FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-23510-2E

ASSP

1.0 GHz band Low Power I/Q Modulator For Direct Conversion

MB54608L/MB54608B

■ DESCRIPTION

The MB54608L/B is an I/Q Modulator for direct conversion method, and is used for up to 1.0 GHz band digital cellular phones such as GSM, PDC and so on.

MB54608L consists of a frequency doubler, a Flip-flop type quadrature phase shifter, I/Q modulator and a mixer for frequency offset with a separate power supply.

Fujitsu's advanced Bipolar process has realized very low current operation(I_{CC} = 16.5 mA @3 V).

SSOP-20 and BCC-16 package are available.(MB54608L: SSOP-20, MB54608B: BCC-16)

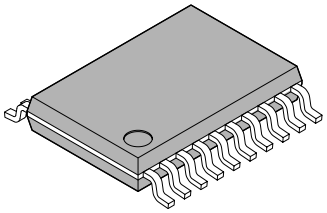
■ FEATURES

- Supporting GSM frequency band
  Output frequency: 1.0 GHz (max.) Output power: –4 dBm(Typical, V_{BB} = 1.0 Vp-p input)
- Low voltage operation: V_{CC} = 2.6 V to 3.8 V

(Continued)

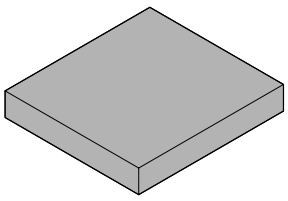
■ PACKAGES

20-pin plastic SSOP



(FPT-20P-M03)

16-pad plastic BCC



(LCC-16P-M04)

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- Low current: Please refer to below table.
- Offset mixer on-chip: The separate power supply control is possible. (only MB54608L)
- Output power level switch (Mode) enables high power mode

		Offset Mixer not used		Offset Mixer used	
		Mode = Open	**Mode = GND**	**Mode = Open**	**Mode = GND**
Normal operation	Icc	16.5 mA	19.0 mA	22.5 mA	25.0 mA
	Pout(V_{BB}=1.0 Vp–p)	–4 dBm	–2 dBm	–4 dBm	–2 dBm
Power down	Ips	0.22 mA		0.44 mA	

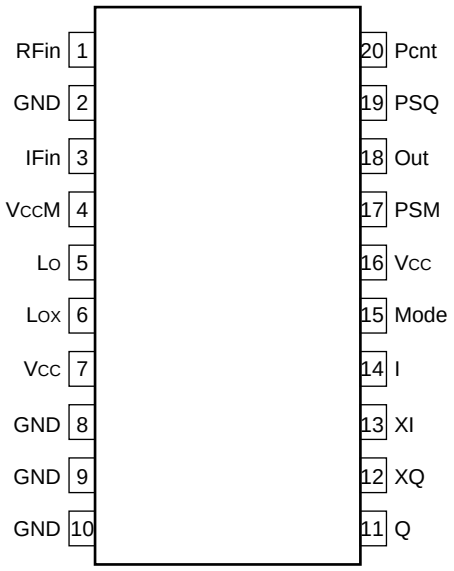
Note: Typical values
Further increase of the output power is possible by attaching a resistor at Pcnt pin.

- Operating temperature range: Ta = –20 to +75°C

■ PIN ASSIGNMENTS

- **MB54608L (SSOP-20)**

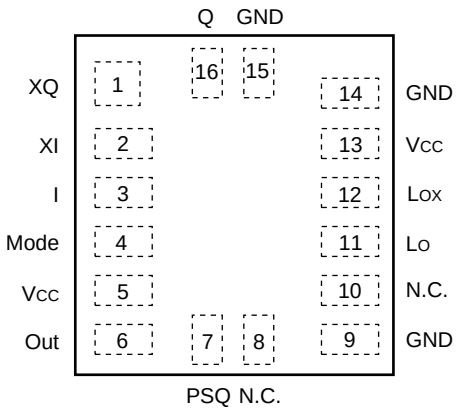
(TOP VIEW)



(FPT-20P-M03)

- **MB54608B (BBC-16)**

(TOP VIEW)



(LCC-16P-M04)

Note: MB54608B doesn't have the off-set Mixer and Pcnt pin.

