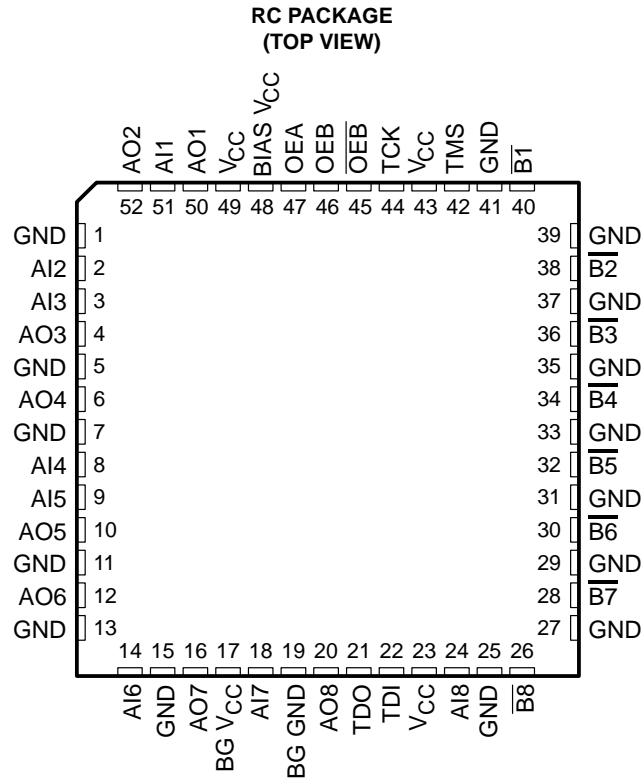


# SN74FB2040 8-BIT TTL/BTL TRANSCEIVER

SCBS173N – NOVEMBER 1991 – REVISED MARCH 2002

- Compatible With IEEE Std 1194.1-1991 (BTL)
- TTL A Port, Backplane Transceiver Logic (BTL)  $\bar{B}$  Port
- Open-Collector  $\bar{B}$ -Port Outputs Sink 100 mA
- High-Impedance State During Power Up and Power Down
- BIAS  $V_{CC}$  Pin Minimizes Signal Distortion During Live Insertion or Withdrawal
- $\bar{B}$ -Port Biasing Network Preconditions the Connector and PC Trace to the BTL High-Level Voltage



## description

The SN74FB2040 is an 8-bit transceiver designed to translate signals between TTL and backplane transceiver logic (BTL) environments.

The  $\bar{B}$  port operates at BTL-signal levels. The open-collector  $\bar{B}$  ports are specified to sink 100 mA. Two output enables (OEB and  $\bar{OEB}$ ) are provided for the  $\bar{B}$  outputs. When OEB is high and  $\bar{OEB}$  is low, the  $\bar{B}$  port is active and reflects the inverse of the data present at the A-input pins. When OEB is low,  $\bar{OEB}$  is high, or  $V_{CC}$  is less than 2.1 V, the  $\bar{B}$  port is turned off.

The A port operates at TTL-signal levels and has separate input and output pins. The A outputs reflect the inverse of the data at the  $\bar{B}$  port when the A-port output enable (OEA) is high. When OEA is low or when  $V_{CC}$  is less than 2.1 V, the A outputs are in the high-impedance state.

The pins TMS, TCK, TDI, and TDO are nonfunctional, i.e., not intended for use with the IEEE Std 1149.1 (JTAG) test bus. TMS and TCK are not connected, and TDI is shorted to TDO.

BIAS  $V_{CC}$  establishes a voltage between 1.62 V and 2.1 V on the BTL outputs when  $V_{CC}$  is not connected.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

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# SN74FB2040 8-BIT TTL/BTL TRANSCEIVER

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## ORDERING INFORMATION

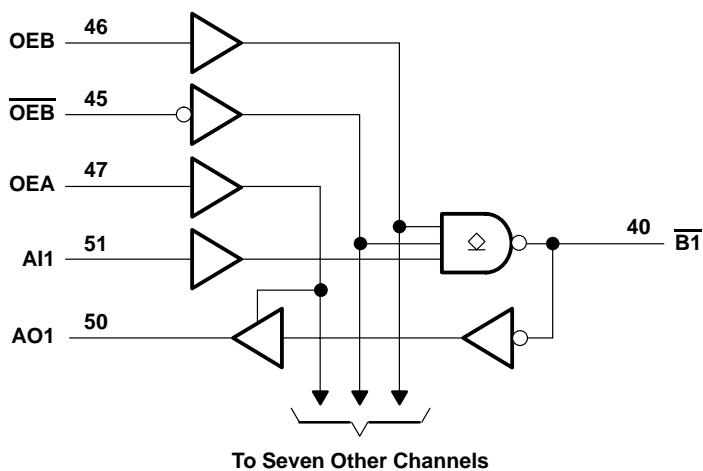
T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	QFP – RC	Tube	SN74FB2040RC	FB2040

