SPECTOR 2

K. W. Newson,
B.Sc(Hons)

Summary SPECTOR (Single Path Error Correcting Telegraphy Over Radio) is the Marconi equipment which meets CCIR Recommendation 476 for the direct-printing marine telex service. The equipment operates in either the automatic repetition request (ARQ) mode or one of two forward error correction (f.e.c) modes and can selectively call similar equipment over h.f radio circuits. It incorporates an optional frequency shift key modulator and demodulator so that the transmitting and receiving equipment is simplified. In addition, control signals for the radio equipment are provided to enable an integrated system to be assembled easily.

SPECTOR 2 supersedes previous equipment and incorporates a microprocessor and other modern techniques. Its use is sufficiently simple for it to be fitted to small ships which have no radio operator. Here it gives an automatic telex receiving and semi-automatic sending facility utilizing a store and forward operating principle. It is equally suitable as a direct interface between a radio operator's teleprinter and a shore station, and integration into a sophisticated automatic message-handling system is facilitated by its serial remote-control capability.

K. W. Newson
Keith Newson graduated with an Honours Degree in Electrical Engineering from the University of Leeds in 1961 and then joined The Marconi Company as a graduate apprentice. He contributed to the design of h.f receivers and naval drive equipment, and subsequently became Section Leader.

In 1973, Mr. Newson was given the oversight of the design of a remote control terminal equipment (H6800) for the control of h.f transmitters and receivers via audio land lines or line-of-sight radio links.

He was later appointed co-ordinator of microprocessor hardware design for h.f equipment and then Section Leader responsible for the design of SPECTOR 2.

Introduction

Since the introduction by Marconi Communication Systems of the SPECTOR equipment Type U2221 some eight years ago, the replacement of hand morse circuits for radio communication between ships and coast stations has proceeded rapidly. Hundreds of Marconi SPECTORs are installed in ships the world over. SPECTOR equipment has also been supplied for totally land-based teleprinter point-to-point circuits using h.f radio. The use of SPECTOR reduces the number of errors introduced into the transmitted text by the effects of interference and fading on the radio circuit. Thus messages can be transmitted from or to a ship without the intervention of a radio operator, and are of adequate quality for a connection directly into or from an international telex network.

The escalating demand for equipment, and the need to be able to accommodate refinements to the operating principles, initiated the design of the new version of SPECTOR, designated SPECTOR 2, Type U2231, which incorporates microprocessor control. It is designed to have a comprehensive inter-working capability with its predecessor and with equipment by other manufacturers which complies with CCIR Recommendation 476 for the direct-printing marine telex service. Some of the detailed refinements incorporated may apply only to a system with a SPECTOR 2 at each end.

The teleprinter interface

Land-based teleprinter traffic is handled using a 5-unit ITA 2 code (International Telegraph Alphabet No.2) at a data rate of 50 baud. The 5-unit code is usually used in asynchronous format, using a 1-bit start element and a 1 or 1½-bit stop element. For transmission over short distances the polarities, voltages and load resistance to be used are to CCITT Recommendation V28, which is often loosely referred to as a 6-0-6V signal. For long-distance direct-line communications, a high-voltage double-current signal is often used, such as ±80V at 20mA, and the UK polarity convention is the same as for V28. Alternative voltage, current and polarity standards exist, most of which can be accommodated by SPECTOR 2.

The radio interface

When data transmission takes place over audio quality lines or h.f radio, as is the case with the radio side of SPECTOR 2, a common practice is to convert to a frequency shift keyed tone (f.s.k), using a modulator. The higher frequency tone or B signal corresponds to a space, and the lower or Y signal to a mark.

H.F radio communication is characterized by variation of the received signal with ionospheric conditions and there are many causes of such variations. Long-distance propagation may involve several ionospheric reflections, each having a different path length. A propagation delay of nearly 30ms is encountered on a path length of 5,000 miles and if the received signal is a combination of signals which have come via different routes, multipath distortion of up to a few milliseconds results. Although the effect is minimized by using the maximum allowable

Fig. 1. SPECTOR 2

frequency for a particular route, it is desirable to have the data bit length not less than 10ms, which corresponds to a 100 baud data rate.

Another aspect of this problem is that propagation conditions may not be the same for signals differing in frequency by only a few hundred Hz, giving rise to selective fading. One solution is to restrict the bandwidth occupied by the radio signal, and here the f.s.k modulator in SPECTOR 2 meets the requirements of CCIR Recommendation 476 in using a 170Hz shift (±85Hz).

The techniques used in SPECTOR 2 to reduce the effects of fading are essentially based on the use of an error-detecting code and repeating a character at a later time. There are two distinct modes in which the SPECTOR 2 passes traffic over the radio path. One is forward error correction (f.e.c) in which each character is sent twice, the repeated character being spaced from the direct one by interleaving four other characters. The other is ARQ mode, in which characters are transmitted in blocks of three and each block is repeated until it is received without a detected error. In order to maintain the character transmission rate over the radio link equivalent to that from the teleprinter, notwithstanding either sending each character twice (in f.e.c mode) or pausing for a response to each transmission (in ARQ mode), 100 baud keying is used in synchronous mode. A 7-unit redundant code is used which permits detection of single-bit errors. The codes for the 5-unit characters and controls all have a net 4:3 space-to-mark ratio.

