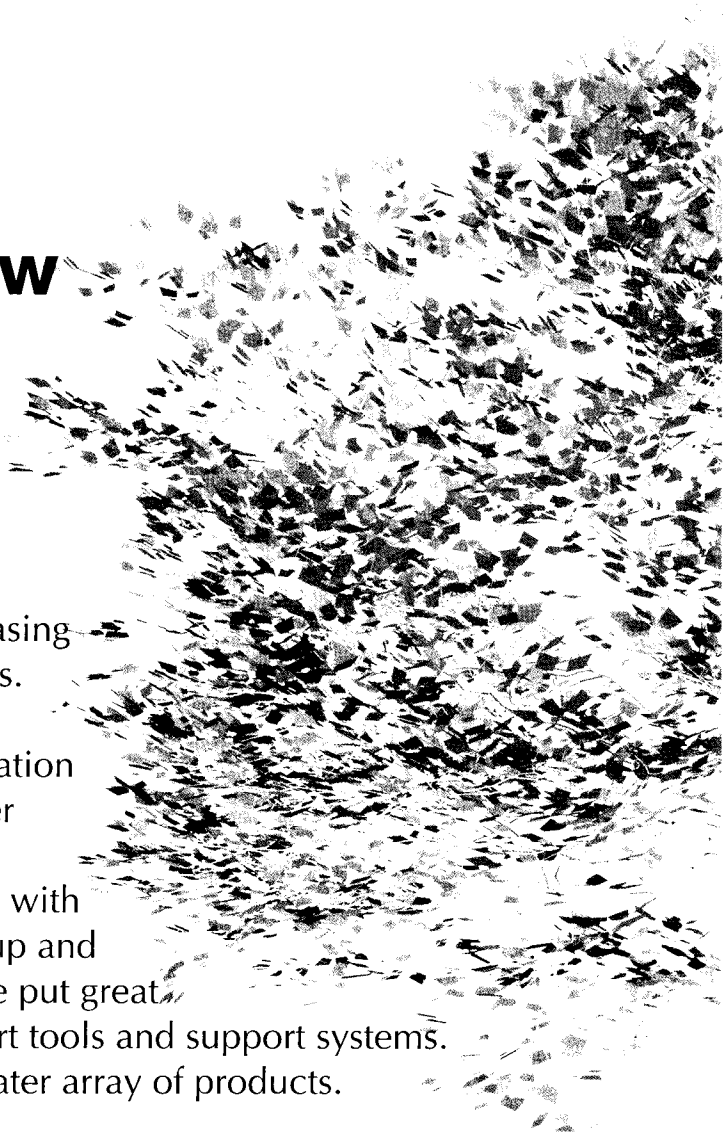
SHARP

Single-chip Microcomputers

MAR. 1996

rp's Complete Lineup Helps You to velop Products to Meet the Needs of he Times!

Sharp's Integrated Approach to Tomorrow



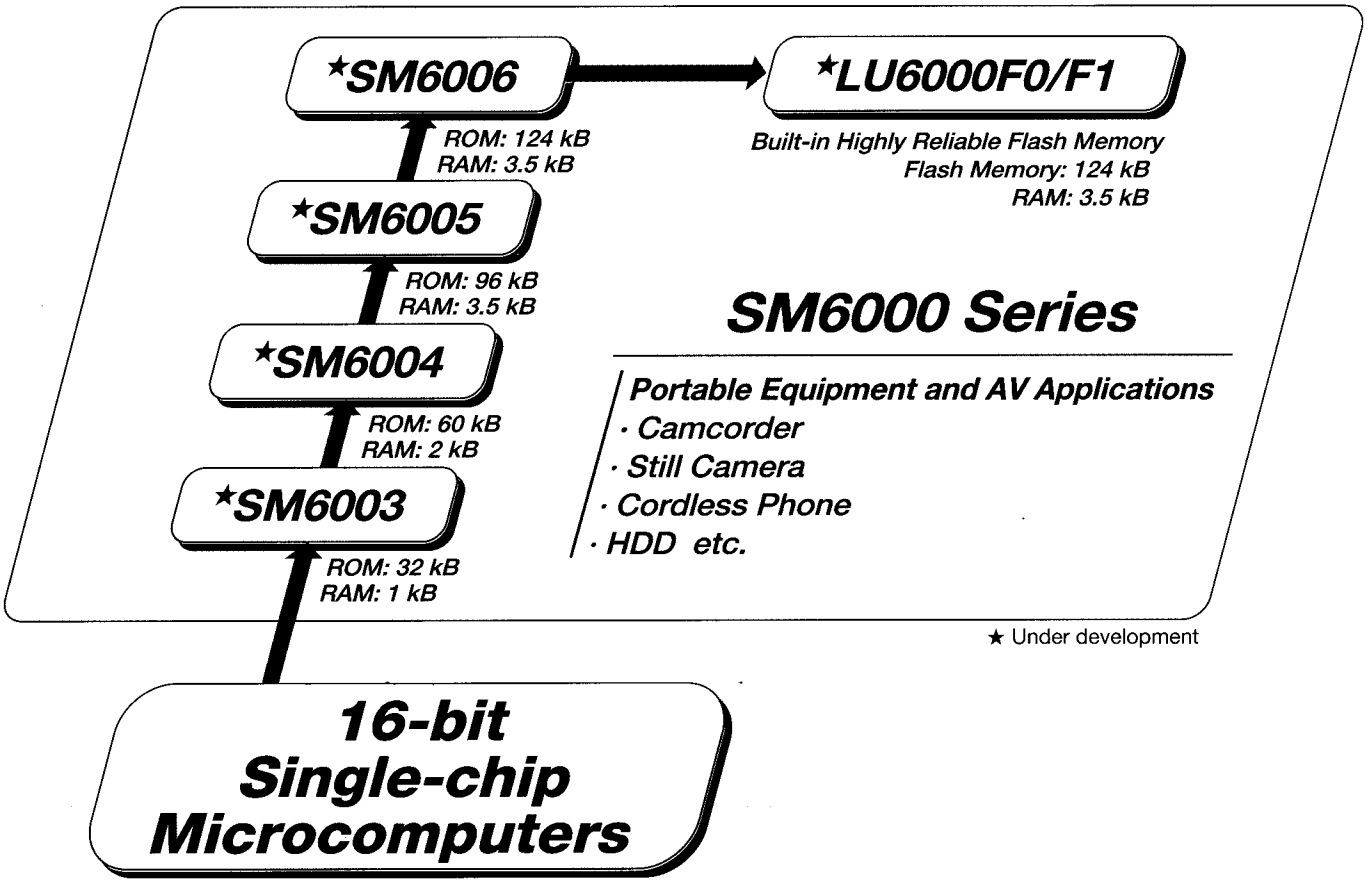
Sharp Creates Advanced Technology for a Better Life

Microcomputers along with electronics are continuing to develop at a high pace while increasing their applications to an unlimited number of fields. Microcomputers have become an indispensable part of our lives and business by enabling the creation of lighter and more compact products with greater functions and improved reliability and safety. Sharp developed high-speed, low-voltage models with greater functions to enhance a wide-ranging lineup and meet the needs of the times. In addition, we have put great efforts into strengthening our development support tools and support systems. Sharp will continue to endeavor to develop a greater array of products.

INDEX

16-bit Single-chip Microcomputers

The SM 6000 Series are 16-bit single-chip microcomputers used as general purpose controllers. Since they are low powered and have a fast speed (10MHz at 2.5V operation), they are optimal for controlling such devices as AV, information and communication equipment.



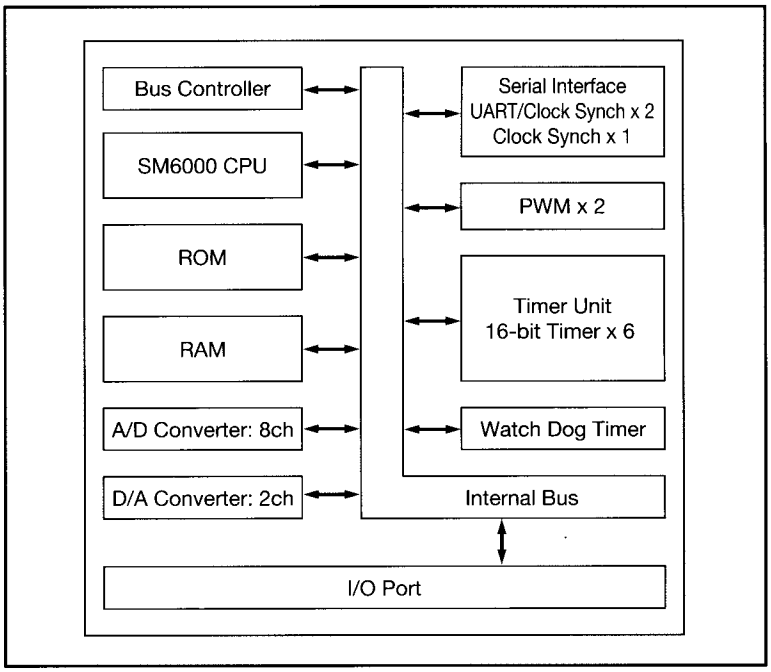
■ Main Features

- Low voltage (2.5V) and high speed (10MHz at 2.5V)
- High-speed Multiplication/Division Instruction applicable to data processing (16-bit x 16-bit: 1µs, 32-bit ÷ 16-bit: 3.9µs)
- Multi-functional Timer Unit suitable for various applications
- Built-In A/D, D/A and real time output suitable for motor control
- Bus Controller allows access to external memory

Applications

Camcorders, portable communication terminals, cellular telephones, PHS, Mini Disc recorders/players, printers, copiers, facsimiles, CD-ROMs, HDDs

