Odyssey 2000-8RPT

Repeater Instruction Manual

575-00001-0002

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Revision History

Document Summary

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Revision	Date	Implemented by	Change Description
0000	3/13/01	Joel N. Holyoak	Created from previous repeater model document for new configuration

Document Approvals

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Introduction

This manual covers the Odyssey 2000 8RPT Repeater Radio for Digital Channel/Multicarrier Architecture, DCMA®, with LTR trunking. This unit is a full duplex radio transceiver featuring digital technology developed by ComSpace™ Corporation, that greatly increases the traffic carrying capabilities of the radio network while at the same time improving the quality of communications. The principal features are:

1. Digital Modulation with DC/MA technology.
2. Digital trunking (Direct Frequency Assignment) compatible with EF Johnson LTR® network protocol.
3. Enhanced voice quality via AMBE+® vocoder.

Thank You

We believe that this *"Technology Development for the Wireless Future"* will be an easy to use transceiver that will provide dependable communications to allow peak operating efficiency. We are grateful you chose ComSpace Corporation for your professional repeater radio applications and believe that you will be pleased with the quality and features of our product.

Warning

One or more of the following statements may be applicable.

FCC Warning

This equipment generates or uses radio frequency energy. Changes or modifications to this equipment may cause harmful interference unless the modifications are expressly approved in the Operator's Manual. The user could lose the authority to operate this equipment if an unauthorized change or modification is made.

Information to Digital Device Users Required by the FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can generate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit breaker different from that to which the receiver is connected.
- Consult the dealer for technical assistance.

Notices to the User

- **GOVERNMENT LAW PROHIBITS THE OPERATION OF UNLICENSED RADIO TRANSMITTERS WITHIN THE TERRITORIES UNDER GOVERNMENT CONTROL.**
- **ILLEGAL OPERATION IS PUNISHABLE BY FINE OR IMPRISONMENT OR BOTH.**
- **REFER SERVICE TO QUALIFIED TECHNICIANS ONLY.**

Safety:

It is important that the operator is aware of, and understands, hazards common to the operation of any transceiver.

WARNING:

- **FCC RF Exposure Compliance:** FCC RF exposure compliance must be addressed at the time of licensing, as required by the responsible FCC Bureau(s), including antenna co-location requirements of §1.1307(b)(3). The applicable exposure limits, to demonstrate compliance, are specified in FCC Part 1.1310. Additionally, to comply with FCC RF exposure compliance requirements, the antenna(s) used for this transmitter must be fixed-mounted on outdoor permanent structures. The installer of the antenna to be used with this transmitter may be required to perform an MPE evaluation and an Environmental Assessment (EA) of the location at the time of licensing per CFR 47 Part 1.1307. Fixed mounted antenna(s) that are co-located with other antenna(s) must satisfy the co-location requirements of Part 1.1307 for satisfying RF exposure compliance.
- **INJURY FROM RADIO FREQUENCY TRANSMISSIONS:** Do not operate the transceiver when someone is either touching the antenna or standing within proximity established by an MPE evaluation to avoid the possibility of radio frequency burns or related physical injury.
- **DYNAMITE BLASTING CAPS** Operating the transceiver within 500 feet of dynamite blasting caps may cause them to explode. Turn OFF your transceiver when in an area where blasting is in progress, or where "TURN OFF TWO-WAY RADIO" signs have been posted. If you are transporting blasting caps in your vehicle, make sure they are carried in a closed metal box with a padded interior. Do not transmit while the caps are being placed into or removed from the container.

Precautions

Please observe the following precautions to prevent fire, personal injury, and transceiver damage.

- Do not modify the transceiver for any reason.
- Do not expose the transceiver to long periods of direct sunlight, nor place it near heating appliances.
- Do not place the transceiver in excessively dusty, humid or wet areas, or on unstable surfaces.
- If an abnormal odor or smoke is detected coming from the transceiver, turn OFF the power immediately. If the unit does not turn OFF, remove the power source. Contact your ComSpace dealer.

