CY74FCT16841T
CY74FCT162841T

20-Bit Latches

SCCS067A - July 1994 - Revised October 2001

Features

- **FCT-C speed at 5.5 ns (FCT16841T Com'l)**
- **I_{off} supports partial-power-down mode operation**
- **Edge-rate control circuitry for significantly improved noise characteristics**
- **Typical output skew < 250 ps**
- **ESD > 2000V**
- **TSSOP (19.6-mil pitch) and SSOP (25-mil pitch) packages**
- **Industrial temperature range of −40˚C to +85˚C**
- **V_{CC} = 5V ± 10%**

CY74FCT16841T Features:

- **64 mA sink current, 32 mA source current**
- **Typical V_{OLP} (ground bounce) <1.0V at V_{CC} = 5V, T_A = 25˚C**

CY74FCT162841T Features:

- **Balanced 24 mA output drivers**
- **Reduced system switching noise**
- **Typical V_{OLP} (ground bounce) <0.6V at V_{CC} = 5V, T_A= 25˚C**

Functional Description

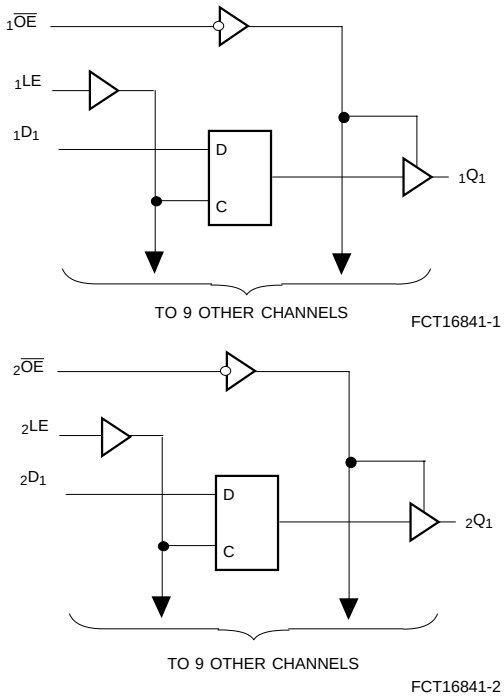
The CY74FCT16841T and CY74FCT162841T are 20-bit D-type latches designed for use in bus applications requiring high speed and low power. These devices can be used as two independent 10-bit latches, or as a single 10-bit latch, or as a single 20-bit latch by connecting the Output Enable ($\overline{OE}$) and Latch (LE) inputs. Flow-through pinout and small shrink packaging aid in simplifying board layout.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

The CY74FCT16841T is ideally suited for driving high-capacitance loads and low-impedance backplanes.

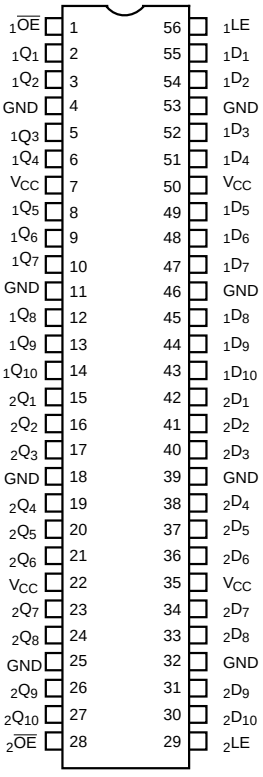
The CY74FCT162841T has 24-mA balanced output drivers with current limiting resistors in the outputs. This reduces the need for external terminating resistors and provides for minimal undershoot and reduced ground bounce. The CY74FCT162841T is ideal for driving transmission lines.

Logic Block Diagrams



Pin Configuration

SSOP/TSSOP
Top View



FCT16841-3

Pin Description

Name	Description
D	Data Inputs
LE	Latch Enable Input (Active HIGH)
$\overline{OE}$	Output Enable Input (Active LOW)
O	Three-State Outputs

Function Table[1]

Inputs			Outputs
D	LE	$\overline{OE}$	Q
H	H	L	H
L	H	L	L
X	L	L	Q[2]
X	X	H	Z

Maximum Ratings[3, 4]

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature ..... –55°C to +125°C

Ambient Temperature with Power Applied ..... –55°C to +125°C

DC Input Voltage ..... –0.5V to +7.0V

DC Output Voltage ..... –0.5V to +7.0V

DC Output Current (Maximum Sink Current/Pin) ..... –60 to +120 mA

Power Dissipation 1.0W

Static Discharge Voltage ..... >2001V (per MIL-STD-883, Method 3015)

