MC100LVE222

3.3 V/5.0 V ECL 1:15 Differential ÷1/÷2 Clock Driver

The MC100LVE222 is a low skew 1:15 differential ÷1/÷2 ECL fanout buffer designed with clock distribution in mind. The LVECL/LVPECL input signal pairs can be differential or used single−ended (with V_{BB} output reference bypassed and connected to the unused input of a pair). Either of two fully differential clock inputs may be selected. Each of the four output banks of 2, 3, 4, and 6 differential pairs may be independently configured to fanout 1X or 1/2X of the input frequency. The LVE222 specifically guarantees low output to output skew. Optimal design, layout, and processing minimize skew within a device and from lot to lot.

The fsel pins and CLK_Sel pin are asynchronous control inputs. Any changes may cause indeterminate output states requiring an MR pulse to resynchronize any 1/2X outputs.

The device tpd is affected by the quantity of output pairs terminated with a minimum occurring with only one output pair and increasing about 10−20 ps for all output pairs. Relative skew distribution is not affected as more pairs are terminated, but the increased tpd does shift the entire distribution. Unused output pairs should be left unterminated (open) to reduce power and switching noise.

The MC100LVE222, as with most ECL devices, can be operated from a positive V_{CC}/V_{CCO} supply in PECL mode. This allows the LVE222 to be used for high performance clock distribution in +3.3 V systems. Operation with >3.8 |(V_{CC} or V_{CCO}−V_{EE}| span will require special thermal handling considerations. Designers can take advantage of the LVE222's performance to distribute low skew clocks across the backplane or the board. In a PECL environment series or Thevenin line, terminations are typically used as they require no additional power supplies. All power supply pins must be connected. For more information on using PECL, designers should refer to Application Note AN1406/D. For a SPICE model, refer to Application Note AN1560/D.

Features

- 200 ps Part−to−Part Skew
- 50 ps Output−to−Output Skew
- Selectable 1x or 1/2x Frequency Outputs
- ESD Protection: >2 kV HBM, >200 V MM
- The 100 Series Contains Temperature Compensation
- PECL Mode Operating Range: V_{CC}/V_{CCO} = 3.0 V to 5.25 V with V_{EE} = 0 V
- NECL Mode Operating Range: V_{CC}/V_{CCO} = 0 V with V_{EE} = −3.0 V to −5.25 V
- Internal Input Pulldown Resistors
- Meets or Exceeds JEDEC Spec EIA/JESD78 IC Latchup Test
- Moisture Sensitivity Level 2
  For Additional Information, refer to Application Note AND8003/D
- Flammability Rating: UL 94 V−0 @ 0.125 in,
  Oxygen Index: 28 to 34
- Transistor Count = 684 devices
- Pb−Free Packages are Available*

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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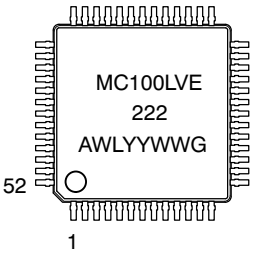
MARKING DIAGRAM*

