

74ACTQ273

Quiet Series Octal D-Type Flip-Flop

Features

- I_{CC} reduced by 50%
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Guaranteed pin-to-pin skew AC performance
- Improved latch-up immunity
- Buffered common clock and asynchronous master reset
- Outputs source/sink 24mA
- 4kV minimum ESD immunity

General Description

The ACTQ273 has eight edge-triggered D-type flip-flops with individual D inputs and Q outputs. The common buffered Clock (CP) and Master Reset (\overline{MR}) input load and reset (clear) all flip-flops simultaneously.

The register is fully edge-triggered. The state of each D-type input, one setup time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's Q output.

All outputs will be forced LOW independently of Clock or Data inputs by a LOW voltage level on the \overline{MR} input. The device is useful for applications where the true output only is required and the Clock and Master Reset are common to all storage elements.

The ACTQ utilizes Fairchild Quiet Series™ technology to guarantee quiet output switching and improved dynamic threshold performance. FACT Quiet Series™ features

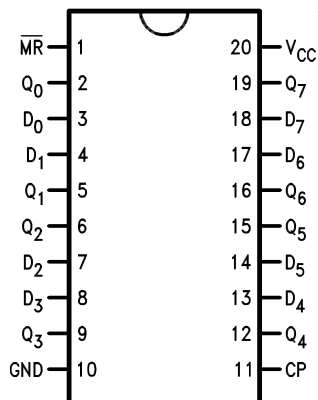
GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

Ordering Information

Order Number	Package Number	Package Description
74ACTQ273SC	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74ACTQ273SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74ACTQ273MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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

Connection Diagram

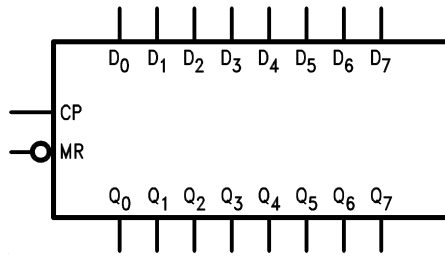


Pin Description

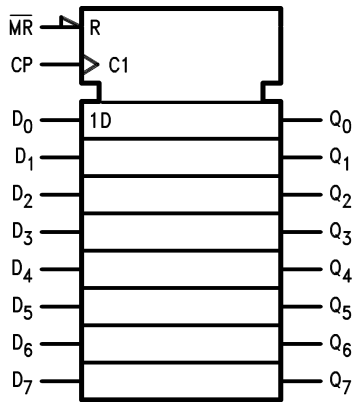
Pin Names	Description
D_0 – D_7	Data Inputs
\overline{MR}	Master Reset
CP	Clock Pulse Input
Q_0 – Q_7	Data Outputs

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Logic Symbols



IEEE/IEC



Mode Select-Function Table

Operating Mode	Inputs			Outputs
	\overline{MR}	CP	D_n	Q_n
Reset (Clear)	L	X	X	L
Load "1"	H	↗	H	H
Load "0"	H	↘	L	L

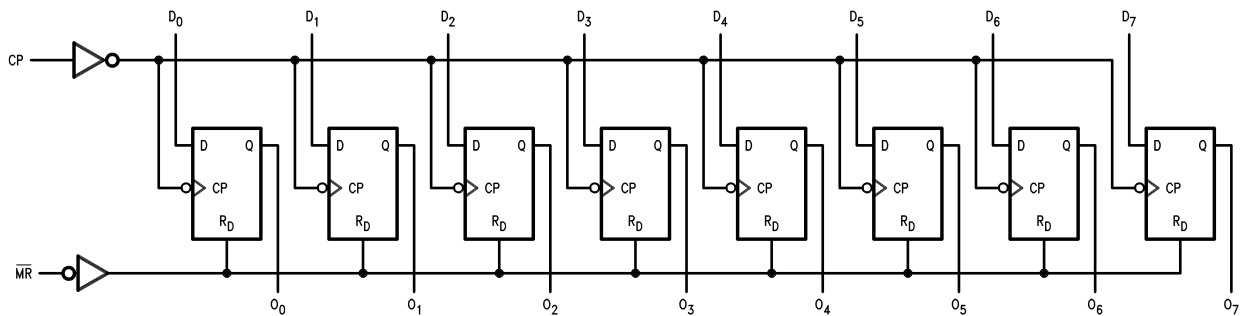
H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

