Project Documentation | EKTSDG-010101 Target Simulator Doppler Generator

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Document Revision History

Table 0-1: Document Revision History

Date	Editor	Description
2012-02-08	Michaelis	Initial design of document
2012-03-21	Mende	Review
2013-04-26	Michaelis	minor updates from version EKTSDG-010000 to EKTSDG-010101
2013-06-11	Michaelis	introduced speed correction factor and conditions of use for Turkey
2013-08-12	Stolhofer	Added chapter disclaimer & contact
2014-01-30	Michaelis	Added chapter "Using EKTSDG with UMRR sensor
2016-10-26	Erkenbrecher	Updated to EKTSDG-010101

1.1 Reference Documents

[RD1] Documentation_UMRR_Traffic_Sensor_2G
[RD2] TMConfigurator Online Help

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3 Overview

The EKTSDG-010101 (Electronic K-band Target Simulator/ Doppler Generator) is a handheld portable moving target simulator for K-band Radar transceivers.

It can be used for:

- alignment of sensors in the field at installation time
- field or lab calibration and year-by-year inspection
- general functional testing in the field and in the lab.

A software generated modulation signal allows generating a low distortion and directional Doppler signal from 44Hz to 9kHz corresponding to speeds from 1km/h to 300km/h.

3.1 Features

Handheld K-Band Target Simulator Doppler Generator
Works with Smartmicro 24GHz sensors
Simulates a moving target in distances up to 100m
Programmable Speed Interval 1 ... 300km/h
Programmable Movement Direction
Programmable Signal Level
Programmable Presets
Rechargeable Accumulator
Standalone or Hosted Operation
USB Interface to Host Computer
Compact and Rugged Construction
EKTSDG-Remote PC Software included

3.2 Applications

UMRR Installation and Adjustment
UMRR Field Performance Test
UMRR Functional Test

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4 Getting Started

This chapter explains the first steps of using the EKTSDG device and the EKTSDG-Remote Software.

4.1 Equipment Needed

EKTSDG Device
EKTSDG-Remote Software
PC with Windows 2000/XP/Vista/7
Micro USB Cable

4.2 EKTSDG-Remote Software

EKTSDG can be connected to any Windows PC via USB. The included EKTSDG-Remote software allows real-time remote controlling and configuring the presets of the EKTSDG.

4.3 Installation

1. Download the EKTSDG-Remote Software from www.smartmicro.de
2. Remove any EKTSDG device connected to your system
3. Unpack the downloaded file "EKTSDG-SW.zip" and start "setup.exe".
   If your computer does not already contain the actual LabVIEW runtime engine, you will be asked to accept licenses of National Instruments.
4. If possible, accept all default program locations. Troubleshooting will be simplified like this.
5. Please be patient while LabVIEW runtime system is being installed.
6. You will find the EKTSDG under START->PROGRAMS->SmartMicro->EKTSDG-Remote
7. Plug your EKTSDG system to a USB port of your PC. There should appear a "New USB Hardware Found" message from Windows.
8. Windows will ask you for a hardware driver. Select to install it manually and chose the location of the unpacked EKTSDG-SW folder. Ignore the Windows logo test message.
9. Start EKTSDG-Remote Software.

As soon as the EKTSDG system has been connected, the search LED stops flashing and EKTSDG-Remote software is ready. It may take some moments until the EKTSDG is found by the software.

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Note: If the EKTSDG Hardware will not be found, please reinstall the hardware driver and try again.

4.4 EKTSDG-Remote Screen

After launching the EKTSDG-Remote Software, the screen below should appear.

