PHILIPS TELECOMMUNICATION

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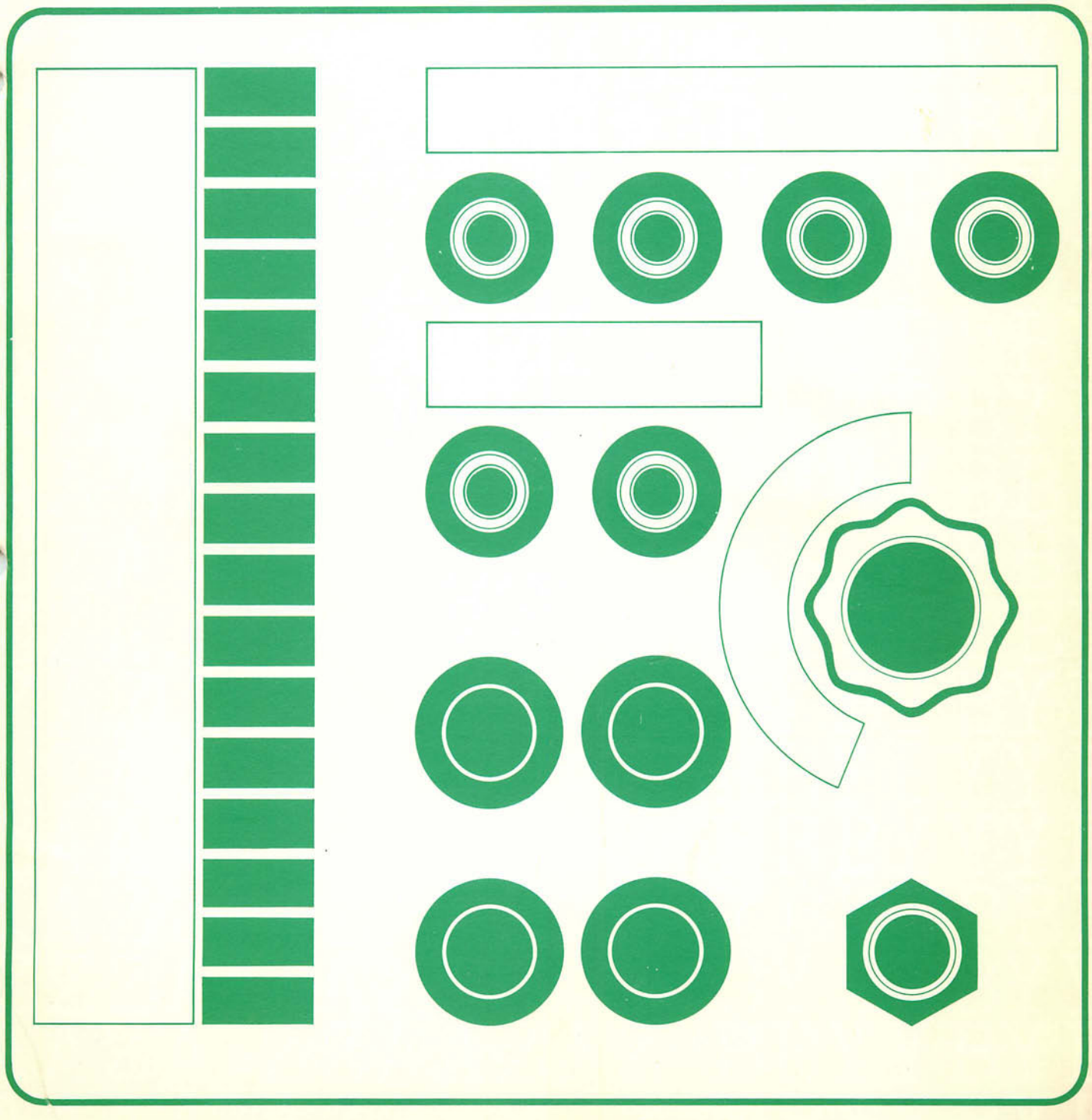
STB|75

