ACSSB Packages Available from ARRL Hq

The ARRL, in cooperation with the Radio Amateur Satellite Corporation (AMSAT) and Project OSCAR, now has amplitude compandored single-sideband packages available to experimenters. If interested, please write for a price list to:

American Radio Relay League
ATTN: Greg Bonaguide, WA1VUG
225 Main Street
Newington, CT 06111

When you write for a price list, please give Greg some idea of the intended experimental application. After you have had your ACSSB transceiver on the air for a while, we would encourage you to write a report on your experience with it. In about a year, we would like to consolidate these reports and be able to form some conclusions about Amateur Radio applications of ACSSB.

The packages are not complete transceivers, but do contain the specialized circuits and documentation needed to get an experimenter started. The packages consist of an RF board, an audio-processor board, a technical manual, and some ARRL lab notes.

The RF board is a complete single-channel transceiver that produces 1 mW PEP CW or ACSSB and will operate anywhere in the 144- to 148-MHz band. The audio board generates the unique 3.1-kHz pilot tone that is used for encoding and decoding the details of the compandoring process. This pilot tone distinguishes ACSSB from ordinary single sideband (SSB).

Originally, ACSSB was developed as a narrow-band solution to overcrowding in the land mobile VHF-FM bands. ACSSB sounds much like speech-compressed SSB. It is easily received on a conventional SSB receiver. The 3.1-kHz tone is not bothersome in most receivers and may not be heard at all in others, depending on IF band-pass characteristics. When received on an ACSSB receiver, an ACSSB signal sounds better than SSB and is capable of quality usually associated with FM. The pilot tone also permits automatic frequency control (AFC) circuits to keep the ACSSB receiver locked on frequency. This eliminates tuning and drifting problems — even satellite-related doppler shift.

The boards were purchased by the ARRL as a bulk surplus from Sideband Technology, just before they moved from Rochester, NY to merge with Aerotron in Raleigh, NC. The boards are sold as is. No warranty is expressed or implied. You'll also get a complete technical manual with the board set; reproduction costs were over $15 each. The boards are in generally good condition, but some of the audio-processing boards need several ICs, as detailed on the price list. Further, each package requires power, crystals, microphone, speaker, and other items (at the discretion of the experimenter) to make them fully operational.

This is your chance to get in on the ground floor of Amateur Radio ACSSB experimentation.

Fourth ARRL Amateur Radio Computer Networking Conference

If you are planning to present a paper at the March 30 conference in San Francisco, you have a deadline of March 1 for camera-ready copy. If you need an author's kit, please request one from Marian Anderson, WB1FSB, at ARRL Hq.

British Amateur Radio Teleprinter Group

I just received my Winter 1984 edition of DATACOM, the quarterly journal of BARTG. This issue is packed (116 pages) with information on Baudot/Murray RTTY, AMTOR, packet radio and FAX. BARTG has more than doubled its membership during 1984 to just under 2700.

As an example of their stepped-up activities, Ian Wade, G3NRW, is giving talks on packet radio at many radio clubs throughout the south east of England. He is scheduled to speak on "How Packet Radio Works" at the RSGB VHF Convention at Sandown Park on March 23, 1985.

For details of membership in BARTG, contact Mrs. Pat Beedie, GW6MOJ, Ffynnonlas, Salem, Llandeilo, Dyfed, Wales, telephone 0558 822286.

— W4RI

Correspondence

Amateur Radio Possibilities with Cellular Radio

My response is in reference to the editorial paragraph on "Cellular (Amateur) Radio" in the Nov. 1984 issue of QEX (no. 33). I feel that it is possible to utilize present cellular radiotelephone technology with Amateur Radio operations on the UHF bands. Certain changes in present repeater operations and associated radio equipment, however, would be necessary.

The initial step is to change to full-duplex operations in place of the current half-duplex method. This change requires separate radio-frequency channels for each direction of transmission to afford the full-duplex requirement, both for transmission and switching. Consequently, this necessitates using the UHF bands, such as 420 to 450 MHz and the proposed 902 to 928 MHz frequencies, for any Amateur Radio cellular radiotelephone systems.

With respect to tutorial data on cellular radiotelephone technology, the initial data for the present systems was issued by the Bell Laboratories in a report to the FCC in December of 1971 entitled, "High-Capacity Mobile Telephone System Technical Report," of which I have a copy on file. Also, the June 1983 issue of IEEE Spectrum has an article, "Cellular Mobile Technology: The Great Multiplier." This article describes current cellular radiotelephone systems. One last resource is an article called, "The Cellular Concept;" it can be found in the January 1979 issue of the Bell System's Technical Journal. — David Talley, W2PF, Suite 1533-S, 10275 Collins Ave., Bal Harbour, FL 33154.

Another Source for Help

In response to the "help" questions featured in the November 1984 "Correspondence" column, Mike Stone, WB∅QCD, of A5 Amateur Television Magazine, suggests that a look through this journal may help you find the answer you are searching for. Mike was able to assist several amateurs whose question appeared in the column.

