To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M62303FP

HIGH PRECISION DOUBIE INTEGRATION TYPE A-D CONVERTER

DESCRIPTION

M62303FP is a double integration type A-D converter support system, and is a semiconductor integrated circuit which can work as A-D converter of 14 bits or more by being used with MCU and by inputting SI, SCK1, CS, and CONTIN.
High precision A-D translation system can be realized without using high precision external parts by proofreading A-D acquired values with two or more known conversion values such as reference voltage, grounding (zero) voltage and so forth.

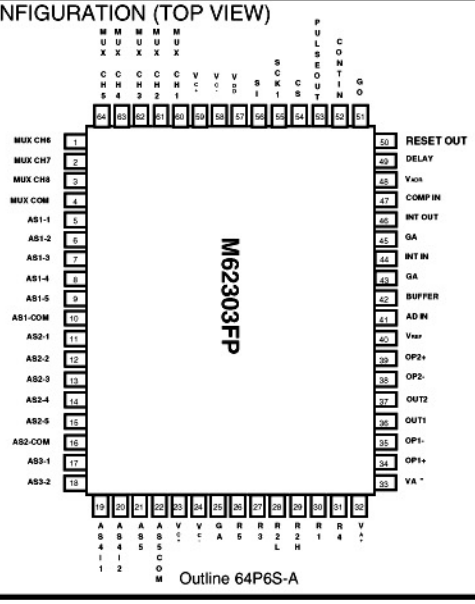
FEATURES

- High precision (14 bits or more) double integration type A-D converter
- Positive/negative constant voltage source built-in (TYP. +6.3v, -6.0v)
- Positive/negative constant current source built-in (max Isource=2mA, Isink=0.2mA)
- Independent 2CH operational amplifier built-in
- System reset built-in (TYP 4.5v)

APPLICATION

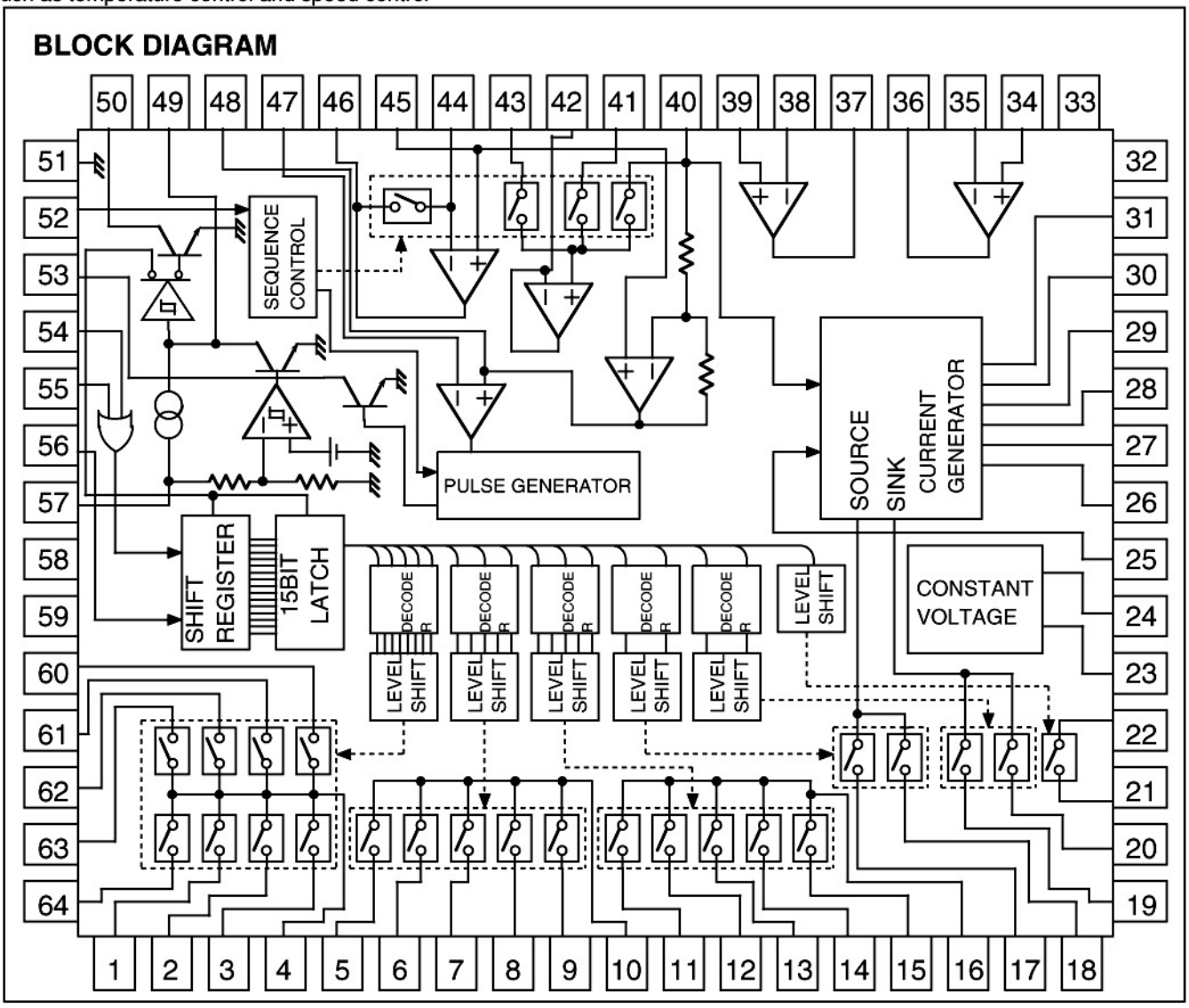
- High precision control systems, such as temperature control and speed control

