SBE Formula D Touch Com Service Manual

Formula D touch/com

MODEL SBE-32CB

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

Channels:	23
Frequency Range:	26.965 to 27.255 MHz
Frequency Control:	Single Crystal, Digitally Synthesized
Frequency Tolerance:	±.003%
Operating Temperature Range:	-20°C to +50°C
Humidity:	95%
Input Voltage:	11.7V DC to 15.9V DC, positive or negative ground.
Microphone:	Dynamic
Size:	2.5"H (60mm), 6-3/4"W (170mm), 9-3/8"D (240mm)
Weight:	5 lbs., 2.27 Kg.

2.2 TRANSMITTER

Power Output:	4 Watts (Maximum)
Modulation:	95-100%
Modulator Response:	300 Hz to 2500 Hz, +3 -10db
Output Impedance:	50Ω, Unbalanced
Output Indicator:	Back lit front panel meter

2.3 RECEIVER

Sensitivity:	0.5 microvolt for 10db S+N/N ratio.
Selectivity:	50db @ ± 10KHz, 60cb @ ± 20KHz, 65db @ ± 30KHz
IF Frequencies:	10 MHz, 455 KHz
Receiver Delta Tune:	±750 Hz, Nominal
Automatic Gain Control:	Less than 10db change in audio output for signal inputs from 10-500,000μV

Squelch Threshold:	0.5μV
Audio Power Output:	Greater than 3.5 watts @ 10% T.H.D.
Built-in Speaker:	8Ω, 3-1/2" Round
External Speaker:	(Not Supplied) 4 or 8Ω. Disables internal speaker when connected.
Spurious Rejection:	
Image:	-40db or better
IF:	-70db or better
Others:	-50db or better

2.4 MISCELLANEOUS

PA System:	3.5 watts into an external 8Ω speaker. The front panel PA gain control allows the operator to control the PA speaker volume when the CB/PA switch is in the PA position. When the CB/PA switch is in the PA position, the PA speaker also monitors the receiver.

SECTION 3
INSTALLATION

GENERAL

The first step in installation of the mobile transceiver is selection of antenna and transceiver mounting positions.

The selection of an antenna and its mounting position is the most critical factor in determining the end performance of an installation. Generally, the most satisfactory installation position for most vehicles is the center of the passenger compartment roof. As a second choice, the trunk can be a satisfactory antenna mounting point, especially on those cars where the trunk is large and flat. Due to increased susceptibility to ignition noise, mounting the antenna in the hood area is discouraged. Follow antenna manufacturer's recommendations carefully during installation.

The SBE-32CB is supplied with a universal mounting bracket and microphone holder. The transceiver may be mounted in any position and on any rigid surface, such as underneath an automobile dashboard, truck roof or vertically on a boat bulkhead.

The transceiver should be mounted with accessibility and operation convenience in mind.

CAUTION: Avoid mounting the transceiver in the direct air stream of the vehicle's heater. Temperatures in this area can exceed 150° F and can result in serious damage to the unit.

It is recommended that the mounting bracket be installed on the transceiver and mounting clearances checked, with the unit held in the desired mounting position. It is especially important to leave sufficient space behind the unit for antenna and accessory cable connections.

When the most desirable mounting installation point has been decided upon, a pencil or other marking device should be used to outline the mounting bracket on the mounting surface. The transceiver should then be removed from the mounting bracket and the bracket held against the dash or other mounting surface, in the position marked, so that mounting holes may be marked and drilled.

CAUTION: Be sure to check behind the dash or other mounting surface to insure against damage of wiring and other devices before drilling any holes.

Install the microphone holder on the radio or other mounting surface as desired.

Install any accessories at this time, including external speaker, public address speaker, etc.

This unit is designed for either 12 volt positive or negative ground systems. In either system, the positive battery terminal always connects to the red supply wire, and the negative battery terminal always connects to the black supply wire. If the transceiver's power lead must be lengthened, use No. 14 or larger wire.

CAUTION: When using this radio in a positive ground system, it is important that none of the accessories are electrically connected to the vehicle's chassis (external speakers, P.A. speakers, etc.). Positive ground installations must utilize an additional 2 ampere fuse in the negative (black) supply lead to avoid possible damage to the transceiver. NOTE: The transceiver power lead may be connected to the accessory section of the ignition switch if desired. However, due to the possible presence of high-level noise from the ignition and accessories, this connection may not be desirable. In cases where excessive noise is present on the accessory line, a direct connection to the battery is recommended.

