

1 Product Description

The MTL100 is an ASIC chip provides counting solution for flow metering based on inductive technology.

The MTL100 provides digital output for counting the turns of flow metering. CWOUT & CCWOUT links to clockwise output & counter clockwise output. Both CWOUT & CCWOUT is open-drain output.

The MTL100 can also be communicated through I2C, and supports 24-bits CW counting & 16-bits CCW counting.

The MTL100 provides QFN3*3-16L for surface mount. The package is RoHS compliant.

2 Features

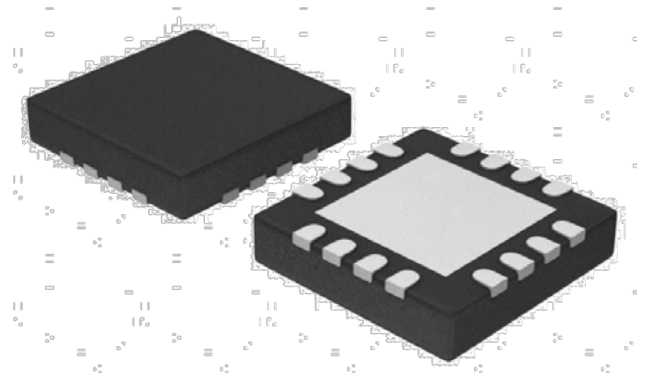
- CMOS Technology
- Icc=6uA @64Hz Sampling & 16Hz Data Refresh Frequency
- 2.4~4.5V Operating Vcc Range
- 64Hz Sampling Frequency
- 16Hz Data Refresh Frequency
- -10~55°C Operating Temperature
- Dual Digital Output for CW & CCW Signal
- Auto Calibration
- I2C Interface
 - 24 Bits CW Counting
 - 16 Bits CCW Counting
- Package Option: QFN3*3-16L

3 Product Overview of MTL100

| Part No. | Description |
|----------|---------------------------------------|
| MTL100QT | QFN3*3-16L, tape & reel (5000pcs/bag) |

4 Applications

- Position Detection
- Smart Meter



5 Pin Configuration and Functions

| Pin No. | Name | Description |
|---------|--------------------|--------------------------|
| 1 | Vcc | Power |
| 2 | SDA | I2C Data |
| 3 | SCL | I2C Clock |
| 4 | GND | Ground |
| 5 | TG4 | Trigger Signal 4 |
| 6 | Coil4 | Coil Signal 4 |
| 7 | Coil3 | Coil Signal 3 |
| 8 | TG3 | Trigger Signal 3 |
| 9 | EC | External Cap |
| 10 | NA | |
| 11 | CCW _{OUT} | Counter Clockwise Output |
| 12 | CW _{OUT} | Clockwise Output |
| 13 | TG2 | Trigger Signal 2 |
| 14 | Coil2 | Coil Signal 2 |
| 15 | Coil1 | Coil Signal 1 |
| 16 | TG1 | Trigger Signal 1 |

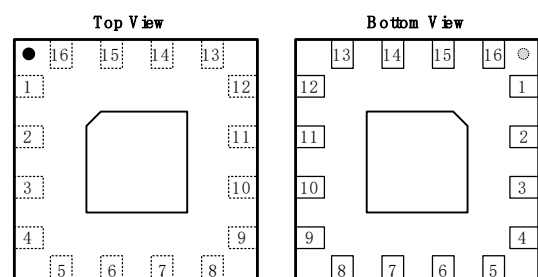


Figure.1 Pin Configuration & Functions

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Reversion History

- 1 Originally Version

6 Electrical and Magnetic Characteristics

6.1 Absolute Maximum Ratings

Absolute maximum ratings are limited values to be applied individually, and beyond which the serviceability of the circuit may be impaired. Functional operability is not necessarily implied. Exposure to absolute maximum rating conditions for an extended period of time may affect device reliability.

| Symbol | Parameters | Min | Max | Units |
|-------------------------------------|--|------|-----|-------|
| V _{CC} | Supply Voltage | -0.7 | 6 | V |
| V _{OUT} | CW _{OUT} & CCW _{OUT} Voltage | -0.7 | 6 | V |
| V _{SDA} & V _{SCL} | SDA & SCL Voltage | -0.7 | 6 | V |
| I _{OUT} | Continuous Output Current | - | 10 | mA |
| T _A | Operating Ambient Temperature | -10 | 55 | °C |
| T _S | Storage Temperature | -50 | 150 | °C |

