INTEGRA METERING

CALEC® ST III

Standard & Smart

Multi-protocol heating and cooling energy calculator

Protocol description LoRaWAN

Contents

Legal notice

Document release index

Version	Date	Modifications(s)
01	18.05.2021	First release
02	19.05.2021	Correction in the data sequences
03	22.09.2021	Since FW > 3.01.05 ; Frame content aligned CALEC STII & CALEC STIII

Original instructions

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The figures and information in these instructions are subject to technical changes that become necessary to improve the product.

1. General Information

This manual contains only specific information about the CALEC® ST III with LoRa Interface. Further information can be found in the CALEC® ST III technical documentation (Installation guide, User manual or Technical datasheet).

REFERENCE

Additional documents can be found on the following website:

CALEC® ST III Standard & Smart INTEGRA Metering (integra-metering.com)

For information about the LoRaWAN specification, see : LoRaWAN for Developers - LoRa Alliance® (lora-alliance.org)

2. CALEC® ST III LoRa Information

LoRaWAN is an innovation that offers many advantages over conventional radio transmission technologies. The main advantages of this technology are its enormous range and low energy consumption. A disadvantage, however, is that no large amounts of data can be transmitted. Therefore, it is mandatory to select properly the right settings in terms of data transmission.

CALEC ST III offers various data sets (See below table) and can be freely selected.

In case of difficulties of communication, “compact frame” is a preferable solution, where data is compacted and result to a shorted frame length, therefore a better radio link.

In “Standard frame” mode, if the device are below to DR_3, to fulfil automatically LoRaWAN specification, the device switch to the SET 1 frame instead of the selected one.

Notes:

- It’s highly recommended to use compact frame setting, because with limited SF (in case of standard frame) performance is limited (and not sufficient for public networks).

		Minimal Bytes	Maximal Bytes	Value	Remark	Include in type
Message header (always transmitted during transmission)	L-Field	1	1	LEN	Number of following bytes	All
	C-Field	1	1	0x44	Specification of the message form (Fix 0x44) = SEND/NO REPLY	All
	M-Field	2	2	0x25b4 (IMT)	Manufacturer	All
	Sec. Addr. Field	4	4	IDENT	Secondary address of the Calculator	All

	Version	1	1	DEV	Device type (from Calculator)	All
	Medium	1	1	MED	Device type	
					0x04 = Return (Warm water)	All except C2, C3
					0x0c = Flow	Not used
					0x07 = Water	C2, C3
	CI-Field	1	1	0x7A	Short Header	All
	Access-Counter	1	1	ACC	Access counter, increment per readout	All
	Status	1	1	STAT	Bit 0-2 = not used Bit 3 = permanent error Bit 4 = temporary error Bit 5-7 = not used (Status according to EN13757)	All
	Signature	2	2	0000h	Not used	All
	Sum	**15**	**15**			
SET 1 (Default, Minimal set):						
Energy reading	DIF	1	1	0x04		All except C2, C3
	VIF	1	2		Depends on Unit:	All except C2, C3
				0x03	0.001 kWh (10^0 Wh)	
				0x04	0.01 kWh (10^1 Wh)	
				0x05	0.1 kWh (10^2 Wh)	
				0x06	0.001MWh / 1 kWh (10^3 Wh)	
				0x07	0.01 MWh (10^4 Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^0 MWh)	
				0x0b	0.001 MJ (10^3 J)	
				0x0c	0.01 MJ (10^4 J)	
				0x0d	0.1 MJ (10^5 J)	
				0x0e	0.001 GJ / 1 MJ (10^6 J)	
				0x0f	0.01 GJ (10^7 J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^0 GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^0 kBTU)	
				0x843d	0.01 MBTU (10^1 kBTU)	
				0x853d	0.1 MBTU (10^5 kBTU)	
				0x863d	1 MBTU (10^6 kBTU)	
	Value	4	4	INT4	(Energy reading pos. / neg.)	All except C2, C3
Current Date and Time (Timestamp)	DIF	1	1	0x04		all
	VIF	1	1	0x6d		all
	Value	4	4	INT4	MBus typ F format	I
Fabrication number	DIF	1	1	0x0c		all
	VIF	1	1	0x78		all

