

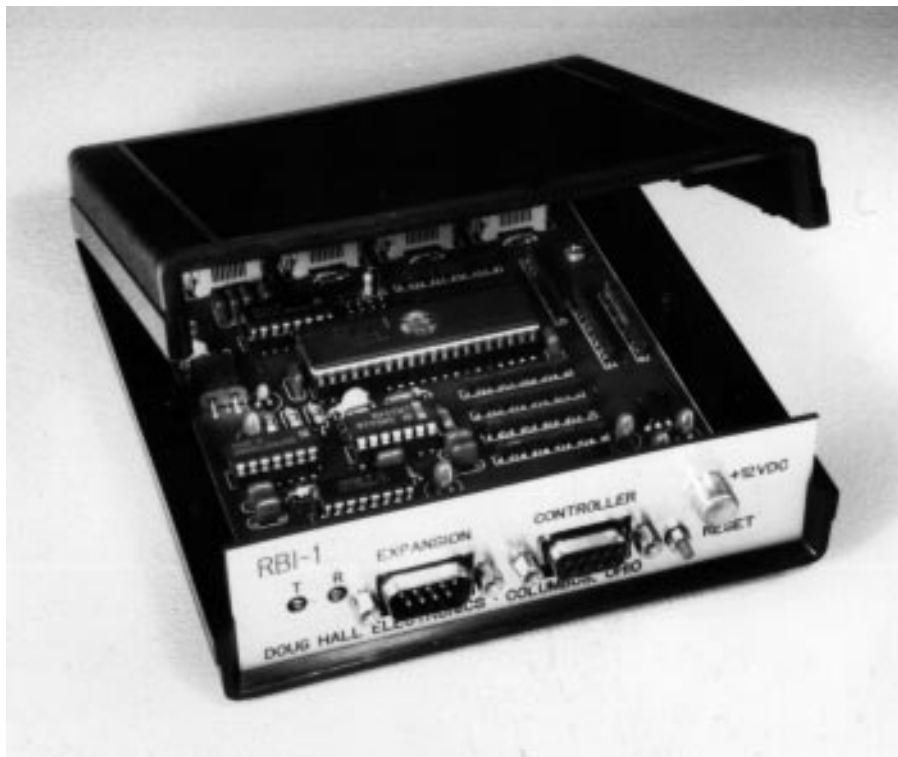
DHE

Doug Hall Electronics

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RBI-1 MANUAL REMOTE BASE INTERFACE



Version 3.4 08/12/96

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INTRODUCTION

The DHE Remote Base Interface (RBI-1) Adapts most of the Kenwood series TM-XX1 mobile radios to several supporting Repeater Controllers. All connections to the Kenwood radio are made thru the microphone jack. In the maximum configuration you can control Frequency, CTCSS encode/decode On/Off, CTCSS Frequency, RF Power, Offset, Power On/Off, and Band. Using the analog inputs available on some controllers you can remotely read back the remote base "S" meter. This is all still accomplished through the microphone jack without any radio modifications.

The Supported Kenwood Mobile Radios are as follows:

140	220	440	1200	DUAL		
TM-221	TM-321	TM-421	TM-521	TM-621+	TM-721+	
TM-231	TM-331	TM-431	TM-531	TM-631+	TM-731+	
TM-241		TM-441	TM-541		TM-701+	

The RBI-1 supports the ACC FC-1 data stream or the DHE "Generic" data stream.

The Supported ACC Controllers are as follows:

ACCRC-850	2 Links 4 Bands
ACCRC-96	2 Bands (see options)
ACCRC-85	2 Bands (see options)

GENERIC SUPPORT

Since the introduction of the RBI-1 and its built in Generic format, several repeater controller Companies have begun supporting this format. Others are working towards implementing the support so that they too can offer an Intelligent remote base. The following is a list of the current supporting controller Companies as of 02/20/96. Contact the controller Companies for a list of controllers supported.

A/D Technologies Inc.
4688 Jefferson Twp. Lane
Marietta, GA 30066
(404) 992-2026
FAX 992-1809 BBS (404)518-6160

Computer Automation Technology, Inc.
4631 N.W. 31st Avenue, Suite 142
Fort Lauderdale, Florida 33309
(305) 978-6171

Link Communications
P.O. Box 1071
Sidney, MT 59270
(406) 482-7515

PC Repeater Controllers PCRC/2™
P.O. Box 459
Bohemia, NY 11716
(516) 286-7610
FAX 563-4716

S-COM Industries
P.O. Box 1718
Loveland, CO 80539-1718
(970) 663-6000

Specialty Controls
P.O. Box 267
Sparks, NV 89432
(702) 972-7245

FF Systems
P.O. Box 2363
Rolla, MO 65401
(314) 368-3716

Copyright (c) 1994 Doug Hall Electronics. All Rights reserved Specifications subject to change without notice. Doug Hall Electronics only provides the list of Controller Companies and is not responsible for, or recommend any particular Company. Contact the Controller companies for special configurations, versions, and models supported.

