Trinidad II

MODEL SBE-30CB

SERVICE MANUAL

SBE®

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SECTION 1
GENERAL

1.1 CUSTOMER SERVICE

The SBE Technical Services Department functions as a source of information on the application, installation and use of SBE products. In addition, the Technical Services Department provides technical consultation on service problems and availability of local and factory repair facilities.

In any communications to the Technical Services Department, please include a complete description of your problems or needs, including model and serial numbers of the unit or units in question, accessories being used, any modifications or attachments in use, or any non-standard installation details.

For assistance on any of the above matters, please contact SBE, Incorporated, Technical Services Department, 220 Airport Boulevard, Watsonville, California 95076. Phone: 408/722-4177.

1.2 PARTS ORDERS

SBE original replacement parts are available from the Factory Parts Department at 1045 Main Street, Watsonville, California 95076.

When ordering parts, please supply the following information:

Model number of the unit.
Serial number of the unit.
Part number.
Description of the part.

1.3 FACTORY RETURNS

Repair services are available locally through SBE Certified Service Stations across the country. A list of these Service Stations is available upon request from the Technical Services Department. Do not return any merchandise to the Factory without authorization from the Factory.

SECTION 2

SPECIFICATIONS

2.1 GENERAL

Compliance	F.C.C. Type Accepted (Part 95, Class D)
Channels	23
Frequency Range	(26.965 - 27.255) MHz
Frequency Control	Crystals, Synthesized
Frequency Tolerance	±0.003%
Operating Temperature Range	-30°C to +50°C
Humidity	95%
Input Voltage	120 VAC or (11.7 - 15.9) VDC positive or negative ground
Microphone	Dynamic
Size	Height: 2″ (53mm) Width: 6¼″ (160mm) Depth: 7-7/8″ (200mm)
Weight	3 lbs., 1.36 Kg.
Power Consumption	40 watts, Full Modulation
Fuse	2A fast blow (Type 3AG or A.G.C.)

2.2 RECEIVER

Sensitivity	0.7μV for 10db S+N/N
Selectivity	-6db @ ±6 KHz, -50db @ ± 10 KHz
IF Frequency	10 MHz, 455 KHz
AGC Response	Less than 10db for 10-100,000μV
Squelch Threshold	Less than 1μV
Audio Power Output	2 watts
External Speaker	(Not Supplied) 4 or 8Ω. Disables internal speaker when connected.
Squelch Range	200μV (Minimum)

2.3 TRANSMITTER

Power Output	4 watts
Modulation	95-100%
Modulator Response	300-2500 Hz
Output Impedance	50Ω, unbalanced
Emission	6A3

SECTION 3
INSTALLATION

3.1 GENERAL

The first step in the installation of the SBE-30CB is to select a site which is convenient and permits accessibility to a good antenna location. The selection of an antenna system and its mounting location are the most critical factors in determining performance.

A vertical ground plane antenna will provide the most uniform horizontal coverage. This type of antenna is best suited for communications with a mobile unit. For point-to-point operation where both stations are fixed, a directional beam antenna will usually increase communication range since this type of antenna concentrates energy in one direction. Beam antennas also allow the receiver to "listen" in only one direction thus reducing interfering signals. F.C.C. regulations limit antenna height of directionals to 20 feet above ground or any formation and omnidirectionals and supporting structure to 60 feet above ground.

3.2 ANTENNA TUNING

The final step in installation is to trim the antenna for minimum S.W.R. The recommended method of antenna tuning is to use an in-line wattmeter or S.W.R. bridge to adjust the antenna for minimum reflected power on channel 11. A properly tuned antenna system will present a suitable load to the transceiver and will insure that maximum power is transfered from the radio to the antenna. If the antenna system in use presents a poor load, as indicated by a high S.W.R. reading, transmitter range will be substantially reduced and damage to the transmitter final amplifier may occur. Poor S.W.R. can usually be corrected by altering the antenna's electrical length in accordance with the manufacturer's instruction. Extremely high S.W.R. readings may be indicative of a defective transmission line, antenna, or connections.