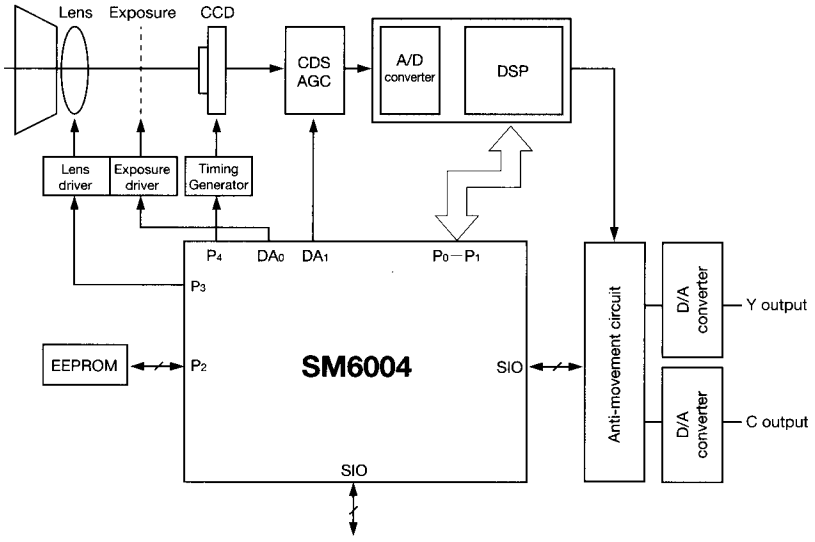
■ Block Diagram



Low-power/High-speed Controller for General Purpose

System Configuration Example

Digital Color Camcorder



■ Specifications

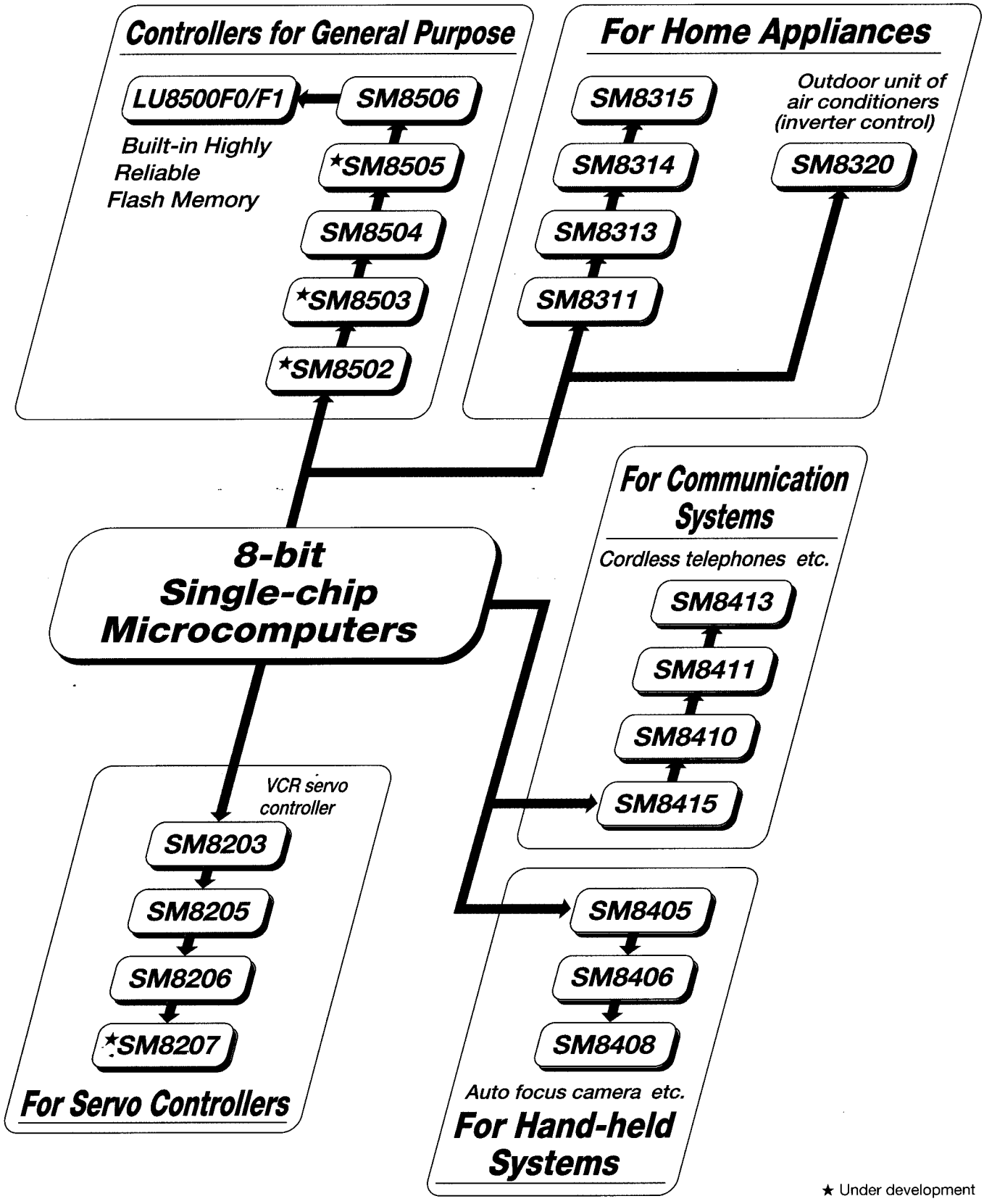
		★SM6003	★SM6004	★SM6005	★SM6006	★LU6000F0/F1
ROM (× 8-bit)		32 k	60 k	92 k	124 k	124 k*1
RAM (× 8-bit)		1 k	2 k	2 k	3.5 k	3.5 k
I/O Port	I	8				8
	I/O	80				80
Serial Interface	UART/Clock Sync.	2				2
	Clock Sync.	1				1
A/D Converters (10-bit)		8 ch				8 ch
D/A Converters (8-bit)		2 ch				2 ch
16-bit Timer		6				6
Input Capture Function		○				○
Output Compare Function		○				○
8-bit Watch Dog Timer		1				1
PWM Output		14-bit x 2 (14-,12-, 10-, 8-bit selectable)				14-bit × 2
Real Time Output (4-bit)		2				2
Bus Controller		External bus access capability Multi/nonmulti-address and data selectable Selectable bus width, 8 and 16 bits Auto-wait				○
Interrupt	Internal	22				22
	External	4				4
Instruction Cycle (μs)		0.133 (5V)				0.133 (5V)
Supply Voltage (V)		2.5 to 5.5 (main-clock 20MHz) 4.5 to 5.5 (main-clock 30MHz)				2.7 to 3.6 (20MHz) 4.5 to 5.5 (30MHz)
Supply Current [TYP.] (mA)		65 (5V, 30MHz)				65 (5V, 30MHz)
Standby Mode		HALT / STOP				HALT / STOP
Operating Temp. Range (°C)		–20 to 70				–20 to 70
Package		100 QFP 100 LQFP*1				100 QFP/ 100 LQFP*2
Remarks						Built-in Flash Memory

*1 Internal Flash Memory capacity
*2 0.5mm fine pin-pitch

★ Under development

8-bit Single-chip Microcomputers

We developed three types of 8-bit single-chip microcomputer CPU cores : the SM82(high-speed type), SM83(standard type) and SM84(low-power consumption type). Each promotes the development of ASSPs, letting you select the optimum product to meet your needs.



