# OPERATION AND MAINTENANCE
# MAINTENANCE SUPPORT
# HOT STANDBY
# DR 6/11-135EC
# DESCRIPTION
# CIRCUIT PACKS

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This section contains a circuit description and a symbolic block diagram for each circuit pack in the radio, line terminal bay, and regenerator bay. A diagram of each unit faceplate can be found under the " Controls, Jacks, Indications, and Options" tab.

### 38A/39A DIRECTIONAL COUPLER

The 38A (6 GHz) and 39A (11 GHz) Directional Couplers (Fig. 1) are used to route a signal from the receiver waveguide assembly to both regular and protection receivers. The signal routed to the regular receiver is a through-put and has minimal loss (typically <1.5 dB). A second coupled signal (-10 dB) is routed to the protection receiver.

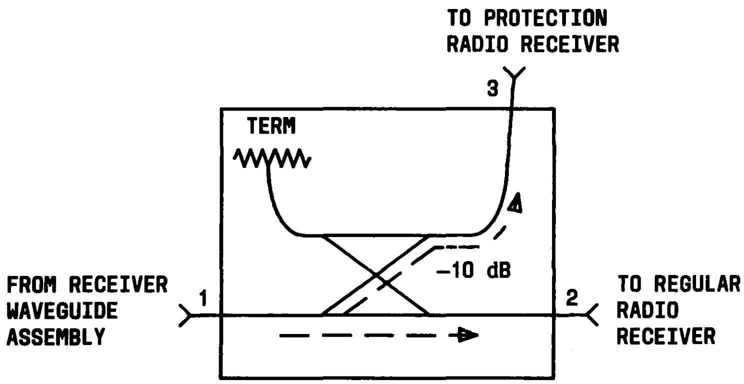



**Fig. 1—38A/39A Directional Coupler**

## 210A MODULE—VOICE FREQUENCY CODER/DECODER

The 210A module (Fig. 2) provides encoding and decoding between voice frequency and digital 64-kb/s PCM (pulse-coded modulation). It has a 4-kHz bandwidth (VF), a standard input level of -16 dBm, and a standard output level of +7 dBm.

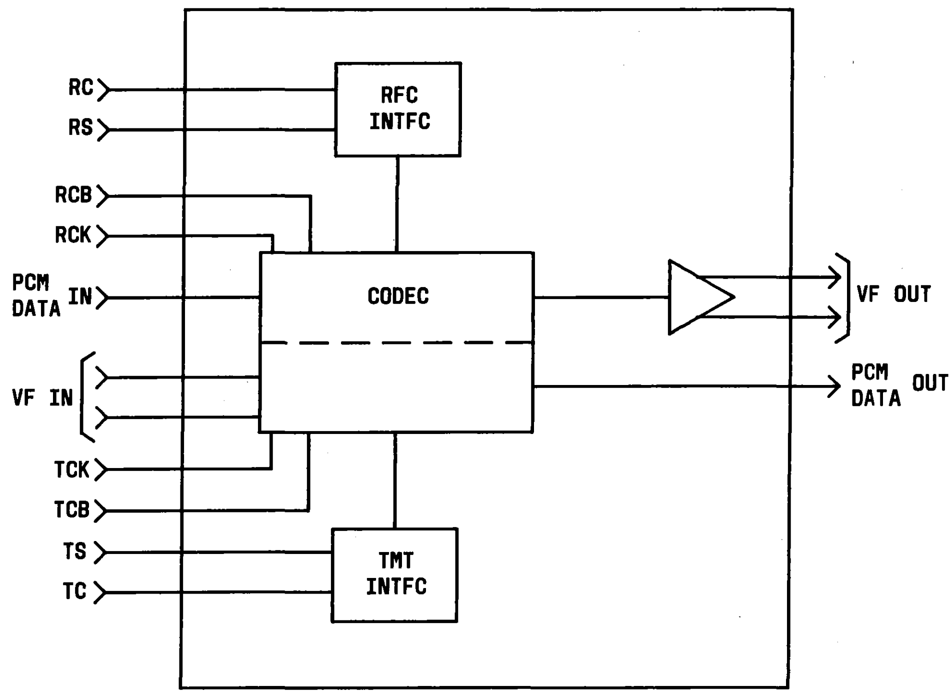



**Fig. 2—210A Module—Voice Frequency Coder/Decoder**

## 210B MODULE—4 x 16 KB/S

The 210B module (Fig. 3) serves as a demultiplexer/multiplexer from a 64-kb/s subchannel to four 16-kb/s RS-422 channels. Each RS-422 channel is capable of extending one E2A serial port to another station.

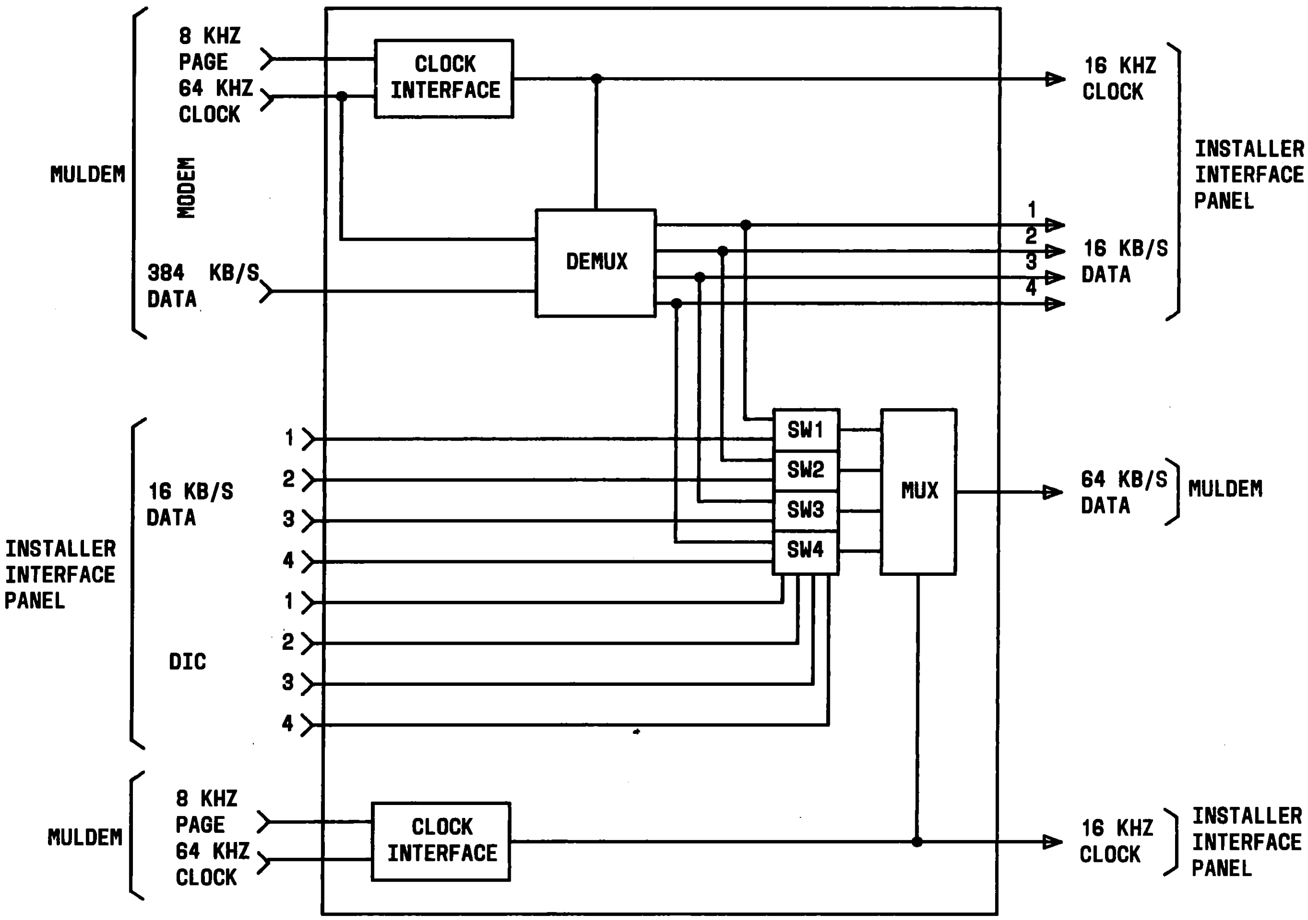



Fig. 3—210B Module—4 x 16 KB/S

## 210C MODULE—DAS EXTENDER

The 210C module (Fig. 4) provides an interface between E2A DAS (Digital Alarm Scanner) telemetry equipment at one station and an RS-232C data set, or an equivalent device (by the service channel), at another station.

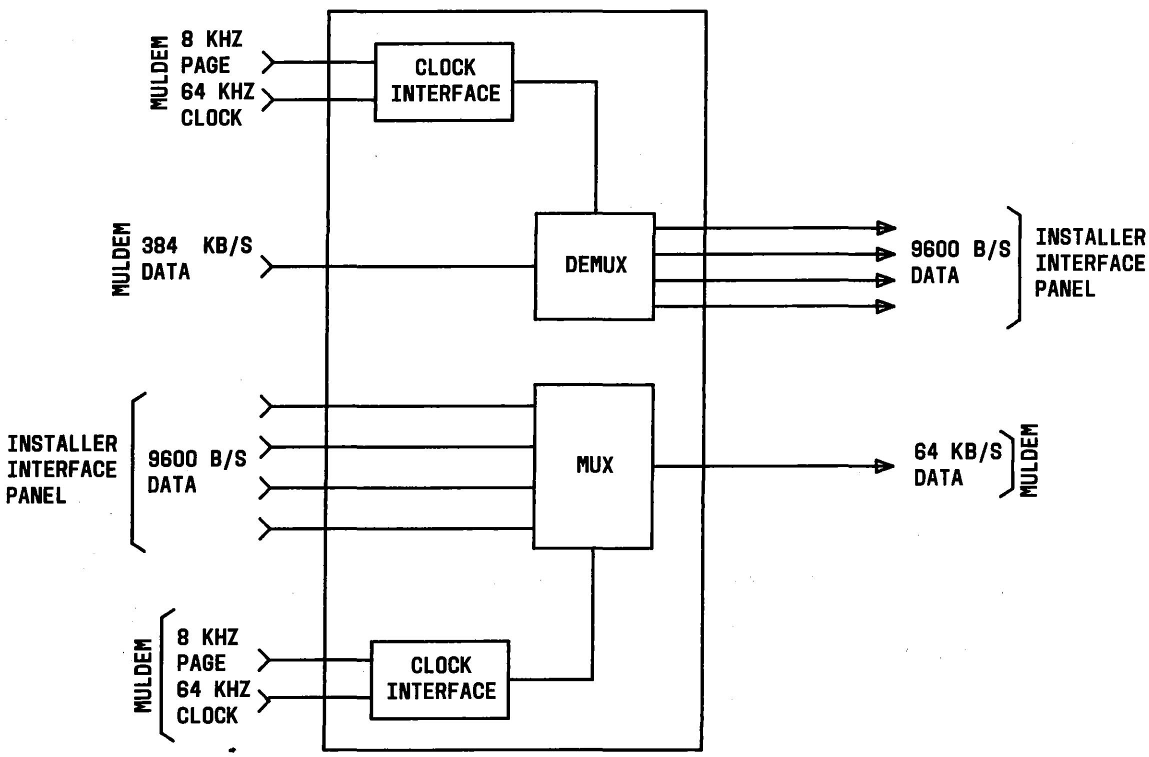
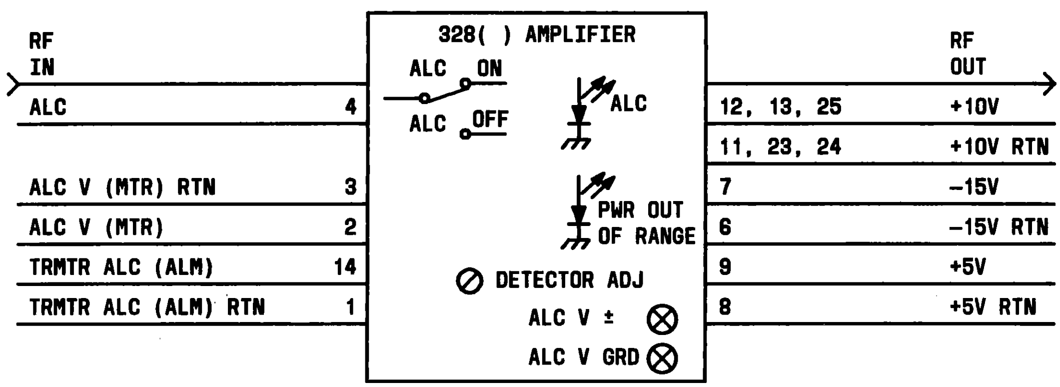



Fig. 4—210C Module—DAS Extender

## 328A AMPLIFIER—6 GHZ

The 328A solid state amplifier (Fig. 5) is used as the last stage RF signal amplifier in the radio transmitter. This unit is designed to operate over the entire 6 GHz common carrier band and has a typical gain of 43 dB. The following controls and/or indications perform the indicated function:

| | |
|---|---|
| ALC ON-OFF SWITCH | Selects input to the ALC circuitry |
| ALC LED | Lighted when the ALC switch is off |
| PWR OUT OF RANGE | Lighted when the output power varies by more than 0.3 dB from the nominal value |
| DETECTOR ADJ | Used to null the voltage generated by the signal detector when the transmitter is adjusted for nominal output level |
| ALC V± & ALC V GRD | ALC voltage test points. |




NOTE:
1. Numbers on leads are pin numbers of J6 which connects to the 328 Amplifier

**Fig. 5—328A Amplifier (6 GHz)**

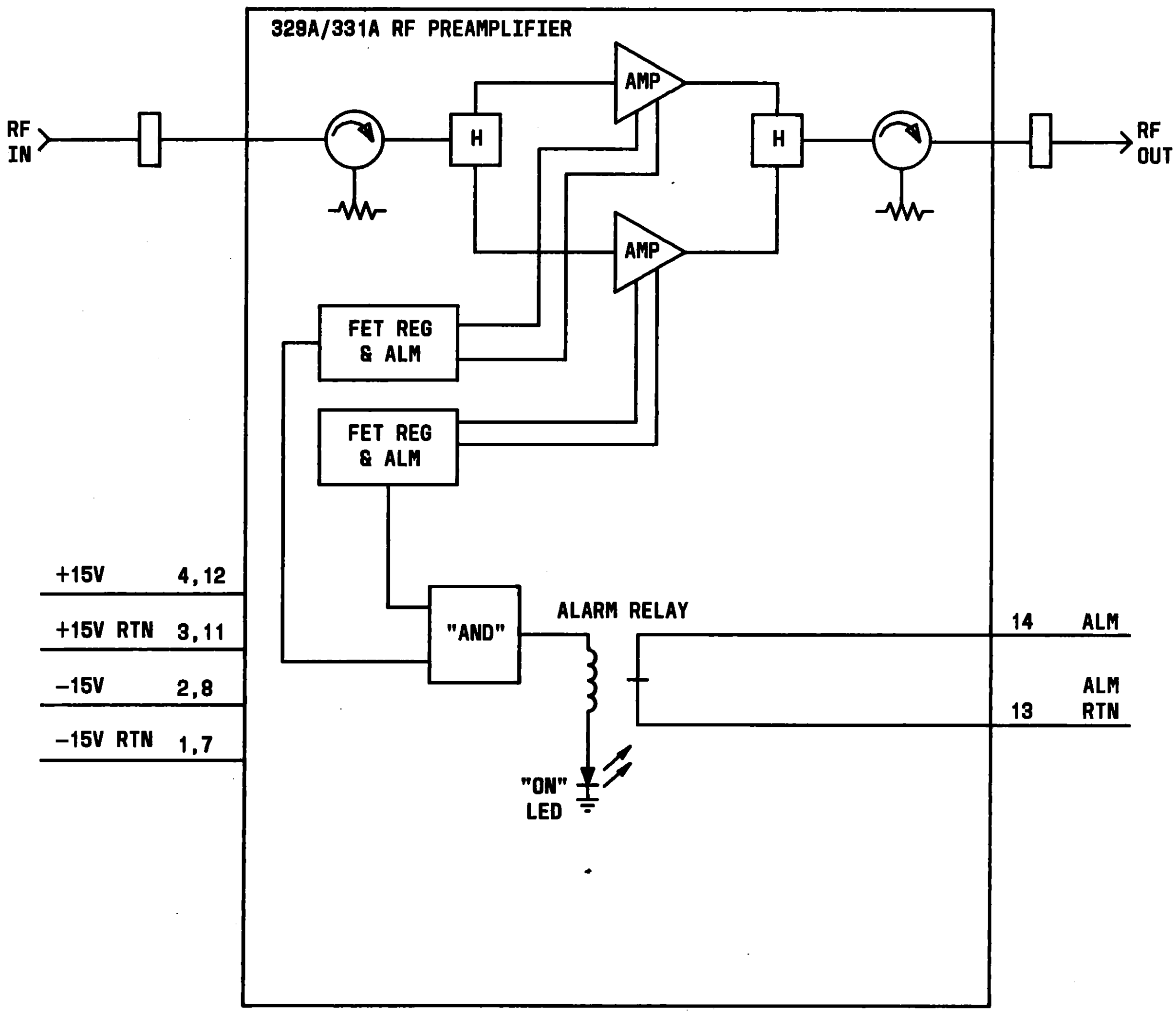
## 329A/331A RF PREAMPLIFIER—6 GHZ

The 329A and 331A units (Fig. 6) are low-noise preamplifiers used to increase the system gain and to improve the noise figure of the radio receivers in long radio hops. Because these units operate over the full lower-six band, they are located in the common waveguide receiver run and amplify the signal to all of the receivers in a bay lineup. The gain of each amplifier is obtained by paralleling two gain stages powered from a common radio receiver or two separate radio receivers. These preamplifiers have a green LED which is ON during normal operation.

The internal alarm circuits monitor the bias current of the individual gain stages. When there is a lack of bias current or an excessive bias current in a gain stage, a relay within the preamplifier provides a contact closure that activates the RF PRE AMP alarm on the ALARM AND METER unit. When the alarm is activated, the green LED on the preamplifier is OFF. Note that pulling the dc power plug causes the LED to extinguish and alarm conditions to immediately activate. A red LED on the ALARM AND METER unit activates a remote PRE AMP alarm.

Some of the key preamplifier characteristics are as follows:

| | | Nominal | One Gain Stage Failed |
|---|---|---|---|
| Gain (nominal) | 329A: | 9 dB | 3 dB |
| | 331A: | 18 dB | 12 dB |
| Noise Figure | 329A: | < 3.5 dB | < 6.5 dB |
| | 331A: | < 3.5 dB | < 6.5 dB |




NOTE:
NUMBERS ON LEADS ARE THE PIN NUMBERS ON THE PREAMPLIFIER PWR CONNECTOR

**Fig. 6—329A/331A RF Preamplifier**

## 471/474 BA POWER UNIT

The 471/474 BA POWER UNIT (Fig. 7) supplies either +5 V or -5 V power, depending on the strapping, to the terminal and regenerator circuit packs. The 471 unit is fed by a -24 V office supply. The 474 unit is fed by a -48 V office supply.

The power unit consists of an inrush current limiter, an input filter, a switching pulse-width-controlled power amplifier, output filters, and control circuits. The power unit latch contains an on/off switch that provides inrush protection and resets any latched protective shutdowns.

| OFFICE SUPPLY | UNIT | OUTPUT |
|---|---|---|
| –24V | 471BA | +5V OR –5V, DEPENDING ON STRAPPING* |
| –48V | 474BA | |

* UNIT ACTUALLY HAS BOTH OUTPUTS, BUT ONLY ONE IS USED.

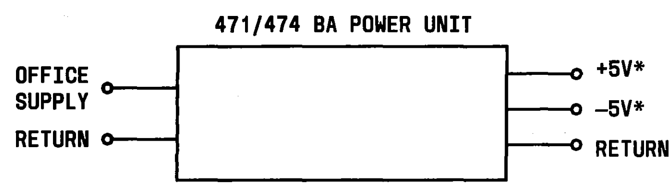



**Fig. 7—471/474 BA Power Units**

## 471/474 EA POWER UNIT

The 471/474 EA POWER UNIT (Fig. 8) supplies either +5 V or -5 V power, depending on the strapping, and +15 V and -15 V power to the terminal and regenerator circuit packs. The 471 unit is fed by an -24 V office supply. The 474 unit is fed by a -48 V office supply.

The power unit consists of an inrush current limiter, an input filter, a switching pulse-width-controlled power amplifier, output filters, and control circuits. The power unit latch contains an on/off switch that provides inrush protection and resets any latched protective shutdowns.

| OFFICE SUPPLY | UNIT | OUTPUT |
|---|---|---|
| –24V | 471EA | +5V OR –5V, DEPENDING ON STRAPPING* AND +15V AND –15V. |
| –48V | 474EA | |

* UNIT ACTUALLY HAS BOTH OUTPUTS, BUT ONLY ONE IS USED.

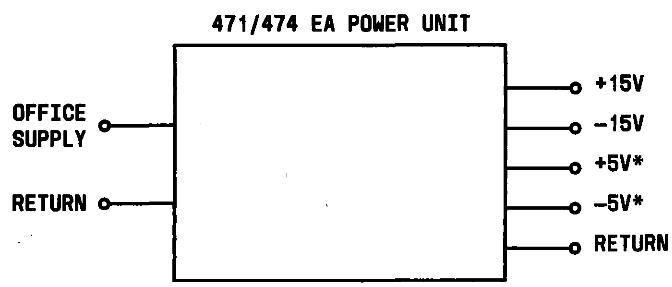



Fig. 8—471/474 EA Power Units

## 471/474 GA POWER UNIT

The 471/474 GA POWER UNIT (Fig. 9) supplies 10 V dc power to the solid-state amplifier.

The power unit consists of an inrush current limiter, an input filter, a switching pulse-width-controlled power amplifier, output filters, and control circuits. The power unit latch contains an on/off switch that provides inrush protection and resets any latched protective shutdowns.

The 471/474 unit operates on an office supply of -24/-48 V, respectively.

| OFFICE SUPPLY | UNIT | OUTPUT |
|---|---|---|
| −24V | 471GA | 10VDC |
| −48V | 474GA | |

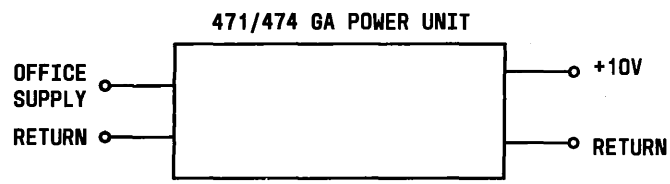



**Fig. 9—471/474 GA Power Units**

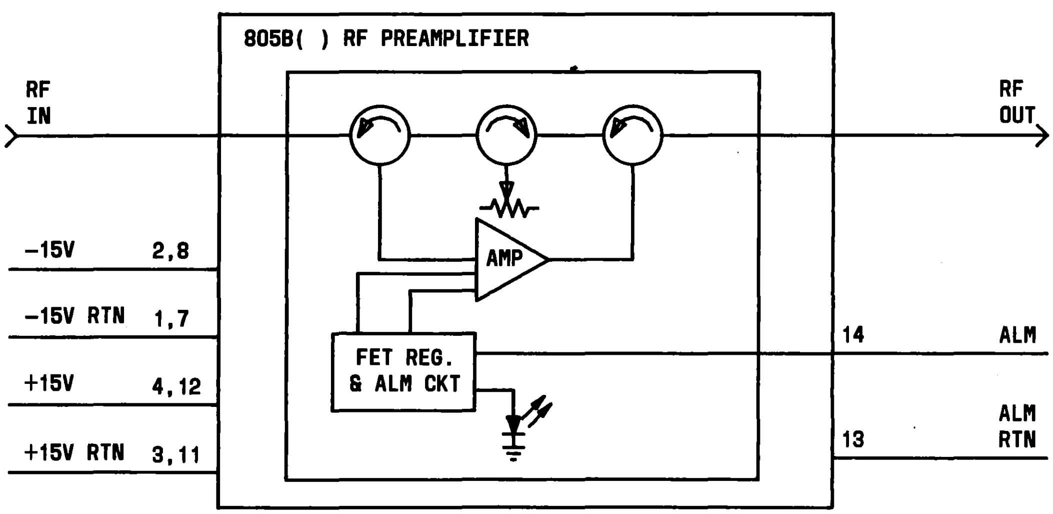
## 805B RF PREAMPLIFIER—11 GHZ

The 805B unit (Fig. 10) is a low-noise preamplifier used to increase the system gain and to improve the noise figure of the radio receivers in long radio hops. This unit operates over the full 11-GHz frequency band and is located in the common waveguide receiver run. It amplifies the signal to all of the receivers in a bay lineup. The amplifier has one gain stage and is powered from two separate radio bays.

The RF preamplifier has a green LED located on the unit that is ON during normal operation. The RF PRE AMP alarm monitors the FET (field effect transistor) bias current. When there is a lack of bias current or an excessive bias current, a relay within the preamplifier provides a contact closure that activates the RF PRE AMP alarm on the ALARM AND METER unit. When the alarm is activated, the green LED on the preamplifier is OFF. Note that pulling the power plug of the preamplifier results in a PREAMP failure. When the RF PRE AMP LED on the ALARM AND METER unit is lighted, a remote PRE AMP alarm is immediately activated.

Some of the key preamplifier characteristics are as follows:

| | Amp Operating | Amp Failed |
|---|---|---|
| Gain (nominal) | 8.0 dB | -20 dB |
| Noise Figure | < 3.5 dB | < 6.5 dB |



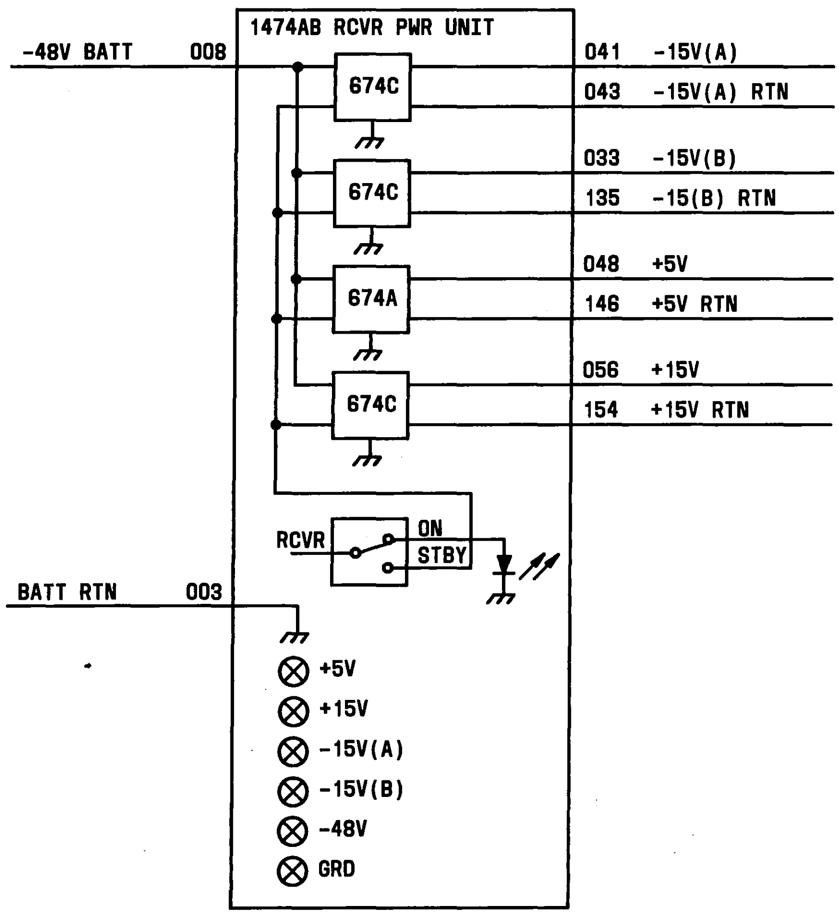

NOTE:
NUMBERS ON LEADS ARE THE PIN NUMBERS ON THE PREAMPLIFIER PWR CONNECTOR

**Fig. 10—805B RF Preamplifier**

## 1474AB RCVR PWR UNIT

This unit (Fig. 11) provides +5 volts, +15 volts, and -15 volts to the receiver portion of the radio bay. The required input voltage is -48 V (battery). Test points are provided to monitor the input and output voltages of this unit. The output voltages can be checked on the radio bay ALARM AND METER unit, if equipped.

In case of an interruption, this power unit automatically restores power to its output. An overload or the STBY/RCVR ON switch being set to the STBY position causes the unit to shut down. Depressing the STBY/RCVR ON switch to the RCVR ON position causes the unit to be powered up.



