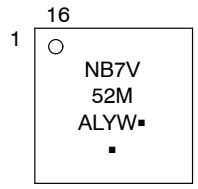
1.8 V / 2.5 V Differential D Flip-Flop w/ Reset and CML Outputs

Multi−Level Inputs w/ Internal Termination

NB7V52M

QFN−16
MN SUFFIX
CASE 485G

MARKING DIAGRAM*



A	= Assembly Location
L	= Wafer Lot
Y	= Year
W	= Work Week
▪	= Pb−Free Package

(Note: Microdot may be in either location)

*For additional marking information, refer to Application Note AND8002/D.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

Description

The NB7V52M is a 10 GHz differential D flip−flop with a differential asynchronous Reset. The differential D/$\overline{D}$, CLK/$\overline{CLK}$ and R/$\overline{R}$ inputs incorporate dual internal 50 Ω termination resistors and will accept LVPECL, CML, LVDS logic levels.

When Clock transitions from logic Low to High, Data will be transferred to the differential CML outputs. The differential Clock inputs allow the NB7V52M to also be used as a negative edge triggered device.

The 16 mA differential CML outputs provide matching internal 50 Ω termination and produce 400 mV output swings when externally receiver terminated with a 50 Ω resistor to V_{CC}.

The NB7V52M is offered in a low profile 3 mm x 3 mm 16−pin QFN package. The NB7V52M is a member of the GigaComm™ family of high performance clock products. Application notes, models, and support documentation are available at www.onsemi.com.

Features

- Maximum Input Clock Frequency > 10 GHz
- Maximum Input Data Rate > 10 Gb/s
- Random Clock Jitter < 0.8 ps RMS, Max
- 200 ps Typical Propagation Delay
- 35 ps Typical Rise and Fall Times
- Differential CML Outputs, 400 mV Peak−to−Peak, Typical
- Operating Range: V_{CC} = 1.71 V to 2.625 V with V_{EE} = 0 V
- Internal 50 Ω Input Termination Resistors
- QFN−16 Package, 3mm x 3mm
- −40°C to +85°C Ambient Operating Temperature
- These are Pb−Free Devices

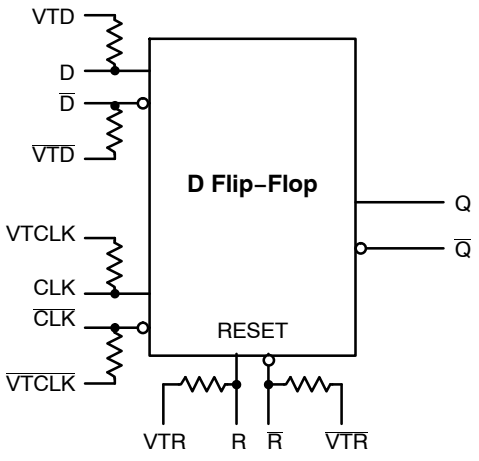


Figure 1. Logic Diagram

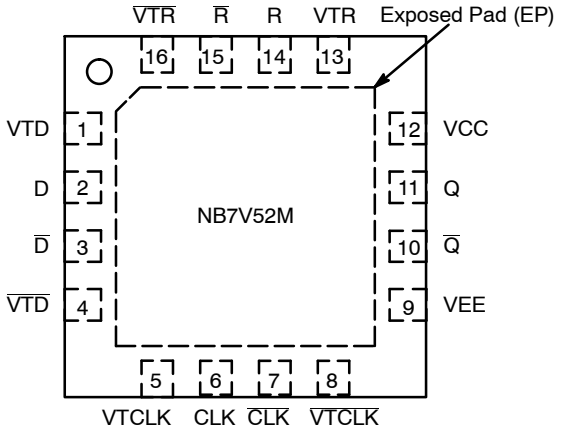


Figure 2. Pin Configuration (Top View)

