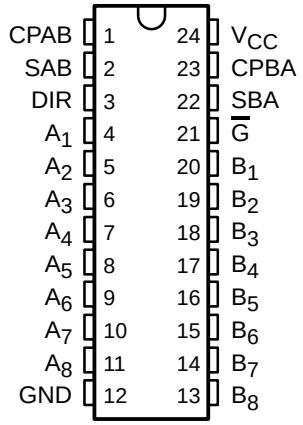
- **Function and Pinout Compatible With FCT and F Logic**
- **Reduced V_{OH} (Typically = 3.3 V) Versions of Equivalent FCT Functions**
- **25-Ω Output Series Resistors to Reduce Transmission-Line Reflection Noise**
- **Edge-Rate Control Circuitry for Significantly Improved Noise Characteristics**
- **I_{off} Supports Partial-Power-Down Mode Operation**
- **Matched Rise and Fall Times**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **200-V Machine Model (A115-A)**
  - **1000-V Charged-Device Model (C101)**
- **Fully Compatible With TTL Input and Output Logic Levels**
- **12-mA Output Sink Current 15-mA Output Source Current**
- **Independent Register for A and B Buses**
- **3-State Outputs**

Q PACKAGE
(TOP VIEW)



description

The CY74FCT2646T consists of a bus transceiver circuit with 3-state, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Data on the A or B bus is clocked into the registers as the appropriate clock pin goes to a high logic level. Output-enable ($\overline{G}$) and direction-control (DIR) inputs determine the transceiver function. On-chip termination resistors at the outputs reduce system noise caused by reflections, so that the CY74FCT2646T can replace the CY74FCT646T in an existing design.

In the transceiver mode, data present at the high-impedance port can be stored in either the A or B register, or in both. Select controls (SAB, SBA) can multiplex stored and real-time (transparent mode) data. DIR determines which bus receives data when $\overline{G}$ is active low. In the isolation mode ($\overline{G}$ is high), A data can be stored in the B register and/or B data can be stored in the A register.

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.

PIN DESCRIPTION

NAME	DESCRIPTION
A	Data register A inputs, data register B outputs
B	Data register B inputs, data register A outputs
CPAB, CPBA	Clock pulse inputs
SAB, SBA	Output data source select inputs
DIR, $\overline{G}$	Output-enable inputs

ORDERING INFORMATION

T_A	PACKAGE†		SPEED (ns)	ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	QSOP – Q	Tape and reel	5.4	CY74FCT2646CTQCT	FCT2646C
	QSOP – Q	Tape and reel	6.3	CY74FCT2646ATQCT	FCT2646A

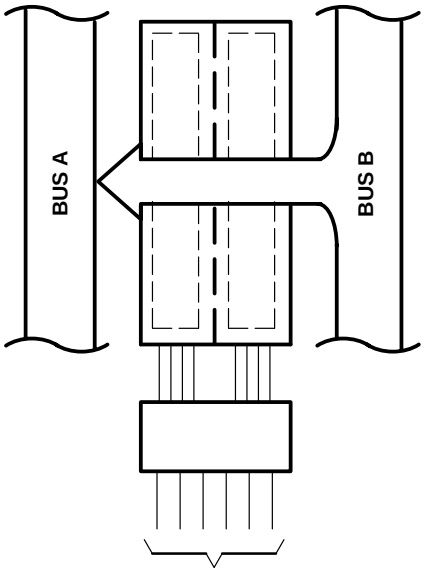
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE

INPUTS						DATA I/O‡		OPERATION OR FUNCTION
$\overline{G}$	DIR	CPAB	CPBA	SAB	SBA	A_1–A_8	B_1–B_8	
H	X	H or L	H or L	X	X	Input	Input	Isolation
H	X	↑	↑	X	X	Input	Input	Store A and B data
L	L	X	X	X	L	Output	Input	Real-time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
L	H	X	X	L	X	Input	Output	Real-time A data to B bus
L	H	H or L	X	H	X	Input	Output	Stored A data to B bus

