

Instructions

for the



RS-232C OUTPUT ACCESSORY

Model GCA-1000-1

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INTRODUCTION

The RS-232C Output Accessory, Model GCA-1000-1, is used to send the time and date, as established by the GC-1000 Most Accurate Clock, to a computer using the standard RS-232C serial format.

PARTS LIST

Remove the parts from the carton and check each part against the following list. The key numbers correspond to the numbers on the "Parts Pictorial" (Illustration Booklet, Page 1). Return any part that is in an individual envelope back into the envelope after you have identified it until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS

NOTE: All resistors are 1/4-watt, 5%.

Refer directly to the enclosed resistor/diode sheet and follow the instructions at the top of that sheet to check your resistors and diodes.

A1	6-181-12	2	180 Ω (brn-gry-brn)	R401, R403
A1	6-471-12	1	470 Ω (yel-viol-brn)	R411
A1	6-102-12	1	1000 Ω (brn-blk-red)	R402
A1	6-472-12	1	4700 Ω (yel-viol-red)	R406
A1	6-103-12	1	10 kΩ (brn-blk-org)	R405
A1	6-223-12	1	22 kΩ (red-red-org)	R404
A1	6-333-12	2	33 kΩ (org-org-org)	R407, R408
A1	6-104-12	1	100 kΩ (brn-blk-yel)	R409

CAPACITORS

B1	21-199	1	.1 μF ceramic	C426
B1	21-140	1	.001 μF ceramic	C423
B2	25-838	1	3.3 μF tantalum electrolytic	C404
B3	25-880	1	10 μF electrolytic	C405
B3	25-885	1	100 μF electrolytic	C401
B4	27-77	1	.1 μF Mylar	C403
B4	27-161	1	.01 μF Mylar	C402

DIODES

C1	56-16	1	1N5231 zener	Z401
C1	56-56	1	1N4149	D401

TRANSISTORS – INTEGRATED CIRCUIT

NOTE: The transistor and integrated circuit may be marked for identification in any one of the following four ways:

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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1. Part number.
2. Type number. (On the integrated circuit, use only those numbers and letters in BOLD print. Disregard any other numbers or letters.)
3. Part number and type number.
4. Part number with a type number other than the one shown.

CAUTION: The IC is protected against damage caused by static electricity. Do NOT remove the IC from its foam pad until you are instructed to do so in a step.

D1	417-801	2	MPSA20 transistor	Q401, Q402
D2	444-293-1	1	3870 programmed microprocessor	U401

MISCELLANEOUS

E1	45-608	1	39 μH coil	L402
E1	45-609	1	2.2 μH coil	L401
E2	60-656	1	Dip switch	S401
E3	252-2	2	4-40 nut	
E4	254-9	2	#4 lockwasher	
E5	255-757	2	4-40 × 3/16" hex spacer	
	347-55	12"	8-wire ribbon cable	
E6	390-2498	1	Function label*	
	346-1	3"	Fiber sleeving	
	346-35	3"	Heat-shrinkable sleeving	
E7		1	Blue and white label	
E8	432-134	2	Wire connector	
E9	432-866	4	Spring connector (one extra)	
E10	432-1032	1	RS-232C connector	
E11	432-1033	4	Gold pin (one extra)	
E12	432-1129	1	4-pin plug	
E13	432-1151	1	4-hole connector	
E14	434-253	1	40-pin IC socket	
E15	438-55	1	Polarizing plug	
	597-3263	1	Resistor/Diode sheet	
		1	Instruction Manual (see front page for part number)	
			Solder	

*Located inside the Manual. Set it aside until it is called for later.

STEP-BY-STEP ASSEMBLY

NOTE: If your GC-1000 Most Accurate Clock is assembled, perform the following "Cabinet Disassembly" procedure. If you are assembling the Clock with the RS-232C Output accessory, skip that section and proceed to "Tone Decoder Circuit Board" on Page 4.

CABINET DISASSEMBLY

Refer to Pictorial 1 (Illustration Booklet, Page 2) for the following steps.

- () If installed, unscrew and remove the telescoping antenna from the unit.
- () Remove the four #6 × 3/8" black phillips screws from the cabinet bottom mounting holes and partially lift the cabinet top and window from the cabinet bottom. Unplug the speaker connector from the receiver circuit board at P304. Then set the cabinet top and hardware aside.
- () Unplug the three receiver circuit board connectors. See Pictorial 8 on Page 3.

NOTE: When you remove the receiver circuit board in the next step, be very careful not to disturb any of the preset trimmers on the circuit board as you handle it.

