INSTALLATION AND OPERATION MANUAL
HF-1030
VLF THROUGH HF RECEIVER
10 KHZ TO 30 MHZ
AM, CW, LSB, USB, FSK

ISSUE 2

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WARNING NOTE

DO NOT APPLY POWER TO THIS UNIT UNTIL THIS MANUAL IS READ AND UNDERSTOOD.

PROPRIETARY DATA

STANDARD WARRANTY

Cubic Communications, Inc. warrants their equipment to be free from defects in material and workmanship, except for tubes and solid-state devices, under normal use and service when used for the purpose for which designed, for a period of one year from date of shipment, provided that the notice of such defect is given to CCI, or its authorized service depot, within 60 days after discovery thereof and provided that inspection by CCI, or its authorized service depot, indicates the equipment or parts are defective to CCI's reasonable satisfaction. Tubes and solid-state devices are warranted for a period of ninety days.

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1.0 INTRODUCTION

The HF-1030 communication receiver is a general purpose receiver which permits reception of signals with carrier frequencies from 10 kHz to 29.99999 MHz in increments of 10 Hz. Typical applications are the monitoring of various transmissions in the VLF to HF frequency range, propagation measurements, and other applications such as point-to-point communication links. The receiver provides a high accuracy and setability of frequency. The various modes available will cover practically all emissions found on the shortwave bands. Additional external detectors can provide options such as independent sideband reception (ISB) or FM.

The signal strength meter displays the incoming voltage over a wide range, and an audio squelch circuit for voice signals permits the use of the receiver in telephone networks. The receiver is controllable by an external computer in all of its main functions.

As an unusual feature, the receiver provides electronic bandpass tuning which allows for positioning of the selective filters over a limited range near the indicated frequency.

The high immunity against interfering signals permits the operation of the receiver on large antennas or in the vicinity of nearby transmitters without an input attenuator and provides distortion-free reception. The AGC keeps the audio level nearly constant over a 120dB input signal range.

All control of frequency and mode selection can be performed remotely using parallel binary logic signals (12V CMOS). All operator selections can be remotely monitored.

The receiver is of modular design. Each of the RF or synthesizer sections are in individually shielded enclosures with extensive filtering and coaxial cables are used in interconnections. The audio amplifiers, AGC amplifiers, and switches are located on the main motherboard. The frequency control module is mounted behind the front panel and the power supply and squelch boards are mounted on the rear panel.

CUBIC COMMUNICATIONS
SIGNAL STRENGTH
VLF-HF RECEIVER
MODEL HF1030
10KHz-30MHz
TUNE
FREQUENCY-MHz
SET
CONTROL
AF GAIN
RF GAIN
MODE
SQUELCH
AGC DECAY
ON
POWER
PHONES

REMOTE CONTROL
EXT. REF. 1 MHz
REF. ADJ.
S.N.
CUBIC COMMUNICATIONS, INC.
OCEANSIDE, CALIFORNIA USA
SPKR
DC POWER
DC
FUSE
AC
AC POWER
AC SELECT
IF OUT
IF OUT
ANTENNA
LINE AF
WIDE BAND
455 KHz

2.0 SPECIFICATIONS

2.1 FREQUENCY

Range	10 kHz - 29.99999 MHz
Resolution	10 Hz steps
Stability (typical with internal reference)	1 ppm/month 1 Hz/°C 1 ppm after 15 min warm-up at +25°C
Tuning Modes	1. Level wheel control switches 2. Opto-electrical shaft encoder 1800 Hz and 18 kHz/turn 3. Remote control BCD
Display	7 digits high intensity red LEDs and lever wheel switches
Power Interrupt	Frequency data retained. Upon restoration of power, receiver automatically returns to previously tuned frequency.

2.2 MODES

AM	(A3 or 5K8A3EJ)
LSB	(A3J or 2K7J3EJ)
USB	(A3J or 2K7J3EJ)
CW	(A1 or OK1A1A)
FSK	(F1 or 1K8J2B)

2.3 RF INPUT

Input	50 ohms, BNC female
VSWR	less than 3:1
Sensitivity for 10dB SINAD (1-30 MHz, typical)	AM (A3) .3uV CW (A1) .1uV SSB (A3J) .2uV FSK (F1) .2uV
Preselection	32 MHz Low Pass; 1.6 MHz High Pass or Low Pass (automatically selected)
Gain Control	
Type	R.F. derived automatic (AGC) with manual override
AGC Range	120dB, minimum
AGC Threshold	0.5uV minimum; Inputs of 1uV-1V produce less than 6dB audio level change
AGC Time Constants (typical)	
CW, SSB, and FSK	Attack Time: less than 10ms Hold Time: Front panel variable 200ms to 3 seconds Release Time: 100ms
AM	Attack Time: 50msec Release Time: 50msec

2.4 IF SECTION

IF Frequencies	40.455 MHz, 455 kHz
IF Bandwidths	
40.455 MHz	±4 kHz at 6dB
455 kHz	(typical)
CW	0.375 kHz at 3dB 3.0 kHz at 60dB
FSK	1.2 kHz at 3dB 5.5 kHz at 60dB
SSB (USB/LSB)	2.2 kHz at 3dB 4.5 kHz at 60dB
AM	5.8 kHz at 3dB 14 kHz at 40dB
Ripple	Less than 2dB

2.5 INTERFERENCE IMMUNITY

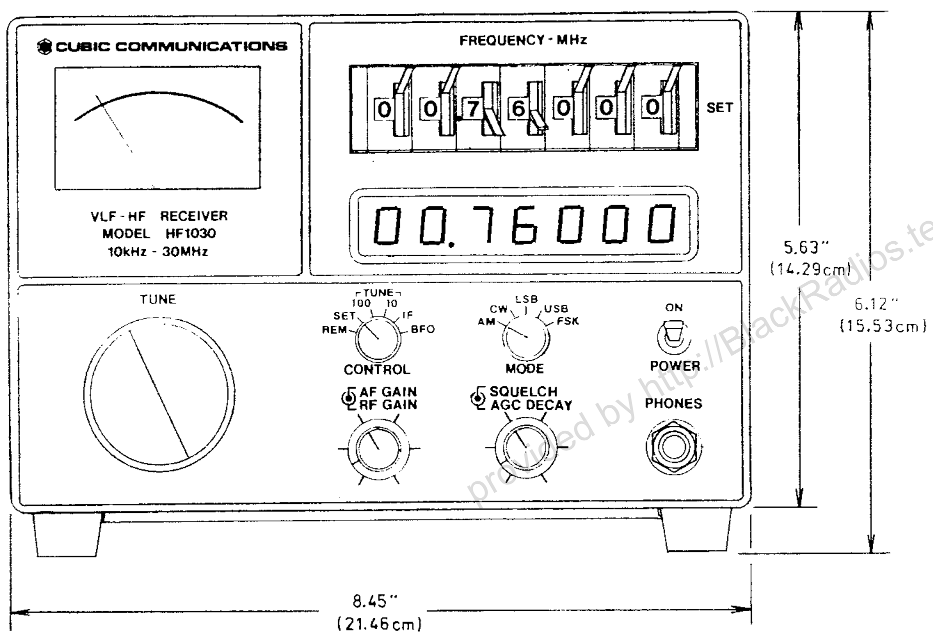
IF Rejection	greater than 100dB
Image Rejection	greater than 70dB
Cross Modulation	Unmodulated wanted signal of 100uV together with a modulated (30% at 1 kHz) unwanted signal of 250mV spaced 100 kHz apart produces less than 10% cross modulation of wanted signal.
Blocking	Attenuation of a wanted RF signal of 50uV and caused by an unmodulated unwanted signal of 1V spaced 100 kHz away, is less than 3dB.
Inherent Oscillator Re-radiation	1uV, worst case
Intermodulation Distortion (typical)	The 3rd Order I.M. products are at the level of the minimum discernable signal with two input signals each 100dB above the level of the minimum discernable signal.

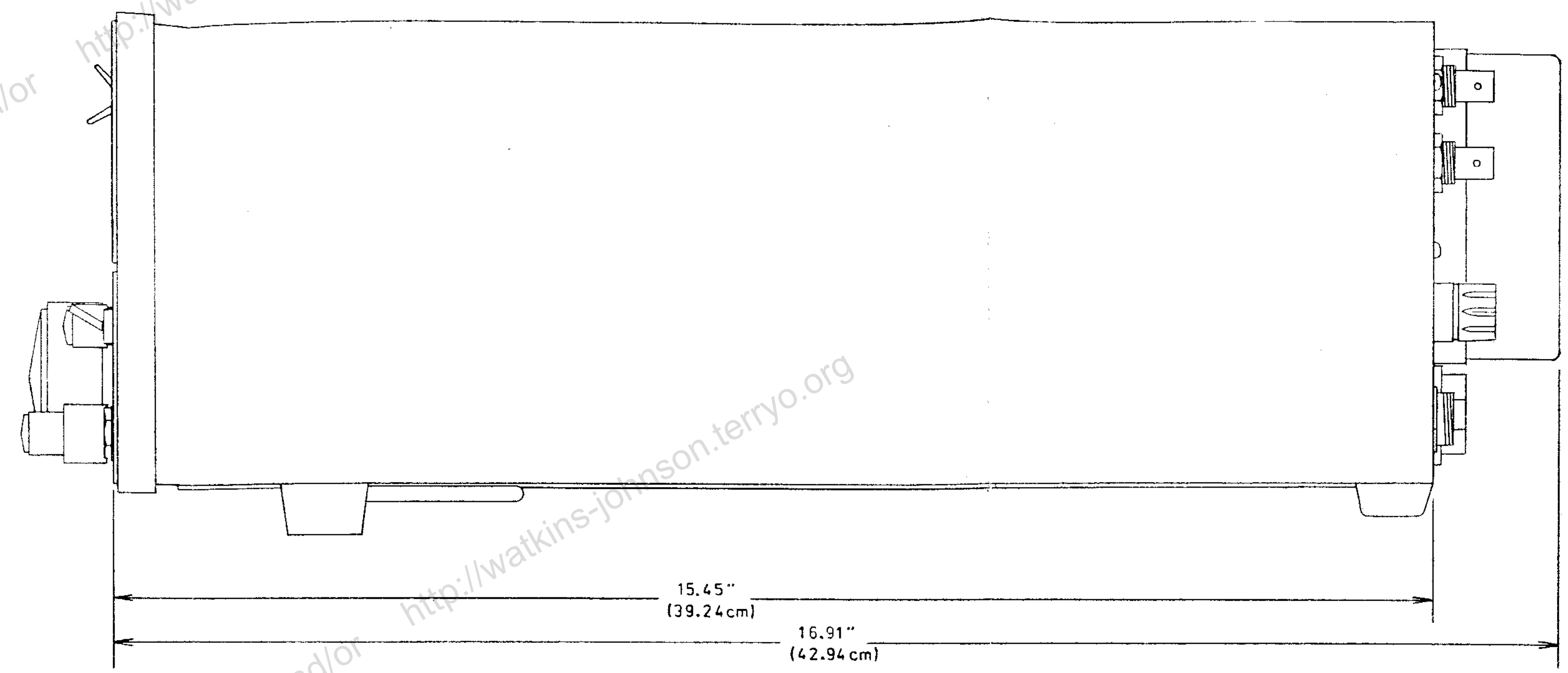
2.6 I/O SIGNALS

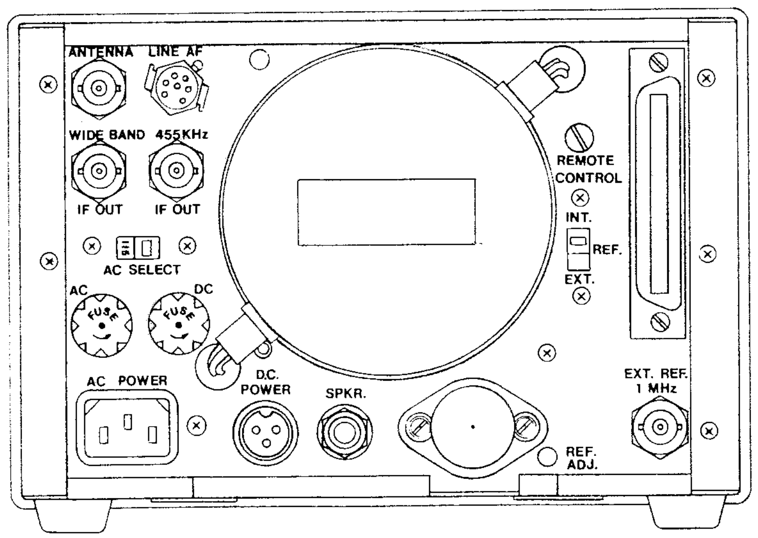
Wideband IF Output	40.455 MHz
IF Output	455 kHz; 200mV PEP into 50 ohm BNC female receptacle
Ref Oscillator Output/Input (Switch Selectable)	1 MHz; 1V EMF; R_s=1 k ohm BNC female receptacle
Audio Outputs	1. 600 ohms bal., 0dBm nominal Adjustable -10 to +3dBm 2. 2 watts at 4 ohms with distortion less than 10%
Control/Monitor	Via 50 pin 3M 3565 connector 1. BCD (1-2-4-8) 12V CMOS parallel command for frequency control or monitor. 2. Mode selection or monitor. 3. AGC output. 4. Receiver mute command.

2.7 GENERAL DATA

Temperature Range	0°C to +50°C; operating -25°C to +55°C; storage
Rel. Humidity	0 to 95% (less than 40°C)
Power Requirements	105 to 130 or 210 or 260 VAC 47-400 Hz; 25 watts 13-20 VDC; 1.8 amps
Size	216 mm x 143 mm x 425 mm (8½ in. x 5-5/8 in. x 16-3/4 in.) W - H - L
Weight	10.9 kg (24 lbs.) net







CUBIC COMMUNICATIONS, INC.		
SCALE: 1:1	APPROVED BY:	DRAWN BY R.ROE
DATE: 3-19-82		REVISED
OUTLINE DRAWING, HF-1030		
	REV	DRAWING NUMBER 1971-1003

3.0 INSTALLATION

The HF-1030 is designed for table top or rack panel mounting in a fixed or mobile environment in a relatively protected location. The unit is not water or dust proof, but will withstand normal interior exposure. The unit is powered from either a source of 105 to 130 VAC or 210 to 260 VAC, 47 to 400 Hz, or from a DC source providing negative ground 13 to 20 volts. After physically locating or mounting the unit in the desired location, the installation procedure consists of connecting up all the required or desired electrical connections.

Refer to Figure 3-1 for a pictorial of the receiver rear panel.

3.1 POWER

Determine if AC or DC voltage is to be used to power the receiver. Go to Section 3.1.1 if AC power is to be used and to Section 3.1.2 if DC power is to be used.

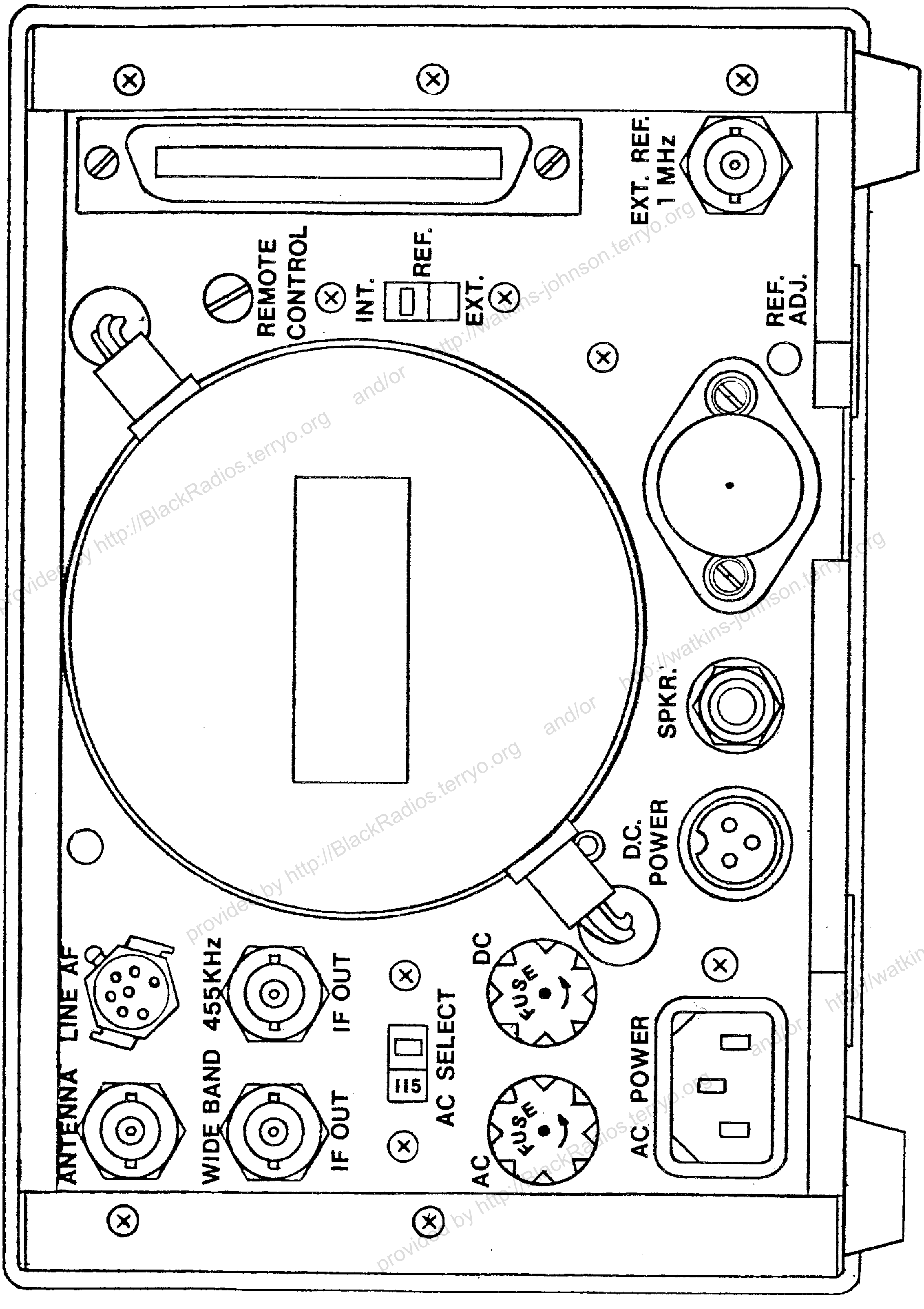
3.1.1 AC POWER

The AC power connector is an IEC standard 3 pin type with chassis ground connection. A mating cord set is supplied having a U.S.A. standard 3 pin plug for 115V service. Should a different plug be required, either cut off the U.S.A. standard plug and replace it with the desired plug or replace the cord set. The U.S.A. standard cord uses the black wire for the AC live side, the white wire for the AC line neutral, and the green wire for chassis ground. Only the green wire is connected to the chassis. CEE color code standards are brown for the live wire, light blue for neutral, and green with yellow for chassis ground.

Determine the AC line voltage available. If it is in the range of 105 to 130V, set the recessed handle slide switch to the 115V position. If the available line voltage is in the 210 to 260V range set the slide switch to the 230V position.

CAUTION: BE SURE THAT THE VOLTAGE SELECTOR SWITCH IS SET TO THE CORRECT POSITION FOR THE LINE VOLTAGE AVAILABLE.

Insert the correct fuse for the AC line voltage available, 1A for 115V, 1/2A for 230V.



REAR PANEL PICTORIAL

3.2 ANTENNA

Connect the antenna to be used to the BNC receptable on the rear panel. The impedance presented to the antenna will be approximately 50 ohms with a VSWR of less than 3 to 1.

It is important to note that an antenna suitable for the very low frequencies (such as 10 to 100 kHz or even higher) will not generally be useful at the higher frequencies and vice versa. The user must select the proper antenna for the frequency range desired.

3.3 FREQUENCY STANDARD

The HF-1030 is designed to use either its internal frequency standard or an external frequency standard where very high accuracy is required. The internal frequency standard provides an overall frequency accuracy of approximately 1 part per million (30 Hz at the highest frequency).

With the rear panel switch set to the INTERNAL position, the rear panel BNC receptacle will provide an output from the internal standard for frequency measurement or other uses. Output frequency is 1 MHz and is approximately a square wave. Output level is approximately 0.5V peak-to-peak and the unit can deliver this voltage into a 50 ohm load.

With the rear panel selector set to the EXTERNAL position, the rear panel BNC receptacle will accept an input from an external frequency standard. The unit will require an approximate square wave at 1 MHz with a level of 0.5V to 2V peak-to-peak. Input impedance is approximately 3K ohms.

Set the selector switch to the desired position. If required, connect a coaxial cable from the frequency standard receptacle to a frequency measuring device, another receiver, or an external frequency standard.

3.4 LINE OUTPUT

A 600 ohm balanced line output is available on the rear panel 7 pin accessory connector. The line connections are Pins A and B. A ground is available on Pin H, but is not connected in any way to the line outputs.

The output level is nominally set to be 0dBm (.774 VRMS) for either a CW signal of 50 microvolts RMS in LSB, USB, CW, or FSK modes or for a 100% modulated signal at 50 microvolts in AM mode. The output level is adjustable by an internal potentiometer over the range of -10 to +3dBm.

The output level will vary from -3 to +3dBm (with nominal setting) over the AGC range from -107dBm (1 microvolt) to 0dBm input signal level. The line output signal is muted by the receiver squelch circuits in the absence of signal, but is not muted by the remote control MUTE command.

3.5 SPEAKER OUTPUT

The low impedance speaker output signal is available on a rear panel phone jack. A standard 1/4 inch diameter phone plug is required.

The internal audio amplifier is capable of delivering in excess of 2 watts to a 4 ohm load with a distortion of less than 10%.

3.6 WIDEBAND IF OUTPUT

A wideband IF output is available on a rear panel BNC receptacle. This signal is centered at 40.455 MHz with a bandwidth of approximately 4 MHz. The signal level at this output is approximately the same as the signal level into the antenna input. This output may be used for wideband reception modes.

3.7 IF OUTPUT

A narrowband IF output is available on a rear panel BNC receptacle. This signal is centered at 455 kHz with a bandwidth determined by the MODE switch. The signal level at this output is established by the AGC circuits to be approximately 200mV peak-to-peak into a 50 ohm load with an input signal level of 50 microvolts RMS. The output level will vary over a -3 to +3dB range over an input signal level range of -107dBm (1 microvolt) to 0dBm.

4.0 REMOTE CONTROL

4.1 GENERAL

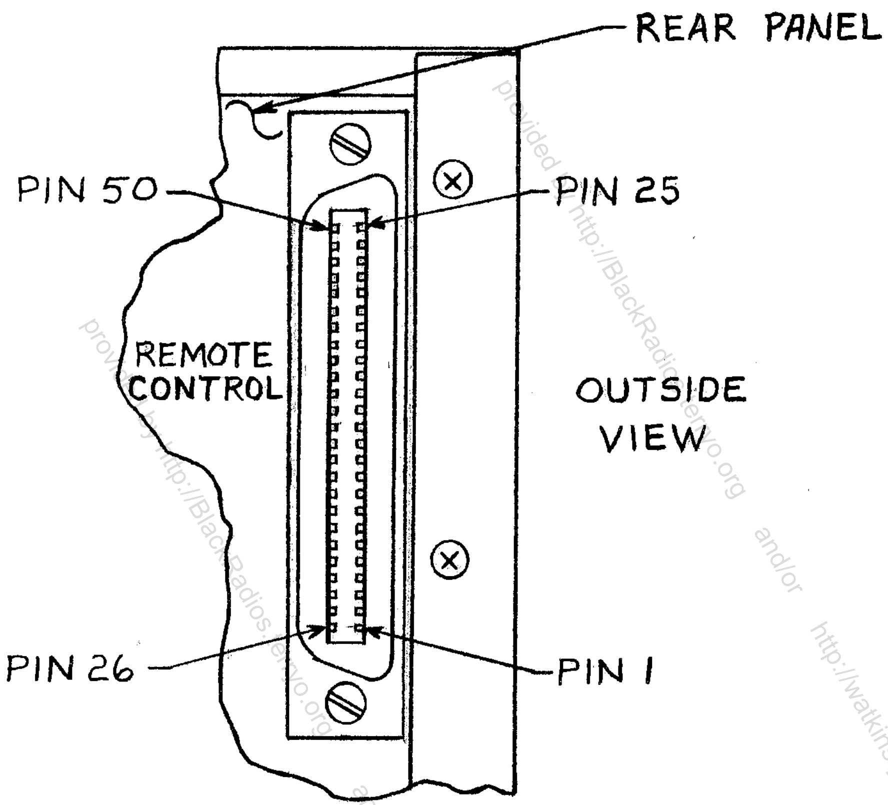
The rear panel REMOTE CONTROL connector provides the capability to control or monitor the receiver tuned frequency and mode from some remote location. Additionally, the remote device may measure the received signal strength and internal backup battery voltage, mute the speaker output, and blank the front panel frequency display. A source of regulated voltage is provided on the REMOTE CONTROL connector to be used by the remote interface device.

4.2 PHYSICAL CHARACTERISTICS

The connections required for remote operation of the HF-1030 are made through a single multi-pin connector on the rear panel. Depending on the application, the remote interface may include connection to the LINE AF jack or SPEAKER jack, also on the rear panel.

The REMOTE CONTROL connector iteself is a 3M type 3565 or equivalent ribbon cable type connector. The remote device should be connected with a 3M type 3654-1001 plug or equivalent (Cubic Communications part number 344-352) and 50 conductor flat ribbon cable (Cubic Communications part number 671-526). The mating connector is normally included in the HF-1030 shipment while the cable may be separately ordered.

Table 4-1 lists the pin connections of the remote control connector and Figure 4-1 shows the pin orientation.



CHASSIS RECEPTACLE:
3M 3565-1000

REMOTE PLUG:
3M 3564-1001

PLUG SHELL:
3M 3485-2500

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SCALE: 1 : 1	APPROVED BY: RJA	DRAWN BY R. ROE
DATE: 3-19-82		REVISED
REMOTE CONTROL CONNECTOR		
		DRAWING NUMBER

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 REMOTE LINE (PIN 15)

The REMOTE line, when pulled low by the remote device, disables the front panel MODE and CONTROL selectors, the TUNE knob, and the SET leverwheel switches. The external device may then place the frequency and mode data on the appropriate REMOTE CONTROL lines. The REMOTE line is normally held at about +1.5 volts by a 100K ohm pullup to +12 volts with diode clamping. The external device must use an active low only type switch such as an open collector NPN transistor to ground and must be pulled to a voltage below 0.5 volts but not below 0 volts.

Care should be taken to prevent the external device from attempting to control the FREQUENCY CONTROL lines when the HF-1030 is in normal operation, outputting frequency and mode data at the REMOTE CONTROL connector. This condition may result in damage to the HF-1030 or the remote device, and may best be prevented by implementing the remote device in such a way that the REMOTE line is pulled low any time the remote device is attempting to control the frequency or mode.

4.3.2 FREQUENCY CONTROL (PINS 1-13, 26-38)

The FREQUENCY CONTROL lines are arranged as seven independent digits of positive logic BCD data. Each digit has four associated control lines: A, B, C, and D. The A line is least significant. Each digit corresponds to one of the seven digits of the front panel display. 10 Hz is the least significant digit; 10 MHz is the most significant digit.

When the HF-1030 is in normal operation (i.e. not in remote control), the FREQUENCY CONTROL lines will output the operating frequency to the remote device. Lines which output a logic "1" are pulled to +12 volts and lines which are a logic "0" are pulled to ground. When reading the operating frequency, the remote device should present a load resistance of 10K ohms or greater to avoid loading the HF-1030 internal circuitry.

When the HF-1030 is in remote operation, the FREQUENCY CONTROL lines read the frequency from the remote device. To input a logic "1", the line should be taken to +9 to +12 volts. To input a logic "0", the line should be taken to 0 to +3 volts. In no case should any FREQUENCY CONTROL line be taken to less than 0 volts or to greater than +12 volts. All input lines are read in parallel and no strobe or clock input is necessary. When in remote operation, the FREQUENCY CONTROL lines present a resistance of 100K ohms.

4.3.3 MODE CONTROL (PINS 18, 20, 39, 43, 44)

Each of the five MODE CONTROL lines corresponds to one of the operating modes: FSK, AM, LSB, USB, and CW. When the HF-1030 is not in remote control, the one MODE CONTROL line corresponding to the selected mode will be pulled down to a voltage between 0 volts and +2.5 volts. The four remaining lines will be pulled up to a voltage between +10 and +12 volts. When reading the mode, the remote device should present a load resistance of 100K ohms or greater.

When remote operation is selected, the remote device selects the operating mode by pulling one of the five mode control lines to a voltage below +2 volts but not below 0 volts. This function should be implemented with an active low only type switch such as an open collector NPN transistor or a switch contact to ground.

4.3.4 FREQ LINE (PIN 46)

The FREQ line is used to control the front panel frequency display when in remote operation. When remote operation is selected, either by placing the front panel CONTROL selector in the REMOTE position or by pulling the REMOTE line low at the REMOTE CONTROL connector, the receiver frequency will be controlled by the remote device. The frequency display on the front panel, however, will indicate the last front panel tuned frequency or show all zeros. The frequency display can be made to show the current remotely controlled frequency by pulling the FREQ line low. (Between 0 and +3 volts).

CAUTION: When not in remote operation, the FREQ line is an output line indicating internal logic status and must not be pulled high or low.

4.3.5 BATTERY (PIN 45)

The BATTERY line is connected to the internal memory backup battery. This line may be used to monitor the status of the battery. The battery has a nominal voltage of 3.9 volts, with a life expectancy of five years under non-severe environmental conditions. Retention of data is assured with battery voltages of 3 volts or greater.

4.3.6 BLANK (PIN 19)

The BLANK line, when pulled low, causes the front panel frequency display to go blank. The line should be pulled to between 0 and +3 volts.

4.3.7 Ø1, Ø2, SET, TUNE, AND SLOW (PINS 16, 40, 41, 42, and 17)

These lines are internal logic output lines that indicate internal frequency control functions. They are not normally useful to the remote device except to indicate a manually set condition.

4.3.8 MUTE (PIN 49)

This line, when pulled high, causes the speaker audio to be muted. It should be activated by an active high only device to a level of between +6 and +12 volts. Input resistance is greater than 47K ohms.

4.3.9 +12 VOLTS (PIN 21)

The +12 VOLTS line is connected to the output of the +12 volt regulator in the HF-1030 power supply and may be used for low power requirements in the remote device. This line is typically used to power the logic circuitry used by the remote device to send and receive the frequency control information. This line should not be used to supply more than approximately 50 milliamperes.

4.3.10 AGC (PIN 24)

The AGC line is an analog output voltage used to indicate the relative signal strength of the tuned signal at the antenna connector. With no signal input, the AGC line voltage is approximately +1.75 volts and increases to over +3 volts at very strong signal levels. Output source resistance is 1000 ohms.

50 PIN REMOTE CONTROL CONNECTOR

PIN	FUNCTION		PIN	FUNCTION	
1.	10 Hz	A	26.	10 Hz	B
2.	10 Hz	C	27.	10 Hz	D
3.	100 Hz	A	28.	100 Hz	B
4.	100 Hz	C	29.	100 Hz	D
5.	1 kHz	A	30.	1 kHz	B
6.	1 kHz	C	31.	1 kHz	D
7.	10 kHz	A	32.	10 kHz	B
8.	10 kHz	C	33.	10 kHz	D
9.	100 kHz	A	34.	100 kHz	B
10.	100 kHz	C	35.	100 kHz	D
11.	1 MHz	A	36.	1 MHz	B
12.	1 MHz	C	37.	1 MHz	D
13.	10 MHz	A	38.	10 MHz	B
14.	GROUND		39.	LSB	
15.	REMOTE		40.	Ø2	
16.	Ø1		41.	SET	
17.	SLOW		42.	TUNE	
18.	FSK		43.	USB	
19.	BLANK		44.	CW	
20.	AM		45.	BATTERY	
21.	+12 VOLTS		46.	FREQ	
22.	N.C.		47.	N.C.	
23.	N.C.		48.	N.C.	
24.	AGC		49.	MUTE	
25.	N.C.		50.	RF GROUND	

TABLE 4-1

5.0 OPERATION

5.1 GENERAL

Operation of the HF-1030 is straightforward and relatively uncomplicated. However, with careful attention to the finer details of operation, considerable improvement in the quality of a marginal signal can often be made. The operator is encouraged to take the time to try each control and it's associated functions to learn of it's effect first-hand.

All normal operating controls are located on the front panel. For the following discussion, refer to Figure 5-1 for control location.

5.2 DESCRIPTION OF CONTROLS

The following is a brief description of the operating controls.

POWER Switch: Controls both AC and DC power inputs. The reference oscillator oven is not energized until this switch is turned on.

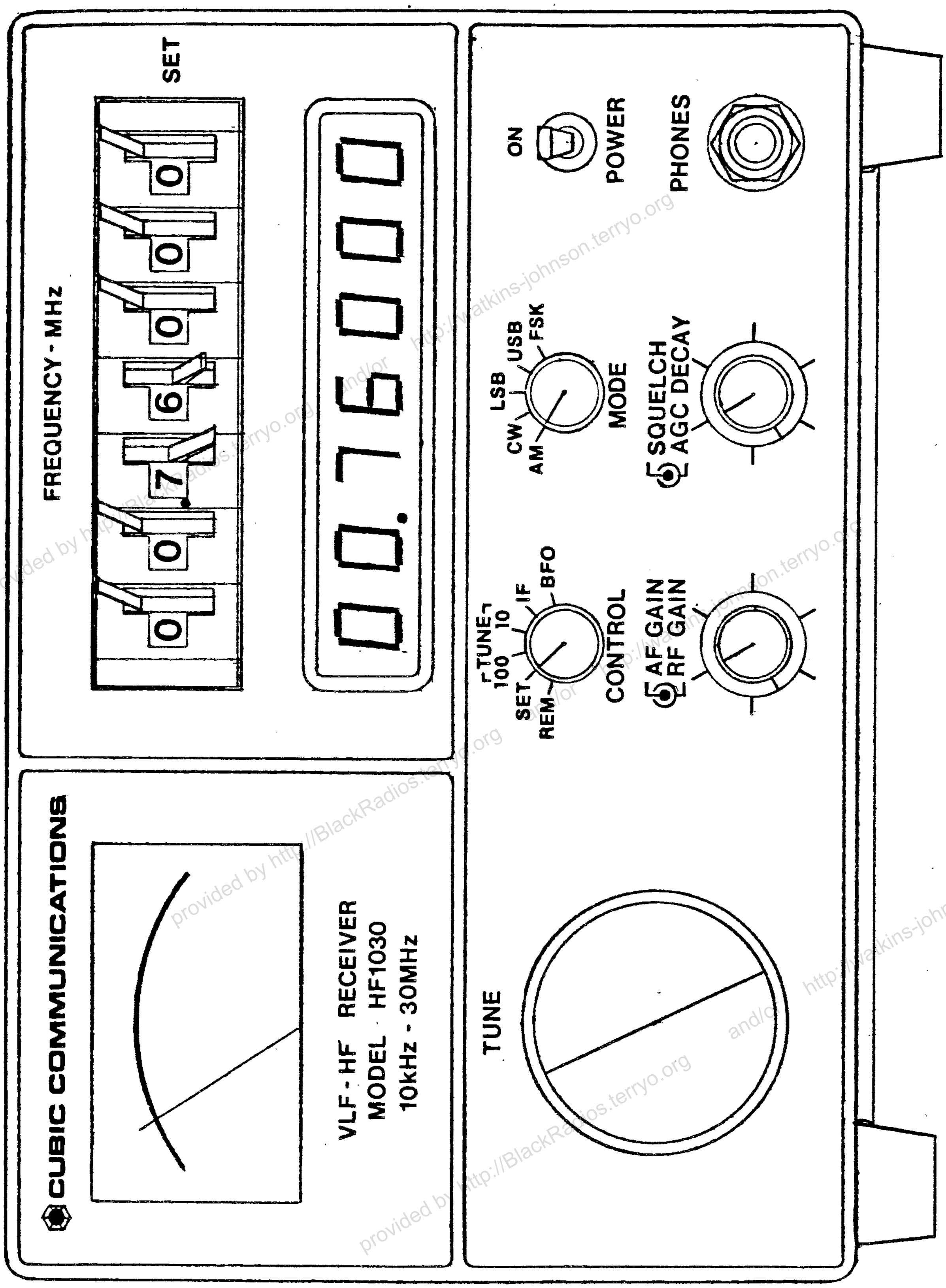
CONTROL Selector: Selects the method by which the operating frequency is varied. Also used to select IF SHIFT and BFO tuning.

MODE Selector: Controls the detection method and IF bandwidth required for the mode of operation desired.

SET Leverwheel Switches: Used to set the receiver to a specific frequency. Indicated frequency is in megahertz. The right-most leverwheel switch changes the frequency in 10 Hz steps, the next leverwheel switch to the left changes the frequency in 100 Hz steps, etc. The left-most leverwheel changes the frequency in 10 megahertz steps.

TUNE Control: Continuous rotation knob used to increase or decrease the operating frequency in 10 Hz or 100 Hz steps, at 1.8 kHz or 18 kHz per revolution and to control the IF SHIFT, and BFO TUNE functions.

AF GAIN Control: Inner knob of concentric pair used to adjust the speaker volume. LINE AF OUT is not affected.