Operating Range

Range	Ambient Temperature	V_{CC}
Industrial	–40°C to +85°C	5V ± 10%

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions	Min.	Typ.[5]	Max.	Unit
V_{IH}	Input HIGH Voltage	Logic HIGH Level	2.0			V
V_{IL}	Input LOW Voltage	Logic LOW Level			0.8	V
V_H	Input Hysteresis[6]			100		mV
V_{IK}	Input Clamp Diode Voltage	V_{CC}=Min., I_{IN}=–18 mA		–0.7	–1.2	V
I_{IH}	Input HIGH Current	V_{CC}=Max., V_I=V_{CC}			±1	µA
I_{IL}	Input LOW Current	V_{CC}=Max., V_I=GND			±1	µA
I_{OZH}	High Impedance Output Current (Three-State Output pins)	V_{CC}=Max., V_{OUT}=2.7V			±1	µA
I_{OZL}	High Impedance Output Current (Three-State Output pins)	V_{CC}=Max., V_{OUT}=0.5V			±1	µA
I_{OS}	Short Circuit Current[7]	V_{CC}=Max., V_{OUT}=GND	–80	–140	–200	mA
I_O	Output Drive Current[7]	V_{CC}=Max., V_{OUT}=2.5V	–50		–180	mA
I_{OFF}	Power-Off Disable	V_{CC}=0V, V_{OUT}≤4.5V[8]			±1	µA

Notes:

1. H = HIGH Voltage Level. L = LOW Voltage Level. X = Don't Care. Z = HIGH Impedance.
2. Output level before LE HIGH-to-LOW Transition.
3. Operation beyond the limits set forth may impair the useful life of the device. Unless otherwise noted, these limits are over the operating free-air temperature range.
4. Unused inputs must always be connected to an appropriate logic voltage level, preferably either V_{CC} or ground.
5. Typical values are at V_{CC}= 5.0V, T_A= +25˚C ambient.
6. This parameter is specified but not tested.
7. Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high-speed test apparatus and/or sample and hold techniques are preferable in order to minimize internal chip heating and more accurately reflect operational values. Otherwise prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parametric tests. In any sequence of parameter tests, I_{OS} tests should be performed last.
8. Tested at +25˚C.

Output Drive Characteristics for CY74FCT16841T

Parameter	Description	Test Conditions	Min.	Typ.[5]	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC}=Min., I_{OH}=–3 mA	2.5	3.5		V
		V_{CC}=Min., I_{OH}=–15 mA	2.4	3.5		
		V_{CC}=Min., I_{OH}=–32 mA	2.0	3.0		
V_{OL}	Output LOW Voltage	V_{CC}=Min., I_{OL}=64 mA		0.2	0.55	V

Output Drive Characteristics for CY74FCT162841T

Parameter	Description	Test Conditions	Min.	Typ.[5]	Max.	Unit
I_{ODL}	Output LOW Current[7]	V_{CC}=5V, V_{IN}=V_{IH} or V_{IL}, V_{OUT}=1.5V	60	115	150	mA
I_{ODH}	Output HIGH Current[7]	V_{CC}=5V, V_{IN}=V_{IH} or V_{IL}, V_{OUT}=1.5V	–60	–115	–150	mA
V_{OH}	Output HIGH Voltage	V_{CC}=Min., I_{OH}=–24 mA	2.4	3.3		V
V_{OL}	Output LOW Voltage	V_{CC}=Min., I_{OL}=24 mA		0.3	0.55	V

Capacitance[6] (T_A =+25˚C, f = 1.0 MHz)

Symbol	Description	Conditions	Typ.[5]	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	4.5	6.0	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	5.5	8.0	pF

Power Supply Characteristics

Parameter	Description	Test Conditions		Min.	Typ.[5]	Max.	Unit
I_{CC}	Quiescent Power Supply Current	V_{CC}=Max.	V_{IN}≤0.2V V_{IN}≥V_{CC}-0.2V	—	5	500	µA
ΔI_{CC}	Quiescent Power Supply Current (TTL inputs HIGH)	V_{CC}=Max.,	V_{IN}=3.4V[9]	—	0.5	1.5	mA
I_{CCD}	Dynamic Power Supply Current[10]	V_{CC}=Max., One Input Toggling, 50% Duty Cycle, Outputs Open, $\overline{OE}$=GND	V_{IN}=V_{CC} or V_{IN}=GND	—	60	100	µA/MHz
I_C	Total Power Supply Current[11]	V_{CC}=Max., f_1=10 MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling, $\overline{OE}$=GND LE = V_{CC}	V_{IN}=V_{CC} or V_{IN}=GND	—	0.6	1.5	mA
			V_{IN}=3.4V or V_{IN}=GND	—	0.9	2.3	
		V_{CC}=Max., f_1=2.5 MHz, 50% Duty Cycle, Outputs Open, Twenty Bits Toggling, $\overline{OE}$=GND LE = V_{CC}	V_{IN}=V_{CC} or V_{IN}=GND	—	3.0	5.5[12]	
			V_{IN}=3.4V or V_{IN}=GND	—	8.0	20.5[12]	

