EPSON

E0C62M2

4-bit Single Chip Microcomputer

Low Voltage Operation Products

- Core CPU Architecture
- Dual Slope Type A/D Converter
- High Quality Display LCD Driver
- SVD Circuit

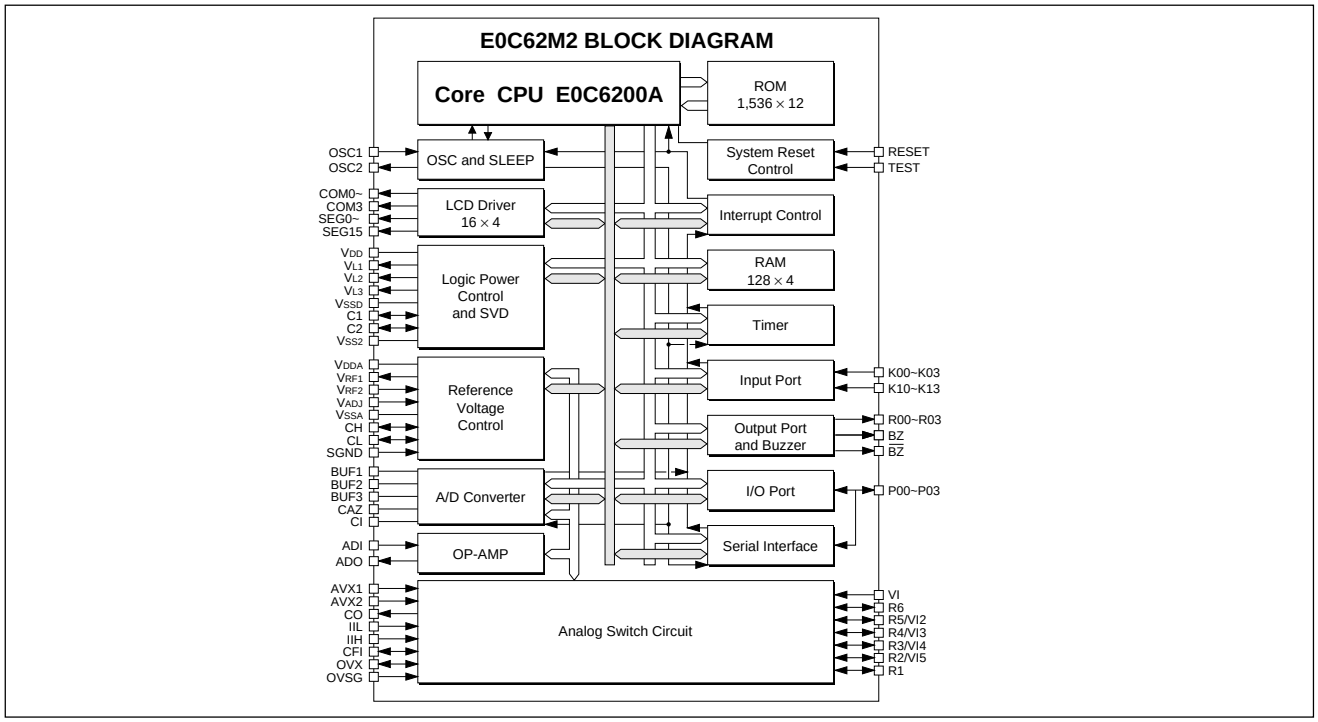
■ DESCRIPTION

The E0C62M2 is a CMOS 4-bit single-chip microcomputer made up of the 4-bit core CPU E0C6200A, ROM, RAM, dual slope type A/D converter, attenuator circuit for various measurement modes, LCD driver, serial interface, and other circuits. It is especially suitable for measurement and LCD display systems such as a digital multimeter.

