# RADIOKIT

## CODE PRACTICE PROCESSOR

### PARTS LIST

RESISTORS:
- R1-R5 15k ¼ watt
- R8,R9 15k ¼ watt
- R6 220k ¼ watt

CAPACITORS:
- C1,C2 22pf disc 50v
- C4,C6 .01uf disc 50v
- C5,C8 .1 monolythic 50v
- C3 1.0 uf electrolytic 16v axial
- C9 100 uf " "
- C7 100 uf " 25v radial

SEMICONDUCTORS:
- IC1 CPPI (programmed 8049)
- IC2,IC3 NE555
- D1,D2 1N914
- 7805 (5v regulator)

MISCELLANEOUS:
- PCBoard
- crystal (color burst 3.579545)
- Rotary switch
- Toggle switch (SPST)
- (2) Monentary pushbutton
- Potentiometer (2Meg linear)
- Speaker 8 ohm 2"
- (2) Knobs
- 40 pin socket
- (2) 8 pin socket
- Rubber grommet
- 6" ribbon cable
- 3' twisted pair wire
- Enclosure (LMB CR 442)
- Hardware (spacers, screws 4x40x3/8,washers nuts)
- [redacted]

KEYER
- R12 4.7k ¼watt resistor
- Q1 2N3904
- phone jack (3 wire)

**MICRO DIGITAL TECHNOLOGY**
**P.O. BOX 1139 MESA,AZ 85201**

# CPP1
# CODE PRACTICE PROCESSOR
# DATA SHEET

FEATURES:

* EASY TO USE
* SIMPLE TO BUILD
* FIFTEEN PRACTICE TABLES
* ADJUSTABLE CODE SPEEDS FROM 1 WPM TO OVER 50 WPM
* LOW COST
* SINGLE 5 VOLT OPERATION
* ELECTRONIC KEYER FEATURE

DESCRIPTION

The CPP1 is the worlds first single chip code practice processor. The copyrighted softwre contained inside the CPP1 is structured to allow learning morse code easily and quickly, without the frustration associated with cassettes and records.

There are fifteen practice tables contained inside the CPP1. Six contain the basic alphabets, numbers, and punctuation. Six more tables correspond to the first six practice groups, however the characters are arranged into five character practice words. There is one table of numbers and another of only punctuation. The final table contains all of the characters arranged into five character words.

The selected practice table will start sending upon pressing the start button. The selected practice group will continue sending until the stop button is pressed. The code speed is set by an external, adjustable, dot clock consisting of a simple one-shot. This allows for quicker learning at increased speed.

An electronic keyer option is also available, with side tone. Upon selecting the keyer option it is initiated by pressing the start button. Whenever a dot or dash is activated an open collector transistor is turned on with the tone. This is used to active an external relay for gating on the transmitter.

CALCULATING CODE SPEED

In radiotelegraphy the basic code element is a dot time. One dot time "on" is equal to a dot, three dot times "on" is a dash. The CPP1 uses an external one-shot (IC2) to produce its dot clock.

The CPP1 fires the one-shot and then waits for it to time out. The time constant is determined by capacitor C8 and resistor R6 and R7. A specific dot time can be calculated using the following formula, DOT=(1.1)(R6+R7)(C8)

It is not necessary to know the dot time unless a fix speed is desired. To detemine the speed of code being sent requires counting a series of dots for one second and using the following formula, SPEED(WPM)=(2.4)(dots/sec)

To do this with the CPP1 requires going to the electronic keyer option and pressing start. Pull the keyer dot in line to ground and counting the dots. If, for example, 10 dots were counted in one second the speed would be 24 WPM (2.4 X 10 dots/sec=24)

ELECTRONIC KEYER OPTION

The electronic keyer option is initiated by setting S1 open and leaving S2 open (position S2H on rotarty switch). When pin 37 of the CPP1 is pull to ground, the CPP1 will send out a series of dots until it is released. If pin 38 is pulled to ground a series of dashes will be sent until it is released. If both lines are pulled low a sereies of alternating dots and dashes will be sent.

S1 OPEN

| S2A CLOSED | S2B CLOSED | S2C CLOSED |
|---|---|---|
| E I S H 5 U F | T N D B 6 - K Y | ? 2 V 3 4 A R |
| **S2D CLOSED** | **S2E CLOSED** | **S2F CLOSED** |
| ( ) C ; X / -- M G | L W P J 1 . " | Z 7 0 Ø 9 8 : Q , |

[ - hypen; ? question mark; () parenthesis; ; semicolon; / fraction bar; -- break; . period; " quotation mark; : colon; , comma ]

S2G CLOSED

E?LTZ I2WN() SVPD7 JOT1A H3BCJ 654.X KUAIO YFR"N ,GVK9
A;JQ-- /8ØEL :-ZBI Z()7JX OM9--L ITNDC .1"KQ EBLWP B4ARV
JØZ?2 V35UF G;8-E ISH6K Y,A/: XLCQP V2FEK :J--DK WR?U-
6/79N "LAZ5 8HAM() T1B4Ø 3;S,Z O1.EB JVGIY