- () Remove the hardware that holds the receiver circuit board to the cabinet bottom, then remove the receiver circuit board from the cabinet and set it aside in a safe place.
- () Remove the two 6-32 × 1/4" black screws which hold the tone decoder circuit board to the display circuit board and remove the tone decoder board. Set the two screws aside. You will use the tone decoder board in the following assembly steps.

TONE DECODER CIRCUIT BOARD

START

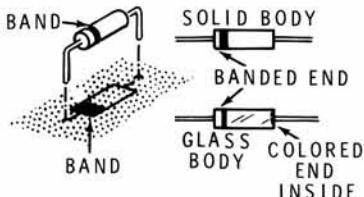
() Position the tone decoder circuit board assembly with the component side facing up as shown.

(/) R409: 100 kΩ (brn-blk-yel).

(/) R406: 4700 Ω (yel-viol-red).

() R405: 10 kΩ (brn-blk-org).

NOTE: When you install a diode in the following steps, be sure to position the banded end as shown on the circuit board. THE CIRCUIT WILL NOT WORK IF A DIODE IS INSTALLED BACKWARDS.



CAUTION: ALWAYS POSITION THE BANDED END OF A DIODE AS SHOWN ON THE CIRCUIT BOARD.

If your diode has a solid body, the band is clearly defined. If your diode has a glass body, do not mistake the colored end inside the diode for the banded end. Look for a band painted on the outside of the glass. See Detail 2A.

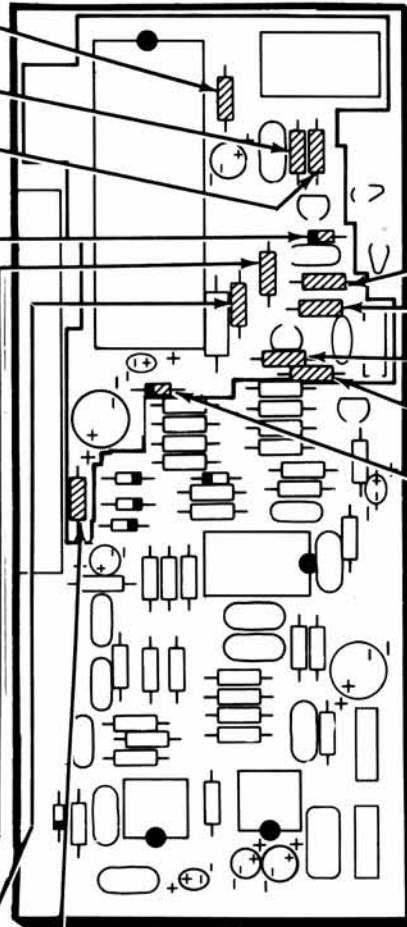
(/) D401: 1N4149 diode (#56-56).

(/) R407: 33 kΩ (org-org-org).

(/) R411: 470 Ω (yel-viol-brn).

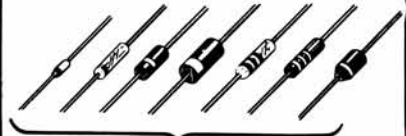
(/) R401: 180 Ω (brn-gry-brn).

() Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 2

NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.



BANDED END (CATHODE)

Detail 2A

CONTINUE

(/) R404: 22 kΩ (red-red-org).

(/) R408: 33 kΩ (org-org-org).

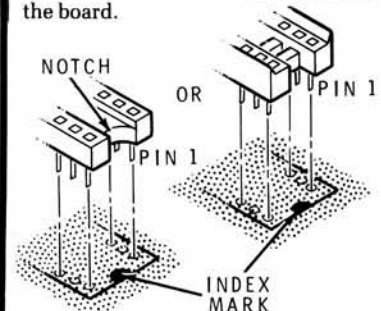
(/) R402: 1000 Ω (brn-blk-red).

(/) R403: 180 Ω (brn-gry-brn).

(/) Z401: 1N5231 zener diode (#56-16).

(/) Solder the leads to the foil and cut off the excess lead lengths.

NOTE: When you mount the 40-pin IC socket in the following step, make sure all pins are straight and insert the socket pins into the circuit board holes. Turn the circuit board over, be sure there is a pin in each of the holes, and then solder two diagonal corner pins of the IC socket to the foil. Check to make sure the IC socket is flat against the circuit board; then solder the remaining pins to the foil. If the socket is indexed, position the index mark over the index outline on the board.



