

# M64092FP

## SERIAL INPUT PLL FREQUENCY SYNTHESIZER FOR TV/VCR

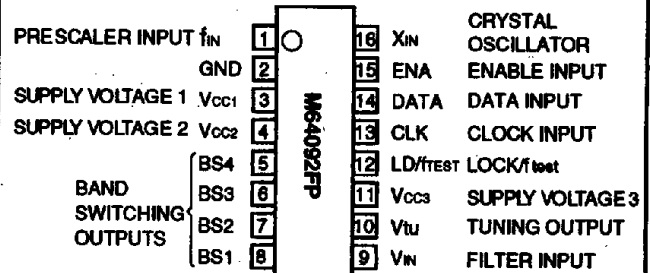
### DESCRIPTION

The M64092FP is a semiconductor integrated circuit consisting of PLL frequency synthesizer for TV/VCR using Bi-CMOS process. It contains the prescaler with operating up to 1.0 GHz, 4 band drivers and tuning. Amp for direct tuning.

### FEATURES

- 4 integrated PNP band drivers  
( $I_o=40mA$ ,  $V_{sat}=0.2V$  typ @  $V_{cc1} \sim 13.2V$ )
- Built-in Op. Amp for direct tuning voltage output (33V)
- Low power dissipation ( $I_{cc}=24mA$ ,  $V_{cc}=5V$ )
- Built-in prescaler with input amplifier ( $F_{max}=1.0GHz$ )
- PLL lock/unlock status display output (Built-in pullup resistor)
- X'tal 4MHz is used to realize 3 type of tuning steps  
(Division ratio 1/512, 1/640, 1/1024)
- Serial data input (3 wire bus)
- Software compatible with M5493X series
- Automatic switching of tuning step according to the number of data bits  
(62.5kHz at 18bits, 31.25kHz at 19bits)