S2H CLOSED

Electronic Keyer OPtion

PRACTICE GROUPS WITH MORSE CODE PATTERN

| S2A CLOSED | | S2B CLOSED | | S2C CLOSED | |
|---|---|---|---|---|---|
| E | . | T | - | ? | ..--.. |
| I | .. | N | -. | 2 | ..--- |
| S | ... | D | -.. | V | ...- |
| H | .... | B | -... | 3 | ...-- |
| 5 | ..... | 6 | -.... | 4 | ....- |
| U | ..- | - | -....- | A | .- |
| F | ..-. | K | -.- | R | .-. |
| | | Y | -.-- | | |
| **S2D CLOSED** | | **S2E CLOSED** | | **S2F CLOSED** | |
| ( ) | -.--.- | L | .-.. | Z | --.. |
| C | -.-. | W | .-- | 7 | --... |
| ; | -.-.-. | P | .--. | 0 | --- |
| X | -..- | J | .--- | Ø | ----- |
| / | -..-. | 1 | .---- | 9 | ----. |
| -- | -...- | . | .-.-.- | 8 | ---.. |
| M | -- | " | .-..-. | : | ---... |
| G | --. | | | Q | --.- |
| | | | | , | --..-- |

S1 CLOSED

S2A CLOSED

HEFSU 5IEUH H5EIF USH5H I5SFE EI5S5 FEIHS SUI5F UEFHE
FUI5E SIFHE 5UESH HEF1U FEH5I USEFI

S2B CLOSED

B-YTD N6KBY -KTD6 TYNKD BKNT- DY6D- TBDKT YKTND -6KYK
BN-TB KYTDN 6-KYD D6YTK YBTND K6NYT

S2C CLOSED

V4R2A ?3R42 A?VR3 24VA? 3A?V3 A23?3 24RAV RRVV? 43?4A
V?A23 RAV42 3R2V4 AVR?2 V4R2V ?RV42

S2D CLOSED

X;()GC /--MXG ()XGCM M/XM-- ;C()--X CGM--X GXCM-- ()MGX()
;--X/C X/()M; MXCGM --X;C/ GM/;C CXM--G M;/()X

S2E CLOSED

J.L1P "WPJ1 LW1." L1JWP .PJWL P1"PL 1J.WW LPJ1W .WL1J
J"LWP LJWP1 ".JPL 1PWJL LJ"P1 W.1JP

S2F CLOSED

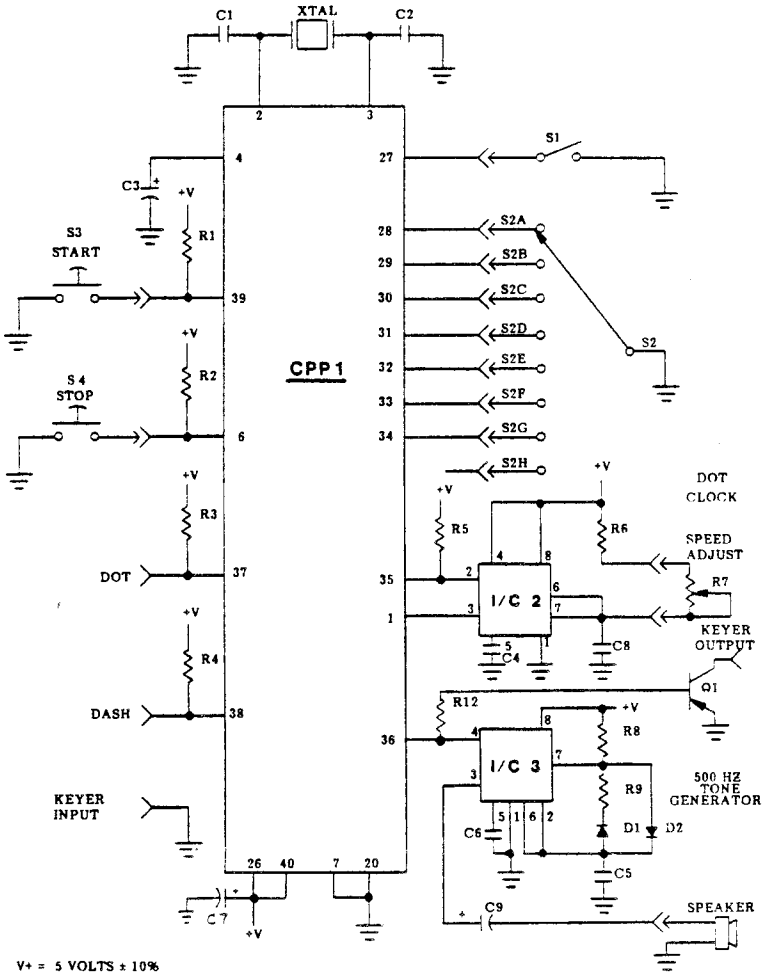
Ø:,ZO 798Q: ZQ087 O9:,8 ,OQ9Z Ø:78Z ZQ8,9 ,8O:Q :9Q9O
Ø7ZO, ZOQ9: Q,9:Z 9OZ7Ø QZØ:9 8O7,Q