Combined Simplex TOR and Forward Error Correcting (FEC) system



INTRODUCTION

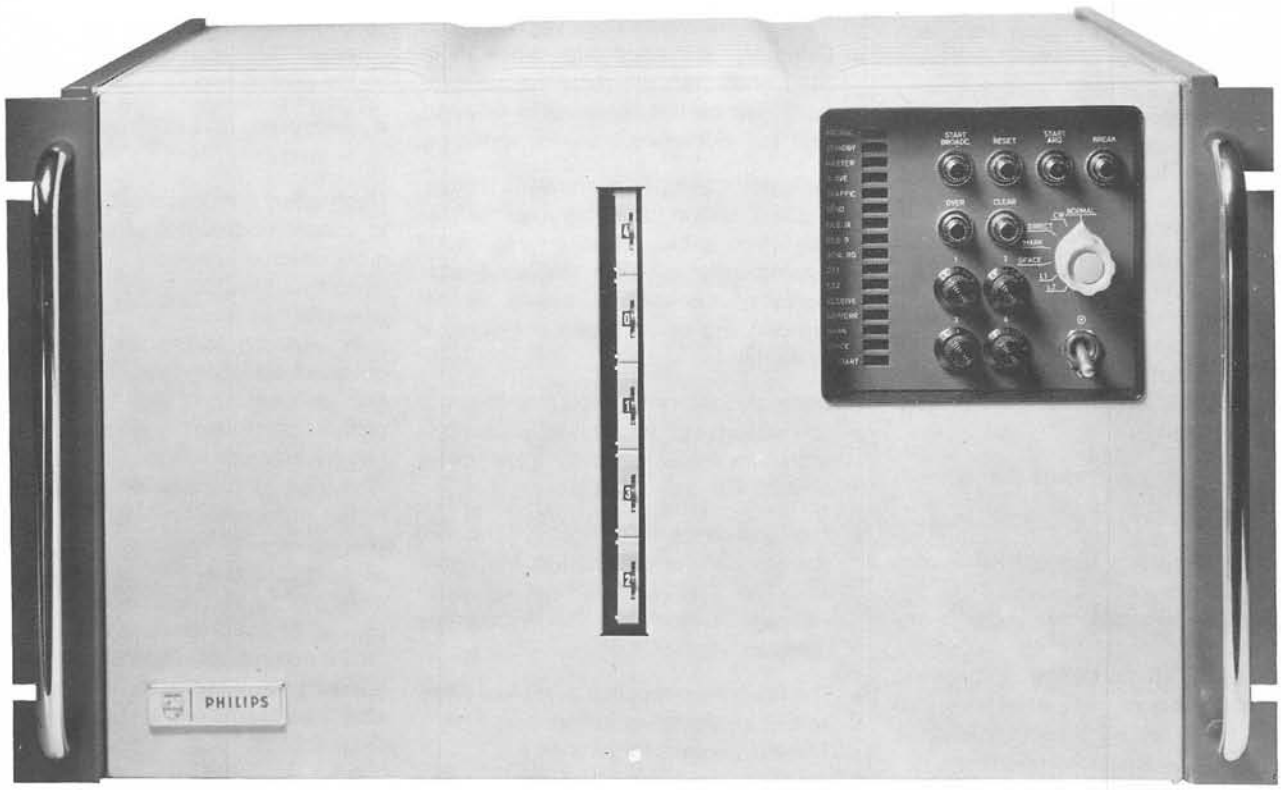
Large areas in the world, and many ships for that matter, still lack adequate means of communication.

This communication gap can now be filled by Philips' combined Simplex TOR and forward error-correcting system, type STB-75. This low-investment equipment may be installed anywhere to provide access to the world-wide telegraph network.

For instance, by itself an unprotected radio connection is liable to errors. It needs, therefore, an effective means of suppressing mutilated characters.
When used in the ARQ-mode the STB-75 system upon receipt of a mutilated character will automatically request repetition of this character and thus ensures practically error-free communication.
When used in the Forward Error Correcting (FEC) mode the system is capable of correcting or indicating errors.
Dozens of years of ARQ-experience have gone into the design of the STB-75 system.

Many attractive features have been built into the STB-75 system. As observed above already a fully equipped system may be switched for two different modes of operation: ARQ-mode and FEC-mode.
Each of these may be used in different ways. On a point-to-point circuit between two stations the ARQ-mode is preferred because of its low error-rate and also because the transmitted message will be received at the other end with certainty. Under conditions where the radio transmitter must not be used (e.g. on board ships in docks) or when the same message must be sent to several stations simultaneously, the FEC-mode provides a good chance of getting the message across at a minimal error rate.

STB-75 Combined Simplex TOR and FEC system



ECONOMIES

More and more ships have their conventional Morse installations replaced by teleprinter equipment.
There is more intensive communication nowadays between ships at sea and shipping company headquarters than in the past. The information is different too: the short messages exchanged formerly have now been replaced by long lists and tables, and even by complete company newspapers.
This change alone would have justified the introduction of teleprinters on board ships. However, there is also the low cost of teleprinter communication, which is about four times as fast as Morse, and makes it the obvious choice.
The potential advantages of a teleprinter link can be exploited to the full only with the STB-75 system. Only with this device can a connection with the public telex network be established with a sufficient degree of reliability.

The most striking economies that go with STB-75 are:

No need to modify existing SSB equipment.
Unattended operation; no extra man/hours.
The task of the Radio Officer is simplified and therefore he may use part of his watch for other purposes such as maintenance of electronic equipment on board.
Immediate contact with called party; no more long waiting hours, a great help in serious situations.
Installation work takes one day on an average, thanks to compact design and versatile mounting methods.
Simple plug-in type connections.
Instructions to a Radio Officer do not take more than one hour.
Maintenance time is reduced to a few minutes for replacing PW-boards in case of faults.

OPERATIONAL ASPECTS

In marine communications or point-to-point circuits between two stations, the ARQ-mode will offer the following advantages:

- STB-75 will replace Morse working by teleprinter operation.
- Error correction will make existing teleprinter channels more reliable.
- Extremely low error rate: when mutilated characters are received, an automatic request for repetition is returned, until the mutilations have disappeared.
- Selective calling is a standard feature: a coast station 'dials' the required station which is then switched into circuit automatically: all other stations standing by on the same frequency, do not respond and cannot listen in. Privacy is guaranteed.
- Coast stations can extend ship-to-shore connections to any telex subscriber, which means faster and more direct contact with the called party.
- The answer-back devices of the two stations can be operated in the usual way. The STB-75 equipment will automatically switch for the appropriate direction.
- The teleprinter operates about four times as fast as Morse equipment.
  There is no need for reruns.
- Printed copies of transmitted and received messages are available immediately.
- When a high degree of secrecy is required, the equipment may be connected to on-line enciphering equipment.
- Messages containing tables and lists of figures can be transmitted safely because there are no misprints.

