

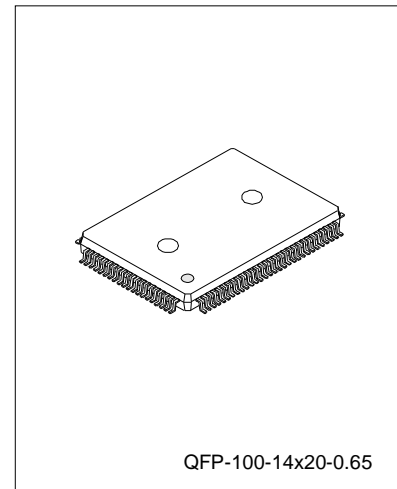
## MCU EMBEDDED A/D CONVERTER FOR DMM(3<sup>3/4</sup> DIGITS)

### DESCRIPTION

SC9711 is a 4000 counts digital multi-meter.

### FEATURES

- \* ADC display three times pre second;
- \* Auto Range Function  
Voltage(DC/AC): 400.0mV, 4.000V, 40.00V, 1000V  
Current(DC/AC): (400.0μA,4000μA), (40.00mA, 400.0mA),  
(10.00A)
- Resistor: 400.0Ω,4.000kΩ, 40.00kΩ,  
400.0kΩ, 4.000MΩ,40.00MΩ
- Diode and Continuity Measurement:  
Capacitance: 4.000nF, 40.00nF, 400.0nF,  
4.000μF, 40.00μF, 200.0μF(30Sec)
- Frequency: 9.999Hz, 99.99Hz, 999.9Hz, 9.999KHz,  
99.99KHz, 999.9KHz, 9.999MHz
- Duty: 0.1%~99.9%
- \* 3V battery operation
- \* Low power consumption: Less than 6mW
- \* Range Selection/Display Hold/Auto Power-Off/Relative
- \* 1/3 bias, 1/4 duty LCD drive
- \* 2.4V battery replacing caution detect
- \* built-in AC/DC switch OPAMP
- \* Built-in CMOS bandgap reference



