

General

Crystal clock oscillations are high-frequency devices that supply clock signals to various electronic circuits. They can be used in lead-electrode and surface mounting applications over frequency ranges from 1.5MHz to 140MHz. Housing crystal units that consist of AT or BT cut fundamental or overtone and their oscillation circuit in the same package, our crystal clock oscillators are designed and manufactured to provide a stable output of signals when the set voltage is applied.

Generally, when customers buy crystal units and use them in their oscillation circuits, they first need to provide analog settings prior to the installation. These include the settings of load capacitance, oscillation allowance, and variations in characteristics due to

temperature changes. With Toyocom's oscillators, these settings are already provided by us, so their output signals can directly control TTL and CMOS ICs. This shortens design processes for customers and contributes to standardizing parts to be used. Our clock oscillators also feature a VCXO function and a Try-state function. The VCXO function enables control of output frequencies with external control voltage, whereas the Try-state feature maintains the output terminals at high impedance levels by outputting signals with control signals while the power is supplied.

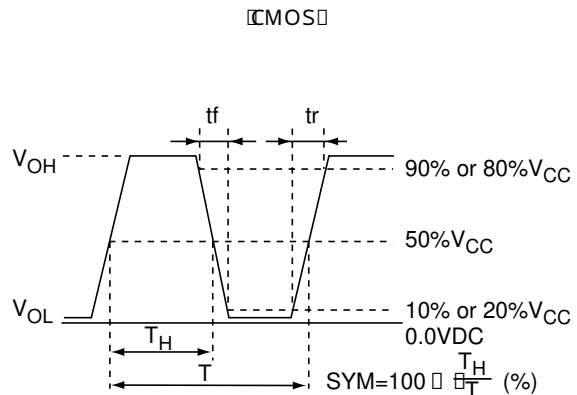
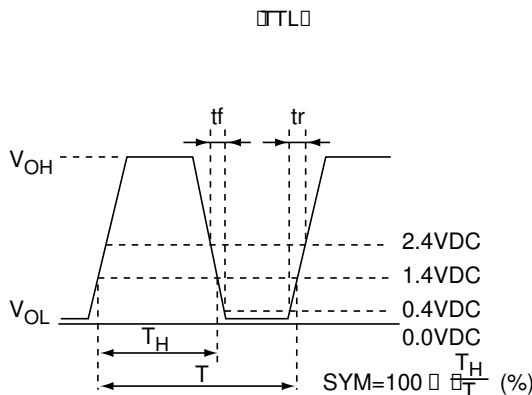
For further details about individual products, please refer to their specification sheets.

1 Definition of symbols and abbreviations

VOLTAGES	All voltages are referenced to ground.
V_{CC} (Opr)	Operating voltage: The range of power supply voltage over which the oscillator is guaranteed to operate within the specified limits.
V_{IH} (Min)	Input HIGH voltage (Minimum): The minimum value represents the guaranteed input logic HIGH threshold for the oscillator.
V_{IL} (Max)	Input LOW voltage (Maximum): The maximum value represents the guaranteed input logic LOW threshold for the oscillator.
V_{OH} (Min)	Output HIGH voltage (Minimum): The minimum voltage at an output terminal for the specified output current I _{OH} and at the minimum value of V _{CC} .
V_{OL} (Max)	Output LOW voltage (Maximum): The maximum voltage at an output terminal sinking the maximum specified load current I _{OL} .

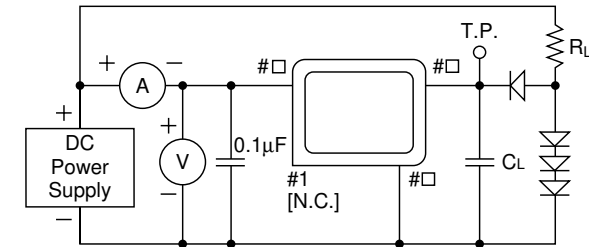
CURRENTS	Positive current is defined as current flow into an oscillator. Negative current is defined as current flow out of an oscillator.
I_{CC}	Operating current : The current flowing into the V _{CC} supply terminal of an oscillator with the specified input and output conditions.
T_{opr}	Operating temperature.
f_o	Output frequency of an oscillator.
Δf/f_o	Frequency stability of the output frequency.
SYM	Symmetry of output waveform at the specified level.
t_r	Waveform rise time (LOW to HIGH), 0.4V to 2.4V or 10% to 90% or 20% to 80% as specified.
t_f	Waveform fall time (HIGH to LOW), 2.4V to 0.4V or 90% to 10% or 80% to 20% as specified.
n	Fanout
C_L	Load capacitance
R_L	Load resistance
t_{st}	Start-up time of the output