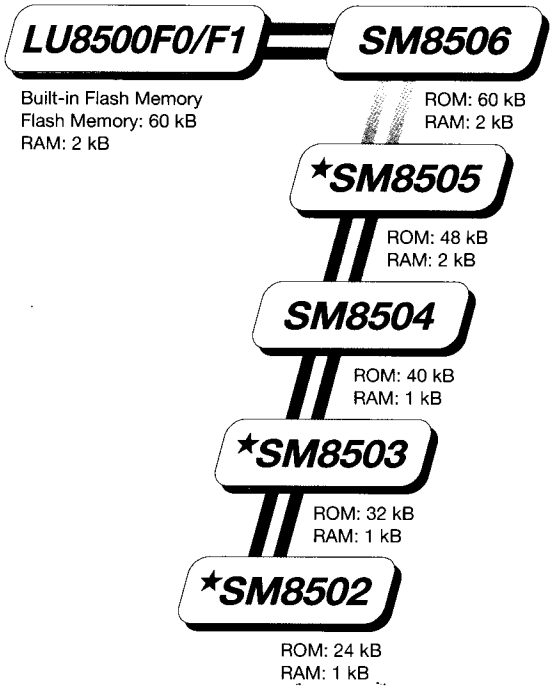
★ Under development

Selection Guide

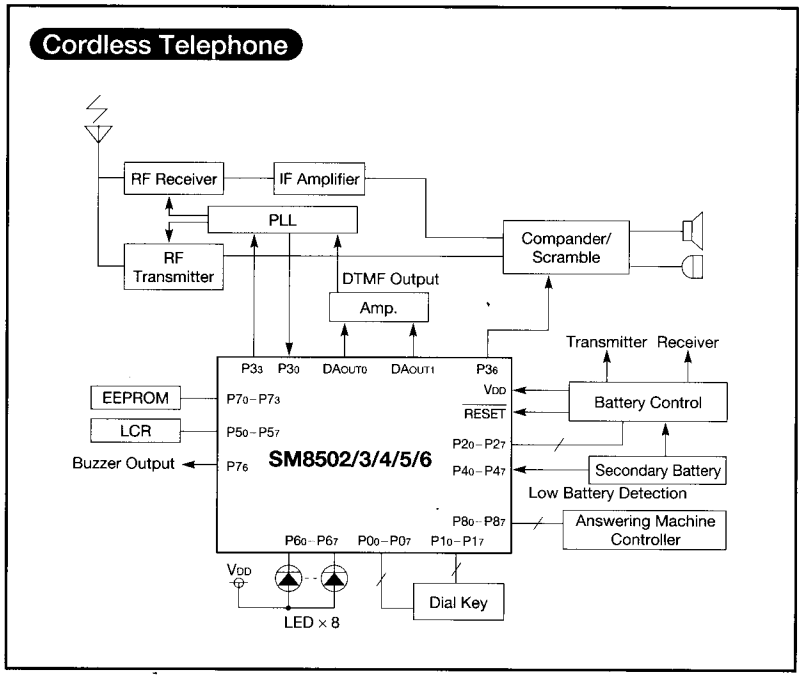
Applications	Controllers for General Purpose						Home Appliances					Communication Systems				Hand-held Systems			Servo Controllers			
	★SM8502	★SM8503	SM8504	★SM8505	SM8506	LU6500F0/F1	SM8311	SM8313	SM8314	SM8315	SM8320	SM8415	SM8410	SM8411	SM8413	SM8405	SM8406	SM8408	SM8203	SM8205	SM8206	★SM8207
LCD Direct Drive																●	●	●				
LED Direct Drive	●	●	●	●	●	●	●	●	●	●												
Serial Interface	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●	●	●	●	●
A/D Converter	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
D/A Converter	●	●	●	●	●	●																
8-bit Timer	5	5	5	5	5	5	3	3	3	3	3	6	6	6	6	2	2	2	3	3	3	3
16-bit Timer	1	1	1	1	1	1	1	1	1	1												
Watch Dog Timer	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●				●	●	●	●
PWM Output	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●				
Buzzer Output	●	●	●	●	●	●	●	●	●	●												
Waveform Generator	●	●	●	●	●	●																
Input Capture Function	●	●	●	●	●	●																
Zero Cross Detection Circuit							●	●	●	●												
Pulse Width Measurement Circuit							●	●	●	●												
Inverter Control Circuit											●											
MSK Data Communication Circuit												1	1	1	2							
OP Amp																●	●					●
Comparator																●	●	●				
VCR Servo Controller																			●	●	●	●
ROM (byte)	24k	32k	40k	48k	60k	60k	8k	16k	24k	32k	12k	10k	16k	24k	32k	8k	12k	16k	10k	16k	16k	16k
RAM (byte)	1k	1k	1k	2k	2k	2k	512	512	1k	1k	256	320	512	512	1k	128	128	256	256	256	512	512
Application Examples	 Cordless telephones, Mini Disc recorders/players, Camcorders, Pagers						 Telephones, Air conditioners, Fan heaters, Washing machines					 Cordless telephones				 Cameras, Hand-held measurement systems			 VCRs			

★ Under development

Controllers for General Purpose



System Configuration Example

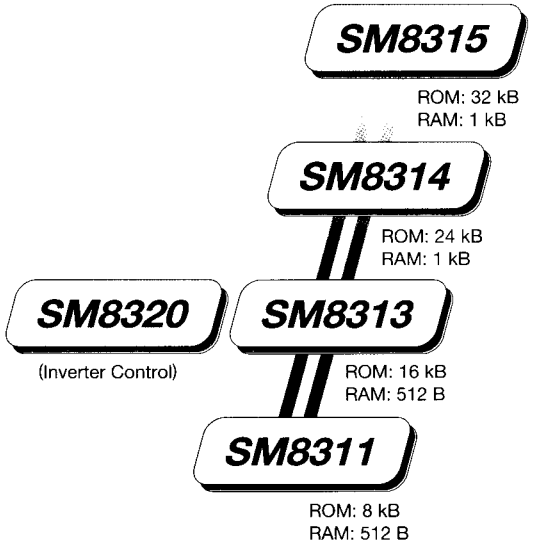


■ Specifications

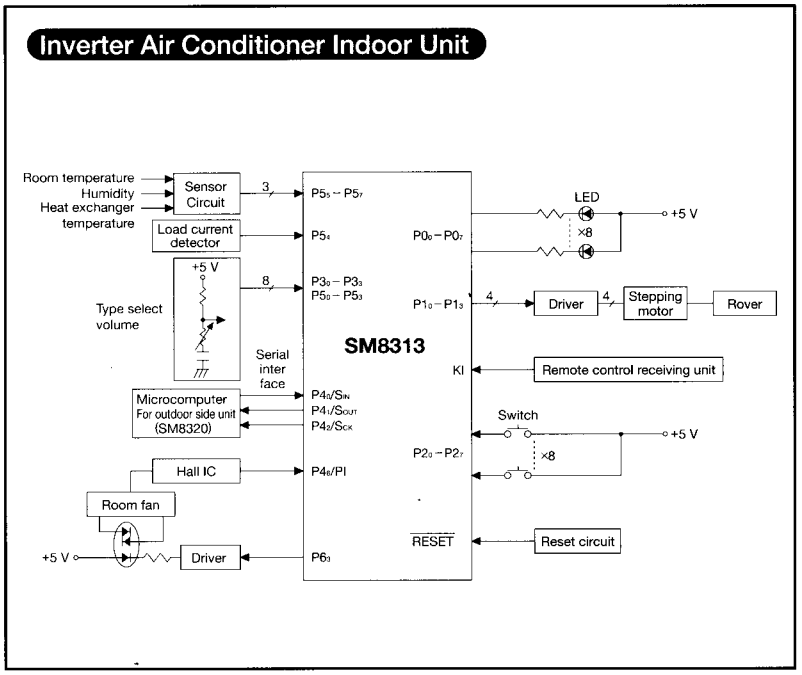
		★SM8502	★SM8503	SM8504	★SM8505	SM8506	LU8500F0/F1
ROM (× 8-bit)		24 576	32 768	40 960	49 152	61 440	61 440*1
RAM (× 8-bit)		1 024	1 024	1 024	2 048	2 048	2 048
External Memory Expansion				○			○
I/O Port	I			16			16
	O (High current)			16			16
	I/O			52			52
Serial Interface (Clock Sync.)				1			1
Serial Interface (UART)				1			1
A/D Converters (10-bit)				8 ch			8 ch
D/A Converters (8-bit)				2 ch			2 ch
8-bit Timer				5			5
16-bit Timer				1			1
8-bit Prescaler				1			1
Watch Dog Timer				○			○
Input Capture Function				○			○
PWM Output				4 ch			4 ch
Waveform Generator				2 ch*2			2 ch*2
Buzzer Output				○			○
Interrupt	Internal			10			10
	External			4			4
Instruction Cycle (µs)				0.33 (5V)			0.33 (5V)
Supply Voltage (V)				1.8 to 5.5			2.7 to 3.6 4.5 to 5.5
Supply Current [TYP.] (mA)				10 (System clock 6 MHz)			20
Standby Mode				HALT / STOP			HALT / STOP
Operating Temp. Range (°C)				–20 to 70			–20 to 70
Package				100 QFP 100 LQFP*3			100 QFP/ 100 LQFP*3
Remarks				Available for DTMF output			Built-in Flash Memory

*1 Internal Flash Memory capacity
*2 Waveform generator can be used by combining with D/A converters.
*3 0.5mm fine pin-pitch
★ Under development

For Home Appliances



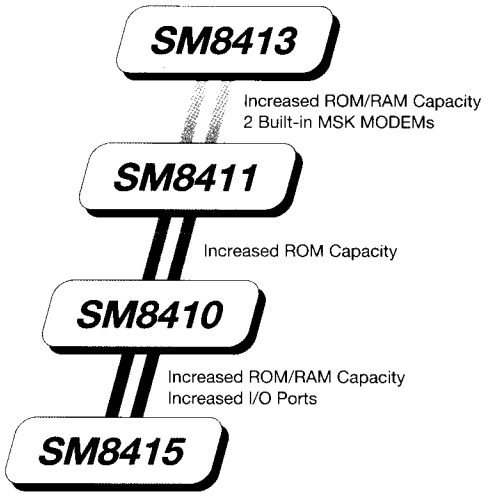
System Configuration Example



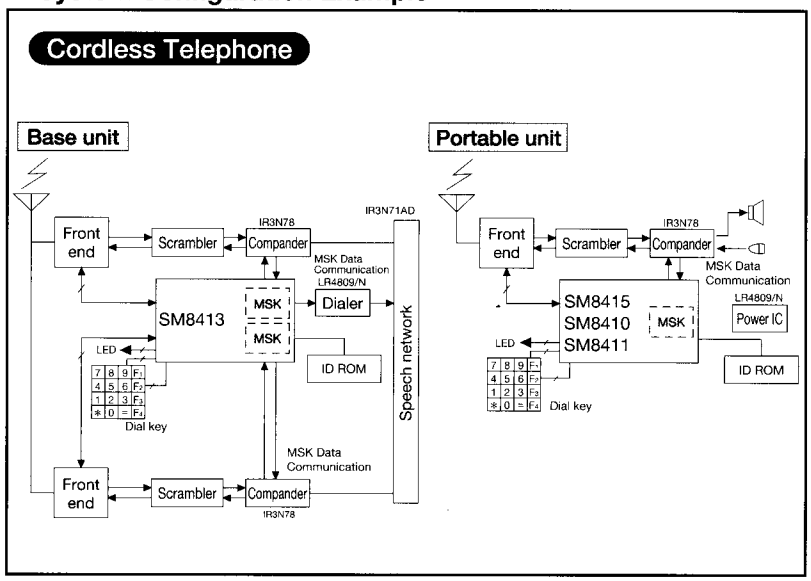
■ Specifications

		SM8311	SM8313	SM8314	SM8315	SM8320
ROM (× 8-bit)		8 192	16 384	24 576	32 768	12 288
RAM (× 8-bit)		512	512	1 024	1 024	256
I/O Port	I	12				8
	O (High current)	16				—
	I/O	24				40
Serial Interface (Clock Synch.)		1				1
A/D Converters (10-bit)		12 ch				8 ch
8-bit Timer		3				3
16-bit Timer		1				—
Prescaler		10-bit ×1				14-bit ×1
Watch Dog Timer		○				○
Zero Cross Detection Circuit		1 ch				—
Pulse Width Measurement Circuit		○				—
PWM Output		1 ch				6 ch (For Inverter Control)
Buzzer Output		○				—
Interrupt	Internal	8				8
	External	2				1
Instruction Cycle (μs)		0.5 (5V)				1
Supply Voltage (V)		2.7 to 5.5				5±10%
Supply Current [TYP.](mA)		6 (1μs)				6
Standby Mode		HALT / STOP				HALT / STOP
Operating Temp. Range (°C)		–20 to 70				–20 to 70
Package		64 SDIP 64 QFP				64 SDIP 80 QFP

