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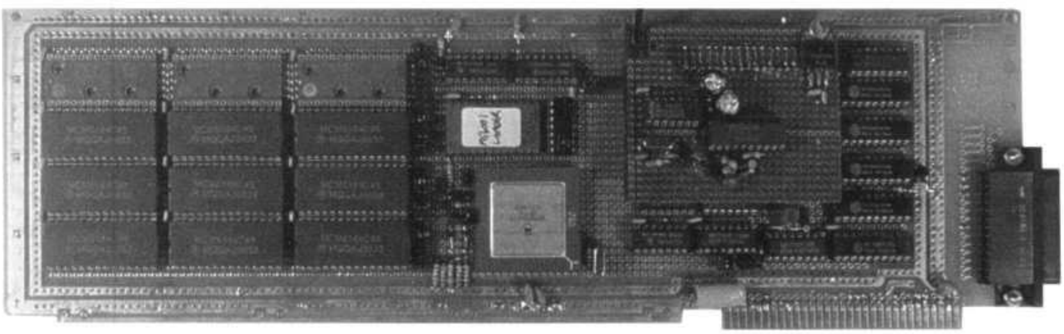
QEX 96

ARRL Experimenters' Exchange

FEBRUARY 1990



Rapid Prototyping Board for Digital Signal Processing

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American Radio Relay League
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Purposes of *QEX*:

1) provide a medium for the exchange of ideas and information between Amateur Radio experimenters
2) document advanced technical work in the Amateur Radio field
3) support efforts to advance the state of the Amateur Radio art.

All correspondence concerning *QEX* should be addressed to the American Radio Relay League, 225 Main Street, Newington, CT 06111 USA. Envelopes containing manuscripts and correspondence for publication in *QEX* should be marked: Editor, *QEX*.

Both theoretical and practical technical articles are welcomed. Manuscripts should be typed and double spaced. Please use the standard ARRL abbreviations found in recent editions of *The ARRL Handbook*. Photos should be glossy, black-and-white positive prints of good definition and contrast, and should be the same size or larger than the size that is to appear in *QEX*.

Empirically Speaking. . .

Phase 4: Let's Get Serious

After a few years of modest Phase 4 program development, and closer attention to the Microsats, we need to get pretty serious about the Phase 4 program. After all, geostationary satellite(s) would provide an important communications facility for the Amateur Radio world. There are a number of concerns in this process of seriously addressing a Phase 4 satellite capability. Among these concerns are subjects such as:

- Is the Amateur Radio community ready to support a Phase 4?
- Is this support just moral, or is the community ready to place real money and effort behind that support?
- Are the technical experts of the amateur community ready to place their expertise behind the Phase 4 effort in order to help create a master program plan? (This is a plan that defines the major program milestones, key events, performance dates, launch opportunities and funding. Such a plan will gate all other activities.)
- Once this master plan is defined, are these same experts ready for some very interesting but very earnest work toward building for the success of Phase 4?

While these questions are of the nature of looking at the forest, rather than just the trees, there are some immediate significant (not to be exclusive of other significant items) ancillary questions and decisions:

- Launch vehicle: Does an Atlas launch vehicle offer a viable opportunity? Are we relegated forever to getting launches on Arianespace vehicles, which are becoming increasingly commercial and expensive? Just where do we turn to lift 200 to 500 kg of spacecraft to synchronous orbit? What are the spacecraft design strategies to be used to get us onto a launch vehicle?
- We need to complete the definition of the spacecraft digital control signal and RF signal bus architecture, both inter- package and intra-package. The prior discussions on such matters have resulted in the conclusions that the principal inter-package bus should be a high-speed serial type, and suggestive even of fiber optic technology. Further, it has been suggested that the intra-package bus be of a parallel nature. The architecture of this bus structure calls for a common smart interface card mounted in each package to provide the interfaces.

Completion of this spacecraft bus architecture is needed prior to defining the plans for any further spacecraft construction/modeling activities. A breadboard of such bus hardware is needed for full demonstration and spacecraft suitability certification. The definition of a bus structure is needed before spacecraft electronic packaging concepts are frozen into hardware designs, as the bus structure governs that packaging engineering.

Once the above items reach a suitable degree of maturity, then we can wrap a meaningful program around the needed activities. We even have the basis for a spacecraft fabrication facility and support infrastructure. We have the basic management tools needed to make this machinery run pretty well, but before we can really turn that capability on hard, we need to answer the questions back up at the top. Do we have any volunteers?

These are really generic program plans and will need a lot more inputs and consideration by all participants. I welcome all such contributions, and especially the creation of the master plan.—*Dick Jansson, WD4FAB*

Radio Prototyping a DSP56001 IBM PC/CLONE System

By David W. Borden, K8MMO
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10808 Mantilla Court
Oakton, VA 22124

