

MAINTENANCE MANUAL

RX160



Revision History

Version	Date	Reason
A0	2013-11-01	1 st released version

Reference Documents

- [Ref 1] Operating manual
- [Ref 2] Receiver assembly drawing
- [Ref 3] Installation manual (Mercury: 948889-000, Jupiter: 948182-000)
- [Ref 4] RX160 Configuration Tool manual (Jupiter: 949689-000)

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1 Intended Readers

This document is intended for Åkerströms certified staff only.

All staff maintaining Åkerströms equipment shall have knowledge in IPC-7711/7721 “Rework, Modification and Repair of Electronic Assemblies” revision B.

2 Introduction

This document contains maintenance instructions for the RX160 radio remote control receiver. It also contains information about visual inspection which must be performed to maintain the safety and availability of the system. All actions in this document may only be performed by personnel trained and qualified by Åkerströms Björbo AB.

Changes or modification of the system or parts of the system must be authorised by Åkerströms Björbo AB.

3 Product changes

Åkerströms retains the right to change the Products, increase or reduce the number of Products, type or Product specification, and/or cease production of a Product after giving ninety (90) days’ notice in writing.

Note that this document is not related to one specific version of system. Therefore there might be mismatches between figures in this document and the actual system.

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5 Warnings regarding installation and maintenance work

This manual must be read and understood before installing and starting the radio remote control system to ensure safe and secure operation.

The installation and/or maintenance work must be carried out by a qualified and educated person in accordance with country installation rules and regulations. Only a correct installation can ensure the necessary level of safety during use.



The equipment can be supplied by different energy sources e.g. for the relay contacts or the regular power supply of the equipment!

Before starting ANY maintenance work ensure by using the external separators / fuses of the permanent installation, that **ALL terminal blocks are free from dangerous voltage!**



CAUTION DOUBLE POLE/NEUTRAL FUSING



If a siren is mounted on the receiver unplug it before any maintenance action. Put it back when the maintenance is done.



Risk of high noise level, hearing protection required

6 Definitions

ID number	Unique identity of a system. Used in the communication between a transmitter and a receiver
Customer object ID	Unique identity of a system with a special functionality and manufactured for a specific customer
MC	Main Contactor control
PLC	Programmable Logic Controller
PC	Personal Computer

Table 1. Definitions

7 Basic description

7.1 General

The RX160 receiver has been designed to be a compact unit. It provides a set of outputs that are driven accordingly to the commands performed by the operator on the transmitter; that is accordingly to the way the operator sets the switches and the joysticks of the transmitter. The outputs are also used for providing information about the working condition of the radio control system. For instance, the “Safety outputs” are used also for notifying an emergency condition: they provide the related information though it is not possible to know how the controlled object manages this information.

The receiver is equipped with six safety relays to monitor the safe function of three moving directions.

The system has a defined “Safe State” of both the transmitter and of the receiver.

The “Safe State” of the transmitter is when no messages are transmitted or when transmitted messages include active stop command.

The “Safe State” of the receiver is when the “Safety outputs” are inactivated.

The safety of the “radio control system” involves mainly the states of its outputs regardless the controlled object assemblies that are driven by the outputs themselves, provided that it has to be suitable for being used as a part of a radio remote control system.

The interface between the radio control system and the controlled object application is intended for being implemented by means of a specific interface assembly; this assembly is not part of the radio control system and for this reason is not considered in the radio control system life cycle. Nevertheless, the radio control system is intended to be safe without the use of any other external assembly or system.

