RFID-radar™ gives precision long range measurement.

By Trolley Scan (Pty) Ltd, Johannesburg,South Africa

In August 2005, Trolley Scan developed a technology which would allow an RFID system not only to measure the identity of the transponders, but also the distance of the transponder from the reader.

What was unique with this new technology was that it had the ability to measure the distance travelled by the radio signal very accurately, in fact so accurately that you will see from this paper that it was better than 1 millimeter in 40000 (one part in forty thousand). The system could also measure the location of multiple transponders simultaneously and used the same low cost passive and battery assisted transponders used in normal RFID readers.

The system uses the wavelength of the operating frequency of the signal travelling from the transponder to the reader as its measuring stick. The wavelength is based on a physical property, namely the speed at which radio waves travel, a value that is very accurately known. In fact the standard definition of the one meter unit of length kept by international standards organisations and linked to all measuring systems, is defined in terms of wavelengths and the speed of light.

RFID-radar is a form of a relatively low cost RFID reader system and is commercially available. By attaching transponders to items, the RFID-radar is able to read the identity of the transponders and the positions of the transponders, effectively combining RFID and Real Time Locating Systems (RTLS) in one product.

The system uses different types of transponders depending on operating range needed,. Low cost passive transponders are used for short ranges (up to 13 meters) and long range battery assisted tags for ranges up to 40 meters.

The system currently has two levels of accuracy - namely absolute accuracy which currently about 0.5 meters, and relative accuracy where the accuracy is about 1 millimeter. This document is about relative accuracy. In relative mode the system measures the changes in distance very accurately between the reader and the transponder.

Relative mode

Use of the system in relative mode allows small movements to be measured at long distances. Such uses might be to monitor movement of a bridge with traffic flow or temperature variation, the bulging of storage tanks with variations in storage content, bulging of a dam wall, slippage of a structure on a mountain with rainfall, movement of a structure in wind and similar situations.

A series of transponders would be attached to the structure, and the RFID-radar set up at a monitoring point at a distance. The radar would continually measure the distance from

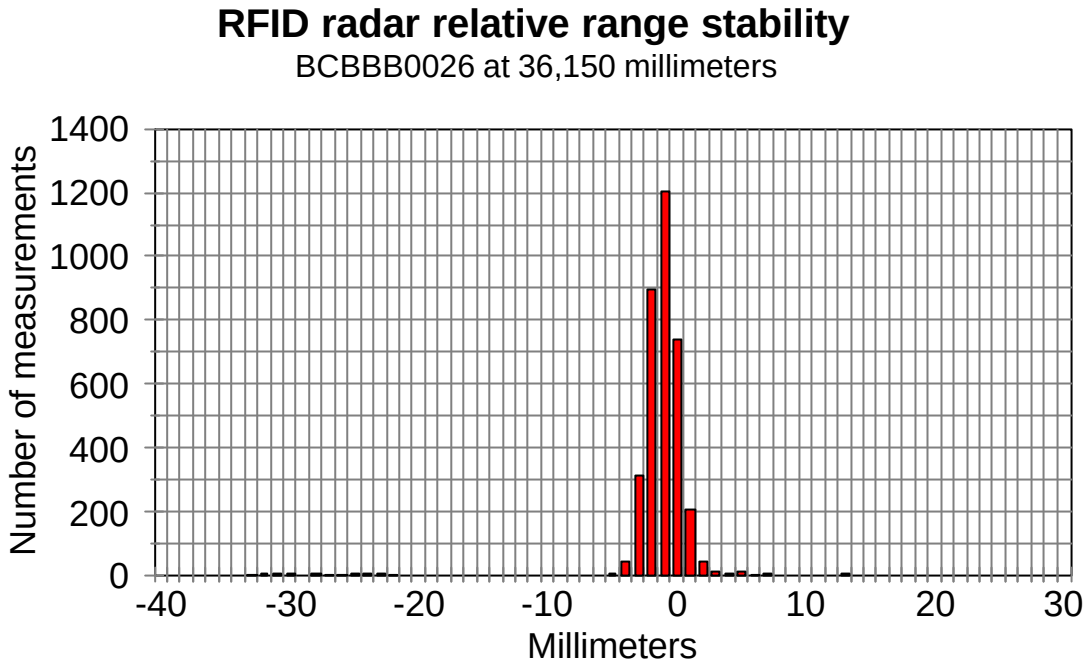

Figure 1 Range variation of 3500 separate distance measurements of a transponder 36,15 meters from the reader. X axis shows variation in millimeters and Y axis shows number of readings at each range bin over the one hour of testing. Readings were taken at one second intervals

the all the transponders to the radar, reporting all the measurements once per second and giving approximately millimeter accuracy 24 hours per day.

