CORERIVER
Total Solution of MCU

TC35xK

Capacitive Touch Sensor Controller

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CoreRiver Semiconductor Co,. Ltd **www.coreriver.com** **sales@coreriver.com**

Revised June 20, 2023

1 TC35xK Overview

1.1 General Description

TC35xK is a high-performance Controller for capacitive touch keys. Its engine is an 8-bit 80C51 compatible Processor.

TC35xK has two timer/counters, maximum 8-channel of touch sensors, maximum 11 programmable I/O pins, 4-channel 8-bit PWMs, 1 Watchdog timer, POR (Power-On Reset), I2C and LVD (Low Voltage Detector) as peripherals. In addition, it contains an internal ring oscillator, which can generate the 24 MHz system clock signal.

TC35xK 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, ***TC35xK*** enables low power consumption by using scan interval and clock control methods after last touch.

TC35xK operates over the extended -25℃ to +85℃ temperature range, and is available in the 16-pin QFN, 16-pin TSSOP package.

1.2 Features

- Capacitive touch key controller
  - Supports up to 8 single-type touch keys.
  - Supports scroll bar-type touch keys.
  - Supports wheel-type touch keys
- Response Time
  - Initial latency of < 20ms for first 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 : +1.8V to +3.6V
- Operating Frequency: Max. 24MHz
- 11 Programmable I/O Pins
- 4-channel 8-bit PWMs
- Communication interfaces
  - 1-channel I2C Communication (Slave)
- Internal Ring OSC with Calibration function
- Supporting ISP/IAP/MDS
- 7 Internal Interrupt Sources and 3 External Interrupt Sources
- 3 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 ±200mA
- Package
  - 16-pin QFN (0.55T)
  - 16-pin TSSOP (0.6T)

1.3 Applications

- Home appliance: TV, Monitor, Home Theater
- Mobile Phones
- Portable MP3, MP4
- Digital Cameras
- Battery power applications

