

FREQUENCY-STABLE NARROWBAND TRANSCEIVER
FOR 10100.5 KHZ
Raymond C. Petit, **W7GHM**

The accompanying diagrams will permit the experienced home builder to assemble a transceiver suitable for **coherent-CW** and Clover operation on the bottom end of the 30 **Meter** ham band. It has been designed for high dynamic range (**SL6440C** high-level mixers), exceptional **i.f.** selectivity (g-pole 300 Hz filters), and **ultra-stable** operation (LO and BFO **phaselocked** to a frequency standard). It is kept as simple as possible and the frequency plan makes use of inexpensive microprocessor clock crystals. It is also designed with thought to the future, when its single-frequency stabilized HFO can be replaced with an 18-19 MHz frequency synthesizer.

I recommend building this unit as a set of shielded modules connected by r.f. cables. Bring the power supply lines through the shielded boxes with feedthrough capacitors. The CMOS-level signals can be routed via **SHORT UNTERMINATED** 50 ohm cables. All the signal path and oscillator **r.f.** is matched to 50 ohms. This makes it easy to build and check out each module separately.

The transmitter and receiver sections have separate but **identical** crystal filters and front-end filters. RF switching of a single crystal filter and a single front-end filter can be used instead, but dual-filter arrangement is no more expensive. The filters are based on the Cohn design described by Hayward in **QST** (July 1987) with a slight variation: The center frequency can be **set over** a small range by choice of the "offset" capacitors (**C10-C18** in the filter schematic).

Unlike most IF amplifiers, this one operates at fixed gain--no **agc**. The combined gain of the IF amplifier and product detector is about 50 **dB**. The audio output varies from about 30 microvolts to about 1 volt, a 90 **dB** range. The Clover TNC does the AGC compensation in its audio processor.

The input and output filters have a bandwidth of about 1 MHz, about 2 **dB** insertion loss, and very steep skirts: the input mixer on the receiver is very well protected from strong out-of-band signals! To align the input filter, connect a **10.5-MHz** **sinewave** r.f. generator with 50 ohm source resistance to one of its ports, and a scope probe to **THE SAME POINT**. Terminate the other port with 50 ohms. Set all the trimmer capacitors to minimum capacitance. Then set the trimmer closest to the source and probe for **MINIMUM** r.f. voltage, and do not change it afterward. Then set the next trimmer for **MAXIMUM** r.f. voltage, and don't change it afterward. Set the third trimmer for **MINIMUM**, the fourth for **MAXIMUM**, and the fifth for **MINIMUM** without changing previous settings. It's done: five adjustments, no tweaking!

The **16-MHz** oscillator provides a signal required by the (future) frequency synthesizer, the 8 MHz BFO signal, and the clock signal required by the Clover TNC. The synthesizer and BFO outputs are

0 dBm /50 ohm sinewaves. Two separate switchable BFO outputs are provided for T/R switching purposes. With R10 removed it should be possible to get the oscillator to deliver 16 MHz exactly for some d.c. voltage between ~2.0 and 2.5 volts applied to the junction of C13 and R9. L5 can be changed if necessary to get it on frequency. With R10 in place, the frequency standard connected to 33 and the jumper set to correspond to the frequency of the standard, correct operation will be indicated by a clean rectangular waveform at U3 pin 6. This waveform will change its duty cycle slightly if the crystal is heated, but the frequency of the oscillator will stay exactly at 16 MHz.

The 2.1 MHz LO circuit uses the same basic scheme for the oscillator and phase detector. The divide-by 21 counter functions by alternately counting out 10 input pulses and then 11 pulses. Extensive decoupling and division by 4 at the output are intended to prevent switching noise from getting into the 2.1 MHz output.