FRONT PANEL PICTORIAL
FIGURE 5-1

RF GAIN Control: Outer knob of concentric pair used to lower receiver RF gain below the level set by the AGC.

SQUELCH Control: Inner knob of concentric pair that selects squelch operation and sets the squelch threshold.

AGC DECAY Control: Outer knob of concentric pair that controls the time period that the receiver gain stays reduced after a signal disappears.

In addition to the controls listed above, the HF-1030 front panel includes a signal strength meter calibrated in dBm and microvolts, a seven digit LED display of the operating frequency, and a headphone jack.

5.3 INITIAL SETTINGS

Before operating the HF-1030 it is useful to preset the operating controls to the settings listed here. The controls may then be varied as the need arises.

POWER........................Off (down)
AF GAIN......................9 O'Clock (approximately)
RF GAIN......................Fully clockwise
AGC DECAY....................Fully counter-clockwise
SQUELCH......................Fully counter-clockwise
MODE.........................To the desired mode
CONTROL......................SET position (see below)
SET..........................To the desired frequency

If the HF-1030 was previously tuned to a frequency with the TUNE control before the power was turned off, the internal memory is storing this frequency. If it is desired to return to this same frequency, the CONTROL switch must be in the TUNE 10, TUNE 100, or IF position before applying power or the stored frequency will be lost.

Energize the HF-1030 by moving the POWER switch to the ON position. Adjust the AF Gain to a comfortable listening level, and wait approximately 15 seconds for the oven temperature to stabilize.

The signal strength meter will indicate the approximate level of the signal or noise present at the antenna connector, if any.

Best frequency accuracy is obtained after approximately five minutes of operation.

5.4 SELECTION OF FREQUENCY AND TUNING

Operating frequency is always displayed on the LED frequency display. This frequency is the IF passband center frequency for the AM, FSK, and CW modes, and the suppressed carrier frequency for the USB and LSB (Single Sideband) modes.

There are two basic methods of frequency selection in the HF-1030, the SET method and the TUNE method. The method is selected by the CONTROL selector. In the initial settings above, the SET method is used.

5.4.1 SET

When the CONTROL selector is in the SET position, the operating frequency is always the same as the settings of the SET leverwheel switches. Any digit of the frequency can be varied independently of the others and the frequency display will always agree with the settings of the SET leverwheel switches. This method of tuning is most useful when the exact desired operating frequency is known ahead of time or as a preset to get the frequency setting into the approximate area where operation is desired, but the exact frequency is not known. The SET method may also be used to step the frequency in large decade increments. For instance, broadcast stations spaced by 10 kHz may be easily tuned by changing the 10 kHz leverwheel switch and carrying to the 100 kHz digit when necessary.

5.4.2 TUNE

The TUNE method is used to vary the frequency in small steps (of 10 or 100 Hz) by rotating the TUNE knob. This is the familiar method of tuning used by most manually tuned radios. The TUNE method is selected by placing the CONTROL selector in the TUNE 10 or TUNE 100 position. The associated number refers to the step size of the tuning increment, either 10 Hz or 100 Hz. When in the TUNE 100 position, the 10 Hz frequency digit will not change, but will remain "frozen" at the last number it was tuned to. There are no limits to the distance the frequency may be tuned away from the SET frequency, as the TUNE knob rotates a digital shaft encoder which has no physical limit. The tuning will automatically stop when the HF-1030's absolute frequency limits are reached, at 0 megahertz tuning down, and 29.99999 megahertz tuning up. (The receiver has no practical utility below 0.010000 MHz, that is 10 kHz.

5.5 IF SHIFT AND BFO TUNING

In addition to controlling the operating frequency, the TUNE knob can be used to vary the IF passband position relative to the operating frequency, and to vary the BFO (Beat Frequency Oscillator) frequency independently of the frequency or IF passband.

5.5.1 IF SHIFT

During conditions of adjacent channel interference, that is when other signals immediately above or below the desired signal cause interference, reception can often be improved by moving the IF passband in the opposite direction without disturbing the operating frequency. This is done by placing the CONTROL selector in the IF position and rotating the TUNE knob. Clockwise rotation moves the IF passband up in relation to the operating frequency and counter-clockwise rotation moves the IF passband down in relation to the operating frequency. The rate that the passband moves is the same as the TUNE 10 setting, that is 1.8 kHz per revolution. The IF passband movement is limited to approximately plus or minus 5 kHz. When the CONTROL selector is returned to the SET or TUNE position, the IF passband is returned to the center location automatically.

5.5.2 BFO TUNING

The BFO (Beat Frequency Oscillator) is used by the detector in all modes except AM to recover the intelligence from the RF signal. The frequency of the BFO in relation to the signal in the IF passband determines the pitch of the audio output. Normally the BFO frequency is preset by the MODE selector to give the appropriate audio frequency beat note required for the mode in use. These presets are 0 for USB and LSB, +600 Hz for CW, and -2550 Hz for FSK. This means that when the HF-1030 operating frequency agrees with the actual signal frequency, there will be a 600 Hz beat note heard in the CW mode and a 2,550 Hz beat note heard in the FSK mode. (In FSK transmission the signal is transmitted on two closely spaced frequencies and the HF-1030 should be tuned midway between the two.) If some other BFO frequencies are desired, the BFO can be offset manually. To vary the BFO frequency manually, the SET leverwheel switches must be set to the desired operating frequency. If the receiver has been tuned away from the SET frequency with the TUNE function, the leverwheels must be set to agree with the frequency display. The CONTROL selector should then be placed in the BFO position. Rotation of the TUNE knob will now move only the BFO frequency, up in frequency with clockwise rotation, or down in frequency with counter-clockwise rotation. (In USB and CW operation the audio pitch will move in the same direction as the BFO frequency, and in LSB and FSK operation the audio pitch will move in the opposite direction.) When the CONTROL selector is returned to the SET or TUNE position the BFO frequency is returned to it's preset value.

5.6 REMOTE OPERATION

When the CONTROL selector is rotated to the REMOTE position, the internal frequency and mode selection circuits are deactivated and the unit reads the remote connector for the frequency and mode information. The remote device may also request control of the receiver overriding the front panel CONTROL selector. For more details on remote operation see Section 4.0

5.7 RF GAIN

Normal operation of the HF-1030 is obtained with the RF GAIN control set at maximum (fully clockwise), and the AGC DECAY control set to minimum (fully counter-clockwise). This insures that even the weakest usable signal will be amplified sufficiently to give full audio output. When stronger signals are received, the AGC (Automatic Gain Control) circuits in the HF-1030 will automatically reduce the RF gain to a level necessary to maintain a nearly constant output. When the strong signal goes away, the AGC will quickly restore full gain. Operating conditions may allow for changing these settings to reduce operator fatigue and produce a more pleasant sounding signal. Reducing the RF GAIN by counter-clockwise rotation will prevent the receiver gain from returning all the way to maximum when no signal is present. The signal strength meter will show the reduced RF GAIN as an increase in the reading. This indicates the level a signal must be to produce AGC action. When the desired signals are all substantially stronger than the background noise, this technique will practically eliminate the background noise.

5.8 AF GAIN

The AF GAIN control adjusts the level of the speaker or headphone audio. Output is reduced to zero at full counter-clockwise rotation and increases to full output, in excess of 2 watts into 4 ohms, with near full clockwise rotation. The LINE AF output is not affected by the AF GAIN control.

5.9 AGC DECAY

The AGC DECAY control adjusts the time that is required for the receiver gain to return to normal after a strong signal disappears. This period of time is known as the AGC "hang" time and, during this time, the RF gain stays fixed at the value caused by the presence of a signal. With the AGC DECAY control at minimum (fully counter-clockwise), the gain returns to normal rapidly (about 100 milliseconds). This is best when conditions of noise may cause the AGC to reduce the gain below that required by the signal. Reception of signals of different levels or severe fading of received signals may also require minimum AGC DECAY. If the signal is relatively strong and steady, the DECAY time may be increased to an amount that keeps the gain constant between syllables and words, but will allow the gain to return to normal during longer pauses. Maximum AGC DECAY time is about 2.5 seconds. The AGC DECAY control has no effect in the AM or FSK modes.

5.10 SQUELCH OPERATION

The HF-1030 squelch circuit is used to mute the audio output when no voice signal is present. It's function is the same as conventional squelch circuits, but, because it is designed on an entirely different principle, it is extremely effective for voice operation under conditions of severe noise. Conventional squelch circuits operate by looking at the amount of signal in the RF circuits and, if below a preset level, the audio circuits are muted. These circuits cannot distinguish between a desired signal and noise, however, so squelch circuits have always been of questionable utility for use on the HF spectrum. The squelch used in the HF-1030 does not look at the relative strength of the signal but instead looks for low frequency variations in the pitch of the detected audio. This allows the receiver to remain muted in the presence of very strong static type noise (loud popping) and yet enable the audio on very weak voice signals.

To set the SQUELCH control, rotate it to the 11 O'Clock position. If the receiver does not mute in the absence of signal after two or three seconds, increase the setting to about 12 O'clock. The squelch circuit is disabled by rotating the SQUELCH control fully counter-clockwise. Setting the SQUELCH control higher than necessary will not result in suppression of weaker signals and passage of stronger signals as with conventional squelch circuits. However, setting the SQUELCH control higher than that required to mute the audio in the absence of voice signals may cause the circuit to mute desired voice signals.

Do not attempt to use the squelch on non-voice type signals (i.e., music, CW, FSK, etc.) as unpredictable operation will result.

5.11 HEADPHONE JACK

A headphone jack, labeled PHONES, is available on the front panel for use by the operator to allow private listening or to exclude high ambient noise. This jack, a standard 1/4 inch single circuit phone type, is connected in the speaker circuit directly. Full speaker level is available at this point so it can also be used as a front panel speaker jack. When a plug is inserted into the PHONES jack, the normal speaker is disconnected.

6.0 THEORY OF OPERATION

6.1 OVERVIEW

The HF-1030 electrically and mechanically consists of four independent sections: the RF section, the synthesizer section, the frequency control section, and the power supply section.

The RF section processes the received signal from the ANTENNA connector to the SPEAKER jack. With the exception of the squelch board and certain front panel controls and selectors, the RF section is all on, or mounted to, the RF motherboard which may be removed for service as a unit.

The synthesizer section, using an internal or external reference oscillator, produces the three oscillator signals required by the RF section. These three oscillator signals are the main LO, the 40 MHz signal or second LO, and the BFO.

The frequency control section controls the synthesizer section and coordinates the operation of the SET, TUNE, IF SHIFT, and BFO TUNE functions and maintains the operating frequency in a memory when the power is removed from the HF-1030.

The power supply section develops a regulated source of voltage which is used by all the other sections.

6.2 RF SECTION

For the following discussion refer to the RF Section Block Diagram, Figure 6-1. The main signal path (USB mode) is shown as a heavy line. Control signal paths are shown as broken lines.

The basic receiver design is up-conversion to 40.455 MHz then down conversion to 455 kHz.

6.2.1 RF INPUT MODULE

From the ANTENNA connector, the incoming signal is fed to one of two filters. For signals below 1.6 MHz, a 5 pole lowpass filter with a cutoff frequency just above 1.6 MHz is used. When the desired input is above 1.6 MHz, a composite filter consisting of a highpass with a cutoff frequency just below 1.6 MHz and a lowpass with a cutoff frequency just above 30 MHz is used. The highpass section has notches at 800 kHz and 1200 kHz and the lowpass section has a notch at 40.455 MHz, the second IF frequency. Attenuation above 40.455 MHz is 80dB or greater which provides a high order of rejection to the image and IF responses, and helps prevent LO radiation.

The signal is then fed to the first mixer, a high level double balanced mixer, which has the main LO signal from the synthesizer section as it's LO input. The first mixer is housed in a separate module and connected with coaxial cable to minimize leakage around the mixer. The signal is mixed with the LO frequency and converted to the difference frequency, 40.455 MHz.

This difference signal, the first IF signal, is then fed to a PIN diode attenuator. This attenuator is a "pi" section 50 ohm network whose attenuation is controlled by the AGC circuits. Attenuation can range from a minimum of 1dB to more than 50dB on reception of very strong signals. The signal is then routed to the first stage of amplification, a pair of grounded gate junction FETs connected in parallel. The gain of this stage is approximately 11dB which does little more than make up for the losses of the filters, the mixer, and the PIN attenuator at minimum attenuation.

6.2.2 FIRST IF MODULE

The signal is then fed to the First IF Module and a bandpass filter. Additionally, the signal at this point is fed through a source follower stage to the rear panel WIDEBAND IF connector for use by an external device. The bandpass filter is a 50 ohm crystal filter with a bandwidth of approximately 8kHz at 6dB points and is centered at 40.455 MHz. This filter prevents strong adjacent channel signals from generating modulation products in the following stages.

The signal is again amplified, this time by a single grounded gate junction FET, and fed to the second mixer, another high level double balanced mixer. The 40 MHz signal from the synthesizer section becomes the LO to this mixer after amplification to the necessary level by the LO driver stage. The output of this second mixer, again the difference frequency, is the second IF at 455 kHz and is fed to the 2nd IF Filter Module.

6.2.3 2ND IF FILTER MODULE

Here the signal is again amplified in a single grounded gate junction FET stage and then in a degenerated common emitter bipolar stage. These stages provide the first significant net gain to the signal. Junction FETs in the grounded gate configuration have been used up to this point to provide wide dynamic range and impedance matching to preserve the low noise figure of the devices.

The signal is then routed through diode switches to one of five mechanical filters. The filter bandwidths and center frequencies are optimized for each of the five operating modes and the selection is made by the mode switch. The AM, CW, and FSK filters are centered on 455 kHz. The USB filter is centered just below 455 kHz and the LSB filter is centered just above 455 kHz. This reversal is necessary to correct for signal inversion that occurs in the first mixer.

After passing through one of five transistor switches, again controlled by the mode switch, the signal is fed to an integrated circuit IF amplifier. This stage's gain is controlled by the AGC circuit and when at maximum is approximately 44dB. The gain can be reduced by the AGC circuits in excess of 70dB. An emitter follower is utilized next to reduce the output impedance of the module.

6.2.4 SSB CW MODULE

The signal goes through a potentiometer gain control to another integrated circuit IF amplifier stage. This circuit is similar to the previous one except that no AGC control is provided. The potentiometer is used to set the overall IF gain of the receiver to the proper level. Following this stage the signal is fed through an emitter follower to the product detector in all modes except AM. Branching from this point, a path goes to the AM/AGC Module for AGC processing. In the AM mode, this path also processes the main signal. Another branch provides an IF output to the rear panel.

The produce detector, an emitter coupled pair, combines the signal with the BFO signal from the synthesizer to produce an audio frequency difference signal. This signal, SSB AF, is fed into the RF motherboard and to the AF switch.

6.2.5 AF CIRCUITS

On the RF motherboard the AF switch circuit selects one of two audio sources for processing. In all modes except AM, the switch selects the SSB AF signal from the product detector. In the AM mode the switch selects the AM AF signal from the envelope detector in the AM/AGC Module. The AF switch itself is a CMOS analog switch integrated circuit. The first stage of audio amplification is a low noise op amp with frequency selective components to provide frequency shaping of the audio response. The output of this circuit is fed to the line AF output amplifier for fixed level balanced output and to the AF GAIN control on the front panel. Upon returning from the AF GAIN control, the signal passes through the squelch gate. If the squelch gate is open the signal passes on to the audio power amplifier where it is amplified to a level sufficient to drive the speaker or headphones.

The LINE AF channel, fed from the output of the first AF amplifier, consists of the LINE LEVEL control for setting the line output level, a squelch gate for muting of the LINE AF output by the squelch circuit, and an op amp stage which amplifies the signal to the level desired. The output is coupled through a 1:1 transformer which provides a balanced output to the line. Adjustment range of the LINE AF channel is -10 to +3dBm at 600 ohms.

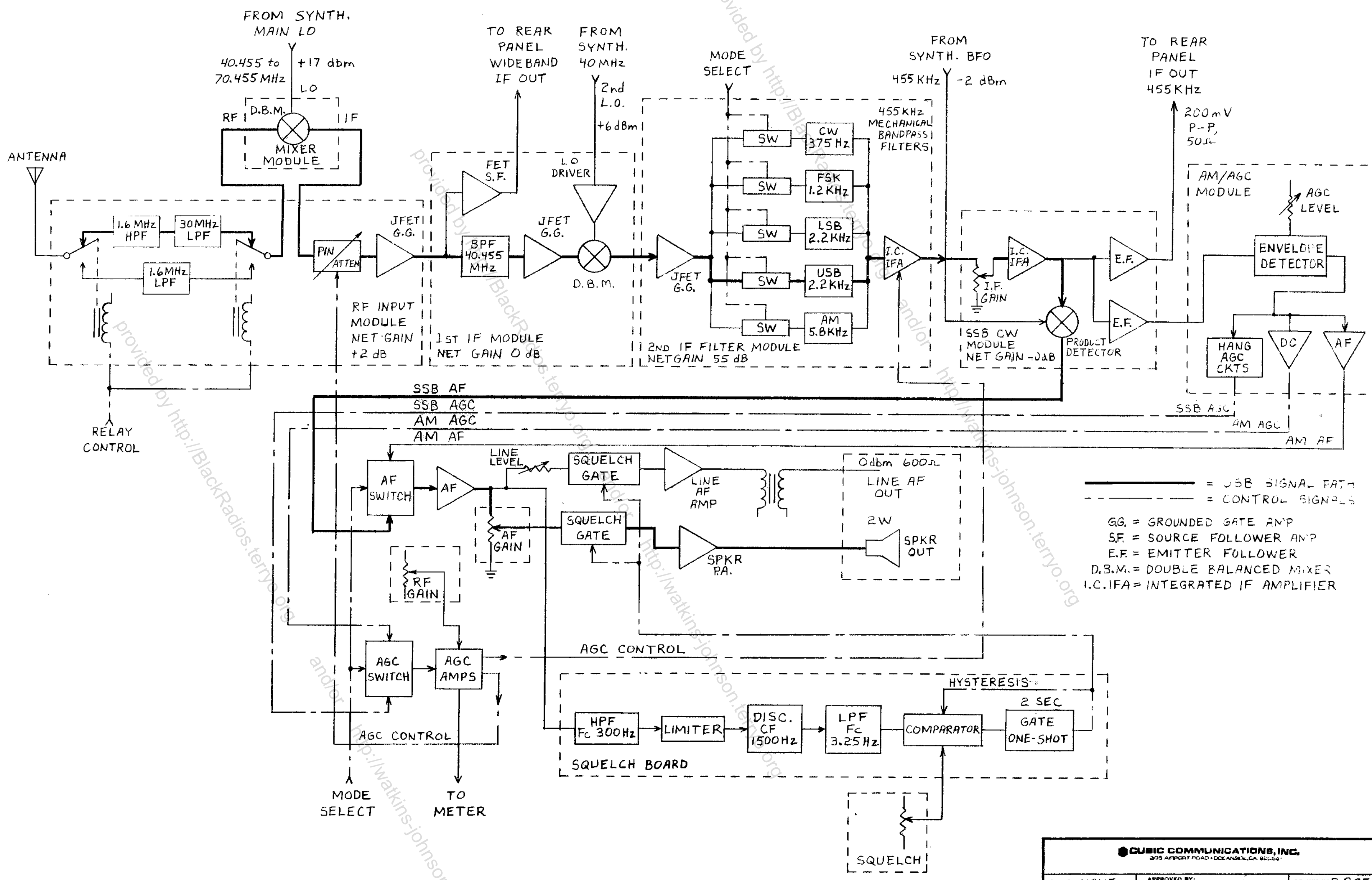
6.2.6 AGC CIRCUITS

Automatic gain control for the HF-1030 is processed in the AM/AGC Module and the RF motherboard. The IF output signal from the SSB CW Module is amplified by a common emitter stage and fed to the envelope detector. This stage serves as both the AGC detector and the AM detector. An adjustment of the base voltage provides a DC offset voltage at the detector output for setting the AGC level. For SSB and CW modes, the AGC has a fast attack, adjustable hang, and slow decay. The hang time is controlled by a timer integrated circuit that is triggered by the audio signal present at the envelope detector output. For AM and FSK modes, the AGC has a symmetrical attack/decay characteristic. The relative gains and offsets of the two AGC channels are set to maintain an AM carrier level that is one half the peak level maintained for an SSB signal. This provides for 100% modulation of the AM signal. (The amplitude doubles at modulation peaks.)

The two AGC signals are fed to the AGC switch for selection by the mode switch. The selected control signal is fed to a group of amplifiers that provide the proper gain and offset to drive the PIN diode attenuator, the first integrated circuit IF amplifier AGC port, the signal strength meter, and the AGC output pin on the REMOTE CONTROL connector. The RF GAIN control on the front panel serves as another input to the AGC amplifiers to override the signal from the AGC detector and reduce the RF gain.

6.2.7 SQUELCH CIRCUIT

The HF-1030 squelch circuit uses a radically different method to control the muting of the receiver audio. Whereas conventional squelch circuits compare the received signal level to a set level, the HF-1030 squelch ignores differences in signal level and instead looks for low frequency variations in the pitch of the received audio. This method allows the squelch to completely ignore static and impulse type noise and immediately open the audio channel on a voice signal. The squelch circuit takes audio from the top of the AF GAIN control, and runs it through a 300 Hz highpass filter. This prevents low pitch audio tones from false triggering the squelch. The signal is then limited to remove all amplitude variations and fed to a discriminator with a center frequency of 1500 Hz. Any variations in the pitch of the audio will show up as variations in the DC level coming from the discriminator. This DC signal is fed to a lowpass filter that removes all variations above 3.25 Hz. Variations in the pitch of voices fall below this frequency and are coupled to the comparator circuit through blocking capacitors. The comparator triggers the gate one-shot whenever the variations exceed a variable threshold in either a positive or negative direction. The gate one-shot when triggered, opens the audio channel for a fixed period of time, about 2 seconds. A feedback signal from the gate one-shot is applied to the comparator to lower the threshold when the squelch gate is open. This hysteresis provides for less false triggering and less drop out of desired signals.



NOTES: 1. ALL CIRCUITRY NOT ENCLOSED BY DOTTED LINE ARE ON RF MOTHER BOARD.

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SCALE: NONE	APPROVED BY:	DRAWN BY R. ROE
DATE: 3-19-82		REVISED
BLOCK DIAGRAM, RF SECTION, HF 1030		
	REV	DRAWING NUMBER 1971-1006

FIGURE 6-1

6.3 SYNTHESIZER SECTION

The synthesizer section produces three local oscillator signals from a single reference oscillator. These phase locked signals are used by the RF section to select the operating frequency and demodulate certain signals. These three local oscillator signals are the main LO, the 40 MHz signal, and the BFO signal. Each is produced independently with information from the frequency control section and reference signals from the reference module.

For the following discussion, refer to the Synthesizer Section Block Diagram, Figure 6-2. This discussion presumes a basic knowledge of phase-locked-loop theory.

6.3.1 REFERENCE MODULE

The Reference Module produces four output signals for use in generating the required oscillator signals. These are 40 MHz REF (1 MHz), STEP REF (1 MHz), FINE REF (1 kHz), and BFO REF (1 kHz).

The REF switch on the rear panel selects the reference source for these signals. When in the INT position, power is applied to the internal reference oscillator which is an oven controlled, 10 MHz crystal oscillator. Two adjustments of the oscillator frequency are provided; a trimmer capacitor provides coarse adjustment and a varactor diode (voltage variable capacitor) provides fine adjustment. The fine adjustment voltage comes from a potentiometer located on the rear panel (REF ADJ).

The oscillator output is translated to TTL logic levels and sent to a decade counter which divides the signal frequency by a factor of ten. The resultant 1 MHz signal is fed to a switch circuit controlled by the rear panel REF switch. When the REF switch is in the INT position, the 1 MHz signal is sent to the following circuits and also sent to the rear panel EXT REF jack. When the REF switch is in the EXT position, the internal oscillator and divider are not powered and a 1 MHz signal fed into the rear panel EXT REF jack becomes the source for the following circuits.

After buffering, the signal is sent to the Step Loop Module at standard TTL logic levels as STEP REF. The signal is also translated to 12 volt CMOS logic levels and, after buffering, is sent to the 40 MHz module as 40 MHz REF. This 12 volt CMOS signal is also fed to a programmable divider hard-wired to divide by one thousand. The resultant 1 kHz signal is sent through separate buffers to the Fine Loop Module as FINE REF and the BFO Module as BFO REF at 12 volt CMOS levels.

An auxiliary function of the Reference Module is to generate a regulated source of 22 volts for use in the step and output loops. The 1 MHz signal, after translation to 12 volt levels, is buffered and amplified to a higher power level by a hex CMOS buffer and a pair of transistors acting as a power amplifier and then fed to a voltage quadrupling rectifier. The resultant DC voltage is regulated to 22 volts and sent to the respective circuits.

6.3.2 MAIN LO GENERATION

The main LO signal is a fixed level signal of high spectral purity and stability that varies in frequency between 40.455 MHz and 70.455 MHz in increments of 10 Hz. This represents three million discreet steps. Because of this complexity, the job of generating the main LO is broken down into three separate parts, each handled by a phase-locked-loop. The Fine Loop Module generates a signal whose frequency contains the fractional megahertz information, that is the 10 Hz through 100 kHz digits. The Step Loop Module generates a signal whose frequency contains the megahertz information, that is the 1 MHz and 10 MHz digits. The Output Loop Module produces a third signal whose frequency is the sum of the frequencies of the fine loop and the step loop. After amplification and filtering, this signal becomes the main LO. The main LO signal is sent to the first mixer in the RF section. Because the circuits following the first mixer will pass only 40.455 MHz plus or minus 4 kHz (the first IF), the main LO selects the incoming frequency to be the main LO frequency minus 40.455 MHz.

6.3.2.1 FINE LOOP MODULE

The Fine Loop Module produces a signal with a frequency between 455 kHz and 1455 kHz that varies in 10 Hz steps. When the selected operating frequency ends on an even number of megahertz (e.g., 15.000 MHz), the fine loop frequency is at its lower limit. The fine loop frequency is always equal to the fractional megahertz part of the operating frequency plus 455 kHz. The fine loop itself operates at 100 times it's output frequency and steps in increments of 1 kHz. This range is broken down into three VCO bands and the appropriate VCO is selected by logic circuits reading the frequency bus. The selected VCO output is buffered and sent to a programmable divider. This circuit uses a technique called "pulse swallowing" to allow full 1 kHz step resolution with prescaling to reduce the frequency into the main divider. This prescaler divides by either 100 or 101 in response to control from the main divider. The programmable divider modulus is controlled by the fractional megahertz part of the frequency bus with a fixed offset number added to account for the 455 kHz offset at the fine loop output. The programmable divider output is compared to the 1 kHz reference signal FINE REF in a phase comparator, and a DC signal is developed that represents the phase error of the VCO. This DC control is applied to the VCO as a tuning voltage and causes the VCO frequency to move to the proper frequency and become phase-locked to the reference signal. Another output from the VCO buffer circuit is divided by 100, filtered, and sent to the output loop as the fine loop output, FINE. The modulus 100 divider reduces the step size from 1 kHz to 10 Hz and reduces incidental FM and other undesirable products by 40dB.

6.3.2.2 STEP LOOP MODULE

The Step Loop Module produces a signal that moves in 1 MHz steps from 40 to 69MHz. The actual frequency is equal to the whole megahertz part of the operating frequency plus 40 MHz. The step loop VCO range, which is the same as the step loop output, is divided into three bands with a separate VCO for each band. The proper VCO is selected by logic circuitry reading the 10 MHz digit of the frequency bus. To reduce the loop gain and consequent stability and noise problems, each VCO has two control voltage inputs: coarse and fine. Only the fine control voltage input is inside the loop. A coarse tuning control voltage is derived from the 1 MHz digit of the frequency bus and is used to preset the VCO frequency to the approximate frequency of operation. The loop, then, must only supply a fine tuning voltage to maintain phase lock with the reference.

The selected VCO output is buffered and sent to the programmable divider. The programmable divider is a high speed Emitter Coupled Logic circuit that can handle the maximum VCO frequency without a prescaler. Because this divider is made up of decade up-counters, the program number required to set the divider modulus must be in nine's complement format. A pair of CMOS integrated circuits between the frequency bus and the programmable divider perform the necessary conversion. The programmable divider output is compared to the STEP REF signal (1 MHz) by a phase comparator circuit and the phase difference used to generate a DC control voltage that is applied to the VCO as the fine tune control voltage, STEP CV. This control voltage causes the VCO frequency to move to the proper frequency and become phase locked to the reference signal. Another buffered output from the selected VCO is sent to the output loop as STEP RF.

6.3.2.3 OUTPUT LOOP AND PA AND LPF MODULES

The Output Loop Module produces a signal whose frequency is equal to the sum of the frequencies of the two inputs, FINE and STEP RF. The output loop VCO circuits are a duplicate of the step loop VCO circuits and operate at only a slightly higher frequency. The same coarse tuning voltage developed for the step loop is used again in the output loop to preset the VCO. The proper VCO is selected in the same manner as the step loop. The VCO signal, after buffering, is applied to a mixer along with the step loop signal, STEP RF. A lowpass filter on the output of this mixer removes all mixer products except the desired difference signal. Since the output loop operates at the sum of the step and fine loops, this mixer difference signal will be equal to the fine loop frequency in normal locked operation. After amplification and translation to TTL signal levels, this signal is fed through a gate to the output loop phase comparator. The reference input to this phase comparator is the fine loop signal, FINE. The resultant output is filtered and applied to the VCO as the fine tune control voltage, OUT CV.

It is possible that in attempting to move to the proper frequency the output loop VCO frequency may pass through a frequency below the step loop frequency by an amount equal to the fine loop frequency. This would produce a difference frequency in the mixer equal to the fine loop frequency and an "on frequency" indication in the phase comparator. But because the mixer output difference frequency would be inverted due to the output loop frequency being lower than the step loop frequency, the control voltage developed by the phase comparator would cause the VCO to move in the wrong direction and prevent phase lock. The VCO would ultimately be driven to the low end of the range and never be able to recover. To prevent this condition from occuring, a wrong-side-lock detector circuit is used. This circuit compares the output loop VCO frequency with the step loop frequency and if the output loop frequency is lower, generates a control signal that is fed to the gate between the lowpass filter following the mixer and the phase comparator. The control signal causes the gate to prevent the normal difference signal from being applied to the phase comparator. This is the equivalent of a signal with zero frequency being applied to the phase comparator and it reacts by generating a control voltage that raises the VCO frequency. This condition will continue until the VCO frequency is raised above the step loop frequency at which time the wrong-side-lock detector recognizes the proper frequency relationship and removes the gate control signal which allows the difference signal to be applied to the phase comparator for normal operation.

Another buffered output from the selected VCO is the output loop output, OUT RF. This signal is applied to the PA and LPF module where it is amplified in a two stage power amplifier that increases the signal from the output loop to the required +17dBm required by the first mixer in the RF section. This power amplifier operates in soft limiting to add amplitude stability to the signal. The signal is then applied to a lowpass filter to remove the harmonic products generated in the VCOs and the power amplifier. The low-pass filter consists of three sections banded in the same arrangement as the step and output loop VCOs. The appropriate filter section is selected by a set of PIN diodes. Current for the selected PIN diode switch is shared with the power amplifier's second stage to conserve power. After the lowpass filter the signal is fed to the RF section as the main LO signal, LO.

6.3.3 40 MHZ LOOP BOARD

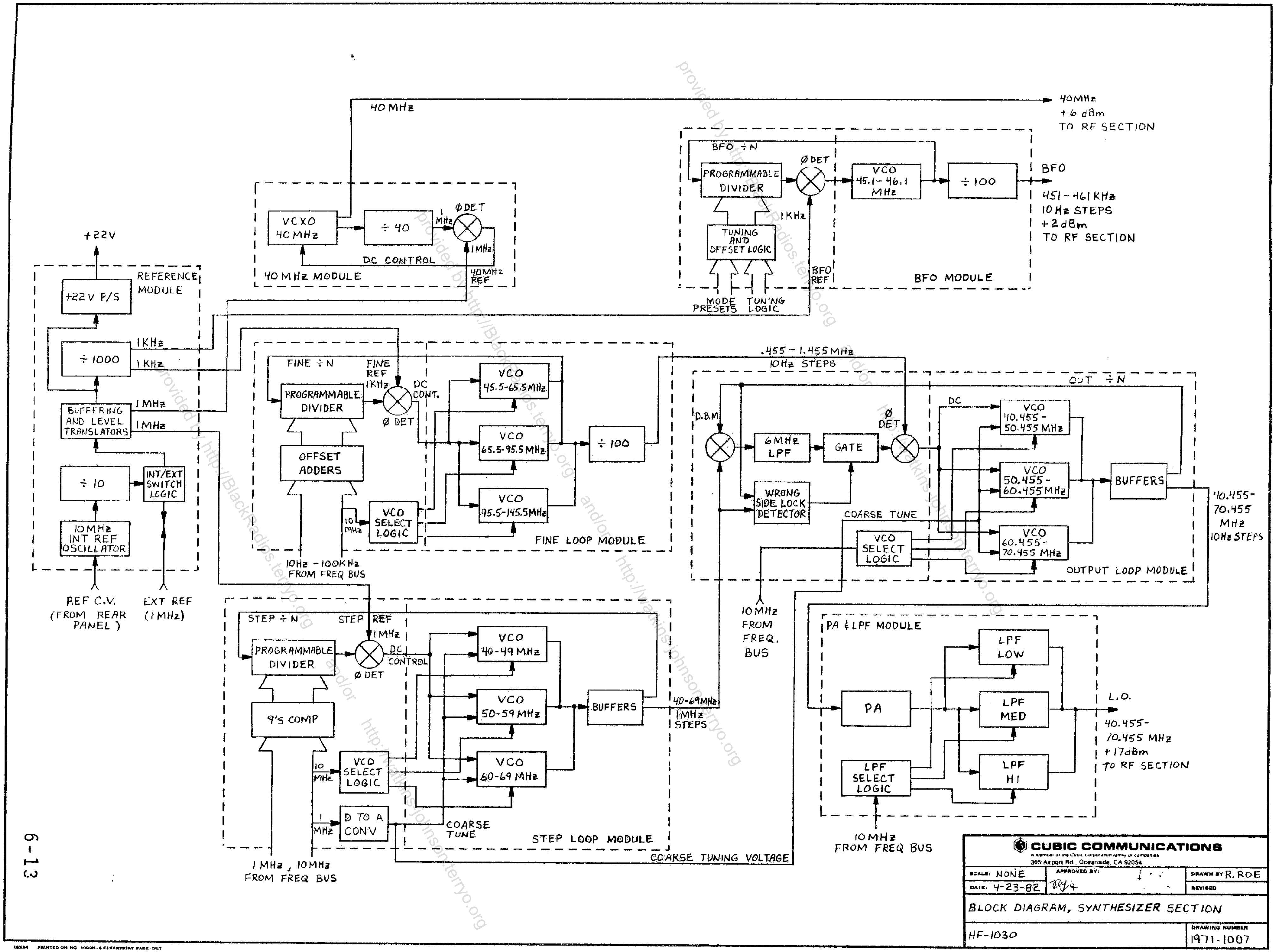
The 40 MHz Loop Board generates the LO signal used by the second mixer in the RF section. This signal is fixed in frequency (40.000 MHz) and amplitude (+6dBm). To enhance purity and stability of this signal, a crystal controlled oscillator is used as the loop VCO. An output from the collector load of this oscillator is fed to a decade divider and then to two binary dividers for a total division factor of 40. The output of the dividers is compared to the 1 MHz reference signal, 40 MHz REF, in an exclusive-or gate operated as a phase comparator. The output is a square wave signal of twice the reference frequency whose duty cycle varies with the phase difference between the divider output and the reference frequency. This control signal is filtered in a simple RC circuit and applied as a DC control voltage to a varactor in series with the crystal in the oscillator. This loop keeps the oscillator on precisely 40 MHz and phase locked to the reference signal. The oscillator's load is a transformer whose secondary is connected through an attenuator pad and lowpass filter to the RF section.

6.3.4 BFO MODULE

The BFO Module produces a signal with a frequency that varies between 451 kHz and 461 kHz in 10 Hz steps. This signal is used by the product detector in the RF section in all modes except AM to demodulate the received signal. The BFO frequency may be varied in two different ways. In normal operation the BFO frequency is preset to one of three frequencies depending on the position of the mode switch. These frequencies are 455 kHz in USB and LSB, 455.6 kHz in CW, and 452.45 kHz in FSK. However, when the CONTROL selector on the front panel is placed in the BFO position, the BFO frequency may be moved up or down in 10 Hz increments by the front panel TUNE control within the limits mentioned above. The BFO frequency is also moved by the TUNE control in tandem with the main LO frequency when the CONTROL selector is in the IF position

As in the case of the fine loop, the BFO VCO operates at 100 times the actual BFO output frequency. The VCO itself is an integrated circuit ECL oscillator. The VCO can be turned on and off in response to a control signal (B-1) which is controlled by the mode switch. The VCO is not energized in the AM mode but is on in all other modes. The oscillator output is fed to a programmable divider that is similar to the one in the fine loop. The divider output is compared for frequency and phase in a phase comparator at 1 kHz, and the output becomes a DC control signal that controls the frequency of the VCO. Again this is much the same as in the fine loop. The manner in which the programmable divider modulus is set, however, is different. Instead of reading the frequency bus, the programmable divider reads a set of cascaded frequency counters. These counters store a program number that represents the BFO frequency. The program counters can be preset to store a fixed number for use as mode presets, or the number in the program counters may be incremented or decremented in response to input from the TUNE control. The manner of setting the program number into the program counter is determined by the $\overline{\text{FREQ}}$ control line. When this line is low, the counters are preset to a number determined by the states of the $\overline{\text{CW}}$ line and the $\overline{\text{FSK}}$ line. When the $\overline{\text{FREQ}}$ line is high the counters retain the last preset number but respond to clocking from the Ø3 line and direction control from the Ø1 line. These lines are derived from the shaft encoder to correspond to distance and direction of rotation of the TUNE control. Control outputs are sent from the BFO Module to the frequency control section to be used to limit the amount of offset that can be tuned.