Information on A5 can be obtained by writing QCD Publications, Inc., P. O. Box H, Lowden, IA 52255-0408. Articles and columns on fast-scan and slow-scan television, microwave satellite TVRO, facsimile and computers are featured in this publication.

Three help questions are listed below. If you have an answer for any one of them, feel free to correspond directly. We, at QEX, are also interested in your reply.

* I have a Dentron Clipperton L that I would like to convert to 10-m operation. How can I obtain details for doing this? -- Anthony Calvani, WA4GRZ, 1018 N.W. 39th Dr., Gainesville, FL 32605.

* The Collins KWM-2 has an offset of 1750 Hz for CW. This makes it almost unusable for this mode. Is there information available on how I can change to the normal 750 Hz offset? -- Hollis J. Nuttall, W1COI, P. O. Box 73, Cheshire, MA 01225.

* I have two old, but usable filament transformers. They are the same and rated at 120-V ac primary winding. The secondary winding is rated at 16 volts at 7 amps. I would like to operate the secondary windings in parallel to obtain 14 amps. For rectification, I prefer a full-wave bridge rectifier. No center taps are provided on the secondaries.

Here is the puzzle: What would you consider the best circuit to use? In operating two filament transformers with the secondaries in parallel to double the current capability, a means must be provided to keep the current load even on each transformer. With two windings connected in parallel, one transformer is bound to hog most of the load, sometimes as much as 2/3 of the total load applied. This makes one transformer overloaded and the other underloaded. This is common when utilizing parallel operation without some means to keep the transformer windings loads even. Off hand, I figure the simplest way is to add a low-ohm resistor with appropriate wattage to the B+ output of each bridge rectifier, to act as a differential/load resistor to keep the loads even. I have not tried it and am asking for opinions. This information was not mentioned in the Handbook and I think it should be there.

Is it possible to set up a full-wave circuit with a balanced load using only four diodes? Is the differential resistor scheme the correct way? Is my schematic (Fig. 1) on the right track? Could it be simplified and still get even load with full-wave rectification? — Harvey Columbine, W2MLO, 410 Scranton Ave., Lynbrook, NY 11563.

Feedback

In the December 1984 issue of QEX (no. 34), the schematic diagram on page 9 belongs to the article on page 8. The S3030 specification sheet on page 8 belongs to the TI announcement on page 9.

Another correction to make note of in the same issue, is the first formula on page 3. It should read: $jE \omega RC$.

A Packet Radio Adapter for the IBM PC

By Jack Botner,* VE3LNY

How would you like to be able to plug a terminal node controller (TNC) circuit into one of the expansion slots of your IBM Personal Computer? The controller can be constructed on the IBM Prototype Card; it already contains the circuit pattern for a system-bus interface and address-decode circuits. This TNC uses the Intel 8273 programmable HDLC/SDLC protocol controller and is simple to interface to the computer's system bus. The circuit is based on the Vancouver terminal node controller.

Circuit Description

The clock frequency is 2.4576 MHz. Since I had a 4.9152-MHz hybrid crystal oscillator handy, U23 was added to divide the oscillator frequency in half to obtain the required value. Any TTL-compatible source of 2.4576 MHz can be used in place of these components.

The IBM Prototype board provides an I/O decode signal for addresses in the range of 300h through 31Fh. To meet the addressing requirements of the 8273, a 74LS139 chip (U9) was used for further I/O address decoding. The resulting I/O addresses for the 8273 are as follows:

8273 Register	Address
Command	300h
Status	300h
Parameter	301h
Result	301h
Reset	302h
TxINT Result	302h
RxINT Result	303h
Transmit Data	304h
Receive Data	308h

A baud-rate-selection circuit identical to the Vancouver TNC is used. It consists of a 4024 divider chip (U11) driven by the clock, and 7 dip switches to select the desired baud rate. In the circuit shown, switch positions 1 through 7 correspond to 600, 1200, 2400, 4800, 9600, 19200 and 38400 baud, respectively. If a 4040 chip is used for U11, the baud rate range may be changed to 75 through 4800 baud. Please note that wiring changes are required to accommodate the 4040 chip.

U12 and U13 are used to present RS-232C logic levels to the modem interface. These inputs and outputs should be taken to a DB-25 socket that can be mounted on the rear edge of the prototype board.

*35 Wynford Hts., Cr.#1708, Don Mills, Ontario, CANADA M3C 1L1

The 8273 is capable of interfacing with the Central Processing Unit (CPU) in one of 3 modes: polling, interrupts or DMA. My choice was to use interrupts to transfer data to and from the 8273. This technique is perfectly satisfactory for the 1200 baud that I use and should be adequate up to 2400 baud. Those of you wishing to operate the 8273 at higher baud rates, however, should consider modifying the circuit for DMA operation.

U24 is used to 'or' the Tx and Rx interrupts onto one line. This was done to conserve interrupt lines on the PC, and assumes that the 8273 will be operated in half-duplex mode only. The interrupt signal is interfaced to the PC's IRQ2 interrupt line through U25. This allows the line to be floated when the 8273 is not in use.

