

# 1 PRODUCT OVERVIEW

The S3C7524/C7528/C7534/C7538 single-chip CMOS microcontroller has been designed for high-performance using SAM 47 (Samsung Arrangeable Microcontrollers). SAM 47, Samsung's newest 4-bit CPU core is notable for its low energy consumption and low operating voltage.

You can select from two ROM sizes: 4K or 8K bytes

Except for the difference in ROM size, the features and functions of the S3C7524 and the S3C7528, the S3C7534 and the S3C7538 are identical.

With its DTMF generator, watchdog timer function, and versatile 8-bit timer/counters, the S3C7524/C7528/C5304/C5308 offers an excellent design solution for a wide variety of telecommunication applications.

Up to 35 pins of the available 42-pin SDIP or 44-pin QFP package for the S3C7524/C7528, and up to 23 pins of the available 30-pin SDIP or 32-pin SOP package for the S3C7534/C7538 can be assigned to I/O. Six vectored interrupts for S3C7524/C7528 and four vectored interrupts for S3C7534/C7538 provide fast response to internal and external events. In addition, the S3C7524/C7528/C7534/C7538's advanced CMOS technology provides for low power consumption and a wide operating voltage range.

## OTP

The S3C7524/C7528 microcontroller is also available in OTP (One Time Programmable) version, S3P7528. The S3C7534/C7538 microcontroller is also available in OTP (One Time Programmable) version, S3P7538. The S3P7528/P7538 microcontroller has an on-chip 8K-byte one-time-programmable EPROM instead of masked ROM. The S3P7528 is comparable to S3C7524/C7528, both in function and in pin configuration. Also, the S3P7538 is comparable to the S3C7534/C7538, both in function and in pin configuration.

**FEATURES SUMMARY****Memory**

- 768 × 4-bit RAM
- 4,096 × 8-bit ROM (S3C7524/C7534)  
8,192 × 8-bit ROM (S3C7528/C7538)

**35 I/O Pins**

- Input only: 4 pins (S3C7524/C7528)  
1 pins (S3C7534/C7538)
- I/O: 23 pins (S3C7524/C7528)  
14 pins (S3C7534/C7538)
- N-channel open-drain I/O: 8 pins

**Memory-Mapped I/O Structure**

- Data memory bank 15

**DTMF Generator**

- 16 dual-tone frequencies for tone dialing

**8-Bit Basic Timer**

- Programmable interval timer
- Watchdog timer

**Two 8-Bit Timer/Counters**

- Programmable 8-bit timer
- External event counter function
- Arbitrary clock frequency output

**Watch Timer**

- Real-time and interval time measurement
- Four frequency outputs to the BUZ pin

**Bit Sequential Carrier**

- Supports 8-bit serial data transfer in arbitrary format

**Interrupts**

- 3 external interrupt vectors (S3C7524/C7528)  
1 external interrupt vectors (S3C7534/C7538)
- 3 internal interrupt vectors
- 2 quasi-interrupts

**Power-Down Modes**

- Idle: Only CPU clock stops
- Stop: System clock stops

**Oscillation Sources**

- Crystal, or ceramic for main system clock
- Main system clock frequency: 0.4–6.0 MHz (typical)
- CPU clock divider circuit (by 4, 8, or 64)

**Instruction Execution Times**

- 0.95, 1.91, and 15.3 μs at 4.19 MHz
- 1.12, 2.23, 17.88 μs at 3.58 MHz
- 0.67, 1.33, 10.7 μs at 6.0 MHz

**Operating Temperature**

- –40 °C to 85 °C

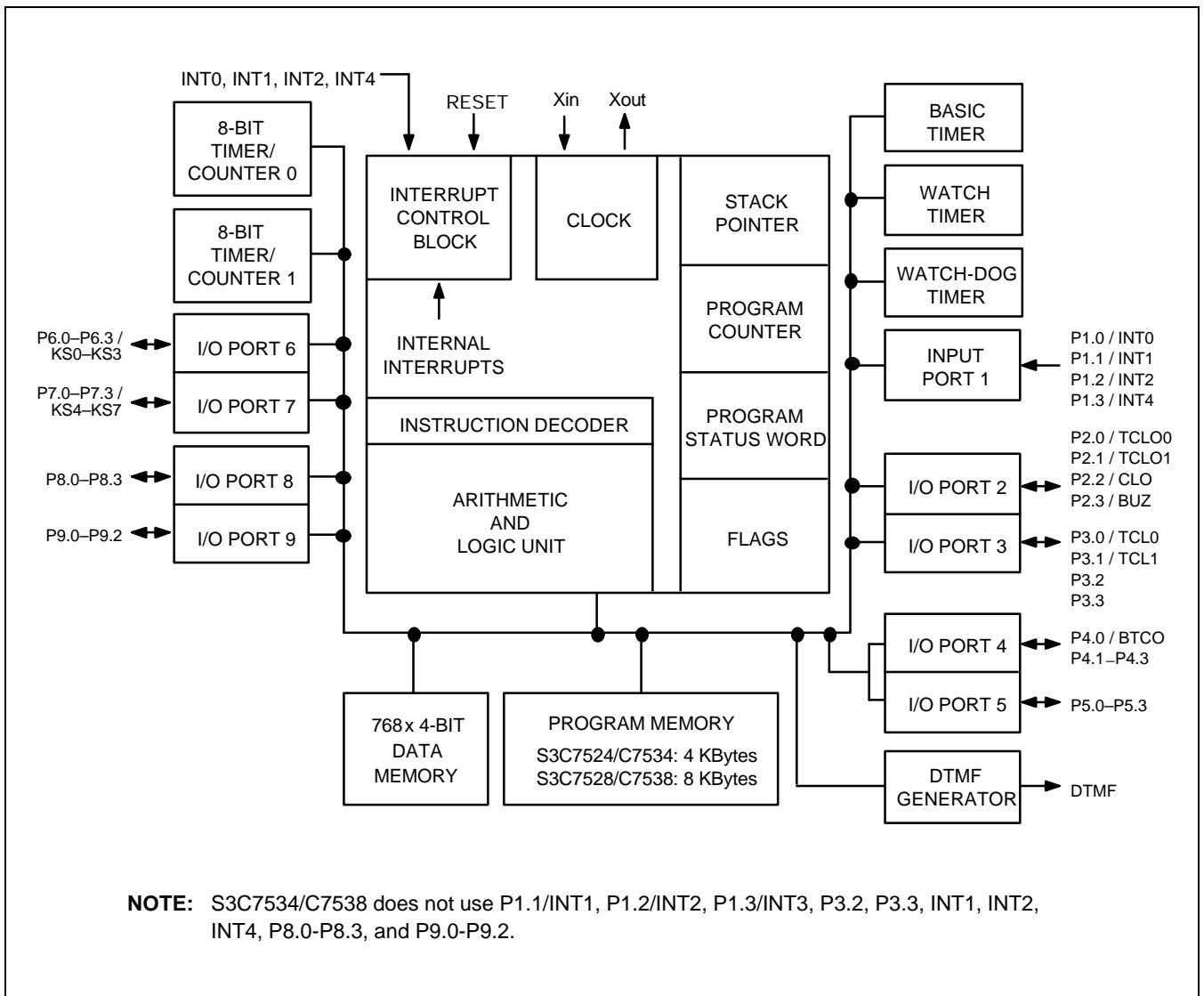
**Operating Voltage Range**

- 2.0 V to 5.5 V

**Package Types**

- 42 SDIP, 44 QFP (S3C7524/C7528)
- 30 SDIP, 32 SOP (S3C7534/C7538)

**BLOCK DIAGRAM**



**Figure 1-1. S3C7524/C7528 Simplified Block Diagram**

**PIN ASSIGNMENTS**

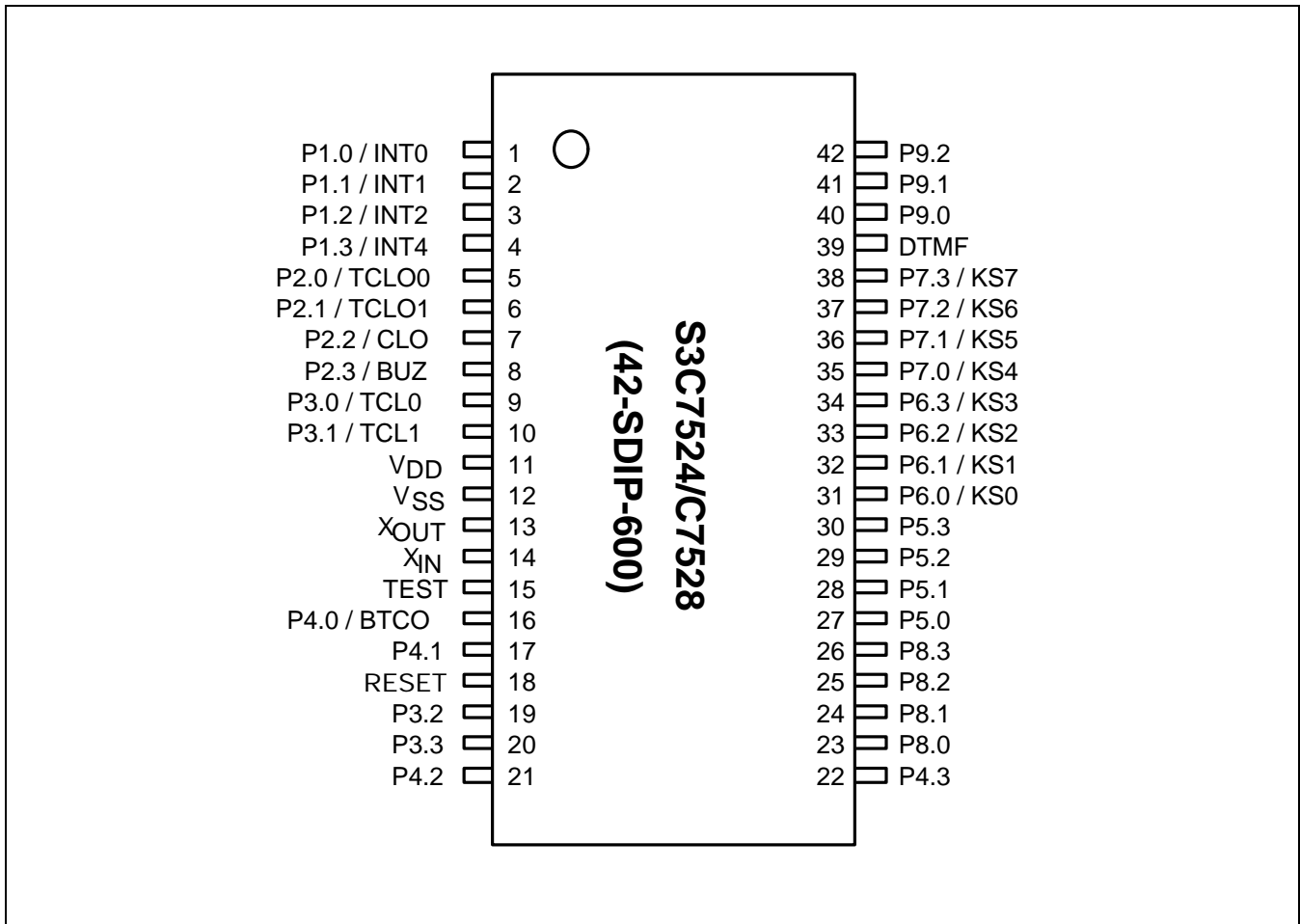


Figure 1-2. S3C7524/C7528 Pin Assignment Diagrams (42-SDIP)

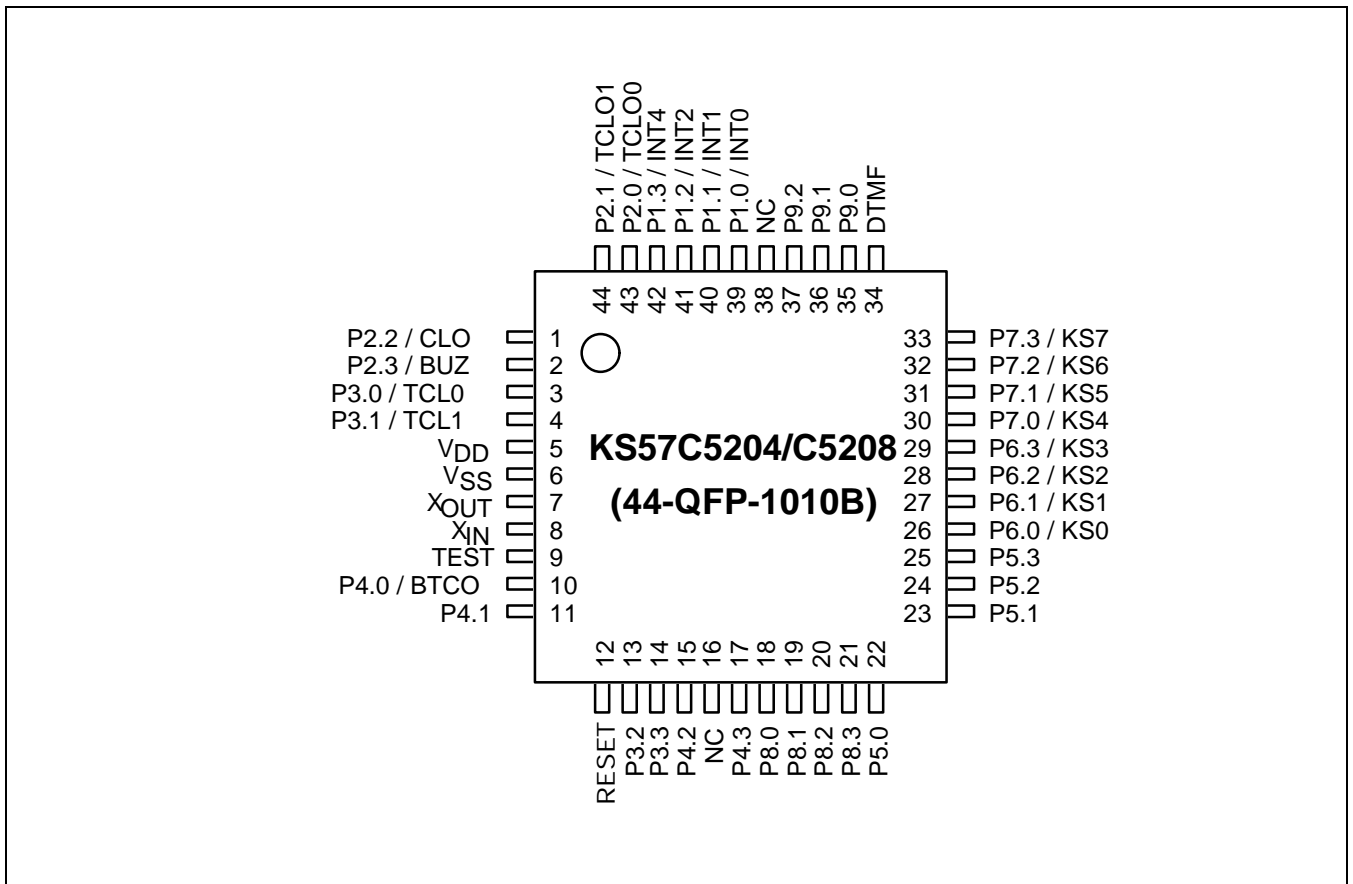


Figure 1-3. S3C7524/C7528 Pin Assignment Diagrams (44-QFP)

