NB3L8533

2.5V/3.3V Differential 2:1 MUX to 4 LVPECL Fanout Buffer

ON Semiconductor®

www.onsemi.com

Description

The NB3L8533 is a low skew 1:4 LVPECL Clock fanout buffer designed explicitly for low output skew applications.

The NB3L8533 features a multiplexed input which can be driven by either a differential or single−ended input to allow for the distribution of a lower speed clock along with the high speed system clock.

The CLK_SEL pin will select the differential clock inputs, CLK and $\overline{\text{CLK}}$, when LOW (or left open and pulled LOW by the internal pull−down resistor). When CLK_SEL is HIGH, the Differential PCLK and $\overline{\text{PCLK}}$ inputs are selected.

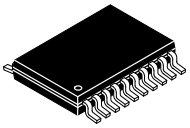
The common enable (CLK_EN) is synchronous so that the outputs will only be enabled/disabled when they are already in the LOW state. This avoids any chance of generating a runt clock pulse when the device is enabled/disabled as can happen with an asynchronous control. The internal flip flop is clocked on the falling edge of the input clock, therefore, all associated specification limits are referenced to the negative edge of the clock input.

Features

- 650 MHz Maximum Clock Output Frequency
- CLK/$\overline{\text{CLK}}$ can Accept LVPECL, LVDS, HCSL, STTL and HSTL
- PCLK/$\overline{\text{PCLK}}$ can Accept LVPECL, LVDS, CML and SSTL
- Four Differential LVPECL Clock Outputs
- 1.5 ns Maximum Propagation Delay
- Operating Range: V_{CC} = 2.375 V to 3.630 V
- LVCMOS Compatible Control Inputs
- Selectable Differential Clock Inputs
- Synchronous Clock Enable
- 30 ps Max. Skew Between Outputs
- −40°C to +85°C Ambient Operating Temperature Range
- TSSOP−20 Package
- These are Pb−Free Devices

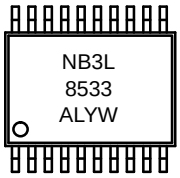
Applications

- Computing and Telecom
- Routers, Servers and Switches
- Backplanes



TSSOP−20
DT SUFFIX
CASE 948E

MARKING DIAGRAM



A	= Assembly Location
WL	= Wafer Lot
YY	= Year
WW	= Work Week
G	= Pb−Free Package

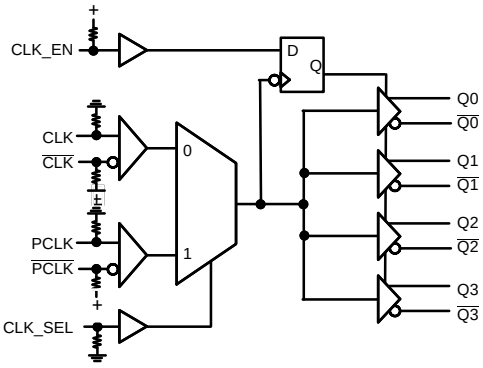


Figure 1. Simplified Logic Diagram of NB3L8533

ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

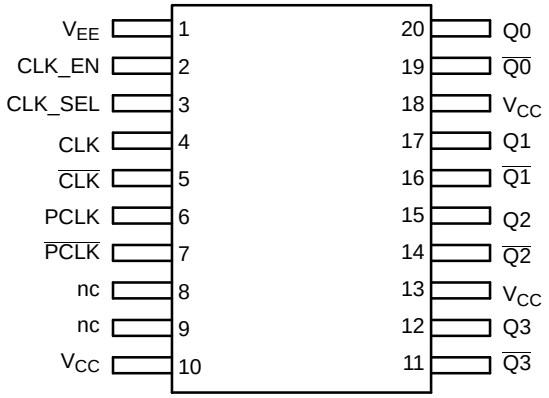


Figure 2. Pinout Diagram (Top View)

Table 1. FUNCTIONS

Inputs			Outputs		
CLK_EN	**CLK_SEL**	**Input Function**	**Output Function**	**Qx**	**$\overline{Qx}$**
0	0	CLK input selected	Disabled	LOW	HIGH
0	1	PCLK Inputs Selected	Disabled	LOW	HIGH
1	0	CLK input selected	Enabled	CLK	Invert of CLK
1	1	PCLK Inputs Selected	Enabled	PCLK	Invert of PCLK

1. After CLK_EN switches, the clock outputs are disabled or enabled following a rising and falling input clock edge as show in Figure 3.