PIN CONFIGURATION (TOP VIEW)

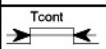


Outline 64P6S-A

BLOCK DIAGRAM



EXPLANATION OF TERMINALS

Pin No	Symbol	Function
56	SI	Serial data input terminal. Serial data of 15 bits data length is input.
55	SCK1	Shift clock input terminal. Signal from SI terminal is input into 15-bit shift register at the rise of a clock.
54	CS	"L" level of this terminal enables shift clock, and "H" level makes shift register contents stored into multiplexer control register(anlog switches) and unenables clock input.
52	CONT IN	 A pulse is input. Double integration type A/D converter is started synchronizing with this pulse. Moreover, the optimal full scale can be set up by setting up with C and R so that it may be set to TCONT<=2.14CR.
57	VDD	Digital part power supply terminal
51	GD	Digital part GND terminal.This terminal is externally connected to analog ground terminal when IC is operative.
50	RESET OUT	Output terminal of reset circuit supervising the fall of a digital part power supply.
49	DERAY	Reset output rise is delayed by adding capacitor..
60,61,62,63 64,1,2,3	MUX1~ 8	Input side terminal of multiplexer (analog switch group) MUX.
4	MUXCOM	Output side COMMON terminal of multiplexer MUX.
5,6,7,8,9	AS1-1~ 5	Input side terminal of multiplexer (analog switch group) AS1.
10	AS1COM	Output side COMMON terminal of multiplexer AS1.
11,12,13,14,15	AS2-1~ 5	Input side terminal of multiplexer (analog switch group) AS2
16	AS2COM	Output side COMMON terminal of multiplexer AS2.
17,18	AS3-1~ 2	Source type constant current source output terminal
19,20	AS4-1~ 2	Sink type constant current source output terminal
21	AS5	Analog switch AS5 input side terminal
22	AS5COM	Analog switch AS5 output side terminal
23,59	VC+	Positive power supply output terminal for analog switch drive
24,58	VC-	Negative power supply output terminal for analog switch drive
25	GA	Analog part GND terminal
26 27 28 29	R5 R3 R2L R2H	Reference currnet setting terminal for constant current source
30	R1	Source type output current setting terminal for constant current source
31	R4	Sink type output current setting terminal for constant current source
32	VA+	Analog part positive power supply terminal
33	VA-	Analog part negative power supply terminal
34	OP1+	Operational amplifier 1 non-inverting input terminal
35	OP1-	Operational amplifier 1 inverting input terminal
36	OUT1	Operational amplifier 1 output terminal
37	OUT2	Operational amplifier 2 output terminal
38	OP2-	Operational amplifier 2 inverting input terminal
39	OP2+	Operational amplifier 2 non-inverting input terminal
40	VREF	Standard voltage input for standard integration, and constant standard voltage input terminal for source current source setup
41	ADIN	A/D conversion input terminal. Analog signal into ADIN terminal is converted into pulse width proportional to the input voltage.
42	BUFFER	Output terminal of buffer amplifier which receives VREF, ADIN, and GA input. Internal analog switch for A/D conversion is switched by the CONTIN signal, and the voltage of three types of VREF, ADIN, and GA is output to BUFFER terminal through buffer amplifier.
43,45	GA	Analog part GND terminal
44	INTIN	Input terminal of integration amplifier
46	INTOUT	Output terminal of integration amplifier
47	COMPIN	Input terminal of the comparator part of a double integration type A/D converter
48	VADR	Power supply output terminal used for refernce terminal of comparator
53	PULSEOUT	A-D translation output terminal. Input analog signal is changed into pulse to be output.

