

FC-900 Interface Manual

for RC-850 Repeater Controller

Introduction

The FC-900 Interface connects ACC's repeater controller products to the ICOM IC-900A and IC-901 FM Mobile band units for an easy-to-hook-up remote base or link installation.

The FC-900 provides the hardware interface to the FM band units, replacing the ICOM IC-900A Interface Units A and B or the IC-901 transceiver in this application. In addition, the FC-900 can recover expanded remote control output functions (UF outputs) for the controllers which may be used for antenna selection and other external control functions. The '850 controller implementation supports up to four link / remote base ports using IC-900A/IC-901 band units.

Please note that the FC-900 Interface supports the FM band units only - *not* SSB band units, and *not* the IC-901 internal 2 meter and 440 MHz transceivers.

ICOM IC-900 / IC-901 System Description

The IC-900 Super-Multibander System is a modular mobile transceiver system which provides trunk-mounted rf decks (band units), dash mounted remote controller, and a fiber-optic link with associated interface units.

The IC-901 is an integrated 2 meter / 440 MHz dual band mobile transceiver which may be expanded to other bands by adding band units. The '901 can be "split apart" to allow trunk mounting of the rf modules with wireline or fiber optic connection to the dash mounted controller, similar to the '900.

Available FM band units cover six amateur bands from 29 MHz to 1300 MHz. Continued availability of the 2 meter and 440 MHz band units is unclear, since the IC-901, which replaces the IC-900, has built-in 2 meter and 440 MHz coverage and does not need external band units for these bands.

The IC-900A/901 system architecture supports two of up to six bands active at a time. The main band is available for transmit and receive while the sub band is receive-only ('850 support permits transmit from *both* band units). Cross-band full-duplex operation is permitted, transmitting on the main while receiving on the sub. There are no provisions for in-band full-duplex since band units are half-duplex and are assigned unique bus addresses.

ACC Remote Base Description

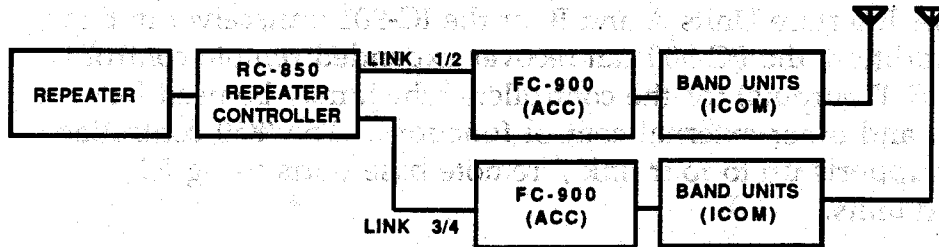
In ACC's remote base application, the ICOM band units are interfaced to the repeater controller through the FC-900 Interface. No additional ICOM interface units are needed. The FC-900 Interface provides the electronic interface to the ICOM internal bus; transmit audio processing including

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pre-emphasis, symmetrical limiting, and level and deviation controls; receive audio processing including squelch pots for each band unit, de-emphasis, and squelch gating; programmable CTCSS encode; and recovery of seven general purpose remote control (UF) outputs.

The controller software is responsible for controlling the internal circuitry of the band units, including the frequency synthesizer and other basic radio functions.