	VALUE	4	4	BCD8		all
	Sum	**33**	**34**		incl. Funk Header	
SET 2:						
Main Energy	DIF	1	1	0x04		All except C2, C3
	VIF	1	2		Depends on Unit:	All except C2, C3
				0x03	0.001 kWh (10^0 Wh)	
				0x04	0.01 kWh (10^1 Wh)	
				0x05	0.1 kWh (10^2 Wh)	
				0x06	0.001MWh / 1 kWh (10^3 Wh)	
				0x07	0.01 MWh (10^4 Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^0 MWh)	
				0x0b	0.001 MJ (10^3 J)	
				0x0c	0.01 MJ (10^4 J)	
				0x0d	0.1 MJ (10^5 J)	
				0x0e	0.001 GJ / 1 MJ (10^6 J)	
				0x0f	0.01 GJ (10^7 J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^0 GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^0 kBTU)	
				0x843d	0.01 MBTU (10^1 kBTU)	
				0x853d	0.1 MBTU (10^5 kBTU)	
				0x863d	1 MBTU (10^6 kBTU)	
	Value	4	4	INT4	(Energy reading pos. / neg.)	All except C2, C3
Flow [l/h]	DIF	1	1	0x05		All except C1
	VIF	1	1	0x3b		All except C1
	Value	4	4	Float		All except C1
Flow temperature [°C]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x5b		All except C2, C3
	Value	4	4	Float		All except C2, C3
Return temperature [°C]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x5f		All except C2, C3
	Value	4	4	Float		All except C2, C3
Current Date and Time (TimeStamp)	DIF	1	1	0x04		all
	VIF	1	1	0x6d		all
	Value	4	4	INT4	MBus typ F format	all
Fabrication number	DIF	1	1	0x0c		all
	VIF	1	1	0x78		all

	VALUE	4	4	BCD8		all
	Sum	**51**	**52**		incl. Funk Header	
SET 3:						
Energy reading	DIF	1	1	0x04		All except C2, C3
	VIF	1	2		Depends on Unit:	All except C2, C3
				0x03	0.001 kWh (10^0 Wh)	
				0x04	0.01 kWh (10^1 Wh)	
				0x05	0.1 kWh (10^2 Wh)	
				0x06	0.001MWh / 1 kWh (10^3 Wh)	
				0x07	0.01 MWh (10^4 Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^0 MWh)	
				0x0b	0.001 MJ (10^3 J)	
				0x0c	0.01 MJ (10^4 J)	
				0x0d	0.1 MJ (10^5 J)	
				0x0e	0.001 GJ / 1 MJ (10^6 J)	
				0x0f	0.01 GJ (10^7 J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^0 GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^0 kBTU)	
				0x843d	0.01 MBTU (10^1 kBTU)	
				0x853d	0.1 MBTU (10^5 kBTU)	
				0x863d	1 MBTU (10^6 kBTU)	
	Value	4	4	INT4	(Energy reading pos. / neg.)	All except C2, C3
Energy Tariff 1	DIF	2	2	0x84, 0x10		C4, C7, C9, CC
	VIF	1	2		Depends on Unit:	C4, C7, C9, CC
				0x03	0.001 kWh (10^0 Wh)	
				0x04	0.01 kWh (10^1 Wh)	
				0x05	0.1 kWh (10^2 Wh)	
				0x06	0.001MWh / 1 kWh (10^3 Wh)	
				0x07	0.01 MWh (10^4 Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^0 MWh)	
				0x0b	0.001 MJ (10^3 J)	
				0x0c	0.01 MJ (10^4 J)	
				0x0d	0.1 MJ (10^5 J)	
				0x0e	0.001 GJ / 1 MJ (10^6 J)	
				0x0f	0.01 GJ (10^7 J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^0 GJ)	

