

## EnOcean 928 MHz (Dolphin V4 Platform) - Migration Overview

### 1. Introduction

EnOcean launched a new product line to enable new regional coverage. The 'J' family of products is currently intended for the Japanese market, operates in the license-free 928 MHz band ([http://www.enocean.com/en/enocean\\_modules\\_928mhz/](http://www.enocean.com/en/enocean_modules_928mhz/)) and uses the ERP2 (EnOcean Advanced Radio Protocol, FSK-based). It is full ARIB STD-T108 compliant.

This guide isn't exhaustive and is mainly intended for engineering management who are migrating their previous standard EnOcean enabled products to enter into the 928 MHz Japanese market and need to establish a level of effort requirement. It provides a high level overview of motivation, important common aspects but also differences, new tools and additional / updated documentation required as consequence to take advantage of EnOcean's new products and developments even for newcomers.

### 2. Additional (and updated) useful References and Resources

- [1] ESP3 (EnOcean Serial Protocol 3): <http://www.enocean.com/esp>
- [2] ERP2 (EnOcean Radio Protocol 2): <http://www.enocean.com/erp2/>
- [3] EEP (EnOcean Equipment Profiles, updated with new RPS profiles according new ERP2): <http://www.enocean-alliance.org/eep/>
- [4] Dolphin Core V4 description: <http://www.enocean.com/dolphin-v4-core-description/>
- [5] Dolphin V4 API (Dolphin V4 Application Programming Interface): <http://www.enocean.com/en/download/>
- [6] Dolphin V4 API User manual: <http://www.enocean.com/fileadmin/redaktion/support/dolphinv4-api/index.html>
- [7] DolphinSuite Tool Chain Graphical user Interface for easy configuration, programming: <http://www.enocean.com/en/download/>
- [8] DolphinSuite User Manual: [http://www.enocean.com/fileadmin/redaktion/support/dolphin-suite/DolphinV4\\_Suite.html](http://www.enocean.com/fileadmin/redaktion/support/dolphin-suite/DolphinV4_Suite.html)
- [9] DolphinView Advanced: <http://www.enocean.com/en/download/>
- [10] Security Concept Specification: <http://www.enocean.com/en/security-specification/>
- [11] Remote Management Description: <http://www.enocean.com/remote-management>
- [12] Smart Acknowledgement Bi-directional Communication Protocol: <http://www.enocean.com/smart-acknowledgement>
- [13] Generic Profiles, Abstract: [http://www.enocean.com/fileadmin/redaktion/enocean\\_alliance/pdf/GenericProfiles\\_V1\\_Extract.pdf](http://www.enocean.com/fileadmin/redaktion/enocean_alliance/pdf/GenericProfiles_V1_Extract.pdf)
- [14] EDK 400J (EnOcean Development Kit for 928 MHz, Dolphin V4 modules): [http://www.enocean.com/en/enocean\\_modules\\_928mhz/edk-400j/](http://www.enocean.com/en/enocean_modules_928mhz/edk-400j/)

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[15] EnOcean Link updated (support of all EnOcean Protocols):

<http://www.enocean.com/en/enocean-software/enocean-link/>

[16] EnOcean Worldwide Radio Approval Overview:

[http://www.enocean.com/fileadmin/redaktion/pdf/tec\\_docs/EnOcean\\_Radio\\_Approvals\\_Overview\\_May2014.pdf](http://www.enocean.com/fileadmin/redaktion/pdf/tec_docs/EnOcean_Radio_Approvals_Overview_May2014.pdf)

### 3. Specific Implementation/Migration Aspects (overview Dolphin V4 vs. Dolphin)

Background: almost all new EnOcean 928 MHz ("J") modules are Dolphin V4 core based. Exceptions thereof are the "J" radio switches (e.g. PTM 210J/430J).

EnOcean Dolphin V4 core is actually the generic name for the special 928 MHz ERP2 variant of the Dolphin core.

#### Firmware Dolphin V4 based Modules

The core software functionality of "J" Dolphin V4 modules lies in the Dolphin V4 API while the device "customer functionality" remains basically the same as for the standard Dolphin core based modules (similar Tool chain, based now on Dolphin V4 API).

<http://www.enocean.com/fileadmin/redaktion/support/dolphinv4-api/index.html>

#### Hardware Dolphin V4 based Modules

928 MHz TCM / STM 4xxJ Dolphin V4 based modules are all HW pin to pin compatible with all other existing Dolphin based versions and will operate with existing current PCB layouts (the Dolphin V4 core has however some enhanced HW features vs. the current Dolphin core.)

