

# Spread Spectrum Clock Generator

## MB88152

### DESCRIPTION

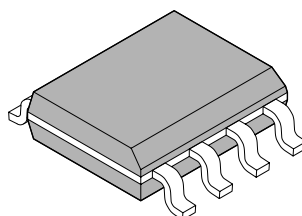
MB88152 is a clock generator for EMI reduction. The peak of unnecessary radiation noise (EMI) can be attenuated by making the oscillation frequency slightly modulate periodically with the internal modulator. It corresponds to both of the center spread which modulates input frequency as Middle Centered and down spread which modulates so as not to exceed input frequency.

### FEATURES

- Input frequency : 20 MHz to 134 MHz
- Output frequency : 20 MHz to 134 MHz
- Modulation rate :  $\pm 0.5\%$ ,  $\pm 1.5\%$  (Center spread),  $- 1.0\%$ ,  $- 3.0\%$  (Down spread)
- Equipped with crystal oscillation circuit: Range of oscillation 20 MHz to 48 MHz
- Modulation clock output Duty : 40% to 60%
- Modulation clock Cycle-Cycle Jitter : Less than 100 ps
- Low current consumption by CMOS process : 5 mA@24 MHz (Typ-sample, no load)
- Power supply voltage : 3.3 V  $\pm$  0.3 V
- Operating temperature :  $- 40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$
- Package : SOP 8 pin

### PACKAGE

8-pin plastic SOP



(FPT-8P-M02)

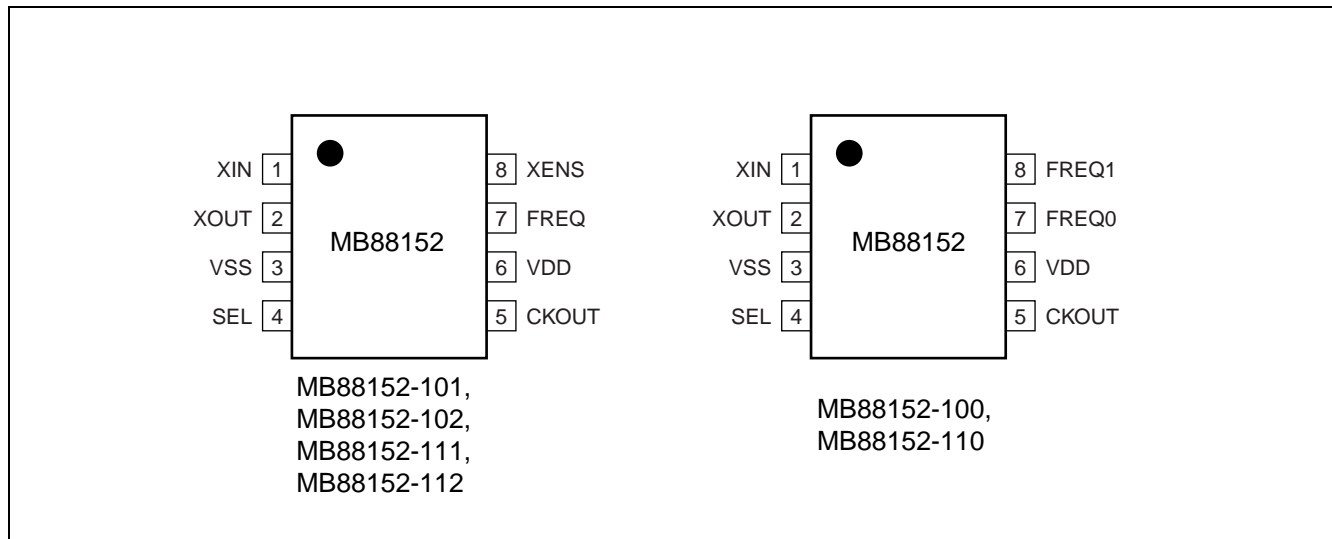
# MB88152

## ■ PRODUCT LINE-UP

MB88152 has three kinds of input frequency, and two kinds of modulation type (center/down spread), total six line-ups.

