



# 12-90-0000

## UHF Transceiver and Store & Forward Repeater



# PRODUCT MANUAL

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## Salcom Product Documentation

This document is designed to familiarize you with Salcom products and guide you through the hardware, configuration, installation and overall system management.

Salcom is an environmentally conscious company and in an effort to conserve paper no longer prints manuals with shipped products. All relevant documentation can be downloaded in PDF form from our website [www.salcom.com](http://www.salcom.com)

## Warranty and Disclaimer

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

All information provided in this document is carefully prepared and offered in good faith as a guide in the installation, use and servicing of Salcom products. Installers must ensure that the final installation operates satisfactorily within the relevant regulatory requirements. Salcom accept no responsibility for incorrect installation. We reserve the right to change products, specifications and installation data at any time without notice

## Product Overview

The 12-90 is a simple to configure POCSAG paging transceiver with high sensitivity receiver combined with a 60mW transmitter. It operates over the frequency range of 440-479MHz decoding and encoding 512 or 1200 baud, alphanumeric or numeric messages.

The 12-90 can be used as:

- A full paging transceiver, allowing both the encoding and decoding of paging messages.
- A standalone receiver.
- A standalone transmitter with channel busy check function before transmissions.
- An autonomous paging store and forward repeater with duplicate message reject.
- A point to point raw serial link.
- A simple telemetry solution.

The 12-90 can be controlled via an RS232 serial interface to provide numeric, alphanumeric and tone-only POCSAG encoding. This enables a user to call a pager (over 2,000,000 codes), append an appropriate priority level (1 of 4), and add a numeric or alphanumeric message.

The 12-90 supports multiple message queuing and will queue up to four 73 character messages, or as many smaller messages that will fit into the available memory buffer. It also supports full batching of serially queued and input messages, ensuring that messages are transmitted quickly with minimal transmit on time. Pre-defined input messages can be configured using any serial terminal application and are limited to a maximum length of 40 characters.

The unit supports 2 discrete inputs with different pre-programmed messages on high and/or low transition. Provision to transmit a message more than once and variable time between transmissions are catered for.

The 12-90 supports Salcom relay control protocol to control one on board relay plus several "virtual outputs". Virtual outputs can be used to remotely trigger input or periodic messages and provide a mechanism to acknowledge reception of messages. The 12-90, through the use of a virtual output, can transmit the received signal strength of the last received message allowing the receiver positioning and system health to be monitored. The 12-90 can be configured to automatically respond with checksum information of the last received message allowing robust, error free systems to be developed.

Expansion of the 12-90 is possible through the use of the 12-32 input module, allowing any number of inputs to be supported, or the 12-34 output module.

The 12-90 utilises an intelligent self-adjusting channel busy check to prevent message collision or corruption which reduces the need to retransmit messages and increases confidence of delivery.

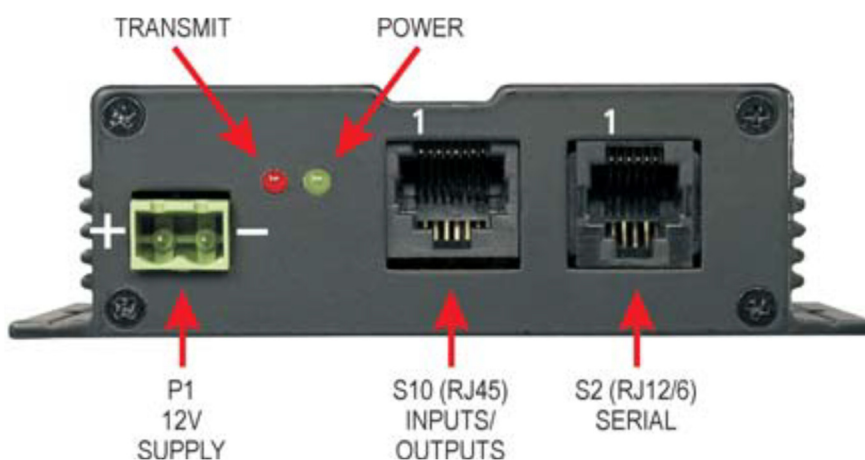
## Installation and Connections

**A correctly matched 50-ohm aerial must be connected before operating the transmitter. Failure to do so may result in damage to the unit.**

Situate the 12-90 away from direct sunlight, vibration and strong heat sources, and avoid close proximity to radio transmission equipment. The unit is not certified as intrinsically safe.

