ORANGE COUNTY AMATEUR RADIO CLUB INC.

VOL. LXV NO. 4 P.O. BOX 3454, TUSTIN, CA 92781 APRIL FOOLs' 2024

The Prez Sez...

By: "Nickel-less" Haban

April Fools' 6 Crazy Freddy

With apologies to Red Skelton, Freddy-the-Freeloader and, of course, Nicholas!

Greeting and Disillusions!

As usual, for the month of April we have lots of fun activities, like the Visalia Ham Radio convection, Tax Day on the 15th and the daily earthquakes and lost planes. We will have yet another excellent program about the LRRA (Long Radio Receives Association) by one of its Directors AA6N. The Vaker to Begas activity was a success this past March with the OPD team almost breaking the 16 hour barrier. Maybe you are not aware, but Field Day is around the corner with only a couple of months to prepare. We will have a GOTA (Get On The Air) station this time, with food on Saturday evening so people with limited or no license can operate RF producing equipment in the low bands, and us low skill operators can learn the "ropes" of proper Field Day operation. I'm pleased to announce that we have several positions filled and the site is secured thanks to the efforts of Ron W6WG. We will have Band, Food and Premises Captains and as always we are in conversations with the higher powers to send us good propagation and sky waves. If you plan to obtain or upgrade your Amateur Radio license, you learn a lot during our Field Day activities. In the plans are to have a VE team in the near future.. In closing, I wish everybody many happy returns on the 15th and hope to see you all at the next meeting.

73 & ½ DE AF6CF

[Editor's note: All misspellings are on purpose]

OFFICIAL
APRIL FOOLs' EDITION

April General Meeting
APRIL 19th
Dick Norton - N6AA
ARRL SWD Director
Presents:
"An ARRL Update"
See Page 5 for details
7:00 PM at the
American Red Cross
Orange County Chapter
600 Parkcenter Drive
Santa Ana, CA
Room 208

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Monthly Events

Membership Meetings*
Time: 7:00 PM
Date: 3rd Friday of the Month
Orange County Red Cross,
600 N Parkcenter Dr, Santa Ana
(Room 208) * Except December

Board Meetings
First Saturday of each Month
8:15 AM Click for Details

Club Nets (Listen for W6ZE)

10M ~ 28.375 MHz SSB
Wed- 7:30 PM - 8:30 PM
Net Control: Corey, KE6YHX

2M ~ 146.55 MHz Simplex FM
Wed- 8:30 PM - 9:00 PM
Net Control: Corey, KE6YHX

75M ~ 3.883 MHz LSB
Tue @ 8:00 PM
Net Control: Corey, KE6YHX

Associated Nets

Catalina Amateur Repeater Association (CARA)
147.090 MHz (+600 kHz) No PL
Monday - Friday
9:00AM & 9:00PM
Prg. Director. Tom W6ETC
COME JOIN US

OCARC 2024 DUES:

Membership period is:
1 January to 31 December

Individual New or Renewal:	$30
Family New or Renewal:	$45
Teen New or Renewal:	$15

***New Member Dues** are prorated quarterly and includes a badge:*

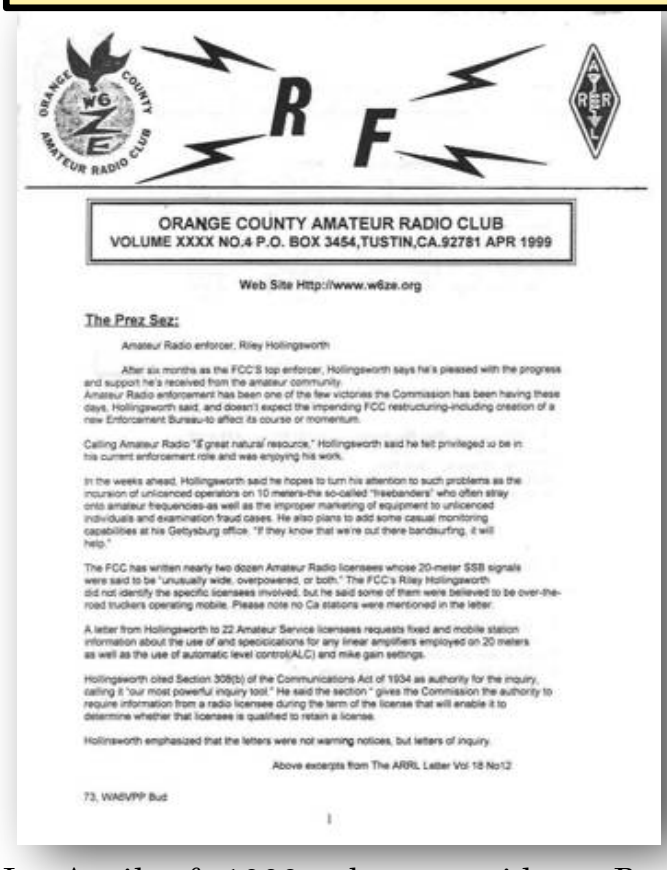
Additional Badges[1]	$3

Use one of our our interactive online forms to calculate current prices, join, renew, or order badges:

Online Forms / Dues & Badges

[1] $3 or less + mailing. See form.

- 25 Years Ago in RF Newsletter - April 1999:



ORANGE COUNTY AMATEUR RADIO CLUB
VOLUME XXXX NO.4 P.O. BOX 3454,TUSTIN,CA.92781 APR 1999

Web Site Http://www.w6ze.org

The Prez Sez:

Amateur Radio enforcer, Riley Hollingsworth

After six months as the FCC'S top enforcer, Hollingsworth says he's pleased with the progress and support he's received from the amateur community.
Amateur Radio enforcement has been one of the few victories the Commission has been having these days, Hollingsworth said, and doesn't expect the impending FCC restructuring-including creation of a new Enforcement Bureau-to affect its course or momentum.

Calling Amateur Radio "if great natural resource," Hollingsworth said he felt privileged to be in his current enforcement role and was enjoying his work.

In the weeks ahead, Hollingsworth said he hopes to turn his attention to such problems as the incursion of unlicenced operators on 10 meters-the so-called "freebanders" who often stray onto amateur frequencies-as well as the improper marketing of equipment to unlicenced individuals and examination fraud cases. He also plans to add some casual monitoring capabilities at his Gettysburg office. "If they know that we're out there bandsurfing, it will help."

The FCC has written nearly two dozen Amateur Radio licensees whose 20-meter SSB signals were said to be "unusually wide, overpowered, or both." The FCC's Riley Hollingsworth did not identify the specific licensees involved, but he said some of them were believed to be over-the-road truckers operating mobile. Please note no Ca stations were mentioned in the letter.

A letter from Hollingsworth to 22 Amateur Service licensees requests fixed and mobile station information about the use of and specicications for any linear amplifiers employed on 20 meters as well as the use of automatic level control(ALC) and mike gain settings.

Hollingsworth cited Section 308(b) of the Communications Act of 1934 as authority for the inquiry, calling it "our most powerful inquiry tool." He said the section " gives the Commission the authority to require information from a radio licensee during the term of the license that will enable it to determine whether that licensee is qualified to retain a license.

Hollinsworth emphasized that the letters were not warning notices, but letters of inquiry.

Above excerpts from The ARRL Letter Vol 18 No12

73, WA6VPP Bud

In April of 1999, then president *Bud Barkhurst WA6VPP* presented in the Prez Sez a letter from FCC's Amateur Radio enforcer Riley Hollingsworth noting the progress that has been made cleaning up the bands, especially 10 meters, and incursions by "free-banders" from 11 meters.

Officers in 1999 were:

President:	*Bud Barkhurst* - WA6VPP
V President:	Chris Breller - KJ6ZH
Secretary:	Cory Terando - KE6WIU
Treasurer:	Ken Konechy - W6HHC
Activities:	*Elmer Thomas* - WA6PFA
Membership:	*Lowell Burnett* - KQ6JD
Publicity:	Phil Andersen - N7PA
Technical:	*Frank Smith* - WA6VKZ
Member at Large:	*Larry Hoffman* - K6LDC
Member at Large:	*Bob Buss* - KD6BWH

(*Silent Keys* are shown in italics).

The April 3rd 1999 Breakfast and board meeting was held at Coco's 2585 N. Tustin near Lincoln Ave. (Now an In-N-Out Burger).

The Baker to Vegas race was run on April 10th and 11th. A group from the club participated manning a station at Pahrump, NV, as well as other duties.

The April meeting speaker was John Ramsey - KD6YKS from the Red Cross disaster committee. The meeting was held at the Red Cross facility in Santa Ana (Current location).

The grand prize at the club meeting raffle was an official analog OCARC clock, from Bob - AF6C

The big event planned by *Larry* - K6DLC for April was a Not So DX-pedition to El Mirage Dry Lake. The event was to be held on the weekend of April 23, 24 & 25th. Tents, campers, trailers, motorhomes were encouraged. Some features of this event were: "No real organization, Campfire nightly, you can sleep-in mornings, and outhouses available".

In April planning was beginning for the yearly OCCARO (Orange County Council of Radio Organizations) Ham Booth at the O.C. Fair. The fair would run from July 9th through July 25th. The various clubs in the organization would each operate the booth over the 17-day period. Perks for operating were free admission and free parking at the event. The ham radio booth always drew a lot of attention from the public.

Field Day planning was beginning. The site in Irvine used in 1998 was no longer available. Newport Dunes, Blue Jay Campground or a site at Edinger and Harvard Ave in Irvine were being looked at.

Check out some of our other 1999 RF Newsletters!

RadioActivity
April 2024

Upcoming Activities:

APRIL

- **ARRL Rookie Roundup SSB:** Sunday April 21, 1800 UTC through 2359 UTC.
- **10-10 International Spring Contest/Digital:** 0001 UTC Saturday April 27 through 2359 UTC Sunday April 28

MAY

- **7TH Call Area QSO Party:** 1300 UTC Saturday May 4 through 0700 UTC Sunday May 5
- **10-10 International Spring Contest/CW:** 0001 UTC Saturday May 4 through 2359 UTC Sunday May 5
- **New England QSO Party: :** 2000 UTC Saturday May 4 to 0500 UTC Sunday May 5 and 1300 to 2400 UTC Sunday May 5
- ***CQ World Wide WPX Contest/CW:** 0000 UTC Saturday May 25 through 2359 UTC Sunday May 26

*** Indicates club entries are accepted**

**** Indicates team entries are accepted**

Note: When submitting logs for ARRL Contests indicate your club affiliation as "Orange County ARC"

State QSO Parties:

- **Georgia QSO Party:** 1800 UTC Saturday April 13 to 0359 UTC Sunday April 14 and 1400 to 2359 UTC Sunday April 14
- **New Mexico QSO Party:** 1400 UTC Saturday April 13 to 0200 UTC Sunday April 14
- **North Dakota QSO Party:** 1800 UTC Saturday April 13 to 1800 UTC Sunday April 14
- **Nebraska QSO Party:** 1100 UTC Saturday April 20 to 2259 UTC Sunday April 21
- **Michigan QSO Party:** 1600 UTC Saturday April 20 to 0400 UTC Sunday April 21
- **Florida QSO Party:** 1600 UTC Saturday April 27 to 0159 UTC Sunday April 28 and 1200 to 2159 UTC Sunday April 28
- **Indiana QSO Party:** 1500 UTC Saturday May 4 to 0300 UTC Sunday May 5
- **Delaware QSO Party:** 1700 UTC Saturday May 4 to 2359 UTC Sunday May 5
- **Arkansas QSO Party:** 1400 UTC Saturday May 18 to 0200 UTC Sunday May 19

Repeating Activities:

- **Phone Fray:** Every Tuesday night at 0230Z to 0300Z. **LINK**
- **SKCC:** Weekend Sprintathon (Straight Key CW) on the first weekend of the month after the 6TH of the month. 1200 Sat. to 2359Z Sunday. **LINK**
- **SKCC** Sprint (Straight Key CW) 0000Z to 0200Z on the 4th Tuesday night (USA) of the month. **LINK**
- **CWops** Every Wednesday 1300 UTC to 1400 UTC 1900 UTC to 2000 UTC and Thursday 0300 UTC to 0400 UTC **LINK**
- **ICWC Medium Speed Test:** (CW, 25WPM Max.) Every Monday 1300 UTC to 1400 UTC 1900 UTC to 2000 UTC and Tuesday 0300 UTC to 0400 UTC. **LINK**
- **K1USN Slow Speed Test:** (CW, 20WPM Max.) Every Friday 2000 UTC to 2100 UTC. Every Sunday night at 0000 UTC to 0100 UTC Monday. **LINK**

OCARC Club Nets:

- **10 Meter Net:** Every Wednesday night at 7:30 pm to 8:30 pm Local Time. SSB 28.375 MHz
- **2 Meter Net:** Every Wednesday night at 8:30 pm to 9:30 pm Local Time. FM Simplex 146.55 MHz

Other Nets:

- **Net-AT-9:** Wellness & Support Monday thru Friday 9:00 am **and** 9:00 pm Local Time 147.090 MHz (+600 MHz) No PL

Send an email to *Ron W6WG, w6wg@w6ze.org to have your favorite activity or your recent RadioActivity listed in next month's column.*

SPEAKER SPOTLIGHT:
Dick Norton – N6AA
ARRL SOUTHWEST DIVISION DIRECTOR
"The ARRL and Current Happenings in Amateur Radio"

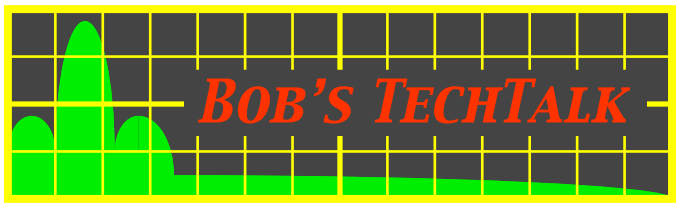
Does the ARRL meet your expectations? Curious about details of some of the ARRL board deliberations? What impact does the ARRL have on its members and amateur radio?

Join us Friday, April 19, as our ARRL Southwest Division Director, Dick Norton, N6AA, brings us up to date on league activities, answers questions you might have about ARRL decisions, and addresses some of the more recent developments that have stirred up the membership.

Dick is a very strong supporter of ARRL transparency and will update us on the latest happenings from ARRL, FCC, and

[See Spotlight, P32].

Dick Norton - N6AA Operates from the Shack of HP3AK in Panama (Zone 7)



Number 54: Measuring Code Speed:
(TechTalk #129)
by: Bob Eckweiler - AF6C

INTRODUCTION:
"Words per minute" (WPM) is a term often used to describe the speed at which CW is transmitted. In this article it will be defined, as will another term ***"Code groups per minute"*** (CGPM). Both terms are used by the FCC. Over the years the FCC has required, or given code tests, at speeds of 5 WPM, 13 WPM, 16 GCPM, 20 WPM 20 GCPM and 25 WPM for amateur and commercial operators. What are the differences between WPM and CGPM? What is the Farnsworth system of speed for CW? Hopefully these will be answered in this article.

Last month's Heathkit article on the HD-10 Electronic Keyer resulted in a discussion on how the dot-widths were obtained in **TABLE III** in that article. The table is repeated here as **TABLE I.** "WPM" was added to the title of the table to distinguish it from **TABLE II** to be presented later.

TABLE I gives the relationship between dots and dashes in international Morse code. If a dit (dot) is 1 unit long, then a dah (dash) is 3 units long and the space between a dit and dah is the same length as a dit. The space between characters is 3 dits long and the space between words is 7 dits long. The time length of one unit (one dit) is noted as 1T.

Of course, no CW operator can effectively send with such timing accuracy. Often operators using a hand key or bug have a rhythm, a 'signature' that others operators can easily recognize. A bug takes some of that signature away, but the rhythm may still be recognizable. A fully electronic key takes more away, leaving the operator sending in control only of the space between characters (inter-character space) and the space between words (inter-word space). Still, some signature probably exists.

Computer generated code, can be very precise in timing. It is often used to send "perfect code" for practice and for testing.

Words Per Minute:
"Words per minute" is quite arbitrary; the length of words vary significantly. Thus a standard word was designated for calculating WPM. That word is **PARIS**. If you send it using the definition of the length of T in **TABLE I** and include the 'inter-word' space,

Morse Code WPM Timing Basics

The timing of an international Morse code sentence is based on the "T-Unit" which is the length of a dit in milliseconds (mS). Here are the defined lengths for other parts of the International Morse code:

Dit length:	1T (by definition)
Dah length:	3T
Intra-character space [a]:	1T
Inter-character space [b]:	3T
Inter-word space:	7T

[a] The space between dits and dahs within a character.
[b] The gap between the characters of a word.

Here are values of T for some common speeds:

5 WPM	240.00 mS.
10 WPM	120.00 mS.
13 WPM	92.31 mS.
18 WPM	66.67 mS.
20 WPM	60.00 mS.
25 WPM	48.00 mS.

Caution: These 'T' values are only good for determining WPM. A second code speed exists, 'code groups per minute' (CGPM) which has slightly shorter values for 'T'.

TABLE I

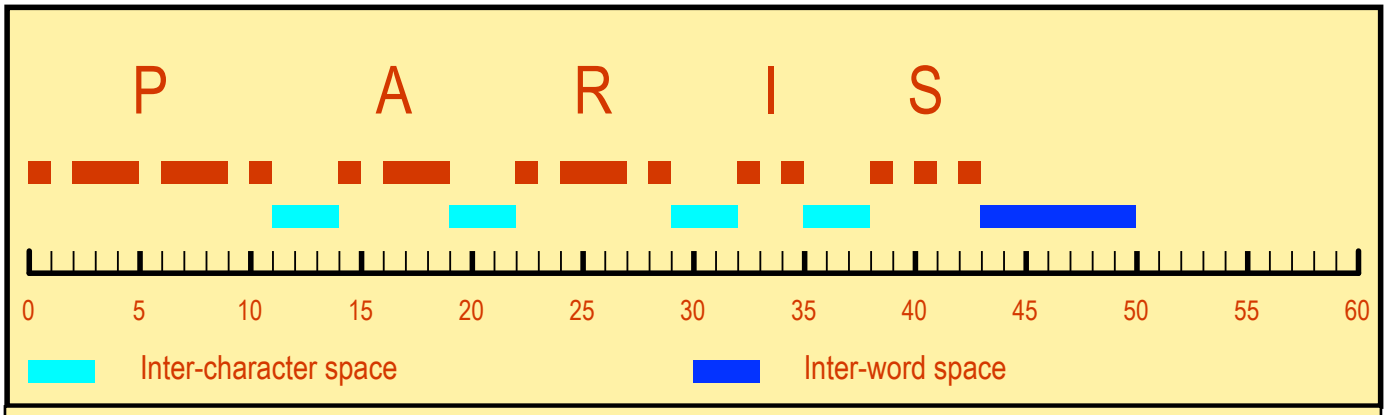


Figure 1: The standard word for calculating WPM is PARIS. As shown, it is exactly 50 T-units of time long.

PARIS is exactly 50 T (dit) lengths long (**Figure 1**). Based on this standard word, the length T in milliseconds can be calculated for any given WPM and vice-versa. The derivation is simple:

The length of a 'word': $L_w = 50T$ in milliseconds (mS) and:

Words Per Minute: $WPM = \frac{1_{min}}{L_w}$

Thus:

$$WPM = \left(\frac{1_{min}}{50T_{ms}}\right)\left(\frac{60_{sec}}{1_{min}}\right)\left(\frac{1{,}000_{ms}}{1_{sec}}\right)$$

$$WPM = \frac{60{,}000_{ms}}{50T_{ms}} = \frac{1{,}200}{T} \qquad (1)$$

And so: $$T = \frac{1{,}200}{WPM} \qquad (2)$$

Equation (2) is the one used to calculate the values in Table I.

Only WPM based Morse code was used by the FCC for amateur code testing. Formerly, when code testing was required, tests of 5 WPM - Element 1A, 13 WPM - Element 1B and 20 WPM Element 1C were given [FCC Title 47 § 97.21(a)(b)(c){1986}]. WPM is currently also used for some commercial code testing, specifically 20 WPM - Telegraphy Element 2, and 25 WPM - Element 4 *, [FCC Title 47 § 13.203(b)]. Telegraphy characters used in WPM testing are: all characters of the alphabet, the numbers 0 – 9, punctuation period, comma, and question mark, as well as prosigns *DN*, *AR*, *BT* and *SK*. Punctuation and prosigns each count as two characters.

Code Groups Per Minute:

"Code groups per minute" is another speed standard. It is used mostly for commercial code testing, specifically Telegraphy Element 1, 16 CGPM and Element 3 *, 20 CGPM [FCC Title 47 § 13.203(b)]. These tests are given using groups of five characters. The characters are random and consist of the same set used for WPM testing.

Like WPM, "Code groups per minute" is also based on a standard 5 character word. That word is **CODEX**. If you send it using the definition of the length of T in **TABLE I** and include the 'inter-word' space, CODEX is exactly 60 T (dit) lengths long (**Figure 2**).

Following the previous derivation:

$$CGPM = \frac{60{,}000_{ms}}{60T_{ms}} = \frac{1{,}000}{T} \qquad (3)$$

Or: $$T = \frac{1{,}000}{CGPM} \qquad (4)$$

*** These elements are no longer in use.**

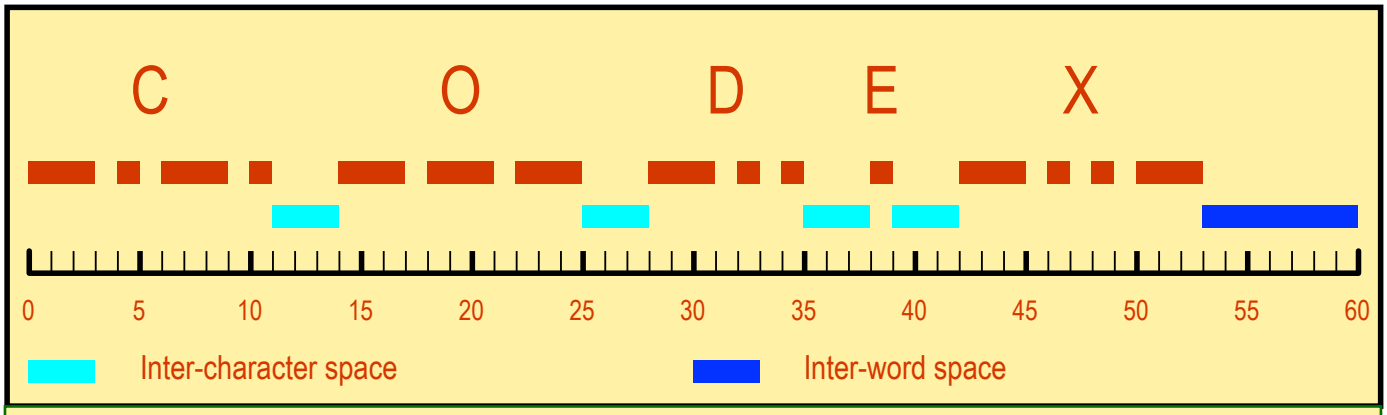


Figure 2: The standard word for calculating Character Groups Per Minute is CODEX. As shown, it is exactly 60 T-units of time long.

Equation (4) is the one used to calculate the values in Table II.

Character groups per minute mimic an encoded message sent using standard letters, numbers and punctuation formed into five-character groups. This was a common way to send encoded commercial or military messages in past times. The encoding used is independent of the message and the message contents is unknown to the CW operators handling the message.

Farnsworth System (WPM):

"The Farnsworth system of International Morse code was developed by Donald. R. Farnsworth, who taught radio telegraphy at the Illinois Institute of Technology in the early 1940s.

