NOVAC INDUSTRIES LIMITED

# QUARTZ CHESS CLOCK

## SERVICE MANUAL

CONTENTS




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DATE: 8th JULY, 1981

## 1. SPECIFICATION

A. Operating Voltage: 9V d.c. (6 pieces UM3 or AA size pen light batteries)

B. Current Consumption: 10MA Typical

C. Battery Life: 100 Hours Typical

D. Operating Temperature: 0°C to + 40°C

E. Storage Temperature: -20°C to + 70°C

F. Dimension: 111 mm (L) X 190 mm (W) X 38 mm (H)

G. Weight: 550 gm

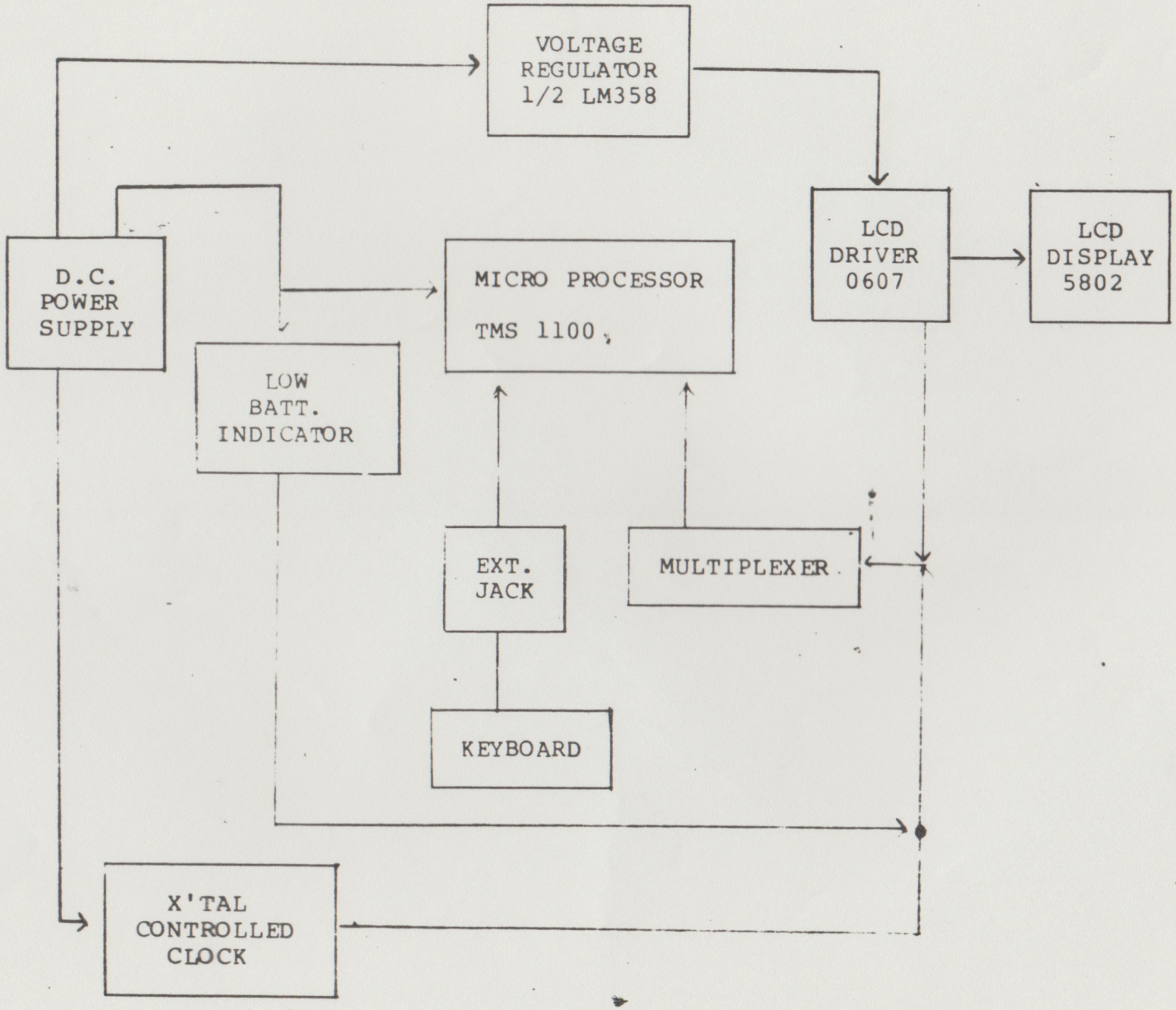
## 2. CIRCUIT DESCRIPTION

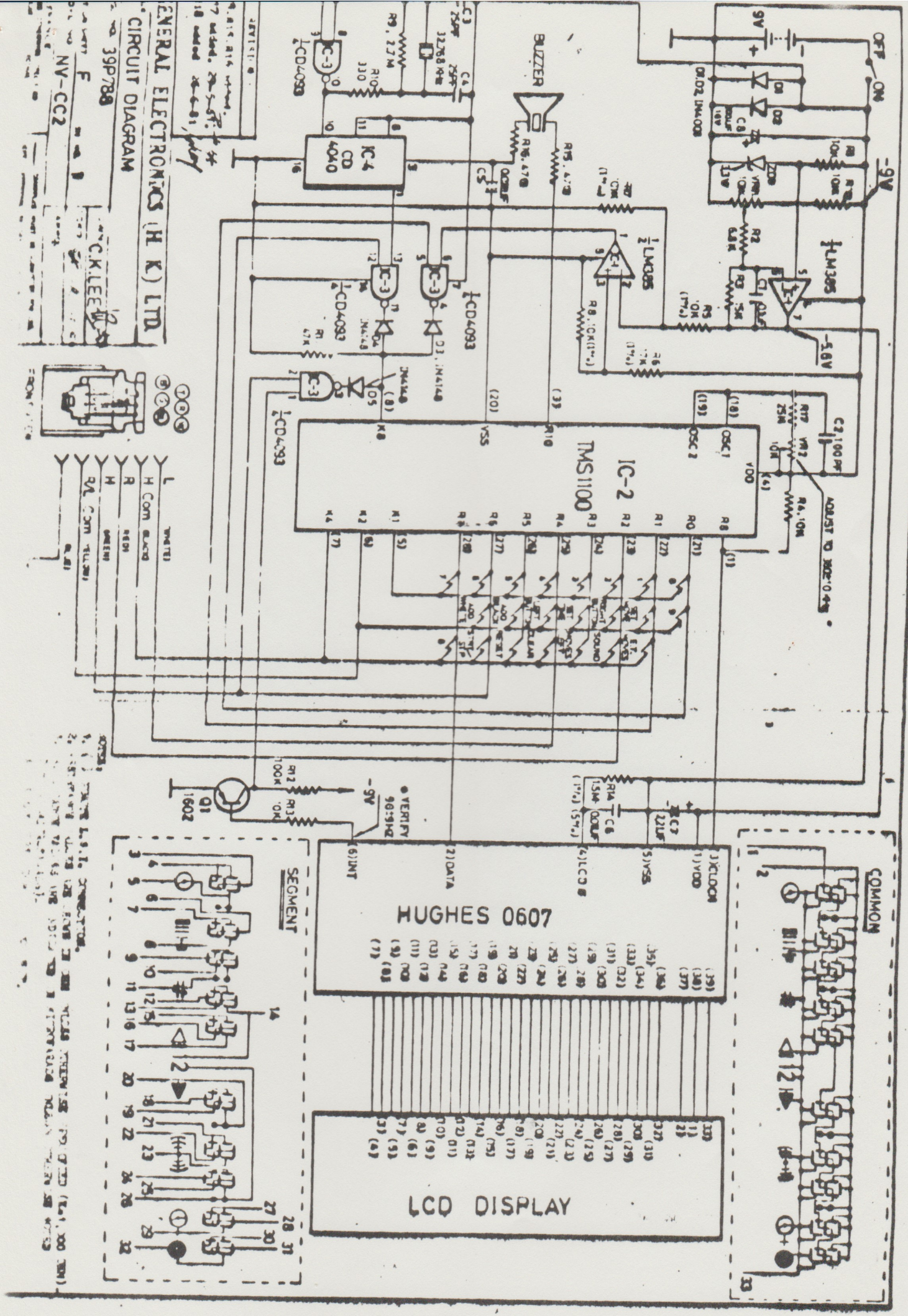
The Quartz Chess Clock consists of essentially a TMS1100 microprocessor programme to provide time functions in accordance with the International Chess Rules. Precision timing is derived from a 32.768KHZ crystal controlled oscillator which feeds the TMS1100. Drive signals from the TMS1100 are converted by the Hughes LCD driver to drive the LCD display.

One half of an operational amplifier LM358 is used as a voltage regulator to supply a stabilised supply to the Hughes driver and the LCD display. The other half of the LM358 is used as a low battery comparater to provide low voltage indicator to indicate that change of batteries is necessary to maintain proper operation of the Clock.

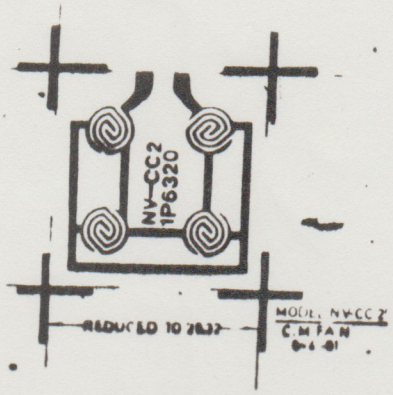
A 6-pin phone jack is available to connect the Clock to other chess computers in the Novag line.

