INTRODUCTION

The RTU870 is a serie of compact outstations with different integrated input/output configurations designed for use in the industrial environment.

The units are designed in a very compact 162 mm wide module for DIN-rail mounting (35 mm symmetrical). Dimensions conform to DIN 43880 (used for circuit breakers) thus insuring easy installation in standard installation panels and boxes widely available in the electrical industry.

The RTU870 are delivered with a range of different power supply options including charger options (with a battery monitor) for an external lead acid battery, enabling the RTU to operate regardless of interruptions in the mains supply.

The RTU870 has a number of integral inputs and outputs and further I/O´s can optionally be added via an expansion bus.

The main communication is done through the EN/IEC60870-5-101 protocol. Communication interface is RS232. The RTU870 do in general support modem dial-up features.

The unit can be programmed to perform simple control sequences using an EN/IEC1131-3 IL (PLC) programming language. Programming and setup is achieved by using a standard PC connected to the programmer port, with the IOTOOL870 software package installed.

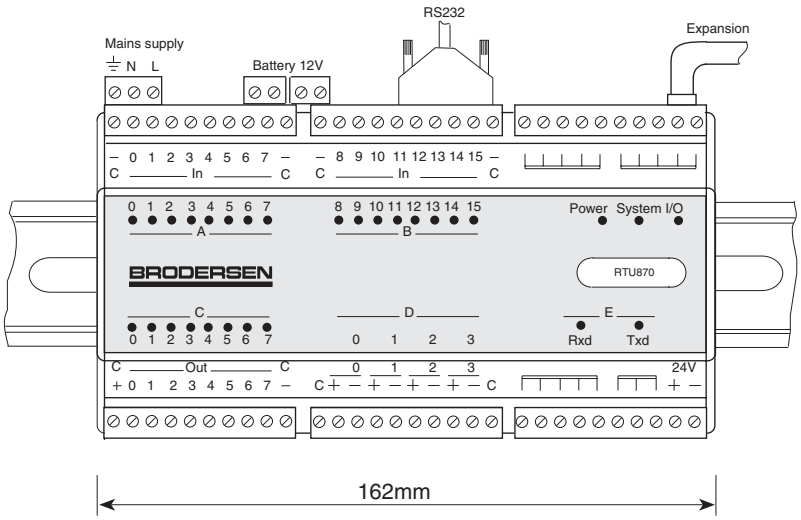
The ModbusRTU protocol is used on the programming port COM2.

VERSIONS/ORDERING CODES

UCR- 28IO / B0460.D6

Type	
UCR	UCR
Input/output	
8 digital input/8 digital output	8DIO
16 digital input/16 digital output	16DIO
32 digital input (10-30V DC)	32DI
8 digital input/4 analog input	12I
16 dig. in./8 dig.out./4 analog in.	28IO
24 digital input/12 relay output	36IO
Options	
/_	(blank)
Branding	
Brodersen	B
COM options	
RS232/V24 serial	04
RS485	05
Power supply	
115-230 VAC	10
115-230 VAC/12VDC UPS chr.	20
24-48VDC/ outp.12VDC	30
Battery12V PS/Solar panel cont.	40
24-60VDC/ outp.24VDC	50
115-230 VAC/24VDC UPS chr.	60
Analogue input range	
0-10V/0-20mA	D1
4-20mA	D2
0-5V	D3
0-20/4-20mA	D6
Digital input range (digital types only)	
10-30VDC uni-polar	P1
30-60VDC uni-polar	P2
30-60VDC bi-polar	P3
40-72VDC uni-polar	P4
40-72VDC bi-polar	P5
10-30VDC bi-polar	P6

DI on modules with AI is always 10-30VDC uni-polar unless other is specified.



CONTENT

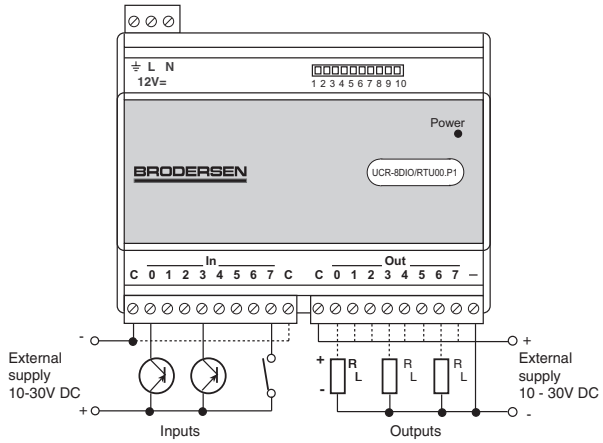
TECHNICAL DESCRIPTION

Input/output
The RTU870 basic I/O fit can include up to 32 input/output terminals. I/O options available:

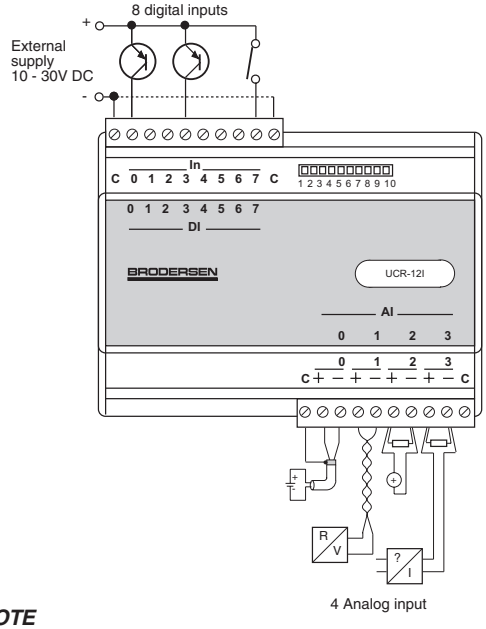
Version UCR-	8DIO	16DIO	32DI	12I	28IO	36IO
Digital inputs (10-30V DC)	8	16	32	8	16	24
Digital outputs (PNP o. c.)	8	16	0	0	8	
Analogue inputs (0-10V/4-20mA)	0	0	0	4	4	
Relay outputs (NO)						12

All digital I/O´s are equipped with opto-couplers. The analogue inputs have galvanic isolation between the individual channels. Solid state relays are used for multiplexing the analogue inputs.

Wiring diagram
UCR-8DIO

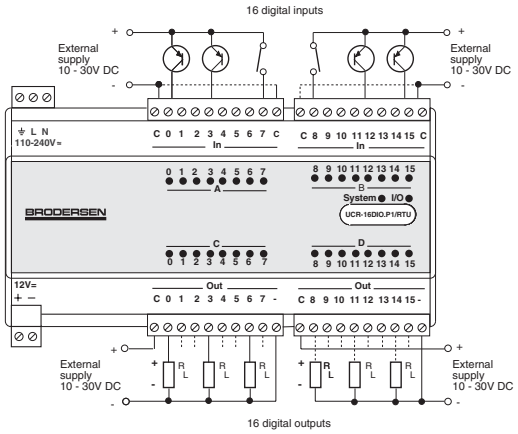


UCR-12I

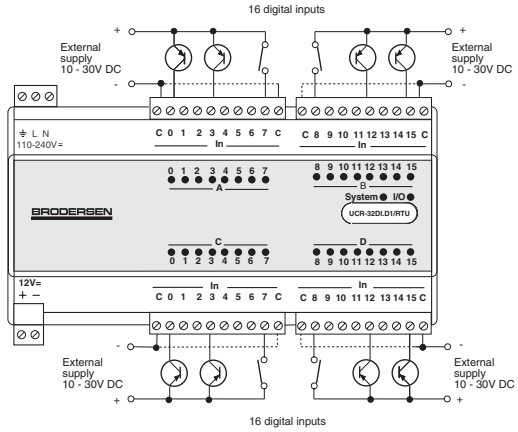


NOTE
See mounting instructions for more details on mounting and wiring.