F.E.C mode

F.E.C, a collective broadcast mode of operation (CCIR Recommendation 476, Mode B), does not require a return path and is particularly useful for sending messages to a ship which either is not permitted to use its transmitter or cannot because it is out of service.

A SPECTOR 2 receiving traffic in f.e.c mode tests each code received in the DX (direct) position for a 4B:3Y ratio, rejecting the character if the ratio is incorrect. Five periods later the same character is received in the RX (repeat) position and tested for a 4:3 ratio. If the ratio is not correct, the character stored from the DX position is output to the teleprinter. If the DX character was not stored because its ratio was also in error, an error symbol is output. Additionally, before a correct RX character is output, it is compared with the stored (and therefore correct ratio) DX character and, if different, an error symbol is printed instead of the RX character. This may occur with multiple bit errors. The definition of the DX and RX positions is provided by phasing signals. These are emitted as a preamble to the message by a SPECTOR 2 calling in f.e.c mode.

To allow a SPECTOR 2 equipment to receive at least some of a long broadcast message in f.e.c mode, of which it has missed the preamble, four pairs of phasing signals are automatically inserted by the sending SPECTOR 2 after every 96 traffic characters (i.e. every 13.44s). A receiving SPECTOR 2 can establish phase on these signals and, following a carriage return or line feed signal, will output the remainder of the message to the teleprinter. In addition, any pauses in the input from the teleprinter to a sending SPECTOR 2 are automatically filled with phasing pairs.

Under conditions of severe fading or signal interruption, random noise received by SPECTOR 2 will be interpreted as comprising some characters having a correct 4B:3Y ratio. A receiving SPECTOR 2 in f.e.c mode counts all the characters and separately counts those without error. If the character count reaches 64 before 20 characters without errors have been received, the SPECTOR 2 will revert to standby.

Whilst a message is unmutilated by error bursts of up to 280ms duration, two single errors affecting the DX and RX positions of the same character result in the printing of an error symbol.

Selective f.e.c mode

The intention of sending a message in this mode is to restrict its reception to the equipment having a specific call-sign, but where acknowledgement of receipt of the message is not possible. A phasing preamble of 64 pairs of signals is transmitted, as for the collective (non-selective) f.e.c mode already described. However, there next follows a transmission of the 4-character call-code delimited by an idle service information signal. This sequence is repeated 16 times. As a security measure, this sequence and all subsequent traffic characters are emitted in a 3B:4Y ratio, i.e. inverted. Consequently, any SPECTOR equipment which has not recognized its own call-code (inverted) will interpret each character as having an error and will revert to standby when the prescribed error count is exceeded. To make unauthorized reception more difficult, the traffic pauses are filled with single idle service information signals instead of the pairs used in collective f.e.c mode to facilitate phasing.

The receiving SPECTOR which detects its own call code (inverted) inverts all subsequent characters before testing for errors and decoding to ITA 2 signals.

ARQ mode

ARQ is the prime mode of operation for this type of equipment and requires a return radio path so that the automatic repeat requests can be passed to the

sending station. The ARQ transmit/receive sequence has to take account of the propagation time over the radio path between the two stations, and the delay of the equipment in switching from receive to transmit. It is necessary to activate the transmitter after the receiver has been muted and, if common-antenna working is employed, to change over the antenna switch. With modern equipment and solid-state switching this can be done very rapidly, but older equipment is slower. SPECTOR 2 caters for these variations by enabling the switching delay to be preset to between 0 and 20ms. The transmit command is generated in advance of the emission of data from SPECTOR 2 by this preset duration. With the delay set to 15ms, a propagation delay of 70ms can be accommodated which corresponds to a path length of approximately half the circumference of the earth which, for the majority of radio circuits, is adequate.

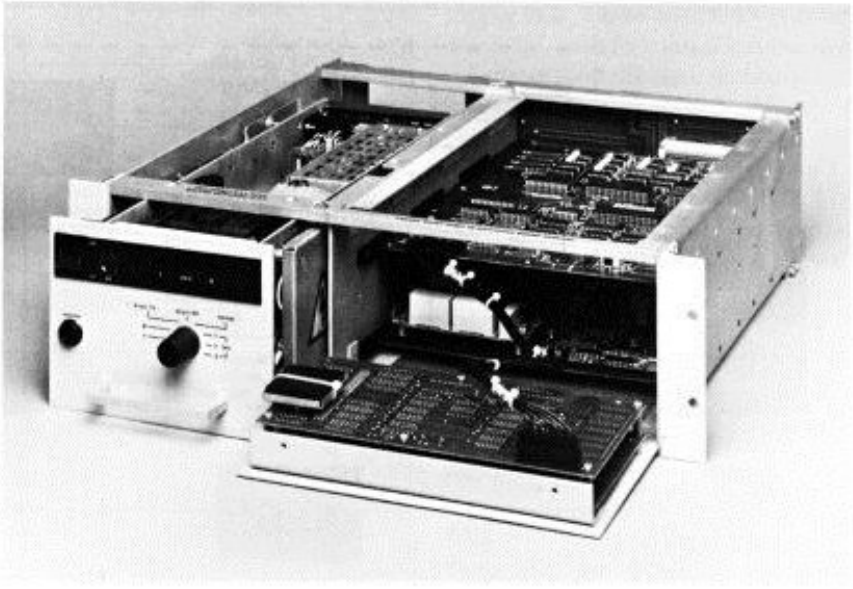

Fig. 2. View with covers removed

ARQ phasing

The station that initiates the call is termed the master station, and the called station becomes the slave. This relationship remains unchanged until the circuit is cleared, regardless of which station at any given time is the Information Sending Station (ISS) and which the Information Receiving Station (IRS). The master controls the timing of the circuit through the exchange.

