



**SM CREATIVE
ELECTRONICS LTD**

The 2nd meeting of the International Committee on GNSS (ICG-02)

***PRECISION TIME AND FREQUENCY
SOLUTIONS***

- Hari Shanker Pandey



SM CREATIVE ELECTRONICS LTD

CORPORATE OVERVIEW

- **AN ISO 9001:2000 CERTIFIED COMPANY WITH FULL FLEDGED R&D FACILITY RECOGNIZED BY GOVT. OF INDIA FOR ALL R&D DISPENSATIONS.**
- **ENGAGED IN DESIGN , MANUFACTURING ,SUPPLY, INSTALLATION AND SERVICING OF ELECTRICAL, ELECTRONICS AND TELECOMMUNICATION PRODUCTS**
- **STRONG PRESENCE IN INDIA WITH BRANCHS ACROSS THE COUNTRY & OVERSEAS**
- **PROVIDES A WIDE RANGE OF PRODUCTS WHICH INCLUDE :-**
 - **HIGH PERFORMANCE**
 - **HIGH RELIABILITY**
 - **HIGH PRECISION**
- **OUR SERVICES :-**
 - **PROJECT MANAGEMENT**
 - **SYSTEM DELIVERY**
 - **TRAINING**
 - **PRODUCT CUSTOMIZATION FOR SPECIFIC REQUIREMENTS**
 - **MAINTENANCE CONTRACTS**
 - **TECHNICAL SUPPORT**



SM CREATIVE ELECTRONICS LTD

TARGET APPLICATIONS

SPACE

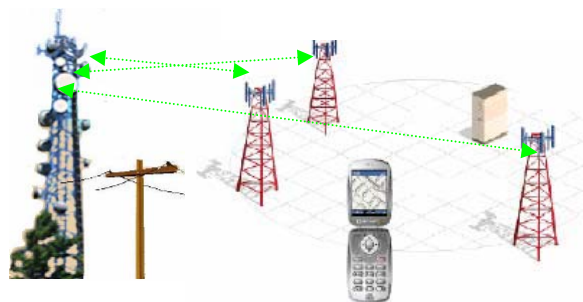
HIGH PRECISION TIME AND FREQUENCY CONTROL TECHNOLOGY



- TRIPLE REDUNDANT ULTRA STABLE OSCILLATORS
- TRIPLE REDUNDANT RUBIDIUM ATOMIC STANDARDS
- TRIPLE REDUNDANT PRECISION QUARTZ OSCILLATORS
- DOUBL REDUNDANT MULTIPLE FREQUENCY RF SYNTHESIZERS
- TRIPLE REDUNDANT DC/DC CONVERTERS
- FREQUENCY TRANSLATORS , MULTIPLIERS AND RECEIVERS
- UP/DOWN CONVERTERS

TELECOM

NETWORK SYNCHRONIZATION



- WIRELESS AND WIRELINE
- 3G CDMA/UMTS
- CARRIER SYNC BITS CLOCKS
- IP NETWORKS
- SITE CALIBRATION
- SYNC REFERENCES



SM CREATIVE ELECTRONICS LTD

TARGET APPLICATIONS

NAVIGATION

- GNSS POSITIONING
- SEA OIL EXPLORATION
- REFERENCE SOURCE
- RADAR CONTROL

TEST & MEASUREMENT

- CALIBRATION
- OSCILLATOR CLOCK CHARACTERIZATION
- TIE MEASUREMENT
- TIME TRANSFER
- DOPPLER SHIFT COMPENSATION
- LAB INSTRUMENT

