

UNCLASSIFIED

AD NUMBER

AD359204

CLASSIFICATION CHANGES

TO: unclassified

FROM: confidential

LIMITATION CHANGES

TO:

Approved for public release, distribution unlimited

FROM:

Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; MAR 1965. Other requests shall be referred to U.S. Naval Civil Engineering Laboratory, Port Hueneme, CA 93041.

AUTHORITY

USNCBC ltr, 25 Jun 1975; USNCBC ltr, 25 Jun 1975

THIS PAGE IS UNCLASSIFIED

THIS REPORT HAS BEEN DELIMITED  
AND CLEARED FOR PUBLIC RELEASE  
UNDER DOD DIRECTIVE 5200.20 AND  
NO RESTRICTIONS ARE IMPOSED UPON  
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;  
DISTRIBUTION UNLIMITED.

UNCLASSIFIED

AD 359204

CLASSIFICATION CHANGED  
TO: UNCLASSIFIED  
FROM: CONFIDENTIAL  
AUTHORITY:

*USNCBC notice 23 Apr 75*

UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any invention that may in any way be related thereto.

NOTICE:

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTIONS 793 and 794. THE TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

359204

CATALOGED BY: DDG

AS AD NO. \_\_\_\_\_

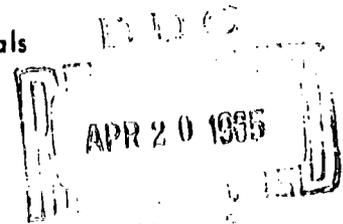
**R 352**

Technical Report

REMOTE INDICATOR SYSTEM FOR  
E21 SERIES AUTOMATIC G-AGENT  
ALARM (U)

24 March 1965

Downgrading at 12-Year Intervals  
Not Automatically Declassified  
DOD DIR 5200.10



U. S. NAVAL CIVIL ENGINEERING LABORATORY

Port Hueneme, California

3 5 9 2 0 4



CONFIDENTIAL

REMOTE INDICATOR SYSTEM FOR E21 SERIES AUTOMATIC G-AGENT ALARM (U)

Y-F011-08-01-151

Type A Final Report

by

L. M. Derr

ABSTRACT

A remote indicating system was developed for incorporation into the Navy's E21 Series Automatic G-Agent Alarm installations so that a number of remote E21 gas-attack alarm units could be monitored at a central control. An alarm sounds at the receiving station when gas is sensed, and a red light indicates the location of the E21 unit that has sensed the gas. As a precaution, a warning indicates the presence of a signal on the assigned radio frequency that may cause either intentional or unintentional jamming of the frequency.

The Remote Indicator System consists chiefly of (1) a transistorized frequency-modulated transmitter mounted in the E21 gas alarm, (2) a transmitting antenna mounted on the gas alarm case, (3) a tone generator producing a modulating tone in the frequency range of 800 to 3600 cps, (4) a programmer to allow time sharing of the frequency by several transmitters, (5) a receiving antenna, (6) a receiving station consisting of one FM radio receiver, 15 Motorola single-tone decoders, one signal-presence indicator, and associated power supplies.

The system was successfully field-tested at a variety of transmitter-to-receiver distances. The maximum distances tested were 4.7 miles over obstructed terrain and 9.8 miles over unobstructed. The transmitter actuated the central alarm in all cases.

Qualified requesters may obtain copies of this report from DDC.  
The Laboratory invites comment on this report, particularly on the  
results obtained by those who have applied the information.

Best Available Copy

## INTRODUCTION

The Bureau of Yards and Docks has approximately 700 E21 Series Automatic G-Agent Alarms operating on station power (115-volt, 60-cycle) or battery power (24-volt). To adequately protect a naval base from gas attack, a number of these units are required and are strategically located at various sites on the base. It is desirable that a remote indicator system be incorporated into this alarm system so that all units may be monitored at a central control. It is further desired that the system be designed along the lines of an inexpensive and compact transistorized wireless transmitter-receiver. Since alarm units may be installed in remote areas where power transmission lines may not be available, it is necessary that a transmitter be installed in or on the alarm. The central control (receiver) should be capable of sounding an alarm upon activation of any of the E21 alarms.

The system should be designed to operate on either 115-volt, 60-cycle station power or 24-volt battery power. The transmission frequency should be based on reliability, range, power requirements, and freedom from interference, and be consistent with other presently operating frequencies. The transmission signal should be coded for identification of individual alarms. The desirable antenna height is 6 to 8 feet, telescoping to 18 inches or less. The unit should be immune to jamming and outside interference.

The task reflecting the above requirements has been undertaken with the following results.\*

## DESIGN AND OPERATION

### The System

The Remote Indicator System for the E21 Series Automatic G-Agent Alarm (Figure 1) consists of a transistorized frequency-modulated transmitter mounted in the E21 gas alarm. When the presence of gas is sensed, the alarm turns on the transmitter. The transmitter is frequency-modulated by a tone supplied from an associated tone generator, in the frequency range of 800 to 3600 cps. The radio signal is transmitted to a receiving station at a central location, such as a switchboard or the base duty office. At the receiving station, an alarm is sounded indicating that gas has been sensed at some location. A red light, actuated by

\* Mr. Joseph C. Quigley assisted in packaging the critical circuitry into a workable unit and fabricated the total system.

12078  
The  
E21  
It's  
12078

...the National  
...of the  
...78 and 79  
...in  
...by law.

CONFIDENTIAL

## CONFIDENTIAL

the tone code, indicates the location of the sensed gas. There are 15 tone decoders in the receiving station spaced 200 cycles apart, giving the system a capacity of 15 alarm units.

### Components

Transmitter. The transmitter (Figure 2) is a fully transistorized FM tone transmitter operating on a carrier frequency of 38.46 mc. The prime consideration in the design of the transmitter was to combine simplicity with reliability. The overall dimensions are 3-7/8 x 2-1/8 x 2-1/4 inches. There is adequate space for mounting directly in the housing of the E21 gas alarm (Figure 3). If later versions of the alarm should be more compact, the transmitter can be attached externally in a weatherproof housing.

The oscillator is crystal-controlled for stability. Frequency modulation is accomplished by varying the capacitive load as seen by the crystal. A voltage-variable capacitor is the device used to vary the capacitive load. This is a solid-state device whose capacity is approximately inversely proportional to the square root of the voltage applied to it. The capacitor is placed in series with the crystal in the oscillator feedback loop. The frequency deviation is about 1.5 kc, which is considered narrow-band FM. The rest of the oscillator circuitry used in the transmitter is standard. It is a Clapp oscillator, using a 2N2951 transistor as the active element. Approximately 0.2 watt of RF power is obtained from the oscillator section. This is coupled from the proper tap on coil L102 via capacitor C201 to the base of Q201, the power amplifier, as shown in the circuit diagram, Figure 4. Front and rear views of the oscillator section are shown in Figure 5.

The power amplifier stage uses a 2N2950 transistor, which is capable of delivering 5 watts at 50 mc. As used in this transmitter it will provide up to 3 watts of RF power with the drive provided by the crystal oscillator. Normally the power output is approximately 0.75 watt. However, by placing a jumper across the 39-ohm (R202) resistor the power output can be increased to 1.5 watts. Placing a jumper across both the 22-ohm (R201) and 39-ohm (R202) resistors will increase the power output to 3 watts. These resistors are shown in Figure 6.

The radio-frequency choke provides a biasing path to the base of the power transistor while isolating it from ground for the RF input signal. The RF tank is a parallel LC circuit with the output taken off from a tap at the proper impedance point to match a quarter-wave vertical antenna. The power transistor is mounted to a heat sink which also serves as a shield between the audio and RF oscillator sections and the power amplifier section.

Tone Generator. The design of the tone generator (Figure 7) was given special consideration from the viewpoint of stability. This was considered necessary because of the possibility of having many closely spaced channels at the receiving station. Also, the alarm unit may be subjected to a severe range of environments such as wide summer-winter temperature variations.

The oscillator uses a unijunction transistor as the active element. An RLC circuit is inserted in place of the normal charging circuit. The LC components are of sufficient Q to produce a sine wave of good quality at a frequency  $F = 1/2\pi\sqrt{LC}$ . Components in the LC circuit must have good temperature-stability characteristics. The capacitors used were Corning "glass caps" having a temperature stability of 10 ppm/°C. The inductor is an adjustable type whose inductance is nominally variable from +200% to -70%; however, only +50% to -70% results in sufficient Q to sustain oscillation with the load presented by the transmitter circuitry. Tests have shown a maximum frequency drift of 6 cps over the temperature range of +28°F to +150°F. Frequency is stable to ±1 cps over a voltage range of 5 to 30 volts.

Programmer. The programmer (Figure 8) provides random time sharing of the transmitting frequency by several transmitters. Time sharing is necessary because reliable actuation of tone decoders in the receiving station is not possible with more than one transmitter on at one time.

The programmer turns the transmitter on for a period of 2 seconds and off for an adjustable period of 3 to 20 seconds. The minimum off period of 3 seconds is adequate if two E21 alarms are used as a protective system, with longer off times required if more alarms are used.

Timing circuits in the programmer use two unijunction transistor (UJT) relaxation oscillator circuits as time generators and a silicon-controlled rectified (SCR) as the power-switching element. (Refer to Figure 9.)

When voltage is applied to the programmer, capacitor C401 charges via resistors R401 and R402 to fire UJT Q401. The firing time is determined by the values of C401, R401, and R402 and is variable from 5 to 22 seconds with the setting of potentiometer R401. When Q401 fires, a positive pulse appears at B<sub>1</sub> which is coupled via C402 to the trigger electrode of the switching element SCR Q402, causing it to conduct and turn on the transmitter. When Q402 is in a conducting state its cathode becomes positive with respect to ground. This allows C404 to charge via R406 to the firing potential of Q403. This charging time, determined by the values of C404 and R406, is approximately 2 seconds. A positive pulse developed at B<sub>1</sub> when Q403 fires is coupled via C403 to the cathode of Q402, momentarily raising its potential above that of the anode, thus causing conduction to cease and turning the transmitter off. Meanwhile C401 is again charging to repeat the above cycle. Capacitor C405 provides a fast charging path to turn on the transmitter the moment voltage is applied to the programmer. Without it the initial actuation of the transmitter would be delayed by the charging time of C401.

Antennas. The transmitting antenna is a telescoping quarter-wave vertical antenna mounted on the E21 gas alarm case. The extended length is 7 feet and the telescoped length is 1 foot. In situations where coverage is difficult because of

## CONFIDENTIAL

buildings, terrain, etc., it may be necessary to use a vertical antenna with ground plane mounted at some greater height. The receiving antenna is an omnidirectional vertical antenna with ground plane, mounted at sufficient height to present a clear view of all transmitting antennas.

Receiver. The receiving station consists of one FM radio receiver, Motorola Model N0TANB-1100A; one Motorola AC power supply, Model P-8531, to operate the receiver and one to operate the tone decoders; 15 Motorola single-tone decoders, Model P9309; and one signal-presence indicator, NCEL design. Front and rear views of the receiving station are shown in Figures 10 and 11.

The Motorola receiver is designed to receive signals on a fixed frequency in the 25-mc to 50-mc band. The frequency of this unit is 38.46 mc, the frequency assigned to NCEL for radio support of Laboratory projects. The receiver is fixed-tuned to the desired frequency. It is a dual-conversion superheterodyne FM receiver with crystal-controlled local oscillators. The temperature of the control crystal (first local oscillator) is regulated by a thermostatically controlled heating element for maximum stability.

The receiver is based on standard FM operational principles. The basic circuit consists of an RF amplifier, a first local oscillator, a first mixer, a first IF amplifier, a second local oscillator, a second mixer, four second IF amplifiers, two limiters, a discriminator, a squelch circuit, and two stages of audio amplification. The only modifications made to the receiver were:

1. Removal of the 180-kilohm resistor (R92) across the secondary of L21, the discriminator coil. This narrowed the bandwidth of the discriminator from 20 kc to 15 kc and thus produced a larger demodulated signal from the narrow-band FM alarm transmitters.
2. Tapping into the rectified noise voltage developed at pin 5 of tube V312A to obtain a sensing voltage for the operation of the signal-presence indicator.

The modifications are shown in the receiver schematic diagram, Figure 12.

Some of the specifications of the receiver are:

Selectivity:	-100 db at $\pm$ 30 kc
Spurious response:	-100 db
Sensitivity:	Less than 0.4 $\mu$ v for 20-db quieting Less than 0.3 $\mu$ v for RETMA usable sensitivity
Channel spacing:	20 kc
Audio output:	1.0-watt to a 3.2-ohm load
Nominal power input:	200 volts at 80 ma 6.3 volts at 3.5 amp

Dimensions:	4-7/8" wide x 5-1/4" high x 16-1/2" long
Weight:	9 lb (less power supply and housing)
Mounting:	19" rack

The Motorola Model P-8531 AC-operated power supply is designed to provide all of the voltages required to operate the Motorola receiver. The primary power source is 117-volt, 60-cycle, single-phase. Output ratings are 200 volts DC at 60 milliamperes and 6.3 volts AC at 3.5 amperes.

The power supply for the 15 single-tone decoder units, identical to the power supply for the receiver, was modified by removing the 11-prong power plug and replacing it with a standard Octal plug. This was done to prevent a mixup in connections to the power supplies. See Figure 13.

A center-tapped 12-volt AC filament transformer supplies voltage to the green and red indicator lights.