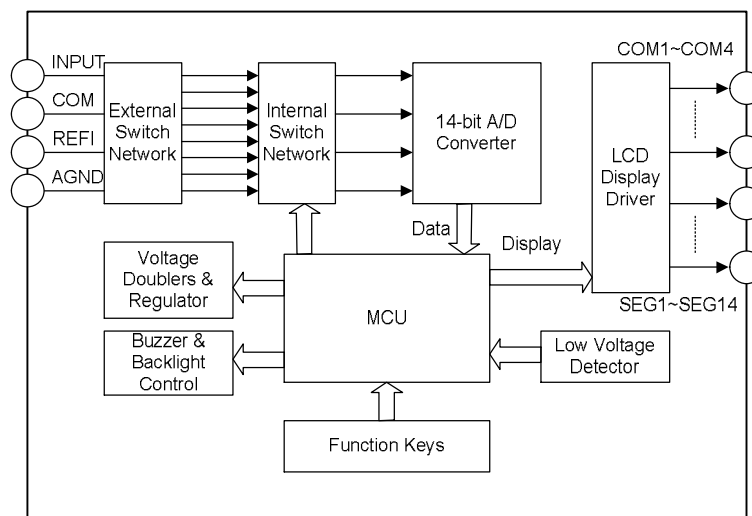
### ORDERING INFORMATION

Device	Package
SC9711	QFP-100-14 x 20-0.65
SC9711X	DIE

### APPLICATIONS

- \* Hand-held DMM
- \* Pocket DMM
- \* Pen-type DMM
- \* Clamp Meter

### BLOCK DIAGRAM



**ELECTRICAL CHARACTERISTICS** (T<sub>amb</sub>=25°C, V<sub>DD</sub>=3V)

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Recommend Operating Voltage	VDD		2.4		3.6	V
Supply Current	IDD	At DCV mode		1.5	2	mA
Power-off Current	IPO	AT Power off			10	μA
Digital Input High Voltage	VIH		VDD-0.5			V
Digital Input Low Voltage	VIL				0.5	V
Pull Up Current	IPU	Vin=0		5	10	μA
Analog Ground Voltage	AGND		VDD/2-3%	VDD/2	VDD/2+3%	V
Analog Power Supply Voltage	VDDA		3.4	3.7	4	V
Build In Reference Voltage	VBAND	Relative AGND voltage	1.1	1.25	1.4	V
Reference Voltage Output Voltage Coefficient		VDD=2.4~3.6	-2000		+2000	ppm/V
Recommend Input Reference Voltage	REF1	Relative to AGND voltage		0.44		V
Low Battery Detector Voltage	VBATT		2.25	2.4	2.55	V
LCD Frame Frequency	FLCD			32		Hz
LCD Pk-Pk Driver Voltage	VLCD		2.8	3	3.2	V
Beeper Frequency	FBEEP			2.7		KHz
Zero Input Reading		DC ADPx1 input=0V	-0.001	0.000	0.0001	
Linearity (max. Deviation From Best Straight Line Fit)		DC ADPx1 input, Full Scale±240.0mV	-1	0	+1	Counts
AC Measurement Bandwidth Error		AC ADPx1 240mVrms 20Hz~1KHz			0.2	%
Continuity Check Value	RCC		10		60	Ohm
ADC Measurement O.L Display Count				4050		Counts
Autorange Up Counts				4000		Counts
Autorange Down Counts				360		Counts
Frequency Counter Input Level (Hz/duty Control)	VFREA	VIL( relative AGND)	-60			mV
		VIH(relative AGND)			60	mV
Frequency Counter Max. Input Frequency (Hz/Duty Control)	FMAXA	VPP=±100mV square wave input	500k			Hz
Duty Measurement Min. Pulse Width Error (Hz/duty Control)	*1	VPP=±100mV square wave input			1	μs
Frequency Counter Input Level (MEAS=0100)	VFRED	VIL(relative AGND)	-600			mV
		VIH(relative AGND)			600	mV
Frequency Counter Input Max. Frequency (MEAS=0100)	FMAXD	VPP=±600mV square wave input	5M			Hz

(To be continued)

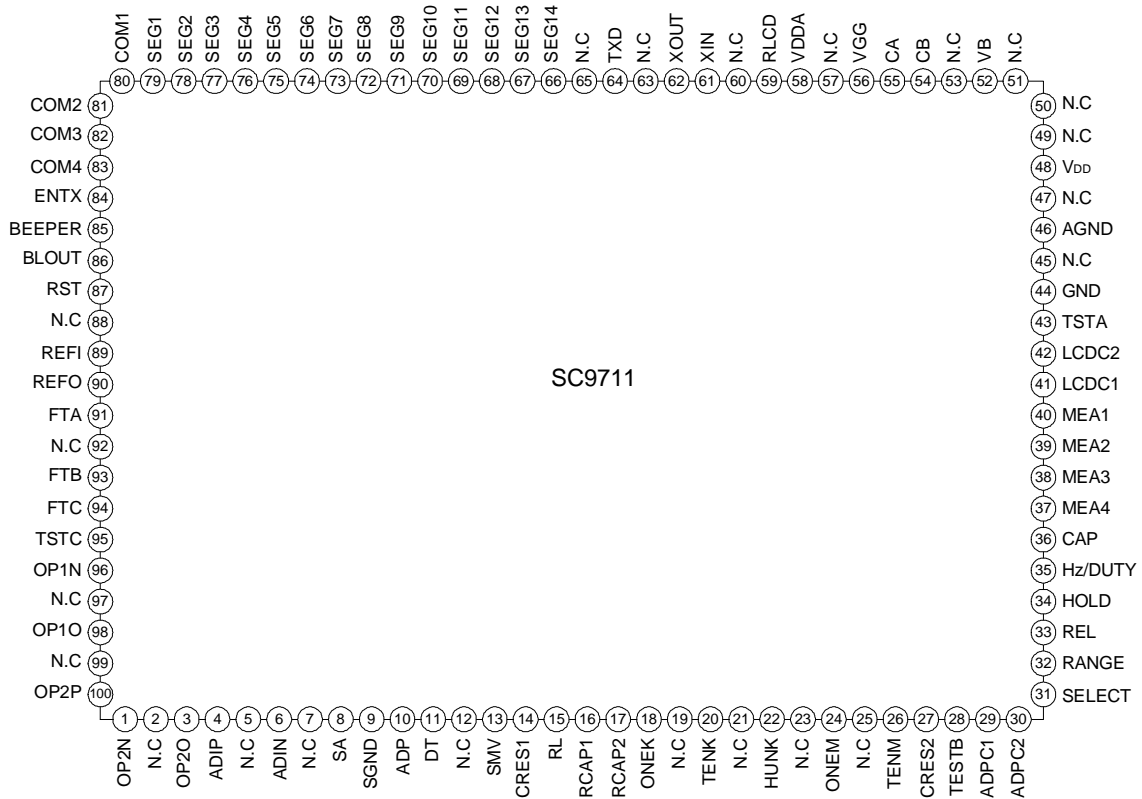
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Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Duty Measurement Min. Pulse Width Error (MEAS=0100)	*1	VPP=±600mV square wave input			100	ns
Capacitor Measurement Accuracy After Zero Input Relative 400.0nF		4.000nF			5%+25	Counts
		40.00nF			2%+10	Counts
		400.0nF			0.5%+3	Counts
		4.000μF			1%+2	Counts
		40.00μF			1.5%+2	Counts

