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Total Solution of MCU

TC301M

Capacitive Touch Sensor Controller

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1 TC301M Overview

1.1 General Description

TC301M is a high-performance Controller for capacitive touch. Its engine is an 8-bit 80C51 compatible Processor.

TC301M has two timer/counters, 1-channel of touch sensors, maximum 4 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.

TC301M 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, ***TC301M*** enables low power consumption by using scan interval and clock control methods after last touch.

TC301M operates over the extended -40℃ to +85℃ temperature range, and is available in the 6-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
- 16KB FLASH
- 1280Byte Internal Aux. RAM
- 256Byte Internal RAM
- Operating Voltage: +2.4V to +5.5V
- Power Supply
  - ✓ Operating Voltage (VDDIO) : +2.4V to +5.5V
- Programmable Max. 4 I/O Pins
  - ✓ Pull-up control(I/O Pins), Open drain, Push-Pull output
  - ✓ TTL and CMOS compatible logic levels
- Low Voltage Detector (LVD): +1.65V
- Operating Frequency: 27MHz
- **1-channel Touch Sensing**
  - ✓ **Capacitive Type Touch Sensing**
  - ✓ **Digital Sensing**
  - ✓ **24-bit Level Resolution**
- Support of ISP/IAP
- two 16/8-bit Timer/Counters
- 26-bit Programmable Watchdog Timer(WDT)
- **1-channel I2C Comm.**
- Max. 10 Interrupt Sources
  - ✓ Timer0/1, WDT, LVR, I2C1, TS, ST
  - ✓ 3 External Interrupt Sources : Both Edge/Level
  - ✓ Two-level Interrupt Priority

- Reset Sources
  - ✓ On-chip Power-On-Reset (POR)
  - ✓ External Reset
  - ✓ Low Voltage Detector Reset (LVR)
  - ✓ Watchdog Timer Reset
- Power Down Wake-up Sources
  - ✓ 3 External Interrupt (Both Levels)
  - ✓ I2C interrupt
  - ✓ Sleep timer interrupt
- Power Consumption
  - ✓ Active Current : Max. 1mA @+3.3V, 2MHz
  - ✓ Sleep Current : Typ. 1.4uA @+3.3V(ST on)
  - ✓ Deep Sleep Current : Typ. 1.0uA @+3.3V
- E.S.D. Protection up to 8,000V
- Latch-up Protection Up to ±200mA
- Package
  - ✓ 6-DFN (1.4mm X 1.4mm, 0.50T)

