20-90

VHF / UHF Low Power Transceiver with Ethernet

PRODUCT MANUAL

Version 0.1.1

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Warranty and Disclaimer

Salcom products are warranted for a period of 12 months from the date of purchase against faulty materials and workmanship.

If any fault should occur, the unit should be returned to the vendor, freight pre-paid. Please include a description of the fault to assist with prompt return. Any unauthorised alterations or repairs will invalidate the warranty.

We reserve the right to change products, specifications, and installation data at any time, without notice.

All information provided in this document is carefully prepared and offered in good faith as a guide in the installation and use of Salcom products. Installers must ensure that the final installation operates satisfactorily within the relevant regulatory requirements. Salcom accepts no responsibility for incorrect installation.

Please refer to the product specifications for specific certification information.

Contents

Product Overview

The Salcom 20-90 is a POCSAG paging transceiver combining a high sensitivity receiver with a low power transmitter. It is available for either the VHF or UHF bands and may be used with 25 kHz, 12.5 kHz or 6.25 kHz wide channels. Power may be programmed from 10mW to 100mW.

The 20-90 may be used as:

- A full paging transceiver, allowing both the encoding and decoding of POCSAG paging messages,
- A standalone POCSAG receiver,
- A standalone transmitter with channel busy checking before transmissions,
- A simple channel busy detector for another transmitter,
- A relay output receiver,
- A switched input monitor,
- An autonomous store and forward paging repeater with duplicate message reject,
- A point to point raw serial link,
- A simple telemetry solution.

Key Features:

- **POCSAG encoding and decoding** of 512, 1200, or 2400 baud, alphanumeric, numeric, or tone only messages. The 20-90 supports full batching of messages, combining messages to ensure that messages are transmitted quickly with minimum on-air time.

- **Serial and Ethernet ports:** The 20-90 may be controlled through either an RS-232 serial port or a TCP/IP or UDP Ethernet connection. Received messages may be directed to the serial port, the Ethernet port or both.

- **Sacoto configuration tool:** The Salcom "Sacoto" configuration software allows full configuration of all functions of the 20-90 transceiver via the serial port or the Ethernet port.

- **Store & Forward repeater:** The 20-90 can be configured to operate autonomously as a store & forward repeater. Received messages can be retransmitted by the 20-90 to provide infill paging in weak signal areas, or extend the range of other low power transmitters. The 20-90 provides a duplicate reject function to prevent loops and unintended retransmissions.

- **Input triggered messages:** The 20-90 provides up to 5 inputs which can trigger message transmissions. Messages may be triggering at power up, on the rising or falling edges with a programmable de-bounce delay, or a using regular watchdog timer. Messages may be repeated several times with a programmable interval between transmissions.

- **Relays and open drain outputs:** The 20-90 supports the Salcom relay control protocol to control up to 7 outputs: two on board relays, two high current open drain outputs with resettable fuses, plus three low current open drain outputs with a 5 mA current limit.

- **Acknowledgement messages:** An acknowledgement message can be triggered when an output has been activated by receipt of a valid message. An acknowledgment is not sent if there is an overcurrent fault on the output. An acknowledgement may be triggered for any received message within a programmed range of CAP codes.

- **Special functions:** Salcom relay control protocol or CAP code ranges may be used to remotely trigger various special functions or transmit stored messages on the 20-90. These may be used to: acknowledge messages; report the battery level, request the received signal strength; request a checksum of the received message; trigger messages to report the current input state; report the state of all inputs and outputs; or restart the 20-90.

- **POCSAG rapid:** POCSAG rapid is a special application of the POCSAG protocol which provides a faster response to the press and release of a button than full POCSAG messages would allow. This allows faster and more accurate time-critical control. The 20-90 supports both the transmission and reception of POCSAG rapid at up to 2400 baud.

- **Busy Detect:** The 20-90 provides a channel busy function to prevent message collision or corruption which reduces the need to retransmit messages and increases confidence of delivery. An output may be configured to provide a channel busy indication to another (higher power) transmitter.

- **Additional I/O:** Expansion of the 20-90 I/O is possible through the use of the 20-03 expansion module, allowing any number of inputs or outputs to be supported.

Connectors and Indicators
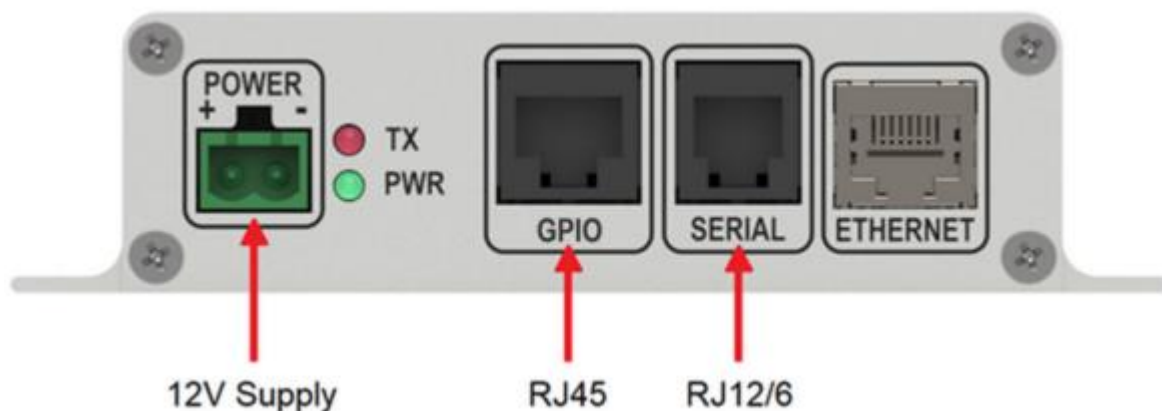
Table 1: Connectors and Indications (L-R)	
Item	**Description**
1	12V Supply
2	TX/Busy LED (Red): Flashing=TX, Solid=channel busy
3	Power LED (Green): Slow blink = ok, Fast = error
4	GPIO: Relays and High current I/O (RJ45)
5	Serial: Serial port and Low current I/O (RJ12)
6	Ethernet (RJ45)

Table 2: GPIO connector (RJ45)	
Pin	**Connection**
1	I/O 4 (500mA)
2	I/O 3 (500mA)
3	Relay 2 Normally Open contact
4	Ground
5	Relay 2 Common contact
6	Relay 1 Normally Open contact
7	Relay 1 Normally Closed contact
8	Relay 1 Common contact

Table 3: Serial connector (RJ12)	
Pin	**Connection**
1	Ground
2	I/O 5 (5mA)
3	I/O 6 (5mA)
4	I/O 7 (5mA)
5	RS232 TXD
6	RS232 RXD

Pin 1 *on left side when viewed from front, as above.*

Physical Dimensions

The 20-90 has an extruded aluminum case with a mounting flange and screw slots. A dimensioned drawing is provided below.
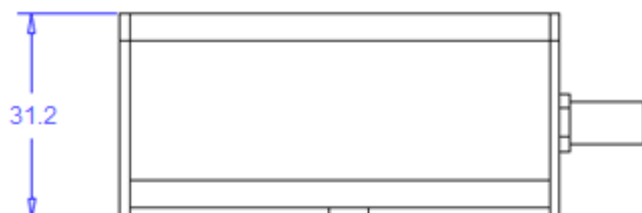
20-90 Installation and Quick Start Guide

Power Supply

Power is connected to the green "Power" connector on the front panel with the polarity as shown. Nominal supply voltage is 13.8V DC, but may vary between 10.8V and 15V. The power source must be reasonably noise free. The 20-90 is protected against reversed polarity.

Antenna Installation

The antenna is connected to the SMA connector on the rear panel. Installing the antenna outside, clear of obstacles, and high above the ground will most likely provide the best radio coverage. A whip antenna may be connected directly to the SMA connector for more convenient installation where range is not a concern.

The antenna should present a nominal load of 50Ω, with a VSWR of better that 1.8:1. Performance may be reduced by a poorly matched antenna (i.e. not 50 ohms at the transmitter frequency).

When used as a Store and Forward repeater in a weak signal area, the antenna should be positioned for best reception, while still providing transmit coverage into the weak signal area.

Important! To comply with FCC Controlled/Occupational Exposure Limits the aerial must be positioned or mounted to operate at least 0.26 metres (0.853 ft) away from operational staff and 0.57 metres (1.87 ft) away from the general public as a safeguard against radiated emissions.

Serial and Ethernet connections

The 20-90 may be configured to operate without a serial or Ethernet connection by: transmitting regular messages; transmitting messages in response to inputs or received messages; operating outputs in response to received messages; or acting as a store and forward repeater.

For transmitting other messages, or monitoring received messages, the RJ12 serial connector, used with the Salcom 12-45 RJ-12 to DB-9 adaptor, provides an RS-232 serial port at 9600 baud, 8N1. Connection may also be made via the Ethernet port, as a TCP or UDP, server or client.

The Ethernet IP address, ports, masks and connection modes can be configured using Salcom's Sacoto configuration software.

Powering-Up

When powered up the GREEN power indicator should flash once per second to indicate normal operation. A rapid GREEN flash indicates a low battery voltage.

The RED indicator will blink for a few seconds at power up if there is a problem. Error messages are sent to the serial port.

Configuration

The 20-90 can be entirely configured using the Salcom "Sacoto" configuration tool. Basic configuration such as frequency, baud rate, Ethernet configuration, output configuration, and input triggered messages are covered in the **Sacoto Quick Start Guide** later in this manual.

Message transmission

Standard serial COM port Terminal software can be used to initiate messages using Salcom Message Protocol.

For example sending the text **CA1234567 1 Hello**, terminated with a carriage return (ASCII 13), will initiate a 512 baud paging message, sent to CAP code 1234567.