The Farnsworth system is based on two different code speeds. One is the overall speed the code is being sent at; the other is the speed each character is being sent at. If the overall speed is 10 WPM, but each character is sent at 20 WPM there will be longer delays between characters and words. The person learns the rhythm of the fast code characters early, and has more time to recognize each character. As the overall speed increases, only the time between characters and words are shorter. The characters continue to sound unchanged. Farnsworth timing is displayed as two numbers such as W_O/W_C. The first or upper number W_O is the actual overall code speed in WPM; the second number W_C is the character speed in WPM. as an example 10/20 means the overall speed is 10 WPM but the

Morse Code CGPM Timing Basics

The timing of an international Morse code sentence is based on the "T-Unit" which is the length of a dit in milliseconds (mS). Here are the defined lengths for other parts of the International Morse code:

Dit length:	1T (by definition)
Dah length:	3T
Intra-character space [a]:	1T
Inter-character space [b]:	3T
Inter-word space:	7T

[a] The space between dits and dahs within a character.
[b] The space between characters of a word.

(The T-Units above are identical to WPM T-units)

Here are values of T for some common speeds:

5 CGPM	200.00 mS.
10 CGPM	100.00 mS.
13 CGPM	76.92 mS.
18 CGPM	55.56 mS.
20 CGPM	50.00 mS.

Caution: These 'T' values are only good for determining CGPM. A second code speed exists, 'words per minute' which has slightly longer values for 'T'.

TABLE II

code characters are being sent at 20 WPM.

TABLE III breaks down PARIS into its five T-unit types. The top three use 31 total T-Units. That is the number of T-units used for dits, dahs and intra-character spaces for PARIS. They are designated by T_C-units as they make up the T-Units for the character speed. The remaining 19 are designated T_F and are available to be lengthened to slow down the code to the overall transmission speed. Even though the inter-character and inter-word can be adjusted, the ratio between them needs to remain the same:

(Inter-character : Inter-word = 3 : 7).

T-Unit Types	P	A	R	I	S	ICS	IWS	Total T-Units
Di(t)s (x 1):	2	1	2	2	3	–	–	T = 10
Dahs (x 3):	6	3	3	0	0	–	–	T = 12
Intra-Character Spaces (x 1):	3	1	2	1	2	–	–	T = 9
Total T-Units at character speed:	9	4	5	1	2	–	–	***31***
4 Inter Character Spaces (x 1):	–	–	–	–	–	12	–	T = 12
1 Inter-Word Spaces (x 7):	–	–	–	–	–	–	7	T = 7
Total Farnsworth T-Units	–	–	–	–	–	12	7	***19***
Totals:	20	9	12	4	7	12	7	T = 50

TABLE III

Calculating T_F:

From equation (2) the time it takes sending the standard word PARIS at the overall speed (W_O) is:

$$50T_O = \frac{(50)1{,}200}{W_O} = \frac{60{,}000}{W_O} \quad \text{in mS}$$

And, the time used by the actual characters sent at W_C is:

$$31T_C = \frac{(31)1{,}200}{W_C} = \frac{37{,}200}{W_C} \quad \text{in mS}$$

The difference in these two times is the total amount of time that needs to be spent in inter-character and inter-word spaces (T_{diff}):

$$T_{diff} = \frac{60{,}000}{W_O} - \frac{37{,}200}{W_C} \quad \text{in mS}$$

Since any number divided by itself is one, lets divide each side by one:

$$T_{diff} = \left(\frac{60{,}000}{W_O}\right)\left(\frac{W_C}{W_C}\right) - \left(\frac{37{,}200}{W_C}\right)\left(\frac{W_O}{W_O}\right)$$

and then simplify the equation to:

$$T_{diff} = \frac{60{,}000W_C - 37{,}200W_O}{W_O W_C} \quad \text{mS} \quad (5)$$

T_{diff} is the total time for *19* T_F-units. So each T_F-unit is: $T_F = \dfrac{T_{diff}}{19}$ in mS (6)

The four Farnsworth inter-character spaces in milliseconds are each three T_F-units long:

$$T_{IC} = 3T_F \text{ in mS} \quad (7)$$

And the Farnsworth inter-word space in milliseconds is seven T_F-units long:

$$T_{IW} = 7T_F \text{ in mS} \quad (8)$$

An Example (10/20 WPM):

From Equation (2), the length of time in mS for each dit and intra-space character will be

$$T_{DIT} = T_{IAC} = \frac{1{,}200}{20} = 60mS$$

Each dah will be:

$$T_{DAH} = 3\left(\frac{1{,}200}{20}\right) = 180mS$$

Before the inter-character spacing and inter-word spacing can be calculated T_{diff} must be solved using Equation (5):

$$T_{diff} = \frac{60{,}000(20) - 37{,}200(10)}{(20)(10)}$$

$$T_{diff} = \frac{1{,}200{,}000 - 372{,}000}{200}$$

$$T_{diff} = 4{,}140 \text{ mS}$$

So the 19 T_F-units take-up 4,140 mS and each T_F-unit then is:

$$T_F = \frac{4{,}140}{19} = 217.89 \text{ mS}$$

Using Equation (7), the length of an inter-character space can be determined:

$$T_{IC} = 3T_F = 653.68 \text{ mS}$$

Using Equation (8), the length of an inter-word space can be determined:

$$T_{IW} = 7T_F = 1{,}525.26 \text{ mS}$$

Checking the Results:
It's always important to check your results to be sure no error crept in. Ten "PARIS" words sent at Farnsworth 10/20 speed should add up to 1 minute of time (60,000 mS) The check follows in **Table IV**.

Name	Quantity	Length (mS)	Total (mS)
DITS	100	60.00	6,000
IAC	90	60.00	5,400
DAHS	40	180.00	7,200
IC	40	653.68	26,147
IW	10	1,525.26	15,253
		Total:	60,000

TABLE IV - Check of the Results

SYMBOLS & DEFINITIONS

T	Length in milliseconds (mS) of one dit in either PARIS or CODEX.
T_F	Length in mS of one Farnsworth time-unit.
T_{IC}	Length in mS of three Farnsworth time-units that is one Inter-Character space.
T_{IW}	Length in mS of seven Farnsworth time-units that is one Inter-Word space.
T_{diff}	In Farnsworth timing, the difference between the overall time of the word and the sum of the time of the dits, dahs and intra-character spaces that makes up the word, in mS.
T_{IAC}	Length in mS of the intra-character gap; the gap between two elements (dits and dahs) that make up a character. Usually the same as the length of a dit.
W_C	Character speed in Farnsworth timing in WPM.
W_O	Overall speed in Farnsworth timing in **W**PM.
G_C	Character speed in Farnsworth timing in C**G**PM.
G_O	Overall speed in Farnsworth timing in C**G**PM.
CGPM	Character Groups Per Minute
WPM	Words Per Minute
mS	milliseconds.
IAC	IntrA Character space.
IC	Inter Character space.
IW	Inter Word space

Ten "PARIS" words result in 100 dits, 90 intra-space characters (IAC), 40 dahs, 40 Farnsworth inter-character spaces (IC), and 10 Farnsworth inter-word spaces (IW).

Farnsworth System (CGPM):
One has to believe that the Farnsworth sys-

T-Unit Types	C	O	D	E	X	ICS	IWS	Total T-Units
Di(t)s (x 1):	2	0	2	1	2	–	–	T = 7
Dahs (x 3):	6	9	3	0	6	–	–	T = 24
Intra-Character Spaces (x 1):	3	2	2	0	3	–	–	T = 10
Total T-Units at character speed:	9	11	5	0	9	–	–	***41***
4 Inter Character Spaces (x 1):	–	–	–	–	–	12	–	T = 12
1 Inter-Word Spaces (x 7):	–	–	–	–	–	–	7	T = 7
Total Farnsworth T-Units	–	–	–	–	–	12	7	***19***
Totals:	20	22	12	1	20	12	7	T = 60

TABLE V

tem is also used learning the Morse code using CGPM instead of WPM.

Solving for T_{diff} using the values in Table V, which is similar to Table III, gives:

$$T_{diff} = \frac{60{,}000G_C - 41{,}000G_O}{G_O G_C} \quad \text{mS} \quad (9)$$

The only change between solving for Farnsworth WPM and CGPM is a different value for T_{diff}. This results in new values for T_F, T_{IC} and T_{IW}, but Equations (6), (7) and (8) remain the same.

T_F-unit is: $$T_F = \frac{T_{diff}}{19} \text{ mS long}$$

The four Farnsworth inter-character spaces in milliseconds are each three T_F-units long:

$$T_{IC} = 3T_F$$

And the Farnsworth inter-word space in milliseconds is seven T_F-units long:

$$T_{IW} = 7T_F$$

The derivation is left for an exercise for the reader.

An Example (10/20 CGPM):
From Equation (4), the length of time in mS for each dit and intra-space character will be:

$$T_{DIT} = T_{IAC} = \frac{1{,}000}{20} = 50mS$$

And each dah will be:

$$T_{DAH} = 3\left(\frac{1{,}000}{20}\right) = 150mS$$

Before the inter-character spacing and inter-word spacing can be calculated T_{diff} must be solved using Equation (9):

$$T_{diff} = 3{,}950 \quad \text{and} \quad T_F = 207.89$$

Thus:

$$T_{IC} = 623.67 \quad \text{and} \quad T_{IW} = 1{,}455.23$$

All in milliseconds.

The reader can confirm these numbers using a table like **Table IV**.

More on the Farnsworth System:
The ARRL uses the Farnsworth System to send its code practice and code proficiency transmissions at speeds below 18 WPM. At and above that speed the code is sent in the normal fashion with inter-character spaces 3 dits long and inter-word spaces. 7 dits long.

If you're just starting to learn the code, the Farnsworth system is recommended. Many people learning code hit a plateau around 10 WPM. At that speed counting dots starts becoming difficult and many new students do that, often subconsciously. With the Farnsworth system you start recognizing characters by their rhythm instead of counting dits at the very beginning.

73, from AF6C

ICAO to Develop New Phonetic Alphabet

(And is Asking for Radio Amateurs' Input)

April 1, 2024

In 1956 the ICAO adopted a new Phonetic Alphabet based on one developed by NATO. It was a huge success, clarifying aviation voice transmissions throughout the world. Of special interest was one letter 'S' as in SIERRA. The success of this combination over almost seven decades has led to an effort to improve the current phonetic alphabet by finding similar phonetic patterns. The plan was to throwout the existing alphabet, except for the letter 'S', and introduce new letter - word combinations that follow the very successful relation of 'S' as in SIERRA.

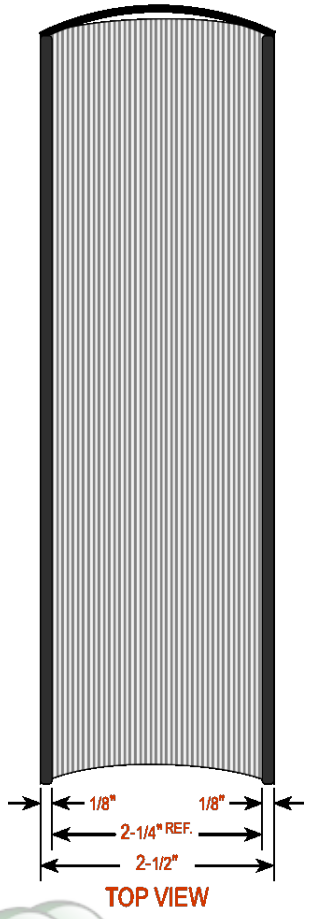
This is a daunting task, but so far twenty of the twenty-six letters have been filled. Each combination has been given a rating designation of 1 to 4. One being a solid pairing; Two being a useable pairing; Three being a weak pairing. Words with a 2 or 3 rating are subject to change. Letters with a four rating have not been assigned yet. Hams help us finish the list.

Radio Hams are asked to provide their input by email. Here is the list as it is now. Feel free to suggest combinations for any of the words, especially the ones with a FOUR rating. Two or three syllable words are preferred.

(1)	A as in ARTIST	(4)	N as in ?
(4)	B as in ?	(2)	O as in OPOSSUM
(1)	C as in CUTIE	(2)	P as in PHISHING
(4)	D as in ?	(2)	Q as in QUICHE
(1)	E as in EXPRESS	(2)	R as in RAPPER?
(2)	F as in FORECAST	(1)	S as in SIERRA
(3)	G as in GYMNIST?	(2)	T as in TSUNAMI
(2)	H as in HIERLOOM	(3)	U as in ULSTER
(1)	I as in IGUANA	(4)	V as in ?
(3)	J as in JUAREZ	(1)	W as in WIRED
(2)	K as in KNOWLEDGE	(1)	X as in XENON
(4)	L as in ?	(1)	Y as in YOOHOO
(2)	M as in MNEMONIC	(4)	Z as in ?

