



## About TTE

TTE, a subsidiary of TACTRON Elektronik GmbH & Co KG, a new Industry Leader for High Technology Test Systems in frequency ranges up to 110GHz. We are located in Planegg near Munich, Germany. Our expertise are State of the Art products for the microwave and millimeter wave industry.

TTE is committed to provide the best RF products, systems and related services – Made in Germany!

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## Active & Passive Target Simulators and Components



# Active Target Simulator (ATS)



## Our Range of Products for Radar and Radar Signal Testing

	dynRTS and staRTS		minRTS		Frequency Converter	
						
Frequency range	77/79 GHz band	24 GHz ISM band	77/79 GHz band	24 GHz ISM band	77/79 GHz band	24 GHz ISM band
Instantaneous bandwidth	5000 MHz (std) up to 10000 MHz	200 MHz	5000 MHz (std) up to 10000 MHz	200 MHz	5000 MHz (std) up to 10000 MHz	200 MHz
Number of targets	1 dynamic or up to 6 static in parallel		1 static		-	
Target distance	up to 1000 m (in 4096 steps)		5 m internal (more with additional optical fiber extensions)		-	
Target Gain Flatness	±2 dB, typ		±2 dB, typ		-	
Target velocity	up to ±400 km/h		-		-	
Target size	80 dB dynamic range		30 dB dynamic range		-	
Exceptional spurious suppression in Doppler Spectrum	40 dB, typ		40 dB, typ		-	
Phase Noise at 77GHz	@10 kHz: 90 dBc		@10 kHz: 90 dBc		@10 kHz: 90 dBc	
Dimensions [mm]	482.6(W) x 450(L) x 177(H)		178.9(W) x 216.4(L) x 100(H)		178.9(W) x 216.4(L) x 100(H)	

3 in 1	Radar Target Simulation	✓	✓	✓ (feasible with external Coax-Cables)
	Calibrated Down-Converter (for Signal Analysis)	✓	✓	✓
	Calibrated Up-Converter (for Interference Test)	✓	✓	✓

Notes:  
All specifications are subject to change without prior notice.

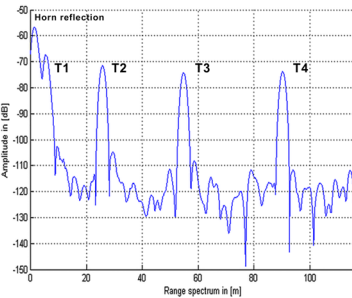


# 3 in 1



# 3 in 1

## RTS Radar Target Simulator



### Simulate Radar Targets

Simulate a single dynamic or multiple static radar targets in the 77/79 GHz or 24 GHz band with our simulator family - customized on your request.

Instantaneous BW: up to 10 GHz (200 MHz at 24 GHz)

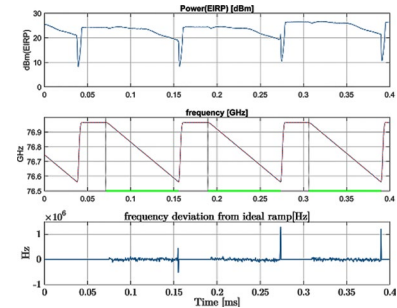
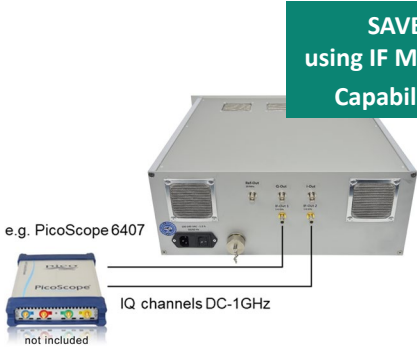
Target Distance: up to 1000 m

Target Velocity: up to ±400 km/h

Exceptional spurious suppression in Doppler spectrum: >40 dB

Phase Noise at 77 GHz / 10 kHz: 90 dBc

## Calibrated Down-Converter (for Signal Analysis)



### Characterize Radar Signals

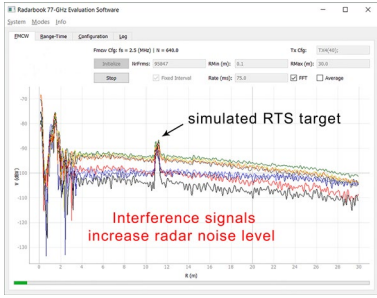
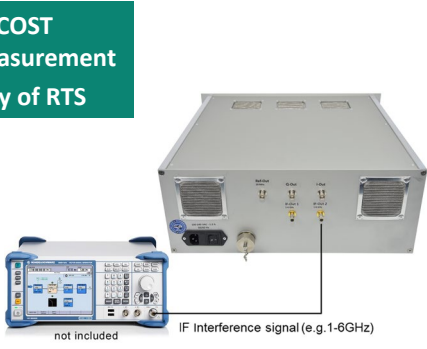
Use calibrated RTS output ports (IF or base-band) for characterizing radar signals by

- Power measurement
- Spectrum analysis
- Ramp analysis

using cost-effective measurement equipment

We offer cost-effective solution for 2 GHz FMCW chirp analysis based on USB PC oscilloscope (PicoScope 6407)

## Calibrated Up-Converter (for Signal Generation)



### Generate (Interference) Signals

Interferer signals like

- sine signal
- noise signals
- FMCW ramps

can be injected at low IF frequencies of RTS using cost-effective signal generators (up to 6 GHz for 76-81 GHz coverage)

Notes:  
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# Passive Target Simulator (PTS)



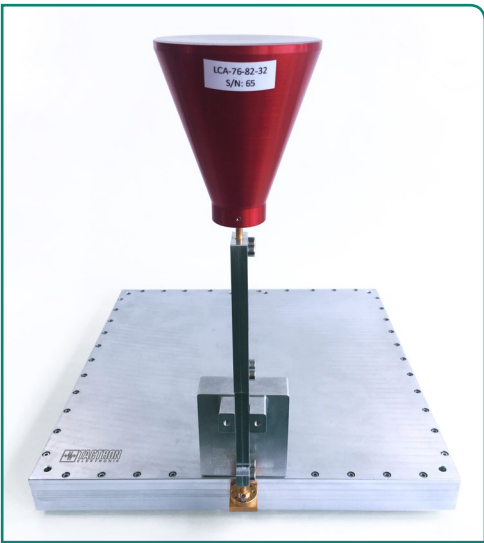
With this new PTS Series TTE introduce the new test system for RF- and Microwave-Applications. This Target Simulator will be offered with different options and can easily customize for simple implementation in existing systems. The body of each system consists of robust aluminum housing, there are no moving parts insight, so it is impassible against shock and vibration. High precision machining cause to very low insertion loss and low interdependence between frequency and delay time. Due to the low attenuation the usage of large antennas with a high gain is unnecessary. The result is the reduction of undesired reflection insight the test chamber.

