CORERIVER
Total Solution of MCU

# TC303-DFN10

## *Capacitive Touch Sensor Controller*

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# 1 TC303-DFN10 Overview

## 1.1 General Description

***TC303-DFN10*** is a high-performance Controller for capacitive touch. Its engine is an 8-bit 80C51 compatible Processor.

***TC303-DFN10*** has two timer/counters, maximum 2-channel of touch sensors, maximum 5 programmable I/O pins, 1 Watchdog timer, POR (Power-On Reset), $I^2C$ and LVD (Low Voltage Detector) as peripherals. In addition, it contains an internal ring oscillator, which can generate the 27 MHz system clock signal.

***TC303-DFN10*** has its own architecture for fast sensing. With the hardware filter, it provides noise immunity and excellent sensitivity. The firmware algorithm supports smart sensitivity and compensates for changes in the sensitivity due to environmental factors such as temperature and humidity.

To effectively manage power, ***TC303-DFN10*** enables low power consumption by using scan interval and clock control methods after last touch.

***TC303-DFN10*** operates over the extended -40℃ to +85℃ temperature range, and is available in the 10-pin DFN package.

## 1.2 Features

- Capacitive Touch Controller
- Touch Response Time
  - The latency of < 20ms for touch, subject to configuration
  - Programmable sensing rate for power saving.
- CPU
  - 8-bit Turbo 80C52 Architecture
  - 4 Cycles / 1 Machine Cycle
  - Instruction Level Compatible with Intel 80C52
- Memory
  - 16KB Flash
  - 768B Internal Aux. RAM
  - 256B Internal RAM
- Power Supply
  - Operating Voltage ($V_{DDIO}$) : +2.3V to +5.5V
  - Operating Voltage ($V_{DDHOST}$) : +1.8V to VDDIO
    (* $V_{DDHOST}$ : P1 I/O Power)
- Operating Frequency: Typ. 27MHz
- Max. 5 Programmable I/O Pins
- Communication interfaces
  - 1-channel I2C Communication (Slave)
- Internal Ring OSC with Calibration function
- Supporting ISP/IAP
- 7 Internal Interrupt Sources and 3 External Interrupt Sources
- 3 Reset Sources
- Power Down Wake-up Sources
  - Reset Sources + 3 External Interrupt (Both Levels)
  - Sleep Timer Interrupt
  - I2C Interrupt

- 4 operating modes:
  - Active : Typ. 1mA
  - IDLE : Typ. 400uA
  - Sleep (ST on) : Typ. 1.4uA
  - Deep Sleep (ST off): Typ. 1.0uA
- E.S.D. Protection up to
  - 8,000V
- Latch-up Protection Up to ±200mA
- Package
  - 10-pin DFN (0.50T)