■ FEATURES

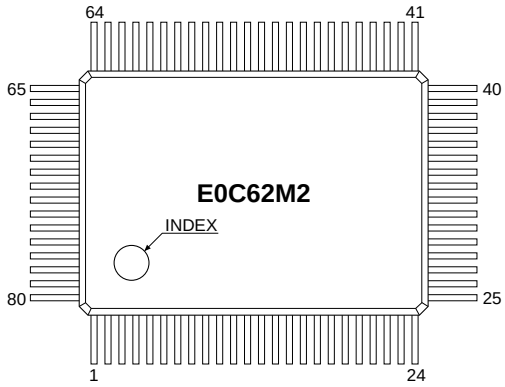
- CMOS LSI 4-bit parallel processing
- Clock ..... 32.768kHz (Typ.)
- Instruction set ..... 100 instructions
- Instruction execution time 153µsec, 214µsec, 366µsec
- ROM capacity ..... 1,536 words × 12 bits
- RAM capacity ..... 128 words × 4 bits
- A/D converter ..... Dual slope type
  Resolution : Conversion time (2 stages)
  4,370 counts : 400 msec
  A/D conversion precision: ±0.1%
  (operating temperature range: 20°C to 40°C)
  441 counts : 100 msec (High speed mode)
  3 integral resistors can be connected
  Current, voltage and resistance can be measured
  AC voltage/AC current can be measured using an external rectifier circuit
  Continuity check mode built-in (measurement value can be displayed)
  Reference voltage generation circuit built-in
- Input port ..... 8 bits (pull down resistors can be supplemented by mask option)
- Output port ..... 4 bits
- Buzzer output ..... 2 ports (BZ, $\overline{BZ}$)
- I/O port ..... 4 bits
- Serial interface ..... 1 port for data input
  1 port for data output
  1 port for clock input/output
  } These ports can be switched to general I/O port
- LCD driver ..... 16 segments × 3 or 4 commons (can be switched using software)
  LCD drive voltage generation circuit built-in (V_{L1}, V_{L2}, V_{L3})
  Compatible with 3V LCD panel
- Timer ..... Built-in
- Watchdog timer ..... Built-in
- Supply voltage detection (SVD) circuit .. 2.3 ± 0.15V
- Interrupt ..... External : Input port interrupt 2 systems
  Internal : A/D interrupt 1 system
  Timer interrupt 1 system
  Serial interface interrupt 1 system
- Supply voltage ..... 3.0V (2.15V to 3.5V)
- Current consumption (Typ.) ..... HALT mode (32.768kHz/3.0V) : 3µA (Typ.)
  A/D operating (32.768kHz/3.0V) : 0.9mA (in DC measurement)
  A/D operating (32.768kHz/3.0V) : 1.1mA (in AC measurement)
- Package ..... QFP5-80pin (plastic/ceramic), QFP14-80pin (plastic) or chip

