HTSDG USER GUIDE (PRELIMINARY)

PROJECT TITLE:
HANDHELD TARGET SIMULATOR DOPPLER GENERATOR

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HTSDG

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1 CONTENT

2 INTRODUCTION

The Handheld Target Simulator Doppler Generator (HTSDG) is a handheld, battery powered, portable target simulator for 76 GHz to 81 GHz radar sensors.

It can be used for:

- Alignment of sensors in the field at the time of installation
- Yearly inspection of sensors
- Sensor development
- General functional testing of sensors in the field or in the lab

3 FEATURES AND APPLICATIONS

The Handheld Target Simulator Doppler Generator has the following features:

- Standalone operation or remote (SCPI) operation
- Programmable speed interval from 0 km/h to ±320.0 km/h
- Programmable RCS
- Programmable presets
- Battery rechargeable by USB
- Display and user interface for easy parameter change
- Compact and rugged construction

4 HANDLING

The following chapter describes how to use the control elements, interfaces, and the pages of the LCD.

4.1 CONTROL ELEMENTS AND INTERFACES

The power button, the navigation button and the LCD are located on the front of the HTSDG.

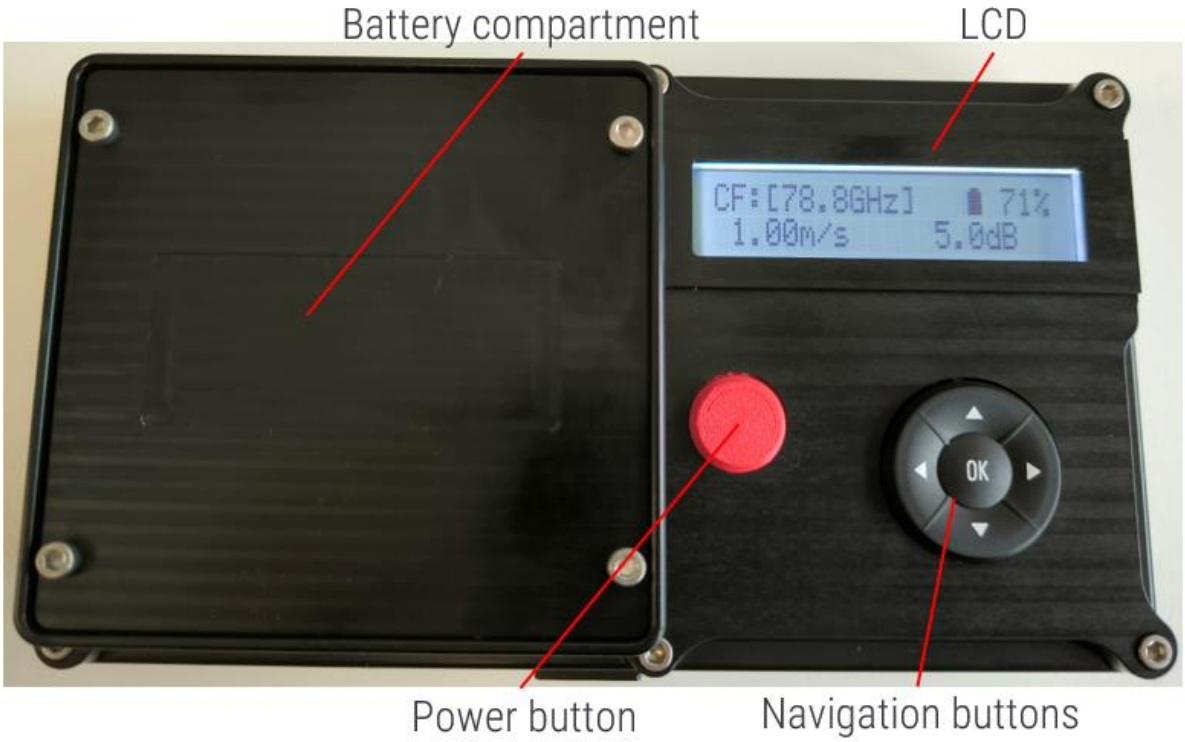

Figure 1 – HTSDG front side

On the upper side, there are two ports for Type-C connectors - one for charging the HTSDG and one for external control of the HTSDG.

Figure 2 – HTSDG upper side

The RF part of the HTSDG is located on the back side of the device and it is covered by the radome.