### PIN CONFIGURATION (TOP VIEW)



Outline 16P2S-A

### APPLICATION

TV, VCR tuners

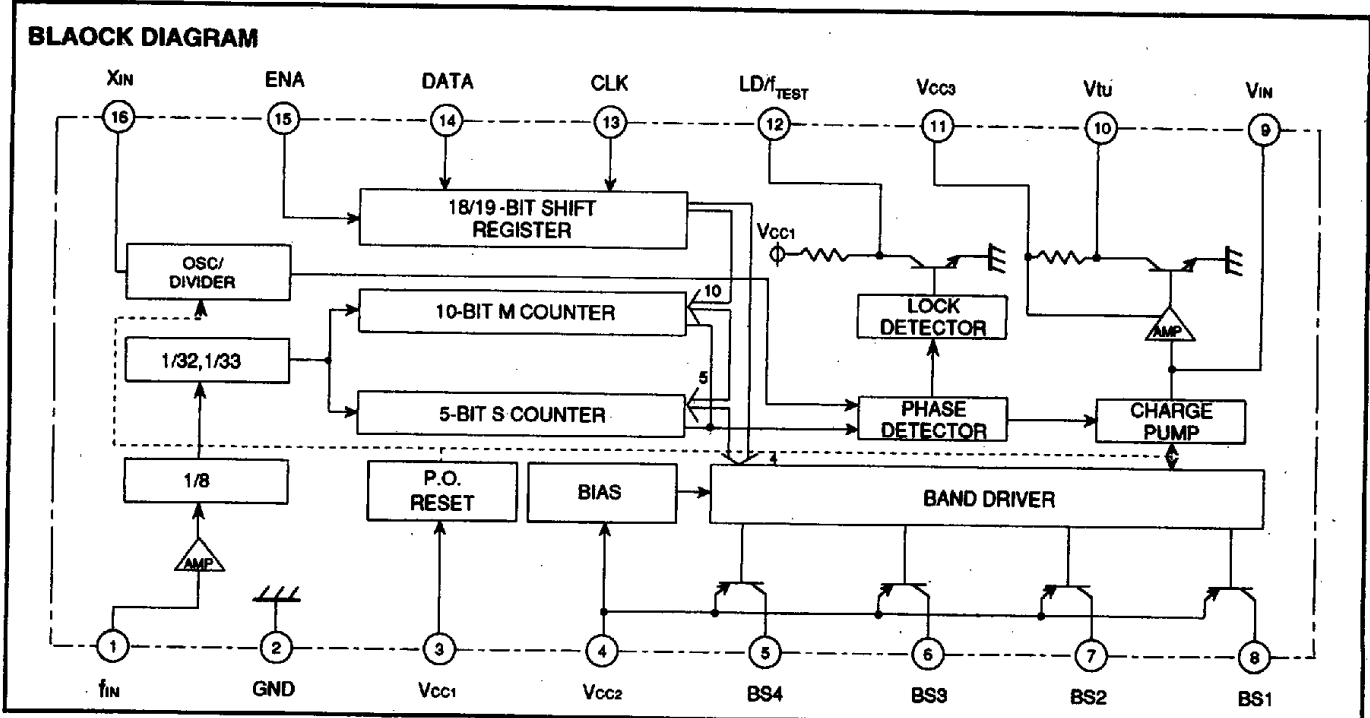
### RECOMMENDED OPERATING CONDITION

Supply voltage range ..... 4.5 ~ 5.5V  
 Rated supply voltage ..... 5.0V

### FUNCTION

- 1/32, 1/33 dual-modulus prescaler
- 4MHz crystal oscillator, reference divider
- Programmable divider  
(10-bit M counter, 5-bit S counter)
- Tri-state phase comparator
- Lock detector
- Band switch driver
- Op. Amp for direct tuning

### BLOCK DIAGRAM



**M64092FP**

**SERIAL INPUT PLL FREQUENCY SYNTHESIZER FOR TV/VCR**

**DESCRIPTION OF PIN**

Pin No.	Symbol	Pin name	Function
①	fin	Prescaler input	Input for the VCO frequency.
②	GND	GND	Ground to 0V.
③	Vcc1	Power supply voltage 1	Power supply voltage terminal. 5.0V ± 0.5V.
④	Vcc2	Power supply voltage 2	Power supply for band switching, 5 ~ 13.2V.
⑤ ⑥ ⑦ ⑧	BS4 BS3 BS2 BS1	Band switching outputs	PNP open collector method is used. When the band switching data is "H", the output is ON. When it is "L", the output is OFF.
⑨	Vin	Filter input (Charge pump output)	This is the output terminal for the LPF input and charge pump output. When the phase of the programmable divider output (F1/N) is ahead compared to the reference frequency (fref), the "source" current state becomes active. If it is behind, the "sink" current becomes active. If the phases are the same, the high impedance state becomes active.
⑩	Vtu	Tuning output	This supplies the tuning voltage.
⑪	Vcc3	Power supply voltage 3	Power supply voltage for tuning voltage 30 ~ 35V
⑫	LD/ f test	Lock detect/ Test port	When 18/19 bit data is input, lock detector is output. When 27 bit data is input, lock detector is output, the programmable freq. Divider output and reference freq. Output is selected by the test mode.
⑬	CLOCK	Clock/input	Data is read into the shift register when the clock signal falls.
⑭	DATA	Data/input	Input for band SW and programmable frequency divider set up.
⑮	ENABLE	Enable input	This is normally at a "L". When this is at "H", data and clock signals are received. Data is read into the latch when the enable signal after the 18th signal of the clock signal falls or when the 19th pulse of the clock signal falls.
⑯	Xin	This is connected to the crystal oscillator.	4.0MHz crystal oscillator is connected.

**AB SOLUTE MAXIMUM RATINGS (Ta=-20°C ~ +75°C, unless otherwise noted)**

Symbol	Parameter	Conditions	Ratings	Unit
Vcc1	Supply voltage 1		6.0	V
Vcc2	Supply voltage 2		14.4	V
Vcc3	Supply voltage 3		36.0	V
Vi	Input voltage	Not to exceed Vcc1	6.0	V
Vo	Output voltage	LD output	6.0	V
VBSOFF	Voltage applied when the band output is OFF		14.4	V
IBSON	Band output current	per 1 band output circuit	50.0	mA
tBSON	ON the time when the band output is ON	50mA per 1 band output circuit 3 circuits are on at same time.	10	sec
Pd	Power dissipation	Ta = 75°C	450	mW
Topr	Operating temperature		-20~+75	°C
Tstg	Storage temperature		-40~+125	°C