Initially, the master station assumes the role of ISS and transmits the call-code of the required station. On recognizing its own call code in an incoming phasing sequence, the selected station assumes the role of a slave IRS. The IRS aligns its element synchronization and character phasing to the received signal and then returns a control signal to the master station. The master station then aligns its timing circuits with the incoming control signal characters, and sends the first block of three traffic characters.

ARQ traffic

When the IRS has received a block without error it transmits the control signal necessary to call the next block. However, if Block 1 is received mutilated, the IRS requests a repeat. It is also possible for reception of the control signals by the ISS to be mutilated and in this case the ISS transmits a block of three special characters. The phasing IRS must now repeat its previous control signal. This sequence permits correct transmission of a message, despite errors introduced in the radio path in either direction.

During temporary gaps in traffic the ISS continues to send blocks of three characters, the gaps being filled with idle service information characters. The IRS responds with control signals exactly the same as for traffic, but no signal is output to the IRS teleprinter.

The Over sequence

A very useful feature of the equipment is the ability to change the direction of communication from either the IRS or ISS, whether a master or a slave station. The OVER control is on the front panel, but at an ISS it is possible to achieve the same result by typing a particular sequence on the teleprinter.

The Answerback sequence

Teleprinter operators on line circuits will be familiar with the WRU (Who are you?) sequence, which interrogates the distant teleprinter and obtains an automatic response giving the distant teleprinter's identification code. Using a radio path, the operator causes his teleprinter to send traffic information combinations 30 and 4 (commonly known as Figs.D). SPECTOR 2 sends these characters as traffic, but at the IRS it initiates an over sequence and actuates the teleprinter answerback code generator. After the changeover and the completion of the transmission of the answer-back code, a second over sequence is automatically initiated so that the status of both stations is reinstated.

Rephasing

When reception of information blocks or of control signals is continuously mutilated, the equipment reverts to standby status after 32 cycles (of 450ms) of continuous repetition. The master station immediately initiates rephasing by sending the slave's call code, trying to establish phase, but if unsuccessful the master station reverts to standby status. If, at the time of losing phase, the slave station was the IRS, successful rephasing will be followed immediately by the same control signal as was last sent before phase was lost. This avoids loss of a traffic block on resumption of communication.

A master station with IRS status, when loss of phase occurs, will initiate an over sequence as soon as phase is re-established.

An ISS which wishes to terminate the established circuit sends the 'end of communication' signal. On receipt of the appropriate control signals indicating unmutilated reception, the ISS reverts to standby status. If, after four transmissions, no control signal has been received, the ISS still reverts to standby status.

Integration with associated equipment

Figure 3 shows SPECTOR 2 diagramatically and the way in which it is integrated with a basic radio system. The traffic buffer store receives the

