Abstract

SkyRadar's PSR Hardware is a Radar system for measuring distances to moving and stationary objects with a high-resolution. Basically there exist different possibilities to measure distances with Radar:

Pulse Radar

This system transmits a very short RF pulse and measures the time it takes until the pulse was reflected by the object to be measured and returns to the Radars receiver antenna. The shorter the pulse the better the resolution of the system. To separate two objects with a distance of 10cm, a maximum pulse length of 300ps is allowed. The pulse repetition rate defines the maximum distance that can be measured. This system is used in airborne radar. The drawback is the high pulse RF power needed due to the low duty cycle.

The SkyRadar-Radar works as a Pulse Radar, it uses pulse compression technology to enlarge the transmitted pulse to a continuous wave signal. So it is possible to work with low power and still having a reasonable range coverage. This is called a Pseudo-Noise (PN) radar.

Principle of Operation

Pseudo-Noise (PN) radar is a radar using very wideband pseudo-random codes, e.g. m-sequences, to stimulate the test scenario. The transmitted signal is periodic and hence deterministic. On the receiver side the original can be reconstructed by the use of a correlator.

A microwave source generates the carrier frequency of 24.125GHz. This signal is BPSK-modulated by a PN code which is created in the 'Wideband Modulator'. The bandwidth of this PN-sequence can be digitally adjusted between 1GHz and 4GHz. The output of the BPSK-modulator now has a bandwidth of up to 8GHz and is further amplified before it is fed to a TX-connector (2.92mm RF connector). Here you can connect a broadband antenna, e.g. a horn-antenna.
The received signal which receives on the RX-connector is amplified by a low-noise amplifier (LNA) and downconverted by a first mixer. This IF signal now has a bandwidth of up to 4GHz and is correlated with the same PN-sequence generated by the Wideband Modulator. The resulting signal from the Correlator is A/D-converted and further processed by a CPU. This CPU calculates a time-domain signal which looks very similar to the output of a conventional Pulse Radar and outputs it at the Analog Output port.

Connect an antenna to the RX- and TX-port

You can use the supplied horn-antennas or also an own one. Please make sure the antenna is able to radiate a 24GHz +/- 4GHz carrier. So normally Patch-Antennas can't be used. The larger the antenna, the smaller is the beam and the larger is the reach of this system. The supplied horn-antennas have an opening angle of 40x30° and can detect persons in a distance of up to 10-15 meters

Connect an oscilloscope to the analog output

The analog outputs are available on one side of the Transceiver Radar system.
Adjust the oscilloscope to 500mV/Div vertical and 200us/Div horizontal. Set the trigger to leading edge at approx. 200mV. Use DC-coupling.

Depending on the used bitrate each distance has the following length in the time-signal:

4GBit/s:	Length: 8.192us	Resolution: 3.75cm	max. Distance: 9.5m
3GBit/s:	Length: 10.912us	Resolution: 5cm	max. Distance: 12.7m
2GBit/s:	Length: 16.384us	Resolution: 7.5cm	max. Distance: 19m
1GBit/s:	Length: 32.768us	Resolution: 15cm	max. Distance: 38m

Technical Data

Parameter	Conditions / Notes	Symbol	Min	Typ	Max	Unit
Operating conditions						
Supply voltage		V_{cc}	12	24	26	V
Supply current	V_{cc} = 24V	I_{cc}		300		mA
Operating temperature		T_{op}	-20		+60	°C
Storage temperature		T_{st}	-20		+80	°C
Transmitter						
Carrier frequency	T_{amb}=-20°C .. +60°C	f_{TX}	24.000	24.125	24.250	GHz
Output power	Measured on SMA connector	P_{TX}	-6	-2	+2	dBm
Spectral width	Measured on SMA connector	f_{full}	20		28	GHz
Spectral density	Outside of ISM band, BW=100kHz	P_s			-30	dBm
Frequency drift vs temperature	V_{cc}=24.0V, -20°C .. +60°C Note 2	f_{TX}		-0.3		MHz/°C
Spurious emission	According to ETSI 300 440	P_{spur}		-30		dBm
Receiver						
Antenna Gain	Supplied horn antenna	G_{Ant}		17		dBi
Receiver sensitivity		P_{RX1}		-91		dBm
Overall sensitivity		D_{system}		-106		dBc
IF output						
IF resistance	Analog output	R_{IF}	100			
IF frequency range	-3dB Bandwidth, IF load = 1k	f_{IF}	0	300	kHz	
IF output offset voltage	No objects in range, logarithmic output	U_{IF}		1300	mV	