# WTC

## Winsem Technology Corp.

# WMF7N65U
# POWER MOSFET
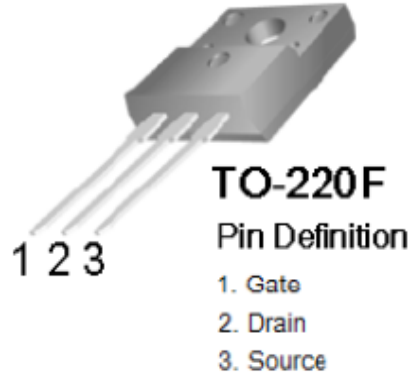
## 650V N-Channel Power MOSFET

## Features

- High Voltage: $BV_{DSS}$=650V(Min.)
- $I_D$ : 7A
- Robust high voltage termination
- Avalanche energy specified
- Fast diode recovery time

## Application
- Ballast Bridge
- Switch Mode Power Supplier
- Power Factor Correction
- Lighting

**TO-220F**

**Pin Definition**
1. Gate
2. Drain
3. Source

## Ordering Information

| Type NO | Marking | Package Code |
|---------|---------|--------------|
| WMF7N65U | 7N65FU | TO-220F |

## Absolute maximum ratings (T<sub>C</sub>=25°C unless otherwise noted)

| Characteristic | | Symbol | Rating | Unit |
|----------------|--|--------|--------|------|
| Drain-source voltage | | $V_{DSS}$ | 650 | V |
| Gate-source voltage | | $V_{GSS}$ | $\pm30$ | V |
| Drain current (DC) * | $I_D$ | $T_C$=25℃ | 7.0 | A |
| | | $T_C$=100℃ | 4.43 | A |
| Drain current (Pulsed) * | | $I_{DM}$ | 28 | A |
| Single avalanche energy ② | | $E_{AS}$ | 92.9 | mJ |
| Repetitive avalanche current ① | | $I_{AR}$ | 7.0 | A |
| Repetitive avalanche energy ① | | $E_{AR}$ | 3.2 | mJ |
| Power dissipation | | $P_D$ | 32 | W |
| Junction temperature | | $T_J$ | 150 | °C |
| Storage temperature range | | $T_{stg}$ | -55~150 | °C |

* Limited by maximum junction temperature

| Characteristic | | Symbol | Typ. | Max | Unit |
|----------------|--|--------|------|-----|------|
| Thermal resistance | Junction-case | $R_{th(J-C)}$ | - | 3.9 | ℃/W |
| | Junction-ambient | $R_{th(J-A)}$ | - | 62.5 | |

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

| Characteristic | | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Drain-source breakdown voltage | | BV$_{DSS}$ | I$_D$=250 $\mu$A, V$_{GS}$=0V | 650 | - | - | V |
| Gate threshold voltage | | V$_{GS(th)}$ | I$_D$=250 $\mu$A, V$_{DS}$= V$_{GS}$ | 3.0 | - | 5.0 | V |
| Drain-source cut-off current | | I$_{DSS}$ | V$_{DS}$=650V, V$_{GS}$=0V | - | - | 1 | $\mu$A |
| | | | V$_{DS}$=650V, T$_c$=150°C | | | 100 | $\mu$A |
| Gate leakage current | | I$_{GSS}$ | V$_{DS}$=0V, V$_{GS}$=±30V | - | - | ±100 | nA |
| Drain-source on-resistance | | R$_{DS(on)}$ | V$_{GS}$=10V, I$_D$=3.5A | - | 1.2 | 1.4 | Ω |
| Forward transfer conductance ③ | | g$_{fs}$ | V$_{DS}$=10V, I$_D$=3.5A | - | 8.7 | - | S |
| Input capacitance | | C$_{iss}$ | V$_{DS}$=25V, V$_{GS}$=0V f=1 MHz | - | 1380 | - | pF |
| Output capacitance | | C$_{oss}$ | | - | 90 | - | |
| Reverse transfer capacitance | | C$_{rss}$ | | - | 9 | - | |
| Turn-on delay time ③④ | | t$_{d(on)}$ | V$_{DS}$=325V, I$_D$=7A R$_G$=25Ω | - | 69 | - | ns |
| Rise time ③④ | | t$_r$ | | - | 37 | - | |
| Turn-off delay time ③④ | | t$_{d(off)}$ | | - | 130 | - | |
| Fall time ③④ | | t$_f$ | | - | 25 | - | |
| Total gate charge ③④ | | Q$_g$ | V$_{DS}$=520V, V$_{GS}$=10V I$_D$=7A | - | 21 | 26 | nC |
| Gate-source charge ③④ | | Q$_{gs}$ | | - | 9 | - | |
| Gate-drain charge ③④ | | Q$_{gd}$ | | - | 5 | - | |