S2G CLOSED

92837 4651Ø 49628 537Ø9 96821 13579 2568Ø 95062 13467
53751

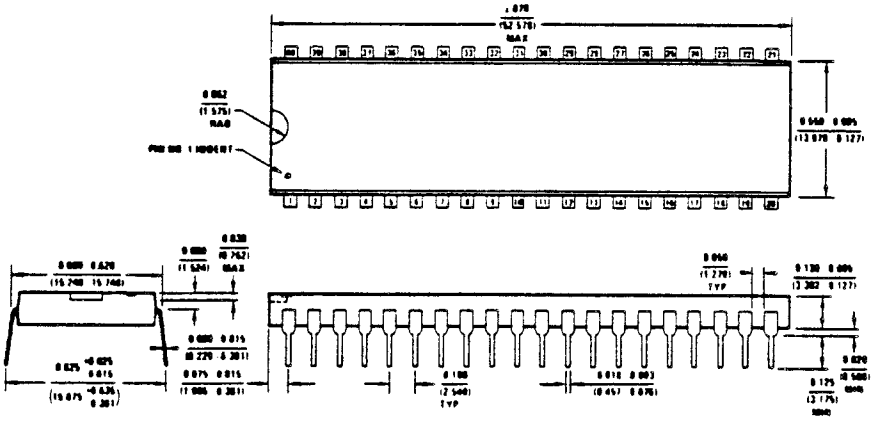
S2H CLOSED

:.—"/ -:()?, -:;.-- ()"/,: :;—.? ?"()/: .-:--, :(),;.
?"-;/ ()"/-?




**PARTS LIST**

| QTY | | IC's |
|---|---|---|
| (1) | IC1 | CPP1 Code Practice Processor |
| (2) | IC2,IC3 | NE555 Timer |
| | | CAPACITORS |
| (2) | C1,C2 | 22 pf ceramic |
| (1) | C3 | 1 ufd 10 vdc |
| (3) | C4,C6 | .01 ufd |
| (2) | C5,C8 | .1 ufd |
| (1) | C9,C7 | 100 ufd 10 vdc |
| | | RESISTORS |
| (9) | R1-R5,R8-R11 | 15 k ¼ watt |
| (1) | R6 | 220 k ¼ watt |
| (1) | R7 | 2 meg pot. |
| | | MISC. |
| (2) | D1,D2 | 1N914 or equiv. |
| (1) | S1 | SPDT toggle switch |
| (1) | S2 | 8 position rotary switch |
| (2) | S3,S4 | normally open push buttons |
| (1) | XTAL | 1-6 mhz(3.57 mhz nominal) |
| (1) | SPEAKER | 8 ohm speaker |
| | | KEYER OPTION |
| (1) | R12 | 4.7 k ¼ watt |
| (1) | Q1 | 2N3904 or equiv. |



Plastic Dual-in-Line Package (N)

## Absolute Maximum Ratings

| | |
|---|---|
| Temperature Under Bias | 0° C to +70° C |
| Storage Temperature | -65° C to +150° C |
| All Input or Output Voltages with respect $V_{SS}$ | -0.5V to +7.0V |
| Power Dissipation | 1.5 Watt |

NOTE: *Absolute maximum ratings indicate limits beyond which permanent damage may occur. Continuous operation at these limits is not intended; operation should be limited to those conditions specified under DC Electrical Characteristics.*

## DC Electrical Characteristics

$T_A$ = 0° C to +70° C, $V_{CC}$ = +5V ±10%,

# You Can Build This Code Trainer

*More than a mere code-practice oscillator, this CPU-controlled trainer features burned-in practice groups. Flick a switch and you have a keyer.*

If you are a ham who wants to upgrade or a ham to be, or if you know someone who wants to be a ham, there is now a low-cost, single-chip microcomputer for you. It is called the CPP1. The CPP1 is a single-chip microcomputer that contains copyrighted software for teaching Morse code. It also doubles as an electronic keyer (iambic) for added versatility.

The unit can be built in one evening. This makes it ideal for the time-pressed person who would rather be involved with amateur radio than with computer technology. Virtually everything is contained on the chip except the dot clock and the tone generator. These are built around the low-cost 555 timer chip.

Learning Morse code using tapes and records is a frustrating experience. It's difficult to concentrate when you have to keep stopping and rewinding to the beginning of a particular practice group. Also, tapes and records never seem to have the right speeds to practice at. They are either too fast or too slow.