7.2 Block diagram for the RX160 receiver

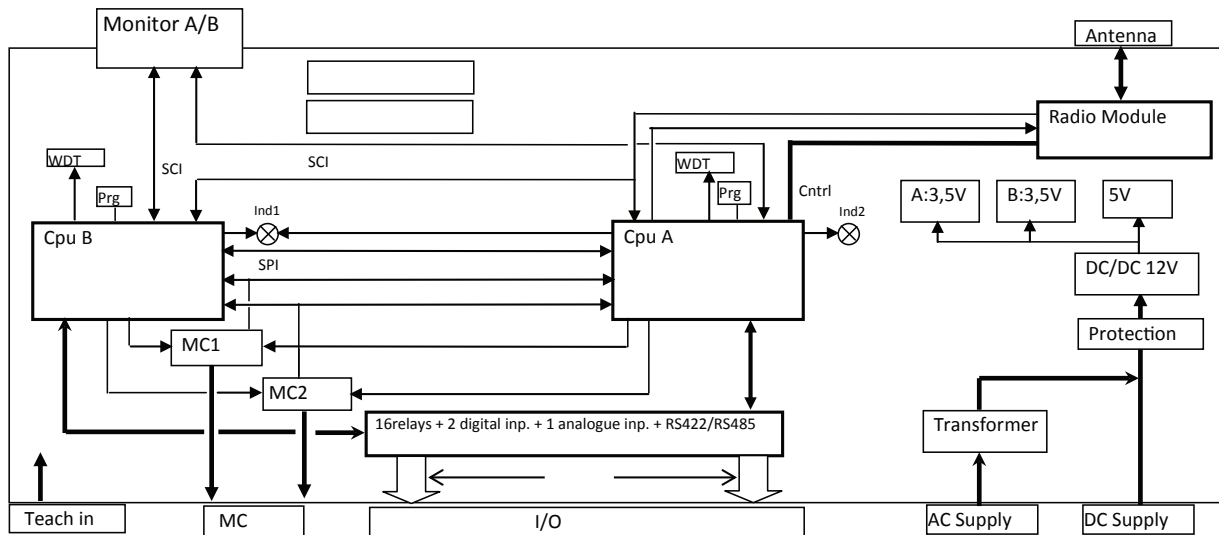


Figure 1. Principle structure of I/O receiver

8 Assembly

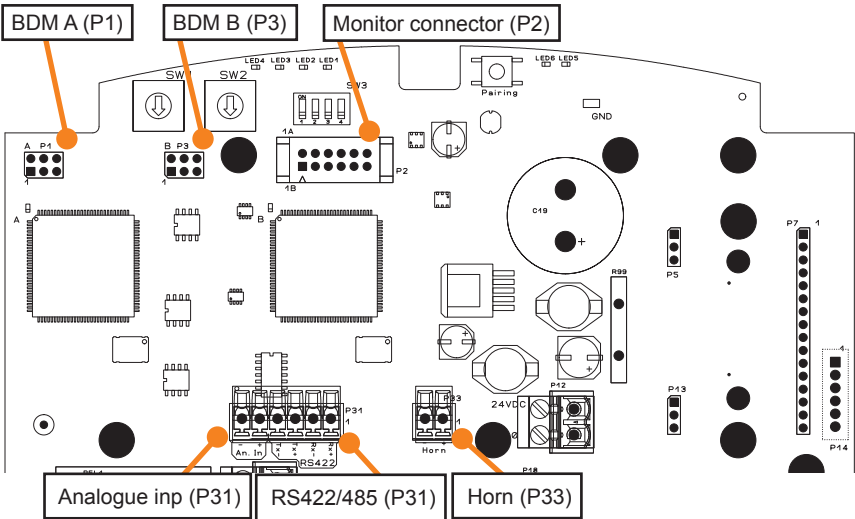
Prescribed Tools

- Screwdriver
- Torque screwdriver, bit Torx T10

8.1 Main parts

- The receiver consists of 4 main parts.
- Enclosure, made of fire resistant UL 94-5V plastic
 - CPU board
 - Antenna board
 - Radio module

9 Maintenance connectors



9.1 Monitor connector P2

Function	Connector pin
GND	1
GND	2
	3
+5V	4
	5
	6
Rx from CPU B	7
Rx from CPU A	8
Tx from CPU B	9
Tx from CPU A	10
B_BDM_WDT_dis (RTS)	11
A_BDM_WDT_dis (RTS)	12

9.2 BDM connectors P1 and P3

Function	Connector pin
BKGD	1
GND	2
	3
/RESET	4
BDM_WDT_dis	5
+3,5V	6

9.3 Horn connector P10

Function	Connector pin
Horn output	1
GND	2

Max load 120 mA.

9.4 RS422/485 connector P31

Function	Connector pin
RS422 A Rx+	1
RS422 B Rx-	2
RS422 Y Tx+	3
RS422 Z Tx-	4

For RS485 pin 1 and 3 resp. pin 2 and 4 shall be connected together.

9.5 Analogue input connector P31

Function	Connector pin
Analogue input	5
GND	6

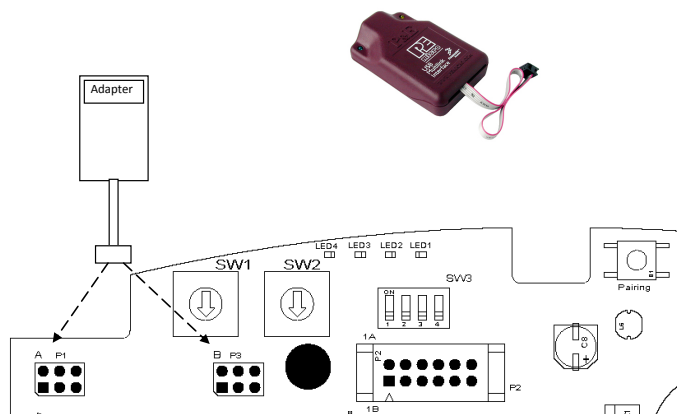
10 Software maintenance

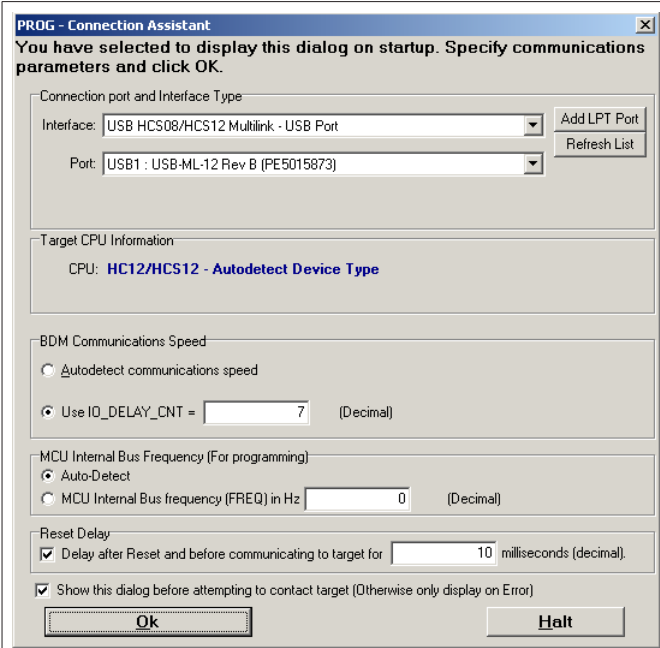
Prescribed Tools

- PC with 2 USB ports
- USB BDM multilink programming adapter (USB-ML-12 from P&E Microcomputer Systems <http://www.pemicro.com/>) with USB cable
- USB cable

10.1 System software

1. Set dipswitch SW3:4 to ON to disable the watchdog timer.
2. Connect the programmer BDM adapter cable to the 6-pin connector for CPU A or B. The adapter is USB-ML-12 from company P&E <http://www.pemicro.com/>.
3. Power up the receiver.
4. Start the programming software “PROG12Z. This software is also from P&E.
5. Follow the instructions on the next pages to program the CPU.
6. Repeat programming on the other CPU (A or B).
7. Set dipswitch SW3:4 to OFF.

