EPSON

SMC62T3

4-bit Single Chip Microcomputer

Wide Voltage Operation Products

- Core CPU Architecture
- SVD Circuit
- DTMF/DP Generator
- High Quality Display LCD Driver

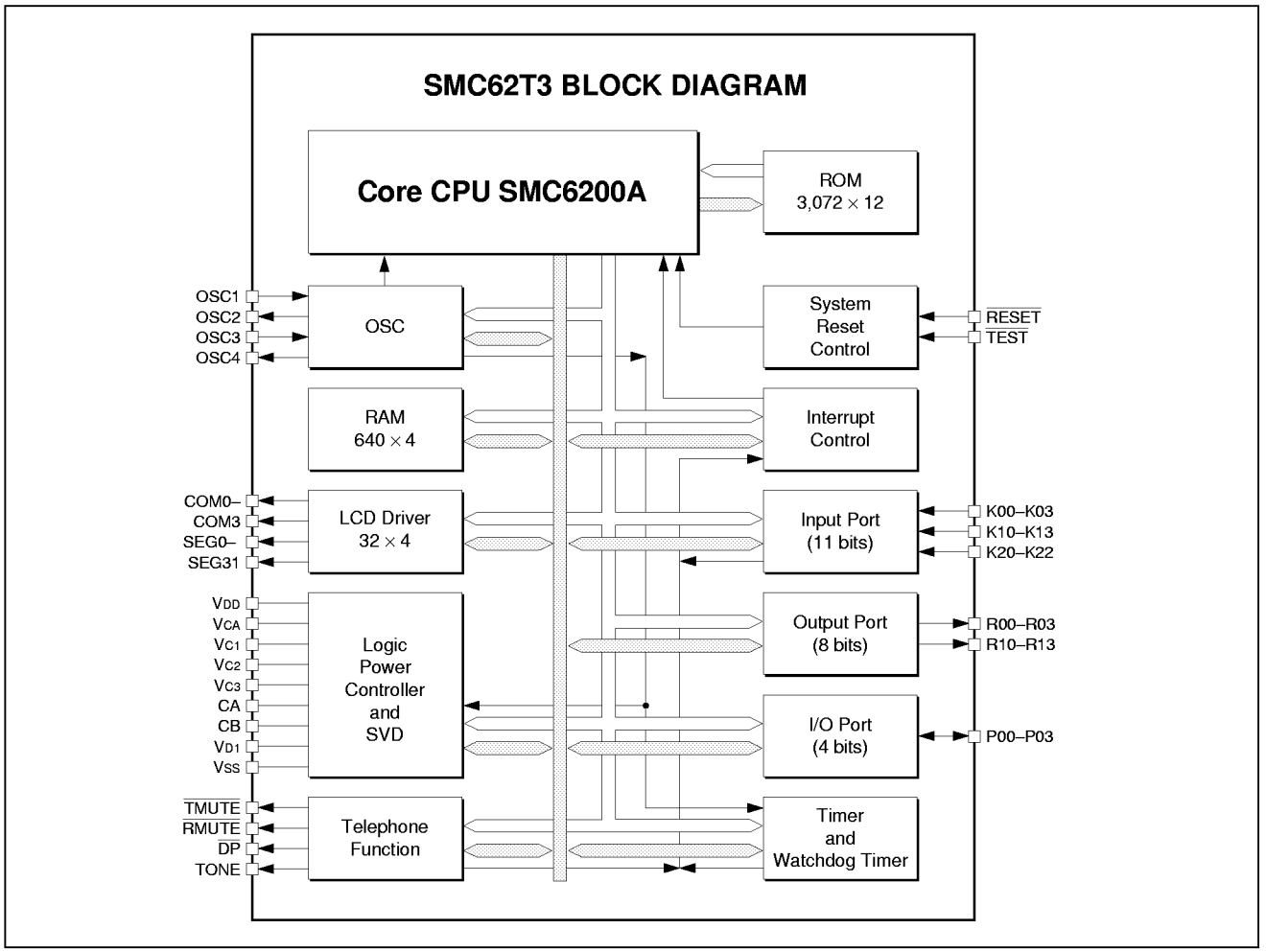
■ DESCRIPTION

The SMC62T3 is a single-chip microcomputer made up of the 4-bit core CPU SMC6200A, ROM, RAM, LCD driver, watchdog timer, time base counter, SVD circuit and DTMF/DP generator. The SMC62T3 can be applied to telephone set which has feature as DTMF/DP switchable, repertory dial, ON/OFF hook dial, etc.

