# Beschreibung des Togo-Timers

[x] Gesprächsnotiz [ ] Kurzmitteilung [ ] Auftrag

000021

[ ] telefonisch [ ] persönlich

mit/an (Herrn / Frau / Firma, in)

Bundeskriminalamt · Postfach 12 80 · 5309 Meckenheim 1

Uhrzeit

Datum: 12.12.90

Bearbeiter: Würth

Org.-Einheit | ☎ Nebenstelle

Aktenzeichen

Betreff

Putschversuch 1986 in TOGO
hier: Beschreibung des "TIMERS"

Anliegende Beschreibung des im Togo 1986 sichergestellten Timers wurde ~~am~~ 11.12.90 von Mr. THURMANN, FBI, an Unterzeichner übergeben.

[ ] Anlage(n) zum Verbleib. [ ] mit der Bitte um Kenntnisnahme. [ ] Stellungnahme. [ ] Erledigung / weitere Veranlassung. [ ] Ihren Anruf. [ ] Rückgabe.

[ ] Bitte Akten beifügen. [ ] Bitte Mitteilung über den Stand der Angelegenheit. [ ] Bitte Bestand prüfen. [ ] Personalien erfassen, Hinweiskarte fertigen. Löschen der KP-Nr.

(Unterschrift) C. A

Kenntnis genommen | Wv. | Z. d. A.

BKA 11-002 08.82

Rough draft Insert Laboratory number 00620050

The K1 specimen is a digital timer. It consists of a solid front and rear panel which are held together by four standoffs. The sides are open. K1 measures 65 by 70 by 21 millimeters. The front panel is the circuit board itself. The back panel is aluminum with a black "wrinkle coat" finish applied. A length of 32 mm double sided tape similar to carpet tape is attached to the back. The protective paper coating is still on the tape. The labels on the front panel are etched copper identical to the circuit traces on the back of the board. The copper is coated with a black solder mask. The device is labeled "MST-13" on the front. There are two slide switches on the front. One is labeled "HRS" and "MIN" and the other is labeled "ON" and "OFF." A push button, momentary contact switch and Light Emitting Diode (LED) are labeled "TEST." Two thumbwheel switches are labeled "TIME." The edges of the front panel and the cut-out for the thumbwheel switch assembly have traces of conductor which indicate lines to cut along when producing the circuit board.

The circuit board components are primarily surface mount components. The thumbwheel switch assembly contains a second circuit board which is a different color material. Only one-half of the circuit board is being used. If components were added to the rest of the circuit board, two additional thumbwheel switches could be added. The main circuit board is designed such that a thumbwheel switch assembly having four switches would exactly fit the opening.

A length of two-conductor, 16 gauge wire connects the timer to a terminal block. The terminal block has an LED mounted between the screw terminals. A resistor is in series with the LED. The LED and resistor are in parallel with the screw terminals.

A "J" battery, having wires soldered directly to the terminals, powers K1. The battery is held in place with double sided foam tape.

## THEORY OF OPERATION

The crystal controlled integrated circuit (IC) with countdown circuitry produces a clock pulse at a one hertz rate. The output of this IC provides a test indication and an input to a divide by 60 counter. The test indication is a test button and red LED. When the test button is depressed and the oscillator is running, the LED will pulse at a one hertz rate. The output of the divide by 60 counter provides a pulse every minute. The output of the divide by 60 counter is connected to the input of another divide by 60 counter and to one contact of a slide switch. The output of the second divide by 60 counter provides a pulse every hour. This pulse is provided to the other contact of the slide switch. The slide switch allows selecting either a

pulse every minute or every hour. The selected pulse is provided to the thumbwheel switch assembly. Each thumbwheel is part of a decade counter. When the proper number of pulses are counted, from zero to 99, a flip-flop is set which turns on a relay. This relay provides power to the load. If no load is attached, the LED on the terminal strip lights. The K1 specimen will provide highly accurate delays of up to 99 hours.

## CONSTRUCTION DETAILS

A circuit drawing was made of K1. Component numbers were assigned arbitrarily when the schematic was drawn. Components are also identified by the same numbers on the main circuit board photograph.

The main circuit board is well constructed. The corners are square and the cuts are well made. The conductor paths appear to have been laid out by hand using tape on the master. This is evidenced by the appearance of the paths when they change direction. The quality of workmanship is excellent. Even though the circuit board was laid out by hand and not by a computerized process, a well equipped printed circuit facility and skilled personnel are indicated.

An error was made when the circuit board was designed. The input to pin 10 of IC U5 was connected to the wrong conductor path. The drill was used to remove a portion of the incorrect path and a jumper was added to connect to the correct path.

IC U1 has two surface mount resistors soldered between pins 3 and 5 and the circuit board. This is accomplished by bending the IC leads up and soldering the resistors to the leads and the circuit board where the leads would have been connected. This type of installation is difficult and labor intensive. If K1 were a commercial product produced in quantity, the circuit board would be redesigned allowing these resistors to be placed on the circuit board itself.

The thumbwheel assembly circuit board had etched copper labels which have been removed. The labels appear to be "M580" or "MEBO" and a three digit number. If all four thumbwheel switches and associated components were installed, the timer could be utilized to provide a delay for as long as 9,999 pulses. With K1, the pulses are one every hour or minute, depending on the switch setting which would result in a maximum delay of 9,999 hours.

Batteries normally have solder tabs welded to them when they are to be soldered into a circuit. The battery with K1 had leads soldered directly to the battery. This is not common practice as it is possible to damage the battery. The battery with K1 is a Mallory Duracell "J" battery made in the United Kingdom. It is a six-volt battery with a 500 milliampere-hour (mAH) capacity. When received, the battery was in a depleted

condition. When in a counting mode, K1 used 0.4 mA of current. With the relay energized, K1 used 68 mA of current. K1 could operate for several hundred hours using a battery of this type. The relay required 4.65 volts direct current (Vdc) to energize. The oscillator remained stable over the operating voltage range.

The LED mounted on the terminal strip allows the timer to be tested including the wiring to the mounting point of the load. This ensures that there are no breaks in the wire as well as the timer operation. When using the timer to detonate an explosive device, the LED on the terminal strip provides an assurance that power is not inadvertently applied to the terminal strip when the blasting cap is attached.

While K1 contains a back panel attached to the front panel with standoffs, the circuit board has markings where the corners of the board can be removed. This would remove the holes to which the standoffs are attached and prepare the circuit board for installation in a particular enclosure.

## TECHNICAL DESCRIPTION

The K1 device utilizes an HEF4521BT IC (U1) which is a crystal controlled device with countdown circuitry to produce a clock pulse at a one hertz rate. The components associated with U1 are the 4.194304 megahertz crystal, capacitors C1 and C2 and resistors R1, R2 and R3. These are connected as recommended in the data sheets for U1. R2 and R3 are recommended for use in low power operations. C1 is a trimmer capacitor used to accurately set the frequency. The output of this oscillator is a 1 Hz pulse.

This pulse is provided to the first of two divide by 60 counters. The output of the first divide by 60 counter provides the input for the second. These are comprised of dual decade counters U2 and U3, portions of logic gates U4 and U5, diodes U7 and U8 and resistors R7, R8 and R9. A switch (S3) on the front panel allows selection of either of the divide by 60 output signals. The first provides a pulse every minute while the second provides a pulse every hour.