Decoder. The Motorola P-9303 single-tone decoder consists primarily of a DC relay, two tubes, an input transformer, and a series-tuned LC circuit. All components are mounted on a single chassis and are protected by a dust cover. The complete assembly including dust cover is 5 inches high, 1-7/8 inches wide, and 7-3/4 inches long. It is designed to operate in conjunction with any standard receiver. The 3.2-ohm output of the standard receiver is fed to the input of the decoder. When the single-frequency signal to which the decoder is tuned is received, the relay on the decoder operates and provides a circuit-closure function. This circuit is connected to a visual and audible alarm. Refer to the schematic diagram, Figure 14, for circuit details of the decoder.

The primary winding of input transformer T1 on the decoder has an electrical center tap. The standard receiver output is connected to this point through a jumper connected across normally closed contacts of alarm relay K1. One end of the input transformer is connected to ground through variable resistor R1. The other end of the transformer is connected to ground through capacitance-inductance circuit L1 and C1, which is capable of being series-resonated at any frequency between 600 and 3200 cps with the exception of those frequencies between 800 and 850 cps.

Operation With "On-Frequency" Tone Signal: When a signal to which the decoder is aligned is fed to transformer T1, the current through both halves of the primary winding are equal and opposite in phase. Therefore, no voltage is induced into the secondary winding. However, the current flow through the series-resonant circuit of L1 and C1 causes a voltage to appear across L1. This voltage is rectified by V1-B, filtered by R3 and C4, and the negative resultant voltage is applied to the grid (pin 2) of V2-A. The negative voltage drives tube V2-A into cutoff.

## CONFIDENTIAL

When tube V2-A is cut off, capacitors C5 and C6 start to charge toward the B+ potential. As the voltage applied to the grid (pin 7) of V2-B increases, sufficient current flows in the cathode circuit to cause relay K1 to energize. As the voltage applied to the grid of V2-B increases, current flows in the grid circuit. This current flow causes a voltage drop across resistors R5, R7, and R10, which limits the grid current to a safe value.

When relay K1 is energized, the circuit connected to Alarm Control jack J1 is closed, thereby completing the external alarm circuit. The other pair of form "A" contacts connects B+ to the relay coil through resistor R8. This locks on the relay and holds the alarm circuit contacts closed until the receiver is reset. The form "C" contacts complete the circuit from the standard receiver output to the speaker. The normally closed pair of these contacts is jumpered to prevent the receiver output from being disconnected from the decoder.

When so connected, either one of two methods for resetting the decoder may be used. The power to the standard equipment may be turned off, or the external push-button switch may be depressed, which will momentarily ground the black lead of the input cable.

Operation With "Off-Frequency" Tone Signals: When the tone signal fed to the center tap of transformer T1 is not on the frequency to which the single-tone receiver is aligned, there is an unequal division of energy. The result is a greater current flow through the upper half of T1. Triode V1-A, connected to the transformer, rectifies the secondary current and a positive voltage is developed across C3. At the same time, triode V1-B, connected in the resonant circuit (C1 and L1), rectifies the voltage appearing across L1, and a negative voltage appears across C4. The resultant of these two opposite voltages is applied to the grid of V2-A, a DC amplifier. With signals moderately or far off frequency, the resultant voltage applied to V2-A is always either positive or else insufficiently negative to cut V2-A off. When V2-A is not cut off, the voltage drop across R5 (4.7 megohms) is very high, the grid voltage of V2-B is relatively low, there is no increase in plate-cathode current (V2-B), and relay K1 therefore does not operate.

The decoder is designed so that the voltage applied to V1-A with signals off frequency is approximately equal the voltage developed across L1 with signals on frequency. The method of deriving the resultant output voltage from the input signal is termed "differential selectivity." The circuit is designed so that the bandwidth does not change with amplitude of input signal. False operation due to voice, harmonics, or noise signals is almost impossible with the differential selectivity principle.

To simplify wiring to warning lights, the following modifications were made in the decoder and are shown in Figure 14: (1) R6 was removed, (2) the orange wire from the center terminal of J1 was removed and connected instead to pin 9 of V2, and (3) a length of wire was connected from the reset terminal of K1 to the center terminal of J1.

CONFIDENTIAL

Signal-Presence Indicator. Task instructions called for the Remote Indicator System to operate on radio frequencies and to be immune to enemy jamming; in fact, this could be quite an undertaking and a major investigation by itself, but it was felt that if a frequency were assigned for the exclusive use of the system, the presence of any signal on this frequency could be considered, for warning purposes, either the presence of gas or an attempt to jam the system. The signal presence indicator (Figure 15) was designed to provide a warning if there should be any signal present on the assigned frequency. The unit is simply a DC relay amplifier intended to operate from the squelch voltages developed in the receiver. (See Figure 16.) When a signal is received on the gas alarm frequency, a red warning light and a buzzer are turned on.

**TESTS**

Field tests of the transmitter were made using the telescoping quarter-wave vertical antenna. Initial tests consisted of activating the transmitter at remote areas of the Construction Battalion Center, Port Hueneme. With the transmitter placed on the ground, tests were made to see if the units would activate the alarm in the receiving station. All tests were made with the receiving antenna at a 45-foot height, which was sufficient to clear nearby buildings.

The transmitter activated the alarm from all points on the base. The maximum distance was 2-1/4 miles. Tests were then made at a variety of places off the base using an RF power output of 0.75 watt, with results as follows:

<u>Location</u>	<u>Distance (miles)</u>	<u>Evaluation</u>
(1) Point 1/2 mile east of Hwy 101 on Pleasant Valley Road	4.3	Actuation ok
(2) Point 1-1/2 mile east of Hwy 101 on Pleasant Valley Road	5.3	Actuation not reliable; approximately 50% actuation of receiver
(3) Hwy 101 and Nauman Road	4.7	Actuation ok
(4) Hwy 101 and Hueneme Road	5.3	Not reliable; 50% actuation
(5) Mugu Rock	9.8	Actuation ok

## CONFIDENTIAL

The site at Mugu Rock presented a clear view of the receiving antenna, and the path was about two-thirds over water. The other sites were flat terrain with trees and buildings in the path.

Tests were made to determine the minimum and maximum frequencies at which the tone decoders actuated. The input voltage to the decoders was set at 3.2 volts peak to peak. Results are tabulated below:

<u>Tone Decoder Frequency (cps)</u>	<u>Minimum Frequency (cps)</u>	<u>Maximum Frequency (cps)</u>
800	700	822
1000	904	1077
1200	1104	1282
1400	1341	1447
1600	1501	1681
1800	1724	1866
2000	1922	2061
2200	2137	2278
2400	2327	2470
2600	2535	2671
2800	2726	2877
3000	2927	3065
3200	3123	3270
3400	3327	3467
3600	3526	3668

The tone generator was tested to determine frequency stability with a change of applied voltage. Measurements were made at three frequency settings of one unit over a voltage range of 5 to 30 volts. The results showed a maximum frequency change of 3 cycles per second with no change at the expected operating voltage of 20 to 25 volts:

<u>Applied Voltage</u>	<u>F<sub>1</sub> (cps)</u>	<u>F<sub>2</sub> (cps)</u>	<u>F<sub>3</sub> (cps)</u>
5	667	1005	1266
15	667	1006	1266
20	666	1006	1266
25	666	1006	1266
30	654	1006	1266

Temperature-stability tests were made on one tone generator at three temperatures, with the following results:

<u>Temperature (°F)</u>	<u>Frequency (cps)</u>
+150	985
+75	988
+28	991

### CONCLUSIONS

The Remote Indicator System will provide an alarm at a central receiving station and will indicate the location of an E21 Series gas alarm that has been actuated by gas. In addition it will provide a warning if there is a signal present on the assigned frequency that may cause either intentional or unintentional jamming of the frequency. The transmitting unit will operate in a greater environmental range than can be tolerated by the E21 alarm unit. The power requirements are compatible with the alarm unit, as the current requirements are no greater than that of the E21 lamp and buzzer replaced by the transmitter. No standby power is necessary.

### RECOMMENDATIONS

The design of any transmitter is determined to a great extent by the choice of operating frequency. Therefore an appropriate frequency assignment should be made to the Remote Indicator System before any units are constructed. The Laboratory-assigned frequency of 38.46 mc was used for the design of prototype units, and a deviation of more than 2 or 3 mc from this will necessitate a change of component values in the units; however, any frequency between 5 and 50 mc will not require a change of basic design. It is also worthwhile to note that the receiving station was left on and monitored for several weeks with considerable base traffic on the frequency, and at no time did these transmissions falsely activate the alarm. This shows the possibility of sharing the frequency already assigned for some other purposes. However, the shared frequency should be limited to one not vital to defense during emergency such as a gas attack, because the alarm transmitters may interfere with emergency operations.

The Remote Indicator System has other applications than indicating the presence of gas at a remote location. One example is the signaling at a central control of fires in unattended buildings. It is therefore recommended that consideration be given to adapting the system to signal other events in addition to signaling the presence of gas.

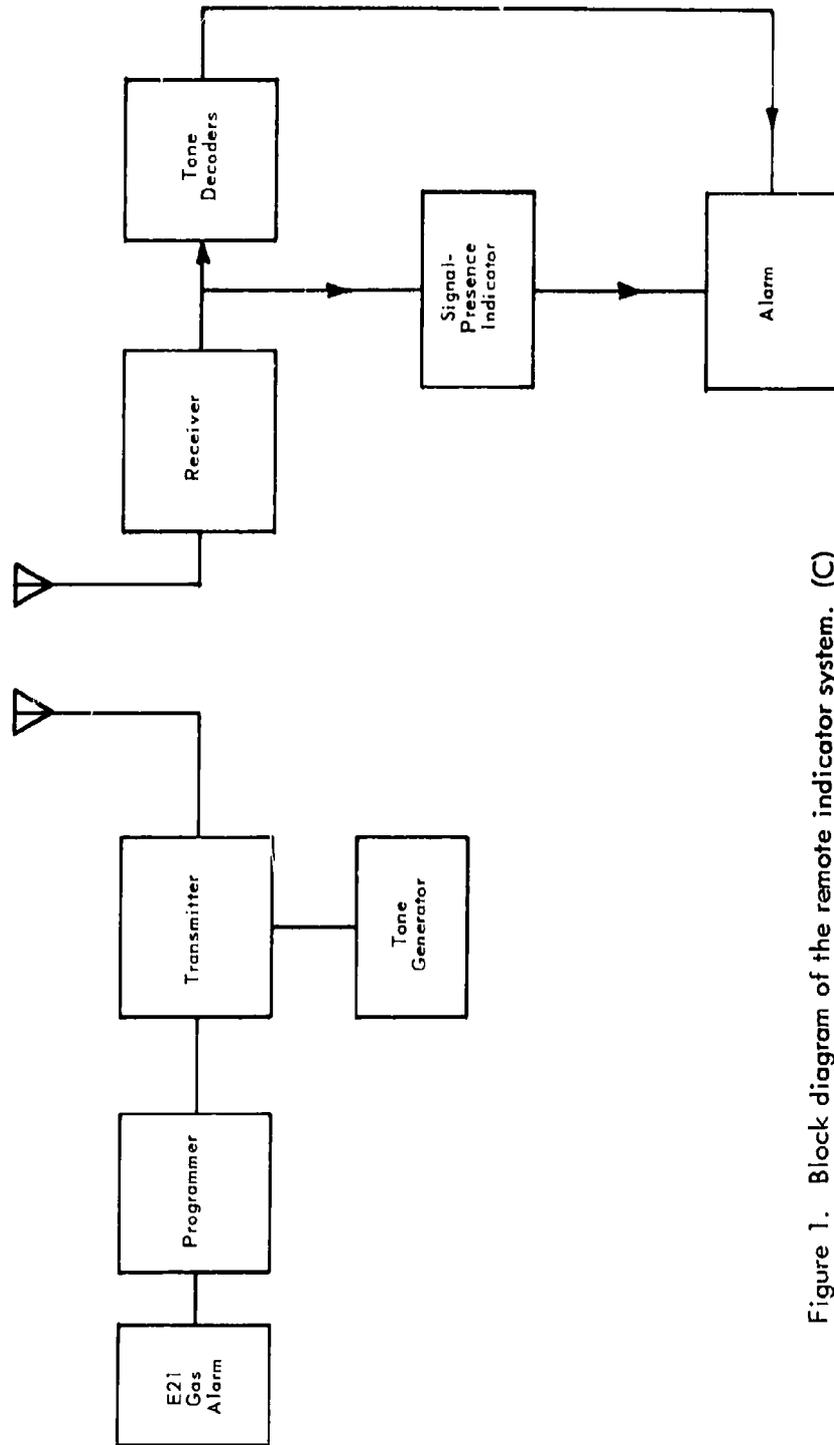


Figure 1. Block diagram of the remote indicator system. (C)