To determine whether the antenna should be lengthened or shortened, test the S.W.R. on channels 1 and 23. If the S.W.R. is the highest on channel 23, the antenna is too long and if highest on channel 1, the antenna is too short. When the antenna system has been tuned correctly, channel 11 should have the lowest S.W.R. and channels 1 and 23 will be slightly higher.

3.3 ACCESSORIES

EMERGENCY DC POWER

If it is anticipated that the unit may be used in the event of a power failure, a 12 volt storage battery may be connected to the terminal strip on the rear panel. Connect the negative and positive battery terminals to the corresponding points on the terminal strip using #14 or larger wire. In the event of AC power failure, the unit will automatically draw primary power from the battery source. When AC power is restored, the unit will automatically return to normal AC operation. It is not necessary to disconnect the emergency DC power source when the AC line is being used. It is recommended that a means to keep the storage battery fully charged be provided.

PUBLIC ADDRESS

An external 8Ω 4 watt speaker may be connected to the PA jack located on the rear panel of the unit when it is to be used as a public address system. The speaker should be directed away from the microphone to prevent accoustical feedback.

EXTERNAL SPEAKER

The external speaker jack on the rear panel is used for remote receiver monitoring. The external speaker may be 4 or 8Ω impedance and should be rated at 3 watts power dissipation. When the external speaker is plugged in, the internal speaker is disconnected. Suitable units are the model SBE-1SP Non-amplified speaker or SBE-1SP/AMP Amplified speaker.

ALTERNATE MICROPHONE INSTALLATION

A desk microphone may be installed with the unit. For best results, a low impedance dynamic type microphone or a transistorized preamplified microphone is recommended. The SBE 100X Preamplified Base Station Microphone or the SBE 200X Non-amplified Base Station Microphone may be ordered and are ready to plug into the unit. If another microphone is selected refer to the schematic diagram for the proper wiring connections to the microphone jack.

3.4 FINAL CHECKOUT

Make an operational checkout of the transceiver to insure operation of it and all the accessories installed. Contact other stations and inquire about their location and their reception of your signal. If an omnidirectional antenna is used, the distance to other stations contacted should be about the same in all directions. A directional antenna should reach more distant stations in the direction in which it is beamed. Also inquire whether the stations contacted are omnidirectional or directional and if directional which way they are beamed.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION

The SBE-30CB is an AM transceiver with a dual-conversion receiver using intermediate frequencies of 10 MHz and 455 KHz.

Refer to the block and schematic diagrams while following the circuit description.

TRANSMIT MODE is initiated by pressing the push-to-talk switch which energizes relay RL-1 which:

DISABLES:

RX RF AMP (Q4),
1st RX MIXER (Q5),
2nd RX MIXER (Q6),
1st IF AMP (Q7),
2nd IF AMP (Q8),
RX OSCILLATOR (Q1),
1st RX AUDIO (Q9),
SPEAKER SP-1,

ENABLES:

TX OSCILLATOR (Q3),
TX MIXER (Q15),
RX PROTECTION DIODE (D1).

When the push-to-talk switch is released, the transceiver is in RECEIVE MODE and the above states are reversed.

4.2 RECEIVER

In receive mode, an RF signal is fed from the antenna to the RF AMP (Q4). The amplified RF signal is then fed to Q5 – the 1st mixer – where it is mixed with an injection signal from the MASTER OSCILLATOR Q2 about 10 MHz below the receive channel frequency. The resultant 10 MHz 1st IF is selected by L1 and L2 and fed to Q6 – the 2nd mixer – where it is mixed with an injection signal from the RX OSCILLATOR Q1 455 KHz below the 10 MHz 1st IF. The ceramic filter FL-1 selects the 455 KHz signal and feeds it to the 1st IF AMP Q7 which then feeds it to the 2nd IF AMP Q8. The output of Q8 is fed through C24 to the AGC detection diodes D3 and D4, through C85 to the S METER detection diodes D15 and D16, and through C22 to the audio detection diodes D5 and D6. After passing through the AUTOMATIC NOISE LIMITER, the detected audio signal is applied across potentiometer VR1 – the volume control. The audio signal developed on the VR1 wiper is then fed to audio amplifier stage Q10 which then feeds Q11. The output of Q11 drives Q12 which is transformer coupled to push-pull speaker driver amplifier Q13 and Q14.

