

ASSP

IF Band PLL Frequency Synthesizer

MB15C101

■ DESCRIPTION

The Fujitsu MB15C101 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 1.0 mA typ.(270MHz) of current realized through the use of Fujitsu's CMOS technology.

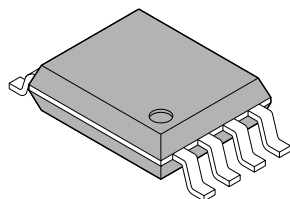
The MB15C101 is ideally suitable for PHS systems.

■ FEATURES

- Low power supply current: $I_{CC} = 1.0 \text{ mA}$ typ. ($V_{CC} = 3 \text{ V}$, 270MHz)
- Pulse swallow function; Prescaler: 16/17
- Setting frequency (Selectable by Div input.)
 - $f_{osc} = 19.2 \text{ MHz}$, $f_{IF} = 233.15 \text{ MHz}$ (Div = "H")
 - $f_{osc} = 19.2 \text{ MHz}$, $f_{IF} = 259.20 \text{ MHz}$ (Div = "L")
- Lock detector
- Low power supply voltage: $V_{CC} = 2.4 \text{ V}$ min.
- Wide operating temperature: $T_a = -40$ to $+85^\circ\text{C}$

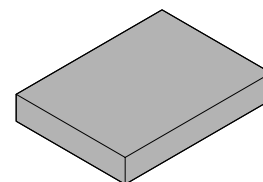
■ PACKAGE

8-pin plastic SSOP



(FPT-8P-M03)

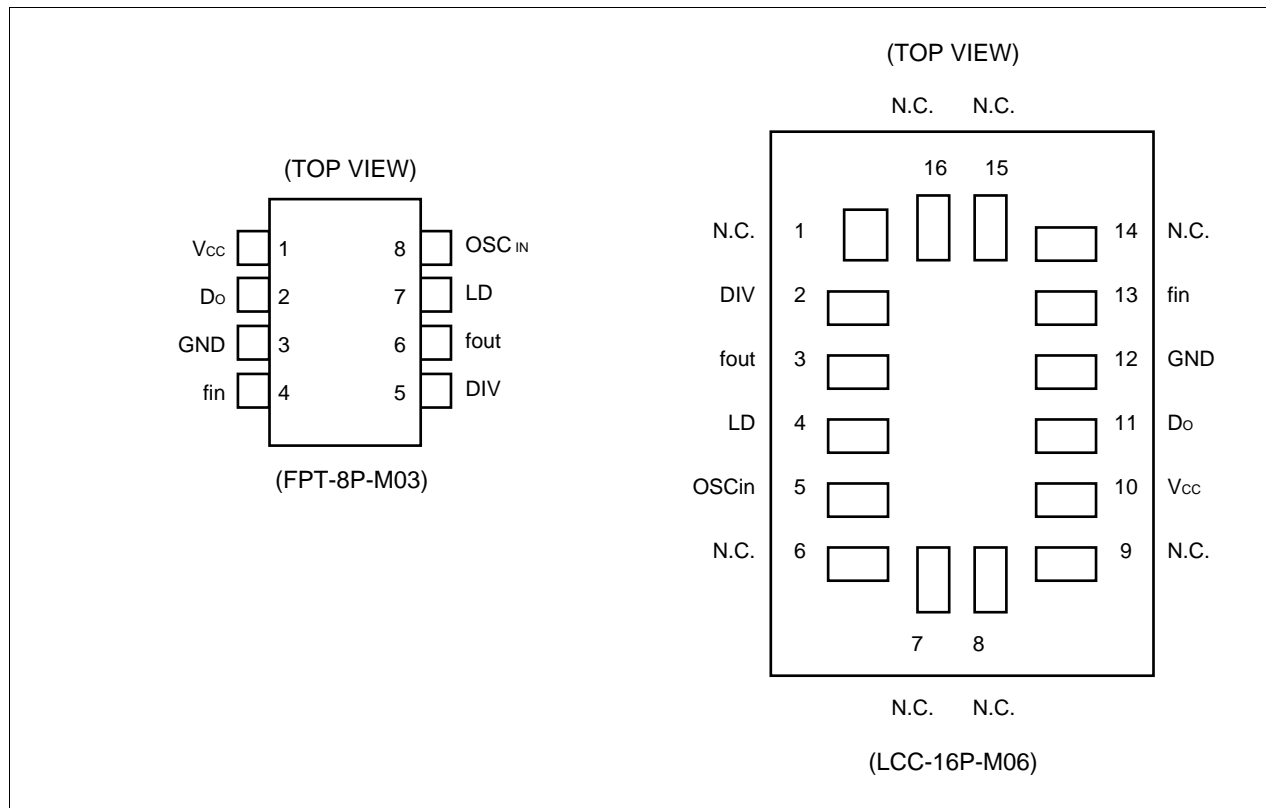
16-pad plastic BCC



(LCC-16P-M06)

