FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-21216-4E

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.

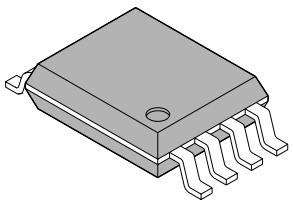
It operates with a supply voltage of 3.0 V typ. and dissipates 0.9 mA typ.(200MHz) of current realized through the use of Fujitsu's CMOS technology.
The MB15C103 is ideally suitable for PDC systems.

■ FEATURES

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

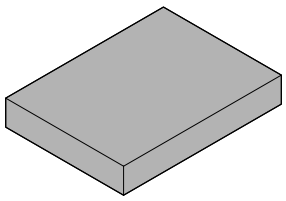
■ PACKAGES

8-pin plastic SSOP



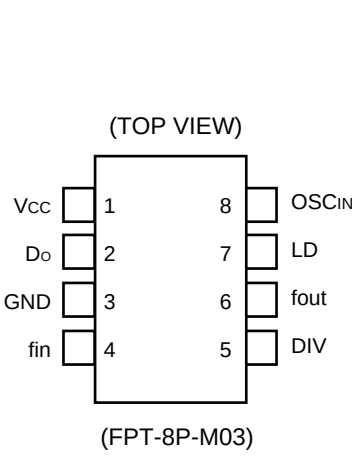
(FPT-8P-M03)

16-pad plastic BCC

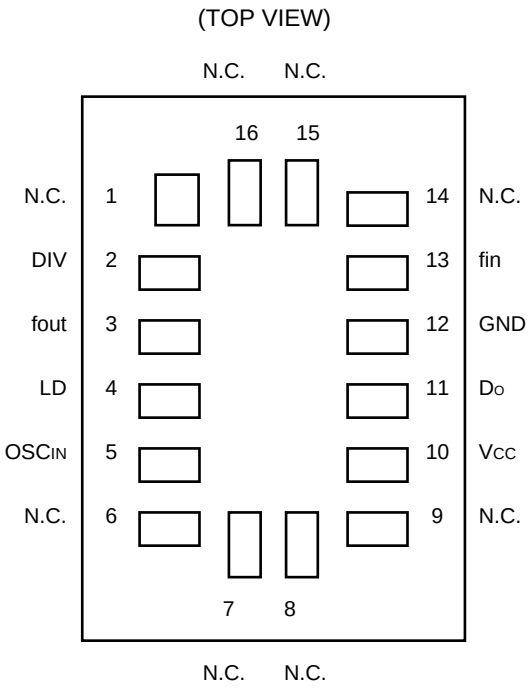


(LCC-16P-M06)

■ PIN ASSIGNMENT



(FPT-8P-M03)

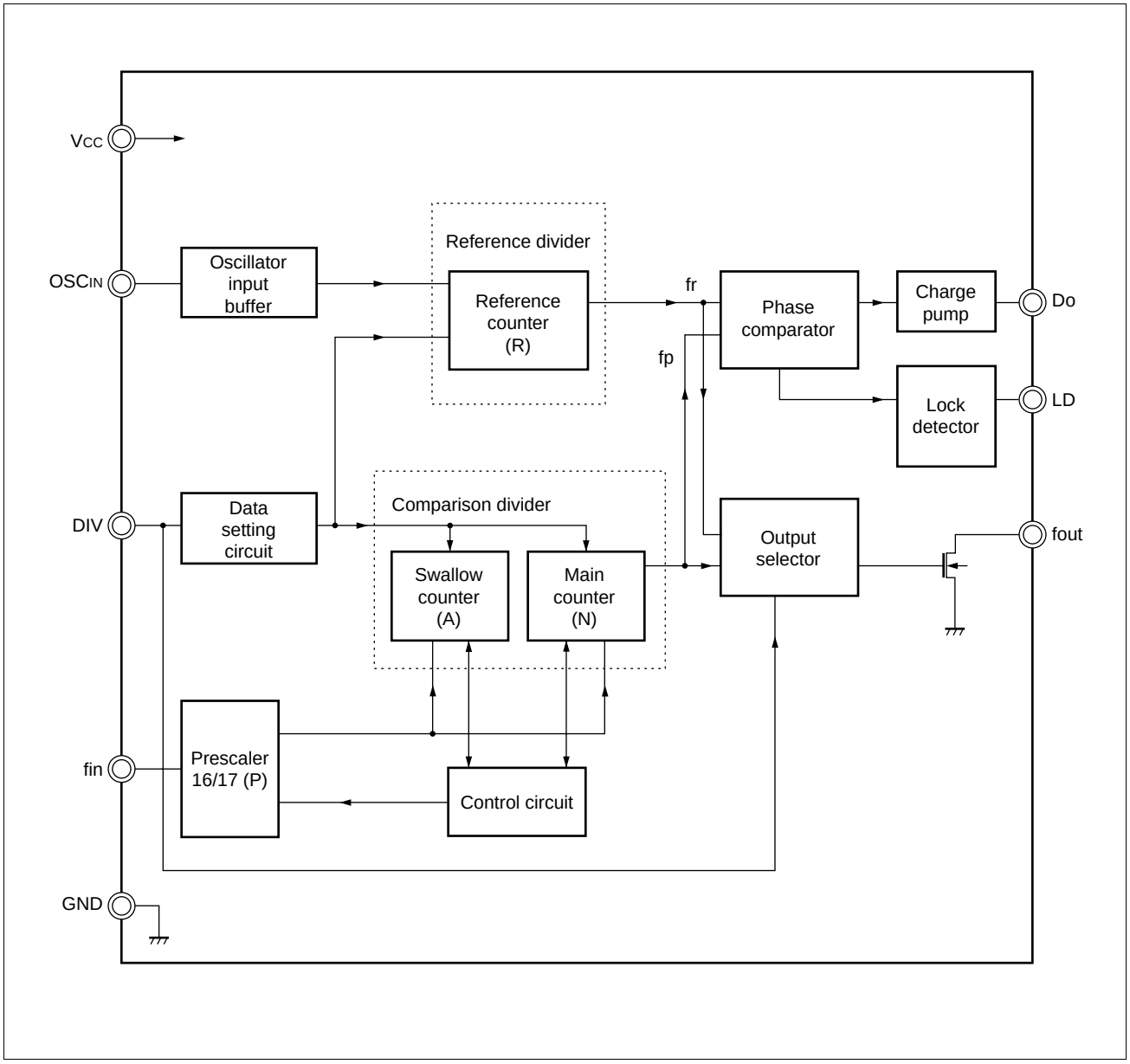


(LCC-16P-M06)