2 Output waveform



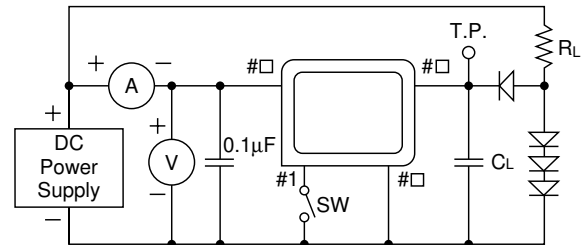
3 Test circuits

TEST01 TTL



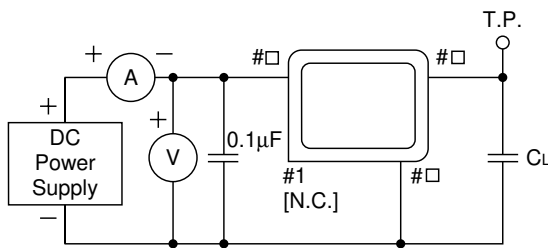
TTL output $C_L = 15 \text{ pF max. (Total fixture and probe capacitance)}$
 R_L : See the specifications

TEST02 TTL (TriState)



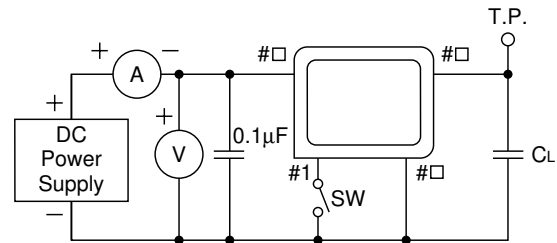
TTL output $C_L = 15 \text{ pF max. (Total fixture and probe capacitance)}$
 R_L : See the specifications

TEST03 CMOS



CMOS output $C_L = \text{See the specifications (Total fixture and probe capacitance)}$

TEST04 CMOS (TriState)



CMOS output $C_L = \text{See the specifications (Total fixture and probe capacitance)}$

4 Directions for proper use

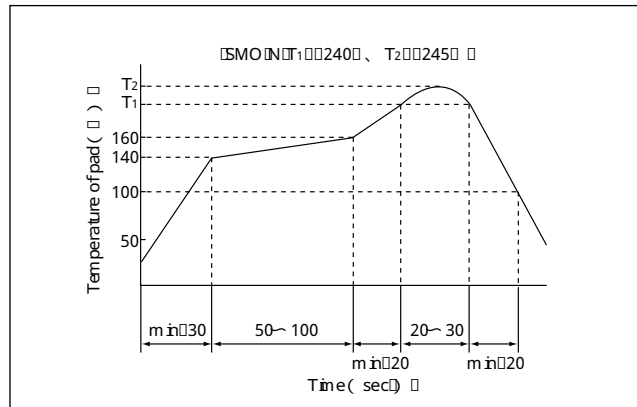
- Clock oscillators are high-frequency devices incorporating crystal units and oscillation circuits. In handling these products, it is critical to observe the following directions:
- When designing circuits and printed circuit boards incorporating these products, install a bypass capacitor in the order of 0.01 μ F at the nearest possible location between the grounding and the oscillator's power terminal.
- These products include semiconductor circuits and very thin crystal blanks. When providing ultrasonic cleaning, we recommend that the user provide assessments prior to the cleaning, as cleaning might damage the crystal blanks depending on how the oscillator is installed and how the cleaning is provided. Also, pay attention to possible impacts on the oscillator both in mechanical and thermal aspects.
- Recommended storage period is 6 months or shorter at 15-35°C, humidity of 75%RH or less.
- Take measures against static electricity during transportation, storage and use.
- Clock oscillators use semiconductors in their internal oscillation circuits with the semiconductor terminals directly connected to the oscillators. Therefore, do not apply voltage to other terminals when power is not provided to the power terminal. Also, do not apply power greater than the rated power voltage to terminals other than the power terminal.

5 Soldering heat resistance

- DIP-14P: +260°C max., 10 sec. max. (at leads)
- SMD : +260°C max., 10 sec. max. (Twice max.) or +230°C max., 3 minutes max.