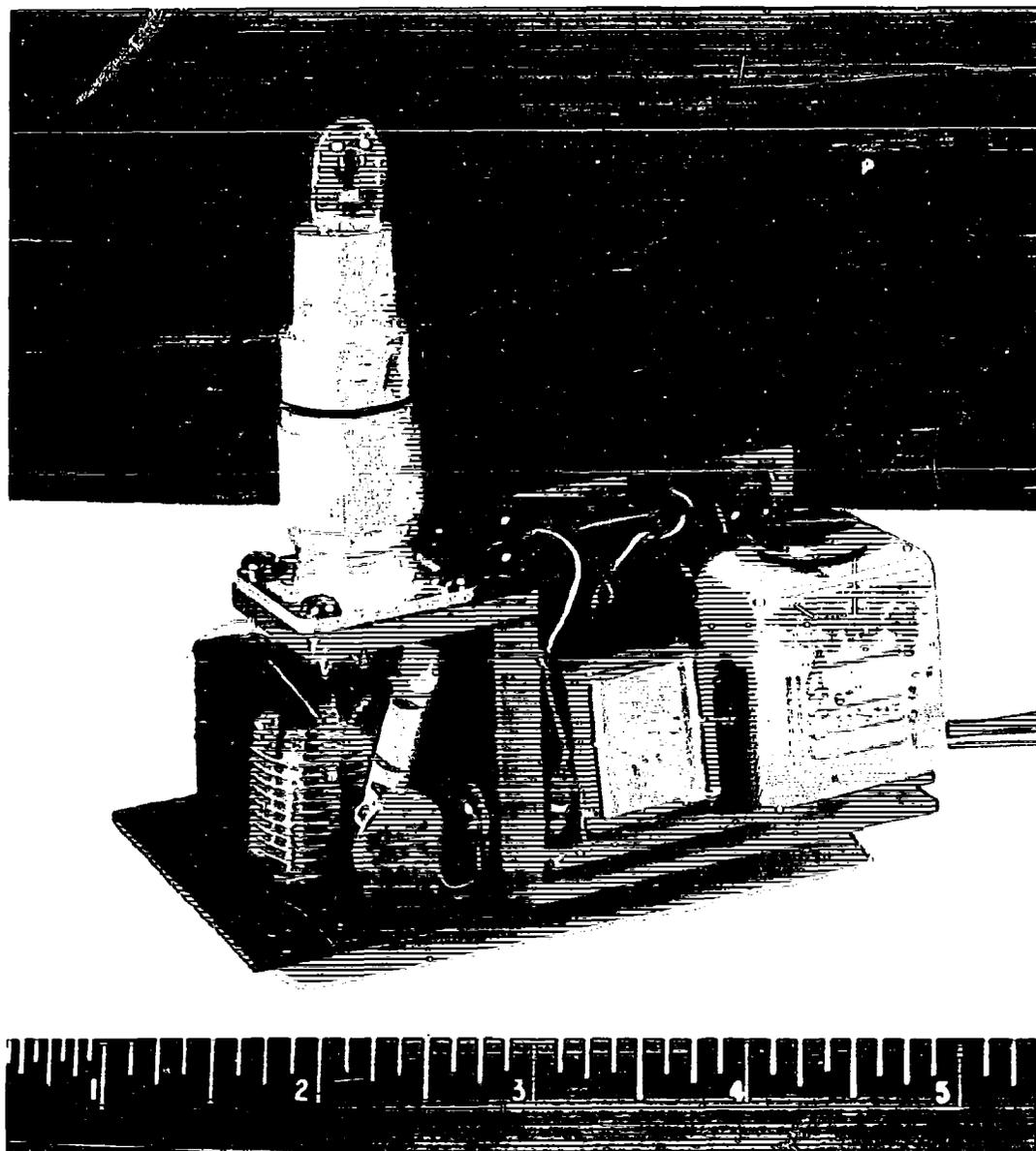


Figure 2. Transmitting unit with dummy antenna load. (C)

**CONFIDENTIAL**

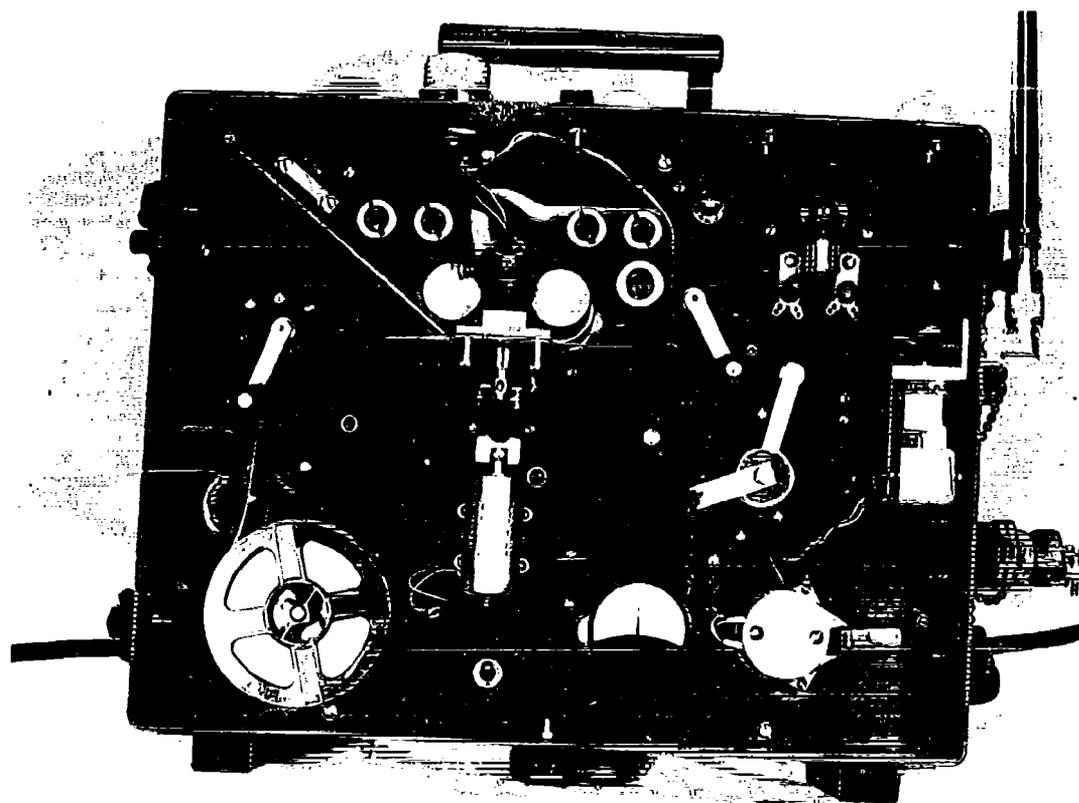


Figure 3. Transmitting unit mounted in E21 gas alarm. (C)

**CONFIDENTIAL**

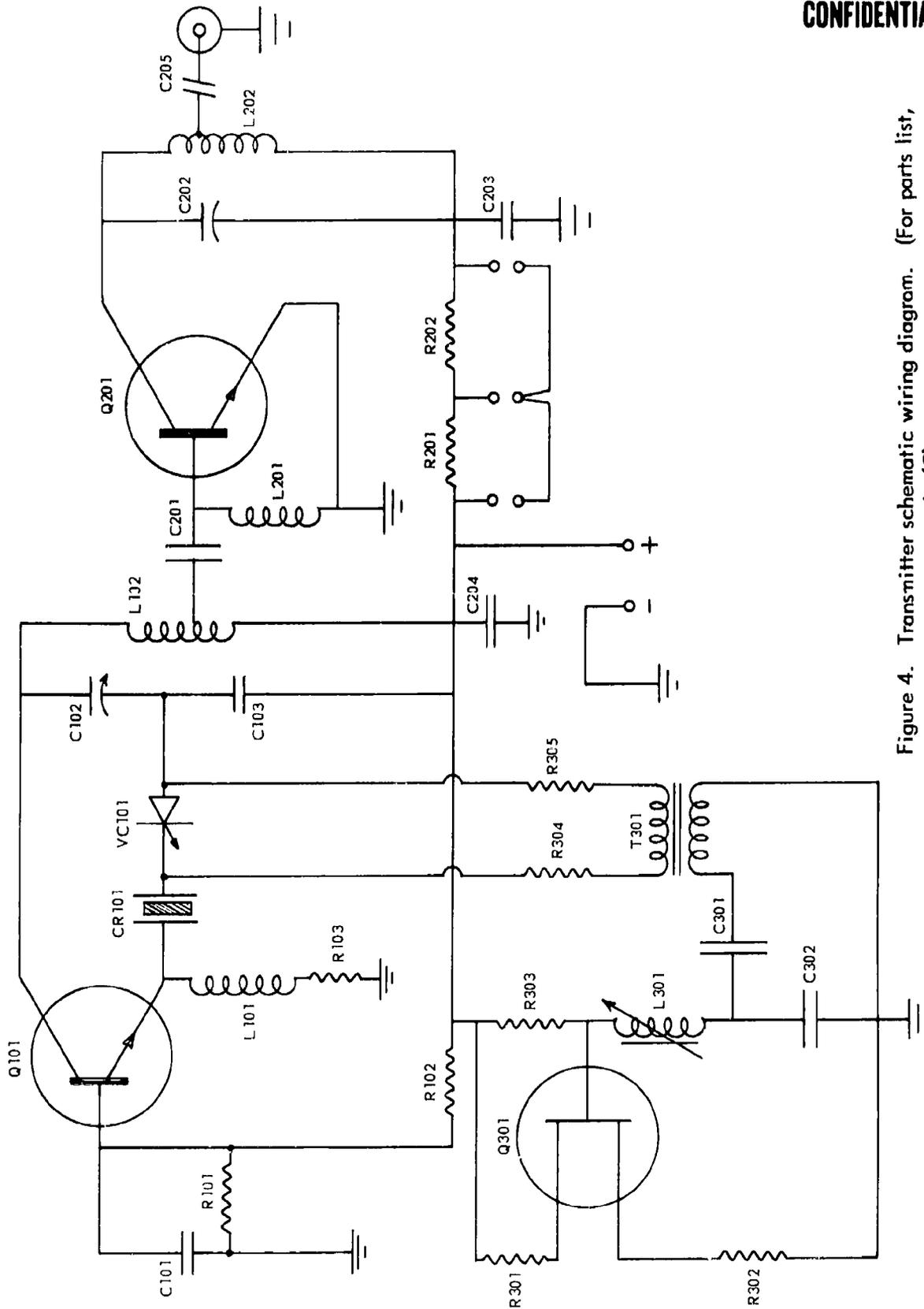
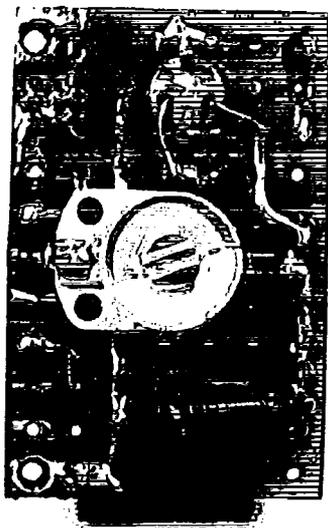


Figure 4. Transmitter schematic wiring diagram. (For parts list, see Appendix.) (C)

CONFIDENTIAL



(a)

(b)

Figure 5. Transmitter oscillator section: (a) front, (b) rear. (C)

CONFIDENTIAL

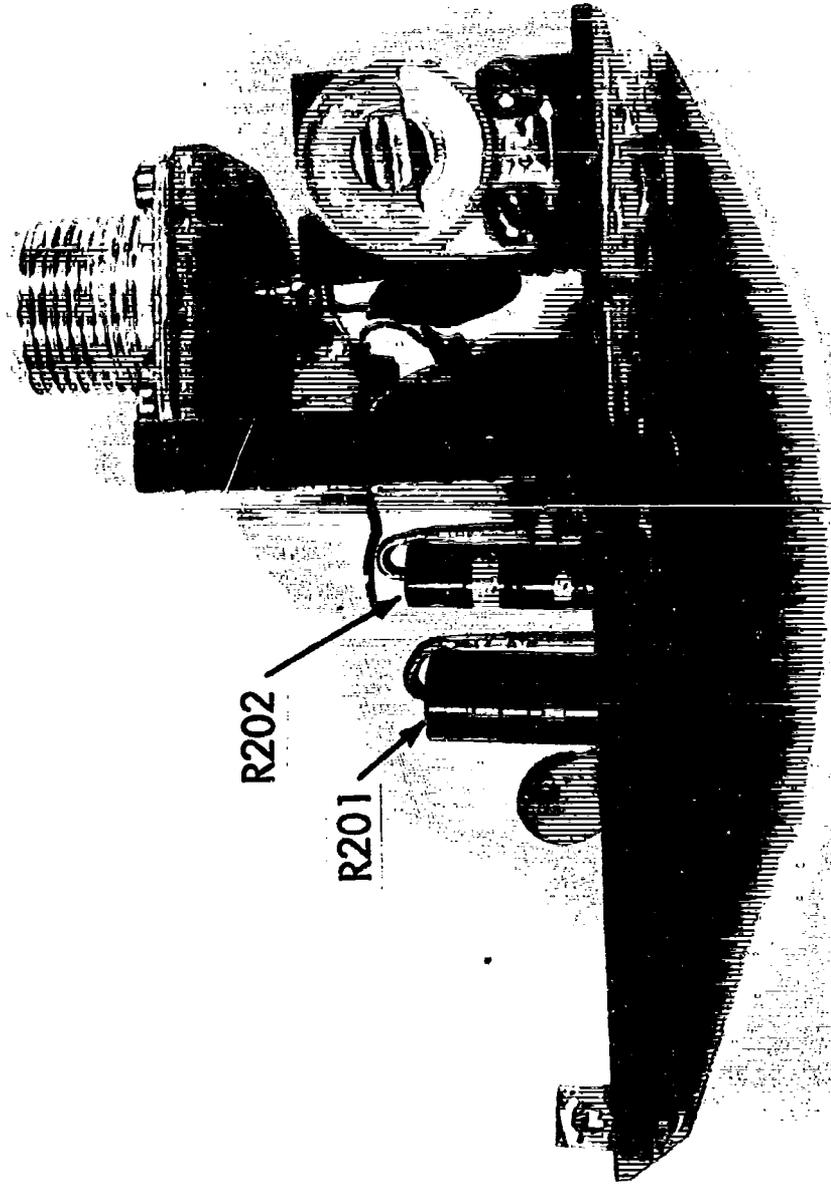


Figure 6. Transmitter power-amplifier section. (C)

