UNCLASSIFIED

TECHNICAL MANUAL

for

TECHNIMATIC TUNED RECEIVER,

MODELS DDR-5BR, DDR-5BR1

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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IN-338

ISSUE DATE: 15 January 1967

NOTICE

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,* fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

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3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

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1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

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2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

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TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

FOREWORD

The DDR-5BR TechniMatiC* Tuned Receiver is made of one each of twelve major components. These are:

HFRR-2	Continuous RF Tuner
HFSR-1	Control Synthesizer and Standard
HFIA-1	Intermediate Frequency Amplifier
HFAR-1A	Audio Amplifier
HAFR-1	Audio Filter
AFCR-3	Automatic Frequency Control
RGCB-1	Remote Gain Control
RTTD-1	Receiver Decoder
RTMU-2	Signal Data Converter-Storer
HSS-3	Speaker Panel
HFP-1	Power Supply
AK-101	Isolation Keyer

The DDR-5BR1 TechniMatiC Tuned Receiver is made of the same components as is the DDR-5BR, with the following exceptions: the Radio Frequency Tuner is Model HFRR-2B (functionally and physically interchangeable with the HFRR-2) and the Audio Filter is Model HAF-1, the non-remote version of the HAFR-1.

The DDR-5BR manual consists of the following manuals, covering the DDR-5BR system and the individual components:

DDR-5BR system manual
HFR-2 manual (w/addendum describing HFRR-2)
HFS-1 manual (w/addendum describing HFSR-1)
HFI-1 manual (w/addendum describing HFIA-1)
HFA-1 manual (w/addendum describing HFAR-1A)
HAF-1 manual (w/addendum describing HAFR-1)
AFC-3 manual (w/addendum describing AFCR-3)
RGCB-1 manual
RTTD-1 manual
RTMU-2 manual
HSS-3 manual
HFP-1 manual
AK-101 manual

The DDR-5BR1 manual consists of the same manuals as does the DDR-5BR except that the HFRR-2 addendum is replaced with an HFRR-2B addendum and there is no HAFR-1 addendum.

All references to DDR-5BR apply also to the DDR-5BR1 unless otherwise specified.

*Trademark applied for.

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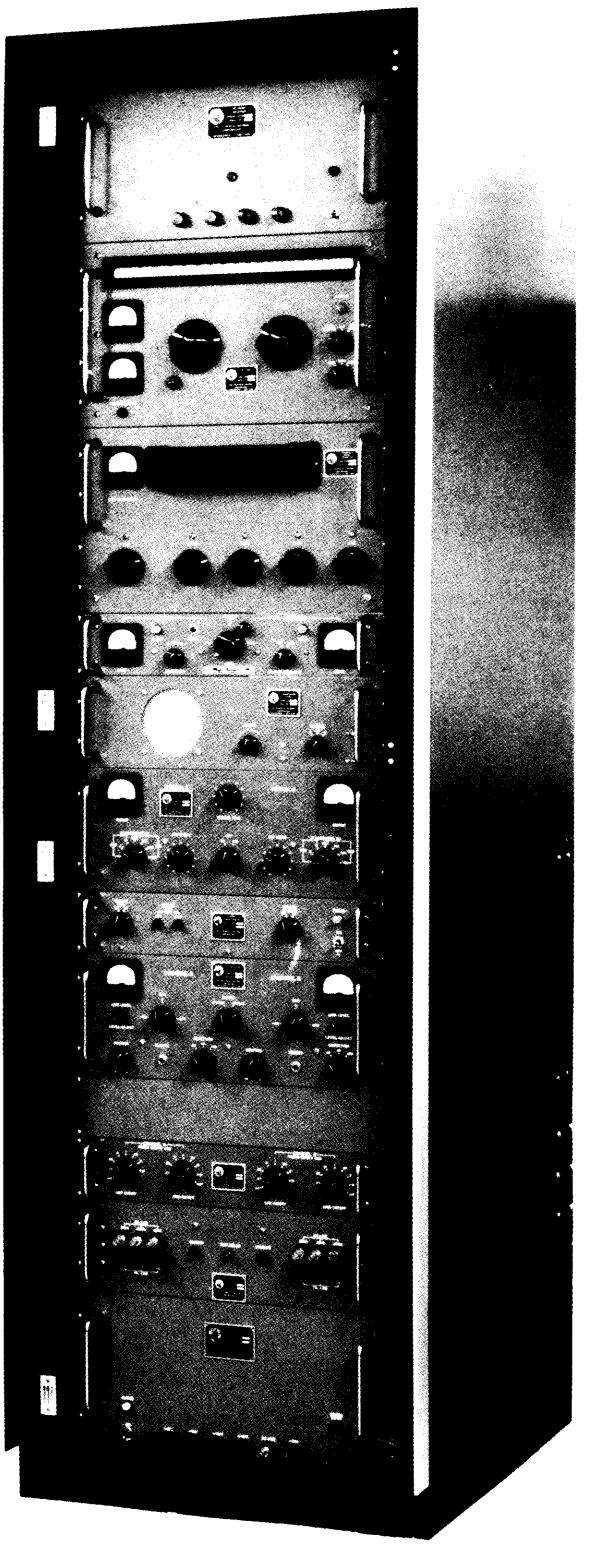

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Figure 1-1. TechniMatiC Tuned Receiver, Model DDR-5BR

SECTION 1
GENERAL INFORMATION

1-1. GENERAL DESCRIPTION

TechniMatiC* Tuned Receiver, Model DDR-5BR, (figure 1-1) is a receiving system covering the frequency range of 2- to 32-mc for the reception of SSB, AM, CW, MCW, FSK, FAX, FM and PM. The DDR-5BR may be tuned either manually or by a combination of 5-bit teletype signals (or equivalent) and analog signals from a remote or local control station, actuating rotary-solenoid decoder switches and servomechanisms in the receiver. Control by teletype signal makes the receiver adaptable to preprogrammed punched cards or punched tape for automatic tuning from remote or local equipment as well as remote keyboard control by radio or wire telegraph transmission. Tuning time from receipt of a receiver-tuned function (E) code is 20 seconds maximum.

The 2- to 32-mc range covered by the DDR-5BR is divided into eight r-f bands, with synthesized coverage in 100-cps steps.

The DDR-5BR comprises various modular units (refer to paragraph 1-2) mounted in a single rack and is used in fixed-station or mobile communication systems. Figures 1-1 and 2-1 illustrate the chassis locations of the modular units that are contained in the DDR-5BR.

When tuning the receiver from a remote control station, a readback of control positions is sent to the remote station.

An alignment signal, an internally generated low-level r-f signal from the synthesizer (HFSR), facilitates accurate and rapid tuning of the complete system in the absence of any received signal. This locally generated signal is also usable as a maintenance tool for checking the alignment of the DDR-5BR.

All major components are mounted on drawer slides. The rack has its own forced-air cooling system using squirrel cage blowers and washable air filters in the rack intake and exhaust.

1-2. DESCRIPTION OF UNITS

a. GENERAL. - Paragraphs b through m below give a brief description of the modular units used in the DDR-5BR. For more detailed information pertaining to any of these units, refer to the individual modular-unit manuals.

All tuning controls (except the MANUAL GAIN and BFO controls) are rotary type for either manual or stepping-switch operation. All such controls consist of a front-panel function switch with a stepping wafer, readback wafer, and rotary solenoid attached to the shaft. The stepping wafer receives an "action function" code (refer to table 1-2) from Receiver Decoder RTTD and activates the rotary solenoid which in turn rotates the control to the proper position. When the control has reached its proper position, the readback wafer provides an appropriate indication to Signal Data Converter Storer RTMU for remote monitoring purposes. Automatic r-f tuning occurs from the action of a servo-mechanism.

b. RECEIVER DECODER, MODEL RTTD-1. - Receiver Decoder RTTD receives 5-bit character codes from Signal Data Converter Storer RTMU and: (1) decodes addressal functions (refer to table 1-2) into control locations on the receiver; (2) routes the subsequent action function code to the associated control. The RTTD also contains the servo amplifier and sequential relays that control the servo motors in Continuous RF Tuner HFRR. The RTTD has a self-contained power supply which is triggered by Signal Data Converter-Storer RTMU.

c. CONTINUOUS RF TUNER, MODEL HFRR-2, -2B**- Continuous RF Tuner HFRR provides coverage from 2- to 32-mc in eight bands, and displays the tuned frequency on a 14-inch slide-rule dial. The Oscillator in Continuous RF Tuner HFRR may or may not (depending upon operational requirements) utilize a synthesized control voltage from control synthesizer and standard HFSR. However, in remote control only synthesized operation is possible. The HFRR obtains its operating voltages from Power Supply HFP.

d. CONTROL SYNTHESIZER AND STANDARD, MODEL HFSR-1. - Control Synthesizer and Standard HFSR monitors the high-frequency oscillator in Continuous RF Tuner HFRR and provides correction voltage to maintain the free-running oscillator to a stability of 1 part in 10^8 for a 24-hour period. The frequency of the incoming r-f signal to the receiver is displayed on front-panel 1-inch high, illuminated numerals. Change of frequency in 100-cps increments is accomplished by means of detented switches (in manual control) or code inputs (in remote control). The HFSR obtains its operating voltages from Power Supply HFP.

*Trademark applied for.
**HFRR-2 in DDR-5BR; HFRR-2B in DDR-5BR1.

e. AUTOMATIC FREQUENCY CONTROL, MODEL AFCR-3. - Automatic Frequency Control AFCR contains the 2-mc and 250-kc injection frequency oscillators for the second and third mixer stages in the receiver. Remote analog-signal control for variation of the 2-mc oscillator frequency produces changes in audio-frequency pitch (bfo control) in CW reception.

In SSB, in which the signal contains a full- to partially-suppressed carrier, the AFCR provides automatic frequency control by locking onto the carrier component. The AFCR provides drift-corrected injection frequencies to IF Amplifier HFIA and Audio Amplifier HFAR in order to compensate for carrier drift thus maintaining the audio output of the receiver correct to within one cycle. Synchronizing the AFCR with the incoming signal is accomplished by the same remote control used for bfo adjustment.

f. SPEAKER PANEL, MODEL HSS-3. - Speaker Panel HSS houses a single speaker and is used to monitor the output of Audio Amplifier HFAR.

g. IF AMPLIFIER, MODEL HFIA-1. - IF Amplifier HFIA accepts a 1.75-mc input signal from Continuous RF Tuner HFRR, processes the signal through dual (channel A & B) front-panel selectable sideband or symmetrical filters and converts this signal to 250-kc for further demodulation in Audio Amplifier HFAR. The HFIA obtains its operating voltages from Power Supply HFP.

h. AUDIO AMPLIFIER, MODEL HFAR-1A. - Audio Amplifier HFAR accepts the 2-channel 250-kc output from IF Amplifier HFIA and independently detects the audio information by a diode detector (AM) or a product detector (SSB, CW). The audio outputs from the detectors are extended to contacts on the rear of the HFAR where an audio filter may or may not be inserted into the signal path.

i. AUDIO FILTER, MODEL HAFR-1, HAF-1*. - The two audio outputs from Audio Amplifier HFAR are independently extended through adjustable bandpass filters within the audio filter (HAF or HAFR) where the upper and lower audio-frequency limits of either channel (A or B) can be selected before final amplification. Filter bandpass adjustment is accomplished by means of two 8-position switches the first seven positions provide varying degrees of frequency response (from .1 kc to 10 kc); the eighth position removes Audio Filter HAF from the circuit. The HAF is a passive device requiring no power.

j. POWER SUPPLY, MODEL HFP-1. - Power Supply, HFP converts line voltage into regulated B+, regulated bias voltages, and filament voltages for the entire DDR system, with the exception of the RTTD, RTMU and RGCB units. The HFP also furnishes power for the HFSR 1-mc frequency standard and crystal ovens throughout the DDR system. The STANDBY positions of manually-operated MAIN POWER and POWER switches in the HFP and in Audio Amplifier HFAR respectively may be used to maintain operating voltages to all ovens contained within the receiver, while all other power voltages are turned off.

k. SIGNAL DATA CONVERTER-STORER, MODEL RTMU-2. - Signal Data Converter-Storer RTMU receives the coded 5-bit teletype pulse input (representing the remote tuning directions) to the DDR receiver system and: (1) rejects all character-recognition codes except the code for which it is programmed thus opening its memory cores only for the subsequent tuning-direction codes addressed to its associated receiver; (2) stores tuning-direction codes until a receiver-tune ("E") code is received; (3) releases all stored information to Receiver Decoder RTTD upon receipt of an "E" code; (4) provides control-position readback information. The RTMU has a self-contained power supply that is connected to the line-voltage strip in the rack.

l. REMOTE GAIN CONTROL, MODEL RGCB-1. - Remote Gain Control RGCB receives two separate analog signals from a remote control station and converts these analog signals into a-c and d-c control voltages that are used for receiver r-f gain and bfo adjustment.

m. ISOLATION KEYER, MODEL AK-101. - Isolation Keyer AK-101 receives neutral (60 ma) or polar (60 or 20 ma) keyed signals and converts these signals to dry-contact keying input for Signal Data Converter-Storer RTMU. The AK-101 also provides isolation between 2 or more RTMU units thus allowing operation of many DDR receivers on one teletype loop.

1-3. TECHNICAL SPECIFICATIONS

Table 1-1 lists the technical specifications that are pertinent to the DDR-5BR. For technical specifications concerning the modular units in the receiver, refer to the individual modular-unit manuals.

TABLE 1-1. DDR-5BR, DDR-5BR1 TECHNICAL SPECIFICATIONS

a. Frequency Range	2 to 32 mcs, synthesized in 100-cps steps.

*HAFR in DDR-5BR

TABLE 1-1. DDR-5BR, 5BR1 TECHNICAL SPECIFICATIONS (CONT)

b. Tuning	DDR can be tuned to any one of eight RF bands as listed below: BAND 1 2-3 mc BAND 2 3-4 mc BAND 3 4-6 mc BAND 4 6-8 mc BAND 5 8-12 mc BAND 6 12-16 mc BAND 7 16-24 mc BAND 8 24-32 mc
c. Modes of Operation	SSB, ISB, AM, CW, MCW, FSK, FAX, FM and PM.
d. Stability	Synthesized stability of 1 part in 10^8 for 24 hours for a change in ambient temperature of 15°C within the limits of 0 to 50 degrees for CW reception. For AM and SSB reception with afc, the residual audio output will remain within 1 cycle of the transmitted intelligence.
e. RF Signal Input Impedance	Nominal 50 ohms, unbalanced.
f. Noise Figure and Sensitivity	6 db or better over the band, i.e.; with a luv signal and a 7.5 KC bandwidth, the output signal to noise ratio is 15 db or better.
g. Intermodulation	Intermodulation products are down 60 db from the maximum tone in the desired sideband as a result of two signals in the unwantedd sideband.
h. Image Ratio	80 db referenced to luv input signal.
i. Spurious Response, as defined by CCIR	Better than 100 db referenced to luv. For synthesized operation, all spurious will be no greater than .01uv when referred to the antenna.
j. IF Rejection	Better than 80 db average.
k. AFC Characteristics	Automatic Frequency Control compensates for transmitter/receiver frequency drift. AFC locks onto carrier suppressed to maximum of 30 db below PEP* and will remain synchronized for approximately ±750 cps at a maximum drift rate at 10 cps per second. A memory circuit will maintain tuning position during signal fades. Audio output is within 1 cycle of transmitted intelligence.
l. IF Selectivity	Seven optional bandwidths selected from the following: 1. 250 to 7500 cps usb ±1.5 db 2. 250 to 7500 cps lsb ±1.5 db 3. 250 to 3500 cps usb ±1.5 db 4. 250 to 3500 cps lsb ±1.5db 5. 250 to 6000 cps usb ±1.5 db 6. 250 to 6000 cps lsb ±1.5 db 7. 1 kc symmetrical ±1.5 db 8. 6 kc symmetrical ±1.5 db 9. 15 kc symmetrical ±1.5 db

* When PEP =5-microvolt minimum input signal at the antenna.

TABLE 1-1. DDR-5BR, 5BR1 TECHNICAL SPECIFICATIONS (CONT)

m. AGC	Output remains within plus or minus 1.5 db for a 100 db change in input within the input voltage range of 1 uv to .1 volt. The agc circuit has a fast attack time and a front panel adjustable decay time from 1 to 10 seconds.* The agc voltage is derived from the strongest of 2 i-f channel signals.
n. Phase Distortion	The system is capable of receiving pulse or phase information without seriously degrading intelligence when the 15 kc symmetrical i-f strip of IF Amplifier HFIA-1 is used in synthesized operation.
o. Audio Amplifier	Plus or minus 1.5 db, 20 cps to 20 KC. Bandpass is dependent on filter selected.
p. Audio Frequency Distortion	Intermodulation products are down at least 40 db through the audio channels.
q. Adjustable Audio Filtering *	Passive audio filters provide adjustable low pass and high pass cutoff points at approximately: 100 cps 2.5 KC 250 cps 5.0 KC 500 cps 10 KC 1 KC
r. Audio Output	One 600 ohm balanced and center-tapped 1-mw output per receiver channel. One 4-watt monitor speaker. One headset monitor jack output per receiver channel.
s. Hum Level	Minus 50 db at 1 watt audio output.
t. Remote Tuning Input (Digital)	Keying for serial pulses in 7.42-unit teletype transmission pattern with 22 millisecond (60 WPM) or 13.7 millisecond (100 WPM) pulse widths**, selected by printed circuit card insertion. 60 ma neutral, polar, or 20 ma polar.
u. Remote Tuning Input Teletype Codes	See table 1-2.
v. Remote Tuning Input (Analog)	±5 VDC for r-f gain; ±5 VDC for bfo.
w. Remote Tuning Readback Output	Dry Contact keying through polar relay for serial pulses in 7.42-unit teletype transmission pattern. 60 WPM or 100 WPM transmission speed, selected by printed circuit card insertion**. Constant cycling of 8 position codes. Relay contacts closed in mark (1) condition, opened in space (0) condition.
x. Remote Tuning Readback Output Codes	See table 1-3.
z. Temperature and Humidity	The equipment is designed to operate in an ambient temperature of 0° to 50°C and any value of relative humidity up to 90%.

* Locally adjusted only on DDR-5BR1.
** As specified.

TABLE 1-2. REMOTE TUNING INPUT CODE, DDR-5BR

CODE RECEPTION ORDER*	ADDRESSAL FUNCTION CODE	ACTION FUNCTION CODE	5-BIT CODE	TELETYPE CHARACTERS	
				CCIT	ASCII**
1	Character Recognition		2 Codes (see table 1-4)		
2	HFRR BAND & TUNING controls and HFSR MC switch (2-16 MC)		11001	W	Y
	HFRR BAND & TUNING controls and HFSR MC switch (17-31 MC)		10001	Z	Q
3		2 or 17 MC	01001	L	I
		3 or 18 MC	01000	Line Feed	H
		4 or 19 MC	00100	Space	D
		5 or 20 MC	01100	I	L
		6 or 21 MC	01010	R	J
		7 or 22 MC	01110	C	N
		8 or 23 MC	01101	P	M
		9 or 24 MC	01111	V	O
		10 or 25 MC	00110	N	F
		11 or 26 MC	00111	M	G
		12 or 27 MC	01011	G	K
		13 or 28 MC	00011	O	C
		14 or 29 MC	00101	H	E
		15 or 30 MC	00001	T	A
		16 or 31 MC	00010	Carriage Return	B
4	HFSR 100 KC switch		10011	B	S
5		0	01000	Line Feed	H
		1	00100	Space	D

* Except for the 1st and 20th character, characters may be received in any order, as long as the corresponding action function character follows its addressal function character. However, quickest tuning results are obtained by the reception of the characters in the order shown.

** With first 5 bits of 7-bit code transmitted in reverse.

TABLE 1-2. REMOTE TUNING INPUT CODE, DDR-5BR (CONT)

CODE RECEPTION ORDER	ADDRESSAL FUNCTION CODE	ACTION FUNCTION CODE	5-BIT CODE	TELETYPE CHARACTERS	
				CCIT	ASCII*
5 (CONT)		2	00010	Carriage Return	B
		3	01001	L	I
		4	01100	I	L
		5	00110	N	F
		6	01011	G	K
		7	01101	P	M
		8	01110	C	N
		9	00111	M	G
6	HFSR 10 KC Switch		10010	D	R
7		0-9	Same as 5th Code		
8	HFSR 1 KC Switch		10111	X	W
9		0-9	Same as 5th Code		
10	HFSR .1 KC switch		10101	Y	U
11		0-9	Same as 5th Code		
12	HFIA CH A & B BAND-WIDTH KC switches		11111	None	←
13		1 DSB	01000	Line Feed	H
		6 DSB	00100	Space	D
		15 DSB	00010	Carriage Return	B
		3.5 U SSB	01001	L	I
		3.5 L SSB	01100	I	L
		7.5 U SSB	00110	N	F
		7.5 L SSB	01011	G	K
		OFF	01101	P	M

* With first 5 bits of 7-bit code transmitted in reverse.

TABLE 1-2. REMOTE TUNING INPUT CODE DDR-5BR (CONT)

CODE RECEPTION ORDER	ADDRESSAL FUNCTION CODE	ACTION FUNCTION CODE	5-BIT CODE	TELETYPE CHARACTERS	
				CCIT	ASCII*
14	HFAR CH A & B DETECTION switches		11011	None	⊏
15		AM	01000	Line Feed	H
		CW	00100	Space	D
		SSB	00010	Carriage Return	B
16	HAFR CHA & CHB LOW CUTOFF switches**		11010	J	Z
17		OUT	00001	T	A
		.1 KC	01000	Line Feed	H
		.25 KC	00100	Space	D
		.5 KC	00010	Carriage Return	B
		1 KC	01001	L	I
		2.5 KC	01100	I	L
		5 KC	00110	N	F
		10 KC	01011	G	K
18	HFAR CH A & CH B HIGH CUTOFF Switches**		10100	S	T
19		.1 KC	01000	Line Feed	H
		.25 KC	00100	Space	D
		.5 KC	00010	Carriage Return	B
		1 KC	01001	L	I
		2.5 KC	01100	I	L
		5 KC	00110	N	F
		10 KC	01011	G	K
		OUT	01101	P	M
20		Receiver tune	10000	E	P

* With first 5 bits of 7-bit code transmitted in reverse.
** On DDR-5BR only.

TABLE 1-3. REMOTE TUNING READBACK OUTPUT CODE, DDR-5BR

CODE TRANSMISSION ORDER	CONTROL	POSITION INDICATED	5-BIT CODE	TELETYPE CHARACTERS	
				CCIT	ASCII*
1	To reset readback indicator panel for new cycle		10000	E	P
2	HFRR BAND & TUNE controls and HFSR MC switch	2 MC	11001	W	Y
		3 MC	11000	A	X
		4 MC	10100	S	T
		5 MC	11100	U	\
		6 MC	11010	J	Z
		7 MC	11110	K	↑
		8 MC	11101	Q	]
		9 MC	11111	Letters	←
		10 MC	10110	F	V
		11 MC	10111	X	W
		12 MC	11011	Figures	[
		13 MC	10011	B	S
		14 MC	10101	Y	U
		15 MC	10001	Z	Q
		16 MC	10010	D	R
		17 MC	01001	L	I
		18 MC	01000	Line Feed	H
		19 MC	00100	Space	D
		20 MC	01100	I	L
		21 MC	01010	R	J
		22 MC	01110	C	N
		23 MC	01101	P	M
		24 MC	01111	V	O
		25 MC	00110	N	F
		26 MC	00111	M	G
		27 MC	01011	G	K
		28 MC	00011	O	C

* With first 5 bits of 7-bit code transmitted in reverse.

TABLE 1-3. REMOTE TUNING READBACK OUTPUT CODE, DDR-5BR (CONT)

CODE TRANSMISSION ORDER	CONTROL	POSITION INDICATED	5-BIT CODE	TELETYPE CHARACTERS	
				CCIT	ASCII*
2 (CONT)		29 MC	00101	H	E
		30 MC	00001	T	A
		31 MC	00010	Carriage Return	B
3	HFSR 100 KC switch	0	01000	Line Feed	H
		1	00100	Space	D
		2	00010	Carriage Return	B
		3	01001	L	I
		4	01100	I	L
		5	00110	N	F
		6	01011	G	K
		7	01101	P	M
		8	01110	C	N
		9	00111	M	G
4	HFSR 10 KC switch	0-9	Same as 3rd Code		
5	HFSR 1 KC switch	0-9	Same as 3rd Code		
6	HFSR .1 KC switch	0-9	Same as 3rd Code		
7	HFIA CH A & B IF BANDWIDTH KC switches	1 DSB	01000	Line Feed	H
		6 DSB	00100	Space	D
		15 DSB	00010	Carriage Return	B
		3.5 U SSB	01001	L	I
		3.5 L SSB	01100	I	L
		7.5 U SSB	00110	N	F
		7.5 L SSB	01011	G	K

* With first 5 bits of 7-bit code transmitted in reverse.

TABLE 1-3. REMOTE TUNING READBACK OUTPUT CODE, DDR-5BR (CONT)

CODE TRANSMISSION ORDER	CONTROL	POSITION INDICATED	5-BIT CODE	TELETYPE CHARACHTERS	
				CCIT	ASCII*
8	HFAR CH A & B DETECTION switch	AM	01000	Line Feed	H
		CW	00100	Space	D
		SSB	00010	Carriage Return	B
9	**HAFR CH A & CH B LOW CUTOFF switches	OUT	00001	T	A
		.1 KC	01000	Line Feed	H
		.25 Kc	00]00	Space	D
		.5 kc	00010	Carrier Return	B
		1 KC	01001	L	I
		2.5 KC	00110	I	L
		5 KC	00110	N	F
		10 KC	01011	G	K
10	**HAFR CH A & CH B HIGH CUTOFF switches	.1 KC	01000	Line Feed	H
		.25 KC	00100	Space	D
		.5 KC	00010	Carriage Return	B
		1 KC	01001	L	I
		2.5 KC	01100	I	L
		5 KC	00110	N	F
		10 KC	01011	G	K
		OUT	01101	P	M
11	Receiver "in tune process"		00100	Space	D
	Receiver "ready"		00001	T	A

* With first 5 bits of 7-bit code transmitted in reverse
**DDR-5BR only.

TABLE 1-4. CHARACTER RECOGNITION CODES

RTRS PUSHBUTTON	5-BIT CODE	CCIT TELETYPE CHARACTER	ASCII* TELETYPE CHARACTER
A	10101	Y	U
B	10110	F	V
C	11010	J	Z
D	11001	W	Y
E	10011	B	S
F	11100	U	/
G	10100	S	K
H	10010	D	R
I	10001	Z	Q
J	11000	A	X
1	01010	R	J
2	01001	L	I
3	00101	H	E
4	00110	N	F
5	01100	I	L
6	00011	O	C
7	01011	G	K
8	01101	P	M
9	01110	C	N
10	00111	M	G

*With first 5 bits of 7-bit code transmitted in reverse.

NOTE

Each DDR has a different character recognition code (a double 5-bit code as specified on order). The first code represents a letter and the second a numeral, both corresponding with the pushbuttons on TMC's RTRS code transmitting equipment. Available codes are as shown in table 1-4 above. The letter and numeral appear printed on the RTMU Z5003 printed circuit card.

SECTION 2
INSTALLATION

2-1. UNPACKING AND HANDLING

Inspect the DDR packing cases for possible damage when they arrive at the operating site. With respect to equipment damage for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts. Inspect the packing material for parts that may have been shipped as loose items. Most of the cable assemblies used in the DDR are mounted in the rack and taped in place.

2-2. RACK LOCATION

Figures 2-1, 2-2, 2-3, and 2-4 show mounting dimensions, clearances and particulars involving the location and installation of the DDR rack. For mobile operation, the rack may be bolted to the floor of mounting base using holes shown in figure 2-3. For vibration problems, a shock-mounting kit is available on order. Locate the receiver in a room or compartment with adequate ventilation. The DDR has its own cooling blowers with a filtered air intake and exhaust as shown in figure 2-4.

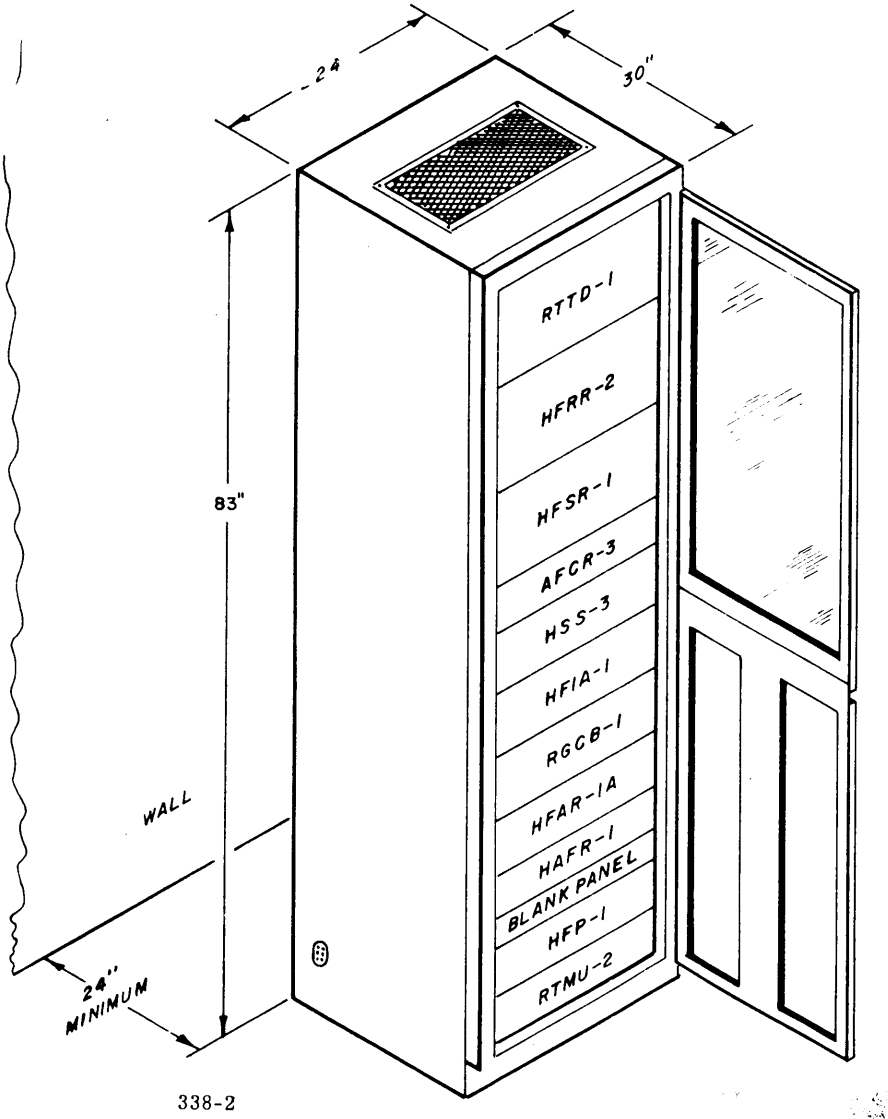


Figure 2-1. Modular Unit Location and Overall Dimensions.