? PUZZLER ?

The Bookworm Puzzle:



In February, Carl received a three volume set of manuals from the ARRL. He carefully, and proudly, placed them neatly on display on his bookshelf section dedicated to ham radio. He planned to start reading Volume I within the next few days.

Unfortunately, life got in the way, and he didn't get to start reading for over two months. When he took down the first volume, he was horrified to find a bookworm had been hiding just inside the front cover of Volume I. Examining the other volumes he found the book worm had eaten her way from inside the front cover of Volume I, all the way to the inside back cover of Volume III.

If each volume is 2½" thick including covers, and the front and back volume covers are each ⅛" thick, how many inches did the book-worm eat through?

(It's Easy Peasy, so send your answer to: puzzler@w6ze.org)

73, from AF6C

? ANSWER ? NEXT MONTH

Heathkit of the Month #122:
by Bob Eckweiler, AF6C

Miscellaneous:

Heathkit GD-232
Thomas by Heathkit
Transistor Electronic Organ

Dedication:

This HotM is dedicated to the memory of Bob Heil - K9EID, Ham, Audio Engineer and accomplished Organist, who taught so many, so much, about sound.

Introduction:

Note Heathkit of the Month #106 [1] discussed the GD-1110 *BALLY™ by Heathkit* FIREBALL® Pinball Game. It was a product that was available on the market completely assembled. Heathkit licensed the pinball game and turned it into a kit. With the GD-232 Heathkit took a Thomas™ home organ and sold it in kit form. How the actual licensing worked is unknown, but it appears Bally and Thomas also received payment from spare parts and assemblies that Heathkit later sold for these kits. It is the only reason, that comes to mind, why Heathkit used special part numbers, different from Heathkit's normal part numbering system. All but a few Note parts for the GD-232 start with 247-[2] and likewise most all the parts for the GD-1110 Note start with 218-[3]. Evidently, parts that are in the original product have a special number,

Here is a link to the index of Heathkit of the Month (HotM) articles:

http://www.w6ze.org/Heathkit/Heathkit_Index.html

1. Notes are on page 23

Figure 1: Thomas by Heathkit GD-232 Organ

and parts that are used only in the Heathkit version continue to carry the Heathkit part number. As an example Heath used IC sockets in GD-1110, but evidently the ICs in the original version are soldered in. Thus Heath used its regular part number (434-xxx) for the various DIP IC sockets they used.

The GD-232 Electronic Organ:

Heathkit introduced the GD-232 Thomas Organ in the Christmas 1962 catalog (80/31). It was originally priced at $329.95, with the optional bench seat an additional $24.95. By the time the Summer 1963 catalog was released, the GD-232 was receiving glowing reports from builders. By then its price had increased to $349.95 (less bench). Available accessories, besides the the GDA-232-1 Bench seat, were the GDA-232-2 Self-Teacher Recorded Lessons - $19.95; The Organ Demonstration Record- "50¢ to cover handling & postage"; and, after the GD-232R was released, the optional GDA-232-4 Variable Repeat Percussion Module (to add the

new GD-232R feature to the GD-232) - $9.95. (discussed later).

The GD-232, and even the later GD-232R and GD-232A have the word Transistor in their title, yet each of them are really hybrid, the GD-232 using five vacuum tubes in addition to sixty-five NPN silicon transistors [4]. The 12 tone generator boards and their associated Eccles-Jordan bistable frequency dividers are transistorized as is the Low 'C' divider board. The power supply, vibrato circuit and amplifier that drives the 12" permanent speaker use tubes. **Table I** lists them. Of interest are the amplifier output tubes. Originally the 6BQ5 tube was shown in the specifications, but later the GD-232 and GD-232R are shown using the 6GK6 tube, but the pinout on the schematic is still for the 6BQ5 tube (See **Table II**).

Note

The GD-232 sold for one year. In the Christmas 1963 catalog (80/41) Heath announced the new GD-232R. The difference between the GD-232 and GD-232R is the addition of a "Variable Repeat Percussion" circuit that produces banjo, marimba, mandolin and balalaika effects.

With the announcement of the new GD-232R, Heathkit offered an upgrade kit for owners of the earlier GD-232 to add "Variable Repeat Percussion". The GDA-232-4 upgrade sold for $9.95. And, since the new model is capable of new sounds, Heath also offered a new demonstration record, the GDA-232-5 for 50¢ "to cover handling & postage."

All the ads for the GD-232 series feature a 5-year warranty. However, the warranty covers only the dozen plug-in tone generator boards:

The transistorized plug-in tone generator boards, the heart of the organ, are warranted for five years. You buy with confidence when you buy a Heathkit version of the Thomas Organ. Replacement upon prepaid return of undamaged board to the Heath Company.

GD-232 Organ Tube Lineup

V701	6CA4	Full Wave Rectifier
V702A	½ 12AT7	Phase Splitter
V702B	½ 12AT7	Vibrato Oscillator
V703A	½ 12AX7	First Preamplifier
V703B	½ 12AX7	Second Preamplifier
V704 – or –	6BQ5/EL84 6GK6	½ Push Pull Amplifier
V705 – or –	6BQ5/EL84 6GK6	½ Push Pull Amplifier

TABLE I

When you ordered the GD-232R you received the standard GD-232 Organ kit, and along with it at no extra cost, the GDA-232-4. Repeat Percussion kit. The first paragraph of the twelve page manual that came with the GDA-232-4 states:

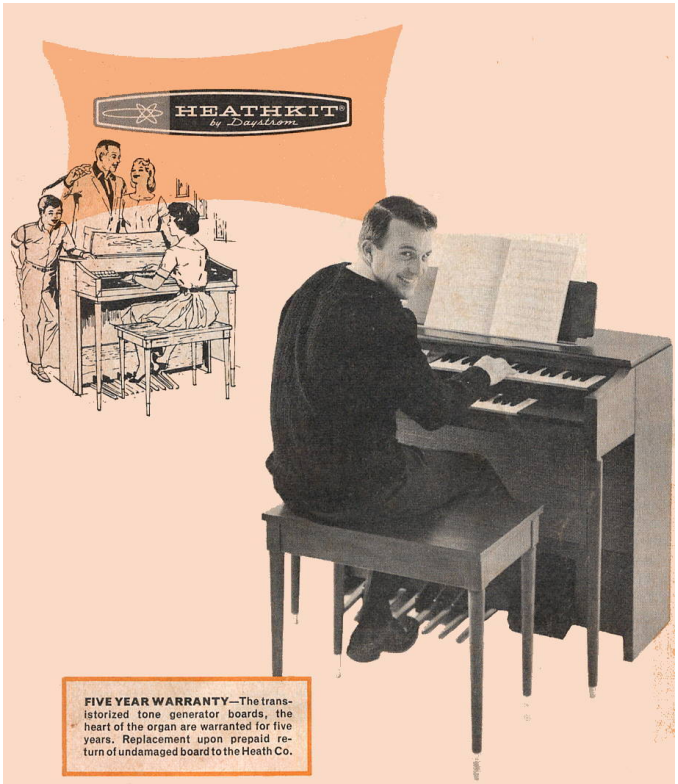
The THOMAS-HEATHKIT Model GDA-232-4 Repeat Percussion kit is an accessory designed for the Model GD-232 Transistor electronic Organ. This Repeat Percussion kit is designed

GD-232 Organ Amplifier Tube Pinout

PIN#	6BQ5	6GK6
1	I.C.[A]	Cathode
2	Grid 1	Grid 1
3	Cathode & Grid 3	Grid 3[B] & Internal Shield
4	Filament	Filament
5	Filament	Filament
6	I.C.[A]	No Connection
7	Plate	Plate
8	I.C.[A]	Grid 2
9	Grid 2	Grid 3[B] & Internal Shield

Notes: [A] Internal Connection (Do not use).
[B] Pins 3 and 9 internally connected.

TABLE II



America's Lowest Cost, Quality Built, Two-keyboard Organ . . . The Thomas Transistor Organ by Heathkit . . . Praised by All Who Have Seen and Built It!

Seldom has an instrument received such enthusiastic praise and acceptance as the sensational Thomas Transistor Organ by Heathkit! Here are some of the comments we have received from our customers . . . "Tonal quality exceeds our expectations" . . . "Assembly manual is a masterpiece" . . . "Far easier to build than I expected" . . . "Functions perfectly" . . . "A beautiful instrument" . . . "I never thought I would enjoy building a kit as much as this" . . . "Tuning is really simple and accurate!" Savings realized through do-it-yourself assembly makes it possible for you to own a truly outstanding organ at hundreds of dollars less than other comparable organs available today! Assembly is easy . . . everything is furnished, everything is explained. Parts are all genuine Thomas factory-fabricated and the factory assembled cabinet is finished, ready for installation of the various component modules as you complete them. Average assembly time, according to our customers, is 50 to 60 hours . . . many indicated that this was their first experience in kit building.

Incorporating an outstanding array of engineering advances, the Heathkit organ features transistorized plug-in tone generators, voicing circuits and low-frequency dividers for clear, undistorted sound, long life and virtual elimination of service problems. Unique self-cleaning keyboard contacts assure positive contact at all times . . . eliminate key clicks . . . never need adjustment! Other features include 10 true organ voices: Trombone, Reed, Flute, Oboe, Cornet, Violin, Saxophone, Horn, Viola, and Diapason for endless combinations of sound, variable Vibrato to add richness and warmth to music, and Expression Pedal to control volume from soft to full majesty, and 13-note bass pedals usually found only on organs costing hundreds more! Order your Heathkit organ now . . . you'll discover a whole new world of entertainment!

Kit GD-232, Organ, 160 lbs., no money down, $23 mo. **$349.95**
GDA-232-1, Matching walnut bench, 16 lbs., no money down, $5 mo. **$24.95**
Export model available for 115-230 VAC, 50-60 cps; write for details.

SELF-TEACHER RECORDED LESSONS—48 STEPS TO FUN!

48 lesson course on four 12" LP records, with music book. Provides a firm basis of music knowledge, not just playing by number or color. 5 lbs.

GDA-232-2, RECORDED LESSONS, List $50. . . . . only **$19.95**

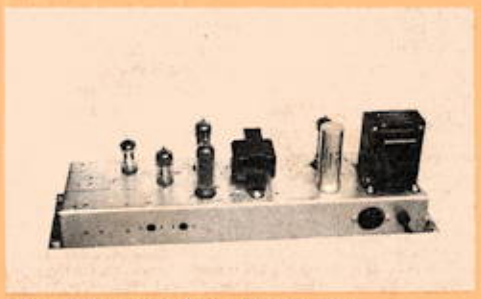
Figure 2A: GD-232 Listing from the Summer 1963 catalog includes a few reviews by satisfied customers. (First of two columns)

to be installed in a completely assembled, tuned, and properly operating Organ. After it has been installed, the Organ model number will become GD-232R.

REAL ORGAN FEATURES—Ten true organ voices, variable bass pedal volume, manual balance control, variable vibrato, expression pedal, 13-note heel & toe bass pedals, overhanging 37-note keyboards (range C through C), beautiful hand-rubbed walnut cabinet, compact size (34½" H x 39¾" W x 21½" D.)

DEMONSTRATION RECORD

Hear for yourself, the many beautiful voices and range of expression offered by the Heathkit organ. Enclose 50c for handling and postage. GDA-232-3, 7" 33⅓ rpm record.



20-WATT PEAK POWER AMPLIFIER

. . . Specially designed to deliver full frequency response and excellent tone quality.

3

Figure 2B: Second column shows the tube amplifier which is located on the floor of the organ cabinet, as well as the available vinyl demo record.

In the February 1964 issue of *Popular Electronics* Heath had an ad for the GD-232A which incorporated the GD-232 and GDA-232-4 into a single kit with a single updated manual, functionally identical to, and replacing, the GD-232R.