6.2 Electrical Specifications

At T_A=-10~55°C, V_{CC}=2.4V~4.5V (unless otherwise specified)

| Symbol | Parameters | Test Condition | Min | Typ | Max | Unit |
|------------------------|--|--|-----|-----|-----|------|
| V _{CC} | Supply Voltage | Operating | 2.4 | 3.6 | 4.5 | V |
| I _{CC} | Supply Current ① | T _A =25°C, V _{CC} =3.3V F _D R=16Hz F _S ampling=64Hz | - | 6 | 10 | μA |
| V _{SAT} | Digital Output Saturation Voltage | I _{OUT} =2mA, V _{OUT} =Low Level | - | - | 0.4 | V |
| I _{OFF} | Digital Output Leakage Current | V _{OUT} =High Level | - | - | 1 | μA |
| T _{PO} | Power on Time | V _{CC} =3.3V | - | - | 20 | ms |
| F _S ampling | Sampling Frequency (Can be adjusted through I2C) | | - | 64 | - | Hz |
| F _D R | Data Refresh Frequency (Can be adjusted through I2C) | | - | 16 | - | Hz |
| T _{OUT} | The Low Voltage Continued Time of CW _{OUT} & CCW _{OUT} (Refer to Figure3) (Can be adjusted through I2C) | | - | - | 64 | ms |
| R _{TH} | Thermal Resistance of QFN3*3-16L | | - | 301 | - | °C/W |

Note: The MTL100 will detect the interference from the NB-IoT automatically, and switch into the anti-interference mode with ~1.2mA I_{CC}

6.3 Register Characteristics

At T_A=-10~55°C, V_{CC}=2.4V~4.5V (unless otherwise specified)

| Symbol | Parameters | Min | Typ | Max | Unit |
|-----------|----------------------------|-----|-----|-----|------|
| COUNT_CW | Clockwise Counting | - | 24 | - | Bit |
| COUNT_CCW | Counter Clockwise Counting | - | 16 | - | Bit |

6.4 ESD Ratings

| Symbol | | Reference | Values | Unit |
|------------------|----------------------------|--------------|--------|------|
| V _{ESD} | Human-body model (HBM) | AEC-Q100-002 | ±6000 | V |
| | Charged-device model (CDM) | AEC-Q100-011 | ±1000 | V |

6.5 NVM Specifications

At TA=-10~55°C, VCC=2.4V~4.5V (unless otherwise specified)

| Symbol | Parameters | Min | Typ | Max | Unit |
|--------------------|--------------------|-----|-----|-----|------|
| V _{PGRM} | Programing Voltage | - | 3.6 | - | V |
| V _{WRITE} | Writing Voltage | 2.4 | - | - | V |
| V _{READ} | Reading Voltage | 2.4 | - | - | V |

