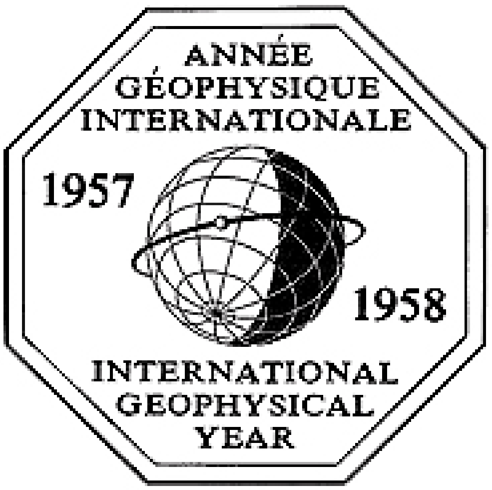
K9YA Telegraph

Robert F. Heytow Memorial Radio Club — Volume 10, Issue 3, March 2013



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IGY

Part I: Amateur Radio's Role, 1957 - 1958

Philip Cala-Lazar, K9PL

The most important result of the International Geophysical Year is that demonstration of the ability of peoples of all nations to work together harmoniously for the common good. I hope this can become common practice in other fields of human endeavor.

President Dwight David Eisenhower, June 30, 1957

The President's statement reflects amateur radio's Part 97.1: Basis and purpose. Not only in enhancing international goodwill via phone patches that provided a voluntary noncommercial radio service to distant research bases, but also in their cooperative efforts with hams of many nations. Participating amateurs contributed to the advancement of radio; during IGY they worked with renowned scientists to improve the amateur service by advancing skills in both the communications and technical phases of the art. Thanks to the positive publicity provided by the mass media, many non-hams were sufficiently intrigued to investigate the service and eventually join our ranks expanding the existing reservoir of trained operators, technicians and electronics experts.

Overview

With a gestation originating in the early 1950s, the 18-month International Geophysical Year 1957-1958 grew to include the participation of more than an estimated 5,000 scientists from 67 countries and included the successful launching of the first artificial earth satellites and the establishment of scientific research bases at the South Pole. This mid-20th century IGY continued the cooperative spirit of the International Polar Year, 1882-1883 and the Second International Polar Year, 1922-1923.

Dr. Lloyd Viel Berkner, ex-9AWM, president of the International Council of Scientific Unions, and who first proposed the IGY in 1950, presented an overview of the immense undertaking that was the IGY to a symposium of the American Association for the Advancement of Science held in Atlanta, Georgia.

"immense undertaking"

His outline included four main goals:

1. Track satellites including the U.S.'s Explorer and Vanguard and the Soviet's Sputnik.
2. Provide "moral support" to personnel stationed at U.S. Antarctic bases via phone patches.
3. Observe and report VHF DX propagation.
4. Assist in the notification of special event alerts.

The breadth of this propagation research included: Vertical Incidence Soundings… Fixed Frequency Back Scatter… Sweep Frequency Back Scatter… Oblique Incidence Back Scatter… Naturally Occurring Terrestrial Radio Noise… Whistlers… Sporadic E Reflection at Oblique Incidence… Radio Star Scintillation and Ionospheric Drift… and Absorption.

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Inside This Issue...

A Work in Progress

Part III

Paul W. Ross, W3FIS

Arduino Micro-Controller

In my previous two articles, I put the emphasis on the software end of programming an Arduino micro controller to function as a QRP keyer. In this article, I would like to deal with the design issues of the circuit interface between the Arduino and the transmitter and paddle key.

To key most modern solid-state transmitters, all you need to do is provide a connection to ground through the key jack. For those with built-in keyers, you provide three connections, rather than two—one for the "dot" key, and the other for the "dash" key. In addition, you may need to provide a sidetone in the event the transmitter does not have that feature.