For Communication Systems



System Configuration Example

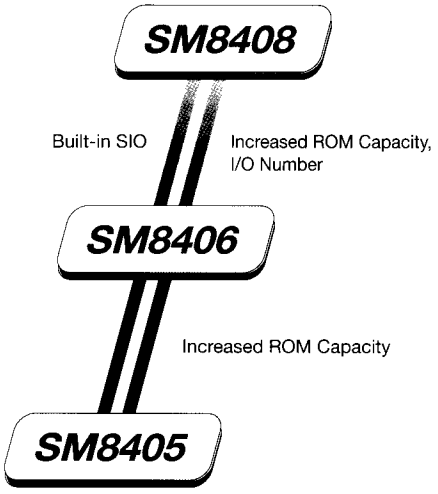


■ Specifications

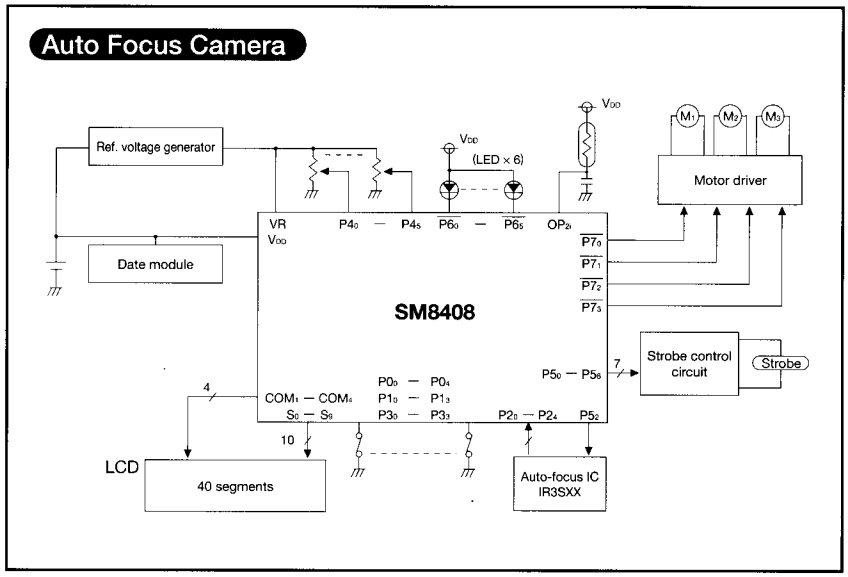
		SM8415	SM8410	SM8411	SM8413
ROM (× 8-bit)		10 240	16 384	24 576	32 768
RAM (× 8-bit)		320	512	512	1 024
I/O Port	I	15	19	19	20
	O	2	2	2	2
	O (High current)	12	16	16	16
	I/O	22	22	22	22
Serial Interface (Clock Synch.)		2	2	2	2
MSK Data Communication Circuit . (Transfer rate)		1 (1200/2400 bps)	1 (1200/2400 bps)	1 (1200/2400 bps)	2 (1200/2400 bps)
A/D Converters (8-bit)		5 ch	7 ch	7 ch	7 ch
8-bit Timer		6	6	6	6
8-bit Prescaler		1	1	1	1
Watch Dog Timer		○	○	○	○
PWM Output		3 ch	3 ch	3 ch	3 ch
Interrupt	Internal	13	13	13	15
	External	2	2	2	2
Instruction Cycle (μs)		2.17*1 1.09*2	2.17*1 1.09*2	2.17*1 1.09*2	0.72
Supply Voltage (V)		1.8 to 5.5*1 3.4 to 5.5*2	1.8 to 5.5*1 3.4 to 5.5*2	1.8 to 5.5*1 3.4 to 5.5*2	5±10%
Supply Current [TYP.](mA)		1*1 4*2	1*1 4*2	1*1 4*2	10
Standby Mode		HALT STOP	HALT STOP	HALT STOP	HALT STOP
Operating Temp. Range (°C)		−20 to 70	−20 to 70	−20 to 70	−20 to 70
Package		80 QFP 80 LQFP*3	80 QFP 80 LQFP*3	80 QFP 80 LQFP*3 100 LQFP*3	80 QFP 100 LQFP*3

*1 The system clock is 1/8 th of the main-clock.
*2 The system clock is 1/4 th of the main-clock.
*3 0.5mm fine pin-pitch

For Hand-held Systems



System Configuration Example

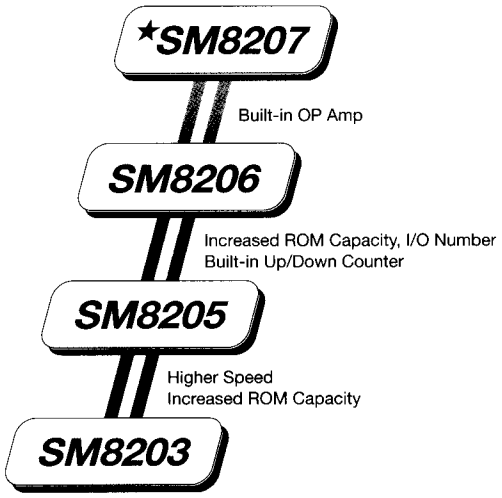


■ Specifications

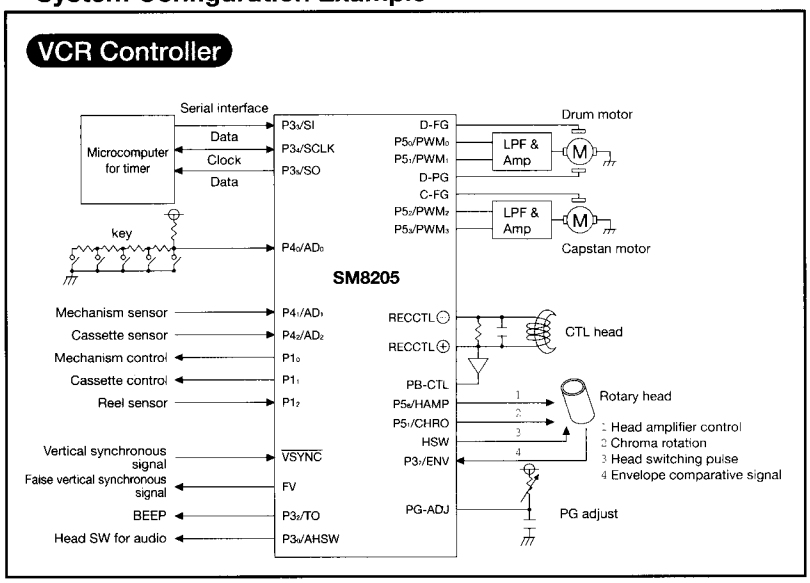
		SM8405	SM8406	SM8408
ROM (× 8-bit)		8 192	12 288	16 384
RAM (× 8-bit)		128	128	256
I/O Port	I	23	23	18
	O (High current)	16	16	16
	I/O	4	4	14
Serial Interface (Clock Synch.)		—	—	1
LCD Driver (Max. segments)		40	40	40
A/D Converter (8-bit)		6 ch	6 ch	8 ch
8-bit Timer		2	2	2
OP Amp		1	1	1
15-bit Prescaler		1	1	—
Comparator		1	1	2
PWM Output		1 ch	1 ch	1 ch
Interrupt	Internal	4	4	5
	External	3	3	3
Instruction Cycle (µs)		2 (3V)	2 (3V)	2 (3V) / 1 (5V)
Supply Voltage (V)		1.8 to 5.5	1.8 to 5.5	1.8 to 5.5
Supply Current [TYP.](mA)		2.5 (3V)	2.5 (3V)	2.5 (3V)
Standby Mode		HALT STOP	HALT STOP	HALT STOP
Operating Temp. Range (°C)		–20 to 70	–20 to 70	–20 to 70
Package		72 QFP*	72 QFP*	80 LQFP*