ACC is the trademark of Advanced Computer Controls, Inc.
PCRC/2 is the trademark of PC Repeater Controllers

SPECIFICATIONS

Microprocessor: INTEL 87C51 or equivalent running at 12MHz.

Connections:

Power: RCA Phono + center pin.

Controller: 9 Pin female "D" Connector

Expansion: 9 Pin male "D" connector.

Radios: 4 - 8 Pin Modular jacks compatible with the Kenwood PG-4H cable.
1 PG-4H provided. Additional cables available from Kenwood or DHE.

Adjustments: "T" (VR1) Radio transmit audio level adjust.
"R" (VR2) Radio receive audio level adjust.

Audio: Radio Transmit 0.050V to 2.5V Input. Impedance 15K.
Radio Receive 0.020V to 2.5V Output. Impedance 5K.

COR output: Open collector, active High 4.7K pullup to 5V.

PTT input: Active Low, with internal 4.7k pullup to 5V.

"S" Meter

output: 0 to +5V Approx. 0V = no signal, 5V = > "S" 9.
Output impedance approximately 5K.

Expansion

output: 8 outputs, ground active, Sink 500mA each, 1A maximum total.

Power

Requirements: +10 to +14 Vdc @ 23mA. Unit can be powered directly from the attached radio, but the radio will not be powered off when the remote is turned off.

Size: 1.5" X 5.1" X 5.5"

Supported

data streams: **ACC** "FC-1" format.
DHE "Generic" format.

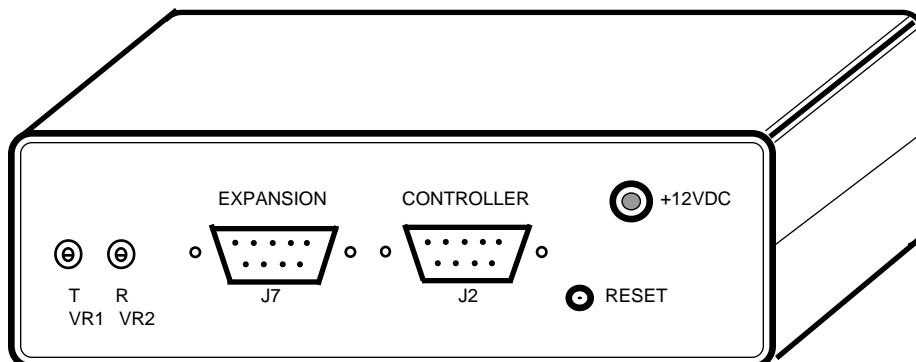
INSTALLATION / CONNECTION

Place or mount the RBI-1 in close proximity to the Kenwood mobile radio to be used. Connect the RBI with the provided PG-4H Cable from the 8 pin modular jack marked "RADIO" to the Kenwood Microphone jack. Only Port 1 (140/DUAL) will support a Dual Band radio. Port 1 is the only Port the 140 MHz radio can be connected.

When using a Generic controller all 4 bands are supported.

RBI-1 CONNECTION Line Name (Reference Controller User Manual) J2 Generic	ACC Line Name	ACC 850 LINK1	ACC 850 LINK2	ACC 96 LINK	ACC 85
1 RBI-1 Reset	Optional	DXX	DXX	N/A	J3-13
2 "S" Meter output	Optional	AXX	AXX	RPT-3	N/A
3 Data	RB Data	D11	D11	3 (CX1)	J3-12 (CX1)
4 Clock/Strobe	RB Strobe	D18	D18	5 (CX2)	J3-9 (CX2)
5 Kenwood TX Audio (T Pot)	TX Audio	TX	TX	6	J4-8
6 Kenwood RX Audio (R Pot)	Link RX Audio	L1 (R111)	L2 (R110)	7 (R103)	J4-6 (R2)
7 COS from Kenwood RX	RX COS	D4	D16	1	J3-2
8 PTT to Kenwood TX	TX PTT	D19	D6	4	J3-11 (CX3)
9 Ground	Ground	GND	GND	8	J3-14

Audio receive level from the Kenwood to the Controller is controlled by VR2 (R). The audio level from the Controller to the Kenwood is adjusted by VR1 (T). Refer to your manuals for additional adjustments in your controller.



RADIO SETUP

The Kenwood radio's need certain parameters setup before they can operate from the RBI. Things such as STEP, etc. This can be found in your Kenwood operating guide. Reset the radio's before memory channels are programmed, after the reset memories will be lost.