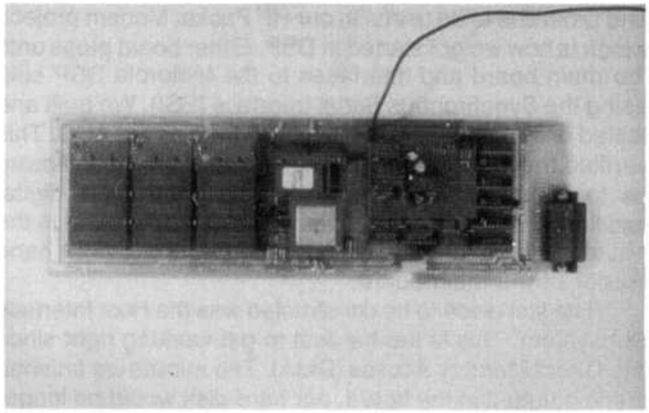
Another digital revolution, similar to the packet radio revolution of the early 1980s, is taking place in Amateur Radio. Digital signal processing (DSP) techniques are being used to do some of the traditional analog jobs amateurs require. Just as hardware large scale integrated (LSI) circuits provided the amateur with easy entry into packet radio technology (the Intel 8273 running on the Doug Lockhart Vancouver Board, for example), the Motorola DSP56001 very large scale integrated (VLSI) circuit provides the amateur with the needed technology to begin useful work with DSP. A major-name Amateur Radio manufacturer will soon announce a product using the DSP56001 which will make it the "chip of choice" for the first round of Amateur Radio DSP work. This article describes the experiences encountered in the building of a system to use this chip. Rapid prototype techniques were employed.

Members of the Amateur Radio Research and Development Corporation (AMRAD) have been rapid prototyping an IBM® PC/Clone board using the DSP56001 for about nine months. In building this prototype board, we approached the project with the idea of building a digital signal processing system, breaking down the job into subsystems. This approach lends itself well to rapid prototyping, that is, getting a working system to function quickly, one small piece at a time.

The subsystem approach is similar to building software by stepwise refinement. A small piece of the finished project is constructed, one that will stand alone and function. Then another small piece is constructed and attached to the first, testing both. Then a third piece is added, continuing in this fashion until the project is complete.

The DSP IBM PC/Clone prototype board that was constructed was designed by Terry Fox, WB4JFI, using the AutoCAD® program on the PC to produce the schematics. The schematics were distributed to the members participating in the project. The first board to be completed was constructed by John Teller, N4NUN, in the K8MMO basement laboratory. Using the subsystem approach, the board was made to work quickly, after the initial wiring was complete. Terry Fox constructed the second board, and Maitland Bottoms is building the third.

The DSP prototype board lent itself to the subsystem approach very well. First, we constructed the DSP Chip Subsystem. This consists of a crystal oscillator, an RS-232 to TTL converter circuit, a reset circuit, a PROM loader to boot from and the DSP chip itself. Wiring in the power and grounds to this piece allowed rapid testing of the subsystem. Motorola provided PROM loader software on their bulletin board. We burned the loader into an old 2716 (remember them?) and connected it to the DSP chip. We



wrote a small software program called LOWHELLO to test the subsystem and reset the board in DSP56001 Mode 1. This mode copies the PROM software addressed at C000 (hex representation) into DSP chip memory at 0000. The last thing Mode 1 reset does is to jump to the beginning of the program. The program expects to load software on the DSP chip asynchronous serial port. We connected the IBM PC/Clone asynchronous serial port to the DSP card with a 25-wire jumper cable and uploaded the LOWHELLO program to the chip using a terminal emulator/uploader program "TERM" written by John Teller. We were rewarded with "Hello World" appearing on our IBM PC/Clone. This proved that the DSP Chip Subsystem was working correctly. The DSP Chip Subsystem can be viewed in the center of the photograph of the board. The large square chip is the Motorola DSP56001.

Next to be constructed and tested is the Memory Subsystem. This is very difficult wiring. John took the longest time of all to wire this subsystem. When it was complete, we wrote a small program called HIHELLO, which runs in the Memory Subsystem, instead of in the DSP chip memory. We are now working on a more complete memory test which is a piece of a DSPDIAG program, which looks at the whole board, figures out what is there, and tests what it finds. When HIHELLO was uploaded after reset, it produced "Hello World" on the IBM PC/Clone, proving the new Memory Subsystem was at least functional. Once the Memory Subsystem was functional, we uploaded DSPBUG, a debugger provided by Motorola, which allows much greater testing of the hardware and user applications software written for the board using the Motorola Assembler and Linker. The Memory Subsystem can be viewed on the left side of the photograph of the board. One more row of memory can be plugged in when our finances allow, or old memory chips from our TAPR TNC 2 packet radio board can be plugged in.

After the Memory Subsystem, we constructed the Analog Subsystem, because we were anxious to do some DSP (no patience here). This is a plug-in board because we have two Analog Subsystems to evaluate. The first uses just the Motorola DSP56ADC16 16-Bit Sigma-Delta Analog-to-Digital Converter. This is a 16-bit A/D, running at a 100-kHz sample rate. It has 96-dB dynamic range, costs $70 and promises to be a real winner in our signal analysis work. The second board contains the Texas Instrument (TI) Analog Interface Chip, the 32041. This chip contains a 14-bit A/D converter, a 14-bit D/A converter, an antialiasing filter for input and a low-pass filter for output. It only costs $45 and promises to be useful in our HF Packet Modem project, which is how we got started in DSP. Either board plugs onto the main board and interfaces to the Motorola DSP chip using the Synchronous Serial Interface (SSI). We built and tested one of the boards using a program called ADC. This verified that the SSI was functioning correctly and allowed us to make our first signal analysis program, a digital oscilloscope. The Analog Subsystem can be viewed in the photograph as the plug on board in the upper right hand corner of the main board.