### Features:

- Low Failure Rate, because there is no Operation Necessary
- Long-Term Stability
- Low Insertion Loss
- Suitable for Broadband Applications
- 24 GHz, 76 GHz, 79 GHz and 81 GHz
- Customized Outline and Delay Time (ns) or Distance (m) on Request
- Special Lens Corrected High-Gain Horns Available
- TEM Transmission Mode

### Application:

- Radar Module Testing in Assembly Lines
- Radar Testing and Development
- Test and Measurement



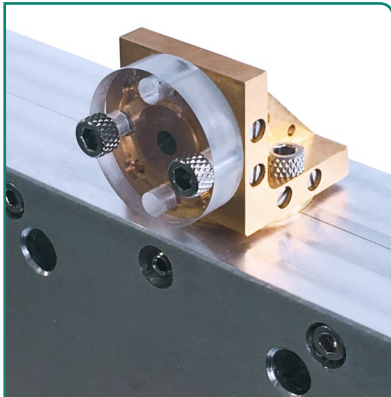
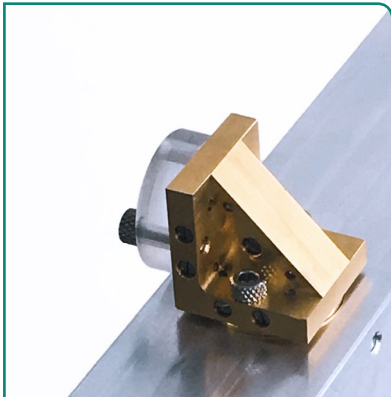
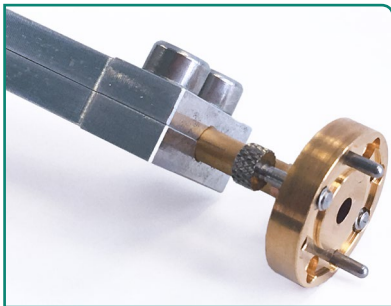
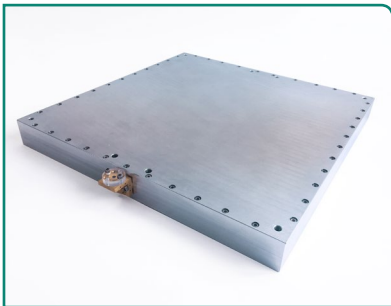
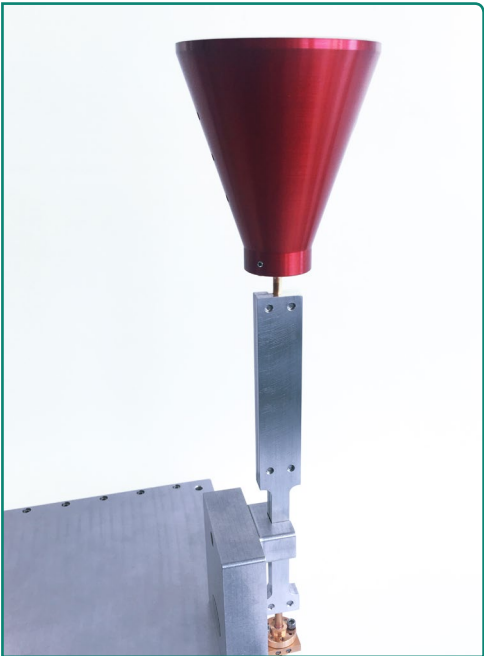
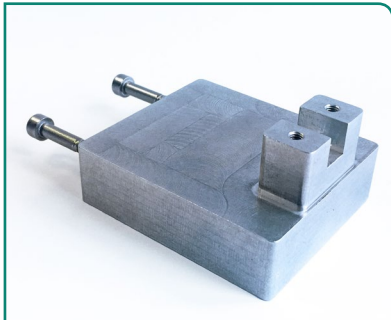
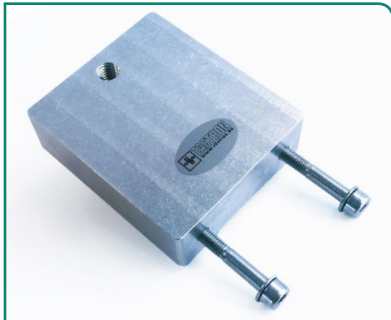
### Specifications

Material	Copper			Aluminum			Dielectric
	Polished			Chromated			
Waveguide Format	WR-15	WR-12	WR-10	WR-15	WR-12	WR-10	Ø 3mm
Frequency	50-75 GHz	60-90 GHz	75-110 GHz	50-75 GHz	60-90 GHz	75-110 GHz	66-88 GHz
Target	Short Circuit						
Delay Distance	0.2-10 m (7.9-393.7 in)	0.2-11 m (7.9-433 in)	0.2-11 m (7.9-433 in)	0.2-10 m (7.9-393.7 in)	0.2-10 m (7.9-393.7 in)	0.2-10 m (7.9-393.7 in)	0.2-8 m (7.9-315 in)
Flanges	UG387/U	UG387/U	UG387/U-M	UG387/U	UG387/U	UG387/U-M	UG387/U
Polarization	Horizontal or Vertical	Horizontal or Vertical	Horizontal or Vertical	Horizontal or Vertical	Horizontal or Vertical	Horizontal or Vertical	Horizontal and Vertical
Mounting	Outside the chamber (with 4 holes Ø5.0 mm, (0.197 in))						
Mechanical Dimension	300x300x30 mm (LxBXH) (11.8x11x8x1.18 in)						
Antennas	10-24 dB Rectangular Gain Horns 34 dB Lense Corrected Gain Horn available						10-25 dB conical Gain Horns 34 dB Lense Corrected Gain Horn
Testplots	Page 9	Page 9	-/-	-/-	Page 10	-/-	Page 10
	DL-WR15-Proto	DL-WR12-UG387-16.7ns-CU			DL-WR12-UG387-4.0ns		203mm Circular Guide+ 90° Bend+Dielectric Delay Line
	Plot 1	Plot 2			Plot 3		Plot 4
Part Number	DL-WR15-UG387-XXNS-CU	DL-WR12-UG387-XXNS-CU	DL-WR10-UG387-XXNS-CU	DL-WR15-UG387-XXNS-AL	DL-WR12-UG387-XXNS-AL	DL-WR10-UG387-XXNS-AL	DL-E-UG387-XXNS-DE