■ 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



■ 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	Ta	–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, Ta = +25°C	0.1	0.9	1.8	mA
Operating frequency	fin	fin	AC coupling by 1000 pF capacitor	50	–	200	MHz
	OSC_{IN}	fosc	AC coupling by 1000 pF capacitor	3	12	26	MHz
Input sensitivity	fin	Pfin	AC coupling by 1000 pF capacitor	–10	–	+2	dBm
	OSC_{IN}	Vosc	AC coupling by 1000 pF capacitor	0.5	–	–	Vpp
Input voltage	DIV	V_{IH}	–	$V_{CC} \times 0.7$	–	–	V
		V_{IL}	–	–	–	$V_{CC} \times 0.3$	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}	$0V \leq V_{DO} \leq V_{CC}$	–	–	3	nA

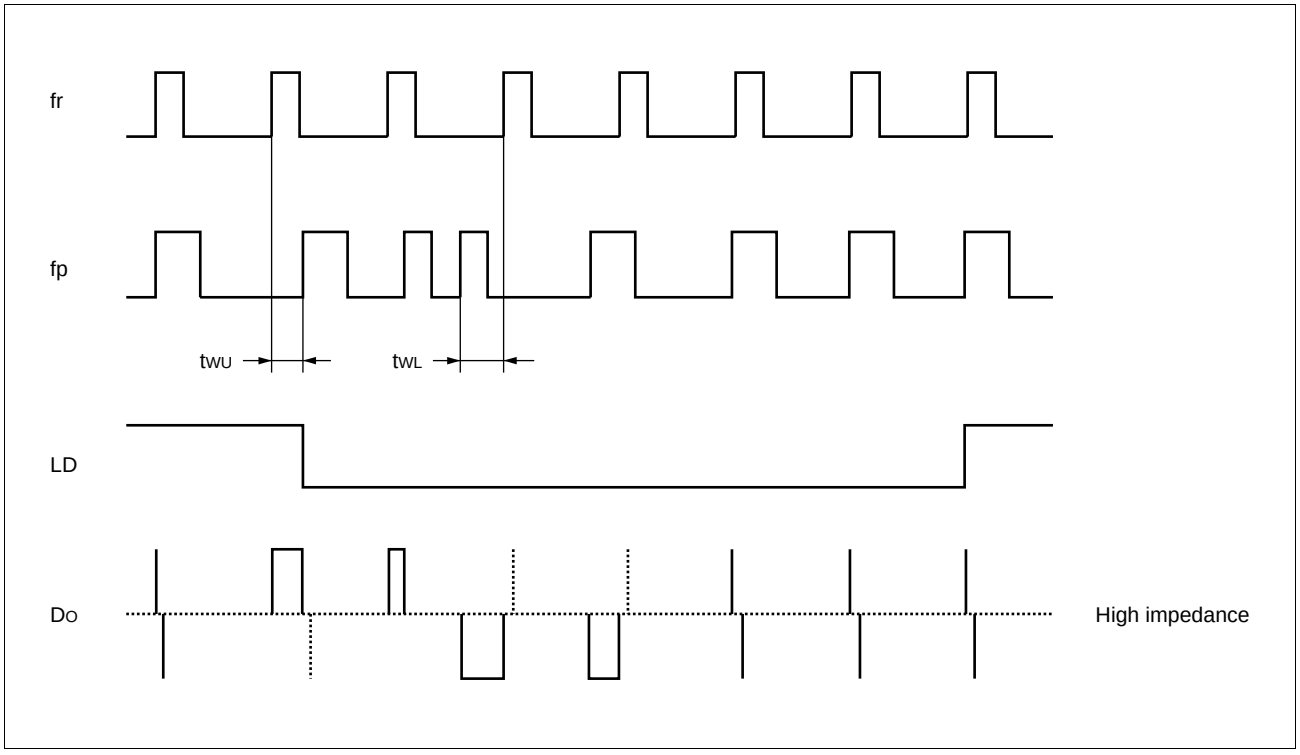
■ FUNCTIONAL DESCRIPTIONS

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”
fvco	Output frequency of external VCO	178.00 MHz	129.55 MHz
fosc	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



