

ASSP

IF Band PLL Frequency Synthesizer

MB15C103

■ DESCRIPTION

The Fujitsu MB15C103 is an exclusive Intermediate Frequency (IF) band Phase Locked Loop (PLL) frequency synthesizer with pulse swallow operation. The reference divider and comparison divider have fixed divide ratios, so that it is not required to set the divide ratios by a microcontroller externally.

It operates with a supply voltage of 3.0 V typ. and dissipates 0.9 mA typ.(200MHz) of current realized through the use of Fujitsu's CMOS technology.

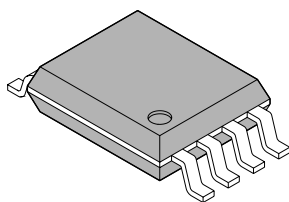
The MB15C103 is ideally suitable for PDC systems.

■ FEATURES

- Low power supply current: $I_{CC} = 0.9 \text{ mA}$ typ. ($V_{CC} = 3 \text{ V}$, 200MHz)
- Pulse swallow function; Prescaler: 16/17
- Setting frequency (Selectable by DIV input.)
 - $f_{osc} = 12.8 \text{ MHz}$, $f_{IF} = 178.00 \text{ MHz}$ (DIV = "H")
 - $f_{osc} = 12.8 \text{ MHz}$, $f_{IF} = 129.55 \text{ MHz}$ (DIV = "L")
- Lock detector
- Low power supply voltage: $V_{CC} = 2.4 \text{ to } 3.6 \text{ V}$
- Wide operating temperature: $T_a = -40 \text{ to } +85^\circ\text{C}$

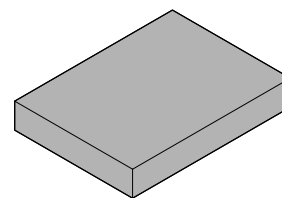
■ PACKAGES

8-pin plastic SSOP



(FPT-8P-M03)

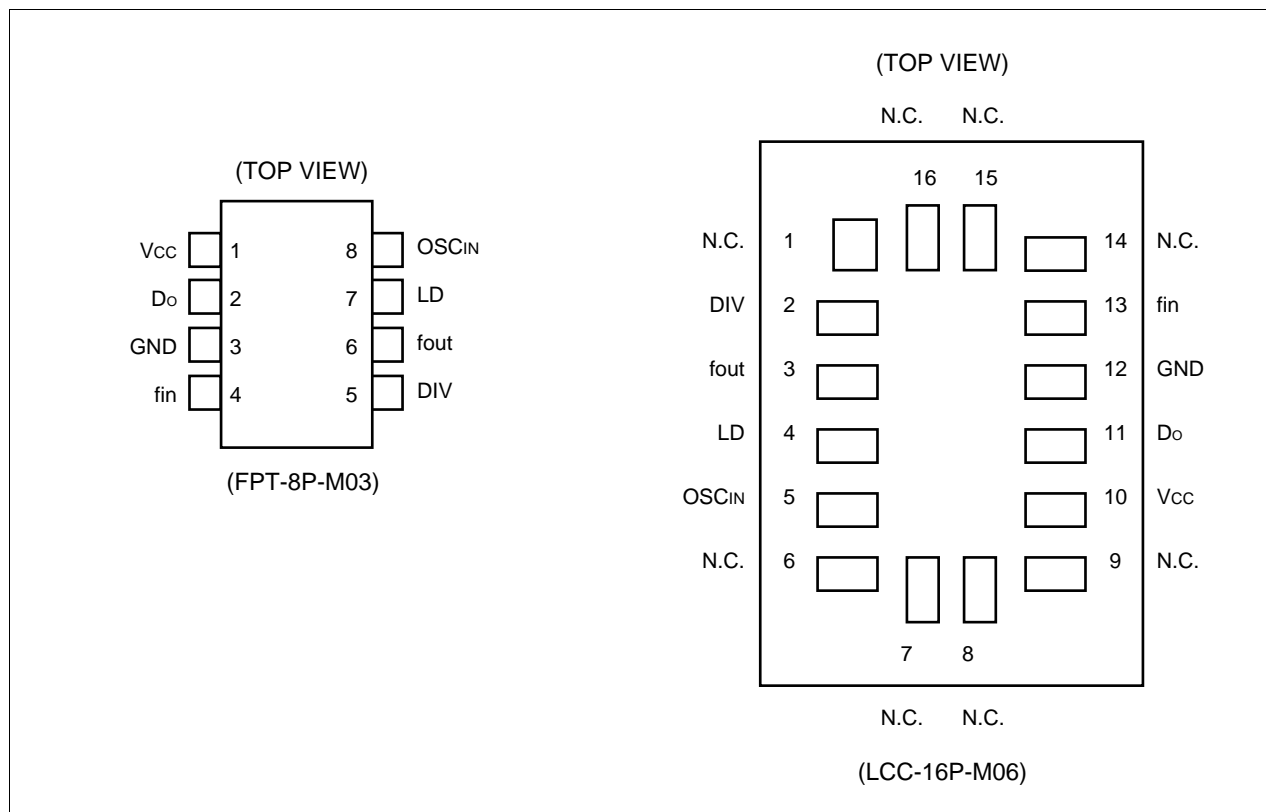
16-pad plastic BCC



(LCC-16P-M06)

