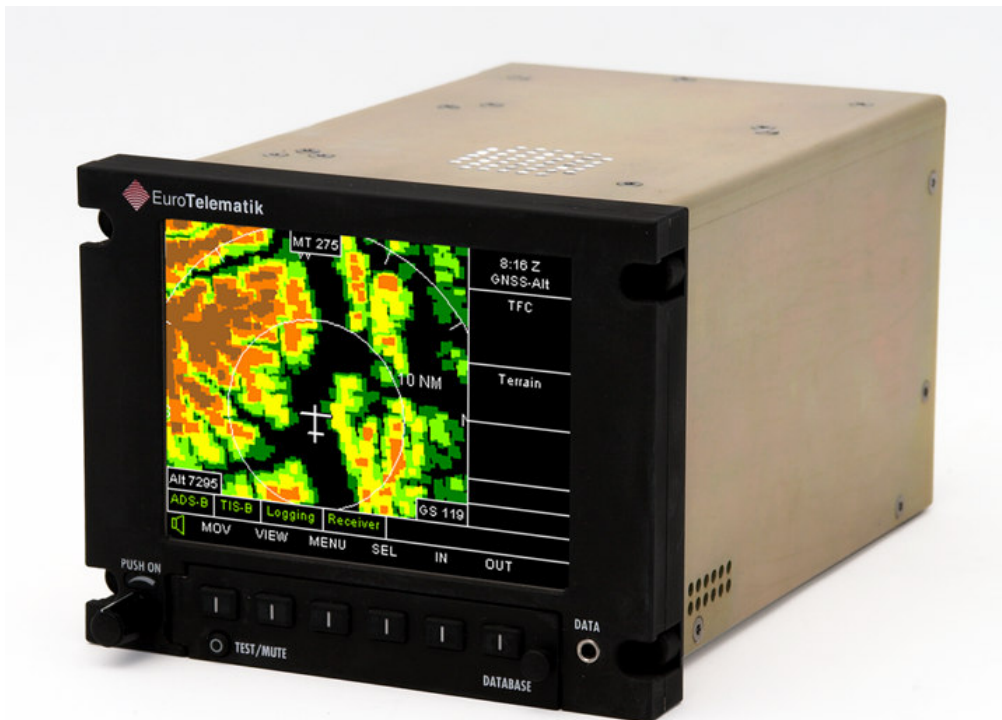


*The Multi-Function Display
and Traffic Information System*

CDTI-2000 TSO



Operation Manual

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Important Notes

"The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. The article may be installed only if the installation is performed in accordance with Part 43 or the applicable airworthiness requirements."

Source: FAA TSO-C-147

The *CDTI-2000* provides non-essential information to the crew. It is not intended to be and must not be used as a navigation device, as a terrain awareness or warning system, or as a traffic warning system of any kind!

Welcome

In purchasing the Multi-Function Display and Traffic Information System **CDTI-2000**, you have chosen a high-quality product. It is designed to support you during your flight and to provide you with exceptional situation awareness of your position, surrounding terrain and obstacles, and traffic so that you can take suitable measures to avert potentially dangerous situations in good time. CDTI stands for **Cockpit Display of Traffic Information**.

In addition to the CDTI view, digital bitmap charts are available as a Moving Map – the ideal accessory to your navigation. At a glance, you can determine your position relative to flight-relevant locations and objects such as airports and airspace.

Presentation of surrounding traffic requires the connection of a traffic sensor, such as the Traffic Collision Avoidance Device TCAD provided by Ryan or a Mode-S 1090 Extended Squitter ADS-B receiver. A visualisation of other aircraft is possible in an integrated presentation together with the terrain and navigation features.

With a connection to a Iridium satellite transceiver, you may exchange messages with a ground station and even receive up-to-date weather information, including RADAR-detected precipitation data that can be shown on the CDTI view.

If you use the **CDTI-2000** together with a GPS receiver which transmits flight plan data in NMEA format, the active flight plan is shown graphically both in the terrain and in bitmap chart view (Moving Map).

We are convinced that the **CDTI-2000** will make your flight safer and more enjoyable and we wish you great pleasure with this product.

Funkwerk Avionics GmbH

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1 INTRODUCTION

1.1 USE AND LIMITATIONS

The **CDTI-2000** has been certified to meet the requirements of JTSO C-113 and JTSO C-147.

Used correctly, the **CDTI-2000** allows you to maintain a high level of situational awareness. The system has been carefully developed. In order to use and apply this system correctly, an understanding of the system-inherent assumptions and limitations is necessary. This includes studying this handbook thoroughly and following the precautions listed below:

The system aims at the avoidance of dangerous situations by increasing the situational awareness of the plane's crew. The system does not serve as the primary means for navigation or even flight guidance. It does not relieve the crew of the responsibility of following published navigation procedures, routes, altitude limits and/or the instructions of the respective air-traffic control centres.

The *CDTI-2000* is not a GPWS (Ground proximity warning system) according to the definition of the respective (J/E)TSOs and must not be used as such.

The *CDTI-2000* is not a TCAS (Traffic Alert and Collision Avoidance System) according to the definition of the respective (J/E)TSOs and must not be used as such.

Do not use this equipment for navigation or flight guidance, especially in poor visibility! In particular, it in no way replaces the required flight and ground visibility. The *CDTI-2000* is not a substitute for careful flight preparations.

All system outputs and indications must always be checked for plausibility.

It is the responsibility of the customer to assure the validity of the data bases. An update-service can be ordered from Funkwerk Avionics.

1.2 LICENCE AGREEMENT

Please review carefully the licence conditions as described in section 4. By using the system the customer agrees to be bound by the terms of this agreement.

1.3 FIRST USE

Please read carefully the information contained in this manual before using the *CDTI-2000* for the first time.

Information for system installation can be taken from the installation manual.

1.4 SYSTEM OVERVIEW

The **CDTI-2000** consists of the following components:

- Computer Housing
- Front Panel as Pilot Interface
- Connection Plugs
- Compact Flash Data Card

The system installation is described in detail in the installation manual. The **CDTI-2000** is designed to be mounted in a standard avionics rack following the DZUS norm. It should be placed in a position within easy view and reach of the pilot. The system works in the full range (10 VDC to 32 VDC) input supply voltage. Connections for power and external sensors can be found on the rear of the system.

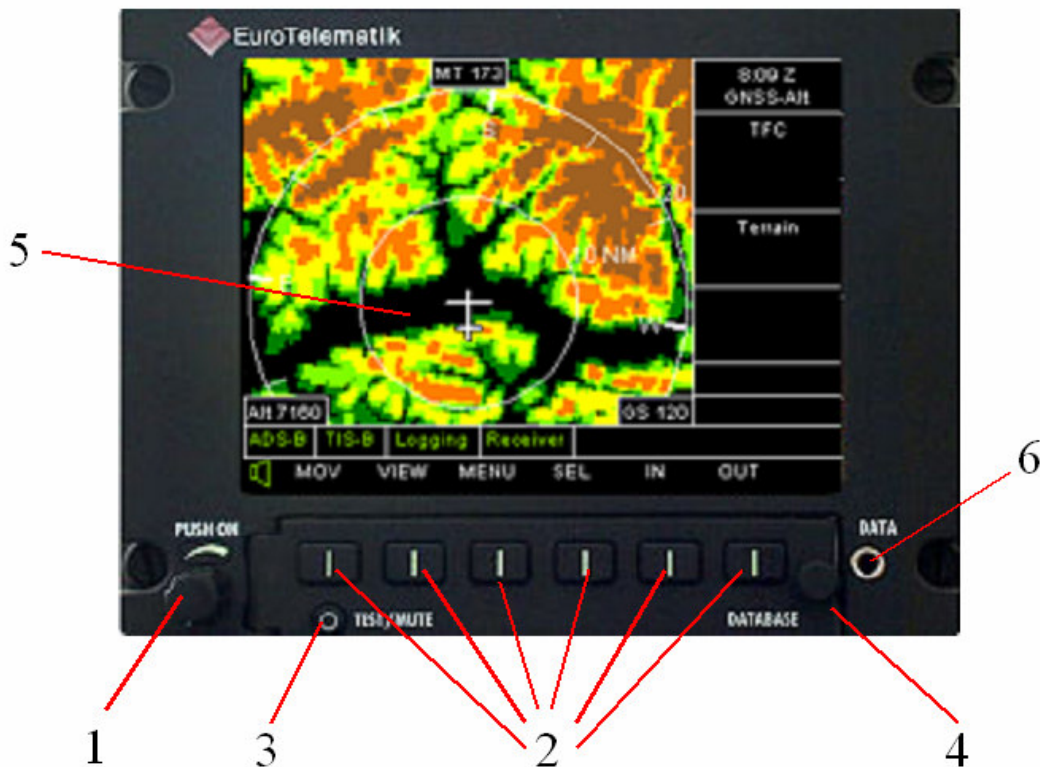


Figure 1-1: CDTI-2000 Front Panel

The front panel (see Figure 1-1) consists of the following components:

- (1) Power/Brightness Knob
- (2) 6 Function Keys
- (3) Test/Mute Knob
- (4) CF-Card Holder
- (5) Display
- (6) Front I/O Connector

1.5 USER INTERFACE

The **CDTI-2000** presents various information on a colour display. The pilot can interact with the system by means of 6 function keys that are located below the display. In addition, a combined power/brightness knob is used for switching the unit on and off and to set the display brightness. An additional test/mute button allows to test and to switch on or off the audio output.

Information is presented on the **CDTI-2000** in various forms. Each presentation form is organised as a display "page" and the user may switch between the various pages using the function keys. There are three principle types of display:

1. A graphical presentation of the situation in the aircraft's vicinity, using vector symbols:

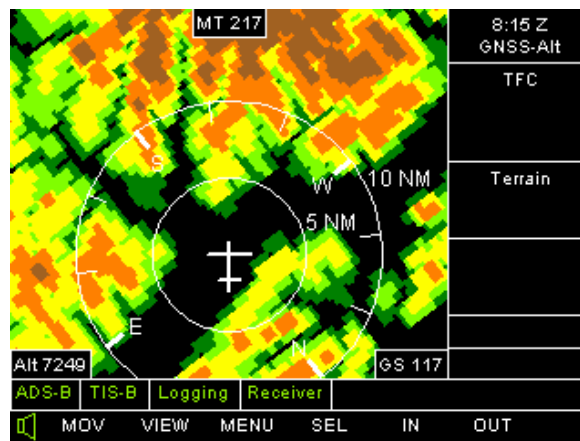


Figure 1-2: CDTI View

This display form is called the "CDTI" (Cockpit Display of Traffic Information) view. It can display the following type of information:

- navigational aids and airports
- terrain data
- traffic data
- weather data
- mission objects (target locations and areas)

2. Another graphical presentation of the situation, using a bitmap chart:



Figure 1-3: Moving Map View

On this page (called "Moving Map"), the current aircraft position is shown on top of a bitmap chart. Charts may come from various sources, such as ICAO VFR charts, approach charts, airport layout charts, or special purpose charts.

The Moving Map page allows to show also mission objects (target locations and areas). It does not provide depiction of traffic, weather, or terrain data!

- Text-based pages that allow to send and retrieve communication messages and to configure the **CDTI-2000** according to individual requirements (e.g. selecting what information shall be shown on the graphic pages):

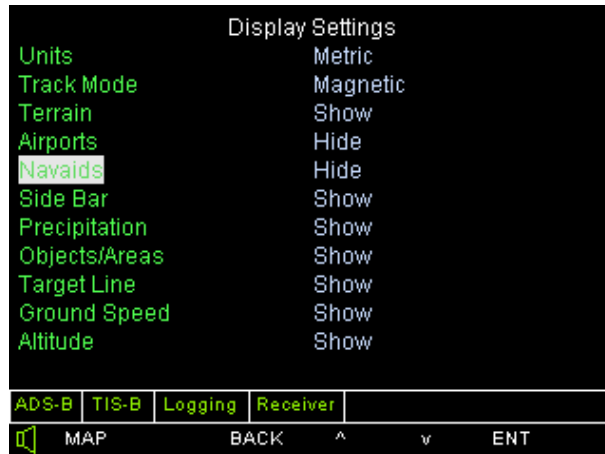


Figure 1-4: Text Page

2 SYSTEM OPERATION

2.1 INTERACTING WITH THE CDTI-2000

2.1.1 Power and Brightness Knob

The system can be switched on by pushing the Power/Brightness Knob. Like all other electrical equipment, the **CDTI-2000** should be switched on only after starting the engine in order to avoid spikes in voltage which could damage the system. For the same reason, please switch-off the **CDTI-2000** through pulling the Power/Brightness Knob before switching off the engines.

Please take care that a valid CF-Card is inserted in the CF-Card Holder since otherwise the system is not able to start. Please make sure as well that the CF-Card Holder is carefully locked.

**Never operate this device with an opened CF-Card Holder
since other cockpit systems might be affected.**

At the start of the boot process the system issues a message containing information about the hardware configuration and the actual software configuration that is stored on the respective CF-Card. In addition, the issue date of the delivered databases is presented. It is the responsibility of the pilot to make sure that only valid databases are used.

In case that no valid CF-Card has been inserted a respective message is displayed and the boot process is stopped. Please switch off the system, insert a valid CF-Card and start the system again.

After successful completion of the boot procedure the CDTI-2000 presents the CDTI view. The total boot process may take approximately one minute. The display brightness can be varied by turning the power/brightness knob.

