

COSPAS-SARSAT BEACON TESTER

BT-611

User manual



Table of contents

1. Introduction	3
2. Measurements review.....	3
3. Specification.....	3
4. Measuring Accuracy.....	4
5. Principles of operation	6
6. Recommended methods for beacon testing	6
7. Measuring procedures.....	8
8. Calibration procedure for power measurement.....	18
9. Annual verification	20
10. Fault removal	21
11. General information.....	22
Annex 1 The results of testing simulated signals	23

1. Introduction

The BT-611 is designed mainly for precise measuring signal parameters of 406 MHz Emergency beacons, which are critical to the Cospas-Sarsat (C-S) System.

It also provides possibilities to test parameters of homing transmitter at 121.5 MHz.

The measuring accuracy complies with C-S document T.007.

The instrument is fully controlled via RS-232 port of host PC running WINDOWS98 or later. It is need also to have installed Internet explorer 5 or higher version.

Provisions made for internal test using embedded 406 and 121 MHz signal simulators.

The instrument provides high stability measuring results at laboratory or field condition at ambient temperature of +10...40C. It is recommended to check annually power measuring accuracy.

Main units of the instrument are manufactured under Russian patent.

2. Measurements review.

Reliable decoding of 406 MHz beacon signal and position location by C-S system depends firstly on phase modulation quality and medium/short frequency stability of beacon's reference oscillator. As a rule, these tests require using optional equipment in addition to standard measuring instruments. The BT-611 provides testing of all emergency beacon basic parameters being connected to host PC only.

In the process of measuring the BT-611 acquires instantaneous amplitude and frequency counts of measured signal. Then required parameters calculated and organized in the form of graphs or tables. It also presents decoded distress message as a whole, so as separated to appropriate fields.

The results may also be saved for further displaying and printing.

3. Specification.

Front panel connectors and indicators

“POWER” TNC connector - RF power input for 406 and 121.5 MHz signals supplied directly from beacon's power amplifier:

- Maximum power level < 10 W;
- Input impedance 50 Ohm , VSWR< 1,2 up to 450 MHz.

“ANTENNA” BNC connector – RF power input for measuring antenna signals:

- Maximum power level < 200 mW;
- Input impedance 50 Ohm , VSWR< 1,5.

Warning! The unit may be permanently damaged in the case of direct beacon connection to ANTENNA input

“RS-232” - connection to host computer.

Front panel LEDs indicates next conditions:

- **ON** - power on;
- **MEAS** – the unit is in measuring mode;
- **LINK** - transition of calculated data to computer;
- **SIGN** - 406 or 121,5 МГц signal data acquisition .

Rear panel elements

- **AC power three-prong connector equipped with 2A fuse.**
 - Input voltage 180...240V,
 - Frequency 47...63Hz,
 - Power consumption 50 W maximum.

Always use the three-prong AC power cord, supplied with this instrument.

- **Ground screw.** Must be connected to the earth ground, when three- to two-prong power line adapter is used.
- **Sweep-tone level regulator.**

Operating environment

- Operating temperature + 10...40C;
- Relative humidity up to 95% at 25C.

Storage conditions

- Temperature - 40... 50°C;
- Humidity up to 90% at 25°C (non condensing)

Weight

- Net 2,8 kg; (measuring unit)
- Gross 3,4 kg (antenna included)

Dimensions

- Measuring unit 252x260x69 mm
- Antenna (when assembled): Height 490 mm

4. Measuring accuracy

4.1 With direct beacon connection, BT-611 provides next accuracy characteristics:

Таблица 1

Measured Parameter limiting error		Measured value	Error	
			C-S T. 008	BT-611
Frequency	406 MHz	406020... 406030 kHz	±100 Гц	$\Delta_{406} = \pm 20,3 \text{ Гц}$
	121.5 MHz	121495... 121505 kHz	-	$\Delta_{121} = \pm 21,6 \text{ Гц}$
Frequency stability		$< 1 \times 10^{-9}$	1×10^{-10}	$\delta_{fS} = +3,88 \times 10^{-11}$
measuring resolution				
Phase deviation		$\pm(63 \pm 6.3)^\circ$	$\pm 2,3^\circ$	$\Delta_\phi = \pm 0,8^\circ$

Deviation Trise/Tfall time	150±100 us	±25 us	$\Delta\tau = \pm 10 \text{ us}$
Asymmetry	< 5%	±1%	$\delta_{AS} = \pm 0,8\%$
Bit rate	400±4 bit/s	±0,6 bit/s	$\Delta_{BR} = \pm 0.18 \text{ bit/s}$
Burst duration	(440±4,4) ms (520±5.2)	±1 ms	$\Delta_{BD} = -80 \text{ us}$
Preamble duration limiting error	(160±1,6ms)	±1 ms	$\Delta_{PD} = -60 \text{ us}$
Burst repetition period	47,5...54,5 s	±10ms	$\Delta_{RP} = \pm 10 \text{ ms}$
Output power 406 MHz	3,1...8 W	±10%	$\delta_{P_{406}} = \pm 10\%$
406 MHz power rise time	5 mc	±0,5 mc	$\Delta_{PR} = \pm 0,5 \text{ ms}$
Output power 121.5 MHz	20...150 mW	-	$\delta_{M_{121}} = \pm 10\%$

Note: the accuracy of parameters related to Power not warranted for measurements with antenna. The accuracy of other parameters not effected if measured with antenna.

4.2 Power rise time measuring conditions differ in BT-611 relative to C-S recommendations.

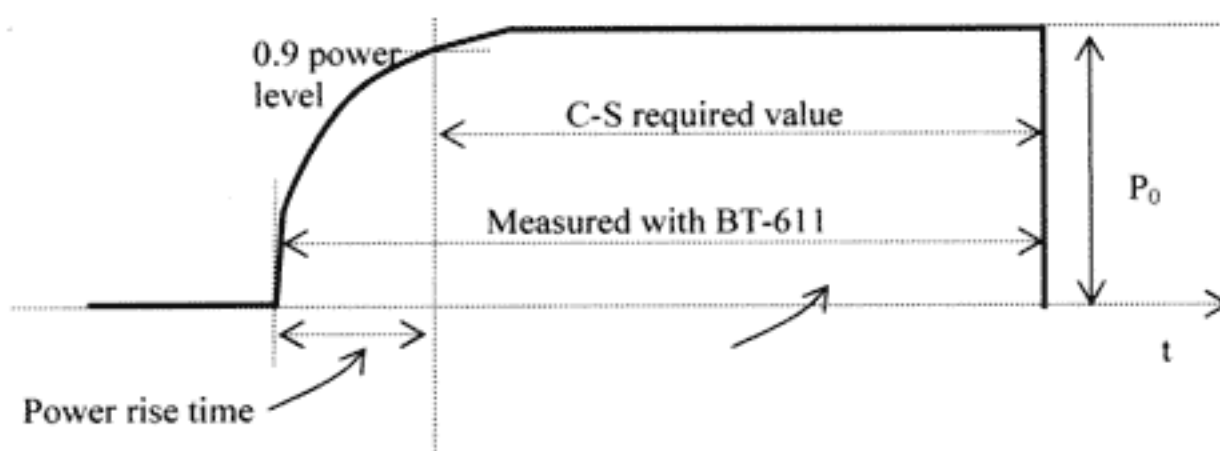


Figure 1 – the difference between BT-611 and C-S recommended method for burst/preamble duration measurements

Figure 1 shows the difference. Since power rise time at most of the beacons less then 1ms BT-611 results remains close to required by C-S method. If measured value exceeds 1 ms, one can get corrected preamble and burst duration value by extracting power rise time from there measured values. For controversial situation, the mentioned values should be measured using spectrum analyzer in zero span mode.

4.3 For 121/5 MHz signal sweep tone modulation parameters additionally estimated

Parameter	Estimated value	error
Minimum and maximum sweep tone frequencies	100...1600 Hz	± 20 %
Modulation index	>50%	±30%

These parameters are optional and not calibrated.