Notes:

9. Per TTL driven input (V_{IN}=3.4V); all other inputs at V_{CC} or GND.
10. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
11. I_C = $I_{QUIESCENT}$ + I_{INPUTS} + $I_{DYNAMIC}$
    I_C = I_{CC}+$\Delta I_{CC} D_H N_T$+$I_{CCD}(f_0/2 + f_1 N_1)$
    I_{CC} = Quiescent Current with CMOS input levels
    ΔI_{CC} = Power Supply Current for a TTL HIGH input (V_{IN}=3.4V)
    D_H = Duty Cycle for TTL inputs HIGH
    N_T = Number of TTL inputs at D_H
    I_{CCD} = Dynamic Current caused by an input transition pair (HLH or LHL)
    f_0 = Clock frequency for registered devices, otherwise zero
    f_1 = Input signal frequency
    N_1 = Number of inputs changing at f_1
    All currents are in milliamps and all frequencies are in megahertz.
12. Values for these conditions are examples of the I_{CC} formula. These limits are specified but not tested.

Switching Characteristics Over the Operating Range[13]

Parameter	Description	Condition[14]	74FCT16841AT		74FCT16841CT 74FCT162841CT		Unit	Fig. No.[15]
			Min.	Max.	Min.	Max.		
t_{PLH} t_{PHL}	Propagation Delay D to Q (LE=HIGH)	C_L=50 pF R_L=500Ω	1.5	9.0	1.5	5.5	ns	1, 5
		C_L=300 pF[16] R_L=500Ω	1.5	13.0	1.5	13.0		
t_{PLH} t_{PHL}	Propagation Delay LE to Q	C_L=50 pF R_L=500Ω	1.5	12.0	1.5	6.4	ns	1, 5
		C_L=300 pF[16] R_L=500Ω	1.5	16.0	1.5	15.0		
t_{PHZ} t_{PZL}	Output Enable Time $\overline{OE}$ to Q	C_L=50 pF R_L=500Ω	1.5	11.5	1.5	6.5	ns	1, 7, 8
		C_L=300 pF[16] R_L=500Ω	1.5	23.0	1.5	12.0		
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{OE}$ to Q	C_L=5 pF[16] R_L=500Ω	1.5	7.0	1.5	5.7	ns	1, 7, 8
		C_L=50 pF R_L=500Ω	1.5	8.0	1.5	6.0		
t_{SU}	Set-Up Time HIGH or LOW, D to LE	C_L=50 pF R_L=500Ω	2.5	—	2.0	—	ns	9
t_H	Hold Time HIGH or LOW, D to LE		2.5	—	1.5	—	ns	9
t_W	LE Pulse Width HIGH		4.0[17]	—	4.0[17]	—	ns	5
$t_{SK(O)}$	Output Skew[18]		—	0.5	—	0.5	ns	—

Notes:
13. Minimum limits are specified but not tested on Propagation Delays.
14. See test circuit and waveform.
15. See “Parameter Measurement Information” in the General Information section.
16. These conditions are specified but not tested.
17. These limits are specified but not tested.
18. Skew between any two outputs of the same package switching in the same direction. This parameter is ensured by design.