3. BLOCK DIAGRAM

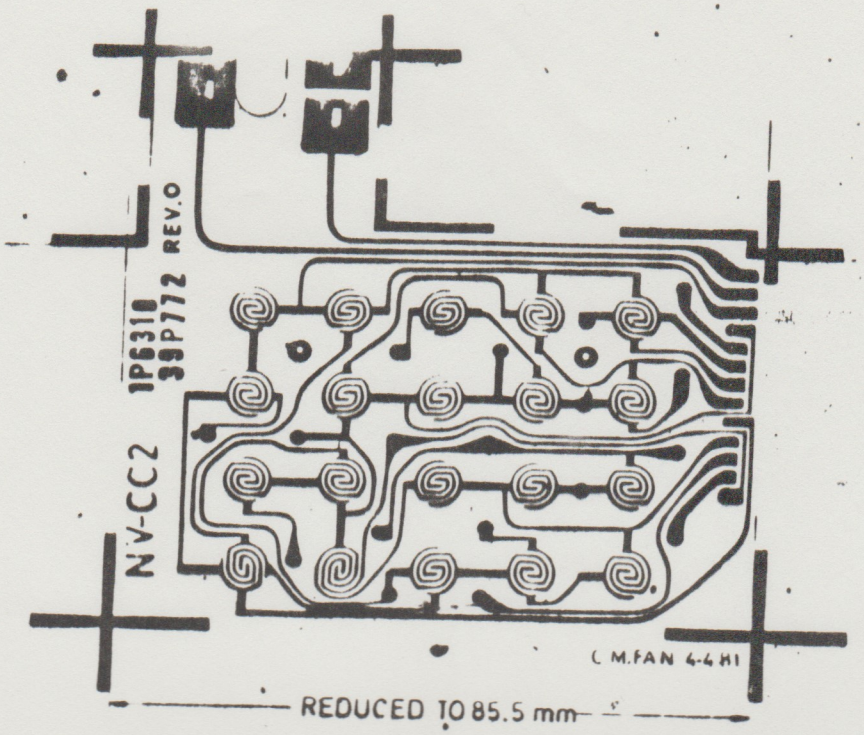




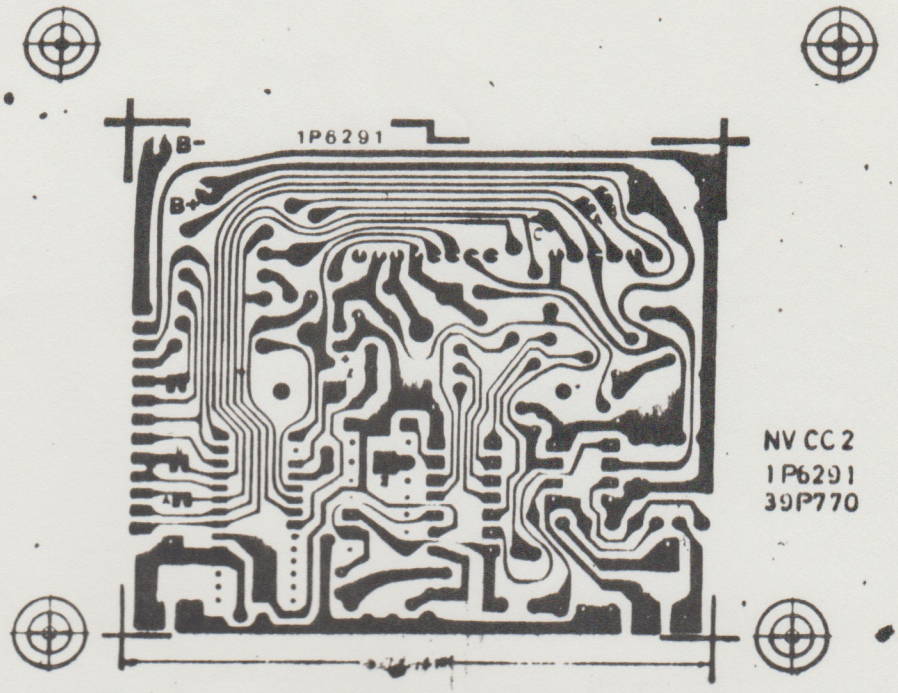

SCHEMATIC DIAGRAM



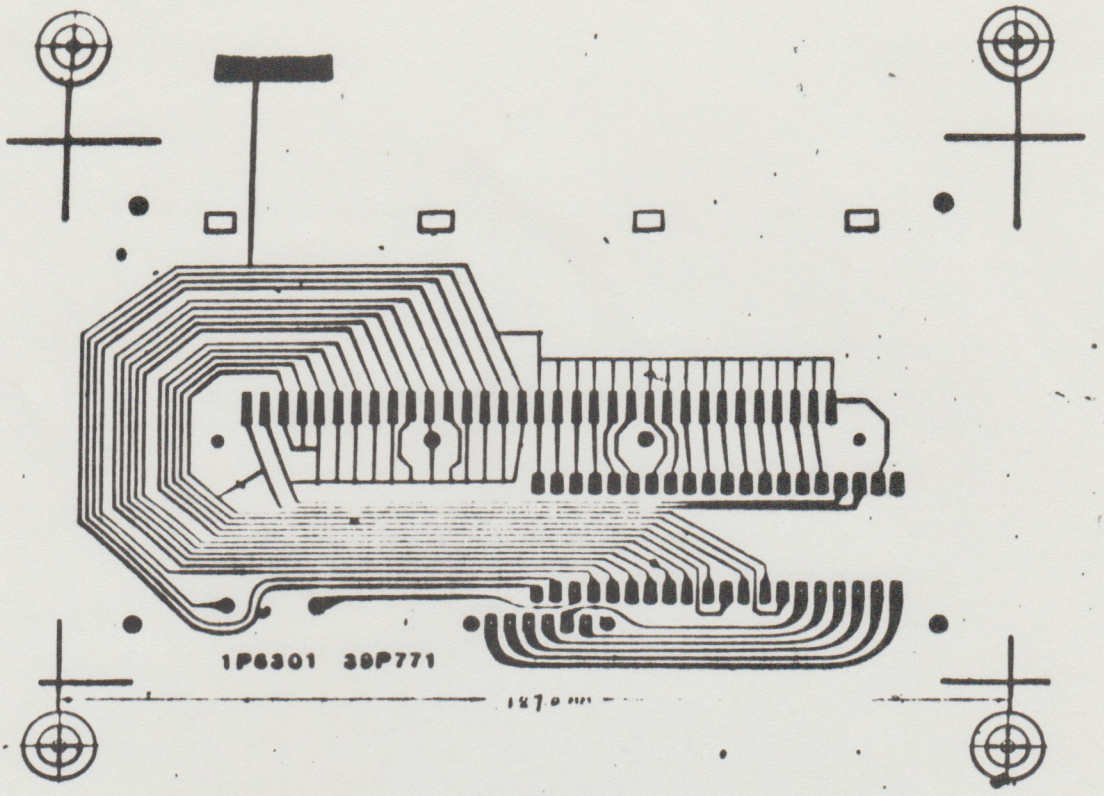

REMOTE BUTTON PCB TRACK DIAGRAM



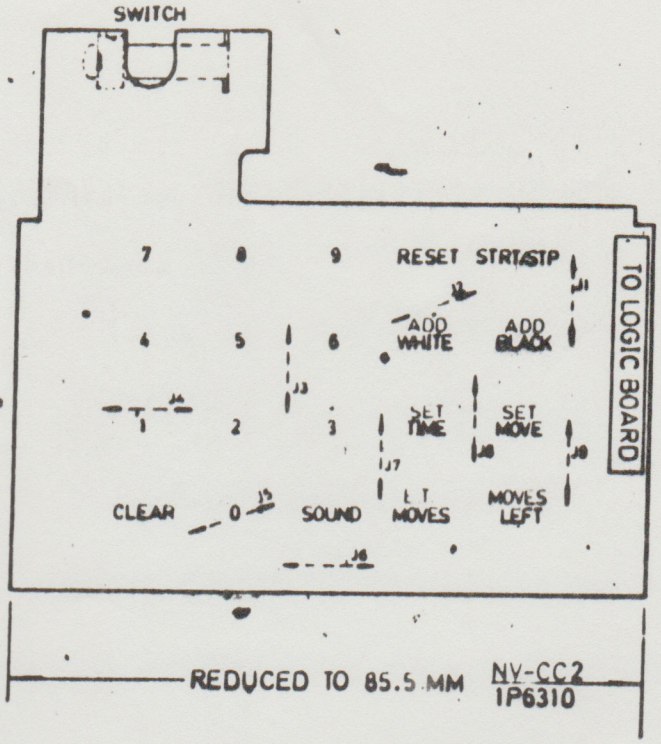

KEYBOARD PCB TRACK DIAGRAM



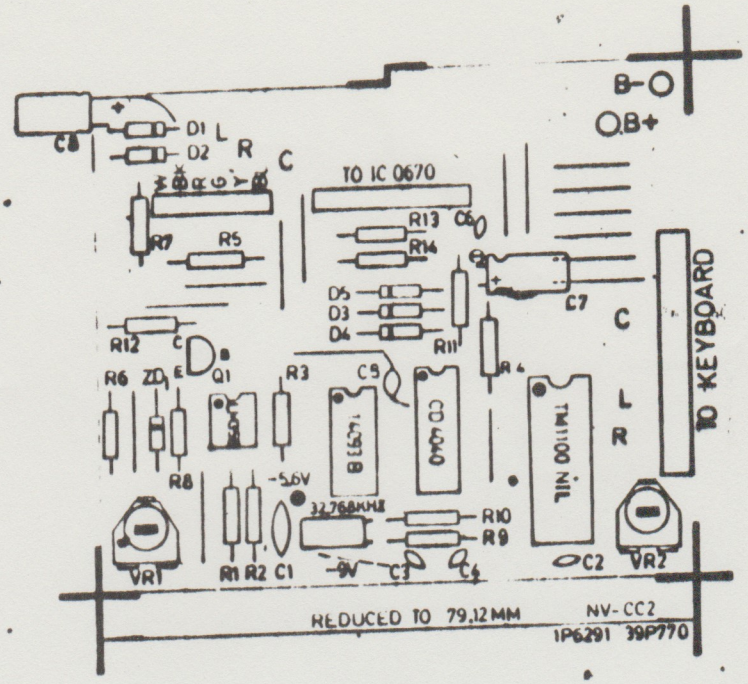

MAIN PCB TRACK DIAGRAM



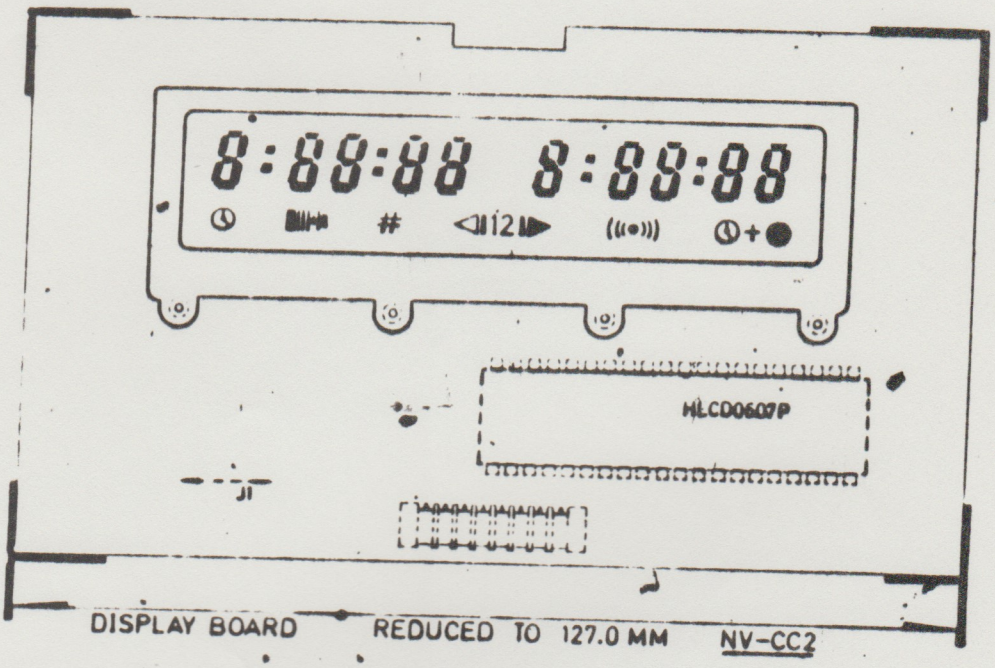

DISPLAY BOARD PCB TRACK DIAGRAM




KEYBOARD JUMPER DIAGRAM




MA1N BOARD COMPONENT LAYOUT DIAGRAM




DISPLAY BOARD COMPONENT LAYOUT DIAGRAM

## 7. ALIGNMENT PROCEDURE

| ALIGNMENT | EQUIPMENT REQUIRED | PROCEDURE |
|---|---|---|
| VOLTAGE | 1. VARIABLE REGULATED DC SUPPLY.<br>2. HIGH INPUT IMPEDANCE VOLTMETER OF AT LEAST 200K OHM/VOLT. | 1. REMOVE BATTERIES FROM UNIT.<br>2. CONNECT POWER SUPPLY TO BATTERY TERMINALS AND SET IT TO 9.0V DC.<br>3. CONNECT VOLTMETER TO PIN 7 OF LM358.<br>4. ADJUST VR1 (10K) UNTIL VOLTAGE AT PIN 7 OF LM358 IS -5.6V. |
