FAIRCHILD SEMICONDUCTOR™

March 1998

100351
Low Power Hex D Flip-Flop

General Description

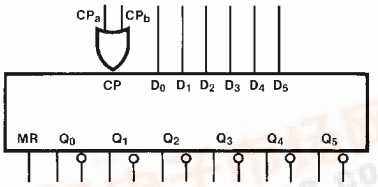
The 100351 contains six D-type edge-triggered, master/slave flip-flops with true and complement outputs, a pair of common Clock inputs (CP_a and CP_b) and common Master Reset (MR) input. Data enters a master when both CP_a and CP_b are LOW and transfers to the slave when CP_a and CP_b (or both) go HIGH. The MR input overrides all other inputs and makes the Q outputs LOW. All inputs have 50 kΩ pull-down resistors.

Features

- 40% power reduction of the 100151
- 2000V ESD protection
- Pin/function compatible with 100151
- Voltage compensated operating range: −4.2V to −5.7V
- Available to industrial grade temperature range

Ordering Code:

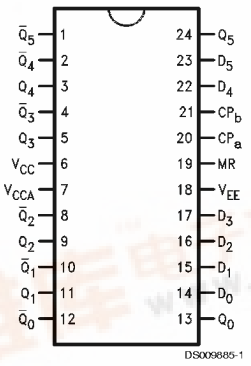
Logic Symbol



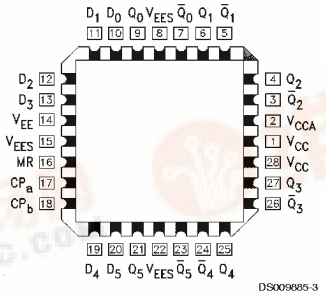
Pin Names	Description
D_0–D_5	Data Inputs
CP_a, CP_b	Common Clock Inputs
MR	Asynchronous Master Reset Input
Q_0–Q_5	Data Outputs
$\overline{Q}_0$–$\overline{Q}_5$	Complementary Data Outputs

Connection Diagrams

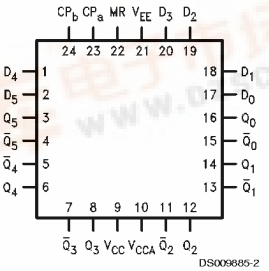
24-Pin DIP/SOIC



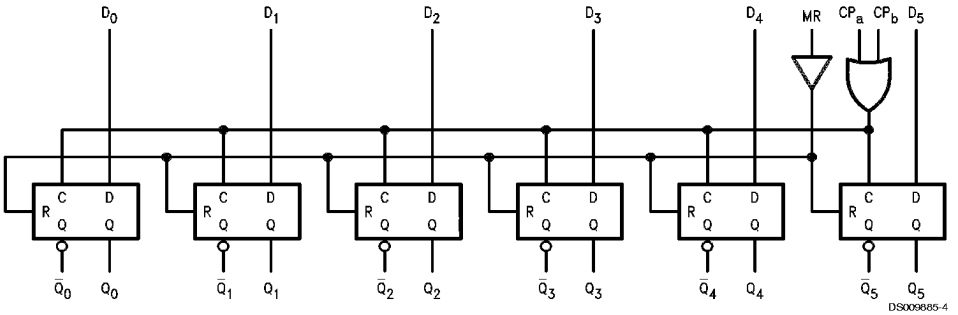
28-Pin PCC



24-Pin Quad Cerpak



Logic Diagram



Truth Tables (Each Flip-flop)

Synchronous Operation

Inputs				Outputs
D_n	CP_a	CP_b	MR	$Q_n(t+1)$
L	⌐	L	L	L
H	⌐	L	L	H
L	L	⌐	L	L
H	L	⌐	L	H
X	H	⌐	L	$Q_n(t)$
X	⌐	H	L	$Q_n(t)$
X	L	L	L	$Q_n(t)$

Asynchronous Operation

Inputs				Outputs
D_n	CP_a	CP_b	MR	$Q_n(t+1)$
X	X	X	H	L

H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care
t = Time before CP positive transition
t+1 = Time after CP positive transition
⌐ = LOW-to-HIGH transition

Absolute Maximum Ratings (Note 1)

Above which the useful life may be impaired

Storage Temperature (T_{STG})	−65°C to +150°C
Maximum Junction Temperature (T_J)	
Ceramic	+175°C
Plastic	+150°C
V_{EE} Pin Potential to Ground Pin	−7.0V to +0.5V
Input Voltage (DC)	V_{EE} to +0.5V
Output Current (DC Output HIGH)	−50 mA
ESD (Note 2)	≥2000V

Recommended Operating Conditions

Case Temperature (T_C)	
Commercial	0°C to +85°C
Industrial	−40°C to +85°C
Military	−55°C to +125°C
Supply Voltage (V_{EE})	−5.7V to −4.2V

Note 1: Absolute maximum ratings are those values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: ESD testing conforms to MIL-STD-883, Method 3015.

