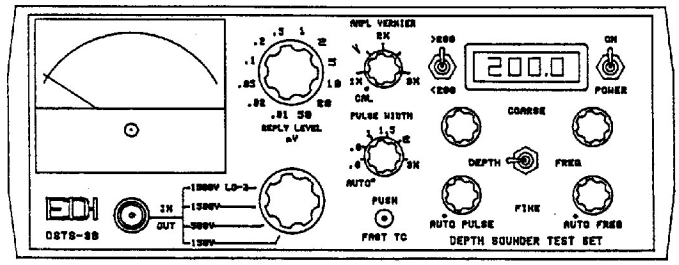
DSTS-3B

Depth Sounder Test Set

INSTRUCTION MANUAL



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DSTS-3B DEPTHSOUNDER TEST SET OPERATOR'S MANUAL

1.0 **INTRODUCTION**

The DSTS-3B is a full-featured test set designed for use with all types of echo sounders from small flashers to large commercial sonar units.

It is capable of measuring all parameters critical to the performance of depth sounders, including:

- -Output pulse voltage to 1500 V p-p.
- -Output pulse frequency from less than 20 kHz to 360 kHz.
- -Output pulse width from 200 usec to 100 msec
- -Receiver sensitivity from 10 uV to 150 mV.
- -Receiver tuning and bandwidth measurements.
- -Accuracy of depth sounder calibration.

In addition, the unit will supply a train of pulses at a selected frequency for testing the sounder's receiver section with its transmitter inoperative.

2.0 **SUMMARY OF FRONT PANEL FUNCTIONS** (refer to Figure 1 for control locations)

2.1 Meter

The **meter** has two scales to match ranges selected by the range switch. The meter is calibrated to read peak-to-peak voltage present at the I/O connector. Overload protection for brief applications of input voltages of 3 KV is provided on all ranges.

2.2 Range Switch

The **range** switch selects both the meter range and the input impedance present at the I/O (Input/Output) connector. The highest impedance is selected for the 150 V range with correspondingly lower impedances selected at higher voltage ranges. A listing of these impedances is provided in the specifications section.

2.3 I/O connector

The transducer port of the depth sounder under test is connected to this BNC connector.

2.4 Reply Level Attenuator

The reply level attenuator switch selects the amplitude of the reply pulse returned to the sounder. It is calibrated in mV RMS

and has a range of 10 uV to 50 mV.

2.5 Reply Level Vernier

The reply level vernier control is used to interpolate between the settings on the step attenuator. It will multiply the output signal up to 3 times, giving a maximum output of 150 mV RMS. For example, if the attenuator is set to .5 mV and the vernier is set to 1.5, then the reply level would be .5 x 1.5 = .75 mV.

2.6 Pulse Width Control

The DSTS will track the transmitted pulse width of the sounder under test. When the pulse width is set to the auto position, the DSTS will always reply with a pulse that is 1.5 times the length of the incoming pulse. Rotating this control clockwise (CW) from the auto position allows the reply pulse to be set from .6 to 3 times the length of the received pulse.

2.7 Depth Range Switch

This switch selects the depth range for the set. When it is in the < 200 ft. range it allows the depth to be set from 0 to approximately 200 feet by the depth controls. Most importantly, it sets the digital display to read tenths of a foot.

When it is in the >200 foot position, it sets the display to read in whole feet up to 9000 feet.

2.8 Display Switch

The display switch selects either depth or frequency to be displayed. Frequency is displayed to the nearest .1 kHz.

2.9 Depth Controls

The coarse and fine depth controls set the time delay (depth) of the reply echo to the sounder under test. The fine control gives about a 10% vernier range from the setting of the coarse control. To display the depth, flip the display switch towards the depth controls.

2.10 Auto Pulse

When the fine depth control is rotated counter-clockwise (CCW) until it clicks, it will place the DSTS into the auto pulse mode.

To use the auto pulse mode, the fine frequency control must also be rotated CW out of the auto freq position and the desired reply frequency selected. The display will automatically switch to the frequency mode.

The DSTS will now supply a train of pulses at the selected frequency for test or alignment of the depth sounder's receiver section without the transmitter section being active.