| MICROPROCESSOR TMS1100 CLOCK ALIGNMENT | 1. VARIABLE REGULATED DC SUPPLY.<br>2. HIGH INPUT IMPEDANCE FREQUENCY COUNTER. | 1. REMOVE BATTERIES FROM UNIT.<br>2. CONNECT POWER SUPPLY TO BATTERY TERMINALS AND SET IT TO 9.0V DC.<br>3. CONNECT FREQUENCY COUNTER TO PIN 18 OF TMS1100.<br>4. ADJUST VR2 UNTIL THE CLOCK FREQUENCY IS 360 ± 10KHZ. |
| LCD DRIVER CLOCK FREQUENCY VERIFICATION | 1. VARIABLE REGULATED DC SUPPLY.<br>2. HIGH INPUT IMPEDANCE FREQUENCY COUNTER. | 1. REMOVE BATTERIES FROM UNIT.<br>2. CONNECT POWER SUPPLY TO BATTERY TERMINALS AND SET IT TO 9.0V DC.<br>3. CONNECT FREQUENCY COUNTER TO PIN 6 OF 0607 DRIVER AND VERIFY THAT FREQUENCY IS 90 ± 9HZ.<br>4. IF FREQUENCY IS INCORRECT, CHANGE R14 ACCORDINGLY. |

| ALIGNMENT | EQUIPMENT REQUIRED | PROCEDURE |
|---|---|---|
| EXTERNAL CLOCK | 1. VARIABLE REGULATED DC SUPPLY.<br>2. HIGH INPUT IMPEDANCE FREQUENCY COUNTER | 1. REMOVE BATTERIES FROM UNIT.<br>2. CONNECT POWER SUPPLY TO BATTERY TERMINALS AND SET IT TO 9.0V DC.<br>3. CONNECT FREQUENCY COUNTER TO 32.768 KHZ CRYSTAL AND VERIFY ITS FREQUENCY<br>4. IF FREQUENCY INCORRECT, CHANGE EITHER C3 OR C4. |