5 Principles of operation

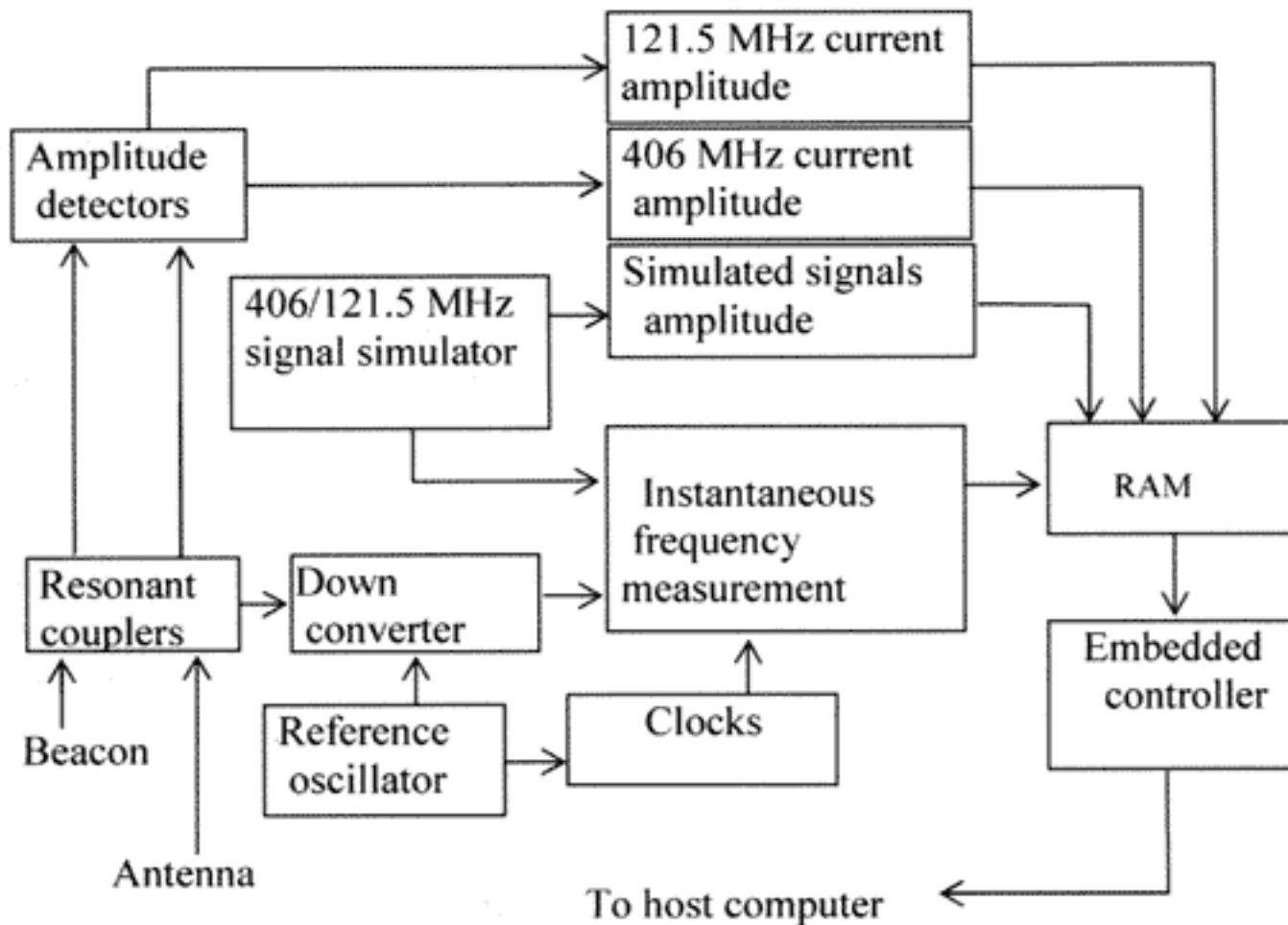


Figure 2 – block diagram of measuring unit

Figure 2 shows the main blocks of signal processing in BT-611.

For measuring amplitude, the signals first selected by resonant couplers, then after peak detector sampled at DAC. Decoupled RF signals down converted to 100 kHz, then instantaneous frequency value measured. Amplitude and frequency samples processed by embedded controller to provide raw results which transmitted to host PC. At the PC, the results organized to graphs and tables.

6. Recommended methods for beacon testing.

6.1 Beacon power output directly connected to the instrument.

The best way to have reliable power readings is to connect BT-611 RF power input with supplied cable to the beacon antenna output using a suitable adapter. If you are well familiar about beacon design, it is possible to connect the instrument to power amplifier or the duplexer output inside the beacon. (Be sure that there is no DC voltage at this point!).

6.2 Radiated signal test

Radiated signals of any beacon models can be tested with measuring antenna in the field so as in the laboratory. Reliable power readings not provided with simple antennas, but the measuring results for other parameters not effected at that. In any case, the test with antenna is always preferable because it makes possible to estimate stability of signal generation technique in real environment. It is need to take into account, that with output power degradation twice and more, the beacon still has a chance to be detected by satellite. At the same time beacon's signal may not be processed properly, if modulation index changes more than ± 10 degree to nominal value or a bit rate deviate more then 5%.

To prepare measurements with antenna:

- Connect antenna rod to the upper side of the holder;
- Fix the legs by screwing them to the bottom of holder;
- Put assembled antenna on the upper surface of the instrument (or other

convenient place) and connect antenna cable to BT-611 antenna input.

Beacon under test should be situated at a distance about 1...3 m. Try to avoid vertical metal planes at the same distance.

Note: some EPIRB models (maritime beacons) may have a problem with modulation index or frequency if they radiate without a ground plane, which should simulate water surface. It means they could be used only being submerged to the water. It is recommended to consult beacon manufacturer about proper radiating conditions, if incorrect phase modulation index or frequency value will be revealed at the test. However, the most of them will work properly being placed on the metal plane about 1 m².

WARNING! It is strictly prohibited to radiate false distress signals!

Use screened room if available (under deck premises, for example). If not, consult to your nearest COSPAS/SARSAT Local User Terminal specialists about time schedule of the satellite passes over your location.

Do the tests only if satellite is out of view.

It is possible in any time to radiate shortly beacon signals having the self-test mode protocol. To be sure does the beacon test signal fit this protocol, test it first in a screened room. The headline of any protocols, graphics or tables, presents beacon message contents. It will be marked as "Test message" if beacon actually radiates in a self-test protocol mode.

7. Measuring procedures

IMPORTANT

- Make sure the available AC power line meets the following requirements: AC 110 or 220 V, frequency 47...63 Hz;
- Verify that the power source outlet provides appropriate ground contact;
- It is recommended to connect BT-611 to PC serial port first, before the equipment will be connected to the mains or grounded;
- The instrument and supplied RF cable are matched set. Power-measuring channel calibration need if you change cable length or use additional matching devices, more suitable for your conditions (see paragraph 7);
- There are no serviceable parts inside;

7.1 User's software

The host PC should run WINDOWS 98 or later and has installed **Internet Explorer 5** version or later. The software contains the next modules:

Name	Used as:
bt02.exe	Main executive module.
bt.url	Web-page shortcut, used to start web page, if module bt02.exe already run but web page was closed.
Calibr1.406, Calibr1.121	Manufacturer's Power Calibration files (for supplied cable only)
DATA	The folder for automatically saved data
bt02.ini	Configuration file.

