SkyRadar To Go V2.2

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Measurement, Analysis, Training, Exploration and Research for Industry, Universities and Academies

1   Release and Legal Information

This data sheet describes the all-in-one product SkyRadar *ToGo* Release Version 2.2. This data sheet has the release number 1.1. The product has been developed for measurement and didactical purposes. It is not released for any safety-relevant Air Traffic Management functions. In- and outside operations may be subject to national telecommunication laws and regulations.

2   Scope of Application

Universities, Flight Academies and Industry have an increased requirement for measuring with advanced short- and medium range radar applications for signal analysis and logging, as well as for applying, learning and exploring Radar systems.

Training and research applications may include Air Traffic Control, Marine or Homeland Security scenarios. Industrial applications may encompass traffic analysis, object speed measurement or distance measurement.

SkyRadar *ToGo* is a new *low cost, all-in-one and ready-to-use radar system* for indoor and outside applications, applicable for close and medium range radar measurements, able to measure in distances exceeding 500 m

Optional Superheterodyne expansion:

This expansion stage provides an improved signal-to-noise (S/N) ratio in comparison to the basic direct conversion principle. Its transceiver provides an enhancement of 20-25dB compared to the standard version leading to a fourfold distance enhancement (with a doubling of the distance range each 12dB).

Typical uses for this are long range (up to 400 m) movement detection of persons, speed measurements in sports applications (persons, balls), long range traffic measurement (cars at distances up to 1000 m) or speed measurement from zero up to more than 400 km/h.

3   Key Technical Data

3.1   Radar Modes

SkyRadar *ToGo* provides the following radar operation modes:

- Frequency Modulated Constant Wave Radar (FMCW) - for distance measurements of static and moving objects;
- Doppler Radar Mode – for speed and direction measurement;
- Frequency Shift Keying Radar Mode (FSK) – for distance measurements with high resolution for moving objets
- Mono Pulse Radar Mode.

All Radar Modes are generated with a FMCW radar source.

The radar system comes with a state of the art Laptop computer. The computer is pre-installed with all necessary management software for signal generation, analysis and graphical user interfaces.
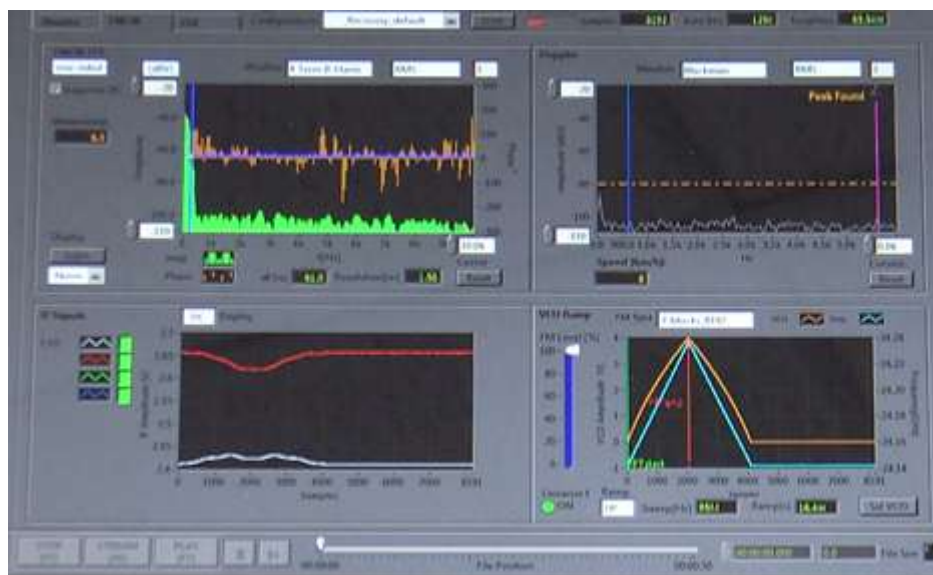