The RED TX indicator will flash rapidly when the unit is transmitting.

A solid RED indicator indicates that the channel is busy. Transmission will start when the channel becomes clear. Chanel busy conditions and thresholds can be configured using Sacoto.

Messages can be initiated over the Ethernet TCP or UDP connection. This uses the same commands as the serial connection. Connecting via Ethernet is described later in this manual.

An Ethernet test tool is provided to assist the initial setup and may be used as a basic interface for sending and monitoring paging messages using the Ethernet connection.

Messages can be triggered by inputs, by a watchdog timer, or as a response to a received message. This is described later in this manual.

Received messages

Received messages can be filtered by CAP code, and are sent over the serial or Ethernet interface using Salcom Message Protocol.

Received messages may be sent to a higher power transmitter, such as the Salcom 20-62, for store and forward operation, or to a Salcom 20-03 I/O expansion unit to provide additional relay and open collector outputs.

The receive baud rate and message type is specified on the POCSAG tab of Sacoto.

Salcom Message Protocol

Messages are transmitted or received using Salcom Message Protocol (Salcom Protocol) over the serial or Ethernet ports.

Salcom protocol takes the basic form: PPXXXXXXX L MMMMMM<CR>

Where:

- PP can be "CA", "CN", "ca", "cn", "Ca", or "Cn"
- Upper case "CA" or "CN" denotes 512 baud
- Lower case "ca" or "cn" denotes 1200 baud
- Mixed case "Ca" or "Cn" denotes 2400 baud
- "A" denotes Alphanumeric, "N" denotes Numeric
- XXXXXXX is a 7 digit CAPcode (Pager number)
- Spaces as shown
- L is the function code (beep level) from 1 to 4.
- MMMMM is the message (up to 240 characters).
- <CR> is a carriage return (enter key).

Alphanumeric messages

Usage: CA<pager#>[<space>]<level>[<space>]<message><CR>
Description: Call alphanumeric pager
Example: CA1119358 1 Please return to reception<CR>
Response: CA11193581<CR><SPACE>Page Sent<CR><LF>

Numeric Messages

Usage: CN<pager#>[<space>]<level>[<space>]<message><CR>
Description: Call numeric pager
Example: CN1119358 1 777<CR>
Response: CN11193581<CR><SPACE>Page Sent<CR><LF>

Tone Only Paging

Usage: CN<pager#>[<space>]<level><CR>
Description: Call pager with beeper only (no message). One of 4 tone options <level>
Example: CN1119358 1<CR>
Response: CN11193581<CR><SPACE>Page Sent<CR><LF>

Channel Busy Detection

The 20-90 provides a channel busy function to prevent transmission when the channel is in use, or when there is interference on the channel. An output may be configured to provide this busy indication to an external high power transmitter or other channel activity indicator.

TX/BUSY Indicator LED

- A rapidly flashing red LED indicates that the 20-90 is transmitting.
- A solid red LED indicates channel activity, and may inhibit the transmitter.

Receiving a message: The TX/BUSY LED is on (solid) whenever a message is being received. Normally the 20-90 transmitter will be inhibited when a message is being received. This can be disabled in cases where unwanted weak signals may block the transmitter but would not interfere with local reception. The RSSI threshold may be used instead to detect local signals or interference.

RSSI threshold: Other signals or interference on the channel can be detected by the received signal strength (RSSI). When enabled, the TX/Busy LED will be on whenever the received signal strength is above the RSSI threshold level. The transmitter will be inhibited until the channel is clear again.

Busy Hold time: This is the delay between the channel becoming clear and the transmitter being free to transmit. This delay reduces the flickering of the busy state with rapidly fluctuating interference. The delay may be increased as required. Maximum delay is 5 seconds.

The Busy Hold time also controls the delay between receiving a message and any response from the 20-90, including acknowledgements, special function replies, or store and forward.

Using a different delay for each transmitter can help control channel access when multiple transmitters are waiting to transmit.

Busy Output: An output on the 20-90 may be used to provide a channel busy signal. The CLOSED state (low) represents a busy channel. This output mirrors the internal transmit inhibit function. The output will be closed if the signal strength is above the threshold when the RSSI threshold is enabled, or a messages is being received and "Receive State" is enabled.

CAP codes

Every paging message includes a CAP code (Channel Access Protocol). This is normally the pager number to which the message is addressed. The CAP code can also be known as a RIC (Radio Identity Code). CAP codes may be unique to a specific pager, or shared by a number of pagers within a group.

A pager may respond to multiple CAP codes, and may respond differently to each range. Multiple pagers may respond to the same CAP code (a broadcast to a group) in addition to a CAP code which is unique to that pager.

Ranges of CAP codes may be assigned different purposes. Ranges may identify the message type being transmitted (Numeric or Alphanumeric). Ranges may also be used to filter messages by network or group, or for some other purpose.

Decode filter

The 20-90 provides up to 8 CAP code ranges. It will only decode messages that are within one or more of these ranges (inclusive). The default range is 0000008 to 2000000. The ranges may be in any order, and may overlap. A CAP code range can be limited to just one CAP code if desired.

Triggering outputs

An output may be closed or opened in reception of a CAP code with a range. Closing an output may be used to trigger a mono-shot output if the mono-shot time is non-zero on the output tab. The output will automatically open after the mono-shot time.

CAP code range triggering outputs provides a method of monitoring messages within a range without the need to include relay protocol in each message.

The output may be used to trigger an acknowledgment message, which can include special function messages like received RSSI or received message checksum. The same range may be specified more than once to trigger more than one output or special function.

When used with a mono-shot time to monitor a remote watchdog, the opening transition may be used to trigger the transmission of an alert message.

POCSAG Rapid

Tone only messages may be sent using POCSAG rapid for fast relay control. Since tone only messages do not include relay protocol, a CAP code range is used to trigger the desired output. POCSAG rapid uses 8 CAP codes, starting at a multiple of 8. See the POCSAG Rapid section below.

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Input and Output Operation

The 20-90 has two Relay outputs and five combined I/O pins. These operate as follows:

- 20-90 Inputs and Outputs are *active low*.
- The low state is referred to as "*Closed*", referring to a closed switch to ground, or an active open-drain output pulling the I/O pin to ground.
- An energized relay is referred to as "Closed" (the normally-open contact is closed).
- When an open-drain output is "Open" (inactive), an internal pull up resistor allows the I/O pin to be used as an input.
- An external switch may pull the I/O pin to ground, triggering a transmission if the 20-90 is configured to do so. A message may also be transmitted when the switch is opened.

Inputs:

- The 20-90 monitors the state of each I/O pin at all times.
- The 20-90 can be configured to transmit a message when an I/O pin changes state.
- Separate messages are defined for open and closed states. Transmission of either or both messages may be enabled or disabled.
- The message corresponding to the input state may be transmitted at startup, or with a regular "watch dog" timer.
- Since inputs and outputs are combined on the same pin, changes to an output can be monitored and acknowledged by configuring the input messages for the I/O pin. This can also detect if the output protection or current limits have been activated.
- Input messages can be defined for I/O channels which are not physically implemented. These can be triggered by the relay protocol or a range of CAP codes as a form of acknowledgement without changing the state of any physical I/O pins.
- Input messages may be defined for relays to provide an acknowledgement of the received message.

Outputs:

- Each output can be opened or closed using Salcom Relay Control Protocol (described below). This may be in a received message, or as a command over the serial or Ethernet ports.
- Each output can be disabled to ensure that no received message can affect the input.
- An output may be configured with a "Monoshot" timer, to automatically open after a specified time.
- Outputs can be closed when a message is received that has a CAP code which is within a specified range. This can be useful for monitoring received transmissions, or for transmitting acknowledgements. This feature is also used for POCSAG rapid.
- The Relay protocol, or a CAP code range, may activate "virtual" outputs, which are not physically implemented, but can trigger special functions within the 20-90. For example, a special function may transmit an acknowledgement which includes the received signal strength or a checksum of the received message. See "special functions".

Salcom Relay Control Protocol

Salcom Relay Control Protocol (relay protocol) is used to control relays or other outputs; or to trigger acknowledgement messages or special functions of the 20-90.

A relay protocol control string can be sent as numeric or alpha-numeric messages. Numeric messages are shorter, and are therefore more efficient to transmit. The receiver must be configured to receive the correct message type.

A relay protocol command is addressed to a specific "unit ID". Each unit ID can control up to 8 outputs.

A single unit may have multiple unit ID's to address more than 8 outputs or special functions.

The relay control string can be embedded anywhere within the message e.g. "CLOSE RELAY ONE 10109". However, the first two digits of any string of digits is always the unit ID. Multiple relay control strings can be contained in one message, each addressing a different unit ID.

The unit ID should **not** be a number that regularly appears anywhere in your typical messages where it may be followed by more digits. This is to avoid the likelihood of false commands.

Command Format:

UUC..C0N..N9S

UU   **Unit ID:**
This must be 2 digits from 00 - 99.

C   **Outputs to Close**
Multiple outputs may be specified, from 1 to 8 in sequential order.

0   **End of Closed Outputs**
"0" terminates the list of outputs to close. This character in mandatory.

N   **Outputs to Open**
Multiple outputs may be specified, from 1 to 8 in sequential order.

9   **End of Open Outputs**
"9" terminates the list of outputs to open. This terminating digit is required to consider this as a valid control string.

S   **Optional Checksum**
If the checksum is enabled, the modulo-10 sum of relay protocol digits, including the checksum digit, must sum to 0 to be considered a valid command.

The 20-90 uses four **Unit ID**'s, starting at the **Base ID** specified in in the **System > Relay Protocol Tab** of Sacoto.

