Wireless Transparent Modules
DUAL MODE TRANSCEIVERS

Command Reference

Description

This document provides the instruction how to use the Extended Mode in the Dual Mode Transceivers family.

Contents

1. Operating Modes of the Dual Mode Transceiver Family

This transceiver family can operate in two modes:

Normal Mode: whose operation is already described in the datasheet
Extended Mode: user programmable, covered in this document

2. Extended Mode Operation

For the setup of the device a serial interface is provided, by means of the same I/O lines that are used for normal operation. These lines are EN, CH_SEL, TX/RX, and must be connected to an external microcontroller.

2.1 Entering programming mode:

To enable the programming mode, it is necessary to:

- set the device in power down state (**by setting pin EN = 0**), and then:
- generate a high pulse **t1** with a duration within **80 µs and 120 µs** on **EN line** (see Figure 1).

2.2 UART Setup:

From that point on, the transceiver is in **UART programming mode on CH_SEL pin.**

The serial port is configured for reception only, with the following parameters:

- Baud rate: 9600 ± 300 baud
- Parity: no
- Stop bit: 1
- Data bit: 8

The time **t2** between the end of the pulse on EN line and start of data transmission on CH_SEL must be at least **1 ms** (see Figure 1).

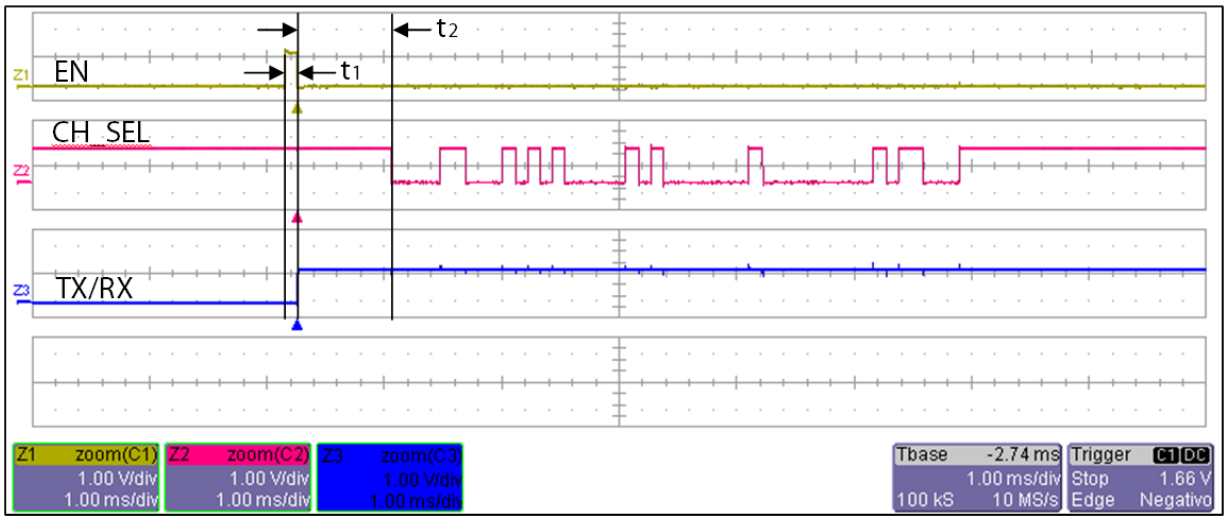


Figure 1: timings. 80µs < **t1** < 120µs; t**2** > 1ms

2.3 Feedback on the state of programming:

The transceiver is capable of returning a feedback in case of successful programming (**ACK**).
To this purpose it is necessary to set the **TX / RX line** as input on the external microcontroller during the programming operation, with pull-up enabled.
The line must be set this way within the end of the pulse **t1** on EN and the beginning of the transmission of serial data (end of **t2**), and kept in pull-up for all the duration of programming phase.
The ACK occurs as a negative pulse **t3** on the TX / RX line and has a duration of **1 ms** (typical) (see Figure 2).