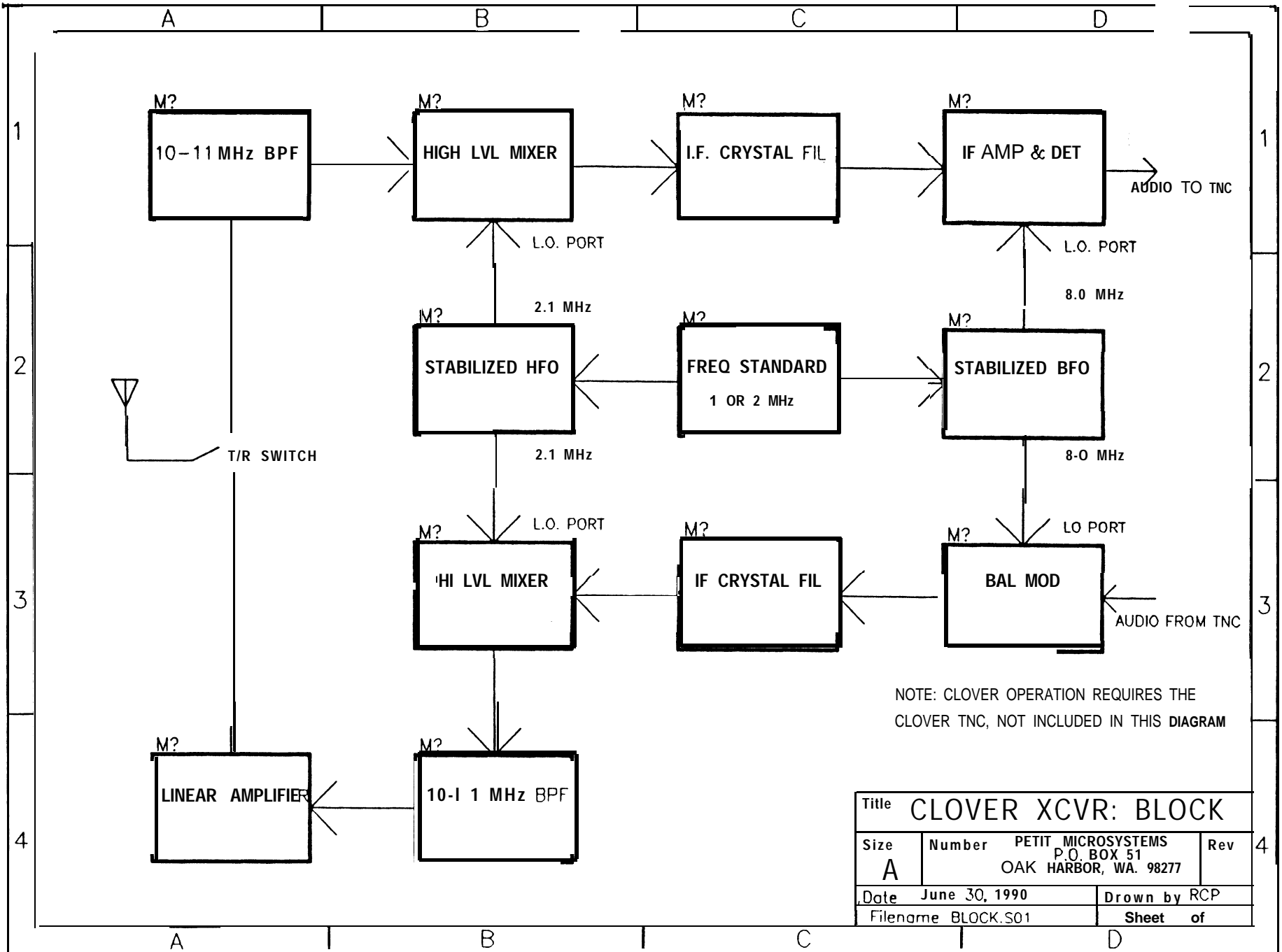
The RF output of the high-level mixer on the transmitter side should be set for about 10 dBm (1 volt peak/50 ohms). Broadband Class A drivers delivering from 0.2 watts to about 2 watts are shown in the ARRL Handbook. Linear amplifiers can be built from plans and parts kits supplied by Communication Concepts, Inc., 508 Millstone Drive, Xenia, Ohio 45385 (513-426-8600).