* 0.5mm fine pin-pitch

For Servo Controllers



System Configuration Example



■ Specifications

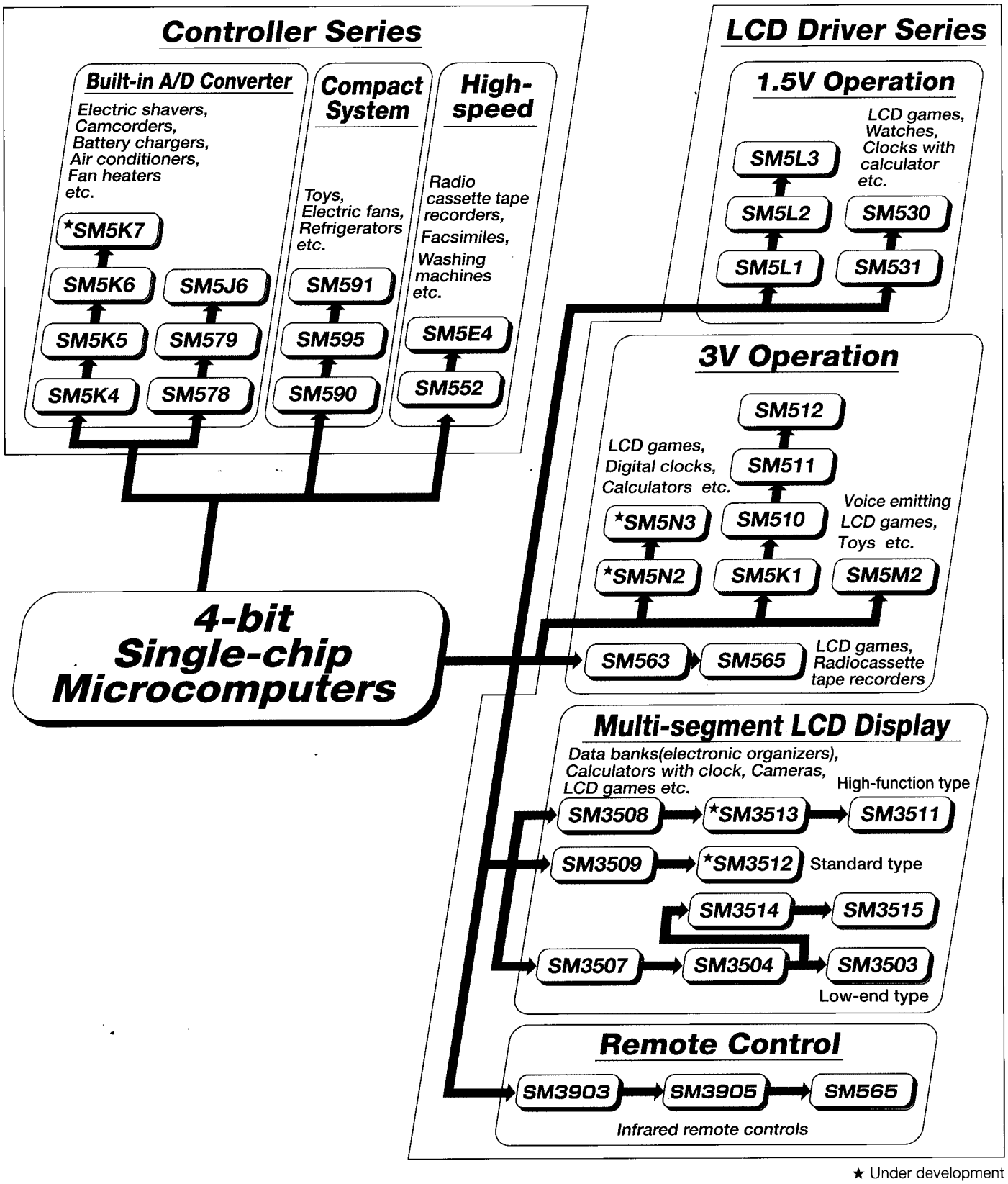
		SM8203	SM8205	SM8206	★SM8207
ROM (× 8-bit)		10 240	16 384	16 384	16 384
RAM (× 8-bit)		256	256	512	512
I/O Port	I	8	8	8	8
	O	16*	16*	24	24
	I/O	24	24	32	32
Serial Interface (Clock Synch.)		1	1	1	1
VCR Servo Controller		○	○	○	○
A/D Converter (8-bit)		8 ch	8 ch	8 ch	8 ch
8-bit Timer		3	3	3	3
8-bit Up/Down Counter		—	—	1	1
Watch Dog Timer		○	—	—	—
OP Amp		—	—	—	2
Interrupt	Internal	8	8	9	9
	External	2	2	2	2
Instruction Cycle (μs)		0.8	0.44	0.5	0.5
Supply Voltage (V)		5±10%	5±10%	5±10%	5±10%
Supply Current [TYP.](mA)		10	15	15	TBD
Operating Temp. Range (°C)		–20 to 70	–20 to 70	–20 to 70	–20 to 70
Package		64 SDIP	64 SDIP	80 QFP	100 QFP

* 8 terminals are middle withstand voltage output ports.

★ Under development

4-bit Single-chip Microcomputers

Sharp developed a wide range of LCD driver series single-chip microcomputers, an indispensable part of consumer products, LCD games, portable information equipment, etc. Our lineup consists of low-voltage/low-power consumption types with a possible 1.5V operation, multi-segment types for optimum use in electronic organizers, built-in transmission circuit types for remote control applications and many other types. And we also offer a controller series of single-chip microcomputers with a built-in 10-bit high-precision A/D converter.



★ Under development

Selection Guide (1)

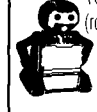
Applications	SM531	SM530	SM5L1	SM5L2	SM5L3	★SM5N2	★SM5N3	SM5M2	SM5K1	SM510	SM511	SM512	SM563	SM565	SM3507	SM3503	SM3504	SM3514	SM3515
	LCD Driver Series (1.5V Operation)					LCD Driver Series (3V Operation)									LCD Driver Series (For Multi-segment LCD)				
LCD Direct Drive	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
LED Direct Drive								●											
Serial Interface												●	●						
8-bit Timer												1	1						
Clock Oscillator (32 kHz)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Voice Synthesizer Circuit (APCM)								●											
Melody Generator Circuit	●	●	●	●	●	●	●	●			●	●							
Buzzer Output									●	●			●	●	●	●	●	●	●
Built-in Carrier Output Circuit For Remote Control													●						
Standby Function	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Character ROM														●	●	●	●	●	●
ROM (byte)	1.2k	2k	2k	3k	4k	3k	4k	3k	1.2k	2.7k	4k	4k	4k	8k	6k (*1)	6k (*1)	6k (*1)	8k (*1)	12k (*1)
RAM (nibble)	52	88	69	130	170	130	170	130	80	128	128	128	160	256	256 + 512 (*2)	256 + 1k (*2)	256 + 512 (*2)	256 + 512 (*2)	256 + 512 (*2)
Application Examples	 LCD games Sports watches Watches with calculator					 Digital clocks Voice emitting clock  LCD games  Calculators  Voice emitting toys							 LCD games  Radio cassette recorders	 LCD games  Calculators with clock  Data banks (Electronic organizers)				

*1 23-bit data width.

*2 Memory for storing telephone numbers, addresses, etc.

★ Under development

Selection Guide (2)

Applications	SM3509	★SM3512	SM3508	★SM3511	★SM3513	SM5K4	SM5K5	SM5K6	★SM5K7	SM578	SM579	SM5J6	SM590	SM595	SM591	SM552	SM5E4	SM3903	SM3905	SM565
	LCD Driver Series (For Multi-segment LCD)					Controller Series (Built-in A/D Converter)							Controller Series (For General Purpose)					Controller Series (For Remote Control)		
LCD Direct Drive	●	●	●	●	●													●	●	●
LED Direct Drive						●	●	●	●											
Serial Interface								●	●	●	●	●				●	●		●	●
10-bit A/D Converter						●	●	●	●											
8-bit A/D Converter										●	●	●								
8-bit Timer						1	1	2	2	2	2	2				1	1		1	1
Watch Dog Timer								●	●											
Clock Oscillator (32 kHz)	●	●	●	●	●		●	●	●	●	●	●				●	●		●	●
Buzzer Output	●	●	●	●	●			●	●	●	●	●						●	●	●
Built-in Carrier Output Circuit For Remote Control			●	●	●													●	●	●
Standby Function	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Character ROM	●	●	●	●	●															
ROM (byte)	8k (*1)	8k (*1)	12k (*1)	24k (*1)	24k (*1)	2k	2k	4k	8k	4k	6k	8k	508 (*2)	762 (*2)	1k (*2)	4k	6k	2.7k	4k	8k
RAM (nibble)	256 + 2k (*3)	256 + 8k (*3)	256 + 3k (*3)	256 + 512 (*3)	256 + 512 (*3)	128	128	256	512	192	256	256	32	32	56	256	320	128	160	256
External Address Memory (byte)	8k	8k	3M	64M	64M															
Application Examples	 Data banks (Electronic organizers)					 Electric shavers  Camcorders  Battery chargers  Air conditioners  Fan heaters								 Toys (robots etc.)  Refrigerators  Electric fans			 Radio cassette recorders  Facsimiles  Washing machines		 Infrared remote controls		

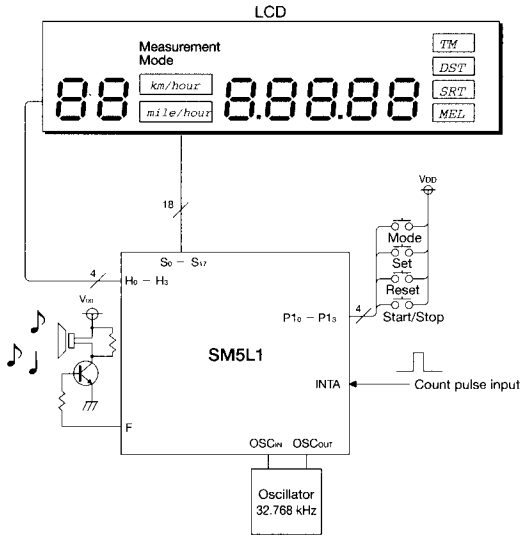
*1 23-bit data width.
*2 9-bit data width
*3 Memory for storing telephone numbers, addresses, etc.

