# 300mA, Low I$_Q$, High PSRR LDO Regulators in SOT23

## FEATURES

- 2.5V to 5.5V Input Voltage Range
- 320mV @300mA Dropout Voltage
- Excellent Transient Response
- Stable with 1µF Ceramic Output Capacitor
- 70dB PSRR at 1kHz
- Low 37µA Quiescent Current
- Output Accuracy: ±2%
- Fixed Output Voltage: 1.2V~3.3V
- Current Limit Protection
- Thermal Shutdown
- RoHS Compliant and 100% Lead (Fb)-Free Halogen-Free

## APPLICATIONS

- Cellular Phones
- Bluetooth portable radios and Accessories
- Battery-Powered Equipment
- Laptop, Palmtops, Notebook Computer
- PDAs
- Digital still Camera and Video Recorders

## GENERAL DESCRIPTION
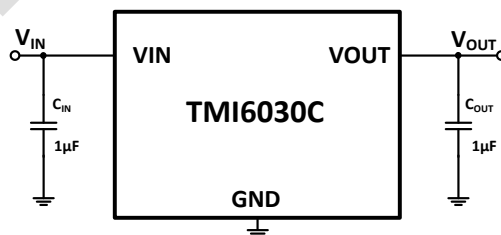
The TMI6030C is a 300mA, low-dropout (LDO) linear regulator with fast transient response and high PSRR. It offers high output accuracy, low dropout voltage and low quiescent current as well as fast start-up time. This regulator is based on a CMOS process.

The TMI6030C is designed to work with low-ESR ceramic capacitors, reducing the amount of the PCB area necessary for power applications. Only a 1µF ceramic output capacitor can make the device stable over the whole load range current (0mA to 300mA). Other key features include over-current protection and thermal shutdown. The TMI6030C is packaged in SOT23 packages.
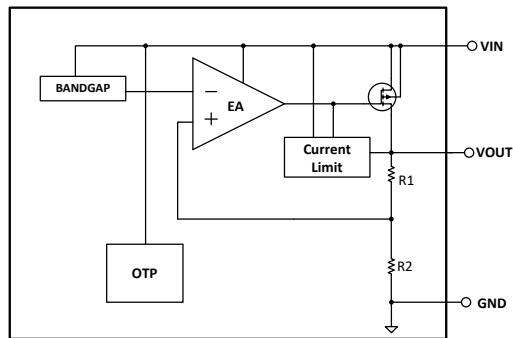
## TYPICAL APPILCATION



Figure 1. TMI6030C Application Circuits

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## BLOCK DIAGRAM



**Figure 2. TMI6030C function block diagram**

## ABSOLUTE MAXIMUM RATINGS

| Description | Value | Unit |
|---|---|---|
| VIN Input Voltage Range | -0.3~6 | V |
| VOUT Voltage Range | -0.3 to ($V_{IN}$+0.3) | V |
| Junction Temperature | 160 | °C |
| Storage Temperature Range | -65~150 | °C |
| Junction-to-ambient Thermal Resistance | 260 (SOT23) | °C/W |
| Junction-to-case(top) Thermal Resistance | 82 | °C/W |
| Lead Temperature Soldering, 10Sec | 260 | °C |

## ESD RATINGS

| Items | Description | Value | Unit |
|---|---|---|---|
| $V_{ESD\_HBM}$ | Human Body Model for all pins | ±2000 | V |
| $V_{ESD\_CDM}$ | Charged Device Model for all pins | ±2000 | V |

JEDEC specification JS-001

## RECOMMEND OPERATING CONDITIONS

| Items | Description | Min | Max | Unit |
|---|---|---|---|---|
| Voltage Range | IN | 2.5 | 5.5 | V |
| $T_J$ | Operation Junction Temperature | -40 | 125 | °C |
| $T_A$ | Operation Ambient Temperature | -40 | 85 | °C |

## PIN CONFIGURATION

| Package Type | Pin Configurations |
|---|---|
| TMI6030C / SOT23 |  |

## PIN FUNCTIONS

| TMI6030C | Name | Function |
|---|---|---|
| 1 | GND | Signal Ground. |
| 2 | VOUT | Output of the LDO |
| 3 | VIN | Input Supply of the LDO. |