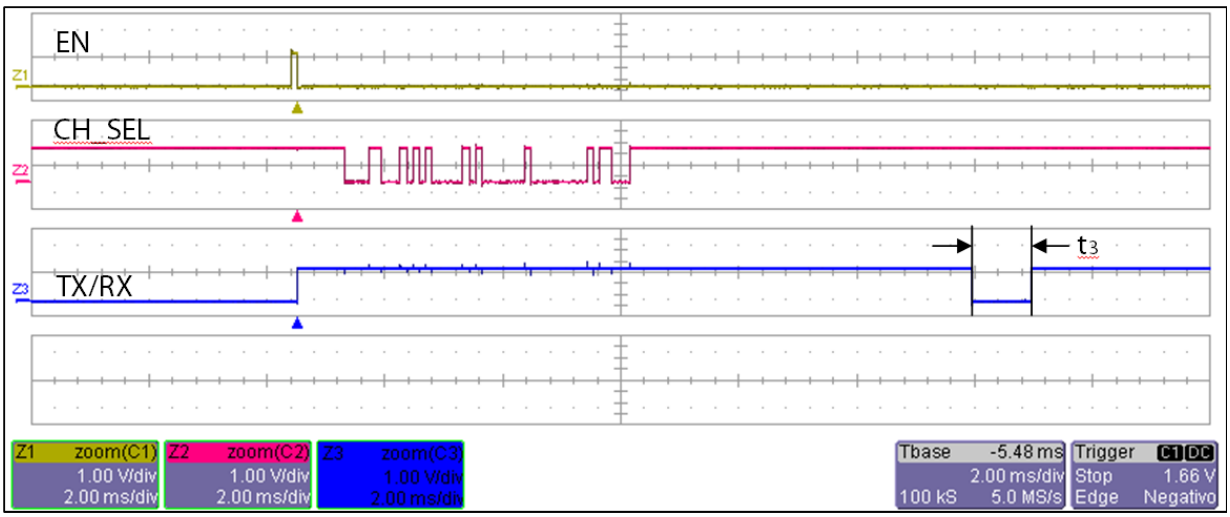


Figure 2: timings. **t3** = 1 ms typ.

If programming is not successful, the line remains in tri-state.

When programming ends, disable the pull-up on the external microcontroller pin on TX/RX line and restore the functionality of this line (input for the transceiver).

The transceiver exits the programming mode after a timeout of **100 ms**. For this reason, the time **t4** elapsed between the end of the pulse on EN and the end of a valid command sent on CH_SEL must be less than **90 ms**.

After programming a single parameter, the user can program other parameters consecutively; the 100 ms time-out is reset at the end of each ACK pulse on the TX / RX line, for each programmed parameter. To avoid errors during the writing of consecutive parameters it is mandatory that during this phase there are no pulses on EN line, and there are no other than programming data on CH_SEL line (see figure 4).

After a valid command, before starting the transmission of new data you must wait for the ACK on the TX / RX line, or if the TX / RX line is not used, a delay of at least **15 ms** for the writing of *single parameters* and of at least **40 ms** to set the *default parameters* (0x0A).

Typical time **t5** between command reception and ACK valid for the writing of *single parameters*: **7 ms** (see Figure 3).

Typical time **t5** between command reception and ACK valid only for setting the *default parameters*: **25 ms** (see Figure 3).

