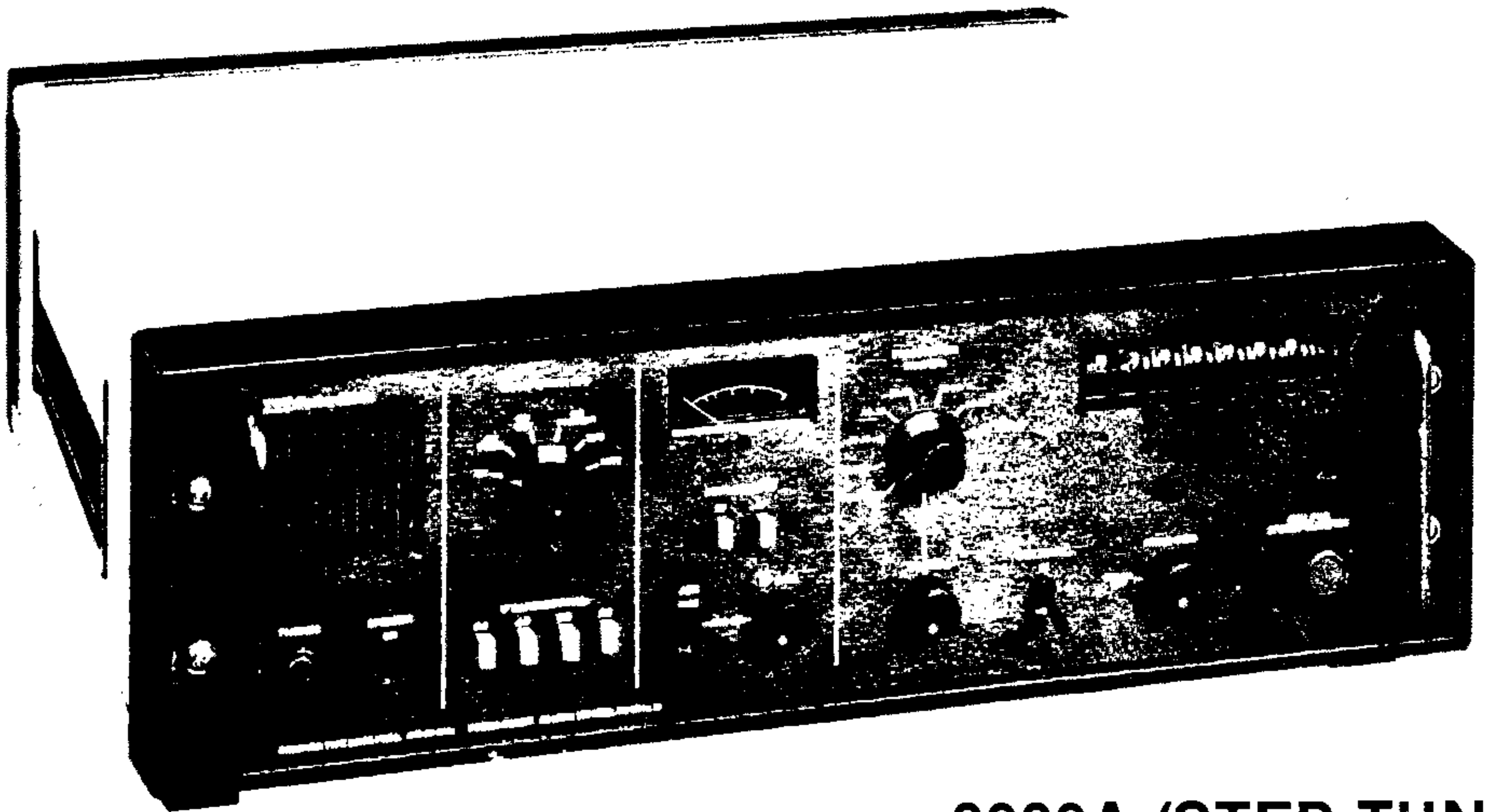
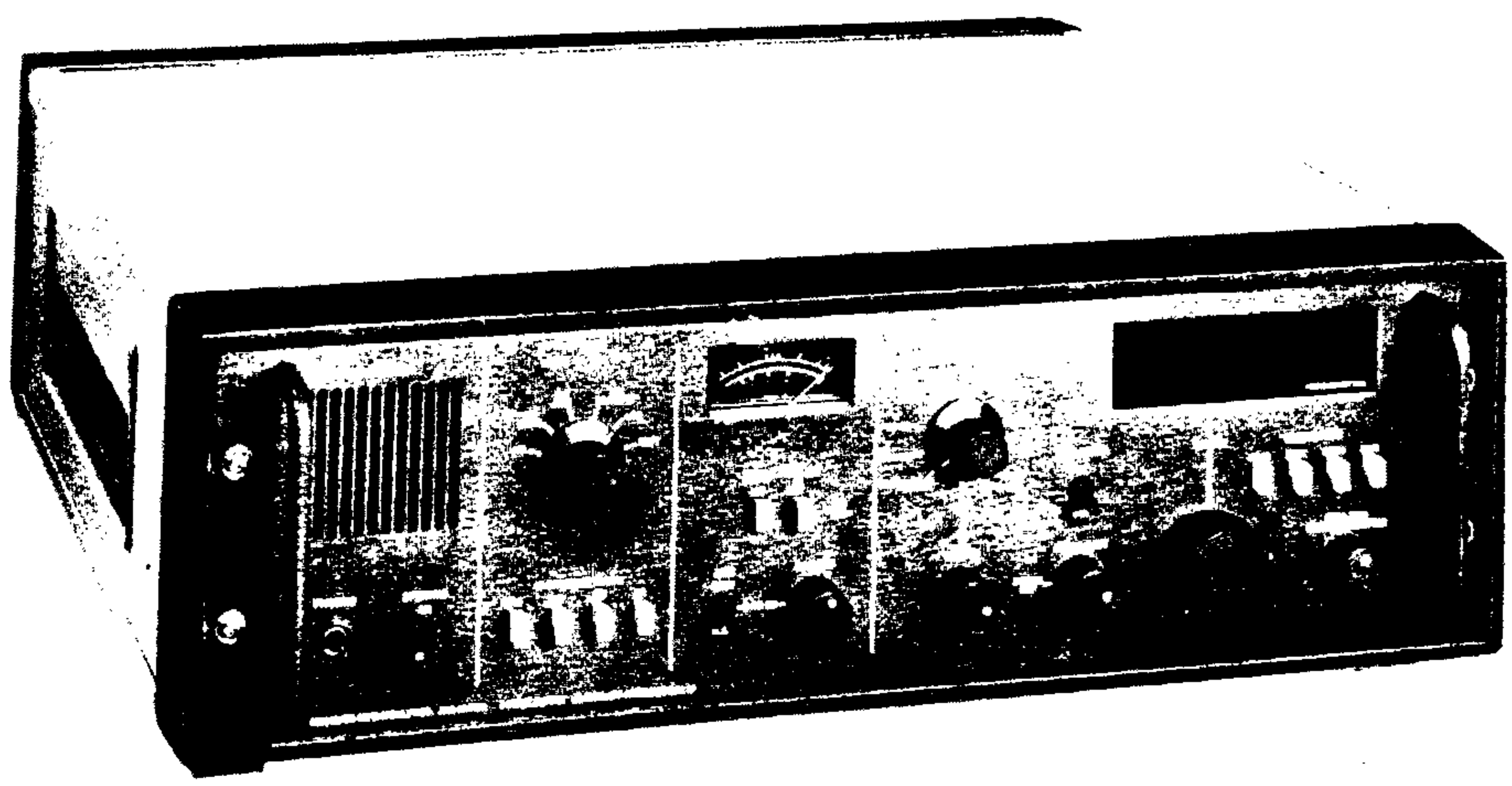
SYNTHESIZED RECEIVERS



3030A (STEP TUNED)



3031A (SWEEP TUNED)

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INTRODUCTION

The 3030A and 3031A are synthesized, dual conversion, superheterodyne, marine and general purpose receivers. The 3030A is step tuned and the 3031A is scan tuned. Both receivers cover a frequency range of 15 kHz to 29.99999 MHz in 10 Hz increments. Both receivers are highly stable. Operating modes are AM (amplitude modulated double sideband), CW (continuous wave), and SSB (single sideband); the RTTY (radioteletype) mode is available with additional equipment.

These receivers are completely solid state and are modular in construction. Electronic components are mounted on printed circuit boards, most of which are housed in chassis mounted plug-in modules. Plug-in type boards are utilized in each module housing more than one PC Board. With the exception of the power supply circuits, interconnections are accomplished by interconnection PC Boards, coaxial cables with snap-on connectors, and flat ribbon cables with plug-in connectors. Maintenance is rapid and simplified, usually consisting of merely substituting modules or PC Boards.

To permit fully synthesized, high resolution tuning, the receivers have a synthesizer which provides the 10 Hz tuning increments. An incoming signal can be tuned within 5 Hz of its exact frequency at a stability equal to that of the internal 10 MHz standard reference crystal oscillator. The 1 ppm stability ensures that the maximum inaccuracy in reading the exact signal frequency will be only 30 Hz at 30 MHz.