| LOW BATTERY INDICATION VERIFICATION | 1. VARIABLE REGULATED DC SUPPLY. | 1. REMOVE BATTERIES FROM UNIT.<br>2. CONNECT POWER SUPPLY TO BATTERY TERMINALS AND SET IT TO 9.0V DC.<br>3. REDUCE VOLTAGE AND OBSERVE WHETHER THE LOW VOLTAGE INDICATOR ON THE DISPLAY APPEAR WHEN VOLTAGE DROPS BELOW 7.5V DC. IF NOT, REPLACE ANY ONE OR MORE OF THE RESISTORS R5, R6, R7 & R8. |

## 8. FUNCTIONAL TEST PROCEDURE

| STEP | PROCEDURE | CORRECT OPERATION |
|---|---|---|
| 1. | Switch on the unit by lifting the display housing. | 1. Buzzer sounds<br>2. Display shows<br>5:00 5:00<br>◷ ◁1 ((•)) ● |
| 2. | Press digit "5" five times. | 1. Everytime key is depressed buzzer makes one blip.<br>2. Display shows:<br>5 55 .55<br>◁1 ((•)) |
| 3. | Press "SET TIME" key. | 1. Buzzer blips.<br>2. Display shows:<br>5 : 55 : 55 : 0<br>◁12 ((•)) |
| 4. | Press "4" & "0" keys. | 1. Buzzer blips.<br>2. Display shows:<br>40<br>◁1 ((•)) |
| 5. | Press "SET MOVE" key. | 1. Buzzer blips.<br>2. Display shows:<br>40 99<br># ◁12 ((•)) |
| 6. | Press "CLEAR" key. | 1. Buzzer blips.<br>2. Display shows:<br>5 : 55 : 55 5 : 55 : 55<br>◷ ◁1 ((•)) ● |
| 7. | Press "STRT/STP" Key. | 1. Buzzer blips.<br>2. Left timer begins to counter down from 5:55:55 |