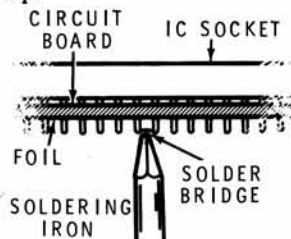
START

- () U401: 40-pin IC socket.
- () Turn the circuit board over so that the foil side faces up.
- () Locate the foil pads for pins 26 and 27 of IC U401. Then use a short piece of scrap wire (lead) to connect pin 26 to pin 27, as shown. Solder the wire to both pins and cut off any excess wire. Be sure this piece of wire does not touch any of the adjacent pins or foils.



- () Turn the circuit board component-side-up and position it as shown in the Pictorial.

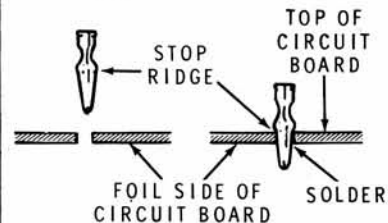
Carefully check the socket for solder bridges between pins. If a solder bridge has occurred, hold the circuit board foil-side-down as shown, and hold the soldering iron tip between the two points that are bridged. The solder will flow down the soldering iron tip.



- () L401: 2.2 μ H coil (#45-609).
- () Solder the leads to the foil and cut off the excess lead lengths.

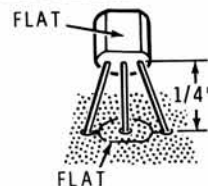
CONTINUE

NOTE: When you install a connector pin, push it as far as possible into the circuit board hole from the lettered side. Then solder the pin to the foil. Use solder sparingly to avoid filling the connector.



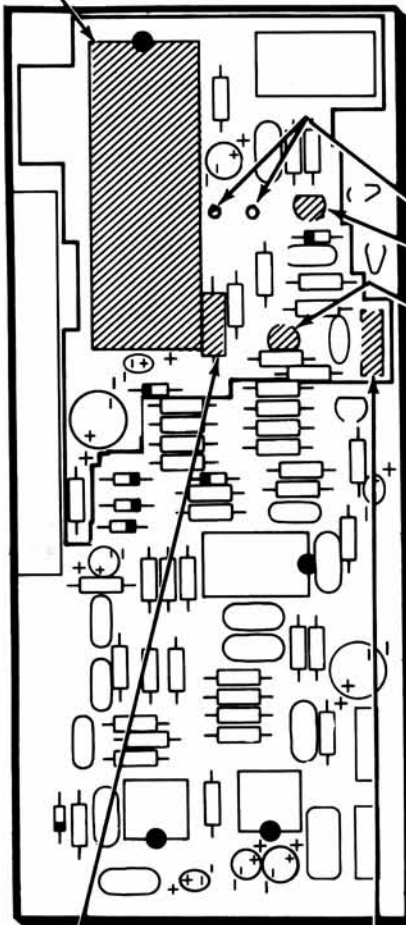
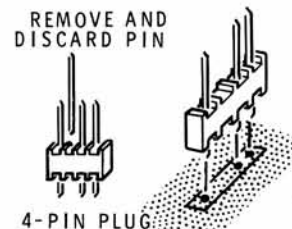
- () Install two connector pins at J401.

NOTE: When you install each of the following transistors, line up the flat of the transistor with the outline of the flat on the circuit board. Insert the transistor leads into their correct holes. Solder the leads to the foil and cut off any excess lead lengths, as you install each transistor.



- () Q402: MP2SA20 transistor (#417-801).
- () Q401: MP2SA20 transistor (#417-801).

- () P401: Remove the indicated pin from the 4-pin plug. Then mount the 3-pin plug at P401 with the shortest pins in the circuit board holes. Solder the pins to the foil.

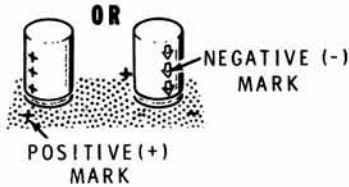


PICTORIAL 3

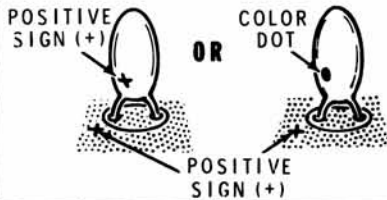
START 

- () S401: Mount the dip switch at S401 with the numbers as shown. Solder the pins to the foil.

NOTE: Before you install a polarized electrolytic capacitor, look at it and identify the leads. One lead will have a positive (+) mark or a negative (-) mark near it. **Be sure** to install the positive lead in the positive-marked hole or the negative lead in the negative-marked hole.



MAY BE MARKED WITH POSITIVE SIGN (+) OR COLOR DOT



- () C404: 3.3 μ F tantalum.

