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IM 221

OPERATING MANUAL for MODELS 2213 and 2214 PINGERS

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SECTION I

GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Benthos deep sea pingers are precision instruments designed as general purpose acoustic beacons suitable for a variety of oceanographic applications such as bottom finding and site relocation. They incorporate a stainless steel shrouded, fully pressure compensated transducer integral with one housing end cap. This exceedingly rugged, proprietary design renders the pingers practically immune to handling and impact damage.

The Model 2213 Utility Pinger is completely self-contained; it does not require the use of conducting cables. Power is supplied by an internal battery pack consisting of easily replacable dry cells or, optionally, rechargeable cells. The pinger is housed in a pressure-resistant stainless steel cylinder fully capable of withstanding the effects of the ocean environment.

The Model 2214 Bottom Pinger is essentially identical to Model 2213, with the addition of variable pulse length and rate features. The pulse rate feature is controlled either by an internal mercury switch or by an external switch input through a connector in the housing end cap. The rate doubling circuit is activated either when the pinger is inverted or, when the external switch is opened. providing an event signal both in real time and on the permanent record. The pulse length feature makes possible switch-selection of any of three pulse lengths: 2 milliseconds, for general applications; 0.5 milliseconds, for finer resolution; and 10 milliseconds for higher audibility, as in ranging.

1.2 MECHANICAL CONFIGURATION

Both Model 2213 and Model 2214 are completely enclosed in the cylindrical housing. At the rear of the housing is the acoustic projector, identified by a collar of slightly larger diameter than the body of the housing, from which projects a cylinder of slightly smaller diameter. Centered in the end cap of this cylinder is a hex-head bolt attached by a safety wire to an Allen-head screw on the outer surface of the cylinder. THIS BOLT IS PRECISION TIGHTENED FOR OPTIMUM PERFORMANCE OF THE ACOUSTIC PROJECTOR. DO NOT MOVE THIS BOLT, OR TAMPER WITH THE SAFETY WIRE.

Recessed in the collar of the acoustic projector is the power actuator switch, which may be operated with a screwdriver, coin, key, or any similar object. Approximately ¼ of the circumference away from this switch is an Allen-head plug which projects slightly from the collar. DO NOT, UNDER ANY CIRCUMSTANCES, REMOVE THIS PLUG— REMOVAL WILL CAUSE FLOODING.

Welded to the body of the housing are two mounting tabs with 9/16" holes for use in shackling the pinger to a supporting wire or companion instrument. Centered about a longitudinal line on the opposite side of the housing are two rounded carrying handles, located at the unit's center of gravity, which also serve as a stable stand for the unit on deck or bench. On the end of the housing opposite the acoustic projector is a removeable end cap, centered in which is the captive closure bolt which retains the chassis in the housing. Both the end cap and the closure bolt are fitted with O-ring seals, as is the housing-chassis contact surface on the acoustic projector.

On Model 2214 a 2-pin Electro-Oceanics connector is mounted through the end cap to permit external switch actuation of the pulse rate doubling circuit. The pinger is supplied with a dummy connector installed. THIS CONNECTOR SHOULD BE REMOVED ONLY TO PERMIT CONNECTION OF AN EXTERNAL SWITCH. A protective shield is mounted around the connector to prevent impact damage.

In both pinger models, the chassis is an essentially cylindrical frame formed of notched rods into which are fitted two plug-in printed circuit cards and a plug-in battery pack consisting of an epoxy casting containing six tubes, each long enough to hold four "C"-cells. In the Model 2214, a three-position switch is mounted on the chassis above the circuit cards - this is the pulse length control. Below the circuit cards are two energy storage capacitors. The chassis is mounted on the rear face of the acoustic projector, on which are also mounted the output transformer, matching coil and switch block. In the Model 2214, the mercury switch which controls the pulse rate doubling circuit is also mounted on the acoustic projector, at the base of the chassis.

1.3 OPERATIONAL DESCRIPTION

Both Model 2213 and 2214 emit an acoustic pulse, or "ping", precisely once every second. In Model 2213, this gated 12 kHz pulse is 2 milliseconds in duration; in Model 2214 the pulse length is switch-selectable, lasting 0.5 ms., 2 ms., or 10 ms. In Model 2214, the pulse repetetion rate is doubled by opening of either the internal mercury switch or a normally closed external switch.

The pings may be received by virtually any 12 kHz sonar receiver and may be displayed and recorded on a Precision Graphic Recorder (PGR) or a Precision Depth Recorder (PDR), or recorded on a magnetic tape recorder. The beam pattern is essentially omnidirectional; the output level is 85 db (minimum) relative to 1 microbar at one yard.

1.4 SPECIFICATIONS

1.4.1 Electrical Specifications

	Model 2213	Model 2214
Operating frequency:	12.288 kHz ± 12 Hz	12.288 kHz ± 12 Hz
Output level:	85 db (minimum) re. 1 ubar @ 1 yard	85 db (minimum re. 1 ubar @ 1 yard
Beam pattern:	Essentially omni-directional	Essentially omni-directional
Range:	Over 8000 meters	Over 8000 meters
Pulse repetition rate:	1 pulse/second ± 50 microseconds (Can be doubled by removing jumper wire)	normal: 1 pulse per second ± 50 microseconds event signalling: 1 pulse per ½ second ±50 microseconds
Pulse length:	2 milliseconds ± 10%	Switch selectable: 0.5 ms ±10 % 2 ms ± 10% 10 ms ±10 %
Battery complement: standard:	20 manganese-alkaline "C" cells plus 4 dummies	20 manganese-alkaline "C"-cells plus 4 dummies
rechargeable option:	24 nickel-cadmium "C" cells	24 nickel-cadmium "C" cells
Battery life:	100 hours, minimum	100 hours, minimum

1.4.2 Mechanical Specifications

Housing material:	17-4PH stainless steel	17-4PH stainless steel
Depth rating:	12,000 meters (Pressure tested to 15,000 meters before shipment)	12,000 meters (Pressure tested to 15,000 meters before shipment)
Length of housing:	26½ inches	29 inches, overall
Housing diameter:	5 inches, maximum	5 inches, maximum
Weight in air:	25 kgs (55 pounds)	26 kgs (57 pounds)
Weight in water:	18 kgs (40 pounds)	18 kgs (40 pounds)

1.5 EQUIPMENT SUPPLIED

Model 2213	Model 2214
Model 2213 Utility Pinger	Model 2214 Bottom Pinger
20 manganese-alkaline "C" cells and 4 dummies, installed OR	20 manganese-alkaline "C" cells and 4 dummies, installed OR
24 nickel-cadmium "C" cells, installed	24 nickel-cadmium "C" cells, installed
1 hex nut driver ("Spin-tite")	1 hex nut driver ("Spin-tite")
Documentation: IM2213,2214 Pressure test certificate	1 hardwood carrying case
	2 Benthos cable clamps
	Documentation: IM2213,2214 Pressure test certificate

1.6 OTHER EQUIPMENT NEEDED (Not Supplied)

1.6.1 Operating Equipment

Operating Equipment	Requirements
12 kHz receiving hydrophone	Fairly omnidirectional
12 kHz receiving amplifier	High gain type, 1 kHz bandwidth
12 kHz precision recorder	Precision sweep rate (not dependant on power voltage, etc.) in integral multiples of 1 sec.

Screwdriver, coin, or similar blade to operate power switch.

1.6.2 Maintenance Equipment

Maintenance Equipment	Purpose
Alcohol, soft cloth, high quality silicone grease	For O-ring maintenance
Electronic multimeter	For checking battery voltage
9/16" hex nut driver	For removing closure bolt for O-ring maintenance
Dessicant (in small bags)	For maintaining low humidity inside instrument housing
Oscilloscope	For trouble-shooting procedures
Kedman screwdriver	For removing switch cam for O-ring maintenance

SECTION II

OPERATION

2.1 CONNECTIONS AND OPTIONS

Model 2213 requires no electrical connections; it is ready to operate as shipped, with a pulse repetition rate of 1 pulse per second. If a 2 pps rate is desired, the jumper wire between fork lugs near the plug end of circuit card TB-2 should be removed. (Refer to Dqg. # C-221-30.)

Model 2214 incorporates many options which should be adjusted as desired before installation.

2.1.1 Pulse length, or duration, is selected by means of the three-position switch located on the chassis above the circuit card connections. The 2 ms length is generally used when neither range nor resolution is critical; 0.5 ms when optimum resolution is desired; and 10 ms when maximum range is desired. The switch is clearly labelled for position.

2.1.2 The pulse rate of Model 2214, with the shorting connector (dummy) in place and the acoustic projector facing down is 1 pps. With a NORMALLY CLOSED switch connected in place of the shorting connector, the pulse rate will remain 1 pps, as long as the pinger remains essentially vertical, with the acoustic projector downward.

2.1.2.1 The pulse rate will double (1 ping per ½ second) when:

a) the pinger is inverted, causing the mercury switch to open,

b) the normally closed external switch connected to the end cap penetrator is opened (as, by a tilt switch contacting the ocean floor or by actuation of a switch-connected pump or motor),

c) a NORMALLY OPEN switch is connected in place of the dummy connector.

2.1.2.2 To operate the pulse rate doubling circuit with option a), above, the pinger is usually installed on a messenger actuated reversing mechanism similar to Nansen bollte frames.

2.1.2.3 To operate the pulse rate doubling circuit with option b), above, connect a NORMALLY CLOSED external switch to the end cap connector, using Electro-Oceanics #53F2F-1 connector on the switch leads. The pulse rate will change to 2 pps when the external switch opens, then return to 1 pps when it closes. (A special Benthos switch is available for this purpose.)

2.1.2.4 To operate the pulse rate doubling circuit with option c), above, connect a NORMALLY OPEN external switch to the end cap connector, using Electro-Oceanics #53F2F-1 connector on the switch leads. The pulse rate will then be 2 pps until the switch closes, shifting to 1 pps until the switch opens again. USE OF THIS OPTION WILL REDUCE BATTERY LIFE.

2.1.2.5 Removal of the shorting connector (dummy connector) will cause the pulse rate to double IN THE LAB. Exposure of the end cap connector contacts to water, however, will cause erratic operation of the circuit and possibly damage to the pinger.

DO NOT SUBMERGE THE PINGER WITH THE END CAP CONNECTOR CONTACTS OPEN: EITHER THE DUMMY CONNECTER OR A MATING CONNECTOR MUST BE INSTALLED BEFORE LAUNCHING.

2.1.3 In Model 2214 with optional rechargerable battery pack, make certain that the dummy connector for the recharging penetrator (female) is firmly in place.

2.2 INSTALLATION

There are several possible methods of mounting the Model 2213 or 2214 pingers, from which that best suited to the operation may be selected. Certain precautions about each method, outlined below, should be observed.

2.2.1 The pingers may be secured to a tow cable by means of Benthos cable clamps (supplied with Model 2214).

2.2.1.1 Model 2214 should be positioned so that the acoustic projector is faced down, to hold the mercury switch in the closed position and thus maintain the 1 pps repetition rate.