| STEP | PROCEDURE | CORRECT OPERATION |
|---|---|---|
| 8. | Press left remote button. | 1. Buzzer blips.<br>2. ◁‖1 sign changes to 1‖▷<br>3. Right timer begins to count down from 5:55:55. |
| 9. | Press right remote button. | 1. Buzzer blips.<br>2. Left timer will now count down from previous time. |
| 10. | Press "MOVES LEFT" button. | 1. Buzzer blips.<br>2. Display shows:<br>39 39<br># ◁‖1 ((•))<br>3. After several seconds, display reverts to show time. |
| 11. | Press "ET/MOVES" key. | 1. Buzzer blips.<br>2. Display shows:<br>1 0:01<br># ◁‖1 ((•)) ⏲+●<br>(Note: The last digit 1 may be 1, 0, 2 or any number depending on how long the proceeding operation has taken. It shows the clapsed time in hours and minutes. |
| 12. | Press "1" key five times. | 1. Buzzer blips five times.<br>2. Display shows:<br>1 11 11<br>◁‖1 ((•)) |
| 13. | Press "ADD WHITE" key. | 1. Buzzer blips.<br>2. White's time is increased by 1 hr. 11 minutes and 11 sec. |
| 14. | Press "ADD BLACK" key. | 1. Buzzer blips.<br>2. Black's time is increased by 1 hr 11 minutes and 11 sec. |