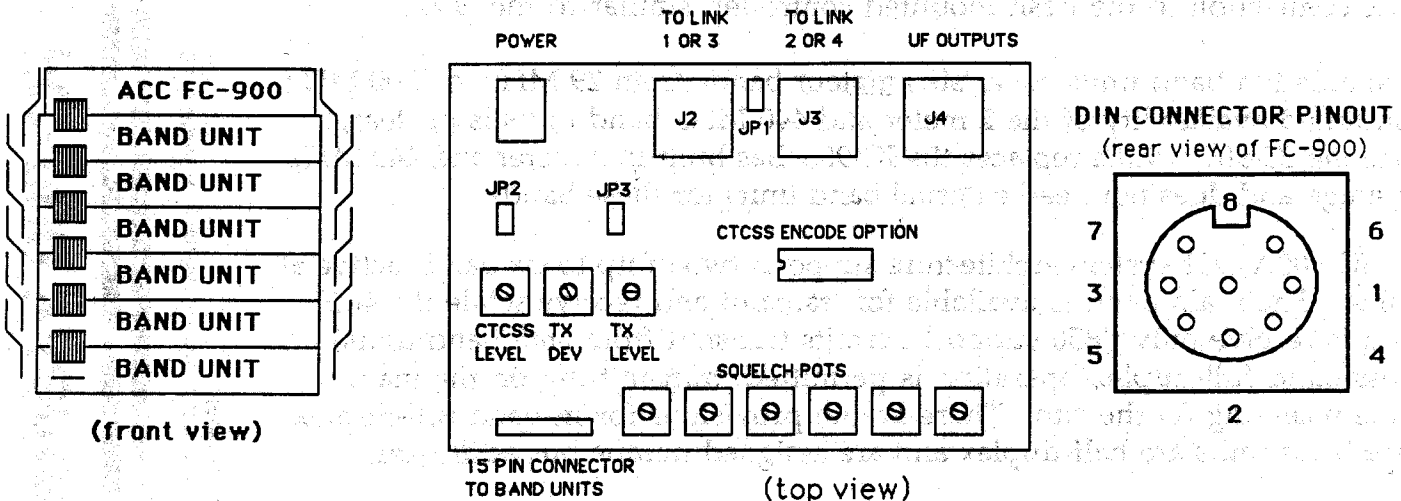
ACC REMOTE BASE SYSTEM DIAGRAM



Mechanical Hookup

The mechanical hookup of the FC-900 Interface is shown below. It mounts on the top of the stack of the available band units and bolts together using mounting brackets supplied with the band units. Use the ACC supplied screws for bolting in the FC-900. The mounting brackets should be configured as shown in the diagram.

The 15 pin cable supplied with each band unit connects it to the band unit mounted above it. The cable from the top band unit connects to the plug in the FC-900. The bottom connector of the bottom band unit does not connect to anything. The band units may be stacked in any order. *No additional mounting brackets or 15 pin jumper cables are needed.*



Power Supply

The ICOM band units operate off +12 volts which must be supplied from a power supply capable of supplying high current on a continuous basis. In addition, the FC-900 requires +12 volts at 25 mA.

Band Units (Power)

The band units are intended to plug into ICOM's Interface Unit B (which you don't have) which has six mating Molex power connectors. Instead, cables which mate to the band unit connectors are available through ICOM dealers. Alternatively, a power bus may be wired using mating Molex connectors or pins. The mating connectors are also available through ICOM dealers.

At most two units (out of six total) may be in transmit. Transmit current ranges from 1.5A (10M low power) to 9.5A (2M 45 watt high power). Refer to the specifications of your band units for details.

The low and high power levels of each band unit are internally adjustable. It may be desirable, depending on the application, air circulation and power available, to back down on one or both power levels (see band unit documentation). If extended high power operation is anticipated, consideration should be given to adding a fan for forced air cooling of the heat sinks. ICOM's CF-11 Cooling Fan Unit is not supported by the FC-900 interface.

FC-900 Interface (Power)

The FC-900 power connector is a barrel jack which is compatible with many wall mount power supplies (center pin positive!). Alternatively, the supplied barrel plug may be wired to your 12 volt power supply.

Connection to Controller

An FC-900 interface can connect either to link ports 1 and 2 or to ports 3 and 4. Two interfaces can connect to both port pairs where four bands need to be active simultaneously.

Connection to the RC-850 controller requires wiring one end of the supplied DIN cables to the controller's digital I/O connector and phono jacks as shown below. (If a single cable is supplied with connectors on both ends, cut the cable in half. Verify wire color vs. pinout with an ohmmeter.) The FC-900 Interface can connect to either Link ports 1 and 2 or to Link ports 3 and 4. Two FC-900 Interfaces can connect to both link port pairs.

Interface to Link 1 and 2 (Controller DIP Switch 4 ON)

<u>J2 DIN Pin #</u>	<u>Color</u>	<u>RC-850 Signal</u>	<u>Connector/Pin</u>
1	black	Link 1 Receiver COS	Digital I/O pin 4
2	brown	Ground	(optional Digital I/O pin 25)
3	red	DATA	Digital I/O pin 11 (formerly RBDATA)
4	orange	STB	Digital I/O pin 19 (formerly L1 PTT)
5	yellow	CLK	Digital I/O pin 6 (formerly L2 PTT)
6	green	Transmitter Audio	TX phono jack
7	blue	Link 1 Receiver Audio	L1 phono jack
8	white	-	-
SHIELD	tinned wire	Ground	Phono jack shield

<u>J3 DIN Pin #</u>	<u>Color</u>	<u>RC-850 Signal</u>	<u>Connector/Pin</u>
1	black	Link 2 Receiver COS	Digital I/O pin 16
2	brown	Ground	(optional Digital I/O pin 25)
3	red	-	-
4	orange	-	-
5	yellow	-	-
6	green	-	-
7	blue	Link 2 Receiver Audio	L2 phono jack
8	white	-	-
SHIELD	tinned wire	Ground	Phono jack shield