The BFO VCO output is also fed to a divide by 100 circuit for step size and spurious signal reduction as in the fine loop. The signal is then fed through a lowpass filter to reduce the harmonics generated in the frequency dividers, and fed to the RF section for use by the product detector.



40 MHz
40 MHz +6 dBm TO RF SECTION
VCXO 40 MHz
÷ 40
1 MHz
Ø DET
1 MHz
DC CONTROL
40 MHz REF
40 MHz MODULE
+22V
REFERENCE MODULE
+22V P/S
÷ 1000
1 KHz
1 KHz
BUFFERING AND LEVEL TRANSLATORS
1 MHz
1 MHz
÷ 10
INT/EXT SWITCH LOGIC
10 MHz INT REF OSCILLATOR
REF C.V. (FROM REAR PANEL)
EXT REF (1 MHz)
BFO ÷ N
PROGRAMMABLE DIVIDER
Ø DET
VCO 45.1-46.1 MHz
÷ 100
BFO
451-461 KHz 10 Hz STEPS +2 dBm TO RF SECTION
1 KHz
TUNING AND OFFSET LOGIC
BFO REF
MODE PRESETS
TUNING LOGIC
BFO MODULE
FINE ÷ N
FINE REF 1 KHz
DC CONT.
Ø DET
PROGRAMMABLE DIVIDER
OFFSET ADDERS
VCO SELECT LOGIC
10 MHz
VCO 45.5-65.5 MHz
VCO 65.5-95.5 MHz
VCO 95.5-145.5 MHz
÷ 100
FINE LOOP MODULE
10 Hz - 100 KHz FROM FREQ BUS
.455 - 1.455 MHz 10 Hz STEPS
D.B.M.
6 MHz LPF
GATE
Ø DET
WRONG SIDE LOCK DETECTOR
OUT ÷ N
DC
VCO 40.455-50.455 MHz
VCO 50.455-60.455 MHz
VCO 60.455-70.455 MHz
BUFFERS
40.455-70.455 MHz 10 Hz STEPS
COARSE TUNE
VCO SELECT LOGIC
OUTPUT LOOP MODULE
10 MHz FROM FREQ. BUS
STEP ÷ N
STEP REF 1 MHz
DC CONTROL
Ø DET
PROGRAMMABLE DIVIDER
9'S COMP
VCO SELECT LOGIC
10 MHz
1 MHz
D TO A CONV
VCO 40-49 MHz
VCO 50-59 MHz
VCO 60-69 MHz
BUFFERS
40-69 MHz 1 MHz STEPS
COARSE TUNE
STEP LOOP MODULE
COARSE TUNING VOLTAGE
1 MHz, 10 MHz FROM FREQ BUS
PA & LPF MODULE
PA
LPF LOW
LPF MED
LPF HI
LPF SELECT LOGIC
10 MHz FROM FREQ BUS
L.O.
40.455-70.455 MHz +17 dBm TO RF SECTION
CUBIC COMMUNICATIONS
A member of the Cubic Corporation family of companies
305 Airport Rd. Oceanside, CA 92054
SCALE: NONE
DATE: 4-23-82
APPROVED BY:
DRAWN BY R. ROE
REVISED
BLOCK DIAGRAM, SYNTHESIZER SECTION
HF-1030
DRAWING NUMBER 1971-1007

FIGURE 6-2

6.4 FREQUENCY CONTROL SECTION

The frequency control section takes inputs from the front panel TUNE knob, and CONTROL and MODE selectors, and generates frequency information and control signals that are passed to the synthesizer section for setting it's oscillators to the proper frequencies. Additionally, the frequency control section operates the 7 digit LED frequency display, stores the frequency information in a non-volatile memory, and recognizes an override signal from the rear panel REMOTE connector which disables the front panel controls.

The frequency information is passed over a 26 line interface known as the frequency bus. It is divided into seven independent digits of BCD data. Each of the six least significant digits is composed of four lines. The most significant digit is composed of two lines as it never contains a number larger than two. The frequency bus appears directly on the rear panel REMOTE connector.

The frequency control section is composed of the front panel board, the frequency control board, the tuning memory module, and the frequency decoder board. For the following discussion, refer to the individual schematic diagrams of the boards under discussion and to the synthesizer mother board and synthesizer module interconnect schematic diagram, drawing number 1971-2404.

6.4.1 FREQUENCY CONTROL BOARD

The frequency control board contains the seven leverwheel switches used to set the frequency when in SET or BFO operation, the logic circuits used to generate tuning signals from the TUNE shaft encoder input, and seven decoder drivers used to drive the frequency display LEDs. The LEDs are located on the front panel board.

Each of the leverwheels generates a BCD number for it's respective digit that is fed to the frequency bus through a set of tri-state buffers. These buffers control whether the switches are on line or off. They are enabled when the control signal $\overline{SET}$ is low which occurs when the front panel CONTROL selector is in the SET or BFO position.

The front panel shaft encoder, driven by the TUNE knob, generates two square wave signals as the shaft is rotated. These signals, S.E.A and S.E.B are always 90 degrees apart in phase but the one that leads in phase is determined by the direction of rotation. The shaft encoder logic circuits on the frequency control board take these two inputs and develop two signals that may be used to increment and decrement the operating frequency, the IF passband, and the BFO frequency. The S.E.A. signal, after passing through a Schmitt trigger circuit which makes the signal into a clean logic square wave, is differentiated and stripped of the negative edge spike to produce a positive pulse that occurs on the rising edge of the input only. This signal is inverted and translated to 12 volt levels and leaves the board as Ø2, the tuning clock signal. The S.E.B. signal also passes through a Schmitt trigger circuit but is not differentiated. After inversion and translation to 12 volt levels it leaves the board as the square wave signal Ø1, the up/down select signal. When the shaft encoder is rotated in a clockwise direction, the Ø2 signal occurs when the Ø1 line is high. When rotated in a counter-clockwise direction, the Ø2 signal occurs when the Ø1 line is low.

Reading the frequency bus are the seven decoder driver circuits that drive the LEDs. These circuits each contain a latch to store input data, a decoder to convert the BCD data to seven segment information, and seven LED drivers. When the CONTROL selector is in the SET, TUNE, or BFO position, the input latches are transparent and the LED display shows the frequency on the bus. When in the IF position the latches are enabled and the frequency information is stored. Thus the display remains unchanged while the frequency bus passes IF shift information to the synthesizer. When in remote operation the $\overline{FREQ}$ line on the rear panel REMOTE connector (pin 46) will disable the latches when pulled low and allow the display to show the frequency being fed into the receiver from the remote control device.

6.4.2 FRONT PANEL BOARD

The front panel board contains circuitry that determines the method of frequency selection, the circuits being tuned (operating frequency, IF passband, or BFO), the tuning speed, the mode presets to the BFO, and remote operation. The front panel board also serves to mount the frequency display LEDs to interconnect all the front panel controls with their respective circuits.

The method of frequency selection is determined by the states of four control lines: SET, TUNE, FREQ, and SLOW. These lines are controlled by the CONTROL selector through a diode matrix. In addition, the mode switch common line is supplied through either the SET or the TUNE lines so that when neither line is low there will be no ground on the mode common line and no mode will be selected. This is the case when the CONTROL selector is in REM or when the REMOTE line on the rear panel REMOTE connector (pin 15) is pulled low. The rear panel REMOTE pin also removes the CONTROL selector common line which disables all four control lines. In this condition the frequency bus is ready to receive a frequency input from the rear panel REMOTE connector.

6.4.3 FREQUENCY DECODER BOARD

The frequency decoder board serves two functions: to switch the filter relays in the RF input module at the proper frequency, and to limit the tuning range of the main synthesizer and the BFO module. The former function is performed by logic gates reading the three most significant digits of the frequency bus and supplying a relay power signal to the RF section whenever the frequency is below 1.6 MHz. The latter function is performed by another group of logic gates reading several of the frequency bus lines and other lines from the tuning memory board and the BFO module. Also input to this circuit are the Ø1 and Ø2 signals from the frequency control board. When the frequency is in a valid range, the signal Ø2 is passed to the synthesizer as Ø3. When the frequency is tuned to 0.0 MHz or 29.99999 MHz this circuit recognizes the limit and prevents the Ø2 signal from being passed as Ø3. When the tuning direction is reversed, the signal is restored. This circuit also prevents the BFO frequency from exceeding it's limits in the same manner. Another part of this circuit monitors the power supply line and disables the Ø3 line when the power is first turned on, preventing power line transients from disturbing the frequency that has been stored in memory.

6.4.4 TUNING MEMORY MODULE

The tuning memory module consists of two seven decade frequency registers that are used to store and control the data on the frequency bus and the necessary logic circuits to operate them. Either frequency register can read a frequency from the bus, control the frequency bus taking its input from the shaft encoder circuits, or store a frequency independent of the bus or shaft encoder circuits. Frequency register A reads data in the SET and BFO positions, controls the frequency bus in the TUNE position, and stores it's frequency in the IF and REM positions. Frequency register B reads data in the SET, TUNE, and BFO positions, controls the bus in the IF position, and stores it's frequency in the REM position.

When the IF shift function is selected, the main LO and BFO frequencies are incremented or decremented together so that the detected signal pitch is not changed. In order to restore the proper frequency when operation is returned to the TUNE function, the operating frequency is stored in register A while register B controls the IF shift function.

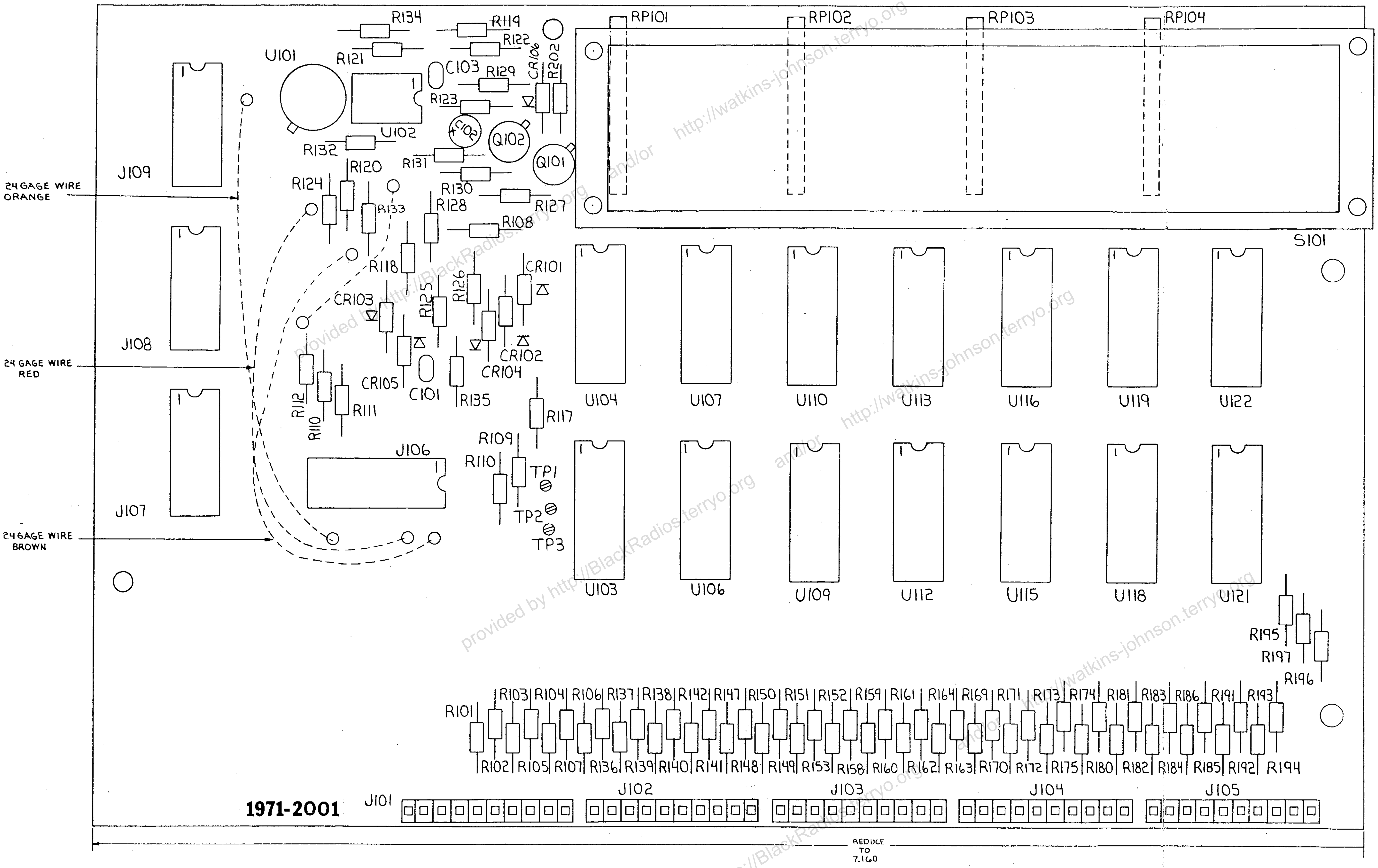
A small lithium battery provides standby power to the tuning memory module whenever the main power is off. This maintains the frequencies in the two frequency registers until power is restored. The registers are composed of all CMOS integrated circuits so standby power consumption is extremely small. Battery discharge current is typically less than one microampere and battery life is conservatively rated at five years.

6.5 POWER SUPPLY SECTION

The power supply section operates from either AC or DC sources to provide all operating power for the receiver. A single supply voltage of 12 volts is maintained by the voltage regulator board. The small 22 volt supply used in the synthesizer section is discussed in section 6.3.1.

AC power is applied to the power transformer through a fuse, the power switch on the front panel, and a line voltage selection switch, which connects the two primary windings in either series or parallel. Protection against power line surges is provided by two metal oxide varistors (MOVs), one across each primary winding. The secondary windings are connected in parallel to the rectifier, a full wave bridge. Filtering is provided by a 2200 MFd capacitor on the rectifier output which is also connected to the input of the voltage regulator board. DC power input is also connected to this point through the power switch and a fuse.

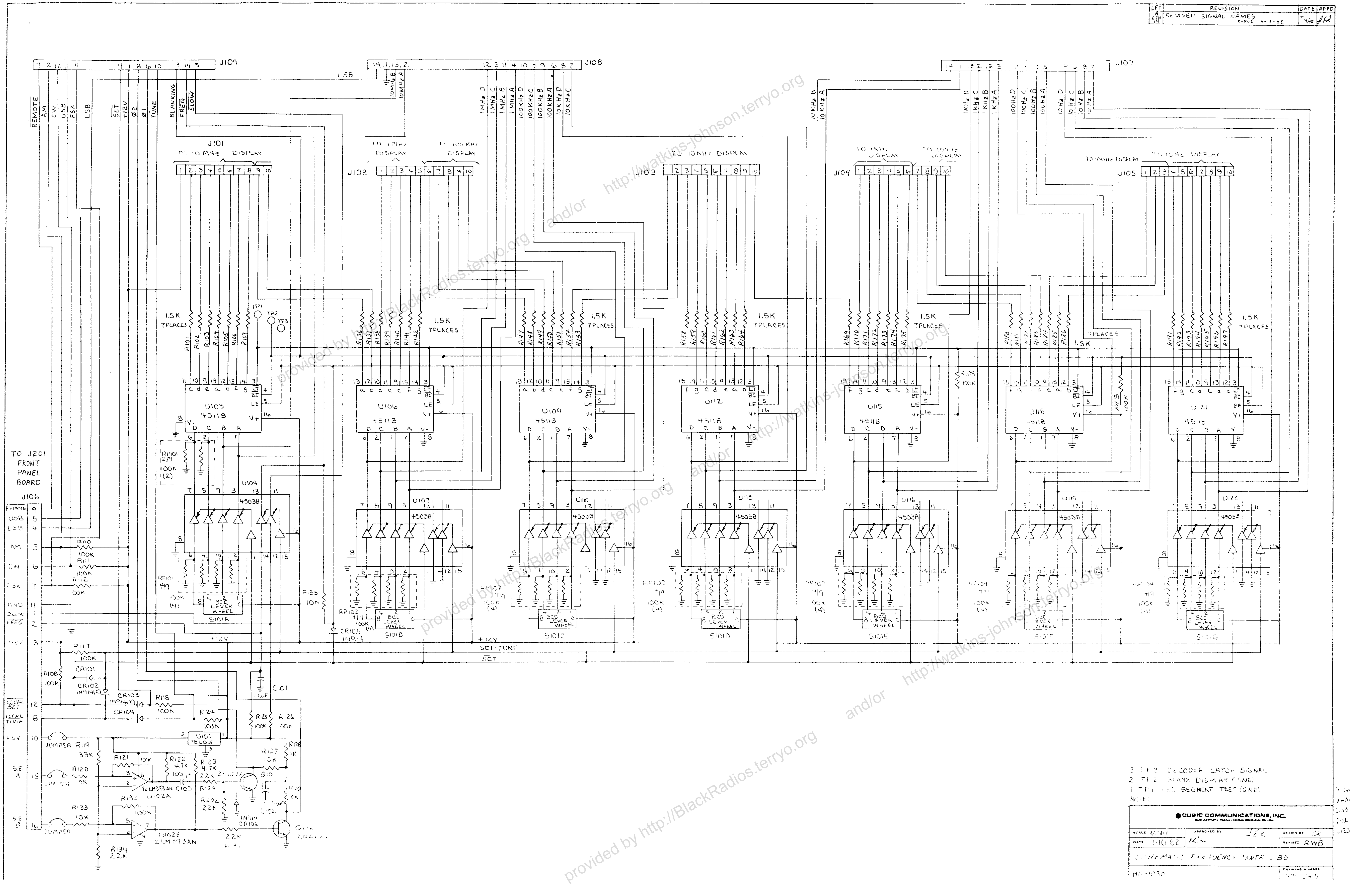
The voltage regulator provides more filtering of the rectifier output and maintains the voltage to the receiver circuits at 12 volts. The regulator pass element is a Darlington PNP power transistor connected for collector output. An op-amp measures the difference between the output voltage and a zener reference voltage and develops a control voltage which is applied to a driver transistor which supplies base current to the pass transistor to maintain regulation. A potentiometer in this feedback path provides an adjustment of output voltage.



CUBIC COMMUNICATIONS, INC.

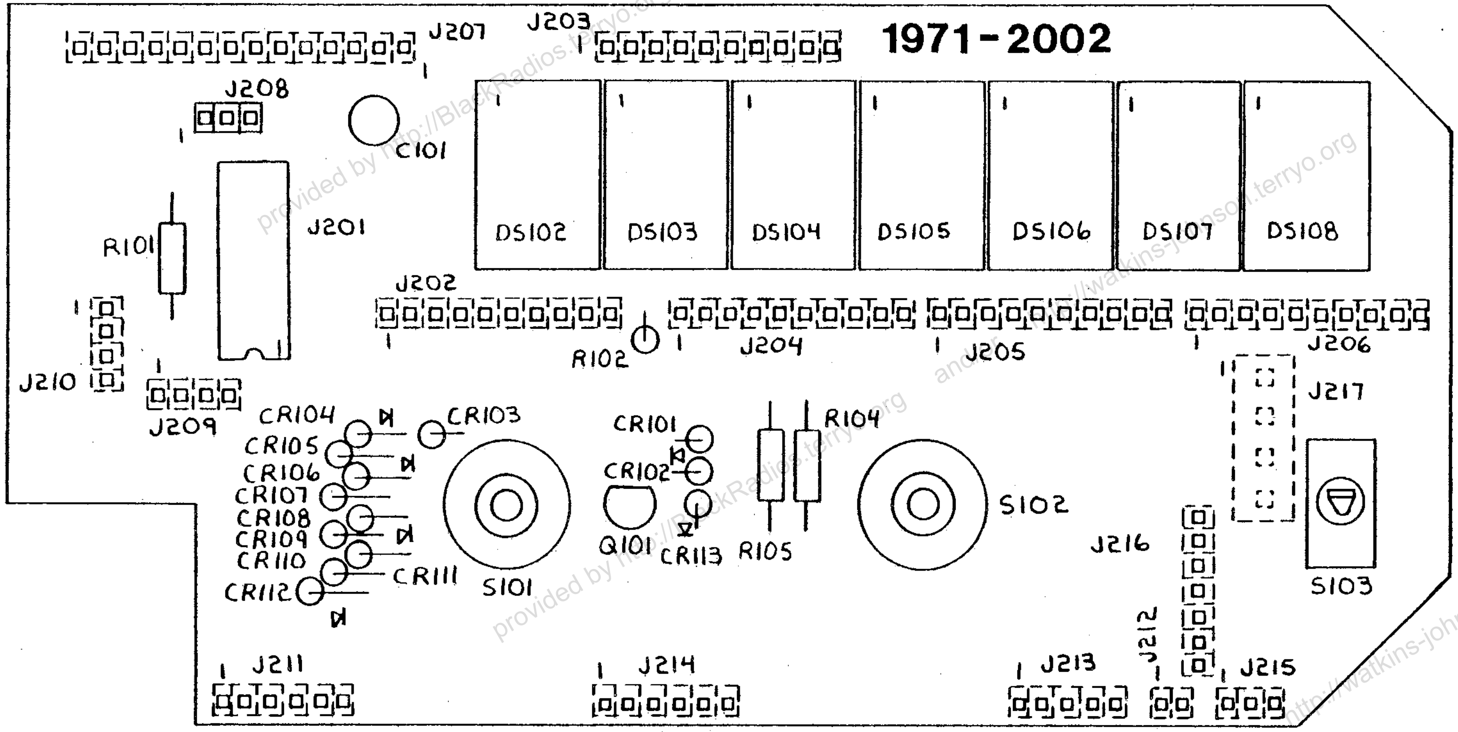
SCALE: 4:1	APPROVED BY: JEL	DRAWN BY RWB
DATE: 3-10-82		REVISED
ASSEMBLY DWG, FREQUENCY CONTROL BD		
HF-1030		DRAWING NUMBER 1971-2001

2. SCHEMATIC NO. 1971-2401
1. CIRCUIT BD PN 1971-2101
NOTES:



REVISION
REVISED SIGNAL NAMES
J109
J108
J107
J101
TO 10 MHZ DISPLAY
J102
TO 1 MHZ DISPLAY
TO 100 KHZ DISPLAY
J103
TO 10 KHZ DISPLAY
J104
TO 1KHZ DISPLAY
TO 100HZ DISPLAY
J105
TO 100Hz DISPLAY
TO 10HZ DISPLAY
LSB
REMOTE
AM
CW
USB
FSK
SET
+12V
Ø2
Ø1
TUNE
BLANKING
FREQ
SLOW
1MHz D
1MHz C
1MHz B
1MHz A
100KHz C
100KHz B
100KHz A
10KHz D
10KHz C
10KHz B
10KHz A
1KHz D
1KHz C
1KHz B
1KHz A
100Hz D
100Hz C
100Hz B
100Hz A
10Hz D
10Hz C
10Hz B
10Hz A
1.5K 7PLACES
U103 4511B
U106 4511B
U109 4511B
U112 4511B
U115 4511B
U118 4511B
U121 4511B
U104 4503B
U107 4503B
U110 4503B
U113 4503B
U116 4503B
U119 4503B
U122 4503B
BCD LEVER WHEEL
S101A
S101B
S101C
S101D
S101E
S101F
S101G
TO J201 FRONT PANEL BOARD
J106
+12V
SET-TUNE
SET
CR105 1N914
U101 78L05
U102A 1/2 LM393AN
U102B 1/2 LM393AN
Q101
JUMPER
3. TP3 DECODER LATCH SIGNAL
2. TP2 BLANK DISPLAY (GND)
1. TP1 LED SEGMENT TEST (GND)
NOTES:
CUBIC COMMUNICATIONS, INC.
DRAWN BY
REVISED RWB
DATE 3-10-82
SCHEMATIC FREQUENCY CONTROL BD
HF-1030

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 13	DELETED R103 RWB 3-30-82	3/30/82	JEL



CUBIC COMMUNICATIONS, INC.
905 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: 2:1	APPROVED BY: JEL	DRAWN BY RWB
DATE: 3-10-82		REVISED

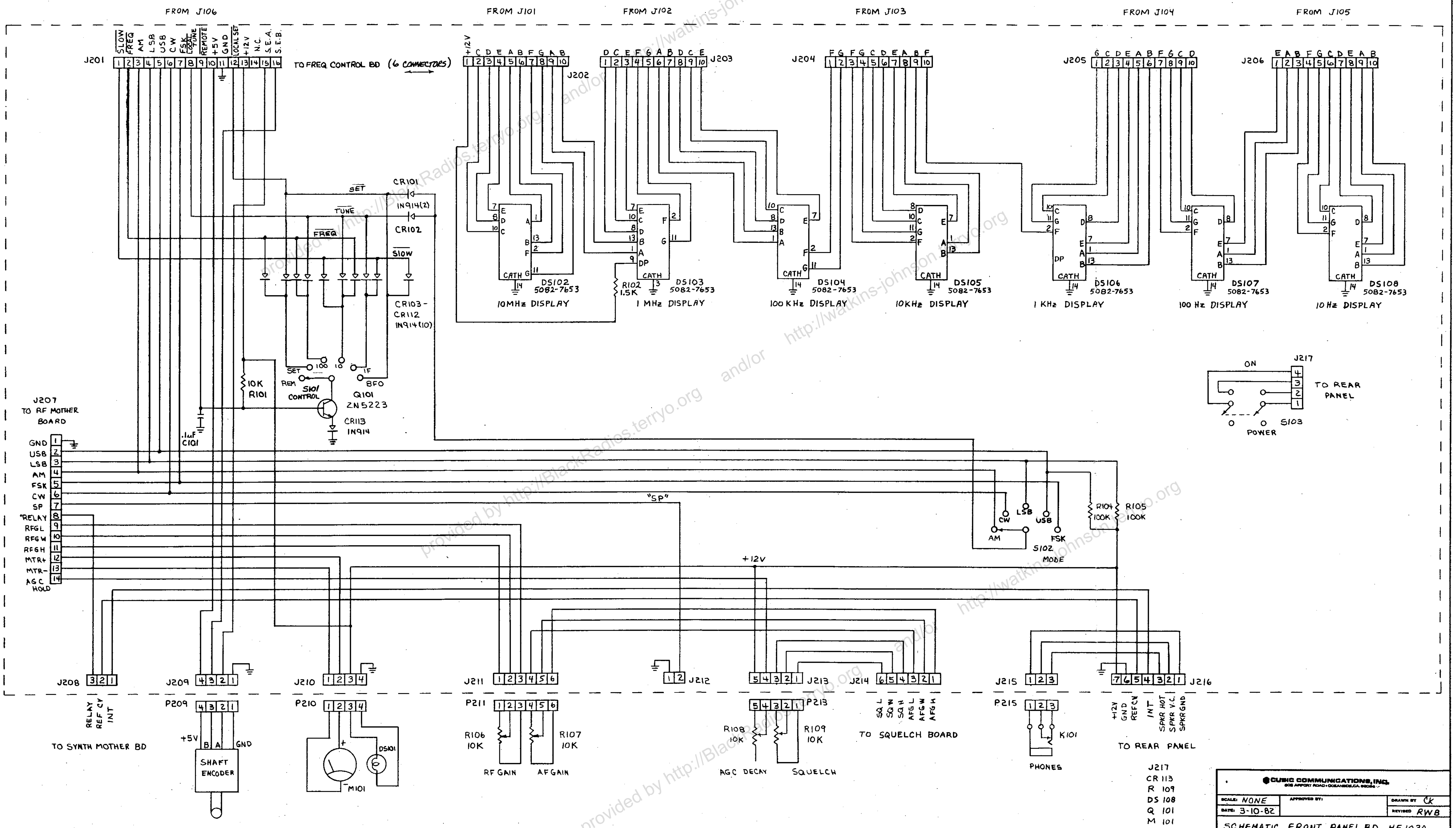
ASSEMBLY DWG, FRONT PANEL BOARD

HF 1030 — REV A — DRAWING NUMBER 1971-2002

2. SCHEMATIC DWG NO 1971-2402
1. CIRCUIT BD P.N. 1971-2102
NOTES

11X17 PRINTED ON NO. 1000H CLEARPRINT

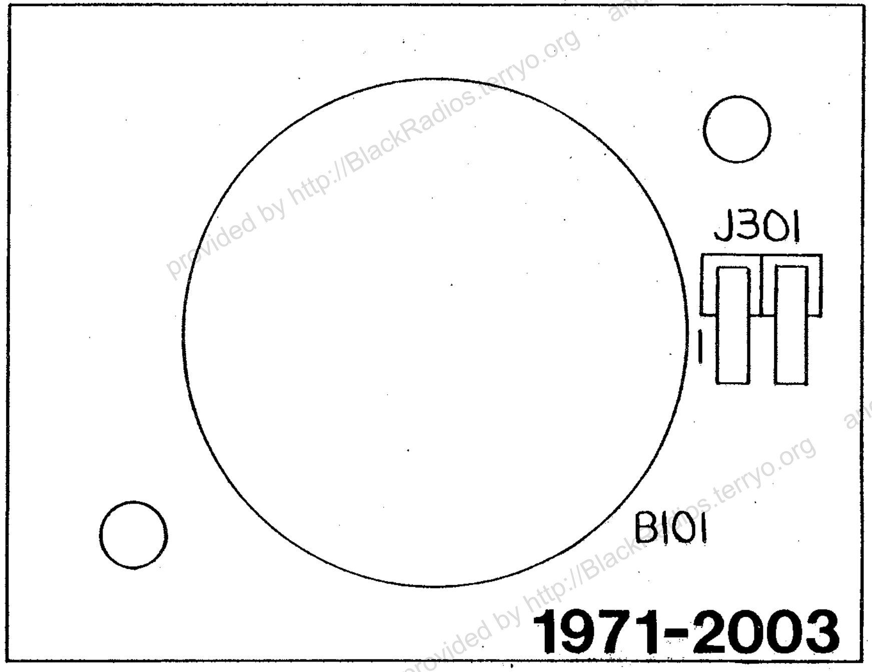
LET	DESCRIPTION	DATE	APP
A ECN 13	DELETED R103 CHANGED VALUES ON R101 100K TO 10K, R102 820Ω TO 1.5K RWB 3-30-82	3/30/82	
B ECN 16	REVISED SIGNAL NAMES. R. ROE 4-16-82	4/19/82	



J217
CR 113
R 109
DS 108
Q 101
M 101
S 103
K 101
C101

CUBIC COMMUNICATIONS, INC.

SCALE: NONE	DRAWN BY CK
DATE: 3-10-82	REVISED RWB
SCHEMATIC, FRONT PANEL BD, HF 1030	
HF-1030	REV A — DRAWING NUMBER 1971-2402