Table 1. INPUT/OUTPUT SELECT TRUTH TABLE

R	D	CLK	Q
H	x	x	L
L	L	Z	L
L	H	Z	H

Z = LOW to HIGH Transition
x = Don't care

Table 1. Pin Description

Pin	Name	I/O	Description
1	VTD	–	Internal 50 Ω Termination Pin for D
2	D	LVPECL, CML, LVDS Input	Noninverted Differential Data Input. (Note 1)
3	$\overline{D}$	LVPECL, CML, LVDS Input	Inverted Differential Data Input. (Note 1)
4	$\overline{VTD}$	–	Internal 50 Ω Termination Pin for $\overline{D}$
5	VTCLK	–	Internal 50 Ω Termination Pin for CLK
6	CLK	LVPECL, CML, LVDS Input	Noninverted Differential Clock Input. (Note 1)
7	$\overline{CLK}$	LVPECL, CML, LVDS Input	Inverted Differential Clock Input. (Note 1)
8	$\overline{VTCLK}$	–	Internal 50 Ω Termination Pin for $\overline{CLK}$
9	VEE	–	Negative Supply Voltage. (Note 2)
10	$\overline{Q}$	CML Output	Inverted Differential Output
11	Q	CML Output	Noninverted Differential Output
12	VCC	–	Positive Supply Voltage. (Note 2)
13	VTR	–	Internal 50 Ω Termination Pin for R
14	R	LVPECL, CML, LVDS Input	Noninverted Asynchronous Differential Reset Input. (Note 1)
15	$\overline{R}$	LVPECL, CML, LVDS Input	Inverted Asynchronous Differential Reset Input. (Note 1)
16	$\overline{VTR}$	–	Internal 50 Ω Termination Pin for $\overline{R}$
–	EP	–	The Exposed Pad (EP) on the QFN−16 package bottom is thermally connected to the die for improved heat transfer out of package. The exposed pad must be attached to a heat−sinking conduit. The pad is electrically connected to the die, and must be electrically and thermally connected to VEE on the PC board.

1. In the differential configuration when the input termination pins (VTx, $\overline{VTx}$) are connected to a common termination voltage or left open, and if no signal is applied on CLK/$\overline{CLK}$ input, then the device will be susceptible to self−oscillation.
2. All VCC and VEE pins must be externally connected to a power supply for proper operation.

Table 2. ATTRIBUTES

Characteristics		Value
ESD Protection	Human Body Model Machine Model	> 2 kV > 200 V
Moisture Sensitivity	16−QFN	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V−0 @ 0.125 in
Transistor Count		173
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

For additional information, see Application Note AND8003/D.

Table 3. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}	Positive Power Supply	V_{EE} = 0 V		3.0	V
V_{IO}	Positive Input/Output Voltage	V_{EE} = 0 V	−0.5 ≤ VIO ≤ VCC + 0.5	−0.5 to V_{CC} +0.5	V
V_{INPP}	Differential Input Voltage |CLK − $\overline{CLK}$|, |D − $\overline{D}$|, |R − $\overline{R}$|			1.89	V
I_{OUT}	Output Current Through R_{TOUT} (50 Ω Resistor)	Continuous Surge		34 40	mA
I_{IN}	Input Current Through R_{TIN} (50 Ω Resistor)			±40	mA
T_A	Operating Temperature Range			−40 to +85	°C
T_{stg}	Storage Temperature Range			−65 to +150	°C
θ_{JA}	Thermal Resistance (Junction−to−Ambient) (Note 3)	0 lfpm 500 lfpm	QFN−16 QFN−16	42 35	°C/W °C/W
θ_{JC}	Thermal Resistance (Junction−to−Case) (Note 3)		QFN−16	4	°C/W
T_{sol}	Wave Solder Pb−Free			265	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

3. JEDEC standard multilayer board − 2S2P (2 signal, 2 power) with 8 filled thermal vias under exposed pad.

Table 4. DC CHARACTERISTICS, Multi−Level Inputs V_{CC} = 1.71 V to 2.625 V, V_{EE} = 0 V, T_A = −40°C to +85°C (Note 4)