**RECOMMENDED OPERATING CONDITIONS (Ta=-20°C ~ +75°C, unless otherwise noted)**

Symbol	Parameter	Conditions	Ratings	Unit
Vcc1	Supply voltage 1		4.5~5.5	V
Vcc2	Supply voltage 2		5.0~13.2	V
Vcc3	Supply voltage 3		30~35	V
fopr1	Operating frequency(1)	Crystal oscillation circuit	4.0	MHz
fopr2	Operating frequency(2)		80~1000	MHz
IBDL	Band output current 5~8	Normally 1 circuit is on. 2 circuits on at the same time is max. It is prohibited to have 3 or more circuits turned on at the same time.	0~40	mA

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ELECTRICAL CHARACTERISTICS (Ta=-20°C ~ +75°C, unless otherwise noted)

Symbol	Parameter	Test pin	Test conditions	Limits			Unit
				Min.	Typ.	Max.	
V <sub>IH</sub>	"H" input voltage	13~15		3.0	—	V <sub>CC1</sub> +0.3	V
V <sub>IL</sub>	"L" input voltage	13~15		—	—	1.5	V
I <sub>IH</sub>	"H" input current	13~15	V <sub>CC1</sub> =5.5V V <sub>I</sub> =4.0V	—	—	10	μA
I <sub>IL</sub>	"L" input current	13~15	V <sub>CC1</sub> =5.5V V <sub>I</sub> =0.4V	—	-2	-10	μA
V <sub>OH</sub>	"H" output voltage	12	V <sub>CC1</sub> =5.5V	5.0	—	—	V
V <sub>OL</sub>	"L" output voltage	12	V <sub>CC1</sub> =5.5V	—	0.3	0.5	V
V <sub>BS</sub>	Output voltage	5~8	V <sub>CC2</sub> =12V I <sub>o</sub> =-40mA	11.6	11.8	—	V
I <sub>OLK2</sub>	Leak current	5~8	V <sub>CC2</sub> =12V Band SW OFF	—	—	1	μA
V <sub>IOH</sub>	"H" output voltage	10	V <sub>CC3</sub> =33V	32.5	—	—	V
V <sub>IOL</sub>	"L" output voltage	10	V <sub>CC3</sub> =33V	—	0.2	0.4	V
I <sub>OH</sub>	"H" output current	9	V <sub>CC1</sub> =5.0V V <sub>o</sub> =1V	—	±250	±470	μA
I <sub>OL</sub>	"L" output current	9	V <sub>CC1</sub> =5.0V V <sub>o</sub> =1V	—	±50	±130	μA
I <sub>CPK</sub>	Leak current	9	V <sub>CC1</sub> =5.5V V <sub>o</sub> =2.5V	—	—	±50	nA
I <sub>CC1</sub>	Supply current 1	2	V <sub>CC1</sub> =5.5V	—	24	34	mA
I <sub>CC2A</sub>	4 circuits OFF	4	V <sub>CC2</sub> =12V	—	—	0.5	mA
I <sub>CC2B</sub>	1 circuit ON, 1 circuits ON, Output open	4	V <sub>CC2</sub> =12V	—	6.0	9.0	mA
I <sub>CC2C</sub>	1 circuit ON, Output current 40mA	4	V <sub>CC2</sub> =12V I <sub>o</sub> =-40mA	—	46.0	49.0	mA
I <sub>CC3</sub>	Supply current 3	11	V <sub>CC3</sub> =33V Output ON	—	3.6	5.5	mA

The typical values are at V<sub>CC</sub> = 5.0V, T<sub>a</sub> = 25°C

SWITCHING CHARACTERISTICS (Ta=-20°C ~ +75°C, unless otherwise noted)