MB15C101

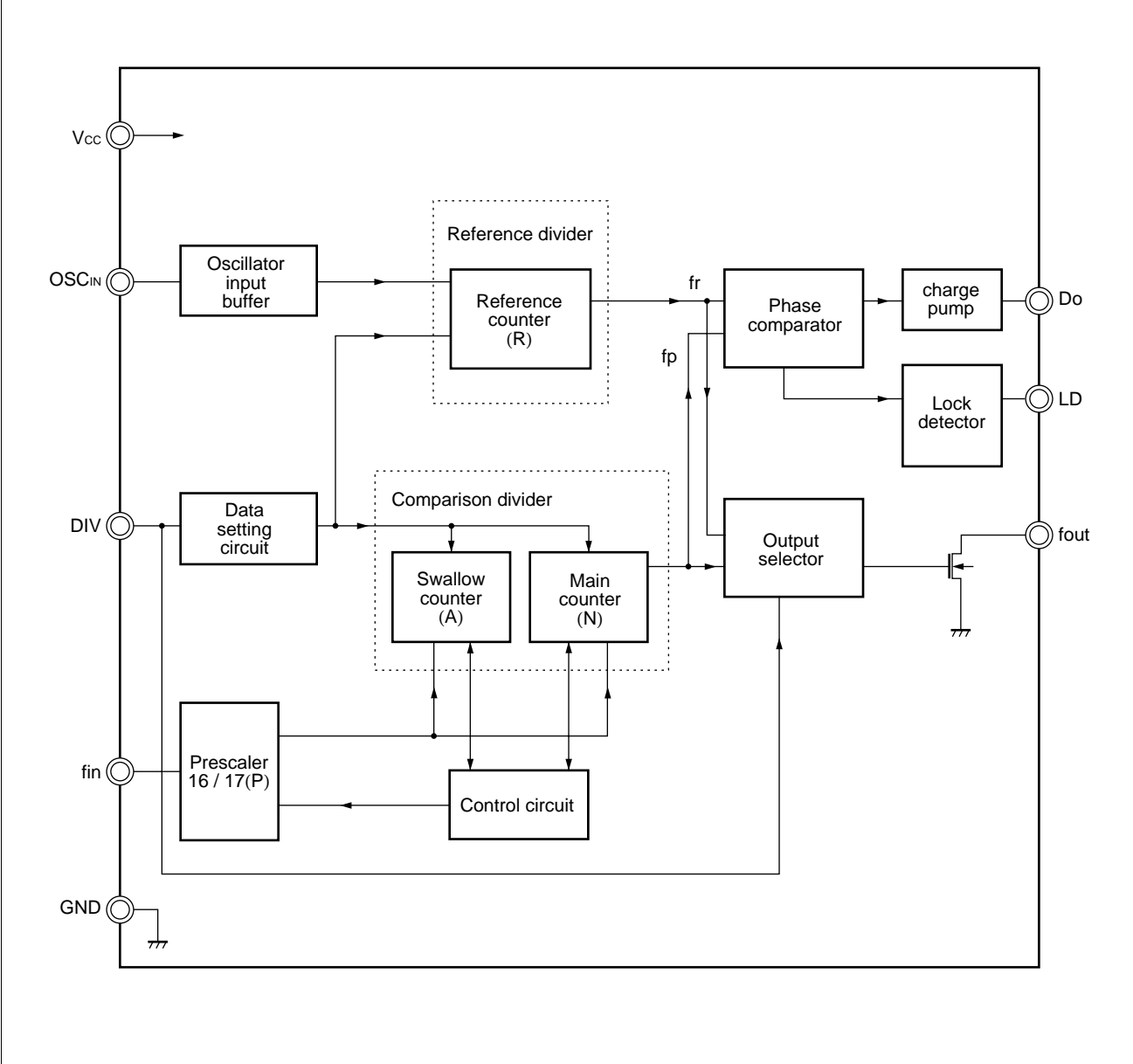
■ PIN ASSIGNMENT



■ 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	D _O	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



MB15C101

■ 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	

Handling 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.

■ ELECTRICAL CHARACTERISTICS

Recommended operating conditions unless otherwise noted.

Parameter	Symbol	Condition	Value			Unit	
			Min.	Typ.	Max.		
Power supply current	I _{CC}	PLL is locked.(270MHz) V _{CC} = 3.0 V, T _a = +25°C	0.1	1.0	2.0	mA	
Operating frequency	f _{in}	AC coupling by 1000 pF capacitor	50	–	270	MHz	
	OSC _{IN}	AC coupling by 1000 pF capacitor	3	–	26	MHz	
Input sensitivity	f _{in}	AC coupling by 1000 pF capacitor	–10	–	+2	dBm	
	OSC _{IN}	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} = –0.3mA	2.6	–	–	V
		V _{OL}	V _{CC} = 3.0 V, I _{OL} = 0.3mA	–	–	0.4	V
Output current	Do	I _{OH}	V _{CC} = 3.0 V, V _{OH} = 2V, T _a = +25°C	–	–6.0	–	mA
		I _{OL}	V _{CC} = 3.0 V, V _{OL} = 1V, T _a = +25°C	–	6.0	–	mA
High impedance cut off current	Do	I _{OFF}	0 ≤ V _{DO} ≤ V _{CC}	–	–	3	nA

MB15C101

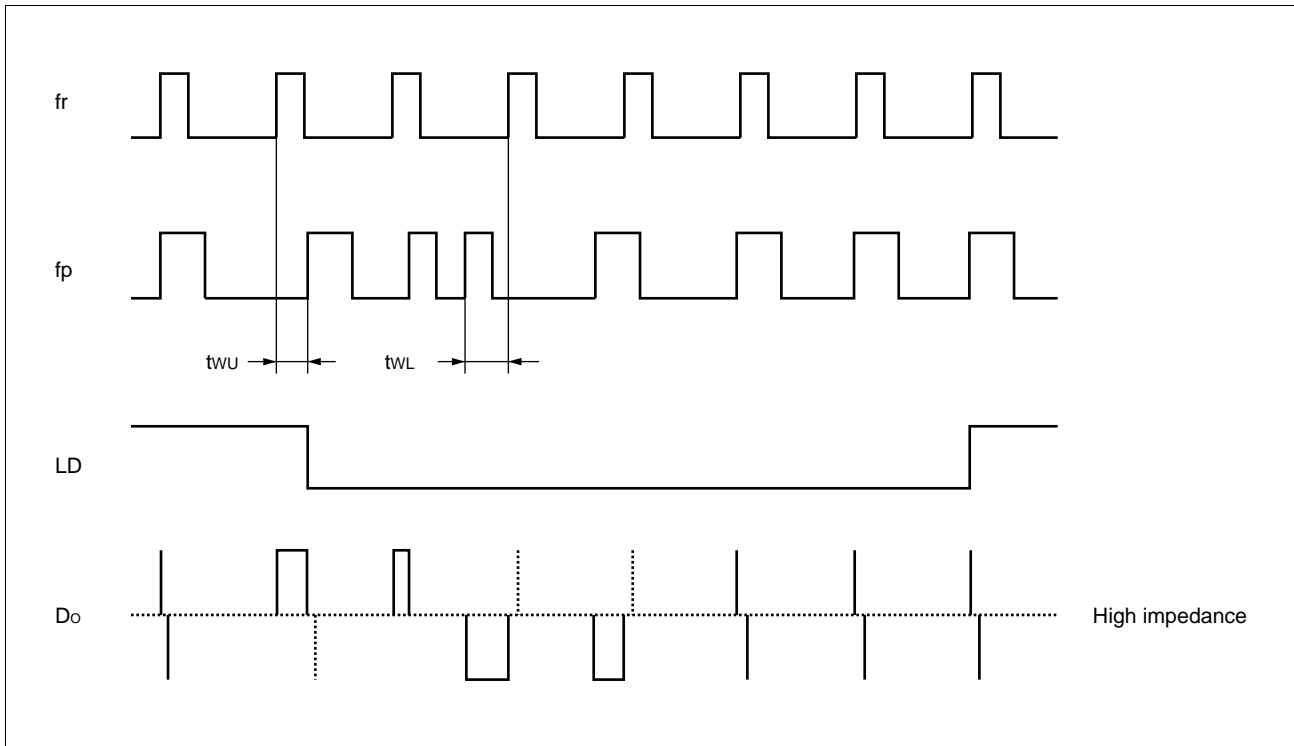
FUNCTIONAL DESCRIPTIONS

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	233.15 MHz	259.20 MHz
f_{osc}	Reference oscillation frequency	19.2 MHz	19.2 MHz
N	Divide ratio of the main counter	291	33
A	Divide ratio of the swallow counter	7	12
P	Preset divide ratio of dual modulus prescaler	16/17	16/17
R	Divide ratio of the reference counter	384 (fr = 50 kHz)	40 (fr = 480 kHz)