Connect a 12-volt DC power supply to P1. The 12-90 is protected against reversed supply connection. The power source must be reasonably noise free.

The connections to the relay contacts are made using pins 6 (normally open contact), 7 (relay common) and 8 (normally closed contact). The relay is not to be connected directly to mains voltages.



Pin numbering: looking into the sockets with the power connector on the left, pin 1 is on the left.

S2 RJ12 6 Way Programming Port	
Pin	Description
1	Ground
2	Not Used
3	Not Used
4	Not Used
5	RS232 Tx
6	RS232 Rx

S10 RJ45 8-Way Relay Connection Port	
Pin	Description
1	+13.8V alternate supply connect
2	Ground
3	Input 1
4	Input 2
5	Do not connect
6	Relay Normally Open
7	Relay Normally Closed
8	Relay Common

## Operation

### Unit Number

Each unit will respond only to messages containing a matching unit ID or a group ID of 00. Up to 99 unique unit numbers are available when configured as a numeric receiver (00-99). Approximately 8000 unique unit codes are available when used as an alphanumeric receiver (any 2 printable characters). Any number of units can be programmed with the same unit number.

### Receiver Operation

When operating normally, the system LED flashes green once every second. When the relay is in the closed state the red LED D1 is lit (not visible external to the enclosure). The relay will operate only when a correct Salcom relay control message is received with a matching unit ID, or a global address ID of "00".

To control the outputs a message must be received that matches the unit ID with a suitable control code sequence (Salcom relay control protocol). The received message must also be the expected baud rate (512 or 1200) and format (alphanumeric or numeric).

A mono-shot timer can be set for the relay allowing it to open automatically after being closed. This timer can be set to between 1 seconds to 65535 seconds (in 1 second steps). Setting the relay mono-shot timer to 0 results in the output remaining latched until a message is received to change its current state.

The 12-90 can be configured to respond to up to 4 different cap code ranges. Messages will only be decoded (and outputs controlled) if the message address falls within a configured cap code range.

### Transmitter Operation

The 12-90 can transmit 3 types of POCSAG message, with any one of 4 function levels:

- Alphanumeric transmissions. Message can contain any alphanumeric 'ASCII' character.
- Numeric transmissions. Message contains only Numeric characters and some symbols.
- Tone Only transmissions (Alphanumeric or numeric with no message)

**Alphanumeric transmissions:** Messages can contain any alphanumeric character. The 12-90 will accept the standard ASCII 7 bit character set.

**Numeric transmissions:** Messages can contain numeric characters and some symbols. These can convey a telephone number, or other numerically coded information. Since the transmitted message is shorter, there is less chance of errors being received by the pager.

The numeric character set is as follows: **0 1 2 3 4 5 6 7 8 9 [ ] - U <space>**

**Tone Only transmissions:** Any numeric or alphanumeric paging message without an actual text message is also considered 'Tone Only'. A function level will control the number of beeps on the receiver (four different function levels can be sent).

### Initiating a Transmission

Paging messages may be initiated from:

- Change in input state.
- Periodic message timeout.
- Salcom protocol message accepted from the serial port.
- Reception and retransmission of a message when configured as a store and forward repeater.
- Reception of a relay control protocol packet configured to trigger input, periodic messages or received signal strength messages to be transmitted.

## Salcom Protocol

Serial messages can be sent to the serial port as a subset of Salcom protocol using a 12-45 serial lead.

Cap codes should be within the range of 0000008 and 2000000. Message payload should not exceed 73 characters in length.

### **Alphanumeric Message Example:**

To send the message of "Test Message" to cap code 1234567 beep level 1 at 512 baud.

**CA1234567<SPACE>1<SPACE>Test Message<CR>**

To send the message of "Test Message" to cap code 1234567 beep level 1 at 1200 baud.