With this in mind, let's look at the design, starting with the paddle key. The Arduino wants to see a logical "1" or "0" on one of its pins to detect key closure. This then requires a "pull up" voltage to keep the line "high," and with the closure to ground, the signal goes to logical "0." Switches are not perfect—they "bounce," meaning the contacts may re-open and close for a very short period after the initial closure. This means "de-bouncing" the contact may be necessary. In the case of paddle closures, the dot or dash is initiated, and is longer than the bounce time, so there is not a problem there. The key is connected through a miniature stereo jack. If a reversal of the dot and dash connections is needed, this can be done with a simple software change. My Alinco DX-SR8 transceiver defaults to dash on the tip, and dot on the ring, the reverse of my Yaesu FT-817ND. Either commercial transceiver can be set to reverse these settings, as necessary with an internal menu.

"Switches are not perfect"

The mode button I used to switch between normal keyer operation and "bug" mode presents a different problem. When that button was pressed (Normally Open push button), an interrupt was generated to select between normal and bug mode. A bounce on the contacts would provide multiple calls to the interrupt service routine, giving quite erratic program performance.

The answer to that was to place a fairly husky capacitor across the button contacts. This meant that pressing the switch would discharge the capacitor, and the time constant formed by the capacitor and the pull-up resistor was longer than the switch bounce time. It might be noted that the prototyping board I used to mount the extra components for the keyer on the Arduino unit does exactly that for its two on-board push buttons.

The closure to ground for the transmitter is easily implemented with a small NPN (2N2222) switching transistor with the base driven through a 680-ohm current limiting resistor from the Arduino. I made it a point to check the current through my keying circuit on my QRP transceiver before completing that part of the circuit, checking both the open circuit voltage across the key, with key up, and the current through the key on key down.

The remaining parts of the interface consist of an LED to show keying, and a piezoelectric speaker for sidetone generation. In my case, the Arduino prototyping board had an on-board LED and current-limiting resistor I could use. When I developed the breadboard version of the circuit, I used a standard LED pilot light.

A miniature piezoelectric speaker provides the sidetone. The Arduino can't produce much audio output, but there is enough for the piezoelectric speaker. I also added a miniature mono headphone jack to allow me to feed the sidetone into a loudspeaker or headphone amplifier, as the usual 8 ohm headphones are much too low an impedance for the Arduino output.

Final packaging was in a plastic case made for the Arduino, which contains the Arduino processor

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Conan Wyatt Burtram Barger, W3CVE

Part IX

Scott B. Laughlin, N7NET

Each day when I picked up the mail at the mayor's office I noticed he gave me a fishy stare. I wondered about this until one day when he said, "Yer're a damn Yankee, ain't ya?" "Yeah," I replied, "and you're a southern Cracker, aren't you?" He roared with laughter.

We located a great many Nazi stations along the east coast, which were contacting German submarines located in the Atlantic. We exposed several medical doctors in Long Island who were using diathermy machines for espionage communications. They were not actually sending code, but were leaving the machines on for one second then again for two seconds, and then for three and four. In this manner, they were signaling to other spy locations. We also monitored Nazi radio nets operating from points all over the world. Little did they realize we were also operating all over the world.

Frank Kratokvil was chief at the primary RID unit in Marietta, Georgia and our unit at St. Augustine reported to Frank at regular intervals.

After nearly a year at St. Augustine I was transferred to the secondary unit at Pensacola, Florida. This unit had the same radio gear, the famous SX-28, and associated equipment. However, at this unit we also had a direction finder (DF) utilizing the Adcock system. The Adcock was mounted in a field some distance from the station, where it was not affected by surrounding metal objects.

"diathermy machines for espionage"

In addition to monitoring the test sent by a station, we were also required to plot its position from day-to-day. We had to use great care with the direction finder, for it was extremely sensitive and large metal objects would often cause erroneous results. In fact, if a train was traveling along a track some half-mile away at the precise time we were taking a reading; our bearing would often be in error by several degrees. Such a reading might indicate the station was mobile when it was not. The FCC had several DF stations around the world and a "cocks hat" could easily be determined.