20-90 Output Map

Base ID + 0

I/O Channel	Output	Function	Description
1	1	Relay 1 (RJ45)	Normally open and normally closed contacts
2	2	Relay 2 (RJ45)	Normally open contacts only
3	3	Output 3 (RJ45)	500mA open drain output with resettable fuse
4	4	Output 4 (RJ45)	500mA open drain output with resettable fuse
5	5	Output 5 (RJ12)	Open drain output with 5mA current limit
6	6	Output 6 (RJ12)	Open drain output with 5mA current limit
7	7	Output 7 (RJ12)	Open drain output with 5mA current limit
8	8	Message 8 (Internal)	Trigger open and close messages

Base ID + 1

I/O Channel	Output	Function	Description
9	1	Message 9 (Internal)	Trigger open and close messages
10	2	Message 10 (Internal)	Trigger open and close messages

Base ID + 2

Not used

Base ID + 3   Trigger special functions - see "Special Functions" below.

I/O Channel	Output	Open function	Relay protocol	Close Function	Relay protocol
30	6	Checksum	23069	Reset	23609
31	7	I/O status	23079	RSSI	23709
32	8	Battery level	23089	Watchdog	23809

Relay protocol example given for a unit base ID of 20.

Special Functions

The 20-90 supports 6 "special functions". These are triggered by relay protocol, using the base unit ID + 3, or by a CAP code range configured to "open" or "close" output channels 30, 31, or 32 on receipt of a matching CAP code.

In the following examples the 20-90 Base ID is configured as 00 (default), thus Base ID + 3 = 03.

The response includes the unit ID of the unit sending the response, a letter to identify the function, and the response data.

Extra text is included in the command message but only the relay protocol command is required.

Checksum: 03069

When a received message triggers the checksum function, the 20-90 will wait until the channel is clear then transmit an alphanumeric message containing the checksum of the message that activated it.

> Message received: CA1234567 1 Checksum test 03069
> Transmitted response: CA1234560 1 00:C:b6

The checksum function may be triggered without including the relay protocol command by configuring the receiving 20-90 to Open I/O channel 30 if the received cap code is 1234560 to 1234567 (or any other range that includes the messages that a checksum is required for).

Other functions can be triggered by configuring a CAP code range to open or close other I/O channels.

I/O Status: 03079

The I/O status function will read the current state of all inputs and outputs (including unimplemented I/O channels) and report the current state (closed=1). Inputs will be the same as the outputs unless external circuitry is pulling the pin up or down.

> Message received: CA1234567 1 Report I/O status 03079
> Transmitted response: CA1234560 1 00:I:00000000:O:00000000

Battery Level: 03089

Reports the battery level when triggered.

> Message received: CA1234567 1 Report battery level 03089
> Transmitted response: CA1234560 1 00:B:13.8

Reset: 03609

Resets the 20-90. Any messages configured to transmit at power up will be transmitted following the reset. There is no other response.

     Message received: CA1234567 1 Reset 20-90 03609

     Unit response: Reset

Report RSSI: (Received Signal Strength Indicator) **03709**

When a received message triggers the RSSI function, the 20-90 will wait until the channel is clear then transmit an alphanumeric message containing the received signal strength, in dBm, of the message that activated it.

     Message received: CA1234567 1 Report RSSI 03709

     Transmitted response: CA1234560 1 00:-29dBm

Trigger Watchdog: 03809

This function can be used to force a watchdog response in between regular watchdog events, or to trigger the watchdog when the timer is not operating (watchdog repeat time = 0).

Regardless of whether the watchdog timer is operating or not, any messages that are configured to be sent with the watchdog timer will be transmitted, including any inputs configured as "with watchdog" and the watchdog message (if enabled).

This function may be used to check if a unit is operating (message only), or to read back the state of inputs that have been configured to be sent with the watchdog.

     Watchdog: Enabled

     Watchdog message: 512A 1234567 1 Watchdog Test

     Received message: CA1234560 1 Trigger watchdog 03809

     Transmitted message: CA1234567 1 Watchdog Test

Special function CAP code, baud rate and level

Except where defined by the input or watchdog messages, the default CAP code and default transmit baud rate is used (configured under the CAP codes and Transceiver tabs in Sacoto). The function level for special function messages is always "1".

POCSAG Rapid

POCSAG rapid allows a faster response to a push button input. POCSAG rapid uses a short preamble, and starts the message transmission in the first POCSAG frame, regardless of the CAP code. For even faster response, keep messages short, use numeric or tone only messages, reduce the de-bounce time, and consider using 1200 or 2400 baud.

The transmitted CAP code will be a multiple of 8. The POCSAG frame number is part of the full CAP code, and POCSAG rapid always starts in frame 0.

POCSAG rapid would be used without "while held" for separate "open" and "close" buttons.

While Held

The "While Held" option sends messages continuously while the input is in the specified state.

When used with POCSAG rapid, messages are transmitted continuously in all eight frames of the POCSAG data stream, until the input is released. This allows the receiver to use a short mono-shot timer on the output, providing quick push-button release response (momentary action).

The transmitted CAP code will be a multiple of 8 plus the slot position, from 0 to 7. A long enough transmission will cycle through all 8 CAP codes the start over. A receiver should be configured to respond to all eight CAP codes.

Mono-shot Delays

The fastest release response can be achieved by reducing the mono-shot delay to the minimum required to guarantee that the output will be retriggered before the mono-shot times out.

Minimum delays (seconds) are as follows:

Message type	512 Baud	1200 Baud	2400 Baud
Tone only: Output defined by CAP code range	0.150	0.075	0.050
Numeric: Relay protocol, up to 10 digits	0.275	0.150	0.075
Alpha-numeric: Relay protocol, up to 14 characters.	0.400	0.175	0.100

Note: POCSAG rapid is not intended to work with pagers.

Watchdog messages

Watchdog Function

The watchdog function provide a means of generating periodic transmissions. These may be regular "I'm alive" messages which can be monitored by a receiver to determine the operational status of a remote transmitter. Another 20-90 can monitor these messages and provide an alert message if the watchdog transmissions stop. Both 20-90's may be configured to monitor each other for even greater reliability.

Regular transmission of input messages

The watchdog timer may also be used to send messages to monitor inputs. Any input message may be configured to be sent "with watchdog". The general watchdog message may be disabled without affecting input messages sent with the watchdog timer.

The watchdog timer is disabled by setting the period to zero.

Triggering the Watchdog with Relay Protocol

Even if the watchdog timer is disabled, the watchdog messages may still be triggered by using the "trigger watchdog" special function, described above.

This allows remote reading of the selected inputs at any time.

Monitoring a remote watchdog message

A relay protocol command maybe included in a watchdog message to trigger an output on the monitoring 20-90. If the mono-shot time is longer than the watchdog period then the output will remain closed as long as the watchdog message continues to be transmitted. The maximum mono-shot time is 24 hours. It is recommended that the mono-shot time be at least twice the watchdog period, in case one watchdog message is not received due to interference.

The output on the monitoring 20-90 will open if the watchdog message is not received, providing an indication that the remote transmitter is not functioning correctly.

The opening of this output may be used to trigger a transmission by the monitoring 20-90 to provide an alert message when the remote transmitter has stopped working. Two or more 20-90s may monitor each other's watchdog transmissions.

Using CAP code ranges instead of relay protocol to trigger the output allows multiple 20-90's to monitor the same watchdog transmission without needing to include the unit ID of every monitoring unit in the watchdog message. Only one remote transmitter should be monitored by a range, and only one remote transmitter per output.

Store and Forward

The 20-90 can operate as a stand-alone store and forward repeater, providing in-fill paging to weak signal areas.

It can also act as a range extender for other 20-90 units by placing the 20-90 repeater in a location with better a better path to the receiving site, while still within range of the remote 20-90 transmitters. This allows 20-90's to monitor locations with a poor radio path to the base location.

Store and forward is configured on the "Advanced" configuration tab of Sacoto.

Duplicate Reject

Store and forward systems can be prone to feedback loops. This is where messages are retransmitted back and forth between multiple repeater units. To prevent this, a repeater can be configured to reject any received message that it has recently transmitted. The reject time can be configured using Sacoto.

In some cases messages are intentionally repeated for additional reliability. To ensure these intended repeated messages are relayed, the repeat time should be longer than the duplicate reject time. The duplicate reject time only needs to be long enough that the message has already been relayed by all other repeaters within range.

Duplicate reject is not required if there is only one repeater.

Transmitter hold off (Busy Hold)

Interference can occur at the repeater site between local transmitters and the next repeater in a chain. Often the local transmitter are unable to receive the next repeater in the chain and may transmit at the same time. The first repeater may not receive local transmissions due to interference from the next repeater.

To solve this issue, the 20-90 provides a Busy Hold feature, where the channel can be considered to be busy for some specified time after the last known channel activity (either the 20-90's last transmission or a received signal). This Busy Hold time can be set on the local 20-90 transmitters to allow time for the repeaters further along the chain to forward the message.

Where there are multiple local transmitters the busy hold times of each transmitter can be staggered so that they do not all transmit at exactly the same time after the channel becomes clear.

See the Channel Busy section for more details.

20-90 Receiver combined with a 20-62 for Store and Forward

Duplicate reject and delays are handled by the 20-62 in store and forward mode. The 20-90 only provides a busy output and a serial message output using Salcom message protocol.

Serial Commands

Reset

Usage:	RES<CR>
Description:	Restart 20-90
Response:	Restart, followed by SALCOM 20-90-0000 VX.XX Rel<CR><LF>
Note:	Reset will immediately stop any transmission and open all outputs. Any messages configured to transmit at startup will be transmitted after the reset.

Query current output states

Usage:	*RWO?<CR>
Description:	Retrieve 32 bit HEX number representing the output states (up to 32 outputs)
Response:	00000004<CR><LF>
Explanation:	4 = third bit is set (bit 2) => Output 3 is closed
Note:	An output should be "Open" (bit=0) for normal use of the I/O pin as an input.

