(continued from page 16)

you a direct readout of the percentage of 3rd harmonic distortion in the receiver audio stage.

This is important in two ways. Practically all of these transceivers use the receiver audio stages for the modulators. This test can be very helpful in finding the cause of distortion in the transmitted signal. For example, if you read the normal 4 watts of RF power, unmodulated, but the audio stages show a maximum output of only 2 watts audio, you will not have enough audio power to produce full modulation. This will cause a clear but weak signal. The reverse is also true. If

you read only 2 watts RF and 4 watts audio, the transmitter is being overmodulated and will garble.

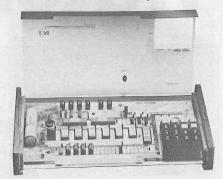
To check for sensitivity, an RF signal generator can be connected to the BNC RF GENERATOR jack on the back panel. It will feed directly into the receiver antenna. You can check for calibration and RF sensitivity if the signal generator has a calibrated RF attenuator.

The third BNC jack on the back panel can be connected to a frequency counter, Just push the mike button and read the channel frequency directly.

This is a very complete "package" for servicing of CB radios, either on the bench, car, boat, mobile home or what have you. With only a few other test instruments, usually already on the bench,

you can get into the CB radio service business in a big way for not too much money. While checking the prototype out, we had a chance to make direct comparisons with some far more expensive types of equipment, and found that the accuracy of the 1040 compared very well with these! R-E

EPA Micro-68 Computer



Circle 120 on reader service card

ELECTRONIC PRODUCT ASSOCIATES' ANSWER to microcomputer fever is a self-contained system complete with power supply and a wood and smoked plastic 9 \times 12 \times 2 inch (229 \times 305 \times 51 mm) case. Plug it in and you're ready to start programming.

The Micro 68 is built around the Motorola M6800 microprocessor. It has a six-digit seven-segment display and a 16key hexadecimal-input keyboard. The display is seven-segment, not a true hexadecimal format, so B and D are indicated by lower case representations using the seven segments. The decimal point is lit when "b" is displayed to help distinguish it from a "6."

The system is controlled by the John-Bug PROM monitor, one of the most sophisticated of the keyboard-display kind. In its basic form, the kit is intended as a learning tool or prototyping system for engineers, scientists, and laymen.

The monitor system is contained on four 1K bit PROM's for a total of 4K bits or 512 8-bit words of firmware. The lettered keys on the input keyboard double as control keys for the system. Keys A through F have been assigned the functions auto, back, change, do, examine, and FORWARD.

To get started, press the one remaining button, the RESET button, and the display lights up with EPA uP . . . very cute. Pressing EXAMINE lights up dashes in the four leftmost places. Punching in an address puts the address in the first four digits and the two remaining digits, which are slightly separated from the rest, light up with the contents of that memory location in hexadecimal. The FORWARD key increments the address one location each time the button is depressed. BACK is an unusual feature not found in most similar systems. It decrements the address and displays memory contents. It is particularly convenient to have the address displayed simultaneously so you don't have to worry about losing your place or getting confused when sequential memory locations are loaded with the same instruction or data.

(continued on page 20)



Soundcraftsmen the equalization leader...

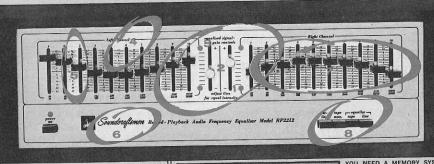
WHY? Because we CARE about HOW an equalizer does its job BEST! That's why we provide our customers with our exclusive...

