Extra manufacturer Data

This page describes the data format of the extra manufacturer data that can be added to the Victron Manufacturer Data record type 0x10 - Product Advertisement.

The block of extra data is called a record and it starts with the following data:

| Start bit	Nr of bits	Meaning
0	8	Record type
8	16	Nonce/Data counter in LSB order
24	8	Byte 0 of the encryption key

The record type can be one of the following:

Value	Record type
0x00	Test record
0x01	Solar Charger
0x02	Battery Monitor
0x03	Inverter
0x04	DC/DC converter
0x05	SmartLithium
0x06	Inverter RS
0x07	GX-Device (Record layout TBD)
0x08	AC Charger (Record layout TBD)
0x09	Smart Battery Protect
0x0A	(Lynx Smart) BMS
0x0B	Multi RS
0x0C	VE.Bus
0x0D	DC Energy Meter
0x0E..0xFF	Unassigned / Reserved for future extensions Possibly with a second type byte

The nonce/data counter in the header is used in the encryption to make the result of the encryption a little more random. This way, somebody that does not have the encryption key has to wait almost a day (assuming a change every second) for the same nonce value before more information can be extracted. What can be extracted in that case is only which bits have changed, but not the final value. For some things the exact value might be deducible after 1 message. For example, the MPPT state is likely to be off in the middle of the night. This would allow someone to determine the exact value of the state when the same nonce is received at a later moment. It however does not give any information on the encryption key or other fields of the record.

The first byte of the encryption key is included in the message. This can be used by the receiving side to check if the key that they have matches the key that was used for the encoding. When this byte does not match the key as stored on the receiving device, then the stored key should be discarded and the device should stop trying to decode the advertisement. The advertising device should change the key when the bluetooth pin code is changed. This keeps the knowledge of the correct key in sync with phones that are also bonded meaning that a phone that can connect can also decode the advertisement messages. The advertising device should limit the chance of re-using a value for the

first byte, for example by simply incrementing the firsts byte when generating a new key instead of taking a random value. When a key is not stored, a complete random key should be generated.

The encryption is done using a AES-CTR operation ([AES-CTR on wikipedia](#))
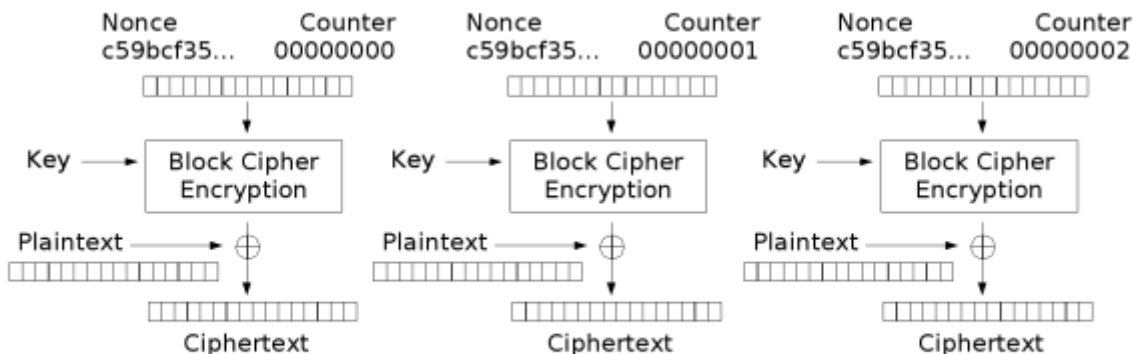
Counter (CTR) mode encryption

In the case of the extra advertisement data, the nonce is 2 bytes wide and contains the nonce bytes of the record header. The counter field of the AES-CTR operation is a MSB counter that starts at 0. Records that contain 16 bytes of data or less can be encrypted/decrypted using 1 AES operation. At the moment, this is true for all records.

The maximum length of a record is 20 bytes for the nRF devices. This maybe less for a GX-Device (TBD!!).

The layout of a record is never changed, it can however be extended in the future. This means that an implementation should not perform an upper bound check on the length. As the length is not fixed and items can be added, a length check should be performed for all items when retrieving data from the record.