Query current input states

Usage:	*RWI?<CR>
Description:	Retrieve 32 bit HEX number representing the output states (up to 32 outputs)
Response:	00000004<CR><LF>
Explanation:	4 = third bit is set (bit 2) => Input 3 is closed (low)
Note:	Reflects the true state of I/O pins. Inputs will be the same state as the associated output, unless the I/O pin is pulled low externally, or the protection or current limit is preventing an output from closing (externally pulled high). See "Inputs" for more information.

Control outputs

Usage:	*RPC=IDC..C0N..N9<CR>
Description:	Salcom Relay Protocol Command over serial or Ethernet link to control outputs
Example:	*RPC=24109<CR>
Response:	OK<CR><LF>
Explanation:	Close Relay 1 on unit ID 24.
Note:	The 20-90 unit ID is configured with Sacoto. See "Outputs" for Relay protocol and further information.

Query Received Signal Strength

|	
Usage:	*RSS?<CR>
Description:	Retrieve signal strength of last message and the current received strength
Response:	60,130 <CR><LF>
Explanation:	Strength of the last message was -60 dBm. Current signal strength is -130 dBm.

Sacoto Configuration Tool

Sa-co-to (**Sa**lcom-**co**nfiguration-**to**ol) is Salcom's configuration software. This tool replaces the serial commands used with older products for product configuration. Serial commands are available if required for systems that may need to change configuration independently of the Sacoto software.

Installation

The latest version of Sacoto can be downloaded from the Salcom website from the 20-90 product page.

Unzip the downloaded file and run **setup_Sacoto_n.n.n.exe**

Connecting Sacoto to the 20-90
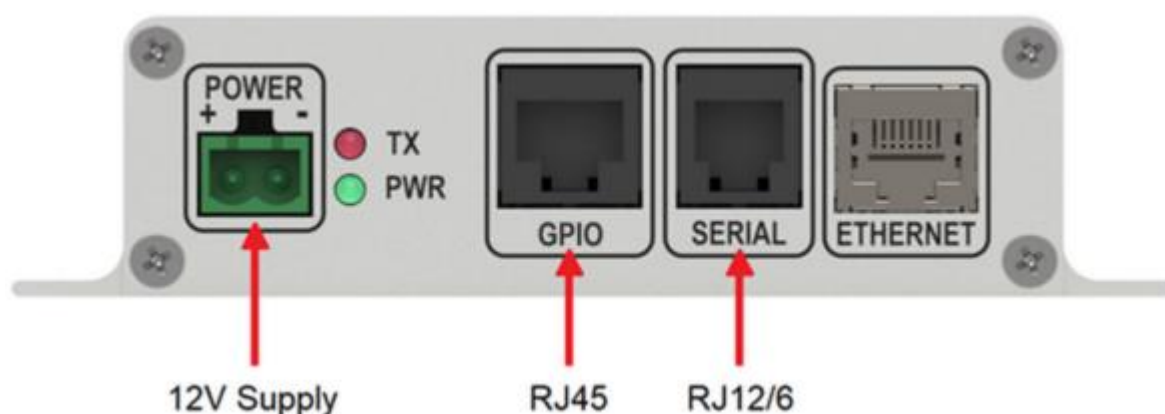
The 20-90 can be connected to a PC via the serial port on the RJ12 connector, or via the Ethernet port.

When shipped the 20-90 Ethernet port is configured as a TCP server using an IP address provided by your network's DHCP server. Sacoto includes a tool to find the settings of any 20-90's on your network. These settings can be used to set up Sacoto for an Ethernet connection to the 20-90. See below for details.

Welcome to Sacoto!
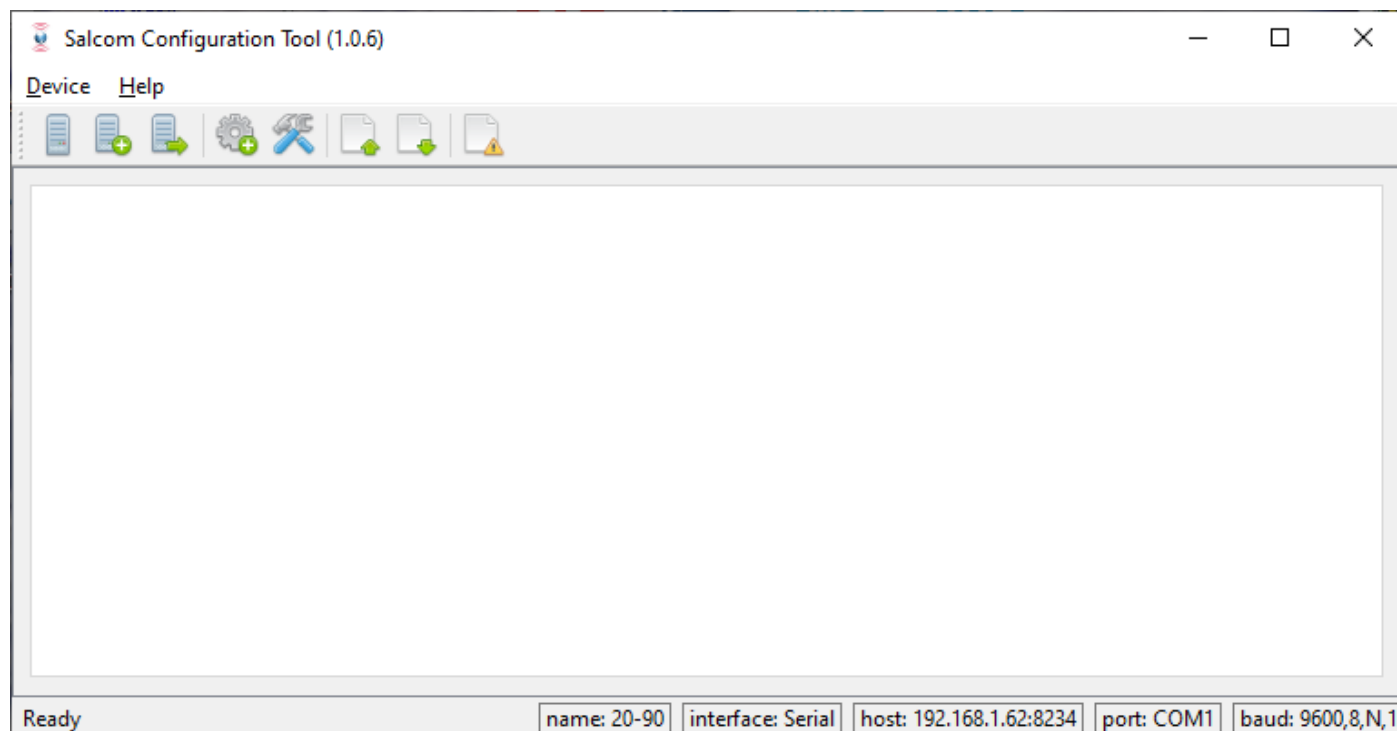
Icons

There are various icons across the top for configuring Sacoto, and for reading and writing 20-90 configuration to or from the unit or a file.

Device Menu

Reading, writing and setup functions can also be accessed from the "Device" menu.
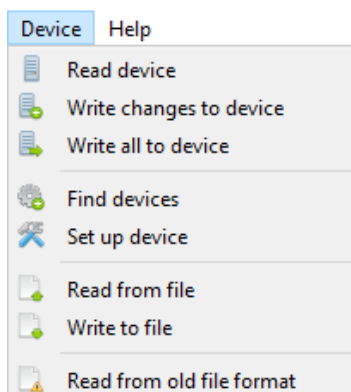
Help!

Advanced configuration information and general help can be found under the "Help" menu.

A brief description of each field is shown when the mouse is over each setting.

Sacoto Connection Settings

Choose "Device > Set up Device" from the menu or click the "device settings" icon to open the setup window. *The connection settings are effective **immediately**. You can close this window any time.*

There is no OK button.

Serial Port Settings

For a physical RS-232 port on a PC, or a third party USB-to-Serial adaptor, set Sacoto as follows:

- Device: 20-90
- Interface: Serial
- Serial port: Identify the COM port associated with your serial connection
- Other setting can be left as the default settings.

To help identify your COM port you can **refresh the list of COM ports** by clicking the "Device settings" icon or select "Device > Set up device" from the main menu. It is not necessary to close the settings window first. Refreshing the list after a USB port has been plugged in, or unplugged, can help identify the COM port number.

Ethernet Settings

When shipped the 20-90 is configured as a **TCP server** and uses the **DHCP server** on your network to obtain an **IP address**. Sacoto provides a discovery tool to find 20-90 units on your network and to discover those unit's IP address and other settings. This is described below. Once these settings are known they can be entered into the Settings window.

- Device: 20-90
- Interface: Ethernet
- Remote IP address and Port: 20-90's IP address from Discovery tool.
- Local IP address and port: Leave as default for a remote TCP server.
- Remote Mode: Typically TCP server.
- Other setting can be left as the default settings.

The 20-90's Ethernet settings can also be read and configured over the serial port using Sacoto's "**IP" tab**.

Sacoto Network Discovery Tool

Sacoto has a special tool for discovering 20-90 units on your network, and for finding their **IP address** and other Ethernet settings.

Choose "Device > Find Devices" from the menu or click the "find devices" icon to open the discovery tool.

Click [Discover] to automatically scan your network for Salcom devices.

All active Salcom devices on your local network will appear in the list below. The **Device Name** shows the model and **serial number** of each device. Click on the device you wish to identify. The device data will appear on the right.

TCP Server mode: If the IP mode is TCP server, note the 20-90's IP address, 20-90's local port. This is all you need to set up the Ethernet connection settings in Sacoto.