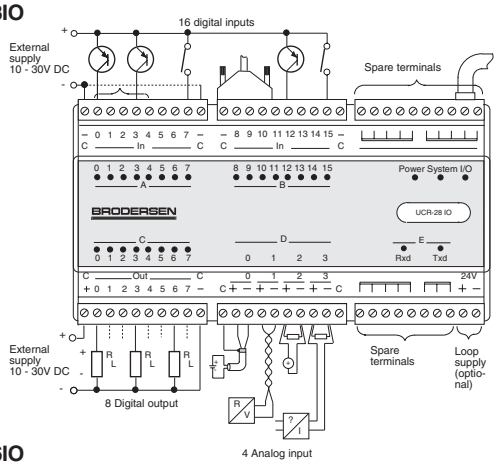
UCR-16DIO



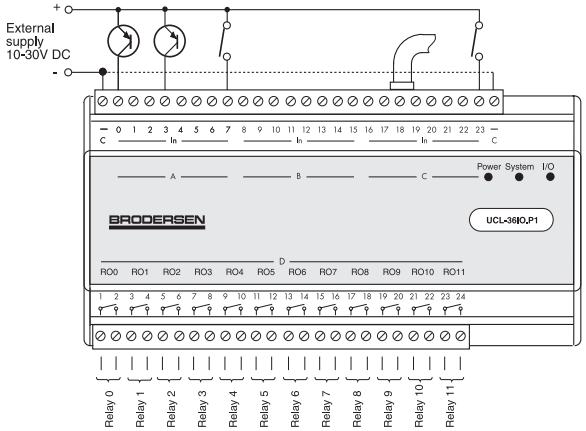
UCR-32DI



UCR-28IO



UCR-36IO

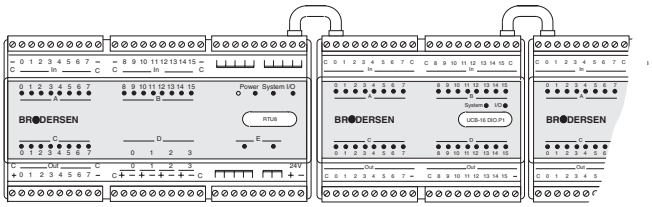


Spare terminals may be used as a supply rail for the sensors.

Compact utility outstation / EN/IEC60870-5-101 slave
RTU870

I/O expansion
The basic I/O fit of the RTU can be expanded by attaching BC expansion modules. Standard 108mm wide.

RTU with expansion modules



Expansion modules are available with the following I/O configuration:

8-32 10-30V inputs
8-32 10-30 V PNP (or NPN) open collector outputs
8 230V inputs / 8 230V outputs (potential free relay)
4-8 analogue inputs (0-10V, 4-20mA, etc.)
8 Thermo coupled inputs (J, K, R, S, T type)
8 Pt-100, Pt-500 or Pt-1000 RTD inputs
4 analogue outputs (0-10V, 4-20mA, etc.)

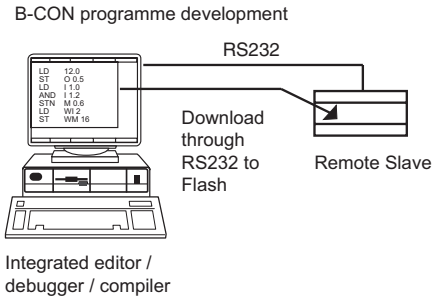
The number of expansion modules to be connected to an RTU is limited of 3 factors; current consumption and I/Os EN/IEC-60870 settings. The total number of I/O´s is limited to 104 analogue or 496 digital I/O´s (maximum 104 words or 31 I/O sections). A word equals one analogue channel or 16 digital channels.
Finally the number of single point and double point I/Os will limit the total expansion I/Os.
In the event that the current consumption of the expansion modules exceeds the capability of the power supply, an additional power supply must be inserted.

Indicators

Indicator	8DIO	12IO	16DIO	32DI	28IO
I/O	On: : I/O including expansion OK ⎍⎍⎍⎍⎍ : I/O configuration error Off: : General fault or no power				
System	On: OK ⎍⎍⎍⎍⎍ : Controller error ⎺⎺⎺⎺⎺⎺⎺ : Mains OK, Battery low* ⎍⎍⎍⎍⎍⎍⎍ : Mains off* Off: General fault or no power				On: OK ⎍⎍⎍⎍⎍ :Controller error Off: General fault or no power
Power					On: OK ⎺⎺⎺⎺⎺⎺⎺ : Mains OK, Battery low* ⎍⎍⎍⎍⎍⎍⎍ : Mains off* Off: No power

* With Power Supply option 20/60 (UPS) only.

Local control
The RTU compact outstation includes an IEC 1131-3 (B-CON) programming facility; it can be programmed using Instruction list programming language.
Mapping of I/O etc. in IEC870-5-101, limited local processing and data handling are configured using a PC with the programming tool installed.
The B-CON (IEC 1131-3) programming tools include an integrated editor, compiler, debugger, and down-load facility, for developing application programmes and to down-load them via the RS232 line to the RTU.

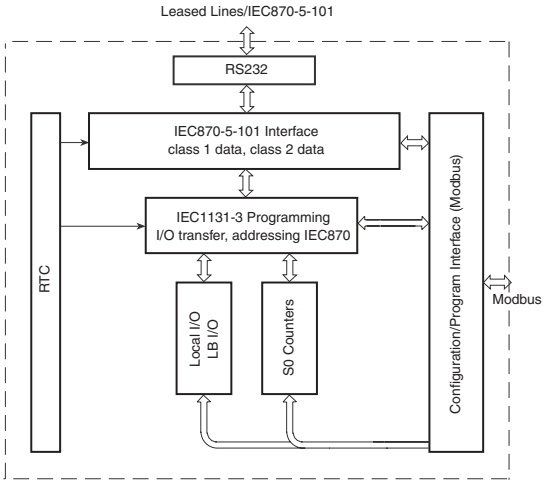


Examples of instructions used in the IEC 1131 language:

LD	load (read) value e.g.: input or internal register
ST	store (write) value e.g.: output or internal register
AND	logical and e.g.: 2 inputs
ADD	add 2 values
MUL	multiply 2 values
R	reset e.g.: an output
GT	greater than, compare 2 values

The compiled instructions are down-loaded into Flash memory in the RTU. The application programme can be up to 23k bytes. A simple load (LD) or store (ST) instruction require only about 10 bytes of memory.

RTU firmware block diagram



Internal I/O addressing (B-CON)
The address of the I/O in the RTU has the same structure as other Series 2000/4000 products. The I/O´s are separated into 4 data types; digital (DI/DO), analogue (AI/AO) and 2 auxiliary types (ZI/ZO and YI/YO). In the RTU the YI/YO is used for transfer of derived values or set-points, to and from the local CPU and to the IEC870-5-101 driver.
The RTU handles bits (Boleans) and Integers (8/16 bit). Analogue values have to be handled as integers; floating point operation (Reals) is not supported.
The PC software tools use words (16 bits) as a reference for addressing the I/O, but as the RTU is equipped with an 8 bit controller, the addressing uses bytes (8 bits) as a reference.
The inputs and outputs are numbered in the order they appear physically (left to right). Please note that input/output and analogue/digital are numbered separately.

In the B-CON programming language the following address and syntax are used for the I/O:

Digital input (DI):

Bit input: **i0.0, i0.1…..i0.7, i1.0…i1.7, i2.0……**
i0.0 loads the first digital input (input 0).
i1.0 loads digital input number 8 (first input in byte 1).

Byte input: **bi0, bi1, bi2, bi3…..**
bi0 loads the first 8 digital inputs (input 0-7).

Word input **wi0, wi2, wi4, wi6……**
wi0 loads the first 16 digital inputs (input 0-15).

Digital Output (DO):

Bit output: **o0.0, o0.1…..o0.7, o1.0…o1.7, o2.0……**
o0.0 sets the first digital output (output 0).
o1.0 sets output number 8 (first output in byte 1).

Byte output: **bo0, bo1, bo2, bo3…..**
bo0 sets the integer of the first 8 outputs (0-255).

Word output: **wo0, wo2, wo4, wo6……**
wo0 sets the integer of the first 16 outputs (0-65535).

Analogue input (AI):

Input (word): **wi2000, wi2002……., wi2014, wi2016……**
wi2000 loads the integer (0-4095) of the first analogue input (channel 0).
wi2014 loads the integer (0-4095) of the analogue input channel 7.

Analogue output (AO):

Output (word): **wo2000, wo2002……., wo2014, wo2016……**
wo2000 sets the first analogue output (channel 0).
wo2014 sets the analogue output channel 3 at the second AO module.

Aux. input (YI), e.g. setpoint transfered via the MODBUS from a central station:

Bit input: **i6000.0, i6000.1....i6000.7, i6001.0, i6002.0..**
i6000.0 is the first input in the first byte/word.
i6001.0 is the first input in byte 1.

Byte input: **bi6000, bi6001, bi6002, b600i3…..**
bi6000 loads the first 8 digital inputs (input 0-7).

Word input: **wi6000, wi6002, wi6004, wi6006……**
wi6000 loads the first 16 digital inputs (input 0-15).