The last piece to be constructed was the Host Interface Subsystem. This is the hardest to get working right since it is Direct Memory Access (DMA). The minute we finished it and plugged in the board, our hard disk would no longer boot. The hard disk is DMA also. Removing the DMA part of the subsystem allowed us to test it using a small program called HOSTEST. This proved we could communicate with the DSP chip using the PC Bus interface, vice the asynchronous interface we had been using. After studying the behavior of this program, Terry and John were able to figure out what needed changing for hard disk and DSP to coexist, both doing DMA. The host interface can be viewed at the right side of the photograph of the prototype board.

The correct functioning of this board has proved the correctness of the subsystem approach and provided us a testbed to continue DSP work. We are hard at work coding our HF Packet Radio Modem and should begin testing it soon, using the same stepwise refinement approach we have used with success in the past. This approach can be summarized as:

1. Build small pieces (of hardware or software)
2. Make each small piece work separately
3. Connect the pieces together, testing the whole each time a new piece is added
4. Test the whole thing and have a party
5. Start working on serious modem software

All software mentioned is available on the AMRAD Bulletin Board, 703-734-1387 in the DSP area. It may be downloaded using any of the more popular protocols, such as XMODEM. In the future, a package of information will be available for any experimenters that wish to duplicate the DSP system. When the major manufacturer releases their DSP box, small modifications may be made to this system to allow greater compatibility. Any new software developed in the future will be made available on the AMRAD Bulletin Board. Currently under development is an FFT program to do signal analysis and an HF modem program. Many HF modem programs shall follow until we can hold a comparative test over a reasonable HF path. This should help decide which HF modem approach is better suited for Amateur Radio packet use.

The AMRAD Newsletter publishes DSP articles in each issue. You may obtain information about AMRAD by writing PO Drawer 6148, McLean, VA 22106-6148, USA.

Bits

Application Notes

HP Application Note 150-1 highlighting spectrum analyzer basics, and amplitude and frequency modulation can be ordered free of charge from Hewlett-Packard. Call 800-752-0900 and request literature part number 5954-9130.

Circuit Prototyping System for Toshiba Lap-tops

Adtron Corporation has announced the availability of its new circuit prototyping system for Toshiba lap-top computers. The LPS-T System and associated applications guide let users prototype and perform limited manufacturing, thus taking a breadboard design confidently to a printed circuit board.

The LPS-T is available from Adtron Corporation for $125. For further information, contact them at 745 North Gilbert Rd, Suite 124 MS 361, Gilbert, AZ 85234, tel 602-940-0060.

Hand-Held Multimeters

Hewlett-Packard announces the HP E2373A. With basic dc accuracy of 0.7 percent, it offers every basic function required in a hand-held multimeter.

In addition to the features of the HP E2372A, the HP E2377A and E2378A have a built-in temperature function, basic dc accuracy of 0.3 percent and data hold.

Prices start at: HP E2372A, $99; HP E2377A, $169, and; HP E2378A, $189. To order, or for more information call Hewlett-Packard at 800-538-8787. Or write Hewlett-Packard, Inquiries, 19310 Pruneridge Avenue, Cupertino, CA 95014.

Quad Power Driver

Teledyne Semiconductor introduces the TSC4469, an improved version of the standard CMOS Quad Power Driver. TSC4469 offers more output power, increased voltage capability and adds Teledyne Semiconductor proprietary Tough CMOS™construction.

Tough CMOS is built on an epitaxial layer to protect against output latch-up and also features input latch-up protection.

TSC4469s are available from stock, and are packaged in 14-pin plastic and ceramic DIPS as well as 20-pin LCCs. Pricing from $2.74 for 1,000 pieces. For more information, contact Teledyne Semiconductor at 800-888-9966.

An AMTOR Mailbox Standard

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Introduction

The packet mailbox network is now very well established, with the forwarding protocols working well. The centralized development of packet TNCs and mailbox software has resulted in one single protocol being universally adopted with others following the lead. Although AMTOR mailboxes have been around for ten years, the development of mailbox software has not been centralized, and different protocols have emerged. Up to now, this has just created a headache for the operators as they call into the different systems. With the increasing interest in using AMTOR for message forwarding between packet networks on HF, the technical problem of devising a common protocol emerges, as does the political problem of getting everyone to agree to it! In this article I will discuss some of the fundamental features which such a protocol must have, with particular reference to the "slightly error-prone" nature of AMTOR. By expressing these features in their simplest forms and choosing easily implemented algorithms to achieve these features, I hope to encourage others to adopt the system I propose, which should then enable AMTOR mailboxes to forward messages between them, and also perhaps remove some of the headaches for AMTOR mailbox users.

The Garble Problem

In packet systems, the possibility of an error occurring in the link is sufficiently low as to be neglected. A simple COMMAND/RESPONSE protocol is sufficient, both for use by human users and by other mailboxes. A time-out is probably all that is required to deal with any unpredictable events.

In AMTOR, although we can be quite happy that text messages sent for human consumption will be sufficiently error-free at the far end, we must have an error-free system of getting the various routing commands and acknowledgements through with a much higher accuracy or risk losing or misrouting whole messages. Any error-correction scheme used should be easy to implement. The system I will now describe meets all these requirements while still allowing individual programmers to "personalize" their mailboxes and build additional features onto the basic structure.

