**Revision History**

Document Name: Metacom MC402 Remote Router Installation Manual V1.0

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
<th>Version</th>
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<tbody>
<tr>
<td>01 Aug 2008</td>
<td>Initial Release</td>
<td>1.0</td>
</tr>
<tr>
<td>23 Jan 2009</td>
<td>Update Picture. Add INFOALL command.</td>
<td>2.0</td>
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Overview

The MC402 Remote Router is a GSM/GPRS based communications device programmed to route data between a SCADA system and remote stations (RTU’s). The MC402 works in conjunction with the Metacom Base Router Server that must be installed and operational at the Master SCADA system.

All remote monitoring and device configuration is available from the Base Router Server and via SMS from a mobile phone making the system easy to maintain and cost effective to administer.
Front Panel and LED indications

- **POWER LED = Blue**
  - Permanently on if power is on

- **NETWORK LED = Green**
  - Permanently off = GSM part of the MC402 in power down mode.
  - Flashing 600 ms on / 600ms off = Limited Network Service: No SIM card inserted or no PIN entered, or network search in progress.
  - Flashing 75 ms on / 3 s off = IDLE mode: The MC402 is registered to the GSM network (monitoring control channels and user interactions). No call is in progress and no GPRS connection is established.
  - Flashing 75 ms on / 75 ms off / 75 ms on / 3 s off (2 fast flashes) = GPRS Connected.
  - Permanently on = CSD call in progress.

- **STATUS LED = Orange**
  - Off = MC402 have not started up yet / Software not running.
  - Flashing 5s on / 5s off = Operating system booted up but not yet on GPRS. The device can be contacted via SMS.
  - Flashing 1.5s on / 1.5s off = Operating system booted up and device ready and connected on GPRS.

- **RECEIVE LED = Orange**
  - Flashing = Data is being received from SCADA by the RTU.

- **TRANSMIT LED = Orange**
  - Flashing = Data is being transmitted from the RTU to SCADA.

- **CD LED = Orange**
  - On = Data call in progress to the Remote Router.

- **SIGNAL LEDS**
  - Red = 0 – 33%
  - Orange = 34 – 66%
  - Green = 67 – 100%
  - Red Flashing = Timing Advance > 60 (too far away from the GSM tower)

- **INPUT/OUTPUT LEDS = Red**
  - Input1/2 On = Input closed
  - Output On = Output closed
Rear Panel diagram

Antenna Connector
The Antenna connector is a gold plated SMA Female panel mount and requires an Antenna cable connection with a SMA male connector. The Antenna cable should be LMR195 low loss cable for best results.

TEST Button
If the TEST button is pressed and hold in for ½ second the MC402 will send a test packet via GPRS to the IP and Port addresses configured for the Base Router Server. The operation is as follows:

- Switch off the signal LED’s
- Switch on the signal LED’s (starting from left to right)
- Send INFOALL response to the routerip1:responseport and routerip2:responseport

NB! Holding the test button down for 5 seconds will reboot the MC402. The LED’s will flash and the Status LED will be off until it boots up again.

Serial Ports
The DB9 DCE connectors on the rear panel comply with standard EIA pin-out. PORT1 is a full wire implementation as per picture below and PORT2 is a 4 wire configuration with only TX, RX, RTS, CTS and GND. 

PORT2 is the primary connection to the RTU.
PORT1 is an Auxiliary port for connection to the RTU configuration port or a second RTU can also be connected. This however requires advanced configuration.

DB9 Female Pin Legend
I/O Connector
The MC402 has 2 voltage free Digital inputs and 1 Output via a relay. The I/O can be controlled and read by SMS or GPRS.

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<th>Column 1</th>
<th>Column 2</th>
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<tr>
<td>Row 1</td>
<td>Input 1</td>
<td>Input 2</td>
</tr>
<tr>
<td>Row 2</td>
<td>Ground</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Inputs are read and updated every 37 msecs by the MC402.