The selected pulse rate is provided to the thumbwheel switch assembly. This assembly consists of two binary coded decimal (BCD) switches, dual decade counter U6, diodes U9, U10, U11 and U12 and resistor R10. The BCD switch connects the common of the switch through diodes to one or more of the decade counter outputs. The outputs connected to depend on the binary equivalent of the number shown on the thumbwheel. The binary equivalent of the number 5 is 0101. A thumbwheel setting of 5 would connect the BCD switch to the first and third outputs of the decade counter. The output of the thumbwheel switch assembly is low (ground) until such time as the number of pulses it has received equals the setting on the two thumbwheel switches. At this point the output is high (supply battery voltage).

This high output is provided to the input of the flip-flop. The flip-flop is comprised of a portion of the logic gate U4. This is a binary counter which has a low output until it receives a high input. The high output of the flip-flop turns on the transistor switch Q2 which causes the relay to energize. The relay provides power to the load.

K1 contains two test circuits. The first consists of transistor Q1, switch S2, LED1 and resistors R4 and R5. Transistor Q1 is used as a switch. The output of the crystal oscillator causes Q1 to pulse LED1 when switch S2 is depressed. LED1 will pulse at a 1 Hz rate if the oscillator is functioning properly. This provides a test of the oscillator. The second test circuit is LED2 and resistor R12. This provides a test of the entire circuit, including the wire to the terminal strip. This also provides assurance that no voltage is on the terminal strip when a blasting cap is attached.

The final portion of the circuit is the power on reset (POR) circuit. This consists of a portion of logic gate U5, resistor R6 and capacitor C3. The POR assures that all of the counters are set to 0 when power is first applied.

K1 does not contain a safe arm delay, low voltage detector or booby traps.

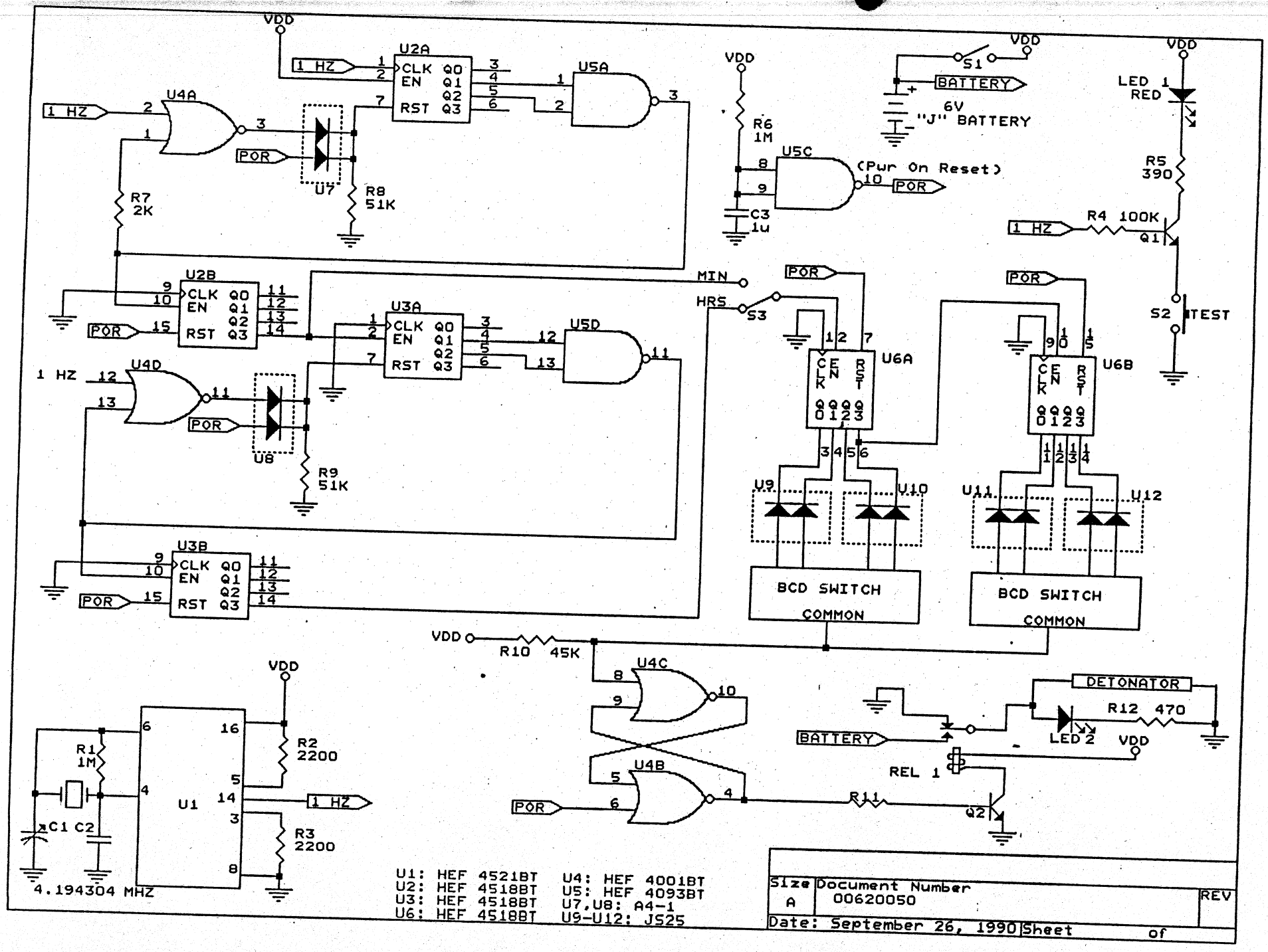
## MANUFACTURER INFORMATION

The integrated circuit labels begin with the letters "HEF" followed by four digits and the letters "BT." This is the manner in which Signetics marks their devices. The "HE" indicates the family of device while the "F" indicates that it is temperature limited. The "B" indicates that it is CMOS circuitry and the "T" indicates that it is in a plastic case.

The battery is a Duracell number 7K67 6 volt battery manufactured by Mallory in the United Kingdom.

The crystal is a NYMPH quartz crystal designed to operate at 4.194304 MHz. The NYMPH part number is NYP041-12. These crystals are produced by SaRonix.

The relay is a Fujitsu FBR211AD006-M ultra-miniature relay. It is a standard, single pole, double throw relay. The manufacture/date code on the relay is "HZ3." The "H" indicates that the relay was manufactured at the Kashiwabara plant in Japan. The "Z" indicates that it was manufactured in 1984 while the "3" indicates the third month.