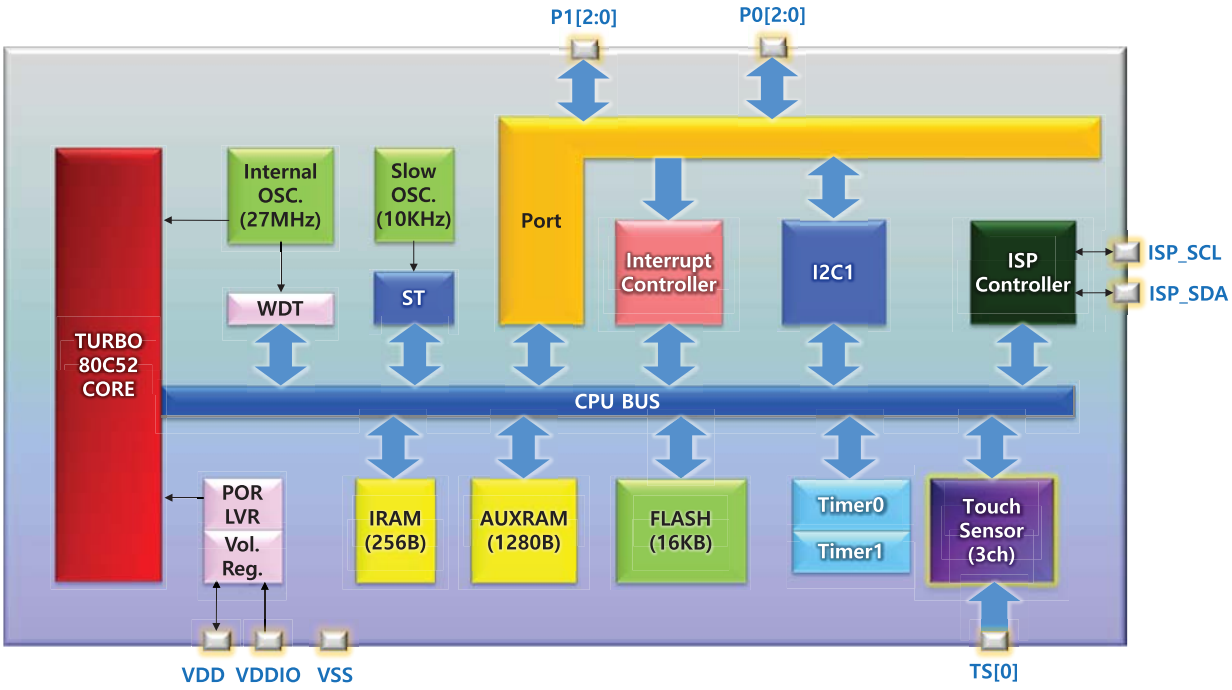
1.3 Product Family Guide

Product	FLASH, [Byte]	RAM [Byte]	Volt [V]	COM I/O	I/O Pins	Touch Channel, Res.	Package	Others
TC301M-DF6IP	16K	1K + 0.5K	VDDIO (2.4~5.5)	I2C	4	1, 65,536	6-DFN	IAP ISP WDT TC0/1 ST LVD POR

2 Block Diagram

Figure shows the block diagram of ***TC301M***. 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 ***TC301M*** are configured as part of the on-chip RAM: therefore each register has an address. This is reasonable for ***TC301M***, since it has so many registers.



3 Pin Configuration

TC301M-DF6IP Package Diagram

Pin No. 6-DFN	Name	Type	Description	Share Pins
1	VDDIO	PWR	Power Supply	
2	VSS	GND	Ground	
5	P1.2	I/O	General I/O Port 1.2	INT2 / T0 / CLO
4	P1.1	I/O	General I/O Port 1.1	I2C1_SCL / INT1
3	P1.0	I/O	General I/O Port 1.0	I2C1_SDA / INT0
6	P0.2	I/O	General I/O Port 0.2	Touch Sensing Channel 2 / RESETB

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 +5.0V
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)	+2.4V to +5.0V
Operating Temperature	-40℃ to + 85℃

5 DC Characteristics

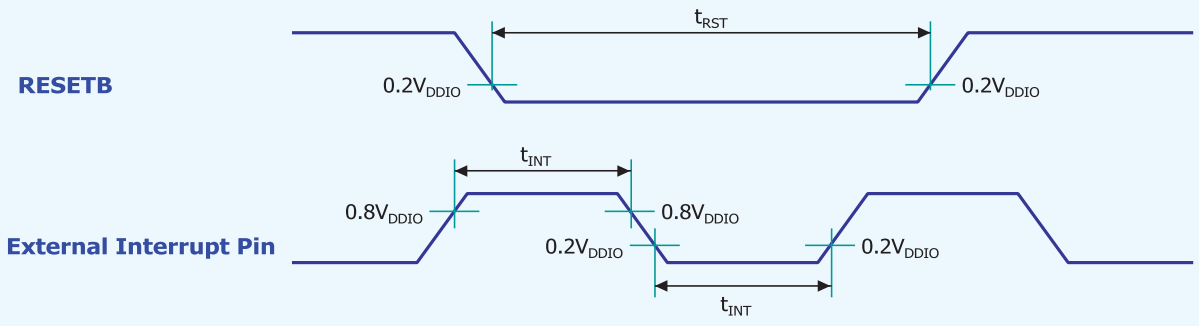
* T_A= -40°C ~ +85°C, V_{DDIO}=2.4V ~ 5.5V unless otherwise specified