First Principles (1): the "command-repeat" rule

Consider the problem of one mailbox sending commands to another. In the packet environment, one station, the commanding station (referred to as C in the remainder of this article) sends a command to the responding station (R). The response can be either the desired response, or a predefined error message. C always knows what action to take, and will never need to repeat the command. In the AMTOR environment, several more possibilities exist. If C receives the "desired response," then all is well. However, the command from C to R may be garbled in transmission, and R may respond with an error message of one sort or another. This error message itself may be garbled in transmission back to C. In general, R will not be able to distinguish between a garbled command and one that is "illegal" in some way, so even the error message, if received correctly at C, cannot be relied upon. Regardless of whether C received an error message or garble, the best strategy is to repeat the command again. If this results in R getting two consecutive good commands, then we have to find some other way to make sure that does not cause problems. If the command was indeed illegal at R, an endless loop will result. To prevent this, C should count the retries, and abandon the command after a suitable number, perhaps storing the error message for human consumption at a later date. It is important to realize that this retry-counting system is the only sure way to detect an illegal command in a link between two dumb mailboxes where both directions are error-prone. Also worth noting is the fact that, from the point of view of the protocol exchange, the error-message itself plays no part in the process. This means that the error-message can be chosen purely to make the system friendly.

First Principles (2): the "read-back" rule

In the above paragraph, the term "desired response" was not defined. C must have some rule to decide if the response it got was what it wanted. If the command sent was a single command word, like LOGIN or BYE, then a simple response like OK would suffice. However, a command like LIST or DIR would have to have some other system. Following our assumption that plain text sent by AMTOR is sufficiently error-free for human use, we could perhaps just prefix the requested plain text with a key word such as OK. On the other hand, if the command had an associated parameter word, like READ (filename), or NAME PETER, then since there is the possibility that the parameter might be transformed from one legal one into another (and not generate an error message), then we must have some way to detect this. Repeating it back is the simplest way. Indeed, reading back the command word would suffice instead of the OK in the case of the single command word described above. If the read-back command (with any parameters) didn't match the transmitted command, C can ignore the whole response and repeat the command. In the case of a garbled parameter, such as a garbled filename in a READ command, the wrong file would be returned, and ignored.

First Principles (3): the "double command"

The commands described so far have a property in common; if they are repeated in succession, the action taken is the same. For example, if R received NAME PETER twice as C: and R:. The lower case text is included just to make the system friendly.

C: GB7PLX DE GB7XXX +?
R: GB7XXX DE GB7PLX mailbox. cmd +?
C: SP VK2SG AT VK2AGE +?
R: SP XK2SG AT VK2AGE ok. enter "text" + ur msg +?
C: SP VK2SG AT VK2AGE +? (C repeats due to read back error)
R: SP VK2SG AT VK2AGE ok. enter "text" + ur msg +?
C: TEXT hello sid... +?
R: TEXT rcvd ok. cmd? +?

There is no need for a BYE command as C can just kill the link. Note that the word AT replaces @, (FROM replaces <, BID replaced $). This is already established practice in AMTOR mailboxes which can forward into packet networks.

I hope I have shown, in devising a mailbox system to work in the AMTOR environment, that a truly error-free protocol can be achieved by the system I have described. Adoption of this simple scheme by all AMTOR mailbox program writers could then enable AMTOR mailboxes worldwide to be formed into a complete network. The proposed GB7PLX AMTOR HF Mailbox will be using this protocol as soon as there are compatible mailboxes to work with. It should then be an easy matter to route messages transparently through both packet and AMTOR systems. I acknowledge help and inspiration in formulating this protocol from a number of AMTOR mailbox operators and programmers, notably WA5SMM, WA8DRZ, and SM6GXQ.

The GB7PLX AMTOR GATEWAY MAILBOX

On May 11, 1989, GB7PLX was licensed and became operational as an AMTOR mailbox and gateway to the UK packet network. It was the culmination of a great deal of experimental work, discussion, and negotiation! This article describes the set-up at GB7PLX, how it works, and how it can be used by both packet and AMTOR operators.

The equipment at GB7PLX, which is operated by the author from his home station, consists of an HF transceiver (Kenwood TS-930S) and associated antennas (covering 3.5, 7, 10, 14, 21 and 28 MHz) connected to an AMTOR terminal (ICS Electronics AMT-2), and from there to a computer (home-brew). The computer can also control the radio to select any of 16 channels on any of the HF bands and switch the antennas. Also connected to the computer is a packet TNC, to which is connected a 2-m transceiver and antenna. In standby condition, the HF radio is scanning all bands with the AMT-2 set to detect the GPLX selcal code, and the TNC is open for packet connects, with the radio on the local mailbox net.

If a call is detected on HF, the AMT-2 responds, the scan stops, and the calling station can then, after identifying itself, enter messages into the mailbox for collection by another station, or for forwarding onwards either on AMTOR or packet. The calling station can also extract messages for himself, or read various other files, in a way which will be familiar to most packet operators. The calling station could be another AMTOR mailbox. Periodically, the mailbox may break off from scanning and call one of several other AMTOR mailboxes worldwide, on the appropriate channel, and forward any outstanding messages.

On the packet side, the mailbox may receive connects from one of the local UK packet mailboxes (but not from individual packet stations) with messages for forwarding to international destinations. The GB7PLX mailbox may periodically connect to one of the local packet mailboxes and pass messages to them for forwarding around the UK.