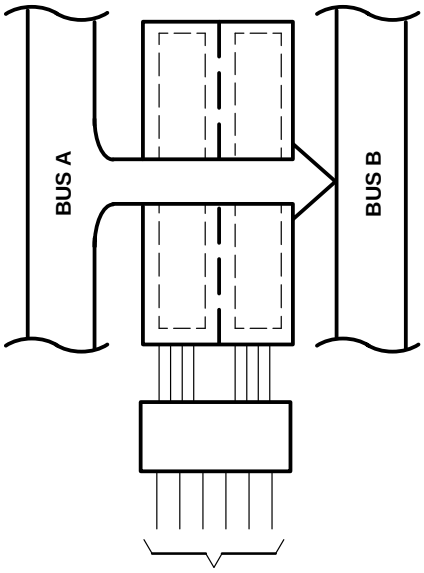
H = High logic level, L = Low logic level, X = Don't care, ↑ = Low-to-high clock transition

‡ The data output functions can be enabled or disabled by various signals at the $\overline{G}$ or DIR inputs. Data input functions always are enabled, i.e., data at the bus pins is stored on every low-to-high transition of the clock inputs.



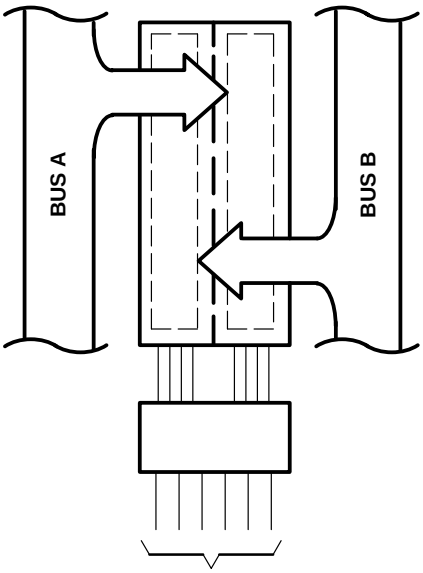
3	21	1	23	2	22
DIR	$\overline{G}$	CPAB	CPBA	SAB	SBA
L	L	X	X	X	X

REAL-TIME TRANSFER
BUS B TO BUS A



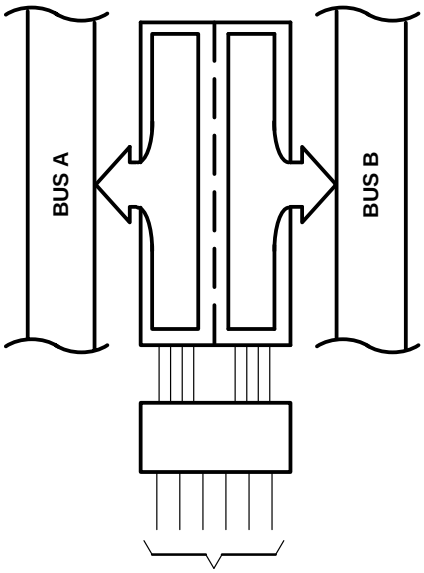
3	21	1	23	2	22
DIR	$\overline{G}$	CPAB	CPBA	SAB	SBA
H	L	X	X	L	X

REAL-TIME TRANSFER
BUS A TO BUS B



3	21	1	23	2	22
DIR	$\overline{G}$	CPAB	CPBA	SAB	SBA
H	L	↑	X	X	X
L	L	X	↑	X	X
X	H	↑	↑	X	X