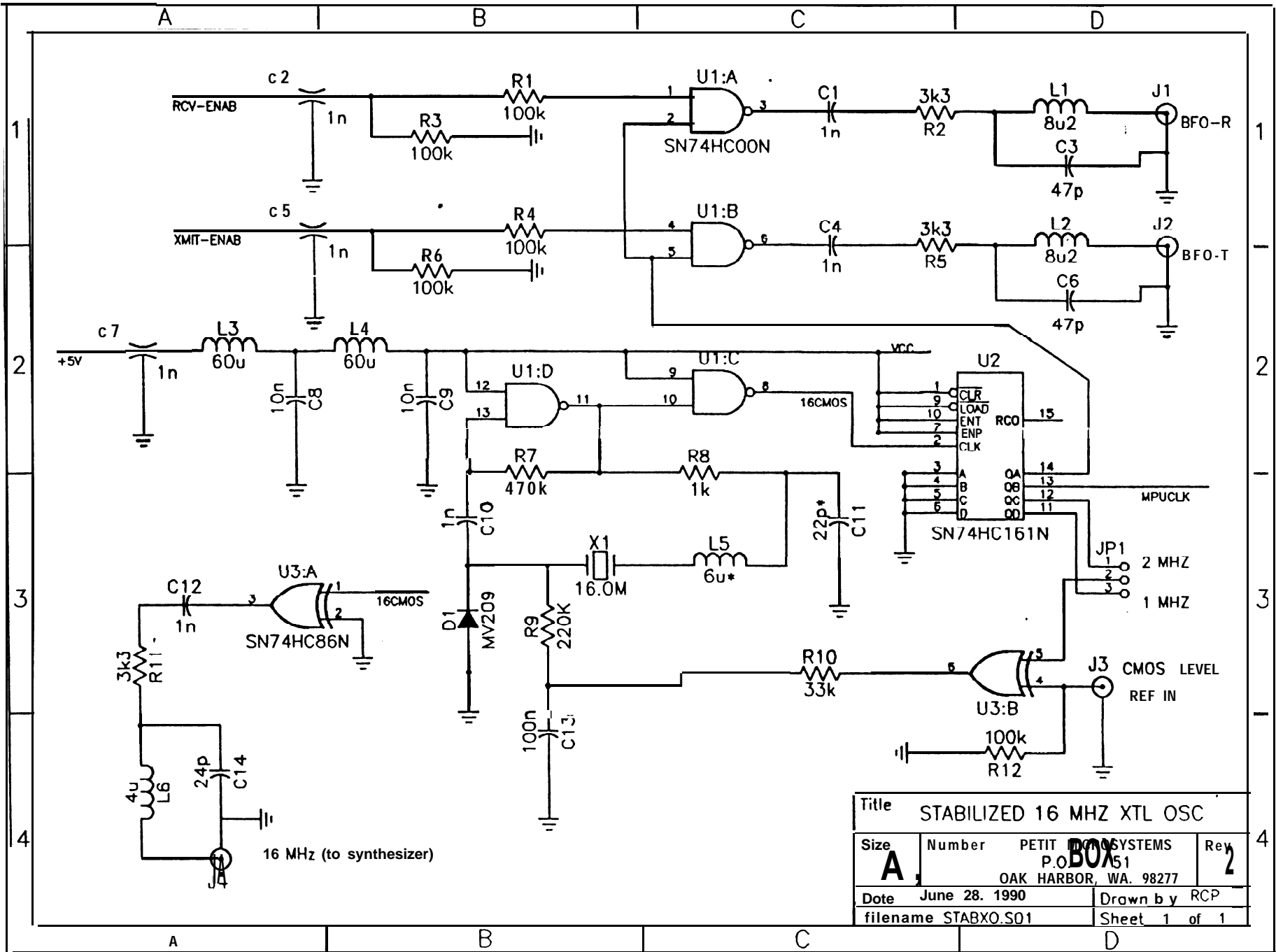
An oven-stabilized 2-MHz frequency standard meeting the requirements of Clover operation can be obtained for \$12.95 plus shipping from Fair Radio Sales, P.O. Box 1105, Lima, Ohio, 45802 (419-223-2196).

Most of the parts needed for this project can be obtained from Digi-Key Corporation, P.O. Box 677, Thief River Falls, MN 56701 (800-344-4539). I have a good stock of the SL6440C mixers, ferrite beads for the 60 uH r.f. chokes and r.f. transformers, and toroid cores for L1-L5 in each of the two front-end filters. If there is sufficient interest, I can supply a complete parts kit including circuit boards as a commercial product.