6 Reflow conditions of SMD

Infrared reflow



CRYSTAL CLOCK OSCILLATORS LINE UP

Package	Type	Output	Frequency range	Frequency stability	Operating voltage	Sealing	Page	
SMD	TCO787RH3	CMOS	15 to 36 MHz	± 100 ppm	+3.3/+5 VDC±10 %	Glass sealed	P. 6	
	TCO786RH		15 to 70 MHz	± 50 ppm	+5 VDC±10 %			
	TCO787RH		36 to 70 MHz	± 100 ppm				
	TCO786NH	TTL	15 to 70 MHz	± 50 ppm			P. 7	
	TCO787NH		± 100 ppm					
	TCO786KH	TTL/CMOS	30 to 75 MHz	± 50 ppm			+3.3 VDC±10 %	P. 8
	TCO787KH			± 100 ppm				
	TCO786ZH		15 to 80 MHz	± 50 ppm	P. 9			
	TCO787ZH			± 100 ppm				
	TFG787RH3	CMOS	70 to 140 MHz	± 100 ppm	+3.3/+5 VDC±10 %		P. 10	
	TFG786RH		70 to 112 MHz	± 50 ppm	+5 VDC±10 %			
	TFG786XH				+3.3 VDC±10 %			
SMD	TCO787SH3	CMOS	15 to 36 MHz	± 100 ppm	+3.3/+5 VDC±10 %	Seam welded	P. 11	
	TCO785SH		15 to 70 MHz	±25 ppm	+5 VDC±5 %			
	TCO785YH	TTL/CMOS	15 to 80 MHz		+3.3 VDC±5 %			
DIP	TCO743A7	TTL	15 to 60 MHz	± 10 ppm	+5 VDC±10 %	DIP	P. 12	
	TCO743HC7	CMOS						
	TCO743TH7	TTL						

The other frequencies and specifications are available upon your request.

Product Data (SMD)

TCO 787RH3 786RH 787RH

Features

- CMOS output
- Small size: 7W 5D 2Hmm
- Enable/Disable control/ Oscillation standby function

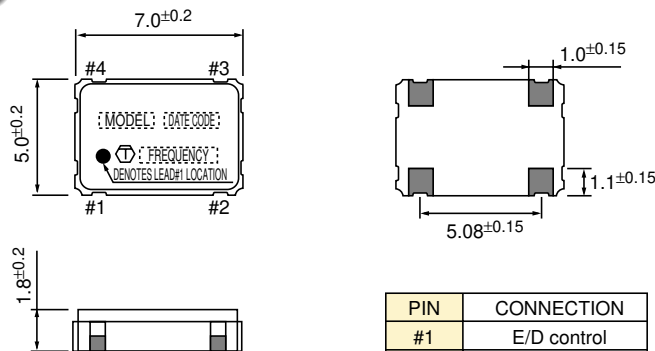


Specifications

Type		TCO 787RH3	TCO 786RH	TCO 787RH
Frequency	f_0	15 to 36 MHz	15 to 70 MHz	36 to 70 MHz
Frequency stability	$\Delta f/f_0$	± 100 ppm	± 50 ppm	± 100 ppm
Operating temperature	Topr	0 to +70°C		
Supply voltage	Vcc	5 VDC $\pm 10\%$	3.3 VDC $\pm 10\%$	5 VDC $\pm 10\%$
Supply current	Icc	10 mA Max (15 to 36 MHz) 15 mA Max (10 to 26 MHz) 35 mA Max (26 to 36 MHz)	7 mA Max (15 to 36 MHz) 13 mA Max (10 to 26 MHz) 30 mA Max (26 to 36 MHz)	0 mA Max (15 to 36 MHz) 15 mA Max (10 to 26 MHz) 35 mA Max (26 to 50 MHz) 50 mA Max (50 to 70 MHz)
Input voltage	VH VL	70 Vcc Min 20 Vcc Max	3.3 V Min 1.5 V Max	
Output voltage	VOH VOL	Vcc Min V Min 0 V Max		
Symmetry	SYM	45 to 55% (50% Vcc level)	40 to 60% (50% Vcc level)	45 to 55% (50% Vcc level)
Rise/Fall time	trif	12 nSec Max (15 to 26 MHz) 10 nSec Max (26 to 36 MHz) at 10 to 90 Vcc	12 nSec Max (15 to 36 MHz) 10 nSec Max (10 to 26 MHz) 8 nSec Max (26 to 36 MHz) at 20 to 80 Vcc	12 nSec Max (15 to 26 MHz) 10 nSec Max (26 to 50 MHz) 6 nSec Max (50 to 70 MHz) at 10 to 90 Vcc
Load capacitance	CL	50 pF Max (15 to 26 MHz) 30 pF Max (26 to 36 MHz)	15 pF Max (15 to 36 MHz)	50 pF Max (15 to 36 MHz) 30 pF Max (26 to 50 MHz) 15 pF Max (50 to 70 MHz)
Startup time	ts	4 mSec Max (15 to 26 MHz) 10 mSec Max (26 to 36 MHz)	4 mSec Max (15 to 26 MHz) 10 mSec Max (26 to 70 MHz)	10 mSec Max (36 to 70 MHz)
Test circuits		TEST#		
Sealing		Glass sealed		

Inclusive of calibration tolerance at 25°C, operating temperature, operating voltage range.