↗ = LOW-to-HIGH Transition

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	Rating
V_{CC}	Supply Voltage	-0.5V to +7.0V
I_{IK}	DC Input Diode Current $V_I = -0.5V$ $V_I = V_{CC} + 0.5V$	-20mA +20mA
V_I	DC Input Voltage	-0.5V to $V_{CC} + 0.5V$
I_{OK}	DC Output Diode Current $V_O = -0.5V$ $V_O = V_{CC} + 0.5V$	-20mA +20mA
V_O	DC Output Voltage	-0.5V to $V_{CC} + 0.5V$
I_O	DC Output Source or Sink Current	$\pm 50mA$
I_{CC} or I_{GND}	DC V_{CC} or Ground Current per Output Pin	$\pm 50mA$
T_{STG}	Storage Temperature	-65°C to +150°C
	DC Latch-Up Source or Sink Current	$\pm 300mA$
T_J	Junction Temperature	140°C

Recommended Operating Conditions

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	Rating
V_{CC}	Supply Voltage	4.5V to 5.5V
V_I	Input Voltage	0V to V_{CC}
V_O	Output Voltage	0V to V_{CC}
T_A	Operating Temperature	-40°C to +85°C
$\Delta V / \Delta t$	Minimum Input Edge Rate: V_{IN} from 0.8V to 2.0V, V_{CC} @ 4.5V, 5.5V	125mV/ns

DC Electrical Characteristics

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = +25°C	T _A = -40°C to +85°C		Units
				Typ.	Guaranteed Limits		
V _{IH}	Minimum HIGH Level Input Voltage	4.5	V _{OUT} = 0.1V or V _{CC} - 0.1V	1.5	2.0	2.0	V
		5.5		1.5	2.0	2.0	
V _{IL}	Maximum LOW Level Input Voltage	4.5	V _{OUT} = 0.1V or V _{CC} - 0.1V	1.5	0.8	0.8	V
		5.5		1.5	0.8	0.8	
V _{OH}	Minimum HIGH Level Output Voltage	4.5	I _{OUT} = -50μA	4.49	4.4	4.4	V
		5.5		5.49	5.4	5.4	
		4.5	V _{IN} = V _{IL} or V _{IH} ; I _{OH} = -24mA		3.86	3.76	
		5.5	I _{OH} = -24mA ⁽¹⁾		4.86	4.76	
V _{OL}	Maximum LOW Level Output Voltage	4.5	I _{OUT} = 50μA	0.001	0.1	0.1	V
		5.5		0.001	0.1	0.1	
		4.5	V _{IN} = V _{IL} or V _{IH} ; I _{OL} = 24mA		0.36	0.44	
		5.5	I _{OL} = 24mA ⁽¹⁾		0.36	0.44	
I _{IN}	Maximum Input Leakage Current	5.5	V _I = V _{CC} , GND		±0.1	±1.0	μA
I _{CC} T	Maximum I _{CC} /Input	5.5	V _I = V _{CC} - 2.1V	0.6		1.5	mA
I _{OLD}	Minimum Dynamic Output Current ⁽²⁾	5.5	V _{OLD} = 1.65V Max.			75	mA
I _{OHD}		5.5	V _{OHD} = 3.85V Min.			-75	mA
I _{CC}	Maximum Quiescent Supply Current	5.5	V _{IN} = V _{CC} or GND		4.0	40.0	μA
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	5.0	Figures 1 & 2 ⁽³⁾	1.1	1.5		V
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	5.0	Figures 1 & 2 ⁽³⁾	-0.6	-1.2		V
V _{IHD}	Minimum HIGH Level Dynamic Input Voltage	5.0	⁽⁴⁾	1.9	2.2		V
V _{ILD}	Maximum LOW Level Dynamic Input Voltage	5.0	⁽⁴⁾	1.2	0.8		V

Notes:

- All outputs loaded; thresholds on input associated with output under test.
- Maximum test duration 2.0ms, one output loaded at a time.
- Max number of outputs defined as (n). n-1 Data inputs are driven 0V to 3V; one output @ GND.
- Max number of Data Inputs (n) switching. (n-1) Inputs switching 0V to 3V (ACTQ). Input-under-test switching: 3V to threshold (V_{ILD}), 0V to threshold (V_{IHD}) f = 1 MHz.