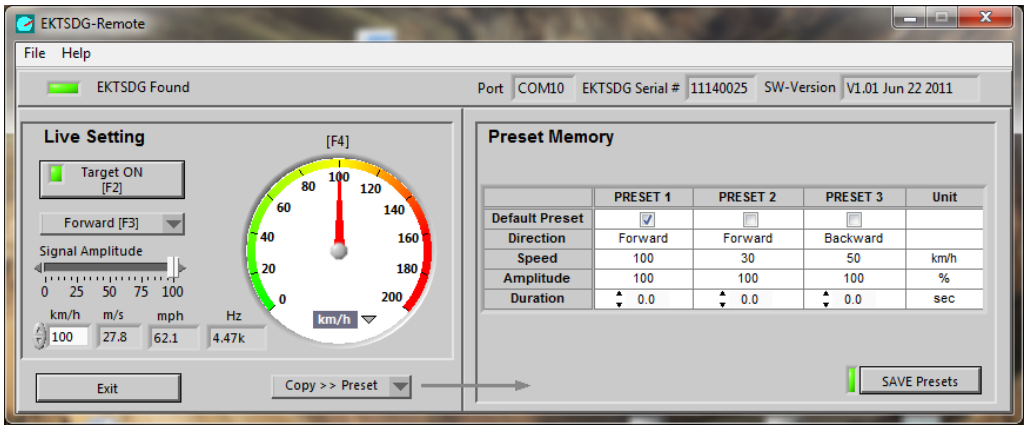


Figure 1: EKTSDG-Remote Screen

See section 6.2 for details on this software.

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5 EKTSDG Handheld Operation

5.1 Controls

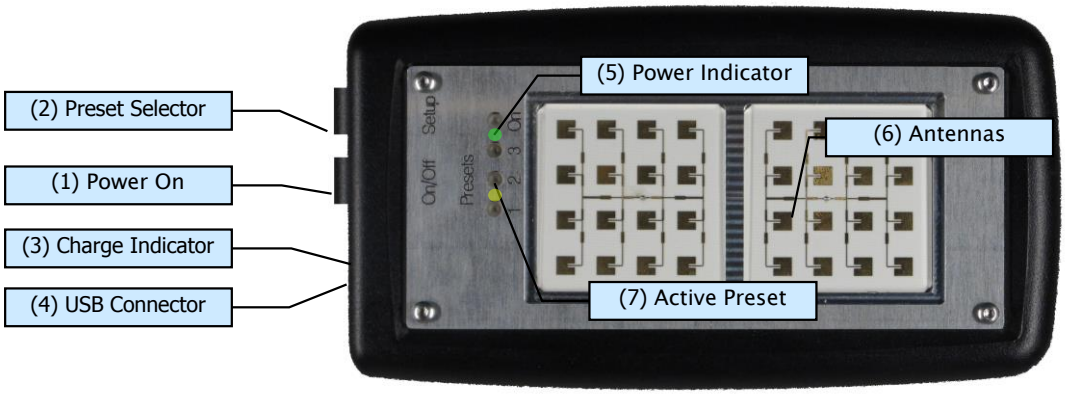


Figure 2: Controls and Displays

5.2 Using EKTSDG

5.2.1 General Remarks

Prepare the settings as described in section 6.2. Maximum distance depends on the UMRR model, its configuration and the amplitude settings of EKTSDG.

5.2.2 Power Indicator and Charging

When you are using the EKTSDG without a USB connection the power indicator (5) begins only to blink if the power of the battery is too low. → Connect the EKTSDG over USB with a PC to charge the accumulator. The charge indicator (3) turns on when you connect and turns off when the accumulator is fully loaded. If the charge indicator blinks the accumulator generates a fail and must be changed.

5.2.3 Using Default Preset

The default preset will be executed, until the programmed duration elapses.

Align the EKTSDG antenna (6) facing the UMRR sensor
Press the Power switch (1) for 0.5 seconds
> EKTSDG begins simulating the programmed speed, amplitude and direction
> EKTSDG stops after the programmed duration or after switching off manually with (1)

5.2.4 Selecting a different Preset

The selected preset will become the new default preset and will be executed, until the programmed duration elapses:

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1. If the EKTSDG is already running, turn it off by pressing the Power switch (1) for 0.5 seconds.
2. Press the Power switch (1) **while** pressing the Preset selector (2)
   > EKTSDG default preset LED (7) blinks
3. Repeat pressing the Preset selector (2) until the desired preset LED (7) flashes
   > after 1 second, the selected LED (7) stops blinking and EKTSDG runs the selected preset
   > the selected preset will become the new default preset