Figure 2: Graphical User Interface

3.2   Data Acquisition and Processing System

The data acquisition and processing system itself has the following features:

- USB Interface to Host Computer
- Onboard Low Noise Power Supplies
- High Performance 16Bit Data Processing
- 250kSamples/s ADC and DAC

With compact and rugged construction SkyRadar *ToGo* builds on a 16 Bit data acquisition system, performing a 250Khz sampling rate. It contains 5V and 3.3V low noise power supplies as well as analog buffers and amplifiers.
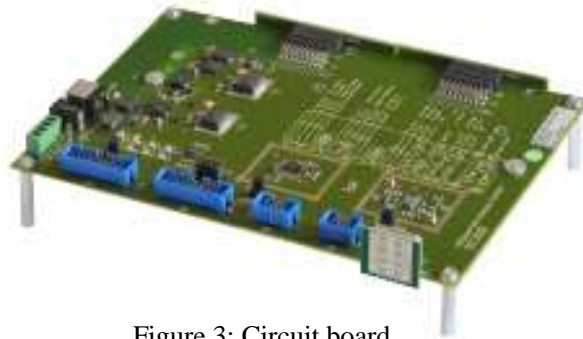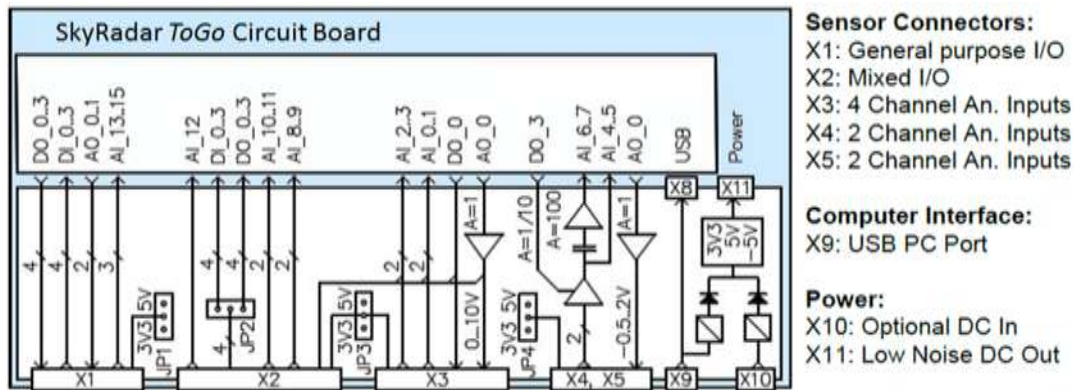

Figure 3: Circuit board

Figure 4: Block diagram of SkyRadar ToGo circuit board

Figure 4 describes the circuit board, applied in the SkyRadar system.

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4 Radar Transceiver

SkyRadar ToGo works with a 60 patch Doppler module and includes a RF low noise amplifier and two 47dB IF preamplifiers for the I-channel as well as for the Q-channel.