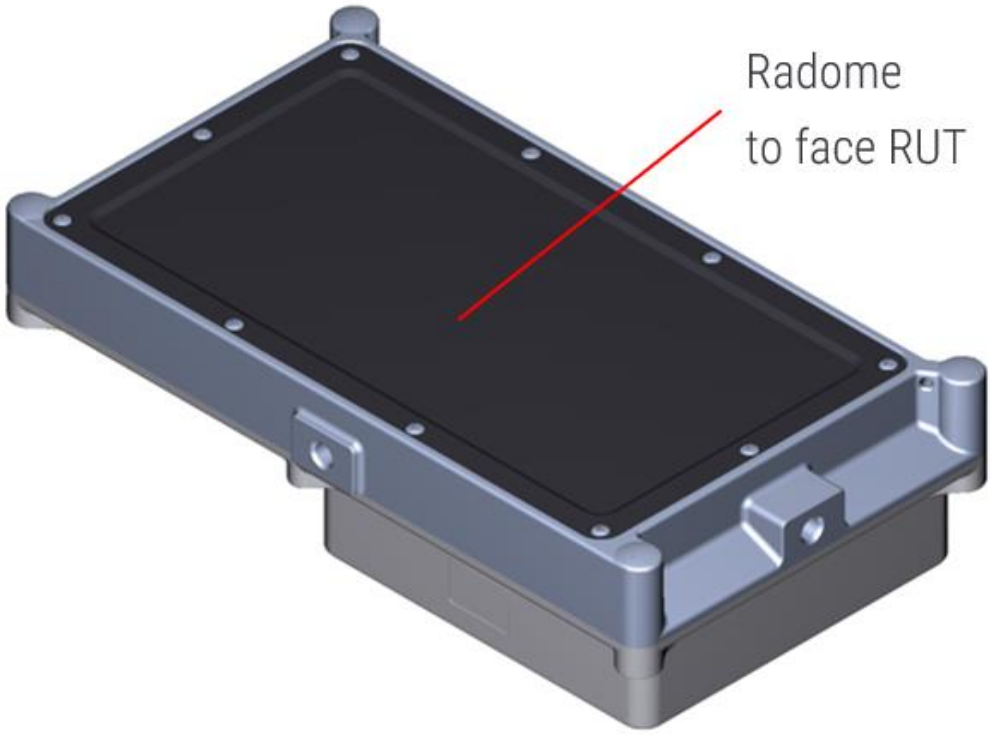

Figure 3 – HTSDG back side

4.2 USAGE

The red power button is used to switch the HTSDG on and off. After a startup, the *Main Configuration Page* is displayed with the attributes of the simulated target. The target attributes are the last attributes used (saved as preset or unsaved). The pages can be changed using the up and down navigation buttons.

4.2.1 MENU NAVIGATION

There are two modes for the navigation buttons: the *Navigation Mode* and the *Edit Mode*.

The use of the buttons in *Navigation Mode* can be seen in the table below.

Table 1 – Navigation Mode:

	Up: previous page	
Left: previous widget		Right: next Widget
	Down: next page	

The *Edit Mode* for the selected widget can be entered by pressing the OK button. The use of the buttons in *Edit Mode* can be found in the table below.

Table 2 – Edit Mode

	Up: add one step	
Left: subtract ten steps		Right: add ten steps
	Down: subtract one step	

Leave the *Edit Mode* and return to *Navigation Mode* by pressing the OK button. Press and hold any of the arrow buttons down to change the value more quickly.

4.2.2 MAIN CONFIGURATION PAGE

The attributes of the simulated target can be configured on the *Main Configuration Page* (Figure 4 - Main Configuration Page). The left and right navigation buttons can be used to select the target attributes. After pressing the OK button, the selected attribute can be changed by pressing the navigation buttons up, down, left, and right. Press the OK button again to accept the change. Value changes are effective immediately. The charge status of the battery is also displayed on the page.

The center frequency (CF) must be adapted to the target system.

In the second line, the velocity and power of the simulated target can be set. The units of velocity and power can also be changed on the *Settings Page*.

Figure 4 - Main Configuration Page

4.2.3 LOAD PRESET PAGE

The left and right navigation buttons can be used to select four different, pre-configured presets (*Figure 5 – Load Preset Page*). The selected preset can be loaded with the OK button. After the loading process, the *Main Configuration Page* is displayed.