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6 EKTSDG-Remote Software

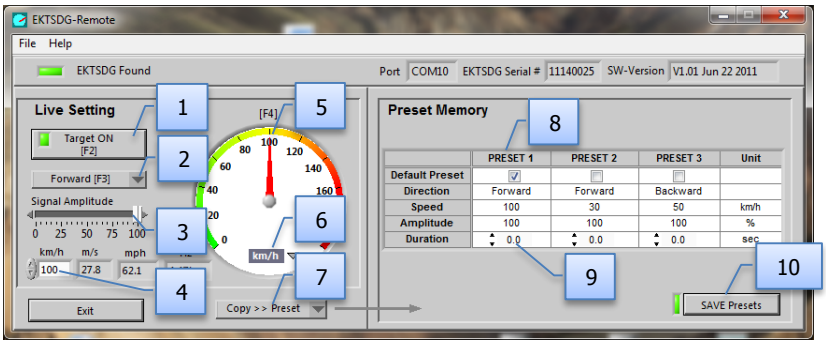


Figure 3: EKTSDG-Remote Software Screen

Legend of Controls:

1. Doppler Signal ON/OFF
2. Direction of Movement
3. Doppler Amplitude (simulates object distance)
4. Object Speed parallel to (5)
5. Object Speed parallel to (4)
6. Select Speed Display Unit
7. Copy Settings to Preset Memory
8. Select Standard Preset
9. Duration of Doppler Signal
10. Save Presets to EKTSDG

This software allows real time control and configuring the EKTSDG target. You can get help by moving the mouse over the control elements. Menu „Help-Show Context Help" opens a small window with additional information.

6.1 Remote Controlling EKTSDG

EKTSDG may be remotely controlled by the EKTSDG-Remote software. The real-time remote control part is called Live Setting on the left half of the Software panel. Please connect EKTSDG to a USB port before changing any controls.

6.1.1 Switching ON/OFF

Click [Target ON] key (1) to toggle speed simulation on and off. Shortcut key [F2].

6.1.2 Setting Speed

Speed setting may be controlled by different methods:
- Move needle (5)
- Type value or use spin controls in (4)
- Use [PageUp] and [PageDown] keys on PC keyboard
- Shortcut key: [F4], then cursor up/down

6.1.3 Setting Movement Direction

Toggle the direction with control (3). This control changes the sign of the 90° phase shift between the I and Q channel. "Forward" will simulate an approaching object, "Backward" will simulate a receding object.

6.1.4 Setting Signal Amplitude

Adjusts the tx signal amplitude (3).
This may be useful for testing the UMRR indoors and close range.

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6.2 Configuring EKTSDG

EKTSDG starts up with a "default preset". This is one of three configurable presets. All presets can be configured by means of the EKTSDG-Remote software or with a terminal software.
Default preset can also be selected manually directly with the EKTSDG. See section 5.2.4.

6.2.1 Storing Settings as Presets

1. Select the desired parameters in the Live Setting section with controls (1) to (6)
2. Copy these parameters to the desired preset with selector (7)
3. **Save presets** with control (10)

6.2.2 Set Signal Duration

The EKTSDG sends a Doppler signal, until signal duration has elapsed and then switches off.

1. For each preset, you may select an individual duration with control (9).
   Value range is 0.1 to 60sec. Value 0 means 'unlimited'
2. **Save presets** with control (10)

6.2.3 Set Default Preset

Default preset will be active after normal power on of the EKTSDG. It may later be altered directly at the EKTSDG.

1. Select default preset with (8)
2. **Save presets** with control (10)

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6.3 EKTSDG Frequency Band preset

After the first installation the EKTSDG-Remote software is preconfigured to operate with UMRR sensors in the default frequency band of UMRR network ID0. (See section 10.3 "How to change the frequency band" in [RD1])

When using the EKTSDG together with an UMRR sensor of a different network ID and thereof a different frequency band, the accuracy between the set and the measured speed will be reduced.

To change the EKTSDG frequency band settings, close the EKTSDG-Remote software, open the file "EKTSDG_OEM.ini" in the EKTSDG-Remote installation folder with a text editor and change the value of the "Speed_Correction" according to Table 2. Then save your changes and start EKTSDG-Remote again.

Table 2: Speed Correction Factors for different UMRR frequency bands

UMRR ID	default Frequency Band	Speed Correction Factor
ID0	FB6	1.013
ID1	FB8	1.014
ID2	FB10	1.014
ID3	FB12	1.016

6.4 Getting Help

Get help by selecting Menu-Help.
Get tips by moving cursor over the controls.

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7 Testing UMRR with EKTSDG

7.1 EKTSDG configuration

Configure a defined speed of 30 m/s (=108 km/h), forward using the EKTSDG-Remote software and copy/save the presets. The direction setting "Forward" causes an approaching simulated target. According to the UMRR's coordinate system this target will have a negative speed of -30 m/s.

