User Manual

# RT-1000 Multichannel DF-Channel

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**Note**

The manufacturer reserves the right to make modifications at any time and without previous information of the here described product.

# Content

# 1 Description

The DF-Channels are the central element of the bearing system. The channels include the receiver unit with the signal demodulation for AM and FM signals. Also the bearing value calculation is done in the DF-Channels.

# 2 Front View

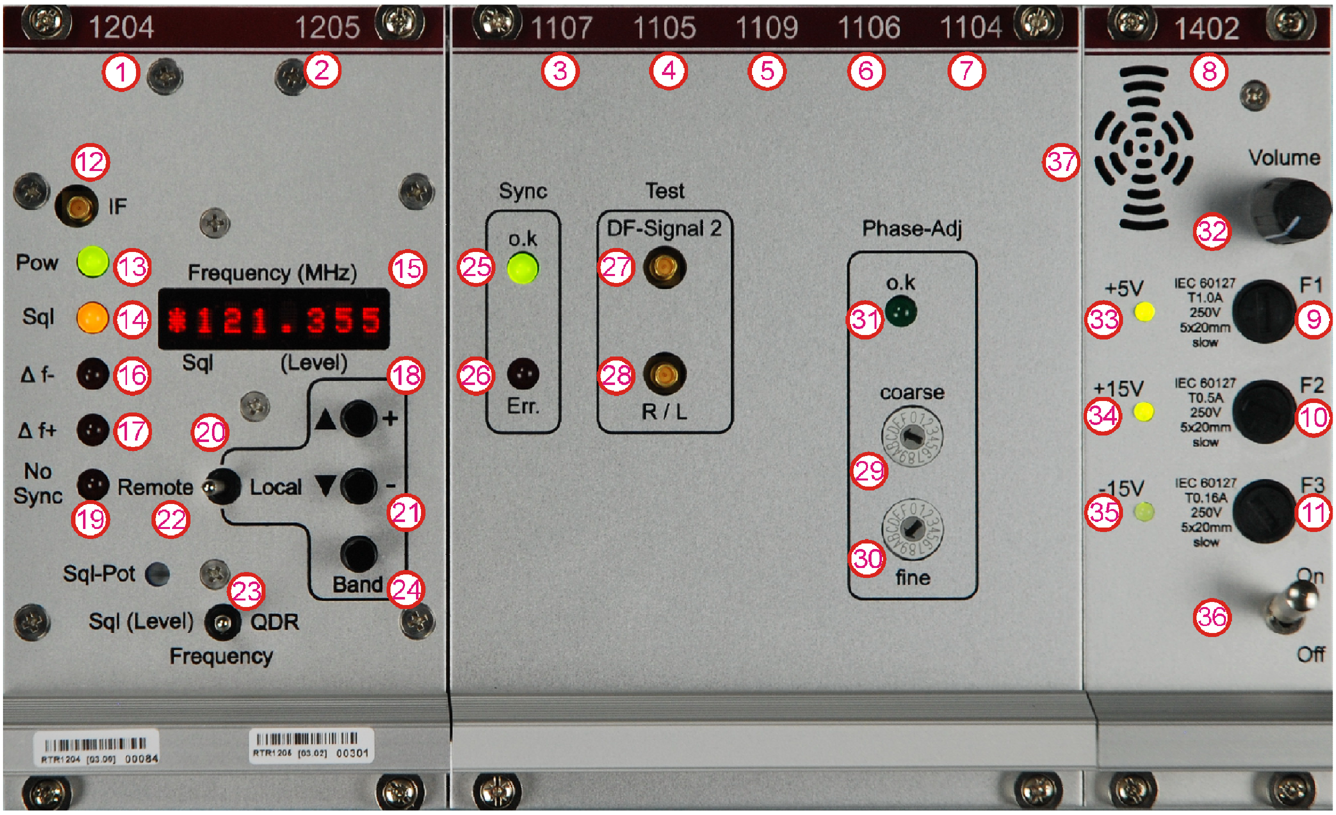
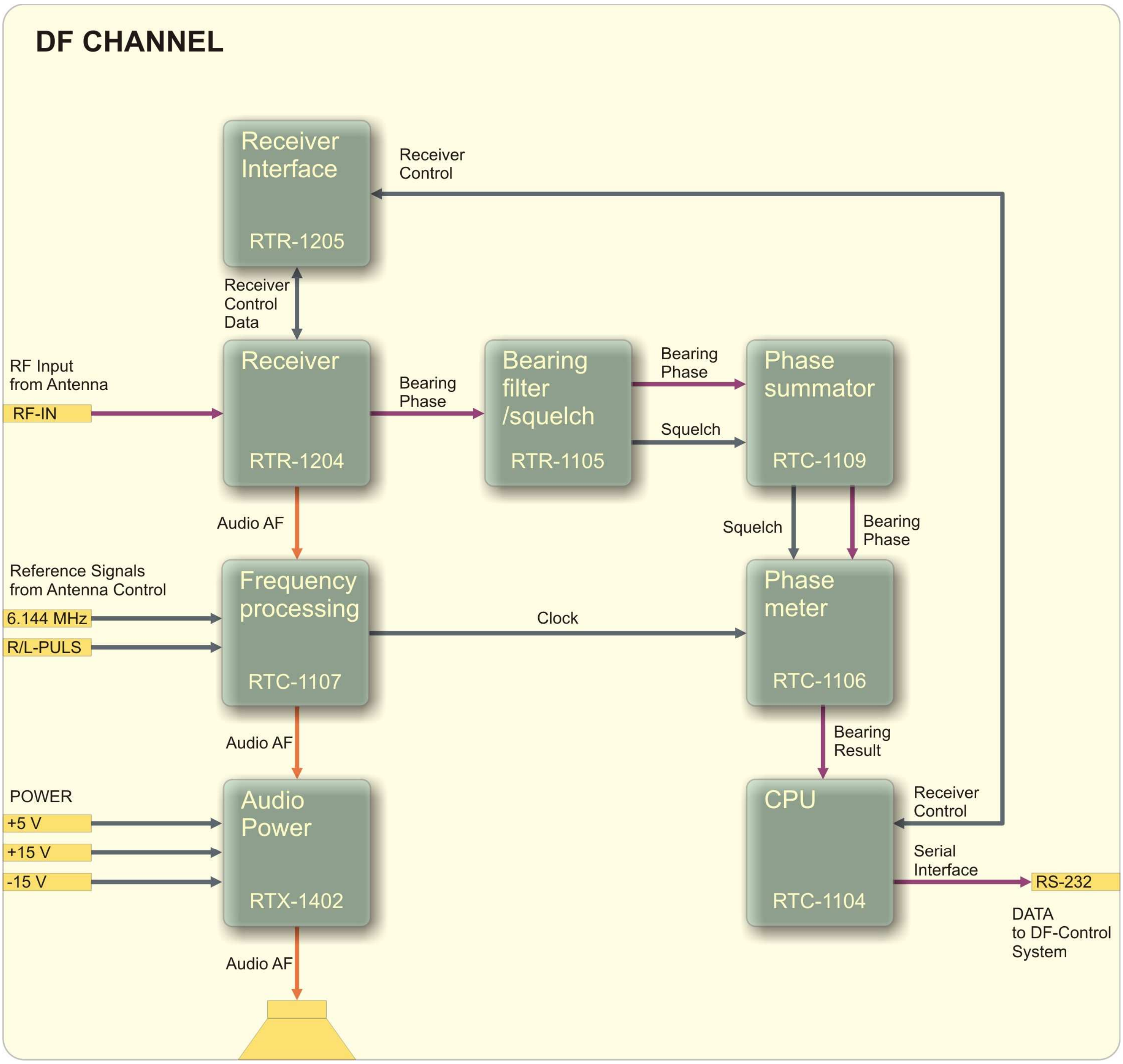