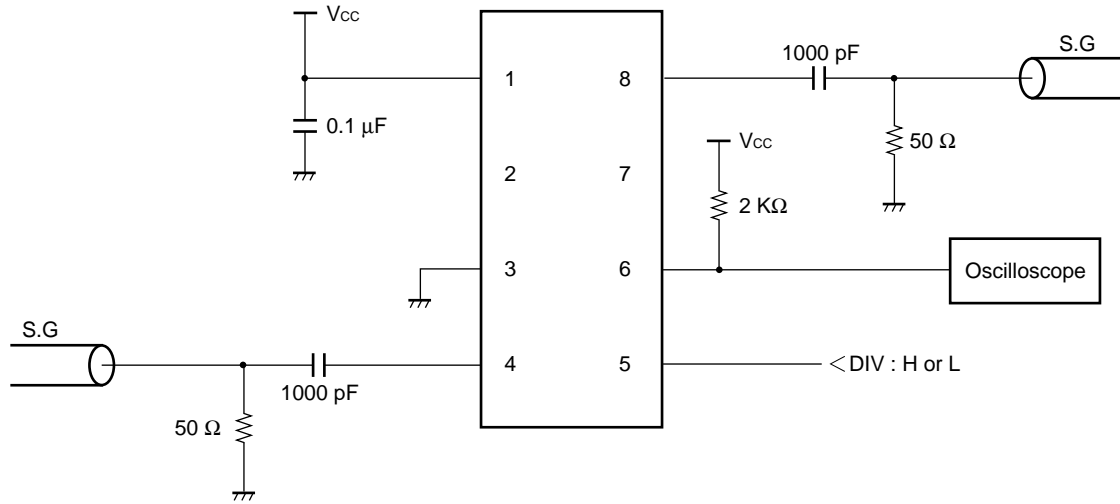
PHASE DETECTOR TIME CHART



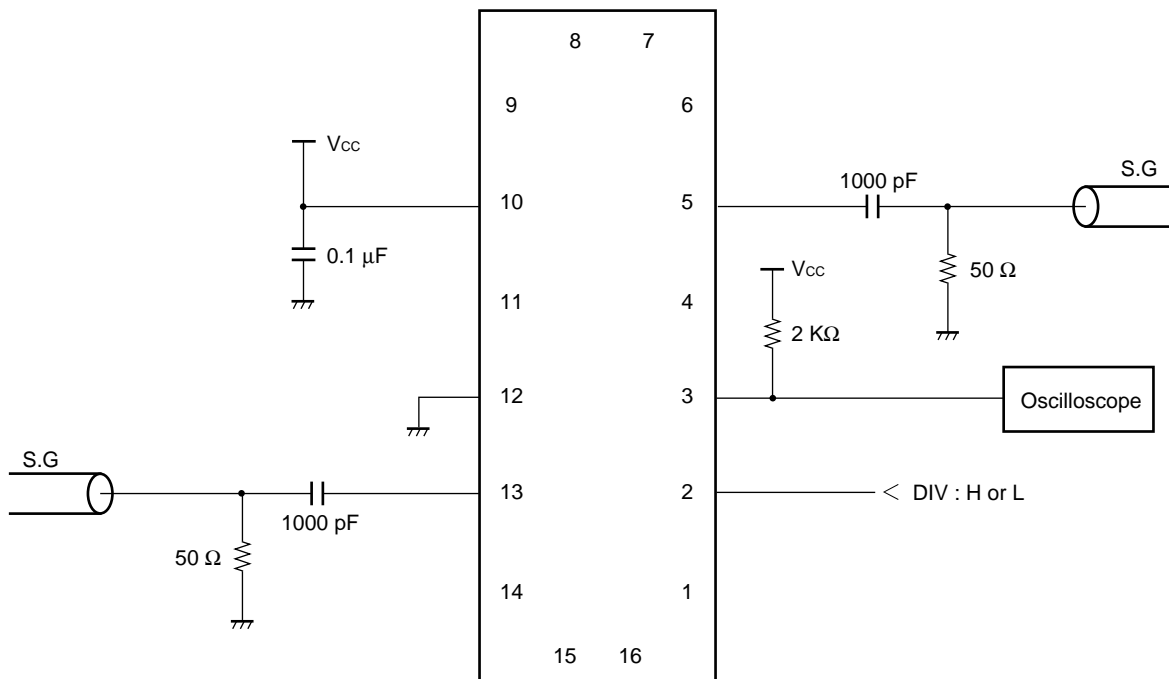
- Note:
- Phase error detection range: -2π to $+2\pi$
 - Pulses on Do output signal during locked state are output to prevent dead zone.
 - LD output becomes low when phase is t_{wU} or more. LD output becomes high when phase error is t_{wL} or less and continues to be so for three cycles or more.
 -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

MEASUREMENT CIRCUIT (for measuring input sensitivity fin/OSCin)