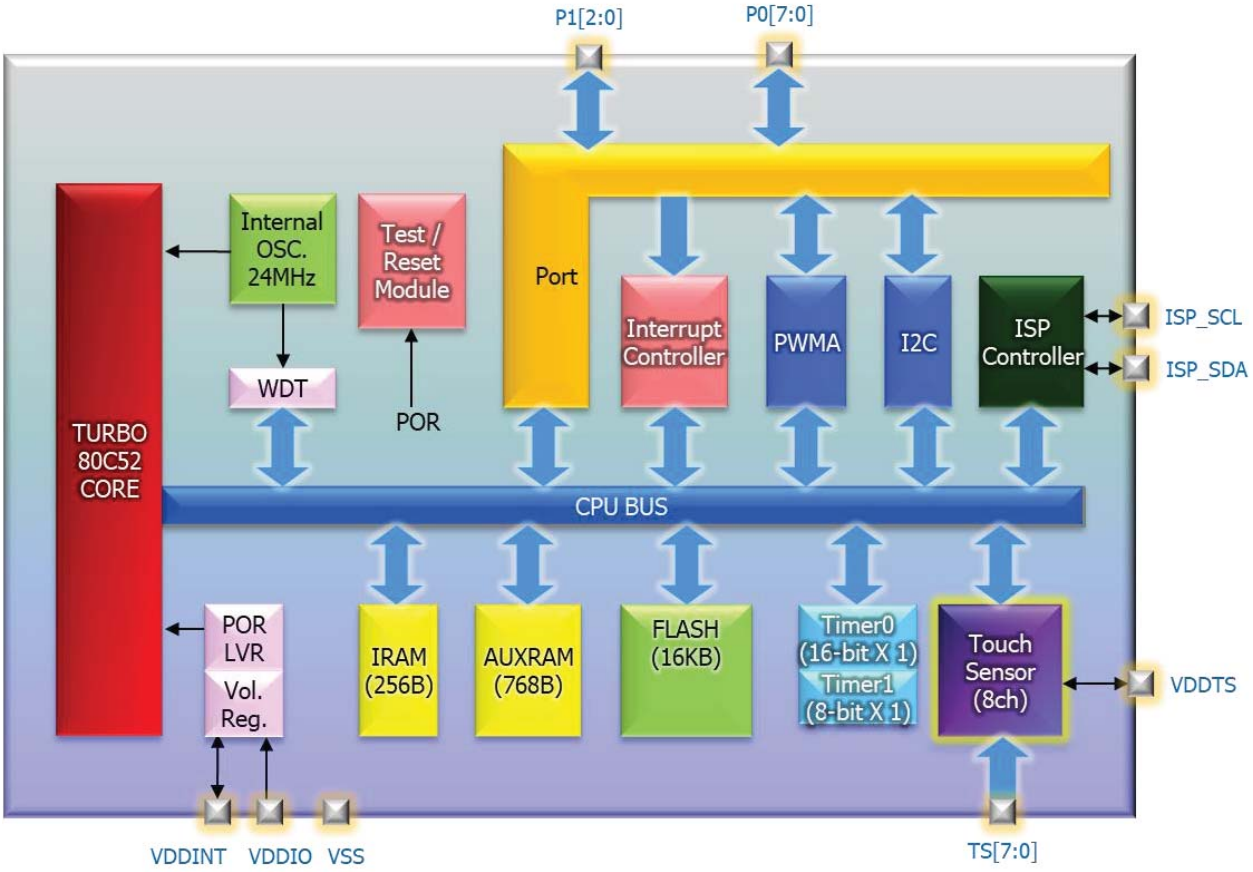
1.4 Product Family Guide

Product	FLASH [Byte]	RAM [Byte]	Volt [V]	PWM (Bit x CH)	I/O Pins	Touch Channel	Package	Others
TC354K-QF16IP	16K	768 + 256	1.80 ~ 3.60	8 x 4	11	**4**	16-QFN 3 x 3mm 0.55T	IAP ISP LVR POR RING
TC354K-TS16IP						**4** (Fine Tune)	16-TSSOP 5.13 x 6.40mm 1T	
TC358K-QF16IP						**8**	16-QFN 3 x 3mm 0.55T	

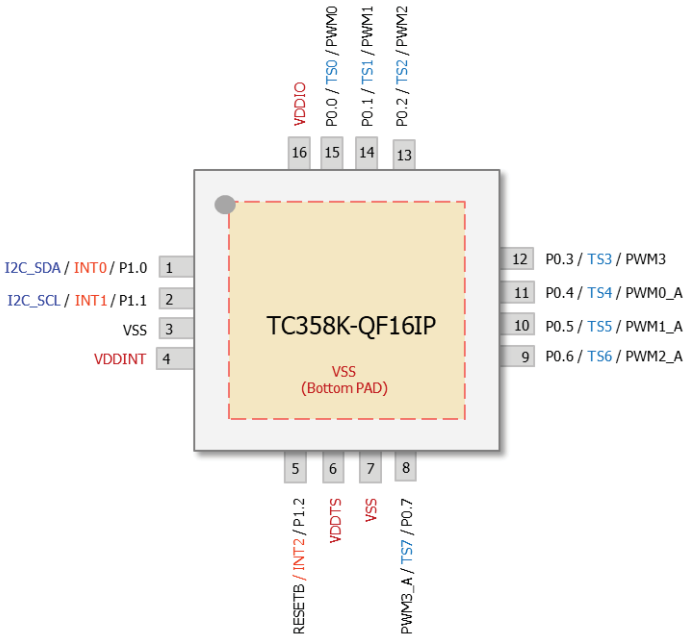
2 Block Diagram

Figure shows the block diagram of ***TC35xK***. 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 ***TC35xK*** are configured as part of the on-chip RAM: therefore, each register has an address. This is reasonable for ***TC35xK***, since it has so many registers.