Ralph DeCourcey was the monitoring officer for the Pensacola unit. I recall one instance when we monitored a station using the call sign JUD. It would transmit every morning at 0100 hours Zulu, sending five-letter cipher groups. All the bearings pointed to the west coast. After several months JUD went silent. We never knew for sure what happened, but a week later I read in a local paper that the FBI had raided several Japanese fishing boats that were taking soundings off the west coast. We could only guess that one of those boats was JUD.

To ensure there was no radiation from wires or cables in the vicinity of the DF, all cables were buried six feet deep.

Many times, we were instructed to take the undercover Hudson, a specially equipped radio-monitoring vehicle, to investigate suspicious radio transmissions. We located several Nazi transmitters that were communicating with Nazi submarines in the Atlantic.

I recall the frightful day of December 7, 1941, when the Japanese bombed Pearl Harbor. DeCourcey called all personnel to report to the monitoring unit at once for detailed instructions. The workload increased ten-fold. We intensified our monitoring and discovered a great number of Japanese stations, which had not been heard earlier.

We were in constant contact with Washington by way of cipher-coded communications. Our messages were going to the most skilled cryptographer in the country, Albert MacIntosh. The cipher codes were changed at regular intervals, making translation by the enemy more difficult.

World War II was well under way and our monitoring workload increased tremendously. The round-the-clock monitoring became very strenuous because we knew each dit and dah had to be copied correctly if the information was to be of any value; which could lead to victory or defeat. I have the highest respect for those who worked in the RID. Few realize the effort that goes into gathering intelligence.

CONTINUED - CONAN BARGER ON PAGE 8

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Noise Level Normally Runs S7 Here, OM

John Kirk, VK4TJ

House CB Panel

Let's get one thing out of the way first off, shall we? There is nothing ***normal*** about a standing noise level of S7. The continued presence of that much noise is going to seriously impinge on your enjoyment of the hobby. Cycle 24 is underway, but most of us are seriously underwhelmed by what it has done for us thus far—DX signals are ***seriously weak***.It is fashionable to speak in jest of repeaters as either "alligators" (big mouth, small ears) or elephants (big ears, small mouth). Guess what? They walk amongst us, even within the HF ham community!

How Do I know if I'm an Alligator?

More and more QSOs are arranged via the Web these days. Sked rooms like K3UK or ON4KST let you know right away, but if you often find yourself sending "SRI OM, TOO WEAK TO CPY" to CQ responders, check your extremities for scale formation, you are almost certainly morphing into a reptile. Even worse, chances are **you** are the architect of your own disaster.

"12 o'clock flasher"

It's apparent in any QSO there is a "dB budget" to meet, and that budget can be met at just about any point on the sliding scale of "him" versus "me." The romance of QRP notwithstanding, I'd like to convince you that asking your QSO partner, time after time, to make up for shortfalls of your making, and well within your means to fix isn't ethical. It's rather like expecting your friend, whom you have seconded to help you shift a large piano, to pick up the heavy end—it simply isn't done in polite circles.

Granted, some noise sources, like the 200 kV power substation just down the road, are going to be difficult if not impossible to eradicate, but this exercise, like charity, begins at home.

Silent Night

Suggest to the XYL that she visit her sister. Obtain the user manuals for the VCR, microwave, oven, and any other appliance likely to turn into a "12 o'clock flasher"[1] to tattletale what you are about to do. Charge up a gel cell. When she who must be obeyed is safely down the driveway, kill power to the entire house, and listen to the bands while running off your gel cell. Maybe it will make no difference, but if you are like millions of other spectrum users, you are going to be shocked by the number of "monsters" you have unwittingly invited into your home. Sweet bliss! This is the way the bands used to sound when you were a kid! Record your observations band by band, because you are going to strive to get back that bliss.

