
TouchCore360L-QF16IP

Capacitive Touch Sensor Controller

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1 TouchCore360L-QF16IP Overview

1.1 General Description

TouchCore360L-QF16IP is a high-performance Controller for capacitive touch keys. Its engine is an 8-bit 80C51 compatible Processor.

TouchCore360L-QF16IP has three timer/counters, maximum 7-channel of touch sensors, maximum 10 programmable I/O pins, 3-channel 8-bit PWMs, 1 Watchdog timer, POR (Power-On Reset), UART, I²C, and LVD (Low Voltage Detector) as peripherals. In addition, it contains an internal ring oscillator, which can generate the 48 MHz system clock signal instead of a crystal oscillator.

TouchCore360L-QF16IP 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, **TouchCore360L-QF16IP** enables low power consumption by using scan interval and clock control methods after last touch.

TouchCore360L-QF16IP operates over the extended -20°C to +85°C temperature range, and is available in the 3mm x 3mm, 0.55T, 16-pin QFN package.

1.2 Features

- ◆ Capacitive touch key controller
 - Supports up to 7 single-type touch keys
 - Supports scroll bar-type touch keys
 - Supports wheel-type touch keys
- ◆ Response Time
 - Initial latency of < 40ms for first touch, subject to configuration
 - Programmable sensing rate for power saving. (Up to 30Hz / Channel)

- ◆ CPU
 - 8-bit Turbo 80C52 Architecture
 - 4 Cycles / 1 Machine Cycle
 - Instruction Level Compatible with Intel 80C52
- ◆ Memory
 - 12KB Flash
 - 1KB User EEPROM
 - 512B Internal Aux. RAM
 - 256B Internal RAM
- ◆ Power Supply
 - Operating Voltage : +1.8V to +3.6V
- ◆ Operating Frequency: Max. 48MHz(@3.3V), 16MHz(@2.0V)
- ◆ 10 Programmable I/O Pins
- ◆ 3-channel 8-bit PWMs
- ◆ Communication interfaces
 - 1-channel I2C Communication (Master/Slave)
 - 1-channel UART Communication
- ◆ Internal Ring OSC with Calibration function
- ◆ Supporting ISP/IAP/MDS
- ◆ 7 Internal Interrupt Sources and 3 External Interrupt Sources
- ◆ 4 Reset Sources
- ◆ Power Down Wake-up Sources
 - Reset Sources + 3 External Interrupt (Both Levels)
 - Watchdog Timer Interrupt
- ◆ 3 Operating modes : Active, Sleep, Deep Sleep
- ◆ E.S.D. Protection up to
 - 8,000V
- ◆ Latch-up Protection Up to $\pm 200\text{mA}$
- ◆ Package
 - 16-QFN (3mm X 3mm, 0.55T)