Table 2. PIN DESCRIPTION

Pin Number	Name	I/O	Open Default	Description
1	VEE	Power		Negative (Ground) Power Supply pin must be externally connected to power supply to guarantee proper operation.
2	CLK_EN	LVCMOS/LVTTL Input	Pull-up	Synchronized Clock Enable when HIGH. When LOW, outputs are disabled ($\overline{Qx}$ HIGH, Qx LOW)
3	CLK_SEL	LVCMOS/LVTTL Input	Pull-down	Clock Input Select (HIGH selects PCLK, LOW selects CLK input)
4	CLK	Input	Pull-down	Non−inverted Differential Clock Input. Float open when unused.
5	$\overline{CLK}$	Input	Pull-up	Inverted Differential Clock Input. Float open when unused.
6	PCLK	Input	Pull-down	Non−inverted Differential Clock Input. Float open when unused.
7	$\overline{PCLK}$	Input	Pull-up	Inverted Differential Clock Input. Float open when unused.
8	NC			No Connect
9	NC			No Connect
10	VCC	Power		Positive Power Supply pins must be externally connected to power supply to guarantee proper operation.
11	$\overline{Q3}$	LVPECL Output		Complement Differential Output
12	Q3	LVPECL Output		True Differential Output
13	VCC	Power		Positive Power Supply pins must be externally connected to power supply to guarantee proper operation.
14	$\overline{Q2}$	LVPECL Output		Complement Differential Output
15	Q2	LVPECL Output		True Differential Output
16	$\overline{Q1}$	LVPECL Output		Complement Differential Output
17	Q1	LVPECL Output		True Differential Output
18	VCC	Power		Positive Power Supply pins must be externally connected to power supply to guarantee proper operation.
19	$\overline{Q0}$	LVPECL Output		Complement Differential Output
20	Q0	LVPECL Output		True Differential Output

Table 3. ATTRIBUTES (Note 2)

Characteristics		Value
ESD Protection	Human Body Model Machine Model	> 2 kV > 200 V
R_{PU} − Pull−up Resistor		50 kΩ
R_{PD} − Pull−down Resistor		50 kΩ
Moisture Sensitivity (Note 2)	TSSOP−20	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V−0 @ 0.125 in
Transistor Count		289
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

2. For additional information, see Application Note AND8003/D.

Table 4. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}	Positive Power Supply Voltage	V_{EE} = 0 V		4.6	V
V_I	Input Voltage	V_{EE} = 0 V	$V_I \le V_{CC}$	−0.5 to V_{CC} + 0.5	V
I_{out}	Output Current	Continuous Surge		50 100	mA 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)	0 lfpm 500 lfpm	TSSOP−20 TSSOP−20	140 50	°C/W
θ_{JC}	Thermal Resistance (Junction−to−Case)	Standard Board	TSSOP−20	23 to 41	°C/W
T_{sol}	Wave Solder			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.

Table 5. DC CHARACTERISTICS V_{CC} = 2.375 V to 3.630 V; V_{EE} = 0 V; T_A = −40°C to +85°C (Note 3)

Symbol	Characteristic		Min	Typ	Max	Unit
POWER SUPPLY						
V_{CC}	Power Supply Voltage		2.375		3.630	V
I_{EE}	Power Supply Current (Outputs Open)				40	mA
LVPECL OUTPUTS (Note 4)						
V_{OH}	Output HIGH Voltage		V_{CC}−1.4		V_{CC}−0.9	V
V_{OL}	Output LOW Voltage		V_{CC}−2.0		V_{CC}−1.7	V
V_{SWING}	Output Voltage Swing, Peak−to−Peak		0.6		1.0	V
DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY (see Figure 5) (Note 7)						
V_{IHD}	Differential Input HIGH Voltage	CLK PCLK	0.5 1.5		V_{CC}−0.85	V
V_{ILD}	Differential Input LOW Voltage	CLK PCLK	0 0.5		V_{IHD}−0.15 V_{IHD}−0.30	V
V_{CMR}	Common Mode Input Voltage; (Note 8)	CLK/CLKb PCLK/PCLKb	0.5 1.5		V_{CC}−0.85	V
V_{ID}	Differential Input Voltage (V_{IHD}−V_{ILD})	CLK/CLKb PCLK/PCLKb	0.15 0.3		1.3 1.0	V
I_{IH}	Input HIGH Current V_{IN} = V_{CC} = 3.630 V	CLK, PCLK CLKb, PCLKb			150 5	μA
I_{IL}	Input LOW Current V_{IN} = 0 V, V_{CC} = 3.630 V	CLK, PCLK CLKb, PCLKb	−5 −150			μA
LVCMOS/LVTTL INPUTS (CLK_EN, CLK_SEL)						
V_{IH}	Input HIGH Voltage		2.0		V_{CC}+0.3	V
V_{IL}	Input LOW Voltage		−0.3		0.8	V
I_{IH}	Input HIGH Current V_{IN} = V_{CC} = 3.630 V	CLK_EN CLK_SEL			5 150	μA
I_{IL}	Input Low Current V_{IN} = 0 V, V_{CC} = 3.630 V	CLK_EN CLK_SEL	−150 −5			μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