## ORDER INFORMATION

**TMI6030C-XX**

| Output Voltage |
|---|
| 12 : 1.2V |
| 15 : 1.5V |
| 18 : 1.8V |
| 25 : 2.5V |
| 28 : 2.8V |
| 30 : 3.0V |
| 33 : 3.3V |
| …. : Voltage |

| Package |
|---|
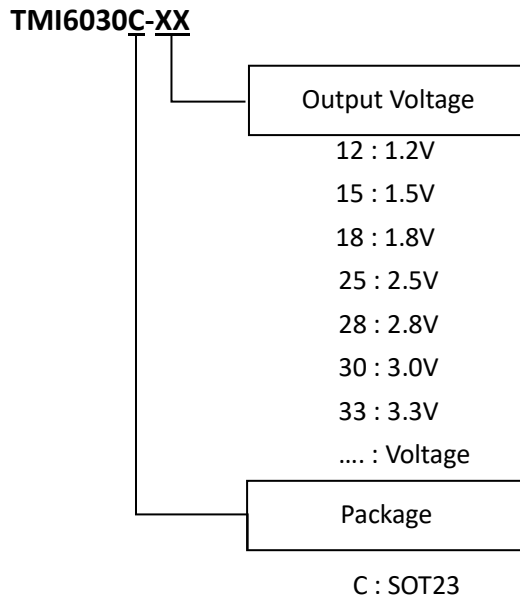
C : SOT23

Top Mark: TcXXXX (TcX: Device Code, XXX: Inside code)

| Part Number | Package | Top Mark | Quantity/ Reel |
|---|---|---|---|
| TMI6030C-12 | SOT23 | TcBXXX | 3000 |
| TMI6030C-15 | SOT23 | TcHXXX | 3000 |
| TMI6030C-18 | SOT23 | TcCXXX | 3000 |
| TMI6030C-25 | SOT23 | TcDXXX | 3000 |
| TMI6030C-28 | SOT23 | TcEXXX | 3000 |
| TMI6030C-30 | SOT23 | TcFXXX | 3000 |
| TMI6030C-33 | SOT23 | TcGXXX | 3000 |

TMI6030C devices are Pb-free and RoHS compliant.

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4    TMI6030C V1.0    2019.08

## ELECTRICAL CHARACTERISTICS

$T_A$=25°C, $V_{IN}$=$V_{OUT}$+1V, or $V_{IN}$=2.5V for $V_{OUT}$<1.5V unless otherwise specified.

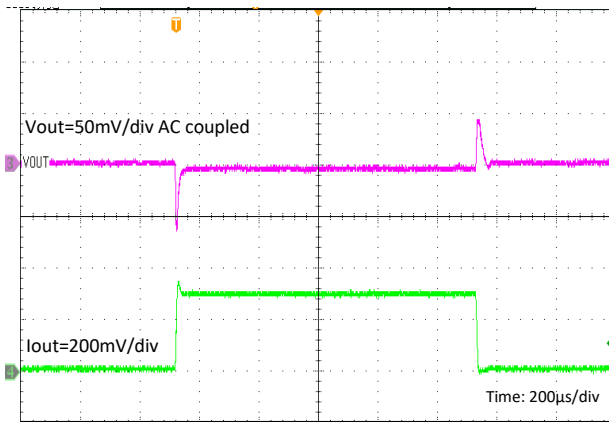| Symbol | Parameter | conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Input Voltage** | | | | | | |
| $V_{IN}$ | Input Voltage Range | | 2.5 | | 5.5 | V |
| $I_Q$ | Quiescent Current | $I_{OUT}$=0mA | 35 | | 70 | µA |
| PSRR | Power Supply Ripple Rejection | $V_{IN}$=Vnom+1$V_{P-P}$, f=1kHz, $I_{LOAD}$=10mA | | 70 | | dB |
| **Output Voltage** | | | | | | |
| $V_{OUT}$ | Output Voltage Accuracy | $V_{IN}$=$V_{OUT}$+1V, $I_{OUT}$=10mA | -2 | | +2 | % |
| | | $V_{IN}$=$V_{OUT}$+1V, $I_{OUT}$=10mA, $T_A$=-40°C to +85°C | -3 | | +3 | % |
| $V_{LNR}$ | Output Line Regulation | $V_{OUT}$+0.5V<$V_{IN}$<5.5V, $I_{OUT}$=10mA | | 0.01 | 0.1 | %/V |
| $V_{LDR}$ | Output Load Regulation | 1mA<$I_{OUT}$<300mA, $V_{IN}$=$V_{NOM}$+1.0V | | 3 | 6 | mV |
| $V_{DROP}$ | Dropout Voltage (Note 1) | $I_{OUT}$=300mA (Applied for $V_{OUT}$≥2.3V) | | 320 | 350 | mV |
| $I_{OUTMAX}$ | Maximum Output Current | | 300 | | | mA |
| **Protection** | | | | | | |
| $I_{limit}$ | Current Limit | | 650 | | | mA |
| $I_{short}$ | Output Short Current Limit | $V_{OUT}$=0V | | 100 | | mA |
| $T_{SD}$ | Thermal Shutdown Temperature (Note 2) | No Load, $V_{IN}$=5V | | 160 | | °C |
| $T_{SDHYS}$ | Thermal Shutdown Hysteresis (Note 2) | No Load, $V_{IN}$=5V | | 20 | | °C |