Interface to Link 3 and 4 (Controller DIP Switch 5 ON)

<u>J2 DIN Pin #</u>	<u>Color</u>	<u>RC-850 Signal</u>	<u>Connector/Pin</u>
1	black	Link 3 Receiver COS	Analog pin 22
2	brown	Ground	(optional Digital I/O pin 25)
3	red	DATA	Digital I/O pin 11 (formerly RBDATA)
4	orange	STB	Digital I/O pin 22 (formerly L3 PTT)
5	yellow	CLK	Digital I/O pin 10 (formerly L4 PTT)
6	green	Transmitter Audio	TX phono jack
7	blue	Link 3 Receiver Audio	SP1 phono jack
8	white	-	-
SHIELD	tinned wire	Ground	Phono jack shield

<u>J3 DIN Pin #</u>	<u>Color</u>	<u>RC-850 Signal</u>	<u>Connector/Pin</u>
1	black	Link 4 Receiver COS	Analog pin 23
2	brown	Ground	(optional Digital I/O pin 25)
3	red	-	-
4	orange	-	-
5	yellow	-	-
6	green	-	-
7	blue	Link 4 Receiver Audio	SP2 phono jack
8	white	-	-
SHIELD	tinned wire	Ground	Phono jack shield

Jumpers

Jumpers JP1 and JP2 should be cut. (These jumpers allow mixing main and sub receiver audio and COS signals into a single port for use with ACC's RC-85 and RC-96 Repeater Controllers.) Jumper JP3 may need to be removed to increase input sensitivity, but this will not be necessary if transmit audio level from the controller is several volts peak-to-peak as recommended.

Adjustments

Several adjustments must be made after installation. Because the band units must be operating to make the adjustments, it will be necessary to read ahead to learn how to command the transceivers. The adjustments are straightforward to make after the units are turned on.

Squelch Pots – Pots R104-R109 are adjusted for the desired squelch setting when the respective band unit is selected. Bring up the band unit in receive-only and adjust the respective pot (each pot is labeled on the board by band).

Transmit Level – R103 adjusts the level of the transmit audio applied to the limiter in the FC-900. It should be adjusted so that transmit audio just enters clipping (at the cathode of CR5).

Transmit Deviation – R102 determines the amplitude of limited audio applied to the modulators in the band units. It should be adjusted for 3-5 kHz peak deviation.

CTCSS – R101 determines the level of the CTCSS signal applied to the modulator. It should be adjusted for ~800 Hz deviation when a CTCSS tone is selected. The CTCSS Encoder option is required for this feature.

Link Receive Audio Level – Adjust controller pot R111, R110, R109 or R108 respectively for Links 1-4.

DIP Switches

Controller DIP switches must be set properly to accommodate the FC-900 interface.

Link Ports 1 and 2

DIP Switch 4 OFF

BCD Frequency Control

DIP Switch 4 ON

FC-900 Frequency Control

Link Ports 3 and 4

DIP Switch 5 OFF

Fixed Frequency

DIP Switch 5 ON

FC-900 Frequency Control

Command Codes

The following sections describe the repeater controller commands which control the FC-900 interface and band units.

Receive-Only / Transmit / Off

Link 1-4 may be controlled independently. A "*" appended to transmit commands brings the link up in crosslink mode.

(Link Prefix) 1 – Link 1 On Receive Only

(Link Prefix) 7 – Link 3 On Receive Only

(Link Prefix) 2 – Link 1 Receive/Transmit

(Link Prefix) 8 – Link 3 Receive/Transmit

(Link Prefix) 3 – Link 1 Off

(Link Prefix) 9 – Link 3 Off

(Link Prefix) 4 – Link 2 On Receive Only

(Link Prefix) * – Link 4 On Receive Only

(Link Prefix) 5 – Link 2 Receive/Transmit

(Link Prefix) 0 – Link 4 Receive/Transmit

(Link Prefix) 6 – Link 2 Off

(Link Prefix) 9 – Link 4 Off

The link frequencies are selected with the following commands. "mhtof" represents MHz, hundreds kHz, tens kHz, ones kHz, and offset (1/minus, 2/simplex, 3/plus). The * (decimal point) is optional but if omitted the frequency readback is inhibited.

(Link Prefix) 1 (m*htof)

Link 1 Frequency

(Link Prefix) 4 (m*htof)

Link 2 Frequency

(Link Prefix) 7 (m*htof)

Link 3 Frequency

(Link Prefix) * (m*htof)

Link 4 Frequency

Band Selections

Users may select the desired band segment for Link 1-4. The band segment definition includes optional transmit offsets and legal frequency ranges. Selecting a band also turns the link on in receive-only mode.