**ca1234567<SPACE>1<SPACE>Test Message<CR>**

### **Numeric Message Example:**

To send the message of "01109" to cap code 1234567 beep level 1 at 512 baud.

**CN1234567<SPACE>1<SPACE>01109<CR>**

To send the message of "01109" to cap code 1234567 beep level 1 at 1200 baud.

**cn1234567<SPACE>1<SPACE>01109<CR>**

If successfully queued for transmission the 12-90 will report:

**CA12345671<CR>** (if Alphanumeric 512 baud) or

**ca12345671<CR>** (if Alphanumeric 1200 baud)

Many messages may be sent to the 12-90 at once without waiting for the transmission to complete. These are added to a batched paging transmission. This is the most efficient method to quickly transmit messages.

If successfully transmitted the 12-90 will report:

**<SPACE>Page Sent<CR>**



## Output Control

The relay and outputs are controlled using Salcom relay control protocol (see Relay Control Protocol below).

The 12-90 will look for the relay control protocol embedded anywhere within the message payload, so will cope with messages like "Main Door Open 01109" or "02112378987 01109".

**Relay Control Protocol:** Relay commands take the form IIC0X9 where:

II is the 2 character unit ID, C is a variable number of relays to close (1-8). 0 marks the end of relays to close, X is a variable length list of relays to open (1-8). Commands are always terminated by a 9. A red LED will display on the PCB showing when the relay is closed.

e.g.

- 23109 Will only address a unit with matching ID 23. Relay will be closed. No other action taken.
- 231509 Will close relay and virtual output 5 on a unit with the ID of 23.
- 230159 Will open relay and virtual output 5 on a unit with the ID of 23.

## Virtual Outputs and Control

Virtual outputs are used to invoke 12-90 actions remotely. These actions include control over triggering of inputs and periodic messages. Virtual outputs can be used to return information about the last received message, such as the received signal strength and checksum information.

Virtual outputs are addressed in exactly the same fashion as the on board relay.

The following examples assume a unit ID of 23.

Control Message	Function
23109	Close on board relay
23019	Open on board relay
23059	Trigger Input 1 high message to be transmitted
23509	Trigger Input 1 low message to be transmitted
23069	Trigger Input 2 high message to be transmitted
23609	Trigger Input 2 low message to be transmitted
23709	Trigger periodic message to be transmitted
23079	Trigger the unit ID, message length and checksum to be transmitted. A message of "CA1234560 2 test 01079" will result in unit 01 responding with "010A02E1" where first 2 digits are the responding unit ID, the second 2 digits are the message length in hex, the last 4 digits are the message checksum in hex. The length and checksum are calculated over the message payload "test 01079". The checksum is the sum of each ASCII value in the message (e.g. 116+101+115...). The responding unit will use the same cap code as used by the "serial pass-through" mode of operation.
23089	Perform a system reset
23809	Trigger received signal strength message to be transmitted. This is the signal recorded when this message is received. This feature is valuable for checking system health or for initial system configuration. This message is transmitted to the first cap code programmed in the first cap code range.  The first 2 characters of the returned message is the unit ID of the responding unit.  Returned example message will be: 01:-87dBm.

23409	<p>Trigger received signal strength message to be sent to SERIAL PORT - but not transmitted.</p> <p>Serial port message will be: caNNNNNNN 1 01:-87dBm. Where N is the first Cap code specified in the first Cap range and 01 is the ID of the responding unit.</p>
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## Message Acknowledgement

Using a virtual output a message can be automatically acknowledged. If both source and destination are 12-90 units then this is very easy to implement. With systems using a 12-90 as an endpoint, systems can be configured with absolute certainty of delivery without corruption.

**Example 1:** To acknowledge a message that has been transmitted to a 12-90 (unit ID 23). In this example, the user wishes to have acknowledgement when a particular message is received by the 12-90.