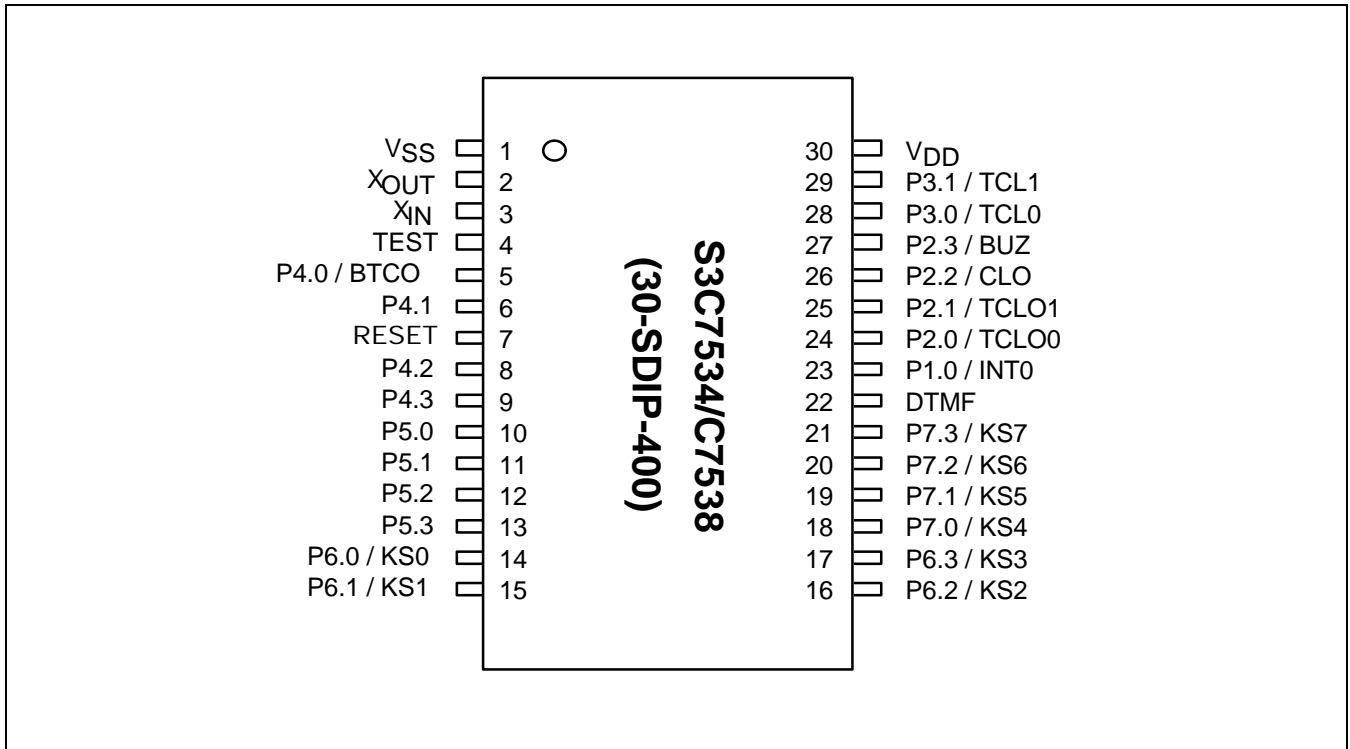


Figure 1-4. S3C7534/C7538 Pin Assignment Diagrams (30-SDIP)

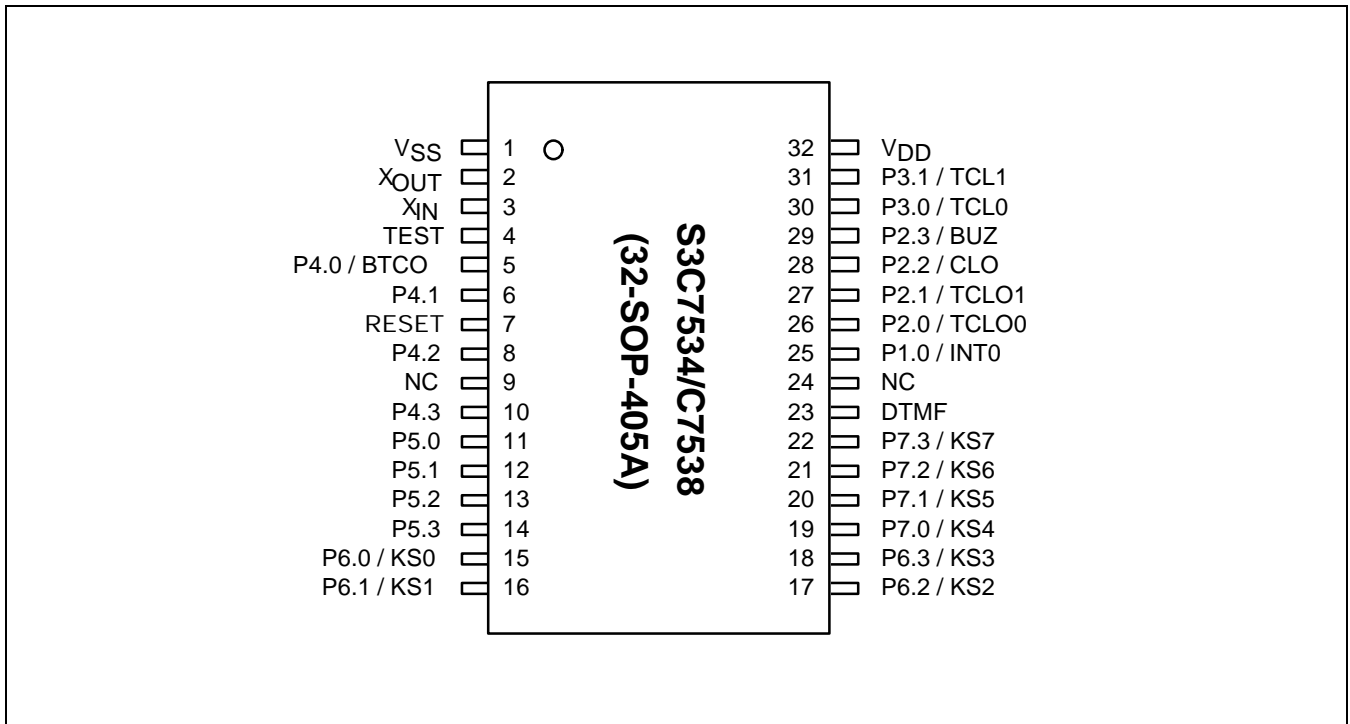


Figure 1-5. S3C7534/C7538 Pin Assignment Diagrams (32-SOP)

## PIN DESCRIPTIONS

Table 1-1. S3C7524/C7528 Pin Descriptions

Pin Name	Pin Type	Reset Value	Description	Pin Number	Share Pin	Circuit Type
P1.0 P1.1 P1.2 P1.3	I	I	4-bit input port. 1-bit and 4-bit read and test is possible. Each pull-up resistors are assignable by software.	1 (39) 2 (40) 3 (41) 4 (42)	INT0 INT1 INT2 INT4	A-4
P2.0 P2.1 P2.2 P2.3	I/O	I	4-bit I/O port. 1-bit and 4-bit read/write and test is possible. Individual pins are software configurable as input or output.	5 (43) 6 (44) 7 (1) 8 (2)	TCLO0 TCLO1 CLO BUZ	D-2
P3.0 P3.1 P3.2 P3.3			4-bit pull-up resistors are software assignable to input pins and are automatically disabled for output pins. Ports 2 and 3 can be paired to enable 8-bit data transfer.	9 (3) 10 (4) 19 (13) 20 (14)	TCL0 TCL1	D-4
P4.0 P4.1 P4.2 P4.3  P5.0–P5.3	I/O	I	4-bit I/O ports. 1-bit and 4-bit read/write and test is possible. Individual pins are software configurable as input or output. 4-bit pull-up resistors are software assignable to input pins and are automatically disabled for output pins. N-channel open-drain or push-pull output can be selected by software (1-bit unit) Ports 4 and 5 can be paired to support 8-bit data transfer.	16 (10) 17 (11) 21 (15) 22 (17)  27–30 (22–25)	BTCL0	E-2
P6.0–P6.3  P7.0–P7.3			4-bit I/O ports. 1-bit or 4-bit read/write and test is possible. Individual pins are software configurable as input or output. 4-bit pull-up resistors are software assignable to input pins and are automatically disabled for output pins. Ports 6 and 7 can be paired to enable 8-bit data transfer.	31–34 (26–29) 35–38 (30–33)	KS0–KS3  KS4–KS7	D-4
P8.0–P8.3  P9.0–P9.2	I/O	I	4-bit I/O port. 1-bit or 4-bit read/write and test is possible. Individual pins are software configurable as input or output. 4-bit pull-up resistors are software assignable to input pins and are automatically disabled for output pins. Ports 8 and 9 can be paired to enable 8-bit data transfer.	23–26 (18–21) 40–42 (35–37)	–	D-2

Table 1-1. S3C7524/C7528 Pin Descriptions (Continued)

Pin Name	Pin Type	Reset Value	Description	Pin Number	Share Pin	Circuit Type
DTMF	O	–	DTMF output.	39 (34)	–	G-6
BTCO	I/O	I	Basic timer clock output	16 (10)	P4.0	E-2
INT0 INT1	I	I	External interrupts. The triggering edge for INT0 and INT1 is selectable.	1 (39) 2 (40)	P1.0 P1.1	A-3
INT2	I	I	Quasi-interrupt with detection of rising edges	3 (41)	P1.2	A-3
INT4	I	I	External interrupt with detection of rising and falling edges.	4 (42)	P1.3	A-3
TCLO0	I/O	I	Timer/counter 0 clock output	5 (43)	P2.0	D-2
TCLO1	I/O	I	Timer/counter 1 clock output	6 (44)	P2.1	D-2
CLO	I/O	I	Clock output	7 (1)	P2.2	D-2
BUZ	I/O	I	2 kHz, 4 kHz, 8 kHz, or 16 kHz frequency output at the watch timer clock frequency of 4.19 MHz for buzzer sound	8 (2)	P2.3	D-2
TCL0	I/O	I	External clock input for timer/counter 0	9 (3)	P3.0	D-4
TCL1	I/O	I	External clock input for timer/counter 1	10 (4)	P3.1	D-4
KS0–KS3 KS4–KS7	I/O	I	Quasi-interrupt inputs with falling edge detection	31–34 (26–29) 35–38 (30–33)	P6.0– P6.3 P7.0– P7.3	D-4
V <sub>DD</sub>	–	–	Power supply	11 (5)	–	–
V <sub>SS</sub>	–	–	Ground	12 (6)	–	–
RESET	–	–	RESET signal	18 (12)	–	B
X <sub>in</sub> X <sub>out</sub>	–	–	Crystal, or ceramic oscillator signal for main system clock. (For external clock input, use X <sub>in</sub> and input X <sub>in</sub> 's reverse phase to X <sub>out</sub> )	14 (8) 13 (7)	–	–
TEST	–	–	Test signal input	15 (9)	–	–
NC	–	–	No connection	(16, 38)	–	–