# Source-Drain Diode Ratings and Characteristics (T$_C$=25°C unless otherwise noted)

| Characteristic | | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Source current (DC) | | I$_S$ | Integral reverse diode in the MOSFET | - | - | 7 | A |
| Source current (Pulsed) | | I$_{SM}$ | | - | - | 28 | |
| Forward voltage | | V$_{SD}$ | V$_{GS}$=0V, I$_{SD}$=7A | - | - | 1.4 | V |
| Reverse recovery time ③④ | | t$_{rr}$ | I$_{SD}$=7A, V$_{GS}$=0V dI$_F$/dt=100A/$\mu$s | - | 410 | - | ns |
| Reverse recovery charge ③④ | | Q$_{rr}$ | | - | 1.7 | - | μC |

Note ;

1. Repetitive rating : Pulse width limited by safe operating area
2. L=10mH, I$_{AS}$=4A, V$_{DD}$=50V, R$_G$=25 Ω, Starting T$_J$=25°C
3. Pulse Test : Pulse width≤ 300 $\mu$s, Duty cycle≤ 2%
4. Essentially independent of operating temperature typical characteristics

## Electrical Characteristic Curves
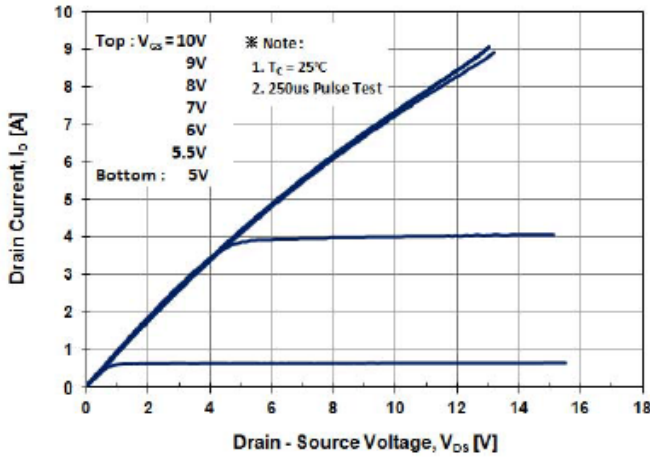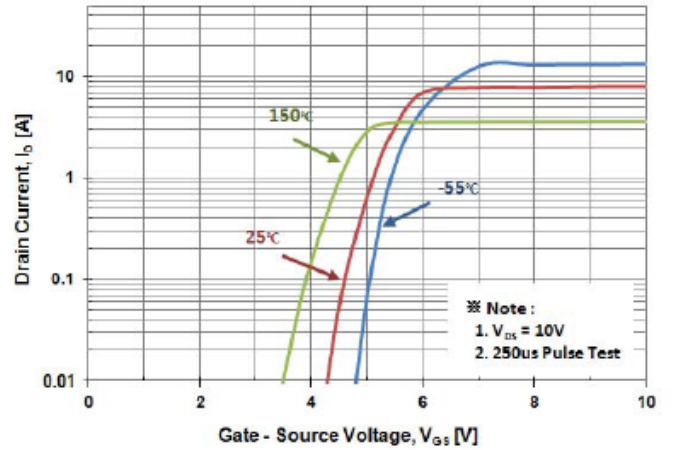
### Fig. 1 Typical Output Characteristics