Notes:  
All specifications are subject to change without prior notice.



# Delay Line

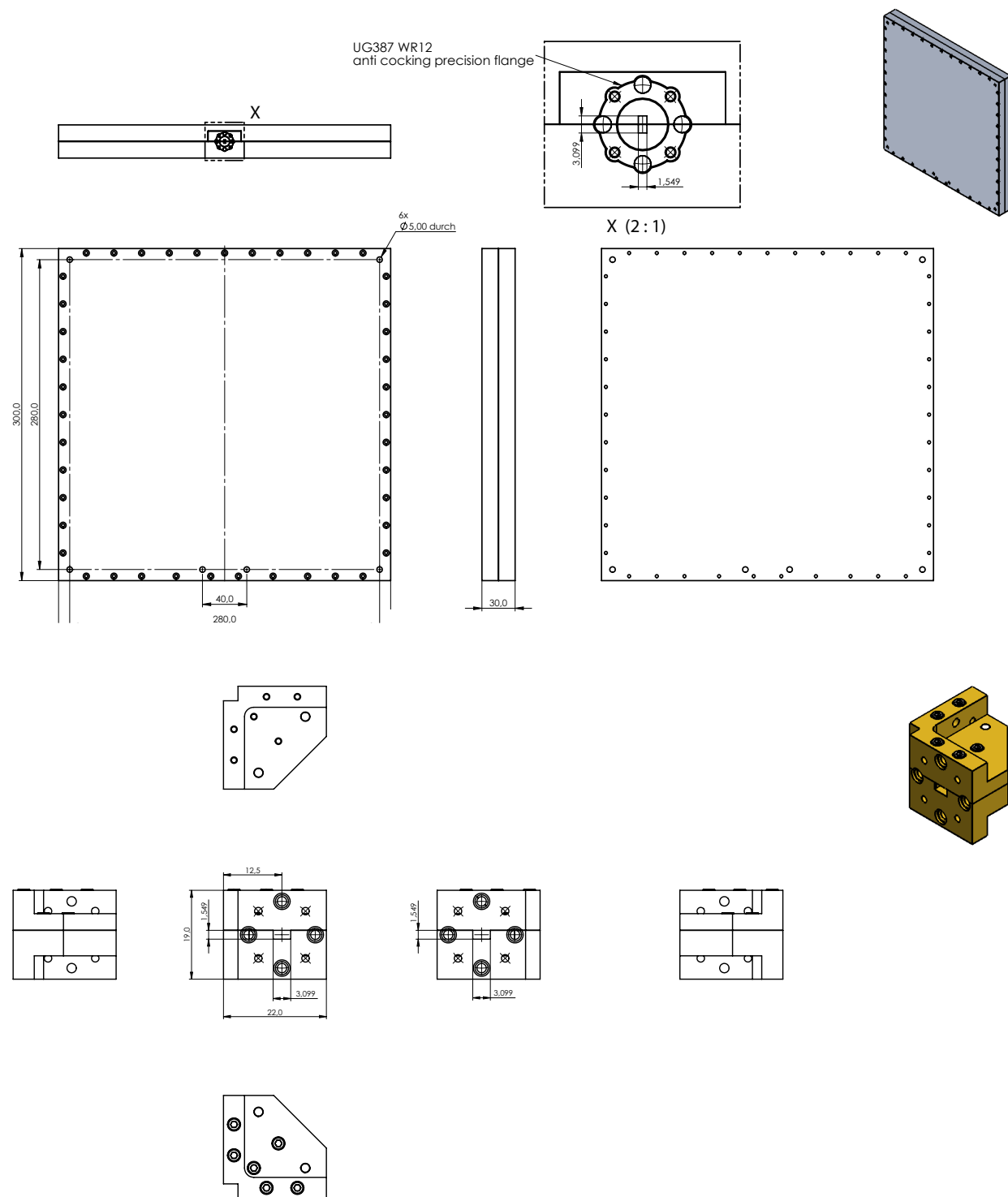


Notes:  
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# Outlines

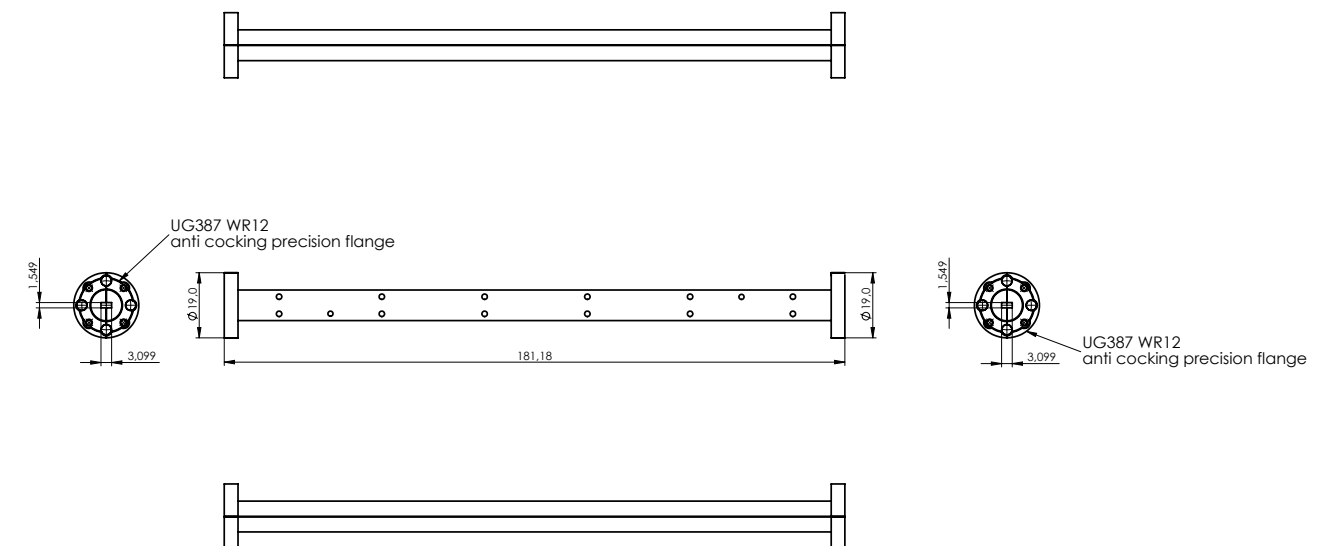
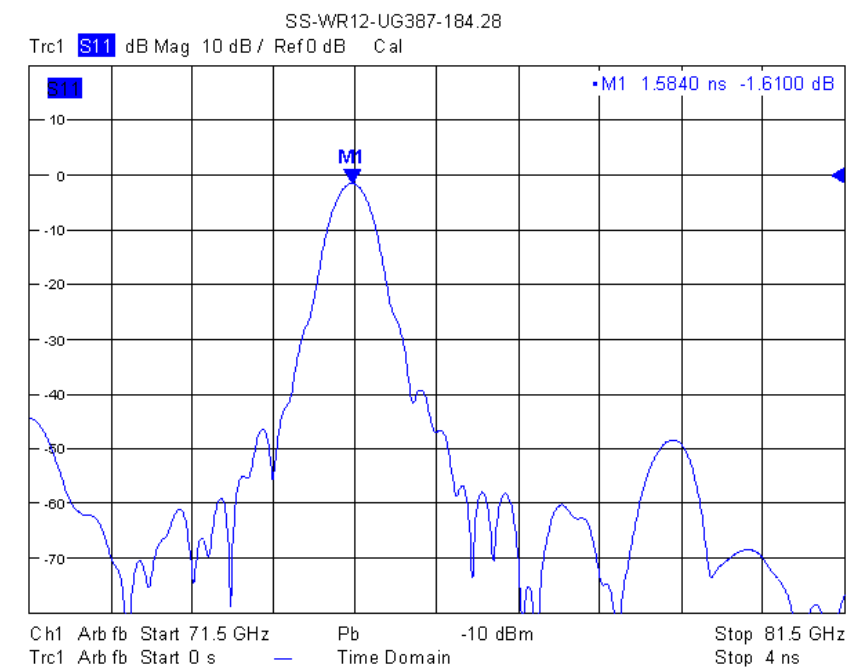


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Notes:  