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 transistor 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 FINAL CHECK

Test drive the vehicle and make an operational check-out of the transceiver to insure proper operation of it and all the accessories installed. At this time, note any degradation of performance due to vehicle noise and take appropriate action to correct any noise suppression and deficiencies as outlined in the following section.

3.4 NOISE SUPPRESSION

The first step in assuring minimum ignition noise is to insure that the engine ignition system is in a good state of tune, and all factory original noise suppression devices are installed and operational. This includes an inspection of distributor points and condenser. Check to see that the spark plugs are clean and properly adjusted. The condition of the ignition wiring should be checked (radio resistor type ignition wire is standard on most late model vehicles and should be installed on vehicles not so equipped). The distributor cap should be checked for traces of carbon tracking or signs of arcing. Resistor type spark plugs are helpful in further reducing ignition noise and are standard as original equipment on many late model vehicles.

Alternator noise may be minimized by the installation of an alternator line filter, available from radio parts distributors.

Installation of bonding straps in the engine compartment will further reduce ignition noise. Short lengths of metal strap or heavy shield braid between the engine and frame, engine and fire wall, alternator and frame, exhaust pipe and frame, or hood to frame, will in many cases, greatly reduce ignition noise. Extremely high ignition noise levels or noise levels that become worse after a period of time are usually indicative of deterioration of the vehicle's electrical system. In some cases, interference may be caused by dash instruments including gasoline gauges, heater blowers and fans, etc. This interference may often be reduced by the installation of bypass capacitors from the terminals of the interfering instruments to ground. .01 microfarad capacitors of the ceramic disc variety rated at 500 working volts DC are recommended for this purpose.

For further information on the suppression of ignition noise in the automotive and marine environment, the Champion Spark Plug Company publication "Giving Two Way Radio Its Voice" is highly recommended. This publication is available from the automotive technical service department Champion Spark Plug Company, Post Office Box 910, Toledo, Ohio 43661. This publication is also available, at no charge, from the SBE Technical Services Department, upon request.

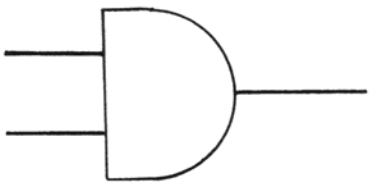
SECTION 4
CIRCUIT DESCRIPTION

4.1 OVERVIEW

Digital Circuit Theory

The SBE-32CB incorporates both analog and digital circuitry. The "conventional" RF, IF and AF stages or COMMUNICATIONS is analog while the FREQUENCY SYNTHESIZER and CHANNEL SELECTOR are digital. Except for the diode AND gate in the CHANNEL SELECTOR, the SBE-32CB utilizes TTL logic. This logic is located on dual-in-line chips that operate on 4.8 to 5.4 volts. "High," "true" or "logic one" is defined as greater than 2 volts while "low," "false" or "zero" is defined as less than 0.8 volts.

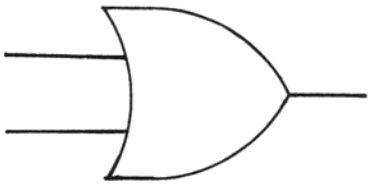
TTL inputs act as highs when unconnected. Normally TTL outputs go high and low without the need for external circuitry. Open collector outputs, however, require an external resistor going to Vcc to pull the output high. When several open collector outputs share the same pull-up resistor they are said to be "wire ANDed" since any output low will cause all outputs to go low. The open collector NAND gates IC-4 in the SBE-32CB SYNTHESIZER are wire ANDed.



AND Gate

All inputs must be high for a high output.

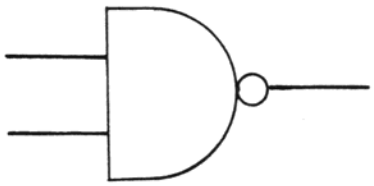
A diode AND gate is used in the CHANNEL SELECTOR of the SBE-32CB to load the UP-DOWN COUNTER.