Symbol	Parameter	Test pin	Test conditions	Limits			Unit
				Min.	Typ.	Max.	
f <sub>opr2</sub>	Prescaler operating frequency	1	V <sub>CC1</sub> =4.5~5.5V V <sub>IN</sub> =V <sub>INmin</sub> ~V <sub>INmax</sub>	80	—	1000	MHz
V <sub>IN</sub>	Operating input voltage	1	V <sub>CC1</sub> =4.5~5.5V 80~100MHz 100~200MHz 200~800MHz 800~1000MHz	-24 -27 -30 -27	— — — —	4 4 4 4	dBm
t <sub>PWC</sub>	Clock pulse width	13	V <sub>CC1</sub> =4.5~5.5V	1	—	—	μs
t <sub>SU(D)</sub>	Data setup time	14		2	—	—	μs
t <sub>H(D)</sub>	Data hold time	14		1	—	—	μs
t <sub>SU(E)</sub>	Enable setup time	15		3	—	—	μs
t <sub>H(E)</sub>	Enable hold time	15		3	—	—	μs
t <sub>INT</sub>	Enable data interval time	15 14		1	—	—	μs
t <sub>r</sub>	Rise time	13 14 15		—	—	1	μs
t <sub>f</sub>	Fall time	13 14 15		—	—	1	μs
t <sub>bt</sub>	Next enable prohibit time	15		5	—	—	μs
t <sub>bcl</sub>	Next clock prohibit time	13 15		5	—	—	μs

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**METHOD OF SETTING DATA**

The frequency demultiplying ratio uses 15bits. Setting up the band switching output uses 4bits.

The test mode data uses 8bits. The total bits used is 27bits. Data is read in when the enable signal is "H" and the clock signal falls.

The band switching data is read in at the 4th pulse of the clock signal. The program mable counter data is read into the latch by the fall of the enable signal after the 18th pulse of the clock signal or the fall of the 19th pulse of the clock signal. When the enable signal goes to "L" before the 18th pulse of the enable signal, only the band SW data is updated and other data is ignored.

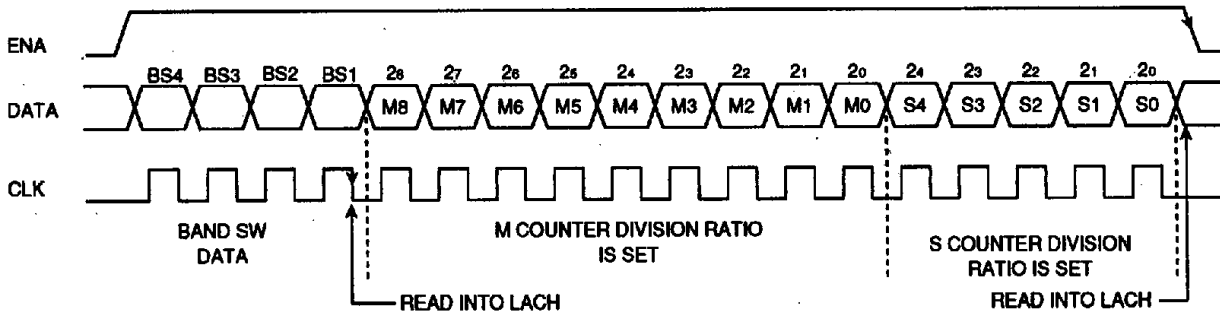
The shift register is equipped with the 18/19 bit automatic decision function. When the 18th bit data is used, the M9 bit of the program

counter is reset and the 1/512 division of the reference frequency is set. In case of the 19th bit, 1/1024 division of the reference frequency is set.

(1) Transfer of the 18th bit data

Data is latched by the fall of the enable signal after the 18th clock signal. At this time, the division of the 1/512 of reference frequency is used.

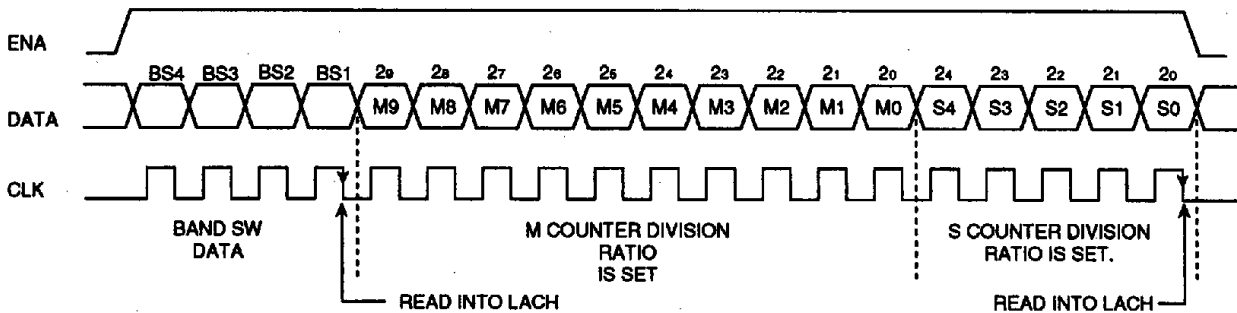
When the enable signal is "H" and the clock signal is input 19 pulses or more, it is considered the 19th bit data and the division of 1/1024 of the reference frequency is set. 18 bits data transmission is not completed till power supply is spent once again when division ratio is established once by 1/1024.