The Radar Transceiver has the following features

- Short range transceiver 24 GHz
- Sweep FM input 90 MHz
- Gain adjustable, buffered I/Q IF outputs
- High sensitivity
- Integrated RF/IF amplifier
- Dual 30 patch antenna
- In addition DC IF outputs
- Slim construction 6mm
- Beam aperture 25°/12°
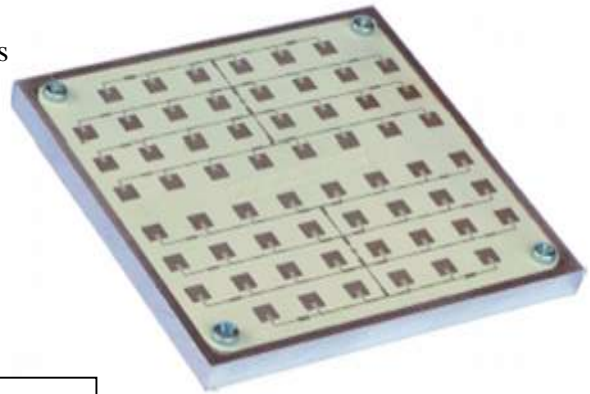
Optional Superheterodyne expansion:
- K-Band Superhet Transceiver System
- Highest Sensitivity Receiver with Integrated IF Amp
- Dual 32 Patch Antenna with 25°/12° Aperture
- PLL Controlled Precision Transmitter
- I/Q IF Doppler Output
- IF Amplitude Output
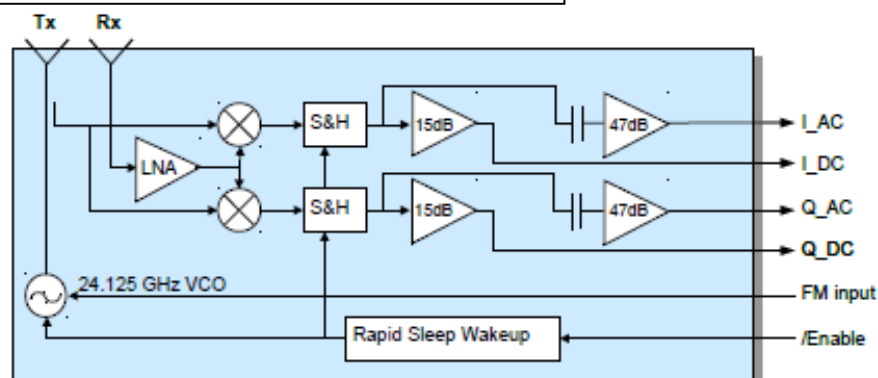- Rugged and Compact Construction

Figure 5: Radar Transceiver

Figure 6: Block Diagram of the transceiver

4.1   Transmitter Data

- Output power: +18 dBm
- Transmitter frequency: 24.150 GHz

4.2   Receiver Data

- Antenna gain (without 60 cm Dish Antenna on Tripod): 18,5 dBi
- LNA gain: 18 dB
- Horizontal -3dB beam-width: 12°
- Vertical -3dB beam-width: 25°With Dish Antenna: approx. 1-2° and additional approx. 35,5 dBi

4.3   Antenna Design

SkyRadar *ToGo* uses a parabolic dish to direct its beams. Distance between antennae and transceiver is calibrated to optimize its gain. The antenna is mounted on a tripod.

- Antenna gain: 35,5 dBi at a frequency of 12,5 GHz
- Diameter of parabolic dish: 600 mm

Figure 7: Antenna design

5   Signal Management Software

The SkyRadar *ToGo* Management Software has three main features, accessible through one comfortable user management system.

- First its general section permits choosing the desired mode of operation and its configuration.

- Second, its comfortable operating section allows for analysis.

- Third, its recorder section enables recording of the captured signals.

Figure 8 shows a screenshot of the Graphical User Interface and describes its three main sections. The software comes in a ready-to-operate pre-configuration which is optimized on the SkyRadar transceiver. For research or teaching reasons, different configurations might bring added value.
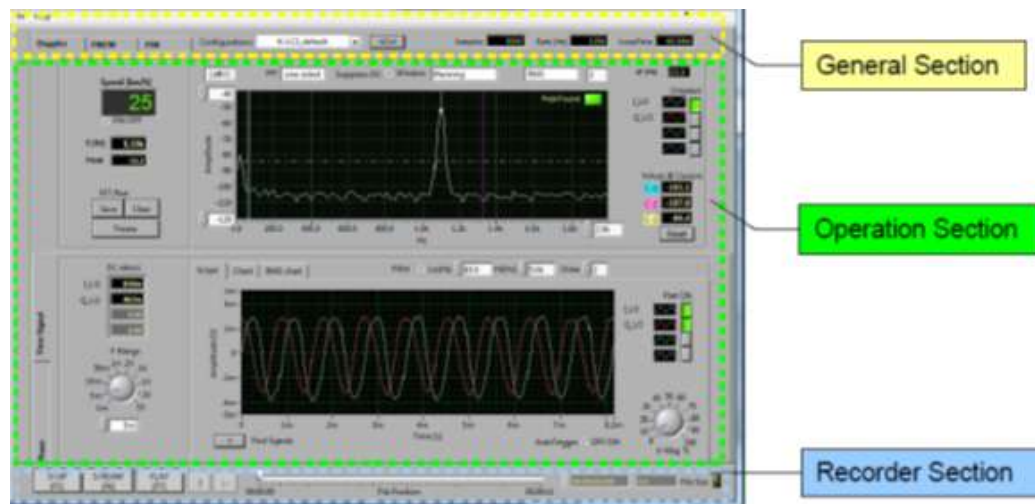