Repeater Specifications

Odyssey™ Series Model 2000 8RPT

General

No.	Parameter	Requirement	Comments
1	Frequency Range Receiver: Transmitter:	 806 MHz – 824 MHz 851 MHz – 869 MHz	
2	Channel Spacing	25 kHz	12.5KHz steps
3	Duty Cycle	100% – RX 100% – TX	
4	Input Voltage	115Vac, nominal	Two separate circuits required
5	Current	20A service	
6	RF Impedance	50 Ω	Unbalanced
7	Frequency Stability	0.0022ppm	
8	Spurious and Image Suppression	-85dBc	
9	FCC ID	PCKCDRTL841FL0001	
10	FCC Compliance	FCC Part 15 & Part 90	Part 15, Class A digital device
11	Normal Test Conditions	Temperature +20°C Relative Humidity 75% Max.	
12	Sub-channel Data Rate: Time Slot Data Rate:	16 kbps for single sub-channel 8.0 kpbs for single time slot	An 800 MHz, 25 kHz DC/MA® channel is divided into four sub-channels with channel offsets of ±2400Hz and ±7200Hz.
13	Temperature Range	-30°C to +60°C	
14	Total Panel Size	40.25 inches – 23 U	19 inch standard rack/cabinet without trunk controllers
		54.25 inches – 31 U	19 inch standard rack/cabinet with trunk controllers
	AC Power Distribution Units	2U high x 4 inches deep	19 inch standard rack/cabinet two 1U units
	Power Supply Enclosure	3U high x 21.6 inches deep	19 inch standard rack/cabinet
	RF Amplifier Enclosure	8U high x 20.1 inches deep	19 inch standard rack/cabinet
	LLRF Enclosure	3U high x 15.83 inches deep	19 inch standard rack/cabinet
	Digital Enclosure	6U high x 11.49 inches deep	19 inch standard rack/cabinet
	Fan Tray	1U x 8 inches deep	19 inch standard rack/cabinet Used for airflow through Digital Enclosure
	1U Spacer Panel	1U high	19 inch standard rack/cabinet Used in two locations: (1) to provide for airflow through the Digital Enclosure (2) spacer at top of assembly
	Trunk Controllers	8U x 7 inches deep	19 inch standard rack/cabinet eight 1U units
15	Weight	240 pounds	Rack/cabinet not included

Receiver

No.	Parameter	Requirement	Comments
1	Passband Ripple	1dB	Measured at baseband, 400Hz to 9.2kHz
2	Total Group Delay	75μsec (max)	Measured at baseband, 400Hz to 9.2kHz
3	Differential Group Delay	TBD	Measured at baseband between the I and Q channels, 400Hz to 9.2kHz
4	I Q Gain Imbalance	0.5dB	Measured at baseband, 400Hz to 9.2kHz
5	I Q Phase Imbalance	≤ 2°	Measured at baseband, 400Hz to 9.2kHz
6	DC Offset	≤ 10% minimum signal level	≅ 216μVrms at 14dB S/N
7	Output Noise	3 bits @ 53.95μV/bit	≅ 432μVrms, Measured at the ADC input
8	Noise Figure	5dB min	
9	Sensitivity	-119dBm	≅ 0.25μVrms, Measured at the receiver input Power of 1 sub-channel.
10	Adjacent Channel Rejection Ratio	80dB min	
11	3rd order Intermodulation Distortion	5dBm min	Interferer tones at $F_0 \pm 50$kHz and ± 100kHz
12	Image Rejection	100dB min	
13	½ IF Rejection	100dB min	
14	Spurious Rejection	100dB min	
15	Gain Variation	15dB	Adjustable for site noise variations
16	ADC	16 bit	Serial output, single ended, 52kHz sample rate
17	Dynamic Range	65dB	16bits – 3.5 noise bits → 12 bits, with a 14dB S/N

Transmitter

No.	Parameter	Requirement	Comments
1	Emission Designator	18K4D7W	
2	Emission Mask	§90.691 for 851-866 MHz §90.210B for 866-869 MHz	
3	Modulation	DC/MA®	16QAM (2 level 8 phase) Digital Channel/Multicarrier Architecture
4	Output Power	90 Watts Continuous Average	DC/MA has a 10dB Peak to Average Ratio
5	Output Impedance	50 Ω	
6	Image Suppression	-55dBc	Image measured at the output of the transmitter.
7	Amplitude Response	<1.0dB	Measured across the 18MHz Tx band
8	Intermodulation Products	-60dBc	DC/MA intermodulation performance measured at the output of the transmitter
9	Tuning Spacing	12.5kHz	
10	Channel Frequency spread	18MHz	
11	Occupied Bandwidth	20kHz	
12	LO Phase Noise	-85dbc/Hz @ 400Hz –126dBc/Hz @ 10kHz –134dBc/Hz @ 25kHz	Single sideband phase noise
13	LO Reference Spur	< -98dBc @ 12.5kHz	Maximum level for the 12.5kHz reference spur

