

AD-768 860

SUBMARINE POWERED, SUBMARINE TRACKING
PINGER

Wiley S. Olsen

Texas University

Prepared for:

Naval Ordnance Laboratory

21 August 1973

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

AD 768860

THE UNIVERSITY OF TEXAS AT AUSTIN

ARL-TM-73-25
21 August 1973

Copy No. 15

SUBMARINE POWERED, SUBMARINE TRACKING FINGER

Wiley S. Olsen

NAVAL ORDNANCE LABORATORY
Contract N60921-73-C-0107
Project CAPTOR



Part of the
NATIONAL TECHNICAL
INFORMATION SERVICE

APPROVED FOR PUBLIC
RELEASE, DISTRIBUTION
UNLIMITED

D L S
R E S E A R C H
R O Y & C O
R E S E A R C H
E

17

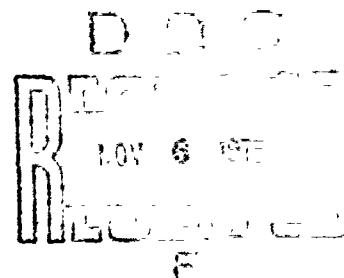
ARL-TM-73-25
21 August 1973

SUBMARINE POWERED, SUBMARINE TRACKING PINGER

Wiley S. Olsen

This work has been sponsored by Naval Ordnance Systems Command
under Contract N60921-73-C-0107, Project CAPTOR,
with Naval Ordnance Laboratory

APPROVED FOR PUBLIC
RELEASE, DISTRIBUTION
UNLIMITED.



APPLIED RESEARCH LABORATORIES
THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS 78712

ABSTRACT

The submarine powered, submarine tracking pinger was designed to provide a signal for accurately tracking the submarine when data are being recorded. The unit operates in synchronization with an on-shore receiver described in a separate report.

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1
II. FRONT PANEL DESCRIPTION	3
CHARGE	3
FUSE	3
SYNC IN	3
SYNC OUT	3
1 MHz OUT	3
BATT VOLTS	3
V OUT	3
I OUT	3
OUTPUT	3
P.A. ON-OFF	7
READY	7
PULSE	7
OSC ADJ	7
TRANSMITTED PULSE	7
Theory of Operation	7
Acknowledgements	14

I. INTRODUCTION

The submarine powered, submarine tracking pinger (SP-STP) is designed to mount on submarines to allow the submarine to be accurately tracked by a sonar system. The SP-STP is synchronized to a master clock and produces a pulse every 10 sec (or 5 sec if desired). There are two SP-STP units, which differ only in the precision of each of the 1 MHz oscillators. Unit I has an accuracy of 1 part in 10^{-9} and is the primary unit, and Unit II has an accuracy of 1 part in 10^{-8} and is the backup unit.

II. FRONT PANEL DESCRIPTION (See Fig. 1)

CHARGE--The charge lamp indicates when the battery is being charged.

FUSE--The unit uses a 1 A slo-blo fuse.

SYNC IN--The sync in connector allows a synchronization pulse from the master clock to be applied just prior to installation aboard the submarine.

SYNC OUT--The sync out connector allows the sync pulse generated within the unit to be monitored or used for synchronizing another unit.

1 MHz OUT--The internal 1 MHz clock frequency is brought to the front panel for easy monitoring.

BATT VOLTS--The battery voltage can be monitored by placing a voltmeter on this connector.

V OUT--The voltage output to the transducer cable can be monitored at this point.

I OUT--The current through the transducer is coupled through a transformer to the front panel.

OUTPUT--The output connector provides the 500 W of power to drive the transducer. The output is isolated from ground.