DIGITAL BROADCASTING

- DVB-T, DVB-H, FLO, DAB, DRM



SM CREATIVE ELECTRONICS LTD

TECHNOLOGY

ACCURACY

HYDROGEN MASER

1 x 10⁻¹⁶

CESIUM STANDARD

GPS RECEIVERS

LORAN RECEIVERS

CDMA RECEIVERS

RUBIDIUM STANDARD

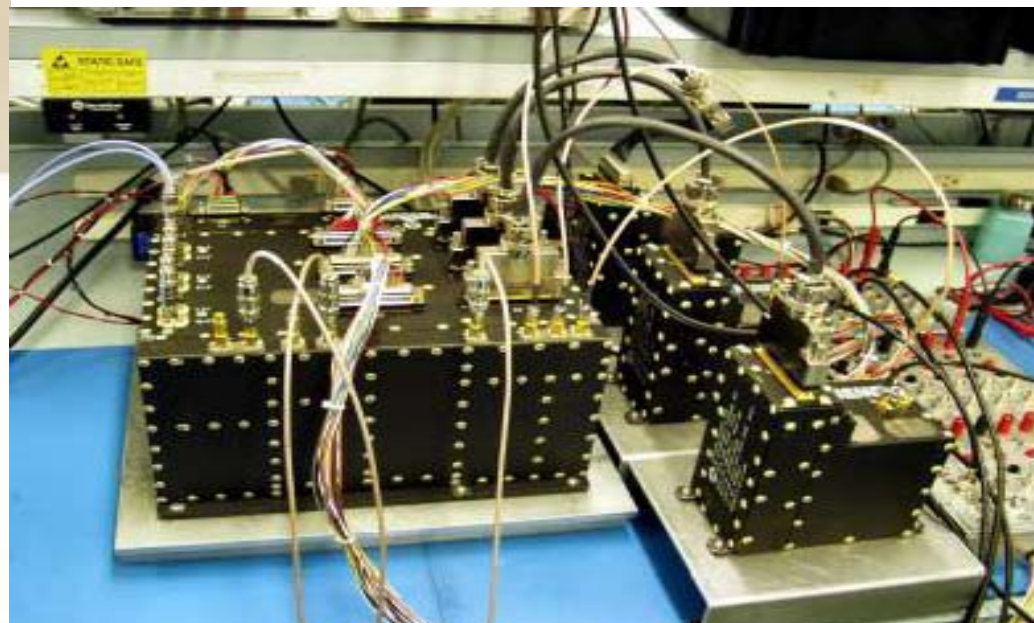
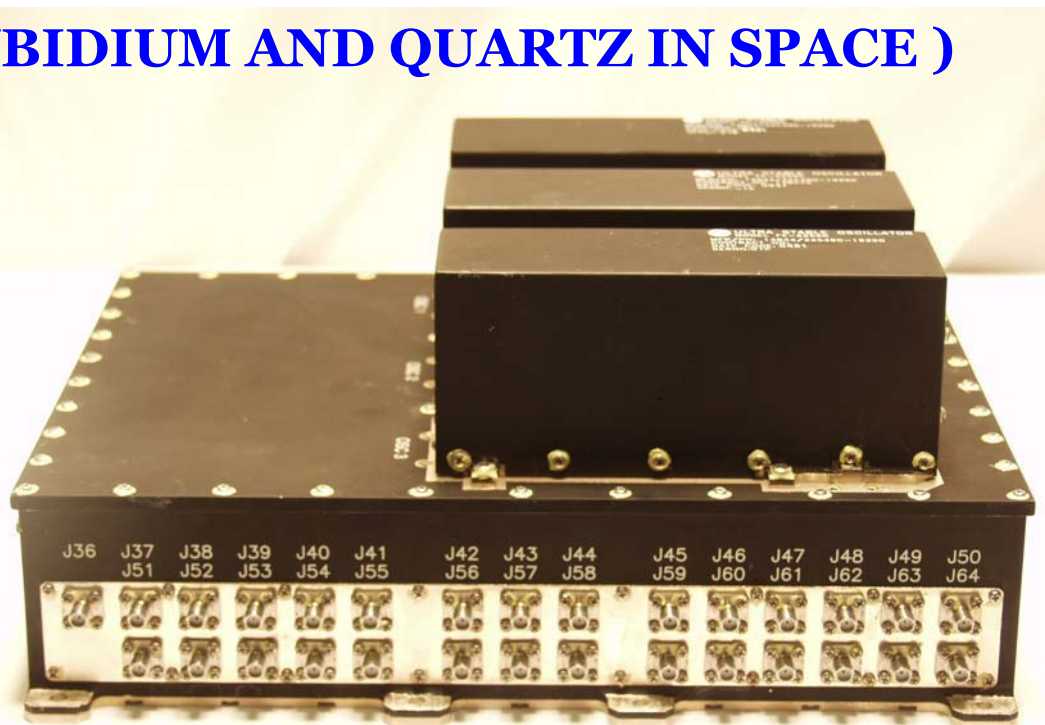
QUARTZ CRYSTAL