■ PIN DESCRIPTIONS

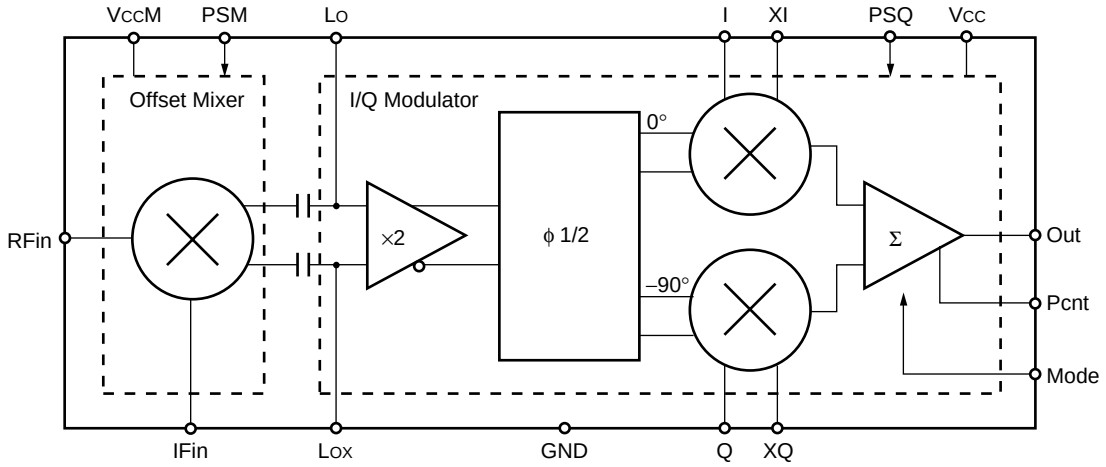
• MB54608L (SSOP-20)

Pin no.	Symbol	I/O	Descriptions
1	RFin	I	RF input for the offset mixer. When the offset mixer is not used, this pin should be opened.
2	GND	—	Ground.
3	IFin	I	IF input for the offset mixer. When the offset mixer is not used, this pin should be opened.
4	VccM	—	Power supply for the offset mixer. Power-on/off is possible indepently to the modulator. When the offset mixer is not used, this pin should be switched OFF.
5	Lo	I/O	Lo input for the I/Q modulator (Output for the offset mixer.)
6	Lox	I/O	Lo complementary input for the I/Q modulator (Complementary output for the offset mixer.)
7	Vcc	—	Power supply for the I/Q modulator.
8	GND	—	Ground.
9	GND	—	Ground.
10	GND	—	Ground.
11	Q	I	Q signal input for the I/Q modulator.
12	XQ	I	Q signal complementary input for the I/Q modulator.
13	XI	I	I signal complementary input for the I/Q modulator.
14	I	I	I signal input for the I/Q modulator.
15	Mode	—	Output mode switch. Mode = Open: Low power mode. Mode = GND: High power mode. This pin should be connected to ground or left open.
16	Vcc	—	Power supply for the I/Q modulator.
17	PSM	I	Power saving control for the offset mixer. When PSM = L(GND), power down mode is selected. When the offset mixer is not used, this pin should be connected to Vcc voltage level or ground.
18	Out	O	Output for the I/Q modulator. (Open collector) Open is prohibited when power is supplied to Vcc pin.
19	PSQ	I	Power saving control for the I/Q modulator. When PSQ = L(GND), power down mode is selected.
20	Pcnt	—	Further, increasing the output power level is possible by attaching a resistor between Pcnt pin and ground externally.

