

# FM400TU-3A

HIGH POWER SWITCHING USE  
INSULATED PACKAGE

## FM400TU-3A



- $I_D(\text{rms})$  .....200A
- $V_{DSS}$  .....150V
- Insulated Type
- 6-elements in a pack
- Thermistor inside
- UL Recognized

Yellow Card No.E80276

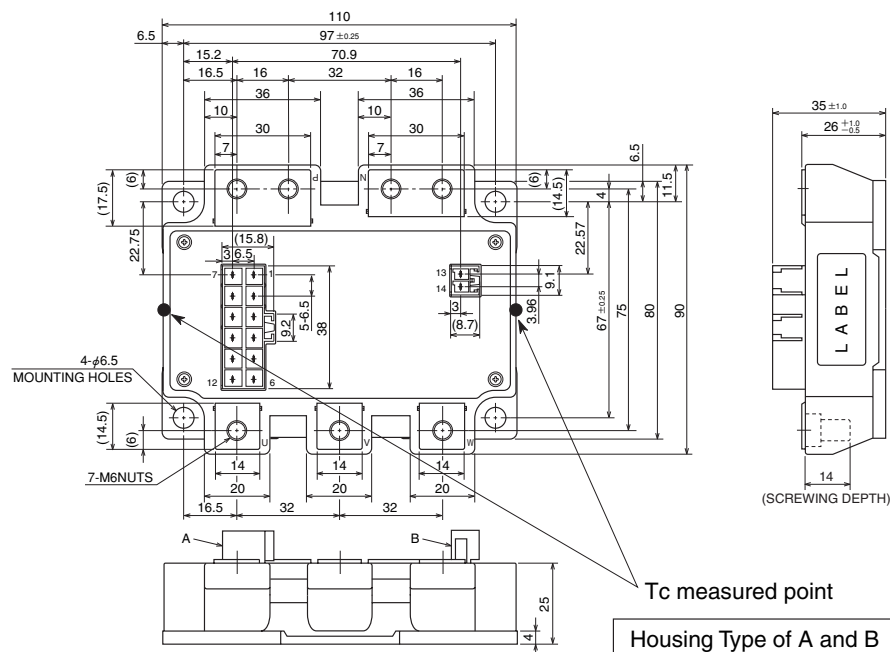
File No.E80271

## APPLICATION

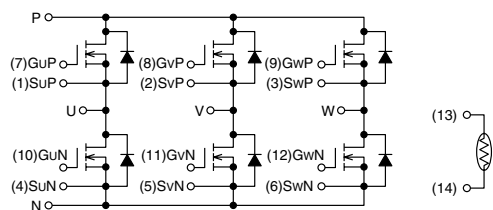
AC motor control of forklift (battery power source), UPS

## OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



### 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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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*3             | 200        | A     |
| I <sub>DM</sub>    |                           | Pulse*2                                | 400        | A     |
| I <sub>DA</sub>    | Avalanche current         | L = 10μH Pulse*2                       | 200        | A     |
| I <sub>S</sub> *1  | Source current            |                                        | 200        | A     |
| I <sub>SM</sub> *1 |                           | Pulse*2                                | 400        | A     |
| P <sub>D</sub> *4  | Maximum power dissipation | T <sub>C</sub> = 25°C                  | 650        | W     |
| P <sub>D</sub> *4  |                           | T <sub>C</sub> ' = 25°C*3              | 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>D</sub> = V <sub>DSS</sub> , V <sub>G</sub> = 0V                                                                                                                       | —                       | —    | 1     | mA   |
| V <sub>GS(th)</sub>    | Gate-source threshold voltage                     | I <sub>D</sub> = 20mA, V <sub>D</sub> = 10V                                                                                                                                   | 4.7                     | 6    | 7.3   | V    |
| I <sub>GSS</sub>       | Gate leakage current                              | V <sub>G</sub> = V <sub>GSS</sub> , V <sub>D</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>G</sub> = 15V                                                                                                                                 | T <sub>ch</sub> = 25°C  | —    | 2.6   | 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>G</sub> = 15V                                                                                                                                 | T <sub>ch</sub> = 25°C  | —    | 0.52  | 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>D</sub> = 10V<br>V <sub>G</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>G</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>G</sub> 1 = V <sub>G</sub> 2 = 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> *1     | Reverse recovery time                             |                                                                                                                                                                               | —                       | —    | 200   | ns   |
| Q <sub>rr</sub> *1     | Reverse recovery charge                           |                                                                                                                                                                               | —                       | 7.0  | —     |      |
| V <sub>SD</sub> *1     | Source-drain voltage                              | I <sub>S</sub> = 200A, V <sub>G</sub> = 0V                                                                                                                                    | —                       | —    | 1.3   | V    |
| R <sub>th(ch-c)</sub>  | Thermal resistance                                | MOSFET part (1/6 module)*7                                                                                                                                                    | —                       | —    | 0.19  | °C/W |
| R <sub>th(ch-c')</sub> |                                                   | MOSFET part (1/6 module)*3                                                                                                                                                    | —                       | —    | 0.142 |      |
| R <sub>th(c-f)</sub>   | Contact thermal resistance                        | Case to fin, Thermal grease Applied*8 (1/6 module)                                                                                                                            | —                       | 0.1  | —     |      |
| R <sub>th(c'-f)</sub>  |                                                   | Case to fin, Thermal grease Applied*3, *8 (1/6 module)                                                                                                                        | —                       | 0.09 | —     |      |

## THERMISTOR PART

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

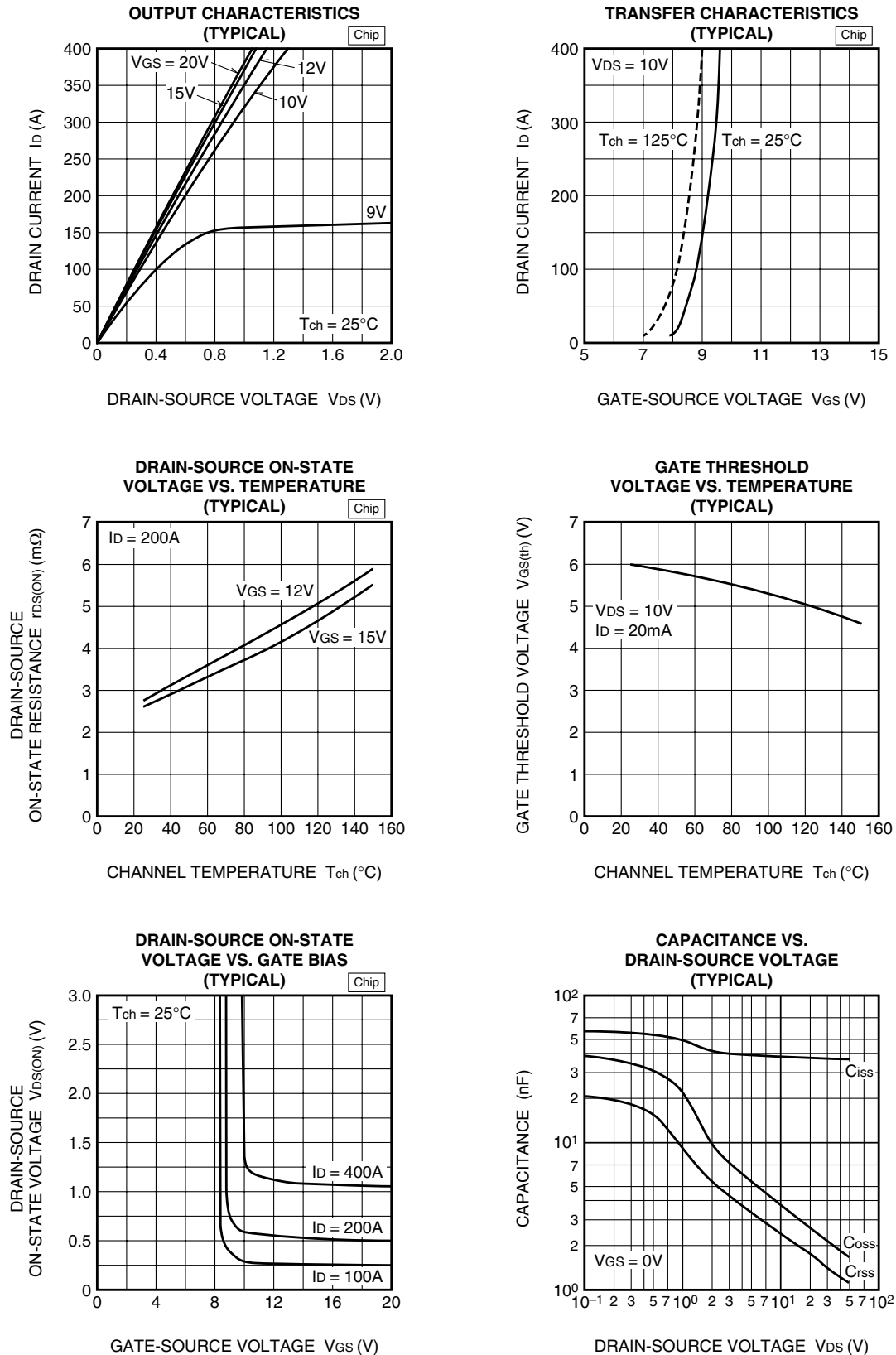
\*5: T<sub>TH</sub> is thermistor temperature.\*6: B = (lnR<sub>1</sub> - lnR<sub>2</sub>) / (1/T<sub>1</sub> - 1/T<sub>2</sub>) R<sub>1</sub>: Resistance at T<sub>1</sub>(K), R<sub>2</sub>: Resistance at T<sub>2</sub>(K)\*7: T<sub>C</sub> measured point is shown in page OUTLINE DRAWING.