**Never remove the CF-Card during operation of the CDTI-2000.
This could lead to a damage of the CF-Card!**

2.1.2 Test/mute button

The Test/Mute Key allows to mute the audio output. Pressing this Key will deactivate the audio output which will be indicated by the presentation of a crossed-out loudspeaker symbol at the bottom left corner of the display. In order to re-activate the audio output the Test/Mute Key has to be pushed again. The crossed-out loudspeaker symbol will disappear and a short test sound will be played. This test sound can also be used for volume fine-tuning.

2.1.3 Function Keys

For system operation six function keys are available below the display. The functions associated with these keys vary with the selected page or view. Each function key is labelled with its currently assigned function on the display above it.

A detailed description of these function keys is given in the following subsections.

2.2 PRIMARY VIEW: CDTI

The CDTI view has the following appearance on the screen.

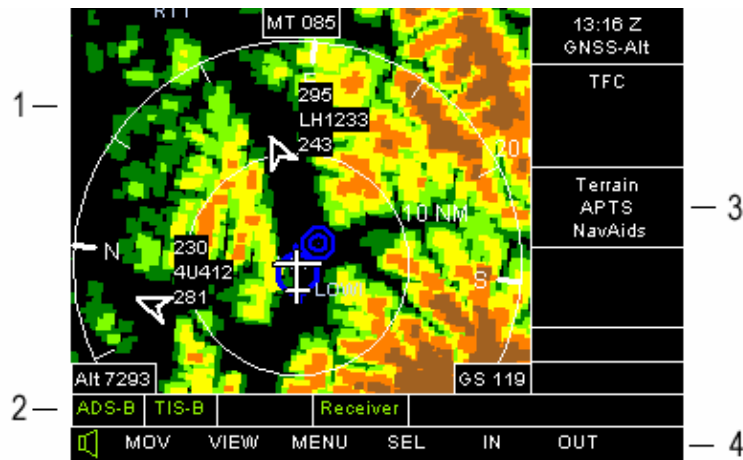


Figure 2-1: Primary View: CDTI

It consists of the Map section (1), the status line (2), the Sidebar section (3) and the function key label section (4). The status line and the function key label section (navbar) are present at each type of view, while the sidebar disappears on the text based setting pages.

As the status line is always presenting the same kind of information a description of the content will follow at this stage:






1	2	3	4	5
ADS-B	TIS-B	Logging	Receiver	
			Receiver	Receiver Degraded

Figure 2-2: Status Line Indications

The status line consists of five segments, where the status is reflected by respective colours. In general following rule apply: If a service is enabled and fully operational, the text is shown in green colour. A disabled service will not be displayed and the square remains black.

1. ADS-B Service Status The service could be disabled or enabled by setting to “On” or “Off” on the receiver settings page (section 2.4.6.3.2). Furthermore a filter may be used to display the respective traffic items or not (section 2.4.5.1). The square remains blank if no receiver is selected on the sensor settings page (section 2.4.6).
2. TIS-B Service Status similar to ADS-B Service Status

The following table shows the meaning of the different status indications with respect to the ADS-B and TIS-B status fields.

ADS-B/TIS-B status	1090ES Receiver Settings (section 2.4.6.3.2) ADS-B Service	TFC Display Settings (section 2.4.5.1) ADS-B-Traffic	Receiver selected in "Sensor Settings" (section 2.4.6)	remark
	"On"	"Show"	Yes	service enabled and working properly
	"Off"	"Show" or "Hide"	Yes	Service disabled
	"On"	"Show" or "Hide"	"None"	Service enabled but no receiver selected on the sensor settings page
	"On"	"Hide"	Yes	receiver provides traffic data, but not displayed due to display filter
	"On"	"Show"	Yes	Service not working properly , i.e. erroneous data

3. Logging Service Status The service could be disabled or enabled by setting to "On" (green text) or "Off" (blank square) on the logging settings page (section 2.4.8).
4. Receiver Service Status If this service is enabled and working properly the text will be shown in green colour. If this service is enabled but not working properly (offline; e.g. due to an equipment failure), the text will be shown in red colour with a red cross over the text. If no receiver is selected on the sensor settings page (section 2.4.6) this field remains blank.
5. General Alert Messages In case of failures in equipment or connection text messages are indicating those failures.

2.2.1 Function Keys for CDTI View

In CDTI view, the function keys will be used as follows:

Key	Label	Function
1	MOV	Change to Chart view (Moving Map)
2	VIEW	Toggle view between North-Up and Heading-Up
3	MENU	Change to Main Menu page
4	SEL	De-/Selection of Target Aircraft
5	IN	Zoom in (decrease display range)
6	OUT	Zoom out (increase display range)

(*) not available, if a traffic sensor is configured in the **CDTI-2000**.

The display range can be varied between approx. 75 NM and 0.75 NM. The display range will be decreased with every press on function button 5 and increased with every press on function button 6 until the respective maximum/minimum value is reached.

2.2.2 Map section

In CDTI view, the Map section of the screen will provide information about the flight situation in the vicinity of the own aircraft's position. It will create a map from various graphical objects which is normally oriented according to the direction of your flight (track up). However, if no traffic sensor is selected, the orientation may also be set to north up mode.

The following elements can be displayed in this section:

1. Ownship symbol
2. Ownship track (magnetic or true)
3. Ownship ground speed
4. Range rings
5. Traffic symbols
6. Traffic data tags
7. Traffic service volumes (for TIS-B)
8. Traffic service status information
9. Terrain
10. Airports
11. Nav aids
12. Mission Objects (uplinked from ground operations)
13. Precipitation (uplinked from ground operations)

These elements are described in detail in the following subsections.

2.2.2.1 Ownship

The following symbol is used to indicate the position of the ownship in relation to other map elements:



It is located at a fixed location on the screen. The ownship symbol is always present.

2.2.2.2 Ownship track

The track of the ownship is indicated according to the selected track orientation setting (see section 2.4.5: Display Settings) as either Magnetic Track (left image, MT) or True Track (right image, TT).



The ownship track indication is displayed centred at the top of the map section. It is always present. However, if no valid track information is received, the following indication will be presented instead of the track value:



2.2.2.3 Ownship ground speed

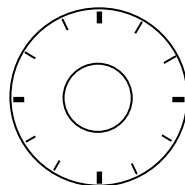
The ground speed of the ownship is indicated in knots (nm/hour).



The ownship ground speed indication is displayed in the bottom right corner of the map section. It is always present.

2.2.2.4 Range rings

Range rings are displayed in the map section according to the current range setting. They have the following appearance on the screen:



The range value associated with a range ring is indicated at the 2 o'clock position of each ring. Range rings are centred at the ownship symbol and are always present.

2.2.2.5 Traffic symbols and Traffic data tag

When traffic is displayed in the map section of the screen, the pilot can select on the TFC Display Settings page (see section 2.4.5.1) one of two different sets of traffic symbols: Standard (Rectangle) symbols and TCAS-like symbols. These symbols sets are described in the following subsections.

The data tag displays altitude and identification information for targets. The pilot can select on the Traffic Tag Settings page (see section 2.4.5.2) whether the traffic altitude is displayed as an absolute value or relative to the own altitude.

Relative altitude indication is only available if barometric altitude information is available for the own aircraft. If traffic service is provided by a Ryan TCAD sensor, only relative altitude indication is available.

The pilot can select on the Traffic Tag Settings page (see section 2.4.5.2) whether or not the traffic identification will be displayed on the screen.

2.2.2.5.1.1 Standard symbols (Rectangles)

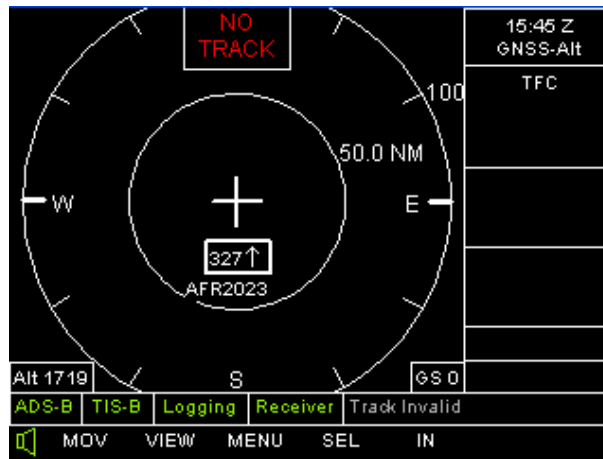


Figure 2-3: Standard Traffic Symbols

When Standard symbols are selected traffic is depicted in the map section of the screen using the following symbols.

Threat Level	Colour	Fill	Symbol
No threat	White	No	
TA (Ryan TCAD)	Yellow	Yes	

ADS-B traffic is displayed in grey colour instead of white colour if no position update has been received for more than the validity period configured in the receiver settings (section 2.4.6.3.2.).

If altitude information for the traffic is available this traffic altitude is displayed within the traffic symbol.

Absolute altitude information is based on the reported traffic altitude as provided by the traffic sensor. The altitude is rounded to 100 feet and the last two digits are omitted. E.g., a non-threat traffic with a reported altitude of 5125 feet will be presented as:



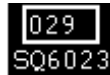
Relative altitude information is based on the reported traffic altitude as provided by the traffic sensor and the barometric altitude of the own aircraft. The resulting relative altitude is rounded to 100 feet and the last two digits are omitted. Aircraft higher than own aircraft are displayed with a leading “+”-sign, aircraft lower than the own aircraft with a leading “-”-sign respectively. E.g., a non-threat traffic with a reported altitude of 5325 feet and an own altitude of 3800 feet will be presented as:



If the traffic sensors reports a climb rate of traffic in excess of 500 feet per minute, an upwards pointing arrow is displayed behind the altitude value. If the traffic sensors reports a descent rate of traffic in excess of 500 feet per minute, an downwards pointing arrow is displayed behind the altitude value:



If Traffic Identifiers are turned on, the traffic identification is displayed below the traffic symbol:



2.2.2.5.2 TCAS symbols

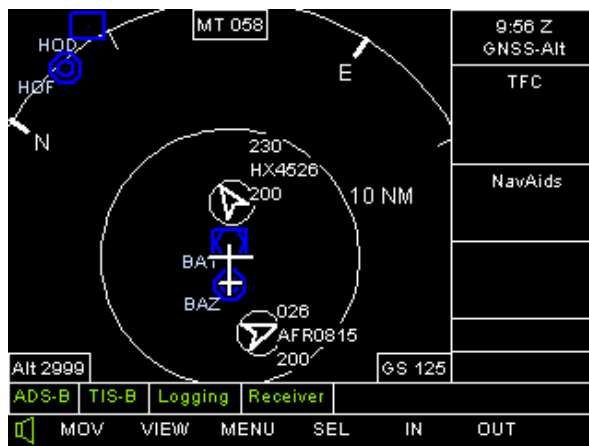


Figure 2-4: TCAS Traffic Symbols

When TCAS symbols are selected, traffic is depicted in the map section of the screen using the following symbols:

Threat Level	Track information	Colour	Fill	Symbol
No threat	Not available	White	No	
No threat	Available	White	No	
TA (Ryan TCAD)	Not available	Yellow	Yes	

ADS-B traffic is displayed in grey colour instead of white colour if no position update has been received for more than the validity period configured in the receiver settings (section 2.4.6.3.2.).

If altitude information for the traffic is available this traffic altitude is displayed to the right of the traffic symbol.

Absolute altitude information is based on the reported traffic altitude as provided by the traffic sensor. The altitude is rounded to 100 feet and the last two digits are omitted. E.g., a non-threat traffic with a reported altitude of 5125 feet will be presented as:



Relative altitude information is based on the reported traffic altitude as provided by the traffic sensor and the barometric altitude of the own aircraft. The resulting relative altitude is rounded to 100 feet and the last two digits are omitted. Aircraft higher than own aircraft are displayed with a leading “+”-sign, aircraft lower than the own aircraft with a leading “-”-sign respectively. E.g., a non-threat traffic with a reported altitude of 5325 feet and an own altitude of 3800 feet will be presented as:



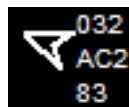
If the traffic sensors reports a climb rate of traffic in excess of 500 feet per minute, an upwards pointing arrow is displayed behind the altitude value. If the traffic sensors reports a descent rate of traffic in excess of 500 feet per minute, an downwards pointing arrow is displayed behind the altitude value:



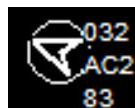
If Traffic Identifiers are turned on, the traffic identification is displayed below the traffic symbol:



If ground speed data is received for a traffic item and the depiction of traffic ground speed is turned on (see 2.4.5.1), the ground speed value will be displayed below the traffic identifier:

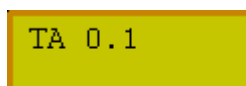


In case the integrity values of a traffic item are below certain thresholds (predefined on the CF-card), a circle will be drawn around the traffic item:



2.2.2.5.3 Traffic Advisories with missing position information (Ryan TCAD)

In certain cases, it is possible that the Ryan TCAD sensor provides information about traffic with no bearing information. In these cases, traffic information is displayed in a yellow rectangle box at the bottom of the display. Together with the TA indication, the distance to the ownship position is presented. If the relative altitude is available, this information will be presented rounded to the next 100 ft.



In the given example the distance between the traffic and the own aircraft is 0.1 nm. However, no bearing or altitude information is available.

2.2.2.6 Traffic service volume

If traffic service is limited to a certain area and/or altitude band, i.e. a service volume, the lateral boundaries of the Traffic service volume are presented on the screen in the map section by lines in grey colour. The lines are drawn solid if the own aircraft is within the lateral boundaries of the Traffic service volume. The lines are draw intermittent (dashed), if the own aircraft is not within the lateral boundaries of the service volume. TIS-B traffic service is typically limited to one or several Traffic service volumes.

