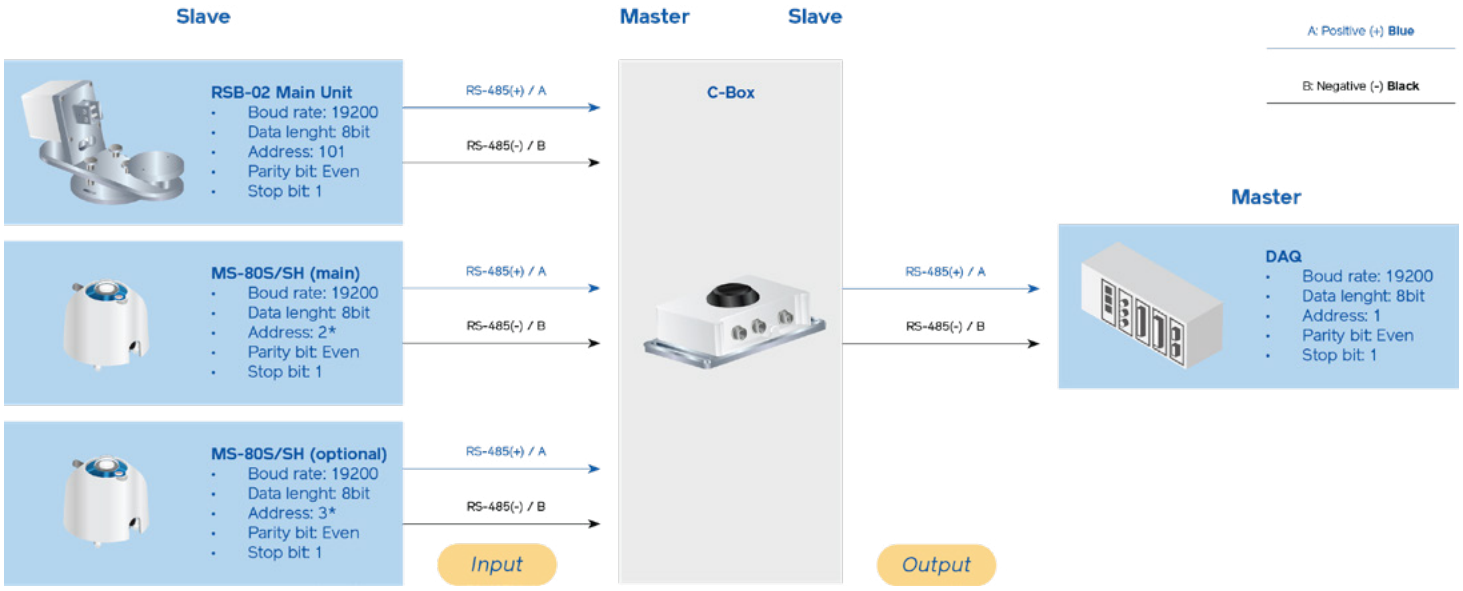
MS-80SH Plus+
Modbus Register Map

A-2 Communication specifications

At the factory, the specification for communication between the RSB-02 and C-BOX is set as follows. In order to connect a pyranometer, the address of the pyranometer must be entered into the C-BOX.



* The default address are **2** and **3** respectively for the main pyranometer and optional pyranometer. To configure your pyranometer on the C-Box write modbus registers 69 (GHI_NODE_ADDR) and 71 (EXT_NODE_ADDR). Insert the last two digits of the pyranometer serial number.
“100” if the last two digits are “00”.

A-2-1 C-BOX Communication Specification (Summary)

This device supports RS485 (Modbus RTU). ASCII mode is not supported. The communication specification is as follows.

Table A-2-1. C-BOX Communication Specification

Item	Remarks
Electrical specification	EIA-485
Connection form	Multi-drop method
Communication protocol	Modbus RTU (slave)
Communication speed (baud rate in bps)	9600 /19200 (default) /38400 /57600 /115200
Data length	8 bit
Stop bit	1 bit (default) / 2bit
Parity bit	None /Even (default) /Odd
Transmission distance	10m (using included cable)
Error detection system	CRC-16

A-2-2. C-BOX communication specification (Function codes)

Data is read and written to the holding Register.

Table A2-2. Supported function codes

Function Code (Hexadecimal)	Function
0x03	Read Holding Registers
0x10	Write Multiple Registers

A-2-3. C-BOX communication specifications (Data format)

Data is read and written to the holding Register.

Table A2-3. Data formats used

16-bit	Abstract
U16	Unsigned 16-bit Integer
S16	Signed 16-bit Integer
U32	Unsigned 32-bit Integer

The communication byte order of communication is big endian.
2-byte values are sent in H-byte -> L-byte order,
4-byte values are sent in H-word -> L-word order.
The table below shows how each format is allocated.

Table A2-4. Assignment of 8/16/32-bit values

8-bit	0x12	0x34	0x56	0x78
16-bit	0x1234 (MSW)		0x5678 (LSW)	
32-bit	0x12345678			

The word order for 32-bit registers is low word (LSW) first, followed by high word (MSW). The table below shows when 0x12345678 can be assigned to address “n” of the Modbus registers.