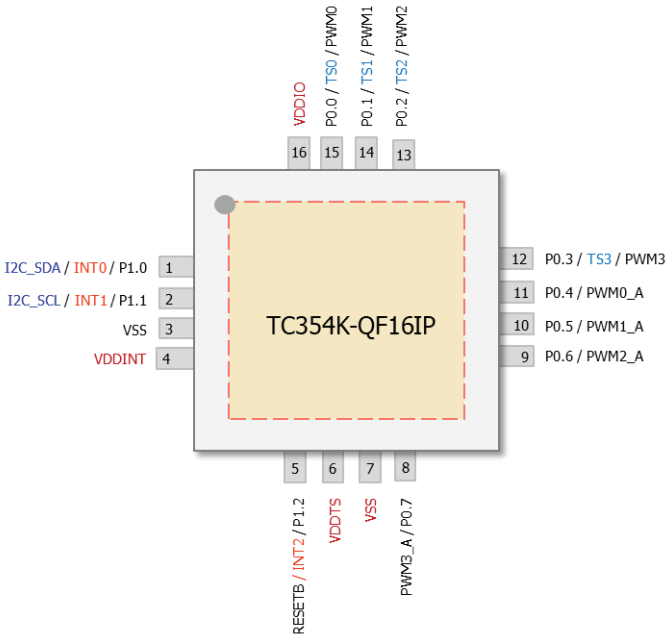


3 Pin Configuration



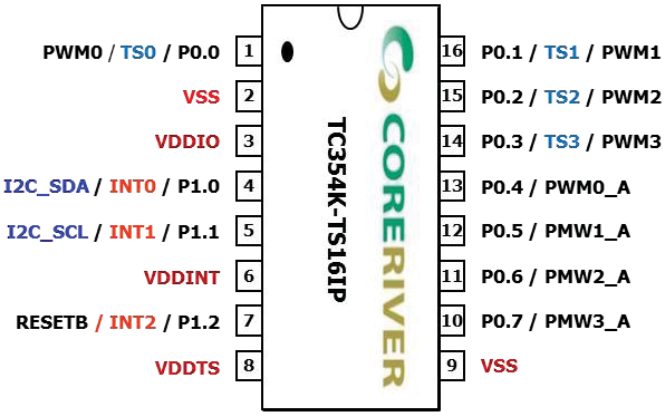
TC358K-QF16IP Package Diagram

Pin No.	Name	Type	Description	Share Pins
1	P1.0	I/O	General I/O Port 1.0	I2C_SDA / INT0
2	P1.1	I/O	General I/O Port 1.1	I2C_SCL / INT1
3	VSS	GND	Ground	
4	VDDINT	O	Digital Power Filter (+1.8V)	
5	P1.2	I/O	General I/O Port 1.2	INT2 / RESETB
6	VDDTS	O	Touch Sensor Power Filter	
7	VSS	GND	Ground	
8	TS7	I/O	Touch Sensing Channel 7	P0.7 / PWM3_A
9	TS6	I/O	Touch Sensing Channel 6	P0.6 / PWM2_A
10	TS5	I/O	Touch Sensing Channel 5	P0.5 / PWM1_A
11	TS4	I/O	Touch Sensing Channel 4	P0.4 / PWM0_A
12	TS3	I/O	Touch Sensing Channel 3	P0.3 / PWM3
13	TS2	I/O	Touch Sensing Channel 2	P0.2 / PWM2
14	TS1	I/O	Touch Sensing Channel 1	P0.1 / PWM1
15	TS0	I/O	Touch Sensing Channel 0	P0.0 / PWM0
16	VDDIO	PWR	Power Supply	



TC354K-QF16IP Package Diagram

Pin No.	Name	Type	Description	Share Pins
1	P1.0	I/O	General I/O Port 1.0	I2C_SDA / INT0
2	P1.1	I/O	General I/O Port 1.1	I2C_SCL / INT1
3	VSS	GND	Ground	
4	VDDINT	O	Digital Power Filter (+1.8V)	
5	P1.2	I/O	General I/O Port 1.2	INT2 / RESETB
6	VDDTS	O	Touch Sensor Power Filter	
7	VSS	GND	Ground	
8	PWM3	I/O	PWM module output 3	P0.7
9	PWM2	I/O	PWM module output 2	P0.6
10	PWM1	I/O	PWM module output 1	P0.5
11	PWM0	I/O	PWM module output 0	P0.4
12	TS3	I/O	Touch Sensing Channel 3	P0.3
13	TS2	I/O	Touch Sensing Channel 2	P0.2
14	TS1	I/O	Touch Sensing Channel 1	P0.1
15	TS0	I/O	Touch Sensing Channel 0	P0.0
16	VDDIO	PWR	Power Supply	



TC354K-TS16IP Package Diagram

Pin No.	Name	Type	Description	Share Pins
1	TS0	I/O	Touch Sensing Channel 0	P0.0 / PWM0
2	VSS	GND	Ground	
3	VDDIO	PWR	Power Supply	
4	P1.0	I/O	General I/O Port 1.0	I2C_SDA / INT0
5	P1.1	I/O	General I/O Port 1.1	I2C_SCL / INT1
6	VDDINT	O	Digital Power Filter (+1.8V)	
7	P1.2	I/O	General I/O Port 1.2	INT2 / RESETB
8	VDDTS	O	Touch Sensor Power Filter	
9	VSS	GND	Ground	
10	PWM3_A	I/O	PWM module output 3	P0.7
11	PWM2_A	I/O	PWM module output 2	P0.6
12	PWM1_A	I/O	PWM module output 1	P0.5
13	PWM0_A	I/O	PWM module output 0	P0.4
14	TS3	I/O	Touch Sensing Channel 3	P0.3 / PWM3
15	TS2	I/O	Touch Sensing Channel 2	P0.2 / PWM2
16	TS1	I/O	Touch Sensing Channel 1	P0.1 / PWM1

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 +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	-	+1.8V to +3.6V
Operating Temperature	-	-25°C to + 85°C

5 DC Characteristics

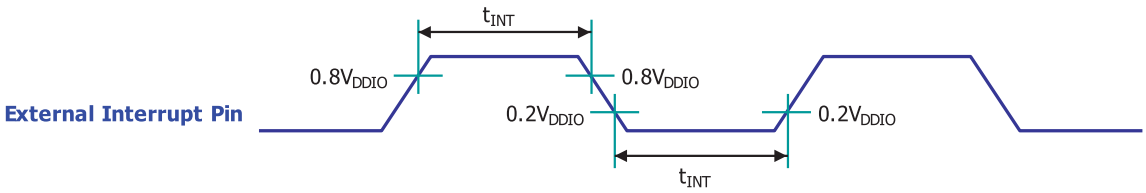
* T_A= -25°C ~ +85°C, V_{DDIO}=1.8V ~ 3.6V unless otherwise specified