The chosen Doppler speed should be unusual for the traffic at the installation site.

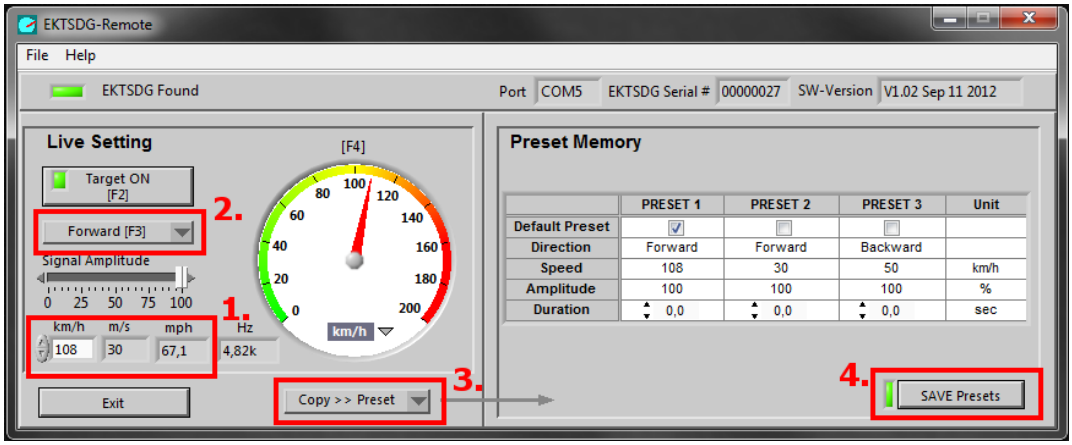


Figure 4: Configuration software EKTSDG-Remote



Figure 5: EKTSDG-010101 handheld Doppler target simulator

The EKTSDG-010101 device is charging the batteries when connected to the pc. When the charging indicator LED goes off, the battery is fully charged.

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7.2 Sensor operational mode configuration

For the performance test with the EKTSDG-010101 Doppler target simulator the UMRR sensor has to be in alignment mode. To run the sensor in the alignment mode send the command:
(see [RD1] and [RD2] for how to send a command to the UMRR sensor)

ParNo:	18
Value:	1 (1: alignment mode activated; 0: alignment mode deactivated)
Action:	0
Type:	Int

In order to filter the sensor output for the configured Doppler speed send the command:

ParNo:	61
Value:	130 (130: -30 m/s; 0: all targets)
Action:	0
Type:	Int

When the value is set to 0 all targets in the field of view are send as sensor output. Values between 1 and 199 [m/s] causes that only targets with the matching speed (±1 m/s) are sent:

Values 1 to 99 for positive speed in m/s (departing objects)
Values 100 to 199 for negative speed in m/s (approaching objects)

You can use the "Object List" view of the TMC to watch the sensor output data. Therefor activate the Object List view in the menu:

Views > Interpreted CAN Data Views > Sensor Target Lists > Object List

In the Object List view select "Tracked_Objects_ID0" from the drop down menu.

With the speed filter activated in alignment mode you should only see the simulated target from the EKTSDG.

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8 Optional: EKTSDG USB Serial Interface

EKTSDG can optionally be operated by a terminal program or by customer software.
The USB port is represented as serial interface by the driver software, that has been installed according to section 4.3.

1. Connect EKTSDG
2. Start EKTSDG-Remote software or check the windows control panel to get the assigned COM port. Close EKTSDG-Remote software before opening terminal software!
3. Open a terminal program like Windows Hyper Terminal
4. Select the appropriate COM port. All other settings are not used.
5. Press [Enter]. Now, the following screen (Fig. 4) should appear:

8.1 Terminal Mode: Remote Control

```
EKTSDG 24GHz Doppler Target #09200100
=============================================
Program Version V1.00 Aug 21 2009

Default Preset            :   1       [0=none, 1..3=Preset]

[d] Direction of Motion   :   0       [0=Forward, 1=Backward]
[s] Speed                 :   3       [001..300km/h]
[r] Reach                 : 100       [001..100%]
[t] Target On/Off         :   1       [0=Off, 1=On]

[p] Presets Setup
[x] Back to manual mode

->
```

Figure 6: EKTSDG Terminal Remote Control Dialog

These settings are directly executed, as long as EKTSDG remains connected to the USB port.
With [p], you will be able to configure the preset memory.

