FAIRCHILD
SEMICONDUCTOR®

February 2008

74LCX373
Low Voltage Octal Transparent Latch
with 5V Tolerant Inputs and Outputs

Features

- 5V tolerant inputs and outputs
- 2.3V–3.6V V_{CC} specifications provided
- 8.0ns t_{PD} max. (V_{CC} = 3.3V), 10μA I_{CC} max.
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal[1]
- ±24mA output drive (V_{CC} = 3.0V)
- Implements proprietary noise/EMI reduction circuitry
- Latch-up performance exceeds JEDEC 78 conditions
- ESD performance
  – Human body model > 2000V
  – Machine model > 200V
- Leadless DQFN package

Note:

1. To ensure the high impedance state during power up or down, $\overline{OE}$ should be tied to V_{CC} through a pull-up resistor: the minimum value of the resistor is determined by the current-sourcing capability of the driver.

General Description

The LCX373 consists of eight latches with 3-STATE outputs for bus organized system applications. The device is designed for low voltage applications with capability of interfacing to a 5V signal environment.

The LCX373 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Ordering Information

Order Number	Package Number	Package Description
74LCX373WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74LCX373SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX373BQX[2]	MLP20B	20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm
74LCX373MSA	MSA20	20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide
74LCX373MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Note:

2. DQFN package available in Tape and Reel only.

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.

All packages are lead free per JEDEC: J-STD-020B standard.

Connection Diagrams

**Pin Assignments for
SOIC, SOP, SSOP, TSSOP**

$\overline{OE}$	1		20	V_{CC}
O_0	2		19	O_7
D_0	3		18	D_7
D_1	4		17	D_6
O_1	5		16	O_6
O_2	6		15	O_5
D_2	7		14	D_5
D_3	8		13	D_4
O_3	9		12	O_4
GND	10		11	LE
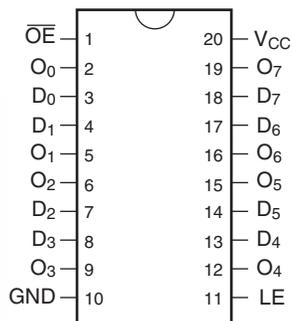
Pad Assignments for DQFN

	$\overline{OE}$ 1	V_{CC} 20		
O_0	2		19	O_7
D_0	3		18	D_7
D_1	4		17	D_6
O_1	5		16	O_6
O_2	6		15	O_5
D_2	7		14	D_5
D_3	8		13	D_4
O_3	9		12	O_4
	GND 10	LE 11		
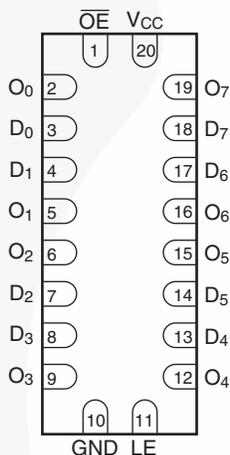
(Top View)

Pin Descriptions

Pin Names	Description
D_0–D_7	Data Inputs
LE	Latch Enable Input
$\overline{OE}$	3-STATE Output Enable Input
O_0–O_7	3-STATE Latch Outputs

Logic Symbols

D_0 D_1 D_2 D_3 D_4 D_5 D_6 D_7
LE
OE
O_0 O_1 O_2 O_3 O_4 O_5 O_6 O_7

IEEE/IEC

$\overline{OE}$	EN	
LE	C1	
D_0	1D ▷ ▽	O_0
D_1		O_1
D_2		O_2
D_3		O_3
D_4		O_4
D_5		O_5
D_6		O_6
D_7		O_7
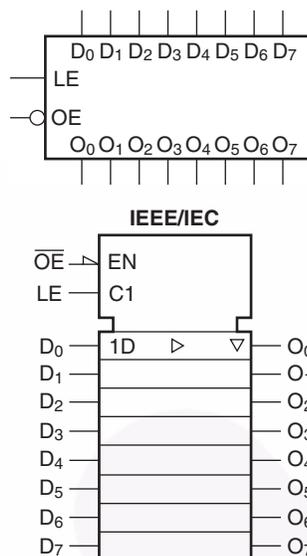
Truth Table

| Inputs			Outputs
LE	$\overline{OE}$	D_n	O_n
X	H	X	Z
H	L	L	L
H	L	H	H
L	L	X	O_0

H = HIGH Voltage

L = LOW Voltage

Z = High Impedance

X = Immaterial

O_0 = Previous O_0 before HIGH-to-LOW transition
of Latch Enable

Functional Description

The LCX373 contains eight D-type latches with 3-STATE standard outputs. When the Latch Enable (LE) input is HIGH, data on the D_n inputs enters the latches. In this condition the latches are transparent, i.e. a latch output will change state each time its D input changes. When LE is LOW, the latches store the information that was present on the D inputs a setup time preceding the HIGH-to-LOW transition of LE. The 3-STATE standard outputs are controlled by the Output Enable ($\overline{OE}$) input. When $\overline{OE}$ is LOW, the standard outputs are in the 2-state mode. When $\overline{OE}$ is HIGH, the standard outputs are in the high impedance mode but this does not inter-fere with entering new data into the latches.