Hunting Big Game

Where, exactly, to look for a monster who might be hiding anywhere? Turning the power back on one breaker at a time will certainly give you some clues, but there are some that are so common that you may as well go for the jugular:

1. If you have permitted a plasma TV into your home, shame on you! Take it outside, and invite the neighbour's brats to throw rocks at it. Big rocks. These things are so bad the European Union recently banned them outright, in a fine display of firmly latching the equine establishment after the proverbial had bolted. Friends do not let friends drive plasma TVs. Trust me on this.
2. Modems, particularly of the DSL ilk. You think it is a coincidence my QRP SSB rig features a DSL driver chip in its 1-watt final? Not!
3. Spawn-of-the-devil switch-mode power supplies. These are a bit more insidious, as they are shape-changers. I have seen these things disguise themselves as VCRs, television sets, set-top boxes, answering machines, phone chargers, lamps, video games and, of course, personal computers. A recent audit of my own abode uncovered 43 of the buggers hiding in my ceiling, masquerading as halogen down-lights.

1 See here for a tongue-firmly-in-cheek explanation of this term.

What to do?

If the XYL arrives back from Sis's place and finds all the above-mentioned apparatus at curbside, it will be off to the funny farm or worse for you. Put the inner sanctum (a.k.a. ham shack) in order first. It's bad enough you had to invite these things into your house. It's a mortal insult they abuse your hospitality by staging a sit-in in your shack!

I am regarded a bit of a heretic on this one: Do you really need a PC in your shack? If the answer is yes, understand you have made a pact with the devil, the price paid in missed QSOs. Lurkers on K3UK's sked page are quite amused I have to run from the office to the shack, a distance of about 50 metres, to make good on sked promises. They are less amused when I report, "You are Q5 copy here, OM, but you don't seem to copy me?" This has played out **thousands** of times, so it isn't a one-off.

Today's average PC has a seriously "cost-reduced" switch-mode power supply; euphemism for "cheap rubbish." Often the toroidal filters installed to get that coveted CE tick of approval are jumpered out in the production model, resulting in a DC to daylight Gaussian noise generator. I'm not implying the power supply is the only portion of the PC capable of interfering, but you have to start somewhere.

Consider a laptop. They are the QRP rigs of the computing world. Energy wasted in smearing the spectrum with excrement is energy unavailable for an extended "off grid" computing session. My laptop even runs off a homebrew "pig iron" power supply. It takes guts to plug it in that first time, but trust me; the technology to run your laptop from an analog power supply is out there, and quite cheap.

"pig iron"

Download these two publications, and take them to heart:

http://www.yccc.org/Articles/W1HIS/CommonModeChokesW1HIS2006Apr06.pdf

http://www.audiosystemsgroup.com/RFI-Ham.pdf

These must be two very clever gentlemen; their prejudices match mine exactly! W1HIS reckons it is possible to reduce the noise level in the average shack by 15 dB! 15 dB more signal arriving in your RX would result in an order of magnitude more QSOs.

Next – Wetware

Right, now that we've done as much as we can with the hardware, let's move onto the wetware. That would be those CPU cycles emanating from approximately midway between your earlobes. This section is primarily for CW operators, but stick around, ratchet-jaws you might learn something too.

Copying signals in noise is a **skill**. You weren't born with it, though undoubtedly some element of it is genetic. Like any skill, it must be honed to perfection via regular practice. Most newcomers to amateur radio have the unreasonable expectation all signals will sound as clear as their code practice oscillator, or in the case of phone, like local FM radio. Tain't so! Morse training software like G4FON's "Koch CW Trainer"[2] allow you to introduce noise and other "anomalies" precisely because they know you're in for a rough, discouraging ride without this skill. A really skilled EME operator can copy CW signals many dB **below** the noise. How is this possible? Nobody knows, but it has been demonstrated enough times in controlled experiments that it cannot be discounted. Once again, many dB are there for the taking free.

INRAD 500 Hz Filter

Filters

Purely for CW ops—you can tune out now, Morse-o-phobes. The stock 2.7 kHz crystal filter delivered with your new Yaecomwood is completely inadequate for CW. Makes sense, right? Reduce bandwidth by a factor of 10; reduce noise by a factor of 10. Reduce desired signal by—hey, that's right, nothing! Besides, nobody on today's crowded bands is going to grace you with a 2.7 kHz slice of guard-band. If you are cursing folks for moving in too close to "your" frequency, chances are the problem lies with you and your equipment, not theirs. Two well-equipped stations should be able to work 500 Hz apart or less, allowing that many more QSOs to take place on the same crowded band.