Construction

As mentioned before, my 8273 adapter was constructed on the IBM Prototype board. The circuit occupies approximately half of the board, but experienced builders can reduce it for less space consumption. I used wire wrapping. If you mount the board in slot 1 of the PC (the outer-most slot), there is plenty of room for the wire-wrap socket pins. (In this location, the board can also be accessed easily for testing purposes.) If you use the last section of the prototype board, be careful for the PC's speaker; it may be in the way. Although not shown on the circuit diagram, I recommend that you use a few power-line decoupling capacitors.

There are three points of connection used in the circuit diagram. Those beginning with the letter E are connections on the prototype board bus-interface circuit. These points are marked on the prototype-board surface. Connections such as Reset and IRQ2 are made directly to the system bus at the card-edge connector, and the labels identify the pin on the edge connector. Other connections such as -IOR and -IOW are taken from points within the prototype board circuit, where they are isolated from the system bus by the line driver-/receiver chip.

Software

It is beyond the scope of this article to discuss the software required to operate the 8273 adapter. Software has been written to support the Vancouver protocol (also known as V1), in the form of a protocol module that drives the 8273 and a terminal program. These adapters have been in operation at VE3LNY and VE3DVV for some time, completely replacing the terminal node controllers previously used. For more information on the software, contact HAPN (Hamilton and Area Packet Network), at my address.

System Resources

The addresses used with the 8273 were outlined previously in a table. In addition, the IRQ2 interrupt line is used, corresponding to hardware interrupt level OAh. The timer tick interrupt, interrupt level 1Ch, provides a convenient source of regular hardware interrupts to drive the protocol module's dispatcher. This vector is driven every 55 ms and permits the packet system to function regardless of what program may be running in the PC. (An exception to this is BASIC. It thinks that it owns the machine and takes over the timer tick interrupts when it is running.)
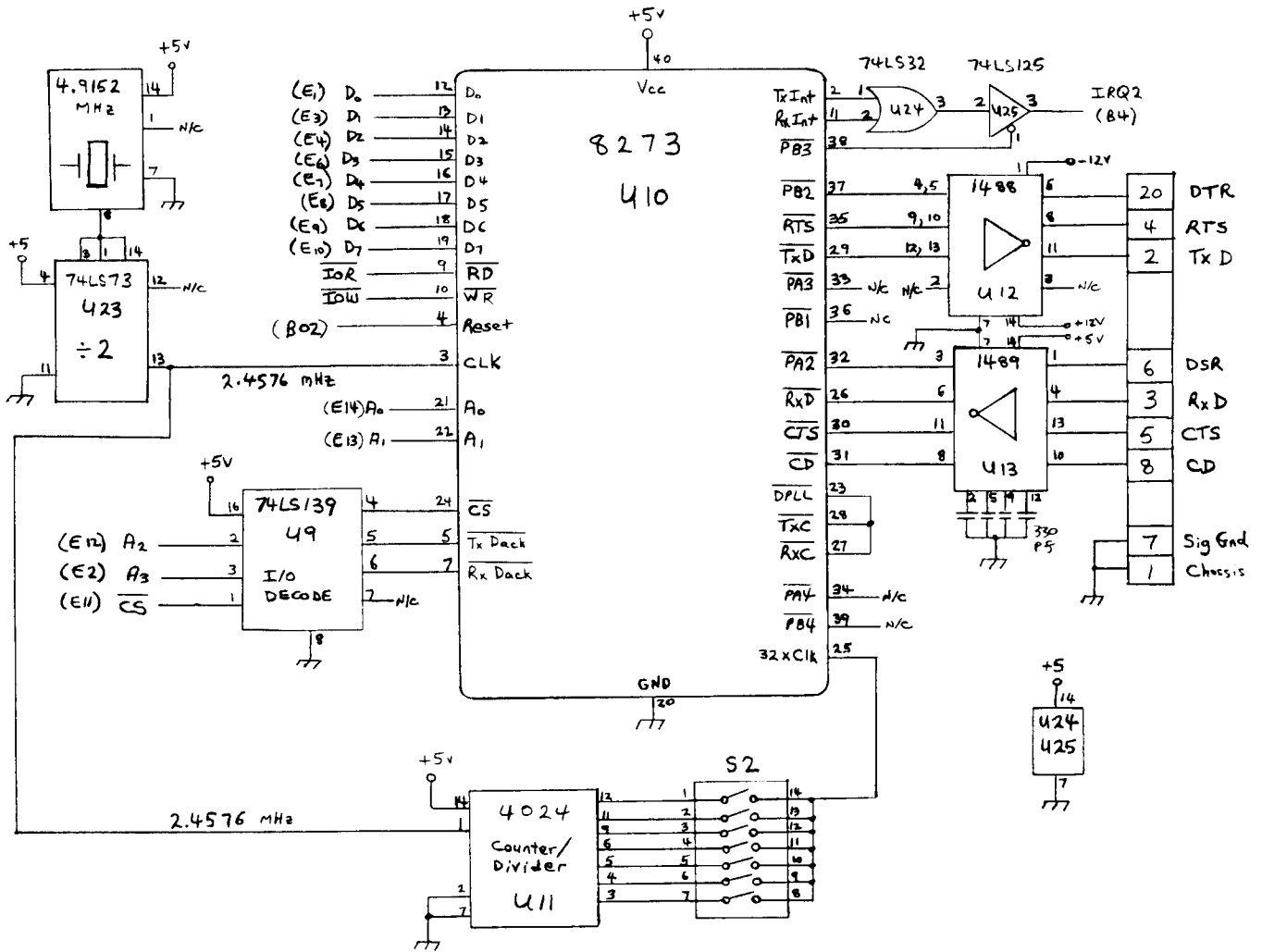
Lasers and Amateur Radio