Symbol	Characteristic		Min	Typ	Max	Unit
POWER SUPPLY CURRENT						
I_{CC}	Power Supply Current (Inputs and Outputs Open)	V_{CC} = 2.5 V V_{CC} = 1.8 V		90 70	110 90	mA
CML OUTPUTS						
V_{OH}	Output HIGH Voltage (Note 5)	V_{CC} = 2.5 V V_{CC} = 1.8 V	V_{CC} − 30 2470 1770	V_{CC} − 10 2490 1790	V_{CC} 2500 1800	mV
V_{OL}	Output LOW Voltage (Note 5)	V_{CC} = 2.5 V	V_{CC} − 650 1850	V_{CC} − 500 2000	V_{CC} − 400 2100	mV
		V_{CC} = 1.8 V	V_{CC} − 600 1200	V_{CC} − 450 1350	V_{CC} − 350 1450	
DIFFERENTIAL CLOCK INPUTS DRIVEN SINGLE−ENDED (Note 6) (Figures 5 and 7)						
V_{th}	Input Threshold Reference Voltage Range (Note 7)		1000		V_{CC} − 100	mV
V_{IH}	Single−Ended Input HIGH Voltage		V_{th} + 100		V_{CC}	mV
V_{IL}	Single−Ended Input LOW Voltage		V_{EE}		V_{th} − 100	mV
V_{ISE}	Single−Ended Input Voltage (V_{IH} − V_{IL})		200		1200	mV
DIFFERENTIAL D/$\overline{D}$, CLK/$\overline{CLK}$, R/$\overline{R}$ INPUTS DRIVEN DIFFERENTIALLY (Figures 6 and 8) (Note 8)						
V_{IHD}	Differential Input HIGH Voltage		1100		V_{CC}	mV
V_{ILD}	Differential Input LOW Voltage		V_{EE}		V_{CC} − 100	mV
V_{ID}	Differential Input Voltage (V_{IHD} − V_{ILD})		100		1200	mV
V_{CMR}	Input Common Mode Range (Differential Configuration, Note 9) (Figure 10)		1050		V_{CC} − 50	mV
I_{IH}	Input HIGH Current (VT_x/$\overline{VT_x}$ Open)		−250		250	μA
I_{IL}	Input LOW Current (VT_x/$\overline{VT_x}$ Open)		−250		250	μA
TERMINATION RESISTORS						
R_{TIN}	Internal Input Termination Resistor		45	50	55	Ω
R_{TOUT}	Internal Output Termination Resistor		45	50	55	Ω

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm.

4. Input and output parameters vary 1:1 with V_{CC}.
5. CML outputs loaded with 50 Ω to V_{CC} for proper operation.
6. V_{th}, V_{IH}, $V_{IL,}$, and V_{ISE} parameters must be complied with simultaneously.
7. V_{th} is applied to the complementary input when operating in single−ended mode.
8. V_{IHD}, $V_{ILD,}$ V_{ID} and V_{CMR} parameters must be complied with simultaneously.
9. V_{CMR} min varies 1:1 with V_{EE}, V_{CMR} max varies 1:1 with V_{CC}. The V_{CMR} range is referenced to the most positive side of the differential input signal.

Table 5. AC CHARACTERISTICS V_{CC} = 1.71 V to 2.625 V; V_{EE} = 0 V; T_A = −40°C to 85°C (Note 10)

Symbol	Characteristic		Min	Typ	Max	Unit
f_{MAX}	Maximum Input Clock Frequency		10	12		GHz
$f_{DATA\ MAX}$	Maximum Input Data Rate (PRBS23)		10	12		Gbps
V_{OUTPP}	Output Voltage Amplitude (@ $V_{INPPmin}$) (See Figures 3 and 10, Note 11)	fin ≤ 7 GHz fin ≤ 10 GHz	300 250	400 400		mV
t_{PLH}, t_{PHL}	Propagation Delay to Differential Outputs, @ 1 GHz, Measured at Differential Cross−point	CLK/$\overline{CLK}$ to Q/$\overline{Q}$ R/$\overline{R}$ to Q/$\overline{Q}$		200 300	350 600	ps
t_S	Setup Time (D to CLK)		40	15		ps
t_H	Hold Time (D to CLK)		50	20		ps
t_{RR}	Reset Recovery		275	200		ps
t_{PW}	Minimum Pulse Width	R/$\overline{R}$	1			ns
t_{JITTER}	RJ − Output Random Jitter (Note 12)	f_{in} ≤ 10 GHz		0.2	0.8	ps RMS
V_{INPP}	Input Voltage Swing (Differential Configuration) (Note 13)		100		1200	mV
t_r, t_f	Output Rise/Fall Times @ 1 GHz (20% − 80%),	Q, $\overline{Q}$	20	35	50	ps

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm.