Top : $V_{GS}$ = 10V
9V
8V
7V
6V
5.5V
Bottom : 5V

※ Note :
1. $T_C$ = 25℃
2. 250us Pulse Test

### Fig. 2 Typical Output Characteristics



150℃
-55℃
25℃

※ Note :
1. $V_{DS}$ = 10V
2. 250us Pulse Test

### Fig. 3 On-Resistance Variation with Drain Current and Gate Voltage



$V_{GS}$=10V
$V_{GS}$=20V

※ Note :
1. $T_J$ = 25℃
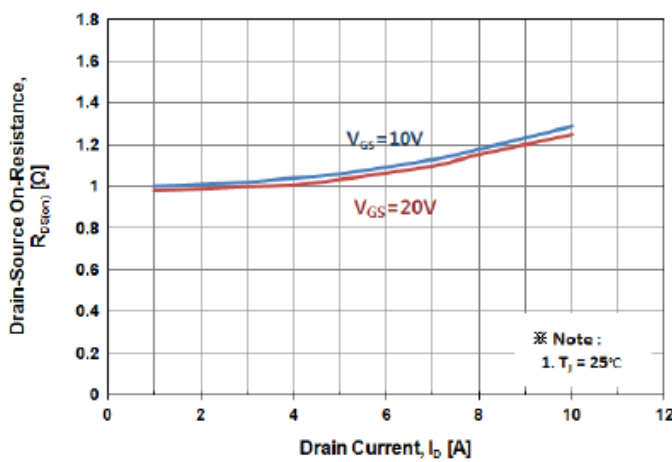
### Fig. 4 Body Diode Forward Voltage Variation with Source Current



※ Note :
1. $V_{GS}$ = 0V
2. 250us Pulse Test
3. $T_J$ = 25℃
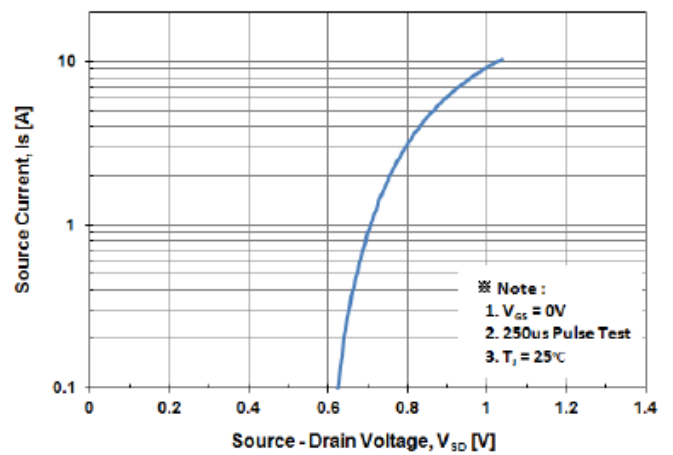
### Fig. 5 Typical Capacitance Characteristics



Ciss
Coss
Crss

Ciss = Cgs + Cgd (Cds = shorted)
Coss = Cds + Cgd
Crss = Cgd
※ Note :
1. $V_{GS}$ = 0V
2. f = 1MHz
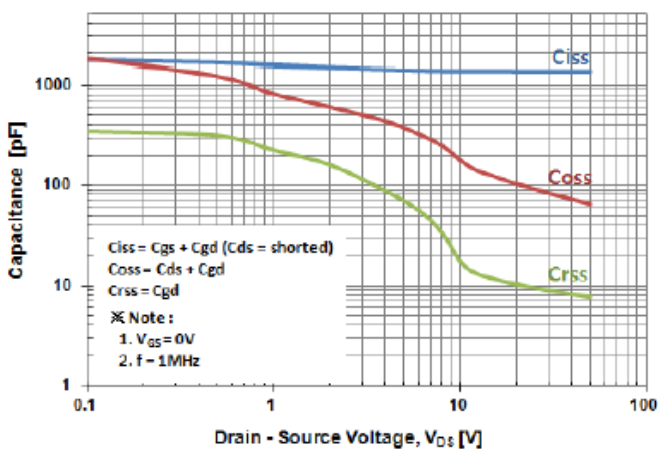
### Fig. 6 Typical Total Gate Charge Characteristics