• **MB54608B (BCC-16)**

Pin no.	Pin nane	I/O	Descriptions
1	XQ	I	Q signal complementary input for the I/Q modulator.
2	XI	I	I signal complementary input for the I/Q modulator.
3	I	I	I signal input for the I/Q modulator.
4	Mode	—	Output mode switch. Mode=Open: Low power mode. Mode=GND: High power mode. This pin should be connected to ground or left open.
5	Vcc	—	Power supply for the I/Q modulator.
6	Out	O	Output for the I/Q modulator. (Open collector) Open is prohibited when power is supplied to Vcc pin.
7	PSQ	I	Power saving control for the I/Q modulator. When PSQ = L(GND), power down mode is selected.
8	N.C.	—	No connection.
9	GND	—	Ground.
10	N.C.	—	No connection.
11	Lo	I/O	Lo input for the I/Q modulator (Output for the offset mixer.)
12	Lox	I/O	Lo complementary input for the I/Q modulator (Complementary output for the offset mixer.)
13	Vcc	—	Power supply for the I/Q modulator.
14	GND	—	Ground.
15	GND	—	Ground.
16	Q	I	Q signal input for the I/Q modulator.

■ BLOCK DIAGRAM



Note: MB54608B doesn't have V_{CC}M, PSM, RFin, IFin and Pcnt pins.

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit	Remarks
		Min.	Max.		
Power supply voltage	V_{CC}	–0.5	+5.0	V	
Output voltage	V_O	–0.5	V_{CC} + 0.5 (<5.0)	V	
Input voltage	V_I	–0.5	V_{CC} + 0.5 (<5.0)	V	
Allowed voltage on the open collector pin	V_{OC}	V_{CC} – 0.3 (–0.5)	V_{CC} + 0.3 (5.0)	V	Out pin, Open is prohibited.
Output current	I_O	0	+10	mA	
Storage temperature	Tstg	–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	Remarks
		Min.	Typ.	Max.		
Power supply voltage	V_{CC}	2.6	3.0	3.8	V	
Input voltage	V_I	GND	—	V_{CC}	V	
Allowed voltage on the open collector pin	V_{OC}	V_{CC} – 0.2	—	V_{CC} + 0.2	V	Out pin. Open is prohibited.
Operating temperature	Ta	–20	—	+75	V	Ambient temperature.

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 conditionranges. 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

1. DC CHARACTERISTICS (MB54608L, MB54608B)

(Ta = +25°C, V_{CC} = 3.0 V)

Parameter	Symbol	Value			Unit	Remarks		
		Min.	Typ.	Max.				
Power supply current	I_{CC}					Offset mix.	Mode pin	DC. No AC signal input.
		12.0	16.5	24.5	mA	Not used	Open	
		13.5	19.0	28.0	mA	Not used	GND	
		16.0	22.5	33.5	mA	Used	Open	
		18.0	25.0	37.0	mA	Used	GND	
Power down current	I_{PS}	—	220	310	µA	Not used	Don't care	
		—	440	620	µA	Used		
Power down pin input voltage	VIH_{PS}	$V_{CC} \times 0.7$	—	—	V			
	VIL_{PS}	—	—	$V_{CC} \times 0.3$	V			
Power down pin input current	IIH_{PS}	—	—	5.0	µA	$V_{IH} = V_{CC}$		PSM, PSQ Value
	IIL_{PS}	–50	—	—	µA	V_{IL} = GND		
Pcnt pin load resistance	Rcnt	50	—	—	Ω			

Note: MB54608B doesn't have Offset mix., so please refer to "offset mix. = Not used" column in regard to power supply current.

2. AC CHARACTERISTICS

- **A case of the offset mixer is used. (only MB54608L)**

(Ta = +25°C, V_{CC} = 3.0 V)