MB15C103

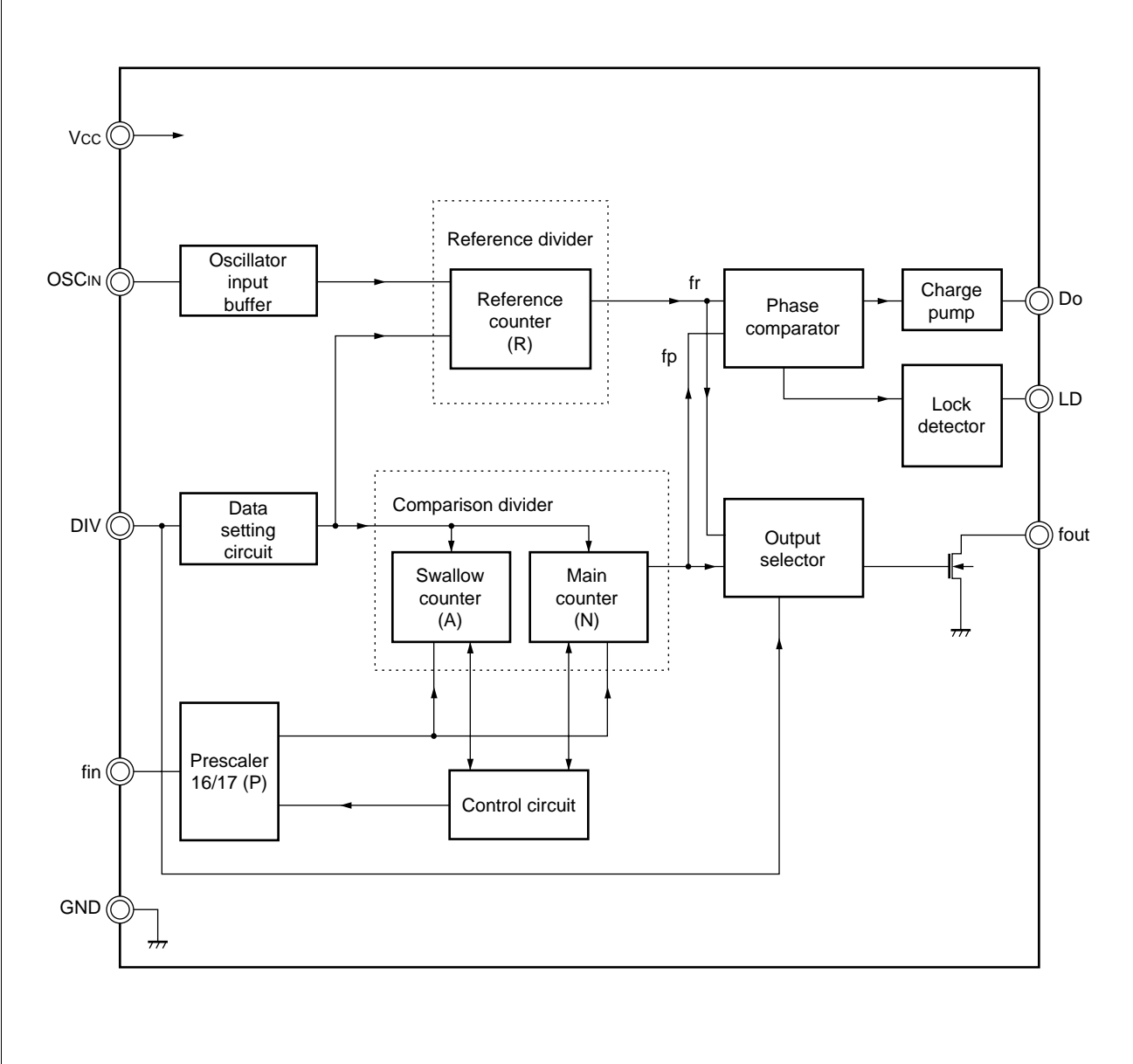
■ PIN ASSIGNMENT



■ PIN DESCRIPTIONS

Pin No.		Pin name	I/O	Descriptions
SSOP-8	BCC-16			
–	1, 6, 7, 8, 9, 14, 15, 16	N.C.	–	No connection
1	10	V _{CC}	–	Power supply voltage input (2.4 V to 3.6 V).
2	11	Do	O	Charge pump output
3	12	GND	–	Ground
4	13	fin	I	Prescaler input. Connection should be with AC coupling.
5	2	DIV	I	Divide ratio switching input. Two kinds of divide ratios are selectable by DIV input "H" or "L".
6	3	fout	O	Test purpose output. This pin is an open drain output so that should be left open usually.
7	4	LD	O	Lock detector output. LD = "H" : Lock LD = "L" : Unlock
8	5	OSC _{IN}	I	Reference counter input. Connection should be with AC coupling.

■ BLOCK DIAGRAM



MB15C103

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Power supply voltage	V_{CC}	-0.5	+4.0	V
Input voltage	V_I	-0.5	$V_{CC} + 0.5$	V
Output voltage	V_{OUT}	-0.5	$V_{CC} + 0.5$	V
Output current	I_{OUT}	0	+5	mA
Storage temperature	T_{STG}	-55	+125	°C

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	Value			Unit	Note
		Min.	Typ.	Max.		
Power supply voltage	V_{CC}	2.4	3.0	3.6	V	
Input voltage	V_{IN}	GND	-	V_{CC}	V	
Operating temperature	T_a	-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

Recommended operating conditions unless otherwise noted.

Parameter	Symbol	Condition	Value			Unit	
			Min.	Typ.	Max.		
Power supply current	I _{CC}	PLL is locked. (200 MHz) V _{CC} = 3.0 V, T _a = +25°C	0.1	0.9	1.8	mA	
Operating frequency	f _{in}	AC coupling by 1000 pF capacitor	50	–	200	MHz	
	OSC _{IN}	AC coupling by 1000 pF capacitor	3	12	26	MHz	
Input sensitivity	f _{in}	P _{f_{in}} AC coupling by 1000 pF capacitor	–10	–	+2	dBm	
	OSC _{IN}	V _{osc} AC coupling by 1000 pF capacitor	0.5	–	–	V _{pp}	
Input voltage	DIV	V _{IH}	–	V _{CC} × 0.7	–	V	
		V _{IL}	–	–	V _{CC} × 0.3	V	
Input current	DIV	I _{IH}	–	–	+1.0	μA	
		I _{IL}	–	–1.0	–	μA	
Input current	OSC _{IN}	I _{osc}	–	–100	+100	μA	
Output voltage	Do	V _{OH}	V _{CC} = 3.0 V, I _{OH} = –0.3 mA	2.6	–	–	V
		V _{OL}	V _{CC} = 3.0 V, I _{OL} = 0.3 mA	–	–	0.4	V
Output current	Do	I _{OH}	V _{CC} = 3.0 V, V _{OH} = 2 V	–	–6.0	–	mA
		I _{OL}	V _{CC} = 3.0 V, V _{OL} = 1 V	–	6.0	–	mA
High impedance cut off current	Do	I _{OFF}	0V ≤ V _{Do} ≤ V _{CC}	–	–	3	nA