**NOTE:** Parentheses indicate pin number for 44 QFP package.



Table 1-2. S3C7534/C7538 Pin Descriptions

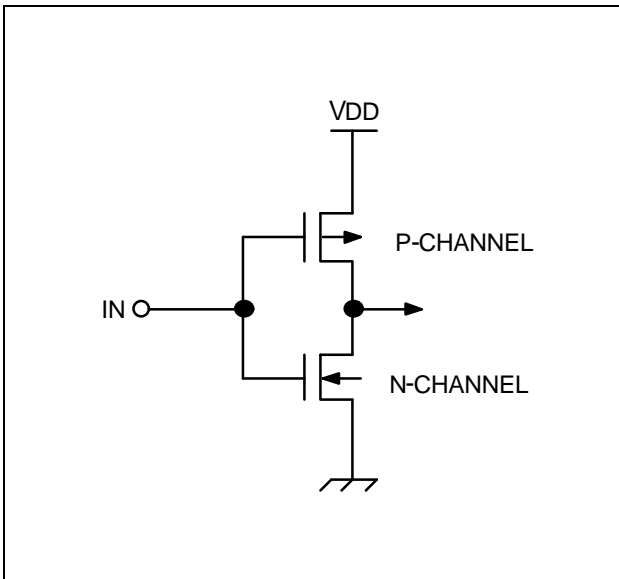
Pin Name	Pin Type	Description	Pin Number	Share Pin	Circuit Type
P1.0	I	1-bit input port. 1-bit and 4-bit read and test is possible. Each bit pull-up resistors are assignable.	23 (25)	INT0	A-4
P2.0 P2.1 P2.2 P2.3	I/O	4-bit I/O port. 1-bit and 4-bit read/write and test is possible. Each individual pin can be assignable as input or output. 4-bit pull-up resistors are software assignable to input pins and are automatically disabled for output pins.	24 (26) 25 (27) 26 (28) 27 (29)	TCLO0 TCLO1 CLO BUZ	D-2
P3.0 P3.1		Ports 2 and 3 can be paired to enable 8-bit data transfer.	28 (30) 29 (31)	TCL0 TCL1	D-4
P4.0 P4.1 P4.2 P4.3 P5.0–P5.3	I/O	4-bit I/O ports. 1-bit and 4-bit read/write and test is possible. Each individual pin can be assignable as input or output. 4-bit pull-up resistors are software assignable to input pins and are automatically disabled for output pins. The N-channel open-drain or push-pull output can be selected by software (1-bit unit). Ports 4 and 5 can be paired to enable 8-bit data transfer.	5 (5) 6 (6) 8 (8) 9 (10) 10–13 (11–14)	BTCO	E-2
P6.0–P6.3 P7.0–P7.3	I/O	4-bit I/O ports. 1-bit and 4-bit read/write and test is possible. Each individual pin can be assignable as input or output. 4-bit pull-up resistors are software assignable to input pins and are automatically disabled for output pins. Ports 6 and 7 can be paired to enable 8-bit data transfer.	14–17 (15–18) 18–21 (19–22)	KS0–KS3 KS4–KS7	D-4

Table 1-1. S3C7534/C7538 Pin Descriptions (Continued)

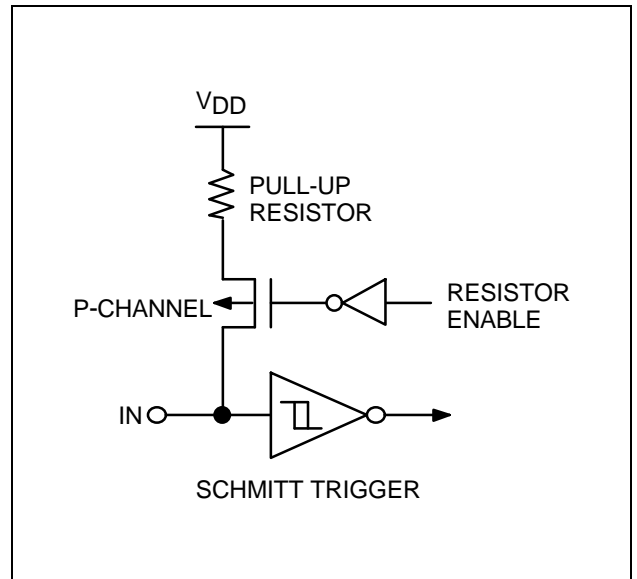
Pin Name	I/O Type	Description	Pin Number	Share Pin	Circuit Type
DTMF	O	DTMF output.	22 (23)	–	G-6
INT0	I	External interrupt input. The triggering edge for INT0 is selectable.	23 (25)	P1.0	A-3
TCLO0	I/O	Timer/counter 0 clock output	24 (26)	P2.0	D-2
TCLO1	I/O	Timer/counter 1 clock output	25 (27)	P2.1	D-2
CLO	I/O	Clock output	26 (28)	P2.2	D-2
BUZ	I/O	2 kHz, 4 kHz, 8 kHz, or 16 kHz frequency output at the watch timer clock frequency of 4.19 MHz for buzzer sound	27 (29)	P2.3	D-2
TCL0	I/O	External clock input for timer/counter 0	28 (30)	P3.0	D-4
TCL1	I/O	External clock input for timer/counter 1	29 (31)	P3.1	D-4
BTCO	I/O	Basic timer clock output	5 (5)	P4.0	E-2
V <sub>DD</sub>	–	Power supply	30 (32)	–	–
V <sub>SS</sub>	–	Ground	1 (1)	–	–
X <sub>in</sub> X <sub>out</sub>	–	Crystal, or ceramic oscillator signal for main system clock. (For external clock input, use X <sub>in</sub> and input X <sub>in</sub> 's reverse phase to X <sub>out</sub> )	3 (3) 2 (2)	–	–
NC	–	No connection	(9, 24)	–	–
TEST	–	Test signal input	4 (4)	–	–
RESET	–	RESET signal	7 (7)	–	B
KS0–KS3 KS4–KS7	I/O	Quasi-interrupt inputs with falling edge detection	14–17 (15–18) 18–21 (19–22)	P6.0– P6.3 P7.0– P7.3	D-4

**NOTE:** Parentheses indicate the pin number for 32-SOP package.

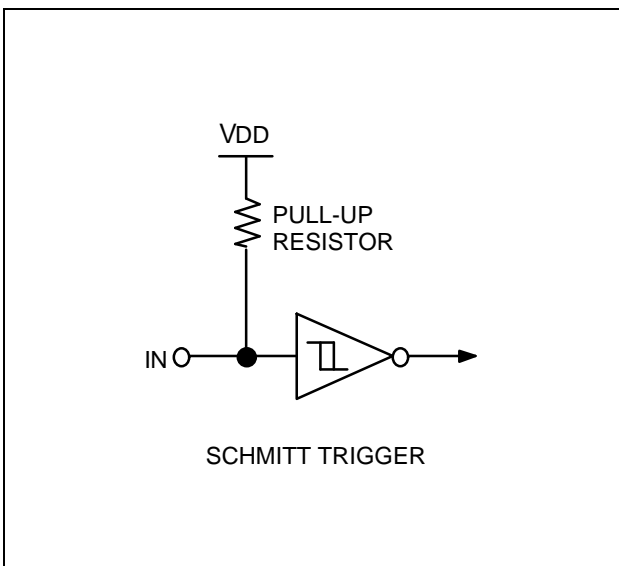
**PIN CIRCUIT DIAGRAMS**



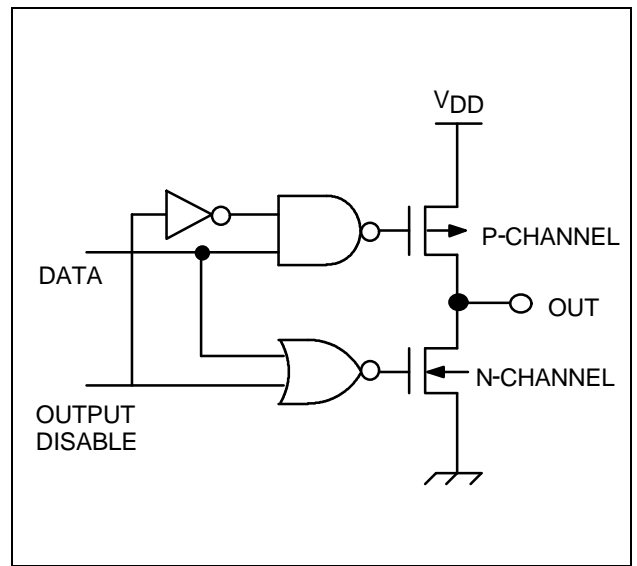
**Figure 1-6. Pin Circuit Type A**



**Figure 1-8. Pin Circuit Type A-4**



**Figure 1-7. Pin Circuit Type B**



**Figure 1-9. Pin Circuit Type C**

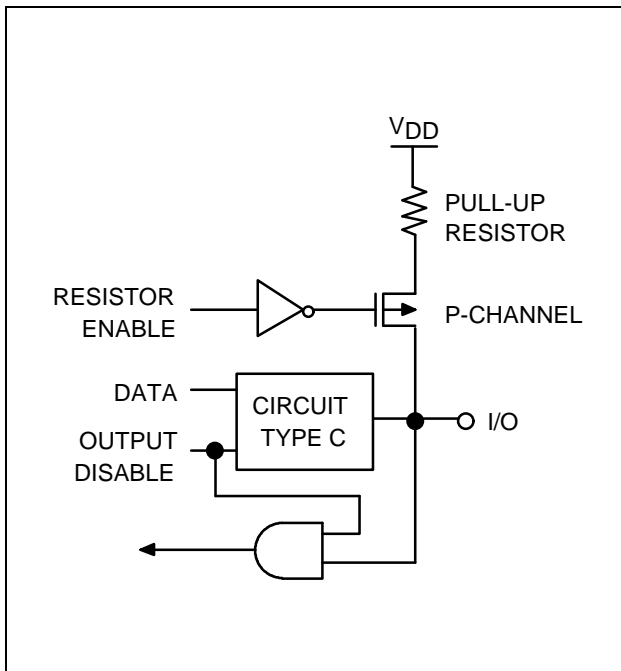


Figure 1-10. Pin Circuit Type D-2

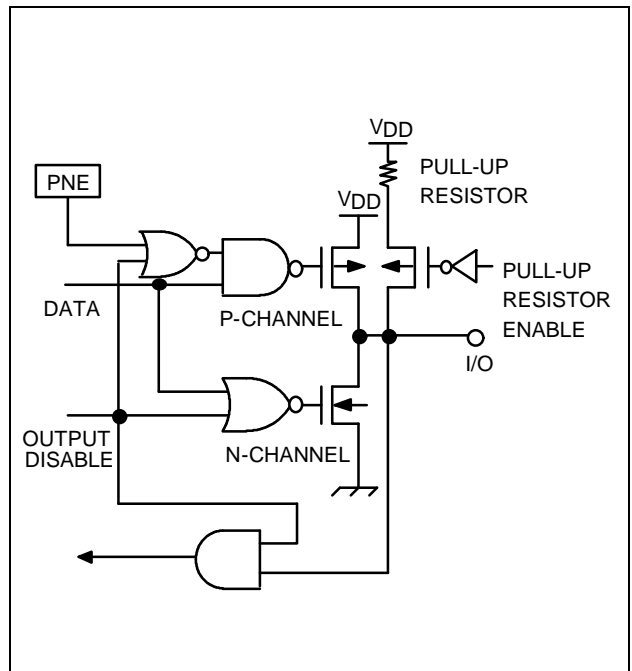


Figure 1-12. Pin Circuit Type E-2

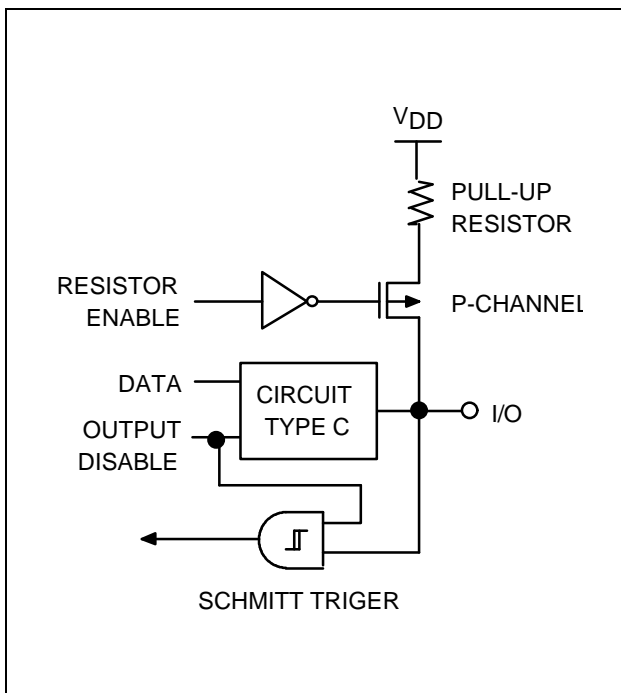


Figure 1-11. Pin Circuit Type D-4

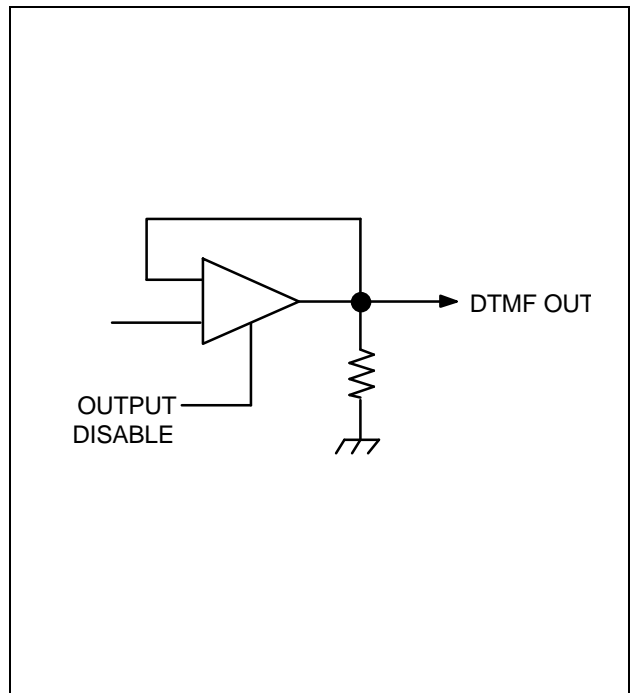


Figure 1-13. Pin Circuit Type G-6

# 13

## ELECTRICAL DATA

In this section, information on S3C7524/C7528 electrical characteristics is presented as tables and graphics. The information is arranged in the following order:

### Standard Electrical Characteristics

- Absolute maximum ratings
- D.C. electrical characteristics
- System clock oscillator characteristics
- I/O capacitance
- A.C. electrical characteristics
- Operating voltage range