1.3 Applications

- ◆ Home appliance: TV, Monitor, Home Theater
- ◆ Mobile Phones

- ◆ Portable MP3, MP4
- ◆ Digital Cameras
- ◆ Battery power applications

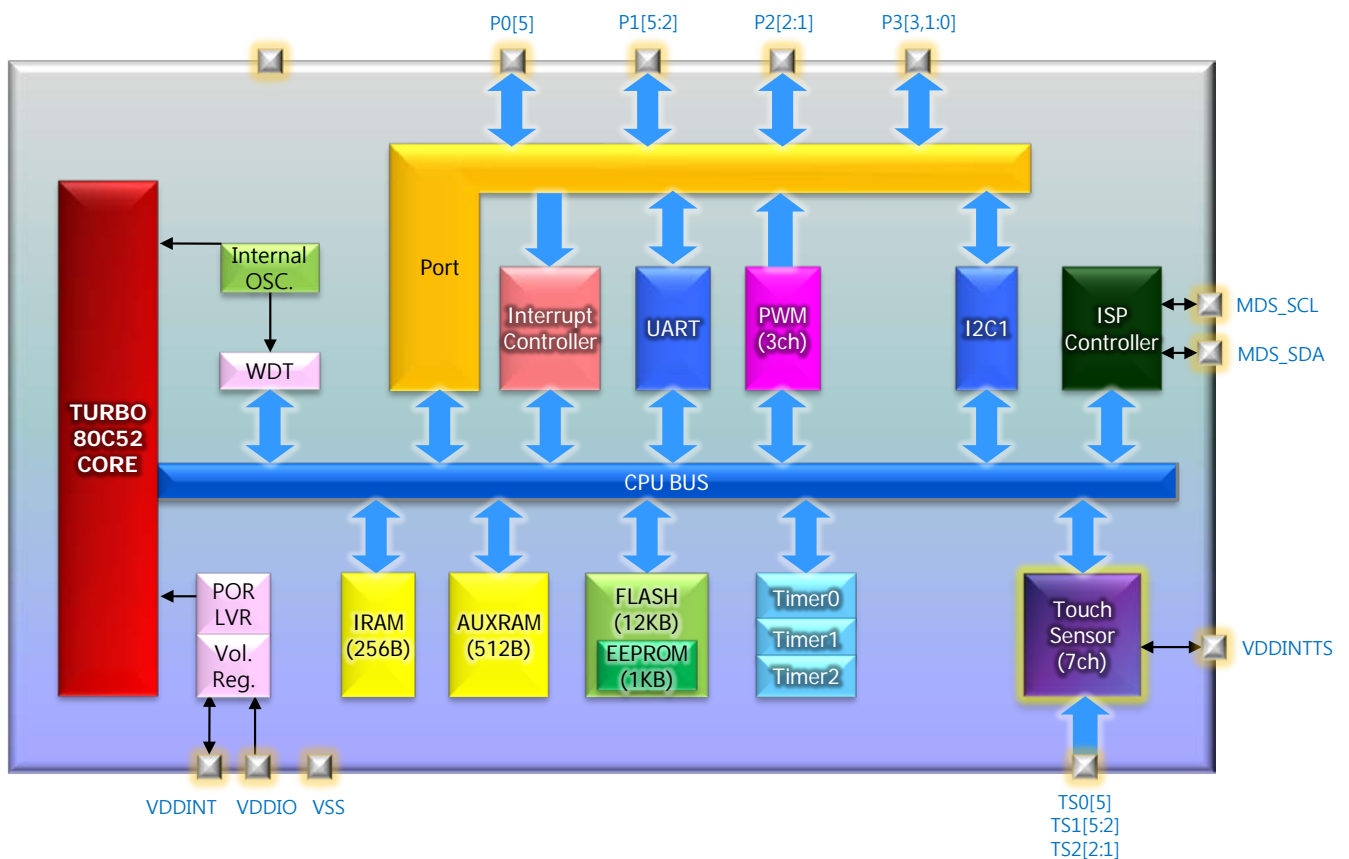
1.4 Product Family Guide

Product	Touch Channels	Flash [Byte]	EEPROM [Byte]	Package
TouchCore360L-QF16IP	7	12kB	1kB	3 x 3 mm, 0.55T, 16-pin QFN