3. Input and Output parameters vary 1:1 with V_{CC}.
4. LVPECL outputs loaded with 50 Ω to V_{CC} − 2 V for proper operation.
5. V_{IH}, V_{IL}, V_{th} and V_{ISE} parameters must be complied with simultaneously.
6. V_{th} is applied to the complementary input when operating in single−ended mode.
7. V_{IHD}, V_{ILD}, V_{ID} and V_{CMR} parameters must be complied with simultaneously.
8. The common mode voltage is defined as V_{IH}.

Table 6. AC CHARACTERISTICS, V_{CC} = 2.375 V to 3.630 V, T_A = −40°C to +85°C (Note 9)

Symbol	Characteristic			Min	Typ	Max	Unit
f_{MAX}	Maximum Input Clock Frequency: $V_{OUTpp} \geq 300$ mV					650	MHz
Φ_N	Phase Noise, f_C = 156.25 MHz	100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 10 MHz 20 MHz	Offset from Carrier		−124.4 −136.1 −144.2 −153.3 −156.2 −156.2 −156.4		dBc/Hz
t_{PLH}, t_{PHL}	Propagation Delay to Differential Outputs, @ 50 MHz (Figures 6 and 7) (V_{CC} = 3.3 V)	Note 10 Note 11	CLK/$\overline{CLK}$ to Q/$\overline{Q}$ PCLK/$\overline{PCLK}$ to Q/$\overline{Q}$	1.0		1.55	ns
$t_{J\Phi N}$	Additive Phase Jitter, RMS; f_C = 156.25 MHz, Integration Range: 12 kHz − 20 MHz				0.05		ps
tsk(o)	Output−to−output skew; (Note 12)					30	ps
tsk (pp)	Part−to−Part Skew; (Note 13)					150	ps
V_{INpp}	Input Voltage Swing/Sensitivity (Differential Configuration) (Note 15)			150		1300	mV
t_r/t_f	Output rise and fall times, 20% to 80%, @ 50 MHz		Q_n, $\overline{Q_n}$	250		600	ps
ODC	Output Clock Duty Cycle			47		53	%

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

All parameters measured at f_{MAX} unless noted otherwise.
The cycle−to−cycle jitter on the input will equal the jitter on the output. The part does not add jitter

9. Measured using a $V_{INPPmin}$ source, Reference Duty Cycle = 50% duty cycle clock source. All output loading with external 50 Ω to V_{CC} − 2 V.
10. Measured from the differential input crossing point to the differential output crossing point.
11. Measured from V_{CC} /2 input crossing point to the differential output crossing point.
12. Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at the output differential cross points.
13. Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.
14. Output voltage swing is a single−ended measurement operating in differential mode.
15. Input voltage swing is a single−ended measurement operating in differential mode.