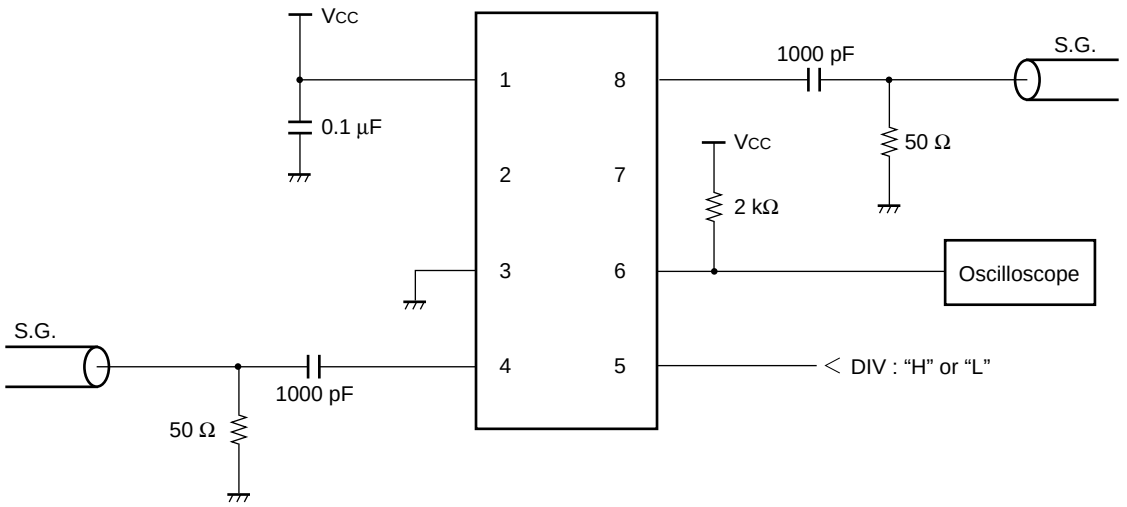
Note: • Phase error detection range: –2π to +2π
- Pulses on Do output signal during locked state are output to prevent dead zone.
- LD output becomes low when phase is t_{WU} or more. LD output becomes high when phase error is t_{WL} or less and continues to be so for three cycles or more.
- t_{WU} and t_{WL} depend on OSC_{IN} input frequency.

  $t_{WU} \geq 8/fosc$ (s) (e. g.$t_{WU} \geq 625.0$ns, fosc = 12.8 MHz)

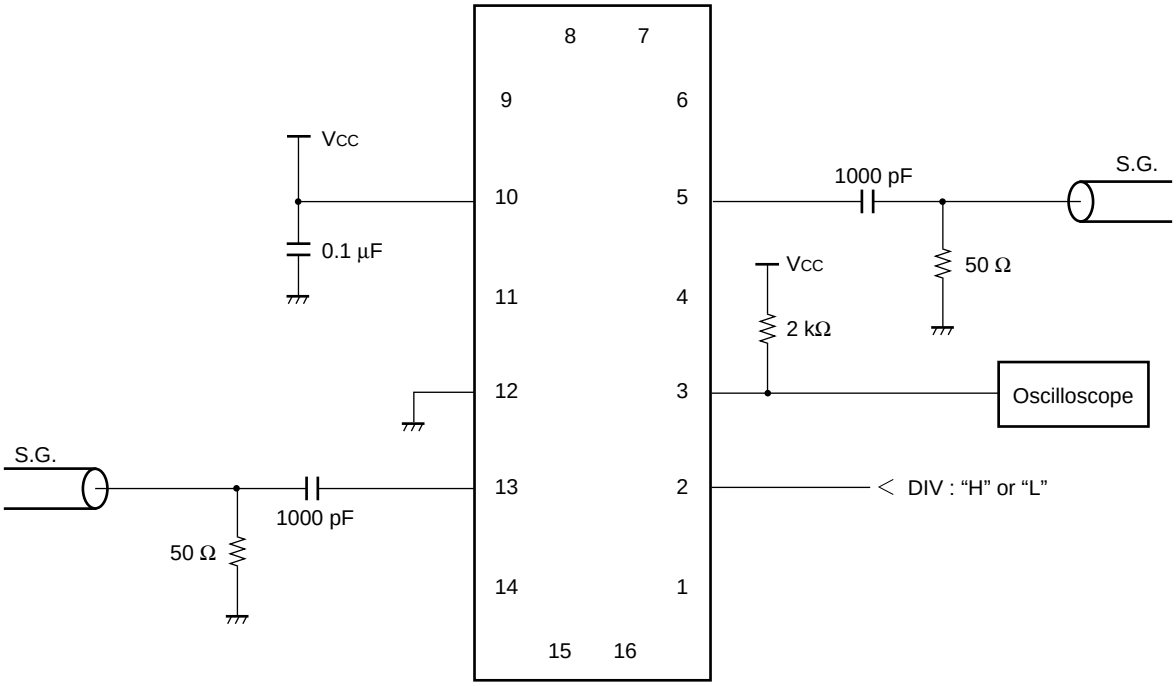
  $t_{WL} \leq 16/fosc$ (s) (e. g. $t_{WL} \leq 1250.0$ns, fosc = 12.8 MHz)

■ MEASURMENT CIRCUIT (for measuring input sensitivity fin/OSC_{IN})