(2) Transfer of the 19th bit data

The data is latched at the 19th pulse of the clock signal. At this time, 1/1024 frequency division ratio is used. Clock signals after the above are invalid.

(It is necessary to have the ENA to fall between the 19th and the 20th bits by all means for the first data transfer after the power is turned ON.)



**HOW TO SET THE DIVIDING RATIO OF THE PROGRAMMABLE DIVIDER**

(1) Transfer of the 18th bit data

Total division N is given by the following formulas in addition to the prescaler used in the previous stage.

$$N = 8 \cdot (32M + S)$$

M : 9bit main counter division  
S : 5bit swallow counter division

The M and S counters are binary the possible ranges of division are as follows.

$$32 \leq M \leq 511$$

$$0 \leq S \leq 31$$

Therefore, the range of division N is 8,192 ~ 131,064.

The tuning frequency  $f_{vco}$  is given in the following equations.

$$f_{vco} = f_{REF} \times N$$

$$= 7.8125 \times 8 \times (32M + S)$$

$$= 62.5 \times (32M + S) \text{ [kHz]}$$

Therefore, the tuning frequency range is 64MHz ~ 1023.9375MHz

(2) Transfer of the 19th bit data

Total division N is given by the following formulas in addition to the prescaler used in the previous stage.

$$N = 8 \cdot (32M + S)$$

M : 10bit main counter division  
S : 5bit swallow counter division

**SERIAL INPUT PLL FREQUENCY SYNTHESIZER FOR TV/VCR**

The M and S counters are binary the possible ranges of division are as follows.

$$32 \leq M \leq 1023$$

$$0 \leq S \leq 31$$

Therefore, the range of division N is 8,192 ~ 262,136.

The tuning frequency  $f_{VCO}$  is given in the following equations.

$$f_{VCO} = f_{REF} \times N$$

$$= 3.90625 \times 8 \times (32M + S)$$

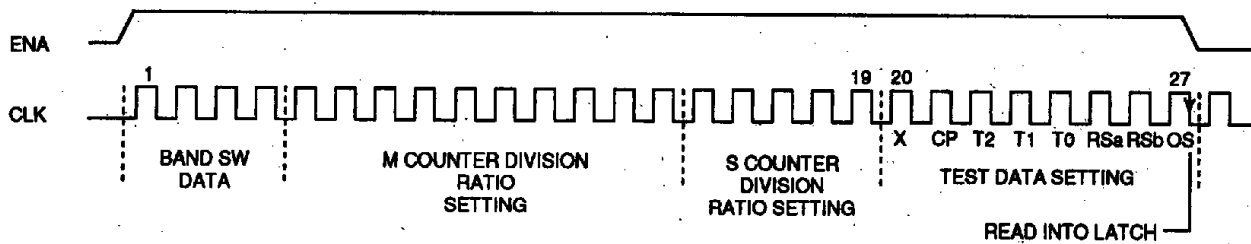
$$= 31.25 \times (32M + S) \text{ [kHz]}$$

Therefore, the tuning frequency range is 32MHz ~ 1023.96875MHz

**TEST MODE DATA SET UP METHOD**

The data for the test mode uses 20 ~ 27bits. Data is latched when the 27th clock signal falls.