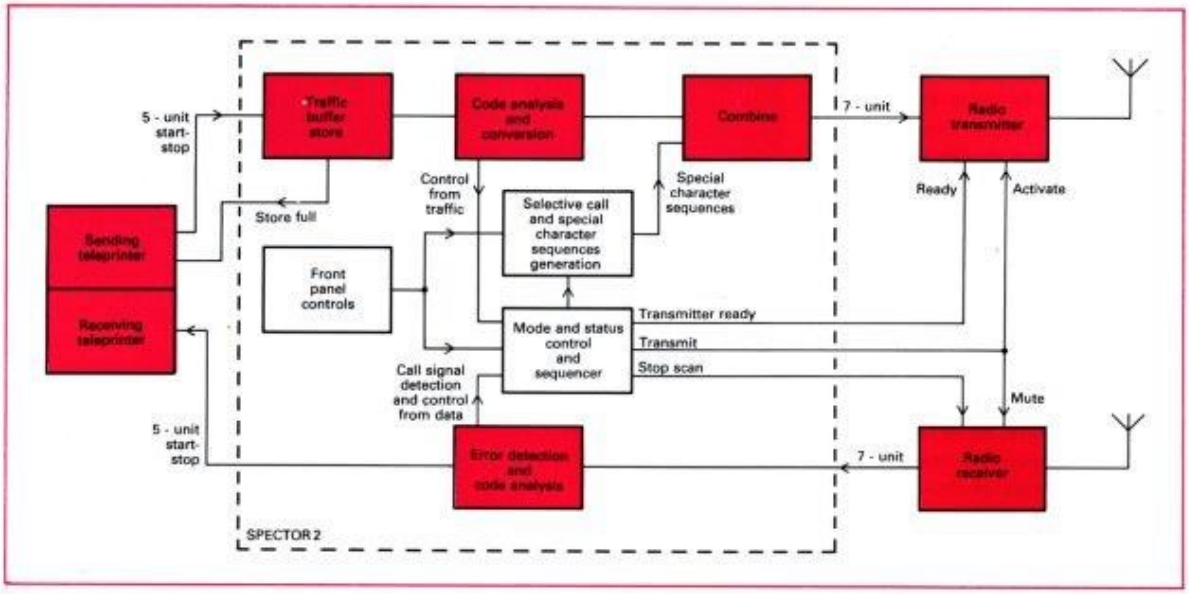

Fig. 3. Simplified functional diagram

5-unit start-stop characters from the sending teleprinter. The store full control is used to stop the teleprinter output when necessary. As the message is read out from this store it is analysed for the presence of special control characters. These are operated upon as necessary, indicated by the rectangle labelled 'Mode and Status Control and Sequencer' in figure 3. A further input to this function comes from the front panel controls (e.g Over and Standby). From the front panel it is also possible to specify a selective call-sign, which generates a special sequence of characters. The sequence of characters produced as a result of front panel operations are combined with the traffic in the appropriate positions as symbolized by the block labelled 'Combine' in figure 3. The 7-unit code resulting from the conversion of 5-unit traffic characters and the control sequences just mentioned, leaves SPECTOR 2 and modulates the radio transmitter.

The 7-unit code demodulated from the received radio signal passes through the error detection function and, again, certain character sequences affect the control of SPECTOR 2. The remainder are converted to 5-unit start-stop format and may be printed by a receiving teleprinter.

The Transmitter Ready control line goes active 450ms before a message is emitted by the SPECTOR 2. This enables the transmitter to be in a state where it can rapidly be activated by the Transmit control line. The Transmit output is active for an adjustable time between 0 and 20ms before data is output in ARQ mode, as described above, where transmission and reception cycles occur every 450ms. This control also de-activates the transmitter and de-mutes the receiver at the appropriate reception times.

It is common practice for ships to work in ARQ mode using a two-frequency simplex operation. The two frequencies, one for receiving and the other for transmitting, are usually in the same waveband. Simplex is necessary because of the low attenuation achievable between the transmit and receive antennas on a ship, which often makes the transmitter noise output at the receive frequency intolerable unless the transmitter is de-activated.