TCP Client mode: If you wish to configure the 20-90 in TCP Client mode, then the 20-90's "Remote server" and "Remote Port" must match your PC's IP address and the "local" port number configured in Sacoto. Sacoto Discovery Tool cannot change any of these settings. You can change these settings over a serial connection using the "IP" tab in Sacoto.

If **DHCP** is selected as the **IP type**, then the 20-90 is getting its IP address from your network's DHCP server. In general, once a DHCP server has allocated an IP address to the unit it will reserve that address for that 20-90, so next time it is connected it will have the same address. However it does not reserve the IP address forever, and may eventually re-allocate it to another device on your network if the 20-90 has not been connected for a while or is reset. Exactly how long and how this works depends on your network's settings.

An alternative is to allocate a **static IP address** which does not change. This needs to be compatible with your network. Contact your network administrator.
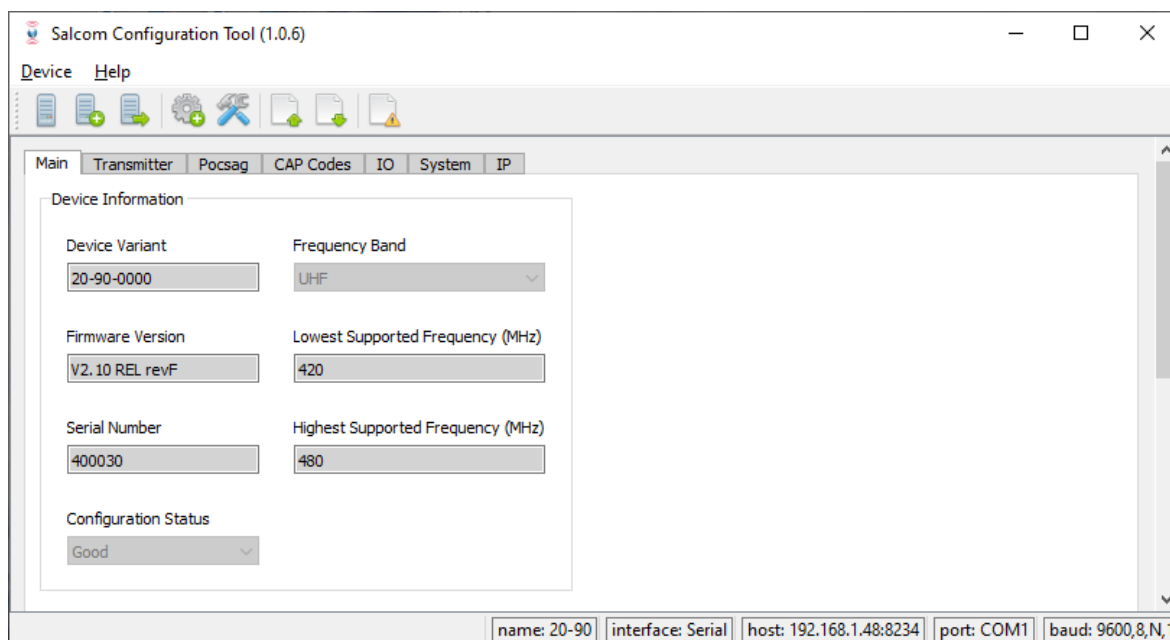
Configuring the 20-90 using Sacoto

Read the configuration

The initial configuration must first be read from the 20-90 or from a file saved on disk. This may then be modified as required and written back to the 20-90.

Select "Device->Read device" from the menu, or Click the icon to read the current configuration.

Sacoto main window after reading the configuration from a 20-90

Configuration Tabs

Tabs along the top provide configuration options for the various 20-90 features:

Main:	Information panel
Transmitter:	Frequency, Power, and channel busy settings
POCSAG:	Default baud rates and message types
Cap Codes:	Cap code filtering
	Cap code triggered outputs
	Default CAP code for special functions
IO > Inputs:	Enable Inputs, input messages, input options
IO > Outputs:	Relay protocol triggered outputs, mono-shot delays
System:	Watchdog, Store and forward, Serial pass-through, message output ports
IP:	Ethernet configuration

Writing the Configuration

Write Changes

Select "Device->Write Changes" from the menu, or Click the icon to write ONLY the fields **highlighted in yellow**. This is much quicker than writing everything.

If a field is changed it will be highlighted in yellow.

Any tabs with fields that have changed will also be highlighted in yellow.

If the configuration has been read from a file, or from another 20-90, any differences from the configuration in Sacoto and in the configuration of the 20-90 is unknown. If you want to preserve the settings in the device and only make a few changes you should **read from the 20-90 first**.

Write All

If you want to duplicate a known configuration read from another 20-90, or restore a previous configuration saved on disk, then you should select "Device->Write All" from the menu, or click the "Write all" icon.

Changes can be made to the configuration before writing, but only the changes from the previously read configuration (from a file or another 20-90) will be highlighted. There may be other differences between the current 20-90 configuration and the configuration shown in Sacato. Select "Write all" to ensure that *all* configuration items read from another source are written to the connected 20-90.

Frequency, Power and Busy Settings
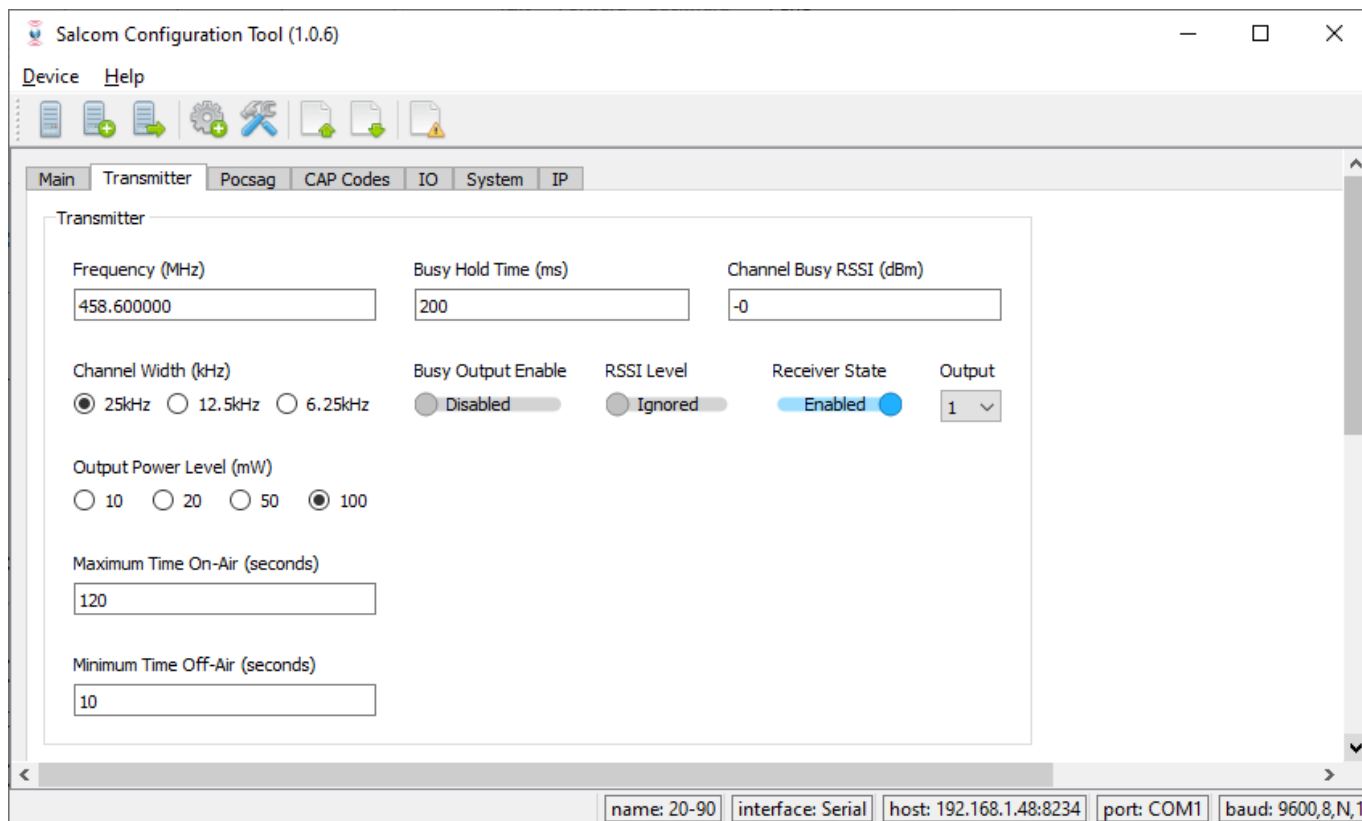
These are found under the Transmitter tab.

Frequency: Entered in MHz. Any frequency within the band may be specified. Frequency is not limited to multiples of the channel width.

Channel Width: Select the width of your allocated channel. This configures the transmitter deviation and receiver bandwidth to suit the specified channel width.

Output power: Select the power level as required. Low power may be required in some jurisdictions.

Channel Busy: The transmitter can be inhibited if the channel is busy. Enable "Receiver state" to inhibit transmission while receiving a message, allowing transmission to begin after the message has been received. Enable "RSSI level" and enter the desired "Channel busy RSSI" threshold in dBm to detect a busy channel when a signal or interference on the channel is above the specified level.

Busy Hold: The minimum delay between the channel becoming free and the next transmission.

Busy Output: The 20-90 can provide a busy output for an external transmitter. Enable the busy output and select the desired I/O port for the busy signal (active low, overrides all other input and output functions on that I/O port).

Write changes back to the 20-90 using "Device>Write changes" menu or the write changes Icon.