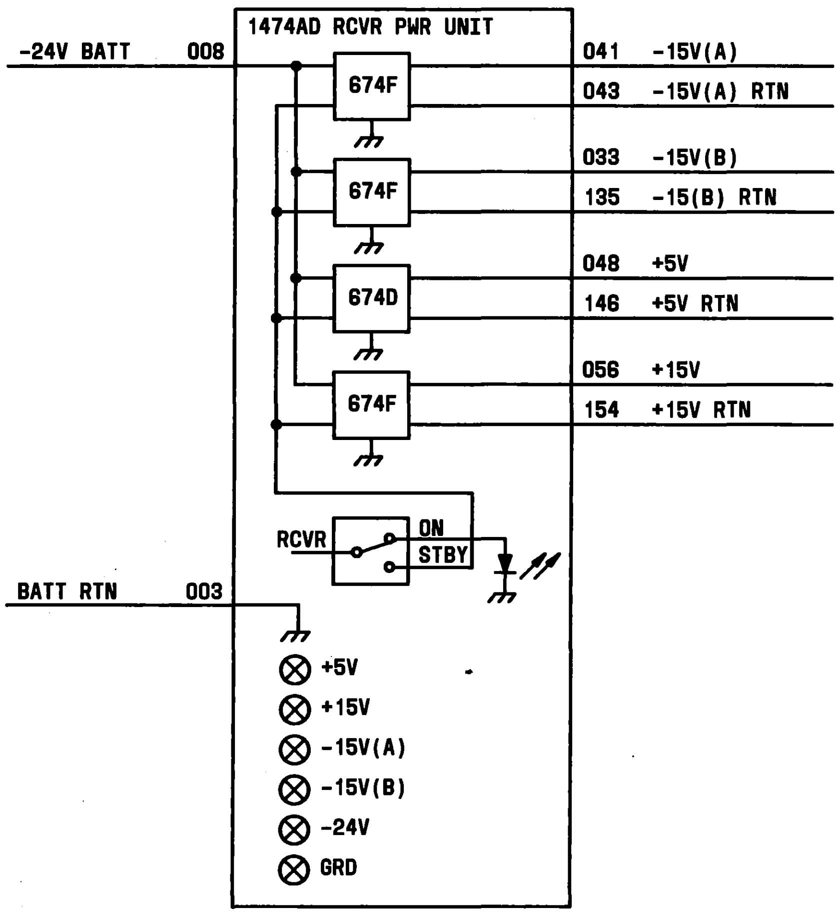

NOTE:
PIN CONNECTIONS ARE FOR P24 WHICH CONNECTS TO 1474AB RCVR PWR UNIT

**Fig. 11—1474AB Receiver Power Unit**

## 1474AD RCVR PWR UNIT

This unit (Fig. 12) provides +5 volts, +15 volts, and -15 volts to the receiver portion of the radio bay. The required input voltage is -24 V battery. Test points are provided to monitor the input and output voltages of this unit. The output voltages can be checked on the radio bay ALARM AND METER unit, if equipped.

In case of an interruption, this power unit automatically restores power to its output. An overload or the STBY/RCVR ON switch being set to the STBY position causes the unit to shut down. Depressing the STBY/RCVR ON switch to the RCVR ON position causes the unit to be powered up.



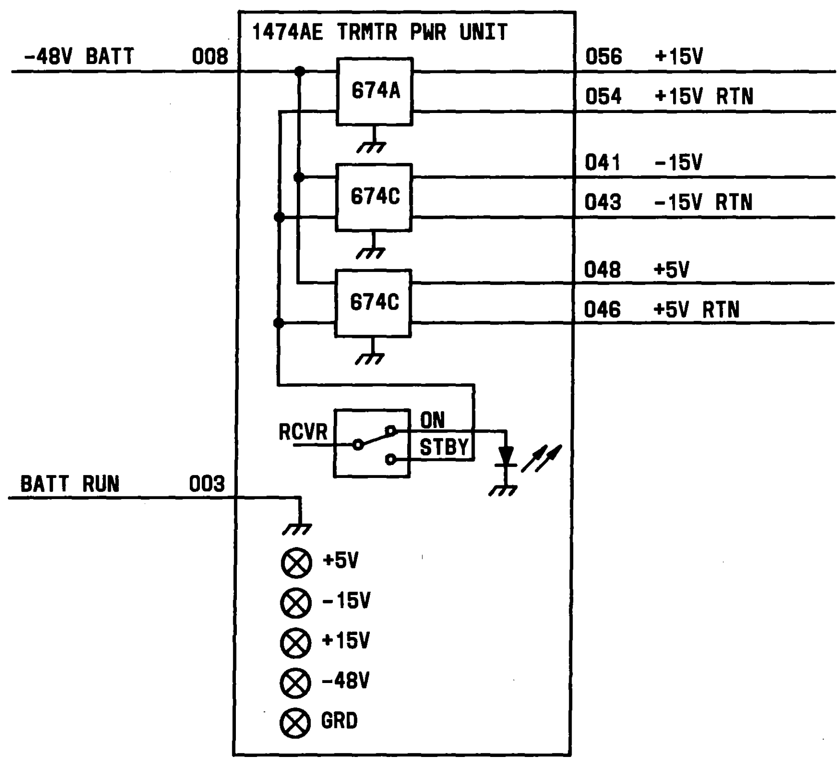

NOTE:
PIN CONNECTIONS ARE FOR P24 WHICH CONNECTS TO 1474AD RCVR PWR UNIT

**Fig. 12—1474AD Receiver Power Unit**

## 1474AE TRMTR PWR UNIT

This unit (Fig. 13) provides +5 volts, +15 volts, and -15 volts to the transmitter portion of the radio bay. The required input voltage is -48 V battery. Test points are provided to monitor the input and output voltages of this unit. The output voltages can be checked on the radio bay meter, if equipped.

In case of an interruption, this power unit automatically restores power to its output. An overload or setting the STBY/TRMTR ON switch to the STBY position causes the unit to shut down. Depressing the STBY/TRMTR ON switch to the TRMTR ON position causes the unit to be powered up.



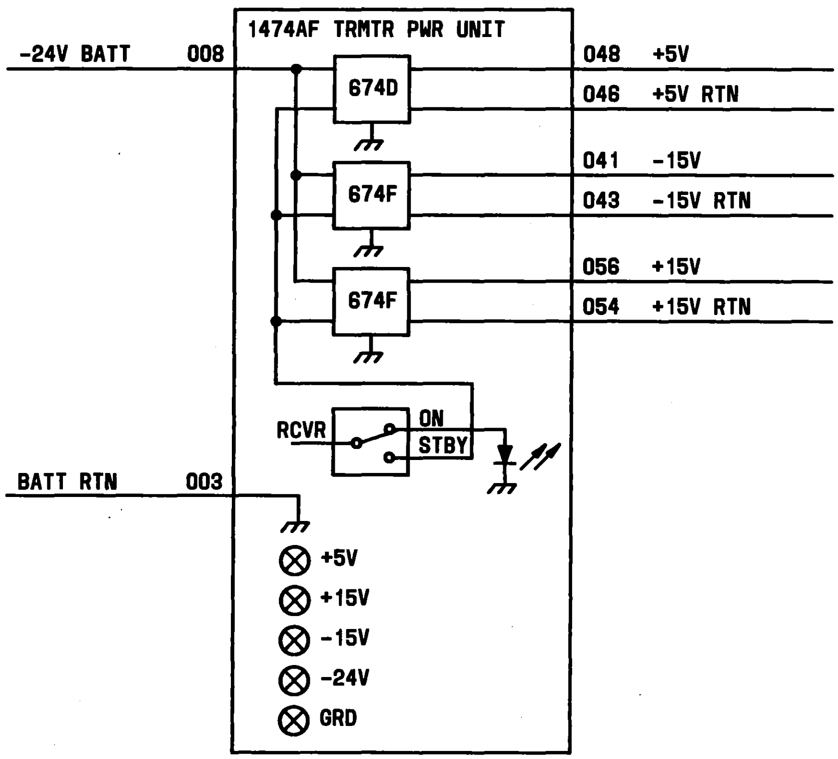

NOTE:
PIN CONNECTIONS ARE FOR P7 WHICH CONNECTS TO 1474AE TRMTR PWR UNIT

**Fig. 13—1474AE TRMTR PWR Unit**

### 1474AF TRMTR PWR UNIT

This unit (Fig. 14) provides +5 volts, +15 volts, and -15 volts to the transmitter portion of the radio bay. The required input voltage is -24 V battery. Test points are provided to monitor the input and output voltages of this unit. The output voltages can be checked on the radio bay meter, if equipped.

In case of an interruption, this power unit automatically restores power to its output. An overload or setting the STBY/TRMTR ON switch to the STBY position causes the unit to shut down. Depressing the STBY/TRMTR ON switch to the TRMTR ON position causes the unit to be powered up.




NOTE:
PIN CONNECTIONS ARE FOR P7 WHICH CONNECTS TO 1474AF TRMTR PWR UNIT

**Fig. 14—1474AF Transmitter Power Unit**

## 1477( ) ALARM OR ALARM AND METER UNIT

The 1477G ALARM AND METER unit provides a way to monitor output power supply and control voltages and to display alarms in the radio bay. The 1477H ALARM unit functions exactly the same, except that there is no meter circuitry.

The 1477( ) ALARM AND METER unit (Fig. 15) network is an interface circuit that processes the radio T/R alarm inputs and generates up to three remote alarm outputs. This unit also contains a meter to facilitate the monitoring of various T/R functions. A number of radio functions can be accessed by a rotary switch on the 1477G and viewed on a digital meter.

When one or more receiver alarms are present, a remote RCVR ALM is generated. The same combining of transmitter alarms generates a remote TRMTR ALM. Because the RF preamplifier is located outside the T/R, its alarm is processed separately. When present, the preamplifier alarm generates its own independent remote PRE AMP ALM. All remote alarms are initiated by providing a relay contact closure.

In some cases, incoming T/R alarms are delayed to avoid generating remote alarms due to atmospheric fading conditions. However, once a TRMTR or RCVR remote alarm is initiated, it is held or latched for at least 25 seconds to allow sufficient recognition time by the remote alarm reporting system. The faceplate of this network shows the presence of each radio alarm by means of a red LED. The relays used on this network are fail-safe, that is, if the dc power to the unit fails, the relays automatically initiate a remote alarm.

Except for the RF PRE AMP, BEAM FLT, and PWR ALM alarms, which provide a relay closure to indicate an alarm state, the circuits interpret the voltages that appear at their alarm input leads as follows:

| | |
|---|---|
| Normal condition (no alarm): | -4 to -15 volts |
| Alarm condition: | -1 to +10 volts |

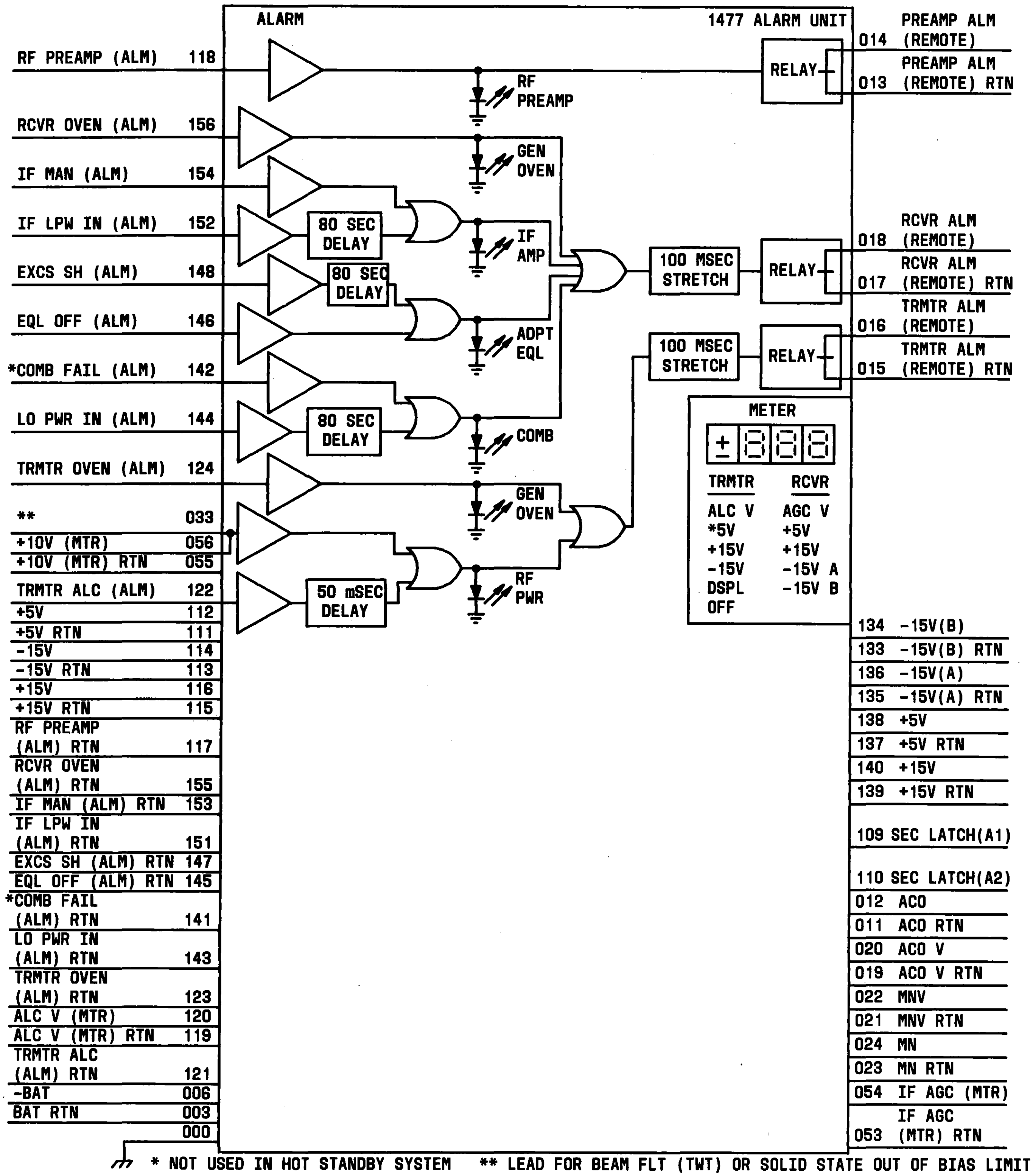



**Fig. 15—1477 Alarm and Meter Unit**

## 2003( ) EQUALIZER ASSEMBLY

The 2003( ) equalizer assembly (Fig. 16) contains a 989( ) equalizer that is designed to operate in the 74-MHz frequency range. This assembly is used between the radio and regenerator or terminal equipment to control transmission frequency characteristics of the 74-MHz frequency panel by increasing loss with increasing frequency.

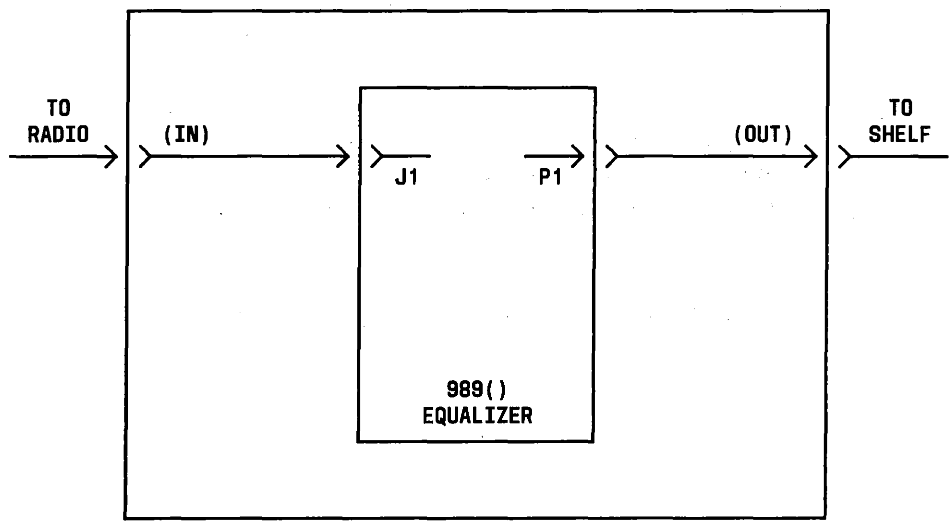



**Fig. 16—2003 Equalizer Assembly**

## 4375A LINEAR DELAY EQUALIZER

The 4375A (Fig. 17) network can accommodate up to two 2001( ) linear delay equalizers. By selecting the appropriate equalizer code(s), the positive or negative linear delay slope of a radio hop can be corrected to within 1 nanosecond.

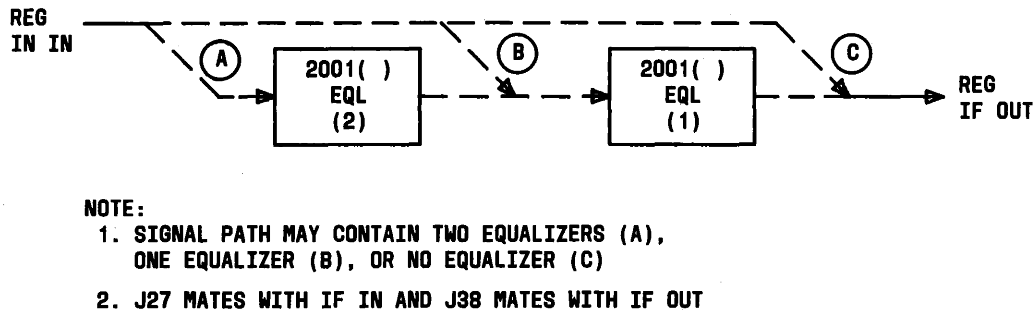



**Fig. 17—4375A Linear Delay Equalizer**

## 4376( ) IF FILTER AND BASIC EQUALIZER

The 4376( ) network (Fig. 18) contains both a BPF (bandpass filter) and a BASIC (parabolic) equalizer. The function of the BPF is to improve the selectivity of the receiver by rejecting out-of-band signals at a point ahead of the IF AGC amplifier. The BASIC equalizer is primarily designed to compensate for the parabolic delay and amplitude shape contributed by the radio transmitter and receiver RF filters.


NOTE:
IF IN MATES WITH J29, AND IF OUT MATES WITH J30

**Fig. 18—4376( ) IF Filter and Basic Equalizer**

## 4383 TRANSMITTER UP CONV & MWV GEN

The 4383( ) network (Fig. 19) is designed to operate in the 11-GHz frequency band and consists primarily of three major units: a 142( ) microwave generator, a 2A multiplier, and a 17A up-converter mounted on a plug-in board. A microwave generator oven alarm interface circuit is also located on this plug-in board.

### 142( ) MWV GENERATOR AND 2A MULTIPLIER

The microwave generator is a free-running DRO (dielectric resonator oscillator). It is tuned to a frequency that is one-half of the required local oscillator frequency of the specific channel in the 11-GHz common carrier band. It is equipped with a fine frequency adjust control that has an adjustment range in excess of ±500 kHz of the channel center frequency. The RF output level of this unit is about +10.0 dBm. This unit is housed in a small insulated oven that is maintained at a constant temperature of about 75 degrees C. The oven temperature is generated by a power transistor regulated by a thermister. The oven is powered directly from the -24 V battery plant or by Zener diodes from a -48 V battery plant. In the case of a power transistor short circuit, damage to the printed wiring is prevented by a thermal fuse located within the oven.

During the first 10 minutes following initial turn-on (cold start), the oven draws about 500 mA of current. As the oven temperature rises, the current gradually decreases and stabilizes at approximately 100 mA. This point is reached about 20 minutes following initial turn-on, at which time the GEN OVEN alarm (described further below) is switched off. Note that, at this time, the generator frequency is still changing and requires additional time to stabilize. An oven control circuit generates an alarm voltage proportional to the current drawn by the power transistor. This voltage is monitored by the oven alarm interface circuit which activates a GEN OVEN alarm when the alarm voltage is outside the range of -0.1 V to -10 V.

### 2A MULTIPLIER

The 2A Multiplier doubles the frequency of the DRO output signal to be used as the local oscillator signal in the 11-GHz up-converter.

### 17A UP-CONVERTER

The 17A up-converter is designed to operate over the 11-GHz common carrier frequency band. It uses a balanced mixer to achieve the up-conversion of the 70-MHz IF signal.

The generator local oscillator signal from the 2A multiplier is applied to the mixer at a nominal level of +11.5 dBm with a 12 dB coupler located within the up-converter. The coupler output serves as the generator in-service power and frequency monitor port. The power level available at this port is nominally 0 dBm. The 70-MHz IF signal applied to this unit is fed through a voltage controlled attenuator, an amplifier, a manual slope adjust, a manually controlled attenuator, and finally to the mixer where it is up-converted to the 11-GHz frequency level. The resulting double sideband signal is then amplified by a 15-dB gain amplifier.

The degree of attenuation inserted by the voltage controlled attenuator is controlled by an ALC (automatic level control) voltage. This voltage is generated by an ALC circuit located at the output of the transmitter power amplifier. The function of this ALC loop is to keep the overall output power of the transmitter relatively constant and independent of temperature variations. The slope adjust control permits the external adjustment of the transmitter amplitude slope by approximately ±1 dB over a 40-MHz range. The manually controlled attenuator is also externally accessible and can provide up to 20 dB of loss to the

IF signal. This control is normally adjusted during initial transmitter alignment for nominal transmitter output power level.

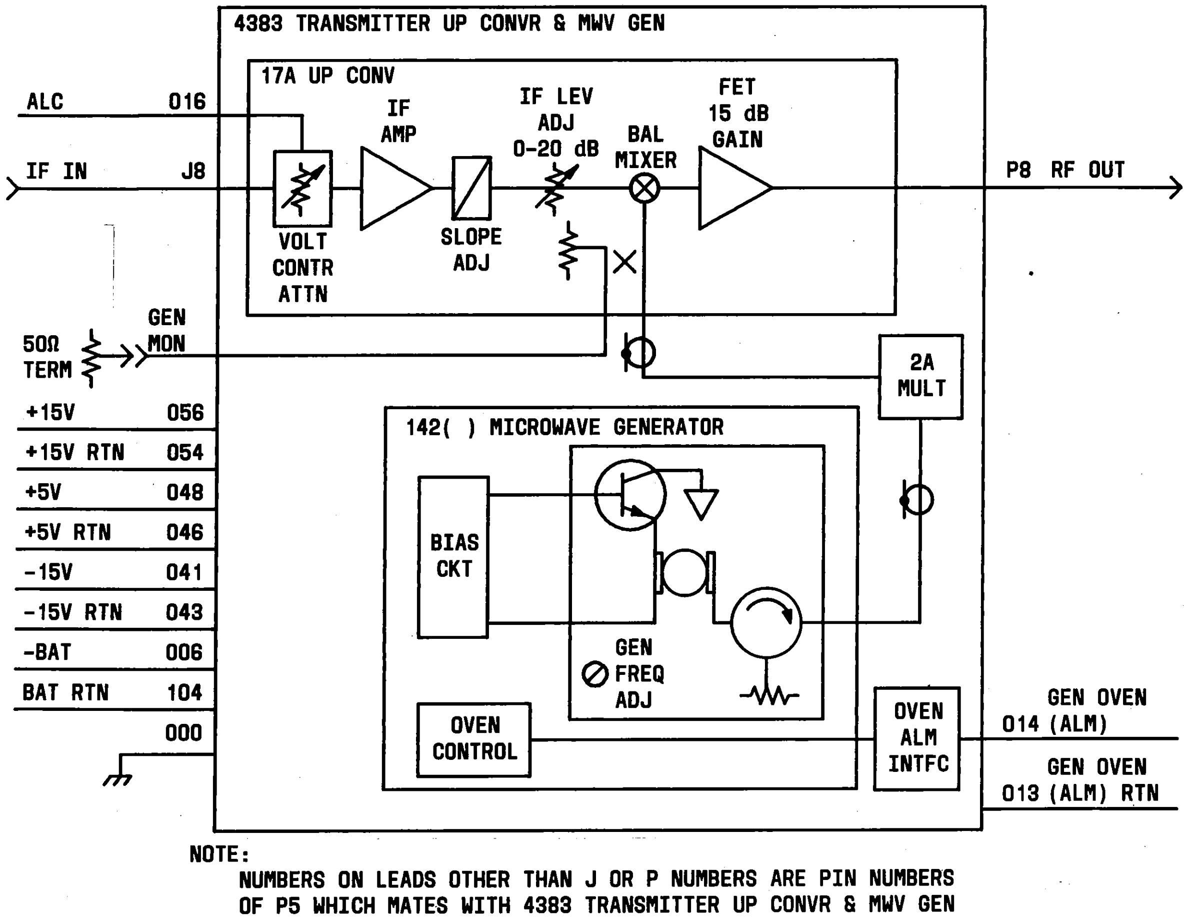



**Fig. 19—4383 Transmitter Up-Converter and Microwave Generator**

## 4384 RECEIVER DOWN CONV & MWV GEN

This network (Fig. 20) consists primarily of an 18B down-converter, a 142( ) microwave generator, and a 2A multiplier mounted on a plug-in board. A microwave generator oven alarm interface circuit is also located on the same board.

## 142( ) MWV GENERATOR AND 2A MULTIPLIER

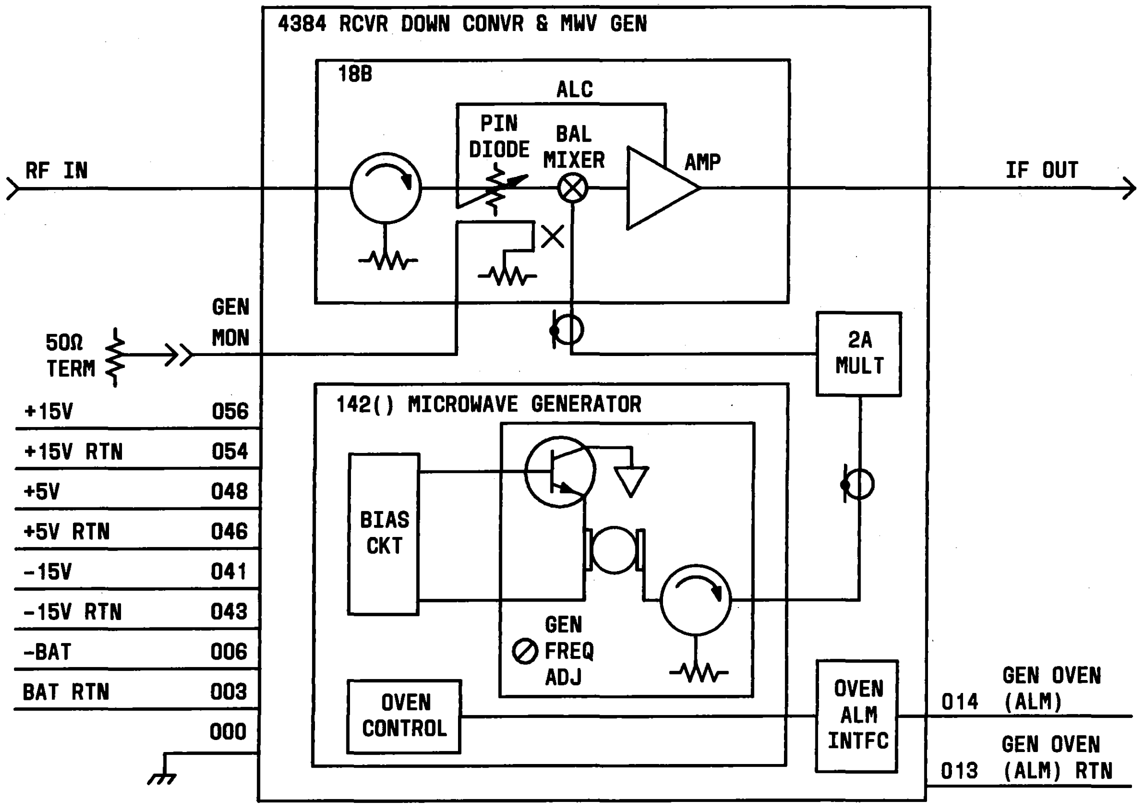
The microwave generator is a free-running DRO. It is tuned to one-half of a specific channel frequency on the 11-GHz common carrier band. This frequency is doubled to the 11-GHz frequency range by the 2A multiplier. It is equipped with a fine frequency adjust control that has an adjustment range in excess of ±500 kHz of the channel center frequency. The RF output level of this unit and the 2A multiplier is about +11.5 dBm. The DRO unit is housed in a small insulated oven that is maintained at a constant temperature of about 75 degrees C. The oven temperature is generated by a power transistor regulated by a thermister. The oven is powered directly from the -24 V battery plant or by Zener diodes from a -48 V battery plant.

During the first 10 minutes following initial turn-on (cold start), the oven draws about 500 mA of current. As the oven temperature rises, the current gradually decreases and stabilizes at approximately 100 mA. This point is reached about 20 minutes following initial turn-on, at which time the GEN OVEN alarm (described further below) is switched off. Note that, at this time, the generator frequency is still changing and requires additional time to stabilize. An oven control circuit generates an alarm voltage proportional to the current drawn by the power transistor. This voltage is, in turn, monitored by the oven alarm interface circuit that activates a GEN OVEN alarm when the alarm voltage is outside the range of -0.1 V to -10 V.

## 18B DOWN-CONVERTER

The 18B down-converter uses a balanced mixer designed to operate in the 11-GHz common carrier frequency band. The generator signal is applied to the mixer through a 2A multiplier to the down-converter. This serves as the generator local-oscillator signal into the balanced mixer of the down-converter.