A facility is included in SPECTOR 2 which enables it to recognize a Channel Free signal, described later, or its call sign and to produce a Stop Scan control signal. This is used to inhibit further scanning of a receiver which has the capability to be programmed to sequence through a number of radio channels until the required signal is detected by the SPECTOR 2.

All the functions described are controlled by a microprocessor interpreting programmed instructions.

Call signs

All SPECTOR 2 equipment requires a call sign to be allocated to it unless its use is restricted to collective f.e.c mode. The equivalent call code is stored in a fusible link PROM (FLP). The call signs are 3, 4 or 5-digit numbers. In SPECTOR 2, 3-digit numbers are applicable only in ARQ mode. The 100,000 different 5-digit call signs are converted to 4-letter combinations as well as the 10,000 4-digit ones. When an equipment makes a call in ARQ mode the call code is transmitted in two blocks of three characters, the gap fillers being service information signals. In the f.e.c mode, the four call-code letters are transmitted sequentially, each 4-letter call code being separated by an idle service information signal.

An additional facility offered by SPECTOR 2 in the f.e.c mode is the use of additional group call signs. As an example, each ship in a fleet would have an individual call sign, but all may additionally have a common group call sign enabling them to be contacted simultaneously, yet still providing protection against reception by unaddressed equipment. SPECTOR 2 caters for two 4 or 5-digit group call sign numbers in addition to the individual three, four or five-digit call sign.

'Break-in' and 'Save' facilities

Further new facilities available in SPECTOR 2 are 'Break-in' and 'Save'.

The break-in facility is effective in any operating mode of SPECTOR 2 and is useful when there is a requirement to send an urgent message whilst a message of lower priority is already being transmitted, some or all of which will be in the main traffic buffer store at the time. Transmission of that message is inter-

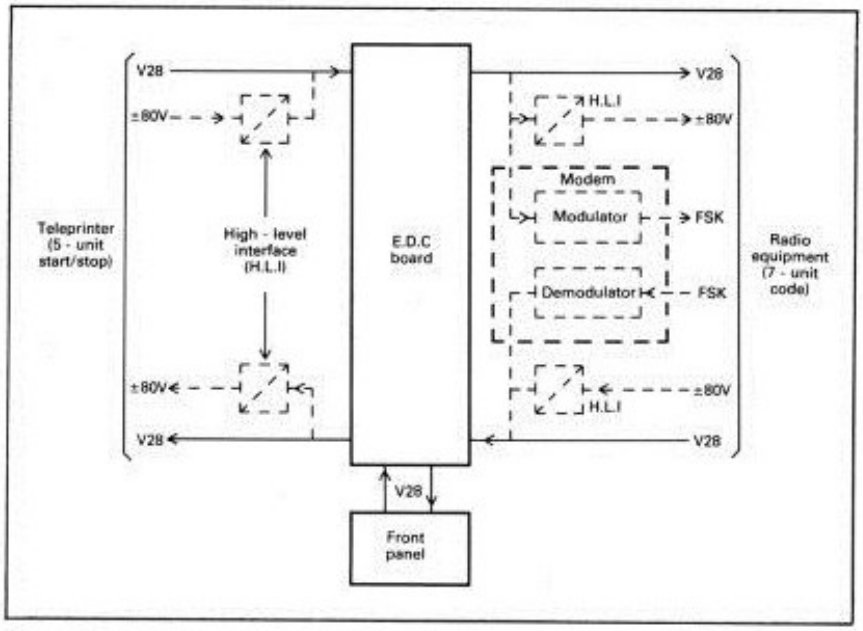

Fig. 4. Simplified block diagram showing options

rupted, the remainder being retained without loss of characters, and the contents of the 37-character break-in buffer store is transmitted, followed by any message from the teleprinter. Following deselection of break-in, transmission of the lower priority message continues.