ELECTRICAL CHARACTERISTICS

1. ABSOLUTE MAXIMUM RATINGS(Ta=25˚C, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{A^+}- V_{A^-}	Analog power supply voltage		22	V
V_{C^+}- V_{C^-}	Switch part power supply voltage		13.2	V
V_{DD}	Digital section supply voltage		-0.3~+7	V
V_{AIN}	A/D converter analog input voltage		-4~+4	V
Isink(PO)	PULSE OUT output current		10	mA
Isink(RE)	Reset output current		10	mA
V_{SWIN}	Switch input voltage		V_{C^-} ~ V_{C^+}	V
		At the time of fault voltage impression	V_{A^-} ~ V_{A^+} *1	
I_{SWIN}	Switch input current	(Per onepin)	+20 *1	mA
		(All theswitch sum totals)	+100 *1	
V_{DIN}	Digital input voltage		-0.3~ VDD+0.3	V
Pd	Power dissipation		740	mW
Topr	Operating temperature		-20~+75	˚C
Tstg	Storage temperature		-40~+125	˚C

* 1 represents the protection level at the time of abnormalities.

2. OPERATING CONDITIONS (Ta=25˚C)

Block	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Analog	V_{A^+}	Power supply voltage (positive side)		+8.1	+12	+13	V
	V_{A^-}	Power supply voltage (negative side)		-9	-8	-7.2	V
	I_{A^+}	Power supply current (positive side)		-	13	17	mA
	I_{A^-}	Power supply current (negative side)		-	12	17	mA
	V_{REF}	A/D converter analog standard voltage		1.0	2.5	3.0	V
	V_{AIN}	A/D converter analog input voltage		-V_{REF}		V_{REF}	V
	VSWIN	Switch input voltage		-6		+6	V
	TCONT	Input integration time		2		20	msec
Digital	V_{DD}	Power supply voltage		4.80 *2	5.0	5.5	V
	I_{DD}	Power supply current		-	1.8	3	mA
	V_{IN}	High-level input voltage		2.4			V
	V_{IL}	Low-level input voltage				0.8	V
	t_{SCSK}	Serial clock waiting time	CS↓→SCKI↓	250			nsec
	t_{SIK}	Serial input setup time	SI → SCKI↑	100			nsec
	t_{HKI}	Serial input hold time	SCKI↑→ SI	50			nsec
	t_{WLK}	Serial clock low level time		200			nsec
	t_{WHK}	Serial clock high level time		200			nsec
	t_{HKCS}	Chip selection hold time	SCKI↑→ CS↑	50			nsec
External parts	C_{INT} * 3	Integration capacitance			0.015		uF
	R_{INT}	Voltage current conversion resistor		56	230	500	K

*2 represents the reset release voltage.
*3....Set up as in 2.14 R_{INT}-C_{INT} T_{CONT}.

3 . ELECTRICAL CHARACTERISTICS(Ta=25˚C, unless otherwise noted)

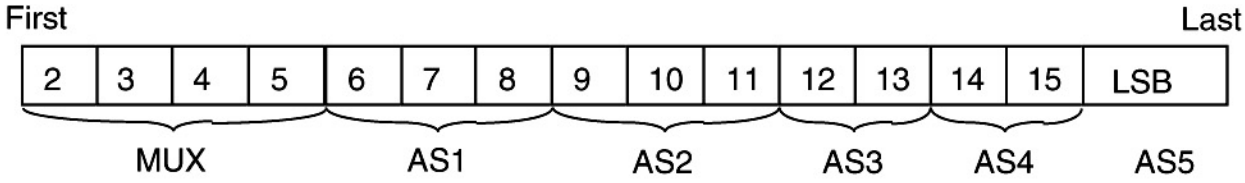
VA^+=12V, VA^-=-SV, V_{REF}=2.5V, V_{DD}=5.0V, T_{CONT}=7.3msec