				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^{0} kBTU)	
				0x843d	0.01 MBTU (10^{1} kBTU)	
				0x853d	0.1 MBTU (10^{5} kBTU)	
				0x863d	1 MBTU (10^{6} kBTU)	
	Value	4	4	INT4		C4, C7, C9, CC
Energy Tariff 2	DIF	2	2	0x84, 0x20		C7, CC
	VIF	1	2		Depends on Unit:	C7, CC
				0x03	0.001 kWh (10^{0} Wh)	
				0x04	0.01 kWh (10^{1} Wh)	
				0x05	0.1 kWh (10^{2} Wh)	
				0x06	0.001MWh / 1 kWh (10^{3} Wh)	
				0x07	0.01 MWh (10^{4} Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^{0} MWh)	
				0x0b	0.001 MJ (10^{3} J)	
				0x0c	0.01 MJ (10^{4} J)	
				0x0d	0.1 MJ (10^{5} J)	
				0x0e	0.001 GJ / 1 MJ (10^{6} J)	
				0x0f	0.01 GJ (10^{7} J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^{0} GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^{0} kBTU)	
				0x843d	0.01 MBTU (10^{1} kBTU)	
				0x853d	0.1 MBTU (10^{5} kBTU)	
				0x863d	1 MBTU (10^{6} kBTU)	
	Value	4	4	INT4		C7, CC
Main volume	DIF	1	1	0x04		All except C1
	VIF	1	2		Depends on Unit:	All except C1
				0x13	0.001 m3 (10^{-3} m^3)	
				0x14	0.01 m3 (10^{-2} m^3)	
				0x15	0.1 m3 (10^{-1} m^3)	
				0x16	1 m3 (10^{0} m^3)	
				0x903d	0.001 USGAL (10^{-3} USGAL)	
				0x913d	0.01 USGAL (10^{-2} USGAL)	

				0x923d	0.1 USGAL (10^{-1} USGAL)	
				0x933d	1 USGAL (10^{0} USGAL)	
	Value	4	4	INT4		All except C1
Flow [l/h]	DIF	1	1	0x05		All except C1
	VIF	1	1	0x3b		All except C1
	Value	4	4	Float		All except C1
Current Date and Time (TimeStamp)	DIF	1	1	0x04		all
	VIF	1	1	0x6d		all
	Value	4	4	INT4	MBus typ F format	all
Fabrication number	DIF	1	1	0x0c		all
	VIF	1	1	0x78		all
	VALUE	4	4	BCD8		all
	Sum	**59**	**63**		incl. Funk Header	
SET 4:						
Main Energy	DIF	1	1	0x04		All except C2, C3
	VIF	1	2		Depends on Unit:	All except C2, C3
				0x03	0.001 kWh (10^{0} Wh)	
				0x04	0.01 kWh (10^{1} Wh)	
				0x05	0.1 kWh (10^{2} Wh)	
				0x06	0.001MWh / 1 kWh (10^{3} Wh)	
				0x07	0.01 MWh (10^{4} Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^{0} MWh)	
				0x0b	0.001 MJ (10^{3} J)	
				0x0c	0.01 MJ (10^{4} J)	
				0x0d	0.1 MJ (10^{5} J)	
				0x0e	0.001 GJ / 1 MJ (10^{6} J)	
				0x0f	0.01 GJ (10^{7} J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^{0} GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^{0} kBTU)	
				0x843d	0.01 MBTU (10^{1} kBTU)	
				0x853d	0.1 MBTU (10^{5} kBTU)	
				0x863d	1 MBTU (10^{6} kBTU)	
	Value	4	4	INT4	(Energy reading pos. / neg.)	All except C2, C3
Energy Tariff 1	DIF	2	2	0x84, 0x10		C4, C7, C9, CC
	VIF	1	2		Depends on Unit:	C4, C7, C9, CC
				0x03	0.001 kWh (10^{0} Wh)	