**FUNCTION AND RANGE TABLE**

MEA4	MEA3	MEA2	MEA1	SELECT(1(0)(1))		Hz/Duty(1(0)(1))
0	0	0	1	DCV		Hz/Duty/V
0	0	1	0	ACV		Hz/Duty/V
0	0	1	1	OHM		
0	1	0	0	Hz		HZ/Duty
0	1	0	1	CAP		
0	1	1	0	Diode/ Beeper	Diode/ Beeper switch	
0	1	1	1	μA	AC/DC switch	HZ/Duty/A
1	0	0	0	V	AC/DC switch	HZ/Duty/V
1	0	0	1	OHM/Diode/Beeper/CAP		
1	0	1	0	A	AC/DC switch	HZ/Duty/A
1	0	1	1	mA	AC/DC switch	HZ/Duty/A
1	1	0	0	Diode		
1	1	0	1	Beeper		
1	1	1	0	Hfe	400mV full scale input, no decimal, input through ADP	
1	1	1	1	Temp	(100/Amp, gain)(V/(C input, no decimal, input from ADP2.	

**PIN CONFIGURATION**



**PIN DESCRIPTIONS**

Pin no.	symbol	Description	Pin no.	symbol	Description
1	OP2N	AC measure negative input	51	NC	
2	NC		52	VB	Bias current input
3	OP2O	AC measure positive input	53	NC	
4	AD1P	AC measurement positive input	54	CB	Double voltage capacitor connection
5	NC		55	CA	Double voltage capacitor positive connection
6	AD1N	AC measurement negative input	56	VGG	Double voltage output
7	NC		57	NC	
8	SA	Current measurement ADC connection	58	VDDA	Voltage stabilization output/ analog power
9	SGND	Analog ground ADC negative input	59	RLCD	LCD drive voltage regulate resistor
10	ADP	Additional ADC positive input	60	NC	
11	DT	Diode measurement resistor connection	61	XIN	Oscillator input port

(To be continued)

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Pin no.	symbol	Description	Pin no	symbol	Description
12	NC		62	XOUT	Oscillator output port
13	SMV	High impedance voltage input/R measurement ADC positive input/diode resistor connection	63	NC	
14	CRES1	R measurement filter capacitor connection	64	TXD	Power control
15	RL	Resistor reference voltage input	65	NC	
16	RCAP1	No Use.	66	SEG14	LCD segment 14
17	RCAP2	No Use.	67	SEG13	LCD segment 13
18	ONEK	1.000kΩ resistor	68	SEG12	LCD segment 12
19	NC		69	SEG11	LCD segment 11
20	TENK	10.01kΩ resistor connection	70	SEG10	LCD segment 10
21	NC		71	SEG9	LCD segment 9
22	HUNK	100.1kΩ resistor	72	SEG8	LCD segment 8
23	NC		73	SEG7	LCD segment 7
24	ONEM	1.111MΩ resistor connection	74	SEG6	LCD segment 6
25	NC		75	SEG5	LCD segment 5
26	TENM	10MΩ resistor connection	76	SEG4	LCD segment 4
27	CRES2	The capacitor of Resistor voltage	77	SEG3	LCD segment 3
28	TESTB	Back light control pin	78	SEG2	LCD segment 2
29	ADPC1	No Use.	79	SEG1	LCD segment 1
30	ADPC2	No Use.	80	COM1	Backplane 1 of LCD display
31	SELECT	Measure mode selected	81	COM2	Backplane 2 of LCD display
32	RANGE	Auto/manual switch control	82	COM3	Backplane 3 of LCD display
33	REL	Relative function	83	COM4	Backplane 4 of LCD display
34	HOLD	Display Hold	84	ENTX	no use
35	Hz/DUTY	Hz/DUTY change	85	BEEPER	Beeper output
36	CAP	No Use.	86	BLOUT	Back Light digital output
37	MEA4	Measure mode select 4	87	RST	CPU reset input
38	MEA3	Measure mode select 3	88	NC	
39	MEA2	Measure mode select 2	89	REFI	reference voltage input
40	MEA1	Measure mode select 1	90	REFO	Bandgap reference voltage output
41	LCDC1	No Use.	91	FTA	ADC filter positive output pin
42	LCDC2	No Use.	92	NC	
43	TSTA	Test pin	93	FTB	ADC filter positive input pin
44	GND	2×1.5V battery negative input	94	FTC	ADC preceding filter negative port
45	NC		95	TSTC	Test pin

(To be continued)