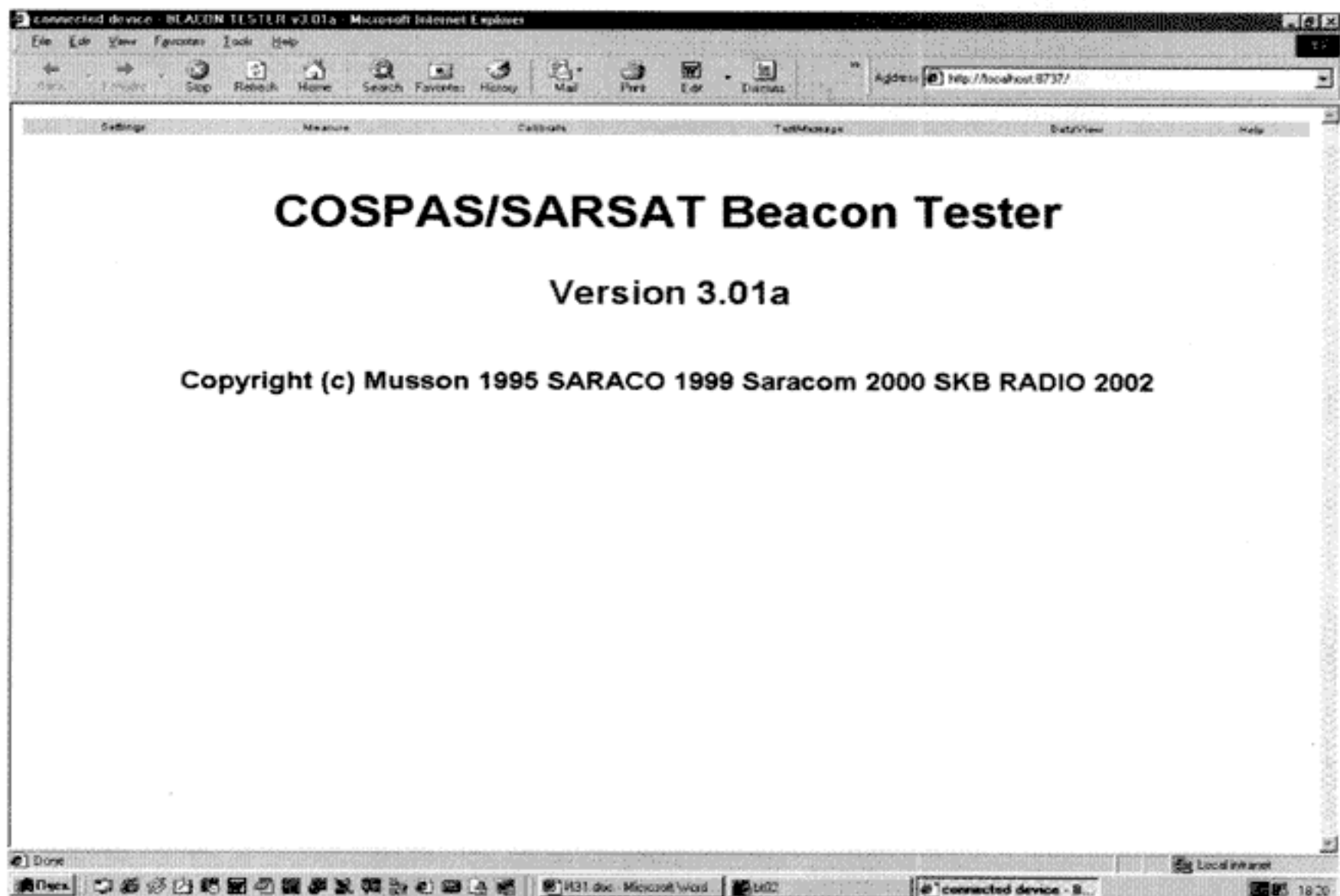
For installation

- Copy all files to any directory you appointed for beacon tester. The number of copies not limited. Automatically saved files with test results you will find at the DATA directory. You could copy them and run at any PC where **bt02.exe** has been installed, without connecting BT611;
- Make backup copy of the diskette and store the original in a safety place;

7.2 Available modes.

A minute later after power on, you will hear the melodious sound and see "MEAS", "SIGN", "LINK" LEDs are flashing on and than off. The instrument is ready to work for short term measurements after 15 minutes. It is recommended to test medium term stability parameters after warming up period of 1 h.

Run the **bt02.exe** software. Below there is a screen you should see.



The auxiliary MS-DOS program will start in parallel. It has no user's data, but it will keep BT running in MEASURE mode even if you close Web Browser or open another window. The BT-611 will continue to collect and store the data, therefore you may see them after returning back to **bt02**. It is recommended to put **bt02.exe** shortcut at the desktop and save web page in your browser after first loading. To escape fully from measuring you need to close MS-DOS window.

At the upper line, you may see the next hot keys:

Settings

Opens menu to select:

- **Signal source** - the signal sources you are going to connect: **Beacon, Antenna or Simulator**;
- **Measuring Channels** - the signals you are going to measure: **406 MHz only, 121 MHz only, or 121+406 MHz**;
- Test conditions, that will be printed at the protocol;
- Start/End time axis, displayed on the graphs ,
- **Checkup time** - (default value 30 minutes) the vertical line on the graphs will mark the time point, after which further monitored parameters should comply with specified values.
- **Power calibration** file numbers linked to the cables (adapters) used;

- **COM port** available in host computer;
- File name for **automatic saving** (beac is default name) and the length of data packet (number of bursts), periodically saved to (hard) disk. Selection "0" means no automatic saving.

Click **Apply** key to fix your settings.

Measure

Opens new window where you may:

- Appoint for printing the test protocol number, date, environment conditions, beacon's model name and serial number;
- Select different forms of results presentation from pulldown menu; (default window **406 Phase modulation**).
- Put the time scale for instantaneous phase
- Put the amplitude scale for instantaneous frequency (applicable for **406 inburst frequency & envelope** only);
- ON/OFF screen refresh (**Update ON/Off**);
- Load previously saved file for review (**Load**); you may do it during the measurements, then click **Tester** soft key to return current screen;
- Save manually the results, stored at the moment (**Save**);
- Start/Stop measurements (**Run/Break**);
- Continue(**Cont**) measurements without cleaning previous data (if there was auto saving mode, the data saving will continue);

Besides default "**406 Phase modulation**" window, for displaying results you may choose:

- **Medium & short stability** parameters (first results appear after 18 burst passed);
- **406 Phase & Rise/Fall** – averaged modulation index, plus modulation Rise/Fall times for consequently received bursts ;
- **406 Frequency & Power** – averaged burst power, plus frequency, plus RMS frequency deviation (averaged at 18-burst window) for consequently received bursts;
- **Inburst frequency & Envelope** - instantaneous frequency as an increment to mean burst frequency, plus power envelope (available for **406 MHz** channel only)
- **Summary table** - table of 121.5/406 MHz signals parameters and message content
- **121 Message params** - table of 121.5 MHz transmitter parameters

Calibrate

This key opens the window for calibration 406/121 power measuring channels (see clause 8)

TestMessage

This window provides possibilities to type hex message content (the whole from bit 1 or shortened from bit 26) to see detailed fields content.

Dataview

This window provides detailed viewing of medium/short term stability results by putting convenient vertical and horizontal (time) scales

In **auto** mode new results added automatically after every burst; alternatively they fixed but added with currently stored if you choose **auto** mode again.

7.3 Recommended procedures.

Make the settings needed in **Settings** menu. It is recommended to select first **Simulator** as a signal source, than:

- Mark **406+121,5 MHz** as **Measuring channels**;
- Choose power calibration files **ADC**
- Mark appropriate COM port;
- Click **Apply** key then return to **Measure** menu.

The default window for displaying parameters is **406 Phase modulation**.

Click **Run** key to start testing of simulated signals. Figures A.1a and A.1b in Appendix 1 shows measuring results. Sweep tone parameters may differ from burst to burst; other parameters should comply with shown ones.

For measuring beacon's signal parameters:

- return to **Settings** menu;
- choose desired signal source **Beacon** or **Antenna**, and measuring channel: «**121 MHz**» only, or «**406 MHz**» only, or «**406+121,5 MHz**», connect signal source;
- click **apply** key than **Run** key at **Measure** menu. The instrument will display real beacon signal parameters.

If «**406+121,5 MHz**» mode selected the 121,5 MHz signal parameters will be measured ones after every 406 MHz burst, while with «**121 MHz**» only, the measurements will be repeated after 2...5 s.

In addition to standard parameters set, selection «**406 MHz**» only channel, makes possible to measure internal burst frequency behavior relative to mean frequency value at **Inburst frequency & Envelope** window.

7.4 Presentation of measured results

Phase modulation It is recommended to use for annual Beacon testing. Current phase behavior inside the burst presented to the left. Solid black lines mark the limit levels $\pm (1.1 \pm 0.1)$ radians. Vertical grid space is 0.1 radian. Other measured burst parameters listed in the column at the right. The meaning of measured values explained at the table 2. Above the phase picture, current burst hexadecimal message contents displayed. Averaged over half a bit modulation index (for degree dimension) additionally displayed at the bottom, together with T_{rise} and T_{fall} readings. The phase picture may be scaled by changing t factor from 1 to 100. The figures 3a through 3g shows differently scaled phase modulation examples of the same burst. Only ones scaled picture may be recalled after saving measuring results.

Current picture at $t = 1..5$ may be inclined up or down until the reference oscillator not warmed up. If it remains inclined long time, there may be internal frequency drift during the burst; it is recommended to check Allan variances after 18 bursts in this case.

Table 2

Current	3621	Current burst number since the test started
FS1,Hz	406027430.108	Frequency value sampled on 12...112 ms interval
FS2,Hz	406027430.168	Frequency value sampled on 217...317 ms interval
FS3,Hz	406027430.135	Frequency value sampled on 317...417 ms interval
Phase+,rad:	1.107	«+» modulation index (averaged)
Phase-,rad:	-1.094	«-»modulation index (averaged)
TRise,mcs:	114.364	Deviation time rise
TFall,mcs:	116.192	Deviation time fall
P,Wt:	6.868	Burst power (averaged at interval from 70 ms to the burst end)
Prise,ms:	0.0	Power rise time (0,1...0,9 level)
BitRate, bps:	399.993	Bit rate
Assymetry,%:	0.000	Half bit asymmetry
Preamble,ms:	159.978	CW preamble
Total,ms:	440.054	Total burst duration
RepPeriod,s:	50.700	Burst repetition period
DifPeriod,s:	3.690	Maximum period difference (over 18 bursts)
Slope:	3.8e-012	Frequency slope relative to carrier (18 FS2 counts window,)
R.variance:	2.5e-010	Residual variations (18 FS2 counts window,)
S.variance:	5.9e-011	Short term stability (Allan variance, corresponds to FS2, FS3 counts)
PDF1 BCH ok		BCH check result

