



12-76-0000
TELEMETRY UNIT



**USER'S
MANUAL**

SALCOM 12-76-0000 TELEMETRY UNIT

1. DESCRIPTION

The 12-76 offers 8 digital and 8 analog (variable) inputs with 8 digital and 2 analog outputs. While it has hundreds of applications, it is primarily used in low level SCADA systems, building monitoring and security, irrigation and pumping control, sewerage, industrial and agricultural systems. The 12-76 operates over conventional radio systems, data circuits, cellular or voice grade landline circuits depending on options as below.

The 12-76 is a versatile telemetry module. It has one dedicated serial port provided for connection to external equipment at RS232 levels. In addition to this there is provision to plug in a range of modules providing compatibility with a range of communications devices.

- Option 1:** The Modem module allows direct connection to all SALCOM Radios, and may be connected to other brands, so long as suitable AUDIO IN, AUDIO OUT, PTT and BUSY connection points are available.
- Option 2:** The serial module provides an additional serial port to RS232 specifications.
- Option 3:** The spread spectrum radio module provides UHF communication between 12-76 units or other compatible devices without the need for an external radio device.
- Option 4:** A Salcom 12-18 five tone encoder/decoder can be used to control inputs from radio networks using five tone sequential signalling.

The digital and analog I/O ports are controlled via a central processing unit that also provides a rugged electrical interface to a radio or landline circuit.

TYPICAL APPLICATIONS

- 1.1 Back-to-back:** A typical application for the 12-76 is to operate in a master/slave configuration for point-to-point systems.
- 1.2 Point-to-multipoint in Network Mode:** For multiple outstation systems, multiple slave units report back to a central location where control system software provides the base supervisor with a modern computer based graphical interface. Since such software is usually proprietary it is generally developed to the customer's specification.
- 1.3 Cellular phone data as SMS Access**
- 1.4 Custom-made solutions**

2. EXTERNAL CONNECTIONS

Access to the Power terminals and I/O ports is via externally accessible screw-less terminals. A 9 pin female D9 socket is wired DCE for RS232 serial communication. All other connections depend on options fitted.

2.1 Connections

RS-232 Connector: D9 Female This is a standard RS-232 socket, wired DCE. Connection to a PC computer is achieved using a standard (straight through) serial cable.

Pin 1	.....	N/C
Pin 2	.....	TXD
Pin 3	.....	RXD
Pin 4	.....	N/C
Pin 5	.....	Ground
Pin 6	.....	N/C
Pin 7	.....	N/C
Pin 8	.....	N/C
Pin 9	.....	N/C

Option 1: Internal Modem - D15 Female.

Pin 1	.....	GND
Pin 2	.....	RX Audio (input from receiver)
Pin 3	.....	TX Audio (Audio to Transmitter)
Pin 4	.....	N/C
Pin 5	.....	PTT (O/C to ground 300mA, with diode spike protection)
Pin 6	.....	N/C
Pin 7	.....	Busy input from Mute, low to enable (needs pullup to disable)
Pin 8	.....	N/C
Pin 9	.....	N/C
Pin 10	.....	N/C
Pin 11	.....	Balanced audio in/out (for connection to)
Pin 12	.....	Balanced audio in/out (cable, T/P, LDC)
Pin 13	.....	N/C
Pin 14	.....	N/C
Pin 15	.....	N/C

Option 2: RS-232 Connector - D9 Male

Pin 1	.....	N/C
Pin 2	.....	RXD
Pin 3	.....	TXD
Pin 4	.....	N/C
Pin 5	.....	Ground
Pin 6	.....	N/C
Pin 7	.....	N/C
Pin 8	.....	N/C
Pin 9	.....	N/C

Option 3: Onboard radio - 1 x SMA female socket.

3. INPUTS AND OUTPUTS

3.1 DIGITAL INPUTS

Eight digital inputs are provided. These are buffered and have pull-ups to 12V with a series input resistor, which results in approx 10 volts appearing on an un-terminated input. Each input is activated by pulling to ground via a switch, open collector, open drain, etc. When grounded each input will source approx 2.4 milli-amps. These inputs are tolerant of +15 volts DC.

3.2 DIGITAL OUTPUTS

8 digital outputs are provided. These are each one pair of dry relay contacts (just a switch).

The relay contacts can handle 1 Amp at 24 Volts DC. Greater loads can be controlled, by using the output to switch a relay with a higher rating. MAINS VOLTAGES MUST NOT BE APPLIED! Each relay has an LED to indicate its state. When the LED is illuminated, the relay contacts are closed.