**Fig. 1: DF-Channel Front View**

# 3 Block Diagram and Component Description



| DF-Channel Components | | | |
|---|---|---|---|
| **Pos.** | **Component** | **Number** | **Description** |
| 1 | Receiver | RTR-1204 | Receives the RF signal from the RF-Splitter. Demodulates the AM and FM signals and generates the bearing phase. |
| 2 | Receiver Interface | RTR-1205 | The Receiver Interface controls the receiver unit. It is the communication interface between the receiver and the CPU. |
| 3 | Frequency Processing | RTC-1107 | The Frequency Processing unit include components for filtering the audio signal. It also generates the reference clock out, which is needed for phase meter out of antenna control signals (6.144 MHz and R/L – Puls) |
| 4 | Bearing Filter | RTC-1105 | The Bearing Filter unit includes the components for bearing filtering, bearing signal synchronization and a circuit to detect an evaluable bearing signal. |
| 5 | Phase Summator | RTC-1109 | The Phase Summator unit is used to average the phase of the bearing phase signal before it is processed by the phase meter. |
| 6 | Phase Meter | RTC-1106 | The Phase Meter unit includes the components for determining the phase position of the demodulated bearing signal relative to the reference phase. The result is the averaged bearing data and also life bearing data, which is process by the CPU. |
| 7 | CPU | RTC-1104 | The CPU contains a microprocessor which controls the assemblies in the DF Channel. The CPU also serves the serial interface, which provide the bearing data and allows the remote control of the DF Channel. |
| 8 | Audio Power | RTX-1402 | The Audio Power unit includes the power switch of the DF Channel, the micro fuses for the DC supplies and the speaker with a volume control. |
| 9 | F1 | -- | Microfuse T1.0A 250V 5x20mm, +5 V DC |
| 10 | F2 | -- | Microfuse T0.5A 250V 5x20mm, +15 V DC |
| 11 | F3 | -- | Microfuse T0.16A 250V 5x20mm, -15 V DC |

# 4 Control Elements

| Front Side Interfaces | | |
|---|---|---|
| **Pos.** | **Component** | **Description** |
| 12 | IF | Receiver test jack |
| 13 | Pow | Receiver Power Control LED |
| 14 | Sql | Control LED for receiver squelch |
| 15 | Frequency(MHz)<br>Sql/(Level) | Receiver Display |
| 16 | Δf- | Control LED for negative frequency deviation |
| 17 | Δf+ | Control LED for positive frequency deviation |
| 18 | ▲ | Button for upward frequency change in local mode |
| 19 | No Sync | Control LED for receiver synchronisation error detection |
| 20 | Remote/Local | Switch remote operation or manual for test purpose |
| 21 | ▼ | Button for downward frequency change in local mode |
| 22 | Sql-Pot | Squelch adjustment potentiometer |
| 23 | Frequency<br>Sql(Level)/QDR | Receiver display |
| 24 | Band | Button to switch between marine and air band (optional) |
| 25 | Sync<br>o.k. | Control LED: synchronization ok, green |
| 26 | Sync<br>Err. | Control LED: synchronization not ok, red |
| 27 | Test: DF-Signal 2 | Test Plug, DF signal (filtered) |
| 28 | Test: R/L | Test Plug, R/L signal |
| 29 | Phase-Adj: coarse | Rotary switch for coarse phase adjustment |
| 30 | Phase-Adj: fine | Rotary switch for fine phase adjustment |
| 31 | Phase-Adj: o.k | Control LED for phase adjustment |
| 32 | Volume | Volume control for the Speaker (pos 31) |
| 33 | +5 V | Power control LED for the 5 $V_{DC}$<br>Green: Power on<br>Red: Fuse defect<br>Off: No Supply Voltage/ DF Channel Off |
| 34 | +15 V | Power control LED for the +15 $V_{DC}$<br>Green: Power on<br>Red: Fuse defect<br>Off: No Supply Voltage/ DF Channel Off |
| 35 | -15 V | Power control LED for the -15 $V_{DC}$<br>Green: Power on<br>Red: Fuse defect<br>Off: No Supply Voltage/ DF Channel Off |
| 36 | On/Off | DF Channel Power switch. All DC supplies are switched together. |
| 37 | Speaker | Adjustable audio output for each channel |

