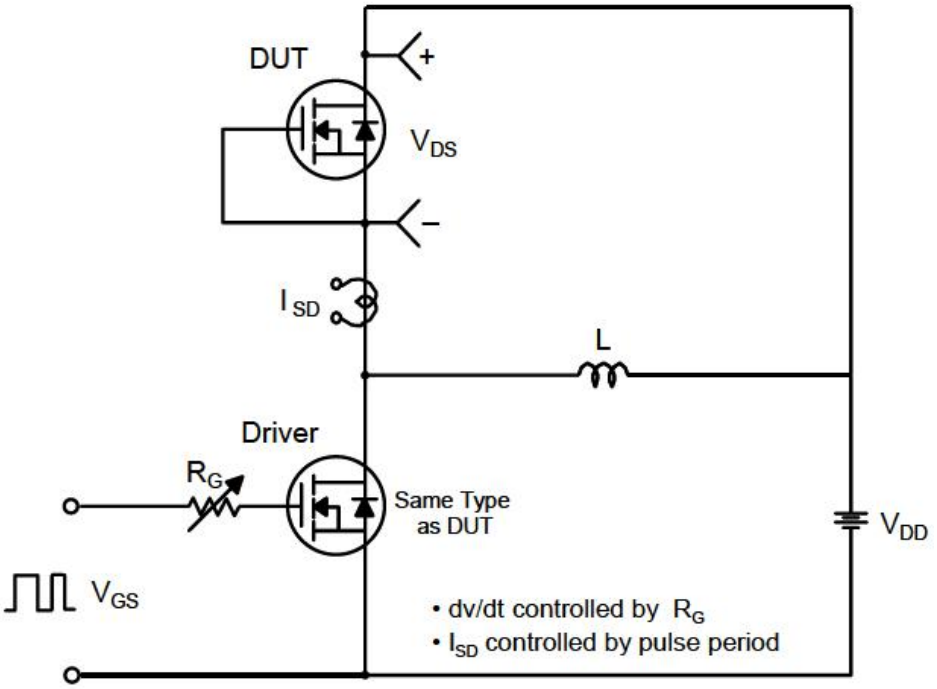



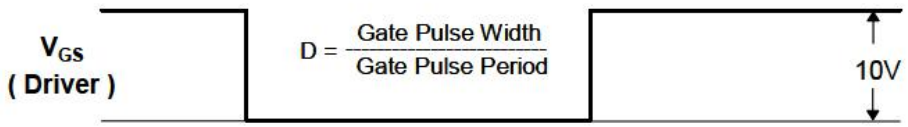

## Unclamped Inductive Switching Test Circuit & Waveforms

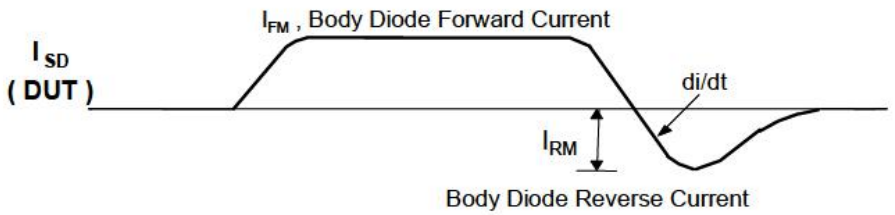


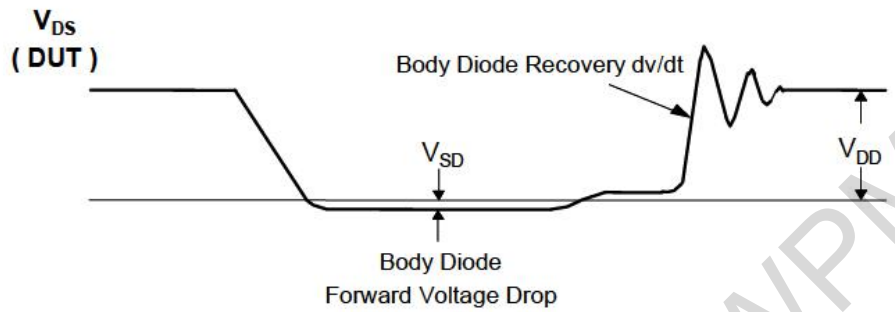



## Peak Diode Recovery dv/dt Test Circuit & Waveforms



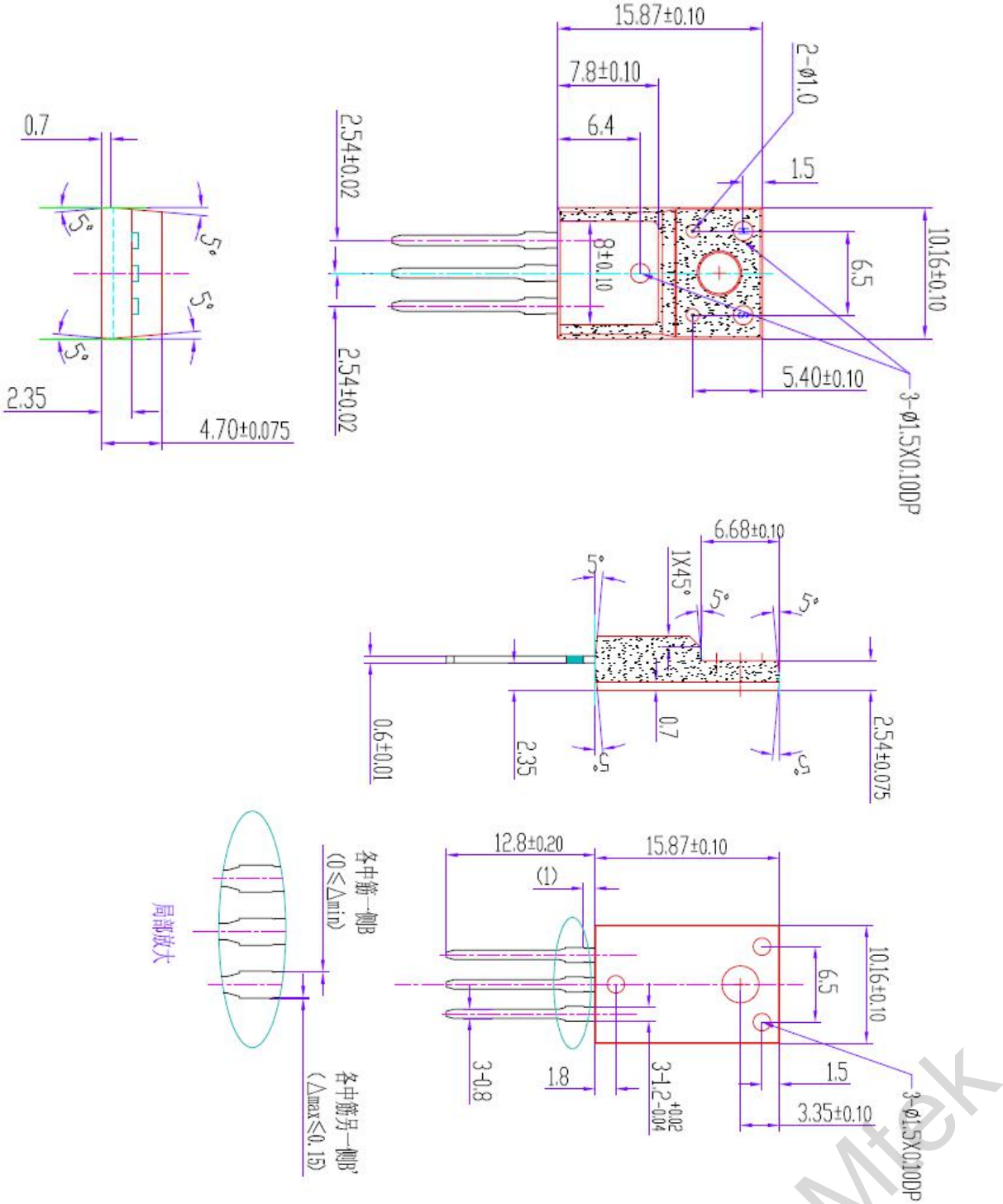



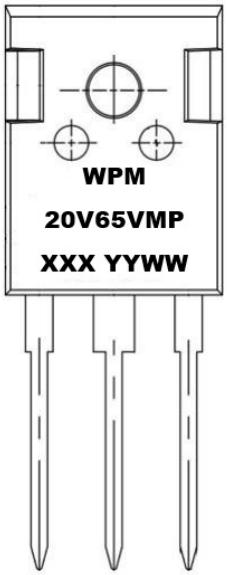
## Package Dimensions

TO220F



## Marking Information

**TO-247**

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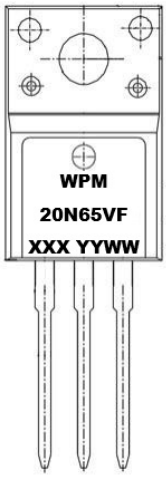


**WPM=WPMtek's Logo**
**20N65VF=Marking**
**XXX YYWW=Date Code**