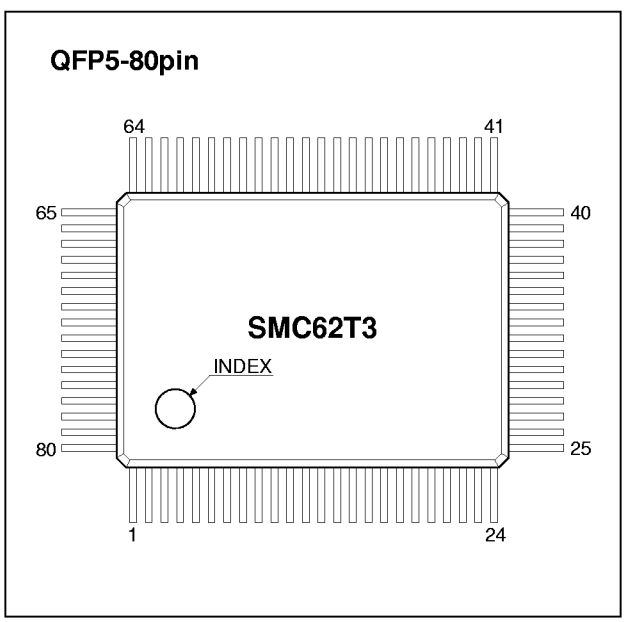
■ FEATURES

- CMOS LSI 4-bit parallel processing
- Twin clock ..... OSC1: Crystal oscillation circuit 32.768kHz (Typ.)
  OSC3: Crystal or ceramic oscillation circuit
  (selected by mask option) 3.579545MHz (Typ.)
- Instruction set ..... 108 instructions
- Instruction execution time ..... During operation at 32kHz: 153µsec, 214µsec, 366µsec
  (depending on instruction) During operation at 3.58MHz: 11.1µsec, 15.6µsec, 26.7µsec
- ROM capacity ..... 3,072 words × 12 bits
- RAM capacity ..... 640 words × 4 bits
- Input port ..... 11 bits (pull-up resistors are available by mask option)
- Output port ..... 8 bits (buzzer, hold-line and handfree output are available by software control)
- I/O port ..... 4 bits (pull-up resistors are available by software control)
- LCD driver ..... 32 segments × 4, 3, 2 or 1 commons (can be selected by software)
  Voltage regulator and booster circuits built-in
  (compatible with 3–4.5V LCD, VR adjustable)
- Built-in DTMF generator
- Built-in DP generator
- Built-in time base counter
- Built-in watchdog timer
- Supply voltage detection (SVD) circuit .. 1.8V
- Built-in stopwatch timer
- Interrupts ..... External : Input port interrupt 4 systems
  Internal : Timer interrupt 1 system
  Dialing interrupt 1 system
- Supply voltage ..... 1.6V to 5.5V (32kHz)
  2.5V to 5.5V (OSC3 = ON, DTMF)
- Current consumption (Typ.) ..... HALT mode (32kHz/3.0V) : 2.0µA
  OPERATING mode (32kHz/3.0V) : 5.0µA
  OPERATING mode (3.58MHz/3.0V) : 200µA
  DTMF operating (3.58MHz/3.0V) : 1.3mA
- Package ..... QFP5-80pin / QFP14-80pin (plastic)
  Die form