Figure 5 – Load Preset Page

4.2.4 SAVE PRESET PAGE

Figure 6 – Save Preset Page shows the *Save Preset Page*. Four different presets can be selected using the left and right navigation buttons. Press the OK button to save the current configuration to the selected preset. After the loading process, the *Main Configuration Page* is displayed.

Figure 6 – Save Preset Page

4.2.5 SETTINGS PAGE

On the *Settings Page* the units of velocity and power of the target can be changed (*Figure 7* – Settings Page). The sleep time can also be changed on the page. The units/sleep time can be selected using the left and right navigation buttons. After pressing the OK button, the unit/sleep time can be changed with up, down, left, and right navigation buttons. Press the OK button again to accept the change. The selectable units/values are shown in the table below.

Table 3 – Units and Values

Item	Unit/Value
Velocity	m/s
	km/h
	mph
	kHz
Power	dB
	%
Sleep time[1]	never
	5 minutes
	10 minutes
	15 minutes
	30 minutes

Figure 7 – Settings Page

[1] Sleep time is not implemented yet.

4.2.6 VERSION PAGE

The *Version Page* shows the version number of the currently flashed HTSDG software.

Figure 8 – Version Page

4.3 CHARGING AND BATTERY OPERATION

The HTSDG can be operated both in battery mode and with an external power supply. The charge status of the battery can be read on the *Main Configuration Page*. In battery mode, the charge status of the battery should be monitored, and an external power supply should be switched on in good time.

4.4 EXTERNAL CONTROL

The HTSDG can be controlled using SCPI commands via UART. The setting for UART is 115200 baud and 8N1 as parity bit. To adjust the simulated target attributes, the commands in

Table 4 – HTSDG proprietary SCPI commands can be used. The adjusted values are not saved automatically. To save the values, the *Save Preset Page* must be used manually. Value changes are effective immediately.

Table 4 – HTSDG proprietary SCPI commands

SCPI Command	Description
"TARget:ATTenuation"	Set power of simulated target in dB Range: 0.0 … 15.5 dB Step size: 0.5 dB
"TARget:ATTenuation?"	Get power of simulated target in dB HTSDG returns string with the value in dB
"TARget:DOPpler:SPEed"	Set velocity of simulated target in m/s Range: ±88.9 m/s Step size: DOPPLER_STEP_SIZE * 3e8 m/s / 2 / f_c Depends on center frequency f_c, e.g., 0.076 m/s for a 79 GHz center frequency
"TARget:DOPpler:SPEed?"	Get velocity of simulated target in m/s HTSDG returns string with the value in m/s
"TARget:DOPpler:FREQuency"	Set doppler shift f_d in Hz Range: ±46,000.0 Hz Step size: DOPPLER_STEP_SIZE
"TARget:DOPpler:FREQuency?"	Get doppler shift f_d in Hz HTSDG returns string with the value in Hz
"FRONTend:FREQency"	Set center frequency f_c in Hz. This shall be set to match the settings in the radar under test. The simulated velocities are only accurate if the center frequency is set correctly. Range: 76,000,000,000.0 … 81,000,000,000.0 Hz
"FRONTend:FREQency?"	Get center frequency f_c in Hz HTSDG returns string with the value in Hz

4.5 FIELD OPERATION

In field operation, the polarization of both the HTSDG and the DUT and the alignment of the HTSDG to the radar under test (RUT) must be observed.

4.5.1 POLARIZATION

The polarization of the HTSDG must match the polarization of the RUT. The HTSDG has a linear polarization and can be seen in *Figure 9 – Polarization of the HTSDG*.

Figure 9 – Polarization of the HTSDG

The polarization of the 77 GHz smartmicro radar sensors are shown in ***Fehler! Verweisquelle konnte nicht gefunden werden.***.

Table 5 – Polarization of the smartmicro 77GHz traffic radars

Radar	Polarization
UMRR-11 Type 132	vertical
TOPGRD	horizontal
DRVEGRD 171	horizontal
DRVEGRD 152	vertical

The polarization is also shown in *Figure 10 – Polarization of UMRR-11 Type 132* and *Figure 11 - Polarization of TOPGRD*.