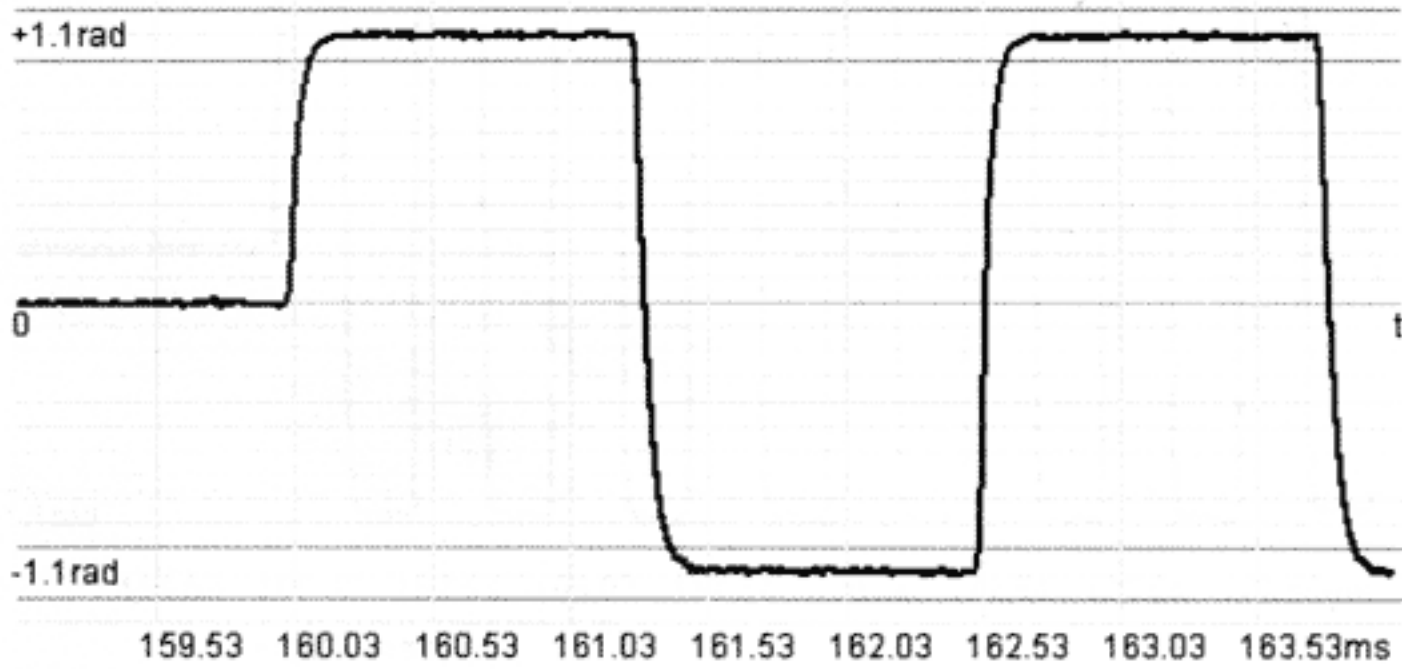


Fig.8 Phase

Phase+ =63.26 ° TRise+ =103.5 mcs
 Phase- =-62.09 ° TFall- =119.4 mcs

Fig. 3a – instantaneous phase, scale 1

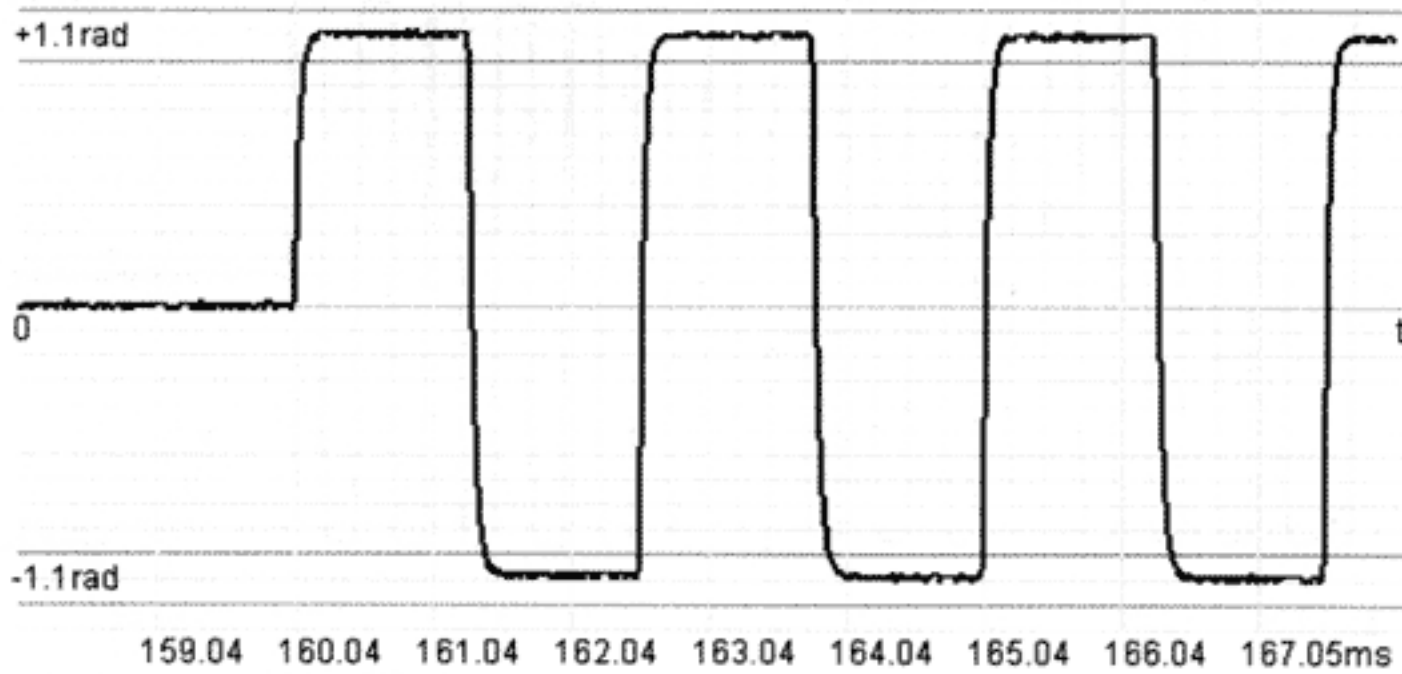


Fig.8 Phase

Phase+ =63.88 ° TRise+ =101.4 mcs
 Phase- =-61.49 ° TFall- =116.5 mcs

Fig. 3b – instantaneous phase, scale 2



Fig.8 Phase

Phase+ =63.73 ° TRise+ =103.5 mcs
 Phase- =-61.75 ° TFall- =119.5 mcs

Fig. 3c – instantaneous phase, scale 5

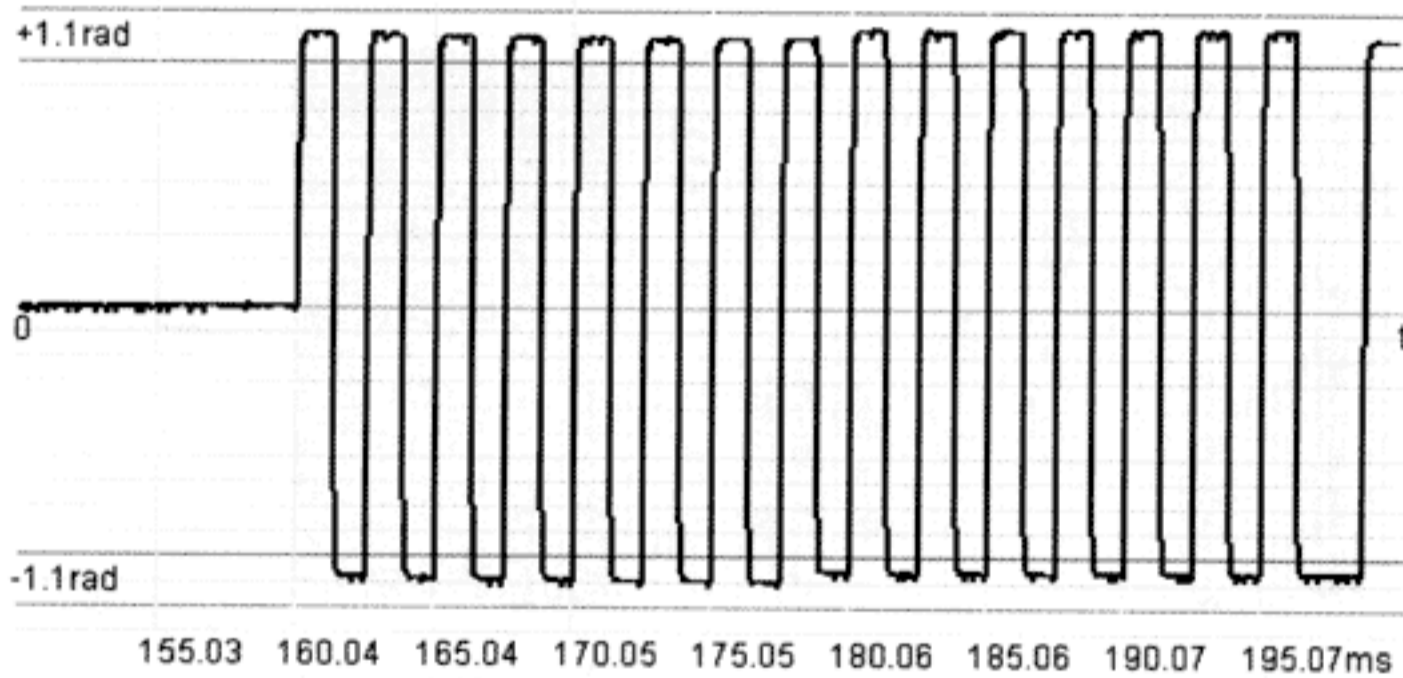


Fig.8 Phase

Phase+ =63.45 ° TRise+ =102.7 mcs
 Phase- =-62.01 ° TFall- =116.7 mcs

Fig. 3d – instantaneous phase, scale 10

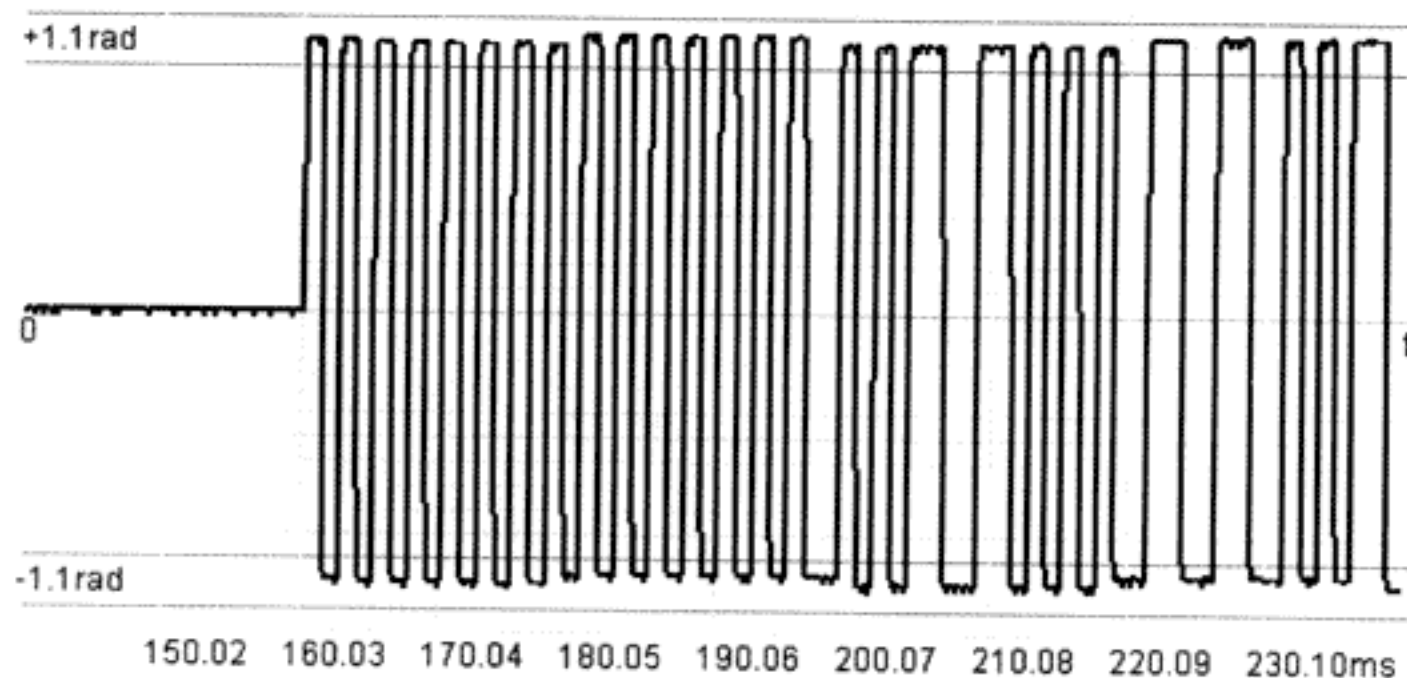


Fig.8 Phase

Phase+ =63.29 ° TRise+ =103.3 mcs
 Phase- =-62.21 ° TFall- =118.7 mcs

Fig. 3e – instantaneous phase, scale 20

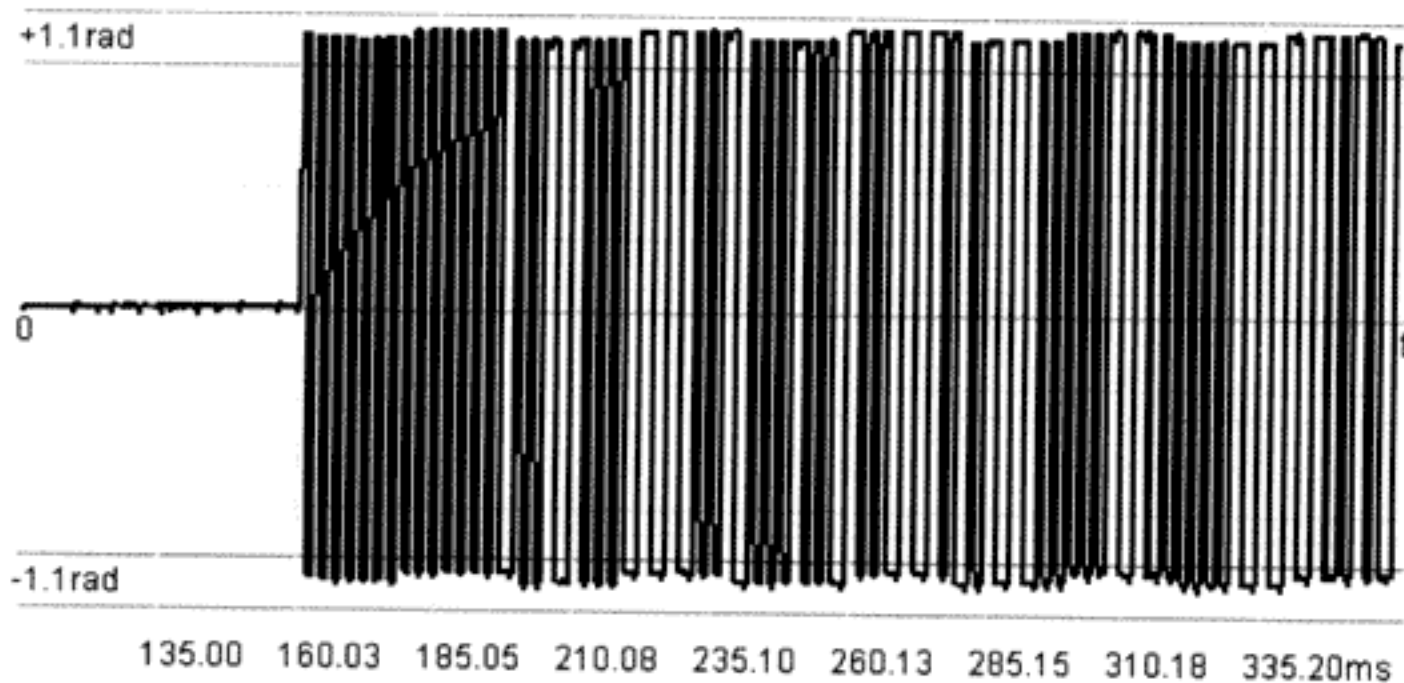


Fig.8 Phase

Phase+ =63.34 ° TRise+ =106.2 mcs
 Phase- =-62.24 ° TFall- =121.1 mcs

Fig. 3f – instantaneous phase, scale 50

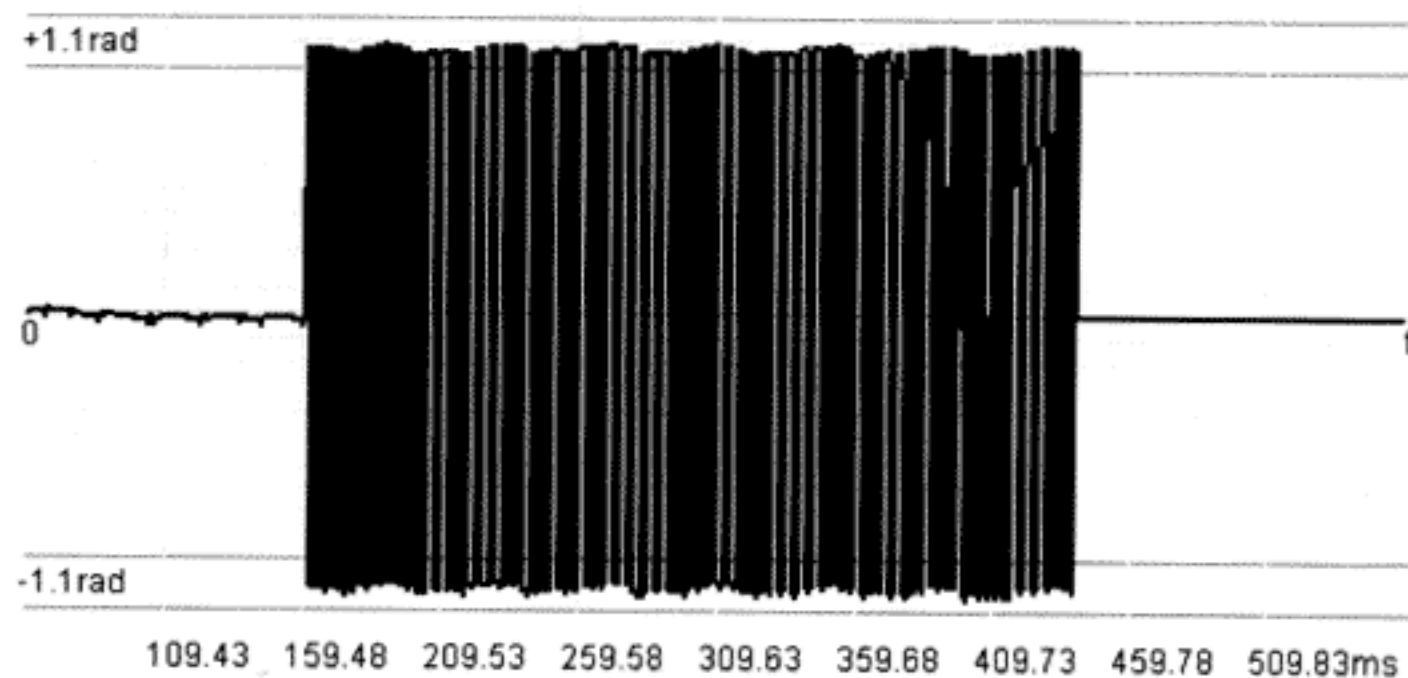


Fig.8 Phase

Phase+ =63.56 ° TRise+ =97.7 mcs
 Phase- =-61.65 ° TFall- =117.1 mcs

Fig. 3g – instantaneous phase, scale 100

Medium & short stability window normally used for the transmitted frequency long-term tests. The measurement begins with the Beacon switched on. Vertical line marks the time point after which frequency stability must come to required limits. Default time value is 30 min. It can be changed at the **Settings** window.