Unused bits in the last byte of a record should be set. This also means that when a record is extended, care should be taken with the NA value, such that when the new field does not cross a byte boundary, the receiver should be able to use the NA value to determine in the field is actually set or not.

Test record

This is used by software test applications

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	30	Uptime	1 s	0 .. 34 year	0x3FFFFFFF	VE_REG_UPTIME
62	7	Temperature	1 °C	-40 .. 86 °C	0xFF	VE_REG_BAT_TEMPERATURE Temperature = Record value - 40
69	91	Unused				

Solar Charger

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	8	Device state		0 .. 0xFE	0xFF	VE_REG_DEVICE_STATE
40	8	Charger Error		0 .. 0xFE	0xFF	VE_REG_CHR_ERROR_CODE
48	16	Battery voltage	0.01 V	-327.68 .. 327.66 V	0x7FFF	VE_REG_DC_CHANNEL1_VOLTAGE
64	16	Battery current	0.1A	-3276.8 .. 3276.6 A	0x7FFF	VE_REG_DC_CHANNEL1_CURRENT Also negative current because of a possibly connected load
80	16	Yield today	0.01 kWh	0 .. 655.34 kWh	0xFFFF	VE_REG_CHR_TODAY_YIELD 655.34 kWh is 27.3 kW@24h
96	16	PV power	1 W	0 .. 65534 W	0xFFFF	VE_REG_DC_INPUT_POWER (un32 @ 0.01W)
112	9	Load current	0.1 A	0 .. 51.0 A	0x1FF	VE_REG_DC_OUTPUT_CURRENT
121	39	Unused				

Battery Monitor

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	16	TTG	1min	0 .. 45.5 days	0xFFFF	VE_REG_TTG
48	16	Battery voltage	0.01 V	-327.68 .. 327.66 V	0x7FFF	VE_REG_DC_CHANNEL1_VOLTAGE
64	16	Alarm reason		0 .. 0xFFFF	-	VE_REG_ALARM_REASON
80	16	Aux voltage Mid voltage Temperature	0.01 V 0.01 V 0.01 K	-327.68 .. 327.64 V 0 .. 655.34 V 0 .. 655.34 K	-	VE_REG_DC_CHANNEL2_VOLTAGE VE_REG_BATTERY_MID_POINT_VOLTAGE VE_REG_BAT_TEMPERATURE
96	2	Aux input		0 .. 3	0x3	VE_REG_BMV_AUX_INPUT 0 ⇒ Aux voltage : VE_REG_DC_CHANNEL2_VOLTAGE 1 ⇒ Mid voltage : VE_REG_BATTERY_MID_POINT_VOLTAGE 2 ⇒ Temperature : VE_REG_BAT_TEMPERATURE 3 ⇒ none
98	22	Battery current	0.001A	-4194 .. 4194 A	0x3FFFFF	VE_REG_DC_CHANNEL1_CURRENT_MA
120	20	Consumed Ah	0.1 Ah	-104,857 .. 0 Ah	0xFFFFF	VE_REG_CAH Consumed Ah = -Record value
140	10	SOC	0.1%	0 .. 100.0%	0x3FF	VE_REG_SOC
150	10	Unused				

Inverter

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	8	Device state		0 .. 0xFE	0xFF	VE_REG_DEVICE_STATE
40	16	Alarm Reason		0 .. 0xFFFF	-	VE_REG_ALARM_REASON
56	16	Battery voltage	0.01 V	-327.68 .. 327.66 V	0x7FFF	VE_REG_DC_CHANNEL1_VOLTAGE
72	16	AC Apparent power	1 VA	0 .. 65534 VA	0xFFFF	VE_REG_AC_OUT_APPARENT_POWER
88	15	AC voltage	0.01 V	0 .. 327.66 V	0x7FFF	VE_REG_AC_OUT_VOLTAGE
103	11	AC current	0.1 A	0 .. 204.6 A	0x7FF	VE_REG_AC_OUT_CURRENT
114	46	Unused				