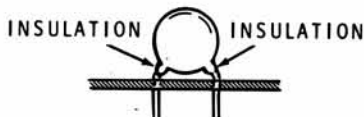
- () C401: 100 μ F electrolytic.

- () C405: 10 μ F electrolytic.

- () C403: .1 μ F Mylar.

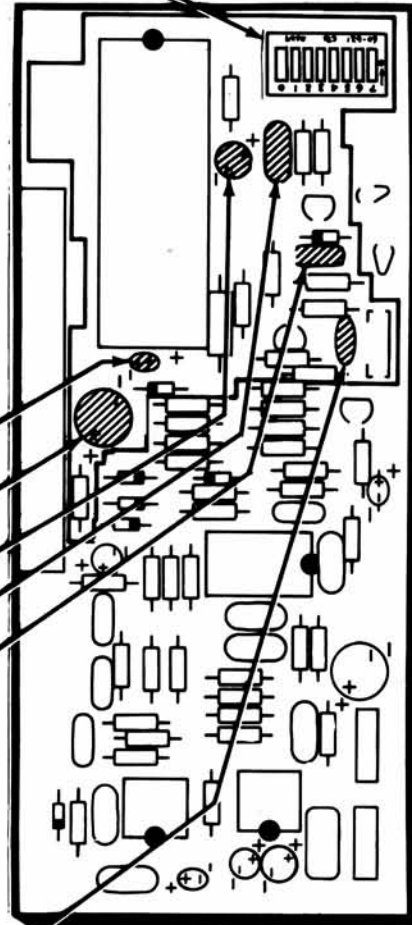
- () C402: .01 μ F Mylar.

NOTE: When you install a ceramic capacitor, do not push the insulated portion of the leads into the holes in the circuit board.



- () C423: .001 μ F ceramic.

- () Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 4

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CAUTION: Integrated circuits (ICs) are complex electronic devices that perform many complicated operations in a circuit. These devices can be damaged during installation. Read all of the following information before you install the ICs.



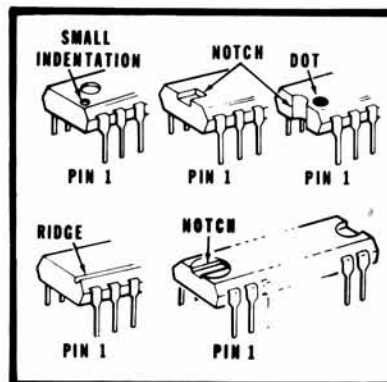
Detail 4A

The pins on the ICs may be bent out at an angle as shown in Detail 4A, and if this is the case, they will not line up with the holes in the IC socket. Do not try to install an IC without first bending the pins as described below. To do so may damage the IC pins or the socket, causing an intermittent contact.



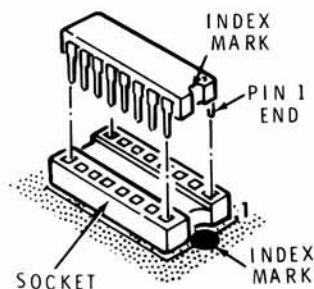
Detail 4B

Before you install an IC, lay it down on its side as shown in Detail 4B and very carefully roll it toward the pins to bend the lower pins into line. Then turn the IC over and bend the pins on the other side in the same manner. **IMPORTANT:** An IC packaged in protective foam can be damaged by static electricity. Once you remove it from its protective foam, do not lay the IC down or let go of it until you install it in its socket. When you bend the leads of the IC, hold it in one hand and place the other hand on the work surface before you touch the IC to that surface. This will equalize the static electricity between the work surface and the IC.



Detail 4C

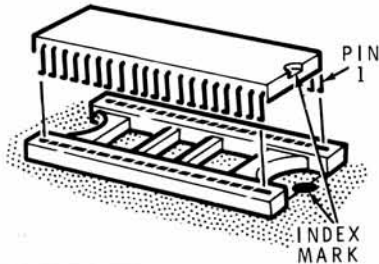
When you install an IC, first you must identify the pin 1 end of the IC. This is illustrated in Detail 4C. Then make sure the pin 1 end of the IC is positioned over the index mark on the circuit board as shown in Detail 4D. Also make sure that all of the pins are started into the socket. Then press the IC firmly into the socket. **NOTE:** An IC pin can become bent under the IC and it will still appear as though it is correctly installed in the socket.



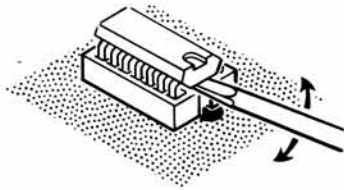
Detail 4D

START →

- () U401: 3870 programmed microprocessor (#444-293-1) IC.