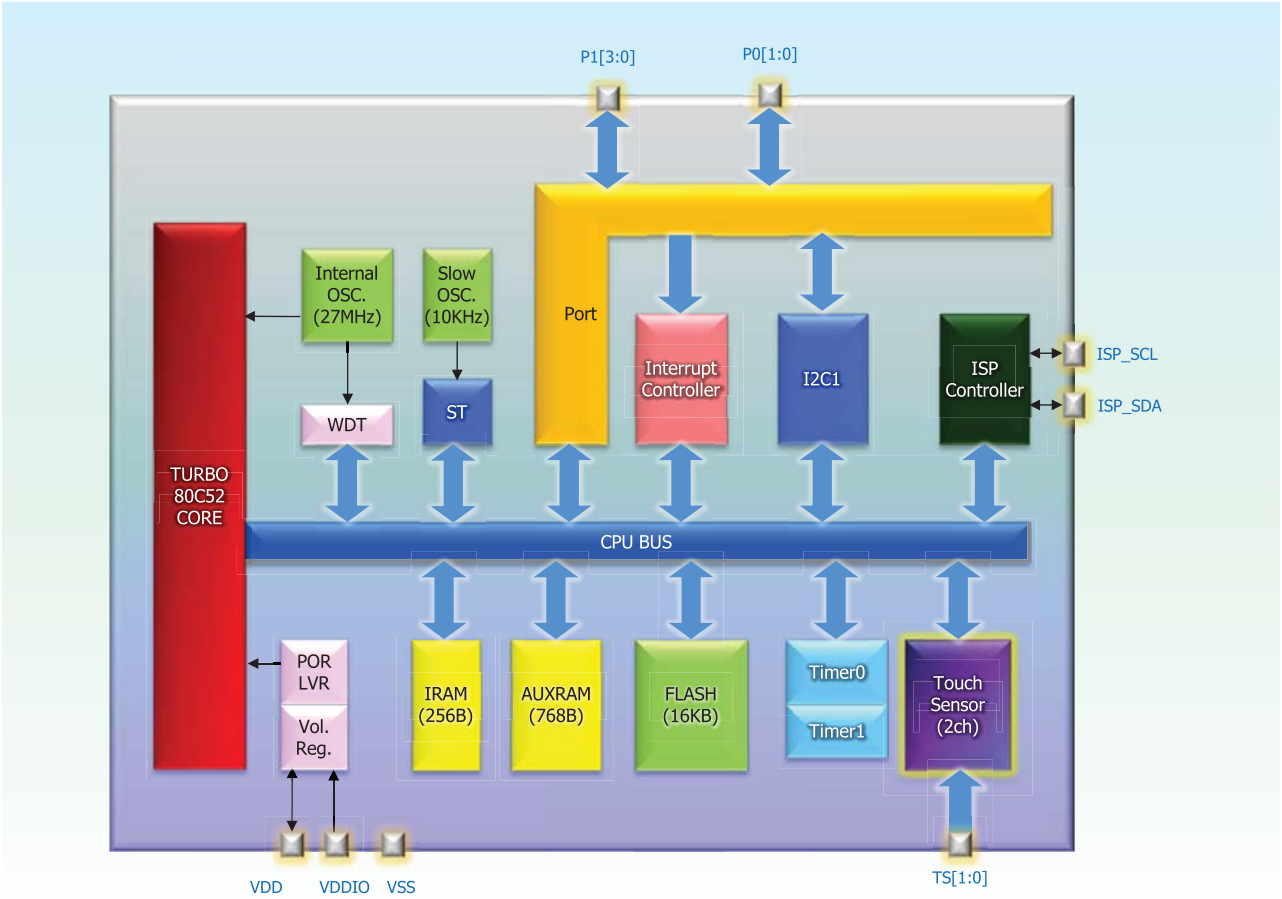
## 1.3 Product Family Guide

| Product | FLASH, [Byte] | RAM [Byte] | Volt [V] | COM I/O | I/O Pins | Touch Channel, Res. | Package | Others |
|---|---|---|---|---|---|---|---|---|
| TC303-DF10IP | 16K | 768 + 256 | VDDIO (2.3~5.5) VDDHOST (1.8~VDDIO) | I2C | 5 | 2, 65,536 | 1.25mm x 1.5mm 0.5T 10-DFN | Timer/ Counter WDT POR LVD ROSC |