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YOU NEED MORE THAN JUST AN EQUALIZER . . . FOR OPTIMUM EQUALIZATION BENEFITS, HERE ARE THE TEN ESSENTIAL ELEMENTS YOU NEED:

YOU NEED VISUAL ZERO-GAIN LEVEL INDICATION: SOUNDCRAFTSMEN provides combination zero-gain controls with LIGHT EMITTING DIODE indicators to show when exact zero-gain is accomplished. Adjusting the zero-gain controls for equal L.E.D. intensity assures you of input vs. output level matching . . . 2. YOU NEED FULL-SPECTRUM BOOST OR CUT CONTROLLABILITY: SOUND-"zero-gain" circuit provides an additional 18 dB control-range over the full spectrum 20 to 20,480 Hz on each channel for instantaneous input-output zero-distortion signal matching.

3. YOU NEED AUTOMATIC/CONTINUOUS OUTPUT-OVERLOAD WARNING SIGNAL: SOUND-CRAFTSMEN'S 2 top L.E.D.'s glow brightly, (bottom L.E.D.'s off), if output voltage is boosted excessively, thus eliminating the danger of distortion and/or damage to related equipment resulting from the high voltages that can be generated by any fine equalizer . . . 4. YOU NEED A POSITIVE METHOD OF READING 1 dB SETTINGS 5. YOU NEED AT LEAST 24 dB TOTAL CONTROL OF EACH OCTAVE . . . 6. YOU NEED A UNIT THAT WILL ADD ZERO NOISE AND DISTORTION: SOUNDCRAFTSMEN'S signal-to-noise and distortion performance figures are far superior to most high fidelity components. SOUNDCRAFTSMEN products are used in professional broadcast and recording systems, assuring you of completely noise-free and distortion-free integration into your system . . . 7. YOU NEED TO BE ABLE TO LOOK AT YOUR ACTUAL "EQ" CURVES . . . 8. YOU NEED THE ABILITY TO EQUALIZE TAPE RECORDINGS . . .



9 YOU NEED AN ACCURATE, EASYTO-USE INSTRUCTIONAL TEST
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FREQUENCY RESPONSE: ±0.5 dB 20-20,480Hz THD: Less than .1% @ 2 v., Typ: .05% @ 1 v S/N RATIO: Better than 106 dB @ full output Better than 96 dB @ 2 v. RMS FILTER TYPE: Toroidal and Ferrite-core. INDIVIDUAL OCTAVE-CONTROL RANGE: MINIM IMDIVIDUAL OCTAVE-CONTROL RANGE: Minimum ± 12 dB (Typ. ± 14 dB), each octave centered at 30, 60, 120, 240, 480, 960, 1920, 3840, 7680, and 15,360Hz.

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RADIO-ELECTRONICS

EQUIPMENT REPORTS

(continued from page 18)

To load a program or alter something at a particular address, first get to that address using the E, F, and B keys and then press CHANGE. The rightmost display digits

0011 44 LSRA

0012 44 LSRA

0014 47

0016 F1

0017 A5

0019 47

0013 DF STX STORE

0015 BD JSR LDDSPY

0018 DE LDX STORE

001A A6 LDAA NBR,x

are extinguished and become loaded with the new data that is keyed in. Another unusual feature is the A key that automatically enters the data, increments the address and awaits the next entry. By using the AUTO function, you can quickly enter a program by continuously keying in the instructions in hexadecimal without the nuisance of hitting any additional keys. If you hit a wrong key or make a mistake, you can immediately correct it by pressing RESET and using the other functions to backtrack, or you can continue on and go back later. It is probably wise to examine the program when you are finished entering it and make the corrections then.

1	T	ABLE 1—COUNT SIX PROGRAM	
	0000 DE LDX THREE 0001 45 0002 4F CLRA ZRONBR 0003 A7 STAA NBR,x 0004 48 0005 09 DEX 0006 26 BNE ZRONBR 0007 FB	001B 48 001C 84 ANDA OF 001D OF ADD 001E BD JSR LDDSPY 001F F1 0020 A5 0021 DE LDX STORE 0022 47	0036 DE LDX THREE 0037 45 0038 A6 LDAA NBR,x 0039 48 003A A9 ADCA INCR,x 003B 4B 003C 19 DAA 003D A7 STAA NBR,x 003E 48
	NXTCNT 0008 BD JSR CLRDSPY 0009 F1 000A BA 000B DE LDX ONE 000C 4D	0023 08 INX 0024 9C CPX FOUR 0025 4F 0026 26 BNE LDTWO 0027 E5	003F 09 DEX 0040 26 BNE ADD 0041 F6 0042 7E JMP NXTCNT 0043 00
	LDTWO 000D A6 LDAA, NBR,x 000E 48 000F 44 LSRA	0028 CE LDX 15 0029 00 002A 15 THREE 00P 002B DF STX STORE 002C 47 STORE	0044 08 0045 00 0046 03