Outline Drawing [mm]



PIN	CONNECTION
#1	E/D control
#2	GND
#3	Output
#4	Vcc (DC)

Product Data (SMOIN)

TCO 786NH 787NH

Features

- TTL output
- Small size: 7W x 5D x 2Hmm
- Enable/disable control & oscillation standby function

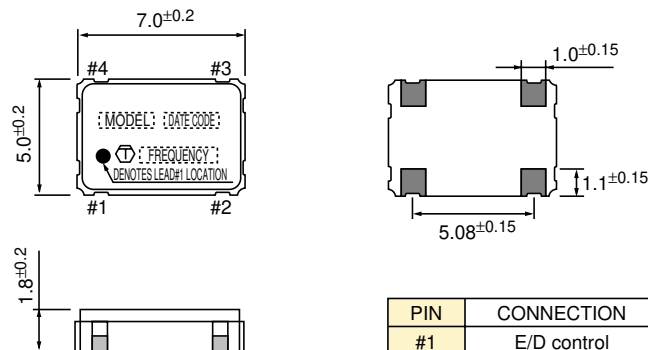


Specifications

Type		TCO 786NH	TCO 787NH
Frequency	f_0	15 to 70 MHz	
Frequency stability	$\Delta f/f_0$	± 50 ppm	± 100 ppm
Operating temperature	Topr	0 to +70°C	
Supply voltage	Vcc	5 VDC $\pm 10\%$	
Supply current	Icc	10 mA Max (15 to 60 MHz) 15 mA Max (10 to 26 MHz) 35 mA Max (26 to 50 MHz) 50 mA Max (50 to 70 MHz)	
Input voltage	V_{HI} V_{LI}	3.5 V Min 1.5 V Max	
Output voltage	V_{OH} V_{OL}	4 V Min 0.4 V Max	
Symmetry	SYM	45 to 55% (1.0 V level)	
Rise/Fall time	tr/ft	5 nSec Max (15 to 70 MHz) at 0.4 to 2.4 V	
Fanout	n	10 Max (15 to 60 MHz) 5 Max (60 to 70 MHz)	
Startup time	ts	4 mSec Max (15 to 26 MHz) 10 mSec Max (26 to 70 MHz)	
Test circuits		TEST 2	
Sealing		Glass sealed	

Inclusive of calibration tolerance at 25°C, operating temperature, operating voltage range.

Outline Drawing [mm]



PIN	CONNECTION
#1	E/D control
#2	GND
#3	Output
#4	Vcc (DC)

Product Data (SMD)

TCO 786KH 787KH

Features

- CMOS/TTL output
- Small size: 7W x 5D x 2Hmm
- Enable/disable control/oscillation standby function

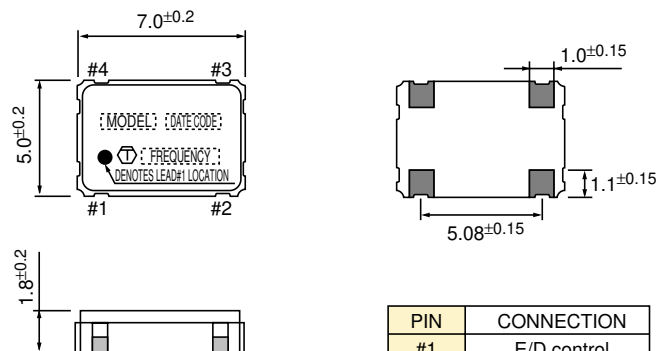


Specifications

Type		TCO 786KH	TCO 787KH
Frequency	f_0	30 to 75 MHz	
Frequency stability	$\Delta f/f_0$	± 50 ppm	± 100 ppm
Operating temperature	Topr	0 to +70°C	
Supply voltage	Vcc	1.5 VDC $\pm 10\%$	
Supply current	Icc	40 mA Max (30 to 50 MHz) 60 mA Max (50 to 75 MHz)	
Input voltage	V_{HI} V_{LI}	2 V Min 0.8 V Max	
Output voltage	V_{OH} V_{OL}	Vcc 4 V Min 0.4 V Max	
Symmetry	SYM	40 to 60% (50% Vcc level, 4 V level)	
Rise/Fall time	tr/TF	7 nSec Max (30 to 75 MHz) at 10 to 90% Vcc (CMOS) at 0.4 to 2.4 V (TTL)	
Load capacitance	C _L	50 pF Max	
Fanout	n	10 Max	
Startup time	t _s	10 mSec Max (30 to 75 MHz)	
Test circuits		TES 0204	
Sealing		Glass sealed	

Inclusive of calibration tolerance at 25°C, operating temperature, operating voltage range.