- | TM-701 Hold the MR key down during power on to reset. Note: Out of band mod's must be removed for the 440 section to operate properly. Set the UHF step size to 5Kc.
- TM-221/321/421/521 Hold the VFO/M and M.IN keys down during power on to reset.
- TM-621/721 Hold the F key down during power on to reset.
- TM-631/731 Hold the MR key down during power on to reset.
- TM-231/331/431/531 Hold the MR key down during power on to reset.
- TM-241/441/541 Hold the VFO key down during power on to reset.

Set the step size to 5KHz. (25KHz on 1200 MHz units)

Set dual band radio's to single band.

Set power to desired setting. Remember, remote base transmitters can have a high duty cycle because it will be transmitting during all activity on the Repeater side. The mobile radio's used in a remote base configuration should be set to low power in most cases.

Set VFO/MEM to VFO for external frequency input.

Set CTCSS for desired frequencies. When using TM-X31/X41 series and an ACC RC-850 or a "GENERIC" controller, it will be set by the controller and will override your initial setting.

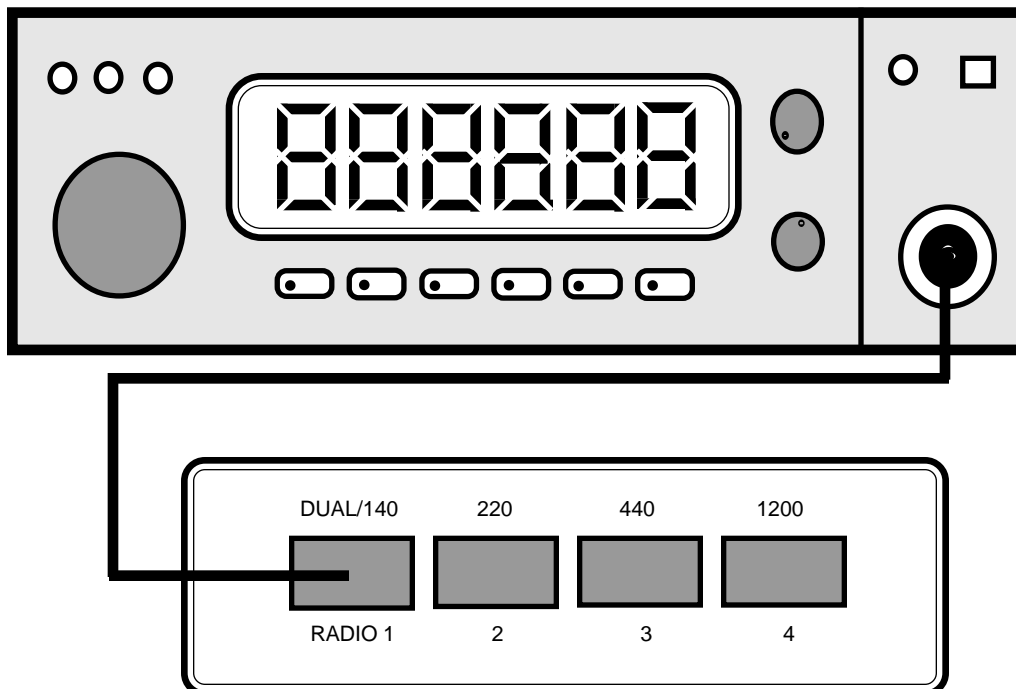
Set CTCSS Decode to off.

Set ABC and AL to off on models that support it.

Turn off Repeat functions.

Once these have been set, connect the Mike jack to the RBI. Reset the RBI to initialize the radio to the controller and get them in sync.

Any time there is manual changes from the radio front panel, the RBI and the Radio can get out of sync. This will require a RBI reset to correct. We recommend hooking the reset line from the RBI to a toggled User function output. Initialize the controller output to "1" on and save those in all your Macro's or the reset line will be held low and disabled. To reset the RBI on ACC controllers, just interrogate the user function, this will toggle the reset line and reset the RBI.



EXPANSION OUTPUT

J8 Pin	RC-85/96	RC-850	GENERIC
1	UF-1	DIRECTION 0	UF-1
2	UF-2	DIRECTION 1	UF-2
3	UF-3	DIRECTION 2	UF-3
4	UF-4	DIRECTION 3	UF-4
5	UF-5 * BAND HI/LOW	DIRECTION 4	UF-5
6	UF-6 * ENCODE ON/OFF	DIRECTION 5	UF-6
7	UF-7 * DECODE ON/OFF	DIRECTION 6	UF-7
8	UF-8 * RF PWR HI/LO	N/A	UF-8
9	GND * 0 Default / 1	GND	GND

* See options section ACC supplement.

J8 6 to 8 required to activate these functions.

RC-850 Translation:

The ACC expansion output is derived from the Rotor value selected. It can be translated to individual bits by using the following formula and example.