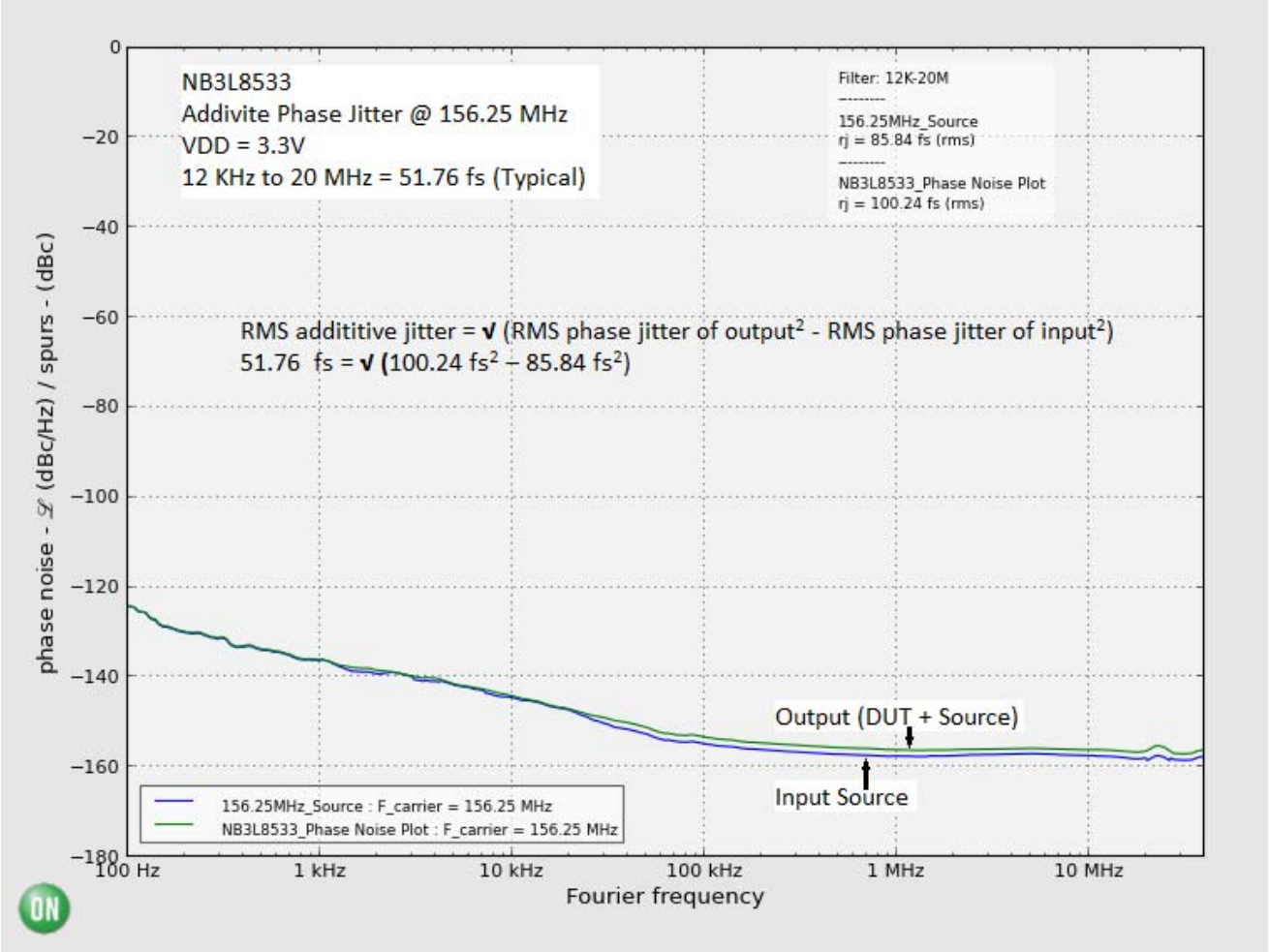


Figure 3. Typical Phase Noise Plot at $f_{carrier}$ = 156.25 MHz at an Operating Voltage of 3.3 V, Room Temperature

The above phase noise data was captured using Agilent E5052A/B. The data displays the input phase noise and output phase noise used to calculate the additive phase jitter at a specified integration range. The RMS Phase Jitter contributed by the device (integrated between 12 kHz and 20 MHz) is 51.76 fs.

The additive phase jitter performance of the fanout buffer is highly dependent on the phase noise of the input source.

To obtain the most accurate additive phase noise measurement, it is vital that the source phase noise be notably lower than that of the DUT. If the phase noise of the source is greater than the device under test output, the source noise will dominate the additive phase jitter calculation and lead to an artificially low result for the additive phase noise measurement within the integration range.

$$\text{RMS additive jitter} = \sqrt{\text{RMS phase jitter of output}^2 - \text{RMS phase jitter of input}^2}$$