VDD
1 HZ
U2A
CLK EN RST
Q0 Q1 Q2 Q3
U5A
U4A
POR
U7
R8 51K
R7 2K
R6 1M
U5C
(Pur On Reset)
C3 1u
S1
BATTERY
6V "J" BATTERY
LED 1 RED
R5 390
R4 100K
Q1
S2 TEST
MIN
HRS
S3
U2B
U3A
U5D
U4D
U8
R9 51K
U3B
U6A
U6B
U9
U10
U11
U12
BCD SWITCH COMMON
R10 45K
U4C
U4B
DETONATOR
R12 470
LED 2
REL 1
R11
Q2
R1 1M
C1 C2
U1
R2 2200
R3 2200
4.194304 MHZ
U1: HEF 4521BT
U2: HEF 4518BT
U3: HEF 4518BT
U6: HEF 4518BT
U4: HEF 4001BT
U5: HEF 4093BT
U7,U8: A4-1
U9-U12: JS25
Size A
Document Number 00620050
REV
Date: September 26, 1990
Sheet of

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~~F-167636~~

~~N-10197~~

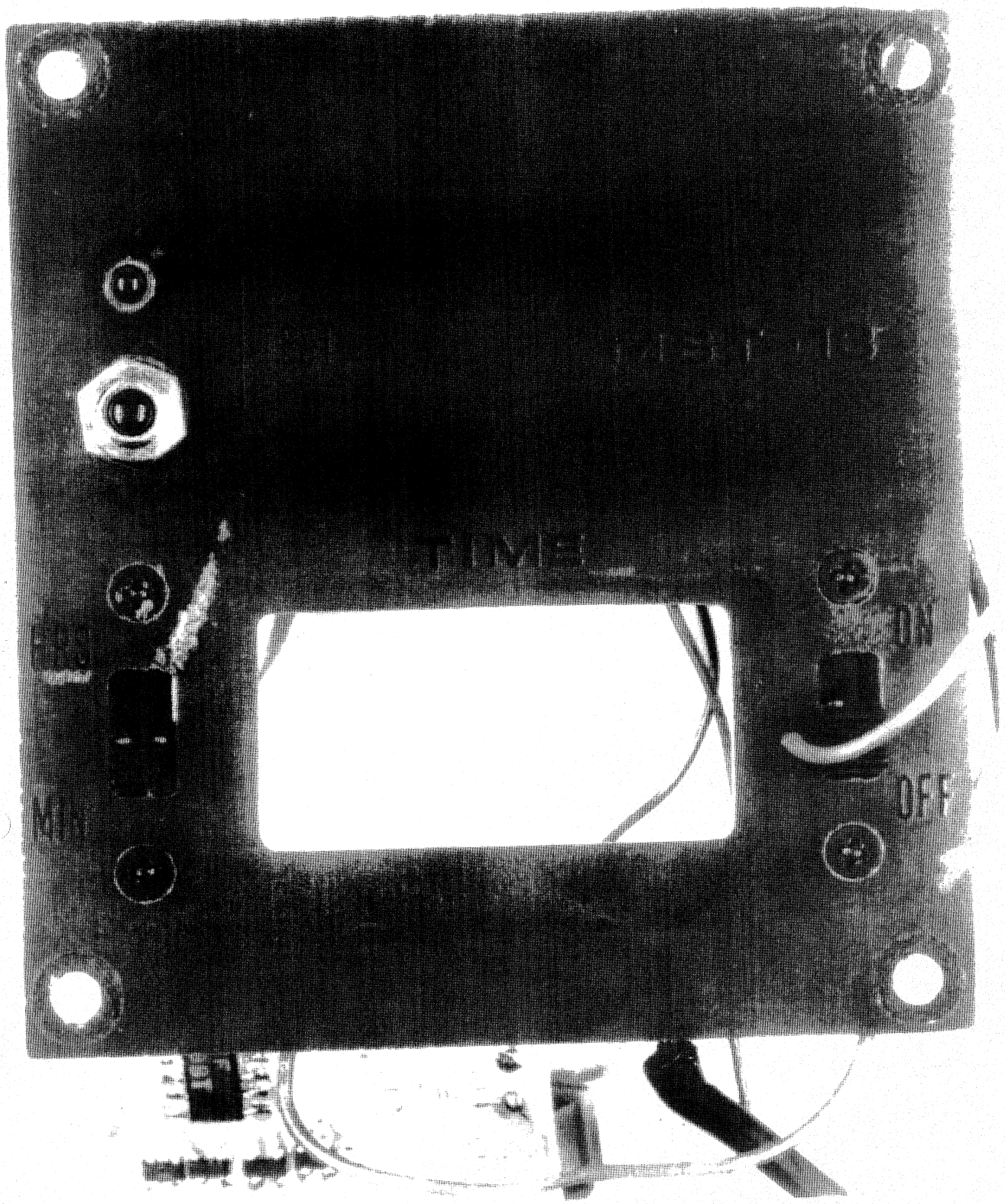
~~N-9243~~

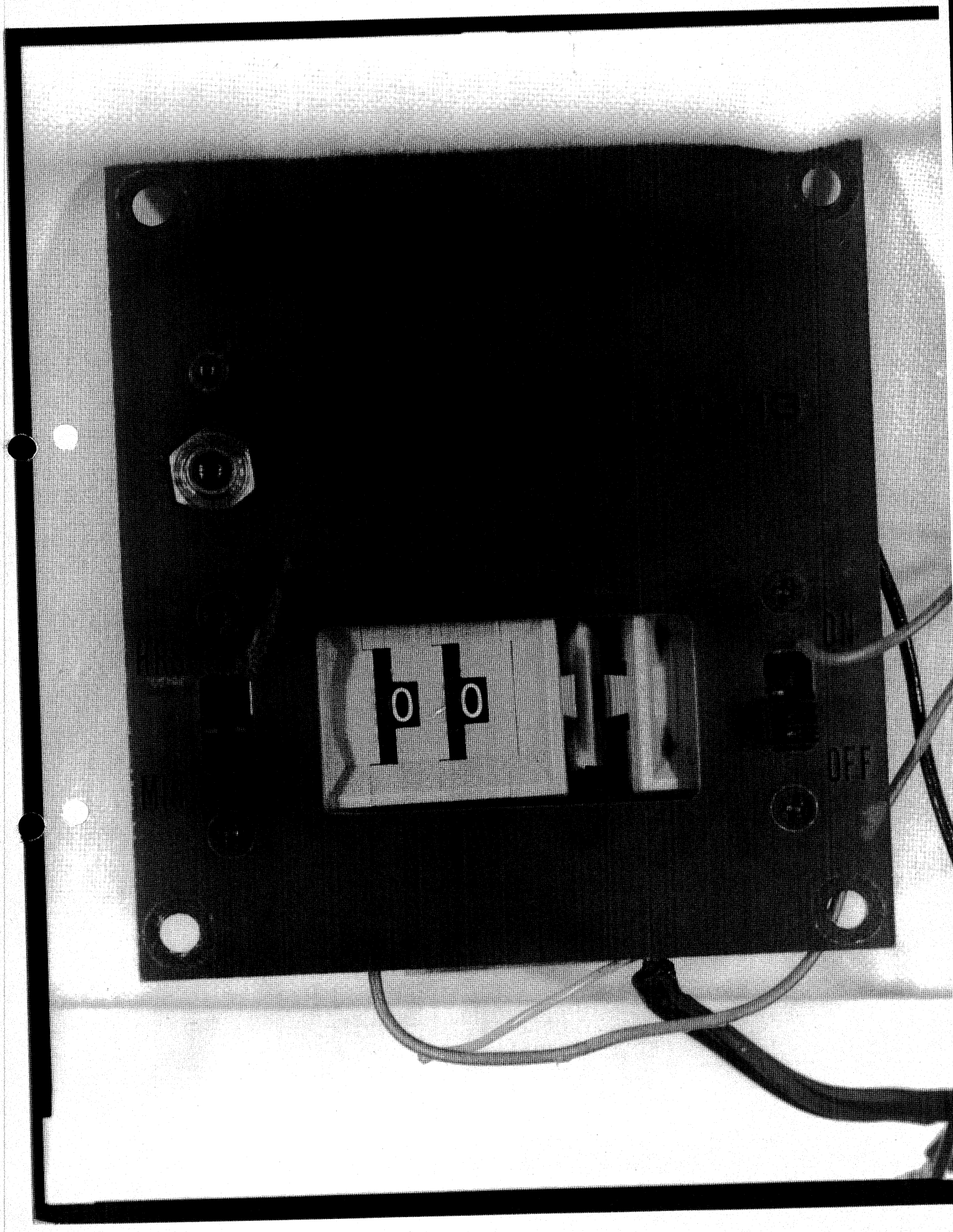
~~3N-10094~~

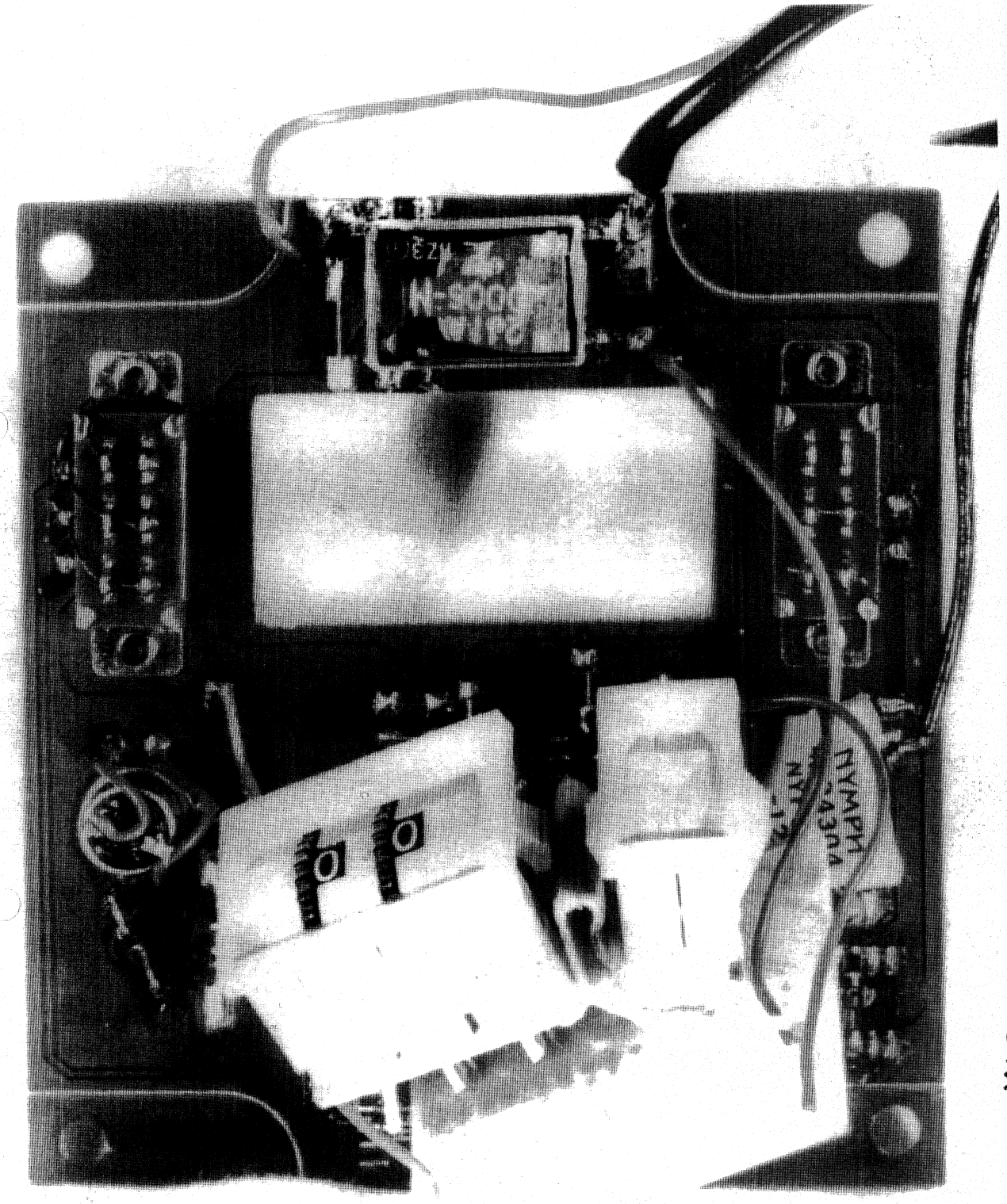
F-168642

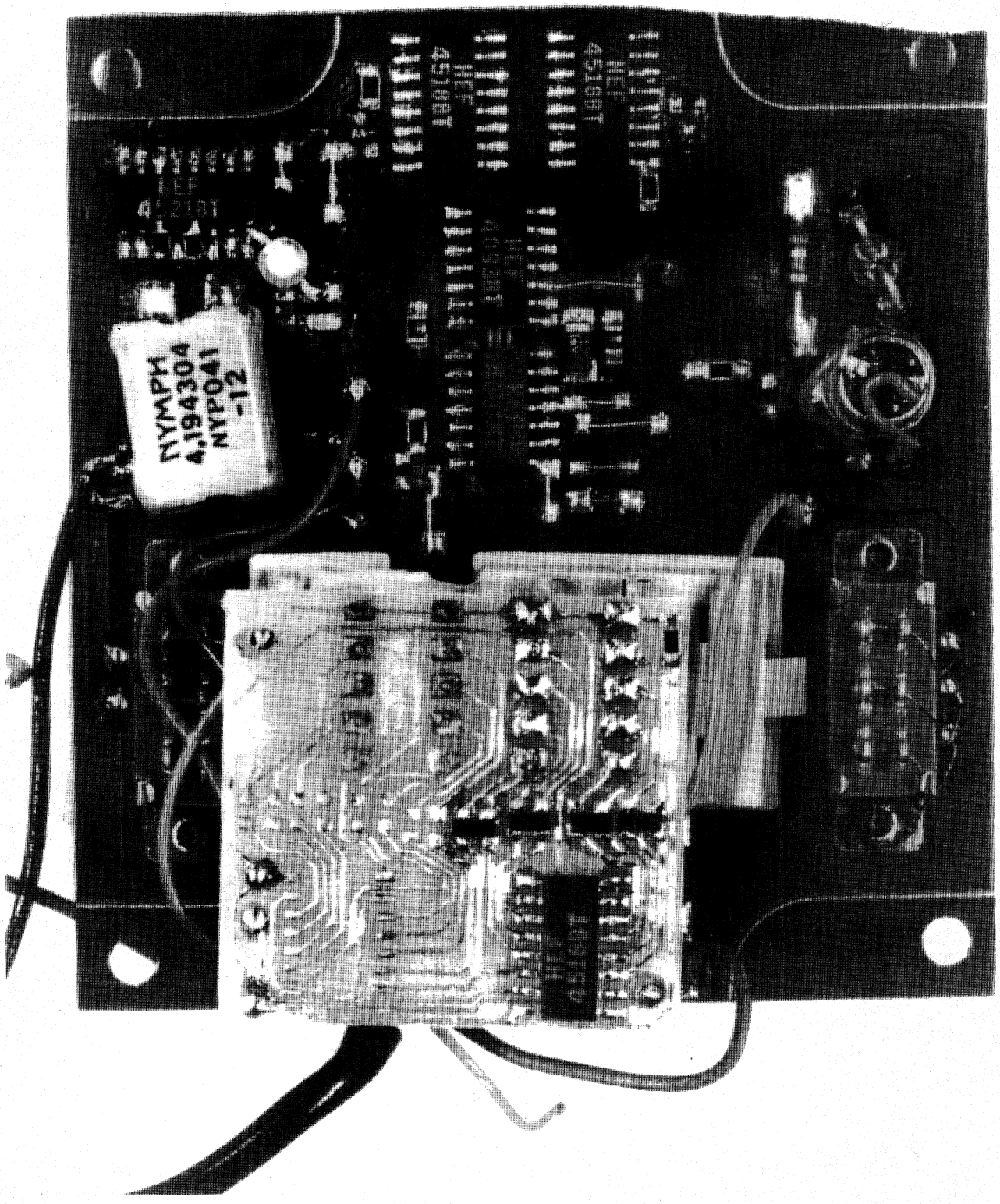
K-131

Fotos vom Togo-Timer


TIME
ON
OFF


OFF




ΠΥΜΑΡΗ
4.194304
NYP041
-12

Funktionsweise des Togo-Timers

ST 31
EG - PAN AM

Meckenheim, den 12.12.90

V E R M E R K

BETREFF
Ermittlungsverfahren im Zusammenhang mit dem Absturz der PAN AM - Verkehrsmaschine über Lockerbie am 21.12.1988 wegen Verdachts eines Verbrechens nach § 211 StGB u.a. Straftaten, Az. StA Frankfurt a.M. 50 Js 401/88

Anläßlich der 7. internationalen Lockerbie-Konferenz in Stockholm wurde von den Beamten des FBI folgende Unterlagen übergeben:
- 16 Lichtbilder, die den 1988 in Senegal sichergestellten Timer zeigen.
- Fotokopie eines Labor-Berichts der CIA
  " *Analysis of Electronic Timer - 88 SP 006* " ( 10 Blatt ),
  in dem der 1986 in Togo sichergestellte Timer beschrieben und abgebildet ist.
  Laut Auskunft des FBI-Agenten Richard Marquise wurde dieser Bericht im Jahr 1988 bereits an die Federal Aviation Agency ( FAA ) gegeben.

( Stoukup ) KR

☐ Gesprächsnotiz ☒ Kurzmitteilung ☐ Auftrag

000033

☐ telefonisch ☐ persönlich

mit/an (Herrn / Frau / Firma, ort)

Bundeskriminalamt · Postfach 12 60 · 6309 Meckenheim 1

Datum: 12.12.90

Bearbeiter: Würth

Org.-Einheit | ☎ Nebenstelle

Aktenzeichen

Betreff

Putschversuch 1986 in TOGO

Am 11.12.1990 hielt sich Mr. THURMANN, FBI, im BKA Meckenheim auf.

Er wurde auf die anliegende Broschüre angesprochen. Hierzu erklärte er, daß es sich um ein behördeninternes Papier handele. Es beziehe sich auf den 1986 im Togo erfolgten Vorfall und beschreibe die Funktionsweise des dort zum Einsatz gelangten "TIMERS".

Anlage(n) ☐ zum Verbleib. | mit der Bitte um ☐ Kenntnisnahme. ☐ Stellungnahme. ☐ Erledigung / weitere Veranlassung. ☐ Ihren Anruf. ☐ Rückgabe.

☐ Bitte Akten beifügen. ☐ Bitte Mitteilung über den Stand der Angelegenheit. ☐ Bitte Bestand prüfen. ☐ Personalien erfassen, Hinweiskarte fertigen. | Löschen der KP-Nr.