STORAGE FROM
A AND/OR B



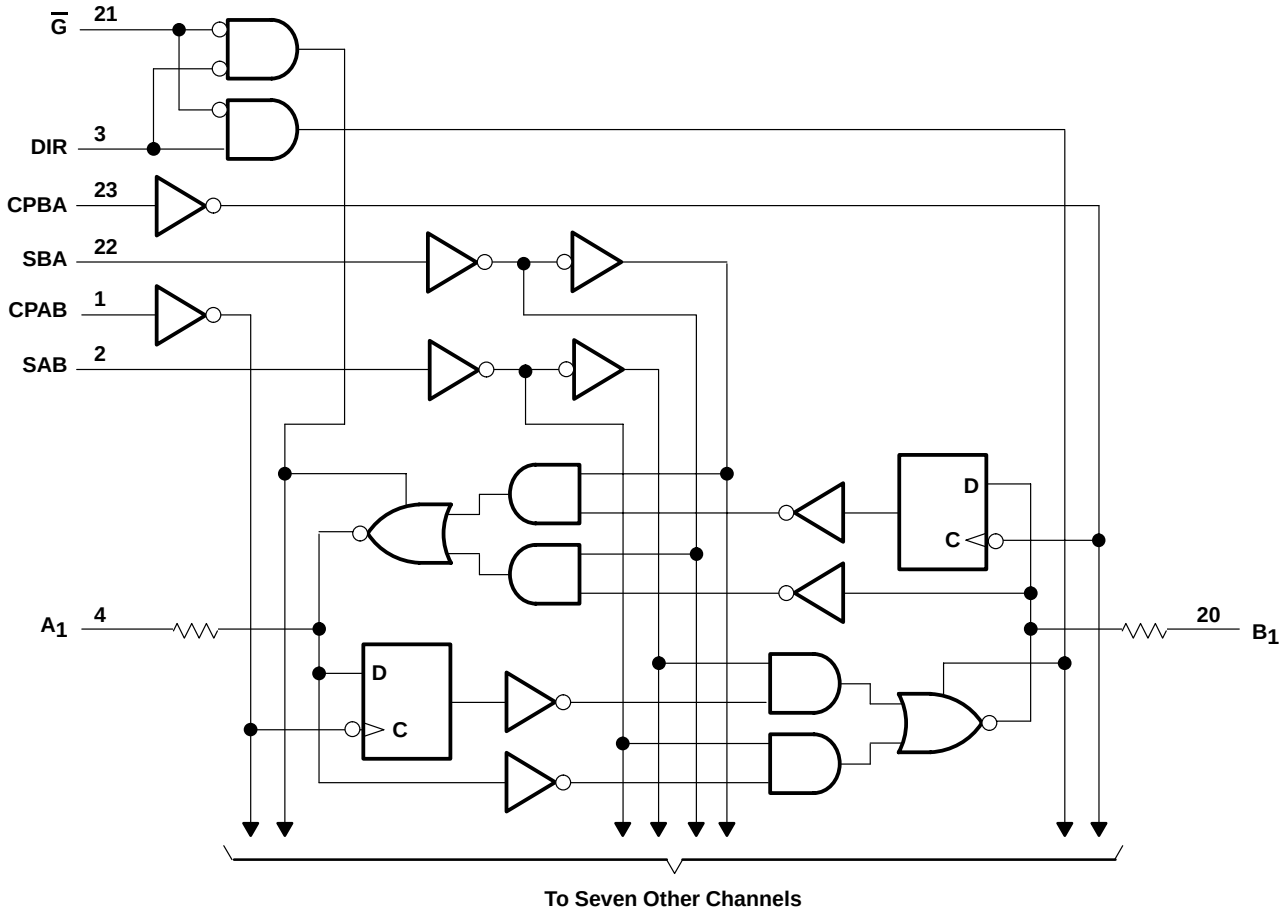
3	21	1	23	2	22
DIR†	$\overline{G}$	CPAB	CPBA	SAB	SBA
L	L	X	H or L	X	H
H	L	H or L	X	H	H

TRANSFER STORED DATA
TO A AND/OR B

† Cannot transfer data to A bus and B bus simultaneously.

Figure 1. Bus-Management Functions

logic diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range to ground potential	–0.5 V to 7 V
DC input voltage range	–0.5 V to 7 V
DC output voltage range	–0.5 V to 7 V
DC output current (maximum sink current/pin)	120 mA
Package thermal impedance, θ_{JA} (see Note 1)	61°C/W
Ambient temperature range with power applied, T_A	–65°C to 135°C
Storage temperature range, T_{stg}	–65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 2)

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	4.75	5	5.25	V
V_{IH}	High-level input voltage	2			V
V_{IL}	Low-level input voltage			0.8	V
I_{OH}	High-level output current			–15	mA
I_{OL}	Low-level output current			12	mA
T_A	Operating free-air temperature	–40		85	°C