Commercial Version

DC Electrical Characteristics

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND, T_C = 0°C to +85°C (Note 3)

Symbol	Parameter	Min	Typ	Max	Units	Conditions	
V_{OH}	Output HIGH Voltage	−1025	−955	−870	mV	V_{IN} = V_{IH} (Max)	Loading with
V_{OL}	Output LOW Voltage	−1830	−1705	−1620		or V_{IL} (Min)	50Ω to −2.0V
V_{OHC}	Output HIGH Voltage	−1035			mV	V_{IN} = V_{IH} (Min)	Loading with
V_{OLC}	Output LOW Voltage			−1610		or V_{IL} (Max)	50Ω to −2.0V
V_{IH}	Input HIGH Voltage	−1165		−870	mV	Guaranteed HIGH Signal for All Inputs	
V_{IL}	Input LOW Voltage	−1830		−1475	mV	Guaranteed LOW Signal for All Inputs	
I_{IL}	Input LOW Current	0.50			μA	V_{IN} = V_{IL} (Min)	
I_{IH}	Input HIGH Current						
	MR			350			
	D_0–D_5			240	μA	V_{IN} = V_{IH} (Max)	
	CP_a, CP_b			350			
I_{EE}	Power Supply Current	−129		−62	mA	Inputs Open	

Note 3: The specified limits represent the "worst case" value for the parameter. Since these values normally occur at the temperature extremes, additional noise immunity and guardbanding can be achieved by decreasing the allowable system operating ranges. Conditions for testing shown in the tables are chosen to guarantee operation under "worst case" conditions.

DIP AC Electrical Characteristics

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND

Symbol	Parameter	T_C = 0°C		T_C = +25°C		T_C = +85°C		Units	Conditions
		Min	Max	Min	Max	Min	Max		
f_{max}	Toggle Frequency	375		375		375		MHz	*Figures 2, 3*
t_{PLH}	Propagation Delay	0.80	2.00	0.80	2.0	0.90	2.10	ns	*Figures 1, 3*
t_{PHL}	CP_a, CP_b to Output								
t_{PLH}	Propagation Delay	1.10	2.30	1.10	2.30	1.20	2.40	ns	*Figures 1, 4*
t_{PHL}	MR to Output								
t_{TLH}	Transition Time	0.35	1.20	0.35	1.20	0.35	1.20	ns	*Figures 1, 3*
t_{THL}	20% to 80%, 80% to 20%								
t_S	Setup Time								*Figure 5*
	D_0–D_5	0.40		0.40		0.40		ns	
	MR (Release Time)	1.60		1.60		1.60			*Figure 4*
t_H	Hold Time	0.80		0.80		0.80		ns	*Figure 5*
	D_0–D_5								
t_{pw}(H)	Pulse Width HIGH	2.00		2.00		2.00		ns	*Figures 3, 4*
	CP_a, CP_b, MR								

SOIC, PCC and Cerpak AC Electrical Characteristics

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND

Symbol	Parameter	T_C = 0°C		T_C = +25°C		T_C = +85°C		Units	Conditions
		Min	Max	Min	Max	Min	Max		
f_{max}	Toggle Frequency	375		375		375		MHz	*Figures 2, 3*
t_{PLH} t_{PHL}	Propagation Delay CP_a, CP_b to Output	0.80	1.80	0.80	1.80	0.90	1.90	ns	*Figures 1, 3*
t_{PLH} t_{PHL}	Propagation Delay MR to Output	1.10	2.10	1.10	2.10	1.20	2.20	ns	*Figures 1, 4*
t_{TLH} t_{THL}	Transition Time 20% to 80%, 80% to 20%	0.45	1.70	0.45	1.60	0.45	1.70	ns	*Figures 1, 3*
t_S	Setup Time D_0–D_5 MR (Release Time)	 0.30 1.50		 0.30 1.50		 0.30 1.50		 ns	*Figure 5* *Figure 4*
t_H	Hold Time D_0–D_5	0.80		0.80		0.80		ns	*Figure 5*
t_{pw}(H)	Pulse Width HIGH CP_a, CP_b, MR	2.00		2.00		2.00		ns	*Figures 3, 4*
t_{OSHL}	Maximum Skew Common Edge Output-to-Output Variation Clock to Output Path		220		220		220	ps	PCC only (Note 4)
t_{OSLH}	Maximum Skew Common Edge Output-to-Output Variation Clock to Output Path		210		210		210	ps	PCC only (Note 4)
t_{OST}	Maximum Skew Opposite Edge Output-to-Output Variation Clock to Output Path		240		240		240	ps	PCC only (Note 4)
t_{PS}	Maximum Skew Pin (Signal) Transition Variation Clock to Output Path		230		230		230	ps	PCC only (Note 4)