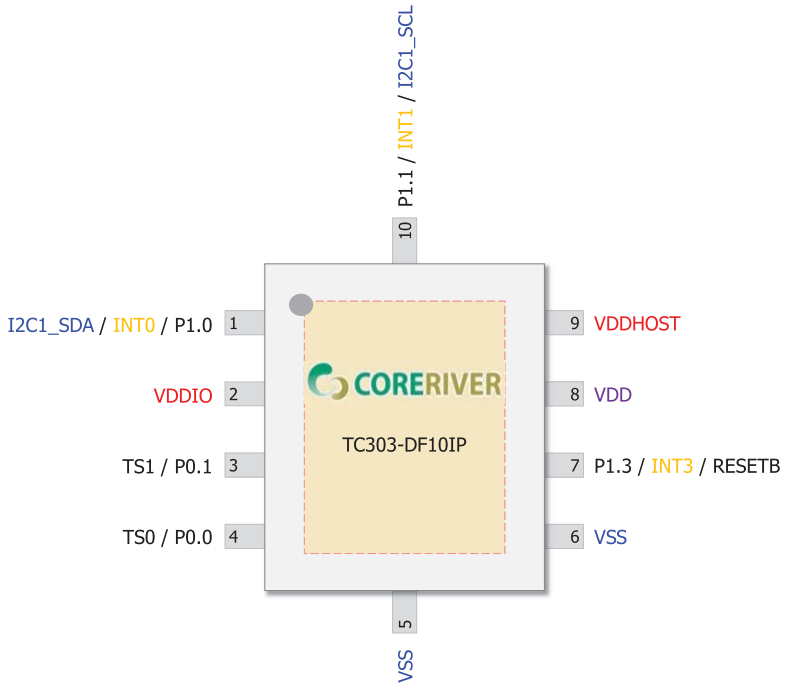
## 2 Block Diagram

Figure shows the block diagram of ***TC303-DFN10***. Programs reside in the internal program memory (Embedded Flash Memory). Data are read from or written to data memory (SRAM) or special function registers (SFRs).

The internal registers of ***TC303-DFN10*** are configured as part of the on-chip RAM: therefore each register has an address. This is reasonable for ***TC303-DFN10***, since it has so many registers.



# 3 Pin Configuration




**TC303-DF10IP Package Diagram**

| Pin No. 10-DFN | Name | Type | Description | Share Pins |
|---|---|---|---|---|
| 2 | VDDIO | PWR | Power Supply | |
| 9 | VDDHOST | PWR | Power Supply for host interface (Port 1 IO Power) | |
| 5, 6 | VSS | GND | Ground | |
| 8 | VDD | O | Digital Power Filter | |
| 7 | RESETB | RESETB | External Reset Input Signal General I/O Port 1.3 | P1.3 |
| 10 | P1.1 | I/O | General I/O Port 1.1 | I2C1_SCL / INT1 |
| 1 | P1.0 | I/O | General I/O Port 1.0 | I2C1_SDA / INT0 |
| 3 | P0.1 | I/O | General I/O Port 0.1 | Touch Sensing Channel 1 |
| 4 | P0.0 | I/O | General I/O Port 0.0 | Touch Sensing Channel 0 |

# 4 Absolute Maximum Ratings

**. Absolute Maximum Ratings (TA = 25 °C )**

| Item | Conditions | Range |
|---|---|---|
| DC Voltage in $V_{DDIO}$ relative to Ground | - | -0.5 V to +6V |
| DC Input Voltage | - | -0.5V to ($V_{DDIO}$+0.5V) |
| DC Output Voltage | - | -0.5 V to ($V_{DDIO}$+0.5V) |
| DC Output Current High | One I/O pin active | -25mA |
| | All I/O pin active | -100mA |
| DC Output Current Low | One I/O pin active | +30mA |
| | All I/O pin active | +150mA |
| Storage Temperature | - | -65 °C to +150 °C |
| Soldering Temperature | - | 260 °C for 10 seconds |

**. Recommended Operating Conditions**

| Item | Range |
|---|---|
| Operating Voltage (VDDIO) | +2.3V to +5.5V |
| Operating Voltage (VDDHOST) | +1.8V to +$V_{DDIO}$ |
| Operating Temperature | -40℃ to + 85℃ |