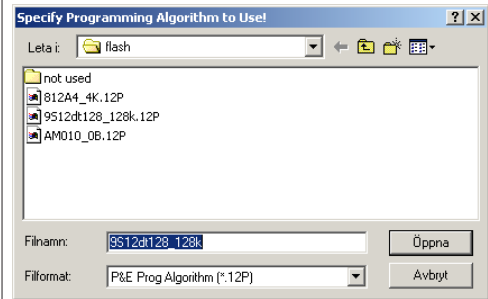




Make sure that “Automatic communications speed” is marked!

Then press OK!

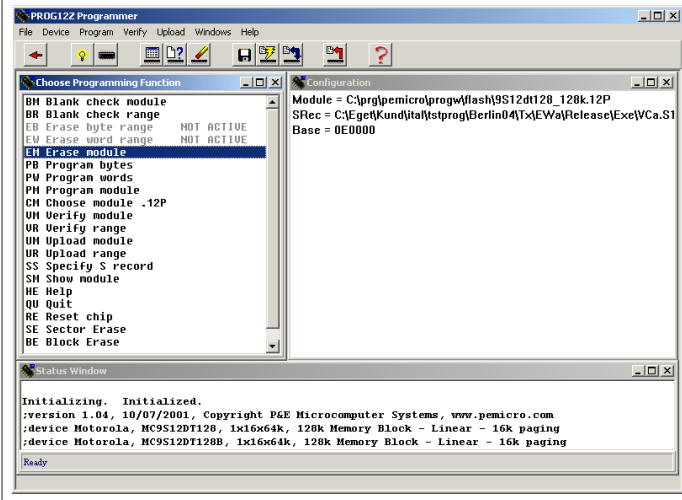
NOTE! Reset Delay setting (10 ms)



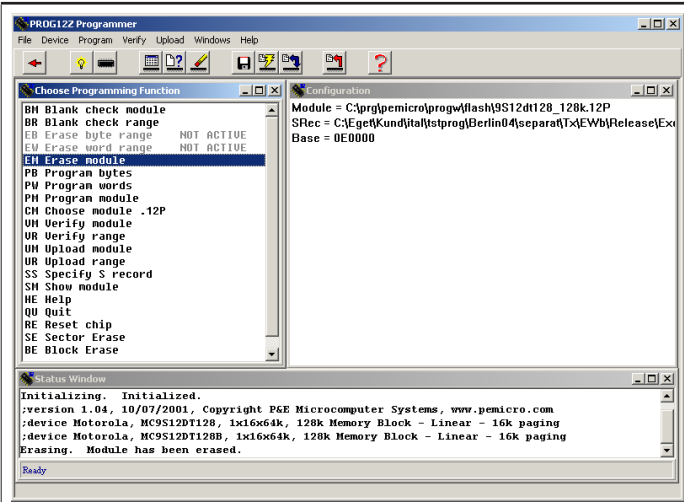
Chose the “device”-file:

**Freescall_9S12XDT256_1x16x128k_25
6k_Linear_16k_page.12P**

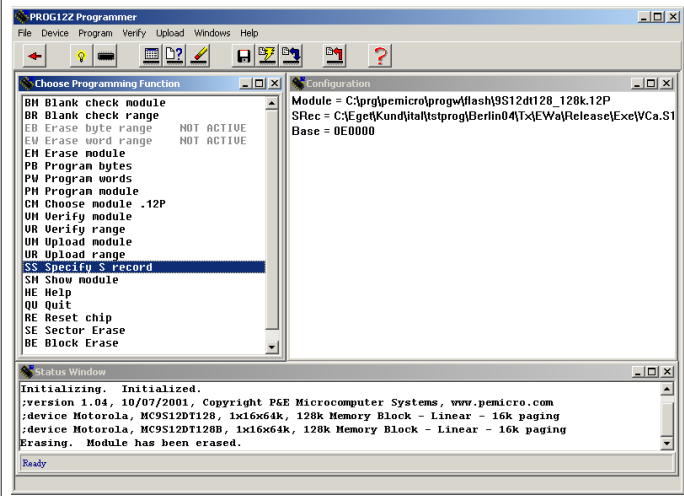
and press open.



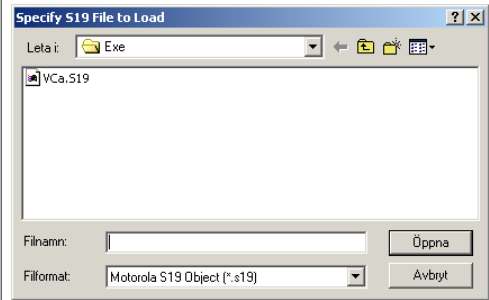
Double click the “Erase module”.