DEGREES/4 = UF Output Binary Where 1 = Ground on pin (Active)

BINARY DEGREES	64	32	16	8	4	2	1	<u>ACC-850 Expanded Functions</u>
0	0	0	0	0	0	0	0	CTCSS Decode OFF, TX Power Low
4	0	0	0	0	0	0	1	CTCSS Decode ON
8	0	0	0	0	0	1	0	TX Power HI
16	0	0	0	0	1	0	0	1200 -12 offset, -20 default
32	0	0	0	1	0	0	0	
64	0	0	1	0	0	0	0	
128	0	1	0	0	0	0	0	
256	1	0	0	0	0	0	0	
508	1	1	1	1	1	1	1	

TT PIN	<u>DEG 7654321</u>	<u>DEG 7654321</u>	<u>DEG 7654321</u>	<u>DEG 7654321</u>	<u>DEG 7654321</u>
000	0000000	104 0011010	208 0110100	312 1001110	416 1101000
004	0000001	108 0011011	212 0110101	316 1001111	420 1101001
008	0000010	112 0011100	216 0110110	320 1010000	424 1101010
012	0000011	116 0011101	220 0110111	324 1010001	428 1101011
016	0000100	120 0011110	224 0111000	328 1010010	432 1101100
020	0000101	124 0011111	228 0111001	332 1010011	436 1101101
024	0000110	128 0100000	232 0111010	336 1010100	440 1101110
028	0000111	132 0100001	236 0111011	340 1010101	444 1101111
032	0001000	136 0100010	240 0111100	344 1010110	448 1110000
036	0001001	140 0100011	244 0111101	348 1010111	452 1110001
040	0001010	144 0100100	248 0111110	352 1011000	456 1110010
044	0001011	148 0100101	252 0111111	356 1011001	460 1110011
048	0001100	152 0100110	256 1000000	360 1011010	464 1110100
052	0001101	156 0100111	260 1000001	364 1011011	468 1110101
056	0001110	160 0101000	264 1000010	368 1011100	472 1110110
060	0001111	164 0101001	268 1000011	372 1011101	476 1110111
064	0010000	168 0101010	272 1000100	376 1011110	480 1111000
068	0010001	172 0101011	276 1000101	370 1011111	484 1111001
072	0010010	176 0101100	280 1000110	384 1100000	488 1111010
076	0010011	180 0101101	284 1000111	388 1100001	492 1111011
080	0010100	184 0101110	288 1001000	392 1100010	496 1111100
084	0010101	188 0101111	292 1001001	396 1100011	500 1111101
088	0010110	192 0110000	296 1001010	390 1100100	504 1111110
092	0010111	196 0110001	300 1001011	404 1100101	508 1111111
096	0011000	200 0110010	304 1001100	408 1100110	
100	0011001	204 0110011	308 1001101	412 1100111	

SUPPORT CROSS REFERENCE

FUNCTION	LINK2	CTCSS ENCODE	CTCSS FREQ SELECT	CTCSS DECODE	MULTI BAND	MEM. SUPP.	POWER ON/OFF RF PWR S-MTR	OUTPUT EXPANSION
<u>CONTROLLER</u>								
ACC RC-850	Y	Y	Y	N	Y	N	Y	ROTOR
ACC RC-85/96	N/A	Y*	N	Y*	Y*	N	Y	Y
GENERIC	N/A	Y	Y	Y	Y	Y	Y	Y
<u>KENWOOD</u>								
TM-221 / 321 / 421 / 521		Y	N	N	N	N	N	
TM-231 / 331 / 431 / 531		Y	Y	Y	N	Y	Y	
TM-241 / 441 / 541		Y	Y	Y	N	Y	Y	
TM-621 / 721		Y	N	N	Y	N	N	
TM-631 / 731		Y	N	N	Y	N	N	
TM-701		Y	Y	Y	Y	Y	Y	

* Options available by user selection.

Memory support is in version 3.0 and above. Memory channels must be supported by the Controller Manufacturer.

Memory support details:

Memory channels 0-20 (depending on the radio) can be selected using the "Generic" controller interface. If the memory channel selected is not programmed the RBI-1 will revert to the VFO frequency.

CTCSS decode is determined by the memory channel. If encode or decode are on in the memory channel, the selection from the controller is overridden. If they are off in the memory channel, tone encode, decode, and frequency can be controlled by the controller.

Offset is always controlled by the memory channel.

In the event of an invalid function, IE: "Memory channel selected but not programmed." will result in an error beep from the RBI-1 to the controller.

ACC Supplement OPERATION / * OPTIONS

There are 3 option jumpers in the RBI-1 to change the operation depending on the controller.

GENERIC:

All options are available without jumpers and are controlled by the Data stream from the controller.

ACC RC-850:

No jumper between J8-7 and J8-8 sets the remote to respond to Link 1.

