

# FM400TU-3A

HIGH POWER SWITCHING USE  
INSULATED PACKAGE

## FM400TU-3A



- ID(rms) .....200A
- VDSS..... 150V
- Insulated Type
- 6-elements in a pack
- Thermistor inside
- UL Recognized

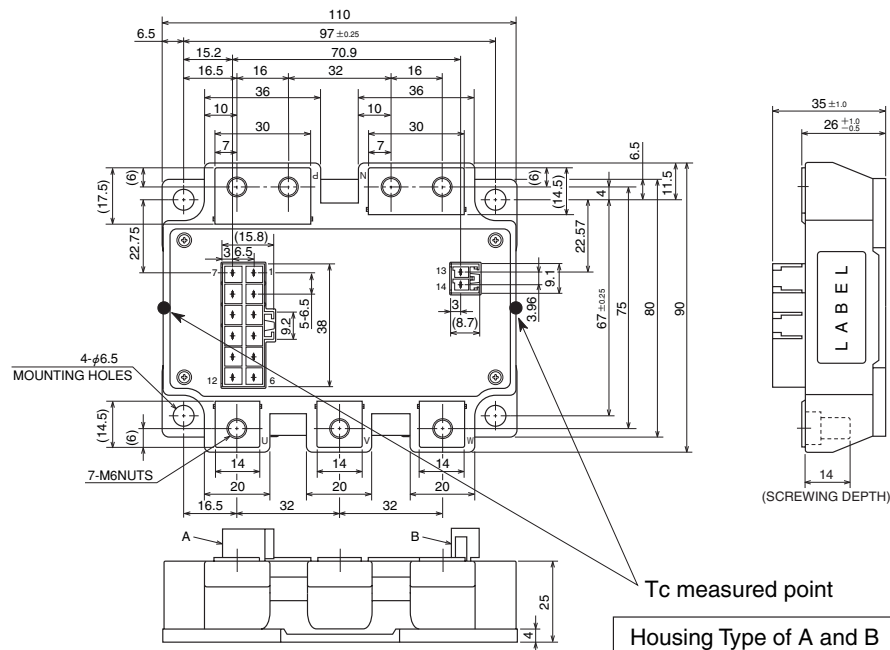
Yellow Card No.E80276  
File No.E80271

## APPLICATION

AC motor control of forklift (battery power source), UPS

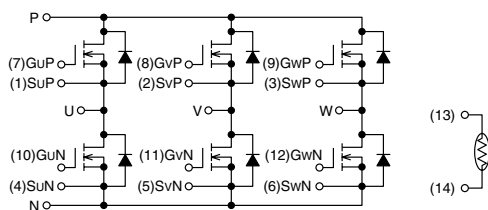
## OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



Tc measured point  
Housing Type of A and B  
(Tyco Electronics P/N:)  
A: 917353-1  
B: 179838-1

### CIRCUIT DIAGRAM



|         |         |        |         |         |         |   |
|---------|---------|--------|---------|---------|---------|---|
| (1)SuP  | (2)SvP  | (3)SwP | (4)SuN  | (5)SvN  | (6)SwN  | A |
| (7)GuP  | (8)GvP  | (9)GwP | (10)GuN | (11)GvN | (12)GwN | A |
| (13)TH1 | (14)TH2 |        |         |         |         | B |

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HIGH POWER SWITCHING USE  
INSULATED PACKAGEABSOLUTE MAXIMUM RATINGS (T<sub>ch</sub> = 25°C unless otherwise specified.)

| Symbol                         | Item                      | Conditions                             | Ratings    | Unit  |
|--------------------------------|---------------------------|--|------------|-------|
| V <sub>DSS</sub>               | Drain-source voltage      | G-S Short                              | 150        | V     |
| V <sub>GSS</sub>               | Gate-source voltage       | D-S Short                              | ±20        | V     |
| I <sub>D</sub>                 | Drain current             | T <sub>C</sub> ' = 112°C* <sup>3</sup> | 200        | A     |
| I <sub>DM</sub>                |                           | Pulse* <sup>2</sup>                    | 400        | A     |
| I <sub>DA</sub>                | Avalanche current         | L = 10μH Pulse* <sup>2</sup>           | 200        | A     |
| I <sub>S</sub> * <sup>1</sup>  | Source current            |  | 200        | A     |
| I <sub>SM</sub> * <sup>1</sup> |                           | Pulse* <sup>2</sup>                    | 400        | A     |
| P <sub>D</sub> * <sup>4</sup>  | Maximum power dissipation | T <sub>C</sub> = 25°C                  | 650        | W     |
| P <sub>D</sub> * <sup>4</sup>  |                           | T <sub>C</sub> ' = 25°C* <sup>3</sup>  | 880        | W     |
| T <sub>ch</sub>                | Channel temperature       |  | -40 ~ +150 | °C    |
| T <sub>stg</sub>               | Storage temperature       |  | -40 ~ +125 | °C    |
| V <sub>iso</sub>               | Isolation voltage         | Main terminal to base plate, AC 1 min. | 2500       | V     |
| —                              | Mounting torque           | Main Terminal M6                       | 3.5 ~ 4.5  | N • m |
| —                              |                           | Mounting M6                            | 3.5 ~ 4.5  | N • m |
| —                              | Weight                    | Typical value                          | 600        | g     |