※ Note :
1. $I_D$ = 7A
2. $V_{DS}$ = 480V
3. $V_{GS}$ = 10V

3
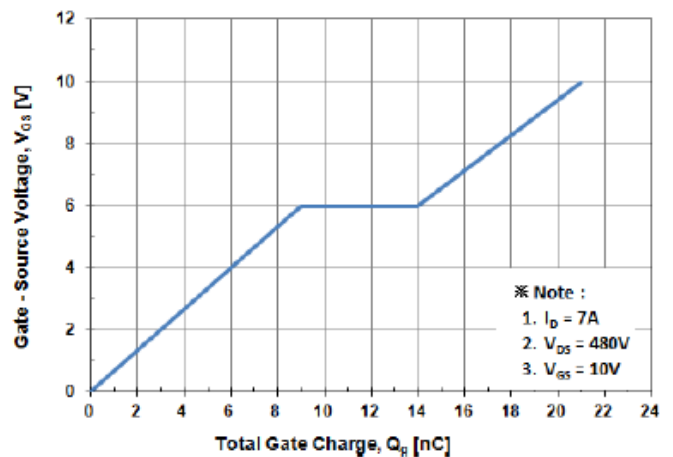
# Electrical Characteristic Curves

### Fig. 7 Breakdown Voltage Variation vs. Temperature



※ Note :
1. $V_{GS}$ = 0V
2. $I_{DS}$ = 250uA
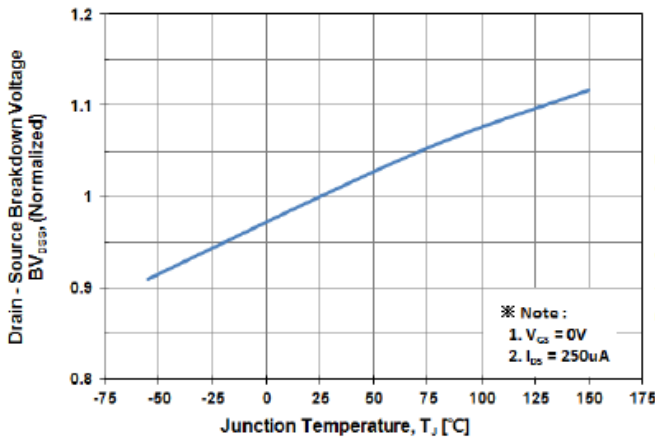
### Fig. 8 On-Resistance Variation vs. Temperature



※ Note :
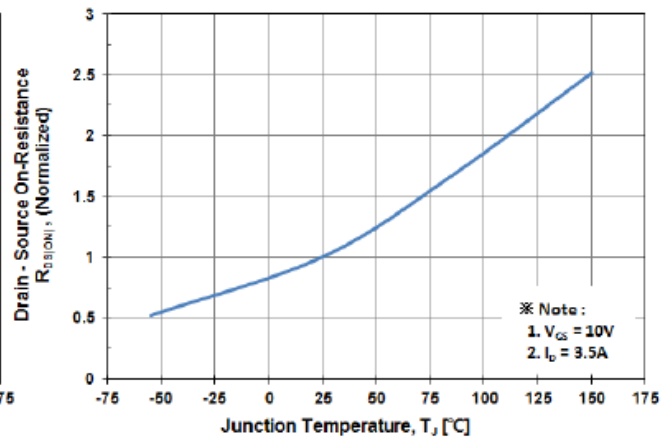1. $V_{GS}$ = 10V
2. $I_D$ = 3.5A