2.2.1.2 If switch actuation of the pulse rate doubling circuit is desired, the Model 2214 should be mounted with Benthos Model 1751 cable clamp. (See instruction sheet supplied with 1751.)

2.2.1.3 Model 2213 should generally be positioned so that the acoustic projector is faced down, to ensure receiving the strongest possible echo.

2.2.2 The pingers may be bolted directly to a companion instrument or piece of equipment, using the mounting tabs on the housing. Care should be taken that no pressure is exerted on the acoustic projector and that nothing will intervene between the projector and either the receiving hydrophone or the ocean bottom.

2.2.3 The pinger may be secured to towed or lowered equipment, using stainless steel bands secured around the body of the housing and a rigid member of the companion equipment.

2.2.3.1 Spacers should be placed between the housing and the object on which it is to be mounted to hold the acoustic projector away from contact with any other object.

NEVER PLACE A MOUNTING BAND AROUND THE ACOUSTIC PROJECTOR ITSELF.

2.3 LAUNCHING

2.3.1 Prior to launching, check battery life records to be certain that sufficient energy remains to complete the operation. If records have not been initiated, test voltage directly, as outlined in Section 3.2.

2.3.2 On Model 2214, check the end cap penetrators to be certain that either the dummy connector supplied or a mating connector is firmly installed. If the Model 2214 is equipped with a charging penetrator, make certain that its dummy connector is firmly installed.

EXPOSURE OF EXTERNAL CONNECTOR CONTACTS TO WATER WILL RESULT IN ERRATIC OPERATION OF THE PULSE RATE DOUBLING CIRCUIT AND POSSIBLE DAMAGE TO THE PINGER.

2.3.3 Set the precision recorder to the 1 second (400 fathom) sweep rate. If the recorder has not been in operation prior to launch time, allow it ample time to warm up.

2.3.4 Check mountings and recheck connections (Model 2214) to make certain that everything is secure.

2.3.5 Immediately prior to launching, turn the power switch to the ON position. Note actuation time. Listen to make sure signals are audible; if none are heard, refer to Section 4.5, Troubleshooting.

2.3.6 Shortly after the pinger is launched, signals will begin to appear on the recorder chart.

(In some cases, as when using a hull-mounted or V-fin hydrophone, no signals will appear until the pinger has passed below the ship's hull or other reflecting surfaces. If the water is very deep and the bottom a poor reflector, no echo signals may appear until the pinger has been lowered a considerable depth.)

2.3.7 When the pinger is about 10 meters below the surface, the direct signal should be fairly clear. At this point, stop lowering the pinger and adjust the receiving and recording equipment until a clear, dark trace is obtained and background noise is reduced to a minimum.

2.3.8 When adjustments are completed, resume lowering the pinger, adjusting gain as necessary to compensate for increasing distance from the hydrophone.

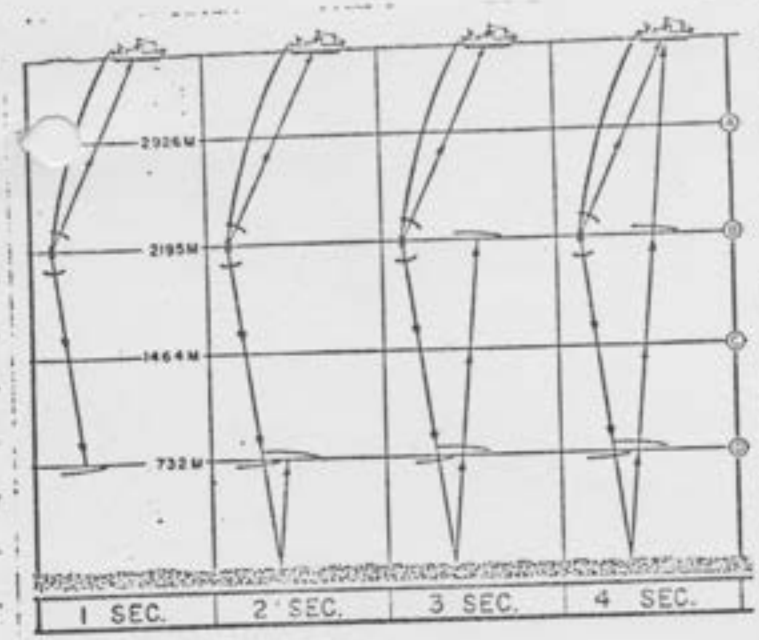
2.4 INTERPRETATION

Interpretation of the signals received from the pinger and its echo is fairly straightforward. Certain information may, however, be of assistance in using the instrument.

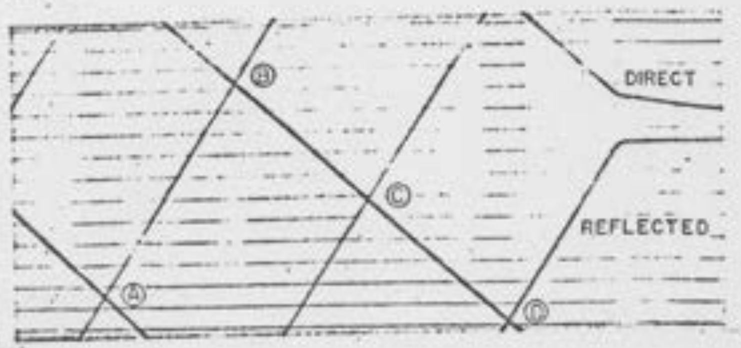
2.4.1 Two lines will appear on the recorder chart (at the 1 pps repetition rate), direct pulse, the other representing the echo of the pulse.

2.4.2 As the pinger moves away from the hydrophone during lowering, the line representing the direct pulse will move toward the right, break off at the right margin, then reappear at the left margin.

2.4.3 Because sound travels through water at a nominal rate of approximately 1463 meters per second, the two lines will cross every 731.5 meters of depth, approximately. (See Figure 2-1).



When a pulse is transmitted from a height off the bottom in excess of approximately 732 meters, the total path length of the reflected pulse exceeds that which can be traversed in one second, with the result that the reflected pulse arrives at the surface *after* the arrival of subsequent direct pulses than the one to which it corresponds. The bottom echo of a signal transmitted from an altitude that is an integer multiple of 732 meters will arrive simultaneously with one of the subsequent direct pulses. The traces of the direct and reflected pulses therefore converge and cross at *each* of the levels from which a direct pulse to the surface arrives along with the bottom reflection of a previous emission. The number of recorder crossings that will occur before the bottom approach is equal to the integer quotient of the water depth divided by 732 meters. The chart record below depicts how the pinger output illustrated above might appear on the ship's record were the lowering continued to the bottom.



2.4.4 It is essential to count the number of times the lines cross, in order to know how deep the instrument is, since echoes delayed by depth may give a false indication that the pinger is very near the bottom.

2.4.5 When operating in very deep water over a poor bottom surface, no echoes may appear until the pinger has reached a fairly great depth. In this case, some crossovers may be missed, and you will have to estimate the depth of the instrument from the length and angle of wire paid out at the time the first echo trace appears.

The first crossover to appear will then give a more accurate indication of depth (see table 2-1).

2.4.6 When the pinger appears to be quite near the bottom, slow the winch and switch the recorder to a faster sweep rate to obtain greater resolution. As the lowering rate is decreased, the lines should stabilize somewhat, and the height above bottom may be read as the distance between the leading edges of the two traces on the recorder paper.

2.4.7 When height above bottom is critical (as with cameras, etc.) final positioning may be more easily accomplished by reading the signals from an oscilloscope set to a 1 msec/cm sweep rate.

TABLE 2-1

HEIGHT ABOVE BOTTOM (meters)	NUMBER OF CROSSOVERS BEFORE INSTRUMENT REACHES BOTTOM
0-731	0
732-1462	1
1463-2194	2
2195-2925	3
2926-3657	4
3658-4388	5
4389-5120	6
5121-5851	7
5852-6583	8
6584-7314	9
7315-8046	10
8047-8777	11
8778-9509	12
9510-10240	13
10241-10972	14
10973-11704	15

SECTION III

ROUTINE MAINTENANCE

3.0 SCOPE

This section deals with procedures for removing the chassis from the housing, checking battery voltage, replacing batteries, recharging the optional battery pack, preventive maintenance routine for O-ring seals, and replacing the chassis in the housing.

3.1 REMOVING CHASSIS FROM HOUSING

3.1.1 Stand the pinger upright, resting on the acoustic projector. Using the nutdriver supplied, loosen the closure bolt by turning counterclockwise until the threads are free.

3.1.2 Carefully lift the end cap from the housing. In Model 2214, there is an electrical connection between the end cap and the chassis. Disconnect the cable from the chassis, then set the end cap aside.

3.1.3 Lift the housing from the chassis, taking care not to scrape it against chassis components, then lay it aside, resting on its carrying handles.

DO NOT SET THE HOUSING DOWN RESTING ON A SEALING (OPEN) END. SCRATCHES ON SEALING SURFACES MAY RESULT IN LEAKAGE.

3.2 CHECKING BATTERY VOLTAGE

3.2.1 The battery pack is connected to provide output voltages as follows:

Pin 1: +15V   Pin 3: +5V   Pin 6: -15V

3.2.2 Acceptable voltages for normal operation range from 12 to 15V on the +15V and -15V supplies and from +4.8 to +6V on the +5V supply.

3.3 REPLACING BATTERIES

3.3.1 To remove the battery pack from the chassis, ~~press down on the spring-loaded pin at the top of the~~ [unscrew the knob on the] center front chassis rod, then pull forward on the rod to free its top end from the frame. Remove the screws which secure the pack on each side rail; then pull straight forward on the battery pack to free its plug from the chassis-mounted jack

3.3.2 Carefully remove the end plate of the battery pack.
Top end plate (with jacks) - 2 screws only
CAUTION: CELLS ARE UNDER SPRING COMPRESSION: BATTERY PACK END PLATES WILL TEND TO SPRING APART WHEN SCREWS ARE LOOSENED.

3.3.3 Dump out expended cells, taking care to retain the dummy cells, then insert fresh cells and dummies, following polarity and position diagram on the back of the battery pack.

3.3.4 Replace the end plate, tightening the screws evenly, then replace the battery pack in the chassis, making certain that the retaining pin at the top of the chassis rod is locked in place.

3.4 RECHARGING OPTIONAL BATTERY PACK

3.4.1 The rechargeable nickel-cadmium cells should be charged at a 200 ma rate until fully charged (14 hours from fully discharged), using a source having a compliance of about 36V. Benthos Model 3540 Battery Charger is recommended.

3.4.2 Model 2214 with optional rechargeable battery pack is equipped with an end cap penetrator for recharging. Mating connector E.O. #53F2M-1 (supplied on Benthos Model 3540 Battery Charger) should be connected to the charger leads.