002D BD JSR DSPLY

0030 DE LDX STORE

0033 26 BNE LOOP

002E F1

002F C7

0031 47

0034 F6

0032 09 DEX

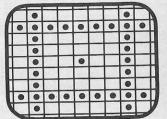
0035 OC CLC

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ATC-10 COLOR BAR PATTERN GENERATOR

- Extra wide range RF/IF attenuator for testing receiver sensitivity.
- GRAY QUAD pattern for gray scale tracking checks/adjustments.
- COLOR BARS pattern with 6th bar marked to make your job easier.
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time you're repeatedly switch-ing static and dy-namic convergence patterns, think how much easier composite HATCH-DOTS pattern below would make your job. It can also perform size, linearity, pincushion and centering checks. It's only one of several unique patterns produced by the ATC-10 that can save you time, trouble and most important - money. We'd love to show you how. Write us



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When the program is entered and ready to go, press p and "do" lights up in the rightmost two digits. Entering the starting address starts the program as soon as the last key is released.

0048 00

0049 00

004A 00

004B 00

004D 00

004E 01

004F 00

0050 04

INCR+1 004C 00

NBR+1

ONE

FOUR

One more feature is the shared function of the "8" key. Next to it is printed RTI (Return To Interrupt). It is very useful for debugging programs by inserting swisoftware interrupt instruction-in your program. Each time the program encounters the instruction, the system is interrupted. The monitor dumps the MPU registers into assigned memory locations that can then be examined as well as any other memory locations. Depressing the RTI key will resume the program from where it left off or from a new condition set up by the programmer. If there is a loop in the program, it is possible to circle the loop each time the button is pressed and recheck the system status each time around.

As with most ROM or PROM monitor systems, the subroutines in the monitor can be used by the programmer. This is particularly helpful in using the display. The Micro 68 display is multiplexed (the segment lines to the six digits are all in parallel.) The software and the monitor program is used to scan the display. One assigned memory location is used as a digit mask. Setting one of the bits to a logic 1 enables a corresponding display digit. Another memory slot is loaded with the character pattern to be displayed.

I have some suggestions for the programmer, particularly the beginner, when approaching this system. Make a numeri-

(continued on page 30)



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EQUIPMENT REPORTS (continued from page 20)

cally increasing listing of all the M6800 instructions so you can quickly analyze a program and then using the monitor, display its own contents in locations FOOO through FFFF. EPA does not include a monitor listing and it will be useful to get an insight into programming techniques and to really understand what is happening when you use the subroutines in the monitor PROM.

Two Motorola/AMI 6820 Peripheral Interface Adapters are wired into the Micro 68 and are used to scan the keyboard and operate the display. The keyboard input port is wired in parallel to 16 connector pins and are also hooked to pull-up resistors. I haven't tried it, but these can probably be used as external device control outputs or inputs by the

If you get serious about this microcomputer, take a good look at my COUNT SIX program listing in Table 1.

The program starts with zeros displayed in all six display digits and then increments the count in steps of 1. The count is stored in the three memory locations starting at 0049, 004A, and 004B. The first eight instructions in the program are a loop that is traversed three times to load these three memory locations with their initial zero values. The bulk of the remaining instructions read these numbers out on the display. The three words consist of two digits each.