Aux. output (YO), e.g. result to be transfered via the MODBUS to a monitoring station

Bit output: o6000.0,o6000.1..o6000.7,o6001.0..o6001.7,o6002.0..
o6000.0 sets the first output (output 0).
o6001.0 sets output number 8 (first output in byte 1)

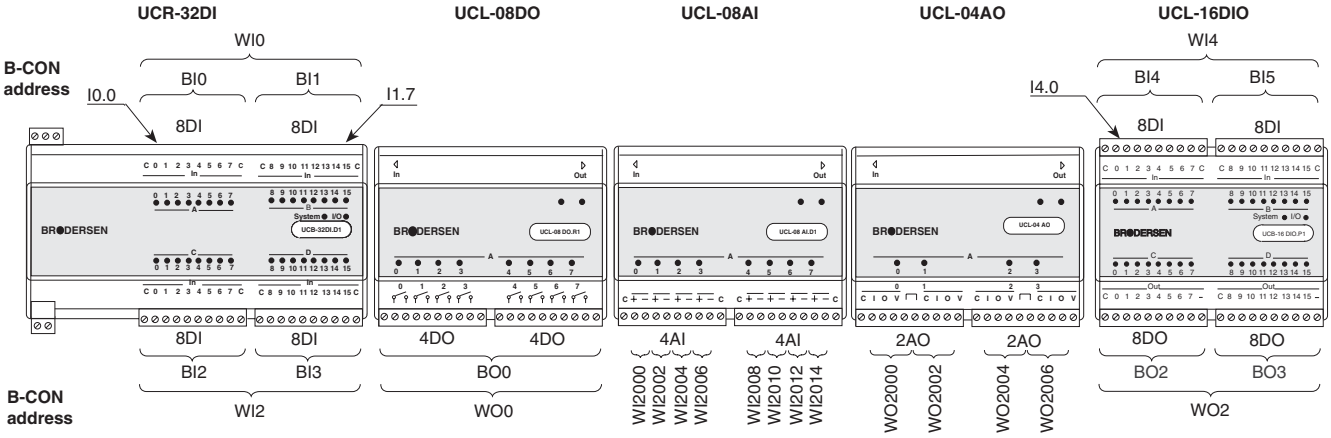
Byte output: **bo6000, bo6001, bo6002, bo6003…..**
bo6000 sets the integer of the first 8 outputs (0-255).

Word output: **wo6000, wo6002, wo6004, wo6006……**
wo6000 sets the integer of the first 16 outputs (0-65535).

Programme example (B-CON)
In appendix B is a B-CON program example listed. It is specific made as an example of how to control the IEC870-5-101 driver together with the local I/Os etc.

Real time clock / time base
The RTU includes a real time clock and time base, which are used for both local control and for the interface drivers. The real time clock includes battery backup (lithium battery).
The real time clock is available for use in the IEC 1131-3 application programme making real time control possible, e.g. to start or stop or do any other time function related to the control or the monitoring of the application.
The real time clock can be synchronised via the IEC870-5-101 connection, and from the PC programmer tool I/O Explorer.

Example of an island



COM1 as RS485
The RS485 port (9 pole sub-D) is equipped with Data and RTS signals (data +/- and RTS +/-). The RS485 interface is isolated with opto-couplers to avoid noise and ground level differences when using long communication lines.

NOTE: When using RS485 the Modem mode of the RTU870 cannot be used. That means also the dial out from the RTU870 is **NOT** possible.
RS485 port

Pin no	Signal	Description
1	Data -	Data minus
2	Data +	Data plus
3	NC	Not connected
4	NC	Not connected
5	DGND	Signal ground
6	RTS -	Request to send minus
7	RTS +	Request to send plus
8	NC	Not connected
9	NC	Not connected

If RTU870 is the last node in a multidrop line, a termination resistor must be mounted.

COM1 as RS232
The RS232 port (9 pole sub-D) is equipped with all hardware handshake signals (DCD, DTR, DSR, RTS, CTS, RI).

The use of RTS, CTS handshake, leading and trailing delays are user configurable via the PC utility menu. The settings are only active in non modem mode. In modem mode (Dial-up) the settings are don't care. The handshake functions are as follows.

Handshake RTS Off
RTS is kept inactive (low) at all time. RTS Leading and Trailing values are don't care.

Handshake RTS On
RTS is kept active (high) at all time. RTS Leading and Trailing values are don't care.

Handshake RTS On/Off
RTS is inactive when receiving data, and become active when transmitting data.
The RTS Leading setting defines the delay from activating the RTS to the first character is transmitted.
The RTS Trailing setting defines the delay from the last character is transmitted to RTS is deactivated.

Handshake RTS/CTS
RTS is inactive when receiving data, and is activated when the RTU wants to transmit data. After activating the RTS, the RTU will wait for the CTS to become active, before start transmitting. The RTS Leading delay is still valid in this mode, and an adjustable delay from CTS is activated to first character is then possible. However by setting the Leading time to zero, there is no unnecessary delay from CTS to first character (like normal RTS / CTS function). After activating RTS the RTU wait up to 10 sec for the CTS signal. If timeout occur ,transmission is discarded, and the RTU wait for a new request.

RTS Leading
The RTS Leading define the delay time from activating RTS to transmitting the first character.
The RTS Leading value is configurable in the range 0..500 of 10ms units. Ie. up to 5000 ms.

RTS Trailing
The RTS Trailing define the delay time from the last character is transmitted to RTS is deactivated.
The RTS Trailing value is configurable in the range 0..50 of 10 ms units. Ie. up to 500 ms.

Note!
When setting the Leading value to a long time (e.g. 5 sec) it could be difficult to changes configuration and download Bcon programs due timeouts in the driver. It is advisable not to use longer delay than necessary, and configure RTS Leading delay as the last part when using long delays. If the RTU is inaccessible due long delays, the module setting could be reset to default by setting all code switches ON.

RS232 port (9 pole sub-D)

Pin no	Signal	Description/Remarks
1	DCD	Data carrier detect (in)
2	RX	Receive data (in)
3	TX	Transmit data (out)
4	DTR	Data terminal ready (out)
5	SG	Signal ground
6	DSR	Data set ready (in)
7	RTS	Request to send (out)
8	CTS	Clear to send (in)
9	RI	Ringing indicator (in)

Dial-up/General
For small amount of process information a dial up configuration for an RTU is possible. Such a configuration consists of an RTU and modem, which is connected to a telephone line. The Central Station (later referred to as CS) may dial these RTUs some times a day. In case of an event or periodic information in the RTU, which should be immediately transmitted to the CS, RTU870 starts to call CS. After a modem connection is established the normal protocol dependent communication takes place. After all data are transmitted, the CS shall close the modem connection.

The functionality of dialled line connection is implemented for the IEC 60870-5-101 with unbalanced communication mode. RTU870 supports an external Hayes compatible Modems (e.g. GSM modem) connected to the RS232 interface. The RTU870 only support communication to one Master.

RTU calls CS/Active Dial up
RTU can be configured for active call up. RTU calls CS if an event of priority 1 occurs (RTU870: change of single or double indication or if active dial back is enabled and activated). If a priority event occurs, RTU870 calls CS. RTU870 starts to call the first telephone number in the number list. If connection to CS is not established the RTU870 will wait the Redial delay time and try again. That will go on the number of Retry counts defined.
If the dial attempt still fail under the number of retries, the RTU870 use the next subscriber no on the phone no list.

If the dial-up attempts run out of Subscribers to try without getting connected, the procedure will be started again after a pause of 30 minutes (B-CON variable).
The RTU870 keeps the state "dial request" until all information, which is marked for transmission, is transmitted. If the link is disconnected before all data is transferred (i.e. by the CS) RTU870 tries to dial the CS after a predefined time e.g. 10 min.

CS is responsible for hanging up the link. This has to be regarded in particular, if there are messages from sub-RTUs that have to be transmitted. Messages from sub-RTUs can be transmitted with delay. The transmission time for a message from the last connected sub-RTU to the router RTU has to be taken into consideration by the CS before abort a dial up connection. This is for the RTU870 only relevant regarding the settings for "Inactivity timer". The RTU870 hang up itself if "Inactivity hang up delay" time is over.

CS calls RTU870
If Dial back is disabled, the RTU870 with the modem, auto answer a call. After a modem connection is establish the normal protocol communication take place.
After the CS has received and transmitted all data, CS is responsible to disconnect.
In this configuration, the RTU870 waits until the modem is connected. After that the RTU870 forces the modem to hang up, and tries itself to connect to the CS as described in section Dial Back.
For this function the phone no list is used, and so are the dial up procedure as described above.
After the CS has received all data, the CS is responsible to hang-up.
EN/IEC 60870-5-101 Protocol procedure details in dial-up mode
For the CS (EN/IEC60870-5-101 Master) the dial up line is treated like a normal transparent line, therefore it's not necessary to start with link initialization after a new modem connection. The Link-layer State is the same as at the end of the last successful communication. It is the responsibility of the CS how to start a correct communication (go on with the last Link State or a link initialization). In case the RTU870 is calling the CS, the CS can't determine which RTU is calling. Therefore is the link address of the substation set to the same address. For RTU870 link address is always 1. For recognizing RTU870 CS may send a broadcast general interrogation. In that case, that the RTU870 must answer with it's own ASDU address and all data.