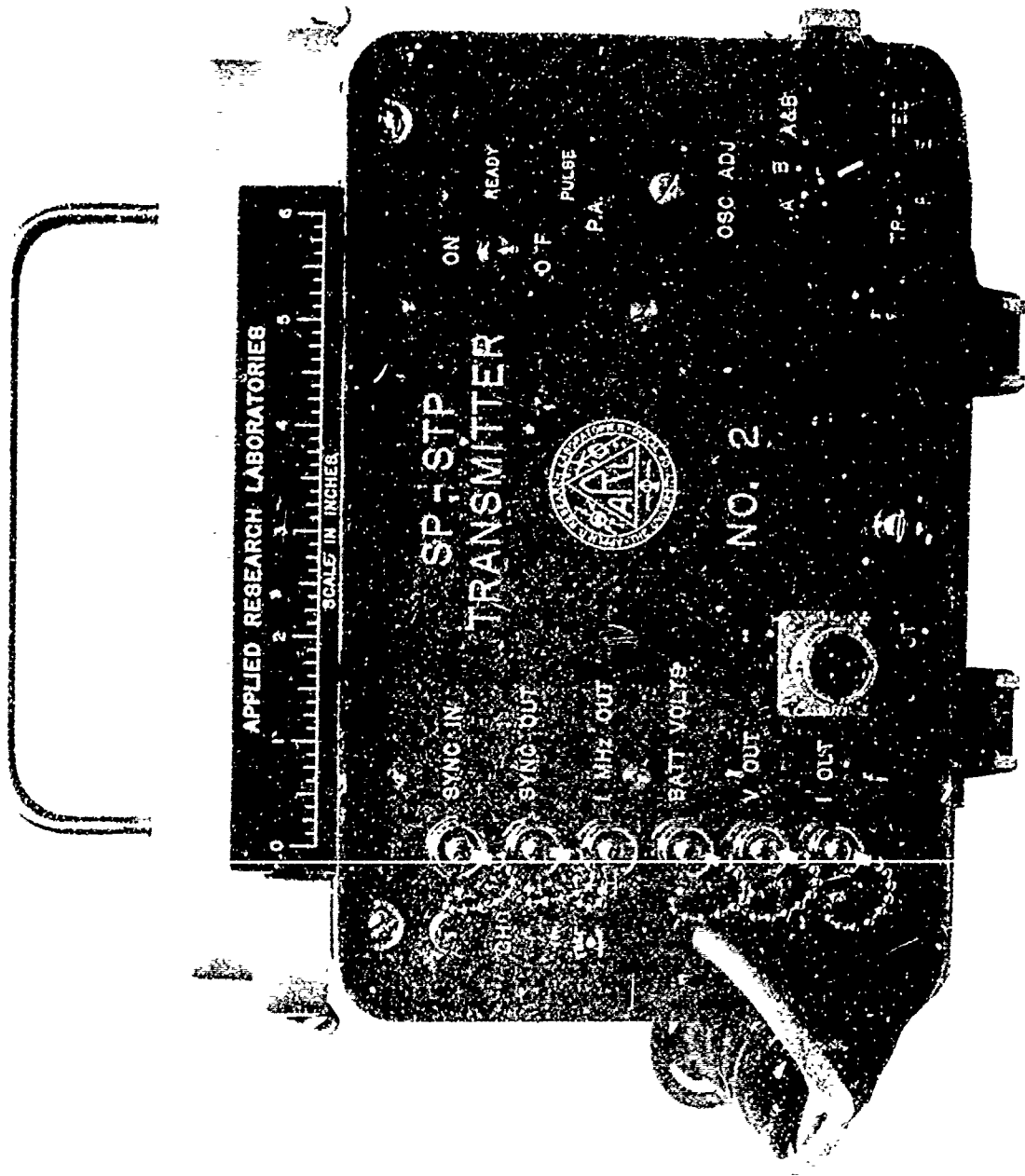


FIGURE 1
SP-STP FRONT PANEL

P.A. ON-OFF--The P.A. switch controls only the voltage to the power amplifier.

READY--The ready light begins to glow when the voltage on the power amplifier has built up to a suitable level for transmitting.