The user transmits:

**CA1234567<SPACE>1<SPACE> Pump Failed 23069<CR>**

When the message is received by the 12-90 a virtual output is controlled which triggers the input 2 high message. The input 2 high message has been previously programmed to be:

**CA1234560 4 Message Acknowledged<CR>**

**Example 2:** The user wishes to control the relay at a destination 12-90 unit and wishes to acknowledge when this output has closed. A simple back to back telemetry system can be implemented driven from automatic acknowledgments.

The system has 2 12-90s, unit ID 23 and 24. When input 1 on unit 23 is closed the user wishes the relay on 12-90 unit ID 24 to close. When the relay has closed on unit 24 the user wishes the relay on unit ID 23 to close as well to mirror the controlled relay state:

Unit 23:           The input 1 low message is configured as           **CA1234567 1 240169**

                          The input 1 high message is configured as           **CA1234567 1 241609**

The configured messages for unit 23 closes both the physical relay and triggers the virtual output that transmits configured input 2 messages.

Unit 24:           The input 2 low message is configured as           **CA1234567 1 23019**

                          The input 2 high message is configured as           **CA1234567 1 23109**

(NOTE: Input 2 is not used on this unit)

**Example 3:** The user wishes to deliver any message to the 12-90, and have absolute confidence that the message was received without corruption.

The user sends the message "test" to unit id 01:

**CA1234560 1 test 01079<CR>**

The virtual output control code "01079" must be added anywhere into the message. This will trigger unit 01 to respond with:

**010A02E1<CR>**

If the unit ID, message length and checksum match that of the transmitted message, then the message has been received, and does not need to be re-transmitted. (See “Virtual Outputs and Control” for more information.)

## Serial Pass-through

The 12-90 can be used to pass raw serial between 12-90 units to form a simplex back to back serial link using a 12-45 serial lead. The serial can be passed to many destinations at once. This mode is well suited as a cost effective link between Salcom 12-76 telemetry units.

The serial mode must be first configured to be '2'. Since the cap code and paging information is not supplied this is taken from the first cap code specified in the first cap code range. The performance of the serial link can be improved considerably by using a cap code that is divisible by 8 - such as 1234560. This cap code must match both the source and destination units. The RX mode must be set to A1200 (auto set when option is enabled). In this mode if configuration changes need to be made the first character after cycling the power must be the '+' character, preventing accidental configuration changes by random commands.

Connection speed at source and destination is 9600:N:8:1 but internally the speed is set to the paging transmission speed (1200 baud by default). Some message buffering is possible (100 characters) but continued transmission at 9600 will result in data loss. The message "BUSY" will be returned from the 12-90 when there has been a buffer overrun.

Serial data is transmitted immediately (if the channel is clear) after a carriage return, or after 100ms of serial inactivity. Only ASCII characters between 0x01 and 0x7f can be transmitted.

Benefits:

- Serial broadcast to many units simultaneously is possible.
- Serial data is packetized and contains bit error correction information which may outperform traditional radio modems in noisy environments.

## Serial Messages

The following messages may be seen during normal operation.

Startup Message:

**SALCOM 12-90 V1.21<CR>**

Error Messages:

**BUSY<CR>**

Transmission queue is full. Try again later.

**Q FULL<CR>**

When configured as a store forward unit the received message was dropped because there was no message queue space available.

Information Messages:

**CHAN BUSY NN<CR>**

Waiting to transmit - there is someone already transmitting on the channel - The 12-90 will transmit when able to. NN provides information as to how busy the channel was.

**DUPL<CR>**

When configured as a store forward repeater this message means that a message has been received and duplicate rejected because there was a message received in the last 40 seconds that was the same.

## Store Forward Repeater Operation

When the store forward repeater option has been enabled the 12-90 will immediately queue messages that have been received for transmission again when possible.

When used as a store forward repeater each store forward repeater should have a unique unit ID. Changing the unit ID results in a varied pre-transmission delay that prevents multiple store forward units from all transmitting at the same time. Although the 12-90 checks the channel if busy before transmission, if the unit ID is the same all units believe that the channel is clear at exactly the same time which may result in message collisions.

A duplicate message check is performed when in this mode that prevents any same message that has been received in the last 40 seconds from being retransmitted. This prevents the possibility of messages bouncing back and forwards between units. The duplicate message reject functionality is also applied to messages received via the serial port.