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Pin no.	symbol	Description	Pin no	symbol	Description
46	AGND	3V battery midpoint, analog ground.	96	OP1N	AC signal buffer operate amplifier input pin (-)
47	NC		97	NC	
48	VDD	2×1.5V battery positive input	98	OP1O	AC signal buffer operate amplifier output pin
49	NC		99	NC	
50	NC		100	OP2P	AC/Dc switcher OPAMP input pin

## FUNCTION DESCRIPTION

### Auto/manual switch: RANGE

RANGE is the Push-Type switcher, and set in auto switch at power-on. If pressed RANGE key, it switch into manual step. In manual states, press it up jumper one step. If jumper from highest step to lowest step, only need pressed the key for 2 second, automatic switch into auto step. Hz/Duty and CAP because of the measure mode cannot switch into manual switch mode.

### Display hold: HOLD

HOLD Key is the Push-Type switcher, use for holding the display data.

### Relatively value display: REL

REL Key is the Push-Type switcher. Besides Hz/Duty, other measurements have this function, it can automatic switch into auto switch mode.

### Auto power-off

When measure operating more than 15 minutes, and didn't switch the measure step (that is didn't press the push button), it will switch into standby mode automatically. If press the select key, auto power off invalidation.

### Back Light Control:

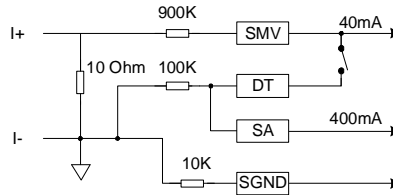
When pressed the BLCTR or RANGE more than 2s, B1OUT will be set to "1", and if press BLCTR again, it will be cleared.

### Beeper

When select、Rel、Hold、Range、HZ/DUTY and BLCTR keys pressed and function switched, the Beeper On about 0.5~1S. When ACV>750V, DCV>1000V, AC/DC $\mu$ A >4000 $\mu$ A, AC/DC mA, AC/DC A>10A, the beeper will hold ON to indicator the warning of the out of range. At one minute before auto power off, beeper will beep five times, and before shut down, beep one time.

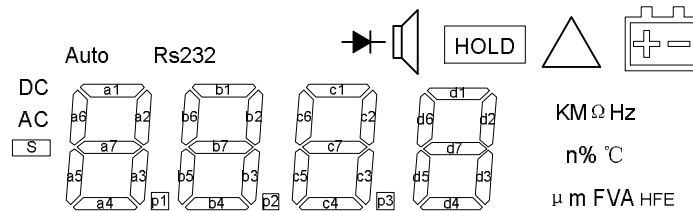
**CURRENT MEASUREMENT**

Current measurement



**LCD DISPLAY**

LCD display



**LCD DISPLAY AND FORMAT**

PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
COM	COM4	COM3	COM2	COM1	SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	SEG8	SEG9	SEG10	SEG11	SEG12	SEG13	SEG14
COM1				COM1	RS232	a1	a2	b1	b2	c1	c2	d1	d2					
COM2			COM2		Auto	a6	a7	b6	b7	c6	c7	d6	d7	K	M		Hz	HFE
COM3		COM3			DC	a5	a3	b5	b3	c5	c3	d5	d3	n	%	Ω	V	°C
COM4	COM4				AC		a4	p1	b4	p2	c4	p3	d4	μ	m	F	A	

**SCHEMATIC**

	Network	Current measure ÷10 R10:R11=9:1	AC measurement R23+VR3,R24=R25	Reference Voltage R18, R19, VR1 Temperature
DC 400mV	No	No	No	Yes
DC 4V	$R5/(R4+R5)=1/10$	No	No	Yes
DC 40V	$R6/(R4+R6)=1/100$	No	No	Yes
DC 400V	$R7/(R4+R7)=1/1000$	No	No	Yes
DC 1000V	$R8/(R4+R8)=1/10000$	No	No	Yes
AC 400mV	$R5/(R4+R5)=1/10$ , R21:R22=9:1	No	Yes	Yes
AC 4V	$R5/(R4+R5)=1/10$	No	Yes	Yes
AC 40V	$R6/(R4+R6)=1/100$	No	Yes	Yes
AC 400V	$R7/(R4+R7)=1/1000$	No	Yes	Yes

(To be continued)

