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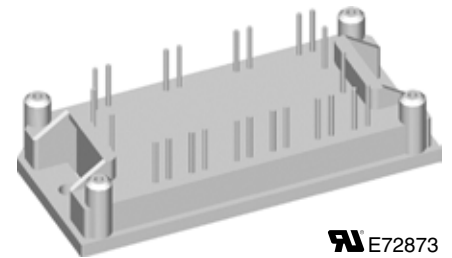
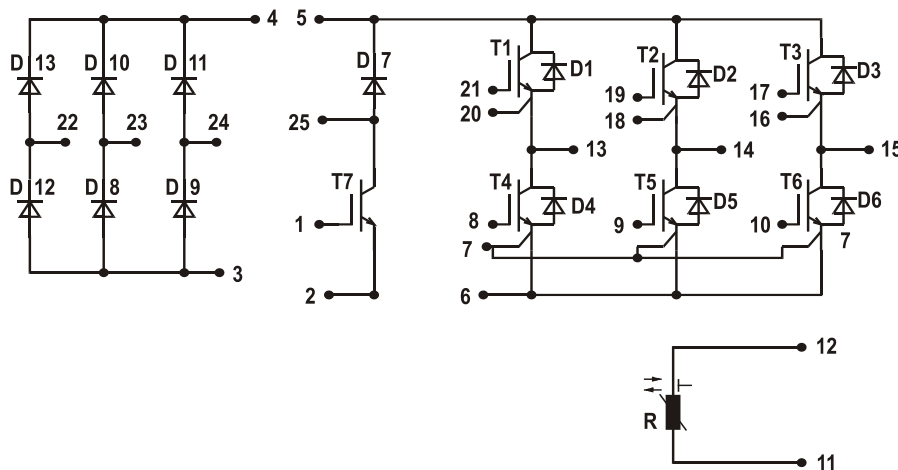
# Converter - Brake - Inverter Module (CBI 1) NPT IGBT

| Three Phase Rectifier       | Brake Chopper                  | Three Phase Inverter          |
|-----------------------------|--------------------------------|-------------------------------|
| $V_{RRM} = 1600 \text{ V}$  | $V_{CES} = 600 \text{ V}$      | $V_{CES} = 600 \text{ V}$     |
| $I_{DAVM25} = 95 \text{ A}$ | $I_{C25} = 12 \text{ A}$       | $I_{C25} = 25 \text{ A}$      |
| $I_{FSM} = 250 \text{ A}$   | $V_{CE(sat)} = 2.25 \text{ V}$ | $V_{CE(sat)} = 2.0 \text{ V}$ |

Preliminary data

**Part name** (Marking on product)

MUBW20-06A6K



E72873

Pin configuration see outlines.

**Features:**

- High level of integration - only one power semiconductor module required for the whole drive
- Inverter with NPT IGBTs
- low saturation voltage
- positive temperature coefficient
- fast switching
- short tail current
- Epitaxial free wheeling diodes with hiperfast and soft reverse recovery
- Industry standard package with insulated copper base plate and soldering pins for PCB mounting
- Temperature sense included

**Application:**

- AC motor drives with
- Input from single or three phase grid
- Three phase synchronous or asynchronous motor
- Electric braking operation