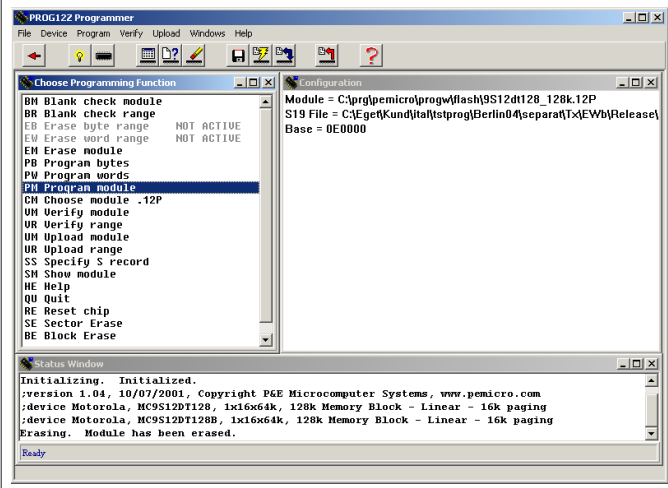
In the “Status window” you will see:
Module has been erased.



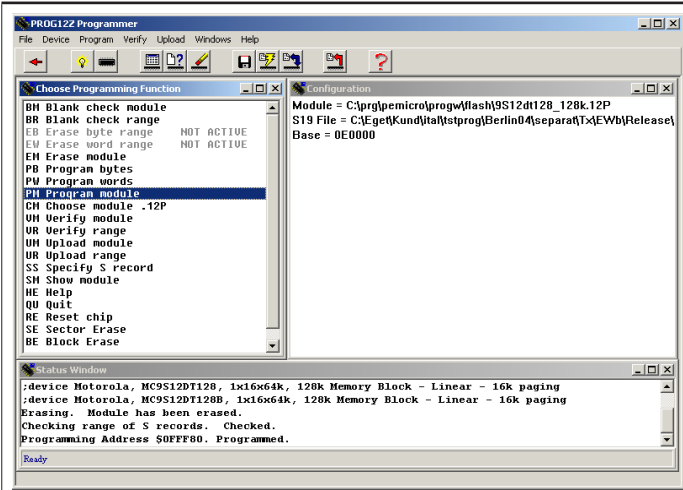
Then double click “Specify S record”



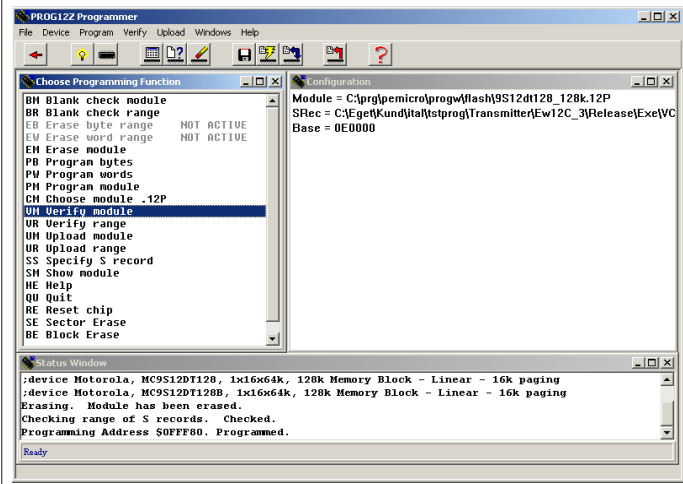
Chose the file to be downloaded and press open.



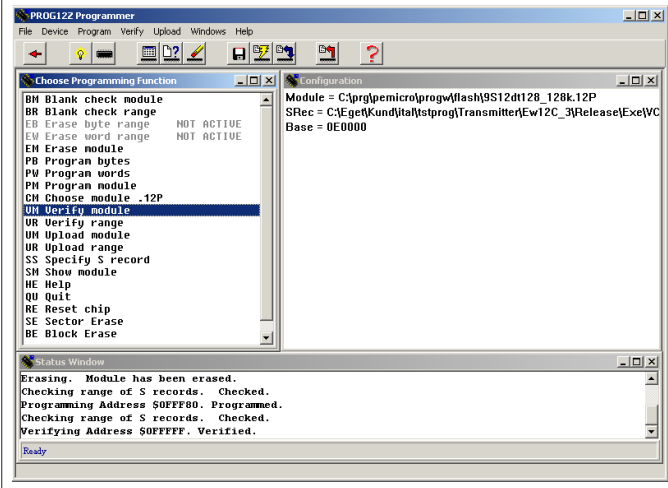
Double click the “Program module”



In the “Status window” you will see:
Programmed.



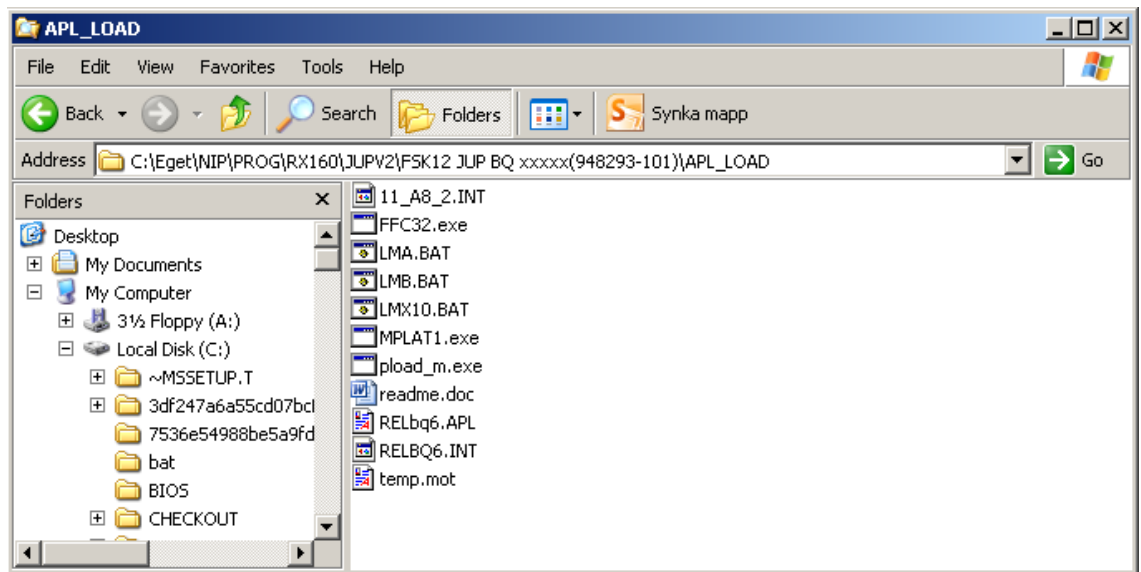
Double click the “Verify module”