Parameter	Symbol	Pin	Conditions	Value			Unit
				Min.	Typ.	Max.	
Input Low Voltage	V_{IL}	P0	VDDIO = +2.4V to +5.5V	-0.5	-	0.2VDDIO +0.1	V
		P1	VDDIO = +2.4V to +5.5V 5V input mode (ALTSEL.INSEL)	-0.5	-	0.2VDDIO +0.1	V
			VDDIO = +2.4V to +5.5V 1.8V input mode (ALTSEL.INSEL)	-0.5	-	0.54	V
Input high Voltage	V_{IH}	P0	VDDIO = +2.4V to +5.5V	0.2VDDIO +1.0	-	VDDIO +0.5	V
		P1	VDDIO = +2.4V to +5.5V 5V input mode (ALTSEL.INSEL)	0.2VDDIO +1.0	-	VDDIO +0.5	V
			VDDIO = +2.4V to +5.5V 1.8V input mode (ALTSEL.INSEL)	1.15	-	VDDIO +0.5	V
Output Low Voltage	V_{OL}	P0, P1	VDDIO = +3.3V (IOL = 4mA)	-	-	0.3VDDIO	V
		P0, P1	VDDIO = +3.3V (IOL = 35mA & High Drive)	-	-	0.3VDDIO	V
Output High Voltage	V_{OH}	P0, P1	VDDIO = +3.3V (IOH = -6mA)	0.7VDDIO	-	-	V
Pull-up Resistor	R_{pu}	P0, P1	VDDIO = +5.0V VDDIO = + 3.3V		37.5 45		KΩ
Logical 1 to 0 Transition Current	ITL	P0, P1	VDDIO = 5.0V±10% (VIN = +1.5V)	-	548	-	μA
Input Leakage Current	IIL	P0, P1	VIN = VIH or VIL	-	-	±1	μA
Pin Capacitance	CIO	All	VDDIO = +5.0V	-	10	-	pF
Active Current	IDD	VSS	VDDIO = +2.4V, TA,=25°C, FSYS =12.5MHz, Touch Sampling 100Hz (4 CH), no I/O sourcing current	-	1.3	2.1	mA
Sleep Current	ISB	VSS	VDDIO = +2.4V, TA,=25°C, no I/O sourcing current	1	2	5	μA