There are three parameters used for frequency stability test:

- *The mean slope*, defined as the mean slope of the least-squares straight line; horizontal solid lines marks the limits $\pm 1E-9$;
- *The residual frequency variations about that least-squares straight line*; horizontal solid line marks the limit $3E-9$;
- *Short-term frequency stability* corresponds to the Allan variance; horizontal solid line marks the limit $2E-9$;

Figure 4 shows the example of results of the transmitted frequency long-term test.

Message:FFFE2F 510E0000000204695C870 0

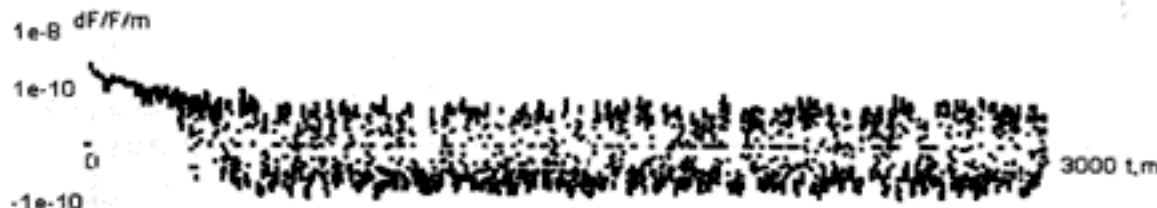


Fig.3 Mean Slope

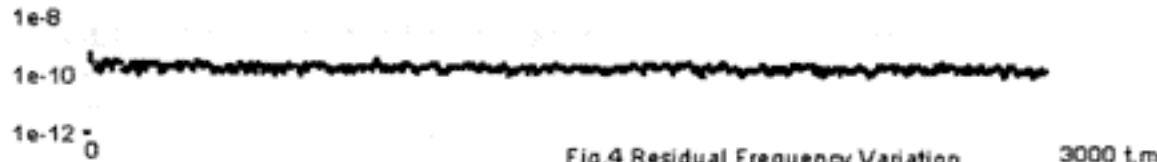


Fig.4 Residual Frequency Variation

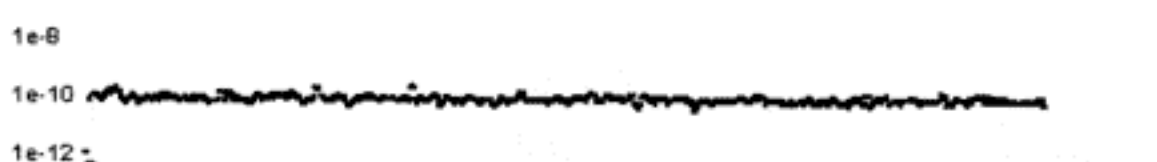


Fig.5 Short-Term Stability

Current	3463
FS1,Hz:	406027308.809
FS2,Hz:	406027308.912
FS3,Hz:	406027308.956
Phase+,rad:	1.105
Phase-,rad:	-1.107
TRise,mcs:	109.497
TFall,mcs:	115.051
P,Wt:	5.803
Prise,ms:	0.1
BitRate,bps:	400.022
Assymetry,%:	0.000
Preamble,ms:	159.973
Total,ms:	439.999
RepPeriod,s:	51.520
DiffPeriod,s:	4.670
Slope:	-2.9e-012
R.variance:	1.7e-010
S.variance:	5.1e-011
PDF1 BCH ok	

Figure 4 - example of results of the transmitted frequency long-term test