A preselector is provided for matching short, marine antennas to the nominal 50 ohm receiver input impedance. The preselector also can be used to attenuate excessively strong interference.

The 3030A and 3031A operate from input supplies of 115 or 230 volts (±10%), 50/60 Hz, single phase. The 3030A and 3031A receivers have a power consumption of only two-thirds that of earlier models, which reduces internal temperatures and improves reliability.

Each receiver can be installed in its own (optional) cabinet for table top mounting, or can be rack mounted as part of a communications console.

IMM RECEIVERS - COMPARISON CHART

	3020A	3030A	3021A	3031A
Frequency Range	15kHz to 30MHz	15kHz to 30MHz	15kHz to 30MHz	15kHz to 30MHz
Frequency Stability	1×10^{-6} 0^{o} to $50^{o}C$ 1×10^{-6} per year aging	1×10^{-6} 0^{o} to $50^{o}C$ 1×10^{-6} per year aging	1×10^{-6} 0^{o} to $50^{o}C$ 1×10^{-6} per year aging	1×10^{-6} 0^{o} to $50^{o}C$ 1×10^{-6} per year aging
Tuning Increments	100Hz steps	10Hz steps	100Hz steps	10Hz steps
Sweep or Step Tune	Step Tune	Step Tune	Sweep Tune	Sweep Tune
Sweep Tuning Rates			2 Rates plus lock (1MHz, 4.3kHz per turn)	3 Rates plus lock (1MHz, 4kHz, 400Hz per turn)
Modes of Reception	CW, AM, USB, LSB	CW, AM, USB (RTTY Option)	CW, AM, USB, LSB	CW, AM, USB (RTTY Option)
Standard Bandwidths	AM/CW 8,2,1,0.4kHz USB/LSB 350 to 2700Hz	AM/CW 8,2,1,0.4kHz USB 350 to 2700Hz RTTY 1500-1900Hz	AM/CW 8,2,1,0.4kHz USB/LSB 350 to 2700Hz	AM/CW 8,2,1,0.4kHz USB 350 to 2700Hz RTTY 1500-1900Hz
Sensitivity for 10dB SINAD	Down to 0.3uV (CW Mode)	Down to 0.3uV (CW Mode)	Down to 0.3uV (CW Mode)	Down to 0.3uV (CW Mode)
Inter-modulation Level*	+50dB	+67dB	+50dB	+67dB
Audio Output	1 Watt	3.5 Watts	1 Watt	3.5 Watts
Input Power	90 Watts	62 Watts	93 Watts	65 Watts
Beat Freq. Oscillator	Variable Only	Variable and Pre-Set	Variable Only	Variable and Pre-Set
24 or 48 VDC Operation	No	Option	No	Option
Number of PCB's	20	16	23	20
Number of Major Replaceable Modules	20	5	22	7

*Intermodulation. Specified is minimum level of two equal interfering signals producing same output as a 16uV reference signal in the range 1.6-30MHz. (MPT1201 method).

TECHNICAL SPECIFICATIONS

All performance parameters meet or exceed U.K. Specification MPT 1201.

Frequency range	15 kHz to 29.99999 MHz in 10 Hz increments.
Operating modes	A1, A2, A2H, A3, A3A, A3H, A3J; RTTY with optional filter and external demodulator. The SSB modes are upper sideband.

IF bandwidths

Switch Position	6dB Bandwidth	60dB Bandwidth
8.0 kHz	8.0 kHz minimum	20 kHz maximum
2.0 kHz	2.0 kHz minimum	12 kHz maximum
1.0 kHz	1.0 kHz minimum	6 kHz maximum
0.4 kHz	0.4 kHz minimum	4 kHz maximum
USB	$\leq$ + 0.35 & $\geq$ + 2.7kHz	$\geq$ - 0.5 & $\leq$ + 3.8 kHz
RTTY*	0.4 kHz minimum	5 kHz maximum

*Centered at 1700 Hz removed from 5 MHz. (RTTY mode is optional).

Frequency stability	1 ppm $0^{\circ}C$ to $+50^{\circ}C$ with $\pm10\%$ power supply variation; $\leq$ 1 ppm per year aging.

Sensitivity

Frequency Range		Sensitivity uV EMF for 10dB SINAD	Dummy Antenna	Mode	Bandwidth (kHz)
100-160	kHz	32	10Ω/220 pF	CW	1
.16-4	MHz	10	10Ω/220 pF	CW	1
.16-4	MHz	32	10Ω/220 pF	AM	2
1.6-4	MHz	32	10Ω/220 pF	AM	8
1.6-30	MHz	0.8	50Ω	SSB	SSB
4-30	MHz	0.6	50Ω	CW	2

Sensitivity is reduced uniformly between 100 kHz and 15 kHz by approximately 20dB.

Spurious response rejection (external)	Greater than 80 dB, referenced to rated sensitivity (includes Image and IF rejection).

Internally generated spurious responses

With the antenna input connector terminated in a 50 ohm load and the preselector set to WIDEBAND, the maximum level of internally generated spurious responses does not exceed 0.13 microvolt (-124 dBm) equivalent input level in any marine band, or 0.5 microvolt outside marine bands.

Cross modulation (using 2 kHz filter)

With a wanted signal of 1.0 millivolt EMF, an unwanted signal of 32 millivolts EMF (30 percent, 400 Hz modulation and separated by 10 kHz) produces an output at least 30 dB below the output level due to the wanted signal standard output. At separation of 20 kHz, the unwanted output is at least 33 dB below the standard output.

Blocking

With a wanted signal of 1 millivolt EMF (2 kHz bandwidth), an unwanted signal of 100 millivolts EMF (separated by 10 kHz) causes less than 3 dB change in output; for the 0.10 to 0.16 MHz frequency band, the separation is 5 kHz (1 kHz bandwidth).

Intermodulation products

With a desired signal of 31.6 microvolts EMF set to give standard output (50 mW), two equal level undesired signals offset +30 and +60 kHz, respectively, do not produce more than standard output when their levels are as specified in the following table.

Frequency Range		Mode	Dummy Antenna	Preselector Position	Minimum Level (EMF) of Each Unwanted Signal
100-525	kHz	AM	10Ω/200pF	As Tuned	100.0 mV
525-1600	kHz	AM	10Ω/200pF	As Tuned	31.6 mV
1.6-30	MHz	SSB	50Ω	Wideband	68.0 mV

TECHNICAL SPECIFICATIONS (CONTINUED)

Automatic Gain Control	Range: less than 6 dB change in output for input signal variation from 1 microvolt to 100 millivolts (100 dB) measured in SSB mode with preselector set to WIDEBAND (50 ohm input). Attack time: 100 milliseconds nominal. Decay time: FAST - 200 milliseconds nominal. SLOW - 1.5 seconds nominal.
Audio Output	Speaker: 3.5 watts into 3.2 ohm speaker with 10% maximum distortion. Line: adjustable to +10 dBm (10 mV) into 600 ohm balanced load.
Spurious Emissions	The RMS voltage present at the antenna terminal of the receiver is less than 10 microvolts into 50 ohm dummy antenna.
Overload	There is no damage to the receiver when an input signal of 30 volts EMF is applied for 15 minutes using a standard antenna.
Operating temperature	Full performance range: $0^{\circ}C$ to $+50^{\circ}C$. Operating temperature range: $-15^{\circ}C$ to $+55^{\circ}C$. Relative humidity: Up to 95%.
Input Power	90 to 130 volts/195 to 260 volts, 47/63 Hz, single phase.
Power Consumption	62 watts for the 3030A; 65 watts for the 3031A.
Clarifier Range	$\pm$150 Hz minimum.
BFO Range	Adjustable to a beat note ranging from 0 to $\geq$ 2 kHz, centered at 1 kHz nominal.
Number of PC Boards (includes mother boards, interconnect boards, and plug-in boards)	16 in the 3030A; 20 in the 3031A.

Number of replaceable plug-in modules	5 in the 3030A; 7 in the 3031A.
Sweep tuning rates (3031A only)	3 rates plus lock (1 MHz, 4 kHz, or 400 Hz per turn).

Dimensions and weight

	Without Cabinet	Cabinet (Optional)
Height	5.75 in. (13.3 cm)	6.00 in. (15.0 cm)
Width	19.00 in. (49.3 cm)	19.75 in. (49.5 cm)
Depth	17.00 in. (43.2 cm)	18.00 in. (45.0 cm)
Weight	19 lb. (8.6 kg)	18 lb. (8.1 kg)

a. Phones Jack

The PHONES jack accepts a standard 1/4-inch (.625 cm) diameter handphones plug. The jack impedance is 3 ohms. When the headphones are plugged in, the speaker is automatically turned off.

b. Speaker Switch

The SPEAKER ON/OFF toggle switch turns the speaker on and off.

c. Mode/Variable BFO Controls

The MODE/VARIABLE BFO controls consist of two concentric control knobs. The MODE (outer) knob selects the following:

1. AM, amplitude modulated double sideband.

2. CW FIXED, which zero beats a signal for centering in the IF passband.

3. CW VAR (variable), which allows adjustment of the CW pitch from 0 to 2 kHz with the signal centered in the IF passband (nominal 1 kHz).