Modem requirement
The modems used must support even parity. This can be a problem for some (older) modems. When using GSM communication the master (CS) must implement long timeout delays for retransmission, 10 sec or more. This is due to large delays on the GSM net.

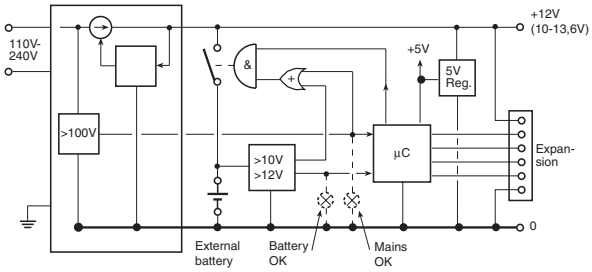
RTU870 Power Supply/battery charger (type 20 and 60)
The RTU870 can be equipped with an integrated switch mode power supply and a charger circuit, able to charge and monitor an external lead acid battery.
The battery can be a 3 to 12 Ahour battery, depending on the actual load and the required backup time. The actual backup time can be calculated from the average consumption of the modules installed (RTU870 and expansion module(s)) and the capacity of the battery used (see examples below). As the power supply has a current limiter, the recharge time will depend on the size of the battery and the average current used for the electronic circuits.

The following outputs/voltages are derived from the RTU870 power supply (voltage levels are for type 20):

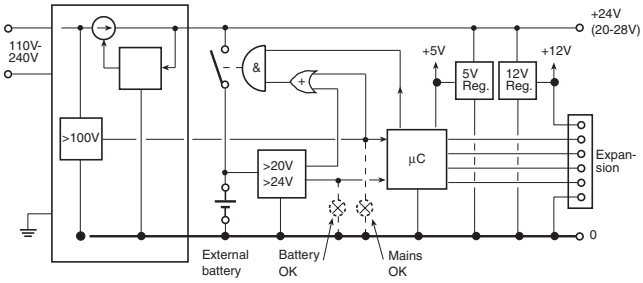
- Supply for the micro controller and other electronics in the RTU870 module itself (5V).
- 12V (10-13.6V) for expansion modules (local bus), 8/10 pole modular jack.
- 12V (10-13.6V) for digital I/O, and optional Radio/modem max. 2A maximum, 2 pole plug-in screw terminal.
- 24V loop supply, max. 200 mA, optional with 28I/O RTU870 only, plug-in screw terminal.
- Battery, charging current up to 1.1A, 2 pole plug-in screw terminal (UPS option only).

The maximum current supplied from the power supply to the battery and electronic circuits is 1.1 A (12V DC).

Power supply block diagram (type 20)



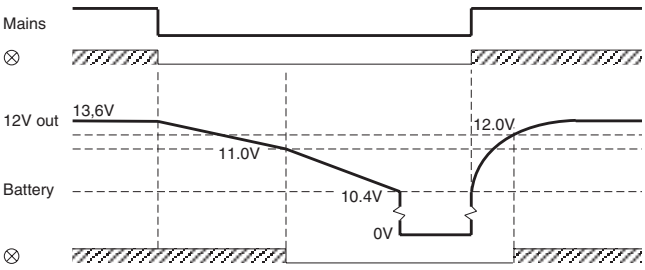
Power supply block diagram (type 60)



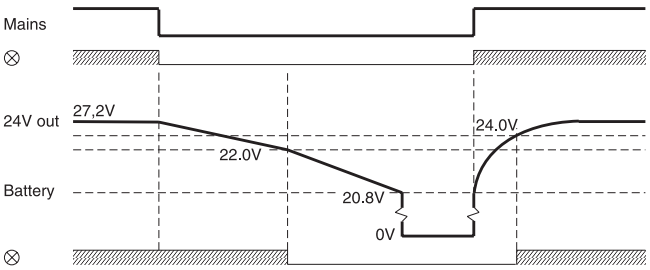
A mains indicator informs the CPU that mains supply is applied. If the mains supply should fail or go lower than accepted by the power supply, a status flag (m9.7) indicates the fault to the application program, which may issue a warning by making a dial-up or by setting a local output. Battery low voltage warning is also given when the battery is discharged to approximately 20% of its capacity. The indicator returns to normal when battery is charged to approximately 80% of its capacity .
The indicator (m9.6) allows the CPU and the application programme to issue a warning and close down before loosing operation. The close down procedure may include a controlled shut down sequence of the process and an emergency alarm to the central monitoring station.
To prevent damaging the battery by deep discharge, the battery will automatically be disconnected and the operation will stop, without any further warning, if the battery voltage goes below the battery low level limit.

The battery ON/OFF signal enables the CPU to disconnect the battery, for a short period, during operation in order to test the battery.
Due to the fact that the output of the charger has a higher open circuit output voltage than the battery voltage, it is not possible to detect a missing battery without disconnecting the battery from the charger.
When mains is applied the battery is disconnected shortly from the charger at start-up and hereafter every 24 hours (00:00) to check the battery voltage. If low or missing battery is detected the battery will be checked every 10 second until the voltage is back to normal.

Typical charge / discharge cycle (type 20)



Typical charge / discharge cycle (type 60)



Power error warnings / status reports
Power and battery errors are reported as single point informations. Refer to the interoperability document for address details.

Power consumption
Power consumption is directly related to the number of I/O´s connected to the RTU870.
Below are examples for the standard RTU870 versions as stand alone units. All figures are typical consumption at 12V. The additional current for expansion modules can be found in the relevant data sheets.

RTU870 version	UCR-8DIO		UCR-16DIO		UCR-32DI		UCR-28IO	
	min.	max.	min.	max.	min.	max.	min.	max.
Controller/electronics/ LEDs	55	90	55	105	55	90	65	100
Digital inputs (12V)	0	25	0	50	0	100	0	50
Digital outputs (load 40mA/12V)	0	160	0	640			0	320
Analogue inputs (4-20mA/24V loop)							20	250
Total 12V consumption (mA)	**55**	**275**	**55**	**795**	**55**	**190**	**85**	**720**

If equipped with 12V type battery back-up, the average consumption per time unit, should be added to calculate the actual load and back-up time.

The mains power supply will, until the battery is fully charged, work as a constant current source limited to 1.1A. The electronic circuits (RTU870 and expansion modules) will draw their required current and the remaining current will be used to charge the battery. If the current consumption exceeds the capacity of the power supply for a short time, such as when a radio enters transmit mode, the excess current will be drawn from the battery.
If the RTU870 consumption alternates between 0.4A and 0.8A, the charging current will alternate between 0.7A and 0.3A until the battery is fully charged. If the two intervals are equal (50% each), the average load will be 0.6A and the corresponding charging current will be 0.5A.
If the load current alternates between 0.5A (90% of time) and 2A (10% of time) the average load will be 0.65A and the corresponding average charging current will be 0.45A.

Battery performance/guidelines
Below are examples for the 3 sizes of batteries and 4 levels of load. All figures are typical. The calculations assume that the battery is fully charged or fully discharged using the RTU870 charger circuit. Also it is assumed that the average load is constant during test (both charge and discharge periods).

Total load (mA / 12V)	**150**			**300**			**600**			**900**		
Battery (A hours)	**3**	**6**	**12**	**3**	**6**	**12**	**3**	**6**	**12**	**3**	**6**	**12**
Backup time (hours)*	20	40	80	10	20	40	5	10	20	2.5	6.5	13
Recharge time (hours)*	6.5	13	26	7.5	15	30	12	24	48	30	60	120

* The figures above assume nominal values for the battery. In reality the figures could degrade dramatically as the performance of a battery may vary widely with temperature and age. If a high degree of security is required, it is strongly recommended that these figures are viewed very conservatively. At high ambient temperature the recharge time may be prolonged.

Counter input
Two 32 bit counters is provided on counter input 0 and 1. The counters can be used for S0 input, only via potential free contacts.
The counters values are battery backed, when power is off.

The counters are configured in the RTU870 Configuration program before use. The counters can be set up to a periodic counter, delivering either absolute or accumulated counter values, or alternative be disabled. When the absolute counter is choosen the value is reset when starting a new counting period, and in accumulate mode the counter is not reset.

The counter periode can be seleced within the range from 1 to 240 minutes. Note than only figures which can be devided up in 1 day (24 hours) are accepted.