3.4.3 In Model 2213, the optional rechargeable battery pack may be recharged through the battery pack connector by connecting the positive charger electrode to pin 1 and the negative to pin 6. Alternately, the positive charger electrode may be connected to the test point jack on the battery pack end plate nearest pin 1, the negative to the test point jack nearest pin 6.

3.5 PREVENTIVE MAINTENANCE, O-RING SEALS

There are five O-ring seals in both Model 2213 and 2214: one on each end cap, two on the closure bolt shaft and one on the switch cam shaft. PREVENTIVE MAINTENANCE ROUTINE SHOULD BE PERFORMED ON END CAP O-RING SEALS EVERY TIME THE HOUSING IS OPENED. Closure bolt and switch cam O-ring seals should be checked annually, as part of a general inspection and preventive maintenance procedure.

3.5.1 Wipe the O-ring with a soft cloth to remove dirt, old grease, foreign particles, etc.

3.5.2 Carefully inspect the O-ring for signs of physical damage (holes, nicks, extrusions, etc.) If there are none, apply a THIN FILM of high quality silicone grease to the O-ring.

3.5.3 If there is any indication of damage to the O-ring, however slight, it should be replaced as follows:

3.5.3.1 Remove the damaged O-ring by carefully inserting a sturdy pin into it and lifting. BE CAREFUL NOT TO SCRATCH THE THE SEATING SURFACE.

3.5.3.2 Clean the O-ring groove with a soft cloth dampened with alcohol. Let it dry.

3.5.3.3 Take a new O-ring and coat it completely with a THIN FILM of high quality silicone grease.

3.5.3.4 Place the new O-ring on the groove and carefully press it into the groove until it is evenly seated.

3.5.4 Access to the closure bolt O-ring seals is attained by removing the closure bolt from the end cap as follows:

3.5.4.1 Using a ½" hex nutdriver, remove the elastic stop nut from the closure bolt shaft (inside the end cap).

3.5.4.2 Remove the two Belleville washers from the closure bolt from the end cap.

3.5.4.3 If both O-ring are to be removed from the shaft, remove the upper one first, rolling it over the lower one; to replace both, snap the lower one into place first, then roll the upper one over it.

3.5.5 Access to the switch cam shaft O-ring seal is attained by removing the switch cam as follows:

3.5.5.1 Remove the two screws from the switch bracket (on the acoustic projector upper face), then remove the bracket.

3.5.5.2 Remove the two screws holding the leaf spring on the switch block, then remove the leaf spring.

3.5.5.3 Using a Kedman screwdriver, remove the switch cam from the collar of the acoustic projector.

3.6 REPLACING THE CHASSIS IN THE HOUSING

3.6.1 PERFORM PREVENTIVE MAINTENANCE ON END CAP O-RING SEALS AS OUTLINED IN PARAGRAPHS 3.5.1 through 3.5.3.

3.6.2 Clean sealing surfaces at both ends of the housing with a soft cloth dampened with alcohol. Let it dry.

BE CAREFUL NOT TO NICK, SCRATCH OR DENT SEALING SURFACES.

3.6.3 CAREFULLY lower the housing over the chassis, taking care not to bump it against the chassis frame or components; make certain that it seats squarely and evenly on the acoustic projector.

3.6.4 Hold the removable end cap in position above the housing so that the closure bolt engages the chassis nut (in Model 2214, connect the end cap cable to the chassis connector, then twist the end cap to coil the cable inside the housing). Using the hex nutdriver supplied, turn the closure bolt clockwise, making certain that the end cap is drawn down evenly, until really snug (about 50-inch pounds).

3.6.5 Visually inspect both seals by rotating the entire unit, checking to be certain that there are no gaps and that the surfaces at the sealing points meet evenly and firmly.

CAUTION: CARELESSNESS IN ANY OF THE PROCEDURES OUTLINED IN THIS SECTION MAY RESULT IN DESTRUCTIVE LEAKAGE OR SERIOUS DAMAGE TO ELECTRONIC COMPONENTS.

SECTION IV

THEORY OF OPERATION

4.1 FUNCTIONAL DESCRIPTION

Type 221 pingers incorporate a battery pack, two multifunctional printed circuit cards and an acoustic projector. In any specific model within this series some input or output pins on the circuit cards are not utilized. The schematic diagram for each model indicates specific connections. (Ref. Fig. 4-1a, Model 2213; 4-1b, Model 2214)

The Time Base Card, TB-2, which is common to both Model 2213 and Model 2214, generates the one-second time base for the ping (E) and the 12 KHz signal (A) which drives the acoustic projector. In Model 2214, the time base interval is controlled by a normally closed mercury switch mounted on the rear mass and a normally closed external circuit wired in series with the mercury switch. Thus, when the pinger is inverted (opening the mercury switch) or the external circuit is broken (by opening of an externally controlled switch), the time base interval is shortened to 0.5 seconds, producing a 2 ping per second repetition rate. (In Model 2213, this can be accomplished by removing a jumper wire between two fork lugs in the Time Base Card.)

The 12KHz signal (A) is fed to the Driver Card (DR-1), where it is gated with the 2 millisecond output of a one-shot. After amplification, this signal drives the acoustic projector assembly with high power 12 KHz bursts. In Model 2213, these bursts have a duration of 2.0 milliseconds; in Model 2214, a three-position switch selects pulse lengths of 0.5 ms, 2 ms or 10 ms.

4.2 CIRCUIT CARD DESCRIPTIONS

4.2.1 TIME BASE CARD (TB-2)

The heart of the time base generator is a 24,576 KHz crystal-controlled oscillator which is accurate and stable to within ± 50 parts per million. The output of this oscillator is divided in two by an integrated circuit flip-flop, IC1, to produce the 12 KHz signal (A) for the acoustic projector. The output of the oscillator is also divided by three and then by 8192 in a chain of similar flip-flops, IC2 through IC16, to produce a stable 1 Hz signal.

In Model 2213, removal of a jumper wire between two fork lugs on the component side of the card disables the last stage of countdown (IC16 and causes the outputs to occur at 2 Hz, thus reducing the time base to 0.5 seconds.

In Model 2214, removal of the external connection between pins 5 and 6 (opening of the mercury switch or of an external normally closed switch) disables the last stage of countdown (IC16) and causes the outputs to occur at 2 Hz, thus reducing the time base to 0.5 seconds.

SIGNAL	PIN	WAVEFORM
A	2	12 KHz square wave - 50% duty cycle 0 and 5V signal levels
E	9	8 ms negative pulse - once every second 0 and 5V signal levels

4.2.2 DRIVER CARD (DR-1)

The Driver Card, which is also common to both Model 2213 and Model 2214, produces short pulses of 12 KHz signal, amplifies them, and drives the acoustic projector assembly.

IC1A, Q5, Q7 and associated circuitry form a one-shot which is triggered by negative pulses from TB-2, occuring at the time base interval. The one-shot's output is gated with the 12KHz signal from the time base and by IC1B, producing a burst of 12KHz signal. This burst is level-translated by Q1 andQ2 and amplified by Q3 , Q4, Q8 and Q9. The collectors of Q8 and Q9 drive the output transformer in the acoustic projector assembly through pins 5 and 7 with pulsed 30V peak square waves

R12 and C1 in combination provide the time constant which establishes the pulse length of the one-shot, which is 2 ms in Model 2213, In Model 2214, the pulse length switch on the chassis frame connects additional resistance in series with R12, altering the time constant and thus the pulse length.

SIGNAL	PIN	WAVEFORM
A	4	12 KHz square wave - 50% duty cycle 0 and 5V signal levels
G	9	8 ms negative pulses 0 and 5V signal levels
H&J	5&7	12 KHz square wave - 50% duty cycle 2 ms burst length - 30V peak

4.2.3 ACOUSTIC PROJECTOR ASSEMBLY

The Acoustic Projector Assembly contains the projector itself, impedance matching and output drive circuitry, and the power ON/OFF switch.

The projector consists of a piston which vibrates longitudinally in a short cylinder. The piston is mechanically coupled to a pair of barium titanate crystals which are caused to vibrate piezoelectrically when stressed by the application of the high voltage electrical drive signal. The vibrating piston transmits vibrations to the surrounding water as bursts of acoustic energy. The inside of the projector is oil-filled to pressure equalize the external and internal forces on the piston at any depth.

A torroidal inductor (L101) impedance matches the projector to the drive circuitry and an output transformer (T101) steps up the low voltage signal from the drive to the high voltage required by the transducer.

A three-pole power switch (S101), activated by turning the slotted cam recessed into the side of the projector. turns on the main voltages to the pinger.

4.2.4 BATTERY PACK (Model 3541)

The battery pack is connected to provide three output voltages of +15V, +5V and-15V, on pins 1, 3 and 6, respectively. It contains 20 C-size manganese-alkaline cells and 4 "dummy" cells (short dircuits electrically).

4.2.5 BATTERY PACK (Model 3542)

The battery pack is connected to provide three output voltages of +15V, +5V and -15V, on pins 1, 3 and 6, respectively. It contains 24 C-size nickel-cadmium cells, which may be recharged directly through the battery pack connector. (In Model 2214, recharging may be accomplished through an end cap penetrator, E.O. #53F2M-1.) The charging source should have a compliance of about 36V, charging rate should be 200 ma for 14 hours when fully discharged, proportionally less when only partially discharged.

4.3 TROUBLESHOOTING

4.3.1 If no pings are hea-d when the power switch is in the ON position, test battery voltage as outlined in Section 3.2.

4.3.2 If no pings are heard when power switch is in the ON position and battery voltages are within tolerances, trace the signal path as follows to determine the source of trouble:

4.3.2.1 Check for signal "A" on pins 2 of TB-2 and 4 of DR-1. If missing, check TB-2 divide and crystal oscillator. If present, proceed to 4.3.2.2

4.3.2.2 Check for two or more negative-going pulses, signal "G", on pin 9 of DR-1 and pin 9 of TB-2.
If present, trouble is with DR-1 card.
If absent, trouble is with TB-2 card.

4.3.2.3 Check for signals "H" and "J" on pins 5 and 7 of DR-1. If present, the difficulty lies with the acoustic projector assembly.

DO <u>NOT</u> ATTEMPT TO DISASSEMBLE THE ACOUSTIC PROJECTOR ASSEMBLY

4.3.3 In Model 2214, if ping rate is not as selected, check external wiring by connecting a clip lead across the fork lugs on TB-2 the pulse rate should then be 1 pps.

