Software manual

MarecX system is equipped with an RS232 COMport connected on the outside of MarecX box.
There is also a CANbus connector with interface to a 4-wire external cable.
CAN-bus is ready to use for external devices like a display or external computers.

All commands and corresponding outputs needs a terminal program on an external computer equipped with a serial port USB or RS232 type. In case of USB a RS232 to USB dongle is needed.
Used protocol is asynchronous, baudrate is 115200, 8 data no parity and one stop bit.
Basic command structure will respond immediately when a keyboard button is pressed.
Printout of the respons will be seen on computer screen. Some commands descend further to get to more commands and keyboard inputs.

MarecX internal RS232 COMport 1 is used for parameter setup, calibration and instant readout of different parameters. When using menu do not use commands 1, 2, 3 and § with the USB stick in place.

Parameter setup menu

1 set scale factors

Hit key '1'. Response is "1 set scale factor 1-9,A. Hit a key to set ch number".
Hit a key corresponding to wanted channel number. Allowed 1-9,A.
Response "Accx scf yyyy enter new value and hit 'enter' ".
Enter new value as either 'enter' or a numeric value. If 'enter' the old value will not change.
If numeric value is entered the new one will be written as "new xxxx".
Command then prompts for a new channel number with ”Input channel number”
Command is then either terminated by hitting 'ESC' key in wich case the response will be "Done" or a new channel number is entered for processing.

2 Speed limit set

Hit key '2'. Response is ”2 Speed limit xx enter new value and hit ’enter’ ”.
Enter new value as either 'enter' or a numeric value. If 'enter' the old value will not change.
If numeric value is entered the new one will be written as "new xxxx".
Command terminate automatically with ”done”
Speed limit value sets the lowest speed where data sampling can start.
Value are put in as 10x value. Example 65 will set 6.5 knots as speed limit.

3 Set sensor type and orientation

Hit key '3'. Response is "3 enter sensor number 1-3 and hit ’enter’".
Response ”Sensorx pos y enter new value and hit ’enter’ ”
Enter new value as either 'enter' or a numeric value. If 'enter' the old value will be shown as xxxx and not changed.
If numeric value is entered the new one will be written as "new xxxx".
Command then prompts with ”Enter sensor number”
Command can then be continued by hitting a new sensor number or terminated with ’ESC’.
Command is terminated by hitting 'ESC' key in wich case the response will be "Done".

Sensor position can have 9 different values according to table below. Crew sensors must be at position 0. Hull sensors must be at positions 1-8. Calibration procedure calls for position 1 for all sensors due to other reasons. Calibration is usually made at the factory and MarecX will be delivered with all sensors calibrated.

Hull sensor(s) positioning table
Position number

0 Crew transducer standard position
1 Cable down, plastic insert FWD
2 Cable down, plastic insert right
3 Plastic insert down, cable FWD
4 Plastic insert down, cable right
5 Plastic insert down, cable AFT
6 Plastic insert down, cable left
7 Cable up, plastic insert FWD
8 Cable up, plastic insert right

Up, down, right, left, fwd and aft relates to boats coordinate axles where up is z-direction+, left is y-direction+ and FWD is x-direction+. Setup number as described for command ‘3’. Plastic insert refers to the MEMS sensor plastic filled cavity in transducer metal body.

6 set to larger than spdlimit for immediate start of file

Hit key ’6’. Response ”Set instant GPS speed”
Enter new value as either 'enter' or a numeric value. If 'enter' the old GPS value is shown.
If numeric value is entered the new one will be written as "new xxxx".
Command terminates automatically and prints ”Done”.
This value is used once and will be overwritten by the next valid GPS speed value in the next second.

§ Set serial number

Hit key ’§’. Response is ”Ser-num old xx enter new value and hit ’enter’ ”.
Enter new value as either 'enter' or a numeric value. If 'enter' the old value is shown.
If numeric value is entered the new one will be written as "new xxxx".
New value needs to be entered as a code. Incorrect code will respond with ”Not allowed”.
Command terminates automatically and prints ”Done”. Special factory code is needed to do this.

Instant response commands

Commands terminate automatically without notice when finished.

7 Hit key ’7’ for data logging start if GPS not present.

Response ”7 set GPS ok”

J Save parameters to Eeprom

Hit key ’J’. Response is printout of any changed parameters.
Used to save parameters in nonvolatile Eeprom memory.

K Print parameters stored in Eeprom

Hit key ’K’. Response is printout of parameters.

b Readout maximum last second values

Hit key ’b’. Response is
”MX xx xx xx xx xx”
”xx xx xx xx xx”

c GPS setup

Hit key lower case ’c’ to initiate a new GPS unit. Needs to be done once if new GPS is mounted. Will be done at factory before delivery of a new MarecX.