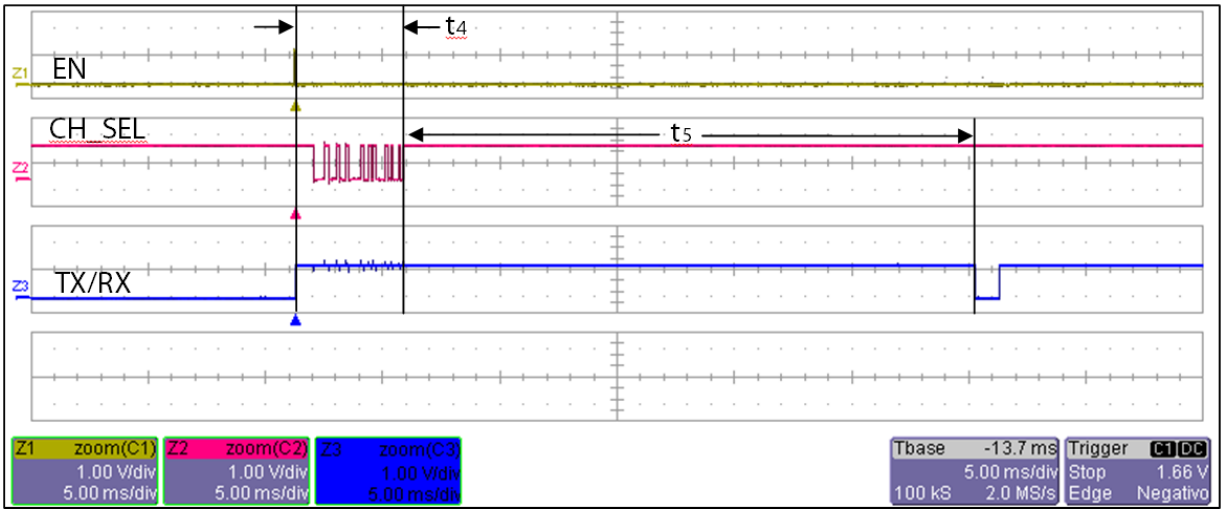


Figure 3: timings. **t4** < 90 ms; t**5** = 7 ms typ. for the setting of single parameters; t**5** = 25 ms typ. for the setting of default parameters.

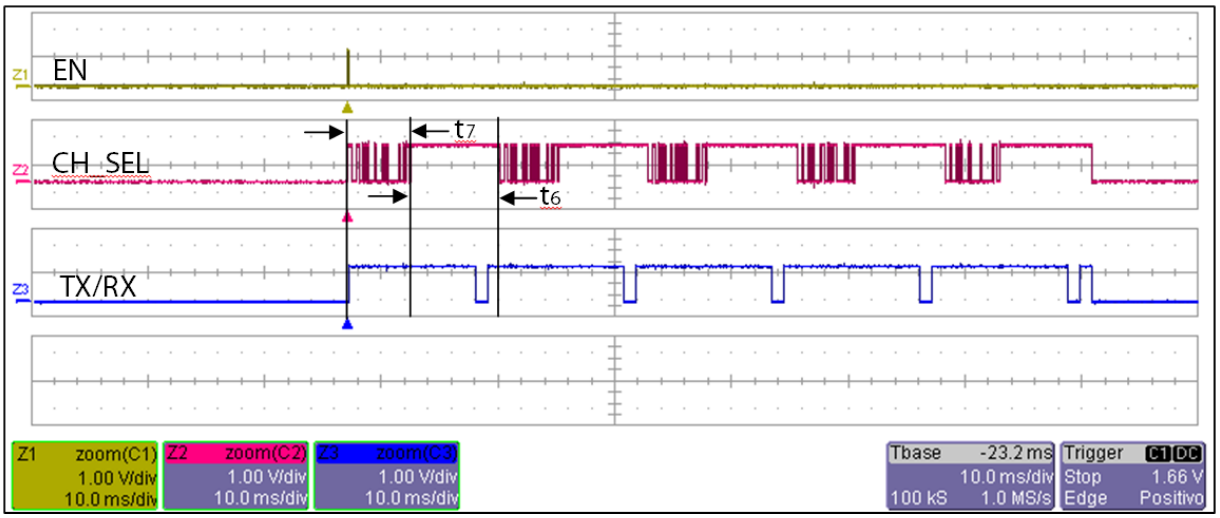


Figure 4: no other data must be present on CH_SEL line during period **t6** elapsed between a frame related to a command (**t7**) and the following.

2.4 Programming bytes sequence:

- START: 0x18
- LEN: number of bytes from START to CHK
- CMD: command to be executed
- D1: first data (if any))
- CHK: checksum (0xFF – (XOR from START to CHK))

If you try to set a parameter with a value other than those permitted, the configuration will remain unchanged.

The settings are valid by the end of the time-out.

