ELECTRONIC CHIME SERVICE INFORMATION

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The NuTone line of "Melody" and "Melody Time" electronic musical chimes offer a selection of keyboard programmed tunes as well as a striking digital clock. Optional connections for connections to Radio-Intercom systems are provided. Provisions for connecting extension speakers to the chime itself are included.

During the evolution of these electronic chimes, several models have been offered for sale. In chronological order they are:

May 1979	LA-55	(25 Tunes)
	LAC-55	(25 Tunes & Clock)
Aug. 1979	LA-55	(Revised) (25 Tunes)
	LAC-55	(Revised) (25 Tunes & Clock)
Jan. 1980	LB-55	(25 Tunes)
	LBC-55	(15 Tunes & Clock)
May/June 1980	LA-55	(Special) (25 Tunes)
	LAC-55	(Special) (25 Tunes & Clock)

To aid in servicing these chimes, the following chart summarizes information pertaining to all eight models.

MODEL NO.	First Mfg. Date	Clock	Short Tune	No. Tunes	PC Board No. Chime	PC Board No. Display	NuTone Microprocessor Part No.	Intel Microprocessor Part No.
LA-55	May 1979	No	Yes	25	37711	---	36705	8021
LAC-55	May 1979	Yes	Yes	25	37712	37710	36696	8022
LA-55 Revised	Aug 1979	No	Yes	25	37721	---	36705	8021
LAC-55 Revised	Aug 1979	Yes	Yes	25	37722	37720	36696	8022
LB-55	Jan 1980	No	No	25	37730	---	36709	8021
LBC-55	Jan 1980	Yes	No	15	37731	37720	36710	8021
LA-55 Special	June 1980	No	Yes	25	37742	---	36696	8022
LAC-55 Special	June 1980	Yes	Yes	25	37742	37720	36696	8022

The Appendix provides detailed information on each of the chime models along with schematics of each.

SHORT DESCRIPTION OF OPERATION

The circuit of FIG. 1 is that of the LAC-55 electronic chime. It is divided into functional circuit areas to help describe the chime operation. Operational descriptions are for the LAC-55 but apply to all the various chime models. Chime only models are similar except for different programs deleting the clock and display functions.

The microcomputer and its associated components form the heart of the system. Inductor L1, capacitors C9 & C10, and internal chip capacitance form a resonant circuit for the microcomputer clock oscillator. This provides all the timing signals for processor internal operation. The oscillator is adjusted for a frequency of 3.00 MHZ. The A.L.E. output pin of the microcomputer is a divide by 30 function of the oscillator (100 KHZ). It can be used as a reference in oscillator frequency adjustment.

An additional timing reference is supplied to T1 input of the microcomputer. This is the 60 HZ power line frequency signal supplied from the power supply circuit.

The microcomputer contains the entire chime operating program in its Read Only Memory (ROM). The ROM capacity is 2048 8-bit bytes in the 36696 (8022) microcomputer and 1024 bytes in all the other chips (8021). This program is like an endless loop of instructions which the microcomputer sequentially executes one step at a time over and over again. Most of the microcomputer's time is spent cycling repeatedly through the part of the program dealing with scanning the input circuitry (keyboard and Front, Side, and Rear inputs) looking for a change in the status of any switch function. If a change is sensed - as when a key is depressed - the microcomputer jumps to the appropriate part of the program for servicing the detected command.

Tune numbers are entered through the keyboard and stored in on-chip Random Access Memory (RAM). When the "TUNE TEST" command is detected by the microcomputer, the tune play portion of the program is accessed and the appropriate tune program data is transferred one byte at a time from ROM to RAM and then sent out of microprocessor port PØ3 as an on/off signal of 50% duty cycle at a frequency equal to the desired note frequency for that particular note in the tune being played.

The on/off signal continues for a programmed length of time corresponding to the appropriate note duration for that particular note in the tune. This time period is measured by an internal counter in the microcomputer using the 60 HZ power line reference signal mentioned previously. At the end of a sequence of notes - end of tune - the program shifts back to the "idle" mode and the microcomputer is busy searching for another command from the INPUT circuit.

The playing of clock strike sounds is done in a manner similar to the playing of a tune but the "strike sound" command comes from a special part of the program which operates as a digital clock for time of day indication. This clock also receives its timing information from the 60 HZ power line.