### Fig. 9 Maximum Drain Current vs. Case Temperature
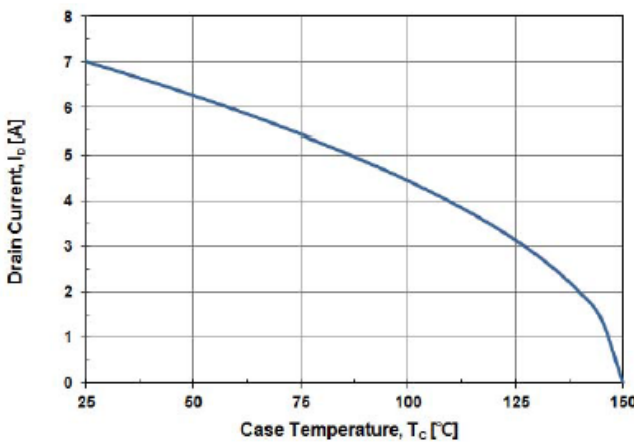


### Fig. 10 Maximum Safe Operating Area



Operation in This Area is Limited by $R_{DS(on)}$

※ Note :
1. $T_C$ = 25℃
2. $T_J$ = 150℃
3. Single Pulse
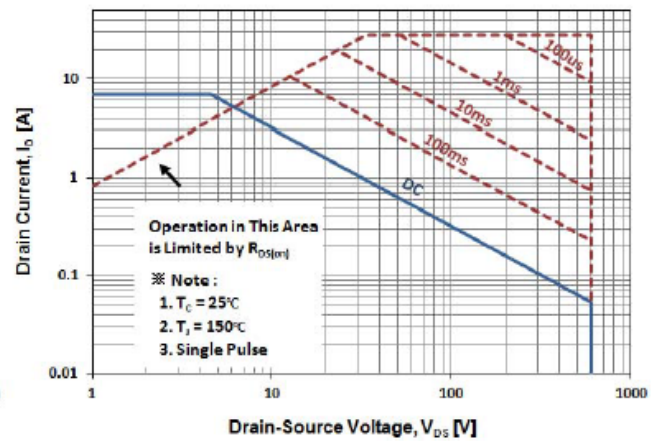
### Fig. 11 Transient Thermal Impedance