Valid parameters are stored in non-volatile memory, and are preserved even if module power is switched off.

3. Command Set 434 MHz TRX Versions

List of the implemented command:

Parameter	Description	Byte CMD	Byte LEN	Value
Channel 1	Channel frequency selection byte	0x50	5	0x00: 433.42 MHz (default) 0x01: 433.92 MHz 0x02: 434.42 MHz 0x03: 433.20 MHz 0x04: 434.64 MHz
Channel 2	Channel 2 frequency selection byte	0x51	5	0x00: 433.42 MHz0x00: 433.42 MHz 0x01: 433.92 MHz 0x02: 434.42 MHz (default) 0x03: 433.20 MHz 0x04: 434.64 MHz
Modulation	Modulation selection byte	0x52	5	0x00: OOK (default) 0x01: 2FSK
Sync	Synchronizer enabled / disabled selection byte (*)	0x53	5	0x00: sync disabled, normal mode, data transparent (default) 0x01: sync disabled, "slow" mode 0x02: sync enabled, baud rate 1200 0x03: sync enabled, baud rate 2400 0x04: sync enabled, baud rate 4800 0x05: sync enabled, baud rate 9600 0x06: sync enabled, baud rate 19200 0x07: sync enabled baud rate 38400
Power	RF output power selection byte	0x01	5	0x00: +10 dBm (default) 0x01: +7 dBm 0x02: +4 dBm 0x03: +1 dBm 0x04: -2 dBm 0x05: -5 dBm
RSSI	RSSI value request	0X55	5	0x00
Default setting	Default parameters setting	0x0A	4	

4. Command Set 868 MHz TRX Versions

List of the implemented command:

Parameter	Description	Byte CMD	Byte LEN	Value
Channel 1	Channel frequency selection byte	0x50	5	0x00: 868.1 MHz 0x01: 868.15 MHz (default) 0x02: 868.2 MHz 0x03: 868.3 MHz 0x04: 868.4 MHz 0x05: 868.45 MHz 0x06: 868.5 MHz 0x07: 868.825 MHz 0x08: 868.95 MHz 0x09: 869.075 MHz 0x0A: 869.85 MHz
Channel 2	Channel 2 frequency selection byte	0x51	5	0x00: 868.1 MHz 0x01: 868.15 MHz 0x02: 868.2 MHz 0x03: 868.3 MHz 0x04: 868.4 MHz 0x05: 868.45 MHz (default) 0x06: 868.5 MHz 0x07: 868.825 MHz 0x08: 868.95 MHz 0x09: 869.075 MHz 0x0A: 869.85 MHz
Modulation	Modulation selection byte	0x52	5	0x00: OOK (default) 0x01: 2FSK
Sync	Synchronizer enabled / disabled selection byte (*)	0x53	5	0x00: sync disabled, normal mode, data transparent (default) 0x01: sync disabled, “slow” mode 0x02: sync enabled, baud rate 1200 0x03: sync enabled, baud rate 2400 0x04: sync enabled, baud rate 4800 0x05: sync enabled, baud rate 9600 0x06: sync enabled, baud rate 19200 0x07: sync enabled baud rate 38400
Power	RF output power selection byte	0x01	5	0x00: +10 dBm (default) 0x01: +7 dBm 0x02: +4 dBm

				0x03: +1 dBm 0x04: -2 dBm 0x05: -5 dBm
RSSI	RSSI value request	0X55	5	0x00
Default setting	Default parameters setting	0x0A	4	

5. Synchronous and Asynchronous Modes

The default factory setting for the transceiver is in "normal mode" (0x00), which means that the operation is independent from the baud rate; the module can operate with any baud rate between 1200 and 4800 baud.
Based on specific user requirements related to particular frame structures and data rate, other operating settings could be managed through the SYNC command.