Testing

To investigate the long term accuracy, a test using 24 500 (twenty four thousand five hundred) measurements from seven transponders at different distances were made. The test collected all the data measured over one hour with each transponder being measured once per second. Different types of transponders were used, from passive credit card sized to battery assisted transponders. The following table shows the range of each and its type.

Four different types of transponders were tested. Charts at the end of this paper show the scatter for each situation.

Id number	Type	Range (meters)
BBBFK0898	Credit card passive	14,3
BCBBB0002	Stick tag (BAT)	9,0
BCBBB5025	Claymore (BAT)	19,3
BCBBB5026	Claymore(BAT)	36
BCBBB0026	Claymore(BAT)	36,15
BCBBB0003	Stick tag with reflector	37,95
BCBBB0004	Stick tag with reflector	35,40

Table showing different types of transponders used. Attached charts at end of paper show scatter for each situation. Note BAT means battery assisted tag.

Conclusion

RFID -radar is effectively a brand new solution to a difficult problem, namely measuring small movements at distances using affordable solutions. Because the transponders are very cheap, it is practically commercially to mount this equipment in permanent monitoring situations to collect data on a 24 hours basis and generate alarms should variations be out of tolerance.

A starter RFID-radar system complete with antennas, cables and twenty transponders costs just about Euro 2260 (US$3390)