2. CIRCUIT BD P.N. 1971-2103
1. SCHEMATIC DWG NO. 1971-2403
NOTES

CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: NONE	APPROVED BY:	DRAWN BY RWB
DATE: 11-10-81	11/13/81	REVISED

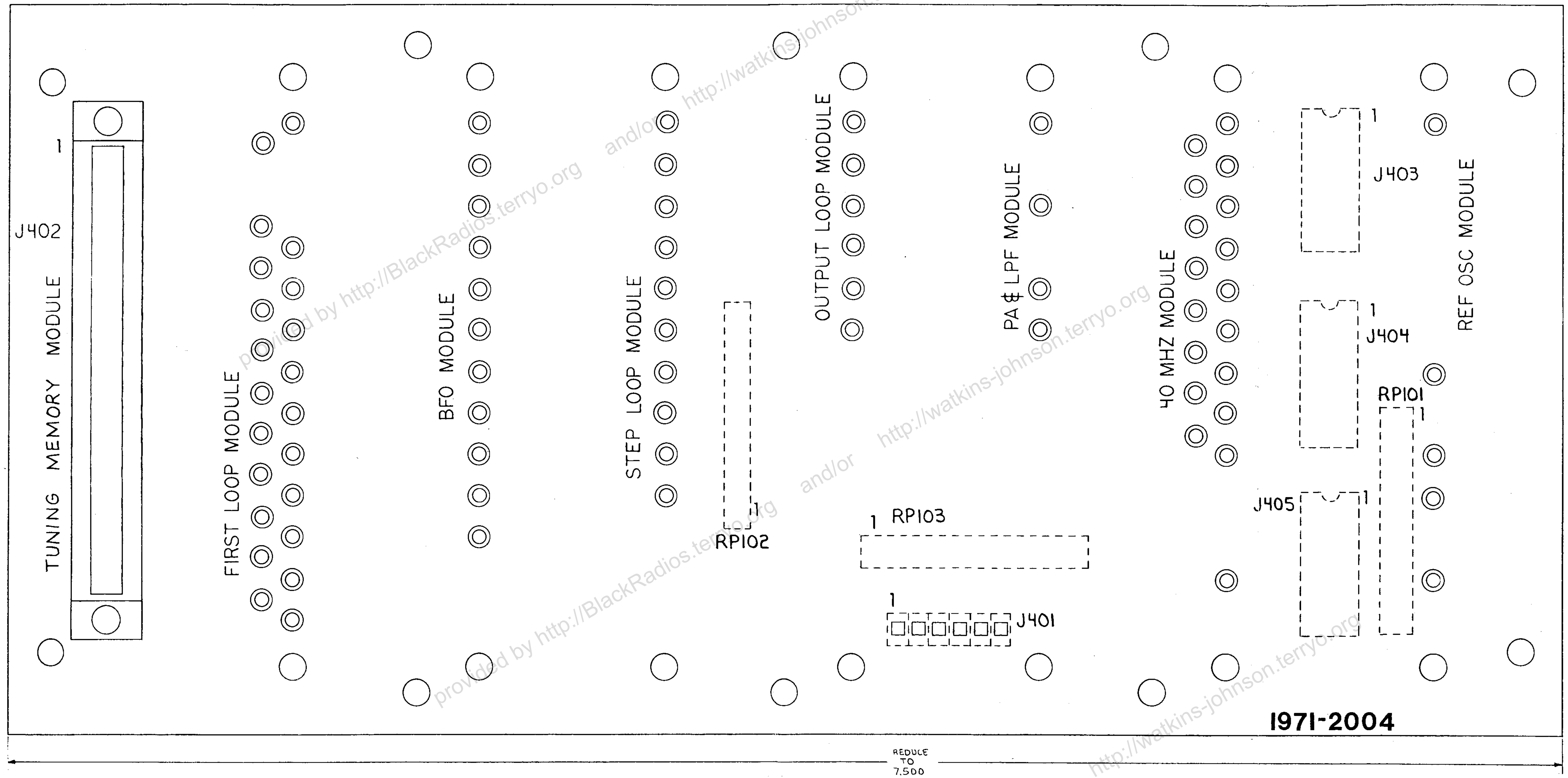
ASSY DWG, BATTERY BOARD

HF-1030

DRAWING NUMBER 1971-2003

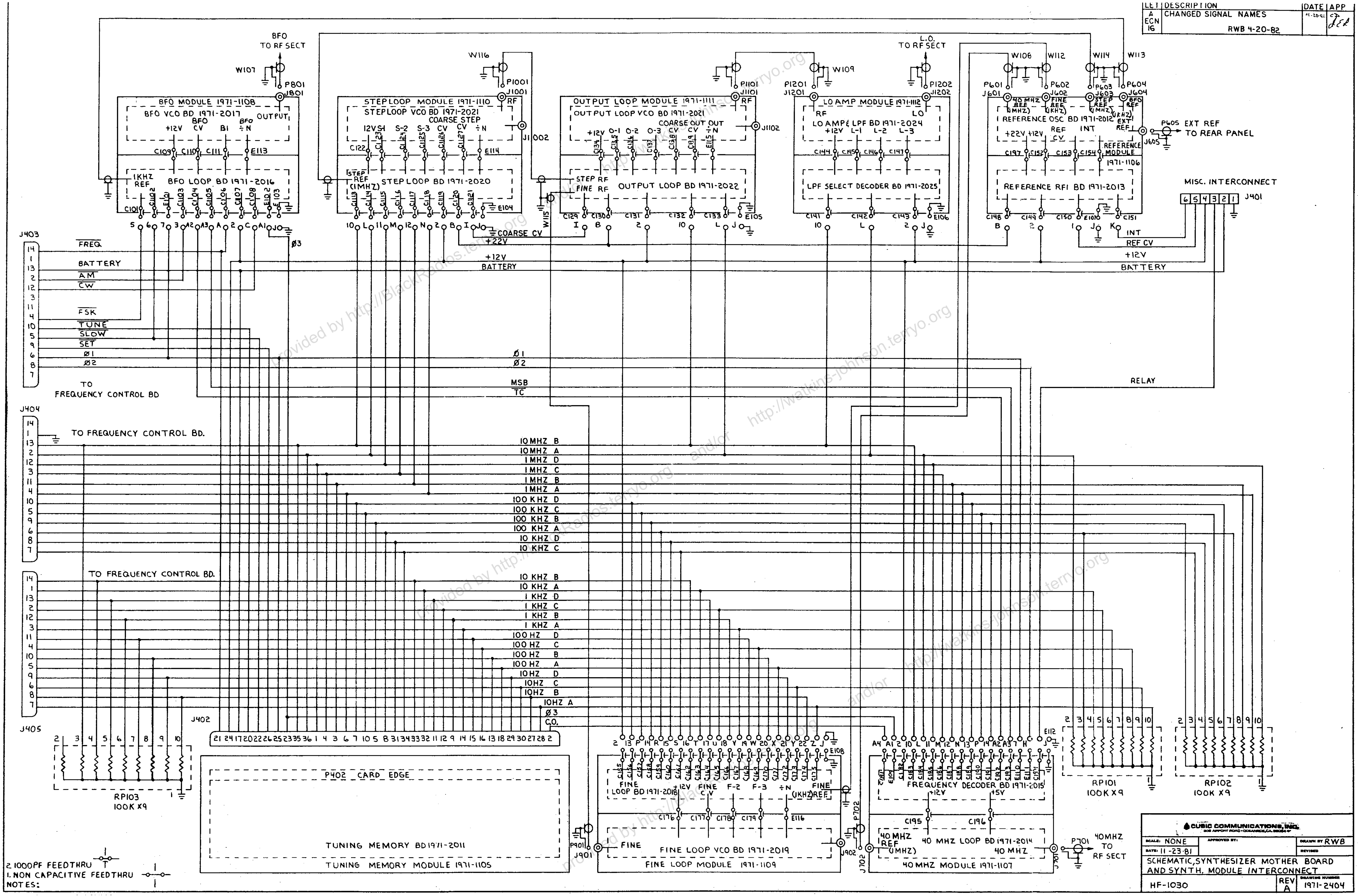
11X17 PRINTED ON NO. 1000H CLEARPRINT

LET	DESCRIPTION	DATE	APP
A ECN 16	ADDED MODULE NAMES RWB 4-20-82	4-21-82	



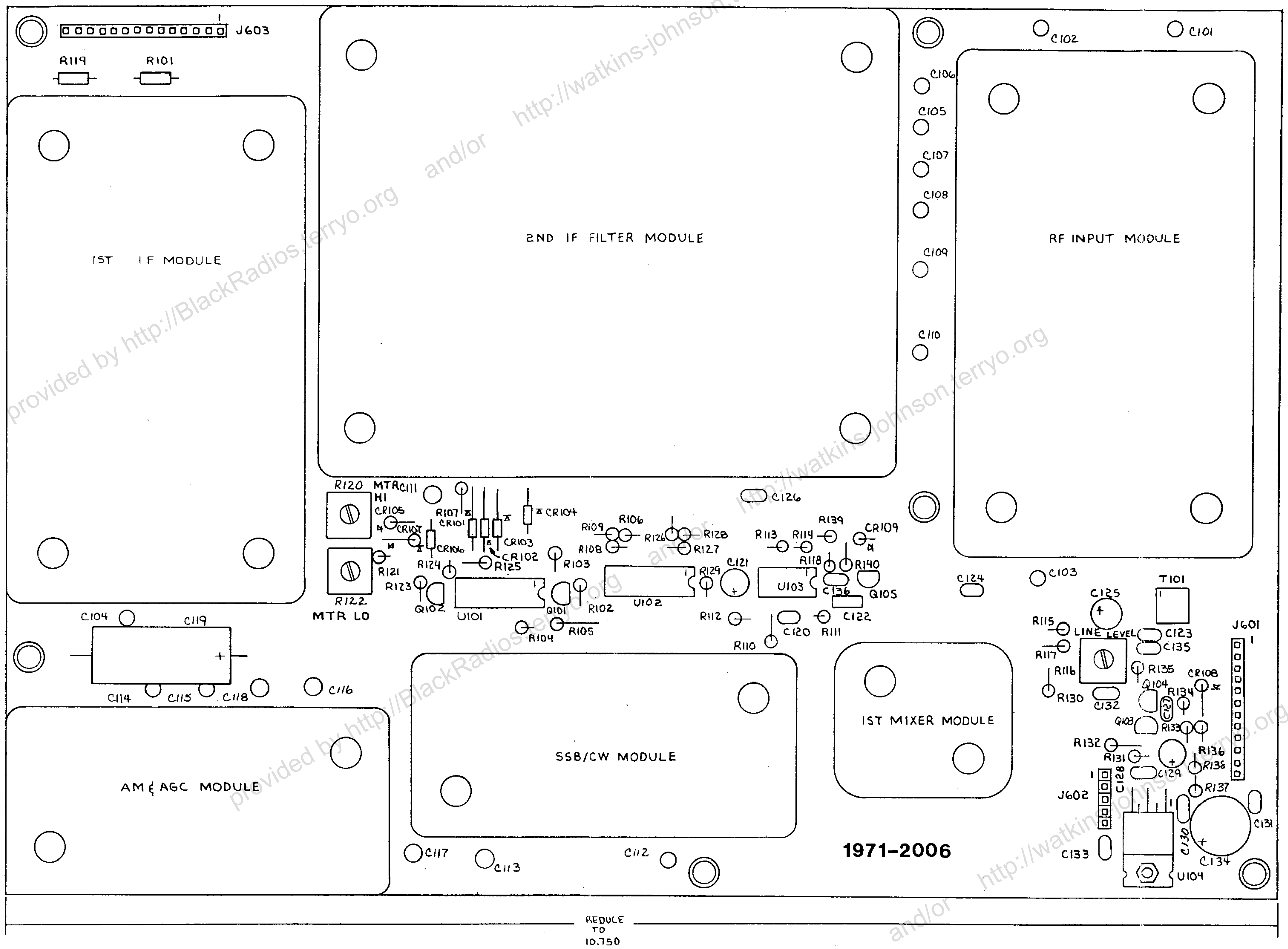
2. SCHEMATIC DWG 1971-2404
1. CIRCUIT BOARD P.N. 1971-2104
NOTE

CUBIC COMMUNICATIONS, INC.		
SCALE: 4:1	APPROVED BY:	DRAWN BY RWB
DATE: 3-10-82		REVISED
ASSEMBLY DWG, SYNTH MOTHER BD.		
HF-1030	REV A	DRAWING NUMBER 1971-2004



LET DESCRIPTION DATE APP
A ECN 16 CHANGED SIGNAL NAMES RWB 4-20-82
BFO TO RF SECT
W107
P801
J801
BFO MODULE 1971-1108
BFO VCO BD 1971-2017
+12V
BFO CV
B1
BFO ÷N
OUTPUT
1KHZ REF
BFO LOOP BD 1971-2016
W116
P1001
J1001
RF
STEPLOOP MODULE 1971-1110
STEPLOOP VCO BD 1971-2021
COARSE STEP
12V S-1 S-2 S-3 CV CV ÷N
J1002
STEP REF (1MHZ)
STEP LOOP BD 1971-2020
E104
W115
P1101
J1101
W109
OUTPUT LOOP MODULE 1971-1111
OUTPUT LOOP VCO BD 1971-2021
COARSE OUT OUT
+12V O-1 O-2 O-3 CV CV ÷N
J1102
STEP RF
FINE RF
OUTPUT LOOP BD 1971-2022
E105
L.O. TO RF SECT
P1201
J1201
P1202
J1202
LO AMP MODULE 1971-1112
RF
LO
LO AMP & LPF BD 1971-2024
+12V L-1 L-2 L-3
LPF SELECT DECODER BD 1971-2025
E106
W106 W112 W114 W113
P601 P602 P603 P604
J601 J602 J603 J604
40 MHZ REF (1MHZ)
FINE REF (1KHZ)
STEP REF (1MHZ)
BFO REF (1KHZ)
REFERENCE OSC BD 1971-2012
EXT REF
+22V +12V
REF CV
INT
REFERENCE MODULE 1971-1106
REFERENCE RFI BD 1971-2013
P605 EXT REF TO REAR PANEL
J605
MISC. INTERCONNECT
J401
6 5 4 3 2 1
INT
REF CV
+12V
BATTERY
RELAY
COARSE CV
+22V
+12V
BATTERY
J403
FREQ
BATTERY
AM
CW
FSK
TUNE
SLOW
SET
Ø1
Ø2
Ø3
TO FREQUENCY CONTROL BD
MSB
TC
J404
TO FREQUENCY CONTROL BD.
10MHZ B
10MHZ A
1MHZ D
1MHZ C
1MHZ B
1MHZ A
100 KHZ D
100 KHZ C
100 KHZ B
100 KHZ A
10 KHZ D
10 KHZ C
J405
TO FREQUENCY CONTROL BD.
10 KHZ B
10 KHZ A
1 KHZ D
1 KHZ C
1 KHZ B
1 KHZ A
100 HZ D
100 HZ C
100 HZ B
100 HZ A
10 HZ D
10HZ C
10HZ B
10HZ A
Ø3
C.O.
J402
P402 CARD EDGE
TUNING MEMORY BD 1971-2011
TUNING MEMORY MODULE 1971-1105
RP103 100K X9
FINE LOOP BD 1971-2018
+12V FINE CV F-2 F-3 ÷N FINE (1KHZ) REF
E108
E116
P901
J901
FINE
FINE LOOP VCO BD 1971-2019
FINE LOOP MODULE 1971-1109
J902
P702
J702
FREQUENCY DECODER BD 1971-2015
+12V +5V
40 MHZ REF (1MHZ)
40 MHZ LOOP BD 1971-2014
40 MHZ
40 MHZ MODULE 1971-1107
J701
P701
40MHZ TO RF SECT
E112
RP101 100K X9
RP102 100K X9
2. 1000PF FEEDTHRU
1. NON CAPACITIVE FEEDTHRU
NOTES:
CUBIC COMMUNICATIONS, INC.
SCALE: NONE
DATE: 11-23-81
DRAWN BY RWB
SCHEMATIC, SYNTHESIZER MOTHER BOARD AND SYNTH. MODULE INTERCONNECT
HF-1030
REV A
1971-2404

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	REVISED SIGNAL NAMES RWB 4-3-82	4-15-82	JEL



2. SCHEMATIC DWG NO. 1971-2406
1. CIRCUIT BD P.N. 1971-2106
NOTES:

CUBIC COMMUNICATIONS, INC.		
SCALE: 2:1	APPROVED BY: JEL	DRAWN BY CK
DATE: 4-3-82		REVISED RWB
ASSEMBLY DWG, RF MOTHER BD		
HF-1030	REV A	DRAWING NUMBER 1971-2006

LET	DESCRIPTION	DATE	APP
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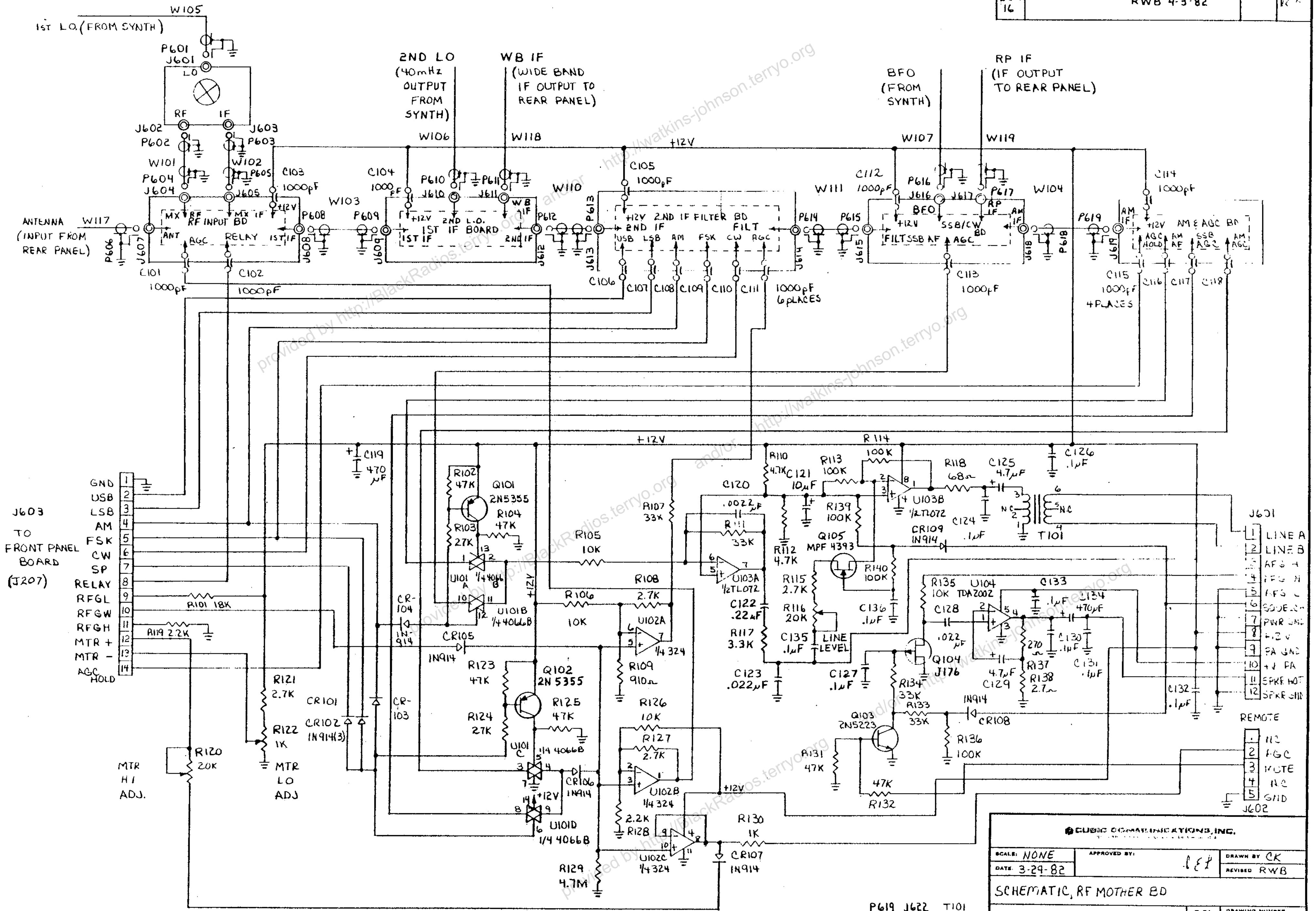


CUBIC COMMUNICATIONS, INC.

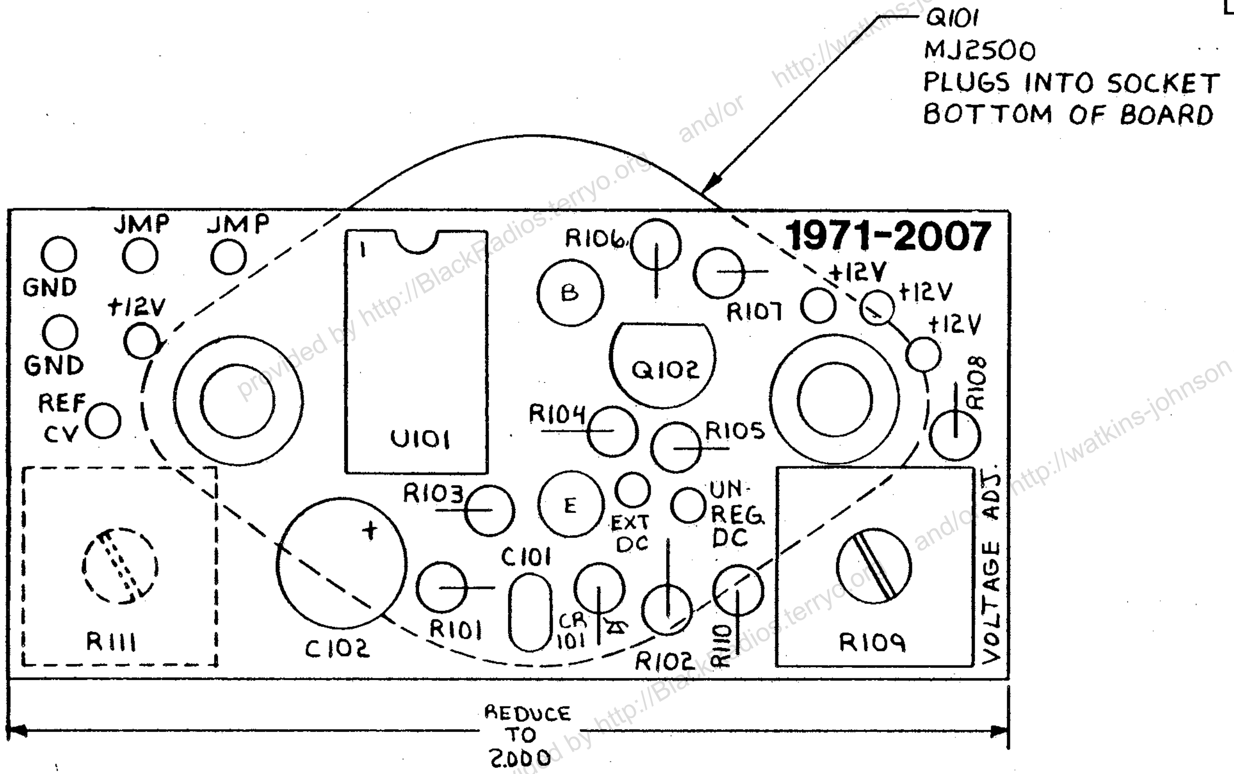
SCALE: NONE	DATE: 3-29-82
APPROVED BY:	
DRAWN BY: CK	REVISED: RWB

SCHEMATIC, RF MOTHER BD

HF-1030 — REV A — DRAWING NUMBER 1971-2406

CR109 C136 P619 R140 J622 Q105 T101 U104

LET	REVISION	DATE	APPD
A ECN 16	CHANGED HOLE POSITION, REVISED SIGNAL NAME, ADDED GND TWO POSITION R.ROE 4-16-82	4/19/82	JEL



2. SCHEMATIC DWG NO. 1971-2407
1. CIRCUIT BD P.N. 1971-2107
NOTES

CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE CA

SCALE: 4:1	APPROVED BY: RJA JEL	DRAWN BY RWB
DATE: 9-30-81		REVISED

ASSEMBLY DWG, VOLTAGE REGULATOR BD

	REV	DRAWING NUMBER
HF-1030	A	1971-2007

LET	REVISION	DATE	APPD
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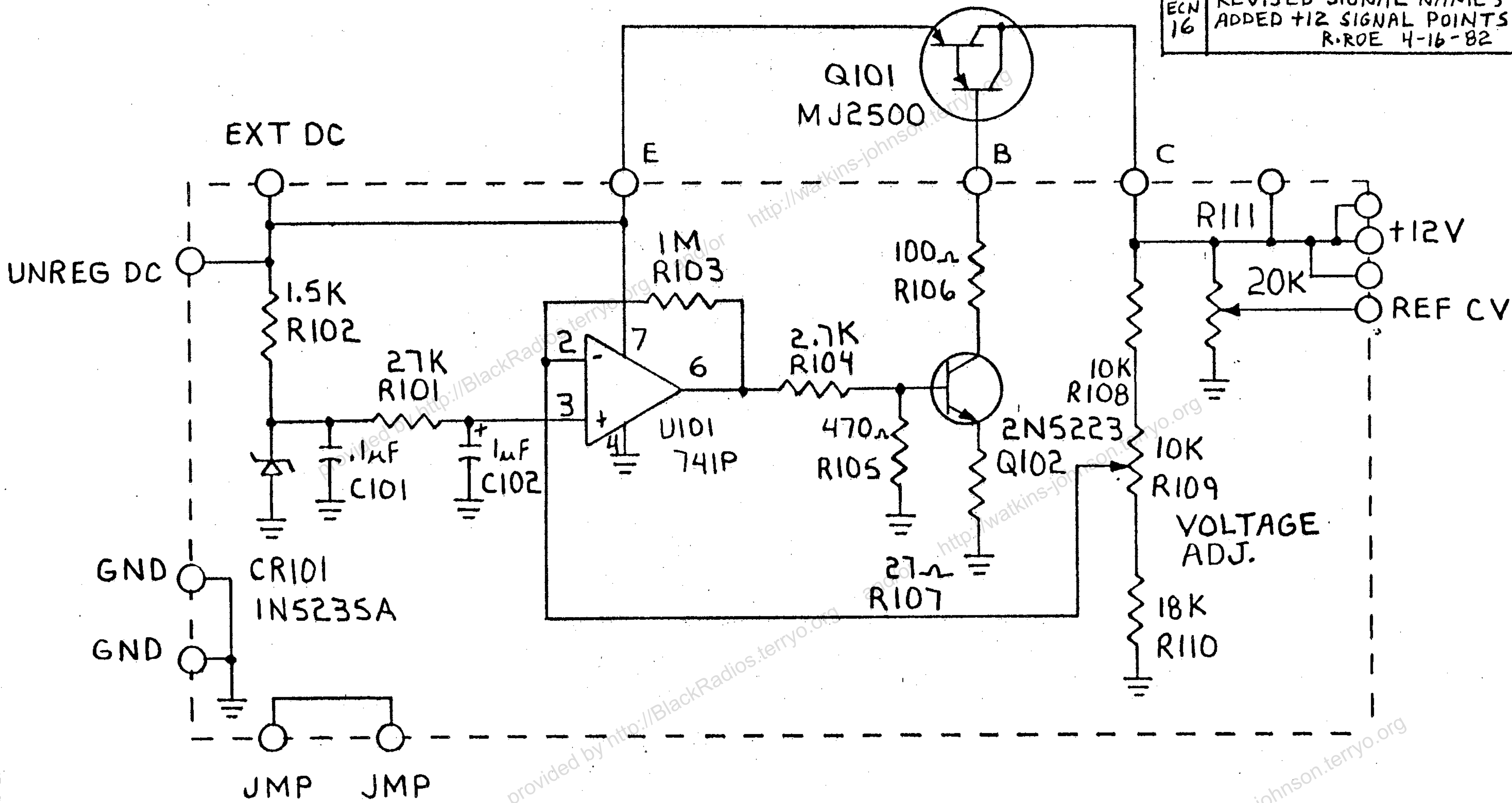


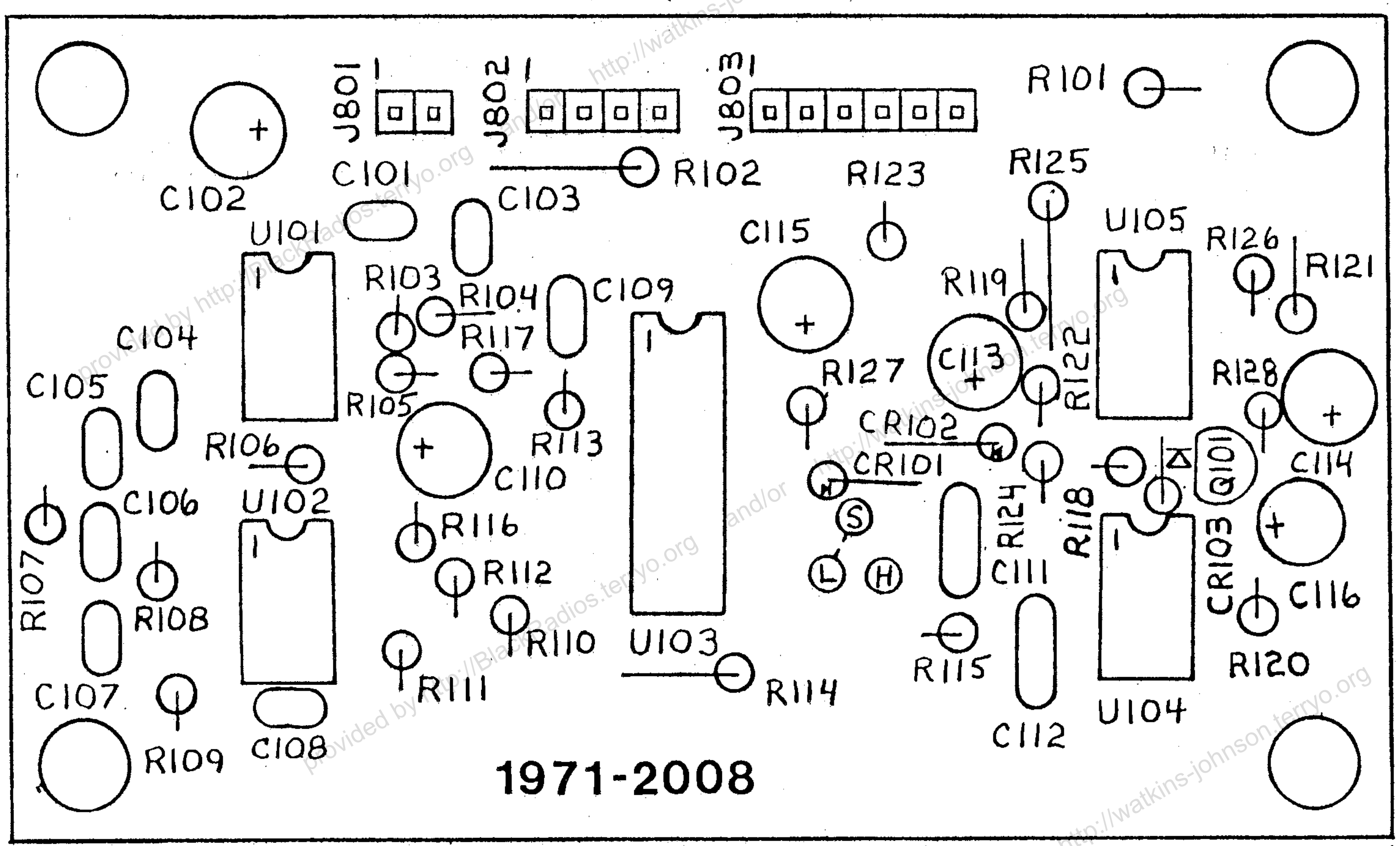
CUBIC COMMUNICATIONS, INC.
605 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: NONE	APPROVED BY: RH JEL	DRAWN BY RWB
DATE: 9-12-81		REVISED

SCHEMATIC, VOLTAGE REGULATOR BOARD

HF-1030 | REV A | DRAWING NUMBER

ECN	DESCRIPTION	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-16-82	JEL



REDUCE TO 3.700

CUBIC COMMUNICATIONS, INC.
805 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: 2 : 1	APPROVED BY: 10/12/81 JEL	DRAWN BY R. ROE
DATE: 3-10-82		REVISED RWB

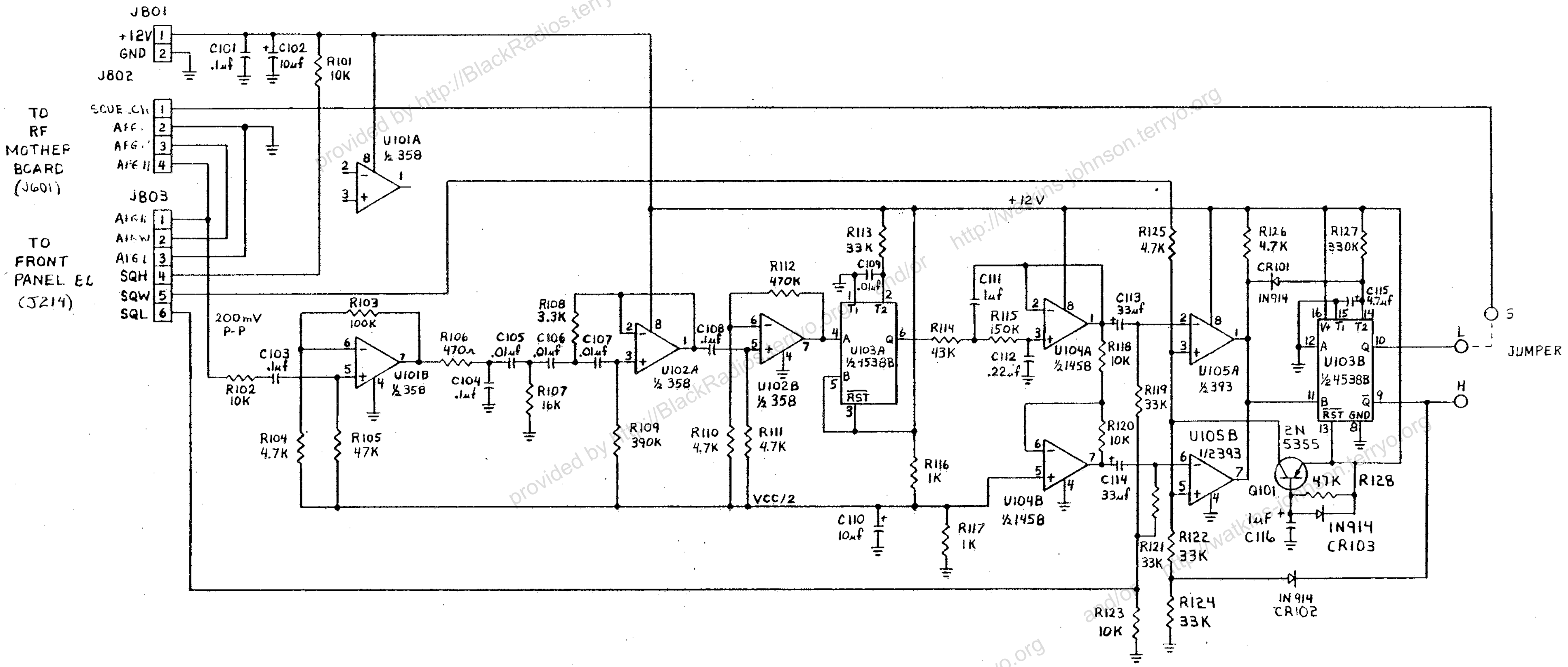
ASSEMBLY DWG, SQUELCH BOARD

REV | DRAWING NUMBER

C115
R128
CR102
U105

2. SCHEMATIC DWG NO 1971-2408
1. CIRCUIT BD P.N. 1971-2108

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	



2. Q OUTPUT PRODUCES + VOLTAGE TO UNSQUELCH, GND TO SQUELCH (L)

1. $\overline{Q}$ OUTPUT PRODUCES GND TO UNSQUELCH, + VOLTAGE TO SQUELCH (H)

NOTES:

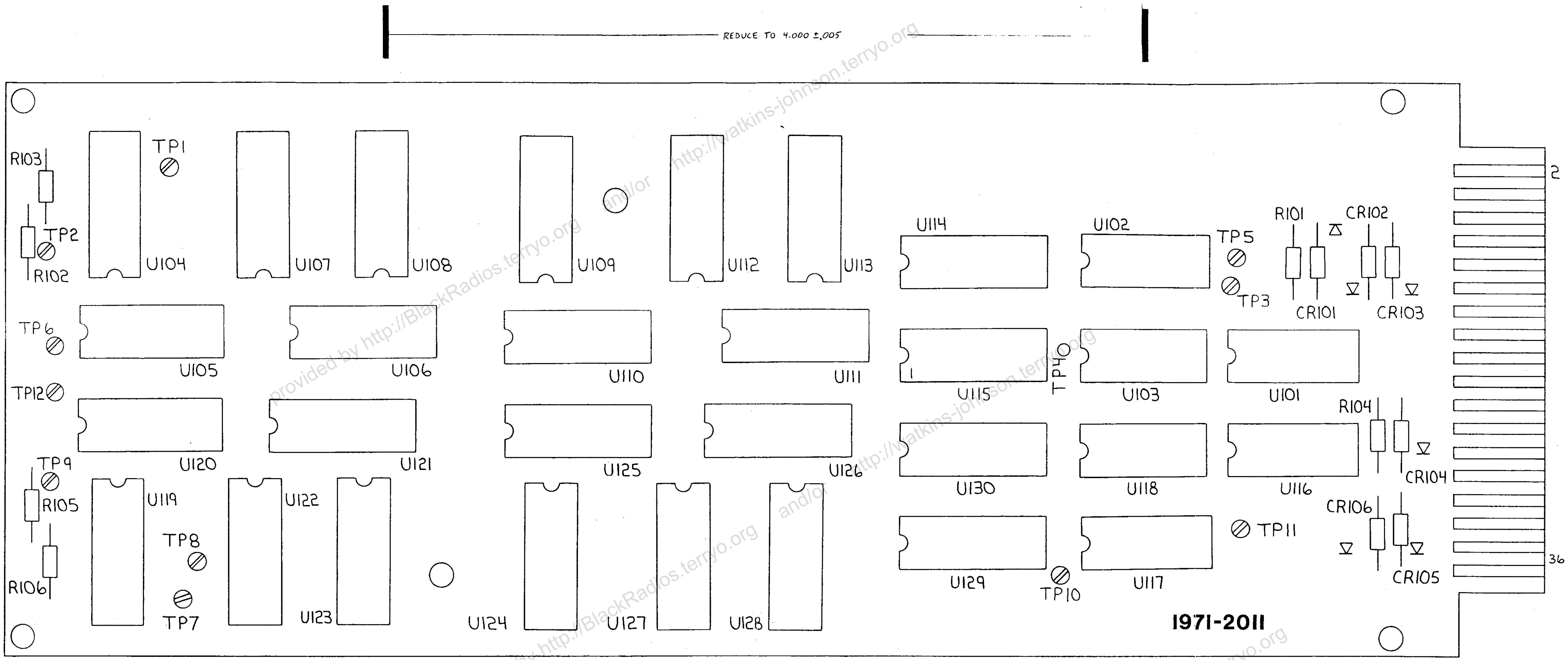
C116 U105
R128
CR103 Q101

CUBIC COMMUNICATIONS, INC.

SCALE: NONE	APPROVED BY:	DRAWN BY R. ROE
DATE: 3-10-82		REVISED RWB

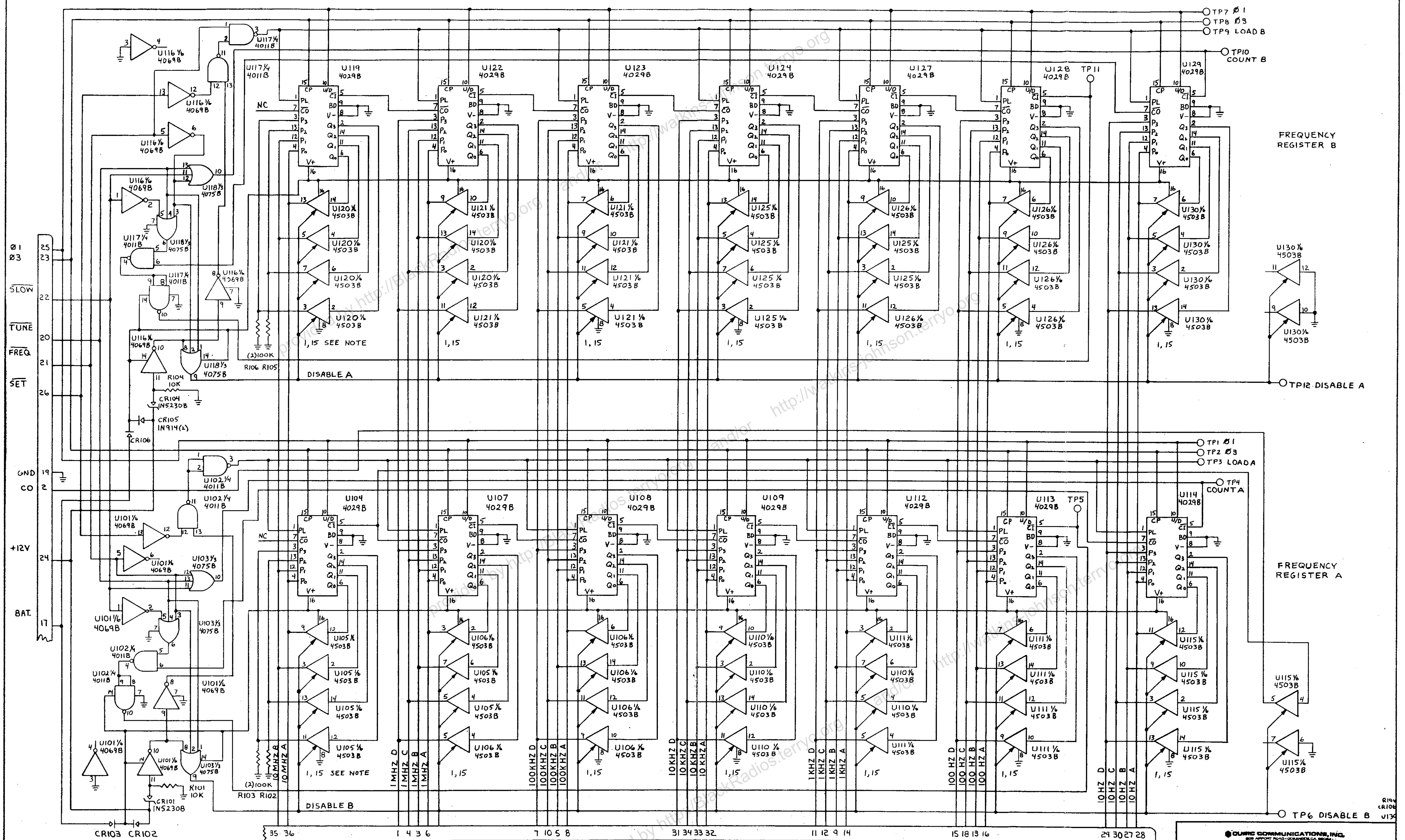
SCHEMATIC, SQUELCH BOARD

	REV	DRAWING NUMBER
HF-1030	A	1971-2408



2. SCHEMATIC DWG 1971-2411
1. CIRCUIT BD P.N. 1971-2111
NOTES:

CUBIC COMMUNICATIONS, INC.		
SCALE: 4:1	APPROVED BY: JEL 10/12/81	DRAWN BY RWB
DATE: 10-10-81		REVISED
ASSEMBLY DWG, TUNING MEMORY BD		
HF-1030		DRAWING NUMBER 1971-2011



QUIRC COMMUNICATIONS, INC.