Repeater Controller Command Set

Communication with the repeater controller is accessible through the RS232 port located on the front panel of this board. This connection requires a pin to pin compatible RS232 cable. A HyperTerminal must be started to communicate with the repeater controller. With a WINDOWS® operating system, the HyperTerminal can be found at:

Start/Programs/Accessories/ HyperTerminal/HyperTerminal

The HyperTerminal should be set up as follows.

Basic Settings	
Bits per second	38400
Data bits	8
Parity	None
Stop bits	1
Flow control	None
Properties	
Settings	
Terminal Key	Selected
Emulation	ANSI
ASCII Setup	
ASCII Receiving	Wrap lines that exceed terminal width

The following table is the Repeater Controller Command Set.

1	**Legend**		
2		[parameter]	parameter is required
3		<parameter>	parameter is optional or required in some cases
4		[parm1|parm2]	parm1 OR parm2
5		PID	Processor ID in [0,20]
6		IPC	Interprocessor Communications
7			
8			
9	**help**	help <command>	display all commands or help on a specific *command*
10	**osinfo**	osinfo <task | queue | sem | part>	display pSOS info for *tasks, queues, semaphores, partitions,* or all of the above if no parameter given
11	**ifconfig**	Ifconfig	display network I/F data
12	**netstat**	netstat	display network connections
13	**arp**	arp [-adsf]	address resolution protocol (ARP) table maintenance; show *all, delete* host, *set* host and MAC address, or load from *file*
14	**date**	Date	display RC860 system date
15	**echo**	echo ["string"]	echo *"string"* to the CONSOLE
16	**getid**	Getid	display user ID and group ID
17	**getpri**	getpri [taskname | tid]	display task *taskname* or *task ID* priority
18	**kill**	kill [taskname | tid]	kill task *taskname* or *task ID*
19	**ping**	ping [IP]	check connectivity to address *IP*

20	**resume**	resume [taskname | task ID]	resume task *taskname* or *task ID*
21	**route**	route [add | delete | -a] <host | net> <dest> <gateway>	IP routing table maintenance
22	**setenv**	setenv <ENV_VAR=value>	set environment variable *ENV_VAR* to *value,* or if no parameters show all environment variables
23	**setid**	setid [uid] [gid]	set user and group Ids
24	**setpri**	setpri [taskname | tid] [priority]	set task *taskname* or *task ID* priority to *priority*
25	**sleep**	sleep [seconds]	suspend shell execution for *seconds* seconds
26	**suspend**	suspend [taskname | tid]	suspend task *taskname* or *task ID*
27	**ber**	ber [subchannel (0-3)] <frequency (seconds)>	toggle bit error rate display on the specified *subchannel*
28	**flashcrc**	flashcrc [target pid | all]	report the flash CRC of the requested *PID*
29	**getRev**	getRev [target pid | all]	report the software revision of on the requested *PID*
30	**remlog**	Remlog	toggles msgLog on telnet sessions
31	**wmsl**	wmsl [target PID] [b|h|w] [address] [value]	write *value* at *address* on slave *PID* using *byte*, *half-word*, or *word* access
32	**dmsl**	dmsl [target PID] [b|h|w] [address] <length>	read (dump) *length* bytes of memory at *address* on *PID* using *byte, half-word,* or *word* access
33	**ipcsl**	ipcsl [target PID]	report IPC info for *PID*
34	**rxmqueue**	Rxmqueue	report info for the RXM I/Q sample circular queue
35	**txmdac**	Txmdac	report info for the TXM transmit DAC buffer
36	**cpdbg**	cpdbg [target PID]	report info for the CP with *PID* pid
37	**statedbg**	Statedbg	report info for the RXM call state machine
38	**time**	Time	display RC860 system time
39	**syspar**	syspar <r | w> <parameter> <value>	*read* or *write parameter* with *value* if writing; no parameters lists all system parameters and current values
40	**sysStatus**	SysStatus	User-friendly display of repeater statuses, as seen by the RC860
41	**reset860**	reset860	resets the entire repeater
42	**shutdown**	Shutdown	stops all RX and TX on the repeater
43	**resetSysParms**	ResetSysParms	resets all non-volatile parameters to defaults
44	**prescheck**	Prescheck	displays task and slave processor presence
45	**flashld**	flashld [pid]	prepare *PID* to receive flash image
46	**iflock**	Iflock	displays RF lock status
47	**chuser**	chuser <-adhm> <username>	change telnet user - *add* a new user, *delete* user, *help, modify* user password
48	**startnow**	Startnow	start repeater initialization now, skipping warm-up timer
49	**log**	Log	toggles msgLog on CONSOLE shell
50	**taskdbg**	taskdbg [DPR|PA|RF|SCON] <pid|amp>	display task DPR, PA, RF, or SCON debug info
51	**memtest**	memtest [h | w] [address] <length>	test memory at *address* for *length* bytes using *half-word* or *word* access