The FEC-mode is ideally suited to one-way transmission to many stations simultaneously (e.g. to all ships of the same shipping company). This mode offers the following features:

- During reception, the own transmitter is not on the air.
- The transmitted message can be received by all stations suitably equipped.
- When errors are detected, these are corrected in most cases. Uncorrected errors are represented by a blank in the printed text.
- Reception of FEC messages is unattended.

Much effort has been put into the design to ensure trouble-free operation under the most adverse conditions.
Integrated circuits, for instance, were used wherever possible, so that dimensions were reduced and greater reliability was obtained. Reliability was further improved and efficient operation guaranteed by built-in measuring and testing facilities and by indicator lamps.
With plug-in modular units repairs are a matter of minutes.
The equipment can be switched into loop; all functions can then be checked completely, from teleprinter sender through all circuits of the STB-75 in ARQ as well as FEC-mode, up to teleprinter receiver. This feature greatly facilitates the initial testing after installation and the location of faults as practically every operational situation can be simulated.
Many stations transmit unprotected messages and these, too, may be received by STB-75 equipment. This is done by the incorporated demodulator and the teleprinter.

Special versions can be supplied simply by omitting printed cards.
Some of these special versions are:

- D.C. inputs and outputs of radio equipment.
- Parallel-controlled input for external buffer store.
- FEC receive only.

GENERAL

The STB-75 unit is a single-channel ARQ system utilizing a 7-unit error-detecting code with constant space/mark ratio. Instead of duplex operation, simplex operation is used on the radio link.
The line terminal output uses the 5-unit start-stop code of the International Telegraph Alphabet No. 2 at a modulation rate of 50 bauds. The modulation rate on the radio link is 100 bauds.
To ensure an uninterrupted flow of start-stop signals during periods of normal operation and to permit the 'information receiving station' (IRS) to confirm the reception or else to ask for repetition, the information has been divided into blocks of three characters (of 21 signal elements) separated by an adequate idle transmitter period.
Three control signals are employed on the return channel, two of which are used to inform the 'information sending station' (ISS) whether the traffic flow is received correctly or not. The third control signal is used to change the transmission direction.

The STB equipment is fully in compliance with the requirements stated in the recommendation for direct printing telegraph equipment in the Maritime Mobile Service (CCIR Plenary Assembly New Delhi, February 1970, No. 476).
The setting of the relative call code is based upon CCIR rules. The selective code number of ship stations and the identification number of coast stations (5 and 4 digits respectively) as issued by ITU can be set up on the STB-75 by means of thumbwheel switches for transmission. For reception the assigned number is arranged by wire links.

CHARACTERISTICS

Arrangement of information in blocks with marked sequence
When a connection is established, the ISS commences to mark the transmission interval of successive blocks of information alternately with 1 and 2. This marking is continued for as long as the station remains in the ISS condition.
The sequence of reception at the IRS is marked in a similar way so long as unmutilated blocks are received. The sequence marking at the IRS is initially synchronized with the sequence marking at the ISS.

Control signals
These will be referred to as control signals 1, 2 and 3. On the return channel control signals 1 and 2 are alternately sent back to the ISS.
The following rules apply to the signals transmitted on the return channel.

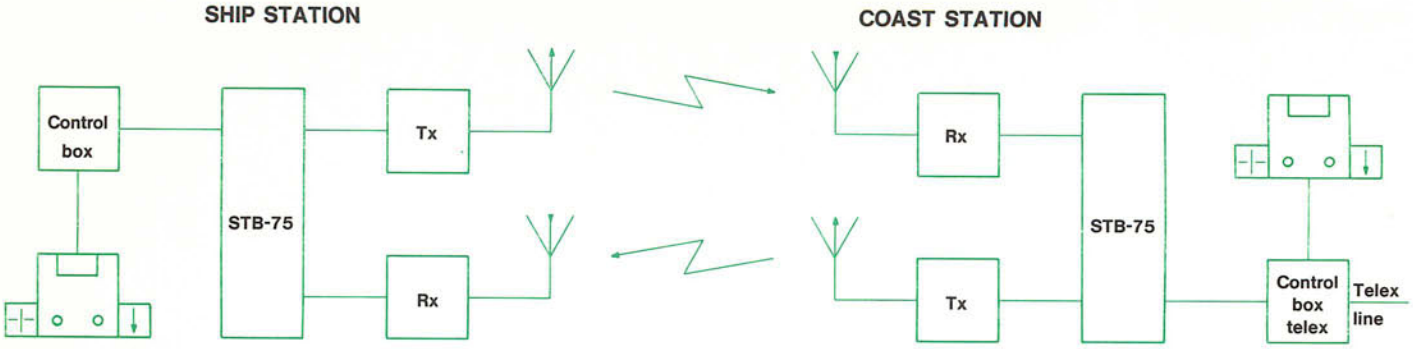
1) On receipt of an information block the IRS transmits only one control signal on the return channel.
2) On receipt of a mutilated block the control signal of the previous block is repeated. This means: repeat transmission of the last block.
3) On receipt of an unmutilated block the IRS transmits the alternative of the control signal transmitted at the reception of the previous block. This means: continue and transmit the next block. If the sequence numbering at the IRS is 1, 2, 1, 2, etc. control signal 2 is transmitted at the end of interval 1, and vice versa.