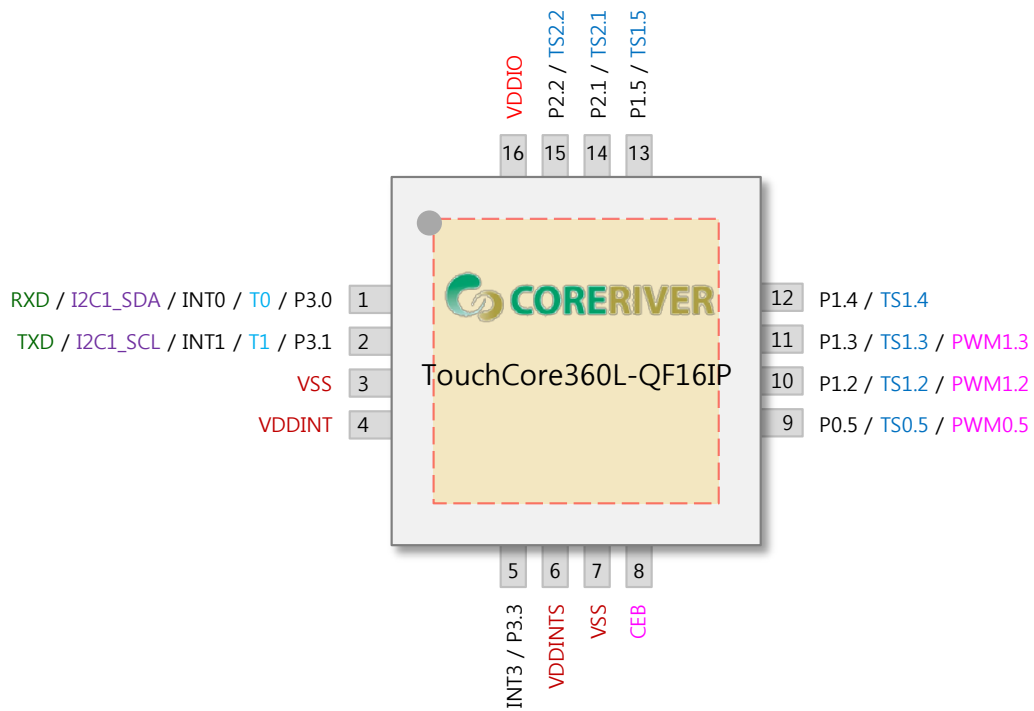
2 Block Diagram

Figure shows the block diagram of **TouchCore360L-QF16IP**. 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 **TouchCore360L-QF16IP** are configured as part of the on-chip RAM: therefore each register has an address. This is reasonable for **TouchCore360L-QF16IP**, since it has so many registers.



3 Pin Configuration



16-pin QFN Package Diagram

4 Pin Description

Pin No.	Name	Type	Description	Share Pins
1	P3.0	I/O	General I/O Port 3.0	RXD / I2C1_SDA / INT0
2	P3.1	I/O	General I/O Port 3.1	TXD / I2C1_SCL / INT1
3	VSS	GND		
4	VDDINT	O	Digital Power Filter (+1.8V)	
5	P3.3	I/O	General I/O Port 3.3	INT3
6	VDDINTS	O	Touch Sensor Power Filter	
7	VSS	GND		
8	CEB	Input	Chip Enable (Active Low)	
9	TS0.5	I/O	Touch Sensing Channel 0.5	P0.5 / PWM0.5
10	TS1.2	I/O	Touch Sensing Channel 1.2	P1.2 / PWM1.2
11	TS1.3	I/O	Touch Sensing Channel 1.3	P1.3 / PWM1.3
12	TS1.4	I/O	Touch Sensing Channel 1.4	P1.4
13	TS1.5	I/O	Touch Sensing Channel 1.5	P1.5
14	TS2.1	I/O	Touch Sensing Channel 2.1	P2.1
15	TS2.2	I/O	Touch Sensing Channel 2.2	P2.2
16	VDDIO	PWR	Digital/IO Power	

5 Absolute Maximum Ratings

.Absolute Maximum Ratings(TA = 25 °C)

Item	Conditions	Range
DC Voltage in V _{DDIO} relative to Ground	-	-0.5 V to +4.6V
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	Conditions	Range
Operating Voltage	-	+1.8 V to +3.6V
Operating Temperature	-	-20 °C to + 85 °C