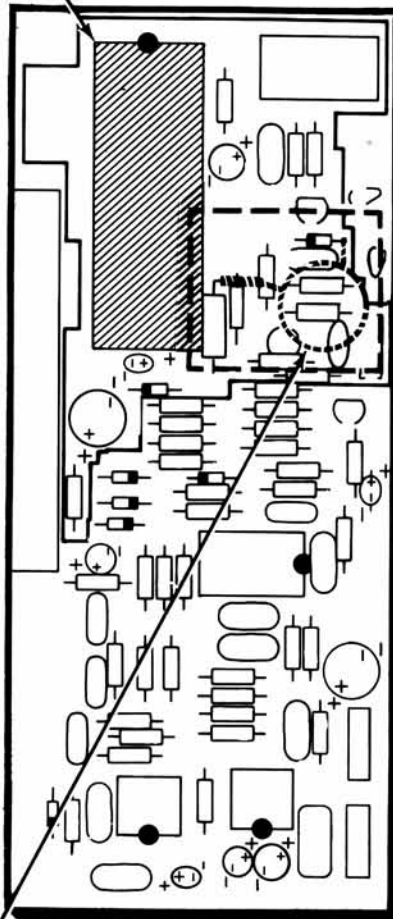


NOTE: Should it ever become necessary to remove an IC, use a small-bladed screwdriver and insert it beneath the IC. Then gently rock it up and down to lift the IC as shown.



Refer to Detail 5A for the following steps.

- () Cut the leads of a .1 μ F ceramic capacitor to 1/8" and 1/2".
- () Cut a 3/8" piece of fiber sleeving and slide it over the 1/2" capacitor lead.
- () Turn the circuit board over so the foil side faces up.
- () C426: Locate the foil pads on the foil side of the circuit board below the indicated leads of diode D401 and inductor L401. Place the prepared .1 μ F ceramic capacitor so the lead ends are over the foil pads and solder the leads to the foils. Keep the capacitor flat against the circuit board. Cut off any excess lead lengths so you do not bridge the foils.



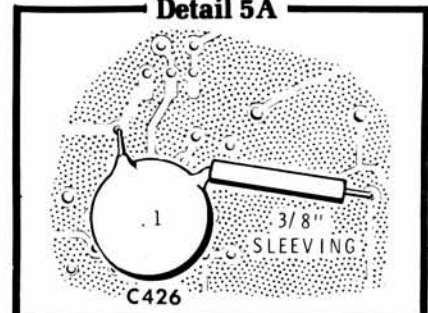
PICTORIAL 5

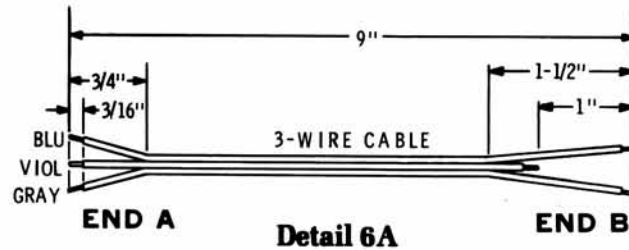
CONTINUE →**Circuit Board Checkout**

Carefully inspect the circuit board for the following conditions.

- () Unsoldered connections.
- () Poor solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.
- () Transistors and IC for the proper type and installation.
- () Electrolytic capacitors for correct position of the positive (+) mark.
- () Diodes for the correct position of the banded end.

This completes the tone decoder circuit board assembly. Set it aside until it is called for later. Proceed to "RS-232C Connector Wiring."

FINISH**Detail 5A**



RS-232C CONNECTOR WIRING

Refer to Pictorial 6 (Illustration Booklet, Page 2) for the following steps.

- () Remove the blue, violet, and gray wires, as a group, from the 12" 8-wire ribbon cable to make a 12" 3-wire cable.
- () Cut the 12" 3-wire cable to 9" and discard the remaining 3".
- () Refer to Detail 6A and separate and prepare the blue, violet, and gray 3-wire cable ends as shown.
- () Refer to inset drawing #1 on the Pictorial, and crimp and solder spring connectors on end A of the 3-wire cable.
- () Refer to inset drawing #2 on the Pictorial and crimp and solder gold pins on the blue and gray wires at end B of the 3-wire cable. Be careful not to get solder on the outside of the pins or they will not go into the connector holes properly.
- () Cut the leads of the 39 μ H coil (#45-608) to 3/8".
- () Refer to inset drawing #3 and form a hook in the end of the violet wire of the 3-wire cable and in one end of the 39 μ H coil. Then crimp and solder the hooked ends together.
- () Refer to inset drawing #3 and crimp and solder a gold pin onto the remaining lead of the 39 μ H coil.
- () Cut the 3" heat-shrinkable sleeving to 1-1/2".
- () Slide the 1-1/2" piece of heat-shrinkable sleeving over the end of the 39 μ H coil so the end of the sleeving is just past the end of the gold

pin. Then shrink the sleeving in place over the coil with a lighter or a match.