NOTE 2: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS			MIN	TYP†	MAX	UNIT
V_{IK}	V_{CC} = 4.75,	I_{IN} = –18 mA			–0.7	–1.2	V
V_{OH}	V_{CC} = 4.75,	I_{OH} = –15 mA		2.4	3.3		V
V_{OL}	V_{CC} = 4.75,	I_{OL} = 12 mA			0.3	0.55	V
R_{out}	V_{CC} = 4.75,	I_{OL} = 12 mA		20	25	40	Ω
V_{hys}	All inputs				0.2		V
I_{IH}	V_{CC} = 5.25 V	$V_{IN} = V_{CC}$				5	µA
		V_{IN} = 2.7 V				±1	
I_{IL}	V_{CC} = 5.25 V,	V_{IN} = 0.5 V				±1	µA
I_{OZH}	V_{CC} = 5.25 V,	V_{OUT} = 2.7 V				10	µA
I_{OZL}	V_{CC} = 5.25 V,	V_{OUT} = 0.5 V				–10	µA
I_{OS}‡	V_{CC} = 5.25 V,	V_{OUT} = 0 V		–60	–120	–225	mA
I_{off}	V_{CC} = 0 V,	V_{OUT} = 4.5 V				±1	µA
I_{CC}	V_{CC} = 5.25 V,	$V_{IN} \le 0.2$ V,	$V_{IN} \ge V_{CC} - 0.2$ V		0.1	0.2	mA
ΔI_{CC}	V_{CC} = 5.25 V, V_{IN} = 3.4 V§, f_1 = 0, Outputs open				0.5	2	mA
I_{CCD}¶	V_{CC} = 5.25 V, One input switching at 50% duty cycle, Outputs open, $\overline{G}$ = DIR = GND, GAB = $\overline{GBA}$ = GND, $V_{IN} \le 0.2$ V or $V_{IN} \ge V_{CC} - 0.2$ V				0.06	0.12	mA/ MHz
I_C#	V_{CC} = 5.25 V, Outputs open, $\overline{G}$ = DIR = GND, GAB = $\overline{GBA}$ = GND	One input switching at f_1 = 5 MHz at 50% duty cycle	$V_{IN} \le 0.2$ V or $V_{IN} \ge V_{CC} - 0.2$ V		0.7	1.4	mA
			V_{IN} = 3.4 V or GND		1.2	3.4	
		Eight bits switching at f_1 = 5 MHz at 50% duty cycle	$V_{IN} \le 0.2$ V or $V_{IN} \ge V_{CC} - 0.2$ V		2.8	5.6‖	
			V_{IN} = 3.4 V or GND		5.1	14.6‖	
C_i					6	10	pF
C_o					8	12	pF

† Typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ 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 to minimize internal chip heating and more accurately reflect operational values. Otherwise, prolonged shorting of a high output can raise the chip temperature well above normal and cause invalid readings in other parametric tests. In any sequence of parameter tests, I_{OS} tests should be performed last.

§ Per TTL-driven input (V_{IN} = 3.4 V); all other inputs at V_{CC} or GND

¶ This parameter is derived for use in total power-supply calculations.

$I_C = I_{CC} + \Delta I_{CC} \times D_H \times N_T + I_{CCD} (f_0/2 + f_1 \times N_1)$

Where:

I_C = Total supply current
I_{CC} = Power-supply current with CMOS input levels
ΔI_{CC} = Power-supply current for a TTL high input (V_{IN} = 3.4 V)
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 milliamperes and all frequencies are in megahertz.

‖ Values for these conditions are examples of the I_{CC} formula.