(1)When transferring 3-wire 27 bit data



(2)Test mode bit set up

X : Random, normal 0

CP : Set up the charge pump current value

T0, T1, T2 : Set up test modes

RSa, RSb : Set the frequency division of the reference frequency

OS : Set up the tuning amplifier

**Setting up the output current value of the charge pump of the phase comparator**

CP	Charge pump current	Mode
0	50uA	Normal
1	250uA	Test

**Set up for the reference frequency division ratio**

RSa	RSb	Division ratio
1	1	1/512
0	1	1/1024
X	0	1/640

**Setting up for the test mode**

T2	T1	T0	Charge pump	12 pin output	Mode
0	0	X	Normal operation	LD	Normal operation
0	1	X	High impedance	LD	Test mode
1	1	0	Sink	LD	Test mode
1	1	1	Source	LD	Test mode
1	0	0	High impedance	$f_{REF}$	Test mode
1	0	1	High impedance	$f_{IN}$	Test mode

**Set up the tuning amplifier**

OS	Tuning voltage output	Mode
0	ON	Normal
1	OFF	Test

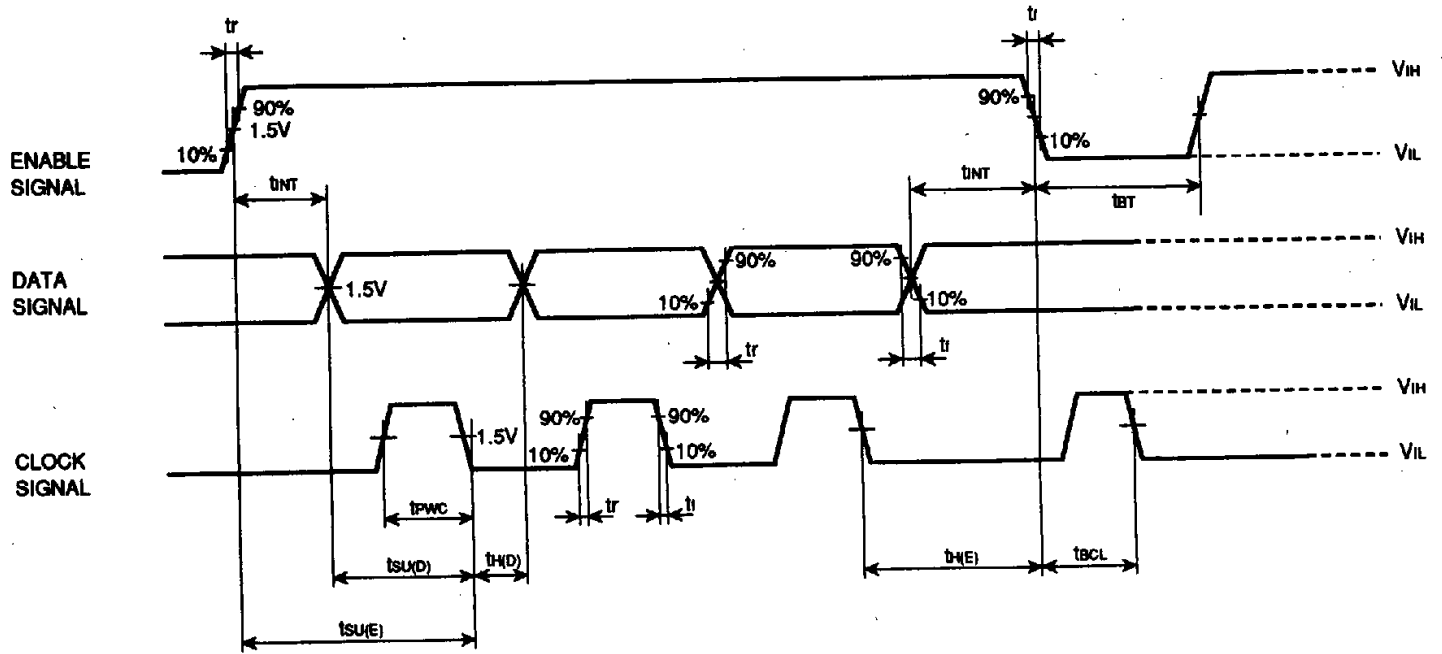
**Power on reset operation**

(Initial state the power is turned ON)

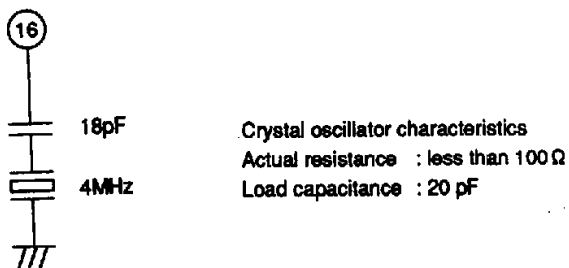
- BS4 ~ BS1 : OFF
- Charge pump : High impedance
- Tuning amplifier : OFF
- Charge pump current : 250  $\mu$ A
- Frequency division ratio : 1/512