A Start data sampling

Hit key ’A’ to stop/start sampling. Test only. Used for special situations.
Response ”Pr x”. X tells if sampling active =1 or not =0.

B Read offset data values

Hit key ’B’ for instant print of current offset data values. Prints current channel offset values ch1->ch10. Xx is replaced with actual channel values at print time.
”Offset values”
”xx xx xx”
”xx xx xx”
”xx xx xx xx”
Used when calibrating transducers.

C Reads raw measured A/D data values

Hit key ’C’ for instant print of current A/D data values. Prints channel values ch1->ch10. Xx is replaced with actual channel values at print time.
”AD val”
”xx xx xx”
”xx xx xx”
”xx xx xx xx”

E Offset value reset

Hit key ’E’ to reset channel offset values to the closest possible values.
Response ”Reset offset”
Used when calibrating transducers.

R Running printout of GPS message

Hit key ’R’ to start running printout of NMEA GPS sentences. Each hit starts/stops print

W Print GPS data if present

Hit key ’W’ to print current GPS data. Response
”UTC 2021-09-10 12:09:34”
”GPS spd xx hdg yy ”
”5 ms xx”

Y Close file and stop sampling

Hit key ’Y’ To stop sampling and end current file store and close file. Test only. Used in very special cases only.
Response ”Shutdown and close files xx yy”. Xx and yy are the timestamps when shutdown starts and ends.

? Sets CPU to boot mode for new flash download

Hit key ’?’ to setup CPU for new SW download from COM1port.

Response ”ISP activated. Start flash tool”
Close your serial terminal pgm or choose another COMport.
Activate Flash Magic program and select correct hexfile for download. When flash finished set your terminal pgm to correct COMport parameters and cycle power. Check new pgm is running as expected. See section on Flash Magic below.

Test only commands. Do not touch

If key hit by accident, cycle pwr to reset system

```
case '4'//Test ON
case '5'//Test OFF
case '8'//enter new read filename
case '9'//enter new write filename
case '0':// Test T1 delay
case '-'//Upgrade write file name to next serial no
case 'a'//Used on CAN bus units only
case 'd'//Start running NMEA GGA
case 'e'//Start running NMEA GLL
case 'f'//Start running NMEA GSA
case 'g'//Start running NMEA GSV
case 'h'//Start running NMEA VTG
case 'i'://Send CAN message to display
case 'm'://print user data buffer
case 'D'://CANBUS trigg
case ’F’://LED blink at 1 Hz. Test only
case 'G':print_to_com1("LED OFF\n");
case 'H' print_to_com1("H xc %u\n",xctime);
```

```
case 'I'//USB interface parameter printout
case 'L': print_to_com1("scsi init\n");
case 'M':print_to_com1("PR1 %d\n",PROUT1);
case 'N'//Main_Copy();
case 'O'//Reads S2 file from USB if present
case 'Q'//Prints USB RAM image. Test only
case 'S'://Prints USB stick file content
case 'T':print_to_com1("T USB struct mem clear\n");
case 'U'//Invokes file shift mechanism
case 'V'//Updates USB stick with RAM image content
case 'X'print_to_com1("Open file %s\n",filename_w);
case 'Z'//print_to_com1("Enter file name to delete\n")
case '+'//Sampling speed, test only 880 Hz
case '.'//Sampling speed, test only 1760 Hz
case ','//Sampling speed, test only 220 Hz
case ':'//Cleans FAT table in both FATs
```

Flash Magic program instructions

Start Flash Magic program and do the following setup actions. Step xx refers to the program window shown.

Step1.

Select LPC1769 as the CPU to be used by pgm.
Select your COMport number to be used 1-32.
Select baudrate. We use 115200
Select interface none
Select oscillator frequency to 12.0 MHz

Step2.

Tick box ”Erase all Flash+Code Rd Prot”

Step3.

Select Hexcode file to flash into MarecX CPU. Use the ”browse” button to select file.

Step4.

Select options if needed/wanted. We use no options.

Step5.

Hit start button to Flash hexfile to CPU. Program shows process progress. Will tell when finished. When finished COMport is released for use so no need to close Flash Magic. Can be left active without causing problems.

Common problems

1. Forgot to close terminal window. Will produce a message that COM port is occupied by something else. Close terminal or change terminal COMport to another number. We use to change COMport to another number. Baud will be preserved when changing back after flash is done.