CONFIDENTIAL

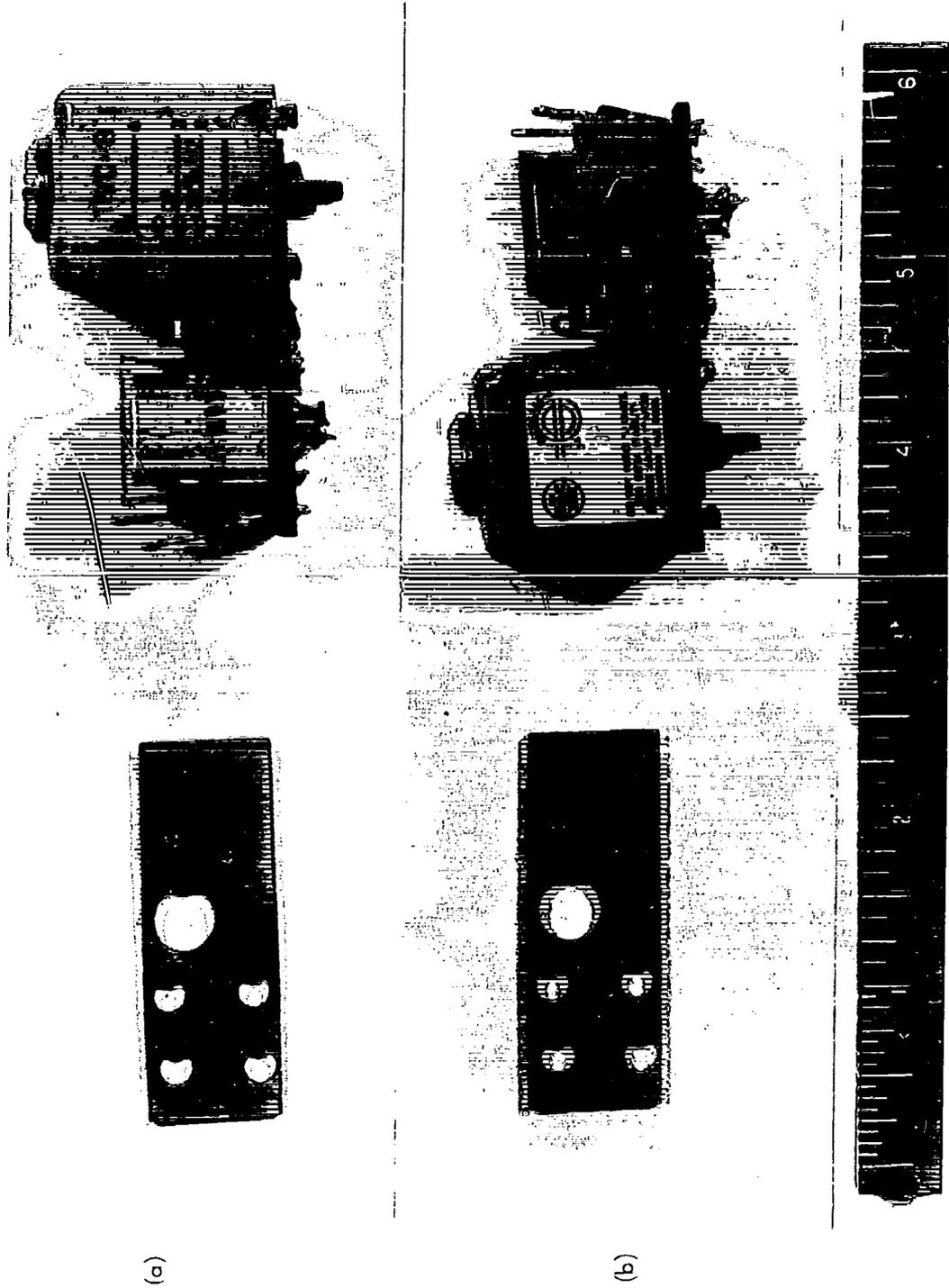


Figure 7. Tone generator: (a) front, (b) rear. (C)

CONFIDENTIAL

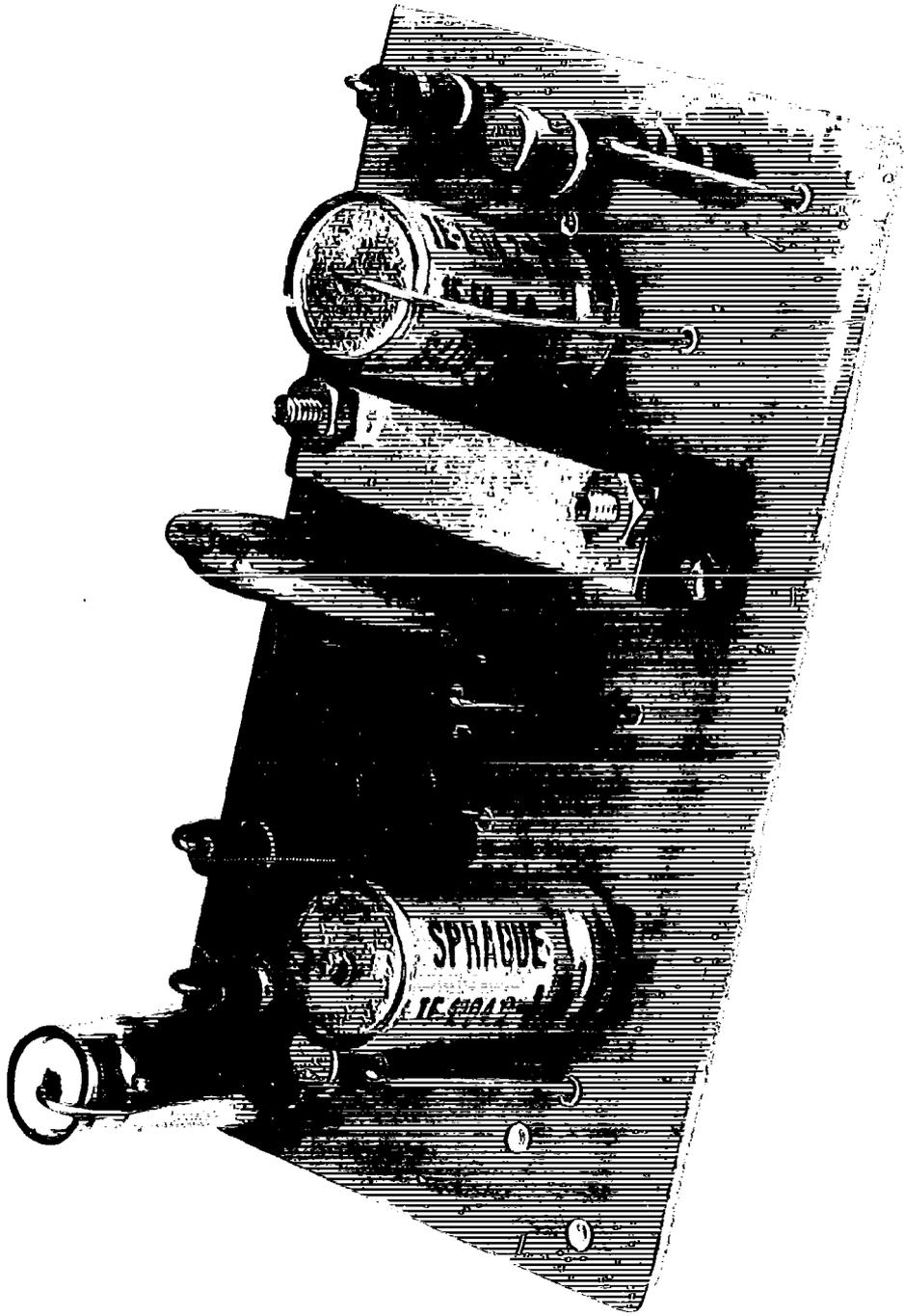


Figure 8. Top view of the transmitter programmer. (C)

CONFIDENTIAL

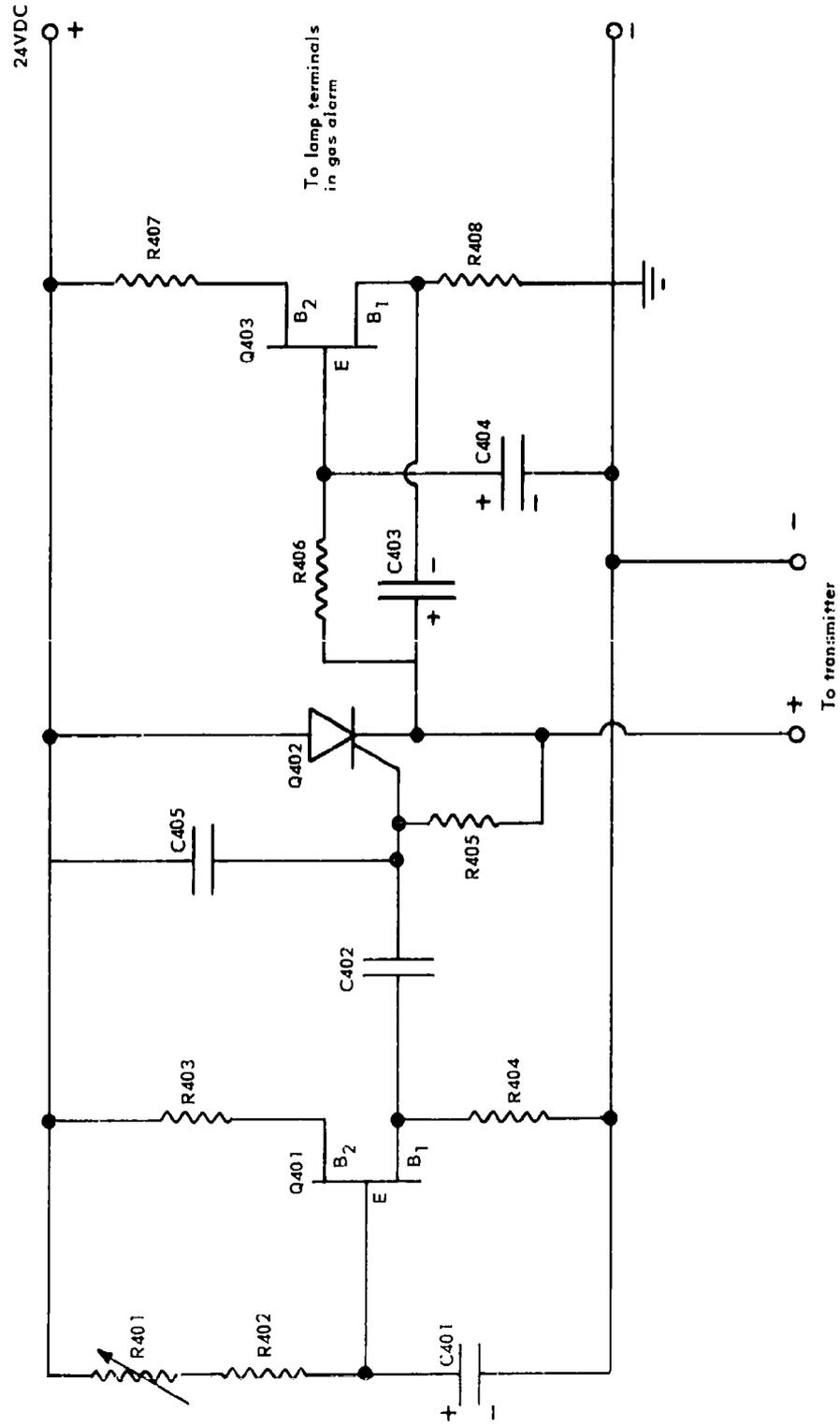


Figure 9. Transmitter programmer schematic wiring diagram. (For parts list, see Appendix.) (C)