TUNED CIRCUITS

1x 10⁻⁵



MASTER CLOCKS (RUBIDIUM AND QUARTZ IN SPACE)

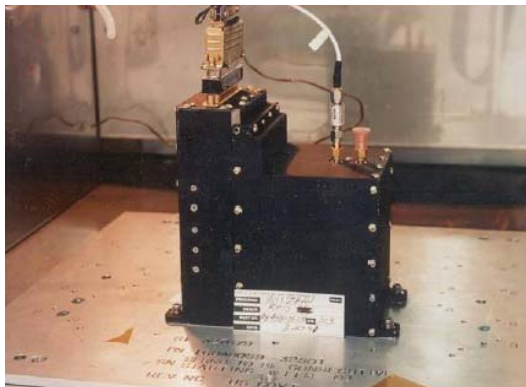




SM CREATIVE ELECTRONICS LTD

RUBIDIUM CLOCKS IN SPACE

- **RUBIDIUM CLOCK SYSTEM ON BOARD MILSTAR SPACE CRAFT SINCE 1994**
 - **ALL FREQUENCIES AND TIMING FOR THE MILSTAR SATELLITES ARE DERIVED FROM THE RMO**
 - **LOW DRIFT $< 3 \times 10^{-14}$ /DAY**
 - **INHERENTLY INSENSITIVE TO RADIATION EFFECTS**
 - **DESIGNED FOR LOW SINGLE EVENT UPSET**
- **RUBIDIUM CLOCK SYSTEM AND SYNTHESIZER ON BOARD AEHF**