The received signal level applied at the down-converter input is in the range of -14 dBm or less. This signal is fed through a circulator to a pin diode and finally to the mixer where it is down-converted to a 70-MHz IF signal. The IF signal is then amplified and routed to the down-converter IF OUT jack. The down-converter has a nominal gain of approximately 20 dB for received signal levels below about -30 dBm. For higher signal levels, the gain is progressively reduced by a pin diode that is controlled by an ALC voltage generated by the amplifier. The ALC function is primarily intended to prevent overdriving the receiver IF AGC amplifier during periods of strong signal up-fades.




NOTE:
NUMBERS ON LEADS ARE PIN NUMBERS FOR THE CONNECTOR FOR THE 4384 FREQ DIV RCVR DOWN CONVR & MWV GEN

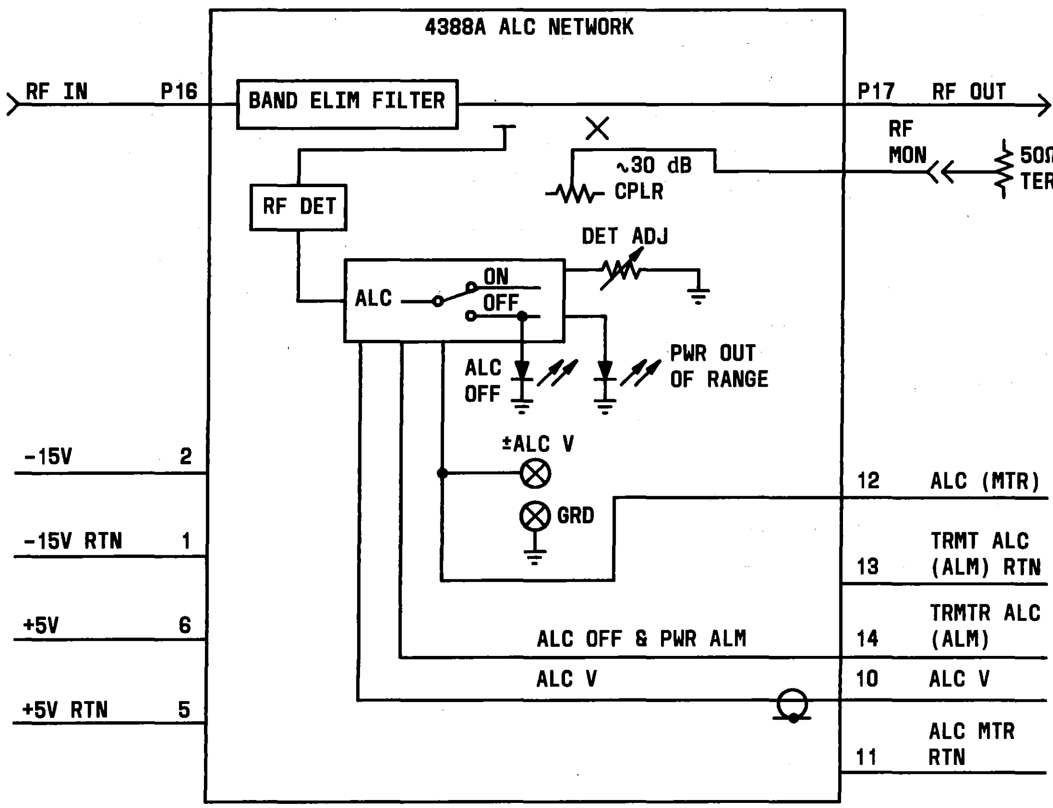
**Fig. 20—4384 Receiver Down-Converter and Microwave Generator**

## 4388A (11 GHZ) ALC NETWORK

The 4388A ALC NETWORK (Fig. 21) is located at the output of the TWT (traveling wave tube) amplifier and is designed to operate in the 10.7- to 11.7-GHz common carrier band. The RF signal applied to this unit is initially directed through a BEF (band elimination filter) that is designed to reject the second and third harmonics from the TWT. This signal is then detected and compared with that of an internal reference. The resulting ALC V (voltage), based on the difference between the detected voltage from the applied signal and the reference voltage, is then fed to the up-converter. The up-converter, in turn, uses the ALC V to control the attenuation of its IF input level and thus maintain the overall transmitter output power constant.

The DET ADJ (detector adjust control) is used to null the voltage generated by the signal detector when the transmitter is adjusted for nominal output level. The ALC switch disables the ALC feature and calls attention to this fact by lighting the ALC OFF LED. Should the overall transmitter output power vary by more than 0.3 dB, the PWR OUT OF RANGE LED also lights. In either case, this unit generates a transmitter alarm (TRMTR ALC ALM) to indicate that these conditions must be corrected prior to returning the radio to normal service.

The ALC V fed back to the up-converter can be monitored by the meter in the radio transmitter and/or by an external meter connected to the ALC V test points on the unit itself. The coupler located at the output of this unit provides about 30 dB of loss to the in-service transmitter RF MON port.




NOTE:
NUMBERS ON LEADS OTHER THAN P NUMBERS ARE PIN NUMBERS OF J10 WHICH MATES WITH THE ALC 4388A NETWORK

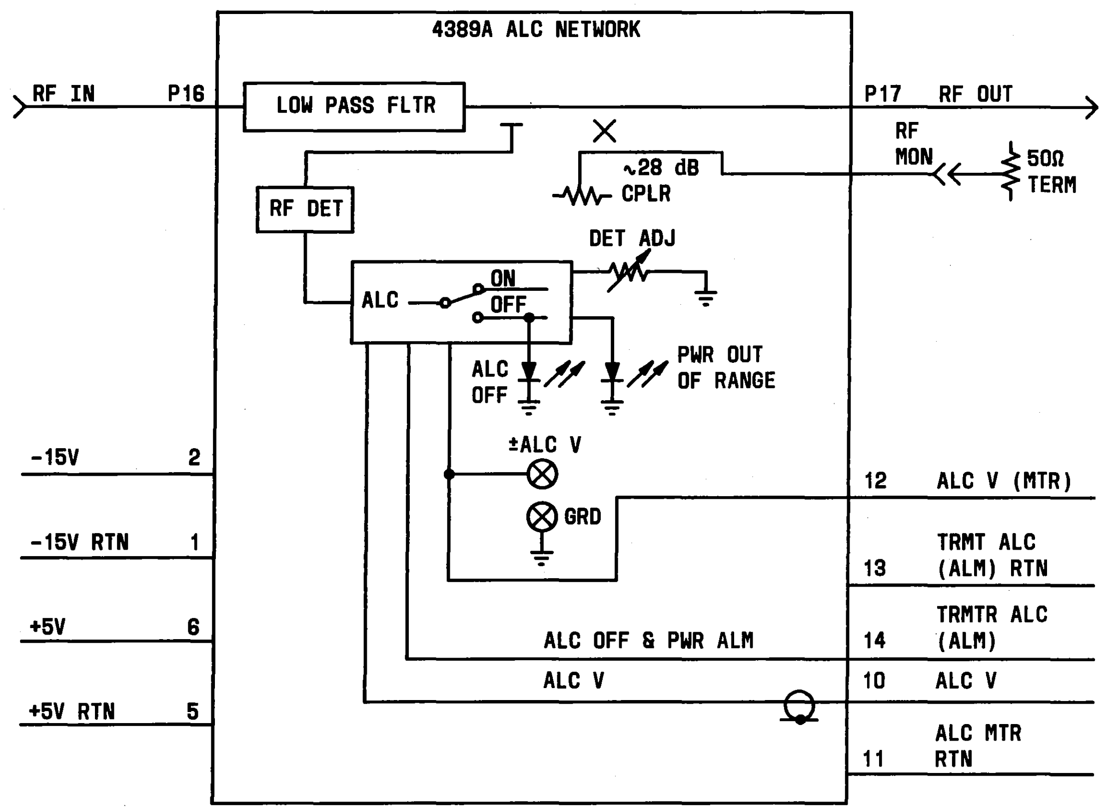
**Fig. 21—4388A (11 GHz) ALC NETWORK Unit**

## 4389A (6 GHZ) ALC NETWORK

The 4389A ALC NETWORK (Fig. 22) is located at the output of the TWT amplifier and is designed to operate in the 5.9- to 6.4-GHz common carrier band. The RF signal applied to this unit is initially directed through an LPF (low-pass filter) that is designed to reject the second or third harmonics from the TWT. This signal is then detected and compared with that of an internal reference. The resulting ALC V, based on the difference between the detected voltage from the applied signal and the reference voltage, is then fed to the up-converter. The up-converter, in turn, uses the ALC V to control the attenuation of its IF input level and thus maintain the overall transmitter output power constant.

The DET ADJ is used to null the voltage generated by the signal detector when the transmitter is adjusted for nominal output level. The ALC switch disables the ALC feature and calls attention to this fact by lighting the ALC OFF LED. Should the overall transmitter output power vary by more than 0.3 dB, the PWR OUT OF RANGE LED also lights. In either case, this unit generates a transmitter alarm (TRMTR ALC ALM) to indicate that these conditions must be corrected prior to returning the radio to normal service.

The ALC V fed back to the up-converter can be monitored by the meter in the radio transmitter and/or by an external meter connected to the ALC V test points on the unit itself. The coupler located at the output of this unit provides about 30 dB of loss to the in-service transmitter RF MON port.




NOTE:
NUMBERS ON LEADS OTHER THAN P NUMBERS ARE PIN NUMBERS OF J10 WHICH MATES WITH THE ALC 4389A NETWORK

**Fig. 22—4389A (6 GHz) ALC Network**

## 4390( ) TRANSMITTER UP CONV & MWV GEN

The 4390( ) network (Fig. 23) consists primarily of a 141( ) microwave generator and of a 20A up-converter mounted on a plug-in board. A microwave generator oven alarm interface circuit is also located on this plug-in board.

### 141( ) MWV GENERATOR

The microwave generator is a free-running DRO. It is tuned to a specific local oscillator frequency in the lower-six common carrier band. It is equipped with a fine frequency adjust control that has an adjustment range in excess of ±500 kHz of the channel center frequency. The RF output level of this unit is about +11.5 dBm. This unit is housed in a small insulated oven that is maintained at a constant temperature of about 75 degrees C. The oven temperature is generated by a power transistor regulated by a thermistor. The oven is powered directly from the -24 V battery plant or by Zener diodes from a -48 V battery plant.

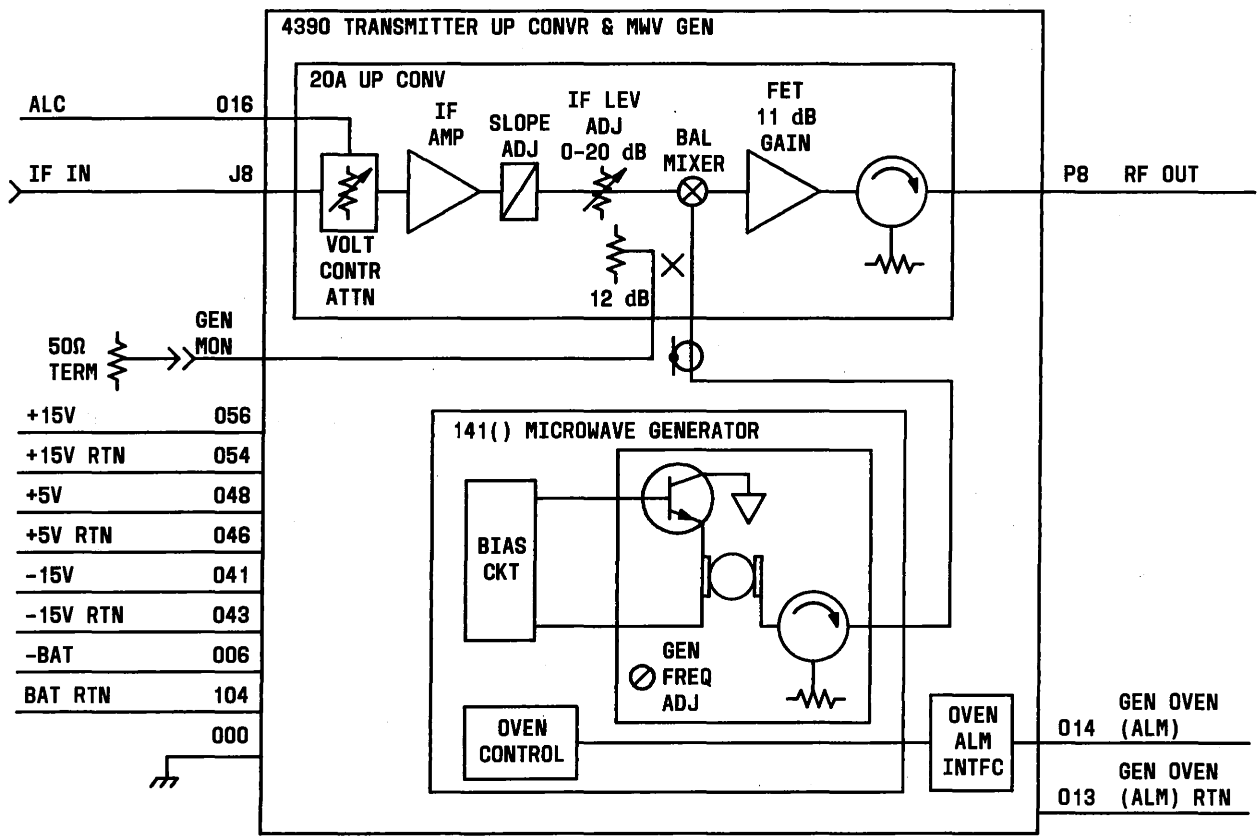
During the first 10 minutes following initial turn-on (cold start), the oven draws about 500 mA of current. As the oven temperature rises, the current gradually decreases and stabilizes at approximately 100 mA. This point is reached about 20 minutes following initial turn-on, at which time the GEN OVEN alarm (described further below) is switched off. Note that, at this time, the generator frequency is still changing and requires additional time to stabilize. An oven control circuit generates an alarm voltage proportional to the current drawn by the power transistor. This voltage is, in turn, monitored by the oven alarm interface circuit that activates a GEN OVEN alarm when the alarm voltage is outside the range of -0.1 V to -10 V.

### 20A UP-CONVERTER

The 20A up-converter is designed to operate over the lower-six common carrier frequency band. It uses a balanced mixer to achieve the up-conversion of the 70-MHz IF signal.

The generator local-oscillator signal is applied to the mixer at a nominal level of +11.5 dBm with a 12-dB coupler located within the up-converter. The coupler output serves as the generator in-service power and frequency monitor port. The power level available at this port is nominally 0 dBm. The 70-MHz IF signal applied to this unit is fed through a voltage controlled attenuator, an amplifier, a manual slope adjust, a manually controlled attenuator, and finally to the mixer where it is up-converted to the 6-GHz frequency level. The resulting double sideband signal is then amplified and routed by an output circulator to the up-converter RF output port.

The degree of attenuation inserted by the voltage controlled attenuator is controlled by an ALC voltage. The voltage is generated by an ALC circuit located at the output of the transmitter power amplifier. The function of this ALC loop is to keep the overall output power of the transmitter relatively constant and independent of temperature variations. The slope adjust control permits the external adjustment of the transmitter amplitude slope by approximately ±1 dB over a 40-MHz range. The manually controlled attenuator is also externally accessible and can provide up to 20 dB of loss to the IF signal. This control is normally adjusted during initial transmitter alignment for nominal transmitter output power level.




NOTE:
NUMBERS ON LEADS OTHER THAN J OR P NUMBERS ARE PIN NUMBERS OF P5 WHICH MATES WITH 4390 TRANSMITTER UP CONVR & MWV GEN

**Fig. 23—4390 Transmitter Up-Converter and Microwave Generator**

## 4391( ) RECEIVER DOWN CONV & MWV GEN

This network (Fig. 24) consists primarily of a 21B down-converter and a 141( ) microwave generator mounted on a plug-in board. A microwave generator oven alarm interface circuit is also located on the same board.

### 141( ) MWV GENERATOR

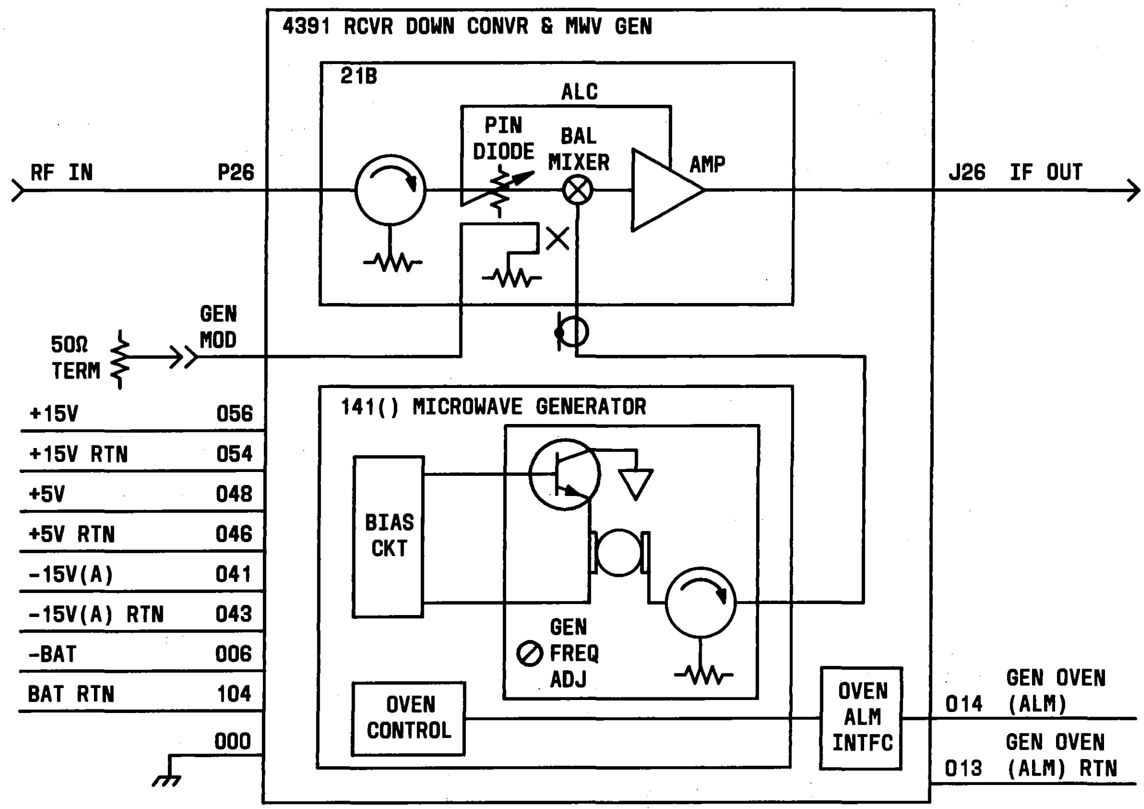
The microwave generator is a free-running DRO. It is tuned to specific local oscillator frequency in the lower-six common carrier band. It is equipped with a fine frequency adjust control that has an adjustment range in excess of ±500 kHz of the channel center frequency. The RF output level of this unit is about +11.5 dBm. The DRO unit is housed in a small insulated oven that is maintained at a constant temperature of about 75 degrees C. The oven temperature is generated by a power transistor regulated by a thermistor. The oven is powered directly from the -24 V battery plant or by Zener diodes from a -48 V battery plant.

During the first 10 minutes following initial turn-on (cold start), the oven draws about 500 mA of current. As the oven temperature rises, the current gradually decreases and stabilizes at approximately 100 mA. This point is reached about 20 minutes following initial turn-on, at which time the GEN OVEN alarm is switched off. Note that, at this time, the generator frequency is still changing and requires additional time to stabilize. An oven control circuit generates an alarm voltage proportional to the current drawn by the power transistor. This voltage is, in turn, monitored by the oven alarm interface circuit that activates a GEN OVEN alarm when the alarm voltage is outside the range of -0.1 V to -10 V.

### 21B DOWN-CONVERTER

The 21B down-converter uses a balance mixer designed to operate over the entire lower-six common carrier frequency band. The generator local-oscillator signal is applied to the mixer through a coupler located within the down-converter. The coupled output (-15 dB) serves as the generator in-service power and frequency monitor port. The power available at this port is approximately -3 dBm.

The received signal level applied at the down-converter input is in the range of -14 dBm or less. This signal is fed through a circulator to a pin diode and finally to the mixer where it is down-converted to a 70-MHz IF signal. The IF signal is then amplified and routed to the down-converter IF OUT jack. The down-converter has a nominal gain of approximately 20 dB for received signal levels below about -25 dBm. For higher signal levels, the gain is progressively reduced by the pin diode that is controlled by an ALC voltage generated by the amplifier. The ALC function is primarily intended to prevent overdriving the receiver IF AGC amplifier during periods of strong signal up-fades.




NOTE:
NUMBERS ON LEADS ARE PIN NUMBERS FOR THE CONNECTOR FOR THE 4391 RCVR DOWN CONVR & MWV GEN

**Fig. 24—4391 Receiver Down-Converter and Microwave Generator**

## 4410A/B SWITCH CONTROL NETWORK

The 4410A/B switch control network (Fig. 25) is designed to operate the RF microwave switch used in the hot standby radio system. The 4410A switch control network uses a 24 V dc source and the 4410B uses a 48 V dc source. The RF switching control circuit in this unit is used to cause the microwave switch to change state. The verify switching circuit is used to operate the regular and standby LEDs. The 4410A/B switch control network, together with the RF microwave switch, make up what is called the Transmitter Switch.

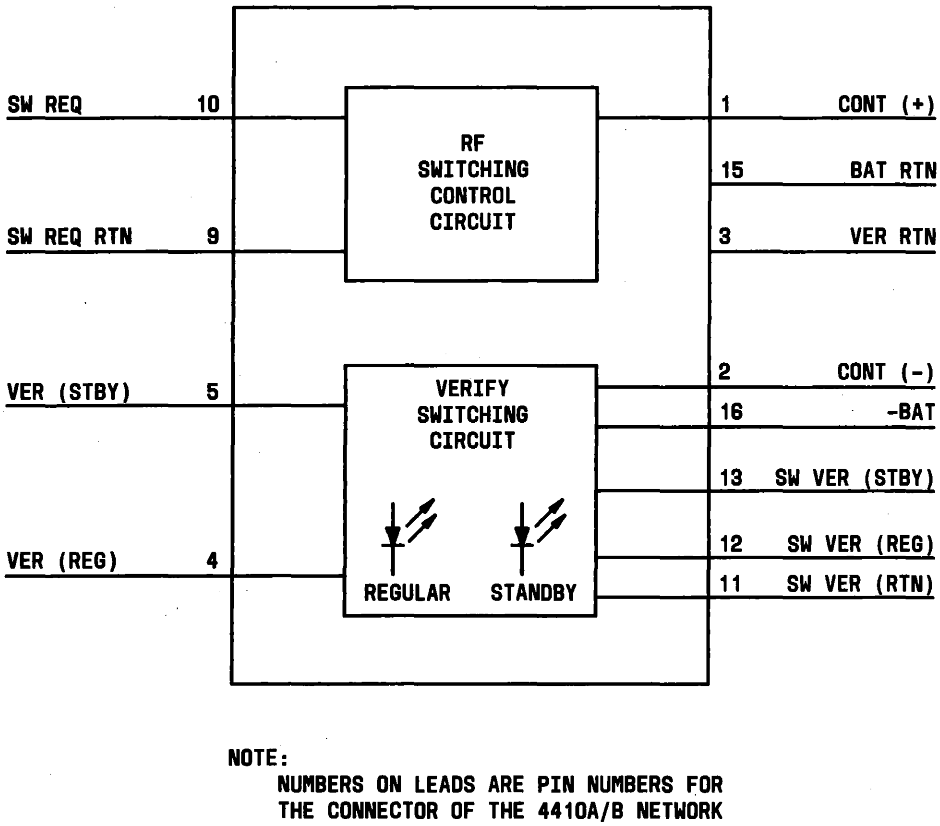



**Fig. 25—4410A/B Switch Control Network**

## AMR2 B3ZS DECODER AND TRANSMIT ELASTIC STORE

The AMR2 B3ZS DCODR (Fig. 26) performs two main functions. The decoder section receives the bipolar 3-zero substitution DS3 signal and decodes it to binary clock and data. The data is then written to elastic store where overhead and stuff bits are added to bring the output to a bit rate that is synchronous with the output of the other AMR2s in the system.

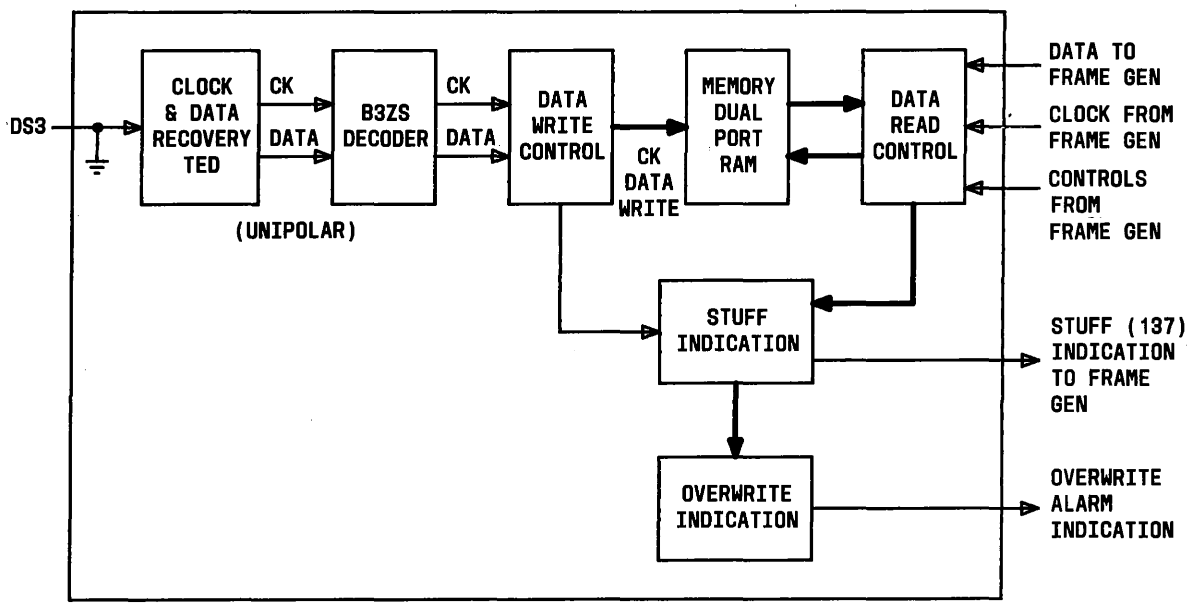



Fig. 26—AMR2 B3ZS Decoder

## AMR6 FRAME GENERATOR

The AMR6 FRAME GEN (Fig. 27) is used in the regular and protection shelves to perform the following functions:

- Generates the high-speed clock and the control signals for transmission to the elastic stores. These control signals determine where the elastic stores put dummy bits in the data stream for overhead bit insertion.
- Receives the data bits from the elastic stores and multiplexes them into the 6-rail format.
- Generates the system symbol clock.
- Scrambles the data received from the elastic stores.
- Generates and inserts the 64-QAM frame format.
- Generates page pulses to align the rest of the DPU (digital processing unit) in the frame structure.
- Transmits the framed 6 rails, page signal, and symbol clock to the DPU and protection boards.

## AMR11 CRC CODER

The AMR11 CRC CODER (Fig. 29) performs a cyclic redundancy check on the incoming data, inserts service channel bits and cyclic redundancy bits into the data stream, and Gray-codes the data before passing it on to the digital-to-analog converter (AMR20). The AMR11 also generates and transmits two signals (the TAC and TAP—transmit auxiliary clock and page) to the service channel muldem to ensure proper timing of the auxiliary data stream relative to the primary 135-Mb/s data stream.