By Maureen Thompson,* KA1DYZ

What do you think of when you hear the word laser? Killer satellites placed within the Earth's atmosphere destroying each other? Comic book space traveller Buck Rogers zapping the enemy, or Star Wars? Though these things are not reality in today's world, the progress of laser technology may soon develop systems such as these.

Amateur Radio operators experimenting with new technology are communicating in popular modes other than CW and voice. AMTOR, packet radio, RTTY and other computer-assisted communication are coming of age. Microwave records are still being created since its invention prior to the 1940's. What about laser communication? You might think its ultimate use is for military operation, industrial processes, or medical surgery, but what about Amateur Radio? What potential do lasers hold for this mode of communication?

The August 1984 issue of QEX featured Geoff Krauss, WA2GFP's, VHF+ Technology column. In Geoff's text, he mentioned laser contacts established during Amateur Radio contests. The data led me to investigate this area further. To understand laser technology, it is wise to look into its operation and what makes it work. Let's take a look at what type of laser would best suit Amateur Radio operation, and its basics.

The Birth of a New Technology

The first experiment involving laser technology began with Albert Einstein and Danish physicist Niels Bohr during the period of 1913 to 1917. They had discovered, through their individual laboratory research, that electrons exposed to external energy sources are raised to higher energy levels momentarily. When the energized electrons fall back to their original energy state, energy in the form of light or electromagnetism is released. It was also noted that electrons of the same material emit light of the same wavelength (like a "pump"). Ruby crystals are more easily pumped than other materials.

Laser is an acronym for "light amplification by stimulated emission of radiation." It is a human-made generator of coherent (monochromatic) light. This means that it is composed of a single wavelength or pure color, and has corresponding points on the wavefront that are in phase. It is an ideal wave whose spatial and time properties are clearly defined and predictable. Noncoherent light on the other hand, consists of random and discontinuous phases of varying amplitudes, and is made up of many wavelengths and colors. Light-emitting diodes (LEDs), produce incoherent radiation, but have a similar structure to that of the
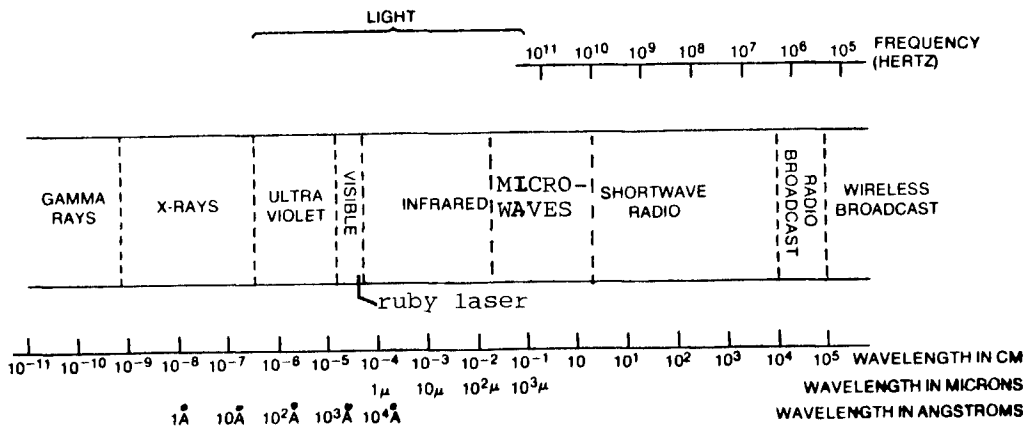
Fig. 1 -- The electromagnetic spectrum. The ruby laser falls within the visible light range. Other lasers producing coherent light span from the microwave region to the part of the spectrum where light is visible.

*Assistant Editor, QEX

semiconductor laser which will be discussed later. Fig. 1 shows the electromagnetic spectrum with the laser placed in its appropriate spot. Coherent radiation, produced by the laser, spans from the microwave region to the part of the spectrum where light is visible.