PULSE--The pulse light indicates each time a current pulse is applied to the transducer. The light glows brightly and then decays in about 1 sec.

OSC ADJ--The screw in the front panel can be removed to allow a tuning instrument to be inserted into the oscillator. The oscillator can then be adjusted to the frequency of the master clock oscillator.

TRANSMITTED PULSE--The SP-STP is capable of transmitting two identical pulses but offset in time. Pulse A is synchronized to the minute and is transmitted each 10 sec. Pulse B is delayed by 5 sec and the transmitter can transmit both pulses alternately, if desired, for a faster data rate.

Theory of Operation

The SP-STP is synchronized with a fixed position receiver and transmits a pulse periodically. The time delay between the time of transmission of the pulse and the time of arrival of the pulse is processed to determine the range and bearing of the submarine. The SF-STP transmits a 0.5 msec 19.23 kHz pulse which has a phase reversal at the end of 3 1/2 cycles. An exploded view of the SP-STP is shown in Fig. 2.

All signals are controlled by the 1 MHz oscillator. The 1 MHz signal is divided by a chain of CD4017AE dividers (see Fig. 3) to generate a 10 sec sync pulse and a 0 and 5 sec transmit start pulse. At the same time, the 1 MHz signal is divided by 26 to generate a 38.46 kHz signal which is twice the transmitted frequency.

