# K-DT1 Portable Radar Doppler Target
User Manual

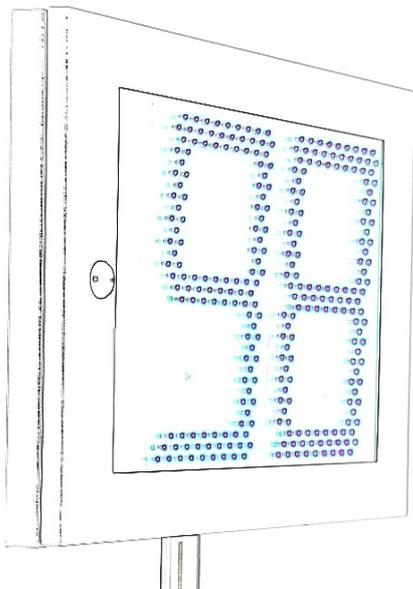## K-DT1 DopplerTarget

## Features

- Handheld K-Band Doppler Target Simulator
- Battery Operation
- Programmable Speed Range 1 ... 200km/h
- Programmable Movement Direction
- Programmable Signal Time
- 3 Programmable Presets
- Standalone or Hosted Operation
- USB Interface to Hostcomputer
- Compact and Rugged Construction
- DT1-Remote PC Software included

## Applications

- Mobile Test Equipments
- Production Final Inspection
- Incoming Components Inspection
- System Tuning and Adjustment

## Overview

K-DT1 is a portable moving target simulator for K-band Radar transceivers. It can be used for calibrating and testing speed displays, door openers, safety systems and other radar based Doppler sensors. K-DT1 uses a circular polarized antenna. You can use K-DT1 in any orientation independently of the sensor orientation.

A software generated modulation signal allows generation of low distortion and directional Doppler signals from 44Hz to 9kHz corresponding to speeds from 1km/h to 200km/h.

## Getting Started

This chapter explains the first steps of using the K-DT1 device and the DT1-Remote Software.

## Equipment Needed

- RFbeam K-DT1 Device
- Four Size AA Batteries
- RFbeam USB Stick with DT1-Remote Software
- PC with Windows 2000/xp/vista
- Optionally an RFbeam ST100 Starterkit

## DT1-Remote Software

K-DT1 may be connected via USB to any Windows PC. The included DT1-Remote software allows realtime remote controlling and configuring the presets of the K-DT1.

## K-DT1 DopplerTarget

### Installing from USB Stick

1. Remove any K-DT1 system connected to your system

2. Insert RFbeam USB memory stick and start `setup.exe`.
   If your computer does not already contain the actual LabVIEW runtime engine, you will be asked to accept licences of National Instruments.

3. If possible, accept all default program locations. Troubleshooting will be simplified like this.

4. Please be patient while LabVIEW runtime system is being installed.

5. You will find DT1-Remote under START-PROGRAMS-RFbeam-DT1 Remote

6. Plug your K-DT1 system to a USB port of your PC. There should appear a "New USB Hardware Found" message from Windows.

7. Windows will ask you for a hardware driver. Select to install it manually and chose the drive letter of the USB stick. Ignore the Windows logo test message.

8. Start DT1-Remote Software.
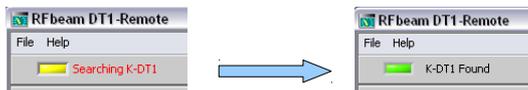


   As soon as K-DT1 system has been connected, the search LED stops flashing and DT1-Remote software is ready.
   If K-DT1 will not be found, please reinstall the hardware driver and try again. (See chapter FAQ for more details).

### DT1-Remote Screen

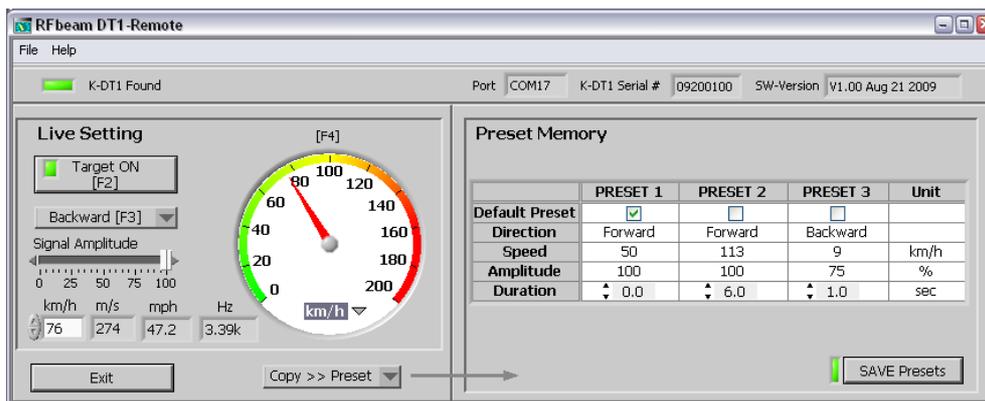After launching the DT1-Remote Software, the screen below should appear.