Block	Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
A/D conversion machine	I_I	Analog input current				20	80	nA
	ER	Resolution			14			Bit
	N. L	Linearity error *1				0.012		%FS
	-	Conversion range of fluctuation *2				0.006		%FS
	Tc	Conversion time	CINT=0.015μF RINT=230K	VAIN=2.5V		8.28		msec
				VAIN=0V		15.58		
				VAIN=-2.5V		22.88		
	$V_{po(sat)}$	Saturation voltage	ISINK(PO)=6mA				0.4	V
Power supply	V_{ADR}	Conversion standard voltage			-6.3	-6.0	-5.7	V
	V_C^+	Output voltage for switch part power supplies			+6.0	+6.3	+6.6	V
	V_C^-	Output voltage for switch part power supplies			-6.6	-6.3	-6.6	V
	△Vc	Input voltage fluctuation	VA^+:8.1~13V , VA^+ :-9~-7.2V				100	mV
Switch part	R_{ON}	ON resistance	-6V Vds 6V Id=1mA	Ta=25˚C		100	200	
				Ta= -40C			200	
				Ta=85˚C			300	
		RON match				10	30	%
	△RON/△T	RON drift				0.5		%/˚C
	Isoff	Input off-leak current	Vd=-6V,Vs=6V and Vs=-6V,Vd=6V	Ta=25˚C		±0.1	±100	nA
				Ta=0˚C			±100	
				Ta=50˚C			±100	
	I_{Doff}	Output off-leak current	Vd=-6V,Vs=6V and Vs=-6V,Vd=6V	Ta=25˚C		±0.1	±100	nA
				Ta=0˚C			±100	
				Ta=50˚C			±100	
	IDon	On-channel leak current	Vs=Vd=6V and Vs=Vd=-6V	Ta=25˚C		±0.1	±100	nA
				Ta=0˚C			±100	
				Ta=50˚C			±100	
	OIRR	Off isolation	Vs=2VP-P,f=1KHz,RL=100		70	80		dB
	CCRR	Cross talk	Vs=2VP-P,f=1KHz,RL=100		70	90		dB
The source of current	I_{CS1}	Output soruce current	RL1=0~3000		0.1		2	mA
	△I_{CS1}	Output source current accuracy	RL1=0~3000				±0.2	%
		Output source current drift				±10		ppM/˚C
	RL1	Permissible load resistance	With the sauce current maximum				3000	
	I_{CS2}	Output sink current	RL2=0~1000				-0.2	mA
	△I_{CS2}	Output sink current accuracy	RL2=0~1000				±0.2	%
		Output sink current drift				±10		ppM/˚C
	RL2	Permissible load resistance	With the sink current maximum				1000	
Reset	Vs	Reset detection voltage			4.3	4.5	4.7	V
	Vhys	Hysteresis (upper side)			40	70	100	mV
	tD	Delay time	CDELAY=0.01μF		0.6	1	1.5	msec
	VR(sat)	Saturation voltage	Isink=6mA				0.4	V
Operational amplifier	Vio	Input offset voltage	Rs=10K			1.0	6.0	mV
	△Vm/△T	Input offset voltage drift	Rs=10K			3		μV/˚C
	Iio	Input offset current				20	200	nA
	△ Im/△T	Input offset current drift				1		nA/˚C
	I_B	Input bias current				80	500	nA
	△ I_B/△T	Input bias current drift				2		nA/˚C
	AV	Open loop gain	RL=2K, Vo=+8V, -4V		20000	100000		
	CMR	Open loop gain rejection ratio	Rs=10K		70	90		dB
	SVR	Power supply change rejection ratio	Rs=10K			30	150	μV/V
	Vom	Maximum output voltage	RL=10K		+9,-5	+11,-7		V
	S. R.	Slew rate	AV=1		0.4	0.8		V/μsec
	Iop	Maximum output current			5	10		mA

*1 V_{REF}~0 and 0~V_{REF} is made into full scale.
*2 Tolerance width at the time of repeated conversion

-V_{REF}~ 0 and 0~ V_{REF} is made into full scale.