Parameter	Symbol	Pin	Conditions	Value			Unit
				Min.	Typ.	Max.	
Input Low Voltage	V_{IL}	P0, P1	V_{DDIO} = +1.8V to +3.6V	-0.5	-	$0.2V_{DDIO}$ +0.1	V
Input high Voltage	V_{IH}	P0, P1	V_{DDIO} = +1.8V to +3.6V	$0.2V_{DDIO}$ +1.0	-	V_{DDIO} +0.5	V
Output Low Voltage	V_{OL}	P0, P1	V_{DDIO} = +3.3V (I_{OL} = 4.20mA) V_{DDIO} = +1.8V (I_{OL} = 1.00mA)	-	-	$0.3V_{DDIO}$	V
		P0, P1 (High Drive)	V_{DDIO} = +3.3V (I_{OL} = 34.14mA) V_{DDIO} = +1.8V (I_{OL} = 8.17mA)	-	-	$0.3V_{DDIO}$	V
Output High Voltage	V_{OH}	P0, P1	V_{DDIO} = +3.3V (I_{OH} = -7.80mA) V_{DDIO} = +1.8V (I_{OH} = -2.22mA)	$0.7V_{DDIO}$	-	-	V
Pull-up Resistor	R_{Pu}	P0	V_{DDIO} = +3.3V		52		KΩ
	R_{Pu1}	P1	V_{DDIO} = +3.3V		5.6		KΩ
	R_{Pu2}		V_{DDIO} = +2.2V (Internal 1.8V Pull-up)		2.2		KΩ
Logical 1 to 0 Transition Current	I_{TL}	P0, P1	V_{DDIO} = 3.0V ± 10% (V_{IN} = +2.0V)	-	-	-650	μA
Input Leakage Current	I_{IL}	P0, P1	V_{IN} = V_{IH} or V_{IL}	-	-	±1	μA
Pin Capacitance	C_{IO}	All	V_{DDIO} = +3.0V	-	10	-	pF
Active Current	I_{DD}	V_{SS}	V_{DDIO} = +1.8V, T_A=25°C, F_{SYS} =12.5MHz, Touch Sampling rate = 100Hz(4 Channels), no I/O sourcing current	-	1.31	2.1	mA
Sleep Current	I_{SB}	V_{SS}	V_{DDIO} = +3.0V, T_A=25°C, no I/O sourcing current	-	3	7	μA

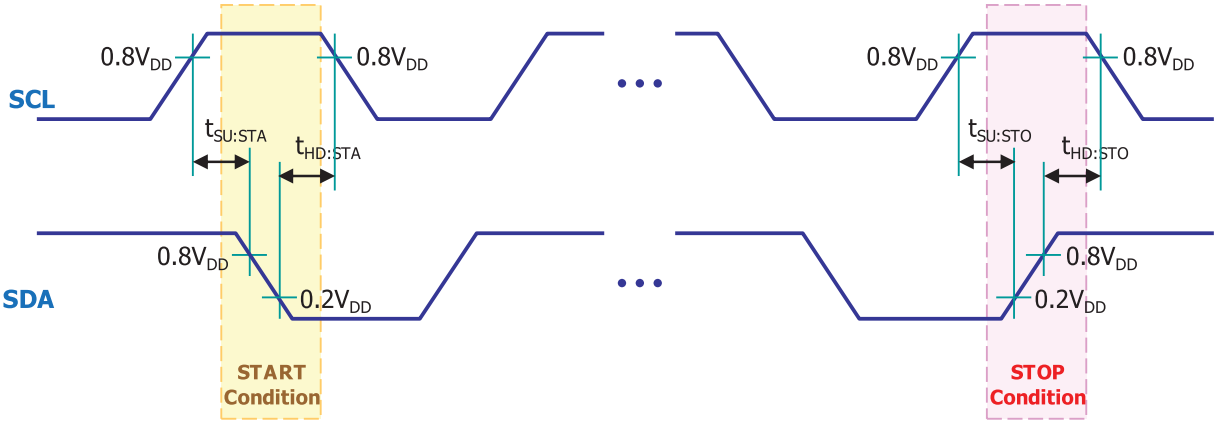
6 AC Characteristics

* T_A = -25°C ~ +85°C, V_{DDIO} = 1.8V ~ 3.6V unless otherwise specified

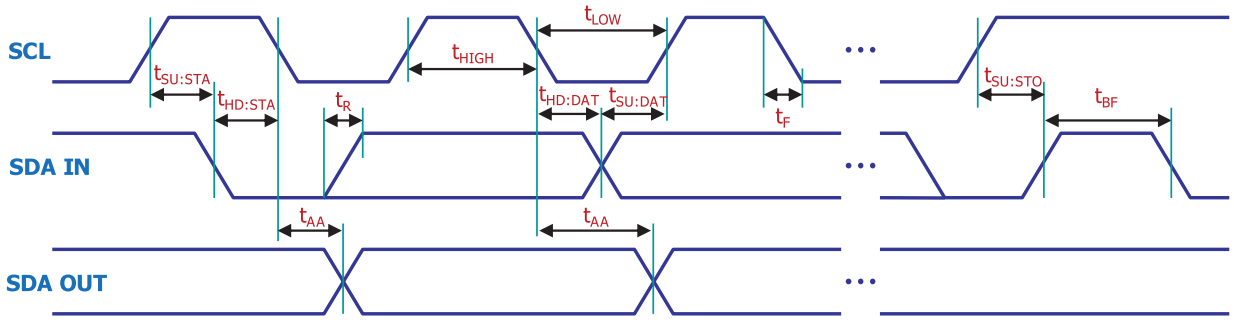
Parameter	Symbol	Pin	Conditions	Value			Unit
				Min	Typ	Max	
External Interrupt Input Width	t_{INT}	External Interrupt	V_{DDIO} = 3V ± 10%	4	-	-	F_{SYS}



