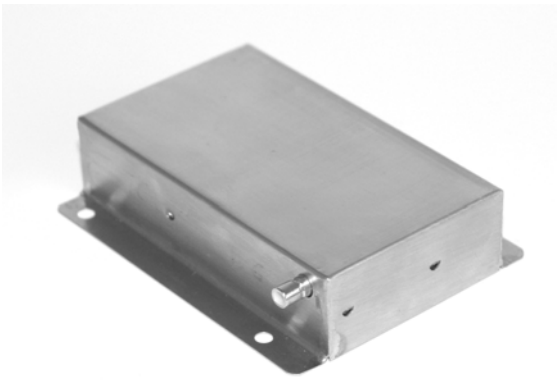
HBC – Transceiver Module

TC 695



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Warnings

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution: Any changes or modifications by the user could void the user's authority to operate the equipment!

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate frequency energy and, if not installed in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Function description of the TC695

UHF transceiver for data transfer.

Consisting of:

1 General
2 First receiver
3 Second receiver
4 Transmitter

1 General:

The TC695 is a UHF transceiver with fast transmit-receive switchover and 2 independent receivers. The frequency range is 902 – 917 MHz, according to the hardware version. The operating voltage is 5.6-7.2 Volts for battery-operated units with five 1.2V cells. Two internal stabilized voltages of 3 V via U3 and 5 V via U9 are generated from the input operating voltage. After switching on (operating voltage supplied) the transceiver can be changed between 2 operating modes. Multipoint connector ST2 Pin 9.

Mode 1 Manual: In this mode the transceiver can be changed over manually between transmitting and receiving, as well as 128 frequencies via the address lines A0-A6. This mode is preferred for alignment and testing purposes.

Mode 2 Auto: In this mode all settings from manual mode can be carried out serially via SPI (Multipoint connector ST2 Pins 5-7). The transmission protocol can be found in the alignment instructions.

The transmit-receive switchover (PTT) can be carried out at ST2 PIN 8 in manual or automatic mode with a normal switch or TTL level.

2 Receiver 1 (user data receiver):

2.1 Preamplifier

The receiver operates according to the double superheterodyne system. The transceiver has a switching bandwidth of about 5 MHz. After the antenna jack (ST1) the received signal arrives in a 2-circuit band filter for the management of the preselection. Via the antenna changeover switch U2 the received signal arrives at the entry to the preamplifier U7, which amplifies the input signal by about 22dB. At the output the received signal passes via the transmit-receive switch U5 to a further preselection by means of a 4-pin spiral circuit filter FI1 and FI2.

2.2 First mixer

The input signal coming from the preamplifier arrives at the input (RF) of the first mixer MI1. The oscillator is fed with a power of about 6dBm at the input of MI1 (LO). The first oscillator (LO) generates from VCO 1 a frequency which is below the input frequency (45 MHz) by the difference of the first IF.

2.3 Oscillator and frequency synthesizer

The VCO1 generates the first oscillator frequency with a power of about 0 dBm. With Q1 the signal is amplified to about 6dBm. A portion of the amplitude of the oscillator signal is led back to the double synthesizer U8 via the voltage divider R29-R32 for reference voltage formation. The synthesizer U8 is fed with 12.8 MHz via a highly stable (+-2ppm -30/+70 deg. Celsius) clock source (TCXO1). The control voltage thus generated is led to the oscillator VCO1 via the loop filter at the output of U8 (D01) and hence determines the frequency stability of the VCO. The frequency setting is carried out with the help of the microcontroller U14. The frequency data is read in via the lines DATA, CLOCK and LE.

2.4 First IF 45 MHz

From the mixer output MI1 (IF), the input signal, which is now mixed to 45 MHz, passes via the transmit-receive switch U6 into the first IF amplifier Q8 . The 4-pin quartz filter XF2 located at the output of Q8 generates the channel selection with a bandwidth of 25kHz. The received signal then continues to the input of the 2nd mixer and the 2nd IF preamplifier U12.

2.5 Second IF 455 kHz and RSSI

The received signal travels via the input RFin to the second mixer and is mixed with the internal quartz oscillator XT4 44.545 MHz to the second IF of 455 kHz. Here the receiving signal is further amplified and selected with 2 further band filters (FI5 and FI7). The IF signal is demodulated with the demodulator circuit L10 and the integrated quadrature demodulator and is then available as a LF signal and AFout of U12. At the RSSIout output of U12 a voltage value RSSI (Radio Signal Strength Indicator) is issued, similar to the input field strength, which goes into microprocessor U14 via RE2 for further processing.

2.6 LF signal

After removing the HF residues (455 kHz) through a passive low-pass filter (R63, C132, R51 and C115) the LF signal still travels through a digital low-pass filter to be amplified again in U13. The max. LF pass frequency is 5 kHz. This LF output signal is now available at Pin 18 (AF-out) on multipoint connector ST2 of the transceiver with an adjustable voltage of 0.2 – 2 Volt (RE5).