SSOP-8



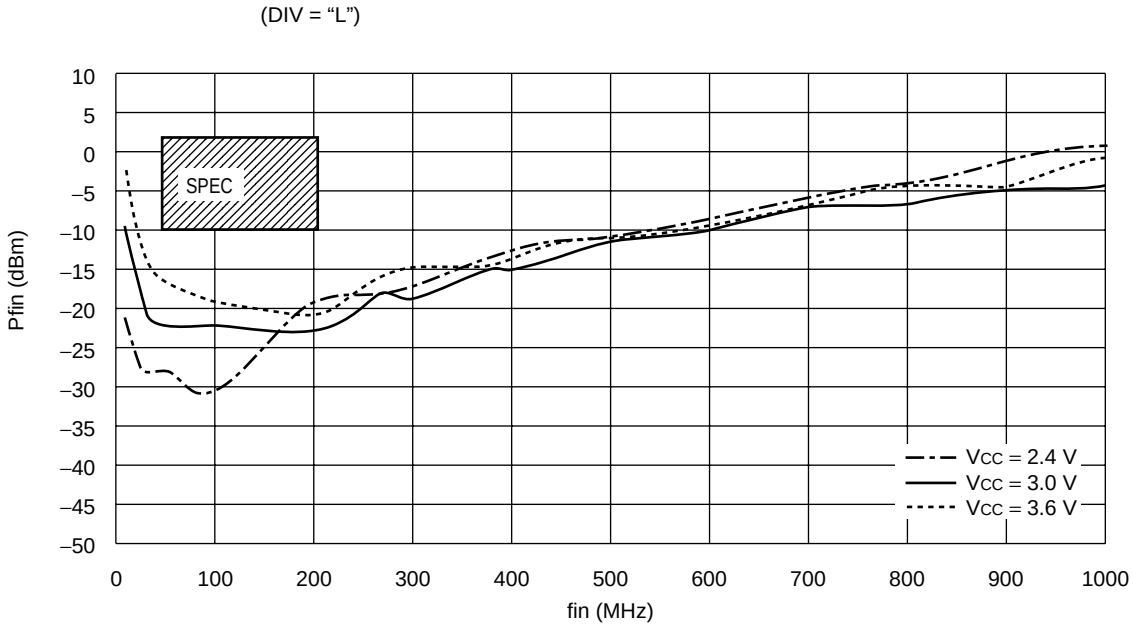
BCC-16



■ TYPICAL CHARACTERISTICS

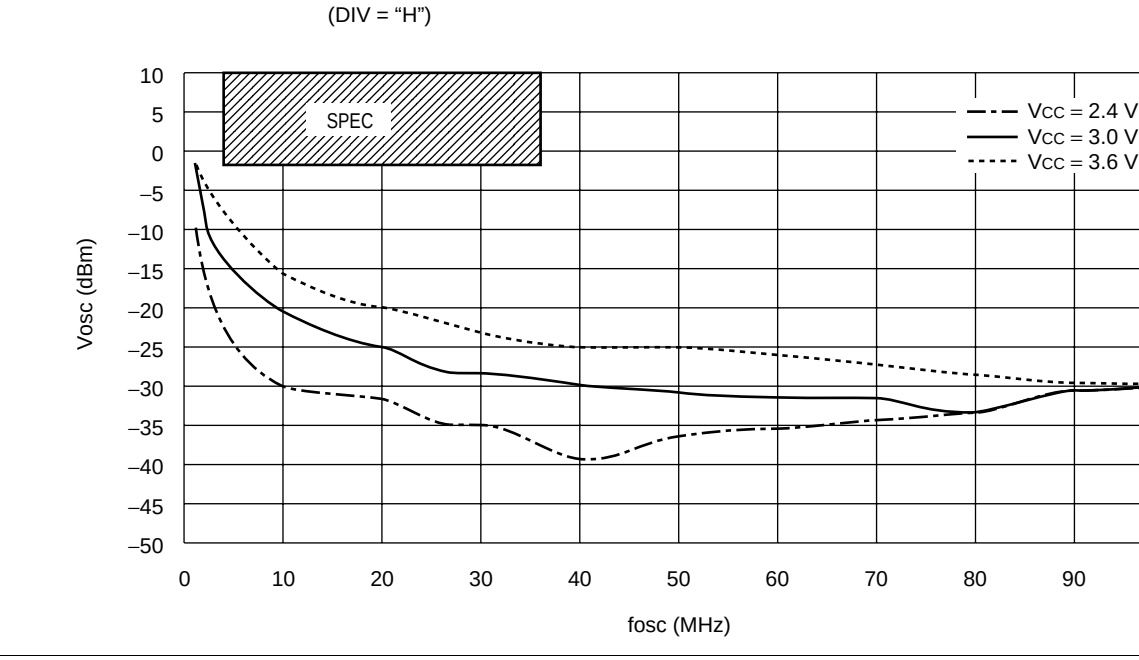
1. fin Input Sensitivity

Input Sensitivity (fin)