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# Components Straight Section



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Notes:  
All specifications are subject to change without prior notice.

## Components

### Antenna

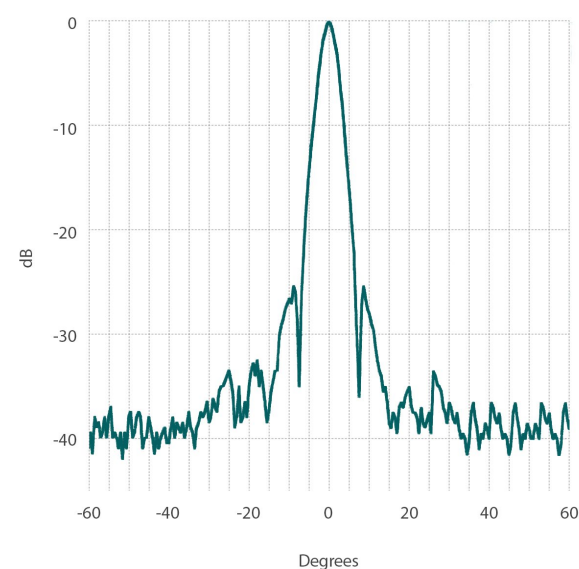
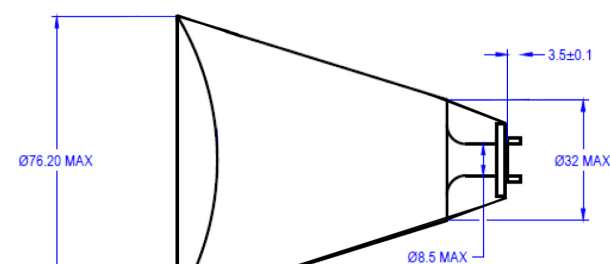
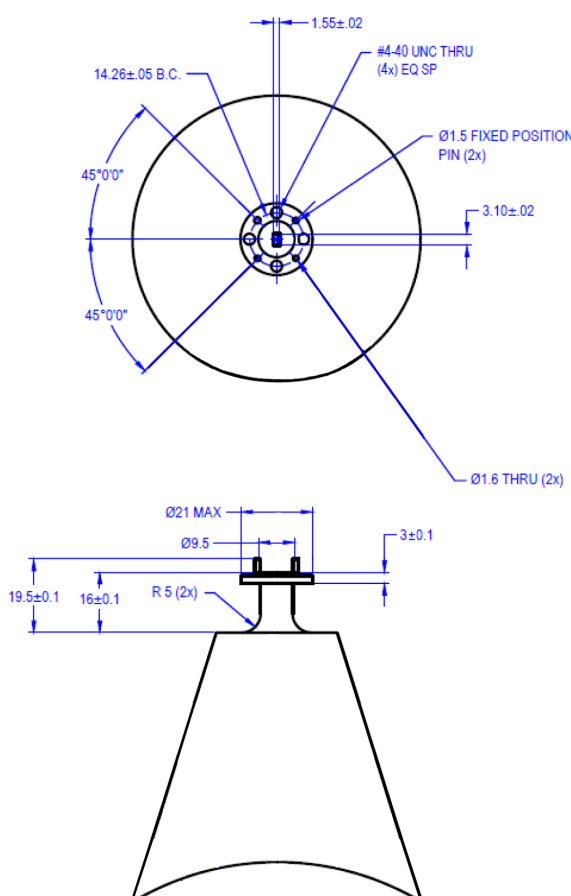