■ BLOCK DIAGRAM



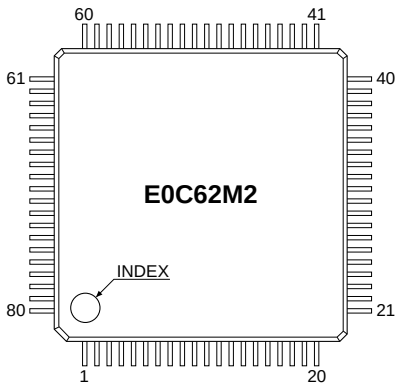
■ PIN CONFIGRATION

QFP5-80pin



No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name
1	SEG15	21	V_{RF1}	41	OVSG	61	$\overline{BZ}$
2	COM0	22	V_{RF2}	42	R1	62	P00/SIN
3	COM1	23	CH	43	R2/VI5	63	P01/SOUT
4	COM2	24	CL	44	R3/VI4	64	P02/SCLK
5	COM3	25	ADI	45	R4/VI3	65	P03/SRDY
6	V_{L1}	26	ADO	46	R5/VI2	66	SEG0
7	V_{L2}	27	AVX1	47	R6	67	SEG1
8	V_{L3}	28	AVX2	48	K00	68	SEG2
9	V_{DD}	29	CO	49	K01	69	SEG3
10	OSC1	30	CAZ	50	K02	70	SEG4
11	OSC2	31	CI	51	K03	71	SEG5
12	RESET	32	BUF1	52	K10	72	SEG6
13	TEST	33	BUF2	53	K11	73	SEG7
14	V_{SSD}	34	BUF3	54	K12	74	SEG8
15	C1	35	IIL	55	K13	75	SEG9
16	C2	36	IIH	56	R00	76	SEG10
17	V_{SS2}	37	CFI	57	R01	77	SEG11
18	V_{DDA}	38	SGND	58	R02	78	SEG12
19	V_{SSA}	39	VI	59	R03	79	SEG13
20	V_{ADJ}	40	OVX	60	BZ	80	SEG14

QFP14-80pin



No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name
1	COM2	21	CL	41	R3/VI4	61	P02/SCLK
2	COM3	22	ADI	42	R4/VI3	62	P03/SRDY
3	V_{L1}	23	ADO	43	R5/VI2	63	SEG0
4	V_{L2}	24	AVX1	44	R6	64	SEG1
5	V_{L3}	25	AVX2	45	K00	65	SEG2
6	V_{DD}	26	CO	46	K01	66	SEG3
7	OSC1	27	CAZ	47	K02	67	SEG4
8	OSC2	28	CI	48	K03	68	SEG5
9	RESET	29	BUF1	49	K10	69	SEG6
10	TEST	30	BUF2	50	K11	70	SEG7
11	V_{SSD}	31	BUF3	51	K12	71	SEG8
12	C1	32	IIL	52	K13	72	SEG9
13	C2	33	IIH	53	R00	73	SEG10
14	V_{SS2}	34	CFI	54	R01	74	SEG11
15	V_{DDA}	35	SGND	55	R02	75	SEG12
16	V_{SSA}	36	VI	56	R03	76	SEG13
17	V_{ADJ}	37	OVX	57	BZ	77	SEG14
18	V_{RF1}	38	OVSG	58	$\overline{BZ}$	78	SEG15
19	V_{RF2}	39	R1	59	P00/SIN	79	COM0
20	CH	40	R2/VI5	60	P01/SOUT	80	COM1

■ PIN DESCRIPTION

Pin name	Pin No.		I/O	Function
	QFP5-80	QFP14-80		
V_{DD}	9	6	(I)	Digital system power supply pin (+)
V_{DDA}	18	15	(I)	Analog system power supply pin (+)
V_{SSD}	14	11	(I)	Digital system power supply pin (–)
V_{SSA}	19	16	(I)	Analog system GND pin (same voltage with V_{SSD})
V_{SS2}	17	14	(O)	Analog system power supply pin (boosted voltage)
C1, C2	15, 16	12, 13	O	Booster capacitor connecting pins for analog system power supply (V_{SS2})
OSC1	10	7	I	Crystal oscillation input pin: 32.768 kHz
OSC2	11	8	O	Crystal oscillation output pin
K00–K13	48–55	45–52	I	Input pins
R00–R03	56–59	53–56	O	Output pins
BZ, $\overline{BZ}$	60, 61	57, 58	O	Buzzer signal output pins
P00–P03	62–65	59–62	I/O	I/O pins
V_{L1}–V_{L3}	6–8	3–5	O	LCD system voltage output pin
COM0–3	2–5	79, 80, 1, 2	O	LCD common output pins (1/3, 1/4 duty, programmable)
SEG0–15	66–80, 1	63–78	O	LCD segment output pin (DC output may be selected by mask option)
V_{ADJ}	20	17	–	Reference voltage adjustment pin
V_{RF1}	21	18	–	Reference voltage output pin
V_{RF2}	22	19	–	Reference voltage output pin
ADI	25	22	I	OP-AMP inverted input pin for AC-DC conversion
ADO	26	23	O	OP-AMP output pin for AC-DC conversion
AVX1	27	24	–	AC-DC converted voltage input pin
AVX2	28	25	–	AC-DC converted voltage input pin
IIL, IIH	35, 36	32, 33	–	Input pins for current measurement
VI	39	36	–	Input pin for voltage measurement
R1	42	39	–	Reference resistor connecting pin (100 Ω)
R2/VI5	43	40	–	Reference resistor connecting pin (1 kΩ)
R3/VI4	44	41	–	Reference resistor connecting pin (10 kΩ)
R4/VI3	45	42	–	Reference resistor connecting pin (101 kΩ)
R5/VI2	46	43	–	Reference resistor connecting pin (1.11 MΩ)
R6	47	44	–	Reference resistor connecting pin (10 MΩ)
OVX	40	37	–	Reference resistor voltage input pin for resistance measurement
OVSG	41	38	–	Reference resistor voltage input pin for resistance measurement
SGND	38	35	–	GND for measurement
CO	29	26	–	Dummy pad
CAZ	30	27	–	Capacitor connecting pin for offset voltage zero adjustment
CI	31	28	–	Integral capacitor connecting pin
BUF1–3	32–34	29–31	–	Buffer AMP output, integral resistor connecting pin
CFI	37	34	–	Noise rejection filter connecting pin
CH	23	20	–	Capacitor connecting pin for reference voltage control
CL	24	21	–	Capacitor connecting pin for reference voltage control
TEST	13	10	I	Testing input pin
RESET	12	9	I	Initial reset input pin