**Fig. 1: K-DT1 Screen**

See chapter DT1-Remote Software for details on this software.

## K-DT1 Handheld Operation

### Controls



**Fig. 2: Controls and Displays**

### Using K-DT1

#### General Remarks

Prepare the settings as described in section Configuring K-DT1
Maximum distance depends on the radar sensitivity and the amplitude settings of K-DT1.

#### Using Default Preset

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

1. Align the antenna (6) against the transceiver
2. Press the Power switch (3) for 0.5 seconds
   > K-DT1 begins simulating the programmed speed, amplitude and direction
   > K-DT1 stops after the programmed duration or after switching off manually with (3)

#### Selecting Another Preset

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

1. Press Power switch (3) **while** pressing the Preset selector (2)
   > K-DT1 default preset LED (5) blinks
2. Repeat pressing the Preset selector (2) until the desired preset LED (5) flashes
   > after 1 second, the selected LED (5) stops blinking and K-DT1 runs the selected preset
   > the selected preset will become the new default preset

#### Playing Around

If you own an RFbeam Starterkit (http://www.rfbeam.com/81.0.html), you may test all the K-DT1 features by running the ST100 SignalViewer with a K-LC1 or even better a K-LC2 sensor.
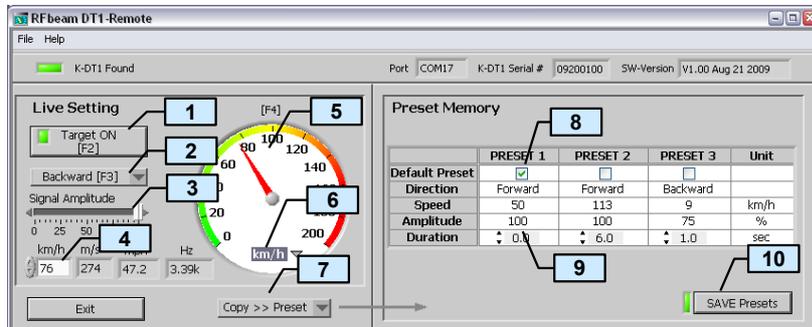
## DT1-Remote Software



**Fig. 3: DT1-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 K-DT1

This software allows real time control and configuring the K-DT1 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.

## Remote Controlling K-DT1

K-DT1 may be remotely controlled by the DT1-Remote software. The realtime remote control part is called Live Setting on the left half of the Software panel. Please connect K-DT1 to a USB port before changing any controls.

### Switching ON/OFF

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

### 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

### 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.
Note: Direction is only detectable by „stereo" sensors like K-LC2, K-MC1, K-MC2 etc.

### Setting Signal Amplitude

Simulate object distances by adjusting the signal amplitude (3).
This may be useful for testing system sensitivity. Please note, that a 100% amplitude produces not a big Doppler signal at the sensor system:

In 1m distance, you get approximately:
200mVpp at the "High Gain Output" of K-MC1
120uVpp at the output of a K-LC1
  60uVpp at the output of a K-LC2

## Configuring K-DT1

K-DT1 starts up with a "default preset". This is one of three configurable presets. All presets can be configured by means of the DT1-Remote software or with a terminal software.
Default preset can also be selected manually directly with the K-DT1. See chapter Selecting Another Preset.

### 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)

### Set Signal Duration

K-DT1 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' (switches off after 3 minutes timeout for battery saving).
2. **Save presets** with control (10)

### Set Default Preset

Default preset will be active after normal power on of the K-DT1. It may later be altered directly at the K-DT1.

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

### Getting Help

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

## K-DT1 USB Serial Interface

K-DT1 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 chapter Installing from USB Stick.

1. Connect K-DT1
2. Start DT1-Remote software or check the windows control panel to get the assigned COM port.
   Close DT1-Remorte 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:

**K-DT1 DopplerTarget**

### Terminal Mode: Remote Control

```
RFbeam K-DT1 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..200km/h]
[r] Reach                : 100       [001..100%]
[t] Target On/Off        :   1       [0=Off, 1=On]

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

->
```

**Fig. 4: K-DT1 Terminal Remote Control Dialog**

These settings are directly executed, as long as K-DT1 remains connected to the USB port.
With [p], you will be able to configure the preset memory.