Personal computers are far better. However, their cost is a problem, especially

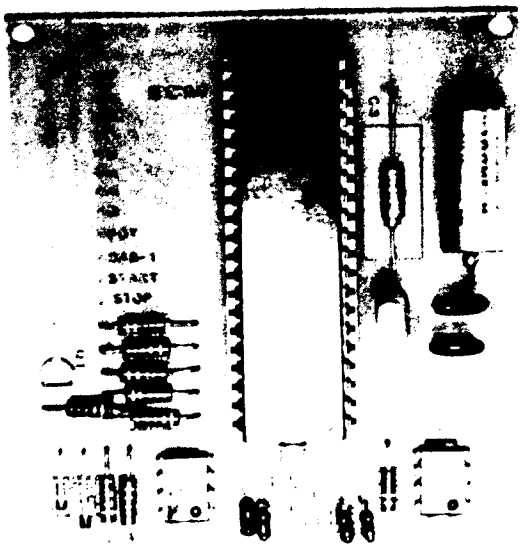


*Photo A. The CPP1 circuit board.*

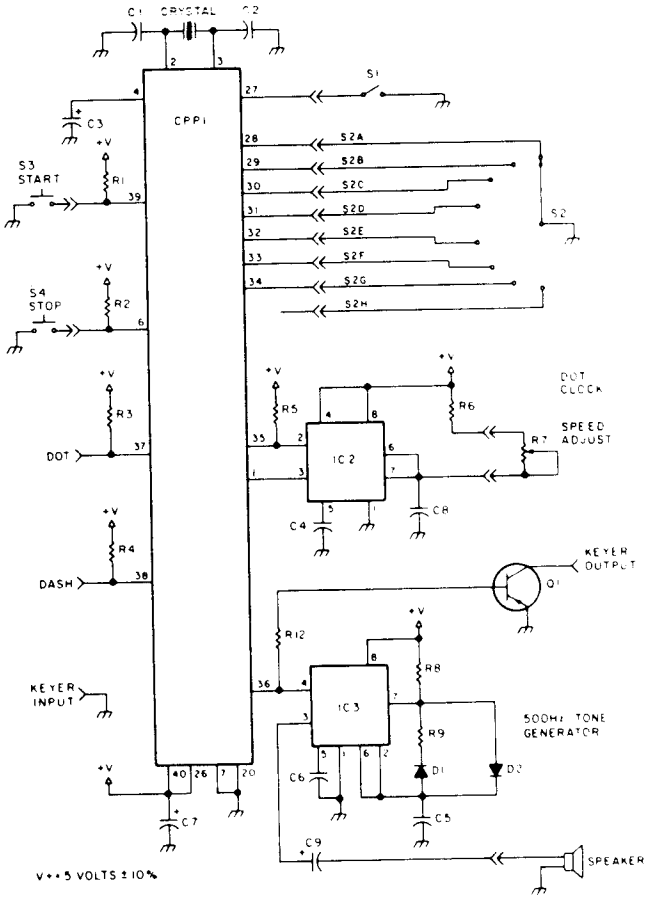



*Fig. 1. Schematic.*

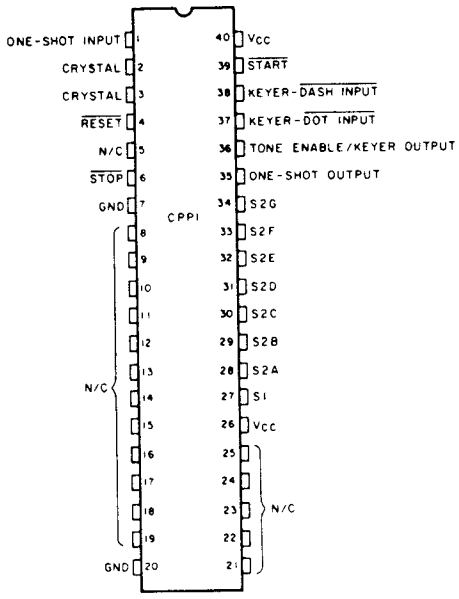



*Fig. 2. Pin description.*

if your budget is tight. In addition, most people do not have the technical or software knowledge to make this approach viable.

The CPP1 solves both of these problems. The chip contains 15 practice tables. They are organized to provide for ease of learning. When a particular table is selected, it will repeat until the user decides to move on. Speed is virtually unlimited, however; with the components called out later, the processor will send perfect code from 2 wpm to over 40 wpm. Finally, it is simple to use. No need for a degree in computer sciences to use it; just select and go.

## Circuit Description

The heart of the code trainer/keyer is the CPP1. Contained in this 40-pin package are 128 bytes of RAM, 2K of ROM, an 8-bit CPU, a reset circuit, a clock, and predefined I/O ports. It is a true system on silicon.

To get the CPP1 to function requires a simple crystal/capacitor addition to pins 2 and 3 of the processor (see Fig. 1). The crystal can be from 1 to 6 MHz. A 3.57-MHz color-burst crystal is recommended because of its availability and low cost.

In order to ensure proper start-up, the chip contains a reset circuit that holds the processor in a known state until power is stable. The chip must stay reset for at least 50 milliseconds. This is accomplished by capacitor C3 on pin 4 of the CPP1. When power is applied, the capacitor will hold this line low. An internal pull-up resistor will then start charging the capacitor. When the capacitor reaches a high level, the processor function will start.

The processor at this time will set the I/O ports up per its internal program. It will then start testing the start button for a closure (pulled to ground). When a valid switch closure is recognized, the program will next test switch S1 to see if it is open or closed.

Switch S1 determines which table is to be executed (see Tables 1 and 2). If switch S1 is open, Table 1 will be selected. If switch S1 is closed, Table 2 will be utilized.

Next, the processor will test switch S2 to determine which subgroup to run. There are a total of 8 subgroups per selected group. Seven require that one of the pins, 28 through 34, be pulled to ground through switch S2. The eighth group is selected when all eight pins are open.

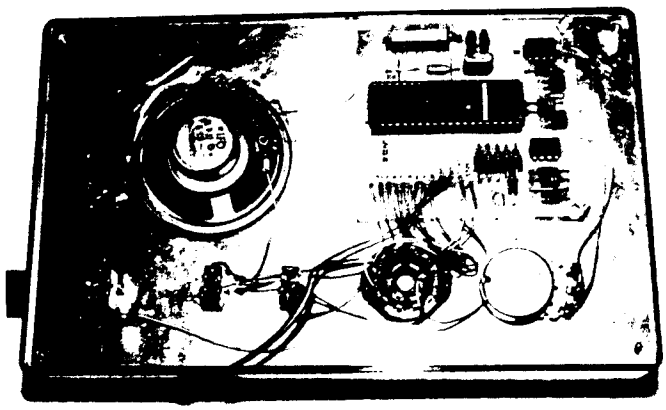


*Photo B. The inside top panel of the CPP1.*

Upon determining which subgroup has been selected, the processor will start sending at the rate of the dot clock, IC2. All timing is based on the dot clock.

The processor will send out a short pulse from pin 35 of the CPP1 to fire the one-shot (IC2). It will then test pin 1 for it to time out. This is one dot time. For dashes, it will do this three times.