Parameter		Symbol	Value			Unit	Remarks	
			Min.	Typ.	Max.			
Baseband input	Operating band	f_{BB}	DC	—	10	MHz		
	Input amplitude	V_{BB}	0.3	1.0	1.3	Vp-p	Single ended input	
	Offset voltage	V_{OS}	1.4	1.5	1.6	V	External offset voltage	
	Offset current	I_{OS}	—	3.0	4.0	μA		
Offset Mixer	Operating band	f_{RF}	—	1078.5	1100	MHz		
		f_{IF}	—	130.5	500	MHz		
		f_{LO}	800	948	1000	MHz	Output	
	Input power level	P_{RF}	–15	–10	0	dBm		
		P_{IF}	–15	–10	0	dBm		
RF output	Operating band	f_{OUT}	800	948	1000	MHz		
	SSB output power level	P_{OUT}	–8	–4	–	dBm	Mode pin is opened	V_{BB} = 1.0 Vp-p (single ended input) f_{RF} = 1078.5 MHz P_{RF} = –10 dBm f_{IF} = 130.5 MHz P_{IF} = –10 dBm f_{OUT} = 948 MHz
			–6	–2	–	dBm	Mode pin is grounded	
Modulation accuracy	Amplitude error	A_{ERR}	—	2.0	3.0	%	RMS value	
	Phase error	P_{ERR}	—	1.5	2.0	deg.	RMS value	
	Vector error	V_{ERR}	—	3.0	4.0	%	RMS value	
Carrier suppression		CS	—	–35	–27	dBc	External offset. No offset adjustment.	
Image rejection		IR	—	–40	–28	dBc		
Adjucent channel power		ACP	—	–65	–60	dB	Δf = 50 kHz	
IF × 7 spurious		IF × 7	—	–65	–60	dBc		

- **A case of the offset mixer is not used. (MB54608L, MB54608B)**

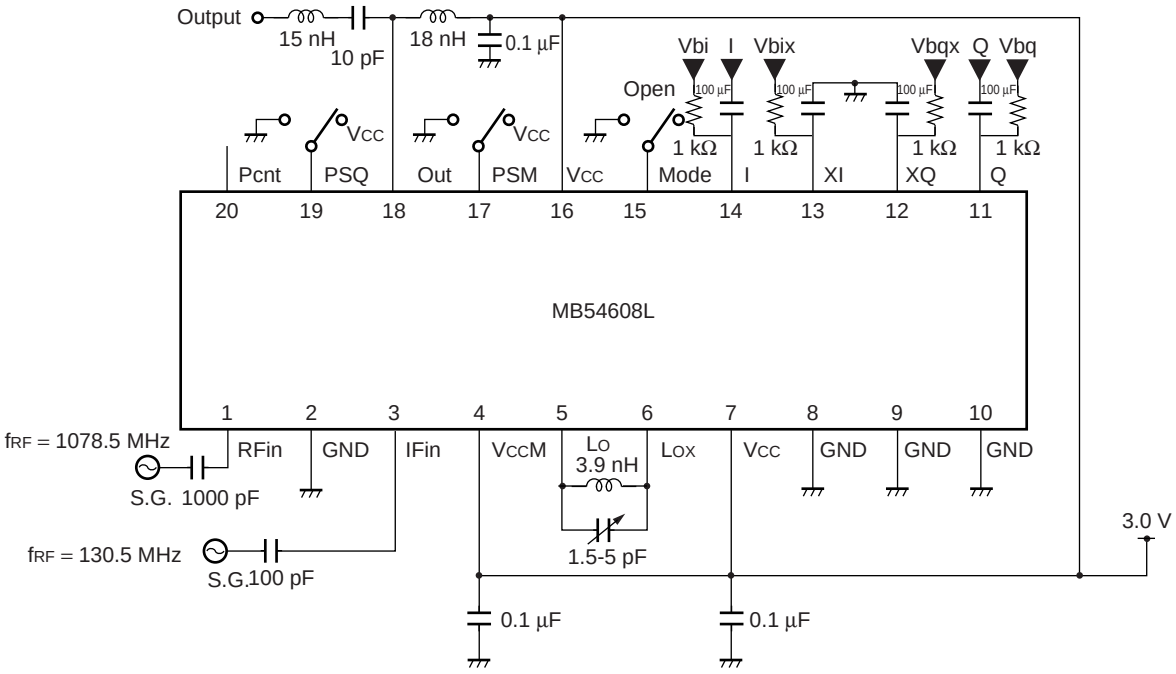
(Ta = +25°C, V_{CC} = 3.0 V)