2.11 Frequency Controls

These controls are only active when the fine frequency control is rotated CW away from the auto freq position.

They allow the reply frequency to be manually set to check receiver bandwidth or for spurious responses.

Use the display switch to select the frequency readout when setting frequency manually. The fine frequency control gives about a 10 % vernier range from the setting of the coarse frequency control.

2.12 Auto Frequency

When the fine frequency control is rotated CCW into the auto frequency position, the DSTS will automatically reply at the same frequency as the transmitted pulse from the sounder.

The rate at which the frequency slews to the correct value depends on the pulse width and repetition rate of the sounder. To speed up the acquisition of the frequency reading, temporarily press the fast TC button of the front panel.

High repetition rate and long pulses will cause the frequency to slew to the correct value rapidly while short pulses or low repetition rates will cause a slow slew rate and will take a longer time for the frequency readout to settle.

2.13 Fast TC Button

The fast TC button greatly decreases the time required for the DSTS to lock onto the correct frequency. This is accomplished by decreasing the loop time constant markedly when the fast TC button is pressed. Allow several seconds to elapse after pressing this switch for the reading to stabilize.

2.14 Power Switch

The power switch turns the DSTS off and on. The display serves as an indicator that power is on.

3.0 **SUMMARY OF REAR PANEL FUNCTIONS** (refer to Figure 2)

3.1 Power Source

Any source of power between 10 and 15 VAC or 12 and 18 VDC

capable of supplying more than 220 mA is adequate. The shell of the power connector is negative. The center pin is positive.

If more than 22 V is applied, the fuse will blow. An internal zener diode provides over-voltage protection for the instrument.

3.2 Fuse

A 3 AG type 1/2 A fuse is required. Slow blow fuses should not be used. To remove the fuse, insert a pointed object into the hole at the top of the fuse holder. The fuse cap will then spring out.

4.0. **INITIAL SET UP AND CHECKOUT PROCEDURE**

4.1 Equipment Required

A simple flasher or chart recorder which is known to be in working condition and has an unbalanced output (single center conductor coax output) is easiest to use for first-time operation of the DSTS. More complex balanced output hookups will be dealt with later.

4.2 Connection to the Depth Sounder

Connect the 12 VAC wall transformer to the power jack on the rear panel of the DSTS.

Connect a test cable from the I/O jack of the DSTS to the transducer output of the sounder.

4.3 Control Settings

Set the controls to the following positions:

Range:	500 V
Pulse Width:	Auto
Reply Level:	50 mV
Vernier:	Cal
Depth range:	<200 Ft
Coarse Depth:	9 o’clock
Fine Depth:	Mid range
Fine Freq:	Auto Freq
Display:	Either depth or freq
Power:	On

4.4 Operational Test

Turn on the depth sounder. The meter should move up range. Try to choose a setting that keeps the meter between 10 and 90% of full scale. This enables the frequency-tracking circuits to perform at their best.

Select the frequency position of the display switch. The frequency readings will update every time the sounder transmits a pulse to the test set. After several seconds, the reading should stabilize at the correct frequency for the sounder under test. Press the fast TC button temporarily to speed up acquisition of the frequency.

Flip the display switch to the depth position and rotate the fine and coarse depth controls for the desired return echo depth.

Note that the reading updates each time the sounder pulses.

To check the sensitivity of the depth sounder, decrease the reply level step by step until the echo disappears, then increase the vernier control until the echo just re-appears. The sensitivity is the product of the vernier and step attenuator control settings.

A small flasher will usually put out between 80-400 V P-P and have a sensitivity of between .1 to 2 mV.

This completes the preliminary operational check of the DSTS-3B.

5.0 **FREQUENCY MEASUREMENTS**

5.1 Display Settling Time

The speed with which the frequency display reaches the actual value depends on the pulse repetition rate and duty cycle of the depth sounder being tested.

The DSTS-3B uses a sampled phase-locked loop (PLL) to read and store pulse frequency.

With a very short pulse, only a few cycles are present for the PLL to use. Therefore, the reading will approach the correct value slowly.

The reverse is true when depth sounders with high rep rates and comparatively long pulses are used. The reading will approach the correct value rapidly.