				0x04	0.01 kWh (10¹ Wh)	
				0x05	0.1 kWh (10² Wh)	
				0x06	0.001MWh / 1 kWh (10³ Wh)	
				0x07	0.01 MWh (10⁴ Wh)	
				0xfb00	0.1 MWh (10⁻¹ MWh)	
				0xfb01	1 MWh (10⁰ MWh)	
				0x0b	0.001 MJ (10³ J)	
				0x0c	0.01 MJ (10⁴ J)	
				0x0d	0.1 MJ (10⁵ J)	
				0x0e	0.001 GJ / 1 MJ (10⁶ J)	
				0x0f	0.01 GJ (10⁷ J)	
				0xfb08	0.1 GJ (10⁻¹ GJ)	
				0xfb09	1 GJ (10⁰ GJ)	
				0x803d	0.001 kBTU (10⁻³ kBTU)	
				0x813d	0.01 kBTU(10⁻² kBTU)	
				0x823d	0.1 kBTU(10⁻¹ kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10⁰ kBTU)	
				0x843d	0.01 MBTU (10¹ kBTU)	
				0x853d	0.1 MBTU (10⁵ kBTU)	
				0x863d	1 MBTU (10⁶ kBTU)	
	Value	4	4	INT4		C4, C7, C9, CC
Energy Tariff 2	DIF	2	2	0x84, 0x20		C7, CC
	VIF	1	2		Depends on Unit:	C7, CC
				0x03	0.001 kWh (10⁰ Wh)	
				0x04	0.01 kWh (10¹ Wh)	
				0x05	0.1 kWh (10² Wh)	
				0x06	0.001MWh / 1 kWh (10³ Wh)	
				0x07	0.01 MWh (10⁴ Wh)	
				0xfb00	0.1 MWh (10⁻¹ MWh)	
				0xfb01	1 MWh (10⁰ MWh)	
				0x0b	0.001 MJ (10³ J)	
				0x0c	0.01 MJ (10⁴ J)	
				0x0d	0.1 MJ (10⁵ J)	
				0x0e	0.001 GJ / 1 MJ (10⁶ J)	
				0x0f	0.01 GJ (10⁷ J)	
				0xfb08	0.1 GJ (10⁻¹ GJ)	
				0xfb09	1 GJ (10⁰ GJ)	
				0x803d	0.001 kBTU (10⁻³ kBTU)	
				0x813d	0.01 kBTU(10⁻² kBTU)	
				0x823d	0.1 kBTU(10⁻¹ kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10⁰ kBTU)	

				0x843d	0.01 MBTU (10^1 kBTU)	
				0x853d	0.1 MBTU (10^5 kBTU)	
				0x863d	1 MBTU (10^6 kBTU)	
	Value	4	4	INT4		C7, CC
Main Volume	DIF	1	1	0x04		All except C1
	VIF	1	2		Depends on Unit:	All except C1
				0x13	0.001 m3 (10^{-3} m^3)	
				0x14	0.01 m3 (10^{-2} m^3)	
				0x15	0.1 m3 (10^{-1} m^3)	
				0x16	1 m3 (10^0 m^3)	
				0x903d	0.001 USGAL (10^{-3} USGAL)	
				0x913d	0.01 USGAL (10^{-2} USGAL)	
				0x923d	0.1 USGAL (10^{-1} USGAL)	
				0x933d	1 USGAL (10^0 USGAL)	
	Value	4	4	INT4		All except C1
Main Masse	DIF	1	1	0x04		C1
	VIF	1	2		Depends on Unit:	C1
				0x1b	0.001 t (10^{-3} t)	
				0x1c	0.01 t (10^{-2} t)	
				0x1d	0.1 t (10^{-1} t)	
				0x1e	1 t (10^0 t)	
	Value	4	4	INT4		C1
Power [W]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x2b		All except C2, C3
	Value	4	4	Float		All except C2, C3
Flow [l/h]	DIF	1	1	0x05		All except C1
	VIF	1	1	0x3b		All except C1
	Value	4	4	Float		All except C1
Current Date and Time (TimeStamp)	DIF	1	1	0x04		All
	VIF	1	1	0x6d		All
	Value	4	4	INT4	MBus typ F format	All
Fabrication number	DIF	1	1	0x0c		All
	VIF	1	1	0x78		All
	VALUE	4	4	BCD8		All
	Sum	**71**	**76**		incl. Funk Header	
SET 5:						
Main Energy	DIF	1	1	0x04		All except C2, C3
	VIF	1	2		Depends on Unit:	All except C2, C3
				0x03	0.001 kWh (10^0 Wh)	
				0x04	0.01 kWh (10^1 Wh)	
				0x05	0.1 kWh (10^2 Wh)	
				0x06	0.001MWh / 1 kWh (10^3 Wh)	
				0x07	0.01 MWh (10^4 Wh)	