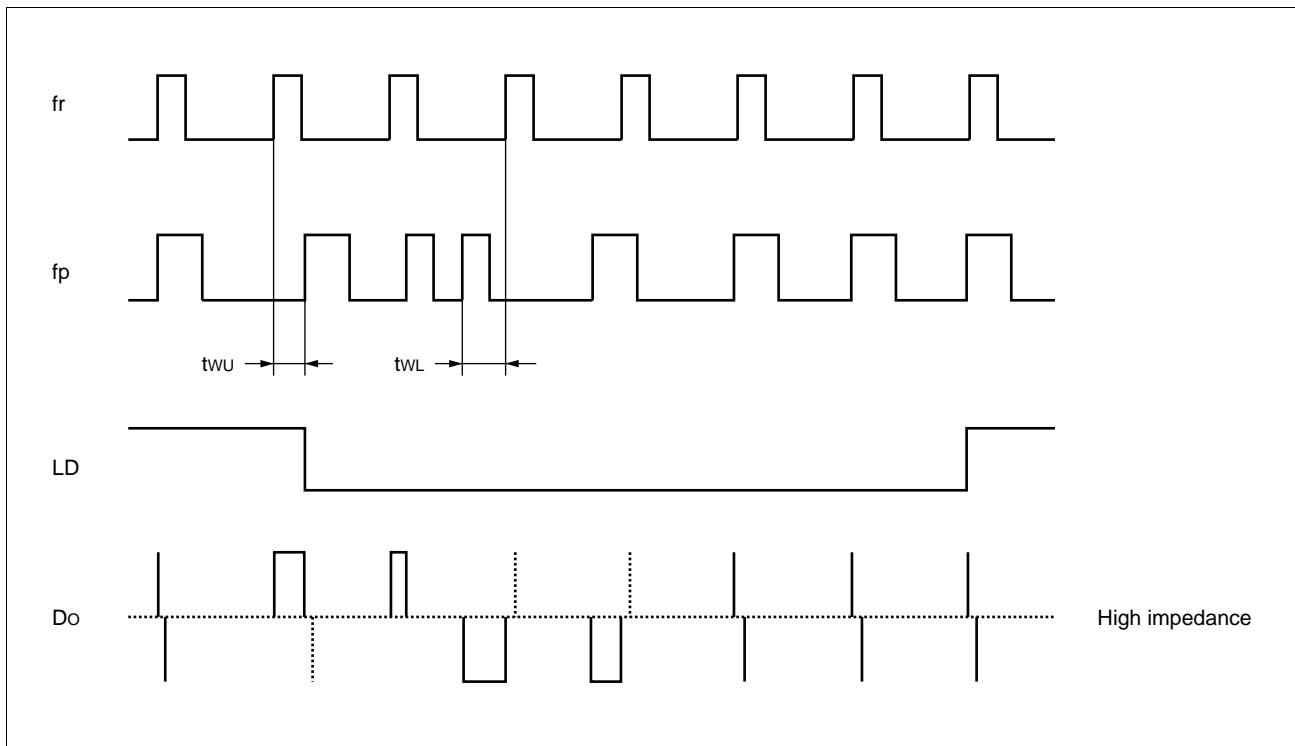
FUNCTIONAL DESCRIPTIONS

Two different frequencies can be selected by DIV input "H" or "L".
The divide ratios are calculated using the following equation:

$$f_{vco} = \{(P \times N) + A\} \times f_{osc} \div R \quad (A < N)$$

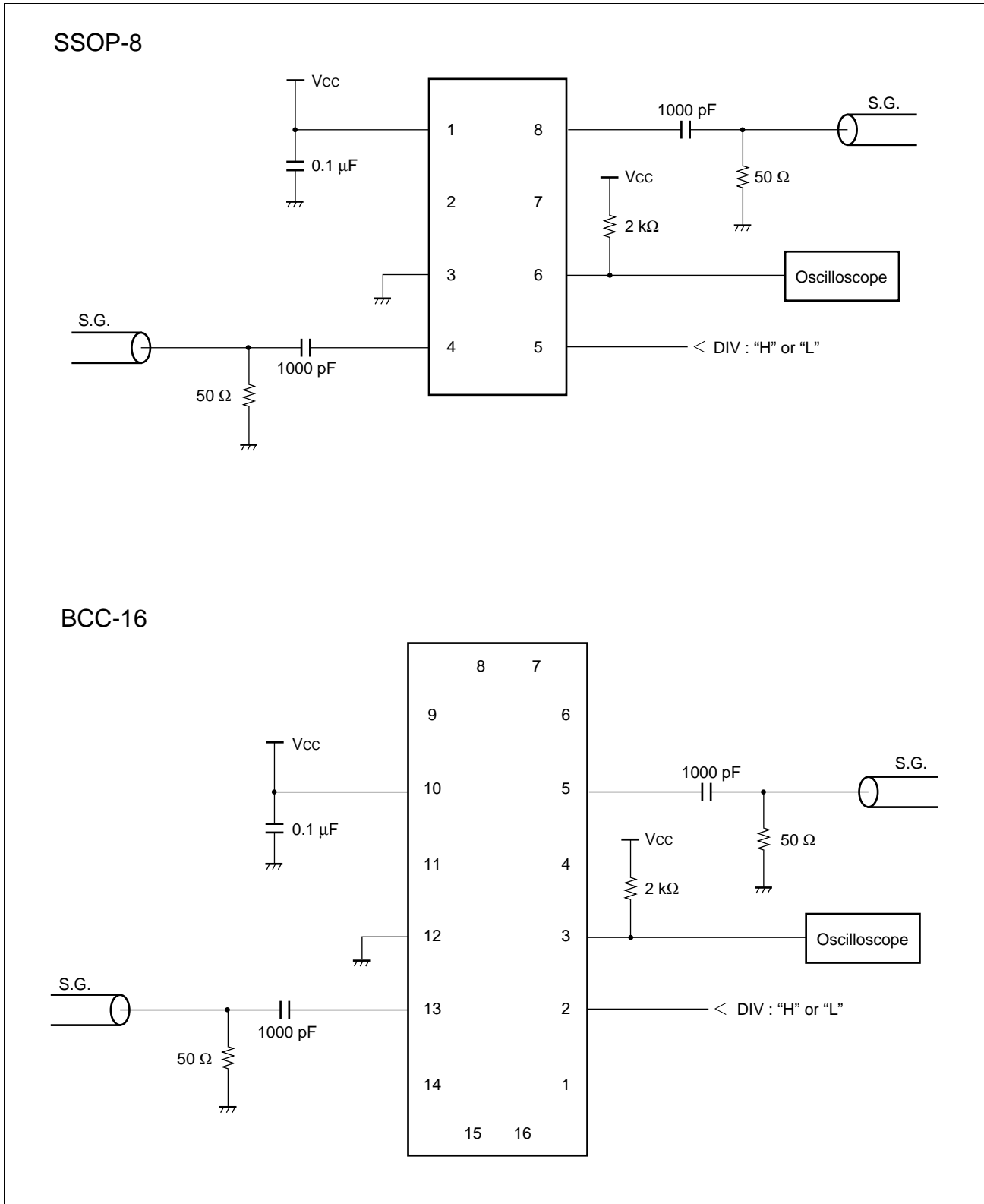
Symbol	Description	DIV = "H"	DIV = "L"
f_{vco}	Output frequency of external VCO	178.00 MHz	129.55 MHz
f_{osc}	Reference oscillation frequency	12.8 MHz	12.8 MHz
N	Divide ratio of the main counter	27	161
A	Divide ratio of the swallow counter	13	15
P	Preset divide ratio of dual modulus prescaler	16/17	16/17
R	Divide ratio of the reference counter	32 (fr = 400 kHz)	256 (fr = 50 kHz)