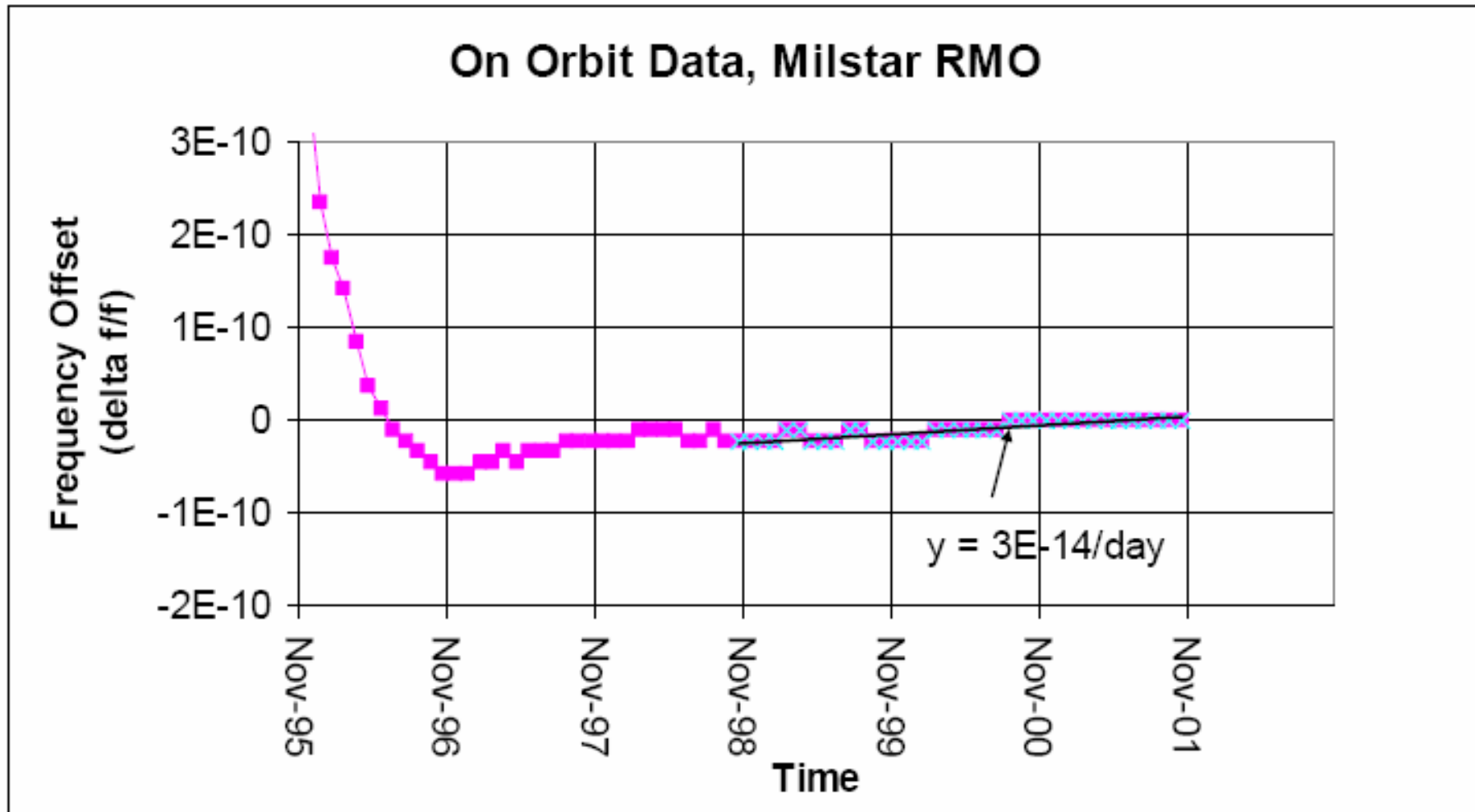


- **RUBIDIUM MASTER OSCILLATOR SN003**
- **TOTAL OF 19 SYSTEMS DELIVERD TO MILSTAR**
- **EXCELLENT PERFORMANCE IN SPCAE**
- **AGING RATE $\approx 3 \times 10^{-14}$ / DAY**