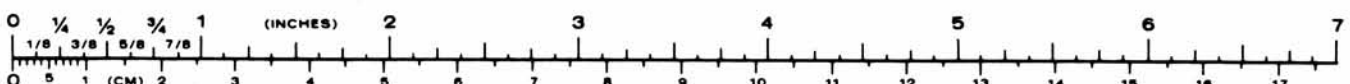
Insert the spring connectors on end A of the 3-wire cable into the 4-hole connector as follows. Position the 3-hole connector slots and the locking tabs on the spring connectors facing up. Insert a spring connector into its hole until you hear a faint latching "click." Pull gently on the wire to make sure the connector is locked in place.

- () Gray wire at hole 1.
- () Violet wire at hole 2.
- () Blue wire at hole 4.
- () Insert a polarizing plug into hole 3. Position the rounded end as shown.
- () X6: Position the RS-232C connector with the pin 1 end as shown. The numbers are stamped on the front and back of the connector.

Insert the gold pins at the other end of the 3-wire cable into the RS-232C connector holes as follows. Press the pins into the holes until they lock into place. Pull gently on each wire to make sure it has locked into place.

- () 39 μ H coil on the violet wire at hole 2.
- () Blue wire at hole 5.
- () Gray wire at hole 7.

This completes the "RS-232C Connector Wiring." If you are assembling the GC-1000 with the RS-232C Output Accessory, set the RS-232C connector assembly aside and refer back to "Main Circuit Board Parts List" in the GC-1000 Manual. If your Clock is already assembled and you are just now installing the accessory, proceed to "RS-232C Installation."



RS-232C INSTALLATION

Refer to Pictorial 7 (Illustration Booklet, Page 3) for the following steps.

- () X6: Position the RS-232C connector assembly as shown. Mount the RS-232C connector assembly to the back panel cutout X6 with two 4-40 × 3/16" hex spacers, two #4 lockwashers, and two 4-40 nuts.
- () Reinstall the tone decoder circuit board in the cabinet bottom and secure it to the display circuit board with the 6-32 × 1/4" black screws you removed previously.
- () Connect the blue, violet, and gray 3-wire cable connector to tone circuit board plug P401 with the slots facing down. Route the cable around connector P201 as shown.
- () Refer to Pictorial 8 (Illustration Booklet, Page 3) and carefully reinstall the receiver circuit board in the cabinet bottom with the 4-40 × 3/8" and the 6-32 × 1/2" black phillips screws. Do not pinch the 3-wire cable coming from the RS-232C connector between the plug and socket.
- () Plug connectors onto the receiver circuit board at P301, P302, and P303 with the slots as shown. Position the cable from P301 down into the cabinet bottom. Position plug P303

with the slots as shown for automatic audio control. Turn the plug over with the slots facing the other way for manual audio control.

Refer to Pictorial 9 (Illustration Booklet, Page 4) for the following steps.

- () Remove the backing from the function label and press the label inside the cabinet top as indicated.
- () Insert speaker connector X4 over receiver circuit board plug P304.
- () Check to make sure that none of the LEDs are bent over. Then mount the cabinet top onto the cabinet bottom with four #6 × 3/8" black phillips screws. Make sure the bottom lip of the window fits inside the cabinet bottom.
- () If you do not intend to use an external antenna, mount the antenna to the antenna bracket through the hole in the cabinet top. Twist the antenna onto the bracket screw until it is just snug.
- () Remove the backing from the blue and white label and press the label onto the cabinet bottom opposite the other labels as shown in inset drawing #1.

This completes the "RS-232C Installation". Proceed to "Theory Of Operation."

THEORY OF OPERATION

Refer to the Schematic (supplied with the GC/GCW-1000) as you read the following "Theory Of Operation."

