

MIGRATION FROM TCM310 to TCM515

MIGRATION FROM TCM 310 to TCM 515 – Factors to consider for transitioning from TCM 310 to TCM 515

Introduction

This document highlights the variants to have in order to transition from EnOcean TCM310x to the TCM 515x module.

The TCM 515 and TCM310 enable the realization of line-powered actuators, controllers and gateways communication based on EnOcean Radio Protocol version 1 (ERP1, 868 MHz ASK) and EnOcean Radio Protocol version 2 (ERP2, 902 MHz FSK).

These modules provide a transparent radio link between EnOcean radio devices and an external host connected via UART interface using the standardized EnOcean Serial Protocol V3 (ESP3) communication protocol.

If you are planning a transition from the TCM 310 to the TCM 515 is highly recommended to make a full review of both User Manuals (Ref. [2] and Ref. [3]), this document aims to highlight the most important points between the two.

1. High Level Functionality

Compared to the current TCM 310, the TCM 515 provides reduced power consumption, smaller size, higher processor performance, and security processing without the need for external components.

The serial interface operates according to EnOcean ESP3 standard for both the TCM 310 and the TCM 515, the later comes with the option to use higher interface speeds – TURBO – mode to reduce latencies.

Both the TCM 310 and the TCM 515 are fully integrated radio transceivers for EnOcean ERP1 (868 MHz ASK) or ERP2 (902 MHz FSK) systems. While the high-level functionality of both modules is the same, the TCM 515 has added features.

The TCM 310 and the TCM 515 are:

- Used to exchange (send and / or receive) radio telegrams with external sensors
- Capable to operate as a repeater
- Connected to an external host which for instance could be a microprocessor, a controller or a gateway

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Figure 1 shows the integration of a TCM 310 or a TCM 515 into a typical system environment:



Figure 1: TCM 310 and TCM 515 system environment

2. Highlights to consider for transition from TCM 310 to TCM 515

2.2 Summary of features

Feature	TCM 515	TCM 310
Receiver Sensitivity (typ, @25°C)	868.3 MHz ASK: -93 dBm 902.875 MHz FSK: -98 dBm	868.3 MHz ASK: -96 dBm 902.875 MHz FSK: -98 dBm
Transmit Power (typ, 25°C)	868.3 MHz ASK: +10 dBm 902.875 MHz FSK: +1 dBm	868.3 MHz ASK +3 dBm 902.875 MHz FSK: +1 dBm
Supply Voltage	2.0 V...3.6 V	2.6 ...4.5V
Current consumption	25mA	Receive mode: 43 mA max. Transmit mode: 33 mA max
Serial Host Interface	UART according to ESP3 (Details in section 2.6)	
Module Dimensions	19.0 mm x 14.7 mm x 3.0 mm	22mm x 19mm x 3.0 mm
Operating Temperature	-40°C...+85°C	-25° to +85°C

Table 1: Summary comparison of modules features

2.3 Pin-out assignment

The TCM 515 and TCM 310 are **not** pin compatible.

Detailed pin-out description could be found in the User manuals Ref. [2] and Ref. [3].

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2.4 Reset circuit

The TCM 515 can be reset by pulling the **nRST** pin, “active low” to ground. The TCM 515 has an integrated a 50kΩ pull-up resistor that will maintain the internal **nRST** input active high or “not active”.

In order to avoid spurious reset events, it is recommended to filter the input signals by means of a small capacitor which is placed as close as possible to the TCM 515 **nRST** pin as shown in Figure 2.

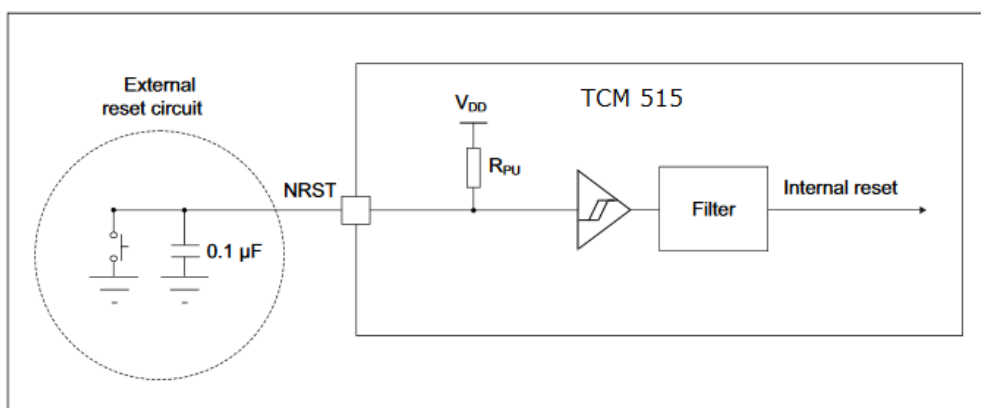


Figure 2: TCM 515 Recommended reset circuit

The reset pulse should have a duration of at least 1 ms in order to guarantee a reliable reset operation.