406 Phase & Rise/Fall - displays *Modulation index* and *Rise and Fall Times* data stored over long-term test; normally used to check signal generation and modulation scheme consistency. Figure 5 shows an example of results recorded. Solid horizontal lines mark the limits.

Message:FFFE2F 510E0000000204695C870 0

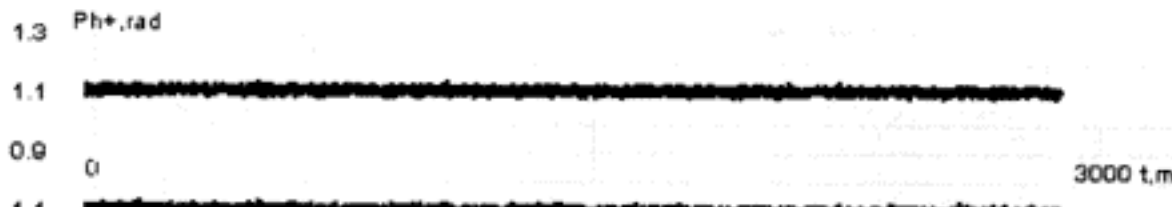


Fig.6 Modulation index

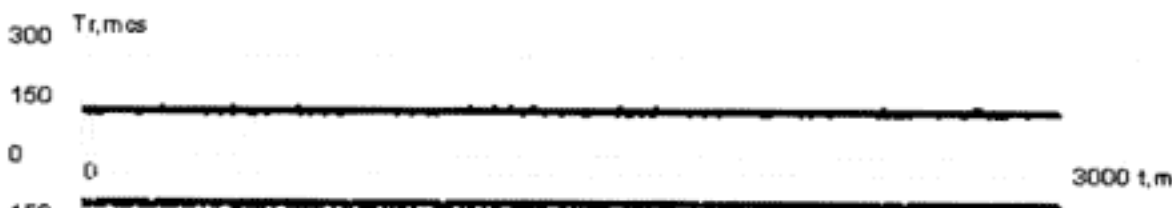


Fig.7 Rise and Fall Times

Current	3463
FS1,Hz:	406027308.809
FS2,Hz:	406027308.912
FS3,Hz:	406027308.956
Phase+,rad:	1.105
Phase-,rad:	-1.107
TRise,mcs:	109.497
TFall,mcs:	115.051
P,Wt:	5.803
Prise,ms:	0.1
BitRate,bps:	400.022
Assymetry,%:	0.000
Preamble,ms:	159.973
Total,ms:	439.999
RepPeriod,s:	51.520
DiffPeriod,s:	4.670
Slope:	-2.9e-012
R.variance:	1.7e-010
S.variance:	5.1e-011
PDF1 BCH ok	

Figure 5 - phase modulation parameters accumulated during long term test

406 Frequency & power - displays similar results for power and frequency parameters. The third auxiliary graph displays frequency stability in the form of RMS frequency deviation of separate bursts, calculated from 18-burst window containing Fs2 readings.

Summary Table - recommended as the final protocol of Beacon annual test; it includes

a set of 121.5 and 406 MHz transmitter's test results. At the bottom of the table, the whole message and separate field's content displayed.

406 Message content и 121, 5 MHz parameters – the window presents tables of 406 MHz message content and 121.5 MHz signal parameters.