### Terminal Mode: Preset Setting

For using presets please refer to chapter Using K-DT1.

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

[q] P1 Direction of Motion  :     0      [0=Forward, 1=Backward]
[w] P1 Speed                :     3      [001..200km/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..200km/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..200km/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

->
```

**Fig. 5: K-DT1 Preset Terminal Dialog**

Refer to chapter Configuring K-DT1 for parameter explanations.

## Characteristics

| Parameter | Conditions / Notes | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Operating conditions** | | | | | | |
| Supply voltage | Battery | $V_{ccBatt}$ | 3.6 | 6 | 7 | V |
| | USB | $V_{ccUSB}$ | 4.5 | 5 | 5.5 | V |
| Supply current | Operating | $I_{cc}$ | | 340 | | mA |
| | Standby | $I_{cc0}$ | | 50 | | uA |
| Battery Lifetime | Daily use 50 seconds, Alcaline cells | $T_{op}$ | | 1 | | Year |
| Operating temperature | non condensing | $T_{op}$ | 0 | | +60 | °C |
| Storage temperature | | $T_{st}$ | -20 | | +80 | °C |
| **Doppler Simulator** | | | | | | |
| Frequency range | Transmit frequency of UUT | $f_{TG}$ | 24.000 | | 24.250 | GHz |
| Doppler frequency range | Digitally adjustable | $f_{Doppler}$ | 44 | | 8800 | Hz |
| Simulated speed range | Digitally adjustable | $v_{Doppler}$ | 1 | | 200 | km/h |
| Output power range | Adjustable simulated object distance | $P_{out}$ | 1 | | 100 | % |
| Antenna gain | | | | 14 | | dBi |
| Antenna polarization | Right hand circular polarized | | | RHCP | | |
| Overall gain | For circular polarized tranceivers | | | 38 | | dB |
| | For linear polarized tranceivers | | | 32 | | dB |
| Out of band spurious | | | | | -30 | dBm |
| Aequivalent reflectivity | For circular polarized tranceivers | $RCS_{circ}$ | | 800 | | cm² |
| | For linear polarized tranceivers | $RCS_{lin}$ | | 200 | | cm² |
| **Host Interface** | | | | | | |
| USB | Serial USB, Mini-USB connector | | | | | |
| **Body** | | | | | | |
| Outline Dimensions | | | | 68x128x24 | | mm³ |
| Weight | Including batteries | | | 185 | | g |
| **Accessories** | | | | | | |
| | Case protection, Softcase, USB Cable, USB Memory Stick, 4 AA-size Alkaline Cells, Windows Software "DT-1 Remote" | | | | | |

## Ordering Information

Part #:  RFbeam K-DT1

## FAQ

*Q*:    *Why does K-DT1 not connect to the DT1-Remote software?*
A:     Please try the following:
   - Close DT1-Remote software and disconnect-reconnect K-DT1. Restart the software.
   - Close DT1-Remote software and connect K-DT1 to an other USB port.
   - Reinstall the driver file 'RFbeam_K-DT1.inf'. This file resides on the installation media and also in the program file directory.

*Q*:    *What is the usable distance range?*
A:     This depends on your radar system. For traffic speed displays, a typical range will be around 3 to 5 meters.

*Q*:    *Why do I get different output amplitudes at the same radar transceiver?*
A:     For precision sensitivity tests, K-DT1 and also the unit under test (UUT) should be mechanically fixed.
       You should also prevent objects nearby the direct link between K-DT1 and the UUT.
       Use distances >=30cm between K-DT1 and the UUT.
       Use absorber material (e.g. Ecosorb AN or Ecosorb LS from Emerson&Cuming) , if the test-setting is placed on a table or in a test chamber.

A:     *What is the expected battery life?*
       With a daily use of 50 seconds, Alkaline cells should last about 1 year.

*Q*:    *Is battery loaded while K-DT1 is connected on USB port?*
A:     No. K-DT1 is powered by the USB port during a host connection.

*Q*:    *How can I measure frequency and RF power of my transceivers?*
A:     K-DT1 is only a Doppler Simulator. For power and frequency mesurements, you may use the RFbeam K-TS1 system.

## User Manual Revision History

| Version | Date | Changes |
|---------|------|---------|
| 1.0 | 15-Sept 2009 | initial release |
| 1.1 | 15-Oct 2009 | corrected chapter Selecting Another Preset |