# 5 Rear View

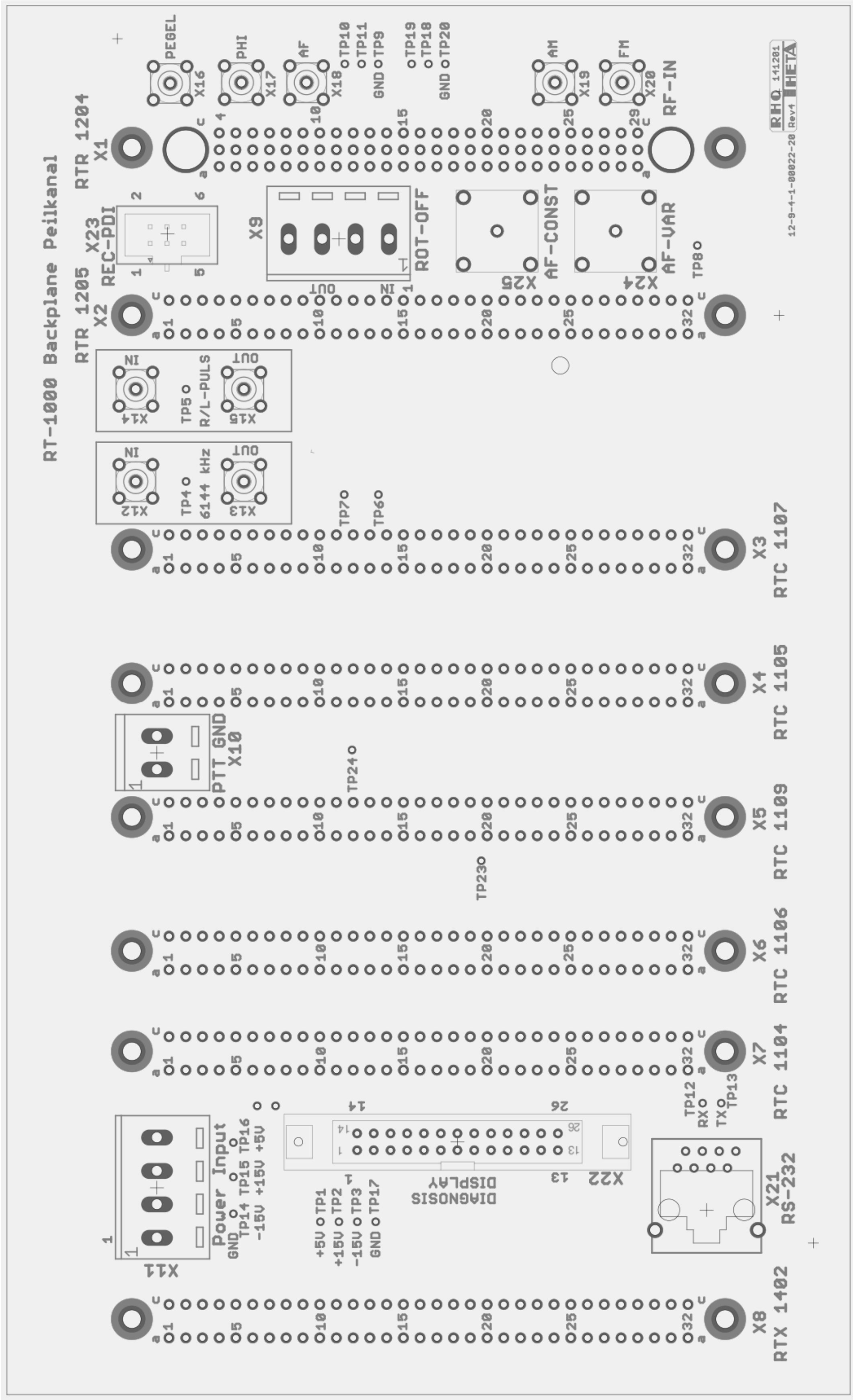



**Fig. 2: DF-Channel Rear View**

| Rear Side Interfaces | | | | |
|---|---|---|---|---|
| **Pos.** | **Connector** | **Pin** | **Signal** | **Note** |
| 1 | X1 | 1 – 4 | RF-IN | RF Input from the RF-Splitter |
| | | 5 – 29 | -- | Internal Connector |
| 2 | X2 | 1 – 32 | -- | Internal Connector |
| 3 | X3 | 1 – 32 | -- | Internal Connector |
| 4 | X4 | 1 – 32 | -- | Internal Connector |
| 5 | X5 | 1 – 32 | -- | Internal Connector |
| 6 | X6 | 1 – 32 | -- | Internal Connector |
| 7 | X7 | 1 – 32 | -- | Internal Connector |
| 8 | X8 | 1 – 32 | -- | Internal Connector |
| 9 | X9 | 1 | ROT-OFF IN | Input Antenna Rotation Control Signal |
| 10 | | 2 | GND | Ground |
| 11 | | 3 | ROT-OFF OUT | Output Antenna Rotation Control Signal |
| 12 | | 4 | GND | Ground |
| 13 | X10 | 1 | PTT | Push to talk input signal |
| 14 | | 2 | GND | Ground |
| 15 | X11 | 1 | GND | Ground Power Input |
| 16 | | 2 | -15 V | - 15 $V_{DC}$ Power Input |
| 17 | | 3 | +15 V | +15 $V_{DC}$ Power Input |
| 18 | | 4 | +5 V | + 5 $V_{DC}$ Power Input |
| 19 | X12 (SMB) | -- | 6144kHZ IN | Input Reference Signal 6,144 MHz |
| 20 | X13 (SMB) | -- | 6144kHZ OUT | Output Reference Signal 6,144 MHz |
| 21 | X14 (SMB) | -- | R/L-PULS IN | Input Reference Signal R/L-Pulse |
| 22 | X15 (SMB) | -- | R/L-PULS OUT | Output Reference Signal R/L-Pulse |
| 23 | X16 (SMB) | -- | PEGEL | Receiver Output Level Signal |
| 24 | X17 (SMB) | -- | PHI | Receiver Output Bearing Phase Signal |
| 25 | X18 (SMB) | -- | AF | Receiver Output Audio Signal |
| 26 | X19 (SMB) | -- | AM | Receiver Output AM-demodulated Signal |
| 27 | X20 (SMB) | -- | FM | Receiver Output FM-demodulated Signal |
| 28 | X21 (RJ 45) | 3 | GND | RS-232, Ground |
| 29 | | 4 | RX | RS-232, Receiving Data |
| 30 | | 5 | TX | RS-232, Transmitting Data |
| 31 | X22 | 1 – 26 | DIAGNOSIS DISPLAY | Service Interface |
| 32 | X23 (PDI) | 1 – 6 | REC-PDI | Service Interface |
| 33 | X25 (BNC) | -- | AF-CONST | Constant Audio Output |
| 34 | X24 (BNC) | -- | AF-VAR | Adjustable Audio Output |

| Rear Side Test Points | | |
|---|---|---|
| **TP** | **Signal** | **Note** |
| 1 | +5 V | +5 V DC Supply after the channel power switch |
| 2 | +15 V | +15 V DC Supply after the channel power switch |
| 3 | -15 V | -15 V DC Supply after the channel power switch |
| 4 | 6144 kHz | Input of the Reference Signal 6.144 MHz |
| 5 | R/L-PULSE | Input of the Reference Signal R/L-Pulse |
| 6 | 6144 kHz | Amplified Reference Signal 6.144 MHz |
| 7 | R/L-PULSE | Amplified Reference Signal R/L-Pulse |
| 8 | RX AFC DC | The AFC signal Level of the receiver |
| 9 | GND | Ground |
| 10 | O TXD | Internal signal, transmitted serial data |
| 11 | O RXD | |
| 12 | RXDATA | Serial Interface X21 receiving data |
| 13 | TXDATA | Serial Interface X21 transmitting data |
| 14 | -15 V | DC Power Supply -15 V Input |
| 15 | +15 V | DC Power Supply +15 V Input |
| 16 | +5 V | DC Power Supply +5 V Input |
| 17 | GND | Ground |
| 18 | RS232-RX | Internal signal, received serial data RS-232 |
| 19 | RS232-TX | Internal signal, transmitted serial data RS-232 |
| 20 | GND | Ground |
| 21 | CPU TXD | Internal signal, transmitted CPU data |
| 22 | CPU RXD | Internal signal, received CPU data |
| 23 | PSUM-SQU | Squelch Signal of the Phase Summator |
| 24 | PFSQL DFSIG | Bearing signal output of the bearing filter |

# 6 Functional Descriptions

## 6.1 Switching on the DF-Channel

The DF-Channel is switched on by the On/Off power switch. Ensure that all components are completely inserted and the screws are in place.
The DF-Channel unit is designed for continuous operation. It must be noted that at low temperatures a warm-up phase lasting up to 30 minutes may be possible after switching on the receiver unit.

## 6.2 Switch-on Reaction, Operation, Control Equipment

The DF-Channel is designed for remote operation. The unit is operated by remote control using the RHOTHETA DF-Commander software. All relevant control functions and indications are transmitted to the remote PC via the serial interface to the DF-Control System which converts the data to LAN. The indications and settings on the DF-Channel are present only for test purposes and for carrying out function checks on the whole system.

## 6.3 Receiver Self-Test

After the DF-Channel has been switched on, an automatic test of the receiver display (Fig 1, Pos.15) is started. This involves the numerical series 88888888 flashing for approximately 4 s. Following this, after that the system identification “RT-1000 A” is displayed and the actual software version is shown for some seconds. When the self-test is finished the last frequency set appears.

## 6.4 Power Supply OK Control LED

After switching on, the green control LEDs (Fig 1, Pos. 33, 34, 35) of the Power Supply module RTX 1402 (Fig 1, Pos. 8) and (Fig 1, Pos. 13) on the receiver RTR 1204 (Fig 1, Pos. 1), lights up. This shows that the power supply module is functioning correctly.

## 6.5 Control Data Transmission

If the DF-Channel works in “Remote” mode (standard) the display (Fig 1, Pos. 15) shows the set frequency. It indicates that the data connection between receiver unit and controller is established. If the communication is disturbed, the error message “No Remote” is displayed.

## 6.6 Squelch Control LED “Sql”

The yellow squelch control LED (Fig 1, Pos. 14) lights up as soon as a signal of sufficient strength is received. This shows that a bearing signal is being transmitted to the controller.

## 6.7 Bearing Indication

If the system receives a signal and calculates a bearing value , the bearing indicator at the right side of the receiver display Figure 1 Pos. 15 lights up as a “*”.
If no signal is received, the indicator lights up every second as a “>”.  If the PTT function is active, the indicator lights up as a “_”.

## 6.8 Δf-, Δf+ Deviation Recognition Control LEDs

The red control LEDs (Fig 1, Pos. 16 & 17) light up if a signal with a large frequency deviation is received. This shows that a signal is being received which is not suitable for direction finding purposes.
For the 25 kHz frequency channel scheme the control LEDs light up for a frequency deviation > 8,0 kHz/ > 9,0 kHz typically.
For the 8,33 kHz frequency channel scheme the control LEDs light up for a frequency deviation > 1,4 kHz/ > 2,7 kHz typically.

## 6.9 Control LED “No Sync”

In case of a PLL lock error the red LED “No Sync” (Fig 1, Pos. 19) illuminates. It indicates a failure on the receiver unit RTR 1204.

## 6.10 “IF” Intermediate Frequency Jack

The intermediate frequency signal supplied by the receiver can be tapped at the IF SMB jack (Fig 1, Pos. 12).

**Caution**

**Only for service use!**

## 6.11 Remote / Local Switch

- “Remote” position: Standard operation mode; Receiver controlled by Controller Unit.
- “Local” position: For test purpose the working frequency can be changed locally. In this position the frequency DF Commander at the Controller side shows “ERR 9”.

## 6.12 “Level-Frequency-QDR” Switch

Standard position of the switch is “frequency”. The display (Fig 1, Pos. 15) shows the actual frequency. In position “Level” the display shows the signal level (0..99 %, not calibrated). In position “QDR” the display shows the actual bearing value.