■ ELECTRICAL CHARACTERISTICS

● Absolute Maximum Ratings

(V_{DD}/V_{DDA}=0V)

Rating		Symbol	Value	Unit
Supply voltage		V_{DD}/V_{DDA}	0	V
		V_{SSD}/V_{SSA}	-3.5	V
		V_{SS2}	-7.0	V
Input voltage	V_{SSD} system	V_{I1}	(V_{SSD}/V_{SSA} - 0.3) to (V_{DD}/V_{DDA} + 0.3)	V
	V_{SS2} system	V_{I2}	(V_{SS2} - 0.3) to (V_{DD}/V_{DDA} + 0.3)	V
Permissible total output current *1		ΣI	10	mA
Operating temperature (1)		$Topr_1$	-20 to 70	°C
Operating temperature (2) *2		$Topr_2$	0 to 40	°C
Storage temperature		Tstg	-65 to 150	°C
Soldering temperature / Time		Tsol	260°C, 10sec (lead section)	–
Permissible dissipation *3		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 drawn in).
*2: The A/D converter is ON status.
*3: In case of plastic package (QFP5-80pin, QFP14-80pin).

● Recommended Operating Conditions

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Supply voltage	V_{SSD}/V_{SSA}	V_{DD}/V_{DDA}=0V	-3.5	-3.0	-2.15	V
Oscillation frequency	f_{OSC1}		–	32.768	–	kHz
Measurement system operating temperature	Tmes	During measurement by the A/D converter	15	25	35	°C

● DC Characteristics

(Unless otherwise specified: V_{DD}/V_{DDA}=0V, V_{SSD}/V_{SSA}=-3.0V, f_{OSC1}=32.768kHz, Ta=25°C, V_{L1}–V_{L3} are internal voltage)