The last revision, the GD-232B, appeared in early 1965. In the March catalog it was selling for $349.95. On the same page was a notice:

Attention Heathkit Organ Owners . . . Last chance to add Variable Repeat Percussion to your Heathkit Organ with this easy-to-install Kit. GDA-232-4, 5 lbs..... Only $9.95

With the B version, the organ finally became fully transistorized. In place of the five tubes are two additional rectifier diodes and seven additional transistors. Also, the audio power out increased substantially from 10 watts music power output (20 watts peak power) to 37-½ watts music power output (75 watts peak power).

The organ cabinet has a *"genuine walnut finish, with solid hardwood at all points which require extra strength and rigidity".*

Features of the GD-232:

The GD-232 features two keyboards, each with 37 keys. The upper keyboard is called the "Swell Manual" and the lower keyboard is called the "Great Manual". Both keyboards cover three octaves plus an additional ♪C note[5] (from ♪C2 through ♪C5, where ♪C3 is middle ♪C). It also features 13 foot pedals that cover one octave from ♪C1 through ♪C2. Actual frequencies are given in **Table III**. along with their associated keyboard or pedal.

Note

On either side of each keyboard are cheek-blocks. The left-hand cheek-block of both manuals contain a series of controls in a row. **Table IV** lists the controls. The tab switches

NOTE FREQUENCIES

Musical Note ♪	Freq. Hz.	Swell Manual	Great Manual	Diapason Pedals
♪C1	65.406	-	-	X
♪C#1	69.296	-	-	X
♪D1	73.416	-	-	X
♪D#1	77.782	-	-	X
♪E1	82.407	-	-	X
♪F1	87.307	-	-	X
♪F#1	92.499	-	-	X
♪G1	97.999	-	-	X
♪A1	110.00	-	-	X
♪A#1	116.54	-	-	X
♪B1	123.47	-	-	X
♪C2	130.81	X	X	X
♪C#2	138.59	X	X	-
♪D2	146.83	X	X	-
♪D#2	155.86	X	X	-
♪E2	164.81	X	X	-
♪F2	174.61	X	X	-
♪F#2	184.99	X	X	-
♪G2	195.99	X	X	-
♪G#2	207.65	X	X	-
♪A2	220.00	X	X	-
♪A#2	233.08	X	X	-
♪B2	246.94	X	X	-
♪C3	261.62	X	X	-
♪C#3	277.18	X	X	-
♪D3	293.66	X	X	-
♪D#3	311.12	X	X	-
♪E3	329.62	X	X	-
♪F3	349.22	X	X	-
♪F#3	369.99	X	X	-
♪G3	391.99	X	X	-
♪G#3	415.30	X	X	-
♪A3	440.00	X	X	-
♪A#3	466.16	X	X	-
♪B3	493.88	X	X	-
♪C4	523.25	X	X	-
♪C#4	554.36	X	X	-
♪D4	587.32	X	X	-
♪D#4	622.25	X	X	-
♪E4	659.25	X	X	-
♪F4	693.45	X	X	-
♪F#4	739.98	X	X	-
♪G4	783.99	X	X	-
♪G#4	830.01	X	X	-
♪A4	880.00	X	X	-
♪A#4	932.32	X	X	-
♪B4	987.76	X	X	-
♪C5	1046.50	X	X	-

TABLE III

Controls on the left Swell Manual Cheek-Block

Left to right:
- Off - On switch: SPST. Full CCW position of pedal volume control
- **PEDAL VOLUME** Control: 10 KΩ pot.
- Pilot Lamp - Jeweled, #53 bulb [6].
- **MANUAL BALANCE** Control: 50 KΩ pot.
- Bank of six tab switches:
  - Voice: **TROMBONE**
  - Voice: **REED**
  - Voice: **FLUTE**
  - Voice: **OBOE**
  - Voice: **CORNET**
  - Voice: **VIOLIN**

Controls on the left Great Manual Cheek-Block

Left to right:
- Bank of six tab switches:
  - Voice: **SAXOPHONE**
  - Voice: **HORN**
  - Voice: **VIOLA**
  - Voice: **DIAPASON**
  - Vibrato: **VIBRATO FULL** / medium
  - Vibrato: **VIBRATO ON** / off

Pedal Control at right of Diapason Pedals
- Expression Pedal

TABLE IV

select the desired voice or voices, and control the Vibrato. The **PEDAL VOLUME** control controls the volume of the bass pedals. The **MANUAL BALANCE** pot controls the relative volume between the two keyboards. The EXPRESSION PEDAL controls the overall volume of the organ.

GD-232 Organ Assembly:

Assembly time reported by builders was on the order of 50 to 60 hours. Or a "20 Evening kit". To aid assembly Heath supplied some special tools with the kit:

490-71 Coil alignment tool.
490-2 Phillips screwdriver.
490-57 Nut driver set: with 3/16" 1/4" 5/16" & 11/32" sockets
490-56 Keyboard alignment tool.
453-66 ¼" shaft. (Switch assembly aid).

Assembly is done in this order:
Pedals: Diapason, and expression pedals.
Amplifier, power supply and vibrato chassis.
Circuit Boards:
- Distribution Circuit Board.
- Low 'C' Divider Circuit Board.
- Tone Generator Circuit Boards (11 ea.)
  - (The 12th tone board comes factory wired and aligned and is used for calibrating the other eleven).

Keyboards: Great Manual then Swell Manual.
Voice Switches: cheek-block controls.
Initial Test and Adjustment.
Final Assembly.

Interestingly, though the organ has 100 switches, only one comes assembled! That is the SPST power switch on the pedal volume control. All the others are assembled as part of the kit. Alignment of the keyboards might have been a torturous job except for the alignment tool and numerous templates that are supplied with the kit, and support from many illustrations and pages of instructions. While not mentioned in the manual, it would be a good idea to have a second person available as the organ must be positioned differently for some steps, and the completed organ weighs 117 lbs. (Shipping weight is 78 lbs for the electronic package and 83 lbs (or 100 lbs. if the optional bench is ordered) with the Cabinet.

GD-232 Organ Circuit Overview:

The circuitry of the GD-323 is too involved for a full explanation. So this will be kept brief. **Figure 3** shows the block diagram of the original GD-232. The specification sheet with a schematic is available online for the GD-232 [7], the GD-232R [8], and the GD-232B [9], No specification sheet nor schematic has been found for the GD-232A.

Notes

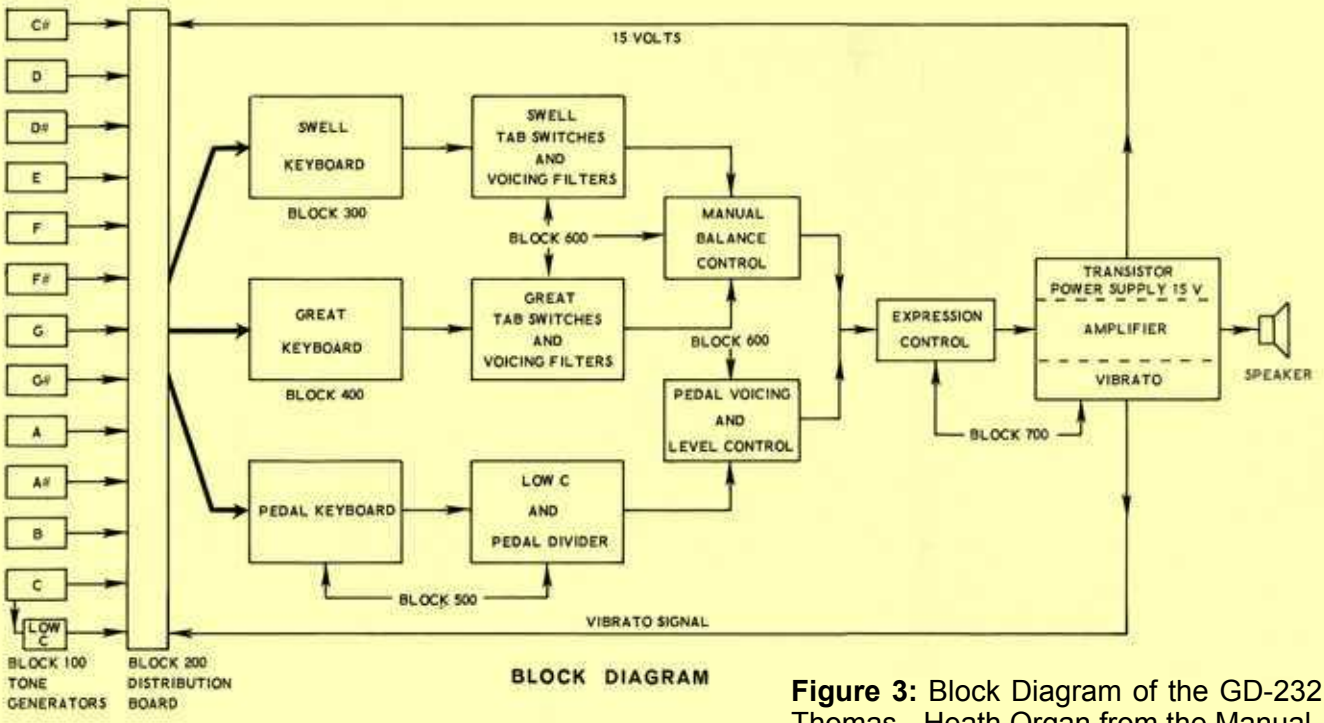


Figure 3: Block Diagram of the GD-232 Thomas - Heath Organ from the Manual.

Tone Oscillator Circuit Boards:

The organ contains 12 tone oscillator boards, for tones from ♪C#4 to ♪C5 (Bold in **Table IV**). The ♪C5 tone board is factory assembled and aligned. Don't touch its adjustment as it will be used to calibrate the remaining eleven tone oscillator boards. All the other tones are sub-harmonics of these 12 tones. The tone oscillator boards are all identical except for the value of three capacitors, C101, C102 and C103. **Table V** gives their values. The tone board schematic is shown in **Figure 4**. Each board has three sections, an oscillator and two identical Eccles-Jordan bistable divide-by-two frequency dividers. TR101 is wired as a simple Harley oscillator, its frequency determined by the inductor and the three capacitors mentioned above. Though not shown on the schematic, the inductor is adjustable with a ferrite slug. The output of the oscillator is fed to the board's connector as well as to the first frequency divider. Each frequency divider uses two transistors.They are wired so when one is on the other is off. The transistors flip states with each fast negative going trigger from the previous stage, as shown on the waveform photos below the schematic. The output of the first frequency divider is half the oscillator frequency and is fed to the

Capacitor Values For Tone Boards

Musical Tone	Freq. Hz	C101 µFD	C102 µFD	C103 µFD
♪C#4	554.36	0.180	0.082	0.180
♪D4	587.32	0.180	0.082	0.180
♪D#4	622.25	0.180	0.082	0.180
♪E4	659.25	0.120	0.053	0.120
♪F4	693.45	0.120	0.053	0.120
♪F#4	739.98	0.120	0.053	0.120
♪G4	783.99	0.091	0.043	0.091
♪G#4	830.01	0.091	0.043	0.091
♪A4	880.00	0.091	0.043	0.091
♪A#4	932.32	0.068	0.033	0.068
♪B4	987.76	0.068	0.033	0.068
♪C5	1046.50	0.068	0.033	0.068