## 6.13 Frequency Selection key ▲/▼

At mode “local” it is possible to increase the frequency in 25 kHz steps by pressing the key ▲ (Fig 1, Pos.18) or decreasing the frequency in 25 kHz steps by pressing the key ▼ (Fig 1, Pos. 21).
If the option 8,33 kHz is active the frequency in-/decreases combined in the 25 kHz and 8,33 kHz channel scheme.
*In accordance with ICAO Annex 10 Volume V clause 4.1.2.4. table 4.1 (bis*).

## 6.14 Squelch adjustment potentiometer

Behind the hole (Fig 1, Pos. 19) there is a potentiometer which allows a squelch adjustment. For this, a small screw driver is necessary.
If turning clockwise the squelch threshold god down, counter clockwise the squelch threshold rises.

## 6.15 Phase Adjustment

A special feature of the RT-1000 DF is its phase compensation by left / right rotation of the antenna. This allows complete compensation of direction finding errors caused by signal phase variations in the reception channel. However, it is only possible to compensate for a limited phase value. For this reason, make a pre-adjustment to the centre of the variation range.

The adjustment can be made either using the RTM 1500 Antenna Model or aligning of the labelled antenna radiator (North dipole) onto a transmitter.

### 6.15.1 Adjustment Using RTM 1500 Antenna Model (Option)

- Connect the antenna model instead to the TEST-IN port of the RF-Splitter (see User Manual of RTM 1501 Antenna Model).
- Feed in a VHF signal in the ATC band range with a signal level of approx. 100 mV at the antenna model RF input and adjust the receiver to the appropriate frequency. Move the antenna signal switch on the dummy antenna to the 180° position.

**Note:**
Since the direction finder was pre-set in the factory, the bearing display must show QDM 180° and QDR 0° on condition that the north adjustment is set to 0°. QDM 0° and QDR 180° may also be displayed if the phase is completely misaligned.

- Phase adjustment can be set using the two rotary switches, "fine" (Fig 1, Pos. 30) and (Fig 1, Pos. 29) "coarse". The total of 256 steps (8 bit) on the coarse switch are divided into 16 steps, and these coarse steps are sub-divided into a further 16 steps on the fine switch. Use these rotary switches to find the middle of the range where the green control LED (Fig 1, Pos. 31) lights up. The QDM display should then show 180° (QDM).

### 6.15.2 Adjustment Using a Transmitter

Position a test transmitter (e.g. walkie-talkie) approx. 100 m away, exactly to the north of the direction finder antenna (dipole north with label pointing towards the transmitter). The bearing display should show QDM 180° and QDR 0°. The north adjustment on the controller should be set to 0°. Phase adjustment is set.

**Note:**
The transmitter has to be exactly in the north of the antenna. The bearing display has to show 180° (or 000°). A deviation of more than ±1° will make it impossible to execute the phase adjustment.

## 6.16 Error Indication

The equipment has a wide range of self-test devices. If an error is discovered, the error code is shown flashing at 1 sec. intervals in the frequency display (Fig 1, Pos. 15).

**Display: E R R 7**

| Error Indication | |
|---|---|
| **Error Code** | **Error Type** |
| 1 | Processor |
| 2 | EPROM |
| 3 | RAM |
| 4 | Power Supply |
| 5 | EEPROM |
| 6 | Synchronisation |
| 7 | Phase Measurement |
| 8 | Data Transfer or Power Supply of the Receiver |
| 9 | Receiver Control |

**Caution**
If an error message appears, the DF-Channel is no longer functional.

## 6.17 "Sync" Synchronisation Indicators

The green indicator (Fig 1, Pos. 25) lights up if in the controller the electronics in the Frequency Processing module RTC 1107 is synchronised with the reference signal from the Antenna Control module RTR 1201.
The red indicator (Fig 1, Pos. 26) lights up if the above mentioned synchronisation is not achieved.
When this indicator is on, it indicates the following possible malfunctions:

- Receiver unit not ready for operation (e.g. switched off)
- Data line defective
- RTR 1201 Antenna Control module defective
- RTC 1107 Frequency Processing module defective

## 6.18 "DF Signal 2" Test Plug

The test signal for bearing determination is applied to the test connector (Fig 1, Pos. 27). The signal can be monitored using an oscilloscope. It indicates the quality of the bearing value.

Plug type: SMB

## 6.19 "R/L" Test Connector

The signal for changing over the fictitious antenna rotation from clockwise to counter-clockwise is applied to the test plug (Fig 1, Pos. 28). This signal is used for triggering the oscilloscope when monitoring the DF signal.

Plug type: SMB

## 6.20 Serial Interface

The serial interface RS-232 (Fig 2, X21) enables the transmission of bearing data to an external control unit and also permits remote control from an external unit.

The characters to be transferred are transmitted in ASCII code from the CPU RTC 1104 Controller. The data bit sequence, which is assigned in each case to the characters to be transmitted, is preceded by a start bit and followed by a stop bit. Both additional bits ensure that both transmitter and receiver are time-synchronized.

The data traffic via the serial interface is in asynchronous mode. For time-synchronisation of the data transmitter and receiver the data receiver is triggered by the rising edge of the start bit at the beginning of the bit sequence of a character.

The transmission of a message begins with the header consisting of an alphanumeric character. The actual message content forms a string of (ASCII) decimal numbers. The transmission of a message is ended by the final identifier "CR" (decimal code 13) and “LF” (decimal code 10).

The signal level on the data lines corresponds to the RS-232 standard, i.e. a high is defined as a voltage between +3 V and +15 V and a low as a voltage between -3 V and -15 V. The data is transmitted in negative logic.

## 6.21 Data Output

The data output is continuous, i.e. no control by means of a handshake signal or control characters is necessary.

| Message | Header | Content | |
|---|---|---|---|
| „Average“ bearing (QDR-value) | A | X X X [CR][LF] | 0° … 359° (QDR) |
| | | X (3rd) —> | Units |
| | | X (2nd) —> | Tens |
| | | X (1st) —> | Hundreds |
| „Live“ bearing, (QDR-value) | L | X X X [CR][LF] | 0° … 359° (QDR) |
| | | X (3rd) —> | Units |
| | | X (2nd) —> | Tens |
| | | X (1st) —> | Hundreds |
| Status | S | X X X [CR][LF] | |
| | | X (3rd) —> | Error No.: 0 = Ok / 1…9 = Error No. |
| | | X (2nd) —> | actual Scan Mode: 0 = Off; 1 = Scan Mode: DOWN; 2 = Scan Mode: M0..9; 3 = Scan Mode: UP; 4 = Scan Mode: ACT/M0 |
| | | X (1st) —> | Status Info: 0 = Bearing signal off; 1 = Bearing signal on; 2 = RF TX deviation (no bearing); 3 = Test; 4 = Ground transmitter suppression; 5 = (Reserved for testing) |
| Frequency | F | X X X X X X [CR][LF] | 118,000 … 174,000 MHz 1) |
| | | X (6th) —> | kHz units |
| | | X (5th) —> | kHz tens |
| | | X (4th) —> | kHz hundreds |
| | | X (3rd) —> | MHz units |
| | | X (2nd) —> | MHz tens |
| | | X (1st) —> | MHz hundreds |
| Receive level | P | 0 X X [CR][LF] | 000 … 099 % |
| | | X (3rd) —> | Units |
| | | X (2nd) —> | tens |
| Squelch Level | Q | 0 X X [CR][LF] | 000 … 090 % |
| | | X (3rd) —> | Units |
| | | X (2nd) —> | Tens |
| Serial No. | N | X X X X X X [CR][LF] | DF System Info |
| | | X (6th) —> | Licenced options: 0…8 |
| | | X (1st–5th) —> | Serial No. 00000…65534 |
| Power On Time | T | X X X X X X [CR][LF] | 000000 … 999999 [minutes] ( = max. 694 days) |

1) Frequency output in the range 118.000 .. 136.975 MHz in accordance with ICAO Annex 10 Vol. V Clause 4.1.2.4 Table 4-1.
See ICAO channel-frequency-table (air band)