Outline Drawing [mm]



PIN	CONNECTION
#1	E/D control
#2	GND
#3	Output
#4	Vcc (DC)

Product Data (SMD)

TCO 86ZH 787ZH

Features

- CMOS/TTL output
- Small size: 7W x 5D x 2Hmm
- Enable/disable control/oscillation standby function
- Low operating voltage 3.3V

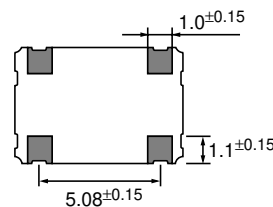
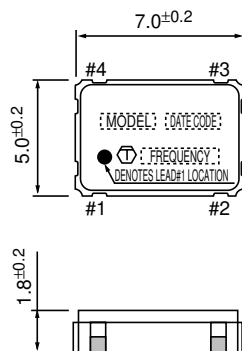


Specifications

Type		TCO 86ZH	TCO 787ZH	
Frequency	f ₀	15 to 80 MHz		
Frequency stability	Δ f/f ₀	± 50 ppm	± 100 ppm	
Operating temperature	T _{opr}	0 to +70°C		
Supply voltage	V _{cc}	3.3 VDC ± 10%		
Supply current	I _{cc}	6 mA Max (15 ≤ f ₀ < 12 MHz) 25 mA Max (28 < f ₀ < 40 MHz) 10 mA Max (12 < f ₀ < 26 MHz) 35 mA Max (40 < f ₀ < 70 MHz) 15 mA Max (26 < f ₀ < 28 MHz) 45 mA Max (70 < f ₀ < 80 MHz)		
Input voltage	V _H V _L	70% V _{cc} Min 30% V _{cc} Max		
Output voltage	V _{OH} V _{OL}	90% V _{cc} Min 10% V _{cc} Max		
Symmetry	SYM	45 to 55% (50% V _{cc} level) 40 to 60% (50% V level)		
Rise/Fall time	t _{rf}	6 nSec Max (15 ≤ f ₀ < 36 MHz) 4 nSec Max (36 < f ₀ < 80 MHz) at 20 to 80% V _{cc} (CMOS) at 10 to 20% V (TTL)		
Load capacitance	C _L	30 pF Max		
Fanout	n	5 Max		
Startup time	t _s	10 mSec Max (15 ≤ f ₀ < 80 MHz)		
Test circuits		TEST 4		
Sealing		Glass sealed		

Inclusive of calibration tolerance at 25°C, operating temperature, operating voltage range.

Outline Drawing [mm]



PIN	CONNECTION
#1	E/D control
#2	GND
#3	Output
#4	Vcc (DC)

Product Data (SMD)