6 DC Characteristics

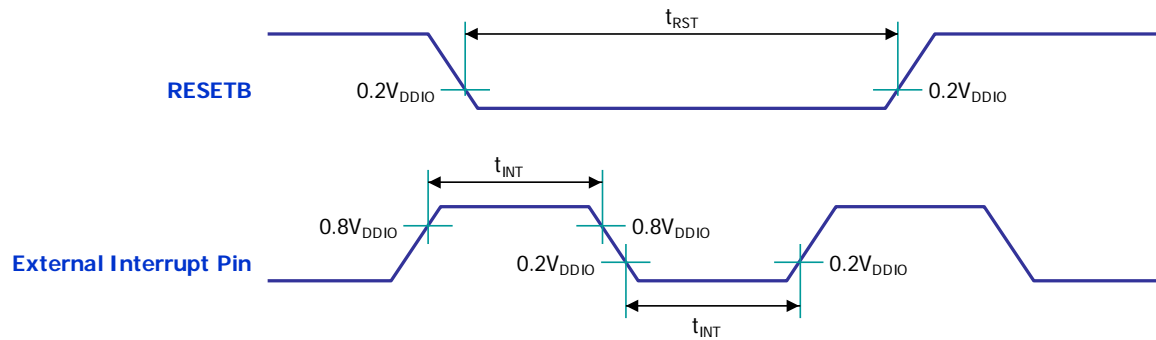
* $T_A = -20^{\circ}\text{C} \sim +85^{\circ}\text{C}$, $V_{DDIO} = 1.8\text{V} \sim 3.6\text{V}$ unless otherwise specified

Parameter	Symbol	Pin	Conditions	Value			Unit
				Min.	Typ.	Max.	
Input Low Voltage	V_{IL}	P0,P1,P2,P3	$V_{DDIO} = 1.8\text{V} \sim 3.6\text{V}$	-0.5	-	$0.2V_{DDIO} + 0.1$	V
Input high Voltage	V_{IH}	P0,P1,P2,P3	$V_{DDIO} = 1.8\text{V} \sim 3.6\text{V}$	$0.2V_{DDIO} + 1.0$	-	$V_{DDIO} + 0.5$	V
Output Low Voltage	V_{OL}	P0,P1,P2,P3	$V_{DDIO} = 3.0\text{V} \sim 3.6\text{V}$ $(I_{OL} = 4.35\text{mA})$ $V_{DDIO} = 1.8\text{V} \sim 3.0\text{V}$ $(I_{OL} = 3.55\text{mA})$	-	-	$0.3V_{DDIO}$	V
		P0,P1,P2,P3[1:0] (High Drive)	$V_{DDIO} = 3.0\text{V} \sim 3.6\text{V}$ $(I_{OL} = 34.79\text{mA})$ $V_{DDIO} = 1.8\text{V} \sim 3.0\text{V}$ $(I_{OL} = 28.41\text{mA})$	-	-	$0.3V_{DDIO}$	V
Output High Voltage	V_{OH}	P0,P1,P2,P3	$V_{DDIO} = 3.0\text{V} \sim 3.6\text{V}$ $(I_{OH} = -8.04\text{mA})$ $V_{DDIO} = 1.8\text{V} \sim 3.0\text{V}$ $(I_{OH} = -6.62\text{mA})$	$0.7V_{DDIO}$	-	-	V
	V_{OHP}	P0,P1,P2,P3 (Pull-up Resistor Only)	$V_{DDIO} = 3.0\text{V} \sim 3.6\text{V}$ $(I_{OHP} = -30.30\mu\text{A})$ $V_{DDIO} = 1.8\text{V} \sim 3.0\text{V}$ $(I_{OHP} = -24.26\mu\text{A})$	$0.7V_{DDIO}$	-	-	V
Logical 1 to 0 Transition Current	I_{TL}	P0,P1,P2,P3	$V_{DDIO} = 3.0\text{V} \pm 10\%$ ($V_{IN} = 2\text{V}$)	-	-	-650	μA
Input Leakage Current	I_{IL}	P0,P1,P2,P3	$V_{IN} = V_{IH}$ or V_{IL}	-	-	± 1	μA
Pin Capacitance	C_{IO}	All	$V_{DDIO} = 3.0\text{V}$	-	10	-	pF