■ BLOCK DIAGRAM



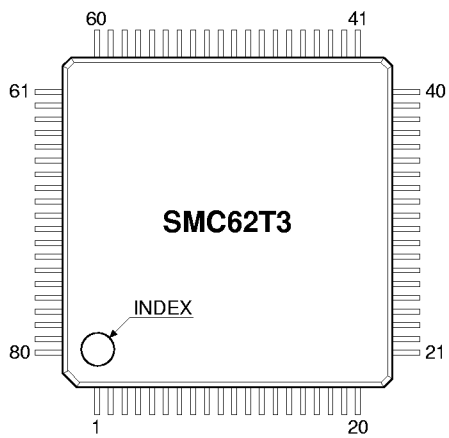
■ PIN CONFIGURATION



Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	SEG14	21	P02	41	R12	61	V_{C3}
2	SEG15	22	P03	42	R13	62	V_{C2}
3	SEG16	23	$\overline{TEST}$	43	$\overline{RESET}$	63	COM0
4	SEG17	24	K00	44	V_{DD}	64	COM1
5	SEG18	25	K01	45	$\overline{RMUTE}$	65	COM2
6	SEG19	26	K02	46	$\overline{TMUTE}$	66	COM3
7	SEG20	27	K03	47	$\overline{DP}$	67	SEG0
8	SEG21	28	K10	48	V_{SS}	68	SEG1
9	SEG22	29	K11	49	OSC1	69	SEG2
10	SEG23	30	K12	50	OSC2	70	SEG3
11	SEG24	31	K13	51	OSC3	71	SEG4
12	SEG25	32	K20	52	OSC4	72	SEG5
13	SEG26	33	K21	53	V_{D1}	73	SEG6
14	SEG27	34	K22	54	TONE	74	SEG7
15	SEG28	35	R00	55	N.C.	75	SEG8
16	SEG29	36	R01	56	N.C.	76	SEG9
17	SEG30	37	R02	57	CA	77	SEG10
18	SEG31	38	R03	58	CB	78	SEG11
19	P00	39	R10	59	V_{C1}	79	SEG12
20	P01	40	R11	60	V_{CA}	80	SEG13

N.C. : No Connection

QFP14-80pin



Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	N.C.	21	COM0	41	SEG16	61	$\overline{TEST}$
2	$\overline{RESET}$	22	COM1	42	SEG17	62	K00
3	V_{DD}	23	COM2	43	SEG18	63	K01
4	$\overline{RMUTE}$	24	COM3	44	SEG19	64	K02
5	$\overline{TMUTE}$	25	SEG0	45	SEG20	65	K03
6	$\overline{DP}$	26	SEG1	46	SEG21	66	K10
7	V_{SS}	27	SEG2	47	SEG22	67	K11
8	OSC1	28	SEG3	48	SEG23	68	K12
9	OSC2	29	SEG4	49	SEG24	69	K13
10	OSC3	30	SEG5	50	SEG25	70	K20
11	OSC4	31	SEG6	51	SEG26	71	K21
12	V_{D1}	32	SEG7	52	SEG27	72	K22
13	TONE	33	SEG8	53	SEG28	73	R00
14	N.C.	34	SEG9	54	SEG29	74	R01
15	CA	35	SEG10	55	SEG30	75	R02
16	CB	36	SEG11	56	SEG31	76	R03
17	V_{C1}	37	SEG12	57	P00	77	R10
18	V_{CA}	38	SEG13	58	P01	78	R11
19	V_{C3}	39	SEG14	59	P02	79	R12
20	V_{C2}	40	SEG15	60	P03	80	R13

N.C. : No Connection

■ PIN DESCRIPTION

Pin name	Pin No.		I/O	Function
	QFP5-80	QFP14-80		
V_{DD}	44	3		Power supply (+)
V_{SS}	48	7		Power supply (–)
V_{D1}	53	12	O	Internal logic system regulated voltage output terminal
V_{CA}	60	18	I	LCD system voltage adjustment terminal
V_{C1}	59	17	O	LCD system regulated voltage output terminal
V_{C2}	62	20	O	LCD system booster voltage output terminal ($V_{C1}\times2$)
V_{C3}	61	19	O	LCD system booster voltage output terminal ($V_{C1}\times3$)
CA, CB	57, 58	15, 16	–	LCD system voltage booster capacitor connecting terminals
OSC1	49	8	I	32.768kHz crystal oscillator input terminal
OSC2	50	9	O	32.768kHz crystal oscillator output terminal
OSC3	51	10	I	3.58MHz crystal or ceramic oscillator input terminal (selected by mask option)
OSC4	52	11	O	3.58MHz crystal or ceramic oscillator output terminal (selected by mask option)
K00–K03	24–27	62–65	I	Input terminals
K10–K13	28–31	66–69	I	Input terminals
K20–K22	32–34	70–72	I	Input terminals
P00–P03	19–22	57–60	I/O	I/O terminals (at input mode, pull-up resistors are selected by software)
R00–R03	35–38	73–76	O	Output terminals
R10–R13	39–42	77–80	O	Output terminals (buzzer, hold-line and handfree are selected by software)
SEG0–SEG31	67–18	25–56	O	LCD segment output terminals (DC output is selected by mask option)
COM0–COM3	63–66	21–24	O	LCD common output terminals (1/4, 1/3, 1/2, 1/1 duty programmable)
$\overline{RESET}$	43	2	I	Initial setting input terminal
$\overline{TEST}$	23	61	I	Test input terminal
$\overline{RMUTE}$	45	4	O	Receiver mute output terminal
$\overline{TMUTE}$	46	5	O	Transmitter mute output terminal
$\overline{DP}$	47	6	O	Dialing pulse output terminal
TONE	54	13	O	DTMF output terminal