Product	Function
MB88152-100	Frequency range from 20 MHz to 134 MHz, Down spread, No enable setting
MB88152-101	Frequency range from 20 MHz to 67 MHz, Down spread, No modulation enable pin
MB88152-102	Frequency range from 40 MHz to 133 MHz, Down spread, Enable setting
MB88152-110	Frequency range from 20 MHz to 134 MHz, Center spread, No modulation enable pin
MB88152-111	Frequency range from 20 MHz to 67 MHz, Center spread, Enable setting
MB88152-112	Frequency range from 40 MHz to 133 MHz, Center spread, Enable setting

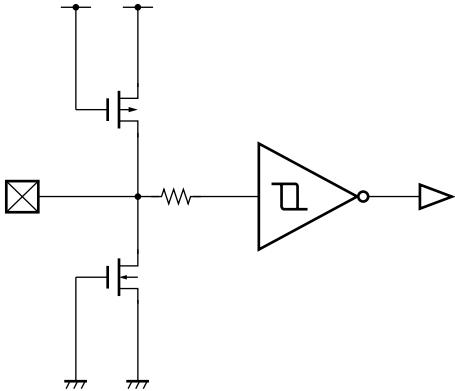
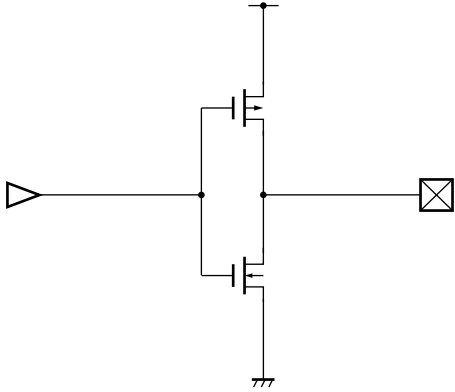
## ■ PIN ASSIGNMENT



## ■ PIN DESCRIPTION

Pin name	I/O	Pin no.	Description
XIN	I	1	Crystal resonator connection Pin/clock input pin
XOUT	O	2	Crystal resonator connection Pin
VSS	—	3	GND Pin
SEL	I	4	Modulation rate setting pin
CKOUT	O	5	Modulated clock output pin
VDD	—	6	Power supply voltage pin
FREQ/FREQ0	I	7	Frequency setting pin
XENS/FREQ1	I	8	Modulation enable setting pin/frequency setting pin

## ■ I/O CIRCUIT TYPE

Pin	Circuit type	Remarks
SEL FREQ FREQ0 FREQ1 XENS		<ul style="list-style-type: none"> <li>• CMOS hysteresis input</li> </ul>
CKOUT		<ul style="list-style-type: none"> <li>• CMOS output</li> <li>• <math>I_{OL} = 4 \text{ mA}</math></li> </ul>

Note : For XIN and XOUT pins, see “■CRYSTAL OSCILLATION CIRCUIT”.

## ■ HANDLING DEVICES

### Preventing Latchup

A latchup can occur if, on a CMOS IC, a voltage higher than VDD or a voltage lower than VSS is applied to an input or output pin or a voltage higher than the rating is applied between VDD and VSS. A latchup, if it occurs, significantly increases the power supply current and may cause thermal destruction of an element. When you use a CMOS IC, be very careful not to exceed the maximum rating.

### Handling unused pins

Do not leave an unused input pin open, since it may cause a malfunction. Handle by, for example, using a pull-up or pull-down resistor.

### The attention when the external clock is used

Input the clock to XIN, and don't connect anything with XOUT you use the external clock.

And please pay attention so that an overshoot and an undershoot do not occur to an input clock of XIN.

### Power supply pins

Please connecting to the power supply terminal of this device by as lower impedance as possible from the current supply source.