OR Gate

Any input high produces a high output.

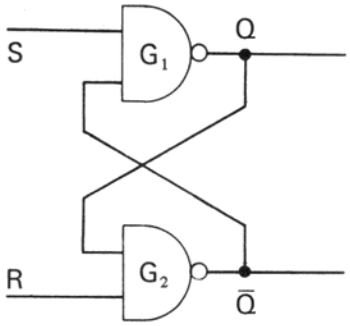
Both AND and OR gates are used symbolically in the SBE-32CB CHANNEL SELECTOR block diagram to represent functions performed by several logic elements.



NAND Gate

All inputs must be high for a low output.

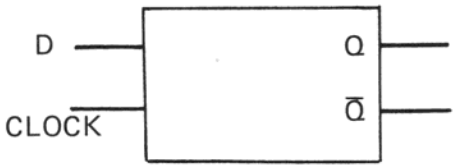
NAND gates are used extensively throughout both the FREQUENCY SYNTHESIZER and CHANNEL SELECTOR in the SBE-32CB.



Cross Connected NAND Flip-Flop (FF)

Low input to S (Set), Q is then high and $\overline{Q}$ is low. Q will remain high and $\overline{Q}$ will remain low after low is removed from S. A low pulse on R (Reset) will drive $\overline{Q}$ high and Q low.

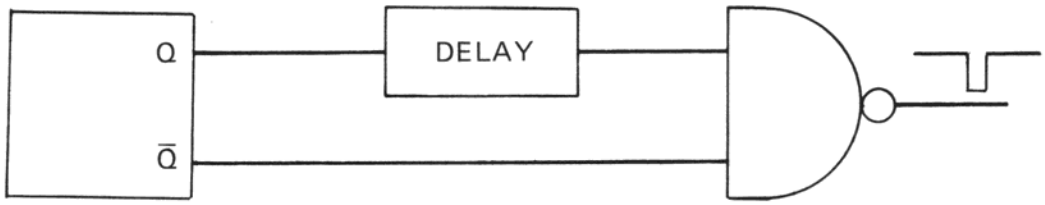
NAND flip-flops are used in the CHANNEL SELECTOR of the SBE-32CB.



D-FLOP

State of D input is transferred to Q output as clock input goes from low to high.

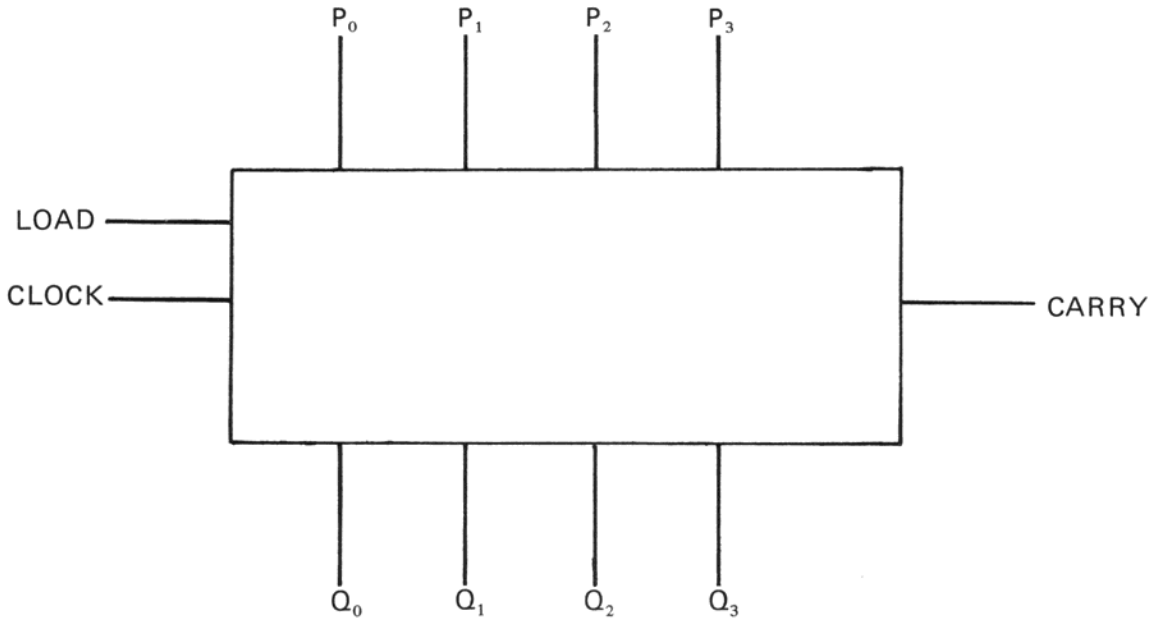
If the $\overline{Q}$ output of a D-FLOP is connected to the D input, the Q and $\overline{Q}$ will change states on every other clock pulse. The flop will "toggle" or divide-by-two, that is, it will put one pulse out Q or $\overline{Q}$ for every two clock pulses. Two D-FLOPS are cascaded to form a divide-by-four in the SBE-32CB SYNTHESIZER (IC-7).