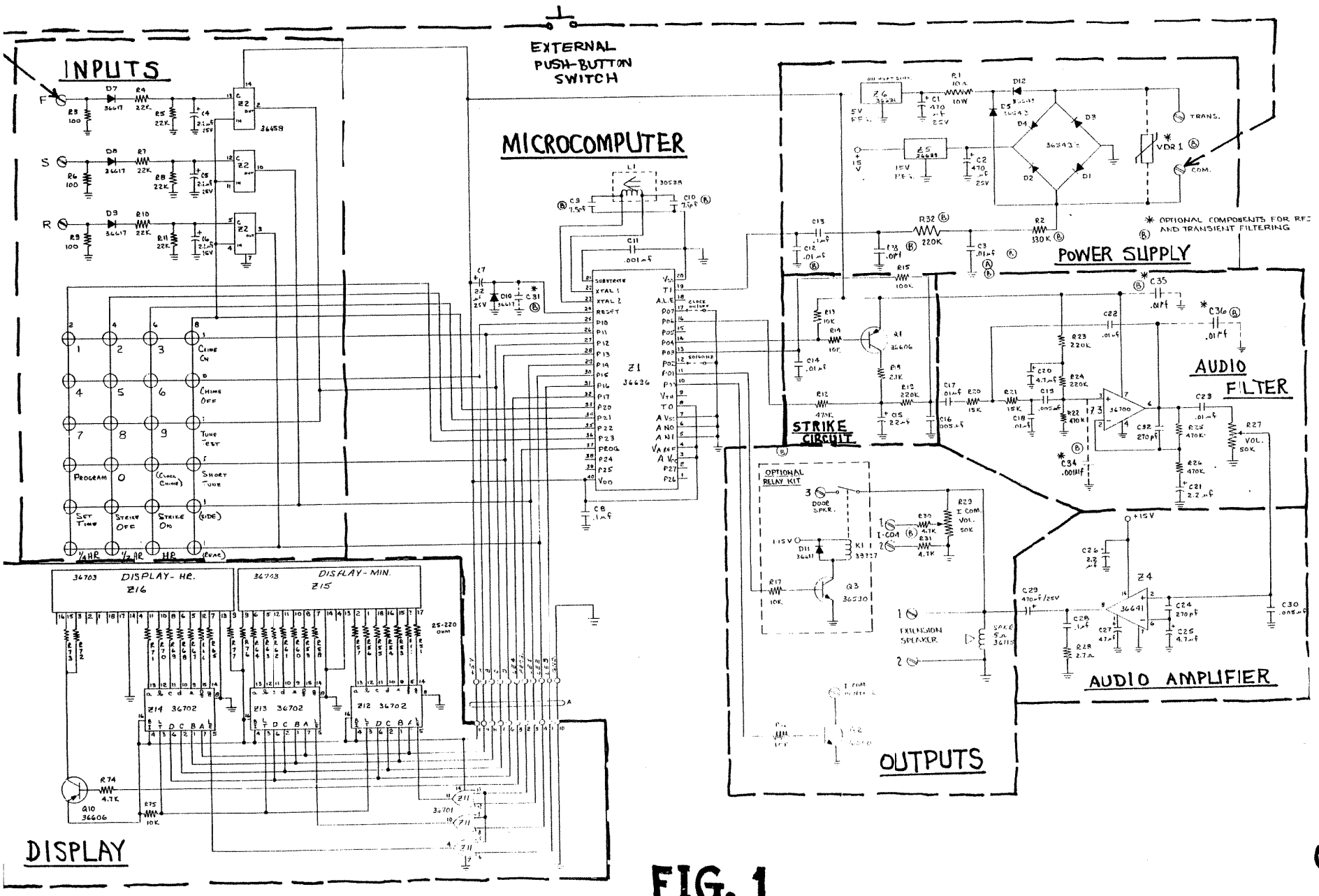

EXTERNAL PUSH-BUTTON SWITCH
INPUTS
MICROCOMPUTER
POWER SUPPLY
* OPTIONAL COMPONENTS FOR RFI AND TRANSIENT FILTERING
AUDIO FILTER
STRIKE CIRCUIT
OPTIONAL RELAY KIT
OUTPUTS
AUDIO AMPLIFIER
DISPLAY
DISPLAY - HR.
DISPLAY - MIN.
Z1 36636
Z2 36459
Z3 36703
Z4 36441
Z5 36488
Z6 36481
Z11 36701
Z12 36702
Z13 36702
Z14 36702
Z15
Z16
Q1 36606
Q2 36606
Q3 36330
Q10 36606
K1 33327
D1 36343
D2 36343
D3 36343
D4 36343
D5 36343
D7 36417
D8 36417
D9 36417
D10 36417
D11 36411
D12 36411
TRANS.
VDR 1
COM.
CRIME ON
CRIME OFF
TUNE TEST
SHORT TUNE
(SIDE)
PROGRAM
(CLOCK CHIME)
SET TIME
STRIKE OFF
STRIKE ON
(CLOCK)
1/4 HR
1/2 HR
HR
DOOR SPKR.
I-COM
EXTENSION SPEAKER
VOL. 50K
SPKR 8 Ω 36115