PHASE DETECTOR TIME CHART



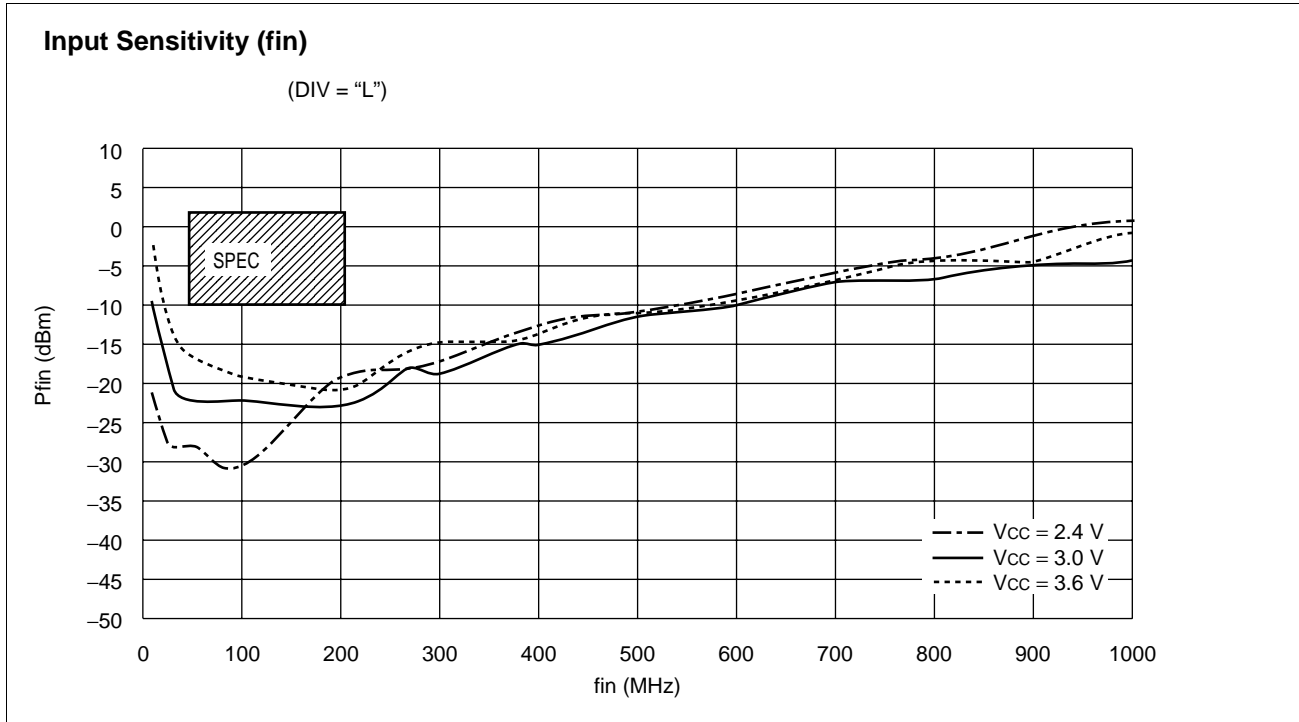
- Note:
- Phase error detection range: -2π to $+2\pi$
 - Pulses on Do output signal during locked state are output to prevent dead zone.
 - LD output becomes low when phase is t_{wU} or more. LD output becomes high when phase error is t_{wL} or less and continues to be so for three cycles or more.
 - t_{wU} and t_{wL} depend on OSC_{IN} input frequency.
 - $t_{wU} \geq 8/f_{osc}$ (s) (e. g. $t_{wU} \geq 625.0ns$, $f_{osc} = 12.8$ MHz)
 - $t_{wL} \leq 16/f_{osc}$ (s) (e. g. $t_{wL} \leq 1250.0ns$, $f_{osc} = 12.8$ MHz)

MEASUREMENT CIRCUIT (for measuring input sensitivity f_{in}/OSC_{IN})