Control signal 3 serves to reverse the direction of transmission of information between the two stations.
On receipt of control signal 3 the ISS sends a block idle signals $\beta\alpha\beta$ and changes than to IRS after reception of a signal repetition.

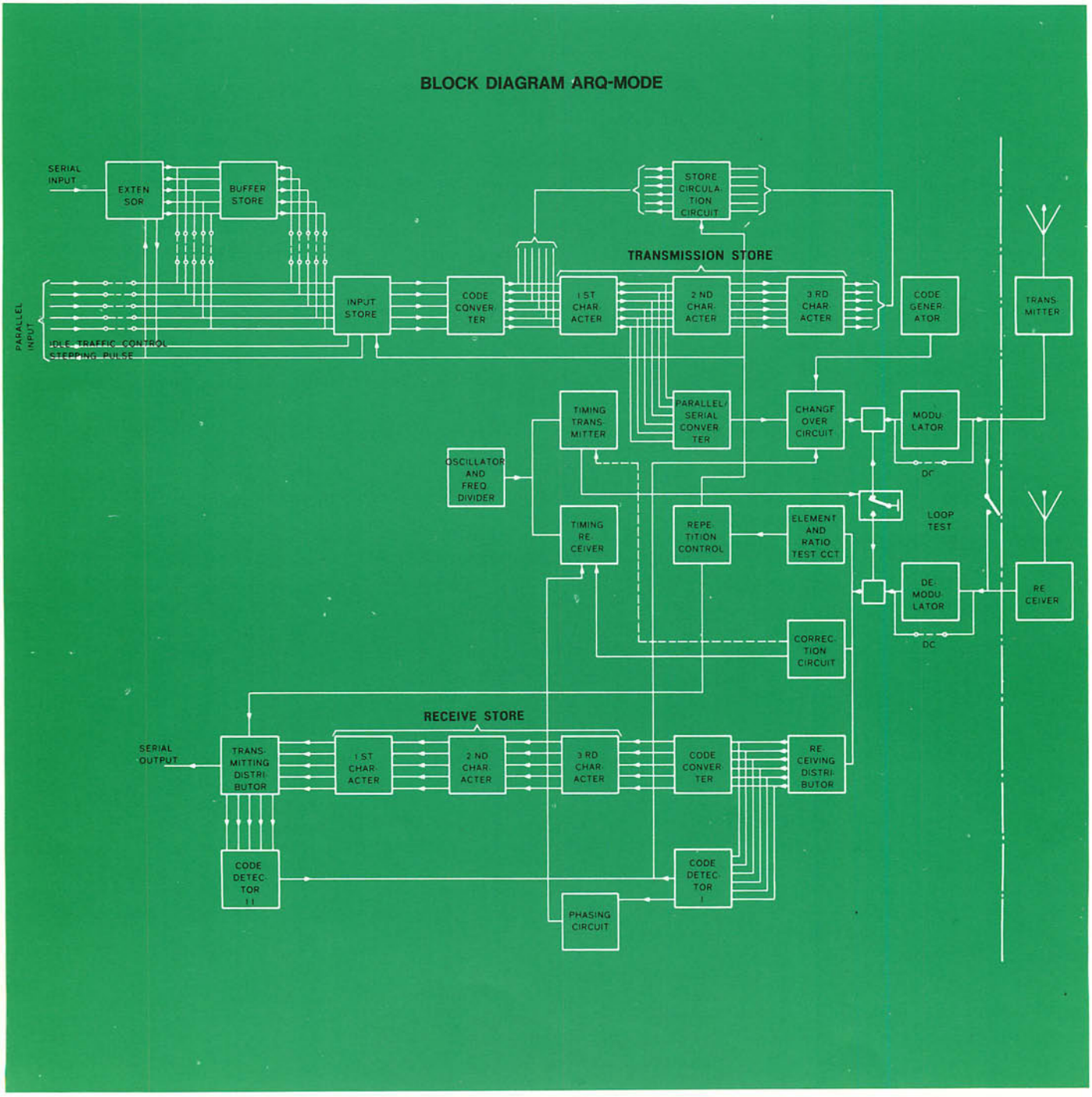
Repetition procedure
The ISS starts repeating the last-transmitted block when the control signal received does not fit the interval of the local sequence just ending. So for a sequence numbering 1, 2, 1, 2, etc., no repetition action is taken so long as control signal 2 is received at the end of interval 1 and control signal 1 at the end of interval 2. When the control signal is not received or is received mutilated at the ISS, this station will transmit three signals repetition in the next block instead of information.
The IRS will not print or pass a block when this contains a signal repetition, or when its contents are mutilated.
Moreover, it retransmits on the return channel the control signal transmitted last.

Modulation rate
The modulation rate on the radio circuit during the signal-on period is 100 bauds. One block, consisting of three characters, is transmitted in 210 ms; an answerback signal in 70 ms.
At the start-stop terminals the interval between successive start elements will be 150 ms, so that the interval between successive blocks is 450 ms.

Master and slave arrangements
The station that initiates the establishment of the connection will be the 'Master' station, and the called station will be the 'Slave' station.
This situation remains unchanged for as long as the connection exists.
The clock in the Master station controls the entire connection.
The clock in the Master station transmit distributor is controlled by the Master clock. The Master station receive distributor is controlled by the transitions of the received signal.
The Slave station transmit distributor is phase-locked to the Slave station receive distributor. The Slave station receive distributor is controlled by the transitions of the received signal.