Ordering Information for CY74FCT16841T

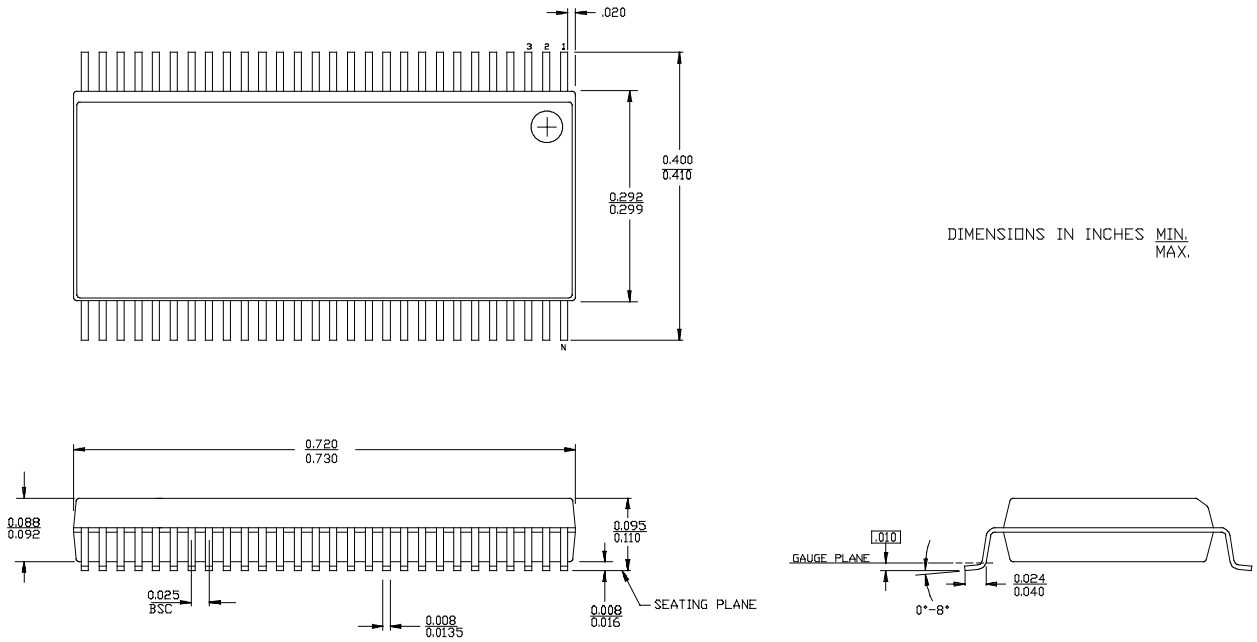
Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
5.5	CY74FCT16841CTPVC/PVCT	O56	56-Lead (300-Mil) SSOP	Industrial
6.5	CY74FCT16841ATPVC/PVCT	O56	56-Lead (300-Mil) SSOP	Industrial

Ordering Information CY74FCT162841T

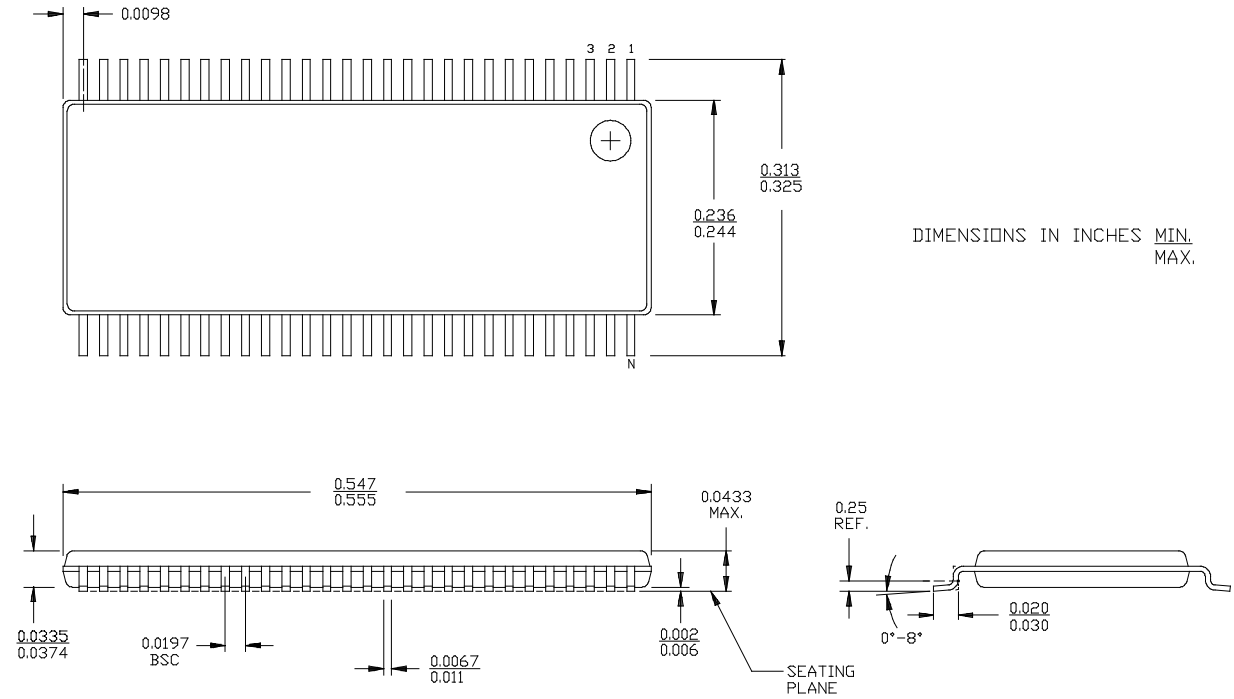
Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
5.5	74FCT162841CTPACT	Z56	56-Lead (240-Mil) TSSOP	Industrial
	CY74FCT162841CTPVC	O56	56-Lead (300-Mil) SSOP	
	74FCT162841CTPVCT	O56	56-Lead (300-Mil) SSOP	