4. CW PRESET, which provides a preset CW pitch when the signal is properly centered.

5. USB, upper sideband for SSB operation.

6. RTTY, radioteletype (the RTTY filter is optional).

The VAR BFO (inner) knob tunes the BFO pitch.

d. IF Bandwidth Pushbuttons

The IF BANDWIDTH kHz pushbuttons select bandwidths of 0.4 kHz (VERY NARROW), 1.0 kHz (NARROW), 2.0 kHz (INTERMEDIATE), or 8 kHz (WIDE).

e. Meter Display Pushbuttons

The METER DISPLAY pushbuttons select either RF or AF input levels for display on the meter. The RF level is in dB above 1 microvolt RMS; the AF level is the 600 ohm line level in dBm (1 milliwatt equals 0 dBm).

f. AGC Switch

The AGC FAST/SLOW toggle switch controls the AGC decay time (FAST equals 200 milliseconds and SLOW equals 1.5 seconds). The FAST position normally is for CW signals and the SLOW position normally is for SSB signals.

g. RF Gain/AGC Off Control

The RF GAIN/AGC OFF control knob permits manual adjustment of overall RF/IF receiver gain. The AGC is automatically disabled when this control is used.

h. Preselector and Tuning Controls

The PRESELECTOR BAND MHz control knob selects the proper preselector tuning range. It has 10 bands, labeled in MHz as follows (WIDEBAND denotes 15 kHz to 29.99999 MHz).

Wideband

.015-.10
.10-.16
.16-.32
.32-.73
.73-1.8
1.8-4.0
4.0-8.0
8.0-16.0
16-30

The TUNING control knob provides tuning in all PRESELECTOR positions but WIDEBAND and .015 to .1 kHz, and is used in conjunction with the RF meter to peak the receiver's input signal. The TUNING control matches the receiver front end to the antenna and provides increased selectivity.

i. Antenna Attenuator Switch

The ANT. ATTEN. IN/OUT toggle switch, when set to IN, provides a 20 dB attenuator in series with the antenna input to reduce interference from extremely strong signals.

j. Audio Gain Control/Power Switch

The AUDIO GAIN/POWER OFF switch turns the power on and off and adjusts the audio level of the speaker and headphones. Turning the knob clockwise turns on the receiver and increases the gain; turning the knob counterclockwise decreases the gain and turns off the receiver.

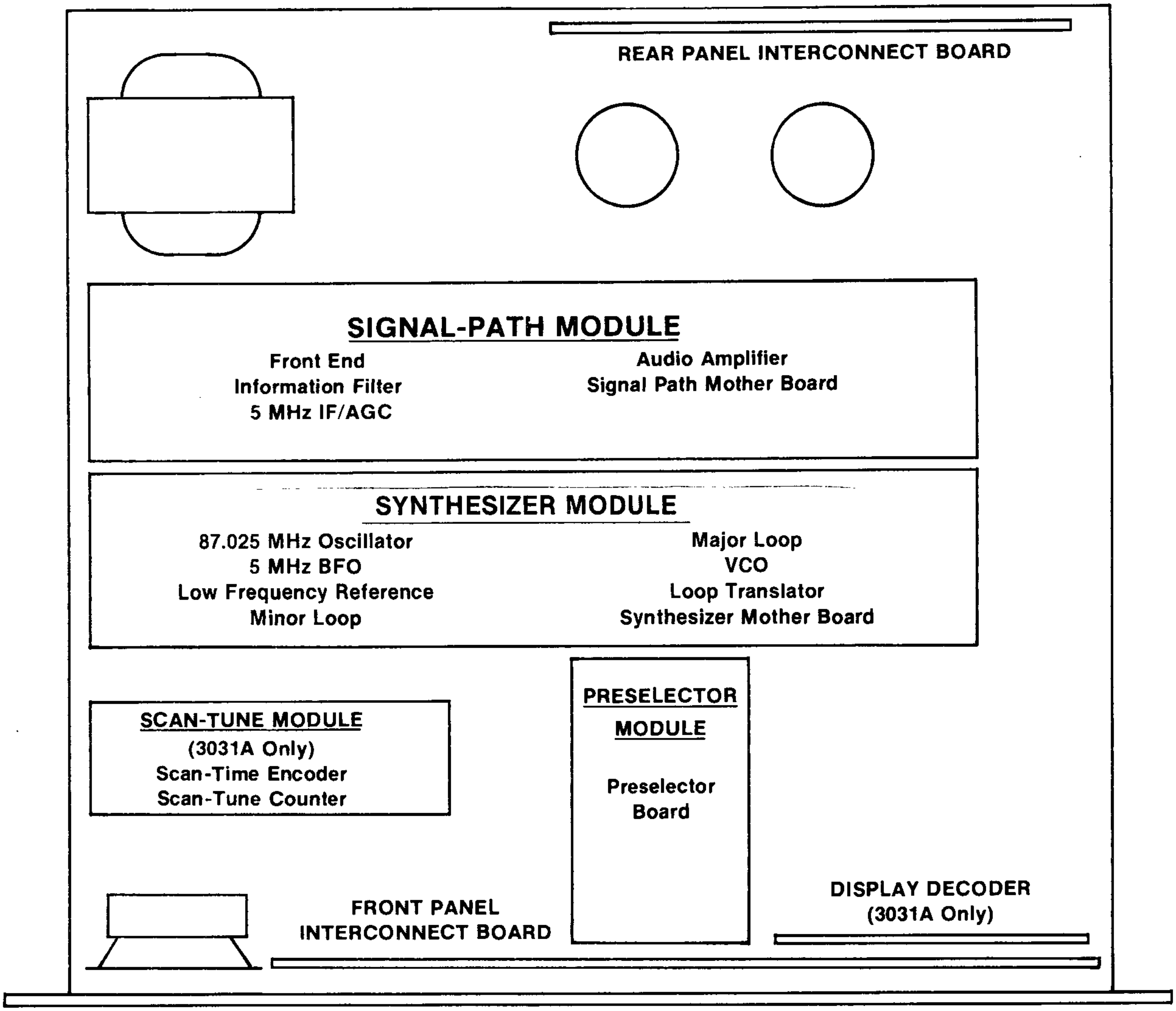
SERVICEABILITY

The 3030A and 3031A receivers have been designed to be particularly easy to service. Compared to previous ITT Mackay receivers, even more of the components are located on printed circuit boards so that maintenance usually can be rapidly achieved by substituting a circuit board. With the exception of the power supply circuits, interconnections are accomplished by interconnection PC Boards, coaxial cables with snap-on connectors and flat ribbon cables with plug-in connectors.

A further improvement is that most of the individual circuit boards are grouped and contained in larger modules that also use plug-in connections and can be readily removed. The individual circuit boards within such a module have handles for extraction purposes, are color-coded and have guide pins of different sizes to ensure they are replaced in their correct positions. Each module has connecting cables of sufficient length so internal adjustments and measurements can be made with the receiver operating; no special extender cards or test cables are needed. This modular construction concept is advantageous when service has to be performed under field conditions, such as aboard ship. For example, a synthesizer fault can be repaired very quickly by exchanging the entire synthesizer module.

