

RTH7050EA

The RTH7050EA is a Hybrid TCXO designed for Stratum 3E applications. Using the cutting-edge proprietary Mercury+[™] ASIC with a high-Q crystal resonator and a built-in heating control system, this TCXO achieves frequency stability of 10 ppb pk-pk over extended operating temperatures ranging from -40 to 95°C within 20°C windows. The frequency ageing is less than 1 ppb/day, and the phase noise floor is as low as -160 dBc/Hz (at 10 MHz). With a small form factor and few discrete components, the RTH7050EA consumes only 400 mW at room temperature and boasts a faster warm-up time of 3 seconds.

The RTH7050EA is a high-performance TCXO with frequencies available from 10 to 50 MHz. Its excellent specifications and features make it the ideal choice for Telecom Boundary Clocks (T-BC) Class C and Class D, which require low dynamic noise contribution from oscillators over the operating temperature range.

Key specifications

Frequency: 10 to 50 MHz

available upon request

Supply voltage: 2.7 to 5 V

Frequency stability (FvT): ±5 ppb

Floor noise: -160 dBc/Hz @ 10 MHz

Applications

- Stratum 3E
- PTP Enabled Ethernet Switches and Routers
- Cable Modem CMTS and Remote PHYs
- G.8262, G.8262.1, G.8263, G.8273.2,
 G.8273.3, G.8273.4

7.5 x 5.5 x 3.3 mm



Frequency Stability over Temperature (FvT)

Operating temperature: -40 to 95°C, -40 to 105°C

All causes long-term stability: ±4.6 ppm/20 year

Output waveform: Clipped sinewave or CMOS



Warm-Up Time (≤±20 ppb) < 15s @ -25°C



Phase Noise – 38.4 MHz RTH7050EA (Typical value at 25°C)



RTH7050EA

1.0 Absolute Maximum Rating¹

Parameter	Min.	Max.	Unit	Note
a. Storage temperature	-55	125	°C	
b. Supply voltage (Vcc)	-0.5	6	V	
c. Load		50	pF	

2.0 Frequency Characteristics²

Ра	rameter	Min.	Тур.	Max.	Unit	Test Condition / Description	
a.	Nominal frequency (Fn)		10 - 50		MHz	Standard frequencies: 10, 12.8, 19.2, 20, 25, 30.72, 38.4, 48, 50 MHz	
b.	Frequency calibration, at time of shipment			±0.2	ppm	At 25°C \pm 2°C, after warm-up, reference to Fn	
c.	Reflow shift			±0.5	ppm	After 1 hour recovery at 25°C	
d.	Operating temperature range	-40		+95	°C	+105°C available on request	
e.	Frequency stability over temperature in still air			10	ppb	Peak-to-peak, in any 20°C window	
f.	Frequency slope $\Delta F / \Delta T$ in still air		0.1	0.5	ppb/°C	Temperature ramp rate \leq 1°C/minute	
g.	Supply voltage stability			±5	ppb	±2% variation, reference to frequency at 3.3V	
h.	Load sensitivity			±5	ppb	±10% variation, reference to frequency at 15pF	
i.	Warm-up time (F0-F1) ³		3	20	S	Time needed after power on for frequency to be within ±20ppb of stable frequency	
j.	Acceleration sensitivity			1 – 2.5	ppb/g	Gamma vector of all three axes from 30Hz to 1500Hz <1ppb/g available for specific requirement	
k.	Long term stability (ageing) ⁴		±0.5	±1	ppb	Per day	
I.	All causes stability			±4.6	ppm	Including calibration, temperature, supply voltage & load changes and 20 years life, reference to Fn	
m.	Wander generation⁵	TDEV compliant with GR-1244 fig 5-4 & G.812 types II & III fig 2 MTIE compliant with GR-1244 fig 5-5 & G.812 types II & III fig 1 TDEV & MTIE compliant with G.8262, G.8262.1, G.8263, G.8273.2, G.8273.3, G.8273.4					

3.0 Root Allan Variance

Parameter	Min.	Тур.	Max.	Unit	Test Condition / Description
a. Root Allan Variance (RAV)		50*10 ⁻¹² 20*10 ⁻¹²			tau = 0.1s tau = 1.0s

¹ Operating beyond this limit may result in change or permanent damage to the device.

² The characteristics of the component may be temporarily affected by the processes of assembly and soldering. The frequency specifications apply after 48 hours of continuous operation after assembly. Nominal conditions (T=25°C, Vcc=3.3V, C_{load}=15pF) apply unless otherwise stated.