Figure 10 – Polarization of UMRR-11 Type 132

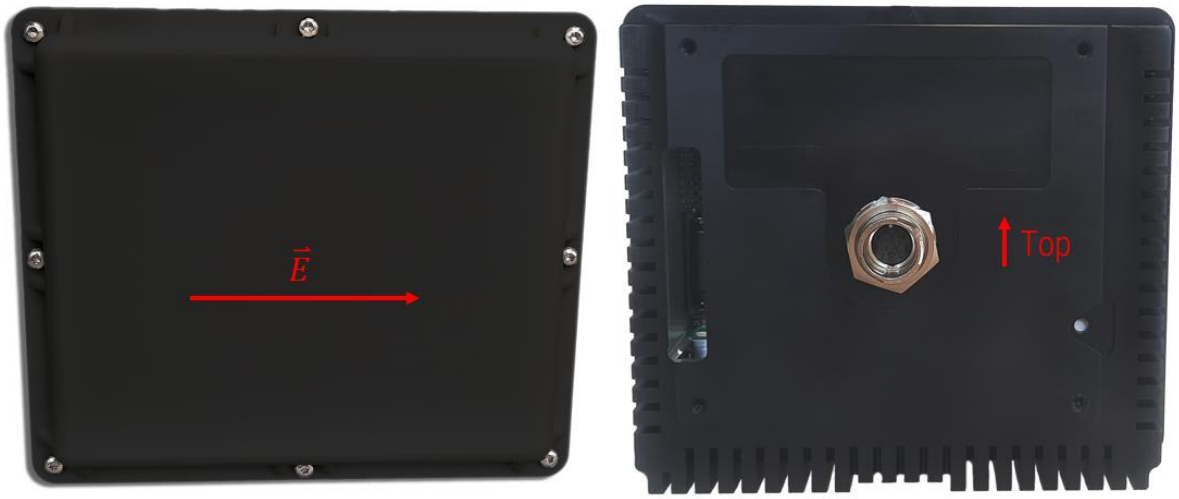

Figure 11 - Polarization of TOPGRD

If the polarization of the RUT is unknown, two measurements must be made. One with vertical and one with horizontal polarization of the HTSDG. The stronger target of the two measurements, which the RUT sees, shows the matching polarization.

4.5.2 ALIGNMENT TO RUT

The boresight of the HTSDG radome must point to the RUT as shown in *Figure 12 – Alignment of the HTSDG to the RUT*.

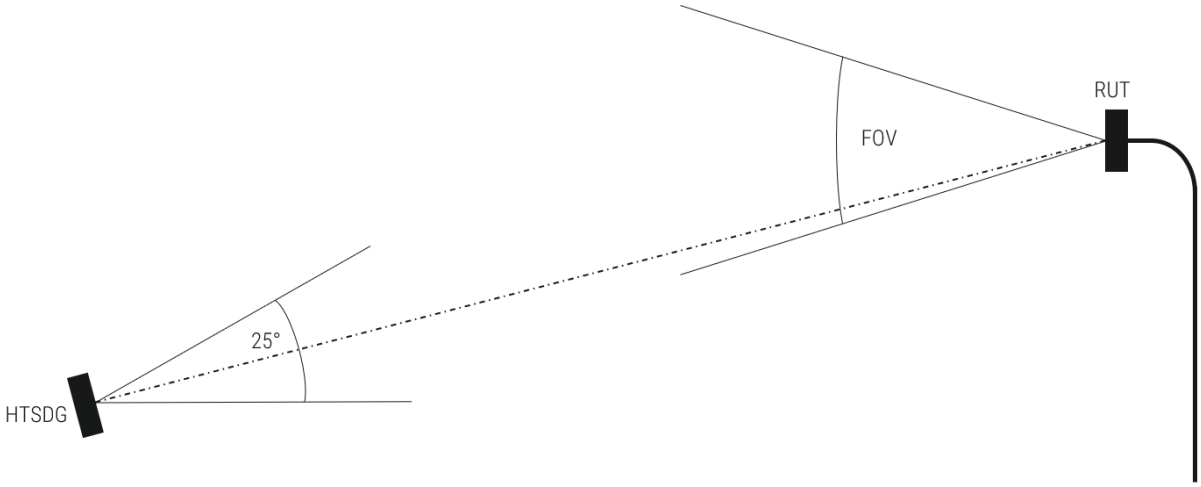

Figure 12 – Alignment of the HTSDG to the RUT

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