2.2.2.7 Terrain

Terrain in your vicinity is displayed relative to your current altitude and position. Your **CDTI-2000** determines the terrain contours from its data base for the whole area displayed and compares them with the current altitude. The difference between the altitude and the terrain height is displayed according to the following colour-code:

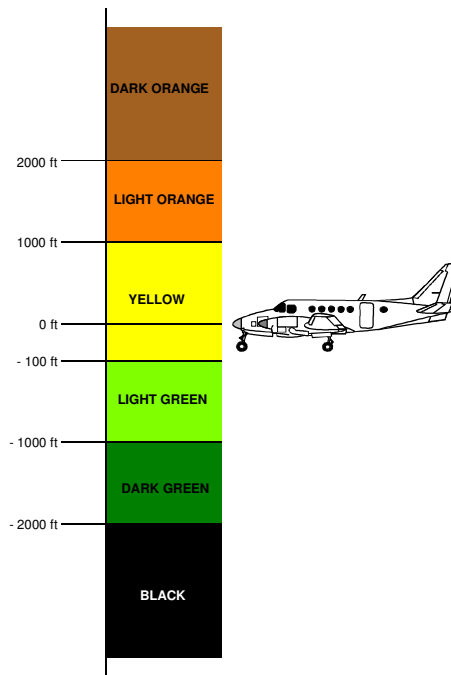


Figure 2-5: Terrain Colours

According to this scheme, terrain which is more than 2,000 feet below your current altitude is coloured black. Two shades of green indicate terrain from 2,000 to 100 feet below the current altitude. Terrain with altitudes from 100 ft below the and 1000 ft above the current altitude is indicated in yellow. The terrain higher than 1,000 and 2,000 feet above the current altitude are light orange and dark orange, respectively.

During the flight, particularly at higher altitudes, it is possible that the entire terrain in the area presented is coloured black and thus not visible on the display. This is normal if the height above terrain (HAT) exceeds 2,000 feet for the entire area displayed.

From the colour-code it is clear that not only yellow to red terrain (terrain is higher than the current altitude!) but also light-green and yellow/green terrain requires particular attention. An altitude below the minimum safety altitude of 500 feet above ground may already have been reached at a light-green coloration.

The map is aligned either according to your flight direction ("head-up") or with north at the top ("north-up"). In Head-Up mode, the terrain in front of you is displayed directly above the aircraft symbol. Please remember that the **CDTI-2000** cannot incorporate any wind correction, so that your heading may deviate from the flight direction.

Displaying terrain can be turned on and off on the Display Settings page (see section 2.4.5). When terrain depiction is turned on, an indication is given in the Sidebar of the display (see section 2.2.3).

2.2.2.8 Airports

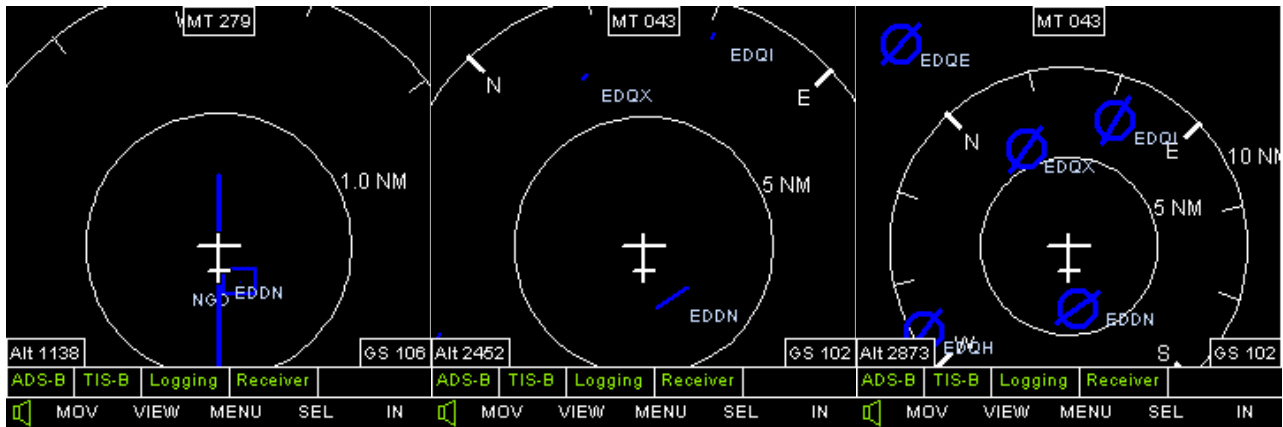


Figure 2-6: Airport Symbols

Airports in your vicinity are displayed relative to your current position. When smaller map ranges are selected (smaller than 10 nm) all runways of the airfield are drawn to scale. When larger map ranges are selected (10 nm and above), the following airport symbol, similar to the one on VFR charts, is used.



Both the 4-Letter-Code name of the airfield and the direction of the longest runway are presented. If no runway information is available, only the circle will be drawn.

Displaying airports can be turned on and off on the Display Settings page (see section 2.4.5). When the display of airports is turned on an indication is given in the Sidebar section of the display (see section 2.2.3).

2.2.2.9 Nav aids

Nav aids in your vicinity are displayed relative to your current position. The following symbols are used:

VORs



VOR/DME or VORTAC



NDBs

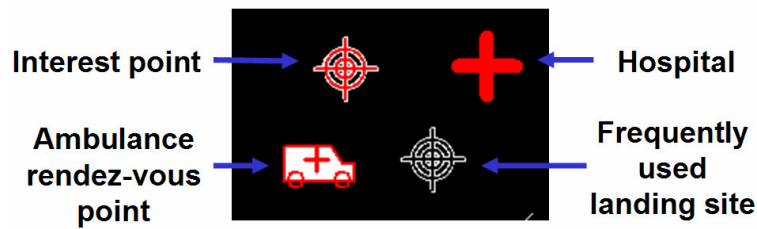


Displaying nav aids can be turned on and off on the Display Settings page (see section 2.4.5). When the display of nav aids is turned on an indication is given in the Sidebar of the display (see section 2.2.3).

2.2.2.10 Target Location and Target Area

The **CDTI-2000** can receive target location and target area data from a ground station. These items will be shown with the following symbols:

Target Locations (symbol decided by ground operator, depending on target location type):



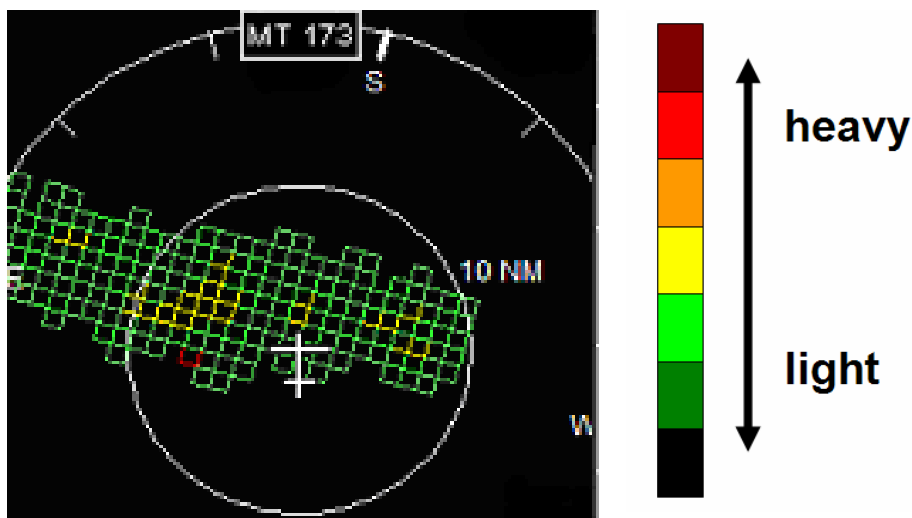
Target Area boundary (colour decided by ground operator, depending on target area type):



A line may be drawn from the current aircraft position to the target location. If this feature is turned “On” on the Display Settings page (see section 2.4.5), that line is shown in magenta colour.

2.2.2.11 Precipitation

The **CDTI-2000** may receive radar data from the ground that contains information about precipitation in the vicinity of the aircraft. If the depiction of precipitation data is switched “On” on the Display Settings page (see section 2.4.5), precipitation will be indicated on the CDTI view using the following symbols:



2.2.3 Sidebar section

On the right hand side of the screen a sidebar area is displayed:

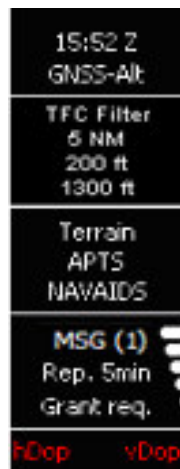


Figure 2-7: Sidebar Section

The side bar comprises 5 sections separated by white lines.

2.2.3.1 Sidebar subsection 1

This section displays time and altitude information of the ownship.

The first line of this section displays the current UTC. The internal clock is synchronized with the UTC information from the current (GNSS) position sensor. The default colour is white. UTC is displayed in yellow when the internal clock has not yet been synchronized with the current position sensor.

The second line of this section displays information about the ownship altitude being used within the **CDTI-2000**. The following table explains possible indications:

Altitude source selection	QNH Setting	Fault condition	Content
GNSS sensor	---	None	GNSS-Alt
Air Data sensor	STD	None	STD
Air Data sensor	QNH value	None	QNH: 1007 (resp. value)
Air Data sensor	STD or QNH value	No barometric altitude data is provided but GNSS altitude is available	No Baro Alt
Any	Any	No altitude data is provided for more than 3 seconds	No Alt

2.2.3.2 Sidebar subsection 2

This section displays traffic information. It is empty if no traffic sensor is connected to the *CDTI-2000*.

The following table explains possible indications in the first line of the second section:

Traffic service	Filter Setting	Fault condition	Content
No sensor connected	---	---	empty
Any	None	None	TFC
Any	Any	Traffic service is not available	No TFC
Any	Range and/or Altitude	None	TFC Filter
TIS-B	Any	Not within boundaries of traffic service volume	Not in SV

If the “No TFC” indication persists for an extended period of time, pilots should first try to reset the traffic service by reselecting it on the Sensor Settings page (see section 2.4.6). If this does not solve the problem pilots should reset the traffic sensor according to the operating manual of the respective traffic sensor.

The second line displays the current traffic range filter setting (see section 2.4.5.1: TFC Display Settings), e.g. 5 nm. It is empty when no traffic range filter is set.

The third and the fourth line display the current traffic altitude above/below filter setting (see section 2.4.5.1: TFC Display Settings). The lines are empty when no traffic altitude filter is set. When a traffic altitude filter is set, but no altitude data for the own aircraft has been provided for more than 3 seconds, the text “No Alt” is indicated in red colour.

2.2.3.3 Sidebar subsection 3

This section displays map element selection information.

The first line displays the phrase “Terrain” if the terrain feature is turned on (see section 2.4.5: Display Settings) and the aircraft is within the boundaries of the terrain data base. The first line displays the phrase “No terrain” in red colour if terrain is turned on and the aircraft is not within the boundaries of the terrain data base. Otherwise line 1 is empty.

The second line displays the phrase “APTS” if the airport feature is turned on (see section 2.4.5: Display Settings), otherwise it is empty.

The third line displays the phrase “NAVAIDS” if the navaid feature is turned on (see section 2.4.5: Display Settings), otherwise it is empty.

2.2.3.4 Sidebar subsection 4

This section displays communication information.

At the right side of this section, a signal strength indicator is shown. It consists of 5 elements that can be either empty or filled. Each segment represents approx. 20% of signal strength.

If there are any unread messages in the message log (compare section 2.4.7: Communication Pages), the number of unread messages is shown in the first line of section 4 with the phrase “MSG (n)” where (n) represents the number of unread messages.

Depending on the communication settings on the communication page (see section , the section will also display the following information:

Rep. x min.

Periodic position reports sent at interval of x minutes

Grant req.

The system will answer to position requests from the ground

2.2.3.5 Sidebar subsection 5

When the integrity values (HDOP / VDOP) from the position sensor fall below the threshold values that are pre-configured on the CF-card, the following indication will be displayed in this section:

hDop

horizontal dilution of precision is below threshold

vDop

vertical dilution of precision is below threshold

2.3 PRIMARY VIEW: MOVING MAP

The Moving Map view has the following appearance on the screen. It consists of the Chart section (top) and the function key label section (bottom).

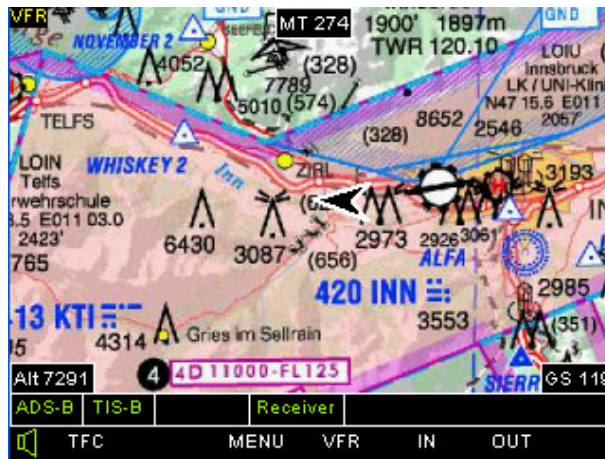


Figure 2-8: Primary View: Moving Map

2.3.1 Function Keys for Moving Map

In Moving Map view, the function keys will be used as follows:

Key	Label	Function
1	TFC	Change to CDTI view
2		not assigned
3	MENU	Change to Main Menu page
4	(name of set/dir)	Change to Chart Set Directory
5	IN	Zoom in (decrease display range)
6	OUT	Zoom out (increase display range)

2.3.2 Map section

In Moving Map view, the chart section of the screen will display a digital chart. The chart is centred at the aircraft position and always oriented north-up.