(Link Prefix) 1 x * Link 1 Band Select
 (Link Prefix) 4 x * Link 2 Band Select
 (Link Prefix) 7 x * Link 3 Band Select
 (Link Prefix) * x * Link 4 Band Select

X	"Band"	Rx Frequency Range	Tx Offsets	Tx Frequency Range*	Band Unit
0	1240	1240.000 - 1249.995 MHz	S, ±12 MHz	1240.000 - 1261.995 MHz	UX-129A
1	10 meter	29.000 - 29.695 MHz	S, ±100 kHz	29.000 - 29.695 MHz	UX-19A
2	2 meter	144.000 - 147.995 MHz	S, ±600 kHz	144.000 - 147.995 MHz	UX-29A/H
3	220	220.000 - 224.995 MHz	S, ±1.6 MHz	220.000 - 224.995 MHz	UX-39A
4	440	440.000 - 449.995 MHz	S, ±5 MHz	438.000 - 449.995 MHz	UX-49A
5	430**	430.000 - 439.995 MHz	S, ±5 MHz	425.000 - 444.995 MHz	UX-49A
6	6 meter	50.000 - 53.995 MHz	S, ±1 MHz	50.000 - 53.995 MHz	UX-59A
7	420**	420.000 - 429.995 MHz	S, ±5 MHz	420.000 - 434.995 MHz	UX-49A
8	1280	1280.000 - 1289.995 MHz	S, ±12 MHz	1268.000 - 1299.995 MHz	UX-129A
9	1290	1290.000 - 1299.995 MHz	S, ±20 MHz	1270.000 - 1299.995 MHz	UX-129A
A	1270	1270.000 - 1279.995 MHz	S, ±20 MHz	1250.000 - 1299.995 MHz	UX-129A
B	1270	1270.000 - 1279.995 MHz	S, ±12 MHz	1258.000 - 1291.995 MHz	UX-129A
C	1250	1250.000 - 1259.995 MHz	S, ±12 MHz	1240.000 - 1271.995 MHz	UX-129A

* Transmit frequency range contains gaps - range indicated is intended to show limits. Add and subtract transmit offset to receive frequency ranges to determine transmit segments. Limited by amateur band edges.

**Warning: Neither ACC nor ICOM guarantees operation of band unit in these frequency ranges. Band units may require retuning. Success and performance may vary from band unit to band unit.

Memories

Band, frequency and CTCSS selection can be recalled from seven memories each for Links 1 and 2. See the Programming Reference Manual Chapter 15 for storing memories; memory names are programmed using the Message Editor (Chapter 3).

(Link Prefix) 1 (1-7) Link 1 Memory 1-7 Frequency
 (Link Prefix) 4 (1-7) Link 2 Memory 1-7 Frequency

High/Low Power Select

The band units include provisions for high/low power selection. Refer to your band unit manual for power level information.

Caution: Remember that the band units are intended for intermittent duty cycle. External cooling may be desirable. Keep this in mind when selecting high power.

(Link Prefix) 1 * Link 1 Power Interrogate
 (Link Prefix) 1 * 1 Link 1 High Power
 (Link Prefix) 1 * 0 Link 1 Low Power
 (Link Prefix) 4 * Link 2 Power Interrogate
 (Link Prefix) 4 * 1 Link 2 High Power
 (Link Prefix) 4 * 0 Link 2 Low Power
 (Link Prefix) 7 * Link 3 Power Interrogate
 (Link Prefix) 7 * 1 Link 3 High Power
 (Link Prefix) 7 * 0 Link 3 Low Power
 (Link Prefix) * * Link 4 Power Interrogate
 (Link Prefix) * * 1 Link 4 High Power
 (Link Prefix) * * 0 Link 4 Low Power

CTCSS Encode (Option)

An optional remotely selectable 37 tone CTCSS encoder is available to allow accessing repeaters which are set up for CTCSS access or control. The option plugs into the IC socket at U7. The CTCSS audio is applied to any band unit selected for transmit.

(Link Prefix) 7 xx
(Link Prefix) * xx

Link 1/2 CTCSS Select (00=off, 01-38=on)
Link 3/4 CTCSS Select (00=off, 01-38=on)

Note: The CTCSS encode level is adjusted using pot CTCSS LEVEL R101 on FC-900 board.