Parameter		Symbol	Value			Unit	Remarks	
			Min.	Typ.	Max.			
Baseband input	Operating band	f_{BB}	DC	—	10	MHz		
	Input amplitude	V_{BB}	0.3	1.0	1.3	Vp-p	Single ended input	
	Offset voltage	V_{OS}	1.4	1.5	1.6	V	External offset voltage	
	Offset current	I_{OS}	—	3.0	4.0	μA		
Lo input	Operating band	f_{LO}	800	948	1000	MHz	Differential input with balun.	
	Input power	P_{LO}	–15	–10	0	dBm		
RF output	Operating band	f_{OUT}	800	948	1000	MHz		
	SSB output power level	P_{OUT}	–8	–4	—	dBm	Mode pin is opened	V_{BB} = 1.0 Vp-p (single ended input) f_{LO} = 948 MHz P_{LO} = –10 dBm (Differential input with balun).
			–6	–2	—	dBm	Mode pin is grounded	
Modulation accuracy	Amplitude error	A_{ERR}	—	2.0	3.0	%	RMS value	
	Phase error	P_{ERR}	—	1.5	2.0	deg.	RMS value	
	Vector error	V_{ERR}	—	3.0	4.0	%	RMS value	
Carrier suppression		CS	—	–35	–27	dBc	External offset. No offset ajustment.	
Image rejection		IR	—	–40	–28	dBc		
Adjucent channel power		ACP	—	–65	–60	dB	Δf = 50 kHz	

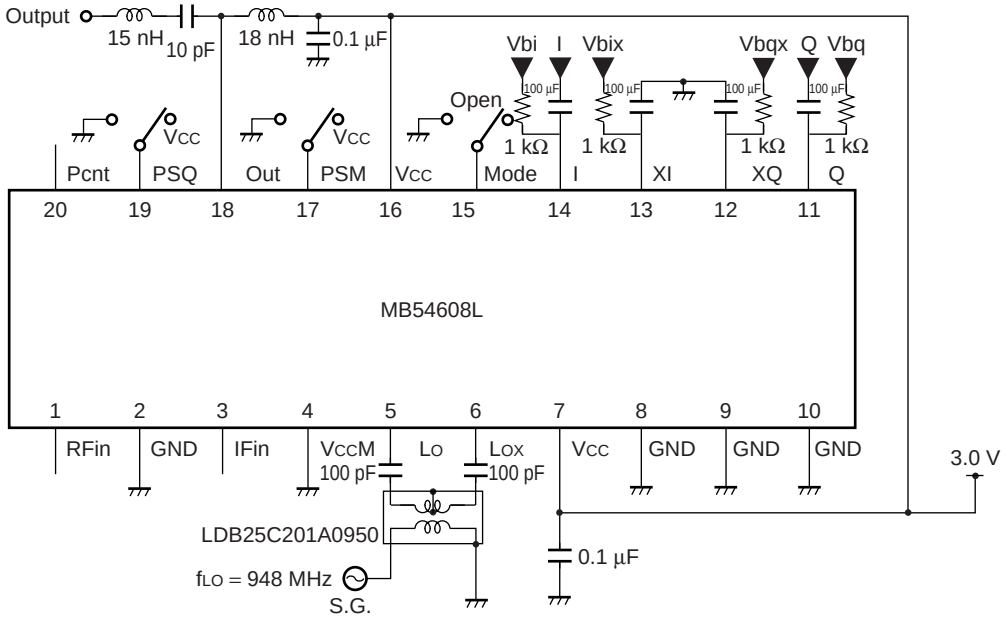
Notes: • Spec. of MB54608B is identical with MB54608L.
• When the offset mixer is not used, using a differential balun is recommended for input. (When the balun is not used, the changing carrier suppression may happen depending on the timing of powering up.)

■ APPLICATION EXAMPLE (MB54608L)

1) A case of the offset mixer is used.



2) A case of the offset mixer is not used.



Note: LDB25C201A0950: Murata Mfg. Co., Ltd.