DIGITAL FORMAT



1.Multiplexer(MUX)

	5th	4th	3rd	2nd
ALL OFF	0	0	0	0
CH1 ON	1	0	0	0
CH2 ON	0	1	0	0
CH3 ON	1	1	0	0
CH4 ON	0	0	1	0
CH5 ON	1	0	1	0
CH6 ON	0	1	1	0
CH7 ON	1	1	1	0
CH8 ON	0	0	0	1
ALL OFF	1	0	0	1
ALL OFF	0	1	0	1
ALL OFF	1	1	0	1
ALL OFF	0	0	1	1
ALL OFF	1	0	1	1
ALL OFF	0	1	1	1
ALL OFF	1	1	1	1

2.Analog switch 1(AS1)

	8th	7th	6th
ALL OFF	0	0	0
AS1-1ON	1	0	0
1-2ON	0	1	0
1-3ON	1	1	0
1-4ON	0	0	1
1-5ON	1	0	1
ALL OFF	0	1	1
ALL OFF	1	1	1

3.Analog switch 2(AS2)

	11th	10th	9th
ALL OFF	0	0	0
AS2-1ON	1	0	0
2-2ON	0	1	0
2-3ON	1	1	0
2-4ON	0	0	1
2-5ON	1	0	1
ALL OFF	0	1	1
ALL OFF	1	1	1

4.Analog switch3(AS3)

	13th	12th
ALL OFF	0	0
AS3-1ON	1	0
3-2ON	0	1
ALL OFF	1	1

5.Analog switch4(AS4)

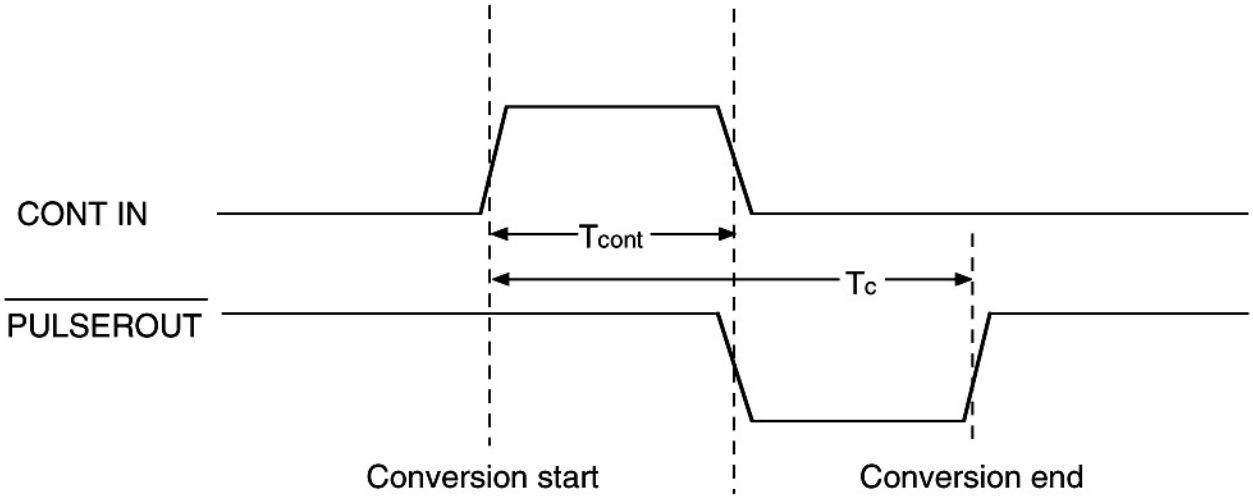
	15th	14th
ALL OFF	0	0
AS4-1ON	1	0
4-2ON	0	1
ALL OFF	1	1

6.Analog switch5(AS5)