A jumper between J8-7 and J8-8 sets the remote to respond to Link 2.

No jumper between J8-5 and J8-8 sets the 1200 MHz minus offset to -12MHz. *

A jumper between J8-5 and J8-8 sets the 1200 MHz minus offset to -20MHz. *

No jumper between J8-6 and J8-8 Rotor control to user function only.

A jumper between J8-6 and J8-8 Enables Rotor control bit expansion. *

* 1200 MHz offset under Rotor control if J8 6-8 is present.

Rotor value	CTCSS Decode	TX Power	1200 MHz Offset
(Prefix) 000	OFF	LOW	-20 MHz
(Prefix) 004	ON	LOW	-20 MHz
(Prefix) 008	OFF	HIGH	-20 MHz
(Prefix) 012	ON	HIGH	-20 MHz
(Prefix) 016	OFF	LOW	-12 MHz
(Prefix) 020	ON	LOW	-12 MHz
(Prefix) 024	OFF	HIGH	-12 MHz
(Prefix) 028	ON	HIGH	-12 MHz

ACC RC-85/RC-96:

A jumper between J8-5 and J8-8 sets the 1200 MHz minus offset to -20MHz.

No jumper between J8-5 and J8-8 sets the 1200 MHz minus offset to -12MHz.

A jumper between J8-6 and J8-8 causes User functions 5-8 to also change the functions of the RBI-1.

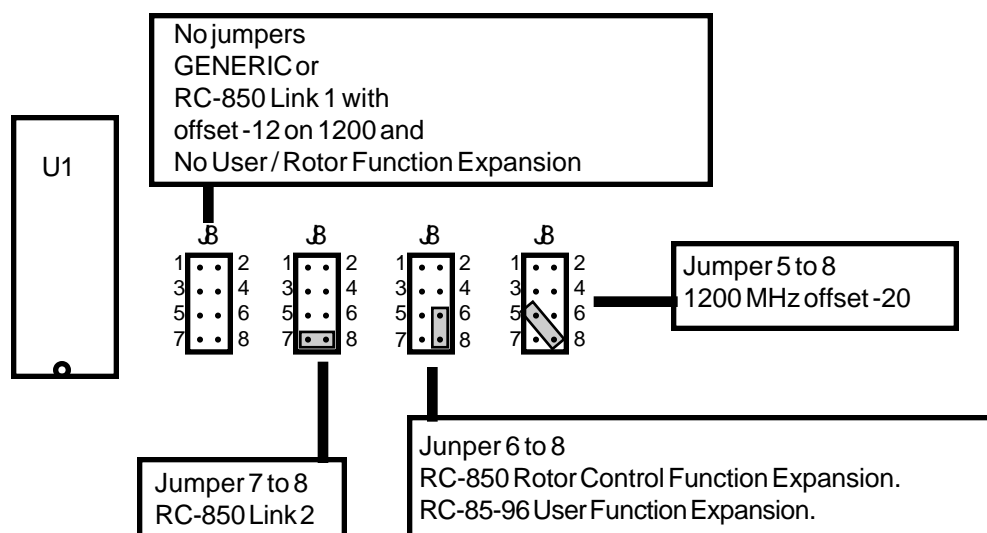
UF-5 On = Highest band. (1290 if 1200 avail.) Off = Lowest band available.

UF-6 On = New style Kenwood CTCSS decode on. Off = decode off.

UF-7 On = CTCSS encode on. Off = encode off.

UF-8 On = High power. Off = Low power.

JUMPER SETTINGS



Note: If more than one jumper function is needed, wire wrap all the appropriate jumper positions together.

ACC Supplement CONTROLLER SETUP

ACC RC-850:

Note: When using an ACC RC-850, the RBI will support all 4 bands (140/220/440/1200) as follows: If Port one is filled, Port 2 is for 220 only, Port 3 is for 440 only, Port 4 is for 1200 only. Basically, if the selected band is unavailable on Port 1 it will go to the port assigned to that band.

S-METER: Connect the S-Meter output of the RBI to an unused Analog input. Assign an S-Meter Meter face (30) to that Analog input port. That will give you a VRT response once interrogated to the corresponding S Unit reading on the Radio.

COR: Set the incoming COR to "1"/High True, active. (Reference Logic I/O sense section in the programming reference manual)

REMOTE BASE/LINK CHANNEL Assignment: Set up the Controller for the RBI to be a Remote Base and select No Commands (may differ for your application).

USER FUNCTION: Set up your User function selected for the RBI reset. We recommend hooking the reset line from the RBI to a toggled User function output. Initialize the User function to "1" on and save those in all your Macro's or the reset line will be held low and disabled. See Operation page under RESET.

MEMORY: See Operation page under MEMORIES. Also set up your Remote Base names, and Remote Base memory names.