Note 4: Output-to-Output Skew is defined as the absolute value of the difference between the actual propagation delay for any outputs within the same packaged device. The specifications apply to any outputs switching in the same direction either HIGH to LOW (t_{OSHL}), or LOW to HIGH (t_{OSLH}), or in opposite directions both HL and LH (t_{OST}). Parameters t_{OST} and t_{PS} guaranteed by design.

Industrial Version

PCC DC Electrical Characteristics

V_{EE}=−4.2V to −5.7V, V_{CC}=V_{CCA}= GND, T_C= 0°C to +85°C (Note 5)

Symbol	Parameter	T_C = −40°C		T_C = 0° to +85°C		Units	Conditions	
		Min	Max	Min	Max			
V_{OH}	Output HIGH Voltage	−1085	−870	−1025	−870	mV	V_{IN} =V_{IH} (Max)	Loading with
V_{OL}	Output LOW Voltage	−1830	−1575	−1830	−1620		or V_{IL} (Min)	50Ω to −2.0V
V_{OHC}	Output HIGH Voltage	−1095		−1035		mV	V_{IN} = V_{IH} (Min)	Loading with
V_{OLC}	Output LOW Voltage		−1565		−1610		or V_{IL} (Max)	50Ω to −2.0V
V_{IH}	Input HIGH Voltage	−1170	−870	−1165	−870	mV	Guaranteed HIGH Signal for All Inputs	
V_{IL}	Input LOW Voltage	−1830	−1480	−1830	−1475	mV	Guaranteed LOW Signal for All Inputs	
I_{IL}	Input LOW Current	0.50		0.50		µA	V_{IN} = V_{IL} (Min)	
I_{IH}	Input HIGH Current MR D_0–D_5 CP_a, CP_b		 350 240 350		 350 240 350	 µA	 V_{IN} = V_{IH} (Max)	

PCC DC Electrical Characteristics (Continued)

V_{EE}=−4.2V to −5.7V, V_{CC}=V_{CCA}= GND, T_C= 0°C to +85°C (Note 5)

Symbol	Parameter	T_C = −40°C		T_C = 0° to +85°C		Units	Conditions
		Min	Max	Min	Max		
I_{EE}	Power Supply Current	−129	−62	−129	−62	mA	Inputs Open

Note 5: The specified limits represent the "worst case" value for the parameter. Since these values normally occur at the temperature extremes, additional noise immunity and guardbanding can be achieved by decreasing the allowable system operating ranges. Conditions for testing shown in the tables are chosen to guarantee operation under "worst case" conditions.

PCC AC Electrical Characteristics

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND

Symbol	Parameter	T_C = −40°C		T_C = +25°C		T_C = +85°C		Units	Conditions
		Min	Max	Min	Max	Min	Max		
f_{max}	Toggle Frequency	375		375		375		MHz	*Figures 2, 3*
t_{PLH} t_{PHL}	Propagation Delay CP_a, CP_b to Output	0.80	1.80	0.80	1.80	0.90	1.90	ns	*Figures 1, 3*
t_{PLH} t_{PHL}	Propagation Delay MR to Output	1.10	2.10	1.10	2.10	1.20	2.20	ns	*Figures 1, 4*
t_{TLH} t_{THL}	Transition Time 20% to 80%, 80% to 20%	0.45	1.70	0.45	1.60	0.45	1.70	ns	*Figures 1, 3*
t_S	Setup Time D_0–D_5	0.60		0.30		0.30		ns	*Figure 5*
	MR (Release Time)	2.20		1.50		1.50			*Figure 4*
t_H	Hold Time D_0–D_5	0.60		0.90		0.90		ns	*Figure 5*
t_{pw}(H)	Pulse Width HIGH CP_a, CP_b, MR	2.00		2.00		2.00		ns	*Figures 3, 4*