6.6 Characteristic Performance

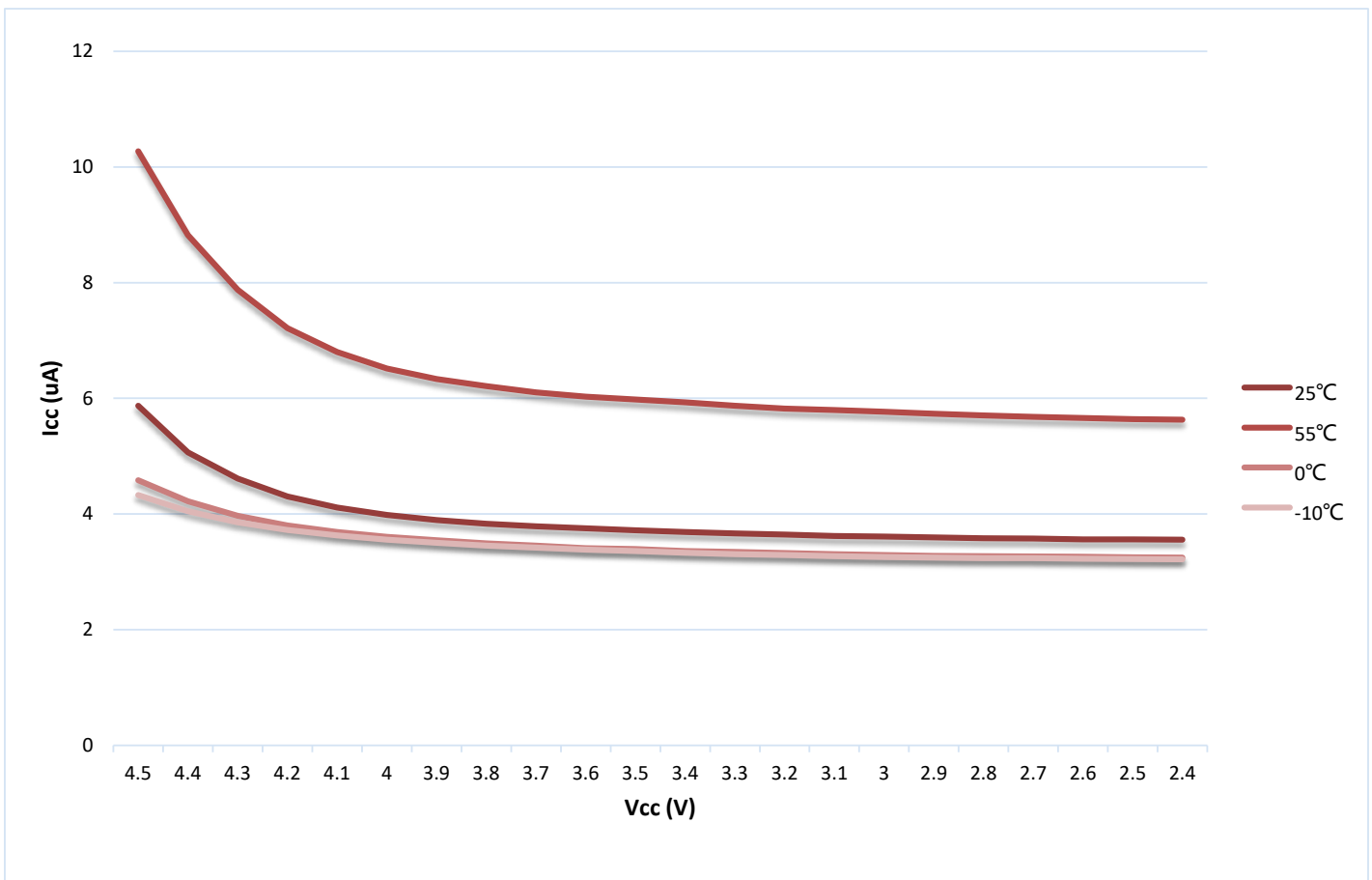


Figure.2 I_{CC} vs. Temp. & V_{CC} @ 64Hz F_{Sampling} 16Hz F_DR

7 Typical Output Waveform

7.1 CW & CCW Output

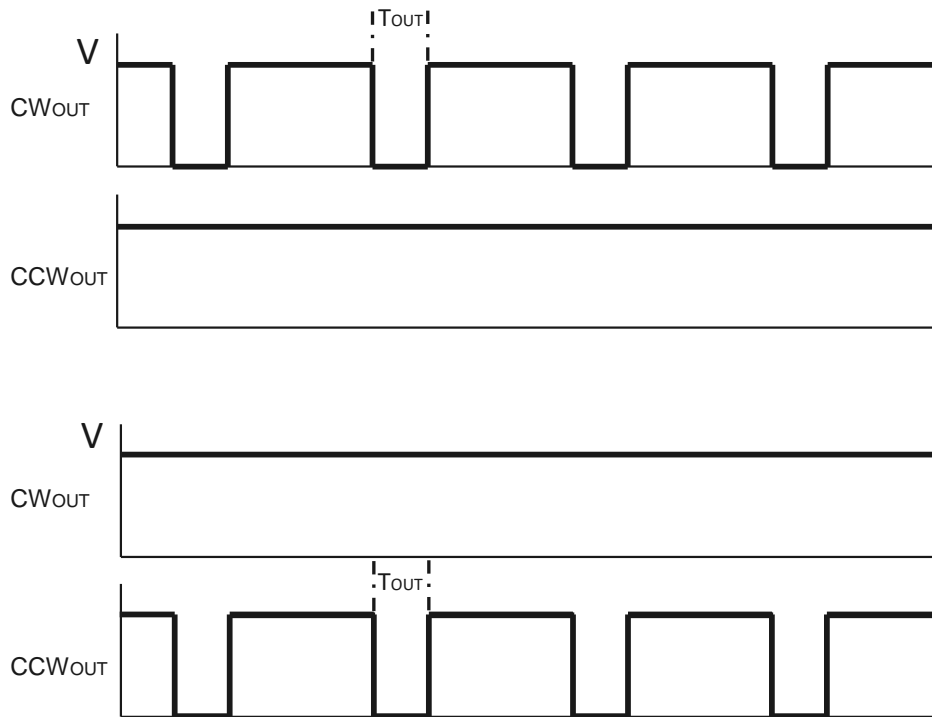


Figure.3 CW & CCW Output Diagram (Default T_{OUT}=64ms)