The save facility, when selected, enables the transmission of a message from the main traffic buffer store non-destructively, so that the same messages can be sent later to another station, or repeated to the same station where necessary.

The equipment

The equipment comprises two essential assemblies, together with a power supply unit. These are the front panel assembly, with its control buttons and indicators, and the error detection and correction (e.d.c) board. Figure 4 shows these two in the centre and also the interfacing options which can be incorporated in the SPECTOR 2. The high-level interface unit (h.l.i), with its associated protected multiple voltage telegraph power supply unit, enables the various keying voltage standards mentioned earlier to be interfaced. The modulator and demodulator are combined into one modem printed-circuit board, and they convert the 7-unit V28 signal to f.s.k and vice versa.

EDC board

From the description of the traffic sequences involved in ARQ mode, coupled with the assumption that further refinements to the operating procedures will be adopted in the future, it will be obvious that a microprocessor design with its program control fulfils the requirements. The processor selected was the Z80. Figure 5 shows the essential component configuration. A high-stability clock generator is used to maintain the 7-unit 100 baud data rate accurately. Two counter timer circuits (CTC)

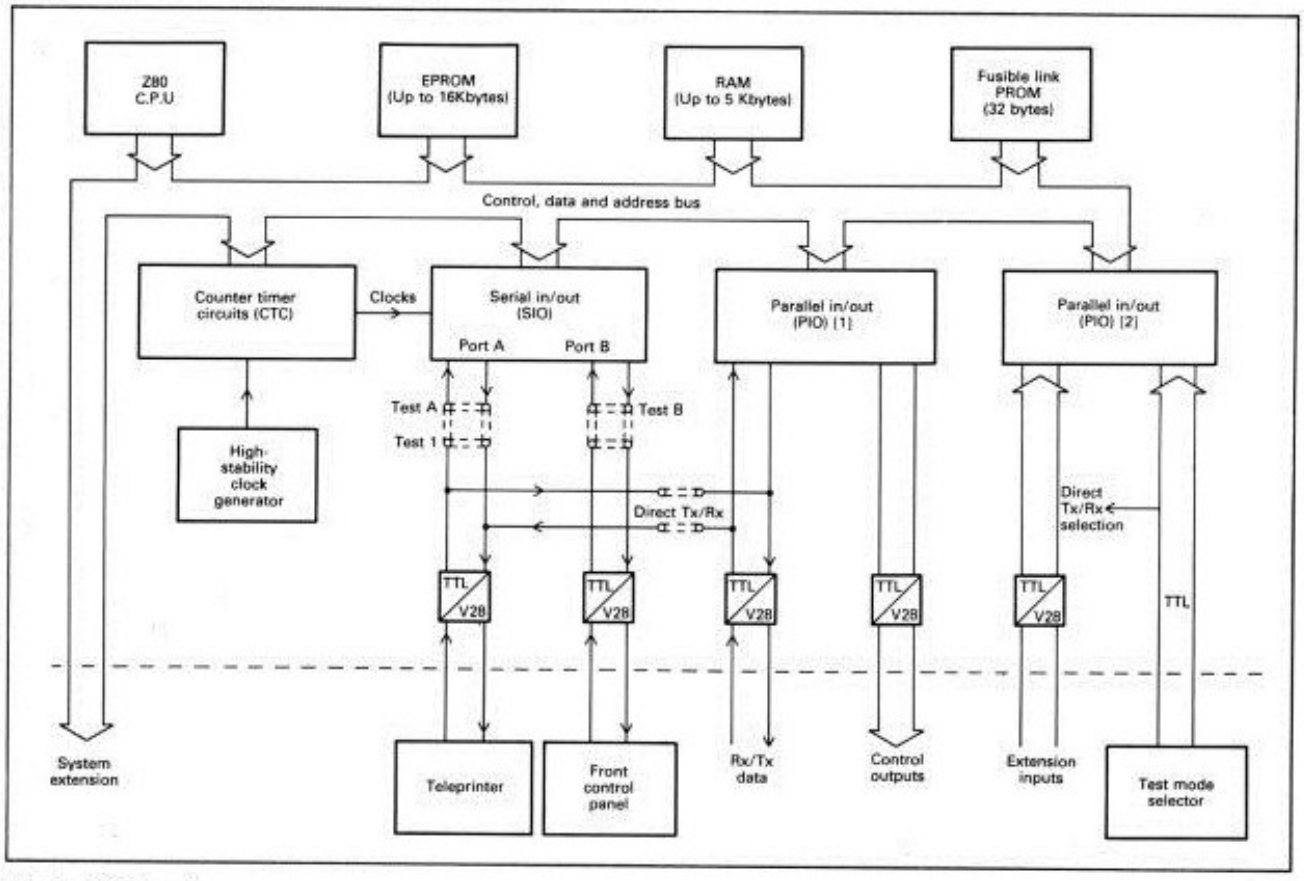

Fig. 5. EDC board

Table 1: Fusible link PROM byte assignment

Byte number	Assignment
0	Number of blocks in coded station call-sign (1 or 2)
1, 2, 3,	Station call-sign in coded form, one byte per alphabetic character, (based on ITA No.2 code)
5	Definition of error symbol to be printed (based on ITA No. 2 code)
6	Selection of occurrences to initiate the alarm
7	Teleprinter mode (half or full duplex)
8	Transmit signal delay time (0–20ms)
9, 10, 11, 12	2-block group call-code No. 1 (same form as station call-sign)
13, 14, 15, 16	2-block group call-code No. 2 (same form as station call-sign)
17	Buffer store capacity

provide the transmit and receive timing, the receive phasing and the element synchronization timing functions. A serial input/output interface controller (SIO) handles the 5-unit start-stop teleprinter signals and the serial interface to the front control panel. Two parallel input/output interface controllers (PIO) handle the 7-unit transmitter and receiver data and the many control inputs. All such signals which leave the equipment are converted to V28 signal levels to provide noise immunity. The memory devices comprise up to 16 Kbytes in EPROMS containing the system program, up to 5 Kbytes in RAMs which store variables and form the traffic buffer store, and 32 byte FLP containing the various customer options (refer to Table 1 for a list). Several loop round test switches have been included to aid fault isolation and these will be described later.

Control panel circuit

To minimize the inter-unit wiring, as well as to make the front panel removable for a remotely controlled equipment, changes in the control panel switch positions and indications are communicated to and from the e.d.c board in a serial data format at V28 voltage levels. A universal asynchronous receiver/transmitter (UART) is used to provide the serial-to-parallel interface. The momentary-action switches set latches which are regularly polled, and double-key operation is prevented. The l.e.d indicators are driven via buffers from latch outputs.

Modem circuits

The three alternative standard centre frequencies of 1500, 1700 or 1900Hz are selectable by simple link changing. Since the modem is designed to simplify the requirements of the radio equipment, elaborate transmit filtering is included to minimize the unwanted output spectrum and to improve the normal receiver i.f selectivity. These provisions help considerably when radio channels at 500Hz spacing are used. For the demodulator, the choice between a discriminator and a slide-back detector resulted in the former being used for simplicity. At the 170Hz shift used, there is a negligible performance difference under practical selective fading conditions.

Referring to figure 6, the two fifth-order equal ripple delay band-pass filters are identical and centred on 5100Hz. The f.s.k generator produces its ±85Hz signal centred on 5100Hz. By down conversion, using one of three local oscillator frequencies derived from the crystal oscillator clock generator, the three alternative output centre frequencies are produced. A low-pass filter removes the unwanted upper sideband at 8500Hz (for 1700Hz output) and reduces any other spurious signals above 3kHz. The output is converted to 600Ω balanced for output to the transmitter drive. Solid-state switches are provided for a loop-round test. The signal from the radio receiver is converted from 600Ω balanced to single-ended and upconverted to