The laser as we know it today, was developed by Dr. Theodore Maiman at the Hughes Aircraft Company in Culver City, CA on May 14, 1960. Dr. Maiman's laser system consisted of a small ruby rod with both ends smoothly polished. The ends were silvered like a mirror, and one end consisted of a very thin silver layer to enable light escapement. A xenon flashtube was wound around the rod. When the flashtube energized, a large number of photons were generated within microseconds. Photons can be perceived as packets of energy whose characteristics are those of matter as well as electromagnetic radiation travelling at the speed of light. Many of these photons were absorbed by the rod because the tube is wrapped around the ruby rod. The absorbed photons excite the ruby and place the atoms in a high-energy state. As these atoms or molecules expel excessive energy, other photons are generated. At the silvered end, the moving photons are reflected back and forth repeatedly. This is called avalanche action. They strike other atoms and molecules during their activity and create more photons. Radiation strength increases within the ruby because of this. One end is semitransparent and some photons escape in a beam of the same

wavelength and diameter of the ruby. This beam is confined to a very narrow frequency characteristic of the ruby material. This single-frequency light is called monochromatic or coherent.

Dr. Maiman's laser system is shown in Fig. 2. This design was suggested by Charles Townes and Arthur Schawlow in their 1958 publication. Their first experiment took place in 1951 and included the use of a "maser." Similar to the laser, the maser consisted of a small metal box containing excited ammonia molecules. With microwaves radiating into the cavity tuned to 24 kHz, a highly coherent beam of high-frequency microwaves was emitted. Prior to this, Gordon Gould wrote his laser ideas in 1957, notarized it and approached the Pentagon for funding. Visions of military "death rays" impounded Gould's notebooks until he won a patent challenge in the late 1970's. In 1968, lasers performed tasks in integrated optics, a discipline that emerged as part of the pursuit to develop optical communications systems (LEDs, electro-optic scanners).

A few years after Dr. Maiman's laser system was widely accepted by research institutes across the country, the first Amateur Radio laser demonstration (one-way) took place. On May 3 and 4, 1963, the Radio Club at Electro-Optical Systems, Inc., of Pasadena transmitted a voice message 118 miles across the California dessert. Using a helium-neon laser and a pair of confocal (having the same focus) mirrors, this event claimed a new
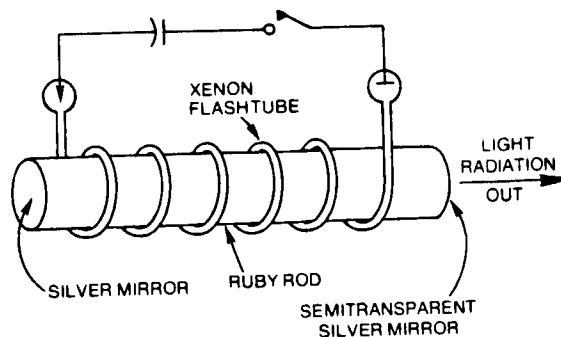

Fig. 2 -- Diagram of the first laser system invented by Dr. Theodore Maiman in 1960.

record for communications on 474,100,000,000 kc.

The laser used in "Operation Red Line" was excited and modulated by a Viking II operating on 28.62 Mc. Measured laser output was 1/8 mW. At the receiving end, a beam was collected through a 12 1/2-inch telescope which fed an S-20 photo-multiplier tube and its associated translation equipment. An audio amplifier was connected to a loudspeaker and a tape recorder.

The first two-way laser QSO took place at the U.S. Air Force Academy in Colorado on February 25, 1971. WA8WEJ/Ø and W4UDS/Ø are credited for establishing point-to-point contact over a 950-foot path on 475 teraHz (Mega-Mega Hertz). Their laser was modified for AM using a power transformer as a modulation transformer. The receiver was an RCA 929 photo tube which sensed the audio variations in light intensity. The audio signal was then amplified and fed into a speaker.

During the 1960's, a laser kit could be purchased for less than $100. Because of this low cost, high school students such as Thomas D. East, WB8LOX, also became involved in experimenting with pulse-frequency modulation (PFM) laser communication systems.

Operation of the System

The laser operates on the principle of stimulated emission. Imagine two levels of electrons; the upper level which is mostly unoccupied by electrons, and the lower or ground level that normally consists of many. When an electron is in the upper level, a light wave of the same wavelength corresponding to the energy difference strikes the electron in the excited state. The light stimulates the electron to transfer down to the lower level and emit a photon. This photon is emitted in the same direction, and its associated wave is in the same phase as that of the incident photon. This is shown in Fig. 3.

"Pumping" is an expression used to describe the process of exciting laser material, or raising electrons to an excited state. It can be done optically using a lamp, by electric discharge, chemical reaction, or semiconductor laser (inject electrons into an upper energy level by means of an electric current).

Laser systems that we are familiar with is the Fabry-Perot Optical Resonator. This type of cavity provides optical feedback and consists of two parallel mirrors. The rear mirror fully reflects while the front partly reflects and partly transmits at the laser wavelength. The light reflected from the front and rear mirrors serves as positive feedback to sustain oscillation. The light transmitted through the front mirror acts as the laser output.