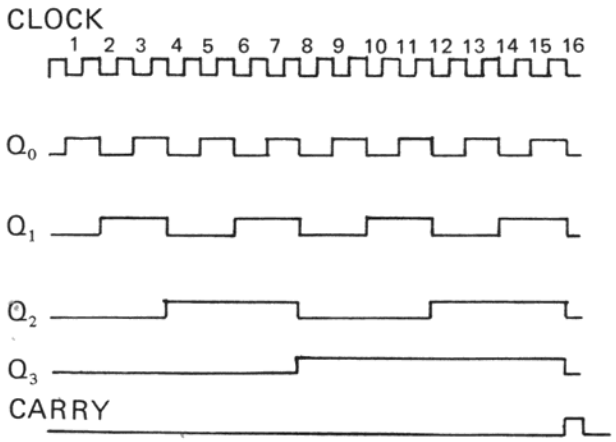


Pulse Forming

When the FLOPs $\overline{Q}$ output goes high, the NAND gate's inputs are both high for the length of the delay during which a low pulse is generated at the output of the NAND gate. The delay can be produced by a capacitor or by the propagation delay of logic elements.

The output of REFERENCE DIVIDER in the SYNTHESIZER of the SBE-32CB forms a pulse by the D-FLOP outputs IC-7 pins 8 & 9 which feed a NAND gate in IC-8. C157 delays the pulse out of pin 9. The propagation delay of four NAND gates (IC-14) in the CHANNEL SELECTOR is used in conjunction with either FF-1 or FF-2 to form the UP or DN pulses respectively.





BINARY COUNTER

Each positive pulse causes Q_0 to change states. Every other pulse changes Q_1 etc. (See chart at left.)

PRESET COUNTERS can be loaded with the P_0, P_1, P_2, P_3 input which then appears on the respective Q outputs.

UP DOWN COUNTERs have two clock inputs — one for counting up and the other for counting down.

Binary counters are used in both the SYNTHESIZER and CHANNEL SELECTOR. Preset counters are used in the PROGRAMMABLE DIVIDER section of the SYNTHESIZER. An up-down preset counter is used in the CHANNEL SELECTOR to count channels.

A ROM (READ ONLY MEMORY) is an IC having a defined set of outputs for each set of inputs. ROMs are used in the CHANNEL SELECTOR.

4.2 INTRODUCTION

The SBE-32CB is an AM transceiver with dual-conversion receiver using 10.7 MHz and 455 KHz IFs.

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

4.3 RECEIVER

GENERAL

In receive mode, the RF signal is fed from the antenna to the RF AMP Q1. The amplified RF signal is then fed to Q2 – the 1st MIXER – where it is mixed with an injection signal 10.7 MHz below the receive channel frequency. T2 and C113 select the 10.7 MHz 1st IF which is then fed to the 2nd MIXER D2 together with an injection signal 455 KHz lower. Ceramic filter FIL-1 selects the 455 KHz 2nd IF which is then fed to 1st and 2nd IF amplifiers Q3 and Q4. The amplified IF signal is then fed to S METER detector D11, AGC detector D6 and D7, and AUDIO detector D8 and D9. After passing through the AUTOMATIC NOISE LIMITER, the detected audio signal is fed to the wiper of potentiometer VR1 – the volume control. The audio signal developed on the top of VR1 is fed to the tone control network C201, C202, R201 and VR4 which then feeds the first audio amplifier stage Q14. The output of Q14 feeds the audio driver Q15 which is transformer coupled to push-pull speaker amplifier Q16 and Q17.