3.3 ANALOG INPUTS

Eight analog inputs are provided only two of which can be used in the back-to-back mode. Up to 20 Volts may be applied to these inputs, the associated trim-pot is then adjusted to provide the required reading from the A to D converter. 5 volts will provide a full scale reading on inputs 1 and 2, and 20 volts on inputs 3 to 8 will provide a full-scale reading.

When used 'back to back' with the analog outputs of another 12-76, only inputs 1 and 2 are used, with a resolution of 10 bits (1024 steps).

3.4 ANALOG OUTPUTS

Two analog outputs are included. When used with another 12-76, these reflect the state of inputs 1 and 2 on the remote unit.

4. POINT-TO-MULTIPOINT OR NETWORK MODE

Several remote sited units may be controlled and monitored by a PC based software program.

Each remote unit is allocated a unique address (01-FF Hex). Demonstration software is available which allows addressable access to each unit, and provides a graphical display of the unit in question. Network applications invariably require custom software. For those qualified we can provide the source code of the demonstration software to assist with further development.

Analogue inputs 3 to 8 are intended for use with a PC based program. These inputs are calibrated to achieve full span of the 10 bit ADC (0-1023 counts), with an input of 20 volts. The user may adjust these to any convenient value from 0 - 24 volts full span, they will of course need to deal with the readings in their software.

The yellow PTT LED will indicate when the unit is transmitting. The yellow AUX LED will normally be in a flashing state (1 sec) to indicate the unit is functioning.

5. BACK-TO-BACK MODE

In this configuration, the two 12-76 units are programmed with each other's address.

Any change in the status of the inputs on either unit, will initiate a transmission to the other unit, which is acknowledged immediately. By this method, the outputs on each unit will mimic the inputs of the other.

As there are only two analogue outputs available, these are mapped to the first two analogue inputs on the remote unit (Analogue 1 & 2). These first two inputs are factory calibrated for a 0-5 Volt input to match the 0-5 Volt remote outputs

The remaining analogue inputs are intended for use with a PC based program.

As an option a special 12-14 output module offering a pair of 4.20 milliamp outputs is available.

Setup mode can be accessed by sending ### to the built-in serial port at any time during operation.

To indicate that the unit is in setup mode, the AUX LED will flash rapidly. During normal operation the AUX LED flashes slowly (1sec clock).

While in setup mode, all incoming messages will be ignored, except the setup commands on the built-in serial port. Also no packets will be sent out and all the timers, I/Os and events of the normal state-event machine are stopped.

An automatic return out of the setup mode and restart will be implemented if there is no incoming data on the built-in port for more than 10min.

5.1 BACK-TO-BACK MODE CONFIGURATION

Entering setup mode:

- (1) Connect the 12-76 serial port to a computer running terminal software set to 9600 baud, No parity, 8 data bits and 1 stop bit (9600,n,8,1).
- (2) Apply power to the 12-76.
- (3) The 12-76 will send its sign on string;

SALCOM 12-76 SE Telemetry Unit

Firmware version 1.10
Point-to-Point Mode
My local address: 78 Remote address: 01
Date: 06.11.06 Time: 08:32:16

- (4) Send # # to the 12-76 with the terminal software.

- (5) The setup menu will now be displayed;

SALCOM 12-76 SE Telemetry Unit
Firmware version 1.10, built 10/06 ss

12-76 Setup Menu:

0: Set time and date
1: Set local address
2: Set remote address
3: Set poll time
4: Set comms failure timeout
5: Set plug-in board (incl. Busy phase & Lead-in delay for modem)
6: Set low battery
7: Set debounce times of DIG IN
8: Set thresholds of ANA IN
9: Exit setup mode

Please select a menu point (0-9) to edit it:

- (6) Press the relevant number to change the settings as described below:

5.1.0 Date and time:

- ! The date and time can be set for the onboard real-time clock.
- ! The 12-76 will display the current date and time and prompt for any changes.
- ! The clock is a 24-hour clock and requires times to be entered in that format.

5.1.1 Remote and Local addresses:

The local address is the identification number of the unit. The remote address is the identification number of the unit that this unit talks to.

In order to get two units to talk to each other they must have their own ID number as the remote address in the Other unit, for example: Two units are set up one with ID 01 the other ID 02, the remote and local addresses would be set as follows:

Unit ID	Local Address	Remote Address
1	1	2
2	2	1

5.1.3 Poll time:

This is how frequently the unit will send the status of its inputs without any inputs changing. Only ONE of the units should be set to poll. The polled unit will respond with its status automatically.

The poll time is anywhere from 1 to 255 minutes. Enter the polling rate required. Setting 0 minutes prevents the unit from sending a poll however it will still respond to polls from the other unit.

5.1.4 Comms failure timeout:

This feature is set to allow the user to detect when the communications link between units has failed. Upon a communications failure being detected the unit will close digital output 7. Digital output 7 will remain closed until the communications link is detected again.