(Unterschrift) | Kenntnis genommen | Wv. | Z. d. A.

BKA-1000

SP LAB REPORT

000034

# Analysis of Electronic Timer

88SP006

COPY Nº 264

SP LAB REPORT

# ANALYSIS OF DIGITAL TIMER
# 88SP006

**BACKGROUND (S)**

This specimen was obtained in an African country.

**SUMMARY AND CONCLUSIONS (S)**

The timer generates accurate (crystal controlled) delays over a range of 1-99 minutes (1 minute steps) or 1-99 hours (1 hour steps). Design and assembly are generally professional, suggesting a well-equipped facility and trained personnel were used. Two errors were made in the printed circuit board routing, but only one was caught and repaired (a well-done repair). The other error can cause at most a 6 second error in the delay. Surface mount components predominate. Physical space and circuit trace provisions exist to expand the range from 2 decades (1-99) to 4 decades (1-9999), but the required components are not installed. Whether this is a modified commercial or a custom device can't be determined.

## PHYSICAL DESCRIPTION (S)

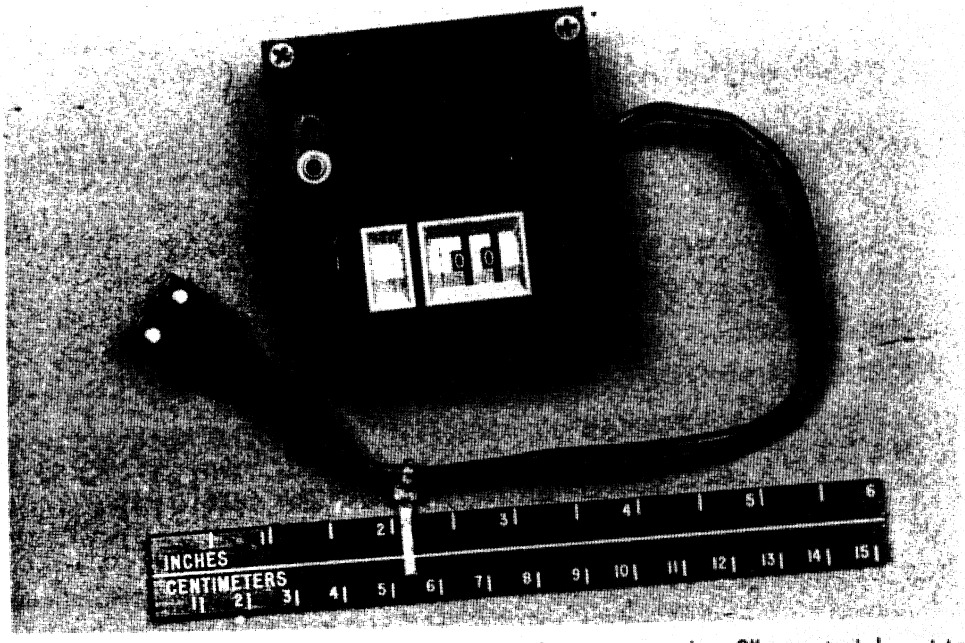



Figure 1. Digital timer as received. Extra endplates are used as filler material next to the thumbwheel switches. A red LED in the terminal block at the end of the zip cord illuminates when the delay expires.