Input triggered Messages

The **Input tab** is under the **IO tab**. Here you can configure the input messages, configure POCSAG rapid, and select other input options and parameters.
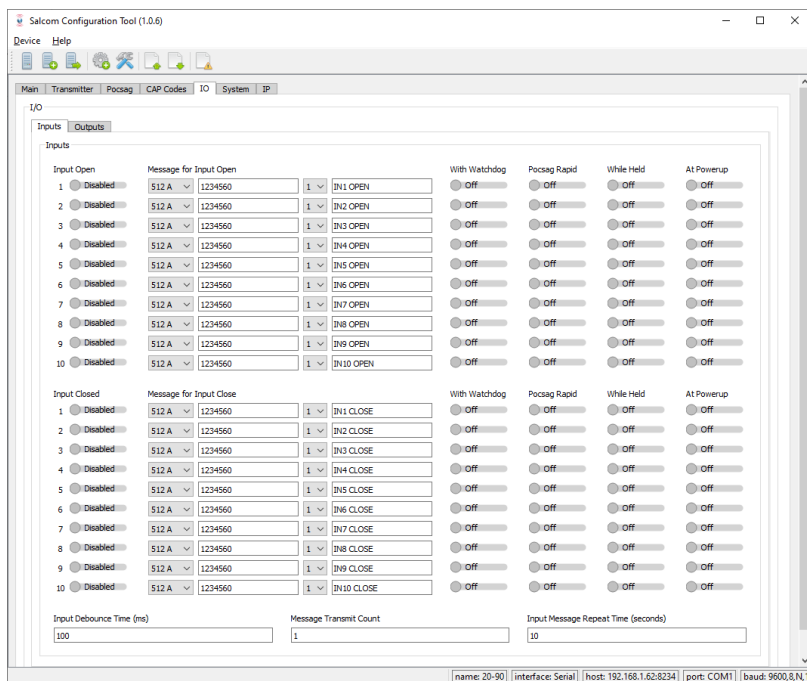
The 20-90 can be configured to transmit messages in response to the state of the inputs. Refer to "Input and output operation".

- A message may be transmitted with a closing or opening transition.
- Input triggered messages are specified with baud rate, Alpha or Numeric message type, CAP code, function level, and the message Text.
- Some inputs are not physically implemented, but may be triggered by received relay protocol messages or CAP code ranges to generate acknowledgements.
- The message corresponding to the initial input state can be sent at power up.
- An input messages can be transmitted with the watchdog timer to transmit the input state on a regular basis.
- POCSAG rapid can be selected for fast relay control.
- A message may be repeated continuously while the input is held in the specified state.
- Messages may be transmitted multiple times from a single trigger event to ensure reliable reception.
- The message repeat period can be specified.
- A de-bounce time can be specified to prevent transmissions until the input is stable.
- Inputs should only be enabled if they are being used to transmit a message.
- Outputs should be disabled on I/O ports that are used for inputs, unless the input is used to monitor an output. Check the Outputs tab.

Outputs

Each output of the 20-90 may be opened or closed by Salcom relay protocol, or by a received CAP code within a range. One output pin may be assigned to be the "Busy" output. See the Inputs and Outputs section and the Salcom Relay Protocol section for a description of the output channels, special functions, and relay protocol. The **Output tab** is under the **IO tab**.

Enabling outputs

The three output sources (relay protocol, cap code range, and busy) can be enabled or disabled independently.

- Relay protocol is enabled on the Outputs tab
- Cap code matching is enabled on the CAP code tab
- Busy is enabled on the Transmitter tab.

Since inputs and outputs share the same physical pins, enabled inputs will respond to changes in the state of the corresponding output. This can be used to monitor outputs or send acknowledgement messages. However, in most cases the **corresponding input should be disabled** when an output is used.

If an output is not used it should be disabled so that the output state remains "open" and the pin can be used as an input.

Mono-shot operation

Outputs can operate as a momentary output, where the output opens automatically after a short delay following "close" trigger. This is the mono-shot timer.

If the mono-shot time is set to 0, the output will remain closed until triggered to open.

For fastest reliable response when using POCSAG rapid use the mono-shot delay time specified in the POCSAG rapid section.

CAP Code Ranges

The 20-90 provides up to 8 CAP code ranges. It will only decode messages that are within one or more of these ranges. The default range is 0000008 to 2000000. The ranges may be in any order, and may overlap.

Triggering outputs

An output may be closed or opened on reception of a CAP code within a range. Closing an output may be used to trigger a mono-shot (pulsed) output if the mono-shot time is non-zero on the output tab.

Outputs are specified by their I/O channel number from 1 to 32. See the Output Map section for details.

Acknowledgements and Special Functions

The output may be used to trigger acknowledgment messages, including special function messages like received RSSI or received message checksum. The same range may be specified more than once to trigger more than one output or special function.

Outputs 8, 9 and 10 are not physically implemented and may be used to trigger the associated "input" messages as an acknowledgement.

Special functions are output channels 30, 31 and 32. They may be opened or closed to trigger the correct function. See the Output Map and Special Function sections for details.

POCSAG Rapid

A CAP code range may be used to trigger a mono-shot output when using tone only POCSAG rapid messages. The range must include all 8 CAP codes associated with the POCSAG rapid transmission.
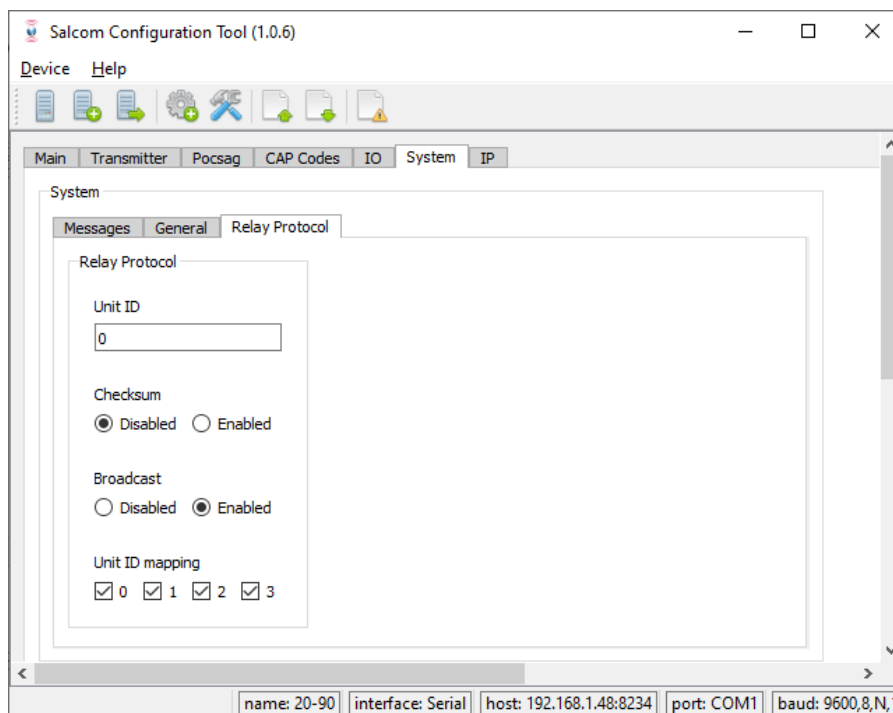
Default CAP code

The default CAP code is used by special functions or any other transmission which does not otherwise specify a CAP code.

Relay protocol configuration

Relay Protocol configuration can be found under the **System > Relay Protocol tab.**

- The 20-90's Base ID is specified here. The outputs and special functions can be addressed using this unit ID plus an offset as specified in the "20-90 Output Map" section.

- The checksum feature may be enabled to provide additional protection against accidental relay activation by unrelated numbers in received messages. See the relay protocol section.

- The broadcast ID is a second Base ID (96) which may be enabled. If enabled, multiple 20-90 units can be addressed either by their individual ID's, or as a group using the broadcast ID.

- Unit ID mapping check boxes may be used to enable or disable specific ID's within the 20-90's four ID's. The can provide additional protection to ensure that noise or unrelated messages cannot activate outputs or special functions.

Watchdog message configuration
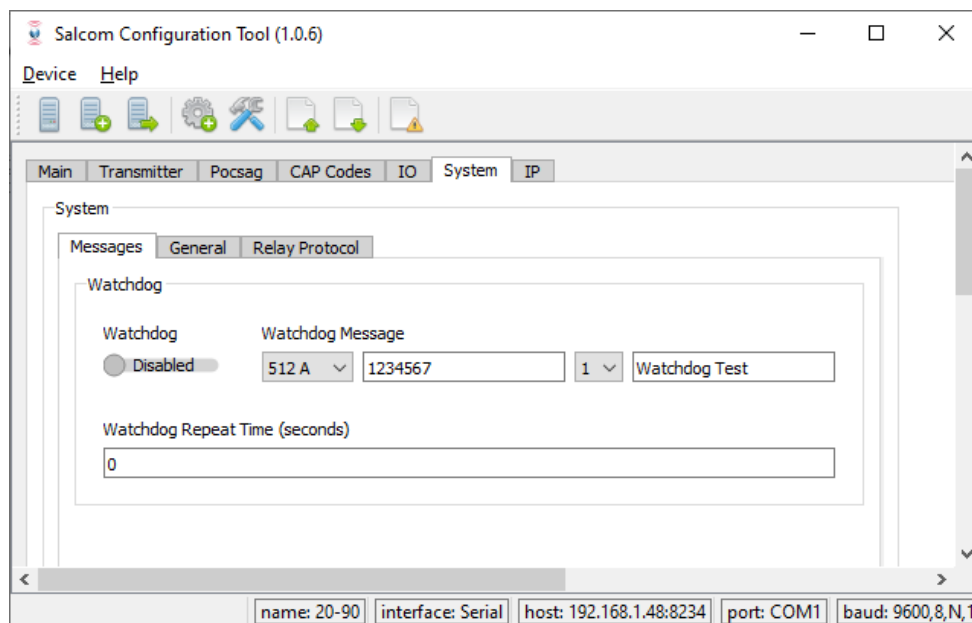
The watchdog configuration can be found under the **System > Messages tab**. Watchdog operation is described in the Watchdog section of this manual.