$$51.76\ \text{fs} = \sqrt{100.24\ \text{fs}^2 - 85.84\ \text{fs}^2}$$

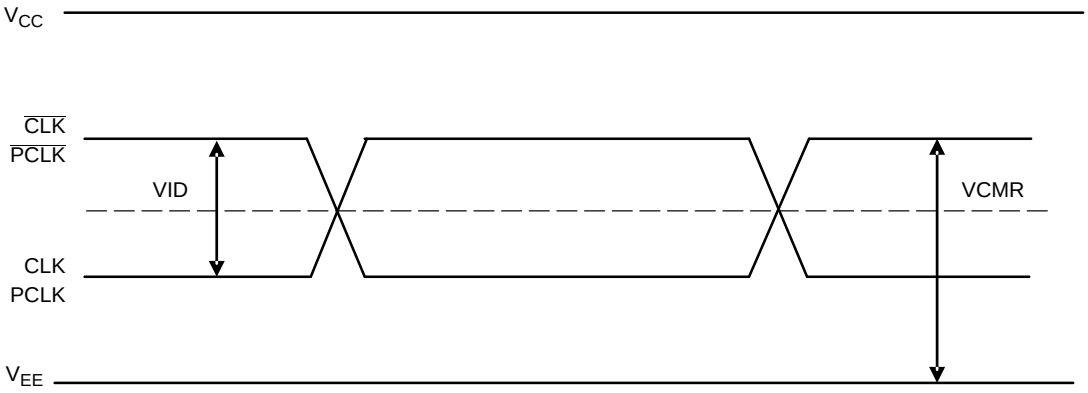


Figure 4. VCMR Diagram

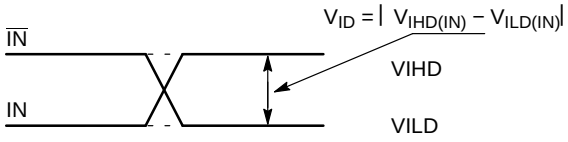


Figure 5. Differential Inputs Driven Differentially

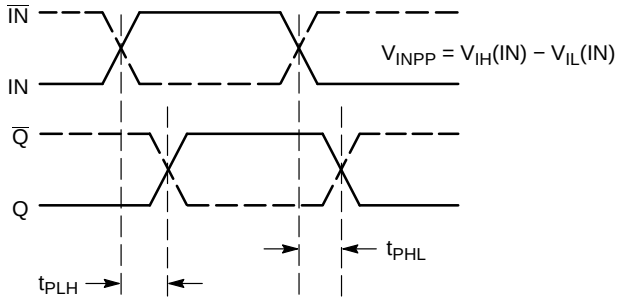


Figure 6. AC Reference Measurement

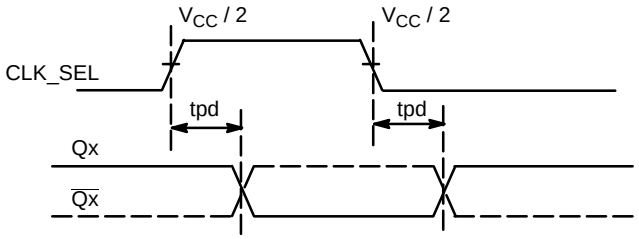


Figure 7. CLK_SEL to Qx Timing Diagram

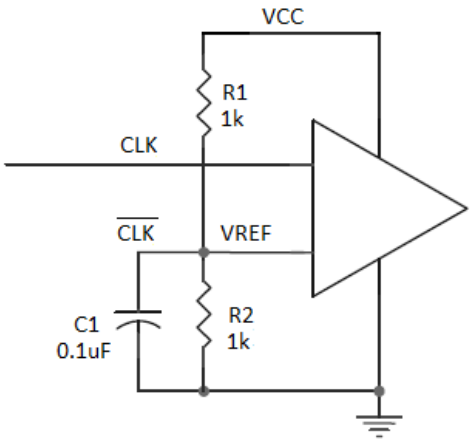


Figure 8. Differential Input Driven Single−ended

Differential Clock Input to Accept Single−ended Input

Figure 8 shows how the CLK input can be driven by a single−ended Clock signal. C1 is connected to the V_{ref} node as a bypass capacitor. Locate these components close the device pins. R1 and R2 must be adjusted to position V_{ref} to the center of the input swing on CLK.

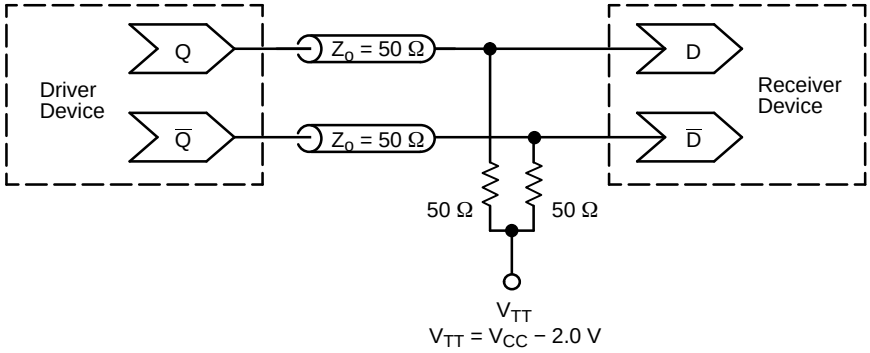


Figure 9. Typical Termination for Output Driver and Device Evaluation (See Application Note AND8020/D − Termination of ECL Logic Devices.)