SM CREATIVE ELECTRONICS LTD

RUBIDIUM CLOCKS IN SPACE

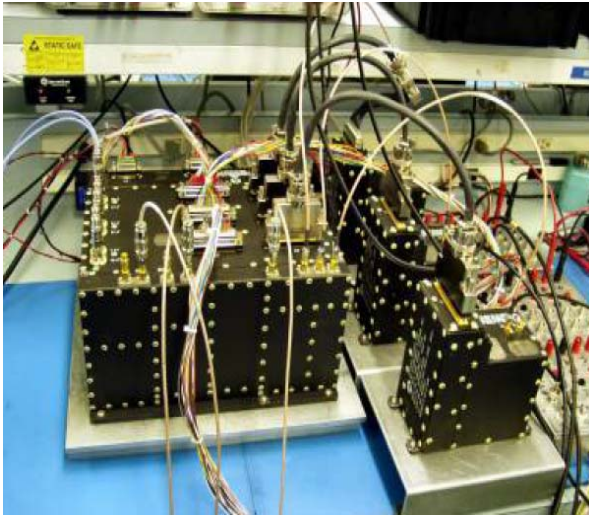




SM CREATIVE ELECTRONICS LTD

RUBIDIUM CLOCKS IN SPACE

ADVANCED EHF SPACE SYSTEM CONSISTING OF :-

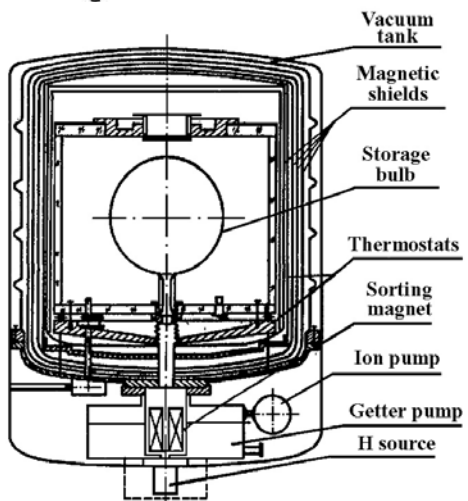


- **TRIPLE REDUNDANT RUBIDIUM ATOMIC STANDARDS**
- **TRIPLE REDUNDANT PRECISION QUARTZ OSCILLATORS**
- **DOUBLE REDUNDANT MULTIPLE FREQUENCY RF SYNTHESIZERS**
- **TRIPLE REDUNDANT DC/DC CONVERTERS**
- **TRIPLE REDUNDANT MIL-STD-1553B SERIAL INTERFACE**



SM CREATIVE ELECTRONICS LTD

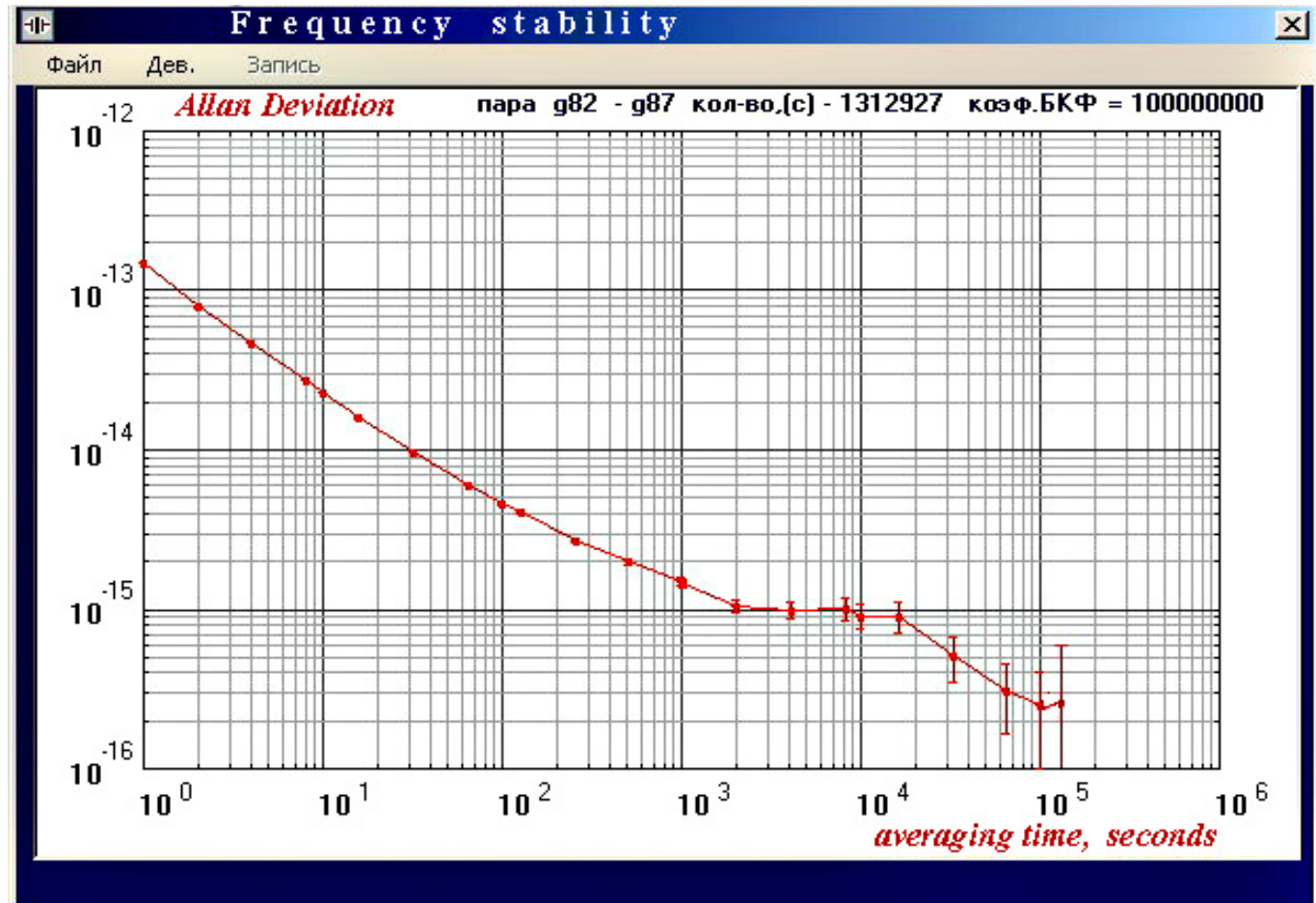
ACTIVE HYDROGEN MASERS (IEM KVARZ RUSSIA)