**Note 1:** Dropout is defined as $V_{IN}$-$V_{OUT}$ when $V_{OUT}$ is 2% below the value of $V_{OUT}$ for $V_{IN}$=$V_{OUT}$+0.5V.

**Note 2:** Thermal shutdown threshold and hysteresis are guaranteed by design.
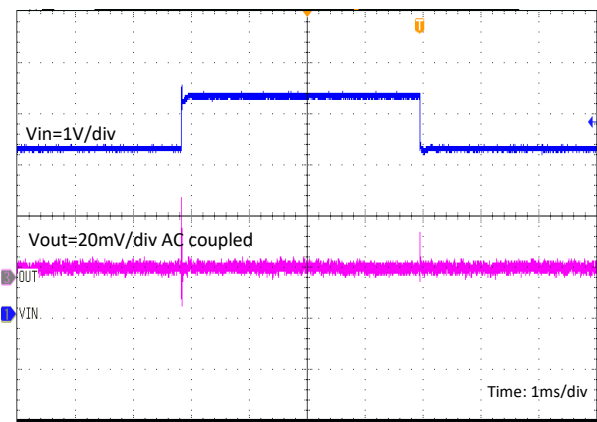
## TYPICAL PERFORMANCE CHARACTERISTICS

### Load Transient
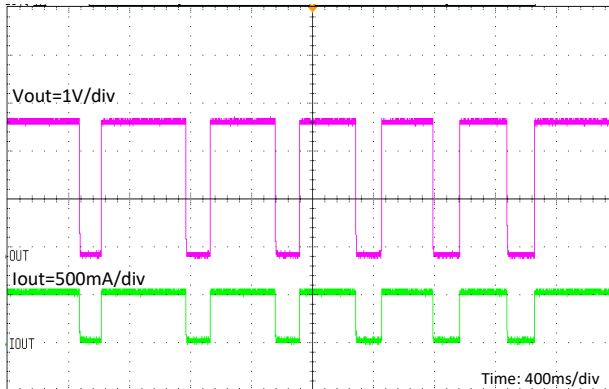Vin=3.8V, Vo=2.8V, Io=10mA to 300mA

Vout=50mV/div AC coupled

VOUT

Iout=200mV/div

Time: 200μs/div

### Line Transient
Vo=2.8V, Io=10mA, Vin=3.3V to 4.3V

Vin=1V/div

Vout=20mV/div AC coupled

OUT

VIN.