Package Diagrams

56-Lead Shrunk Small Outline Package O56



56-Lead Thin Shrunk Small Outline Package Z56



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
74FCT162841CTPACT	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74FCT162841CTPVCG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74FCT162841CTPVCT	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74FCT162841ETPVCT	OBSOLETE	SSOP	DL	56		TBD	Call TI	Call TI
74FCT16841ATPVCG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74FCT16841CTPVCG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74FCT16841CTPVCTG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT162841CTPVC	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT162841ETPVC	OBSOLETE	SSOP	DL	56		TBD	Call TI	Call TI
CY74FCT16841ATPVC	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT16841CTPVC	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT16841CTPVCT	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
FCT162841CTPACTE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
FCT162841CTPACTG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
FCT162841CTPVCTG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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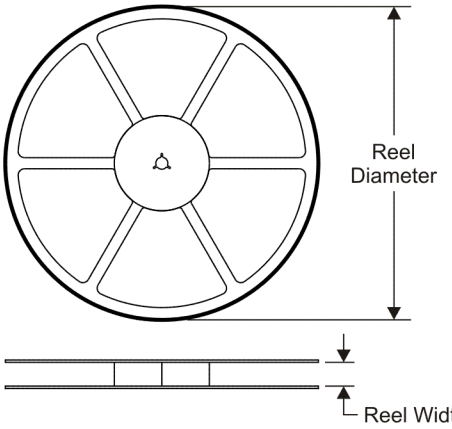
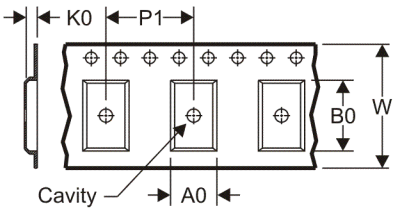
TAPE AND REEL INFORMATION

REEL DIMENSIONS

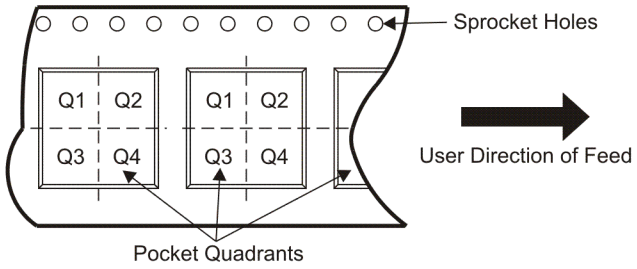


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

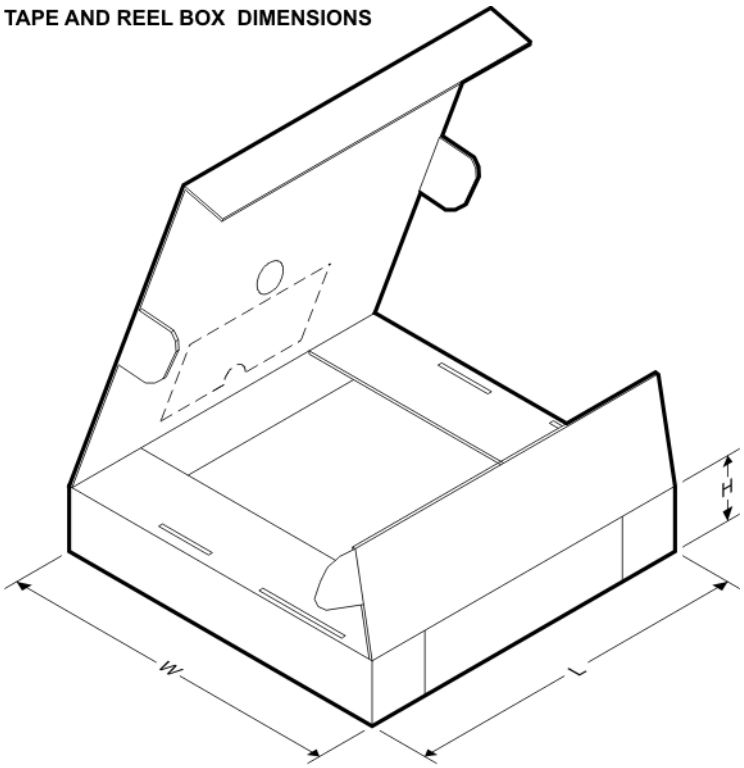
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
74FCT162841CTPACT	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
74FCT162841CTPVCT	SSOP	DL	56	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1
CY74FCT16841CTPVCT	SSOP	DL	56	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1