Performance	CH1-75A "KVARZ"
Allan Deviation.	
1 s	2×10^{-13}
10 s	2.5×10^{-14}
10^2 s	7×10^{-15}
10^3 s	2×10^{-15}
10^4 s	1×10^{-15}
1 day	7×10^{-16}
Temperature sensitivity, 1/°C	1×10^{-15}
Magnetic sensitivity	1×10^{-14} /Gauss
CAT technique	Cavity frequency switching
Size, m (H x W x D)	0.7×0.48×0.6
Weight; kg	95



SM CREATIVE ELECTRONICS LTD



- Highest Accuracy ,short term and long term frequency instability $7 \cdot 10^{-16}/\text{day}$, $2 \cdot 10^{-13}/\text{s}$
- Output Signal Frequencies: 5 MHz, 100 MHz



SM CREATIVE ELECTRONICS LTD

ACTIVE HYDROGEN MASER CH1-90



- Frequency of output signals 5, 10, 100 MHz (pulse 1 Hz)
- Output Signal instability:
 - Per 1 sec $1,5 \cdot 10^{-13}$
 - Per 1 day $3 \cdot 10^{-16}$
- Weight 90 Kg



SM CREATIVE ELECTRONICS LTD



PRECISE TIMING FACILITY FOR GLONASS GROUND INFRASTRUCTURE

Provided by: IEM KVARZ RUSSIA (OUR TECHNOLOGY PARTNER)



SM CREATIVE ELECTRONICS LTD

CORE TASK OF THE PRECISE TIMING FACILITY:-

- Navigation Timekeeping
- Critical function for fulfilling the navigation mission
- Needed for accurate satellite orbit determination and satellite clock synchronization
- Generation of GLONASS's own permanent reference timescale
- To follow the atomic world time TAI (UTC)
- The Timing Station- Group Keeper of frequency and time
- Formation of a highly stable redundant signal of group frequency of 5 MHz
- Formation of redundant time scales with the period of repeating 1 sec
- Gathering and processing of measurement results
- Frequency stability information recording, consistent check of normal operational conditions of all equipment and display of results of work in the form of reports and graphs
- Conducting a database of results of work



SM CREATIVE ELECTRONICS LTD

PASSIVE HYDROGEN MASERS (IEM KVARZ RUSSIA)



- Output Signal Frequency 5 MHz
- Compact and light weight
- Transportable

Performance	CH1-76A “KVARZ”
Allan Deviation	
1 s	$<8 \times 10^{-13}$
10^2 s	$<7 \times 10^{-14}$
1 day	$<5 \times 10^{-15}$
Size, m (H × W × D)	0.28×0.48×0.55
Weight, kg	51



SM CREATIVE ELECTRONICS LTD

PASSIVE HYDROGEN MASERS (IEM KVARZ RUSSIA)