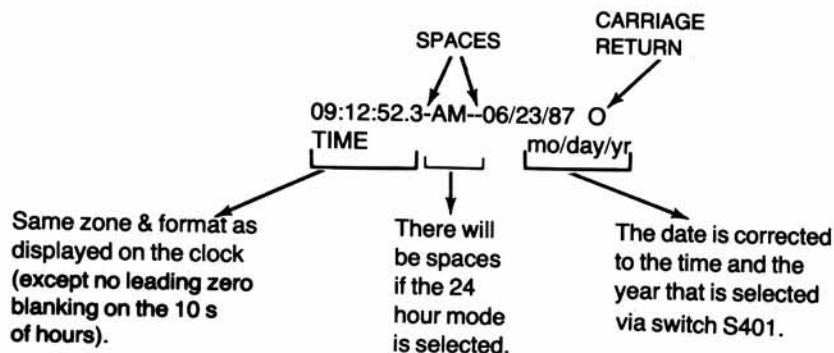
The RS-232C Output Accessory, Model GCA-1000-1, receives the WWV (or WWVH) time and date information from the Clock microprocessor (IC U203) every 10 milliseconds (ms). The RS-232C microprocessor (IC U401) then converts the date from the Julian format into the standard month and day format. It then reads the year you have selected via the binary coded switches. It computes the year by adding the decimal equivalent of this binary code to the number "83." Next, it corrects the month and day for leap year and your selected time zone.

IC U401 then checks to see if there has been a request by your computer to send this time and date information to it. If no request has been sent, the microprocessor repeats the process described previously. (The request to send the information requires a low-to-high voltage transition at pin 4 of P401. This voltage is coupled through resistor R404 and capacitor C402 to cause transistor Q402 to briefly turn on and pull pin 38 of U401 to a low state.)

In the normal mode (S401 switch setting), the microprocessor is looking for the request-to-send signal. When it receives this signal, the microprocessor (IC U401) waits 1.00 seconds to allow time for your computer to get ready to receive the time and date information. The microprocessor then determines the BAUD rate, (S401 switch setting) and the number of stop bits (J401) that you have selected, and a transmission is made. In the auto mode (S401 switch setting), the microprocessor sends time and date information continuously with no delay. (See the RS-232 function label on the inside of the cabinet top for S401 switch settings). The microprocessor sends the time and date in ASCII format through pin 2 of P401 via transistor Q401.

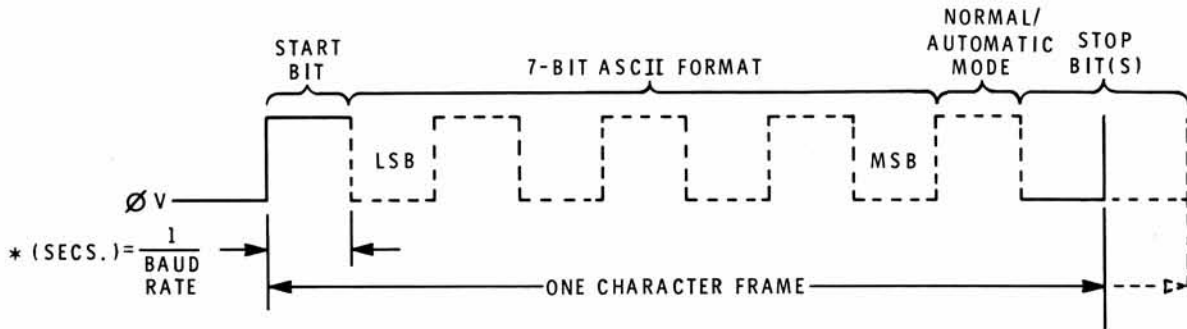
When this transmission is completed, it will send the ASCII character for a carriage return (0D in hexadecimal) to signal your computer that it is done sending the information. NOTE: If you are operating in the normal mode, the next transmission of information will be 1.00 second slow at the beginning of the transmission. Thus, you must make the necessary corrections for this, the BAUD rate used, and the execution time of your program to preserve the accuracy of time, if needed.

An example of the format that is sent is as follows:



In all, there are 24 characters sent (the 24th character is a carriage return).

The waveforms of one ASCII character transmitted (at pin 2, P401) will have the following format:



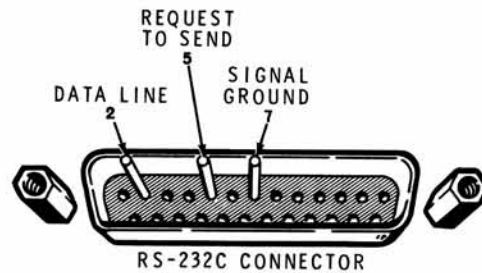
RS-232C CONNECTOR (X6) WIRING INFORMATION

NOTE: The true RS-232C requirement (a signal that exceeds ± 3 volts) is fulfilled by +5 volts (through resistor R403 at pin 1) used as a pseudo-signal ground connection.