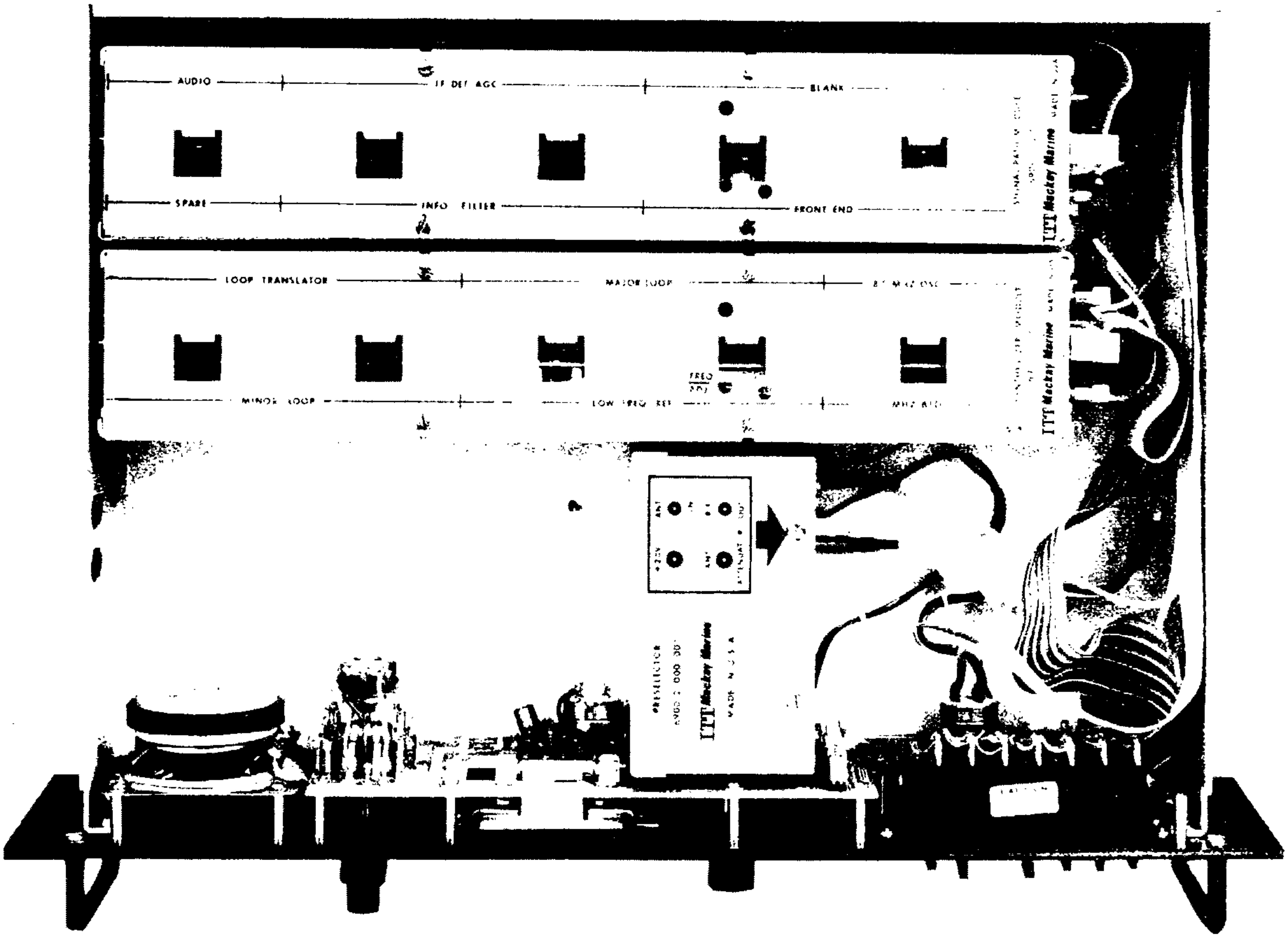
As most of the individual components in the 3030A and 3031A receivers are contained on printed circuit boards and as the majority of interconnections to the boards are of a plug-in nature, maintenance is also easy for those customers who wish to service at the component level.

The diagram and photographs on the next pages demonstrate the ease of servicing at the module level, the circuit board level and at the component level.

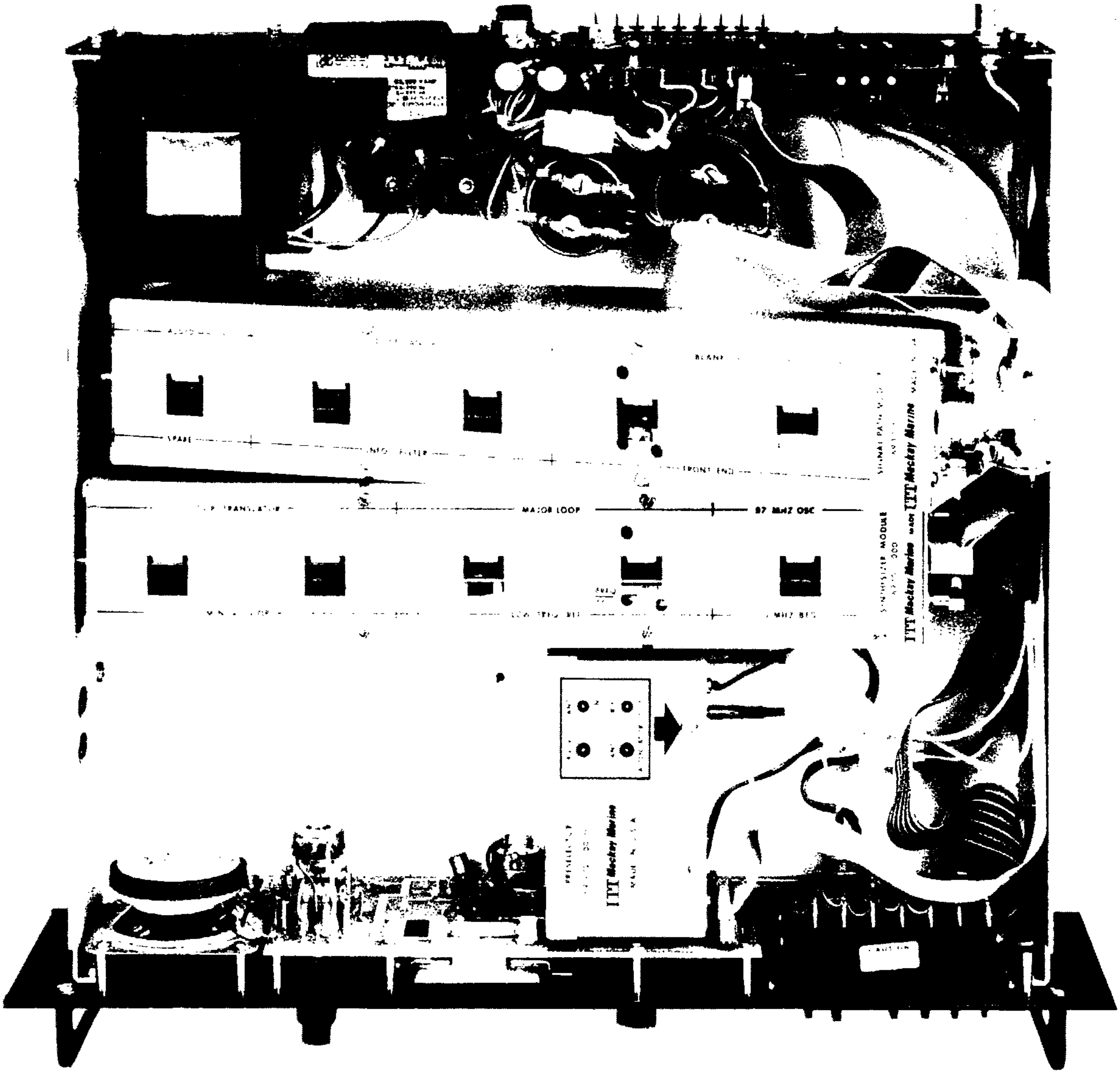


3030A/3031A RECEIVER — LOCATION OF PRINTED CIRCUIT BOARD AND MODULES

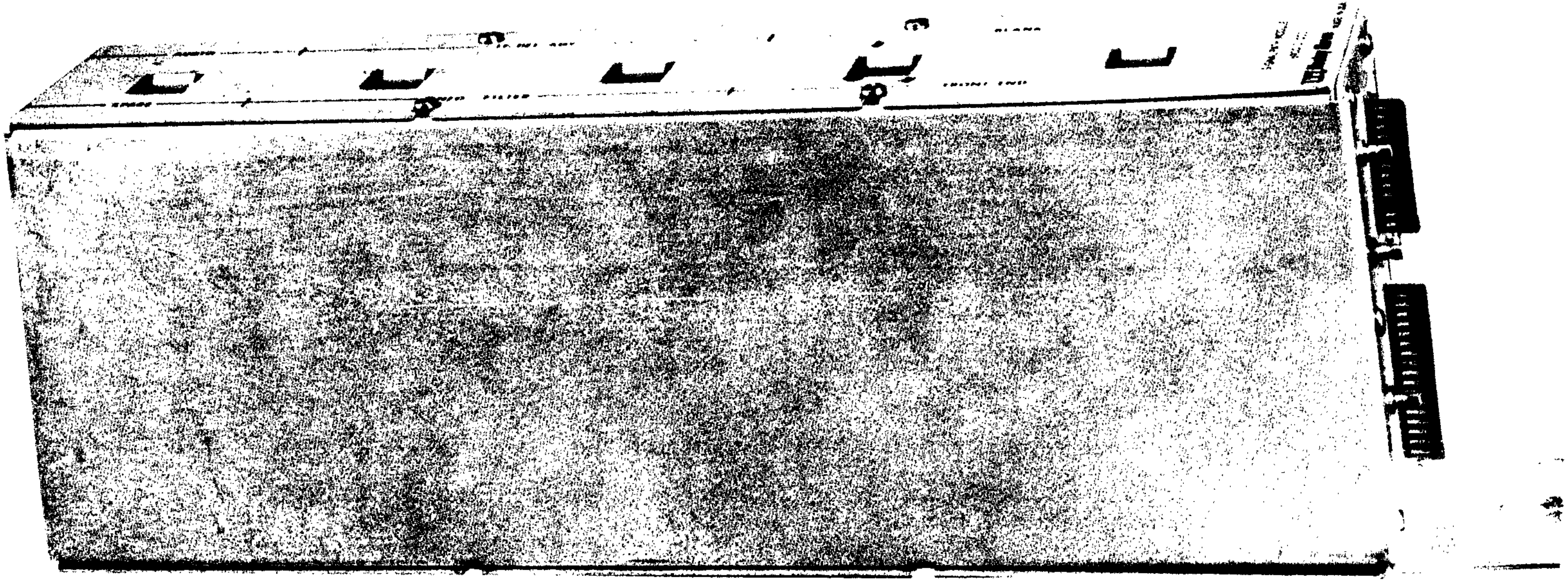
(Top View, Cover Removed)