Using the SYNC command it is possible to:

- set the module in **"slow mode"** (0x01): this setting could to be used with encodings that have long pauses in their frame and/or have very slow data rates (e.g. slow HT12 coding). **In this mode the 3dB RF bandwidth is 200kHz.**

- set the module in **"synchronous modes"** (0x02 – 0x07): with this option it is possible to enhance the receiver sensitivity, but the user must observe the set baud rate with a tolerance of ± 5%. This mode is recommended for advanced users, in order to take advantage of maximum performance of the module, as long as the radio frame is implemented in accordance with the suggestions given in Mipot's application note **AN_RF001_rev1.0.pdf**.

6. RF Characteristics vs Operating Modes

6.1 434 MHZ Versions

The following tables show the sensitivity values (BER = $10E^{-2}$) and the RF bandwidth in the various operating modes for the 434 MHz versions:

6.1.1 OOK Modulation

Baud rate	Sync off (0x00)	Sync on 1200 (0x02)	Sync on 2400 (0x03)	Sync on 4800 (0x04)	Sync on 9600 (0x05)	Sync on 19200 (0x06)	Sync on 38400 (0x07)
1200	-98	-116	-	-	-	-	-
2400	-108	-	-116	-	-	-	-
4800	-110	-	-	-115	-	-	-
9600	-	-	-	-	-113	-	-
19200	-	-	-	-	-	-108	-
38400	-	-	-	-	-	-	-105
3 dB RF BW:	200 kHz	100 kHz	100 kHz	100 kHz	100 kHz	200 kHz	200 kHz

6.1.2 2FSK Modulation

Baud rate	Sync off (0x00)	Sync on 1200 (0x02)	Sync on 2400 (0x03)	Sync on 4800 (0x04)	Sync on 9600 (0x05)	Sync on 19200 (0x06)	Sync on 38400 (0x07)
1200	-106	-117	-	-	-	-	-
2400	-107	-	-116	-	-	-	-
4800	-107	-	-	-114	-	-	-
9600	-	-	-	-	-111		
19200	-	-	-	-	-	-106	-
38400	-	-	-	-	-	-	-105
3 dB RF BW:	100 kHz	100 kHz	100 kHz	100 kHz	100 kHz	100 kHz	100 kHz

Example: To set the 32001269 or 32001398 TRX in 2FSK and channel 1 on 433.92 MHz, you must send the 100 µs pulse on the EN line and then send the following two commands on the CH_SEL line:

- Select the channel frequency 433.92 MHz: 0x18 0x05 0x50 0x01 0xB3
- Select the modulation 2FSK: 0x18 0x05 0x52 0x01 0xB1

6.2 868 MHZ Versions

The following tables show the sensitivity values (BER = $10E^{-2}$) and the RF bandwidth in the various operating modes for the 868 MHz versions:

6.2.1 OOK Modulation

Baud rate	Sync off (0x00)	Sync on 1200 (0x02)	Sync on 2400 (0x03)	Sync on 4800 (0x04)	Sync on 9600 (0x05)	Sync on 19200 (0x06)	Sync on 38400 (0x07)
1200	-101	-115	-	-	-	-	-
2400	-109	-	-115	-	-	-	-
4800	-110	-	-	-115	-	-	-
9600	-	-	-	-	-112	-	
19200	-	-	-	-	-	-109	-
38400	-	-	-	-	-	-	-107
3 dB RF BW:	200 kHz	100 kHz	100 kHz	100 kHz	100 kHz	200 kHz	200 kHz

6.2.2 2FSK Modulation

Baud rate	Sync off (0x00)	Sync on 1200 (0x02)	Sync on 2400 (0x03)	Sync on 4800 (0x04)	Sync on 9600 (0x05)	Sync on 19200 (0x06)	Sync on 38400 (0x07)
1200	-102	-116	-	-	-	-	-
2400	-102	-	-115	-	-	-	-
4800	-104	-	-	-113	-	-	-
9600	-	-	-	-	-106	-	-
19200	-	-	-	-	-	-105	-
38400	-	-	-	-	-	-	-103
3 dB RF BW:	100 kHz	100 kHz	100 kHz	100 kHz	100 kHz	100 kHz	100 kHz