LQFP
FA SUFFIX
CASE 848D



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

*For additional information, see Application Note AND8002/D

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

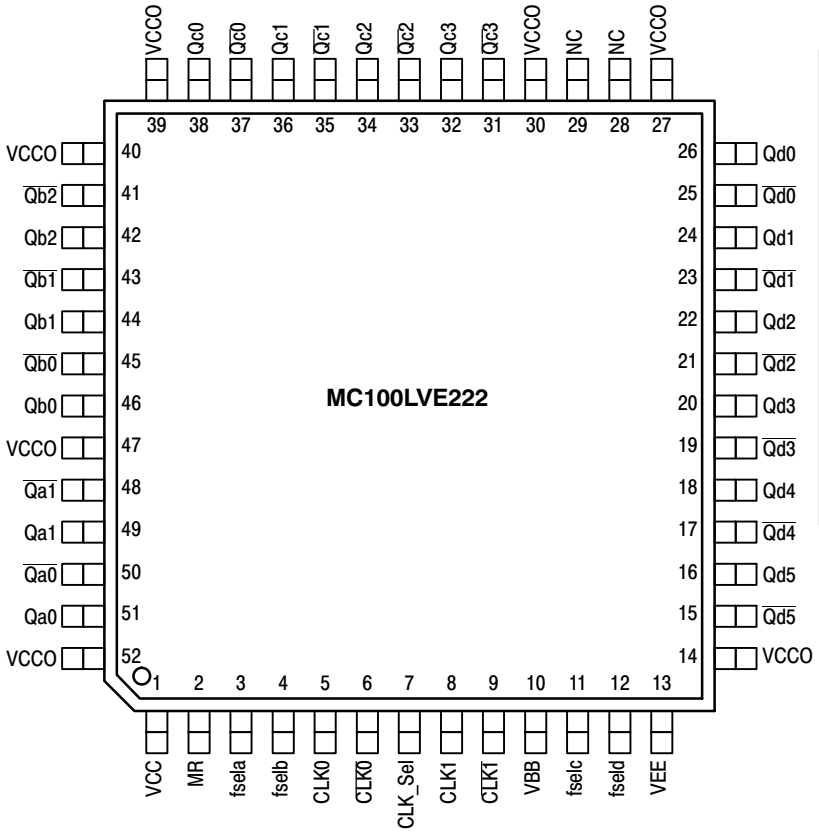


Figure 1. Pinout Assignment (Top View)

Table 1. PIN DESCRIPTION

PIN	FUNCTION
CLK0, $\overline{\text{CLK0}}$	ECL Differential Input Clock
CLK1, $\overline{\text{CLK1}}$	ECL Differential Input Clock
CLK_Sel	ECL Clock Select
MR	ECL Master Reset
Qa0:1, $\overline{\text{Qa0:1}}$	ECL Differential Outputs
Qb0:2, $\overline{\text{Qb0:2}}$	ECL Differential Outputs
Qc0:3, $\overline{\text{Qc0:3}}$	ECL Differential Outputs
Qd0:5, $\overline{\text{Qd0:5}}$	ECL Differential Outputs
fseln	ECL ÷1 or ÷2 Select
V_{BB}	Reference Voltage Output
V_{CC}/V_{CCO}	Positive Supply (V_{CC} = V_{CCO})
V_{EE}	Negative Supply
NC	No Connect

Note: All V_{CC}/V_{CCO}, and V_{EE} pins must be externally connected to Power Supply to guarantee proper operation. All V_{CC}/V_{CCO} pins are internally interconnected.