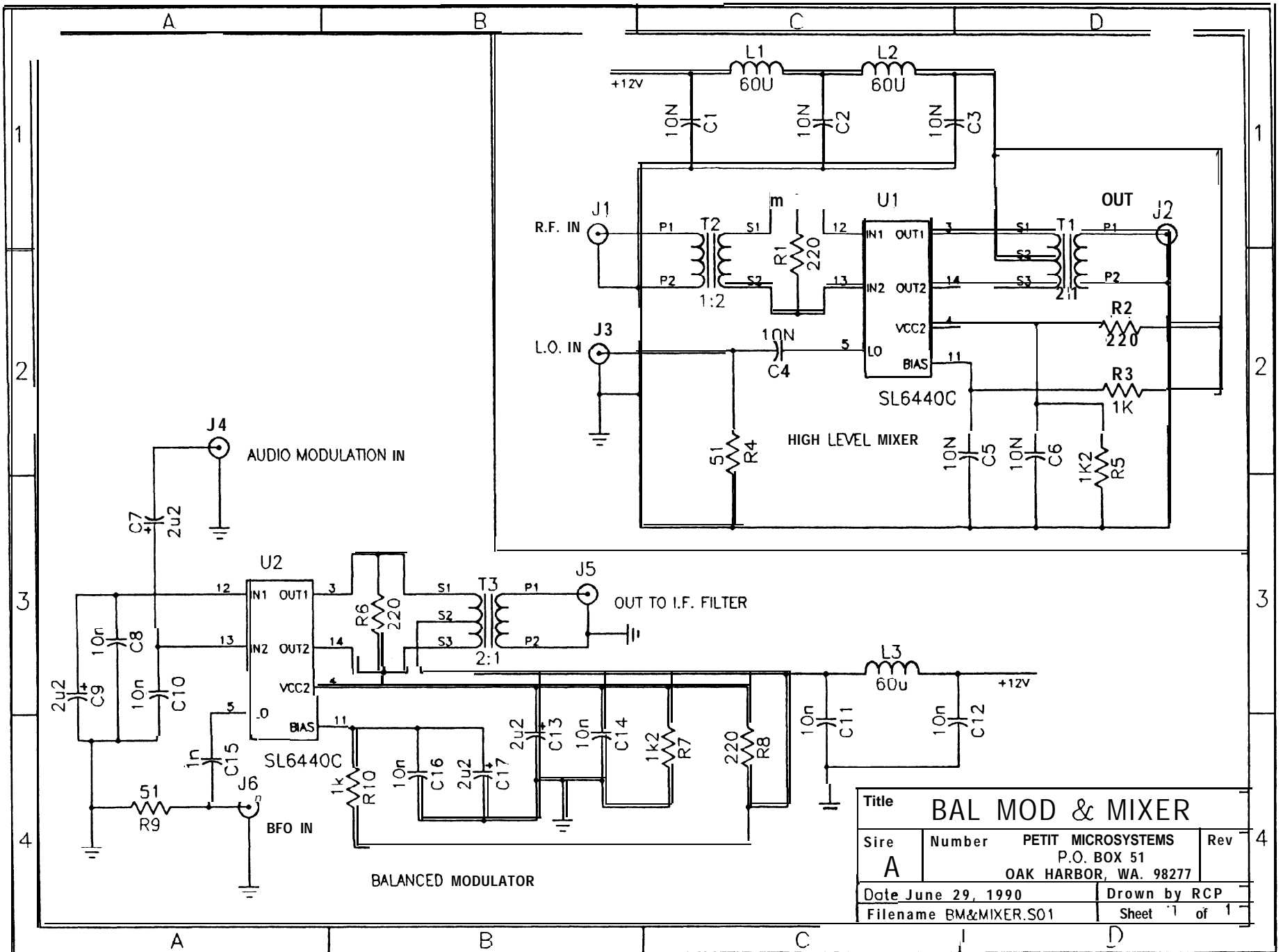
I hope the FIRST CLOVER NETWORK can get on the air before the end of the year, using some of these transceivers. UP FRONT, I inform you that you will need FOUR items for Clover operation: The frequency standard, the transceiver (with at least a few watt linear amplifier), a CRT terminal or a computer with communications software and an RS-232 port, and the CLOVER single-channel TNC which I plan to offer as a commercial product for about \$300.

Please keep me informed of your progress as we build the first operational CLOVER systems!