★ Under development

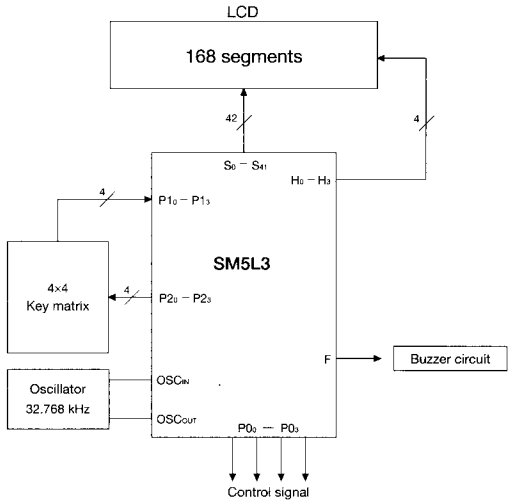
LCD Driver Series (1.5V/3.0V Operation)

System Configuration Example

Sports Watch



Calculator with Game Function



■ Specifications

		SM531	SM530	SM5L1	SM5L2	SM5L3	★SM5N2	★SM5N3
ROM (× 8-bit)		1 260	2 016	2 048	3 072	4 096	3 072	4 096
RAM (× 4-bit) (Including display RAM)		52	88	69	130	170	130	170
I/O Port	I	6	8	1			1	
	O	—	8	5			5	
	I/O	—	—	8			8	
LCD Drive Output Port	Segment	40	48	21	34	42	34	42
	Common	2	2	4	4	4	4	4
Duty Ratio (Duty, Bias)		1/2, 1/2	1/2, 1/2	1/4, 1/2	1/4, 1/2	1/4, 1/2	1/4, 1/2	1/4, 1/2
Clock Oscillator (32 kHz)		○ Available for system clock	○ Available for system clock	○ Available for system clock			○ Available for system clock	
Melody Generator Circuits		○	○	○			○	
Instruction Cycle (μs)		91.6	91.6	61			61	
Supply Voltage (V)		1.5±20%	1.5±20%	1.5±20%			2.4 to 3.3	
Supply Current [TYP.](μA)		10	12	8 (122μs)	10 (122μs)	12 (122μs)	25 (122μs)	30 (122μs)
Standby Mode		HALT	HALT	HALT STOP			HALT STOP	
Operating Temp. Range (°C)		0 to 50	0 to 50	0 to 50			0 to 50	
Package		60 QFP	80 QFP	60 QFP	72 QFP* 80 QFP	80 QFP	72 QFP* 80 QFP	80 QFP

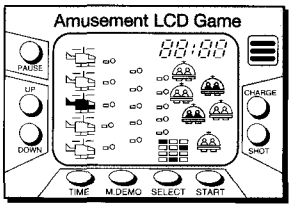
* 0.5mm fine pin-pitch

★ Under development

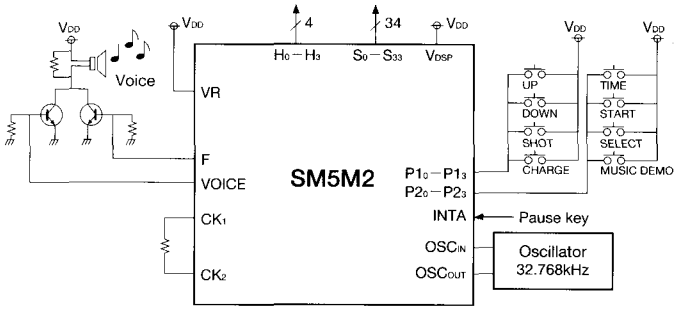
LCD Driver Series (3V Operation)

System Configuration Example

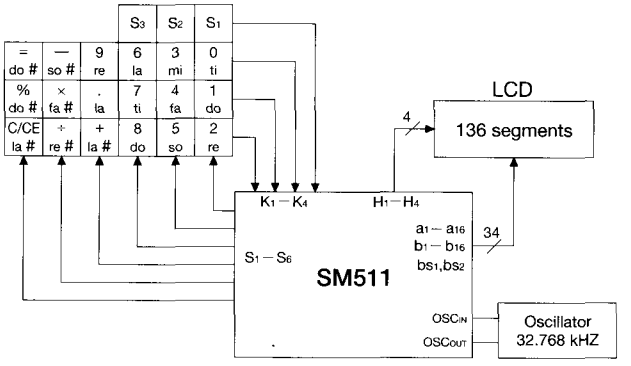
Voice Emitting LCD Game



To LCD Panel



Calculator with Game and Melody Function



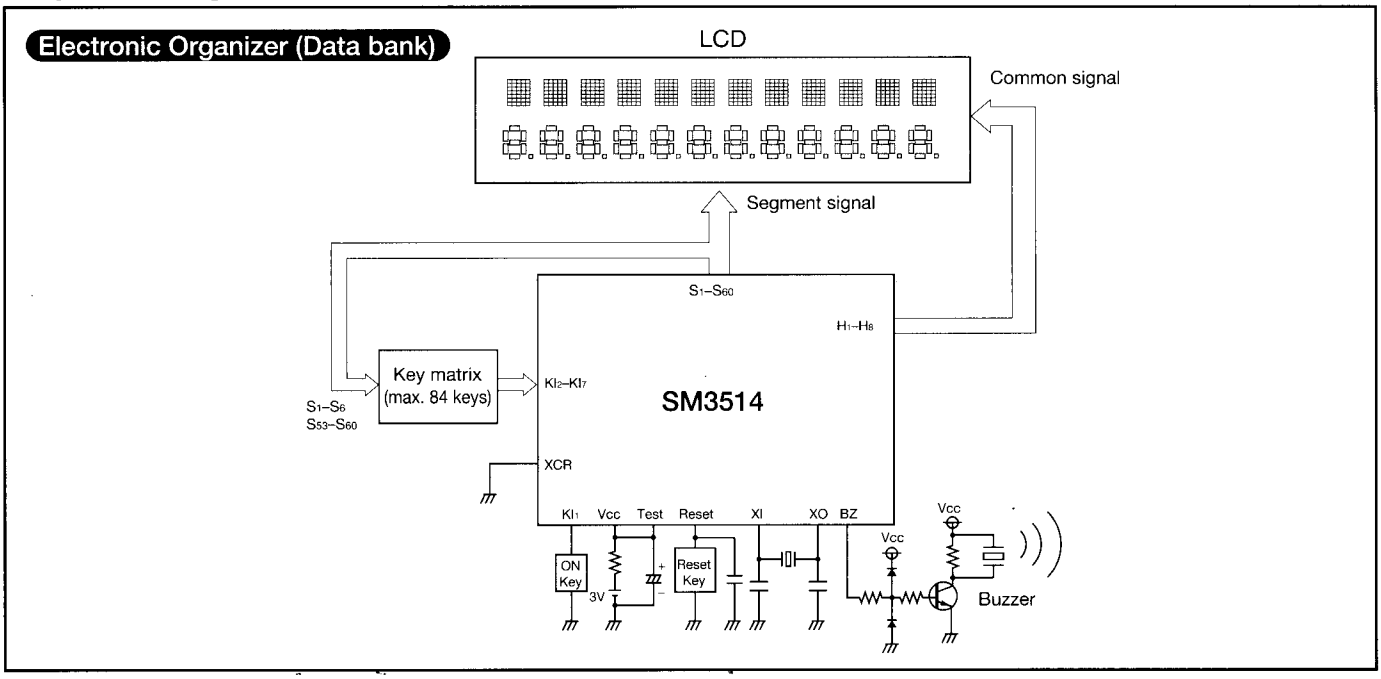
■ Specifications

		SM5M2	SM5K1	SM510	SM511	SM512	SM563	SM565
ROM (× 8-bit)		3 072	1 280	2 772	4 032	4 032	4 096	8 192
RAM (x4-bit) (Including display RAM)		130	80	128	128	128	160	256
I/O Port	I	1	6	6	6	6	4	4
	O	6	5	10	9	9	—	—
	I/O	7	8	—	—	—	11	11
LCD Drive Output Port	Segment	34	16	33	34	50	32 (15*1)	64 (16*1)
	Common	4	4	4	4	4	4	4
Duty Ratio (Duty, Bias)		1/4, 1/2	1/3 or 1/4, 1/3	1/4, 1/3	1/4, 1/3	1/4, 1/3	1/4, 1/3	1/4, 1/3
LED Drive Output Port		—	4*2	—	—	—	—	—
Serial Interface (Clock Synch.)		—	—	—	—	—	1	1
8-bit Timer		—	—	—	—	—	1	1
Clock Oscillator (32 kHz)		○ Available for system clock*3	○ Available for system clock	○ Available for system clock	○ Available for system clock	○ Available for system clock	○	○
Voice Synthesizer Circuit (APCM)		○	—	—	—	—	—	—
Melody Generator Circuit		○	—	—	○	○	—	—
Buzzer Output		—	○	○	—	—	○	○
Instruction Cycle (μs)		25.9 (61*3)	5	61	61	61	2 (5V) 6.7 (3V)	8.79
Supply Voltage (V)		2.4 to 3.3	2.4 to 5.5	3±10%	3±10%	3±10%	2.7 to 5.5	2.4 to 5.5
Supply Current [TYP.](μA)		120	250(3V)	40	50	50	400 (3V)	160 (3V)
Standby Mode		HALT/STOP	HALT/STOP	HALT	HALT	HALT	STOP	STOP
Operating Temp. Range (°C)		0 to 50	–20 to 70	0 to 50	0 to 50	0 to 50	–20 to 70	–20 to 70
Package		Chip 72 QFP*4	42 SDIP 48 QFP	60 QFP	60 QFP	80 QFP	64 QFP	100 QFP
Remarks		12.8s voice emission time (sampling at 5MHz)						Built-in carrier output circuit for remote control

*1 From among the segment output terminals, the number of terminals which can be used with the I/O ports is indicated in parentheses.
*2 When using with I/O port
*3 Incorporates two oscillators. With the removal of the main oscillator, the sub-oscillator (32kHz) is available for system clock use.
*4 When using the clock with the system clock.
*5 0.5mm fine pin-pitch

Multi-segment LCD Driver Series (For data bank use)