COURTESY SELECTION: The Remote Base 1 uses Courtesy tone 9, Remote Base 2 uses Courtesy tone 0, Remote base Transmit uses *3.

REMOTE BASE TYPE: Set the controller to support the FC-1 (BCD). Set Dip switch #4 off. Refer to your Hardware Reference Manual for your Version software.

COMMAND CODE PREFIXES: Set up your Remote Base prefix, User Function, Voice Response Telemetry / S-Meter, etc. to suite your needs.

ACC-85/96:

The ACC RC-96 and RC-85 now support the RBI-1 Generic data stream. This mode will control many more functions of the Kenwood radio's than in FC-1 mode. If the Generic mode is available, ignore the ACC supplement section

REMOTE BASE TYPE: Set the controller to support the FC-1 (BCD) format. Set the dip switches according to the manual for synthesized remote and expanded UF outputs. Switches 4 ON 5-7 OFF for the RC-96. Switches 4,5,7 ON and 6 off for the RC-85.

COMMAND CODE PREFIXES: Set up your Remote Base prefix to suite your needs.

ACC Supplement PROGRAMMING

Refer to the Operation/Programming guides provided with your Controller. There is always changes and different versions that can make the programming unique to your controller. The following is a small list of Programming hints. Software versions may cause some information about the Controller to be incorrect.

Remember, the Doug Hall Electronics RBI uses the ACC FC-1 data provided by the controller to control the Kenwood radio's functions. Most of the information in this section is a supplement and review of some of the ACC commands needed to operate the RBI.

ACC RC-850:

The RC-850 is capable of controlling 2 RBI's. Since there is only one Band selection for both remote bases, There cannot be duplicate bands on both links. There can be only one remote base per band, otherwise both RBI's will respond to any link function that contains its available band.

The remote base is jumper selected. For Link 2 jumper J8-7 to J8-8. (refer to parts layout for location)

Set the RC-850 (refer to the 850 programming manual) for FC-1 (not FC-900) type remote base.

The "S" meter is attached to an Analog port.

The reset line is normally attached to a UFX and is reset by interrogating UFX which pulses the reset line to the RBI.

The following is a list of items that need or can be programmed in the RC-850 to fully support the Remote Base:

Remote Base Prefix

Remote Base Attributes

Remote Base Memories (7)

Remote Base Offset

Remote Base Band

Remote Base Frequency

Analog input port to meter face

Voice Response Prefix (for "S" meter prefix)

User function remote control attributes

User function prefix

User function response

Remote Base Memory responses (7 for each RBI)

Scheduler Remote base functions

Each remote base Memory has Rotor (EXPANSION) information.

Each remote base Memory has tone on/off and frequency information.

BANDSELECTION:

0= 430 1= 1250 2=140 3=220 4=440 5=1270 6=1280 7=1290

ACC-85/96:

The Expansion connector has the User Function expansion. Refer to Expansion Outputs.

On version 5 and above you must clear the HF remote base prefix. Unlock and enter *5020. Then lock.

Remote base Prefix

Remote Base Memories (MACRO'S)

Remote base Offset

Remote Base Frequency

To expand the functions of the controller, refer to the Options section.

TROUBLESHOOTING

Symptom: Radio is dead, no response. **Test:** Press reset on RBI-1. The radio's should respond by the frequency of 000 temporarily entered (not valid on 1200 MHz only). This checks out the connection from the radio, the RBI-1 and the microprocessor inside the RBI-1. If the radio's don't respond, disconnect the connector to the controller at the RBI-1 (J2). Try the reset again, if the radio's now respond, the RESET line is being held low by the controller. This line must float around +5V to keep it from locking up the RBI-1.

Symptom: Radio doesn't respond to some commands, Macro's or Memories. An unavailable band selected in the controller will cause improper operation, or no response to commands from the controller. **Fix:** Correct band selection and retry.

Symptom: Intermittent or no response to commands from the controller. There can easily be ground currents between the controller and the Radio used for the remote base even if they share the same power connections. **Test:** Try the failing command with the remote base radio antenna disconnected. (Most ground currents will be coming from the antenna grounding system.) If this corrects the problem the best way of eliminating these currents is to have all antenna's go thorough a common grounded bulkhead or ground all feedlines together as they enter the cabinet, grounding it to the cabinet itself.

Symptom: Loud hum on the transmit or receive audio. **Fix:** Do the ground checks and procedures mentioned above.

Symptom: Remote base doesn't respond. **Fix:** The remote base could be disabled in the controller. Verify the remote base is on by issuing the remote base enable and on commands and retry the failing operation.