The Relay output can withstand 125Vac/30Vdc, 1A.
The output can be closed, opened or pulsed. Pulsing the output will close and open the output with a delay in msec as set by the OutputDelay software parameter (default = 2000msec).
This feature will typically be used to reset an external device like an RTU.

Power connector
The power connection is a Molex 5557-02R male connector with a positive clip feature to hold the cable in place. The mating connector should be a Molex 5569-02AI housing with 5556-TL lug crimped onto the cable.

Input voltage is 8Vdc – 32Vdc or 6Vac - 22Vac and is polarity independent.
MC402 Installation

**Step 1.**
Connect the antenna and serial cables first and then connect the power supply and switch the power on. The blue power LED should go on.

**Step 2.**
The Network LED should flash slowly every second as it is searching for a GSM network. After about 20 seconds the Network LED must give a short flash every 3 seconds indicating that the device is registered on the cellular network. After another 10 seconds the Network LED must give a short double flash every 3 seconds indicating that the device is connected to GPRS and the Status LED will start flashing on and off every 1 ½ seconds. The MC402 is now operational.

**Step 3.**
The Signal LED should be Green for best performance. If it is orange it will still be able to communicate but the signal may degrade depending on atmospheric conditions. If the Red LED is on the antenna must be moved to get a better signal.

If the Red LED is flashing then the device is too far away from the Cellular Base Station and you will not get data communication. GSM cannot be used at this site. Take care when using a directional high gain antenna as you may still get good signal strength (Orange or Green LED) but if the Red LED flashes you will not get Date communication.

**Step 4.**
The MC402 Remote Router will already be configured to route data to the specific Base Router Server at the SCADA Equipment room. If not you have to configure the following parameters via SMS:

- APN
- Gprsuser
- Gprspwd
- RouterIp:Clientport
- AliveAddress:port and Alivetimeout
- Serverport
- ClientPort
- Baudrate

After the parameters have been set the device must be rebooted with the REBOOT SMS or a cold reboot by pressing and holding the TEST button for 5 seconds.

**Step 5.**
Test the Remote Router by sending the word INFO as an SMS to the MSISDN Number associated with the SIM card. Check all the parameters. Refer to the section on “Device settings and GSM information Commands”. Also send the CELLS command to check and record the number of Cellular Base Stations it can access and the signal strength of each one.

**Step 6.**
Make sure the MC402 Remote Router is loaded and configured on the Base Router Server and that the IP address and MSISDN correspond to the details on the back of the MC402 Remote Router. Also ensure that the RTU address corresponds with the address configured on the Base Router for this specific MC402 Remote Router.

**Step 7.**
Connect the RTU’s SCADA Data serial cable to PORT2 and the RTU Engineering Port serial cable to PORT1 of the MC402 Remote Router. Test the SCADA Data communications with an Integrity Poll via the SCADA system. Use the Engineering software for the specific RTU (WSOS, etc.) and connect to the RTU. Monitor the TX and RX LED’S to check data communications.
Device settings and GSM information Commands

In addition to the configuration parameters, the following commands may be sent to the MC402 Remote Router by using SMS or the GPRS Base Router communication. The response will be returned on the same channel as the request.

INFO
Description: Request general device information
Response:
- Serial Number
- APN
- GPRS User
- GPRS Password
- ServerPort - Port the MC402 listens on for data that will be send to COM PORT2
- RemoteIP:Port – IP address data received on COM PORT2 will be send to.
- Baud Rate for COM PORT2
- Signal Strength %
- Firmware Version
- Up Time (Days hour:min) since last reboot.
- Mode
  - 1 No communications
  - 2 SMS Only
  - 3 GPRS Error
  - 4 GPRS
- Connection state: GPRS or NO GPRS
- Date and Time of module (yy/mm/dd, hh:mm:ss)
- Area information if available
- IMEI no.