Figure 2-9: Chart Section

The following elements are additionally displayed in the chart section:

1. Ownship position
2. Ownship altitude
3. Ownship ground speed
4. Ownship track
5. Available chart sets
6. Target locations and target areas (same symbols as on CDTI view, see 2.2.2.10)

2.3.2.1 Ownship position

This aircraft position is indicated by the following symbol:



The symbol is oriented according to the aircraft's true track, e.g. if the aircraft's true track is due east the aircraft symbols points to the right. If the aircraft 's track information is older than the corresponding own data validity, but the position data are still valid the following symbol appears:



2.3.2.2 Ownship altitude

The altitude of the ownship is indicated in feet (ft).



The ownship altitude indication is displayed in the bottom left corner of the map section. It is always present.

2.3.2.3 Ownship track

The track of the ownship is indicated according to the selected track orientation setting (see section 2.4.5: Display Settings) as either Magnetic Track (left image, MT) or True Track (right image, TT).

MT 173

TT 173

The ownship track indication is displayed centred at the top of the map section. It is always present. However, if no valid track information is received, the following indication will be presented instead of the track value:

NO
TRACK

2.3.2.4 Ownship ground speed

The ground speed of the ownship is indicated in knots (NM/hour).

GS 240

The ownship ground speed indication is displayed in the bottom right corner of the map section. It is always present.

2.3.2.5 Chart Sets

Depending on what is stored on the CF-card, there may be several chart sets available, e.g. one VFR enroute chart set and one set of approach charts. The list of available sets (name of directory on CF card) is displayed in the top left corner with the currently active set shown in yellow colour:

M1
VFR

2.4 SETTINGS PAGES: MAIN MENU

The settings pages allow the flight crew to configure the **CDTI-2000** according to their individual requirements. Pilots can vary several parameters of the connected sensors, monitor data from external and internal sources and configure the screen content. The hierarchy of setting pages is described in the following subsections.

2.4.1 Function Keys for the Settings Pages

On the Settings pages, the function keys will be used as follows:

Select mode:

Key	Label	Function
1	MAP	Change back to primary view
2		not assigned
3	BACK	Change back to previous page
4	↑	Move selection marker one line up (if any)
5	↓	Move selection marker one line down (if any)
6	ENT	Open selected item for Edit mode

Edit mode:

Key	Label	Function
1	MAP	Change back to primary view
2		not assigned
3	ESC	Discard change and exit Edit mode
4	-	Decrease selected item
5	+	Increase selected item
6	ENT	Accept change and exit Edit mode

2.4.2 Main Menu page

The Main Menu is giving an overview over possible adjustments and is providing access to detailed settings pages.

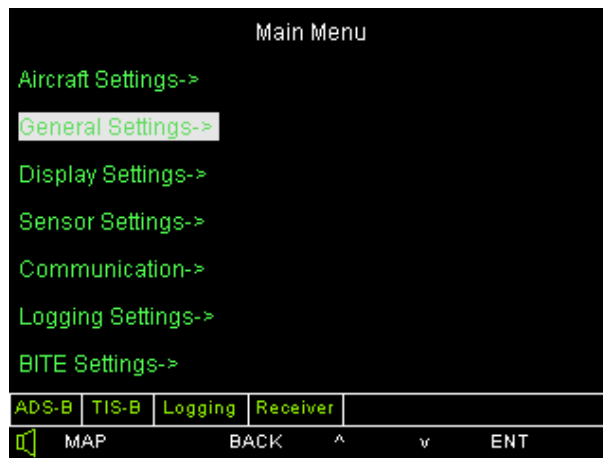


Figure 2-10: Main Menu Page

2.4.3 Aircraft Settings

The aircraft settings page presents the main aircraft position data at a glance and also allows to adjust the QNH setting.

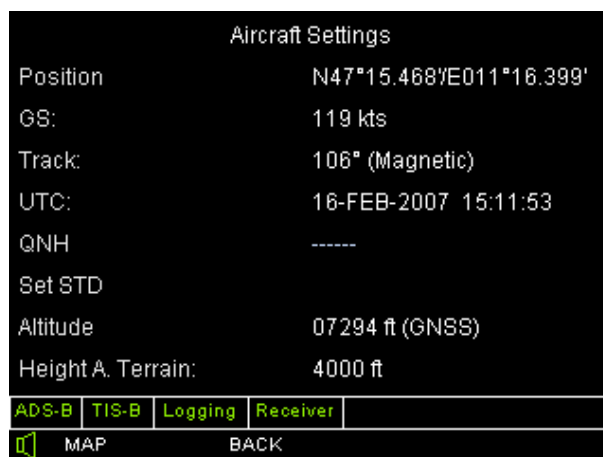


Figure 2-11: Aircraft Settings Page

The following elements are displayed:

- Position: GNSS latitude and longitude in degrees and minutes
- GS: The current aircraft ground speed
- TRACK: The current aircraft track (true or magnetic)
- UTC: The current date and time
- QNH: The pilot can adjust the QNH settings. The QNH can be adjusted in increments of 1 hPa or 0.03 inHg depending on the units setting (see section 2.4.5). This function is only available if BARO-altitude information is available.
- Set STD: This function resets the QNH setting to the standard value of 1013 hPa (29.92 inHg, respectively).

ALTITUDE: The current aircraft altitude. The altitude value is marked with the label (BARO) if pressure altitude information is provided by an air data sensor. The altitude value is marked with the label (GNSS) if pressure altitude information is provided by satellite navigation sensor, e.g. GPS or EGNOS.

HEIGHT A. TERRAIN: This value represents the difference between the current aircraft altitude and the terrain elevation at the current position as provided by the internal digital terrain model.

2.4.4 General Settings

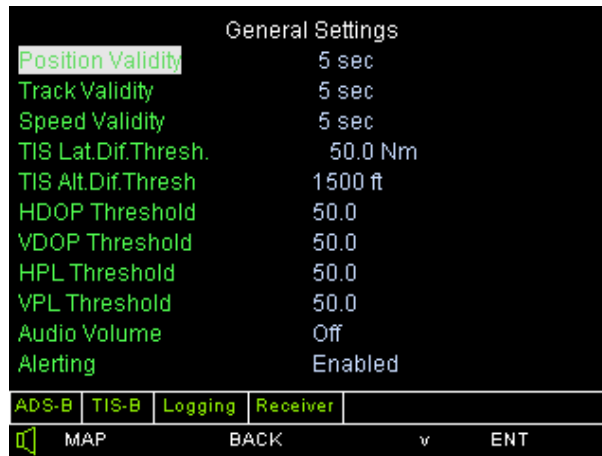


Figure 2-12: General Settings Page

The following elements are displayed:

A validity period could be defined to adjust how long a value is considered to be up to date.

Position Validity: This option specifies how long the own position should be indicated as valid. The own position validity is adjustable to 2 sec, 5 sec, 10 sec, 20 sec, 30 sec or 60 min.

Track Validity: This option specifies how long the own track should be indicated as valid. The own track validity is adjustable to 2 sec, 5 sec, 10 sec, 20 sec, 30 sec or 60 min.

Speed Validity This option specifies how long the own speed should be indicated. The own speed validity is adjustable to 2 sec, 5 sec, 10 sec, 20 sec, 30 sec or 60 min.

The **CDTI-2000** indicates the lateral boundaries of a TIS-B service volume by a solid thick grey line when the ownship is inside the volume or a thin dashed line when the ownship is outside of the volume.

TIS Lat. Dif. Thresh. A threshold used to define whether the own aircraft is within the TIS-B service volume or not. The value's boundaries are at the minimum 100 ft and at maximum 10.000 ft.

TIS Alt. Dif. Thresh. A threshold used to define whether the own aircraft is within the TIS-B service volume or not. The value's boundaries are at the minimum 10 ft and at maximum 3.000 ft.

HDOP Threshold If the horizontal dilution of precision is larger then the configured value, this is indicated in the sidebar section. The values that could be entered cover a range of 0,1 to 99,9.

VDOP Threshold If the vertical dilution of precision is larger then the configured value, this is indicated in the sidebar section. The value could be selected out of a range of 0,1 to 99,9.

HPL Threshold If the horizontal protection level is provided by the GNSS receiver and it is larger then the configured value, this is indicated in the sidebar section. The values that could be entered cover a range of 0,1 to 99,9.

- VPL Threshold If the vertical protection level is provided by the GNSS receiver and it is larger then the configured value, this is indicated in the sidebar section. The values that could be entered cover a range of 0,1 to 99,9.
- Audio Volume To adjust the audio volume following values are possible: Off, 1 or 2
- Alerting This options allows to disable or enable the alerting function of the CDTI.

2.4.5 Display Settings

This page allows to adjust general parameters of the **CDTI-2000** display contents.

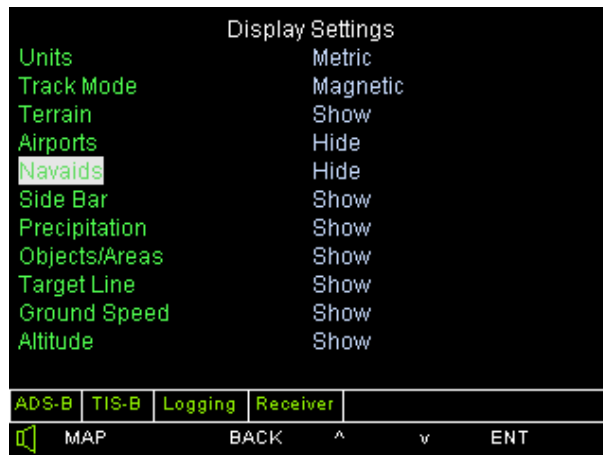


Figure 2-13: Display Settings Page

The following elements are displayed:

- Units: The following options are available: “Metric” and “U.S.”, e.g. “hPA” will be used with QNH setting when “Metric” is selected, “inHg” when “U.S.” is selected.
- Track Mode: The following options are available: “True” and “Magnetic”. This option is used for instance for the orientation of the map section in CDTI view.
- Terrain: The following options are available: “Show” and “Hide”. When “Show” is selected terrain features are displayed in the map section in CDTI view. See section 2.2.2.7.
- Airports: The following options are available: “Show” and “Hide”. When “Show” is selected airport or runway symbols (according to the range selection) are displayed in the map section in CDTI view. See section 2.2.2.8.
- Nav aids: The following options are available: “Show” and “Hide”. When “Show” is selected navaid symbols are displayed in the map section in CDTI view. See section 2.2.2.9.
- Sidebar: The following options are available: “Show” and “Hide”. When “Show” is selected sidebar is displayed in the map section in CDTI and Moving Map view.
- Precipitation: Selects whether precipitation data uplinked from the ground shall be shown on the CDTI view. See section 2.2.2.11.
- Objects/Area: If set to "Show", target objects and areas uplinked by the ground will be shown on the CDTI and Moving Map View.
- Target Line: The target location or target area uplink message will bear a flag that decides if a target line is available for the attached location/area.

	This setting allows to turn the display of that line on or off.
Ground Speed	The following options are available: "Show" and "Hide". When "Show" is selected the ownship ground speed is indicated in the bottom right corner of the map section.
Altitude	The following options are available: "Show" and "Hide". When "Show" is selected the ownship altitude is indicated in the bottom left corner of the map section
Heading	The following options are available: "Show" and "Hide". When "Show" is selected the ownship track is indicated centred at the top of the map section.
Range Rings	With this option the display of the range rings within the CDTI view could be switched on or off.
TFC Display Settings ->	If this item is selected the TFC Display Settings page (see section 2.4.5.1) is opened.
Traffic Tag Settings->	This line allows to open the Traffic Tag Settings page (see section 2.4.5.2).

2.4.5.1 TFC Display Settings

This page allows to adjust traffic display parameters of the **CDTI-2000**.

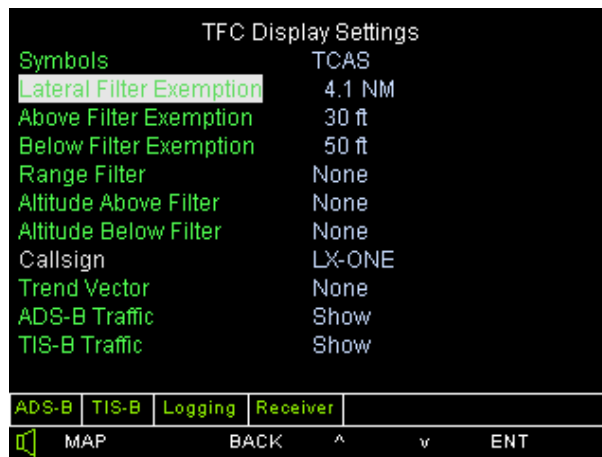


Figure 2-14: TFC Display Settings Page

The following elements are displayed:

Symbols: The following options are available: "Rectangles" and "TCAS". The respective symbol set is used for the indication of traffic. See section 2.2.2.5.

Only traffic that matches the filter criteria for **range** or **altitude** - if set - will be displayed.

Range Filter: The following options are available: "None", "2 nm", "5 nm", and "10 nm". Traffic that has been detected by the traffic sensor but that is not within the selected filter range is not displayed on the **CDTI-2000**. See section 2.2.3.2.