Table 2. FUNCTION TABLE

	Function	
Input	L	H
MR	Active	Reset
CLK_Sel	CLK0	CLK1
fseln	÷1	÷2

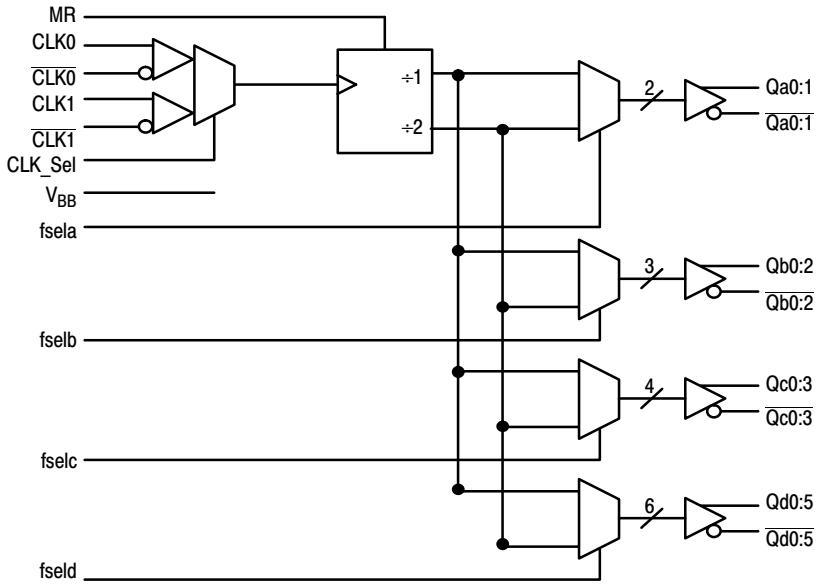


Figure 2. Logic Diagram

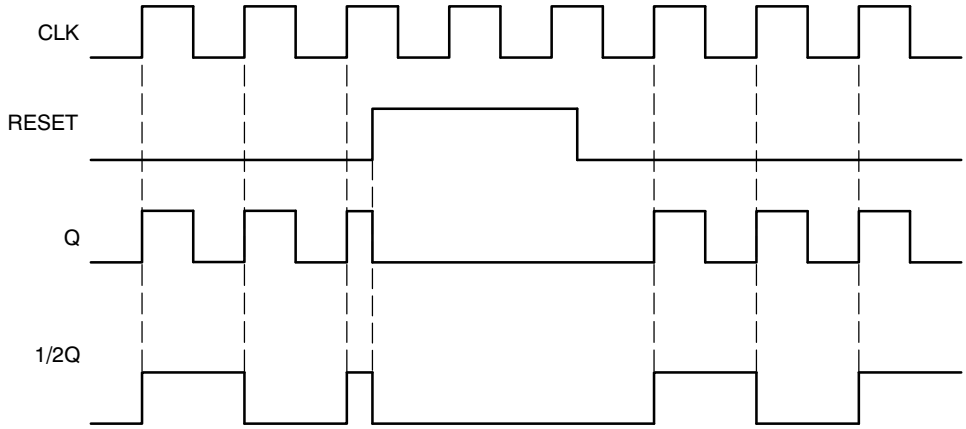


Figure 3. Timing Diagram

Table 3. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}/V_{CCO}	PECL Mode Power Supply	V_{EE} = 0 V		8 to 0	V
V_{EE}	NECL Mode Power Supply	V_{CC} or V_{CCO} = 0 V		−8 to 0	V
V_I	PECL Mode Input Voltage NECL Mode Input Voltage	V_{EE} = 0 V V_{CC} or V_{CCO} = 0 V	$V_I \leq (V_{CC}$ or $V_{CCO})$ $V_I \geq V_{EE}$	6 to 0 −6 to 0	V V
I_{out}	Output Current	Continuous Surge		50 100	mA mA
I_{BB}	V_{BB} Sink/Source			±0.5	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	52 LQFP 52 LQFP	35.6 30	°C/W °C/W
θ_{JC}	Thermal Resistance (Junction−to−Case)	Standard Board	52 LQFP	21	°C/W
T_{sol}	Wave Solder	<2 to 3 sec @ 248°C		265	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 4. LVPECL DC CHARACTERISTICS V_{CC} or V_{CCO} = 3.3 V; V_{EE} = 0.0 V (Note 1)

		–40°C			25°C			85°C			
Symbol	**Characteristic**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**
I_{EE}	Power Supply Current		122	136		122	136		125	139	mA
V_{OH}	Output HIGH Voltage (Note 2)	2215	2295	2420	2275	2345	2420	2275	2345	2420	mV
V_{OL}	Output LOW Voltage (Note 2)	1470	1605	1745	1490	1595	1680	1490	1595	1680	mV
V_{IH}	Input HIGH Voltage (Single−Ended)	2135		2420	2135		2420	2135		2420	mV
V_{IL}	Input LOW Voltage (Single−Ended)	1490		1825	1490		1825	1490		1825	mV
V_{BB}	Output Voltage Reference	1.92		2.04	1.92		2.04	1.92		2.04	V
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 6) V_{PP} < 500 mV $V_{PP} \geqq$ 500 mV	 1.3 1.6		 2.9 2.9	 1.2 1.5		 2.9 2.9	 1.2 1.5		 2.9 2.9	 V V
I_{IH}	Input HIGH Current			150			150			150	μA
I_{IL}	Input LOW Current Others $\overline{CLK0}$, $\overline{CLK1}$	0.5 −300			0.5 −300			0.5 −300			μA μA

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.

1. Input and output parameters vary 1:1 with V_{CC}/V_{CCO}. V_{EE} can vary +0.3 V to −1.95 V. Operation with $|V_{CC}$ or $V_{CCO}-V_{EE}| \geq$3.8 V span will require special thermal handling considerations.
2. Outputs are terminated through a 50 Ω resistor to (V_{CC} or V_{CCO}) − 2.0 V.
3. V_{IHCMR} min varies 1:1 with V_{EE}, max varies 1:1 with V_{CC}/V_{CCO}. V_{IHCMR} is defined as the range within which the V_{IH} level may vary, with the device still meeting the propagation delay specification. The V_{IL} level must be such that the peak to peak voltage is less than 1.0 V and greater than or equal to V_{PP}(min).