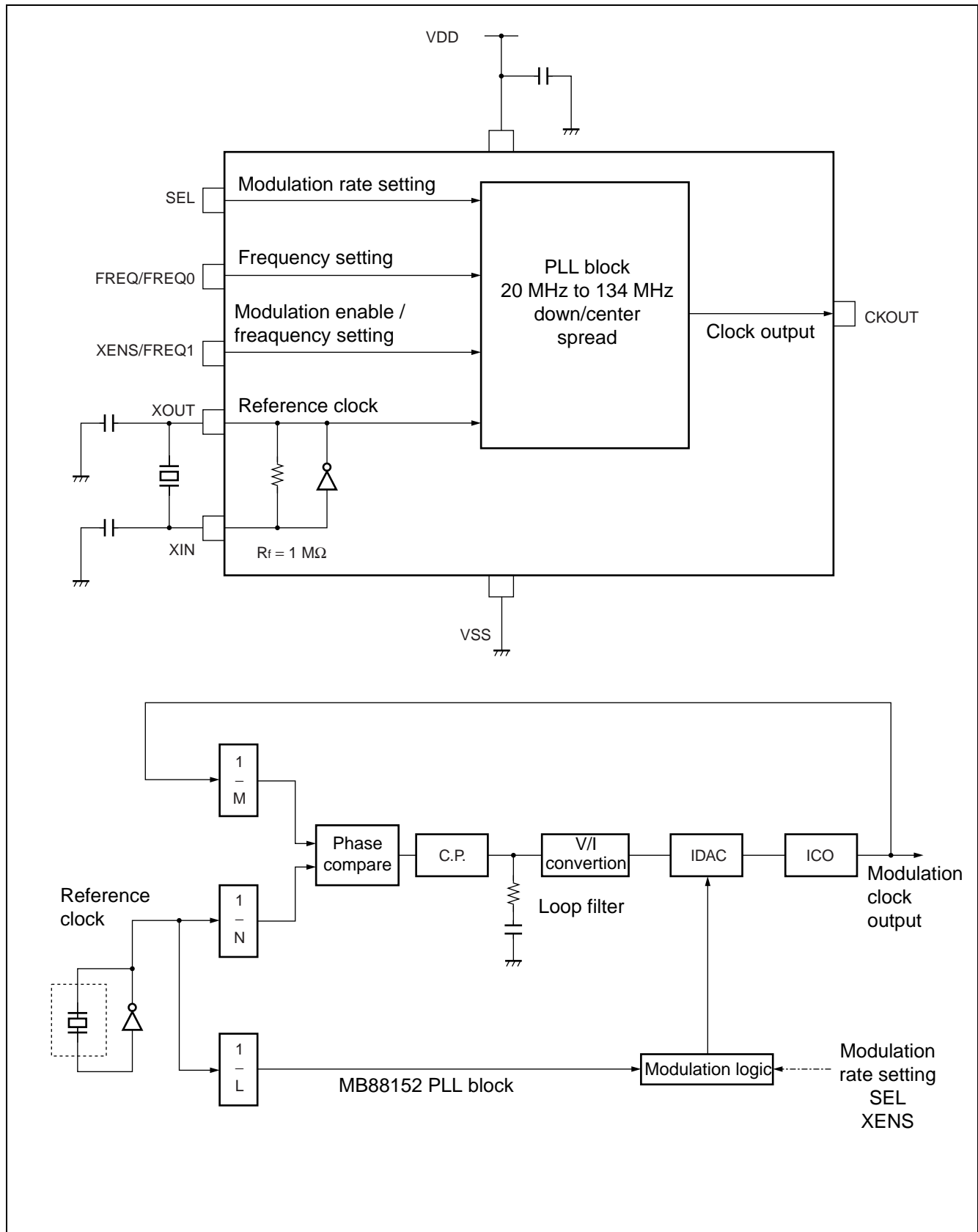
We recommend connecting electrolytic capacitor (about 10  $\mu\text{F}$ ) and the ceramic capacitor (about 0.01  $\mu\text{F}$ ) in parallel between VSS and VDD near the device, as a by-pass capacitor.

### Crystal Oscillator Circuit

Noise near the XIN or XOUT pin may cause the device to malfunction. Design printed circuit boards so that electric wiring of XIN and XOUT and crystal resonator (or ceramic resonator) don't intersect other wiring.

It is strongly recommended that printed circuit board artwork that surrounds the XIN and XOUT pins with ground be used to increase the expectation of stable operation.

## ■ BLOCK DIAGRAM



# MB88152

## ■ PIN SETTING

When changing the pin setting, the stabilization wait time for the modulation clock is required. The stabilization wait time for the modulation clock takes the maximum value of Lock-Up time in “■ ELECTRICAL CHARACTERISTICS”.

### Modulation enable setting

XENS	Modulation	
0	Modulation enable	MB88152-101, 102, 111, 112
1	Modulation disable	

Note : MB88152-100 and 110 do not have XENS pin.

### SEL modulation rate setting

SEL	Modulation rate		Remarks
0	± 0.5%	MB88152-110, 111, 112	Center spread
	– 1.0%	MB88152-100, 101, 102	Down spread
1	± 1.5%	MB88152-110, 111, 112	Center spread
	– 3.0%	MB88152-100, 101, 102	Down spread

Note : The modulation rate can be changed at the level of the terminal.