406 MHz frequency & envelope - in-burst frequency graph displays frequency deviation from mean value inside the burst at 0.1 Hz resolution. This graph recommended for assessment of signal generation schematic quality. Figure 6a shows an example how the power amplifier may effect frequency generating. The figure 6b provides an example of frequency behavior with stable frequency generating schematic.



Figure 6a - switching on power amplifier disturbs frequency inside the burst

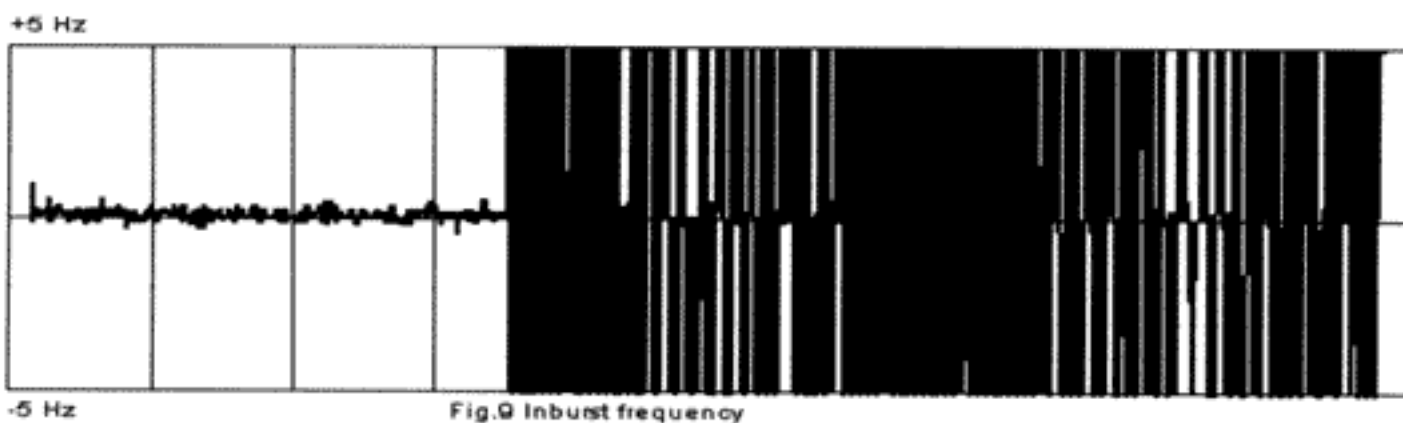


Figure 6b - Power amplifier switching on makes no influence on burst frequency

8. Calibration procedure for POWER measurement.

It is recommended for user to provide calibration:

- For self-made cables or matching devices;
- Annually for "POWER" input.

To approximate 121.5 and 406 MHz amplitude detector nonlinearity, the next equation used in BT-611:

Power = $A \cdot X^2 + B \cdot X + C$, where X is ADC data. Special program calculates A,B,C factors by comparing the readings of reference power meter and internal ADC counts at 8 power points. It is recommended to use the beacon as source power, with possibilities output

power adjusted over the range 0.2 ... 8 W for 406 MHz transmitter and 5 ... 130 mW for 121,5 MHz transmitters. For 121.5 MHz channel power calibration standard signal generator may be used.

The next power points recommended for calibration "POWER" input (approximate):

406 MHz transmitter (W):

0.2, 0.3, 0.5, 1.2, 2, 3.5, 5, 8

For 121.5 MHz transmitter (mW):

4, 6, 10, 15, 25, 50, 80, 130.

To provide reference power value, the spectrum analyzer (SA) may be used (e.g. HP4396). It is need to connect auxiliary attenuator at SA input, to prevent failure because of high power level. Reference power level applied to the cable under calibration should be calculated taking into account cable and attenuator losses.

Calibration block diagram shown in the figure 7.

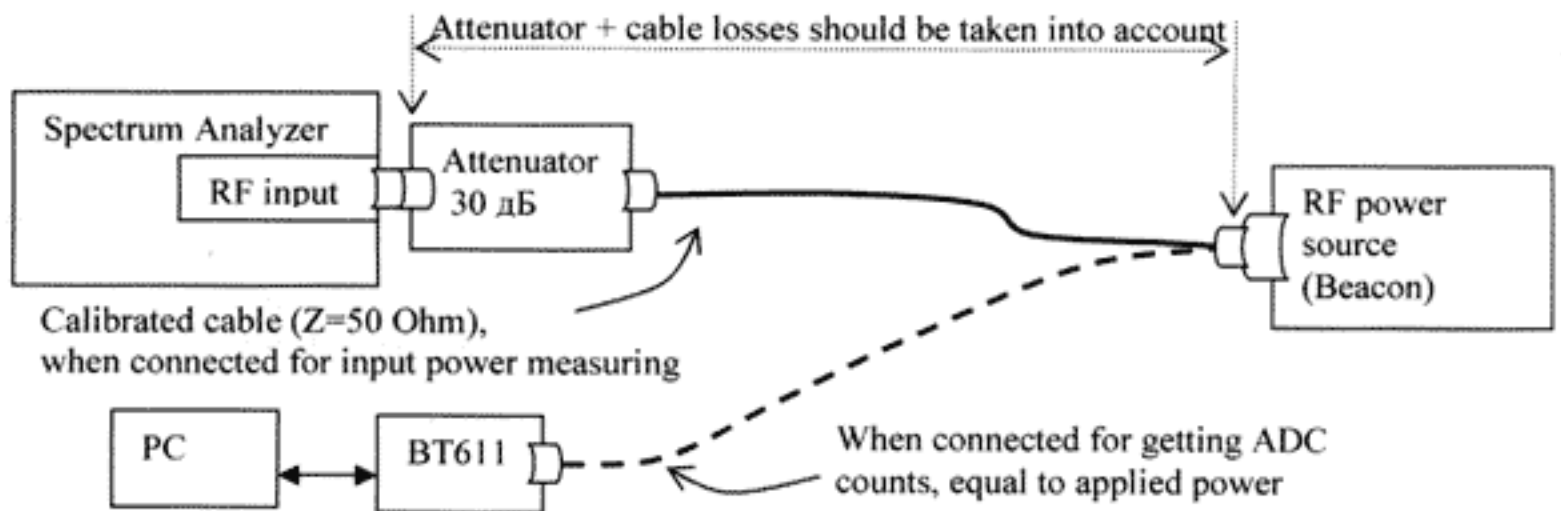


Figure 7 – connections diagram for power calibration

For 406 MHz power calibration set the analyzer to video triggered zero span mode with sweep duration of 500 ms. To avoid modulation influence (if present) to the envelop, IF bandwidth of 100 kHz may be selected. Power readings recommended to be taken at 150 ms marker position. For 121.5 MHz signal manual synchronization may be more convenient.

To provide BT611 equivalent ADC counts it is need to choose *Channel 406(121) file #* as ADC in the "SETTINGS" window. The ADC counts may be read at any appropriate window after running measurements. Note that 121 ADC data must be divided by 10. It is recommended to calculate and use mean value for 3...5 measurements.

During calibration, the cable in use consequently connected to the attenuator or BT-611 for every power point.

It is recommended to count the power point as maximum if ADC reading exceeds 210.

After all data from 8 power points (406 or 121) will be collected they should be filled up to appropriate table (figure 8) at the CALIBRATE window Then it is need to click **calculate**

adc	power	New coeffs	
0	0.000000	A =	0.000000
0	0.000000	B =	0.000000
0	0.000000	C =	0.000000
0	0.000000	manual set	
0	0.000000		
0	0.000000		
0	0.000000		
0	0.000000		
0	0.000000		
calculate			

Current coeffs		
A	=	0.000000
B	=	1.000000
C	=	0.000000

File ADC view save

clear

Figure 8 The table for A, B, C factors calculation

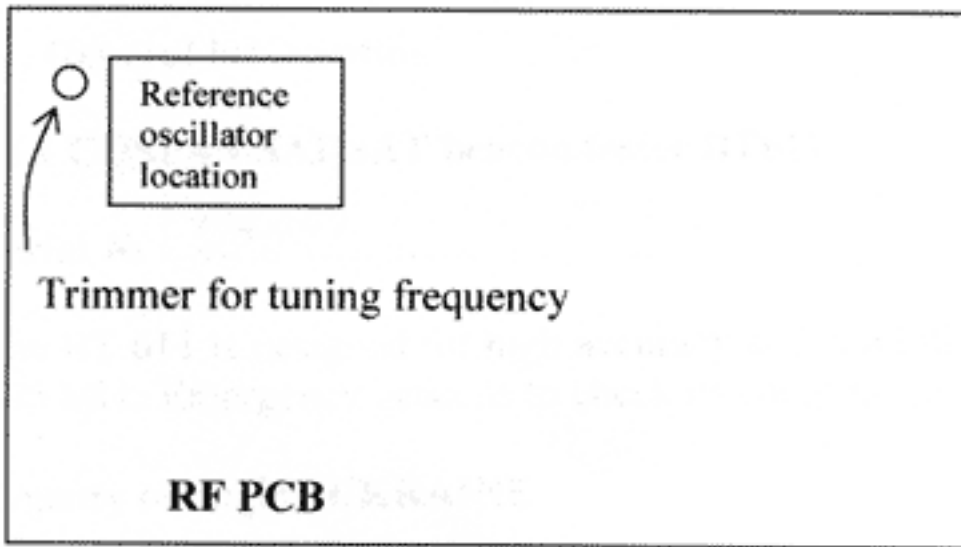
soft key, select file number you want to appoint at **File window** and click **save** soft key. User may prepare eight files for different cable length and test site conditions (including tests with measuring antenna).