- Output Signal Frequency 5 MHz
- Compact and light weight
- Transportable

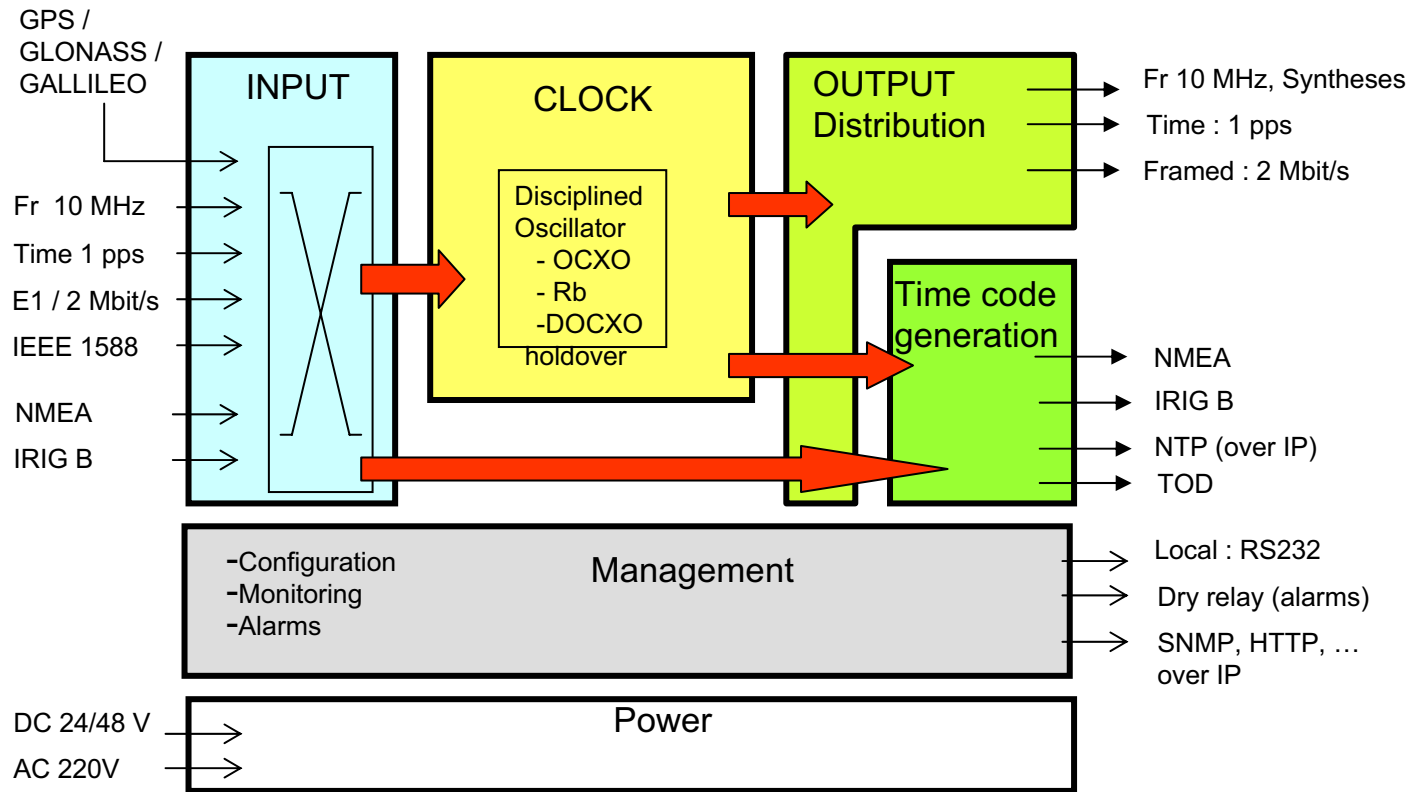
	CH1-91 "KVARZ"
Performance	
Allan Deviation	
1 s	5×10^{-13}
10^2 s	5×10^{-14}
1 day	$2,5 \times 10^{-15}$
Size, m (H × W × D)	0.2×0.44×0.59
Weight, kg	30



SM CREATIVE ELECTRONICS LTD

External reference
inputs

N outputs of
each type





**SM CREATIVE
ELECTRONICS LTD**

THANK YOU

Hari Shanker Pandey

E-mail IDs: hspandey@smcel.com

hspandey.smcel@gmail.com