SCALE: NONE | APPROVED BY: 4/26/82 | DRAWN BY R. ROE

DATE: 3-14-82

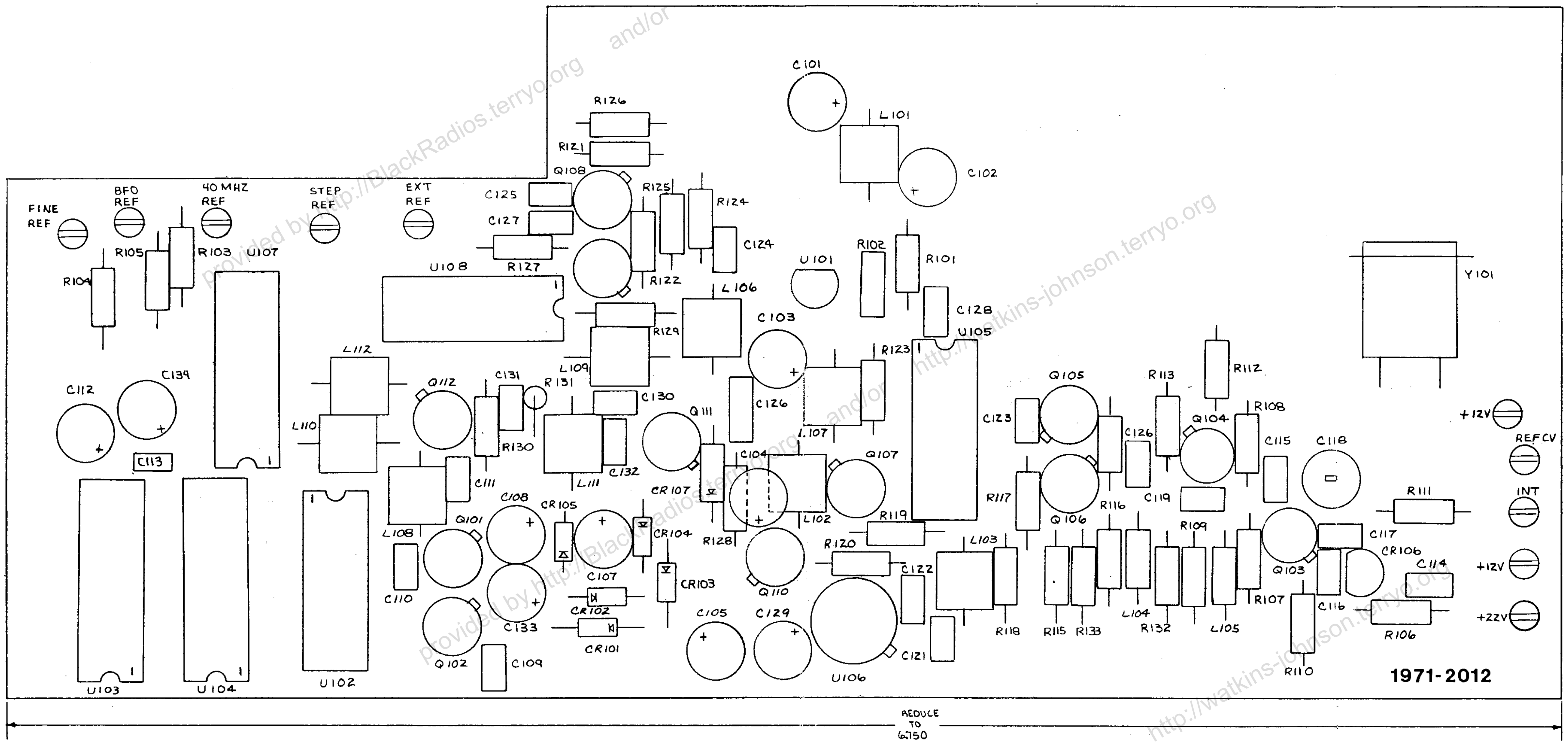
SCHEMATIC, TUNING MEMORY BOARD

HF-1030 | REV A | DRAWING NUMBER 1971-2411

LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-20-82		

NOTES: I. PINS 1+15 OF ALL 4503B IN EACH REGISTER TIED COMMON.

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	



NOTES

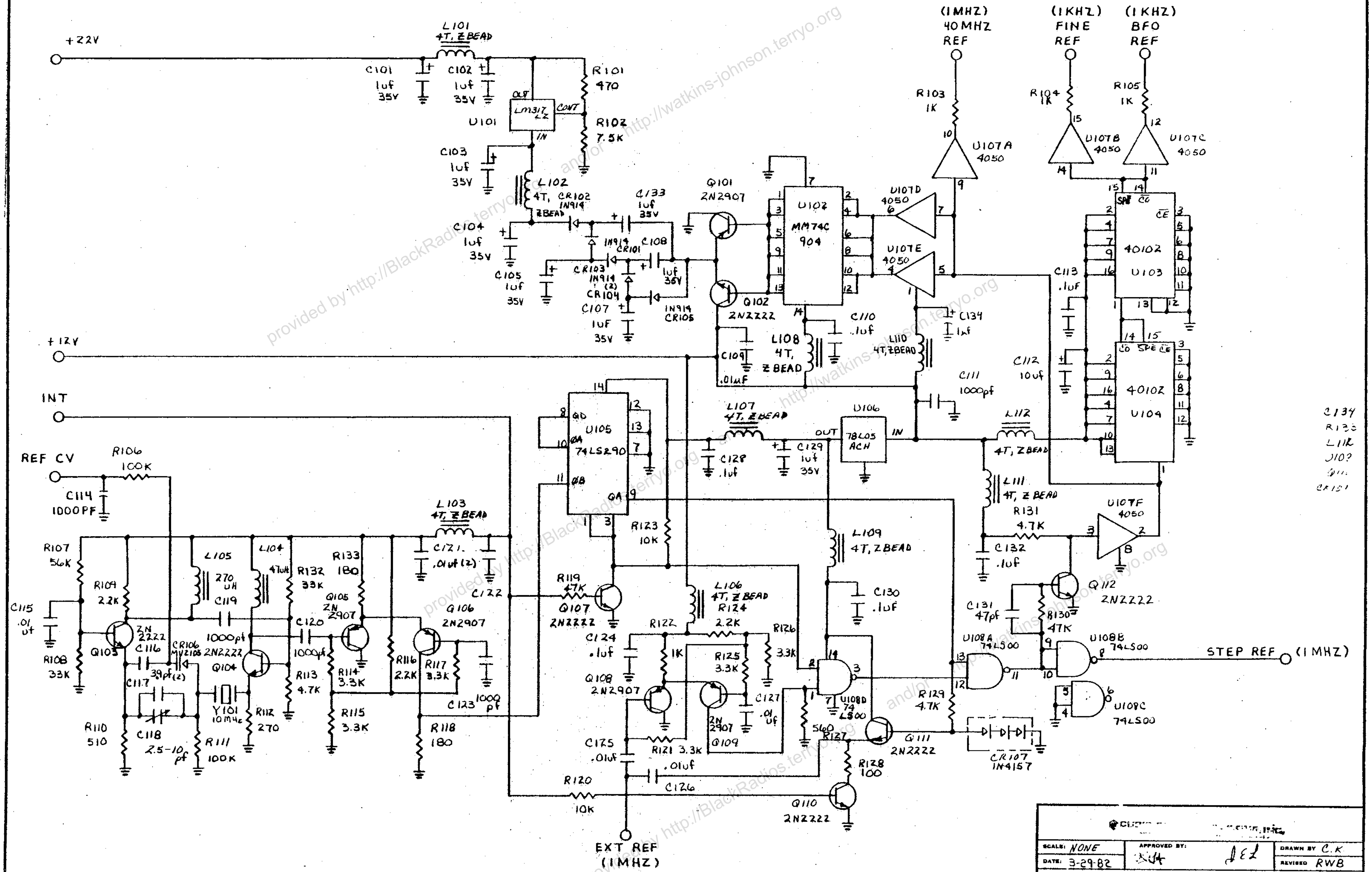
1. CIRCUIT BRD P.N 1971-2112
2. SCHEMATIC DWG NUMBER 1971-2412

SCALE: 4:1	APPROVED BY:	DRAWN BY CK
DATE: 9-1-81		REVISED RWB

ASSY DWG, REFERENCE OSCILLATOR BD

HF-1030 | REV A | DRAWING NUMBER 1971-2012

REVISION			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	

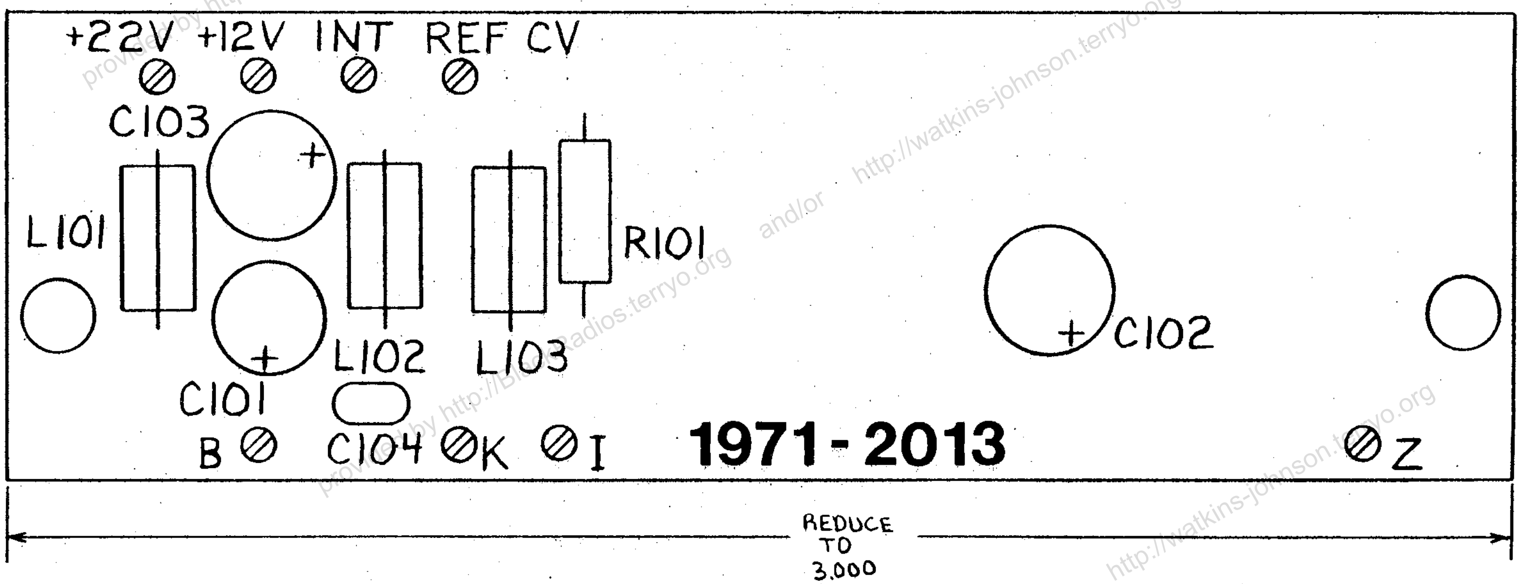


SCALE: NONE	APPROVED BY:	DRAWN BY C.K
DATE: 3-29-82		REVISED RWB

SCHEMATIC, REFERENCE OSCILLATOR BD

HF-1030 | REV A | DRAWING NUMBER 1971-2412

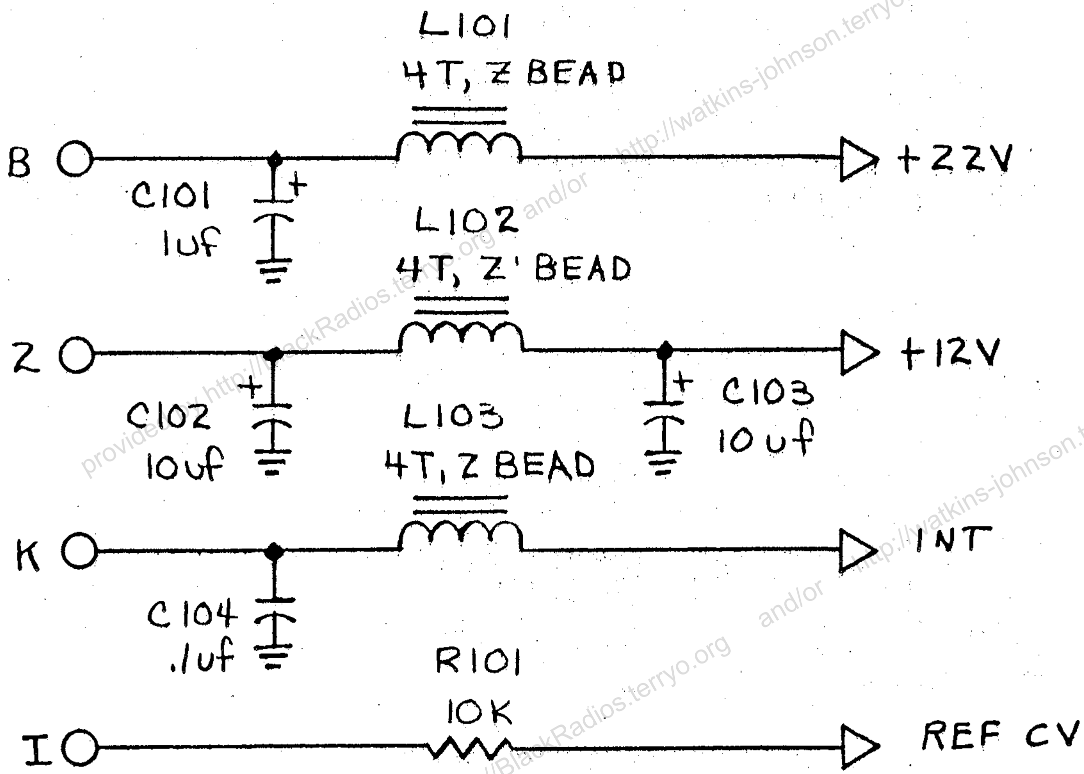
LET	REVISION	DATE	APPD
A ECN 76	REVISED SIGNAL NAMES. R. ROE 4-16-82	4/19/82	JEL



2. SCHEMATIC DWG. NO 1971-2413
1. CIRCUIT BD P.N. 1971-2113
NOTES

CUBIC COMMUNICATIONS, INC. 305 AIRPORT ROAD • OCEANSIDE, CA 92054		
SCALE: 4:1	APPROVED BY: RYA JEL	DRAWN BY ROR
DATE: 9/9/81		REVISED
ASSEMBLY DWG, REFERENCE RF1 BD		
HF-1030	REV A	DRAWING NUMBER 1971-2013

11X17 PRINTED ON NO. 1000H CLEARPRINT



C104
L103
R101

▷ TO REFERENCE OSC. BOARD

○ TO SYNTH. MOTHER BOARD

NOTES:

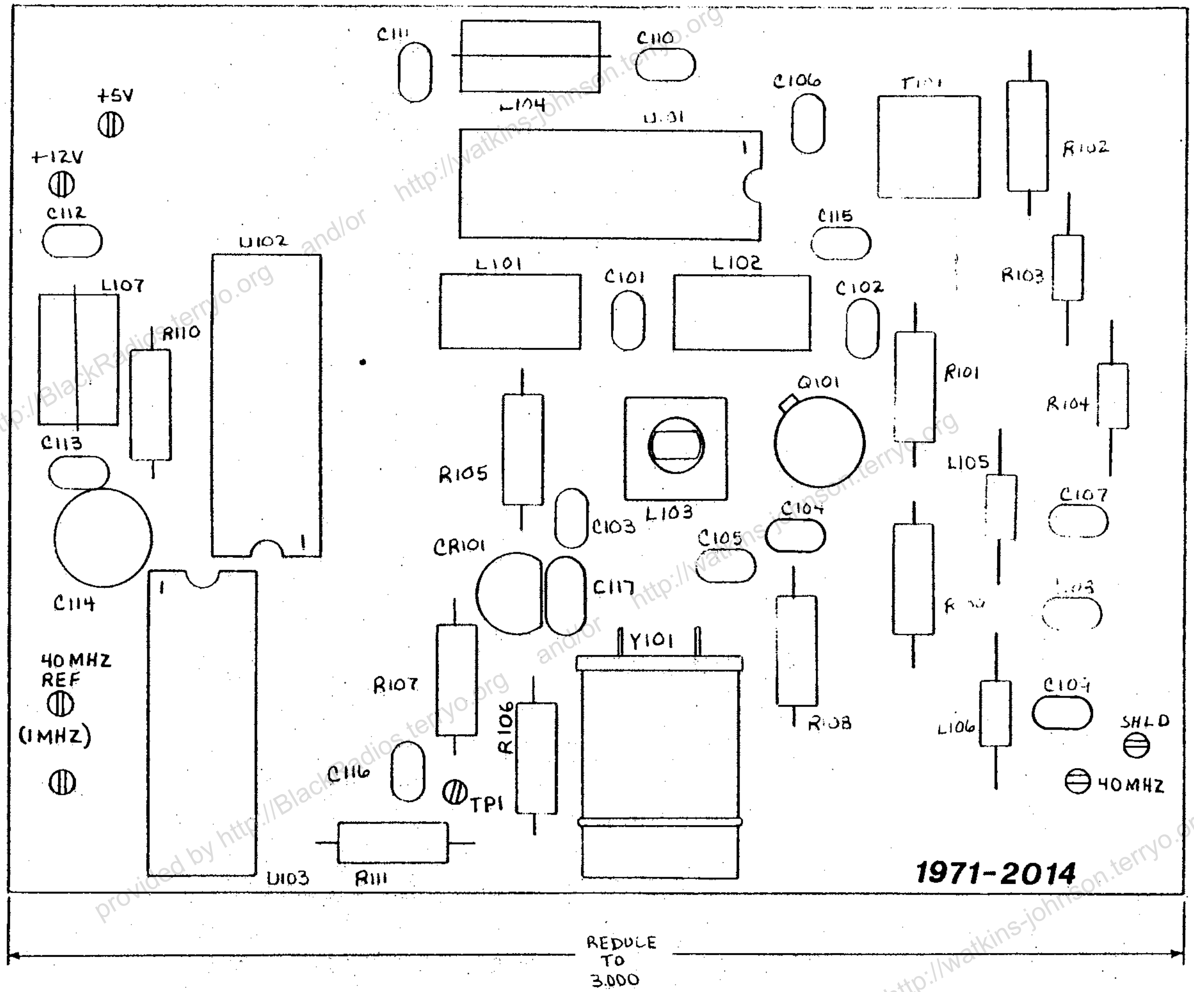
CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: NONE	APPROVED BY: JEL	DRAWN BY CK
DATE: 5-1-81		REVISED

SCHEMATIC, REFERENCE RFI BD

HF-1030

DRAWING NUMBER 1971-2413



LET	DESCRIPTION	DATE	APP
ECN 16 B	CHANGED SIGNAL NAMES, ADDED TP-1 RWB 4-5-82		
ECN 9 A	ADDED C117 RWB 3-12-82	3-15-82	

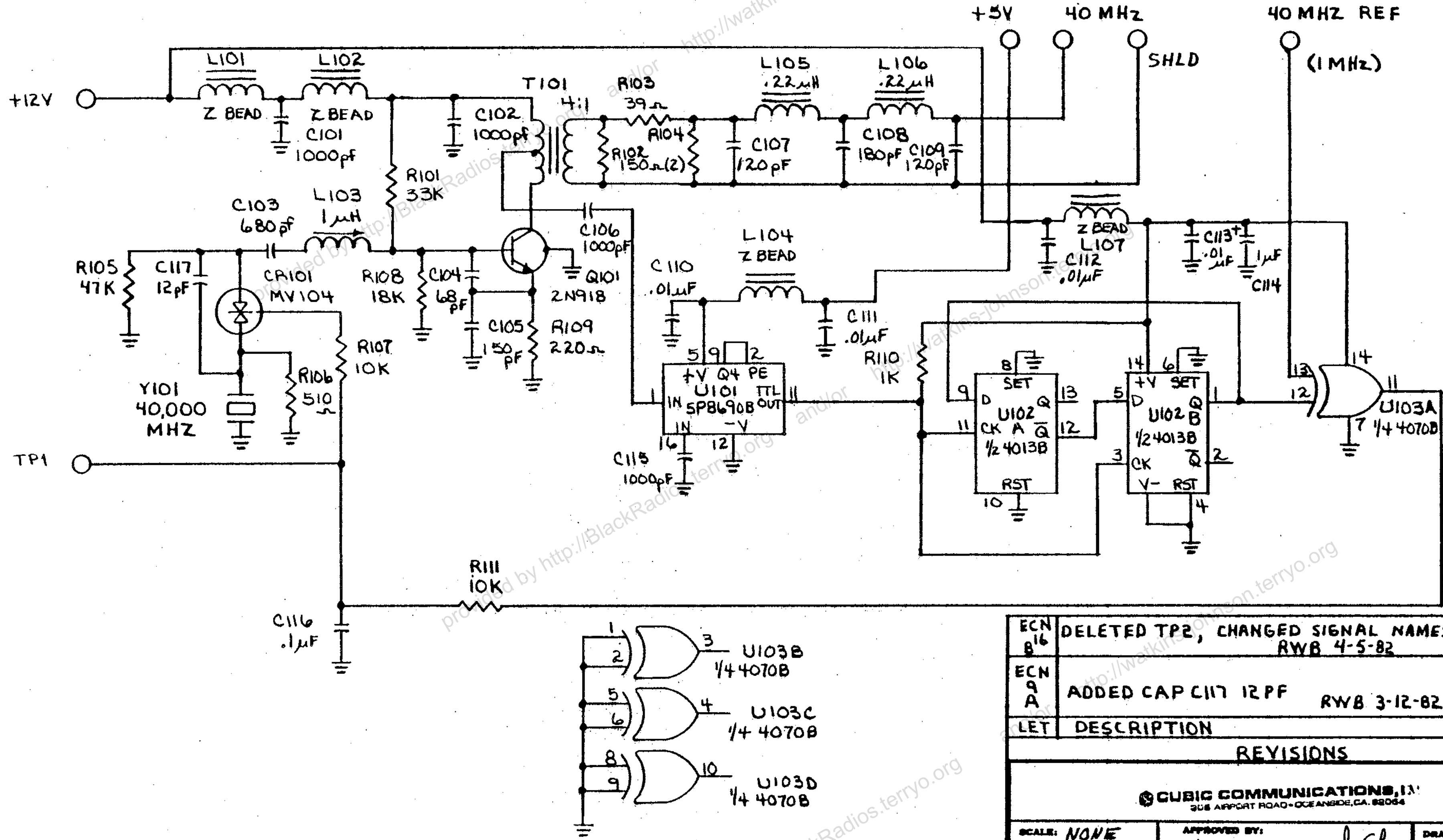
REVISIONS

SCALE: 4:1	APPROVED BY:	DRAWN BY CK
DATE: 8-31-81		REVISED RWB

ASSEMBLY DWG, 40 MHz LOOP BD.

UF-1030 | REV | DRAWING NUMBER

2. SCHEMATIC DWG NO. 1971-2414
1. CIRCUIT BD P.N. 1971-2114
NOTES



LET	DESCRIPTION	DATE	APP
ECN 16 B	DELETED TP2, CHANGED SIGNAL NAMES RWB 4-5-82	4-16-82	
ECN 9 A	ADDED CAP C117 12 PF RWB 3-12-82	3-15-82	

REVISIONS

CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: NONE
DATE: 8-19-81
APPROVED BY:
DRAWN BY CK
REVISED

SCHEMATIC, 40 MHz LOOP BD

HF - 1030

REV B

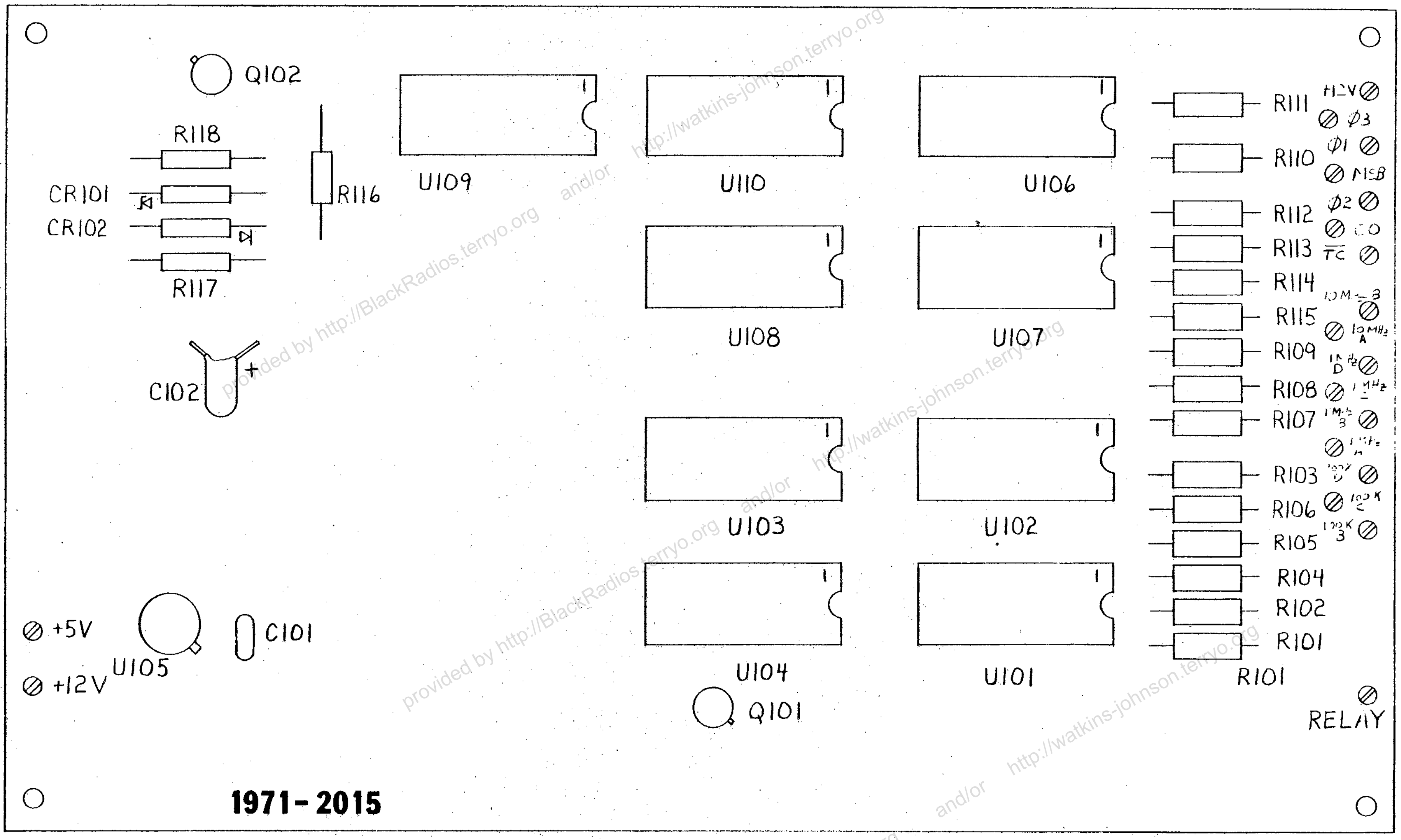
DRAWING NUMBER 1971-2414

L10
C11
R11
T10
Q101
CR10

11X17 PRINTED ON NO. 1000H-10 CLEARPRINT FADE-OUT

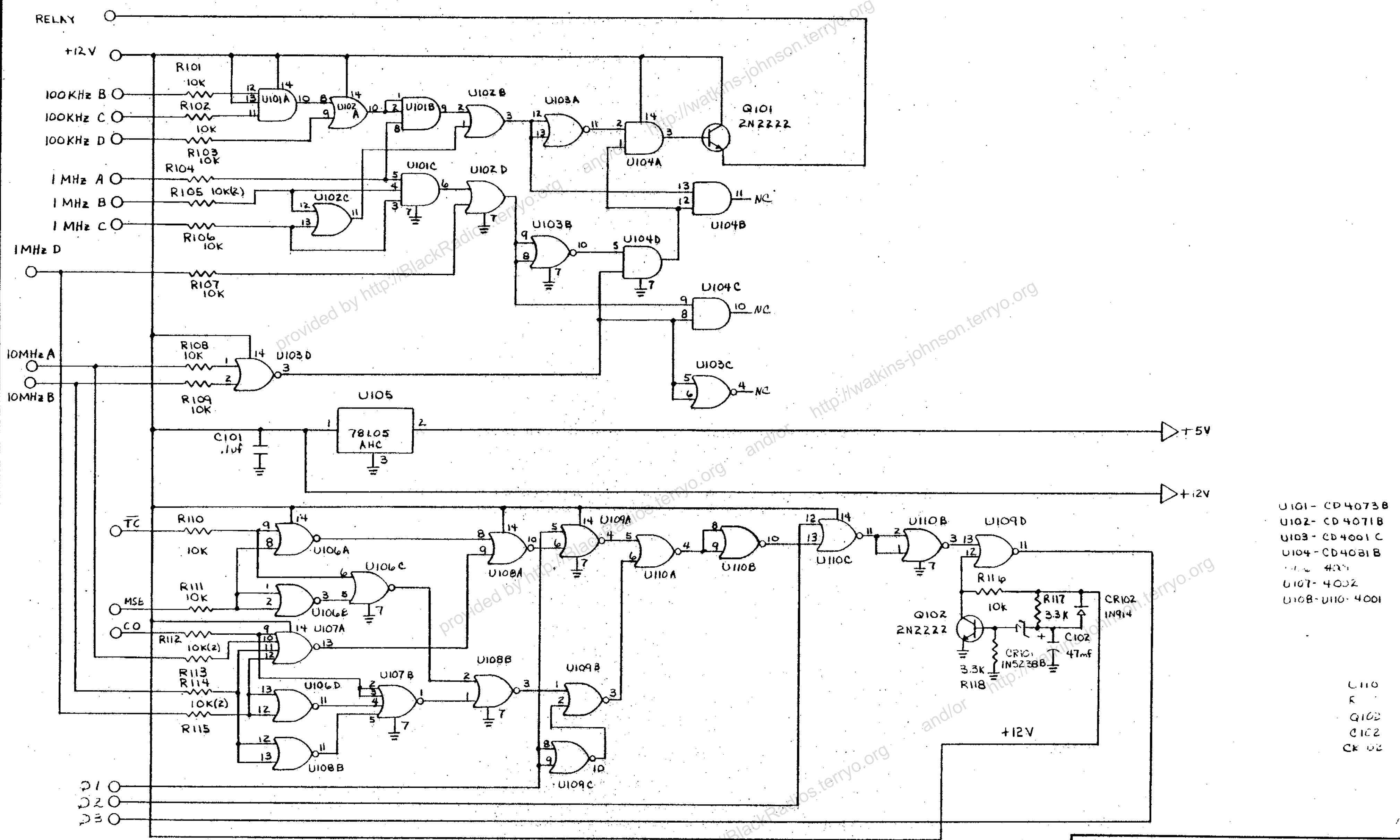
LET	REVISION	DATE	APPD
A ECN 16	REVISED SIGNAL NAMES R.RUE 4-19-82		

REDUCE TO 3.000 ± .005



2. SCHEMATIC DWG NO. 1971-2415
1. CIRCUIT BD P.N. 1971-2115
NOTES:

CUBIC COMMUNICATIONS, INC.		
SCALE: 4:1	APPROVED BY:	DRAWN BY RWR
DATE: 9-9-81		REVISED
ASSEMBLY, FREQUENCY DECODER BOARD		
HF-1030	REV	DRAWING NUMBER 1971-2015



CONNECTION TO 40 MHZ LOOP BOARD

CONNECTION TO SYNTH MOTHER BOARD

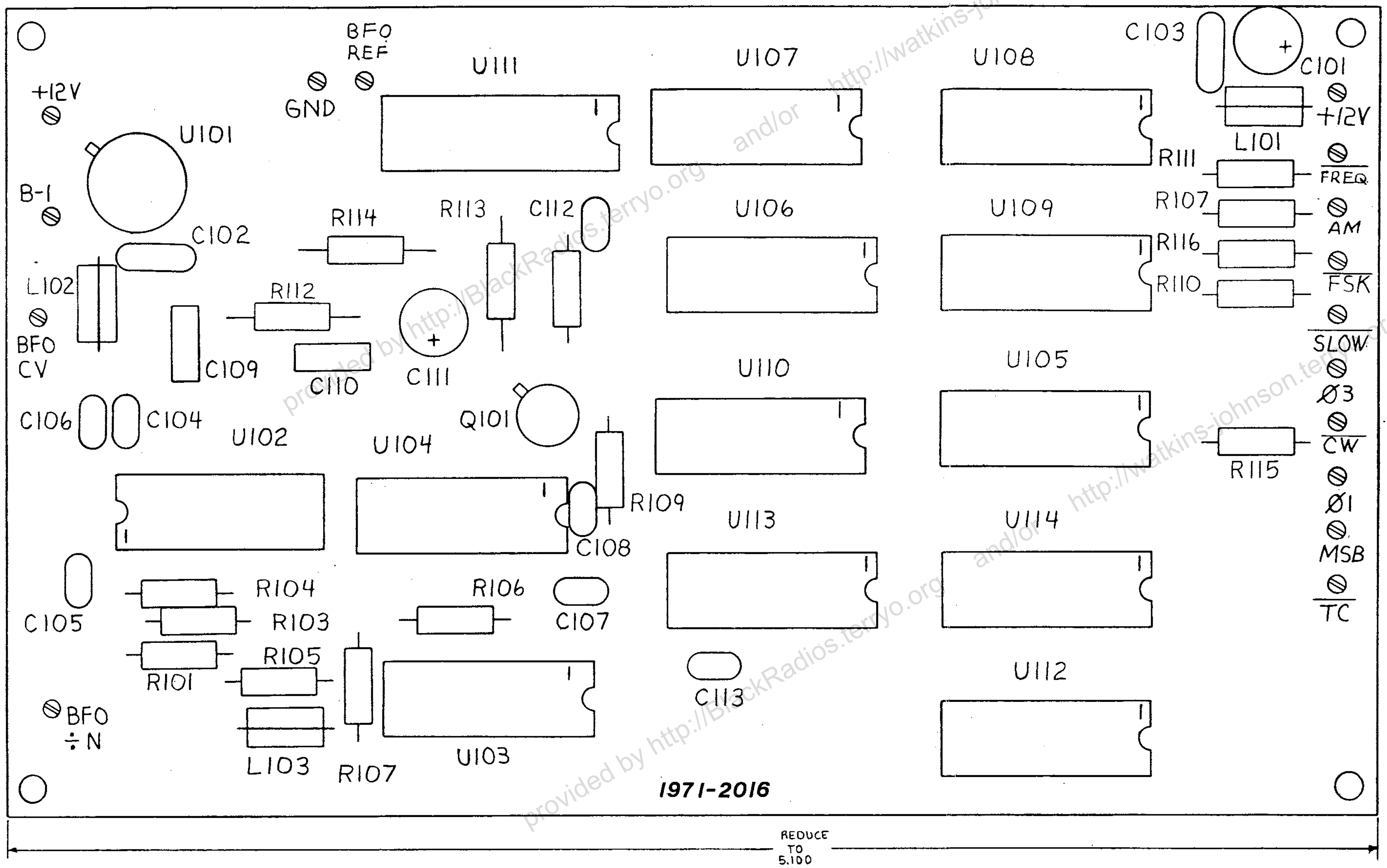
SCALE: NONE	APPROVED BY:		DRAWN BY CK
DATE: 3-10-82			REVISED

SCHEMATIC, FREQUENCY DECODER BD

HF-1030

DRAWING NUMBER 1971-2415

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	

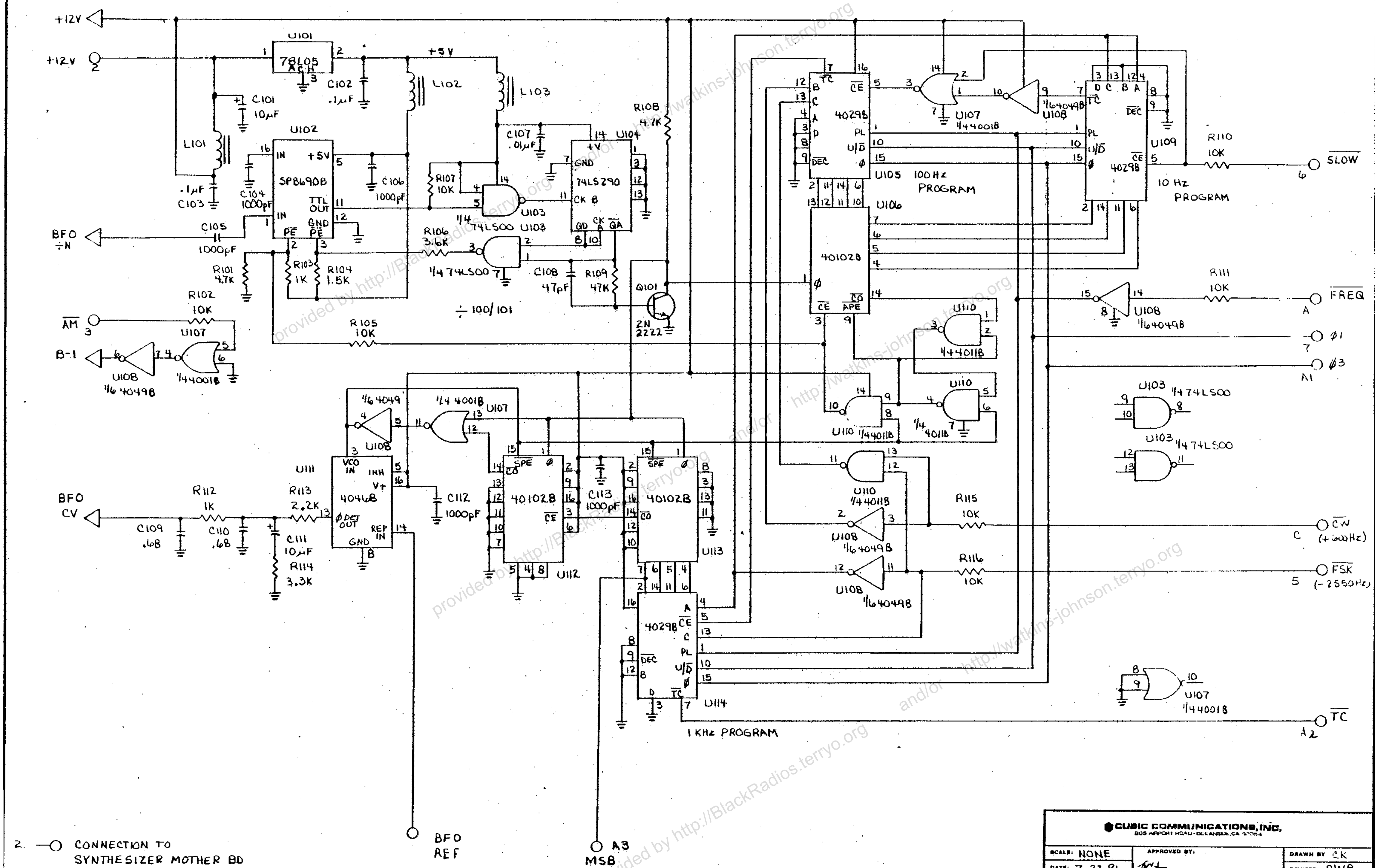


COMMUNICATIONS, INC.