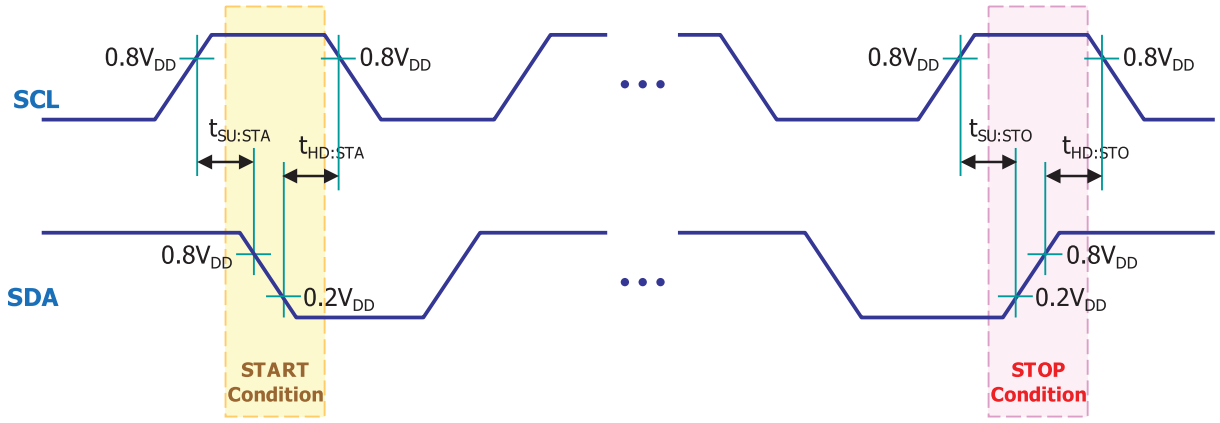
6 AC Characteristics

* T_A = -40 °C ~ +85 °C, V_{DDIO} = 2.4V ~ 5.5V unless otherwise specified

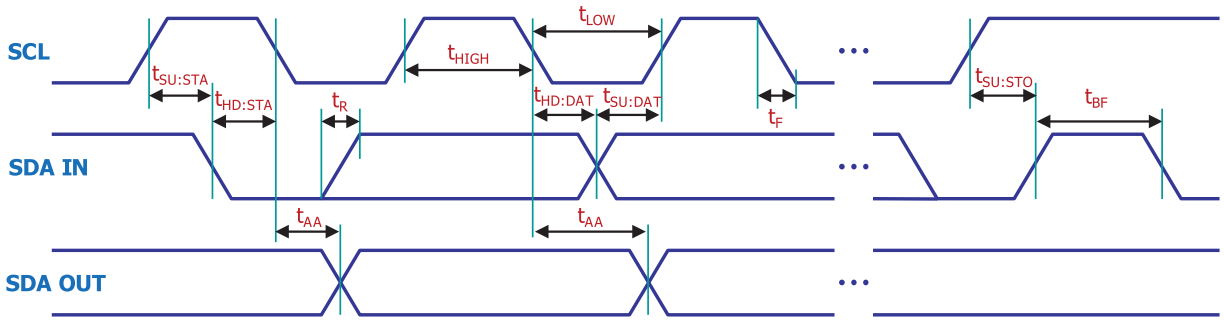
Parameter	Symbol	Pin	Conditions	Value			Unit
				Min	Typ	Max	
RESETB Input Width	t_{RST}	RESETB	V_{DDIO} = 3V ± 10%	24	-	-	F_{SYS}
External Interrupt Input Width	t_{INT}	External Interrupt	V_{DDIO} = 3V ± 10%	4	-	-	F_{SYS}



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	

6-pin DFN Package Dimension

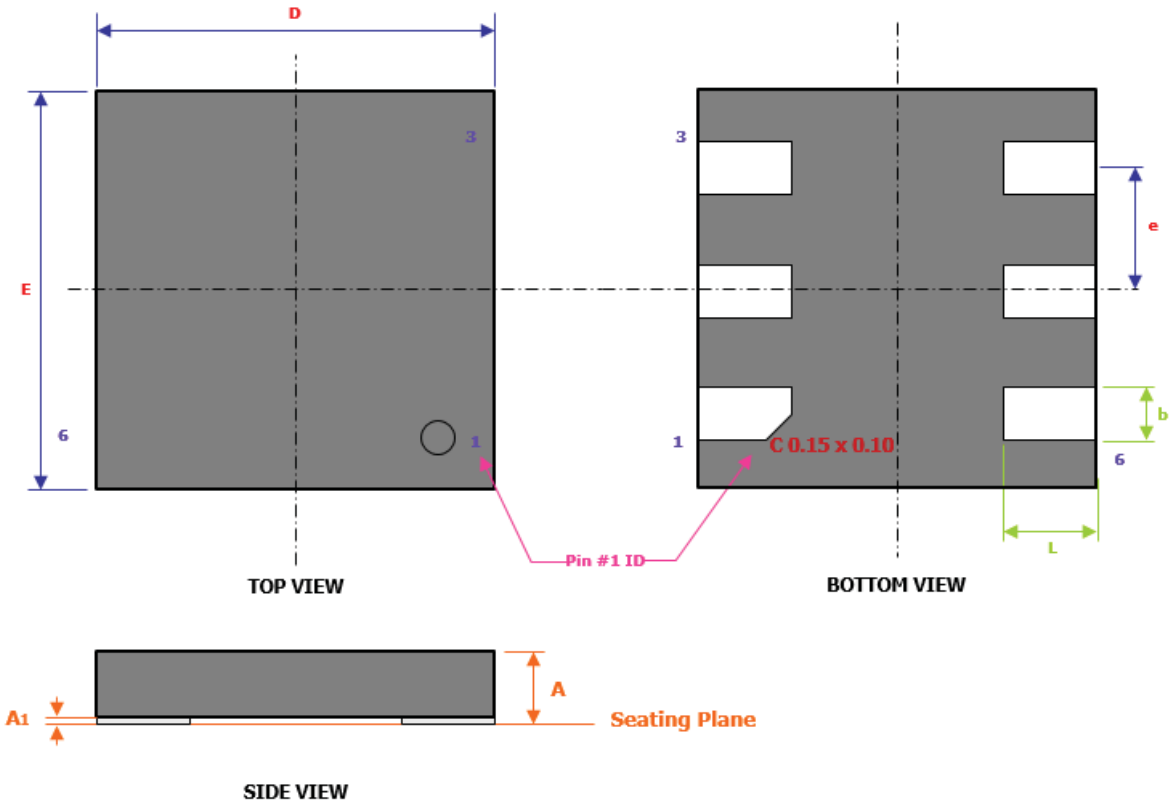


Figure 0-1 6-DFN Package

Symbol	Dimensions [mm]		
	Min.	Nom.	Max.
A	0.50	0.55	0.60
A1	-	-	0.05
D	1.35	1.40	1.45
E	1.35	1.40	1.45
b	0.15	0.20	0.25
e	0.40 BSC		
L	0.35	0.40	0.45

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 without tolerance, for information purpose only.