CONFIDENTIAL

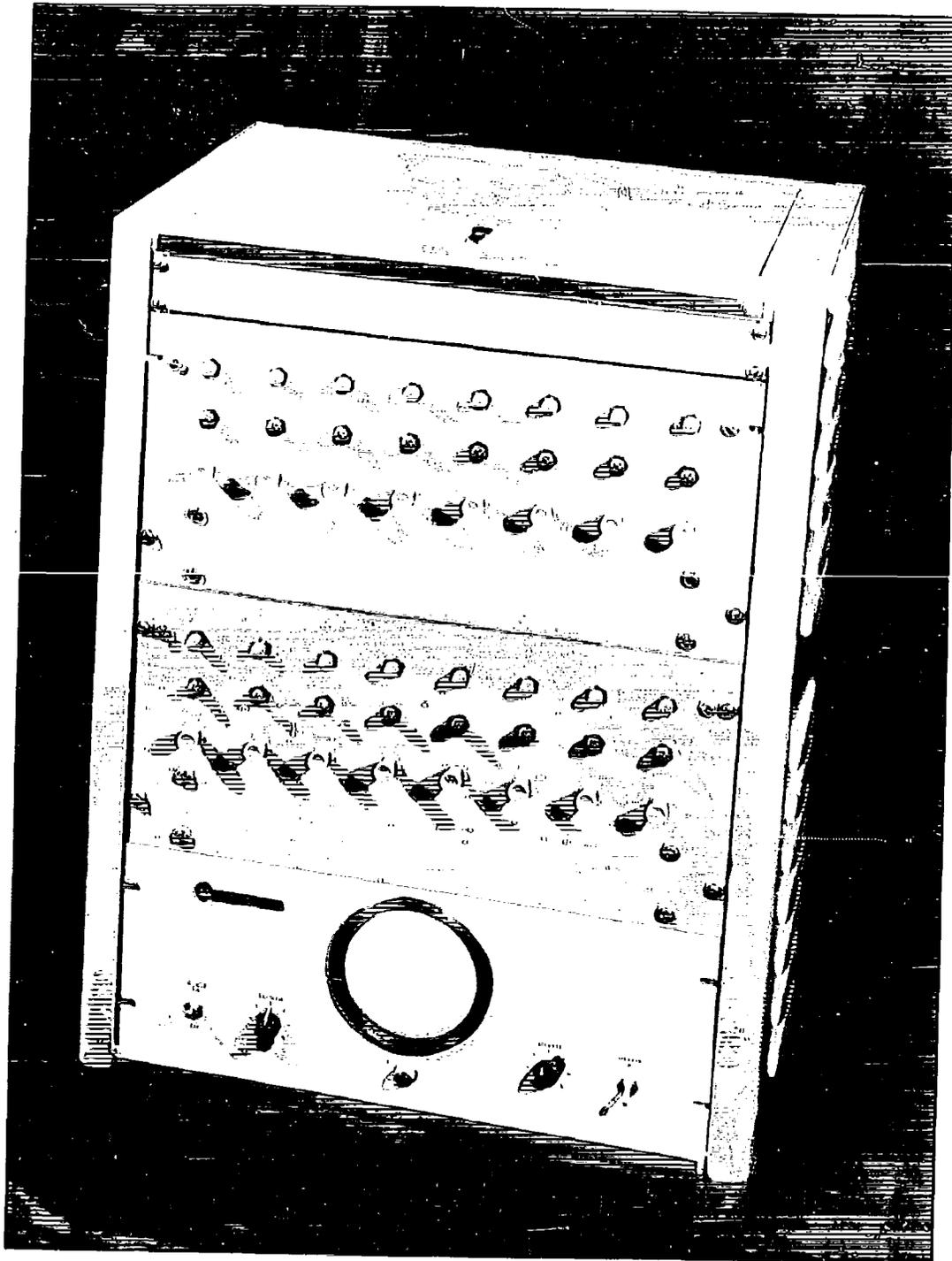


Figure 10. Front view of the receiving station. (C)

CONFIDENTIAL

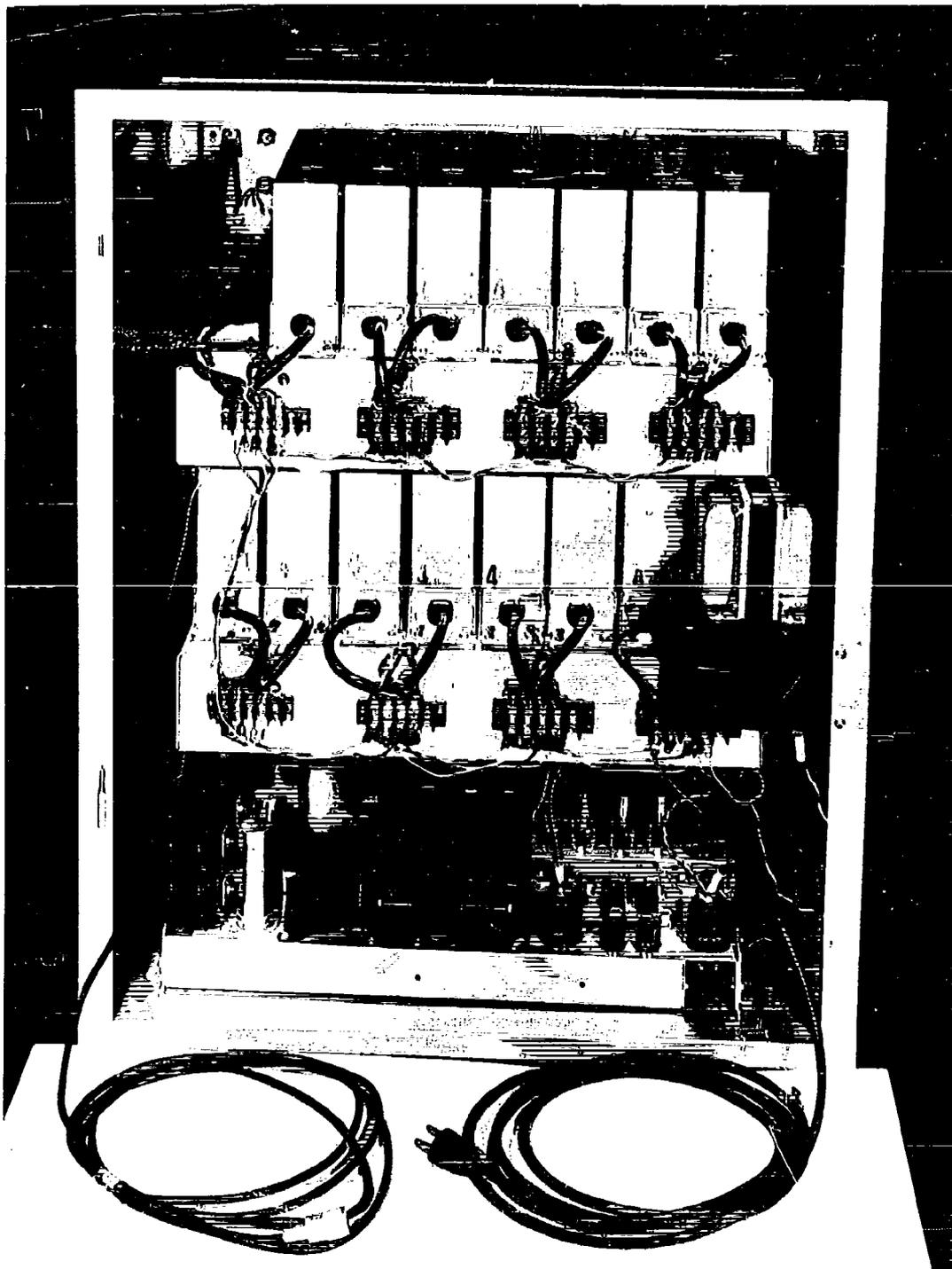
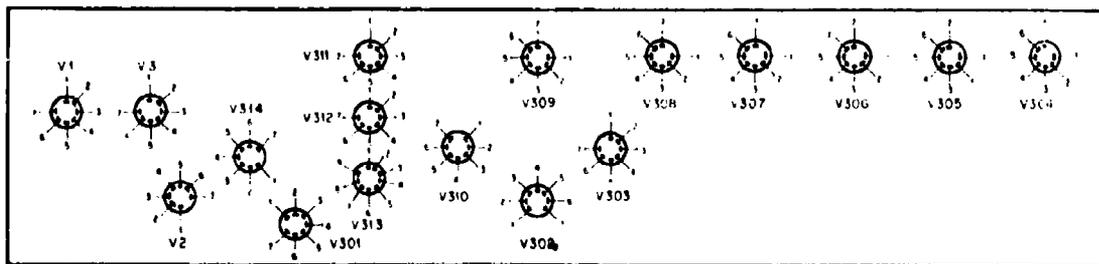
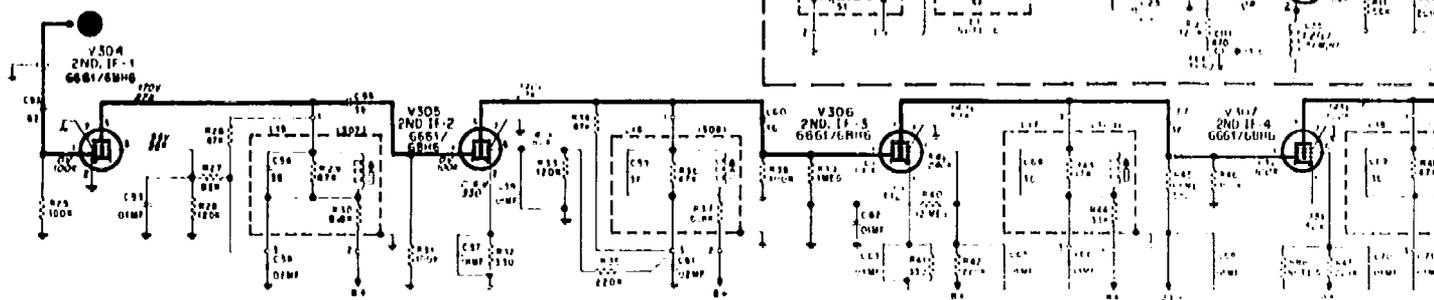
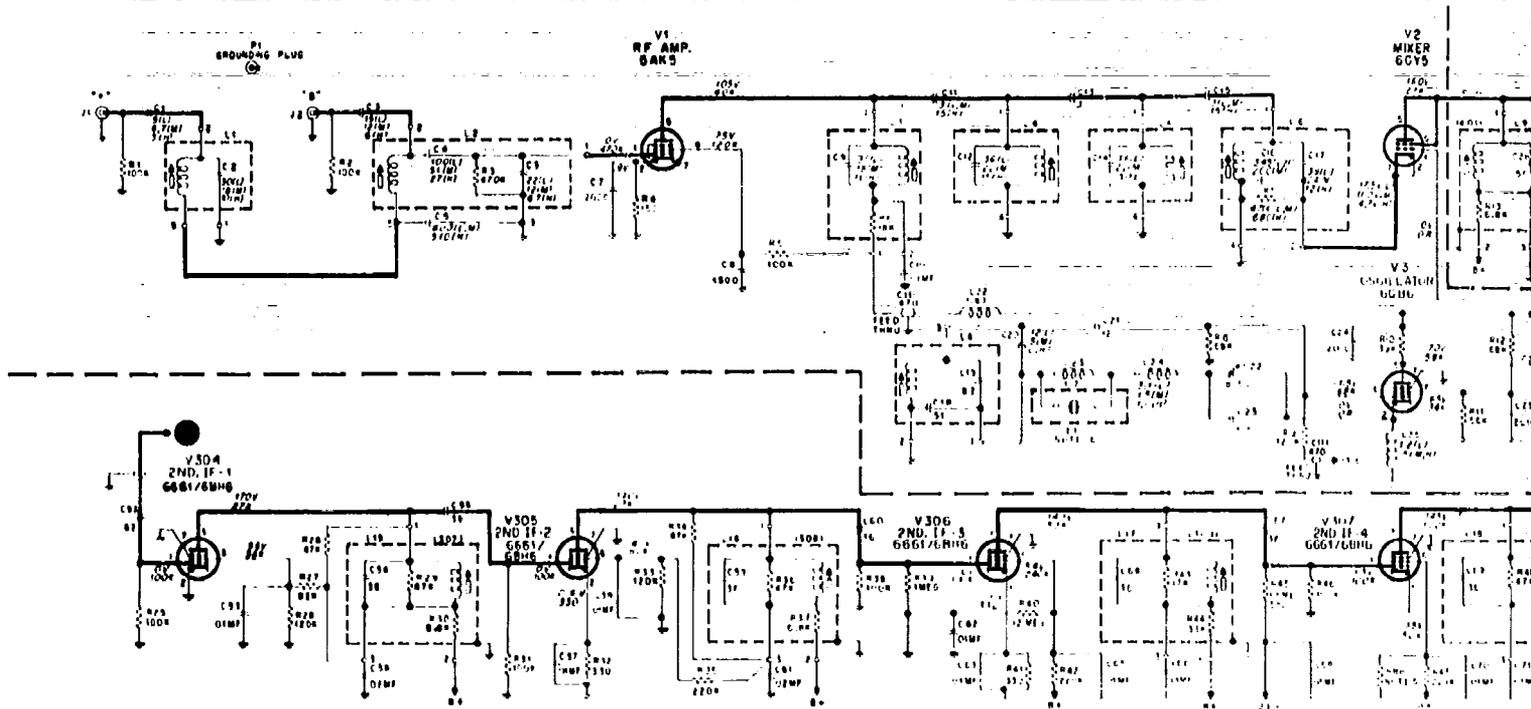


Figure 11. Rear view of the receiving station. (C)

CONFIDENTIAL



BOTTOM VIEW OF CHASSIS



Figure 12.