In the “Status window” you will see:
Verified.

10.2 Downloading the APL (PLC) software

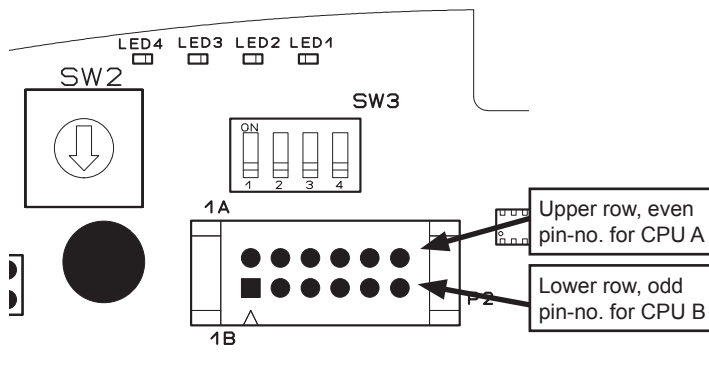
To download a new application program into the receiver you need a software utility package.



All the files shall be put in the same directory (map).

Connect two “FTDI TTL-232R-3V3-WE” 6 cores USB to UART cable between PC USB and the monitor connector for CPU A and CPU B.

Pin 1, black, part in the cable shall be faced to the left in the picture below.

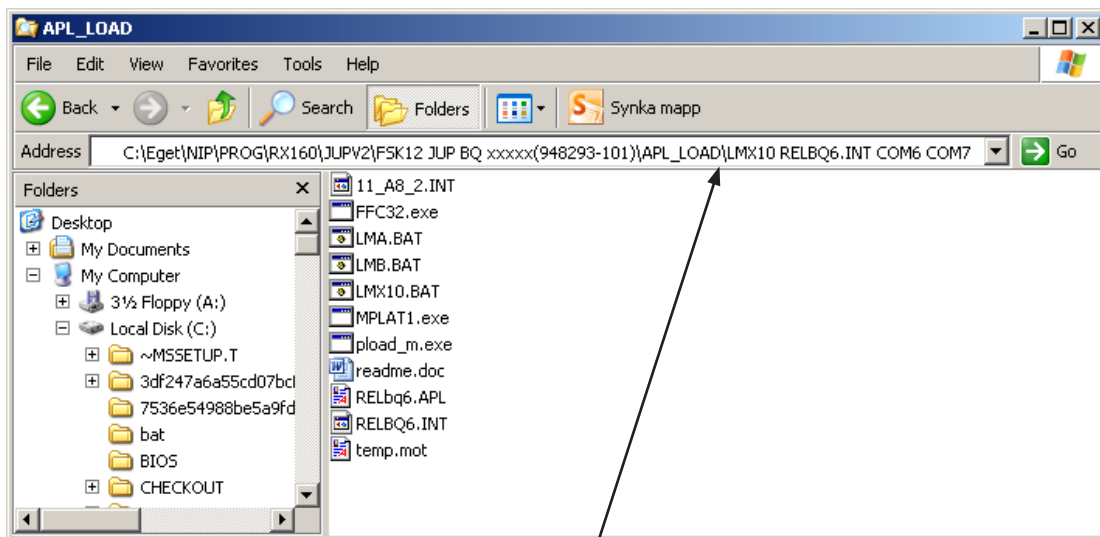


Find out which com-port numbers, COMx and COMy, the FTDI cables are using. COMx and COMy may be found in the device manager under “ports”.

Then enter the following command on the PC: LMX10 <xxxxxxx.int> COM(x) COM(y)

Where: xxxxxx.int is the APL(PLC)-program and n is com-port number.

LMX10.bat controls the firmware used for APL programming.



Example:

LMX10 RELBQ6.int com6 com7. Note the backslash.

The bat-file will download the software to the CPU A or B.

Watch the information on the screen for error information.

Repeat the procedure above also for the other CPU. Both CPU's shall have the same APL (PLC)-program.

11 Diagnostic information

11.1 Monitor

There is one connector for the monitor for both CPUA and CPUB.
The monitor for CPU A is UART TTL interface on even pins
and the monitor for CPU B is UART TTL interface on odd pin.

When logging into the monitor (password=23250) the following menu appears:
(9600 baud 8N1).

```
RX160 V:94xxxx-yyy
ID=1234
PLC ID=00001
Parameter set:--
Cust.Obj.ID=xx
BQ TYPE:x.x.x
FX sequence=xxx x:xx
```

-- appears if no parameter file is loaded

Or

```
RX160 V:94xxxx-yyy
ID=1234
PLC ID=00001
Parameter set:xxxx<M>
Cust.Obj.ID=xx
BQ TYPE:x.x.x
FX sequence=xxx x:xx
```

M appears only if parameters are changed.