ELECTRICAL CHARACTERISTICS (T<sub>ch</sub> = 25°C unless otherwise specified.)

| Symbol                         | Item  | Conditions  | Limits                  |      |       | Unit |    |
|--------------------------------|---|---|-------------------------|------|-------|------|----|
|                                |   |   | Min.                    | Typ. | Max.  |      |    |
| I <sub>DSS</sub>               | Drain cutoff current                              | V <sub>DS</sub> = V <sub>DSS</sub> , V <sub>GS</sub> = 0V   | —                       | —    | 1     | mA   |    |
| V <sub>GS(th)</sub>            | Gate-source threshold voltage                     | I <sub>D</sub> = 20mA, V <sub>DS</sub> = 10V  | 4.7                     | 6    | 7.3   | V    |    |
| I <sub>GSS</sub>               | Gate leakage current                              | V <sub>GS</sub> = V <sub>GSS</sub> , V <sub>DS</sub> = 0V   | —                       | —    | 1.5   | μA   |    |
| r <sub>DS(ON)</sub>            | Static drain-source<br>(chip) On-state resistance | I <sub>D</sub> = 200A<br>V <sub>GS</sub> = 15V  | T <sub>ch</sub> = 25°C  | —    | 2.6   | 3.55 | mΩ |
|                                |   |   | T <sub>ch</sub> = 125°C | —    | 4.8   | —    |    |
| V <sub>DS(ON)</sub>            | Static drain-source<br>(chip) On-state voltage    | I <sub>D</sub> = 200A<br>V <sub>GS</sub> = 15V  | T <sub>ch</sub> = 25°C  | —    | 0.52  | 0.71 | V  |
|                                |   |   | T <sub>ch</sub> = 125°C | —    | 0.96  | —    |    |
| R <sub>(lead)</sub>            | Lead resistance                                   | I <sub>D</sub> = 200A<br>terminal-chip  | T <sub>ch</sub> = 25°C  | —    | 0.8   | —    | mΩ |
|                                |   |   | T <sub>ch</sub> = 125°C | —    | 1.12  | —    |    |
| C <sub>iss</sub>               | Input capacitance                                 | V <sub>DS</sub> = 10V<br>V <sub>GS</sub> = 0V   | —                       | —    | 75    | nF   |    |
| C <sub>oss</sub>               | Output capacitance                                |   | —                       | —    | 10    |      |    |
| C <sub>rss</sub>               | Reverse transfer capacitance                      |   | —                       | —    | 6     |      |    |
| Q <sub>G</sub>                 | Total gate charge                                 | V <sub>DD</sub> = 80V, I <sub>D</sub> = 200A, V <sub>GS</sub> = 15V   | —                       | 1300 | —     | nC   |    |
| t <sub>d(on)</sub>             | Turn-on delay time                                | V <sub>DD</sub> = 80V, I <sub>D</sub> = 200A, V <sub>GS1</sub> = V <sub>GS2</sub> = 15V<br>R <sub>G</sub> = 6.3Ω, Inductive load switching operation<br>I <sub>S</sub> = 200A | —                       | —    | 400   | ns   |    |
| t <sub>r</sub>                 | Turn-on rise time                                 |   | —                       | —    | 300   |      |    |
| t <sub>d(off)</sub>            | Turn-off delay time                               |   | —                       | —    | 450   |      |    |
| t <sub>f</sub>                 | Turn-off fall time                                |   | —                       | —    | 200   |      |    |
| t <sub>rr</sub> * <sup>1</sup> | Reverse recovery time                             |   | —                       | —    | 200   |      |    |
| Q <sub>rr</sub> * <sup>1</sup> | Reverse recovery charge                           |   | —                       | 7.0  | —     |      | μC |
| V <sub>SD</sub> * <sup>1</sup> | Source-drain voltage                              | I <sub>S</sub> = 200A, V <sub>GS</sub> = 0V   | —                       | —    | 1.3   | V    |    |
| R <sub>th(ch-c)</sub>          | Thermal resistance                                | MOSFET part (1/6 module)* <sup>7</sup>  | —                       | —    | 0.19  | °C/W |    |
| R <sub>th(ch-c')</sub>         |   | MOSFET part (1/6 module)* <sup>3</sup>  | —                       | —    | 0.142 |      |    |
| R <sub>th(c-f)</sub>           | Contact thermal resistance                        | Case to fin, Thermal grease Applied* <sup>8</sup> (1/6 module)  | —                       | 0.1  | —     |      |    |
| R <sub>th(c'-f)</sub>          |   | Case to fin, Thermal grease Applied* <sup>3, 8</sup> (1/6 module)   | —                       | 0.09 | —     |      |    |