CTCSS FREQUENCIES			
01	67.0	11	-
02	71.9	12	100.0
03	74.4	13	103.5
04	77.0	14	107.2
05	79.7	15	110.9
06	82.5	16	114.8
07	85.4	17	118.8
08	88.5	18	123.0
09	91.5	19	127.3
10	94.8	20	131.8
21	136.5	31	192.8
22	141.3	32	203.5
23	146.2	33	210.7
24	151.4	34	218.1
25	156.7	35	225.7
26	162.2	36	233.6
27	167.9	37	241.8
28	173.8	38	250.3
29	179.9		
30	186.2		

Macro Set Storage

The repeater controller has the ability to take "snapshots" of your controller setup, which are stored in "macro sets". Each macro set can be called up with a single control operator level command allowing instant selection of an entire group of parameters. The FC-900 support software (V3.6 and up) integrates link and remote base information into the macro sets for quick selection of a link or remote base setup.

The information stored in the controller's macro sets include for each link:

- Off / receive-only / receive-transmit
- Band
- Frequency
- High / low power
- CTCSS encode on/off and tone

Recovering Expanded UF Outputs

In addition to controlling the IC-900 band units, the FC-900 Interface can recover seven expanded User Function remote control outputs supplied by the controllers. (The limitation to seven rather than eight is due to the seven bit width of the IC-900 control word.) The outputs are available at connector J4, with pinout shown below. Outputs are open collector and are low true. The outputs are the true UF outputs controllable from the UF user commands, not the alternate functions which the direct outputs may serve.

Interface to Link 1 and 2 (Controller DIP Switch 4 ON)

Signal	Pin	Signal	Pin
UF1	1	UF5	5
UF2	2	UF6	6
UF3	3	UF7	7
UF4	4	+12V	8
		GND	shield

Interface to Link 3 and 4 (Controller DIP Switch 5 ON)

Signal	Pin	Signal	Pin
UF9	1	UF13	5
UF10	2	UF14	6
UF11	3	UF15	7
UF12	4	+12V	8
		GND	shield

Command Summary

Link 1/2 Ports

(Link Prefix) 1	Link 1 On Receive Only
(Link Prefix) 2 [*]	Link 1 On Receive/Transmit
(Link Prefix) 3	Link 1 Off
(Link Prefix) 4	Link 2 On Receive Only
(Link Prefix) 5 [*]	Link 2 On Receive/Transmit
(Link Prefix) 6	Link 2 Off
(Link Prefix) 1 x *	Link 1 Band Select
(Link Prefix) 4 x *	Link 2 Band Select
x = 0 1240	7 420
1 10 meter	8 1280
2 2 meter	9 1290
3 220	A 1270 (± 20 MHz)
4 440	B 1270 (± 12 MHz)
5 430	C 1250
6 6 meter	
(Link Prefix) 1 (mhtof)	Link 1 Frequency
(Link Prefix) 1 (m*htof)	Link 1 Frequency
(Link Prefix) 4 (mhtof)	Link 2 Frequency
(Link Prefix) 4 (m*htof)	Link 2 Frequency
(Link Prefix) 1 (1-7)	Link 1 Memory 1-7 Frequency
(Link Prefix) 4 (1-7)	Link 2 Memory 1-7 Frequency
(Link Prefix) 1 *	Link 1 Power Interrogate
(Link Prefix) 1 * 1	Link 1 High Power
(Link Prefix) 1 * 0	Link 1 Low Power
(Link Prefix) 4 *	Link 2 Power Interrogate
(Link Prefix) 4 * 1	Link 2 High Power
(Link Prefix) 4 * 0	Link 2 Low Power
(Link Prefix) 7 xx	CTCSS Select (00=off, 01-38=on)

Link 3/4 Ports

(Link Prefix) 7	Link 3 On Receive Only
(Link Prefix) 8 [*]	Link 3 On Receive/Transmit
(Link Prefix) 9	Link 3 Off
(Link Prefix) *	Link 4 On Receive Only
(Link Prefix) 0 [*]	Link 4 On Receive/Transmit
(Link Prefix) 9	Link 4 Off
(Link Prefix) 7 x *	Link 3 Band Select
(Link Prefix) * x *	Link 4 Band Select
(see above)	
(Link Prefix) 7 (mhtof)	Link 3 Frequency
(Link Prefix) 7 (m*htof)	Link 3 Frequency
(Link Prefix) * (mhtof)	Link 4 Frequency
(Link Prefix) * (m*htof)	Link 4 Frequency
(Link Prefix) 7 *	Link 3 Power Interrogate
(Link Prefix) 7 * 1	Link 3 High Power
(Link Prefix) 7 * 0	Link 3 Low Power
(Link Prefix) * *	Link 4 Power Interrogate
(Link Prefix) * * 1	Link 4 High Power
(Link Prefix) * * 0	Link 4 Low Power
(Link Prefix) * xx	CTCSS Select (00=off, 01-38=on)