Time: 1ms/div

### Over Temperature Protection
Vin=3.8V, Vo=2.8V, Ro=5.1Ω

Vout=1V/div
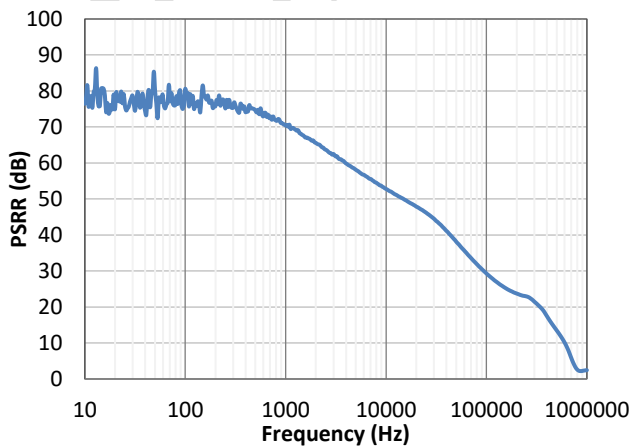
OUT
Iout=500mA/div

IOUT

Time: 400ms/div

### Dropout vs. Iout
Vin=3.8V, Ta=25°C
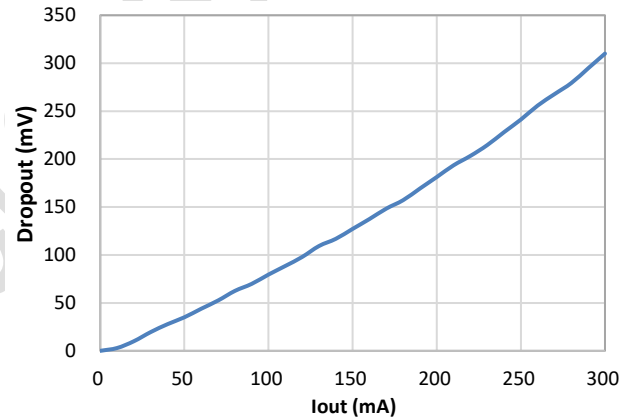


### PSRR vs Frequency
Vin=2.5V, Vo=1.5V, Io=10mA, Ta=25°C



### PSRR vs Frequency
Vin=3.8V, Vo=2.8V, Io=10mA, Ta=25°C

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6                                                                    TMI6030C V1.0    2019.08
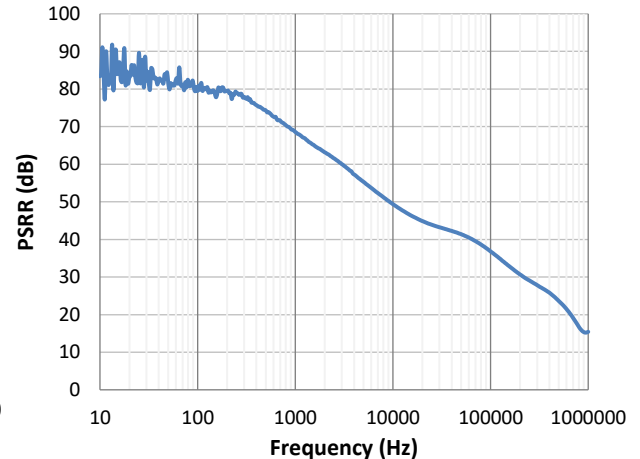
## Detailed Function Description

The TMI6030C is a high output current, low dropout linear regulator with fast transient response and high PSRR in SOT23 package. It offers high output accuracy, low quiescent current and fast start-up time. It is designed to work with low-ESR ceramic capacitor, reducing the amount of the PCB area. Only a 1μF ceramic output capacitor can make the device stable over the whole load range.

As shown in the function block diagram, the TMI6030C is composed of the bandgap reference voltage, the error amplifier, P-channel MOSFET pass transistor, internal resistor divider and some additional protection circuits. The reference voltage, connected to the cathode terminal of the error amplifier, compares with the feedback voltage to regulate the output voltage to make it constant over the whole load current range. If the feedback voltage is lower than the reference voltage, the pass transistor gate is pulled lower to increase its conductivity. This allows more current to flow to the output and increase the output voltage. If the feedback voltage is higher than the reference voltage, the pass transistor gate is pulled higher to decrease its conductivity. This allows less current to flow to the output and decrease the output voltage. The feedback point is the output of the inner resistor divider connected to the $V_{OUT}$ pin.

### Current Limit

The TMI6030C includes a current limit circuit to monitor the gate voltage of the pass transistor to limit the output current. When the output current is higher than the over-current limit, the circuit will clamp the gate voltage of the pass transistor to limit the output current.