For the TCM 310 the reset is achieved by pulling the **Reset** pin to VDD, “active high.” In order to ensure reliable operation it is recommended to externally connect both the reset with a 10kΩ resistor in parallel with a 10nF capacitor to ground. This avoids spurious signal detection in very noisy environments.

The suggested circuit is shown below.

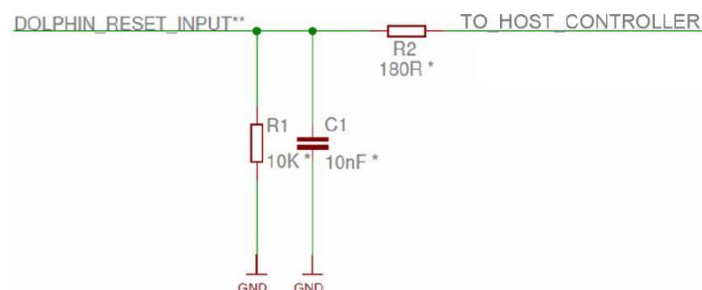


Figure 3: TCM 310 recommended reset circuit

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2.5 Summary of ESP3 Commands supported

	TCM 310	TCM 515
Type 1	ERP1 Radio Telegram	
Type 10	ERP2 Radio Telegram (TCMxxxU only)	
Type 11	Configuration commands (TCMxxxU only)	
Type 2	Responses	Responses
Type 4	Event	
	SA_CONFIRM_LEARN	SA_CONFIRM_LEARN
	CO_READY	CO_READY
	CO_DUTYCYCLE_LIMIT	CO_DUTYCYCLE_LIMIT
Type 5	Common Commands	
	CO_WR_SLEEP	CO_WR_SLEEP
		CO_WR_STARTUP_DELAY
	CO_WR_RESET	CO_WR_RESET
	CO_RD_VERSION	CO_RD_VERSION
	CO_RD_SYS_LOG	
	CO_WR_SYS_LOG	
	CO_WR_BIST	
	CO_WR_IDBASE	CO_WR_IDBASE
	CO_RD_IDBASE	CO_RD_IDBASE
	CO_WR_REPEATER	CO_WR_REPEATER
	CO_RD_REPEATER	CO_RD_REPEATER
	CO_WR_FILTER_ADD (Up to 30 filters)	CO_WR_FILTER_ADD
	CO_WR_FILTER_DEL	CO_WR_FILTER_DEL
	CO_WR_FILTER_DEL_ALL	CO_WR_FILTER_DEL_ALL
	CO_WR_FILTER_ENABLE	CO_WR_FILTER_ENABLE
	CO_RD_FILTER	CO_RD_FILTER
		CO_WR_LEARNMODE
		CO_RD_LEARNMODE
	CO_WR_WAIT_MATURITY	CO_WR_WAIT_MATURITY
	CO_WR_MEM	
	CO_RD_MEM	
	CO_RD_MEM_ADDRESS	
	CO_RD_DUTYCYCLE_LIMIT	CO_RD_DUTYCYCLE_LIMIT
		CO_GET_FREQUENCY_INFO
		CO_SET_BAUDRATE
Type 5	Common commands for security handling	
		CO_WR_SECUREDEVICE_ADD
		CO_WR_SECUREDEVICE_DEL
		CO_WR_SECUREDEVICE_COUNT
		CO_WR_SECUREDEVICE_BY_INDEX
		CO_WR_SECUREDEVICE_BY_ID
		CO_WR_SECUREDEVICE_SENDTEACHIN
		CO_WR_SECUREDEVICE_CLEAR_LIST
Type 6	Smart Acknowledge commands	
	SA_WR_LEARNMODE	SA_WR_LEARNMODE
	SA_RD_LEARNMODE	SA_RD_LEARNMODE
	SA_WR_LEARNCONFIRM	SA_WR_LEARNCONFIRM
	SA_WR_RESET	SA_WR_RESET
	SA_RD_LEARNEDCLIENTS	SA_RD_LEARNEDCLIENTS
	SA_WR_POSTMASTER	SA_WR_POSTMASTER
Type 7	Remote Management messages	