The display is set up to begin scanning from the left by the CLRDSPY subroutine. The next loop is used three times, once for each 2-digit word. Each time around the loop displays two digits. First the left four bits of the memory word are shifted right and entered into the digitdisplay memory words by the LDDSPY routine. Then the same number word is recalled and the right four-bits are stored in the next memory word.

Once this procedure is complete, the actual display takes place in the next loop. The initial setting of the x register to 15 in the program determines the number of times around the loop and the rate of the display count. DSPLY does the actual scan of the six digits and includes a loop of its own, so there is a multiplication effect in the time it takes to finish this part of the program.

Finally the last part of the program increments the number by one. It is a multiword addition that adds the 00 00 01 increment in locations 4C, 4D, and 4E.

I'm sure there are some tricks that can be pulled to shorten this program somewhat, but the display system demands some intricate programming.

As you can see, quite a few steps are taken to perform this simple exercise so the standard memory of 128 words does not go very far. Additional memory will probably be an early consideration.

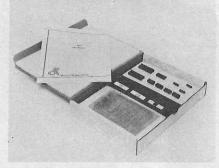
The Micro 68 documentation includes the Motorola M6800 Systems Reference and Data Sheets Manual and the Micro 68 User's Manual. Edge connectors are provided for memory expansion up to 64K

This system is not available as a kit.

The price of the fully assembled system is \$430. A maximum of 768 words of RAM can be contained on the main circuit board and goes for \$5.50 per 128 words. When you are ready for a data terminal, the Motorola MIK-BUG TTY monitor can be purchased for \$28.50. You will also need the \$40 TTY/RS-232C adapter in that case. An optional 8K static memory board sells for \$270.

Descriptive literature is available from Electronic Product Associates, Inc., 1157 Vega Street, San Diego, CA 92110.

Microcomputer Associates **JOLT Microcomputer**



Circle 89 on reader service card

JOLT IS AN IMPRESSIVE MICROCOMPUTER designed for the serious application engineer and yet is a viable learning tool for the beginner. A fully equipped JOLT system can have as much as 32K of RAM and 128 bidirectional input/output lines. JOLT is a modular series of 4.25 \times 7 inch (108 \times 178 mm) PC boards that can be vertically stacked.

The minimum system configuration consists of a single \$159 CPU board. Microcomputer Associates has taken the MOS Technology NMOS MCS6502 µP and surrounded it with a powerful complement of 12 other IC's. The JOLT CPU comes equipped with an R-C timing network that runs the on-the-chip clock oscillator at 750 kHz. A crystal can be mounted on the board for applications that call for that kind of accuracy.

Power up the CPU with a 5-volt supply and hook it to a video or printing terminal, and you have a highly usable system. It is one of the most sensible approaches I have seen so far.

How can a single small uncrowded board do such a superb job? By a rational balance between hardware and firmware. The JOLT CPU takes advantage of the family of 6500 devices. The MCS6530 Interface/Memory chip contains many of the vital system components. Some of its input/output pins are dedicated to the terminal, high-speed tape reader and other system functions, but there are still ten left over for user control. The mask programmed DEMON monitor is located in 1024 words of memory on this same chip. DEMON is allocated the top 1K of the first 32K of memory from 7000 to 73FF. It decodes the serial input from the terminal and controls the entire system operation with a minimum of added switches. . . . no control panel is needed.

Sixty-four words of RAM used as in-(continued on page 66)

In Canada: Atlas Electronics, Toronto

terrupt vector locations are also on the 6530 chip. A programmed timer is the last major element which DEMON uses to time the terminal input pulses so it can automatically operate over a range of data transmission rates.

Then there is the PIA Peripheral Interface IC that adds 16 more input/output lines for a grand total of 26. Any of these can be configured as either inputs or outputs under the guidance of the program-

Four NMOS memory chips on the CPU board add 512 words of RAM which is on the whole available for user programs. A small part of this memory is used by DEMON. User RAM is assigned to the first 512 bytes of memory space from 0000

to 01FF. The rest of the IC's are terminal interfacing components and address decoding gates.