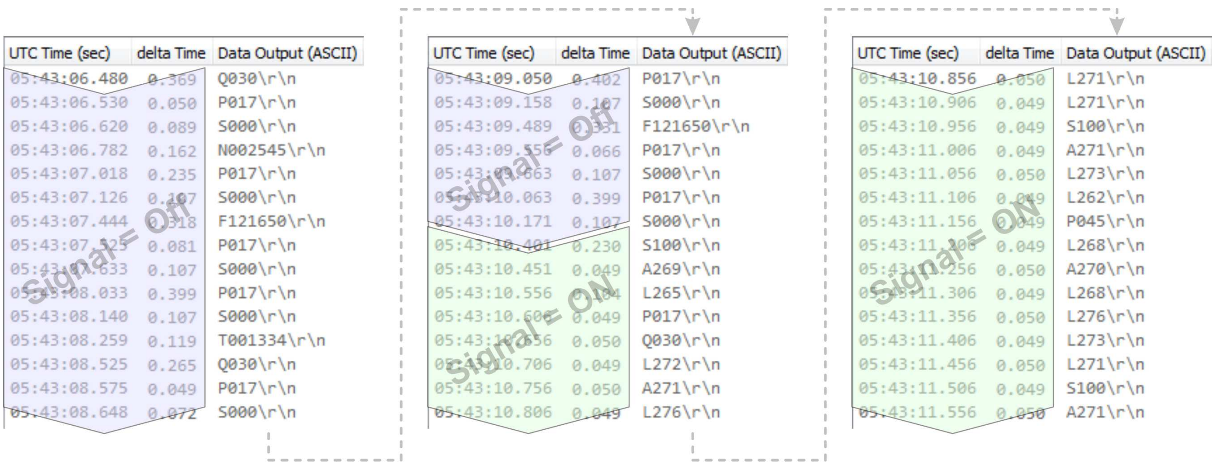
### Timing and priority of cyclic data output

| Message | | |
|---|---|---|
| „Average“ bearing | approx. every 0,25 sec | The first bearing value (after start of signal) will be transmitted immediately. Without signal, no average value will be transmitted. |
| „Live“ bearing | approx. every 0,1 sec | With low priority. (in all available transmission breaks). Without signal, no live bearing value will be transmitted. |
| Status | approx. every 0,5 sec | After start of signal, „S000[CR][LF]“ → „S1000[CR][LF]“ will be transmitted immediately. |
| Frequency | approx. every 2 sec | When frequency changes, the new frequency will be transmitted immediately (also at active Scan Mode) |
| Receive level | approx. every 0,5 sec | |
| Squelch Level | approx. every 2 sec | |
| Serial No. | approx. every 10 sec | |
| Power On Time | approx. every 60 sec | |

The following example shows the output of the average QDR bearing 315° as a sequence of ASCII characters

```
A 3 1 5 [CR][LF]
| | | |   └──┴───>        Final character      (decimal: 13 and 10)
| └─┴─┘  ─────────>       Content (bearing)    (decimal: 51, 49, 53)
└─────────────────>       Header               (decimal: 65)
```

**Example of 5 sec data output (with start of signal, respectively begin of bearing)**




| UTC Time (sec) | delta Time | Data Output (ASCII) |
|---|---|---|
| 05:43:06.480 | 0.369 | Q030\r\n |
| 05:43:06.530 | 0.050 | P017\r\n |
| 05:43:06.620 | 0.089 | S000\r\n |
| 05:43:06.782 | 0.162 | N002545\r\n |
| 05:43:07.018 | 0.235 | P017\r\n |
| 05:43:07.126 | 0.107 | S000\r\n |
| 05:43:07.444 | 0.318 | F121650\r\n |
| 05:43:07.525 | 0.081 | P017\r\n |
| 05:43:07.633 | 0.107 | S000\r\n |
| 05:43:08.033 | 0.399 | P017\r\n |
| 05:43:08.140 | 0.107 | S000\r\n |
| 05:43:08.259 | 0.119 | T001334\r\n |
| 05:43:08.525 | 0.265 | Q030\r\n |
| 05:43:08.575 | 0.049 | P017\r\n |
| 05:43:08.648 | 0.072 | S000\r\n |

| UTC Time (sec) | delta Time | Data Output (ASCII) |
|---|---|---|
| 05:43:09.050 | 0.402 | P017\r\n |
| 05:43:09.158 | 0.107 | S000\r\n |
| 05:43:09.489 | 0.331 | F121650\r\n |
| 05:43:09.556 | 0.066 | P017\r\n |
| 05:43:09.663 | 0.107 | S000\r\n |
| 05:43:10.063 | 0.399 | P017\r\n |
| 05:43:10.171 | 0.107 | S000\r\n |
| 05:43:10.401 | 0.230 | S100\r\n |
| 05:43:10.451 | 0.049 | A269\r\n |
| 05:43:10.556 | 0.104 | L265\r\n |
| 05:43:10.606 | 0.049 | P017\r\n |
| 05:43:10.656 | 0.050 | Q030\r\n |
| 05:43:10.706 | 0.049 | L272\r\n |
| 05:43:10.756 | 0.050 | A271\r\n |
| 05:43:10.806 | 0.049 | L276\r\n |

| UTC Time (sec) | delta Time | Data Output (ASCII) |
|---|---|---|
| 05:43:10.856 | 0.050 | L271\r\n |
| 05:43:10.906 | 0.049 | L271\r\n |
| 05:43:10.956 | 0.049 | S100\r\n |
| 05:43:11.006 | 0.049 | A271\r\n |
| 05:43:11.056 | 0.050 | L273\r\n |
| 05:43:11.106 | 0.049 | L262\r\n |
| 05:43:11.156 | 0.049 | P045\r\n |
| 05:43:11.206 | 0.049 | L268\r\n |
| 05:43:11.256 | 0.050 | A270\r\n |
| 05:43:11.306 | 0.049 | L268\r\n |
| 05:43:11.356 | 0.050 | L276\r\n |
| 05:43:11.406 | 0.049 | L273\r\n |
| 05:43:11.456 | 0.050 | L271\r\n |
| 05:43:11.506 | 0.049 | S100\r\n |
| 05:43:11.556 | 0.050 | A271\r\n |

Remark:
Data logging with Wireshark via TCPIP; Timestamp as additional info; final character is displayed here as „\r\n“ instead of [CR][LF]

## 6.22 Data Input

All received data are checked for correct syntax and plausibility referring to the actual unit setting. All received data are also checked for compliance with the limiting values. The data input is monitored over a time-out of 100 ms, i.e. all ASCII characters of a message must be transmitted to the bearing unit within this time.
If errors are found, the received commands are not carried out. A correct data input momentarily sets the direction finder to the required setting.

| Message | Header | Content | |
|---|---|---|---|
| Status | S | X [CR][LF]<br>└──────────> | 0 = Clear average memory<br>1 = (not used)<br>4 = Ground transmitter suppression active<br>9 = Initiate System Reset<br>3 = Clearance for EEProm save functionality (1 sec active)<br>2 = Scan Mode: M0..9 start / continue<br>6 = Scan Mode: ACT/M0 start<br>7 = Scan Mode: UP start / continue<br>8 = Scan Mode: DOWN start / continue<br>5 = Scan Mode: STOP Stop (finish) active Scan Modes |
| Frequency | F | X X X X X X [CR][LF] | 118,000 … 174,000 MHz 1)<br>kHz units<br>kHz tens<br>kHz hundreds<br>MHz units<br>MHz tens<br>MHz hundreds |
| Squelch Level | Q | X X [CR][LF] | 00 … 90 % (Standard input for digital squelch)<br>-1 (Receiver squelch potentiometer instead of digital squelch)<br>units<br>tens |
| MEM Recall | R | X [CR][LF]<br>└──────────> | 0 … 9<br>Recall of one frequency memory from M0…9 |
| MEM Store | R | X X X X X X X [CR][LF] | Store of one valid frequency to the frequency memory M0…9 (used for channel scan mode M0..9)<br>0 … 9 ( M0..9)<br>118,000 … 174,000 MHz 1) (valid frequency)<br>kHz units<br>kHz tens<br>kHz hundreds<br>MHz units<br>MHz tens<br>MHz hundreds |

1) Frequency input is possible only within the valid range. Frequency settings in the range 118.000 .. 136.975 MHz have to be in accordance with ICAO Annex 10 Vol. V Clause 4.1.2.4 Table 4-1. Other inputs will be ignored (also see ICAO channel frequency table next page).