Transmissions are timed when configured as a store forward repeater. A lock out period equal to the last transmission time prevents any further transmission attempts until the next store forward in the chain has had time to clear the next message (together with channel busy checking).

Store forward units must all be configured to be the same baud rate and message type.



## Configuration

All serial commands are sent and received using a standard terminal application connected at 9600:N:8:1 using a 12-45 programming adaptor.

Sending MAP<CR> to the 12-90 will display current configuration information.

```
+01 Unit ID: 01
+02 Freq: 458600000
+03 RX Mode: A512
+04 Relay Monoshot: 0
+05 RIC Range 1: 1234567,1234567
+06 RIC Range 2: 0000000,0000000
+07 RIC Range 3: 0000000,0000000
+08 RIC Range 4: 0000000,0000000
+09 Store Forward Mode: 0
+10 WDog Timeout: 0
+11 In Debounce: 4
+12 In Tx Count: 1
+13 In Resend Delay: 5
+14 In 1 Hi Msg: CA1234560 1 Input 1 High
+15 In 1 Lo Msg: None
+16 In 2 Hi Msg: None
+17 In 2 Lo Msg: None
+18 WDog Msg: None
+19 Serial Mode: 1
```

**Unit ID:** The unit ID is used to uniquely address a unit to control outputs. The unit ID must be 2 characters. If numeric decoding is specified, then the unit ID must be between 00 and 99. If alphanumeric decoding is used then any printable character can be used as part of the unit ID allowing for approximately 8000 possible addressing codes. The unit of '00' can also be set, but is also used as a group address code.

Typical usage: **+01=01<CR>**

**Freq:** This is the receive and transmit frequency. This parameter should be programmed to be between 440000000 and 479000000 and must be specified in Hz.

Typical usage: **+02=458600000<CR>**

**Mode:** The mode primarily determines the receiver mode of operation. Possible settings are A512, A1200, N512 or N1200. 'A' specifies alphanumeric operation. 'N' specifies numeric operation. 512 and 1200 specifies the receiver decode baud rate.

Typical usage: **+03=A512<CR>**

**Relay Mono-shot:** If specified, the mono-shot will open the relay after the relay has been closed for the configured mono-shot period. Setting the relay to 0 results in latched operation (mono-shot timer not operating). The timer can be set in 1 second increments to a maximum of 65535 (approx 18 hours). When configured, timeout is rounded up to closest second (setting to 1 second will result in a mono-shot of 1-2 seconds).

Typical usage: **+04=0<CR>**

**RIC Range:** Up to 4 receiver decode ranges can be specified. If all 4 RIC ranges are set to 0, the unit will not operate as a receiver. The first parameter of each range, when non zero, must not be greater than the second parameter. Each parameter should be between 0000008 and 2000000. All 7 digits must be specified. The first and second parameter can be set to the same code if only a single code is required.

Typical usage (to decode all messages for addresses between 1234560 and 1234567):

**+05=1234560,1234567<CR>**

**Store Forward Mode:** When set to 1 the store forward repeater operation is enabled. In this mode of operation a 40 second duplicate message reject timer is enabled. All received messages are immediately queued for re-transmission when the channel is not busy.

In this mode each transmission is timed, preventing the transmission of any newly queued messages until a period equal to the last transmission has elapsed (to give any downstream repeaters a chance to pass the message on again). In store forward mode a pre-transmission delay is applied that varies based on unit ID.

This delay ensures that if multiple repeaters receive a message simultaneously they will not check if the channel is busy at exactly the same time (which may result in more than one repeater transmitting at the same time, possibly corrupting the message).

Typical usage: **+09=1<CR>** (1=enable, 0=disable)

**Wdog Timeout:** This parameter defines how often to transmit the Wdog periodic message (if configured) in seconds. If this parameter is set to 0 the Wdog periodic message is disabled. If to be enabled, this parameter should be set between 10 and 65535.

Typical usage: **+10=0<CR>**

**In Debounce:** This is the period that an input must be settled for before transmitting a message (if configured) for that input. The debounce period is programmed in 25mS increments. The input debounce can be set between 25mS and 27minutes (0-65535).