Logic Diagram
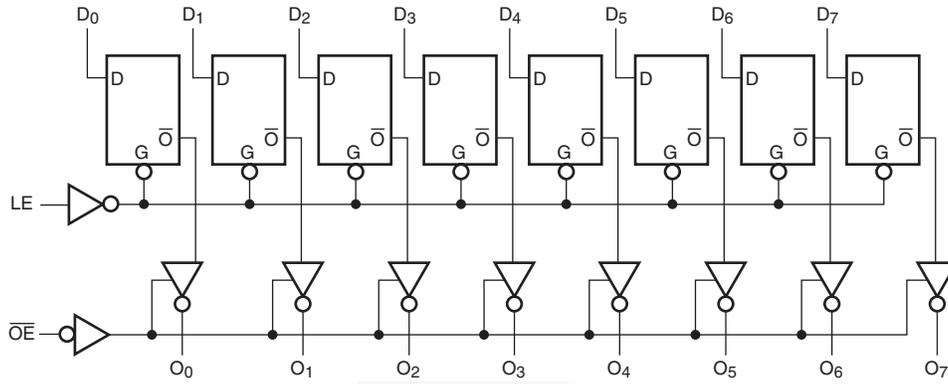
Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Conditions	Value	Units
V_{CC}	Supply Voltage		−0.5 to +7.0	V
V_I	DC Input Voltage		−0.5 to +7.0	V
V_O	DC Output Voltage	Output in 3-STATE	−0.5 to +7.0	V
		Output in HIGH or LOW State[3]	−0.5 to V_{CC} + 0.5	
I_{IK}	DC Input Diode Current	V_I < GND	−50	mA
I_{OK}	DC Output Diode Current	V_O < GND	−50	mA
		V_O > V_{CC}	+50	
I_O	DC Output Source/Sink Current		±50	mA
I_{CC}	DC Supply Current per Supply Pin		±100	mA
I_{GND}	DC Ground Current per Ground Pin		±100	mA
T_{STG}	Storage Temperature		−65 to +150	°C

Recommended Operating Conditions[4]

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Conditions	Min.	Max.	Units
V_{CC}	Supply Voltage	Operating	2.0	3.6	V
		Data Retention	1.5	3.6	
V_I	Input Voltage		0	5.5	V
V_O	Output Voltage	HIGH or LOW State	0	V_{CC}	V
		3-STATE	0	5.5	
I_{OH}/I_{OL}	Output Current	V_{CC} = 3.0V–3.6V		±24	mA
		V_{CC} = 2.7V–3.0V		±12	
		V_{CC} = 2.3V–2.7V		±8	
T_A	Free-Air Operating Temperature		−40	85	°C
$\Delta t/\Delta V$	Input Edge Rate	V_{IN} = 0.8V–2.0V, V_{CC} = 3.0V	0	10	ns/V

Notes:

3. I_O Absolute Maximum Rating must be observed.

4. Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	Conditions	$T_A = -40°C$ to $+85°C$ Min.	$T_A = -40°C$ to $+85°C$ Max.	Units
V_{IH}	HIGH Level Input Voltage	2.3–2.7		1.7		V
		2.7–3.6		2.0		
V_{IL}	LOW Level Input Voltage	2.3–2.7			0.7	V
		2.7–3.6			0.8	
V_{OH}	HIGH Level Output Voltage	2.3–3.6	$I_{OH} = -100µA$	$V_{CC} - 0.2$		V
		2.3	$I_{OH} = -8mA$	1.8		
		2.7	$I_{OH} = -12mA$	2.2		
		3.0	$I_{OH} = -18mA$	2.4		
		3.0	$I_{OH} = -24mA$	2.2		
V_{OL}	LOW Level Output Voltage	2.3–3.6	$I_{OL} = 100µA$		0.2	V
		2.3	$I_{OL} = 8mA$		0.6	
		2.7	$I_{OL} = 12mA$		0.4	
		3.0	$I_{OL} = 16mA$		0.4	
		3.0	$I_{OL} = 24mA$		0.55	
I_I	Input Leakage Current	2.3–3.6	$0 \leq V_I \leq 5.5V$		±5.0	µA
I_{OZ}	3-STATE Output Leakage	2.3–3.6	$0 \leq V_O \leq 5.5V$, $V_I = V_{IH}$ or V_{IL}		±5.0	µA
I_{OFF}	Power-Off Leakage Current	0	V_I or $V_O = 5.5V$		10	µA
I_{CC}	Quiescent Supply Current	2.3–3.6	$V_I = V_{CC}$ or GND		10	µA
		2.3–3.6	$3.6V \leq V_I, V_O \leq 5.5V$[5]		±10	
ΔI_{CC}	Increase in I_{CC} per Input	2.3–3.6	$V_{IH} = V_{CC} -0.6V$		500	µA

AC Electrical Characteristics

Symbol	Parameter	$V_{CC} = 3.3V \pm 0.3V$, $C_L = 50pF$ Min.	$V_{CC} = 3.3V \pm 0.3V$, $C_L = 50pF$ Max.	$V_{CC} = 2.7V$, $C_L = 50pF$ Min.	$V_{CC} = 2.7V$, $C_L = 50pF$ Max.	$V_{CC} = 2.5 \pm 0.2V$, $C_L = 30pF$ Min.	$V_{CC} = 2.5 \pm 0.2V$, $C_L = 30pF$ Max.	Units
t_{PHL}, t_{PLH}	Propagation Delay, D_n to O_n	1.5	8.0	1.5	9.0	1.5	9.6	ns
t_{PHL}, t_{PLH}	Propagation Delay, LE to O_n	1.5	8.5	1.5	9.5	1.5	10.5	ns
t_{PZL}, t_{PZH}	Output Enable Time	1.5	8.5	1.5	9.5	1.5	10.5	ns
t_{PLZ}, t_{PHZ}	Output Disable Time	1.5	7.5	1.5	8.5	1.5	9.0	ns
t_S	Setup Time, D_n to LE	2.5		2.5		4.0		ns
t_H	Hold Time, D_n to LE	1.5		1.5		2.0		ns
t_W	LE Pulse Width	3.3		3.3		4.0		ns
t_{OSHL}, t_{OSLH}	Output to Output Skew[6]		1.0					ns