TABLE V

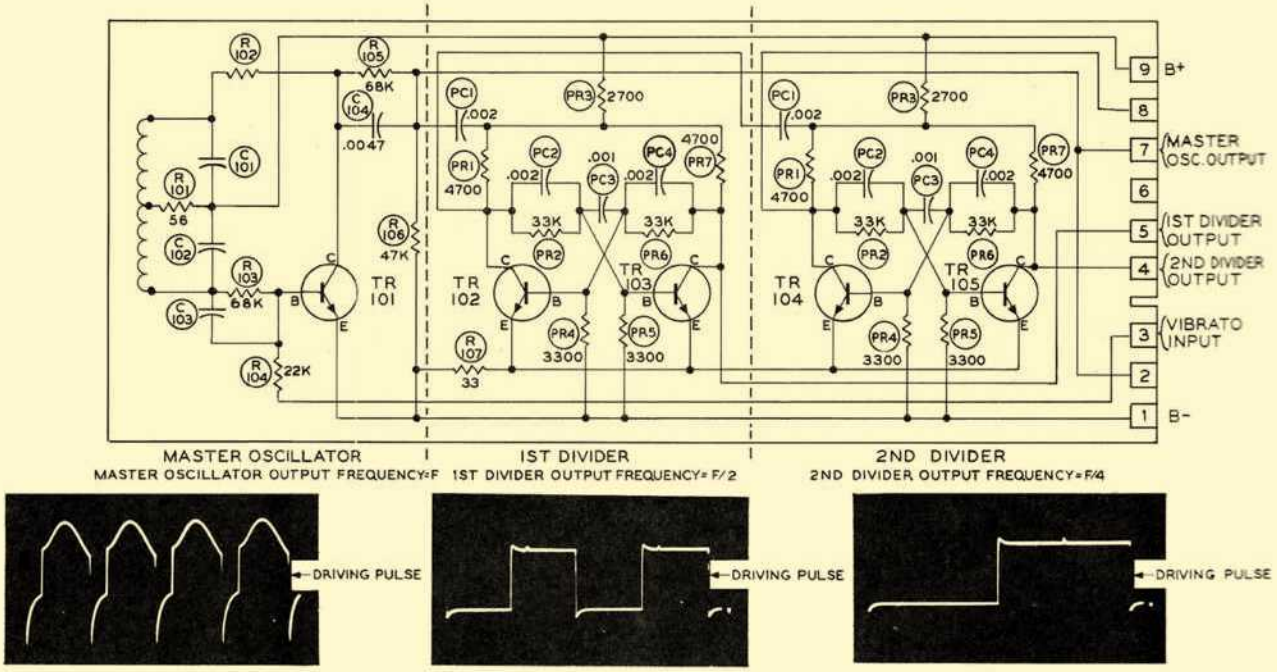


Figure 4: Schematic of one of twelve Tone Oscillators with dividers.

board's connector as well as to the second frequency divider. The second frequency divider is identical to the first, and its output, a fourth of the oscillator's frequency, is also fed to the board's connector. Thus, for example, the ♪C tone board produces three octaves; ♪C5, ♪C4 and ♪C3. Tones ♪C2 through ♪C1 are developed later in the low ♪C divider board.

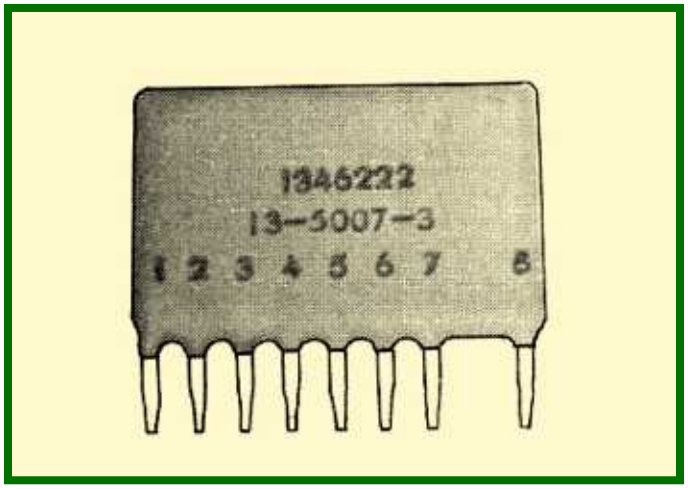


Figure 5: This Packaged Electronic Circuit (P.E.C.) Thomas Part # 13-5007-3 contains 7 resistors and 4 capacitors. (Heath Part #: 247-12).

Except for R107, which should be shown in the oscillator section, all the components, except the transistors, for the two dividers are located in a packaged electronic circuit (P.E.C.) See **Figure 5**.

Distribution Board and Keyboards:

The distribution board is a long board with mating connectors where the 12 tone boards plug in. It distributes B+ and B- power and the vibrato signals to the tone boards. It also accepts the oscillator (Osc) and frequency divided signals (F/2) and (F/4) from each of the tone boards.

While the Osc signal is rich in both odd and even harmonics, the outputs from the frequency dividers, being a square wave, only contains odd harmonics. On the distribution board the Osc signal is combined in a resistive 'Y' network with F/2, that results in F/2 becoming rich in both odd and even harmonics. In a similar network F/2 and F/4 are combined, resulting in F/4 also becoming rich in both harmonics. These resistive networks are

contained in 12 P.E.C.s mounted on the distribution board, each containing 9 resistors.

All the tones required for both keyboards are available from the tone cards except for ♪C2. The distribution board sends ♪C3 to the Low C and Pedal Divider circuit board where it is divided by two, its harmonics enriched and is sent back as ♪C2 to the distribution board.

Both the swell and great manual keyboards connect to the distribution board through wiring harnesses. Each manual operates independently and when one or more keys are pressed on the manual the resulting tone(s) are combined (not mixed) and sent to that manual's voicing filters.

The pedal keyboard is also connected to the distribution board by a third wiring harness. It operates a bit differently. First, excluding ♪C2, none of the other tones, ♪B1 through ♪C1 are available on the distribution board, so the pedals actually select the second harmonic tones ♪B2 through ♪C2. Also the pedals are wired in series so only one tone is output at a time. If more than one pedal is pushed, only the lower tone is output.

Low C and Pedal Divider Board:

As mentioned in the previous section, one function of this board is to create tone ♪C2 from ♪C3 and enrich it in harmonics. The second function is to divide the output from the pedal keyboard by two, giving the desired ♪B1 through ♪C1 tones. The tone from the pedal keyboard is first amplified to insure proper divider triggering. The dividers are the same as used on the tone boards, including utilizing the same type P.E.C.s, with one exception; the pedal divider adds two capacitors to the divider circuit in parallel with the capacitors within the P.E.C. This is done to enhance the low frequency capability of the divider.

Voicing Filter Circuit Board:

The voicing circuits take the tones rich in harmonics and modify the harmonic content to produce the desired organ voice. This is done with groups of filters. The great manual and swell manual keyboards have separate groups of voice filters.

The pedal keyboard has a fixed voice set by a two-pole low-pass filter, which is located on the Pedal Divider Board. After the filter the signal is sent to the PEDAL VOLUME control.

One voice of the swell keyboard, the FLUTE voice is basically harmonic free. In order to remove harmonics, the output from the keyboard is split into three groups each an octave or so wide. It does this by using three separate bus bars over the 37 keyboard range. The groups are each filtered and then combined for the FLUTE voice. The three groups are also combined through a resistor network to provide a single signal which is then fed to the remaining swell voice filters. Rocker switches on the left swell manual cheek-block select which voicing filter or filters will be used.

The great keyboard does not have the FLUTE problem so all three octaves use the same keyboard bus bar. the signal is sent to the input of each voicing circuit. Each output can be selected by the tab switches on the left great manual cheek-block.

The outputs from the swell and great voicing filters are fed to opposite ends of the MANUAL BALANCE control. The center of that control is combined with the output from the PEDAL VOLUME control and the combined signal is sent to the amplifier.

Amplifier Chassis:

The amplifier has four sections, a +305 VDC power supply for the amplifier, a +15 / −13 VDC power supply for the transistor circuit-

ry and amplifier bias, the amplifier itself and a vibrato oscillator. A 12-pin Molex socket (S701) connects the amplifier chassis to the rest of the organ. **Table VI** lists the connections for this socket. A second, 5-pin, socket S702 named **TONE CABINET SOCKET** on the schematic is located on the amplifier chassis. No reference to this socket could be found in the manual. It is evidently for an unknown accessory. The S702 socket connections are also shown in Table VI.

The amplifier power supply uses a transformer with three secondary windings. A 6.3 volt winding provides filament current for the five vacuum tubes and pilot light. The HV winding produces 500 VAC center-tapped (CT). Output, after the 6CA7 rectifier and a filter capacitor, is about 305 VDC. The third winding is 43 volts CT and produces +15 VDC, available at pin 2 of S701 for the transistorized circuitry. It also produces –13 VDC for grid bias for the amplifier output tubes. The AC line-cord for the organ goes directly to the Amplifier chassis.

The amplifier section is made up of two stages of pre-amplification using a 12AX7 dual triode, followed by a phase splitter using one-half of a 12AT7. The phases are sent to a push-pull amplifier using two 6BQ5 or 6GK6 tubes. To improve linearity, negative feedback is applied from the secondary of the output transformer to the cathode of the second preamplifier section. Output is also sent to the speaker via pin 9 of S701. Pin 2 of S701 is the ground return for the speaker.

The remaining section of the 12AT7 is the vibrato oscillator. It is a phase shift oscillator that produces a signal at about 6 cps. This signal is output on pin 4 of S107. When the VIBRATO ON tab switch is depressed, the vibrato signal is fed to each of the tone oscillators changing the bias, and causing the frequency to change slightly at 6 cps with the vibrato signal. When the VIBRATO FULL tab switch is depressed, the full vibrato voltage is applied to the tone boards; otherwise the vibrato signal is attenuated by passing through a 6.8 KΩ resistor (R641).

As part of the vibrato circuit, a pulse is sent out when the organ is powered on. This pulse appears on pin 1 of S701 and is fed via the vibrato bus to each of the tone oscillators to insure all oscillators startup.

Amplifier Socket S701 Pin-Out

PIN #	Purpose
1	Start-up Pulse to tone boards
2	+15 VDC Power
3	6.3 VAC to pilot light terminal 1
4	Vibrato Oscillator Signal to tone boards
5	To terminal 1 of Power Switch
6	Chassis Ground
7	Audio to optional Tone cabinet
8	6.3 VAC to pilot light terminal 2
9	8 Ω Audio Out to Speaker
10	To terminal 2 of Power Switch
11	Speaker Return (Chassis Ground)
12	Unused

Note: Pin 7 and 9 are jumpers in mating P701

Amplifier Socket S702 Pin-Out

PIN #	Purpose
1	8 Ω Audio Out and Pin 9 of S701
2	115 VAC power (hot)
3	Chassis Ground
4	115 VAC power (neutral)
5	8 Ω Audio Out to Speaker and pin 7 of S701

TABLE VI

GD-232 Organ Tuning:

Tuning is done in two steps. First a rough tuning sets the tones close, followed by a fine tuning. Both tuning procedures use the principle of the “beat note”. this is a note that is created when two tones are nearly the same

frequency. If they are off by three cps from each other, three beat notes will be heard per second.

Rough Tuning:

The ♪C tone board came factory built and tuned. and is used to tune the other oscillators. To do the rough calibration you need to set the MANUAL BALANCE fully CW; turn the organ on using the PEDAL VOLUME control; set only the FLUTE tab switch and set the EXPRESSION PEDAL at about ⅓ of its travel.

Use the lower octave keys of the swell manual for the following steps.

Press the ♪C3 key then release it and press the ♪B2 key. If it sounds lower in pitch than the ♪C3 key turn the adjustment on the ♪B tone generator board coil CCW; if it is higher in pitch turn it CW.

Continue alternating keys and adjusting the ♪B coil until they sound nearly same. Now press down both the ♪C3 and ♪B2 keys. You should hear a beat note. Adjust the ♪B2 coil for zero beat. Then turn the ♪B2 coil adjustment 1-¾ turns CW.

Repeat this procedure using the ♪B2 and ♪A#2 keys, except adjust the ♪A# coil and, after zero-beat is achieved, turn the ♪A# coil 2¼ turns.

Continue this procedure using the Rough Tuning Chart - **Table VII**,

This completes the rough tuning. In some cases this will tune the organ close enough that only a trained ear can detect any mis-tuning.