Unpacking and Checking Equipment

Note: The following unpacking instructions are for use by your ComSpace dealer, an authorized ComSpace service facility, or the factory.

Carefully unpack the transceiver. ComSpace recommends that the items listed in the following table be identified prior to discarding the packing material. If any items are missing or have been damaged during shipment, file a claim with the carrier immediately.

Power Supply and RF Components

Subsystem	Item	Part Number	Quantity
AC Power Distribution	Surge Suppressor	Tripp-Lite, IBAR 12/20 Ultra	2
	AC Service Cables – to power supply	060-00053-0001	2
Power Supply	Power Supply Module	075-00028-0001	1
	1U Blank Panel	300-00056-0001	1
	PA Power Cable	060-00016-0001	1
	LLRF Power Cable - +/- 15 VDC	060-00025-0001	1
	Digital Power Cable	060-00024-0001	1
	Digital Power Cable - +/- 12 VDC	060-00026-0001	1
	Digital Power Sense Cable	060-00023-0001	1
	Trunking Controller Power Cable	060-00032-0001	1
Power Amplifier	Power Amplifiers (PA)	PARADIGM MAF860-25S	4
	RF Enclosure	PARADIGM MR860-41S	1
Low-Level RF	LLRF Enclosure	075-00027-0001	1
	Exciter Signal Cable	060-00040-0001	1

Digital Components

Subsystem	Item	Part Number	Quantity
Digital	Digital Enclosure – with backplane	075-00026-0001	1
	Repeater Controller	050-00003-0200	1
	Tx Master	050-00004-0203	1
	Rx Master	050-00004-0201	1
	Rx Slave	050-00004-0202	2
	Channel Cards	050-00023-0200	4
	Fan Tray	Comair Rotron 31038	1
	1U Blank Panel	300-00056-0001	1
	RF/Digital DB-25 Communications Cable	060-00051-0001	2
	RF/Digital DB-9 Communications Cable – to PA	060-00055-0001	1
	RF/Digital DB-9 Communications Cable – to LLRF	060-00042-0001	1
	RF/Digital Coaxial 13MHz Reference Cable	060-00034-0001	1
	Trunking Controller DB-15 (short length)	060-00049-0001	2
	Trunking Controller DB-15 (medium length)	060-00049-0002	3
	Trunking Controller DB-15 (long length)	060-00049-0003	3
	LAN Adapter Cable	060-00054-0001	1

Other Components – installed separately

Subsystem	Item	Part Number	Quantity
Trunk Controllers	Trunk Controllers	075-00031-0001	8
	4U Blank Panel	300-00056-0004	1
LAN Interface	LANTRONIX Multiport Server	EPS2-100	1
MODEM	Modem	3COM-3C886A	1