ARQ-mode: telegraph or telex service between ship and coast station or telex subscriber



Phasing

When no connection exists, both stations are in the 'Stand-by' position. In this position no ISS or IRS status and no Master or Slave position is assigned to either of the stations.
The station which wants to make a call begins to send the 'Call' signal. This 'Call' signal consists of one or two blocks of three signals.
A one-block call signal is composed of signal repetition followed by any combination of information signals. A two-block call signal contains in the first block signal repetition in the second character position, and any combination of information signals in the first and third position. The second block contains: signal repetition in the third position preceded by any combination of information signals in the other two positions.
On receipt of the appropriate call signal the called station changes from Stand-by to the Slave-IRS position and sends control signal 1.
On receipt of a control signal 1, the calling station is switched to the ISS status and sends a block of information or idle-time signals.

Rephasing

When reception of information blocks or control signals is continuously mutilated, the system returns to the Stand-by position after a pre-determined time of continuous repetition.
Rephasing proceeds along the same lines as the procedure for phasing; however if, at the time of interruption, the Slave station was in the ISS position, it sends, after rephasing, control signal 3.

NOTE
Composition and assignment of call signals require international agreement.

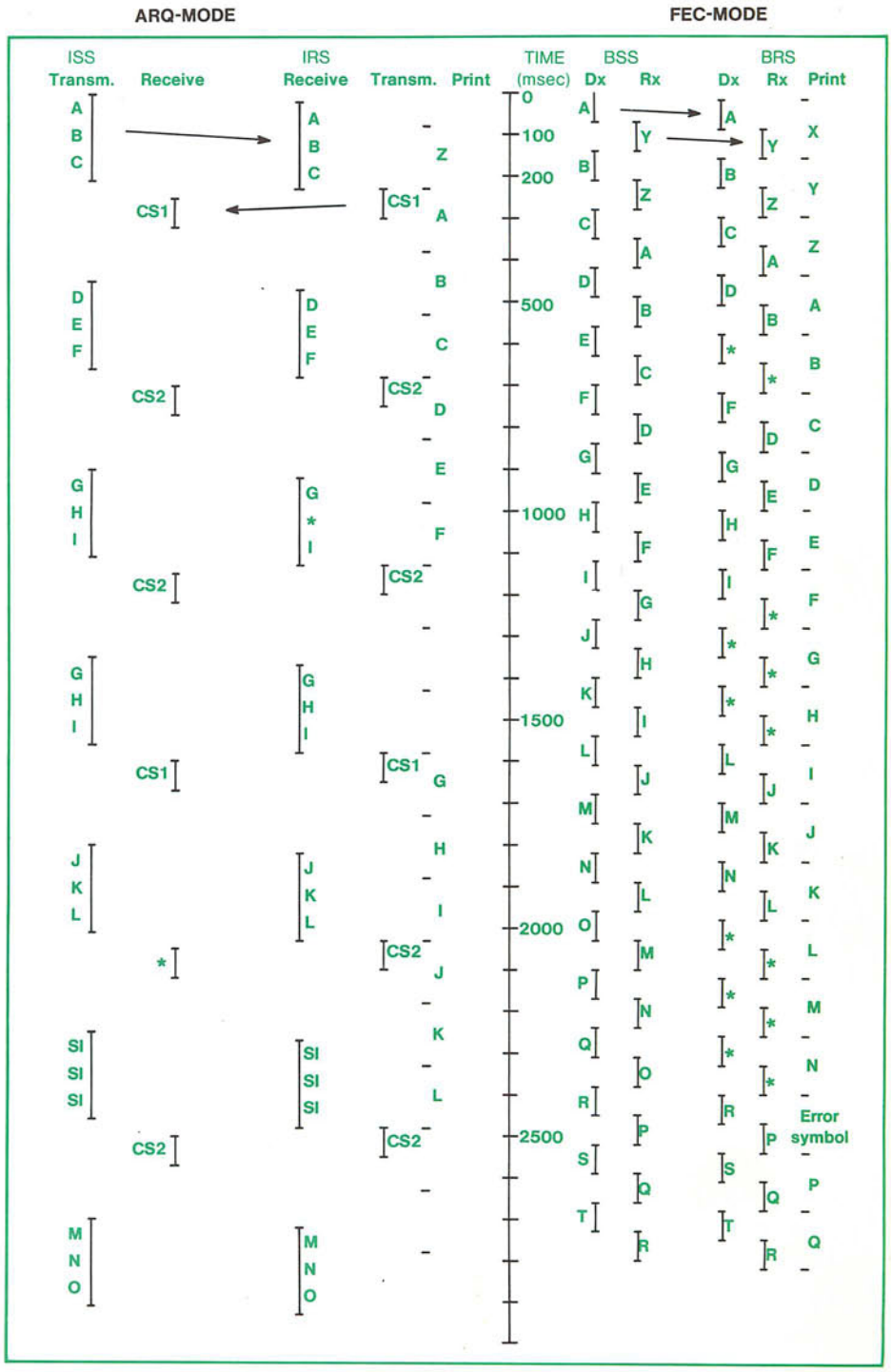
SIGNAL SEQUENCE CHART

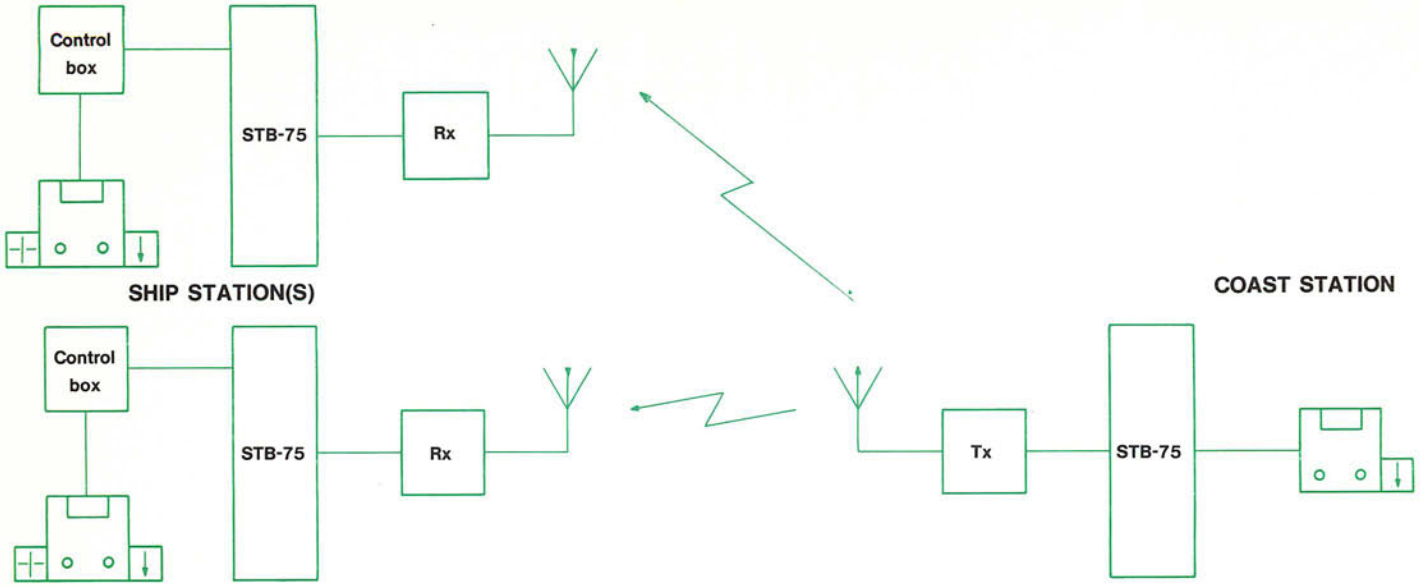
ARQ-MODE

The information sending station (ISS) transmits a block of three characters and at the information receiving station (IRS) a control signal (CS) is send back after good reception of the block.
After transmission of the next block CS2 is returned. During unmutilated reception of blocks at the IRS and of control signals at the ISS this will continue alternately with CS1 and CS2.
If a mutilation is detected in a block the preceding control signal is repeated and the ISS repeats the earlier transmitted block until it receives the next appropriate control signal for continuation (see sequence chart at time 820-1580). The print-out line is at continuous stop polarity during repetition.
If the control signal is received mutilated by the ISS it transmits one block of three signals repetition; upon reception at the IRS the same control signal is repeated (see sequence chart at time 2050-2570). Print-out is also interrupted.