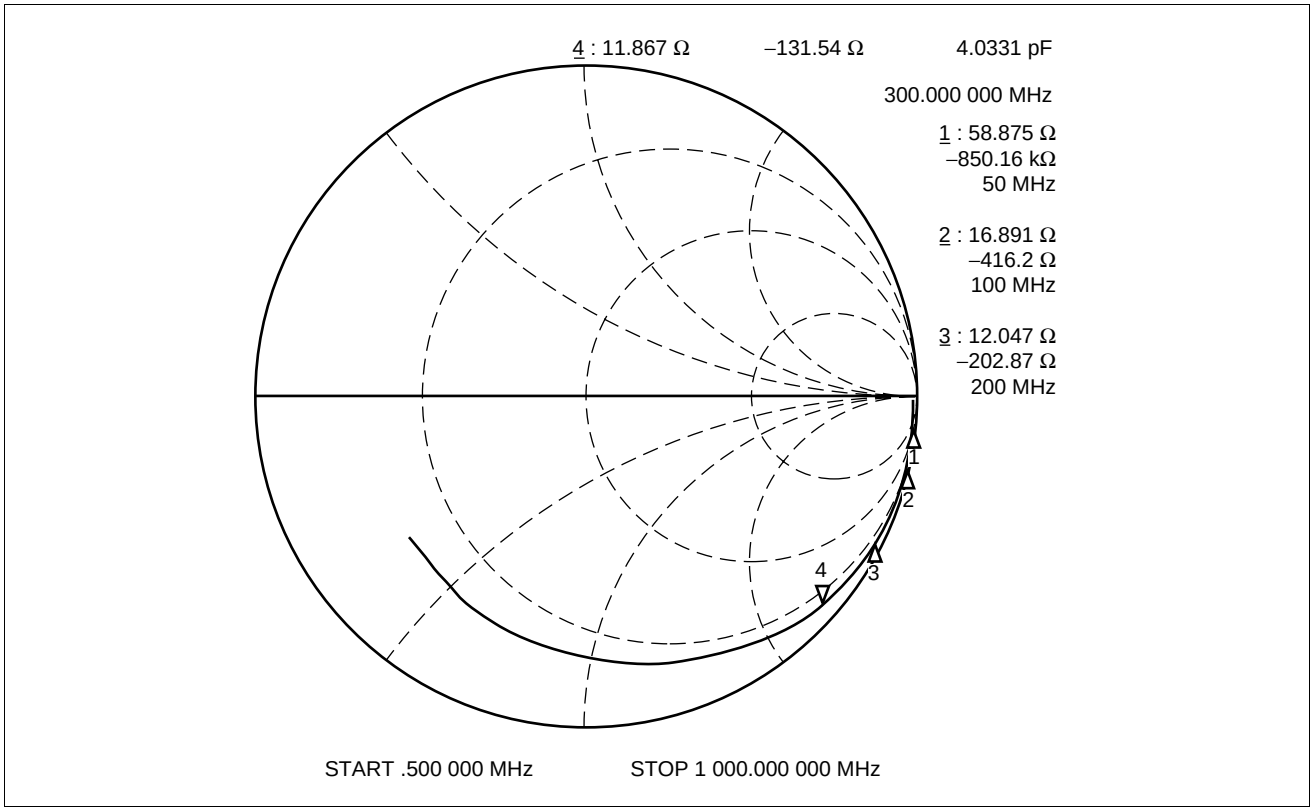


2. OSC_{IN} Input Sensitivity

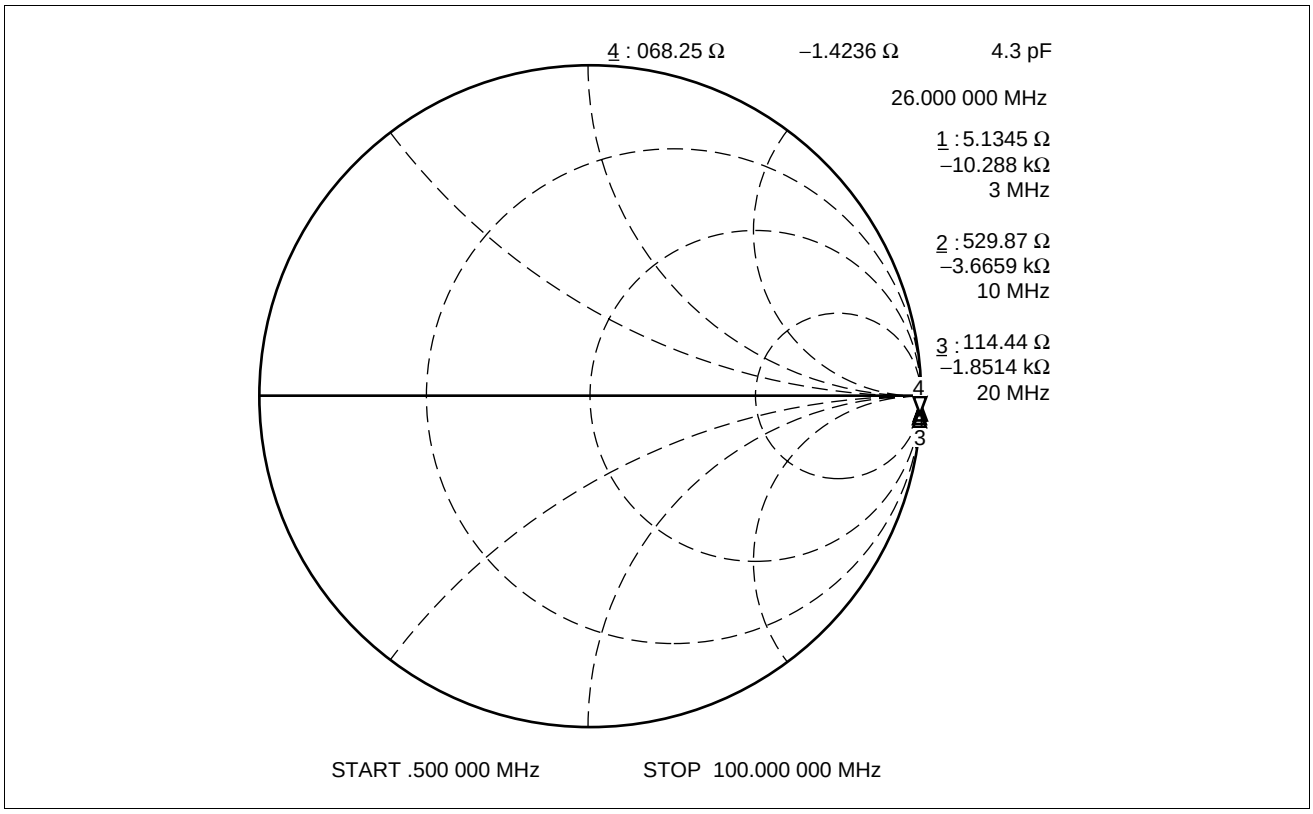
Input Sensitivity (OSC_{IN})