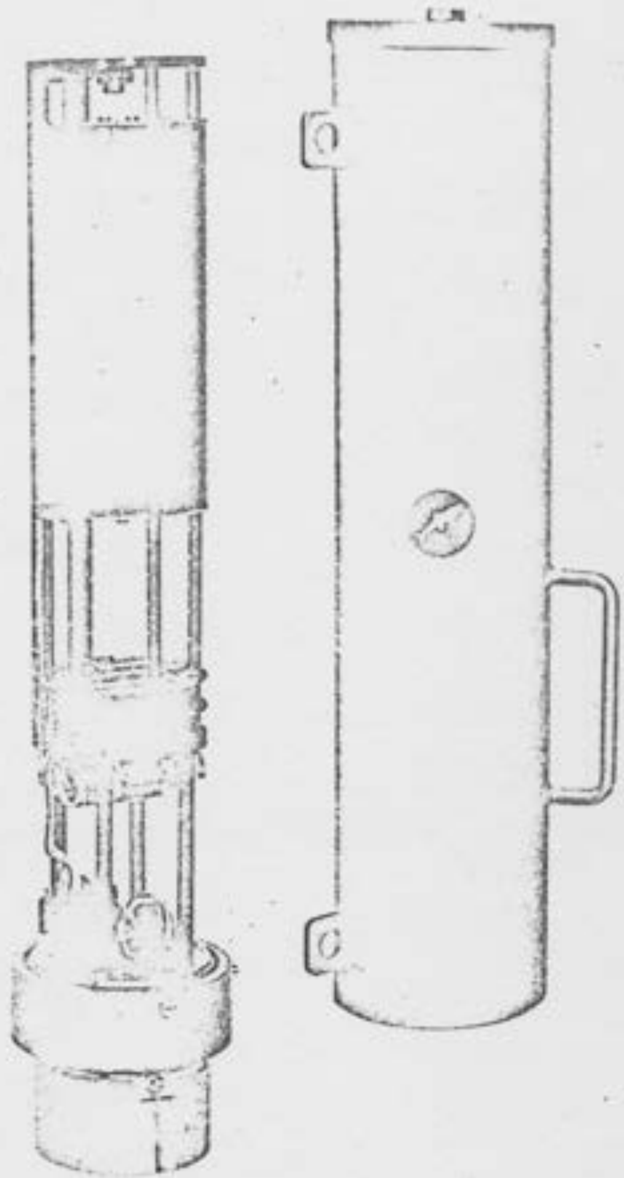
SECTION V

DRAWINGS, PARTS LIST

5.0 The following supportive drawings are included in this section:

Utility Pinger Model 2213	D-221-2
System Schematic Model 2213	C-221-31
Bottom Pinger Model 2214	D-221-3
System Schematic Model 2214	C-22-33

UTILITY PINGER, MODEL 2213



The BENTHOS Model 2213 Utility Pinger is an economical, general purpose acoustic beacon suitable for a variety of deep ocean applications such as bottom finding or site relocation. The Model 2213 incorporates a stainless steel shrouded, fully pressure compensated transducer integral to one housing end cap. This exceedingly rugged, proprietary design results in a unit that is practically immune to handling and impact damage, a feature of particular importance for seagoing equipment and one not provided by similar devices with rubber covered components.

The output of the Utility Pinger is a 12 kHz acoustic pulse with an amplitude of +85 db (minimum) relative to one microbar at one yard. The pulse has a fixed length of 2 milliseconds that is appropriate for both general purpose bottom echo or acoustic tracking applications. The repetition rate is precisely controlled at one pulse per second ± 50 micro econds (0.005%) for easy tracking on standard shipboard graphic recording equipment.

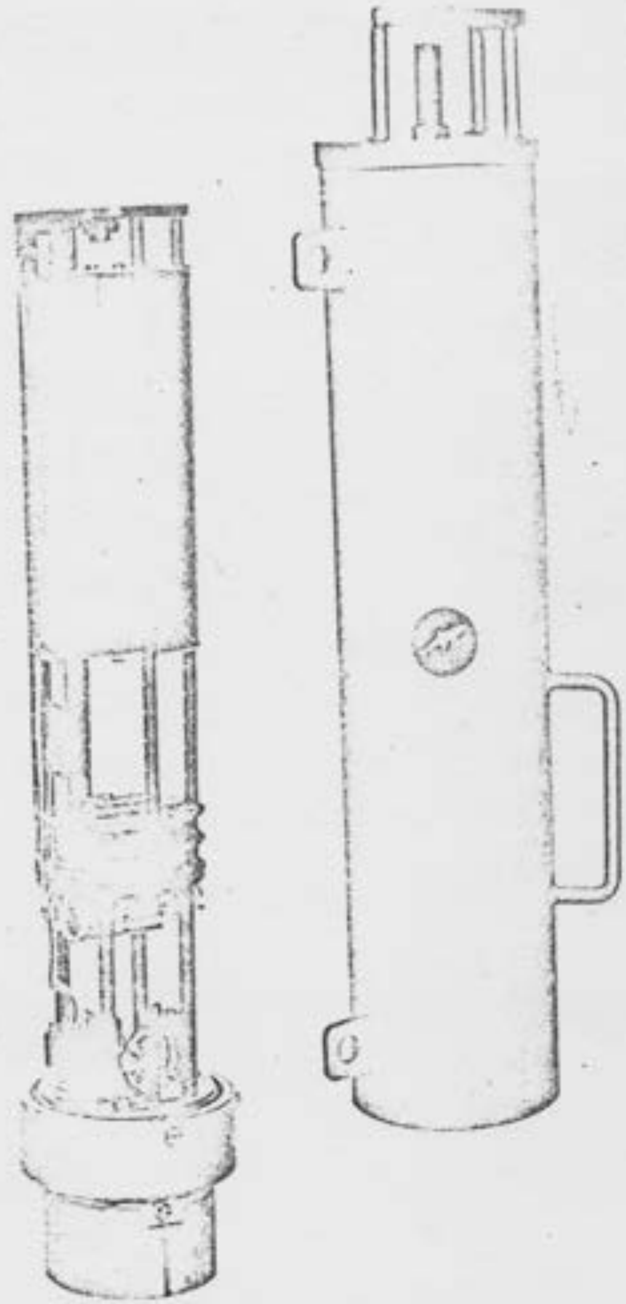
The Model 2213 Utility Pinger uses crystal-controlled digital timing logic with integrated circuits. The internal electronics are mounted on pluggable printed circuit cards for ease of test and repair. It is powered by readily obtained, manganese-alkaline "C" cell batteries which can be replaced in an mergency with ordinary flashlight cells. A rechargeable pack (Model 3542) is available with nickel-cadmium cells. The batteries in both instances are contained within a molded epoxy module that is easily removed for charging or changing cells.

The Model 2213 is enclosed in a stainless steel housing rated for operation to full ocean depths. It is held closed with the special single bolt closure system unique to Benthos products. The closure system is hand operable and requires no tools. The housing is equipped with convenient carrying handles located at the unit's center of gravity and welded mounting tabs to permit attachment of wire clamps or bolting to parent structures. An external ON-OFF switch can be operated with a coin or screwdriver. Both a hardwood carrying case and the Model S-2213-K Spare Parts Kit are available. (See the section on Options and Accessories.)

SPECIFICATIONS

Weight in Air: 25 kgs. (55 lbs.).
Weight in Water: 18 kgs. (40 lbs.).
Housing Material: 17-4PH Stainless Steel.
Transducer Construction: Stainless steel shrouded, pressure compensated, integral to housing end cap.
Dimensions: 5 inches diameter (max.) by 26½ inches overall length.
Housing Depth Rating: 12,000 meters (pressure tested to 15,000 psi prior to shipment).
Closure: Hand operable single bolt system, O-ring sealed.
Handles: Two handles located at center of gravity.
Mounting: Two mounting tabs welded to housing.
Output Frequency: 12.288 kHz ± 12 Hz.
Output Level: +85 db (minimum) relative to one microbar at one yard.
Beam Pattern: Essentially omnidirectional.
Pulse Length: 2 milliseconds (±10%).
Pulse Repetition Rate: 1 per second ± 50 microseconds.
Temperature Range: −10°C to 45°C, operating; −20°C to 60°C, storage.
Operating Switch: ON-OFF switch external to housing, operable with coin or screwdriver.
Battery Supply: Twenty manganese-alkaline "C" cells, Eveready E-93 or equivalent. (Rechargeable pack available as a standard option.)
Battery Operating Life: 100 hours (minimum).

BOTTOM PINGER, MODEL 2214



The BENTHOS Model 2214 Bottom Pinger is a sophisticated acoustic transmitter specifically designed for giving height-off-the-bottom information from underwater gear such as environmental sensors, towed instrument vehicles, and deep sea camera equipment. It can be used as an acoustic marker on submerged well heads, pipe lines, subsurface buoys or other installations. It incorporates many of the design features of the Model 2213 Utility Pinger, including the single unit construction and the proprietary, fully pressure compensated transducer integral to one housing end cap. Like the Model 2213, the Model 2214 is a rugged instrument well suited for ocean duty.

The output of the Bottom Pinger is a 12 kHz acoustic pulse at a level of +85 db (minimum) relative to one microbar at one yard. The pulse has switch selectable lengths of 0.5, 2, or 10 milliseconds for convenient adaptation to a variety of bottom echo or marking applications. The repetition rate is precisely timed at one pulse per second ±50 microseconds. Event occurrence such as messenger arrival or bottom contact can be signaled by a pulse rate doubling circuit that is actuable either by external switch opening or by inversion of the unit to operate on an internal mercury switch. This signal appears on the chart record as a second set of the direct and reflected pulse lines. The external switch actuation is input via a penetrator on the housing end cap.

The Model 2214 Bottom Pinger uses a crystal time base and integrated circuits identical with those of the Model 2213. The circuitry is mounted on pluggable cards and is powered by manganese-alkaline "C" cell batteries. A Rechargeable Option (Model A-2214-RO) is available with nickel-cadmium cells that includes a through-housing penetrator to enable recharge without opening the case. The individual cells of either supply are contained within a removable molded epoxy module.

The Model 2214 is enclosed in a full depth, stainless steel housing held closed by the Benthos single bolt closure system. The housing is equipped with convenient handles located at the unit's center of gravity and supplied with cable clamps allowing attachment midwire. An external ON-OFF switch can be operated with a coin or screwdriver. It is furnished complete with a rugged carrying case with ample room for the Model S-2214-K Spare Parts Kit. (See the section on Options and Accessories.)

SPECIFICATIONS

Weight in Air: 26 kgs. (57 lbs.).

Weight in Water: 18 kgs. (40 lbs.).

Housing Material: 17-4PH Stainless Steel.

Transducer Construction: Stainless steel shrouded, pressure compensated, integral to housing end cap.

Dimensions: 5 inches diameter (max.) by 29 inches overall length.

Housing Depth Rating: 12,000 meters (pressure tested to 15,000 psi prior to shipment).

Closure: Hand operable single bolt system, O-ring sealed.

Handles: Two handles located at center of gravity.

Mounting: Cable clamps for attachment midwire.

Output Frequency: 12.288 kHz ± 12 Hz.

Output Level: +85 db (minimum) relative to one microbar at one yard.

Beam Pattern: Essentially omnidirectional.

Pulse Length: 0.5, 2, or 10 milliseconds (± 10%), switch selectable.

Pulse Repetition Rate: 1 per second ± 50 microseconds.

Event Signaling: Pulse rate doubling by external contact closure input via Electro-Oceanics connector #53F2F-1.

Event Switch: Internally mounted mercury switch to actuate event signal when unit is inverted.