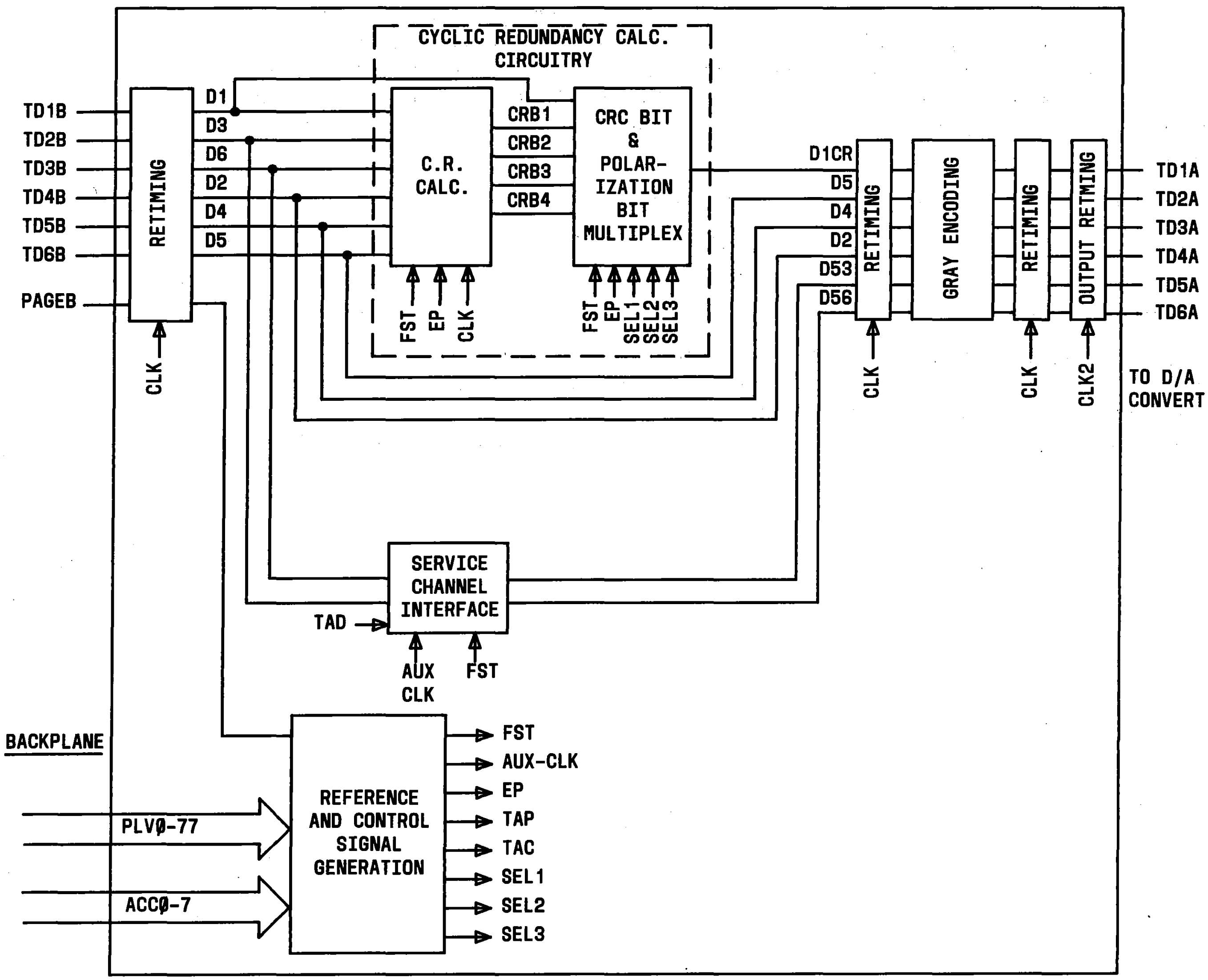



Fig. 29—AMR11 CRC Coder

## AMR17 FRAME RESUPPLY

The AMR17 FRAME RSPLY (Fig. 30) is an optional circuit pack that may be placed between a regenerator framer and the D/A (digital-to-analog) converter circuit pack. It has two purposes:

- Provides service channel transmission within a valid frame format when the regenerator framer is unable to frame on the received data
- Generates a valid frame for an out-of-service IF loopback test of a regenerator.

The frame resupply receives clock and data from the regenerator framer. This clock and data are multiplexed with clock and data that are generated internally. The internally generated data contains a valid frame format that includes service channel data from the service channel muldem. When the clock and data from the regenerator framer are sent to the D/A converter, the frame resupply is considered off. Three conditions will turn the frame resupply on (allow it to pass the internally generated clock and data to the D/A converter):

- If the frame loss indication (AIFIFL) from the regenerator framer is low
- If the control lead (CFRSR) from the channel controller is high
- If the frame resupply is manually turned on with the MAN FRS pushbutton and the manual inhibit lead, CFRSI, is low.

The frame resupply condition is indicated to the channel controller by the IFRS lead. This is normally high and goes low when the frame resupply turns on, lighting the FRS ON LED. The state of the MAN FRS pushbutton is indicated by the IMFRS lead. This is normally high and goes low when the pushbutton is pressed, lighting the MAN FRS ON LED.

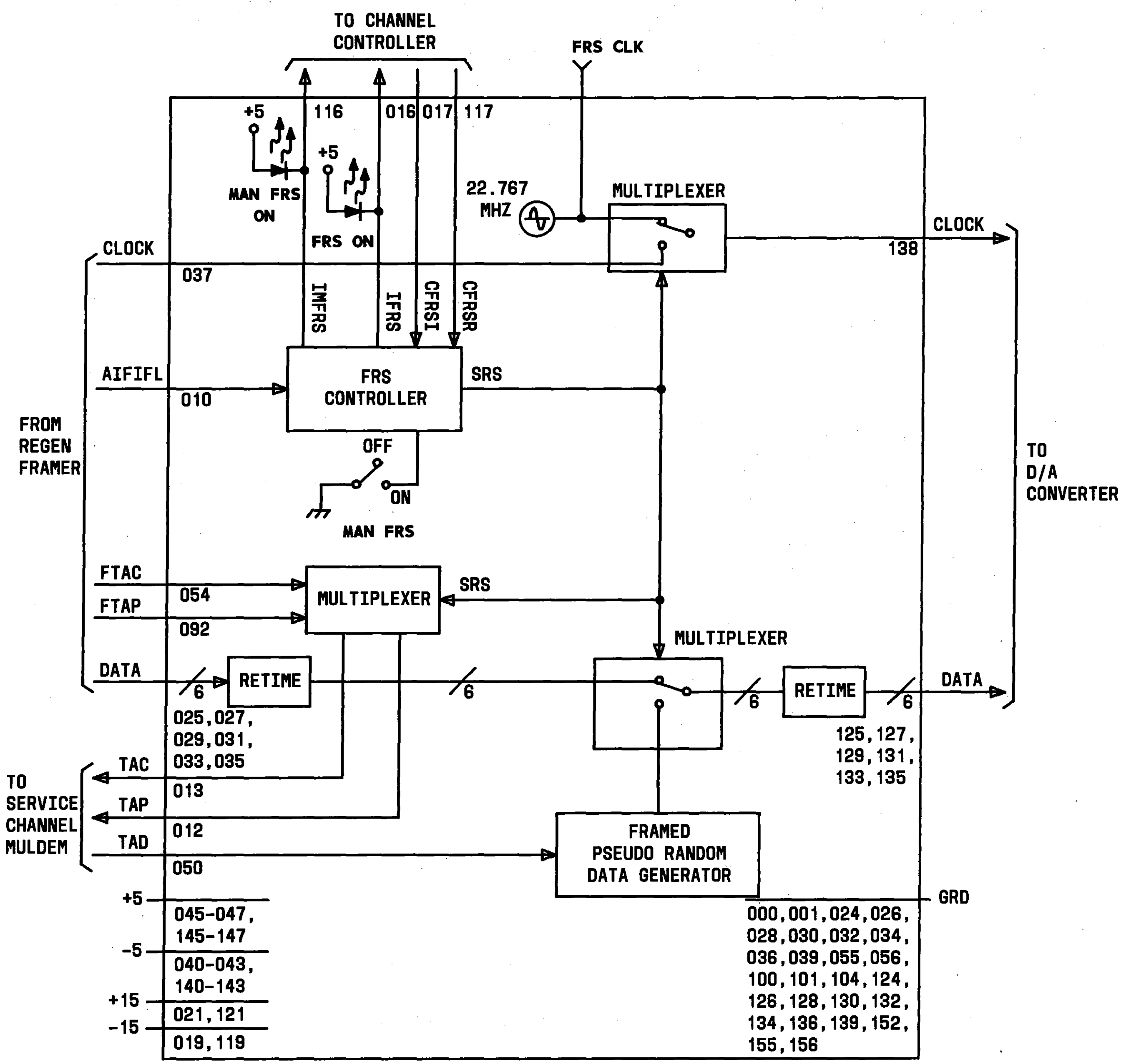



**Fig. 30—AMR17 Frame Resupply**

## AMR20 D/A CONVERTER

The AMR20 D/A CONVR (Fig. 31) converts six input unipolar signals plus a clock into two quadrature 8-level baseband signals (BBI and BBQ). In a regenerator, the input signals are supplied by the Frame Resupply, the Regenerator Framer, or the AMR44 64 QAM Decision units, depending on which is provided. In a terminal, the input signals are supplied by the AMR11 CRC Coder (if provided) or the AMR6 Frame Generator.

The output BBI and BBQ signals are connected to the AMR24 Transmit Filters.

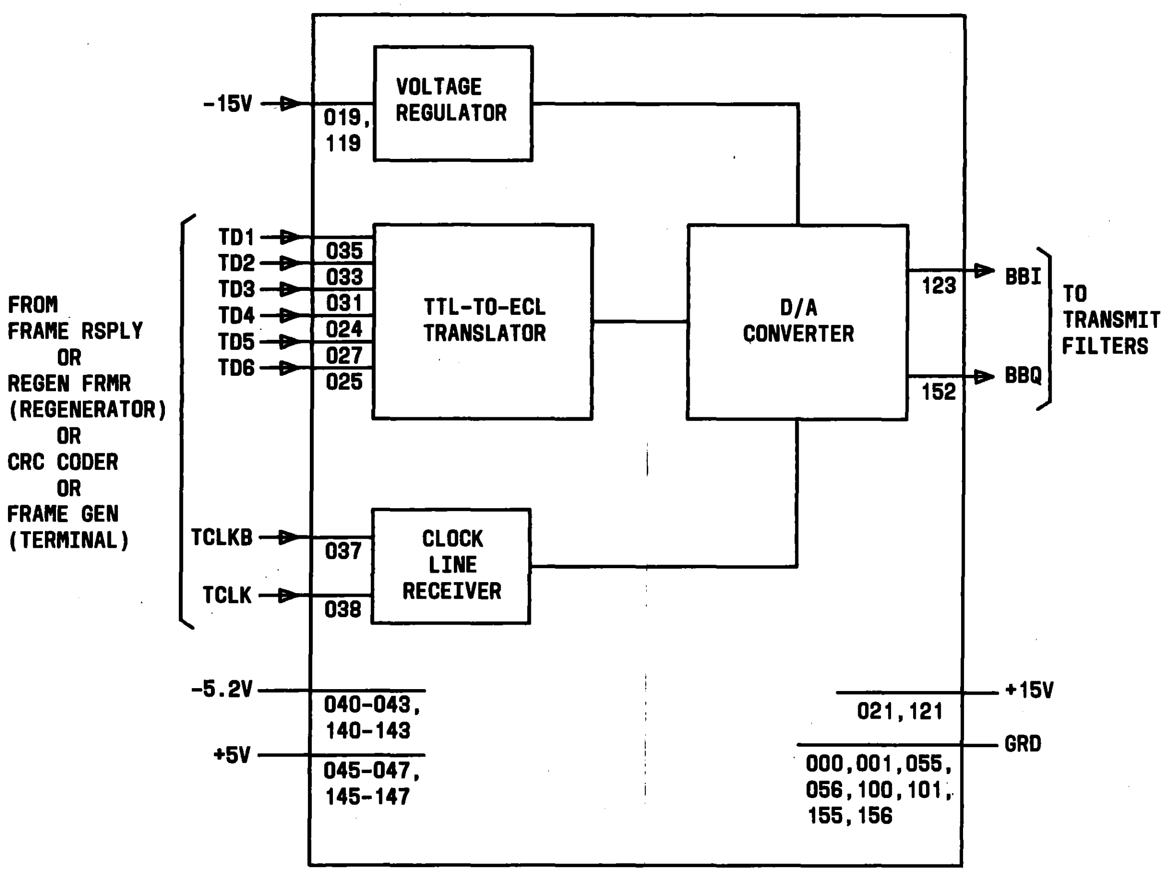



**Fig. 31—AMR20 D/A Converter**

## AMR24 TRANSMIT FILTER

The AMR24 TRMT FLT (Fig. 32) limits the baseband frequency spectrum of the transmitter. It contains two identical low-pass filters, one for each rail of the system. Each filter presents half of the Nyquist shaping required for each rail. The other half is provided by the receive filter in the receive section of the system. Each filter section of the transmit filter circuit pack passes frequencies from dc to 11.3835 MHz and attenuates frequencies from 24 MHz to 100 MHz by more than 45 dB.

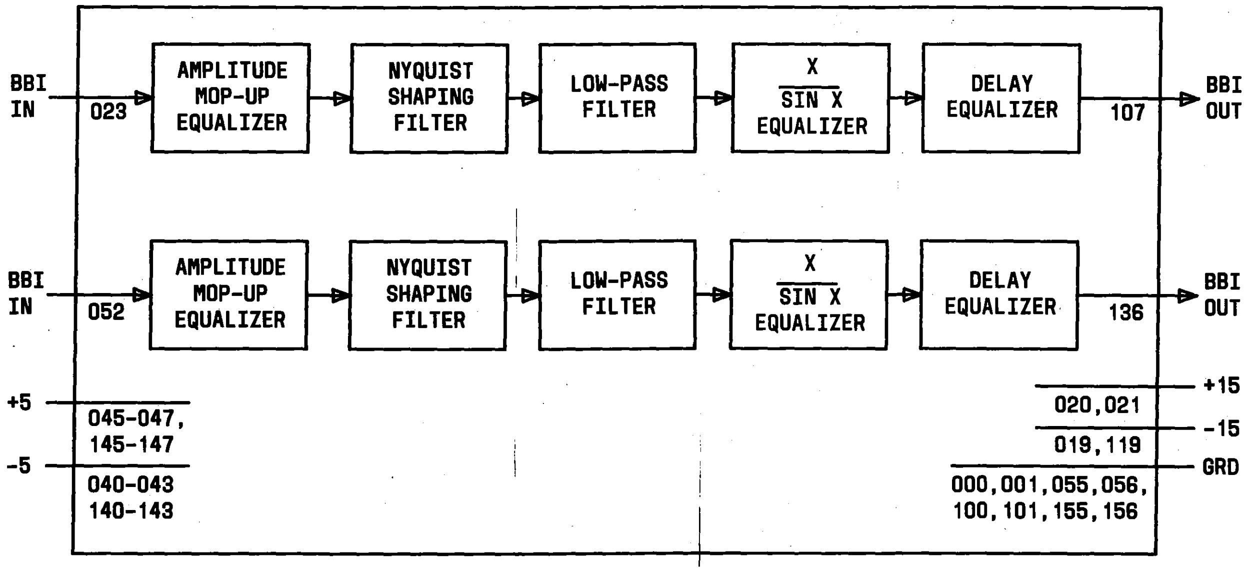



Fig. 32—AMR24 Transmit Filter

## AMR27/28 64 QAM MODULATOR

The AMR27/28 64QAM MOD (Fig. 33) converts the two 8-level analog baseband input signals (I and Q) from the AMR24 Transmit Filter into a single 64-state QAM IF signal at 70 MHz. The baseband amplifiers, A1 and A2, amplify the input I and Q signals and provide buffering and impedance matching between the Nyquist filters (located before the 64-QAM modulator) and the internal mixers. The low-pass filters provide a constant source impedance for the mixers and have a cutoff frequency of 51 MHz. Mixers then up-convert each signal to 70 MHz, each one having four amplitudes with two possible phase states apiece. The two 8-level IF signals are summed in amplifier A3 to form the 64-state QAM IF output signal. This IF signal is further amplified by A4 and then passed through a low-pass filter to the output. If the output power drops below -9 dBm, the OUTPUT LOSS LED lights. The output lead, AIMOL, permits external monitoring of the alarm.

***Note:*** The AMR***27*** is used when the IF cable is less than or equal to 50 ft. long. The AMR***28*** is used when the IF cable is longer than 50 ft.

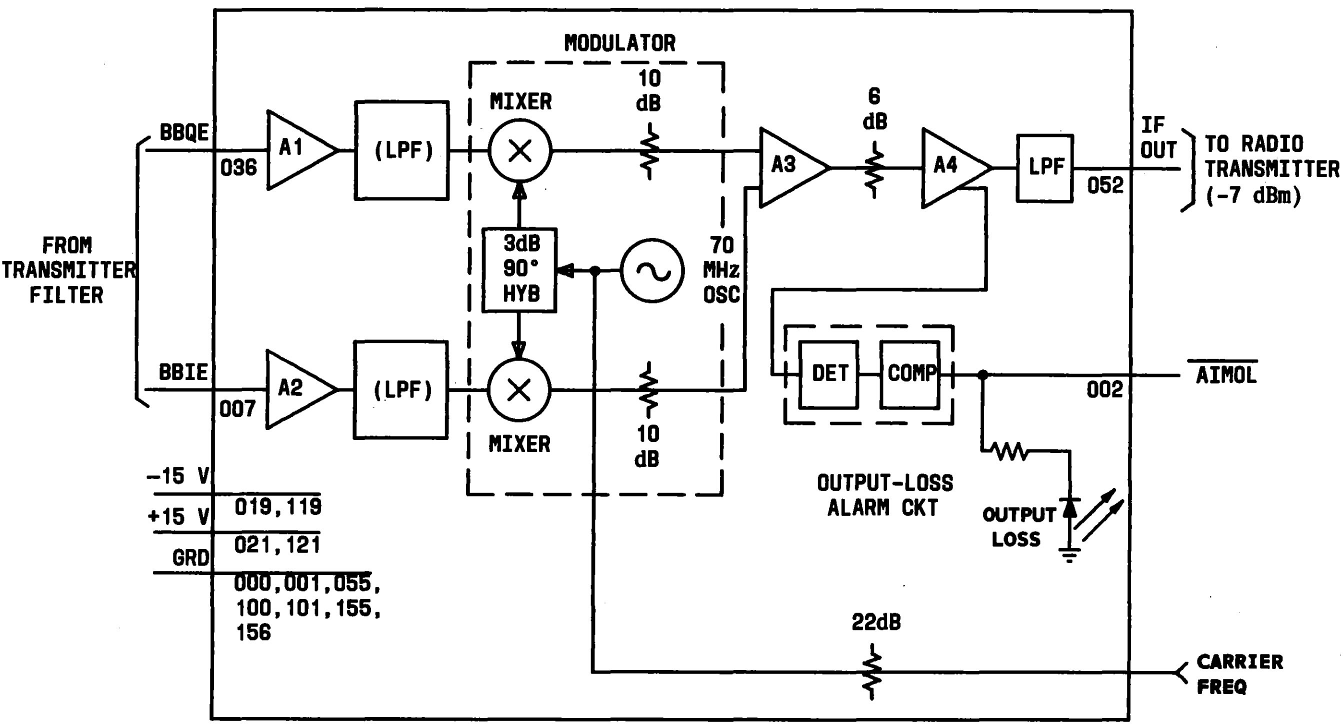



**Fig. 33—AMR27/28 64-QAM Modulator**

## AMR29/30 64-QAM DEMODULATOR

The AMR29/30 64QAM DEMOD (Fig. 34) converts the received 64-QAM double-sideband, suppressed carrier IF signal into two 8-level baseband signals at a data rate of approximately 135 Mb/s with a baud rate of approximately 22.7 Mb/s. The AMR29/30 also recovers the transmitted carrier for use in synchronously demodulating the IF signal.

***Note:*** The AMR***30*** is used when the IF cable is less than or equal to 50 ft. The AMR***29*** is used when the IF cable is longer than 50 ft.

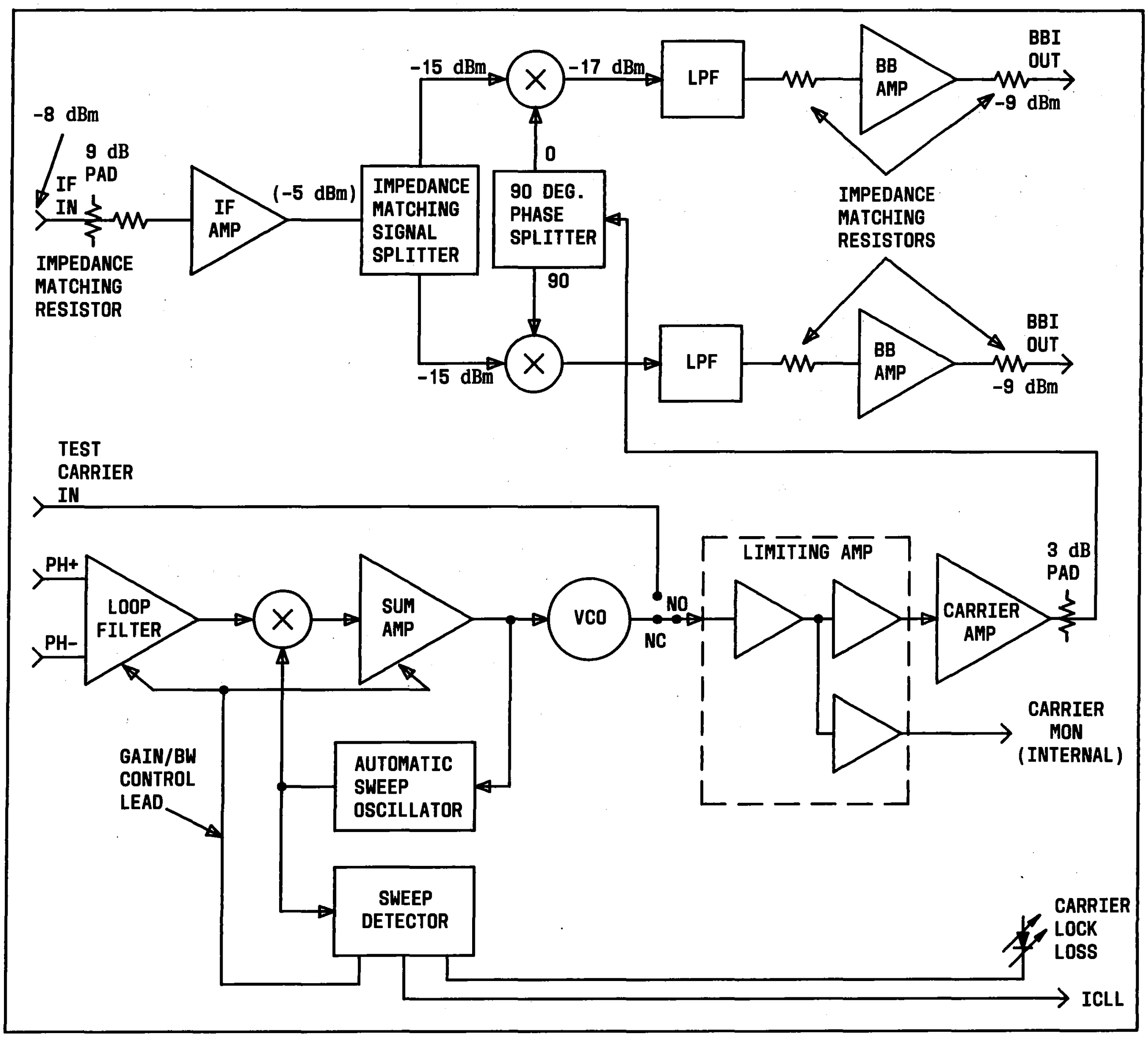



**Fig. 34—AMR29/30 64QAM Demodulator**

## AMR32 TRANSVERSAL FILTER

The AMR32 (Fig. 35) reduces the intersymbol interference caused by the imperfect Nyquist channel. Both in-rail and cross-rail distortions are removed through the use of seven synchronous complex-valued taps. The variable tap weight amplifiers are driven by the AMR34B Correlator to output the appropriate delayed or advanced signal. This signal is summed with the main signal to cancel the cross-rail coupling and intersymbol interference.

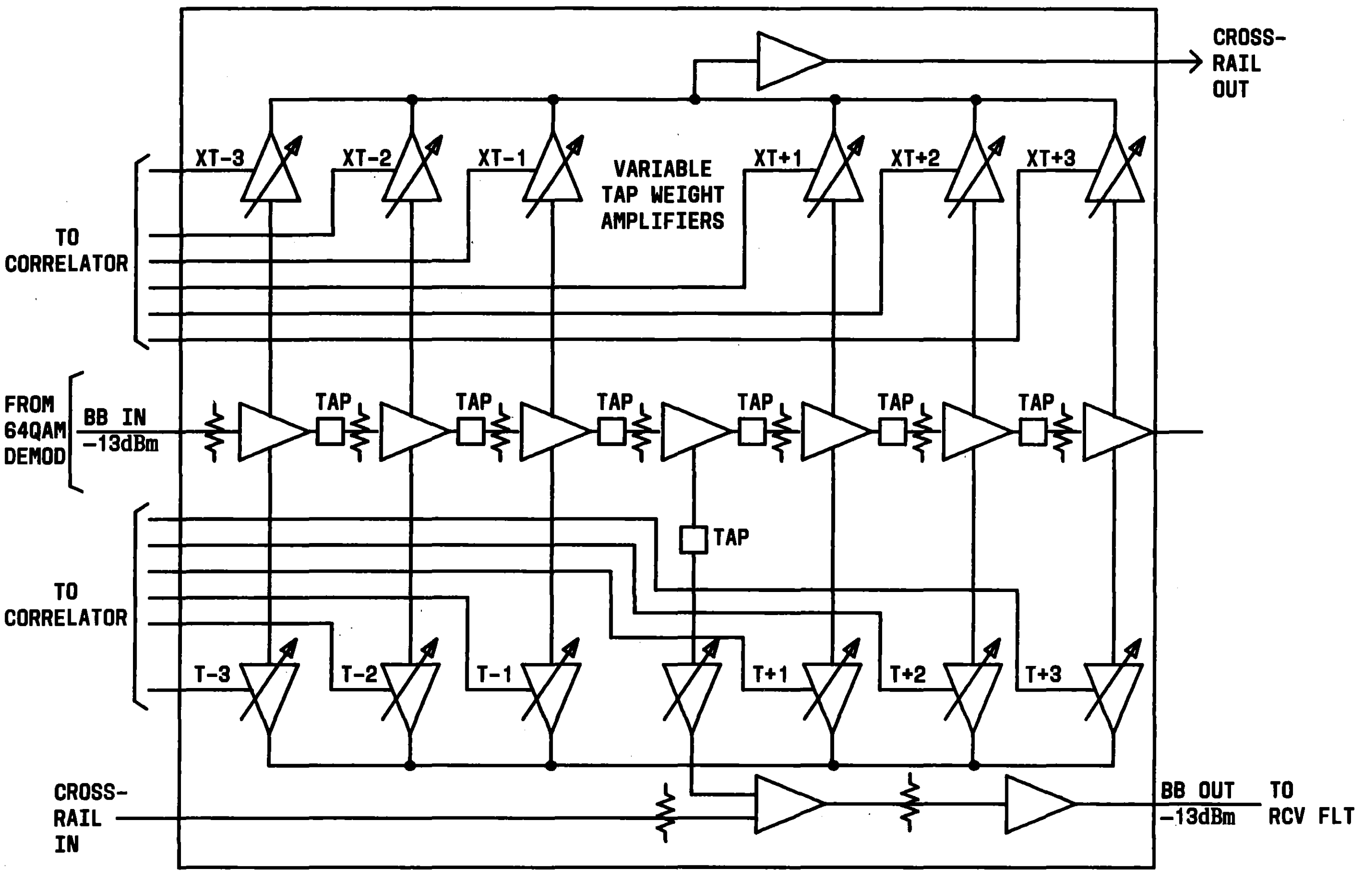



**Fig. 35—AMR32 Transversal Filter**

# AMR34B CORRELATOR

## FUNCTIONAL DESCRIPTION

The basic function of the correlator (Fig. 36) is to provide the control signals required to operate the transversal equalizers. The unit also contains the phase detector circuitry required for carrier recovery.

A baseband adaptive transversal equalizer which provides equalization for transmission impairments caused by multipath fading is implemented using the correlator and two transversal filter units. Equalization is provided using tapped delay lines which equalize the distorted waveform in the time domain. The correlator automatically adjusts the two tapped delay line units (transversal filters), one for each rail, by monitoring the intersymbol interference of each baseband signal.

## BLOCK DIAGRAM DESCRIPTION

The correlator receives the clock and the data signals from the I and Q decision units and correlates the data for various combinations of symbol periods. Then, it averages the results to derive the control signals. The averaging is accomplished with balanced integrators to produce control voltages that control the gain of the tap weight amplifiers on the transversal filter units. Low-pass filters are provided for the +5 and -5.2 dc voltages supplied to the unit.

