TSDG-0001xx

24 GHz Radar Target Simulator

Datasheet

Project Number:

...

SMS Project Number:

...

Project Title:

TSDG

Keyword(s):

Datasheet

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Document:

TSDG-0001xx_Datasheet.docx

1 Contents

2 Reference Documents

Nr.	Document	Comments
[1]	TSDG-0001xx_Users_Manual.docx	User's Manual
[2]	KTSDG-02xxxx_Datasheet.docx	Datasheet of previous generation of Doppler generators "KTSDG-02"
[3]		
[4]		

Table 1: Reference Documents

3 Document History

Date	Author	Action
2016-08-31	SBR	New datasheet for TSDG
2016-11-24	SBR	Added 1m minimum target distance

Table 2: Document History

4 Datasheet

The TSDG-0001xx is a highly integrated, 19” rack mountable radar target simulator, which is capable of simulating a single target at 24 GHz with programmable Doppler shift and RCS. All settings can be programmed over Ethernet. The TSDG receives the radar sensor signal via an antenna connected to its input, a programmable synthesizer converts the frequency down to an intermediate frequency (IF). A second individually programmable synthesizer converts the frequency back up before it gets transmitted back to the radar sensor by a second antenna.

The delta frequency between the two synthesizers defines the Doppler shift of the signal. The RCS of a radar target can also be adjusted by programming of a variable attenuator inside the TSDG. Real time delays can be realized with the TSDG by inserting a coaxial cable or fiber optic media converter into the IF signal path.

With an external frequency converter, the TSDG-0001xx can easily be upgraded to work with sensors operating between 76 - 81 GHz.

4.1 Technical Overview

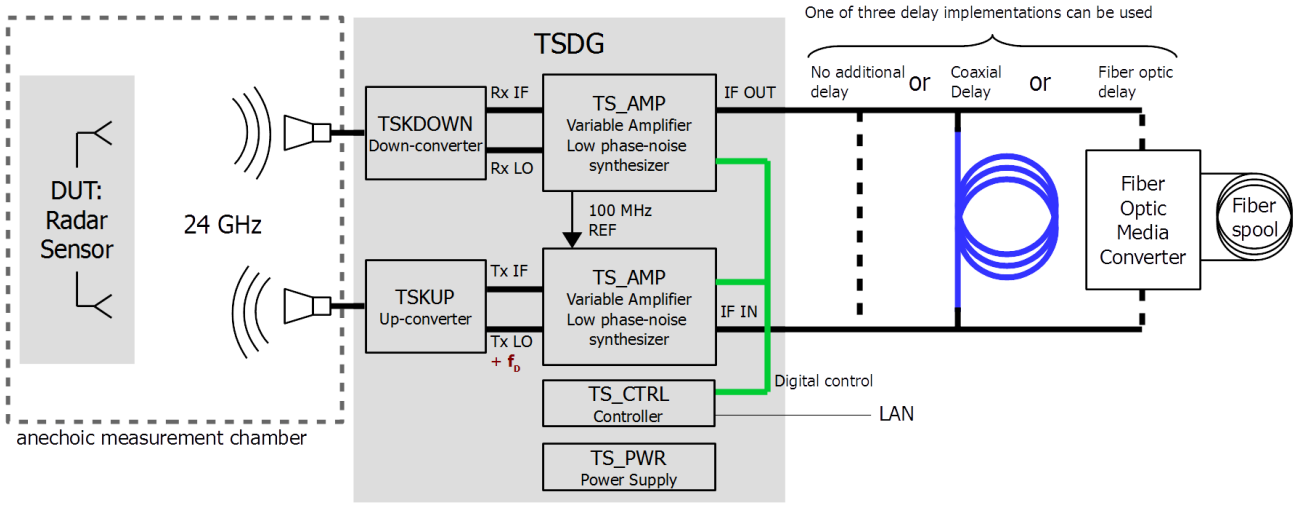
- Precise single target simulation.
- Customized signal delay times possible.
- Programming of radar target RCS in 0.5dB steps.
- Programmable Doppler frequency resolution in 12 Hz steps.
- Easy to use GUI Interface.
- Ethernet controlled.
- Optional extension for use at 76 - 81 GHz available.