				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^{0} MWh)	
				0x0b	0.001 MJ (10^{3} J)	
				0x0c	0.01 MJ (10^{4} J)	
				0x0d	0.1 MJ (10^{5} J)	
				0x0e	0.001 GJ / 1 MJ (10^{6} J)	
				0x0f	0.01 GJ (10^{7} J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^{0} GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^{0} kBTU)	
				0x843d	0.01 MBTU (10^{1} kBTU)	
				0x853d	0.1 MBTU (10^{5} kBTU)	
				0x863d	1 MBTU (10^{6} kBTU)	
	Value	4	4	INT4	(Energy reading pos. / neg.)	All except C2, C3
Energy Tariff 1	DIF	2	2	0x84, 0x10		C4, C7, C9, CC
	VIF	1	2		Depends on Unit:	C4, C7, C9, CC
				0x03	0.001 kWh (10^{0} Wh)	
				0x04	0.01 kWh (10^{1} Wh)	
				0x05	0.1 kWh (10^{2} Wh)	
				0x06	0.001MWh / 1 kWh (10^{3} Wh)	
				0x07	0.01 MWh (10^{4} Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^{0} MWh)	
				0x0b	0.001 MJ (10^{3} J)	
				0x0c	0.01 MJ (10^{4} J)	
				0x0d	0.1 MJ (10^{5} J)	
				0x0e	0.001 GJ / 1 MJ (10^{6} J)	
				0x0f	0.01 GJ (10^{7} J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^{0} GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^{0} kBTU)	
				0x843d	0.01 MBTU (10^{1} kBTU)	
				0x853d	0.1 MBTU (10^{5} kBTU)	
				0x863d	1 MBTU (10^{6} kBTU)	

	Value	4	4	INT4		C4, C7, C9, CC
Energy Tariff 2	DIF	2	2	0x84, 0x20		C7, CC
	VIF	1	2		Depends on Unit:	C7, CC
				0x03	0.001 kWh (10^0 Wh)	
				0x04	0.01 kWh (10^1 Wh)	
				0x05	0.1 kWh (10^2 Wh)	
				0x06	0.001MWh / 1 kWh (10^3 Wh)	
				0x07	0.01 MWh (10^4 Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^0 MWh)	
				0x0b	0.001 MJ (10^3 J)	
				0x0c	0.01 MJ (10^4 J)	
				0x0d	0.1 MJ (10^5 J)	
				0x0e	0.001 GJ / 1 MJ (10^6 J)	
				0x0f	0.01 GJ (10^7 J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^0 GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^0 kBTU)	
				0x843d	0.01 MBTU (10^1 kBTU)	
				0x853d	0.1 MBTU (10^5 kBTU)	
				0x863d	1 MBTU (10^6 kBTU)	
	Value	4	4	INT4		C7, CC
Flow [l/h]	DIF	1	1	0x05		All except C1
	VIF	1	1	0x3b		All except C1
	Value	4	4	Float		All except C1
Flow temperature [°C]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x5b		All except C2, C3
	Value	4	4	Float		All except C2, C3
Return temperature [°C]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x5f		All except C2, C3
	Value	4	4	Float		All except C2, C3
Current Date and Time (Timestamp)	DIF	1	1	0x04		All
	VIF	1	1	0x6d		All
	Value	4	4	INT4	MBus typ F format	All
Fabrication number	DIF	1	1	0x0c		All
	VIF	1	1	0x78		All
	VALUE	4	4	BCD8		All
	Sum	**65**	**68**		incl. Funk Header	

SET 6 (as Set 2, but without flow rate parameter)						
- *Main Energy*	DIF	1	1	0x04		All except C2, C3
	VIF	1	2		Depends on Unit:	All except C2, C3
				0x03	0.001 kWh (10^0 Wh)	
				0x04	0.01 kWh (10^1 Wh)	
				0x05	0.1 kWh (10^2 Wh)	
				0x06	0.001MWh / 1 kWh (10^3 Wh)	
				0x07	0.01 MWh (10^4 Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^0 MWh)	
				0x0b	0.001 MJ (10^3 J)	
				0x0c	0.01 MJ (10^4 J)	
				0x0d	0.1 MJ (10^5 J)	
				0x0e	0.001 GJ / 1 MJ (10^6 J)	
				0x0f	0.01 GJ (10^7 J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^0 GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^0 kBTU)	
				0x843d	0.01 MBTU (10^1 kBTU)	
				0x853d	0.1 MBTU (10^5 kBTU)	
				0x863d	1 MBTU (10^6 kBTU)	
	Value	4	4	INT4	(Energy reading pos. / neg.)	All except C2, C3
Flow temperature [°C]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x5b		All except C2, C3
	Value	4	4	Float		All except C2, C3
Return temperature [°C]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x5f		All except C2, C3
	Value	4	4	Float		All except C2, C3
Current Date and Time (TimeStamp)	DIF	1	1	0x04		All
	VIF	1	1	0x6d		All
	Value	4	4	INT4	MBus typ F format	All
Fabrication number	DIF	1	1	0x0c		All
	VIF	1	1	0x78		All
	VALUE	4	4	BCD8		All
	Sum	**45**	**46**		incl. Funk Header	
SET 7:						
Main Energy	DIF	1	1	0x04		All except C2, C3
	VIF	1	2		Depends on Unit:	