The tone is generated by IC3, a simple 500-Hz tone generator. Pin 36 of the CPP1 will go to a high level whenever the tone is on; it

**S1 Open**

| S2A closed | S2B closed | S2C closed |
|---|---|---|
| E I S H 5 U F | T N D B 6 - K Y | ? 2 V 3 4 A R |
| **S2D closed** | **S2E closed** | **S2F closed** |
| ( ) C ; X / -- M G | L W P J 1 . " | Z 7 0 Ø 9 8 : Q , |

[ - hyphen; ? question mark; () parentheses; ; semicolon; / fraction bar; --break; . period; " quotation mark; : colon; , comma ]

**S2G closed**

E?LTZ I2WN() SVPD7 JOT1A H3BCJ 654.X KUAIO YFR"M .GVK9 A;JQ-- /8ØEL :-ZBI Z()7JX OM9--L ITNDC .1"KQ EBLWP B4ARV JØZ?2 V35UF G;8-E ISH6K Y,A/: XLCQP V2FEK :J--DK WR?U-6/79N "LAZ5 8HAM() T1B4Ø 3;S,Z O1.EB JVGIY

**S2H closed**

Electronic Keyer Option

**Practice Groups With Morse Code Pattern**

| S2A closed | | S2B closed | | S2C closed | |
|---|---|---|---|---|---|
| E | . | T | - | ? | ..--.. |
| I | .. | N | -. | 2 | ..--- |
| S | ... | D | -.. | V | ...- |
| H | .... | B | -... | 3 | ...-- |
| 5 | ..... | 6 | -.... | 4 | ....- |
| U | ..- | = | -...- | A | .- |
| F | ..-. | K | -.- | R | .-. |
| | | Y | -.-- | | |
| **S2D closed** | | **S2E closed** | | **S2F closed** | |
| ( ) | -.--.- | L | .-.. | Z | --.. |
| C | -.-. | W | .-- | 7 | --... |
| ; | -.-.-. | P | .--. | O | --- |
| X | -..- | J | .--- | Ø | ----- |
| / | -..-. | 1 | .---- | 9 | ----. |
| -- | -...- | . | .-.-.- | 8 | ---.. |
| M | -- | " | .-..-. | : | ---... |
| G | --. | | | Q | --.- |
| | | | | , | --..-- |

*Table 1.*

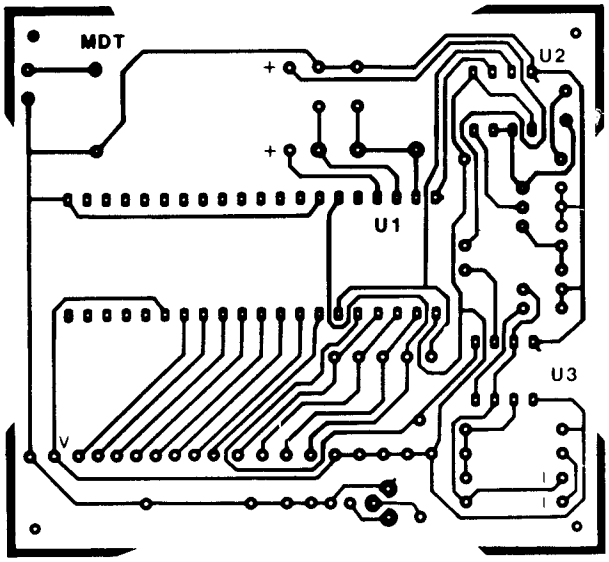



*Fig. 3. Circuit board, foil side.*

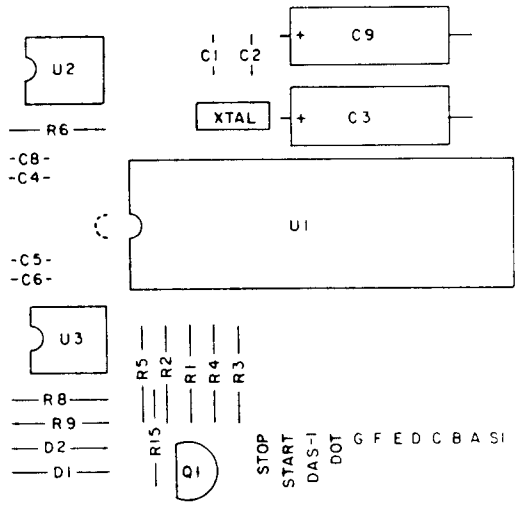



*Fig. 4. Circuit board showing parts placement.*

goes low to turn it off. To stop the sequence, pin 6 of the CPP1 must be pulled to ground through the stop button. (It should be noted that the start and stop buttons can be either normally-open push-buttons, as shown in Fig. 1, or toggle switches.) At this time, the processor will start testing the start pin again, except in the keyer mode.

In the keyer mode (switch S1 and S2 open), when the start is pressed, the chip will enter the keyer mode. To leave it, the power must be turned off. This is to eliminate any chance of the keyer going out during transmission.