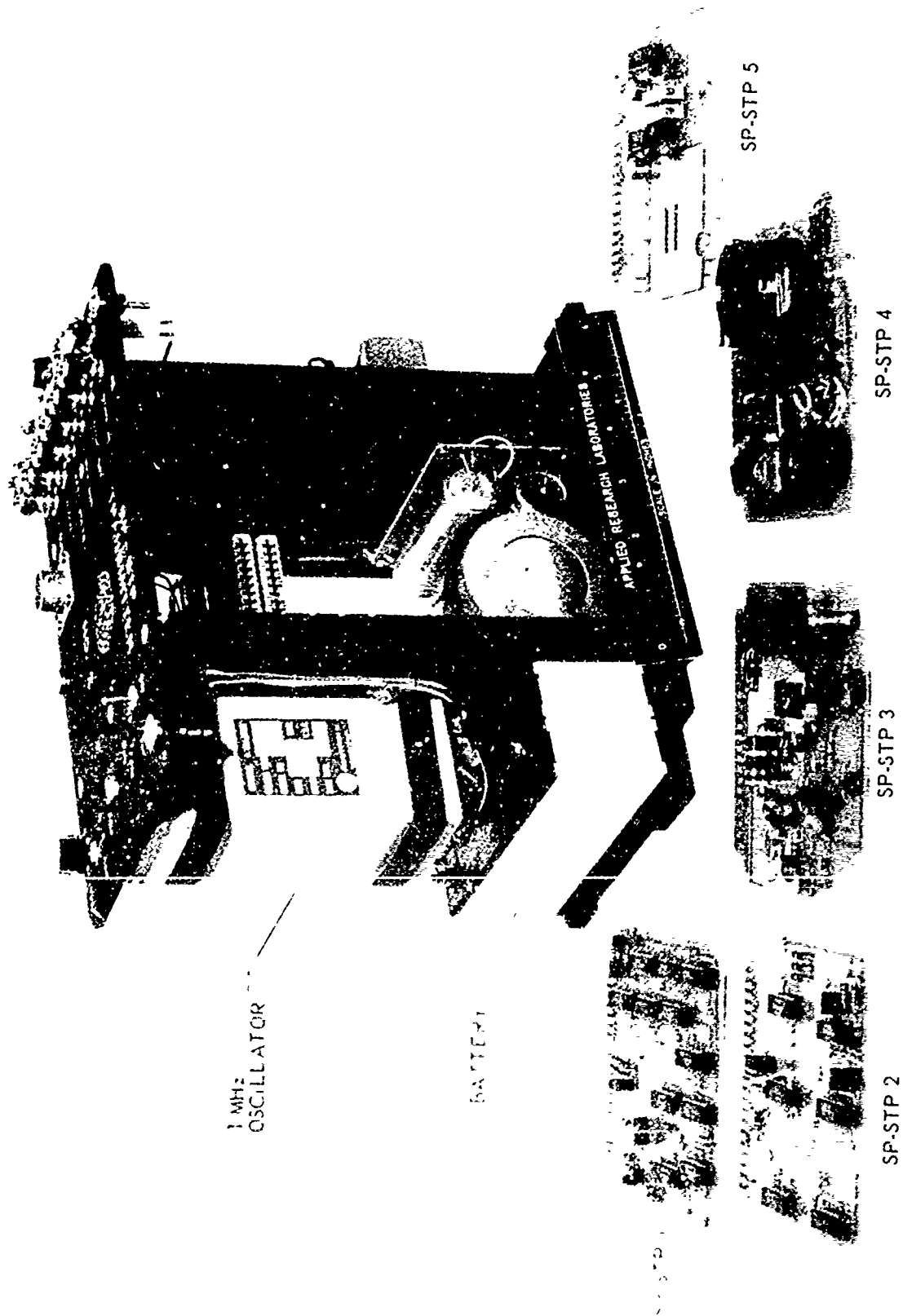


FIGURE 2
EXPLODED VIEW OF SP-STP

The 38 kHz and the 0 and 5 sec transmit start pulses go into the pulse generator circuit shown in Fig. 4. The 0 and 5 sec pulses generate the channel sync pulse which starts the output signal. The CD4017AE ends the transmit pulse when ten cycles of 19.23 kHz are counted. The flip-flop chip C divides the 38 kHz pulse by 2, providing two 19.23 signals 180° out of phase. During the first three cycles, one of the phases is gated to output 1 and the phase is reversed for the remaining seven cycles. Output 2 is a single pulse with a 0.5 msec duration, starting one-half cycle before output 1.

The outputs from outputs 1 and 2 are applied to the input of the summing integrator (Fig. 5) to generate the signal that has a 180° phase reversal after 3 1/2 cycles. The battery charger is also located on the SP-STP 3 board and maintains a 90 mA charge current into the battery. The battery is maintained on charge at all times except during transit to and from the submarine. During the time it is in transit the battery provides power for the digital clock circuit so that synchronization with the master clock is maintained. The battery will power the clock up to 12 hours.

The 500 W power amplifier, shown in Fig. 6, couples the signal through the power transformer to the transducer. The source level in the horizontal plane of the transducer was measured to be +202 dB re 1 μ Pa at 1 yd.

Figure 7 shows the 24 V regulator and the 12 V regulator, along with the 5 V switching regulator. (The 5 V switching regulator is left out of SP-STP II since the oscillator in SP-STP II operates from 12 V).

The wiring diagram of the SP-STP is shown in Fig. 8.