### Frequency setting

FREQ	Frequency	
0	20 MHz to 40 MHz	MB88152-101, 111
	40 MHz to 80 MHz	MB88152-102, 112
1	33 MHz to 67 MHz	MB88152-101, 111
	66 MHz to 134 MHz	MB88152-102, 112

Note : MB88152-100 and 110 do not have FREQ pin.

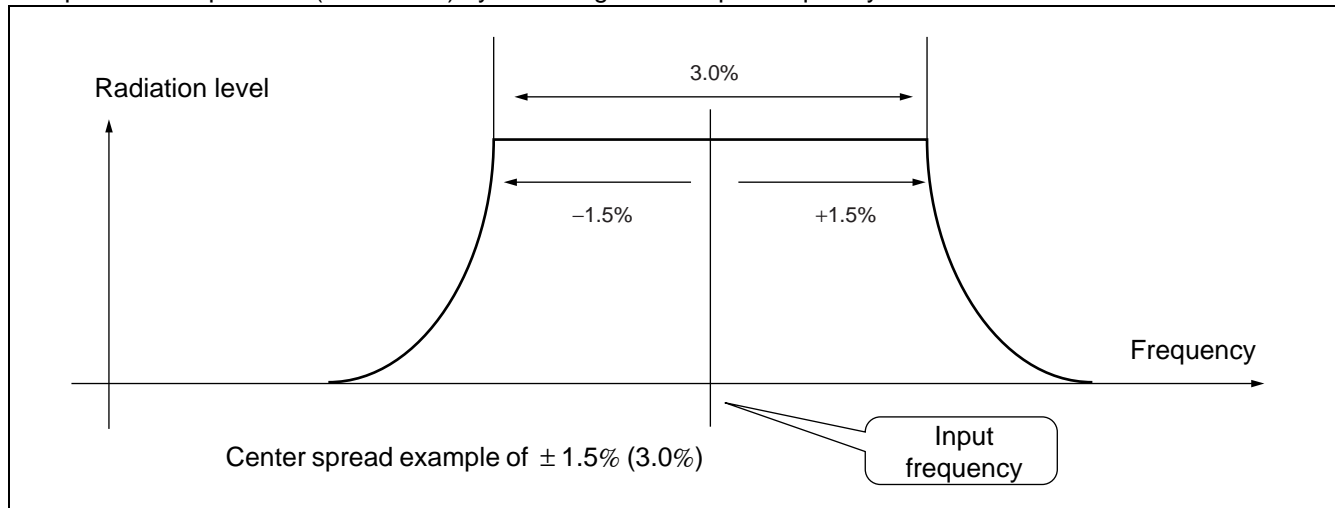
### frequency setting

FREQ1	FREQ0	Frequency	
0	0	20 MHz to 40 MHz	MB88152-100, 110
0	1	33 MHz to 67 MHz	
1	0	40 MHz to 80 MHz	
1	1	66 MHz to 134 MHz	

Note : MB88152-101, 111, 102 and 112 have neither FREQ0 pin nor FREQ1 pin.