The counters are firmware polled, which limit the count frequency when the CPU is loaded heavily. If the module is loaded with max. I/O, extra local control functions via the internal application program etc. only up to 60 Hz count frequency could be expected.
In IEC870-5-101 the counter inputs are defined as integrated totals. See the Interoperability document.

Note ! When downloading a project file, or changes of the module configuration, the counters are blocked for a short period, and counts could be lost.

Analogue input settings
The analogue inputs is configurable in two ranges; 0-20mA and 4-20mA. The range is selected in the configuration table. In the word representing the actual analogue input bit 14 and 15 define overflow and underflow:

Bit	Status	Detection value
14	1 = under flow	input < 3,5mA (only valid in range 4-20mA)
15	1 = over flow	input > 20mA + 10 counts (20,05mA)

IEC870-5-101 General
The main serial interface port is, via a modem or direct used to provide an IEC60870-5-101 slave protocol functionality. The slave driver handles the reception of the requests from the master. When a error free request is received the slave driver will signal the B-CON application which is supposed to act on the request and send a response back to the master. This means that much of the IEC870-5-101 protocol is the responsibility of the B-CON application, which is free to define which requests it will support and the mapping of the information object addresses. However the B-CON language can in rare cases set some restriction on what kind of requests can be handled.
The main port is configurable from 300 to 9600 baud, with fixed 8 data bit, even parity.
The second serial port (COM2, 6 pole RJ45 connector) is used for configuration of the RTU870 module using the IOTOOL32 Pro driver toolkit. The configuration of the second serial port is default, 9600 baud 8 data bit, none parity. Configuration via modem is not supported. The Modbus slave/node number on second COM2 port is fixed to 1.

IEC60870-5-101 slave driver implementation

Overview
The IEC60870-5-101 slave driver is implemented as a separate task in the RTU firmware. The driver will operate at the main RS232 port of the Dallas 80C320 controller in the RTU. The driver occupies a number of BM registers. BM 30..33 are used for dial control, and BM38..BM49 are used to receive IEC60870-5-101 data buffers in control direction.
The driver will use RX, TX, DCD and RTS (and GND) signals to communicate with a dialup modem or a null modem connection (e.g. radio modem).
If dialup mode is enabled, the driver activates the RTS signal permanently, and uses the DCD to determinate when a connection is established. When DCD is activated, the slave driver is ready to receive requests from the master station, no matter if the slave initiated the connection, or it is receiving an incoming call. If dialup mode is disabled, the DCD signal state is don't care, and RTS is activated according to the handshake option in the configuration menu.

Communication sequence
When connected, the RTU870 IEC60870-5-101 slave is typically scanned with one of the supported function codes in the control field:

0 SEND/CONFIRM expected Reset of remote link
Returned answer
- Single char frame E5 as acknowledge

3 SEND/CONFIRM expected User data
Returned answers:
- Single char frame E5 as acknowledge
- Fixed length frame function codes 0=ACK or 1=NACK

9 REQUEST/RESPOND expected Request status of link
Returned answers:
- Fixed length frame function code 11=Status of link or access demand

10 REQUEST/RESPOND expected Request user data class 1
11 REQUEST/RESPOND expected Request user data class 2
Returned answers:
- Single char frame E5 if no data available in either trans mit queue.
- Fixed length frame function code 9=NACK if no data available in the requested transmit queue.
- Variable length frame function code 8 with user data.

Process/System information in control direction
All process and system information in control direction (received by RTU) is mapped into BM area. The B-CON application program must then monitor these registers to act on the requests and respond.

BM38 TYPE IDENTIFICATIONS Type ID (0=no command)
BM39 VARIABLE STRUCTURE QUALIFIER (always = 1)
BM40 CAUSE OF TRANSMISSION
BM41 COMMON ADDRESS OF ASDU (the RTU870 node address or 255)
WM42 INFORMATION OBJECT ADDRESS
BM44..BM49 Data (see below)

The RTU IEC60870-5-101 slave firmware is able identify following requests. It is however the responsibility of the B-CON application to respond to these commands. Following ASDUs in control direction are supported by the firmware, all other TYPE IDENTIFICATIONS numbers are discarded and will return NACK:

Process information in control direction:

Type ID	Type Name	Description	BM44	BM45	BM46
45	C_SC_NA_1	Single command	SCO	N/A	N/A
46	C_DC_NA_1	Double command	DCO	N/A	N/A
48	C_SE_NA_1	Set point command, normalised value	NVA hi byte	NVA lo byte	QOS
49	C_SE_NB_1	Set point command, scaled value	SVA hi byte	SVA lo byte	QOS

System information in control direction:

Type ID	Type Name	Description	BM44	BM45	BM46
100	C_IC_NA_1	Interrogation command	QOI	N/A	N/A
101	C_CI_NA_1	Counter interrogation command	QCC	N/A	N/A
103	C_CS_NA_1	Clock synchronisation command	This ASDU is handled by the firmware. The B-CON application will not see it.		

Process information in monitor direction
All process and system information in monitor direction (transmitted by the RTU) is must copied into BM registers before it is sent. The B-CON application program is responsible to format the registers correctly and then put them into one of the transmission queues for transmission. The transmission queues are built as FIFO buffers. There are low and high priority transmission queues. Low priority transmission queue is transmitted as a response to Class 2 request and high priority transmission queue is transmitted as a response to Class 1 request. Each transmission queue can contain until 190 KB.

Cyclic data transmission
Further more there are transmission buffers for cyclic data transmission. The cyclic buffers only keeps the current values and are not able to keep historical values. The cyclic buffers are built as array of ASDUs. There is space for 32 ASDUs for each class. The cyclic buffers have higher priority than the FIFO queues, which means if there are ASDUs in the cyclic buffer and in the FIFO queue the cyclic buffer will be transmitted first. The B-CON application should cyclically with specific interval queue ASDUs with current process values. B-CON application must supply an ASDU buffer number when creating and updating the ASDUs.

It is the B-CON application that controls into which queue a message is transferred to.

BM50
M50.0..2 Transmission queue number.
0=Class 2
1=Class 1
2=Class 2
3=Class 1 (Cyclic scan).
4=Class 2 (Cyclic scan).
All other values are ignored

M50.3..7	ASDU buffer array number 0..31. Only used if transmission queue number is equal 3 or 4 (Cy clic scan).
BM51	TYPE IDENTIFICATIONS Type ID
BM52	VARIABLE STRUCTURE QUALIFIER
BM53	CAUSE OF TRANSMISSION
BM54	COMMON ADDRESS OF ASDU (if 0 or 255 then the firmware will use RTU870 node address)
WM55	INFORMATION OBJECT ADDRESS A
BM57..BMxx	data (see below)

The B-CON application must then make a call to the QueueFrame function in order to move the data into one of the transmission queues.

Following ASDUs in monitor direction are supported by the firmware, all other TYPE IDENTIFICATIONS numbers are discarded:

Process information in monitor direction

Type ID	Type Name	Name Description	SQ	Description
1	M_SP_NA_1	Single point information	0	WM55 Information object address A BM57 SIQ WM58 Information object address BM60 SIQ Etc.
			1	BM57 SIQ BM58 SIQ address A+1 BM57+n SIQ address A+n
2	M_SP_TA_1	Single point information with time tag	0	WM55 Information object address A BM57 SIQ[1] WM58 Information object address BM60 SIQ[1] Etc.
3	M_DP_NA_1	Double point information	0	WM55 Information object address A BM57 DIQ WM58 Information object address BM60 DIQ Etc.
			1	BM57 DIQ BM58 DIQ address A+1 BM57+n DIQ address A+n
4	M_DP_TA_1	Double point information with time tag	0	WM55 Information object address A BM57 DIQ[1] WM58 Information object address BM60 DIQ[1] Etc.
9	M_ME_NA_1	Measured value, normalised value	0	WM55 Information object address A WM57 NVA BM59 QDS WM60 Information object address WM62 NVA BM64 QDS Etc.
			1	WM57 NVA BM59 QDS WM60 NVA address A+1 BM62 QDS Etc.
10	M_ME_TA_1	Measured value, normalised value with time tag	0	WM55 Information object address A WM57 NVA[2] BM59 QDS WM60 Information object address WM62 NVA[1] BM64 QDS Etc.
11	M_ME_NB_1	Measured value, scaled value	0	WM55 Information object address A WM57 SVA BM59 QDS WM60 Information object address WM62 SVA BM64 QDS Etc.
			1	WM57 SVA BM59 QDS WM60 SVA address A+1 BM62 QDS Etc.
12	M_ME_TB_1	Measured value, scaled value with time tag	0	WM55 Information object address A WM57 SVA[3] BM59 QDS WM60 Information object address WM62 SVA[1] BM64 QDS Etc.
15	M_IT_NA_1	Integrated totals	0	WM55 Information object address A WM57 BCR HiWord WM59 BCR LoWord BM61 SEQ WM62 Information object address WM64 BCR HiWord WM66 BCR LoWord BM68 SEQ Etc.
16	M_IT_TA_1	Integrated totals with time tag	0	WM55 Information object address A WM57 BCR HiWord WM59 BCR LoWord BM61 SEQ WM62 Information object address WM64 BCR HiWord WM66 BCR LoWord BM68 SEQ Etc.
30	M_SP_TB_1	Single-point information with time tag CP56Time2a	0	WM55 Information object address A BM57 SIQ WM58 Information object address BM60 SIQ Etc.
31	M_DP_TB_1	Double-point information with time tag CP56Time2a	0	WM55 Information object address A BM57 DIQ WM58 Information object address BM60 DIQ Etc.
34	M_ME_TD_1	Measured value, normlized value with time tag CP56Time2a	0	WM55 Information object address A WM57 NVA BM59 QDS WM60 Information object address WM62 NVA BM64 QDS Etc.
35	M_ME_TE_1	Measured value, scaled value with time tag CP56 Time2a	0	WM55 Information object address A WM57 SVA BM59 QDS WM60 Information object address WM62 SVA BM64 QDS Etc.
37	M_IT_TB_1	Integrated totals with time tag CP56Time2a	0	WM55 Information object address A WM57 BCR HiWord WM59 BCR LoWord BM61 SEQ WM62 Information object address WM64 BCR HiWord WM66 BCR LoWord BM68 SEQ Etc.
45	C_SC_NA_1	Single Command	0	BM57 SCO
46	C_DC_NA_1	Double Command	0	BM57 DCO
48	C_SE_NA_1	Set-point command, normalised value	0	WM57 NVA BM59 QOS
49	C_SE_NB_1	Set-point command, scaled value	0	WM57 SVA BM59 QOS
100	C_IC_NA_1	Interrogation command	0	BM57 QOI
101	C_CI_NA_1	Counter interrogation command	0	BM57 QCC

At POR all BM registers used by the driver are set to zero.
There is synchronisation between the driver and the B-CON application. All registers used by process and system information in control direction are updated before scanning the B-CON application to be sure the data is consistent.

[1] The three-octet binary time tag is added automatically by the firmware for each information object address.

[2] The three-octet binary time tag is added automatically by the firmware for each information object address.
[3] The three-octet binary time tag is added automatically by the firmware for each information object address.
A number of BM registers are used by the B-CON application program, in conjunction with some configuration registers, to control the IEC60870-5-101 slave driver. The BM registers are defined as follows:

Register	Description	
BM30	IEC60870 Command register	0 = Idle mode
m30.0..3		1 = dialup
		2 = hangup
m30.4	Not Used	
m30.5	Not Used	
m30.6	Not Used	
m30.7	Not Used	
BM31	Telephone number to dial (0..19)	
BM32		
m32.0	Not Used	
m32.1	Not Used	
m32.2	Not Used	
m32.3	DCD Data Carrier Detect (Input/ReadOnly)	
m32.4..5	Communication state (Input/ReadOnly)	
	00 Idle No communication (com counter = 0)	
	01 Active: outgoing Communication (com counter >= 1)	
	10 Active: Incoming Communication (com counter >=1)	
m32.6	Not Used	
m32.7	Dial request suspended (ReadOnly)	
BM33	Communication counter (Read/Write)	
WM34	Number of ASDUs in Class 1 transmission FIFO	
WM36	Number of ASDUs in Class 2 transmission FIFO	

Register for receiving process and system information in control direction

BM38	TYPE IDENTIFICATIONS Type ID (0=no command)
BM39	VARIABLE STRUCTURE QUALIFIER (always = 1)
BM40	CAUSE OF TRANSMISSION
BM41	COMMON ADDRESS OF ASDU (the RTU870 node address)
WM42	INFORMATION OBJECT ADDRESS
BM44..BM49	Request information in control direction

Register for transmitting process and system information in monitor direction

BM50	
M50.0..2	Transmission queue number. 0=Class 2 1=Class 1 2=Class 2 3=Class 1 (Cyclic scan). 4=Class 2 (Cyclic scan). All other values are ignored
M50.3..7	ASDU buffer number 0..31. Only used if transmission queue number is equal 3 or 4 (Cyclic scan).
BM51	TYPE IDENTIFICATIONS Type ID
BM52	VARIABLE STRUCTURE QUALIFIER
BM53	CAUSE OF TRANSMISSION
BM54	COMMON ADDRESS OF ASDU (if 0 then RTU870 node address will be used by firmware)
WM55	INFORMATION OBJECT ADDRESS
BM57..BMxx	Transmit data in monitor direction see chapter 3.4

TECHNICAL DATA

INTERFACE

Serial interface/programmer port:

Signal level:	RS232C/v.24.
Connector:	6 pole RJ11.
Hardware handshake:	Default RTS on/off, configurable
Baud Rate:	Default 9600, configurable
Format (default):	8 bit (binary), 1 start bit. No parity, 1 stop bit.
Protocol:	Modbus slave (RTU mode).
Error Check:	CRC (16).

Serial Main Interface RS232:

Signal level:	RS232C/v.24.
Connector:	9 pole D-sub male.
Hardware handshake:	DCD, DTR, DSR, RTS, CTS, RI
Baud Rate:	300-9600
Format (default):	8 bit (binary), 1 start bit. Even parity, 1 stop bit.
Protocol:	IEC870-5-101

Modem control: Hayes compatible.

Dial-up (modem): DTMF or pulse dialling to pre-stored telephone numbers.
Up to 30 pre-stored numbers.
Each number can be up to 20 digits.

I/O AND CONTROL

IEC 1131-3 (B-CON)

Program memory (Flash):	23 Kbytes (note 19).
Memory usage per instruction line:	6-24 bytes.
Typical maximum program size:	1500 instruction lines.
Scan interval:	50-250 ms (note 1).
Internal registers (BM):	2048 (note 15).

Real time clock

Automatic correction for leap years.

Accuracy:	25°C:	Better than +/- 1 second per day.
	-20 + 50°C:	Better than +/- 5 seconds per day.
Adjustment accuracy:		±1s.
Back-up battery:		Internal Lithium battery (800 mAh).
Back-up time:		min. 2 years (without external battery or mains supply).

Counters:

Minimum pulse / pause width:	6ms, note 20
Max. counting frequency:	80Hz, note 20

I/O expansion bus

Capacity:	To be defined.
Connector:	RJ45 Modular jack, 8/10 pole.
Signal level:	5V (CMOS).
Protocol:	Synchronous data (shift register type).
Local bus cable length:	Max. 1 m between 2 modules. Max. 5 m totally.

POWER SUPPLY/CHARGER

Supply Versions:	**10**	**20**	**30**	**40**	**50**	**60**
Supply voltage nominal	110-240V AC/DC	110-240V AC/DC	24-48VDC	12VDC Battery	24-60VDC	110-240V AC/DC
Supply voltage absolute maximum input range	100-265V	100-265V	20-60V	12-15V DC only	20-72V	100-265V
Mains frequency	40-60Hz	40-60Hz	DC only	Max 24W	DC only	40-60Hz
Power consumption	Max 18W	Max 20W	Max 14W		Max 14W	Max 20W
Outputs:				2.0A		
Output current, total	1.1A (note 5)	1.1A	0.9A	12V+/-0,5V	0.9A	1.0A
Output 12V expansion (local bus) Output 12V external output	12V+/-0,5V (note 16&17) 12V+/-1,5V max. 400mA note 16, 17&18)	10-13,6V (note 5) 10-13,6V max. 2A note 5	12V+/-0,5V (note 16&17) 12V+/-1,5V max. 400mA note 16, 17&18)		12V+/-0,5V 24V+/-1V max. 300mA	10-13,6V 20-28V max. 1A
Loop supply (optional)		12V±5%/max0,4A 24V±5%/max0,2A				
Isolation:						
Input/mains (primary) to electronics	3,75kV AC	3,75kV AC	1500V AC	0V	1500V AC	375kV AC

Battery back-up (option 2x only)**:**

Battery:	12V lead acid		
Battery capacity:	3-12 Ah (note 3)		
Charging current:	0-1 A (note 4)		
Charging time:	Battery capacity / (1.1A - average load current) (note 5).		
Back-up capacity (battery fully charged):	Average load current x 0.8 x battery capacity.		
Cut-off voltage:	10.3V.		
Off state battery load:	<0.5 mA.		
Monitor outputs:			
Mains:	>100V	ON	(note 2)
Battery:	>12.0V	ON	80% capacity
	<11.5V	OFF	20% capacity

Battery back-up (option 60 only)**:**

Battery:	24V lead acid		
Battery capacity:	3-12 Ah (note 3)		
Charging current:	0-0,5 A (note 4)		
Charging time:	Battery capacity / 0,5A - average load current) (note 5).		
Back-up capacity (battery fully charged):	Average load current x 0.8 x battery capacity.		
Cut-off voltage:	21.0V.		
Off state battery load:	<0.5 mA.		
Monitor outputs:			
Mains:	>100V	ON	(note 2)
Battery:	>24.0V	ON	80% capacity
	<23.0V	OFF	20% capacity

DIGITAL INPUT/OUTPUT

Inputs:

Input voltage activated:		10-30V DC (note 10).
Input voltage deactivated:		Max. 3V DC.
Input current:	12V DC:	Typical 3mA.
	24V DC:	Typical 6mA.
Input delay:		Typical 1ms.