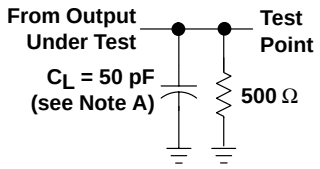
timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 2)

			CY74FCT2646AT		CY74FCT2646CT		UNIT
			MIN	MAX	MIN	MAX	
t_w	Pulse duration, high or low		5		5		ns
t_{su}	Setup time, high or low	Data before CPBA↑ or CPAB↑	2		2		ns
t_h	Hold time, high or low	Data after CPBA↑ or CPAB↑	1.5		1.5		ns

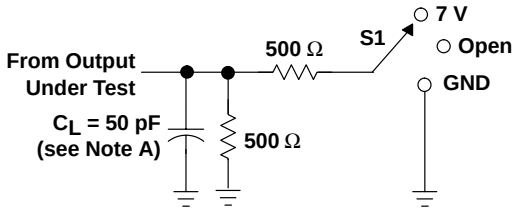
switching characteristics over operating free-air temperature range (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	CY74FCT2646AT		CY74FCT2646CT		UNIT
			MIN	MAX	MIN	MAX	
t_{PLH}	A or B	B or A	1.5	6.3	1.5	5.4	ns
t_{PHL}			1.5	6.3	1.5	5.4	
t_{PZH}	$\overline{G}$	A or B	1.5	9.8	1.5	7.8	ns
t_{PZL}			1.5	9.8	1.5	7.8	
t_{PZH}	DIR	A or B	1.5	9.8	1.5	7.8	ns
t_{PZL}			1.5	9.8	1.5	7.8	
t_{PHZ}	$\overline{G}$	A or B	1.5	6.3	1.5	6.3	ns
t_{PLZ}			1.5	6.3	1.5	6.3	
t_{PHZ}	DIR	A or B	1.5	6.3	1.5	6.3	ns
t_{PLZ}			1.5	6.3	1.5	6.3	
t_{PLH}	CPAB or CPBA	B or A	1.5	6.3	1.5	5.7	ns
t_{PHL}			1.5	6.3	1.5	5.7	
t_{PLH}	SAB or SBA	B or A	1.5	7.7	1.5	6.2	ns
t_{PHL}			1.5	7.7	1.5	6.2	

PARAMETER MEASUREMENT INFORMATION

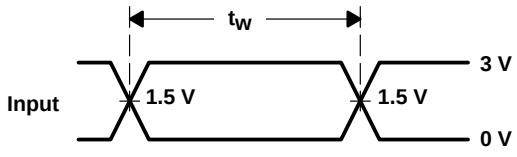


LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS

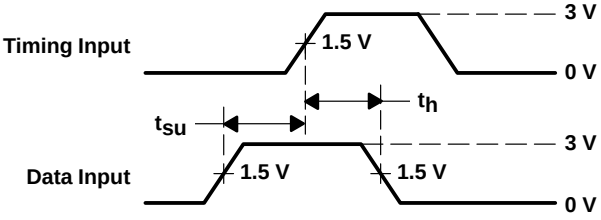


LOAD CIRCUIT FOR
3-STATE OUTPUTS

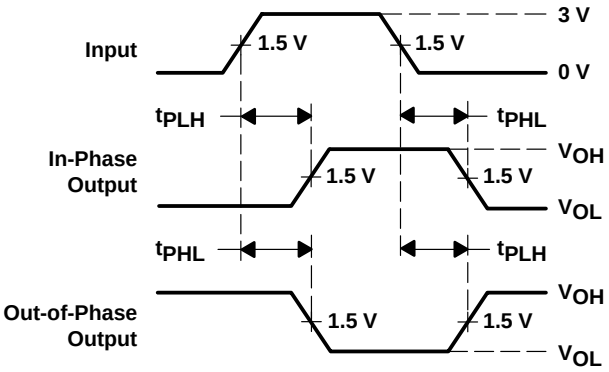
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open



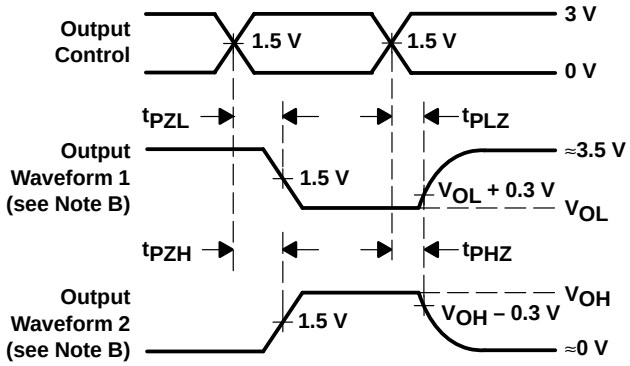
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. The outputs are measured one at a time with one input transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
74FCT2646ATQCTE4	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
CY74FCT2646ATQCT	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
CY74FCT2646CTQCTE4	ACTIVE	SSOP/ QSOP	DBQ	24		TBD	Call TI	Call TI
CY74FCT2646CTQCTG4	ACTIVE	SSOP/ QSOP	DBQ	24		TBD	Call TI	Call TI
SN74FCT2646ATQCTG4	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR

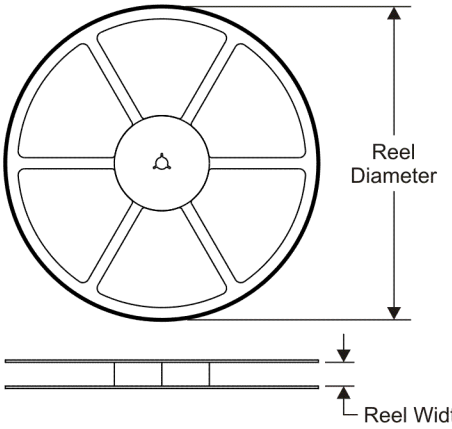
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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)

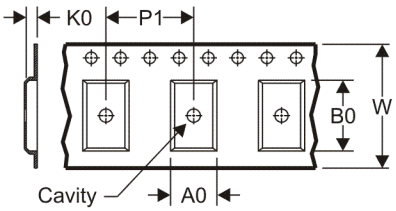
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

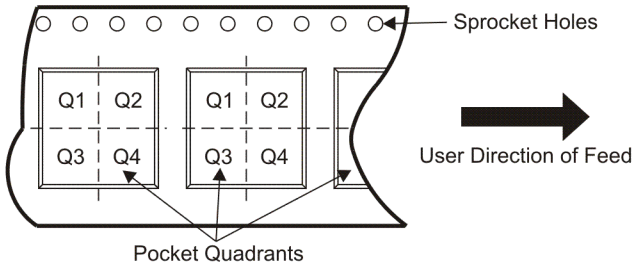


TAPE DIMENSIONS



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

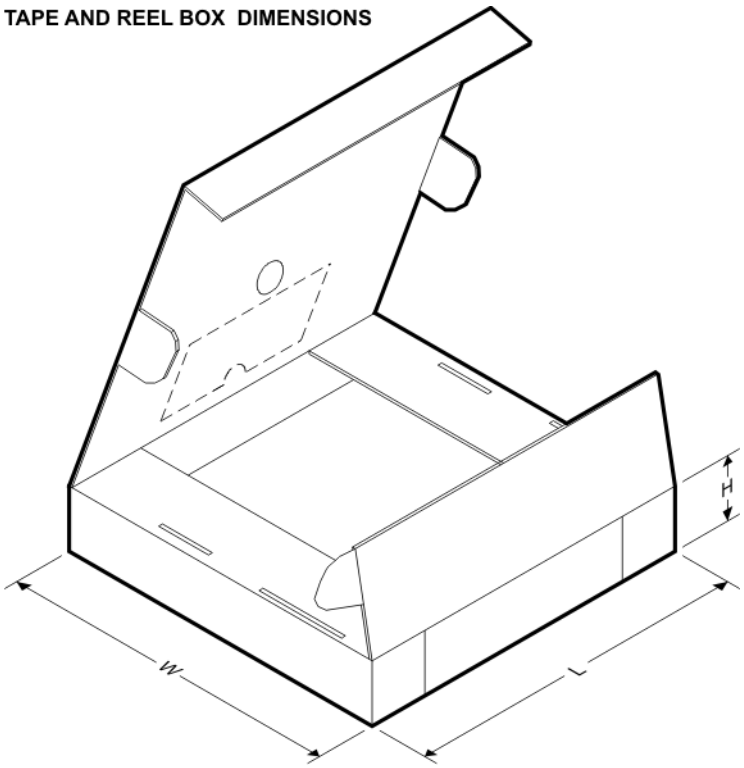
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CY74FCT2646ATQCT	SSOP/ QSOP	DBQ	24	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