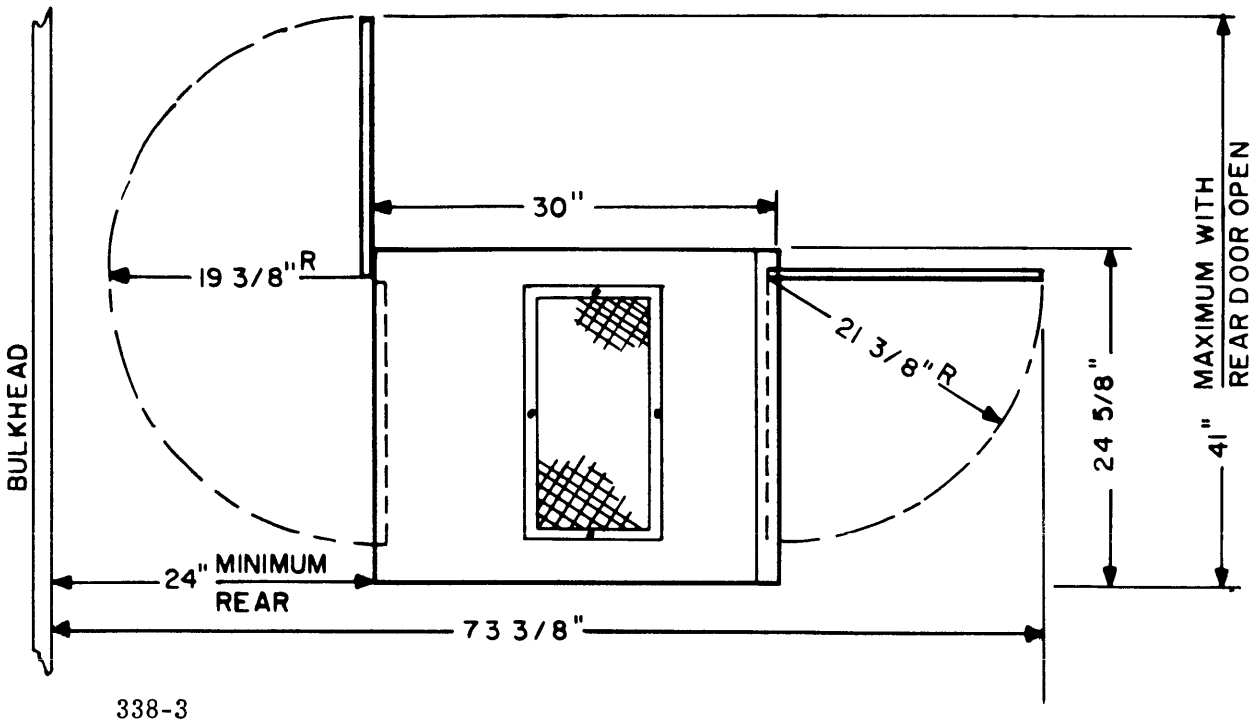


Figure 2-2. Top View of DDR-5BR

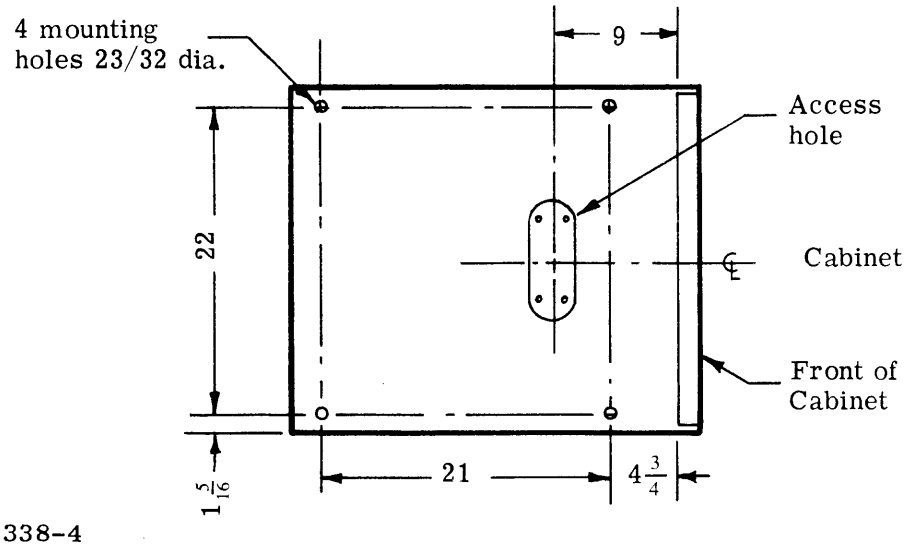


Figure 2-3. Bottom View of DDR-5BR

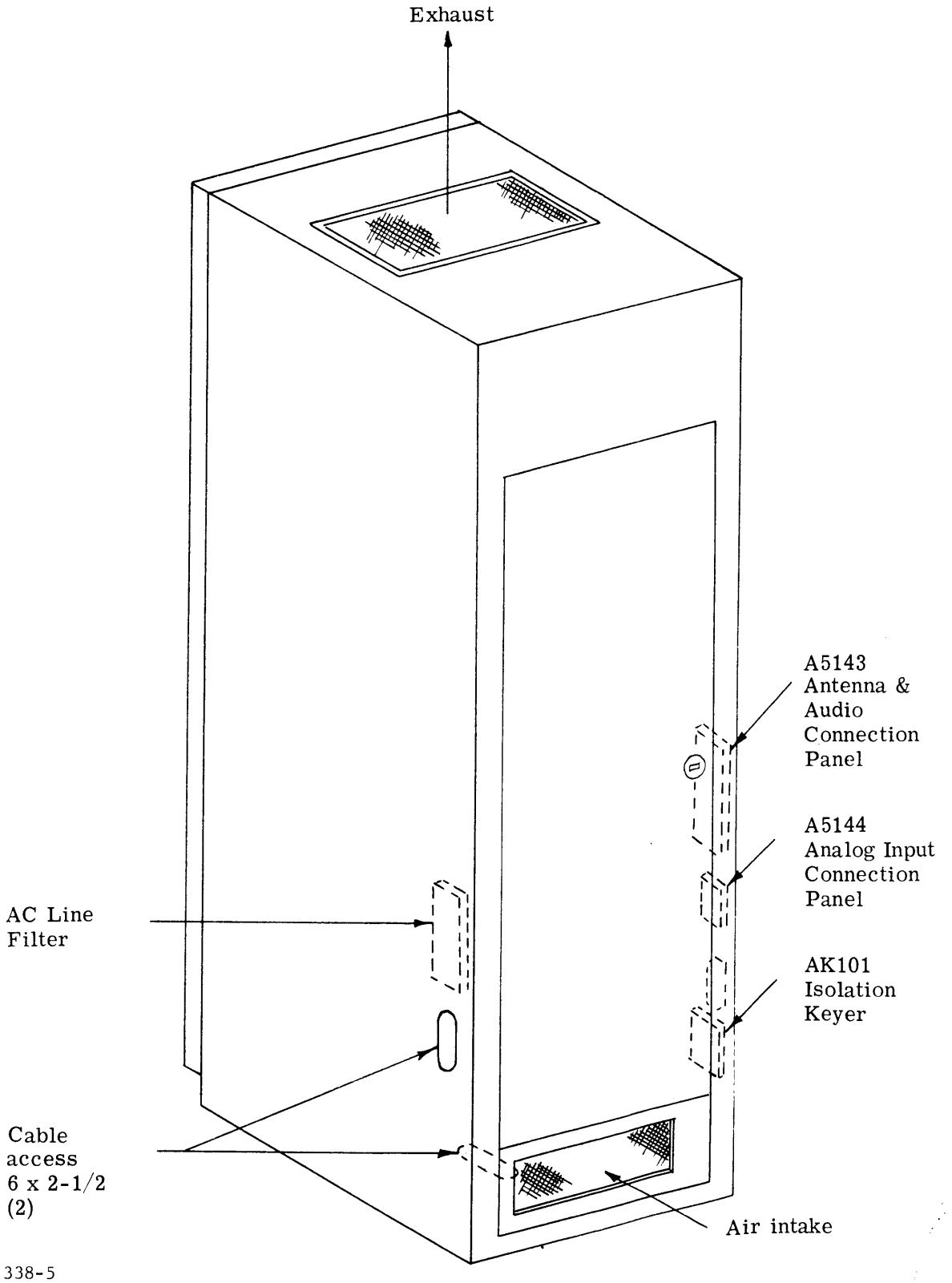


Figure 2-4. Rear Angle View of DDR-5BR with External Cabling Points

2-3. POWER REQUIREMENTS

All units of the DDR leave the factory wired for 115 volt, 50/60 cycle operation; change may be made to 230 volt, 50/60 cycle operation by making minor wiring changes. Consult the installation section of the individual manual for each unit receiving line voltage (i.e. HFP, RTMU, RTTD, RGCB, and AFCR). Also change the wiring of Blower Panel AX-390 in the rear of the rack as shown in figure 2-9 at the end of this section.

CAUTION

If 230 volt, 50/60 cycle operation is used, all line fuses must be reduced to one half their rated current values to assure adequate circuit protection.

Power consumption of the DDR is approximately 1000 watts; power cabling of sufficient size to provide 10 amperes at 115 vac, single phase, is adequate for each receiver.

2-4. INSTALLATION

a. INSTALLATION OF MODULAR UNITS. - Refer to figure 2-1 for information regarding location of all modular units. All major units are slide mounted on tilt-lock drawer slides. To install any slide-mounted unit in its compartment, refer to figure 2-5 and proceed as follows:

(1) Untape or unstrap cable assemblies and all other components secured to the rack frame for shipment.

CAUTION

Start by installing bottom units first per steps 2 through 6 in order to avoid rack tipping over from extended center of gravity.

(2) Pull center section of associated compartment track out until it locks in an extended position.

(3) Position slide mechanisms of modular unit in tracks, and ease modular unit forward into rack until release buttons engage holes in track.

(4) Make the necessary cable and electrical connections as described in paragraph 2-4c. To prevent cables from snagging when modular units are slid in or out of rack, utilize the reel-mounted clamps located inside the rack as shown in figure 2-6.

(5) Depress release buttons and slide modular unit completely into compartment.

(6) Secure front panel of modular unit to rack with screws.

b. REMOTE TUNING & READBACK SPEED SELECTION: Remote tuning input and readback output information is adjustable to either 60 WPM or 100 WPM by inserting printed circuit cards in the memory and readback card bins of the RTMU. The DDR is shipped with the 60 WPM cards installed in the bins (Unless otherwise specified on order.) Clock circuit card Z5001 with a "60 WPM" decal is installed in J5008 receptacle of the memory bin; card number Z5015 with a "60 WPM" decal is installed in J5022 receptacle in the readback bin. Z5001 and Z5015 cards with "100 WPM" decals are available on order.

NOTE

60 and 100 WPM refers to the speed of character transmissions from the RTMU readback output, based on 5 characters to a word, with each character immediately following the other. In the RTMU tuning input, however, the 60 and 100 WPM refers to the two pulse widths (22 and 13.7 milli-seconds, respectively) associated with these speeds, within each character. The characters themselves may be fed into the RTMU at any speed or timing.

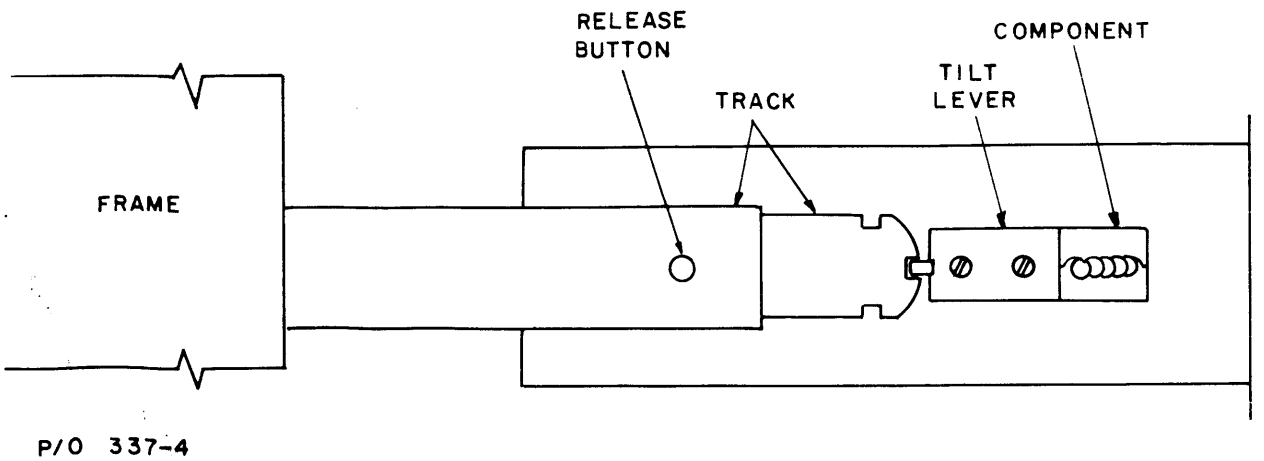


Figure 2-5. Slide Mounting Details

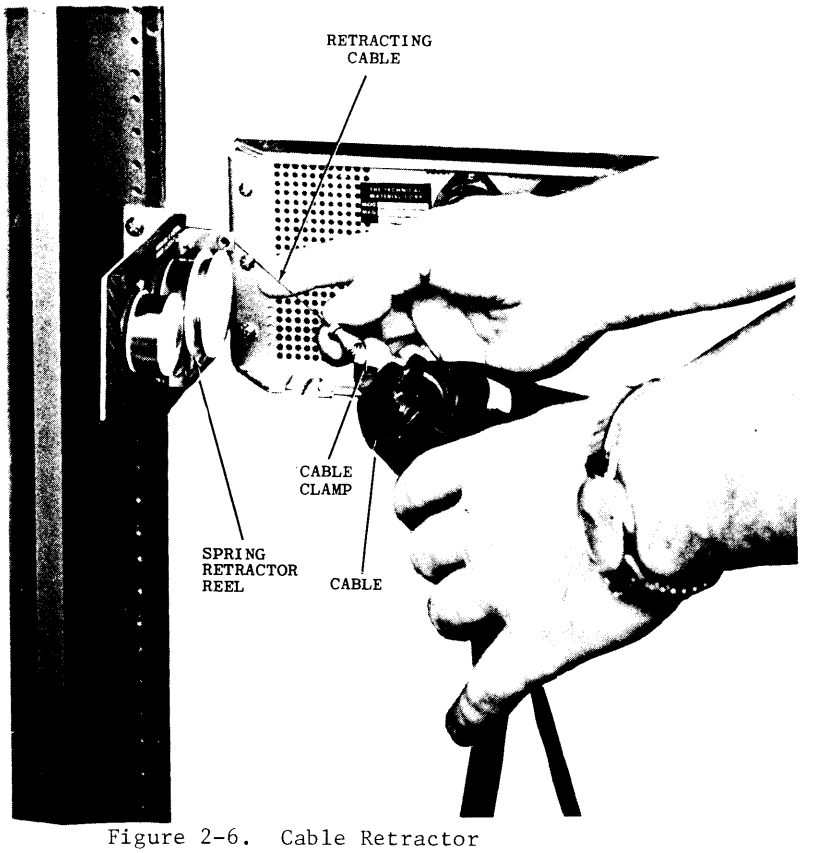


Figure 2-6. Cable Retractor

c. ELECTRICAL CONNECTIONS. - Make electrical connections as indicated in figures 2-7, 2-8, and 2-9.

d. CONNECTION OF EXTERNAL EQUIPMENT

(1) ANTENNA. - The DDR is normally used with a sloping V, rhombic, or log-periodic antenna. The antenna input to the receiver is 50 ohms, unbalanced. Make antenna connections at ANTENNA connector CP3001, located on A5143 vertical panel inside rack rear service door at right. CP3001 is a receptacle for a QDS (quick disconnect) series r-f coaxial plug. TMC #PL-149 QDS plug is supplied in shipment for this purpose. TMC #SA-105 QDS-to-BNC adapter and #UG-88/U BNC plug are also supplied to provide a BNC connection, if preferable.

(2) AUDIO LOADS. - Connect 600-ohm loads for channels A and B 0-1 mw audio outputs at terminals 7,8,9,11,12 and 13 of TB3001 terminal block on A5143 vertical panel. See figure 2-8 for connections of balanced or unbalanced loads.

(3) REMOTE TUNING DIGITAL SIGNAL SOURCE- Connect teletype tuning-code keying input at terminal 1 and 2 of TB9501 terminal block on Isolation Keyer AK-101 located inside rack rear service door at right. See figure 2-8 (shown for 60 ma neutral) for connection details. The AK-101 represents 25K resistance across the teletype equipment output. To obtain the 60 ma current and a 12 volt drop across the AK-101, insert a 200-ohm resistor across TB9501 terminals 1 and 2.

(4) REMOTE TUNING ANALOG SIGNAL SOURCE. Connect the ±5 VDC bfo and r-f gain analog signal inputs at r-f BNC connectors J3004 (REMOTE BFO INPUT) and J3005 (REMOTE RF GAIN INPUT) on A5144 vertical panel located inside rack service door at right. See figure 2-8 for connection details. Two TMC #UG-88/U mating BNC plugs are supplied in shipment for this purpose.

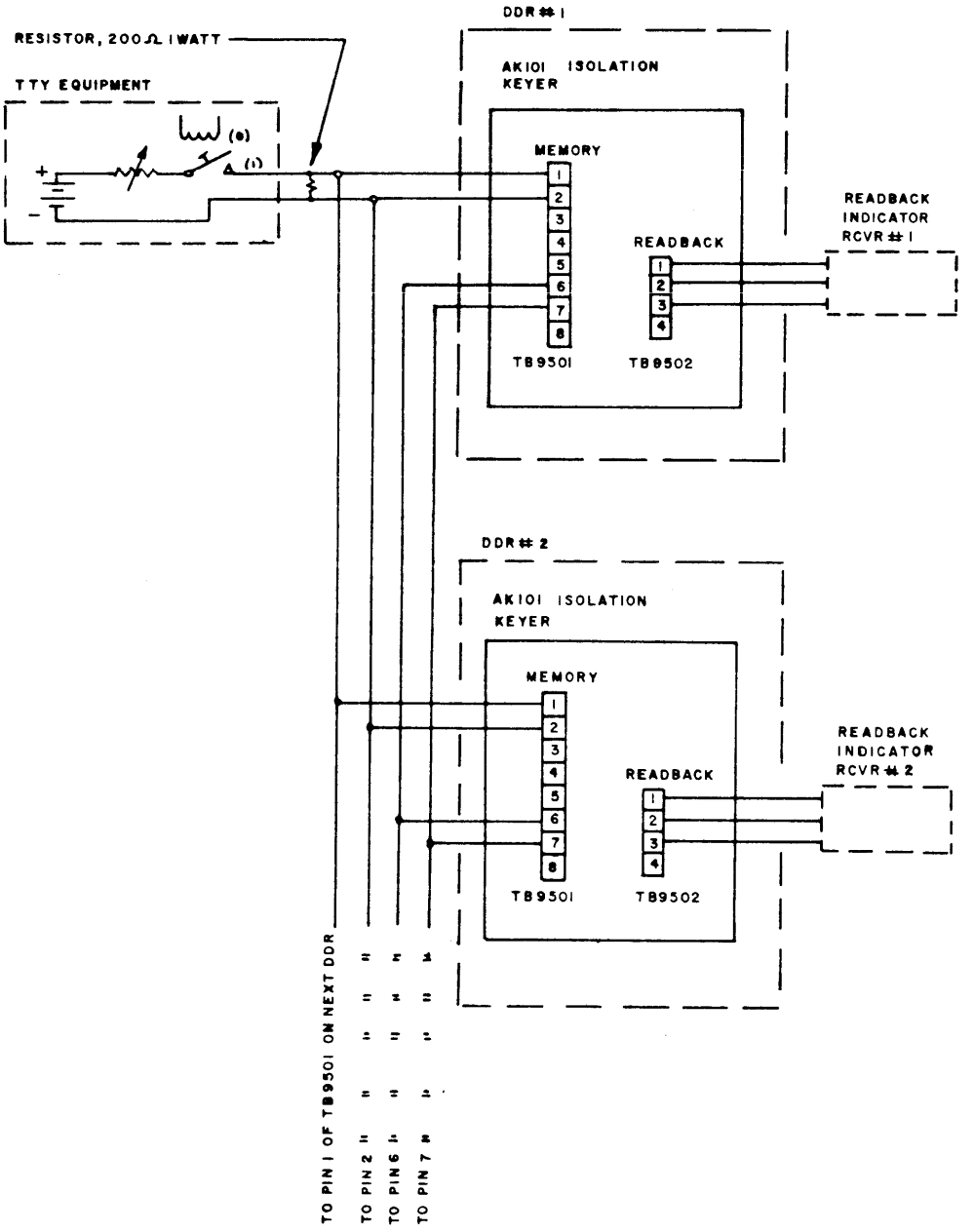
(5) REMOTE TUNING DIGITAL READBACK INDICATOR.- Connect remote-tuning teletype readback keying output at terminals 1, 2 and 3 of TB9502 terminal block on AK-101 Isolation Keyer assembly. See figure 2-8 for connection details.

(6) MULTIPLE RECEIVER SITES. - When more than one DDR is controlled by the same remote-control station, make connections as shown in figure 2-7. Jumper the teletype tuning code keying inputs together from the common signal source (teletype equipment). Each DDR represents 25K resistance across the source. To obtain the 12V drop across each DDR, place one 200-ohm resistor across TB9501 terminals 1 and 2 of the first DDR. When each receiver contains a different Character Recognition Code (see table 1-2) in its RTMU unit, run the stunt wire and its ground extension wire between receivers as shown, attaching them at terminals 6 and 7 of TB9501 in each re-

ceiver. Run separate remote bfo and rf gain inputs into each receiver. Run teletype readback outputs separately from each receiver to separate readback indicator or to a selector switch for the same indicators.

2-5. INITIAL ADJUSTMENTS

The DDR has been factory tested and aligned as a complete receiver system before disassembly for shipment. No initial adjustments of chassis mounted variable components are necessary before operation.



338-6

Figure 2-7. Multiple Receiver Connections, DDR-5BR Remote Control.

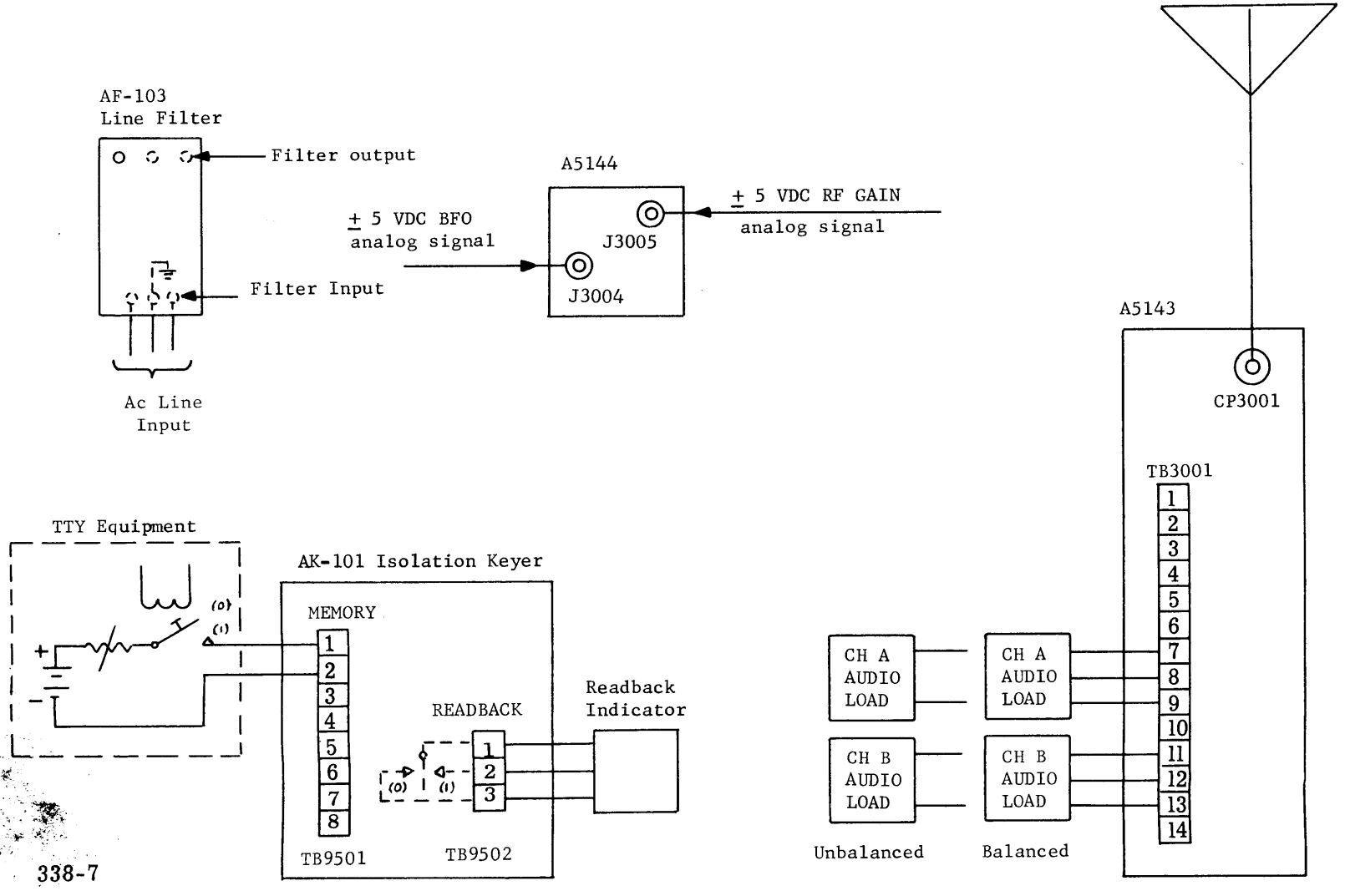
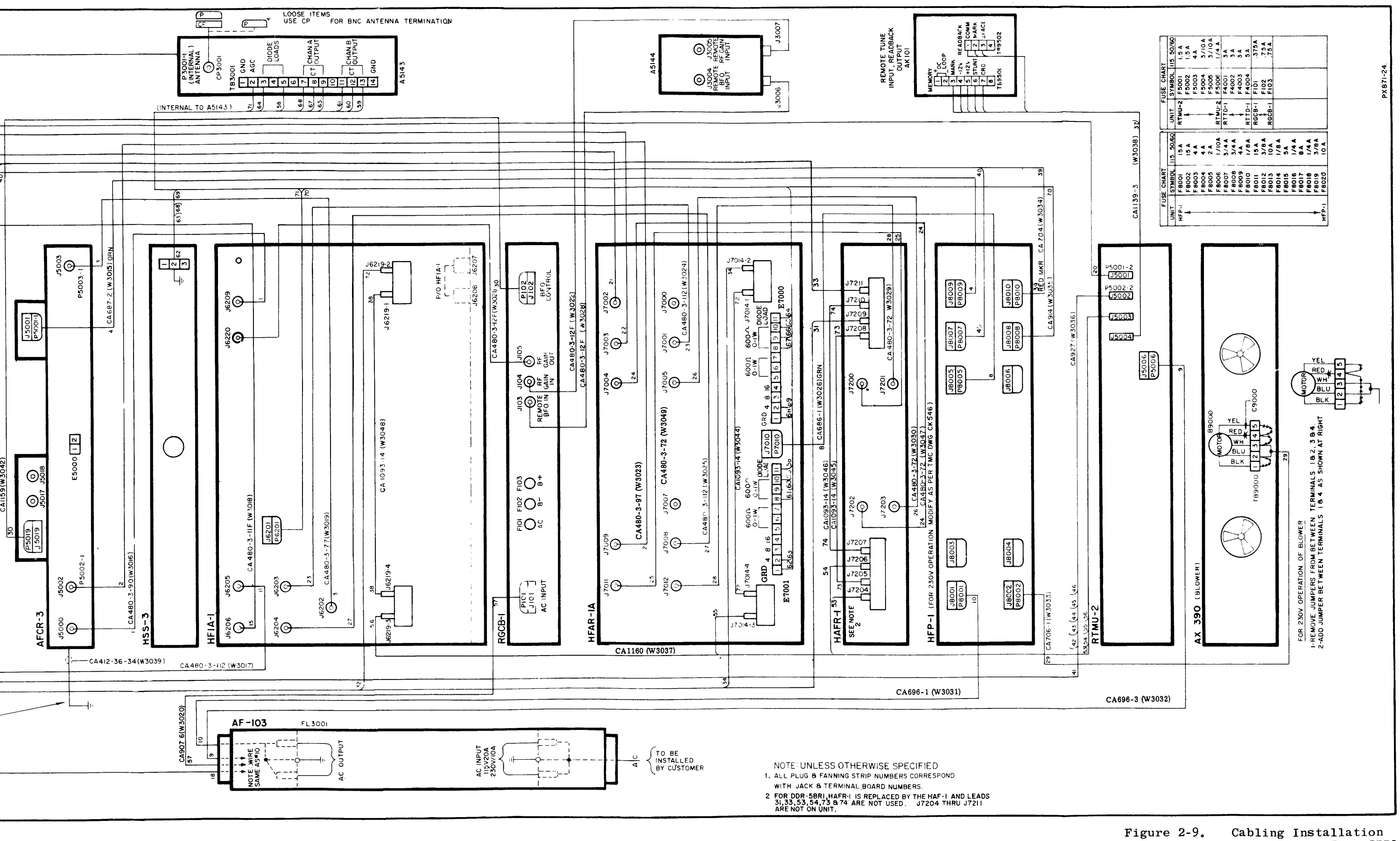