Figure 1 shows the digital timer as received. The overall dimensions are 65x75x21 mm. It has solid front (printed circuit material) and rear (aluminum) panels with open sides. Four standoffs hold the panels together. A black "wrinkle coat" finish has been applied to the rear panel, along with a length of 32 mm double sided tape similar to carpet tape (Figure 2).

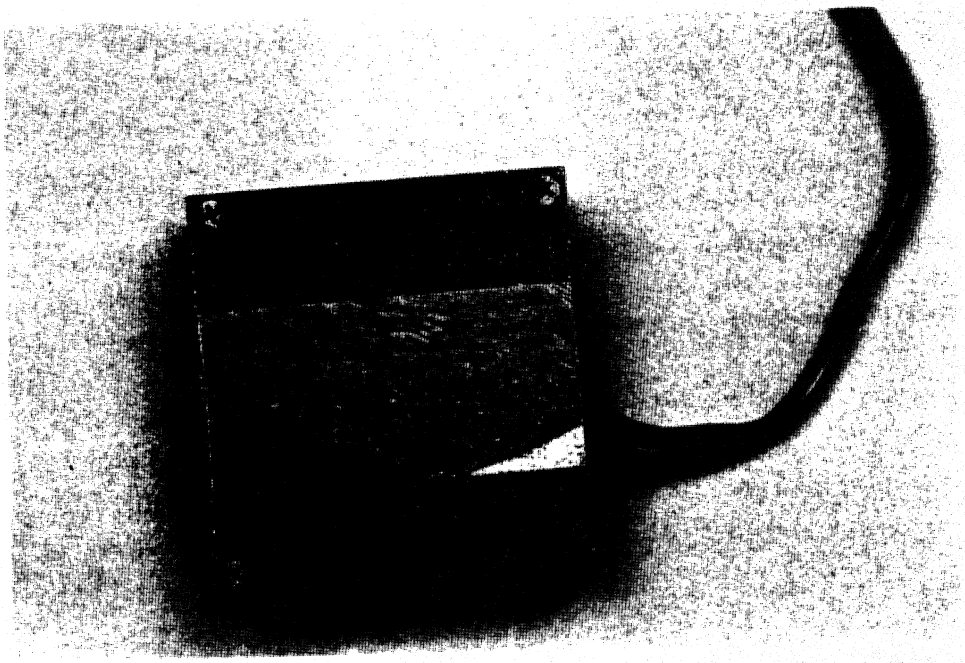


Figure 2. Rear panel showing double sided tape and black "wrinkle" finish.

**PHYSICAL DESCRIPTION (Continued)**
(S)

Control switches and labels are on the front panel. Each label is etched copper, identical to a circuit trace (except no components are connected!). Solder mask covers the entire panel. The controls are:

2 thumbwheel switches labeled TIME
1 slide switch labeled ON/OFF
1 slide switch labeled HRS/MIN
1 push button momentary contact switch labeled TEST
1 red light emitting diode (LED).

The inside surface of the front panel has circuit traces etched and surface mount components installed. Solder mask also covers this surface. Traces of conductor along the edges indicate shear lines were made when the conductor pattern was etched. These shear lines indicate where the board is to be cut.

A smaller printed circuit board is mounted directly to the thumbwheel switches. As seen in Figure 3, this board is a different color (lighter) and has no solder mask. Again, surface mount components are installed.

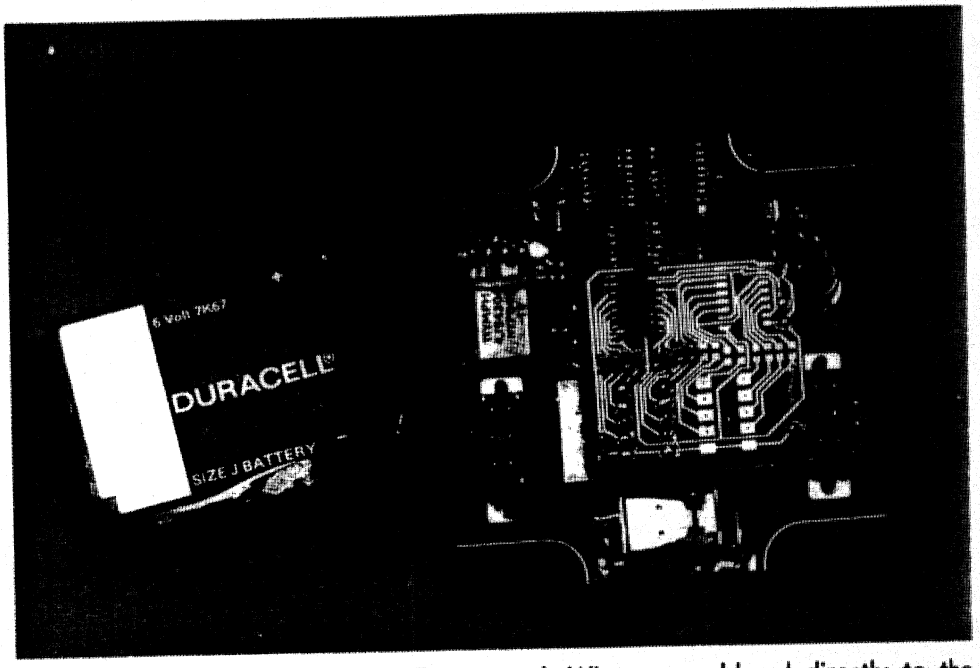



Figure 3. Rear panel and standoffs removed. Wires are soldered directly to the battery. The smalled printed circuit board is visible with only 1 integrated circuit installed and many empty pads. It has no solder mask coating.

PHYSICAL DESCRIPTION (Continued) (S)

Circuit traces and unpopulated component locations (Figure 4) exist to support 2 more thumbwheel switches. No evidence exists that the additional components were ever installed. Indeed, the opening in the front panel will accommodate 2 more thumbwheel switches. As received, the panel has 2 switches with 2 endplates, 2 additional endplates as fillers, and a piece of folded plastic glued in as another filler. Four switches and 2 endplates would just fit the opening.