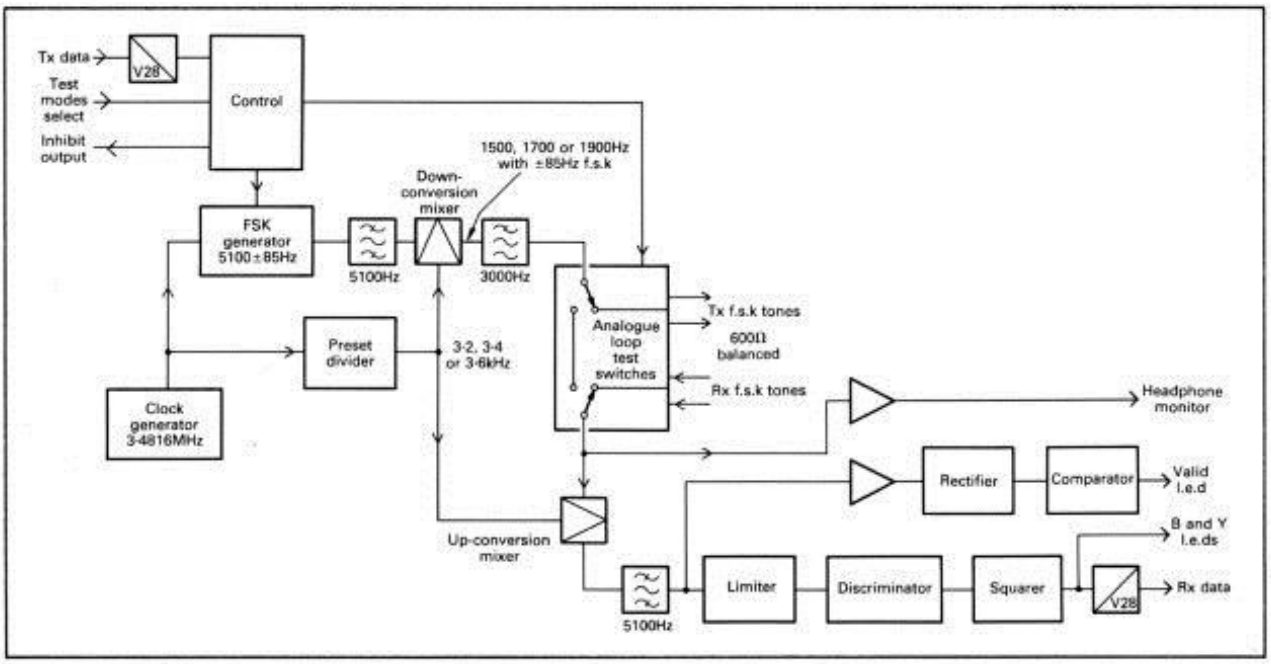

Fig. 6. Modem block diagram

5100Hz using the same local oscillator frequency as the downconverter. An amplifier, rectifier and comparator circuit are used to illuminate a VALID l.e.d when the signal amplitude is large enough to be successfully demodulated. After the discriminator, the output is converted to V28 levels for connection to the e.d.c board. A drive to two B and Y tone indicating l.e.ds is also provided. As a monitor, headphones may be plugged in to listen to the audio signal from the receiver.

High-level interface and power supply unit

The high level interface (h.l.i) unit contains two circuits for converting high-voltage telegraph signals to V28 levels, with links which can easily be changed to permit operation on double or single-current circuits, and to accept single-current voltages of either polarity over a wide voltage range. The circuits switch at generally accepted threshold levels and introduce negligible telegraph distortion. Opto-isolating devices eliminate any conducted interference between the high-level signalling voltages and the SPECTOR 2 circuits. Two similar circuits are provided for conversion in the opposite direction. Reference to figure 4 will show the possible functional locations of these four interface circuits.

An optional addition to the power supply unit (p.s.u) contains the components required to power the high-level output interfaces. Wire links can easily be changed to provide the various supply voltage options and to select internal or external supply, with or without additional short-circuit protection. Also in the p.s.u is a relay which can loop round the 7-unit high-level signals for test purposes.

The main p.s.u function is to provide a closely controlled +5V supply (at up to 5A when extension circuits are powered from it), a ±12V 250mA supply, predominantly for the many V28 interface circuits, an unstabilized dual polarity supply for the modem (which has on-board stabilization) and a.c supplies to the high-level telegraph supply mentioned above. To minimize the heat dissipation, a switching regulator is used to stabilize the 5V supply. Remote voltage sensing, current fold-back short-circuit protection and excess-voltage crowbar protection are incorporated.

Front panel

Considerable thought has been given to the layout and appearance of the front panel and to the selection of pushbutton switches for reliability and convenience of use. The numeric keypad, used to set up the call-sign, is placed on the right-hand side and arranged in an easy-to-use 3×4 array, including the associated CLEAR and ENTER keys. The call-sign display is immediately above it. The three most frequently used pushbuttons, namely MUTE ALARM, CALL and STANDBY are emphasized by making them wider than the others. All the pushbuttons (excluding those forming the keypad) incorporate l.e.d indicators. The test function switch, the monitor socket and B, Y tone indicators are mounted on the left-hand side, on the front panel of the p.s.u. Also on the p.s.u front panel is the mains switch, neon indicator and fuse. These remain part of the equipment when the controlling front panel is mounted separately in remote-control situations.

Fault location

The aim of the design was to establish whether the fault is in SPECTOR 2 and subsequently to enable the fault to be traced easily to a replaceable unit. A number of the loop-round facilities have already had a brief mention and reference to Table 2 will show the functions of all the test modes. For checks on the input from the radio receiver, the B, Y and VALID indicators are provided, in addition to the headphone monitor socket. If a failure of the e.d.c board occurs it is possible, in an emergency, to use the Direct Tx test mode and transmit the 5-unit start-stop code directly. A hardware gating circuit provides this link on the e.d.c board (figure 5).

Conclusions

The microprocessor design has led to a considerable reduction in the number of components required to perform the specified functions, which in turn has reduced the number of units and the size of the equipment. The functional

Table 2: Integral test facilities

Test mode selected	Function
Y	Causes a steady V28 signal of positive polarity. If a modem is fitted this will generate the higher frequency tone of the two tones. If a high-level interface is fitted that will produce a steady positive polarity (i.e. +80V, but customizing links permit alternatives). Transmit control line is active.
B	Causes the opposite polarity to that of Y or, if a modem is fitted, the lower frequency tone.
Direct Tx	The ITA No. 2 to 7-unit code conversion and the error detection is bypassed. Teleprinter data is connected directly to the Tx/Rx data. Transmit and Stop Scan control lines are active.
Direct Rx	As for Direct Tx but with Transmit control line inactive.
Normal	Normal operation.
Test 1	The teleprinter output is looped to its input at TTL levels for confirmation of the external wiring and the V28/TTL conversion circuits. Where a high-level interface is used this is also included in the loop.
Test 2	A sum-check on the contents of the EPROMS, a RAM read/write test and an SIO loop-round test are automatically carried out, giving error code indications if a fault is detected. An on/off test of all front panel indicators is also performed.
Test 3	If a high-level interface is fitted, the Tx/Rx data (7-unit) is looped round by a relay at the high-voltage level or, if a modem is fitted, the f.s.k signal is looped round. A successful test is indicated, as in Test 2, by all the panel indicators flashing.

part of the equipment, excluding the p.s.u, is totally incorporated in the e.d.c board and the front panel assembly, which compares with 14 plug-in printed circuit cards for its predecessor. Extra operational features have been included and the versatility provided by software control enables equipment to be modified by replacing only the EPROMs should some other new facility be required. The extension facilities of the e.d.c board and the space provided for an extra plug-in p.c.b will permit adaptation to some future system requirement involving extra hardware.