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	Network	Current measure $\pm 10$ R10:R11=9:1	AC measurement R23+VR3,R24=R25	Reference Voltage R18, R19, VR1 Temperature
AC 1000V	$R8/(R4+R8)=1/10000$	No	Yes	Yes
R 400 $\Omega$	$R4/R8=1k\Omega$	No	No	No
R 4k $\Omega$	$R4/R8=1k\Omega$	No	No	No
R 40k $\Omega$	$R4/R7=10k\Omega$	No	No	No
R 400k $\Omega$	$R4/R6=100k\Omega$	No	No	No
R 4M $\Omega$	$R4/R5=1M\Omega$	No	No	No
R 40M $\Omega$	$R4=10M\Omega$	No	No	No
DC 400 $\mu$ A	$R13+R14+R15=1k\Omega$	No	No	Yes
DC 4000 $\mu$ A	$R13+R14+R15=1k\Omega$	Yes	No	Yes
DC 40mA	$R13+R14=10\Omega$	No	No	Yes
DC 400mA	$R13+R14=10\Omega$	Yes	No	Yes
DC 10A	$R13=0.01\Omega$	No	No	Yes
AC 400 $\mu$ A	$R13+R14+R15=1k\Omega$	Yes	Yes	Yes
AC 4000 $\mu$ A	$R13+R14+R15=1k\Omega$	No	Yes	Yes
AC 40mA	$R13+R14=10\Omega$	Yes	Yes	Yes
AC 400mA	$R13+R14=10\Omega$	No	Yes	Yes
AC 10A	$R13=0.01\Omega$	No	Yes	Yes
CAP	R9+VR2	No	No	No
Diode	$(R30+R31)/R31=10$	No	No	Yes

**FUNCTION AND JUMPER SERRING**

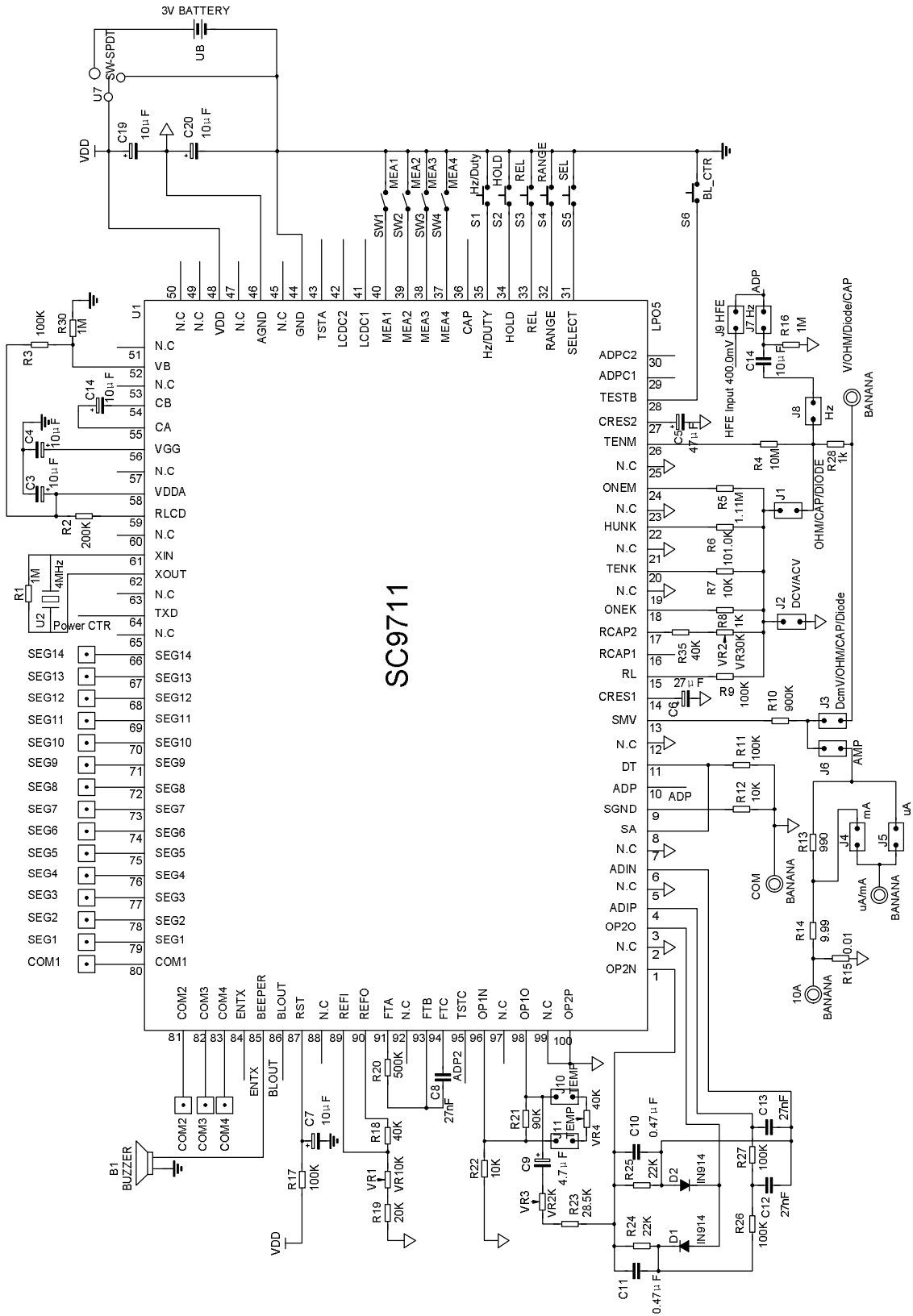
MEA4	MEA3	MEA2	MEA1	Function	Jumper	Input
0	0	0	1	DCV	J2	V/OHM/Diode, COM
0	0	1	0	ACV	J2	V/OHM/Diode, COM
0	0	1	1	OHM	J1, J3	V/OHM/Diode, COM
0	1	0	0	Hz	J7, J8	V/OHM/Diode, COM
0	1	0	1	CAP	J1, J3	V/OHM/Diode, COM
0	1	1	0	Diode/Beeper	J1, J3	V/OHM/Diode, COM
0	1	1	1	$\mu$ A	J5, J6	$\mu$ A/mA, COM
1	0	0	0	V	J2	V/OHM/Diode, COM
1	0	0	1	OHM/Diode/Beeper/CAP	J1, J3	V/OHM/Diode, COM
1	0	1	0	A	J6	10A, COM
1	0	1	1	mA	J4, J6	$\mu$ A/mA, COM
1	1	0	0	Diode	J1, J3	V/OHM/Diode, COM
1	1	0	1	Beeper	J1, J3	V/OHM/Diode, COM
1	1	1	0	Hfe	J9	ADP (pin 10), COM
1	1	1	1	Temp	J10, J11	ADP2 (pin 95), COM