### Short Circuit Protection

When $V_{OUT}$ pin is short-circuit to GND, short circuit protection will be triggered and clamp the output current to approximately 100mA. This feature protects the regulator from over current condition and damage due to overheating.

### Thermal Shutdown

The TMI6030C monitors internal temperature. When the junction temperature exceeds 160°C, the over temperature protection (OTP) circuit turn off the pass transistor until the device is cooled down by 20°C. Then the pass transistor resumes. For continue operation, do not exceed absolute maximum junction temperature.

## Application Information

### External capacitor

The TMI6030C requires external capacitor for stability. It is specifically designed to work with low-ESR capacitors requiring minimum PCB area. Place the external capacitors as close as possible to the device.
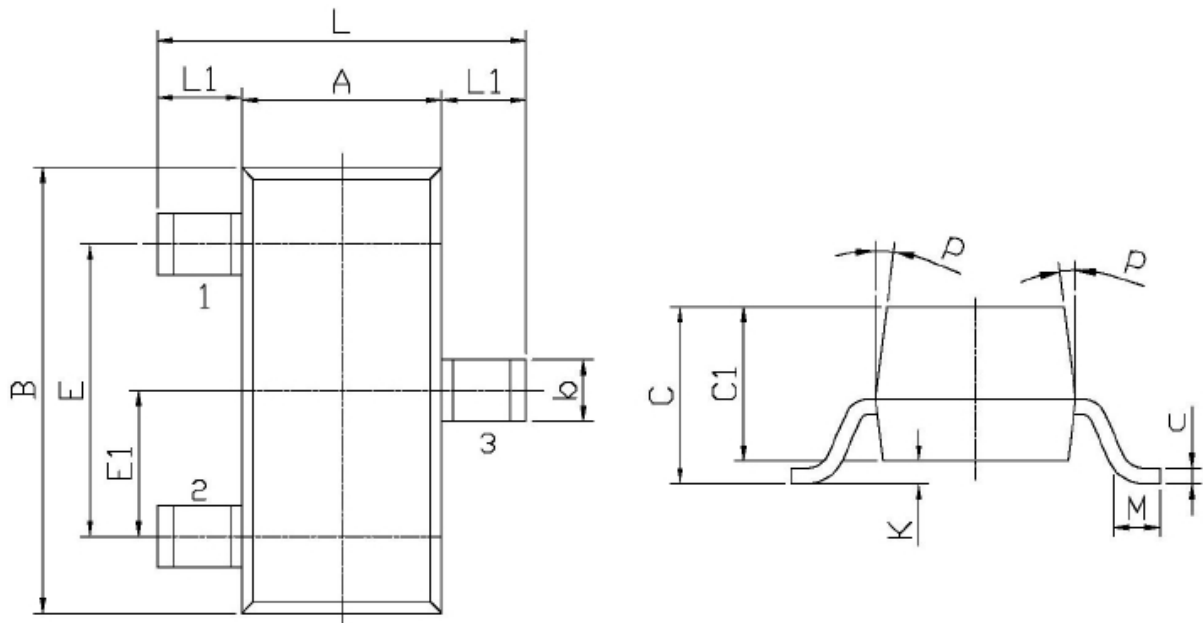
### Input capacitor

A 1µF or higher capacitance value ceramic capacitor is required between the VIN pin and the GND pin. Place it as close as possible to the device. There are no requirements for the ESR on the input capacitor, but the tolerance and temperature coefficient must be capacitance is 1µF over the whole operating temperature range.

### Output capacitor

An output capacitor ($C_{OUT}$) is needed to improve transient response and maintain stability. The TMI6030C is stable with very small ceramic output capacitors. A 1µF to 10µF capacitor is suitable for the most TMI6030C applications.