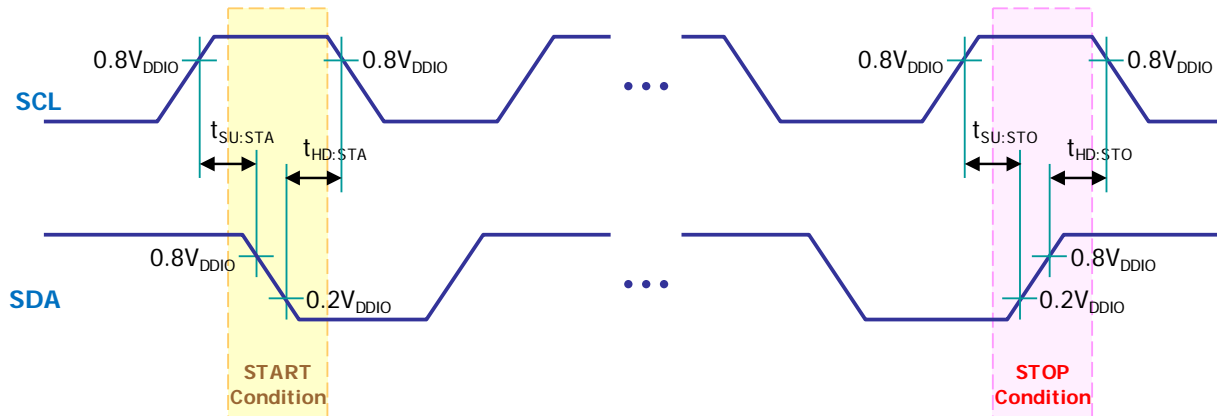
7 AC Characteristics

* $T_A = -20\text{ }^\circ\text{C} \sim +85\text{ }^\circ\text{C}$, $V_{DDIO} = 1.8\text{V} \sim 3.6\text{V}$ unless otherwise specified

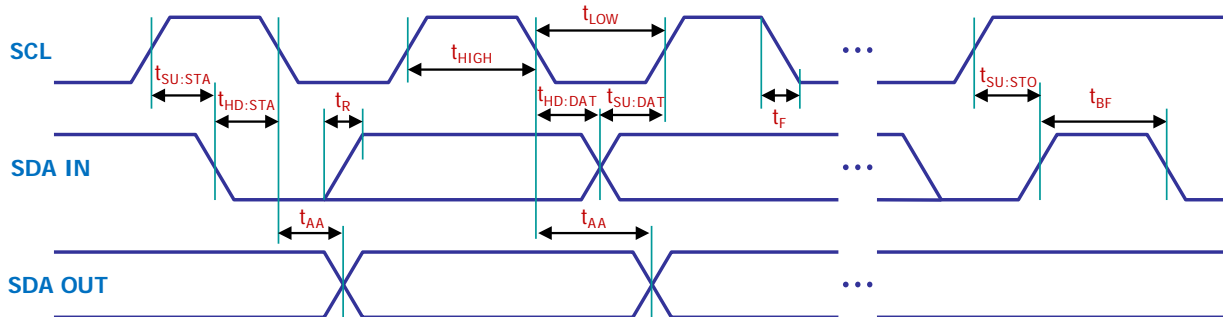
Parameter	Symbol	Pin	Conditions	Value			Unit
				Min	Typ	Max	
RESETB Input Width	t_{RST}	RESETB	$V_{DDIO} = 3\text{V} \pm 10\%$	24	-	-	F _{sys}
External Interrupt Input Width	t_{INT}	External Interrupt	$V_{DDIO} = 3\text{V} \pm 10\%$	4	-	-	F _{sys}