ORDERING INFORMATION

Device	Package	Shipping†
NB3L8533DTG	TSSOP−20 (Pb−Free)	75 Units / Rail
NB3L8533DTR2G	TSSOP−20 (Pb−Free)	2500 / Tape & Reel

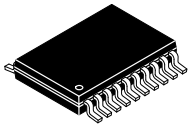
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

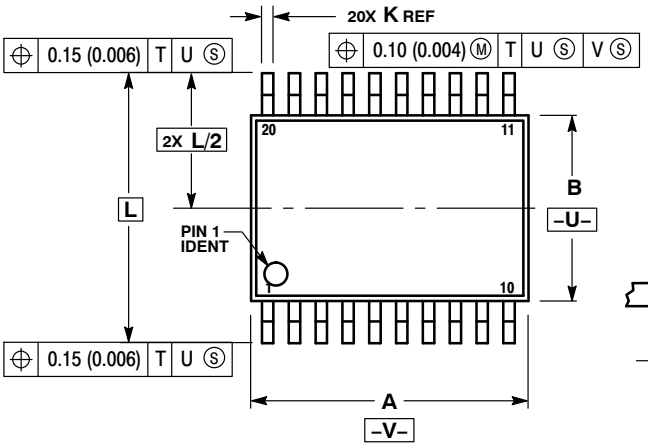
ON Semiconductor®

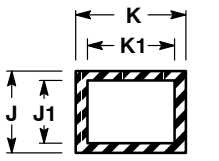
TSSOP−20 WB
CASE 948E
ISSUE D

DATE 17 FEB 2016

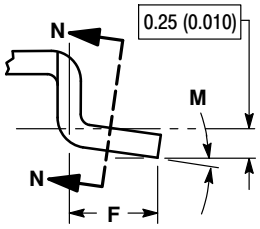


SCALE 2:1

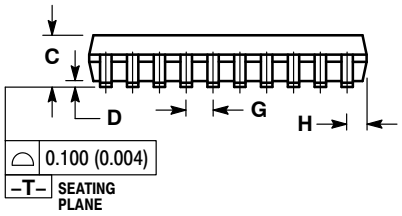


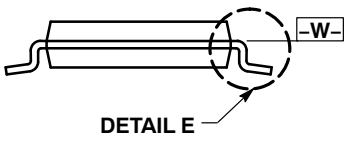


SECTION N−N



DETAIL E

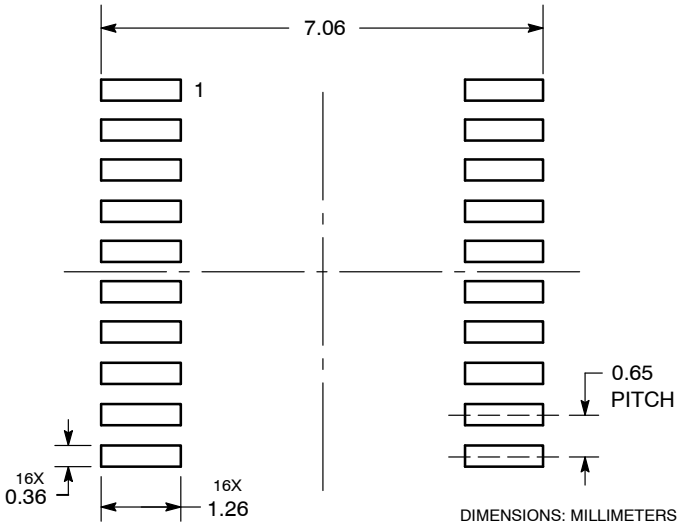




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

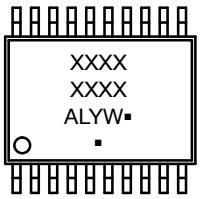
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

GENERIC MARKING DIAGRAM*



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.

DOCUMENT NUMBER:	98ASH70169A	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	TSSOP−20 WB	PAGE 1 OF 1

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Email Requests to: orderlit@onsemi.com

onsemi Website: www.onsemi.com

TECHNICAL SUPPORT
North American Technical Support:
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

◊