### Miscellaneous Timing Waveforms

- A.C timing measurement point
- Clock timing measurement at  $X_{in}$  and  $X_{out}$
- TCL timing
- Input timing for RESET
- Input timing for external interrupts
- Serial data transfer timing

### Stop Mode Characteristics and Timing Waveforms

- RAM data retention supply voltage in stop mode
- Stop mode release timing when initiated by RESET
- Stop mode release timing when initiated by an interrupt request

Table 13-1. Absolute Maximum Ratings

 $(T_A = 25\text{ }^\circ\text{C})$ 

Parameter	Symbol	Conditions	Rating	Units
Supply Voltage	$V_{DD}$	–	– 0.3 to + 6.5	V
Input Voltage	$V_{I1}$	All I/O ports	– 0.3 to $V_{DD} + 0.3$	V
Output Voltage	$V_O$	–	– 0.3 to $V_{DD} + 0.3$	V
Output Current High	$I_{OH}$	One I/O port active	– 15	mA
		All I/O ports active	– 35	
Output Current Low	$I_{OL}$	One I/O port active	+ 30 (Peak value) + 15 (note)	mA
		All I/O ports active	+ 100 (Peak value) + 60 (note)	
Operating Temperature	$T_A$	–	– 40 to + 85	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	–	– 65 to + 150	$^\circ\text{C}$

**NOTE:** The values for output current low ( $I_{OL}$ ) are calculated as peak value  $\times \sqrt{\text{Duty}}$ .

Table 13-2. D.C. Electrical Characteristics

 $(T_A = -40\text{ }^\circ\text{C}$  to  $+85\text{ }^\circ\text{C}$ ,  $V_{DD} = 2.0\text{ V}$  to  $5.5\text{ V}$ )

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input high voltage	$V_{IH1}$	All input pins except those specified below for $V_{IH2} - V_{IH3}$	$0.7 V_{DD}$	–	$V_{DD}$	V
	$V_{IH2}$	Ports 1, 3, 6, 7, and RESET	$0.8 V_{DD}$		$V_{DD}$	
	$V_{IH3}$	$X_{in}$ and $X_{out}$	$V_{DD} - 0.1$		$V_{DD}$	
Input low voltage	$V_{IL1}$	All input pins except those specified below for $V_{IL2} - V_{IL3}$	–	–	$0.3 V_{DD}$	V
	$V_{IL2}$	Ports 1, 3, 6, 7, and RESET			$0.2 V_{DD}$	
	$V_{IL3}$	$X_{in}$ and $X_{out}$			0.1	

Table 13-2. D.C. Electrical Characteristics (Continued)

(T<sub>A</sub> = -40 °C to +85 °C, V<sub>DD</sub> = 2.0 V to 5.5 V)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Output high voltage	V <sub>OH</sub>	I <sub>OH</sub> = -1 mA Ports except 1	V <sub>DD</sub> - 1.0	-	-	V
Output low voltage	V <sub>OL1</sub>	V <sub>DD</sub> = 4.5 V to 5.5 V I <sub>OL</sub> = 15 mA, Ports 4 and 5 only	-	0.4	2	V
		V <sub>DD</sub> = 2.0 to 5.5 V, I <sub>OL</sub> = 1.6mA	-	-	0.4	
	V <sub>OL2</sub>	V <sub>DD</sub> = 4.5 V to 5.5 V I <sub>OL</sub> = 4 mA, all out ports except 4,5	-	-	2	V
		V <sub>DD</sub> = 2.0 to 5.5 V, I <sub>OL</sub> = 1.6mA	-	-	0.4	
Input high leakage current	I <sub>LIH1</sub>	V <sub>I</sub> = V <sub>DD</sub> All input pins except those specified below	-	-	3	μA
	I <sub>LIH2</sub>	V <sub>I</sub> = V <sub>DD</sub> X <sub>in</sub> and X <sub>out</sub>	-	-	20	
Input low leakage current	I <sub>LIL1</sub>	V <sub>I</sub> = 0 V All input pins except below and RESET	-	-	-3	μA
	I <sub>LIL2</sub>	V <sub>I</sub> = 0 V X <sub>in</sub> and X <sub>out</sub> only	-	-	-20	
Output high leakage current	I <sub>LOH</sub>	V <sub>O</sub> = V <sub>DD</sub> All out pins	-	-	3	μA
Output low leakage current	I <sub>LOL</sub>	V <sub>O</sub> = 0 V X <sub>in</sub> and X <sub>out</sub> only	-	-	-3	μA
Pull-up resistor	R <sub>L1</sub>	V <sub>DD</sub> = 5 V; V <sub>I</sub> = 0 V except RESET	25	47	100	kΩ
		V <sub>DD</sub> = 3 V	50	95	200	
	R <sub>L2</sub>	V <sub>DD</sub> = 5 V; V <sub>I</sub> = 0 V; RESET	100	220	400	
		V <sub>DD</sub> = 3 V	200	450	800	

Table 13-2. D.C. Electrical Characteristics (Concluded)

(T<sub>A</sub> = -40 °C to +85 °C, V<sub>DD</sub> = 2.0 V to 5.5 V)

Parameter	Symbol	Conditions	Min	Typ	Max	Units			
Supply current (1)	I <sub>DD1</sub> (DTMF on)	Run mode; V <sub>DD</sub> = 5 V ± 10% (2) 3.58 MHz crystal oscillator, C1 = C2 = 22 pF	-	2.9	5.0	mA			
		V <sub>DD</sub> = 3 V ± 10%		1.6	3.0				
	I <sub>DD2</sub> (DTMF off)	Run mode; V <sub>DD</sub> = 5 V ± 10%	-	2.6	8.0	mA			
		6.0 MHz		3.58 MHz	1.8		4.0		
		3.58 MHz			1.8		4.0		
		V <sub>DD</sub> = 3 V ± 10%		6.0 MHz	3.58 MHz		1.2	2.3	
	I <sub>DD3</sub>	Idle mode; V <sub>DD</sub> = 5 V ± 10% crystal oscillator, C1 = C2 = 22 pF	6.0 MHz	-	0.7	2.5	mA		
			3.58 MHz		0.6	1.8			
			V <sub>DD</sub> = 3 V ± 10%		6.0 MHz	3.58 MHz		0.3	1.5
			3.58 MHz		0.2	1.0			
I <sub>DD4</sub>	Stop mode; V <sub>DD</sub> = 5 V ± 10%	-	0.01	3	μA				
				Stop mode; V <sub>DD</sub> = 3 V ± 10%		2			
Row tone level	V <sub>ROW</sub>	V <sub>DD</sub> = 5 V ± 10% V <sub>DD</sub> = 3 V ± 10% V <sub>DD</sub> = 2 V RL = 5kΩ	-16.0	-14.0	-11.0	dBV			
Ratio of column to row tone	dB <sub>CR</sub>	V <sub>DD</sub> = 5 V ± 10% V <sub>DD</sub> = 3 V ± 10% V <sub>DD</sub> = 2 V RL = 5kΩ	1	2	3				
Distortion (Dual tone)	THD	V <sub>DD</sub> = 5 V ± 10% V <sub>DD</sub> = 3 V ± 10% V <sub>DD</sub> = 2 V RL = 5kΩ, 1MHz band	-	-	5	%			

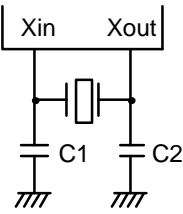
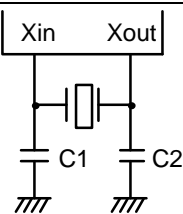
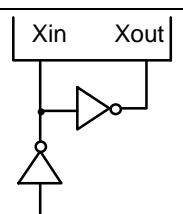
## NOTES

1. D.C. electrical values for Supply Current (I<sub>DD1</sub> to I<sub>DD3</sub>) do not include current drawn through internal pull-up registers.
2. For D.C. electrical values, the power control register (PCON) must be set to 0011B.



Table 13-3. Main System Clock Oscillator Characteristics

(T<sub>A</sub> = -40 °C + 85 °C, V<sub>DD</sub> = 2.0 V to 5.5 V)

Oscillator	Clock Configuration	Parameter	Test Condition	Min	Typ	Max	Units
Ceramic Oscillator		Oscillation frequency (1)	V <sub>DD</sub> = 2.7 V to 5.5 V	0.4	–	6.0	MHz
			V <sub>DD</sub> = 2.0 V to 5.5 V	0.4	–	4.2	
		Stabilization time (2)	V <sub>DD</sub> = 3 V	–	–	4	ms
Crystal Oscillator		Oscillation frequency (1)	V <sub>DD</sub> = 2.7 V to 5.5 V	0.4	–	6.0	MHz
			V <sub>DD</sub> = 2.0 V to 5.5 V	0.4	–	4.2	
		Stabilization time (2)	V <sub>DD</sub> = 3 V	–	–	10	ms
External Clock		X <sub>in</sub> input frequency (1)	V <sub>DD</sub> = 2.7 V to 5.5 V	0.4	–	6.0	MHz
			V <sub>DD</sub> = 2.0 V to 5.5V	0.4	–	4.2	
		X <sub>in</sub> input high and low level width (t <sub>XH</sub> , t <sub>XL</sub> )	–	83.3	–	1250	ns

**NOTES**

- Oscillation frequency and X<sub>in</sub> input frequency data are for oscillator characteristics only.
- Stabilization time is the interval required for oscillating stabilization after a power-on occurs, or when stop mode is terminated.

Table 13-4. Input/Output Capacitance

 $(T_A = 25\text{ }^\circ\text{C}, V_{DD} = 0\text{ V})$ 

Parameter	Symbol	Condition	Min	Typ	Max	Units
Input Capacitance	$C_{IN}$	f = 1 MHz; Unmeasured pins are returned to $V_{SS}$	–	–	15	pF
Output Capacitance	$C_{OUT}$		–	–	15	pF
I/O Capacitance	$C_{IO}$		–	–	15	pF

Table 13-5. A.C. Electrical Characteristics

 $(T_A = -40\text{ }^\circ\text{C to } +85\text{ }^\circ\text{C}, V_{DD} = 2.0\text{ V to } 5.5\text{ V})$ 

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Instruction Cycle Time (1)	$t_{CY}$	$V_{DD} = 2.7\text{ V to } 5.5\text{ V}$	0.67	–	64	$\mu\text{s}$
		$V_{DD} = 2.0\text{ V to } 5.5\text{ V}$	0.95			
TCL0, TCL1 Input Frequency	$f_{TI0}, f_{TI1}$	$V_{DD} = 2.7\text{ V to } 5.5\text{ V}$	0	–	1.5	MHz
		$V_{DD} = 2.0\text{ V to } 5.5\text{ V}$			1	MHz
TCL0, TCL1 Input High, Low Width	$t_{TIH0}, t_{TIL0}$ $t_{TIH1}, t_{TIL1}$	$V_{DD} = 2.7\text{ V to } 5.5\text{ V}$	0.48	–	–	$\mu\text{s}$
		$V_{DD} = 2.0\text{ V to } 5.5\text{ V}$	1.8			
Interrupt Input High, Low Width	$t_{INTH}, t_{INTL}$	INT0, INT1, INT2, INT4, KS0–KS7	10	–	–	$\mu\text{s}$
RESET Input Low Width	$t_{RSL}$	Input	10	–	–	$\mu\text{s}$

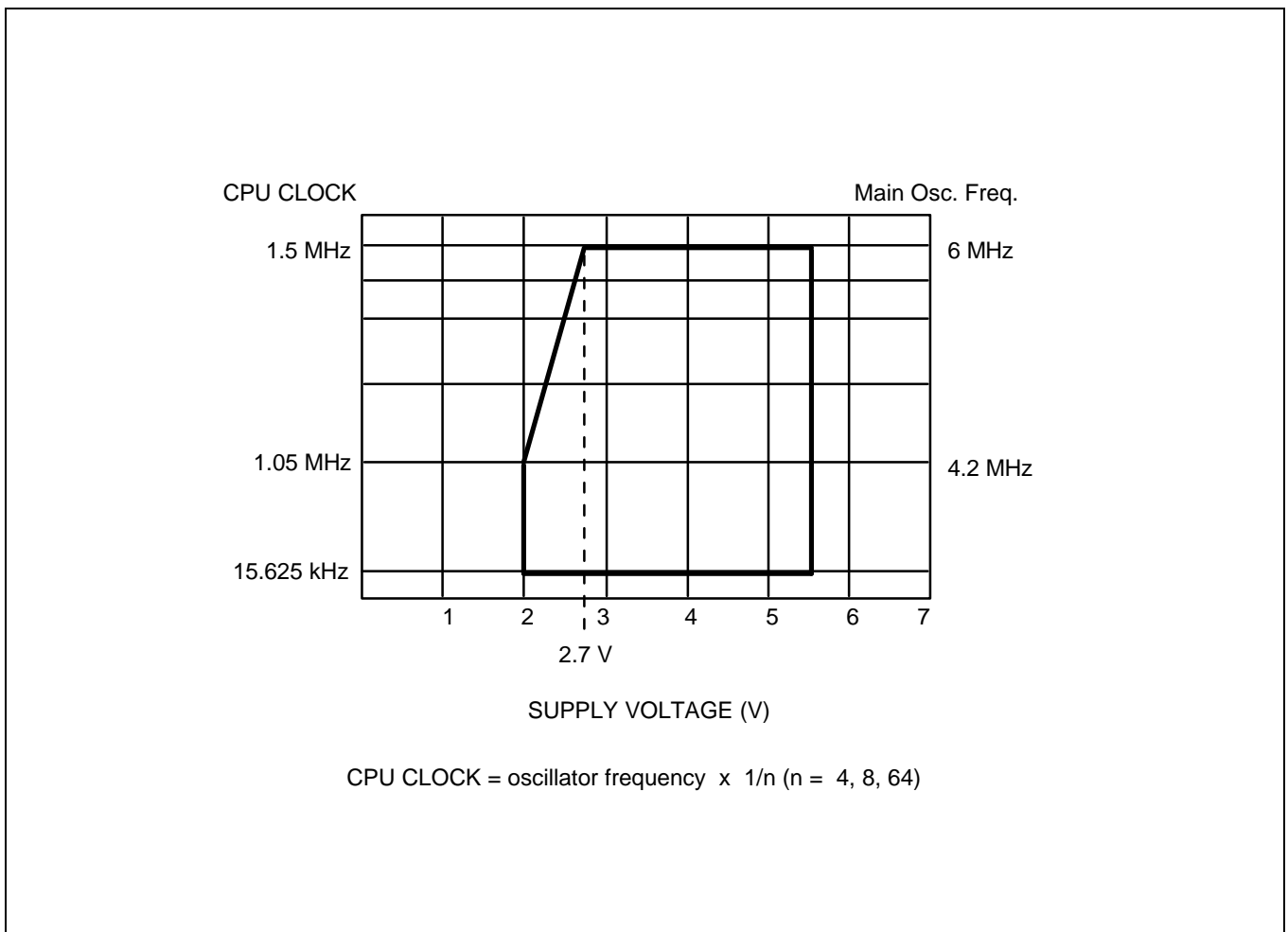


Figure 13-1. Standard Operating Voltage Range

Table 13-6. RAM Data Retention Supply Voltage in Stop Mode

(T<sub>A</sub> = -40 °C to +85 °C)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Data retention supply voltage	V <sub>DDDR</sub>	–	1.5	–	5.5	V
Data retention supply current	I <sub>DDDR</sub>	V <sub>DDDR</sub> = 1.5 V	–	0.1	10	μA
Release signal set time	t <sub>SREL</sub>	–	0	–	–	μs
Oscillator stabilization wait time <sup>(1)</sup>	t <sub>WAIT</sub>	Released by RESET Released by interrupt	–	2 <sup>17</sup> /f <sub>x</sub> <sup>(2)</sup>	–	ms ms