Single Pulse
δ=0.01
δ=0.02
δ=0.05
δ=0.1
δ=0.2
δ=0.5

※ Note :
1. $Z_{θJC}(t)$ = 3.9℃/W Max.
2. Duty Factor, δ = t1 / t2
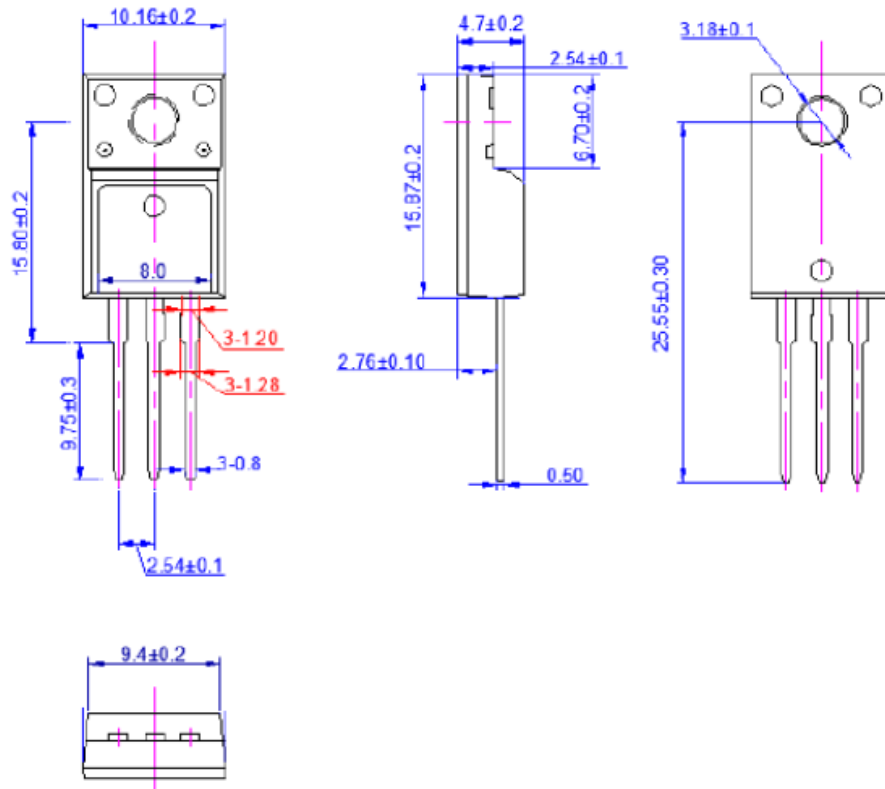3. $T_{JM} - T_C = P_{DM} × Z_{θJC}(t)$
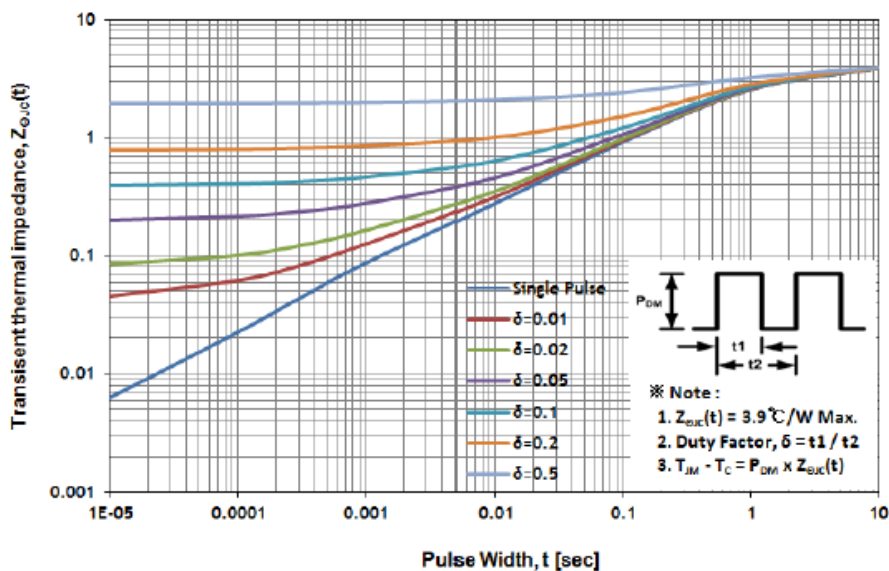
## Outline Dimension : TO-220F



**Unit : mm**

## Marking Diagram
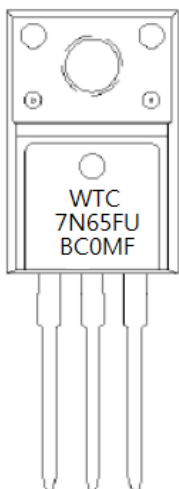


| First Line | WTC | Company Name | |
|---|---|---|---|
| Second Line | 7N65FU | Product Code | |
| | | 1st ( Year Code ) | A-2010   B-2011   C-2012 ··· |
| | | 2nd ( Month Code ) | A-Jan   B-Feb   C-Mar   D-Apr   E-May   F-Jun   G-Jul   H-Aug   I-Sep   J-Oct   K-Nov   L-Dec |
| Third Line | BC0MF | 3rd ( Lot Code ) | 0-1 , A-9 |
| | | 4th ( Product Code ) | M-MOS  ,  T-Transsistor |
| | | 5th ( Package Code ) | X-TO-220, F-TO-220F |
| | | 6th ( Spec Code ) | ( Reserve ) |