The following example shows the data sequence for the frequency command
(set new frequency 125,375 MHz)

```
F  1  2  5  3  7  5  [CR][LF]
|  |  |  |  |  |  |    |__|____>      final character
|  |__|__|__|__|__|____________>      content (valid frequency)
|______________________________>      Header
```

**ICAO channel-frequency-table (air band):**

| Frequency [MHz] | Channel grid | Channel / Frequency Input FXXXXXXCRLF |
|---|---|---|
| 118,0000 | 25 kHz | 118000 |
| 118,0000 | 8,33 kHz | 118005 |
| 118,0083 | 8,33 kHz | 118010 |
| 118,0167 | 8,33 kHz | 118015 |
| 118,0250 | 25 kHz | 118025 |
| 118,0250 | 8,33 kHz | 118030 |
| 118,0333 | 8,33 kHz | 118035 |
| 118,0417 | 8,33 kHz | 118040 |
| 118,0500 | 25 kHz | 118050 |
| 118,0500 | 8,33 kHz | 118055 |
| 118,0583 | 8,33 kHz | 118060 |
| 118,0667 | 8,33 kHz | 118065 |
| 118,0750 | 25 kHz | 118075 |
| 118,0750 | 8,33 kHz | 118080 |
| 118,0833 | 8,33 kHz | 118085 |
| 118,0917 | 8,33 kHz | 118090 |
| 118,1000 | 25 kHz | 118100 |
| 118,1000 | 8,33 kHz | 118105 |
| 118,1083 | 8,33 kHz | 118110 |
| 136,9583 | 8,33 kHz | 136960 |
| 136,9667 | 8,33 kHz | 136965 |
| 136,9750 | 25 kHz | 136975 |

**Remark for frequency- and squelch input:**
If a newly tuned frequency or squelch value are retained permanently in the system, even after a RT-1000 device restart, it must be stored in the EEPROM device in addition. This is done by directly transmitting a previous "S3 [CR][LF]" commands.

**Caution**
Since the allowable write cycles to EEProms are limited, this option should be used only when necessary.

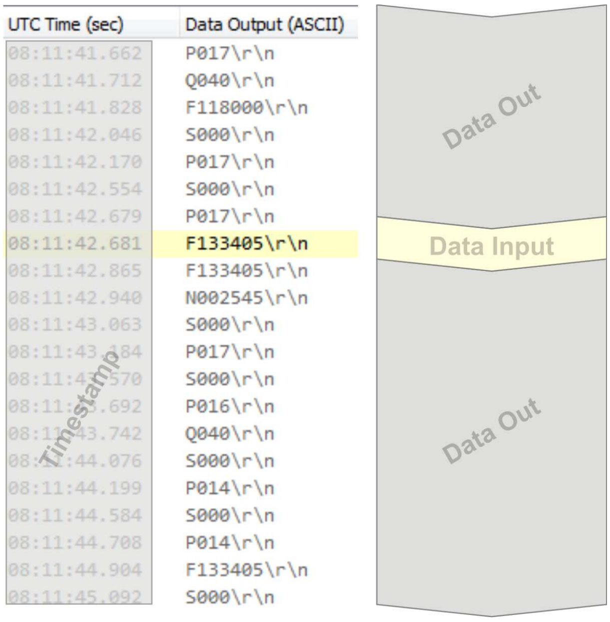
## Example of frequency change Data In/Output:

Frequency-change to 133,400 MHz (with 8.33 kHz ICAO grid) using a data input message.

„Fxxxxxx[CR][LF]

Remark:
After valid data input, the new changed frequency will be transmitted immediately …

Data logging with Wireshark via TCPIP;
Timestamp as additional info;
final character displayed as „\r\n“ instead of [CR][LF]



| UTC Time (sec) | Data Output (ASCII) |
|---|---|
| 08:11:41.662 | P017\r\n |
| 08:11:41.712 | Q040\r\n |
| 08:11:41.828 | F118000\r\n |
| 08:11:42.046 | S000\r\n |
| 08:11:42.170 | P017\r\n |
| 08:11:42.554 | S000\r\n |
| 08:11:42.679 | P017\r\n |
| 08:11:42.681 | F133405\r\n |
| 08:11:42.865 | F133405\r\n |
| 08:11:42.940 | N002545\r\n |
| 08:11:43.063 | S000\r\n |
| 08:11:43.184 | P017\r\n |
| 08:11:43.570 | S000\r\n |
| 08:11:43.692 | P016\r\n |
| 08:11:43.742 | Q040\r\n |
| 08:11:44.076 | S000\r\n |
| 08:11:44.199 | P014\r\n |
| 08:11:44.584 | S000\r\n |
| 08:11:44.708 | P014\r\n |
| 08:11:44.904 | F133405\r\n |
| 08:11:45.092 | S000\r\n |



## Example of storing one frequency to memory Data In/Output:
## (is used as example, when configuring Scan Mode M0..9)

Frequency 156,800 MHz is stored to MEM3. and then recalled from the same memory for verifying:

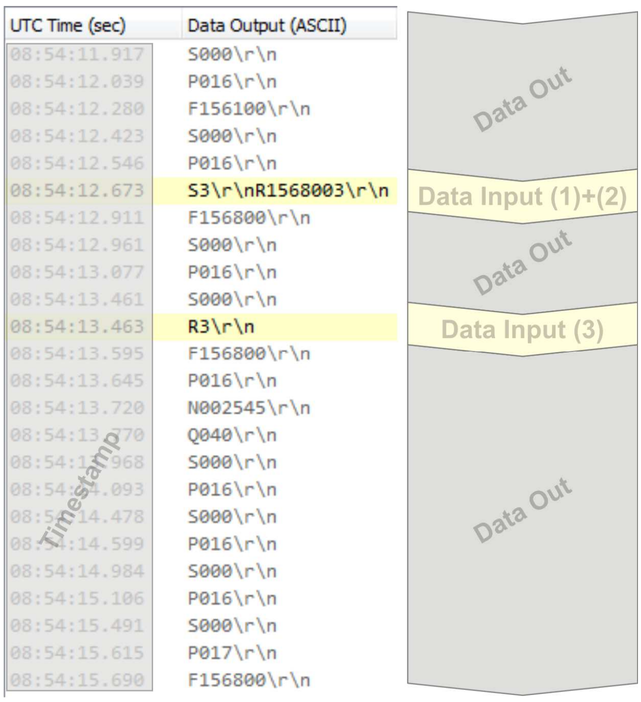
(1) „S3[CR][LF]“
(Clearance for EEprom)

(2) „Rxxxxxxx[CR][LF]“
(Store to M3)

(3) „Rx[CR][LF]“
(Recall/Read from M3)

Remark:
After valid data input, the new changed frequency will be transmitted immediately …

Data logging with Wireshark via TCPIP;
Timestamp as additional info;
final character displayed as „\r\n“ instead of [CR][LF]



| UTC Time (sec) | Data Output (ASCII) |
|---|---|
| 08:54:11.917 | S000\r\n |
| 08:54:12.039 | P016\r\n |
| 08:54:12.280 | F156100\r\n |
| 08:54:12.423 | S000\r\n |
| 08:54:12.546 | P016\r\n |
| 08:54:12.673 | S3\r\nR1568003\r\n |
| 08:54:12.911 | F156800\r\n |
| 08:54:12.961 | S000\r\n |
| 08:54:13.077 | P016\r\n |
| 08:54:13.461 | S000\r\n |
| 08:54:13.463 | R3\r\n |
| 08:54:13.595 | F156800\r\n |
| 08:54:13.645 | P016\r\n |
| 08:54:13.720 | N002545\r\n |
| 08:54:13.770 | Q040\r\n |
| 08:54:13.968 | S000\r\n |
| 08:54:14.093 | P016\r\n |
| 08:54:14.478 | S000\r\n |
| 08:54:14.599 | P016\r\n |
| 08:54:14.984 | S000\r\n |
| 08:54:15.106 | P016\r\n |
| 08:54:15.491 | S000\r\n |
| 08:54:15.615 | P017\r\n |
| 08:54:15.690 | F156800\r\n |