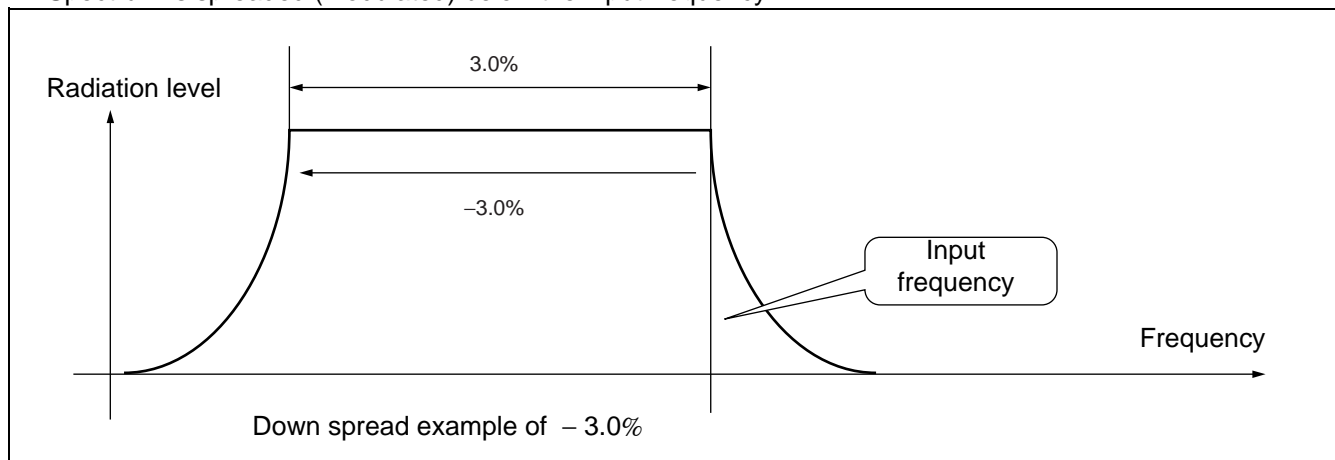
- Center spread

Spectrum is spreaded (modulated) by centering on the input frequency.



- Down spread

Spectrum is spreaded (modulated) below the input frequency.



## ■ ABSOLUTE MAXIMUM RATINGS

(V<sub>SS</sub> = 0.0 V)

Parameter	Symbol	Rating		Unit
		Min	Max	
Power supply voltage	V <sub>DD</sub>	- 0.5	+ 4.0	V
Input voltage	V <sub>I</sub>	V <sub>SS</sub> - 0.5	V <sub>DD</sub> + 0.5	V
Output voltage	V <sub>O</sub>	V <sub>SS</sub> - 0.5	V <sub>DD</sub> + 0.5	V
Storage temperature	T <sub>ST</sub>	- 55	+ 125	°C
Operation junction temperature	T <sub>J</sub>	- 40	+ 125	°C
Output current	I <sub>O</sub>	- 14	+ 14	mA
Overshoot	—	—	V <sub>DD</sub> + 1.0 (within 50 ns)	V
Undershoot	—	V <sub>SS</sub> - 1.0 (within 50 ns)	—	V

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

## ■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Pin	Conditions	Value			Unit
				Min	Typ	Max	
Power supply voltage	V <sub>DD</sub>	VDD	—	3.0	3.3	3.6	V
“H” level input voltage	V <sub>IH</sub>	SEL FREQ/FREQ0, XENS/FREQ1	—	V <sub>DD</sub> × 0.80	—	V <sub>DD</sub> + 0.3	V
		XIN	20 MHz to 100 MHz	V <sub>DD</sub> × 0.80	—	V <sub>DD</sub> + 0.3	V
			100 MHz to 134 MHz	V <sub>DD</sub> × 0.90	—	V <sub>DD</sub> + 0.3	V
“L” level input voltage	V <sub>IL</sub>	SEL FREQ/FREQ0, XENS/FREQ1	—	V <sub>SS</sub>	—	V <sub>DD</sub> × 0.20	V
		XIN	20 MHz to 100 MHz	V <sub>SS</sub>	—	V <sub>DD</sub> + 0.20	V
			100 MHz to 134 MHz	V <sub>SS</sub>	—	V <sub>DD</sub> + 0.10	V
Input clock [Duty Cycle]	T <sub>DCI</sub>	XIN	20 MHz to 100 MHz	40	50	60	%
			100 MHz to 134 MHz	45	50	55	
Operating temperature	T <sub>a</sub>	—	—	-40	—	+ 85	°C

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representatives beforehand.