**NOTES**

- During oscillator stabilization wait time, all CPU operations must be stopped to avoid instability during oscillator start-up.
- Use the basic timer mode register (BMOD) interval timer to delay execution of CPU instructions during the wait time.

TIMING WAVEFORMS

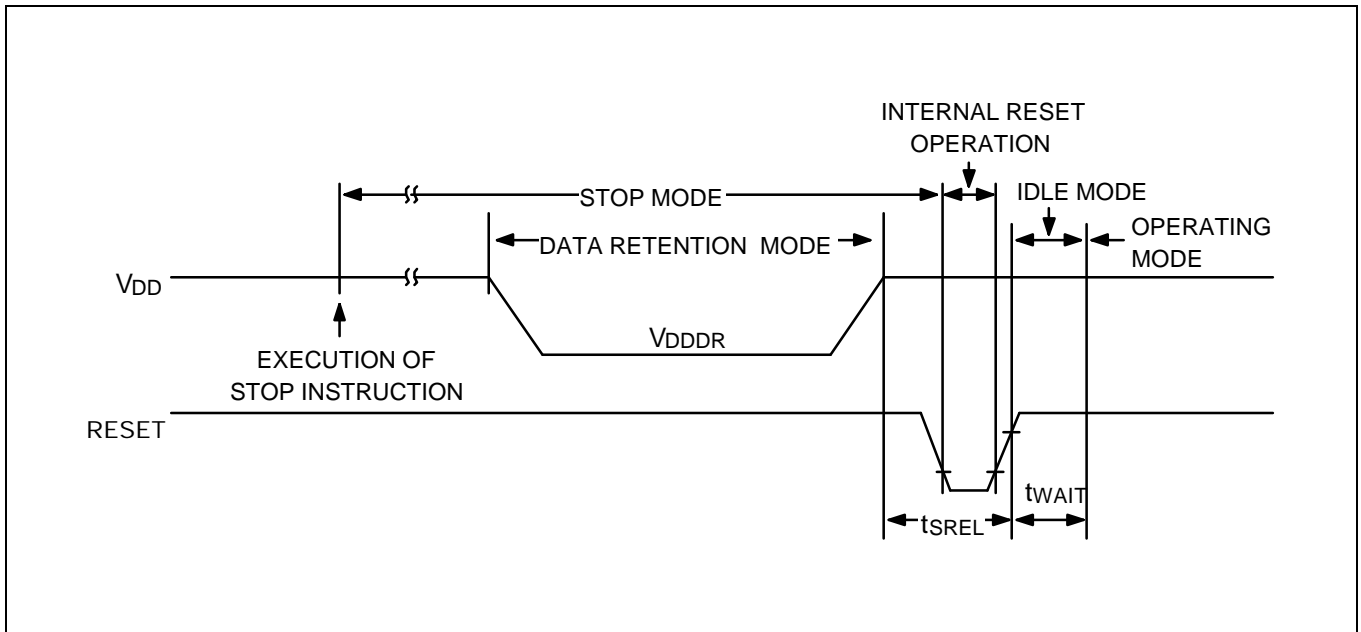


Figure 13-2. Stop Mode Release Timing When Initiated By RESET

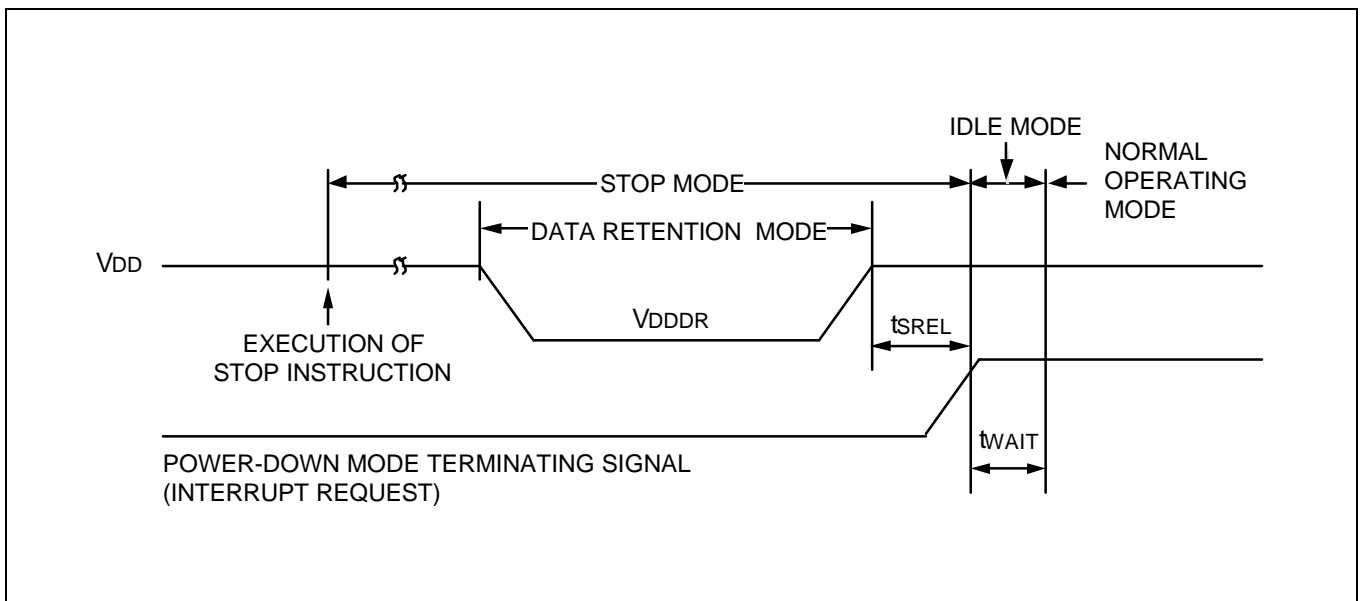


Figure 13-3. Stop Mode Release Timing When Initiated By Interrupt Request

Timing Waveforms (continued)

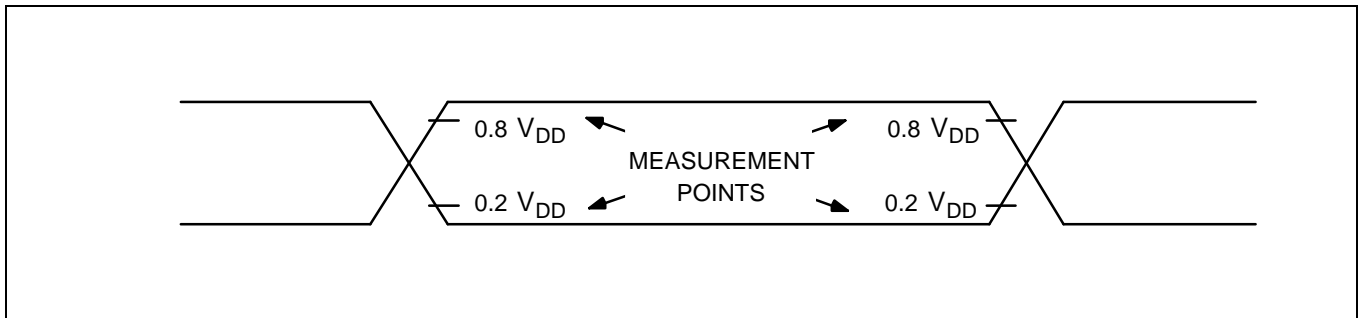


Figure 13-4. A.C. Timing Measurement Points (Except for  $X_{in}$ )