Let's suppose that you are an AMTOR operator wishing to use the mailbox. How do you go about it? First, decide on the best band and listen on one or more of the channels which appear in Appendix 1. Remember that you will probably need to offset your radio dial one way or the other by an amount which will depend on the configuration of your radio and AMTOR terminal. Check that the channel is not in use. Remember that the GB7PLX mailbox (or any other for that matter) has no priority over any other activity on any channel. So, if all the channels are occupied, you will have to wait patiently! Having chosen the channel, start an ARQ call to GPLX. If GB7PLX is not busy, and there is a path, then the scanner will find you within 10 seconds. Therefore, there is little point in calling for much longer than this. Best to make frequent short calls rather than sitting on the channel. When the link is established, type:

"GB7PLX DE (your call sign) +?"

The mailbox will reply with:

"(your call sign) DE GB7PLX MAILBOX"

If it comes back with QRZ or a garbled version of your call sign, then you start again. After the response, the mailbox will then tell you if there is any traffic for you, and you can then enter one of several commands, the first of which is HELP, which tell you about all the others. The most used commands are: QTC, which reads out any messages for you in the same way as the RN command familiar to packet mailboxes users, and the SP command, which is used in a way similar to that of packet mailboxes, except that since AMTOR cannot transmit the "@" symbol used in the packet version of the SP command, the word "AT" is used instead.

The method by which the mailbox routes messages to their correct destinations may need some explanation as it uses the new "hierarchical addressing" format, which is fairly new to the packet world. In this format, the "address," namely that part of the SP command line after the "AT," may consist of several parts or "tokens" separated by dots. The first of these will normally be the destination mailbox call sign, and the second and subsequent tokens will be the names of regions, countries, continents, and so on, to help with the routing. In any mailbox, a list of known mailbox call signs, region names, country names, and continent names, is kept, together with the best routing for each one. When a message is received, the mailbox looks to see if it recognizes the first token in its list. If so, it passes the message along the corresponding route. If it doesn't recognize the first token, then it looks at the second, and so on. In this way a mailbox can route messages to destinations in other regions, countries (or networks), without having to know routes for each destination individually. In the GB7PLX mailbox, the address list currently contains (a) a selection of worldwide AMTOR mailboxes, (b) three-letter country codes representing those countries to which it is possible to forward messages for the national packet net-in a row, of which the second is spurious because C got a garbled response to the first, no error results, just PETER overwriting itself in some internal store. However, there is another class of commands which would cause problems if we used the protocol as defined so far. These are commands associated with the flow of messages. If, for example, we had a simple command "PRINT (text message)," then spurious repeats would cause multiple copies of the message to be printed. A similar problem in the other direction, that is to say, with messages being "pulled out" of R by C, results in messages being lost. We can, however, solve this problem without having to throw away our ideas so far by introducing the concept of a double-command. If, in the above example, we replaced PRINT with a sequence of two commands, the first of which having the meaning "turn the printer on," and the second of which meaning "if the printer is on, then print the following text, then turn the printer off," we can see that spurious repeats of command one will not cause any problem, just turning on a printer that is already on, and spurious repeats of command two will not cause trouble either. To get this PRINT operation done, C simply carries out the first command, repeating it as required until the correct response is received, then the second in the same way. We can implement the well known SP command by devising one command called SP, having the meaning "open a message file ready for writing," and another command called TEXT, meaning "if a file is open, write the following text to it, then close the file." In a similar way, a pair of commands can be constructed for messages flowing in the other direction. For this double-command process to be completely error-free, the second command in a double must always follow immediately after the first, so C should always send them as a pair in sequence.

The mailbox standard stated

We can summarize the ideas so far by writing out formally the command procedures. First for the responding station:

1. Receive a command.
2. If the command (and parameters) is valid, go to 5.
3. Send any error message you like.
4. Go to 1.
5. Send back the command word (and parameters) and the required response.
6. Go to 1.

Provided each command is constructed so that, if repeated, it doesn't do any more than one command by itself, and message-flow commands are constructed as double commands, then this is all that is required for a mailbox-to-mailbox system free of errors, except for the odd error in text, which we can accept.

The procedure to be followed by the commanding mailbox is as follows:

1. Set retry counter to zero.
2. Send command (and parameters).
3. Receive the response.
4. If the received command (and parameters) is the same as that transmitted, go to 8.
5. Increment retry counter.
6. If retry counter is less than the limit, then go to 2.
7. "Bad command" exit point (with error message).
8. Process the response.
9. "Good command" exit point.

The commanding station constructs double commands by simply chaining together the two half-commands, skipping the second if the first one fails. At the responding station, the two half-commands are just implemented separately, with no other procedure required to account of their use in combination, except perhaps to trap the unlikely possibility that the two halves of the double command may appear out of sequence.

Tying up loose ends

One of the things we haven't covered is how to signal the end of a command or response. In packet mailboxes, responses are usually terminated by >, commands by a RETURN, and text is terminated by control-Z or /EX. Because of the possibility of commands like SP being repeated by C when R is expecting TEXT, we must, in the AMTOR system, terminate both types of commands (TEXT is a command) in the same way. We need to protect against a garbled terminator. We can use the normal AMTOR +? for this purpose admirably. The response to a +? is the link changing direction. If the link stays idle after sending +? rather than changing over, then +? (or rather "figs" +?), is repeated. The worst that can then happen is a bit of garble (usually a spurious ZB!) on the end of a text. The +? should, of course, be stripped off after reception.