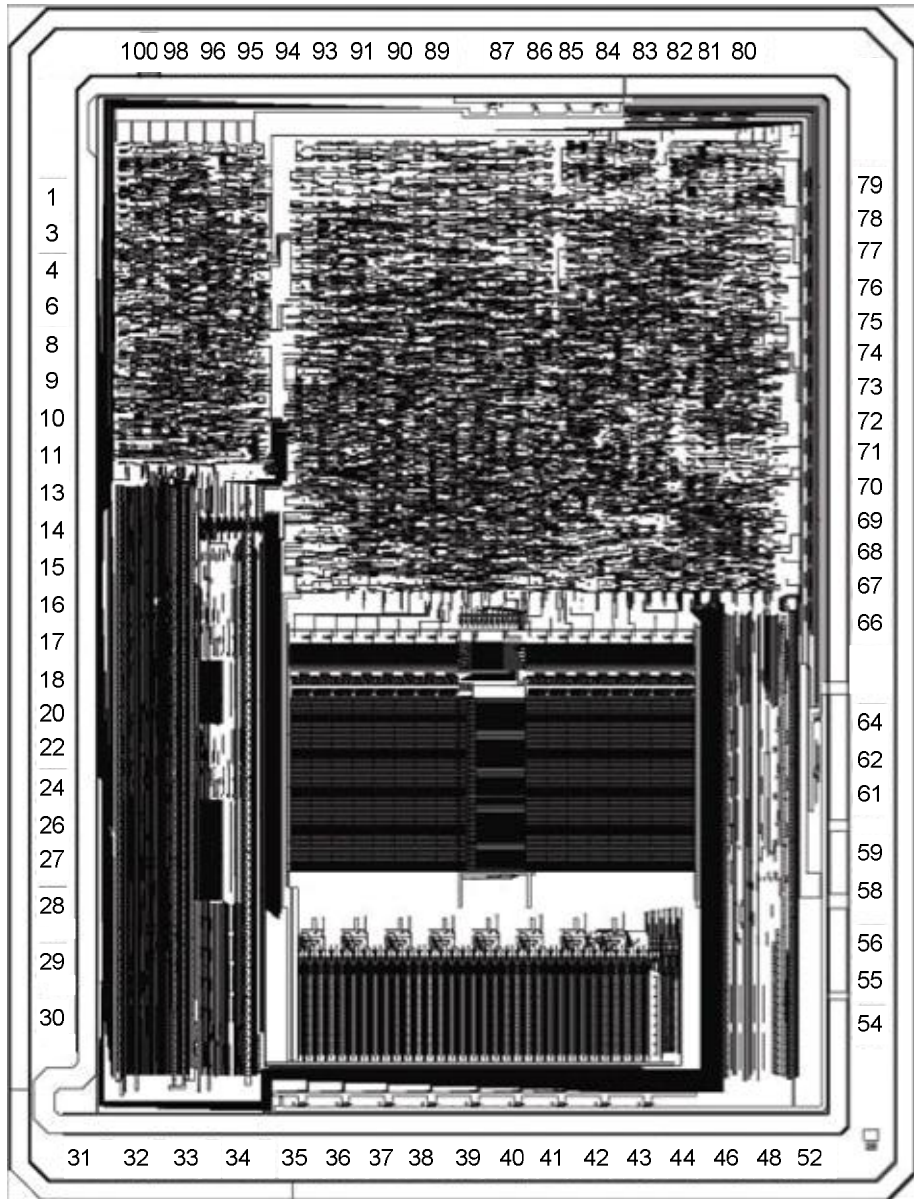
**LIST OF COMPONENT PARAMETER**

PART TYPE	DESIGNATOR	PART TYPE	DESIGNATOR	PART TYPE	DESIGNATOR
0.01	R15	10 $\mu$ F	C14	4.7 $\mu$ F	C9
0.47 $\mu$ F	C10	10 $\mu$ F	C3	40k	R35
0.47 $\mu$ F	C11	10 $\mu$ F	C4	40k	R18
1.111M	R5	1k	R8	47nF	C5
100k	R11	1k	R28	4MHz	U2
100k	R26	1M	R16	500k	R20
100k	R27	1M	R30	9.99	R14
100k	R9	1M	R1	900K	R10
100k	R3	1N914	D1	90k	R21
100k	R17	1N914	D2	990	R13