SCALE: 4:1	DRAWN BY: ROR
DATE: 9/10/81	
ASSEMBLY DWG, BFO LOOP BD	
HF-1030	REV A 1971-2016

2. SCHEMATIC DWG NO 1971-2416
1. CIRCUIT BD P.N. 1971-2116
NOTES

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	



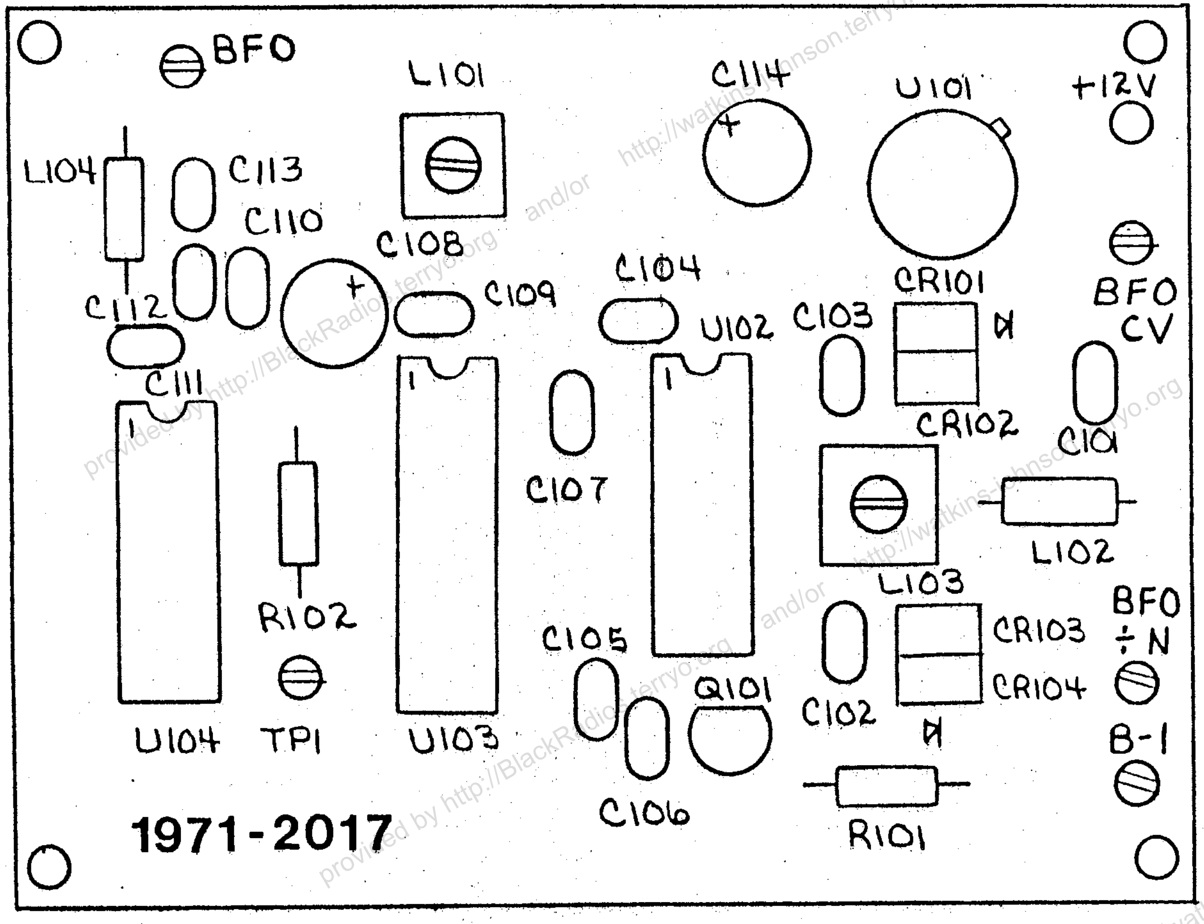
NOTES

2. —○ CONNECTION TO SYNTHESIZER MOTHER BD

1. —▷ CONNECTION TO VCO

CUBIC COMMUNICATIONS, INC.		
SCALE: NONE	APPROVED BY:	DRAWN BY CK
DATE: 7-22-81		REVISED RWB
SCHEMATIC, BFO LOOP BD		
HF-1030	REV A	DRAWING NUMBER 1971-2416

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN16	CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	CD dEL



CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

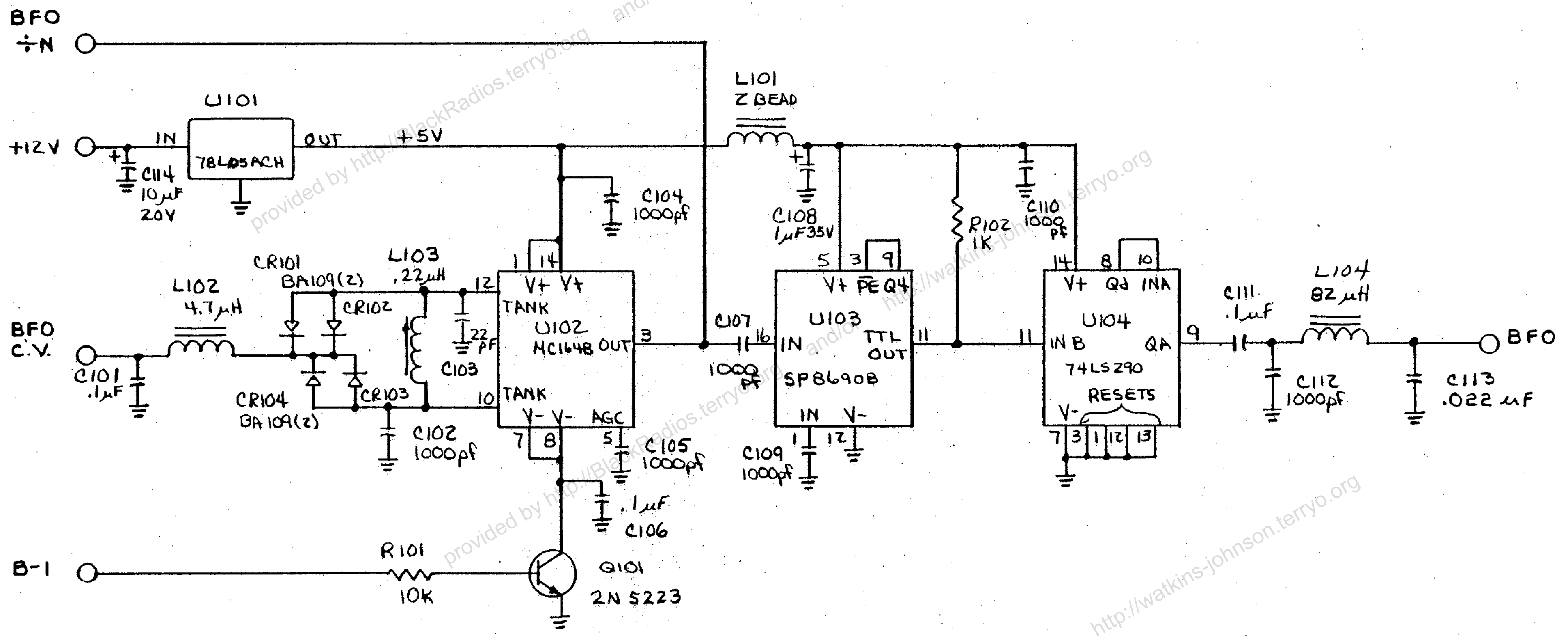
SCALE: 2:1	APPROVED BY:	DRAWN BY CK
DATE: 8-28-81	RYA dEL	REVISED

ASSEMBLY DWG., BFO VCO BD

	REV	DRAWING NUMBER
HF-1030	A	1971-2017

2. SCHEMATIC DWG NO. 1971-2417
1. CIRCUIT BD P.N. 1971-2117
NOTES

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	JER

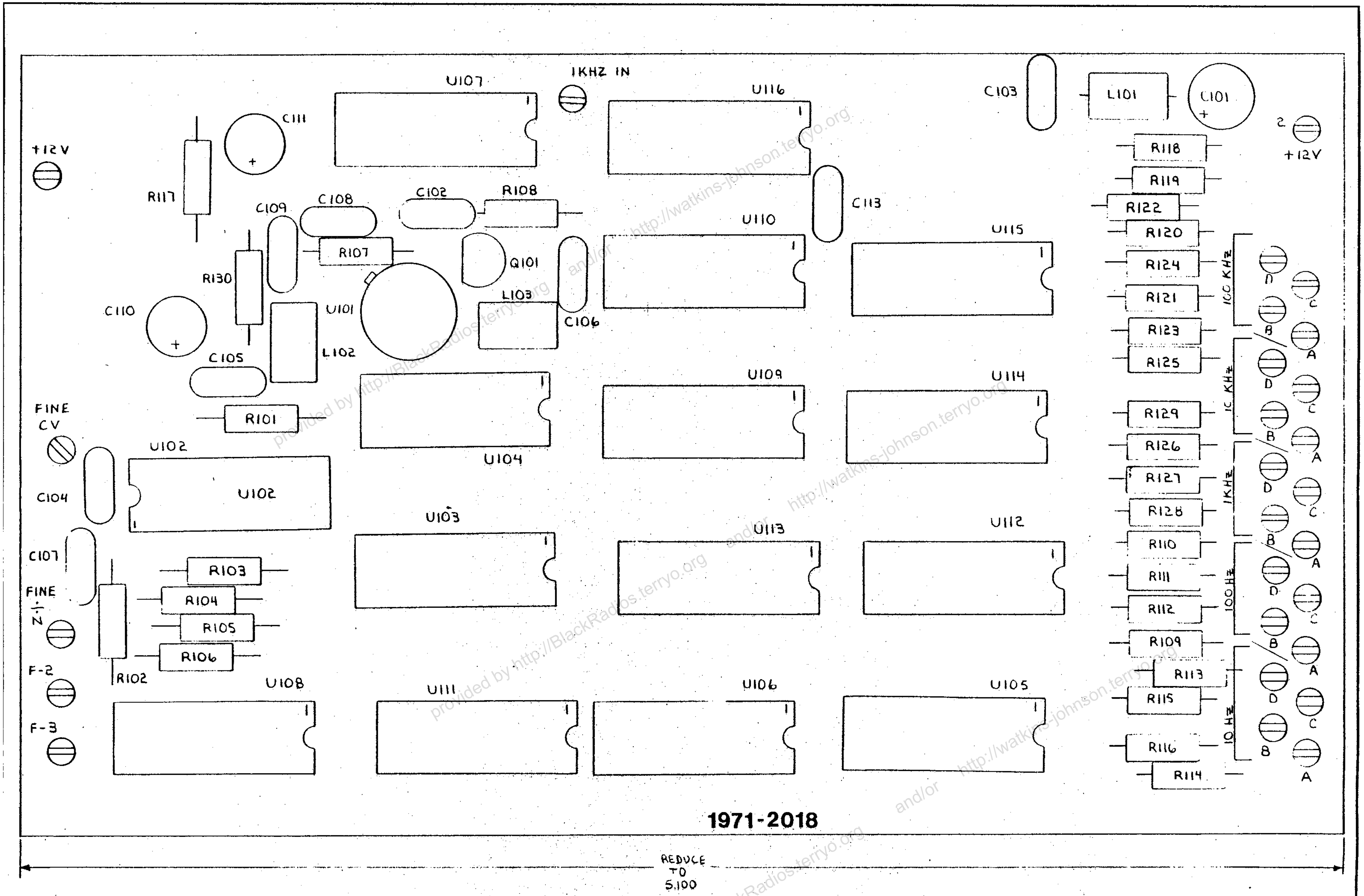


CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD - OCEANSIDE, CA. 92054

SCALE: NONE	APPROVED BY: JER	DRAWN BY CK
DATE: 11-16-81		REVISED RWB

SCHEMATIC, BFO VCO BD

HF-1030 | REV A | DRAWING NUMBER 1971-2417



LET	DESCRIPTION	DATE	APP
ECN A16	CHANGED SIGNAL NAMES RWB 4-5-82	4/16/82	

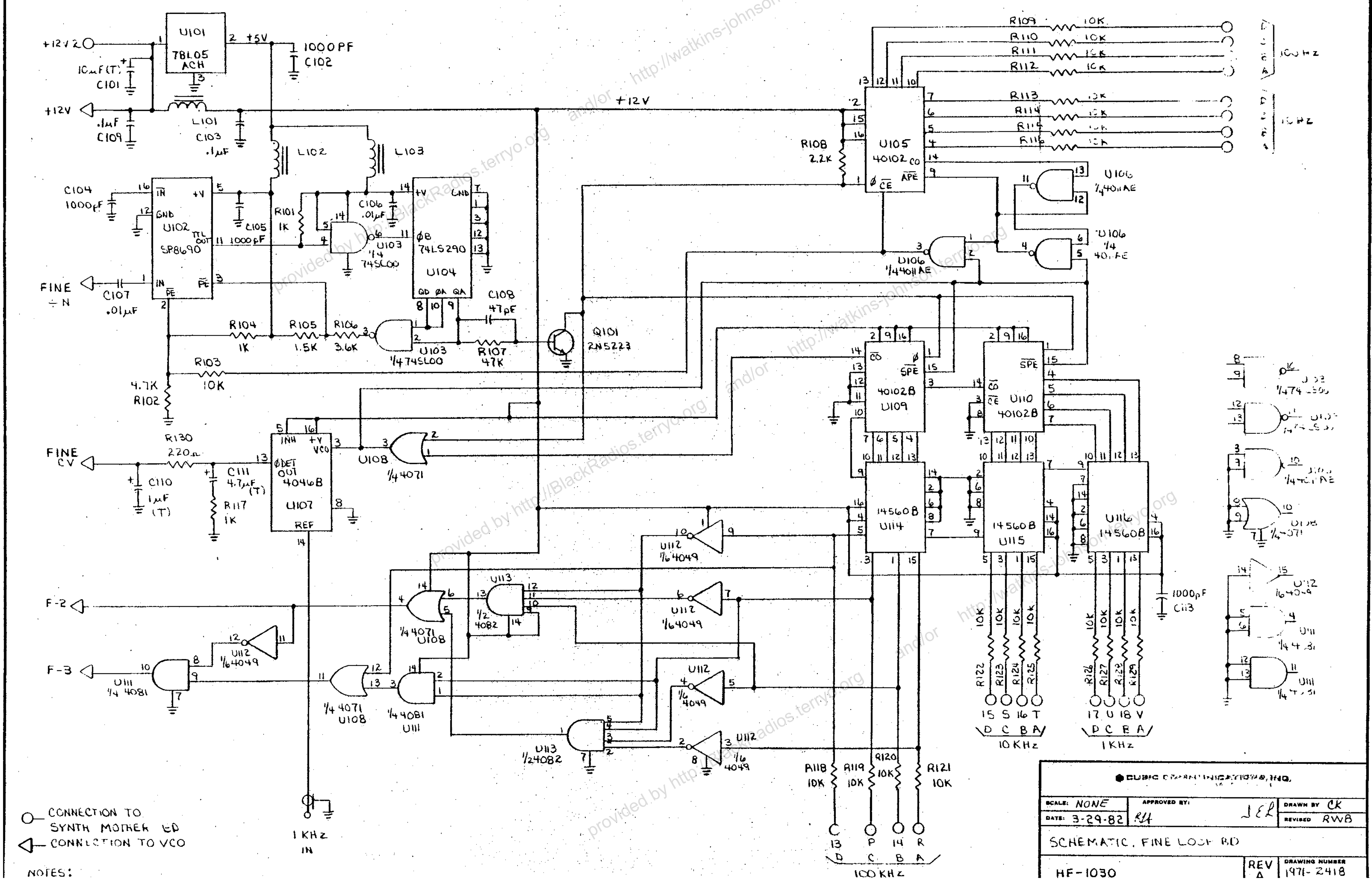
CUBIC COMMUNICATIONS, INC.

SCALE: 4:1
DATE: 8-31-81
APPROVED BY:
DRAWN BY RWB
REVISED

ASSEMBLY DWG, FINE LOOP BD

DRAWING NUMBER

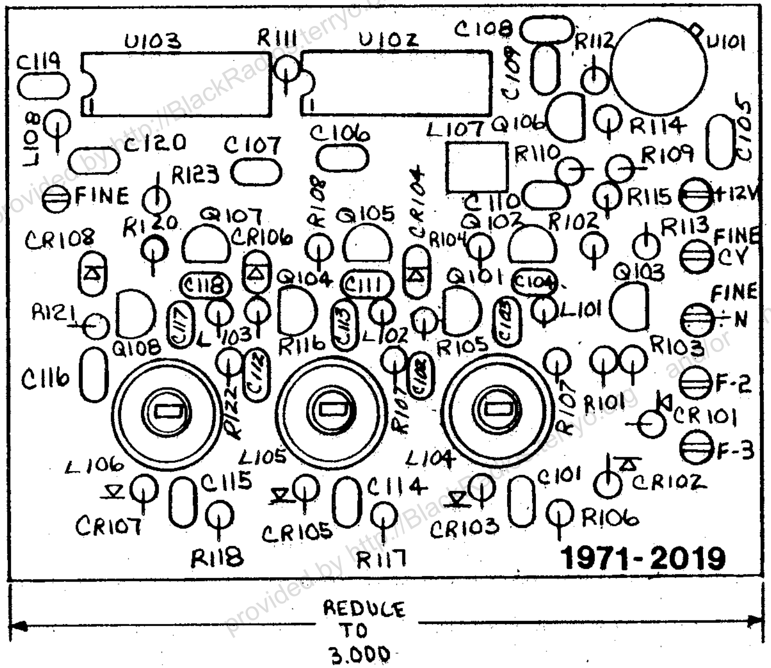
REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	[illegible]



CUBIC COMMUNICATIONS, INC.

SCALE: NONE	APPROVED BY:		DRAWN BY CK
DATE: 3-29-82	RH	JEL	REVISED RWB
SCHEMATIC, FINE LOOP BD			
HF-1030		REV A	DRAWING NUMBER 1971-2418

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-5-82	4-19-82	GD dER

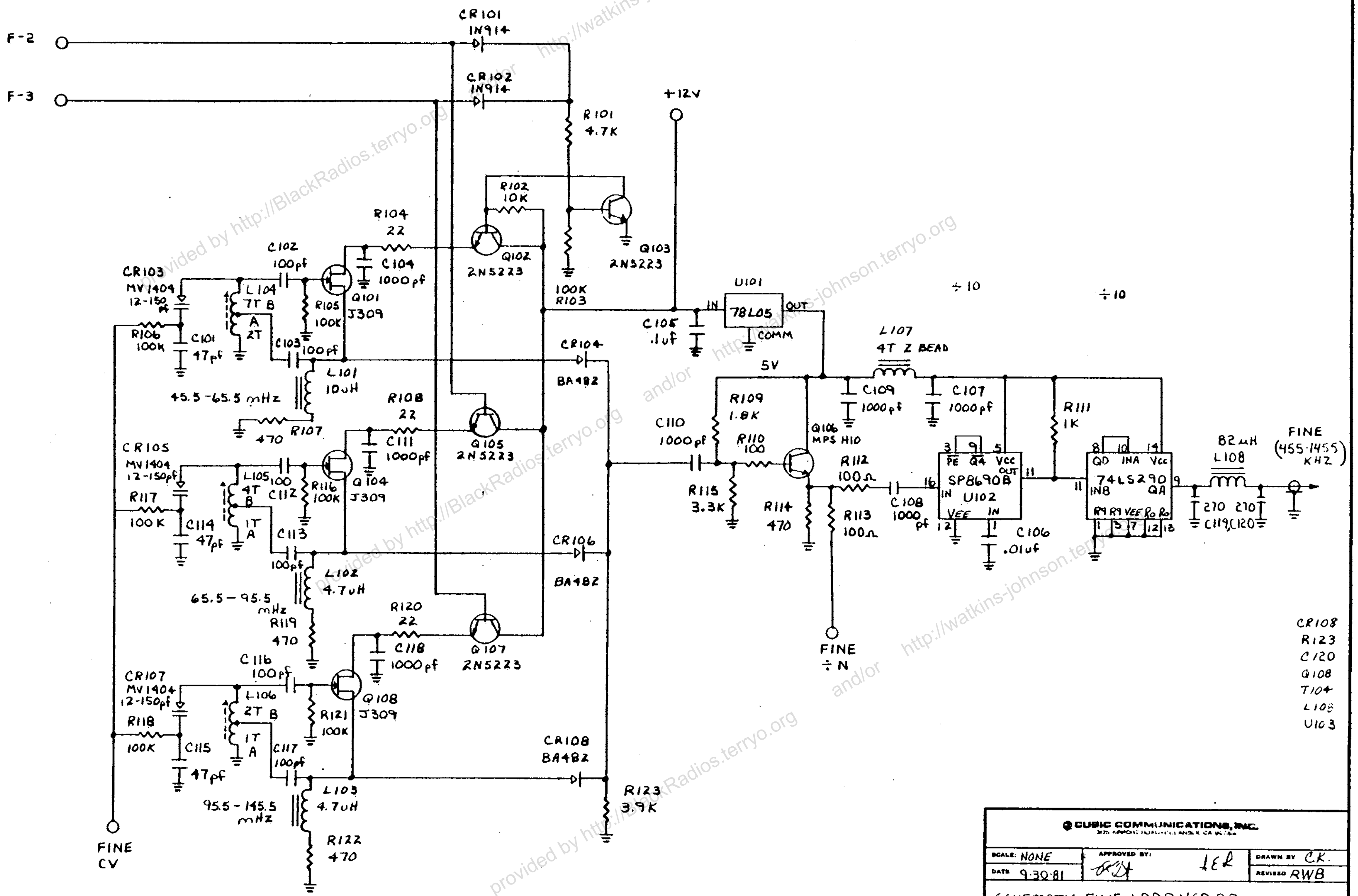


2. SCHEMATIC DWG NO 1971-2419
1. CIRCUIT BD P.N. 1971-2119
NOTES

CUBIC COMMUNICATIONS, INC. 305 AIRPORT ROAD • OCEANSIDE, CA. 92054		
SCALE: 2:1	APPROVED BY: RGH dER	DRAWN BY CK
DATE: 12-2-81		REVISED
ASSY. DWG, FINE LOOP VCO BD		
HF-1030	REV A	DRAWING NUMBER 1971-2019

11X17 PRINTED ON NO. 1000H CLEARPRINT

REVISION			
LET	DESCRIPTION	DATE	APP
A ECN 14 + 16	CHANGED VALUES ON R112 + R113 470Ω TO 100Ω, CHANGED SIGNAL NAMES RWB 4-5-82	4-15-82	CB LEL

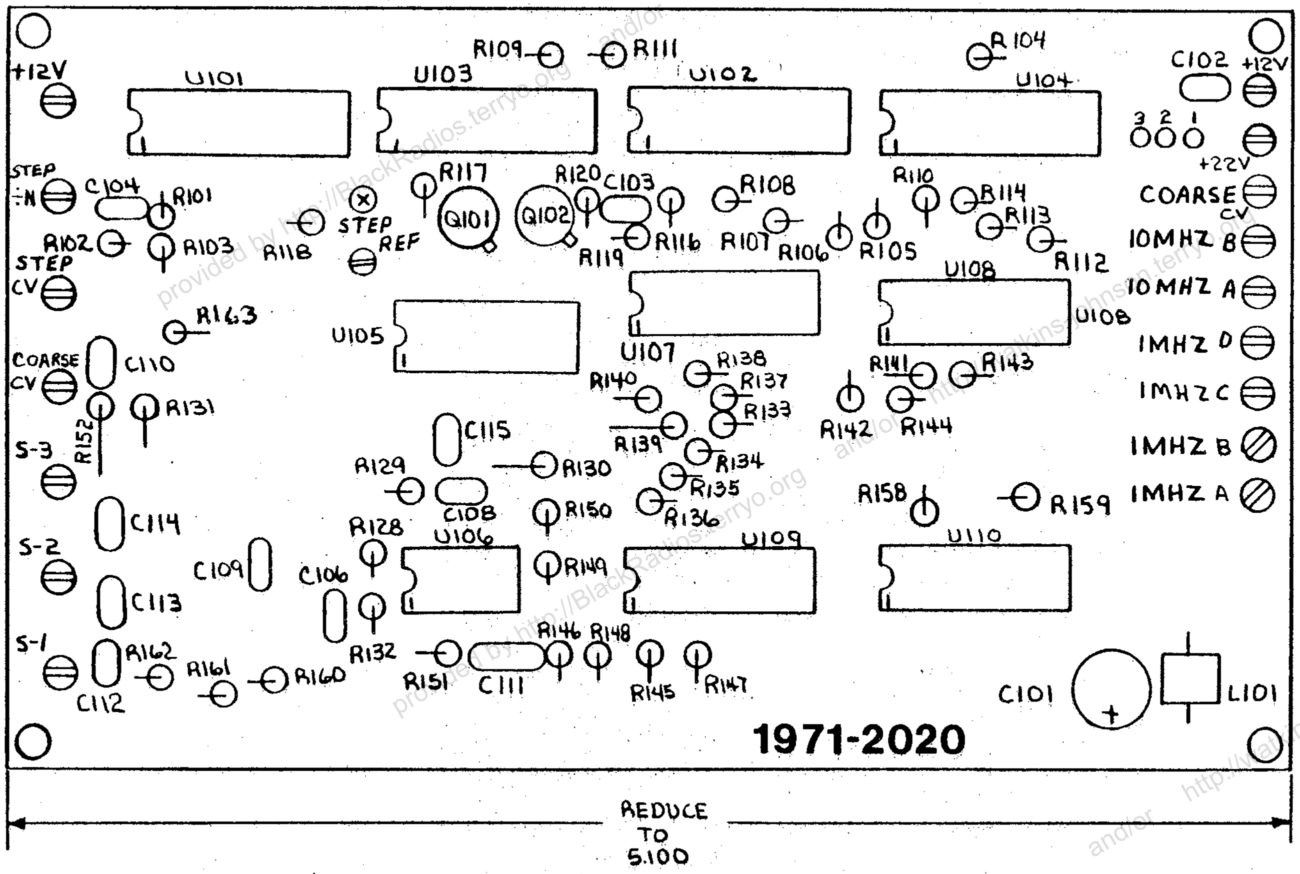


CUBIC COMMUNICATIONS, INC.

SCALE: NONE	APPROVED BY: LEL	DRAWN BY C.K.
DATE 9-30-81		REVISED RWB

SCHEMATIC, FINE LOOP VCO BD

HF-1030	REV A	DRAWING NUMBER 1971-2419



ECN 19 B	ADDED R163 RWE 5-12-82		
ECN 16 A	CHANGED SIGNAL NAMES RWB 4-5-82	4-14-82	
LET	DESCRIPTION	DATE	APP
	REVISIONS		

NOTES:
1. CIRCUIT BD P.N. 1971-2120
2. SCHEMATIC DWG. NO. 1971-2420

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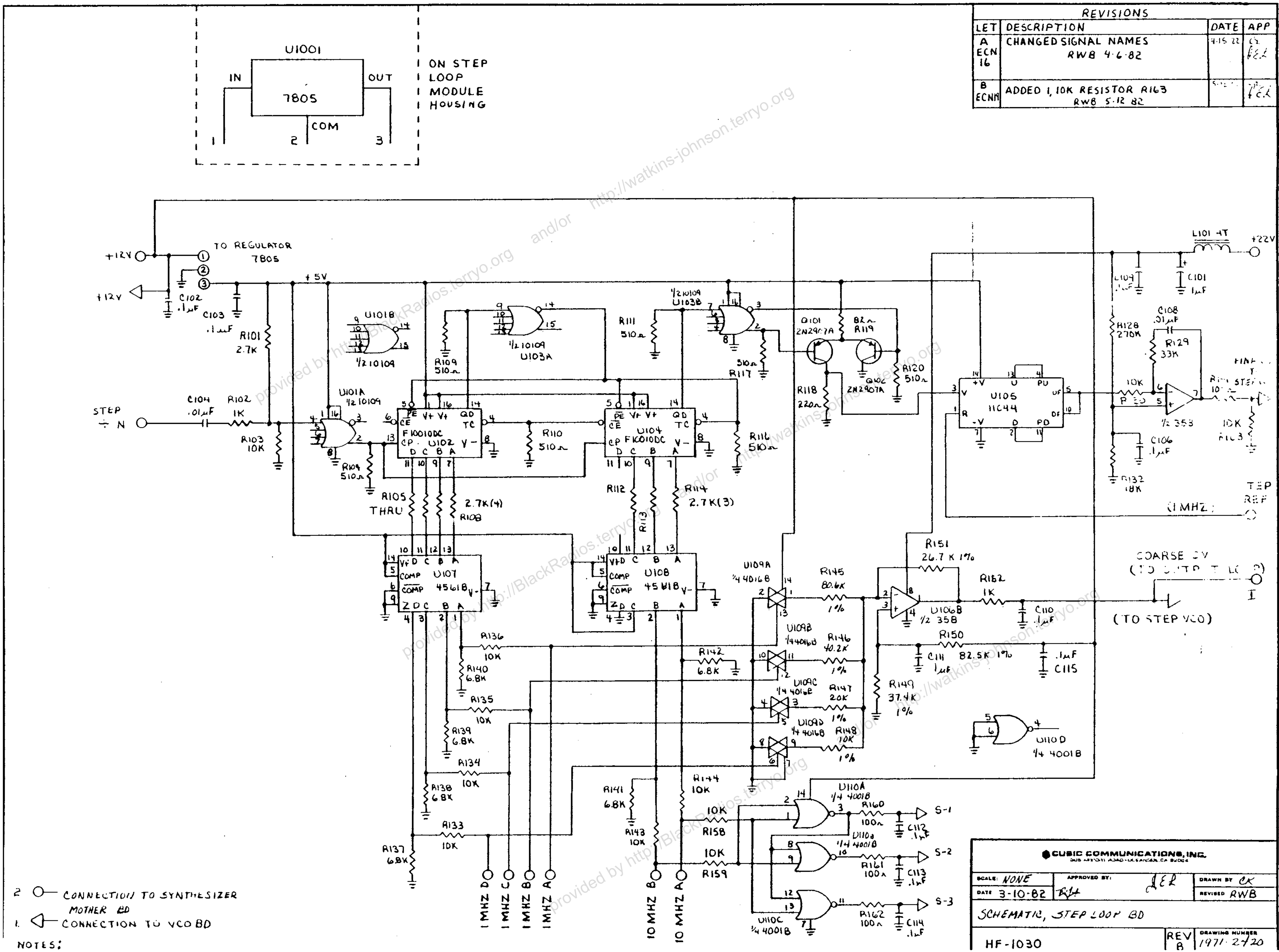
SCALE: 2:1	APPROVED BY:	DRAWN BY CK
DATE: 9-16-81		REVISED RWB

ASSEMBLY DWG., STEP LOOP BD

HF-1030	REV B	DRAWING NUMBER 1971-2020

11X17 PRINTED ON NO. 1000H CLEARPRINT

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	
B ECN 17	ADDED 1, 10K RESISTOR R163 RWB 5-12-82		



2 ○— CONNECTION TO SYNTHESIZER MOTHER BD

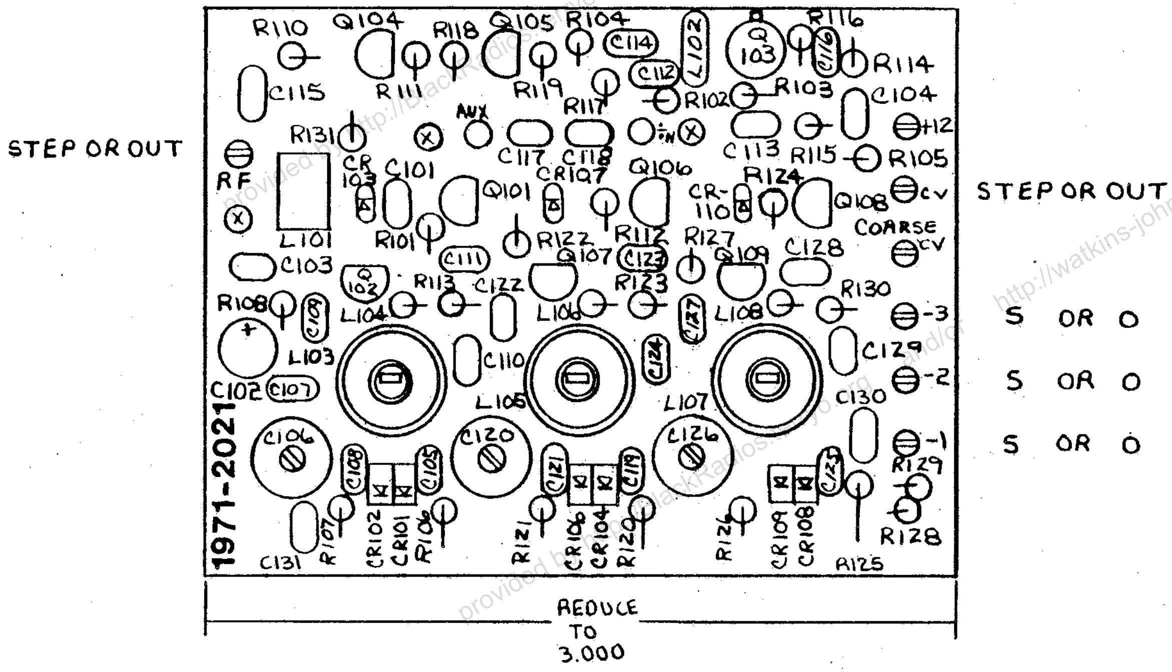
1. ◁— CONNECTION TO VCO BD

NOTES:

CUBIC COMMUNICATIONS, INC.