				0x03	0.001 kWh (10^0 Wh)	All except C2, C3
				0x04	0.01 kWh (10^1 Wh)	
				0x05	0.1 kWh (10^2 Wh)	
				0x06	0.001MWh / 1 kWh (10^3 Wh)	
				0x07	0.01 MWh (10^4 Wh)	
				0xfb00	0.1 MWh (10^{-1} MWh)	
				0xfb01	1 MWh (10^0 MWh)	
				0x0b	0.001 MJ (10^3 J)	
				0x0c	0.01 MJ (10^4 J)	
				0x0d	0.1 MJ (10^5 J)	
				0x0e	0.001 GJ / 1 MJ (10^6 J)	
				0x0f	0.01 GJ (10^7 J)	
				0xfb08	0.1 GJ (10^{-1} GJ)	
				0xfb09	1 GJ (10^0 GJ)	
				0x803d	0.001 kBTU (10^{-3} kBTU)	
				0x813d	0.01 kBTU(10^{-2} kBTU)	
				0x823d	0.1 kBTU(10^{-1} kBTU)	
				0x833d	0.001 MBTU / 1 kBTU (10^0 kBTU)	
				0x843d	0.01 MBTU (10^1 kBTU)	
				0x853d	0.1 MBTU (10^5 kBTU)	
				0x863d	1 MBTU (10^6 kBTU)	
	Value	4	4	INT4	(Energy reading pos. / neg.)	All except C2, C3
Main Volume	DIF	1	1	0x04		All except C1
	VIF	1	2		Depends on Unit:	All except C1
				0x13	0.001 m3 (10^{-3} m^3)	
				0x14	0.01 m3 (10^{-2} m^3)	
				0x15	0.1 m3 (10^{-1} m^3)	
				0x16	1 m3 (10^0 m^3)	
				0x903d	0.001 USGAL (10^{-3} USGAL)	
				0x913d	0.01 USGAL (10^{-2} USGAL)	
				0x923d	0.1 USGAL (10^{-1} USGAL)	
				0x933d	1 USGAL (10^0 USGAL)	
	Value	4	4	INT4		All except C1
Power [W]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x2b		All except C2, C3
	Value	4	4	Float		All except C2, C3
Flow [l/h]	DIF	1	1	0x05		All except C1
	VIF	1	1	0x3b		All except C1
	Value	4	4	Float		All except C1
Flow temperature [°C]	DIF	1	1	0x05		All except C2, C3

	VIF	1	1	0x5b		All except C2, C3
	Value	4	4	Float		All except C2, C3
Return temperature [°C]	DIF	1	1	0x05		All except C2, C3
	VIF	1	1	0x5f		All except C2, C3
	Value	4	4	Float		All except C2, C3
Current Date and Time (Timestamp)	DIF	1	1	0x04		All
	VIF	1	1	0x6d		All
	Value	4	4	INT4	MBus typ F format	All
Fabrication number	DIF	1	1	0x0c		All
	VIF	1	1	0x78		All
	VALUE	4	4	BCD8		All
	Total sum	**63**	**65**		incl. Funk Header	

Example of message:

32 44 b4 05 78 56 34 12 c0 04 7a 23 04 00 00 04 06 01 00 00 00 05 3b 00 50 9a 44 05 5b 00 00 5c 42 05 5f 00 00 0c 42 04 6d 00 21 21 21 0c 78 78 56 34 12

3. Compact mode Variant

For data length limitation reasons, there is a variant which ensures that only rarely a structure message (Format Frame) is sent and regularly a user data message (Compact Frame).