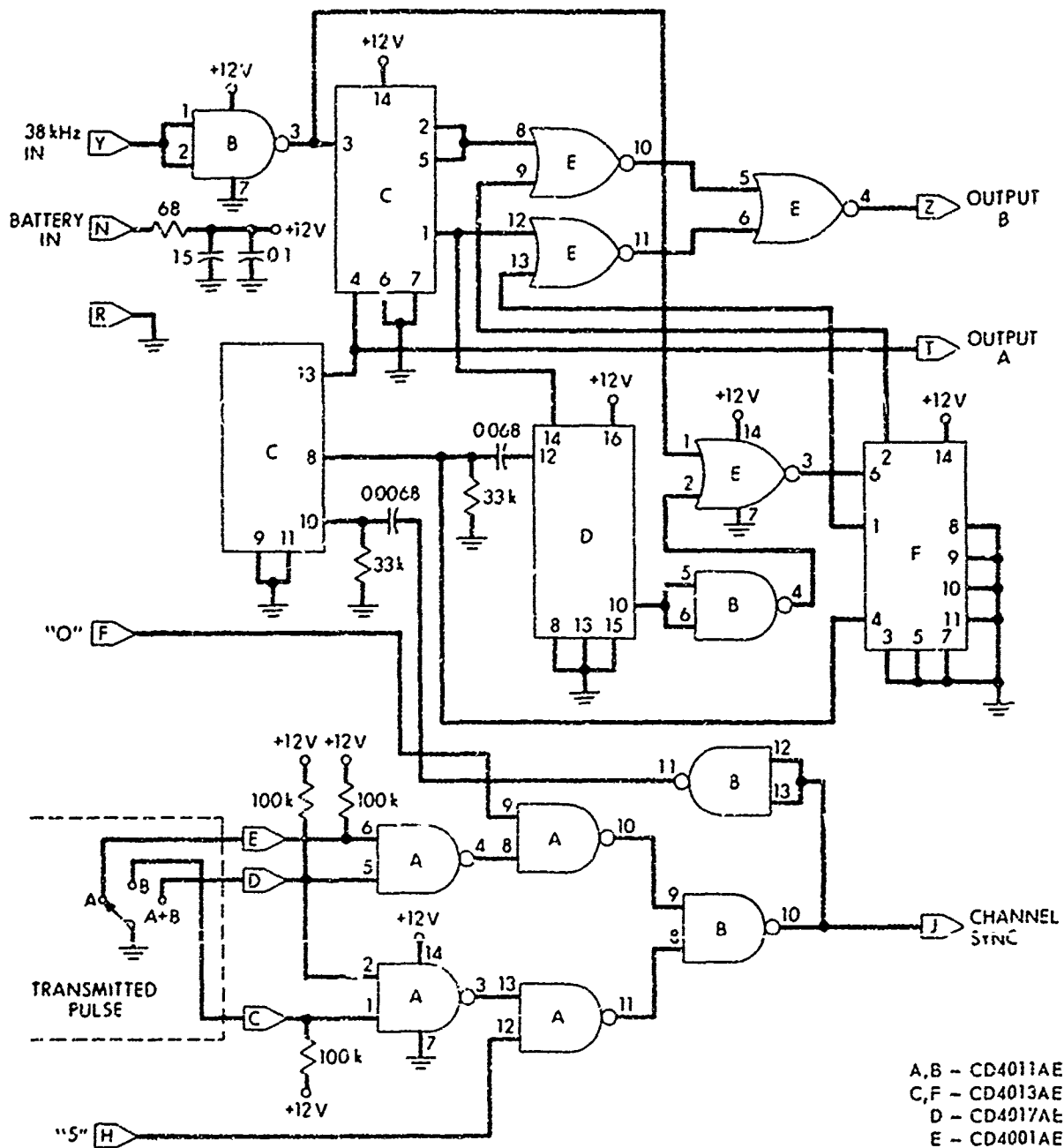


FIGURE 4
PULSE GENERATOR
SP-STP 2

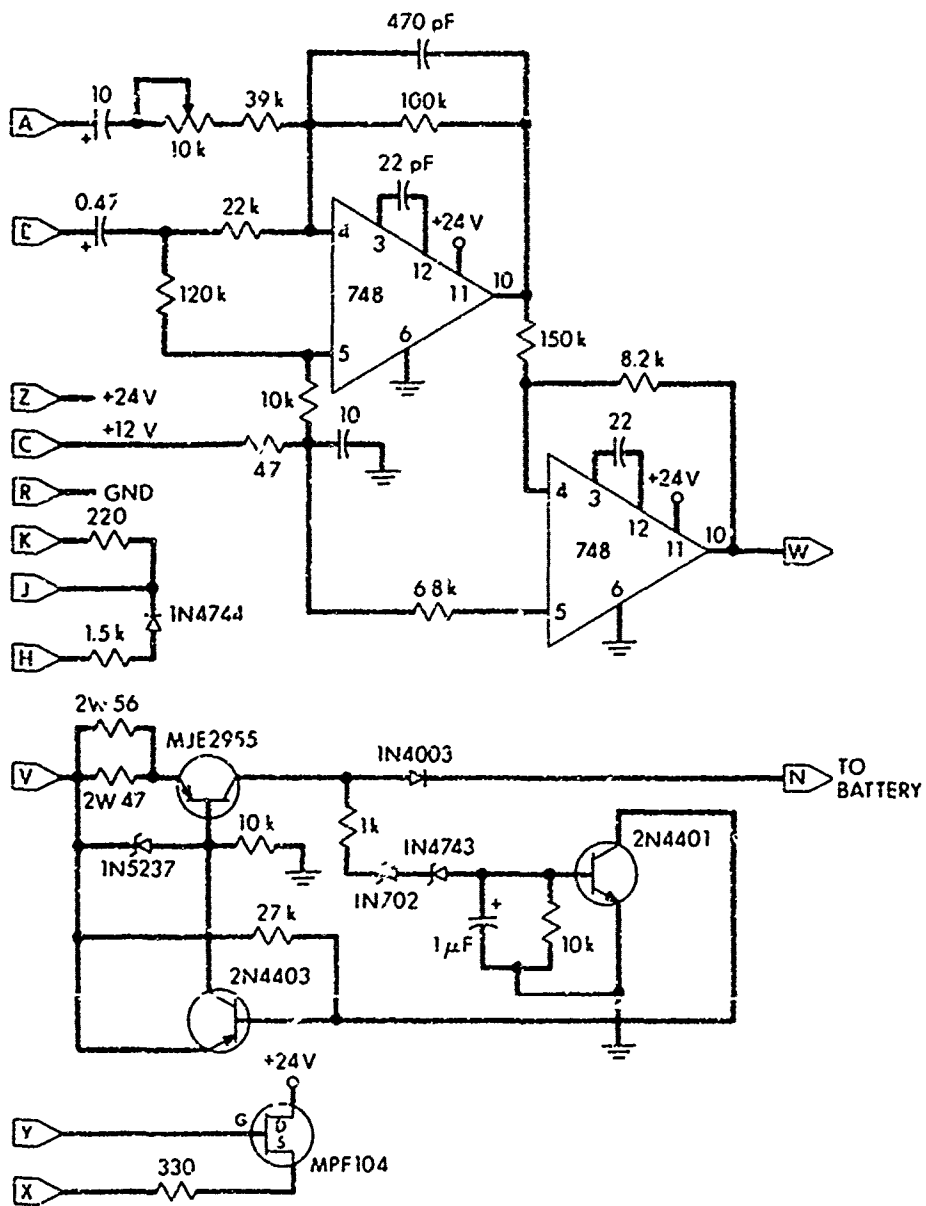


FIGURE 5
PULSE SHAPER AND BATTERY CHARGER
SP-STP 3