Fine Tuning:

For fine tuning use the TROMBONE voice instead of the FLUTE voice; continue using the swell manual. Referring to **Table VIII** hold down the two keys listed in the first column. If the rough tuning was done correctly, you

ZERO BEAT	THEN ADJUST GENERATOR COIL CLOCKWISE
1. ♪B2 with ♪C3	B 1-3/4 turns
2. ♪A#2 with ♪B2	A# 2-1/4 turns
3. ♪A2 with ♪A#2	A 1-3/4 turns
4. ♪G#2 with ♪A2	G# 2 turns
5. ♪G2 with ♪G#2	G 2-1/4 turns
6. ♪F#2 with ♪G2	F# 1-3/4 turns
7. ♪F2 with ♪F#2	F 2 turns
8. ♪E2 with ♪F2	E 2-1/4 turns
9. ♪D#2 with ♪E2	D# 1-3/4 turns
10. ♪D2 with ♪D#2	D 2 turns
11. ♪C#2 with ♪D2	C# 2-1/4 turns

ROUGH TUNING CHART - TABLE VII

PLAY NOTES	Coil Turn CW	Beats in 10 Sec.	Beats in 30 Sec.
1. ♪C3 and ♪G3	G	9	26
2. ♪G2 and ♪D3	D	7	20
3. ♪D3 and ♪A3	A	10	29
4. ♪A2 and ♪E3	E	7	23
5. ♪E3 and ♪B3	B	11	33
6. ♪B2 and ♪F#3	F#	8	25
7. ♪F#2 and ♪C#3	C#	6	18
8. ♪C#3 and ♪G#3	G#	10	28
9. ♪G#2 and ♪D#3	D#	7	21
10. ♪D#3 and ♪A#3	A#	11	31
11. ♪A#2 and ♪F3	F	8	24
12. ♪F2 and ♪C3	Check Only	6±3*	18±3*

* See Text

FINE TUNING CHART - TABLE VIII

should hear a beat note. Slowly adjust the coil referenced in the second column until the beat count each ten seconds equals the number in the third column. If desired, you can further refine the tuning by further adjusting the designated coil until the beat count each thirty seconds equals the number in the fourth column. Continue this process for each of the 11 tone coils. When completed, check the tuning by holding down the ♪F2 and ♪C3 and counting the beat notes. If you only made the adjustment using column 3 and, you count between 3 and 9 beats, tuning is acceptable, if you opted to use the fourth column and you are within ±3 of 18 beats you are well tuned and if the beats are right on you are in perfect tune. Should the count be outside the ±3 beats you should run through the final tuning process from the beginning one more time.

Final Assembly:
With the organ tuned, all that is needed is to secure the swell manual frame to the assembly tray with two ¼" x 4" bolts, install top cover to the cabinet that was removed during assembly, slide the music rack into its two mounting holes and install the back panel, after dressing the line-cord through the proper hole. If you're a skilled musician enjoy your playing. If you're just learning, keep the volume down or your family and neighbors may complain!

Comments:
I have to confess that its been over 60 years since I last played a piano. I was not really good even then. I learned a lot writing this article, exploring organs on the Internet and reading the GD-232 manual almost from cover to cover.

I'd like to thank Chuck Penson - WA7ZZE for his help researching his extensive library of catalogs to fill in dates and model numbers. Without his input I would not have learned about the GD-232R. Chuck also provided me with the spec sheets which I scanned (see notes 7, 8 & 9 below), as well as the GD-232 assembly manual.

73, from AF6C

Notes:

1. https://www.w6ze.org/Heathkit/Heathkit_106%20GD1110.pdf.
2. From the numerical index in Heathkit's Parts MasterFile:
   218 – – – BALLY PARTS PINBALL
   247 – – – SET OF PARTS – THOMAS ORGAN
3. See Note 2 above.
4. Three different transistors are used in the GD-232. Part #s; 247-254 (1); 247-256 (12); and 247-257 (52). There is no identification given to these transistors except orange, violet and blue dots respectively.
5. Notes are designated with a leading ♪ so they won't be confused with a component designator. After the ♪ is the note (A to G#) followed by (when necessary) a number that signifies the octave. ♪C3 is middle ♪C
6. If the GD-232-4 Repeat Percussion kit is installed, the pilot light is replaced with by the **REPEAT RATE** control.
7. The specification sheet with full schematic for the GD-232 is available online at:
   https://www.w6ze.org/Heathkit/HeathSpecSheets/MUS/GD-232%20[596-652]%206-14-63.pdf
8. The specification sheet with full schematic for the GD-232R is available online at:
   https://www.w6ze.org/Heathkit/HeathSpecSheets/MUS/GD-232R%20[696-652]%2010-4-63.pdf
9. The specification sheet with full schematic for the GD-232B is available online at:
   https://www.w6ze.org/Heathkit/HeathSpecSheets/MUS/GD-232B%20[596-722]%204-9-65.pdf

Heath Logo: An April Fools' tribute to my favorite candy bar.

Remember, if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.

This article is Copyright 2024 R. Eckweiler, AF6C and The OCARC Inc.

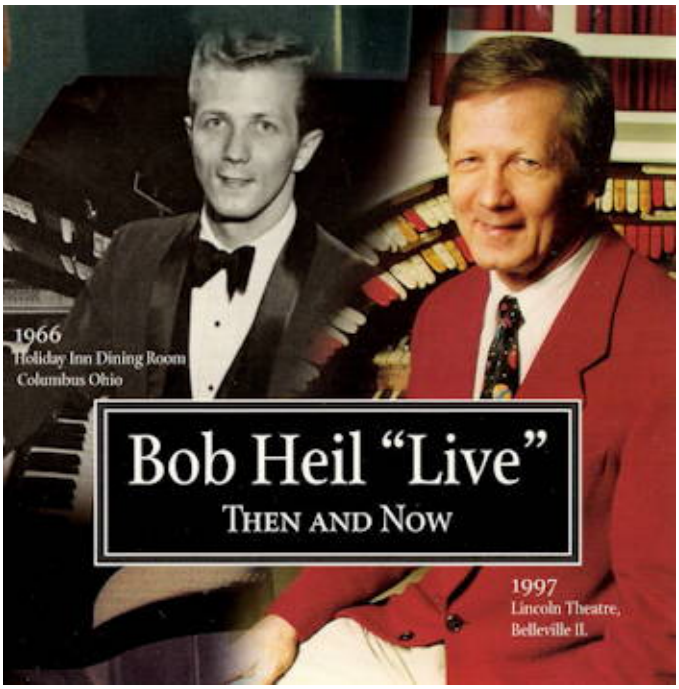
Thanks - AF6C

Heathkit of the Month #122 is Dedicated to:
Robert (Bob) G. Heil - K9EID
10/5/1940 - 2/28/2024.

During late February, while thinking about what piece of Heathkit gear would be the topic for the April Heathkit article, a bunch of ideas came to mind. In recent years the April article often features one of the more esoteric products, at least in the eyes of the typical radio amateur. This is done to celebrate the notorious April Fools' Day.

Looking through a batch of Heathkit spec sheets gave some ideas, a sonar fish finder, a model railroad controller, or a kit clone of the Thomas "Artiste" organ - Heath GD-232.

On March 1st, our VP, Janet - KL7MF sent an email to the club board sadly telling us Bob Heil had become a silent key. It was indeed sad news. Bob was an accomplished organist, and that evening, I played his CD, ***Bob Heil "Live" - Then and Now.*** The "Thomas by Heathkit GD-232 Organ" seemed a worthy topic for the April HotM article.



Cover Art of one of Bob Heil's CDs

Bob Heil at the keyboard (2006 OCARC Field Day at JFTB Los Alamitos) Photo by AF6C

I can't remember at which Hamvention I first heard Bob Heil talk. Most likely it was while on business in Dayton back in the 70s. One Friday evening, everyone at the hotel seemed to be wearing a ham badge. It was Hamvention weekend! Whenever it was that I first watched a Bob Heil presentation, it was outstanding, filled with science, and backed by his vast experience. Since then, at every Hamvention I attended, I'd be in the audience if Bob was giving a talk.

For about 7 years Bob was an honorary member of the OCARC. At the time Chip Margelli was associated with Heil Sound and Bob occasionally gave a live presentation at a club meeting. During our 2006 ARRL Field Day Frank Suggs WF1A brought his Yamaha Keyboard and Bob sat down and played.

The organs Bob played are a lot more sophisticated than the one in the article. Heathkit sold many different organ kits (At least ten, excluding variations). One wonders if Bob might have built one?

73, from AF6C

Gene Eckert - KJ6OML - Silent Key

Gene - KJ6OML and his wife June -.AG6UG (ex-KJ6QZO) in December 2013 at the OCARC Holiday Party held at The Jägerhaus Restaurant in Anaheim, CA. Photo by AF6C

Sadly, Gene Eckert - KJ6OML passed away on February 5th. after a short illness. Gene and his wife June first joined the club in 2011.

Gene was one of a four-man group from the OCARC who volunteered at the Braille Institute in Anaheim once a week, fixing talking book machines. The others were Elmer Thomas - WA6PFA (SK), Bruce Creager - KC6DLA (SK) and Bob Eckweiler - AF6C. Gene joined shortly after Elmer died, and immediately brought his talent and ingenuity to the group. The group went on furlough during the year Braille decided to teardown and rebuild a more modern facility on the same campus. Evidently, during the reconstruction, a decision was made to move all the repair work to their LA facility, and the furlough became permanent. This was right about the time the pandemic was starting.

Gene was an active club member attending club meetings, joining the Zoom© meetings during the pandemic, participating on the club nets, and he was always willing to help out at events like Field Day. He converted a boat trailer to carry Field Day towers and equipment in its bed, and later built a container on the trailer to keep things secure and dry incase of bad weather. His ingenuity and the way he attacked problems made him the club "MacGyver".

Gene and June planned, setup and manned the Field Day publicity booth at numerous Field Days. Gene always enjoyed the task, and he and June were good ambassadors for the club. He also provided a lot of support during setup of the towers and assembly of the antennas.

Gene and June were awarded the prestigious OCARC "Good of the Club Award" for 2022, a well deserved honor.

Gene, we're going to miss you, and we hope June stays in touch.

de AF6C

Gene - KJ6OML pauses while setting up the Publicity Booth at the 2018 Field Day site at the Walter Knott Elementary School Property, in Buena Park, CA. Photo by AF6C

POTPOURRI

Nicholas sent some nice photos, one to be used with the Prez Sez article.
Here's the first:
The Prez says: "Cuando el Rio suena, agua lleva; (When the river sounds, it carries water)….

…And here's the second photo, which is captioned: '"Some times it's too cold for Amateur Radio". Is this next year's Winter Field Day, site?

Unfortunately the evil AF6C no 'F' guy, the editor, had already gotten a better Prez Sez photo for the April RF!

What is HAM RADIO?
Here is one humorist's idea,
The HORMEL 2000.
A Deluxe Version is also available
The SMITHFIELD 2050.
As is an Entry Level Version,
The SPAM HAM 1000

On this day in 1925, the IARU was formed in Paris. Since then, on 18 April every year, radio amateurs worldwide have taken to the airwaves to celebrate World Amateur Radio Day.

Amateur operators had discovered the potential of the short-wave spectrum, previously overlooked in the development of radio-communications. Yet in the rush that followed to use these shorter wavelengths, amateur radio operators were “in grave danger of being pushed aside,” notes the IARU’s official history. Two years later, at the International Radiotelegraph Conference of 1927, amateur radio received the radio frequency spectrum allocations – 160, 80, 40, 20, and 10 meters – still recognized today.

A HISTORY OF APRIL FOOLS' DAY

April Fools' Day or All Fools' Day is an annual custom on 1 April consisting of practical jokes and hoaxes. Jokesters often expose their victims by shouting "April Fools!" at the recipient. Mass media can be involved with these pranks, which may be revealed as such the following day. The custom of setting aside a day for playing harmless pranks upon one's neighbour has been relatively common in the world historically.

A disputed association between 1 April and foolishness is in Geoffrey Chaucer's The Canterbury Tales (1392). In the "Nun's Priest's Tale", a vain cock Chauntecleer is tricked by a fox on "Since March began thirty days and two," i.e. 32 days since March began, which is 1 April. However, it is not clear that Chaucer was referencing 1 April since the text of the "Nun's Priest's Tale" also states that the story takes place on the day when the sun is "in the sign of Taurus had y-runne Twenty degrees and one," which would not be 1 April. Modern scholars believe that there is a copying error in the extant manuscripts and that Chaucer actually wrote, "Syn March was gon". If so, the passage would have originally meant 32 days after March, i.e. 2 May....