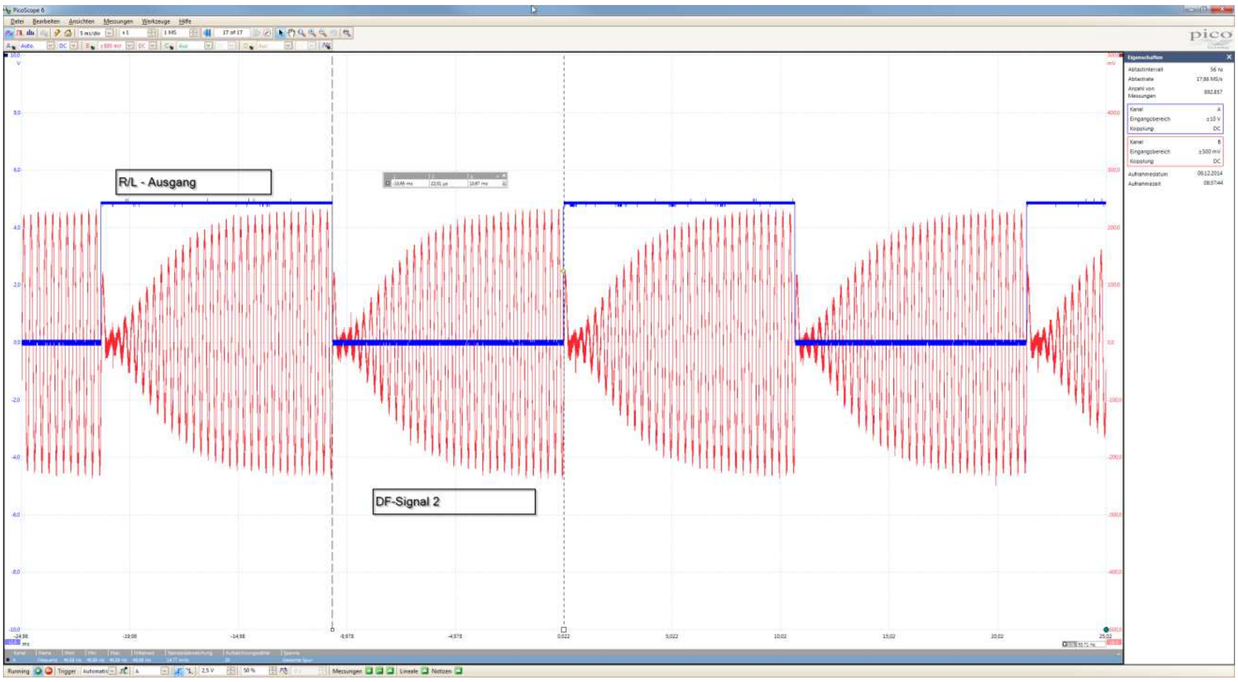
# 7 Electrical Parameters

## 7.1 Power Supply

| Power Supply | | | |
|---|---|---|---|
| **Pos.** | **Test Point** | **Value** | |
| 1 | TP 1 | $+5,15\ V_{DC} \pm 0,15\ V$ | I = 500 mA |
| 2 | TP 2 | $+15\ V_{DC} \pm 0,25\ V$ | I = 300 mA |
| 3 | TP 3 | $-15\ V_{DC} \pm 0,25\ V$ | I = 50 mA |

## 7.2 DF-Signal 2 and R/L

| Reference Signals | | | |
|---|---|---|---|
| **Pos.** | **Signal** | **Test Point** | **Value** |
| 1 | DF-Signal 2 | 27 (Fig 1) | See measurement below |
| 2 | R/L | 28 (Fig 1) | f = 46,875 Hz |
| | | | $U_{High} \geq 4,0\ V$ |
| | | | $U_{Low} \leq 0,5\ V$ |

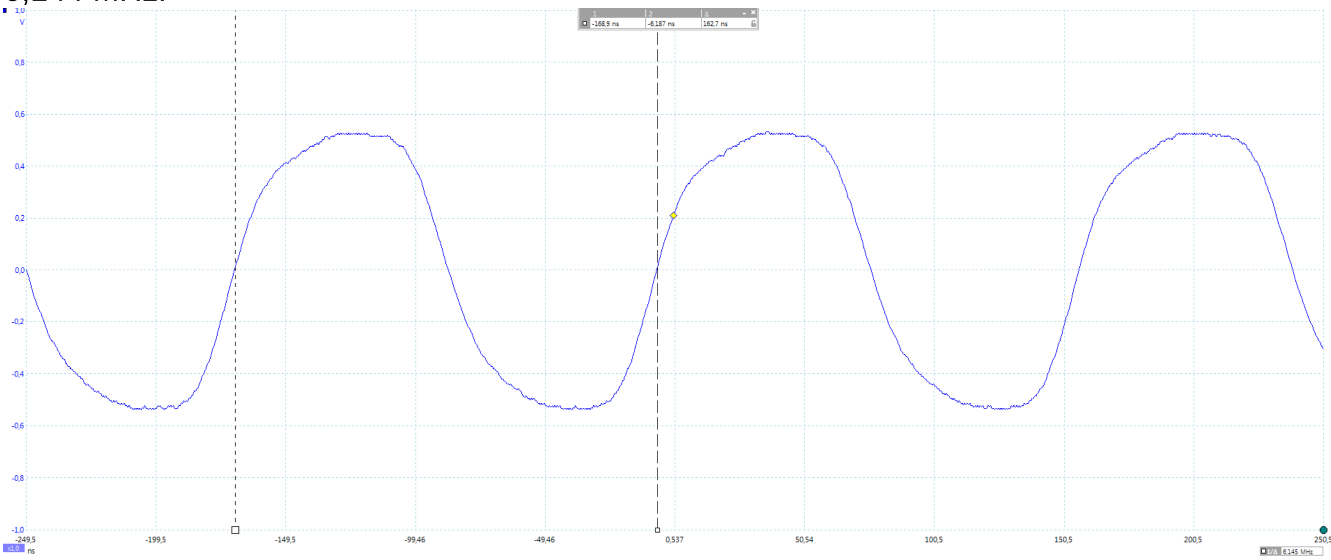


## 7.3 Reference Signals Input

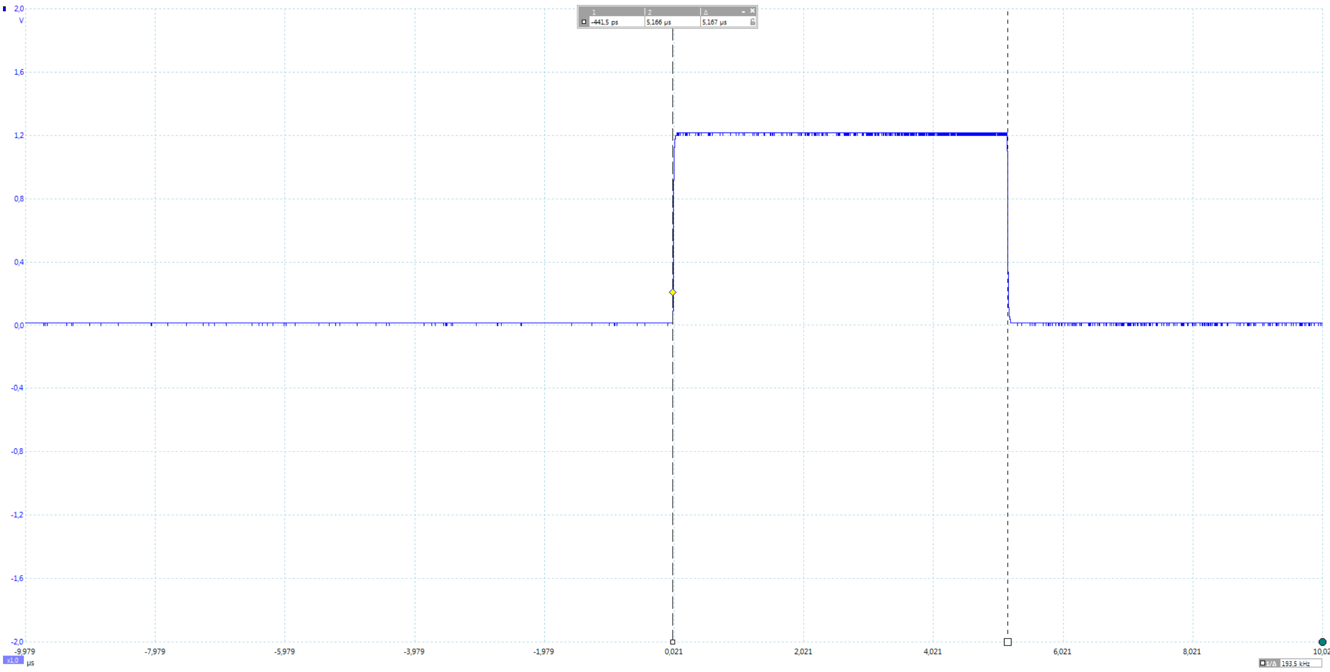
To test the reference signals an Antenna Control unit has to be connected to the DF-Channel.