## THERMISTOR PART

| Symbol                         | Parameter  | Conditions   | Limits |      |      | Unit |
|--------------------------------|------------|--|--------|------|------|------|
|                                |            |  | Min.   | Typ. | Max. |      |
| R <sub>TH</sub> * <sup>6</sup> | Resistance | T <sub>TH</sub> = 25°C* <sup>5</sup>                     | —      | 100  | —    | kΩ   |
| B* <sup>6</sup>                | B Constant | Resistance at T <sub>TH</sub> = 25°C, 50°C* <sup>5</sup> | —      | 4000 | —    | K    |

\*1: It is characteristics of the anti-parallel, source to drain free-wheel diode (FWDi).

\*2: Pulse width and repetition rate should be such that the device channel temperature (T<sub>ch</sub>) does not exceed T<sub>ch</sub> max rating.\*3: T<sub>C</sub>' measured point is just under the chips. If use this value, R<sub>th(f-a)</sub> should be measured just under the chips.

\*4: Pulse width and repetition rate should be such as to cause negligible temperature rise.

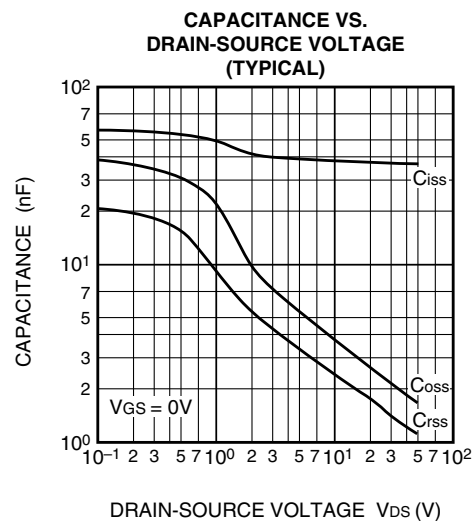
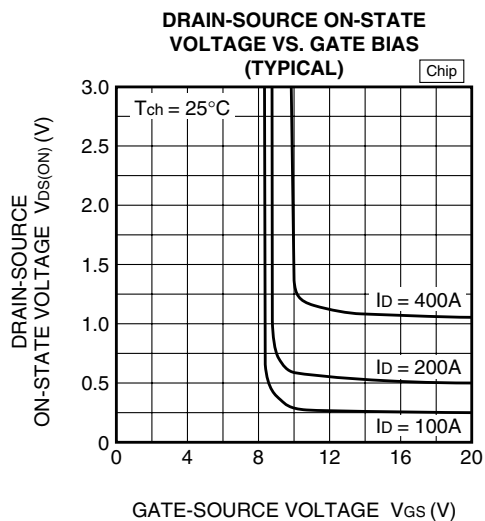
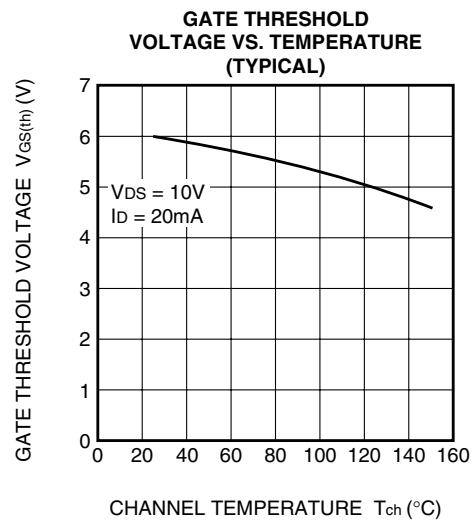
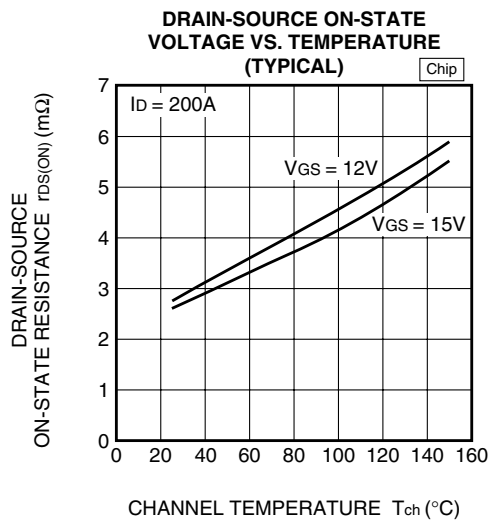
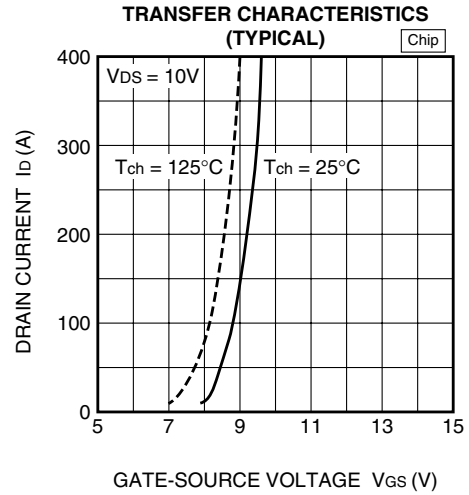
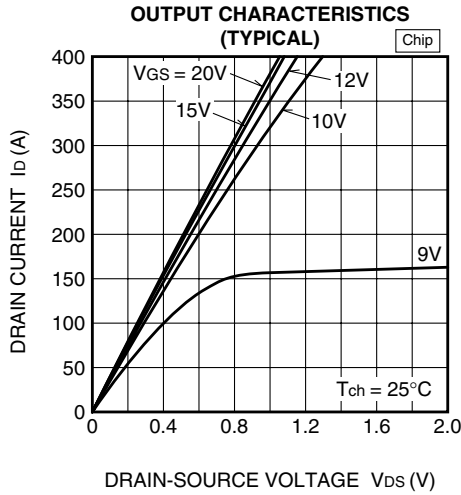
\*5: T<sub>TH</sub> is thermistor temperature.\*6: B = (lnR<sub>1</sub> - lnR<sub>2</sub>) / (1/T<sub>1</sub> - 1/T<sub>2</sub>) R<sub>1</sub>: Resistance at T<sub>1</sub>(K), R<sub>2</sub>: Resistance at T<sub>2</sub>(K)\*7: T<sub>C</sub> measured point is shown in page OUTLINE DRAWING.

\*8: Typical value is measured by using Shin-Etsu Chemical Co., Ltd "G-746".

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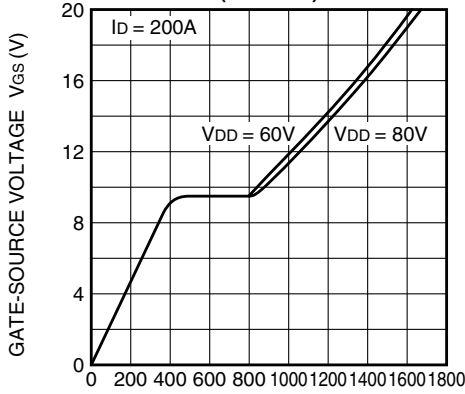
## PERFORMANCE CURVES



# FM400TU-3A

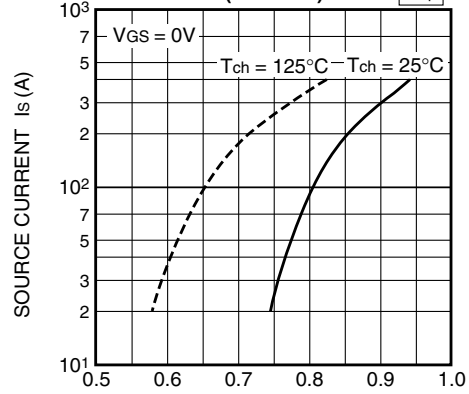
HIGH POWER SWITCHING USE  
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**GATE CHARGE CHARACTERISTICS (TYPICAL)**