Altitude Below Filter: The values could be adjusted from 100ft to 40.000ft. Traffic that has been detected by the traffic sensor but that is not within the selected altitude limits is not displayed on the **CDTI-2000**. See section 2.2.3.2.

Altitude Above Filter: see Altitude Below Filter

If it is necessary to add exemptions to the filter criteria, this could be done by the following options:

Lateral Filter exemption The value range varies from 0,1 nm to 100 nm

Above Filter exemption The value range varies from 10 ft to 5000 ft

Below Filter exemption The value range varies from 10 ft to 5000 ft

All traffic within the range defined by the parameters Lateral, Above, and Below Exemption are excluded from the traffic display regardless of the filter criteria.

Callsign: This parameter is only available if a VDL-4 transceiver is connected. It allows to modify the call sign that is stored in the transceiver. To modify the value, set the call sign to one of the pre-defined options (the list of available call signs is pre-configured on the CF-card). The **CDTI-2000** will transmit the new call sign to the transceiver and reboot it. While the transceiver is rebooting, the parameter can not be accessed.

The Callsign value will also be used to filter out ownship data from any TIS-B reports being received by the CDTI-2000.

Trend Vector: For each traffic item that reports speed and track information, a trend vector may be shown on the CDTI and MAP view. With this parameter, the length of that trend vector can be set. The options available are: "None", "1 min", "2 min", "3 min", "4 min", and "5 min".

ADS-B Traffic: This option enables the pilot to **show** or **hide** the traffic derived from ADS-B reports.

TIS-B Traffic: This option enables the pilot to **show** or **hide** the traffic derived from TIS-B reports.

If an ADS-B traffic item corresponds to a TIS-B traffic item and the TIS-B display is enabled, the ADS-B traffic item is not shown.

If the deviation between an ADS-B and TIS-B reported traffic item exceeds the following thresholds, it will be displayed as two different items with a small circle at the centre of the symbol indicating this inconsistency.

Lat. Incons.Threshold adjustable from 0.1 nm to 99.9 nm

Alt. Incons.Threshold adjustable from 100 ft to 5.000 ft

It is possible to configure threshold values for the integrity (NUC/NAC/NIC/SIL) of the traffic position data, so that the pilot is notified of traffic items reported to be outside these values. In this case a circle is drawn around the respective traffic symbol. (Not for the rectangle symbol set).

NUC Limit adjustable values from 0 to 4 with incremental steps of 1

NAC Limit adjustable values from 0 to 11 with incremental steps of 1

NIC Limit adjustable values from 0 to 11 with incremental steps of 1

SIL Limit adjustable values from 0 to 3 with incremental steps of 1

Traffic Type All TIS-B traffic items are marked with a line along the centre line of the symbol if this parameter is set to "Show". (Not for the rectangle symbol set).

2.4.5.2 Traffic Tag Settings

The settings on this page define the appearance of the traffic tags that are shown next to the traffic symbols.

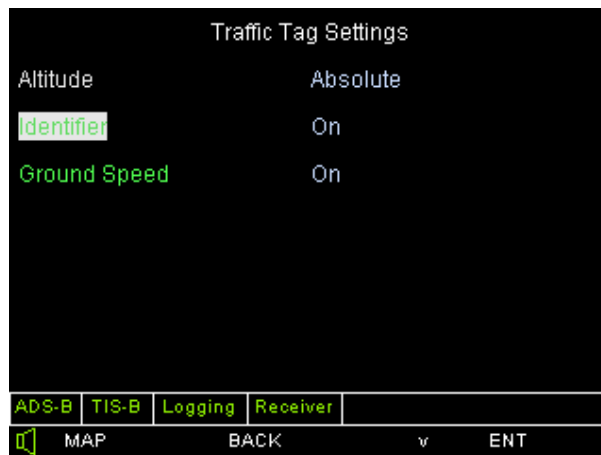


Figure 2-15: Traffic Tag Settings

The following elements are available:

- Altitude: The following options are available: “Relative” and “Absolute”. This parameter determines whether altitude information of detected traffic is indicated relative to the own altitude or as an absolute value (see section 2.2.2.5). When a Ryan TCAD is connected, only “Relative” is available. When the altitude of the own aircraft is derived from a GNSS sensor and not from an air data source, only “Absolute” is available.
- Identifier: The following options are available: “On” and “Off”. When “On” is selected, the traffic identification (if provided by the traffic sensor) is displayed in the traffic data tag. See section 2.2.2.5.
- Ground Speed: This parameter may be set to "On" or "Off". When "On" is selected, the ground speed (if provided by the traffic sensor) is displayed below the traffic identifier. See section 2.2.2.5.

2.4.6 Sensor Settings

The main Sensor Settings page and the associated sub-pages allow to select and configure the sensors that will be used for data input into the **CDTI-2000**.

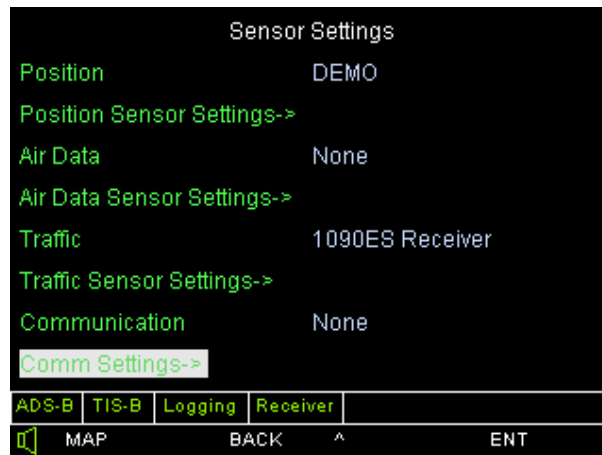


Figure 2-16: Main Sensor Settings Page

The following elements are displayed on the Main Sensor Settings page:

- Position This parameter selects which sensor is used to determine the own aircraft position information and UTC. The following options are available: "Frontside GNSS", "Rearside GNSS", and "VHF Transceiver". "Frontside GNSS" uses a GNSS receiver connected to Front I/O connector (see section 1.4:

System Overview). The selections “Rearside GNSS” and “VHF Transceiver” require the respective sensors to be connected to the rear side of the **CDTI-2000**.

- Position Sensor Settings If this item is selected the Position Sensor Settings page is opened.
- Air Data This parameter selects which sensor is used to determine the own aircraft altitude. The following options are available: “None”, “Sandia”, “Shadin”, and “VHF Transceiver” If “None” is selected the **CDTI-2000** will use the altitude information provided by the position sensor (see above). The other selections require the respective sensor to be connected to the rear side of the **CDTI-2000**.
- Air Data Sensor Settings If this item is selected the Air Data Sensor Settings page is opened.
- Traffic This parameter selects which sensor is used to determine traffic. The following options are available: “None”, “Ryan TCAD”, “1090ES Receiver”, and “VHF Transceiver”. The selections “Ryan TCAD”, “1090ES Receiver”, and “VHF Transceiver” require the respective sensors to be connected to the rear side of the **CDTI-2000**.
- Traffic Sensor Settings Selecting this item opens the Traffic Sensor Settings page.
- Communication This parameter selects which sensor is used to exchange communication messages. The following options are available: “None” and “Iridium Transceiver”. The selection “Iridium Transceiver” requires that system to be connected to the rear side of the **CDTI-2000**.
- Comm Settings -> If this item is selected the Communication Settings page is opened.

2.4.6.1 Position Sensor Settings

This page gives an overview of the position sensors connected to the **CDTI-2000**. Settings pages which present details of the connected sensors are also accessible from here.

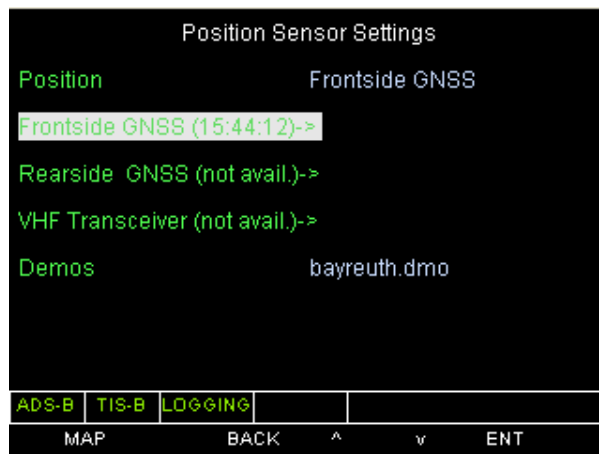


Figure 2-17: Position Sensor Settings

The following elements are displayed:

- Position: This parameter selects which sensor is used to determine the own aircraft position information and UTC. The following options are available: “Frontside GNSS”, “Rearside GNSS”, and “VHF Transceiver”. “Frontside GNSS” uses a GNSS receiver connected to Front I/O connector (see section 1.4:

System Overview). The selections “Rearside GNSS” and “VHF Transceiver” require the respective sensors to be connected to the rear side of the **CDTI-2000**.

- Frontside GNSS: If a position sensor is connected to I/O connector on the front side of the **CDTI-2000** the UTC provided by this sensor is displayed here. If this item is selected the Frontside GNSS Settings page is opened.
- Rearside GNSS: similar to Frontside GNSS
- VHF Transceiver: similar to Frontside GNSS

2.4.6.1.1 Frontside/Rearside GNSS Settings

The pages for Frontside and Rearside GNSS Settings allow to select the protocol and Baud rate. In addition, the data received from the respective sensor is shown.

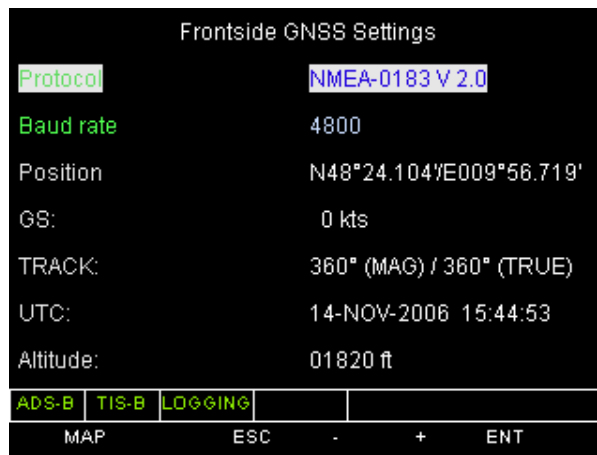


Figure 2-18: Frontside GNSS Settings

The following elements are shown:

- Protocol: This parameter selects which protocol is used for the data connection. The following options are available: “NMEA”, “X0”, and “Garmin aviation”.
- Baud rate: This parameter selects which baud rate is used for the data connection. The following options are available: “2400”, “4800”, “9600”, and “19200”.
- Position: GNSS latitude and longitude in degrees and minutes as determined by this sensor
- GS: The aircraft ground speed as determined by this sensor
- TRACK: The aircraft track (true and magnetic) as determined by this sensor
- UTC: The date and time as determined by this sensor
- Altitude: The aircraft altitude as determined by this sensor

2.4.6.1.2 VHF Transceiver Settings

On this page, data received from the VHF transceiver position sensor is displayed.

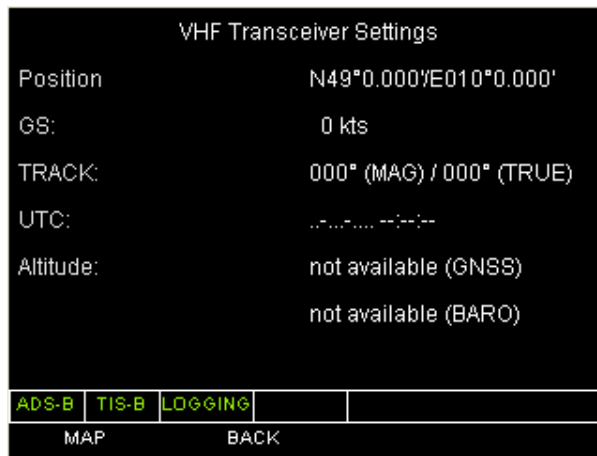


Figure 2-19: VHF Transceiver Settings

The following elements are presented:

- Position: GNSS latitude and longitude in degrees and minutes as determined by this sensor
- GS: The aircraft ground speed as determined by this sensor
- TRACK: The aircraft track (true and magnetic) as determined by this sensor
- UTC: The date and time as determined by this sensor
- Altitude: The aircraft altitude (GNSS and Baro) as determined by this sensor

2.4.6.2 Air Data Sensor Settings

This page gives an overview of the air data sensors connected to the **CDTI-2000**.

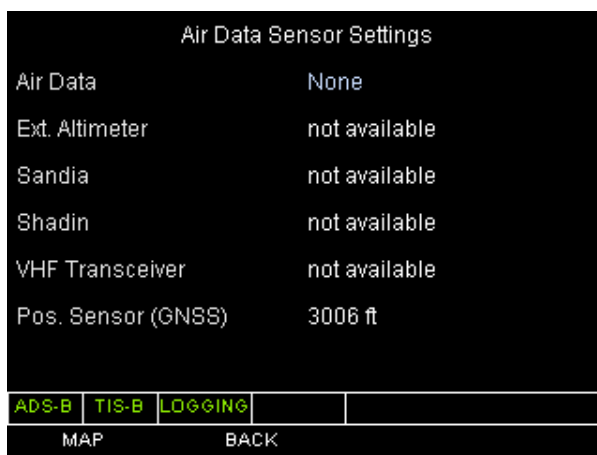


Figure 2-20: Air Data Sensor Settings

The following elements are displayed:

- Air Data: This parameter selects which sensor is used to determine the own aircraft altitude. The following options are available: "None", "Sandia", "Shadin", and "VHF Transceiver". If "None" is selected the **CDTI-2000** will use the altitude information provided by the

position sensor (see above). The selections “Sandia”, "Shadin", and “VHF Transceiver” require the respective sensors to be connected to the rear side of the **CDTI-2000**.