System Configuration Example



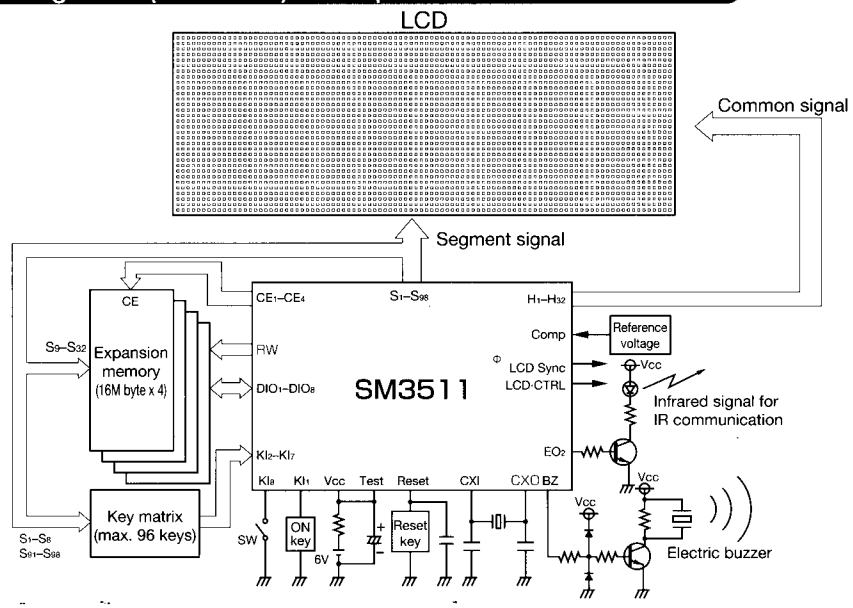
■ Specifications

		SM3507	SM3503	SM3504	SM3514	SM3515
ROM (× 23-bit)		6 144	6 144	6 144	8 192	12 288
Working RAM (× 4-bit)		256	256	256	256	256
Data RAM (× 8-bit)		512	1 024	512	512	512
Display RAM (bit)		48 × 8	60 × 8		60 × 8	
Character ROM	Character Number	128	128		128	
	Character Configuration	4 × 8 dot	5 × 8 dot		5 × 8 dot	
I/O Port	I	2	—		—	
	O	2	—		—	
	I/O	8	—		—	
LCD Drive Output Port	Segment	48*1	60*1		60*1	
	Common	8	8		8	
Duty Ratio (duty, bias)		1/8, 1/3.75	1/8, 1/3.75		1/8, 1/3.75	
Clock Oscillator (32 kHz)		○	○		○	
Key Matrix		14 × 4	14 × 6		14 × 6	
ON Key		1	1		1	
Buzzer Output		○	○		○	
Instruction Cycle (µs)		12	12		10	
Supply Voltage (V)		2.5 to 3.4	2.5 to 3.4		2.5 to 3.4	
Supply Current [TYP.] (µA)	Operating	85	85		100	
	System Clock Stopped / Display ON	20	20		20	
	System Clock Stopped / Display OFF	3*2/1	3*2/1		3*2/1	
	Standby	1 (MAX.)	1 (MAX.)		1 (MAX.)	
Operating Temp. Range		–10 to 60	–10 to 60		–10 to 60	
Package		Chip / 80 QFP	Chip / 100 QFP	Chip / 80 QFP	Chip / 100 QFP	

*1 Available for segment/strobe pins.
*2 During clock operation.

System Configuration Example

High-End Electronic Organizer (Data bank) with Optical Transmission Function



■ Specifications

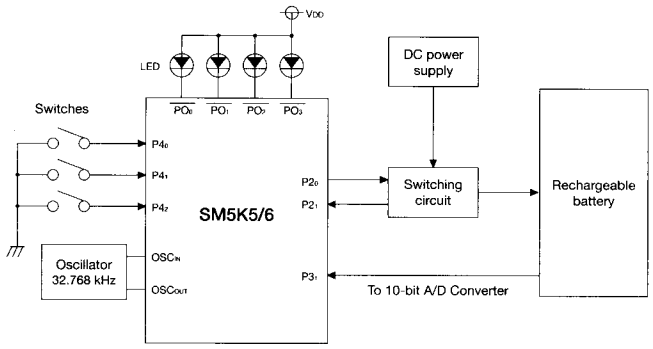
		SM3509	★SM3512	SM3508	SM3511	★SM3513
ROM (× 23-bit)		8 192		12 288	24 576	
Working RAM (× 4-bit)		256		256	256	
Data RAM (× 8-bit)		2 048	8 192	3 072	512	
External Address Memory Space		8 k-byte		3 M-byte	64 M-byte	
Display RAM (bit)		60 × 9		74 × 16	98 × 32	74 × 32
Character ROM	Character Number	128		256	256	
	Character Configuration	5 × 9 dot		6 × 8 dot	6 × 8 dot	
I/O Port	I	—		2	2	
	O	2		2	3	
	I/O	8		8	8	
LCD Drive Output Port	Segment	60*1		74*1	98*2	74*2
	Common	9		16	32	
Duty Ratio (duty, bias)		1/9, 1/4		1/16, 1/2*3	1/32, 1/3 or 1/6.65	
LCD Contrast Adjustable Level		—		16	16	
Infrared Communication		—		○	○	
Clock Oscillator (32 kHz)		○		○	○	
Key Matrix		14 × 6		16 × 5	16×5	
ON Key		1		1*4	1*4	
Low Battery Detector (External Reference Voltage)		—		—	○	
Buzzer Output		○		○	○	
Instruction Cycle (µs)		12		3	3	
Supply Voltage (V)		2.5 to 3.4		2.5 to 5.5	3.8 to 6.0	
Supply Current [TYP.] (µA)	Operating	85		270 (3V)	600 (5V)	
	System Clock Stopped / Display ON	20		40 (3V)	50 (5V)	
	System Clock Stopped / Display OFF	3		4 (3V)	10 (5V)	
	Standby	1 (MAX.)		1 (MAX.)	1 (MAX.)	
Operating Temp. Range		–10 to 60		–10 to 60	–10 to 60	
Package		Chip / 100 QFP		Chip / 128 QFP	Chip	

*1 Available for segment/strobe and segment/address pins. *4 Can be used as key matrix. ★ Under development
*2 Available for segment/strobe pins.
*3 1/4 bias, 1/5 bias also possible

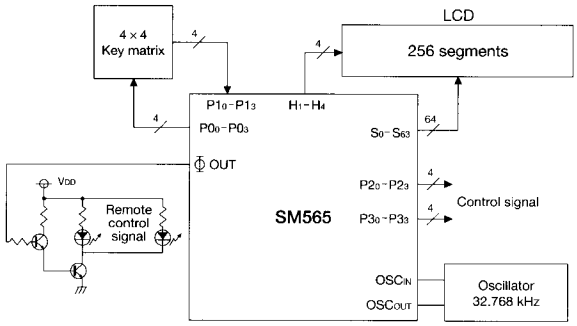
Controller Series (For General Purpose/Remote Control)

System Configuration Example

Charger Control



Remote Control with LCD Display



■ Specifications: Controller Series (Built-in A/D Converter)

		SM5K4	SM5K5	SM5K6	★SM5K7	SM578	SM579	SM5J6
ROM (bit)		2 048 × 8		4 096 × 8	8 192 × 8	4 064 × 9	6 096 × 9	8 192 × 9
RAM (× 4-bit)		128		256	512	192	256	256
I/O Port	I	8 (MAX.)*1		4		9	9	9
	O	4		—		2	2	12
	I/O	12 (MAX.)*2		20		41	41	31
LED Drive Output Port		4*3		8*3		—	—	—
Serial Interface (Clock Sync.)		—		1		1	1	1
A/D Converters	10-bit	4 ch		8 ch		—	—	—
	8-bit	—		—		20 ch	20 ch	10 ch
8-bit Timer		1		2		2	2	2
Watch Dog Timer		—		○ Available for 8-bit timer		—	—	—
Clock Oscillator (32 kHz)		—	○ Available for system clock	○ Available for system clock		○	○	○
Buzzer Output		—		○		○	○	○
Instruction Cycle (µs)		1.2	1	1		2	2	2
Supply Voltage (V)		2.7 to 5.5	2.2 to 5.5	2.0 to 5.5		2.7 to 5.5	2.7 to 5.5	2.7 to 5.5
Supply Current [TYP.] (mA)		1.2		1.6		1.8	1.8	5
Standby Mode		HALT STOP		HALT STOP		HALT STOP	HALT STOP	HALT STOP
Operating Temp. Range (°C)		–20 to 85	–20 to 70	–20 to 70		–10 to 70	–10 to 70	–10 to 80
Package		30 SDIP 24 SSOP 32 SOP 36 QFP	30 SDIP 28 SOP 32 SOP 36 QFP	30 SDIP 32 SOP 36 QFP		64 SDIP 64 QFP	64 SDIP 64 QFP	64 SDIP 64 QFP

*1 8 (30 SDIP/28 SOP/32 SOP/36 QFP), 5 (24 SSOP)
*2 12 (32 SOP/36 QFP), 11 (30 SDIP), 8 (24 SSOP/28SOP)
*3 Available for I/O ports.

★ Under development

■ Specifications : Controller Series (For General Purpose)

		SM590	SM595	SM591	SM552	SM5E4
ROM (× 8-bit)		508	762	1 016	4 096	6 144
RAM (× 4-bit)		32	32	56	256	320
I/O Port	I	—	—	—	4	4
	O	—	—	—	16	16
	I/O	15 (MAX.)*	15 (MAX.)*	15 (MAX.)*	28	48
Serial Interface (Clock Synch.)		—	—	—	1	1
8-bit Timer		—	—	—	1	1
Clock Oscillator (32 kHz)		—	—	—	○	○
Instruction Cycle (μs)		1 (5 V)	1 (5 V)	1 (5 V)	1.74 (5 V)	1.74 (5 V)
Supply Voltage (V)		2.5 to 5.5	2.5 to 5.5	2.5 to 5.5	2.7 to 5.5	2.7 to 5.5
Supply Current [TYP.] (mA)		1 (2μs)	1 (2μs)	1 (2μs)	1 (4μs)	1 (4μs)
Standby Mode		STOP	STOP	STOP	STOP	STOP
Operating Temp. Range (°C)		−10 to 70	−10 to 70	−10 to 70	−20 to 70	−20 to 70
Package		16 DIP 18 DIP 20 DIP	16 DIP 18 DIP 20 DIP 18 MFP	16 DIP 18 DIP 20 DIP 18 MFP	64 SDIP 60 QFP	80 QFP

* 10 I/O ports (at a maximum) can be used as output ports for 10mA. (7mA for the SM595)