# 5 DC Characteristics

* $T_A$= -40°C ~ +85°C, $V_{DDIO}$=2.3V ~ 5.5V unless otherwise specified

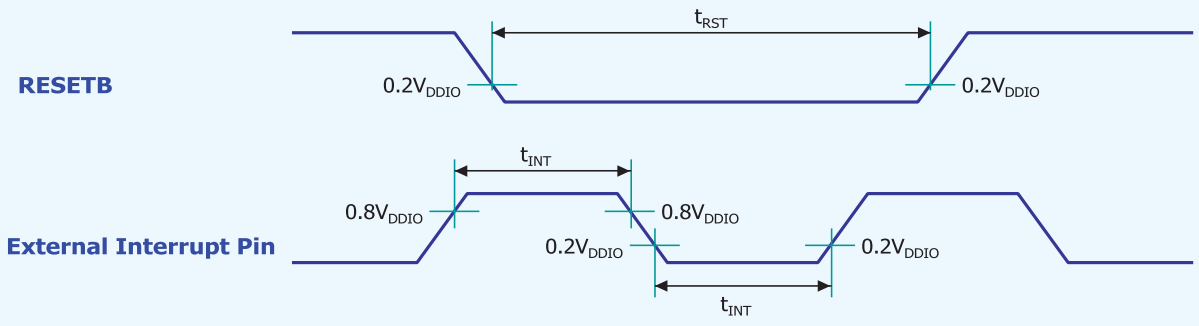
| Parameter | Symbol | Pin | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Power Source | PWR | $V_{DDIO}$ | - | +2.3 | - | 5.5 | V |
| Power Source | PWR | $V_{DDHOST}$ | $V_{DDIO}$ = +2.3V to +5.5V | +1.8 | - | $V_{DDIO}$ | V |
| Input Low Voltage | $V_{IL}$ | P0 | $V_{DDIO}$ = +2.3V to +5.5V | -0.5 | - | $0.2V_{DDIO}$ +0.1 | V |
| | | P1 | $V_{DDIO}$ = +2.3V to +5.5V<br>$V_{HOST}$ = +1.8V to +$V_{DDIO}$ | -0.5 | - | $0.2V_{DDHOST}$ +0.1 | V |
| Input high Voltage | $V_{IH}$ | P0 | $V_{DDIO}$ = +2.3V to +5.5V | $0.2V_{DDIO}$ +1.0 | - | $V_{DDIO}$ +0.5 | V |
| | | P1 | $V_{DDIO}$ = +2.3V to +5.5V<br>$V_{HOST}$ = +1.8V to +$V_{DDIO}$ | $0.2V_{DDHOST}$ +1.0 | - | $V_{DDHOST}$ +0.5 | V |
| Output Low Voltage | $V_{OL}$ | P0 | $V_{DDIO}$ = +5.0V<br>($I_{OL}$ = 8mA)<br>$V_{DDIO}$ = +3.3V<br>($I_{OL}$ = 4mA) | - | - | $0.3V_{DDIO}$ | V |
| | | P1 | $V_{DDHOST}$ = +5.0V<br>($I_{OL}$ = 8mA)<br>$V_{DDHOST}$ = +3.3V<br>($I_{OL}$ = 4mA) | - | - | $0.3V_{DDHOST}$ | V |
| | | P0 (High Drive) | $V_{DDIO}$ = +3.3V<br>($I_{OL}$ = 35mA) | - | - | $0.3V_{DDIO}$ | V |
| | | P1 (High Drive) | $V_{DDHOST}$ = +3.3V<br>($I_{OL}$ = 35mA) | - | - | $0.3V_{DDHOST}$ | V |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Output High Voltage | $V_{OH}$ | P0 | $V_{DDIO}$ = +5.0V<br>($I_{OH}$ = -12mA)<br>$V_{DDIO}$ = +3.3V<br>($I_{OH}$ = -6mA) | $0.7V_{DDIO}$ | - | - | V |
| | | P1 | $V_{DDHOST}$ = +5.0V<br>($I_{OH}$ = -12mA)<br>$V_{DDHOST}$ = +3.3V<br>($I_{OH}$ = -6mA) | $0.7V_{DDHOST}$ | - | - | V |
| Pull-up Resistor | $R_{Pu}$ | P0 | $V_{DDIO}$ = +5.0V<br>$V_{DDIO}$ = + 3.3V | | 37.5<br>45 | | KΩ |
| Pull-up Resistor | $R_{Pu1}$ | P1 | $V_{DDHOST}$ = +5.0V<br>$V_{DDHOST}$ = + 3.3V | | 37.5<br>45 | | KΩ |
| Logical 1 to 0 Transition Current | $I_{TL}$ | P0 | $V_{DDIO}$ = 5.0V ± 10%<br>($V_{IN}$ = +1.5V) | - | 548 | - | μA |
| | | P1 | $V_{DDHOST}$ = 5.0V ± 10%<br>($V_{IN}$ = +1.5V) | - | 548 | - | μA |
| Input Leakage Current | $I_{IL}$ | P0, P1 | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | - | - | ±1 | μA |
| Pin Capacitance | $C_{IO}$ | All | $V_{DDIO}$ = +5.0V | - | 10 | - | pF |
| Active Current | $I_{DD}$ | $V_{SS}$ | $V_{DDIO}$ = +2.3V, $T_{A,}$=25°C,<br>$F_{SYS}$ =12.5MHz,<br>Touch Sampling rate =<br>100Hz(4 Channels),<br>no I/O sourcing current | - | 1 | 2.1 | mA |
| Deep Sleep Current | $I_{SB}$ | $V_{SS}$ | $V_{DDIO}$ = +2.3V, $T_{A,}$=25°C,<br>no I/O sourcing current | - | 1 | 5 | μA |