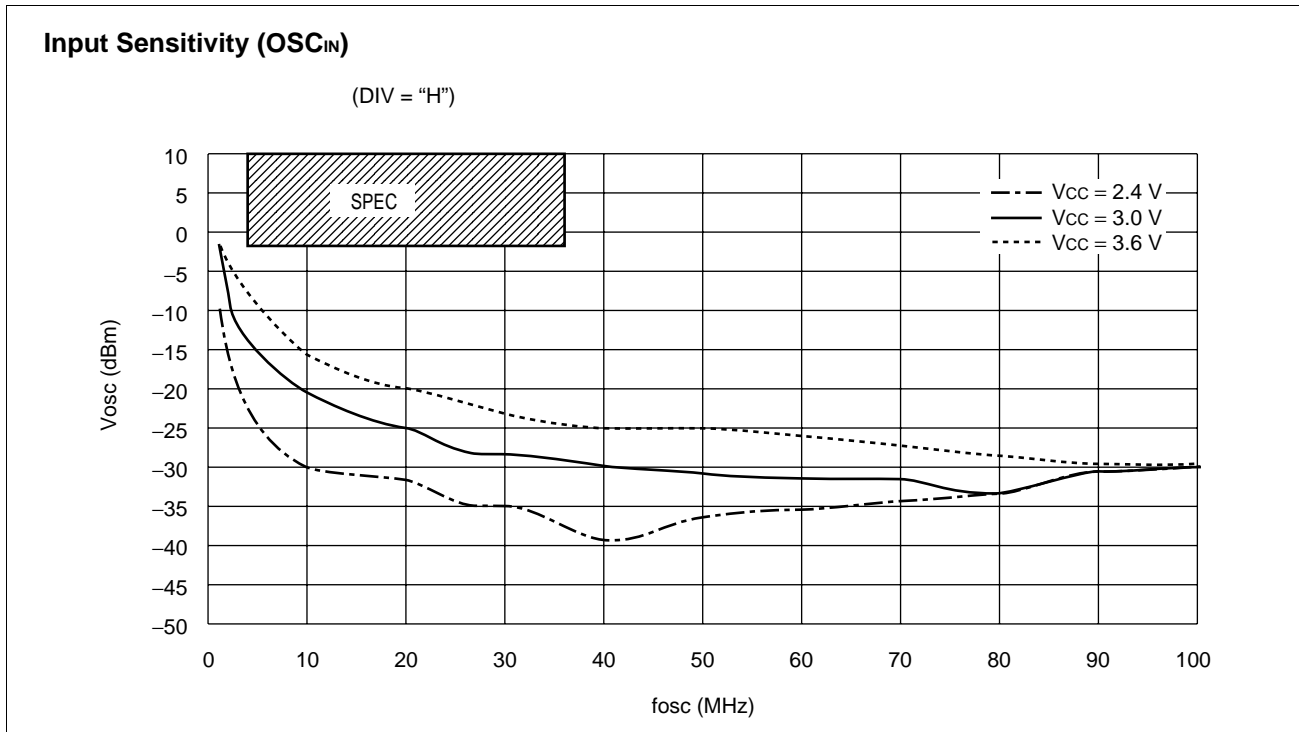


■ TYPICAL CHARACTERISTICS

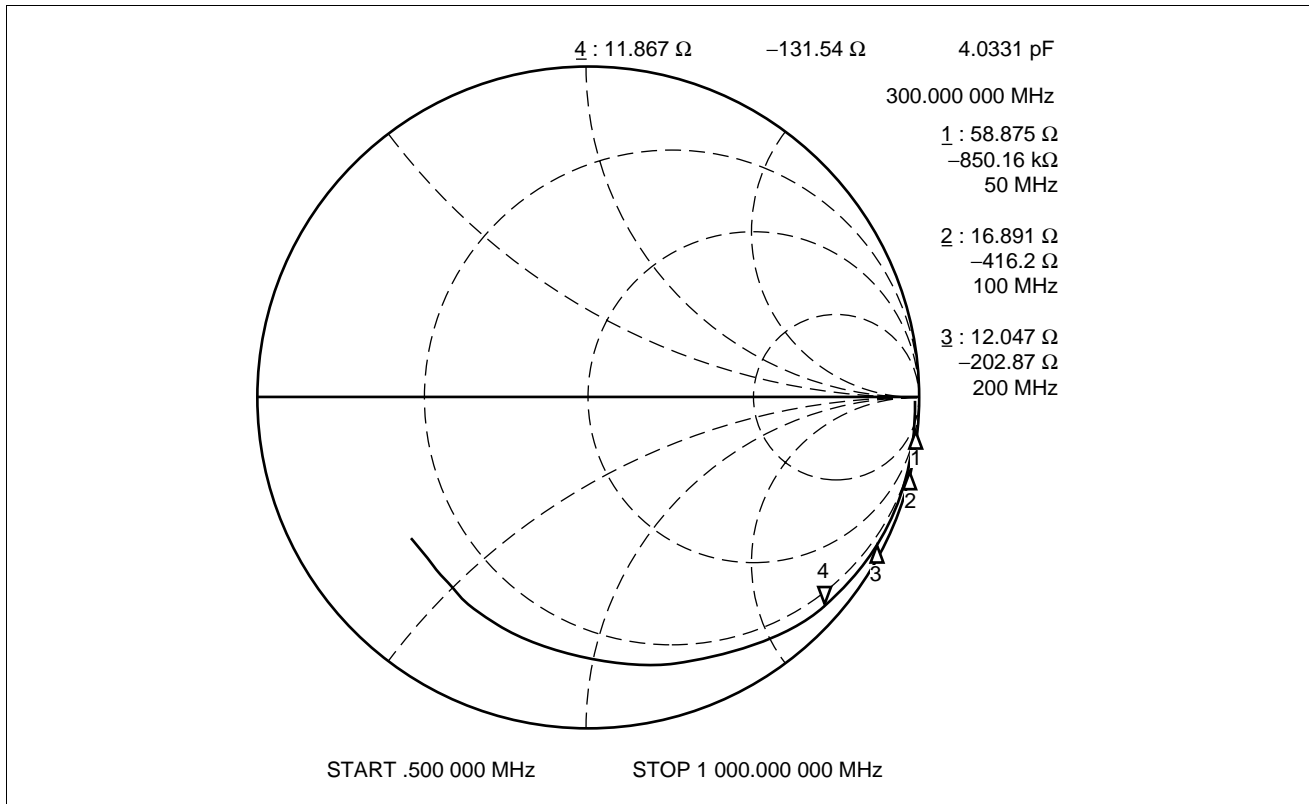
1. fin Input Sensitivity



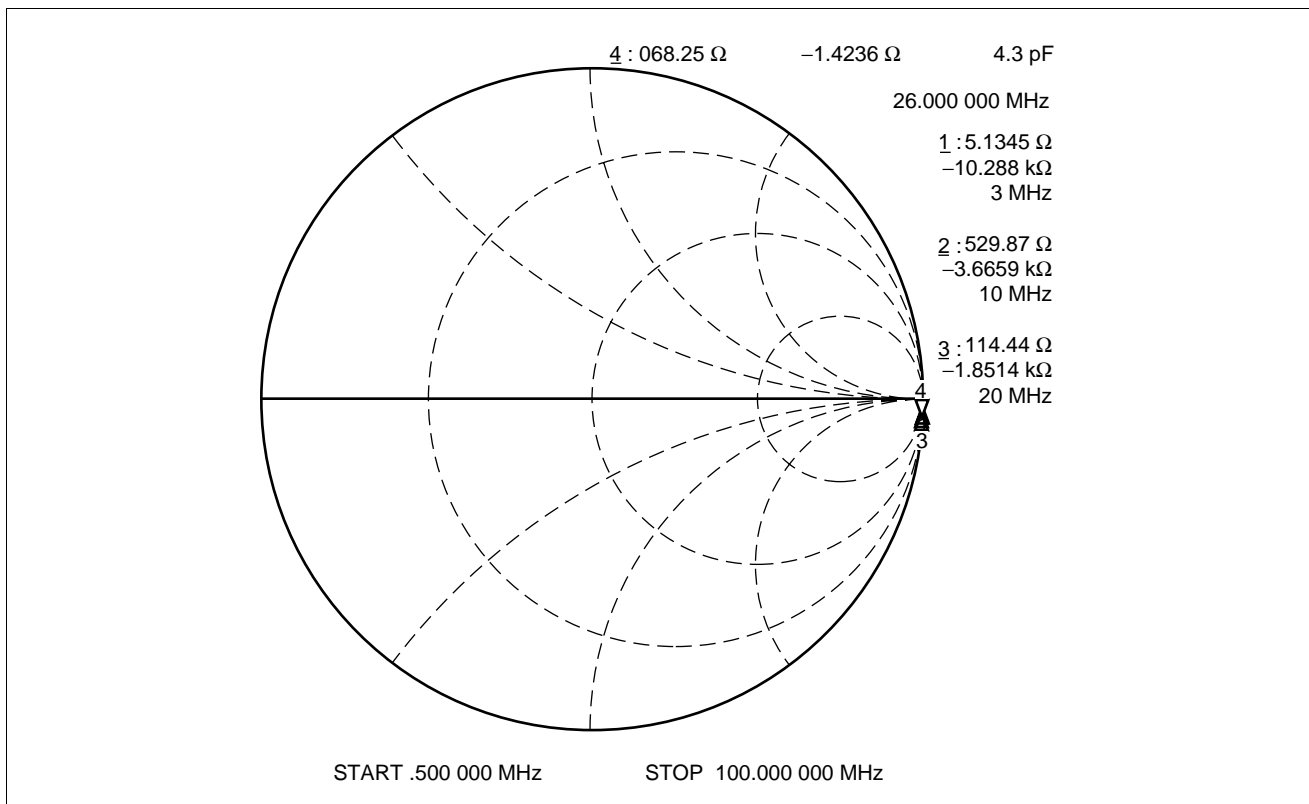
2. OSC_{IN} Input Sensitivity



3. fin Input Impedance



4. OSC_{IN} Input Impedance