³ Parameter is assembly and operating history dependent.

⁴ After 60 days of continuous operation.

⁵ Oscillator stabilised 24 hours at constant temperature (±1°C, still air). Data subjected to relevant loop filter values (-3dB cut-off, 2nd order high pass).

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15*10 ⁻¹²	tau = 10s	
40*10 -12	tau = 100s	
20*10 -11	tau = 1000s	

4.0 Power Supply

Parameter	Min.	Тур.	Max.	Unit	Test Condition / Description
a. Supply voltage (Vcc)	x.xx	2.7 – 5	x.xx	V	Nominal value in the range ±5% variation
b. Input power (Warm up)		1200	1500	mW	At Vcc = 3.3V
c. Input power (Steady state in still		400	440	mW	At Vcc = 3.3V, over -40 to 95°C
air at 25°C)		500	540		At Vcc = 3.3V, over -40 to 105°C

5.0 Oscillator Output – Regulated CMOS 1.0V

Parameter	Min.	Тур.	Max.	Unit	Test Condition / Description
a. Output voltage level low (V_{OL})	0		0.1	V	
b. Output voltage level high (V_{OH})	0.9		1.1	V	
c. Rise and fall time		1	2	ns	10% to 90% level
d. Duty cycle	45		55	%	At 50% level
e. Load		15		pF	Nominal

f. Waveform screenshot (Example at 20MHz)



6.0 Oscillator Output – Regulated CMOS 1.8V

Par	ameter	Min.	Тур.	Max.	Unit	Test Condition / Description
a.	Output voltage level low (V _{OL})	0		0.15	V	
b.	Output voltage level high (V_{OH})	1.65		1.95	V	
c.	Rise and fall time		1	2	ns	10% to 90% level
d.	Duty cycle	45		55	%	At 50% level
e.	Load		15		pF	Nominal

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7.0 Oscillator Output – Regulated CMOS 2.5V

Parameter	Min.	Тур.	Max.	Unit	Test Condition / Description
a. Output voltage level low (V_{OL})	0		0.2	V	
b. Output voltage level high (V_{OH})	2.3		2.7	V	
c. Rise and fall time		1	2	ns	10% to 90% level
d. Duty cycle	45		55	%	At 50% level
e. Load		15		pF	Nominal

f. Waveform screenshot (Example at 20MHz)



8.0 Output Waveform – CMOS (Unregulated)

Par	ameter	Min.	Тур.	Max.	Unit	Test Condition / Description
a.	Output voltage level low (V $_{\text{OL}}$)			10% Vcc	V	

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b.	Output voltage level high (V_{OH})	90% Vcc			V	
c.	Rise and fall time		1	2	ns	10% to 90% level
d.	Duty cycle	45		55	%	At 50% level
e.	Load		15		pF	Nominal

f. Waveform screenshot (Example at 20MHz, 3.3V)



9.0 SSB Phase Noise (10 MHz, Typical value at 25°C)

Parameter	Min.	Тур.	Max.	Unit.	Test Condition / Description
1Hz offset		-82		dBc/Hz	
10Hz offset		-114		dBc/Hz	
100Hz offset		-114		dBc/Hz	
1kHz offset		-158		dBc/Hz	
10kHz offset		-160		dBc/Hz	
100kHz offset		-160		dBc/Hz	
1MHz offset		-160		dBc/Hz	

10.0 Marking

Parameter	Test Condition / Description
а. Туре	Engraved
b. Line 1	[R FFFF YM] Rakon identifier R, Frequency FFFF (M=MHz, e.g. 19M2=19.2MHz), Year Y (A=2010, B=2011,), Month M (1=Jan, 2=Feb,, A=Oct, B=Nov, C=Dec)
c. Line 2	[• LLL] Pin 1 • identifier (embossed), Lot code LLL

11.0 Manufacturing Information

Parameter	Test Condition / Description
a. Reflow	Reflow profile as per IPC/JEDEC J-STD-020E (see drawing)

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b.	Packaging description	Tape & Reel as per EIA-481-E (see drawing)
c.	Application note	For optimum performance follow the instructions in Guidelines for use of Mercury™ /Mercury+™ Oscillators
d.	Net weight	17 mg/pc