3. fin Input Impedance



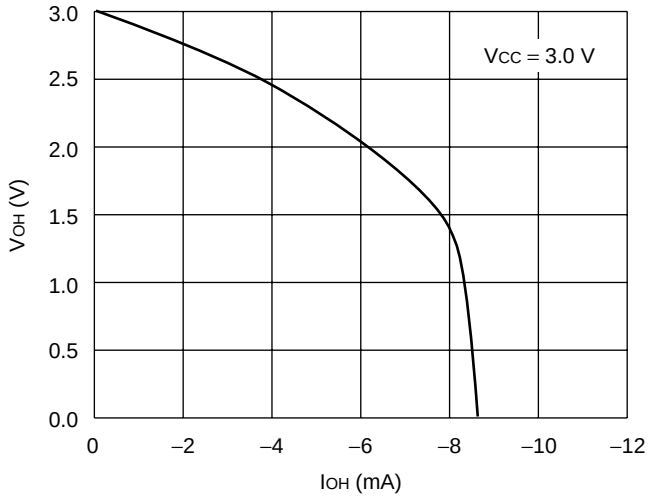
4. OSC_{IN} Input Impedance



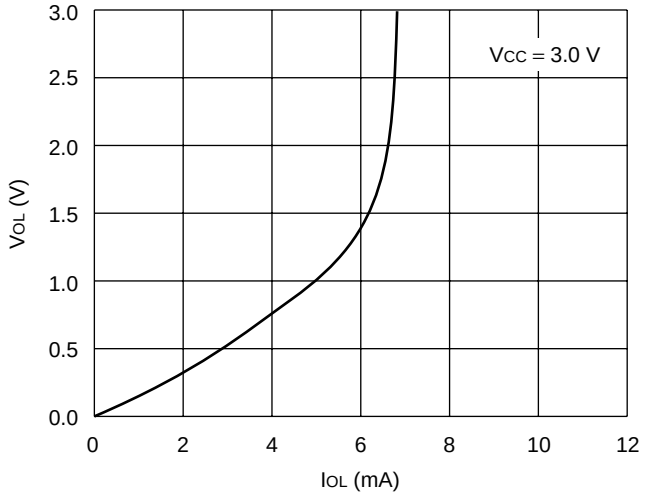
5. Do Output Current

Charge pump current

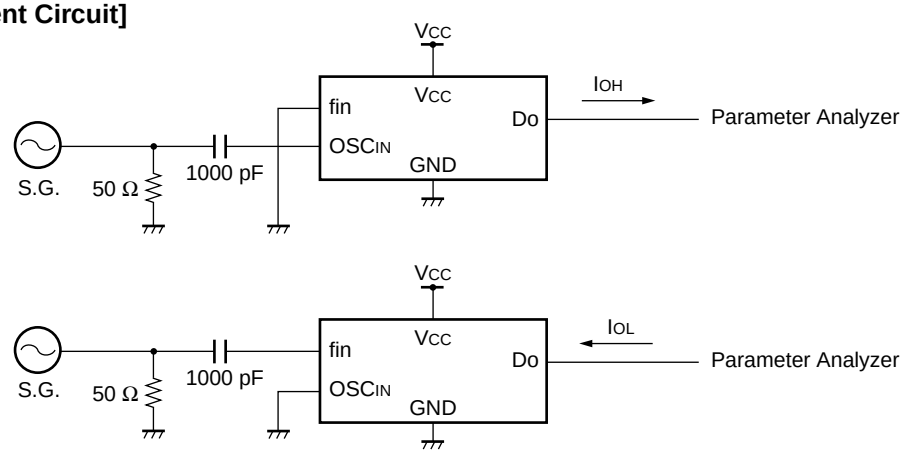
[V_{OH} – I_{OH}]



[V_{OL} – I_{OL}]



[Measurement Circuit]