AUTOMATIC GAIN CONTROL CIRCUIT

The AGC (Automatic Gain Control) on the SBE-30CB reduces the gain of the receiver in response to a strong signal by lowering the bias on the RF and IF amplifiers. The AGC voltage is developed at the R2, R19 junction and filtered by C25. With a weak receiver input signal – less than 1μV – diodes D3 and D4 are forward biased by current through R2, R27, R28 and R19. About 1.5 volts of AGC appear at the C25, R19 junction. As the input signal increases, the signal at the top of C24 increases. When the signal at the top of C24 swings negative, current flows through D3 on to C24. As the signal swings positive, C24 discharges through D4. The increase in current through R2, R27, R28 decreases the AGC voltage. The AGC voltage is then fed through R1 and the secondary of T1 to the base of Q4, through R5 and the secondary of T2 to the base of Q5, through R19 and L2 to the base of Q6, and through R12 to the base of Q7.

THE AUDIO DETECTOR

The AUDIO DETECTOR on the SBE-30CB demodulates the received signal. The output of the 2nd IF AMP is fed from the top of the primary T5 through C22 to the detector diodes D5 and D6. When the signal at the top of T5 swings negative, D5 conducts current on to C22. As the signal swings positive, C22 discharges through D6 and charges C26. The voltage on C26 thus tends to follow the peak-to-peak voltage of the received signal and is thus the demodulated audio signal which is then fed through the AUTOMATIC NOISE LIMITING circuit, through C28 to the top of VR1 – the volume control, and from the wiper of VR1 through C39 to Q10 – the first stage of audio.

AUTOMATIC NOISE LIMITER CIRCUIT

The ANL circuit prevents impulse noise, such as ignition noise, from being amplified. The audio output voltage from the detector diodes D5 and D6 is reduced about 1/3 by voltage divider R20 and R21 and then fed to the cathode of D7 – the ANL diode. The audio output from the detector diodes is also fed through R22 to C27 where it is filtered and then fed through R23 to the anode of D7. Since the audio signal is positive, the signal at the anode of D7 is normally more positive than the cathode and the diode is forward biased providing a low impedance path for the audio to the first audio stage, Q10. When a noise pulse appears in the output of the detector, the time constant of R22 and C27 prevents the anode of D7 from responding as fast as the cathode. The cathode of D7 is thus driven more positive than the anode causing D7 to become backed biased. D7 then becomes a high impedance that blocks the noise.

SQUELCH CIRCUIT

The squelch circuit shuts the audio off when the received signal is less than the threshold level as determined by the SQUELCH CONTROL. If Q9 – the SQUELCH AMP – is off, R29, R30, and R31 form a voltage divider network that provides the proper forward bias to the base of Q10 – the first audio stage – permitting it to amplify the audio signal fed from the detector. Raising the wiper on VR2 – the SQUELCH CONTROL – tends to forward bias the base of Q9 which turns Q9 on. When Q9 is on, the forward bias is removed from the base of Q10 thus preventing amplification of the audio signal. As the received signal becomes stronger, however, the AGC voltage lowers the bias on Q9 which then permits Q10 to amplify audio. Thus raising the wiper on VR2 increases the threshold level a signal must overcome to "break squelch" – turn Q9 off and permit Q10 to amplify audio.

S METER CIRCUIT

In receive mode, meter M1 functions as an S-METER, and indicates relative strength of the received signal. When the signal swings positive at the top of the T5 secondary, current flows through D16 on to C85. As the signal swings negative, C85 discharges through D15 and charges C84. The voltage on C84 thus tends to follow the received signal strength. C84 discharges through VR5 – the S METER ADJ – to meter M1.