Figure 2-8. External Connection Diagram, DDR-5BR, 5BR1



NOTE: UNLESS OTHERWISE SPECIFIED

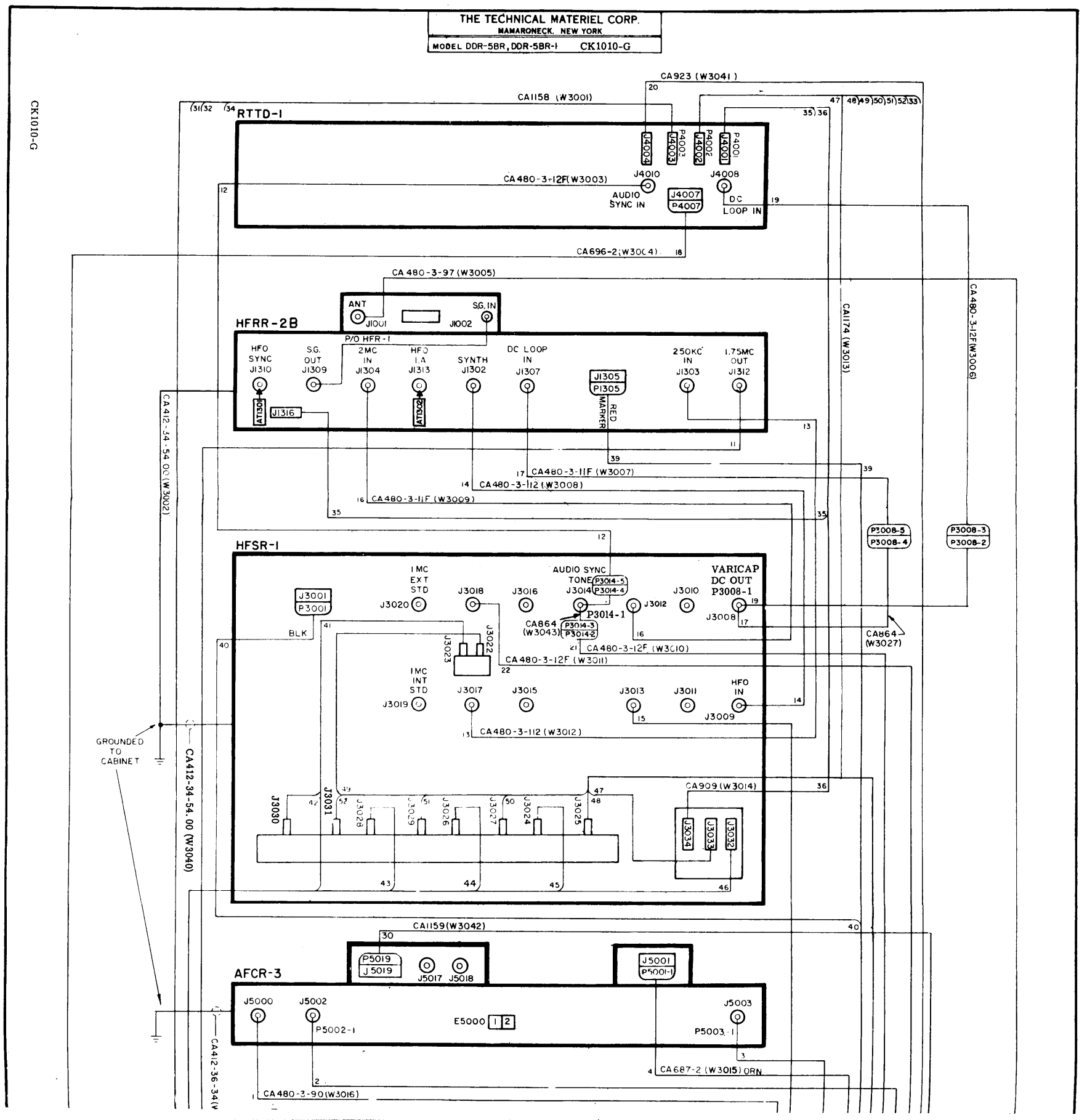
1. ALL PLUG & FANNING STRIP NUMBERS CORRESPOND WITH JACK & TERMINAL BOARD NUMBERS.
2. FOR DDR-5BR1, HAFR-1 IS REPLACED BY THE HAF-1 AND LEADS 31, 33, 53, 54, 73 & 74 ARE NOT USED. J7204 THRU J7211 ARE NOT ON UNIT.

Figure 2-9. Cabling Installation Diagram, DDR-5BR, 5BR1

THE TECHNICAL MATERIEL CORP.
MAMARONECK, NEW YORK

MODEL DDR-5BR, DDR-5BR-1 CK1010-G

CK1010-G



SECTION 3
OPERATOR'S SECTION

3-1. GENERAL

The DDR may be operated either manually or by remote control teletype signal intput. The coded message in the teletype input, containing tuning information (see table 1-2), may originate from a pushbutton keyboard, or from the insertion of a pre-programmed punched card or tape (see note). The readback output (see table 1-3) back to the remote control station begins cycling upon application of a-c power to the RTMU and provides the remote operator with continuous information on control positions.

NOTE

CCIT or ASCII teletypewriters may be used for code input, if desired (see table 1-2). When using ASCII 7-bit code, use the first 5 bits only and reverse the order of the bits by turning the punched tape over as it enters the tape reader.

Control functions should be reviewed by the operator (remote or local) for familiarization. These functions are described in detail in the individual modular manuals.

CAUTION

Front-panel knobs for automated controls may be rotated in a clockwise direction only. Do not force knobs in a counter-clockwise direction. Exceptions are the HFRR knobs; they may be moved in either direction.

3-2. REMOTE CONTROL

a. TUNING PROCEDURE

(1) INITIAL CONTROL SETTINGS AT RECEIVER SITE. - Manually set DDR controls at positions indicated in table 3-1 in the order given, before operating by remote control. Positions of controls not listed are optional.

TABLE 3-1. LOCAL CONTROL SETTINGS FOR REMOTE TUNING

Control	Position
RTMU POWER ON/OFF switch	ON
HFRR NOISE SILCENCER/OFF/ALIGNMENT SIGNAL switch	OFF
HFRR TUNE/SYNC/OPERATE switch	OPERATE
AFCR TUNING knob	0
AFCR CARRIER SELECTOR switch	OSC
AFCR SENSITIVITY knob	fully cw
HSS CHANNEL, A/OFF/B switch	OFF
HFIA CHANNEL A & B AGC DECAY knob	mid-position
HFIA AFC ON/OFF switch	ON*
HFIA MANUAL GAIN knob	AGC position
HFAR CHANNEL A LEVEL ADJUST knob	**
HFAR CHANNEL B LEVEL ADJUST knob	**

* If AFC feature is to be used, set at ON and set RGCB BFO ON/OFF switch at OFF; if AFC is not desired, set HFIA switch at OFF (see paragraph 3-2d). If CW is to be received, set switch at ON.

** With audio load attached, tune receiver for CW, as described in paragraph 3-3b (2), and adjust LEVEL ADJUST knob to obtain "VU" indication on the channel LINE LEVEL meter.

TABLE 3-1. LOCAL CONTROL SETTINGS FOR REMOTE TUNING (CONT)

Control	Position
HFAR CHANNEL A BFO knob	0
HFAR CHANNEL B BFO knob	0
HFAR POWER STANDBY/OPERATE switch	OPERATE
RTTD ON/OFF switch	ON
RGCB REMOTE BFO ON/OFF switch	ON
RGCB REMOTE RF GAIN ON/OFF switch	ON
HFP MAIN POWER, STANDBY/OFF switch (on chassis rear)	STANDBY*
HAF HIGH and LOW CUTOFF switches	OUT**

*For full rated stability, HFP MAIN POWER switch should be in STANDBY for at least 24 hours. This switch should be left in STANDBY continually.
**On DDR-5BR1 only.

(2) TUNING METHODS. - A variety of remote-control station designs may be used for tuning the DDR. The only specification is that the teletype tuning characters conform to the code shown in table 1-2. Tuning codes may be in any sequence but the first code must be the Charactor Recognition Code and the last code a "10000". Time is saved, however, by sending the tuning codes in the order shown in table 1-2, since this ascertains the minimum number of correction movements in the r-f tuning servo-mechanism. The remote readout panel, on the other hand, must be designed to receive the readback characters in the order and code as shown in table 1-3. Tuning codes may be originated by manual push-buttons on a keyboard or by insertion of a pre-programmed punched card or tape, as well as the other variations. The readback indicator panel may be in the form of an indicator light for each control and its position or one light to show that the controls have stabilized on the correct positions as programmed. It may also include a "fault" light to indicate when an operator at the site has turned a control into a non-programmed position or to indicate malfunctioning.

The bit characters of each tuning code may be sent at any speed. The memory section (RTMU) of the DDR stores each character in its cells indifinitely and will not release them to the tuning mechanism until it receives the "10000" (receiver-tune) code.

NOTE

The DDR is always tuned for the carrier frequency, even though, as in some cases of sideband reception, the carrier is fully suppressed at the transmitter. The exception to this is tuning for FSK and FAX reception (non-sideband), in which case the receiver is tuned for the center frequency.

To program the DDR to receive a CW signal of 9.0524 megacycles with an 800 cps pitch tone (as an example) send the following codes in the order shown:

1. Character Recognition Code (coded for each DDR)
2. HFSR 2-16 MC code (11001)
3. 9 MC code (01111)
4. HFSR 100 KC switch code (10011)
5. 0 code (01000)
6. HFSR 10 KC switch code (10010)
7. 50 KC code (00110)
8. HFSR 1 KC switch code (10111)
9. 2 KC code (00010)
10. HFSR .1 KC switch code (10101)
11. 400 cps code (01100)
12. HFIA CHA & B BW switches code (11111)
13. 6 KC SYM code (00100)
14. HFAR CH A & B DETECTION switches code (11011)
15. SSB code (00010) (In order to have remote controlled adjustable pitch, SSB code is sent rather than CW.)

* 16. HAFR CH A & B LOW CUTOFF switches code (11011)

* 17. 0.5 KC code (00010)

* 18. HAFR CH A & B HIGH CUTOFF switches code (10100)

19. 1 KC code (01001)

20. For energizing tuning mechanism in receiver: Receiver-Tune code (10000)

Set remote bfo control for 800 cps and remote r-f gain for clearest signal.

To program the DDR to receive a 3-kc width lower sideband signal with a 15.3452-mc partially suppressed carrier, send the following codes in the order shown: -

1. Character recognition code (coded for each DDR)

2. HFSR 17-31 MC code (10001)

3. 15 MC code (00001)

4. HFSR 100 KC switch code (10011)

5. 300 KC code (01001)

6. HFSR 10 KC switch code (10010)

7. 40 KC code (01100)

8. HFSR 1 KC switch code (10111)

9. 5 KC code (00110)

10. HFSR .1 KC switch code (10101)

11. .2 KC code (00010)

12. HFIA CH A & B BW switches code (11111)

13. 3.5 KC LSB code (01100)

14. HFAR CH A & B DETECTION switches code (11011)

15. SSB code (00010)

*16. HAFR CH A & B LOW CUTOFF switches code (11010)

*17. 0.1 KC code (01000)

*18. HAFR CH A & B HIGH CUTOFF switches code (10100)

*19. 5 KC code (00110)

20. For energizing tuning mechanism in receiver: - Receiver tune code (10000)

Adjust r-f gain for clearest signal. Set remote bfo control at 0; if automatic frequency control is desired, refer to paragraph 3-2d.

To program the DDR to pick out one sideband (upper or lower) from an AM signal in heavy interference conditions, use the same method as for SSB tuning. To keep the tone steady, use the afc feature by adjustment of the remote bfo control as described in paragraph 3-2d. Generally one sideband (either the upper of lower) will give good reception.

b. READBACK MONITORING. - Readback of the control positions is continuous and starts when line voltage is applied to the DDR. The readback is in the form of 10 control position characters repeated in cycles as listed in table 1-3. The repitition frequency of the cycles is 1 cycle per 2.5 seconds (for 60 WPM output) or 1 cycle per 1.5 seconds (for 100 WPM output). Readback transmission from the DDR can only be turned off at the receiver site by interrupting the readback transmission equipment, or setting the RTMU POWER switch at OFF.

Included in the readback information, besides control positions, is a "ready" and an "in tune process" signal. This information is sent out in the eleventh code. The "in tune process" code indicates to the remote operator that the HFRR HFO has not yet sychronized with the HFSR: the "ready" signal indicates the synchronization point has been reached.

c. RETUNING. - At any time after the controls are stabilized any or all of the controls may be re-positioned by a new message from the remote control station. The new message must start with the Character Recognition Code and end with a 10000 code in order to reactivate the controls. In the case of retuning for another reception, all characters will be used again with the new information contained in them.

For any type of operational change, the new message need contain only the character Recognition code, the adressal function (control selector) code, its corrected action function (control position) code and the 10000 code (receiver tune).

d. REMOTE TUNING FOR AFC. - When, upon monitoring the receiver audio output, the transmitter appears to be relatively unstable in SSB or AM transmission, the remote bfo control may be used to tune the AFCR Automatic Frequency Control unit to "lock" onto the carrier component in the signal. Starting with the remote bfo control adjusted to "0 KC", rotate it to the plus and minus side until the wavering tones in the monitored audio become steady and remain steady. When using the AFC, the HFIA-AFC switch must be in the ON position. The RGCB BFO switch must be set at ON during the remote tuning and then set at OFF when the AFCR has locked onto the carrier.

e. LOCAL ADJUSTMENTS FOR NOISE ELIMINATION. - The DDR has a filter in the r-f stage for eliminating locally caused interference, if the remotely-adjusted IF BW and a-f bandwidth filters

* On DDR-5BR only

do not eliminate it. If the noise is of the impulse type, set the HFRR NOISE SILENCER/OFF/-ALIGNMENT SIGNAL switch at NOISE SILENCER.

3-3. LOCAL CONTROL

a. GENERAL. - By placing the RTMU, RTTD and RGCB ON/OFF switches at OFF, the DDR may be disconnected from remote tuning input messages in order to leave it free for pure manual control. In manual control, CHANNEL A and B controls may be worked independently in order to receive an ISB (independent sideband) signal with two channels of information.

b. TUNING PROCEDURE

(1) PRELIMINARY CONTROL POSITIONS.- Before operating the DDR manually, set the following controls at positions listed in Table 3-2.

(2) TUNING METHOD. - In all modes of reception, the DDR is tuned to the carrier frequency, even if the carrier is fully suppressed at the transmitter. The exception is FSK or FAX reception (non-sideband) in which the DDR is tuned to the center frequency. To tune for the carrier frequency, proceed as follows:

Set HFAR POWER switch at OPERATE. Yellow TIME DELAY lamp on HFP will light and remain lit for 60 seconds, then go out; the red OPERATE lamp on HFP will light. If the carrier frequency falls between 100 cps increment, the HFSR cannot be used and the DDR is operated in its "non-synthesized" condition. Operating the receiver in its synthesized condition, however, in which it is tunable in 100-cps increments, provides its full rated stability (within 1 part in 10^8). Tuning for synthesized or non-synthesized operation is hereafter referred to as synthesized and non-synthesized tuning, respectively.

For synthesized or non-synthesized tuning, all modes, first set HFIA CH A and/or B IF BW KC knob and HFAR CH A and/or B DETECTION switches at appropriate positions for type of signal expected. For AM, MCW, FSK, FAX, FM and PM modes, set the IF BW KC knob for one of the DSB positions depending on bandwidth to be received and the channel output desired; for SSB or ISB, set knob/s at one of the USB and/or LSB positions. For AM and MCW modes, set CH A or B DETECTION switch on HFAR at AM. For CW reception with adjustable pitch, set switch at CW. For ISB, FSK, FAX, FM and PM, set switch/es at SSB. For SSB set desired channel switch at SSB and other channel switch at AM.

For non-synthesized tuning all modes, first set HFSR MC, 100 KC, 10 KC, 1 KC and .1 KC knobs

TABLE 3-2. PRELIMINARY CONTROL POSITION FOR LOCAL TUNING

Control	Position
HFRR NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch	OFF
AFCR TUNING/KCS knob	0
AFCR CARRIER SELECTOR switch	OSC
HSS VOLUME control	mid-position
RGCB REMOTE BFO switch	OFF
RGCB REMOTE RF GAIN switch	OFF
HFAR CHANNELS A & B BFO knobs	0
HFAR POWER switch	STANDBY
HFAR CHANNELS A & B LEVEL ADJUST knobs	fully cw
HFIA MANUAL GAIN knob	mid-position
HFIA AFC switch	OFF
*HAFR CHANNELS A & B HI- and LO- CUTOFF switch	OUT
RTMU POWER switch	OFF
RTTD AC POWER switch	OFF
HFP MAIN POWER switch	STANDBY**

*HAF in DDR-5BR1. (Non-automated).
**For full rated stability, HFP MAIN POWER switch should be in STANDBY for at least 24 hours. This switch should be left in STANDBY continually.

to bring zeros on HFSR lighted numeral indicators. Then tune HFRR to the carrier frequency by means of its BAND switch and TUNE knob.

For synthesized tuning all modes, proceed with the steps as follows:

Step 1. - Set HFRR BAND switch and TUNE knob for frequency. Set HFSR MC, 100 KC, 10 KC, 1 KC and .1KC switches for frequency. Set HFRR TUNE/SYNC/OPERATE switch at SYNC. Carefully tune HFRR TUNE knob for a zero beat at HFAR PHONES jack and to obtain a steady light on HFRR SYNC IND lamp. Proceed to Step 2.

Step 2. - Set HFRR TUNE/SYNC/OPERATE switch at OPERATE; SYNC IND lamp should be lit and SYNCHRONIZE meter should indicate zero center scale or nearly so. Carefully adjust TUNE knob to bring SYNCHRONIZE meter to zero center scale, then tighten LOCK control on knob.

(3) SIGNAL ADJUSTMENTS AND CLARIFICATION

(a) ALL MODES. - Set HFIA MANUAL GAIN knob for AGC by turning knob clockwise until HFRR RF LEVEL meter reading just begins to drop off. Then set HFAR LEVEL ADJ knob/s to obtain "0 VU" on LINE LEVEL meters. If interference is present at either end of the audio output range, adjust HAFR* CH A and/or B HI- and LO-CUTOFF switches to eliminate noise without losing part of desired signal.

(b) SSB and ISB MODES. - Adjust CH A and/or B AGC DECAY switches on HFIA to obtain clearest signal. If suppressed carrier is above 30 db below PEP (peak envelope power) the AFC feature may be employed as follows:

Set HFIA AFC ON/OFF switch at ON, RGCB BFO switch at OFF, AFCR TUNING/KCS control at 0, SENSITIVITY control fully clockwise, CARRIER SELECTOR switch at OSC. Observing CARRIER LEVEL meter hold down RESET button and adjust TUNING/KCS control to obtain peak indication on meter. Then release RESET button and observe DRIFT meter; needle will remain steady within the green zone through tone frequency variations if the AFCR is locked onto the carrier. If this condition is not realized, the control loops are locked onto a sideband and the process should be repeated. It may be necessary to also try a new .1 KC setting of the HFSR (for synthesized tuning) or an adjustment of the HFRR TUNE control (for non-synthesized tuning) to ultimately capture the carrier. When the AFCR has been adjusted satisfactorily, the SENSITIVITY control may be backed off, if necessary, to eliminate noise.

In the case of tuning in a SSB or ISB signal containing tone telegraph channels, a steady telegraph tone on one of the sidebands may be captured instead of the carrier. To prevent this, the operator should vary the HFRR TUNE control up and down the frequency scale in order to identify the carrier by its relative position and level to the sideband tones before tuning the AFCR.

(c) AM, SSB, ISB and MCW MODES.- For SSB, ISB and MCW, adjust the HFIA CH A or CH B AGC DECAY switch to some low value. Sometimes reception of an AM signal can be greatly improved by tuning in one of its sidebands; usually one sideband will give excellent reception. This is done by the same procedure as tuning in a SSB signal using AFC.

(d) CW, FSK, FAX, FM and PM. - There are several ways that these signals may be sent out and received. For instance, FSK and FAX may be transmitted as two alternating mark and space frequencies by themselves or they may be transmitted on a sideband with partially suppressed carrier as is VFT (voice-frequency telegraph). In the latter case, these signals are tuned in by the DDR by methods as for SSB, using AFC to a great advantage to compensate for transmitted frequency drift. In the former case, FSK and FAX signals are received by tuning to the center frequency and switching the HFAR DETECTION switch to either CW or SSB. The CW position gives a tone adjustment by means of the HFAR BFO control; the SSB position gives no tone adjustment but does give the greater stability of the HFSR injection frequency. These statements also hold true for CW, FM and PM reception. The AGC DECAY knob on the HFIA is set for the cleanest signal in some of its slower decay speeds because of the intermittent nature of the signal. The HAFR* may be used to narrow the audio output and cut out adjacent noise.

3-4. STANDBY CONDITION

a. FOR REMOTE CONTROL. - To place DDR in standby condition for remote control, set switches as listed in Table 3-1, Local Control Settings for Remote Tuning. This keeps all power on, ready for operation, tuning input open and readback transmitting. For continuous remote operation, leave the switches in positions as listed.

b. FOR LOCAL CONTROL. - To set DDR in standby condition for local control only, set HFP MAIN POWER switch in STANDBY and HFAR POWER switch in STANDBY. Set RTMU, RTTD and RGCB switches OFF. This keeps power supplied to the frequency-stabilizing ovens only and keeps the remote tuning input closed.

*HAF on DDR-5BR1

SECTION 4
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

Functional and detailed analysis for local- and remote-controlled operation of the DDR is given in the following paragraphs. Local-controlled operation analysis is given first; analysis of the remote control tuning circuits follows separately.

4-2. FUNCTIONAL ANALYSIS.

a. LOCAL-CONTROLLED OPERATION (Figure 4-1).

(1) RF AMPLIFICATION AND FIRST CONVERSION. - R-f signals from the antenna are applied to Continuous RF Tuner HFRR. Within the HFRR, a BAND switch and TUNE control selects the carrier frequency in the 2- to 32-mc range. This frequency undergoes 4 tuned stages of amplification and is beat with a high frequency oscillator (HFO) output signal of 3.75-mc to 33.75-mc to produce the first i-f of 1.75-mc which is applied to IF Amplifier HFIA.

A sample of the HFO output signal from the HFRR is applied to Control Synthesizer and Standard HFSR where it is converted to a 3.25- to 4.25-mc* signal. This 3.25- to 4.25-mc signal (containing the error, if any) is applied to a phase detector where it is compared with a nominally identical, ultrastable 3.25- to 4.25-mc signal developed by the HFSR circuits. Any phase difference between the two signals produces a proportional d-c voltage that is used to correct the HFO output of Continuous RF Tuner HFRR thereby maintaining a high stability. A front-panel SYNCHRONIZE meter monitors the d-c correction voltage being applied to the HFO.

An audio sync tone (developed by the HFSR phase detector) is applied simultaneously to: (1) the servo amplifier in Receiver Decoder RTTD (paragraph 4-3h); (2) channel A audio amplifiers of AF Amplifier HFAR via contacts of relay K7001 K7001 is energized when the TUNE/SYNC/OPERATE switch of Continuous RF Tuner HFRR is set at SYNC.

Noise silencer stages in Continuous RF Tuner HFRR may be switched in to eliminate noise in the 1.75-mc output by means of the NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch. When set at ALIGNMENT SIGNAL, this switch disconnects the antenna input and replaces it with a 2- to 32-mc alignment signal in order to check TUNE dial calibrations. The alignment signal is produced by beating the 3.75- to 33.75-mc HFO output with a stable 1.75-mc balanced modulator output. Injection frequencies (250-kc and 2-mc) for the balanced modulator are derived from the 1-mc standard in Control Synthesizer and Standard HFSR. When set at OFF, the NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch disconnects the noise silencer circuit and the alignment signal, and reconnects the HFRR to the antenna.

(2) SECOND CONVERSION AND IF AMPLIFICATION. - Within IF Amplifier HFIA, the 1.75-mc signal from Continuous RF Tuner HFRR is applied to a second converter where it is beat with a 2-mc injection frequency to produce a 250-kc i-f. This 250-kc i-f signal is extended through selectable bandpass filters and i-f amplifiers and is provided as a dual-channel (A & B) output for detection in AF Amplifier HFAR. The 2-mc injection frequency for the converter stage is obtained from the 1-mc standard in Control Synthesizer and Standard HFSR or from the drift-corrected 2-mc signal form Automatic Frequency Control AFCR, depending upon the setting of the AFC switch.

The IF BANDWIDTH KC selector switches select the bandpass filter output for the appropriate channel (A or B). The DSB (symmetrical) filters used for CW, MCW, AM, FSK**, FAX**, FM** and PM**, provide the desired bandwidth centered at 250-kc. The USB (upper sideband) and LSB (lower sideband) filters, used for SSB and ISB, attenuate the 250-kc carrier component and pass only the upper or lower sideband.

Two AGC voltages, one for each channel, are developed from the output of the filters for that channel. The strongest AGC voltage is selected by means of an AGC comparator circuit and applied to the input i-f amplifier stage of the HFIA and to the r-f amplifier stages of the HFRR. The AGC DECAY switch on the HFIA has 10 adjustments for setting slow to fast AGC decay time constants for varying types of signals.

(3) DETECTION AND AUDIO AMPLIFICATION. - Channel A and B signals, in the 250-kc range, are received by one of two detector circuits contained in AF Amplifier HFAR. When the channel A or channel B DETECTION switch is set at SSB or CW, the associated product detector is selected for CW, SSB, ISB, FAX, FSK, FM and PM reception. In the AM position, the diode detector circuit is selected for MCW and AM reception. In CW recep-

*Depending on the setting of the HFSR MC, 100-KC, 10-KC, 1-KC and 1-KC switches.
**With appropriate converter.

tion, the keyed 250-kc frequency enters the product detector and is beat with the output of the BFO (adjustable through 247- to 253-kc) to produce the keyed audio tone. In SSB and ISB the sideband frequencies are beat with an ultra-stable 250-kc signal derived from the 1-mc standard of Control Synthesizer and Standard HFSR or the drift-corrected 250-kc signal from Automatic Frequency Control AFCR (depending upon the setting of the AFC switch).

The resulting difference frequency is the audio output.

The outputs of channels A and B detector circuits are routed to the HAFR* Audio Filter. By means of front-panel switches this filter may be used to chop off the low and/or high ends of the audio band in varying amounts in order to eliminate adjacent noise.

The A and B audio signals are routed back to AF Amplifier HFAR, through two audio amplifiers, and out to the DDR audio outputs and to Speaker Panel HSS.

(4) AUTOMATIC FREQUENCY CONTROL. - Automatic Frequency Control AFCR is generally used to overcome audio-frequency output changes that occur as a result of a combined frequency drift in the receiver and distant transmitter.

A sample of the 250-kc output (carrier and sideband energy with $\pm\Delta f$, if any) from the amplifier stages of IF Amplifier HFIA is passed through a narrow bandpass filter which allows only carrier energy to be amplified and applied to a phase detector circuit in the AFCR. With the phase detector circuit, the amplified 250-kc $\pm\Delta f$ signal is compared with an internally generated 250-kc signal to produce a d-c correction voltage. Within the AFCR, this d-c correction voltage is applied simultaneously: (1) to the 250-kc oscillator stage; (2) through a time-constant network to a 2-mc variable oscillator.

The internal 250-kc oscillator output frequency is rapidly adjusted and closely resembles the 250-kc $\pm\Delta f$ from IF Amplifier HFIA. This internally generated 250-kc $\pm\Delta f$ (drift-corrected 250-kc) is extended via the CARRIER SELECTOR switch to the detector stages of Audio Amplifier HFAR. Thus instabilities in the i-f are proportionately applied to the detector stages maintaining the audio frequency stability to within $\pm\frac{1}{2}$ cps.

The internal 2-mc oscillator output undergoes slow frequency changes in accordance with the d-c correction voltage applied. The output, 2-mc $\pm$ delayed Δf (drift-corrected 2-mc), is applied via the AFC switch of IF Amplifier HFIA to the converter stage within the HFIA. Thus, the output of the converter stage is corrected and kept within the capture range of the AFCR and of the selectable filters within the HFIA.

(5) NON-SYNTHISIZED OPERATION. - Non-synthesized operation of the DDR is similar to synthesized operation except that Control Synthesizer and Standard HFSR is not used for stabilizing the high-frequency oscillator of Continuous RF Tuner HFRR. The TUNE/SYNC/OPERATE switch of the HFRR is kept in TUNE, and the d-c correction voltage and audio sync tone from the HFSR is disconnected. Outputs from the HFSR are still used, however, for the test alignment signal and the 2-mc and 250-kc injection frequencies when Automatic Frequency Control AFCR is not used.

b. REMOTE-CONTROLLED OPERATION. - Refer to figure 4-1. The additional components, the functions of which are purely for remote control, are: Signal Data Converter-Storer RTMU, Receiver Decoder RTTD, and Remote Gain Control RGCB. These units convert remote-control information (analog and digital signals) to voltages that operate appropriate controls of the DDR receiver.