**Package:**

- UL registered
- Industry standard E1-pack

**Output Inverter T1 - T6**

| Symbol              | Definitions                           | Conditions  | Ratings |      |            | Unit            |
|---------------------|---------------------------------------|---|---------|------|------------|-----------------|
|                     |                                       |   | min.    | typ. | max.       |                 |
| $V_{CES}$           | collector emitter voltage             | $T_{VJ} = 25^{\circ}\text{C to } 150^{\circ}\text{C}$   |         |      | 600        | V               |
| $V_{GES}$           | max. DC gate voltage                  | continuous  |         |      | $\pm 20$   | V               |
| $V_{GEM}$           | max. transient collector gate voltage | transient   |         |      | $\pm 30$   | V               |
| $I_{C25}$           | collector current                     | $T_C = 25^{\circ}\text{C}$  |         |      | 25         | A               |
| $I_{C80}$           |                                       | $T_C = 80^{\circ}\text{C}$  |         |      | 17         | A               |
| $P_{tot}$           | total power dissipation               | $T_C = 25^{\circ}\text{C}$  |         |      | 85         | W               |
| $V_{CE(sat)}$       | collector emitter saturation voltage  | $I_C = 15\text{ A}; V_{GE} = 15\text{ V}$   |         |      | 2.0<br>2.3 | V<br>V          |
| $V_{GE(th)}$        | gate emitter threshold voltage        | $I_C = 0.4\text{ mA}; V_{GE} = V_{CE}$  | 4.5     |      | 6.5        | V               |
| $I_{CES}$           | collector emitter leakage current     | $V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$   |         |      | 1.3        | 0.6<br>mA<br>mA |
| $I_{GES}$           | gate emitter leakage current          | $V_{CE} = 0\text{ V}; V_{GE} = \pm 20\text{ V}$   |         |      | 100        | nA              |
| $C_{ies}$           | input capacitance                     | $V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}$   |         |      | 800        | pF              |
| $Q_{G(on)}$         | total gate charge                     | $V_{CE} = 300\text{ V}; V_{GE} = 15\text{ V}; I_C = 15\text{ A}$  |         |      | 57         | nC              |
| $t_{d(on)}$         | turn-on delay time                    | inductive load<br>$T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CE} = 300\text{ V}; I_C = 15\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_{G(on)} = 39\ \Omega$<br>$R_{G(off)} = 22\ \Omega$ |         |      | 30         | ns              |
| $t_r$               | current rise time                     |   |         |      | 25         | ns              |
| $t_{d(off)}$        | turn-off delay time                   |   |         |      | 160        | ns              |
| $t_f$               | current fall time                     |   |         |      | 50         | ns              |
| $E_{on}$            | turn-on energy per pulse              |   |         |      | 0.42       | mJ              |
| $E_{off}$           | turn-off energy per pulse             |   |         |      | 0.44       | mJ              |
| $I_{CM}$            | reverse bias safe operating area      | RBSOA; $V_{GE} = \pm 15\text{ V}; R_G = 68\ \Omega$<br>$L = 100\ \mu\text{H};$ clamped induct. load<br>$V_{CEmax} = V_{CES} - L_S \cdot di/dt$                                    |         |      | 30         | A               |
| $t_{SC}$<br>(SCSOA) | short circuit safe operating area     | $V_{CE} = 600\text{ V}; V_{GE} = \pm 15\text{ V};$<br>$R_G = 68\ \Omega;$ non-repetitive  |         |      | 10         | $\mu\text{s}$   |
| $R_{thJC}$          | thermal resistance junction to case   | (per IGBT)  |         |      | 1.5        | K/W             |
| $R_{thCH}$          | thermal resistance case to heatsink   | (per IGBT)  |         |      | 0.55       | K/W             |

**Output Inverter D1 - D6**

| Symbol         | Definitions                         | Conditions  | Ratings                        |      |      | Unit |               |
|----------------|-------------------------------------|---|--------------------------------|------|------|------|---------------|
|                |                                     |   | min.                           | typ. | max. |      |               |
| $V_{RRM}$      | max. repetitive reverse voltage     | $T_{VJ} = 150^{\circ}\text{C}$  |                                |      | 600  | V    |               |
| $I_{F25}$      | forward current                     | $T_C = 25^{\circ}\text{C}$  |                                |      | 36   | A    |               |
| $I_{F80}$      |                                     | $T_C = 80^{\circ}\text{C}$  |                                |      | 24   | A    |               |
| $V_F$          | forward voltage                     | $I_F = 15\text{ A}; V_{GE} = 0\text{ V}$  |                                |      | 2.1  | V    |               |
| $I_{RM}$       | max. reverse recovery current       | $V_R = 300\text{ V}$<br>$di_f/dt = -400\text{ A}/\mu\text{s}$<br>$I_F = 15\text{ A}; V_{GE} = 0\text{ V}$ |                                |      | 14   | A    |               |
| $t_{rr}$       | reverse recovery time               |   | $T_{VJ} = 100^{\circ}\text{C}$ |      |      | 80   | ns            |
| $E_{rec(off)}$ | reverse recovery energy             |   |                                |      |      | tdb  | $\mu\text{J}$ |
| $R_{thJC}$     | thermal resistance junction to case | (per diode)   |                                |      | 1.6  | K/W  |               |
| $R_{thCH}$     | thermal resistance case to heatsink | (per diode)   |                                |      | 0.55 | K/W  |               |