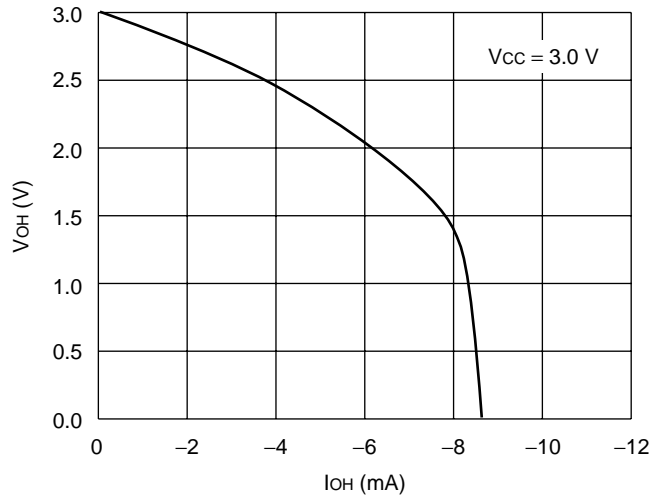


MB15C103

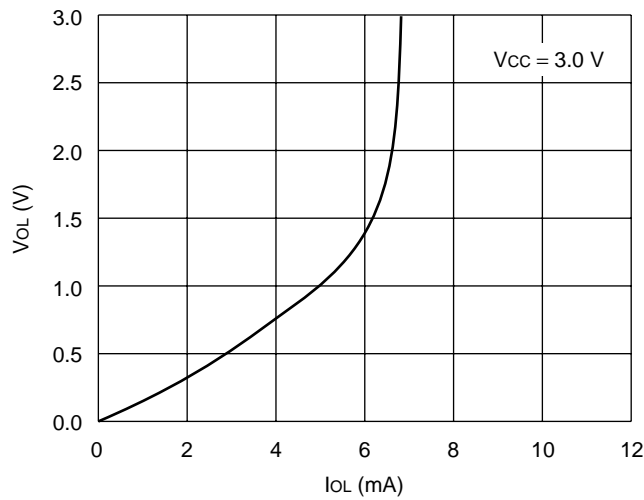
5. Do Output Current

Charge pump current

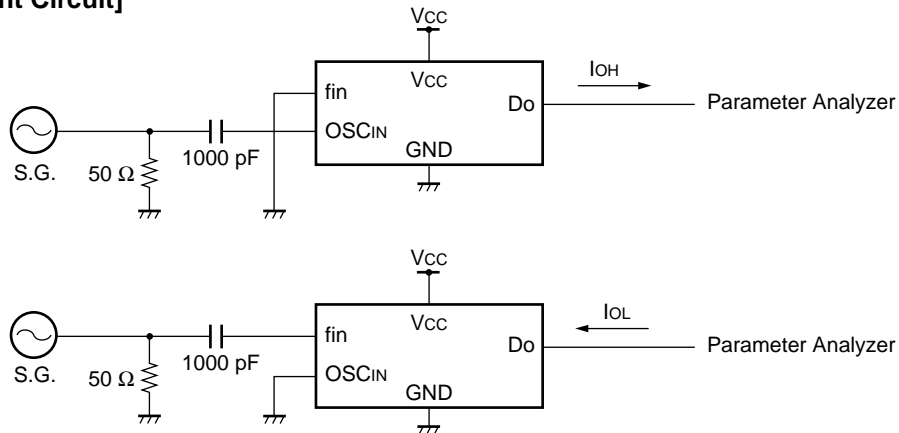
[$V_{OH} - I_{OH}$]



[$V_{OL} - I_{OL}$]



[Measurement Circuit]