The feature is normally used with the Poll feature. The time for a communications failure MUST be greater than the time set in the Poll.
When using this feature **do not** use digital input 7 on remote unit.

The communications failure timeout can be from 1 to 255 minutes. Setting the timeout to 0 disables the feature on the unit.

5.1.5 Plug in Board:

There are three options for plug in board displayed by selecting option 5 as follows:

Current plug-in board is: RS-232 Serial board

Enter 0 for: RS-232 Serial board

Enter 1 for: 922MHz transceiver board

Enter 2 for: 1200Hz FSK Modem board

or just press ENTER to keep the current board.

If the 1200Baud FSK Modem is selected then another option is available for setting the phase of the busy signal

Current busy phase for the modem board is: active LOW

Enter 'H' to set the busy phase to active HIGH

Enter 'L' to set the busy phase to active LOW

or just press ENTER to keep the current busy phase.

NOTE: If the busy phase is set to active low then the input signal from the radio must have a pull-up resistor to force the input high when the mute/busy is closed.

Once the busy phase is set the PTT Lead-In Delay will need to be set, this will be displayed as below:

Current PTT Lead-In delay is: 200 ms

Enter the new value in milliseconds from 0 to 2500 (0ms to 2.5sec) in 10ms STEPS or just press ENTER to keep the current value.

5.1.6 Low Battery:

Enabling low battery will make the unit close the contacts on digital output 8 when the supply voltage falls below 11.2 volts. Digital output 8 contacts will be opened when the supply voltage is restored to above 11.2 volts. When using this feature ***do not*** use digital input 8 on remote unit.

5.1.7 Set De-Bounce times of Digital In:

Each input has a configurable debounce timer, selecting option 7 displays the following menu:

Current debounce times for digital inputs DIG IN:

DIG IN 1: 200ms
 DIG IN 2: 200ms
 DIG IN 3: 200ms
 DIG IN 4: 200ms
 DIG IN 5: 200ms
 DIG IN 6: 200ms
 DIG IN 7: 200ms
 DIG IN 8: 200ms

Press 1 - 8 to edit the debounce time of one of the inputs
 or just press ENTER to keep the current values and return to the main menu.

Selecting an input allows the debounce to be set to suit:

Current debounce time of DIG IN 1 is: 200ms
 Enter the NEW value for the debounce time of DIG IN 1
 The value can be from 0 to 25500 (= 0ms to 25.5sec) in 100ms STEPS

5.1.8 Set Thresholds of Analogue In:

This determines how much of a change in voltage on an analogue input is required to initiate a transmission. The value is entered as a percentage of the full scale of the analogue input.

Current thresholds for analog inputs ANA IN:

ANA IN 1: 10%
 ANA IN 2: 10%
 ANA IN 3: 10%
 ANA IN 4: 10%
 ANA IN 5: 10%
 ANA IN 6: 10%
 ANA IN 7: 10%
 ANA IN 8: 10%

Press 1 - 8 to edit the threshold of one of the inputs
 or just press ENTER to keep the current values and return to the main menu.

Factory defaults: Inputs 1 and 2 are set to a 5V scale, inputs 3 to 8 are set to a 20V scale. The default analog input change to trigger the 12-76 to volunteer its status when used in the back-to-back mode is 10% of full scale.

Setting the A to D TX span to 10 will mean that a change in voltage of 10% of the full span voltage (0.5 V for inputs 1 or 2 and 2V for inputs 3 to 8) will initiate a transmission.

Setting the A to D TX span to 0 prevents the unit from initiating a transmission on a change of status on an analogue input.

Some examples follow:

A to D TX Span	5V Input (1 or 2)	20V Input (3 to 8)
1	0.05 V	0.2 V
5	0.25 V	1 V
10	0.5 V	2 V
20	1 V	4 V
25	1.25 V	5 V

5.1.9 Exit setup and run:

After setting the values to those required press 9 and the unit will send 'System Active' and the AUX led will start to flash at 1 second intervals. This indicates normal operation.

6. PROTOCOL AND COMMAND SET

The 12-76 communicates using readable ASCII characters. These are invisible to the user in back to back mode, as the units' converse directly over the radio, or wire link. However all commands which are received or sent by the 12-76 are echoed out the serial port at 9600,N,8,1, for diagnostic purposes.

When used back to back, the 12-76 will volunteer its status whenever a digital input changes state, or whenever an analogue input changes by a preset amount (default is 10% of full scale, see setup).

The information is sent as a packet of data, containing the source and destination addresses, and the state of all inputs and outputs, not just the values that have changed. The destination unit receives this and updates its outputs, it then responds with an acknowledgment packet, which also contains all information relating to the remote unit. This ensures that whenever the two units converse, all data is current.