3 Receiver 2 (scanner receiver):

3.1 The function of the 2nd receiver largely corresponds with that of receiver 1, 2.1-2.6, with the difference that the second IF 21.4 MHz and the VCO2 frequency vary by the difference of the 2nd IF above the input frequency. During reception, the second receiver searches for the occupancy data of the frequencies. The 2nd receiver requires about 3 seconds for the process of scanning 67 frequencies. The field strength data for each respective HF channel is issued via the Pin RSSIout, U11 for further processing on the microprocessor. The field strength data on the frequencies is available via RS232 at St2 PIN 1 (TXD) for further processing (e.g. TC6X5 spectrum monitor)

3 Transmitter:

3.1 Transmission oscillator

The transmitter operates according to the mixing principle. Transmission oscillator Q10 generates the frequency 45 MHz with the quartz oscillator XT3 and is amplified via Q5 and Q6 to about 10 dBm and then travels via the transmit-receive switch U6 to the mixer MI1

3.2 Mixer

Mixer MI1 operates in reverse mode (all ports RF, IF and LO can be operated in reverse) and generates from the oscillator frequency of 45 MHz and the VCO1 (LO) frequency the mixed product of the end frequency (e.g. 902…MHz) and in the case of transmission is available with about 1dBm at port RF (MI1) for further amplification.

3.3 Transmission amplifier and output stage

The transmission signal is led via the two spiral circuit filters FI1 und FI2 to the transmit-receive switchover U5. Here the transmission signal is amplified with U 3 and U1 to about 16dBm and then travels via the antenna changeover switch U2 and the spiral circuit filters FI 4 to the antenna connection ST1.

Technical Data

Common data (RX+TX):
Frequency range: 902.025 ... 918.000 MHz
Operating voltage: 5.6 ... 7.2 V
Channel pattern: 25 kHz
LF transmission bandwidth: 150 Hz .... 4.8 kHz
Modulation type: F9D
Operating temperature range: -30 ... +70 °C

Transmitter:
Output power: +10 dBm
Frequency deviation: +/- 5 kHz
Current consumption when transmitting: 140 mA
Switch-over time (RX-TX): < 300 µs

Receiver 1 (traffic channel receiver):
Sensitivity: -107 dBm (20dB S/N)
First IF: 45 MHz
Second IF: 455 kHz
Current consumption when receiving: 75 mA
Switch-over time (TX-RX): < 300 µs
LF output voltage: 150 mV RMS at +/-5 kHz deviation

Receiver 2 (scanner receiver):
Sensitivity: -107 dBm (20dB S/N)
First IF: 21.4 MHz
Second IF: 455 kHz
Current consumption: 20 mA

Measure channel changeover time with field strength < 30 ms

Transceiver operating modes:

Manual
After applying the operating voltage the frequency can be set with the address lines A0 ... A6 and the unit can be switched over from receive to transmit with the PTT line. The field strength data of all scanned RF channels is available at TXD (RS232) (can be displayed with the PC program: Database field strength, dwell time, stored maximum field strength for each RF channel, installation software on HBC G: HFE/TC695/TC695.EXE).

Automatic
After applying the operating voltage the transceiver issues its identity code, consisting of an 8 byte string, every 30 msec to the SPI (MOSI, SS and CLK). The default data transmission rate is 125 kBit/sec (adjustable up to 1 Mbit/s SW). The default data receiving rate is up to 1 Mbit/sec. After the first valid response to the cyclic transmission of the ID code the transceiver only reacts to a request from the other end. Time between request and response to the SPI about 300 µSek.

Request options at TC695:
1. Byte: IdentByte = h72 (ID code for TC695 transceiver)
2. Byte: Number of bytes in this string (HBC protocol agreement) = h07
3. Byte: Operating RF channel = 0xx (up to max. h7F)
4. Byte: State what should be contained in the next string? h00 = Request for IniString every 30 msec, h01 = Request for no answer, h02 = Request for 8 byte string (standard string with field strength of traffic channel), h03 = Request for 74 byte string (standard string with field strength of traffic channel + field strength values of all RF channels in the block – ReNEW time of data for 67 channels approx. 2.5 sec)
5. Byte: Not used yet
6. Byte: Block check (sum)

Request responses from TC695:
1. Byte: IdentByte = h72 (ID code for TC695 transceiver)
2. Byte: Number of bytes in this string (HBC protocol agreement) = h07 (without block check byte).
3. Byte: RF block
W4 (h09) Block 902.025 – 905.200 MHz maximum number of channels = 128
W5 (h0a) Block 905.225 – 908.400 MHz maximum number of channels = 128
W6 (h0b) Block 908.425 – 911.600 MHz maximum number of channels = 128
W7 (h0c) Block 911.625 – 914.800 MHz maximum number of channels = 128
W8 (h0d) Block 914.825 – 918.000 MHz maximum number of channels = 128
(6LSB) = h06 and channel pattern (2MSB) default 25kHz channel pattern = b00xxxxxx
4. Byte: Maximum number of channels in block = d128 h7F (128 channels)
5. Byte: Momentary traffic channel = hxx (max h7F)
6. Byte: Status (request status) h00 = Cyclic inistring, h01= No response, h02= Short response (includes field strength of traffic channel) h03=Long response (includes field strength of traffic channel and all channels found in the block). The status byte is reset to h01 after receipt and execution of the commands. Frequency changing is possible with all requests.
7. Byte: Field strength of traffic channel = hxx
8. Byte: 8 bit block check (sum)