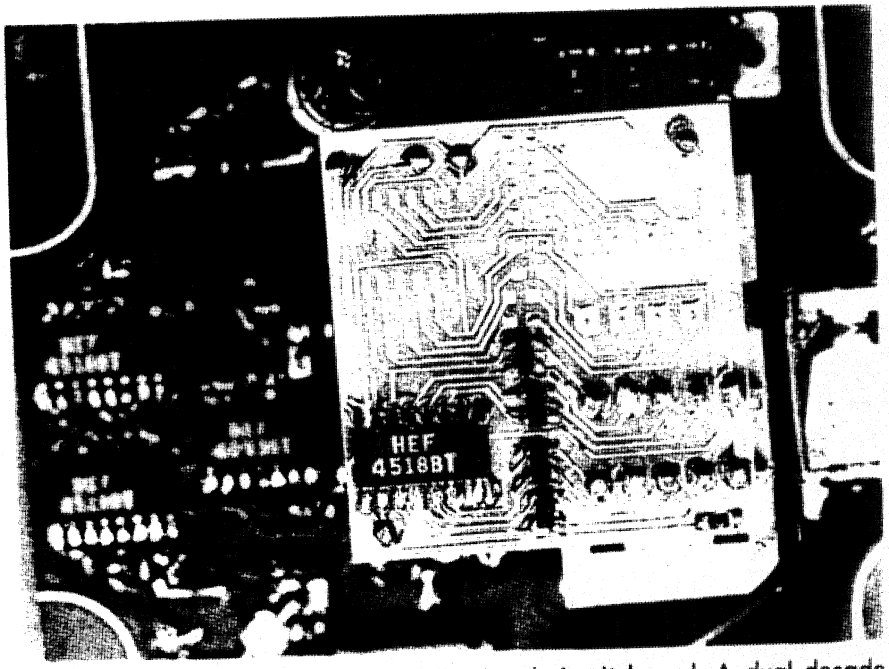



Figure 4. A closer view of the small printed circuit board. A dual decade counter (HEF 4518), 4 dual diode array chips, and a chip resistor are visible.

A length of 16 gauge zip cord connects the timer to the load (assumed to be an electric detonator). A small screw terminal block is used to connect the detonator to the zip cord. The block's mounting hole has a LED and resistor mounted inside.

A single "J" battery is soldered directly to wires and is held in place with double sided foam tape (thicker than that on the rear panel). The battery mounting is strictly an afterthought—no volume is dedicated to a battery holder. It is literally stuffed in among the components.

All screw holes are countersunk, the shear lines are square, and the general assembly is professional. A well equipped printed circuit facility and trained personnel are indicated.

PHYSICAL DESCRIPTION (Continued) (S)

Figure 5 shows a "cut and jumper" repair to an incorrectly routed trace. The cut is made by drilling through the offending trace, then the jumper is added. A very nicely done repair.

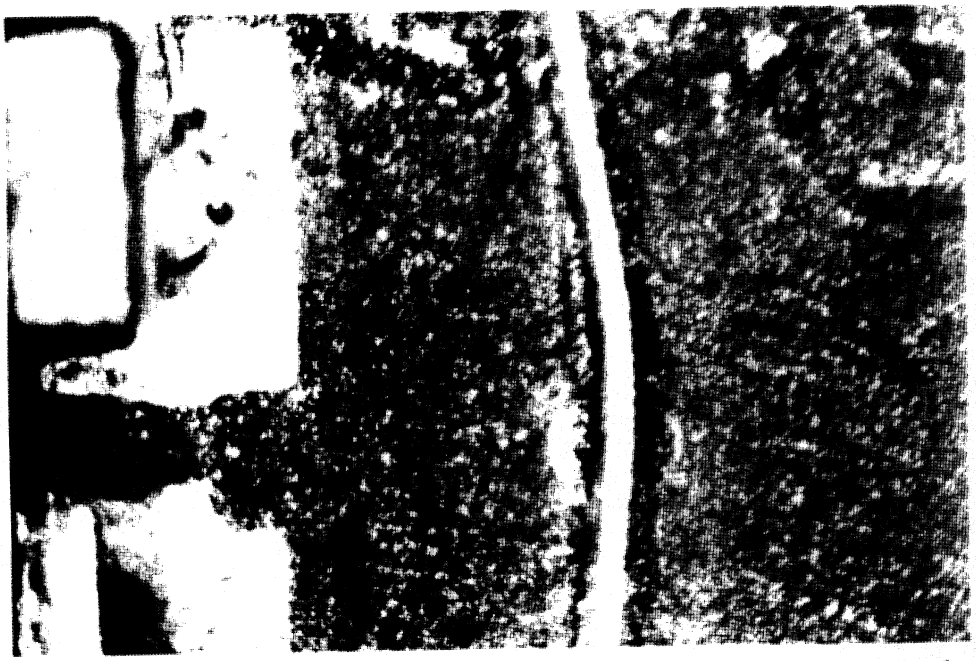


Figure 5. A jumper wire added to correct a misrouted trace. The trace was cut by drilling a shallow hole through the conductor (visible near the center of the jumper).

Figure 6 shows two chip resistors added "tombstone" fashion by bending the integrated circuit leads up. This installation is not easy to do and is very labor intensive.

Figure 6. Two chip resistors added by bending up leads on an integrated circuit.

TECHNICAL DESCRIPTION (S)

Figure 7 is a block diagram of the digital timer, derived from the hardware. The crystal oscillator generates a 1 Hz clock which feeds a series of divide by 60 counters. The output of the first divide by 60 is one pulse per minute; the output of the second is one pulse per hour. One of these (MIN or HRS) is selected with a slide switch on the front panel. This signal clocks a series of decade counters. After the first counter increments 10 times, a ripple carry scheme increments the next counter once.

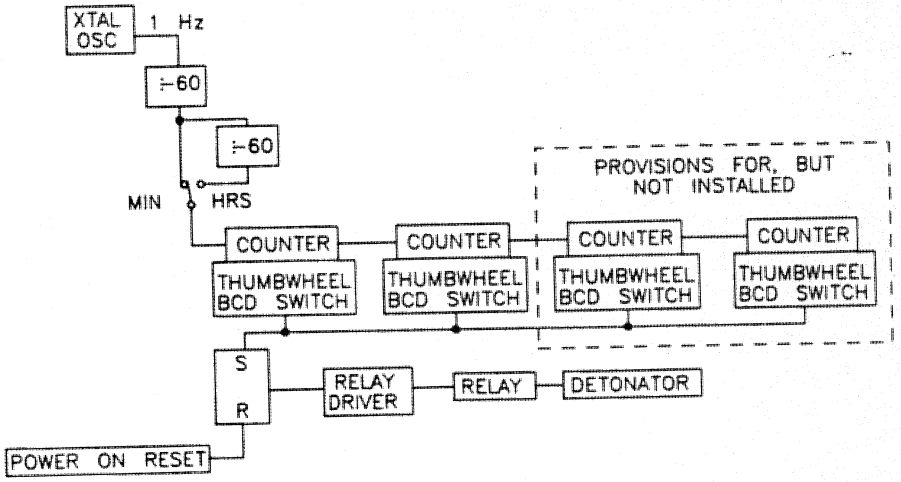



**Figure 7. Block diagram of the digital timer.**

The binary coded decimal (BCD) output from each counter feeds a BCD thumbwheel switch. When the correct count is reached, a flipflop is set which turns on a relay to provide power to the load.

Overall, the design is sound and quite capable of generating accurate delays.

TECHNICAL ANALYSIS (S)

Figure 8 is the schematic diagram derived from the hardware. The reference designators are assigned for convenience only.

The crystal oscillator is essentially a standard data book application generating a 1 Hz clock. Resistors R2 and R3 are recommended for low power operation, but are not necessary. These are the two added resistors shown in Fig 6. Holding the TEST switch closed allows the red LED to flash at 1 Hz, indicating the oscillator is working.

The dual decade counters (U2,U3) and associated logic gates create two divide by 60 counters. The output from the first is the MIN clock; the output from the second one is the HRS clock. Selection is made with a slide switch on the front panel.

