Radio Module

HG 75430

Revision A (English)	Developed by: A.K. / T.N.
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1 Description of Device

1.1 Introduction

The transmission and reception module HG 75430 represents state-of-the-art technology for industrial narrow band systems in the 70cm band. Sophisticated technology and minimizing the number of equalization elements guarantees long-term stable and reliable operation even under difficult conditions. Separate synthesizers for transmitter and receiver mean extremely short switchover times. Modern GMSK modemchips enable transmission with low bit error rates at low receive levels. Digitally temperature compensated reference quartz oscillators (DTCXO option) enable power saving operation covering a large temperature range.

1.2 Operation

1.2.1 Synchronization

For synchronizing, a synchronization sequence has to be transmitted following activation of TX_ON, in order to prepare the decoding unit within the receiver. The receiver tries to recognize the synchronization pattern from the stream of received data with existing RF signal, and controls the decoding unit. The data is permanently output.

1.2.2 Transmitting Data

Data control line TX_ON is activated for transmitting. Synchronously to the data sequence, data bits have to be transferred serially at input RX_DATA. These data bits are accepted by the radio module at input RX_DATA during period t_L using DATA_CLK. Thus data may not change during this period of time.

The data may not include a steady component and thus the coding should be changed accordingly. Examples are found in the code changing table (Table 2 on page 7).

1.2.3 Receiving Data

In case an RF carrier is recognized and the level is above the programmed limiting value, DCD is being set.

Synchronously to the data sequence, decoded data bits are then transferred serially at output. These data bits are output by the radio module at output RX_DATA during the period of DATA_CLK and can be accepted by an external computer during this period of time.

1.2.4 Control Commands

The integrated synchronous serial interface including HCMOS levels enable easy setting of parameters for the radio module. Calibration, setting system parameters and setting frequencies are some of the implemented features.

Activating the command sequence can be started at any time by externally setting line RX_DATA actively to low for a minimum of 2 ms while TX_ON is not active. The processor recognizes this. The processor recognizes this status and waits for a high level at pin RX_DATA. Then the radio module answers with string ’KO’ + CR according to the timing during data reception. Then the first bit of this command is being accepted by DATA_CLK during the period t_L similar to the task of transmitting data. The radio module transmits the string 'OK' + CR as acknowledgement and leaves command mode. Command mode has to be started anew for each command.

1.2.5 Formatting Control Commands

Control commands are started by the sequence 'AT' followed by parameters. The parameters are hexadecimally ASCII coded.

Example: permanent setting of frequency no.: 1A (decimal 26)
KO<0x0D> OK<0x0D>
ATF<0x31><0x41><0x0D>

Example: reading out current RSSI measured value: 4F (decimal 79)
KO<0x0D> OK<0x0D>
ATB<0x34><0x46><0x0D>

Example: reading out current SW version: AA1.05
KO<0x0D> OK<0x0D>
ATV<0x41><0x41><0x31><0x2E><0x30><0x35><0x0D>

1.2.6 Available Control Commands

Code	Parameter/Direction	Function
F	2 on	Setting and saving frequency permanently
T	2 on	Setting frequency temporarily
G	2 off	Reading out current frequency
A	2 off	Reading out current RSSI value
S	0	Setting RSSI threshold according to measured RSSI value
B	2 off	Reading out current RSSI threshold
V	6 off	Reading out version of operating system

Table 1 List of available control commands

1.2.7 Hop Measurement

This radio module enables the user to assemble components for constructing his own measurement equipment. A few examples are measuring transmitter, bit error rate measuring device, measuring receiver, field strength measuring equipment (...).

1.3 Control

1.3.1 UB

Power supply +5 V.

1.3.2 GND

Chassis ground

1.3.3 DATA_CLK

Data sequence signal output which enables receiving and transmitting transmission and reception data synchronously. The signal is permanently active.

1.3.4 CTS (Tx_Rdy)

Indicates that transmission data can be transferred synchronously to DATA_CLK to the radio module.

1.3.5 RX_DATA

Data input and output.