If the Poll value is set to a value greater than zero (see set-up), a 12-76 will volunteer its status at preset intervals even if no changes occur. A Poll value set to one will initiate an automatic poll every minute. The time between polls can be set to a maximum of 255 minutes. Generally one unit of a pair would be set to poll every minute or so, the other unit would be set to zero (no poll). If nothing else, this ensures that a dialog is initiated at switch-on time, and that the state of both units is known, even if no changes occur immediately.

6.1 The command set for Point-to-Point Mode is as follows.

When a unit sends its data in back-to-back mode the start character is a \$ sign which allows the command to be recognised as requiring an acknowledgement.

- ! Unit 01 sends to Unit 05
\$050100200108021004010010560000023408761001255128 <cr>
- ! Unit 05 replies
%0105255002002302351004045608761023037540371255128 <cr>
- ! Unit 01 receives its status and recognises that it is an acknowledge and does not reply, to prevent lockup.

6.2 The command set for Network (PC) Mode is as follows.

In network mode, the 12-76 units respond to shorter commands, ie. activate relay 1, or set analogue output 1 to 3.2 Volts.

Query remote only, with no changes

!FF0000 <cr> or !FF<cr>
where FF = address of remote (01 - FF Hex)

Set a voltage level on remote Analogue output 1

&FFAAAA <cr>
where FF = address of remote (01 - FF Hex)
where AAAA = value to pass to DAC (0000 - 1023)
00= 0 volts, 512 = 2.5 volts, 1023= 5 volts

Set a voltage level on remote Analogue output 2

*FFAAAA <cr>
where FF = address of remote (01 - FF Hex)
where AAAA = value to pass to DAC (0000 - 1023)
00= 0 volts, 512 = 2.5 volts, 1023= 5 volts

Clear a remote digital output

@FF0007 <cr>
where FF = address of remote (01 - FF Hex)
where 7 = bit to clear 0 - 7

Set a remote digital output

FF0007 <cr>
where FF = address of remote (01 - FF Hex)
where 7 = bit to set (0 - 7)

Clear a remote digital output. BYTE

+FF0022 <cr>
where FF = address of remote (01 - FF Hex)
where 22 = byte to clear

6.3 Acknowledge packet

On receipt of a valid command from the PC or another 12-76 the unit will reply with the following.

%DDSSAAABBB11112222333344445555666677778888XXXXYYYYSS<cr>

Description of the 12-76 response string

Character: %

Start Character, shows it is an acknowledge packet, does not require an acknowledgement

Characters: DD

Destination address (01 - FF Hex)

Characters: SS

Source address (01 - FF)

Characters: AAA

Decimal representation of the input byte at the remote (000 - 255)

Characters: BBB

Decimal representation of the output byte at the remote (000 - 255)

Characters: 1111 .. 8888
Decimal representation of remote analogue inputs 1-8, (10 bit, 0000 - 123)
Characters: XXXX
Decimal representation of the 8 bit D to A register for remote analogue Output 1. (0000-1023 ; equ. 0 - 5 volts)
Characters: YYYY
Decimal representation of the 8 bit D to A register for remote analogue Output 2. 0000-1023 ; equ. 0 - 5 volts
SS
Checksum of the data packet
<cr>
Carriage return character ASCII 13

7. SPECIFICATIONS

Inputs & Outputs	8 Digital Inputs 8 Digital Outputs 8 Analog Inputs 2 Analog Outputs	1 Amp @ 24 volts DC up to 20 volts adjustable 0 to 2.5 volt or 0 to 25 volt 4 to 20 mA driver available (Salcom 12-14)
Resolution	10 Bit	
Signalling	See "SIGNALLING/MODULES AVAILABLE" below	
Current drain	@13.2 volts per active relay per active input	50 mA 30 mA 3 mA
Custom Applications	32 Kilobytes of non-volatile FRAM of which 20 Kilobytes are available for custom applications	
Dimensions	193 mm x 113 mm x 50 mm	
SIGNALLING/MODULES AVAILABLE		
Salcom	12-76-1000 12-76-2000 36-40-0922 12-18-0000 19-29-0000 19-30-0000 19-31-3600 11-76-4000	Additional RS232 serial port module Modem Module - AFSK 1200 baud 922 MHz Spread Spectrum decoder module 5 Tone encoder/decoder module C.D.M.A. Cellular modem G.S.M. Cellular modem UHF transceiver/modem I/O extender (adds 40 mixed ports)

8. WARRANTY

Our Products are warranted for a period of 12 months from 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 unauthorized alterations or repairs will invalidate the warranty.

9. DISCLAIMER

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

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**12-76-0000 TELEMETRY UNIT
CONNECTIONS**