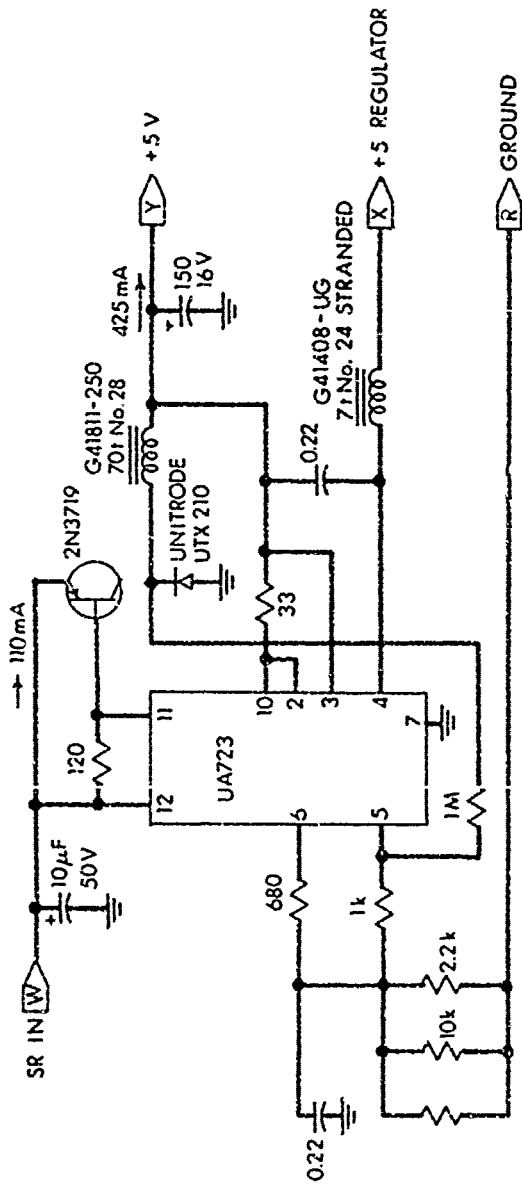
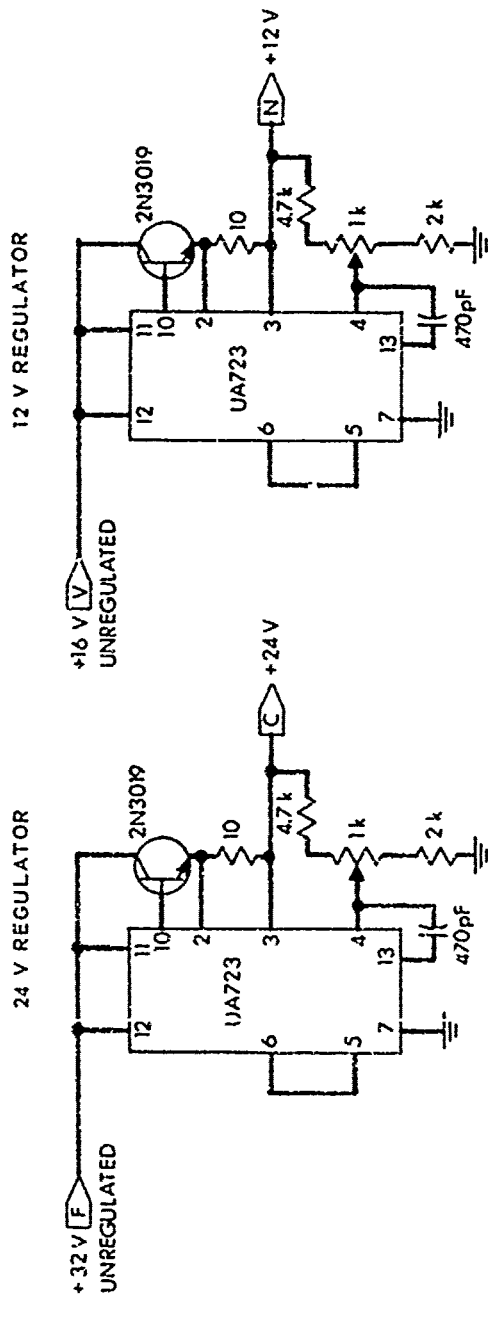
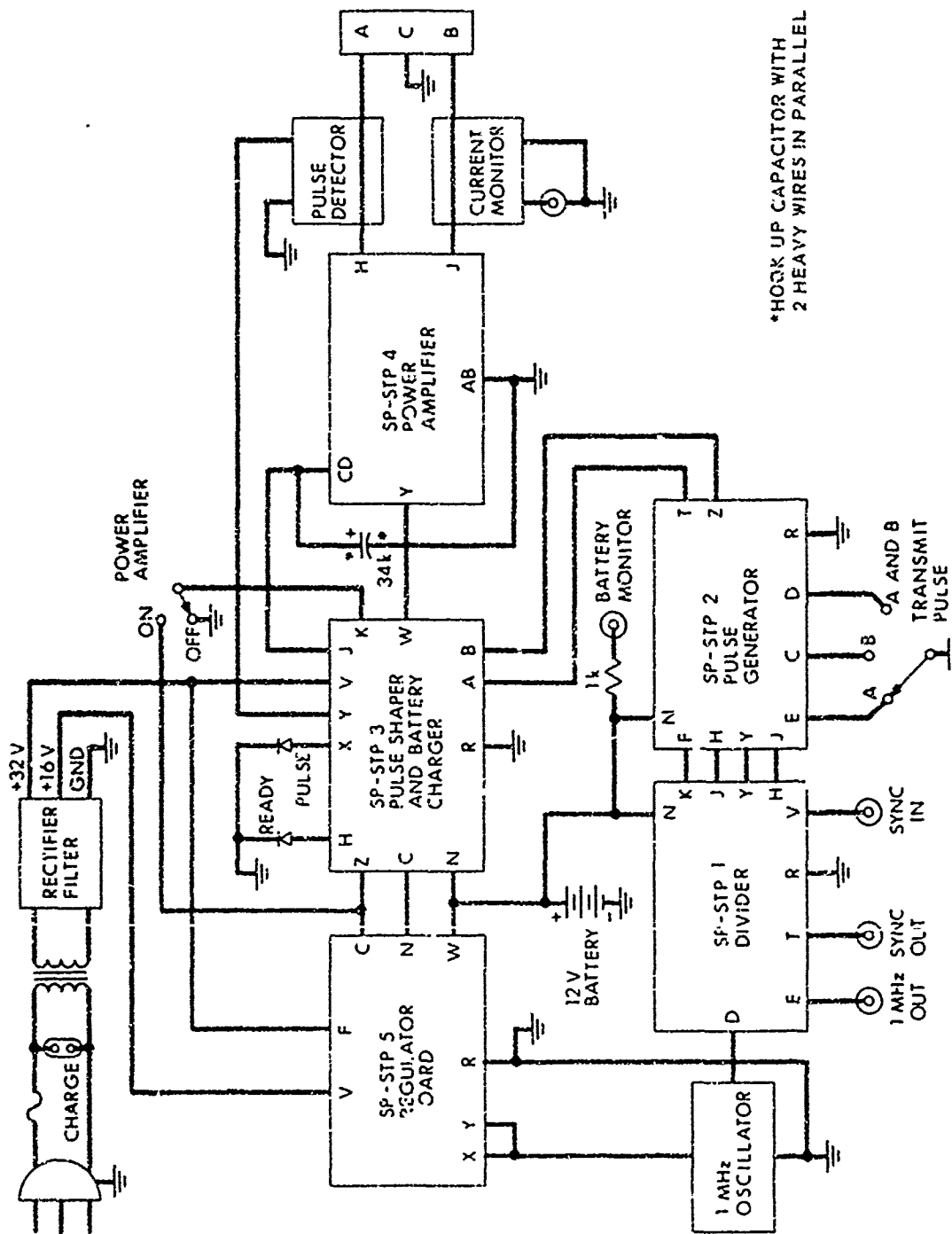


FIGURE 7
REGULATOR BOARD
SP-STP 5



*HOOK UP CAPACITOR WITH 2 HEAVY WIRES IN PARALLEL

FIGURE 8
SP-STP WIRING DIAGRAM

Acknowledgements

The author wishes to express his appreciation to Messrs. Barry Marks and Richard Cearley for the engineering and construction of the SP-STP transducers and to Messrs. Herb Marshall and Vic Scherer for the construction of the SP-STP units.