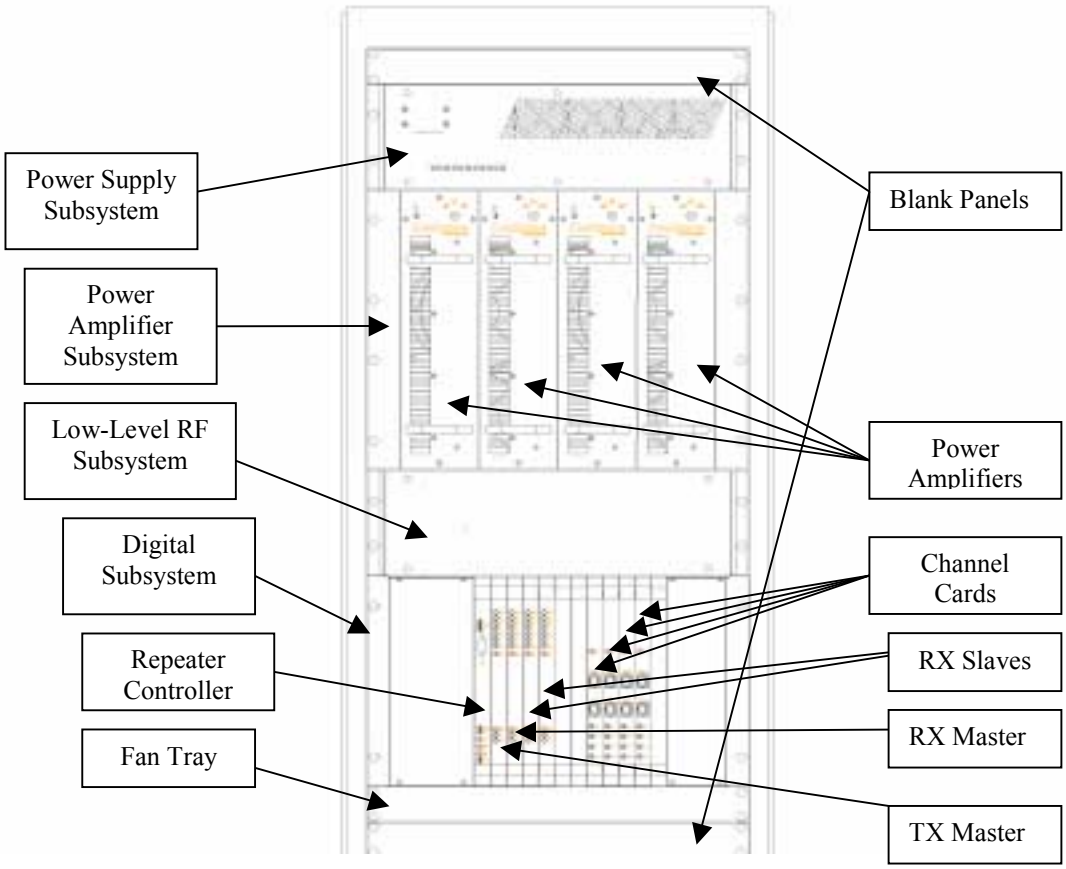
The installation of the Trunk Controllers is described in the Repeater Trunk Controllers Instruction Manual. The installations for the LAN Interface and MODEM are described in the Repeater Data Communications Instruction Manual.

Assembly

The repeater should be assembled as indicated in the following diagram. The repeater, excluding elements like trunk controllers, LAN interface, and modem that are not shown in the diagram, consists of:

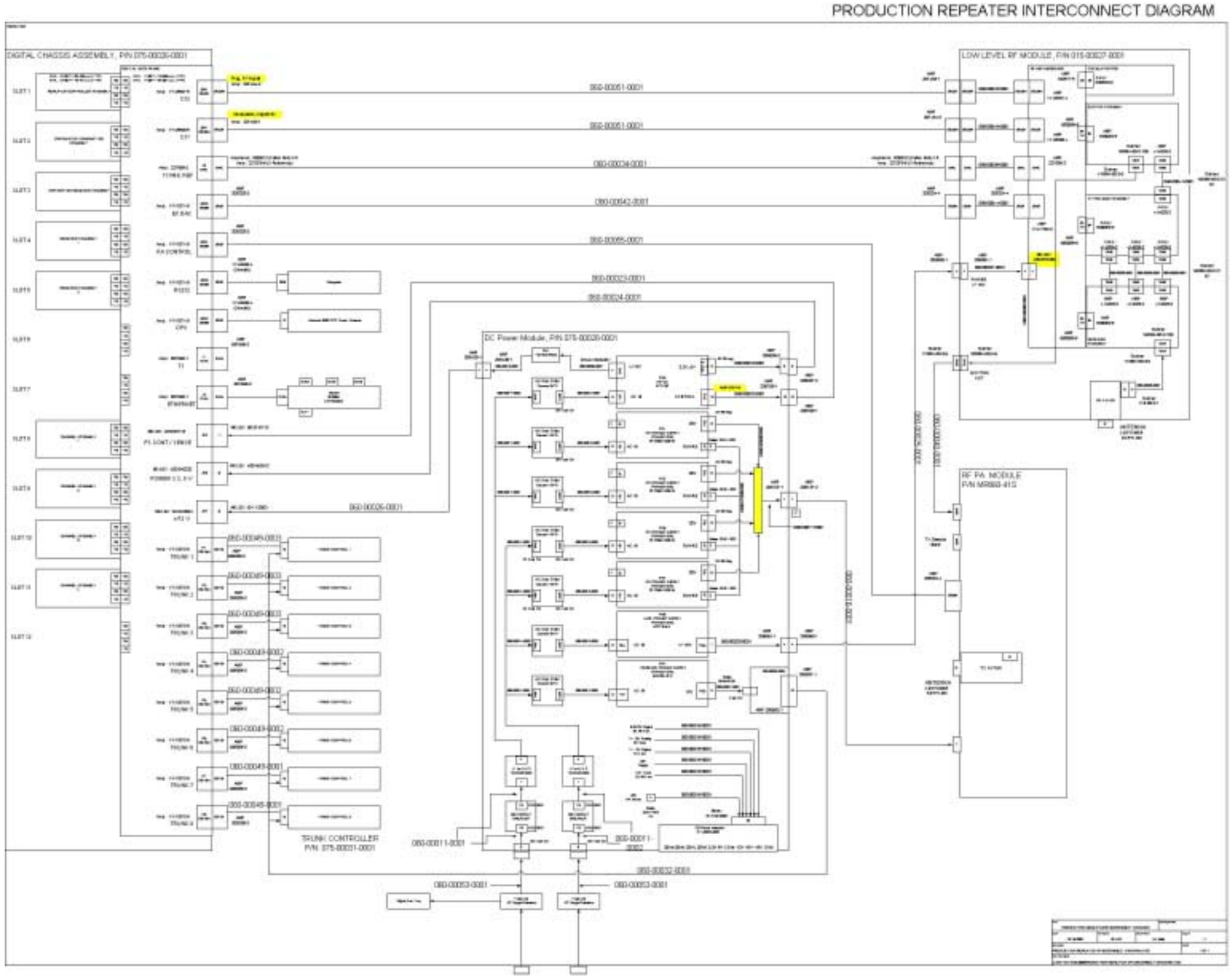
1) AC Power Distribution (not shown – mounted in rear of rack-based system),
2) Power Supply Subsystem,
3) Power Amplifier Subsystem,
4) Low-Level RF Subsystem, and
5) Digital Subsystem.

In a rack-based system, the AC Power Distribution should be mounted in the rear of the rack enclosure with the other four subsystems mounted in the front of the rack enclosure from top-to-bottom in the order listed above. In a relay rack-based system, all five components/subsystems should be mounted top-to-bottom in a relay rack in the order listed above. The following figure shows the rack layout.



The following figure shows the interconnection wiring for the repeater.

PRODUCTION REPEATER INTERCONNECT DIAGRAM



The assembly steps are as follows:

1) The two AC Power Distribution units (Tripp-Lite, IBAR 12/20 Ultra) should be mounted first. In a rack-based system, they will be mounted in the rear of the rack and in relay rack-based system, they will be mounted at the top of the front of the rack. In either case, they must be mounted in close proximity to the Power Supply Subsystem as the interconnect cabling between the units is on the order of one foot.

2) The Power Supply Subsystem (075-00028-0001) should be mounted in the rack next. Space should be left for later installation of a 1U blank panel (300-00056-0001) which is installed above the Power Supply Subsystem. As previously noted, the Power Supply Subsystem must be in close proximity to the AC Power Distribution units.

3) The interconnecting cables (060-00053-0001) between the AC Power Distribution and the Power Supply Subsystem enclosure should be installed next.

4) The Power Amplifier Subsystem enclosure (MR860-41S) should be mounted in the rack next.

5) With the Power Amplifier Subsystem enclosure in place, the four RF power amplifiers (MAF860-25S) should be inserted in the enclosure and retained in place with the captive hardware.

