Master Reference Oscillator – High Reliability

The MRO HR (Master Reference Oscillator High Reliability) is a modular space equipment that generates and distributes highly stable and reliable frequency signals. It is specifically designed for telecommunication, navigation and earth observation satellites where frequency stability and ultra-low phase noise are crucial. The MRO HR is particularly suited to GEO missions with a lifetime of up to 20 years.

It achieves a highly stable long-term frequency stability down to ±100 ppb over 20 years. Up to 48 outputs are available from 5 to 200 MHz, with the output level adjustable per port. The architecture has no single point of failure and offers a reliability of 99.99% thanks to its 3:1 redundancy. The unit can easily be connected to a Master Local Oscillator to create a Frequency Generation Unit.

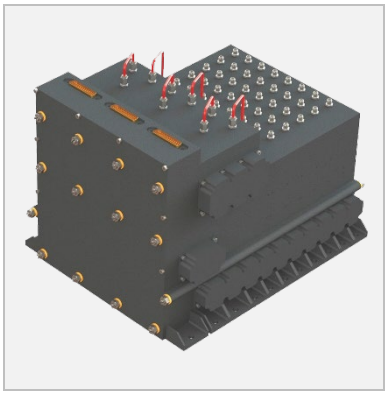
The current baseline includes integrated DC/DC converters which allow the clock to be powered directly from the primary power of the satellite, ON & OFF TM/TC and one block of 8 outputs @ 10 or 100 MHz. Custom solutions are available on request (e.g., synchronisation to a PPS signal, different stability class oscillators, digital electronic frequency control, or additional outputs).

All components are selected according to ECSS QST60 Class 1 and materials according to ECSS-QST70.