SCALE: NONE	DRAWN BY CK
DATE 3-10-82	REVISED RWB
APPROVED BY:	
SCHEMATIC, STEP LOOP BD	
HF-1030	REV B · DRAWING NUMBER 1971-2720

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-15-82	4-15-82	JEL



3. SIGNAL NAMES HAVE STEP OR OUT PREFIX (S OR O) DEPENDING ON APPLICATION TO STEP OR OUTPUT LOOPS

2. SCHEMATIC DWG NO 1971-2421

1. CIRCUIT BD P.N. 1971-2121

NOTES:

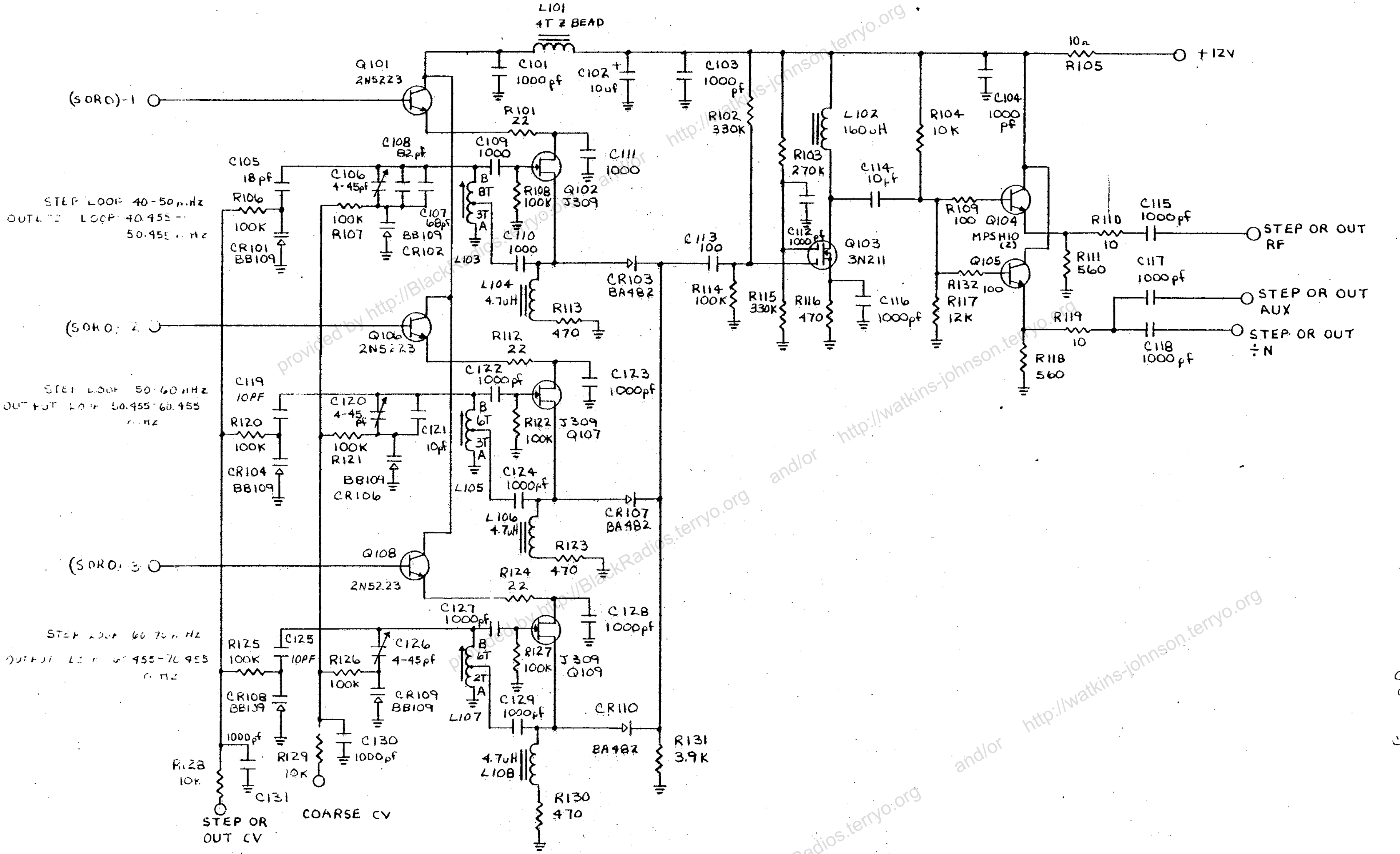
CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: 2=1	APPROVED BY:	DRAWN BY C.K
DATE: 9-17-81		REVISED

ASSY DWG, VCO STEP & OUTPUT LOOP BDS

HF-1030	REV A	DRAWING NUMBER 1971-2021

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	
B ECN18	CHANGED VALUES ON C105, C119, C125 RWB 5-12-82	5-12-82	

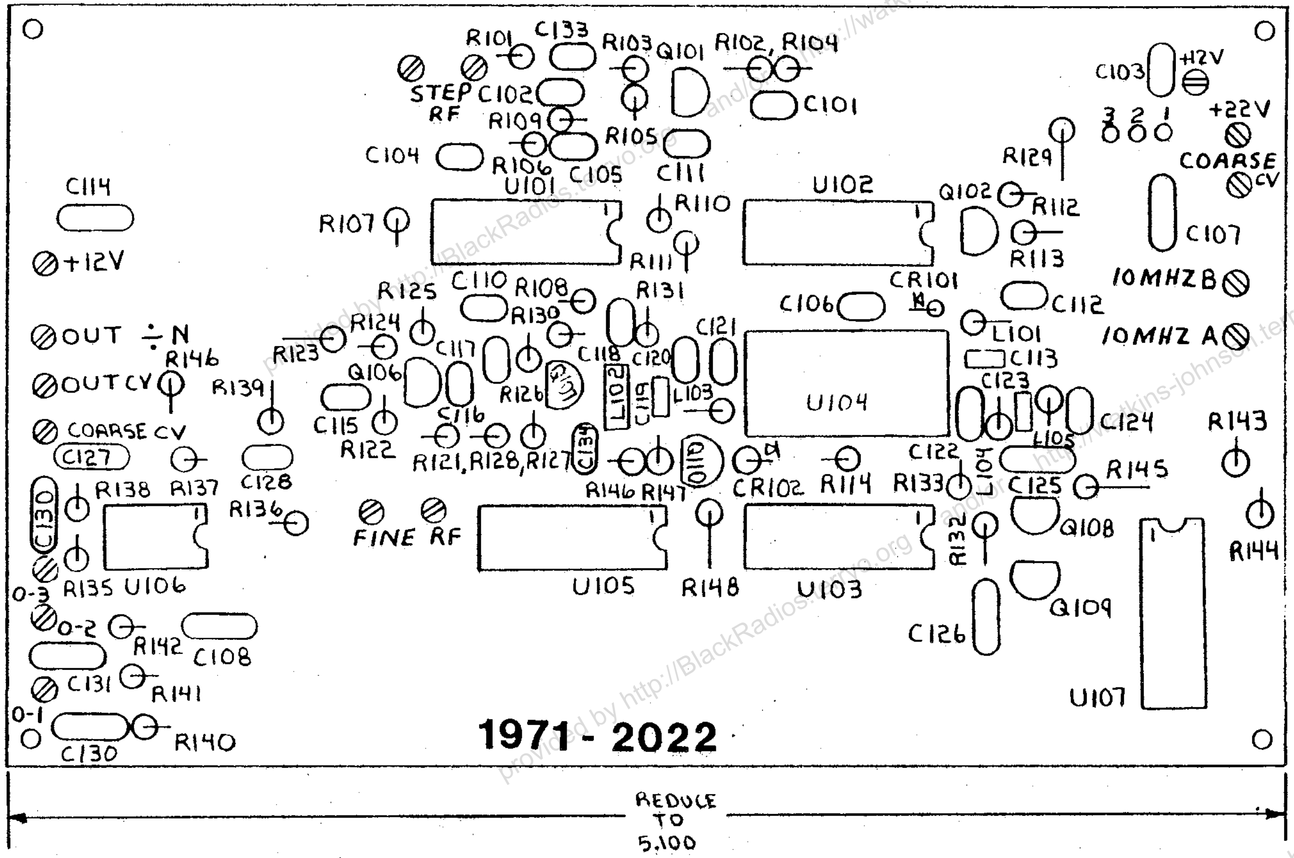


Q107
C131
R131
L108
CR110

1. SIGNAL NAMES HAVE STEP OR OUT PREFIX (S OR O) DEPENDING ON APPLICATION TO STEP OR OUTPUT LOOPS

NOTES:

SCALE: NONE	APPROVED BY:	DRAWN BY C.K.
DATE: 9-25-81		REVISED
SCHEMATIC, VCO STEP + OUTPUT LOOP BDS		
HF-1030	REV B	DRAWING NUMBER 1971-2421



CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

LET	DESCRIPTION	DATE	APP
ECN 20 B	ADDED R146 RWB 5-12-82	5-12-82	CD
ECN 16 A	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	CD

REVISIONS

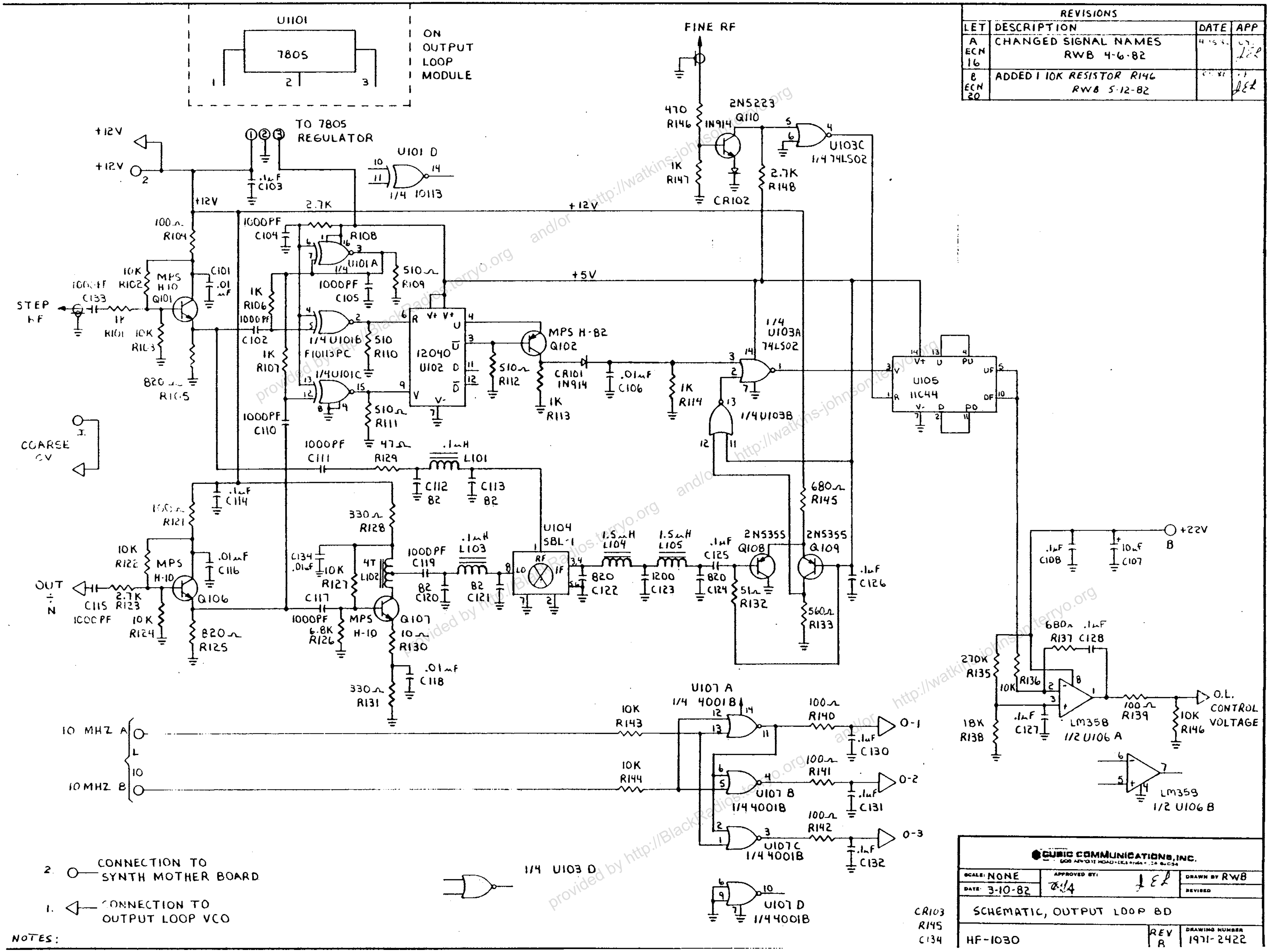
SCALE: 2:1
DATE: 9-14-81
APPROVED BY:
DRAWN BY RWB
REVISED

ASSEMBLY DWG, OUTPUT LOOP BOARD

HF-1030 REV B DRAWING NUMBER 1971-2022

NOTES:
1. CIRCUIT BD NO 1971-2122
2. SCHEMATIC DWG NO 1971-2124

11X17 PRINTED ON NO. 1000H CLEARPRINT



REVISIONS

LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82		
B ECN 20	ADDED 1 10K RESISTOR R146 RWB 5-12-82		

CUBIC COMMUNICATIONS, INC.

SCALE: NONE
DATE: 3-10-82
DRAWN BY RWB

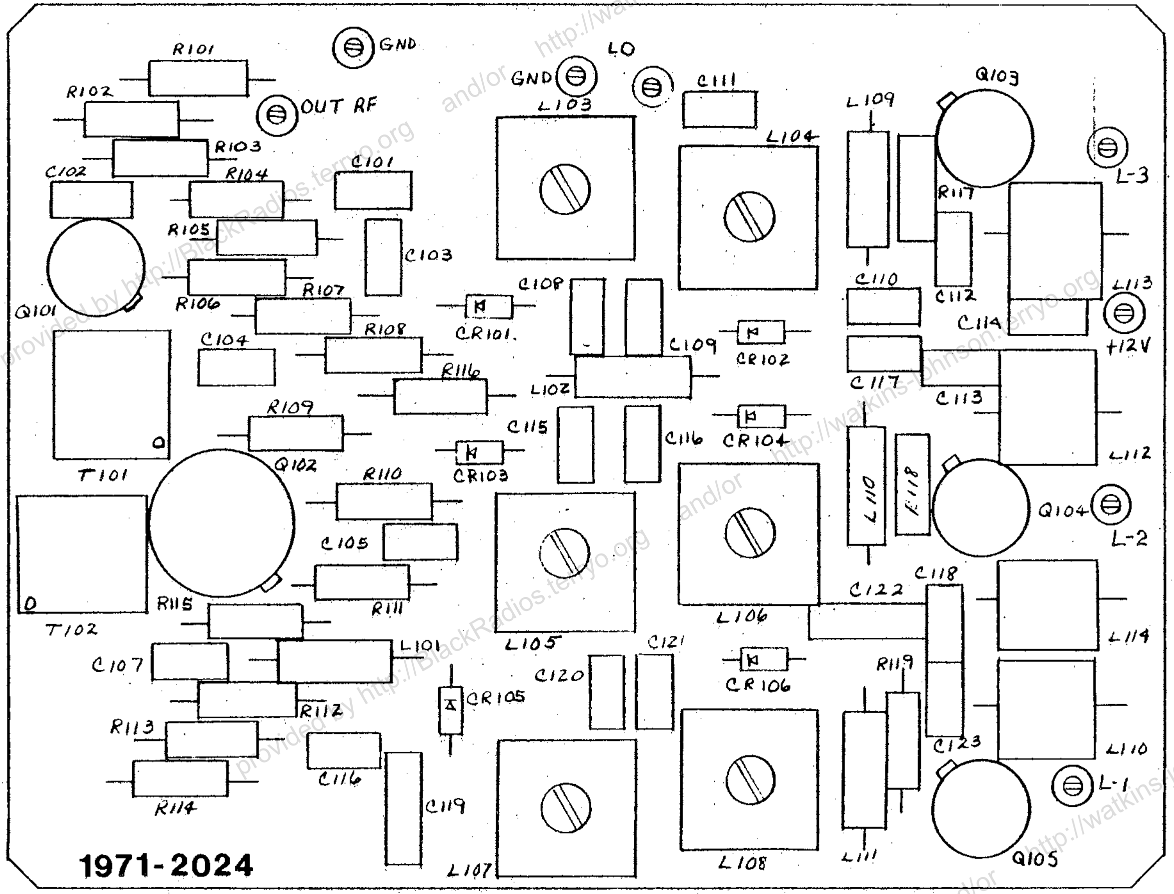
SCHEMATIC, OUTPUT LOOP BD

HF-1030

REV B

DRAWING NUMBER 1971-2422

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	



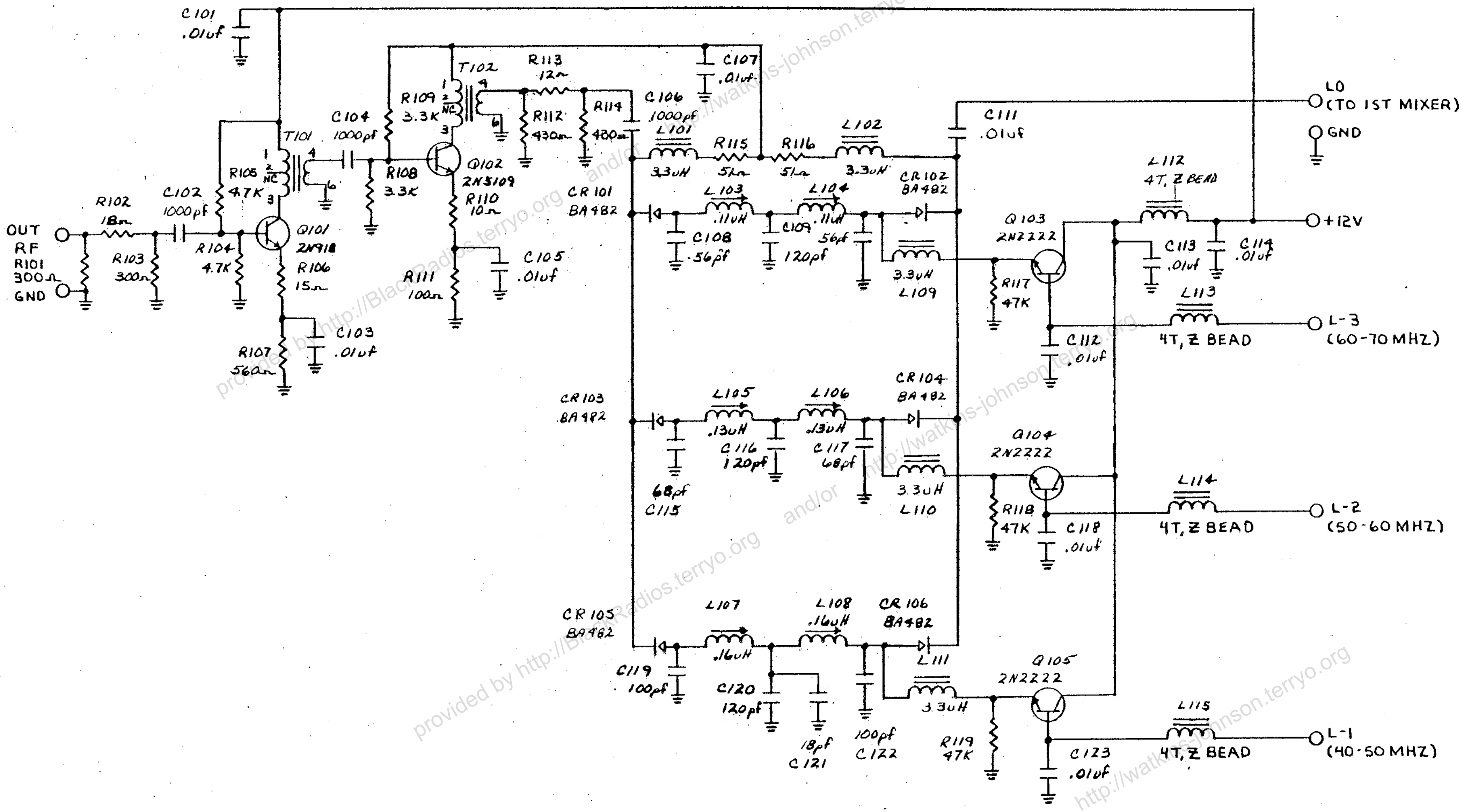
SCALE: 4:1	APPROVED BY:	DRAWN BY CK
DATE: 4-7-81		REVISED

ASSY. DWG, L.O. AMP AND LPF BD

REV | DRAWING NUMBER

2. SCHEMATIC DWG NO 1971-2424
1. CIRCUIT BD P.N. 1971-2124
NOTES

REVISION			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	



R119
C123
T102
Q105
L115
CR106

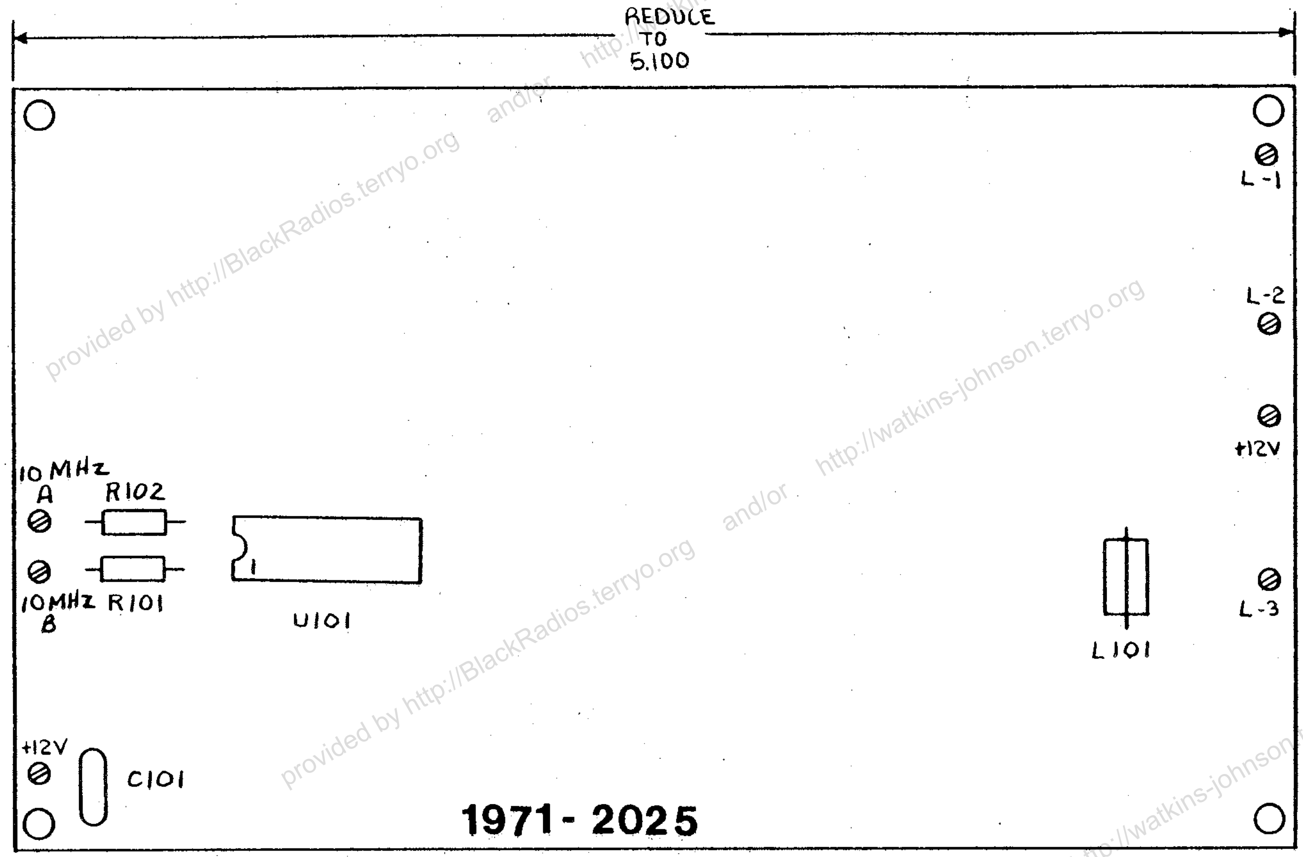
1. T101 & T102 PINOUT AS SHOWN

6 5 4 — 1 2 3

TOP VIEW

NOTES:

CUBIC COMMUNICATIONS, INC.		
SCALE: NONE	APPROVED BY:	DRAWN BY C.K
DATE: 4-13-81		REVISED
SCHEMATIC, L.O. AMP AND LPF BD		
HF-1030	REV A	DRAWING NUMBER 1971-2424



2. SCHEMATIC DWG. NO 1971-2425
1. CIRCUIT BD P.N. 1971-2125
NOTES

LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	CD JEL

REVISION

CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

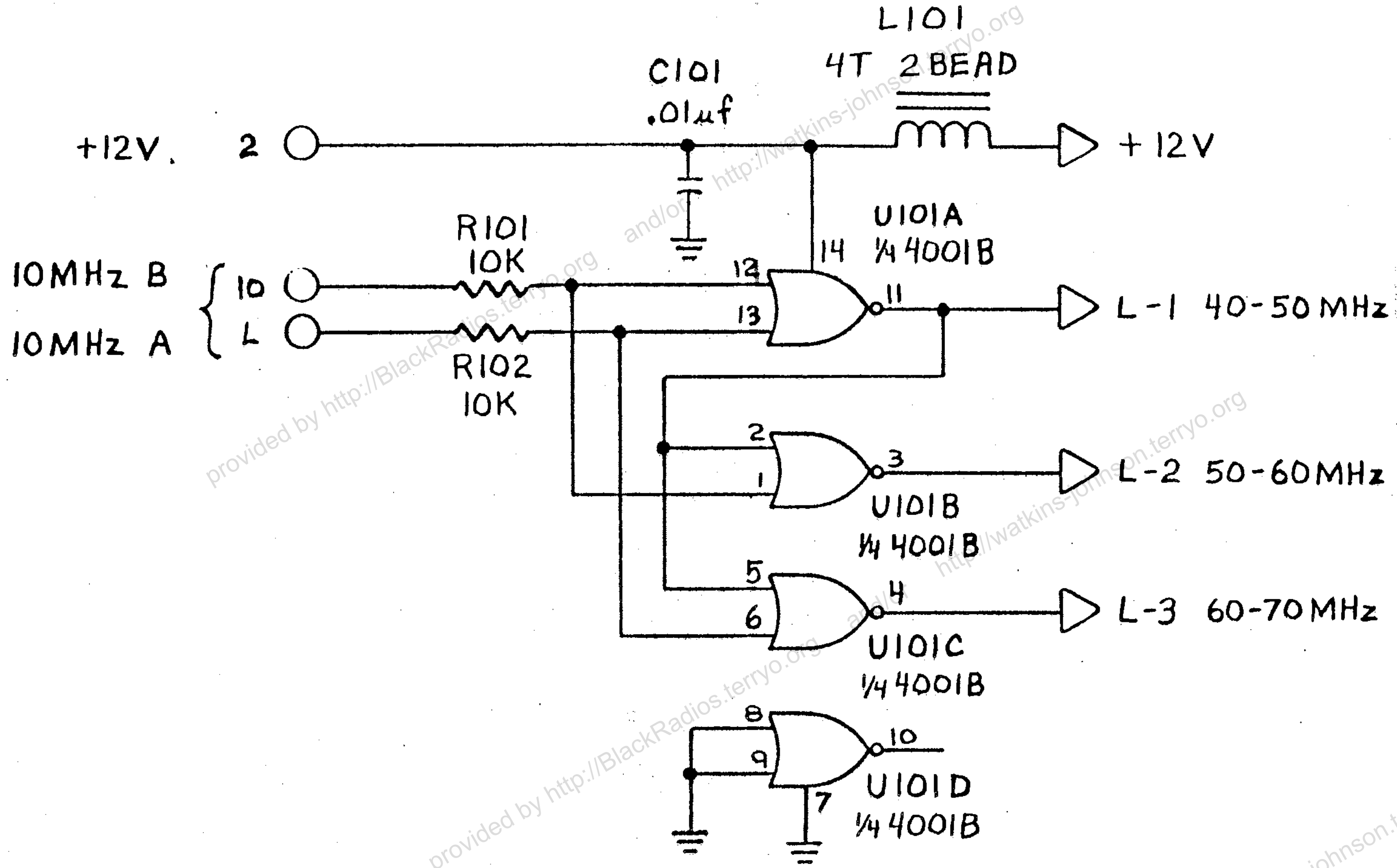
SCALE: 2:1	APPROVED BY: RJA JEL	DRAWN BY R. ROE
DATE: 9/11/81		REVISED

ASSEMBLY DWG, LPF SELECT DECODER

	REV	DRAWING NUMBER
HF-1030	A	1971-2025

11X17 PRINTED ON NO. 1000H CLEARPRINT

LET	DESCRIPTION	DATE	APP
A ECN16	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	GB dEL



NOTE: → TO LO AMP & LPF BOARD

—○ TO SYNTH MOTHER BOARD

C101 L101
R102
U101

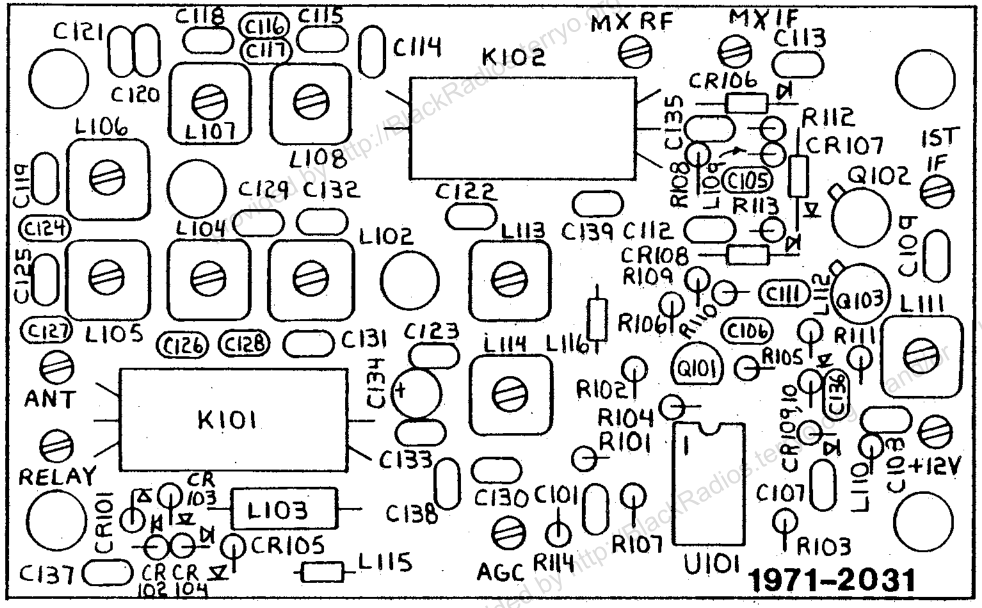
CUBIC COMMUNICATIONS, INC.
GOO AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: NONE	APPROVED BY: dEL	DRAWN BY ROR
DATE: 9/8/81	RHA	REVISED

SCHEMATIC, LPF SELECT DECODER BD

HF-1030	REV A	DRAWING NUMBER 1971-2425

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82	4-16-82	DEL
B ECN 17	DELETED C104 RWB 4-19-82	4-19-82	DEL



2. CKT BD 1971-2131

1. SCHEMATIC DWG 1971-2431

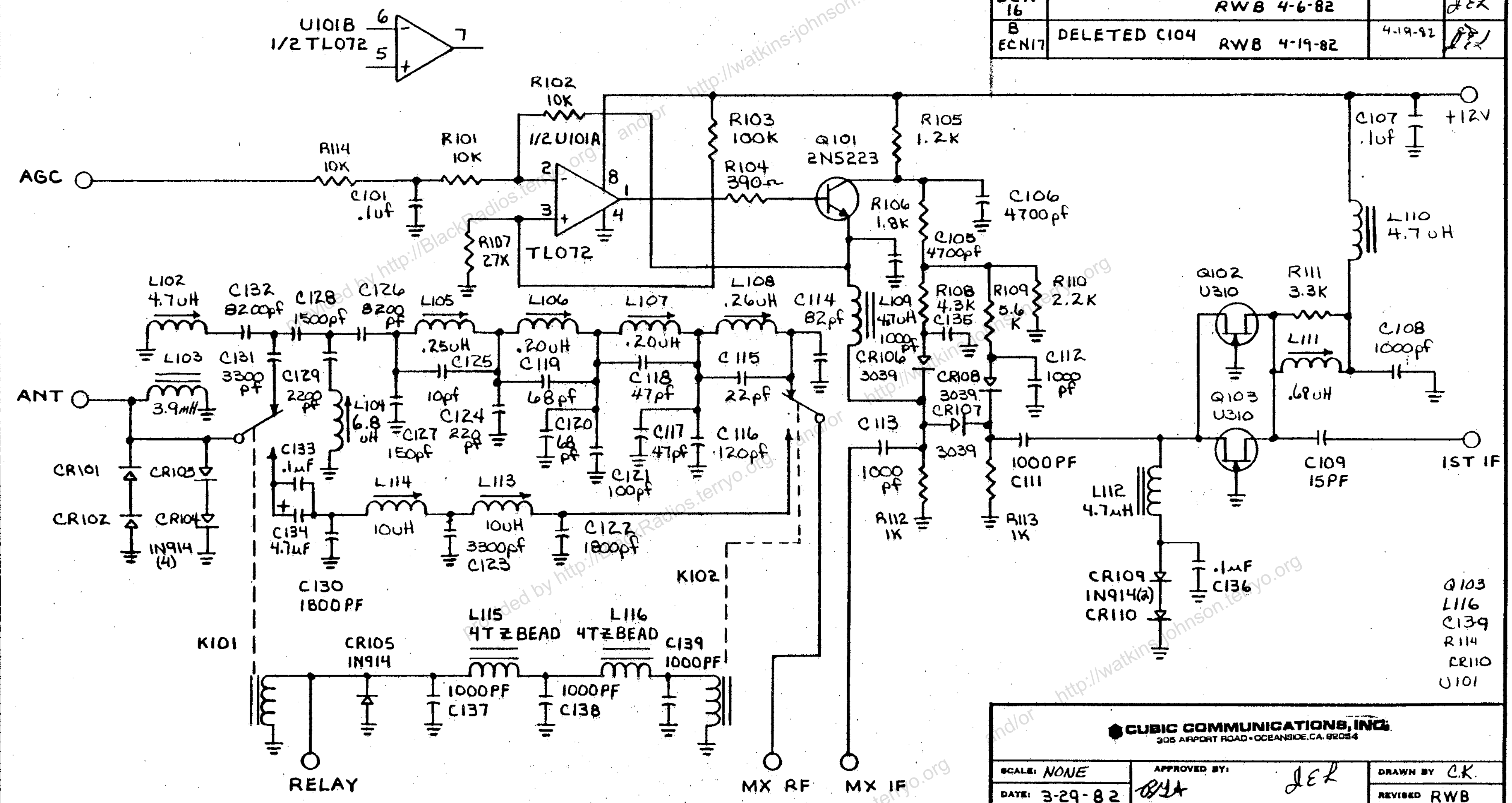
NOTES:

11X17 PRINTED ON NO. 1000H CLEARPRINT

CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: 2:1	APPROVED BY: DEL 10/27/81	DRAWN BY RWB
DATE: 10-13-81		REVISED
ASSY DWG, RF INPUT BOARD		
HF-1030	REV B	DRAWING NUMBER 1971-2031

LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	JEL
B ECN17	DELETED C104 RWB 4-19-82	4-19-82	JEL



1. RELAYS ENERGIZED BELOW 1.6 MHZ

NOTES:

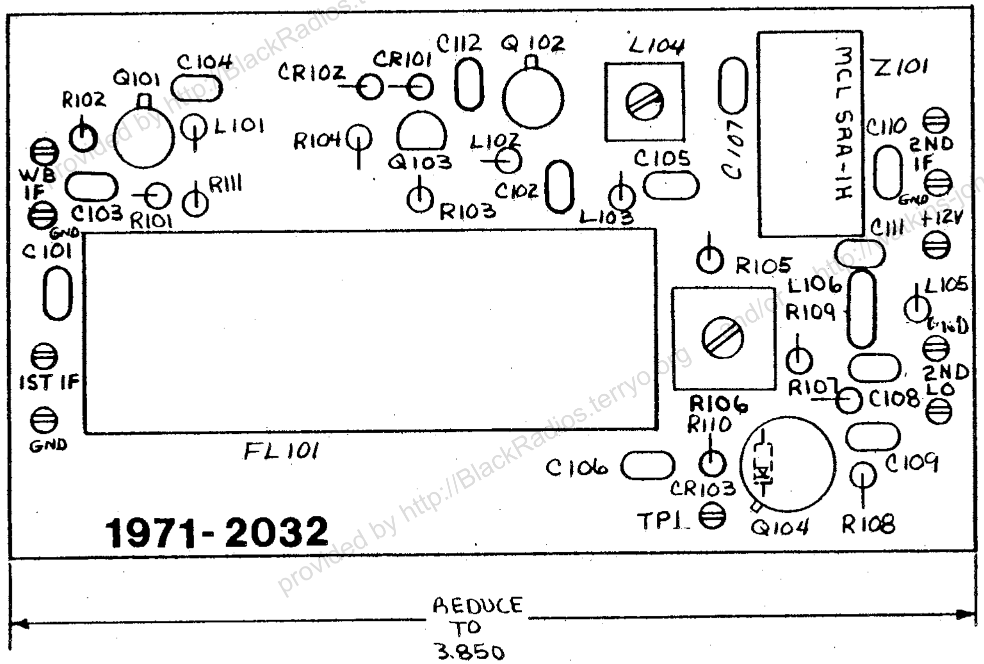
CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: NONE	APPROVED BY: JEL	DRAWN BY C.K.
DATE: 3-29-82		REVISED RWB

SCHEMATIC, RF INPUT BD.