 $T_C = 25^{\circ}\text{C}$  unless otherwise stated

**Brake Chopper T7**

| Symbol              | Definitions                           | Conditions   | Ratings                        |      |             | Unit          |
|---------------------|---------------------------------------|--|--------------------------------|------|-------------|---------------|
|                     |                                       |  | min.                           | typ. | max.        |               |
| $V_{CES}$           | collector emitter voltage             | $T_{VJ} = 25^{\circ}\text{C to } 150^{\circ}\text{C}$  |                                |      | 600         | V             |
| $V_{GES}$           | max. DC gate voltage                  | continuous   |                                |      | $\pm 20$    | V             |
| $V_{GEM}$           | max. transient collector gate voltage | transient  |                                |      | $\pm 30$    | V             |
| $I_{C25}$           | collector current                     | $T_C = 25^{\circ}\text{C}$   |                                |      | 11          | A             |
| $I_{C80}$           |                                       | $T_C = 80^{\circ}\text{C}$   |                                |      | 8           | A             |
| $P_{tot}$           | total power dissipation               | $T_C = 25^{\circ}\text{C}$   |                                |      | 50          | W             |
| $V_{CE(sat)}$       | collector emitter saturation voltage  | $I_C = 10\text{ A}; V_{GE} = 15\text{ V}$  |                                |      | 2.65<br>3.1 | V<br>V        |
| $V_{GE(th)}$        | gate emitter threshold voltage        | $I_C = 0.2\text{ mA}; V_{GE} = V_{CE}$   | 4.5                            |      | 6.5         | V             |
| $I_{CES}$           | collector emitter leakage current     | $V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$  |                                |      | 0.7         | mA<br>mA      |
| $I_{GES}$           | gate emitter leakage current          | $V_{CE} = 0\text{ V}; V_{GE} = \pm 20\text{ V}$  |                                |      | 120         | nA            |
| $C_{ies}$           | input capacitance                     | $V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}$  |                                |      | 220         | pF            |
| $Q_{G(on)}$         | total gate charge                     | $V_{CE} = 300\text{ V}; V_{GE} = 15\text{ V}; I_C = 6\text{ A}$  |                                |      | 32          | nC            |
| $t_{d(on)}$         | turn-on delay time                    | inductive load<br>$V_{CE} = 300\text{ V}; I_C = 8\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_{G(on)} = 54\ \Omega$<br>$R_{G(off)} = 22\ \Omega$ | $T_{VJ} = 125^{\circ}\text{C}$ |      | 20          | ns            |
| $t_r$               | current rise time                     |  |                                |      | 10          | ns            |
| $t_{d(off)}$        | turn-off delay time                   |  |                                |      | 110         | ns            |
| $t_f$               | current fall time                     |  |                                |      | 30          | ns            |
| $E_{on}$            | turn-on energy per pulse              |  |                                |      | 0.21        | mJ            |
| $E_{off}$           | turn-off energy per pulse             |  |                                |      | 0.26        | mJ            |
| $I_{CM}$            | reverse bias safe operating area      | RBSOA; $V_{GE} = \pm 15\text{ V}; R_G = 54\ \Omega$<br>$L = 100\ \mu\text{H};$ clamped induct. load<br>$V_{CEmax} = V_{CES} - L_S \cdot di/dt$ | $T_{VJ} = 125^{\circ}\text{C}$ |      | 18          | A             |
| $t_{SC}$<br>(SCSOA) | short circuit safe operating area     | $V_{CE} = 600\text{ V}; V_{GE} = \pm 15\text{ V};$<br>$R_G = 54\ \Omega;$ non-repetitive   | $T_{VJ} = 125^{\circ}\text{C}$ |      | 10          | $\mu\text{s}$ |
| $R_{thJC}$          | thermal resistance junction to case   | (per IGBT)   |                                |      | 2.75        | K/W           |
| $R_{thCH}$          | thermal resistance case to heatsink   | (per IGBT)   |                                |      | 0.9         | K/W           |