Example:

Format Frame

21 44 B4 05 15 92 18 19 C0 04 6A 60 00 00 00 12 48 B3 04 06 04 15 04 6D 0C 78 05 2B 05 3B 05 5B 05 5F

Compact Frame

32 44 B4 05 15 92 18 19 C0 04 7B 61 00 00 00 48 B3 3E B6 A9 58 00 00 99 5E 00 00 15 2A 2B 28 03 49 58 05 00 00 00 80 00 00 00 00 34 45 2D 42 D4 DE 2E 42

4. Commissioning the CALEC® ST III with the LoRa interface

After installing the LoRa print, the antenna socket, the antenna feed cable and the antenna itself, the power can be supplied. The external antenna can either be a rigid stub antenna or a detachable magnetic base antenna, which is supplied with a 3 metre antenna extension cable as standard. As soon as the CALEC ST III is supplied with power, the LoRa bus radio module starts to transmit with the factory settings stored.

5. Parameterizing the LoRa interface of the CALEC® ST III

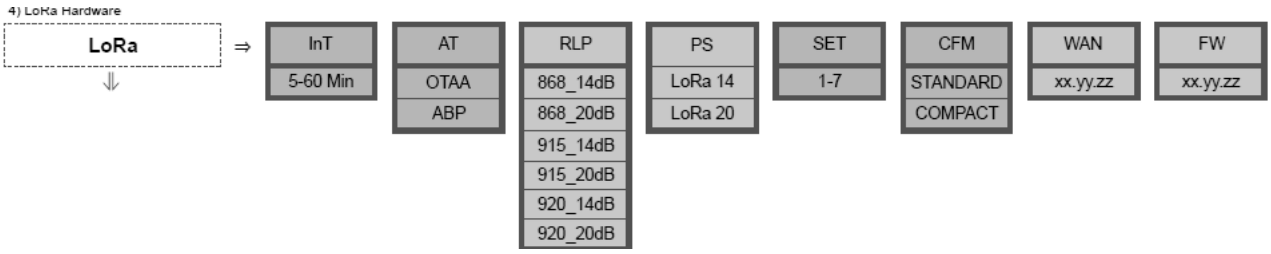
If you want to change the factory settings, use the "PARAM® Win II" driver and parameterisation software. The energy calculator is connected to the software, for example, via the M-Bus interface of the CALEC ST III (terminals 24 to 25) in combination with an M-Bus mini master (output: USB connection to Windows notebook/PC). A point-to-point connection via the optical interface is also possible.

The following parameters can be edited:

LoRa Parameter	**Range of values**	**Displayed on Device**	**Display Text**	
Transmission interval	1min – 60min	15 min	Yes	InT
DevAddr (Device Address)	0000 0000 – FFFF FFFF	Individual at factory	No	-
NwkSKey (Network Session Key)	0000 0000 0000 0000 0000 0000 0000 0000 – FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF	Individual at factory	No	-
DevEUI (EUI)	0000 0000 0000 0000 – FFFF FFFF FFFF FFFF	Individual at factory	No	-
AppEUI	0000 0000 0000 0000 – FFFF FFFF FFFF FFFF	Individual at factory	No	-
AppKey (Application Key)	0000 0000 0000 0000 0000 0000 0000 0000 – FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF	Individual at factory	No	-
AppSKey (Application Session Key)	0000 0000 0000 0000 0000 0000 0000 0000 – FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF	Individual at factory	No	-
Activation mode (OTAA, ABP)	OTAA (0x00), ABP (0x01)	OTAA	Yes	AT
Regional LoRa Parameter set	EU868_14dBm (0x00), EU868_20dBm (0x01), EU915_14dBm (0x00), EU915_20dBm (0x01), EU920_14dBm (0x00), EU920_20dBm (0x01)	EU868_14dBm	Yes	RLP
Radio standard	List : LoRa_14, LoRa_20	LoRa_14	Yes	PS
Frame format	List : Standard or Compact	Standard	Yes	CFM

Data package Set number	1 – 7	1	Yes	SET
FW-Version Calculator	x.yy.zz (numeric)	-	Yes	FW
LoRaWAN-Version LoRa Module	x.yy.zz (numeric)	-	Yes	WAN
FW-Version LoRa Module	x.yy.zz (numeric)	-	Yes	FW

In addition to the PARAM® Win III parameterisation software, navigation on the device itself provides a second option for changing parameters. However, editing the AES key is not possible due to the considerable character length.



6. Troubleshooting

Error / malfunction	Possible cause	Solution
CALEC® ST III does not communicate with LoRa-Bus radio module	Missing antenna	Check whether an antenna is connected to the device. (Stub antenna or remote magnetic base antenna). The arithmetic unit can be destroyed if the device is supplied with power or if no antenna is connected.