The fast TC button will decrease the loop time constant while depressed, thereby speeding up the acquisition of the correct frequency.

When the correct frequency is reached, the reading will oscillate slightly around the correct value.

5.2 Other Factors Affecting Frequency Readings

The output frequency of many smaller depth sounders is somewhat sensitive to the load impedance at their output. It is therefore not uncommon to notice a frequency change of several percent when switching the DSTS range selector.

If the transducer impedance is known, choose the voltage range with the closest impedance match. This will give the most accurate frequency reading.

A listing of the DSTS internal load impedances versus the range switch setting may be found in the specifications section.

5.3 Accuracy of Readings With Narrow Pulses

When reading the frequency of depth sounders using very narrow transmitted pulses, the frequency reading will read a few percent lower than the correct value. This error may be compensated for by utilizing the graph in figure 5.

To use this graph, first calculate the number of cycles present in the pulse. The number of cycles present can be found by mu1tip1iying the pulse frequency times the pulse width. Next, find the approximate number of cycles on the horizontal axis of the graph and read the correction factor from the left side of the graph. The actual frequency may be calculated by the following formula:

Correct frequency = (frequency reading) X (correction factor).

For example, a sounder with a frequency of approximately 200 kHz and a 100 uS pulse width will have 20 cycles in the pulse. From the graph, the correction factor is 1.007. If the frequency reading was 199.4 khz, then the correct frequency would be = (199.4) X (1.007) or 200.8 kHz.

5.4 Manual Frequency

The output frequency may be selected manually by rotating the fine frequency knob CW from the auto freq position.

Switch the display to the frequency position and set the frequency as desired.

The bandwidth of a depth sounder may be checked by rocking the frequency about the correct value for the depth sounder and noting the change in sensitivity. The bandwidth of most inexpensive sounders is very wide, occasionally on the order of 50 to 100 kHz for a 200 Khz sounder.

6.0 **SENSITIVITY MEASUREMENTS**

6.1 Minimizing Noise Pick up

Most of the more expensive depth sounders use balanced outputs to reduce common mode noise pickup from shipboard electrical sources.

The DSTS-3B has a single-ended input. If it is simply connected to the output pins of balanced lines with no shield ground, enough noise will be introduced to make sensitivity checks difficult if not impossible. To reduce the noise pickup, one side of the balanced line must be grounded.Refer to Figure 3 for more information on connecting the DSTS-3B to these types of sounders.

6.2 Sensitivity Check

With the DSTS-3B properly connected, set the reply level to 50 mV and select a depth of about 30 feet or more to ensure that any time variable gain circuit is inactive.

Decrease the reply level until the echo reading disappears. The amplitude vernier should then be rotated CW until the echo just reappears. The sensitivity is the product of the reply level attenuator and the amplitude vernier.

High-quality recorders will often have sensitivities as high as .01 mV. Small flashers may be as low as 10 mV.

6.3 Bandwidth Check

A quick check of the receiver tuning and bandwidth may be made by going to the manual frequency mode and checking the variation in sensitivity with a change in reply frequency.

Generally, recorders will have much narrower bandwidths than flashers.

7.0 **OUTPUT POWER MEASUREMENT**

7.1 Output Voltage Readings

For the most accurate voltage reading, select a range where the meter will read between 10 and 90% of full scale.

Allow enough time for the meter to settle when switching ranges. This is necessary as the time constant is very long to allow accurate readings of low repetition rate pulses.

Remember the meter reads peak-to-peak output voltage.

Voltage readings will also change when changing ranges due to

changes in the load impedance.

Peak power may be computed by the following formula:

$$\frac{(V\ P\text{-}P/2.82)2}{\text{LOAD IMPEDANCE}}$$

Load impedance depends on the range switch setting. Values are listed in the specifications section.

The computed value may differ considerably from the manufacturer's specifications unless the load impedance is the same as the transducer normally used with the depth sounder.

7.2 Pulse Width

The transmitted pulse width of the sounder under test may also be measured.

To do this, connect the DSTS-3B to the depth sounder in the normal manner. Set the depth range switch to the < 200 position and rotate the depth controls to the minimum (max CCW) position but not to the Auto Pulse position.