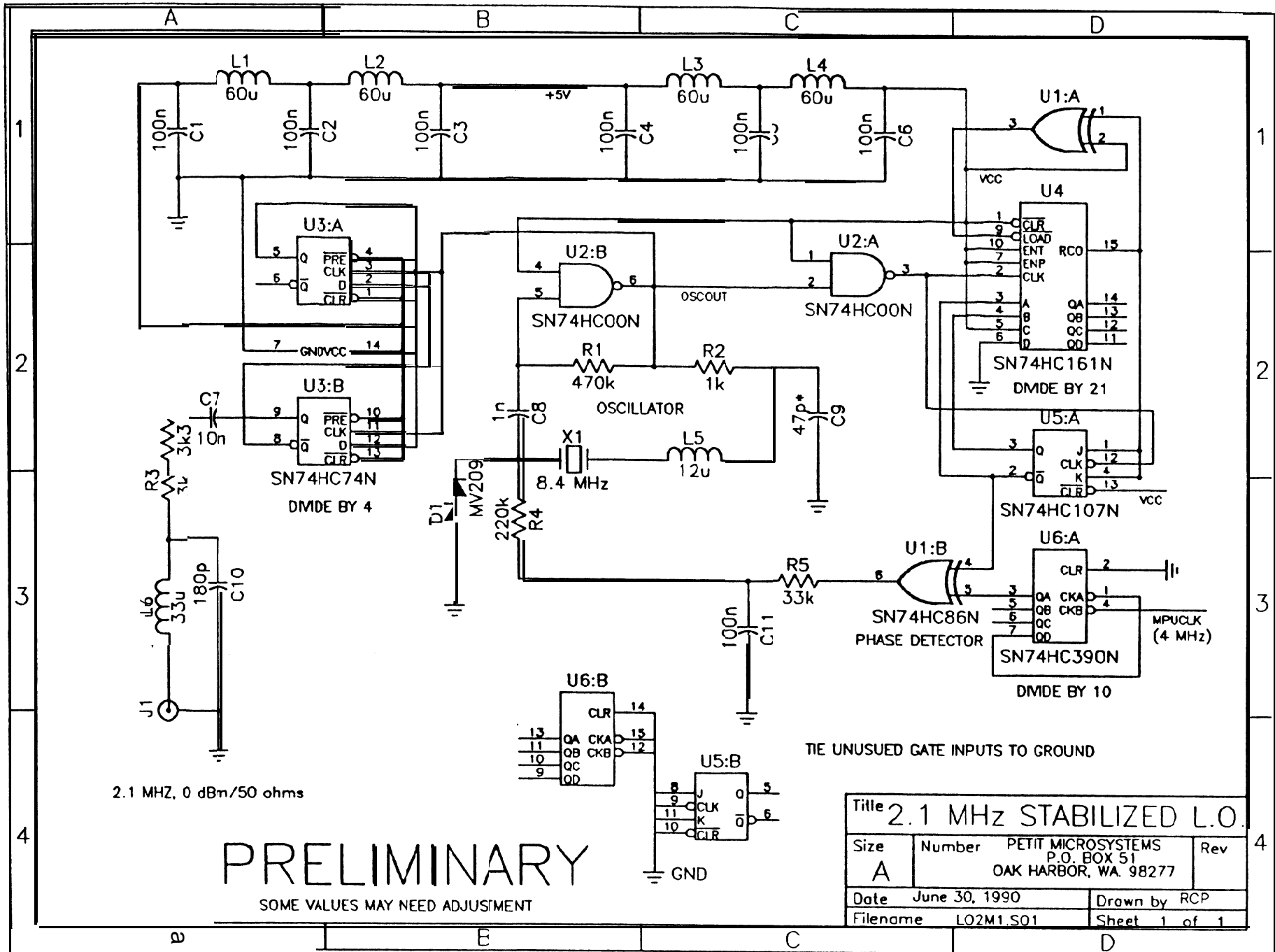




Title				STABILIZED 16 MHz XTAL OSC	
Size	Number	PETIT BOX SYSTEMS		Rev	
A		P.O. BOX 51		2	
				OAK HARBOR, WA. 98277	
Date	June 28, 1990		Drawn by RCP		
filename STABXO.S01			Sheet 1 of 1		



Title			
BAL MOD & MIXER			
Sire	Number	PETIT MICROSYSTEMS	Rev
A		P.O. BOX 51	
		OAK HARBOR, WA. 98277	
Date June 29, 1990		Drawn by RCP	
Filename BM&MIXER.S01		Sheet 1 of 1	