Front Panel View

Rear Panel View

4.2 Block Diagram

Recommended measurement setup diagram:



The TSDG is split into a receiver path and a transmitter path, each using a frequency converter and a variable gain amplifier. The receiver path comprises the modules TSKDOWN and TS_AMP. The transmitter path comprises the modules TSKUP and a second TS_AMP.

In the receiver path the radar waveform is down-converted to an intermediate frequency centered at f_{if}=6.525 GHz. The IF signal is accessible on an SMA connector at the output of the receiver chain, labelled "IF OUT". In order for the TSDG to function, "IF OUT" must be connected to the "IF IN" SMA connector of the transmitter path. A wide variety of connections are possible:

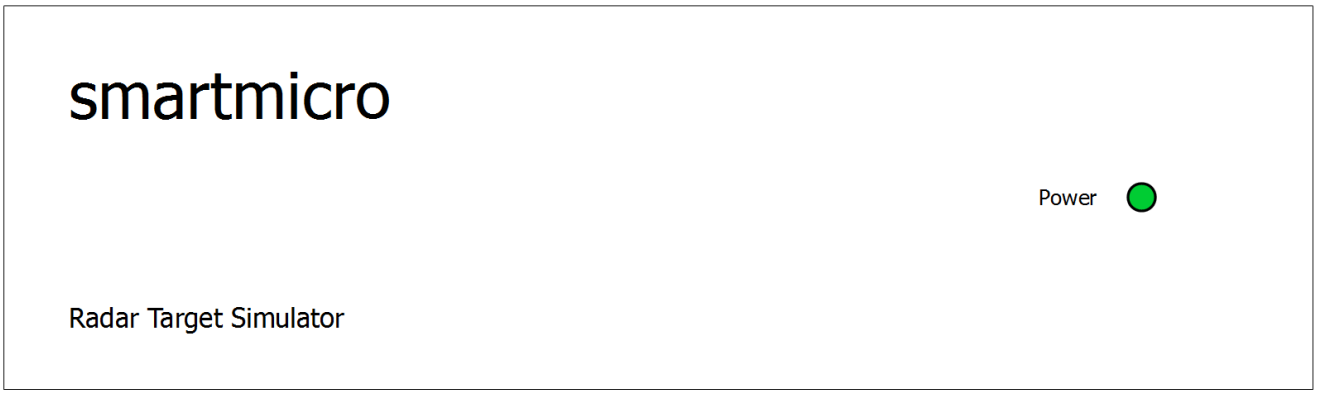
1. To get the minimum target distance of the TSDG itself with no additional delay, a short coaxial "jumper" cable can be installed.
2. A longer coaxial cable can be connected here to simulate target distances of up to 15m.
3. For distances over 15m, a fiber optic media converter may be used. Target distances of 10 km and beyond are attainable in this configuration.

The customer is free to connect his own delay or, if desired, have Smartmicro recommend and procure components for a particular application.