### Specifications

RF Band	68 - 82 GHz
VSWR	1.3:1 nominal
Gain nom.	32 dB

### Model Number

LCA-76-82-32



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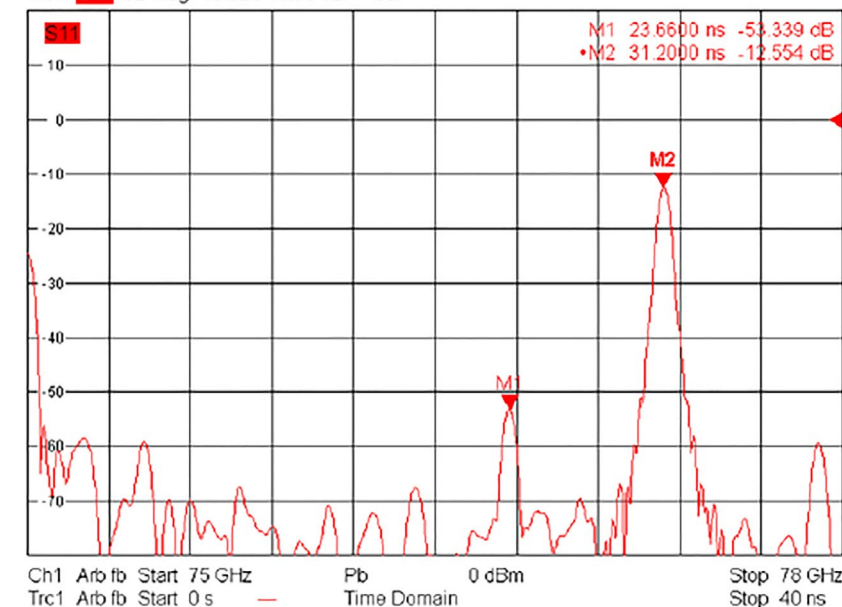


**Notes:**  
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## Performance Graph

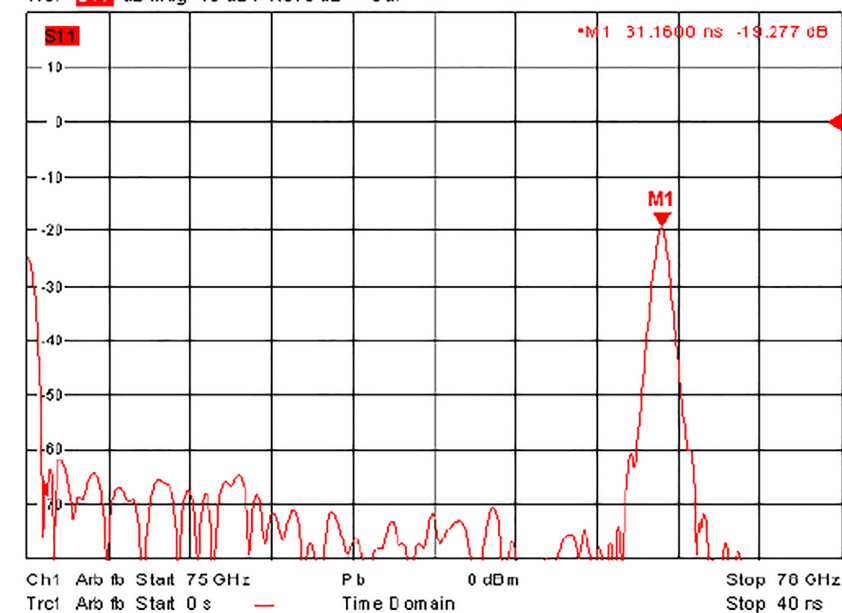


DL-WR15-Proto (Flange at 3015mm (M1) Short at End (M2))  
Trc1 S11 dB Mag 10 dB / Ref 0 dB Cal



DL-WR15-Proto  
Plot 1

DL-WR12-UG387-16.7ns-CU  
Trc1 S11 dB Mag 10 dB / Ref 0 dB Cal



DL-WR12-UG387-16.7ns-CU  
Plot 2

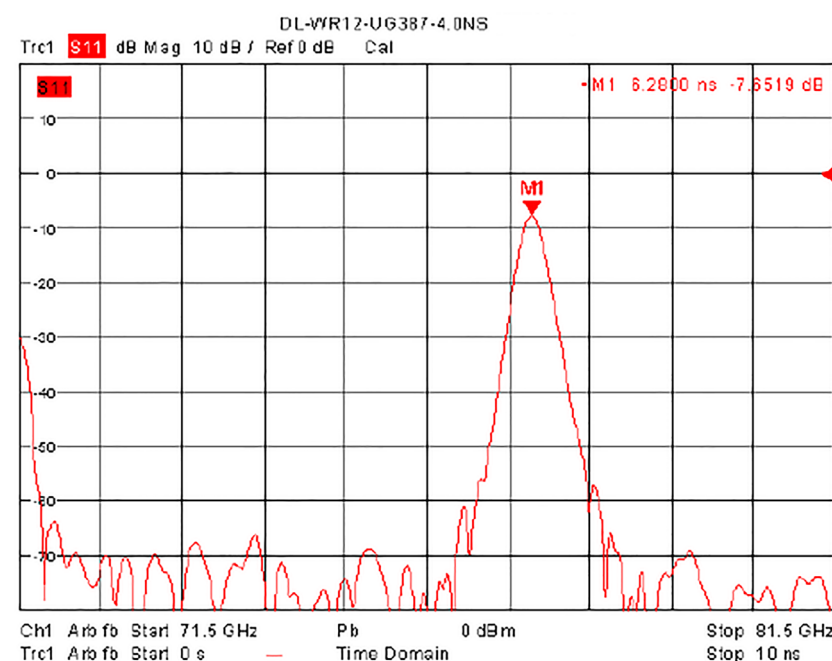
**Notes:**  
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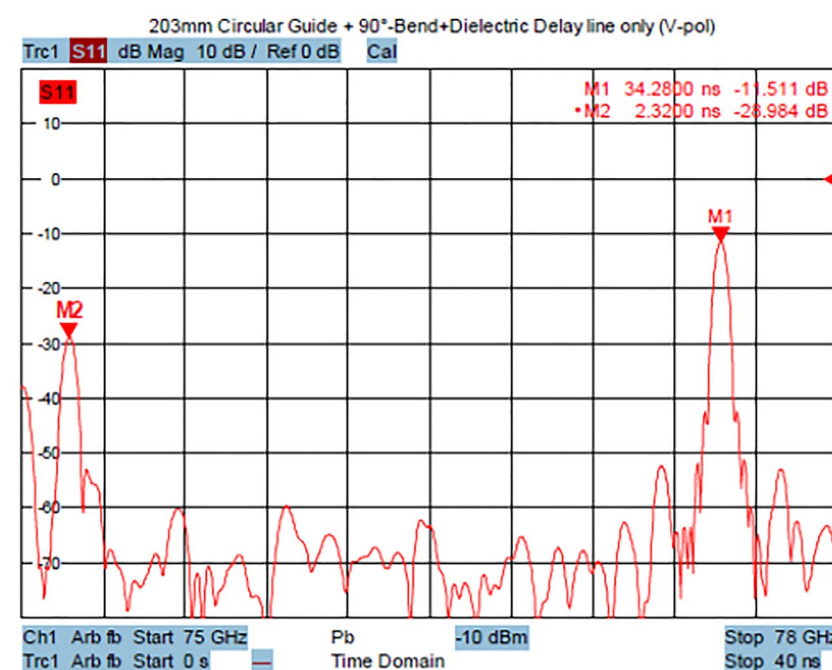