8 I2C Timing Characteristics

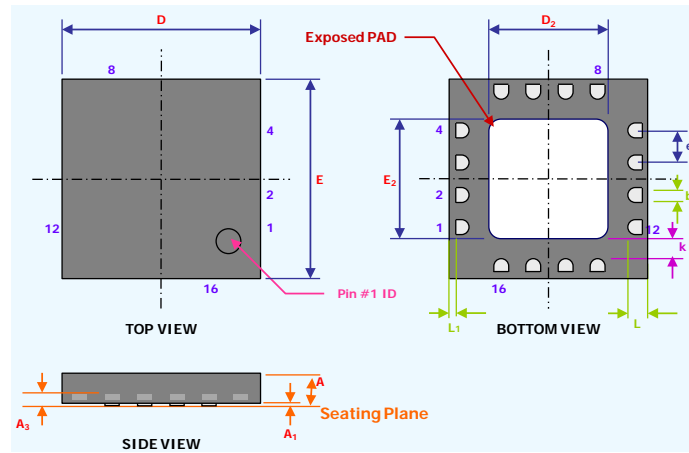


Symbol	Characteristics		Min. [ns]	Max. [ns]	Conditions
$t_{SU:STA}$	START Condition Setup Time	100kHz Mode	4,700	-	Only relevant for repeated START condition
		400kHz Mode	600	-	
$t_{HD:STA}$	START Condition Hold Time	100kHz Mode	4,700	-	After this period, the first clock pulse is generated
		400kHz 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 C _b is from 10pF to 400pF
		400kHz Mode	2.0 + 0.1C _b	300	
t _F	SDA & SCL Falling Time	100kHz Mode	-	300	The Range of C _b is from 10pF to 400pF
		400kHz Mode	2.0 + 0.1C _b	300	

9 16-pin QFN Package Dimension



Symbol	Dimensions [mm]		
	Min.	Nom.	Max.
A	0.50	0.55	0.60
A ₁	0.00	0.01	0.05
A ₃	0.15 REF		
D	2.92	3.00	3.08
E	2.92	3.00	3.08
D ₂	1.80	1.90	2.00
E ₂	1.80	1.90	2.00
b	0.20	0.25	0.30
E	0.50 BSC		
L	0.20	0.30	0.40
L ₁	0	0.062	-
K	0.02	-	-

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.

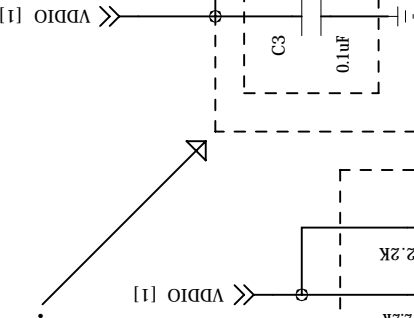
TC360L - QF16IP

Body Size : 3mm x 3mm

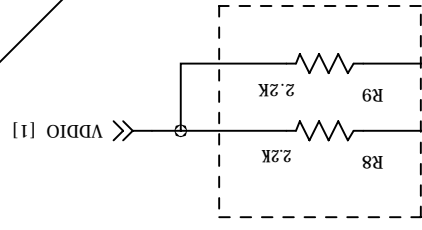
>>VDDIO [Operating Voltage] : +1.8V to +3.6V

-> If you use the VDDIO level to 1.8V, you'll need to connect the VDDIO and VDDINT.