## ■ ELECTRICAL CHARACTERISTICS

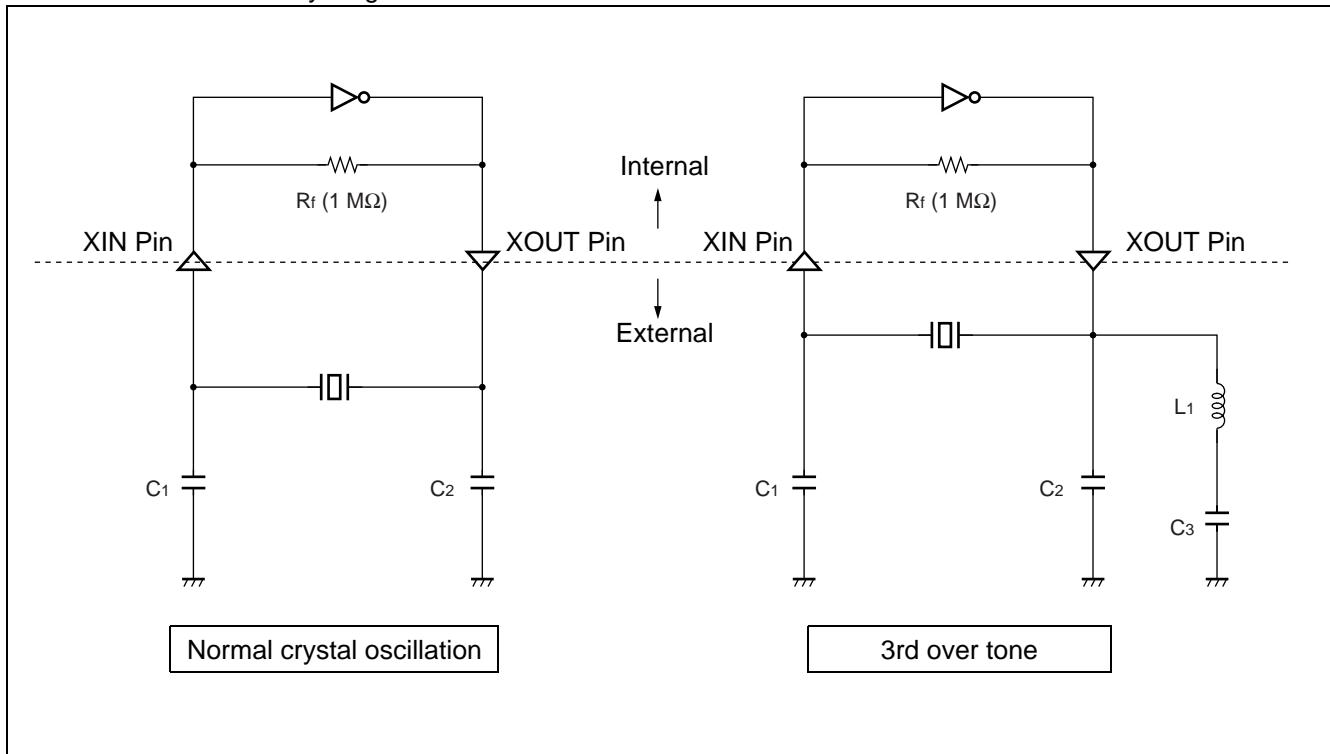
(Ta = + 25 °C, V<sub>DD</sub> = 3.3V)

Parameter	Symbol	Pin	Conditions	Value			Unit
				Min	Typ	Max	
Power supply current	I <sub>CC</sub>	VDD	24 MHz output No load capacitance	—	5.0	7.0	mA
Crystal oscillation frequency	f <sub>x</sub>	XIN, XOUT	Basic wave oscillation	20	—	40	MHz
			3rd over tone	40	—	48	
Input frequency	f <sub>in</sub>	XIN	MB88152-100, 110	20	—	134	MHz
			MB88152-101, 111	20	—	67	
			MB88152-102, 112	40	—	134	
Output frequency	f <sub>OUT</sub>	CKOUT	MB88152-100, 110	20	—	134	MHz
			MB88152-101, 111	20	—	67	
			MB88152-102, 112	40	—	134	
Output voltage	V <sub>OH</sub>	CKOUT	H level output I <sub>OH</sub> = - 4 mA	V <sub>DD</sub> - 0.5	—	V <sub>DD</sub>	V
	V <sub>OL</sub>		L level output I <sub>OL</sub> = 4 mA	V <sub>SS</sub>	—	0.4	V
Output through rate	SR	CKOUT	0.4 V to 2.4 V	0.4	—	4.0	V/ns
Output high impedance	Z <sub>o</sub>	CKOUT	20 MHz to 134 MHz	—	45	—	Ω
Output clock Duty Cycle	T <sub>DCC</sub>	CKOUT	1.5 V	40	—	60	%
Input capacitance	C <sub>IN</sub>	XIN SEL FREQ/ FREQ0 XENS/ FREQ1	Ta = + 25 °C V <sub>DD</sub> = V <sub>I</sub> = 0.0 V f = 1 MHz	—	—	16	pF
Load capacitance	C <sub>L</sub>	CKOUT	20 MHz to 67 MHz	—	—	15	pF
			67 MHz to 100 MHz	—	—	10	
			100 MHz to 134 MHz	—	—	7	
Modulation cycle	F <sub>MOD</sub>	CKOUT	—	—	12.5	—	kHz
Lock-Up time	T <sub>LK</sub>	CKOUT	—	—	2	5	ms
Cycle-cycle jitter	T <sub>JC</sub>	CKOUT	No load capacitance	—	—	100	ps