8 Functional Block Diagram

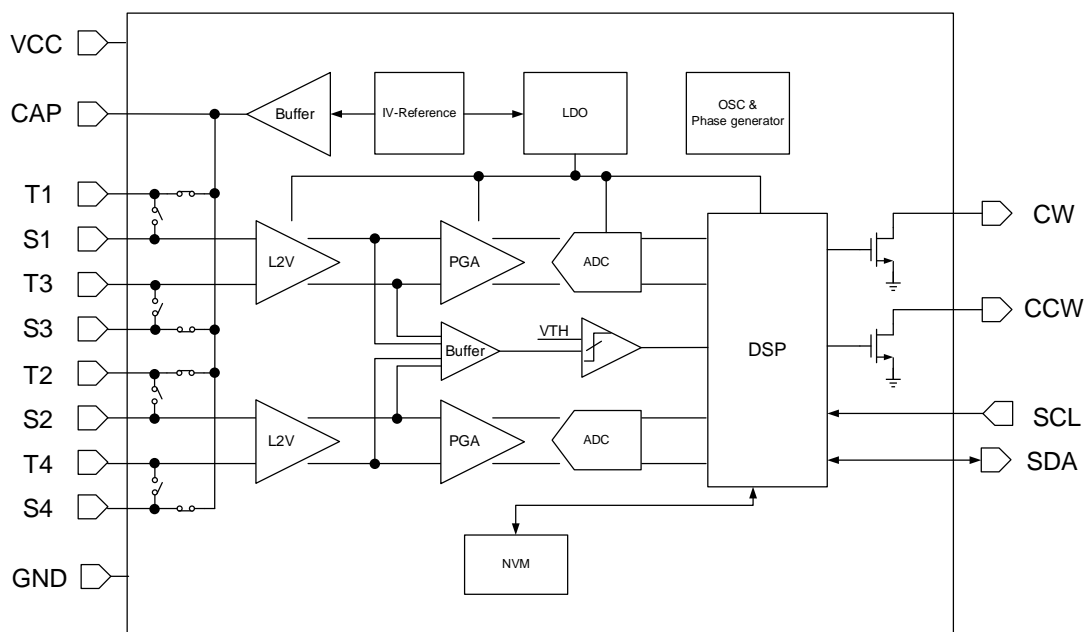


Figure.4 Functional Block Diagram

9 I2C Interface

9.1 Timing Requirement

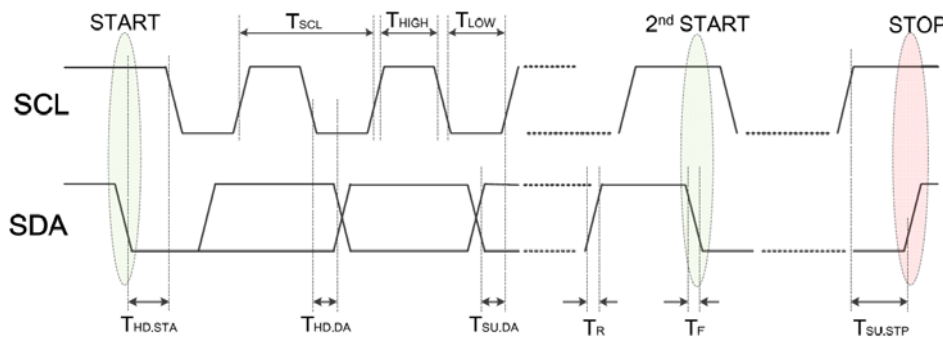


Figure.5 I2C Timing Diagram

| Parameter | Description | Min. | Max. | Unit |
|--------------|-------------------------|------|------|------|
| T_{SCL} | SCL Clock Period | 1 | - | Ms |
| $T_{HD,STA}$ | Hold Time of 'START' | 250 | - | ns |
| T_{LOW} | Low Phase of SCL | 250 | - | ns |
| T_{HIGH} | High Phase of SCL | 250 | - | ns |
| $T_{SU,DA}$ | Setup Time of SDA | 100 | - | ns |
| $T_{HD,DA}$ | Hold Time of SDA | 50 | - | ns |
| T_R | Rising Time of SDA/SCL | - | 150 | ns |
| T_F | Falling Time of SDA/SCL | - | 150 | ns |
| $T_{SU,STP}$ | Setup Time of 'Stop' | 250 | - | ns |