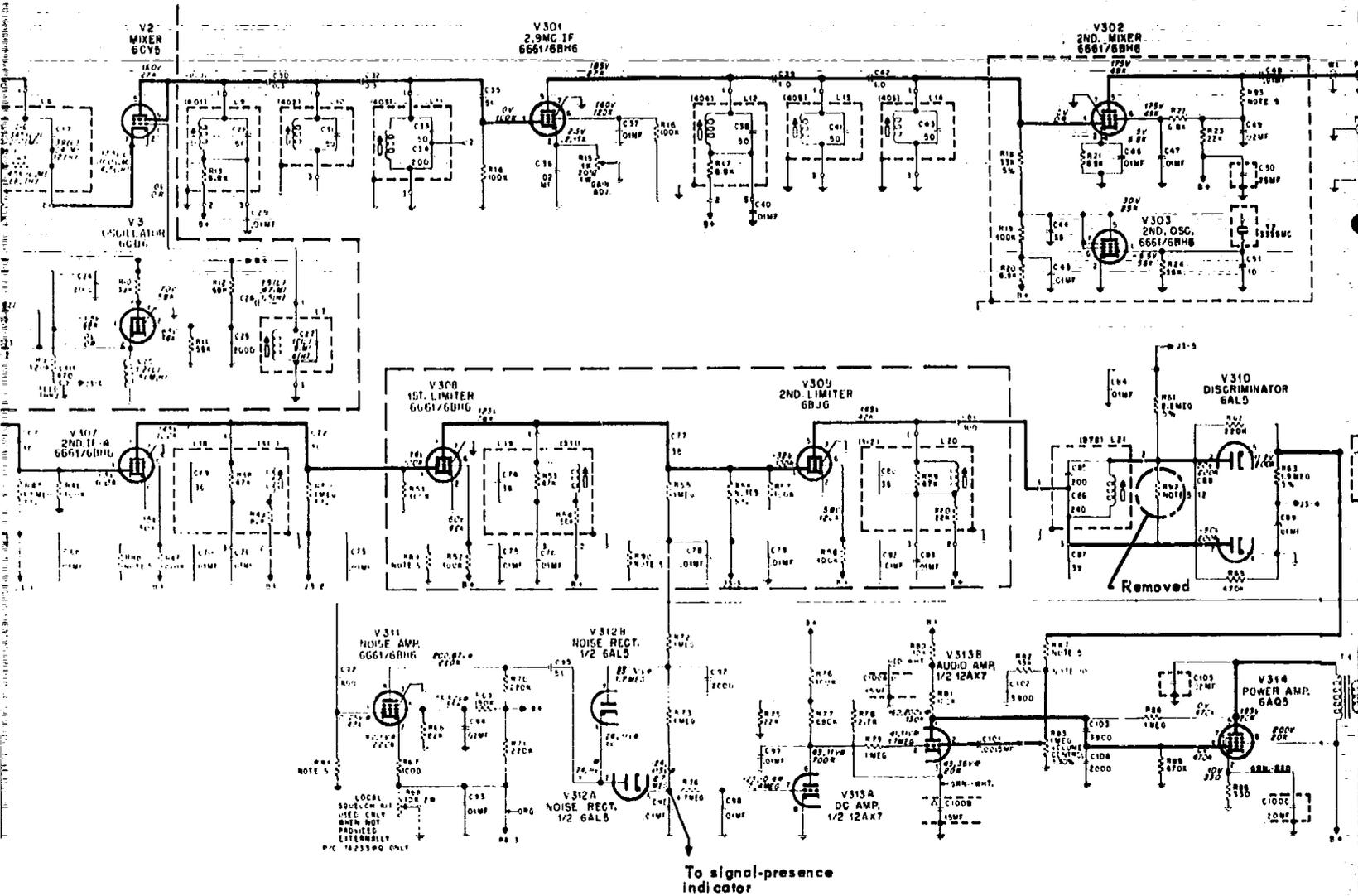
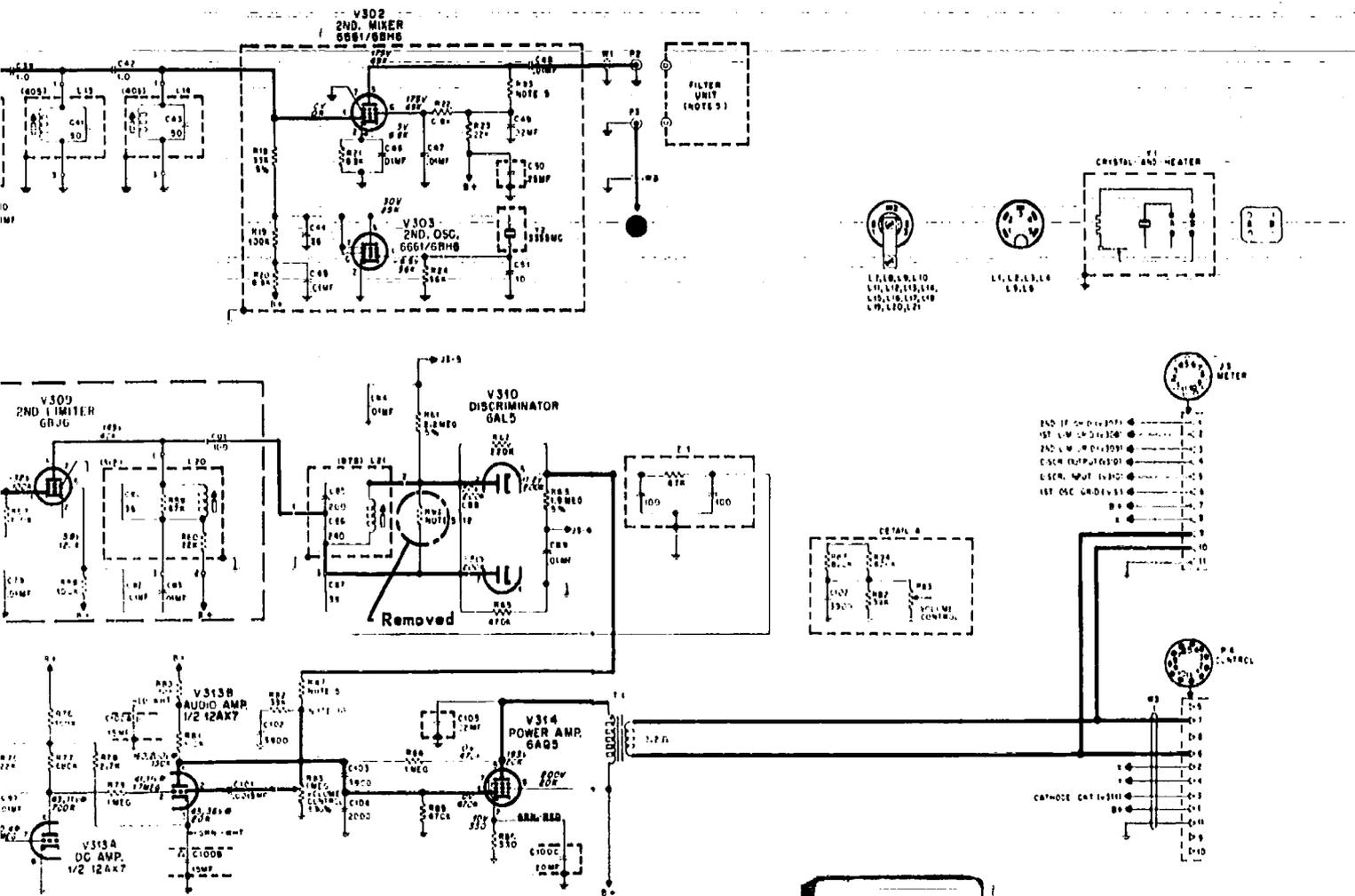


Figure 12. Receiver schematic wiring diagram. (C)





presence



CONFIDENTIAL

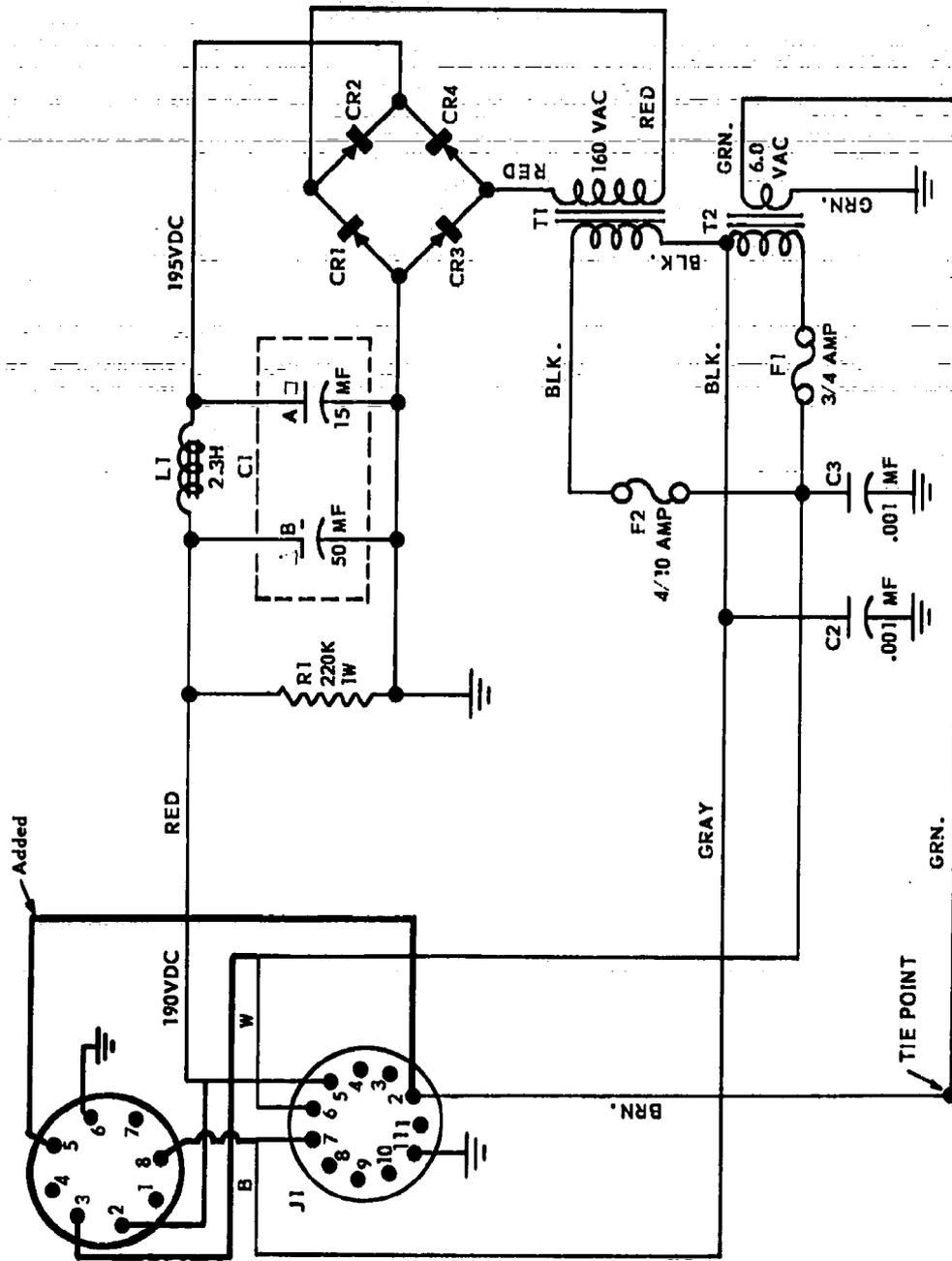


Figure 13. AC power supply schematic wiring diagram. (C)