(Header: $T_A = -40°C$ to $+85°C$, $R_L = 500\Omega$)

Notes:

5. Outputs disabled or 3-STATE only.

6. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}).

Dynamic Switching Characteristics

Symbol	Parameter	V_{CC} (V)	Conditions	T_A = 25°C Typical	Units
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	3.3	C_L = 50pF, V_{IH} = 3.3V, V_{IL} = 0V	0.8	V
		2.5	C_L = 30pF, V_I = 2.5V, V_{IL} = 0V	0.6	
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	3.3	C_L = 50pF, V_{IH} = 3.3V, V_{IL} = 0V	−0.8	V
		2.5	C_L = 30pF, V_I = 2.5V, V_{IL} = 0V	−0.6	

Capacitance

Symbol	Parameter	Conditions	Typical	Units
C_{IN}	Input Capacitance	V_{CC} = Open, V_I = 0V or V_{CC}	7	pF
C_{OUT}	Output Capacitance	V_{CC} = 3.3V, V_I = 0V or V_{CC}	8	pF
C_{PD}	Power Dissipation Capacitance	V_{CC} = 3.3V, V_I = 0V or V_{CC}, f = 10MHz	25	pF

AC Loading and Waveforms (Generic for LCX Family)
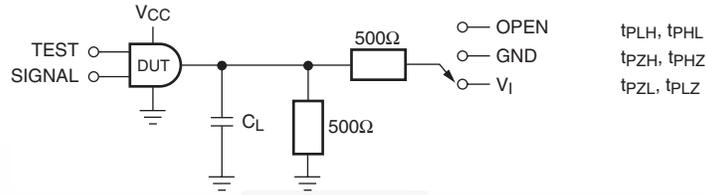
Figure 1. AC Test Circuit (C_L includes probe and jig capacitance)

Test	Switch
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V$ V_{CC} x 2 at $V_{CC} = 2.5 \pm 0.2V$
t_{PZH}, t_{PHZ}	GND
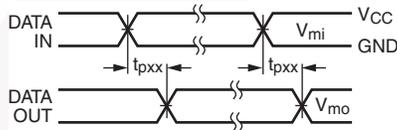
Waveform for Inverting and Non-Inverting Functions
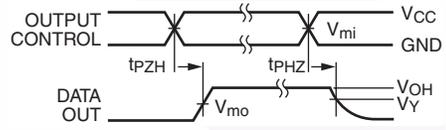
3-STATE Output High Enable and Disable Times for Logic
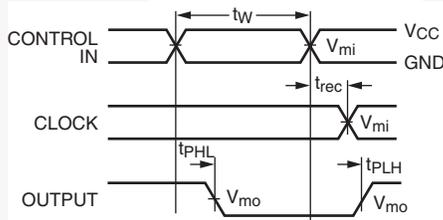
Propagation Delay, Pulse Width and t_{rec} Waveforms
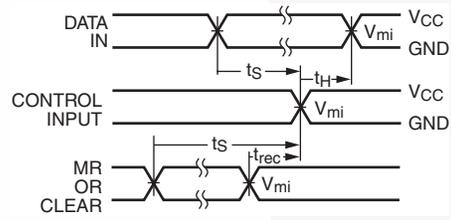
Setup Time, Hold Time and Recovery Time for Logic
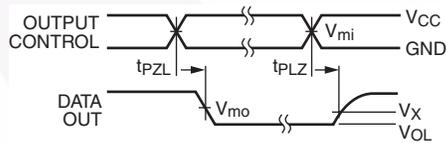
3-STATE Output Low Enable and Disable Times for Logic

t_{rise} and t_{fall}
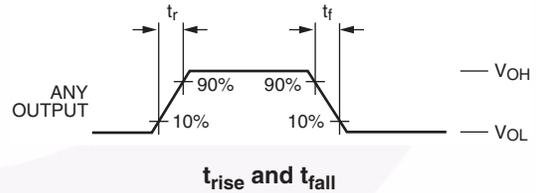
Figure 2. Waveforms (Input Characteristics; f = 1MHz, $t_r = t_f$ = 3ns)

Symbol	V_{CC}		
	3.3V ± 0.3V	2.7V	2.5V ± 0.2V
V_{mi}	1.5V	1.5V	V_{CC} / 2
V_{mo}	1.5V	1.5V	V_{CC} / 2
V_x	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
V_y	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$

Schematic Diagram (Generic for LCX Family)