AC Electrical Characteristics

Symbol	Parameter	V _{CC} (V) ⁽⁵⁾	T _A = +25°C, C _L = 50pF			T _A = -40°C to +85°C, C _L = 50pF		Units
			Min.	Typ.	Max.	Min.	Max.	
f _{MAX}	Maximum Clock Frequency	5.0	125	189		110		MHz
t _{PLH} , t _{PHL}	Propagation Delay, CP to Q _n	5.0	1.5	6.5	8.5	1.5	9.0	ns
t _{PHL}	Propagation Delay, MR to Q _n	5.0	1.5	7.0	9.0	1.5	9.5	ns
t _{OSHL} , t _{OSLH}	Output to Output Skew ⁽⁶⁾	5.0		0.5	1.0		1.0	ns

Notes:

- Voltage range 5.0 is 5.0V ± 0.5V.
- Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs within the same packaged device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}). Parameter guaranteed by design. Not tested.

AC Operating Requirements

Symbol	Parameter	V _{CC} (V) ⁽⁷⁾	T _A = +25°C, C _L = 50 pF		T _A = -40°C to +85°C, C _L = 50pF		Units
			Typ.	Guaranteed Minimum			
t _S	Setup Time, HIGH or LOW, D _n to CP	5.0	1.0	3.5	3.5		ns
t _H	Hold Time, HIGH or LOW, D _n to CP	5.0	-0.5	1.5	1.5		ns
t _W	Clock Pulse Width, HIGH or LOW	5.0	2.0	4.0	4.0		ns
t _W	$\overline{\text{MR}}$ Pulse Width, HIGH or LOW	5.0	1.5	4.0	4.0		ns
t _W	Recovery Time, $\overline{\text{MR}}$ to CP	5.0	0.5	3.0	3.0		ns

Note:

- Voltage range 5.0 is 5.0V ± 0.5V.

Capacitance

Symbol	Parameter	Conditions	Typ.	Units
C _{IN}	Input Capacitance	V _{CC} = OPEN	4.5	pF
C _{PD}	Power Dissipation Capacitance	V _{CC} = 5.0V	40.0	pF

FACT Noise Characteristics

The setup of a noise characteristics measurement is critical to the accuracy and repeatability of the tests. The following is a brief description of the setup used to measure the noise characteristics of FACT.

Equipment:

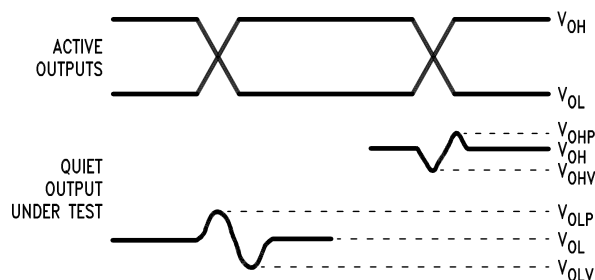
Hewlett Packard Model 8180A Word Generator

PC-163A Test Fixture

Tektronics Model 7854 Oscilloscope

Procedure:

1. Verify Test Fixture Loading: Standard Load 50pF, 500Ω.
2. Deskew the HFS generator so that no two channels have greater than 150 ps skew between them. This requires that the oscilloscope be deskewed first. It is important to deskew the HFS generator channels before testing. This will ensure that the outputs switch simultaneously.
3. Terminate all inputs and outputs to ensure proper loading of the outputs and that the input levels are at the correct voltage.
4. Set the HFS generator to toggle all but one output at a frequency of 1MHz. Greater frequencies will increase DUT heating and effect the results of the measurement.
5. Set the HFS generator input levels at 0V LOW and 3V HIGH for ACT devices and 0V LOW and 5V HIGH for AC devices. Verify levels with an oscilloscope.



Notes:

8. V_{OHV} and V_{OLP} are measured with respect to ground reference.
9. Input pulses have the following characteristics:
 $f = 1\text{MHz}$, $t_r = 3\text{ns}$, $t_f = 3\text{ns}$, skew < 150ps.