The RTMU receives 5-bit digital tuning signals in the form of addressal function and action-function codes (refer to table 1-2) via Isolation Keyer AK-101. After receipt of a character-recognition code, additional addressal function codes may enter the RTMU in any sequence as long as their corresponding action function codes follow them. The quickest tuning action is accomplished, however, by programming the message to enter in the order given in table 1-2 (particularly for the first 12 codes). This order permits the servo action on the TUNE control of continuous RF Tuner HFRR to stabilize more quickly. For purposes of simplification, the following description is based on receiving the codes in the sequence shown in table 1-2.

Each RTMU is programmed for a particular character-recognition code (first addressal function). A recognition circuit within the RTMU samples all character-recognition codes; upon receipt of the proper code, an input gate permits all succeeding characters (arranged in code groups), including a receiver-tune code (10000), to be stored temporarily in the RTMU memory cores. As the receiver-tune code enters the memory cores, it is simultaneously applied to an E-pulse generator which: (1) causes the RTMU input gate to close and an output gate for the memory cores to open; (2) energizes Receiver Decoder RTTD; (3) causes a tamping action to be applied to the message characters if the RTMU memory cores (refer to paragraph 4-3f).

As a result of the tamping action, the message characters are progressively moved toward the output end of the memory cores. When the message characters reach the output end of the memory cores, a monitor pulse is generated. This monitor pulse, in conjunction with the E pulse, causes a core-shift register to advance the first

* HAF in DDR-5BR1

character to the input-relay circuit of Receiver Decoder RTTD.

The first character (addressal function) applied to the input-relay circuit (a 5-bit parallel pulse input circuit) of Receiver Decoder RTTD advances the Master Decoder Switch to the appropriate position. The input-relay circuit then functions together with a clock and timer circuit to send advance pulses into an advance circuit of Signal Data Converter Storer RTMU causing the remaining characters in the memory cores to advance, one at a time, into Receiver Decoder RTTD (refer to paragraph 4-3f).

The second character (action function) applied to the input-relay circuit of the RTTD is extended through the Master Decoder Switch to the appropriate rotary-solenoid decoder switch within the DDR receiver. The decoder switch then drives the associated control to the correct position. When the control has reached its correct position, the decoder-switch drive circuit is opened, the clock and timer circuit is activated, and an advance pulse is applied to the memory cores of Signal Data Converter-Storer RTMU causing the next character to be advanced into the input relays of Receiver Decoder RTTD.

The remaining characters (addressal functions and action functions) of the tuning message are advanced through the RTMU and RTTD in the same manner thereby positioning the RTTD Master Decoder Switch and rotary-solenoid decoder switches throughout the DDR receiver to complete the tuning procedure.

In the case of i-f bandwidth and detection switches, the channel A and corresponding channel B switches are slaved together. The CHANNEL A IF BANDWIDTH KC and CHANNEL A DETECTION switches receive the addressal function and action function codes, and the corresponding channel B switches are positioned accordingly.

Frequency-change information (addressal function and action function codes) contained in the tuning message drives the MC, 100 KC, 10 KC, 1 KC, and .1 KC controls of Control Synthesizer and Standard HFSR to the appropriate positions. These controls, in turn, position the BAND switch of Continuous RF Tuner HFRR, and prepare the HFRR for frequency search. When the wiper arm of the Master Decoder Switch in Receiver Decoder RTTD makes contact with pin 7 or 8 (CH A + B IF BANDWIDTH KC or CH A + B DET.), +28 vdc is applied to a servo amplifier in Receiver Decoder RTTD. The servo amplifier activates a motor in Continuous RF Tuner HFRR and causes this motor (coupled to the TUNE control) to rotate either clockwise or counterclockwise (depending upon the setting of 100 KC switch in HFSR). As the HFRR is tuned closer and closer to the proper frequency, a phase detector circuit in Control Synthesizer and Standard HFSR emits an audio sync tone and a d-c correction voltage that are used by the servo amplifier to complete the alignment of Continuous RF Tuner HFRR to the incoming frequency. To prevent continual searching due to an error, after 30 seconds from the time that Receiver Decoder RTTD has been energized (from the E pulse), a delay circuit shuts off the RTTD power supply.

Continuous adjustment of the bfo and r-f gain controls from a remote location is accomplished via Remote Gain Control RGCB. The RGCB receives two independent analog signals (in the ±5 vdc range) from the remote operating site and converts these signals into a-c (115 volts) and d-c (0 to 10 volts) voltages. The d-c output of the RGCB is applied to the receiver agc line thereby overriding the internally generated agc voltage applied to r-f amplifier stages in Continuous RF Tuner HFRR and i-f amplifier stages of IF Amplifier HFIA. The a-c output of Remote Gain Control RGCB is used to drive a servo motor connected to the 2-mc oscillator of Automatic Frequency Control AFCR. Depending upon the potential of the input analog signal, relays within the RGCB apply the a-c output to windings of the servo motor that provide clockwise or counterclockwise rotation of the TUNING KCS control (tuning capacitor for 2-mc oscillator) of the AFCR. A potentiometer connected to the shaft of the servo motor provides readback information to the input circuits of the RGCB thus nullifying the input analog signal when the TUNING KCS control reaches the operator-selected position.

The altered 2-mc oscillator output of the AFCR is applied to the converter stage of IF Amplifier HFIA and is used as the receiver bfo control during remote operation. This same remote control of the 2-mc oscillator contained in Automatic Frequency Control AFCR may also be used to affect automatic frequency control.

c. DIGITAL REMOTE CONTROL READBACK. - Readback information (control-position indications) from each decoder switch (ⓞ on figure 4-1) in the DDR receiver is supplied in 4-bit parallel form to a diode matrix in Signal Data Converter Storer RTMU. A Code Shift Register within the RTMU scans the diode matrix and applies the 4-bit readback information and an internally-generated bit (corresponding to the first bit of a 5-bit character) simultaneously to inputs of a Bit Shift Register. This Bit Shift Register converts the parallel 5-bit input to a 5-bit serial pulse (a 7.42 baudot code) for application to remote indicating device.

4-3. DETAILED ANALYSIS.

a. INTRODUCTION. - A detailed analysis of each modular component in the DDR is contained in the instruction manual for the component. The following detailed analysis of the DDR describes that part of its circuitry (the Techni-MatiC tuning system) that extends through the receiver, and, in some cases, causes interaction between modular components. The description

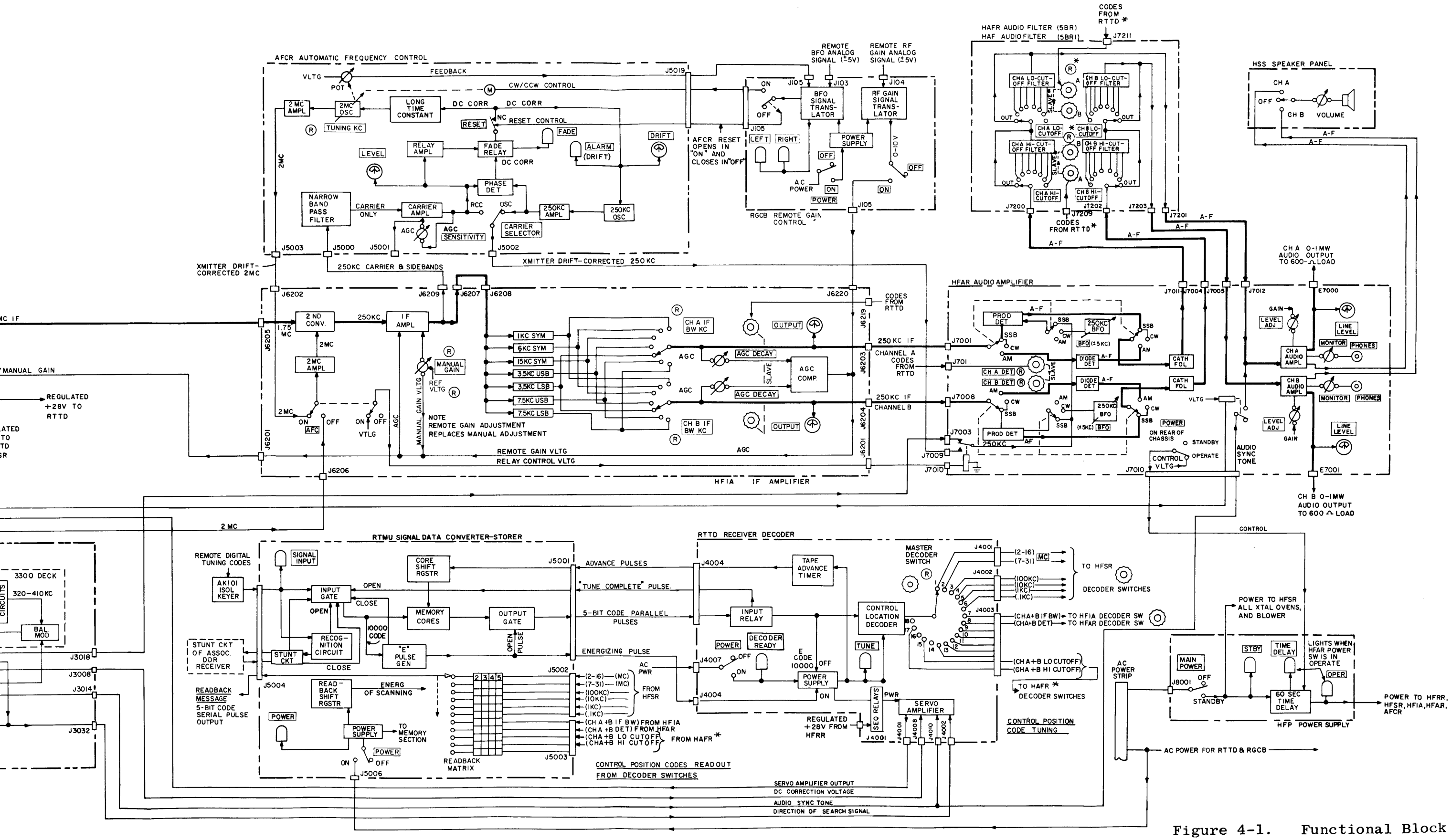
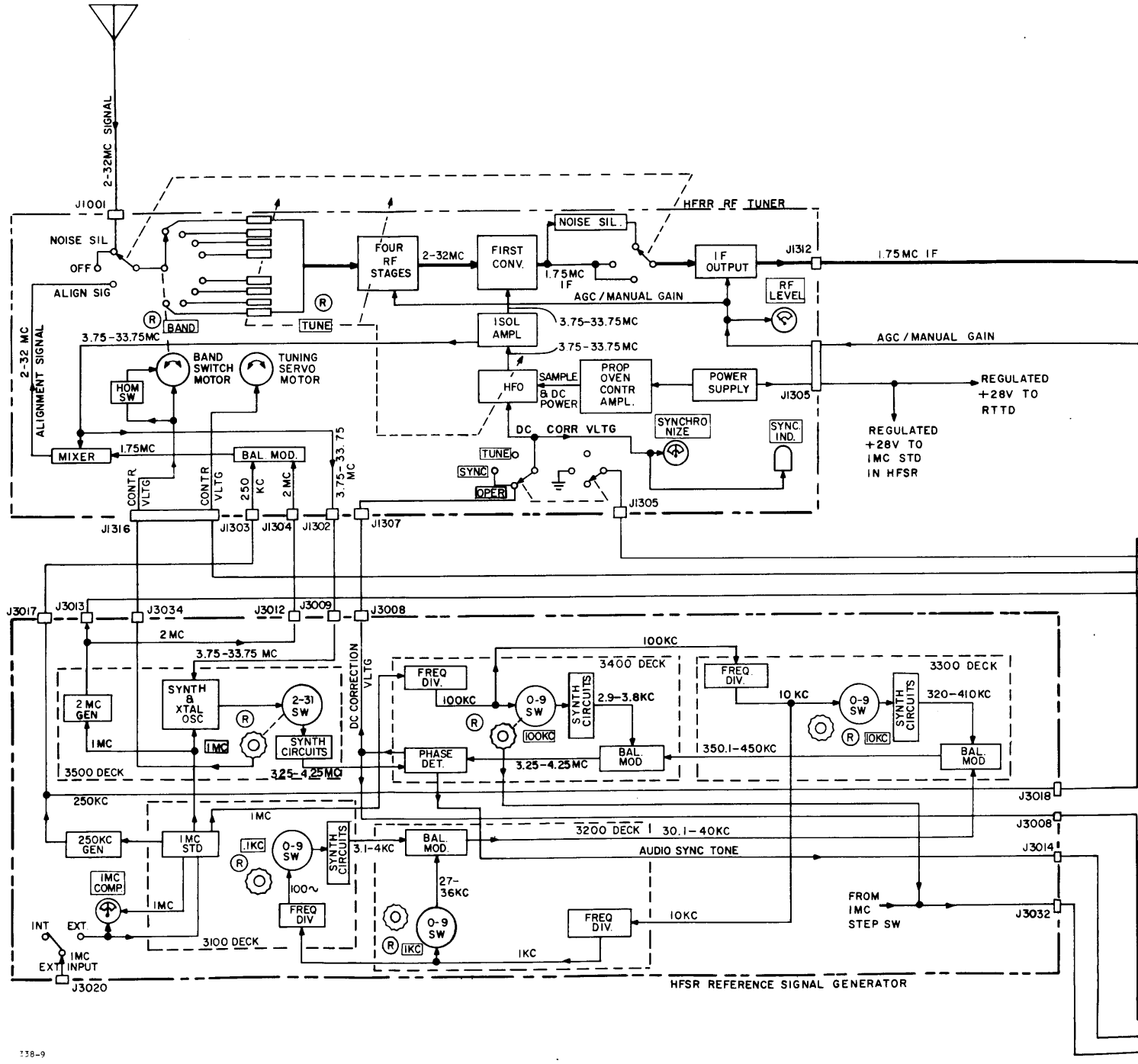


Figure 4-1. Functional Block Diagram, DDR-5BR, DDR-5BR1

NOTES
1. (R) DENOTES REMOTELY OPERATED CONTROL
2. ⊙ DENOTES STEPPING SWITCH DRIVEN
3 → PATH OF SIGNAL
4 * ON DDR-5BR ONLY



is arranged in the same order in which events occur in TechniMatiC tuning.

b. APPLICATION OF POWER. - The remote tuning feature of the DDR is enabled by application of line voltage to Signal Data Converter-Storer RTMU, Receiver Decoder RTTD, and Remote Gain Control RGCB through their respective POWER switches. Line voltage to the RTMU immediately energizes the readback circuits; logic voltages are also supplied to the RTMU's memory circuits, preparing it for reception of the first code. When the POWER switch of the RTTD is set at ON (see figure 4-2), the line voltage lights the DECODER READY lamp. Full line voltage is not connected across the primary of power transformer T4001 in the RTTD until the circuit is completed through contacts of energized relay K4030 and power lock-up relay K4027. These relays only energize when the RTMU receives the E (10000) code at the end of a tuning message.

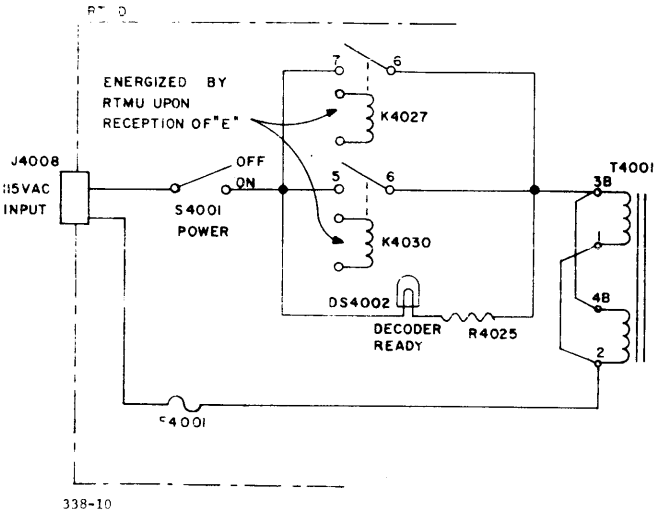


Figure 4-2. Simplified Schematic, Energization of RTTD by RTMU

c. CODE ENTRY (See Figure 4-3). - All input codes enter Isolation Keyer AK-101 at terminals 1 and 2 of terminal block TB9501. The AK-101 serves two purposes: (1) it isolates the Signal Data Converter-Storer RTMU units in multiple receiver systems utilizing a common input from one teletype line; (2) it converts the keyed d-c loop input from the teletype line into the required dry-contact keying of the RTMU.

When a negative pulse (space condition) is applied to TB9501, transistor Q9501 is reverse biased (non-conducting state), collector current is minimal, and current flow (from +12V in RTMU power supply) through resistor R9502 and the space coil (terminals 1 and 2) to ground at J5004 biases relay K9501 toward the space coil. When a positive pulse (mark condition) is applied to TB9501, transistor Q9501 conducts, collector current increases, the mark coil of polar relay K9501 is energized and overcomes the space-coil bias. Closed contacts of relay K9501 then complete a path for -12vdc (from the RTMU power supply) to pin 1 of J5004 on Signal Data Converter-Storer RTMU. From here, the code proceeds into the RTMU as described in the RTMU manual. Potentiometer R9502 is adjusted to cause sufficient current through the space coil of polar-relay K9501 to bias the relay towards the space coil when Q9501 is not conducting.

d. CHARACTER - RECOGNITION CODE. - The first two characters in the tuning message constitute the character-recognition code (refer to table 1-2), an alpha-numerical code, which will be accepted by only one receiver in a multiple receiver system utilizing a common input from one input teletype line. The function of this dual code is to open the RTMU input gate in order that the rest of the tuning codes may proceed into the memory cores. The input 5-bit character (in serial form) to Signal Data Converter-Storer RTMU is applied to Shift Register Circuits (Z5002 and Z5006) where the serial pulses are converted to parallel form.

The first 5-bit (alpha) parallel pulse is then applied to the input of andgate Z6 in Input Recognition Module Z5003 (refer to figure 4-4); upon satisfying input conditions established via cross connections, Z6 will open and set flip flop Z2 which in turn prepares andgate Z7 to operate upon receipt of the proper (programmed) numerical code. The next 5-bit (numeric) parallel pulse is applied to the input of andgate Z7; upon satisfying input conditions established by cross connections Z7 will open and set flip flop Z3. The negative output of Z3 is applied simultaneously to: (1) an inverter which energizes relay K1; (2)andgate 5 of Z9 contained in Shift Register No. 6 (Z5006) - this establishes one of the two conditions required to trigger andgate 5.

One set of energized relay K1 contacts connects ground to pin 9 of andgate Z6 and Z7 in the Input Recognition Module (Z5003) and to terminal 10 of J5004; this action closes Z6 and Z7. Interconnection of J5004 terminal 10 of each RTMU utilizing a common teletype input line results in closing all recognition gates. This prevents any of the succeeding tuning codes (which might also correspond with one of the character recognition codes) from opening the recognition gates (Z6 and Z7) of a receiver sharing the common teletype line.

Another set of contacts on energized relay K1 complete the operate path for relay K5002 in the readback section. Energized relay K5002 performs two functions: (1) it provides an In-Tune Process signal to an indicating device at the remote operating site; (2) it opens the operate path of relay K5001 which was held energized by closed contacts of sync relay K3001 within Control Synthesizer and Standard HFSR.

e. TUNING CODE STORAGE. - After receipt of the proper recognition code, each character of the tuning message applied to Shift Registers

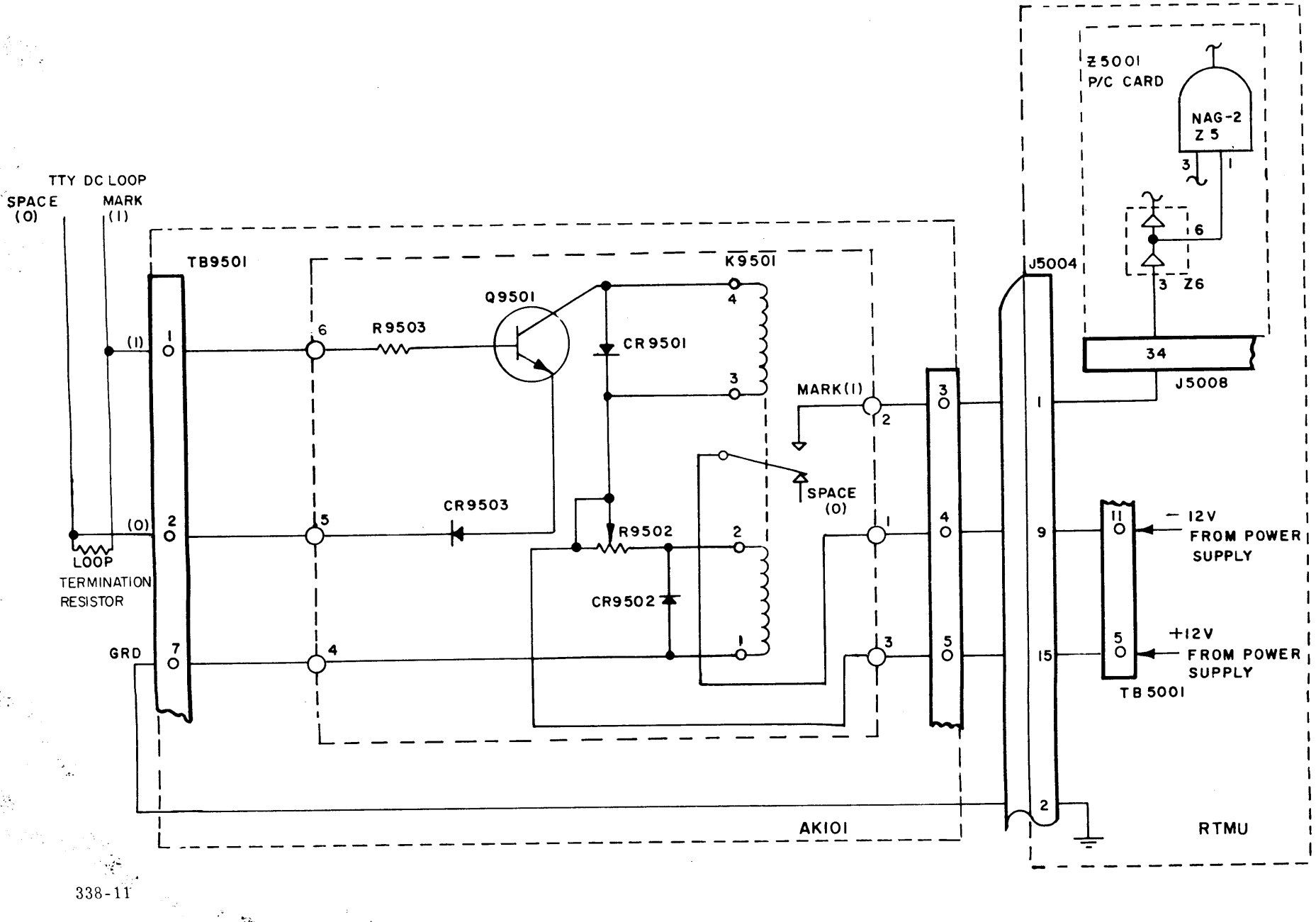


Figure 4-3. Tuning Code Entry into RTMU and AK-101, Simplified Schematic

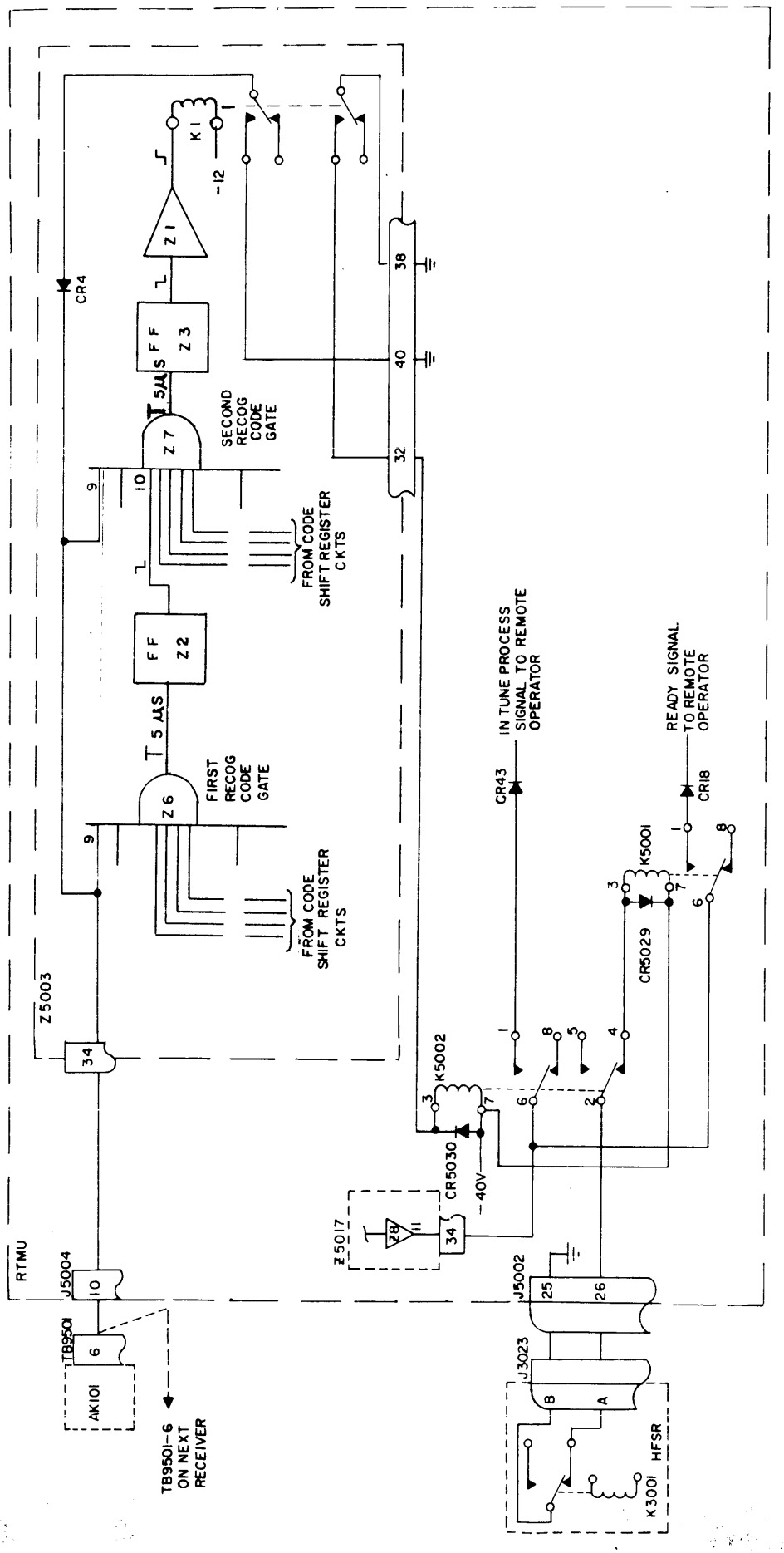


Figure 4-4. In-Tune Process/Ready Readback Circuits, Simplified Schematic

Z5002 and Z5006 are extended into the RTMU cores by an interaction between Shift Registers Z5002 and Z5006 and Advance Circuit No. 2 (Z5005). The 5 bits of each character applied to Shift Register Z5002 are extended in serial form to Shift Register No. 6 (Z5006). Flip flop circuits (Z2 through Z8) contained in Shift Register Z5002 operate sequentially; each time flip flop Z8 is set, circuits contained in Advance Circuit No. 2 Z5005 extend a triggering pulse to Shift Register No. 6 causing each bit of the tuning message to be advanced into the memory cores. For detailed information, refer to the RTMU technical manual.

f. E CODE INTO RTMU. - The last 5-bit character to be stored in the memory cores is a receiver tune (E) code. This code also opens nandgate Z8 of Equipment Recognition Module Z5003 (refer to figure 4-5); Z8 then issues a 5 us pulse that is applied simultaneously to Equipment Recognition Module Z5003, to Shift Register Z5006, and to Advance Circuit Z5004.

1. The 5 us pulse from nandgate Z8 resets flip flop Z3 of Equipment Recognition Module Z5003; thereby producing the positive swing necessary to close the memory core input gate and de-energize relay K1 which in turn re-opens the recognition code gates of other receivers utilizing the common teletype input line. For detailed analysis, refer to the RTMU manual.

2. The 5 us pulse from nandgate Z8 sets flip flop Z3 of Shift Register Z5006 which results in triggering clock generator Z2 to produce regularly timed pulses (tamping action); these pulses working through one shot Z1 ultimately move the code bits to the output end of the RTMU memory cores (not shown). For detailed analysis, refer to the RTMU manual.

3. The 5 us pulse from nandgate Z8 fires one shot Z4 of Advance Circuit Z5004 producing a negative 450 millisecond pulse that: (1) is extended through an inverter to relay K4030 of Receiver Decoder RTTD thus energizing the RTTD power supply (see note below); (2) is applied directly to diode andgate (comprising CR3 and CR6) of Equipment Recognition Module Z5003 thus satisfying one of the input requirements for the diode andgate. For detailed analysis, refer to the RTMU manual.

NOTE

Relay K4027 operates when RTTD is energized and: (1) closes a secondary operating path for relay K5002 of RTMU; (2) extends +12V to flip flop Z5 of Advance Circuit Z5004 which succeeds in closing the code input gate of Clock Timing Circuit Z5001 (refer to RTMU manual).