Table 5. LVNECL DC CHARACTERISTICS V_{CC} or V_{CCO} = 0.0 V; V_{EE} = −3.3 V (Note 4)

		–40°C			25°C			85°C			
Symbol	**Characteristic**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**
I_{EE}	Power Supply Current		122	136		122	136		125	139	mA
V_{OH}	Output HIGH Voltage (Note 5)	−1085	−1005	−880	−1025	−955	−880	−1025	−955	−880	mV
V_{OL}	Output LOW Voltage (Note 5)	−1830	−1695	−1555	−1810	−1705	−1620	−1810	−1705	−1620	mV
V_{IH}	Input HIGH Voltage (Single−Ended)	−1165		−880	−1165		−880	−1165		−880	mV
V_{IL}	Input LOW Voltage (Single−Ended)	−1810		−1475	−1810		−1475	−1810		−1475	mV
V_{BB}	Output Voltage Reference	−1.38		−1.26	−1.38		−1.26	−1.38		−1.26	V
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 6) $_{PP}$ < 500 mV $V_{PP} \geqq$ 500 mV	 −2.0 −1.7		 −0.4 −0.4	 −2.1 −1.8		 −0.4 −0.4	 −2.1 −1.8		 −0.4 −0.4	 V V
I_{IH}	Input HIGH Current			150			150			150	μA
I_{IL}	Input LOW Current Others $\overline{CLK0}$, $\overline{CLK1}$	0.5 −300			0.5 −300			0.5 −300			μA μA

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.

4. Input and output parameters vary 1:1 with V_{CC}/V_{CCO}. V_{EE} can vary +0.3 V to −1.95 V. Operation with $|V_{CC}$ or $V_{CCO}-V_{EE}| \geq$3.8 V span will require special thermal handling considerations.
5. Outputs are terminated through a 50 Ω resistor to (V_{CC} or V_{CCO}) − 2.0 V.
6. V_{IHCMR} min varies 1:1 with V_{EE}, max varies 1:1 with V_{CC}/V_{CCO}. V_{IHCMR} is defined as the range within which the V_{IH} level may vary, with the device still meeting the propagation delay specification. The V_{IL} level must be such that the peak to peak voltage is less than 1.0 V and greater than or equal to V_{PP}(min).

Table 6. AC CHARACTERISTICS V_{CC} or V_{CCO} = 3.3 V; V_{EE} = 0.0 V or V_{CC}/V_{CCO} = 0.0 V; V_{EE} = −3.3 V (Note 7)

		−40°C			25°C			70°C			
Symbol	**Characteristic**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**
f_{max}	Maximum Toggle Frequency	1.2	> 1.5		1.2	> 1.5		1.2	> 1.5		GHz
t_{PLH} t_{PHL}	Propagation Delay to Output IN (differential) (Note 8) IN (single−ended) (Note 9) MR	 1040 940 1100	 1140 1140 1250	 1240 1290 1400	 1080 980 1170	 1180 1180 1320	 1280 1330 1470	 1120 1020 1220	 1220 1220 1370	 1320 1370 1520	ps
t_{skew}	Within−Device Skew (Note 10) Part−to−Part Skew (Differential Configuration)			50 200			50 200			50 200	ps
t_{JITTER}	Random CLOCK Jitter (RMS)		< 1.0			< 1.0			< 1.0		ps
V_{PP}	Input Swing (Differential) (Note 11)	400		1000	400		1000	400		1000	mV
t_r/t_f	Output Rise/Fall Time 20%−80%	200		600	200		600	200		600	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. 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.