Table A2-5. Relationship between 32-bit values and Modbus registers.

32-bit	0x12345678
Modbus register (address n)	0x5678 (LSW)
Modbus register (address n+1)	0x1234 (MSW)

A-2-4. C-BOX Communication Specifications (Register map)

This device is for use only with holding registers.

Table A2-6. Holding registers

Address	Label	R/W	Format	Description
0	FW_VERSION	R	UINT16	Firmware version
1	SERIAL	R	UINT16	Last 4 digits of serial number
2	SENSOR_MODEL	R	UINT16	Sensor model: **2:** CBOX1 RSB **3:** C-Box-S2 (MS-80 Plus+) **9001:** CBOX1 MS90 **9002:** C-Box-S1 (MS-90 Plus+)
3	STATUS_FLAGS	R	UINT16	**Bitwise flags:** RESERVED 0x1 NO_GPS 0x2 NO_CAL 0x4 OFFSET_ERROR 0x8 NO_MOTOR 0x16
4	ACTIVE_MODE	R	UINT16	**ACTIVE mode:** **0:** STARTUP mode **1:** RSB mode **2:** DHI mode **3:** Calibration mode **4:** Engine off **5:** Manual control To change the mode after startup use the WORK_MODE register
5	TIMESTAMP	R	UINT32	Timestamp from GPS : Low
6				Timestamp from GPS : High
7	GHI	R	INT16	MS-80S/SH 1st GHI (W/m2) (x10)
8	DHI	R	INT16	MS-80S DHI (W.m-2) (x10)
9	DNI	R	INT16	MS-80S DNI (W.m-2) (x10)
10	DHI	R	INT16	Band Corrected DHI (W.m-2) (x10)
11	DNI	R	INT16	Band Corrected DNI (W.m-2) (x10)
12	TRANSPOSED IRRADIANCE	R	INT16	Transposed irradiance (W.m-2) (x10)
13	IRR2	R	INT16	MS-80S IRR2, (-) band offset (W.m-2) (x10)
14	IRR3	R	INT16	MS-80S IRR3, raw DHI (W.m-2) (x10)
15	IRR4	R	INT16	MS-80S IRR4, (+) band offset (W.m-2) (x10)
16	IRR5	R	INT16	MS-80S IRR5, GHI after (W.m-2) (x10)
17	PYR1_READING	R	INT16	MS-80S (W.m-2) (x10) direct output
18	PYR1_TEMP	R	INT16	MS-80S Temperature (degree C°) (x10)
19	PYR1_TILT_X	R	INT16	MS-80S Tilt X (degree °) (x10)
20	PYR1_TILT_Y	R	INT16	MS-80S Tilt Y (degree °) (x10)
21	PYR1_RH	R	UINT16	MS-80S Relative Humidity (x10)
22	PYR2_IRRAD	R	INT16	MS-80S 2nd (W.m-2) (x10)
23	PYR2_TEMP	R	INT16	MS-80S 2nd Temperature (degree C°) (x10)
24	PYR2_TILT_X	R	INT16	MS-80S 2nd Tilt X(degree °) (x10)
25	PYR2_TILT_Y	R	INT16	MS-80S 2nd Tilt Y (degree °) (x10)

Table A2-6. Holding registers

26	PYR2_RH	R	UINT16	MS-80S 2nd Relative Humidity (x10)
27	GPS_SATS	R	UINT16	Amount of visible GPS satellites
28	GPS_HDOP	R	UINT16	GPS HDOP value (x10)
29	GPS_VDOP	R	UINT16	GPS VDOP value (x10)
30	LAT	R	INT16	Latitude (x100)
31	LON	R	INT16	Longitude (x100)
32	ELEVATION	R	INT16	Sun elevation (degree °) (x100)
33	AZIMUTH	R	UINT16	Sun azimuth (degree °) (x100)
34	QC_ETN	R	UINT16	Extraterrestrial irradiance at normal incidence (ETN) (W.m-2) (x10)
35	QC_KN	R	UINT16	DNI/ETN (x1000) Quality check
36	QC_KD	R	UINT16	DHI/GHI (x1000) Quality check
37	QC_KT	R	UINT16	GHI/(ETN.COS(SZA)) (x1000) Quality check SZA is solar zenith angle (90 – ELEVATION)
38	QC_GHI	R	UINT16	GHI Quality check
39	QC_OFF	R	UINT16	Band offset Quality check
40	BA	R	INT16	Calculated band-angle (degree °) (x10)
41	DT	R	UINT16	Band sweep time in millisecond
42	RSB_CAL	R	UINT16	RSB Motor calibration value
43	RSB_ENC	R	UINT16	RSB Encoder value 0...1024
44	SUN_RISE	R	UINT32	Calculated Sunrise time stamp : Low
45				Calculated Sunrise time stamp : High
46	SUN_SET	R	UINT32	Calculated Sunset time stamp : Low
47				Calculated Sunset time stamp : High
48	PYR2_CALC	R	INT16	**DN if Mode is TSB Albedo (RHI/GHI) (x1000)** **RHI if Mode is RSB Albedo (RHI/GHI) (x1000)**
64	UPDATE	**R/W**	UINT16	Set to 1 to store settings in EEPROM.
65	BAUDRATE	**R/W**	UINT16	Baudrate default 9600 for larger numbers than 65535 use value/10
66	PARITY_STOPBITS	**R/W**	UINT16	256 x parity + stopbits where: No parity: 0 Odd parity: 1 Even parity: 2
67	NODE_ID	**R/W**	UINT16	Node ID (default 1)
68	GHI_SENSOR	**R/W**	UINT16	First digital pyranometer: **2:** MS-80M **3:** MS-80S
69	GHI_NODE_ADDR	**R/W**	UINT16	MS-80S Node ID (default 2)
70	EXT_SENSOR	**R/W**	UINT16	First digital pyranometer: **0:** Not connected **2:** MS-80M **3:** MS-80S
71	EXT_NODE_ADDR	**R/W**	UINT16	MS-80S 2nd Node ID (default 3)
72	PYR2_ENABLED	**R/W**	UINT16	MS-80S 2nd function: 0: Not connected **0:Disable** >0 Connected **1:Enable**
73	S	**R/W**	UINT16	Geometrical corrrection factor S (-) (x1000); default 40 (0.04