7 I2C Timing Characteristics

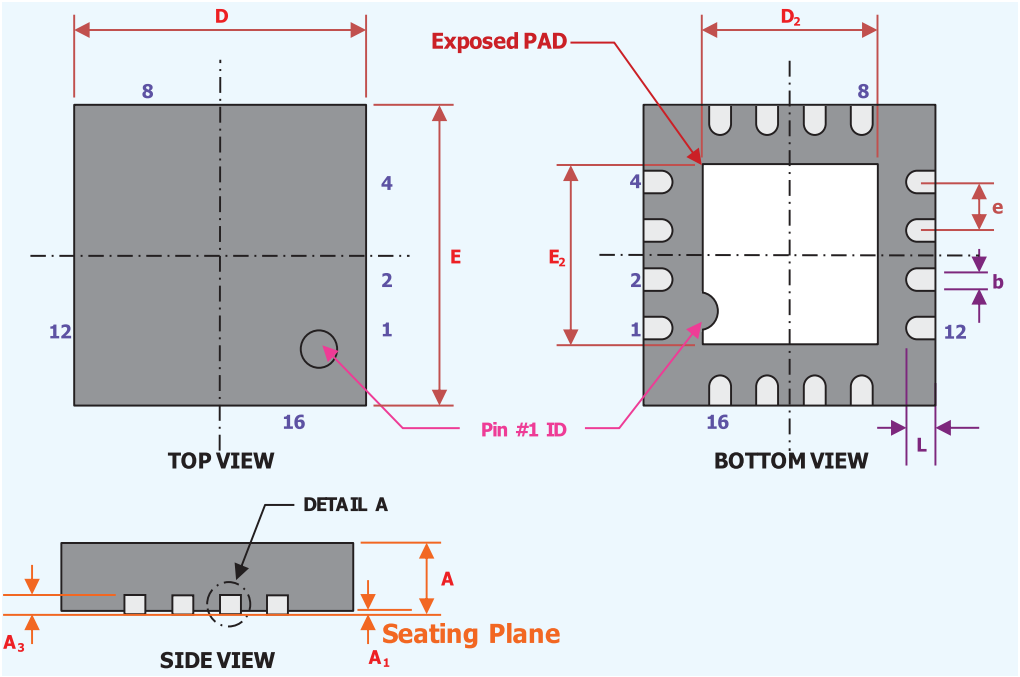


Symbol	Characteristics		Min. [ns]	Max. [ns]	Conditions
$t_{SU:STA}$	START Condition Setup Time	100kHz Mode	4,700	-	Only relevant for repeated START condition
		400kHz Mode	600	-	
$t_{HD:STA}$	START Condition Hold Time	100kHz Mode	4,700	-	After this period, the first clock pulse is generated
		400kHz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

8 16-pin QFN Package Dimension

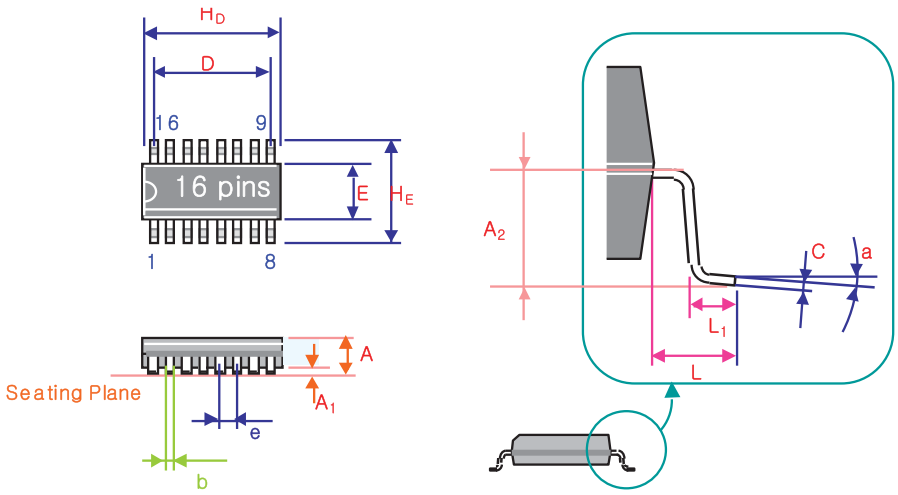


Symbol	Dimensions [mm]		
	Min.	Nom.	Max.
A	0.500	0.550	0.600
A_1	0.000	-	0.050
A_3		0.152 REF	
D		3.000 BSC	
E		3.000 BSC	
D_2	1.650	1.700	1.750
E_2	1.650	1.700	1.750
b	0.200	0.250	0.300
e		0.500 BSC	
L	0.300	0.350	0.400

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.