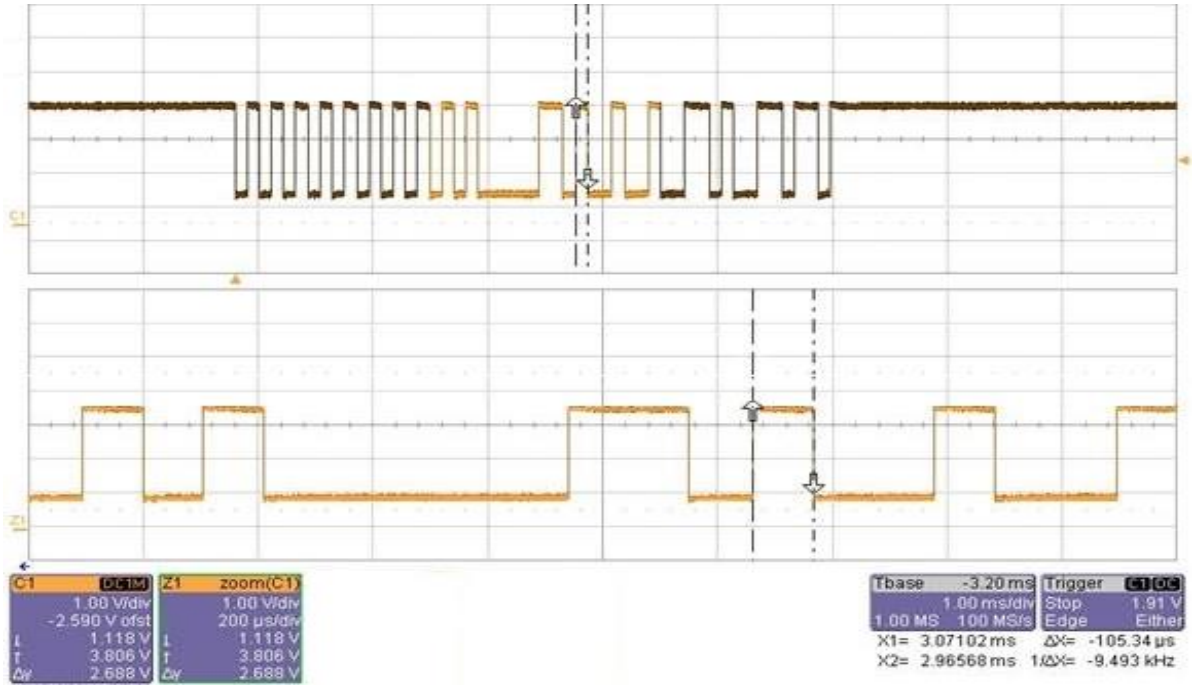
Example: To set the 32001270 or 32001399 TRX in OOK and channel 1 on 868.3 MHz, you must send the 100 µs pulse on the EN line and then send the following two commands on the CH_SEL line:

- Select the channel frequency 868.3 MHz: 0x18 0x05 0x50 0x03 0xB1
- Select the modulation OOK: 0x18 0x05 0x52 0x00 0xB0

6.3 RSSI Level Readout

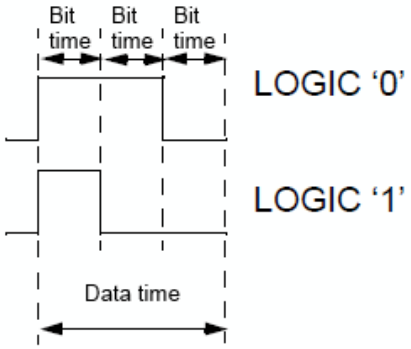
The device is able to supply information about RSSI level.

The feedback is sent on the TX/RX line (the same used for the ACK), simulating UART data at 9600 baud/s:



The data packet is made up of:

- 10 bits preamble
- 5 bits pause
- One byte representing the RSSI value, Manchester-coded as follows:



- Bit time is 1/9600 = 104us.

The returned datum is not the final RSSI value, but rather an integer called RSSI val, with which it is possible to calculate the true value of RSSI (in dBm) according to the following formula:

RSSI [dBm] = (RSSI_val/2) – 125

7. Revision History

Revision	Date	Description
1.6	06.10.2020	Final Release