Monitor Prompt

```
RX160A>           ;for CPUA
RX160B>           ;for CPUB
```

11.1.1 Valid commands

To see all valid commands, type HELP. The following information will be displayed:

```
LX   LL   LY   LR   LRH
VX   VL   VY   EVX  EVL  EVY
ERR  WHY  LEDS STAT SQ
TERM1  SETC      SETPROT
SETFREQ ANTENNA  HKSTAT
SETFID  SETSID
HELP
```

All commands may not be supported in all versions of the receiver. When using a not supported command the receiver returns "syntax error".

11.1.2 Runtime information

The following information is available online and helps finding out why the MC outputs fails to activate. Note that this information appears spontaneous when you are not logged in to the monitor. When logged in the same information is available by the command “WHY”.

Monitor output information	Description
Operating mode	Normal indication when the MC outputs are activated.
The other CPU is not responding	Indicates that there is an error in the other CPU.
MCx ON error. Shall be OFF	If MCx output is ON when it should be OFF.
MCx OFF error. Shall be ON	If MCx output is OFF when it should be ON.
RELx ON error. Shall be OFF	If RELx output is ON when it should be OFF.
RELx OFF error. Shall be ON	If RELx output is OFF when it should be ON.
DRIVER error	Indicates that there is a relay driver error.
Interlocking. Press start!	There might be some interlocking from the PLC-program. For instance the operator must press the SIGNAL-button in order to activate the main contactor.
SYS-ver mismatch	If different system versions are loaded in CPU A and B.
APL-ver mismatch	If different PLC versions are loaded in CPU A and B.
Timeout or error in radiomessage	The receiver does not receive a correct message.
BQradio communication error	Communication with “BQ radio” fails.

11.1.3 Monitor commands

In the monitor several useful commands are available:

- **Command LEDS**

is used to get the status indication showed by the LED5 and LED6.

If Bluetooth is used and NOT connected

0 Not connected

If MC=ON

1 Connected, MC=ON

If MC=OFF

2 Connected, MC=OFF

If MC=ON and close to radiomessage timeout

3 Connected, MC=ON, 50% timeout

If internal errors are found in the receiver

4 Receiver internal error

If internal errors are found in the transmitter

5 Transmitter internal error

If receiver is in pairing mode but not paired

6 In pairing mode, NOT paired

If receiver is in pairing mode and paired

7 In pairing mode, paired

- **Command ERR**

gives some information of detected errors since last power on.

EPROM-error =x
 RAM-error =x
 PLC-error =x
 SYS-ver mismatch =x
 APL-ver mismatch =x

x is not "0" if an error is detected.

Following information is stored in EEPROM so it is available after power off:

MC1 output ON. Shall be OFF
 MC2 output ON. Shall be OFF
 MC1 output OFF. Shall be ON
 MC2 output OFF. Shall be ON
 Relay DRIVER error
 WDTx error
 Msg sequence no. error
 REL1 error
 REL2 error
 REL3 error
 REL4 error
 REL5 error
 REL6 error

;communication between CPU A & B
 ;radio message fault!

The information may be cleared by entering a C (or c).

- **Command HKSTAT**

gives some statistics about MC off.

Reception quality:xxx(yyy)%
 MC off due to emergency command :002%
 MC off due to timeout :098%
 MC off due to low battery voltage :000%
 Do you want to clear the statistics (Y/N)?

- **Command STAT**

LOGGED conditions
 Temperature:25(L-20 H60)

The information may be cleared by entering a C (or c).

- **Command LX**

Syntax: LX no ;no = 0 - 255
 Read/modify PLC-input (from radio transmitter).

- **Command LL**

Syntax: LL no ;no = 0 - 255
 Read/modify PLC-flag.

- **Command LY**

Syntax: LY no ;no = 0 - 255
Read/modify PLC-output (to relays or serial protocol).

- **Command LR**

Syntax: LR no ;no = 0 - 511
Read/modify PLC-register.

For LX, LL, LY and LR the following is valid:
RX160 answers: [X][L][Y][R]nnn=[n][nnnnn] ->
Ex. X102=1 -> or. R200=63920 ->

By entering a new value followed by ENTER the variable takes the new value and the next variable is showed. By only pressing the ENTER key the value of the variable is left unchanged.

Terminating with "<" gives the preceding variable.
Terminating with "." updates the value of the present variable automatically.
Terminating with ESC ends the command.
Terminating with "<", "." or. ESC does not change the value

- **Command LRH**

Syntax: LRH no ;no = 0 - 511
Read/modify PLC-register in hexcode.

RX160 answers: Rnnn=hhhh ->
Ex. X102=1 -> or. R200=10FA ->

By entering a new value followed by ENTER the variable takes the new value and the next variable is showed. By only pressing the ENTER key the value of the variable is left unchanged.

Terminating with "<" gives the preceding variable.
Terminating with "." updates the value of the present variable automatically.
Terminating with ESC ends the command.
Terminating with "<", "." or. ESC does not change the value

- **Command LS**

Syntax: LS no ;no = 0 - 20 (sequence no.)
Read PLC-step (step no. in a sequence).
RX160 answers: Snn=nnn
Ex. S02=1

By pressing the ENTER key the next sequence step value is showed.
Terminating with "<" shows the preceding sequence step value
Terminating with "." updates the step value of the present sequence automatically
Terminating with ESC ends the command.