AUTOMATIC GAIN CONTROL

The AGC reduces the gain of the 1st IF amplifier Q3 in response to a strong signal by lowering its bias voltage. The rectified output of D6 and D7 is filtered by R119 and C126 to produce the AGC voltage which is then fed through R113 to the base of Q3.

AUTOMATIC NOISE LIMITER

The ANL circuit prevents impulse noise, such as ignition noise, from being amplified. The audio output voltage from the detector diodes D8 and D9 is attenuated to about 1/3 by voltage divider R120 and R121 and fed to the cathode of D10 – the ANL diode. The audio output from the detector is also fed through R122 to C132 where it is filtered and then fed through R123 to the anode of D10. Since the audio signal is positive, the signal at the anode of D10 is normally more positive than the cathode and the diode is forward biased providing a low impedance path for the audio. When a noise pulse appears in the output of the detector, the time constant of R123 and C132 prevents the anode from responding as fast as the cathode. The cathode of D4 is thus driven more negative than the anode causing D10 to become reversed biased. D10 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 VR3. The 2nd IF signal is AC coupled from the secondary of T6 through C301 to the cathode of D15. A DC bias is applied to the signal from the wiper on VR3. An IF signal

thus produces a negative voltage at the base of Q11 which tends to turn it off. When Q11 is turned off, Q12 is turned on and Q13 is turned off. With Q13 off, the audio amp Q14 is properly biased to amplify audio. Moving the wiper on VR3 so as to make the DC component more positive, turns Q11 and Q13 on. Q13 then back biases Q14 and shuts the audio off. Thus moving the wiper on VR3 more positive increases the threshold level a signal must overcome to "break squelch" – turn Q11 off and permit Q10 to amplify audio.

S METER

The S METER indicates the relative strength of the RX signal. The IF signal from T6 is rectified by D11, filtered by C803 and fed through S METER ADJ VR7 to meter M-1.

4.4 TRANSMITTER

GENERAL

The output of the VOLTAGE CONTROLLED OSCILLATOR Q21 (16-17 MHz see Table 5-5) is fed to Q22 – the 1st VCO BUFFER – and then to Q23 – the 2nd VCO BUFFER. The output of Q23 is fed to the TX MIXER Q5 together with a 10.2381 MHz signal from the REFERENCE OSCILLATOR Q9. The sum of the frequencies is selected and fed to the TX BUFFER Q6. The output of Q6 is fed to the TX DRIVER Q7 and then to the TX FINAL Q8. Modulation is accomplished by feeding the MIC output to the audio amplifier Q14, Q15, Q16 and Q17, and taking modulated B+ from the bottom secondary of the audio output transformer T9 and using it to drive Q7 and Q8 – the TX DRIVER and FINAL.

AUTOMATIC MODULATION LIMITER

The AML regulates the gain of the audio amplifier so as to accommodate a wide range of voice levels. The audio output signal is fed from the bottom secondary of T9, the audio output transformer, through D19, C213 and AML ADJ VR9. D17 rectifies the signal, and R207 and C206 filter it producing an average DC level which is fed to the emitter of Q14 – the 1st AUDIO AMP. As the sound level into the MIC increases, this DC level will increase and reduce the gain of the audio amplifier.

RFO METER

The RFO METER indicates TX power output. TX RF is sampled from the antenna by C801. The RF is then rectified by D12, filtered by C802 and fed through RFO METER ADJ VR6 to meter M-1.

PA GAIN

The PA GAIN circuit permits the MIC input level to be varied in PA mode, but not in TX mode. In TX mode, the positive voltage, developed on C802 to drive the RFO meter, is fed through R901 to the base of Q901. Q901 is turned on, forward biasing D901 while Q902 is turned off, reverse biasing D902. Thus the audio signal from the MIC in TX mode is fed through C903, D901, C217, D16 to the base of Q14 – the 1st AUDIO AMP. In PA mode D901 is reverse biased while D902 is forward biased. The MIC signal is then fed through PA GAIN adjust VR2 before being fed to the audio amplifier.