Military Version—Preliminary
DC Electrical Characteristics

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND, T_C = −55°C to +125°C

Symbol	Parameter	Min	Max	Units	T_C	Conditions		Notes
V_{OH}	Output HIGH Voltage	−1025	−870	mV	0°C to +125°C	V_{IN} = V_{IH} (Max) or V_{IL} (Min)	Loading with 50Ω to −2.0V	(Notes 6, 7, 8)
		−1085	−870	mV	−55°C			
V_{OL}	Output LOW Voltage	−1830	−1620	mV	0°C to +125°C			
		−1830	−1555	mV	−55°C			
V_{OHC}	Output HIGH Voltage	−1035		mV	0°C to +125°C	V_{IN} = V_{IH} (Min) or V_{IL} (Max)	Loading with 50Ω to −2.0V	(Notes 6, 7, 8)
		−1085		mV	−55°C			
V_{OLC}	Output LOW Voltage		−1610	mV	0°C to +125°C			
			−1555	mV	−55°C			
V_{IH}	Input HIGH Voltage	−1165	−870	mV	−55°C to +125°C	Guaranteed HIGH Signal for All Inputs		(Notes 6, 7, 8, 9)
V_{IL}	Input LOW Voltage	−1830	−1475	mV	−55°C to +125°C	Guaranteed LOW Signal for All Inputs		(Notes 6, 7, 8, 9)
I_{IL}	Input LOW Current	0.50		µA	−55°C to +125°C	V_{EE} = −4.2V V_{IN} = V_{IL} (Min)		(Notes 6, 7, 8)

DC Electrical Characteristics (Continued)

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND, T_C = −55°C to +125°C

Symbol	Parameter	Min	Max	Units	T_C	Conditions	Notes
I_{IH}	Input HIGH Current					V_{EE} = −5.7V	(Notes 6, 7, 8)
	CP, MR		350	µA	0°C to	V_{IN} = V_{IH} (Max)	
	D_0–D_5		240		+125°C		
	CP, MR		500	µA	−55°C		
	D_0–D_5		340				
I_{EE}	Power Supply Current	−135	−50	mA	−55°C to +125°C	Inputs Open	(Notes 6, 7, 8)

Note 6: F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals −55°C), then testing immediately without allowing for the junction temperature to stabilize due to heat dissipation after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

Note 7: Screen tested 100% on each device at −55°C, +25°C, and +125°C, Subgroups 1, 2, 3, 7, and 8.

Note 8: Sample tested (Method 5005, Table I) on each manufactured lot at −55°C, +25°C, and +125°C, Subgroups A1, 2, 3, 7, and 8.

Note 9: Guaranteed by applying specified input condition and testing V_{OH}/V_{OL}.

AC Electrical Characteristics

V_{EE} = −4.2V to −5.7V, V_{CC} = V_{CCA} = GND

Symbol	Parameter	T_C = −55°C		T_C = +25°C		T_C = +125°C		Units	Conditions	Notes
		Min	Max	Min	Max	Min	Max			
f_{max}	Toggle Frequency	375		375		375		MHz	*Figures 2, 3*	(Note 13)
t_{PLH}	Propagation Delay	0.50	2.40	0.60	2.20	0.60	2.60	ns	*Figures 1, 3*	
t_{PHL}	CP_a, CP_b to Output									(Notes 10, 11, 12)
t_{PLH}	Propagation Delay	0.70	2.70	0.80	2.60	0.80	2.90	ns	*Figures 1, 4*	
t_{PHL}	MR to Output									
t_{TLH}	Transition Time	0.20	1.60	0.20	1.60	0.20	1.60	ns	*Figures 1, 3*	(Note 13)
t_{THL}	20% to 80%, 80% to 20%									
t_s	Setup Time									
	D_0–D_5	0.90		0.80		0.90		ns	*Figure 5*	
	MR (Release Time)	1.60		1.80		2.60			*Figure 4*	
t_h	Hold Time	1.50		1.40		1.60		ns	*Figure 5*	
	D_0–D_5									
t_{pw}(H)	Pulse Width HIGH	2.00		2.00		2.00		ns	*Figures 3, 4*	
	CP_a, CP_b, MR									

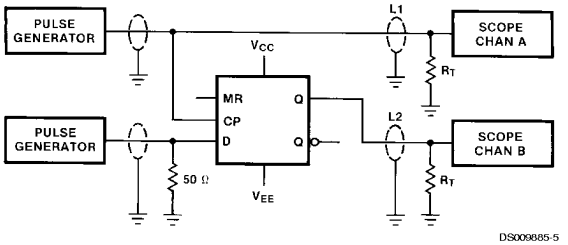
Note 10: F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals −55°C), then testing immediately without allowing for the junction temperature to stabilize due to heat dissipation after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

Note 11: Screen tested 100% on each device at +25°C, Temperature only, Subgroup A9.