7. V_{EE} can vary +0.3 V to −1.95 V. Operation with $|V_{CC}$ or $pV_{CCO}-V_{EE}| \geq 3.8$ V span will require special thermal handling considerations.
8. The differential propagation delay is defined as the delay from the crossing points of the differential input signals to the crossing point of the differential output signals.
9. The single-ended propagation delay is defined as the delay from the 50% point of the input signal to the 50% point of the output signal.
10. The within−device skew is defined as the worst case difference between any two similar delay paths within a single device.
11. V_{PP}(min) is defined as the minimum input differential voltage which will cause no increase in the propagation delay. The V_{PP}(min) is AC limited for the LVE222. A differential input as low as 50 mV will still produce full ECL levels at the output.

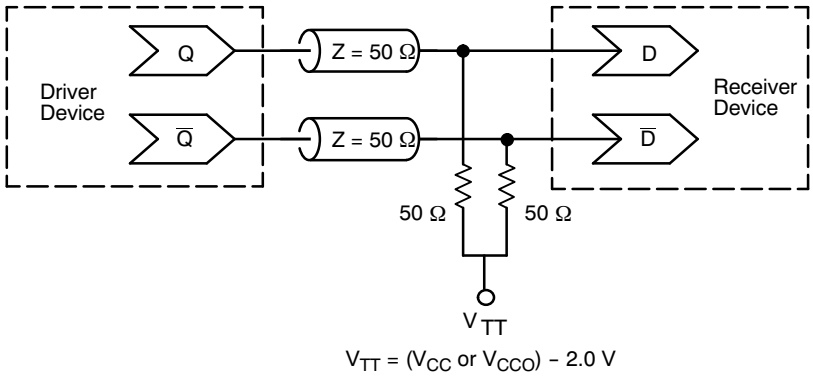


Figure 4. Typical Termination for Output Driver and Device Evaluation (Refer to Application Note AND8020 − Termination of ECL Logic Devices)

ORDERING INFORMATION

Device	Package	Shipping†
MC100LVE222FA	LQFP−52	160 Units / Rail
MC100LVE222FAG	LQFP−52 (Pb−Free)	160 Units / Rail
MC100LVE222FAR2	LQFP−52	1500 / Tape & Reel
MC100LVE222FAR2G	LQFP−52 (Pb−Free)	1500 / 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.

Resource Reference of Application Notes

AN1404 − ECLinPS™ Circuit Performance at Non−Standard V_{IH} Levels

AN1405 − ECL Clock Distribution Techniques

AN1406 − Designing with PECL (ECL at +5.0 V)