| STEP | PROCEDURE | CORRECT OPERATION |
|---|---|---|
| 15. | Press "RESET" key. | 1. Buzzer blips.<br>2. Both white and black time reverts to 5:55:55. Also there is no count down. |
| 16. | Press 'SOUND' key. | 1. ((•)) sign disappears.<br>2. Pressing any other key or remote button will not produce a blip. |

## 9. TROUBLE SHOOTING CHART

| PROBLEMS | POSSIBLE CAUSES |
|---|---|
| Unit Dead | 1. Battery voltage too low.<br>2. Battery connecting wires broken.<br>3. Push button on/off switch defective. |
| No Sound (Except when unit is turn off and then on again within five seconds) | 1. Buzzer defective.<br>2. Connection to buzzer broken.<br>3. Defective microprocessor. |
| Display Segment or Symbol missing | 1. Defective display.<br>2. Defect zebra connector.<br>3. Broken track.<br>4. Defective microprocessor or driver. |
| Remote Control no function | 1. Connecting wire broken.<br>2. Open circuit track.<br>3. Defective microprocessor. |
| Key or Keys no function | 1. Defective microprocessor.<br>2. Defective rubber conductor.<br>3. Open circuit track. |
| Low battery indicator wrong indication | 1. Incorrect low battery indication circuit component.<br>2. Defective op. amplifier. |
| Inaccurate Timing | 32.768 KHz crystal oscillator circuit defective. |

# PART LIST

| ITEM | DESCRIPTION | PART NO. | QTY | UNIT COST US$ |
|---|---|---|---|---|
| 1 | LOGIC PCB SINGLE SIDE | 1P6269 | 1 | 0.50 |
| 2 | DISPLAY PCB SINGLE SIDE | 1P6301 | 1 | 0.70 |
| 3 | K.B. PCB SINGLE SIDE | 1P6311 | 1 | 0.40 |
| 4 | REMOTE PCB SINGLE | 1P6320 | 2 | 0.20 |
| 5 | MICROPROCESSOR TMS1100 | 1V2650 | 1 | 4.50 |
| 6 | QUAD-NAND SCHMIDT CD4093 | 1V2651 | 1 | 0.45 |
| 7 | 12-STAGE COUNTER CD4040 | 1V2652 | 1 | 0.65 |
| 8 | DUAL OP-AMP LM358 | 1V2641 | 1 | 0.56 |
| 9 | LCD DRIVER 0607 | 1V2653 | 1 | 4.00 |
| 10 | LCD CLOCK DISPLAY TP5802 | 1V4370 | 1 | 8.00 |
| 11 | PNP G.P. TRANS.2N2907 | 3M3190 | 1 | 0.20 |
| 12 | SWITCHING DIODE 1N4148 | 3M1051 | 3 | 0.05 |
| 13 | SILICON RECTIFIER 1N4001 | 3M1030 | 2 | 0.10 |
| 14 | ZENER DIODE 3.3V 5% | 3M1490 | 1 | 0.15 |
| 15 | 32.768KHZ CRYSTAL | 3K0080 | 1 | 0.80 |
| | RESISTORS 5% 1/4W | | | |
| 16 | 470 OHM | 3R0431 | 2 | 0.01 |
| 17 | 25 KOHM | 3R0791 | 1 | 0.01 |
| 18 | 6.8 KOHM | 3R0681 | 1 | 0.01 |
| 19 | 10 KOHM | 3R0711 | 4 | 0.01 |
| 20 | 15 KOHM | 3R0741 | 1 | 0.01 |
| 21 | 47 KOHM | 3R0381 | 1 | 0.01 |
| 22 | 330 KOHM | 3R0411 | 1 | 0.01 |
| 23 | 2.7 MOHM | 3R1191 | 1 | 0.01 |
| 24 | 100 KOHM | 3R0951 | 1 | 0.01 |