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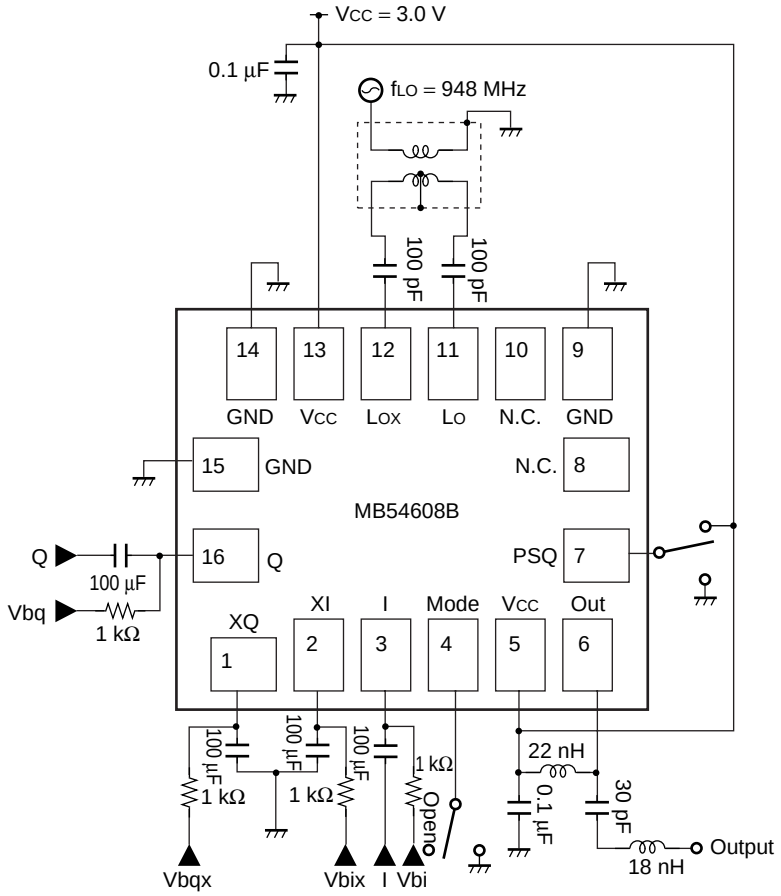
(MB54608L)