Solely PTM 'J' radio switch transmitters are actually not Dolphin V4 based.

TCM / STM 4xxJ Dolphin V4 based Footprint vs. Dolphin based device	No changes 868 MHz	No changes 315 MHz-'C'	No changes 902 MHz-'U'
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#### ERP2 and 928 MHz Band considerations

##### Why 928 MHz?

1. Shorter antenna, easier to integrate
2. In higher frequency band less interference noise from typical electrical appliances like e.g. electronic ballasts /HVAC.
3. Optimal certification conditions for the specific Japan market.

##### Why FSK?

For better sensitivity and higher noise immunity vs. ASK (Amplitude Shift Keying).

Background: ASK as opposed to FSK is more dependent on the matching of the specific antenna and is more sensitive to interfering signals independent of the used frequency.

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### Why ERP2?

1. More suitable for FSK – longer payload telegrams up to 255 bytes, (currently used 44) vs. max. 21 bytes possible with ERP1.
2. 48 bit source ID – required for ARIB STD-T108 compliance, requires longer telegrams!

Background: EnOcean FSK-based radio protocol requires EnOcean Radio Protocol 2 (ERP2); ASK stays historically for EnOcean Radio Protocol 1 (ERP1).

### Overview EnOcean Dolphin V4 vs. their Dolphin pendants and specific differences:

E.g. TCM 410J vs. TCM 310 (both having "GatewayController" functionality):

TCM 410J as opposed to TCM 310 is reprogrammable, however no actuator FW for TCM 4xxJ (e.g. like for TCM 300 FW) is currently available, default GatewayController functionality only (means no "TCM 400J" pendant for current "TCM 300" standard versions available).

DOLPHIN V4		DOLPHIN	
HW NAME	CORE / FW (NAME)	HW NAME	CORE / FW (NAME)
USB 400J	Dolphin V4 GatewayController	USB 300	Dolphin GatewayController
TCM 410J	Dolphin V4 GatewayController (reprogrammable!)	TCM 310	Dolphin GatewayController
STM 431J	Dolphin V4 TRH	STM 33x	Dolphin TRH
STM 429J	Dolphin V4 MAG	STM 32x	Dolphin MAG
STM 400J	Dolphin V4 USN	STM 300	Dolphin USN
PTM 430J	N/A	PTM 330	Dolphin RPS

### Dolphin V4 based Product Overview and specific differences vs. Dolphin based

The following products can be programmed / configured by customer with custom specific SW:

- STM 400J, STM 431J (Source code and FW available), TCM 410J
- TCM 410J (Firmware available) STM 4xxJ modules will also have Generic Profiles as an option by Teach-In and up to 35 bytes payload in telegrams.

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### Enhanced Security Modules Overview, current status

DOLPHIN V4	
HW NAME	CORE / FW (NAME)
STM 435J HW + EEPROM already on board)	Dolphin V4 TRH S
STM 425J HW + EEPROM already on board)	Dolphin V4 MAG S
STM 405J (STM 400J HW + EEPROM on customer board) <sup>1</sup>	Dolphin V4 USN S
TCM 415J (TCM410J HW + EEPROM on customer board) <sup>1</sup>	Dolphin V4 GatewayController Secured
USB 405J (USB 400J HW + EEPROM already on board)	Dolphin V4 GatewayController Secured

<sup>1</sup> Additional appropriate EEPROM must be therefore provided on the customer board.

### Some of the enhanced features Dolphin V4 (928 MHz) vs. Dolphin core<sup>2</sup>:

- V4 core has lower overall consumption:

Dolphin V4 – 928 MHz						Dolphin							
Symbol	Parameter	Conditions / Notes	Typ	Max	Units	Symbol	Parameter	Conditions / Notes	Min	Typ	Max	Units	
IDDOFF	Current Consumption "OFF Mode"	@ VDD=1 V @27 °C	75		nA	IDDOFF	Current Consumption "OFF Mode"	@ VDD=V <sub>OFF</sub> @ VDD=1 V @27 °C		200		nA	
IDDOS	Current Consumption "Deep Sleep Mode"	@27 °C @85 °C	100 350	130 1000	nA	IDDOS	Current Consumption "Deep Sleep Mode"	@27 °C @85 °C		220 2000	360 3100	nA	
IDDIS	Current Consumption "Flywheel Sleep Mode"	@27 °C @85 °C	720 1000	880 2000	nA	IDDIS	Current Consumption "Flywheel Sleep Mode"	@27 °C @85 °C		720 2300	1000 4000	nA	
IDDS	Current Consumption "Short Term Sleep Mode"	@27 °C @85 °C	4 15	5 20	µA	IDDS	Current Consumption "Short Term Sleep Mode"	@27 °C @85 °C		8 25	10 35	µA	
IDDSB	Current Consumption "Standby Mode"	Ultra low power blocks, voltage regulators and XTAL oscillator running	@27 °C @85 °C	1.0 1.2	1.2 1.8	mA	IDDSB	Current Consumption "Standby Mode"	Ultra low power blocks, voltage regulators and XTAL oscillator running		1.4	1.8	mA
IDDCPU	Current Consumption "CPU Mode"	Voltage regulators, XTAL, and CPU 8051 at 16.385 MHz	3.9	4.8	mA	IDDCPU	Current Consumption "CPU Mode"	Voltage regulators, XTAL, and CPU 8051 at 16 MHz		3.7	5.1	mA	
IDDTX	Current Consumption TX	@928.35 MHz, 125 kbps FSK, 0 dBm TX power, CPU stopped	23.1	25.9	mA	IDDTX	Current Consumption TX	@868 MHz and +6 dBm TX power during transmission of "H". CPU stopped		23.4	30	mA	
IDDRX	Current Consumption RX	@928.35 MHz, CPU stopped	26.5	29.8	mA	IDDRX	Current Consumption RX	@868 MHz CPU stopped		27.4	40	mA	

- V4 core is 4 times faster
- V4 Radio settings stored separately by EnOcean
- V4 core ADC now with Rail to Rail measurement.
- V4 core 64 kb and 2 RAM (both 2 times larger vs. current Dolphin core)

### Implicated consequences

Updated EnOcean Specifications & Protocols (especially ERP2, ESP3 and EEP), new specific Development Tools (API V4 core related similar to the Dolphin API ones).

<sup>2</sup> More details see [4].

## EnOcean 928 MHz (Dolphin V4) - Migration Overview

### Required Software Tools

1. **Dolphin V4 API** for 928 MHz has similar interfaces as 868 MHz / 315 MHz / 902 MHz did. Porting existing custom application on the new platform is enabled.  
Overview changes/differences to Dolphin API:  
<http://www.enocean.com/fileadmin/redaktion/support/dolphinv4-api/changes13page.html>
2. **Dolphin V4 Suite:**  
DolphinStudio will be replaced by the Tool Chain **Dolphin V4 Suite**. Unlike DolphinStudio, Dolphin V4 Suite will have these separate, V4 core specific SW toolsets:
  - Programmer
  - API Configurator
  - Module Configurator
  - Calibration
3. **DolphinView:** remains the same, shows the 928 MHz ERP2 Telegrams too.

### Further V4 related specific notes

- 48 bit ID instead of 32 bit: 'J' Modules must have 48 bit IDs. The 48 bit ID is however not used in all radio telegrams – e.g. a Teach-In telegram with 48 ID bit is enough.

- Maturity time parameters:

The time frame shall be used for sending a maximum of 3 sub-telegrams. Same timing applies for repeaters, only 1 level supported at 928 MHz for ARIB compliance.