4.3 TRANSMITTER

In transmit mode, the output of the MASTER OSCILLATOR Q2 and the TX OSCILLATOR Q3 are mixed in the TX MIXER D12. The output of D12 is then fed through BAND PASS FILTER L4, and T8 (26.965 - 27.255 MHz) to the TX BUFFER Q15. The output of the BUFFER feeds the TX AMP Q16 which in turn feeds the TX DRIVER Q17. The TX DRIVER then feeds the TX FINAL Q18. The output of the TX FINAL is then fed through a low pass filter, L8, C78, L10, C80, L11 and C81, and a second harmonic trap CV1 and L12, to the antenna. Modulation is accomplished by driving the collector of the TX DRIVER and TX FINAL by modulated B+ derived from the lower secondary of T7 – the AUDIO OUTPUT transformer.

FREQUENCY MIXING SCHEME

Channel Selector switch S2 selects one of six crystals (X5 - X10) to set the MASTER OSCILLATOR Q2 frequency about 10MHz below the selected channel frequency. (See Table 5-3.) The output of Q2 is fed to the 1st MIXER Q5 to produce the 1st IF. S2 also selects one of four crystals (X1 - X4) for the RX OSCILLATOR Q1. The output of Q1 is fed to the 2nd MIXER Q6 to produce the 455 KHz 2nd IF. One of four crystals (X11 - X14) is also selected by S2 for the TX OSCILLATOR Q3. The outputs of the TX and MASTER OSCILLATORS are mixed in TX MIXER diode D12. The sum of the frequencies from these oscillators is selected to produce the transmitter frequency.

OVERMODULATION LIMITER

The OML regulates the gain of the audio amplifier so as to accommodate a wide range of voice levels without overmodulating the carrier. The audio signal is fed from the secondary of the audio output TRANSFORMER T2 to D18 where it is rectified; it is then filtered by C116, R40, and C43, and fed to the emitter of Q11 – the MIC AMP – through the OML adjustment VR4. As the sound level into the MIC increases, the voltage at the emitter of Q11 will rise and thus lower the amplification of the sound input.