* C3, C4 : Mandatory
Power Noise filter Cap
C3 : 0.1uF
C4 : 2.2uF

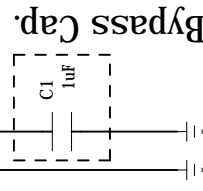


* R8, R9 : Mandatory
External Pull up
R8 = R9 = 2.2K

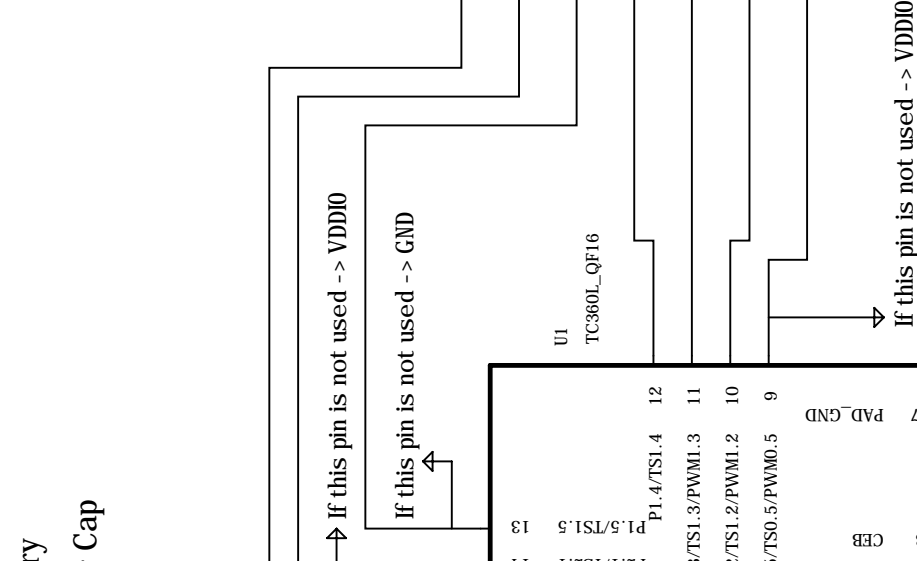
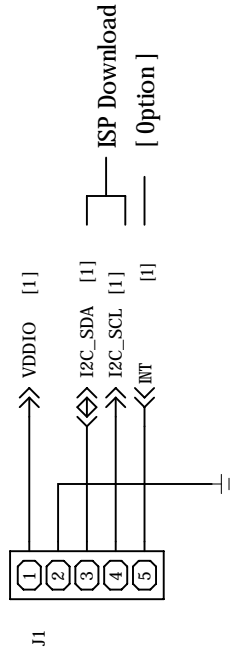


[1] I2C_SDA <<>>
[1] I2C_SCL <<>>

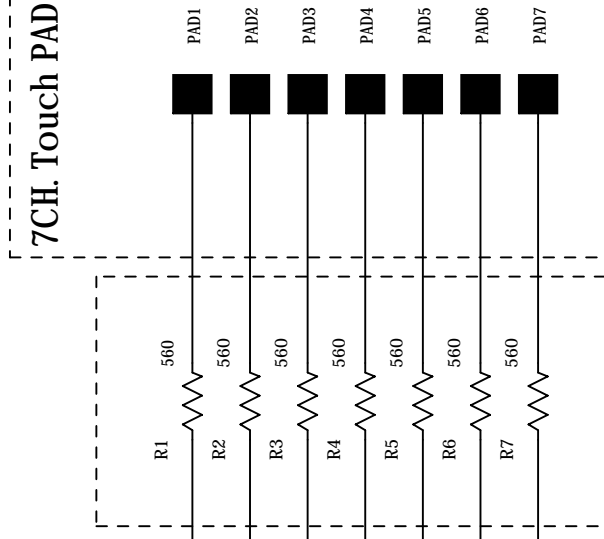
* C1, C2 : Mandatory
LDO Filter Cap
C1 = C2 = 1uF



External interface
ISP Download



* R1 ~ R7 : Option
ESD Countermeasure
Value : 0 ~ 3K [ohm]



If this pin is not used -> VDDIO
If this pin is not used -> GND

NO	REVISION NO.	NO.	REVISION NO.	C	B	A	NO	PART NO.	DESCRIPTION	MATERIAL	COLOR FINISH	NOTE
1				QUANTITY					DRAWN.	D'SCHEMATIC		
2				SCALE			A3					
				UNIT			mm		2014-12-10			<undefined>
				SHEET			1 / 1					