| ITEM | DESCRIPTION | PART NO. | QTY | UNIT COST US$ |
|---|---|---|---|---|
| | RESISTORS 1% 1/4W | | | |
| 25 | 10 KOHM | 3R0713 | 3 | 0.04 |
| 26 | 17 KOHM | 3R1163 | 1 | 0.04 |
| 27 | 1.5 MOHM | 3R1162 | 1 | 0.04 |
| 28 | TRIMMER RES. 10 KOHM | 3R2145 | 2 | 0.20 |
| | CAPACITORS | | | |
| 29. | ELECT. 2.2UF/16V | 3E0052 | 2 | 0.05 |
| 30 | CER. 10% 25PF/50V | 3C0182 | 2 | 0.05 |
| 31 | CER. 10% 100PF/50V | 3C0362 | 1 | 0.05 |
| 32 | CER. 10% 0.1UF/25V | 3C0684 | 1 | 0.05 |
| 33 | MYL. 5% 0.01UF/25V | 3C1246 | 1 | 0.05 |
| 34 | ELECT. 100UF/16V | 3E0142 | 1 | 0.05 |
| 35 | CER. 0.02UF/16V | 3C0654 | 1 | 0.05 |
| 36 | 6-PIN CONN. RT ANGLE | 4T7340 | 1 | 0.25 |
| 37 | 6-PIN CONN. STRT | 4T7330 | 1 | 0.25 |
| 38 | 13-PIN CONN. ARRAY | 4T7210 | 1 | 0.10 |
| 39 | COND. RUBBER (K.B.) | 4T3441 | 1 | 0.40 |
| 40 | COND. RUBBER (REMOTE) | 4D3450 | 2 | 0.10 |
| 41 | 6-POS'N FLEX CABLE | 4T7170 | 1 | 0.20 |
| 42 | REMOTE CONTROL CABLE | 3W2131 | 2 | 0.10 |
| 43 | 6-PIN PHONE SOCKET | 2J0210 | 1 | 1.00 |
| 44 | 27mm TRANSDUCER | 3K0050 | 1 | 0.25 |
| 45 | STTRADED WIRES | - | A/R | - |
| 46 | DISPLAY HOUSING TOP | 4D3330 | 1 | 0.55 |
| 47 | DISPLAY HOUSING BOTTOM | 4D3340 | 1 | 0.55 |
| 48 | K.B. HOUSING TOP | 4D3361 | 1 | 0.30 |
| 49 | K.B. HOUSING BOTTOM | 4D3351 | 1 | 0.30 |
| 50 | REMOTE SW. HOUSING TOP | 4D3390 | 2 | 0.10 |

| ITEM | DESCRIPTION | PART NO. | QTY | UNIT COST US$ |
|---|---|---|---|---|
| 51 | REMOTE SW. HOUSING BOTTOM | 4D3400 | 2 | 0.10 |
| 52 | KEYTOPS | 4D3320 | 20 | 0.02 |
| 53 | BATTERY DOOR | 4D3370 | 1 | 0.10 |
| 54 | LCD COVER (MOUNT) | 4D3380 | 1 | 0.30 |
| 55 | REMOTE SW. BUTTON | 4T7130 | 2 | 0.20 |
| 56 | AL. DISPLAY INLAY #1 | 7X077 | 1 | 0.10 |
| 57 | AL. DISPLAY INLAY #2 | 7X078 | 1 | 0.25 |
| 58 | DISPLAY PVC INLAY | 7X080 | 1 | 0.15 |
| 59 | K.B. FUNCTION PLATE | 7X079-1 | 1 | 0.15 |
| 60 | BATTERY CONTACT 1P | 4T7140 | 1 | 0.10 |
| 61 | BATTERY CONTACT 1P | 4T7141 | 1 | 0.10 |
| 62 | BATTERY CONTACT 2P | 4T7150 | 1 | 0.20 |
| 63 | NI. PLATED HINGES | 4T7160 | 2 SETS | 0.20 |
| 64 | BATTERY LABEL | 7J766 | 1 | 0.02 |
| 65 | WOOD GRAIN PAPER | 4F1290 | 1 | 0.05 |
| 66 | RUBBER SHEET | 4D3460 | 2 | 0.05 |
| 67 | RUBBER FEET | 4D3280 | 4 | 0.01 |
| 68 | SPACER | 4D3410 | 1 | 0.02 |
| 69 | SCREWS | - | A/R | - |
| 70 | WASHER | - | A/R | - |
| 71 | POLYFOAM | 7F098 | 1 SET | 0.30 |
| 72 | POLYBAG | 6G1050 | 1 | 0.05 |
| 73 | TEL. CABLE W/PLUG | 3W2121 | 1 | 1.60 |
| 74 | MANUAL | 7G779 | 1 | 0.30 |
| 75 | WARRANTY CARD | 7G778 | 1 | 0.05 |
| 76 | GIFT BOX | 7B625 | 1 | 0.60 |
| 77 | PAPER LABEL | - | 1 | 0.02 |
| 78 | SHIPPING CARTON | 7T324 | 1/12 | 1.20 |