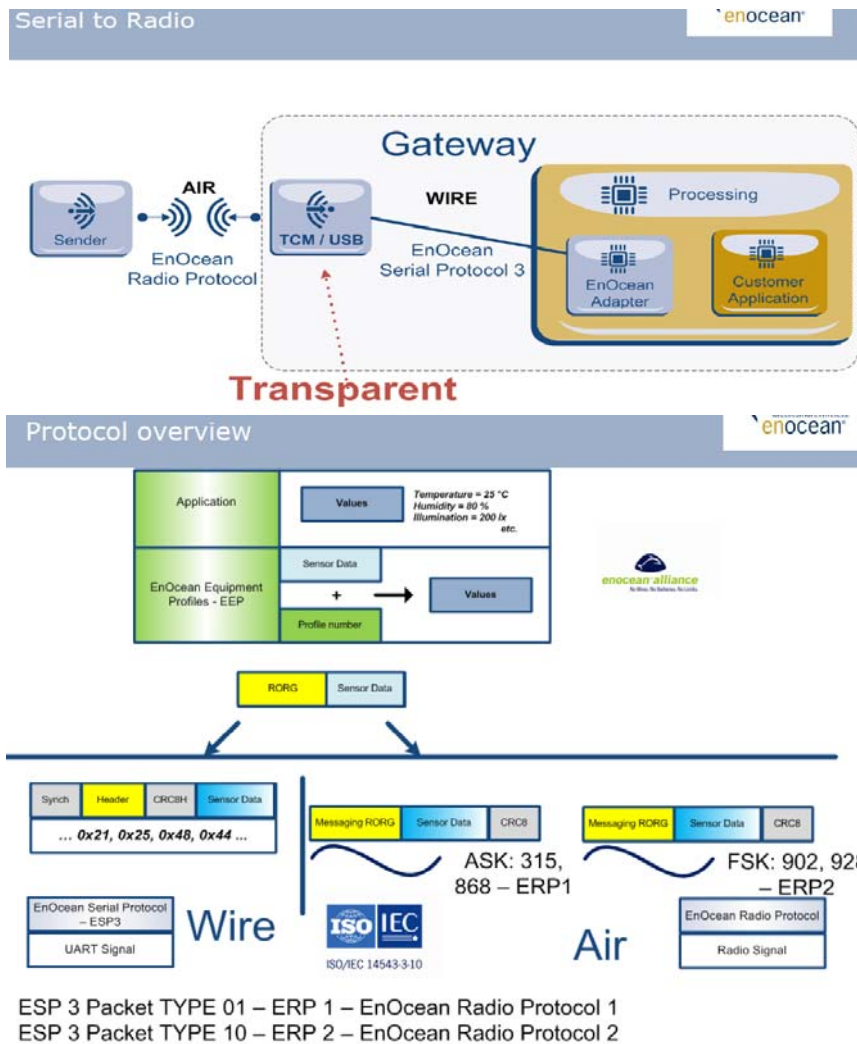
Description	Parameter
TX maturity time	25 ms
RX maturity time	100 ms

Backgrounds therefore see ERP2 specification, e.g. limitations for Japan compliance: "Redundant transmissions (means also repeating!) shall be finished within 50 ms. After the last transmission no transmission is allowed for 50 ms".

- EEP new F6-RPS profiles coding for ERP2, also see updated EEP [3]
- Security: security concept for EnOcean "J" devices is the same as for all other frequencies.

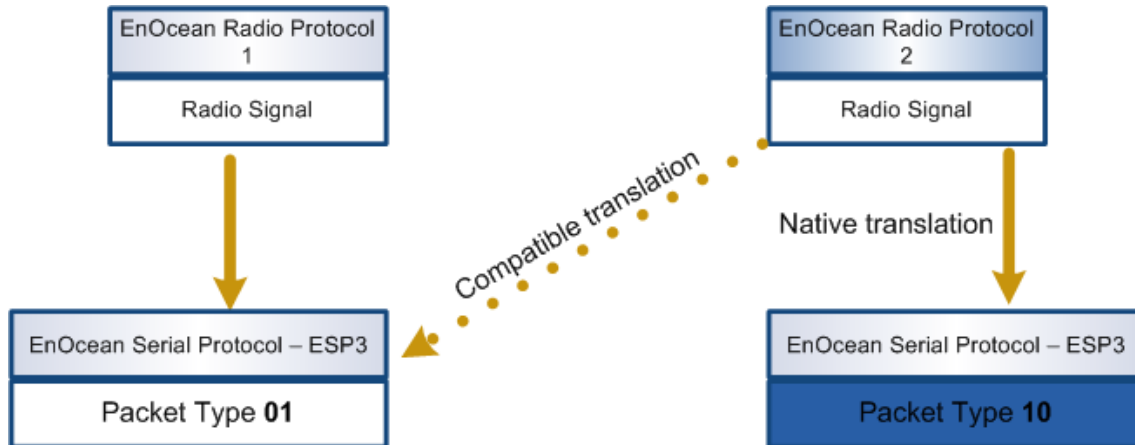
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### 4. Important aspects regarding FW migration from Dolphin platforms to Dolphin V4 (Gateway, Radio / Serial translation):



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### ERP Overview:



### Ways to change the gateway serial communication mode (e.g. for TCM 410J):

- Through serial command (see ESP3, volatile change, non permanent):

Code 28: CO\_WR\_MODE

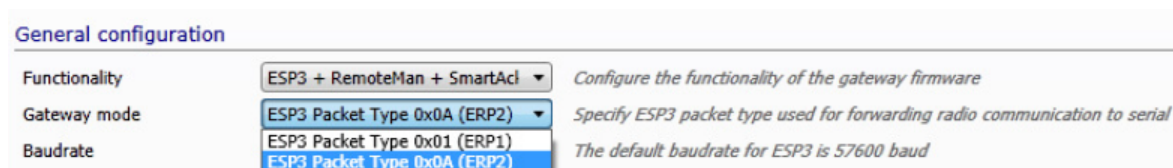
Function: Sets the gateway transceiver mode.