## Performance Graph



**DL-WR12-UG387-4.0ns**  
**Plot 3**



**203mm Circular Guide+  
90° Bend+ Dielectric Delay Line**  
**Plot 4**

**Notes:**  
All specifications are subject to change without prior notice.

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## Flexible Dielectric Waveguides (FDW)



With this new FDW Series, TTE introduce the new signal transmission lines for RF- and Microwave-Applications. This Dielectric Waveguides will be used, where low attenuation and high flexibility is required. The integrated transitions make the Dielectric Waveguide 100% compatible to your existing, rectangular waveguide equipment. The outer electrical shielding gives an additional mechanical protection to the waveguide section.

### Features:

- Flexible Waveguide (bend- and twistable)
- Frequency up to 110 GHz (V, E and W Band)
- Full Waveguide Bandwidth
- Ultra-Low Attenuation, compared to Metal Waveguide
- Transition from Dielectric to metallic rectangular Waveguide included
- Mechanical and Electrical Shielding
- Customized Length

### Application:

- S-Parameter Measurement
- Test and Measurement
- On-Wafer Probing

### Specifications

Waveguide Format	WR-15	WR-12	WR-10
Frequency	50-75 GHz	60-90 GHz	75-110 GHz
Length:	0.4-2 m (1.57-78.7in)		
Technology	Rectangular dielectric Material		
Flanges	UG387/U	UG387/U	UG387/U-M
Outside Protection	Metal Shielding		
Performance Graph	-/-	-/-	page 12/13
Part Number	FDW-15-XXm XX= length in m	FDW-12-XXm XX= length in m	FDW-10-XXm XX= length in m



**Notes:**  
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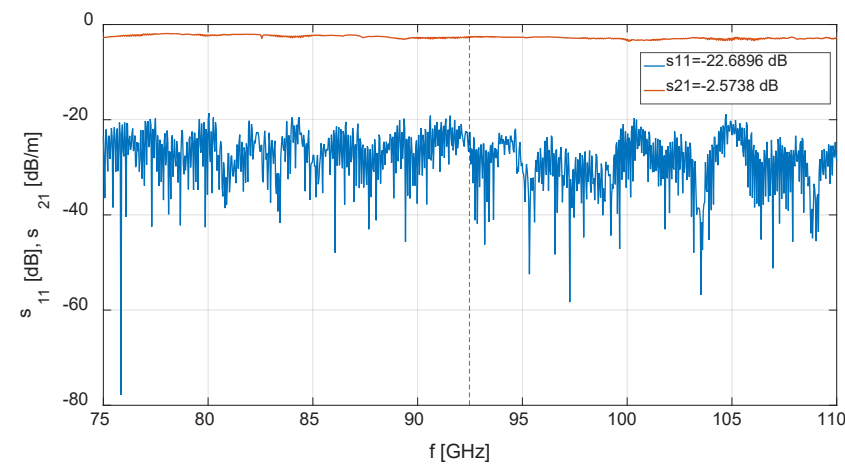


## Performance Graph

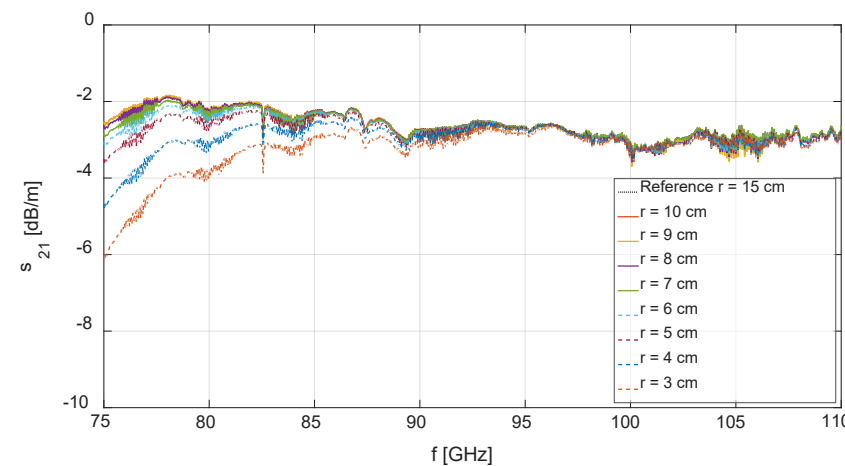
FDW-10-1m



Test Setup: Extender-Mode Changer-Dielectric Waveguide-Mode Changer-Extender  
 Frequency: 75-110GHz (W-Band)  
 Length: 1m