**S1 Closed**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S2A closed** | | | | | | | | |
| HEFSU | 5IEUH | H5EIF | USH5H | I5SFE | EI5S5 | FEIHS | SUI5F | UEFHE |
| FUI5E | SIFHE | 5UESH | HEFIU | FEH5I | USEFI | | | |
| **S2B closed** | | | | | | | | |
| B-YTD | N6KBY | -KTD6 | TYNKD | BKNT- | DY6D- | TBDKT | YKTND | -6KYK |
| BN-TB | KYTDN | 6-KYD | D6YTK | YBTND | K6NYT | | | |
| **S2C closed** | | | | | | | | |
| V4R2A | ?3R42 | A?VR3 | 24VA? | 3A?V3 | A23?3 | 24RAV | RRVV? | 43?4A |
| V?A23 | RAV42 | 3R2V4 | AVR?2 | V4R2V | ?RV42 | | | |
| **S2D closed** | | | | | | | | |
| X;()GC | /--MXG | ()XGCM | M/XM-- | ;C()--X | CGM--X | GXCM-- | ()MGX() | |
| ;--X/C | X/()M; | MXCGM | --X;C/ | GM/;C | CXM--G | M;/()X | | |
| **S2E closed** | | | | | | | | |
| J.L1P | "WPJ1 | LW1." | L1JWP | .PJWL | P1"PL | 1J.WW | LPJ1W | .WI1J |
| J"LWP | LJWP1 | ".JPL | 1PWJL | LJ"P1 | W.1JP | | | |
| **S2F closed** | | | | | | | | |
| 0:,ZO | 798Q: | ZQO87 | O9:,8 | ,OQ9Z | 0:78Z | ZQ8,9 | ,8O:Q | :9Q9O |
| 07ZO, | ZOQ9: | Q,9:Z | 9OZ70 | QZ0:9 | 8O7,Q | | | |
| **S2G closed** | | | | | | | | |
| 92837 | 46510 | 49628 | 53709 | 96821 | 13579 | 25680 | 95062 | 13467 |
| 53751 | | | | | | | | |
| **S2H closed** | | | | | | | | |
| :.--"/ | -:()?, | -:;.-- | ()"/.: | :;--.? | ?"()/: | .-:--, | :(),:. | |
| ?"-.;/ | ()"/-? | | | | | | | |

*Table 2.*

## Construction

Assembly is very straightforward. The circuit can be hand-wired in about an hour or two, or a simple single-sided PC board can be used.

The crystal should be located as close as possible to the CPP1. This is standard for any microprocessor.

C7 must *not* be left out. This stabilizes the power to the chip when the tone is on. If it is left out, it is possible that the internal program will jump out of sequence.

Custom tailoring the CPP1 to your particular needs can also be done. Some examples are:

- replacing the speed control with a rotary switch with fixed resistors,
- replacing R9 with a potentiometer for tone control, and
- adding a volume control.

These are just a few of the many variations possible.

## Operation

The CPP1 is extremely easy to use. Apply power. Set switch S1 to the appropriate practice table. Set switch S2 to the desired subgroup. Press start and adjust speed. That's it!

Your selected practice group will cycle until stop is pressed. At this time, another practice group can be selected. Speed may be adjusted any time.

To use the keyer function, set both switches S1 and S2 to the open position. Then press start. You are now in the keyer mode.

When pin 37 is brought to ground, a series of dots will be sent. When pin 38 is brought to ground, a series of dashes will be sent. Finally, when both pins 37

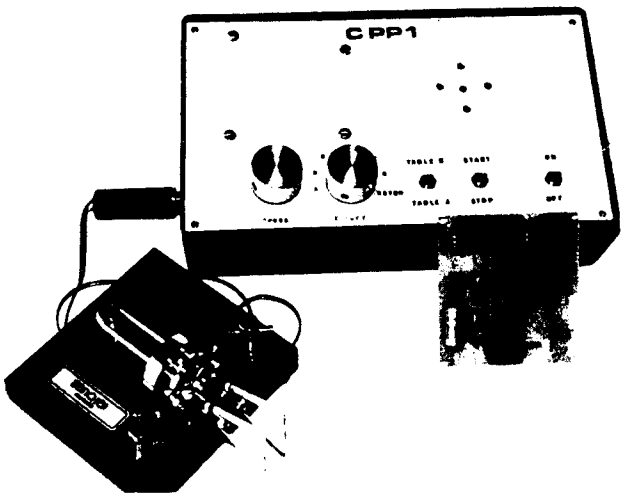


*Photo C. Adding a key turns the CPP1 into an iambic keyer.*

and 38 are held to ground, alternating dots and dashes will be sent.

A final operating note concerning speed: Selecting the proper speed for practice may be done in one of two ways. The simplest way is counting dots. This is accomplished by setting the CPP1 to the keyer mode and pressing start. Hold the dot input line low and count the dots for one second. Once the number of dots per second has been determined, it is a simple case of calculating the speed by the following formula: speed (wpm) = 2.4 × dots/sec. For example, if 5 dots are counted in one second, then speed = 2.4 × 5 dots/sec = 12 wpm.

The second method is based on a known fixed resistor value. Since all timing is based on a dot time, it is a simple matter of using the following formula for determining the one-shot time: dot = 1.1 × (R6 + R7) × C8.

## Conclusion

Learning Morse code, or increasing one's speed, has been a problem since the early days of ham radio. Learning Morse code should be fun and easy. However, traditional means using tapes and records generally make it less than desirable.