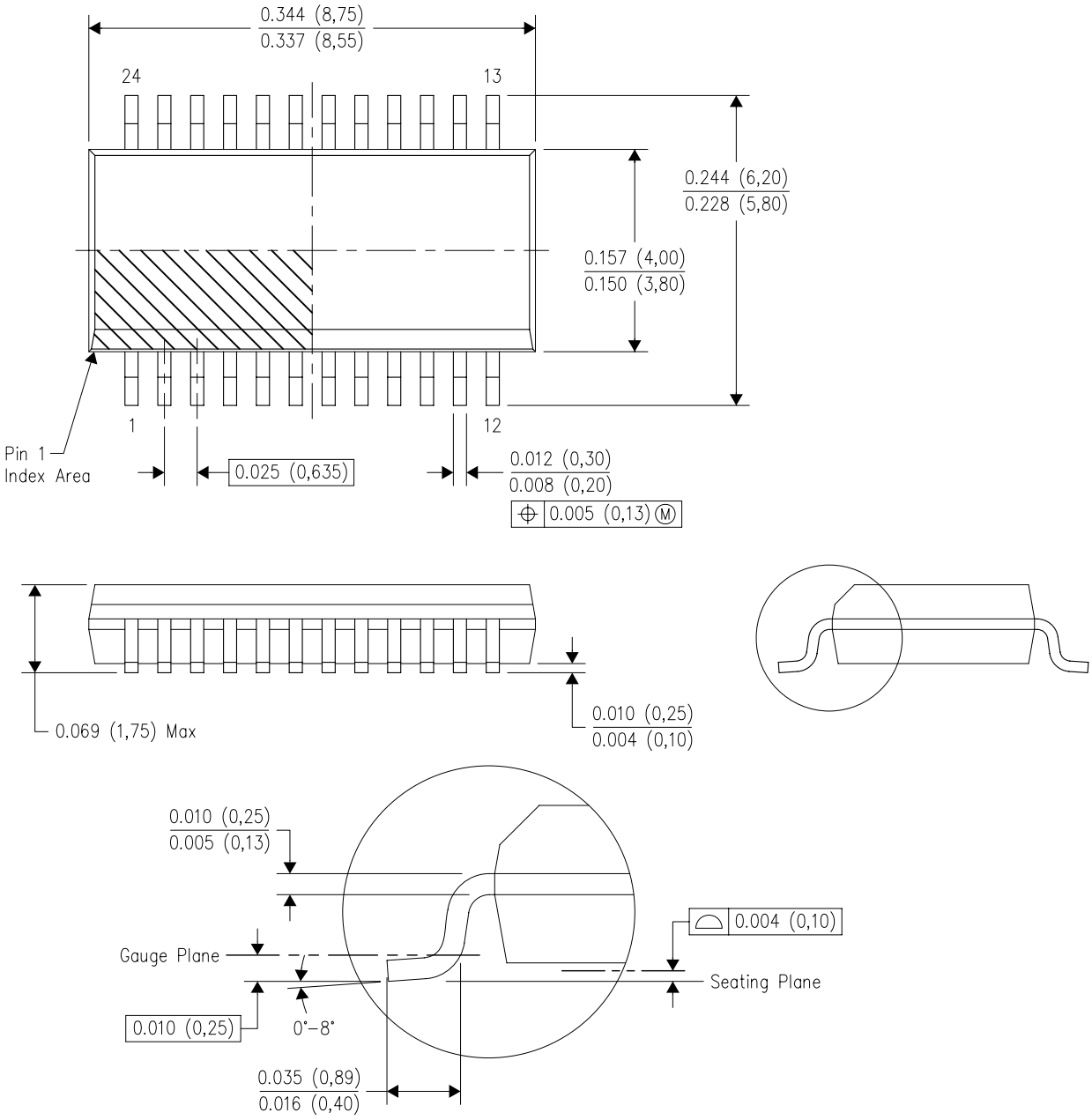
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