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TIMING DIAGRAM

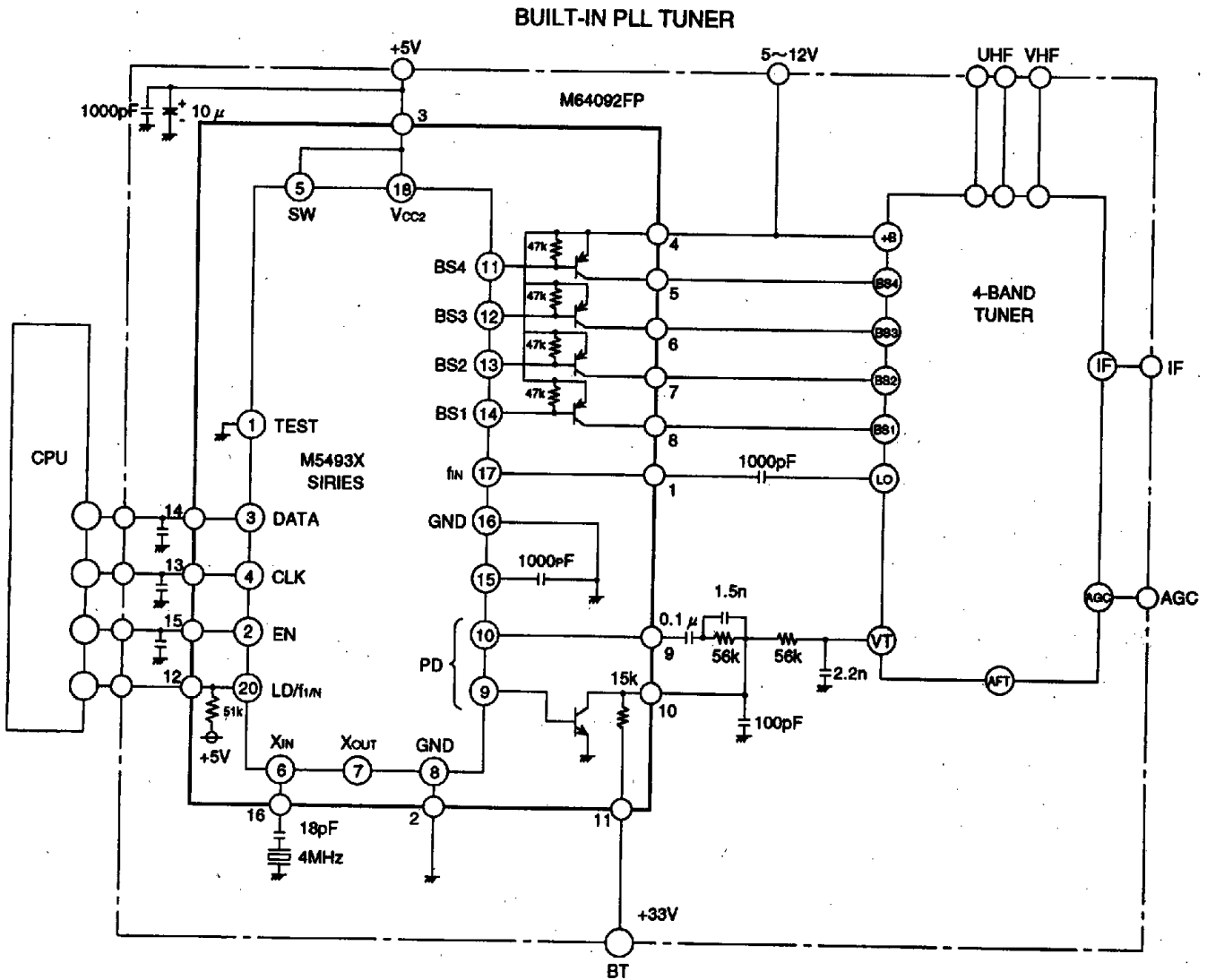


CRYSTAL OSCILLATOR CONNECTION DIAGRAM



SERIAL INPUT PLL FREQUENCY SYNTHESIZER FOR TV/VCR

APPLICATION EXAMPLE



Units Resistance: Ω  
Capacitance: F