More information can be found at
http://rfid-radar.com

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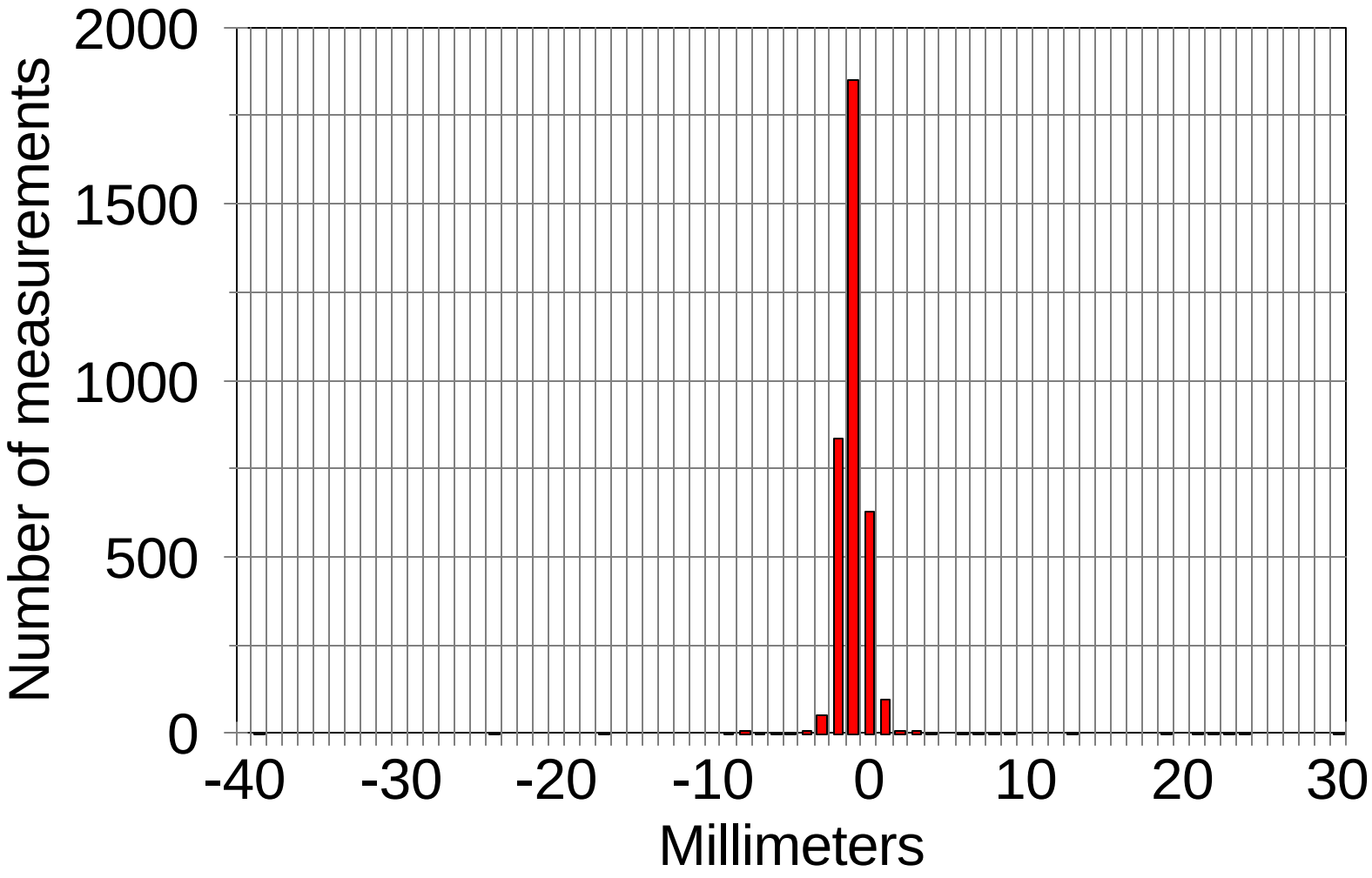
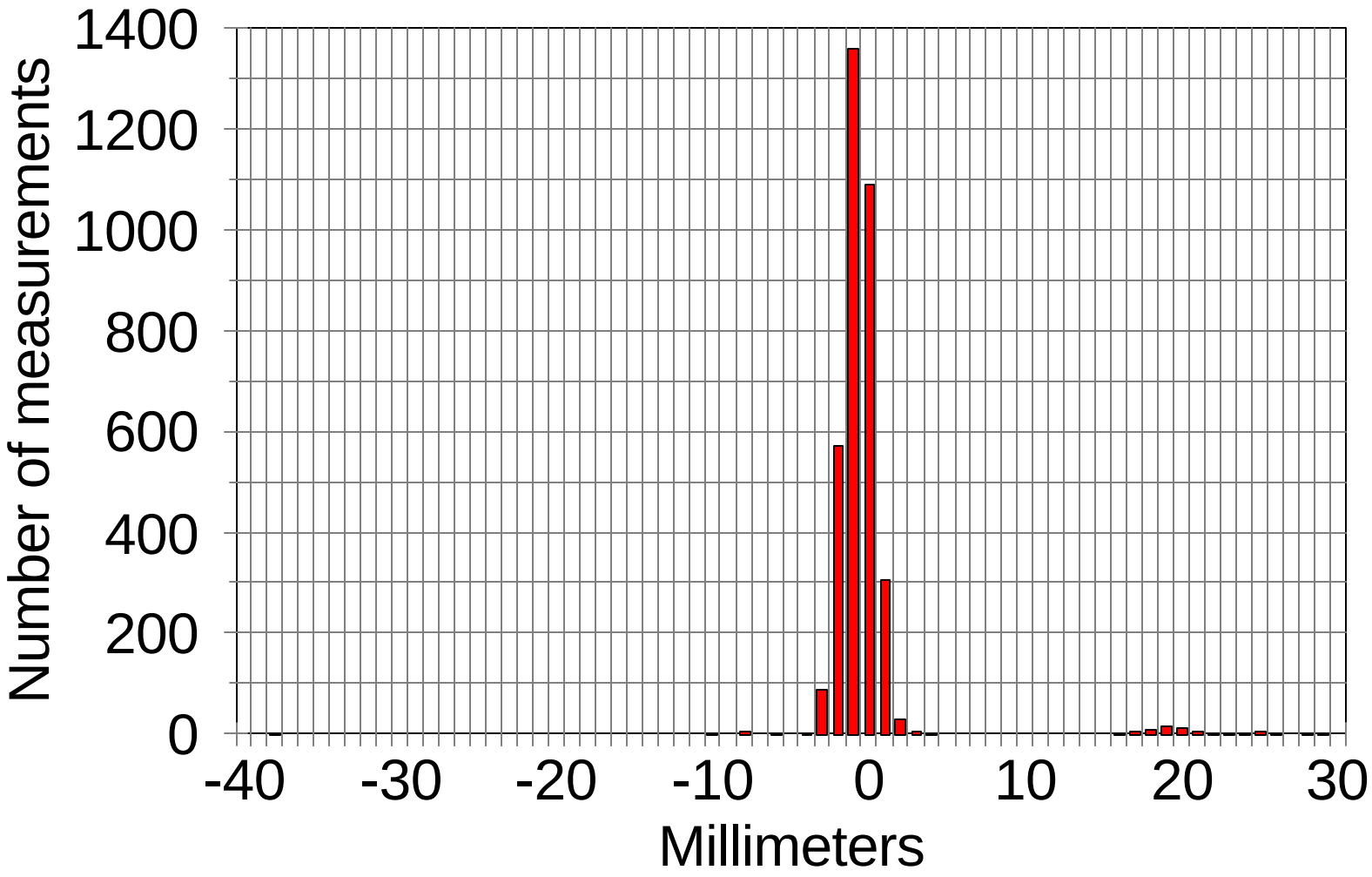
RFID radar relative range stability