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	TCM 310	TCM 515
Type 9	Radio Message	

Table 2: ESP3 commands supported by TCM 310 and TCM 515

The full specification of the EnOcean Serial Protocol V3 can be found at the following link:

[1] <https://www.enocean.com/esp>

Note: For the TCM 310, common command `CO_RD_DUTYCYCLE_LIMIT` was introduced to modules manufactured after March 2015, the manufacture date can be found on the sticker of the module (WW/JJ), e.g. K310-10 **26/13**

2.6 UART interface

The TCM 310 and the TCM 515 communicate with the external host using the standard ESP3 serial (UART) interface based on the signals `UART_TX` and `UART_RX`.

The default interface speed of the ESP3 interface is 57600 bit per second and data is transmitted using 8 data bits, 1 STOP bit and no parity.

Only for the TCM 515 is possible to select faster communication speeds during operation using the ESP3 **CO_SET_BAUDRATE** command. The following interface speeds are supported:

- 57600 bit per second
- 460800 bit per second

Additionally, it is possible to change the default ESP3 interface speed at power up from 57,600 Bit per second to 460,800 Bit per second by connecting the **nTURBO** input to ground. Subsequent modification of the interface speed during operation using the `CO_SET_BAUDRATE` command is always possible irrespective of the state of the TURBO input pin.

In all cases, care should be taken not to select a UART interface speed which cannot be supported by the connected host processor as this would prevent subsequent communication.

2.7 TCM 515 Teach-in

Teach-in is the process by which a remote device wants to setup communication with the TCM 515. To do so, the remote device communicates to the TCM 515 all parameters required to establish communication with in a specially formatted telegram. The TCM 310 does not support these commands.

In order to accept teach-in requests from remote devices, the TCM 515 must be in teach-in mode via the ESP3 interface by using the **CO_WR_LEARNMODE** command.

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After a successful teach-in process the whole teach-in message is forwarded as RADIO_MESSAGE (PACKET TYPE 0x09) to the external host via the ESP3 interface. If the TCM 515 is not in teach-in mode, teach-in requests from unknown devices are ignored.

If the TCM 515 receives a teach-in message from a known – previously taught-in – device operating in high security mode then the sequence counter information in the TCM 515 secure link table is updated. This approach is used in case the sequence counters of the receiver and sender become desynchronized.

For details please consult section 5 of the TCM 515 User Manual Ref. [3].

2.8 TCM 515 Build-in Security

The TCM 515, in contrast with the TCM 310, implements the security handling functions as specified in the EnOcean security specification: Ref. [4] <https://www.enocean-alliance.org/sec/>

Specifically the TCM 515 can automatically decrypts and authenticates messages originating from taught-in remote devices transmitting messages according to the EnOcean Network Security Specification.

The TCM 515 receives and decrypts messages from the following supported products:

- PTM 215
- PTM 335
- STM 320 / STM 329 / STM 250 (or similar with same profile)
- STM 330 / STM 331 (or similar with same profile)

The TCM 515 implements the following security functions:

- Message decryption using VAES 128
- Message encryption using VAES 128
- Management of 2/3 byte sequence counter
- CMAC (3 / 4 bytes length) validation based on sequence counter (2 / 3 bytes length) and telegram content
- CMAC (3 / 4 bytes length) generation

The TCM515 uses Type 5 Common commands for security handling:

- CO_WR_SECUREDEVICE_ADD
- CO_WR_SECUREDEVICE_DEL
- CO_RD_SECUREDEVICE_COUNT
- CO_RD_SECUREDEVICE_BY_INDEX
- CO_RD_SECUREDEVICE_BY_ID
- CO_WR_SECUREDEVICE_SENDTEACHIN

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■ CO_WR_SECUREDEVICE_CLEAR_LIST

An application note with a detailed explanation regarding handling security with the TCM515 will be released by the end of May 2018.

3. References

[1] EnOcean Serial Protocol V3 (ESP3):

<https://www.enocean.com/esp>

[2] TCM 310 User Manual:

https://www.enocean.com/en/enocean_modules/tcm-310/user-manual-pdf/

[3] TCM 515 User Manual:

https://www.enocean.com/en/enocean_modules/tcm-515/user-manual-pdf/

[4] EnOcean Security Specification:

<https://www.enocean-alliance.org/sec/>

Disclaimer

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