- **Command VX**

- **Command EVX**

Is used to show inputs to the receiver.
Terminate with ESC.

- **Command VL**

- **Command EVL**

Is used to show flags inside the PLC environment.
Terminate with ESC.

- **Command VY**

- **Command EVY**

Is used to show outputs from the receiver.
Terminate with ESC.

- **Command TERM1**

Makes a direct connection between the monitor port and RS422/485-port.
Terminate with “@”.

- **Command BLUE**

Makes a direct connection between the monitor port and the radio.
Terminate with “@”.

- **Command SETFREQ**

Used to set the frequency code for the radio channel.

FX-CODE=nn<cr> ;nn is the hexadecimal frequency code

** Change FREQUENCY-CODE **

?nn

** Restart after change **

This command is only effective if the receiver is configured to NOT use frequency hopping which is specified in the PLC-program.

- **Command SETBQBNK**

Used to set the frequency bank for the BQradio.

Every bank has 30 frequencies.

Syntax: SETBQBNK no<cr> ;no = 0 - 15

If SETBQBNK is entered without value (no), the response is the following

** Change BQ-radio FX-bank settings **

SETBQBNK (0-15)

#xx ;where xx is the present frequency bank

Response to changed parameters:

OK!<ACK> ; <ACK> is hexcode=06h

The value of <type> is stored in PLC-parameter no. 13.

- **Command SETANA**

Used to configure the analogue input:

Syntax: SETANA no<cr> ;no=0-3

If SETANA is entered without parameter, the response is the following

**** Change ANALOGUE INPUT settings ****

SETANA INTERFACE(0:0-10V; 1:2-10V; 2:0-20mA; 3:4-20mA)

#xx ;where xx is the present parameter

Response to changed parameters:

OK!<ACK> ; <ACK> is hexcode=06h

The value of <type> is stored in PLC-parameter no. 8.

- **Command SETPROT**

```
<pollt>,<startt>,<stopt>,<timeout>,<offset value>,<offset sign>,<toledo>,<rs433/rs485><cr>
```

Used to configure the serial RS422/485 protocol. The parameters are used to define rules when capturing a string of characters from a connected scale or similar device.

If only SETPROT<cr> is entered the present settings is showed as follows

**** Change SERIAL PROTOCOL ****

```
'SETPROT POLLCHAR(hex),STARTCHAR(hex),STOPCHAR(hex),TIMEOUT(dec)100ms,
```

'OFFSET VALUE(dec),OFFSET SIGN(dec),TOLEDO(0 or 1),RS422/RS485(0 or 1)

```
#00,0D,0A,100,001,000,000,000;present parameter settings
```

Response to changed parameters:

OK!<ACK> ; <ACK> is hexcode=06h

The parameter values are stored in PLC-parameter no. 0-7.

The captured string may be shown using the command: **RSBUF**

- **Command SETDISPL** range(dec),decimals(dec),unit(dec),select(dec)<cr>

Used to change the transmitter display settings.

If only SETDISPL<cr> is entered the present settings is showed as follows

**** Change DISPLAY FORMAT settings ****

SETDISPL RANGE(dec),DECIMALS(dec),UNIT(dec),SELECT(dec)

```
#00000,000,000,000 ;present parameter settings
```

Response to changed parameters:

OK!<ACK> ; <ACK> is hexcode=06h

The parameter values are stored in PLC-parameter no. 9-12.

- **Command SETBQPWR**

Used to set the transmitter output power for the BOradio.

Syntax: SETBQPWR no<cr> ;no = 0 - 2

If SETBQWR is entered without value (no), the response is the following

**** Change BQ-radio power settings ****

SETBQPWR (0:Auto; 1:100%; 2:25%)

#xxx ;where xxx is the present setting

Response to changed parameters:

OK!<ACK> ; <ACK> is hexcode=06h

The value of <type> is stored in PLC-parameter no. 20.

- **Command SETFXSEQ**

Used to set the radio frequency sequence allocation settings for the radio in frequency hopping mode.

Syntax: SETFXSEQ no<cr> ;no = 0 – 119 or 255

If 255 is set the sequence is based on the system ID.

If SETFXSEQ is entered without value (no), the response is the following

**** Change radio FX-sequence settings ****

SETFXSEQ (0-119; 255:Disabled)

#xxx ;where xxx is the present setting

Response to changed parameters:

OK!<ACK> ; <ACK> is hexcode=06h

The value of <type> is stored in PLC-parameter no. 21.

11.2 Software aid tools

11.2.1 JUPITER RX160 Configuration Tool

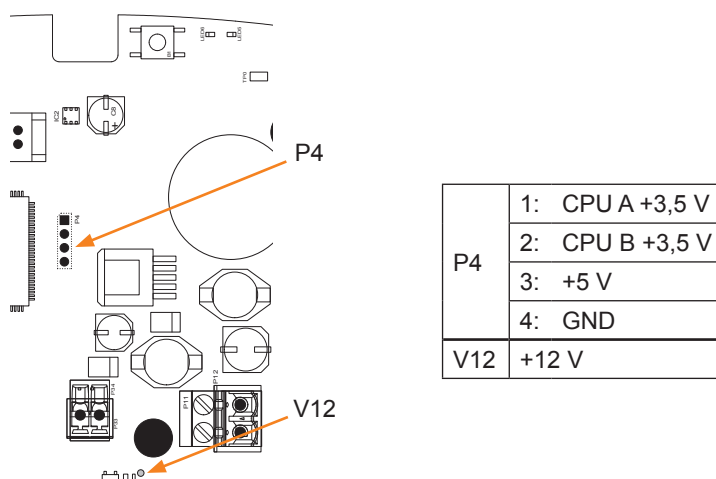
As the behaviour of each system may vary it might be necessary to modify the properties for scale communication, display information and radio communication. For the configuration settings a graphical PC-based tool is available. With this tool configuration files may be created, changed, downloaded from or uploaded to the receiver.