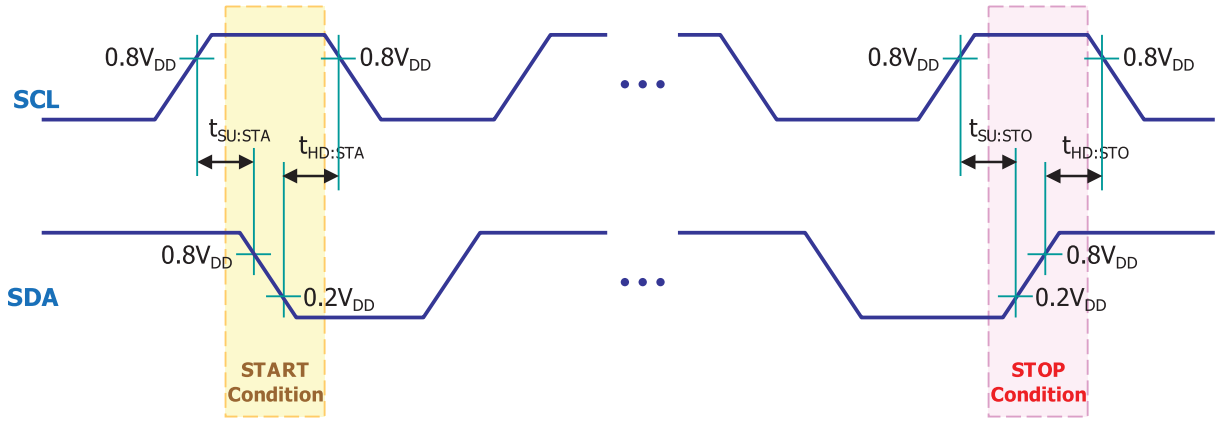
# 6 AC Characteristics

* $T_A$ = -40 °C ~ +85 °C, $V_{DDIO}$ = 2.3V ~ 5.5V unless otherwise specified

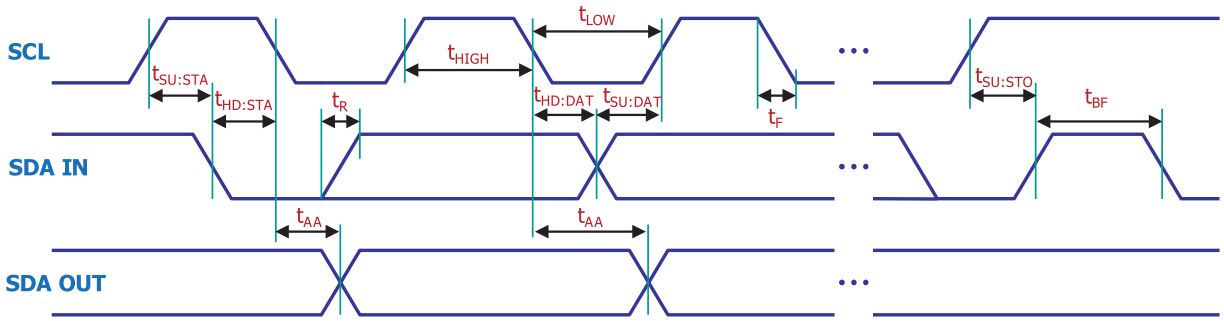
| Parameter | Symbol | Pin | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| RESETB Input Width | $t_{RST}$ | RESETB | $V_{DDIO}$ = 3V ± 10% | 24 | - | - | $F_{SYS}$ |
| External Interrupt Input Width | $t_{INT}$ | External Interrupt | $V_{DDIO}$ = 3V ± 10% | 4 | - | - | $F_{SYS}$ |



# 7 I2C Timing Characteristics

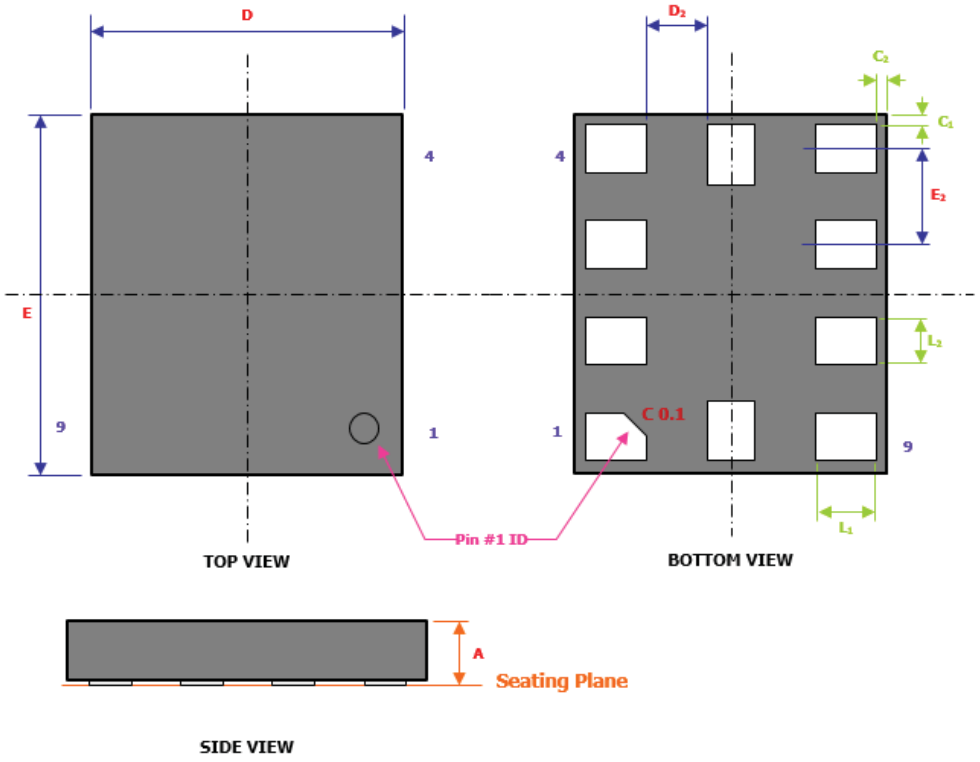



| Symbol | Characteristics | | Min. [ns] | Max. [ns] | Conditions |
|---|---|---|---|---|---|
| $t_{SU:STA}$ | START Condition Setup Time | 100kHz Mode | 4,700 | - | Only relevant for repeated START condition |
| | | 400kHz Mode | 600 | - | |
| $t_{HD:STA}$ | START Condition Hold Time | 100kHz Mode | 4,700 | - | After this period, the first clock pulse is generated |
| | | 400kHz Mode | 600 | - | |
| $t_{SU:STO}$ | STOP Condition Setup Time | 100kHz Mode | 4,700 | - | |
| | | 400kHz Mode | 600 | - | |
| $t_{HD:STO}$ | STOP Condition Hold Time | 100kHz Mode | 4,700 | - | |
| | | 400kHz Mode | 600 | - | |