**Brake Chopper D7**

| Symbol     | Definitions                         | Conditions   | Ratings                        |      |      | Unit     |
|------------|-------------------------------------|--|--------------------------------|------|------|----------|
|            |                                     |  | min.                           | typ. | max. |          |
| $V_{RRM}$  | max. repetitive reverse voltage     | $T_{VJ} = 150^{\circ}\text{C}$   |                                |      | 600  | V        |
| $I_{F25}$  | forward current                     | $T_C = 25^{\circ}\text{C}$   |                                |      | 21   | A        |
| $I_{F80}$  |                                     | $T_C = 80^{\circ}\text{C}$   |                                |      | 14   | A        |
| $V_F$      | forward voltage                     | $I_F = 10\text{ A}; V_{GE} = 0\text{ V}$   |                                |      | 2.1  | V        |
|            |                                     |  |                                |      | 1.25 | V        |
| $I_R$      | reverse current                     | $V_R = V_{RRM}$  |                                |      | 0.06 | mA<br>mA |
|            |                                     |  |                                |      | 0.2  |          |
| $I_{RM}$   | max. reverse recovery current       | $V_R = 100\text{ V}; I_F = 12\text{ A}$<br>$di_F/dt = -100\text{ A}/\mu\text{s}$ | $T_{VJ} = 100^{\circ}\text{C}$ |      | 3.5  | A        |
| $t_{rr}$   | reverse recovery time               |  |                                |      | 80   | ns       |
| $R_{thJC}$ | thermal resistance junction to case | (per diode)  |                                |      | 2.5  | K/W      |
| $R_{thCH}$ | thermal resistance case to heatsink | (per diode)  |                                |      | 0.85 | K/W      |

 $T_C = 25^{\circ}\text{C}$  unless otherwise stated

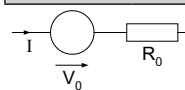
| Input Rectifier Bridge D8 - D13 |                                 |                                 |                          |                 |   |
|---------------------------------|---------------------------------|---------------------------------|--------------------------|-----------------|---|
| Symbol                          | Definitions                     | Conditions                      |                          | Maximum Ratings |   |
| $V_{RRM}$                       | max. repetitive reverse voltage |                                 |                          | 1600            | V |
| $I_{FAV}$                       | average forward current         | sine 180°                       | $T_C = 80^\circ\text{C}$ | 23              | A |
| $I_{DAVM}$                      | max. average DC output current  | rectangular; $d = 1/3$ ; bridge | $T_C = 80^\circ\text{C}$ | 65              | A |
| $I_{FSM}$                       | max. surge forward current      | $t = 10$ ms; sine 50 Hz         | $T_C = 25^\circ\text{C}$ | 250             | A |
| $P_{tot}$                       | total power dissipation         | $T_C = 25^\circ\text{C}$        |                          | 65              | W |