| **Reference Signals** | | | |
|---|---|---|---|
| **Pos.** | **Signal** | **Test Point** | **Value** |
| 1 | 6,144 MHz | TP 4 | f = 6,144 MHz ± 0,03 MHz |
| | | | $U_{High}$ ≥ +0,5 V |
| | | | $U_{Low}$ ≤ -0,5 V |
| 2 | R/L Pulse | TP 5 | $t_{High}$ = 5,1 µs ± 0,2 µs |
| | | | $t_{Low}$ = 21,3 ms ±0,5 ms |
| | | | $U_{High}$ ≥ 1,0 V |
| | | | $U_{Low}$ ≤ 0,25 V |

6,144 MHz:




R/L Pulse



## 7.4 Pegel- Output

To test the level output, connect a signal generator to RF-Splitter RF-IN and measure the DC voltage with a multimeter.

| Level-Output | | | |
|---|---|---|---|
| **Connector** | **Signal** | **Conditions** | **Value** |
| X16 | Pegel | f = 127,500 MHz | |
| | | Modulation: Off | |
| | | $P_{HF}$= -120 dBm | $U_{PEGEL}$ = 1,25 V ± 0,15 V |
| | | $P_{HF}$= -100 dBm | $U_{PEGEL}$ = 2,55 V ± 0,15 V |
| | | $P_{HF}$= -80 dBm | $U_{PEGEL}$ = 3,55 V ± 0,15 V |
| | | $P_{HF}$= -60 dBm | $U_{PEGEL}$ = 4,55 V ± 0,15 V |
| | | $P_{HF}$= 0 dBm | $U_{PEGEL}$ = 4,75 V ± 0,15 V |

## 7.5 AM – Output

To check the AM-Output of the DF-Channel, connect signal generator to RF-Splitter RF-IN and measure the output with an analyzer (600 Ω impedance).

| AM-Output | | | | |
|---|---|---|---|---|
| **Connector** | **Signal** | **Settings** | | **Value** |
| X 19 | AM | Signal Generator | | $P_{out}$ = 0 dBm ±2 dB<br>($U_{eff}$ = 775 mV ±10% @600 Ω) |
| | | f | 121,500 MHz | |
| | | Level | -40 dBm | |
| | | Modulation | AM | |
| | | m | 60 % | |
| | | $f_{mod}$ | 1 kHz | |
| | | DF-Channel | | |
| | | f | 121,500 MHz | |

## 7.6 FM – Output

To check the AM-Output of the DF-Channel, connect signal generator to RF-Splitter RF-IN and measure the output with an analyzer (600 Ω impedance).

| FM-Output | | | | |
|---|---|---|---|---|
| **Connector** | **Signal** | **Settings** | | **Value** |
| X 19 | FM | Signal Generator | | $P_{out}$ = 0 dBm ±2 dB<br>($U_{eff}$ = 775 mV ±10% @600 Ω) |
| | | f | 156,800 MHz(1)<br>(121,500 MHz) | |
| | | Level | -80 dBm | |
| | | Modulation | FM | |
| | | Δf | 3 kHz | |
| | | $f_{mod}$ | 1 kHz | |
| | | DF-Channel | | |
| | | f | 156,800 MHz(1)<br>(121,500 MHz) | |

(1)*Use 121,500 MHz if the optional marineband is not included.*

## 7.7 PHI – Output

To check the PHI-Output of the DF-Channel, connect signal generator to the Antenna Model and the Antenna Model with the RF-Splitter TEST-IN and measure the output with an analyzer (600 Ω impedance).

| PHI-Output | | | | |
|---|---|---|---|---|
| **Connector** | **Signal** | **Settings** | | **Value** |
| X 17 | PHI | Signal Generator | | $f_{mod}$ = 3 kHz<br>$P_{out}$ = -7,5 dBm ±1,5 dB<br>($U_{eff}$ = 330 mV @ 600 Ω) |
| | | f | 121,500 MHz | |
| | | Level | -20 dBm | |
| | | Modulation | OFF | |
| | | DF-Channel | | |
| | | f | 121,500 MHz | |

## 7.8 AF – Output

To check the AF-Output of the DF-Channel, connect signal generator to the Antenna Model and the Antenna Model with the RF-Splitter TEST-IN and measure the output with an analyzer (600 Ω impedance).

| AF-Output, FM Characteristic 25 kHz Raster | | | | |
|---|---|---|---|---|
| **Connector** | **Signal** | **Settings** | | **Value** |
| X 18 | AF | Signal Generator | | $P_{out}$ = -3,5 dBm ±1,5 dB<br>($U_{eff}$ = 500 mV ±10% @600 Ω) |
| | | f | 156,800 MHz(1)<br>(121,500 MHz) | |
| | | Level | -45 dBm | |
| | | Modulation | FM | |
| | | Δf | 3 kHz | |
| | | $f_{mod}$ | 1 kHz | |
| | | DF-Channel | | |
| | | f | 156,800 MHz(1)<br>(121,500 MHz) | |

*(1)Use 121,500 MHz if the optional marineband is not included.*

| AF-Output, AM Characteristic 25 kHz Raster | | | | |
|---|---|---|---|---|
| **Connector** | **Signal** | **Settings** | | **Value** |
| X 18 | AF | Signal Generator | | $P_{out}$ = -9,5 dBm ±1,5 dB<br>($U_{eff}$ = 250 mV ±10% @600 Ω) |
| | | f | 121,650 MHz | |
| | | Level | -45 dBm | |
| | | Modulation | AM | |
| | | m | 30 % | |
| | | $f_{mod}$ | 1 kHz | |
| | | DF-Channel | | |
| | | f | 121,650 MHz | |

If the optional 8,33 kHz raster is included the following values are additional relevant.

| AF-Output, FM Characteristic 8,33 kHz Raster | | | | |
|---|---|---|---|---|
| **Connector** | **Signal** | **Settings** | | **Value** |
| X 18 | AF | Signal Generator | | $P_{out}$ = -10 dBm ±1,5 dB<br>($U_{eff}$ = 250 mV ±10% @600 Ω) |
| | | f | 121,650 MHz | |
| | | Level | -45 dBm | |
| | | Modulation | FM | |
| | | Δf | 3 kHz | |
| | | $f_{mod}$ | 1 kHz | |
| | | DF-Channel | | |
| | | f | 121,655 MHz | |

| AF-Output, AM Characteristic 8,33 kHz Raster | | | | |
|---|---|---|---|---|
| **Connector** | **Signal** | **Settings** | | **Value** |
| X 18 | AF | Signal Generator | | $P_{out}$ = -10 dBm ±1,5 dB<br>($U_{eff}$ = 250 mV ±10% @600 Ω) |
| | | f | 121,650 MHz | |
| | | Level | -45 dBm | |
| | | Modulation | AM | |
| | | m | 30 % | |
| | | $f_{mod}$ | 1 kHz | |
| | | DF-Channel | | |
| | | f | 121,655 MHz | |

# 8 Mechanical Parameters

| Mechanical Parameters | | |
|---|---|---|
| **Parameter** | **Condition** | **Data** |
| Dimensions | B x H x T | 213,36 x 133,35 x 180 mm<br>(42 TE, 3 U) |

# 9 Notes