There are two modes available:

- Compatible mode - ERP1 - gateway uses Packet Type 1 to transmit and receive radio telegrams – for ASK products
- Advanced mode – ERP2 - gateway uses Packet Type 10 to transmit and receive radio telegrams – for FSK products with advanced protocol

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x1C	CO_WR_MODE = 28
	6	1	Mode	0xnn	0x00 – Compatible mode (default) - ERP1 0x01 – Advanced mode - ERP2
-	7	1	CRC8D	0xnn	

- Through Dolphin V4 Suite / Module Configurator (configuration, permanent change)



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**Backgrounds to the different Telegram Packet Types used, also see [1]**

### Serial Packet Types:

Type No.	Value hex	Name	Description
0	0x00	---	Reserved
1	0x01	RADIO	Radio telegram (ERP1)
2	0x02	RESPONSE	Response to any packet
3	0x03	RADIO_SUB_TEL	Radio subtelegram
4	0x04	EVENT	Event message
5	0x05	COMMON_COMMAND	Common command
6	0x06	SMART_ACK_COMMAND	Smart Ack command
7	0x07	REMOTE_MAN_COMMAND	Remote management command
8	0x08	---	Reserved for EnOcean
9	0x09	RADIO_MESSAGE	Radio message
10	0x0A	RADIO_ADVANCED	Advanced protocol radio telegram (ERP2)
11 ... 127	0x08 ... 7F	---	Reserved for EnOcean
128...255	0x80 ... FF	available	Manufacturer specific commands and messages

Background: ARIB STD-T108 (Japanese) compliance requires 48 bit (instead of 32) device ID, therefore the shorter, up to date default used Packet Type 01 (RADIO) cannot be used anymore.

### EEP updated: Special Note regarding all F6-RPS profiles by ERP2 migration:

With ERP2 all current EnOcean EEPs and Protocols can be used as before with one exception, the RPS profiles. The ERP2 does not use the same RPS telegram coding anymore which ERP1 does.

The biggest difference is the usage of the Status Field. The Status Field in ERP2 is now defined as a Repeater Count field (also other position in the telegram!). Other functionalities and fields T21 and NU are no longer needed either, therefore a new encoding was developed.

Background: EEP describes an equipment – device – application. The meaning of the payload data did not change, only its coding. The logic and semantic of the application remains still the same. So it is defined that RPS profiles on ERP2 have different coding of the actual telegram data, but the logic remains the same on ERP1 and ERP2. The new RPS coding for ERP2 is published as new profiles in the EEP specification. This was required to keep the same interfaces on the EEP processing (e.g. existing gateways / IP gateways –additional information like which radio protocol was used – ERP1 / ERP2 is not relevant for the end application).

The new specific RPS profiles added according ERP2 (RPS new coding) are currently:

F6-02-04 - Light and Blind Control ERP2	(pendant for ERP1: F6-02-01)
F6-04-02 - Key Card Activated Switch ERP2	(pendant for ERP1: F6-04-01)
F6-10-01 - Window Handle ERP2	(pendant for ERP1: F6-10-00)



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### Final Conclusions

In TCM 4XXJ and USB 4XXJ, the ERP2 radio telegrams put on the serial interface ESP3 can be “translated” to Packet Type 01 (=RADIO) for compatibility to an existing application. However the native Packet Type for “J” devices is always Type 10 (=RADIO\_ADVANCED). We recommend therefore using Packet Type 10 in all new product developments. (“Compatible mode” limits the types of the handled telegrams due to limited data length and is available only to easy porting of already existing product variants to 928 MHz. It is actually not recommended for new developments).

The EDK PCB board (HW) as well as the DolphinView Tool (FW) are device independent and unique and will be used for all Dolphin / Dolphin V4 core based frequency variants.

The Dolphin V4 core based single “J” devices (customer functionality, security options, radio and serial communication packet type) are quite similar but in deeper detail however, ERP, ESP, EEP (see RPS profiles), Frequency, Application and Compliancy requirement specific.

This overview tries to point out the most important aspects and bundle the relevant documentation sources as well as to explain the specific difference reasons and motivations. It is intended as a first reference source for an easier device design start and / or migration.

If you have further questions or support queries, please visit the EnOcean website, especially the support area at <http://www.enocean.com/en/support/> or contact the application engineering team at EnOcean: [support@enocean.com](mailto:support@enocean.com)

### Disclaimer

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