12.0 Environmental Specification⁶

Parameter	Test Condition / Description
a. RoHS compliant	Parts are fully compliant with the European Union directives 2011/65/EU and 2015/863/EU (amending annex II to directive 2011/65/EU) on the restriction of the use of certain hazardous substances in electrical and electronic equipment
b. Solderability	IPC/ECA J-STD-002, method 2, precondition 150°C, 16 hours
c. Latch Up	EIA/JESD78, tested at room temperature and maximum ambient operating temperature
d. Electrostatic Discharge (ESD)	Human Body Model (HBM), JEDEC JS-001, ≥ 2000V Charged Device Model (CDM), JESD22-C101, ≥ 1000V Machine Model (MM), JESD22-A115, ≥ 200V
e. Low Temperature Storage	JESD22-A119, 1000 hours at -55°C, unbiased
f. Thermal Shock	JESD22-A104 / MIL-STD-883, method 1010, 15 cycles from -55°C to 125°C
g. Temperature Humidity Bias	EIA/JESD22-A101-B, 85°C / 85% RH, 1008 hours, at max. Vcc
h. Temperature Cycling	JESD22-A104 / MIL-STD-883, method 1010, 1000 cycles, -55°C to +125°C, non-operating, 15 minute soak
i. High Temperature Operating Life	JESD22-A108, ≥ 2000 hours at 125°C & max. Vcc
j. Cold Power Cycling	Rakon standard, -40°C, 12 minutes OFF, 4 minutes ON, 1000 cycles
k. Frequency Ageing	MIL-PRF-55310, 1008 hours
I. Mechanical Shock	MIL-STD-202 (method 213), 1500g, 0.5ms duration, 18 shocks total
m. Vibration	JESD22-B103 (section 4.2.2), test Fc: 20g, 20 to 2000Hz, 4 minute sweep, 4 sweeps x 3 axes

13.0 **3D Model**

Parameter	Remarks
Package size	7.5 x 5.5 x 3.3 mm
STEP file	<u>RTH7050EA 3D model</u> To open or view the STP file, you will need to import it into one of the following software programs: Autodesk Fusion 360, CATIA, SolidWorks, Solid Edge, TurboCAD, Kubotek KeyCreator, FreeCAD, ABViewer, ShareCAD, or eMachineShop.

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 $^{^{6}}$ For all relevant tests the units are pre-conditioned as per JESD22-A113 (5 temperature cycles -40°C to +60°C + bake for 24 hours at T = +125°C + moisture soak for 168 hours at +85°C / 85% RH + 3x reflow at TMAX = +260°C).



14.0 Model Outline and Test Circuit





FRONT VIEW





4	

SIDE VIEW

RECOMMENDED PAD LAYOUT - TOP VIEW



NOTE:

The area between the pads is a keep-out area, no tracks or ground plane allowed on any layer.

Pin	Connections
1, 2	NC
3	Do not connect (GND optional)
4	GND
5	RF Output
6, 7, 8	NC
9	Supply Voltage (Vcc)
10	Do not connect (GND optional)



Millimetres

Hole =



TITLE: 7050 Series Oscillators Tape & Reel	FILENAME: CAT1534	TOLERANCES:	
RELATED DRAWINGS:	REVISION: A	$X.X = \pm 0.2$	colco
	DATE: 05-Sep-2019	$X.XX = \pm 0.10$	Iakon
	SCALE:	$X.XXX = X^{\circ} =$	
	Millimetres	Hole =	© 2019 Rakon Limited

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16.0 Reflow



Note:

- The Pb-free Reflow follows the guidelines of IPC/JEDC J-STD-020.
- The product has been tested to withstand the Reflow Profile shown. The Reflow Profile used to solder Rakon products is determined by the solder paste Manufacturer's specification. It is recommended that the Reflow Profile used does not exceed the one shown above.

TITLE: Pb-Free Oscillator Reflow (Classification Temperature Tc = 250°C)	FILENAME:	CAT649	
RELATED DRAWINGS:	REVISION:	В	
	DATE:	15-May-2019	rakon
	SCALE:	NTS	
	Millimetres		© 2009 Rakon Limited



17.0 Disclaimer

Parameter	Test Condition / Description
a. Disclaimer	"Samples supplied according to this specification are supplied from our development or pre- production programme and are not qualification approved products. No condition, warranty or representation regarding quality, suitability, performance, life or continuation of supply is given or implied and Warranty in clause 7 of our standard Conditions of Sale is not applicable. The right is reserved to change the design or specification or cease supply without notice." Rakon Limited