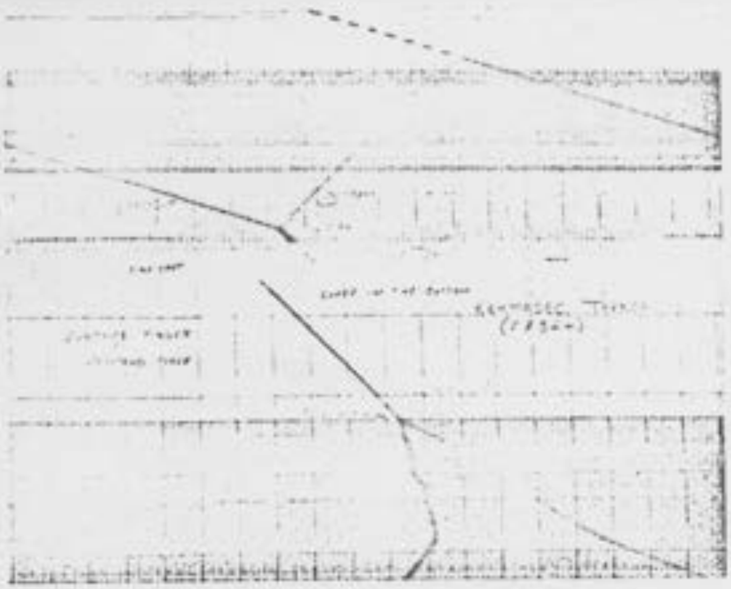
Temperature Range: −10°C to 45°C, operating; −20°C to 60°C, storage.

Operating Switch: ON-OFF switch external to housing, operable with coin or screwdriver.

Battery Supply: Twenty manganese-alkaline "C" cells, Eveready E-93 or equivalent. (Rechargeable supply with housing penetrator available as a standard option.)

Battery Operating Life: 100 hours (minimum).

Carrying Case: Rugged hardwood construction with space for spare parts kit, batteries and instruction manuals.



The illustration at left is an actual record of the output of a BENTHOS Bottom Pinger attached to a corer. The chart shows the approach and subsequent retrieval from the bottom at a depth of 7732 meters (25,380 ft.) in the Kermadec Trench in the southwestern Pacific. The record was made by Dr. George Keller of ESSA while on a survey aboard the USC&GSS "Oceanographer".

OPTIONS AND ACCESSORIES

Several options and accessories are available to extend the usefulness of the BENTHOS pingers, including modifications of the standard operating specifications for unique requirements. Changes of the repetition rate, pulse length, or battery life can be provided on special order. The following items are also available:

Spare Parts Kit, Model S-2213-K—A kit containing a complete set of the printed circuit boards, other minor electronic components, and spare O-rings for the Model 2213 Utility Pinger.

Spare Parts Kit, Model S-2214-K—A kit containing a complete set of the printed circuit boards, other minor electronic components, and spare O-rings for the Model 2214 Bottom Pinger.

Rechargeable Option, Model A-2214-RO—A rechargeable nickel-cadmium battery pack (see Model 3542 below) plus the necessary wiring and electrical penetrator to permit recharge without opening the housing. Available only for the Model 2214 Bottom Pinger.

Battery Charger, Model 3540—A voltage limited, current tapering charger that can be left connected to the battery supply for an indefinite period without danger of overcharge. The battery module can be charged either directly from a connector on the charger front panel or via cable connection through the instrument housing as with the Rechargeable Option above.

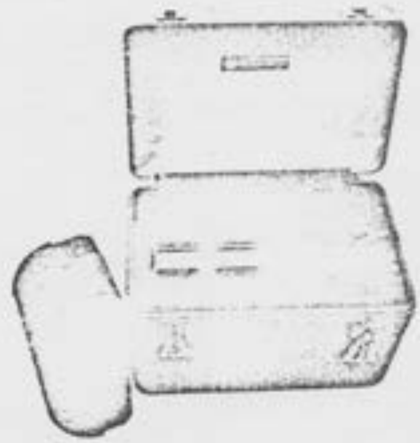
Spare Battery Pack, Model 3541—A spare module containing twenty (20) manganese-alkaline cells, Eveready E-93 or equal, plus four (4) spacers. Operating life is 100 hours (minimum).

Spare Battery Pack, Model 3542—A spare module containing twenty-four (24) rechargeable nickel-cadmium cells, Gould 2.0SC or equal. Operating life is 50 hours (minimum) per charge.

Wire Clamp, Model 1750—A cast bronze clamp for attachment of the Model 2213 midwire (two required). Not necessary with the Model 2214. Specify wire size when ordering.

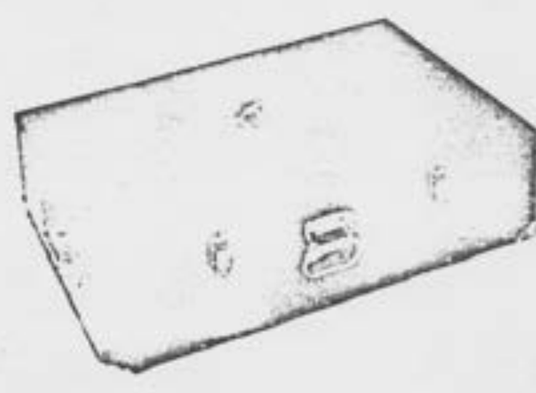
Wire Clamp, Model 1751—A special reversing clamp which allows the Model 2214 Bottom Pinger to invert upon arrival of a wire messenger to actuate the pulse rate doubling event signal.

Carrying Case, Model A-2213-CC—A rugged hardwood case with space for the Utility Pinger, spare battery pack, and spare parts kit.



MODEL 3540 BATTERY CHARGER
(with Model 3542 Spare Battery Pack)

MODEL 1750 WIRE CLAMP



MODEL A-2213-CC CARRYING CASE

DEEP SEA PINGERS

BACKGROUND AND APPLICATION

Pingers are one of the best known and most widely used items of acoustic equipment available to the ocean scientist. Categorically, these are any of a variety of devices which generate short pulses, "pings," of medium to high frequency sound underwater. Pingers are used as underwater markers, tracking and relocation aids, distress beacons, event signals and echo sounders. One of their most useful applications is for determination of height off the ocean bottom (altitude) of equipment or apparatus lowered from the surface.*

The height-off-bottom information is determined aboard ship by measuring the time difference between arrival of the direct pulse from the pinger transducer and the reflected pulse off the ocean bottom. This altitude is calculated by multiplying half the measured time interval by the velocity of sound in seawater. (A nominal value for this velocity is 1464 meters/second.) The use of half the time interval in the calculation accounts for the fact that the reflected pulse has made a round trip transit of the distance being measured. When received and displayed on the recording equipment availa le aboard most oceanographic survey vessels, a succession of the direct and reflected pulses generates two lines whose distance apart represent a permanent and immediately available record of the pinger altitude.

Pingers which are used for bottom finding must incorporate a number of important features that, though desirable, are not inherently necessary in the other pinger applications mentioned earlier. Among these are the characteristics highlighted below:

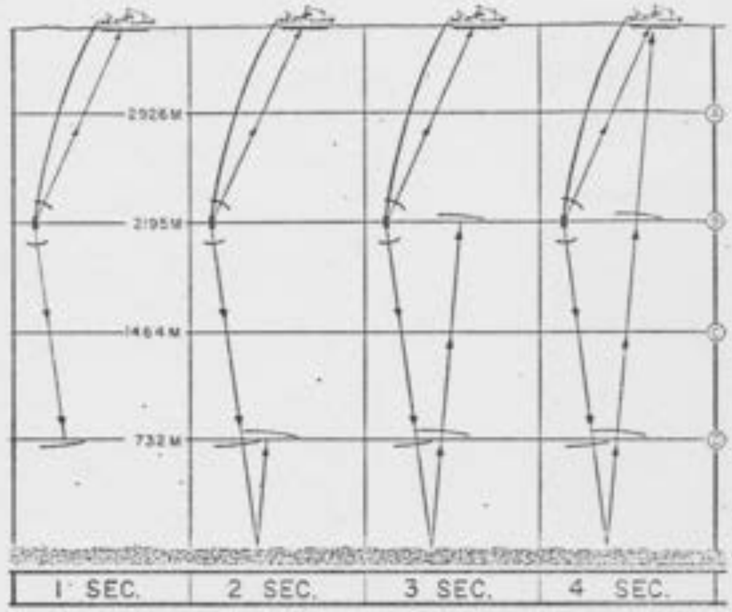
Output Level—The acoustic pulse should have adequate amplitude for transmission over considerable path lengths, taking into account the effects of attenuation upon reflection from the bottom. It must be discernible at the surface from among whatever background or ship noise is present.

Output Frequency—The acoustic wavelength should be short enough for generation by a compact transducer yet not so short as to suffer excessive attenuation over the anticipated path length. A frequency of 12 kHz has been generally adopted for this application and is compatible with the commercially available graphic recorders normally installed on research ships.

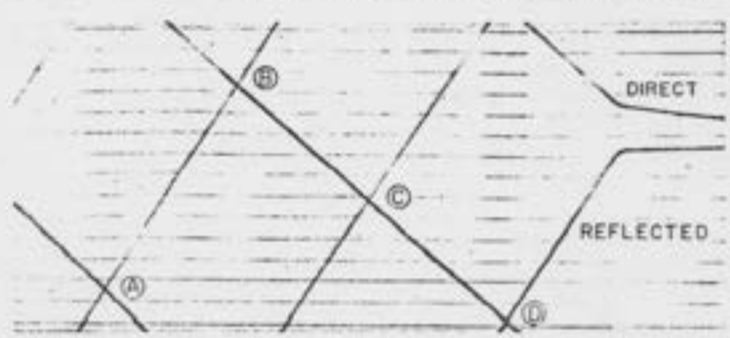
Repetition Rate Stability—Bottom finding pingers usually have pulse rates of one pulse/second both for information updating and in order to be compatible with commonly available recorder sweep rates. It is essential that the pulse rate be accurately controlled to assure that the ship's recorder sweep and the pulses are closely synchronized; otherwise, the graphic display consists of two severely skewed lines, spacing between which is difficult to determine. Rate stability of ±0.01% or better is desirable.

Pulse Length—A short pulse length is required to obtain good resolution of the bottom location though longer pulses are easier to detect. A two millisecond pulse will indicate bottom location within 3-5 meters and is satisfactory for most applications. Closer resolutions, and therefore shorter pulses, are needed for applications such as bottom photography. For tracking, where range is often more important than resolution, longer pulse lengths are effective.

In deep water, the shipboard record of the pinger output will display one or more "crossovers" of the direct and reflected pulse lines during a lowering. These crossings must be properly interpreted to avoid false indications of approach to the vicinity of the bottom. The figure below illustrates graphically the reason for these apparent approaches.