In Summary

By virtue of our avocation, we are nearly always early adopters of electronic gewgaws… er…"technology." Some good, some the bane of good RF engineering practice. Some never should have left the lab or factory, let alone grace our shacks. Allow any of these to enter our shacks voluntarily, and we forfeit bitching rights!

"Just say **no** to switch-mode power supplies!" ■

2 http://www.g4fon.net/

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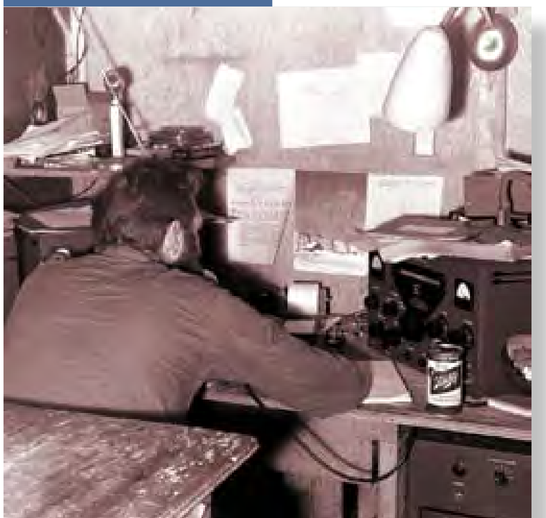
Who Better Than Hams?

What better group than amateur radio operators could be recruited to form a cadre of reliable monitors and reporters to collect and record the coming avalanche of scientific data? Hams were organized, trained, technically minded and skilled, familiar with log keeping, easily identifiable and maintained a long tradition of working with government and private entities on scientific endeavors. With that in mind, the ARRL recruited amateur observers under a U.S. Air Force contract. Point man for the U.S.A.F. was Dr. Wolfgang Pfister of the Air Force Cambridge Research Center. Mason F. Southworth, W1VLH, was named to collect and analyze the data for the ARRL.



KC4USN

The International Amateur Radio Union requested volunteers from its member countries to join the Propagation Research Project (PRP). Other volunteers were targeted via a mailing list comprising contributors and operators appearing in *QST*'s "World Above 50 Mc." column, those operating Official Experimental Stations and hams listed in the *VHF/UHF Directory*.

QST April 1957
PRP - A Progress Report

The program's eight hundred registered participants were obliged to report, twice monthly, stations worked and heard "via ionospheric propagation modes above 50 Mc." They were also asked to note and report operating and listening periods when no DX was heard. These were known as "'positive'" and "'negative'" reports.

"adventurous but stable"

Of transequatorial scatter, participants noted anomalous openings, i.e., at times when north-south path openings were unexpected. Other propagation modes monitored were sporadic-E skip, auroral and meteor scatter, and F2 openings, "both conventional skip and the back-scatter variety."

In that month's "Strays" Dartmouth College posted it had "IGY Jobs" available in northern Quebec performing ionospheric research. In addition to technical knowledge and experience what was also needed was, "An adventurous but stable personality for whom a period of 18 months in a small isolated community in a sub-Arctic climate would prove an interesting and challenging experience."

It wasn't all serious business for amateur radio; there were many opportunities to work some rare DX. The May 1957 *CQ* article, "VK's … Australians in Antarctica" noted that 11 VKØ licensees stationed at the Macquarie, Davis and Mawson bases were "keen to work as many countries and stations as their spare time from scientific projects will allow."

IGY Amateur Radio Snapshots

The New York Times, July 9, 1957
14 Men to Dispute 150,000 Penguins

The staff of the ionospheric and weather research camp established at Antarctica's Cape Hallett awaited the return of the flightless birds. In September both groups would again compete for space when the penguins returned to their breeding grounds at the start of the antipodean spring. Via radio link the camp's medical officer, Dr. Juan J. Tur said, "with a touch of bravado," "We are waiting for them." The "…radio contact was made through the facilities of Jules Madey [K2KGJ], an amateur radio operator in Clark, N.J."