FIG. 1

INPUTS

The keyboard is scanned as an X Y matrix. A logic low signal is sequentially applied to the rows of the keyboard and the columns are examined by the microcomputer Port P2Ø - P23 to see if switch closures have occurred. The Front, Side and Rear inputs are activated by standard, or lighted, door chime pushbutton switches. A control voltage is generated to turn on one of the CMOS transmission gates (Z2). The outputs of these gates are connected across their appropriate places in the X Y keyboard matrix to activate playing of the correct tune.

DISPLAY

The display serves two functions. As numbers are entered through the keyboard, they are displayed on the LED indicators. Also, the digital clock program displays its time of day status on these LED's.

The appropriate type of data to be displayed (tune entry or time of day) is determined by the program. The actual data is transferred from the microcomputer to the Display Module through Port PlØ - P17. Data is supplied in Binary Coded Decimal (BCD) format on a one-digit-at-a-time basis. Digit select and latch strobe signals are provided for storing the data in the display module latch/decoder/digit driver IC's.

STRIKE CIRCUIT

At the beginning of each note to be played a Strike Pulse is generated at Port PØ4. This turns on Q1 charging up capacitor C15. This charge becomes the supply voltage source for the succeeding cycles of the audio frequency on/off switching signal from Port PØ3. As the voltage across C15 discharges, the peak voltage of the audio frequency waveform decays until finally the amplitude decreases to zero. This accomplishes a decay envelope for the audio output from the chime. The decay rate can be changed from one tune to another by switching resistor R12 in and out of the circuit.

AUDIO FILTER

The audio filter has as its input a sawtooth type waveform. An active filter in association with passive RC filtering, shapes this waveform so as to remove both low and high frequency components and act as a band pass filter ahead of the power amplifier stage. This gives the notes a more pure and pleasing sound.

AUDIO AMPLIFIER

This circuit is a conventional audio power amplifier using a 36641 (LM380) IC. It is designed to drive the 8 ohm chime speaker with additional extension speakers.

OUTPUTS

There are 6 output terminals included in the chime circuit. Extension Speaker 1 and 2 are used to drive up to three extension 16 ohm speakers. Terminal 1 is the high side of the output and 2 is chime circuit ground.

I-COM CONTROL is the collector of an NPN transistor which switches this terminal to ground whenever a tune is being played or a clock strike is occurring. It is normally used to control muting of a radio-intercom system but could be put to other uses as well.

I-COM 1 & 2 are a low level audio output from the audio amplifier used for driving the chime circuit inputs of radio-intercom systems. Connection is made to both 1 and 2 on balanced intercom systems. Terminal 1 only, along with Extension Speaker 2 (chime circuit ground), are used for unbalanced intercom systems.

EXTENSION SPEAKER 3 terminal is not connected in normal use. It is used with an accessory relay kit where it is desired to provide separate speaker lines for chime and clock strike audio and chime only audio. This might be desired for an outside chime extension speaker near a door. The relay is energized only on chime tune playing.

POWER SUPPLY

The power supply operates from a 16VAC source (105-N or 301-N transformer). It contains both +5 VDC and +15VDC regulators. All circuitry is supplied from the regulated +5 VDC except the audio amplifier and optional relays which are powered by the +15 VDC regulator.

An RC filter is used to provide a clean 60 HZ sine wave sync signal to the microcomputer.

"REVISED"MODELS

The LAC-55 (Revised) and LA-55 (Revised) incorporate some refinements in the original circuit to improve performance.

The impedance of the volume control circuit was lowered by a factor of 10 to reduce the amount of hum and buzz coupled into the audio amplifier.

In addition, an RC filter was substituted for the 2.5 Volt zener circuit used to derive the 60 HZ power line sync signal for the microcomputer.

"B - SERIES" MODELS

As a result of a redesign effort, the 8021 microcomputer was programmed to execute the digital clock and display functions. Both the LB-55 and LBC-55 use the 28-pin 8021 microcomputer.