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

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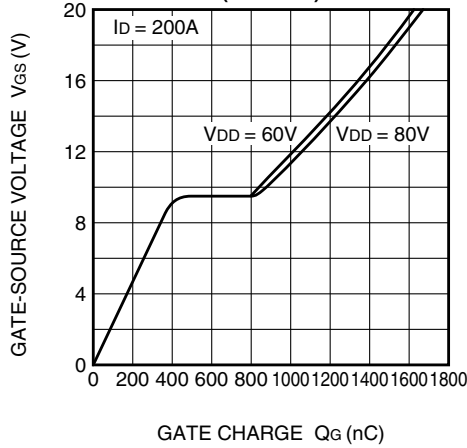
## PERFORMANCE CURVES



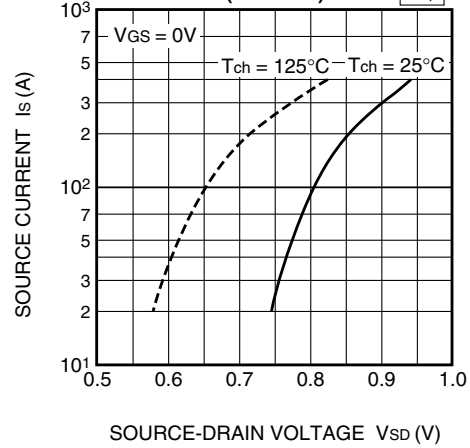
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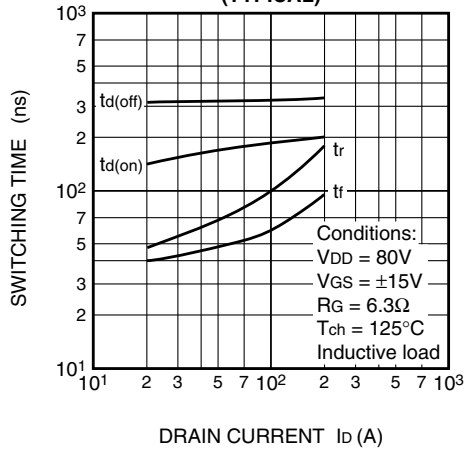
**GATE CHARGE CHARACTERISTICS  
(TYPICAL)**