6) The Low-Level RF enclosure (075-00027-0001) should be installed next.

7) The Digital Enclosure with backplane (075-00026-0001) should be installed next.

8) The Fan Tray (Comair Rotron 31038) should be installed next.

9) The two 1U blank panels (300-00056-0001) should be installed at the top and bottom of the installed units.

10) With the subsystem enclosures in place, install the following cables:
    a) PA Power Cable (060-00016-0001)
    b) LLRF Power Cable - +/- 15 VDC(060-00025-0001)
    c) Digital Power Cable (060-00024-0001)
    d) Digital Power Cable - +/- 12 VDC (060-00026-0001)
    e) Digital Power Sense Cable (060-00023-0001)
    f) Trunking Controller Power Cable (060-00032-0001)

11) With the Digital Enclosure installed, the digital cards must be inserted in the following order:
    Note: Proper grounding practice should be followed while inserting all of the digital cards.
    a) The Repeater Controller (050-00003-0200) must be inserted into slot one.
    b) The Tx master (050-00004-0203) must be inserted into slot two.
    c) The Rx master (050-00004-0201) must be inserted into slot three.
    d) The two Rx Slaves (050-00004-0202) must be inserted into slots four and five.
    e) The four Channel Cards (050-00023-0200) must be inserted into slots eight through eleven.

12) Install the following interconnect cables:
    a) Exciter Signal Cable (060-00040-0001)
    b) RF/Digital DB-25 Communications Cable (060-00051-0001)
    c) RF/Digital DB-9 Communications Cable – to PA (060-00055-0001)
    d) RF/Digital DB-9 Communications Cable – to LLRF (060-00042-0001)
    e) RF/Digital Coaxial 13MHz Reference Cable (060-00034-0001)
    f) Two Trunking Controller DB-15 cables (short length) (060-00049-0001)
    g) Three Trunking Controller DB-15 cables (medium length) (060-00049-0002)
    h) Three Trunking Controller DB-15 cables (long length) (060-00049-0003)

i) LAN Adapter Cable (060-00054-0001)

13) The rack should be grounded to a properly installed building ground.

14) Two AC lines of a minimum 20Amp service at 115V must be available for the repeater. These lines should be connected to the AC Power Distribution units.

15) Connect the Rx and Tx connection from the repeater to a duplexer or multicoupler/splitter system.

Basic Operation

After all the cables have been properly connected, the repeater is ready for service.

The transceiver frequency has already been pre-programmed at the factory and is confirmed on the shipping papers.

To begin basic operation, simply follow these steps.

1) Turn on the power switches for the two AC Power Distribution units (Tripp-Lite, IBAR 12/20 Ultra)
2) Turn on the power breakers on the four RF power amplifiers (MAF860-25S).
3) Turn on the main power switch on the Power Supply Subsystem (075-00028-0001).

After an approximately five minute timeout period, the 13MHz ovenized crystal oscillator will be sufficiently stabilized, and the repeater will begin modulating and transmitting a pseudo-random DC/MA signal.

The frequency and other repeater parameters can be checked by connection a computer running a HyperTerminal and typing in the syspar command.

Setting the Receiver Noise Floor

Based on the ambient noise level at the repeater site, it is desirable to determine the noise floor of the site and to set the receiver appropriately. Setting the noise floor allows for the maximum dynamic range of the receiver to be used in decoding the radio signals.

The steps for setting the receiver noise floor are:

1) Using the data logging capability of the repeater, establish the value for the noise floor based on the receive antenna configuration.

2) Using the noise floor value and the table of noise floor values versus receive amplifier voltage settings, select the proper receive amplifier voltage setting and adjust the receiver amplifier voltage to the proper voltage value.

Voltage (VDC)	Attenuation (dB)
0.00	15.1
-0.10	14.8
-0.20	14.5
-0.30	13.9
-0.40	13.6
-0.50	13.4
-0.60	13.0
-0.70	12.7
-0.80	12.0
-0.90	11.6
-1.00	11.2
-1.10	10.7
-1.20	10.3
-1.30	9.2
-1.40	8.6
-1.50	8.1
-1.60	7.2
-1.70	6.5
-1.80	4.6
-1.90	3.6
-2.00	2.7
-2.10	1.8
-2.20	1.0
-2.30	0.2
-2.40	0.1
-2.50	0.0