10. Measured using a 400 mV V_{INPP} source, 50% duty cycle clock source. All output loading with external 50 Ω to V_{CC}. Input edge rates ≥ 40 ps (20% − 80%).
11. Output voltage swing is a single−ended measurement operating in differential mode.
12. Additive RMS jitter with 50% duty cycle clock signal.
13. Input voltage swing is a single−ended measurement operating in differential mode.

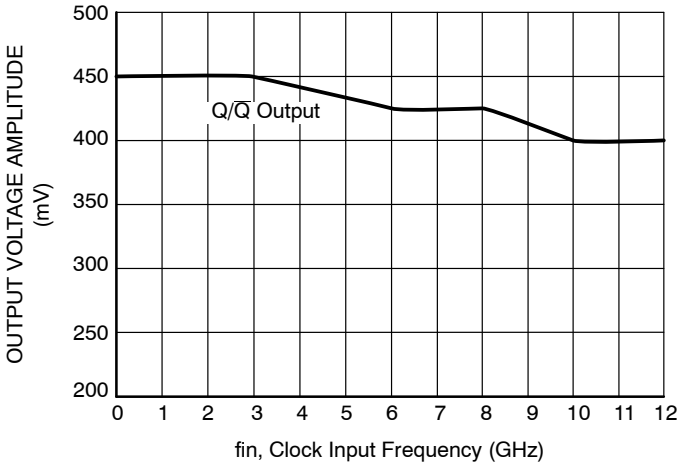


Figure 3. Clock Output Voltage Amplitude (V_{OUTPP}) vs. Input Frequency (f_{in}) at Ambient Temperature (Typ)