The selected clock feeds another dual decade counter which is mounted on the printed circuit board attached to the thumbwheel switches. The Q3A output clocks the second counter. Provisions exist for another dual counter chip to handle two more thumbwheel switches.

When a thumbwheel switch is set, the common terminal is connected to a combination of decade counter outputs in a "1-2-4-8" fashion. For example, a switch setting of 7 connects the counter outputs Q0, Q1, and Q2 to the switch common. A setting of 0 connects no counter outputs to the switch common. The common terminals for all thumbwheel switches are connected together. If any selected counter output is low, necessarily the switch common line is also held low. The diodes between the switch and the counter protect the counter outputs which are high. When all selected counter outputs are high, then the switch common line goes high. In the example of a switch set to 7, this happens when the counter has received 7 clock pulses.

A high on the switch common line sets the flip flop formed by U4B and U4C. This in turn turns on Q2 to actuate the relay. The load is now powered. The red LED in the terminal block also illuminates (briefly if a detonator is installed). Turning the device on with all switches set to 0 will actuate the relay after the POR signal times out (approximately 1.5 seconds).

The power on reset (POR) circuit is a standard design used to ensure the counters are all reset to 0 when the power is first applied. An error in the routing of the U2A reset line does not allow the POR to reset the U2A counter. The error created is less than 6 seconds. A correction is noted in Figure 8 (connect U2A RESET A to the cathode of D1, not the anode). Another curiosity in the U2A reset circuit is the presence of R7. It adds delay where no delay is required. The other divide by 60 counter has no comparable component. R7 is not a last minute addition either—it bridges a trace.

Because the battery is stuffed in haphazardly with no insulation or protection, the bare wire/battery joints might contact a circuit element. This could cause the timer to fire early, late, immediately, or perhaps never.

This device has no safe arm delay, no energy storage circuit, no low voltage detector, and no booby traps.

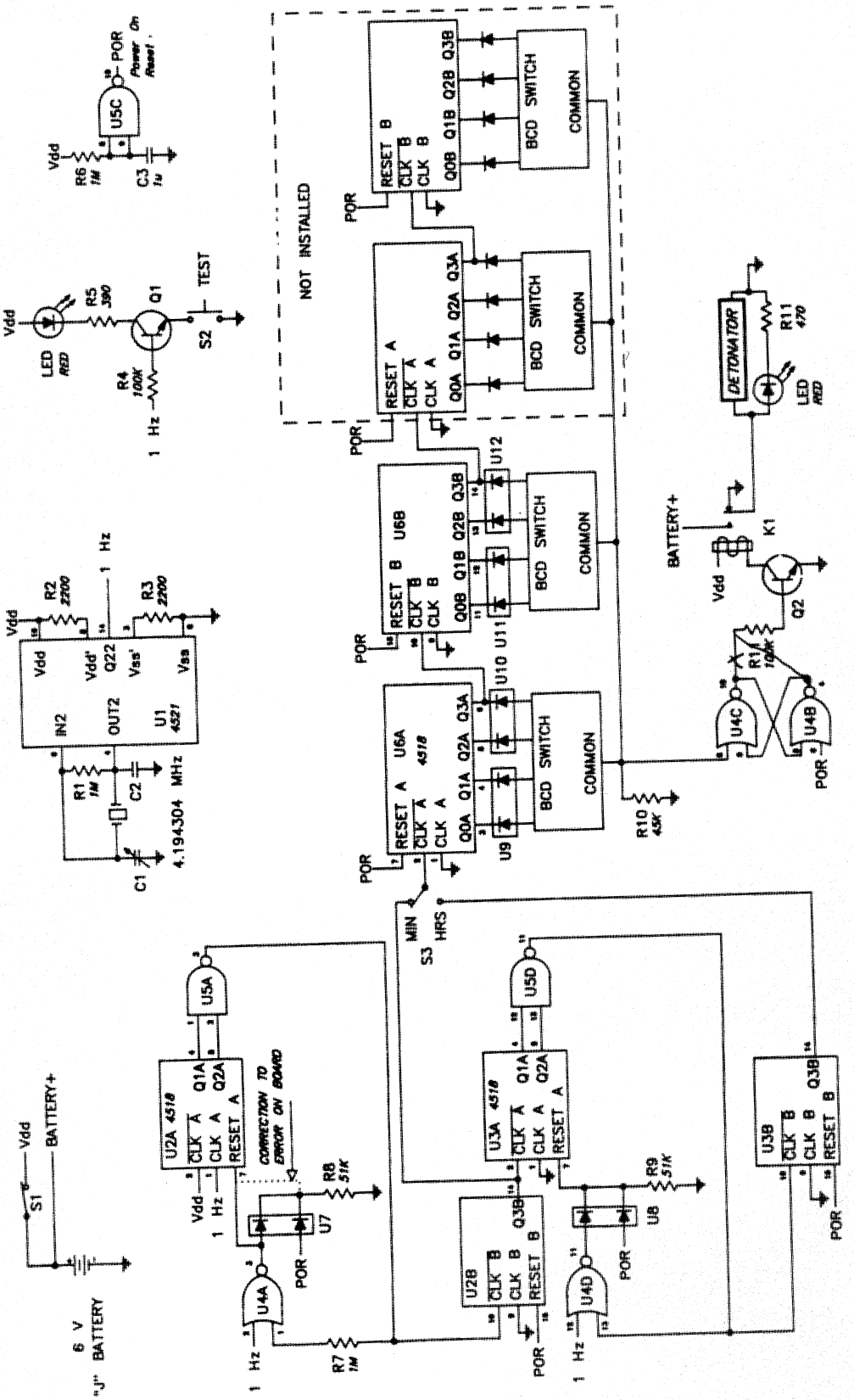



Figure 8. Schematic diagram of the digital timer. An error (an incorrectly routed trace) is noted along with the logical correction.

**POWER SOURCE (S)**

The specimen arrived with a Duracell "J" battery soldered to wires. This battery has a capacity in the 500 mAH class, adequate for several hundred hours of operation.

Soldering directly to the battery contacts is not good practice because it can damage the battery. Good joints are difficult to form, and changing the battery is starting all over.

**PERFORMANCE (S)**

The battery was dead upon arrival. All testing was done with a bench power supply. At 5.5 Vdc, the device used 0.4 mA while counting and 68 mA with the relay actuated. Below 4.65 Vdc, the relay did not actuate. Over the operating voltage range, the crystal oscillator frequency remained stable.

**MARKINGS (S)**

The markings are not obscured and the device is not potted.

BATTERY: Duracell 6 Volt 7K67 made in UK (mfg: Mallory)
CRYSTAL: NYMPH 4.194304 NYP041-12
U1: HEF 4521BT (mfg: Signetics)
U2: HEF 4518BT (mfg: Signetics)
U3: HEF 4518BT (mfg: Signetics)
U4: HEF 4001BT (mfg: Signetics)
U5: HEF 4093BT (mfg: Signetics)
U6: HEF 4518BT (mfg: Signetics)
U7, U8: A4-1
U9-U12: JS 25
Q1, Q2: FF
D1/D2 and D3/D4 packages: A4-1
RELAY: F HZ3 211A D006-M (mfg: Fujitsu)
FRONT PANEL: MST-13