■ ELECTRICAL CHARACTERISTICS

● Absolute Maximum Ratings

(V_{SS}=0V)

Rating	Symbol	Value	Unit
Supply voltage	V_{DD}	-0.5 to 7.0	V
Input voltage (1)	V_I	-0.5 to V_{DD} + 0.3	V
Input voltage (2)	V_{IOSC}	-0.5 to V_{D1} + 0.3	V
Permissible total output current *1	ΣI_{VDD}	10	mA
Operating temperature	Topr	-20 to 70	°C
Storage temperature	Tstg	-65 to 150	°C
Soldering temperature / Time	Tsol	260°C, 10sec (lead section)	–
Permissible dissipation *2	P_D	250	mW

*1: The permissible total output current is the sum total of the current (average current) that simultaneously flows from the output pins (or is draw in).
*2: In case of plastic package (QFP5-80pin, QFP14-80pin).

● Recommended Operating Conditions

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Supply voltage	V_{DD}	V_{SS}=0V, OSC1=32kHz, OSC3=stop	1.6	3.0	5.5	V
		V_{SS}=0V, when DTMF is used	2.5		5.5	V
Oscillation frequency (1)	f_{OSC1}			32.768		kHz
Oscillation frequency (2)	f_{OSC3}			3.579545		kHz

● DC Characteristics

(Unless otherwise specified: V_{SS}=0V, V_{DD}=3.0V, f_{OSC1}=32.768kHz, Ta=25°C, V_{D1}/V_{C1}–V_{C3} are internal voltage, C_1–C_5=0.1µF)

Characteristic	Symbol	Condition		Min.	Typ.	Max.	Unit
High level input voltage (1)	V_{IH1}		K00–K03, K10–K13, K20–K22 P00–P03	0.8·V_{DD}		V_{DD}	V
High level input voltage (2)	V_{IH2}		$\overline{RESET}$, $\overline{TEST}$	0.9·V_{DD}		V_{DD}	V
Low level input voltage (1)	V_{IL1}		K00–K03, K10–K13, K20–K22 P00–P03	0		0.2·V_{DD}	V
Low level input voltage (2)	V_{IL2}		$\overline{RESET}$, $\overline{TEST}$	0		0.1·V_{DD}	V
High level input current (1)	I_{IH1}	V_{IH1}=3.0V No pull-up resistor	K00–K03, K10–K13, K20–K22 P00–P03	0		0.5	µA
High level input current (2)	I_{IH2}	V_{IH2}=3.0V With pull-up resistor	K00–K03, K10–K13, K20–K22 P00–P03, $\overline{RESET}$, $\overline{TEST}$			0.5	µA
Low level input current (1)	I_{IL1}	V_{IL1}=V_{SS} No pull-up resistor	K00–K03, K10–K13, K20–K22 P00–P03, $\overline{RESET}$, $\overline{TEST}$	-0.5		0	µA
Low level input current (2)	I_{IL2}	V_{IL1}=V_{SS} With pull-up resistor	K00–K03, K10–K13, K20–K22 P00–P03, $\overline{RESET}$, $\overline{TEST}$	-20	-10	-5	µA
High level output current (1)	I_{OH1}	V_{OH1}=0.9·V_{DD}	R00–R03, R10–R13, P00–P03			-1	mA
High level output current (2)	I_{OH2}	V_{OH2}=0.9·V_{DD}	DP, $\overline{TMUTE}$, $\overline{RMUTE}$			-1	mA
Low level output current (1)	I_{OL1}	V_{OL1}=0.1·V_{DD}	R00–R03, R10–R13, P00–P03	3			mA
Low level output current (2)	I_{OL2}	V_{OL2}=0.1·V_{DD}	DP, $\overline{TMUTE}$, $\overline{RMUTE}$	3			mA
Common output current	I_{OH3}	V_{OH3}=V_{C3}-0.05V	COM0–COM3			-3	µA
	I_{OL3}	V_{OL3}=V_{SS}+0.05V		3			µA
Segment output current (during LCD output)	I_{OH4}	V_{OH4}=V_{C3}-0.05V	SEF0–SEG31			-3	µA
	I_{OL4}	V_{OL4}=V_{SS}+0.05V		3			µA
Segment output current (during DC output)	I_{OH5}	V_{OH5}=0.9·V_{DD}	SEG0–SEG31			-300	µA
	I_{OL5}	V_{OL5}=0.1·V_{DD}		300			µA