Input Stage

P1

P2

Data

ESD

D2 N+/P−

N1

N2

V_CC

P5

X1

V_DD

GTO™

Output

D6
N+/P−

Input Stage

P4

P3

Enable

ESD

D4 N+/P−

N3

N4

N5
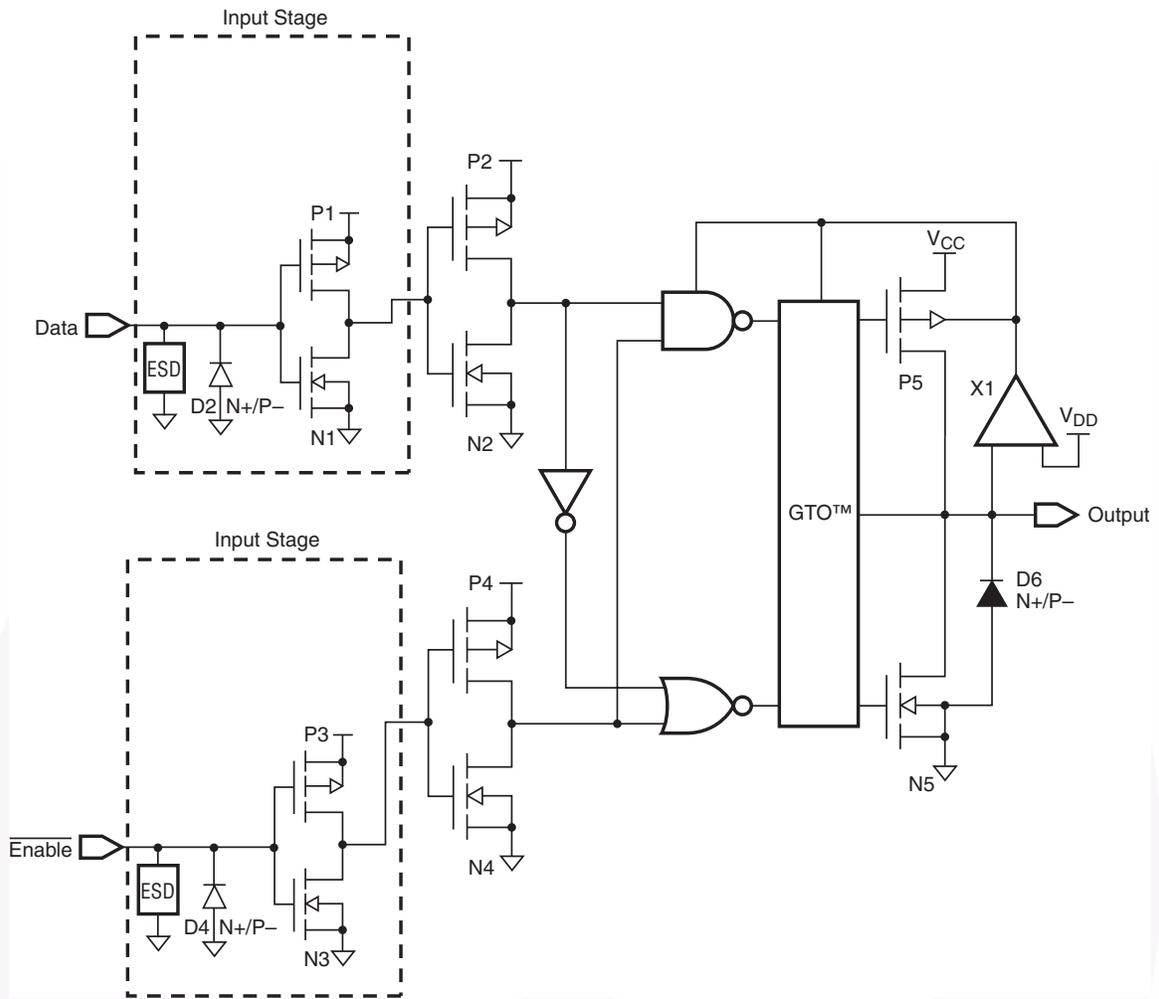
Tape and Reel Specification

Tape Format for DQFN

| Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
BQX	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	3000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

Tape Dimensions inches (millimeters)

SECTION B-B

SECTION A-A
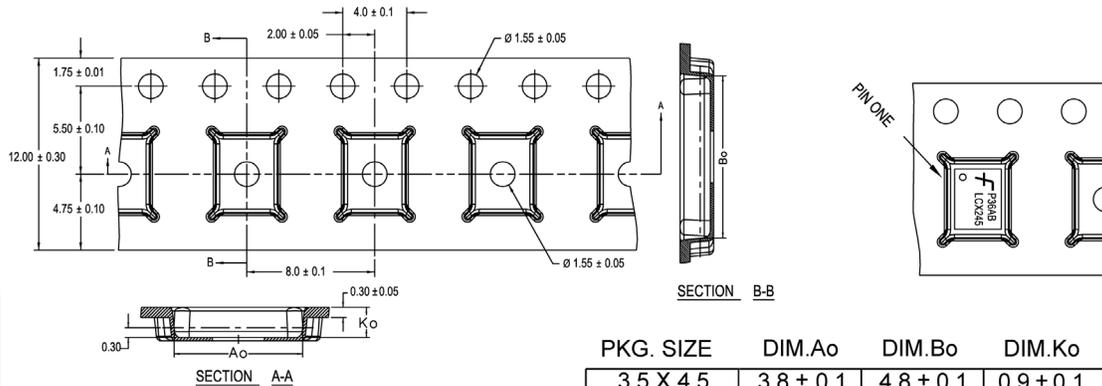
PKG. SIZE	DIM.Ao	DIM.Bo	DIM.Ko
3.5 X 4.5	3.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
3.0 X 3.0	3.3 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 4.5	2.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
2.5 X 3.5	2.8 ± 0.1	3.8 ± 0.1	0.9 ± 0.1
2.5 X 3.0	2.8 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 2.5	2.8 ± 0.1	2.8 ± 0.1	0.9 ± 0.1

DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

1. Cummulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is ±0.002[0.05] for these dimensions on all 12mm tapes.
5. Ao and Bo measured on a plane 0.120[0.30] above the bottom of the pocket.
6. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Diemension in inches rounded.