AN1503 − ECLinPS I/O SPICE Modeling Kit

AN1504 − Metastability and the ECLinPS Family

AN1560 − Low Voltage ECLinPS SPICE Modeling Kit

AN1568 − Interfacing Between LVDS and ECL

AN1596 − ECLinPS Lite Translator ELT Family SPICE I/O Model Kit

AN1650 − Using Wire−OR Ties in ECLinPS Designs

AN1672 − The ECL Translator Guide

AND8001 − Odd Number Counters Design

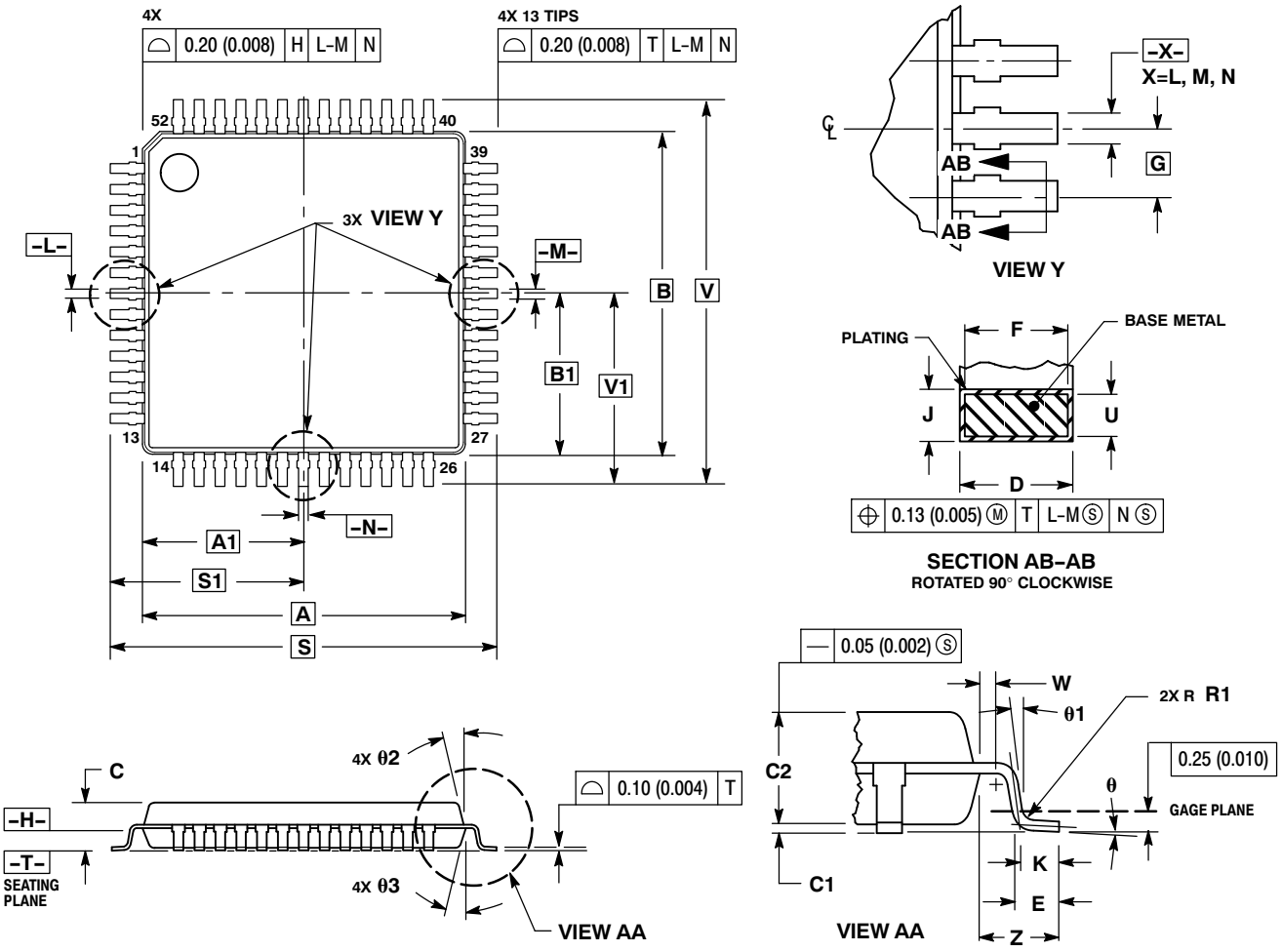
AND8002 − Marking and Date Codes

AND8020 − Termination of ECL Logic Devices

AND8020 − Termination of ECL Logic Devices

PACKAGE DIMENSIONS

FA SUFFIX
LQFP PACKAGE
CASE 848D−03
ISSUE D



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE −H− IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS −L−, −M− AND −N− TO BE DETERMINED AT DATUM PLANE −H−.
5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE −T−.
6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE −H−.
7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED 0.46 (0.018). MINIMUM SPACE BETWEEN PROTRUSION AND ADJACENT LEAD OR PROTRUSION 0.07 (0.003).

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	10.00 BSC		0.394 BSC	
A1	5.00 BSC		0.197 BSC	
B	10.00 BSC		0.394 BSC	
B1	5.00 BSC		0.197 BSC	
C	---	1.70	---	0.067
C1	0.05	0.20	0.002	0.008
C2	1.30	1.50	0.051	0.059
D	0.20	0.40	0.008	0.016
E	0.45	0.75	0.018	0.030
F	0.22	0.35	0.009	0.014
G	0.65 BSC		0.026 BSC	
J	0.07	0.20	0.003	0.008
K	0.50 REF		0.020 REF	
R1	0.08	0.20	0.003	0.008
S	12.00 BSC		0.472 BSC	
S1	6.00 BSC		0.236 BSC	
U	0.09	0.16	0.004	0.006
V	12.00 BSC		0.472 BSC	
V1	6.00 BSC		0.236 BSC	
W	0.20 REF		0.008 REF	
Z	1.00 REF		0.039 REF	
θ	0°	7°	0°	7°
θ1	0°	---	0°	---
θ2	12° REF		12° REF	
θ3	12° REF		12° REF	

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