The watchdog timer may be used to send a regular watchdog message, or to regularly send any input messages configured to be sent "with watchdog" depending on the input state.

The watchdog function is **enabled** by setting the **Watchdog Repeat Time**. When set to zero, the watchdog function is disabled.

The regular watchdog message is specified and enabled here. The watchdog repeat time must also be set for watchdog operation.

Input messages configured to be sent "with watchdog" will be sent at regular intervals specified by the watchdog repeat time. Disabling the watchdog message does *not* disable the input watchdog messages.

The maximum "watchdog repeat time" is 1800 seconds = 30 minutes.

Advanced features
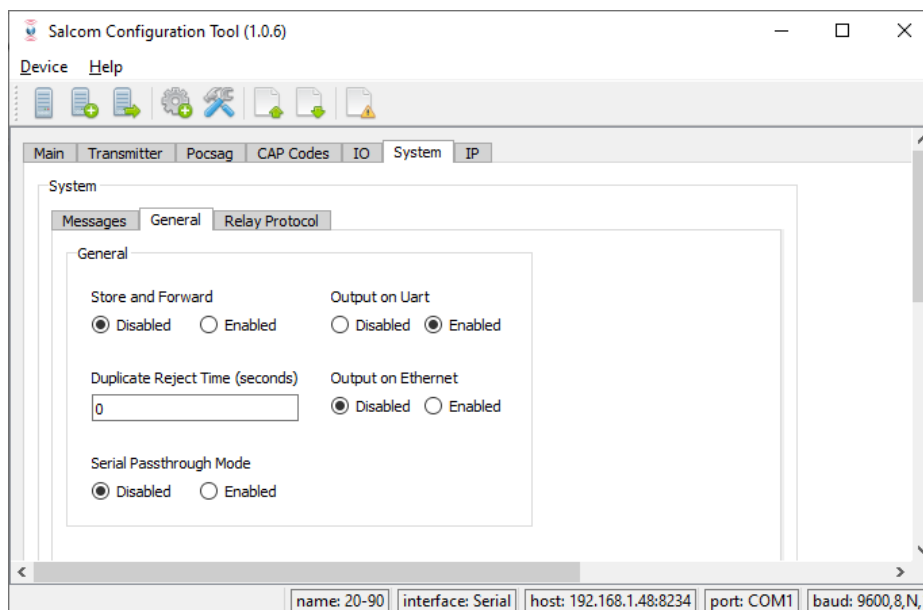
Store and Forward

This is described in the Store and Forward section of this manual. Store and forward operation, and the store and forward duplicate reject feature may be enabled here.

Serial Pass through

When enabled every byte sent to the 20-90 will be transmitted, unaltered, to another 20-90 also configured to serial pass through mode. Serial pass through mode is activated after the unit is reset.

WARNING:

Once serial pass through mode has been activated, Sacoto will only work if the unit configuration is read *immediately* after the 20-90 has been powered on or reset.

To restore normal operation turn the 20-90 off and back on again then immediately read the configuration from the unit. You may then disable serial pass through mode and "write changes" to the 20-90.

Received Message Output

Received messages may be directed to the serial port (UART) or Ethernet connection, or both.

Ethernet Configuration

DHCP server and IP address

When shipped, the 20-90 is configured to use your network's **DHCP server** to get an IP address on your network. To connect to the 20-90 you will need to know the IP address that it has been allocated by your network's DHCP server.

You can use the **Sacoto Network Discovery Tool** to find 20-90 units on your network and see their IP number, Serial number, and other settings. See "Sacoto Network Discovery Tool" at the start of the Sacoto section of this manual.
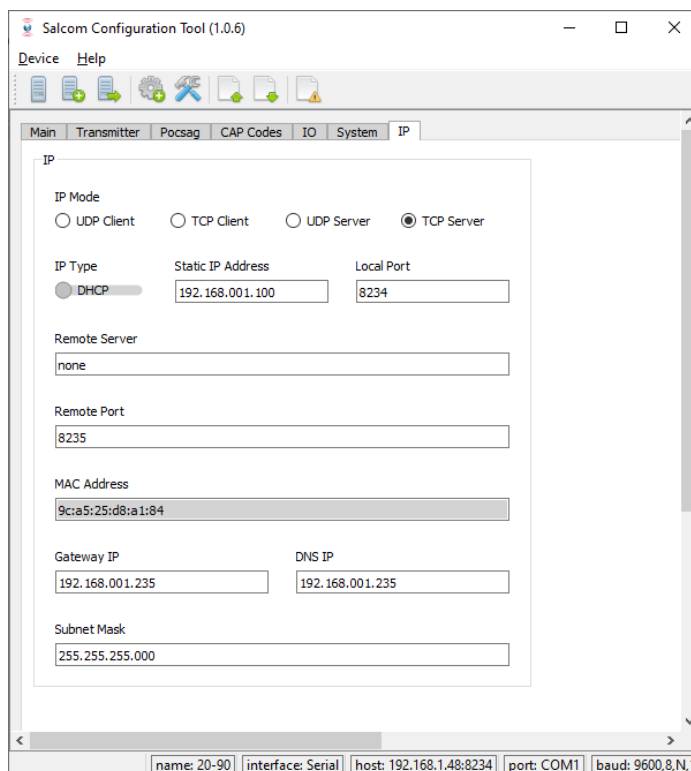
Port

In addition to the IP address, an Ethernet connection requires a **"port"** number. There may be many "ports" available at an IP address, each corresponding to a different connection on the device. By default the 20-90 uses port 8234 for incoming connections, but this can be changed as required.

Subnet Mask should normally be set to 255.255.255.0

TCP server

When shipped, the 20-90 is configured as a TCP server. Other applications can connect to the 20-90's TCP server. The application should be configured as a TCP client and only requires the IP address and port of the 20-90. Once connected the 20-90 will respond to text messages sent from the application in the same way as a serial connection.

Connecting

You can test the TCP/IP connection by connecting with Sacoto (see Sacoto Connection Settings), or using the Salcom UDP/TCP test tool described below.

Clients and Servers

The 20-90 may function as either a "client" or a "server" using either TCP/IP or UDP protocol.

When operating as a **"TCP/IP Server"** it will respond to any device on the local network that connects to the 20-90's IP address and port. A "Remote Server" address and port is not required in the 20-90.

When operating as a **"TCP/IP Client"** the 20-90 will attempt to connect to a specific server at the IP address and port specified in the "Remote Server" fields. The remote TCP/IP server does not need to know the IP address or port of the 20-90. *In TCP/IP client mode the 20-90 will only connect to the specified IP "Remote Server" address and port.*

If there are multiple 20-90's configured as TCP/UDP clients on the same network, then they must all connect to different IP addresses or different ports on the same IP address.

A **"UDP client"** will only send data to the specified remote server address and port while a **"UDP server"** will send any response to the originating IP address and port. At startup a UDP server will act as a client, sending data to the "remote" IP address and port until data is received from another address.

When using **UDP**, *the 20-90 will receive all commands sent to its IP address and port, regardless of client or server mode.*

Static IP addresses

A network DHCP server will typically reserve an IP address for the same unit once it has been allocated. However it does not reserve it forever, and may eventually reassign that address to another device if the 20-90 remains disconnected for a while. How long this takes depends on your network settings. The 20-90 using the DHCP server would then be allocated a new address when it is next connected. This can cause connection issues.

To prevent this, a static IP address can be used. The static IP address never changes, but it must be compatible with your network configuration. Typically a DHCP server must know that the address should not be reallocated to another device. Assigning a static IP address usually requires coordination with your network configuration. Contact you network administrator to obtain a static IP address.

Salcom UDP/TCP Test Tool

Salcom provides a simple tool for testing TCP/IP and UDP Ethernet connections. This can be downloaded from the Salcom website under the 20-90 product page.

This tool may be used to:

- Establish and test connections,
- Send serial commands,
- Initiate paging messages,
- Monitor received messages.

Testing a connection

➢ If the 20-90 is configured as a *TCP server*, the test tool should be a *client*.

➢ Enter the 20-90's *IP address* and *port* number in the "Remote IP Address and Port" fields.

➢ Click "Connect"

➢ Enter data to send in the bottom line and click "SEND"

➢ Any returned data will appear in the *Data Received* box.

➢ The command "SN?" will return the serial number and product information, and can be used as a handy test command.

➢ "CA1234560 1 Hello" can be used to initiate a paging message in Salcom protocol.

NOTE: To monitor received messages, the 20-90 must be configured to send received messages out the Ethernet port. This can be configured on the **System > General** tab of Sacoto.

Virtual Serial Port over Ethernet

Third party software, such as USR-VCOM, can create a virtual COM port on your computer and connect it to the 20-90 over the Ethernet. This allows you to access the 20-90 via the Ethernet in the same way you would access a physical RS-232 port or USB serial port.

This virtual COM port can be used to send paging messages and serial commands but it cannot be used with Sacoto. Socoto can connect to the 20-90 via Ethernet directly, without the use of a virtual COM port.

Important: USR-VCOM is *proprietary software* for *exclusive* use with USR Ethernet modules, such as the USR-TCP232-S2 used in the Salcom 20-90. USR-VCOM may not be used for any other purpose.

Downloading and Installing USR-VCOM

USR-VCOM may be downloaded from the USR IOT website:

https://www.usriot.com/support/downloads/usr-vcom-virtual-serial-software.html

To install USR-VCOM you will need to run the installation package with *administrator privileges*. In some cases accessing the Ethernet will require access to be granted through a firewall.