| Symbol | Characteristics | | Min. [ns] | Max. [ns] | Conditions |
|---|---|---|---|---|---|
| $t_{HIGH}$ | Clock High Time | 100kHz Mode | 4,000 | - | Minimum Frequency : 1MHz |
| | | 400kHz Mode | 600 | - | Minimum Frequency : 5MHz |
| $t_{LOW}$ | Clock Low Time | 100kHz Mode | 4,700 | - | Minimum Frequency : 1MHz |
| | | 400kHz Mode | 1,300 | - | Minimum Frequency : 5MHz |
| $t_{SU:DAT}$ | Data Input Setup Time | 100kHz Mode | 250 | - | |
| | | 400kHz Mode | 100 | - | |
| $t_{HD:DAT}$ | Data Input Hold Time | 100kHz Mode | 0 | - | |
| | | 400kHz Mode | 0 | 900 | |
| $t_{AA}$ | Data Valid from Clock | 100kHz Mode | - | 3,500 | |
| | | 400kHz Mode | - | - | |
| $t_{BF}$ | BUS Free Time | 100kHz Mode | 4,700 | - | |
| | | 400kHz Mode | 1,300 | - | |
| $t_R$ | SDA & SCL Rising Time | 100kHz Mode | - | 1,000 | The Range of Cb is from 10pF to 400pF |
| | | 400kHz Mode | 2.0 + 0.1Cb | 300 | |
| $t_F$ | SDA & SCL Falling Time | 100kHz Mode | - | 300 | The Range of Cb is from 10pF to 400pF |
| | | 400kHz Mode | 2.0 + 0.1Cb | 300 | |

# 10-pin DFN Package Dimension




| Symbol | Dimensions [mm] | | |
|---|---|---|---|
| | Min. | Nom. | Max. |
| A | 0.45 | 0.50 | 0.55 |
| $C_1$ | | 0.05 REF | |
| $C_2$ | | 0.05 REF | |
| D | 1.20 | 1.25 | 1.30 |
| $D_2$ | | 0.225 REF | |
| E | 1.45 | 1.50 | 1.55 |
| $E_2$ | | 0.40 BSC | |
| $L_1$ | 0.20 | 0.25 | 0.30 |
| $L_2$ | 0.15 | 0.20 | 0.25 |

**Notes:**

1. All Dimension are in mm. Angles in Degrees.
2. Dimension b applies to Plated Terminal & is measured.
3. BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, Usually

# 8 Revision History

| Date | Revision | History |
|---|---|---|
| Oct. 2019 | 0.0 | Preliminary version. |
| Mar. 2021 | 0.4 | Notation error corrected. |