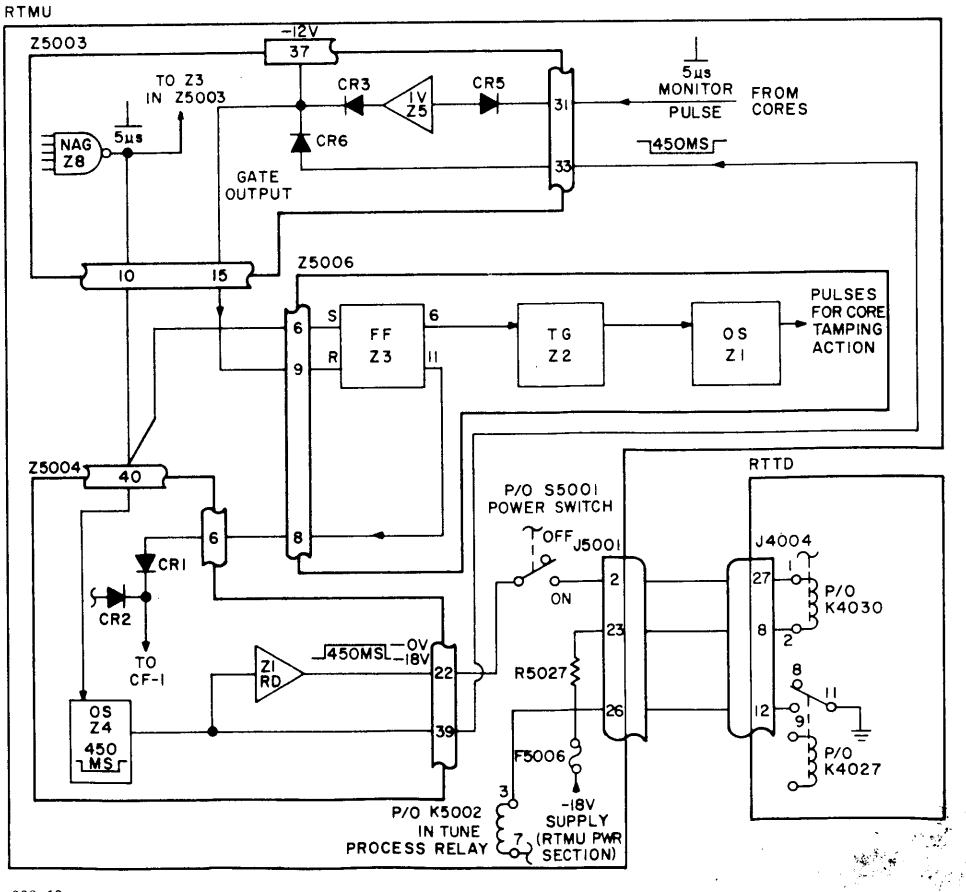


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Figure 4-5. E Code Action, RTMU To RTTD

g. CODE TRANSFER FROM RTMU TO RTTD (Refer to Figures 4-5, 4-6 and 4-7). - When the first character of the tuning message reaches the 29th position in the memory cores, a negative 5 us monitor pulse is applied through an inverter to diode andgate CR3 and CR6 of Recognition Module Z5003; the output of the diode andgate swings positive and resets flip flop Z3 of Shift Register Z5006 which will: (1) stop clock generator Z2 thereby stopping the tamping action; (2) apply a negative pulse to a diode andgate (comprising CR1 and CR2) of Advance Circuit Z5004 thus satisfying one of the input requirements of the diode andgate.

When Receiver Decoder RTTD is energized (paragraphs 4-3b and 4-3f), relays K4006 and K4027 operate; closed contacts of relay K4006 simultaneously extend: (1) +12vdc to contact 18 of relay K4008; (2) +28vdc to a multivibrator control circuit (comprising Q4001 and Q4002) for relay K4008. Relay K4008 controls the code-advance circuits as follows:

(1) Initially relay K4008 is held de-energized by a time-delay circuit; during this time, +12vdc from contacts 17 and 18 resets flip flop Z6 of Advance Circuit Z5004 in the RTMU.

(2) Upon completion of the time-delay interval, relay K4008 operates momentarily, operating voltage (+28v) is removed from relays K4001 through K4005, and +12vdc from contacts 18 and 19 of K4008 sets flip flop Z6 of Advance Circuit Z5004. The output of Z6 fires one shot Z3 which produces a .4 millisecond pulse that opens diode andgate CR1 and CR2 and is applied to emitter follower Z2. The amplified output of Z2 is applied to the RTMU memory cores moving the first code through Relay Drive Circuit Z5014 to the coils of input relays K4001 through K4005 of Receiver Decoder RTTD. For detailed analysis, refer to the RTMU and RTTD instruction manuals.

Closed contacts of relays K4001 through K4005 of the RTTD energize relays K4020 through 4025 in accordance with the tuning code (bit information) received from Signal Data Converter Storer RTMU. Depending upon the first bit of the tuning code, closed contacts of relays (K4020 through K4025) that are energized complete a path for +28vdc from contacts 6 and 7 of relay K4015 to the solenoid of the Master Decoder switch (S4004) in the RTTD or to the solenoids of the appropriate decoder switch in the DDR receiver system. If the first bit of the tuning code is 1, relays K4001 and K4019 are energized and +28vdc is applied to the Master Decoder Switch S4004. If the first bit of the tuning code is 0, relays K4001 and K4019 are not energized and +28vdc is applied to the appropriate decoder switch in the DDR.

In either case, the current drawn by a moving rotary solenoid results in energizing relay K4012 thus disabling the multivibrator control circuit (Q4001 and Q4002) and opening the operate path of relay K4008. When the stepping switch (S4004 or DDR decoder switch) reaches the position prescribed by the tuning code, contacts of a notch homing wafer open the +28 volt connection to the solenoid and the switch stops at the prescribed position. The operate path of relay K4012 is opened, the multivibrator control circuit is enabled, and relay K4008 is again energized. The sequential operation of relay K4008 sets and resets flip flop Z6 of Advance Circuit Z5004, thus advancing the tuning code from Signal Data Converter Storer RTMU to Receiver Decoder RTTD and activating rotary solenoids throughout the DDR receiver system. For detailed analysis, refer to the RTTD and RTMU instruction manuals.

h. SERVO TUNING ACTION. - There are three distinct stages of servo tuning action: (1) TUNE servo AZ103 of the RTTD is disabled until the BAND switch of Continuous RF Tuner HFRR is properly positioned; (2) motor B1002 of the HFRR is energized and the BAND switch is positioned in accordance with tuning information received; (3) TUNE servo AZ103 is then energized and frequency search takes place.

(1) DISABLING TUNE SERVO AZ103 (Refer to figure 4-8). - As the wiper of Master Decoder switch S4004 in Receiver Decoder RTTD makes connection with contacts 1 and 2, relay K4032 of the RTTD energizes and disconnects +28 vdc from contact 6 of relay K4007 thus opening the locking path of K4007. (This is in the event that K4007 is still energized from a previous tuning sequence). De-energized relay K4007 opens contacts 9 and 10 and removes regulated +28 vdc supplied from Continuous RF Tuner HFRR.

(2) ENERGIZING BAND SWITCH MOTOR OF HFRR (Refer to Figure 4-9). - As the wiper of Master Decoder switch S4004 in Receiver Decoder RTTD makes connections with contacts 3 and 4, +28vdc is extended through contacts 8 and 9 of de-energized relay K4017, through the BAND switch positioning wafer of Control Synthesizer and Standard HFSR, through homing switch S1007 in Continous RF Tuner HFRR, to the coil of relay K4028 K4028 energizes and: (1) closed contacts 6 and 7 connect 115 vac to solenoid L1063 in the HFRR. Current through the solenoid draws the cam follower out of the BAND switch cam; this action closes contacts 1 and 2 of micro switch S1006, thus applying +28 vdc to the coil of relay K4017. Relay K4017 energizes and: (1) contacts 8 and 9 open the initial operate path of relay K4028--K4028 is locked operated at this time by its closed contacts 1 and 3; (2) contacts 20 and 21 open the operate path of the TUNE servo thus preventing servo operation until the BAND switch has positioned; (3) contacts 6 and 7 apply a-c power to motor B1002 causing it to rotate the BAND switch. When the BAND switch has positioned, homing switch S1007 opens the +28 vdc locking path to relay K4028, K4028 is de-energized, the operate paths of relay K4017 and solenoid L1063 are opened, and the cam follower is

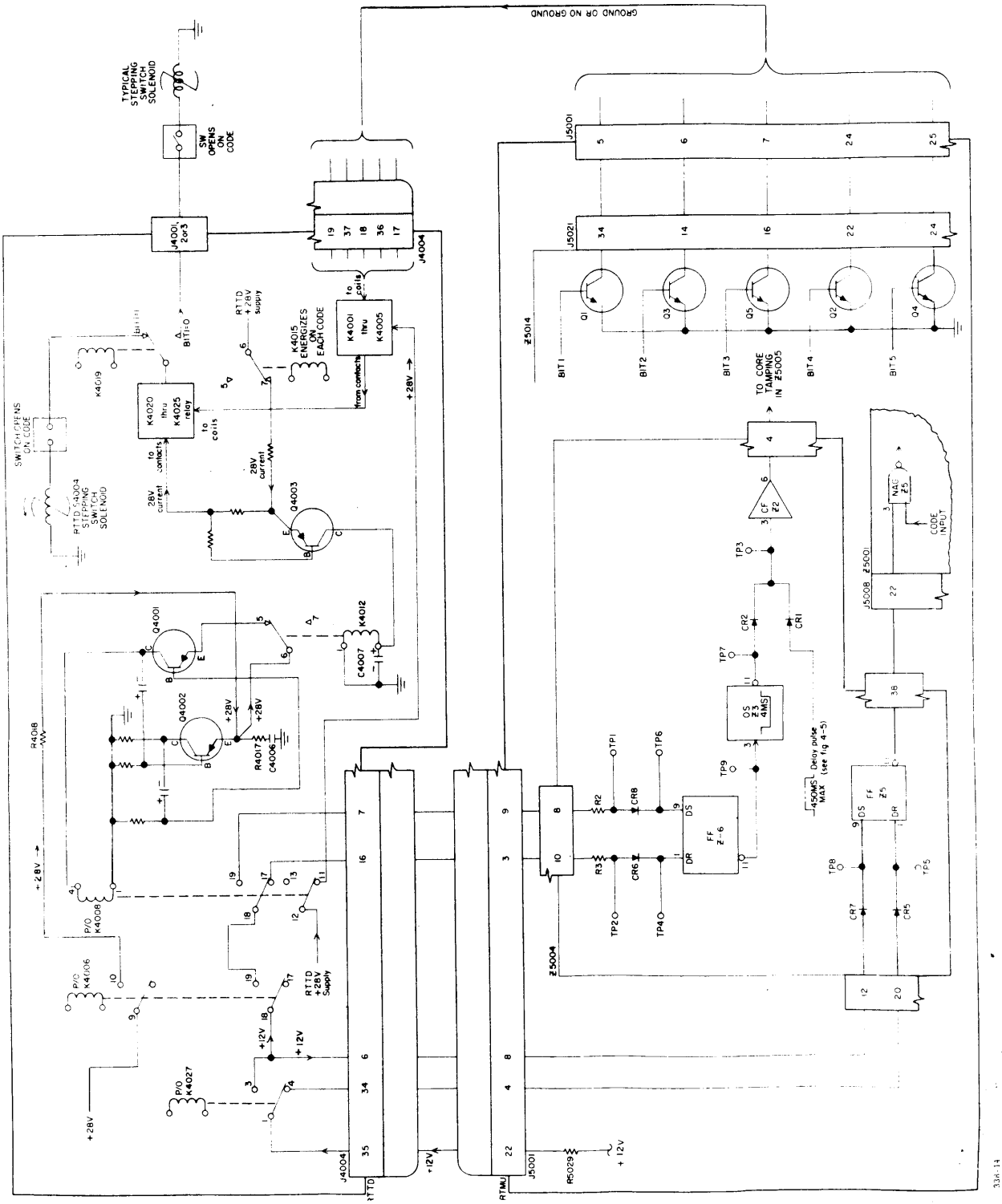

Figure 4-6. Simplified Schematic, Code Transfer from RTMU to RTTD

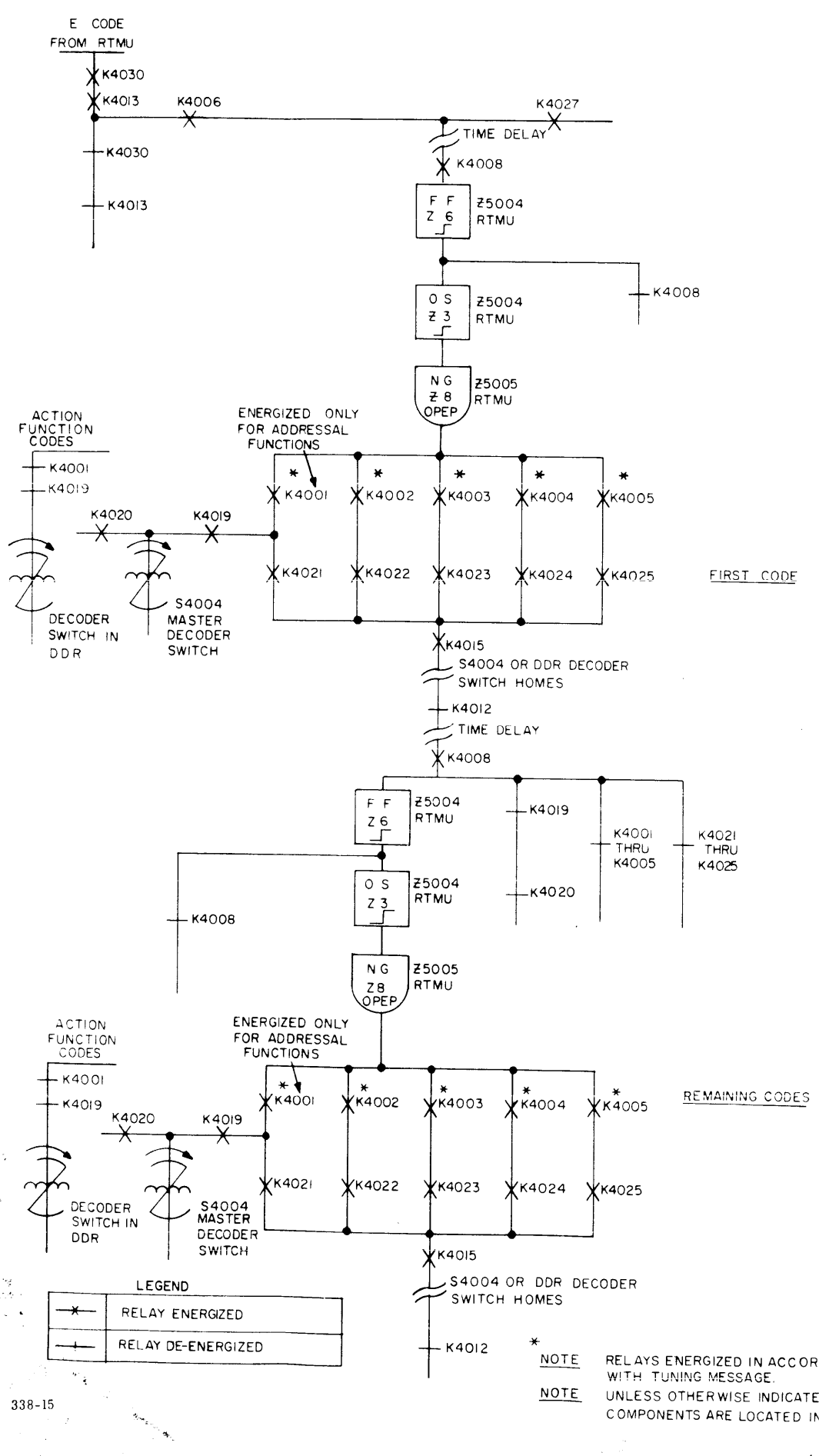

Figure 4-7. Code Transfer, RTMU to RTTD, Sequence Chart

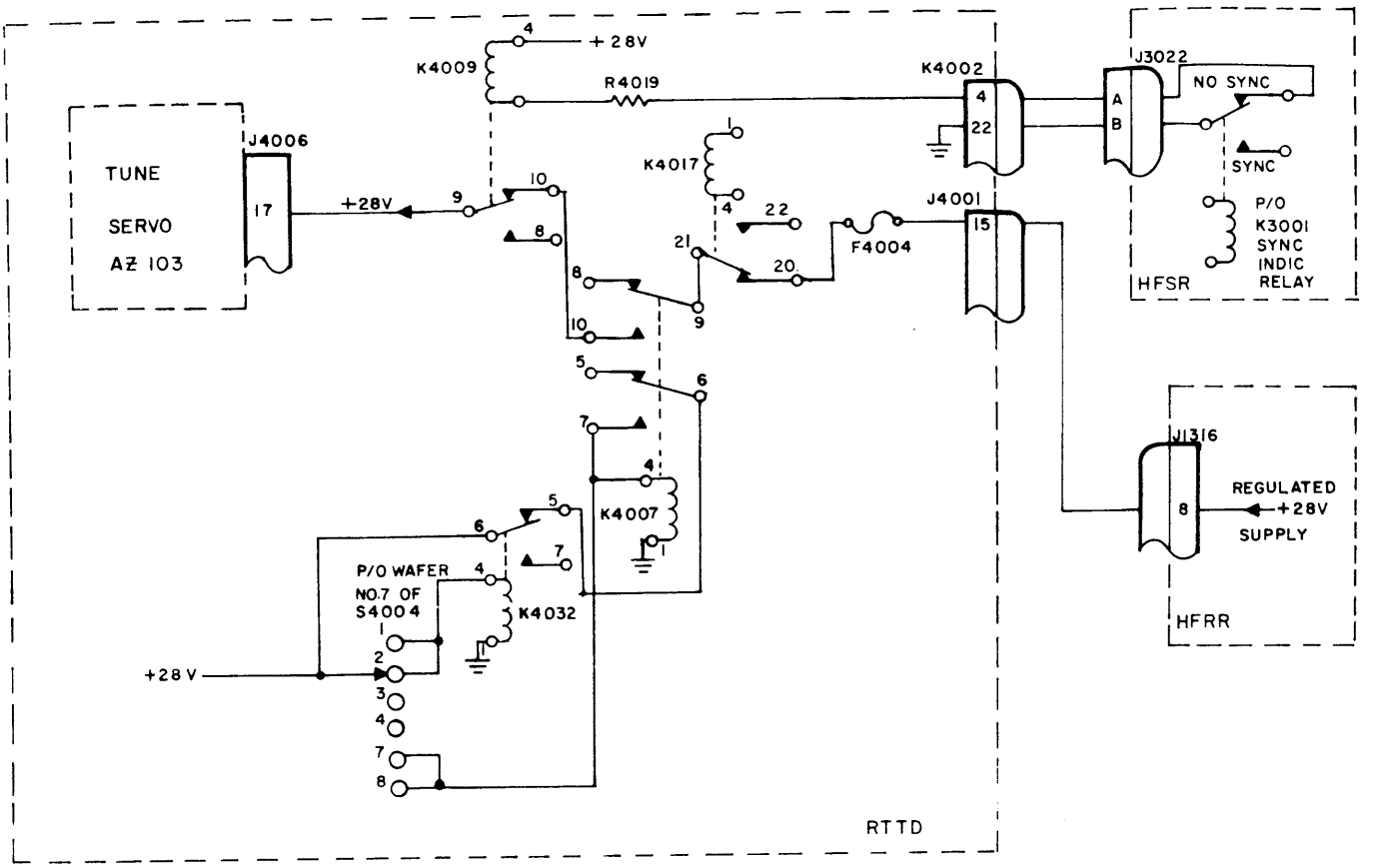

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Figure 4-8. Operate Path of Tune Servo AZ103, Simplified Schematic

released locking the BAND switch in its prescribed position.

(3) ENERGIZING TUNE SERVO OF RTTD (Refer to Figures 4-8 and 4-10). - As the wiper of Master Decoder switch S4004 makes connection with contacts 7 and 8, relay K4007 energizes and locks operated by means of its contacts 6 and 7. Closed contacts 9 and 10 of relay K4007 complete the +28 vdc operate path for TUNE servo AZ103 through contacts 9 and 10 of relay K4009. Relay K4009 is held energized by the no-sync condition of relay K3001 of Control Synthesizer and Standard HFSR.

When the wiper of Master Decoder switch S4004 in the RTTD has passed contacts 7 and 8, the HFSR stepping switches (MC, 100KC, 10KC, 1KC, and .1KC) have stopped at their prescribed positions. The MC and 100 KC switches (S3006 and S3004) in the HFSR determine the operate or non-operate condition of relay K4018 in the RTTD. Relays K4018 and K4011 then determine the "direction of search" signal applied to TUNE servo AZ103 which in turn causes motor B1001 of Continuous RF Tuner HFRR to rotate in the correct direction. If the frequency selected falls in the left half of the MEGACYCLES dial of Continuous RF Tuner HFRR, the operate path of relay K4018 is completed through switches S3006C and S3004C, relay K4018 is energized, 6.3vac of proper phase is applied to TUNE servo AZ103, and motor B1001 in the HFRR moves the cursor of the MEGACYCLE dial towards the low-frequency end of the dial (refer to figure 4-10). If the selected frequency falls in the right half of the MEGACYCLES dial, the operate path of relay K4018 is not completed, relay K4018 remains de-energized, 6.3vac of proper phase is applied to TUNE servo AZ103, and motor B1001 in the HFRR moves the cursor of the MEGACYCLES dial toward the high-frequency end of the dial. For detailed analysis, refer to the RTTD instruction manual.

If the cursor on the HFRR MEGACYCLES dial does not encounter the prescribed frequency setting, it will continue to the end of the dial. When the cursor reaches the end of the dial, a limit switch (S1005 or S1006) is actuated, relay K4011 is energized, the phase of the 6.3vac applied to TUNE servo AZ103 is reversed, and motor B1001 reverses its direction. For detailed analysis, refer to the RTTD instruction manual.

j. E CODE INTO RTTD. - The receiver tune code (E) is transferred from Signal Data Converter-Storer RTMU to Receiver Decoder RTTD in the same manner as all other characters of the tuning message (refer to paragraph 4-3f). When the E code enters the code bit relays of the

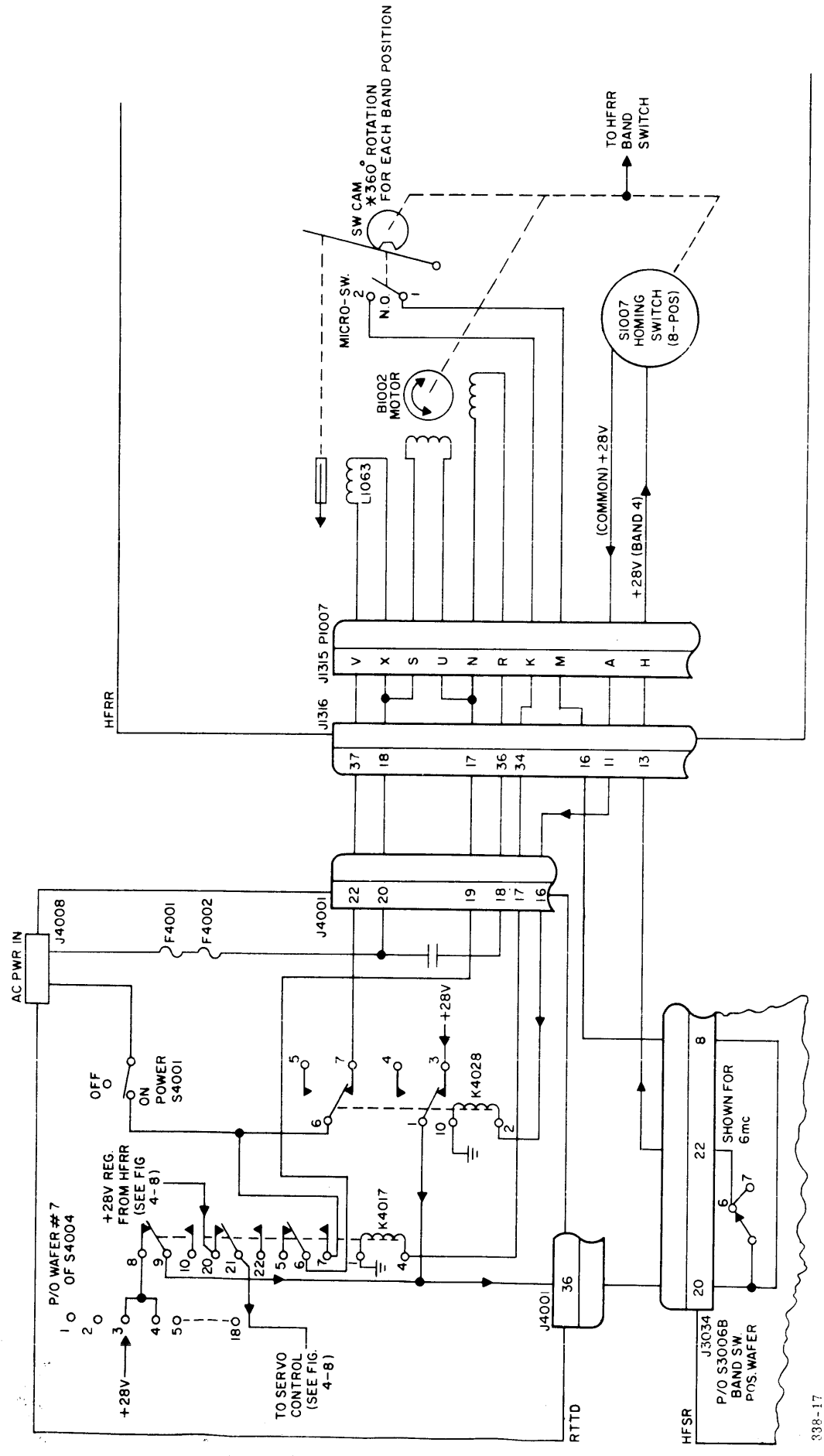
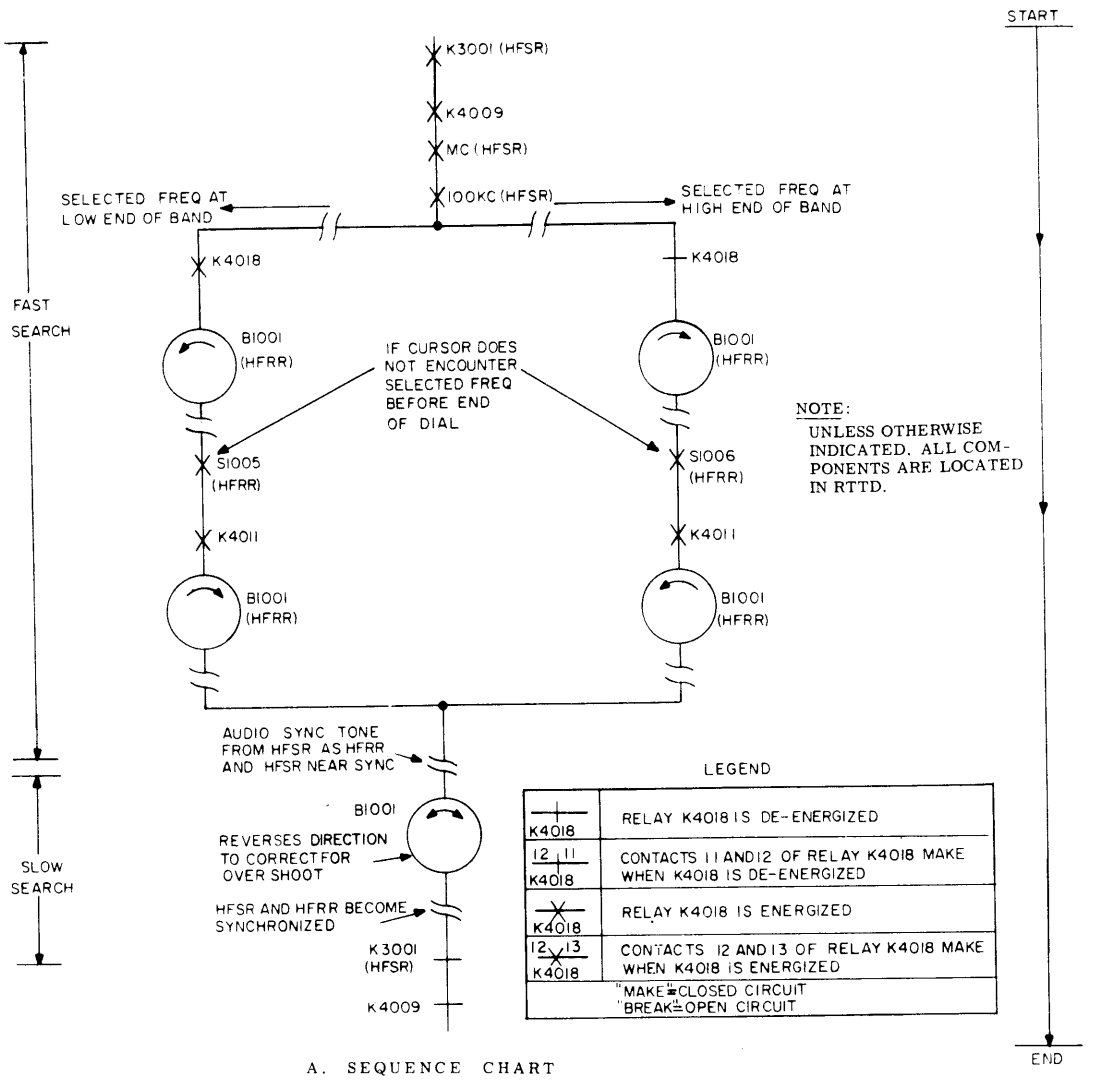
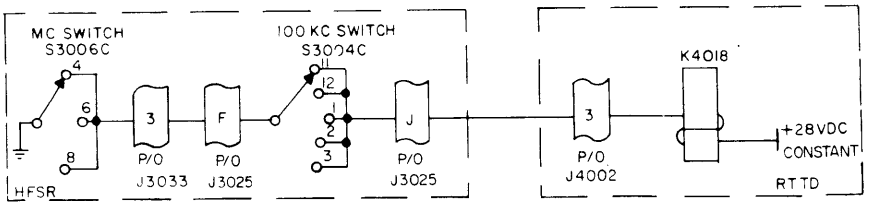


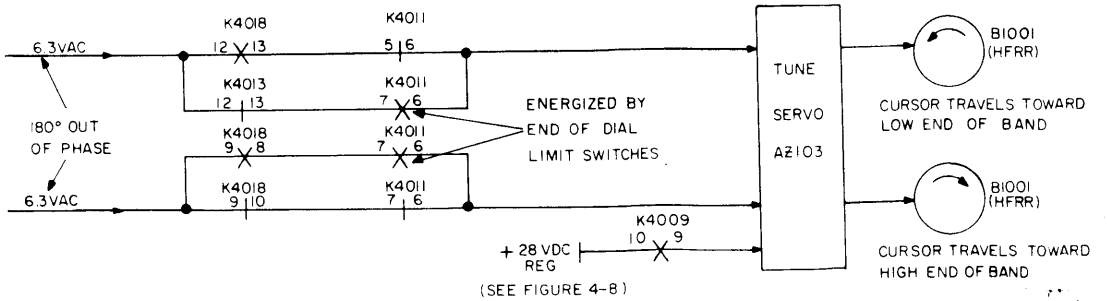
Figure 4-9. Energization of BAND Switch Motor, Simplified Schematic



A. SEQUENCE CHART



B. OPERATIONAL SCHEMATIC



C. OPERATIONAL SCHEMATIC

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Figure 4-10. Frequency Search, Sequence Chart and Operational Schematics

RTTD, Master Decoder switch S4004 moves to position 16 and wafer 7 connects +28 vdc to the coil of relay K4014 via contacts 5 and 6 of de-energized relay K4013 and contacts 12 and 13 of energized relay K4006 (refer to figure 4-11). Relay K4014 then energizes and opens the +28 vdc locking path of relay K4006 (through its own contacts 6 and 7).