● Analog Circuit Characteristics and Current Consumption

(Unless otherwise specified: V_{SS}=0V, V_{DD}=3.0V, f_{OSC1}=32.768kHz, f_{OSC3}=3.579545MHz/crystal, C_G=25pF, Ta=25°C, V_{D1}/V_{C1}–V_{C3} are internal voltage, C_1–C_5=0.1µF)

Characteristic	Symbol	Condition		Min.	Typ.	Max.	Unit
LCD drive voltage	V_{C1}	Connect 1MΩ load resistor between V_{SS} and V_{C1} V_{CA}=V_{C1}, (without panel load)		0.95	1.05	1.15	V
	V_{C2}	Connect 1MΩ load resistor between V_{SS} and V_{C2} (without panel load)		2·V_{C1}×0.9		2·V_{C1}+0.1	V
	V_{C3}	Connect 1MΩ load resistor between V_{SS} and V_{C3} (without panel load)		3·V_{C1}×0.9		3·V_{C1}+0.1	V
SVD voltage	V_{SVD}			1.65	1.8	1.95	V
SVD circuit response time	t_{SVD}					100	µS
Current consumption	I_{OP}	During HALT (32kHz)	Without panel load		2	5	µA
		During execution (32kHz) *1			5	12	µA
		During execution (3.58MHz) *1			200	500	µA
		During execution (3.58MHz) *2			1.3	4	mA

*1: The SVD and DTMF generator are OFF status.
*2: The DTMF generator is ON status. The SVD is OFF status.

● Oscillation Characteristics

The oscillation characteristics change depending on the conditions (components used, board pattern, etc.). Use the following characteristics as reference values.

OSC1 crystal oscillation circuit

(Unless otherwise specified: V_{SS}=0V, V_{DD}=3.0V, Crystal: C-002R, C_I=35kΩ, C_G=25pF, C_D=built-in, Ta=25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	Vsta	tsta≤3sec (V_{DD})	1.6			V
Oscillation stop voltage	Vstp	tstp≤10sec (V_{DD})	1.6			V
Built-in capacitance (drain)	C_D	Including the parasitic capacity inside the IC		18.5		pF
Frequency/voltage deviation	∂f/∂V	V_{DD}=2.0 to 5.5V			5	ppm
Frequency/IC deviation	∂f/∂IC		-10		10	ppm
Frequency adjustment range	∂f/∂C_G	C_G=5 to 25pF	35			ppm
Harmonic oscillation start voltage	V_{hho}	C_G=5pF (V_{DD})			5.5	V
Permitted leak resistance *	R_{leak}	Between OSC1 and V_{SS}	200			MΩ

*: The shielding plate for OSC1 and OSC2 should be connected to V_{SS}.

OSC3 crystal oscillation circuit

(Unless otherwise specified: V_{SS}=0V, V_{DD}=3.0V, Crystal: CA-301, C_G=5pF, C_D=built-in, Ta=25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	Vsta	tsta≤30msec (V_{DD})	1.6			V
Oscillation stop voltage	Vstp	tstp≤10sec (V_{DD})	1.6			V
Built-in capacitance (drain)	C_D	Including the parasitic capacity inside the IC		14		pF
Frequency/voltage deviation	∂f/∂V	V_{DD}=2.0 to 5.5V			5	ppm
Frequency/IC deviation	∂f/∂IC		-10		10	ppm
Frequency adjustment range	∂f/∂C_G	C_G=5 to 25pF		35		ppm
Harmonic oscillation start voltage	V_{hho}	C_G=5pF (V_{DD})			5.5	V
Permitted leak resistance	R_{leak}	Between OSC3 and V_{DD}, V_{SS}	200			MΩ

OSC3 ceramic oscillation circuit

(Unless otherwise specified: V_{SS}=0V, V_{DD}=3.0V, Ceramic oscillator: 3.579545MHz, C_{GC}=C_{DC}=30pF, R_F=1MΩ, Ta=25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	Vsta	(V_{DD})	2.0			V
Oscillation start time	tsta				3	mS
Oscillation stop voltage	Vstp	(V_{DD})	2.0			V