DC/DC Converter

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	8	Device state		0 .. 0xFE	0xFF	VE_REG_DEVICE_STATE
40	8	Charger Error		0 .. 0xFE	0xFF	VE_REG_CHR_ERROR_CODE
48	16	Input voltage	0.01 V	0 .. 655.34 V	0xFFFF	VE_REG_DC_INPUT_VOLTAGE
64	16	Output voltage	0.01 V	-327.68 .. 327.66 V	0x7FFF	VE_REG_DC_CHANNEL1_VOLTAGE
80	32	Off reason		0 .. 0xFFFFFFFF	-	VE_REG_DEVICE_OFF_REASON_2
112	48	Unused				

SmartLithium

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	32	BMS flags		0 .. 0xFFFFFFFF		VE_REG_BMS_FLAGs
64	16	SmartLithium error		0 .. 0xFFFF		VE_REG_SMART_LITHIUM_ERROR_FLAGS
80	7	Cell 1	0.01V	2.60 .. 3.86 V	0xFF	VE_REG_BATTERY_CELL_VOLTAGE*
87	7	Cell 2	0.01V	2.60 .. 3.86 V	0xFF	VE_REG_BATTERY_CELL_VOLTAGE*
94	7	Cell 3	0.01V	2.60 .. 3.86 V	0xFF	VE_REG_BATTERY_CELL_VOLTAGE*
101	7	Cell 4	0.01V	2.60 .. 3.86 V	0xFF	VE_REG_BATTERY_CELL_VOLTAGE*
108	7	Cell 5	0.01V	2.60 .. 3.86 V	0xFF	VE_REG_BATTERY_CELL_VOLTAGE*
115	7	Cell 6	0.01V	2.60 .. 3.86 V	0xFF	VE_REG_BATTERY_CELL_VOLTAGE*
122	7	Cell 7	0.01V	2.60 .. 3.86 V	0xFF	VE_REG_BATTERY_CELL_VOLTAGE*
129	7	Cell 8	0.01V	2.60 .. 3.86 V	0xFF	VE_REG_BATTERY_CELL_VOLTAGE*
136	12	Battery voltage	0.01 V	0 .. 40.94 V	0x0FFF	VE_REG_DC_CHANNEL1_VOLTAGE
148	4	Balancer status		0 .. 15	0x0F	VE_REG_BALANCER_STATUS
152	7	Battery temperature	1 °C	-40 .. 86 °C	0x7F	VE_REG_BAT_TEMPERATURE Temperature = Record value - 40
159	1	Unused				

* VE_REG_BATTERY_CELL_VOLTAGE
0x00 (0) when cell voltage < 2.61V
0x01 (1) when cell voltage == 2.61V
0x7D (125) when cell voltage == 3.85V
0x7E (126) when cell voltage > 3.85
0x7F (127) when cell voltage is not available / unknown

Inverter RS

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	8	Device state		0 .. 0xFE	0xFF	VE_REG_DEVICE_STATE
40	8	Charger Error		0 .. 0xFE	0xFF	VE_REG_CHR_ERROR_CODE
48	16	Battery voltage	0.01 V	-327.68 .. 327.66 V	0x7FFF	VE_REG_DC_CHANNEL1_VOLTAGE
64	16	Battery current	0.1A	-3276.8 .. 3276.6 A	0x7FFF	VE_REG_DC_CHANNEL1_CURRENT
80	16	PV power	1 W	0 .. 65,534 W	0xFFFF	VE_REG_DC_INPUT_POWER
96	16	Yield today	0.01 kWh	0 .. 655.34 kWh	0xFFFF	VE_REG_CHR_TODAY_YIELD 655.34 kWh is 27.3 kW@24h
112	16	AC out power	1 W	-32,768 .. 32,766 W	0x7FFF	VE_REG_AC_OUT_REAL_POWER
128	32	Unused				

GX-Device

Record layout is still to be determined and might change.