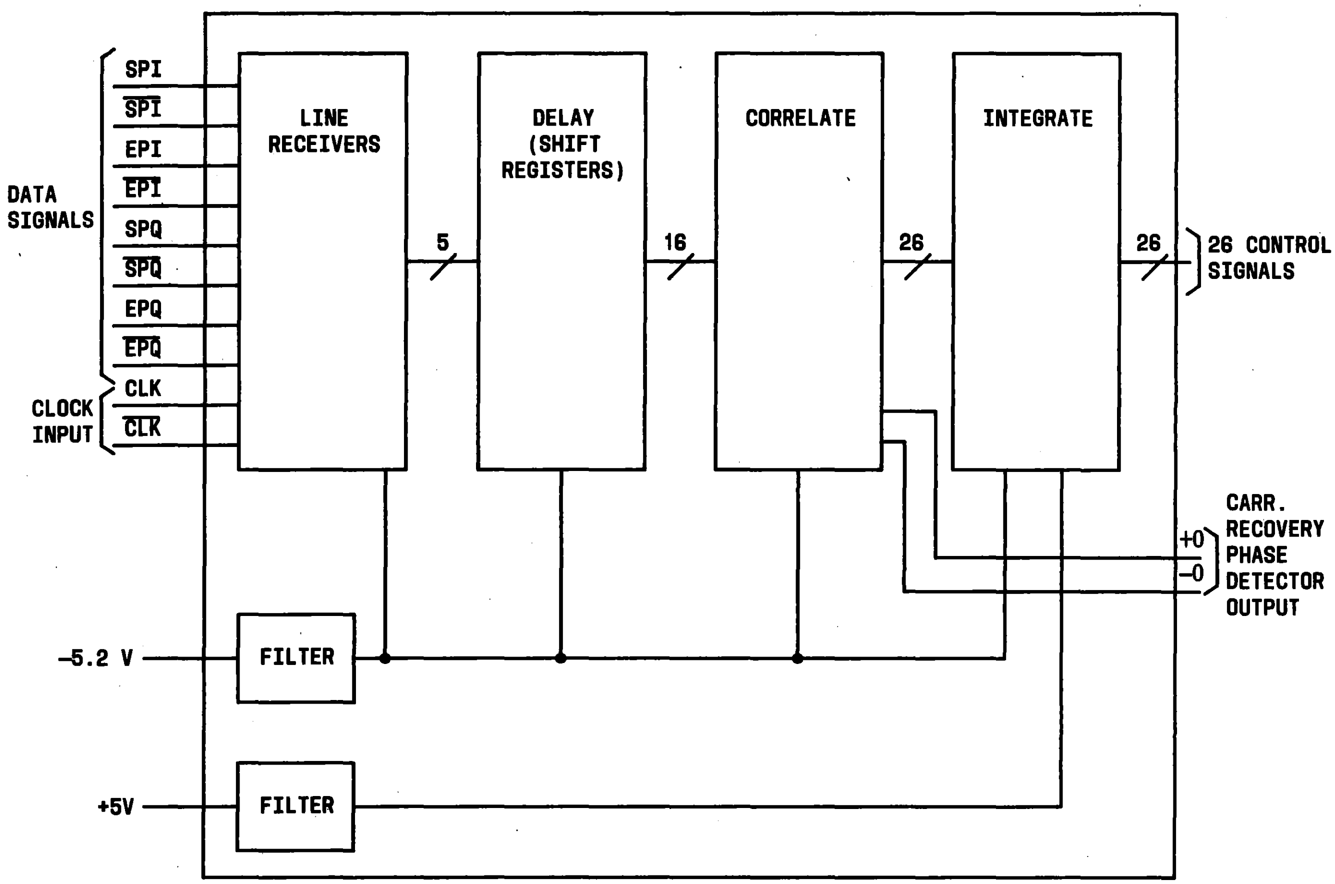



**Fig. 36—AMR34B Correlator**

## AMR38 RECEIVE FILTER

The AMR38 RCV FLT (Fig. 37) limits the baseband frequency spectrum of the receiver. It contains two identical low-pass filters, one for each rail of the system. Each filter provides one-half of the Nyquist shaping required for each rail. The other half of the Nyquist shaping is provided by the transmit filter in the transmit section of the system. Each filter of the receive filter circuit pack passes frequencies from dc to 11.3835 MHz and attenuates frequencies from 24 to 100 MHz by more than 45 dB.

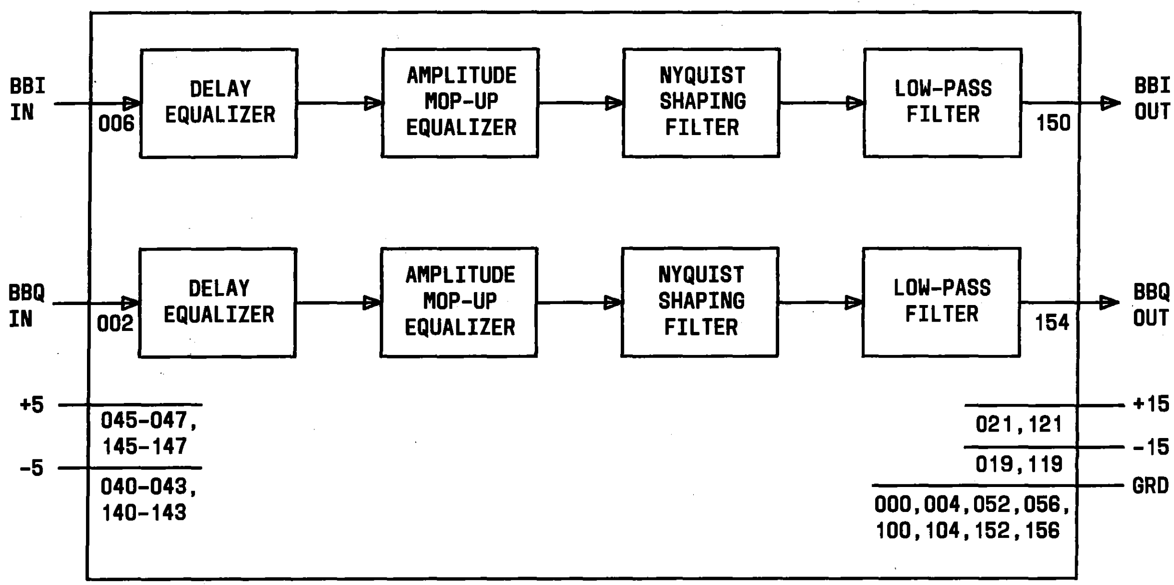



**Fig. 37—AMR38 Receive Filter**

## AMR44 64QAM DECISION

The AMR44 (Fig. 38) regenerates the original three data signals with the use of a 6-bit A/D (analog-to-digital) converter and passes them on to either the regenerator framer or the terminal framer.

Secondary functions necessary for proper A/D conversion are clock recovery, to sample the signal at the proper time, and threshold circuits, to establish the proper references. Clock recovery is accomplished through the use of a phase-lock loop. This circuit derives a clock of the proper frequency and phase, and maintains the sample time at the center of the received eye. The threshold circuits also use a decision directed algorithm to derive the top, center, and bottom references that are necessary to perform the A/D process.

The data signals and clock are output to the correlator for carrier recovery phase detection and transversal equalizer. Samples of the input baseband signal (EYE), recovered clock (CLOCK), and pseudoerrors (PSEUDO ERRORS) are available at jacks on the unit faceplate.

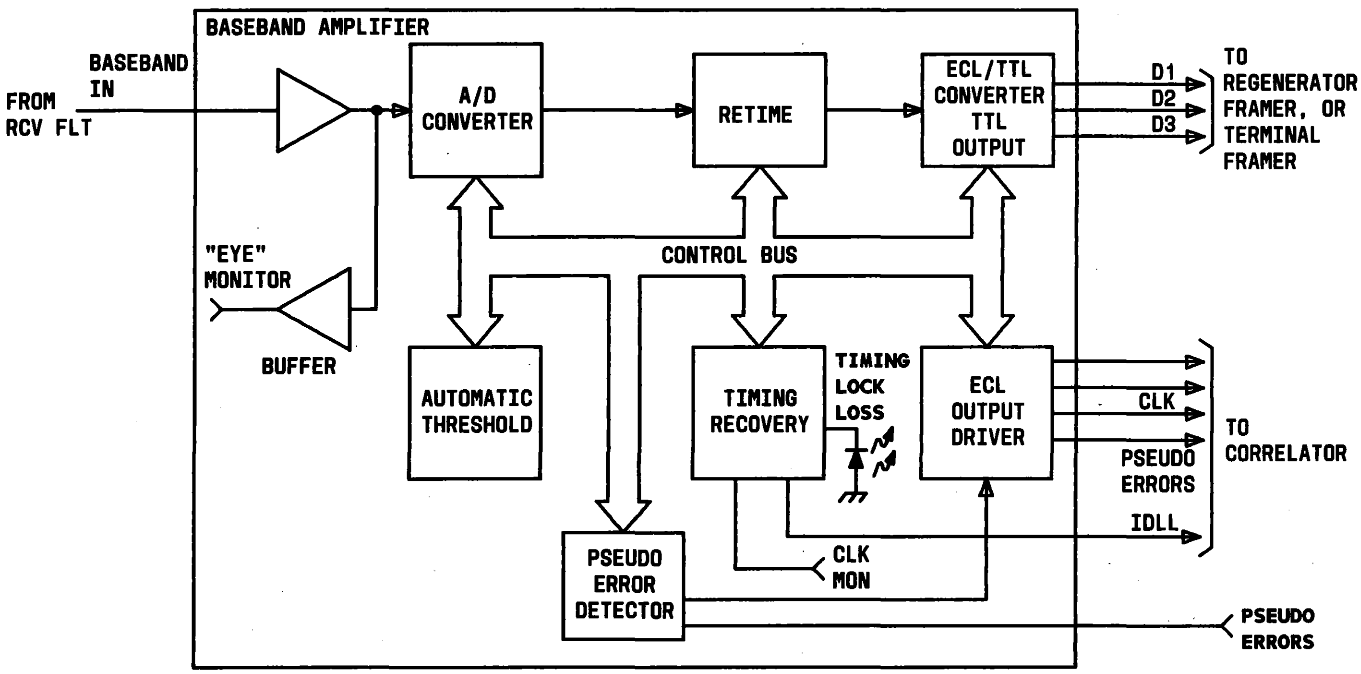



Fig. 38—AMR44 64-QAM Decision

## AMR47 TRANSVERSAL EQUALIZER PATCH

The AMR47 TE PATCH (Fig. 39) is used when the AMR32 Transversal Filter is not equipped. The AMR47 allows the BBI and Q outputs of the AMR29/30 64-QAM Demodulator to be passed on to the AMR38 Receive Filter.

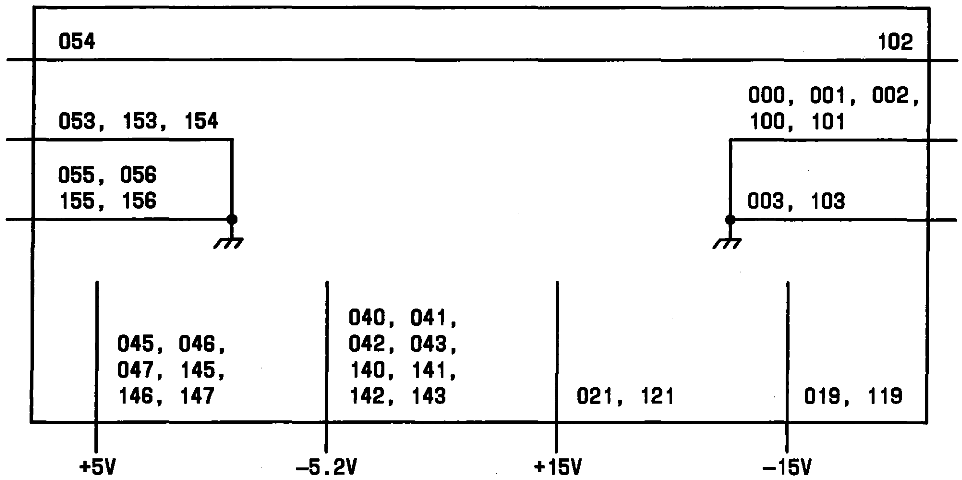



**Fig. 39—AMR47 Transversal Equalizer Patch**

## AMR50 ERROR CORRECTION REENCODER

The AMR50 EC RECDR (Fig. 40) is the first of three boards (AMR50, 51, 52) comprising the error correction decoder in the terminal bay. The AMR50 performs the following functions:

- Rotate and Gray decode the received data rails
- Calculate check bits for the received information symbols
- Compare the recalculated to the received check bits
- Output syndrome bits which indicate when the check bits do not agree.

The syndrome bits allow the other error correction decoder units to locate and correct errors.

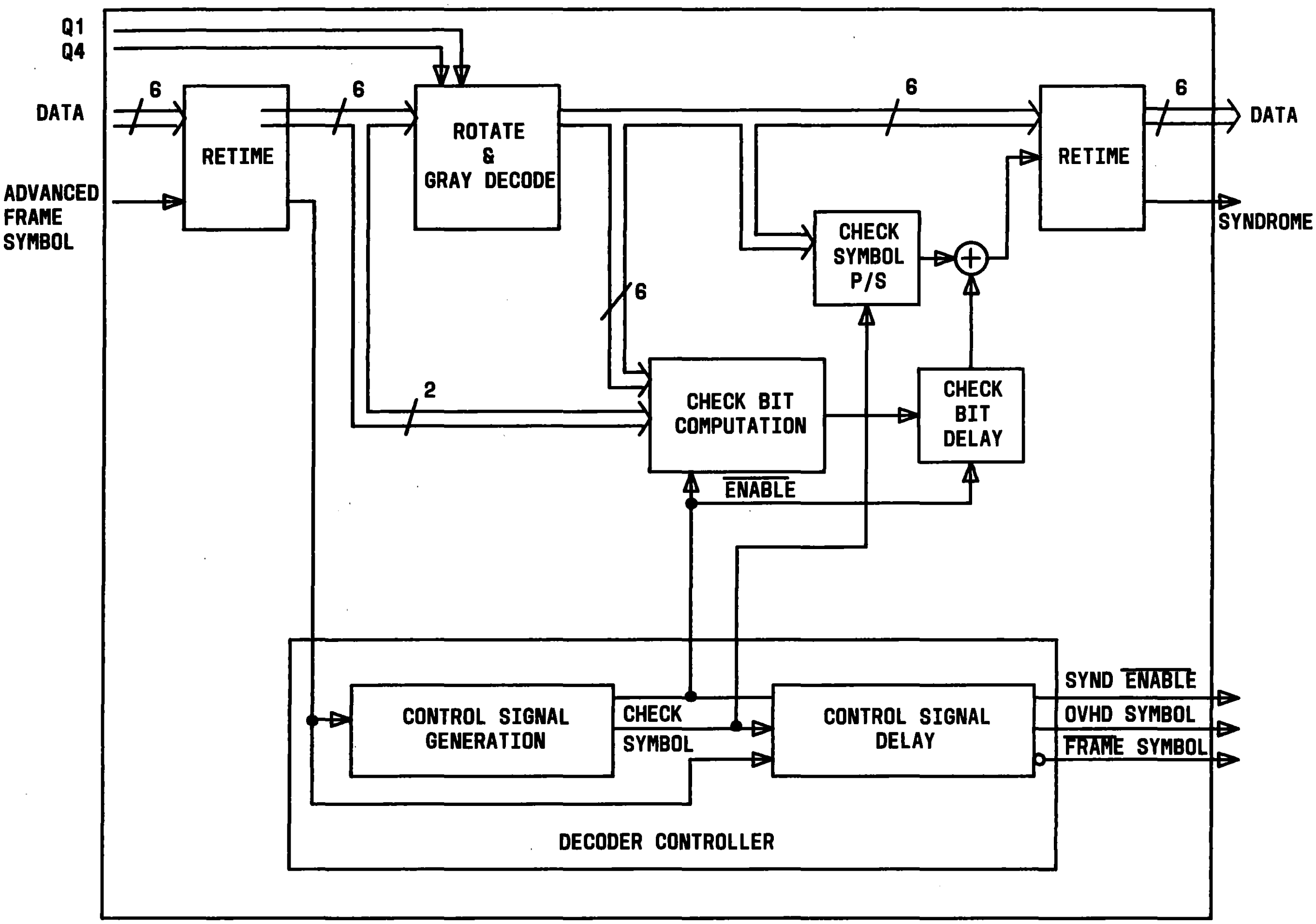



Fig. 40—AMR50 Error Correction Reencoder

## AMR51 ERROR LOCATER

The AMR51 ERROR LOCTR (Fig. 41) is the second of three units (AMR50, 51, 52) comprising the error correction decoder in the terminal bay. The AMR51 determines, from the syndrome bits generated by the error correction reencoder (AMR50), which information and check bits were received in error. A check bit and correct information signal are sent to the error corrector (AMR52) to indicate if a check bit or information symbol is to be corrected.

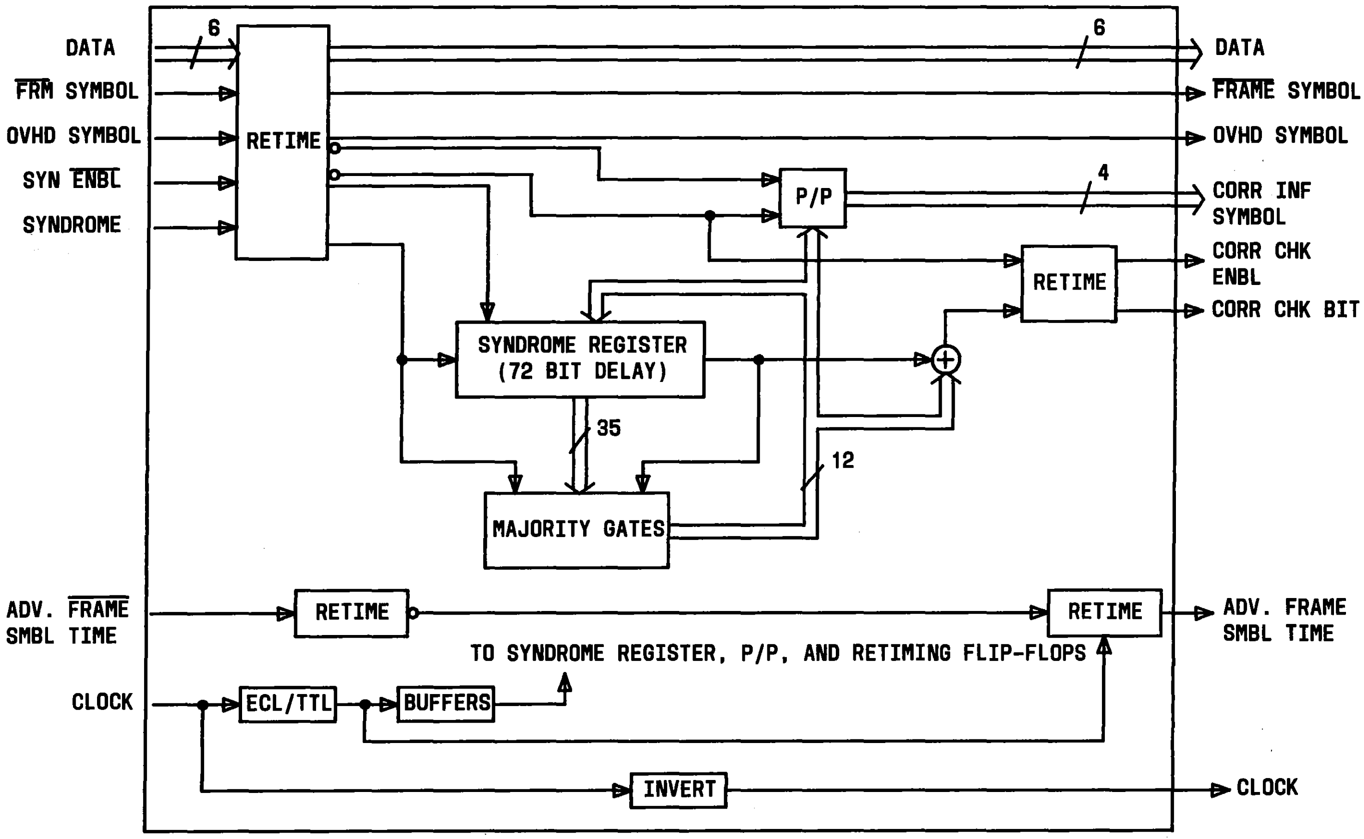



Fig. 41—AMR51 Error Locater

## AMR52 ERROR CORRECTER

The AMR52 ERROR CORR (Fig. 42) is the last of three units (AMR50, 51, 52) comprising the error correction decoder in the terminal bay. Error correction is performed by delaying the data rails and inserting the corrected information or check symbols as instructed by the error locater unit (AMR51).

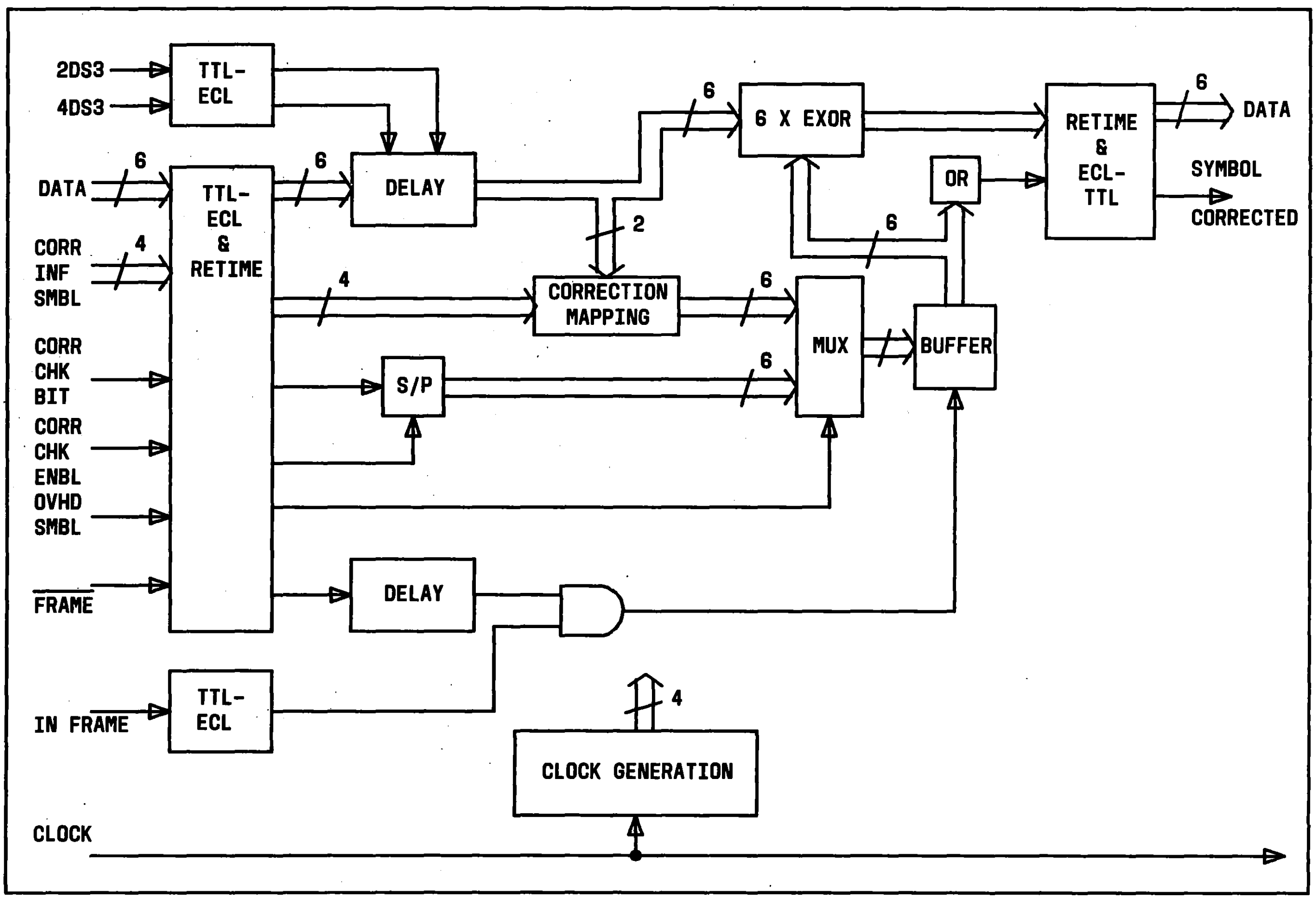



Fig. 42—AMR52 Error Corrector

## AMR60 TERMINAL FRAMER

The AMR60 TERM FRMR (Fig. 43) has four functions:

- Finds the frame pattern to synchronize itself and the rest of the DPU with the received data
- Determines the quadrant rotation due to carrier phase ambiguity
- Monitors the error rate using the CRC bits and the error correction indication
- Extracts the service channel data and sends this data, a clock, and a page signal to the service channel muldem board (ANB1).

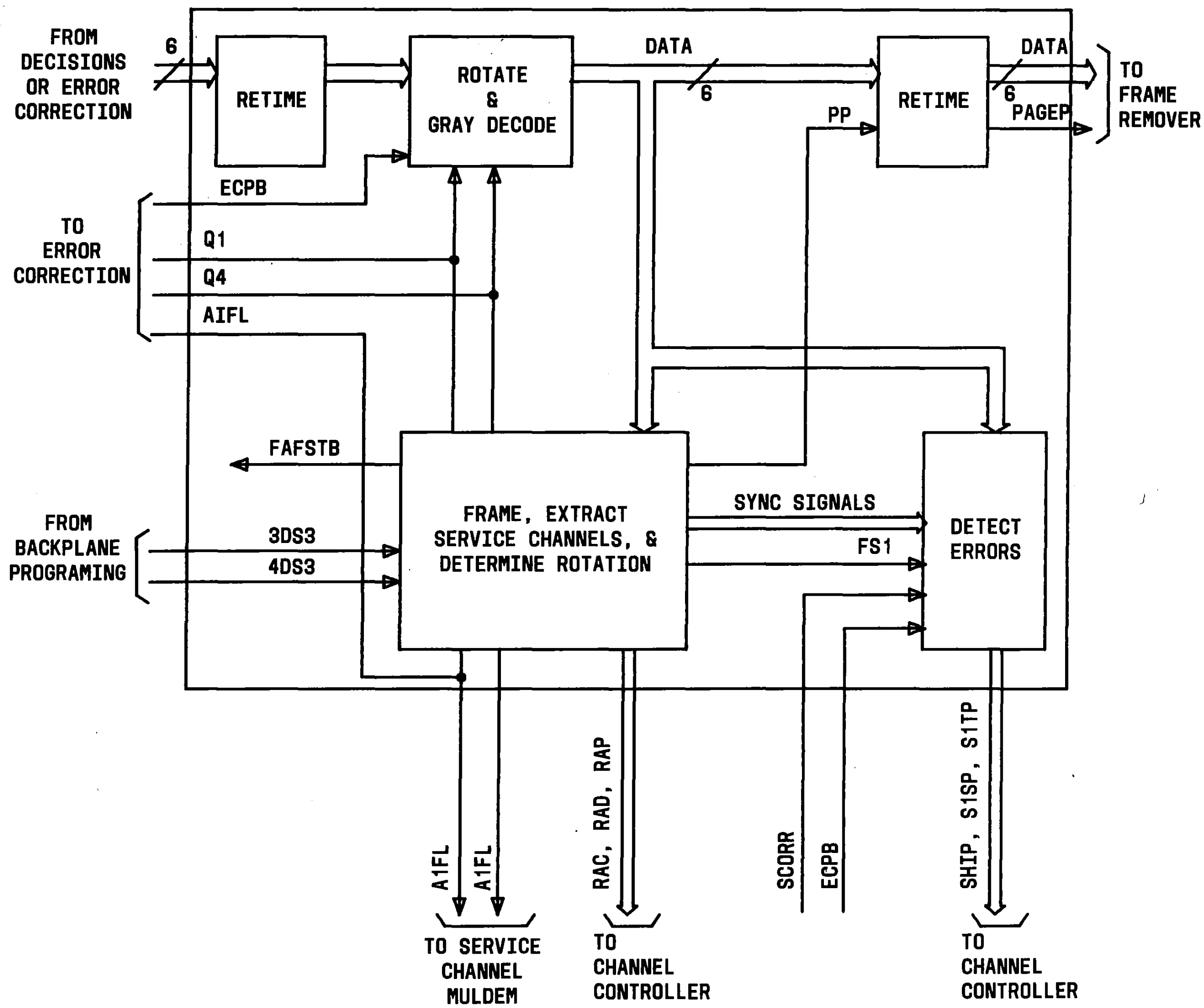



**Fig. 43—AMR60 Terminal Framer**

## AMR69 REGENERATOR FRAMER

The AMR69 REGEN FRMR (Fig. 44) is an optional circuit pack that receives clock and data from the decision circuit packs. The regenerator framer performs two functions:

- Monitors the transmitted data
- Provides service channel access.

The regenerator framer monitors the transmitted data for the frame pattern and compares the received CRC bits with CRC bits computed internally. If a valid frame pattern cannot be found, the AIFIFL lead goes low to signal the frame resupply and the channel controller that the received data is worthless. When framing is accomplished, the regenerator framer provides the channel controller with error indications from the CRC comparison.

The regenerator framer works with the service channel muldem to provide service channel access at a regenerator. Received service channel data, clock, and page signals (RAD, RAC, and RAP) are sent to the service channel muldem. After the service channel data is extracted from the data stream, it may be replaced by the transmit service channel data (TAD). Six control leads from the service channel muldem determine if the data is to be passed through or substituted on the six service channels. If substituted, the data will be internally generated pseudo data that maintains frame format. The transmit service channel data is synchronized with the regenerator framer by transmit clock and page symbols (FTAC and FTAP).