Bending; Stability with Flexure  
 Bending of Dielectric Waveguide: 180°  
 Bending Variation:  $r = 10\text{ cm} \dots 3\text{ cm}$   
 $r = \text{min. } 6\text{ cm}$  for shielded version (see dotted line)



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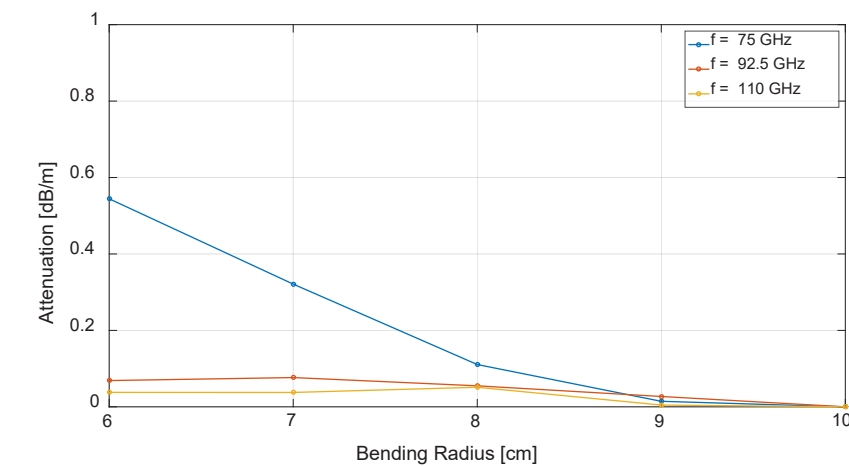
Notes:  
 All specifications are subject to change without prior notice.

## Performance Graph

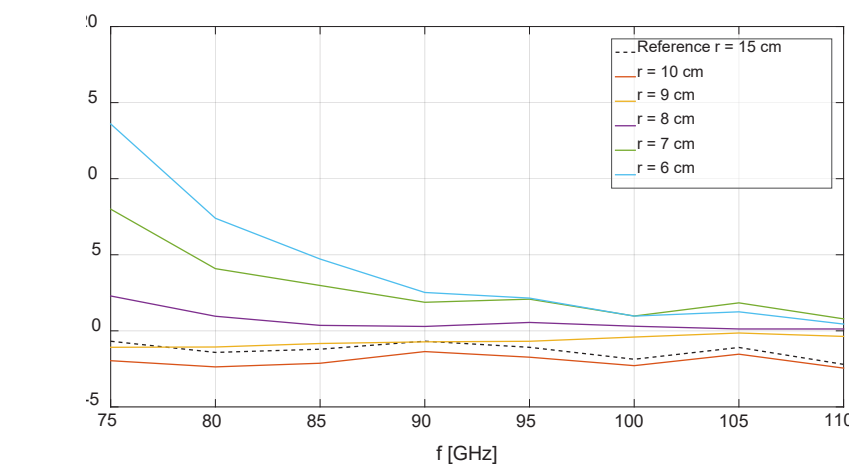
FDW-10-1m



Bending; Stability over Radius  
 Bending of Dielectric Waveguide: 180°  
 Bending Variation:  $r = 10\text{ cm} \dots 3\text{ cm}$   
 $r = \text{min. } 6\text{ cm}$  for shielded version (see dotted line)



Bending; Phase Delay versus Frequency  
 Bending of Dielectric Waveguide: 180°  
 Bending Variation:  $r = 10\text{ cm} \dots 3\text{ cm}$   
 $r = \text{min. } 6\text{ cm}$  for shielded version (see dotted line)  
 Average Phase Delay:  $\Delta\varphi = 2.5^\circ/\text{m}$ ,  $\Delta\varphi_{\text{max}} = 14.7^\circ/\text{m}$



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Notes:  
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## Corner Reflector (CRF)



The Trihedral is a high precise machined component. The clutter on measurements that are caused by cars and other models will be nearly reduced. According customers required RCS and frequency we offer different sizes.

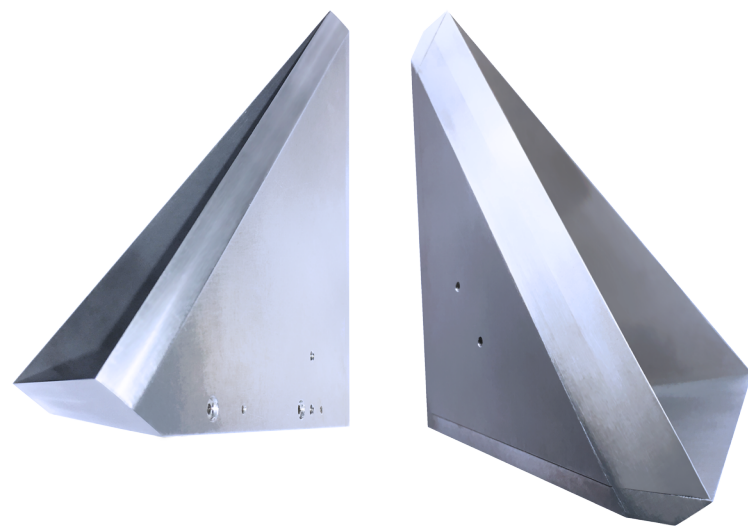
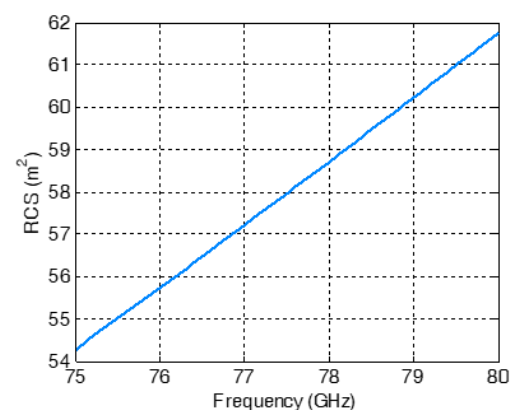
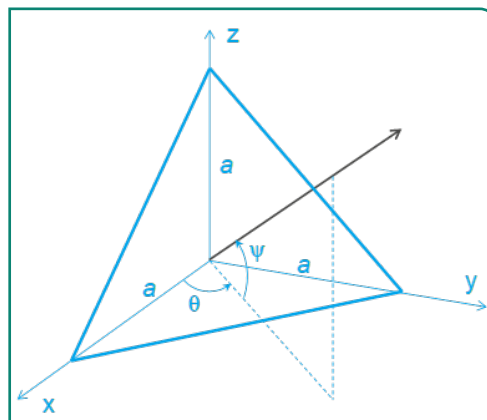
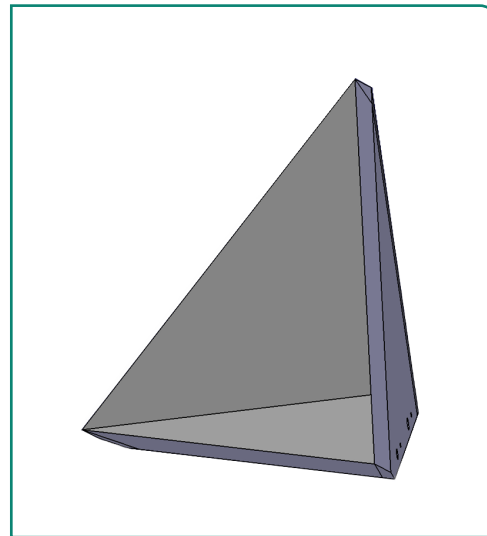
### Features:

- Different Sizes available
- High Precisie
- High Radar Cross Section

### Application:

- RCS Reference
- Radar Test and Measurement

Theoretical max. RCS  $\sigma = \frac{4\pi a^4}{3\lambda^2}$



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**Notes:**  
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## Radarbook



Innovative Evaluation Platform for Microwave Radar Sensors

## Radarbook

Start Your First Microwave Radar Measurements Within 5 Minutes

The **Radarbook** is a novel microwave radar evaluation platform for R&D laboratories, educational institutions, and for rapid prototyping. With out of the box software examples, startup of 24- or 77-GHz radar sensors from Doppler-radars to multi-channel MIMO-sensors is done within minutes.

A high performance analog processing chain and the FPGA based raw data processing allow radar experiments on a state-of-the art level in a very short time.

Full software support of 24- and 77-GHz radar ICs with a Python or Matlab based GUI for a fully configurable processing chain.



Modular  
RF-Frontend

High-Performance  
FPGA Processing

LINUX based OS or  
USB 3.0 to Host

### Supported MIMO Frontends

- Infineon 77-GHz
- Infineon 24-GHz
- Analog Devices 24-GHz

### Analog Input Chain

- 12 analog channels
- Programmable signal-conditioning

### Signal-Processing

- Rate reduction
- FFT, chirp-z
- Zoom-FFT
- Re-configurable

### Available Frameworks

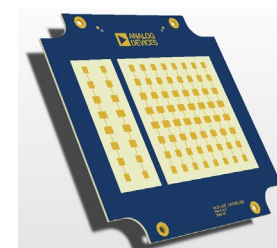
- Sampling
- Range-Doppler
- Beamforming
- MIMO

### Architecture/Interfaces

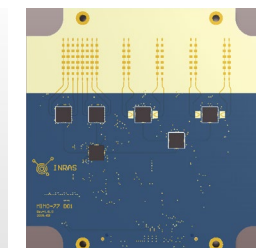
- Linux OS on ARM with LAN, WLAN
- Optional USB 3.0 interface to host PC
- Flexible configuration
- Standardized command interface

### Single Power Supply

- 12 – 36 V

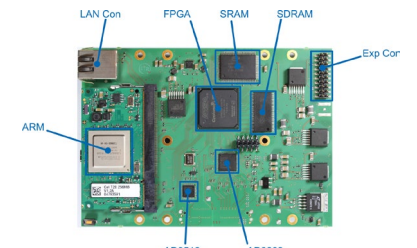


ADF-24G-TX2RX8 Frontend



MIMO-77-TX4RX8 Frontend

FOCUS ON YOUR  
APPLICATION AND  
DON'T WASTE TIME  
WITH HARDWARE  
DEBUGGING



Bottom view of the Radarbook with ARM module and FPGA.





**RF- and Microwave Components • Coaxial DC to 110GHz** • Terminations • Adapters • Antennas • Bias Tees • Attenuators • DC-Blocks • Detectors • Equalizers • Filters • Cables and Cable Assemblies • Dividers • Combiners • Mixers • Multipliers • Noise Sources • Phase Shifters • Couplers • Hybrid Couplers • Switches • Connectors • Amplifiers • Circulators • Isolators • **RF- and Microwave Components • Waveguides DC to 500GHz** • Terminations • Adapters • Antennas • Attenuators • Detectors • Filters • flexible Waveguides • flexible dielectric Waveguides • Multipliers • Waveguide Structures • Couplers • Noise Sources • Mixers • Oscillators • Phase Shifters • Switches • Amplifiers • Circulators • Isolators • **SMDs DC to 110 GHz** • Terminations • Attenuators • Diodes • Filters • Inductors • Capacitors • Dividers • Transistors • Resistors • **Chips / MMICs to 125 GHz** • **Modules** • ASICs and ICs • Up / Downconverters • Frequency Standards • Frequency Extenders • Filters • customized Modules • Synthesizers • Amplifiers • **Systems** • Radar Evaluation Boards • Radar Target Simulators (active/passive) • System Development • Satellite Hardware • Quasi-Optical Network Analyzers • Material • **Software** • CAD / CAE • Test&Measurement • **Measurement Technology** • Spectrum & Network Analyzing • Frequency Extenders • Handheld Synthesizers • Power Sensors • Test and Measurement Equipment • Cable/Antenna Testers • Power Monitoring • Delay Lines • Radar Target Simulators • **Security** • Radar Testsimulators • Signal Logging and Analyzing • Cellular Radio Jammers • **SatCom** • LNBs • Block Converters • 70/140 IF Converters • Transmitters/ Receivers • Oscillators • Frequency Sources • Redundant Switching Systems • Amplifier Systems • Low Noise Amplifiers • Test Translators • Amplitude / Slope Equalizers • Power Supply Systems • Waveguides • Rotary Joints