SSOP-8



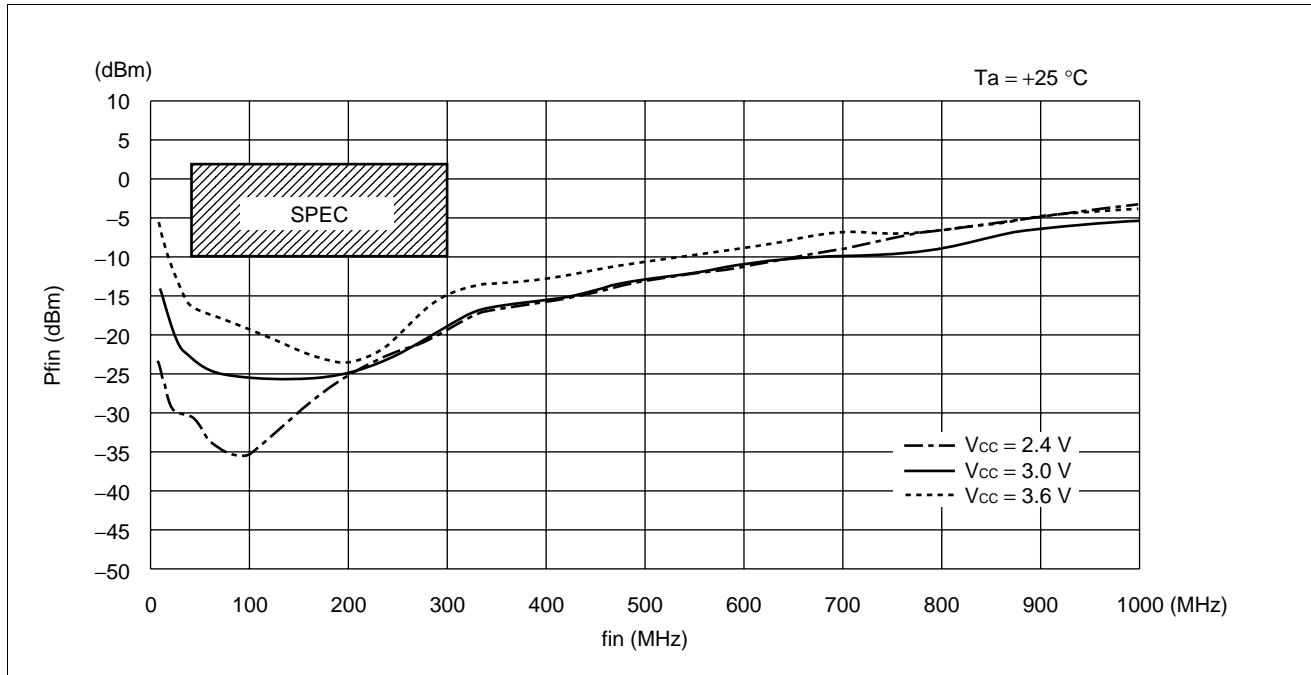
BCC-16



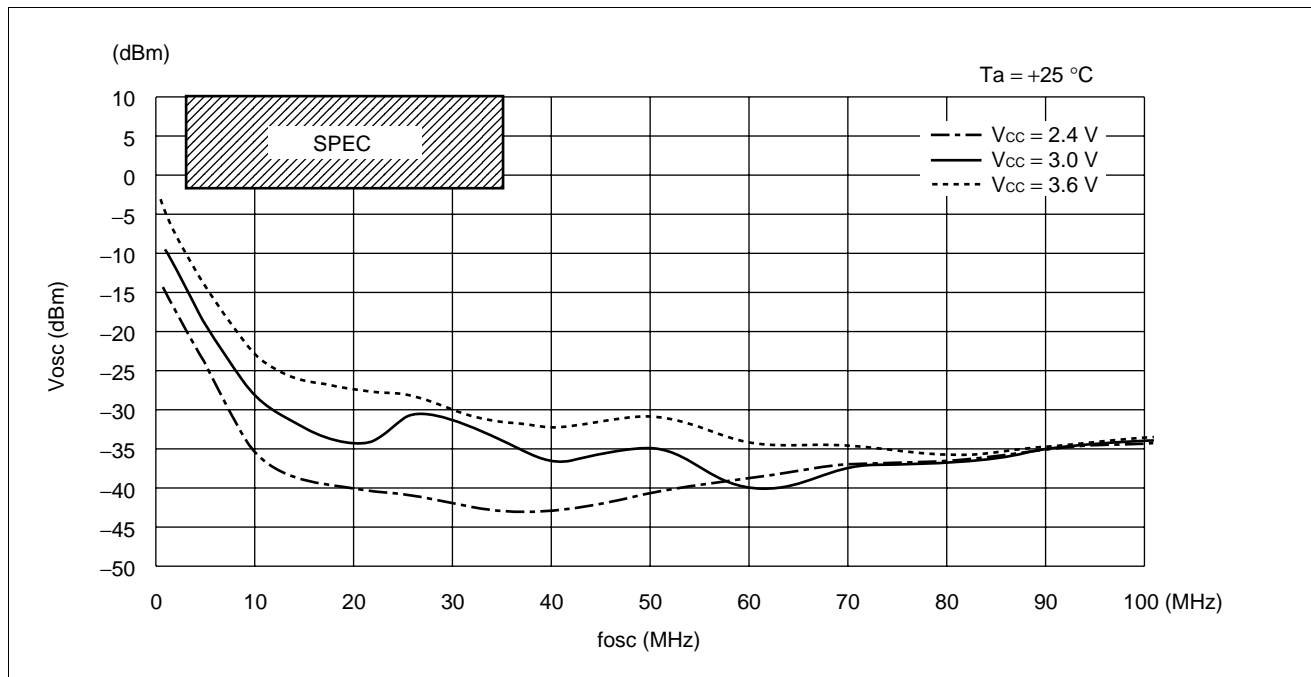
MB15C101

■ TYPICAL CHARACTERISTICS

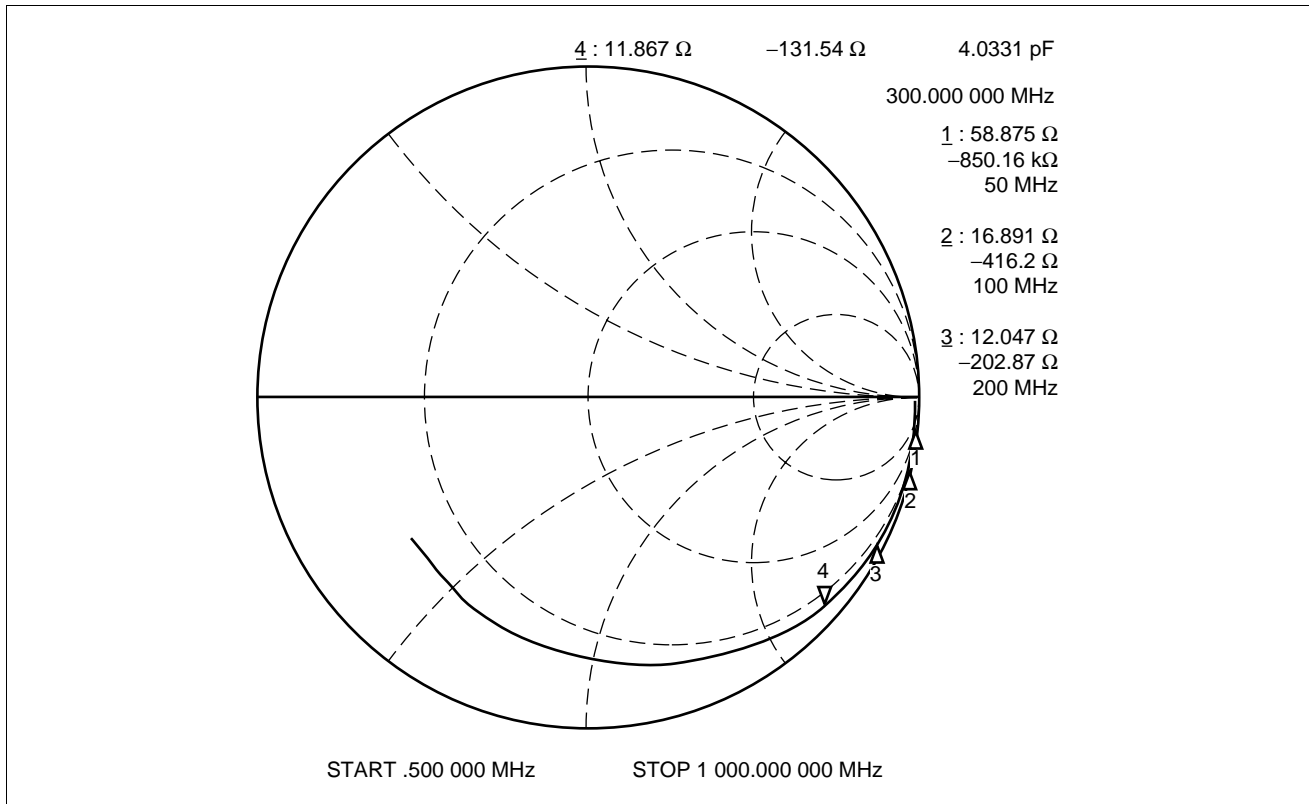
1. f_{in} Input Sensitivity