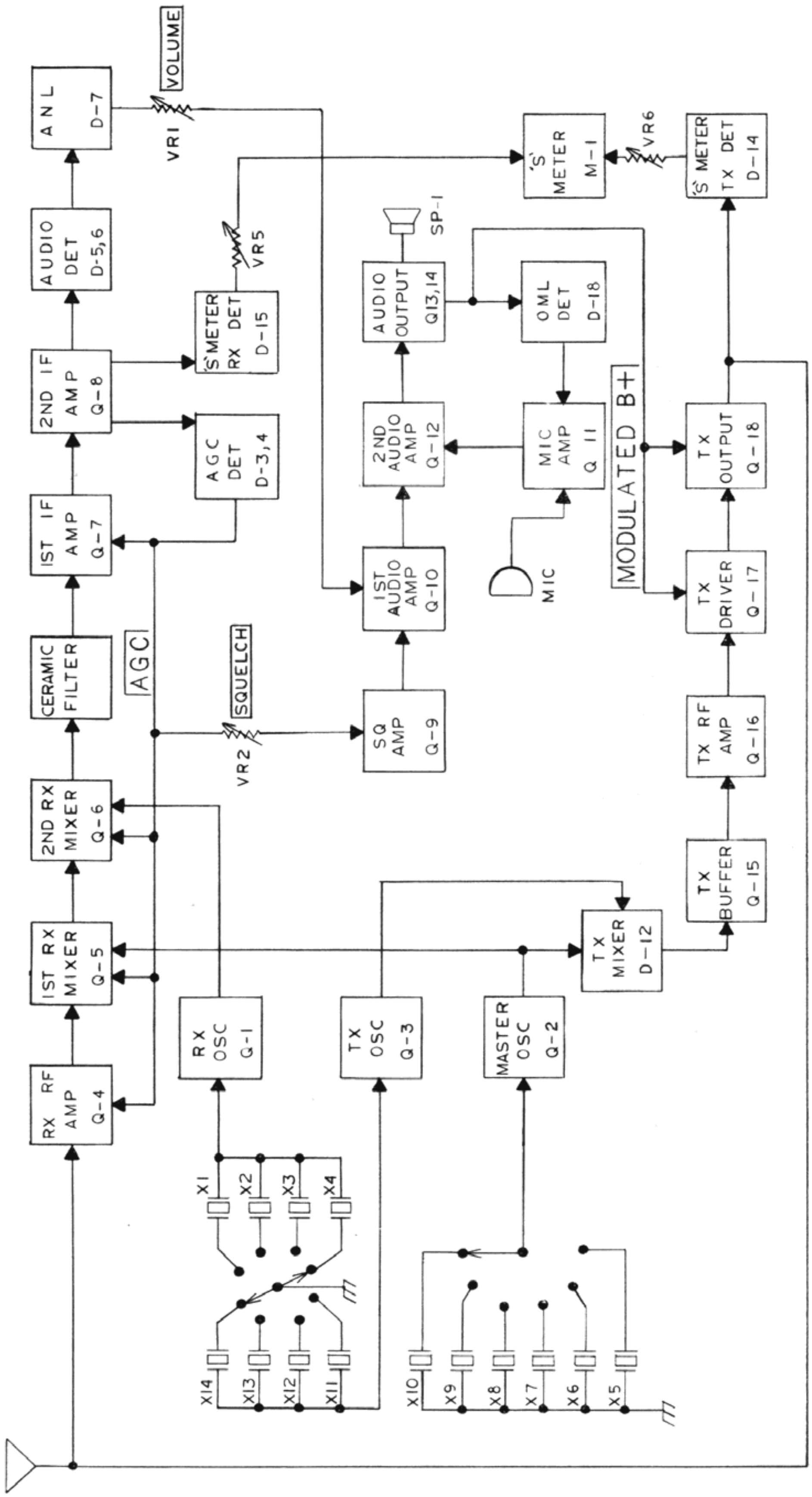
OSCILLATORS

Crystal oscillators Q1, Q2 and Q3 are common collector, colpitts circuits. Outputs are taken from the emitters. The collectors of Q1, Q2 and Q3 are at AC ground.

RF OUTPUT METER

In transmit mode, meter M1 functions as a transmitter power output indicator. A small sample of the transmitter's RF output signal is fed by C82 to network R64, D14, and C11 where it is rectified and filtered and then fed through VR6 – the RFO ADJ – to meter M1.

FIG. 4-1 SBE-30CB TRANSCEIVER BLOCK DIAGRAM



SECTION 5

SERVICING

5.1 INTRODUCTION

Read this section carefully before attempting any repair of the SBE-30CB. Refer to the circuit description, block and schematic diagrams. The transistor case diagrams are shown on the schematic diagram. Refer to these diagrams before checking transistors. Component layout and location prints are provided to aid troubleshooting and alignment. Use only recommended replacement parts. Refer to the parts list in the back of this book. **Never replace blown fuses with higher rated ones or fast acting with slow blow.** To check operation of the unit, refer to Table 5-1, PERFORMANCE VERIFICATION PROCEDURE. Figures 5-4, -5, TRANSMITTER TEST CONNECTION and RECEIVER TEST CONNECTION respectively, show the proper manner to connect the unit to test instruments for performance verification or alignment. Table 5-2 lists RECOMMENDED TEST INSTRUMENTS. Tables 5-10, -6 show the proper TRANSMITTER ALIGNMENT PROCEDURE and RECEIVER ALIGNMENT PROCEDURE respectively. Figure 5-8, ALIGNMENT LAYOUT is placed next to the alignment procedures to show alignment adjustments at a glance.

5.2 TEST SIGNALS

OSCILLOSCOPE WAVEFORMS are shown which were taken from various points in the SBE-30CB during normal operation into a dummy load. CHECK POINT numbers next to the waveform pictures correspond to numbers in boxes on both the schematic diagram and component layout drawing. Figure 5-11 shows RF amplification through a properly aligned transmitter. Figure 5-12 shows 50%, 100% and overmodulation respectively. Notice that the waveform at the ANODE of D12 – the TX MIXER – contains several frequency components. Also notice that the waveform at the collector of Q18 – the TX FINAL – is unsymmetrical (Figure 5-11e). This is proper since the TX FINAL operates class C for greater efficiency. Figure 5-11f shows how the output should look at the dummy load.