Refer to the Configuration tool manual Jupiter RX160 Document-ID: 949689-000.

11.3 Table over fault conditions in the receiver

Fault	Action Rx
Ramtest error	Rx clears the RCSS outputs and stops resetting the watch dog which will reset the cpu
Safe code error Crc8 test	Rx clears the RCSS outputs and stops resetting the watch dog which will reset the cpu
All code error Crc8 test	Rx clears the RCSS outputs and stops resetting the watch dog which will reset the cpu
Application code error Crc8 test	Enters stop (all outputs will be cleared)
CPU test	The program hangs and the watch dog will reset the cpu.
Test of the other cpu's watch dog Fault tolerance time=500ms	Enters stop (all outputs will be cleared)
Test of MC1, MC2, REL Y0-Y5 circuits and relays Fault tolerance time =500ms	Enters stop (all outputs will be cleared)
Test of REL Y6-Y13 driver circuits	Fault -> the safety stop relays will not activate
Task counter and watchdog. The counter must match a predetermined value in each software loop or the watch dog will not be maintained.	Fault -> reset (all outputs will be cleared)
Test of valid message number and timing Radio dependent	Enters stop (all outputs will be cleared)
Test for valid message time-out in the receiver	Enters stop (all outputs will be cleared) after predetermined time
Test of radio protocol checksum CRC32	Ignore the received message
Test at start up that checks that both cpu A and cpu B has the same program ID and VERSION and PLC-program crc8	The receiver remains in stop (all outputs will be cleared) in case of mismatch
+3,5 V under voltage test. Valid >3,25 V	Fault -> reset The receiver enters automatic stop (all outputs will be cleared)
+3,5 V over voltage test. Valid <3,75 V	Fault -> reset The receiver enters automatic stop (all outputs will be cleared)

12 Voltage test points



13 Receiver indications

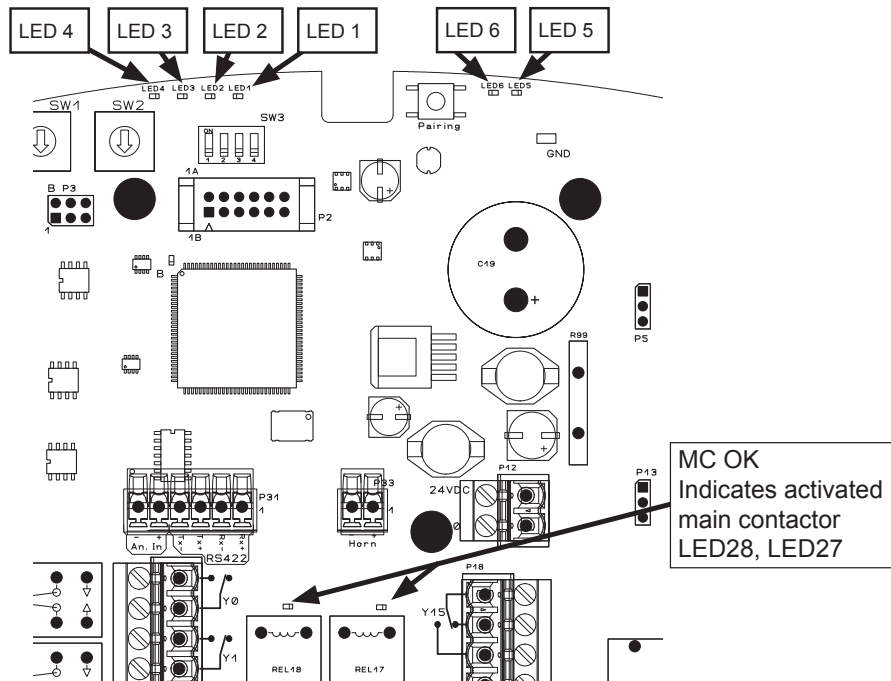


Figure 2. Indications on the MAIN board

Mode	Event	Indication on RX	Flash rate
LED 1-4			
TX command change	Changes in the transmitter switches or joysticks	LED 1 flashes	
Input data change		LED 2 flashes	
Message received		LED 3	
Squelch	Signal strength > -90 dBm	LED 4	
LED 5-6			ON/OFF
System OK	Not connected	LED 5 fast	50/50 ms
	Connected, MC=OFF	LED 5 slow	50/250 ms
	Connected, MC=ON	LED 5 extra slow	30/970 ms
	50% time out	LED 5 and LED 6 steady	
ERROR	Receiver internal error	LED 6 steady	
	Transmitter internal error	LED 6 fast	50/50 ms
Pairing	In pairing mode	LED 5 steady LED 6 fast	50/50 ms
	Paired	LED 5 steady	
LED 27-28			
MC activated		LED 27 & 28 steady	

Table 2. Mode, event and indications on the MAIN board

14 Scheduled maintenance program

To maintain availability and operational safety, a regular maintenance is necessary on the system. Annually; a visual inspection of the receiver is to be made. Make sure the receiver is still attached and that the cabling inside the receiver is still in place and secured.

Make a visual inspection of the antenna and the antenna cabling, if present.



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