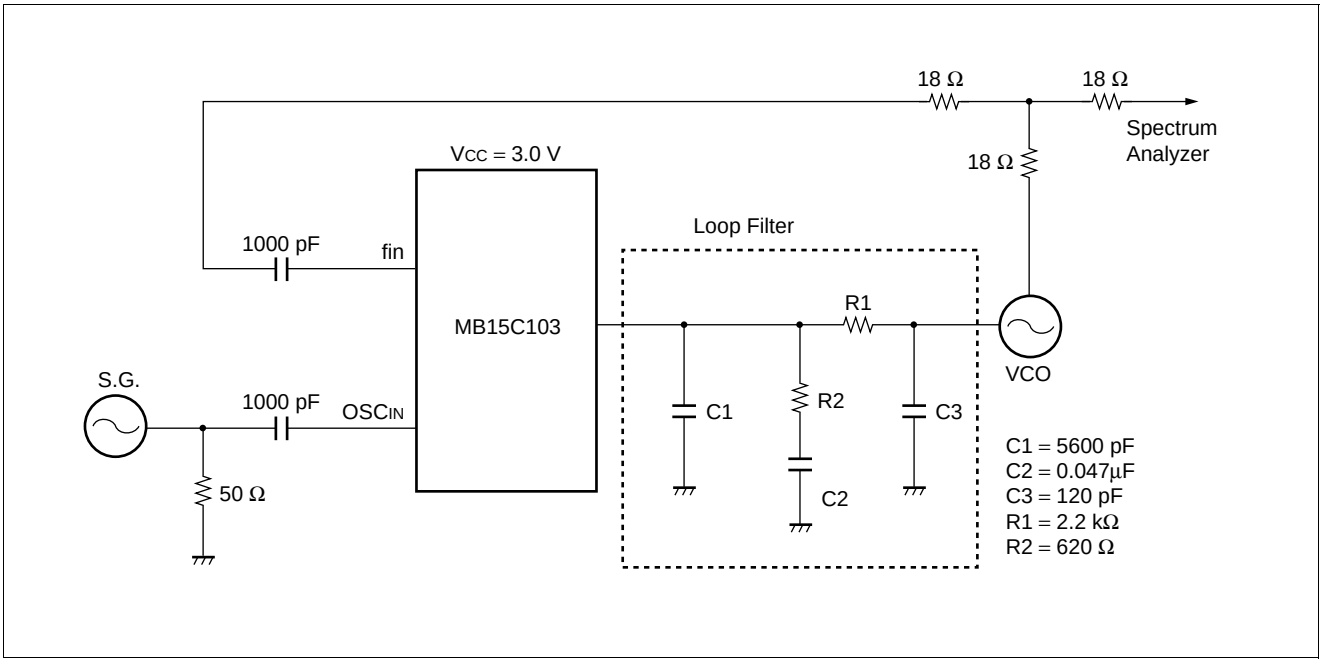
■ REFERENCE INFORMATION

1. Application Measurement

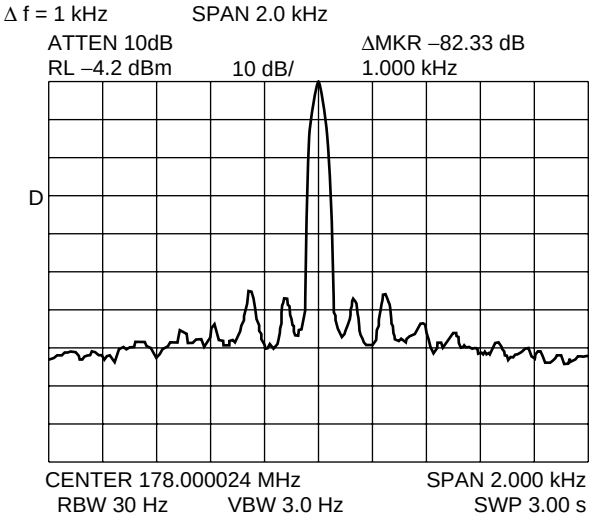
Test results

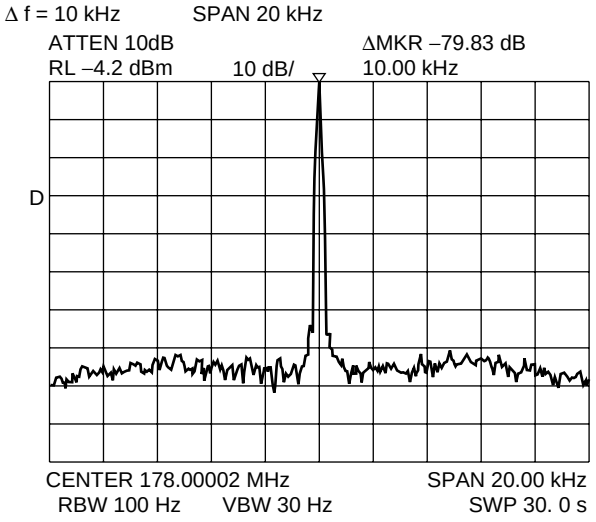
		Results
Lock up time ±1kHz	Unlock --> Lock Power on --> Lock	350 µs 2.15 ms
Reference leakage(Δf = 400kHz)		89.2 dBc
Phase noise	(Δf = 1 kHz)	97.1 dBc/Hz
	(Δf = 10 kHz)	99.8 dBc/Hz
	(Δf = 100 kHz)	119.0 dBc/Hz
	(Δf = 1 MHz)	130.1 dBc/Hz
V_{CC} (V)		3.0 V
VCO		Discrete VCO (Kv = 8.2MHz/V) Lock Frequency = 178.0MHz (fr=400kHz)

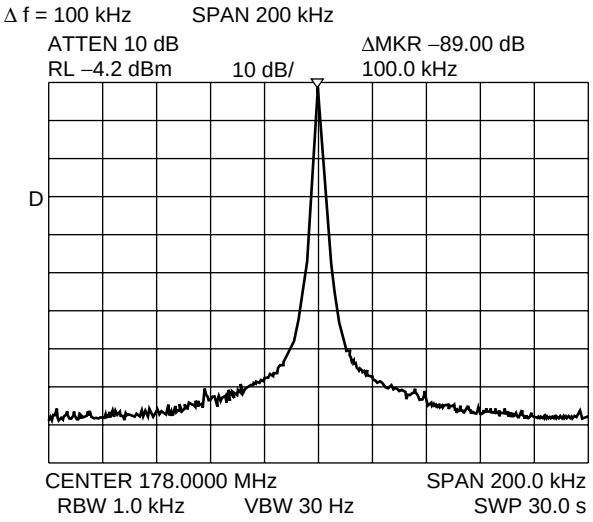
Measurement circuits

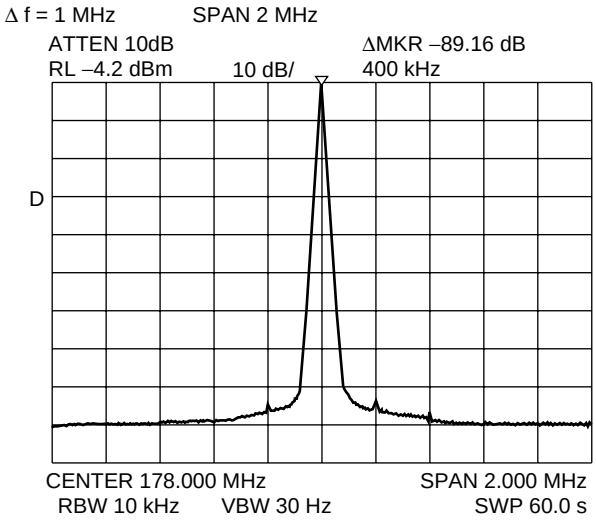


2. Phase Noise



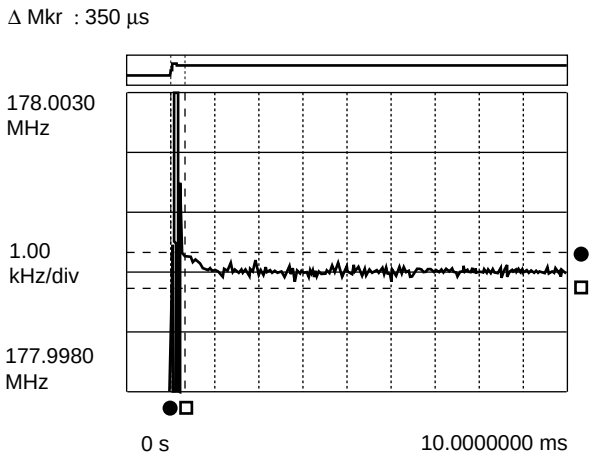




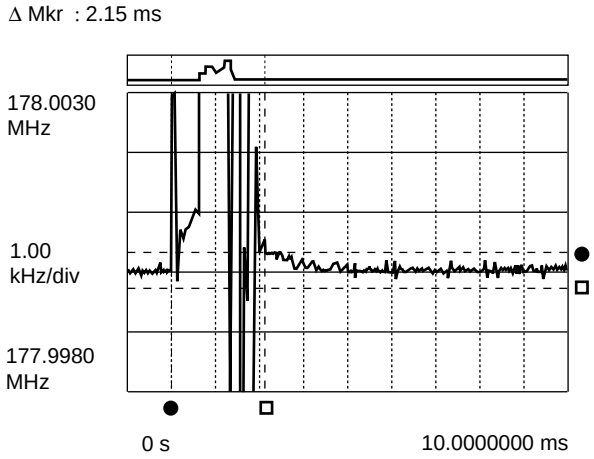


3. Lock Up Time

Un-Lock to Lock: DIV = "L" → "H"



V_{CC} "OFF" to V_{CC} "ON"



■ 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.