9 16-pin TSSOP Package Dimension



Symbol	Dimensions [mm]		
	Min.	Nom.	Max.
A	0.95	1.00	1.05
A1	0.3865	0.4365	0.4865
A2	0.65	0.7	0.75
b	0.20	0.22	0.24
C	0.09	0.145	0.20
D	4.47	4.55	4.63
E	4.35	4.4	4.45
HD	5.077	5.127	5.177
HE	6.30	6.40	6.30
L	0.85	0.95	1.05
L1	0.50	0.60	0.70
a	1°	3°	5°
e	0.65 BSC		

Notes:

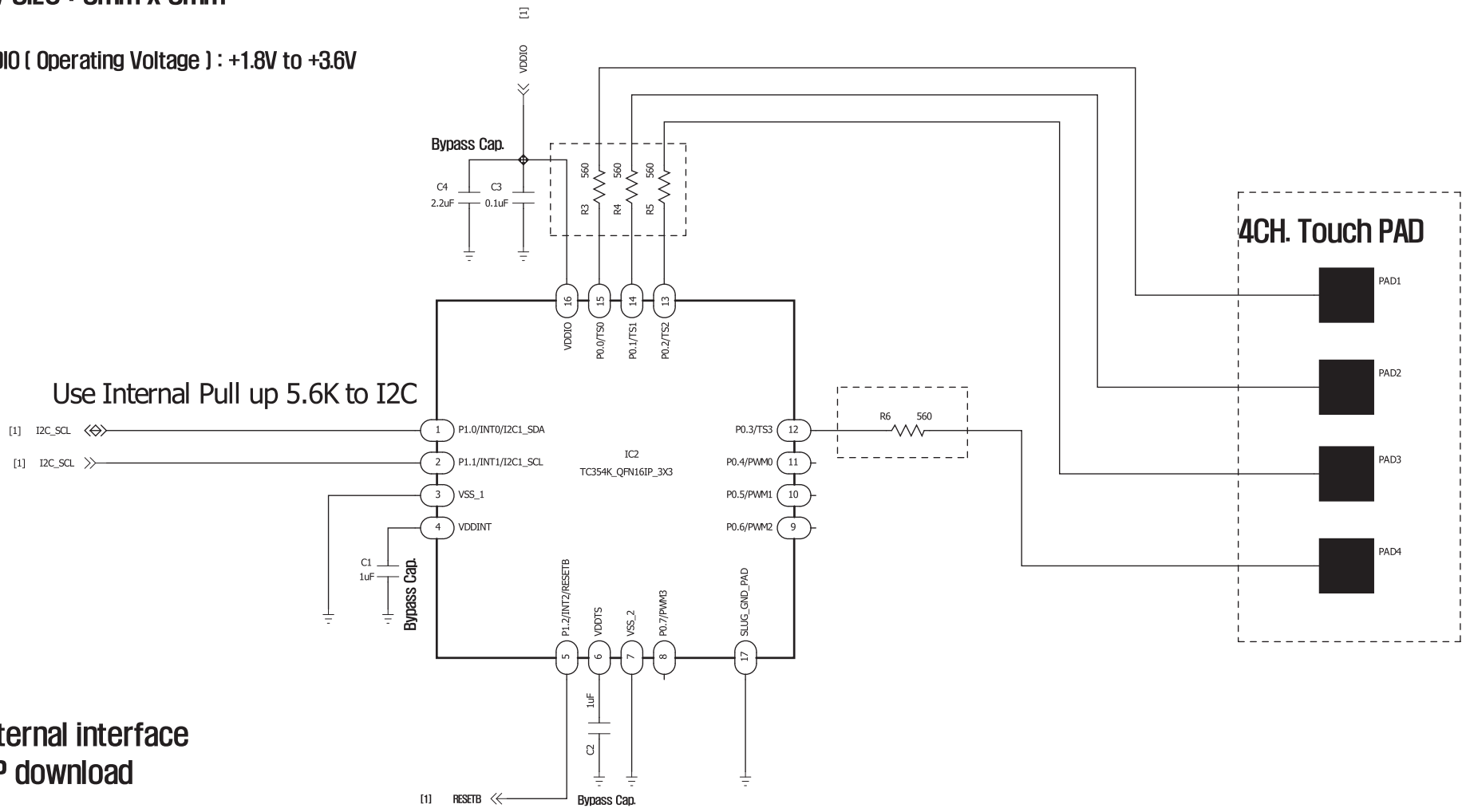
1. **All Dimension are in mm. Angles in Degrees.**
2. **Dimension b applies to Plated Terminal & is measured.**
3. **BSC: Basic Dimension. Theoretically exact value shown without tolerances.**
   REF: Reference Dimension, usually without tolerance, for information purpose only.

10 Revision History

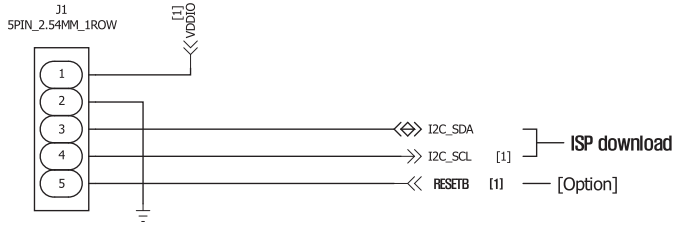
Date	Revision	History
Jan-2017	1.0	Update “1.8V Pull-up Resistor Characteristics”
Mar-2021	1.1	Notation error corrected.
Mar-2021	1.2	Changed the Operating Temp. (-20℃ to -25℃) and Deleted 16-MLF info.
June-2023	1.3	Changed QFN16 Package Dimension on page 8 to UNISEM POD.