VOLTAGE MEASUREMENTS are shown on the schematic diagram for normal operation. All voltages were measured with an AC VTVM having 10MΩ input impedance. Voltage measurements on high impedance RF points should be taken through a choke. While any choke about 100μH is suitable, SBE part number 8000-00011-0018 (150μH) may be ordered from the factory. Mini-test clips are very useful for making voltage measurements in hard to reach places.

RECEIVER INJECTION VOLTAGES are given in Table 5-9 together with CHECK POINT numbers which correspond to numbers in boxes on both the schematic diagram and component layout drawing. This table specifies the voltage level, carrier frequency and particular points in the receiver string at which a 30% - 1 KHz modulated signal injected through a .01 MFD capacitor should produce 2 VAC of audio across the speaker or 8Ω load plugged into the speaker jack, EXT SP. While the value of this capacitor is not critical, capacitive coupling of the signal generator to the circuit is necessary to prevent grounding out the transistor biases.

Before setting up to measure RECEIVER INJECTION VOLTAGES, small hand-held "all-purpose signal generators" can be used to provide a quick check of the receiver string. Basically, these devices generate pulses rich in harmonics from AF to RF to test whether a stage is working.

AGC VOLTAGES versus RF INPUT LEVEL are shown in Table 5-7. This table should be consulted before any adjustments are made on the squelch circuit since squelch is a function of AGC.

5.3 TROUBLESHOOTING

Troubleshooting the SBE-30CB transceiver is not essentially different than troubleshooting any other electronic device. Be a detective; suspect everything and everyone. Carefully inspect the unit for evidence of overheated components, cold solder joints, or tampering. Understand thoroughly the circuit description and block diagram. Try to start big and isolate the problem. Devise tests that will divide the transceiver in two and isolate the trouble to a particular half. Continue to divide into two parts until the trouble is located. For example, it is determined that a problem exists in a particular transceiver. The unit is divided into:

TRANSMITTER – RECEIVER.

Suppose that the receiver functions properly but there is no carrier when the transmitter is keyed. Since the receiver audio works, it can be assumed that all of the audio amplifier is good except the MIC AMP Q10 – the condition of which is yet unknown. The MASTER OSCILLATOR can be assumed working since it is used by both the transmitter and receiver. After checking the TX/RX relay RL-1 and transmitter B+, the transmitter is then divided into:

BEFORE TX AMP – TX AMP and AFTER.

Figure 5-11, TRANSMIT ALIGNMENT WAVEFORMS, shows typical waveforms taken at various points in an SBE-30CB transmitter during normal operation. Place an oscilloscope probe on the collector of Q15. If a signal is present and doesn't differ significantly from the waveform picture then the problem exists after Q15. Keep dividing until the trouble is found.

This technique is sometimes called, "partitioning," "boxing-in-the-trouble," "divide and conquer," or "binary search"; it is mandatory for complex electronic systems, but can save time and energy on almost any electronic device.

A blown fuse should only be replaced by one of the proper rating and type. If the fuse blows again, replace it, but place an Ω meter at the power terminals in place of the supply. Make certain that the + side of the Ω meter is connected to the red power wire of the SBE-30CB. Some VOM's place the - side of the Ω meter out the red test jack. Observe that D17 protects the unit from a reversed supply.

The second harmonic trap (L12 and CV1) is adjusted at the Factory; field adjustment should not be attempted without proper equipment. Failure of particular channels to work or be on frequency probably indicates a defective crystal. Refer to Table 5-3 SYNTHESIZER MIXING SCHEME. Notice that the same Transmit and Receive crystals are used every fourth channel while each Master crystal is used on four adjacent channels. Check channel selector switch, S2, by swapping crystals.