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8                                                                    TMI6030C V1.0    2019.08

## PACKAGE INFORMATION

**SOT23**



Unit: mm

| Symbol | Dimensions In Millimeters | | Symbol | Dimensions In Millimeters | |
|--------|------|------|--------|------|------|
| | Min | Max | | Min | Max |
| L | 2.2 | 2.7 | C | 1.30 MAX | |
| L1 | 0.45 | 0.65 | C1 | 0.90 | 1.20 |
| A | 1.15 | 1.50 | c | 0.05 | 0.20 |
| B | 2.70 | 3.10 | K | 0 | 0.10 |
| E | 1.70 | 2.10 | M | 0.20 MIN | |
| E1 | 0.85 | 1.05 | P | 7° | |
| b | 0.35 | 0.55 | | | |

**Note:**

1) All dimensions are in millimeters.

2) Package length does not include mold flash, protrusion or gate burr.

3) Package width does not include inter lead flash or protrusion.

4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.

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## TAPE AND REEL INFORMATION

### TAPE DIMENSIONS:



Direction of feed
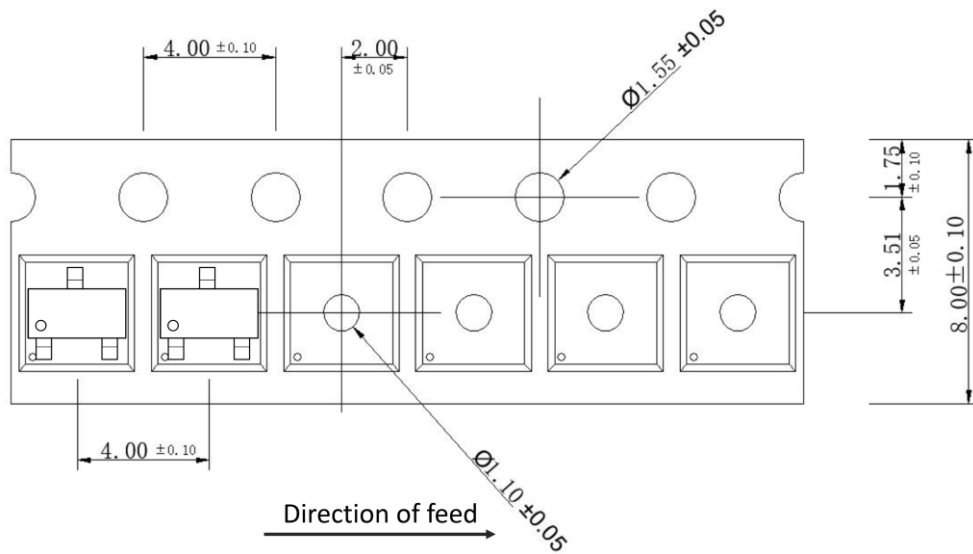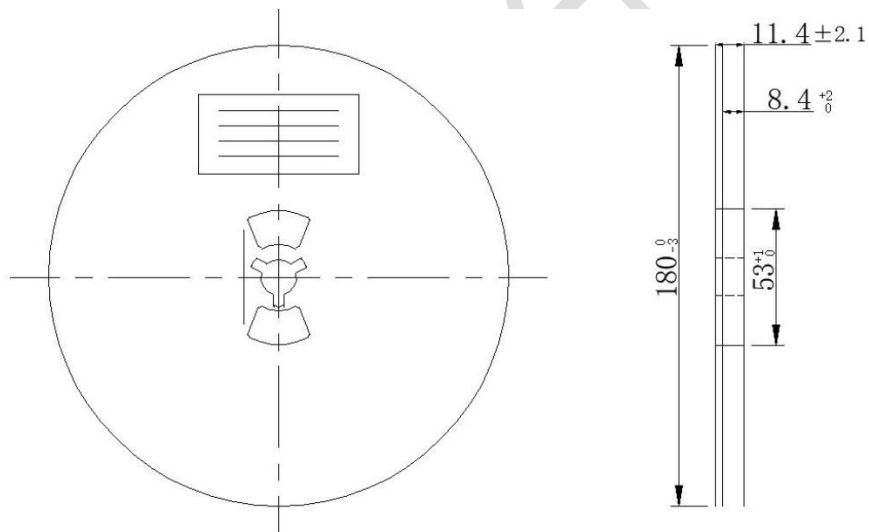
### REEL DIMENSIONS:



**Note:**

1) All Dimensions are in Millimeter
2) Quantity of Units per Reel is 3000
3) MSL level is level 3.

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10                                                                                  TMI6030C V1.0    2019.08