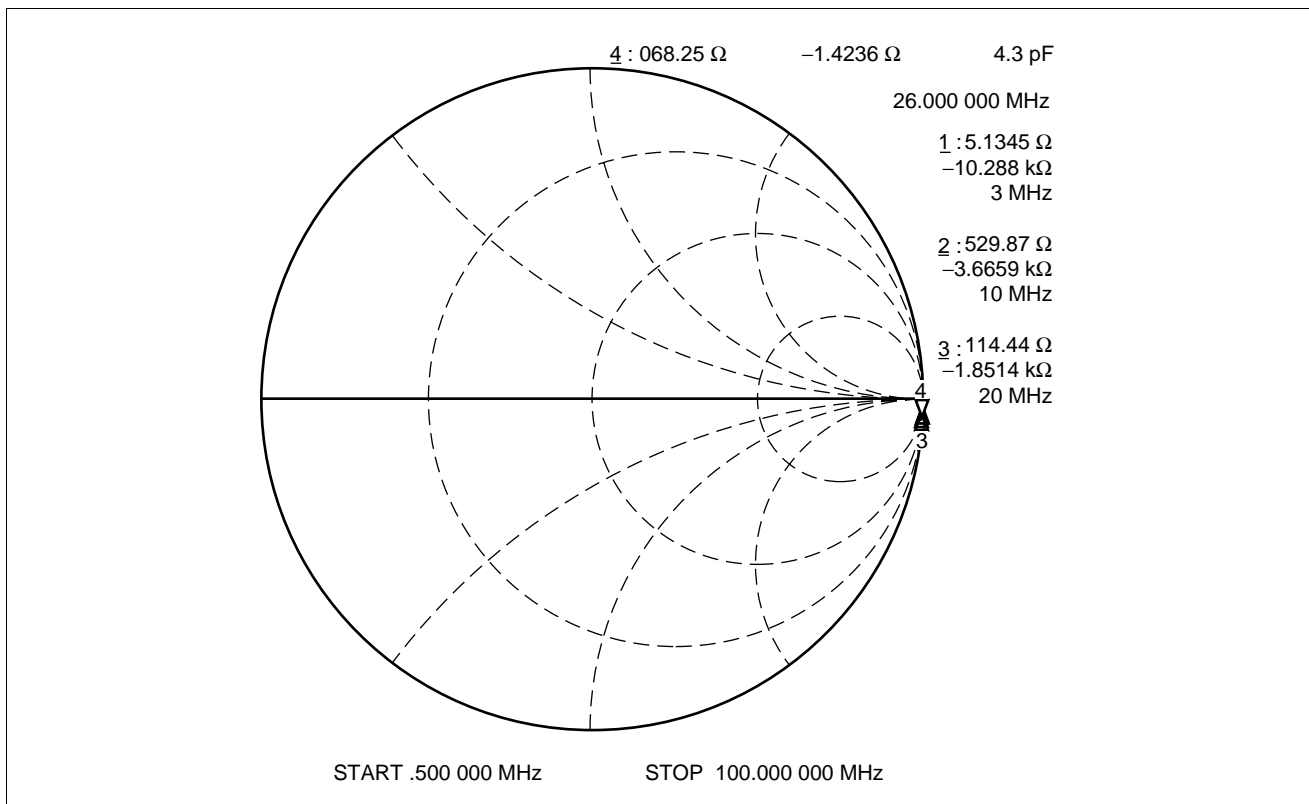
2. OSC_{IN} Input Sensitivity



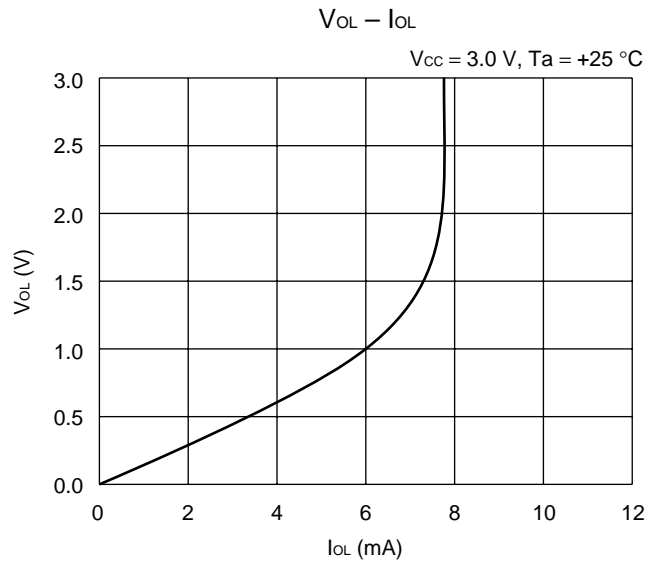
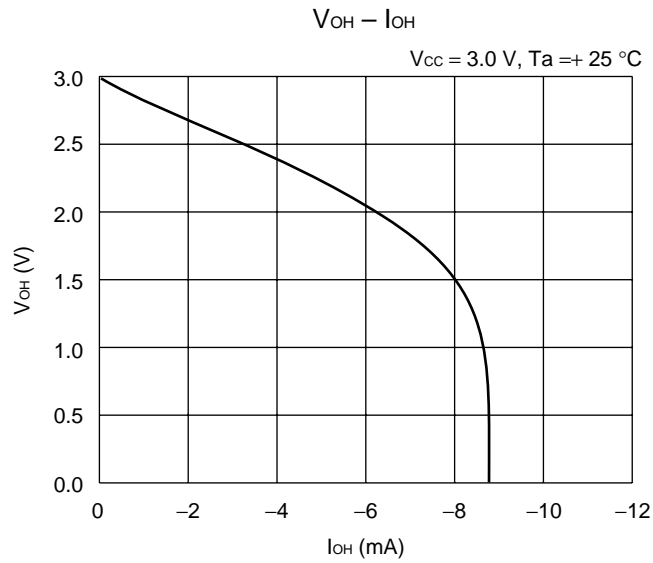
3. fin Input Impedance