101.0k	R6	BUZZER	B1	Key	S6
10k	R22	200k	R2	Key	S2
10k	R7	20k	R19	Key	S1
10k	R12	22k	R25	Key	S4
10M	R4	22k	R24	Key	S3
10nF	C7	27nF	C13	Key	S5
10 $\mu$ F	C14	27nF	C6	VR10k	VR1
10 $\mu$ F	C20	27nF	C8	VR2k	VR3
10 $\mu$ F	C19	27nF	C12	VR30k	VR2
		28.5k	R23	VR40k	VR4

**TYPICAL APPLICATION CIRCUIT**



CHIP TOPOGRAPHY



Chip Size: 4.12 x 5.37 (mm<sup>2</sup>)

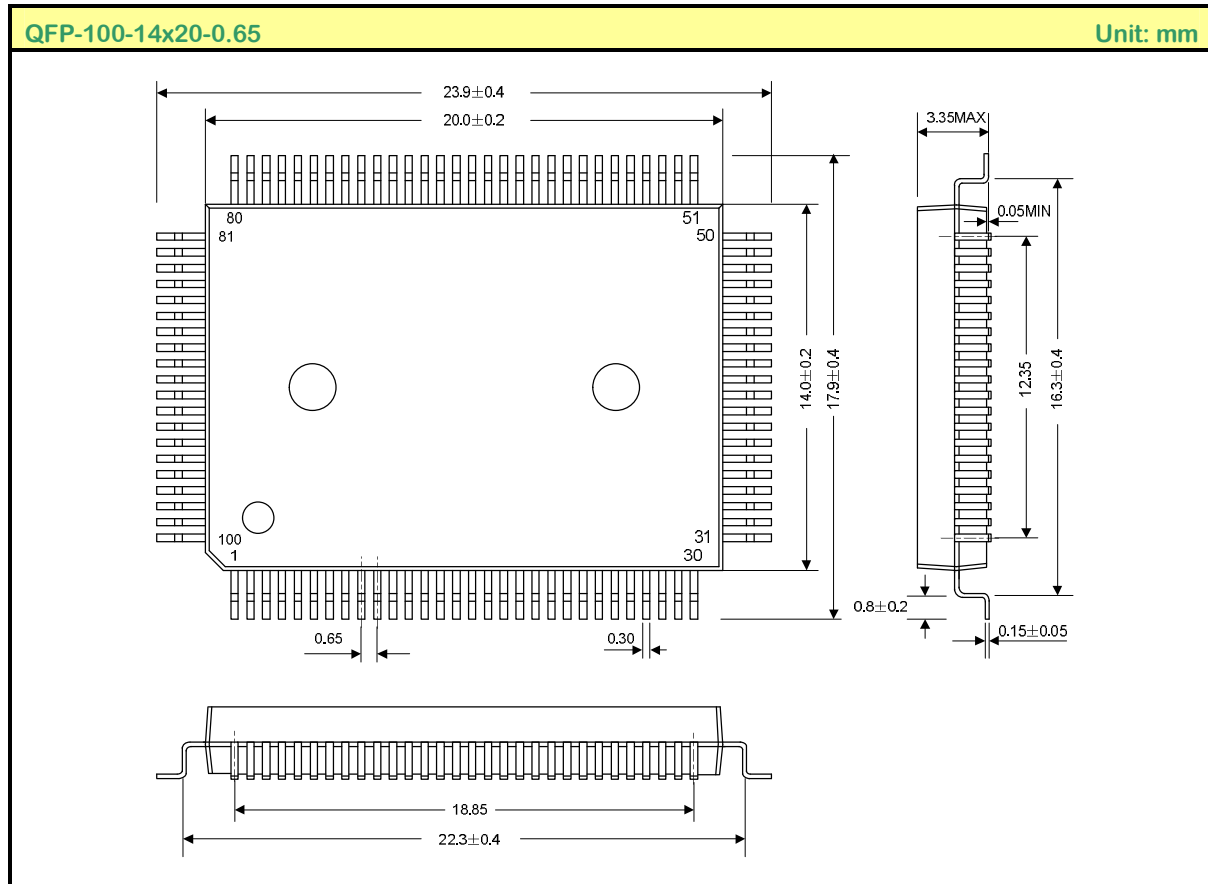
Note: the substrate is connecting with VDD.