## CRYSTAL OSCILLATOR CIRCUIT

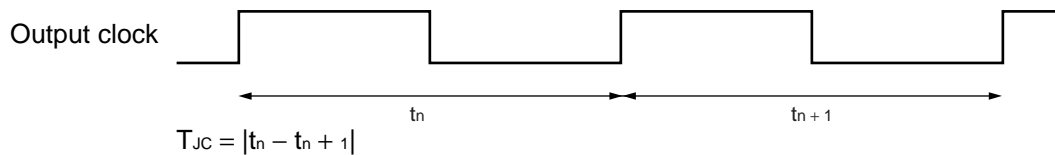
The left side of figures below shows the connection example about general crystal resonator. The oscillation circuit has the built-in feedback resistanc (1 MΩ). The value of capacity (C<sub>1</sub> and C<sub>2</sub>) is required adjusting to the most suitable value of an individual crystal resonator.

The right side of figures below shows the example of connecting crystal for the 3rd over-tone oscillation. The value of capacity (C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub>) and inductance (L<sub>1</sub>) is needed adjusting to the most suitable value of an individual crystal oscillator. When an external clock is used (the crystal resonator is not used) , input the clock to XIN pin and do not connect anything with XOUT.



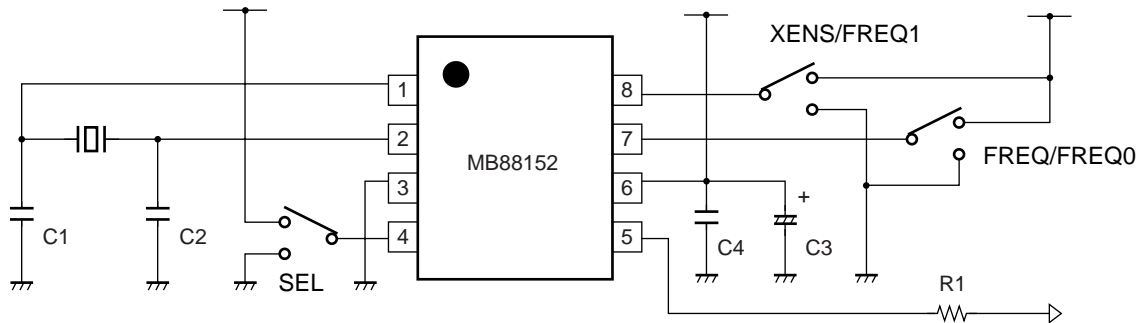
## DEFINITION OF JITTER

- Cycle-cycle jitter



Cycle - cycle jitter is defined the difference between a certain cycle and immediately after (or, immediately before).

## ■ INTERCONNECTION CIRCUIT EXAMPLE



- C1, C2 : oscillation stabilization capacitance  
 (see "■ CRYSTAL OSCILLATOR CIRCUIT")  
 C3 : Ta condenser or electrolytic capacitor of 10  $\mu$ F or higher  
 C4 : laminated ceramic capacitor about 0.01  $\mu$ F (connect to close to this device)  
 R1 : impedance matching resistor for board pattern