When the high-frequency oscillator of Continuous RF Tuner HFRR and Control Synthesizer and Standard HFSR are synchronized, the operate path of relay K4009 in the RTTD is opened via energized relay K3001 in the HFSR. Relay K4009 of the RTTD de-energizes and opens one of the two operate paths of relay K4027 (de-energized relay K4006 opened the other operate path). Relay K4027 de-energizes and: (1) shuts off the RTTD power supply (refer to RTTD manual); (2) de-energizes relay K5002 of the RTMU; (3) applies +12 vdc to diode CR5 of Advance Circuit Z5004 thus resetting flip flop Z5. (See figure 4-6)

De-energized relay K5002 energizes relay K5001 and the tuning cycle is complete with the readback code being transmitted to the remote operating site. The output of reset flip flop Z5 swings negative and sets nandgate Z5 of Clock Timing Circuit Z5001; to open on the first code of the next remote tuning message.

j. REMOTE RF GAIN CONTROL (Refer to Figure 4-12). - As stated in paragraph 4-2b, Remote Gain Control RGCB provides a d-c output signal that is used as a gain potential for the DDR receiver system. An input analog signal (in -5 vdc to +5 vdc range) is applied to the dc-to-dc converter stage of Remote Gain Control RGCB and is converted to a corresponding linear signal in the -10 vdc to 0 vdc range for controlling the agc stages of IF Amplifier HFIA and Continuous RF Tuner HFRR. A -5 vdc input into the RGCB produces a -10 vdc output, and a +5 vdc input produces a 0 vdc output. A -10 vdc signal into the HFIA sets the HFIA i-f amplifier (and HFRR r-f stage) for maximum gain; a 0 vdc signal sets these two stages for minimum gain.

k. REMOTE BFO CONTROL (Refer to Figure 4-13). - As stated in paragraph 4-2b, the 2-mc oscillator of Automatic Frequency Control AFCR is used as the receiver bfo control during remote operation. A remote analog signal (a voltage in -5 vdc to +5 vdc range) is applied via J103 to a relay driver circuit comprising Q103 through Q109 and relays K101 and K102 located in Remote Gain Control RGCB. When the incoming analog signal is on the positive side (0- to +5 vdc), relay K101 energizes and, in turn, energizes relay K103. Relay K103 then connects 115 vac across the clockwise coil of motor B1001 in Automatic Frequency Control AFCR; B1001 then rotates the TUNING KCS control (C5063) towards the +3 KC position. Similarly, when the incoming analog signal is on the negative side (0-to-5 vdc), relays K102 and K104 energize and motor B1001 rotates the TUNING KCS control towards the -3 KC position.

A dc-to-dc converter circuit in the RGCB applies reference voltages (-5 vdc and +5 vdc) across potentiometer R5131 in the AFCR. The wiper arm of R5131 is attached to the drive shaft of the TUNING KCS control; as the TUNING KCS control rotates, the wiper arm of R5131 extends an error voltage back to the relay driver circuit. The relay driver circuit remains operated and the tuning process continues until the error voltage from R5131 is identical to the input analog signal.

When relay K103 or K104 energizes at the

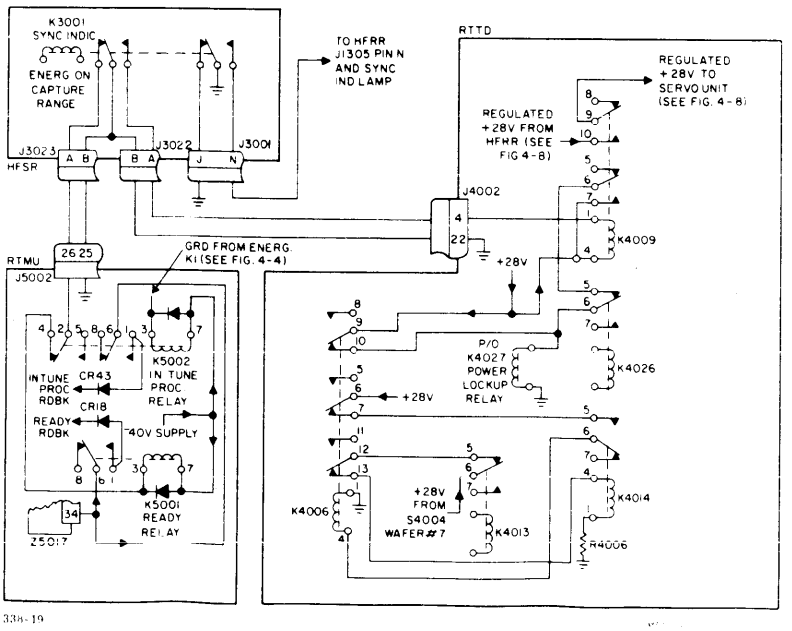


Figure 4-11. Shut-Down of Digital Tuning System

beginning of the tuning process, relay K105 also energizes. When the tuning process is completed and relay K103 or K104 de-energizes, relay K105 remains energized for several seconds supplying a braking action for motor B5001 in the AFCR. Part of the REMOTE BFO switch on Remote Gain Control RGCB is wired to parallel the RESET button of Automatic Frequency Control AFCR. When the REMOTE BFO switch is set at ON, the d-c correction voltage in the AFCR is disabled (refer to AFCR manual) in order that the RGCB servo control can override the AFCR electrical correction loop. The dc-to-dc converter in the RGCB supplies operating potential for the REMOTE BFO DRIVE lamps for local monitoring purposes.

1. DIGITAL READBACK. - Except for the "in-tune process" and "ready" signals from Control Synthesizer and Standard HFSR and Continuous RF Tuner HFRR, all readback signals are generated by Signal Data Converter-Storer RTMU. Although the readback leads are extended through Isolation Keyer AK-101, this unit serves only as a tie point for connections and does not effect the signals in any way. A complete description of RTMU scanning and transmission of codes on the receiver stepping switch readback wafers may be found in the RTMU manual.

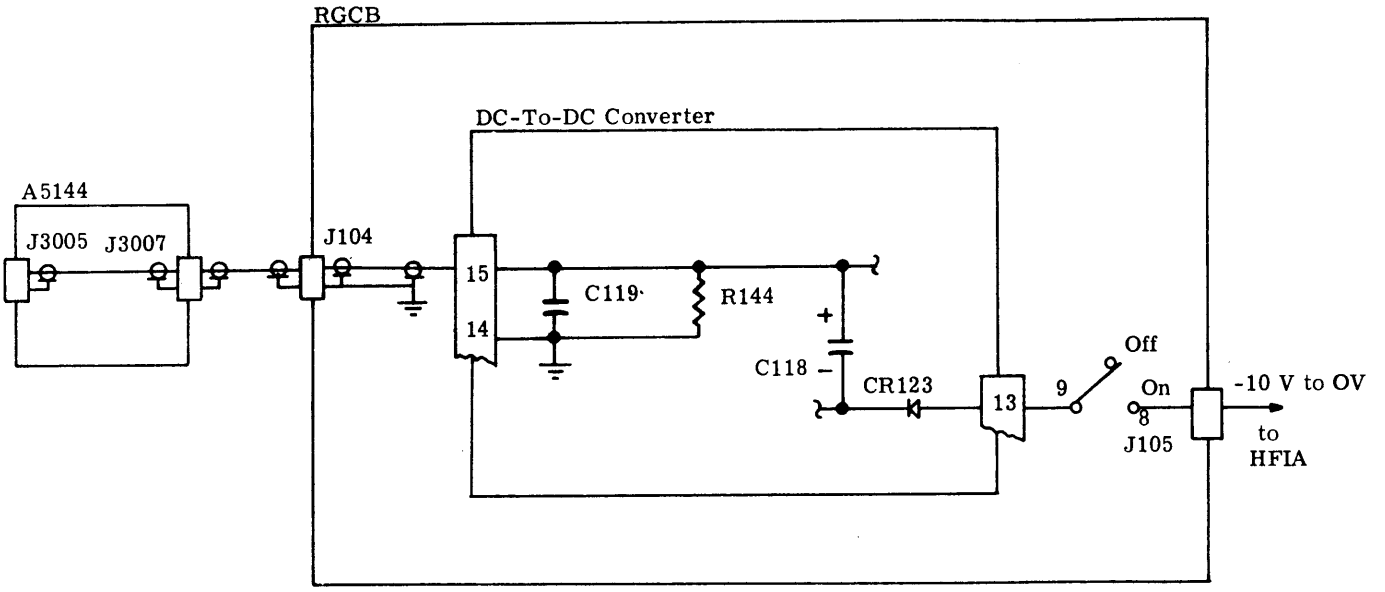


Figure 4-12. RF Gain Analog Control.

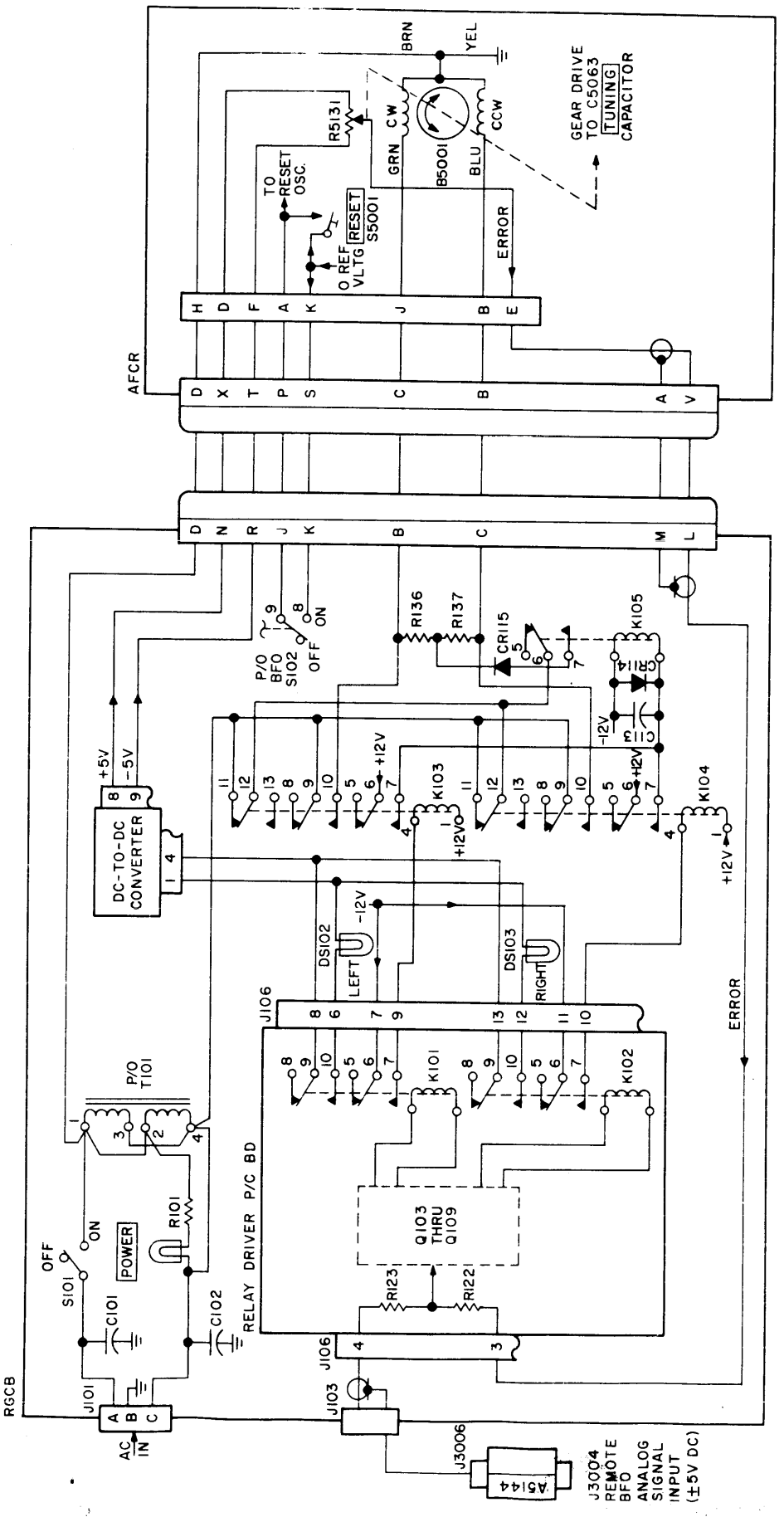


Figure 4-13. BFO and AFC Analog Control

SECTION 5
MAINTENANCE

5-1. SPECIAL TOOLS AND TEST EQUIPMENT

Special tools included in the shipment and required for DDR alignment and maintenance are shown in figures 5-1 and 5-2. Table 5-1 lists standard laboratory equipment required but not supplied.

5-2. PREVENTIVE MAINTENANCE

a. CLEANING AND INSPECTION. - In order to prevent equipment failure due to dust, dirt or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

At periodic intervals, the equipment should be removed from its mounting for cleaning and inspection. The wiring and all components should be inspected for dirt, dust, corrosion, grease or other harmful conditions. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichlorethylene or methylchloroform may be used, providing the necessary precautions are observed.

WARNING

When using toxic solvents, make certain that adequate ventilation exists. Avoid prolonged or repeated breathing of the vapor. Avoid prolonged or repeated contact with skin. Flammable solvents shall not be used on energized equipment or near any equipment from which a spark may be received. Smoking, "hot work", etc. is prohibited in the immediate area.

CAUTION

When using trichlorethylene, avoid contact with painted surfaces, due to its paint removing effects.

b. REPLACEMENT OF ELECTRON TUBES. - While the modular units are out of the cabinet for periodic inspection, all electron tubes should be checked and replaced as required. Particular attention should be paid to the following:

(1) When withdrawing miniature tubes from their sockets, pull them straight out; do not rock or turn them. If pins of miniature tubes are bent, straighten them with a proper pin straightener before replacing the tube.

(2) Some circuits, for example oscillator circuits, may function better with one tube than with another even though both tubes are new or both tubes measure the same when checked on a tube tester.

(3) Tubes should not be replaced or discarded merely because they have been used for some time. Satisfactory operation in a circuit is the final proof of tube quality; the tube in use may work better than a new tube.

TABLE 5-1. TEST EQUIPMENT, DDR

ITEM	MANUFACTURER
Frequency Counter	Hewlett Packard, Model 524C, or equivalent.
Signal Generator	Measurements, Model 82, or equivalent.
Vacuum Tube Voltmeter	Hewlett Packard, Model 410B, or equivalent.
R-f Voltmeter	Ballantine Laboratories, Model 314, or equivalent.
Teletypewriter Set (with keyboard, tape puncher, tape reader and 7.42 baudot CCIT 5-level code electrical output)	Smith-Corona Marchant (Kleinschmidt Div.) AN/FGC-25 or equivalent.

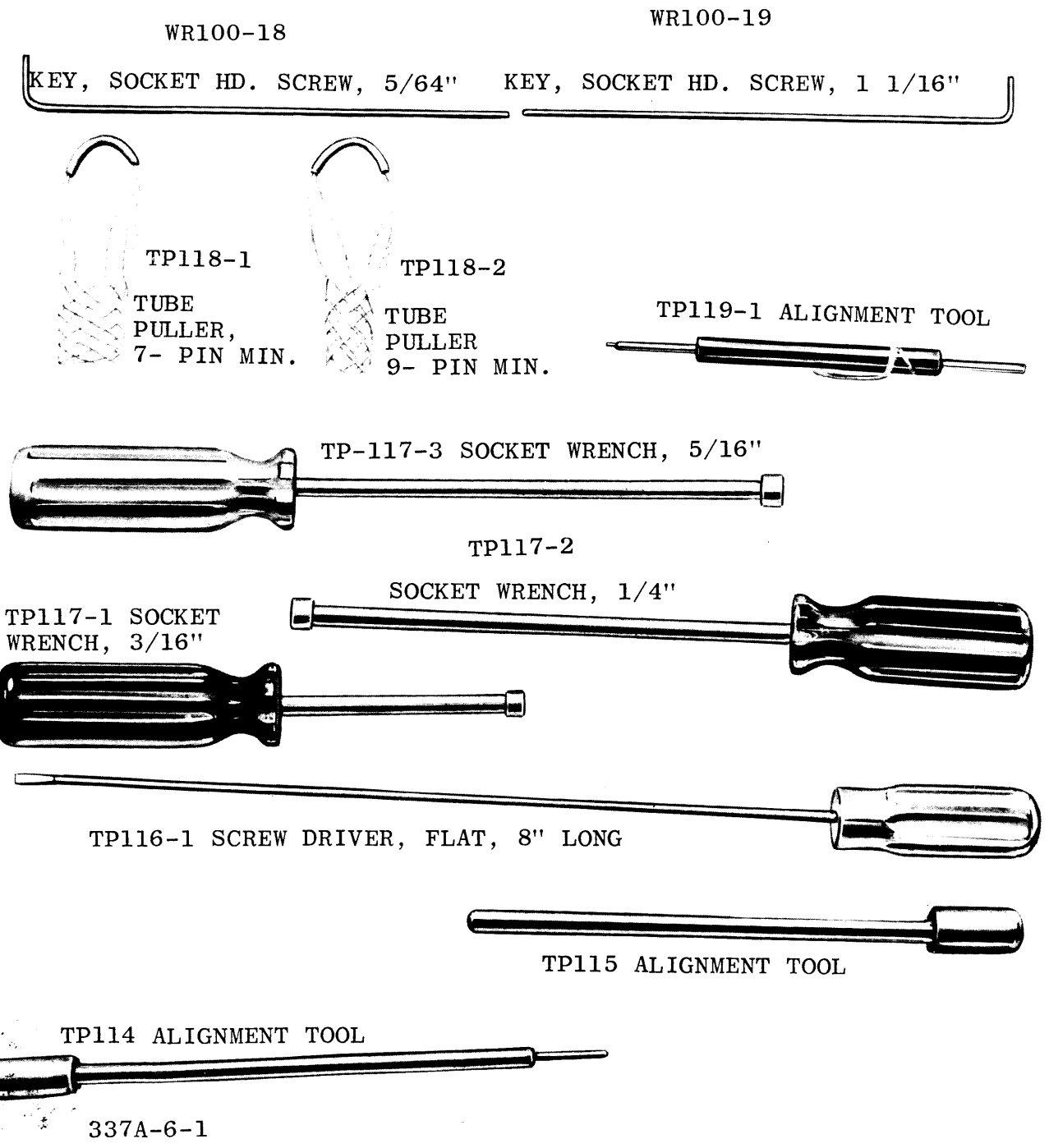


Figure 5-1. Special Tools, DDR Maintenance, Alignment.

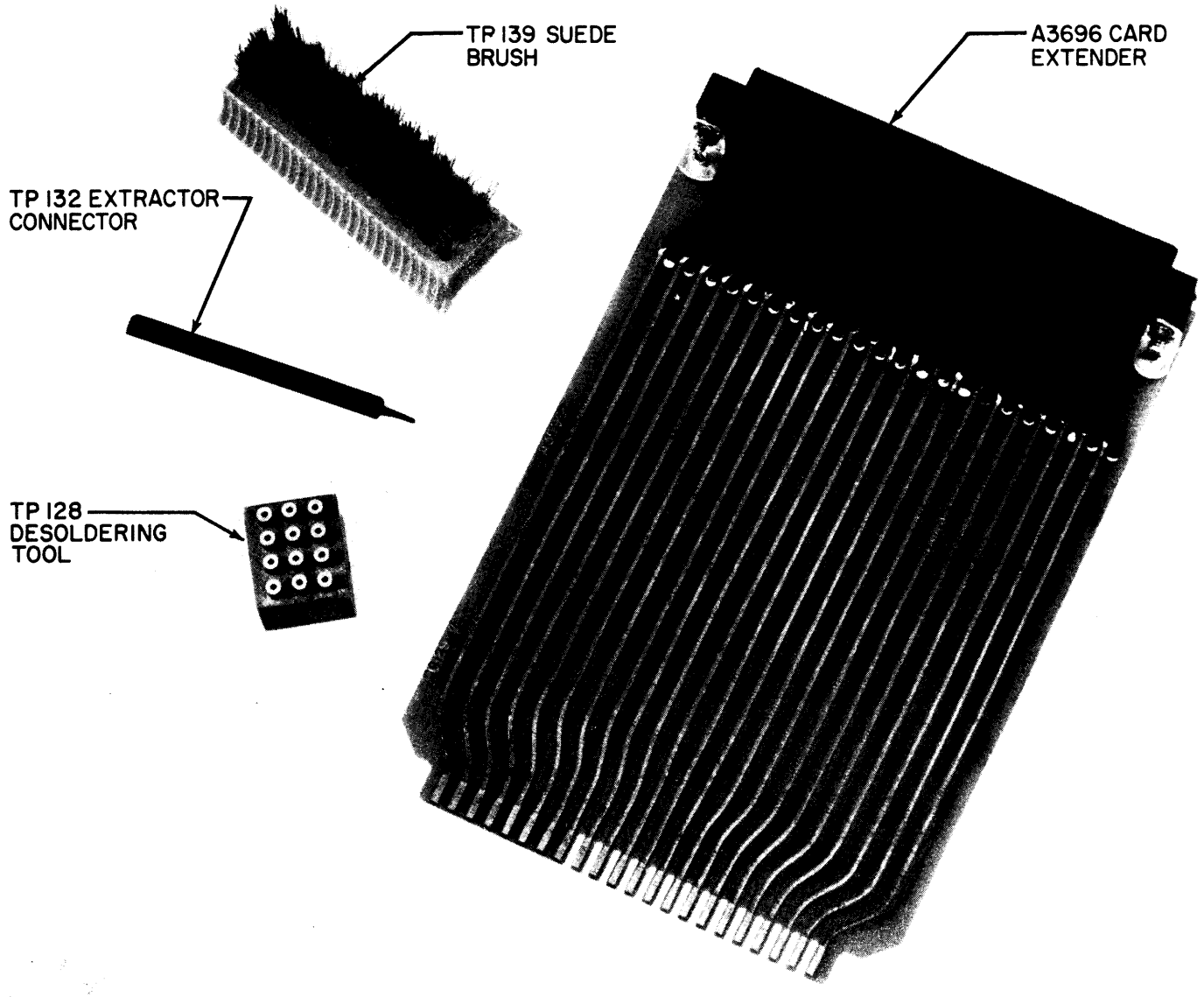


Figure 5-2. Special Tools, DDR, Maintenance, Logic Circuit

c. GEAR LUBRICATION. - Examine all gears and gear assemblies contained in the modular units. If any of the gears show signs of becoming dry, coat them heavily with a molydenum disulphide compound such as Molykote Type G made by the Alpha Corporation of Greenwich, Conn.

5-3. ALIGNMENT AND ADJUSTMENT

a. INTRODUCTION. - With the exception of the procedure given in the following paragraphs (b, c, and d), all alignment and adjustment is accomplished on an individual modular unit basis. Refer to the appropriate modular-unit manual for the necessary alignment and adjustment procedures. The following procedure is for alignment of HFRR circuits, utilizing a tested HFSR and the audio sync tone generated by it.

b. ALIGNMENT OF HFO CIRCUIT IN HFRR. - Proceed as follows:

(1) Ascertain that the receiver has been in the STANDBY condition for at least 24 hours.

(2) Set RTMU and RTTD POWER switches at OFF.

(3) Set HFAR CHANNELS A and B LEVEL ADJUST knobs fully clockwise.

(4) Set HFRR NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch at ALIGNMENT SIGNAL.

(5) Set HFSR selector switches for a reading of 2.0000 mc on the digital display.

(6) Adjust HFRR TUNE knob to bring exactly 2 mc on dial. If SYNC IND lamp lights and remains lit and SYNCHRONIZE meter indicates zero center scale, no adjustment is necessary. If these indications are not present, insert alignment tool TP115 in rear orifice on top of HFO oven enclosure and adjust oscillator trimmer to obtain them.

(7) Set HFSR selector switches for a reading of 3.0000 mc on the digital display.

(8) Adjust HFRR TUNE knob to bring exactly 3 mc on dial. If SYNC IND lamp lights and remains lit and SYNCHRONIZE meter indicates zero center scale, or nearly so, no adjustment is necessary. If these indications are not present, insert alignment tool TP114 in front orifice on top of HFO oven enclosure and adjust HFO trimmer to obtain them.

(9) Repeat steps (5) through (8) until no further adjustment is necessary.

CAUTION

When performing the following step, be sure to remove alignment tools before attempting to rotate the HFRR BAND control.

(10) Using procedures outlined in steps (5) through (9), align HFO circuit at high and low frequencies of each band.

c. ALIGNMENT OF RF CIRCUITS IN HFRR. - Proceed as follows:

(1) Repeat steps (1) through (4) in HFO alignment procedure.

(2) Set HFSR selector switches for a reading of 2.0000 mc on the digital display.

(3) Adjust HFRR TUNE knob to bring exactly 2 mc on dial. Remove top cover of HFRR r-f turret to expose "L" and "C" adjustments of r-f tuner strips. Using alignment tool TP115, adjust inductors L1001, L1005, L1007 and L1009 of HFRR for maximum indication on associated RF LEVEL meter. Adjustment of L1001 will be very broad.

(4) Set HFSR selector switches for a reading of 3.0000 mc on the digital display.

(5) Adjust HFRR TUNE knob to bring exactly 3 mc on dial. Using alignment tool TP114, adjust capacitors C1009, C1015, C1023, and C1031 for maximum indication on RF LEVEL meter.

(6) Repeat steps (2) through (5) until no further peaking can be obtained.

(7) Repeat procedure outlined in steps (2) through (6) for high and low frequencies of each band. Adjust inductors at low end of band and capacitors at high end of band; in all cases, adjustment of input inductor will be very broad.

d. ADJUSTMENT OF HFRR SYNCHRONIZE METER. - To adjust the SYNCHRONIZE meter, set the HFRR TUNE/SYNC/OPERATE switch at TUNE or SYNC, and adjust R1320 for zero center scale on the SYNCHRONIZE meter.

5-4. TROUBLESHOOTING

Figure 4-1, depicting the detailed paths of frequencies and signals in the DDR, is included in this manual as a primary aid in troubleshooting the receiver system as a whole. Running the receiver system through a typical manual operation, per paragraph 3-3, and referring to figure 4-1, should reveal which modular unit (HFRR, HFSR, etc.), is at fault. With this determined, reference to the detailed troubleshooting procedure in the modular-unit manual should reveal the faulty area or component. In the case of a repeatedly blown fuse in the HFP Power Supply, refer to the fuse table in figure 2-3 for location of the circuit. For wire tracing, refer to figure 2-3 and section 7 of this manual, and the schematic sections of the individual modular-unit manuals.

If, after a manual tuning, the receiver performs satisfactorily, it may be assumed that the trouble lies in either the RTMU, RTTD, or RGCB

units or possibly in the automated circuitry and stepping switches in the remote controlled modules. For checking the RTMU and RTTD, a substitute code input signal is required.

CAUTION

Do not apply test probe to pins of encapsulated logic modules on RTMU printed circuit cards! Apply probe only to "TP" test points indicated on card or to receptacle pin test points at the bottom of the card. It is difficult to touch the probe to the miniature pins on the module without shorting and destroying the module. (See figure 5-3).