Configuring USR-VCOM
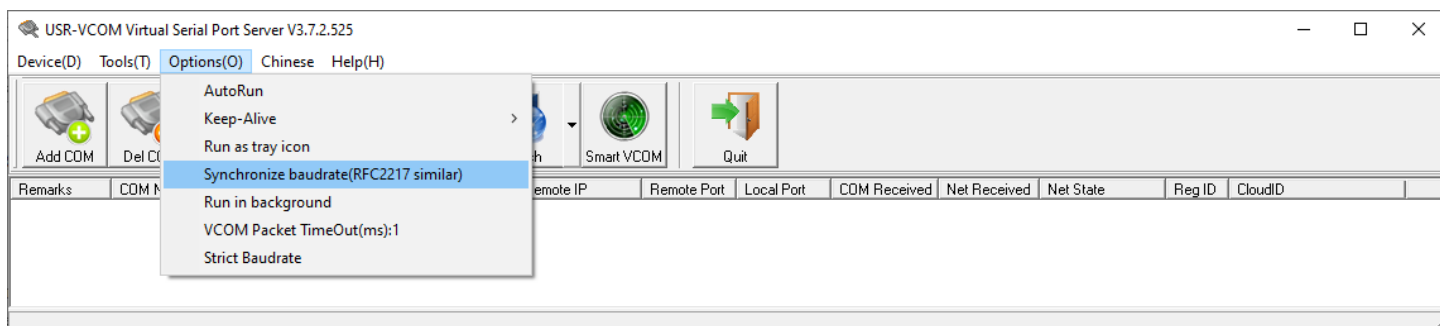
Ensure that "Synchronize baud rate" is NOT ticked under the "options" menu.

If it's ticked then you can only connect at 115200 baud.

Configuring a Virtual serial port

- ➢ Click "Add COM"
- ➢ Select the new port number to assign to the virtual COM port
- ➢ If the 20-90 is a TCP **server**, you must configure the virtual COM port as a TCP **client**.
- ➢ Enter the IP address and port number of the 20-90
- ➢ Click OK
- ➢ Turn on the 20-90 and ensure the Ethernet is connected.

- ➢ The "Net State" should show "connected" when a connection has been established.
- ➢ Start your terminal software or other paging application and connect to the COM port you have just created.

Antenna Selection and Installation

A simple rubber whip antenna, designed for the band of operation, when connected to the SMA connector on the 20-90 will generally provide reliable coverage over short distances within buildings.

An outdoor antenna is preferable and will usually provide better radio coverage. A suitable antenna, such as ground independent half wave, can be connected to the unit with a coax cable via the SMA connector on the end plate of the unit. The aerial connection should present a nominal load of 50Ω, with a VSWR of better that 1.8:1. Other options such folded dipoles with 50 ohm impedance, co-linears and quarter wave whips with suitable ground planes are also suitable. A high quality aerial and cable installation will provide additional performance and reliability.

Note: The 20-90 is a low power device. Transmission range can exceed 1000m in an open outdoor environment with an outside antenna mounted high above the ground, however buildings, obstructions, radio interference, low gain antennas, and antennas mounted indoors or low to the ground can dramatically reduce range.

The 20-90 has a high sensitivity receiver. For best reception in weak signal areas, some antenna locations may provide a significant advantage due to addition and cancellation of reflected radio wave. Choosing the antenna location to take advantage of this effect may significantly improve the system performance when used as a store and forward infill paging repeater in weak signal areas.

Recommended aerial suppliers:

Region	Supplier
New Zealand	Hi-Tec Aerials NZ Ltd http://www.hi-tec-aerials.co.nz/ Pacific Aerials Ltd http://www.pacificaerials.co.nz/
Australia	RFI Wireless http://www.rfiwireless.com.au/
UK / Europe	Procom (antennaPRO Ltd) http://www.procomuk.co.uk/

Trouble Shooting

Fault	Problem/Solution
No illumination of Green LED	Check power supply and connection
No transmission, but solid red LED.	Solid red LED indicates the channel is busy. Wait for a clear channel or check channel busy configuration in Sacoto.
Input activated but no transmission	Check and write input configuration in Sacoto.
Output not activated by received message	Check message is received on 20-90 serial output Output disabled Unit ID incorrect or disabled Monoshot timer too short External circuit holding output high or low Check output state (*RWO? Command) Relay protocol format incorrect Relay protocol checksum enabled but missing or incorrect in message.
Unit transmits (rapidly flashing red LED) but nothing received on pager	Check pager configuration Wrong frequency Incorrect channel width Incorrect CAP code Incorrect baud-rate Poor antenna Poor antenna position
Pager receives message from another transmitter but 20-90 does not.	Check frequency, channel width, baud rate, and antenna. Check CAP code range in Sacoto. A solid red LED indicates signal is being received.
No RS232 serial communication	Cable not plugged in to RJ12 serial socket. Incorrect COM port selected. COM port configuration incorrect (baud rate, parity) USB to serial adaptor not installed correctly. Faulty cable or adaptors.
No Ethernet connection	Check IP address, port, subnet mask, Server/Client configuration & TCP/UDP mode on 20-90 *and* in paging software. Ping 20-90 to test Ethernet connection.
Unit starts transmission, but does not complete it.	Poor supply voltage, or low current limit.

Glossary

Definition
ASCII: Acronym for "American standard code for information interchange," a 7 bit code representing upper and lower case letters, numbers, punctuation, control codes, and other special symbols. The term "ASCII" typically refers to the character set and control codes this code represents.
SMA connector: A standard miniature RF connector. Not to be confused with "Reverse SMA" often used with WIFI.
De-bounce: When a contact is switched it may make and break contact several times before settling in its final state. To avoid repeated false triggers during the switching transition, a "de-bounce" delay is added so that the no action is taken until the input has settled.
Duty cycle: The fraction of time that the transmitter is transmitting. Duty cycle is commonly expressed as a percentage or a ratio.
POCSAG: A radio transmission standard for the on-air coding and signaling used for paging.
NRZ (Non-return-to-zero): Digital data that may remain in either a high or low state indefinitely.
FSK: Frequency Shift Keying. A form of RF modulation where binary states are represented by shifting the carrier frequency high or low.
RS-232: An electrical standard for the serial transmission of data.
Universal Serial Bus (USB): A common interface that enables communication between devices and a host controller such as a personal computer (PC).
VSWR (Voltage Standing Wave Ratio): is a measure of how well the impedance of an antenna or other RF load is matched to the nominal load impedance expected by a transmitter. For correct performance a good match is required. A VSWR of 1:1 represents a perfect match.
Watchdog (timer): A regular event intended to monitor the performance of a system. Typically an independent system would respond to the loss of a watchdog event to provide an alert, activate a failsafe system, or attempt to recover from the fault.

Accessories and Related Products

Name	Description	Part Number
RS-232 serial Port adaptor	An RJ-12 to DB9 (RS-232) adaptor and cable for connection to the 20-90 serial port	12-45-0000
Ethernet Cable	Standard Ethernet cable.	Standard Ethernet Cable
Configuration Software	Salcom configuration tool (Sacoto). Can be downloaded from: http://www.salcom.com/products/20-90-0000-vhf-uhf-transceiver	Website download
Power Connector	Screw terminal power connector.	Supplied with product.
RJ45 Cable	RJ45 cable to allow the connection of trigger inputs and other functions.	Supplied with product.

Technical Specifications

Technical Specification 20-90 – VHF / UHF Transceiver	
Frequency Range	140 - 176MHz - VHF 420 - 480MHz - UHF
Frequency Selection	User configurable
Transmit Power	10mW, 20mW, 50mW, 100mW
Transmit Duty Cycle	100%
Channel Width	6.25 kHz, 12.5 kHz, 25 kHz
Modulation	GFSK with NRZ data (POCSAG)
Deviation	±1.0kHz, ±2.3kHz or ±4.5KHz
Baud Rates	512, 1200, 2400
Receive sensitivity	-123 dBm @ 512 baud -118 dBm at 2400 baud
Relays	Two Relays on RJ45 connector
Open drain outputs	Two 500mA open drain outputs with resettable fuses on RJ45 Three 5mA current limited open drain outputs on RJ12
Inputs	Five active low inputs on open drain output pins.
Serial Port	RS-232 on RJ12 connector. 9600 baud, N,8,1
Data interfaces	RS-232 (with adaptor) and Ethernet
Serial Protocols	Salcom Protocol
Configuration Software	Salcom Configuration Tool (Sacoto)
RF Connector	SMA
Power Connector	DC power plug with screw terminals provided.
Power Supply	+13.8V typical (10 to 15 VDC range)
Power Consumption	Standby: 45mA Transmit: 90mA Ethernet: +35mA when connected to Ethernet Relays: +20mA per energized relay
Environmental Protection	Not suitable for unprotected outdoor use. Must be protected from adverse environmental conditions.
Operating Temperature	-10ºC to +55ºC

Technical Specification 20-90 – VHF / UHF Transceiver	

Indicators	Power LED (Green)
	  - Slow Flashing = Normal Operation
	  - Fast Flashing = low battery
	TX/Busy LED (Red)
	  - Flashing fast = Transmitting
	  - Solid on = Chanel busy

Weight	178g
Enclosure Dimensions	130mm x 68mm x 31mm (WxDxH)
Enclosure Material	Extruded aluminium
Colour	Bright silver anodised aluminium
Type Approvals	AS/NZS 4769.1:2000 + Amendment 1:2002 (RF) EN 300-224 V2.1.0 (RF), EN 301-489-2 V2.1.0 (EMC) EN 60950-1:2006 (Safety) FCC CFR47 Part 90 (RF), Part 2 (RF), Part 15 (EMC), Part 1 (Safety)

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