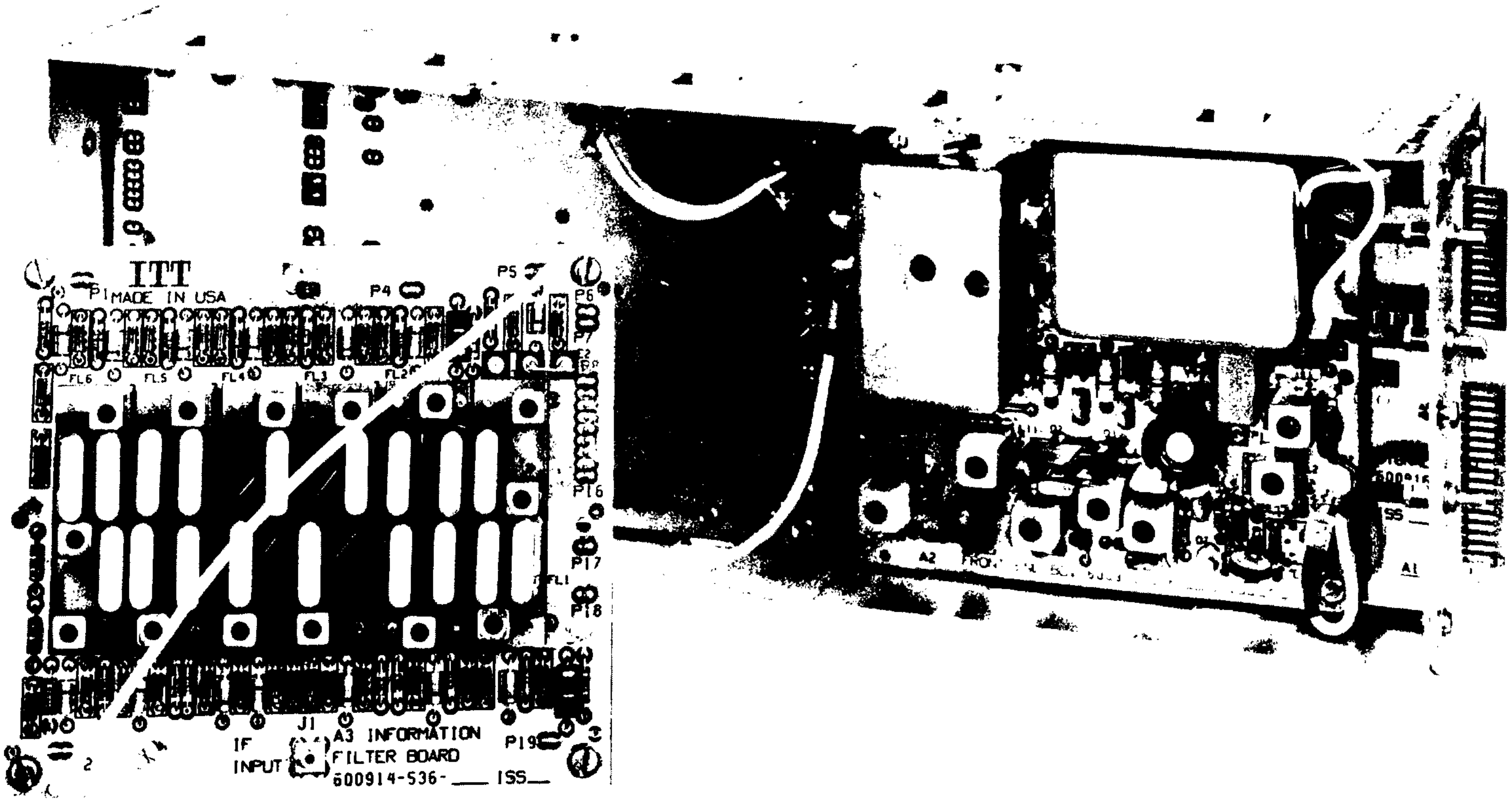
Top View of 3020A showing location of synthesizer, signal path and preselector modules.



3020A with signal path module being removed from service.



3020A signal path module removed for exchange or service.



3020A Signal path module opened for service. The information filter printed board sub-module has been unplugged for inspection.

CIRCUIT DESCRIPTION

GENERAL

The following modules are installed in the 3030A and 3031A: (1) the SIGNAL PATH module, which provides mixing, filtering, and amplification, (2) the SYNTHESIZER module, which generates various outputs to provide mixer and product detector signals for the signal path module, and (3) the PRESELECTOR module, which matches certain marine antennas to the receivers. In addition, the SCAN TUNE module, which is installed in the 3031A, facilitates scan tuning.

Each of the modules houses at least one printed circuit board. Plug-in type boards are utilized in each module housing more than one PC Board. The signal path and synthesizer modules have mother boards which interconnect the sub PC Boards containing the actual circuitry.

SIGNAL PATH MODULE

Refer to the signal path block diagram, drawing 690013-028. The received signal passes through the preselector module and is routed to the signal path module. The preselector has an overload protection circuit which will sustain a 30-volt EMF applied signal for 15 minutes without damage to the receiver. The preselector also has a low-pass filter which rejects incoming signals above 40 MHz and various local oscillator signals which otherwise would leak to the antenna output connector.

In the signal path module, the signal passes through a low-pass filter (which provides additional rejection), then is applied directly to a high-performance, double-balanced mixer. The mixer is followed by a low-noise, high-dynamic-range 92 MHz IF amplifier. This combination simultaneously provides a good balance between overload immunity and overall noise figure.

To obtain high-level overload performance, the mixer is pumped at +17 dBm (1.5 volts rms) of local oscillator injection. The local oscillator is run at 92 to 122 MHz so that incoming signals are up-converted to the 92 MHz first IF frequency.

The 92 MHz IF amplifier has three gain stages and two sections of crystal bandpass filters for obtaining the required selectivity. The final 92 MHz amplifier is also controlled by the AGC circuitry to provide delayed AGC. This amplifier drives the second mixer which converts the 92 MHz IF signal to 5 MHz by mixing it with the 87 MHz signal derived from the synthesizer.

The resultant 5 MHz second IF is applied to selectable crystal filters located on the information filter PC Board, which yield final IF selectivity appropriate to the desired signal mode. For AM, an 8 kHz filter normally is used (a 6 kHz filter is available as an option). In the CW mode, the operator can select an 8, 2, 1, or 0.4 kHz filter to provide high performance reception in crowded communications bands. In the USB mode, a filter is selected which essentially passes signals removed by 350 Hz to 2700 Hz from 5 MHz, and rejects others. (In the optional RTTY mode, a filter centered at 1700 Hz removed from 5 MHz provides a 400 Hz bandpass for optimum reception of narrow-shift RTTY signals).

The output from the information filter PC Board then is applied to the 5 MHz IF PC Board. The 5 MHz IF PC Board has two IF gain stages which provide approximately 80 dB of controllable gain. The amplified signal is applied to appropriate detectors for AM, CW, or SSB signals, and also is applied to the AGC detector. For AM, a diode detector is provided; for CW and SSB, a high-performance product detector is provided. The output from these detectors is applied to the audio amplifier PC Board (described later).

The AGC detector drives a dc amplifier which has selectable decay time constants. The decay times, of approximately 50 milliseconds and 1.5 seconds, permit optimum reception of stable or rapidly fading signals in all modes. Attack time for the circuit is about 5 to 10 milliseconds. The AGC is applied to the two 5 MHz IF stages previously described, and to the 92 MHz IF stage through a delay circuit.

The audio signal from the detectors is applied to a gain controlled amplifier, which is adjusted by a dc level obtained from the front panel audio gain control. The amplified signal then drives a 3.5 watt amplifier which drives either the internal speaker or an external unit that can be connected to the rear panel barrier terminal strip.

The audio amplifier PC Board has a low-level amplifier which drives a 600 ohm balanced line at an output level of up to +10 dBm. This amplifier is independent of the front panel audio gain control, but can be adjusted with the board-mounted potentiometer to obtain the desired line level. The line output is accessible at the rear panel barrier terminal strip. This line level can be monitored by the front panel meter. The meter also monitors the AGC voltage to indicate relative input signal levels. The metering functions are pushbutton selectable.

SYNTHESIZER MODULE

Refer to the synthesizer block diagram, drawing 600015-028. The synthesizer module generates outputs of 5 MHz, 87 MHz, and 92 to 122 MHz to provide mixer and product detector signals for the signal path module. The circuitry consists of three phase-locked loops, an 87 MHz crystal oscillator, a 6 MHz crystal controlled BFO, and a low frequency reference.

a. Low Frequency Reference PC Board

The low frequency reference PC Board provides outputs of 5 MHz, 100 kHz, and 1 kHz. The 5 MHz output is fed directly to the signal path module where it is applied to the product detector on the 5 MHz IF PC Board. In the SSB mode, this signal is derived from a high stability, 10 MHz temperature compensated crystal oscillator (TCXO) by dividing the TCXO output by 2. In the CW mode, the signal is derived from the 5 MHz BFO PC Board, which generates a 5.001 MHz ($\pm$1.1 kHz) output that can be adjusted by the front panel BFO tuning control. This oscillator permits the CW beat note to be varied from 0 to approximately 2 kHz.