FEC-MODE

A stream of information is transmitted on a time diversity basis from the FEC sending station (BSS) and received at the FEC receiving station (BRS).
The first transmission of a character is the direct transmission (DX), the second is the retransmission (RX). Mutilated reception of several characters does not affect correct print-out (see sequence chart at times around 650 and 1400). The last-mentioned case shows that error bursts of maximum 280 msec do not result in incorrect print-out.
The example given around time 2200 shows that an error burst or fading of not more than 420 msec results in only one print-out of the error indicating symbol (space).
Summarizing it can be said that all received errors will be corrected if the burst or fading time length does not exceed 280 msec and if bursts are separated by at least 420 msec.





FEC-mode: telegraph service between one station and a number of receiving (ships) stations

BLOCK DIAGRAM FEC-MODE

GENERAL

In the FEC-mode a synchronous system transmits an uninterrupted stream of characters from a FEC sending station (BSS) to one or more radio receiving stations (BRS). The signal offered to the line output terminal is a 5-unit start-stop signal at a modulation rate of 50 bauds.
The modulation rate on the radio link is 100 bauds.

CHARACTERISTICS

Sending
The FEC sending station (BSS) transmits each character twice; the first transmission (DX) of a particular character is followed by the transmission of 4 other characters, after which the retransmission (RX) of the first character takes place, allowing for time diversity reception at 280 milliseconds intervals.
The BSS sends idle signals before and between the FEC message; these idle signals consist of phasing signal 1 and phasing signal 2, so that phasing signal 1 is transmitted in the RX, and phasing signal 2 in the DX position.

Receiving
The FEC receiving station(s) (BRS) check both characters (DX and RX) and print an unmutilated DX or RX character or an error symbol if both are mutilated.

Phasing
When no radio reception takes place, the system is in the 'Stand-by' position.
It can phase-in on receipt of phasing signal 2 followed by the reception of phasing signal 1, in such a way that phasing signal 2 determines the DX and phasing signal 1 the RX position. The station is then switched to the BRS status. The BRS falls back to the stand-by position if only mutilated signals have been received for a preset time.