Symptom: Output Expansion doesn't appear to work. (User functions / Rotor bits / Output expansion) These outputs on J7 are open collector outputs. Some applications may require external pullups to make these lines go positive. Without a pullup resistor these lines will never go high. **Fix:** Add approximately a 4.7k resistor to +5 or +12 volts as required by your application. These sinker outputs are all driven by U6. **Fix:** Replace U6 UCN5821 if problem persists.

Symptom: Radio's won't power off but appear to work, or won't power on from the RBI-1. **Fix:** Check the Support Cross Reference pages for radio's that support Power on / off. **Fix:** External +12V is only required to allow the radio's that are capable of powering off to do so when the band or remote base is disabled. **Fix:** The RBI-1 has an internal fuse F1 that could be blown, meter or replace the fuse:

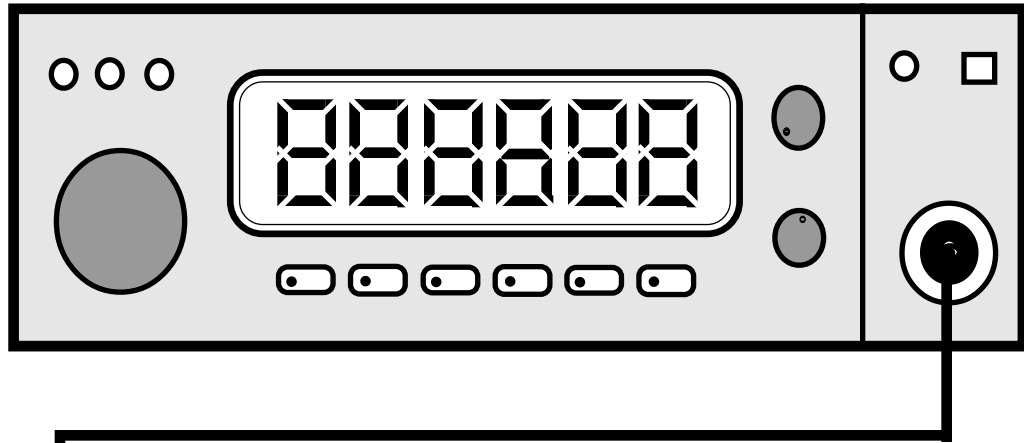
Symptom: The transmit audio out of the Kenwood remote base is muffled or has little or no high frequency response. **Fix:** We incorporated de-emphasis and high frequency roll-off to allow for custom audio tailoring between controllers. Remove C17 or both C17 and C16 depending on how much if any roll-off you need. It is easier to remove than to add roll-off so we decided to provided it if needed.

Symptom: Audio levels out of balance between radio's on different ports. **Fix:** They should match, but if they don't they can be adjusted in the Kenwood radio's. Refer to the operator guide or service manual for adjustments.

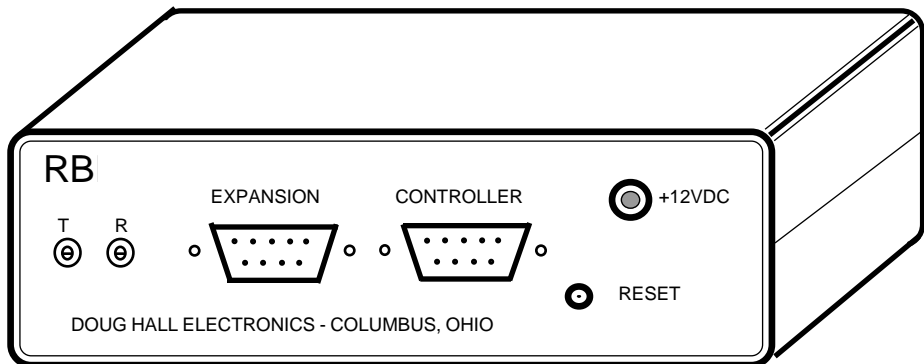
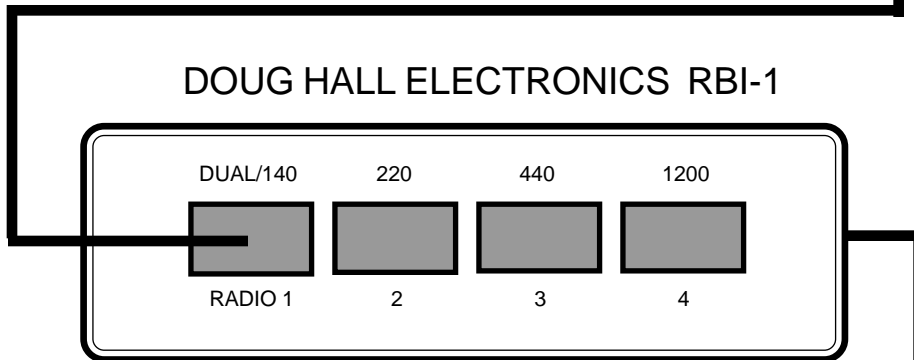
Symptom: Everything works except the frequency entry. **Fix:** A memory channel is selected and the VFO frequency is ignored.