HF-1030	REV B	DRAWING NUMBER 1971-2431

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-6-82	4-15-82	



CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: 2:1	APPROVED BY:	DRAWN BY CK
DATE: 7-7-81		REVISED

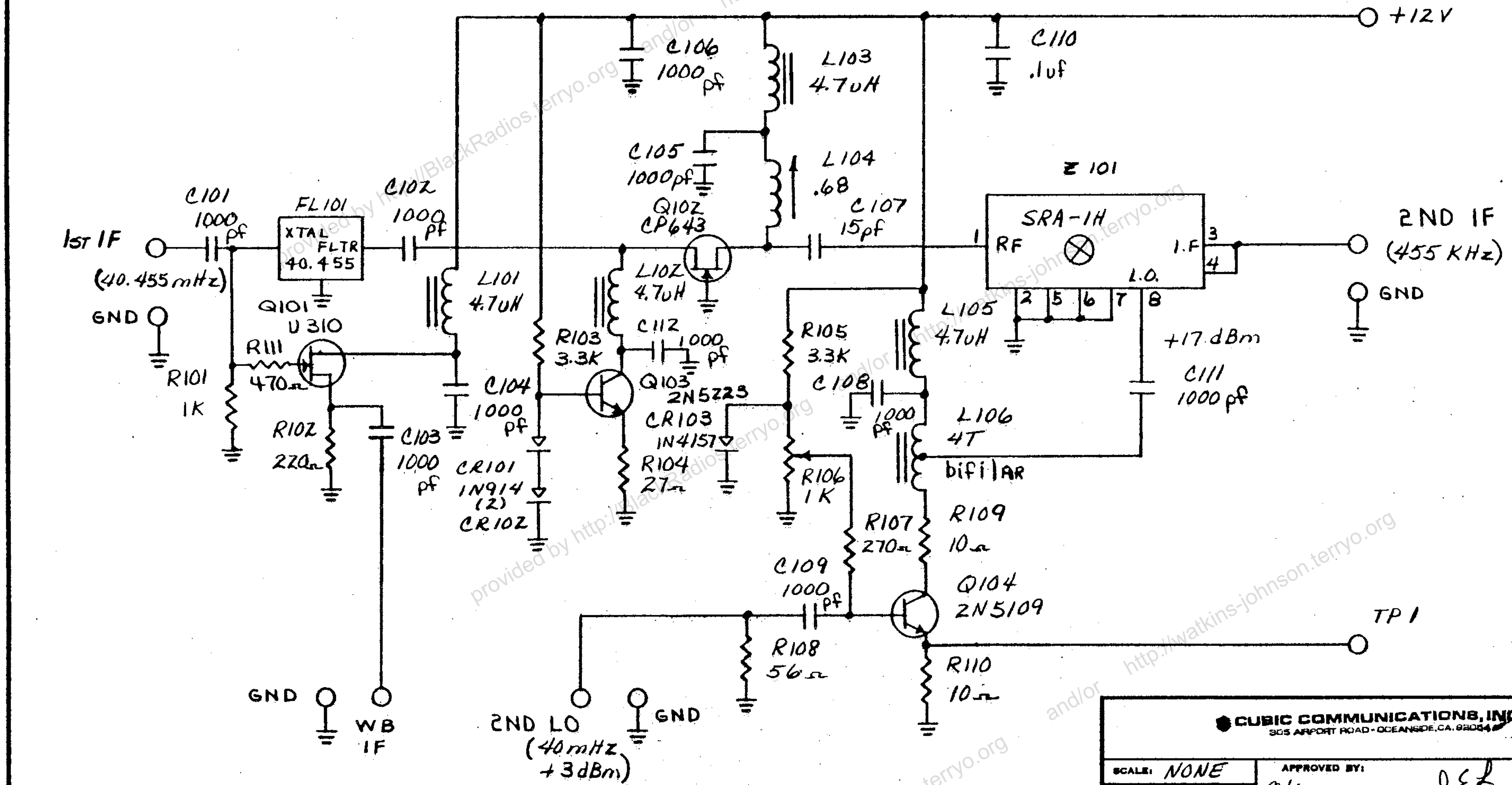
ASSEMBLY DWG, 1ST IF AMPLIFIER BD

HF-1030	REV A	DRAWING NUMBER 1971-2032

2. SCHEMATIC, 1971-2432
1. CIRCUIT BD, 1971-2132
NOTES:

11X17 PRINTED ON NO. 1000H CLEARPRINT

LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-7-82	4-15-82	JEL



Z101
C111
R111
FL101
Q104
L106
CR103

1. SET R106 FOR 0.5V AT TP1

NOTES:

CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD - OCEANSIDE, CA. 92054

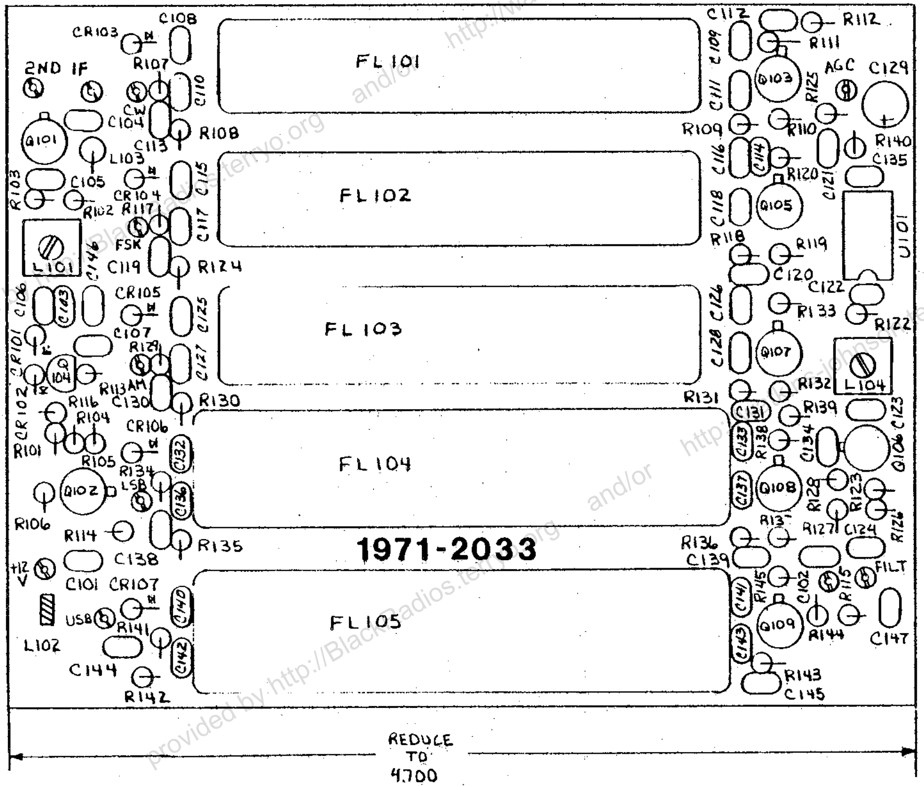
SCALE: NONE	APPROVED BY: BH JEL		DRAWN BY CK
DATE: 7-7-81			REVISED

SCHEMATIC, 1ST IF AMPLIFIER BD

HF-1030	REV A	DRAWING NUMBER 1971-2432

11X17 PRINTED ON NO. 1000H-10 CLEARPRINT FADE-OUT

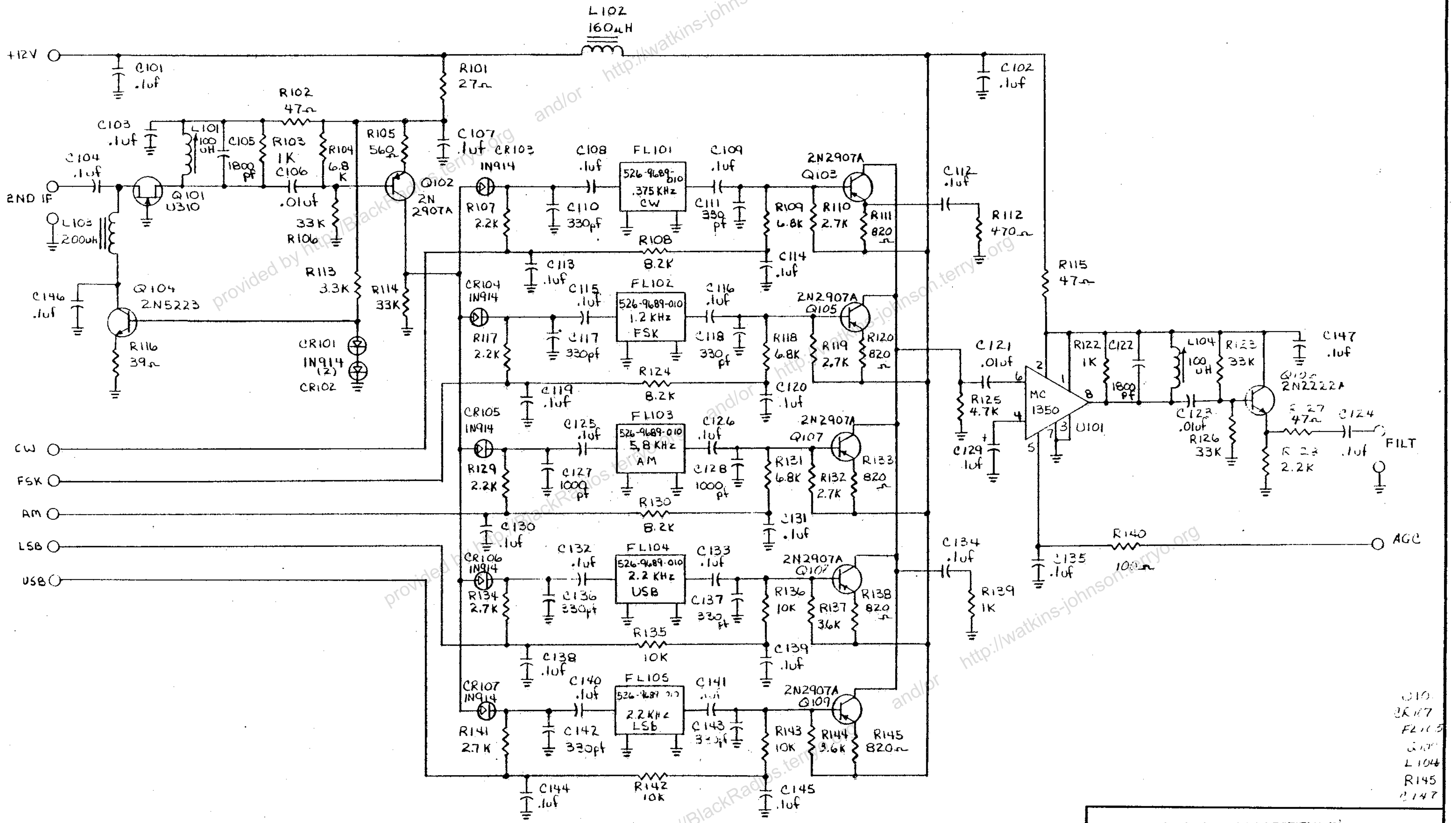
REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-7-82	4-15-82	



2. SCHEMATIC, 1971-2433
1. CIRCUIT BD, 1971-2133

CUBIC COMMUNICATIONS, INC.		
SCALE: 2:1	APPROVED BY:	DRAWN BY CK
DATE: 5-15-81		REVISED
ASSY DWG, 2ND IF FILTER BD		DRAWING NUMBER

REVISIONS			
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-7-82	5-12-82	CD, fEP

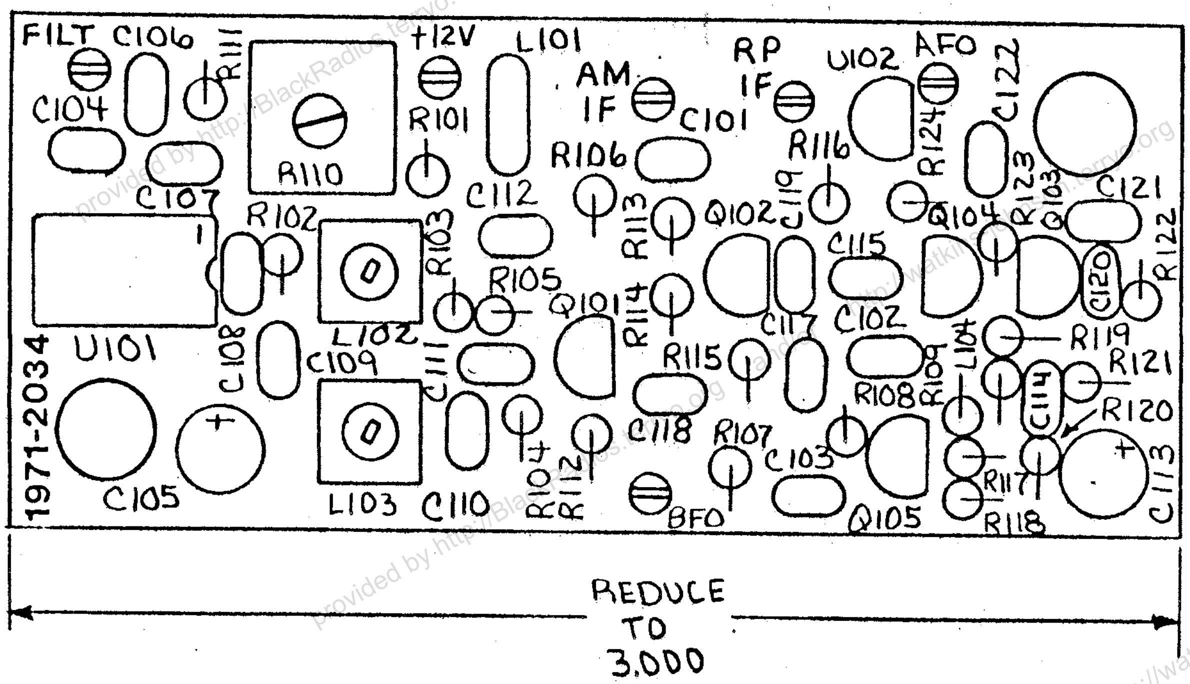


Q110
CR107
FL105
C147
L104
R145
C147

CUBIC COMMUNICATIONS, INC.

SCALE: NONE	APPROVED BY: RB fEP	DRAWN BY CK
DATE: 5-7-81		REVISED
SCHEMATIC, 2ND IF FILTER BD		
HF-1030	REV A	DRAWING NUMBER 1971-2433

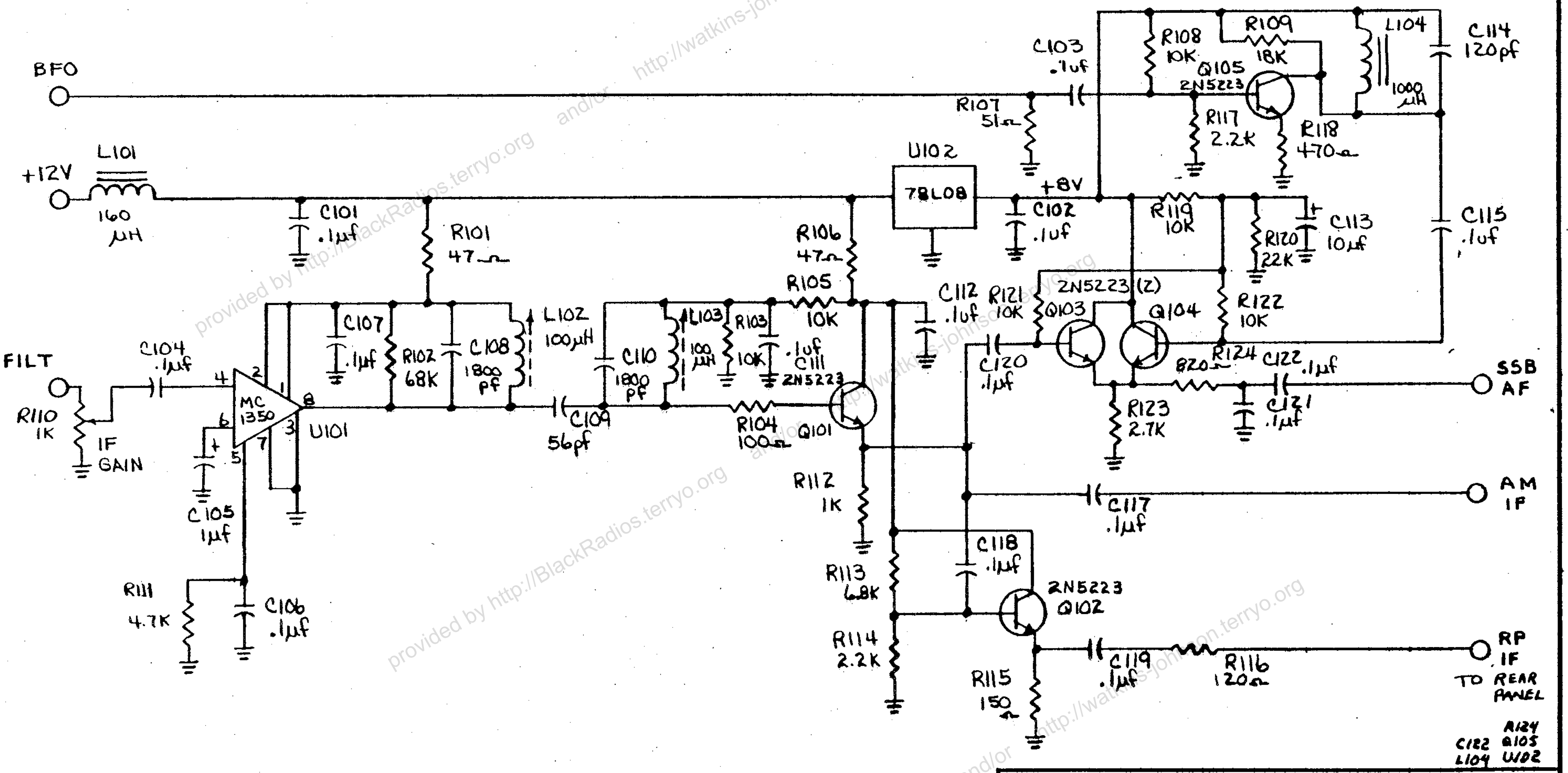
LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-7-82	4-15-82	JEL



CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: 2:1	APPROVED BY: JEL	DRAWN BY CK
DATE: 9-23-81		REVISED
ASSEMBLY DWG, SSB/CW BD		
HF-1030	REV A	DRAWING NUMBER 1971-2034

2. SCHEMATIC DWG NO 1971-2434
1. CIRCUIT BD P.N. 1971-2134
NOTES:



CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: NONE	APPROVED BY: RH JEL	DRAWN BY CK
DATE: 5/19/81		REVISED

SCHEMATIC, SSB/CW BD

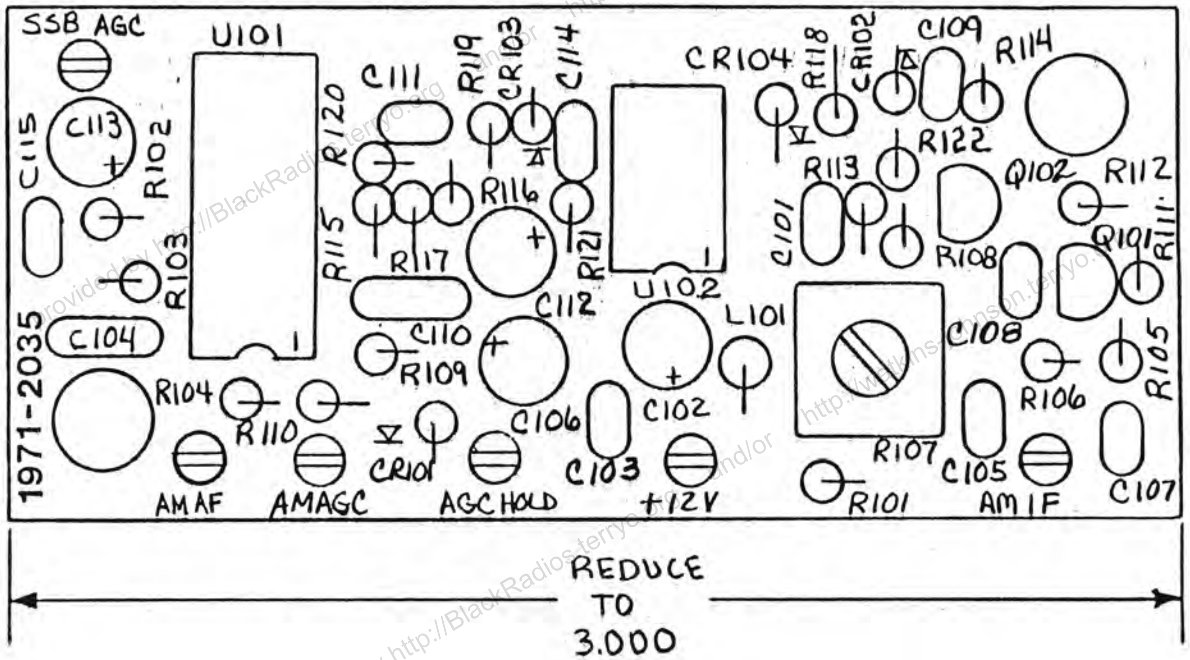
HF-1030

DRAWING NUMBER 1971-2434

LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-7-82	4-15-82	JEL

11X17 PRINTED ON NO. 1000H-10 CLEARPRINT FADE-OUT

REVISION			
LET	DESCRIPTION	DATE	APP
A ECN 15	REVERSED DESIGNATORS R102, R103 RWB 3-31-82	3-31-82	JEL



REDUCE TO 3.000

CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: 2:1	APPROVED BY:	DRAWN BY CK
DATE: 3-29-82	JEL	REVISED RWB

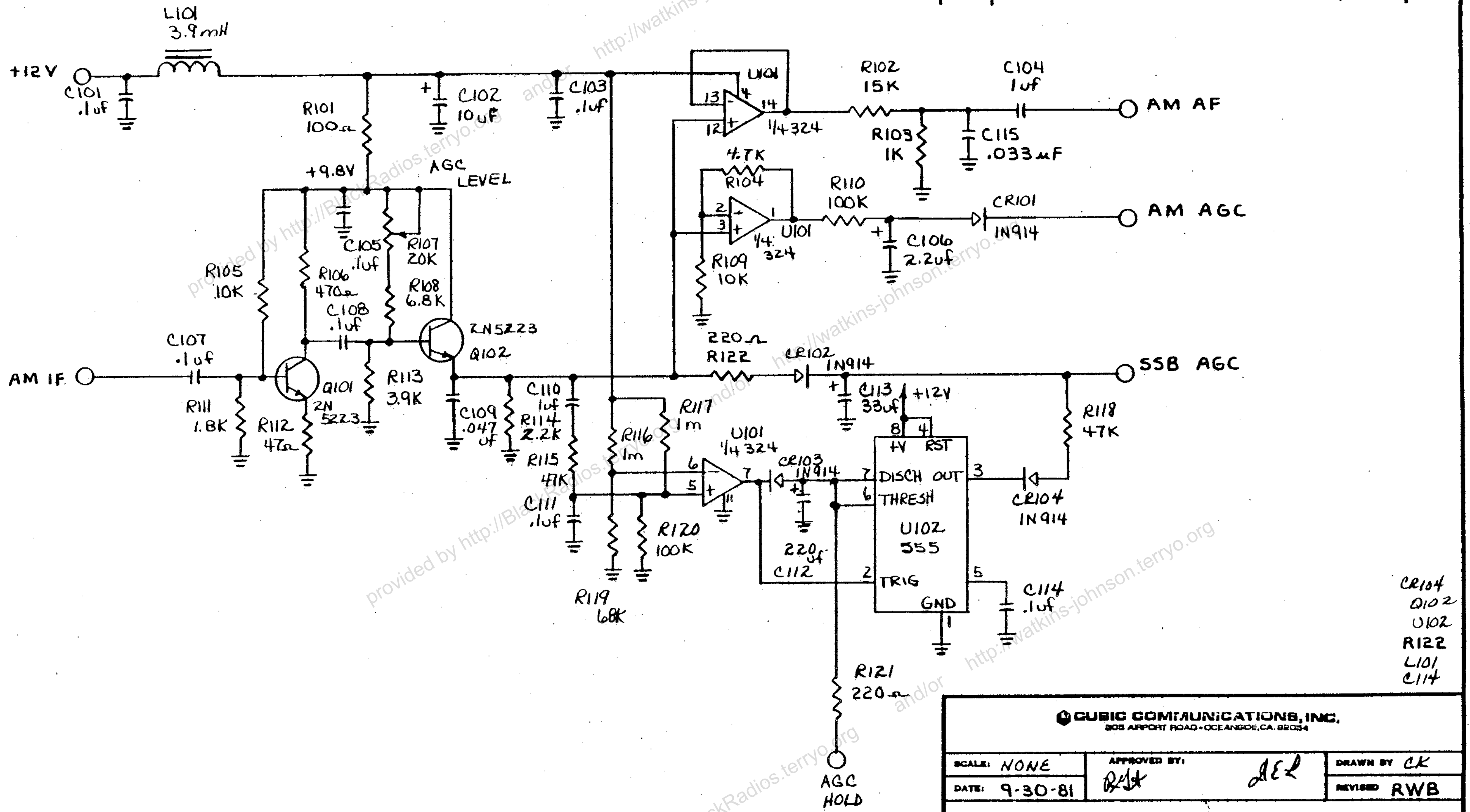
ASSEMBLY DWG, AM & AGC BD,

REV | DRAWING NUMBER

. SCHEMATIC DWG NO. 1971-2435

CIRCUIT BD P.N. 1971-2135

LET	DESCRIPTION	DATE	APP
A ECN16	CHANGED SIGNAL NAMES RWB 4-7-82	4-15-82	

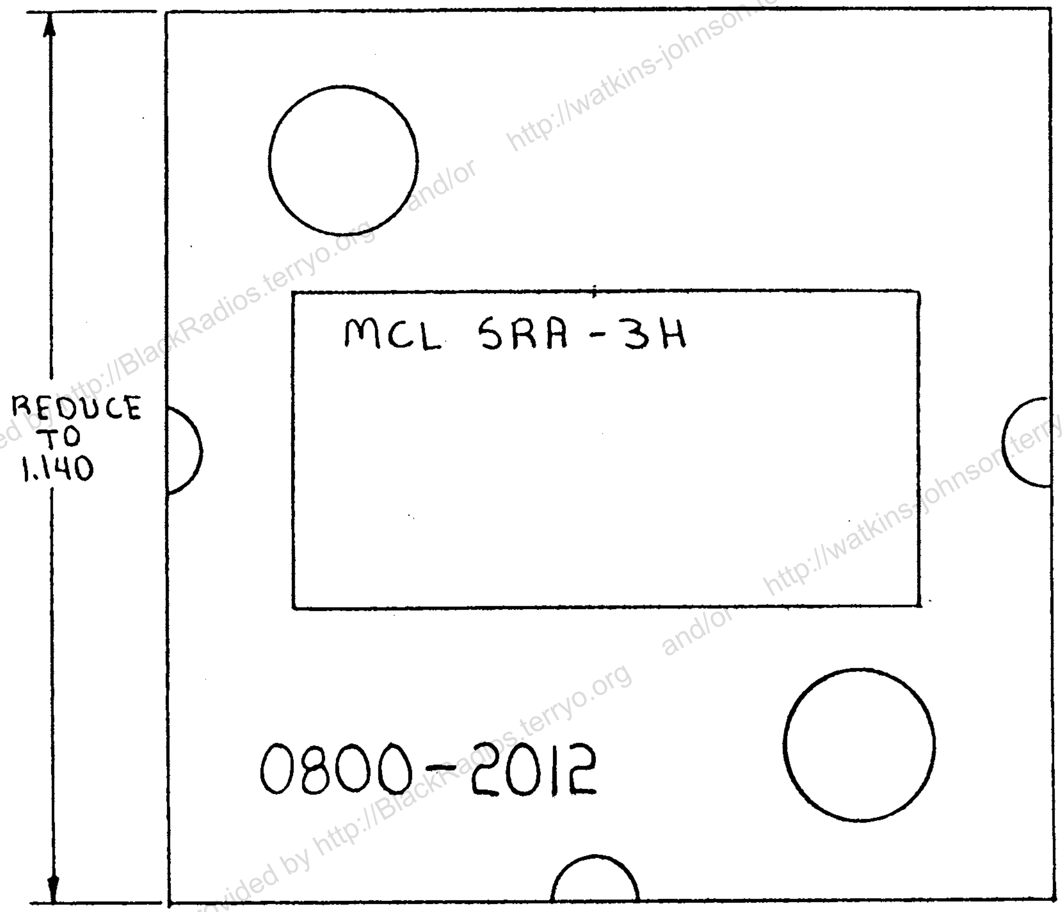


CUBIC COMMUNICATIONS, INC.
305 AIRPORT ROAD • OCEANSIDE, CA. 92054

SCALE: NONE	APPROVED BY:	DRAWN BY CK
DATE: 9-30-81		REVISED RWB

SCHEMATIC, AM & AGC BOARD,

HF-1030 — DRAWING NUMBER 1971-2435



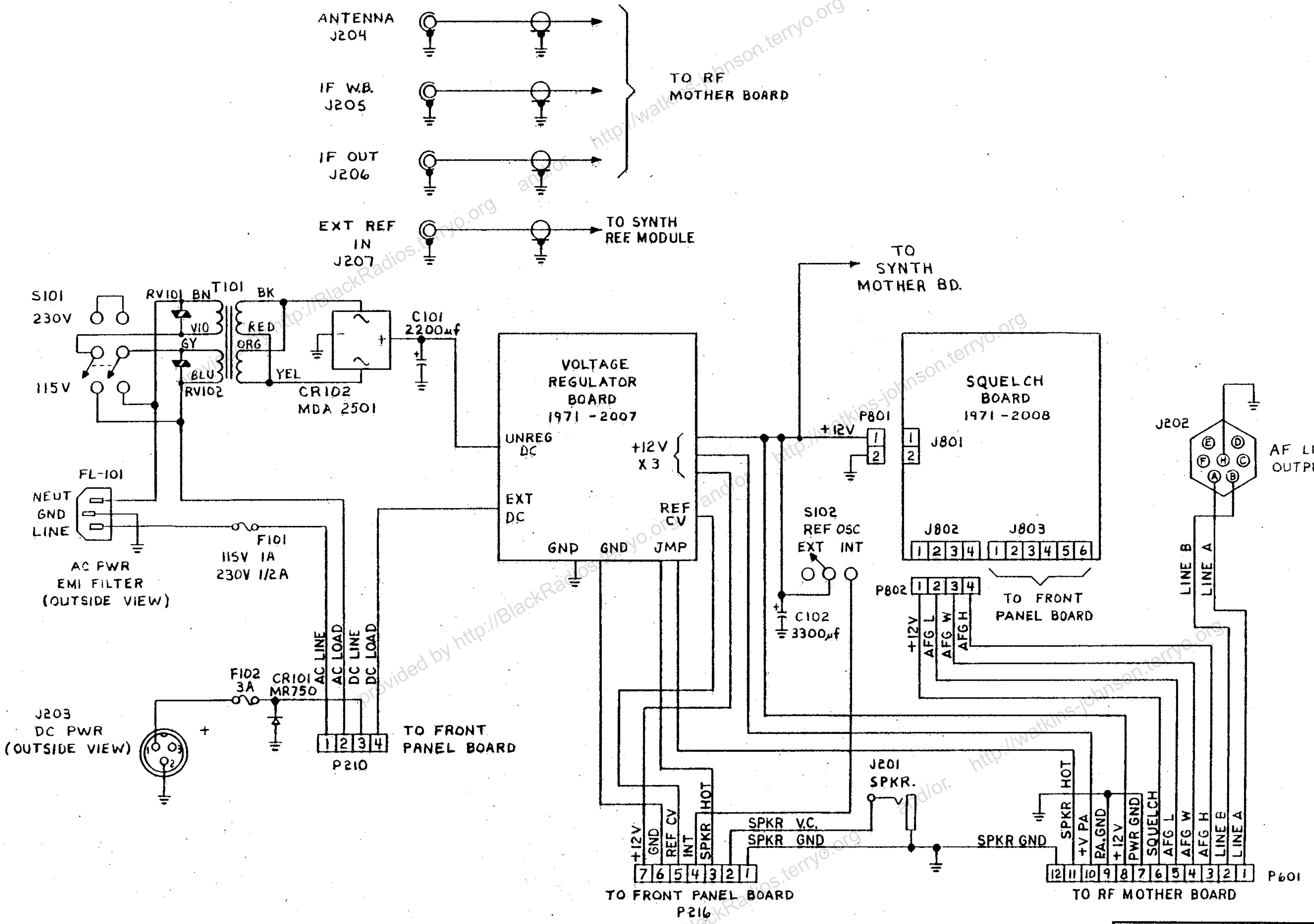
SCALE: 4:1	APPROVED BY:	DRAWN BY CK
DATE: 8-28-81		REVISED

ASSEMBLY DWG, MIXER BD

DRAWING NUMBER

. CIRCUIT BD P.N. 0800-2112

LET	DESCRIPTION	DATE	APP
A ECN 16	CHANGED SIGNAL NAMES RWB 4-20-82	4-20-82	



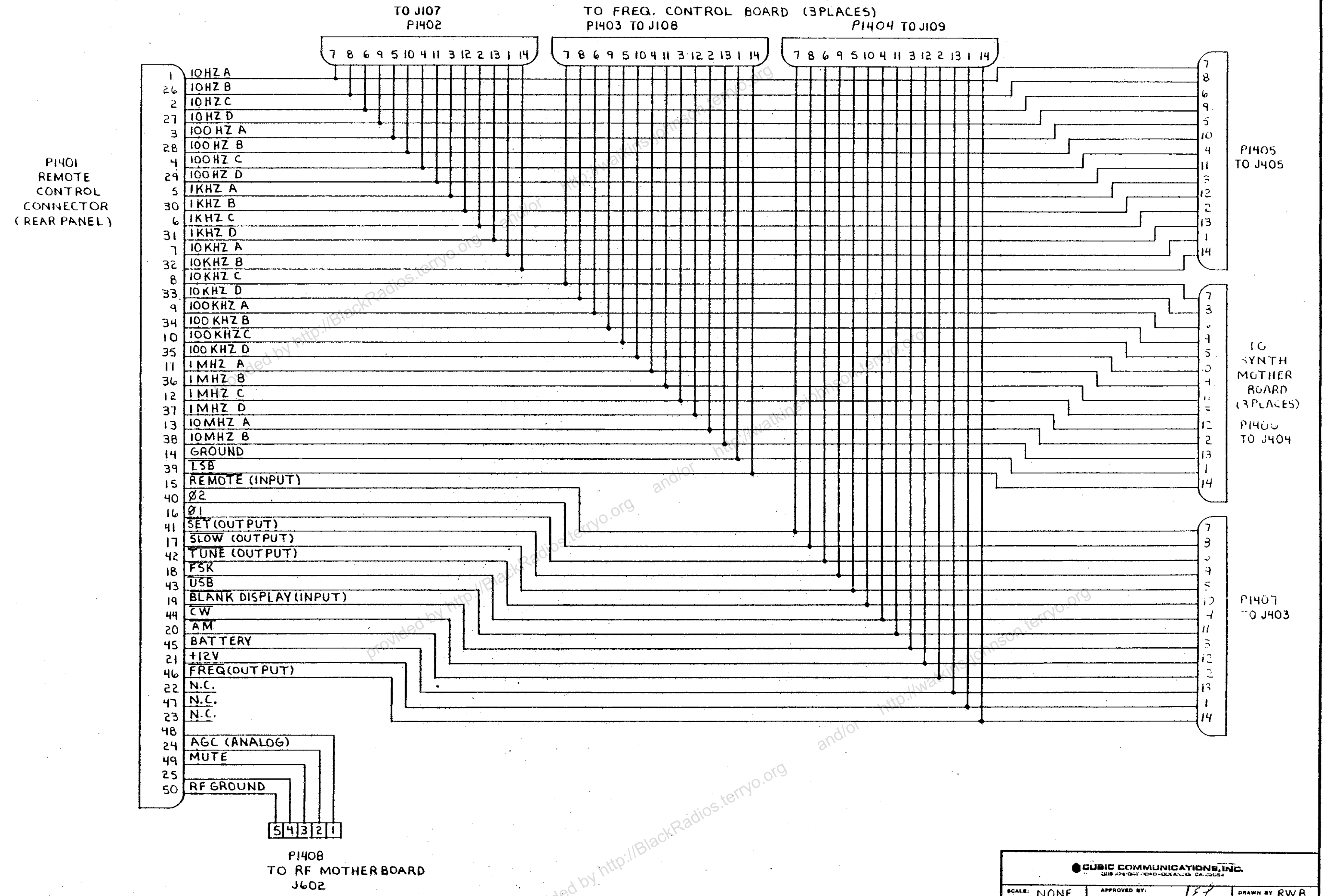
C102
CR102
F102
T101
FL101

CUBIC COMMUNICATIONS, INC.

SCALE: NONE | APPROVED BY: | DRAWN BY R. ROE
DATE: 3-29-82 | REVISED RWB

SCHEMATIC, REAR PANEL

REV A | DRAWING NUMBER 1971-1302



CUBIC COMMUNICATIONS, INC.

SCALE: NONE	APPROVED BY:	DRAWN BY RWB
DATE: 4-19-82		REVISED

CABLE ASSEMBLY

HF-1030 — DRAWING NUMBER 1971-5005

NOTES:
1. MAKE FROM 680-014