Outgoing SMS:
12345;INFO

Response SMS:
40203065
datalinx.co.za
mc9000927
mc003xv729
2004
192.168.2.46:2004
9600
54%
MC402 5.17-65
Up: 0, 0:8
4
GPRS
08/05/07,08:10:24
NDABENI
358244012205342
INFOALL
Description: Request general device information for both serial ports.
Response:
- Serial Number
- APN
- GPRS User
- GPRS Password
- ServerPort - Port the MC402 listens on for data that will be send to COM PORT2
- RemoteIP:Port – IP address data received on COM PORT2 will be send to.
- Baud Rate for COM PORT2
- Signal Strength %
- Firmware Version
- Up Time (Days hour:min) since last reboot.
- Mode
  - 1 No communications
  - 2 SMS Only
  - 3 GPRS Error
  - 4 GPRS
- Connection state: GPRS or NO GPRS
- Date and Time of module (yy/mm/dd, hh:mm:ss)
- Area information if available
- IMEI no.
- Timing Advance
- ServerPort - Port the MC402 listens on for data that will be send to COM PORT1
- RemoteIP:Port – IP address data received on COM PORT1 will be send to.
- Baud Rate for COM PORT1

Outgoing SMS:
12345;INFOALL

Response SMS:
40203065
datalinx.co.za
mc9000927
mc003xv729
2004
192.168.2.46:2004
9600
54%
MC402 5.17-65
Up: 0, 0:8
4
GPRS
08/05/07,08:10:24
NDABENI
358244012205342
6
2005
192.168.2.46:2005
19200
CELLS

Description: Request the Neighboring cell tower information. 1st row is the active cell.
- The following information is returned for up to 7 GSM Base Stations
  - CELL = Cell Tower ID (In Hexadecimal format)
  - BSIC = Base Station ID Code
  - CHAN = Absolute Frequency Number
  - RSSI = Signal Strength (0-63)

Outgoing SMS:
12345;CELLS

Response SMS:
cell,BSIC,chan,RSSI
BA9B,03,107,023
05A1,03,107,022
FFFF,24,111,021
5035,54,084,019
1A23,44,102,016
FFFF,61,109,014

This information can be used to check how many GSM Cell Towers are available in the area and the signal strength for each tower with your current antenna installation. It is a value out of 63. e.g 23 = 23/63 = 37%
If there is a GPRS problem the Cell Tower ID (in the first row) can be used by the cellular network provider to investigate the problem.

Hardware Watchdog

The hardware watchdog monitors the operation of the Remote Router software and will reboot the device after 6 minutes if no program activity is detected.
It also monitors the main processor and if it shuts down it will restart it immediately.
Fault Finding

If a problem cannot be solved in the field please contact Metacom Support between 7h30 and 22h30, 7 days a week.

Metacom Customer Support : 086 111 2655 or support@metacom.co.za.

Please have the MC402 serial number, MSISDN and IP ready and a description of the fault. Also clearly state your region within Eskom e.g. Eskom Western Region, Eskom Eastern Region, etc.

Below some possible faults and how it can be solved:

**Symptom:** Power LED not ON
**Causes:** Power not connected, Power not On, Voltage to low.

**Symptom:** Signal LED is RED or Orange.
It is best to have a GREEN signal LED. Send the INFO command to the MC402 and check the actual signal strength. If it is just under 66% then it is not a problem. If not then try the following:
- Check that the antenna cable is screwed into the antenna connector on the RTU and the MC402.
- If there was a good signal before with the current installation then replace the antenna and all cables up to the MC402 and test again.
- The antenna cable should not be more than 2 meters. If it is, it must be a low loss cable type LMR195 or LMR400.
- The antenna must be installed as far away from other electric or electronic circuits and cables or equipment, especially Transformers.
- The antenna must be as high as possible above ground.
- If you cannot get a better signal then use a MC402 from a different GSM network e.g. Vodacom in place of MTN.
- If you still cannot get a better signal strength then use a high gain directional Log-periodic Dipole Antenna (LPDA). (Looks like a Yagi antenna).