The achievements are thus flexibility, smaller size, modern appearance, improved reliability and additional operational facilities, including fault-location aids.

The equipment should make an effective contribution to the modernization of the international marine telex service and to other similar applications.

RÉSUMÉ

SPECTOR (système de radio-télégraphie mono-circuit avec correction automatique des erreurs) est l'appareil de Marconi qui répond à la recommandation CCIR 476 concernant le service télex maritime à impression directe. Ce système fonctionne soit en mode ARQ automatique ou selon l'un des deux modes de f.e.c (correction directe des erreurs). Ce système permet l'appel sélectif d'appareils similaires sur les voies radio H.F. Il comporte un modulateur par déplacement de fréquence et un démodulateur optionnels qui simplifient l'émetteur et le récepteur. En outre, des signaux de commande sont fournis pour les appareils radio qui permettent d'assembler un système intégré.

SPECTOR 2, qui comporte un microprocesseur et d'autres technologies modernes, remplace un appareil plus ancien. Simple de fonctionnement, il peut être installé sur des petits navires n'embarquant pas d'opérateur radio. Il fonctionne automatiquement en réception télex et semi-automatiquement en émission selon le principe 'enregistrement et émission'. On peut également l'utiliser comme interface directe entre le téléimprimeur d'un opérateur radio et une station à terre. De plus, son intégration à un système d'acheminement automatique des messages de conception avancée est facilitée par la présence d'une télécommande en série.

ZUSAMMENFASSUNG

SPECTOR – Single Path Error Correcting Telegraphy Over Radio (Einweg-Fehlerberichtigungstelegrafie über Funkstrecke) von Marconi entspricht der CCIR-Empfehlung 476 für Bordtelex mit Direktausdruck. Das Gerät arbeitet entweder mit automatischer Widerholungsanforderung (ARQ) oder mit einer von zwei Durchlaß-Fehlerkorrekturbetriebsarten (f.e.c) und ist in der Lage, ähnliche Geräte über HF-Funkkreise selektiv aufzurufen. Ein wahlweiser Frequenz-Umtast-Modulator und Demodulator vereinfacht die HF-Funksende und-empfangsgeräte. Zur leichten Erstellung eines integrierten Systems sind außerdem Steuersignale für die dazugehörigen Funkgeräte vorgesehen.

SPECTOR 2 ersetzt frühere, unter dem gleichen Namen bekannte, Geräte und enthält einen Mikroprozessor sowie weitere moderne Technik. Betrieb ist dabei einfach genug, um den Einbau in kleine, funkerlose Schiffe zu gestatten, in denen sich, unter Anwendung eines Speicher- und Durchlaßbetriebsprinzips, eine automatische Telexempfangsmöglichkeit sowie eine halbautomatische Sendemöglichkeit ergibt. Das Gerät eignet sich gleichermaßen als unmittelbare Schnittstelle zwischen dem Fernschreiber des Kunkers und der Küstenstation, wobei die in Reihe geschalteten Fernsteuerungsmöglichkeiten außerdem die Integration in ein technisch hochgezüchtetes automatisches Nachrichtenverarbeitungssystem gestatten.

RESUMEN

El 'SPECTOR' (Telegrafia por ondas radioeléctricas correctora de errores de trayectoria única) es el equipo de Marconi que satisface la Recomendación 476 del Comité Consultivo Internacional de Radiocomunicaciones (CCIR) para el servicio de télex marítimo por impresión directa. El equipo opera, ya sea en virtud del modo a petición de repetición automática (ARQ) o por uno de los dos modos de corrección directa de errores, y puede llamar selectivamente a equipos análogos por circuitos de radiocomunicación de alta frecuencia. Incorpora un modulador y desmodulador para la manipulación de cambio de frecuencia optativa, de suerte que los equipos de transmisión y recepción se simplifican. Se suministran, además, señales de control para el equipo radioeléctrico que permite el fácil montaje de un sistema integrado.

El 'SPECTOR 2' reemplaza a equipos anteriores e incorpora un microsistematizador y otras técnicas modernas. Su empleo es lo suficientemente sencillo como para adaptarse a embarcaciones pequeñas que no tienen operador de radio. Aquí proporciona una instalación automática para la recepción por télex y una semiautomática para la transmisión, utilizando un principio operativo de almacenamiento y retransmisión. Es igualmente adecuado como una interconexión directa entre un teleimpresor del operador de radio y una estación costera, y como integración en un mensaje automático solisticado – el sistema de manipulación lo facilita su capacidad de telecontrol serial.