# TC303-DF10IP

## Body Size : 1.25mm x 1.5mm

>>VDDIO [ Operating Voltage ] : +2.4V to +5.0V

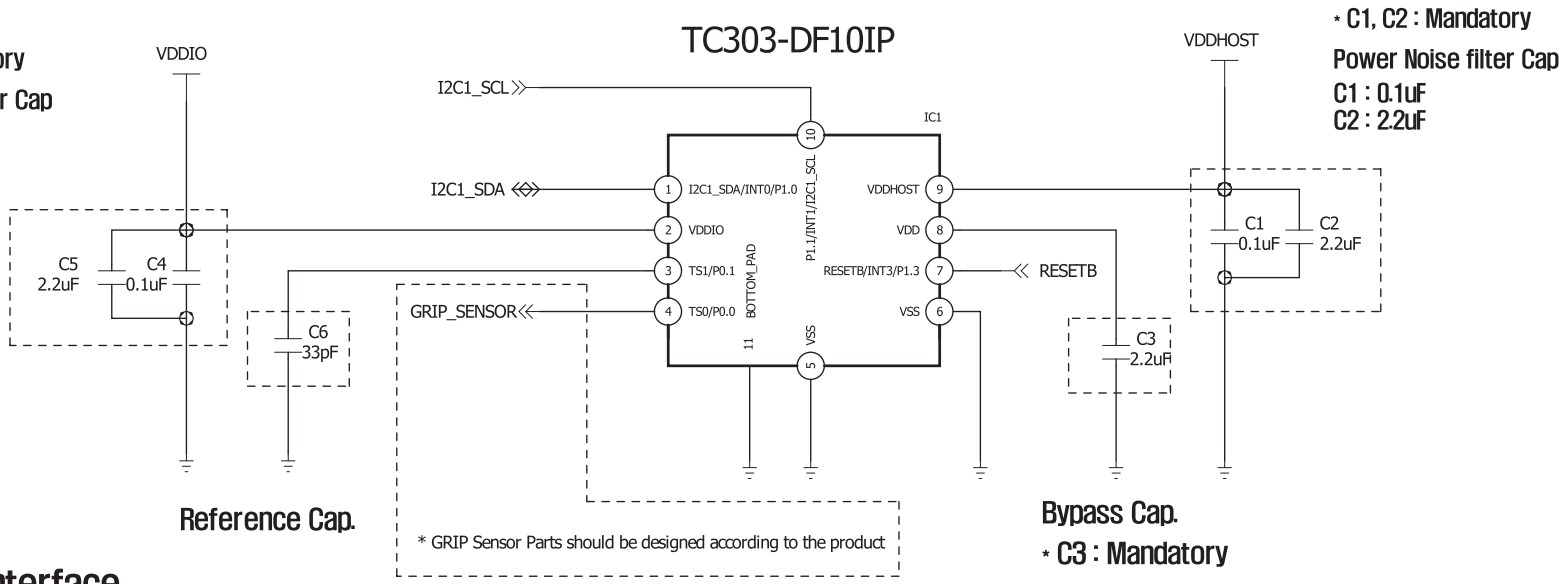
>>VDDHOST [ IIC Pull Up Voltage ] : +1.8V to VDDIO

* C4, C5 : Mandatory

Power Noise filter Cap

C4 : 0.1uF

C5 : 2.2uF




Reference Cap.

* GRIP Sensor Parts should be designed according to the product

* C1, C2 : Mandatory

Power Noise filter Cap

C1 : 0.1uF

C2 : 2.2uF

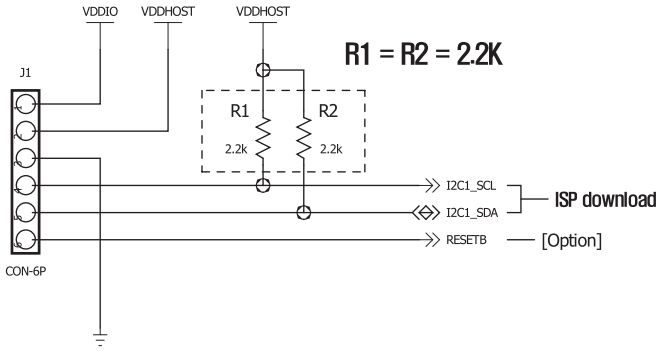
Bypass Cap.

* C3 : Mandatory

LDO Filter Cap

C3 =2.2uF (or 4.7uF)

## External interface
## ISP download




| NO. | REVISION NO. | NO. | REVISION NO. |
|---|---|---|---|
| 1 | | | |
| 2 | | | |

C B A QUANTITY

| NO | PART NO. | DESCRIPTION | METERIAL | COLOR FINISH | NOTE |
|---|---|---|---|---|---|

| SCALE | UNIT | DRAWN. | D'SCHEMATIC |
|---|---|---|---|
| A3 | mm | 2019-10-08 | TC303-DF10IP |
| SHEET | 1 / 1 | CORERIVER | |