U.S. Antarctic Stations

"The installation of and use of amateur radio facilities at each station has proved to be of great importance to station morale." To these stations the FCC assigned the following callsigns: Little America, KC4USA; Byrd, KC4USB; Amundsen-Scott, KC4USN; Ellsworth, KC4USW; Wilkes, KC4USK; Hallett, KC4USH; and NAF McMurdo, KC4USV. Gear at all U.S. stations included Collins KWS-1 transmitters and Collins 75A-4 receivers. Operating modes were "CW, voice, and single sideband. Provisions are made for coupling-in radio teletype if desired."

The New York Times, August 18, 1957
I.G.Y. Team to Test Long-Range Radio

Kenneth Bowles of the national Bureau of Standards Laboratory announced a program to investigate ionospheric forward scatter. He described the phenomenon: *When high-powered radio transmissions are beamed at the lower ionosphere, an "electric blanket" of air starting forty miles above the earth, small but useful amounts of radio energy are known to bounce back.* Further, he stated it was caused by, "…turbulence and the effects of meteors."

"Mr. Bowles said radio amateurs from Canada to South America would participate by reporting on their reception of the scatter signals." It was hoped research

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in this area would contribute to more reliable communications, especially that concerning civilian aviation.

QST, August 1957
N.B.S. Equatorial Region V.H.F. Scatter Research Program for the I.G.Y.

Research into ionospheric scattering was a shared endeavor between scientists and hams of the Americas. The National Bureau of Standards built high power (variable between 3 kW and 20 kW) VHF stations in the city of Arequipa located in southern Peru, OA3AAE, and near the port city of Antofagasta in northern Chile, CE8AE. These stations beamed signals northward and radio amateurs were asked to supply signal reception reports. Their signals, on 49.490 Mc and 49.900 Mc, respectively, were focused by 1,000-foot long rhombic antennas. A third station, located at Huancayo in Peru's central highlands, OA3AAF, ran 50 watts on 49.880 Mc through a Yagi antenna. (*K9YA Telegraph* readers with long memories will recall S.L. Seaton, 3BWL, of the non-magnetic yacht *Carnegie* [May 2010 issue] was posted to Huancayo in 1929 [June 2010 issue] to install radio equipment to communicate with Watheroo, Western Australia and Washington, D.C. and install gear of his design to investigate the Kennelly-Heaviside layer.)

Project Moonbeam

Project Moonbeam was established as part of the Naval Research Laboratory's (NRL) Project Vanguard to track satellites by radio and optically. Amateur radio operators and amateur astronomers were integral to Project Moonbeam, indeed, it had been designed anticipating their participation. It could not have existed without them. The project's optical tracking system was co-designed by Dr. J. Allen Hynek, later founder of the Center for UFO Studies.

"'Poor Man's' Minitrack"

Amateurs were asked to tape record the transmissions of orbiting U.S. and U.S.S.R. artificial earth satellites. To assist them monitor recently launched satellites, plans for the Mark II Minitrack satellite tracking system were included in the September 1957 *QST*. Developed by the NRL's Roger Easton, his Mark II, aka, the "Jiffy" or "Poor Man's" Minitrack was a simplified, less costly version of the Minitrack system used by professionals. That same issue also featured the translation of a satellite primer by V. Vakhin originally published in the Russian amateur periodical *Radio*.

From the 1957 U.S. government publication, *Project Vanguard Report No. 21: Minitrack Report No. 2: The Mark II Minitrack System*:

Using radio-frequency phase-comparison techniques by means of hybrid junctions, the Mark II later became the nucleus of "Project Moonbeam," a program sponsored by Project Vanguard to encourage radio hams and their organizations to build their own stations and participate in tracking satellites.