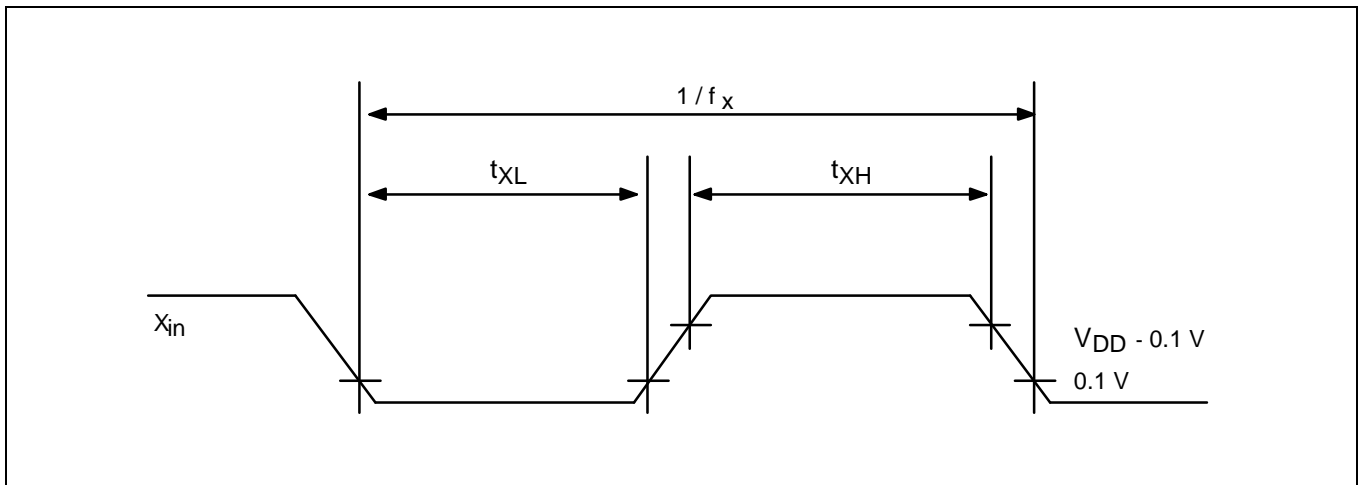


Figure 13-5. Clock Timing Measurement at  $X_{in}$

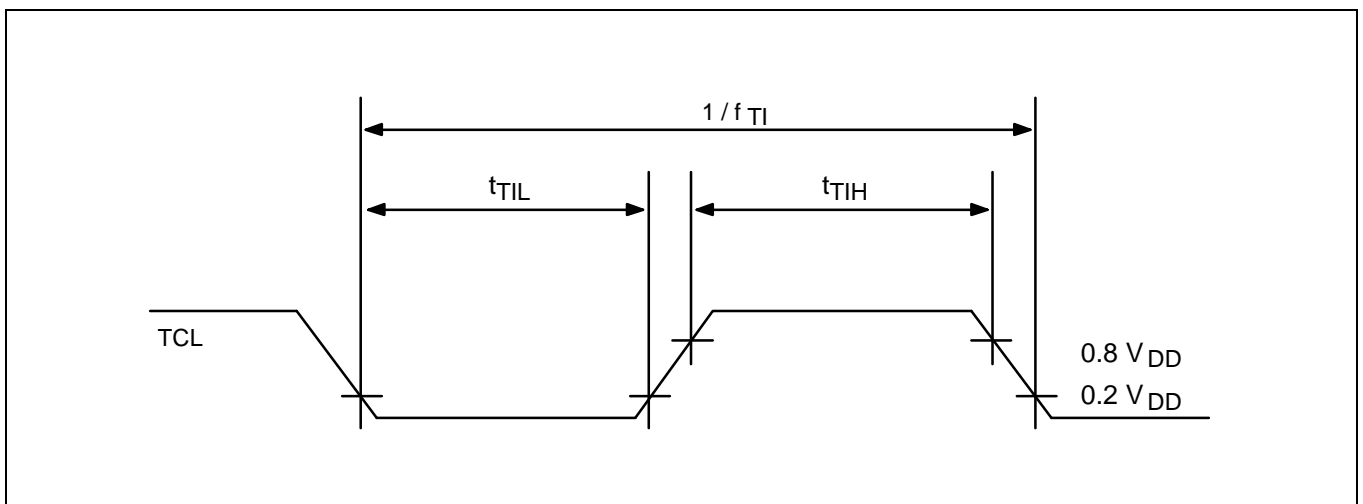


Figure 13-6. TCL Timing

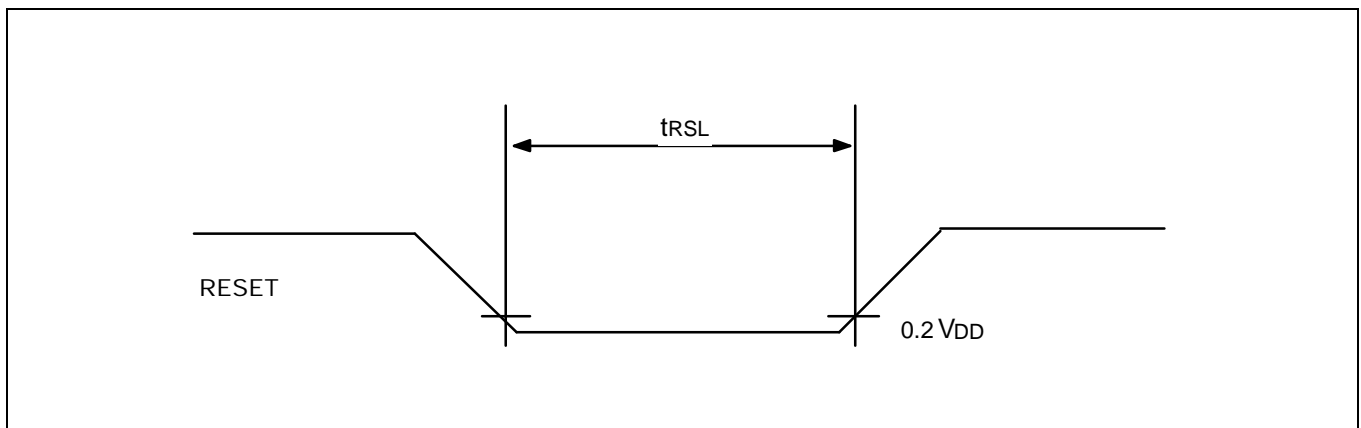


Figure 13-7. Input Timing for RESET Signal

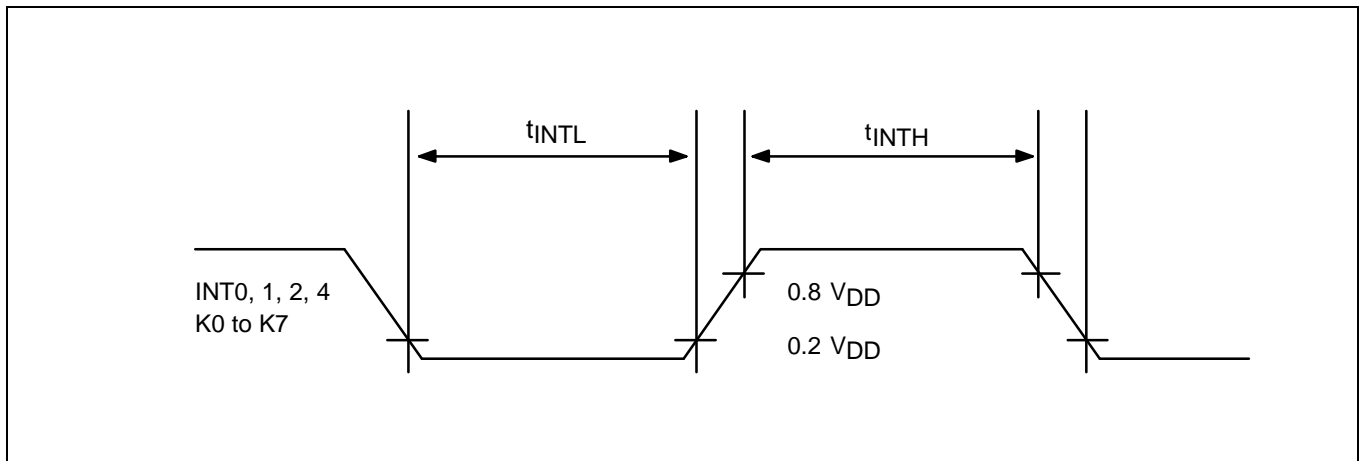


Figure 13-8. Input Timing for External Interrupts and Quasi-Interrupts

# 14 MECHANICAL DATA

This section contains the following information about the device package:

- Package dimensions in millimeters
- Pad diagram
- Pad/pin coordinate data table