Figure 8: Overview of the Graphical User Interface.

5.1   General Section of the Graphical User Interface

The general section (see Figure 9) allows for a choice between Doppler, FMCW and FSK-mode on its left side. The subsequent configuration allows for a detailed set up, choosing from the vast database of preconfigured setups. The setup button in addition allows for a completely free setup.

On its right side, the general mode displays samples, rate and loop time. *Samples* describes the number of samples per channel as input from the signal processing through a fast Fourrier transformation. Rate describes the ADC sampling rate per channel. The *loop time* is the time required to read the samples in the selected configuration (defined by the ratio of number of signals / sampling rate).

Figure 9: General section oft he Graphical User Interface

5.2   Operating Section of the Graphical User Interface

Figure 10 gives an insight into the scope of analysis, which is possible with the SkyRadar *ToGo*. It allows for graphical representation of signals in time and frequency.
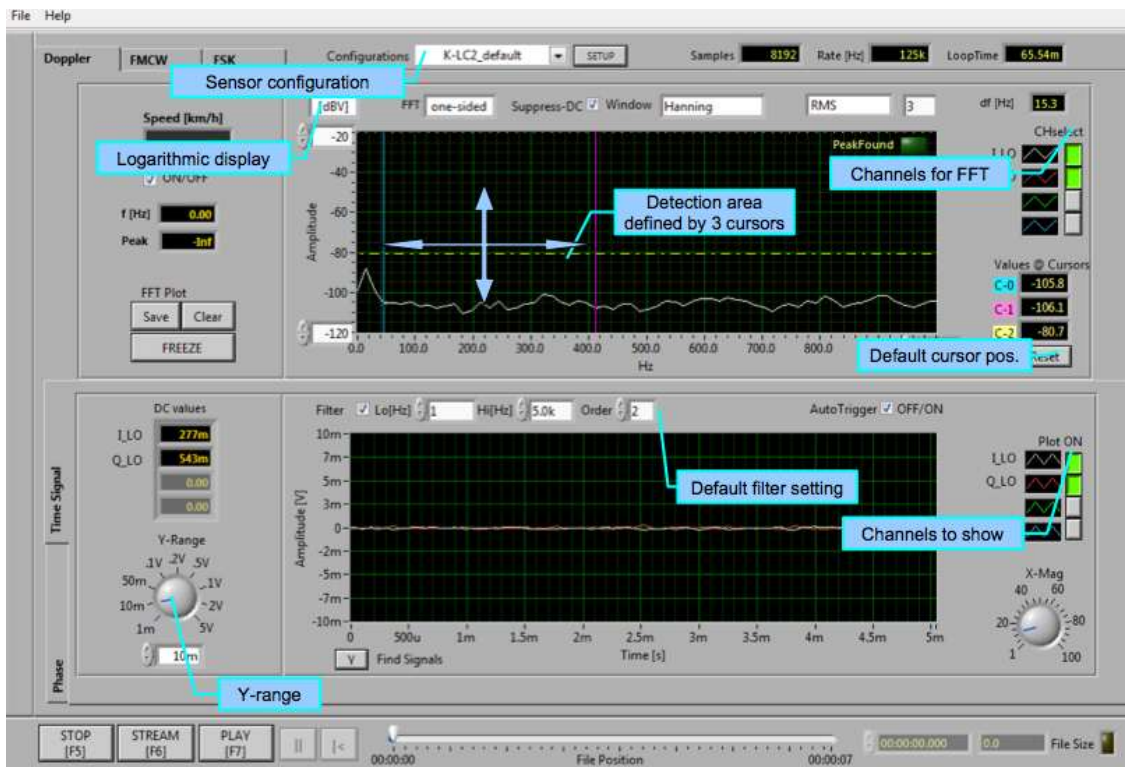