- Ext. Altimeter If an external altitude encoder (with serializer) is connected on the rear side of the **CDTI-2000** the altitude information provided by this sensor is displayed here.
- Sandia: If an air data sensor via a Sandia SAE5-35 altimeter is connected on the rear side of the **CDTI-2000** the altitude information provided by this sensor is displayed here.
- Shadin: If an air data sensor via a Shadin SD-940011 serializer is connected on the rear side of the **CDTI-2000** the altitude information provided by this sensor is displayed here.
- VHF transceiver: If a VHF transceiver is connected on the rear side of the **CDTI-2000** the altitude information provided by this sensor is displayed here.
- Pos. Sensor (GNSS): As a reference and for comparison, the altitude information as provided by the selected GNSS position sensor is displayed here.

2.4.6.3 Traffic Sensor Settings

This page gives an overview of the traffic sensors connected to the **CDTI-2000**. It also allows the selection of the traffic service to be used for the traffic indication.

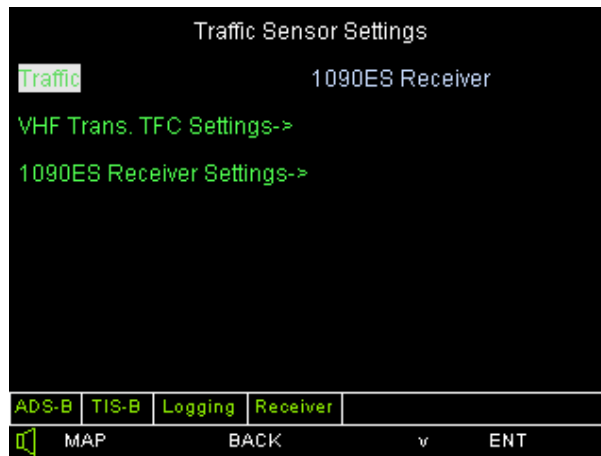


Figure 2-21: Traffic Sensor Settings

The following elements are displayed:

- Traffic: This parameter selects which sensor is used to determine traffic. The following options are available: “None”, “Ryan TCAD”, and “VHF Transceiver”. The selections “Ryan TCAD” and “VHF Transceiver” require the respective sensors to be connected to the rear side of the **CDTI-2000**.
- VHF Trans. TFC Settings If this item is selected the VHF Transceiver TFC Settings page is opened.
- 1090ES Rec. Settings This line selects the 1090ES Receiver Settings page.

2.4.6.3.1 VHF Transceiver TFC Settings

On this page traffic information received from the VHF transceiver traffic sensor is displayed.

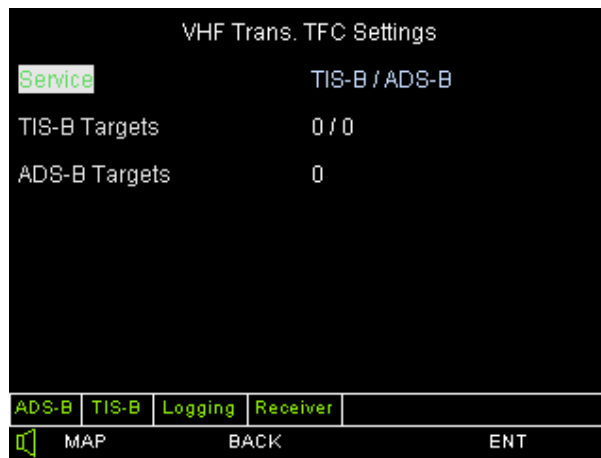


Figure 2-22: VHF Transceiver TFC Settings

The following elements are displayed:

- Service: This parameter selects which traffic service will be used. The pilot can choose from two options: “ADS-B” and “TIS-B/ADS-B” in combination.
- TIS-B targets: The first number represents the number of TIS-B targets in the last update cycle as provided by the last management message. The second number represents the actual number of targets received in the last update cycle. This element is displayed in red colour if the two numbers do not match.
- ADS-B Targets: The number of ADS-B targets that are currently being received from the 1090ES receiver, not counting outdated traffic data.

2.4.6.3.2 1090ES Receiver Settings

This page allows to switch on and off the logging of traffic data received from a Mode-S 1090 Extended Squitter receiver and to view the settings and number of received ADS-B targets for that receiver.

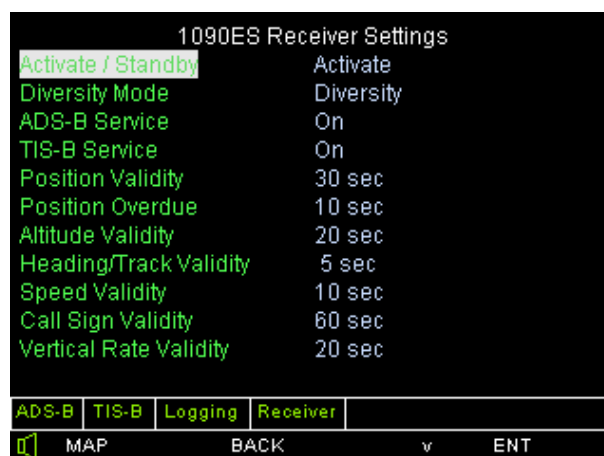



Figure 2-23: 1090ES Receiver Settings

The following elements are displayed:

Activate/Standby	The receiver mode could be set to “Activate” (On) or “Standby” (Off).
Diversity Mode	There are several modes of antenna utilisation, it could be chosen between the following elements: "Diversity", "Top", "Bottom", "Alternate", and "Inhibited".
ADS-B Service	This option is used to enable or disable the ADS-B service of the receiver. If the ADS-B Service is set to “Off” the receiver will provide no data and therefore no traffic data will be logged. Please note that this a different option from the “ADS-B Traffic” option on the TFC Display Settings page (section 2.4.5.1), which is only a display filter, while the derived data still could be logged.
TIS-B Service	This option is used to enable or disable the TIS-B service of the receiver. If the TIS-B Service is set to “Off” the receiver will provide no data and therefore no traffic data will be logged. Please note that this a different option from the “TIS-B Traffic” option on the TFC Display Settings page (section 2.4.5.1), which is only a display filter, while the derived data still could be logged.

A validity period could be defined for each attribute to adjust how long a value is considered to be up to date.

Position Validity	If the position data has not been updated in the preset time the position is considered to be invalid and the traffic item disappears from the screen. The time of validity is adjustable to one of the following values: "2 sec", "5 sec", "10 sec", "20 sec", "30 sec", "1 min".
Position Overdue	If the position data has not been updated in the preset time the position is considered to be overdue and the traffic item is shown in grey colour. The time is adjustable to one of the following values: "5 sec", "10 sec", "20 sec", "30 sec", "1 min", "2 min", "5 min".
Altitude Validity	If the preset time is exceeded the altitude value within the traffic tag is replaced by NOA (no altitude) One of the following times is configurable: "2 sec", "5 sec", "10 sec", "20 sec", "30 sec", "1 min".
Heading/Track Val.	If the preset time is exceeded the aircraft symbol changes into the no track symbol  One of the following times is configurable: "2 sec", "5 sec", "10 sec", "20 sec", "30 sec", "1 min".
Speed Validity	If the preset time is exceeded the speed value is not shown within the traffic tag. One of the following times could be applied "2 sec", "5 sec", "10 sec", "20 sec", "30 sec", "1 min".
Call Sign Validity	If the preset time is exceeded the call sign is replaced by the ICAO-ID. One of the following times is selectable "2 sec", "5 sec", "10 sec", "20 sec", "30 sec", "1 min".
VRate Validity	If the preset time is exceeded the arrow indicating the vertical rate will not be shown. One of the following times is selectable "2 sec", "5 sec", "10 sec", "20 sec", "30 sec", "1 min".
Status Validity	If the preset time is exceeded the aircraft status as derived from the ADS-B report is regarded as invalid. One of the following elements could be selected "2 sec", "5 sec", "10 sec", "20 sec", "30 sec", "1 min".

2.4.6.4 Communication Settings

On this page the data connection of a communication device connected to the **CDTI-2000** can be configured.

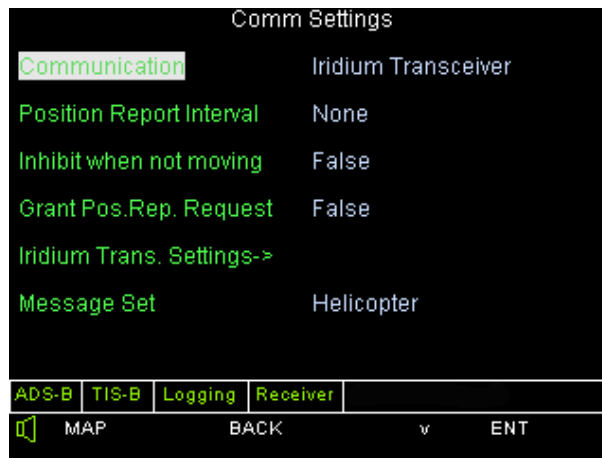


Figure 2-24: Communication Settings

The following elements are displayed:

- Communication:** This parameter selects which sensor is used to exchange communication messages. The following options are available: “None” and “Iridium Transceiver” or “VHF Transceiver”. The selection “Iridium Transceiver” or “VHF Transceiver” requires that system to be connected to the rear side of the **CDTI-2000**.
- Position Report Interval:** This parameter selects the rate at which position reports are automatically sent to the ground station. The following options are available: "None", "1 min", "3 min", "5 min", and "10 min".
- Inhibit when not moving:** This parameter selects whether position reports are sent to the ground station when the own aircraft is not changing its position. The following options are available: “True” and “False”.
- Grant Pos.Rep. Requests:** This parameter selects whether a position report is automatically sent to the ground station when a request for a position report has been received by the **CDTI-2000**. The following options are available: “True” and “False”.
- Iridium Trans. Settings ->** Selecting this line opens the Iridium Transceiver Settings page (see below).
- Message Set** The **CDTI-2000** supports various sets of standard downlink messages. These sets will be defined in a configuration file on the CF-card. This parameter allows to select which message set shall be used.

For the Iridium Transceiver, an additional sub-page is available that provides information about the transceiver.

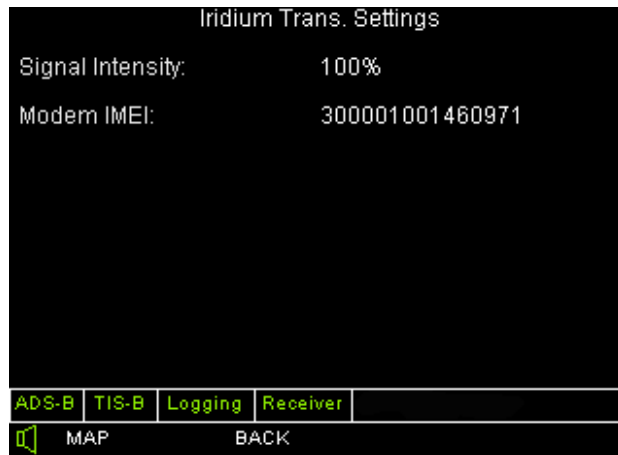


Figure 2-25: Iridium Transceiver Settings

The following elements are displayed:

- Signal Intensity: This parameter shows the signal quality in percent. Generally, any value above 60% indicates a sufficiently reliable data link.
- Modem IMEI: The transceivers internal identification number is shown in this line.

2.4.7 Communication

2.4.7.1 Overview

The **CDTI-2000** allows to exchange messages with ground stations (equipped with Funkwerk Avionics AeroFleet system) via a satellite communication link (Iridium). The communication pages are entered from the main menu page by selecting "COMMUNICATION". The following page will be displayed:

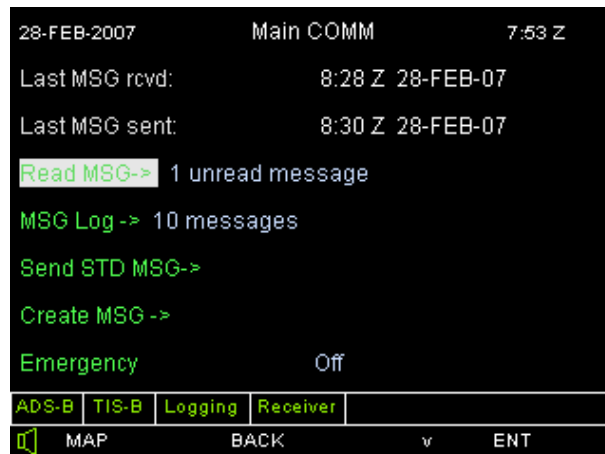


Figure 2-26: Main Communications Page

This page shows the date and time of the last received (uplinked) and last transmitted (downlinked) message. There are 5 entry items that can be selected:

1. "Read MSG->" This item can be selected if there are new, unread uplink messages. The number of new messages is shown, as well. If this line is selected and the "ENT" key is pressed, the first of the new messages is shown.

2. "MSG Log->" Selecting this item and pressing "ENT" will open a new page that shows all the uplink and downlink messages that have been exchanged in chronological order.
3. "Send STD MSG->" This item allows to select a new downlink message from a list of pre-defined standard messages. Some of these standard messages may have additional parameters.
4. "Create MSG->" This item allows to enter and transmit a freetext message.
5. "Emergency" If this parameter is set to "On", an emergency position report is generated and downlinked repeatedly at the highest rate that the selected datalink allows.