TABLE OF CODE CONVERSION / TRAFFIC INFORMATION SIGNALS

		International code no. 2	7-unit code	emitted signal
1	A –	ZZAAA	ZZZAAAZ	BBBYYYB
2	B ?	ZAAZZ	AZAAZZZ	YBYYBBB
3	C :	AZZZA	ZAZZZAA	BYBBBYY
4	D WRU	ZAAZA	ZZAAZAZ	BBYYBYB
5	E 3	ZAAAA	AZZAZAZ	YBBYBYB
6	F	ZAZZA	ZZAZZAA	BBYBBYY
7	G	AZAZZ	ZAZAZZA	BYBYBBY
8	H	AAZAZ	ZAAZAZZ	BYYBYBB
9	I 8	AZZAA	ZAZZAAZ	BYBBYYB
10	J BELL	ZZAZA	ZZZAZAA	BBBYBYY
11	K (	ZZZZA	AZZZZAA	YBBBBYY
12	L)	AZAAZ	ZAZAAZZ	BYBYYBB
13	M .	AAZZZ	ZAAZZZA	BYYBBBY
14	N ,	AAZZA	ZAAZZAZ	BYYBBYB
15	O 9	AAAZZ	ZAAAZZZ	BYYYBBB
16	P 0	AZZAZ	ZAZZAZA	BYBBYBY
17	Q 1	ZZZAZ	AZZZAZA	YBBBYBY
18	R 4	AZAZA	ZAZAZAZ	BYBYBYB
19	S '	ZAZAA	ZZAZAAZ	BBYBYYB
20	T 5	AAAAZ	AAZAZZZ	YYBYBBB
21	U 7	ZZZAA	AZZZAAZ	YBBBYYB
22	V =	AZZZZ	AAZZZZA	YYBBBBY
23	W 2	ZZAAZ	ZZZAAZA	BBBYYBY
24	X /	ZAZZZ	AZAZZZA	YBYBBBY
25	Y 6	ZAZAZ	ZZAZAZA	BBYBYBY
26	Z +	ZAAAZ	ZZAAAZZ	BBYYYBB
27	Carriage return	AAAZA	AAAZZZZ	YYYBBBB
28	Line feed	AZAAA	AAZZAZZ	YYBBYBB
29	Letters	ZZZZZ	AZAZZAZ	YBYBBYB
30	Figures	ZZAZZ	AZZAZZA	YBBYBBY
31	Space	AAZAA	AAZZZAZ	YYBBBYB
32	Unperforated tape	AAAAA	AZAZAZZ	YBYBYBB

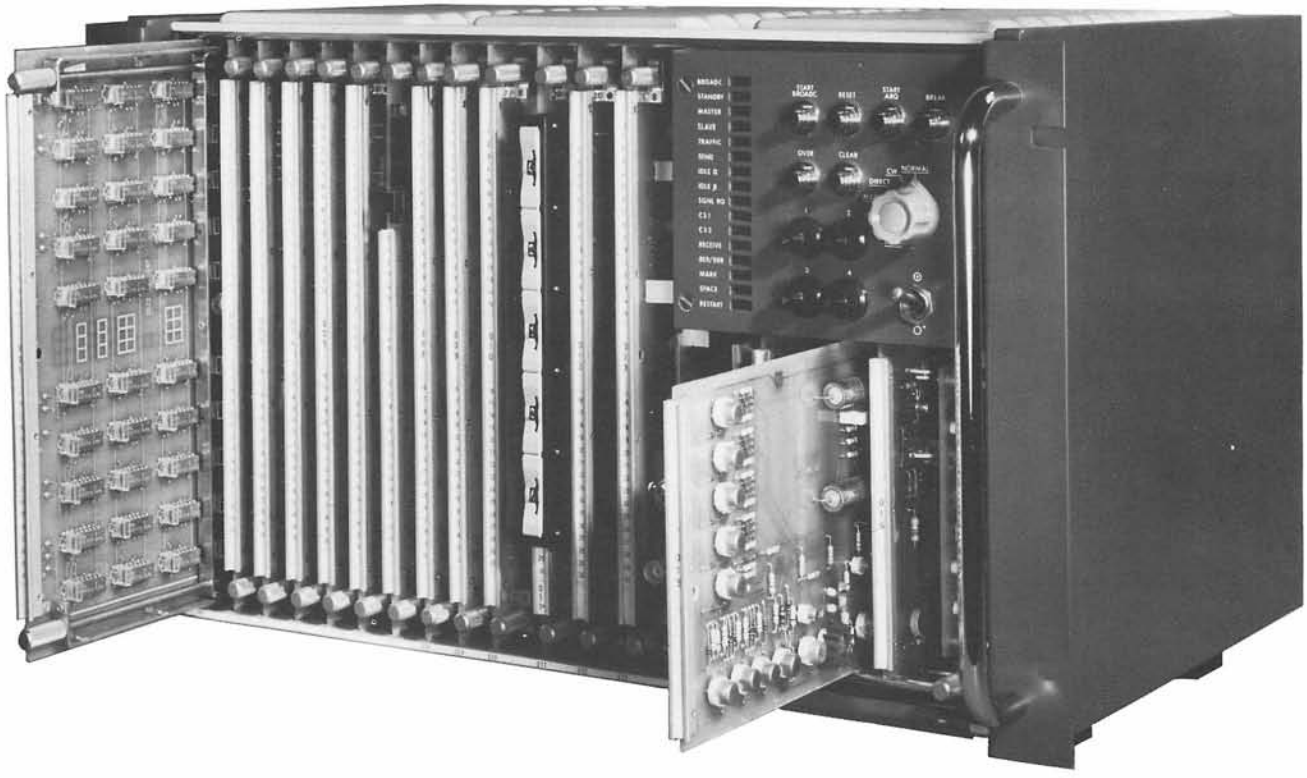
SERVICE INFORMATION SIGNALS

Mode A (ARQ)	emitted signal	Mode B (FEC)
Control signal 1	BYBYYBB	
Control signal 2	YBYBYBB	
Control signal 3	BYYBBYB	
Idle time ß	BBYYBBY	
Idle time α	BBBBYYY	Phasing signal 1
Signal repetition	YBBYYBB	Phasing signal 2