CONFIDENTIAL

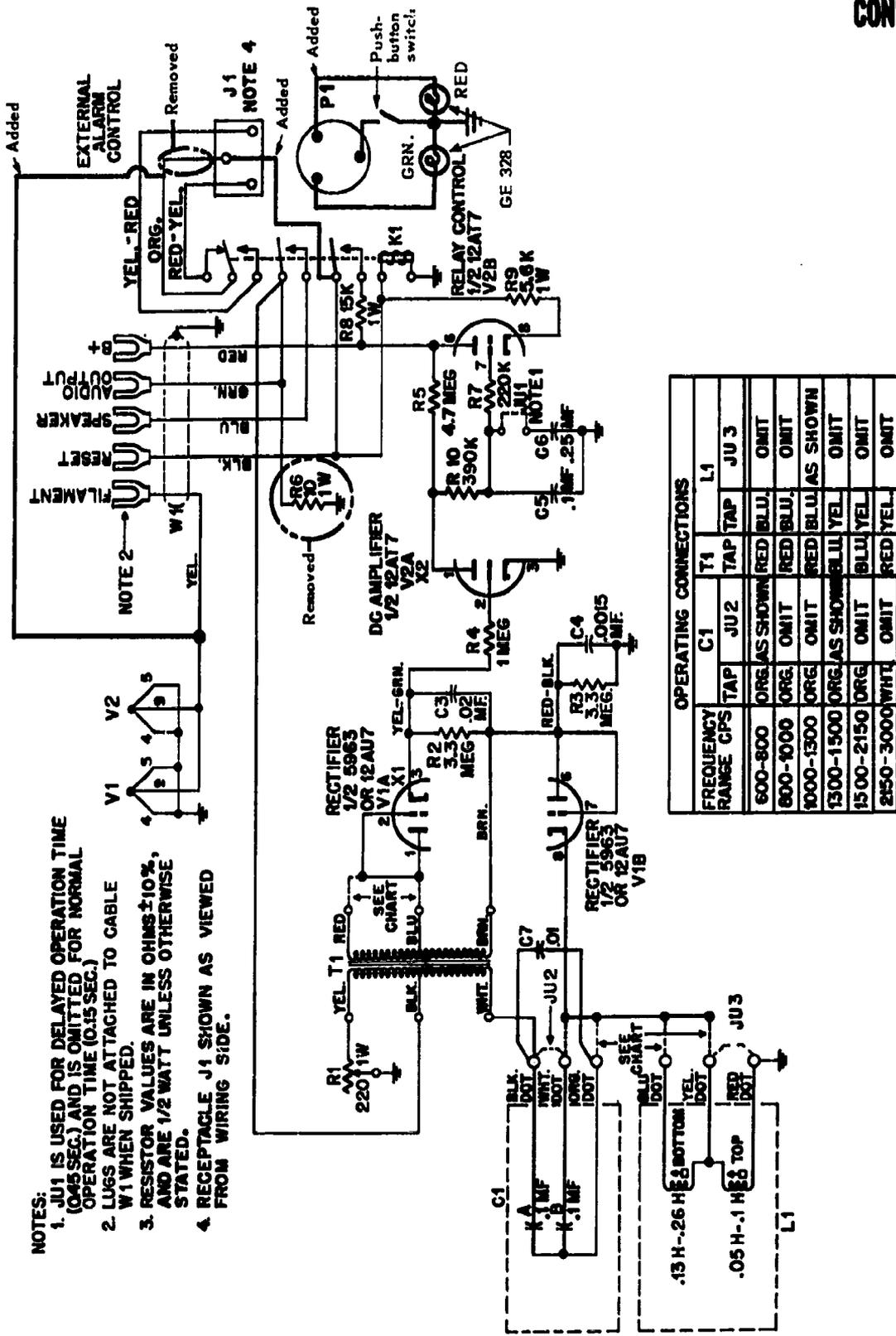
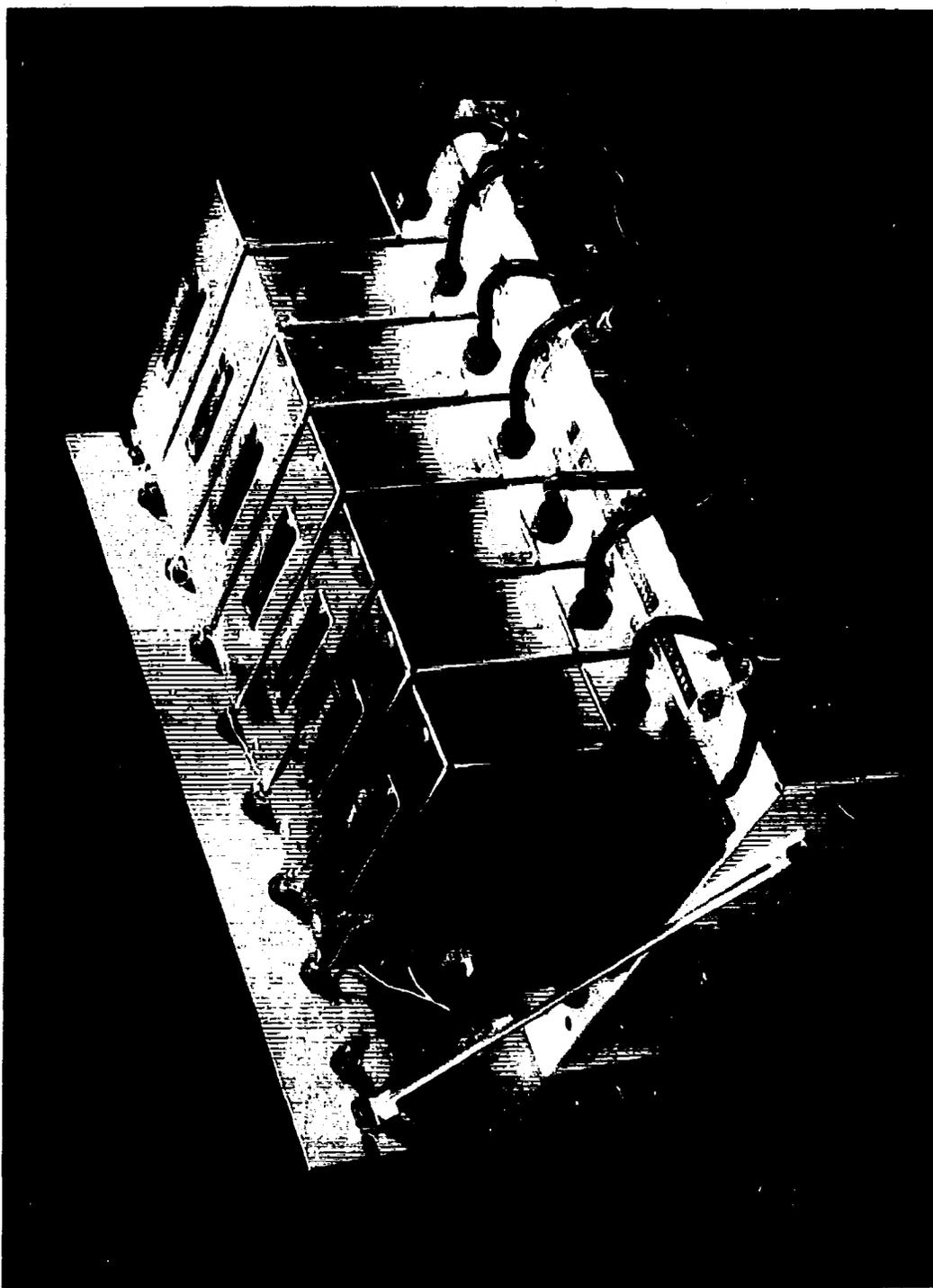


Figure 14. Tone decoder schematic wiring diagram. (C)

**CONFIDENTIAL**



**Figure 15. Rear view of the top section of the receiving station showing seven tone-decoder units and the signal-presence indicator. (C)**

**CONFIDENTIAL**

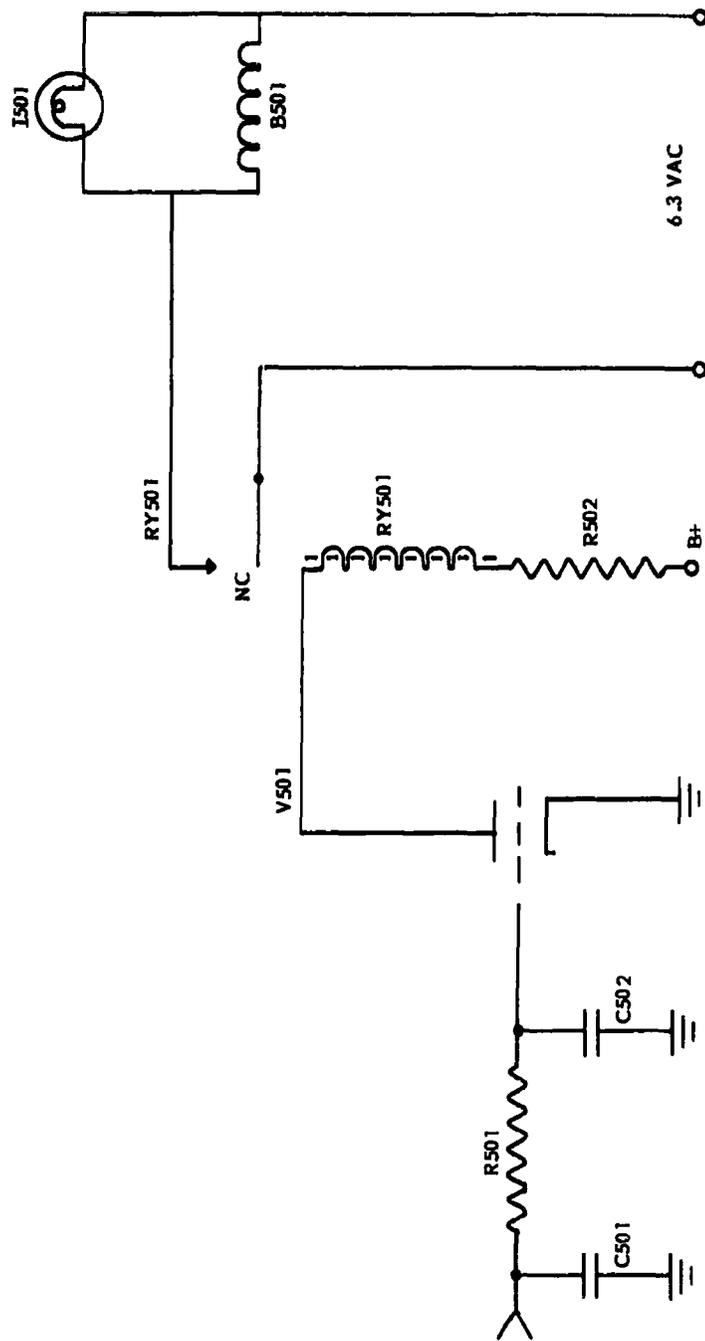


Figure 16. Signal-presence indicator schematic wiring diagram. (For parts list, see Appendix.) (C)

CONFIDENTIAL

CONFIDENTIAL

**CONFIDENTIAL**

**Appendix**  
**PARTS LISTS**

**CONFIDENTIAL**

Reference Symbol	Manufacturer	Part Number	Description
TRANSMITTER			
R101	Ohmite	Little Devil Series	2.2-k $\Omega$ , 5%, 1/2-watt composition resistor
R102	Ohmite	Little Devil Series	18-k $\Omega$ , 5%, 1/2-watt composition resistor
R103	Ohmite	Little Devil Series	75-ohm, 5%, 1/2-watt composition resistor
R201	Ohmite	Little Devil Series	22-ohm, 5%, 2-watt composition resistor
R202	Ohmite	Little Devil Series	39-ohm, 5%, 2-watt composition resistor
R301	Ohmite	Little Devil Series	390-ohm, 5%, 1/2-watt composition resistor
R302	Ohmite	Little Devil Series	51-ohm, 5%, 1/2-watt composition resistor
R303	Ohmite	Little Devil Series	6.8-k $\Omega$ , 5%, 1/2-watt composition resistor
R304	Ohmite	Little Devil Series	500-k $\Omega$ , 5%, 1/2-watt composition resistor
R305	Ohmite	Little Devil Series	500-k $\Omega$ , 5%, 1/2-watt composition resistor
Antenna	Motorola	NAB 6090 A	Collapsible antenna, frequency 38.46 mc
C101	Sprague	10TS-S10	0.01- $\mu$ f temperature-stable capacitor, 1000 WVDC
C102	Centralab	CV11D450	7 to 45- $\mu$ f variable capacitor
C103	Sprague	10TS-T10	100- $\mu$ f temperature-stable capacitor, 1000 VDC
C201	Sprague	10TS-T12	120- $\mu$ f temperature-stable capacitor, 1000 VDC
C202	Centralab	CV11D450	7 to 45- $\mu$ f variable capacitor

Reference Symbol	Manufacturer	Part Number	Description
C203	Sprague	10TS-S10	0.01- $\mu$ f temperature-stable capacitor, 1000 WVDC
C204	Sprague	10TS-S10	0.01- $\mu$ f temperature-stable capacitor, 1000 WVDC
C205	Sprague	10TS-S10	0.01- $\mu$ f temperature-stable capacitor, 1000 WVDC
C301	Coming Glass	CYFM	Temperature-stable capacitor (value depends on tone channel)*
C302	Coming Glass	CYFM	Temperature-stable capacitor (value depends on tone channel)*
L101	J. W. Miller Co.	70 f 103A1	1-mh RF choke, subminiature
L102	J. W. Miller Co.	4590	0.68- $\mu$ h choke tapped 2 turns from cold end
L201	J. W. Miller Co.	70 f 103A1	1-mh RF choke, subminiature
L202	Brown & Williamson		Miniductor, 1/2" dia, 16 turns/in., 8 turns
L301	United Transformer Corp.	TVC 6 or TVC 8	Variable inductor (value depends on tone channel)*
T301	Triad	SP-4	Transformer, miniature primary 200,000-ohm CT secondary 1000-ohm CT
Q101	Motorola	2N2951	Transistor

\* Tone Frequency (cps)

Tone Frequency (cps)	C301 ( $\mu$ f)	C302 ( $\mu$ f)	L301
660-1260	0.01	0.01	TVC 8
750-1800	0.0051	0.0051	TVC 8
1775-2775	0.0051	0.0051	TVC 6
2350-3750	0.0033	0.0033	TVC 6

Reference Symbol	Manufacturer	Part Number	Description
Q201	Motorola	2N2950	Transistor
Q301	Texas Inst.	2N1671A	Transistor
CR101	International Crystal Mfg Co.	FA-9	3rd overtone crystal, 38.46 mc
VC101	Pacific Semiconductor Co.	VC-33	Voltage-variable capacitor, 33 $\mu$ f
TRANSMITTER PROGRAMMER			
R401	Bourns	272-1-105	1-M $\Omega$ potentiometer
R402	Ohmite	Little Devil Series	330-k $\Omega$ , 5%, 1/2-watt composition resistor
R403, R407	Ohmite	Little Devil Series	390-ohm, 5%, 1/2-watt composition resistor
R404	Ohmite	Little Devil Series	27-ohm, 5%, 1/2-watt composition resistor
R405	Ohmite	Little Devil Series	68-ohm, 5%, 1/2-watt composition resistor
R406	Ohmite	Little Devil Series	270-k $\Omega$ , 5%, 1/2-watt composition resistor
R408	Ohmite	Little Devil Series	56-ohm, 5%, 1/2-watt composition resistor
C401, C403	Sprague	TE-1304.2	15- $\mu$ f, 50-VDC electrolytic capacitor
C402	Sprague	TG-S20	0.02- $\mu$ f, 50-VDC capacitor
C404	Sprague	TE-1302.1	4- $\mu$ f, 50-VDC electrolytic capacitor
C405	Sprague	TG-S10	0.01- $\mu$ f, 50-VDC capacitor
Q401, Q403	General Electric	2N2646	Unijunction transistor
Q402	General Electric	2N2328	Silicon-controlled rectifier