● Telephone Function Characteristics

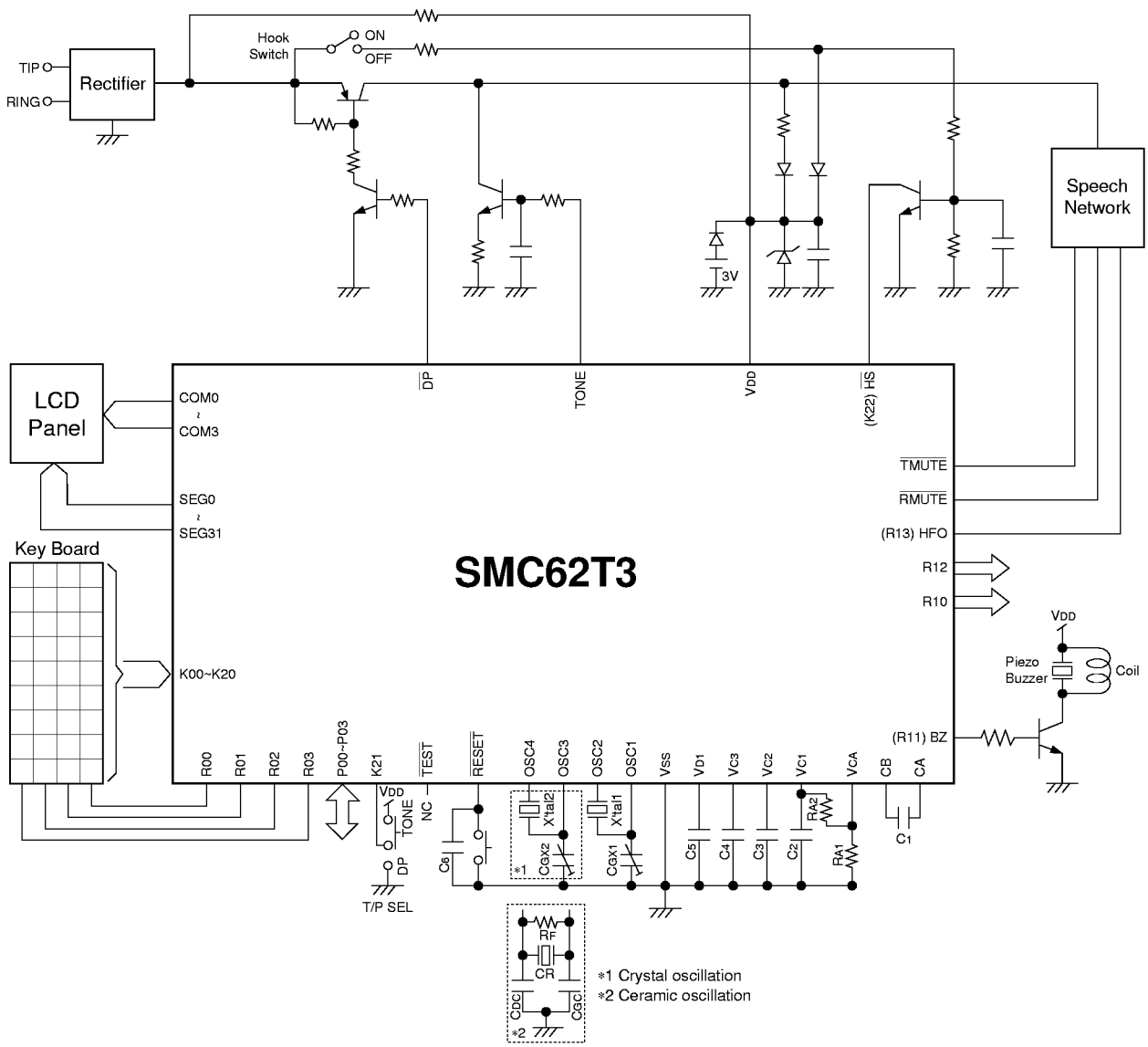
(Unless otherwise specified: V_{SS}=0V, V_{DD}=3.0V, f_{OSC1}=32.768kHz, f_{OSC3}=3.579545MHz, Ta=25°C, V_{D1}/V_{C1}–V_{C3} are internal voltage, C_1–C_5=0.1µF)