Note 12: Sample tested (Method 5005, Table I) on each Mfg. lot at +25°C, Subgroup A9, and at +125°C, and −55°C Temperature, Subgroups A10 and A11.

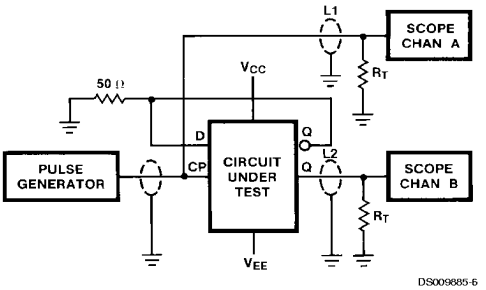
Note 13: Not tested at +25°C, +125°C and −55°C Temperature (design characterization data).

Test Circuitry



Notes:
V_{CC}, V_{CCA} = +2V, V_{EE} = −2.5V
L1 and L2 = equal length 50Ω impedance lines
R_T = 50Ω terminator internal to scope
Decoupling 0.1 µF from GND to V_{CC} and V_{EE}
All unused outputs are loaded with 50Ω to GND
C_L = Fixture and stray capacitance ≤ 3 pF

FIGURE 1. AC Test Circuit



Notes:
V_{CC}, V_{CCA} = +2V, V_{EE} = −2.5V
L1 and L2 = equal length 50Ω impedance lines
R_T = 50Ω terminator internal to scope
Decoupling 0.1 µF from GND to V_{CC} and V_{EE}
All unused outputs are loaded with 50Ω to GND
C_L = Jig and stray capacitance ≤ 3 pF

FIGURE 2. Toggle Frequency Test Circuit

Switching Waveforms

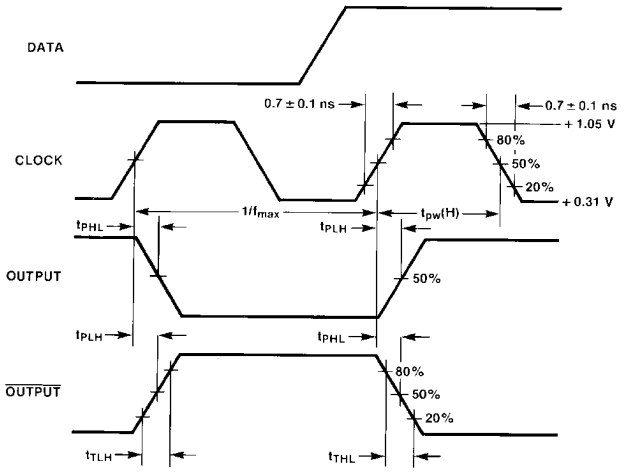


FIGURE 3. Propagation Delay (Clock) and Transition Times

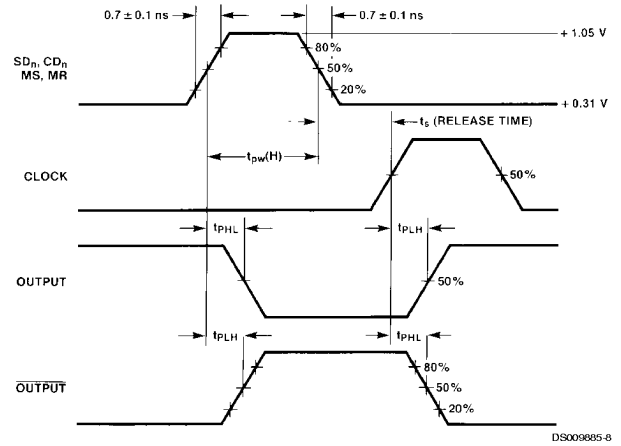
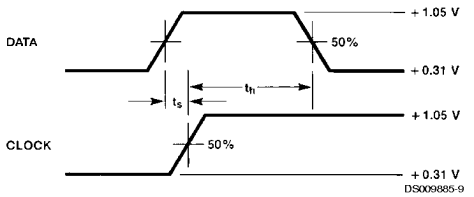