The port is bi-directional. This port is operated as open-drain with internal pull-up resistance.

1.3.5.1 Data Output

Whenever DCD is active, received data is output synchronously to DATA_CLK. Whenever DCD is not active, control data can be output.

1.3.5.2 Data Input

Whenever TX_ON is active, data is interpreted as transmitted data and scanned and transmitted synchronously to DATA_CLK.

Whenever TX_ON is not active, data is interpreted as control data.

1.3.6 TX_DATA

ATTENTION! Do not connect!

1.3.7 TX_ON

log. 1 Transmitter on. If transmitter is in steady state, CTS becomes active.

log. 0 Transmitter off (ready for receiving). The last scanned bit is transmitted completely before the transmitter is switched off.

1.3.8 DCD

RF carrier and synchronization recognized. Whenever DCD becomes active, with the next upward slope of DATA_CLK the first data bit can be read-in.

1.3.9 -MCLR

Sets the built-in microcontroller into a defined status. Input has to be set to low level for a minimum of 5 ms. Once level has been set back to high, it will take approximately 200 ms for the radio module to be in operation mode.

1.3.10 RSSI

Analog output for evaluation of received signal (0,75 to 3,25 V correspond to -120 dBm to -50 dBm).

1.4 Data

1.4.1 Coding Data

Radio modules are only able to transmit steady components at disproportionately high effort. Thus the data has to be converted in such a way, that the numbers of zeros and ones are distributed statistically equal and are not transmitted in rows of three equal bits in sequence.

1. Transforming 8 bit code words into 10 bit code words in order to decrease impact of steady components
2. Converting levels in flanks for polarity independent decoding
3. Unique generation of synchronization sequences (10101010 sequence)
4. Violating the synchronization sequence for generation of data start condition
5. Generating a CRC16 word for block error recognition

Data packet start (RunIn): alternating 0/1 sequence for building-up transient and synchronization of receiver and interpreter (active up to TxRdy minimum).

In order to adapt the transmission channel to the frequency spectrum, there is the following channel coding:

a) logical ’1’ generates alternation of data signal,

b) logical ’0’ effects no changes.

c) The data block does not contain more than eight ’1’ and not more than two ’0’ in sequence.

This requires conversion according to the following keys (each Nibble – half a byte – is converted into five bit):

Nibble		Bit	
0	0x00	01010	0x0A
1	0x01	01011	0x0B
2	0x02	10010	0x12
3	0x03	10011	0x13
4	0x04	01110	0x0E
5	0x05	01111	0x0F
6	0x06	10110	0x16
7	0x07	10111	0x17
8	0x08	01001	0x09
9	0x09	11001	0x19
10	0x0A	11010	0x1A
11	0x0B	11011	0x1B
12	0x0C	01101	0x0D
13	0x0D	11101	0x1D
14	0x0E	11110	0x1E
15	0x0F	10101	0x15

Table 2 Conversion

This procedure requires for channel coding 10 + 10 x 32 = 330 bit for 32 Byte (256 data bits). This corresponds to a redundancy of 74 bit equivalent to 28.9 % and this is relatively economical. With Manchester coding 8 + 2 x 256 = 520 bit would be necessary, which are additional 264 bit equivalent to 103 % redundancy.

The user may decide to use different kinds of conversions (e.g. through scramblers).

1.4.2 Filling up Gaps

Gaps in the data stream may be filled up with synchronization words consisting of ten '1' per byte.

1.4.3 CRC16 Safeguarding

Each data block should be protected by a CRC16 safeguarding word.