JPL Microlock Antenna

There were two forms of the Mark II, known, respectively, as the "simple" and the "advanced." The amateurs who joined Project Moonbeam used only the simple form. Costing about $5,000 [estimated at $1,000 by other sources] *to erect as against twice that much for the advanced Mark II, this arrangement consisted of two matched antennas in an extended base array, a receiver, and oscillograph. Passage of the artificial earth satellite produced a pattern of reinforcement and cancellation, successively, of the signals received at each antenna. These were recorded as a pattern of peaks and nulls. A difficulty in interpreting these records, even where satisfactory time signals were recorded in an auxiliary channel, was in determining which null corresponded to the time of the passage of the satellite through the principal plane of the antenna array. In general these ambiguities were resolved at the Vanguard satellite computing centers by references to the data received at the prime Minitrack stations operated by professionals.*

QST, September 1957
Mark II Minitrack Base-Line Components

Antenna construction plans for the Mark II Minitrack satellite tracking system. Built to contend with the rigors of "wind and weather," the system's eight-element, high-gain antenna was named its most expensive component; it must provide "a broad beam in direction so a large number of satellite transits can be recorded."

The primary system for tracking the satellites by radio and recording their telemetry was a "picket fence" of Minitrack stations manned by professionals. The supporting Moonbeam program used its Mark II version and a similar system developed by hams at the Jet Propulsion Laboratory and known as "Microlock." Originally designed to receive Soviet satellite signals

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War was declared on Japan on December 7, 1941 and Germany on December 11, 1941.

The FCC, with a worldwide staff of 528 worked at top efficiency. Nazi radio nets numbering 10 to 15 were monitored during cipher traffic of five and six digits. The Japanese stations sent messages in Kana code. (Kata-Kana–73 syllables each with a sign of its own and assigned a Roman equivalent. Ref. *The Code Breakers,* by David Kahn, editor.) ■

Continued - IGY from Page 7

on 40 Mc, Microlock was later modified for America's Explorer I and Vanguard I satellites with their 5 Mw, 108.03 Mc tracking system signals. Both Minitrack and Microlock employed phase comparison techniques.

The New York Times, September 10, 1957
'Hams' Will Track Earth Satellites
Hams, as participants in the "Moonbeam" program, used "an especially designed receiver… to pick up valuable information on the course and position of satellites launched in the current International Geophysical Year." The receivers were designed to be built from plans, and with technical assistance, provided by the Naval Research Laboratory. They were simplified versions of the type used by "scientists in following the satellite in its orbit around the earth. Estimated cost of this receiving gear was $1,000 as projected and built by "interested amateur radio groups."

Its steep, for the time, cost: $7,990 ($39,950 using the $5,000 figure above) in 2011 dollars ("relative real price" based on the CPI from 1957 to 2011). ■

Hyperlinks

The *K9YA Telegraph* contains both internal and external hyperlinks. An internal link may take you to another page where an article continues. An external link, can take you to another Web site or document. Here are two examples how we may link to the *Morse Telegraph Club.*

http://www.morsetelegraphclub.org/

If you click on any part of a URL or within the bounding box surrounding text, a new window will open and whisk you away to the club Web site.

If you're using a PDF reader application other than Adobe Reader, make sure links are turned on in your application's options.

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and space enough for one prototyping shield. Holes were drilled in one end of the case for the jacks and the pushbutton. The pushbutton was added later, and placed in the top of the case. Power for the Arduino keyer is either from the USB connector on my shack computer, or from an external "wall-wart" power supply for the Arduino. Alternatively, it can be driven from four AA cells, which I have done for field portable work.

The case, Arduino micro controller, and prototyping board can be obtained from a variety of sources. The remaining components were either from my junk box, or the local Radio Shack, who also carry the Arduino. The total cost for all components, including the Arduino microcontroller, was comparable to most commercial keyers. In addition, the interface design becomes a convenient test bed for all sorts of experimentation in the future, such as a Hellschreiber interface, as the Hellschreiber signal is an on-off keying protocol.

A side benefit to the project is that I have a nice code practice oscillator in the event I don't connect the keyer to a transmitter! However, in the interest of domestic tranquility, I suggest the audio output jack be the switching kind, so as to disconnect the piezoelectric speaker when the headphone amplifier is connected.

Have fun! ■

Ham Lingo

DICK SYLVAN, W9CBT

LIGHTHOUSE TUBES WERE USED FOR VHF/UHF APPLICATIONS IN THE 1940S

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