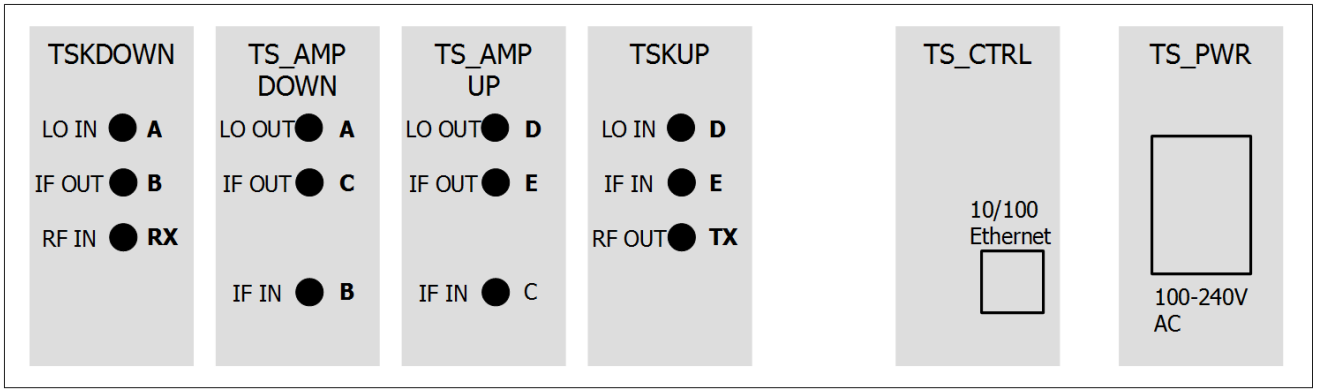
After the IF signal is fed back into the TSDG it enters the transmitter chain. A variable gain amplifier compensates for any attenuation introduced into the IF signal by external equipment, like the previously mentioned fiber optic media converter. The up-converter shifts the signal back up into the 24 GHz band and adds the selected Doppler shift f_D.

The TSDG if built from individual modules that mount into a 19" subrack frame. This modular design allows for simple upgrades to additional frequency bands. All RF and IF signals are available on the rear panel of the unit for monitoring and expansion.

4.3 Connections



Front Panel



Rear Panel

All connections are made on the rear panel of the TSDG. A set of coax jumpers and instructions on what connections to make for common measurement setups are included with the unit.

4.4 Specifications

Absolute Maximum Ratings			
Input Power	20	dBm	RF IN
	20	dBm	IF IN
	20	dBm	LO IN
DC voltage	0	V	RF IN
	0	V	IF IN
	0	V	LO IN

Recommended Operating Conditions			
RF IN	-10	dBm, max.	
IF IN	-30	dBm, max.	
External IF attenuation TS_AMP DOWN: IF OUT to TS_AMP UP: IF IN	20 40	dB, min. dB, max.	

Electrical Specifications for TSDG-0001xx T_A=25°C; RF IN power: -30dBm; external attenuation in IF path: 40dB; Test frequency: 24.125 GHz; $L_1 = L_2 = L_3 = L_4$ = 20 dB; RF IN to RF OUT			
RF Frequency Range	24 – 24.25	GHz	
Input Return Loss	-10	dB, typ.	RF IN
Input 1 dB Compression Point	-5	dBm, typ.	RF IN
Output Return Loss	-10	dB, typ.	RF OUT
Output 1 dB Compression Point	10	dBm, typ.	RF OUT
IF Frequency Range	6.4 – 6.65	GHz	
Input Return Loss	-10	dB, typ.	IF IN
Output Return Loss	-10	dB, typ.	IF OUT
Gain Ripple	±1	dB, typ.	
Attenuation Accuracy	± (2.4 + 5% * L)	dB, max.	$L = L_1 + L_2 + L_3 + L_4$ see section 4.5
Local Oscillator SSB Phase Noise 10 kHz Offset 100 kHz Offset 1 MHz Offset	 -85 -110 -130	dBc/Hz, max.	LO OUT, 17.6 GHz
Local Oscillator SSB Phase Noise 10 kHz Offset 100 kHz Offset 1 MHz Offset	 -95 -120 -140	dBc/Hz, typ.	LO OUT, 17.6 GHz
Non-harmonic spurs	-60	dBc, typ.	