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8.2 Terminal Mode: Preset Setting

For using presets please refer to section 5.2.

```
Presets Setup Page
==================

[q] P1 Direction of Motion   :     0     [0=Forward, 1=Backward]
[w] P1 Speed                 :     3     [001..300km/h]
[e] P1 Reach                 :   100     [001..100%]
[r] P1 Time                  :     0     [001..600x100ms, 0=endless]

[t] P2 Direction of Motion   :     0     [0=Forward, 1=Backward]
[z] P2 Speed                 :   113     [001..300km/h]
[u] P2 Reach                 :   100     [001..100%]
[i] P2 Time                  :    60     [001..600x100ms, 0=endless]

[o] P3 Direction of Motion   :     0     [0=Forward, 1=Backward]
[p] P3 Speed                 :     9     [001..300km/h]
[a] P3 Reach                 :   100     [001..100%]
[s] P3 Time                  :    10     [001..600x100ms, 0=endless]

[c] Default Preset           :     1     [0=none, 1..3=Preset]
[l] Save and Leave Preset Setup

->
```

Figure 7: EKTSDG Preset Terminal Dialog

Refer to section 6.2 for parameter explanations.

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9 Statement of Accuracy

Manufacturer certifies that their EKTSDG-010101 handheld Doppler simulator complies with the accuracy figures given below. This certificate is valid for one year after purchase. After one year, the EKTSDG-010101 needs to be re-inspected at the manufacturer or an approved partner.

The EKTSDG-010101 is used to simulate Doppler signals (=moving objects) for K-band radar transceivers. The simulated speed of the object can be set by the user. The accuracy of the simulated speed is influenced by these factors, the accuracy of the radar itself is beyond the scope of this certificate:

- **Frequency error of the EKTSDG-010101's crystal.**
  The frequency error of the crystal is +/- 50ppm, independent of the set object speed.

- **Rounding error within the EKTSDG-010101.**
  The set speed is converted to km/h and rounded to the nearest integer. Subsequently the resulting Doppler frequency is calculated. Any non-integer km/h values therefore result in a speed error of up to +/- 0.5 km/h. If integer km/h values are used, no additional speed error is created.

- **Transmit frequency of the radar transceiver.**
  Conversion of object speeds into resulting Doppler frequencies depend on the transmit frequency of the radar. The conversion routine inside the EKTSDG-010101 assumes a transmit frequency of 24.150GHz (center frequency of the K-band). If the real transmit frequency of the radar (f_{TX}) differs from the assumed transmit frequency, this results in a small deviation of the simulated object speed.

  $$\Delta f = (1 - \frac{f_{TX}}{24.150GHz}) * 100\%$$

The maximum deviation of the simulated speed can be given as:

$$\Delta v = v * \left(\left|\left(1 - \frac{f_{TX}}{24.150GHz}\right)\right| + 0.00005\right) + \text{rounding error, if any}$$

v = simulated speed
f_{TX} = transmit frequency of the radar transceiver

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Please see the table below for maximum errors at typical transmit frequencies and simulated speeds:

	24.081GHz	**24.106GHz**	**24.131GHz**	**24.156GHz**
30.0km/h	0.09km/h	0.06km/h	0.03km/h	0.01km/h
30.5km/h	0.59km/h	0.56km/h	0.53km/h	0.51km/h
150.0km/h	0.44km/h	0.28km/h	0.13km/h	0.04km/h
150.5km/h	0.94km/h	0.78km/h	0.63km/h	0.54km/h

The amplitude of the simulated Doppler signal depends both on the range between radar and simulator as well as on the production tolerance of the EKTSDG-010101. At any given range, deviations of up to +/- 3dB may be introduced by the simulator, equaling to +/-30%.

The signal propagation time inside the EKTSDG-010101 is 0.8ns +/- 0.4ns.

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10 Conditions of use for Turkey

To use the EKTSDG-010101 target simulator in Turkey, you have to make sure to use it only together with an UMRR sensor device that is configured for the allowed frequency band in Turkey, which is 24.15 GHz to 24.25 GHz.

Refer to section 10.3 "How to change the frequency band" in the UMRR documentation [RD1] for more information.

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