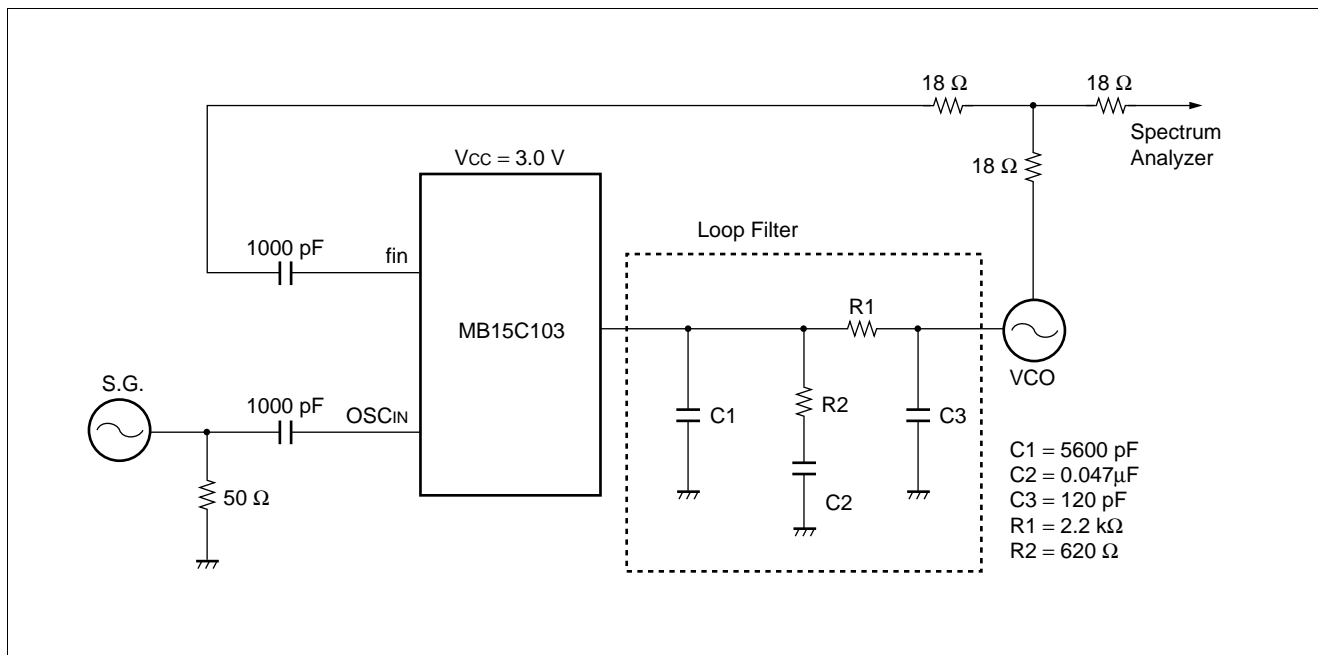
■ REFERENCE INFORMATION

1. Application Measurement

Test results

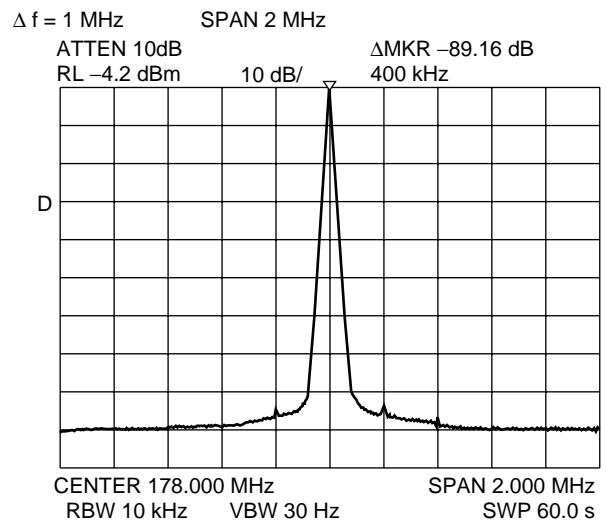
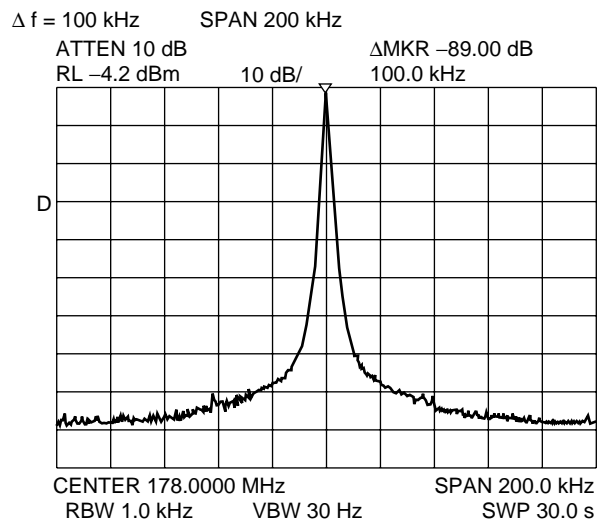
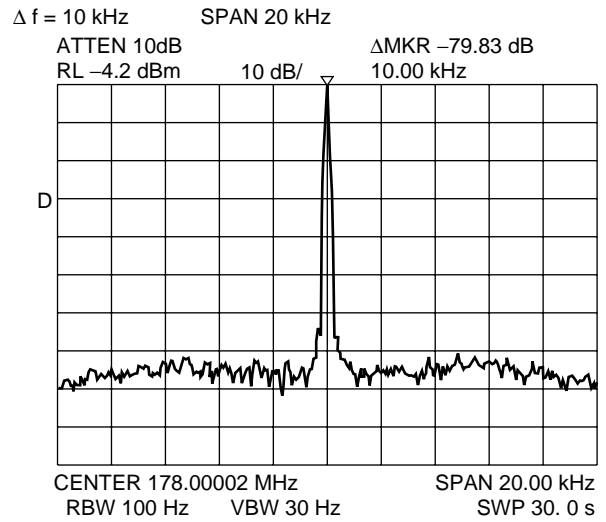
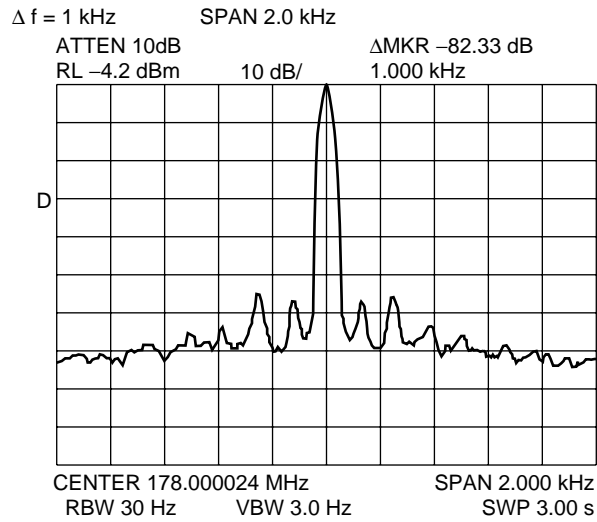
		Results
Lock up time $\pm 1\text{kHz}$	Unlock --> Lock Power on --> Lock	350 μs 2.15 ms
Reference leakage($\Delta f = 400\text{kHz}$)		89.2 dBc
Phase noise	($\Delta f = 1\text{ kHz}$)	97.1 dBc/Hz
	($\Delta f = 10\text{ kHz}$)	99.8 dBc/Hz
	($\Delta f = 100\text{ kHz}$)	119.0 dBc/Hz
	($\Delta f = 1\text{ MHz}$)	130.1 dBc/Hz
V_{CC} (V)		3.0 V
VCO		Discrete VCO ($K_v = 8.2\text{MHz/V}$) Lock Frequency = 178.0MHz ($f_r = 400\text{kHz}$)