There are two commands which need special treatment. One is the very first command in a link. In packet, the basic transmission system provides the identity of the calling station to the called station, but in AMTOR the called station only knows that he has been called. The first command, therefore, should send this information. Following traditional custom and practice, I propose that the calling station should, on his first transmission, enter the call sign of the station he is calling, followed by his own call sign, with an optional DE between them. For example, "GB7PLX DE G9ZZZ +?." Thus, "GB7PLX" is the command word and "G9ZZZ" is the parameter. The response to this command, naturally, should be "G9ZZZ DE GB7PLX," with perhaps some extra text. The calling station need only check that his own call sign has come back correctly. This command might need to be repeated due to garbles, or simply to meet license regulations. An automated calling station should, if this command exceeds the retry count, kill the link, since it must have linked with the wrong station!

To deal with the other "special" command, it should be remembered that so far, we have talked about one station sending commands and the other responding to them. If it is thought necessary to reverse this state of affairs, so that commands can be sent in the other direction, then an new command, perhaps called OVER, will be needed. This is equivalent to the command F>, used between forwarding packet mailboxes. The response to an OVER command is simply the first valid command in the reverse direction. Incidentally, although it wasn't mentioned before, if we want to think about implementing the OVER command, it is necessary to define that the command terminator and response terminator are the same, to cater to the possibility of repeats during the OVER process. This means using +? as the terminator both ways.

To round off this article, here is an example of a typical exchange between two AMTOR mailboxes using this proposed protocol. Commands and responses are identified work. The list is quite small at the moment, but will grow rapidly as more AMTOR mailboxes become operational. See Appendix 2.

Here are some examples of SP commands which are possible at the moment:

SP G9ZZZ +?	This is simply a message for G9ZZZ to collect next time he calls into GB7PLX.
SP HB9XX AT HB9AK	This is a message to be forwarded to the HB9AK AMTOR mailbox for HB9AK.
SP WØRLI AT WØRLI.USA	This one will get forwarded to USA on AMTOR, then via packet to the WØRLI mailbox.

In order to guarantee that the message can never go astray, even if there is an odd garbled character in the command line, a technique slightly different to that used to enter SP commands to packet mailboxes has been devised for use at GB7PLX. First enter the SP command line, ending with the usual +?. If the command has been received correctly and can be forwarded, the mailbox will read it back. If it was garbled, either in transmission or read-back, then just enter it again. If the read-back is good, then enter the command word TEXT, followed by a short title line, followed by the message itself, ending with +?. The mailbox will respond with TEXT STORED OK. If the mailbox got your TEXT transmission garbled and responded with an error message or you receive the response garbled so that you are not sure if the mailbox got it, then you can again repeat the TEXT transmission. If the mailbox did, in fact, get it the first time, it will respond TEXT IGNORED. Either way, if you receive a response starting with TEXT, you can be sure it was received okay.

This procedure has been carefully devised to be completely foolproof and, like the call sign exchange in the sign-on procedure, can be very easily implemented automatically, for example, in another AMTOR mailbox forwarding messages. The only difference in a forwarded SP message from another mailbox, is the addition, after the "AT (address)" information, of "FROM (originator)," being equivalent to the "<" field in forwarded packet messages. To sign off, just close down the ARQ link in the usual way.

From the point of view of the packet user, he does not need to know any of the above procedures. He will just enter messages in the normal way to his home mailbox, but a wider choice of destinations will be made available to him by the packet network. In the UK, the packet network recognizes the address "AMTOR" as meaning "the nearest AMTOR gateway," which, for the moment, means "GB7PLX," but could, if other gateways become operational, be interpreted differently in different parts of the country. Thus, for example, a packet operator in the UK can enter into his home mailbox:

SP VK4AHD @ VK4BBS.AUS.AMTOR

This will be routed to the nearest AMTOR gateway, from there to Australia on AMTOR, and from there to VK4BBS by whatever medium is appropriate.

It is worth mentioning that, unlike packet which can transmit the full ASCII character set, AMTOR is restricted to upper-case letters, figures 0-9, and a relatively small set of punctuation marks. At GB7PLX, incoming packet messages are converted from lower case to upper case, and any punctuation marks which cannot be transmitted, are simply ignored. Incoming AMTOR messages are passed to packet as received, that is, in upper case only. Also, since AMTOR is slower than packet, messages should be kept short. GB7PLX will not handle bulletins.

This is a brief description of the GB7PLX mailbox. It is hoped that this will be the start of the development of worldwide network of AMTOR mailboxes, each with gateways into national packet networks. Much work needs to be done to optimize and standardize the procedures in use, and we need many more compatible AMTOR gateways worldwide.

Appendix 1

GB7PLX Frequencies

3.5 MHz:	3587.5	3588.5	3589
7 MHz:	7025	7036	
10 MHz:	10140	10146	
14 MHz:	14076	14077	14078
21 MHz:	21080	21081	
28 MHz:	28075		

Appendix 2

Forwarding List

(a) AMTOR mailboxes
- GB7PLX
- SM6GXQ
- SK7CS
- KS5V, Texas
- WA8DRZ, California
- KB1PJ, Ohio
- VK2AGE, Sydney
- HB9AK
- PAØRYS
- LA9OK

(b) Country codes
- AUS Australia
- GBR United Kingdom
- IRL Republic of Ireland
- SWE Sweden
- NOR Norway
- USA United States

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Feedback on Previous Articles

Bits

Low Cost, Wide Band GaAs MMIC Amp

California Eastern Laboratories has announced the availability of the new UPG110B/P GaAs MMIC 2-8 GHz amplifier from NEC. Designed for systems where wide-band operation and high gain characteristics are required, the UPG110B/P MMICs are ideal for microwave communications and test equipment. They're also available in MIL Screened versions for EW, radar and other military applications.