Note the depth reading and divide it by 2.4. The result is the width of the transmitted pulse in milliseconds.

$$PW\ (mS) = \frac{\text{DEPTH READING}}{2.4}$$

8.0 **DEPTH CALIBRATION MEASUREMENTS**

The DSTS-3B uses a crystal-controlled time base for all frequency and depth measurements. Therefore, very accurate calibration may be done for survey recorders or other critical units.

The speed of sound in water varies from about 4700 FPS in fresh water to 4900 FPS in salt water.

The reference used in the DSTS-3B is 4800 FPS, the standard for the English system of measurements.

Therefore, if a sounder is to be calibrated for a different propagation velocity, an appropriate correction must be made to the depth setting on the DSTS-3B.

The formula is: $$\text{DEPTH SETTING} = \frac{\text{CAL DEPTH X 4800}}{\text{PROPAGATION VELOCITY}}$$

FOR EXAMPLE: Suppose a survey recorder is to be calibrated for a propagation velocity of 4920 FPS and a calibration

mark is to be made at 50 feet.

CAL DEPTH = 50 FT
PROPAGATION VELOCITY = 4920
DEPTH SETTING = $50 \times \frac{4800}{4920} = 48.78$

Therefore, set the DSTS-3B to 48.8 feet and adjust the sounder to read 50.0 feet.

9.0 **AUTO PULSE OPERATION**

The auto pulse mode provides a series of output pulses at a manually selected frequency.

To operate in this mode, the fine depth must be maximum CCW to the auto pulse position and the fine frequency must be clockwise from the auto frequency position.

The display switch is automatically disconnected and the display will only read frequency when in auto pulse mode.

The auto pulse mode will allow receiver repairs to be made with the transmitter rendered inoperative.

This is often handy as the motor can be disconnected in a flasher or recorder, eliminating the danger of the rotor or belt catching a finger or test probe while troubleshooting.

The pulse repetition rate is about 20 pulses per second with a width of .2 msec.

On some flashers, this high repetition rate may tend to overload the lamp driver circuitry if the gain is set too high. Consequently caution should be observed on this point.

10.0 **SPECIFICATIONS**

DEPTH CALIBRATION RANGE

Dual range 1 to 200.0 feet or 40 to 9000 feet continuously variable. with vernier adjustment. Accuracy: +/- 1 digit on display. Calibrated for 4800 FPS sound velocity.

FREQUENCY RANGE

20 kHz to 360 kHz, automatically tracked or manually set. Usable to less than 10 kHz.

ACCURACY

Accuracy is .1% +/- 1 digit in automatic mode, and +/- 1 digit in the manual frequency mode.

PULSE WIDTH TRACKING

Automatically tracks pulses from .1 msec to 100 msec in width with an accuracy of 1%.

REPLY LEVEL

Calibrated reply pulse amplitude from 10 uV to 50 mV. Accuracy of 5%.

METER RANGE

0-150-500-1500 volts peak-to-peak. Accuracy of 5% for pulses greater than .1 msec duration.

INTERNAL LOAD

Coupled with meter range switch.

0-150 V P-P range: 2.2 kilohms and 470 pF
0-500 V P-P range: 560 ohms and 1000 pF
0-1500 V P-P range: 330 ohms and 4700 pF
0-1500 V lo Z range:150 ohms and 10,000 pF

POWER REQUIRED

12-18 V DC or 11-15 V AC @ 220 MA nominal.
120 V plug transformer supplied for line operation.

OPTIONS AVAILABLE:

BP-1 Rechargeable Battery Pack: A ni-cad battery pack which is internally installed underneath the top cover of the DSTS-3B test set.

Charging is done automatically when the DSTS-3B AC power supply is connected. Charging time for a completely discharged battery is about 30 hours.

Occasionally, the DSTS-3B battery pack should be cycled by using the unit on internal power for 2-3 hours or until discharged,followed immediately by a full 30-hour charge.This will ensure that the ni-cads will remain at full capacity throughout their useful lifetime.

Since the charging current fed to the battery pack is related to the voltage present at the DSTS-3B rear panel power connector, the DSTS-3B should only be used with the AC power supply provided with the unit.