TFG 787RH3 786RH 786XH

Features

- CMOS output
- Small size: 7W 5D 2Hmm
- One chip PLL with VCO

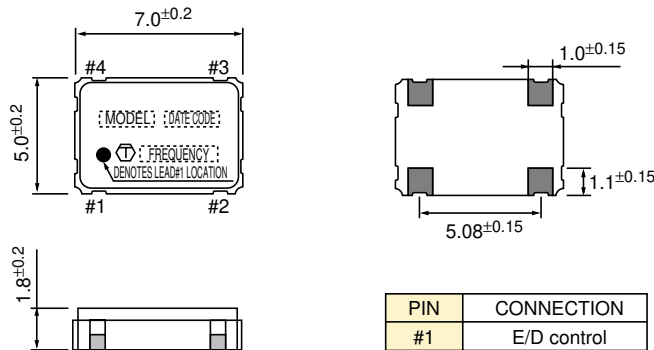


Specifications

Type		TFG 787RH3	TFG 786RH	TFG 786XH
Frequency	f_0	70 to 140 MHz	70 to 112 MHz	
Frequency stability	$\Delta f/f_0$	± 100 ppm	± 50 ppm	
Operating temperature	Top	0 to +70°C		
Supply voltage	Vcc	5 VDC $\pm 10\%$	3 VDC $\pm 10\%$	3 VDC $\pm 10\%$
Supply current	Icc	60 mA Max (70 to 96 MHz) 70 mA Max (96 to 120 MHz) 60 mA Max (120 to 140 MHz)	40 mA Max (70 to 96 MHz) 50 mA Max (96 to 140 MHz)	60 mA Max (70 to 96 MHz) 70 mA Max (96 to 112 MHz) 50 mA Max (96 to 112 MHz)
Input voltage	V _H V _L	70 Vcc min 20 Vcc Max		
Output voltage	V _{OH} V _{OL}	90 Vcc min 10 Vcc Max		
Symmetry	SYM	45 to 55% (50 Vcc level)		
Rise/Fall time	tr/f	3 nSec Max (70 to 140 MHz) at 20 to 80% Vcc	3 nSec Max (70 to 112 MHz) at 20 to 80% Vcc	
Load capacitance	C _L	30 pF Max (70 to 120 MHz) 15 pF Max (120 to 140 MHz)	30 pF Max (70 to 112 MHz)	
Startup time	t _s	2 mSec Max		
Test circuits		TEST #4		
Sealing		Glass sealed		

Inclusive of calibration tolerance at 25°C, operating temperature, operating voltage range.

Outline Drawing [mm]



PIN	CONNECTION
#1	E/D control
#2	GND
#3	Output
#4	Vcc (DC)

Product Data (SMO INK)

TCO 787SH3 785SH 785YH

Features

- Small size: 7W x 5D x 1.8Hmm
- Enable/disable control / Oscillation standby function

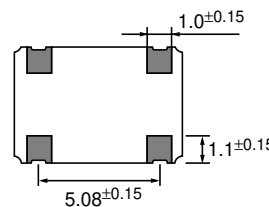
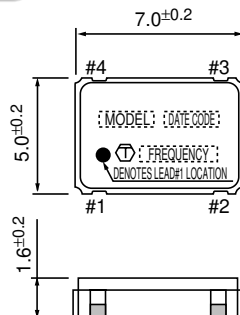


Specifications

Type		TCO 787SH3	TCO 785SH	TCO 785YH
Frequency	f_0	1.5 to 36 MHz	1.5 to 70 MHz	1.5 to 80 MHz
Frequency stability	$\Delta f/f_0$	± 100 ppm	± 25 ppm	
Operating temperature	Top	0 to 70°C		
Supply voltage	Vcc	5 VDC $\pm 10\%$	3.3 VDC $\pm 10\%$	3.3 VDC $\pm 5\%$
Supply current	Icc	10 mA Max (1.5 to 10 MHz) 15 mA Max (10 to 26 MHz) 35 mA Max (26 to 36 MHz)	7 mA Max (1.5 to 10 MHz) 13 mA Max (10 to 26 MHz) 30 mA Max (26 to 36 MHz)	10 mA Max (1.5 to 10 MHz) 6 mA Max (1.5 to 12 MHz) 10 mA Max (12 to 26 MHz) 15 mA Max (26 to 28 MHz) 25 mA Max (28 to 40 MHz) 35 mA Max (40 to 70 MHz) 45 mA Max (70 to 80 MHz)
Input voltage	VH VL	70 Vcc Min 20 Vcc Max	3.5 V Min 1.5 V Max	70 Vcc Min 30 Vcc Max
Output voltage	VOH VOL	Vcc 0.4 V Min 0.4 V Max	Vcc 0.4 V Min 0.4 V Max	90 Vcc Min 10 Vcc Max
Symmetry	SYM	45 to 55% (50% Vcc level) 40 to 60% (50% Vcc level)	45 to 55% (50% Vcc level)	45 to 55% (50% Vcc level) 40 to 60% (0.1 V level)
Rise/Fall time	tr/f	12 nSec Max (1.5 to 26 MHz) 10 nSec Max (26 to 36 MHz) at 10 to 90 Vcc	12 nSec Max (1.5 to 10 MHz) 10 nSec Max (10 to 26 MHz) 8 nSec Max (26 to 36 MHz) at 20 to 80 Vcc	12 nSec Max (1.5 to 26 MHz) 10 nSec Max (26 to 50 MHz) 6 nSec Max (50 to 70 MHz) at 10 to 90 Vcc
Load capacitance	CL	50 pF Max (1.5 to 26 MHz) 30 pF Max (26 to 36 MHz)	15 pF Max (1.5 to 36 MHz) 30 pF Max (26 to 50 MHz) 15 pF Max (50 to 70 MHz)	30 pF Max at 20 to 80 Vcc (CMOS) at 0.4 to 0.2 V (TTL)
Fanout	n	—		
Startup time	ts	4 mSec Max (1.5 to 26 MHz) 10 mSec Max (26 to 36 MHz)	4 mSec Max (1.5 to 26 MHz) 10 mSec Max (26 to 70 MHz)	10 mSec Max (1.5 to 80 MHz)
Test circuits		TEST 4		TEST 04
Sealing		Seam welded		

Inclusive of calibration tolerance at 25°C, operating temperature, operating voltage range.