FIGURE 4. Propagation Delay (Reset)



Notes:

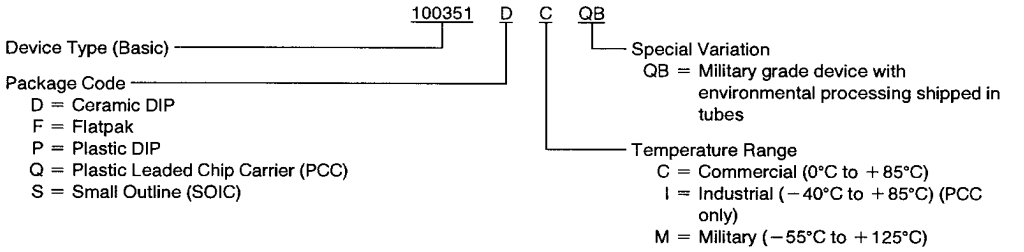
t_s is the minimum time before the transition of the clock that information must be present at the data input.

t_h is the minimum time after the transition of the clock that information must remain unchanged at the data input.

FIGURE 5. Setup and Hold Time

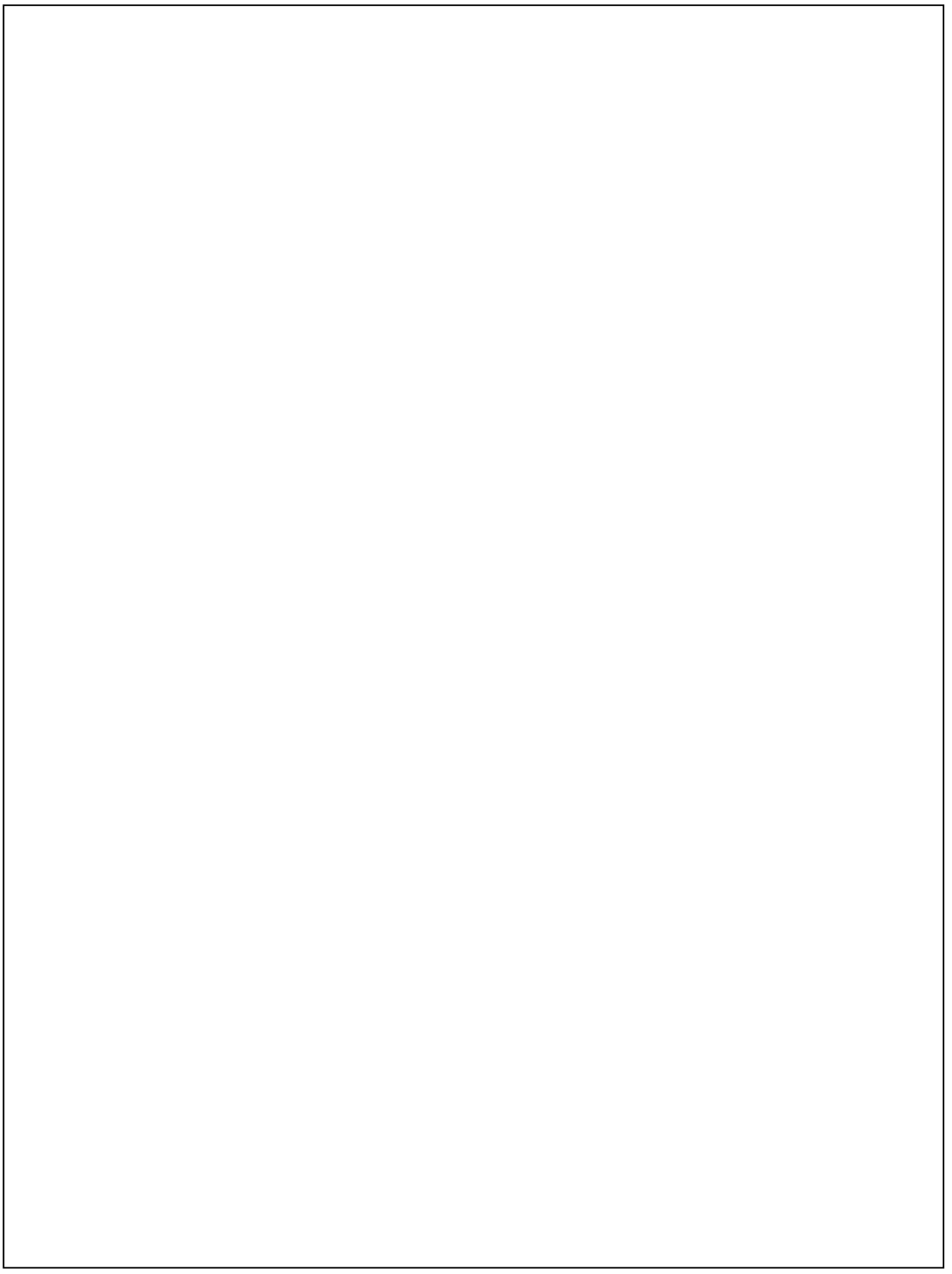
Ordering Information

The device number is used to form part of a simplified purchasing code where a package type and temperature range are defined as follows:

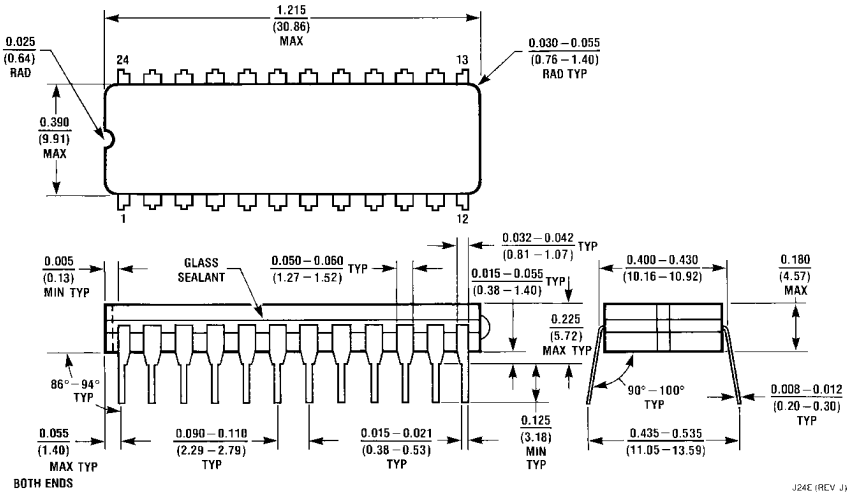


DS009885-12

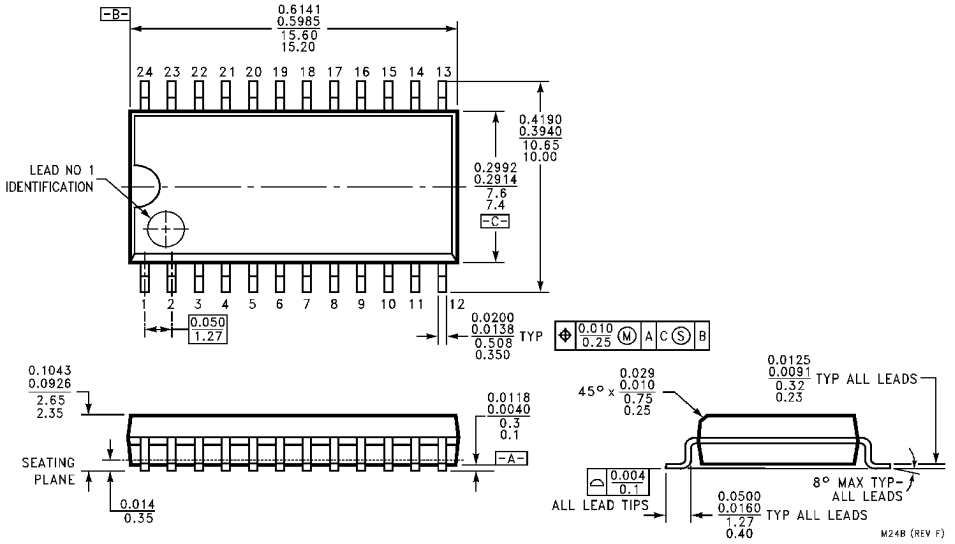
查询"100351DC"供应商



Physical Dimensions inches (millimeters) unless otherwise noted

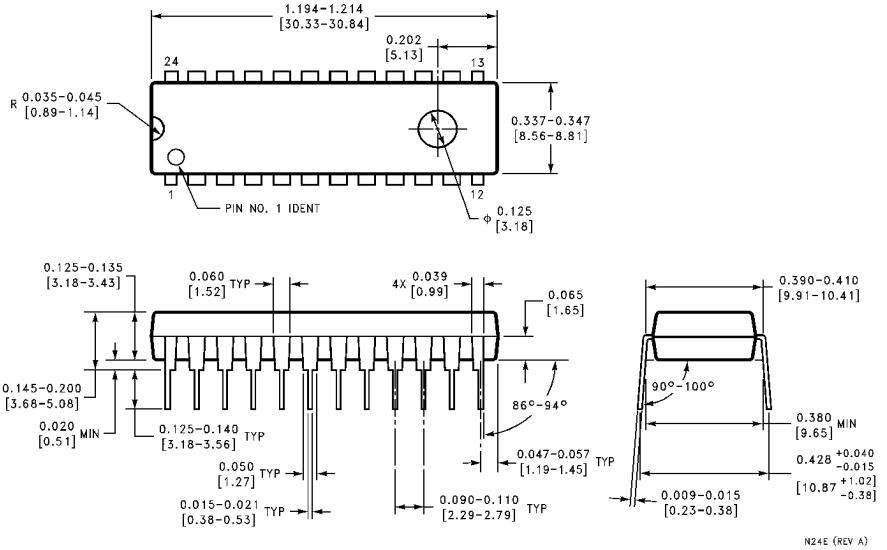


24-Lead Ceramic Dual-In-Line Package (0.400" Wide) (D)
Package Number J24E



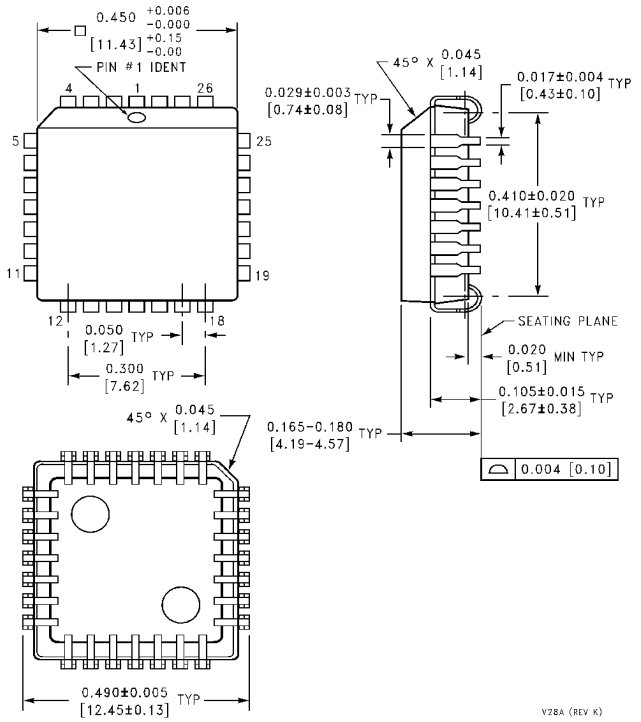
24-Lead Molded Package (0.300" Wide) (S)
Package Number M24B

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