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	16	Battery voltage	0.01 V	0 .. 655.34 V	0xFFFF	VE_REG_DC_CHANNEL1_VOLTAGE
48	20	PV power	W	0 .. 1 MW	0xFFFFF	VE_REG_DC_INPUT_POWER
68	7	SOC	1%	0 .. 100%	0x7F	VE_REG_SOC
75	21	Battery power	W	-1 .. 1 MW	0x0FFFFF	VE_REG_DC_CHANNEL1_POWER
96	21	DC power	W	-1 .. 1 MW	0x0FFFFF	
		TBD - AC in power				
		TBD - AC out power				
		TBD - Warnings / Alarms				
		TBD				
117	43	Unused				

AC Charger

Record layout is still to be determined and might change.

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	8	Device state		0 .. 0xFE	0xFF	VE_REG_DEVICE_STATE
40	8	Charger Error		0 .. 0xFE	0xFF	VE_REG_CHR_ERROR_CODE
48	13	Battery voltage 1	0.01 V	0 .. 81.90 V	0x1FFF	VE_REG_DC_CHANNEL1_VOLTAGE
61	11	Battery current 1	0.1A	0 .. 204.6 A	0x7FF	VE_REG_DC_CHANNEL1_CURRENT
72	13	Battery voltage 2	0.01 V	0 .. 81.90 V	0x1FFF	VE_REG_DC_CHANNEL2_VOLTAGE
85	11	Battery current 2	0.1A	0 .. 204.6 A	0x7FF	VE_REG_DC_CHANNEL2_CURRENT
96	13	Battery voltage 3	0.01 V	0 .. 81.90 V	0x1FFF	VE_REG_DC_CHANNEL3_VOLTAGE
109	11	Battery current 3	0.1A	0 .. 204.6 A	0x7FF	VE_REG_DC_CHANNEL3_CURRENT
120	7	Temperature	°C	-40 .. 86 °C	0x7F	VE_REG_BAT_TEMPERATURE Temperature = Record value - 40
127	9	AC current	0.1A	0 .. 51.0 A	0x1FF	VE_REG_AC_ACTIVE_INPUT_L1_CURRENT
136	24	Unused				

Smart Battery Protect

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
8	8	Device state		0 .. 0xFE	0xFF	VE_REG_DEVICE_STATE
16	8	Output state		0 .. 0xFE	0xFF	VE_REG_DC_OUTPUT_STATUS
24	8	Error code		0 .. 0xFE	0xFF	VE_REG_CHR_ERROR_CODE
32	16	Alarm reason		0 .. 0xFFFF	-	VE_REG_ALARM_REASON
48	16	Warning reason		0 .. 0xFFFF	-	VE_REG_WARNING_REASON
64	16	Input voltage	0.01 V	327.68 .. 327.66 V	0x7FFF	VE_REG_DC_CHANNEL1_VOLTAGE
80	16	Output voltage	0.01 V	0 .. 655.34 V	0xFFFF	VE_REG_DC_OUTPUT_VOLTAGE
96	32	Off reason		0 .. 0xFFFFFFFF	-	VE_REG_DEVICE_OFF_REASON_2
128	32	Unused				

(Lynx Smart) BMS

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	8	Error			0x0	VE_REG_BMS_ERROR
40	16	TTG	1min	0 .. 45.5 days	0xFFFF	VE_REG_TTG
56	16	Battery voltage	0.01 V	-327.68 .. 327.66 V	0x7FFF	VE_REG_DC_CHANNEL1_VOLTAGE
72	16	Battery current	0.1A	-3276.8 .. 3276.6	0x7FFF	VE_REG_DC_CHANNEL1_CURRENT

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
88	16	IO status			0x0	VE_REG_BMS_IO
104	18	Warnings/Alarms			0x0	VE_REG_BMS_WARNINGS_ALARMS
122	10	SOC	0.1%	0 .. 100.0%	0x3FF	VE_REG_SOC
132	20	Consumed Ah	0.1 Ah	-104,857 .. 0 Ah	0xFFFFF	VE_REG_CAH Consumed Ah = -Record value
152	7	Temperature	°C	-40 .. 86 °C	0x7F	VE_REG_BAT_TEMPERATURE Temperature = Record value - 40
159	1	Unused				