Quoted from Wikipedia

Silent Keys Remembered

In memory of those who've passed,
Their voices once so clear.
Their absence leaves an empty space,
Yet their essence lingers near.
Through the airwaves, they did speak,
Their messages like art.
Now they're silent, but not forgotten,
Forever in our hearts.

by
Mark Waldrop KE4WA

OUTSTANDING CLUB BADGES

No, they're not outstanding because they're better than other OCARC club badges. They're outstanding because they have not been picked up by their owner.

Here is a list of recently ordered badges still in the possession of the "Little Olde Badge Maker":

Date Made	Call	Name	Pd.2024
01/19/23	KN6OIN	ADNAN	–
05/05/23	WA6TKR	JEFF	*
07/07/23	KE7GMK	TIM	√
11/15/23	KI6VUX	JOE	√
01/05/24	N6HXF	PAUL	√
01/05/24	KO6BJX	CHUCK	√
02/14/24	KN6QDV	DON	√
03/14/24	N6JBW	JOHN	√

* I will be delivering Jeff 's badge.

During the pandemic badges were mailed at club expense (less clips) so there are no outstanding badges from mid 2019 through 2022. Prior to mid-2019 the following badges are still outstanding. Many - if not all are no longer members:

Early 2019:
KK6RZS Gordon, KJ6ZEW Robert.

2018;
KM6PZY Prakash, KM6VWQ Charles.

2017
KK6ABW Frank, KØTZ Stephen,
KM6BED Brad, W7YMC Russell.

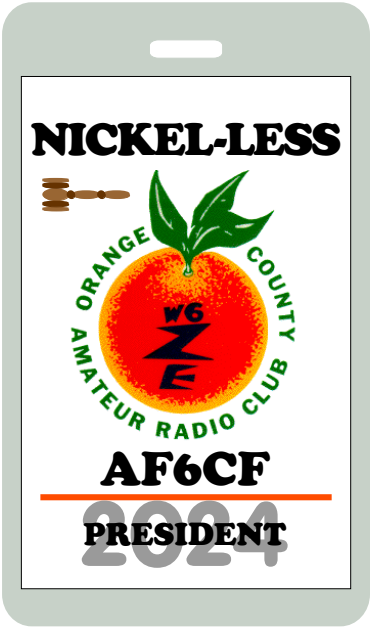
2016 [None].

2015
KK6ULJ Frank, K5MAF Mike.

2014
K6ACJ Bill.

2013
N6NVB Steve, KK6FXZ Joe.

Anyone wanting their badge mailed to them can send an SASE envelope to AF6C.



OCARC General Meeting Minutes

March 15, 2024

President Nicholas Haban, AF6CF started the meeting promptly and proceeded with the Pledge of Allegiance followed by guest and visitor introductions.

Our VP Janet KL7MF introduced this evening's speaker, Michael Scofield, N6OKG.

Michael's presentation was on the reuse of frequencies within the same system with particular emphasis on examples from the Air Traffic Control system. This type of re-use helps maintain system margins so there is no confusion about which traffic center a pilot is talking with while making smart decisions about frequencies that are likely to be used in a new geography as pi-lot's transit to more distant areas.

After a short break the meeting continued with club business.

Business Meeting

A majority of board members were in atten-dance.

A Quick chorus of Happy Birthday was for our VP Janet KL7MF with cupcakes to share.

VP Report – next month's speaker is Dick Norton, N6AA ARRL Division Director.

Treasurer Report – renewals of mem-bership have made their way to the cof-fers.

Membership Report – tonight's meeting attendance – 19 in person and 4 via Zoom.

Show & Tell

AJ KN6WNO presented a backpack go kit for roving in a contest. Yaesu FTM 300. 12ah Bioenno battery, Antenna with cover-age on 2-meter, 1.25 meter and 440. Since the Yaesu does not cover 1.25 meter a BTECH UV-5X3 stands in for that frequen-cy. 28-watt Bioenno folding solar panel and charge controller round out the package.

Field Day – look out for more information in the weeks ahead.

The meeting was adjourned at this point.

Tim Millard - N6TMT
OCARC Secretary

AJ - KN6WNO Demonstrates his Go-Bag for the club attendees.

Photo by Tim - W6TMT

OCARC Board Meeting Minutes

APRIL 6, 2024

OCARC Board Meeting Minutes for: April 6, 2024, The OCARC Board meeting was held at The Streamliner Lounge, 186 N. Atchison St., Orange, and called to order to order by President Nicholas Haban AF6CF at 8:16 am. A quorum of Board Members was in attendance.

VP: Has speakers arranged through September.

Treasurer report –Cash Flow has improved with the end of the 1st Quarter Membership renewals.

Membership report – with renewals the club has 84 members with 4 members being honorary members.

Directors at Large –Joe – still on the hunt for an "Activities Director".

Newsletter Apr Bob AF6C, May Ron W6WG, Jun Dan KI6X, Jul Tim N6TMT

Speakers –

Apr – Dick Norton, N6AA ARRL Division Director.

May – Ron Wilcox, KF7ZN – "Visit to the Sun and the Ionosphere".

Jun - Sean Kutzko, KX9X "Get Ready for Field Day"

Jul - Kevin Caramons – 12 Volt Power and Kevin Zanjani from Bioenno Power.

Aug – Bob Brehm, AK6R Palomar Engineers.

Sep – MFJ presentation.

Field Day 2024 – Ron will lead us as this year's FD Chairman. The location has been changed to a school site about half mile away due to a dog show event at the original location.

Monthly Planner still in testing. N6TMT will be contacting KN6WNO for assistance.

Report from Tim N6GP on the CSUF Morse Code demonstration. Activity went well with Tim and Arnie N6HC participating. Tim and Arnie attempted the CW vs Texting challenge however they did get beat by the Texter. Better luck next time.

New Business

The Board is exploring offering an occasional VE testing session. This was prompted on the news that West Coast Amateur Radio Club – WC6ARC is in the process of disbanding. They had monthly VE sessions.

FD Field – discussion of possibly ordering a catered meal for Saturday evening dinner at Field Day.

The club was contacted about assisting with comm's for a bike race in Costa Mesa on July 7th. After discussion it was determined that the club as an entity would not pursue this event. Members can contact the vendor majesticcycling.com if they wish to help.

Good of the Club

Corey KE6YHK mentioned that there is some old club gear that SK member Gene KJ6OML had in his possession that came from SK Bob Evans WB6IXN. Corey is hoping we can retrieve that gear.

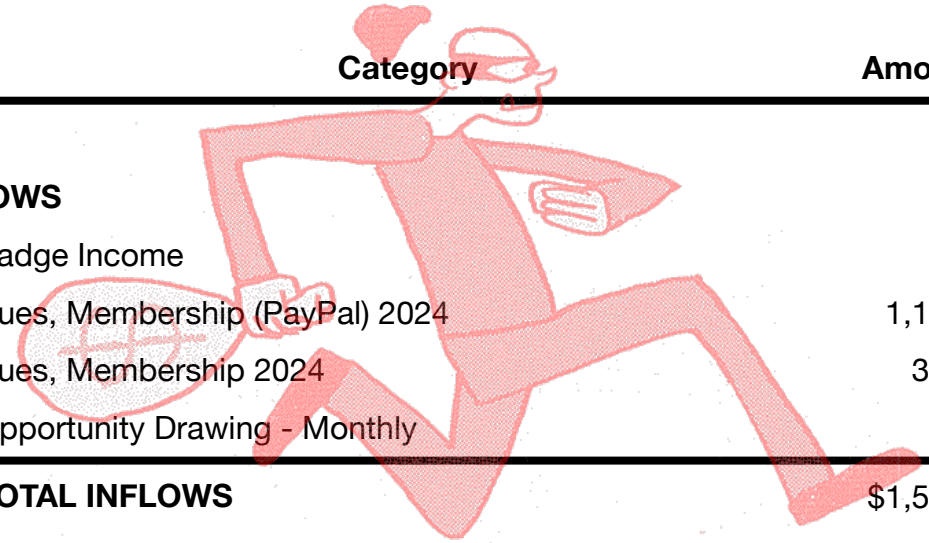
Ken W6HHC mentioned that the previous weekend was the Baker to Vegas race. The City of Orange Police Department ran a very good time this year with the course completed in 16:09 hours.

Adjournment occurred around 9:51 am.

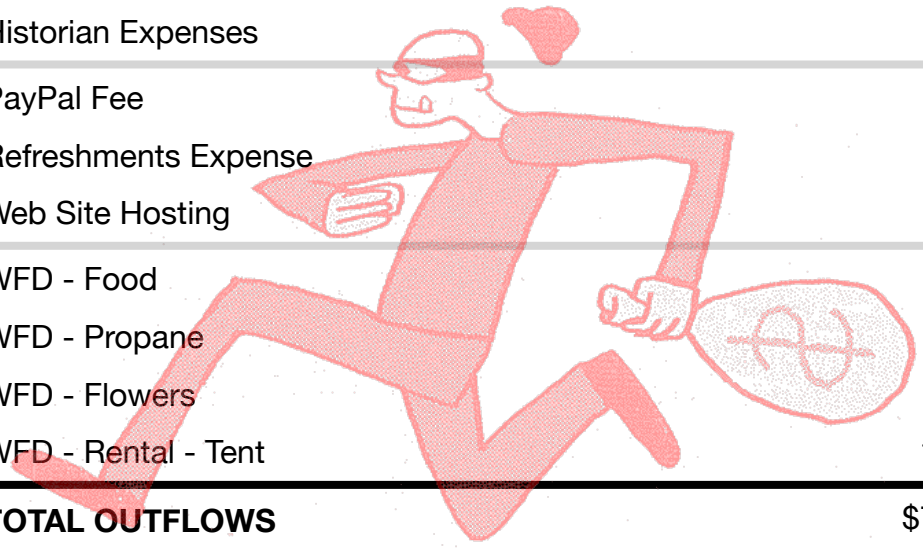
Tim Millard - N6TMT
OCARC Secretary

CASH FLOW - Last Quarter

January 1, 2024 through March 31, 2024



Category	Amount
INFLOWS	
Badge Income	$3.00
Dues, Membership (PayPal) 2024	1,153.46
Dues, Membership 2024	345.01
Opportunity Drawing - Monthly	63.00
TOTAL INFLOWS	$1,564.47
OUTFLOWS	
Flowers Expense	$50.00
Guest Speaker Meal - Exp	108.00
Historian Expenses	74.24
PayPal Fee	58.04
Refreshments Expense	32.34
Web Site Hosting	75.00
WFD - Food	62.91
WFD - Propane	40.85
WFD - Flowers	34.00
WFD - Rental - Tent	170.00
TOTAL OUTFLOWS	$705.38
OVERALL TOTAL	$859.09



Spotlight, [from page 5]

perhaps the latest on the Congressional Bills H.R.4006 and S.3670, which reflect ARRL's campaign to eliminate HOA land use restrictions on antennas.

Dick Norton, N6AA, was first licensed in 1955 as KN2PHF in New York. Originally active on traffic nets and DXing, he is in more recent years mostly on the air contesting. Operating in CQWW Contests from all 40 zones has given him not only an opportunity to see the world, but to meet and interact with amateur radio operators all over the globe.

Dick is currently also president of the Southern California Contest Club, and can be found speaking at Dayton, Visalia, and other conventions.

Again, that is Friday, April 19, at 7PM at the American Red Cross, 600 Parkcenter Drive, Room 208, Santa Ana. Come and hear the latest and greatest about ham radio's national resource. In person or via Zoom, we hope to see you there!

Janet Margelli, KL7MF
VP – W6ZE/OCARC

Next RF Deadline is: MAY 6th

The **ORANGE COUNTY AMATEUR RADIO CLUB, INC.**
RF - VOLUME LXV ISSUE 4 - APRIL 2024
P.O. BOX 3454
TUSTIN, CA 92781-3454

First Class Mail
Time Dated Material.
Please Expedite!
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