TouchCore354K,QF16IP
Body Size : 3mm x 3mm

>> VDDIO (Operating Voltage) : +1.8V to +3.6V



External interface
ISP download



NO.	REVISION NO.	NO.	REVISION NO.
1			
2			

C B A

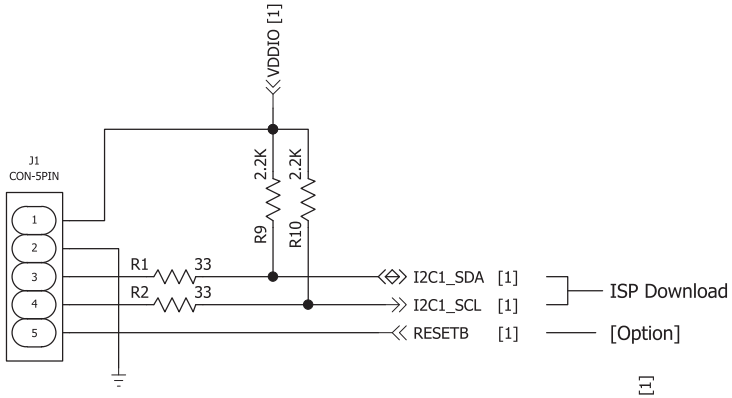
QUANTITY

NO	PART NO.	DESCRIPTION	METERIAL	COLOR FINISH	NOTE

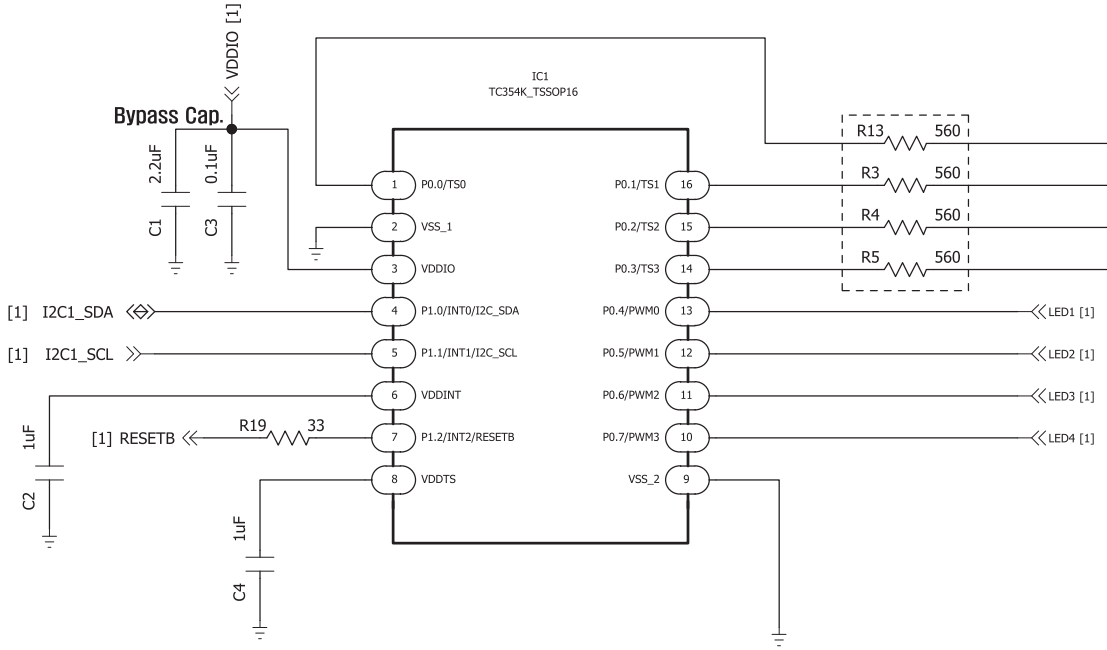
SCALE	UNIT	DRAWN.	D'SCHEMATIC
A3	mm	2014-05-21	TC354K_QF16IP_3X3
SHEET	1 / 1	CORERIVER	

TC354K_TSSOP16

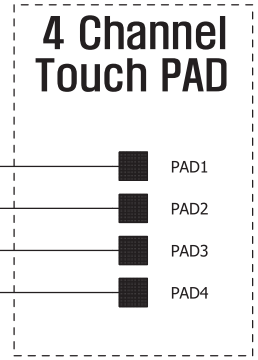
>> VDDIO (Operating Voltage) : +1.8V to +3.6V