2.4.7.2 Sample Communication Tasks

This chapter explains in detail how to perform various communication tasks.

2.4.7.2.1 Reading an Uplink Message

If the **CDTI-2000** receives a new uplink message, an indication is given on the sidebar section:

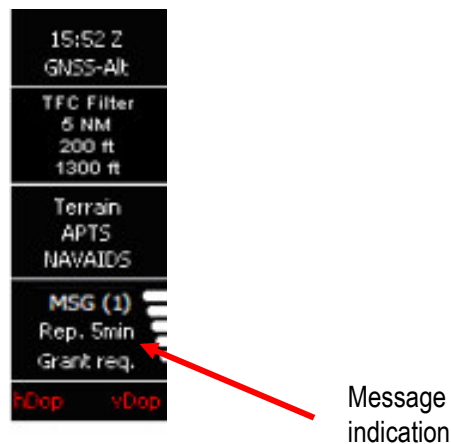


Figure 2-27: Uplink Message Indication

In addition, a short audio tone is generated. To read the message, enter the main communication page via the Main Menu and select "COMMUNICATION":

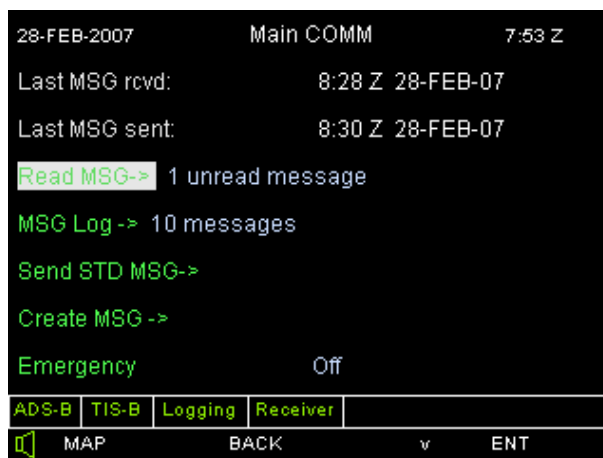


Figure 2-28: Select Message Display

The line "Read MSG->" will be highlighted and the number of newly received messages is shown. Pressing the key "ENT" will then show the first of the new messages:

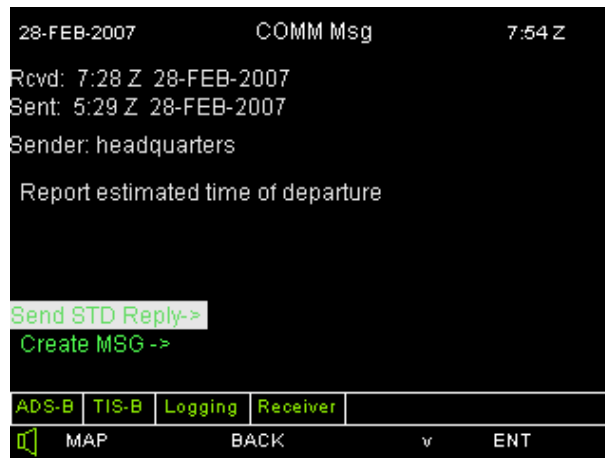


Figure 2-29: Uplink Message Display

This page shows the text of the received message, the time at which it was transmitted and received, and the name of the sending station. At the bottom, two selectable items are shown that allow to either send a standard reply ("Send STD Reply->") or to reply with a freetext message ("Create MSG->"). If no response is intended at this time, simply press "BACK" to go back to the main communication page. **Please note that a later reply to an uplink message is always possible by selecting the uplink message from the message log and then choose one of the reply options.**

The standard reply page will offer the list of pre-defined downlink messages:

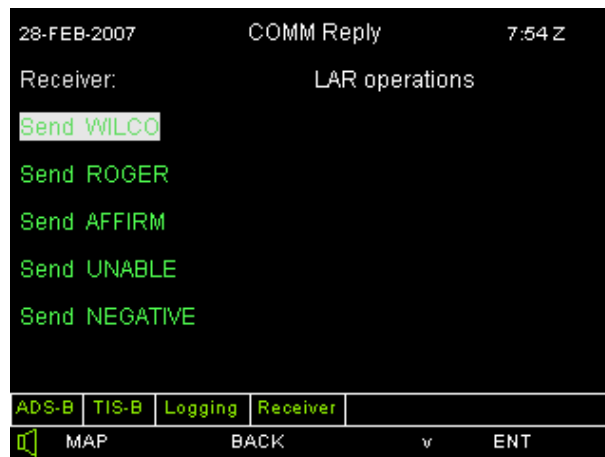


Figure 2-30: List of Standard Downlink Messages

2.4.7.2.2 Sending a Standard Downlink Message

To send a new downlink message, enter the main communication page and select the line "Send STD MSG->":

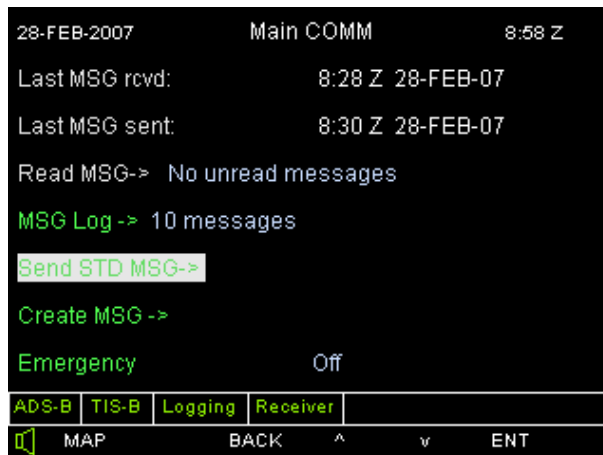


Figure 2-31: Sending a Standard Downlink Message

Pressing "ENT" will then open the page that allows you to select from the list of pre-defined messages. Messages without any parameters will be transmitted directly when the respective line is selected and the "ENT" key is pressed.

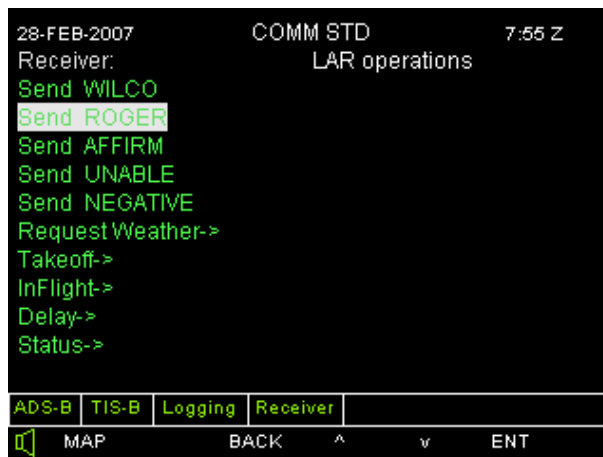


Figure 2-32: Selecting from the List of Standard Messages

Messages that have additional options are marked with a "->" at the end. Selecting one of these messages and pressing "ENT" will open a new page where the parameter(s) can be set.

For the example shown above, a pre-defined message "Takeoff->" may be provided:

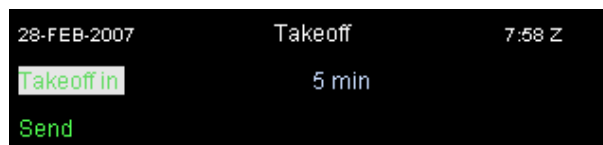


Figure 2-33: Downlink Message Template (Takeoff)

After setting the correct value, selecting "Send" and then pressing "ENT" will downlink the message. Pressing "BACK" will bring you back to the previous page without sending the message.

Besides "Takeoff" following pre-defined messages are provided:

- Request Weather (further described in section 2.4.7.2.5)

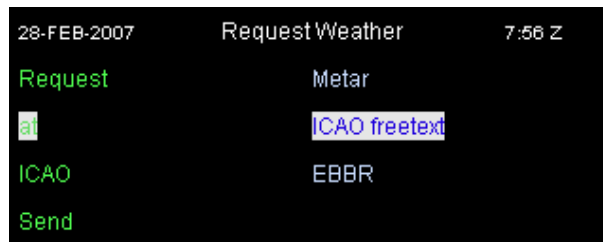


Figure 2-34: Downlink Message Template (Request Weather)

- InFlight



Figure 2-35: Downlink Message Template (InFlight)

- Delay



Figure 2-36: Downlink Message Template (Delay)

- Status

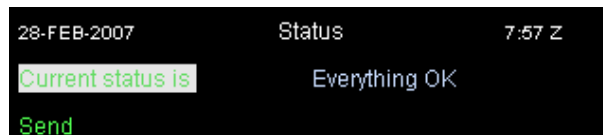


Figure 2-37: Downlink Message Template (Status)

2.4.7.2.3 Sending a Freetext Downlink Message

If a freetext message shall be sent, enter the main communications page and select the line "Create MSG->".

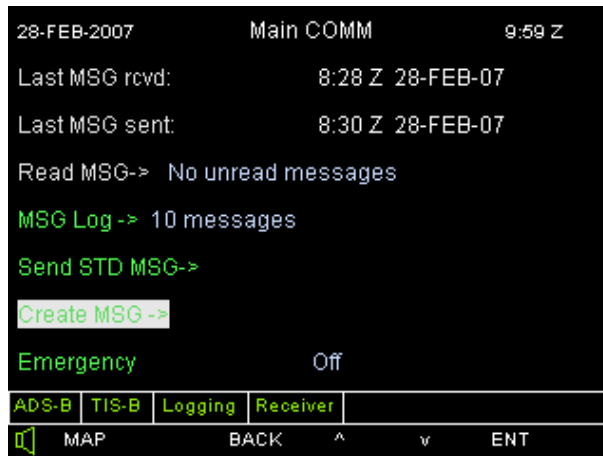


Figure 2-38: Sending a Free Text Message

Pressing "ENT" will then open a new page that allows to enter the message:

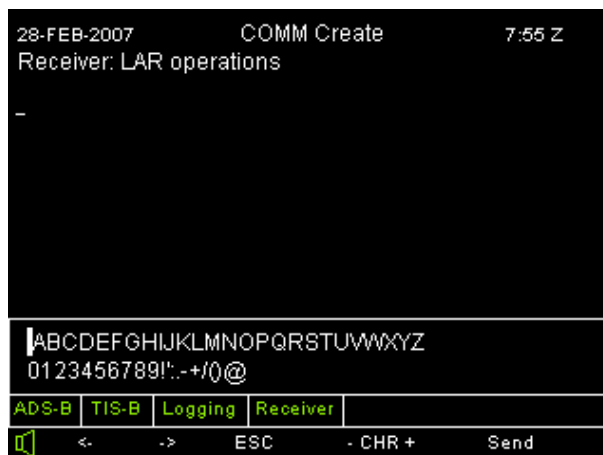


Figure 2-39: Free Text Entry

Function keys 1 and 2 are marked "<-" and "->" and allow to move the cursor (shown as a thin line underneath the character). The character at the cursor position can be changed with function keys 4 and 5 ("- CHR +"). Below the message text, a list of available characters is shown and the current character is highlighted.

To abort the message entry, press function key 3 ("ESC"). Please note that the entries you have made will then be lost!

In order to send the entered text, press "Send".

2.4.7.2.4 Viewing older Messages

All messages received and transmitted are stored in a log file and are available for later review. (They will be deleted, however, after a pre-configured time to avoid memory card overflow.) To access the list of logged messages, enter the main communication page and select the line "MSG Log->". Pressing "ENT" will then open the message log page:

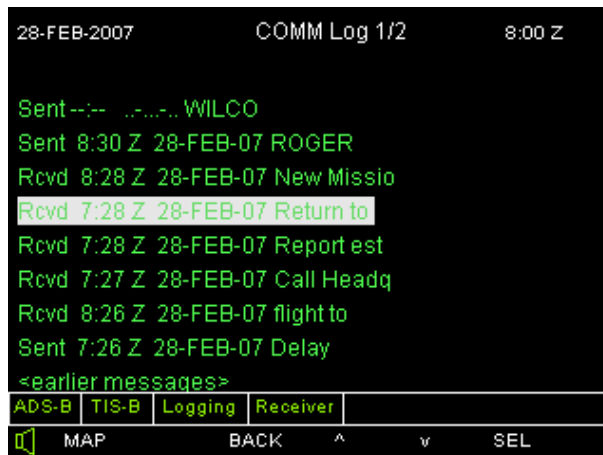


Figure 2-40: Message Log

This page shows a list of all the uplink and downlink messages in chronological order with the latest message shown at the top. If there are more messages than can be shown on the page, “earlier messages” is indicated at the bottom of the page and will provide access to preceding log entries.

For each message, the direction (received or sent), the time and date, and the first characters of the message content are shown. To review one of these messages, move the selection marker to that message and press "SEL". This will open the message page. If the message is an uplink message, the message page will also offer to create a response message.