The 1 kHz output is applied to the minor loop PC Board for use by the phase comparator. The minor loop output is phase locked to this reference. In addition, the minor loop output is added to the final output of the synthesizer so that a change in the minor loop frequency causes a like change in the synthesizer output (and a corresponding change in the receiver tuned frequency).

The minor loop output can be changed in 10 Hz increments by changing its counter address (controllable from the front panel). In some applications, the operator may desire continuous adjustment of the received frequency. This is accomplished by deriving the 1 kHz output from a variable frequency crystal oscillator (the 5 MHz clarifier oscillator). Due to the nature of the circuitry involved, a 1 kHz change in the clarifier oscillator frequency causes a 200 Hz change in the final output frequency. See the low frequency reference PC Board description for details.

The 100 kHz output is applied to the major loop PC Board as the phase comparator reference. This output is also derived from the 10 MHz standard by dividing down. The 1 kHz and 100 kHz outputs are both TTL.

b. Minor Loop PC Board

The minor loop PC Board generates a 1 to 1.09999 MHz output which moves in 10 Hz, 100 Hz, 1 kHz, or 10 kHz steps. The output is phase locked to a 1 kHz reference. A 100 to 110 MHz VCO output is divided down to 1 kHz and applied to a phase comparator. By changing the modulus of a variable divider, the VCO frequency changes; the VCO frequency is defined as follows:
$f_{VCO} = Nf_{ref}$. In this case, $N = 100 \times 10^3$ to 109.999×10^3 and $f_{ref} = 10^3$ Hz, so f_{VCO} ranges from 100 MHz to 109.999 MHz. The VCO actually moves 1 kHz for an integer change in N.

The VCO output, however, is divided by 100 to obtain the final 1 to 1.09999 MHz output so that a 1 kHz step causes a 10 Hz change at the 1 MHz output. This technique permits use of a 1 kHz reference to obtain low lock time and high spectral purity, while simultaneously generating small step sizes.

c. Loop Translator PC Board

The loop translator PC Board provides the facility for the minor loop output to be translated up to 88 MHz and combined with the major loop to obtain a final synthesizer output that moves in 10 Hz steps.

The loop translator has a VCO which oscillates at 88.0 to 88.09999 MHz. This VCO output is mixed with a signal from the 87 MHz oscillator PC Board to produce a difference frequency of 1 to 1.09999 MHz. This signal is applied to the phase comparator, together with the 1 to 1.09999 MHz signal from the minor loop PC Board. As the minor loop frequency varies, the translator VCO tracks the minor loop. Thus a 10 Hz shift in the minor loop frequency moves the 88 MHz translator output by 10 Hz.

d. Major Loop PC Board

The major loop PC Board provides the final synthesizer output for the receiver first mixer; this output is 92 to 121.99999 MHz (see the block diagram). In order to combine the translator output with the major loop signal, these two signals are mixed down. The resultant 4 to 33.99999 MHz signal drives the major loop variable divider; the divider's output is 100 kHz. This signal is applied to the phase comparator, together with the 100 kHz reference from the low frequency reference PC Board.

If the translator output stays constant and the major loop divider modulus is changed, the major loop output changes to maintain the 100 kHz applied to the phase detector. The equation for this loop is as follows:

$$f_{MAJ\ LOOP} = Nf_{ref} + f_{TRANSLATOR}$$

The major loop output can be moved in 100 kHz, 1 MHz, or 10 MHz steps by varying N; interpolation between these steps is accomplished by moving the translator frequency.

The major loop VCO PC Board is mounted on the major loop PC Board.

e. 87 MHz Oscillator PC Board

The 87 MHz oscillator PC Board provides an output that is applied to the loop translator and the receiver second mixer. Although this oscillator is not phase locked to the 10 MHz standard, it is injected into the translator and second mixer so that any drift associated with this oscillator cancels by the time the incoming signal reaches the 5 MHz second IF. This maintains overall receiver frequency stability.

f. 5 MHz BFO PC Board

The BFO is a 5.001 MHz voltage controlled crystal oscillator (VCXO) which can be trimmed approximately ±1.1 kHz. Its output ranges from 4.9999 to 5.0011 MHz, accomplished by varying the voltage applied to a varicap diode placed in the frequency determining network. Adjustment can be made by a potentiometer mounted on the front panel.

PRESELECTOR MODULE

The primary function of the preselector module is to provide selectivity ahead of the first mixer above 100 kHz, and to provide matching of short antennas in the 100 kHz to 4 MHz frequency range. Below 100 kHz and above 4 MHz, the receiver input impedance is nominally 50 ohms.

In the frequency band 15-100 kHz, the preselector acts only as a passive low-pass filter which rejects interfering signals above a 100 kHz cut-off frequency. In the five frequency bands from 100 kHz to 4 MHz, an FET amplifier provides about 5 dB of gain to compensate for preselector network loss. Because the preselector has a net voltage loss in these bands, the receiver maintains good intermodulation performance. Above 4 MHz, however, where there is less network loss, the preamp is switched out and the receiver achieves its maximum rejection to intermodulating signals. This rejection is technically characterized by the high intercept point of +17 dBm and gives the receiver excellent immunity from interference in the crowded HF bands. Above 4 MHz the preselector acts as a tuneable bandpass filter having a nominal 50 ohm input and output impedance and can be fine-tuned over 3 bands; 4 to 8, 8 to 16 and 16-30 MHz.

The preselector can be operated in the wideband position (50 ohms in and out), in which case it looks transparent between 15 kHz and 30 MHz. This position allows the operator to tune continuously over the receiver's range with no need to make additional tuning adjustments. The preselector also can be operated on individual bands, selected to permit matching short antennas below 4 MHz or to provide selectivity in 50 ohm systems above 4 MHz.

To reduce interference from adjacent and/or high power transmitters, the preselector has a 20 dB pad which can be switched in to attenuate incoming signals. Under certain conditions, in which the receiver is severely overloaded, the pad permits reception of signals that otherwise would be unintelligible.

The preselector also has a low-pass filter which attenuates signals above 30 MHz. In particular, this filter provides image suppression because the first image of the receiver is 184 MHz above the tuned channel frequency. The filter also reduces first local oscillator feedthrough to the antenna connector to prevent unwanted signal radiation from the receiver.

SCAN TUNE MODULE (3031 ONLY)

The scan tune module provides the circuitry which facilitates scan tuning. To accomplish scan tuning, the angular rotation of the tuning knob must be converted to a digital address for the synthesizer. This address must be applied to a frequency readout for displaying the receiver tuned frequency.

The conversion is achieved by using a scan tune generator mechanism, consisting of a chopper disk attached to the shaft of the tuning knob, and two opto-couplers which monitor the movement of the disk. The opto-couplers are comprised of an LED and a photocell combined into a single unit. The LED emits light which activates the photocell. Interrupting the light coupling causes a change in output at the photocell terminals. A succession of interruptions causes a pulsating output from the photocell. This is accomplished with the chopper disk.

The two opto-couplers are spaced so that their pulses are 90 degrees out of phase which permits the direction of the chopper disk rotation to be detected. Logic in the scan tune module senses a change in direction of the chopper disk which produces a command to the up-down counter, the main component in the module.

The up-down counter counts the pulses from one of the opto-couplers (the "Q" terminals on each counter ship can be monitored to determine the state of an individual chip). The resultant BCD readout provides the address for the 3031A front panel frequency display. As the tuning knob is rotated in one direction, the counter increments; it decrements when the knob is rotated in the opposite direction.

The BCD code is applied simultaneously to the synthesizer and to the frequency readout. Since the readout is constructed of seven-segment LED displays, the BCD is converted to a seven-segment code by the code converter/display driver mounted on the front panel.