TC301M-DF6IP

Body Size : 1.4mm x 1.4mm

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

REVISION RECORD			
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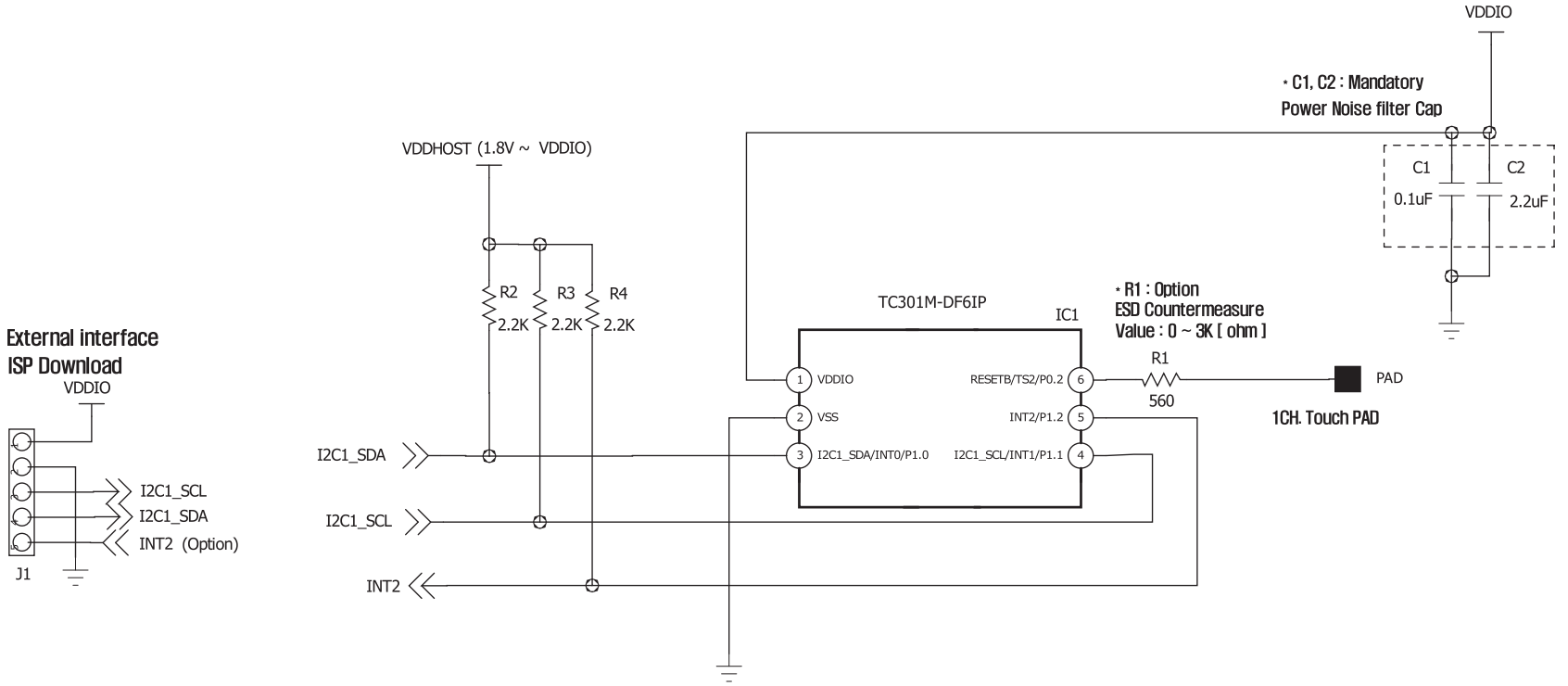

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