Reel Dimensions inches (millimeters)

DETAIL AA
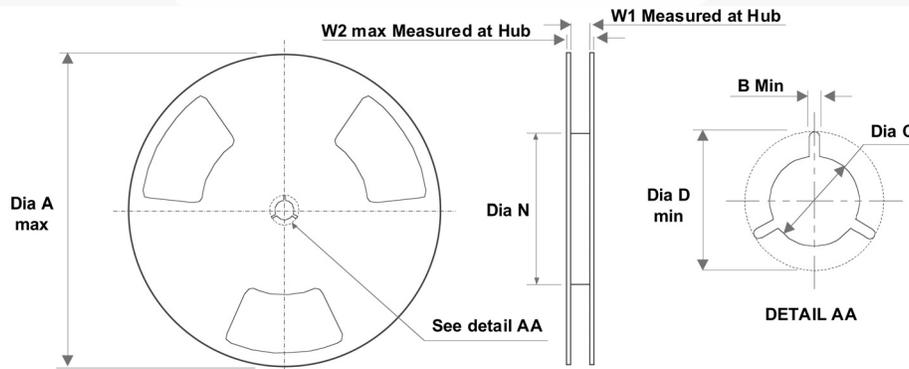
Tape Size	A	B	C	D	N	W1	W2
12mm	13.0 (330.0)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.488 (12.4)	0.724 (18.4)

Physical Dimensions

13.00
12.60

11.43

A

20

B

11

10.65   7.60
10.00   7.40

1

PIN ONE
INDICATOR

0.51
0.35

1.27

10

⊕ | 0.25 Ⓜ | C | B | A

9.50

2.25

1.27

0.65

LAND PATTERN RECOMMENDATION

2.65 MAX

C

0.30
0.10

⌒ | 0.10 | C

SEE DETAIL A

0.33
0.20

SEATING PLANE

0.75
0.25   X 45°

(R0.10)

(R0.10)

GAGE PLANE

8°
0°

0.25

1.27
0.40

SEATING PLANE

(1.40)

DETAIL A
SCALE: 2:1

NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO JEDEC
    MS-013, VARIATION AC, ISSUE E

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONS DO NOT INCLUDE MOLD
    FLASH OR BURRS.

D) CONFORMS TO ASME Y14.5M-1994

E) LANDPATTERN STANDARD: SOIC127P1030X265-20L

F) DRAWING FILENAME: MKT-M20BREV3

Figure 3. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

http://www.fairchildsemi.com/packaging/

Physical Dimensions (Continued)

12.6±0.10
−A−

0.40 TYP

20   11

7.8   5.3±0.10
−B−

3.9

PIN #1 IDENT.   1   10   ALL LEAD TIPS   ⌖ 0.2 C B A

LAND PATTERN RECOMMENDATION

20 19   12 11

5.01 TYP
9.27 TYP

1   2   9   10

(2.13 TYP)

1.27 TYP   0.6 TYP

ALL LEAD TIPS
⌖ 0.1 C

2.1 MAX.

1.8±0.1

−C−

1.27 TYP

0.35−0.51

0.15±0.05

⌖ 0.12Ⓜ C A

DIMENSIONS ARE IN MILLIMETERS

NOTES:
A. CONFORMS TO EIAJ EDR−7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