Reference Symbol	Manufacturer	Part Number	Description
<b>SIGNAL-PRESENCE INDICATOR</b>			
R501	Ohmite	Little Devil Series	4.7-M $\Omega$ , 5%, 1/2-watt composition resistor
R502	Ohmite	Little Devil Series	15-k $\Omega$ , 5%, 2-watt composition resistor
V501	RCA	12AU7	Vacuum tube
C501	Sprague	10TS-S10	0.01- $\mu$ f temperature-stable capacitor, 1000 WVDC
C502	Sprague	10TS-S10	0.01- $\mu$ f temperature-stable capacitor, 1000 WVDC
RY501	Guardian	54874	Relay
B501	Edwards	730	Buzzer
I501	General Electric	328	Lamp

**CONFIDENTIAL**

**DISTRIBUTION LIST**

<b>SNDL Code</b>	<b>No. of Activities</b>	<b>Total Copies</b>	
	1	10	Chief, Bureau of Yards and Docks (Code 42)
<b>A2A</b>	1	1	Chief of Naval Research - Only
<b>A3</b>	2	2	Chief of Naval Operation (OP-07, OP-04)
<b>E4</b>	1	2	Laboratory ONR (Washington, D. C. only)
<b>E5</b>	1	1	Research Office ONR (Pasadena only)
<b>J84</b>	1	1	School Postgraduate
	1	1	Deputy Chief of Staff, Research and Development, Headquarters, U. S. Marine Corps, Washington, D. C.
	1	1	Chief of Staff, U. S. Army, Chief of Research and Development, Department of the Army, Washington, D. C.
	1	1	Chief of Engineers, Department of the Army, Washington, D. C., Attn: Engineering Research and Development Division
	1	1	Air Force Weapons Laboratory, Kirtland Air Force Base, Albuquerque, N. M., Attn: Code WLRC
	1	1	Deputy Chief of Staff, Development, Director of Research and Development, Department of the Air Force, Washington, D. C.
	1	20	Defense Documentation Center, Building 5, Cameron Station, Alexandria, Va.
	1	2	Director of Defense Research and Engineering, Department of Defense, Washington, D. C.
	1	2	U. S. Army Engineer Research and Development Laboratories, Attn: STINFO Branch, Fort Belvoir, Va.
	1	5	Commanding Officer, U. S. Naval Civil Engineering Laboratory, Port Hueneme, Calif. Attn: Code L31
	1	1	U. S. Army Chemical Corp Research and Development Command, Chemical Warfare Laboratories, Army Chemical Center, Md.

**CONFIDENTIAL**

U. S. Naval Civil Engineering Laboratory  
REMOTE INDICATOR SYSTEM FOR E21 SERIES AUTOMATIC  
G-AGENT ALARM (U), by I. M. Derr

TR-352 39 p. illus 24 Mar 65 Confidential  
I. Y-F011-08-01-151

1. Alarm - Gas-attack

A remote indicating system was developed for incorporation into the Navy's E21 Series Automatic G-Agent Alarm installations so that a number of remote E21 gas-attack alarm units could be monitored at a central control. An alarm sounds at the receiving station when gas is sensed, and a red light indicates the location of the E21 unit that has sensed the gas. As a precaution, a warning indicates the presence of a signal on the assigned radio frequency that may cause either intentional or unintentional jamming of the frequency.

The Remote Indicator System consists chiefly of (1) a transistORIZED frequency-modulated transmitter mounted in the E21 gas alarm, (2) a transmitting antenna mounted on the gas alarm case, (3) a tone generator producing a modulating tone in the frequency range of 800 to 3600 cps, (4) a programmer to allow time sharing of the frequency by several transmitters, (5) a receiving antenna, (6) a receiving station consisting of one FM radio receiver, 15 Motorola single-tone decoders, one signal-presence indicator, and associated power supplies.

The system was successfully field-tested at a variety of transmitter-to-receiver distances. The maximum distances tested were 4.7 miles over obstructed terrain and 9.8 miles over unobstructed. The transmitter actuated the central alarm in all cases.

Card CONFIDENTIAL

U. S. Naval Civil Engineering Laboratory  
REMOTE INDICATOR SYSTEM FOR E21 SERIES AUTOMATIC  
G-AGENT ALARM (U), by I. M. Derr

TR-352 39 p. illus 24 Mar 65 Confidential  
I. Y-F011-08-01-151

1. Alarm - Gas-attack

A remote indicating system was developed for incorporation into the Navy's E21 Series Automatic G-Agent Alarm installations so that a number of remote E21 gas-attack alarm units could be monitored at a central control. An alarm sounds at the receiving station when gas is sensed, and a red light indicates the location of the E21 unit that has sensed the gas. As a precaution, a warning indicates the presence of a signal on the assigned radio frequency that may cause either intentional or unintentional jamming of the frequency.

The Remote Indicator System consists chiefly of (1) a transistORIZED frequency-modulated transmitter mounted in the E21 gas alarm, (2) a transmitting antenna mounted on the gas alarm case, (3) a tone generator producing a modulating tone in the frequency range of 800 to 3600 cps, (4) a programmer to allow time sharing of the frequency by several transmitters, (5) a receiving antenna, (6) a receiving station consisting of one FM radio receiver, 15 Motorola single-tone decoders, one signal-presence indicator, and associated power supplies.

The system was successfully field-tested at a variety of transmitter-to-receiver distances. The maximum distances tested were 4.7 miles over obstructed terrain and 9.8 miles over unobstructed. The transmitter actuated the central alarm in all cases.

Card CONFIDENTIAL

U. S. Naval Civil Engineering Laboratory  
REMOTE INDICATOR SYSTEM FOR E21 SERIES AUTOMATIC  
G-AGENT ALARM (U), by I. M. Derr

TR-352 39 p. illus 24 Mar 65 Confidential  
I. Y-F011-08-01-151

1. Alarm - Gas-attack

A remote indicating system was developed for incorporation into the Navy's E21 Series Automatic G-Agent Alarm installations so that a number of remote E21 gas-attack alarm units could be monitored at a central control. An alarm sounds at the receiving station when gas is sensed, and a red light indicates the location of the E21 unit that has sensed the gas. As a precaution, a warning indicates the presence of a signal on the assigned radio frequency that may cause either intentional or unintentional jamming of the frequency.

The Remote Indicator System consists chiefly of (1) a transistORIZED frequency-modulated transmitter mounted in the E21 gas alarm, (2) a transmitting antenna mounted on the gas alarm case, (3) a tone generator producing a modulating tone in the frequency range of 800 to 3600 cps, (4) a programmer to allow time sharing of the frequency by several transmitters, (5) a receiving antenna, (6) a receiving station consisting of one FM radio receiver, 15 Motorola single-tone decoders, one signal-presence indicator, and associated power supplies.

The system was successfully field-tested at a variety of transmitter-to-receiver distances. The maximum distances tested were 4.7 miles over obstructed terrain and 9.8 miles over unobstructed. The transmitter actuated the central alarm in all cases.

Card CONFIDENTIAL

U. S. Naval Civil Engineering Laboratory  
REMOTE INDICATOR SYSTEM FOR E21 SERIES AUTOMATIC  
G-AGENT ALARM (U), by I. M. Derr

TR-352 39 p. illus 24 Mar 65 Confidential  
I. Y-F011-08-01-151

1. Alarm - Gas-attack

A remote indicating system was developed for incorporation into the Navy's E21 Series Automatic G-Agent Alarm installations so that a number of remote E21 gas-attack alarm units could be monitored at a central control. An alarm sounds at the receiving station when gas is sensed, and a red light indicates the location of the E21 unit that has sensed the gas. As a precaution, a warning indicates the presence of a signal on the assigned radio frequency that may cause either intentional or unintentional jamming of the frequency.

The Remote Indicator System consists chiefly of (1) a transistORIZED frequency-modulated transmitter mounted in the E21 gas alarm, (2) a transmitting antenna mounted on the gas alarm case, (3) a tone generator producing a modulating tone in the frequency range of 800 to 3600 cps, (4) a programmer to allow time sharing of the frequency by several transmitters, (5) a receiving antenna, (6) a receiving station consisting of one FM radio receiver, 15 Motorola single-tone decoders, one signal-presence indicator, and associated power supplies.

The system was successfully field-tested at a variety of transmitter-to-receiver distances. The maximum distances tested were 4.7 miles over obstructed terrain and 9.8 miles over unobstructed. The transmitter actuated the central alarm in all cases.

Card CONFIDENTIAL

Confidential

Security Classification

DOCUMENT CONTROL DATA - R&D <small>(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)</small>		
1. ORIGINATING ACTIVITY <small>(Corporate author)</small> U. S. Naval Civil Engineering Laboratory Port Hueneme, California 93041		2a. REPORT SECURITY CLASSIFICATION <b>Confidential</b>
		2b. GROUP <b>3</b>
3. REPORT TITLE <b>Remote Indicator System for E21 Series Automatic G-Agent Alarm (U)</b>		
4. DESCRIPTIVE NOTES <small>(Type of report and inclusive dates)</small> <b>Final report -- February 1963 to August 1964</b>		
5. AUTHOR(S) <small>(Last name, first name, initial)</small> <b>Derr, J. M.</b>		
6. REPORT DATE <b>24 March 1965</b>	7a. TOTAL NO. OF PAGES <b>39</b>	7b. NO. OF REFS <b>0</b>
8a. CONTRACT OR GRANT NO.	8b. ORIGINATOR'S REPORT NUMBER(S) <b>TR-352</b>	
b. PROJECT NO. <b>Y-F011-08-01-151</b>		
c.	8d. OTHER REPORT NO(S) <small>(Any other numbers that may be assigned this report)</small>	
d.		
10. AVAILABILITY/LIMITATION NOTICES <b>Release to the Clearinghouse is Not Authorized. Qualified requesters may receive copies of this report from DDC.</b>		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY <b>BUDOCKS</b>	
13. ABSTRACT <p>A remote indicating system was developed for incorporation into the Navy's E21 Series Automatic G-Agent Alarm installations so that a number of remote E21 gas-attack alarm units could be monitored at a central control. An alarm sounds at the receiving station when gas is sensed, and a red light indicates the location of the E21 unit that has sensed the gas. As a precaution, a warning indicates the presence of a signal on the assigned radio frequency that may cause either intentional or unintentional jamming of the frequency.</p> <p>The Remote Indicator System consists chiefly of (1) a transistorized frequency-modulated transmitter mounted in the E21 gas alarm, (2) a transmitting antenna mounted on the gas alarm case, (3) a tone generator producing a modulating tone in the frequency range of 800 to 3600 cps, (4) a programmer to allow time sharing of the frequency by several transmitters, (5) a receiving antenna, (6) a receiving station consisting of one FM radio receiver, 15 Motorola single-tone decoders, one signal-presence indicator, and associated power supplies.</p> <p>The system was successfully field-tested at a variety of transmitter-to-receiver distances. The maximum distances tested were 4.7 miles over obstructed terrain and 9.8 miles over unobstructed. The transmitter actuated the central alarm in all cases.</p>		

DD FORM 1 JAN 64 1473 0101-807-6800

Confidential  
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Warning systems	8					
Gas detectors	10					
Radio transmitters	10					
Radio receivers	10					
Monitors	10					
Centralized control	4					
Civil defense	4					

**INSTRUCTIONS**

1. **ORIGINATING ACTIVITY:** Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (*corporate author*) issuing the report.
- 2a. **REPORT SECURITY CLASSIFICATION:** Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.
- 2b. **GROUP:** Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.
3. **REPORT TITLE:** Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.
4. **DESCRIPTIVE NOTES:** If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.
5. **AUTHOR(S):** Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.
6. **REPORT DATE:** Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.
- 7a. **TOTAL NUMBER OF PAGES:** The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.
- 7b. **NUMBER OF REFERENCES:** Enter the total number of references cited in the report.
- 8a. **CONTRACT OR GRANT NUMBER:** If appropriate, enter the applicable number of the contract or grant under which the report was written.
- 8b, 8c, & 8d. **PROJECT NUMBER:** Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.
- 9a. **ORIGINATOR'S REPORT NUMBER(S):** Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.
- 9b. **OTHER REPORT NUMBER(S):** If the report has been assigned any other report numbers (*either by the originator or by the sponsor*), also enter this number(s).
10. **AVAILABILITY/LIMITATION NOTICES:** Enter any limitations on further dissemination of the report, other than those

imposed by security classification, using standard statements such as:

- (1) "Qualified requesters may obtain copies of this report from DDC."
- (2) "Foreign announcement and dissemination of this report by DDC is not authorized."
- (3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through \_\_\_\_\_."
- (4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through \_\_\_\_\_."
- (5) "All distribution of this classified DDC users shall be \_\_\_\_\_."

If the report has been furnished to the Department of Commerce, indicate this fact and enter the price.

11. **SUPPLEMENTARY NOTES:** Enter supplementary notes.

12. **SPONSORING MILITARY AGENCY:** Enter the departmental project office (or the research and development office) for the research and development.

13. **ABSTRACT:** Enter an abstract summary of the document indicating where it may also appear elsewhere in the report. If additional space is required, the abstract may be attached.

It is highly desirable that all reports be unclassified. Each paragraph should contain an indication of the military security classification in the paragraph, where appropriate.

There is no limitation on the length of the abstract. However, the suggested length is from 100 to 200 words.

14. **KEY WORDS:** Key words are words or short phrases that characterize the report and are selected for index entries for cataloging the report. They are selected so that no security classifiers, such as equipment model numbers, project code name, geographic location, etc., are used as key words but will be followed by a security classification. The assignment of links, if any, is optional.