This effective hardware-firmware combination is supported by an apparent basic philosophy: Don't make a keyboard-display a standard CPU feature. Most serious users and even the beginner, once beyond the early phases of experimentation, will be using a data terminal. The terminal user is not saddled with the unnecessary expense of an unused feature. All bases will be covered since a keyboard-display board is under development for those who want to start out without a terminal.

The terminal interface has been designed to work with virtually any data terminal. Standard 20-mA teletype loops are handled by using an additional -10volt supply; TTL terminals such as TV typewriters run with the single 5-volt supply. The third option, the one I used, is the

EIA interface that requires two additional supplies-+12 and -10 volts. These supplies are low current and in some cases can be tapped off the terminal itself. The only other real requirement is a SPST RESET switch. An additional MMI (Non-Maskable Interrupt) switch and debouncing circuit is a helpful add-on.

I encountered one minor problem when connecting the JOLT to my fairly sophisticated TI ASR733 terminal. I hooked everything up according to directions but the printer would not receive anything. Frankly, I suspected the microcomputer since it was the item I was least familiar with at that point. As it turned out I was missing an interconnect wire! My terminal has a data-carrier detector lead that an external modem uses to disable the printer. When a modem is not used, this pin must be tied to the DSR (Data Set Ready) lead on the JOLT board. As soon as I made

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ELTONE 76 + GN 1375B = AM/SSB

A PERFECT MATCH FOR CB RADIOS

- . 100% solid state.
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UPDATED CRYSTAL CONTROLLED CB & COMMUNICATION ANALYZER MOD. GN-1375B with laboratory accuracy. DEALER NET \$595 includes rechargeable batteries and all accessories. Custom made for quality and dependability. 5 YEAR GUARANTEE on modules and crystals.

Applications: X-TAL CONTROLLED RF GEN.

- For fast, professional servicing and testing on all makes of CB transceivers and other communication products.
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- Alignment and calibration.
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 Functions as modulated low pwr. transmitter or frequency references for system checkout.

"TRANSTESTER"

- · Measurement of true RF pwr. output to 50 W.
- Measurement of modulation percentage.
 Measurement of SWR (fwd. & ref.)
- · Monitoring relative field strength
- 50 Ohms noninductive built in dummy load 50 W cont.

MOD. GN-1375B **DEALER NET \$595**

• RF generator has 23 X-tal controlled CB frequencies, as authorized by FCC • Each channel has individual crystal with tol. + 0.002% • 72 reserve channels from 3.5 MHz to 160 MHz or Civil Air Patrol (C.A.P.), Radio control channels A, B, C, D and E, Special business band channels 22A, 22B, 24, and 25 Optional. • 455kHz IF signal • 400 Hz audio signal • AC/battery operated for more flexibility • Two X-tal sockets are available for external X-tals • Calibrated RF output into 50 Ohms . Double RF shielding and aluminum cast RF attenuator . All Ohms • Double HF shielding and authinitiated in a circuitry are built in 5 epoxy glass P.C. modules shielded and sealed for dust and rain proof. • RF/AF Signal tracer with probe • Regulated power supply-charger with rechargeable Ni. Ca. batteries • BNC output connector for frequency counter for testing unknown X-tals and all RF frequency sources from GN-1375B • RF wattmeter 0-10 and 0-50 W • Dummy Load 50 Ohms/50W • SWR meter • RFS (relative field strength monitor) • % modulation.

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. Input for Ext. Mod. or two-tone generator Mod. Eltone 76.



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TABLE 1—DEMONSTRATION PROGRAM

7052 30 40 FF 01 FF T.H.