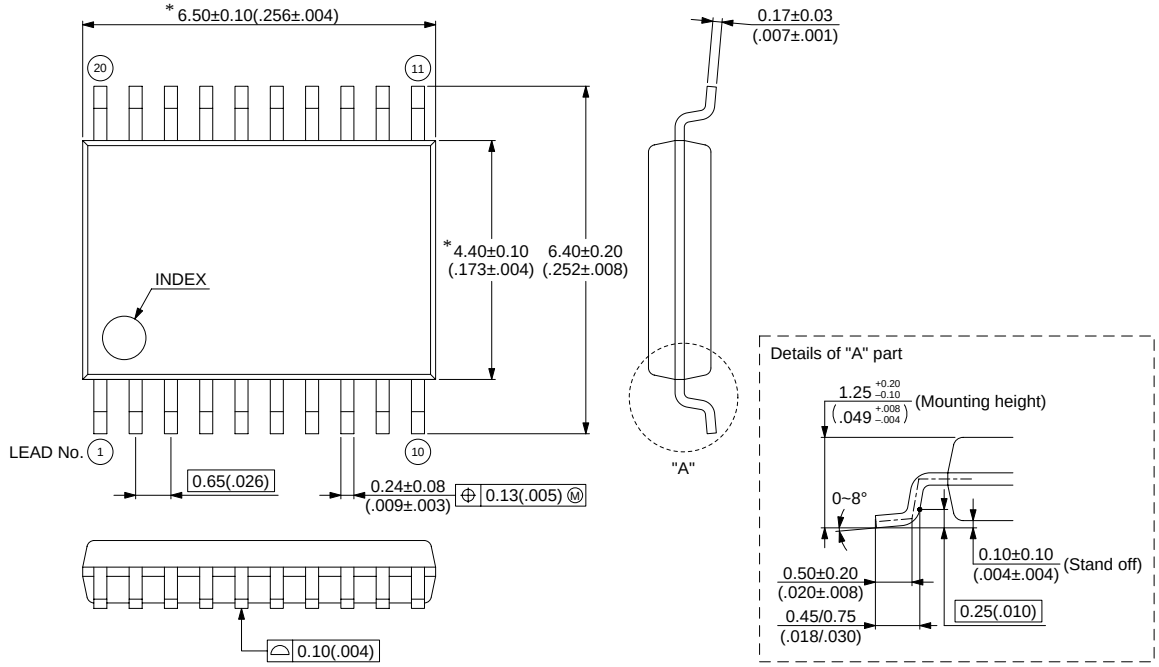
■ ORDERING INFORMATION

Part number	Package	Remarks
MB54608L PFV	20-pin, Plastic SSOP (FPT-20P-M03)	MB54608L
MB54608L PV1	16-pad, Plastic BCC (LCC-16P-M04)	MB54608B

■ PACKAGE DIMENSION

20-pin Plastic SSOP
(FPT-20P-M03)

Note 1) *:This dimension does not include resin protrusion.
Note 2) Pins width and pins thickness include plating thickness.



Dimensions in mm (inches)

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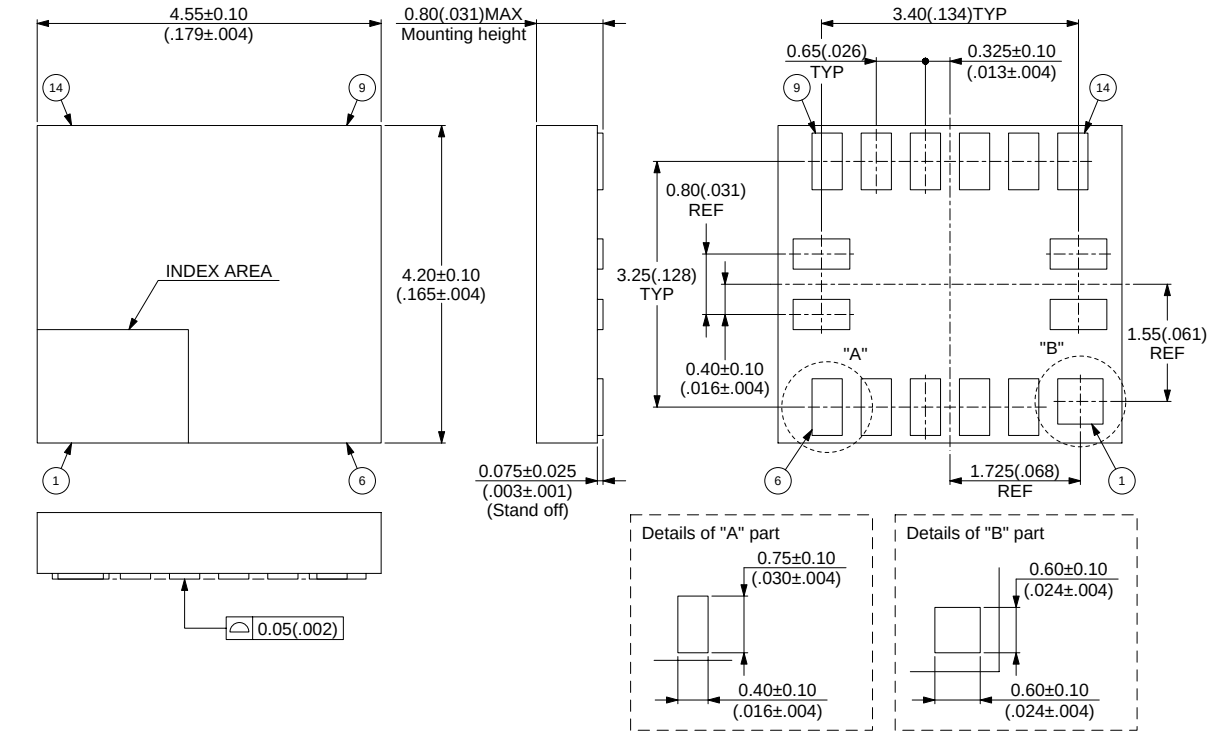
16-pad Plastic BCC
(LCC-16P-M04)



Dimensions in mm (inches)

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