Characteristic	Symbol	Condition					Min.	Typ.	Max.	Unit
		FTS3	FTS2	FTS1	FTS0			–		
Flash time	t_{FL}	0	0	0	1			94		mS
		0	0	1	0			188		
		0	0	1	1			281		
		0	1	0	0			375		
		0	1	0	1			469		
		0	1	1	0			563		
		0	1	1	1			656		
		1	0	0	0			750		
		1	0	0	1			844		
		1	0	1	0			938		
		1	0	1	1			1031		
		1	1	0	0			1125		
		1	1	0	1			1219		
		1	1	1	0			1313		
		1	1	1	1			1406		
Flash pause time	t_{FLP}							938		mS

(Unless otherwise specified: V_{SS}=0V, V_{DD}=3.0V, f_{OSC1}=32.768kHz, f_{OSC3}=3.579545MHz, Ta=25°C, V_{D1}/V_{C1}–V_{C3} are internal voltage, C_1–C_5=0.1µF)

Characteristic	Symbol	Condition					Min.	Typ.	Max.	Unit
Pause time	t_{PS}		PTS3	PTS2	PTS1	PTS0		–		
			0	0	0	1		1		
			0	0	1	0		2		
			0	0	1	1		3		
			0	1	0	0		4		
			0	1	0	1		5		
			0	1	1	0		6		
			0	1	1	1		7		sec
			1	0	0	0		8		
			1	0	0	1		9		
			1	0	1	0		10		
			1	0	1	1		11		
			1	1	0	0		12		
			1	1	0	1		13		
			1	1	1	0		14		
			1	1	1	1		15		
Mute hold time	t_{MH}						–	4	–	mS
Inter-digit pause time	t_{IDP}		IDP3	IDP2	IDP1	IDP0		–		
			0	0	0	1		94		
			0	0	1	0		188		
			0	0	1	1		281		
			0	1	0	0		375		
			0	1	0	1		469		
			0	1	1	0		563		
			0	1	1	1		656		mS
			1	0	0	0		750		
			1	0	0	1		844		
			1	0	1	0		938		
			1	0	1	1		1031		
			1	1	0	0		1125		
			1	1	0	1		1219		
			1	1	1	0		1313		
			1	1	1	1		1406		
Make/Break ratio	M/B	Software–selected					–	1/2 2/3	–	–
Dialing pulse rate	DR	Software–selected					–	10 20	–	pps
Make time	t_M	10pps, M/B=1/2					–	33.2	–	mS
		20pps, M/B=1/2					–	16.6	–	
		10pps, M/B=2/3					–	39.1	–	
		20pps, M/B=2/3					–	19.5	–	
Break time	t_B	10pps, M/B=1/2					–	66.4	–	mS
		20pps, M/B=1/2					–	33.2	–	
		10pps, M/B=2/3					–	58.6	–	
		20pps, M/B=2/3					–	29.3	–	
Tone output DC level	V_{TDC}						–	0.5(V_{DD}-V_{SS})	–	V
Single Row tone output amplitude	V_R	V_{DD}=3V, R_L=10kΩ					–	92	–	mVrms
		V_{DD}=5.5V, R_L=10kΩ					–	168	–	mVrms
Single Column tone output amplitude	V_C	V_{DD}=3V, R_L=10kΩ					–	122	–	mVrms
		V_{DD}=5.5V, R_L=10kΩ					–	224	–	mVrms
Tone output voltage ratio	dB_{CR}	V_{DD}=3V, R_L=10kΩ					–	2.5	–	dB
		V_{DD}=5.5V, R_L=10kΩ					–	2.5	–	dB
Tone load impedance	R_{TL}	V_{DD}=2–5.5V					7	–	–	kΩ
Total harmonic distortion	THD	V_{DD}=2–5.5V, R_L=10kΩ					–	–	6	%
Tone output frequency	f_{ROW1}						–	701.32	–	Hz
	f_{ROW2}						–	771.45	–	
	f_{ROW3}						–	857.17	–	
	f_{ROW4}						–	935.10	–	
	f_{COL1}						–	1215.88	–	
	f_{COL2}						–	1331.68	–	
	f_{COL3}						–	1471.85	–	
	f_{COL4}						–	1645.01	–	
Tone duration time	t_{TD}						94	–	–	mS
Tone inter-digit pause	t_{TIP}						–	94	–	mS
Maximum dial rate	t_T	t_{TD} + t_{TIP}					188	–	–	mS