When a pulse is transmitted from a height off the bottom in excess of approximately 732 meters, the total path length of the reflected pulse exceeds that which can be traversed in one second, with the result that the reflected pulse arrives at the surface *after* the arrival of subsequent direct pulses than the one to which it corresponds. The bottom echo of a signal transmitted from an altitude that is an integer multiple of 732 meters will arrive simultaneously with one of the subsequent direct pulses. The traces of the direct and reflected pulses therefore converge and cross at *each* of the levels from which a direct pulse to the surface arrives along with the bottom reflection of a previous emission. The number of recorder crossings that will occur before the bottom approach is equal to the integer quotient of the water depth divided by 732 meters. The chart record below depicts how the pinger output illustrated above might appear on the ship's record were the lowering continued to the bottom.



*EDGERTON and COUSTEAU. (1959) Underwater camera positioning by sonar. The Review of Scientific Instruments, vol. 30 (12), pp. 1125-1126.

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CERTIFICATE OF CONFORMANCE

This is to certify that the materials/services used in P.O. # 276102

Oregon State University (customer) conform to the specifications called for in the above purchase order and/or our standards.

TESTING

Item(s) Number 1 , Quantity 1 Date 7-24-73

Description Bottom Pinger

Model # 2214 Serial # 1047 Benthos Job #2214-B-487

X Hydrostatic Pressure Test

DESCRIPTION OF TESTS

15,000 psi for 15 minutes

Results

X No fracturing, leaking, etc. All specifications met.

__ Electrical Testing

DESCRIPTION OF TESTS

X Other Testing

Acoustic output +97DB re 1 microbar @ 1 yard

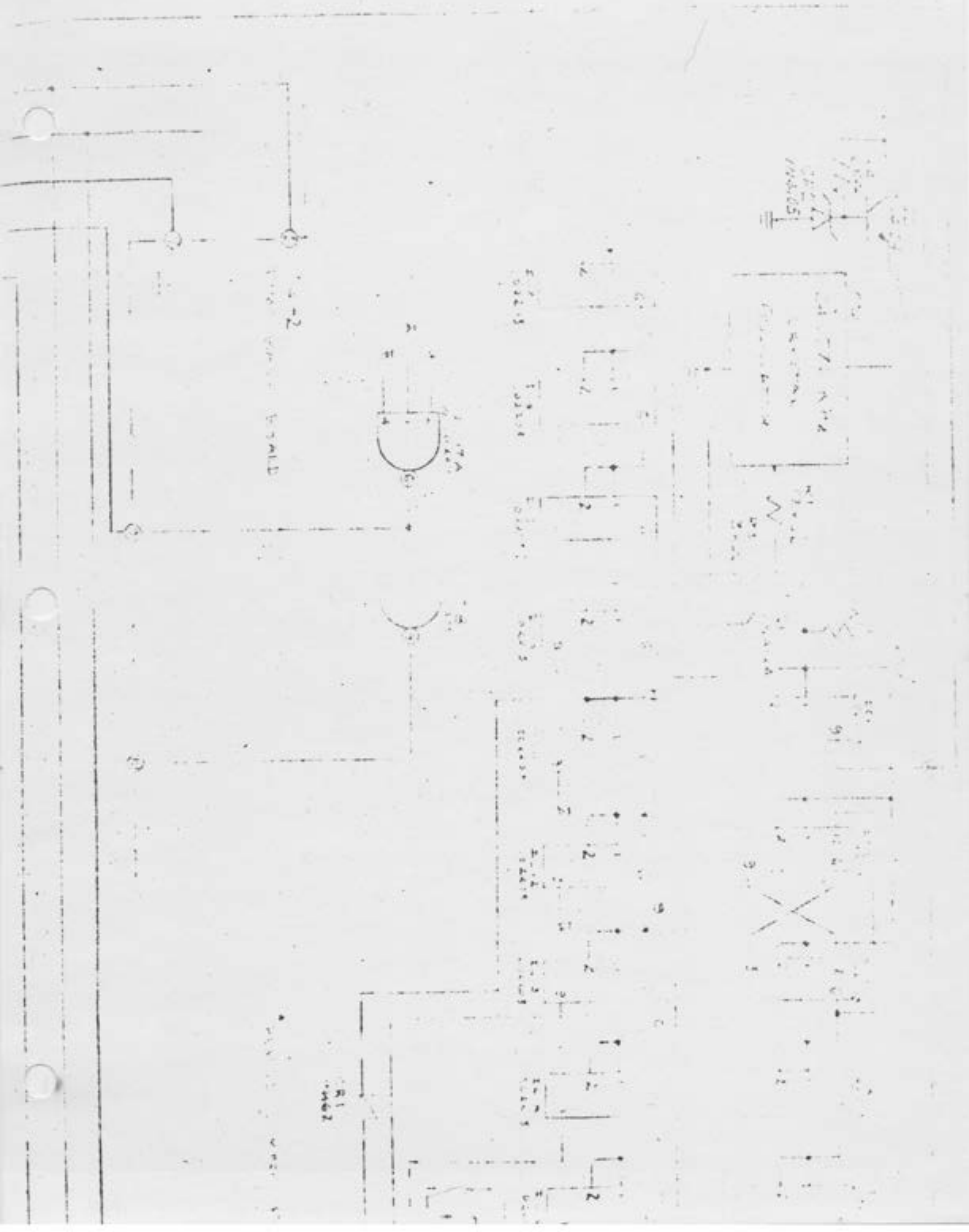
__ Remarks

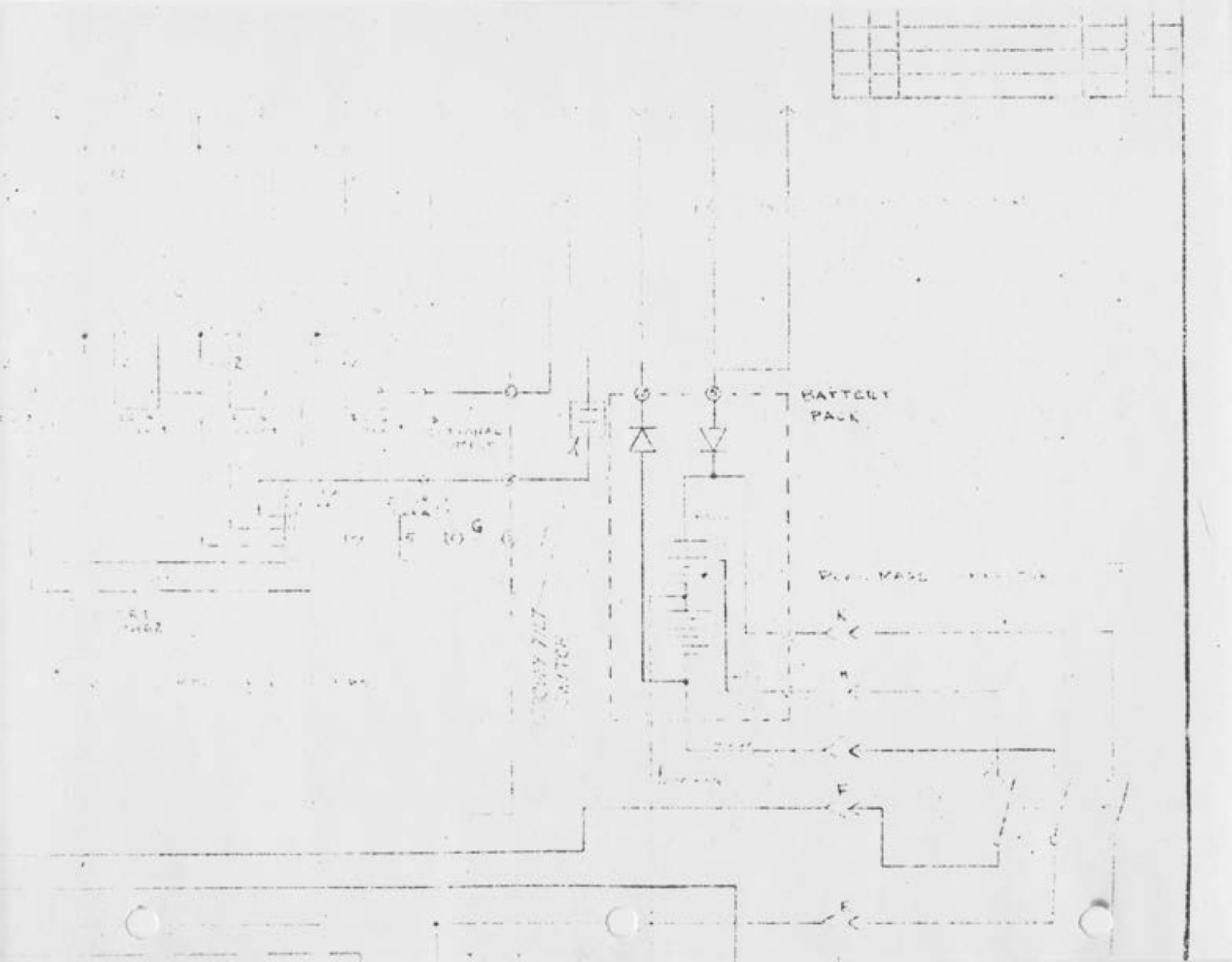
I certify the above information to be true and correct to the best of my knowledge and belief.