Option T(Trigger) provides a positive going +lOV pulse which occurs every time the DSTS-3B receives a pulse from the depth sounder under test. The width of the pulse is the same as the width of the input pulse.

Option G (Gate) provides a positive going +8V pulse which occurs

every time the DSTS-3B transmits a reply pulse. The width of the pulse is identical to the reply pulse width.

Option M (Meter) provides an external voltage which is proportional to the amplitude of the pulse received from the depth sounder under test. The output voltage range is 0 to +SV which corresponds to full scale deflection of the front panel meter. Source impedance is lK ohm.

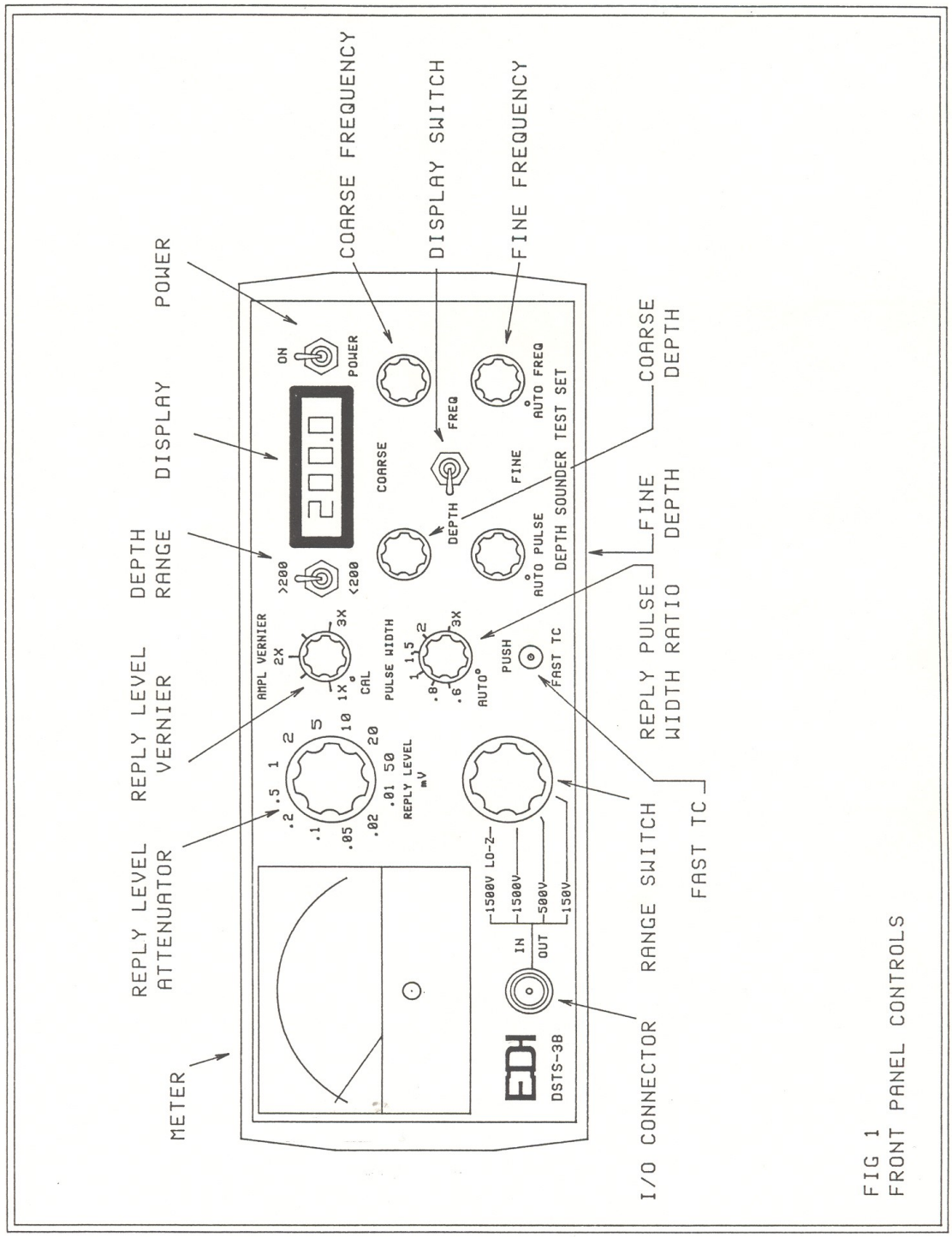

FIG 1
FRONT PANEL CONTROLS