Characteristic	Symbol	Condition		Min.	Typ.	Max.	Unit
High level input voltage (1)	V_{IH1}		K00–K03, K10–K13 RESET, TEST	0.1•V_{SSD}		V_{DD}	V
High level input voltage (2)	V_{IH2}		P00–P03	0.1•V_{SSD}		V_{DD}	V
Low level input voltage (1)	V_{IL1}		K00–K03, K10–K13 RESET, TEST	V_{SSD}		0.9•V_{SSD}	V
Low level input voltage (2)	V_{IL2}		P00–P03	V_{SSD}		0.9•V_{SSD}	V
High level input current (1)	I_{IH1}	V_{IH1}=V_{DD}, V_{SSD}=-3.0V Without pull down resistor	K00–K03, K10–K13 P00–P03, RESET, TEST	0		0.5	µA
High level input current (2)	I_{IH2}	V_{IH2}=V_{DD}, V_{SSD}=-3.0V With pull down resistor	K00–K03, K10–K13 P00–P03, RESET, TEST	5	10	20	µA
Low level input current	I_{IL}	V_{IL}=V_{SSD}=-3.0V	K00–K03, K10–K13 P00–P03, RESET, TEST	-0.5		0	µA
High level output current (1)	I_{OH1}	V_{OH1}=0.1•V_{SSD}, V_{SSD}=-3.0V	R00–R03, P00–P03			-0.9	mA
High level output current (2)	I_{OH2}	V_{OH2}=0.1•V_{SSD}, V_{SSD}=-3.0V	BZ, $\overline{BZ}$			-1.2	mA
Low level output current (1)	I_{OL1}	V_{OL1}=0.9•V_{SSD}, V_{SSD}=-3.0V	R00–R03, P00–P03	3.0			mA
Low level output current (2)	I_{OL2}	V_{OL2}=0.9•V_{SSD}, V_{SSD}=-3.0V	BZ, $\overline{BZ}$	3.5			mA
Common output current	I_{OH3}	V_{OH3}=V_{DD}-0.05V	COM0–COM3			-3.0	µA
	I_{OL3}	V_{OL3}=V_{L3}+0.05V		3.0			µA
Segment output current (during LCD output)	I_{OH4}	V_{OH4}=V_{DD}-0.05V	SEG0–SEG15			-3.0	µA
	I_{OL4}	V_{OL4}=V_{L3}+0.05V		3.0			µA
Segment output current (during DC output)	I_{OH5}	V_{OH5}=0.1•V_{SSD}	SEG0–SEG15			50	mA
	I_{OL5}	V_{OL5}=0.9•V_{SSD}		-70			mA

● Analog Circuit Characteristics and Current Consumption

(Unless otherwise specified: V_{DD}/V_{DDA}=0V, V_{SSD}/V_{SSA}=-3.0V, f_{OSC1}=32.768kHz, Ta=25°C, V_{L1}–V_{L3} are internal voltage)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
LCD drive voltage	V_{L1}	Connect 1MΩ load resistor between V_{DD} and V_{L1}, C_{L1}=0.047µF	-1.15	-1.05	-0.95	V
	V_{L2}	Connect 1MΩ load resistor between V_{DD} and V_{L2}, C_{L2}=0.047µF	-2.20	-2.10	-2.00	V
	V_{L3}	Connect 1MΩ load resistor between V_{DD} and V_{L3}, C_{L3}=0.047µF	-3.25	-3.15	-3.05	V
SVD voltage	V_{SVD}		-2.45	-2.30	-2.15	V
SVD circuit response time	t_{SVD}				100	µS
Power current consumption	I_{OP}	During SLEEP V_{SSD}/V_{SSA}=-3.0V		1.5	4.0	µA
		During HALT V_{SSD}/V_{SSA}=-3.0V		3.0	6.0	µA
		During A/D operation *1 V_{SSD}/V_{SSA}=-3.0V		0.9	2.0	mA
		During A/D operation *2 V_{SSD}/V_{SSA}=-3.0V		1.1	2.2	mA

*1: DCV and DCA measurement mode
*2: DCV and ACV measurement mode (The general AMP is ON status.)