9.2 Register Map

| Name | Addr. | Type | DATA | | | | | | | |
|---------------|-------|------|----------------------|------|------|------|------|------|------|--------------|
| | | | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
| COUNTER_CLEAR | 0x21 | R/W | | | | | | | | CLEAR [0] |
| COUNT_CW | 0x44 | R/O | COUNT_CW [23 : 16] | | | | | | | |
| | 0x45 | R/O | COUNT_CW [15 : 8] | | | | | | | |
| | 0x46 | R/O | COUNT_CW [7 : 0] | | | | | | | |
| COUNT_CCW | 0x47 | R/O | COUNT_CCW [15 : 8] | | | | | | | |
| | 0x48 | R/O | COUNT_CCW [7 : 0] | | | | | | | |

10 Package Material Information (For Reference Only – Not for Tooling Use)

10.1 QFN3*3-16L Package Information

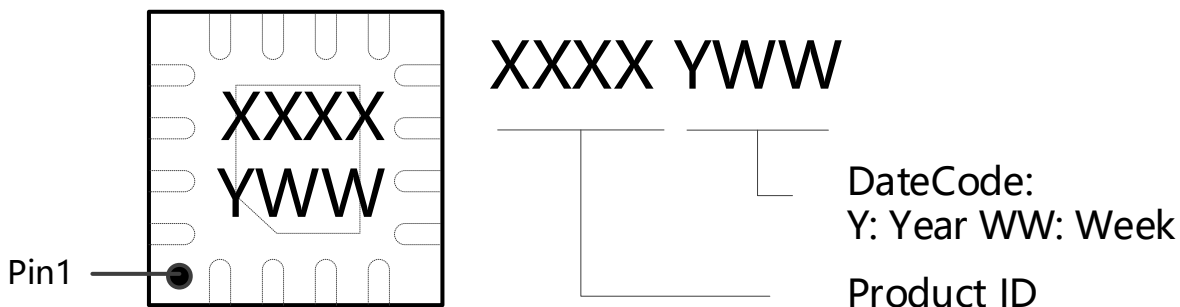


Figure.6 QFN3*3-16L Chip Marking Spec

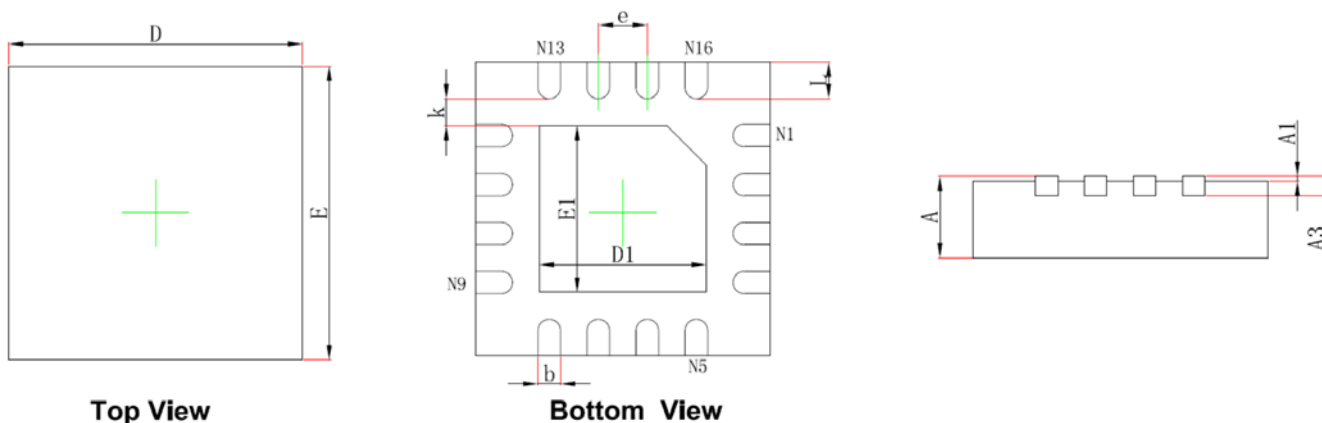


Figure.7 QFN3*3-16L Package Drawing

| Symbol | Dimensions in Millimeters | | Dimensions in Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A3 | 0.203REF | | 0.008REF | |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| D1 | 1.600 | 1.800 | 0.063 | 0.071 |
| E1 | 1.600 | 1.800 | 0.063 | 0.071 |
| k | 0.275REF | | 0.011REF | |
| b | 0.180 | 0.300 | 0.007 | 0.012 |
| e | 0.500REF | | 0.020REF | |
| L | 0.300 | 0.500 | 0.012 | 0.020 |
| X | 1.690 | 1.990 | 0.066 | 0.078 |
| Y | 1.110 | 1.410 | 0.043 | 0.055 |
| Z | 0.420 | 0.620 | 0.016 | 0.024 |

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