As shown on the Schematic, the RS-232C connector is wired as Data Terminal Equipment (DTE). This wiring is as follows:

P401	RS-232C connector
Pin 2	Pin 2 — Data line
Pin 1	Pin 7 — Signal ground
Pin 4	Pin 5 — Request to send

This is the wiring used for the example Heathkit/Zenith H/Z-89 Computer program using HDOS. You may need to alter this wiring to fit your own computer. Use DCE Connector Part 340Q.



NOTE: An RS-232 cable is not supplied with this kit. You can purchase an HCA-11 (RS-232) cable from the Heath Replacement Parts Department if you desire.

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Here is an example program written in Microsoft HDOS Basic 4.7 for 110 BAUD or ATC:

```

10 CLEAR 1000:DEFINT A-Z
20 Z$(1,1) = "05/00" : Z$(1,2) = "04/30"
30 Z$(2,1) = "07/00" : Z$(2,2) = "06/30"
40 Z$(3,1) = "10/00" : Z$(3,2) = "09/30"
50 Z$(4,1) = "12/00" : Z$(4,2) = "11/30"
60 P=&0340
70 OUT P+4,&020
80 OUT P+3,&0200
90 OUT P,&027
100 OUT P+1,4
110 OUT P+3,26
120 X=INP(P)
130 OUT P+4,0
140 OUT P+4,2:OUT P+4,0
150 X1$=""
160 GOSUB 210:IF X<>13 THEN X1$=X1$+X$:GOTO 160
170 PRINT X1$ :GOSUB 240
180 PRINT "RETURNED DATA IS ";X1$:PRINT:PRINT
190 LINE INPUT "TRY AGAIN? ";A$
200 IF LEFT$(A$,1)="Y" THEN 140 ELSE STOP
210 IF (INP(P+5) AND 1) = 0 THEN 210
220 X=INP(P) AND &0177:X$=CHR$(X)
230 RETURN
240 M$ = MID$(X1$,16,5)
250 FOR Z = 1 TO 4
260 IF M$ = Z$(Z,1) THEN MID$(X1$,16,5) = Z$(Z,2) : RETURN
270 NEXT Z
280 RETURN

```

PROGRAM INFORMATION

NOTE: Refer to inset drawing #2 of Pictorial 9 (Illustration Booklet, Page 4). To program the RS-232C Output Accessory, refer to the function label inside the cabinet top and set switch S401 and jumper J401 as follows:

STOP BITS: If you desire one stop bit, do **not** use a jumper at J401. If you desire two stop bits, use a 1" piece of bare wire (a cut off component lead will do) across J401. **NOTE:** One stop bit is normal.

BAUD RATE: Activate one or more of the three baud rate switches at S401 so that their total equals the desired baud rate. For example, if you desire a baud rate of 2400, activate the first (1) and third (4) switches ($1 + 4 = 5 = 2400$). Thus, the GCA-1000-1 will send the time and date (in ASCII) at a 2400 baud rate.

YEARS: The year information is not supplied by station WWV, so it is necessary to set the year yourself. Activate one or more of the four "year" switches at S401 so their total equals the desired year in excess of '83 (1983). For example, if you desire the year "1992," activate the first (1) and fourth (8) switches ($1 + 8 + 83 = 92$ (1992)).

AUTO/NORMAL: In the "normal" position, the GCA-1000-1 will send the time and date (with no delay) only when it senses a low-to-high voltage transition on pin 5 of the RS-232C connector. In the "auto" position, the time and date will be sent continuously with no delay. No request-to-send signal from your computer is required.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram while you read this "Circuit Description."

RS-232C OUTPUT CIRCUIT — U401, Q401, Q402

For the computer to request the time and date, it must send a low-to-high transition signal on pin 5 of the RS-232C connector (X6). This signal is coupled through resistor R404 and capacitor C402 to briefly turn on transistor Q402 and cause its collector to go low. The RS-232C microprocessor IC U401 senses this low voltage and sends the desired information in the RS-232C format via transistor Q401 to pin 2 of connector P401. Thus, the computer is supplied the time and date information.

The RS-232C microprocessor IC U401 sends the time in the same format as displayed by the GC-1000 Most Accurate Clock. The date information is supplied by the GC-1000 Clock microprocessor IC U203 and is in the Julian format, (i.e., day of year). IC U401 converts the date into a month/day format and reads the year select switch settings from dip switch S401 to compute the year and correct the date for a leap year when necessary. When the computer requests information, IC U401 checks the other dip switch settings at S401 and jumper J401 to determine the baud rate, and the number of stop bits to be used in the RS-232C serial information.