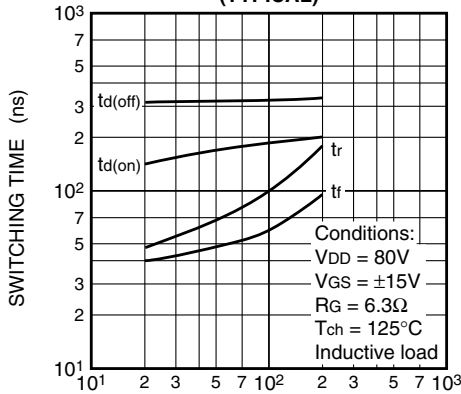
GATE CHARGE  $Q_G$  (nC)

**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**



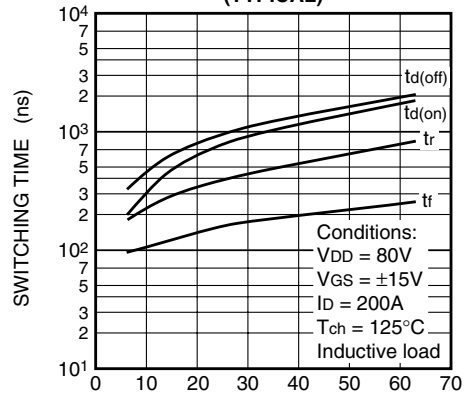
SOURCE-DRAIN VOLTAGE  $V_{SD}$  (V)

**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**



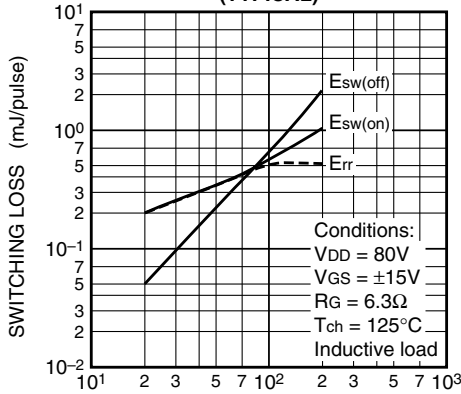
DRAIN CURRENT  $I_D$  (A)

**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**



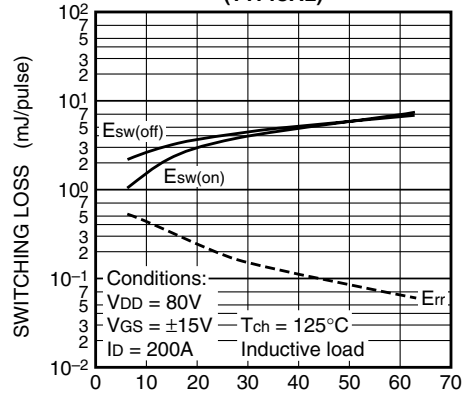
GATE RESISTANCE  $R_G$  ( $\Omega$ )

**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**



DRAIN CURRENT  $I_D$  (A)

**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

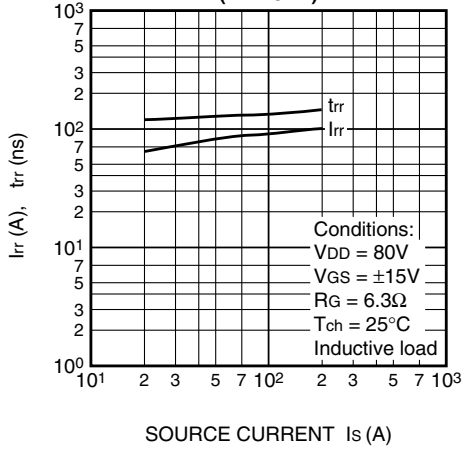


GATE RESISTANCE  $R_G$  ( $\Omega$ )

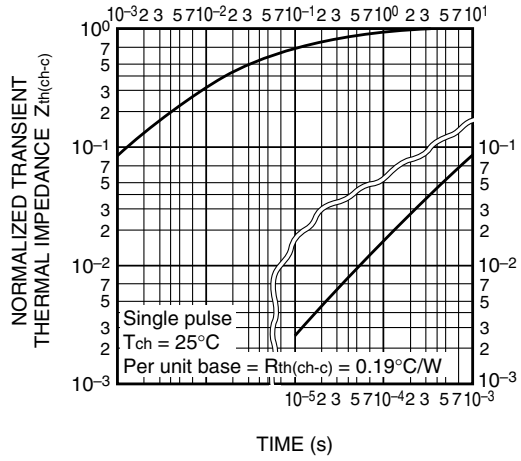
# FM400TU-3A

HIGH POWER SWITCHING USE  
INSULATED PACKAGE

**REVERSE RECOVERY CHARACTERISTICS  
OF FREE-WHEEL DIODE  
(TYPICAL)**



**TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS**



**CHIP LAYOUT**