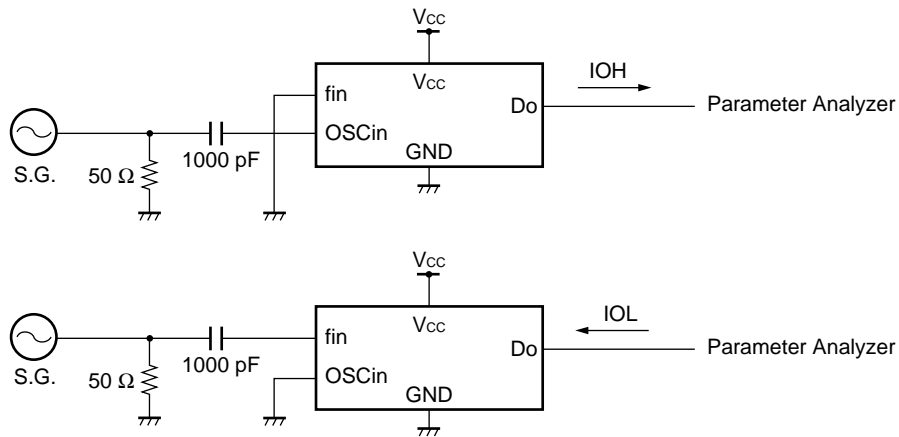
4. OSC_{IN} Input Impedance



5. Do Outut Current



Measurement Circuit



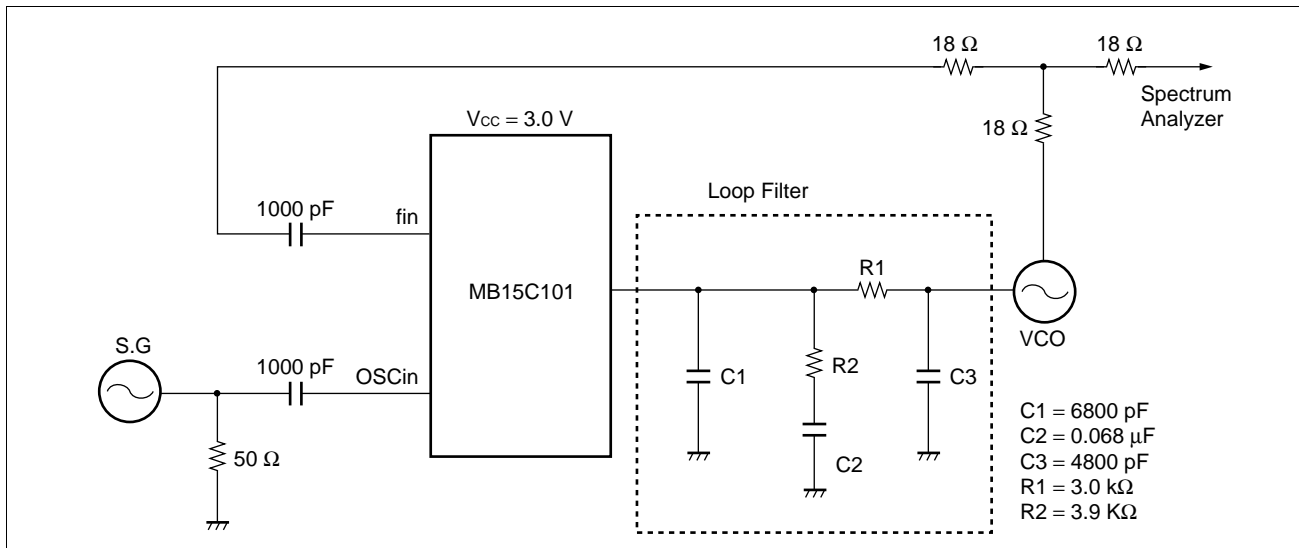
■ REFERENCE INFORMATION

1. Application Measurement

- Test Results

	Results
Lockup time ± 1 kHz Un lock \rightarrow Lock Power on \rightarrow Lock	2.3 ms 3.4 ms
Reference leakage ($\Delta f = 58$ kHz)	-88.5 dBc
Phase noise ($\Delta f = 1$ kHz) ($\Delta f = 10$ kHz) ($\Delta f = 100$ kHz) ($\Delta f = 1$ MHz)	-88.0 dBc/Hz -111.0 dBc/Hz -118.0 dBc/Hz -134.0 dBc/Hz
V _{CC} (V)	3.0 V
VCO	Discrete VCO ($K_v = 3.5$ MHz/V) Lock Frequency = 274.0 MHz ($f_r = 58$ kHz)

- Measurement Circuit

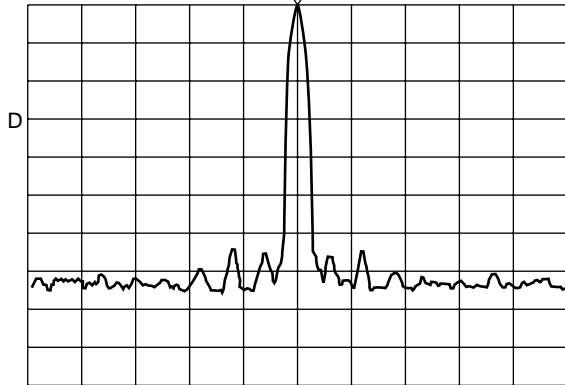


MB15C101

2. Phase Noise

$\Delta f = 1 \text{ kHz}$

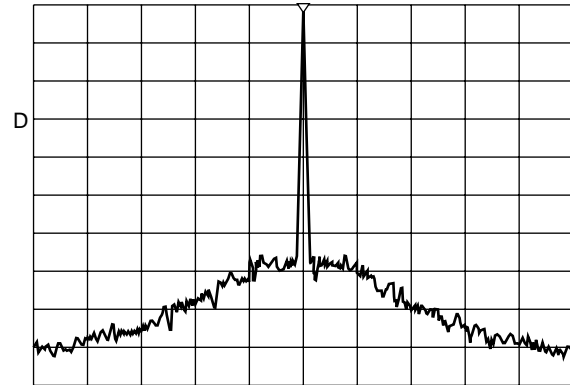
ATTEN 10dB SPAN 2.0 kHz $\Delta\text{MKR} -73.83 \text{ dB}$
RL -1.5 dBm 10 dB/ 1.000 kHz



CENTER 273.999827 MHz SPAN 2.000 kHz
RBW 30 Hz VBW 3.0 Hz SWP 3.00 sec

$\Delta f = 10 \text{ kHz}$

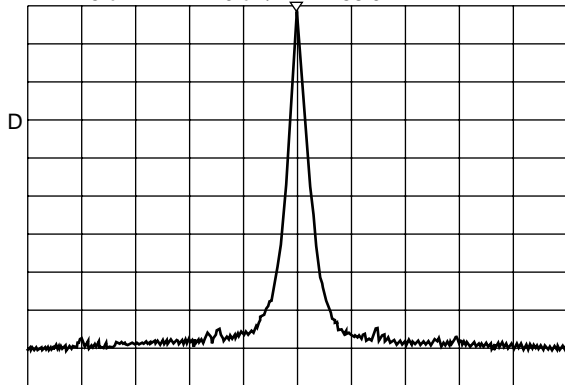
ATTEN 10dB SPAN 20 kHz $\Delta\text{MKR} -91.83 \text{ dB}$
RL -1.5 dBm 10 dB/ 10.00 kHz