Figure 1. Quiet Output Noise Voltage Waveforms

V_{OLP}/V_{OLV} and V_{OHP}/V_{OHV} :

- Determine the quiet output pin that demonstrates the greatest noise levels. The worst case pin will usually be the furthest from the ground pin. Monitor the output voltages using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- Measure V_{OLP} and V_{OLV} on the quiet output during the worst case transition for active and enable. Measure V_{OHP} and V_{OHV} on the quiet output during the worst case active and enable transition.
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

V_{ILD} and V_{IHD} :

- Monitor one of the switching outputs using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- First increase the input LOW voltage level, V_{IL} , until the output begins to oscillate or steps out a min of 2ns. Oscillation is defined as noise on the output LOW level that exceeds V_{IL} limits, or on output HIGH levels that exceed V_{IH} limits. The input LOW voltage level at which oscillation occurs is defined as V_{ILD} .
- Next decrease the input HIGH voltage level, V_{IH} , until the output begins to oscillate or steps out a min of 2ns. Oscillation is defined as noise on the output LOW level that exceeds V_{IL} limits, or on output HIGH levels that exceed V_{IH} limits. The input HIGH voltage level at which oscillation occurs is defined as V_{IHD} .
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

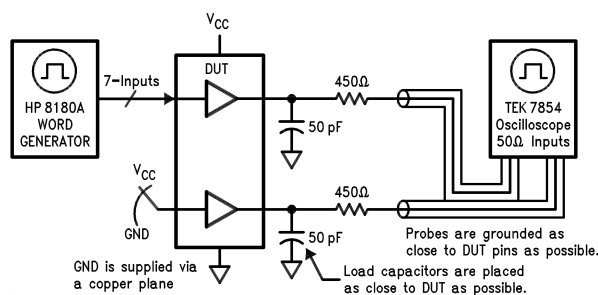


Figure 2. Simultaneous Switching Test Circuit

Physical Dimensions

Dimensions are in inches (millimeters) unless otherwise noted.

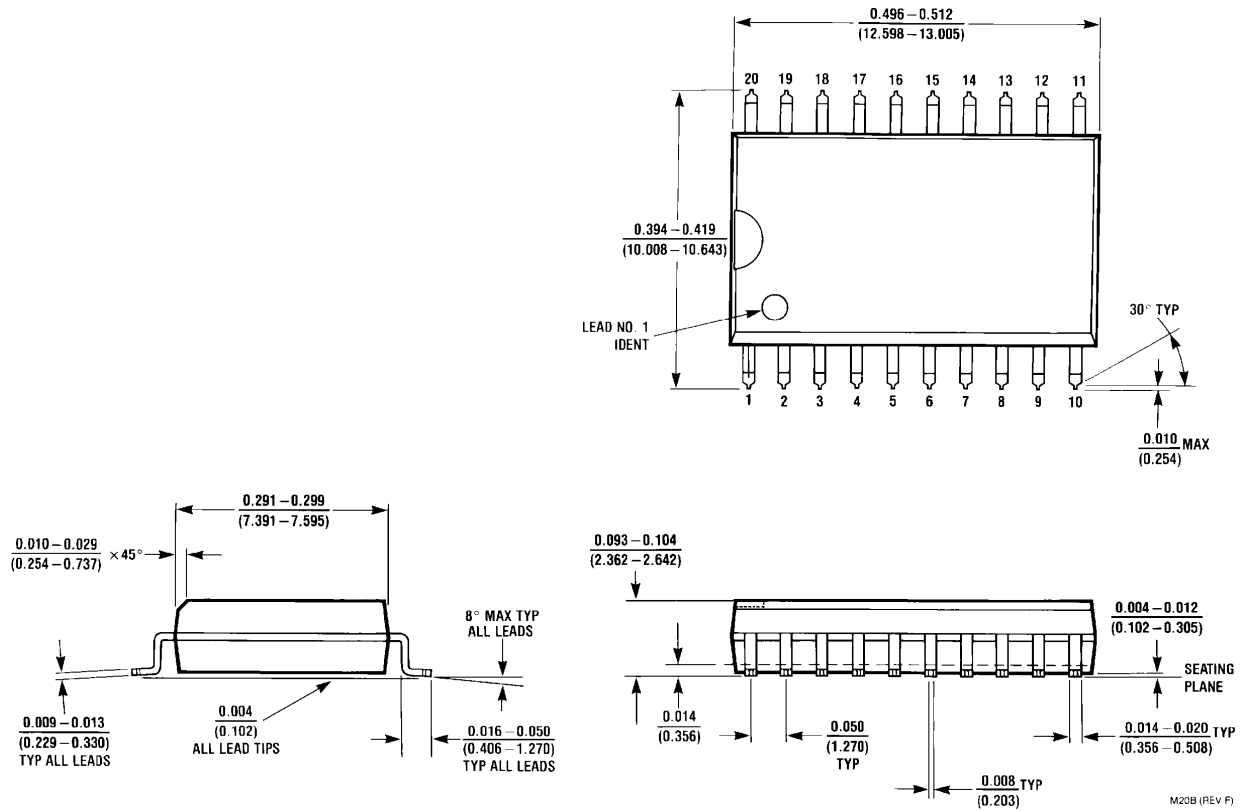
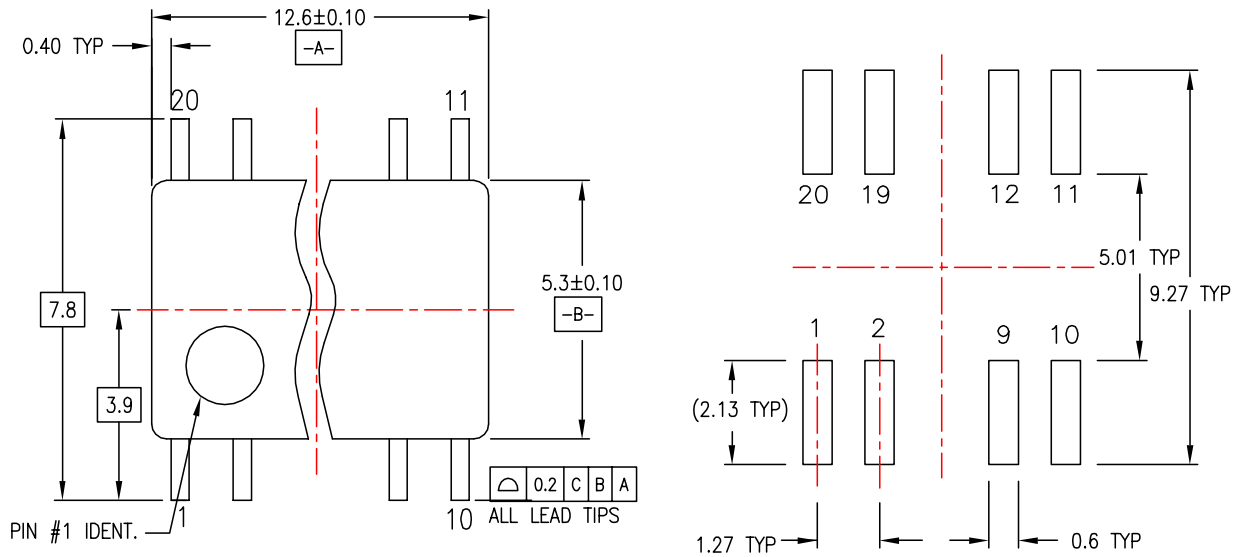