Multi RS

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	8	Device state		0 .. 0xFE	0xFF	VE_REG_DEVICE_STATE
40	8	Charger Error		0 .. 0xFE	0xFF	VE_REG_CHR_ERROR_CODE
48	16	Battery current	0.1A	-3276.8 .. 3276.6 A	0x7FFF	VE_REG_DC_CHANNEL1_CURRENT
64	14	Battery voltage	0.01 V	0 .. 163.83 V	0x3FFF	VE_REG_DC_CHANNEL1_VOLTAGE
78	2	Active AC in		0 .. 3	0x3	VE_REG_AC_IN_ACTIVE 0 = AC in 1, 1 = AC in 2, 2 = Not connected, 3 = unknown
80	16	Active AC in power	1 W	-32,768 .. 32,766 W	0x7FFF	VE_REG_AC_IN_1_REAL_POWER or VE_REG_AC_IN_2_REAL_POWER, depending on VE_REG_AC_IN_ACTIVE
96	16	AC out power	1 W	-32,768 .. 32,766 W	0x7FFF	VE_REG_AC_OUT_REAL_POWER
112	16	PV power	1 W	0 .. 65534 W	0xFFFF	VE_REG_DC_INPUT_POWER
128	16	Yield today	0.01 kWh	0 .. 655.34 kWh	0xFFFF	VE_REG_CHR_TODAY_YIELD 655.34 kWh is 27.3 kW@24h
144	16	Unused				

VE.Bus

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	8	Device state		0 .. 0xFE	0xFF	VE_REG_DEVICE_STATE
40	8	VE.Bus error		0 .. 0xFE	0xFF	VE_REG_VEBUS_VEBUS_ERROR
48	16	Battery current	0.1A	-3276.8 .. 3276.6 A	0x7FFF	VE_REG_DC_CHANNEL1_CURRENT
64	14	Battery voltage	0.01 V	0 .. 163.83 V	0x3FFF	VE_REG_DC_CHANNEL1_VOLTAGE

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
78	2	Active AC in		0 .. 3	0x3	VE_REG_AC_IN_ACTIVE 0 = AC in 1, 1 = AC in 2, 2 = Not connected, 3 = unknown
80	19	Active AC in power	1 W	-262,144 .. 262,142 W	0x3FFFF	VE_REG_AC_IN_1_REAL_POWER or VE_REG_AC_IN_2_REAL_POWER, depending on VE_REG_AC_IN_ACTIVE
99	19	AC out power	1 W	-262,144 .. 262,142 W	0x3FFFF	VE_REG_AC_OUT_REAL_POWER
118	2	Alarm		0 .. 2	3	VE_REG_ALARM_NOTIFICATION (to be defined) 0 = no alarm, 1 = warning, 2 = alarm
120	7	Battery temperature	1 °C	-40 .. 86 °C	0x7F	VE_REG_BAT_TEMPERATURE Temperature = Record value - 40
127	7	SOC	1 %	0 .. 126 %	0x7F	VE_REG_SOC
134	26	Unused				

DC Energy Meter

Start bit	Nr of bits	Meaning	Units	Range	NA value	Remark
32	16	BMV monitor mode		–32768 .. 32767	-	VE_REG_BMV_MONITOR_MODE
48	16	Battery voltage	0.01 V	-327.68 .. 327.66 V	0x7FFF	VE_REG_DC_CHANNEL1_VOLTAGE
64	16	Alarm reason		0 .. 0xFFFF	-	VE_REG_ALARM_REASON
80	16	Aux voltage Temperature	0.01 V 0.01 K	-327.68 .. 327.64 V 0 .. 655.34 K	-	VE_REG_DC_CHANNEL2_VOLTAGE VE_REG_BAT_TEMPERATURE
96	2	Aux input		0 .. 3	0x3	VE_REG_BMV_AUX_INPUT 0 ⇒ Aux voltage : VE_REG_DC_CHANNEL2_VOLTAGE 2 ⇒ Temperature : VE_REG_BAT_TEMPERATURE 3 ⇒ none
98	22	Battery current	0.001A	-4194 .. 4194 A	0x3FFFFF	VE_REG_DC_CHANNEL1_CURRENT_MA
120	40	Unused				