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

## FUNCTION TABLE

INPUTS			FUNCTION
OEB	$\overline{\text{OEB}}$	OEA	
L	X	L	Isolation
X	H	L	Isolation
L	X	H	$\overline{\text{B}}$ data to AO bus
X	H	H	$\overline{\text{B}}$ data to AO bus
H	L	L	$\overline{\text{AI}}$ data to B bus
H	L	H	$\overline{\text{AI}}$ data to B bus, $\overline{\text{B}}$ data to AO bus

## functional block diagram



**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

Supply voltage range, $V_{CC}$ .....	–0.5 V to 7 V
Input voltage range, $V_I$ : Except $\bar{B}$ port .....	–1.2 V to 7 V
$\bar{B}$ port .....	–1.2 V to 3.5 V
Voltage range applied to any $\bar{B}$ output in the disabled or power-off state, $V_O$ .....	–0.5 V to 3.5 V
Voltage range applied to any output in the high state, $V_O$ : A port .....	–0.5 V to $V_{CC}$
Input clamp current, $I_{IK}$ : Except $\bar{B}$ port .....	–40 mA
$\bar{B}$ port .....	–18 mA
Current applied to any single output in the low state, $I_O$ : A port .....	48 mA
$\bar{B}$ port .....	200 mA
Package thermal impedance, $\theta_{JA}$ (see Note 1) .....	44°C/W
Storage temperature range, $T_{stg}$ .....	–65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51-7.

**recommended operating conditions (see Note 2)**

		MIN	NOM	MAX	UNIT
$V_{CC}$ , BIAS $V_{CC}$ , BG $V_{CC}$	Supply voltage	4.5	5	5.5	V
$V_{IH}$	High-level input voltage	$\bar{B}$ port	1.62	2.3	V
		Except $\bar{B}$ port	2		
$V_{IL}$	Low-level input voltage	$\bar{B}$ port	0.75	1.47	V
		Except $\bar{B}$ port		0.8	
$I_{IK}$	Input clamp current			–18	mA
$I_{OH}$	High-level output current			–3	mA
$I_{OL}$	Low-level output current	AO port		24	mA
		$\bar{B}$ port		100	
$T_A$	Operating free-air temperature	0		70	°C

NOTE 2: To ensure proper device operation, all unused inputs must be terminated as follows: A and control inputs to  $V_{CC}$ (5 V) or GND, and B inputs to GND only. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

# SN74FB2040

## 8-BIT TTL/BTL TRANSCEIVER

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### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V <sub>IK</sub>	$\overline{B}$ port	V <sub>CC</sub> = 4.5 V,	I <sub>I</sub> = -18 mA			-1.2	V
	Except $\overline{B}$ port	V <sub>CC</sub> = 4.5 V,	I <sub>I</sub> = -40 mA			-0.5	
V <sub>OH</sub>	AO port	V <sub>CC</sub> = 4.5 V,	I <sub>OH</sub> = -3 mA	2.5	3.3		V
V <sub>OL</sub>	AO port	V <sub>CC</sub> = 4.5 V,	I <sub>OL</sub> = 24 mA		0.35	0.5	V
	$\overline{B}$ port	V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 80 mA	0.75		1.1	
			I <sub>OL</sub> = 100 mA			1.15	
I <sub>I</sub>	Except $\overline{B}$ port	V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 5.5 V			50	μA
I <sub>IH</sub> ‡	Except $\overline{B}$ port	V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 2.7 V			50	μA
I <sub>IL</sub> ‡	Except $\overline{B}$ port	V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 0.5 V			-50	μA
	$\overline{B}$ port	V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 0.75 V			-100	
I <sub>OH</sub>	$\overline{B}$ port	V <sub>CC</sub> = 0 to 5.5 V,	V <sub>O</sub> = 2.1 V			100	μA
I <sub>OZH</sub>	AO port	V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 2.7 V			50	μA
I <sub>OZL</sub>	AO port	V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 0.5 V			-50	μA
I <sub>OZPU</sub>	A port	V <sub>CC</sub> = 0 to 2.1 V,	V <sub>O</sub> = 0.5 V to 2.7 V			50	μA
I <sub>OZPD</sub>	A port	V <sub>CC</sub> = 2.1 V to 0,	V <sub>O</sub> = 0.5 V to 2.7 V			-50	μA
I <sub>OS</sub> §	AO port	V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 0	-30		-180	mA