Also incorporated in this series is a CMOS transmission gate audio muting circuit. This provides virtually complete hum and buzz suppression out of the audio amplifier by shunting its input to ground, except during the playing of a tune or striking of the clock.

"SPECIAL" MODELS

These models, LA-55 (Special) and LAC-55 (Special) are hybrids by the fact that they make use of the original 36696 (8022) microcomputer in a circuit very similar to the "B-SERIES" including all the revisions previously incorporated.

SPECIAL MODIFICATIONS

HUM & BUZZ PROBLEMS

The sources of hum or buzz found in the LAC-55 and LA-55 are the digital switching transients of the microprocessor itself and the keyboard circuitry. The higher impedance of the original audio circuitry aggravated this problem by allowing higher than desired hum levels to be coupled into the input of the power amplifier IC. Reduction of the input impedance of this circuitry by a factor of 10 provides increased hum rejection and should be satisfactory in most applications.

In cases where sufficient hum reduction cannot be obtained, contact NUTONE FIELD SERVICE for the required procedures for modifying the LAC-55 and LA-55. These procedures involve addition of a reed relay to the LAC-55 to switch the chime output on during chime play and off when output is not required.

The LA-55 procedure involves the addition of an audio amplifier muting circuit similar to the LB series of electronic chimes.

ADDITION OF ACCESSORY KITS

KIT 5783A: RELAY KIT (LAC-55, LAC-55 (Revised), LBC-55, and LAC-55 (Special)

This kit is intended for applications where it is desired to separate the chime tune and clock strike audio so as to provide chime tune audio only to some speakers (ie, front door extension speaker) and chime tune plus clock strike audio to other speakers (ie, inside extension speakers).

KIT 5803A: CHIME DOOR SPEAKER BOARD (All "A" and "B" Series)

This kit is for use where it is desired to connect an LAC-55, LA-55, LBC-55 or LB-55 to a radio-intercom system DOOR SPEAKER for playing the chime signals through the DOOR SPEAKER. This module is not required to accomplish this function with any of the IM-300 series radio-intercom masters. See chime instruction sheets for further information.

RFI PROBLEMS

Should any of the various electronic chime models experience radio frequency interference, the individual schematics indicate the addition of appropriate components depending on the part of the circuit involved.

All models, except the original LA-55 and LAC-55, have holes provided for installation of these components in the circuit board itself.

RFI troubleshooting procedures should be undertaken in a manner similar to that for radio-intercoms and other control circuits.

NOTE: The Appendix contains copies of "TECH TIPS" issued for the electronic chime products.

TEST FIXTURE DESCRIPTION

The electronic chime test fixture consists of a PC board mounting frame with threaded terminal connectors, various clip leads and cables, and electrical circuitry to provide AC power, test signals, and control signals to the chime under test.

This fixture can be used with all models of the electronic chime. 16 VAC power connections are provided to the LA-55, LAC-55, LA-55 (Revised), and LAC-55 (Revised) through special threaded stud adapters and YELLOW and GREEN binding posts. LB-55, LBC-55, LA-55 (Special), and LAC-55 (Special) models contain attached power leads and can be directly connected to the YELLOW and GREEN binding posts.

All of the chime PC boards are mechanically interchangeable allowing easy connection to the test frame.

CABLES, CLIP LEADS & JACKS

As previously mentioned, the YELLOW and GREEN leads are for 16 VAC hookup of LA-55, LAC-55, LA-55 (Revised) and LAC-55 (Revised) chime boards. The YELLOW binding post is "TRANS." and GREEN is "COM.".