Outputs:

External voltage:	10 - 30V DC (note 10).
Output voltage drop:	Max. 1.5V (output activated).
Output current:	Max. 0.5A.
Output peak current:	Max. 5A in 1 second (note 10).
Output leakage current (off):	Max. 0.5mA.
Output delay:	Max. 1ms.

Isolation
(input or output to electronics, input to output): 1kV AC.

Indicators:

Digital input:	One for each digital input (red) indicating active input.
Digital output:	One for each digital output (yellow) indicating active output.
System:	Indicating RTU OK (green)
I/O:	Indicating I/O and local bus OK (green)
Power: (28IO only)	Indicating power and battery OK (green)
Rxd/Txd (28IO only)	Indicating serial communication on RS232 line.

ANALOG INPUT

Inputs: 4 multiplexed analogue channels with solid state multiplexer (note 12).

Input configuration: Differential (+/ -), flying capacitor type.

Input measuring ranges:

Type no. code	Voltage input	Current input
.D1	0-10V	0-20mA
.D2		4-20mA
.D3	0-5V	
.D6		0-20/4-20mA

Resolution: 12 bit, 0-4095.

Input impedance:

Voltage:	D1:	100 kOhm.
	D3:	50 kOhm.
Current:	D1:	500Ohm (note 11).
	D2/D6:	100 Ohm.

Absolute maximum ratings (note 10):

Input voltage:	±40V DC.
Input current:	±30mA DC.

Sampling interval: Min. 100 ms (note 12).

Measuring accuracy:

25°C:	±0.2% ±6LSB (typically 0.05%±3LSB).
-10°-55°C:	±0.3% ± 8LSB (typically 0.1% ± 4LSB).

Linearity: Better than ± 1LSB.

Temperature stability: Better than ± 50ppm/°C (typical).

Common mode input voltage: Max. ±80V DC (note 8).

Common mode rejection ratio: Min. 60dB (typical 72dB).

Series mode rejection: Min. 30dB (50-120Hz)

Isolation (input to input): 500V (note 8).

Loop supply (optional): 24V±5% / max. 200mA
12V±5% max. 400mA
(short circuit protected).

RELAY OUTPUTS

Outputs: 12 potential free SPST-N/O contacts.

Output voltage : Max. 240V AC.
Output current: Max. 1A AC (resistive).
Output delay: Typical 10ms.

Lifetime (relay): Min. 100.000 operations at rated load.

Contact material: Gold overlay silver alloy.

Isolation (coils-contacts): 2kV AC 50Hz 1 min (IEC255-5).
4kV 1,2/50micro s. / impulse withstand (IEC255-5).

GENERAL

Current consumption (12V) note 14:

UCR-16DIO:	max. 105 mA.
UCR-32DI:	max. 90 mA.
UCR-28IO:	max. 100 mA.

Isolation: IEC class II, 3,75 kV. (mains supply versions) Safety earth required.

Ambient temperature: -10 - +55°C.

Module reliability (25°C): Calculated MTBF= $3x10^5$ hours
Calculated failure rate $\lambda = 3,3x10^{-6}$

EMC: EN 50081-1/EN50082-2.

Climatic:

Dry heat:	IEC 68-2-2, Test Bd, Temp. +55°C, Duration 8h.
Cold:	IEC 68-2-1, Test Ad, Temp. -10°C, Duration 8h.
Damp heat:	IEC 68-2-3, Test Ca, Temp. 40°C, RH 95%, Duration 8h.

Mechanical:

Vibration:	IEC 68-2-6, Test Fc (sinusoidal), Freq. 10-150Hz, Amp. 4g, 5 sweeps in 3 orthogonal axes.
Shock:	IEC 68-2-27 (half sine), Acc. 15g, Pulse time 11msec., 3 x 6 shocks.

Protection: IP20.

Mounting: 35 mm DIN-rail, EN50022.

Terminals: Max. 1.5 mm^2 wire.

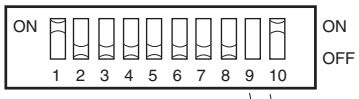
Housing: Anodized aluminium with plastic ends. According to DIN 43880.

Dimensions: HxWxD: 80(+connectors)x108/162x62mm.

CODE SWITCH/ADDRESS SELECTOR

The code switch of the RTU870 selects the common ASDU address according to IEC870-5-101 as a 8-bit binary (0-255). Additional two switches are free and can be used by the application program. All switches are readable from the application program.

Code switch



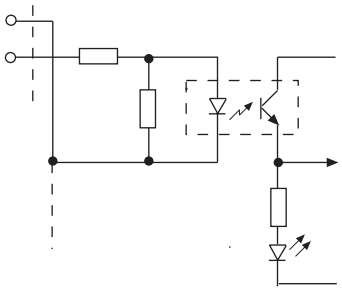
ASDU/Slave address 1-255

ON	Active dial back enabled- RTU870 call CS if new data in class 1 queue.
OFF	Active dial back disabled.
ON	Modem mode
OFF	Null modem mode

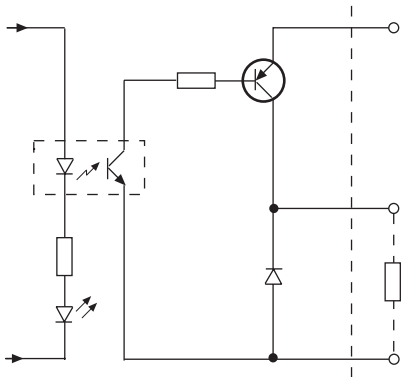
The logical common ASDU address is defined as the sum of the binary value selected using switch 1-8 and the binary value of the logical address configured in the FLASH (default = 0).

CIRCUIT CONFIGURATION (DIGITAL)

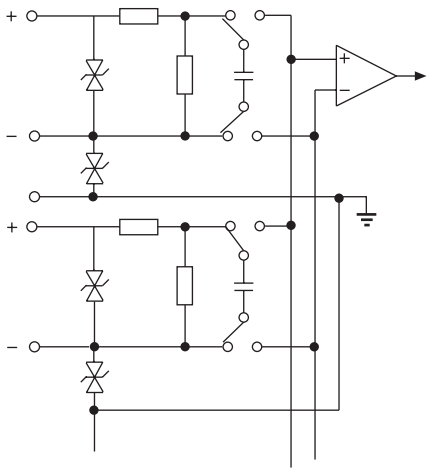
Input



Output (PNP)



CIRCUIT CONFIGURATION (ANALOGUE)



CONFIGURATION

The RTU870 Configuration program is used to configure the RTU870. The configuration tool makes it possible to setup both hardware specific and protocol specific parameters. Refer to the RTU870 Configuration tool user guide for more info.

For experienced user, the IO Explorer can also be used. With this tool you may configure the RTU870 with additional control features, change many protocol specific parameters. High level programming skills required.

RTU870 Configuration fields
A number of configuration fields are provided. The field values are changed and downloaded into the RTU flash memory, using the RTU870 Configuration menu. The fields are used for values that are programmed once when setting up the module (e.g. baud rate).
The following fields are provided to control the RTU with the actual interfaces including the EN/IEC60870-5-101 slave port driver.