CENTER 273.999827 MHz SPAN 20.00 kHz
RBW 100 Hz VBW 30 Hz SWP 30.0 sec

$\Delta f = 100 \text{ kHz}$

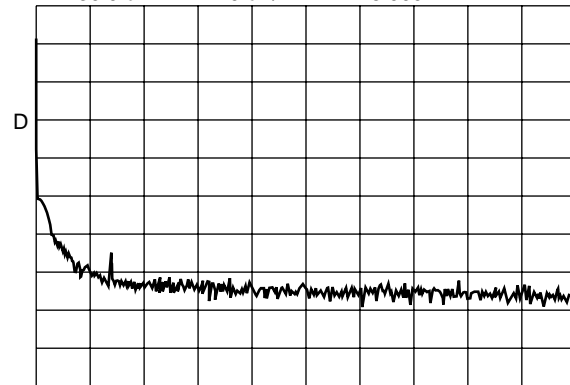
ATTEN 10 dB SPAN 200 kHz $\Delta\text{MKR} -88.50 \text{ dB}$
RL -1.5 dBm 10 dB/ 58.0 kHz



CENTER 274.0002 MHz SPAN 200.0 kHz
RBW 1.0 kHz VBW 30 Hz SWP 30.0 sec

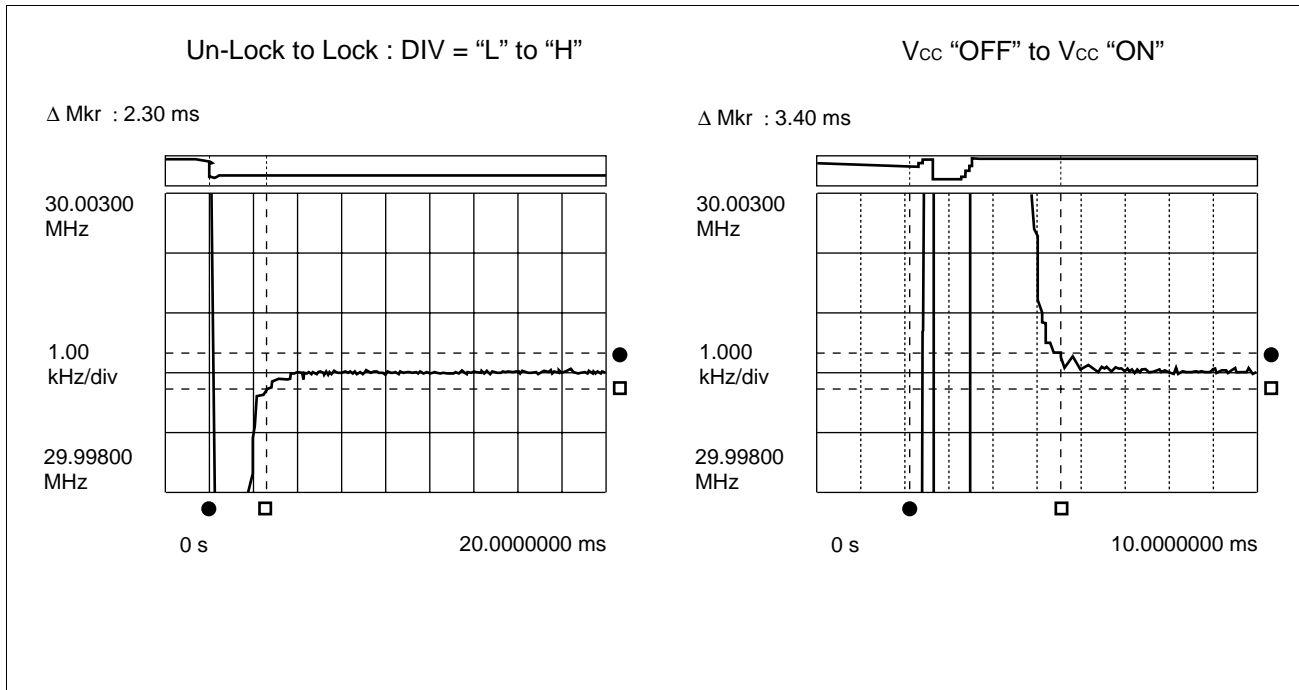
$\Delta f = 1 \text{ MHz}$

ATTEN 10dB SPAN 2 MHz $\Delta\text{MKR} -105.5 \text{ dB}$
RL -30.0 dBm 10 dB/ 275.000 MHz