Symptom: COR is slow to close, squelch tail **Fix:** The COR is sent in a serial stream from the radio to the RBI-1, The COR speed is determined by the radio model. The RBI-1 closes the COR as soon as it can with the Kenwood architecture.

KENWOOD TM-XX1 SERIES MOBILE



DOUG HALL ELECTRONICS RBI-1



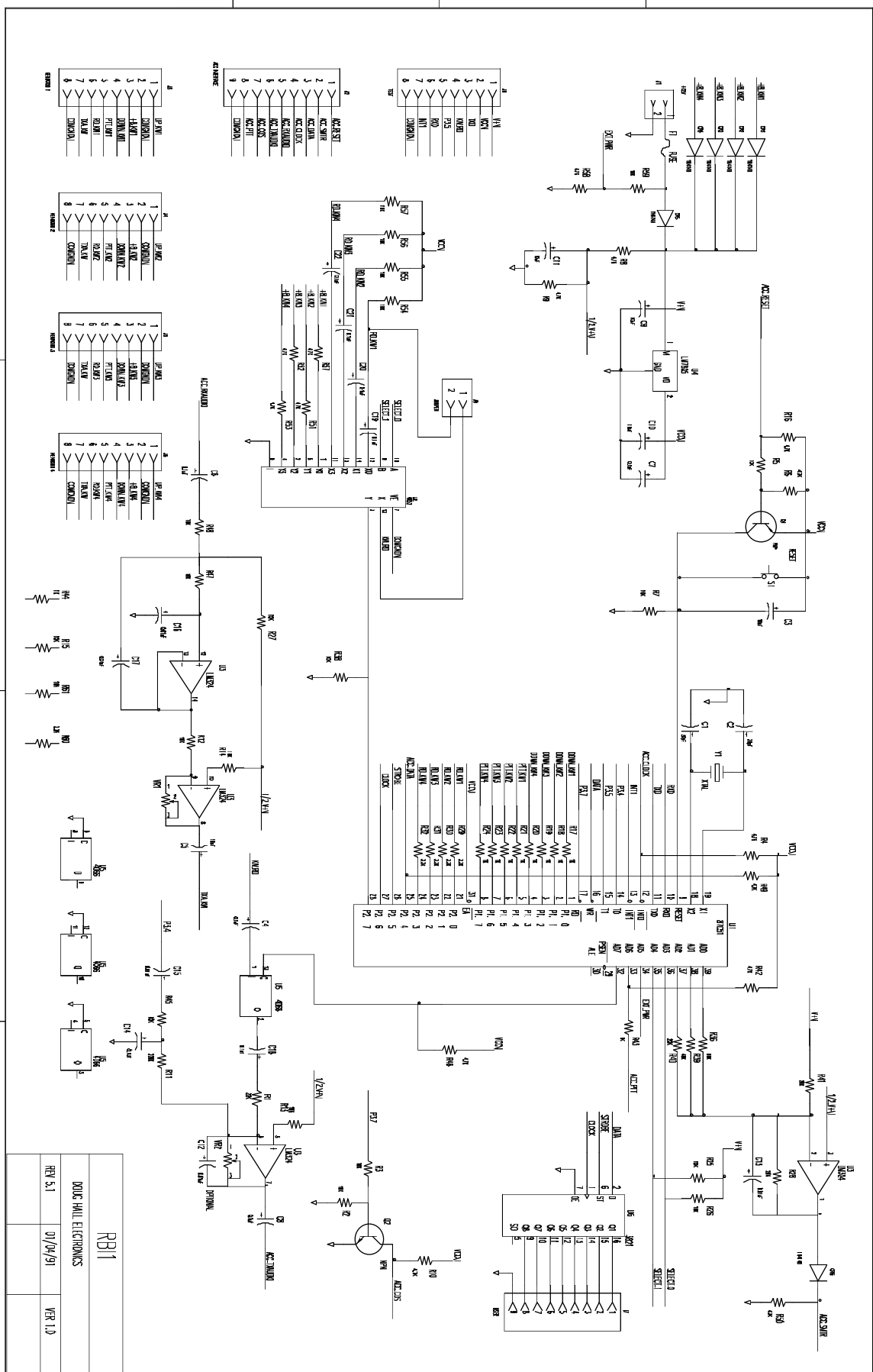


TABLE 1

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 2

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 3

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 4

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 5

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 6

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 7

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 8

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 9

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 10

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

TABLE 11

1	JP.PIN1
2	CONTROL
3	DATA IN
4	DATA OUT
5	STROBE
6	DATA IN
7	DATA IN
8	CONTROL

RB11
DOUG HALL ELECTRONICS
01/04/91
VER 1.0