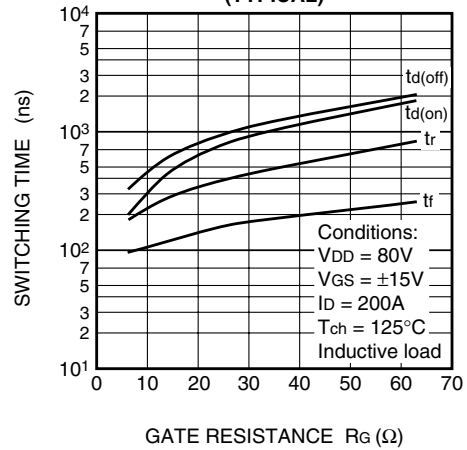
**FREE-WHEEL DIODE  
FORWARD CHARACTERISTICS  
(TYPICAL)**



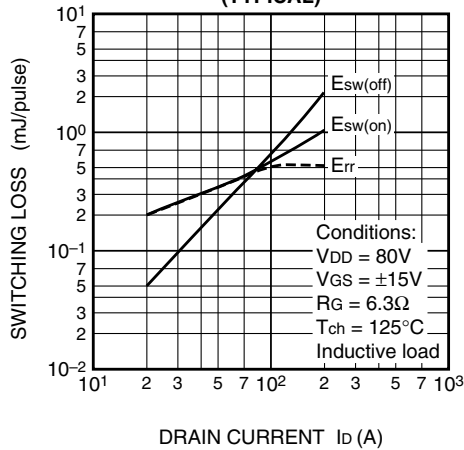
**HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)**



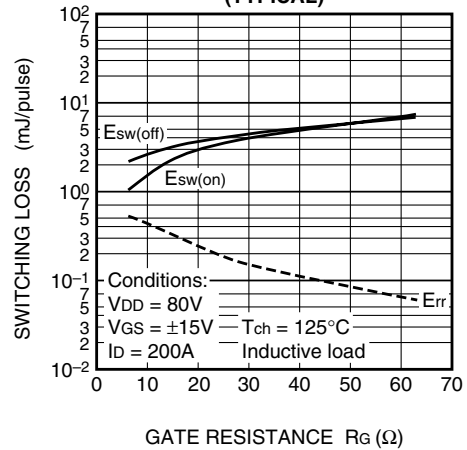
**HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)**



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



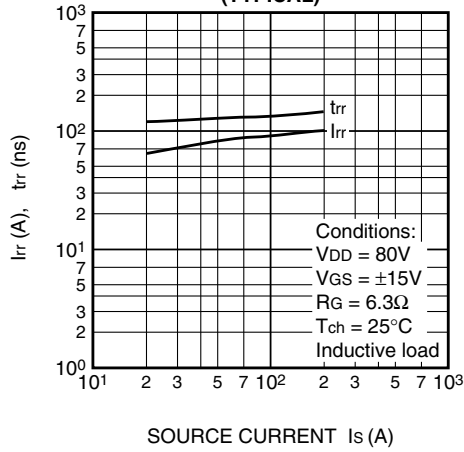
**HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)**



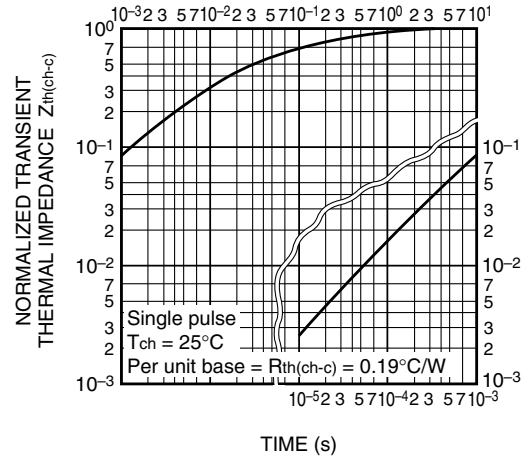
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HIGH POWER SWITCHING USE  
INSULATED PACKAGE

REVERSE RECOVERY CHARACTERISTICS  
OF FREE-WHEEL DIODE  
(TYPICAL)



TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS



## CHIP LAYOUT