**PAD CORRINATES** (Unit:  $\mu\text{m}$ )

Pin no.	Symbol	X	Y	Pin no.	Symbol	X	Y
1	OP2N	819.4	203.75	54	CB	4432.95	3790.65
3	OP2O	980.6	203.75	55	CA	4239.75	3790.65
4	ADIP	1141.8	203.75	56	VGG	4083.55	3790.65
6	ADIN	1303	203.75	58	VDDA	3837.65	3790.65
8	SA	1464.2	203.75	59	RLCD	3696.75	3790.65
9	SGND	1625.4	203.75	61	XIN	3425.75	3790.65
10	ADP	1786.6	203.75	62	XOUT	3274.35	3790.65
11	DT	1947.8	203.75	64	TXD	3113.45	3790.65
13	SMV	2109	203.75	66	SEG14	2667.05	3790.65
14	CRES1	2270.2	203.75	67	SEG13	2521.15	3790.65
15	RL	2431.4	203.75	68	SEG12	2375.25	3790.65
16	RCAP1	2592.6	203.75	69	SEG11	2229.35	3790.65
17	RCAP2	2753.8	203.75	70	SEG10	2083.45	3790.65
18	ONEK	2915	203.75	71	SEG9	1937.55	3790.65
20	TENK	3076.2	203.75	72	SEG8	1791.65	3790.65
22	HUNK	3237.4	203.75	73	SEG7	1645.75	3790.65
24	ONEM	3398.6	203.75	74	SEG6	1499.85	3790.65
26	TENM	3559.8	203.75	75	SEG5	1353.95	3790.65
27	CRES2	3721	203.75	76	SEG4	1208.05	3790.65
28	TESTB	3912.2	203.75	77	SEG3	1062.15	3790.65
29	ADPC1	4162.2	203.75	78	SEG2	916.25	3790.65
30	ADPC2	4412.2	203.75	79	SEG1	770.35	3790.65
31	SELECT	5037.4	324.75	80	COM1	203.8	3216.25
32	RANGE	5037.4	555.55	81	COM2	203.8	3070.35
33	REL	5037.4	786.85	82	COM3	203.8	2924.45
34	Hz/HOLD	5037.4	1018.15	83	COM4	203.8	2778.55
35	DUTY	5037.4	1259.45	84	ENTX	203.8	2623.85
36	CAP	5037.4	1448.7	85	BEEPER	203.8	2453.85
37	MEA4	5037.4	1637.95	86	BLOUT	203.8	2302.65
38	MEA3	5037.4	1827.2	87	RST	203.8	2156.25
39	MEA2	5037.4	2016.45	89	REFI	203.8	1867.65
40	MEA1	5037.4	2205.7	90	REFO	203.8	1706.45
41	LCDC1	5037.4	2394.95	91	FTA	203.8	1545.25
42	LCDC2	5037.4	2584.2	93	FTB	203.8	1384.05
43	TSTA	5037.4	2773.45	94	FTC	203.8	1222.85
44	GND	5037.4	2963.2	95	TSTC	203.8	1061.65
46	AGND	5037.4	3146.1	96	OP1N	203.8	900.45
48	VDD	5037.4	3335.85	98	OP1O	203.8	739.25
52	VB	5037.4	3515.2	100	OP2P	203.8	578.05

Note: the original point of the coordinate is the die center.

PACKAGE OUTLINE



**HANDLING MOS DEVICES:**

Electrostatic charges can exist in many things. All of our MOS devices are internally protected against electrostatic discharge but they can be damaged if the following precautions are not taken:

- Persons at a work bench should be earthed via a wrist strap.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed for dispatch in antistatic/conductive containers.



ATTACHMENT

Revision History

Data	REV	Description	Page
2004.08.04	1.0	Original	
2007.11.07	1.1	Modify the "FUNCTION AND JUMPER SERRING"	