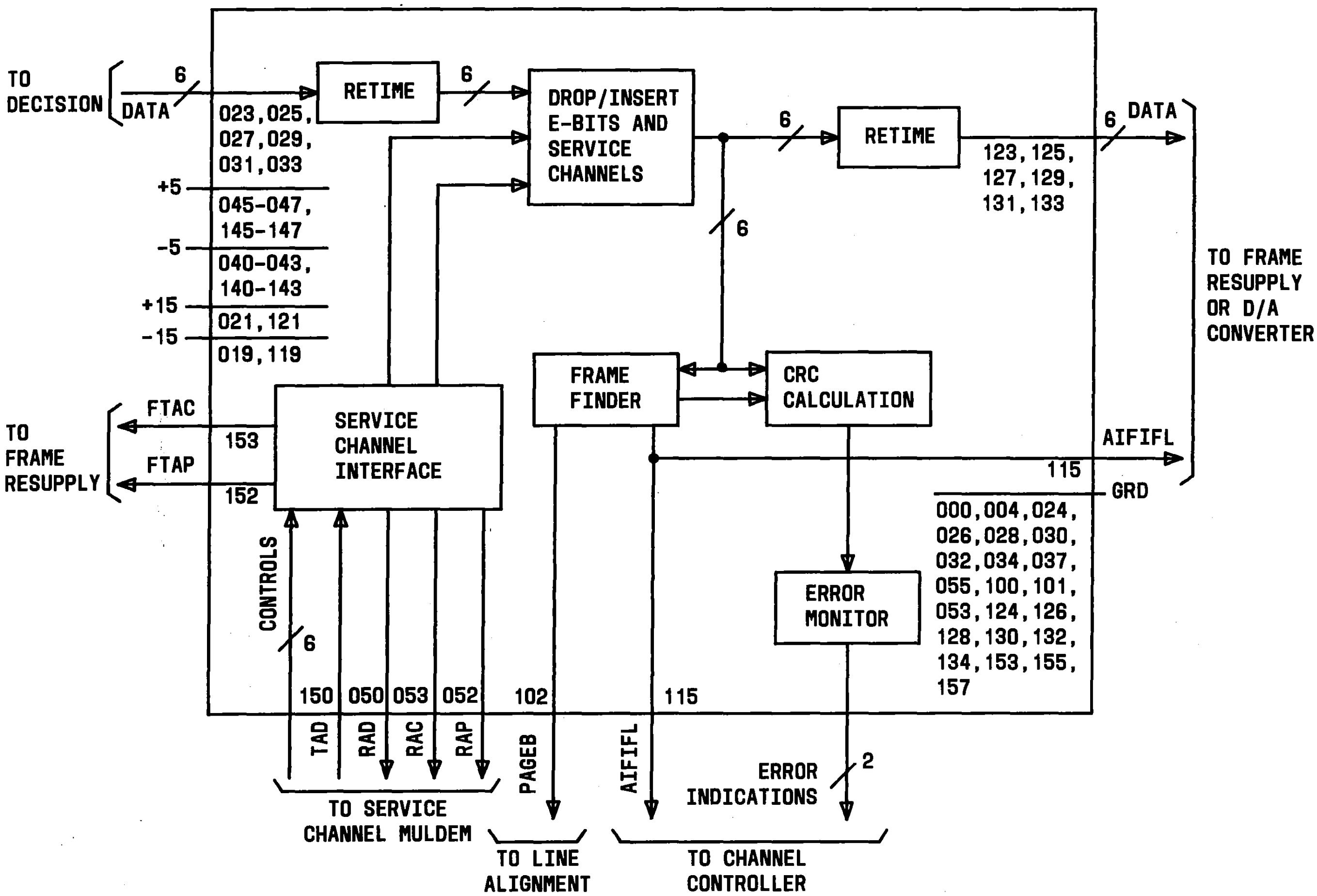



**Fig. 44—AMR69 Regenerator Framer**

## AMR72/72B VMR AND CODER

The AMR72 VMR & CODER (Fig. 45) receives data, clock, and enable signals from the frame remover. The elastic store portion of the AMR72 then removes the 64-QAM radio frame overhead bits, performs a parallel-to-serial conversion, and recovers the DS3 clock from the input high-speed clock. This clock and serial data are then sent to the violation monitor portion of the AMR72. This section of the AMR72 examines the data and clock for frame, parity, or logic errors. The outputs of the violation monitor go to the coder section of the AMR72 and to the AMR72 control logic. If a good signal is detected, the coder portion of the circuit outputs the appropriate signals to the DS3 output circuit, which takes the pulses and forms the DS3 signals. When the violation monitor detects errors in the clock data signals, the control logic determines the type of errors and sends the appropriate response to the violation monitor and coder portions of the AMR72. The control section also has the capability to be controlled by the system firmware, which, in turn, allows the AMR72 to be monitored and updated as necessary.

The AMR72***B*** VMR & CODER provides the same functions as the AMR72 plus the capability to allow external monitoring of DS3 signals.

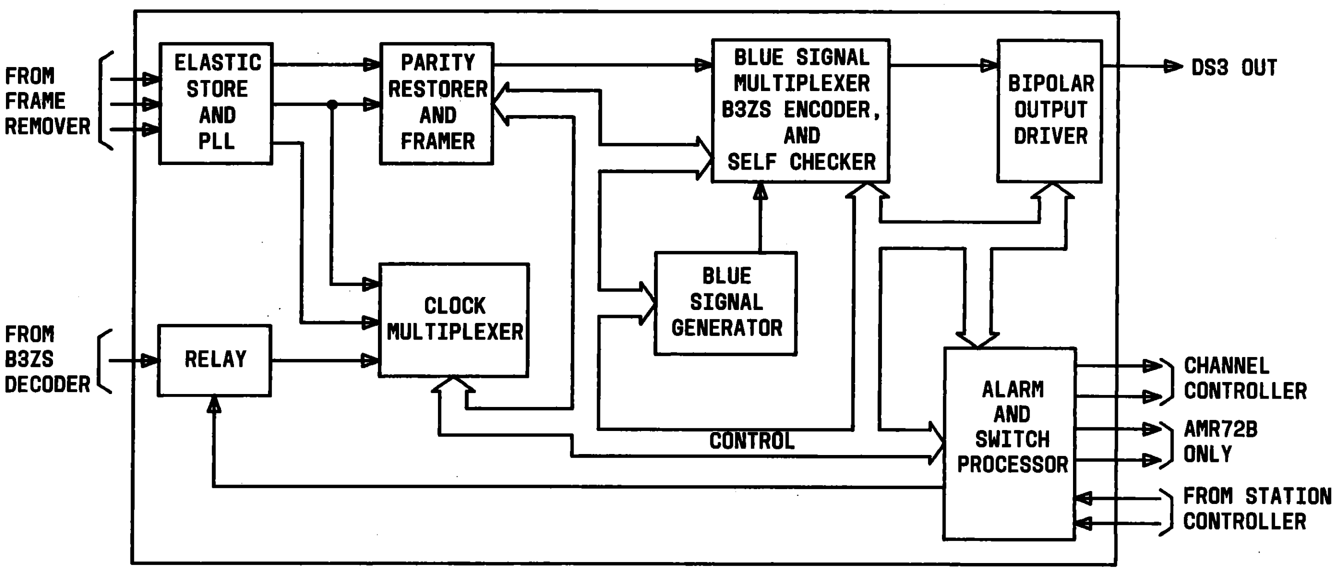



**Fig. 45—AMR72/72B VMR and Coder**

## AMR74 FRAME REMOVER

The AMR74 FRAME RMVR (Fig. 46) has two main functions: descrambles incoming data and converts the six incoming data rails to two or three rails, depending on whether the system is 2-DS3 or 3-DS3. Each data bit sent to a receive elastic store is accompanied by an indication of whether it is a customer information bit or an inserted framing or error-correction bit. The elastic store uses this indication to decide which bits, frame symbols, check symbols, and stuff bits, must be removed from the data stream.

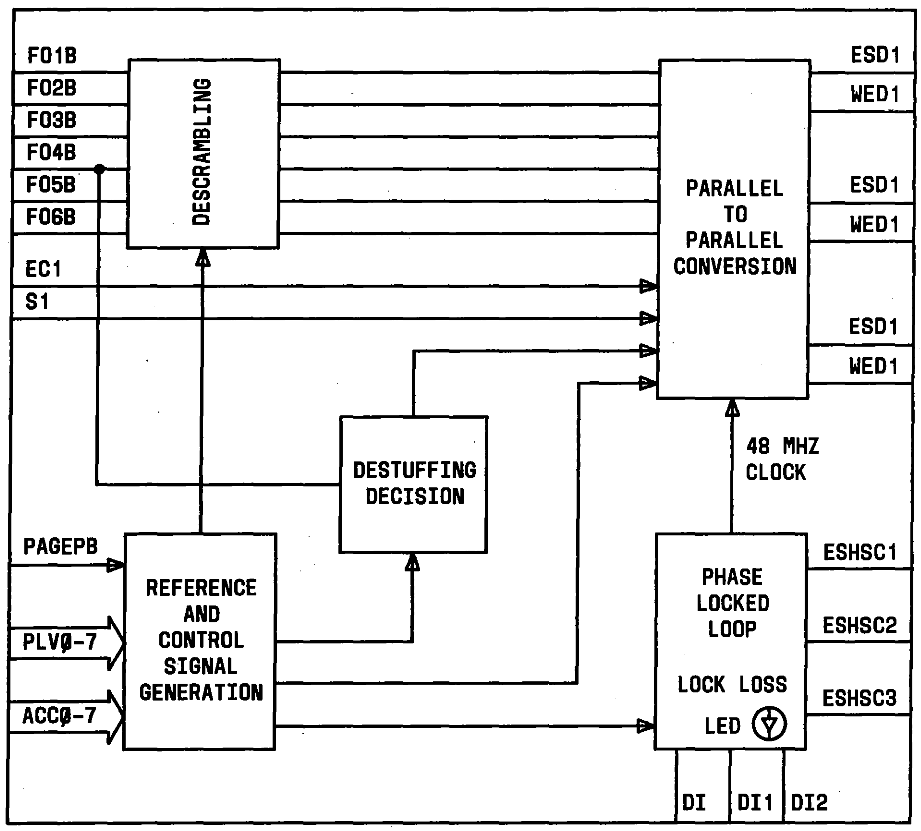



**Fig. 46—AMR74 Frame Remover**

## AMR85 RECEIVE SWITCH

The AMR85 RCV SW (Fig. 47), located on the regular channel shelf, detects alignment between the regular and protection channels and switches without error between them.

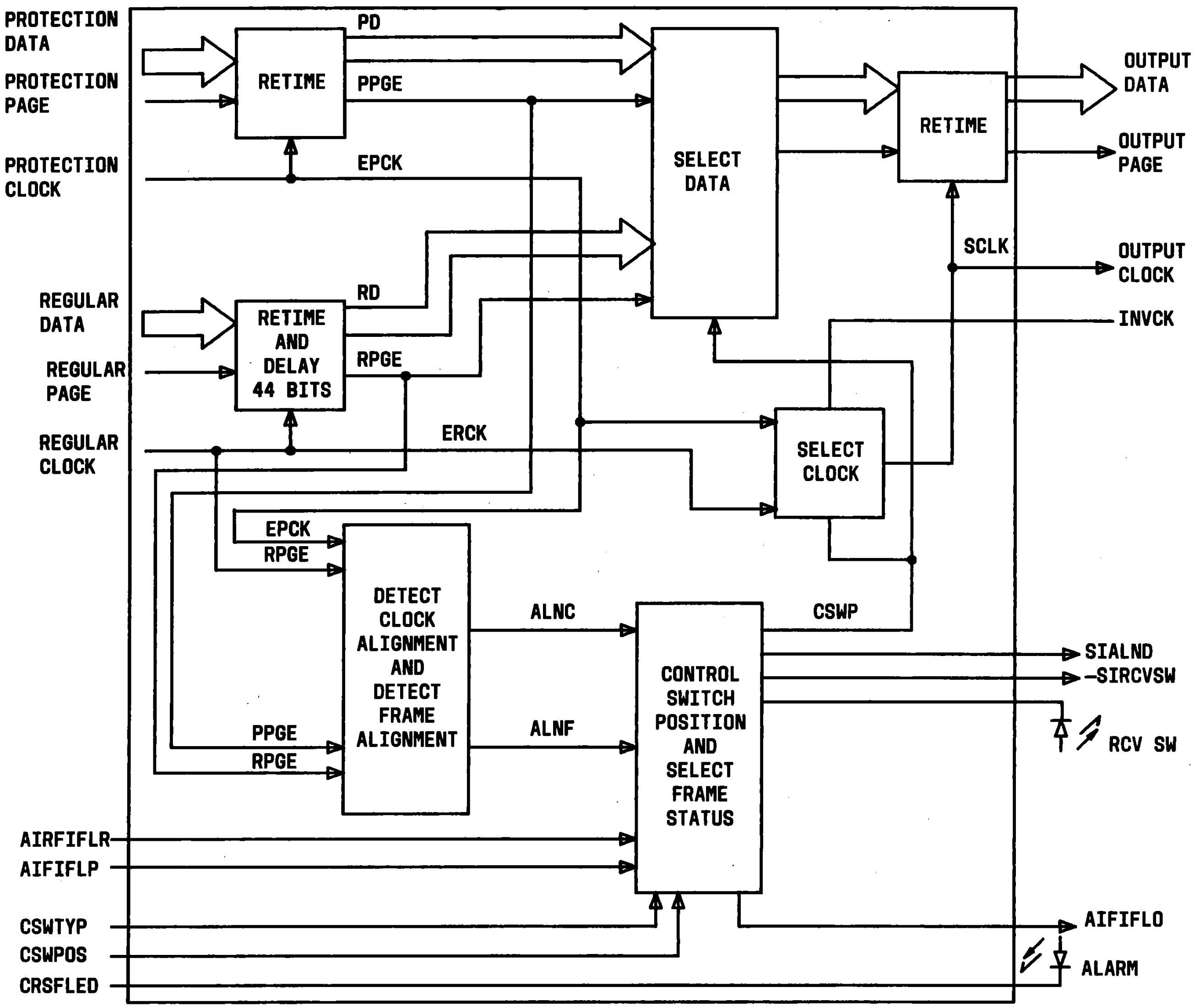



**Fig. 47—AMR85 Receive Switch**

## AMR91 TERMINAL ORDER WIRE

The AMR91 TERM OW (Fig. 48) contains all of the voice frequency communications and signaling for the order-wire system. It consists of two major circuits:

- Voice frequency transmission
- Controlling logic.

The voice frequency section is further divided into two functions:

- Detects touch-tone signaling for the order-wire system to alert personnel with an audible device
- Provides, on an optional basis, a DDD (direct distance dialing) interface.

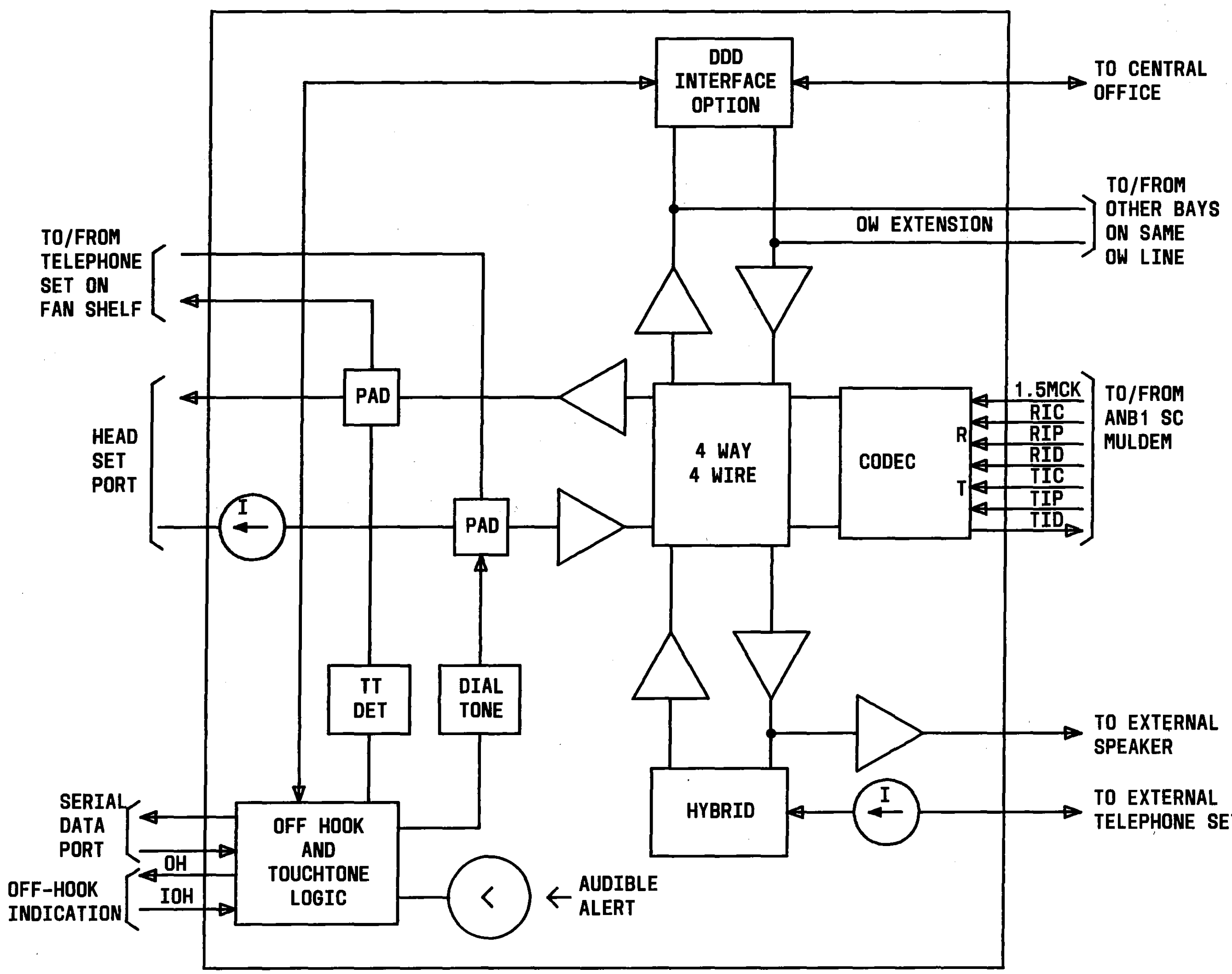



Fig. 48—AMR91 Terminal Order Wire

## AMR94 SERVICE CHANNEL EXPANSION

The AMR94 SC EXPN (Fig. 49) supplies power and a physical interface for the 210-type modules that provide channels X, Y, and Z.

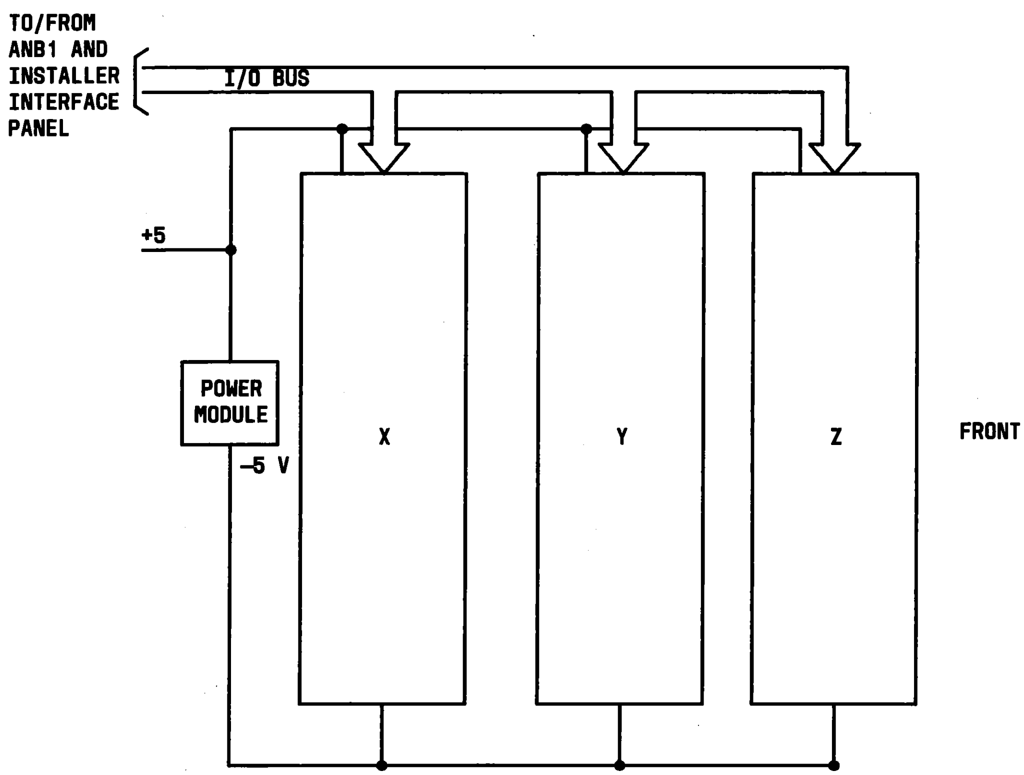



Fig. 49—AMR94 Service Channel Expansion

## AMR95 REGENERATOR ORDER WIRE

The AMR95 REGEN OW (Fig. 50) contains all of the voice frequency communications and signaling for the order-wire system. It consists of two major circuits:

- Voice frequency transmission (detects touch-tone signaling for the order-wire system and alerts personnel with an audible device)
- Controlling logic.

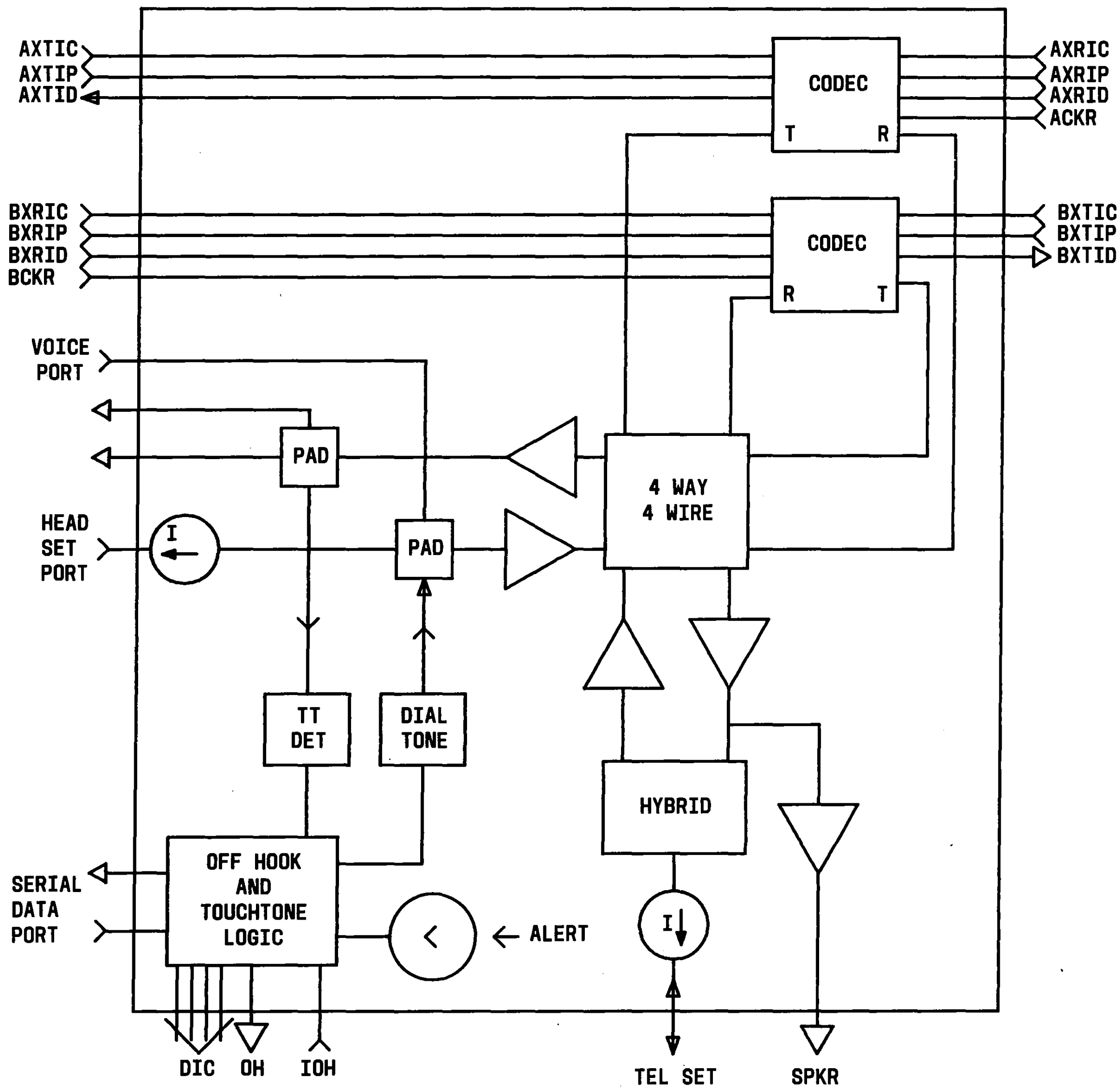



**Fig. 50—AMR95 Regenerator Order Wire**

## AMR102 MASTER ALARM

The AMR102 MSTR ALARM (Fig. 51) interfaces the station controller (terminal or regenerator) to the office alarm system. The unit also provides a technician interface to the manual controls. When one of the master control pushbuttons is operated with the associated OPR key of a status unit, the switch system features are initiated. Additional features include order-wire off-hook control interfacing, power and fan-fail alarming, up to 16 user remote scan points, and up to 13 user remote controls.

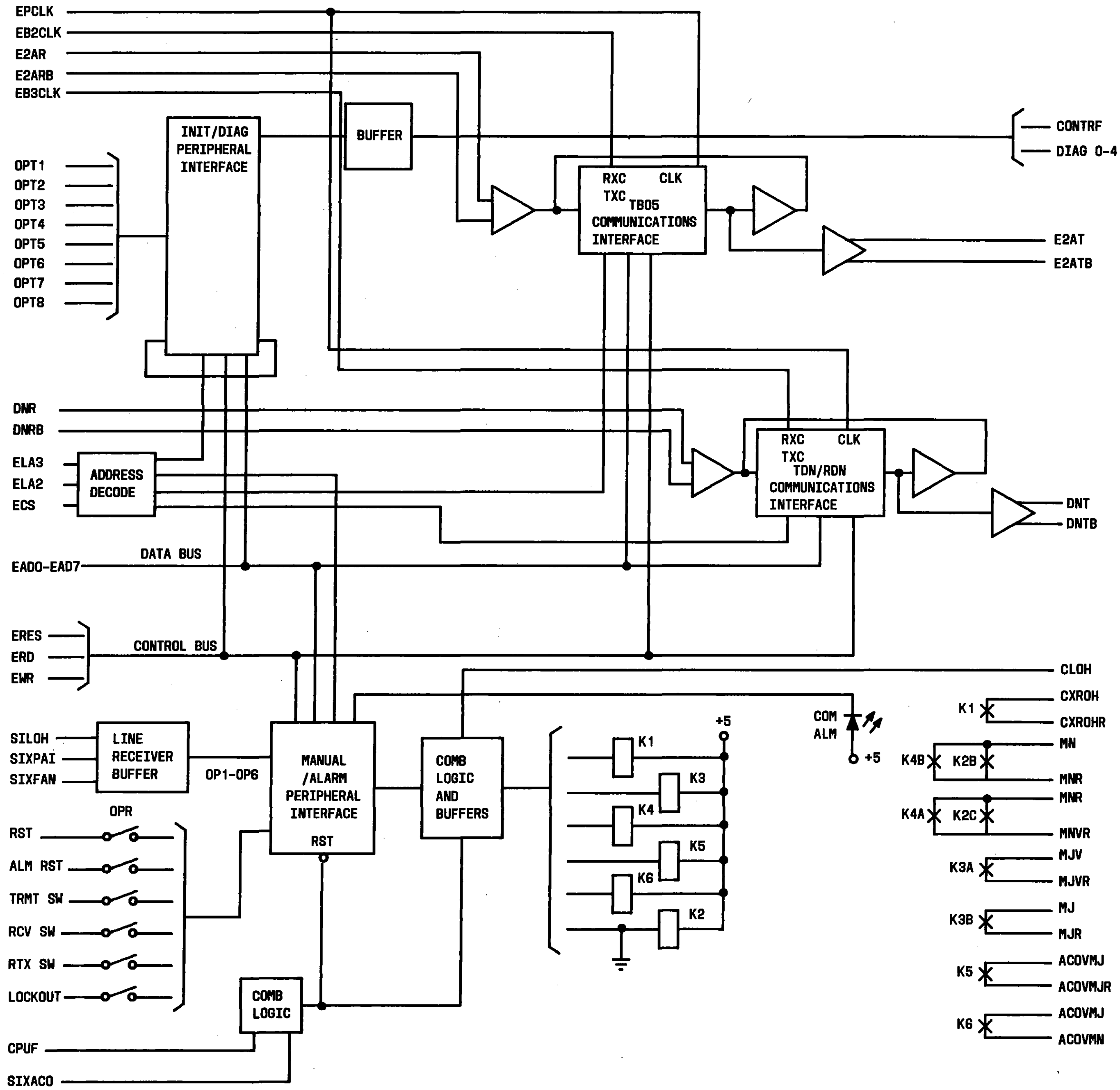



**Fig. 51—AMR102 Master Alarm**

## AMR103 TERMINAL STATUS

The AMR103 TERM STAT (Fig. 52) provides transmitting and receiving status indicators. It has two RS422 standard service links S1 (end- to-end signaling) and S2 (hop-to-hop signaling).