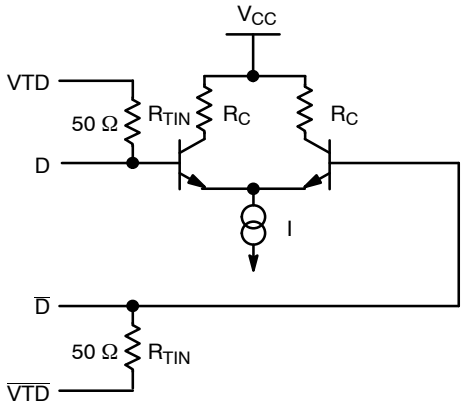


Figure 4. Simplified Input Structure

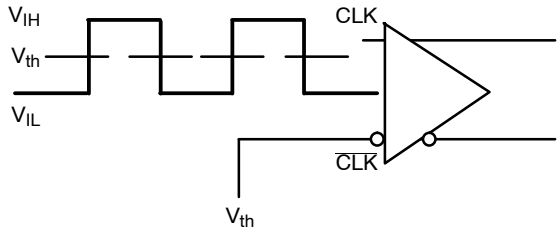


Figure 5. Differential Input Driven Single−Ended

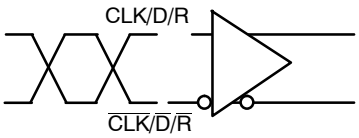


Figure 6. Differential Inputs Driven Differentially

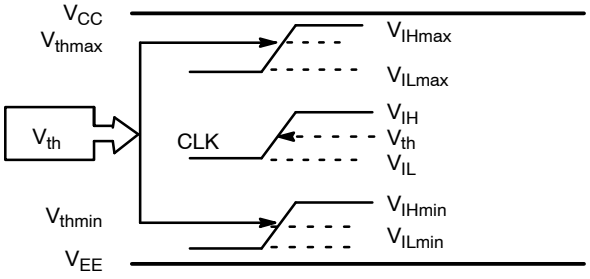


Figure 7. V_{th} Diagram

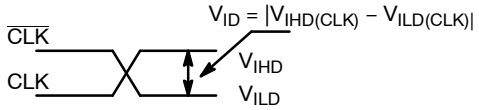


Figure 8. Differential Inputs Driven Differentially

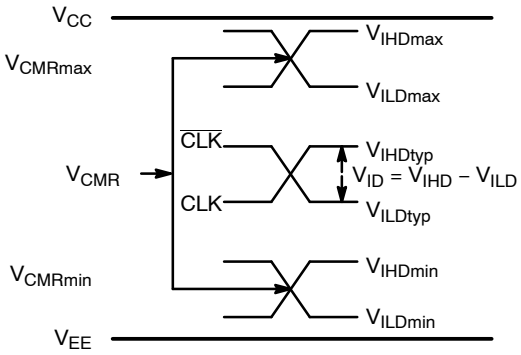


Figure 9. V_{CMR} Diagram

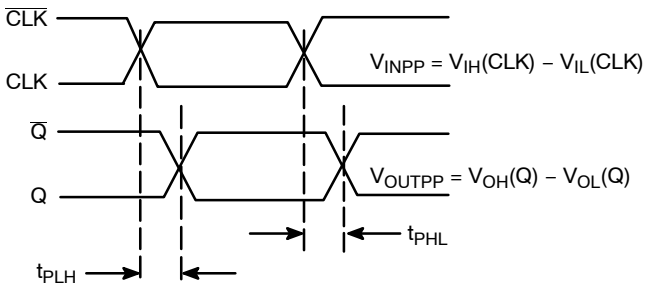


Figure 10. AC Reference Measurement

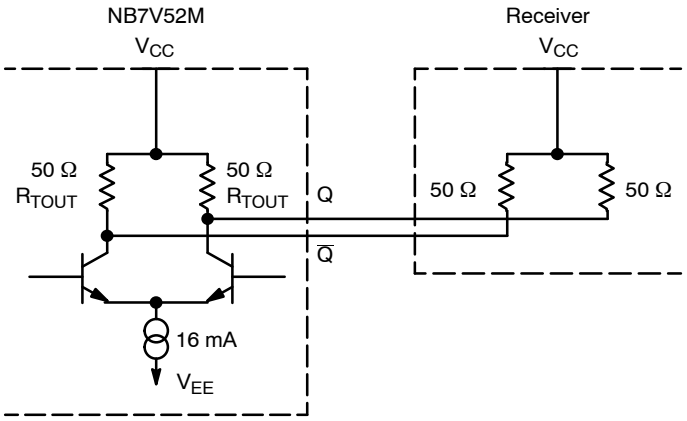


Figure 11. Typical CML Output Structure and Termination

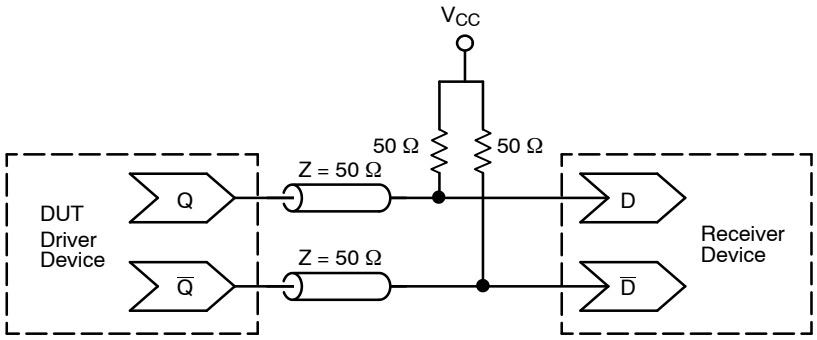