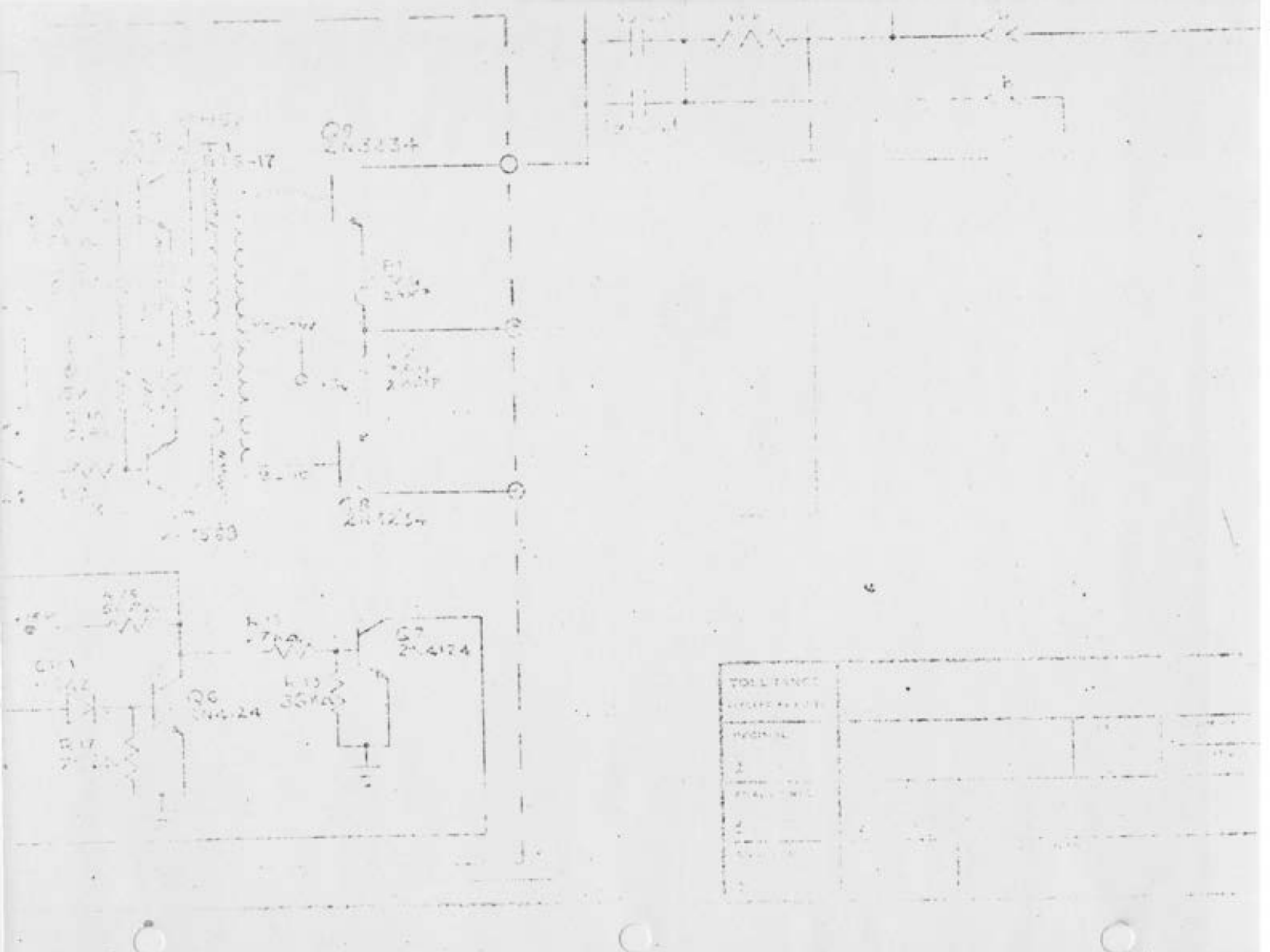
Alan Douglas
Operator

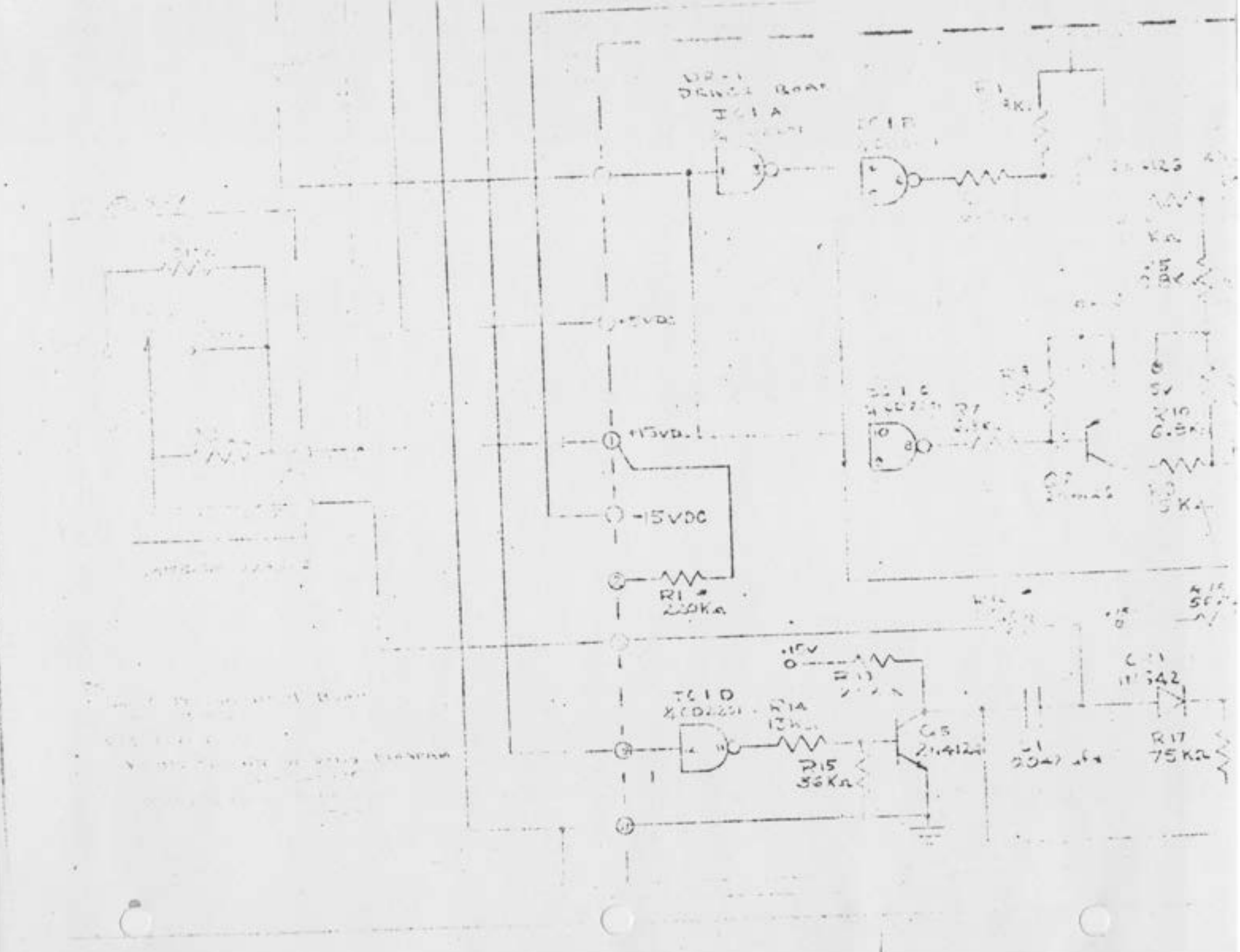
Jim Milam
Witness

Douglas Jim Milam

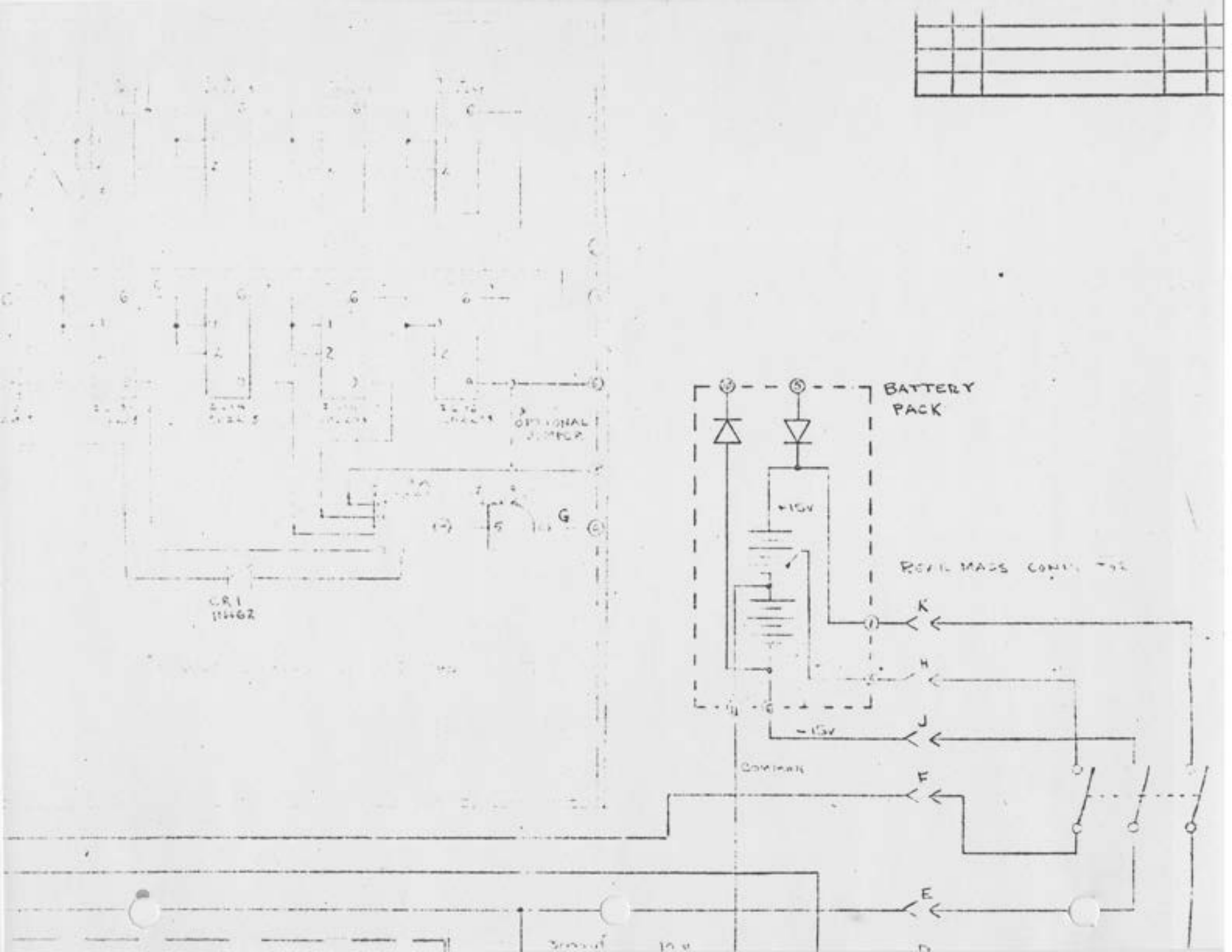



BATTERY
PACK

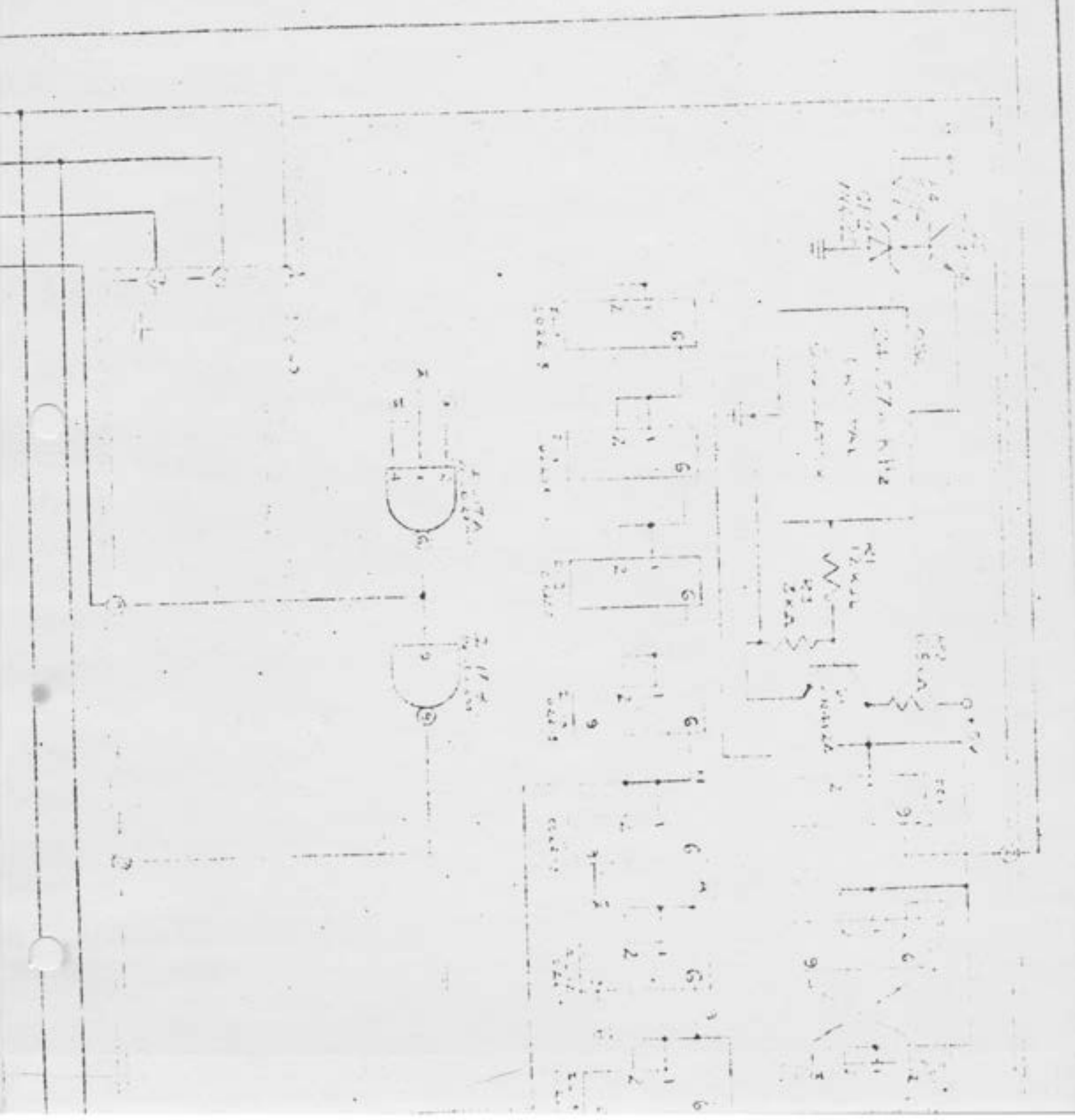

Q9
T1
Q8
Q7
2N4124
Q6
TOLERANCE

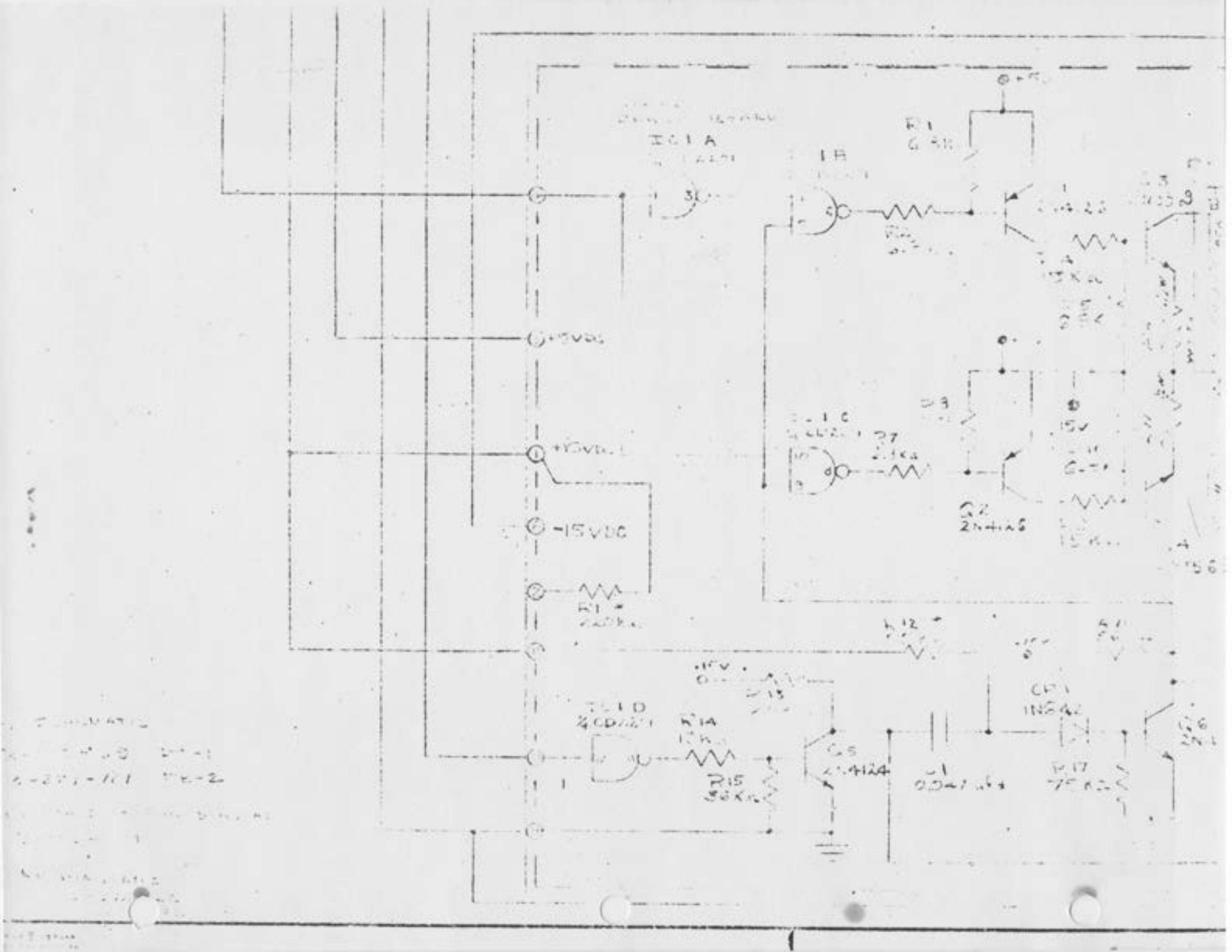


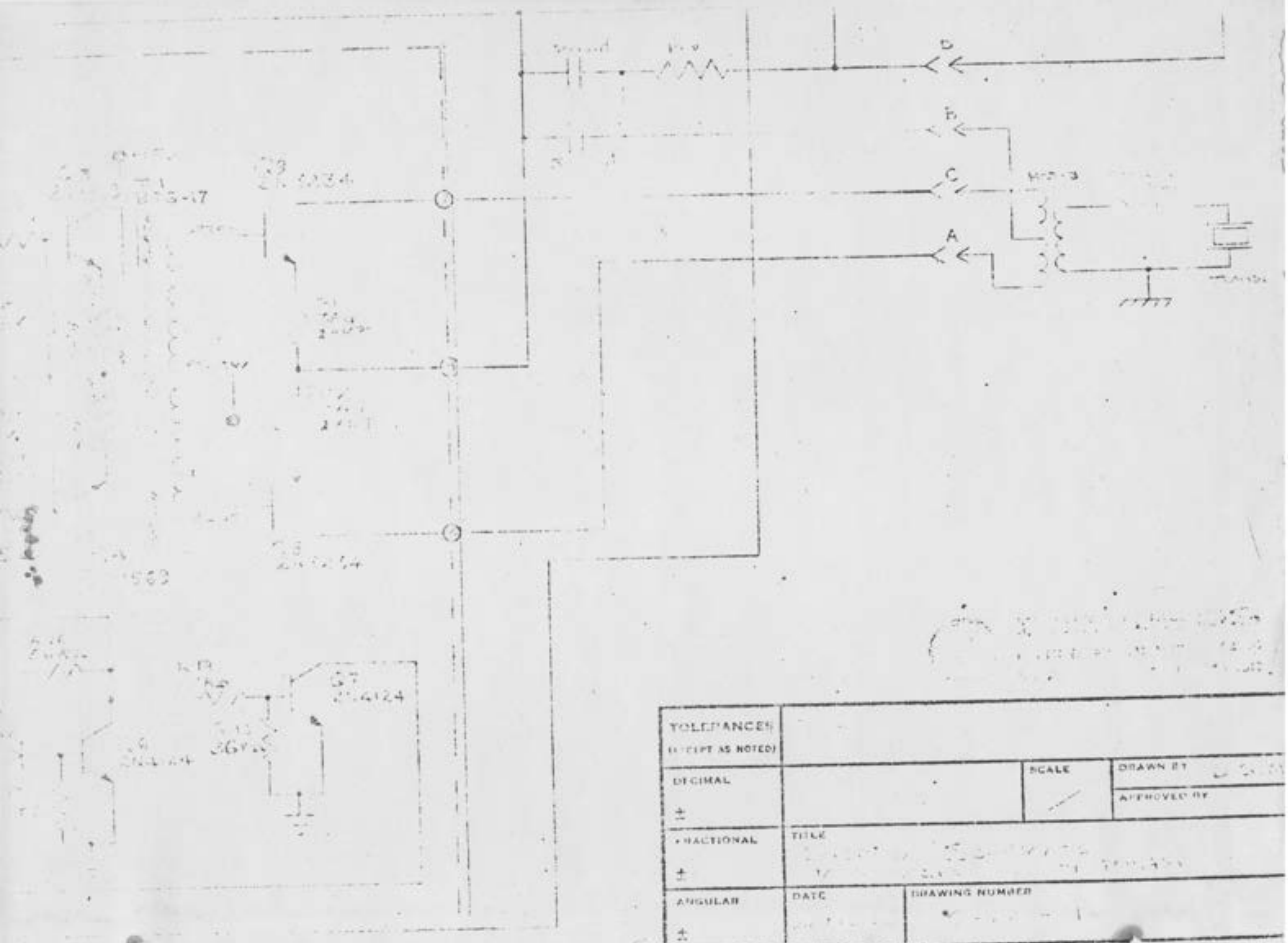
IC1A
IC1B
+5VDC
+15VDC
-15VDC
R1
220KΩ
IC1D
R14
R15
56KΩ
Q5
R17
75KΩ
R10
6.8K



BATTERY
PACK
+15V
-15V
COMMON
K
H
J
F
E
G
CR1
1N462
OPTIONAL
JUMPER




IC1A
IC1B
R1
Q1
Q3
+5VDC
+15VDC
-15VDC
R11
IC1C
R7
R8
Q2
2N4125
15V
IC1D
R14
R15
R13
R12
Q5
2N4124
C1
CR1
1N842
R17
Q6



TOLERANCES (EXCEPT AS NOTED)			
DECIMAL ±		SCALE	DRAWN BY / APPROVED BY
FRACTIONAL ±	TITLE		
ANGULAR ±	DATE	DRAWING NUMBER	