Outline Drawing [mm]



PIN	CONNECTION
#1	E/D control
#2	GND
#3	Output
#4	Vcc (DC)

Product Data (DIP 14P)

TCO 743A7 743HC7 743TH7

Features

- DIP 14 pin IC package compatible
- Tight stability ± 10 ppm
- Hermetically double sealed metal package and high reliability

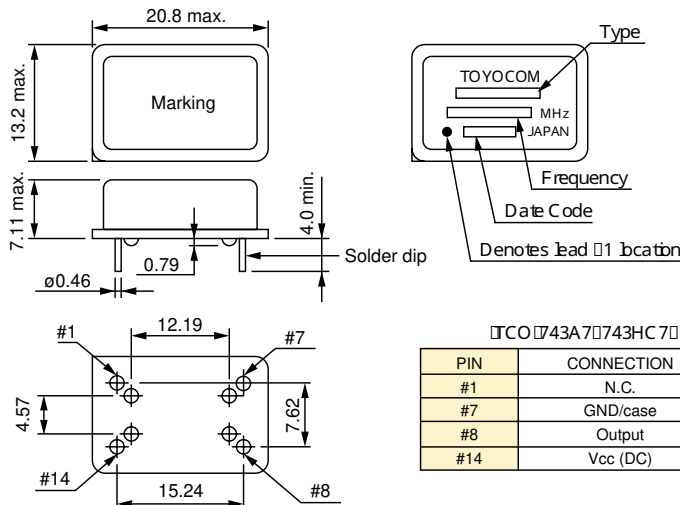


Specifications

Type		TCO 743A7	TCO 743HC7	TCO 743TH7
Frequency	f ₀		15 to 60 MHz	
Frequency stability	$\Delta f/f_0$		± 10 ppm	
Operating temperature	T _{op}		0 to 70°C	
Supply voltage	V _{cc}		5 VDC ± 10	
Supply current	I _{cc}	15 mA Max (15 to 10 MHz) 20 mA Max (10 to 26 MHz) 40 mA Max (26 to 60 MHz)	10 mA Max (15 to 10 MHz) 15 mA Max (10 to 26 MHz) 35 mA Max (26 to 50 MHz) 50 mA Max (50 to 60 MHz)	15 mA Max (15 to 10 MHz) 20 mA Max (10 to 26 MHz) 40 mA Max (26 to 60 MHz)
Input voltage	V _H V _L	—	—	3.5 V Min 1.5 V Max
Output voltage	V _{OH} V _{OL}	4 V Min 0.4 V Max	V _{cc} 4 V Min 0.4 V Max	4 V Min 0.4 V Max
Symmetry	SYM	45 to 55% (1.4 V level)	45 to 55% (50% V _{cc} level)	45 to 55% (1.4 V level)
Rise/Fall time	t _{rf}	5 nSec Max (15 to 60 MHz) at 0.4 to 2.4 V	12 nSec Max (15 to 26 MHz) 10 nSec Max (26 to 50 MHz) 6 nSec Max (50 to 60 MHz) at 10 to 90% V _{cc}	5 nSec Max (15 to 60 MHz) at 0.4 to 2.4 V
Load capacitance	C _L	—	50 pF Max (15 to 26 MHz) 30 pF Max (26 to 50 MHz) 15 pF Max (50 to 60 MHz)	—
Fanout	n		10 Max	
StartUp time	t _t		4 mSec Max (15 to 26 MHz) 10 mSec Max (26 to 60 MHz)	
Test circuits		TEST1	TEST2	TEST2