TAPE AND REEL BOX DIMENSIONS

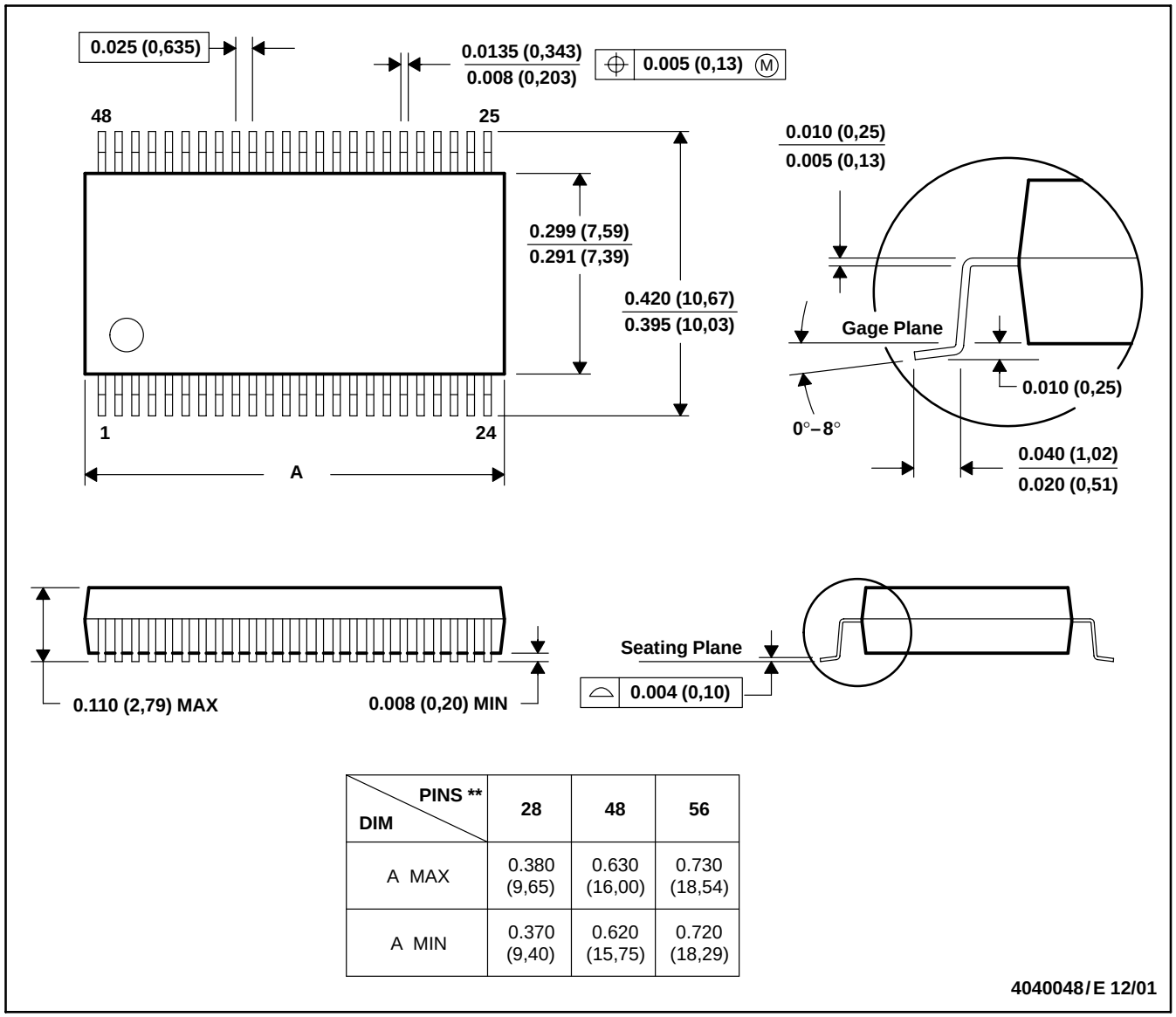


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
74FCT162841CTPACT	TSSOP	DGG	56	2000	346.0	346.0	41.0
74FCT162841CTPVCT	SSOP	DL	56	1000	346.0	346.0	49.0
CY74FCT16841CTPVCT	SSOP	DL	56	1000	346.0	346.0	49.0