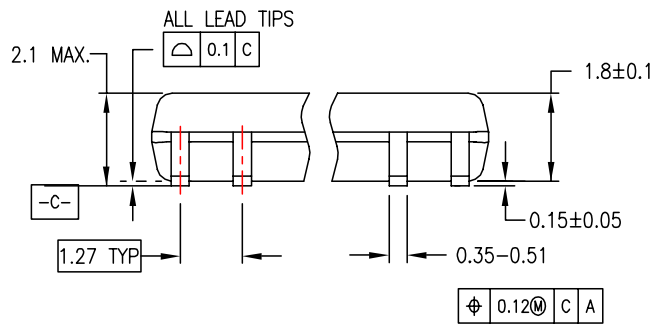
Figure 3. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Package Number M20B

Physical Dimensions (Continued)

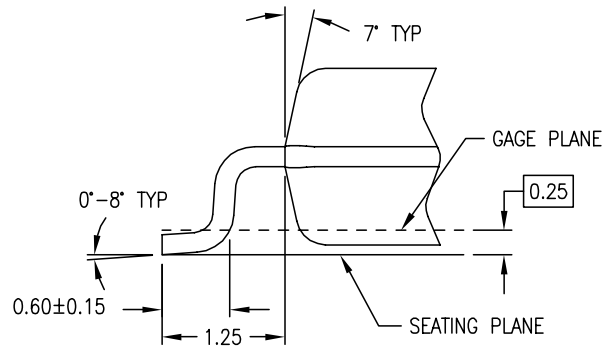
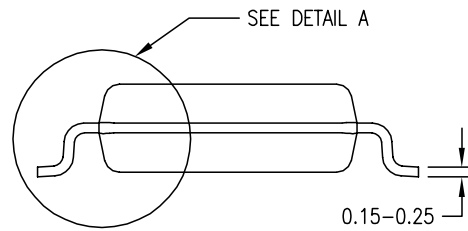
Dimensions are in millimeters unless otherwise noted.



LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS



DETAIL A

NOTES:

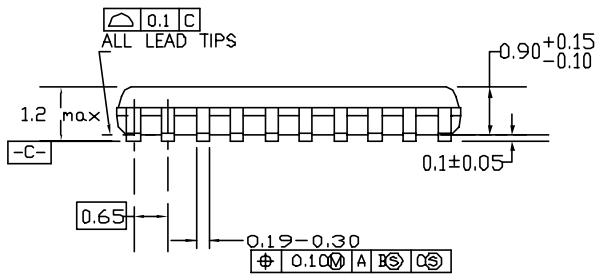
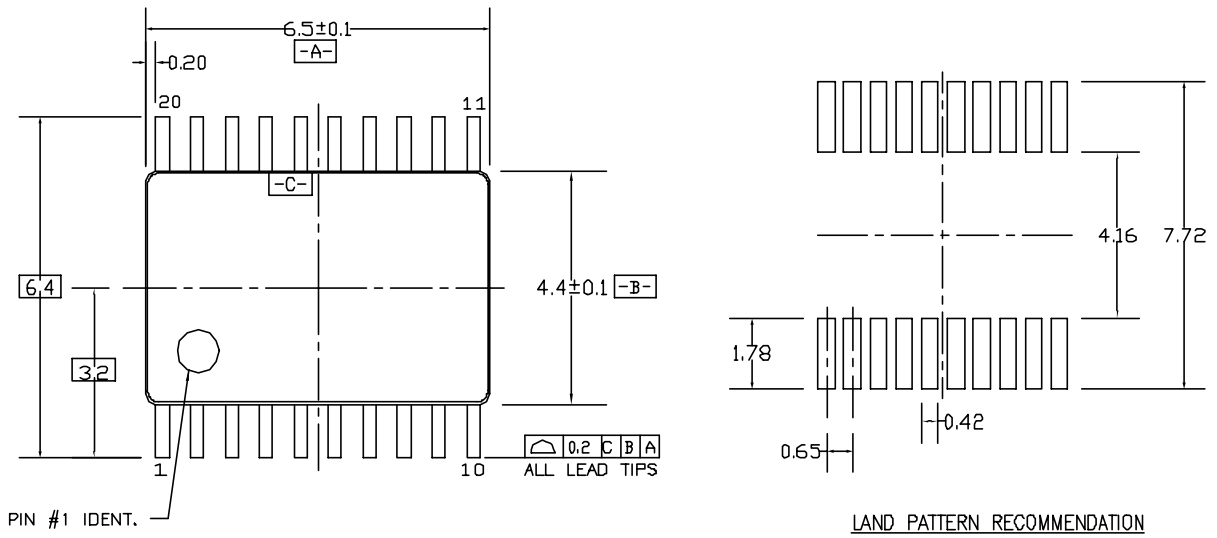
- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M20DREVC

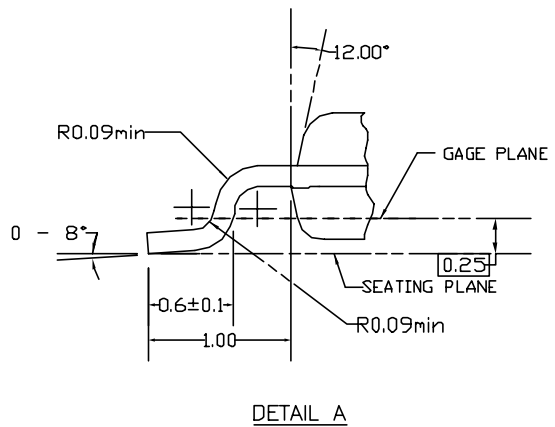
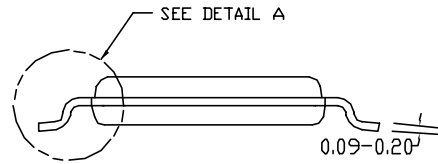
Figure 4. 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M20D

Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.



DIMENSIONS ARE IN MILLIMETERS



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.


MTC20REV D1

Figure 5. 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC20



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PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
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