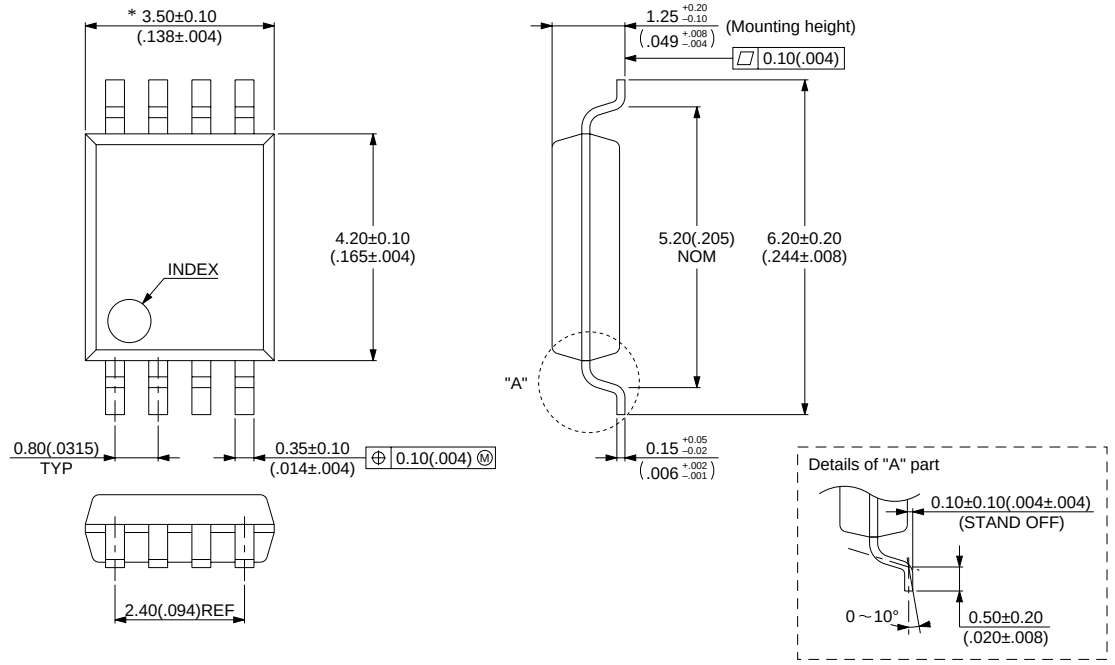
■ ORDERING INFORMATION

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

■ PACKAGE DIMENSIONS

8-pin, Plastic SSOP
(FPT-8P-M03)

*: This dimension does not include resin protrusion.



Dimensions in mm (inches)

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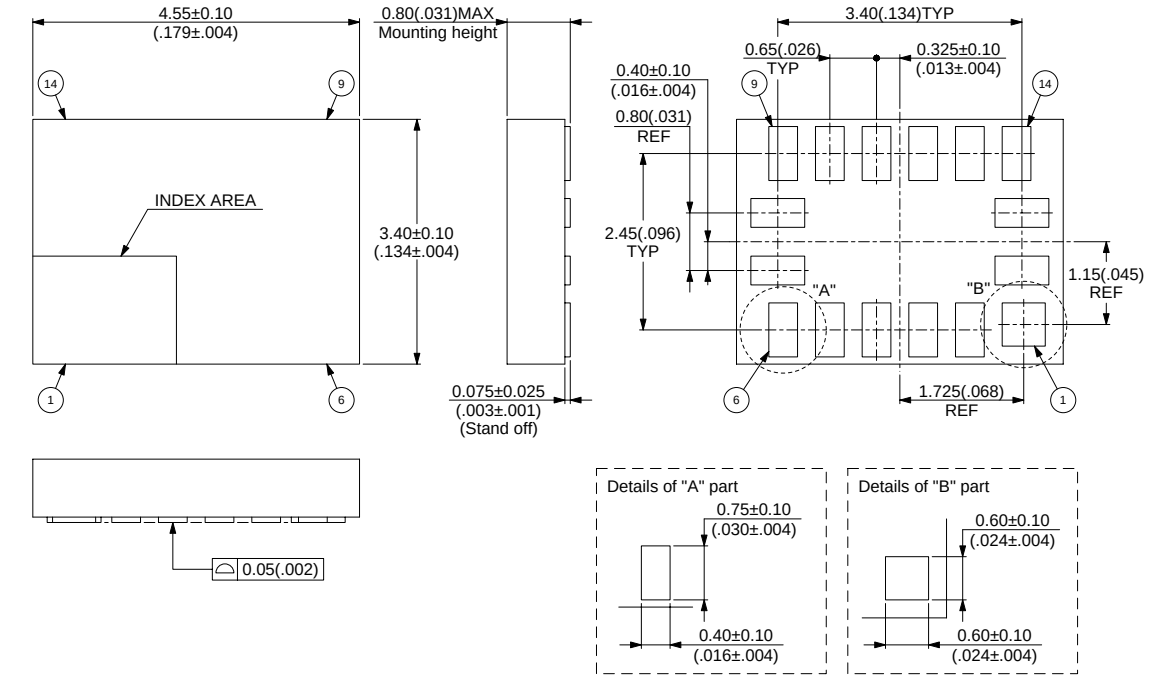
16-pad, Plastic BCC
(LCC-16P-M06)



Dimensions in mm (inches)

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