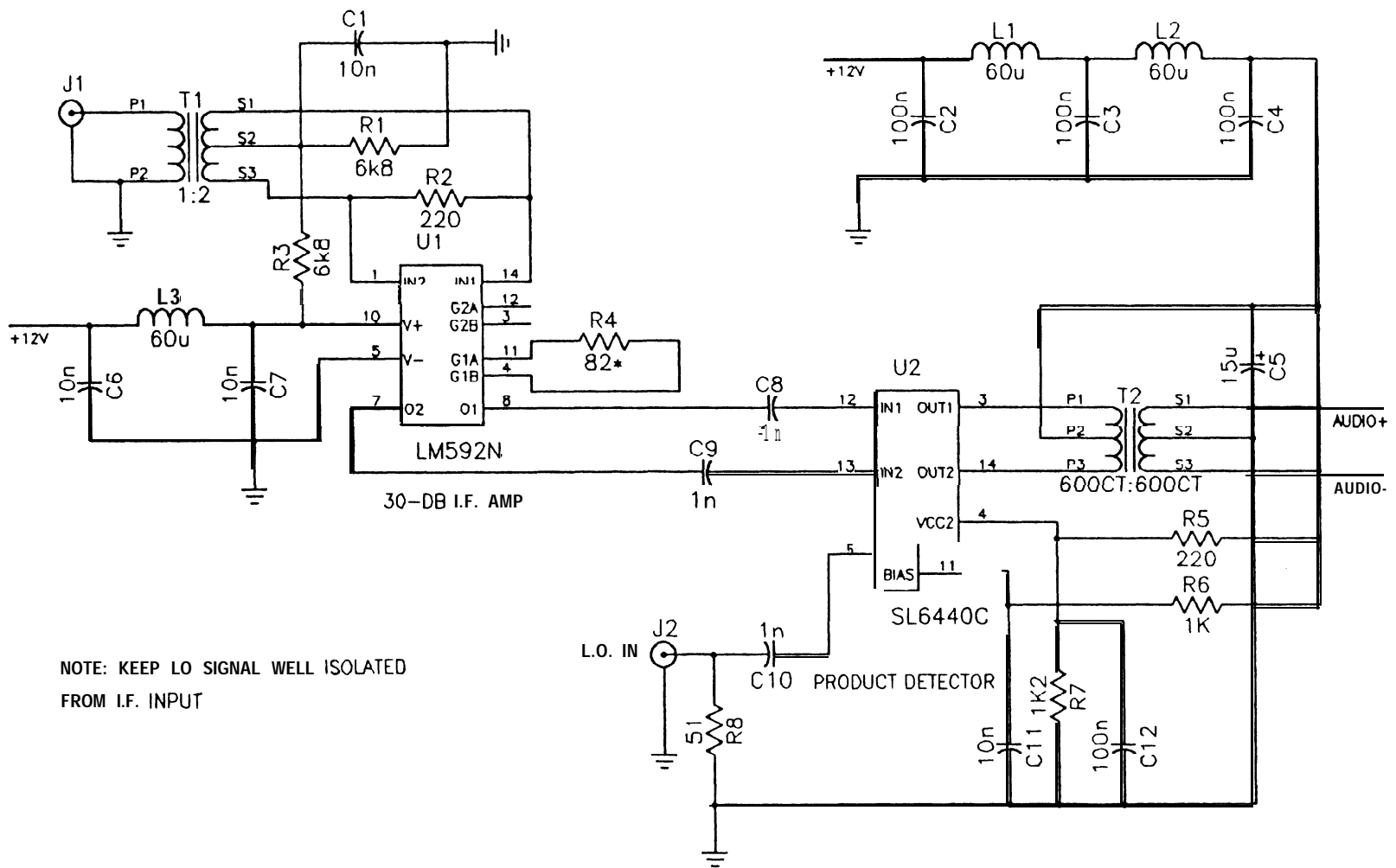


2.1 MHz, 0 dBm/50 ohms

PRELIMINARY
SOME VALUES MAY NEED ADJUSTMENT

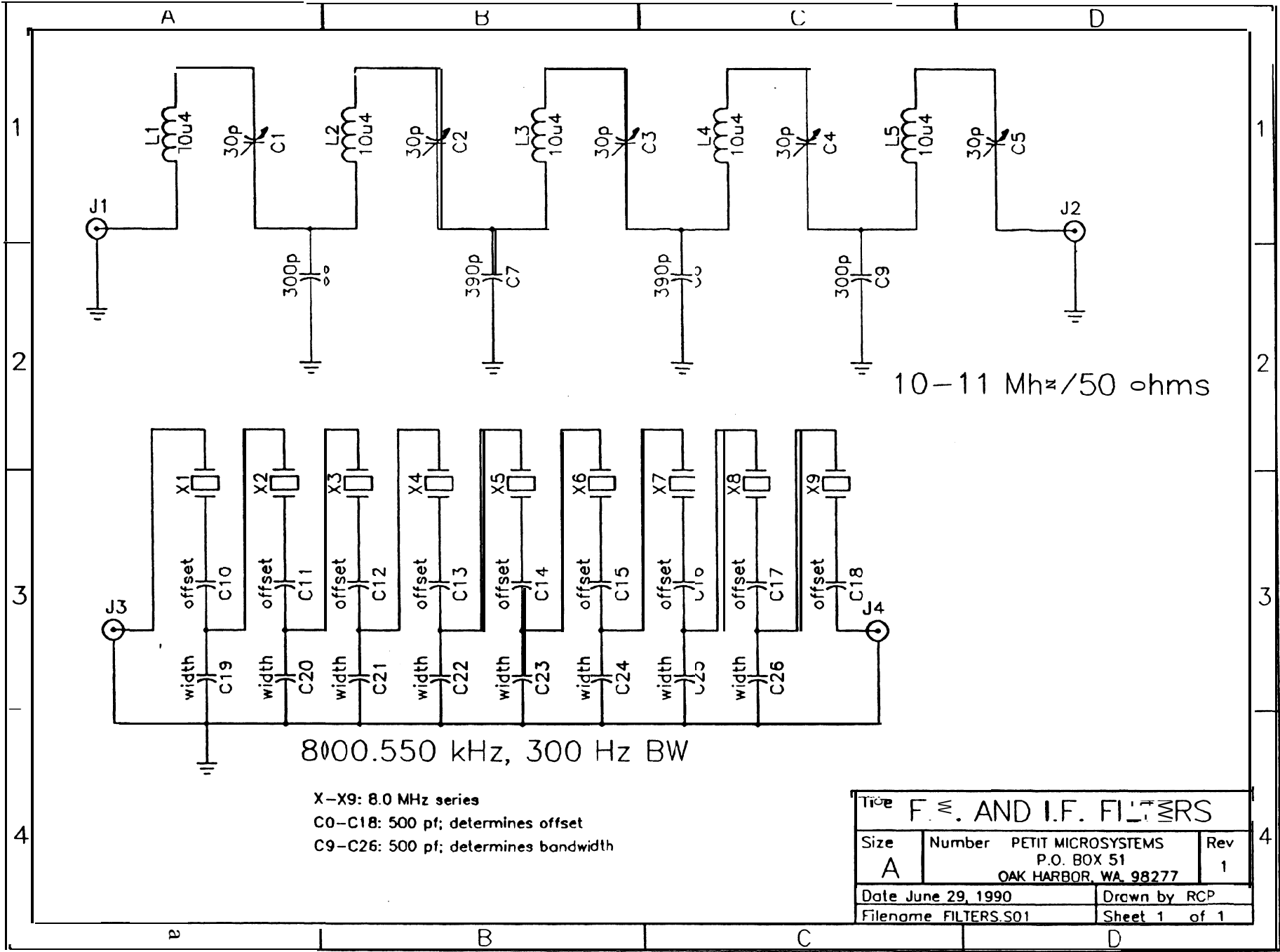
TIE THE UNUSED GATE INPUTS TO GROUND

Title 2.1 MHz STABILIZED L.O.			
Size A	Number	PETIT MICROSYSTEMS P.O. BOX 51 OAK HARBOR, WA. 98277	Rev
Date	June 30, 1990	Drawn by RCP	
Filename	LO2M1.S01	Sheet 1 of 1	



NOTE: KEEP LO SIGNAL WELL ISOLATED
FROM I.F. INPUT

Title			
IF AMP, PROD DET			
Size	Number	PETIT MICROSYSTEMS P.O. BOX 51 OAK HARBOR, WA. 98277	Rev
A			
Date June 29, 1990		Drawn by RCP	
Filename IFPRODET.S01		Sheet 1 of 1	



10-11 MHz / 50 ohms

8000.550 kHz, 300 Hz BW

X-9: 8.0 MHz series
 C0-C18: 500 pf; determines offset
 C9-C26: 500 pf; determines bandwidth

Title F.M. AND I.F. FILTERS			
Size A	Number	PETIT MICROSYSTEMS P.O. BOX 51 OAK HARBOR, WA, 98277	Rev 1
Date June 29, 1990		Drawn by RCP	
Filename FILTERS.S01		Sheet 1 of 1	