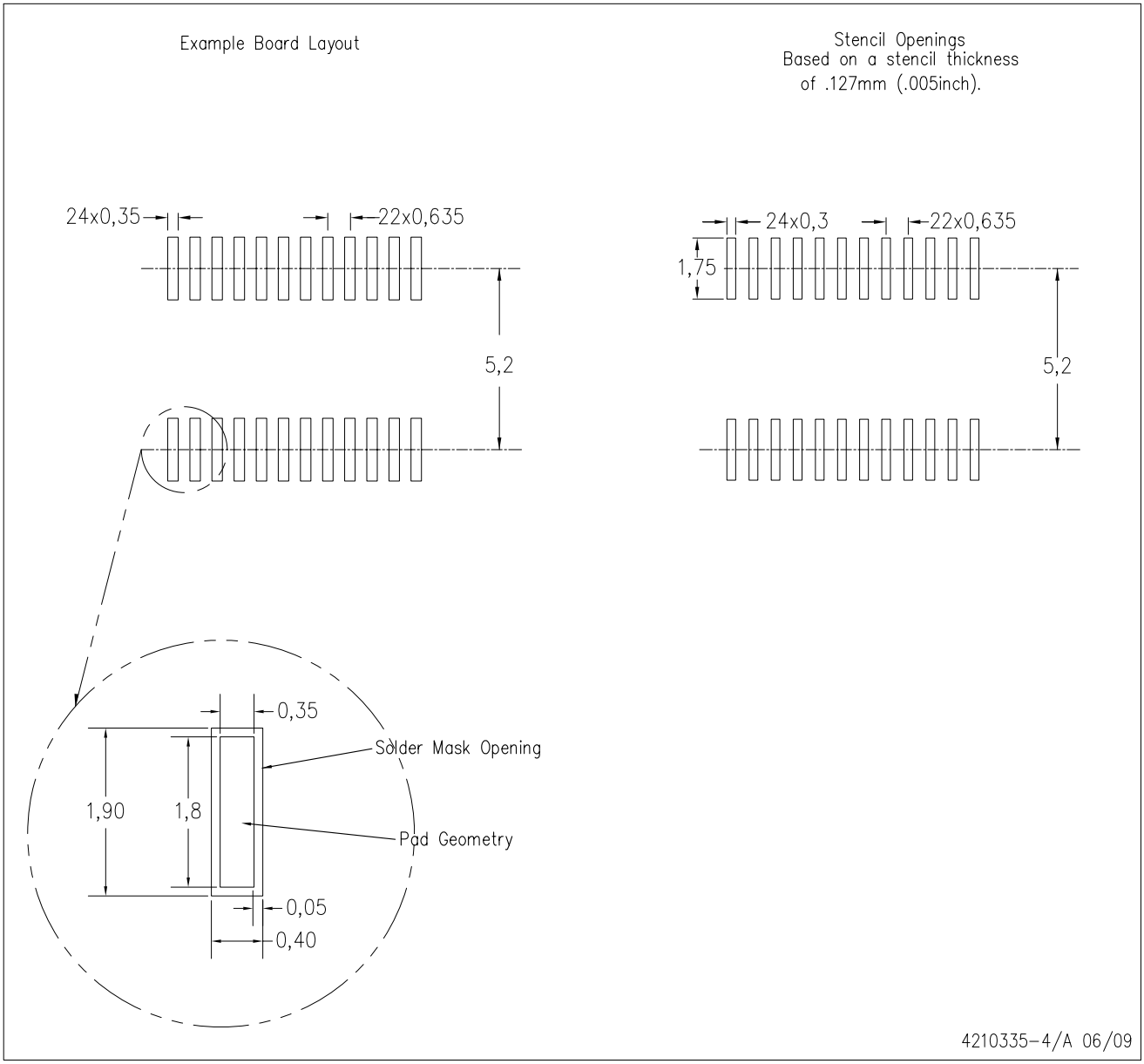
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CY74FCT2646ATQCT	SSOP/QSOP	DBQ	24	2500	346.0	346.0	33.0

DBQ (R–PDSO–G24) 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) per side.
D. Falls within JEDEC MO–137 variation AE.

DBQ (R–PDSO–G24)



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

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