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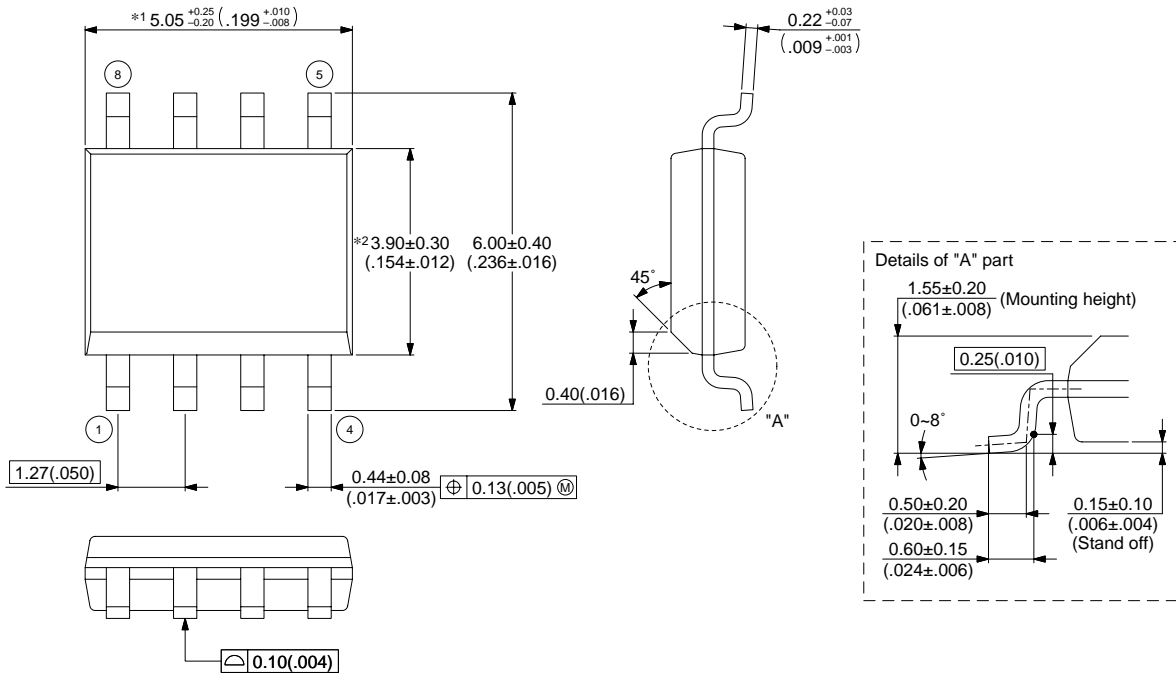
## ■ ORDERING INFORMATION

Part number	Frequency	Spread	XENS	Package	Remarks
MB88152PNF-G-100-JNE1	20 MHz to 134 MHz	Down	No	8-pin plastic SOP (FPT-8P-M02)	
MB88152PNF-G-101-JNE1	20 MHz to 67 MHz	Down	Yes		
MB88152PNF-G-102-JNE1	40 MHz to 134 MHz	Down	Yes		
MB88152PNF-G-110-JNE1	20 MHz to 134 MHz	Center	No		
MB88152PNF-G-111-JNE1	20 MHz to 67 MHz	Center	Yes		
MB88152PNF-G-112-JNE1	40 MHz to 134 MHz	Center	Yes		
MB88152PNF-G-100-JN-EFE1	20 MHz to 134 MHz	Down	No	8-pin plastic SOP (FPT-8P-M02)	Embos taping (EF type)
MB88152PNF-G-101-JN-EFE1	20 MHz to 67 MHz	Down	Yes		
MB88152PNF-G-102-JN-EFE1	40 MHz to 134 MHz	Down	Yes		
MB88152PNF-G-110-JN-EFE1	20 MHz to 134 MHz	Center	No		
MB88152PNF-G-111-JN-EFE1	20 MHz to 67 MHz	Center	Yes		
MB88152PNF-G-112-JN-EFE1	40 MHz to 134 MHz	Center	Yes		
MB88152PNF-G-100-JN-ERE1	20 MHz to 134 MHz	Down	No	8-pin plastic SOP (FPT-8P-M02)	Embos taping (ER type)
MB88152PNF-G-101-JN-ERE1	20 MHz to 67 MHz	Down	Yes		
MB88152PNF-G-102-JN-ERE1	40 MHz to 134 MHz	Down	Yes		
MB88152PNF-G-110-JN-ERE1	20 MHz to 134 MHz	Center	No		
MB88152PNF-G-111-JN-ERE1	20 MHz to 67 MHz	Center	Yes		
MB88152PNF-G-112-JN-ERE1	40 MHz to 134 MHz	Center	Yes		

## PACKAGE DIMENSION

8-pin plastic SOP  
(FPT-8P-M02)

Note 1) \*1 : These dimensions include resin protrusion.  
 Note 2) \*2 : These dimensions do not include resin protrusion.  
 Note 3) Pins width and pins thickness include plating thickness.  
 Note 4) Pins width do not include tie bar cutting remainder.



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Dimensions in mm (inches).

Note : The values in parentheses are reference values.

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