2. In some computers 115200 baud does not work. Try a lower baud setting.

3. CPU is not setup for flash programming by giving command ’?’. Do setup with ’?’ before trying to flash.

Calibration procedure

The different transducers connected to the MarecX system will need a unique scale factor to be stored in nonvolatile memory to be able to set the accuracy of sampled data on the different channels. Transducers output signal can be analog signals in the range 0-5.0 volt. A/D system can sample signals with resolution 24 bits 0-5 volt despite the fact that acceleration transducers used only need 19 bits at the moment due to noise consideration.

Calibration procedure used for the MEMS-based sensors are described here despite the fact that it is possible to use other types of sensors that will need totally different procedures.

Procedure for accelerometers relies on the use of earths gravity field and the fact that our MEMS sensors can sense statically.

MarecX is normally delivered with a calibrated set of sensors so no calibration needs to be done until sensors are replaced or you want to check that calibration is still accurate.

For each 3-axis transducer the channel order will be ch1→x, ch2→y and ch3→z. Sensor1 uses ch1-3, sensor2 uses ch4-6 and sensor3 uses ch7-9. Use command ’3’ for sensor pos setup. All transducers must be setup in sensor position number one to be able to calibrate correctly. Even crew transducers must be set to position 1 at calibration time. Use command ’3’ to set this up first. Then store these settings with command ’J’ . This means that correct axle coordinate system position is x fwd, y left and z cable down. X fwd is the plastic insert in each sensor. Be aware that each axle direction(xyz) to be calibrated must be aligned to earths g-vector with a precision of better than +/- 1 degree to be accurate.

0. With MarecX box powered and set up without GPS and USB stick but with all transducers connected to their corresponding connector, start sampling by hitting key ’A’ once, then wait five seconds and hit ’A’ again. This starts up data sampling. Check by hitting key ’C’ several times to see that the values on the different channels ”plays”.

1. Set up all sensors in the same vertical direction. You choose wich at this moment. Sensors must be statically fixed for each calibration measurement cycle.

2. Hit the key ’E’ and wait for roughly 3-5 minutes until the readout offset values(key ’B’) gets stable to +/- 15 units over time.

3. Note the last values for the channels in the g-vector direction(vertical).

4. Turn all sensors upside down(180 deg) to measure in the opposite vertical direction. This effectively puts a static measured value that should differ by 2.0g from the noted value in point 3.

5. Reset offset by hitting key ’E’ and wait until offset values(key ’B’) again gets stable over time.

6. Note these new values.

7. Set up sensors to measure another vertical axle and proceed to point 2 until all axles(x y z) have been measured and channel values noted.

8. Calculate each channels calibration factor by subtracting the high channel value from the low one and divide this value by 1.96132. The calculated value is the scale factor for that channel. Scale factor calculated this way is the measured value you get for acceleration value 10.00 m/s**2. With these notes for each of the ten channels proceed to point 9.

9. Use command ’1’ and put these calculated cal factors in for each of the measured channels.

10. Use command ’K’ to confirm all channels are set with correct values.

11. Store the values with command ’J’.

12. If file s2.txt are present on the USB stick. Delete it, because the new cal factors needs to be stored on the stick. Otherwise stick will be left with old cal values. Next time MarecX box is powered up it will produce a new s2.txt if USB stick is connected.

13. Calibration completed!!

Remenber to use command ’3’ to set the different sensors in their correct mechanical position after calibration is completed. Crew sensors are always position 0 while hull sensors can be 8 different mounting positions. Store the values with command ’J’. Also remember to delete s2.txt after any reordering of sensor is made.

Data format on binary file

MarecX samples its ten analog channels 600 times per second. Sampling of the ten channels are made in parallel so no timing skew exists in between the different channels in a single sample. Store order in the file content is ch1→ch10 for each consecutive sample of four bytes. Each channel is stored as a raw AD value in an unsigned 32 bit integer. As the sensors are MEMS circuits they also contain some random noise. System therefore uses only 19 bits of the available 30 bit resolution. AD value 262144 corresponds to 0.00 volts and 786432 corresponds to 5.00 volts. DC resolution roughly 9.54 microvolt.

Data on file are stored in one second records where the first sixteen bytes are the GPS data block. Longitude 32 bit float. Latitude 32 bit float. Speed 16 bit unsigned integer scaled 10x to get one decimal. COG 16 bit unsigned integer scaled 10x to get one decimal. Timestamp 32 bit unsigned integer containing the number of samples from midnight the current date. Then comes 40x600 bytes with channel data. Total byte count in one second is 24016 bytes.

File name tells date and serial number as in following example.

21091239.dat is stored 2021 september 12 as file number 39 that date.

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