SEE DETAIL A

0.15−0.25

7° TYP

GAGE PLANE

0.25

0°−8° TYP

0.60±0.15

1.25

SEATING PLANE

DETAIL A
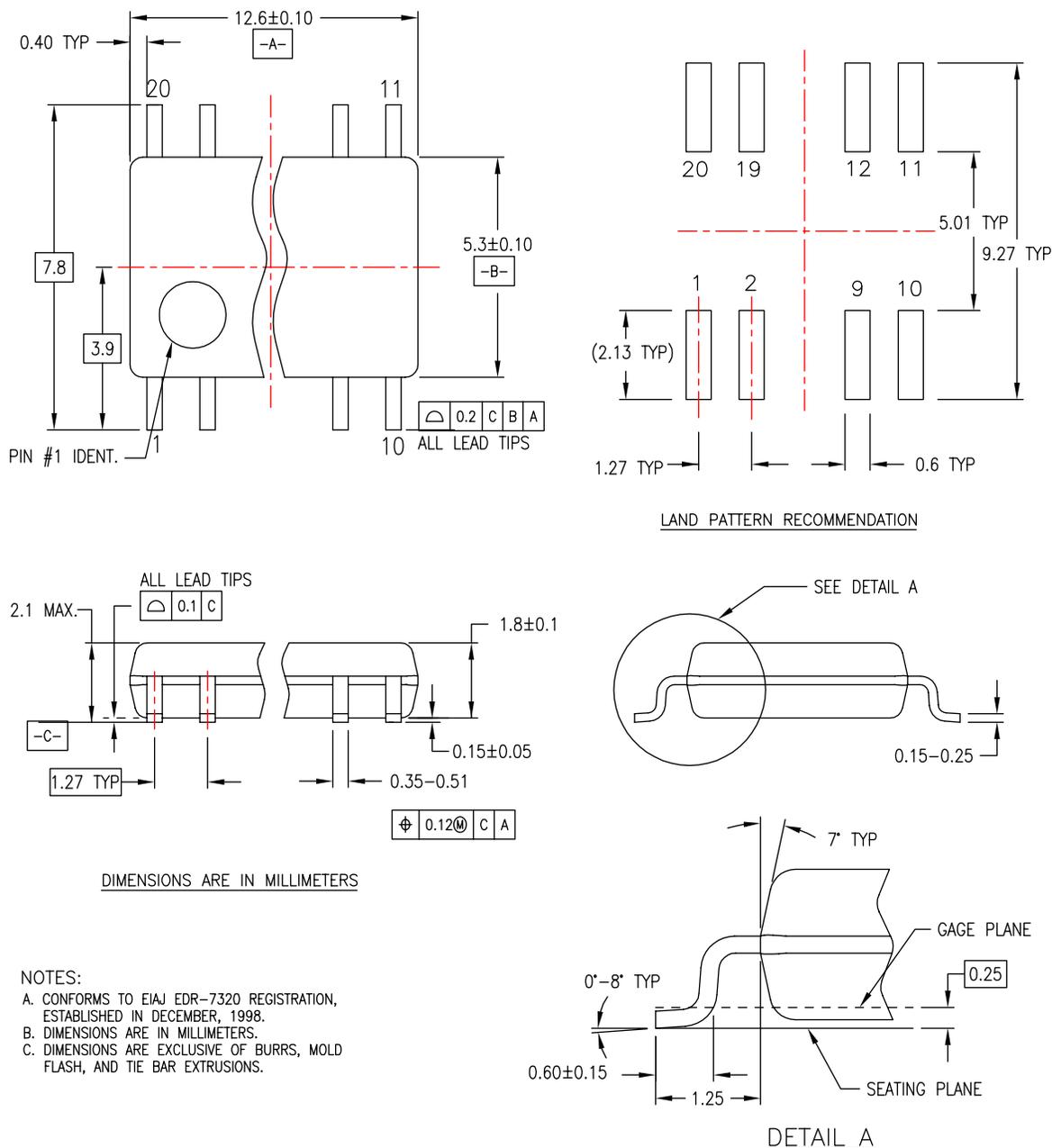
M20DREVC

Figure 4. 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide

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http://www.fairchildsemi.com/packaging/

Physical Dimensions (Continued)

TOP VIEW

RECOMMENDED LAND PATTERN

SIDE VIEW

BOTTOM VIEW
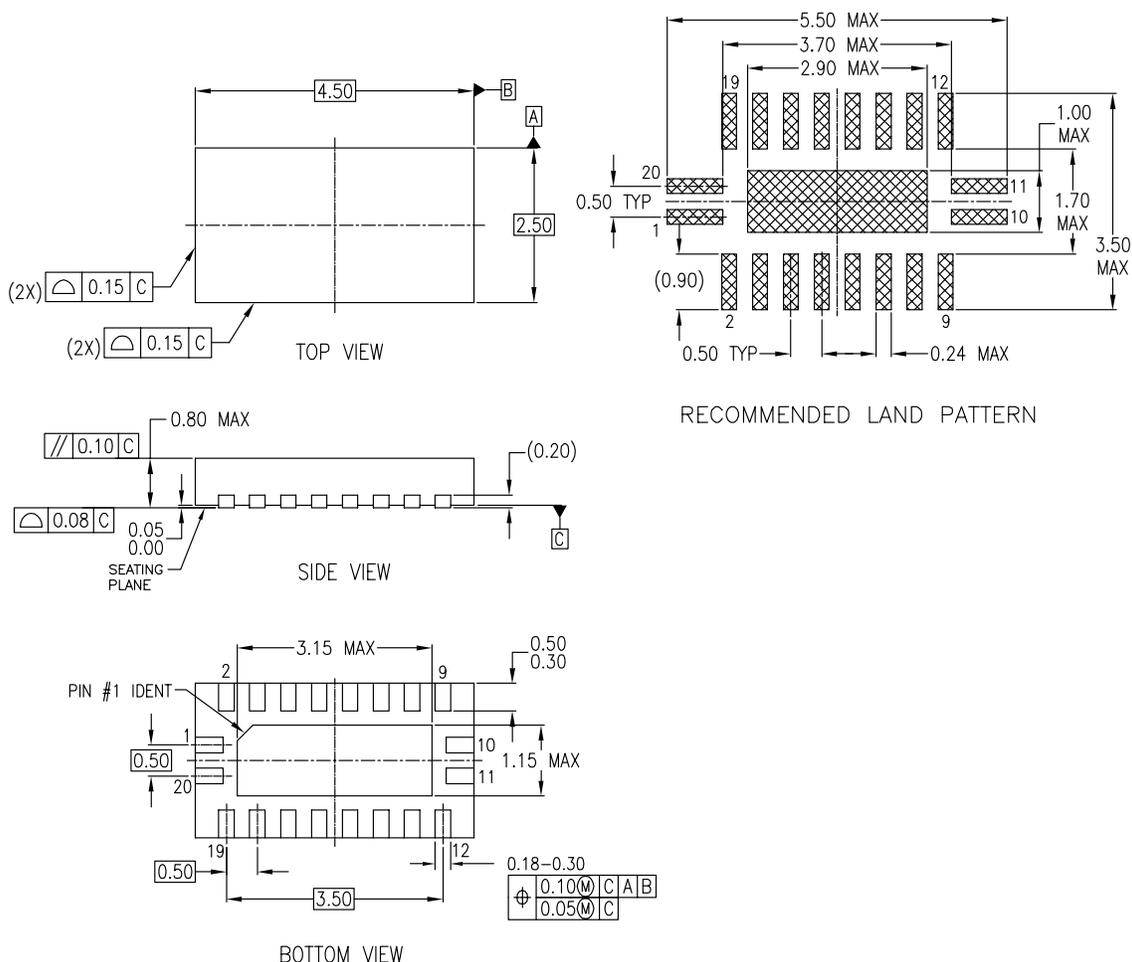
NOTES:

A. CONFORMS TO JEDEC REGISTRATION
   MO-241, VARIATION AC
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER
   ASME Y14.5M, 1994

MLP20BrevA

Figure 5. 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm

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http://www.fairchildsemi.com/packaging/

Physical Dimensions (Continued)

7.2±0.30   A

0.68 TYP

20   11   B

5.3±0.30

7.8

3.9

PIN #1 IDENT.

1   10

ALL LEAD TIPS
△ 0.2 C A B

△ 0.10 C
ALL LEAD TIPS

2.0 MAX.

1.75±0.04

0.65 TYP   0.22−0.38

0.13±0.08

⊕ 0.15Ⓜ C AⓈ BⓈ

C

DIMENSIONS ARE IN MILLIMETERS

20   11

9.12

5.58

1   10

1.77 TYP

0.65 TYP   0.45 TYP

LAND PATTERN RECOMMENDATIONS

SEE DETAIL A

0.09
0.25

0° MIN.

GAGE PLANE

0° − 8°

0.25

0.75±0.2

(1.25)

SEATING PLANE

DETAIL A
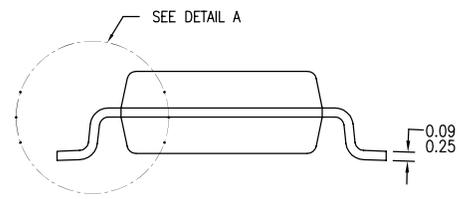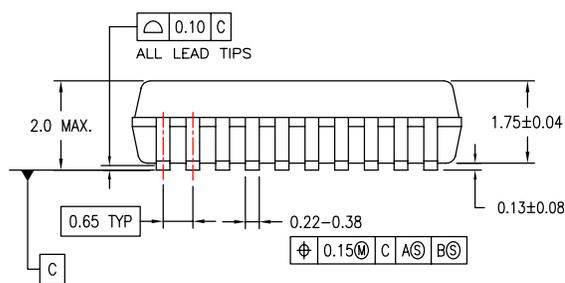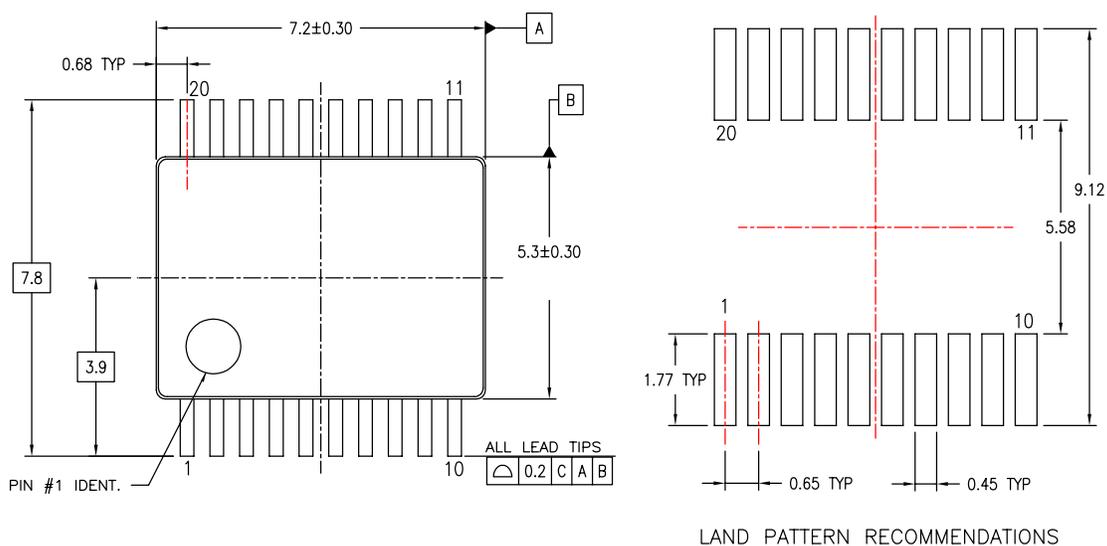
NOTES:
   A. CONFORMS TO JEDEC REGISTRATION MO−150,
      VARIATION AE, DATE 1/94.
   B. DIMENSIONS ARE IN MILLIMETERS.
   C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH,
      AND TIE BAR EXTRUSIONS.
   D. DIMENSIONS AND TOLERANCES PER ASME Y14.5M − 1994.
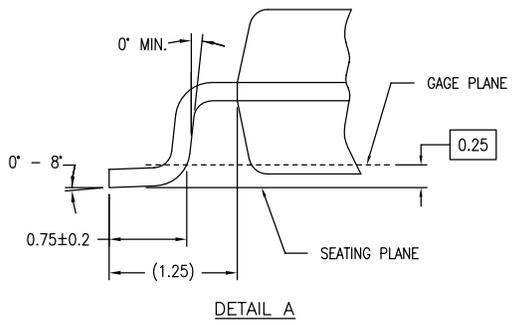
MSA20REVB

Figure 6. 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide

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Physical Dimensions (Continued)

6.5±0.1
-A-

20   11

-C-

6.4

3.2

4.4±0.1 -B-

1   10

PIN #1 IDENT.