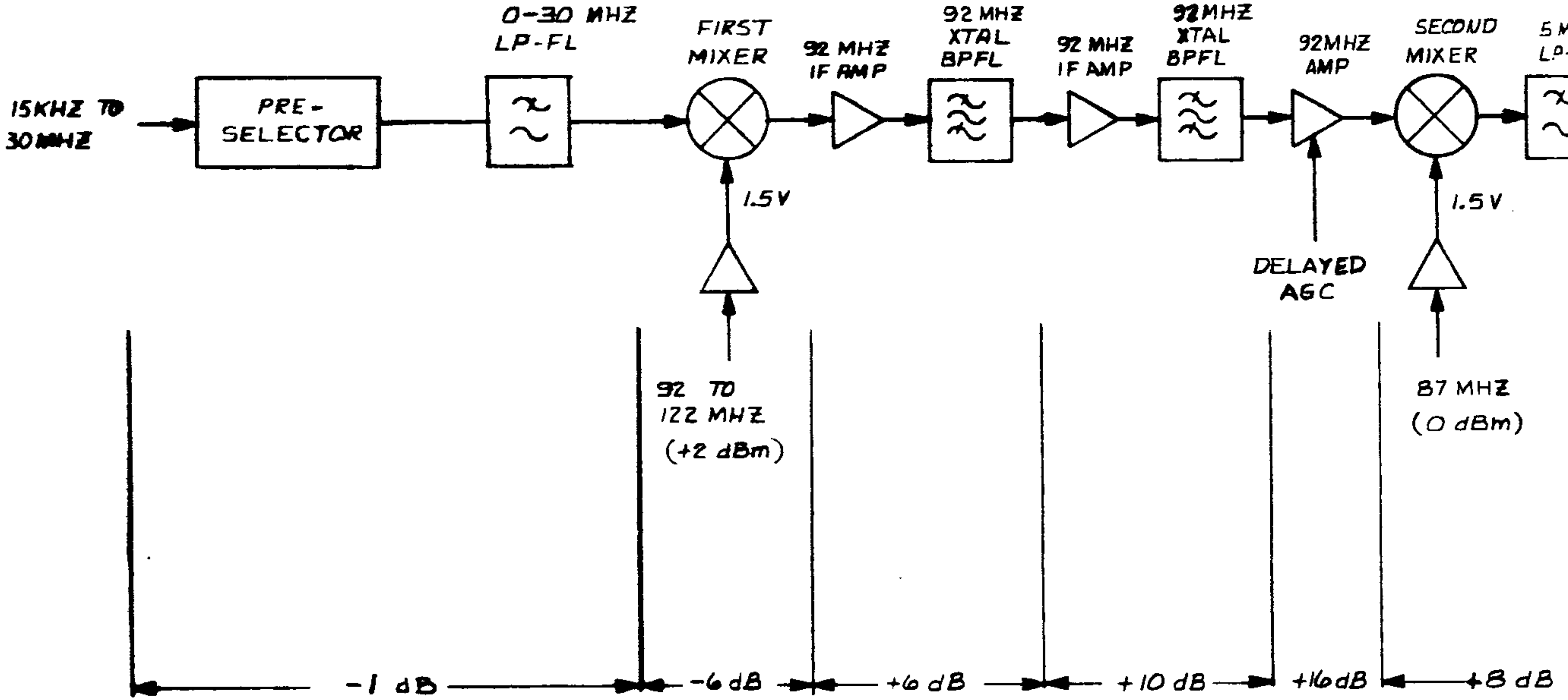
There is very little power consumption because the chips in the scan tune counter are all CMOS. This permits the state of the counters to be maintained with an internal 6-volt NICAD battery when the 3031A is turned off. This, in turn, allows the 3031A to remain at its tuned frequency; power interruptions do not necessitate retuning the receiver.

POWER SUPPLY

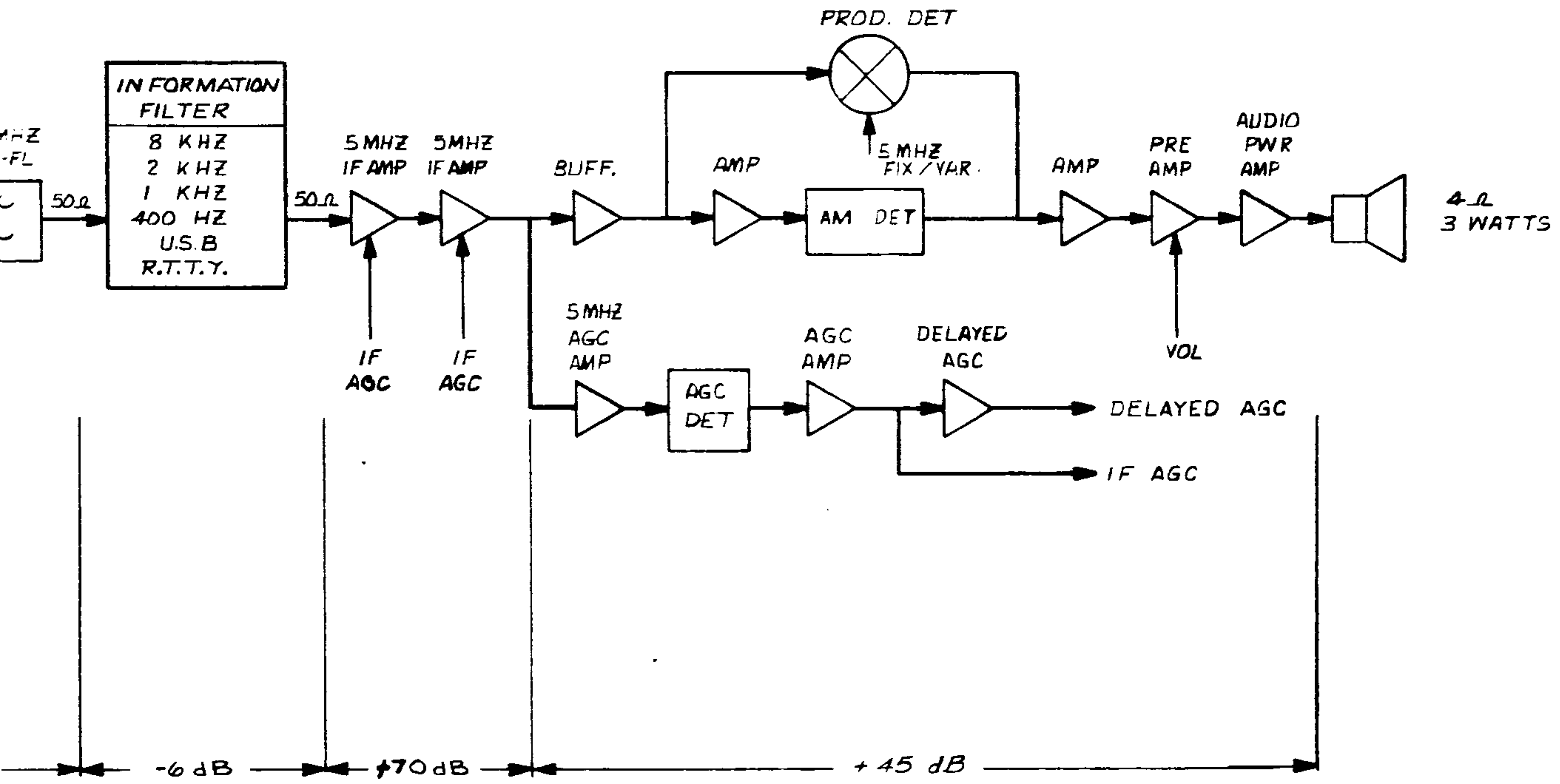
The power supply consists of regulated outputs of +5, +12, and +20 volts dc. These voltages are derived from a bridge rectifier, followed by single-chip current limited voltage regulators.

The +5 volt supply has a crowbar circuit which shunts the line to ground if the line surges above seven volts (approximately) dc. Since the regulator is current limited, there is no damage to the supply and the sensitive TTL chips are protected from over-voltage blowout.

The power supply accepts 115 or 230-volt ($\pm$10%) ac inputs which are fused and selectable by means of a plug-in printed circuit strapping mechanism mounted on the rear panel. Change-over can be accomplished in less than one minute. The line cord is detachable to permit use with different types of power plugs, and to permit rapid removal from rack mounted installations.



15KHZ TO 30MHZ
PRE-SELECTOR
0-30 MHZ LP-FL
FIRST MIXER
1.5V
92 TO 122 MHZ (+2 dBm)
92 MHZ IF AMP
92 MHZ XTAL BPFL
92 MHZ IF AMP
92 MHZ XTAL BPFL
92MHZ AMP
DELAYED AGC
SECOND MIXER
1.5V
87 MHZ (0 dBm)
-1 dB
-6 dB
+6 dB
+10 dB
+16 dB
+8 dB