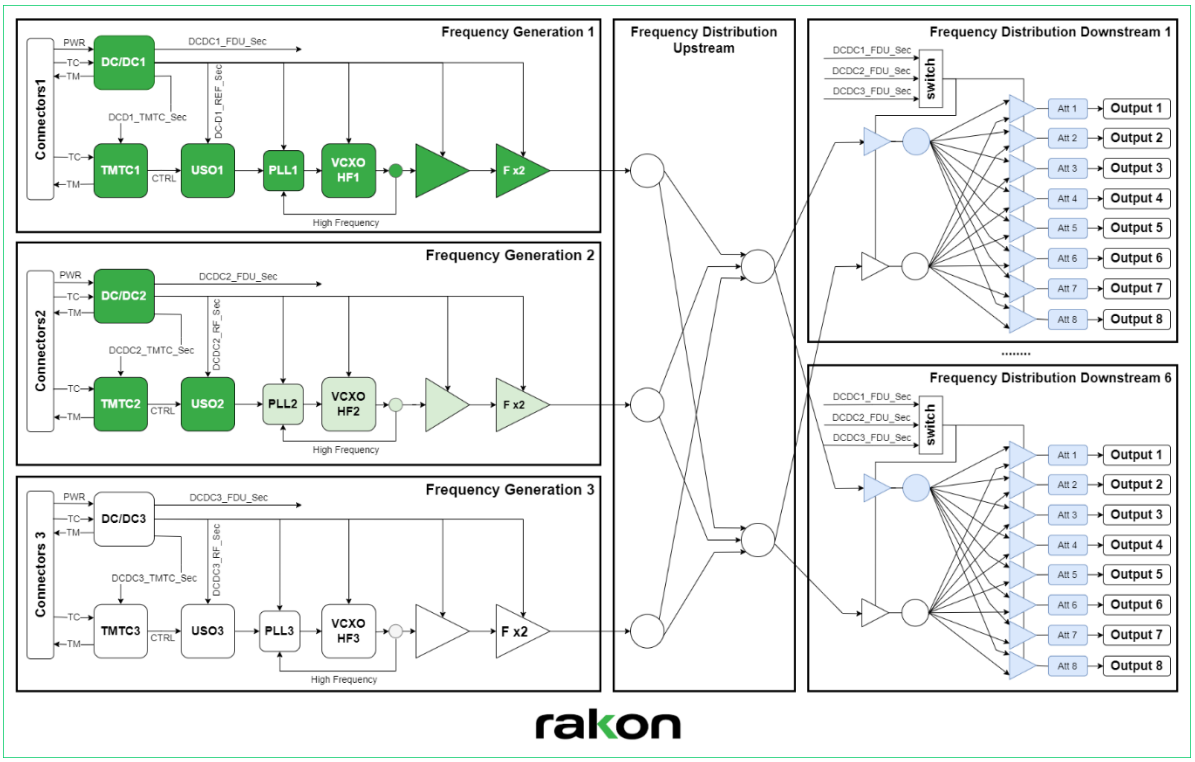
Key Features

- Output frequency: 5 to 200 MHz
- 3 classes of overall frequency stability:
  STD: ±2.5 ppm for 20 years
  PERF: ±1 ppm for 20 years
  USTAB: ±0.1 ppm for 20 years
- Typical phase noise @10 MHz:
  -105 dBc/Hz (@ 1 Hz)
  -133 dBc/Hz (@ 10 Hz)
  -145 dBc/Hz (@ 100 Hz)
  -150 dBc/Hz (@ 1 kHz)
  -155 dBc/Hz (@ 10 kHz)
- Up to 16 outputs
- Output power: -7 to 5 dBm
- Isolation between 2 outputs: > 50 dB
- Redundancy 3:1
- Up to 48 outputs
- Power bus: 100 V
- Communication interface: low level Command
- Mass (8 outputs): 7 kg
- Power (8 outputs): 16 W steady-state
- Connector: DSUB; microD, SMA

240 x 270 x 240 mm



Modules and Block Diagram



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Environment Conditions

Parameter	Condition / Remarks	Min.	Typ.	Max.	Unit
Operating temperature (TOp)	FvT: ±5 ppb	-40		70	°C
Non-operating temperature	Qualification	-55		85	°C
Nominal thermal conductance between baseplate and caloducs			1130		W/m²/K
Thermal flux Density over Baseplate				5	W/cm²
Random vibration	Out of plane 10 Hz: 0.03 50 Hz: 1 g²/Hz 90 Hz: 1 g²/Hz 100 Hz: 1.5 g²/Hz 300 Hz: 1.5 g²/Hz 510 Hz: 0.65 g²/Hz 772 Hz: 0.05 g²/Hz 2000 Hz: 0.05 g²/Hz Overall level = 26.3 gRMS		In Plane 10 Hz: 0.006 g²/Hz 80 Hz: 0.1 g²/Hz 600 Hz: 0.1 g²/Hz 2000 Hz: 0.05 g²/Hz Overall level = 12.2 gRMS		
Sine vibration	Any plane 5 – 26 Hz: ± 10 mm 26 – 100 Hz: ± 30 g				
Mechanical shock (SRC – Q = 10)	Any plane 100 Hz: 30 g 500 Hz: 2000 g 10000: 2000 g				
Radiation	MEO and GEO				
Lifetime	20 years				

Typical Performance Characteristics

Parameter	Condition / Remarks	Min.	Typ.	Max.	Unit
Nominal frequency			10		MHz
Steady state input current power	Vacuum @ +20°C			16	W
Warm up supply power	Vacuum, EOL @ -30°C			28	W
Overall frequency drift	EOL (20 years)			±100	ppb
Short-term stability	ADEV @1-10s			5E-12	
Output waveform	Sine				
Output power level	EOL (20 years) / adjusted by port	-7		+5	dBm
Harmonics level				-50	dBc
Spurious level				-100	dBc
Phase noise @ 10 MHz	1 Hz offset 10 Hz offset 100 Hz offset 1 kHz offset 10 kHz offset		-105 -133 -145 -150 -155		dBc/Hz

Physical Parameters (8 outputs @ 10MHz and 10^{-9} stability class reference)

Parameter	Condition / Remarks
Mass	7 kg
Package	W x L x H: 240 x 270 x 240 mm
Power	Steady state: 16 W; Warm-up (2 MROs warming up at the same time): 28 W

Model outline