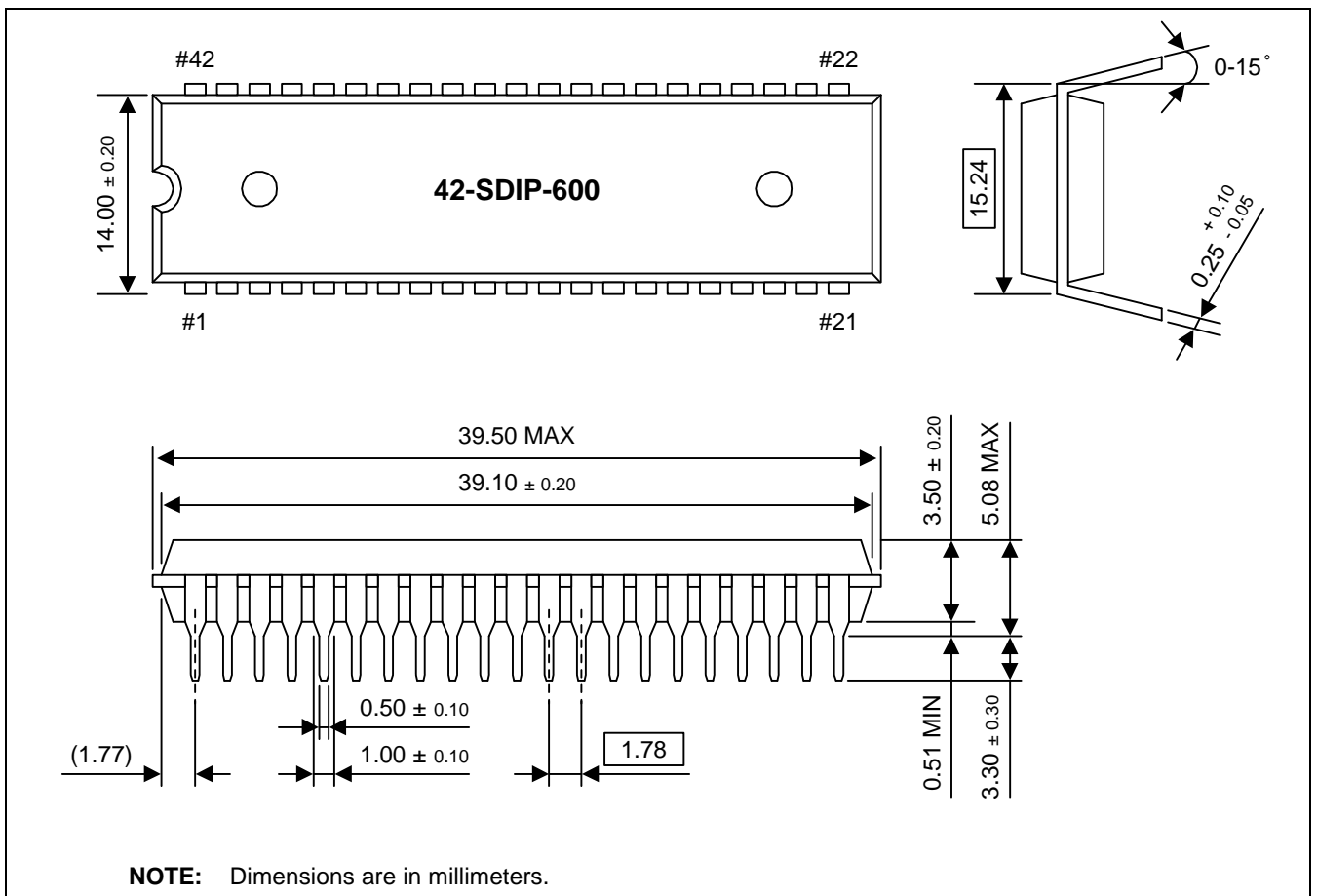


Figure 14-1. 42-SDIP-600 Package Dimensions

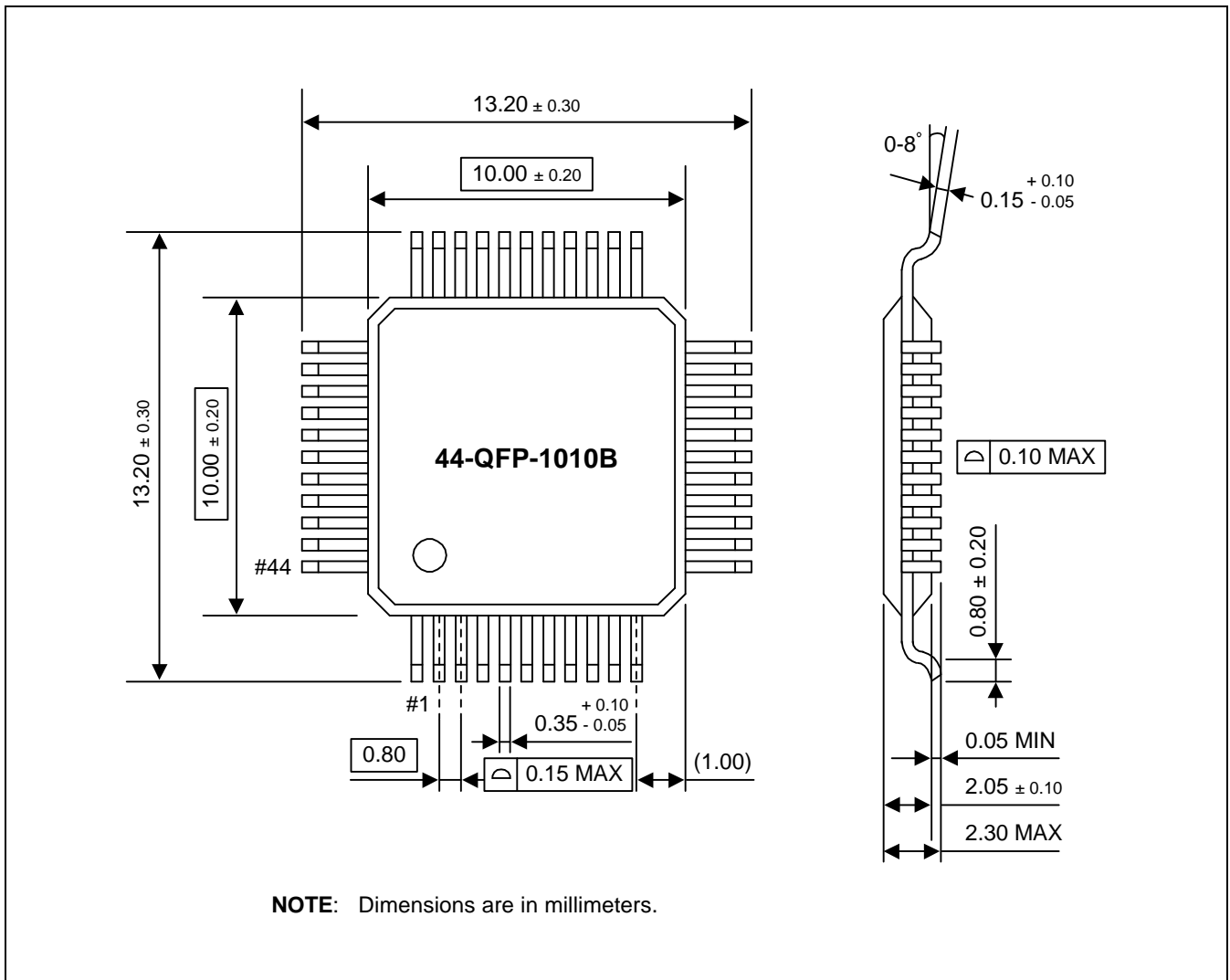


Figure 14-2. 44-QFP-1010B Package Dimensions



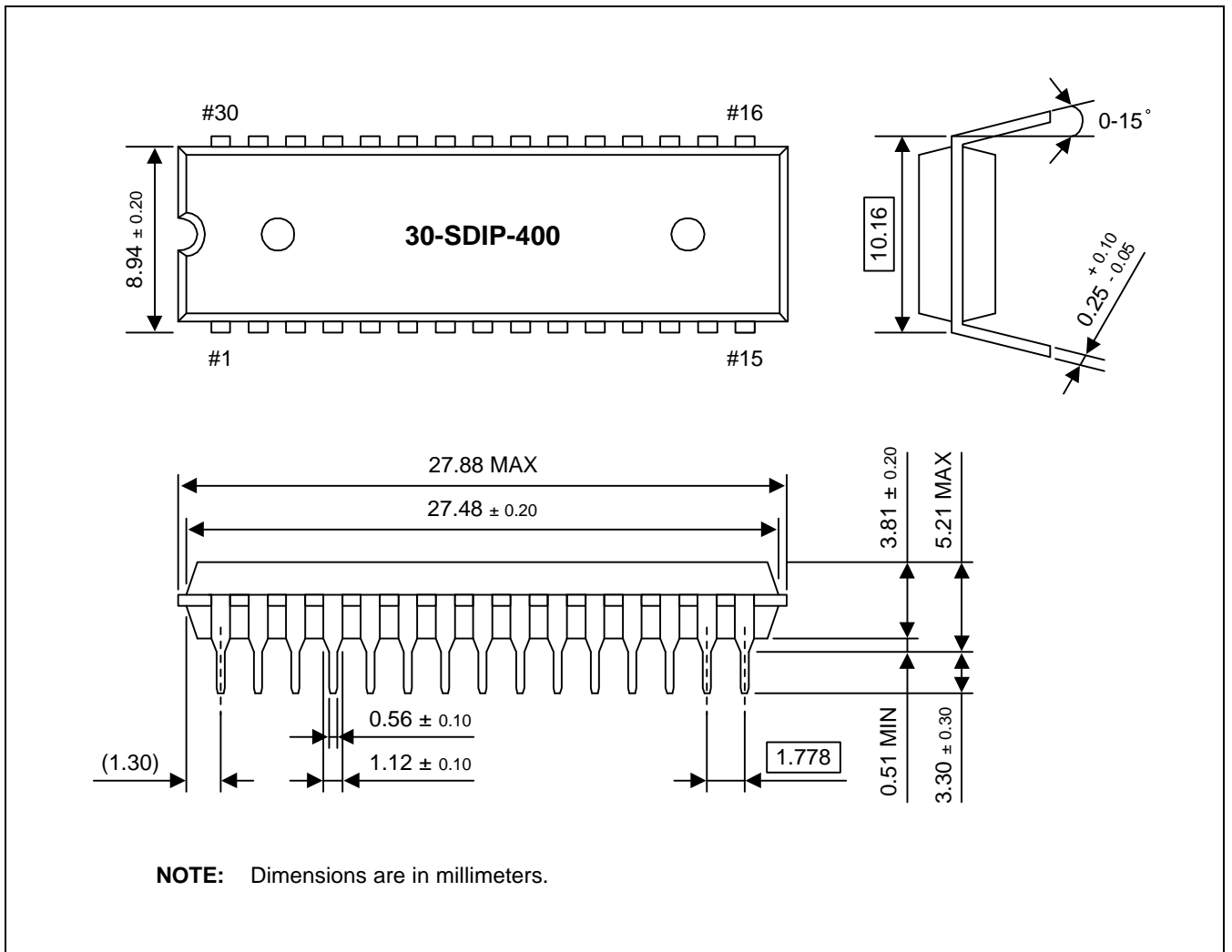


Figure 14-3. 30-SDIP-400 Package Dimensions

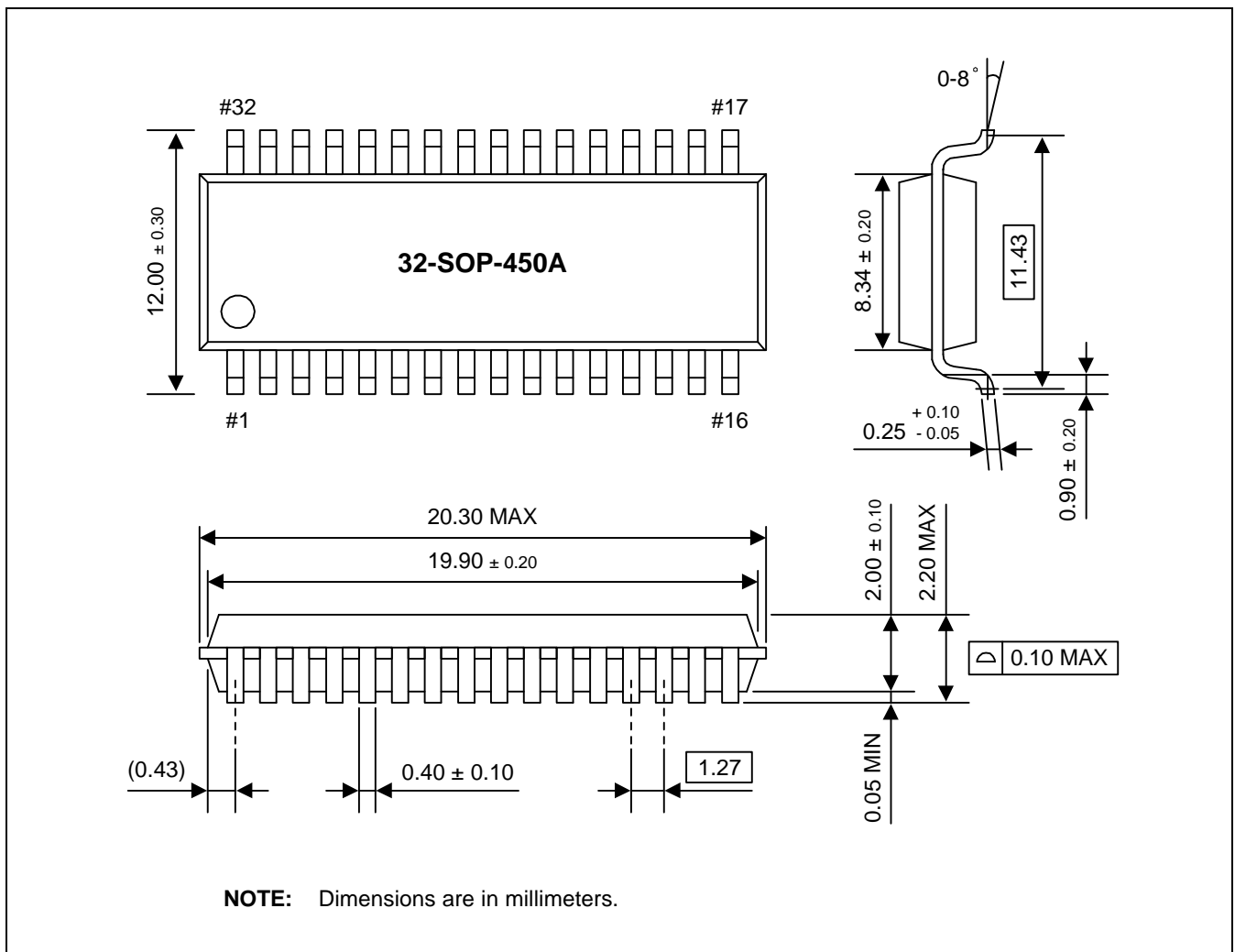


Figure 14-4. 32-SOP-450A Package Dimensions

# 15

## S3P7528/P7538 OTP

### OVERVIEW

The S3P7528/P7538 single-chip CMOS microcontroller is the OTP (One Time Programmable) version of the S3C7524/C7528/C7534/C7538 microcontroller. It has an on-chip EPROM instead of masked ROM. The EPROM is accessed by a serial data format.

The S3P7528/P7538 is fully compatible with the S3C7528/C7538, both in function and in pin configuration. Because of its simple programming requirements, the S3P7528/P7538 is ideal for use as an evaluation chip for the S3C7528/C7538.

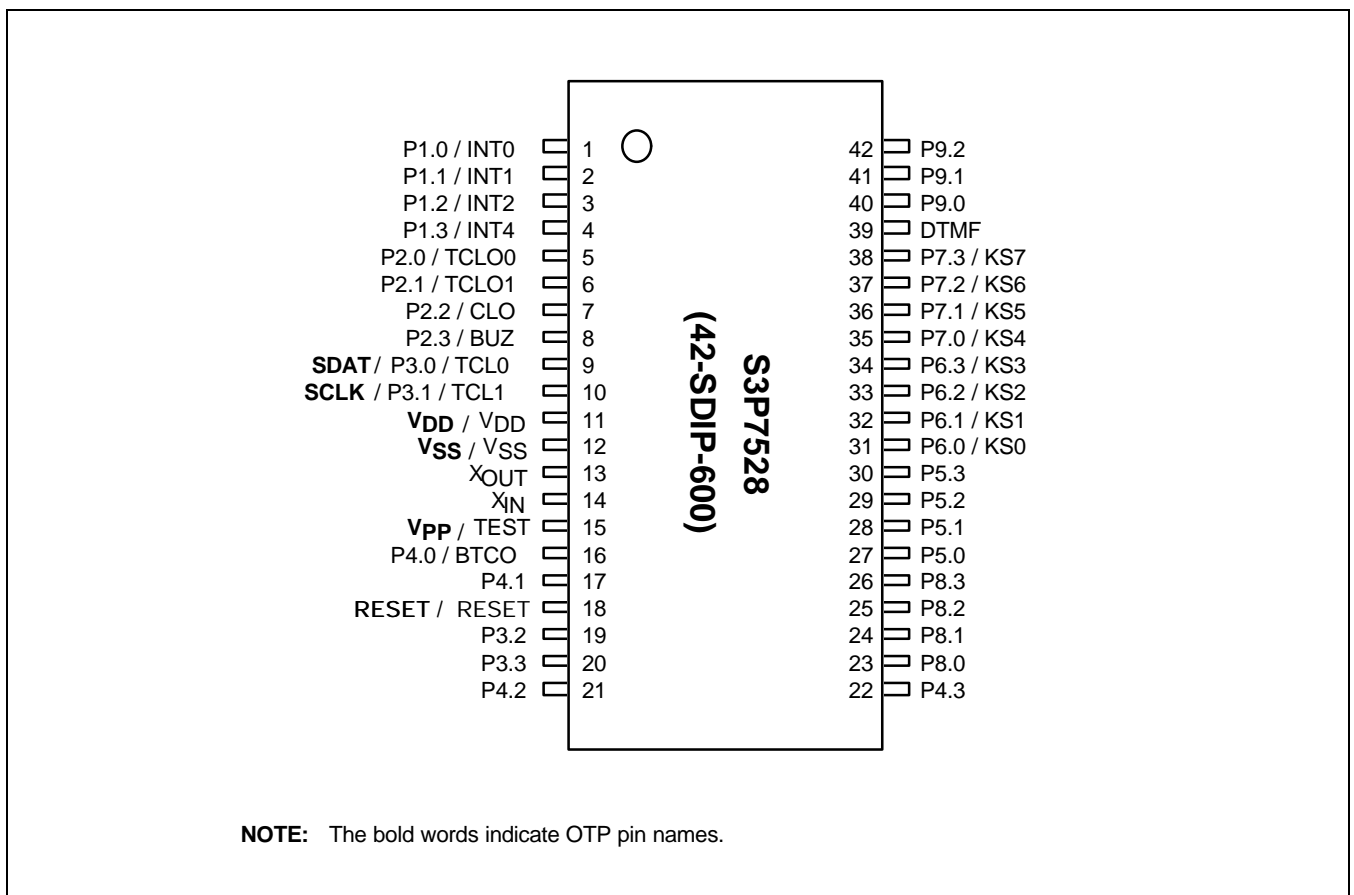


Figure 15-1. S3P7528 Pin Assignments (42-SDIP)

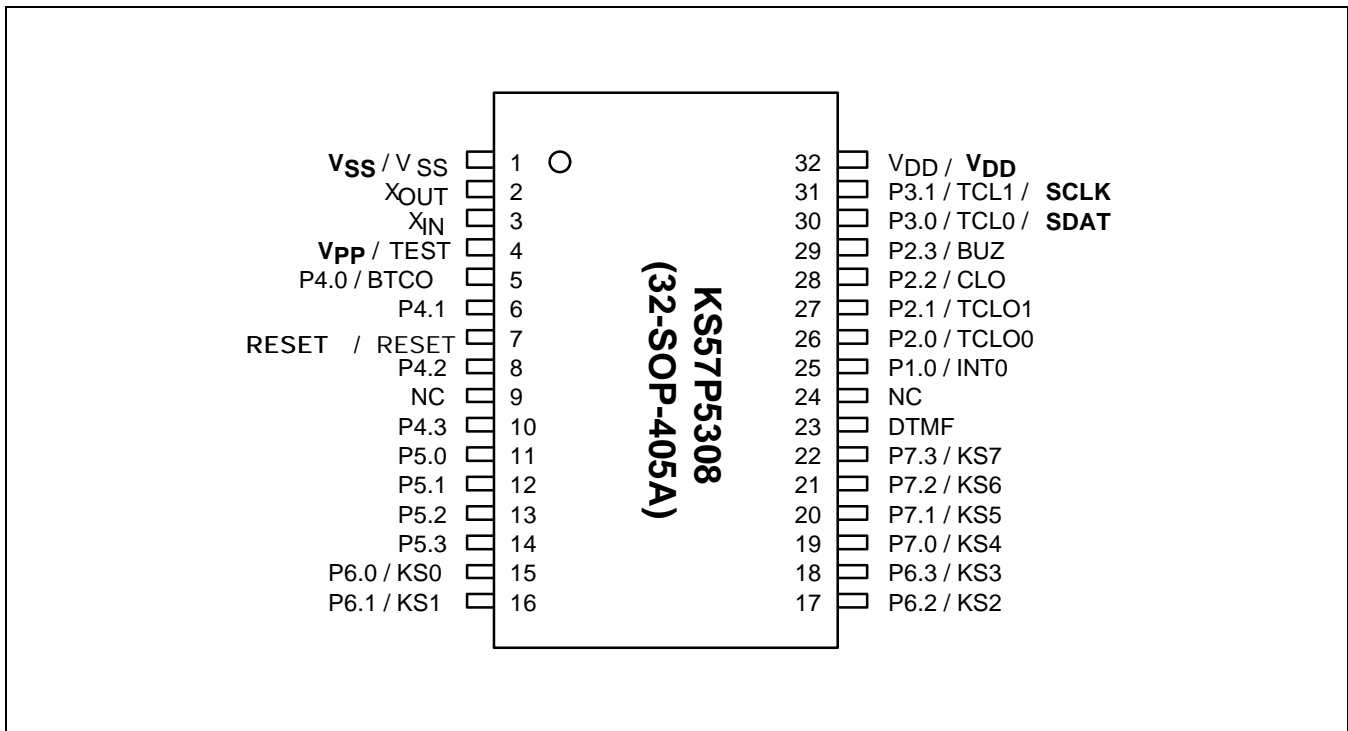


Figure 15-2. S3P7528 Pin Assignments (44-QFP)