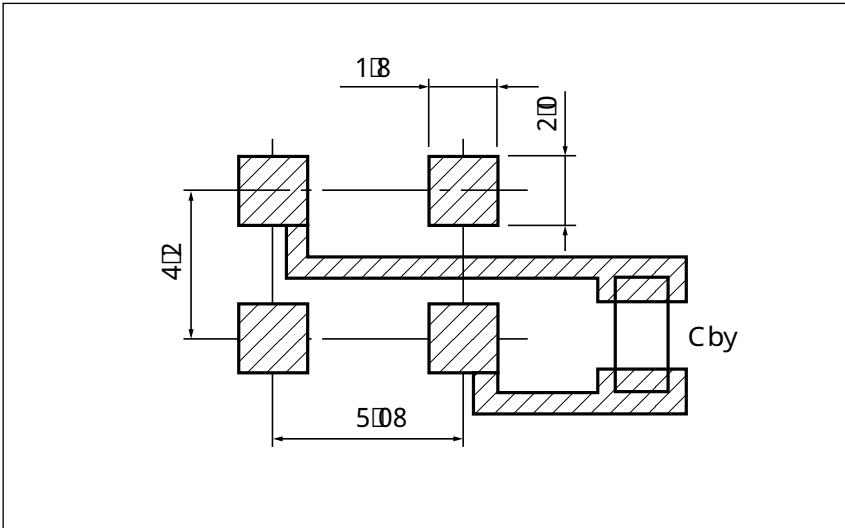
Inclusive of calibration tolerance at 25°C, operating temperature.

Outline Drawing [mm]



Reference Footprint [mm]

SMOIN SMOINK



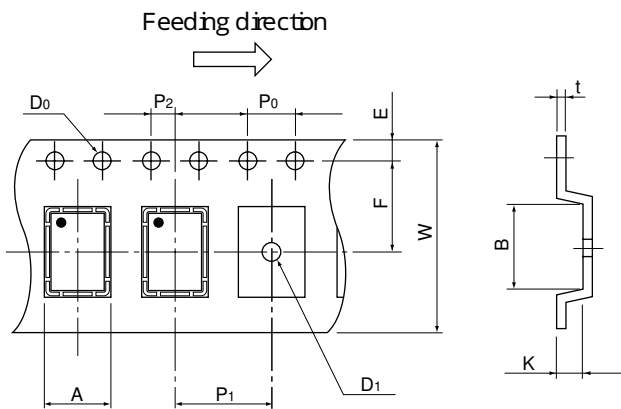
- The figure shows oscillator arrangements close to the idea
- The bypass capacitor Cby must be a ceramic type with 0 μ F or greater
- The ED control terminal (oscillation standby function) should be used for control purposes only. When not in use, this terminal must never be connected to the mains nor grounded

PACKAGING [Tape and Reel] [mm]

SMOIN □ SMOIN□

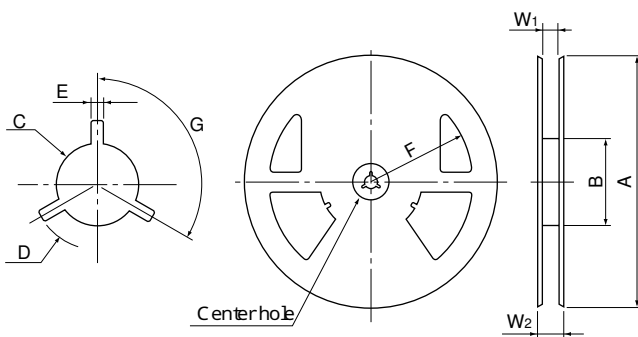
□ Tape(Embossed carrier)

Packing unit: 1000pcs□reel



A□	B□	D0	D1	E□	F□	K□	P0	P1	P2	t□	W□
5□	7□	φ 1□	φ 1□	1□75	7□	2□	4□	8□	2□	0□	16□

□ Reel



A□	B□	C□	D□	E□	F□	G□	W1□	W2□
φ 254	φ 100	φ 13	φ 21	2□	102	120□ □	17□	21□

Inquiry and Ordering Information

- 1 . Type: _____

- 2 . Package: SMDIP14P

- 3 . Frequency: _____ MHz

- 4 . Frequency stability: 100ppm 50ppm 25ppm 10ppm

- 5 . Operating temperature range: 0 to 70 -40 to 85 or _____

- 6 . Supply voltage: Vcc 5V 10 or _____ V \pm _____ %

- 7 . Output:
 - Logic: TTL (Fanout 10 Max)
 - CMOS (CL 15pF 30pF 50pF)
 - Symmetry: 40/60 45/55 or _____ %
 - tr_{tf}: TOYOCOM standard or _____ ns

- 8 . Function: Normal output
 - TriState output
 - or _____

- 9 . Marking: TOYOCOM standard or _____

- 10 . Other requirements if any: _____

- 11 . Sample:
 - Engineering: _____ pcs Delivery needed by _____
 - Qualification: _____ pcs Delivery needed by _____

- 12 . Project
 - Total usage: _____ pcs
 - Schedule: _____