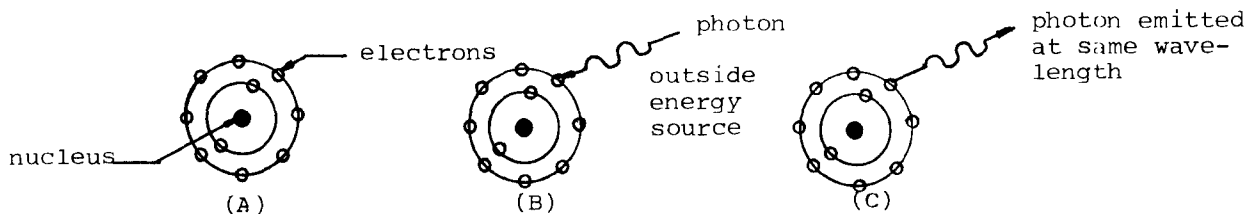Laser action is started by spontaneously emitted light from excited atoms or molecules.

Fig. 3 -- Fig. A shows an atom with electrons orbiting its nucleus. When an outside energy source strikes the atom, a photon is absorbed, sending the atom into an excited state. (Fig. B) When a photon at the same frequency is released, the atom is allowed to return to a low-energy level (Fig. C) until another photon strikes. This process goes on continuously, amplifying energy buildup until a coherent light beam is produced.

The two mirrors form an optical cavity that can be tuned by varying the spacing of the mirrors. The laser can operate only at wavelengths for which a standing-wave pattern can be set up in the cavity (the length of the cavity is an integral number of half wavelengths). Mirrors may be separate or deposited on its end faces.

Population inversion is necessary to initiate and sustain laser action. Let's look at our two levels again. When the upper level has a greater collection of electrons in an excited state than the lower one, a population inversion is said to exist. This supports lasing since a travelling wave of the proper frequency can stimulate downward transitions and the associated energy can be amplified.

Spectral mode means the multiplicity of radiation patterns permitted within the cavity. Spacing of the mirrors determines the longitudinal (or axial) modes. This mode structure oversees the spectral characteristics of the laser (coherence length and spectral bandwidth). Transverse modes (set crosswise), vary not only in wavelength, but also in field strength in the plane perpendicular to the cavity axis. It determines the spatial characteristics (beam divergence and beam energy distribution).

Mode control or selection is achieved by varying the mirror curvatures, restricting the beam by apertures in the cavity, using resonant reflectors that reflect only a narrow band of wavelengths, and using Q-switching techniques. Q switching (Q spoiling) is a means of obtaining all the energy in a single spike of very high peak power. These spikes result because the inverted population is being alternately built up and depleted. Lowering the Q of the optical cavity means the laser cannot oscillate, and a large inverted population builds up. When the cavity Q is restored, a single "giant pulse" is generated. This method is useful in communication.

Gas Lasers

There are four basic categories of lasers. They are: gas, solid-state optically pumped, liquid dye and semiconductor. I will go through each of them quickly, but the one Amateur Radio communications is concerned with is the gas laser. The helium-neon laser is a popular device in this category and produces a continuous wave (cw) beam in the red and near infrared region of the electromagnetic spectrum. For applications such as data transmission, it is necessary to have sources of continuous light beams. This is accomplished in liquid and gas lasers. It also has the broadest spectral coverage and offers variety. The laser medium, the material used as the rod in the cavity, may be very pure, a single-component gas

or a mixture. It can also be a permanent gas, or vaporized solid or liquid. The active species in the gas laser may be a neutral atom, an ionized atom, or a molecule (including excimers, "stable" molecules only in an excited state).

Operating pressures range from a fraction of a torr to atmospheric pressure, with operating temperature from $-196^\circ$to 1600°C. Excitation methods include electric discharges (glow, arc, pulse, RF, dc), chemical reactions, supersonic expansion of heated gases (gas dynamic), and optical pumping. Average output power of useful gas lasers range from a few microwatts to tens of kilowatts (10 orders of magnitudes). Peak power ranges are from a fraction of a watt to 100 MW. Range of output wavelengths extend from 0.16 to 774 μm at discrete wavelengths.

Most gas-laser materials have different wavelengths. The neon atom has more than 100, the argon ion more than 30. By rotating a prism or diffraction grating in the optical cavity, it can be operated with a multiwavelength output or one transition at a time.

Most gas lasers are excited by electric discharges. This method is performed with two electrodes protruding into the laser tube. Electrons accelerated by the electric field transfer energy to the gas atoms and molecules by collisions. These collisions may excite the upper laser level directly. Indirect excitation is also possible by cascading from higher-energy levels of the same atom (or molecule) or resonant-energy transfer from one atom (or molecule) to another by collision. Radio frequencies of about 20 to 30 kHz are used and the electrodes are wound around the discharge tube.