Available in hermetically sealed ceramic package (UPF110B) and chip (UPG110P). Prices start at $42 for chips and $70 for packages in quantities of 100. For data sheet and further information, contact Don Apte, Product Marketing Manager, at 408-988-5183.

VHF+ Technology

By Geoff Krauss, WA2GFP
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VHF/UHF Contest Operating

A number of my readers have asked me, having now gone over the state-of-the-art up through our 2300-MHz band, to discuss my views on the relationship between technology and VHF/UHF contests, especially in view of certain rule change proposals made in the "VHF-UHF Contesting" column in a recent issue of *NCJ*, the League's companion *National Contest Journal* publication. I believe that a very high percentage of VHF + ers participate in these contests, as there is no better time to find someone on and to work a new band, station, grid-square, etc, at whatever level of intensity you yourself select. I urge each of you to read the *NCJ* column and, as requested, respond. This is especially important to VHF + ers as we do not have a standing VHF/UHF Contest Advisory Committee (we *do* have a V/UAC—general Advisory Committee—but they must work on *all* aspects of the bands above 50 MHz). Personally, I believe that the highest possible intensity level of contest activity is necessary to increase the availability of gear for, and use of, our SHF + bands, and that the suggested changes are counterproductive for contests held in the warm-weather months. The seven proposals in question can be divided into only two categories: (a) limiting the number of bands a winning multioperator station can use in one or more of the January, June or September ARRL contests; and (b) suppressing the point advantage gained by using higher frequency bands. The *NCJ* column does provide some historical prospective, especially concerning the switch of scoring multipliers from ARRL Sections to grid squares. This one change did a lot to even out the scoring potential for stations all over the continent (compare Section spacing in the northeast US and in the southwest US, for example).

Okay, so you want to have some fun and go VHF/UHF contesting. There are three factors which are involved for *any* contest operation: location, operator(s) and equipment. Availability of equipment will be a gating factor (you can't do anything without it), but since it is the major factor, let's leave it for last. If you have some equipment capable of any level of communication, you can probably find a location from which you can operate and contact at least one other station, *provided* that there is another station out there to contact (and that's also a matter of equipment and someone to operate it). If you are going out to *win*, and that's the premise behind the *NCJ* proposals in question, you need a super location (whether your effort is to be one or multioperator). This involves a compromise. If you stay close to either coast, where most of the high-population densities are to be found, you can expect lots of QSOs on most of the 50-1296 MHz bands, *but* a considerable percentage of potential grid-square multipliers will never be contacted—they're out in the open ocean and not very highly occupied by stations. The best compromise is a location in a middle-population density part of North America, several hundred miles inland from any ocean. If I were to choose a QTH, it would be in, or near to, the W8 or W9 call area. In fact, review of contest records will show that many clubs/groups, such as W3CCX, W9IP, W1XX, etc, have expeditioned to exactly that part of the continent for contesting. Of course, not everyone wants to go "out on the road" for a full contest, so some operate (alone, or with a friend or two) at their own station, or a borrowed station (ala guest operating at K2CBA or WA2FGK), or out in the wild in some capacity as a rover (such as the multiband efforts of KF6NY in California or the KØTLM bunch in Missouri in the September '89 'test). Having been involved in setting up/taking down a multiband station for a weekend contest, I look with envy on anyone who has the tenacity to do it not once, but several times, each at a different location and in a short amount of time. Since it is easier to set up a simple UHF or SHF station, with its smaller antennas, we find many part-time rovers operating those bands in somewhat rare squares—I'm not in favor of penalizing them, even if they cannot QSO any one particular contest station. Sometimes, the factors are such that someone cannot talk to all others; that should not prevent those who can from working a "rare" location (otherwise, we could throw out the whole basis of all ham contesting, DXCC awards, etc).

Once you have set up at a chosen location, your contest effort needs at least one operator. With commercial equipment available for the 50- to 3456-MHz and 10/24-GHz bands, you do not need any special engineering talent to operate and have some fun. Of course, if you try to *win* using only a few high-activity bands, you may be forced to allow only a few highly skilled operators to participate. One interesting facet of VHF/UHF contesting is that the skills that make a fantastic 6- or 2-meter SSB/CW contest operator, are not necessarily the same skills needed to make a good 220-FM op, and are probably of little use in eking out a weak contact on any of the SHF bands! If you use many bands, you can let relatively unskilled/new ops work some low-contact-total band, have fun, gain experience/enthusiasm, etc. To do multioperator contesting, you need a group of people who are good, both on their own and also with each other. It is true that perhaps the most formidable VHF contest group ever assembled fell apart some years ago because they would, or could, not equitably share operating time, set-up tasks and glory. If you would win, heed the rule that "The larger the group, the more difficult the interpersonal dynamics."