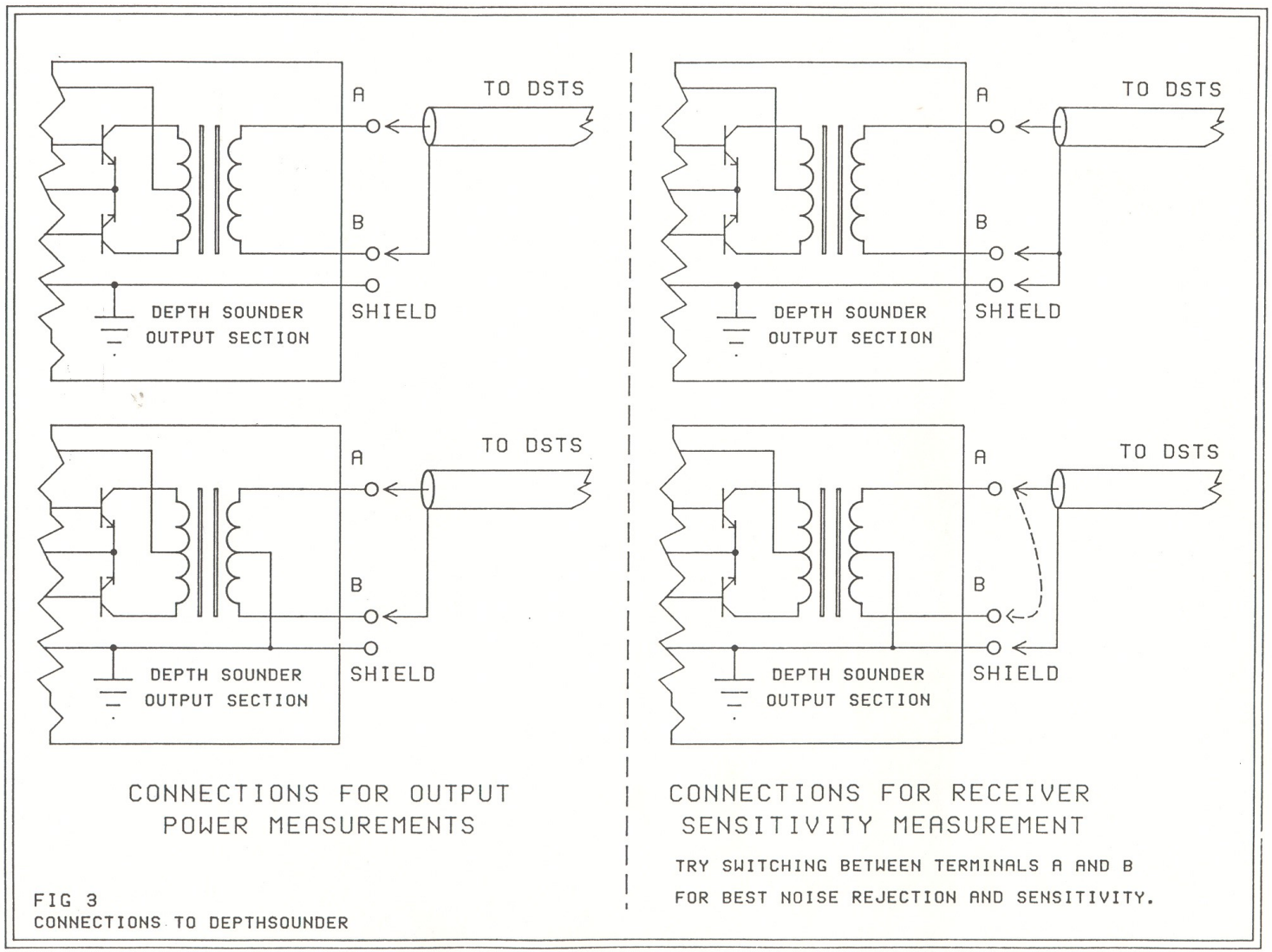

FIG 3
CONNECTIONS TO DEPTHSOUNDER

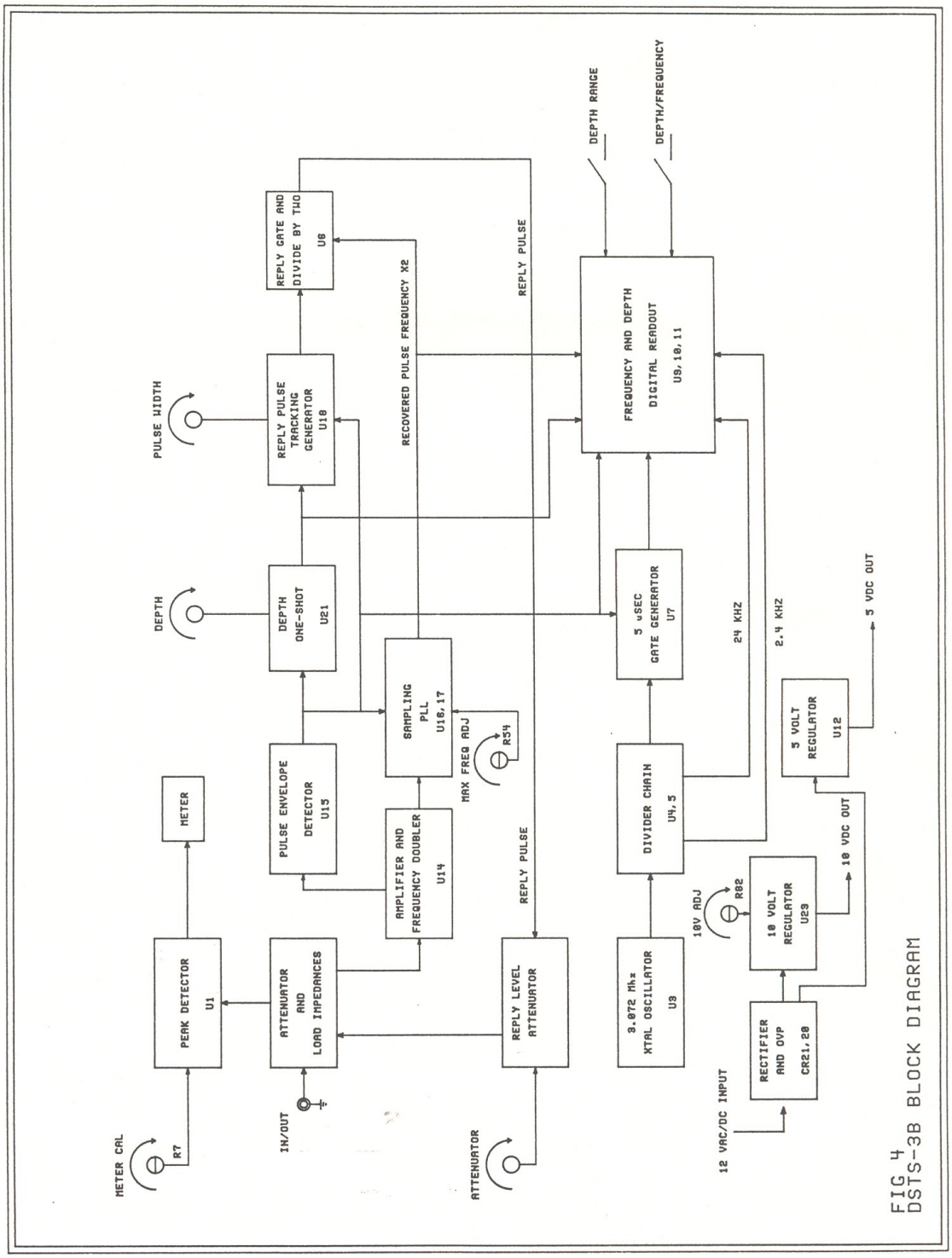

FIG 4
DSTS-3B BLOCK DIAGRAM

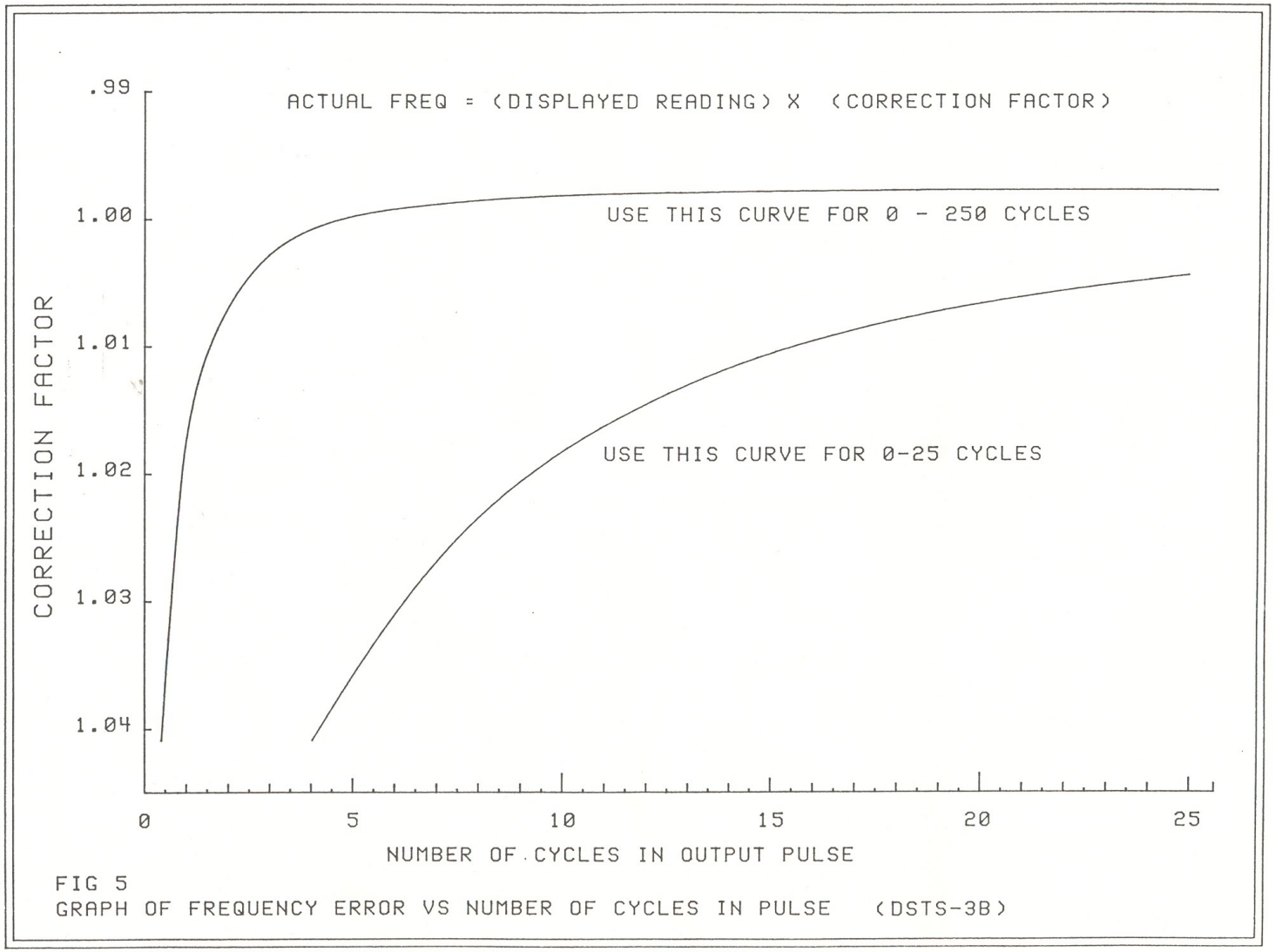

FIG 5
GRAPH OF FREQUENCY ERROR VS NUMBER OF CYCLES IN PULSE (DSTS-3B)