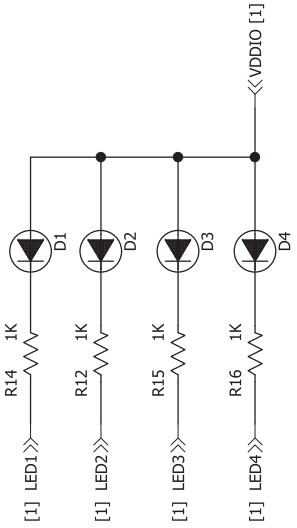


ISP download & External interface



4 Channel Touch PAD



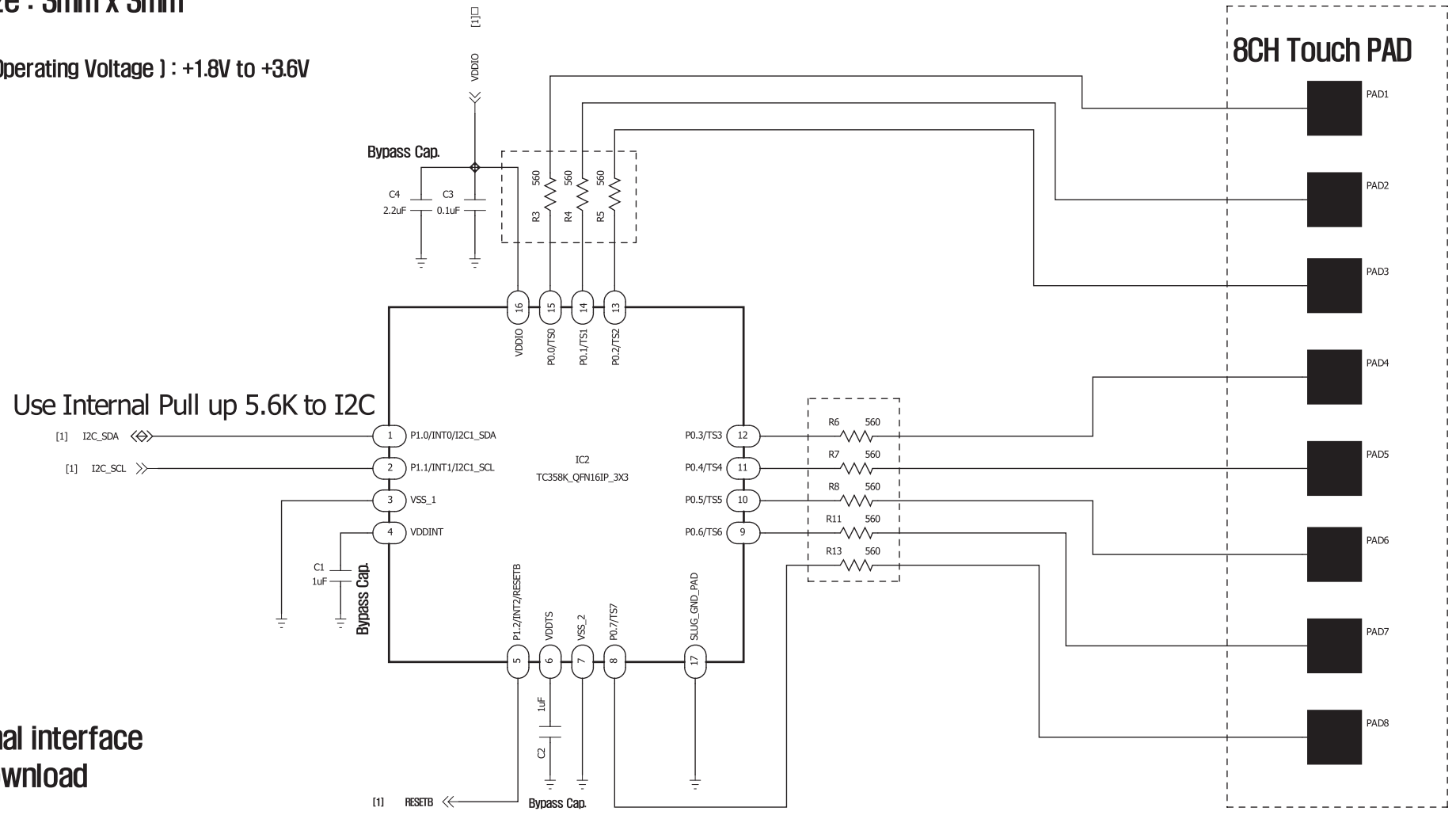


NO.	REVISION NO.	NO.	REVISION NO.	C B A	NO	PART NO.	DESCRIPTION	METERIAL	COLOR FINISH	NOTE
1				QUANTITY						
2										

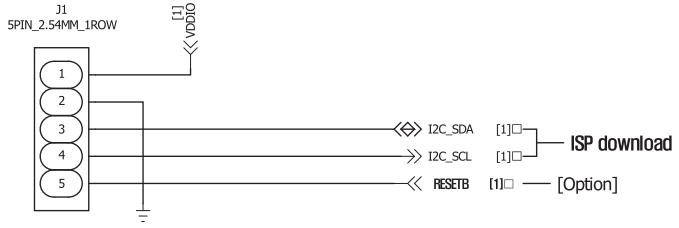
SCALE	UNIT	DRAWN.	D'SCHEMATIC
A3	mm	2013-07-03	TC354K_TSSOP16
SHEET	1 / 1	CORERIVER	

TC358K,QFN16IP
Body Size : 3mm x 3mm

>> VDDIO (Operating Voltage) : +1.8V to +3.6V



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	2013-11-20	TC358K_QF16IP_3X3

SHEET 1 / 1

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