Contest equipment is the area I am most concerned with. Some additional history may be helpful to my readers. In the early days, *all* VHF-contest equipment was home brew; commercial 6/2-meter rigs were not available/affordable to most hams until the mid '50s (possibly because the new Technician class then raised demand to a proper level). Thirty years ago, the big single-op and multi-op stations may have done three, or at most four, bands (6, 2, 220 and 432 or 6, 2, 432 and 1296); home-brew rigs were almost always used on the bands above 148 MHz. By 1970, store-bought rigs were available on 220 and 432, and many better contest stations had 1296, but very few had anything above 1300 MHz. Parts either did not exist, or were too expensive for most of us; equipment was hard to build and harder to test. Nevertheless, there was (is) always something new being tried in each contest; it may not have been the same station or operator in each contest, but there was some effort going on in each contest to push the state-of-the-art out just a little further. I could tell many personal stories (six years of different diode multipliers to get a real 2304 signal along a two-way path, or the year we tried surplus 3400-MHz equipment and could hear the shouting of the operator on the other end better than the microwave signal), but the bottom line is that people kept trying.

In the late '70s, the W1FC group appeared and swept each VHF contest they entered because they somehow were able to make contest QSOs on additional bands (2304, 3456 and 5760 MHz) that were not then available to other contest stations. Having just gotten involved with the MGEF group (W2SZ/1), I began to work, along with several other group members, on equipment to neutralize the W1FC advantage. Even after we found out how the other group was doing its "magic," it took out group several years to design, build, test and deploy our SHF equipment. Be we did it—maybe even better than the first group. And we published our results so that others could build the same, or similar, gear. True, MGEF started its SHF work with rover stations staffed by its own group members, but each and every group I have ever discussed this with has done the same; you need operators who are intimately familiar with the equipment the first few times after the rigs were made to work and bugs ironed out. SZ rover stations are now used by local hams who want to do something a little exotic, one weekend day in June (or August or September); some enjoy the experience sufficiently to do it over again. Having shown that SHF stations can work each other, others started building equipment to contact us and each other. It was not easy, as you could not, until recently, go into a store and buy a 13- or 9-cm rig. Even with a rig and an antenna, you would not be assured of making a contest QSO each time. But,. . . more people learned how, over the years, and there are now many times more UHF and SHF equipment and activity than ever before. If you look at contest results, you will note that there is still much to be done in broadening use of the 2304- and 3456-MHz and 10- or 24-GHz bands, and that few stations, of any type, do work at 5760 MHz.

For these reasons, I am totally against any proposal that would give the same point value for a VHF (say, 50 MHz) QSO and a UHF/SHF QSO. If anything, I think it is time to differentiate scoring even further (say, 1 point for 6/2 meters, 1.5 points for 432, 2 points on 220, 3 points on 902/1296/lasers, 4 points on 2304/3456/10 GHz, 5 points for 5760 or 24 GHz and 10 points for 47+ GHz!) to take all factors into consideration. Since many harder-to-make UHF/SHF QSOs to new grid squares still require rovers, we need to keep up high interest in having them go out. A proposed Rover class (presumably 2 classes, one for single-op rovers and the other for multi-op rovers) is a good idea, but will require continuation of the present rule allowing new QSO credit for each new contact from a new grid square.

I have to agree with the so-called Limited Band Contest since I myself made a proposal, several years ago, to limit activity to 4-6 bands (50-432 or 50-1296) for *all* stations in one yearly contest; but I feel we already have this as a *de facto* standard in the January VHF Sweepstakes. Winter conditions prevent most roving, and even the biggest multi-ops use only 50-1296. In fact, the August UHF Contest also falls into this category, as most stations use 3-5 bands. Unfortunately, most of the well-known multi-ops do not go out for this contest (maybe because 6 and 2 meters are not used?). In any event, it seems counter-productive to seriously consider removal of our above 500-MHz bands from use by any class of participant in any ARRL-sponsored contest, as more gear production and activity is still needed, and would be needed for years to come. Certainly, the June and September contests are so nicely placed in warm weather that any new uses of roving, or other techniques, and new bands are most likely to succeed at that time of year. Similarly, a separate category encouraging use of only a few high-activity bands will discourage more activity on the UHF+ bands that we should be using to ever-greater extent. In my opinion, VHF+ers should oppose any attempt to rule out such activity, for whatever lesser reasons.

Bits

HP Solid-State Relays

Hewlett-Packard Company has introduced the HSSR-8200, the first in a series of small signal-switching, solid-state relays.

The HSSR-8200 relay consists of a high-voltage IC that is optically coupled with an LED controlling the ON/OFF function. The detector contains high-voltage MOS transistors and a high-speed, photosensitive drive circuit. The result is a normally off, single-pole relay.

For further information on the HSSR-8200, contact Hewlett-Packard Company, Inquiries, 19310 Pruneridge Avenue, Cupertino, CA 95014.

New Silicone Gels

GE Silicones has introduced a new line of low-viscosity silicon dielectric gels, designed to preserve dielectric integrity and provide protection to delicate electronic circuit assemblies operating in harsh environments.

The new line of GE materials includes four new grades: RTV6156 high-performance silicone gel; RTV6166 general-purpose silicon gel; RTV6186 high-tear-strength silicone gel; and RTV6196 fast-sure silicon gel.

For more information on RTV silicone gels, contact GE Silicones, Inquiry Handling Service—PR#EE-01-89, 260 Hudson River Road, Waterford, NY 12188, 800-255-8886.