Technical Materiel Corporation manufactures equipment, such as the Model RTDA TechnMatiC Test Set, specifically to act as a convenient substitute code input at the RTTD Receiver Decoder receptacle J4004. This unit tests the RTMU, RTTD and the automated circuitry in the modules fed by it as a whole. The RTDA provides a selection of four modes of testing (see figure 5-4): - (1) by pre-punched tape from a CCIT 5-level or ASCII 7-level teletype puncher, (2) by bit pushbutton code generation from the RTDA keyboard, (3) a code-by-code extraction of the message stored in the RTMU memory by "advance" pulse generation manually controlled at the RTDA and (4) extraction of the entire message stored in the RTMU, triggered manually at the RTDA. By testing with all 4 modes, the RTDA will pinpoint the area of trouble (i.e.: RTMU, RTTD, individual module stepping switch). The RTDA, (see figure 5-5) is designed to mount in a 19-inch width rack or in its own desk model cabinet. It receives its power from the RTTD unit under test. Detailed instructions for the test setup and procedure are included in the RTDA manual. Interconnecting cables between RTDA, RTMU and RTTD are shipped as loose items with the RTDA.

TMC's TechniMatiC remote control equipment (code generator, card/tape puncher and reader) and the TechniMatiC receivers are designed for the CCIT 5-level code as shown in table 1-2. However, an easy adaptation is made to ASCII 7-level code equipment. Test Tape from a 7-level code puncher may be used by punching the equivalent ASSCII 7-level codes as reference in table 1-2 and turning the tape over to reverse the reading order as the tape is fed into the 5-bit reader in the RTDA. This arrangment enables the sprocket holes in the tape to engage with the 5-level reader sprockets.

If an RTDA unit is not used, code input at the RTMU can be substituted by test tape into a CCIT 5-level teletype reader (TTY). In this case, the output of the reader should be modified to dry contact keying into the RTMU at J5004 receptacle. Refer to the RTMU manual for pin numbers in the connector. Ascertain that the pulse widths (60 WPM or 100 WPM) of the reader match those of the RTMU (Z5001 printed circuit card in RTMU).

Another method, that may be used, is the employing of the DDR controls and RTMU readback section as the substitute code input. This method has the added advantage of testing the RTMU readback section at the same time. Figure 5-6 shows the test setup. The procedure is to manually set the receiver controls for a particular combination of positions and note these positions. This sets up readback codes, representing the positions, on the RTMU diode matrix. The readback shift-register transmits the codes in 7.42 pattern serial pulse form to the TTY tape puncher, including the "E" code at the end of each cycle. After the tape is punched with two or more readback cycles, the receiver controls are manually re-set to positions other than those in the test arrangement. Then the tape is fed into the TTY tape reader to transmit one cycle with the "E" code falling at the end of the message. The reader transmits this set of codes into the RTMU memory section in a 7.42 pattern serial pulse form. If the RTMU and RTTD are performing correctly they work together to bring the receiver controls to their former positions.

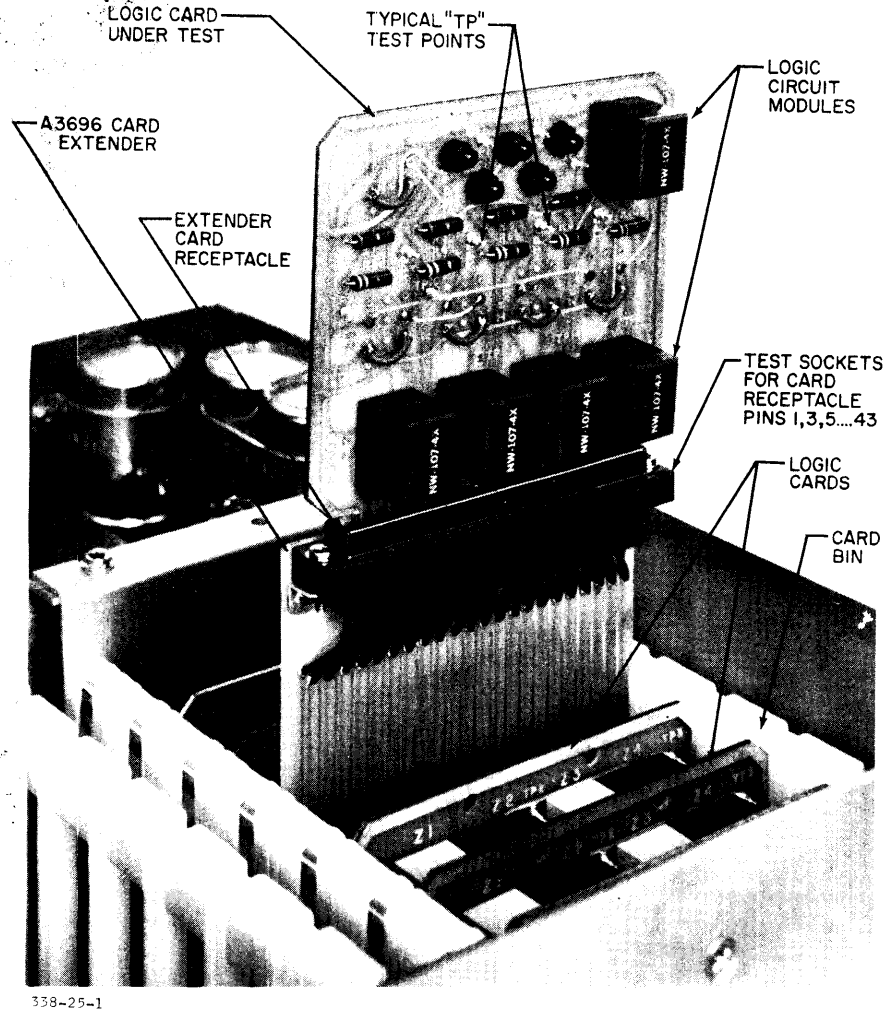
The RGCB may be checked for performance by substituting variable $\pm$5vdc sources for the remote analog BFO and RF gain inputs (refer to figure 4-1). In the BFO check, starting at 0 volts, as the voltage is increased in the + direction RGCB RIGHT lamp should light and the AFCR TUNING knob should rotate clockwise; as the voltage is increased in the minus direction, RGCB LEFT lamp should light and the AFCR TUNING knob should rotate counterclockwise. For the RF gain check, set HFRR NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch to ALIGNMENT SIGNAL. Increasing the input voltage from 0V towards the -10V direction should cause the HFRR RF LEVEL meter needle to move towards the right; decreasing the voltage from -10V towards 0V should cause the needle to swing left.

5-5. REPAIR

Repair procedures and replaceable electrical parts lists for the modular units may be found in the modular Technical Manuals for these units. Repair of DDR rack interconnecting cabling and replacement of components may be done by referring to the rack components parts list in Section 6 and detail cable wire run lists in Section 7 of this manual.

CAUTION

Repair of the printed circuit logic cards in the RTMU require special techniques and tools as described in the RTMU manual. Do not attempt to repair these cards without first referring to the manual.



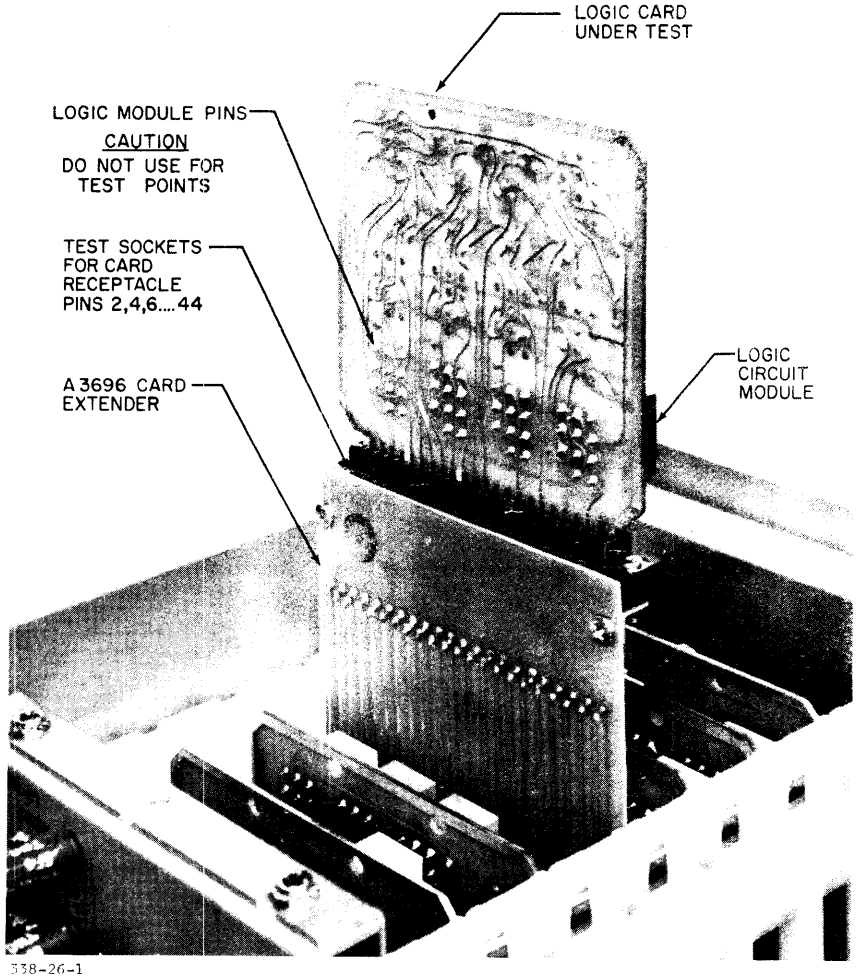


Figure 5-3. RTMU P/C Card in Test Position.

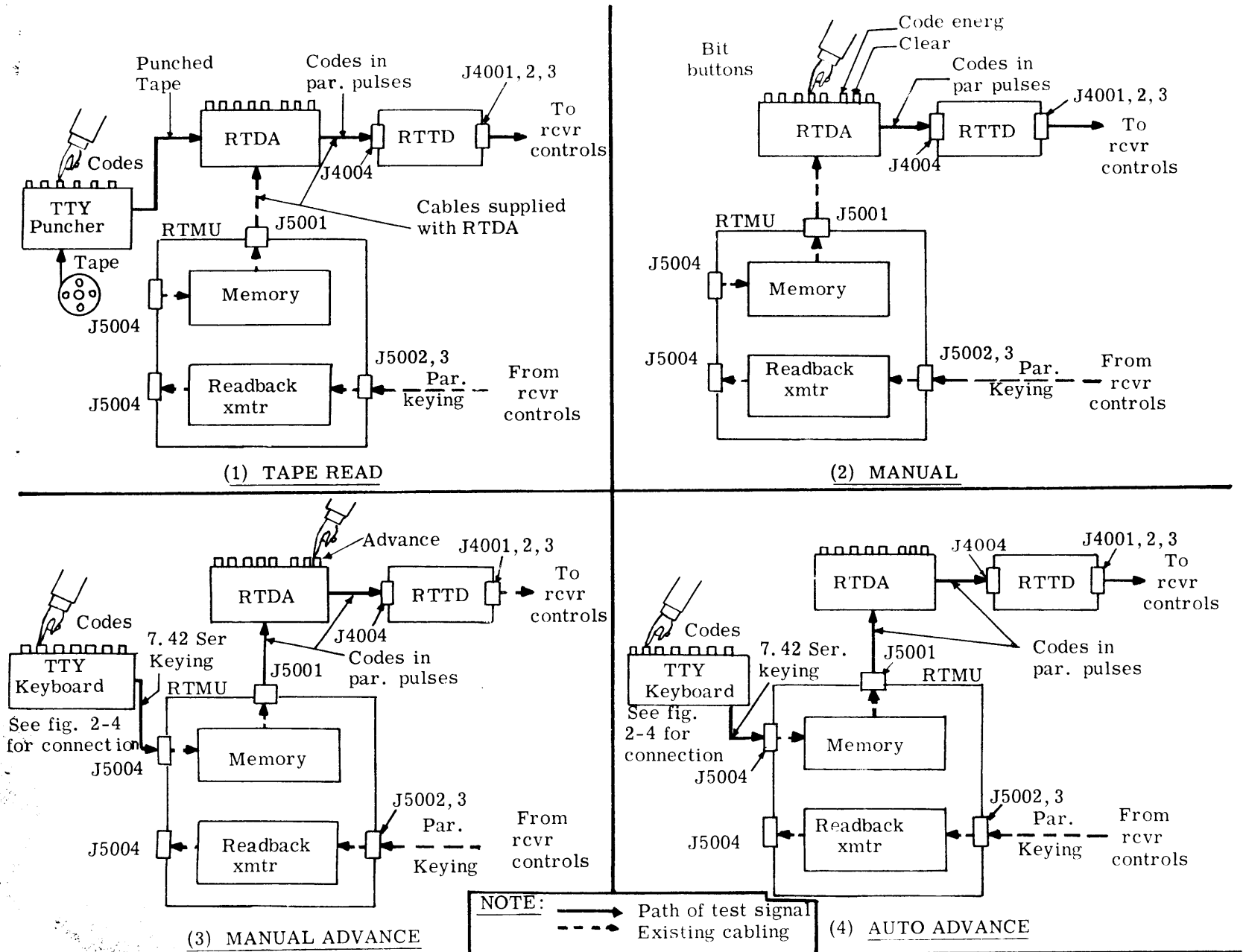


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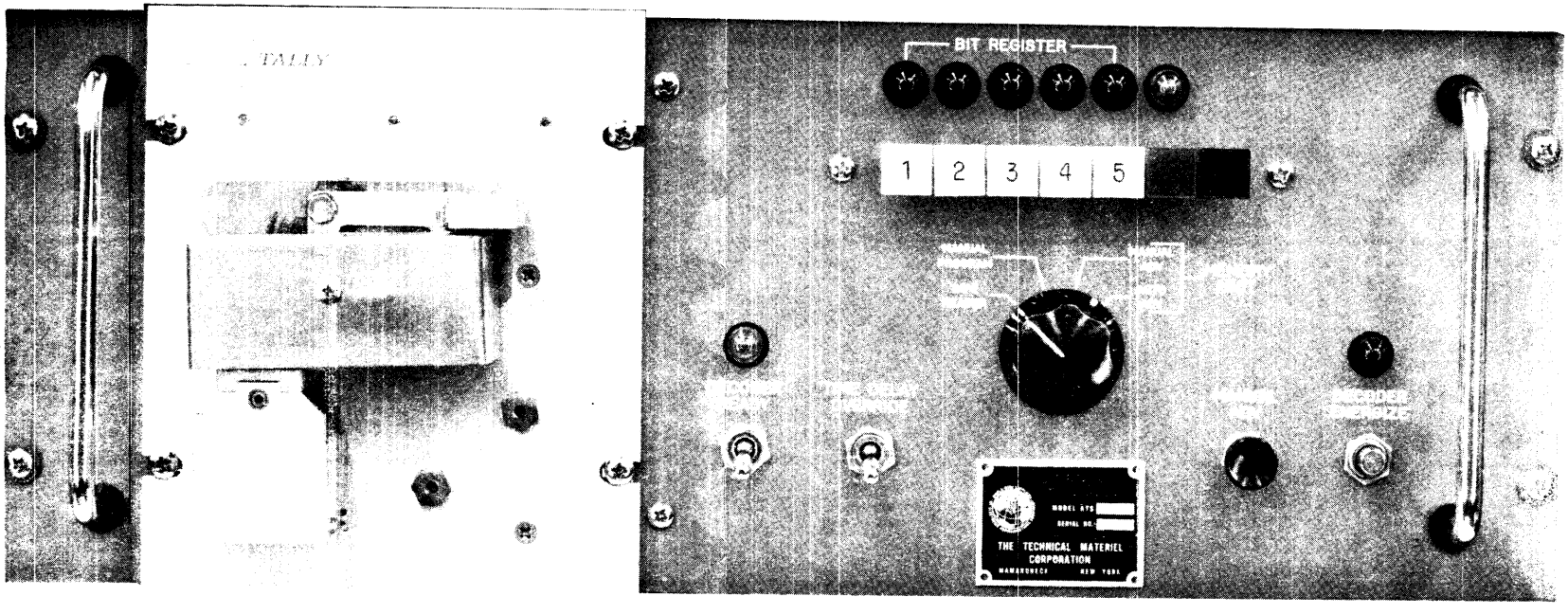
Figure 5-4. Testing TechniMatiC Circuits with RTDA



T101-1

Figure 5-5. Control Panel, TechniMatiC Test Set RTDA

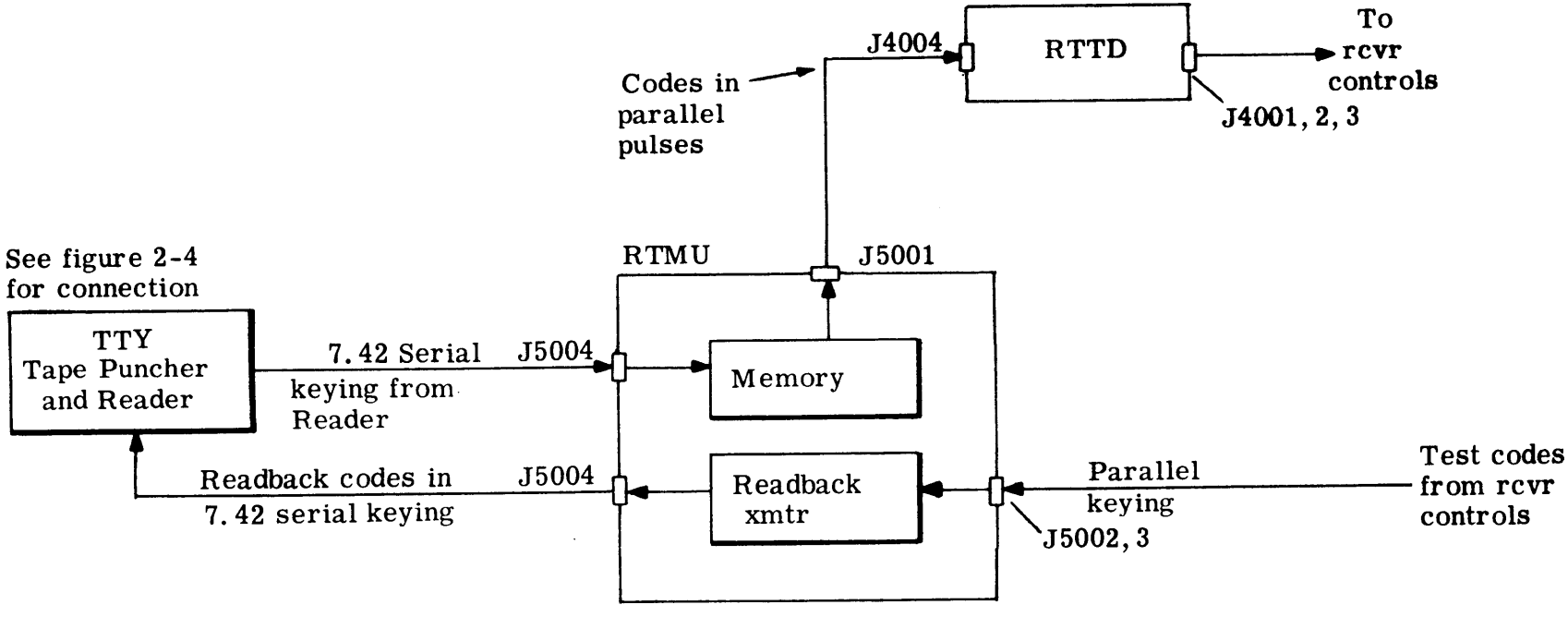


Figure 5-6. Testing TechniMatiC Circuits with TTY Puncher/Reader

SECTION 6
PARTS LIST

6-1. INTRODUCTION

The parts list presented in this section is a cross-reference list of parts identified by a reference designation and TMC part number. In most cases, parts appearing on schematic diagrams are assigned reference designations in accordance with MIL-STD-16. Wherever practicable, the reference designation is marked on the equipment, close to the part it identifies. In most cases, mechanical and electro-mechanical parts have TMC part numbers stamped on them.

To expedite delivery when ordering any part, specify the following:

a. Reference symbol.

b. Description as indicated in parts list.

c. TMC part number.

d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

For replacement parts not covered by warranty (refer to warranty sheet in front of manual), address all purchase orders to:

The Technical Materiel Corporation
Attention: Sales Department
700 Fenimore Road
Mamaroneck, New York

PARTS LIST

for

CABINET, ELECTRICAL EQUIPMENT, DDR-5BR, 5BR1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
B9000	FAN, CENTRIFUGAL: dual; 115/230 VAC, current rating 1.2/0.6 amps; single phase, 60 cps; nominal RPM 1,725; black anodize housing.	BL112
C1501	CAPACITOR, FIXED, MICA DIELECTRIC: 510 uuf, ±5%; 500 WVDC; char. F.	CM15F511J03
C1502 thru C1506	Same as C1501.	
C9000	CAPACITOR, FIXED, PAPER DIELECTRIC: 4 uf, ±10%; 370 WVAC.	CP113-1
CP3001	ADAPTOR, CONNECTOR, ELECTRICAL: RF; 1 female contact; teflon dielectric; 50 ohms nominal impedance; max. peak voltage 500 V; bulkhead mounting; QDS to BNC type.	JJ213
FL3001	FILTER, RADIO INTERFERENCE: 0 to 400 cps, 250 VAC/ 600 VDC; max. current rating 20 amps; 60 db min. attenuation from 150 Kc thru 10 Kmc; 8-32 thd. screw type terminals; 3" square x 16-1/2" long steel case.	AF103
J3001 thru J3003	NOT USED	
J3004	CONNECTOR, RECEPTACLE, ELECTRICAL: RF; 1 round female contact, straight type; series BNC.	UG625*/U
J3005 thru J3007	Same as J3004.	
L1501	COIL, RADIO FREQUENCY: fixed; 10.0 uh, ±10%; current rating 1,080 maDC; molded case.	CL270-10
L1502 thru L1512	Same as L1501.	
MP3001	RETRACTING ASSEMBLY, SPRING	A3517
MP3002 thru MP3008	Same as MP3001.	

CABINET, ELECTRICAL EQUIPMENT, DDR-5BR, 5BR1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
MP3009	FILTER, AIR CONDITIONING: replaceable type; medium filtering, steel mesh and frame; o/a dim. 16-7/8" x 7-5/8" x 1/2".	AD103-5
MP3010	FILTER, AIR CONDITIONING: replaceable type; medium filtering, steel mesh and frame; o/a dim. 16-1/4" x 6" x 1/2".	AD103-11
P101	CONNECTOR, PLUG, ELECTRICAL: 3 number 16 female contacts, straight type. Part of W3020.	MS3106A14S-1S
P102	CONNECTOR, PLUG, ELECTRICAL: 14 round number 16 male contacts, straight type. Part of W3042.	PL212-1
P103	CONNECTOR, PLUG, ELECTRICAL: 1 male contact; voltage rating 500 V peak; nom. impedance 50 ohms; bayonet polarization; twist lock; BNC crimp type. Part of W3028.	PL244-1
P104	Same as P103. Part of W3022.	
P105	Same as P103. Part of W3021.	
P1001	Same as P103. Part of W3005.	
P1301	NOT USED	
P1302	Same as P103. Part of W3008.	
P1303	Same as P103. Part of W3012.	
P1304	Same as P103. Part of W3009.	
P1305	Same as P102. Part of W3034.	
P1306	NOT USED	
P1307	Same as P103. Part of W3007.	
P1308 thru P1311	NOT USED	
P1312	Same as P103. Part of W3017.	
P1313 thru P1315	NOT USED	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P1316	CONNECTOR, PLUG, ELECTRICAL: with hood; 37 male contacts, removeable crimp pin style; current rating 5 amps at 500 V RMS; connector shape polarization; steel cadmium plate, clear chromate finish. Part of W3014.	JJ313-3H
P3001	Same as P102. Part of W3034.	
P3001-1	Same as P103. Part of W3005.	
P3002 thru P3005	NOT USED	
P3006	Same as P103. Part of W3028.	
P3007	Same as P103. Part of W3022.	
P3008-1	CONNECTOR, PLUG, ELECTRICAL: RF; BNC type. Part of W3027.	UG260*/U
P3008-2	CONNECTOR, PLUG, ELECTRICAL: RF; BNC type. Part of W3027.	PL243-1
P3008-3	Same as P103. Part of W3006.	
P3008-4	Same as P3008-2. Part of W3027.	
P3008-5	Same as P103. Part of W3007.	
P3009	Same as P103. Part of W3008.	
P3010	NOT USED	
P3011	NOT USED	
P3012	Same as P103. Part of W3009.	
P3013	Same as P103. Part of W3018.	
P3014-1	Same as P3008-1. Part of W3043.	
P3014-2	Same as P103. Part of W3010.	
P3014-3	Same as P3008-2. Part of W3043.	
P3014-4	Same as P3008-2. Part of W3043.	
P3014-5	Same as P103. Part of W3003.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P3015	NOT USED	
P3016	NOT USED	
P3017	Same as P103. Part of W3012.	
P3018	Same as P103. Part of W3011.	
P3019 thru P3021	NOT USED	
P3022	CONNECTOR, PLUG, ELECTRICAL: 11 female contacts, rated at 2 amps max., 1,800 V RMS at sea level; phosphor bronze, gold over silver plate; key polarization; aluminum anodized, green case. Part of W3013.	PL247-2S
P3023	Same as P3022. Part of W3036.	
P3024	Same as P3022. Part of W3036.	
P3025	Same as P3022. Part of W3013.	
P3026	Same as P3022. Part of W3036.	
P3027	Same as P3022. Part of W3013.	
P3028	Same as P3022. Part of W3036.	
P3029	Same as P3022. Part of W3013.	
P3030	Same as P3022. Part of W3036.	
P3031	Same as P3022. Part of W3013.	
P3032	Same as P3022. Part of W3036.	
P3033	Same as P3022. Part of W3013.	
P3034	CONNECTOR, RECEPTACLE, ELECTRICAL: with hood; 25 female contacts, removeable crimp pin style, rated for 5 amps at 500 V RMS; connector shape polarization. Part of W3014.	JJ310-2H
P4001	CONNECTOR, RECEPTACLE, ELECTRICAL: with hood; 37 female contacts, removeable crimp pin style, rated for 5 amps at 500 V RMS; connector shape polarization. Part of W3014.	JJ310-3H

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P4002	Same as P1316. Part of W3013.	
P4003	Same as P1316. Part of W3001.	
P4004	Same as P1316. Part of W3041.	
P4005	NOT USED	
P4006	NOT USED	
P4007	CONNECTOR, PLUG, ELECTRICAL: 2 female contacts, straight type, rated for 10 amps at 250 V; polarized; twist lock type; midget size, brown bakelite. Part of W3004.	PL176
P4008	Same as P103. Part of W3006.	
P4009	NOT USED	
P4010	Same as P103. Part of W3003.	
P5000	Same as P103. Part of W3016.	
P5001-1	Same as P102. Part of W3015.	
P5001-2	Same as P1316. Part of W3041.	
P5002-1	Same as P103. Part of W3023.	
P5002-2	Same as P1316. Part of W3036.	
P5003	Same as P1316. Part of W3037.	
P5003-1	Same as P103. Part of W3019.	
P5004	CONNECTOR, PLUG, ELECTRICAL: with hood; 25 male contacts, removeable crimp pin style, rated for 5 amps at 500 V RMS; connector shape polarization; steel cadmium plate, clear chromate finish. Part of W3038.	JJ313-2H
P5005	NOT USED	
P5006	Same as P4007. Part of W3032.	
P5007 thru P5018	NOT USED	
P5019	CONNECTOR, PLUG, ELECTRICAL: 24 number 20 female contacts, rated for 7.5 amps, 500 V RMS. P/O W3042.	PL212-4

CABINET, ELECTRICAL EQUIPMEMT, DDR-5BR, 5BR1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P6201	CONNECTOR, PLUG, ELECTRICAL: 14 number 16 female contacts, rated for 17.0 amps, 500 V RMS. Part of W3035.	PL212-2
P6202	Same as P103. Part of W3019.	
P6203	Same as P103. Part of W3024.	
P6204	Same as P103. Part of W3025.	
P6205	Same as P103. Part of W3017.	
P6206	Same as P103. Part of W3018.	
P6207	NOT USED	
P6208	NOT USED	
P6209	Same as P103. Part of W3016.	
P6210 thru P6218	NOT USED	
P6219-1	CONNECTOR, PLUG, ELECTRICAL: 11 male contacts, rated at 2 amps max., 1,800 V RMS at sea level; phosphor bronze, gold over silver plate; key polarization; aluminum anodized, green case. Part of W3048.	PL247-2P
P6219-2	Same as P3022. Part of W3001.	
P6219-3	Same as P3022. Part of W3037.	
P6219-4	Same as P3022. Part of W3048.	
P6220	Same as P103. Part of W3021.	
P7001	Same as P103. Part of W3024.	
P7002	Same as P103. Part of W3010.	
P7003	Same as P103. Part of W3011.	
P7004	Same as P103. Part of W3047.	
P7005	Same as P103. Part of W3030.	
P7006	NOT USED	
P7007	NOT USED	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P7008	Same as P103. Part of W3025.	
P7009	Same as P103. Part of W3023.	
P7010	Same as P6201. Part of W3026.	
P7011	Same as P103. Part of W3049.	
P7012	Same as P103. Part of W3029.	
P7013	NOT USED	
P7014-1	Same as P3022. Part of W3044.	
P7014-2	Same as P3022. Part of W3001.	
P7014-3	Same as P3022. Part of W3037.	
P7014-4	Same as P6219-1. Part of W3044.	
P7200	Same as P103. Part of W3049.	
P7201	Same as P103. Part of W3029.	
P7202	Same as P103. Part of W3047.	
P7203	Same as P103. Part of W3030.	
P7204	Same as P3022. Part of W3037.	
P7205	Same as P6219-1. Part of W3045.	
P7206	Same as P3022. Part of W3037.	
P7207	Same as P6219-1. Part of W3046.	
P7208	Same as P3022. Part of W3045.	
P7209	Same as P3022. Part of W3001.	
P7210	Same as P3022. Part of W3046.	
P7211	Same as P3022. Part of W3013.	
P8001	Same as P4007. Part of W3031.	
P8002	CONNECTOR, PLUG, ELECTRICAL: 2 prong male; polarized; current rating 10 amps at 250 V, 15 amps at 125 V; midget size, twist lock type; black bakelite. Part of W3033.	PL177

CABINET, ELECTRICAL EQUIPMENT, DDR-5BR, 5BR1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P8003	NOT USED	
P8004	NOT USED	
P8005	CONNECTOR, PLUG, ELECTRICAL: 24 number 20 male contacts, rated for 7.5 amps, 500 V RMS. Part of W3026.	PL212-3
P8006	NOT USED	
P8007	Same as P6201. Part of W3034.	
P8008	Same as P102. Part of W3035.	
P8009	Same as P6201. Part of W3015.	
P8010	Same as P6201. Part of W3034.	
TB3001	TERMINAL BOARD, BARRIER: 14 number 6-32 thd. x 1/4" long binder head machine screws; black phenolic body.	TM100-14
TB9000	TERMINAL BOARD, BARRIER: 2 number 6-32 thd. x 1/4" long binder head machine screws; black phenolic body.	TM102-5
W3001	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of various lengths and colors of insulated wire, insulation sleeving, 4 connectors P4003, P6219-2, P7014-2, P7209.	CA1158
W3002	LEAD, ELECTRICAL: consists of 54" length of 25/32 wire, insulation sleeving, 2 solderless terminal lugs.	CA412-34-54.00
W3003	CABLE ASSEMBLY, ELECTRICAL: RF; consists of 12 ft. length black coaxial cable, RG174/U, 2 connectors P3014-5, P4010.	CA480-3-12F
W3004	CABLE ASSEMBLY, ELECTRICAL: AC power; consists of 180" length rubber sheathed cable, 3 solderless type terminal lugs, 1 connector P4007.	CA696-2
W3005	CABLE ASSEMBLY, ELECTRICAL: RF; consists of 97" length black coaxial cable, RG174/U, 2 connectors P1001, P3001-1.	CA480-3-97
W3006	Same as W3003. Consists of P3008-3, P4008.	