RTU870 configuration table

Property	Value	Unit
COM1 cfg. IEC870-5-101		
Link addr.	0	
Link AddrOct	1	
Baud rate	9600	
Use E5 resp.	Ack/No data	
Resp. Delay	1	of 10 msec
RTS Leading	5	of 10 msec
RTS Trailing	1	of 10 msec
Retry count	3	
Max comm cnt	256	
Subs to try	1	
Redial delay	90	Seconds
Tel. no.	(Table)	
Modem init.	(Table)	
PIN Code	(Table)	
Modem Reinit	37	Minutes
Dial back	Disabled	
User	0	integer var
Date/Time	(Clock)	
Boot delay	2	Seconds
S0 Cnt Type	Accumu.	
S0 Interval	3	Minutes
Analog Range	0...20 mA	
COM2 cfg Modbus Slave		
Baud rate	9600	
Parity	None	
Handshake	RTS On/Off	
RTS Leading	1	of 10 msec
RTS Trailing	0	of 10 msec

COM1 cfg.
This is the header for the configuration of IEC870-5-101 parameters

Link Addr
ASDU/Slave address. The logical common ASDU address is defined as the arithmetic sum of the binary value selected using switch 1-8 and the binary value of the Link addr configuration field.

LinkAddrOct
Set link address size in octets. Default set to 1 octet.

Baud rate
Define the baud rate for the serial port, with 101 slave mirrored driver.

Use E5 resp
Option for using E5 response. It is possible to select; Not used, used as acknowledge and used as acknowledge and no data.

Resp. Delay
Defines the response delay in times of 10ms.

RTS Leading
Defines the delay from the RTU is activating the RTS to the transmission of the first character.

RTS Trailing
Defines the delay from the RTU is transmitting the last character to de-activating RTS.

Retry count
Defines the number of retries which should be made to the same telephone number before giving up or continuing to the next number, if the call is not successful. Default value: 3, Range: 0 .. 10.

Max comm cnt.
Defines the number of times the input and output will be read and written before the module makes a hang-up. If Max Com Count=256 the PC is responsible for correct hang-up.
This option should normally not be changed.

Subs. to try.
Defines the number of subscribers to try after being through the number of retries on the first number in the list of phone numbers. If the value is set to 3, it will try number 1, 2 and 3 in the phone no list.
Default value: 1, Range 1-10.

Redial delay.
Defines the delay from an unsuccessful attempt to dial to a new attempt to establish connection.
Default value: 90 sec, Range: 2-120 sec.

Tel. no.
The maximum number of telephone numbers stored in RTU is 30, the maximum length is 20 characters. The telephone numbers can although include some special characters to control the dialling function of the modem.

Modem init.
The modem initialisation string has a maximum length of 60 characters. This string contains the configuration data for the connected modem. It will be sent cyclic to the modem and every time a connection is established by the RTU. Default value: ATV0E0&C1S0

PIN code.
If GSM modem is used and PIN code is required for the SIM card, the PIN code must be entered here. Be careful to enter the right PIN code – if not, the three normal attempts will quickly be used up and a PUK code is required to re-open the SIM card again. Use a normal mobile telephone to change PIN code parameters and enter PUK codes.
Default: blank

Modem Reinit.
Defined the time in minutes between cyclic re-initialisation of the modem. If the modem of some reason is reset and the required modem settings not has been save in the modem flash, the modem will start up with its default settings. With this option you can make sure that the modem is initialised periodically. Default value: 0 min, range 0-999min.

Dial back
Enable or disable the dial back function.

User
User defined value. Constant value can be used in B-CON application / IEC870

Date/Time
Real time clock adjustment. The actual time in the module can be monitored and adjusted either by entering the time or by copying the PC clock to the module.

Boot Delay
Ensure that master boot is not started until the I/O bus is fully up running. In case of several analogue I/O modules connected you may encrease this value in sec.

S0 Cnt Type
Define the counter type. Absolute values or acumulated values is possible.

S0 Interval
Define the length of the time between counter values is tranfered to the IEC870-5-101 queue. Values from 1min to 240min is posssible, however the selected value has to dividable into 1 day (24hours).

Analog Range
Select the analogue input range; 0-20mA or 4-20mA. Note that underflow alarm is only valid in range 4-20mA.

COM2 MODBUS SLAVE

Baud Rate
Define the port baud rate. 300, 600,1200, 2400, 4800, 9600 baud is possible.

Parity
Defines port parity. None, Even, Odd is possible. The caracter length is fixed at 8 data bits.

HandShake
Second serial port handshake. Select RTS, CTS functions.

RTS Leading
Defines the delay from the RTU is activating RTS to transmission of the first character.

RTS Trailing
Defines the delay from transmission of the last charcter to deactivating RTS.

NOTES/REMARKS

1) The scan interval can be selected by the user, however it should be noted that the capacity of the micro-controller will limit the minimum scan time. The time related performance versus capacity for the RTU8 is a result of the actual CPU load. The technical data related hereto, must be considered in total. A large application programme with the maximum number of I/O´s, is not able to scan the I/O´s with minimum interval and simultaneously log all process values.

2) The mains indicator is activated when the mains voltage is sufficient to enable the power supply to work.
Due to the fact that the output of the charger has a higher open circuit output voltage than the battery voltage, it is not possible to detect a missing battery without disconnecting the battery from the charger.
When mains is applied, the battery is disconnected shortly from the charger at start-up and hereafter every 24 hours (00:00) to check the battery voltage. If low or missing battery is detected the battery will be checked every 10 seconds until the voltage is back to normal (>12V).

3) The capacity of the battery must be selected according to the actual consumption and required backup time. The battery could degrade dramatically due to temperature and age. If a high degree of security is required, it is strongly recommended that such figures are considered very conservatively.

4) The internal power supply and charger will act as a constant current source until the battery is charged. The actual charging current, will be the difference between the capacity of the power supply (1.1A nominal) and the actual consumption of the RTU8, including expansion modules.

5) The 12V output is supplied from the power supply/battery circuit. When the battery is fully charged (operating on mains supply) the voltage will typically be13.6V. When operating at battery supply, the voltage drops slowly while discharging until the cut-off voltage is reached (typically at 10.4V).
If the current exceeds the maximum current of the built-in power supply (1.1A), the excessive current will be drawn from the battery thus discharging the battery. The power supply/charger circuit includes thermal protection. At maximum ambient temperature (55°C) the continuos output current is automatically reduced to approx. 0.8A after a certain time (10-15 minutes). The de-rating is approximately 1% per °C above 25°C.
If the unit has a battery connected to it, it is possible to supply a high output current (maximum 2A specified) for a period of time, as the battery will deliver the remaining current. At high ambient temperature the recharging time may be prolonged.
The battery MUST be equipped with an external fuse, max. 2A.

6) Setup can be configured using the IO Explorer.

7) The station address or net no. in the RTU8 is defined as the sum of the binary value, set using switches 1-5 and the binary value of the logical address configured in the FLASH (default = 0).

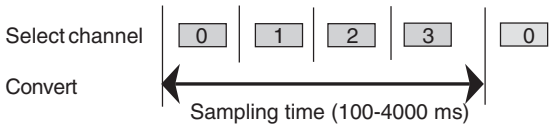
8) Section A, B, C and D are isolated from each other. The individual analogue inputs (UCR-28IO) are isolated from each other. Due to protection devices in the analogue inputs the voltage measured from the common (C) terminals to any other terminals must not exceed ±80V.

9) The polarity at the input must be positive. The common terminal must be connected to the negative.

10) Input signals exceeding the maximum values **MAY CAUSE PERMANENT DAMAGE** to the module.

11) External resistor (500 Ohm) to be mounted for ~0-20mA input. Note that the internal resistance must be calculated as parallel to the 500 ohm.

12) Only one analogue input channel is active at a time, the multiplexing is automatic via the built-in micro-controller.
The actual scan time for the analogues relates to the CPU load and hence the selected interval for the application program. If the application program is executed with a short interval there might not be sufficient time to perform the analogue multiplexing thus resulting in a slow sampling rate (worst case 4 seconds).



The analog input is represented by an integer (binary number) from 0 to 4095 depending on the input signal, see table above.

13) Depending on the noise level versus signal level, shielded cables and/or twisted pairs might be necessary. The shield of the cable should normally be connected to common (C) of the I/O modules.

14) Figures exclude load on 12 or 24V loop supply. The loop supply's contribution to the consumption is approximately 2.9 times the actual loop currect at 24V and 1.4 times the actual loop current at 12V.
The total current consumption increases when the battery voltage decreases. At minimum voltage the current can increase up to 20%.

15) Register BM 0-511 are cleared at start-up. Registers BM 512-2047 are battery backed, the values stored are independent of power and must therefore be cleared manually if required.

16) The 12V external supply is not isolated from the circuit supplying the electronics. It is therefore recommended to use an external source for the I/O if the I/O signals are influenced by electrical noise, e.g. from long cables or inductive load.

17) The sum of current consumed from the 12V rail, i.e. internal consumption, consumption from the external screw terminals and by expansion modules at the local bus, must never exceed the maximum total output current.

18) The external output is short circuit protected and overload protected. The maximum current is limited at high ambient temperature. The maximum load current should be de-rated approximately 1% per °C above 25°C.