Figure 12. Typical Termination for CML Output Driver and Device Evaluation

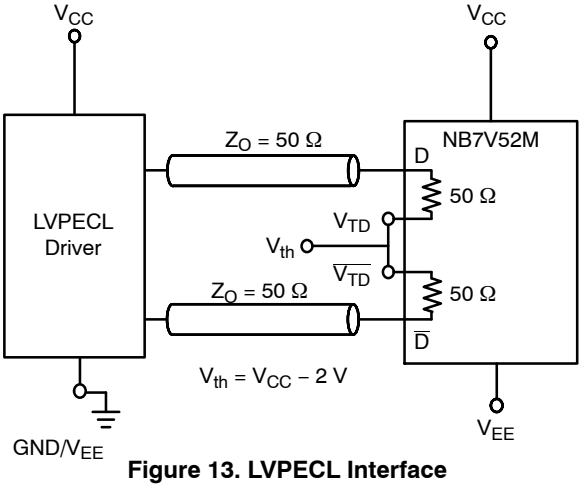


Figure 13. LVPECL Interface

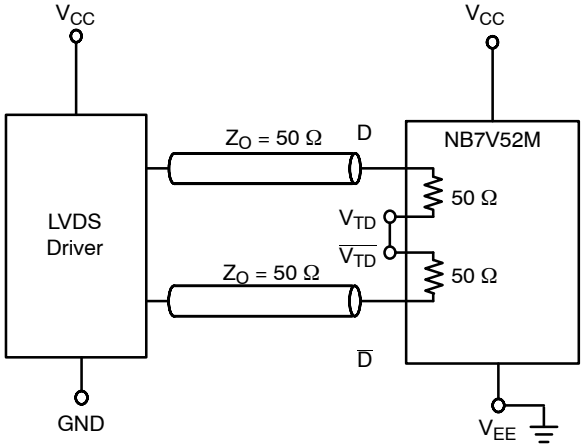


Figure 14. LVDS Interface

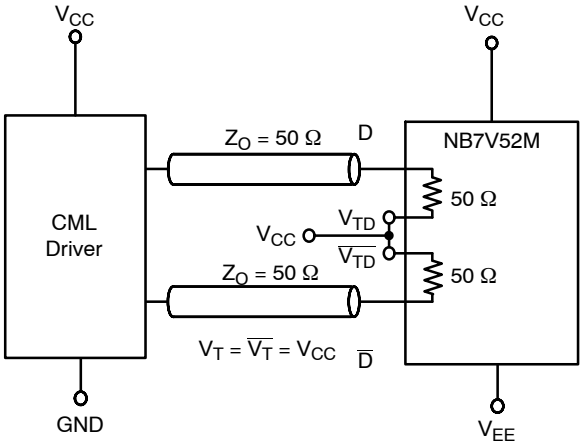


Figure 15. Standard 50 Ω Load CML Interface

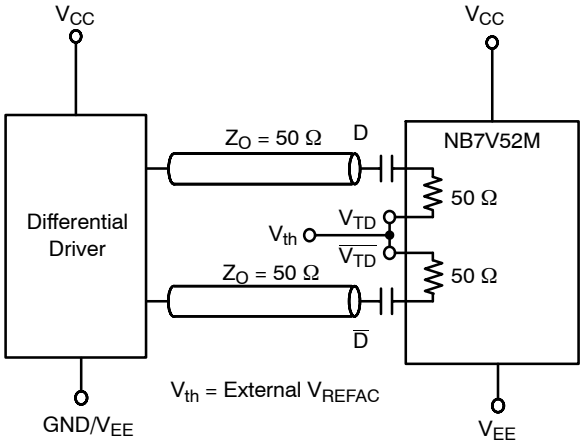


Figure 16. Capacitor−Coupled Differential Interface ($V_T/\overline{V_T}$ Connected to External V_{REFAC}; V_{REFAC} Bypassed to Ground with 0.1 μF Capacitor)

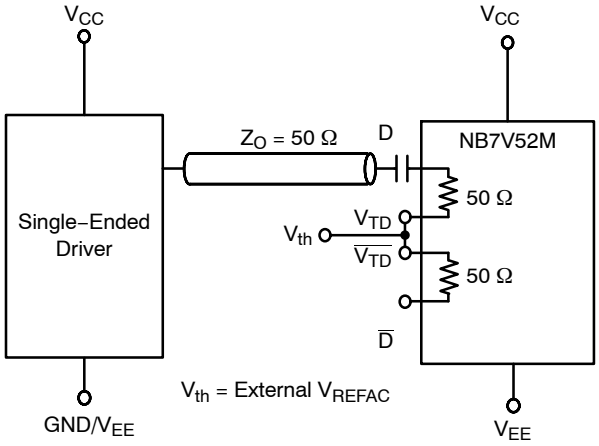


Figure 17. Capacitor−Coupled Single−Ended Interface ($V_T/\overline{V_T}$ Connected to External V_{REFAC}; V_{REFAC} Bypassed to Ground with 0.1 μF Capacitor)