⌒ 0.2 C B A
ALL LEAD TIPS

LAND PATTERN RECOMMENDATION

4.16   7.72

1.78

0.65

0.42

⌒ 0.1 C
ALL LEAD TIPS

1.2 max

-C-

0.65

0.19−0.30
⊕ 0.10Ⓜ A BⓈ CⓈ

0.90 +0.15 −0.10

0.1±0.05

DIMENSIONS ARE IN MILLIMETERS

SEE DETAIL A

0.09−0.20

12.00°

R0.09min

GAGE PLANE

0 − 8°

0.25

SEATING PLANE

0.6±0.1

R0.09min

1.00

DETAIL A
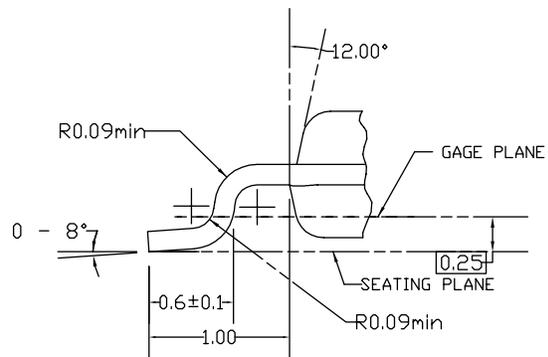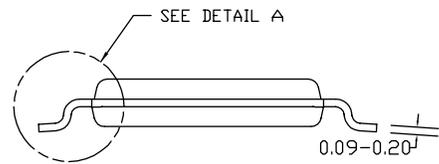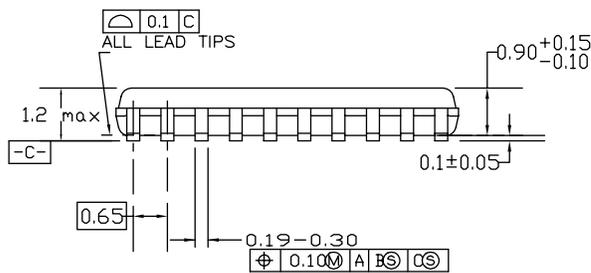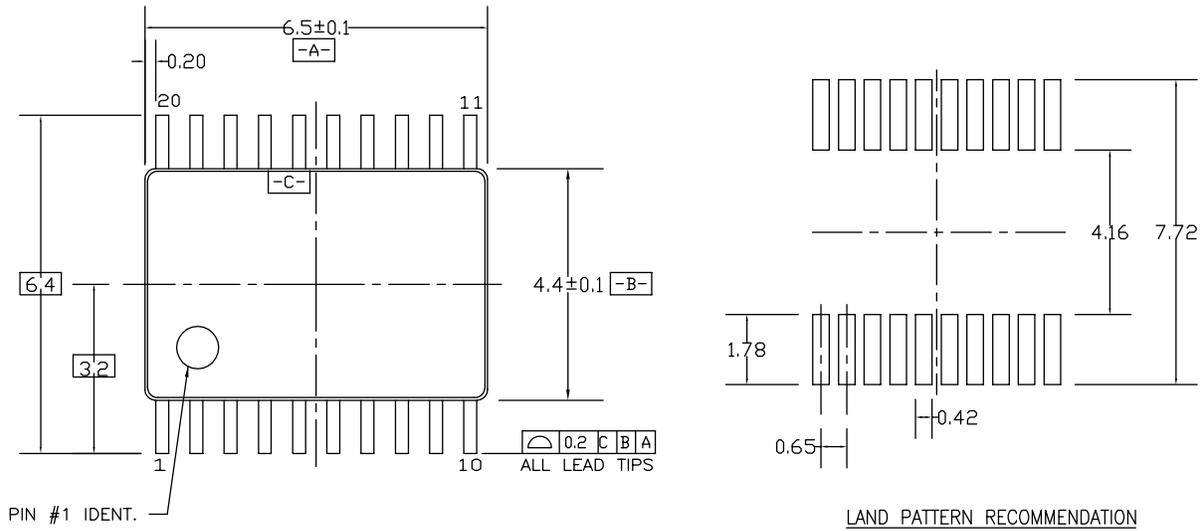
NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO−153, VARIATION AC,
   REF NOTE 6, DATE 7/93.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLDS FLASH,
   AND TIE BAR EXTRUSIONS.

D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTC20REVD1

Figure 7. 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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F®	MegaBuck™	Quiet Series™	TINYOPTO™
	MICROCOUPLER™	RapidConfigure™	TinyPower™
Fairchild®	MicroFET™	SMART START™	TinyPWM™
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