CABINET, ELECTRICAL EQUIPMENT, DDR-5BR, 5BR1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
W3007	CABLE ASSEMBLY, ELECTRICAL: RF; consists of 11 ft. length black coaxial cable, RG174/U, 2 connectors P1307, P3008-5.	CA480-3-11F
W3008	CABLE ASSEMBLY, ELECTRICAL: RF; consists of 112" length black coaxial cable, RG174/U, 2 connectors P1302, P3009.	CA480-3-112
W3009	Same as W3007. Consists of P1304, P3012.	
W3010	Same as W3003. Consists of P3014-2, P7002.	
W3011	Same as W3003. Consists of P3018, P7003.	
W3012	Same as W3008. Consists of P1303, P3017.	
W3013	WIRING HARNESS, BRANCHED, ELECTRICAL: system interconnect; consists of various lengths and colors of insulated wire, insulation sleeving, rubber bushing, 8 connectors P3022, P3025, P3027, P3029, P3031, P3033, P4002, P7211.	CA1174
W3014	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of various lengths and colors of number 22 wire, insulation sleeving, 3 connectors P1316, P3034, P4001.	CA909
W3015	CABLE ASSEMBLY, ELECTRICAL: interconnect; consists of various lengths and colors of number 16, 20, and 22 MWC wire, 81" length insulation sleeving, 2 connectors P5001-1, P8009.	CA687-2
W3016	CABLE ASSEMBLY, ELECTRICAL: RF; consists of 90" length black coaxial cable, RG174/U, 2 connectors P5000, P6209.	CA480-3-90
W3017	Same as W3008. Consists of P1312, P6205.	
W3018	Same as W3007. Consists of P3013, P6206.	
W3019	CABLE ASSEMBLY, ELECTRICAL: RF; consists of 77" length black coaxial cable, RG174/U, 2 connectors P5003-1, P6202.	CA480-3-77
W3020	CABLE ASSEMBLY, ELECTRICAL: AC power; consists of 130" length special purpose cable, insulation sleeving, clamp, solderless terminal lugs, 1 connector P101.	CA907-6
W3021	Same as W3003. Consists of P105, P6220.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
W3022	Same as W3003. Consists of P104, P3007.	
W3023	Same as W3005. Consists of P5002-1, P7009.	
W3024	Same as W3008. Consists of P6203, P7001.	
W3025	Same as W3008. Consists of P6204, P7008.	
W3026	CABLE ASSEMBLY, ELECTRICAL: interconnect; consists of various lengths and colors of number 20 MWC wire, 78" length of insulation sleeving, 2 connectors P7010, P8005.	CA686-1
W3027	CABLE ASSEMBLY, BRANCHED, ELECTRICAL: RF; consists of coaxial cable, RG174/U, insulation sleeving, 3 connectors P3008-1, P3008-2, P3008-4.	CA864
W3028	Same as W3003. Consists of P103, P3006.	
W3029	CABLE ASSEMBLY, ELECTRICAL: RF; consists of 72" length black coaxial cable, RG174/U, 2 connectors P7012, P7201.	CA480-3-72
W3030	Same as W3029. Consists of P7005, P7203.	
W3031	CABLE ASSEMBLY, ELECTRICAL: AC power; consists of 72" length rubber sheathed cable, 3 solderless type terminal lugs, 1 connector P8001.	CA696-1
W3032	CABLE ASSEMBLY, ELECTRICAL: AC power; consists of 108" length rubber sheathed cable, 3 solderless type terminal lugs, 1 connector P5006.	CA696-3
W3033	CABLE ASSEMBLY, ELECTRICAL: AC power; consists of 54" length rubber sheathed cable, 2 solderless type terminal lugs, 1 connector P8002.	CA706-1
W3034	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of various lengths and colors of number 16, 18, and 22 MWC wire, insulation sleeving, 4 connectors P1305, P3001, P8007, P8010.	CA704
W3035	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of various lengths and colors of number 18 and 22 MWC wire, insulation sleeving, 2 connectors P6201, P8008.	CA914
W3036	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of various lengths and colors of number 26 LWC wire, insulation sleeving, 7 connectors P3023, P3024, P3026, P3028, P3030, P3032, P5002-2.	CA927

CABINET, ELECTRICAL EQUIPMENT, DDR-5BR, 5BR1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
W3037	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of various lengths of number 26 LWC insulated wire, insulation sleeving, 5 connectors P5003, P6219-3, P7014-3, P7204, P7206.	CA1160
W3038	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of 1 connector P5004.	CA1139-3
W3039	LEAD, ELECTRICAL: consists of 34" length number 3/8 wire, black insulation sleeving, 2 solderless type terminal lugs.	CA412-36-34.00
W3040	Same as W3002.	
W3041	CABLE ASSEMBLY, ELECTRICAL: consists of 2 connectors P4004, P5001-2.	CA923
W3042	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: consists of various lengths of number 20 MWC shield/ jacket cable, insulation sleeving, insulated coaxial cable ferrules, 1 spaded terminal lug, 2 connectors P102, P5019.	CA1159
W3043	Same as W3027. Consists of P3014-1, P4014-3, P3014-4	
W3044	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: consists of 14" lengths, colored, insulated wire; insulation sleeving, 2 connectors P7014-1, P7014-4.	CA1093-14.00
W3045	Same as W3044. Consists of P7205, P7208.	
W3046*	Same as W3044. Consists of P7207, P7210.	
W3047*	Same as W3029. Consists of P7004, P7202.	
W3048	Same as W3044. Consists of P6219-1, P6219-4.	
W3049	Same as W3029. Consists of P7011, P7200.	
	ISOLATION KEYER, AK101 (SEE SEPARATE PARTS LIST FOR BREAKDOWN (REFER TO ISOLATION KEYER, AK101 MANUAL))	

* Used on DDR-5BR only.

SECTION 7

RACK WIRING DATA

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1

CABLE	FROM:- CONNECTOR	PIN	TO:- CONNECTOR	PIN	WIRE GAUGE	WIRE COLOR	S/US*
CA-686-1	HFP	P8005 B	HFP	P8005 V	24	Grey	US
		V	HFAR	P7010 P	20	WH/BLK	US
		U		B	20	WH/GRN	US
		K		K	20	Red	US
		a		R	20	WH/RED	US
		L		L	20	Black	US
		E		E	20	Brown	US
		F		F	20	WH/BRN	US
		S		A	20	Yellow	US
		R		D	20	WH/YEL	US
		M		C	20	Blue	US
		N		H	20	WH/BLU	US
CA-686-1	HFP	P8005 P	HFAR	P7010 J	20	Orange	US
CA-687-1	HFP	P8006 L	HNF	P4003-2 L	20	Black	US
		J		J	22	Green	S
		K		K	22	Red	US
		E		E	16	Brown	US
		F		F	16	WH/BRN	US
		A		A	20	Grey	US
		B		B	20	WH/Grey	US
		H		H	20	Violet	US
		C		C	20	Blue	US
		P		P	20	WH/BLK	US
		R	HNF	P4003-2 R	20	White	US
	HFP	P8006 SHLD J	HFP	P8006 L	SHIELD TERMINAL		--
CA-687-1	HNF	P4003-2SHLDJ	HNF	P4003-2 L	SHIELD TERMINAL		--
CA-687-2	HFP	P8009 L	AFCR	P5001-1 L	20	Black	US
		J		J	22	Green	S
		K		K	22	Red	US
		E		E	16	Brown	US
		F		F	16	WH/BRN	US
		A		A	20	Grey	US
		B		B	20	WH/Grey	US
		H		H	20	Violet	US
		C		C	20	Blue	US
		P		P	20	WH/BLK	US
		R	AFCR	P5001-1 R	20	WHITE	US
	HFP	P8009 SHLD J	HFP	P8009 L	SHIELD TERMINAL		--
CA-687-2	AFCR	P5001-1SHLD J	AFCR	P5001-1 L	SHIELD TERMINAL		--

(Ref: DWG CA-686 Rev. C)

(Ref: DWG CA-687 Rev. C)

(Ref: DWG CA-687 Rev. C)

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1 (CONT)

CABLE	FROM:- CONNECTOR PIN		TO:- CONNECTOR PIN		WIRE GAUGE	WIRE COLOR	S/US*
CA-696-1	AF-103 FL3001	OUT	HFP P8001	1	16	Green	US
CA-696-1	AF-103 FL3001	OUT	HFP P8001	2	16	White	US
CA-696-1	AF-103 FL3001	GND	HFP P8001/GND		16	Black	US
CA-696-2	AF-103 FL3001	OUT	RTTD P4007	1	20	Green	US
CA-696-2	AF-103 FL3001	OUT	RTTD P4007	2	20	White	US
CA-696-2	AF-103 FL3001	GND	RTTD P4007/GND		20	Black	US
CA-696-3	AF-103 FL3001	OUT	RTMU P5006	1	20	Green	US
CA-696-3	AF-103 FL3001	OUT	RTMU P5006	2	20	White	US
CA-696-3	AF-103 FL3001	GND	RTMU P5006/GND		20	Black	US
CA-704	HFP P8010	D	HFRR P1305	D	16	WH/BRN	US
		R		R	16	Brown	US
		C		C	22	Blue	US
		P		P	22	WH/OR	US
		B		B	16	WH/GRY	US
		A		A	18	Grey	US
		F		F	16	WH/BRN	US
		E		E	16	Brown	US
		K		K	22	Red	US
		H		H	22	Violet	US
		M		M	22	Yellow	S
		L		L	22	Black	US
	HFP P8010	J	HFRR P1305	J	22	Green	S
	HFP P8007	H	HFSR P3001	H	16	WH/BRN	US
		P		P	22	Orange	US
		F		F	16	WH/BLU	US
		L		L	16	Black	US
		E		E	16	Brown	US
		R		R	22	WH/BLU	US
		K		K	22	Red	US
		C		C	22	Blue	US
		D		D	16	WH/BRN	US
		B		B	16	Brown	US
	HFP P8007	A		A	16	Brown	US
	HFRR P1305	N		N	22	WH/BLK	US
CA-704	GND ON RACK		HFSR P3001	J	18	White	US

(Ref: DWG CA-696 Rev. D)

(Ref: CA-704 Rev. E)

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1 (CONT)

CABLE	FROM:- CONNECTOR PIN		TO:- CONNECTOR PIN		WIRE GAUGE	WIRE COLOR	S/US*
CA-706-1	HFP P8002		AX-390 TB9000	2	2-wire AC cable		
CA-706-1	HFP P8002		AX-390 TB9000	3			
CA-907-6	AF103 FL3001	OUT	RGCB P101	A		Red	US
	| FL3001		| P101	B		Black	US
CA-907-6	AF103 FL3001	OUT	RGCB P101	C		White	US
CA-909	RTTD P4001	1	HFRR P1316	1	22	GRY/YEL/OR	US
		2		20	22	GRY/YEL/YEL	US
		3		2	22	GRY/YEL/GRN	US
		4		21	22	GRY/YEL/BLU	US
		5		3	22	White	S
		6		22	22	GRY/GRN/YEL	US
		7		4	22	GRY/GRN/GRN	US
		8		28	22	GRY/GRN/BLU	US
		9		5	22	Red	US
		10		24	22	Black	US
		11		6	22	WHT/OR/OR	US
		12		25	22	WHT/YEL/OR	US
		13		7	22	WHT/OR/GRN	US
		14		26	22	WHT/YEL/GRN	US
		15		8	22	Violet	US
		16		11	22	WHT/YEL/YEL	US
		17		34	22	WHT/YEL/BLU	US
		18		36	22	GRY/VI/OR	US
		19		17	22	GRY/VI/YEL	US
		20		18	20	WH/GRY	US
		21		35	22	White	US
		22	HFRR P1316	37	20	WH/BLK	US
		23	HFSR P3034	1	22	Black	US
		24		14	22	WH/BRN/OR	US
		25		2	22	WH/BRN/YEL	US
		26		15	22	WH/BRN/GRN	US
		27		3	22	WH/BRN/BLU	US
		28		16	22	WH/BRN/VI	US
		29		4	22	GRY/BRN/OR	US
		30		17	22	GRY/BRN/YEL	US
		31		5	22	GRY/BRN/GRN	US
		32		18	22	GRY/BRN/BLU	US
CA-909	RTTD P4001	33	HFSR P3034	6	22	GRY/BRN/VI	US

(Ref: DWG CA-706 Rev. B)

(Ref: DWG CA-909 Rev. B)

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1 (CONT)

CABLE	FROM:- CONNECTOR PIN			TO:- CONNECTOR PIN			WIRE GAUGE	WIRE COLOR	S/US*
CA-909	RTTD	P4001	34	HFSR	P3034	19	22	WH/BRN/RED	US
			35	HFSR	P3034	7	22	WH/GRY/GRY	US
			36	HFSR	P3034	20	22	WH/BLU	US
	RTTD	P4001	37	HFRR	P1310	9	22	WH/BLK/BLK	US
	HFSR	P3034	8			16	22	WH/YEL	US
			21			30	22	WH/RED/OR	US
			9			12	22	WH/RED/YEL	US
			10			31	22	WH/RED/GRN	US
			22			13	22	WH/RED/BLU	US
			23			32	22	WH/BLU/OR	US
			11			14	22	WH/BLU/YEL	US
			24			33	22	WH/BLU/GRN	US
	HFSR	P3034	12	HFRR	P1316	15	22	WH/BLU/BLU	US
	RTTD	P4001	SHLD 5	RTTD	P4001	6	SHIELD TERMINAL		--
CA-909	HFRR	P1316	SHLD 3	HFRR	P1316	22	SHIELD TERMINAL		--
CA-910	RTTD	P4002	19	HFSR	P3025	A	22	WH/RED/OR	US
			37			B	22	WH/RED/YEL	US
			18			C	22	WH/RED/GRN	US
			36			D	22	WH/RED/BLU	US
			17	HFSR	P3025	E	22	Black	US
			35	HFSR	P3027	A	22	GRY/RED/OR	US
			16			B	22	GRY/RED/YEL	US
			34			C	22	GRY/RED/GRN	US
			15			D	22	GRY/RED/BLU	US
			33	HFSR	P3027	E	22	Black	US
			14	HFSR	P3029	A	22	GRY/OR/OR	US
			32			B	22	GRY/OR/YEL	US
			13			C	22	GRY/OR/GRN	US
			31			D	22	GRY/OR/BLU	US
			12	HFSR	P3029	E	22	Black	US
			30	HFSR	P3031	A	22	WH/OR/OR	US
			11			B	22	WH/OR/YEL	US
			29			C	22	WH/OR/GRN	US
			10			D	22	WH/OR/BLU	US
	RTTD	P4002	28	HFSR	P3031	E	22	Black	US
	HFSR	P3025	F	HFSR	P3033	A	22	Yellow	US
	HFSR	P3025	H	HFSR	P3033	B	22	Blue	US
	RTTD	P4002	3	HFSR	P3025	J	22	WH/YEL	US
	RTTD	P4002	4	HFSR	P3022	A	22	WH/BLK/BLK	US
CA-910	RTTD	P4002	22	HFSR	P3022	B	22	Black	US

(Ref: DWG CA-909 Rev. C)

(: DWG CA-910 Rev. B)

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1 (CONT)

CABLE	FROM:- CONNECTOR PIN		TO:- CONNECTOR PIN		WIRE GAUGE	WIRE COLOR	S/US*
CA-912	RTTD P4003	19	HFIA P6219-2	A	22	WH/YEL/OR	US
		37		B	22	WH/YEL/YEL	US
		18		C	22	WH/YEL/GRN	US
		36		D	22	WH/YEL/BLU	US
		28	HFIA P6219-2	E	22	Black	US
		14	HFIA P6219-4	A	22	WH/GRN/OR	US
		32		B	22	WH/GRN/YEL	US
		13		C	22	WH/GRN/GRN	US
		31		D	22	WH/GRN/BLU	US
		4	HFIA P6219-4	E	22	Black	US
		9	HFIA P6218	A	22	GRY/BLU/OR	US
		27		B	22	GRY/BLU/YEL	US
		8		C	22	GRY/BLU/GRN	US
		26		D	22	GRY/BLU/BLU	US
		7		E	22	Black	US
		3		M	22	WH/BLU/OR	US
		22		L	22	WH/BLU/YEL	US
		12	HFIA P6218	J	22	Black	US
		35	HFIA P7014-4	A	22	GRY/YEL/OR	US
		16		B	22	GRY/YEL/YEL	US
		34		C	22	GRY/YEL/GRN	US
		15		D	22	GRY/YEL/BLU	US
		17	HFAR P7014-4	E	22	Black	US
		30	HFAR P7014-2	A	22	GRY/GRN/OR	US
		11		B	22	GRY/GRN/YEL	US
		29		C	22	GRY/GRN/GRN	US
		10		D	22	GRY/GRN/BLU	US
CA-912	RTTD P4003	23	HFAR P7014-2	E	22	Black	US
CA-914	HFP P8008	F	HFIA P6201	F	18	WH/BRN	US
		E		E	18	Brown	US
		D		D	18	Brown	US
		C		C	18	WH/BRN	US
		L		L	22	Black	US
		P		P	22	Black	US
		H		H	22	Violet	US
		K		K	22	Blue	US
		A		A	22	WH/BLU	US
		B		B	22	Red	US
		M		M	22	Green	US
CA-914	HFP P8008	R	HFIA P6201	R	22	Black	S

(Ref: DWG CA-912 Rev. B)

(Ref: DWG CA-914 Rev. A)

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1 (CONT)

CABLE	FROM:- CONNECTOR PIN	TO:- CONNECTOR PIN	WIRE GAUGE	WIRE COLOR	S/US*
CA-914 (Ref: DWG CA-914 Rev.A)	HFIA P6201 M	A3860 TB3001 2	22	Green	S
	HFAR E7000 1	3	22	Orange	S
	2	9	22	Red	S
	3	A3860 TB3001 8	22	Yellow	S
	4	HSS TB1501 7	22	Blue	S
	10	HSS TB1501 2	22	WH/BLU	S
	HFAR E7000 11	HSS TB1501 3	22	Black	US
	HFAR E7001 1	A3860 TB3001 5	22	Orange	S
	2	13	22	Red	S
	3	12	22	Yellow	S
	4	A3860 TB3001 11	22	Blue	S
	10	HSS TB1501 1	22	Blue	S
	HFAR E7001 11	HSS TB1501 3	22	Black	US
	HFP P8008 SHLDM	HFP P8008 R	SHIELD TERMINAL		--
	HFIA P6201 SHLD M	HFIA P6201 R	SHIELD TERMINAL		--
	HFIA P6201 SHLD M	HFIA P6201 L	SHIELD TERMINAL		--
	HFAR E7000 ALL SHLDS	HFAR E7000 11 GND	SHIELD GROUND		--
	HFAR E7001 ALL SHLDS	HFAR E7001 11 GND	SHIELD GROUND		--
CA-914	A3860 TB3001 ALL SHLDS	A3860 TB3001 14	SHIELD GROUND		--
CA-923 (Ref: DWG CA-923 Rev. A)	RTMU P5001-2 9	RTTD P4004 7	20	Black	S
	3	16	20	WH/BLK	S
	2	27	20	WH/GRY	S
	21	24	22	WH/BLU/YEL	US
	20	15	22	WH/GRN	US
	4	34	22	Red	US
	5	19	22	Grey	US
	6	37	22	WH/RED/RED	US
	7	18	22	Blue	US
	22	35	22	Yellow	US
	23	8	22	Violet	US
	24	36	22	WH/BRN	US
	25	17	22	WH/RED/YEL	US
	26	12	22	WH/BRN/OR	US
	8	6	22	WH/OR	US
	1	33	22	WH/YEL	US
	27	25	22	WH/OR/OR	US
CA-923	RTMU P5001-2 28	RTTD P4004 26	22	WH/RED/YEL	US

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR,5BR1 (CONT)

CABLE	FROM:- CONNECTOR PIN				TO:- CONNECTOR PIN				WIRE GAUGE	WIRE COLOR	S/US*
CA-923	RTMU	P5001-2	SHLD	9	RTMU	P5001-2	30		SHIELD TERMINAL		--
			SHLD	3	RTMU	P5001-2	30				--
	RTMU	P5001-2	SHLD	2	RTMU	P5001-2	30				--
	RTTD	P4004	SHLD	7	RTTD	P4004	30				--
	RTTD	P4004	SHLD	16	RTTD	P4004	30				
CA-923	RTTD	P4004	SHLD	27	RTTD	P4004	30		SHIELD TERMINAL		--
CA-927	HFSR	P3032		A	RTMU	P5002	1		26	White	US
				B			2		26	WH/BLK	US
				C			3		26	WH/BRN	US
				D			4		26	WH/RED	US
				E			5		26	WH/OR	US
				F			6		26	WH/YEL	US
				H			7		26	WH/GRN	US
				J			8		26	WH/BLU	US
				K			9		26	WH/VIO	US
	HFSR	P3032		L			10		26	WH/GRY	US
	HFSR	P3024		A			11		26	Brown	US
				B			12		26	Red	US
				C			13		26	Orange	US
				D			14		26	Yellow	US
	HFSR	P3024		E			15		26	White	US
	HFSR	P3026		A			16		26	Green	US
				B			17		26	Blue	US
				C			18		26	Violet	US
				D			19		26	Gray	US
	HFSR	P3026		E			37		26	White	US
	HFSR	P3028		A			36		26	WH/BRN	US
				B			35		26	WH/RED	US
				C			34		26	WH/OR	US
				D			33		26	WH/YEL	US
	HFSR	P3028		E			32		26	White	US
	HFSR	P3030		A			31		26	WH/GRN	US
				B			30		26	WH/BLU	US
				C			29		26	WH/VIO	US
				D			28		26	WH/GRY	US
	HFSR	P3030		E			27		26	White	US
	HFSR	P3023		A			26		26	WH/BRN	US
CA-927	HFSR	P3023		B	RTMU	P5002	25		26	White	US

(Ref: DWG CA-923 Rev. C)

(Ref: DWG CA-927 Rev. B)

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1 (CONT)

CABLE	FROM:- CONNECTOR	PIN	TO:- CONNECTOR	PIN	WIRE GAUGE	WIRE COLOR	S/US*
CA-929 (Ref: DWG CA-929 Rev. A)	HFAR P7014-1	A	RTMU P5003	6	26	White	US
		B		7	26	Blue	US
		C		8	26	Violet	US
		D		9	26	Grey	US
	HFAR P7014-1	E		10	26	White	US
	HFAR P7014-3	A		16	26	WH/GRN	US
		B		17	26	WH/BLU	US
		C		18	26	WH/VIO	US
		D		19	26	WH/GRY	US
	HFAR P7014-3	E		20	26	White	US
	HFIA P6219-3	A		11	26	WH/BRN	US
		B		12	26	WH/RED	US
		C		13	26	WH/OR	US
		D		14	26	WH/YEL	US
	HFIA P6219-3	E		15	26	White	US
	HFIA P6219-1	A		1	26	Brown	US
		B		2	26	Red	US
		C		3	26	Orange	US
		D		4	26	Yellow	US
	HFIA P6219-1	E		5	26	White	US
	HFIA P6217	A		26	26	Green	US
		B		27	26	Blue	US
		C		28	26	Violet	US
		D		29	26	Gray	US
		E		30	26	White	US
		J		25	26	White	US
		M		21	26	Orange	US
CA-929	HFIA P6217	L	RTMU P5003	23	26	Brown	US
CA-934 (Ref: DWG CA-934 Rev. B)	A3860 P3001	2	RTMU P5004	1	22	Brown	US
		3		4	22	Orange	US
		4		5	22	Yellow	US
		5		9	22	Green	US
		6		12	22	Violet	US
	A3860 P3001	7	RTMU P5004	13	22	Gray	US
	RTMU P5004	2	A3862 P3002	1	22	Red	US
CA-934	RTMU P5004	10	A3862 P3002	2	22	Blue	US

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1 (CONT)

CABLE	FROM:- CONNECTOR	PIN	TO:- CONNECTOR	PIN	WIRE GAUGE	WIRE COLOR	S/US*
CA1093-14	HAFR	P7205 A	HAFR	P7208 A	22	Orange	US
		B		B	22	Yellow	US
		C		C	22	Brown	US
		D		D	22	Bluw	US
		P7205 E		P7208 E	22	Black	US
		P7207 A		P7210 A	22	Orange	US
		B		B	22	Yellow	US
		C		C	22	Green	US
		D		D	22	Blue	US
CA1093-14	HAFR	P7207 E	HAFR	P7210 E	22	Black	US
CA1139-3	RTMU	P5004 1	AK101	TB9501 MARK	22	Brown	US
		P5004 2		TB9501 GRD	22	Red	US
		P5004 4		TB9502 COMM	22	Orange	US
		P5004 5		TB9502 MARK	22	Yellow	US
		P5004 9		TB9501 -12V	22	Green	US
		P5004 10		TB9501 STUNT	22	Blue	US
		P5004 12		TB9502 SPACE	22	Violet	US
CA1139-3	RTMU	P5004 15	AK101	TB9501 +12V	22	Gray	US
CA1158	RTTD	P4003-1 19	HFIA	P6219 A	22	GRY/GRN/OR	US
		37		B	22	GR/GRN/YEL	US
		18		C	22	GRY/GRN/GRN	US
		36		D	22	GRY/GRN/BLU	US
		17		E	22	Black	US
		1	HFIA	P6219-2 J	22	Red	US
		35	HFAR	P7014-2A	22	GRY/YEL/OR	US
		16		B	22	GRY/YEL/YEL	US
		34		C	22	GRY/YEL/GRN	US
		15		D	22	GRY/YEL/BLU	US
		33		E	22	Black	US
		2	HFAR	P7014-2J	22	Red	US
		25	HAFR	P7209 A	22	WHT/GRN/OR	US
		6		B	22	WHT/GRN/YEL	US
		24		C	22	WHT/GRN/GRN	US
		5		D	22	WHT/GRN/BLU	US
		23		E	22	Black	US
CA1158	RTTD	P4003-1 21	HAFR	P7209 J	22	Red	US

** (Ref: DWG CA-1093-14 Rev. B)

** (Ref: DWG CA-1139-3 Rev. A)

** (Ref: DWG CA-1158 Rev. A)

TABLE 7-1. WIRE RUN LIST, CABLES, DDR-5BR, 5BR1 (CONT)

CABLE	FROM:- CONNECTOR	PIN	TO:- CONNECTOR	PIN	WIRE GAUGE	WIRE COLOR	S/US*
CA1159	AFCR P5019	A	RGCB P102	M	20	Black	US
	P5019	T	P102	R	20	Brown	S
	P5019	X	P102	N	20	Red	S
	P5019	P	P102	J	20	Orange	S
	P5019	S	P102	K	20	Yellow	S
	P5019	V	P102	L	20	Green	S
	P5019	C	P102	B	20	Blue	S
	P5019	B	P102	C	20	Violet	S
CA1159	AFCR P5019	D	RGCB P102	D	20	Grey	S
CA1160	RTMU P5003	1	HFIA P6219-3	A	26	Brown	US
		2		B	26	Red	US
		3		C	26	Orange	US
		4		D	26	Yellow	US
		5	HFIA P6219-3	E	26	White	US
		6	HFAR P7014-3	A	26	Green	US
		7		B	26	Blue	US
		8		C	26	Violet	US
		9		D	26	Gray	US
		10	HFAR P7014-3	E	26	White	US
		11	HAFR P7206	A	26	WH/BRN	US
		12		B	26	WH/RED	US
		13		C	26	WH/OR	US
		14		D	26	WH/YEL	US
		15	P7206	E	26	White	US
		16	P7204	A	26	WH/GRN	US
		17		B	26	WH/BLU	US
		18		C	26	WH/VIO	US
		19		D	26	WH/GRY	US
CA1160	RTMU P5003	20	HAFR P7204	E	26	White	US

(Ref: DWG CA1159 Rev. 0) (Ref: DWG CA1160 Rev. 0)

**) **

* S=shielded; US=unshielded.

** Used on DDR-5BR only.