BCBBB0002 at 9,000 millimeters



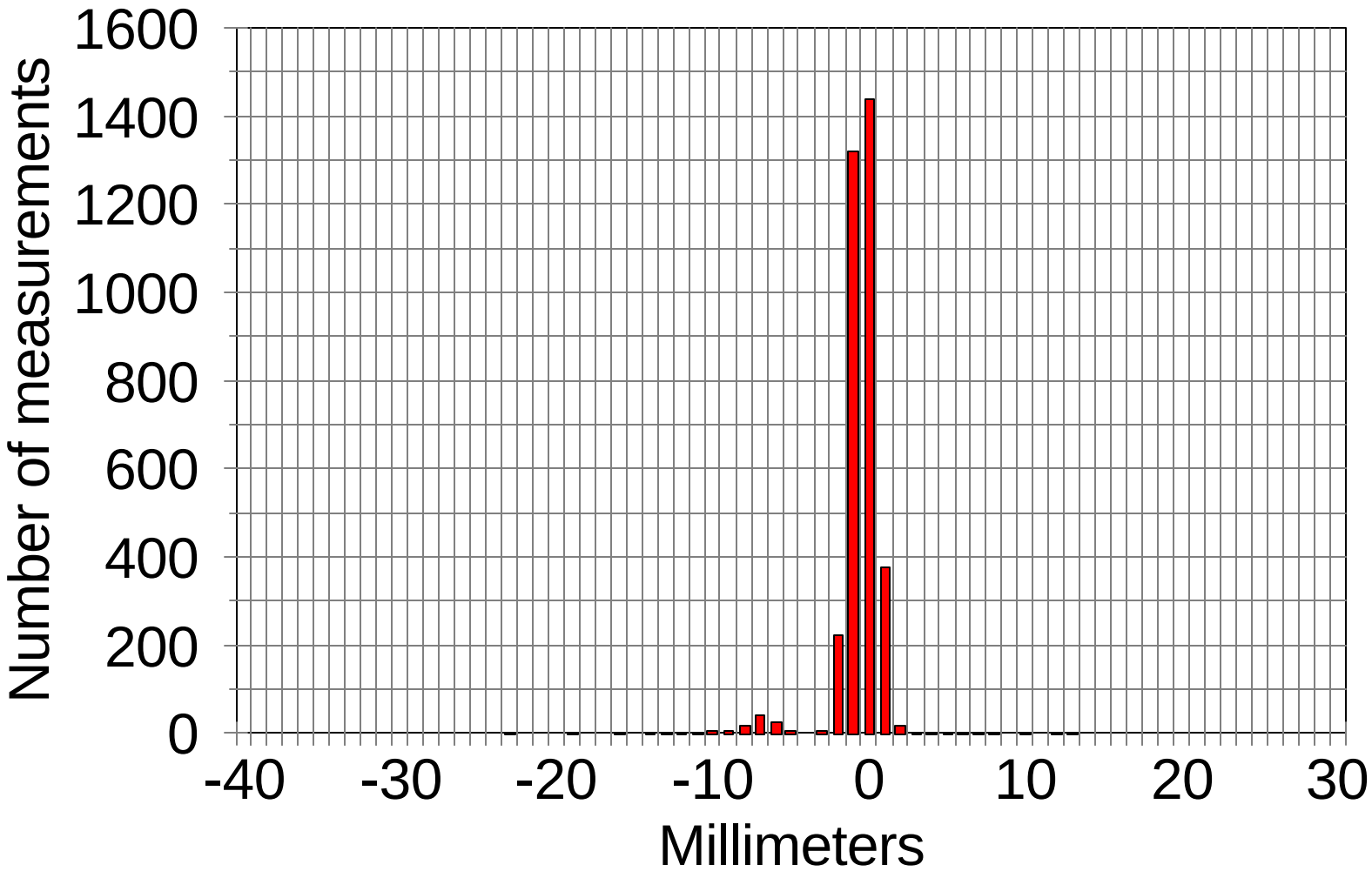
RFID radar relative range stability

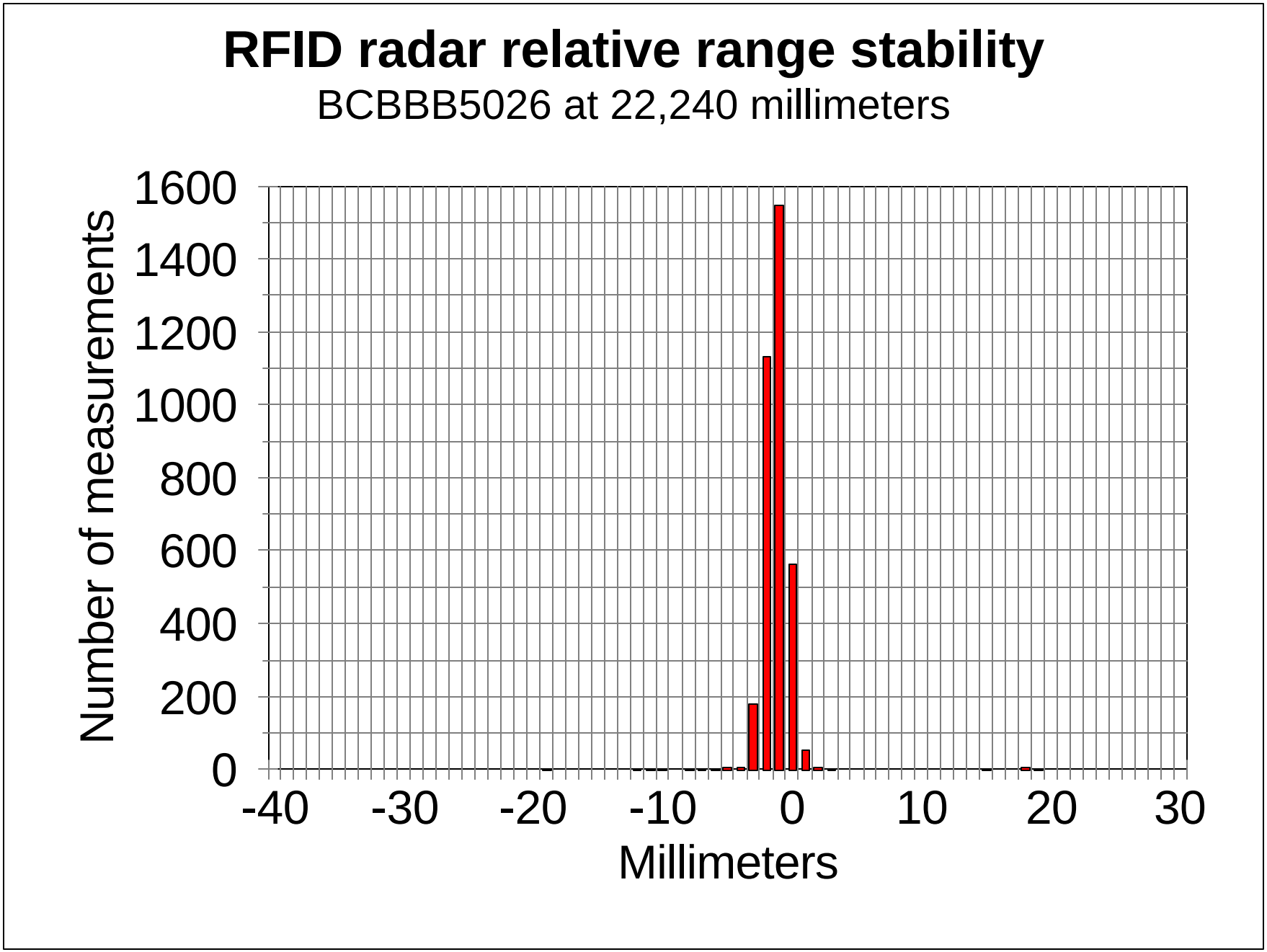
BBBFK0898 at 14300 millimeters

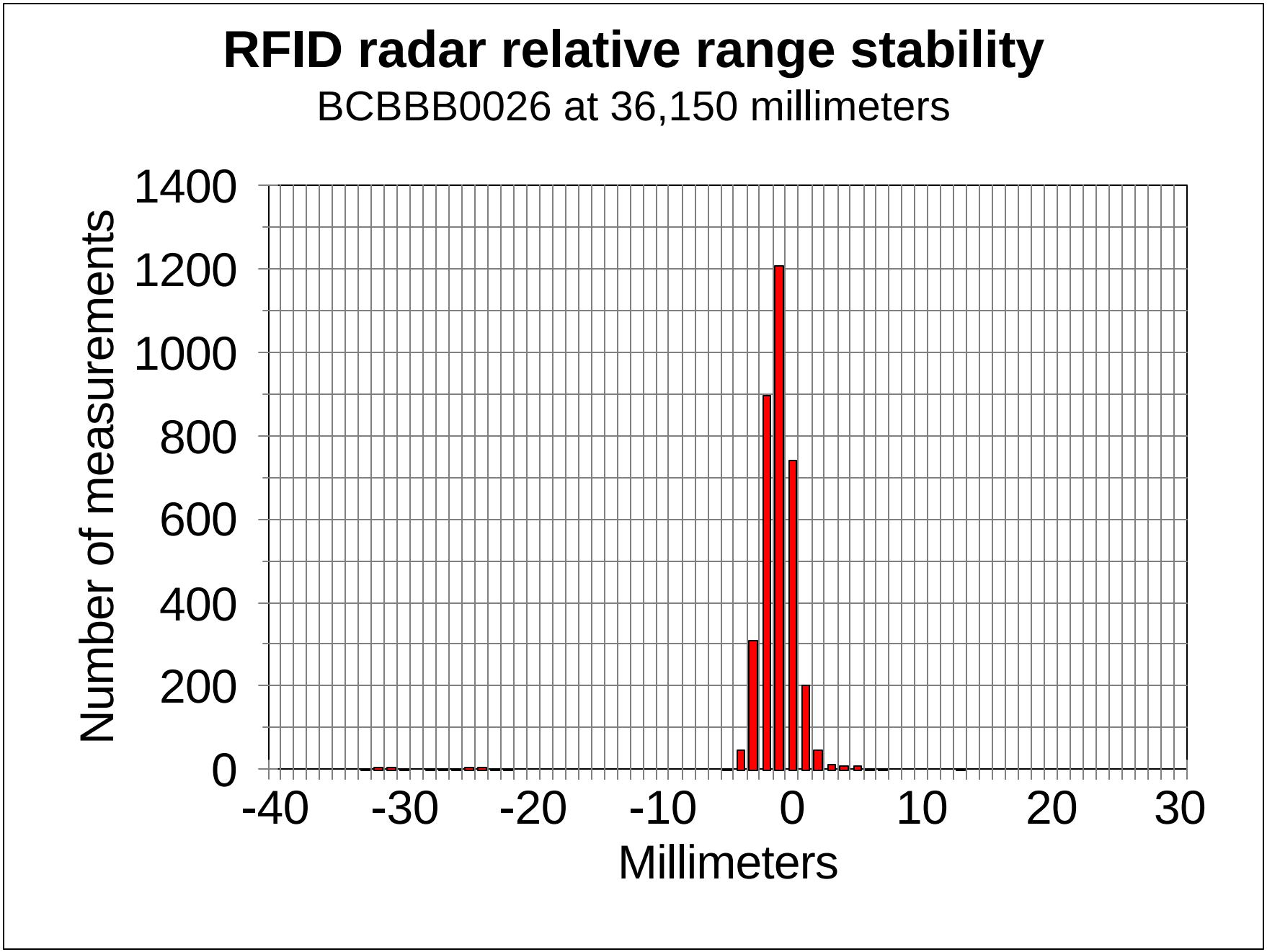


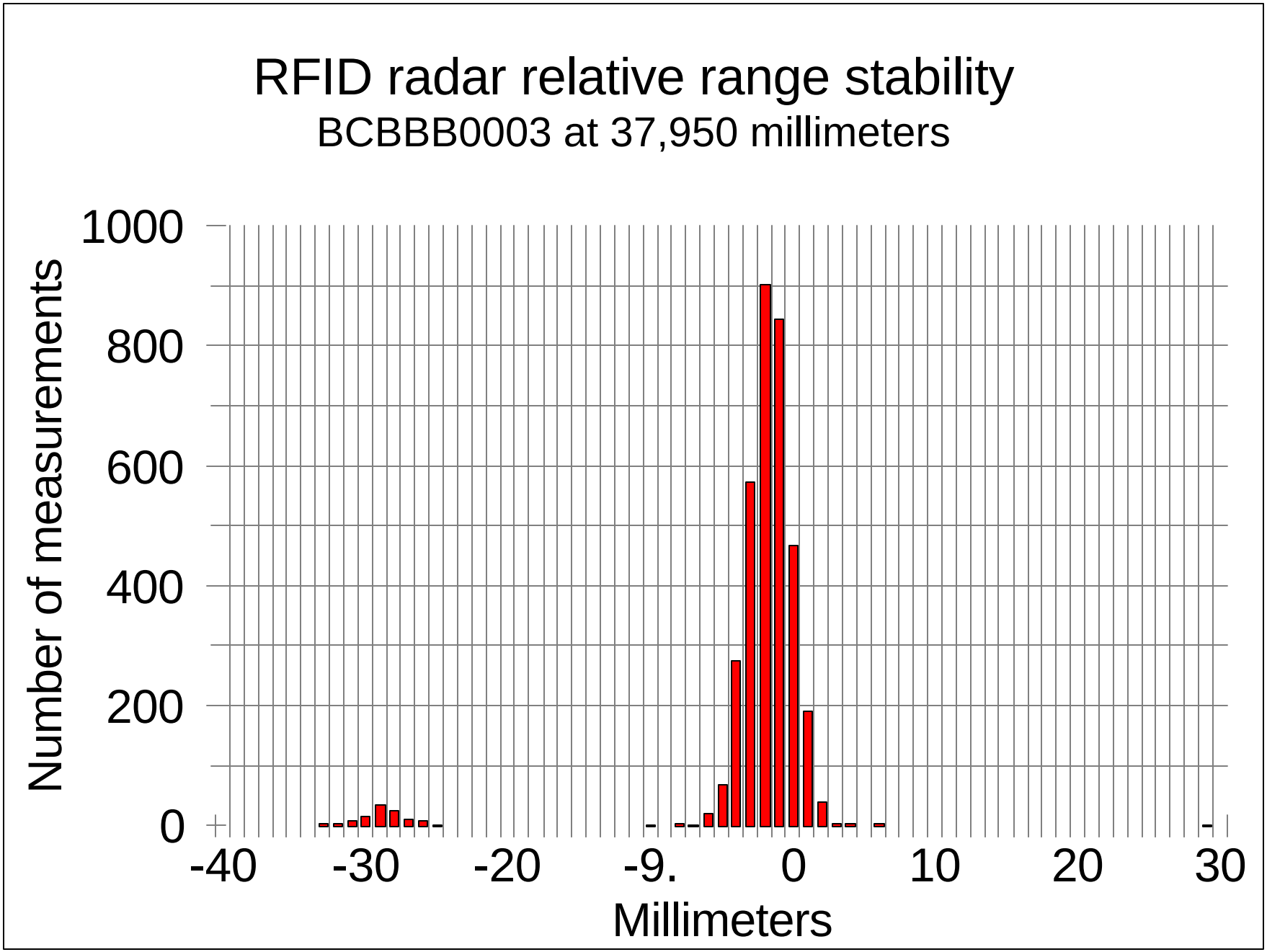
RFID radar relative range stability

BCBBB5025 at 19,300 millimeters




RFID radar relative range stability
BCBBB5026 at 22,240 millimeters
Number of measurements
1600
1400
1200
1000
800
600
400
200
0
-40
-30
-20
-10
0
10
20
30
Millimeters


RFID radar relative range stability
BCBBB0026 at 36,150 millimeters
Number of measurements
1400
1200
1000
800
600
400
200
0
-40
-30
-20
-10
0
10
20
30
Millimeters


RFID radar relative range stability
BCBBB0003 at 37,950 millimeters
Number of measurements
1000
800
600
400
200
0
-40
-30
-20
-9.
0
10
20
30
Millimeters

RFID radar relative range stability

BCBBB0004 at 35,400 millimeters