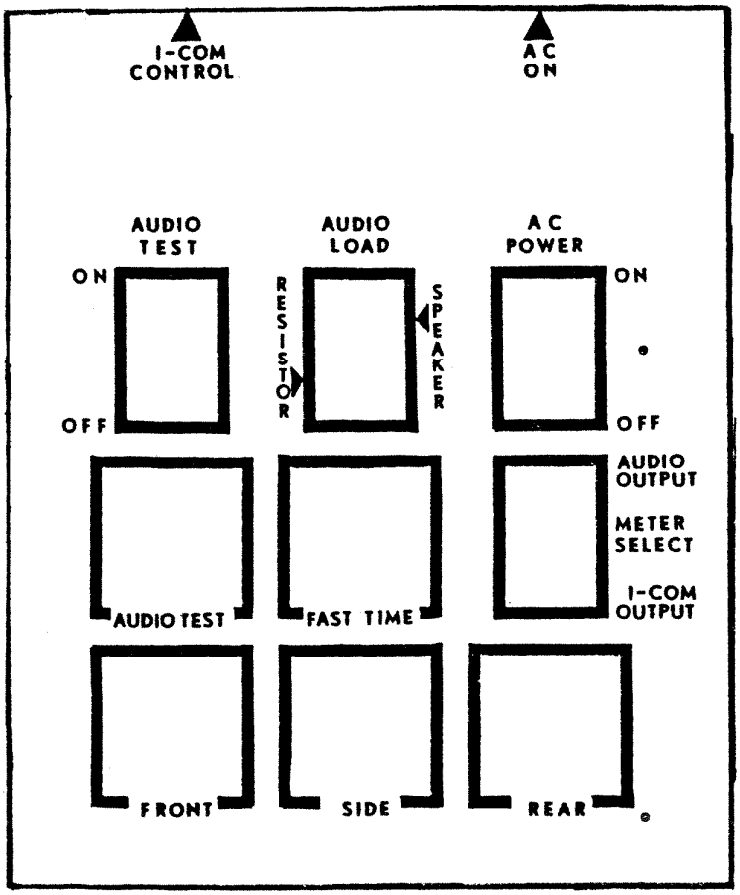
The two ORANGE clip leads are for connection of the "FAST TIME" circuit in the fixture to the chime models containing digital clocks. This provides for a fast means of advancing the clock circuit to check out the various clock features.

The BLACK and WHITE clip leads are the output of a 400 HZ oscillator in the fixture. They provide a signal to test the audio portion of the chimes by insertion of a low level audio signal at the input of the bandpass filter. BLACK is attached to the low side of the audio circuit and WHITE is the high side.

The RED test probe and wire are used for probing the A.L.E. (Automatic Latch Enable) signal output by the microcomputer. The BNC test jack on the side of the fixture provides a connection point to a frequency counter to measure the frequency of this A.L.E. signal (F=100.00 KHZ).

The RED and BLACK binding posts are for use with an oscilloscope and AC voltmeter. RED is the high side of the measured voltage and BLACK the low side. A selector switch determines which of two audio voltages are available at this test point.

EXPLANATION OF FIXTURE SWITCHES



AC POWER: Switches 16 VAC to YELLOW and GREEN binding posts on and off. (Fixture on/off control by line cord)

AC ON (GREEN LED): Indicates 16 VAC on/off to YELLOW and GREEN binding posts.

AUDIO LOAD:

This switch controls the load applied to the audio power amplifier. In the "RESISTOR" position a 3.3 ohm resistive load only is applied. In the "SPEAKER" position a parallel load of a fixed resistor and the 16 ohm test speaker are applied to the amplifier. This load is approximately 3.3 ohms as well.

AUDIO TEST:

There are two AUDIO TEST switches - one slide switch and one pushbutton. These switches control the output of the 400 HZ sine wave to the chime under test through the BLACK and WHITE test leads. The slide switch provides a continuous test tone while the pushbutton provides a momentary tone.

FAST TIME:

Depressing this pushbutton switch activates the pair of ORANGE test leads. A contact closure occurs at about a 10 HZ rate across the ORANGE leads. This activates a portion of the microcomputer program allowing speed up of the clock for testing in clock equipped chimes.

METER SELECT:

This selector determines which of two audio voltages is connected to the RED and BLACK meter/oscilloscope terminals. AUDIO OUTPUT monitors the audio voltage across the amplifier load. I-COM OUTPUT monitors the audio voltage across the I-COM 1 and 2 terminals.

FRONT, SIDE & REAR:

These pushbuttons provide connection between each of the door control inputs and the GREEN, or COMMON terminal of the door chime.

I-COM CONTROL (RED LED):

Indicates that the computer is in the process or playing a tune or clock strike tone.

FIXTURE CIRCUIT DESCRIPTION

The chime test fixture schematic is shown on the following page.

This schematic shows the connection of all switches and terminals in the fixture. Also shown is the fixture power supply with its two power transformers. A 105-N transformer is included for independently powering the chime under test.

Two oscillator circuits are included. One is a Wein Bridge Oscillator (Z3) to generate a pure 400 HZ sine wave test signal. The other is a 10 HZ oscillator (Z2) for driving a reed relay (K-1). This relay contact closure controls the "FAST TIME" function of the microcomputers incorporating a digital clock program.