DL (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

48 PINS SHOWN



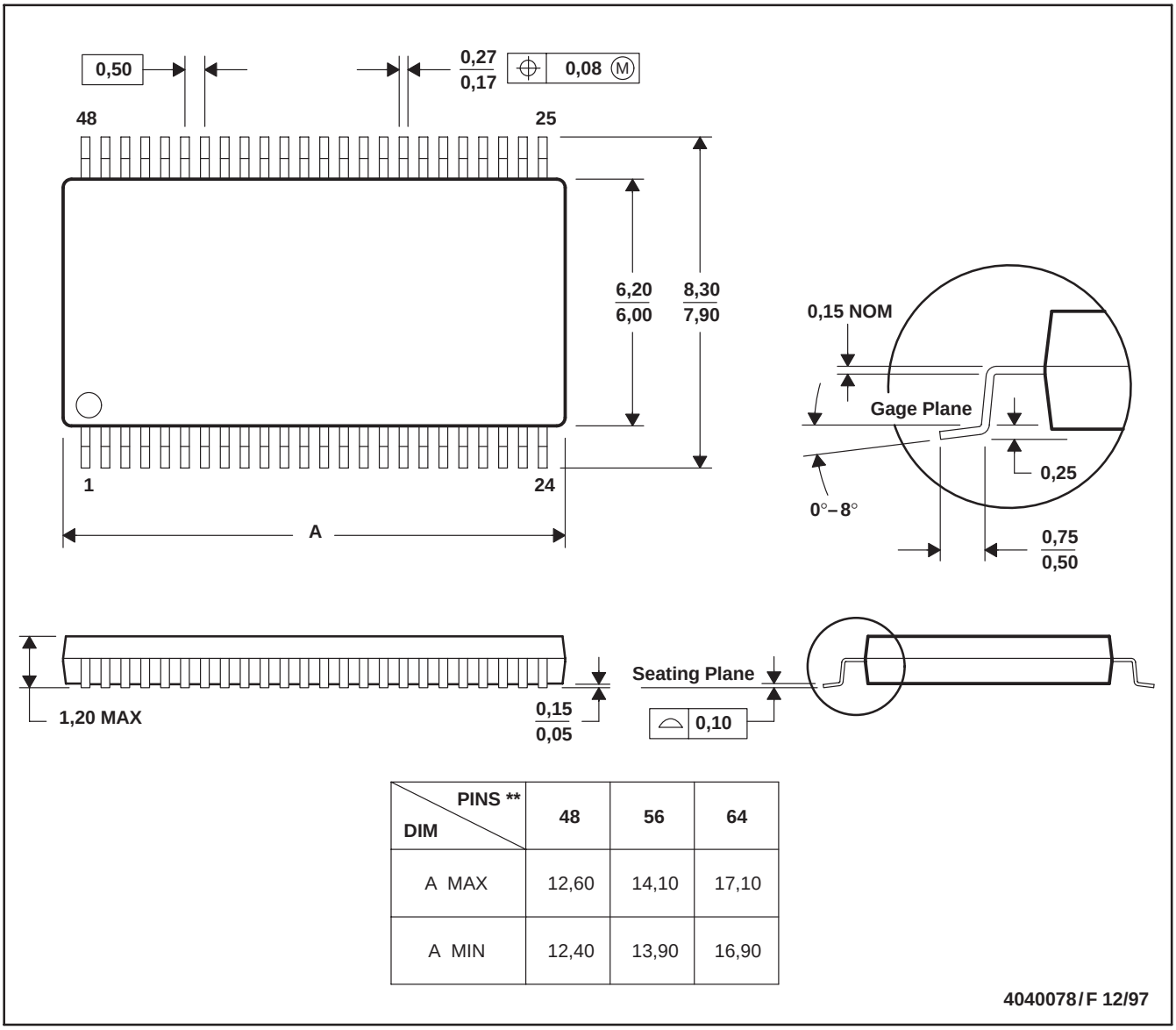
DIM \ PINS **	28	48	56
A MAX	0.380 (9,65)	0.630 (16,00)	0.730 (18,54)
A MIN	0.370 (9,40)	0.620 (15,75)	0.720 (18,29)