Typical usage (to set a debounce time of 100mS): **+11=4<CR>**

**In Tx Count:** When an input is triggered (and input message configured) this parameter defines how many times the input message is transmitted. Setting to 0 prevents any input messages from being transmitted. This parameter can be set between 0 and 9.

Typical usage: **+12=1<CR>**

**In Resend Delay:** When the In Tx Count has been configured to be more than 1 then the resend delay is the delay in seconds before the triggered input message is transmitted again.

**In Hi/Lo Msg:** This message must be a valid Salcom protocol message in order to be used. Setting these parameters to anything other than a Salcom protocol message will result in no message being transmitted. Setting to an invalid message such as "None" effectively disables the message from being sent. Any input message cannot be programmed to be longer than 40 characters.

Typical usage (to send to RIC 1234560 beep level 1 Alphanumeric 512 baud when input 1 transitions to low):

**+15=CA1234560 1 Input 1 Low<CR>**

**Wdog Msg:** This is the periodic message that when configured is transmitted when the Wdog timeout expires. This message must be configured in the same manner as the input messages. This message will not be sent if the Wdog timeout is configured to be 0.

Typical usage (to send to RIC 1234560 beep level 1 Alphanumeric 512 baud):

**+18=CA1234560 1 Periodic Message<CR>**

**Serial Mode:** This mode configures serial options. When set to 1 this is the default "verbose" serial mode. In this mode serial information is displayed when the channel is busy (CHAN BUSY) and if acting as a store forward repeater will show when a message has been duplicate rejected (DUPL).

When set to 0, CHAN BUSY and DUPL messages will be suppressed - this allows greater compatibility with other Salcom transmitter products.

When set to 2 the 12-90 enters the serial passthrough mode of operation.

Typical usage: **+19=1<CR>**

## Technical Specification

<b>Technical Specification</b>	
<b>12-90-0000 - UHF Transceiver and Store &amp; Forward Repeater</b>	
Frequency Range	440-479MHz - UHF <i>Note: Custom 433MHz model available on request</i>
Frequency Selection	User configurable
Power Supply	+13.8V typical (11 to 15 VDC range)
Power Consumption	Standby: 33mA Transmit: 150mA
Transmit Power	60mW
Channel Spacing	10kHz, 12.5kHz
Modulation	FSK with NRZ data
Deviation	±4.5kHz
Receiver Sensitivity	Approx -125 dBm
Receive Bandwidth	10kHz (suitable for 12.5kHz channel operation)
Baud Rates	512, 1200
Message Format	POCSAG
Configuration Application	Salcom Configuration Tool
Programming Cable	12-45-0000 (RJ12 to DB9) Can be used with a USB to RS232 DB9 Serial Adapter Cable
Serial Port	9600 , N, 8, 1; RS232
Serial Protocols	Salcom
Discrete Inputs	2 (Ground activated)
Discrete Outputs	1 Relay Contact (1A @ 24VDC) <i>Note: Not suitable for 240VAC Connections</i>
Connectors	Serial Port (RS232) = RJ12 (6P6C) Inputs / Relay Output = RJ45 (8C)
Power Connector	2-way plug & socket, screw connections (supplied)
RF Connector	50Ω BNC
Environmental Protection	Not suitable for outdoor use and should be protected from adverse environmental conditions
Operating Temperature	-10°C to +50°C (+14°F to +122°F)
Indicators	Power LED (Green) - Flashing (1s Freq) = Normal Operation Status LED (Red) - On = Transmitting - Flashing = Error Condition
Weight	178g
Enclosure Dimensions	70mm x 100mm x 30mm (WxDxH)
Enclosure Material	Extruded aluminium
Colour	Matt black
Type Approvals	AS/NZS 4769.1:2000 + Amendment 1:2002 (RF) EN 300-224-2 (RF) FCC CFR47 Part 90 (RF) FCC CFR47 Part 15 (EMC)



EN 301 489-2 V2.1.0 (EMC)  
EN 60950-1:2006 (Safety)

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