■ BASIC EXTERNAL CONNECTION DIAGRAM

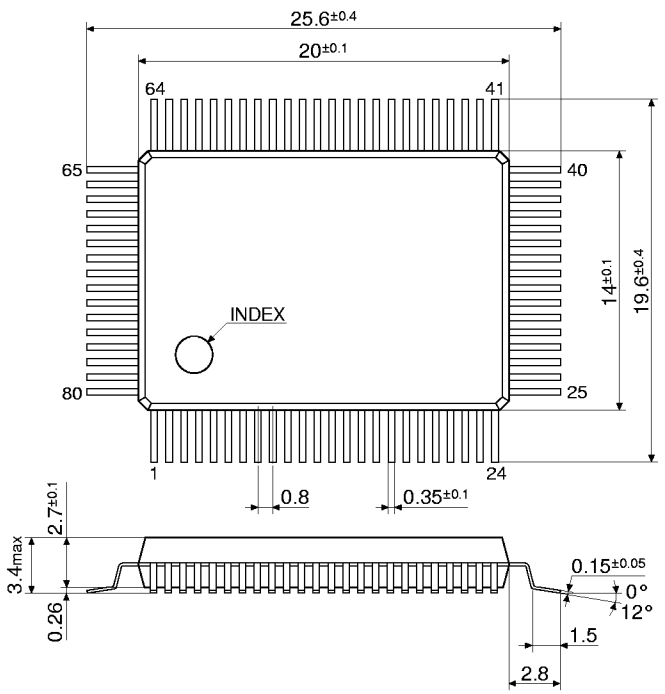


X'tal1	Crystal oscillator	32.768kHz CI (MAX)=35kΩ
C_{GX1}	Trimmer capacitor	5–25pF
X'tal2	Crystal oscillator	3.579545MHz
C_{GX2}	Trimmer capacitor	5–25pF
CR	Ceramic oscillator	3.579545MHz
R_F	Feedback resistor	1MΩ
C_{GC}	Gate capacitor	30pF
C_{DC}	Drain capacitor	30pF
R_{A1}	Resistance for LCD drive voltage adjustment	2MΩ (V_{C1}=1.5V)
R_{A2}	Resistance for LCD drive voltage adjustment	1MΩ (V_{C1}=1.5V)
C_1–C_6	Capacitor	0.1μF

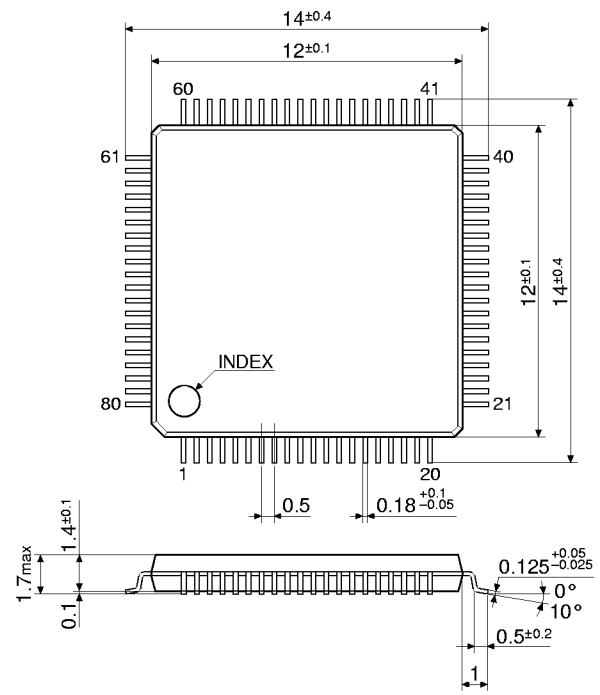
Note: The above table is simply an example, and is not guaranteed to work.

■ PACKAGE DIMENSIONS

Plastic QFP5-80pin



Plastic QFP14-80pin



Unit: mm

SEIKO EPSON CORPORATION
ELECTRONIC DEVICE MARKETING DEPARTMENT

IC Marketing & Engineering Group
421-8, Hino, Hino-shi, Tokyo 191, JAPAN
Phone : 0425-87-5816 FAX : 0425-87-5624

International Marketing Department I (Europe & U.S.A.)
421-8, Hino, Hino-shi, Tokyo 191, JAPAN
Phone : 0425-87-5812 FAX : 0425-87-5564

International Marketing Department II (Asia)
421-8, Hino, Hino-shi, Tokyo 191, JAPAN
Phone : 0425-87-5814 FAX : 0425-87-5110

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