NAMECHECK7

- :180100A020A9338532205400A2008A4820E972A868AA989530CAC90A79
- :1801180DD0F08A49FF8531E631A00EA95C8532205400A431A930D80B01 :10013038E5318532205400208A72004C0001700493
- :1800304A0B250020204552454820454D414E2052554F592052455405E1 :1800484E4520455341454C50202020B13220C67288D0F86020554F08DC
- ;10006059204B4E414854200A0D200D0A11E11903D8 :0200F6000100F9
- .G PLEASE ENTER YOUR NAME HERE JACK SPRAT THANK YOU JACK SPRAT
- ♦ 013C 32 00 00 00 FF
- PLEASE ENTER YOUR NAME HERE ABCDEFGHIJKLMNOPQRSTUVWXYZ THANK YOU ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 013C 32 00 00 00 FF
- 0100 A0 20 A9 33 85 32 20 54 0108 00 A2 00 8A 48 20 E9 72
- 0110 A8 68 AA 98 95 30 CA C9 0118 OD DO FO 8A 49 FF 85 31
- 0120 E6 31 A0 OE A9 5C 85 32 0128 20 54 00 A4 31 A9 30 D8
- 0130 38 E5 31 85 32 20 54 00 0138 20 8A 72 00 4C 00 01 70 0030 41 1B 15 00 20 20 45 52
- 0038 45 48 20 45 4D 41 4E 20
- 0040 52 55 4F 59 20 52 45 54 0048 4E 45 20 45 53 41 45 4C
- 0050 50 20 20 20 B1 32 20 C6 0058 72 88 D0 F8 60 20 55 4F
- 0060 59 20 4B 4E 41 48 54 20 .M 0068 0A 0D 20 0D 0A 11 E1 19

BOOSTER AMPLIFIER

RESPONSE FLAT FROM 50-20000 HZ.

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PARTS, KNOBS, ENCLOSURE.

MAY BE CONNECTED TO THE OUTPUT OF ANY CAR STEREO OR

RADIO UNIT. WILL DELIVER A POWERFUL 60W (30W PER CHANNEL) OUTPUT AT LESS THAN 3% THD. FREQUENCY

EASY TO ASSEMBLE KIT, COMPLETE WITH ALL PARTS, ENCLOSURE.

WILL WORK WITH EITHER THE MODEL 6000 OR 3000 BOOSTER

AMPLIFIER. FEATURES FULL RANGE BASS, MID, TREBLE

CONTROLS, PUSHBUTTON CONTROL FOR TAPE HIS'S FILTER,

HEADPHONE JACK. CONNECTS BETWEEN CAR STEREO

OUTPUT AND EITHER OF THE TWO BOOSTER AMPLIFIERS.

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AMPLIFIERS. EASY TO ASSEMBLE KIT, COMPLETE WITH ALL

MODEL 6000

producing the first line of printout prefixed by the asterisk. DEMON measures the terminal transmission speed of the carriage return, sets some constants in memory, and echoes and transmits characters at the same rate. It adapts to speeds from 10 to 30 characters per second. The first four-digit number is the program counter 7052 which is the next ad-

dress following a BRK (break) instruction. In this case, the printout is caused by a BRK instruction in the monitor ROM at location 7051. The next number is the status condition that shows the settings of

MODEL 3000 BOOSTER AMPLIFIER



KIT \$36.50

this connection, it took right off and

Table 1 is an actual printout from my

terminal. I had previously written a simple

demonstration program called NAME-

CHECK. Seven versions later it was finally

debugged and running. About 120 words

of memory are used for program and vari-

able storage to perform an elementary

task, but one that uses some interesting

programming techniques. A program loop

reads sequential addresses in memory for

Tape, of course, is a tremendous con-

venience during the program development

stage since it eases the job of reentering

the program after power interruption or

memory wipeout due to faulty program

execution. My terminal has a dual tape

transport built-in. I was not using an audio

I turned on the power, pressed the RE-

SET button and hit the carriage return key

printout of text messages.

cassette option.

worked perfectly.

FULL 30W (15W PER CHANNEL)

* LESS THAN 3% THD.

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