9. Annual verification

The annual verification includes power calibration described above and reference oscillator frequency correction. Because of high stability reference oscillator used, it is recommended first to test frequency accuracy. For that connect reference frequency source adjusted to 5±5 dBm at 406025000 Hz to ANTENNA input and start measurement. Check measured frequency value at 406 Phase modulation window. Correction is needless in the case measured accuracy found within ±10 Hz.

Otherwise for frequency correction:

- turn the unit upside-down an open the bottom cover to see RF PCB (use figure 9 for reference);
- Adjust power level of reference signal source to 5±5 dBm at 406025000 Hz,
- Warm up about 1 hour the unit and reference frequency source.
- Connect reference signal source to ANTENNA input and start measuring;
- By observing frequency readings at **406 Phase modulation** window, adjust the trimmer (see Fig. 9) to get frequency value as close as possible to the reference one. The tolerance should not exceed ±10 Hz.
- screw the bottom cover back.



Figurer 9 – location of trimmer potentiometer

10. Fault removal.

Manufacturer only shall provide any repairing and adjusting procedures.

11. General information

11.1 COSPAS-SARSAT beacon tester BT611

Serial № *U4007*

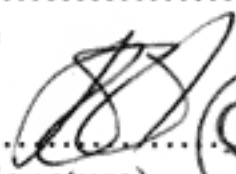
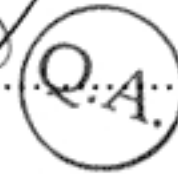
The BT 611 is designed for high accuracy and resolution measurements of signal parameters of 406 MHz Emergency beacons to check its compliance with C-S requirements.

Country of origin: **UKRAINE**

11.2 Component Parts

Part name	Quantity
1. BT611 measuring unit	1
2. Antenna, consisting of:	
- Antenna rod	1
- The trivet with cable	1
- Supporting legs	3
3. RF calibrated cable	1
4. Data link cable	1
5. Three prong AC power cord	1
6. User's manual (this document)	1

11.3 BT611 serial № *U4007* confirms with technical documentation and approved as ready to use

Tested and approved by   /

(Signature)

11.4 Warranty

- manufacturer guaranties proper operation of the devise provided it was kept, mounted, and maintained according to the requirements stated in the User's Manual
- storage warranty period is 2 years sins the day of shipment
- operation warranty period is 1 year since the day of putting into operation, but within storage period.

Annex 1
The results of testing simulated signals

Unknown Message:FFFFFF FFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFF

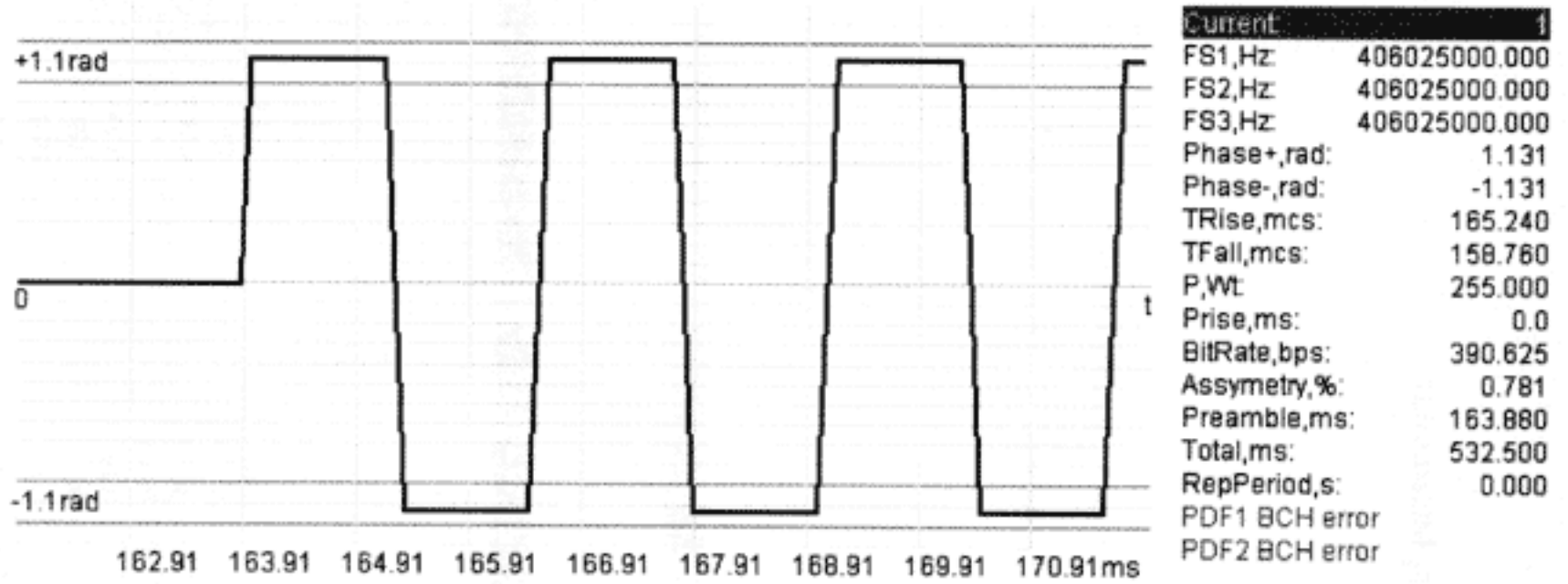


Fig.8 Phase

Phase+ =64.80 ° TRise+ =165.2 mcs
 Phase- =-64.80 ° TFall- =158.8 mcs

Fig. A.1a – Instantaneous phase and other parameters of 406 MHz simulated beacon signal, scale 2

406 MHz Transmitter Parameters		Measured	min limit	max limit
Frequency, kHz		406025.000	see C-S T.012 docum.	
+Phase deviation, rad		1.13	1.0	1.2
-Phase deviation, rad		-1.13	-1.0	-1.2
Phase time rise, mcs		165.24	50	250
Phase time fall, mcs		158.76	50	250
Power, Wt		255.00	3.16	7.94
Power rise, ms		0.04	less than 5 ms	
Bit Rate, bps		390.63	396.0	404.0
Asymmetry, %		0.78	0	5.0
CW Preamble, ms		163.88	158.4	161.6
Total burst duration, ms		532.50	435.6	444.4
Repetition period, s		0.00	47.5	52.5
Delta Rep. period, s		0.00	>=1.0	
Slope(E-9)		0.000	-1.0	1.0
Residual variations (E-9)		0.000	0	3.0
Short term variations (E-9)		0.000	0	2.0
121.5 MHz Transmitter Parameters				
Carrier Frequency, Hz		121500000	Low Sweep Frequency, Hz	194
Power, mW		2550.0	High Sweep Frequency, Hz	1667
Sweep Period, sec		0.3	Sweep Range, Hz	1473
Modulation Index, %		100		
Message				
Contents (full)		.FFFFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF		
Message contents (26...85 bits)		.FFFFFF FFFFFFFF FFFFFFFF		
Bit Synchronization		:1..15 :7FFFh :OK		
Frame Synchronization		:16..24 :1FF :ERR		
Format Flag		:25 :1 :Long Message		
Protocol Flag		:26 :1 :User Protocol		
Country Code		:27..36 :3FF :1023		
User Protocol Type		:37..39 :7h :Test User Protocol		
National use.		:40..83 :FFFFFFFh		
Auxiliary radio-locating device type		:84..85 :3h :other auxiliary radio-locating device		
BCH-1 code		:86..106 :1FFFFFFh :2097151 error		
Position Data Source		:107..107 :1 :encoded position data is provided by an internal device		
Latitude N/S flag		:108..108 :1 :south		
Latitude degrees(0 to 90)		:109..115 :7F :127		
Latitude minutes(0 to 56 inc 4 min)		:116..119 :F :60		
Longitude E/W flag		:120..120 :1 :west		
Longitude degrees(0 to 180)		:121..128 :FF :255		
Longitude minutes(0 to 56 inc 4 min)		:129..132 :F :60		
BCH-2 code		:133..144 :FFFh :4095 error		

Fig. A.1b – Summary table for 406/121.5 MHz simulated beacon signal parameters