| Symbol     | Conditions                          | Characteristic Values |                              |      | Unit |     |
|------------|-------------------------------------|-----------------------|------------------------------|------|------|-----|
|            |                                     | min.                  | typ.                         | max. |      |     |
| $V_F$      | forward voltage                     | $I_F = 30$ A          | $T_{VJ} = 25^\circ\text{C}$  | 1.1  | 1.45 | V   |
|            |                                     |                       | $T_{VJ} = 125^\circ\text{C}$ | 1.2  |      | V   |
| $I_R$      | reverse current                     | $V_R = V_{RRM}$       | $T_{VJ} = 25^\circ\text{C}$  | 0.4  | 0.02 | mA  |
|            |                                     |                       | $T_{VJ} = 125^\circ\text{C}$ |      |      | mA  |
| $R_{thJC}$ | thermal resistance junction to case | (per diode)           | $T_{VJ} = 25^\circ\text{C}$  |      | 1.9  | K/W |
| $R_{thCH}$ | thermal resistance case to heatsink | (per diode)           |                              | 0.65 |      | K/W |

| Temperature Sensor NTC |             |            |                          |      |      |      |            |
|------------------------|-------------|------------|--------------------------|------|------|------|------------|
| Symbol                 | Definitions | Conditions | Ratings                  |      |      | Unit |            |
|                        |             |            | min.                     | typ. | max. |      |            |
| $R_{25}$               | resistance  |            | $T_C = 25^\circ\text{C}$ | 4.45 | 4.7  | 5.0  | k $\Omega$ |
| $B_{25/85}$            |             |            |                          |      | 3510 |      | K          |

| Module        |                                   |                                |         |      |      |                  |
|---------------|-----------------------------------|--------------------------------|---------|------|------|------------------|
| Symbol        | Definitions                       | Conditions                     | Ratings |      |      | Unit             |
|               |                                   |                                | min.    | typ. | max. |                  |
| $T_{VJ}$      | operating temperature             |                                | -40     |      | 125  | $^\circ\text{C}$ |
| $T_{VJM}$     | max. virtual junction temperature |                                |         |      | 150  | $^\circ\text{C}$ |
| $T_{stg}$     | storage temperature               |                                | -40     |      | 125  | $^\circ\text{C}$ |
| $V_{ISOL}$    | isolation voltage                 | $I_{ISOL} \leq 1$ mA; 50/60 Hz |         |      | 2500 | V~               |
| $M_d$         | mounting torque                   | (M4)                           | 2.0     |      | 2.2  | Nm               |
| $d_S$         | creep distance on surface         |                                | 12.7    |      |      | mm               |
| $d_A$         | strike distance through air       |                                | 12.7    |      |      | mm               |
| <b>Weight</b> |                                   |                                |         | 40   |      | g                |