1.5 Outline of Casing including Position of Connectors

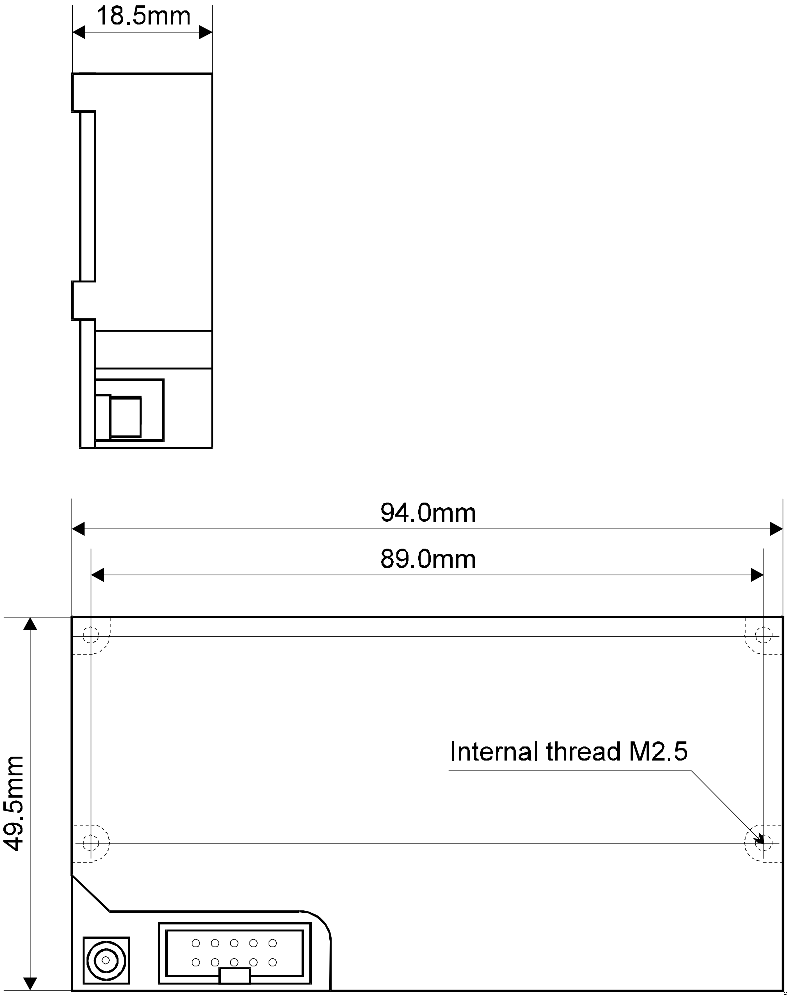

Figure 1 Outline of casing including position of connectors (original size)

2 Technical Data

2.1 Electrical Data

Power supply	5 Volt
Current consumption	300 mA transmitting, 50 mA receiving
Modulation procedure	GMSK 9,6 kbit/s (19,2 kbit/s)
Frequencies	70cm frequencies of groups B, D and F: - **group B:** 456,17; 456,21; 456,29; 456,33, 466,17; 466,27; 466,33 MHz - **group D:** 456,25; 456,41; 456,43; 466,41 MHz - **group F:** 433,100; 433,125; 433,150; ..; 434,750 MHz
Output power	500 mW
Sensitivity	-105 dBm for BER 1E-3

Table 3 Technical Data – Electrical Data

2.2 Mechanical Data

Dimensions (including connector)	94 x 50 x 19 mm
Antenna connector	MCX socket
Data connection	10pin ribbon cable RM 1,27 via pole connectors

Table 4 Technical Data – Mechanical Data

2.3 Environmental Conditions

Operating temperature	-10 to +50° C normal, -20 to +60° C extended
Storage temperature	-25 to +70° C

Table 5 Technical Data – Environmental Conditions

2.4 Interfacing

Name	Pin	Description
UB	1	Power supply
GND	2	Ground
DATA_CLK	3	Data synchronous clock output (HCMOS output)
CTS	4	Ready-to-transmit state (HCMOS output)
RX_DATA	5	Received data (HCMOS input)
TX_DATA	6	Transmission data (HCMOS output)
TX_ON	7	Switch on transmission device (HCMOS input)
DCD	8	Reception RF-carrier recognized (HCMOS output)
-MCLR	9	Reset Low-active (HCMOS input)
RSSI	10	Reception signal strength (analog 0 to 5 V)

Table 6 Technical Data – Interfacing

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