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

‡ For I/O ports, the parameters I<sub>IH</sub> and I<sub>IL</sub> include the off-state output current.

§ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted) (continued)

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
I <sub>CC</sub>	A <sub>I</sub> port to $\overline{B}$ port	V <sub>CC</sub> = 5.5 V,	I <sub>O</sub> = 0		40		mA
	$\overline{B}$ port to AO port				70		
C <sub>i</sub>	A <sub>I</sub> port	V <sub>I</sub> = V <sub>CC</sub> or GND			3.5		pF
	Control inputs				3		
C <sub>O</sub>	AO port	V <sub>O</sub> = V <sub>CC</sub> or GND			6		pF
C <sub>io</sub>	$\overline{B}$ port per IEEE Std 1194.1-1991	V <sub>CC</sub> = 0 to 4.5 V				5	pF
		V <sub>CC</sub> = 4.5 V to 5.5 V				5	

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

### live-insertion specifications over recommended operating free-air temperature range

PARAMETER		TEST CONDITIONS			MIN	MAX	UNIT
I <sub>CC</sub> (BIAS V <sub>CC</sub> )		V <sub>CC</sub> = 0 to 4.5 V,	V <sub>B</sub> = 0 to 2 V,	V <sub>I</sub> (BIAS V <sub>CC</sub> ) = 4.5 V to 5.5 V		450	μA
		V <sub>CC</sub> = 4.5 to 5.5 V,	V <sub>B</sub> = 0 to 2 V,	V <sub>I</sub> (BIAS V <sub>CC</sub> ) = 4.5 V to 5.5 V		10	
V <sub>O</sub>	$\overline{B}$ port	V <sub>CC</sub> = 0,	V <sub>I</sub> (BIAS V <sub>CC</sub> ) = 5 V		1.62	2.1	V
I <sub>O</sub>	$\overline{B}$ port	V <sub>CC</sub> = 0,	V <sub>B</sub> = 1 V,	V <sub>I</sub> (BIAS V <sub>CC</sub> ) = 4.5 V to 5.5 V		-1	μA
		V <sub>CC</sub> = 0 to 5.5 V,	OEB = 0 to 0.8 V			100	
		V <sub>CC</sub> = 0 to 2.2 V,	OEB = 0 to 5 V			100	



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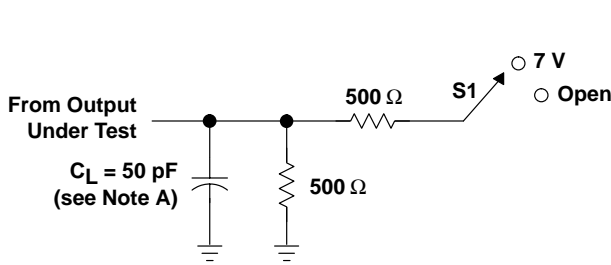
switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C			MIN	MAX	UNIT
			MIN	TYP	MAX			
t <sub>PLH</sub>	AI	$\overline{B}$	3.2	4.5	6	2.4	6.5	ns
t <sub>PHL</sub>			2.8	4.2	5.6	2.7	5.8	
t <sub>PLH</sub>	$\overline{B}$	AO	2.3	3.8	5.7	1.9	6.2	ns
t <sub>PHL</sub>			2.3	4.2	5.9	2	8.2	
t <sub>PLH</sub>	OEB	$\overline{B}$	3.7	5.1	6.7	3	7	ns
t <sub>PHL</sub>			3.1	4.6	5.9	3	6.1	
t <sub>PLH</sub>	$\overline{OEB}$	$\overline{B}$	3.6	5.2	6.8	3.3	7	ns
t <sub>PHL</sub>			2.9	4.4	5.9	2.6	6.1	
t <sub>PZH</sub>	OEA	AO	2.5	4	5.5	2.1	5.8	ns
t <sub>PZL</sub>			2.1	3.6	4.8	2	5	
t <sub>PHZ</sub>	OEA	AO	2.3	4.1	5.9	1.9	6.5	ns
t <sub>PLZ</sub>			1.6	3.1	4.5	1.4	4.7	
t <sub>sk(p)</sub>	Skew for any single channel  t <sub>PHL</sub> - t <sub>PLH</sub>  , AI to $\overline{B}$ or $\overline{B}$ to AO		0.5					ns
t <sub>sk(o)</sub>	Skew between drivers in the same package, AI to $\overline{B}$ or $\overline{B}$ to AO		0.4					ns
t <sub>r</sub>	Rise time, 1.3 V to 1.8 V, $\overline{B}$ port		2	2.8	3.8	1.7		ns
t <sub>f</sub>	Fall time, 1.8 V to 1.3 V, $\overline{B}$ port		1	1.9	3	1	4.2	ns
t <sub>(pr)</sub>	$\overline{B}$ -port input pulse rejection					1	3.4	ns