**Symptom:** RED Signal LED is flashing 1 sec on 1 sec off.
**Causes:** The device is too far away from a GSM tower. Your only option is to use a MC402 from a different GSM network e.g Vodacom in place of MTN.

**Symptom:** Remote Router does not respond to SMS commands
**Causes:** Check Network LED flash. Should be 1 short flash every 3 seconds to show it is on GSM network or 2 flashes every 3 seconds to show it is on GSM and GPRS. Refer to antenna installation above.
If this is not the problem:
- Check your SMS to make sure the MSISDN is correct and that the command is spelled correctly.
- Check the heartbeats on the BaseRouter to see if the MC402 reboots all the time or if it stopped sending heartbeats at some stage. Check the signal strength from the last heartbeat.
- Contact Metacom support if none of the above solves the problem.
Symptom: **No reply to INFO command from the Base Router Management tool or Remote Router does not route SCADA packets** (contact SCADA Engineering to test/resolve this problem)

Causes: Network or SIM related:
- Check SIM logged on to APN using PING command.
- Check following configuration parameters with an INFO sms:
  - APN
  - Grpsuser
  - Gprspwd
  - Serverport
  - RouterIp
  - Clientport
  - Baudrate
  - Mode

If Mode = 3 then the device is not on GPRS due to a GPRS problem in the area. The MC402 will automatically detect GPRS problems and set the mode=3 and try to reconnect to GPRS regularly (Default is 15 Minutes). You should wait for 15 minutes and try again.

Configuration problem on the Base Router and SCADA
- Check the data coming from SCADA to the correct COM port of the Base Router Server. Use Fieldcom to analyse.
- Check RTU address and IP address is correct on the Base Router.
- If the RTU is configured to connect via e.g. the 3rd COM port to the Second Base Router then the ClientPort on the MC402 should reflect that setting.

Wiring problem
Check correct wiring and cables connected to correct ports on Remote Router. The RTU must be connected to PORT2. Monitor the TX and RX LED’s to see if data is send to the RTU or Received from the RTU. The RTU must not be set for modem controls. E.g. No RTS/CTS or DCD/DTR/DSR. You only need RX, TX and GND.

Symptom: **Remote Router reboots every 6 minutes.**

Causes: The internal watchdog monitoring the software in the MC402 picked up a problem and is rebooting the MC402 every 6 minutes. Contact Metacom Support to resolve this.
Trademarks

Java and all Java based marks are trademarks or registered trademarks of Sun Microsystems, Inc.
Windows is a registered trademark of Microsoft Corporation.

Abbreviations

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<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>APN</td>
<td>Access Point Name</td>
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<tr>
<td>BER</td>
<td>Bit Error Rate</td>
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<tr>
<td>CSD</td>
<td>Circuit Switched Data</td>
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<tr>
<td>DCE</td>
<td>Data Communications Equipment</td>
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<tr>
<td>DNP3</td>
<td>Distributed Network Protocol Version 3.0</td>
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<tr>
<td>DTE</td>
<td>Data Terminal Equipment</td>
</tr>
<tr>
<td>EDGE</td>
<td>Enhanced Data for Global Evolution</td>
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<tr>
<td>GPRS</td>
<td>General Packet Radio Services</td>
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<td>GSM</td>
<td>Global System for Mobile Communications</td>
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<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
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<tr>
<td>IMEI</td>
<td>International Mobile Equipment Identity</td>
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<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
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<td>LPU</td>
<td>Large Power User</td>
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<tr>
<td>MSISDN</td>
<td>Mobile Station Integrated Services Digital Network</td>
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<tr>
<td>RTU</td>
<td>Remote Terminal Unit</td>
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<tr>
<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
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<tr>
<td>SIM</td>
<td>Subscriber Identity Module</td>
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<tr>
<td>SMS</td>
<td>Short Message Service</td>
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<tr>
<td>VPN</td>
<td>Virtual Private Network</td>
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