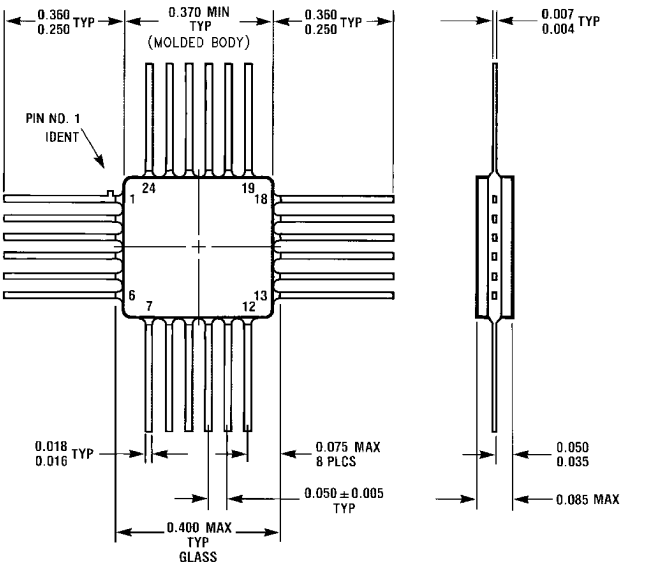
24-Lead Plastic Dual-In-Line Package (P)
Package Number N24E

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



28-Lead Plastic Chip Carrier (Q)
Package Number V28A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



24-Lead Quad Cerpak (F)
Package Number W24B

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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