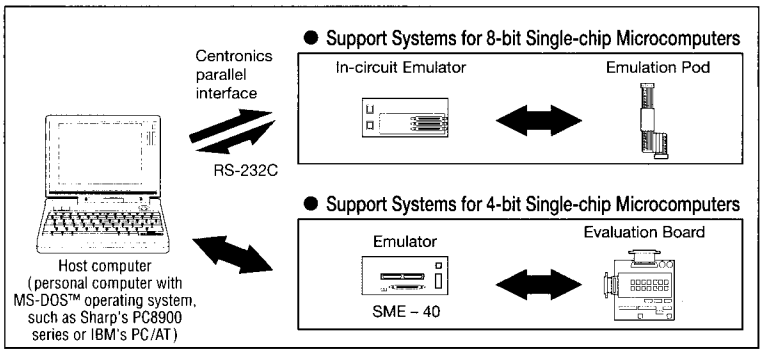
■ Specifications : Controller Series (For Remote Control)

		SM3903	SM3905	SM565
ROM (× 8-bit)		2 772	4 096	8 192
RAM (× 4-bit)		128	160	256
I/O Port	I	6	4	4
	O	10	—	—
	I/O	—	11	11
LCD Drive Output Port	Segment	33	32 (15)*	64 (16)*
	Common	4	4	4
Duty Ratio (Duty, Bias)		1/4 , 1/3	1/4 , 1/3	1/4 , 1/3
Serial Interface (Clock Synch.)		—	1	1
Built-in Carrier Output Circuit for Remote Control		○	○	○
8-bit Timer		—	1	1
Clock Oscillator (32 kHz)		—	○	○
Buzzer Output		—	○	○
Instruction Cycle (μs)		52.8	8.79	8.79
Supply Voltage (V)		2.6 to 3.2	2.7 to 3.6	2.4 to 5.5
Supply Current [TYP.] (μA)		40	160	160 (3 V)
Standby Mode		HALT	STOP	STOP
Operating Temp. Range (°C)		0 to 50	−20 to 70	−20 to 70
Package		60 QFP	64 QFP	100 QFP

* The figures in parentheses represent the number of ports that can be used as I/O ports.

Development Support Systems

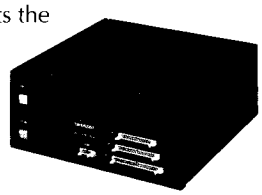
The development support systems for 8-bit single-chip microcomputers are configured with a host computer and an appropriate in-circuit emulator. The development support systems for 4-bit single-chip microcomputers are configured with a host computer and dedicated debugging tools (an emulator and an evaluation board). The SME-40 is a currently available high-performance SM emulator. The development of 16-bit and 8-bit single-chip computers by using the development support systems of another manufacturer is also possible.



8-bit Single-chip Microcomputer Development Support Systems

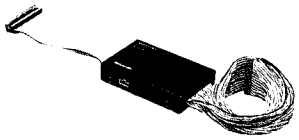
In-circuit Emulator

This emulator helps develop 8-bit single-chip microcomputer programs efficiently. It implements the functions of a single-chip microcomputer, allowing PC-based program entry and debugging.



Emulation Pod

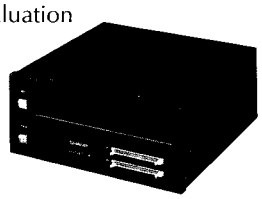
This emulation pod connects an emulator to a user system. It has a probe cable for external signals.



4-bit Single-chip Microcomputer Development Support Systems

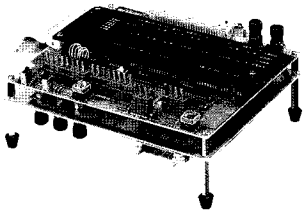
Emulator

This emulator expedites the development of 4-bit single-chip microcomputer programs. An evaluation board connected to an SME-40 emulator allows program development plus PC-based program entry and debugging.



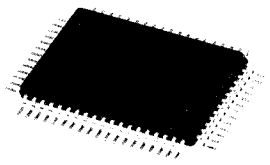
Evaluation Board

Evaluation boards provide the functions of a single-chip microcomputer running in a user system. An evaluation chip and an EPROM socket are mounted on the board. An evaluation board connected to the SME-40 emulator permits programs to be run in the emulator.



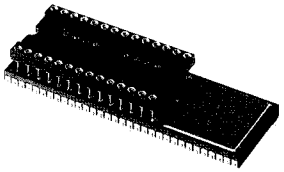
One-time Programmable Microcomputer

8-bit single-chip microcomputers with one-time-programmable (OTP) memory are pin-compatible with SM83/84 series microcomputers. Data can be written into their program ROM once only in the same way as a EPROM is written onto.
When OTP microcomputers are installed in user systems after memory writing, they function in the same way as masked ROM devices used for evaluation or production.



Piggyback

Piggyback chips have a double stacking structure in which an EPROM socket is mounted on an evaluation chip housed in a regular IC package. They can be installed in user systems to allow evaluation in a physical package similar to that used in mass production.



Microcomputer with Built-in Flash Memory

Microcomputers with a built-in flash memory are pin-compatible with the SM8500 and SM6000 series microcomputers. Data can be rewritten repeatedly onto their program ROM in the 3 write modes of PROM mode, copy mode and serial transmit mode (on-board mode). When microcomputers with built-in flash memory are installed in user systems after memory writing, they function in the same way as masked ROM devices used for evaluation or production.

Evaluation Chip

An evaluation chip is a program debugging LSI device to which an external memory module can be connected in place of the internal ROM of a single-chip microcomputer.

■ 8-bit Single-chip Microcomputer Development Support Systems

★ Under development

Model No.	In-circuit emulator		Evaluation chip	Piggyback	Built-in OTP microcomputer
	Unit	Emulation pod			
SM8203/5/6/7★	LU8200H7	LU8203/5H4	LU8203/5/6H5	LU8203/5/6/7H6	–
SM8311/3/4/5	LU8300H7	LU8313H4	LU8313H5	LU8313H6	LU8311P0/P1
SM8320		LU8320H4	LU8320H5	LU8320H6	–
SM8405/6		LU8405H4	LU8405H5	LU8405H6	LU8405P0
SM8408		LU8408H4	LU8408H5	LU8408H6	LU8408P0
SM8410/11		LU8410H4	LU8410H5	LU8410H6	LU8410P0/P1
SM8413		LU8413H4	LU8413H5	LU8413H6	LU8413P0
SM8415		LU8410H4	LU8410H5	LU8410H6	LU8410P0

Support Systems	Features
SM82 and SM83/84 In-circuit emulators (LU8200H7, LU8300H7)	• 64k-byte emulation memory • RS232C interface to host • Instruction cycle time count • C compiler for SM82 • Real-time trace function • Line assembler and reverse assembler • Centronics interface • Coverage function • Structured assembler for SM83/84

■ 4-bit Single-chip Microcomputer Development Support Systems

SME-40 System

- Target microcomputers :
  4-bit single-chip microcomputers
- Emulator :
  SME-40(LU4DH400)
- Evaluation board
- Host computer
  Personal computer with
  MS-DOS™ operating system
- Optional software :
  Cross-assembler/Mapper
  Emulator software

SM Series	Evaluation board	Piggyback
SM3503/04/14	LI3504H2	–
SM3507	LI3504H2*1	–
SM3508	LI3508H2	–
SM3509	LI3502H2	–
SM3511/13★	LI3511H2	–
★SM3512	LI3512H2	–
SM3515	LI3515H2	–
SM3903	–	–
SM3905	–	–
SM500	LU500H2A	–
SM510	LU510H2A	–
SM511/512	LU512H1*2	LU512H3*3
SM530/531	LU530H2A	–
SM552	LU550H2A	LU550H6A
SM563	LU563H2	LU563H6
SM565	LU565H2	LU565H6
SM578/579	LU578H2A	LU578H6
SM590/591/595	LU590H2A	LU590H6
SM5E4	LU5E3H2	LU5E4P0P*4
SM5J6	LU5J6H2	LU5J6H6
SM5K1	LU5K1H2E/2R	LU5K1H6E/6R
SM5K4/5K5	LU5K5H2	LU5K5P0/P1/P2/P5/P6/P7*4
SM5K6/★SM5K7	★LU5K6H2	★LU5K6P00/P10/P20/P50/P60/P70*4
SM5L1/5L2/5L3	LU5L1H2	–
★SM5M2	LU5M1H2	–

*1 Evaluation chip : LI3507H5
*2 Emulation by a bread board
*3 Piggy board
*4 OTP microcomputer

■ Development Support System Supplied by the Following Vendor

(For 16-bit/8-bit Single-chip Microcomputer)

Vendor	Support System	Applicable Model No.	Remark
YOKOGAWA Digital Computer Corporation	Emulator advice	SM8311/3/4/5 SM8502★/3★/4/5★/6 ★SM6003/4/5/6	Cross-software is supplied by Sharp

SHARP

SHARP CORPORATION Japan

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Ref. No. WT 285C

Singlechip LH7xxxx ‘790 ‘789 ‘791 SMxxxx ‘K series MCU Microcontroller MPU Microprocessor ARM Advanced RISC Machines Databank LCD Controller LCD Driver Controllers Processors Portable Low Power Low Voltage High Performance Power curve MIPS MIPS/Watt Execution Cycle Multiplier High Speed Compact Handheld System on Chip System Integration Chip Integration Integration Superchip Standard Cell Core Core based IC VHDL Verilog Synthesis Chip on Board COB Chip on Flex COF Device on Board DOB Power Supply Controller Handy Products Development Tools Board Support Software Tools Tools 2.10 Software Support Emulators Evaluation Boards ICE In-Circuit Emulators ROM ICE SME Series Programmable User Configurable RTOS Real Time Operating Systems Third Party Support Software Hardware Yokogawa Digital Cosmic Compiler C Language C Like Assembler Linker Debugger Debug A/D D/A DAC Analog Digital 10-bit 4-bit 8-bit 16-bit 32-bit Address bus Data Bus