START 274.000 MHz STOP 276.000 MHz
RBW 1.0 Hz VBW 100 Hz SWP 100 sec

3. Lockup Time: Un-Lock to Lock

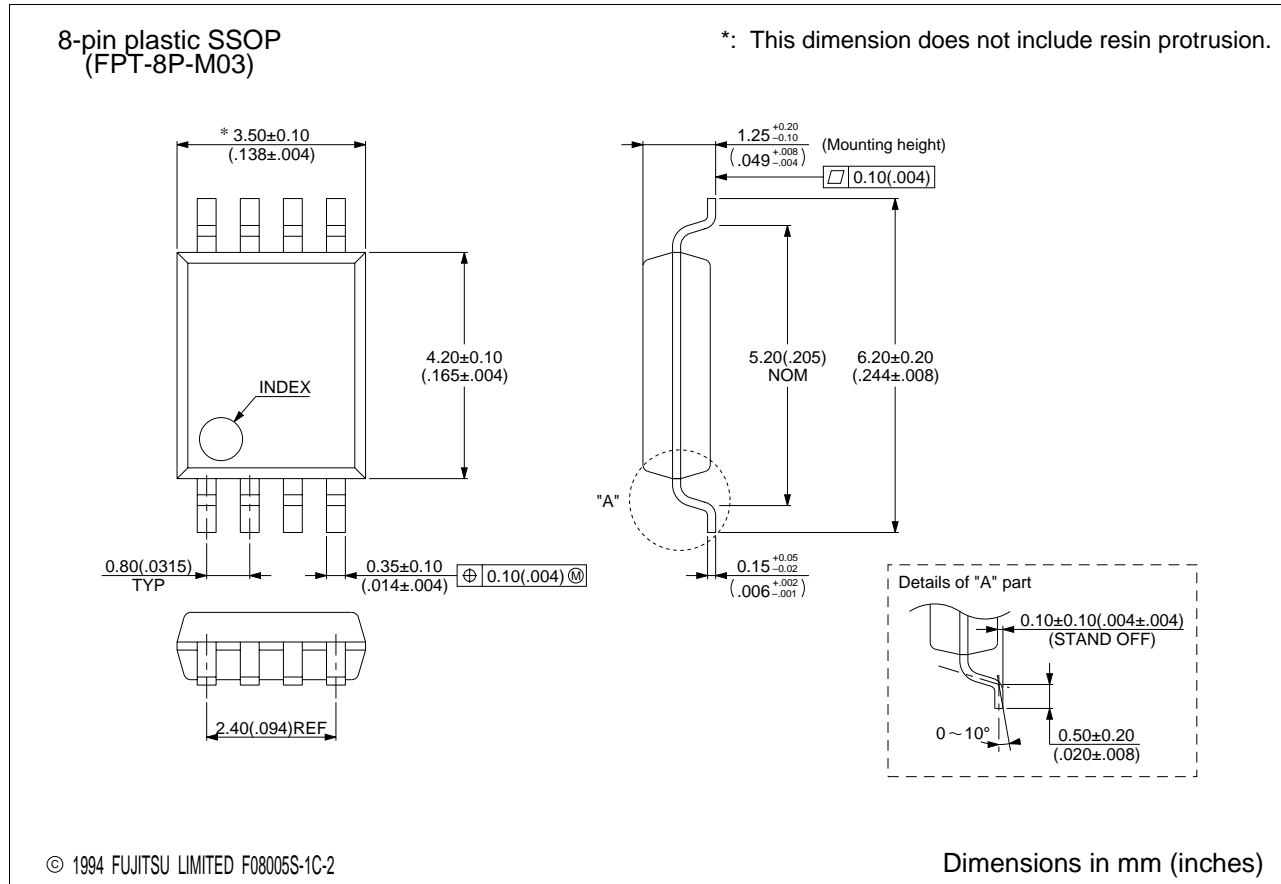


MB15C101

■ ORDERING INFORMATION

Part number	Package	Remarks
MB15C101PFV	8-pin, Plastic SSOP (FPT-8P-M03)	
MB15C101PV1	16-pad, Plastic BCC (LCC-16P-M06)	

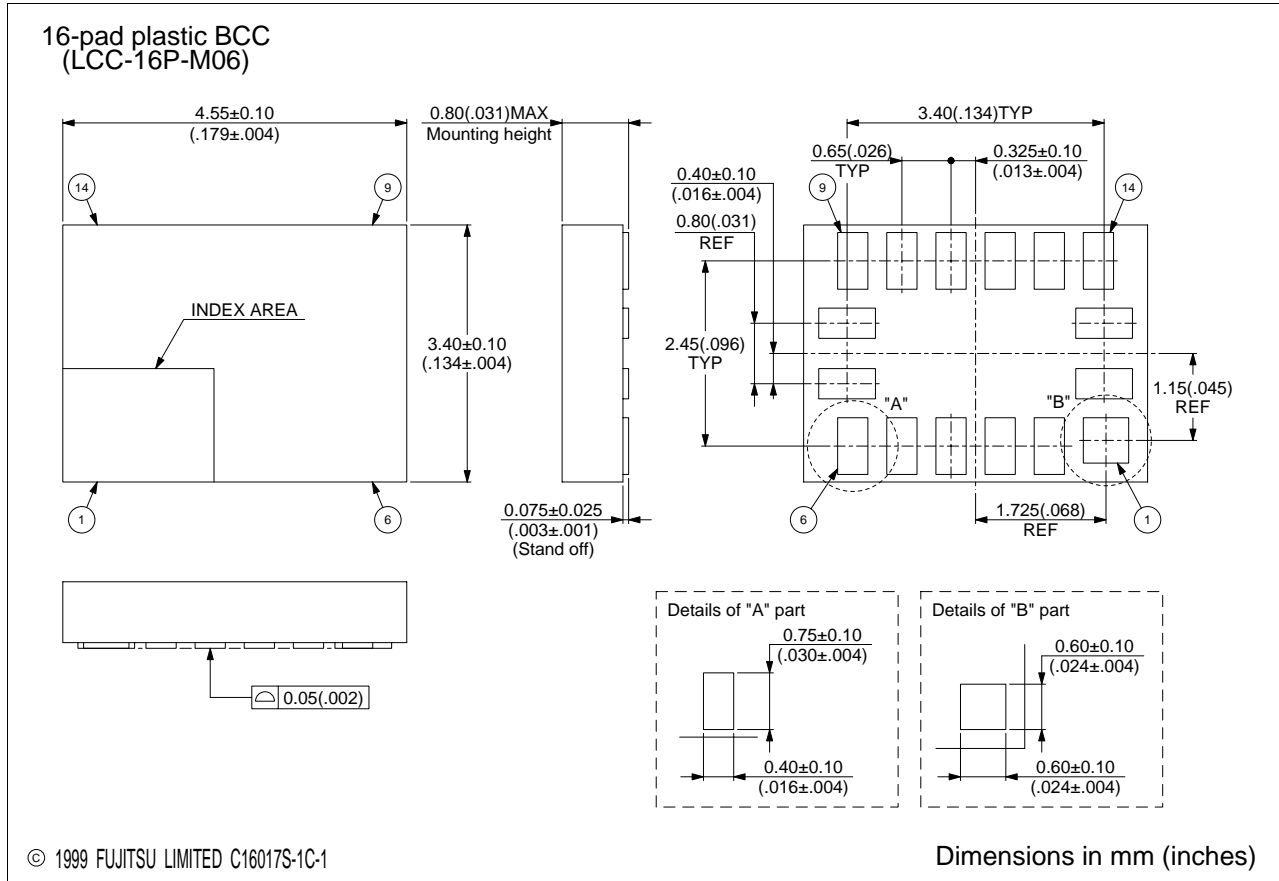
■ PACKAGE DIMENSIONS



(Continued)

MB15C101

(Continued)



FUJITSU LIMITED

For further information please contact:

Japan

FUJITSU LIMITED
Corporate Global Business Support Division
Electronic Devices
KAWASAKI PLANT, 4-1-1, Kamikodanaka
Nakahara-ku, Kawasaki-shi
Kanagawa 211-8588, Japan
Tel: 81(44) 754-3763
Fax: 81(44) 754-3329

<http://www.fujitsu.co.jp/>

North and South America

FUJITSU MICROELECTRONICS, INC.
Semiconductor Division
3545 North First Street
San Jose, CA 95134-1804, USA
Tel: (408) 922-9000
Fax: (408) 922-9179

Customer Response Center
Mon. - Fri.: 7 am - 5 pm (PST)
Tel: (800) 866-8608
Fax: (408) 922-9179

<http://www.fujitsumicro.com/>

Europe

FUJITSU MIKROELEKTRONIK GmbH
Am Siebenstein 6-10
D-63303 Dreieich-Buchsschlag
Germany
Tel: (06103) 690-0
Fax: (06103) 690-122

<http://www.fujitsu-edo.com/>

Asia Pacific

FUJITSU MICROELECTRONICS ASIA PTE LTD
#05-08, 151 Lorong Chuan
New Tech Park
Singapore 556741
Tel: (65) 281-0770
Fax: (65) 281-0220

<http://www.fmap.com.sg/>

F9904

© FUJITSU LIMITED Printed in Japan

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.

FUJITSU semiconductor devices are intended for use in standard applications (computers, office automation and other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.).

CAUTION:

Customers considering the use of our products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded (such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.) are requested to consult with FUJITSU sales representatives before such use. The company will not be responsible for damages arising from such use without prior approval.

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.