A/D Converter

(Unless otherwise specified: V_{DD}/V_{DDA}=0V, V_{SSD}/V_{SSA}=-3.0V, f_{OSC1}=32.768kHz, Ta=25°C, V_{L1}–V_{L3} are internal voltage)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Sampling time	S_{t1}	A/D conversion in normal mode		100		mS
	S_{t2}	A/D conversion in high speed mode		10		mS
Sampling rate	S_{r1}	A/D conversion in normal mode		2.5		/S
	S_{r2}	A/D conversion in high speed mode		10		/S
Linearity error	L_{IN}	A/D conversion in normal mode	-0.2		0.2	%FS
Porality error	E_P	A/D conversion in normal mode	-2		+2	dgt
Zero point error	Z_{OFF}	A/D conversion in normal mode	-2		+2	dgt
Voltage range	V_{SSD}/V_{SSA}	V_{DD}=V_{DDA}=0V	-3.5		V_{SVD} *1	V

*1: V_{SVD}: SVD judgment voltage

Reference Voltage Generator

(Unless otherwise specified: V_{DD}/V_{DDA}=0V, V_{SSD}/V_{SSA}=-3.0V, f_{OSC1}=32.768kHz, Ta=25°C, V_{L1}–V_{L3} are internal voltage)

Characteristic	Symbol	Condition		Min.	Typ.	Max.	Unit
Temperature characteristics	V_{refT}	0 to 40°C		-300	0	300	ppm/deg
Supply voltage characteristics	V_{refV}	V_{SSA} (V_{SSD})=-2.15 to -3.5V		-0.1		0.1	%
Reference voltage output	V_{ref1}	Short-circuit between V_{RF1} and V_{ADJ} terminals Voltage between V_{RF1} and V_{SSA} Connect 70 kΩ load resistor between V_{RF1} and V_{SSA}		400		780	mV
Output voltage during resistance measurement	Vrmes	V_{RF1}-V_{SSA}=1.0V (Output voltages are values in case of V_{SSA} standard)	400Ω range		V_{DDA}		V
			4kΩ range		0.7		V
			40kΩ range		0.47		V
			400kΩ range		0.47		V
			4MΩ range		0.47		V
			40MΩ range		0.47		V