Typical configuration of these lasers has the gas contained in a glass tube with an electrode near either end. The ends are sealed by windows mounted at Brewster's angle (Hutchinson, Technical Correspondence, May 1983, p. 43) to minimize reflections at the windows (for one plane of polarization). An optical cavity is formed by two mirrors (usually both are concave), at least one of which is partially transmitting. When an electric discharge is produced in the tube between the electrodes, the gas atoms or molecules are excited and laser action begins.

In laser terminology we refer to a laser transition by its wavelength in micrometers (μm) or nanometers (nm), and discuss the structure of the transition in terms of frequency. Oscillation can occur at discrete frequencies (cavity modes) at frequency spacing of f = frequency; c = velocity of light, and L = separation of cavity mirrors. The formula for this is: $\Delta f = c/2L$

Depending on the nature of the laser medium and geometry of the optical cavity, oscillation may occur at a number of different modes, within the line width of the transition. Typical widths of the Helium Neon (HeNe) common-gas laser are:

(HeNe)	λ, μm	line width, MHz
	0.6328	1,700
	1.15	920
	3.39	310

Single-axial-mode oscillation is generally achieved by reducing L so that only one axial mode lies within the line width of the laser transition. A stable optical cavity is required for both frequency and amplifier stability.

The HeNe exhibits low-power (few milliwatts) visible (CW), with over 35 gas-laser species commercially available. Continuous wave lasers are mostly manufactured with helium and neon gases and are electrically stimulated. It contains a power supply that delivers high voltage to a tube filled with the gas(es). Mirrors, one partially transparent, are located at opposite ends of the tube. As long as there is power, a coherent light beam is produced by the electrons of the gas(es). Circulating liquids in lieu of gases, are suitable for lasing in a continuous wave laser. Chemical lasers are now being developed and require no external source of power.

Other Laser Systems

The solid-state optically pumped laser category spans the visible to near infrared region. Its output frequency is limited to a few sharp closely spaced lines. The wavelength of these lines depends on the active ion in the laser. This is the only laser class that can be Q-switched or cavity-dumped. The electronic transitions are pumped either by flash lamps or by semiconductor diodes. Their size is equivalent to that of a sliver of glass. It can be continuous wave or pulsed at microsecond durations with a peak of about 10 watts of power.

Optically-pumped organic-dye lasers extends in wavelength from 0.4 to 1 μm. The major distinction within this category is its continued tunability over the entire visible spectrum. Because of their broadband spectral output, these lasers can generate subpicosecond pulses when mode-locked. Primary use is in spectroscopy and photochemistry.

Semiconductor or injection lasers are pumped by the injection of excess electrons and holes into a thin semiconductor layer. Radiation is produced when the excess carriers recombine, producing photon energies equal to the band-gap ener-

gy. Lead-salt laser diodes operate from 4 to 30 μm, continuously tunable either by varying the drive current or temperature. This form of laser is also used primarily for spectroscopy and must be cooled to 77 K during operation. Semiconductor lasers possess narrow emission bands and a change in temperature varies the output wavelength. They are distinguished by small size and require a low voltage dc power supply.

Fiber-optic communications is potentially the broadest application for semiconductor lasers and LEDs. Research is currently directed toward emitters in the 1.1- to 1.4-μm range. Here, fibers exhibit the lowest loss and dispersion. Selection of the emitter, LED, or laser depends upon required information bandwidth and the fiber length. Key factors considered are fiber attenuation, pulse broadending, and coupling efficiency. First and last factors determine diode power and radiance. Pulse broadending dictates the broadest acceptable spectral bandwidth, assuming fiber dispersion is the limiting factor. Long-distance applications prefers the laser because of its narrow spectral bandwidth (0.16 to 2.0 nm) and high radiance. Short distance lower data-rate applications, the LED may be preferred because of its reduced temperature stability and simpler construction.

Carbon dioxide lasers are continuous wave devices and are most efficient and powerful. Their beams radiate at a wavelength of 10.6 microns, making them invisible to the human eye. This type provides high wattage and heat. Fifteen thousand watts of coherent light can melt almost anything (within the range of this laser).

Conclusion

From the above data, you will agree that the laser holds a great potential as a communications mode. If you are involved in Amateur Radio laser activity (out of the laboratory), keep in mind that eye protection is mandatory and the goggles chosen should be "tuned" to the laser frequency in use! In every book I referenced, this important rule was stressed. There is currently an argument concerning the energy density of collimated (beam) light incident on the cornea (and retina) that will produce eye damage. If you have any questions of the energy levels involved, contact the proper sources for the facts.

The intensity of laser light can reach levels of over 1,000 MW/cm2. A beam of such intensity can cut through and vaporize materials. A laser currently being developed for atomic fusion applications has a temperature of about 100 million degrees and can supply 40 trillion watts of power on target to an atom.

What role does the laser play in the world familiar to us? Thousands of lasers in medical use perform tasks such as cauterizing wounds and destroying cancerous cells. The focused beam exhibits a high energy concentration — as high as the surface of the sun in spots a few thousandths of an inch in diameter. From a short distance away, however, the beam is no stronger than that from a standard light bulb.