4040048/E 12/01

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MO-118

DGG (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

48 PINS SHOWN



DIM \ PINS **	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CY74FCT162841CTPVC	ACTIVE	SSOP	DL	56	20	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT162841C	Samples
CY74FCT16841ATPVC	ACTIVE	SSOP	DL	56	20	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT16841A	Samples
CY74FCT16841CTPVC	ACTIVE	SSOP	DL	56	20	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT16841C	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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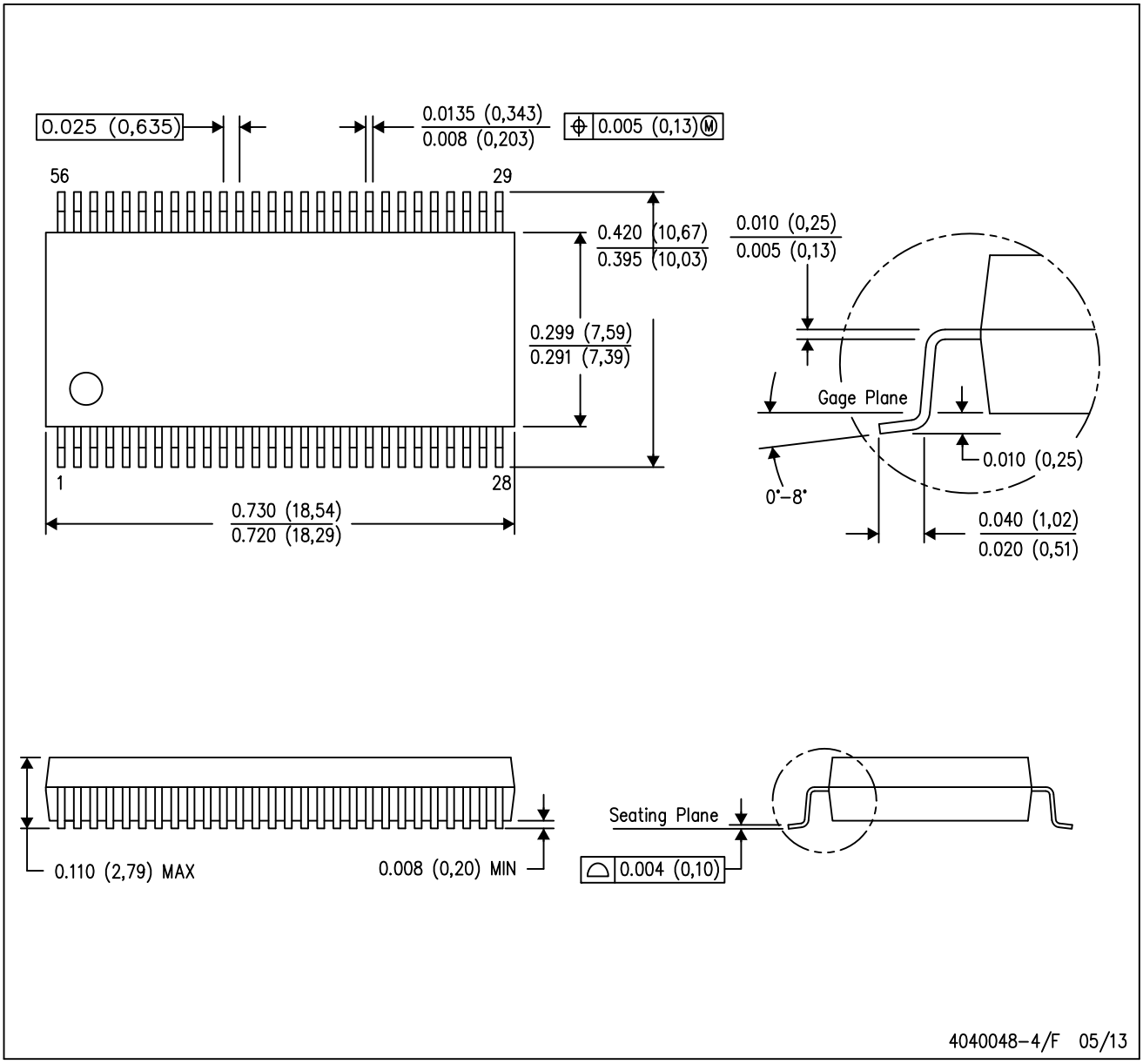
DL (R–PDSO–G56) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MO–118

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