### Equivalent Circuits for Simulation

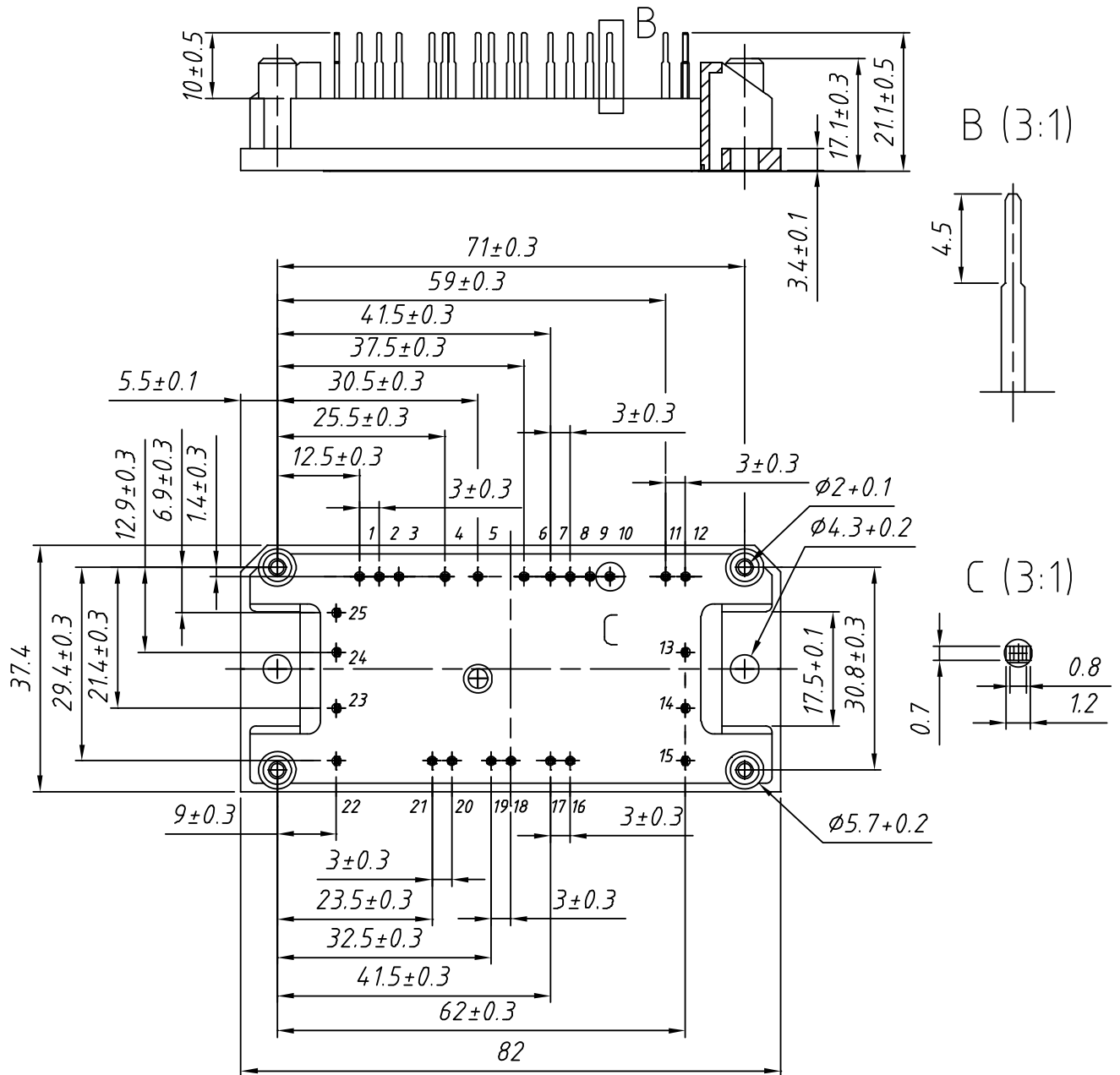


| Symbol | Definitions         | Conditions | Ratings                      |      |      | Unit       |
|--------|---------------------|------------|------------------------------|------|------|------------|
|        |                     |            | min.                         | typ. | max. |            |
| $V_0$  | rectifier diode     | D8 - D13   | $T_{VJ} = 125^\circ\text{C}$ | 0.90 |      | V          |
| $R_0$  |                     |            |                              | 12   |      | m $\Omega$ |
| $V_0$  | IGBT                | T1 - T6    | $T_{VJ} = 125^\circ\text{C}$ | 1.0  |      | V          |
| $R_0$  |                     |            |                              | 70   |      | m $\Omega$ |
| $V_0$  | free wheeling diode | D1 - D6    | $T_{VJ} = 125^\circ\text{C}$ | 1.25 |      | V          |
| $R_0$  |                     |            |                              | 13   |      | m $\Omega$ |
| $V_0$  | IGBT                | T7         | $T_{VJ} = 125^\circ\text{C}$ | 1.4  |      | V          |
| $R_0$  |                     |            |                              | 150  |      | m $\Omega$ |
| $V_0$  | free wheeling diode | D7         | $T_{VJ} = 125^\circ\text{C}$ | 1.25 |      | V          |
| $R_0$  |                     |            |                              | 26   |      | m $\Omega$ |

$T_C = 25^\circ\text{C}$  unless otherwise stated

**Outline Drawing**

Dimensions in mm (1 mm = 0.0394")



**Product Marking**

| Ordering | Part Name     | Marking on Product | Delivering Mode | Base Qty | Ordering Code |
|----------|---------------|--------------------|-----------------|----------|---------------|
| Standard | MUBW 20-06A6K | MUBW20-06A6K       | Box             | 10       | 500 103       |