The distance to the moon was measured to an accuracy of less than five feet when Apollo 11 carried a special mirror reflector on their journey. The use of microminiature solid-state laser arrays in the computer memory area, in conjunction with light-sensitive materials, can store and retrieve up to a billion bits of data from an area measuring one centimeter square (0.2 in^2). This is a density increase of nearly ten thousand times that of the modern computer memory.

Holography, invented by Dennis Gabor in 1949, is being developed as a medium for data storage in computers. The manufacture of IC chips is assisted by laser beams 300 millionths of a meter wide in the photographic processes, providing precision necessary for the scale of the work.

For the time being, laser communications are limited. Turbulence in the atmosphere limits the amount of information that can be transmitted. One method of eliminating this problem is to confine the beam to a pipe. This might not be practical for the average radio operator, however.

I could cite more examples of lasers in use today, but it would fill many pages. If you are involved in laser communications, drop me a line. I would be happy to hear about your project and share your experiences with others. Though much has been written on laser systems and how they operate, little can be found in the Amateur Radio journals. How many experimenters are dabbling in the world of lasers and employing those applications toward Amateur Radio?

References

[1] Carroll, John M., The Story of the Laser, E. P. Dutton & Co., Inc., New York, 1964, First edition.

[2] East, Thomas D., WB8LOX, "Oh, I Work the 8000-Angstrom Band," QST, July 1974, p. 64.

[3] Fink, Donald G., and Christiansen, Donald, Electronics Engineers' Handbook, McGraw-Hill, Second Edition.

[4] Fox, R. W., Optoelectronics Guidebook — With Tested Projects, Tab Books/No. 836, Copyright 1977, First Edition.

[5] Leinwoll, Stanley, "Lasers, Part I," CQ, August 1964, p. 24.

[6] Marsh, Ken, The Way the New Technology Works, Simon & Schuster, New York, Copyright 1982.

[7] Meyer-Arendt, Jurgen R., Introduction to Classical and Modern Optics, Prentice-Hall, Inc., Englewood Cliffs, NJ, 1972.

[8] Patterson, Jack L., W6POP, "Operation Red Line," QST, July 1963, p. 66.

[9] Schrader, William L., W4UDS/Ø, Amateur Laser Contact Established, QST, July 1971, p. 93.

[10] Technical Staff of CSELT (Centro Studi e Laborator; Telecomunicazioni, Turin, Italy), Optical Fibre Communication, 896 pps., McGraw-Hill, Publication date: February 1981, Copyright 1980.

[11] Texas Instruments, Inc., The Optoelectronics Data Book for Design Engineers, First Edition.

Bits

The Handbook of Bar Coding Systems

By Harry E. Burke, under the aegis of the Data Pathing Systems Division/NCR Corp., 240 pages, 83 illustrations, 6 x 9, Van Nostrand Reinhold, $42.50. Publication date: August 1984.

Bar coding has quickly progressed from an obscure pattern on a few grocery items to a technology of major concern to nearly every productive organization. Now recognized as the cornerstone of any effective MRP program, bar coding can help companies realize tremendous savings through tighter control of shipping, receiving, work in process and finished goods inventory.

This handbook provides sound guidelines for organizing a good bar coding system — one that is versatile, economical and reliable. Written in clear nontechnical language, it describes what bar codes are and how they are used. It examines various coding schemes, showing how to implement them, how to use them in document networking, how to read the codes and how to print them using various state-of-the-art printers.

Harry E. Burke clearly relates the technology of bar codes to their applications showing why bar coding, to be effective, must be treated as a printable machine language. His comparison of bar codes, Mag-stripe and OCR reveals bar coding as the only practical alternative. Burke also describes what performance to expect from a system constructed from currently available products and what advances to expect in the future.

Document networking is thoroughly covered. This area holds great potential for both computers and bar coding technology. Applications examples clarify documents used to direct work and control performance reporting, labels used in automated identification, methods of maximizing transaction security and ways of developing audit trails. As a useful aid to comparison, the appendix details the composition of a number of bar codes.

The handbook will be of value to both users and suppliers of bar codes, or anyone responsible for implementing the technology. It will be particularly useful to those involved in production control and management information systems.

The author founded and managed Consolidated Systems Corp. as a joint venture between Allis Chalmers, IBM, and Bell and Howell. He supervised the development of mass spectrometers, chromatographs, infrared spectrophotometers, magnetic tape recorders, and a wide variety of data collecting and processing systems. He has given over 200 tutorials on this subject in five countries, and has written published articles on instrumentation, data processing, factory data collecting, process control and general management.

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A second level of support is provided with utility subroutine libraries callable from "C," BASICA or Assembly Language. Several other functions can be called directly from PC-DOS.

The PC-EYE Model 1100 is priced at $610. For further information, address inquiries to Bruce Monk, V.P. Marketing, 6 Continental Blvd., P. O. Box 370, Merrimack, NH 03054; tel. 1-800-OCHORUS or (603) 424-2900.

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