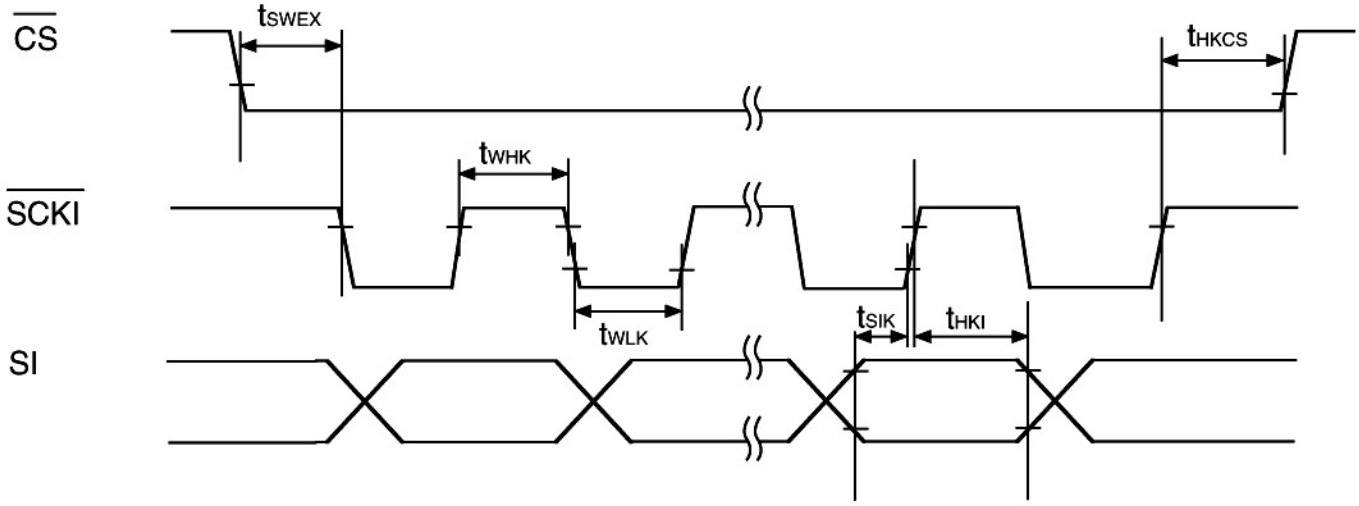
	LSB
OFF	0
AS5ON	1

SEQUENCE TIMING CHART

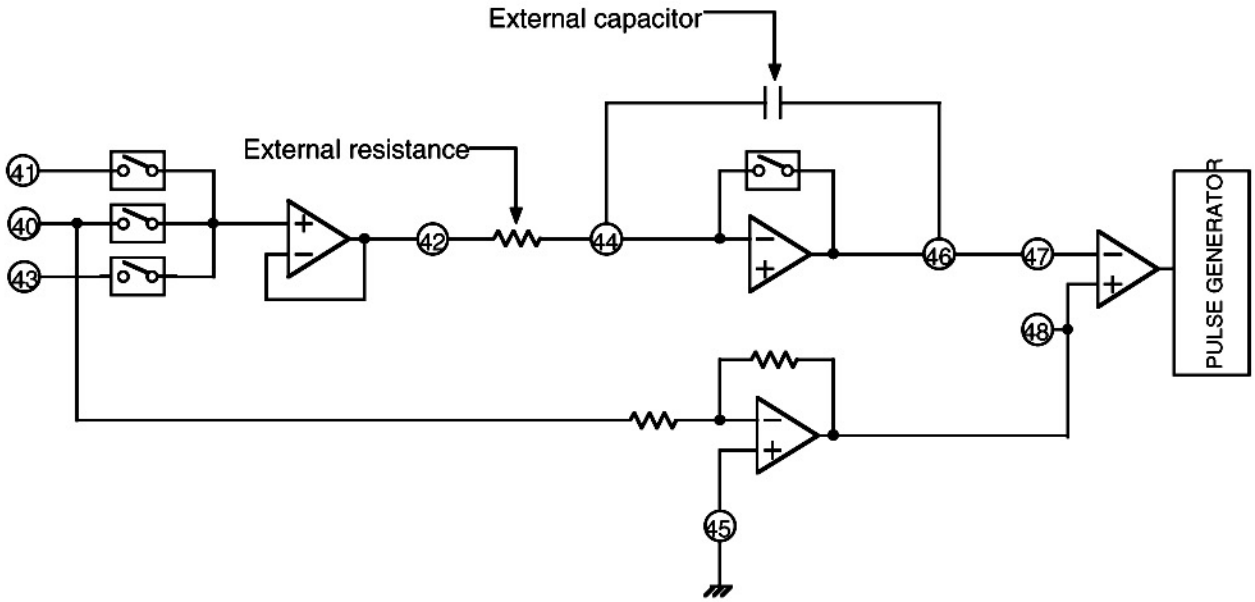
(1)A-D CONVERSION



(2) DATA INPUT



ABOUT THE INPUT VOLTAGE VX



Given the applied voltage into 41pin is VX in the diagram above,

$$VX = \frac{TGND - TX}{TGND - TR} \cdot VR \qquad T = \text{Pulse width}$$

TGND, TR, and TX can be respectively expressed with nGND/f, nR/f, and nX/f,
(f is clock frequency; nGND, nR, nX is count values for clock frequncy f.)
If these are substituted for an upper formula,

$$VX = \frac{nGND - nX}{nGND - nR} \cdot VR$$

VX can be expressed in this way for the number of counters.