The CPP1 puts learning Morse code into the computer age without the hassle. Using the CPP1 makes learning code fun and easy. Using this device 15 or 20 minutes a day, followed by listening to actual ham conversations for about the same amount of time, will make code learning exciting and rewarding ■

### Parts List

| QTY | | |
|---|---|---|
| | | **ICs** |
| 1 | IC1 | CPP1 code practice processor |
| 2 | IC2, IC3 | NE555 timer |
| | | **Capacitors** |
| 2 | C1, C2 | 22 pF ceramic |
| 1 | C3 | 1 uF, 10 V dc |
| 3 | C4, C6 | .01 uF |
| 2 | C5, C8 | .1 uF |
| 1 | C9, C7 | 100 uF, 10 V dc |
| | | **Resistors** |
| 9 | R1-R5, R8-R9 | 15k, ¼ Watt |
| 1 | R6 | 220k, ¼ Watt |
| 1 | R7 | 2 meg potentiometer |
| | | **Miscellaneous** |
| 2 | D1, D2 | 1N914 or equivalent |
| 1 | S1 | SPDT toggle switch |
| 1 | S2 | 8-position rotary switch |
| 2 | S3, S4 | normally-open push-buttons |
| 1 | crystal | 1-6 MHz (3.57 MHz nominal) |
| 1 | speaker | 8-Ohm speaker |
| | | **Keyer Option** |
| 1 | R12 | 4.7k, ¼ Watt |
| 1 | Q1 | 2N3904 or equivalent |

The CPP1 code practice processor chip is available from Micro Digital Technology, PO Box 1139, Mesa AZ 85201, for $19.95 ppd., PCB, $5.00. Checks, Visa, and Mastercard accepted. On credit card orders, please include card number, expiration date, telephone number, and full name. For phone orders, call (602)-897-2534. OEM and dealer inquiries welcome. Complete parts kits available from the following distributors:

Greenbrier Marketing International, Inc.
509 S. 48th St., Suite 105
Tempe AZ 85201.
Price: $49.95 postpaid.

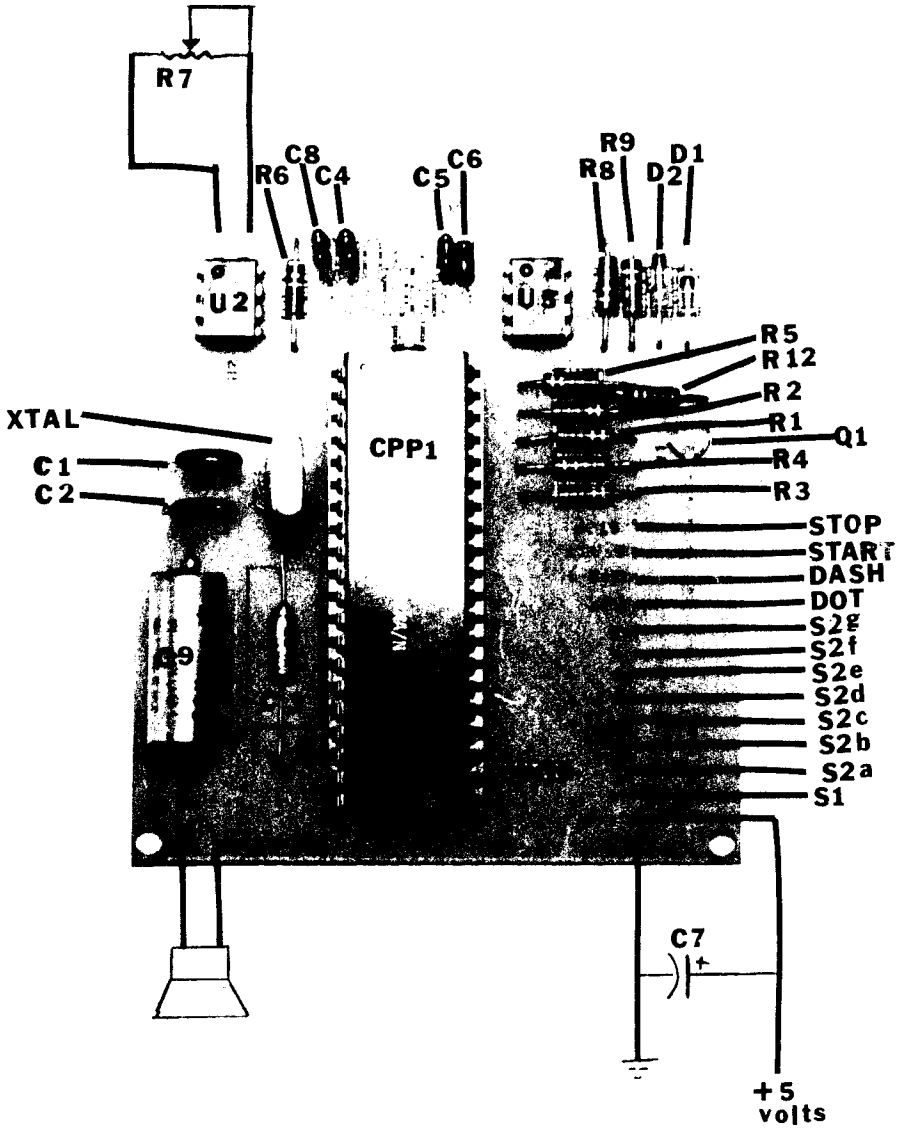
Chaney Electronics
PO Box 27038
Denver CO 80227
(303)-781-5750

Circuit Specialists
PO Box 3047
Scottsdale AZ 85287
(800)-528-1417

Radiokit
Box 411
Greenville NH 03048
$47.00 (kit)