Figure 10: Graphical User Interface with focus on the operating mode

Examples are logarithmic or linear FFT scales (see Figure 11), various chart modes that write the signals on slow moving scales (see Figure 12) or the exploration of phase relations (see Figure 13).
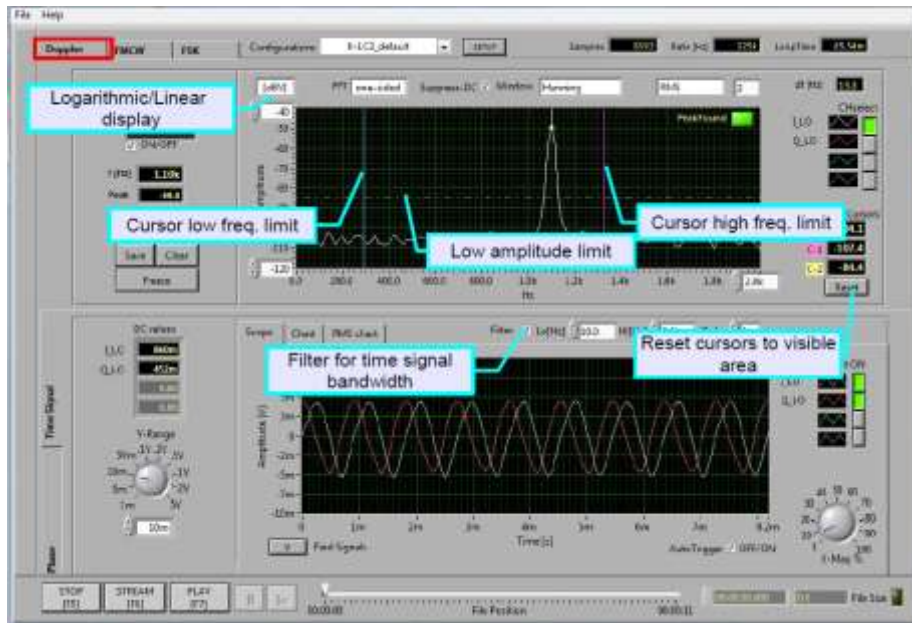
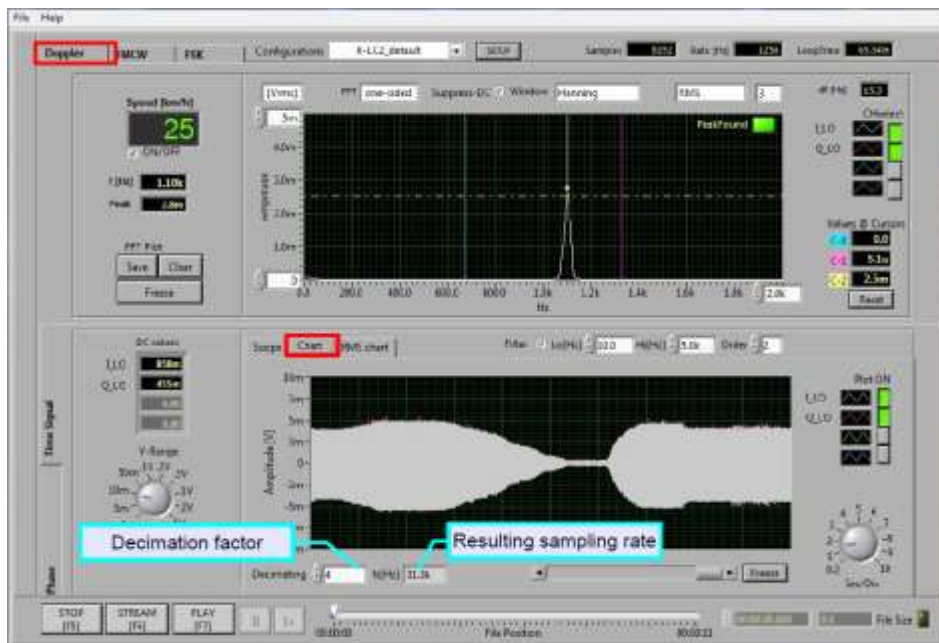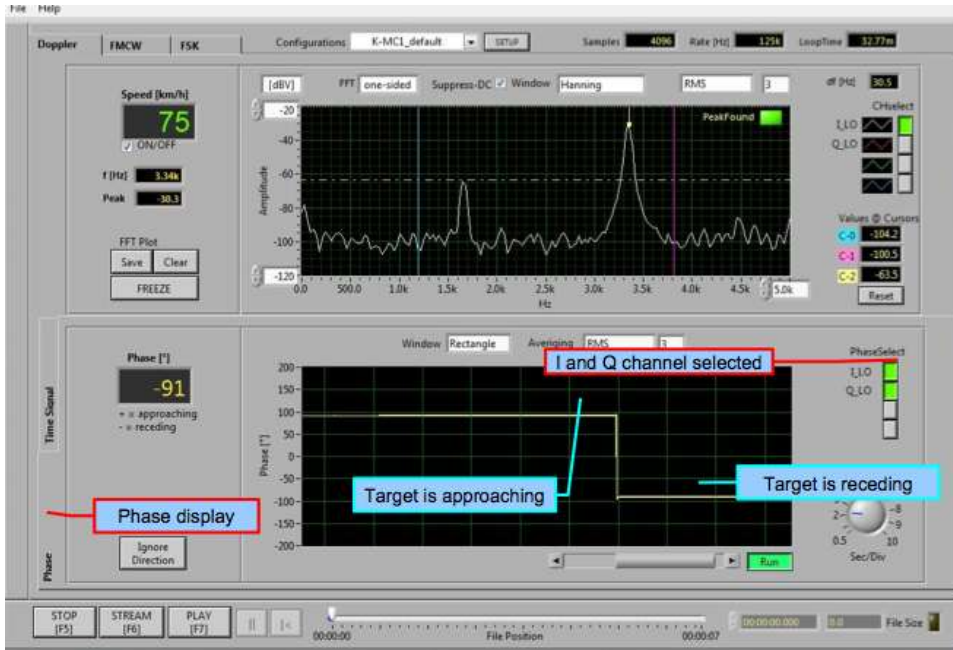Figure 11: Logarithmic FFT scale in the Doppler mode

Figure 12: Chart mode

Figure 13: Exploration of phase relations

Figure 14: Overview screen

5.3   Recording Section of the Graphical User Interface

The system is able to record and to play back radar signals in uncompressed multichannel TDMS files (National Instrument format). The current release is limited to recording Doppler or FSK signals. Apart from the radar signals, the system stores the following metadata: Channel related information (channel name, data length, samples / cycles, date / time of recording) and administrative information (sensor name, author, configuration name, Doppler or FSK mode).

Figure 15: Recorder panel

6   Terms of Delivery

The system comes in a plug-and-play ready to operate way. It is accompanied by an operating manual written in English. Webinars for Assembly and Operations published on Youtube.com provide additional support.