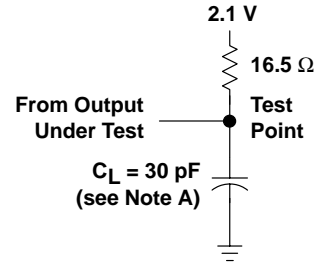
# SN74FB2040 8-BIT TTL/BTL TRANSCEIVER

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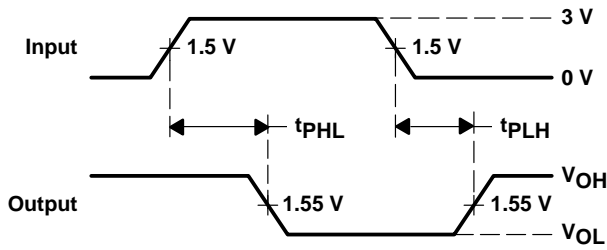
## PARAMETER MEASUREMENT INFORMATION



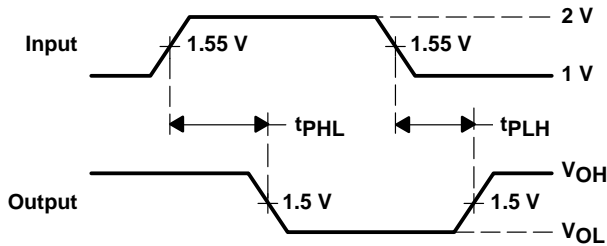
LOAD CIRCUIT FOR A OUTPUTS



LOAD CIRCUIT FOR B OUTPUTS

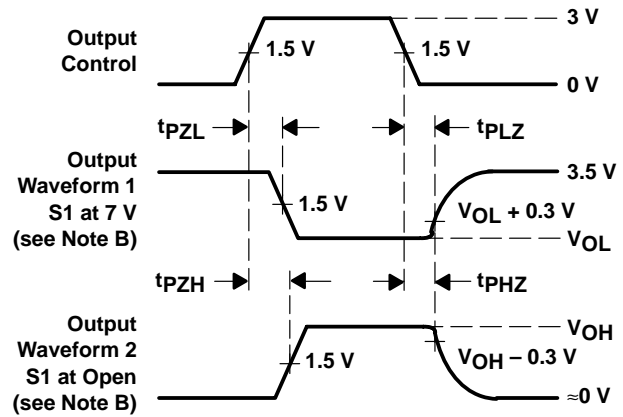


VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES (A TO B)



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES (B TO A)

TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES (A PORT)

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.  
 C. All input pulses are supplied by generators having the following characteristics: TTL inputs:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns; BTL inputs:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns.  
 D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN74FB2040RC	ACTIVE	QFP	RC	52	96	TBD	CU SNPB	Level-2-240C-1 YEAR
SN74FB2040RCG3	ACTIVE	QFP	RC	52	96	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR
SN74FB2040RCR	ACTIVE	QFP	RC	52	500	TBD	CU SNPB	Level-2-240C-1 YEAR
SN74FB2040RCRG3	ACTIVE	QFP	RC	52	500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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- Military: [SN54FB2040](#)

NOTE: Qualified Version Definitions:

- Military - QML certified for Military and Defense Applications

**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74FB2040RCR	QFP	RC	52	500	330.0	24.4	14.2	14.2	2.6	24.0	24.0	Q2
SN74FB2040RCRG3	QFP	RC	52	500	330.0	24.4	14.2	14.2	2.6	24.0	24.0	Q2



**TAPE AND REEL BOX DIMENSIONS**

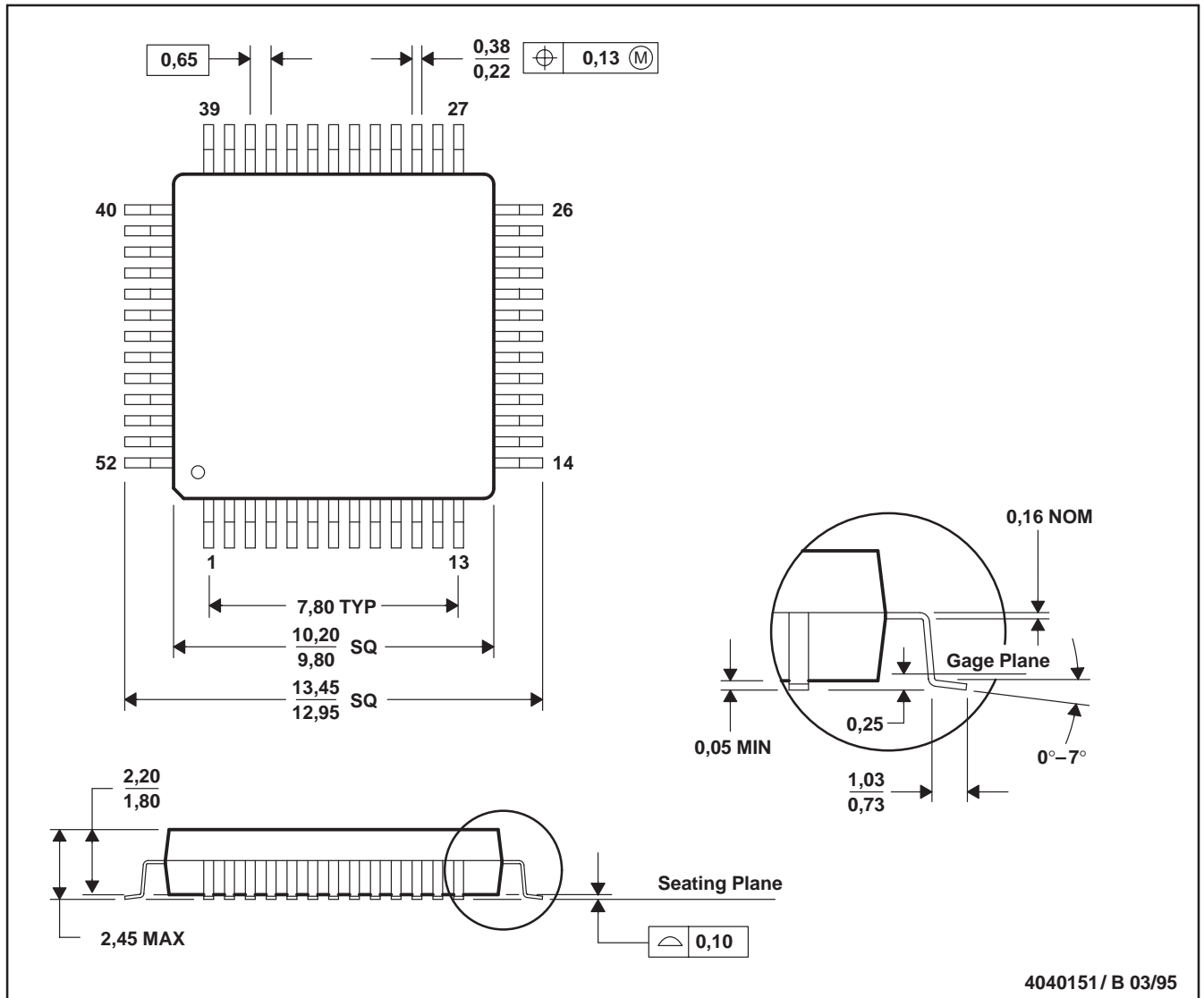


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74FB2040RCR	QFP	RC	52	500	346.0	346.0	41.0
SN74FB2040RCRG3	QFP	RC	52	500	346.0	346.0	41.0

RC (S-PQFP-G52)

PLASTIC QUAD FLATPACK



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-022

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