Measurement circuits

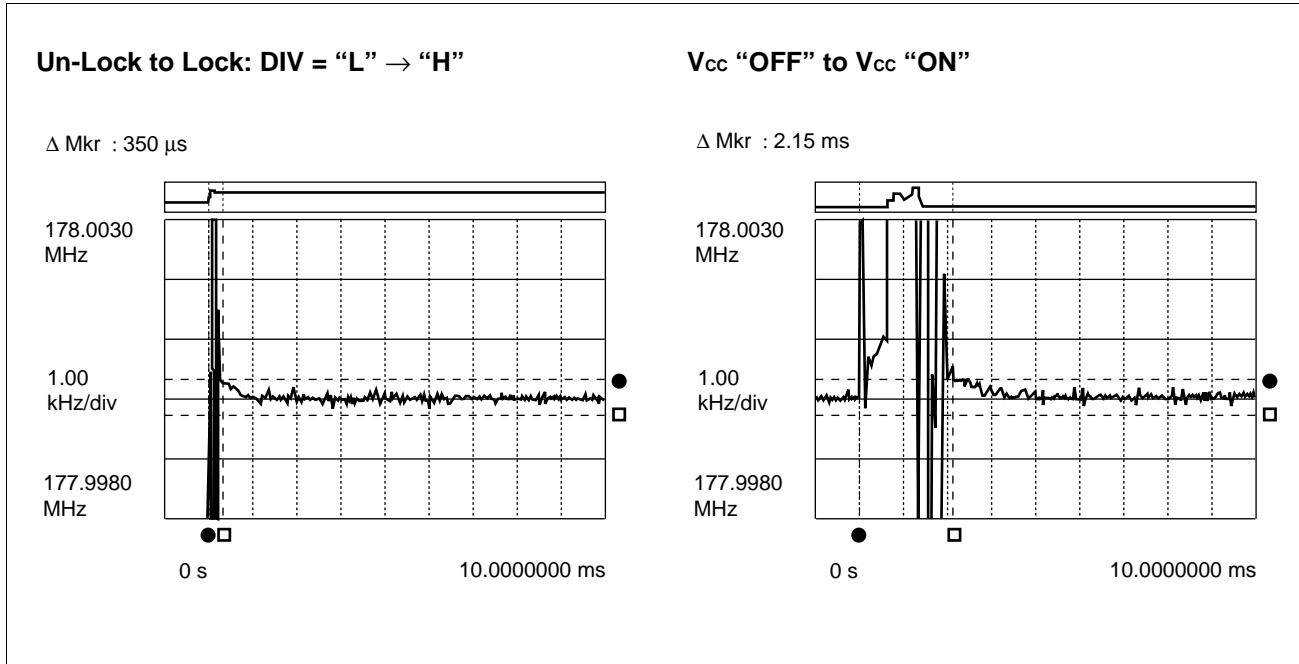


MB15C103

2. Phase Noise



3. Lock Up Time



■ USAGE PRECAUTIONS

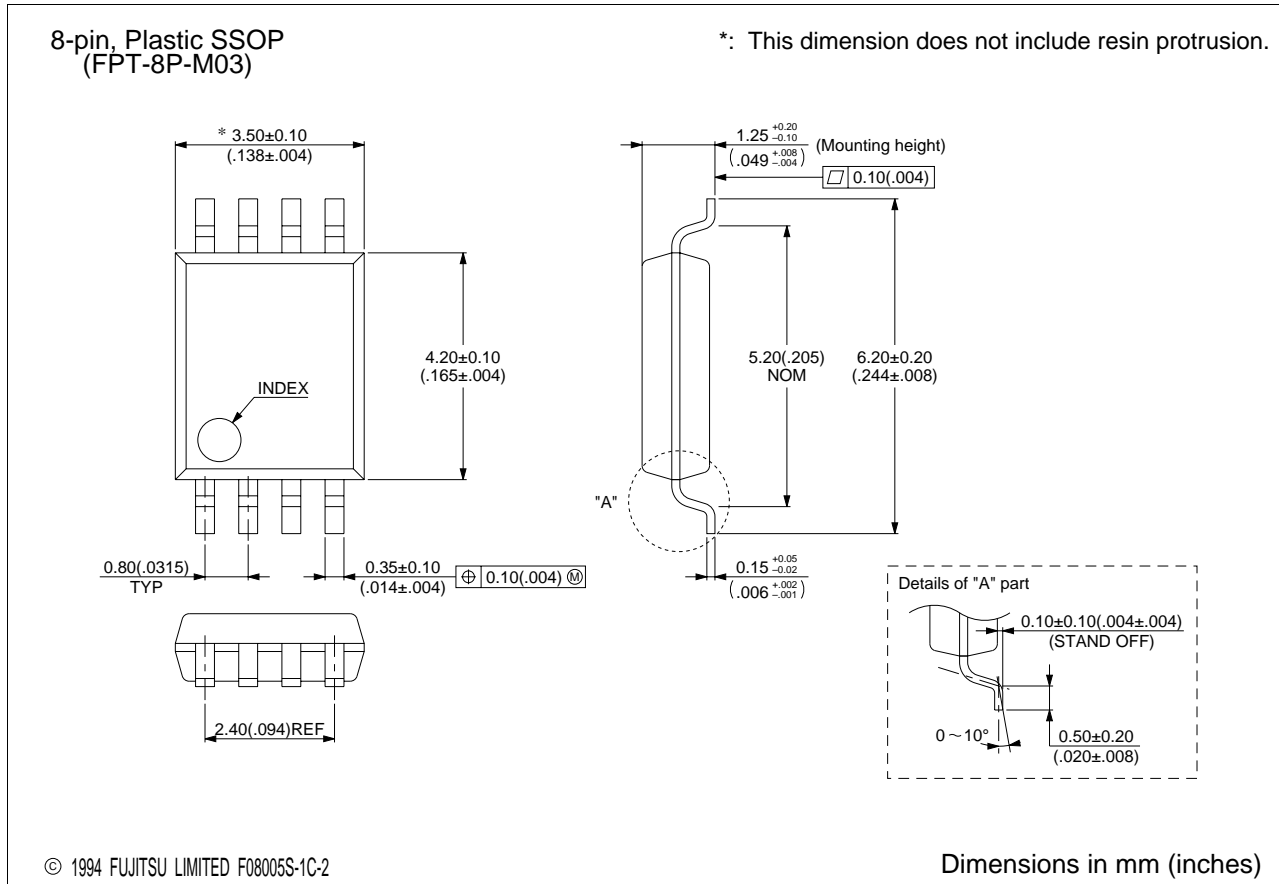
- This device should be transported and stored in anti-static containers.
- This is a static-sensitive device; take proper anti-ESD precautions. Ensure that personnel and equipment are properly grounded. Cover workbenches with grounded conductive mats.
- Always turn the power supply off before inserting or removing the device from its socket.
- Protect leads with a conductive sheet when handling or transporting PC boards with devices.

■ ORDERING INFORMATION

Part number	Package	Remarks
MB15C103PFV	8-pin, Plastic SSOP (FPT-8P-M03)	
MB15C103PV1	16-pad, Plastic BCC (LCC-16P-M06)	

MB15C103

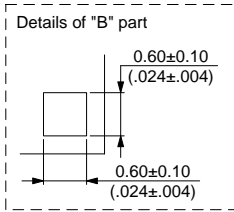
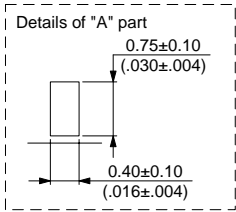
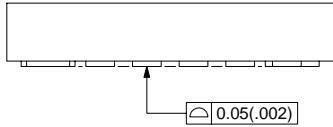
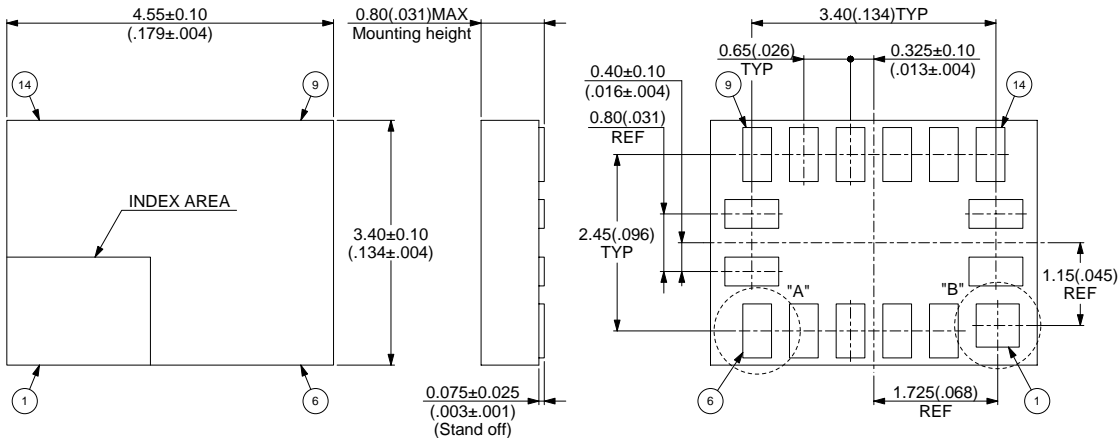
■ PACKAGE DIMENSIONS



(Continued)

(Continued)

16-pad, Plastic BCC
(LCC-16P-M06)



Dimensions in mm (inches)

FUJITSU LIMITED

All Rights Reserved.

The contents of this document are subject to change without notice. Customers are advised to consult with FUJITSU sales representatives before ordering.

The information and circuit diagrams in this document are presented as examples of semiconductor device applications, and are not intended to be incorporated in devices for actual use. Also, FUJITSU is unable to assume responsibility for infringement of any patent rights or other rights of third parties arising from the use of this information or circuit diagrams.

The products described in this document are designed, developed and manufactured as contemplated for general use, including without limitation, ordinary industrial use, general office use, personal use, and household use, but are not designed, developed and manufactured as contemplated (1) for use accompanying fatal risks or dangers that, unless extremely high safety is secured, could have a serious effect to the public, and could lead directly to death, personal injury, severe physical damage or other loss (i.e., nuclear reaction control in nuclear facility, aircraft flight control, air traffic control, mass transport control, medical life support system, missile launch control in weapon system), or (2) for use requiring extremely high reliability (i.e., submersible repeater and artificial satellite).

Please note that Fujitsu will not be liable against you and/or any third party for any claims or damages arising in connection with above-mentioned uses of the products.

Any semiconductor devices have an inherent chance of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

If any products described in this document represent goods or technologies subject to certain restrictions on export under the Foreign Exchange and Foreign Trade Law of Japan, the prior authorization by Japanese government will be required for export of those products from Japan.