ITT Mackay Marine
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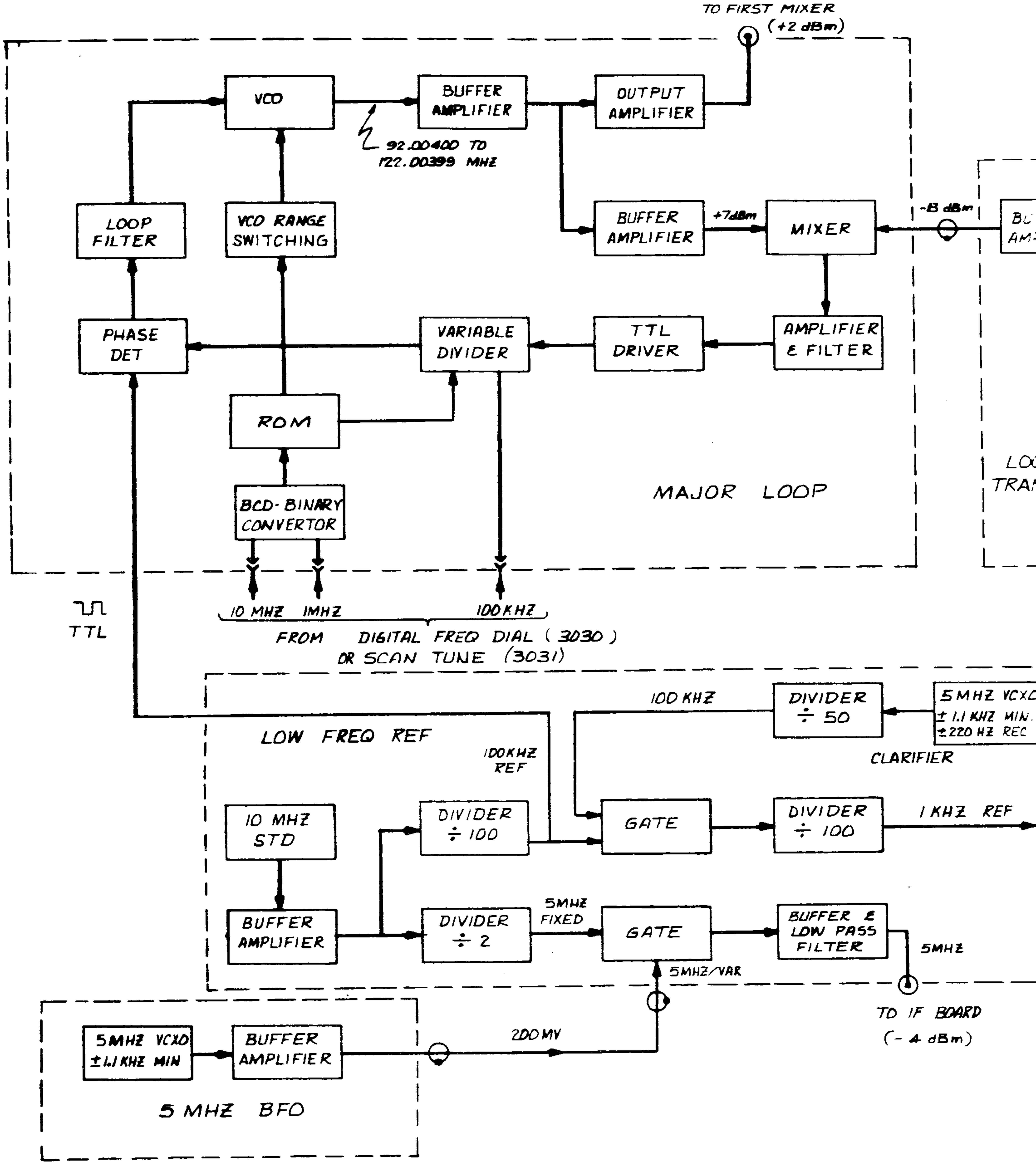
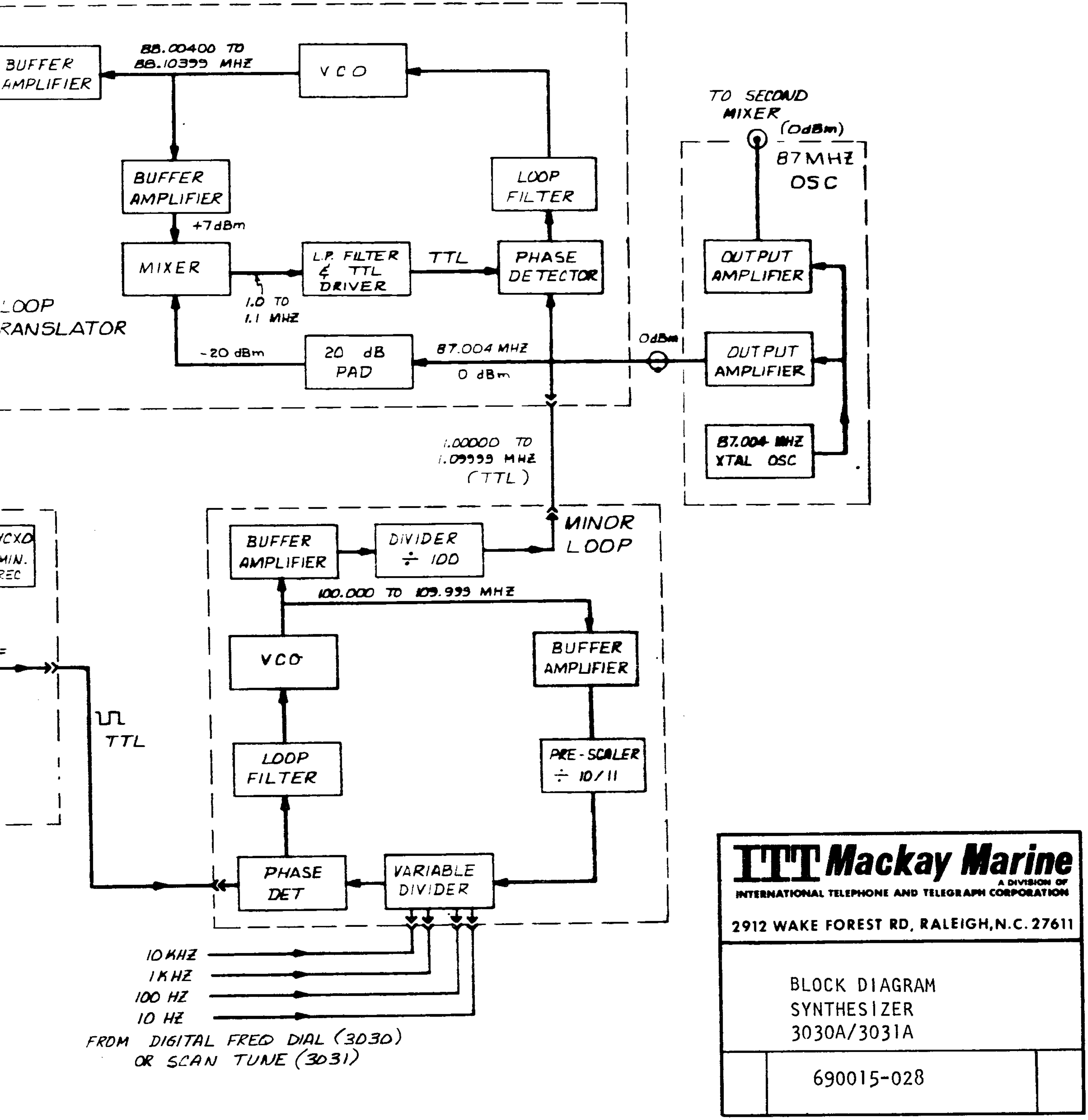
BLOCK DIAGRAM
SIGNAL PATH
3030A/3031A

690013-028



TO FIRST MIXER
(+2 dBm)
VCO
BUFFER AMPLIFIER
OUTPUT AMPLIFIER
92.00400 TO 122.00399 MHZ
LOOP FILTER
VCO RANGE SWITCHING
BUFFER AMPLIFIER
+7dBm
MIXER
-13 dBm
PHASE DET
VARIABLE DIVIDER
TTL DRIVER
AMPLIFIER & FILTER
ROM
BCD-BINARY CONVERTOR
MAJOR LOOP
10 MHZ
1MHZ
100 KHZ
TTL
FROM DIGITAL FREQ DIAL (3030)
OR SCAN TUNE (3031)
100 KHZ
DIVIDER ÷ 50
5 MHZ VCXO
± 1.1 KHZ MIN.
± 220 HZ REC
LOW FREQ REF
100 KHZ REF
CLARIFIER
10 MHZ STD
DIVIDER ÷ 100
GATE
DIVIDER ÷ 100
1 KHZ REF
BUFFER AMPLIFIER
DIVIDER ÷ 2
5MHZ FIXED
GATE
BUFFER & LOW PASS FILTER
5MHZ
5MHZ/VAR
TO IF BOARD
(- 4 dBm)
5 MHZ VCXO
± 1.1 KHZ MIN
BUFFER AMPLIFIER
200 MV
5 MHZ BFO



BUFFER AMPLIFIER
88.00400 TO 88.10399 MHZ
VCO
BUFFER AMPLIFIER
+7dBm
MIXER
L.P. FILTER & TTL DRIVER
TTL
PHASE DETECTOR
LOOP FILTER
1.0 TO 1.1 MHZ
LOOP TRANSLATOR
-20 dBm
20 dB PAD
87.004 MHZ
0 dBm
0dBm
TO SECOND MIXER
(0dBm)
87 MHZ OSC
OUTPUT AMPLIFIER
OUTPUT AMPLIFIER
87.004 MHZ XTAL OSC
1.00000 TO 1.09999 MHZ (TTL)
MINOR LOOP
BUFFER AMPLIFIER
DIVIDER ÷ 100
100.000 TO 109.999 MHZ
VCO
BUFFER AMPLIFIER
TTL
LOOP FILTER
PRE-SCALER ÷ 10/11
PHASE DET
VARIABLE DIVIDER
10 KHZ
1 KHZ
100 HZ
10 HZ
FROM DIGITAL FREQ DIAL (3030) OR SCAN TUNE (3031)
ITT Mackay Marine
A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
2912 WAKE FOREST RD, RALEIGH, N.C. 27611
BLOCK DIAGRAM
SYNTHESIZER
3030A/3031A
690015-028