ORDERING INFORMATION

Device	Package	Shipping†
NB7V52MMNG	QFN−16 (Pb−free)	123 Units / Rail
NB7V52MMNHTBG	QFN−16 (Pb−free)	100 / Tape & Reel
NB7V52MMNTXG	QFN−16 (Pb−free)	3000 / Tape & Reel

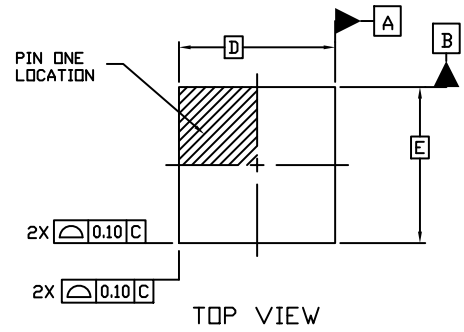
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

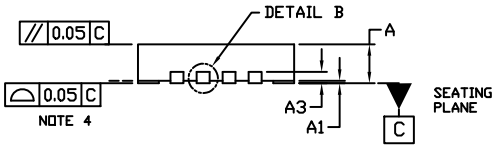
QFN16 3x3, 0.5P
CASE 485G
ISSUE G

DATE 08 OCT 2021

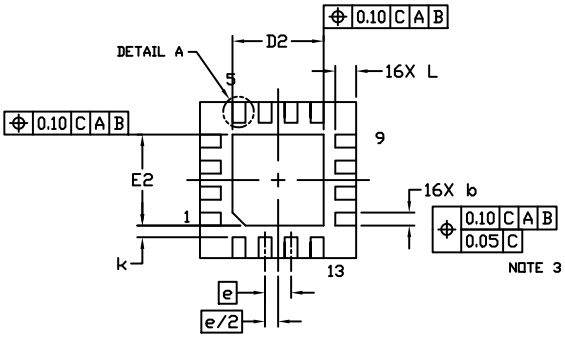
SCALE 2:1



TOP VIEW

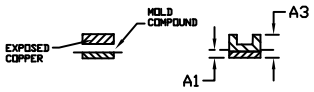


SIDE VIEW

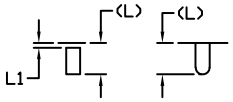


BOTTOM VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.



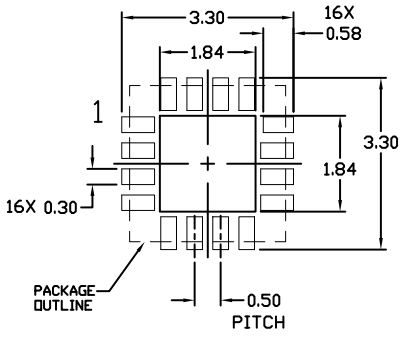
DETAIL B
ALTERNATE CONSTRUCTIONS



DETAIL A
ALTERNATE TERMINAL CONSTRUCTIONS

	MILLIMETERS		
DIM	MIN.	NOM.	MAX.
A	0.80	0.90	1.00
A1	0.00	0.03	0.05
A3		0.20 REF	
b	0.18	0.24	0.30
D		3.00 BSC	
D2	1.65	1.75	1.85
E		3.00 BSC	
E2	1.65	1.75	1.85
e		0.50 BSC	
k		0.18 TYP	
L	0.30	0.40	0.50
L1	0.00	0.08	0.15

MOUNTING FOOTPRINT



GENERIC MARKING DIAGRAM*

XXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	**98AON04795D**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	**QFN16 3X3, 0.5P**	**PAGE 1 OF 1**

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

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