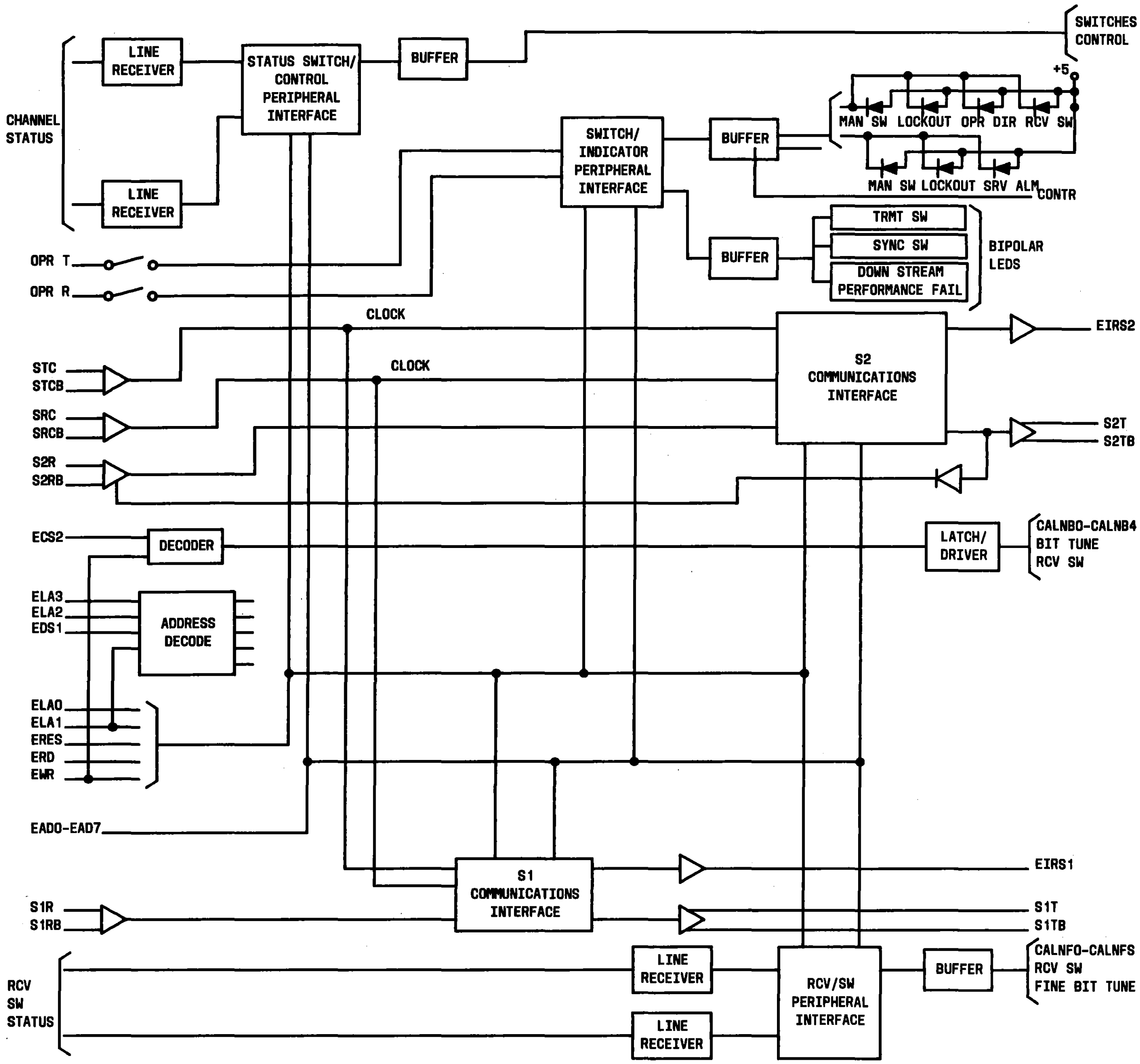



Fig. 52—AMR103 Terminal Status

## AMR104 REGENERATOR STATUS

The AMR104 REGEN STATUS (Fig. 53) provides transmitting and receiving status indicators. It has two RS422 standard serial links S2 for hop-to-hop signaling, one for each direction of transmission.

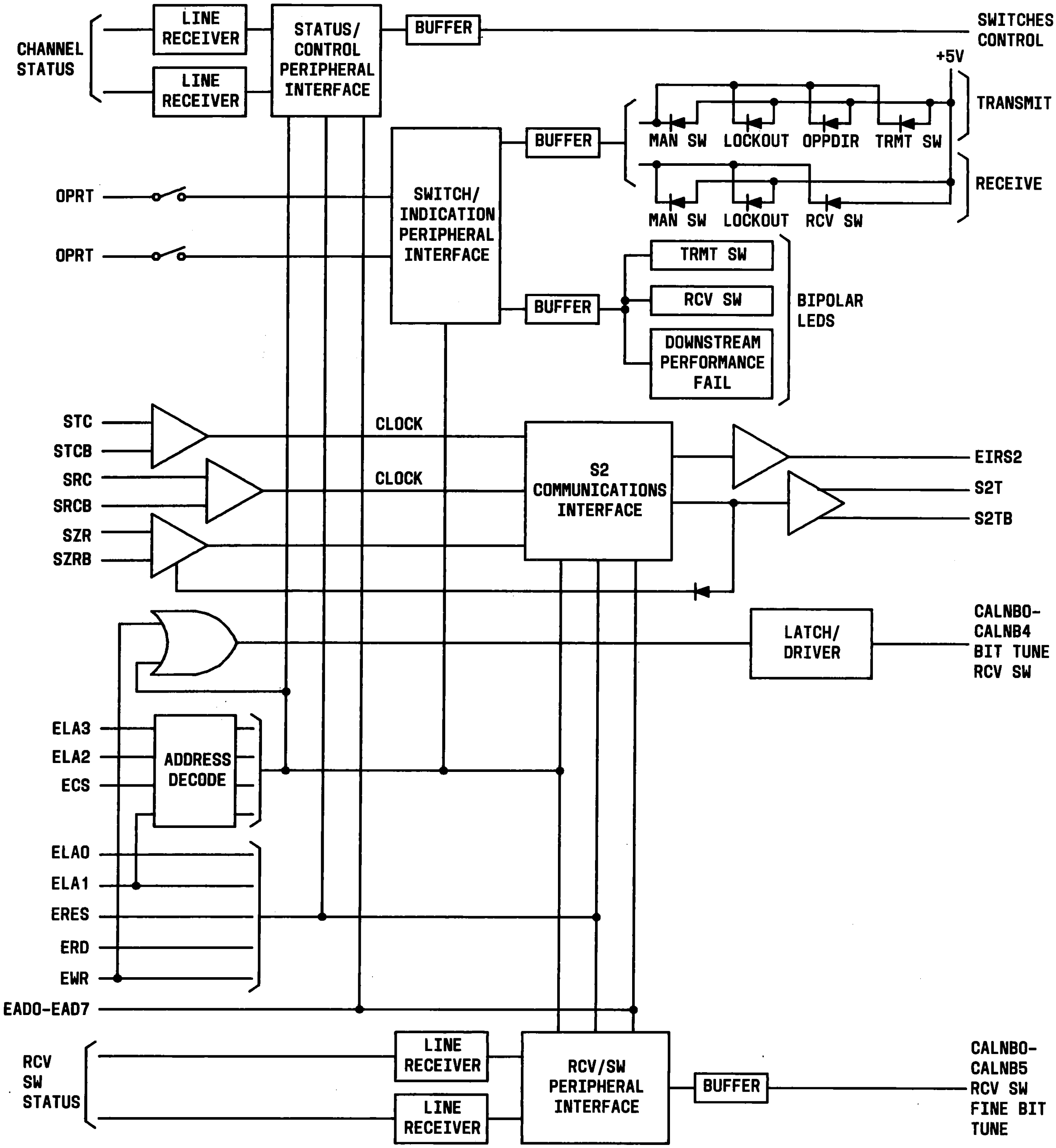



Fig. 53—AMR104 Regenerator Status

## AMR105 PARALLEL TELEMETRY

The AMR105 PAR TELEM (Fig. 54) provides a microprocessor interface for discrete telemetry information through the use of relay closures.

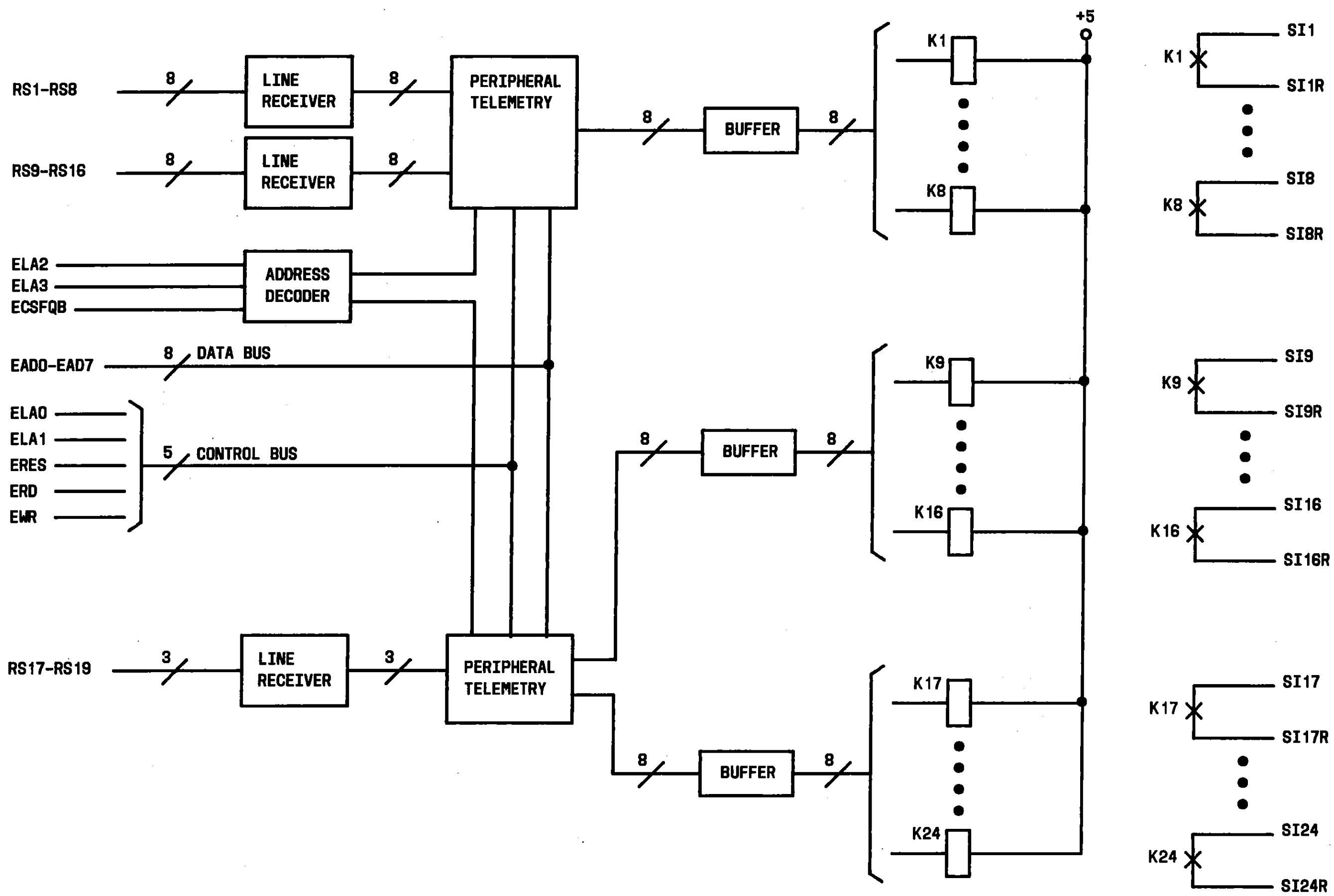



**Fig. 54—AMR105 Parallel Telemetry**

## AMR108 USER INTERFACE

The AMR108 USER INTFC (Fig. 55) provides user scan points and user control points interface.

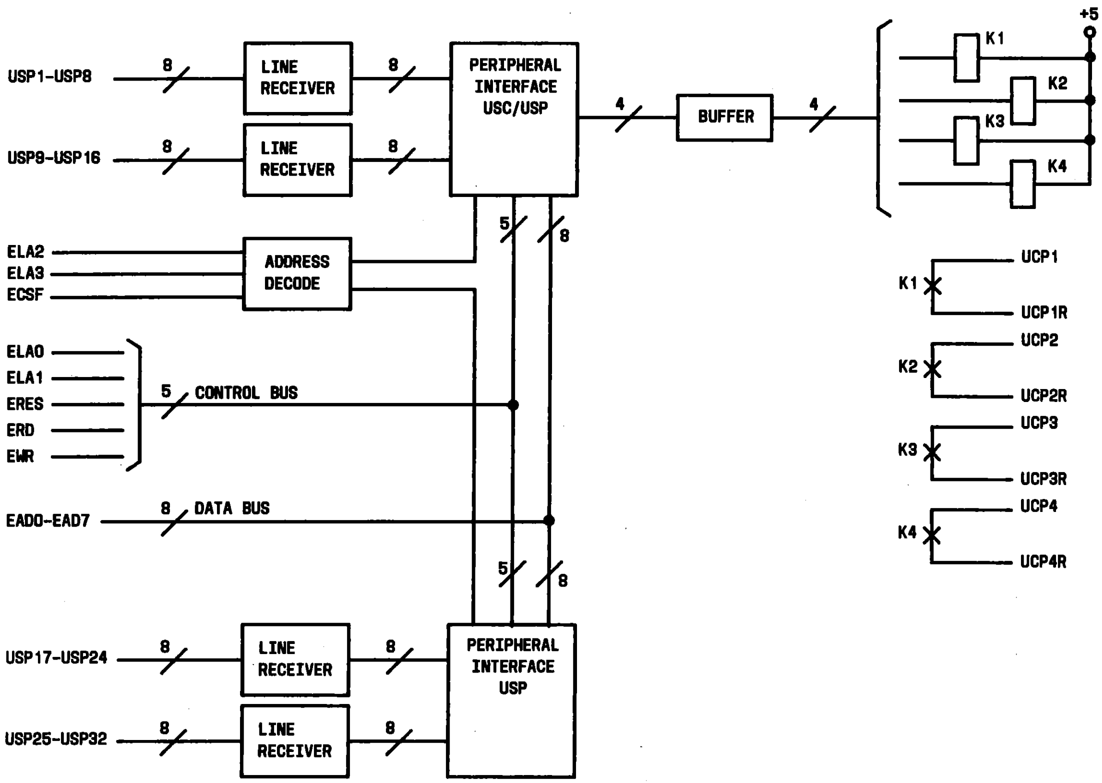



**Fig. 55—AMR108 User Interface**

## AMR176 LINE ALIGNMENT

The AMR176 LINE ALNMT (Fig. 56) adjusts delay on the protection channel feed to the regular channel receive switch so that the two channels may be properly aligned for errorless switching. The AMR176 passes the protection channel feed on to the rest of the protection channel unchanged.

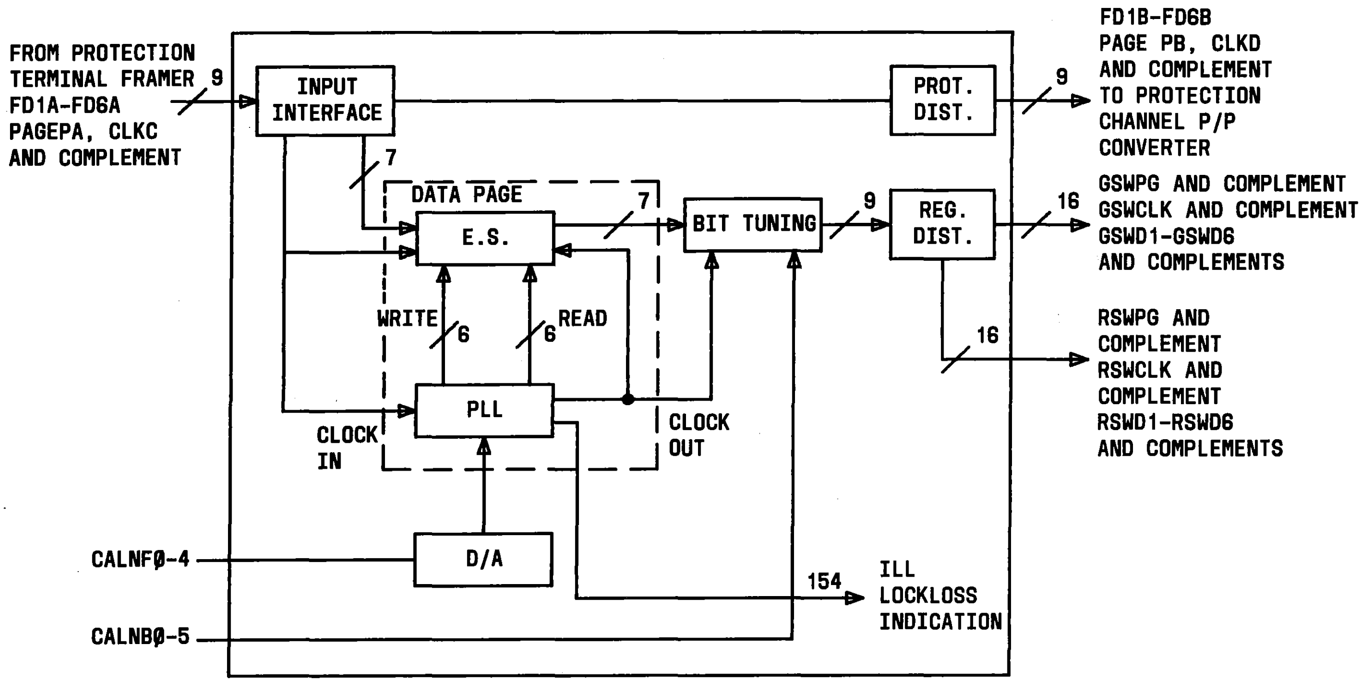



Fig. 56—AMR176 Line Alignment

## ANB1 SERVICE CHANNEL MULDEM

The ANB1 SC MULDM (Fig. 57) receives the 384-kb/s signal from the DPU and demultiplexes them into six channels. It also multiplexes them to 384-kb/s signal going to the DPUs. The six channels are applied as follows:

- S - Used for internal communications between terminal stations and among all stations of a switch section. Because all protection switch information is contained within this channel, no external facilities are required for system operation.

  The S channel is further subdivided as follows:

  S1 - Protection switch signaling

  S2 - Hop switch signaling (service channel)

  S3 - Scan point signaling

  S4 - Fault location data.

- OW - Used for an order wire when bays are prewired.
- W,X,Y - Used, if equipped, to provide voice-frequency trunks, E2A DAS telemetry extensions, or RS-422 extensions between various terminal and regenerator stations.
- Z - Used, if equipped, to provide a voice-frequency trunk or an E2A DAS telemetry extension between various terminal and regenerator stations.

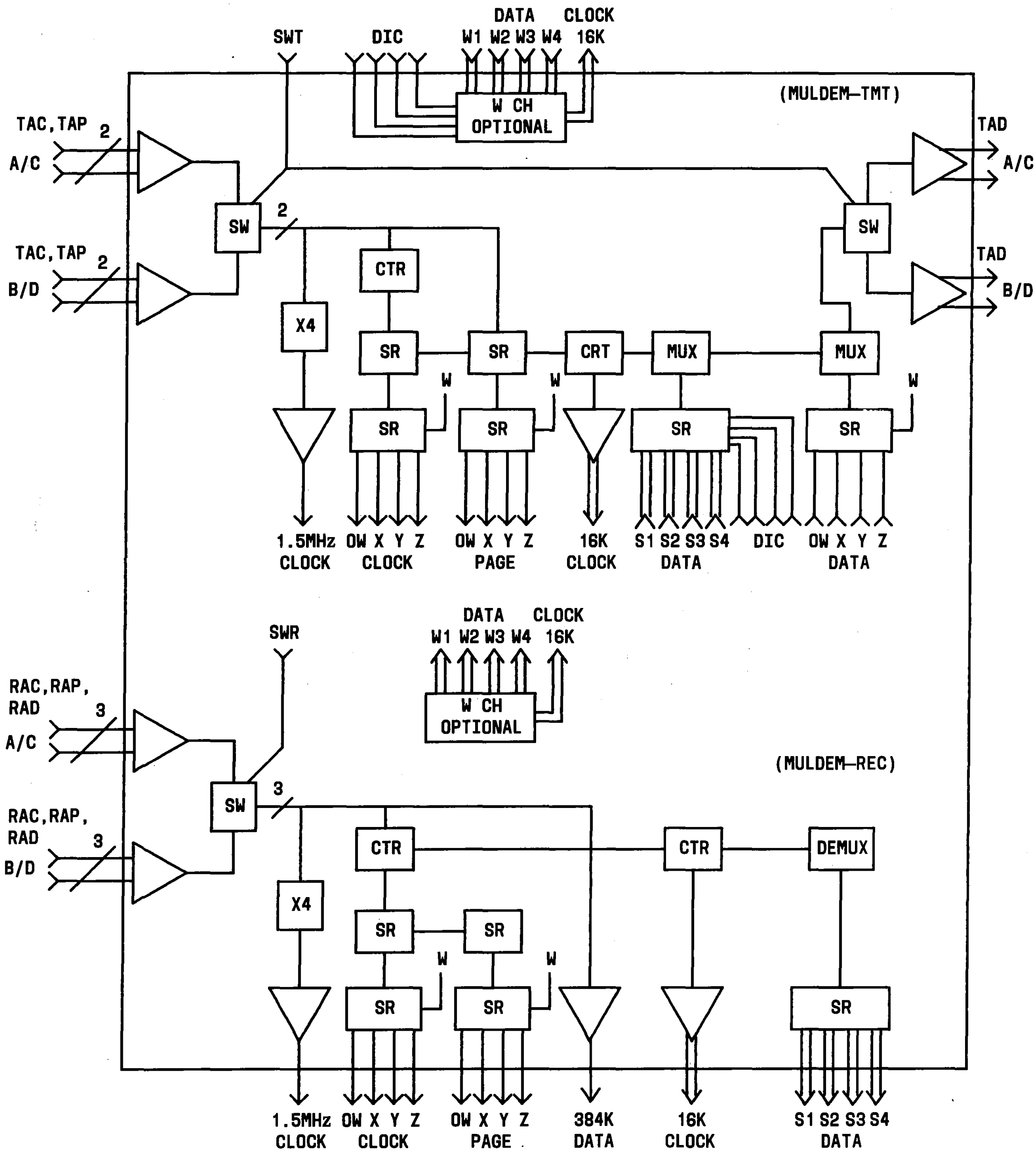



**Fig. 57—ANB1 Service Channel Muldem**

## MC450( ) TERMINAL/REGENERATOR STATION CONTROLLER

The MC450( ) TERM/REGEN CONTR (Fig. 58) is used in the terminal and regenerator stations to perform the station processing function. Additional features include buffered data, address and control buses, interrupt controller, programmable timers, RAM for data, EPROM program memory, address decoding, and a sanity timer.

The MC450( ) can be equipped for either Discrete, FMAS, TABS, or TBOS telemetry applications.

### TABLE A

### TERMINAL/REGENERATOR STATION CONTROLLER APPLICATIONS

| APPLICATION | | DISCRIPTION | |
|---|---|---|---|
| TERMINAL | REGENERATOR | TELEMETRY | ETS |
| MC45059A1 | MC45061A1 | DISCRETE | NO |
| MC45054A1 | MC45055A1 | DISCRETE | YES |
| MC45037A1 | MC45038A1 | FMAS | YES |
| MC45064A1 | MC45066A1 | TABS | NO |
| MC45063A1 | MC45065A1 | TABS | YES |
| MC45033A1 | MC45034A1 | TBOS | NO |
| MC45058A1 | MC45060A1 | TBOS | YES |

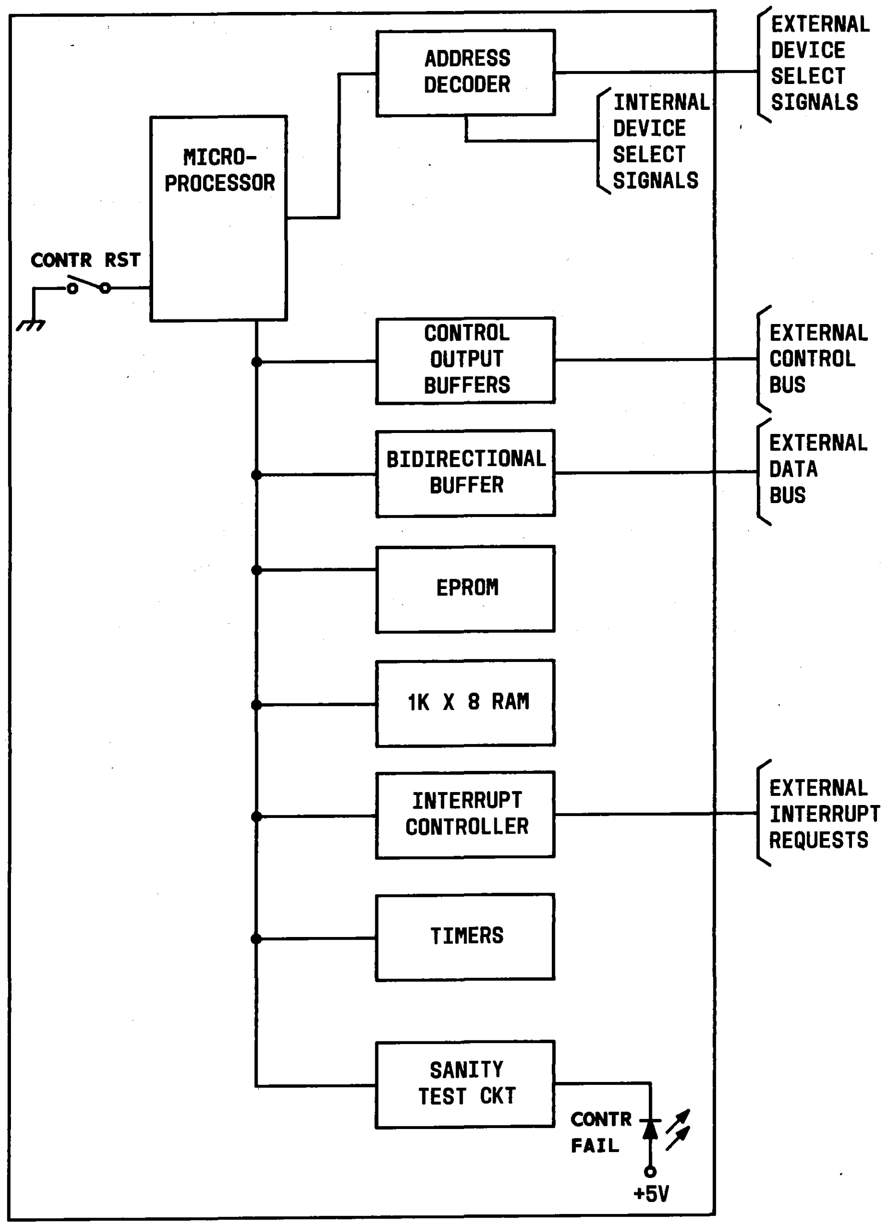



**Fig. 58—MC450( ) Terminal/Regenerator Station Controller**

## MC450( ) TERMINAL/REGENERATOR CHANNEL CONTROLLER

The MC450( ) CHAN CONTR (Fig. 59) is the interface between the terminal/regenerator controller and the regular or protection channel transmission units. Communications between the terminal/regenerator controller and the channel controller is done by a high-speed RS422 serial link. The functions of the channel controller are software controlled by an on-board program. This program allows the channel controller to perform four functions:

- Monitors information from the transmission units. This information consists of out-of-frame, error rate, and equipment failure. The information is then sent to the terminal/regenerator controller for further processing.
- Calculates the bit error rate for the transmission channels. Error pulses from the transmission units are sent to the channel controller and counted. If the count exceeds a number that corresponds to the switch threshold, a switch request is sent to the terminal/regenerator controller.
- Consolidates all alarm information and, upon request, sends it to the terminal/regenerator controller.
- Displays on its faceplate the status of the channel. This information includes transmit and receive radio fail, transmit and receive digital fail, excessive bit error rate, excessive misframe rate, and excessive activity indicated by individual LEDs. Frame loss and error rate are displayed on the bar graph. The bar graph is graduated into eight sections that light from bottom to top as the error rate increases. When there is a frame loss, the bar graph lights and flashes.

The terminal channel controller is coded MC45035A1. The regenerator channel controller is coded MC45036A1.