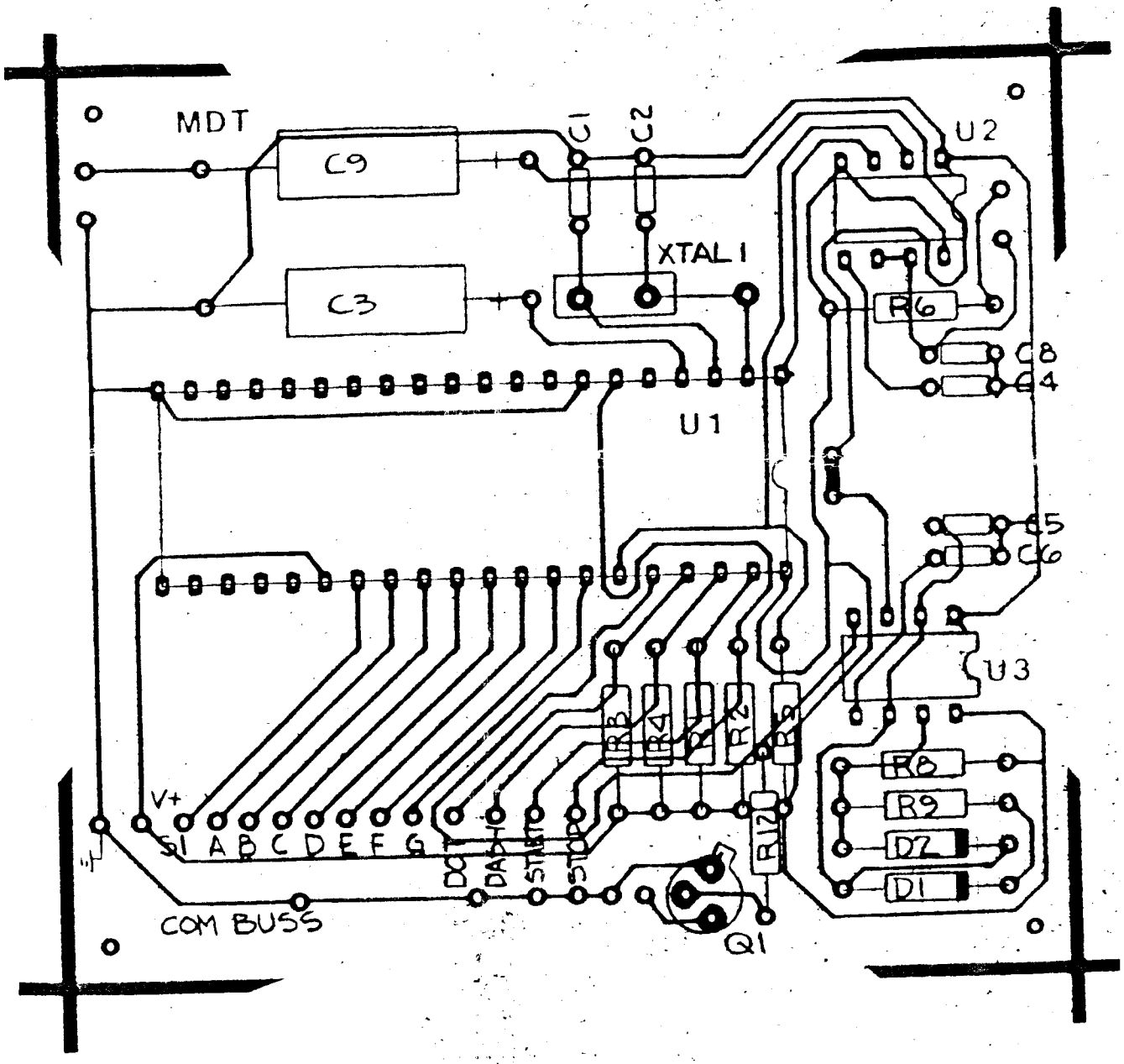
Gigatech*
9520 Chesateake Dr.
San Diego CA 92123
(714)-268-8131

*will be selling completed units in addition to kits.




## PARTS LIST

| QTY | | IC's |
|---|---|---|
| (1) | IC1 | CPP1 Code Practice Processor |
| (2) | IC2,IC3 | NE555 Timer |
| | | CAPACITORS |
| (2) | C1,C2 | 22 pf ceramic |
| (1) | C3 | 1 ufd 10 vdc |
| (3) | C4,C6 | .01 ufd |
| (2) | C5,C8 | .1 ufd |
| (1) | C9,C7 | 100 ufd 10 vdc |
| | | RESISTORS |
| (9) | R1-R5,R8-R9 | 15 k ¼ watt |
| (1) | R6 | 220 k ¼ watt |
| (1) | R7 | 2 meg pot. |
| | | MISC. |
| (2) | D1,D2 | 1N914 or equiv. |
| (1) | S1 | SPDT toggle switch |
| (1) | S2 | 8 position rotary switch |
| (2) | S3,S4 | normally open push buttons |
| (1) | XTAL | 1-6 mhz(3.57 mhz nominal) |
| (1) | SPEAKER | 8 ohm speaker |
| | | KEYER OPTION |
| (1) | R12 | 4.7 k ¼ watt |
| (1) | Q1 | 2N3904 or equiv. |


MDT
C9
C3
C1
C2
XTAL1
U1
U2
U3
R6
C8
C4
C5
C6
R8
R4
R2
R5
R12
R6
R9
D2
D1
Q1
V+
S1 A B C D E F G
DATA
START
STOP
COM BUSS