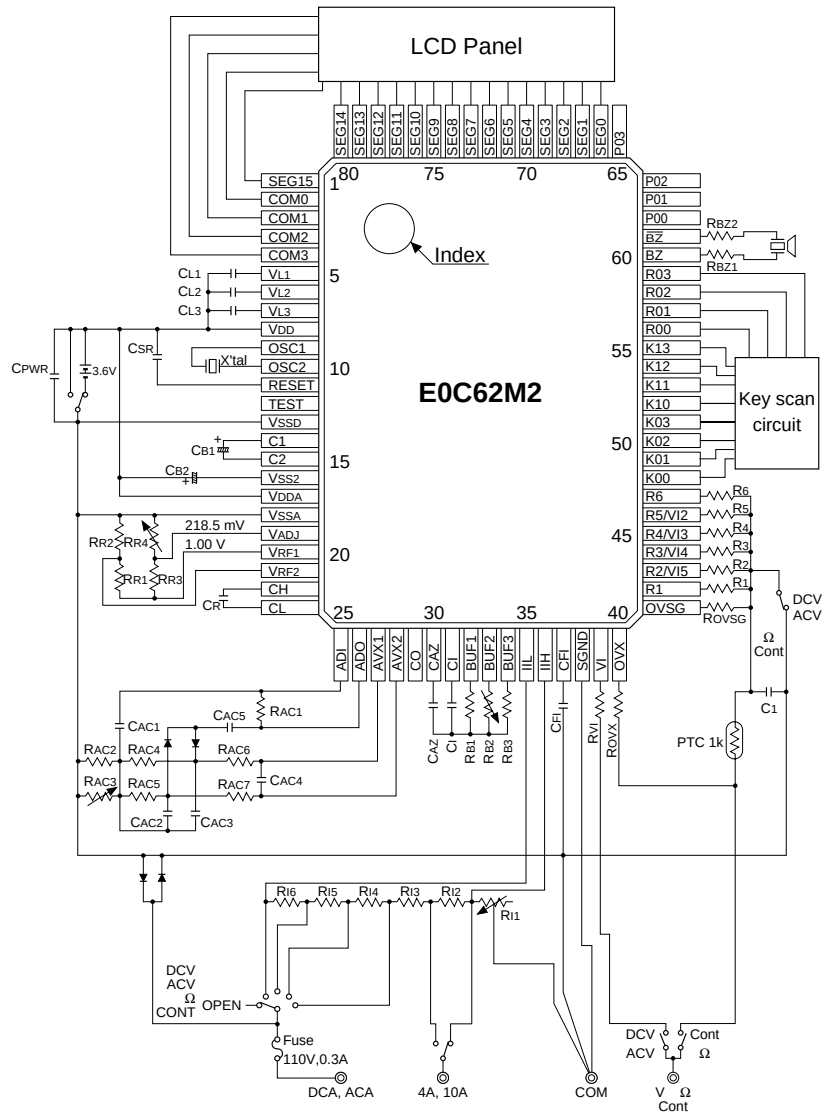
● Oscillation Characteristics

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

(Unless otherwise specified: V_{DD}/V_{DDA}=0V, V_{SSD}/V_{SSA}=-3.0V, Crystal: C-002R (C_I=35kΩ), C_G=C_D=built-in, f_{OSC1}=32.768kHz, Ta=25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	Vsta	t_{sta} ≤ 3sec			-2.15	V
Oscillation stop voltage	Vstp	t_{stp} ≤ 10sec			-1.8	V
Built-in capacitance (gate)	C_G			20		pF
Built-in capacitance (drain)	C_D			15		pF
Harmonic oscillation start voltage	V_{hho}				-3.5	V
Permitted leak resistance	R_{leak}		200			MΩ

■ BASIC EXTERNAL CONNECTION DIAGRAM



Parts	Value	SR
C_{L1}	0.047 µF	
C_{L2}	0.047 µF	
C_{L3}	0.047 µF	
C_{SR}	0.33 µF	
C_{B1}	2.2 µF	
C_{B2}	2.2 µF	
C_R	0.22 µF	
C_{AC1}	0.1 µF	
C_{AC2}	2.2 µF	
C_{AC3}	2.2 µF	
C_{AC4}	0.22 µF	
C_{AC5}	0.1 µF	
C_{AZ}	0.1 µF	
C_1	0.1 µF	
C_{FI}	0.01 µF	
C_I	0.1 µF	
R_{R1}	82 kΩ	1.0 %
R_{R2}	22 kΩ	1.0 %
R_{R3}	120 kΩ	1.0 %
R_{R4}	75~412 kΩ	
R_{AC1}	22 MΩ	1.0 %
R_{AC2}	21 kΩ	1.0 %
R_{AC3}	500 kΩ	
R_{AC4}	22 kΩ	1.0 %
R_{AC5}	22 kΩ	1.0 %
R_{AC6}	330 kΩ	1.0 %
R_{AC7}	330 kΩ	1.0 %
R_{B1}	390 kΩ	0.1 %
R_{B2}	-329 kΩ	
R_{B3}	39 kΩ	0.1 %
R_{VI}	10 MΩ	0.1 %
R_{OVX}	1 MΩ	
R_{OVSG}	680 kΩ	
R_1	100 Ω	0.1 %
R_2	1 kΩ	0.1 %
R_3	10 kΩ	0.1 %
R_4	101 kΩ	0.1 %
R_5	1.11 MΩ	0.1 %
R_6	10 MΩ	0.1 %
R_{BZ1}	100 Ω	
R_{BZ2}	100 Ω	
R_{I1}	0.01 Ω	0.5 %
R_{I2}	0.09 Ω	0.5 %
R_{I3}	0.9 Ω	0.5 %
R_{I4}	9 Ω	0.5 %
R_{I5}	90 Ω	0.5 %
R_{I6}	900 Ω	0.5 %
PTC	1 kΩ	

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

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