Table A2-6. Holding registers

74	WORK_MODE	**R/W**	UINT16	When the active mode is changed to RSB_MODE or TSB_MODE this register will be set accordingly. **This register sets the operation mode for the next startup. Set the following value to this register and set 1 to register No.64 "UPDATE". The operation mode of the device can be changed by power cycle.** **1: RSB mode** **2: TSB mode**
75	NEW_RSB_MODE	**R/W**	UINT16	Set requested RSB_MODE, use SET_RSB_MODE to activate. **This register is used to shift to Calibration mode. When this register is set to 3 and register No.76 is set to 1, the device enters Calibration mode.**
76	SET_RSB_MODE	**R/W**	UINT16	Set to 1 to activate the RSB mode written in NEW_RSB_MODE register. See the description of register No.75.
77	MANUAL_ANGLE	**R/W**	UINT16	When RSB_MODE is manual control: Set manual bandangle (x10): 45 degrees is 450. Activate by SET_ANGLE
78	SET_ANGLE	**R/W**	UINT16	Set to 1 to activate the angle when RSB_MODE is manual control
79	MANUAL_GPS	**R/W**	INT16	Set to 1 to enable fake GPS. Time, date and location is taken from registers 61 to 67 at the moment this register becomes 1. Set to 0 to enable normal GPS mode.
80	YEAR	**R/W**	UINT16	Year to be used when MANUAL_GPS is set to 1
81	MONTH	**R/W**	UINT16	Month to be used when MANUAL_GPS is set to 1
82	DAY	**R/W**	UINT16	Day to be used when MANUAL_GPS is set to 1
83	HOUR	**R/W**	UINT16	Hour to be used when MANUAL_GPS is set to 1
84	MINUTE	**R/W**	UINT16	Minute to be used when MANUAL_GPS is set to 1
85	LAT_MANUAL	**R/W**	INT16	Latitude (x100) to be used when MANUAL_GPS is set to 1
86	LON_MANUAL	**R/W**	INT16	Longitude (x100) to be used when MANUAL_GPS is set to 1
87	DEMO_MODE	**R/W**	UINT16	Set to 1 to enable demo mode (Manual GPS). By sending Update = 1, this mode will be stored and active after power-cycle.
88	SET_CAL	**R/W**	UINT16	When in RSB_MODE is CAL, set this register to 1 to fix calibration.
89	BA_OFFSET	**R/W**	UINT16	Band-angle offset (degree °). Set to 0 to turn off band-angle offsets. Use UPDATE to store in EEPROM
90	AZIMUTH OF TRANSPOSITION	**R/W**	UINT16	Azimuth of transposition, store to EEPROM using UPDATE
91	ANGLE OF TRANSPOSITION	**R/W**	INT16	Angle of transposition, store to EEPROM using UPDATE
92	MOTOR_MIN_SB_CURRENT	**R/W**	UINT16	Default 8 (max 255)

Table A2-6. Holding registers

93	MOTOR_MAX_SB_ CURRENT	**R/W**	UINT16	Default 129 (max 255)
94	MOTOR_MAX_CUR- RENT	**R/W**	UINT16	Default 129 (max 255)
95	MOTOR_MAX_ SPEED	**R/W**	UINT16	Default 1000 (max 2048)
96	MOTOR_MIN_ACCEL	**R/W**	UINT16	Default 1000 (max 2048)
97	MOTOR_MAX_AC- CEL	**R/W**	UINT16	Default 1000 (max 2048)
98	PANDRIVE_NODE	R/W	UINT16	Stepper motor Node ID (default 101)
99	PANDRIVE_PARITY	R/W	UINT16	Parity to be used by both pyranometer and engine: 0: None 1: Odd (never used) 2: Even