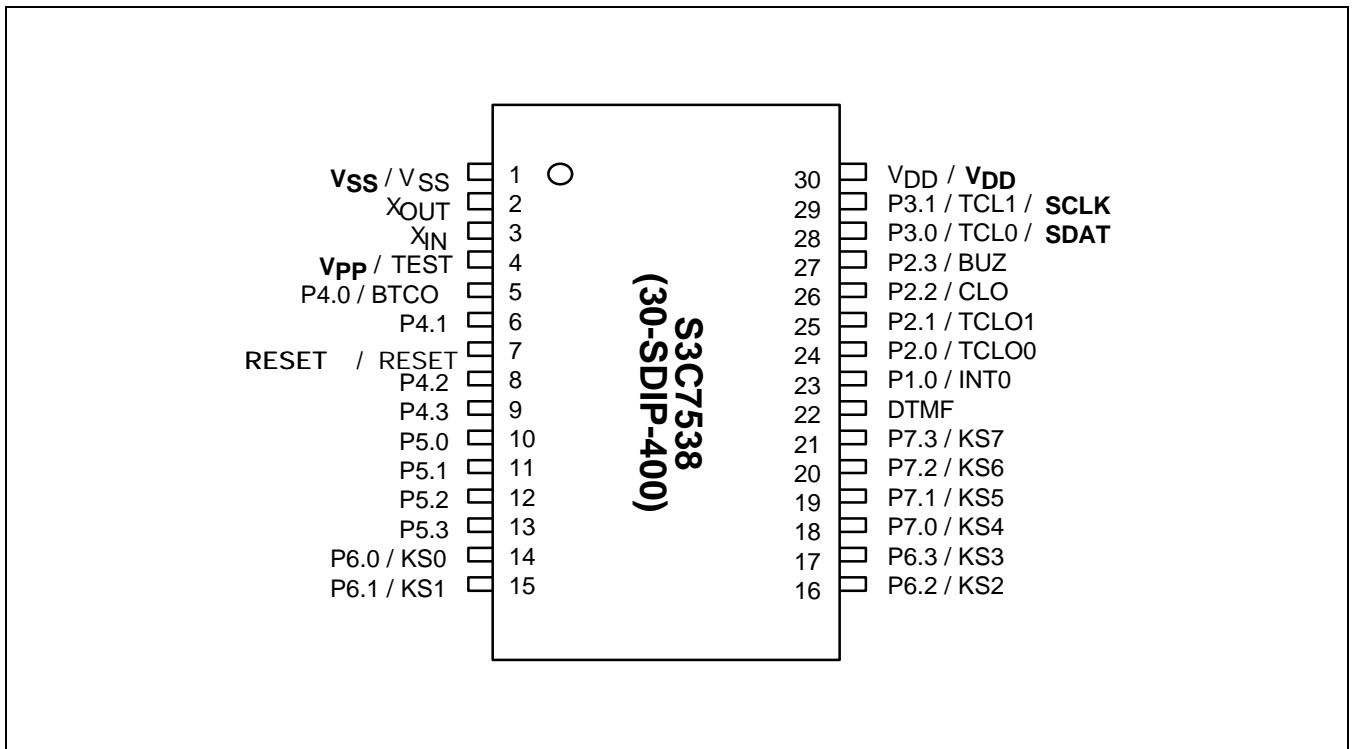


Figure 15-3. S3P7538 Pin Assignments (30-SDIP)

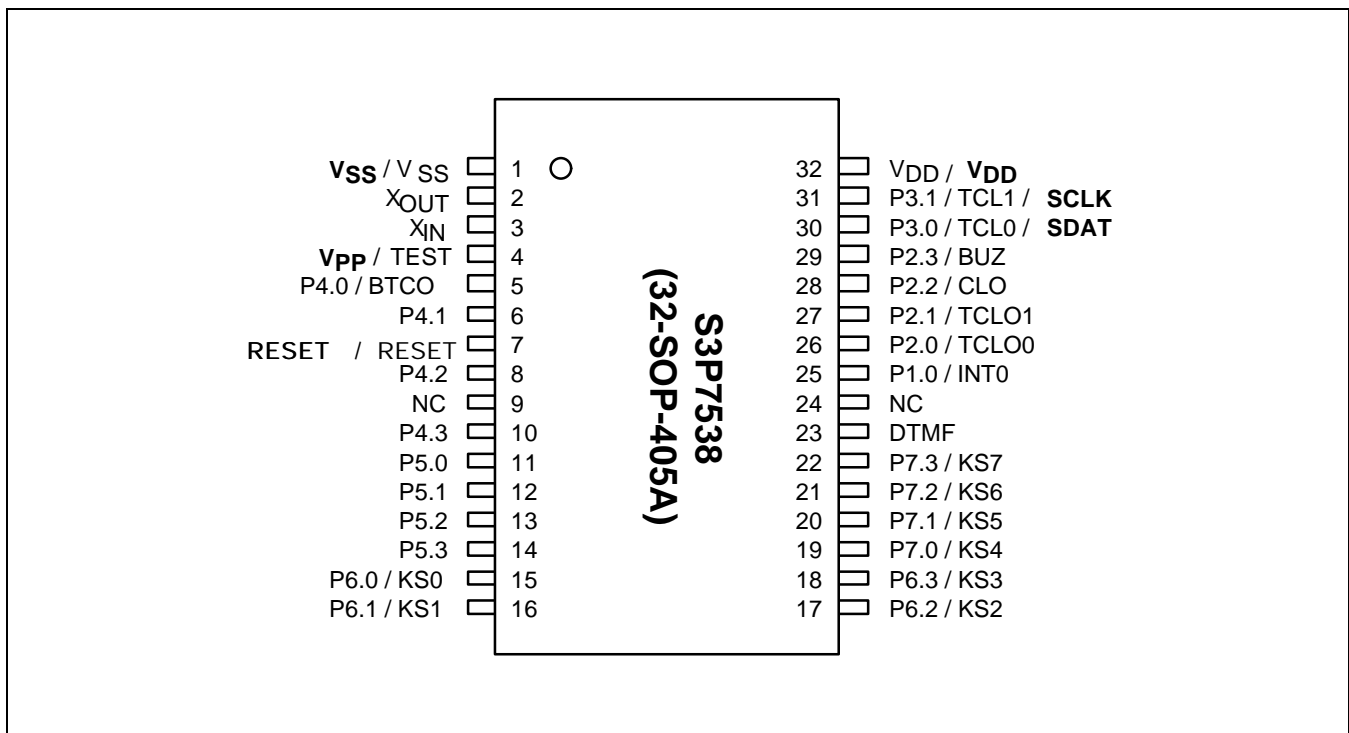


Figure 15-4. S3P7538 Pin Assignments (32-SOP)

Table 15-1. S3P7528 Pin Descriptions Used to Read/Write the EPROM

Main Chip	During Programming			
Pin Name	Pin Name	Pin No.	I/O	Function
P3.0	SDAT	9 (3)	I/O	Serial data pin. Output port when reading and input port when writing. Can be assigned as a Input / push-pull output port.
P3.1	SCLK	10 (4)	I/O	Serial clock pin. Input only pin.
TEST	V <sub>PP</sub> (TEST)	15 (9)	I	Power supply pin for EPROM cell writing (indicates that OTP enters into the writing mode). When 12.5 V is applied, OTP is in writing mode and when 5 V is applied, OTP is in reading mode. (Option)
RESET	RESET	18 (12)	I	Chip initialization
V <sub>DD</sub> /V <sub>SS</sub>	V <sub>DD</sub> /V <sub>SS</sub>	11/12 (5/6)	I	Logic power supply pin. V <sub>DD</sub> should be tied to +5 V during programming.

**NOTE:** Parentheses indicate pin numbers of 44 QFP package.

Table 15-2. S3P7538 Pin Descriptions Used to Read/Write the EPROM

Main Chip	During Programming			
Pin Name	Pin Name	Pin No.	I/O	Function
P3.0	SDAT	28 (30)	I/O	Serial data pin. Output port when reading and input port when writing. Can be assigned as a Input / push-pull output port.
P3.1	SCLK	29 (31)	I/O	Serial clock pin. Input only pin.
TEST	V <sub>PP</sub> (TEST)	4 (4)	I	Power supply pin for EPROM cell writing (indicates that OTP enters into the writing mode). When 12.5 V is applied, OTP is in writing mode and when 5 V is applied, OTP is in reading mode. (Option)
RESET	RESET	7 (7)	I	Chip initialization
V <sub>DD</sub> /V <sub>SS</sub>	V <sub>DD</sub> /V <sub>SS</sub>	30/1 (32/1)	I	Logic power supply pin. V <sub>DD</sub> should be tied to +5 V during programming.

**NOTE:** Parentheses indicate pin numbers of 32 SDIP package.

Table 15-3. Comparison of S3P7528 and S3C7528 Features

Characteristic	S3P7528	S3C7528
Program Memory	8 K byte EPROM	8 K byte mask ROM
Operating Voltage ( $V_{DD}$ )	2.0 V to 5.5 V	2.0 V to 5.5 V
OTP Programming Mode	$V_{DD} = 5 V$ , $V_{PP} (TEST) = 12.5 V$	–
Pin Configuration	42 SDIP / 44 QFP	42 SDIP / 44 QFP
EPROM Programmability	User Program 1 time	Programmed at the factory

Table 15-4. Comparison of S3P7538 and S3C7538 Features

Characteristic	S3P7538	S3C7538
Program Memory	8 K byte EPROM	8 K byte mask ROM
Operating Voltage ( $V_{DD}$ )	2.0 V to 5.5 V	2.0 V to 5.5 V
OTP Programming Mode	$V_{DD} = 5 V$ , $V_{PP} (TEST) = 12.5 V$	–
Pin Configuration	30 SOP / 32 SOP	30 SOP / 32 SOP
EPROM Programmability	User Program 1 time	Programmed at the factory

## OPERATING MODE CHARACTERISTICS

When 12.5 V is supplied to the  $V_{PP}(TEST)$  pin of the S3P7528, the EPROM programming mode is entered. The operating mode (read, write, or read protection) is selected according to the input signals to the pins listed in Table 15-3 below.

Table 15-5. Operating Mode Selection Criteria

$V_{DD}$	$V_{pp} (TEST)$	REG/ MEM	Address (A15-A0)	R/W	Mode
5 V	5 V	0	0000H	1	EPROM read
	12.5V	0	0000H	0	EPROM program
	12.5V	0	0000H	1	EPROM verify
	12.5V	1	0E3FH	0	EPROM read protection

**NOTE:** "0" means Low level; "1" means High level.



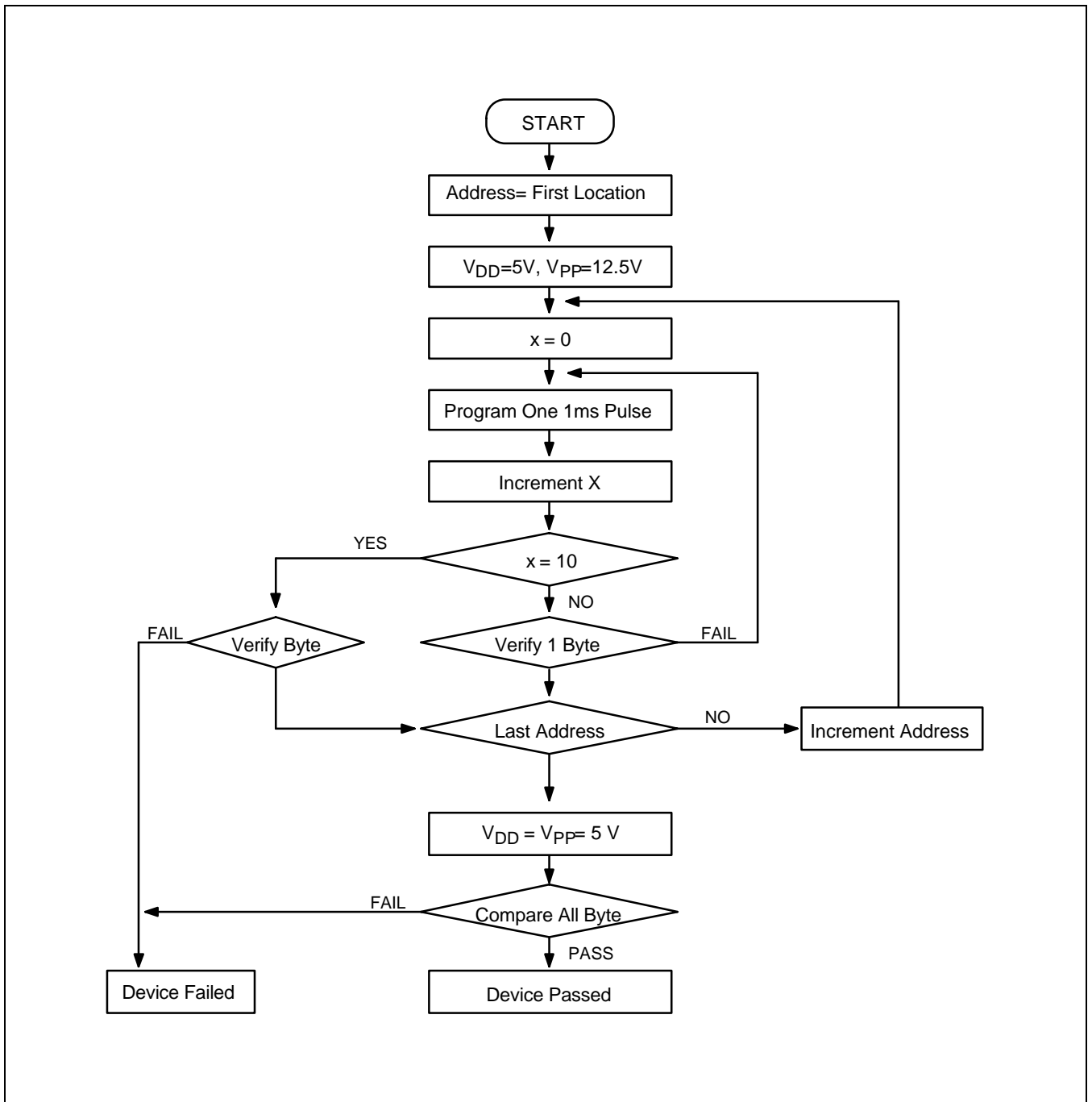


Figure 15-5. OTP Programming Algorithm

NOTES