Propagation Delay	8	ns, typ.	TSDG with 5" IF jumper; without external cabling or antennas
Simulated target distance	< 1	m, typ.	TSDG, using only one of two TS_AMPs
	< 2	m, typ.	TSDG with 5" IF jumper; without external cabling or antennas
	>1000	m	with fiber optic delay
Doppler Frequency Step	11.92	Hz	0.074 m/s
Doppler Frequency Accuracy	< 0.1%		
Max. Doppler Shift	±100	kHz	±2237km/h ±621m/s

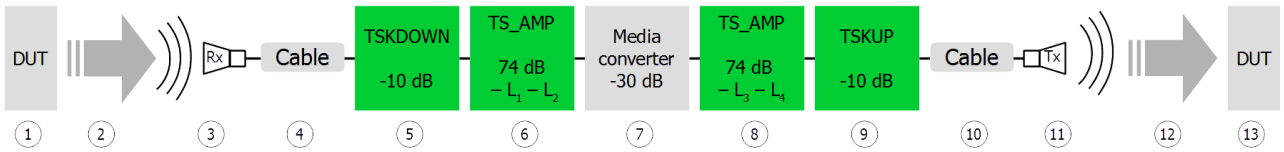
Electrical Specifications for Individual Modules			
TSKDOWN Conversion Gain	-10	dB, typ.	
TS_AMP Maximum Gain	74	dB, typ.	
TS_AMP Attenuation Control Range	0 - 31.5 0 - 63	dB dB	Per attenuator L_x Total per TS_AMP
TSKUP Conversion Gain	-10	dB, typ.	

Mechanical Specifications			
RF Interface	SMA-F or 2.92 mm		2.92 mm mates with SMA
IF Interface	SMA-F		
Weight	5	kg	
Dimensions	19	inch	Form Factor
	3	U	height (1 U = 44.45 mm)
	295	mm	depth

Environmental Specifications			
Temperature	+10 to +35°C	Operating	

Operating voltage	100 - 240	VAC	72W max., 50/60Hz
Warm-Up Time	120	Minutes	

4.5 Typical Loss Budget Calculation



Nr.	Component	Gain	Power
1	DUT E.I.R.P.		**+20 dBm**
2	Free Space Loss 2m @ 24 GHz	-60 dB	-40 dBm
3	Antenna Gain	+10 dBi	-30 dBm
4	Cable Loss 5m, -3 dB/m @ 24 GHz	-15 dB	-45 dBm
5	TSKDOWN Conversion Gain	-10 dB	-55 dBm
6	TS_AMP Attenuator L_1 (0 – 31.5 dB) Attenuator L_2 (0 – 31.5 dB)	+74 dB -15 dB -15 dB	-11 dBm
7	Fiber optical media converter incl. cabling	-30 dB	-41 dBm
8	TS_AMP Attenuator L_3 (0 – 31.5 dB) Attenuator L_4 (0 – 31.5 dB)	+74 dB -15 dB -15 dB	3 dBm
9	TSKUP Conversion Gain	-10 dB	-7 dBm
10	Cable loss	-15 dB	-22 dBm
11	Antenna Gain	+10 dBi	-12 dBm
12	Free Space Loss	-60 dB	-72 dBm
13	DUT input power	**-72 dBm**	

To prevent oscillation, it is important to make sure that the isolation between Tx and Rx antenna is larger than the sum of gains 4 – 10 (23 dB in this example).

4.6 Product ID

The product ID of every product consists of a name as an identifier and a 6 digit long product number plus a unique serial number for each build unit.

TSDG – 000100	00000000
TSDG – GGMMRR	Serial Number

Product Name: TSDG

At first is the product name, which identifies the type of product.

Generation: GG

Then the first two digits stand for the generation of the product, which changes if a complete redesign has been done. The generation always starts with the number 00.

Modification: MM

The two modification digits stand for functional changes within parts of the unit. Units with the same modification number can be exchanged. The modification always starts with the number 00.

Modification	Functionality
00	24 GHz + 76-81 GHz bands supported
01	24 GHz band
02	76 – 81 GHz band

Revision: RR

A change in revision happens if parts of the design change without any functional change in the unit. For example if a new manufacturer is producing the product. The revision always starts with the number 00.

The first build unit of the instrument described in this document will have the product ID:

TSDG-000100 00000000

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