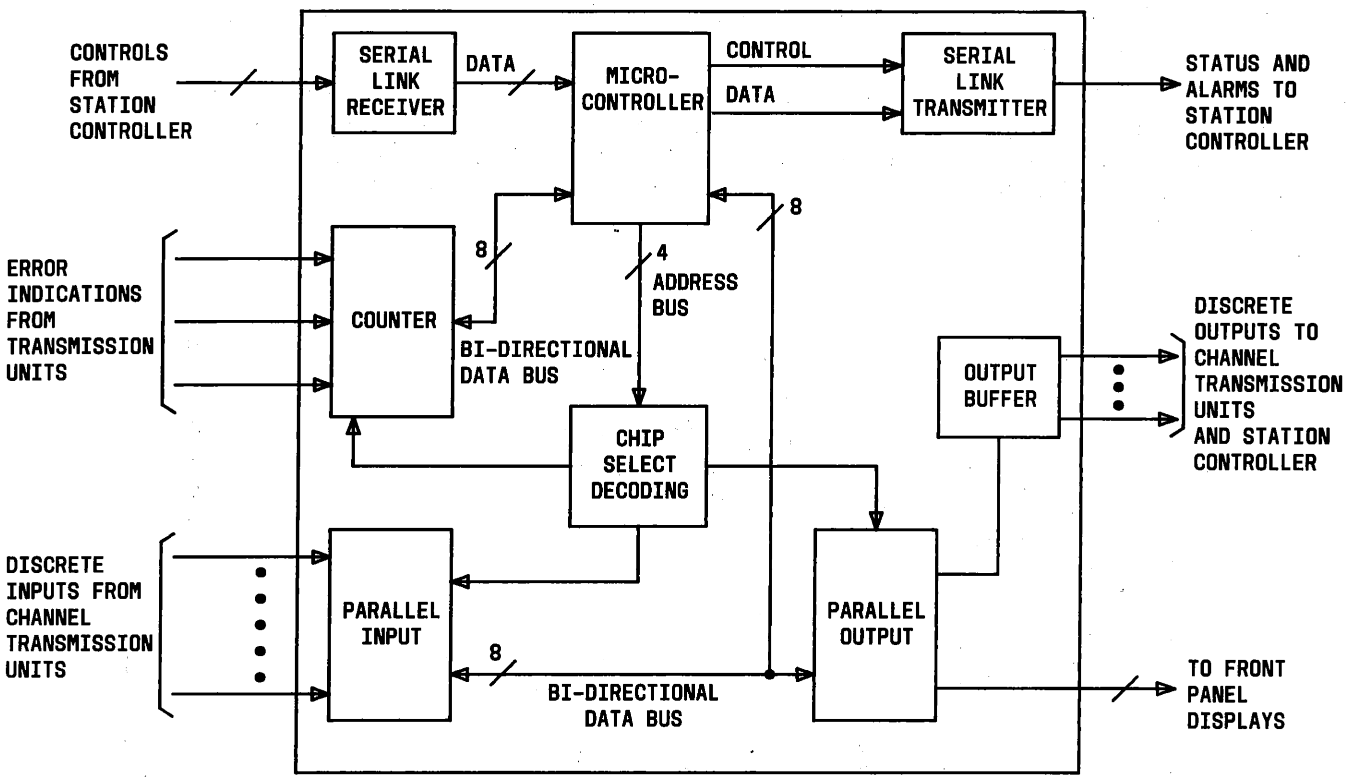



**Fig. 59—MC450( ) Channel Controller**

## MC45022/23A2 TERMINAL TELEMETRY CONTROLLER

The MC45022A2 FMAS TELEM unit (Fig. 60) provides FMAS capability at the terminal bay and communication (by S3 service channel) with the regenerator bay(s) for implementing remote FMAS capability. Additional functions include a buffered GTP (general telemetry processor) interface using TABS protocol and a dual port RAM for communicating with the terminal station controller.

The MC45023A2 TABS TELEM (Telemetry Asynchronous Block Serial Telemetry) unit provides AS&C information at the terminal bay and communication (by S3 service channel) with the regenerator bay(s) for obtaining remote AS&C information. Additional functions include a buffered GTP interface and a dual port RAM for communicating with the terminal station controller.

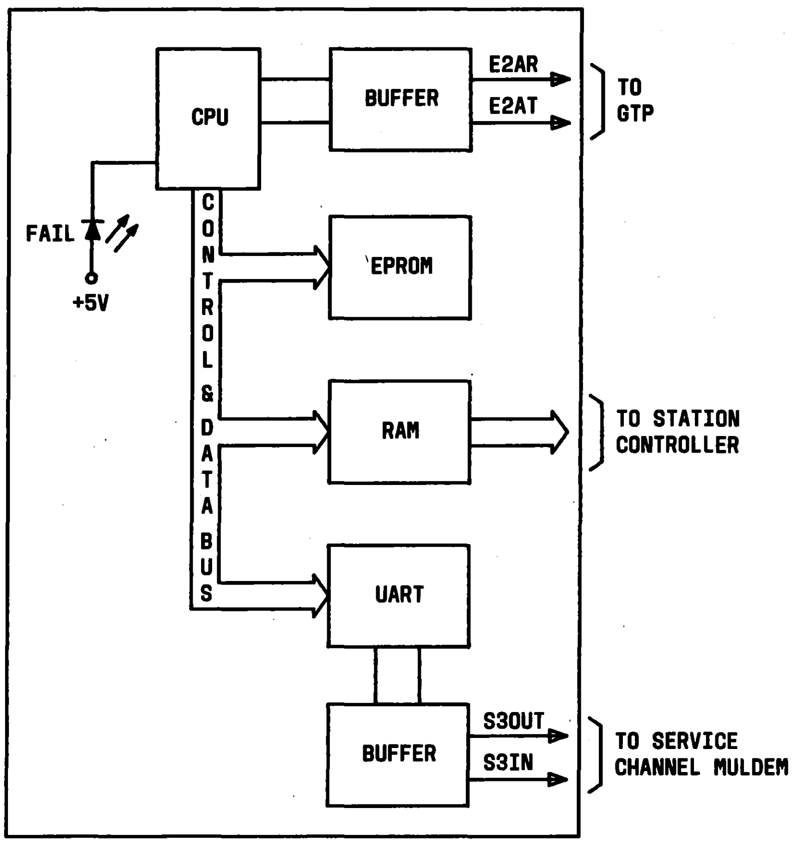



Fig. 60—Terminal Telemetry Controller

## MC45057A2 REGENERATOR TELEMETRY CONTROLLER

The MC45057A2 FMAS TELEM (Facility Maintenance and Administration System Telemetry) unit (Fig. 61) provides AS&C (alarm surveillance and control) information at the regenerator station. The AS&C information is communicated (by S3 service channel) to the terminal FMAS TELEM (or TABS TELEM) unit upon request. Additional functions include a dual port RAM for communicating with the regenerator station controller.

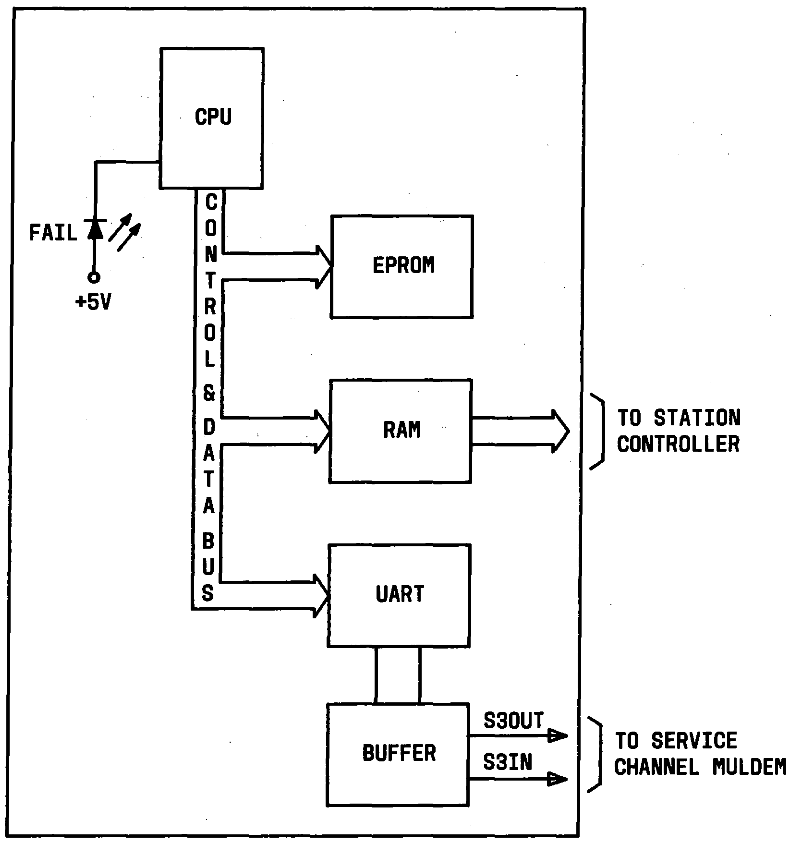



**Fig. 61—Regenerator Telemetry Controller**

## RF MICROWAVE SWITCH

The RF microwave switch (Fig. 62) is a broadband miniature device with a voltage standing wave ratio (VSWR) of 1.5 to 1 maximum and an insertion loss of 0.5 dB maximum. This switch is basically a single pole double throw type of relay and its coil is activated by 24/48 V dc for the two models that are used on this hot standby system. The RF microwave switch is used in conjunction with the 4410A/B switch control network to make up what is known as the transmitter switch.

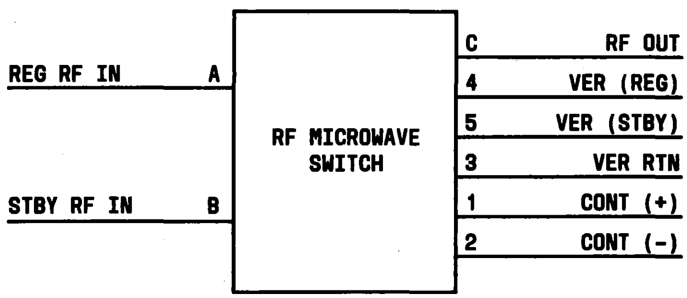
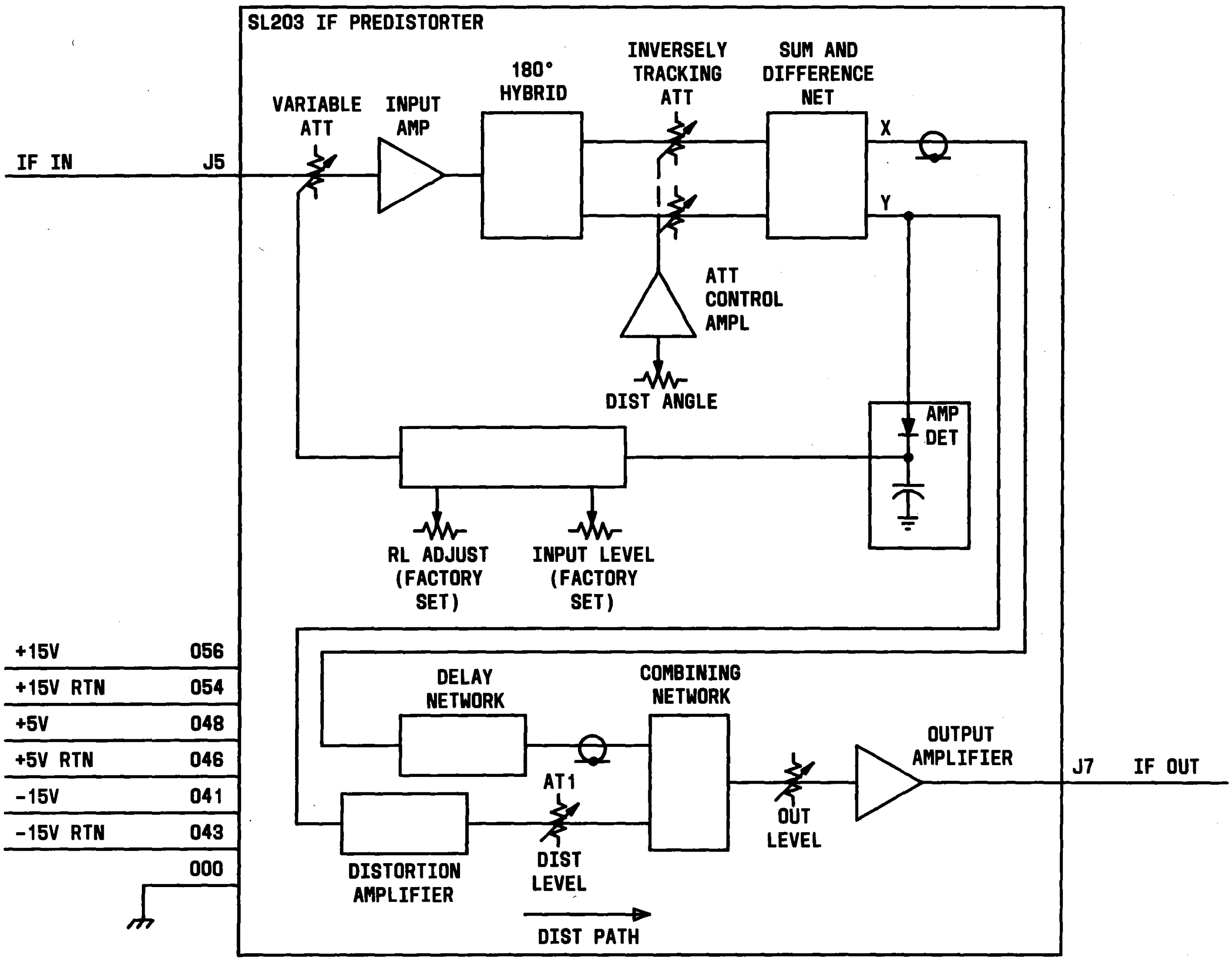



**Fig. 62—RF Microwave Switch**

## SL203 IF PREDISTORTER

The function of the IF predistorter (Fig. 63) is to generate third-order distortion of the proper phase and magnitude to cancel third-order distortion generated in the traveling wave tube or solid state amplifier at the output of the radio transmitter. This unit is capable of canceling the distortion product by more than 20 dB, thereby allowing greater transmitter output power while meeting the linearity required for 64 QAM-transmission. The predistorter operates at 70 MHz, with a 40-MHz bandwidth, and at an overall gain of 0 dB. Three field adjustable controls are accessible through the faceplate. There are no LEDs or alarms activated by this unit. The predistorter is capable of canceling distortion over 180°. A field selectable switch is provided to allow cancellation of distortion over a full 360°. The switch is positioned according to whether the LO is above or below the channel frequency of the transmitter. Tables in the IF Predistorter " Replacement Procedures" tab specify the proper switch position.




NOTE:
NUMBERS ON LEADS OTHER THAN J NUMBERS ARE PIN NUMBERS OF P10 WHICH MATES WITH SL203 IF PREDISTORTER

**Fig. 63—SL203 IF Predistorter**

## SL244 RADIO DATA CARD

The purpose of the radio data card (Fig. 64) is to keep a record of the various frequencies, voltages, currents, and power levels for various components that make up the transmitter and receiver (both regular and diversity). Levels of the output voltages for the dc power supplies used in the transmitter and receiver are permanently recorded for reference purposes only.

There is a place on the radio data card to record the serial numbers of the traveling wave tube (TWT-SN), the power unit (PS-SN), and the control unit (CU-SN) that are used in the transmitter portion of the radio.

Other information that is recorded on the radio data card is the system used, and the position numbers and channel numbers for the receiver and transmitter.

SIDE VIEW

FRONT VIEW

## RADIO DATA CARD

SYSTEM ____________ POSITION NO. ____________

**TRMTR**

| | | | | | |
|---|---|---|---|---|---|
| CHANNEL NO. | ____________ | | | | |
| GEN MON PWR | ____________ | dBm | | | |
| GEN MON FREQ | ____________ | MHz | | | |
| IF IN LEVEL (J4) | ____________ | dBm | TWT-SN | ____________ | |
| ALC V NORMAL | ____________ | V | PS-SN | ____________ | |
| AT PWR OUT OF RANGE LIMITS | + ____________ | V | CU-SN | ____________ | |
| | - ____________ | V | | | |
| ALC NET OR PWR AMPL SER NO. | ____________ | | | | |
| ALC NET OR PWR AMPL RF MON OUT | ____________ | dBm | | | |
| PWR AMPL RF OUT | ____________ | dBm | | | |
| FOR TWT APPLICATIONS | IK ____________ | mA | IH | ____________ | mA |

| | | |
|---|---|---|
| DC-DC POWER SUPPLY VOLTAGE TOLERANCES | +5.0V±0.3V | +15.0V±0.4V |
| | +10.0V±0.3V | +15.0V±0.4V |

**RCVR**

| CHANNEL NO. ____________ | REG | | DIV | |
|---|---|---|---|---|
| RF PREAMPL GAIN | ____________ | dB | ____________ | dB |
| RECEIVED SIGNAL LEVEL | ____________ | dBm | ____________ | dBm |
| CONV RF IN | ____________ | dBm | ____________ | dBm |
| CONV IF OUT | ____________ | dBm | ____________ | dBm |
| LIN DEL EQL IF OUT | ____________ | dBm | ____________ | dBm |
| GEN MON PWR | ____________ | dBm | ____________ | dBm |
| GEN MON FREQ | ____________ | MHz | ____________ | MHz |
| IF COMB IF OUT | ____________ | dBm | (SPACE DIV ONLY) | |
| IF FLT BASIC EQL IF OUT | ____________ | dBm | | |
| IF AGC AMPL IF OUT | ____________ | dBm | | |
| AGC V NORMAL | ____________ | V | | |
| AT LPW IN | ____________ | V | | |
| ADPT SL EQL IF OUT | ____________ | dBm | | |
| CONT V MAN | ____________ | V | | |
| CONT V AUTO | ____________ | V | | |
| POSITIVE SL TEST | ____________ | V | | |
| NEGATIVE SL TEST | ____________ | V | | |

DATA CARD

SL 244

**Fig. 64—SL244 Radio Data Card**

## TWT AMPLIFIERS (6 AND 11 GHZ)

The TWT amplifier (Fig. 65) is used as the last stage RF signal amplifier in the radio transmitter. These units, which are designed to operate over the entire 6- or 11-GHz common carrier band, have a typical gain of 46 dB and are adjusted for a nominal RF output signal level of +38 dBm. The following controls and/or indications perform the indicated function:

| | |
|---|---|
| ON-OFF switch: | Controls dc power to the TWT power supply. A green ON LED is lighted when the switch is in the ON position. |
| TRANS-STBY switch: | Controls the transmission of the RF signal through the TWT. |
| RESET pushbutton: | Overrides the shutdown feature and tries to turn on the TWT again. |
| PREAL: | An amber LED. This alarm is activated when the TWT helix current (Ih) increases to within the range of 2.2 to 2.8 mA. The helix current is a measure of how well the TWT is focused. Typically, as the TWT approaches end-of-life, the value of Ih increases and the TWT exhibits a decrease in gain. This alarm is connected to the transmitter alarm and meter network. |
| AL: | A red LED. This alarm indicates a more severe alarm state than the PREAL above and is activated by a higher Ih. When the AL is activated the TWT shuts down eight times (once per second for eight seconds). If the trouble is not cleared during this interval, the TWT remains shut down. This alarm is not connected to the transmitter alarm and meter network. |
| Ih and Ik: | Test points that allow the measurement of the Ih and Ik (beam current). |
| BEAM ADJ: | An adjustment control used to adjust the TWT beam current to a predetermined value. |

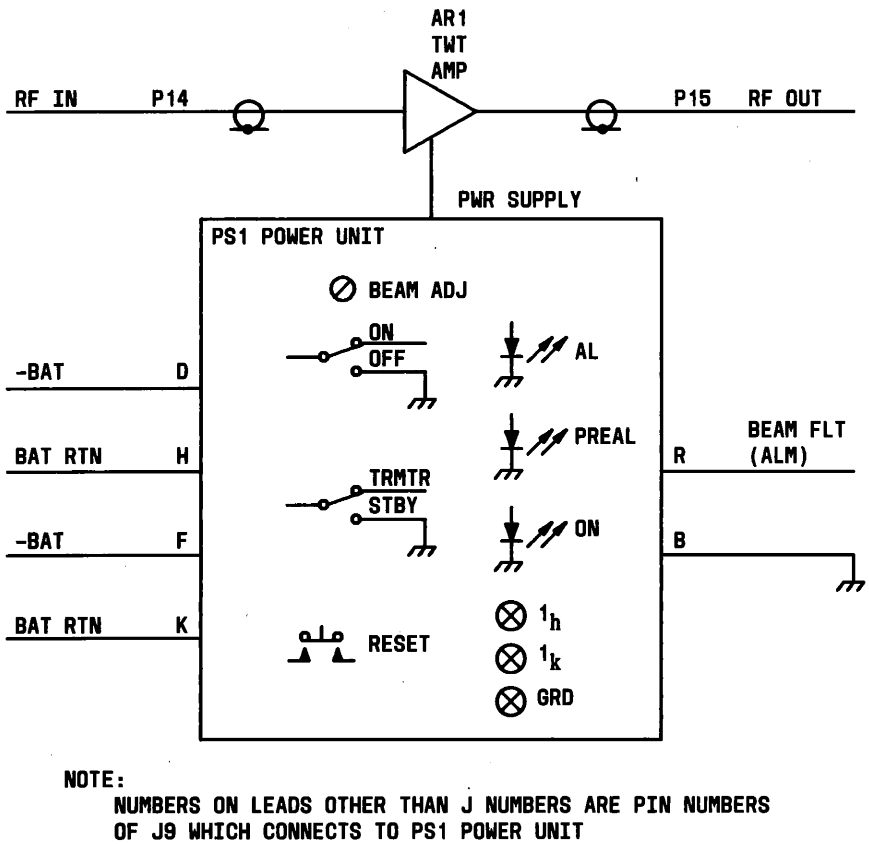



**Fig. 65—TWT Amplifiers (6 and 11 GHz)**

## YJ102 ADAPTIVE SLOPE EQL

The function of the adaptive slope equalizer (Fig. 66) is to automatically correct for linear amplitude slope of the IF digital spectrum. A control circuit samples the applied signal and controls Bode networks that affect a slope reduction of 10:1. This reduces a fade produced slope of 10 dB across the received signal to 1 dB. This unit simultaneously lights an LED on its faceplate and generates an EXCS SLP alarm when the slope at the 70 ±10 MHz points is approximately ±7 dB. A pushbutton switch is also provided to allow the equalizer correction to operate in either the manual or automatic (normal) mode. When in the manual mode, this unit simultaneously lights an LED located on its faceplate, initiates a MAN alarm, and places a predetermined correction on the Bode networks.

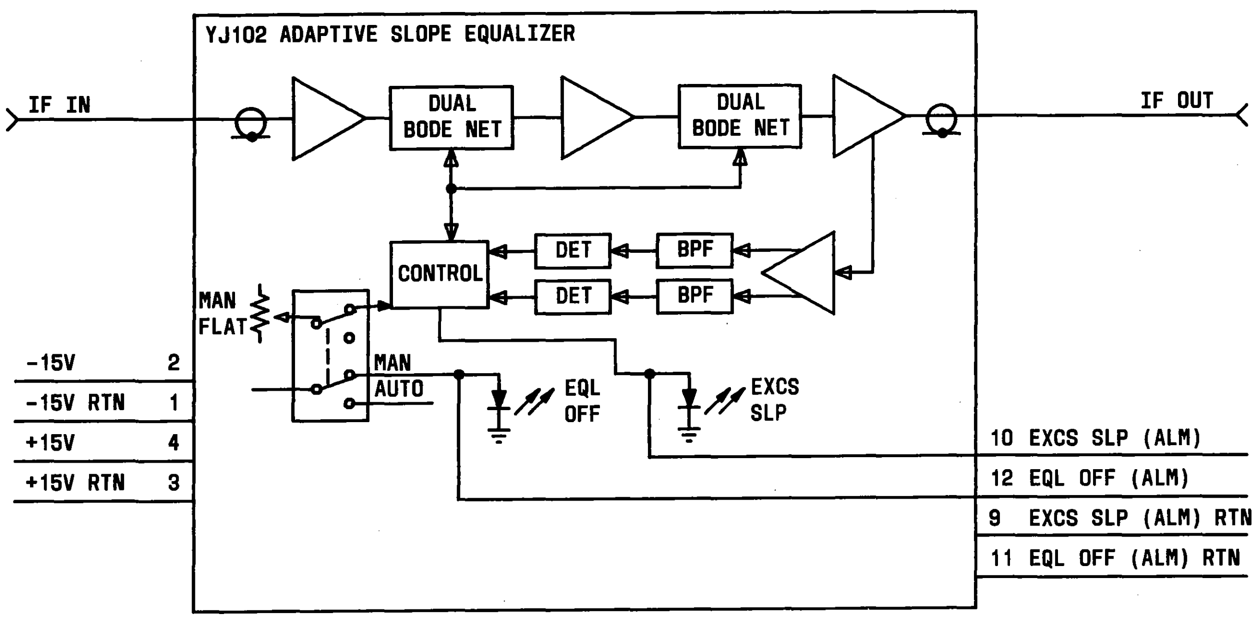



Fig. 66—YJ102 Adaptive Slope Equalizer

## YJ104B IF AGC AMPL

The function of the YJ104B amplifier (Fig. 67) is to supply an IF signal with a constant output level of -2 ±0.5 dB for an input signal level variation of -10 to -55 dBm. This unit makes use of three AGC (automatic gain controlled) stages followed by a fixed gain stage that can provide a maximum gain of 75 dB. The amplifier can be switched to operate in either an AGC (AUTO) or a constant gain manual (MAN) mode. Independent AUTO and MAN gain adjust controls are used to set the output level for each mode of operation. The fixed gain MAN mode is not the normal operating mode and is generally used when troubleshooting or performing swept type tests. For this reason, when operated in the MAN mode, the switch also lights a MAN LED located on the faceplate of the unit and initiates a MAN alarm. A power detector is used to monitor the IF input signal. When this signal falls below a value preset by the LPW IN TRIP adjust control, a LPW IN LED located on the faceplate of the unit lights and an LPW IN alarm is initiated. The AGC voltage gives an indication of the received signal level. This voltage is available at the AGC V test points on the faceplate of the unit and is also sent to the alarm and meter unit (if equipped) where it can be observed by the meter at that point.

## ISSUING ORGANIZATION

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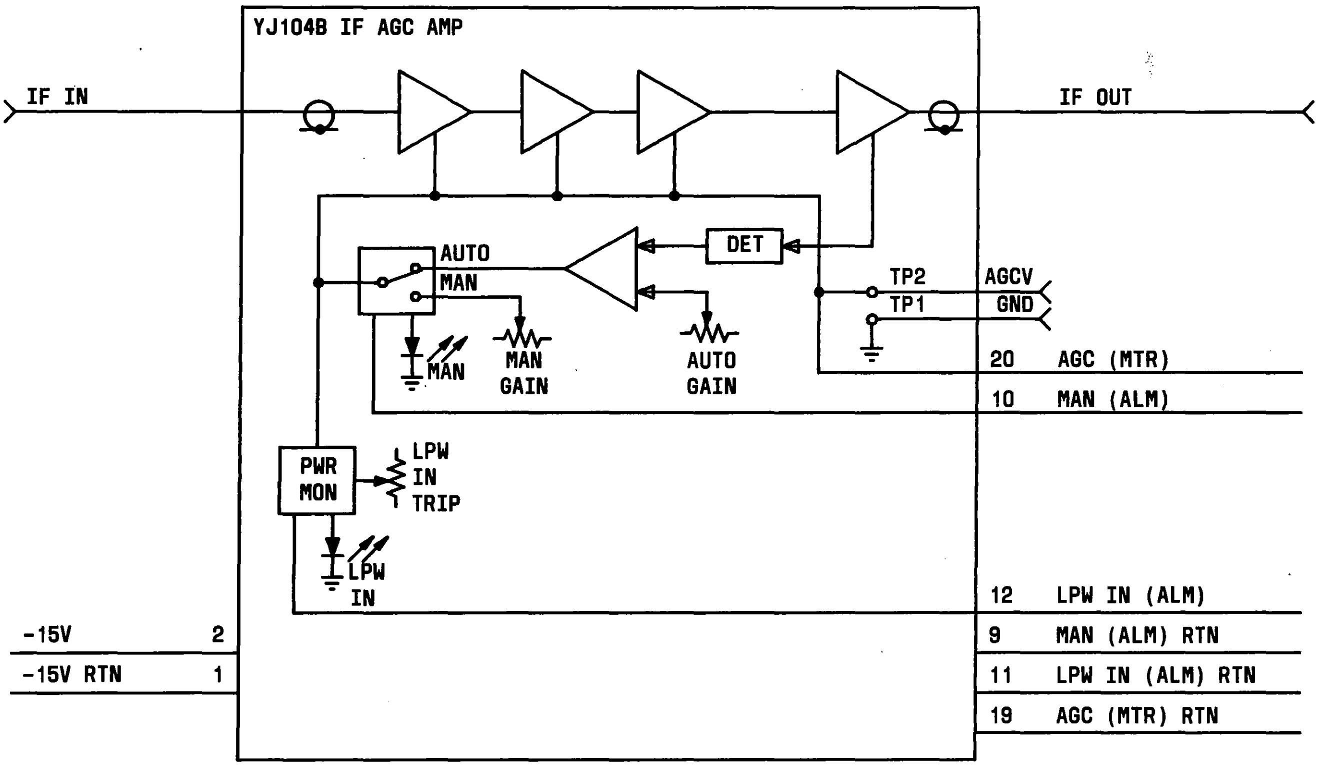


**Fig. 67—YJ104B IF AGC Amplifier**