2.4.7.2.5 Requesting Weather Information

One of the pre-defined messages is a request for weather information. To retrieve weather data, select the line "Request Weather->" from the list of standard downlink messages:



Figure 2-41: Requesting Weather Information

This will open the page "Request Weather". The first parameter on this page allows to select what kind of weather data is requested. The options are:

- METAR
- TAF
- Radar

2.4.7.2.5.1 METAR/TAF

METAR and TAF messages can be requested for any airport. The ICAO identifier can be either selected from a pre-defined list or entered freely. For the pre-defined list, set the parameter "at" to "ICAO from list". The parameter "ICAO" then offers the list of ICAO identifiers that are pre-defined on the CF-card:

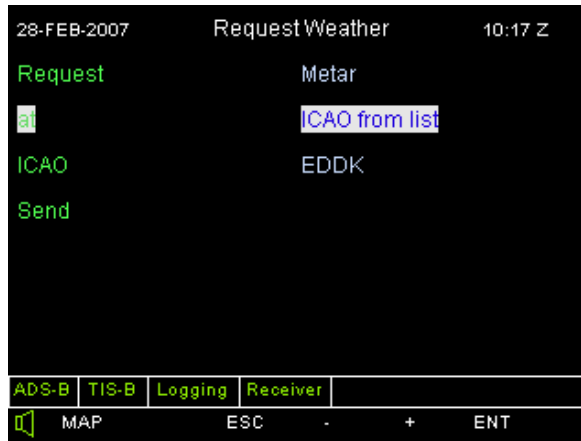


Figure 2-42: Compiling a Weather Request Message

Alternatively, the ICAO identifier may be freely entered. For this, set "at" to "ICAO freetext".

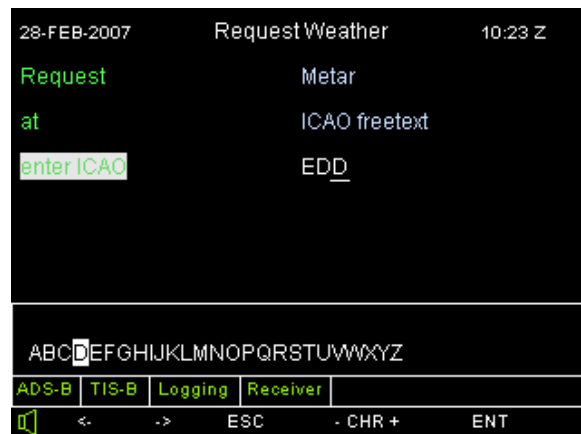


Figure 2-43: Entering the ICAO Identifier

Selecting the parameter "enter ICAO" and pressing "ENT" then activates a text entry that allows to enter the 4-letter ICAO identifier for the desired airport:

After the correct ICAO identifier is set, select the line "Send" and press "ENT". The request will then be sent to ground operations. If the ground centre is equipped with Funkwerk Avionic MeteoServer, the ground system will assemble the requested information and send an uplink message with the METAR or TAF data:

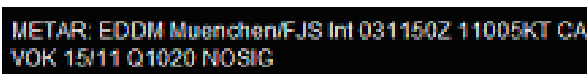


Figure 2-44: METAR Weather Report

If the requested data is not available for the selected airport, an empty message will be sent:



Figure 2-45: No Weather Data Available

2.4.7.2.5.2 Radar Data

In addition to METAR and TAF data, precipitation data for the vicinity of the aircraft's current position may also be requested. For this, set the "Request" parameter to "Radar":

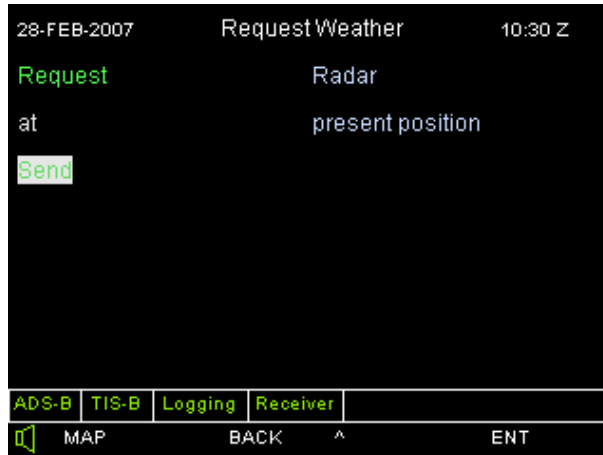


Figure 2-46: Requesting RADAR Precipitation Data

After selecting "Send" and pressing "ENT", the **CDTI-2000** will send a request for radar data at the current aircraft position. If the ground centre is equipped with Funkwerk Avionics MeteoServer, it will generate an uplink message with the current precipitation data. That uplink message contains a short text message that is shown as any other uplink message:



Figure 2-47: RADAR Message

In addition, the message will contain information about the precipitation that can be shown on the CDTI view:

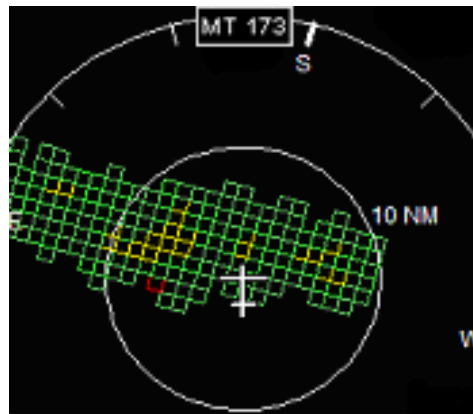


Figure 2-48: Display of Precipitation Data

For details on the graphical presentation, please refer to section 2.2.2.11.

2.4.7.2.6 Receiving Target Location/Area Data

In addition to pure text messages, the ground centre may also uplink messages that contain information about a target location or target area for the aircraft. These messages consist of a text part and a graphical part. The text part is shown as any other uplink message:

Guidance object: Hospital

Figure 2-49: Target Location Message

The graphical object may either be a single target location or a target area. A single location will be shown with a symbol that represents the type of location (e.g. a hospital). Optionally, if selected by the ground operator, a line from the current aircraft position to the target location may be drawn (depending on the display settings, see section 2.4.5). This information is shown on both the CDTI and the Moving Map view. The symbol for the target location will be chosen by the ground operator depending on the type of target location.

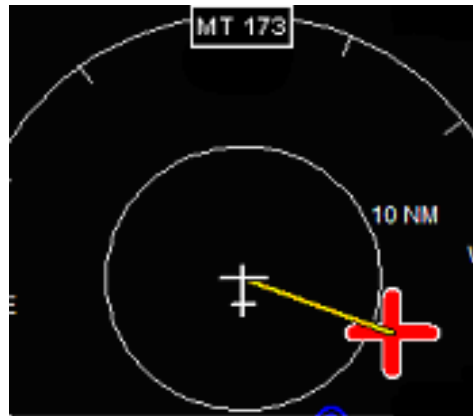


Figure 2-50: Target Location on CDTI View (Hospital)

A target area consists of a sequence of points that define the boundaries of the target area. These boundaries will be shown on both the CDTI and Moving Map view as coloured lines. The colour will be chosen by the ground operator depending on the type of target area.

Mission area: Target Area 1

Figure 2-51: Target Area Message

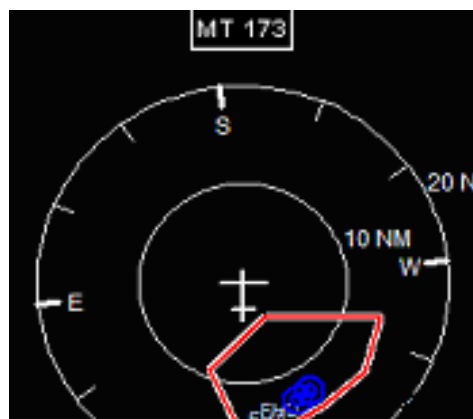


Figure 2-52: Target Area on CDTI View

2.4.8 Logging Settings

On this page settings on the logging service could be done. The Logging Service is storing system parameters, events and incoming messages.

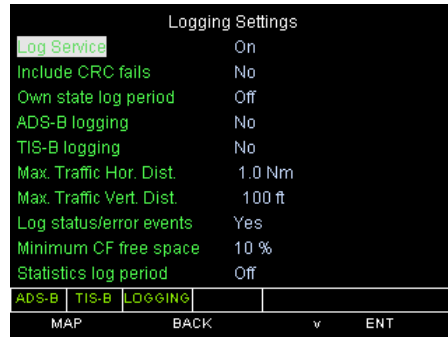


Figure 2-53: Logging Settings Page

Log Service	The Logging Service could be switched ON or OFF
Include CRC fails	If set to "Yes", all 1090ES messages, regardless of their CRC check result will be included in the logging, otherwise only those messages with a correct CRC checksum will be included.
Own state log period	If Own Log Period is set to a value other than "Off", the complete own aircraft state will be logged at the interval specified in this parameter.
ADS-B logging	If set to "Yes", all ADS-B messages are included in the logging of 1090ES messages, otherwise ADS-B messages will be excluded.
TIS-B logging	If set to "Yes", all TIS-B messages are included in the logging of 1090ES messages, otherwise TIS-B messages will be excluded.
Max. Traffic H./V. Dist.	Only 1090ES messages of traffic within the specified limits will be included in the logging. If the respective value is not (yet) available for a target, it will be logged
Log status/error events	If this system parameter is set to "Yes", all changes in service status (activation/de-activation) and all alerts (including BITE failures) being raised (or removed) by the system will be logged. Otherwise, such events will not be logged.
Minimum CF free space	The Logging will be halted if the free CF space falls below the specified value.
Statistics log period	If not "Off" the operational statistics as being presented on the BITE settings page will be logged at the specified interval.

2.4.9 BITE Settings

On the Built-In-Test Settings page the status of tests and the status of the system inputs and resources (operational statistics) are displayed. The User is enabled to initiate testing (IBIT) and to adjust the rate (statistics rate) in which the system statistics are updated. BITE includes the BITE functions from the external 1090ES receiver. The three tests (power-on, continuous, user initiated) comprise common and also slightly different actions (see Table 2-1:)

BITE actions	PBIT	CBIT	IBIT
CF card presence and accessibility	x	x	x
Ability to open all configured interfaces	x		
1090ES receiver status	x	x	x
configuration file plausibility	x		
data base checksum	x		x
successful start of all activated services	x		
status of all activated services		x	
average CPU load less than 90 %		x	
RAM usage less than 80 %		x	
RAM write/read			x

Table 2-1: xBIT actions

BITE Settings	
PBIT Status	Failure
CBIT Status	Failure
Initiate IBIT	Not Performed
ADS-B per sec	1.9
ADS-B wrong	0
TIS-B per sec	0.0
TIS-B wrong	0
Statistics Rate	15 min
CPU load	50 %
RAM free	512.0 MB
Disk free	512.0 MB
ADS-B	TIS-B
LOGGING	
MAP	BACK
v	ENT

Figure 2-54: Bite Settings Page

- PBIT** This parameter gives an indication of the PBIT results (either "OPERATING" or "FAILURE")
- CBIT** This parameter gives an indication of the last CBIT results (either "OPERATING" or "FAILURE"). The test will be performed at least every minute.
- Initiate IBIT** This parameter gives an indication of the IBIT status or results. ("Not Performed" or "TESTING" or "OPERATING" or "FAILURE"). If the parameter states "Not performed" this indicates that no IBIT has been initiated since system boot.
- ADS-B per sec** This parameter gives an indication of the average number of ADS-B messages received per second since system start or last reset of the statistics function.

ADS-B wrong	This parameter gives an indication of the total number of wrong ADS-B messages since system start.
TIS-B per sec	This parameter gives an indication of the average number of TIS-B messages received per second since system start or last reset of the statistics function.
TIS-B wrong	This parameter gives an indication of the total number of wrong TIS-B messages since system start
Statistics Rate	This parameter prescribes the interval at which the statistics, presented at the BITE-settings page, are refreshed. It is adjustable from "1 min" to a maximum value of "120 min" with an increment of "1 min".
CPU load	This parameter gives an indication of the CPU load as a percentage value (as reported by the operating system).
RAM free	This parameter gives an indication of free RAM space in MB (as reported by the operating system).
Disk free	This parameter gives an indication of free CF disk space in MB (as reported by the operating system).

3 TECHNICAL DATA

CDTI-2000 dimensions:

Height	114 mm (12 DZUS units)
Depth	85 mm
Width	146 mm
Weight	1.9 kg
Power	14 / 28 VDC, 50 W

Further information can be taken from the installation manual.

For the development and production of the **CDTI-2000** high quality standards are applicable. Climatic, mechanic and electromagnetic behaviour of the **CDTI-2000** has been tested according to RTCA/DO-160D test categories. The system may be used for installation in fixed-wing turboprops and helicopters. The following qualification can be summarised:

Do-160D Env. Cat. [(B1)Z]CAB[(SM)(UF)]XXXXXXZBABZWM[XXF3]XXA

Temperature range (storage)	-25 °C through +85 °C
Temperature range (operation)	-20 °C through +55 °C
Temperature variation	2°C per minute
Altitude	up to 25000 ft
Vibration	Turboprop and Helicopter
Shock (operation)	6 g
Shock (crash safety)	20g (impulse and sustained)
Power input	10-33 VDC
Voltage spikes	short term up to 600 V

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5 ABBREVIATIONS AND ACRONYMS

BITE	Built-In-Testing
CDTI	Cockpit Display of Traffic Information
CRC	cyclic redundancy check
DME	Distance Measuring Equipment
ft	feet
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HDOP	Horizontal Dilution of Precision
VDOP	Vertical Dilution of Precision
HPL	Horizontal Protection Level
VPL	Vertical Protection Level
ICAO	International Civil Aviation Organisation
kts	knots
METAR	Meteorological Aviation Routine Weather Report
MSL	Mean Sea Level
NDB	Non-directional beacon
NM	Nautical Miles
QNH	Question Normal Height
TA	Traffic Advisory
TCAD	Traffic Collision Alerting Device
TCAS	Traffic Alert Collision Avoidance System
UTC	Universal Time Coordinated
VDL	VHF Datalink
VHF	Very High Frequency
VOR	VHF Omnidirectional Radio Beacon