CONSTRUCTION

The equipment is housed in a sheet steel cabinet and finished in two-tone grey.
Printed-wire cards are used in the form of slide-in modules with plugs to fit the cabinet cabling. The cards or units are mechanically locked into the cabinet.
Plug and socket contacts are gold plated.
Wherever possible, integrated circuits are used, ensuring troublefree, long life operation. The small size of the equipment is mainly due to the use of this type of components and to the careful design.
The equipment has been designed with a view to the severe environmental conditions to which it may be exposed in the field. It can withstand shocks and vibrations to a very severe degree. Electrically, too all precautions have been taken to ensure troublefree operation. Even during mains voltage dips and surges or after complete line interruption the status of operation is resumed where it broke off without any manual intervention.
Many testpoints are available for checking with an incorporated test circuit or an oscilloscope.
The equipment can be fitted into a standard 19-in rack or cabinet.
Fastening material can be supplied to fit the equipment on the wall; in this case shock absorbers can be used.
External connections are by means of cords with plugs.

Integrated circuits are used as much as possible



REMOTE CONTROL BOX

A separate remote control box CBX 75 is available for installations where the STB 75 is not within reach of the teleprinter operator.
Important controls and indications are repeated on this table-top control box, small enough to be placed next to the teleprinter.
An added feature is automatic start/stop of the teleprinter motor. Connection to the STB and teleprinter is by plugged cables.
An external device can be connected to the control box to alarm the operator that traffic (sent in ARQ- or FEC-mode) is going to be received.
A switchable connection for a Morse key enables direct operation of the modulator.

TECHNICAL DATA

General

Construction	Cabinet, suitable for mounting in 19-in frame or free standing
Dimensions	Height: 285 mm (11.2 in) 265 mm (10.4 in) for rack mounting Width : 440 mm (17.3 in) (excluding flanges) Depth : 300 mm (11.8 in) (without handles)
Remote control box	145 x 215 x 240 mm (5.7 x 8.4 x 9.5 in)
Weight cabinet	36 kg (74 lb.)
Weight control box	4 kg (9 lb.)
Mechanical and climatic resistance	Vibration and bump test, dry heat and heat test } according to IEC public
Ambient temperature	Operating: 0° to 45° C, storage 70° C
Relative humidity	Operating 75%, temporarily 95%

Electrical Data

Mains	110, 127, 220 or 240 V AC, +10 −15% 50-60 Hz, ± 10%
Power consumption	90 VA
Internal voltages and protection	+5 V, +12 V, −12 V (short-circuit proof); regulated; guarded at ± 10% deviation; +80 V max. 200 mA (fused, ripple 1 V max.) at ± 20%
Allowable external disturbance	On mains line: 1 V eff. maximum between 50 and 15000 Hz
Radiation	According to VDE 0875 grade K mains line: < 25 µV up to 30 MHz field strength: < 6µV/m up to 300 MHz
Connection	Plugs and sockets

System Characteristics

Clock	Crystal oscillator, Frequency: 2457.600 kHz Stability: 5×10^{-5}
Telegraph code	Local side: 5-unit start-stop code, CCITT No. 2 Line side: 7-unit with constant A to Z ratio
Operation modes	1. ARQ system, semi-duplex 2. FEC system, with error detecting and correcting facility, simplex 3. Direct system, receiving only
Modulation rate	Line side: 100 bauds Local side: ARQ, 50 bauds, 7½ units FEC, 50 bauds, 7 units
Phasing	ARQ: one-shot phasing FEC: phasing signals, automatically transmitted at start, after every line feed and during idle condition
Signal test	1. Constant ratio of B and Y units 2. Horizontal, adjustable element check
Selective calling system	About 110,000 combinations Selection: transmitting: thumbwheel switches or programmed plug, reception: straps
Buffer store	Incorporated; capacity of 25 characters

Terminations

Local side	Input: 1. Sequential, earth/open 50 bauds, 7 or 7½ units 2. Non-sequential, earth/open Output: Sequential start-stop signals 80 V, single current, max. 60 mA Character release pulse: if required, as output
Line side	Input: DC minimum ± 3 V, max. ± 48 V VF impedance nominal 600 ohms Level +10 to −30 dBm f_y 1415 Hz, f_B 1585 Hz Optional: f_y 1615 Hz, f_B 1785 Hz Output: DC single current 80 V, 40 mA max. VF impedance 600 ohms Level adjustable up to +2 dBm f_y 1415 Hz, f_B 1585 Hz Optional: f_y 1615 Hz, f_B 1785 Hz

Supervision

Indication lamps	Stand-by / FEC / Master / Slave Send / Receive / Restart Traffic / Idle alpha / Idle beta Signal RQ / Repetition / Error Control Signal 1 / Control Signal 2 Mark / Space unit received
Controls	Start: ARQ / FEC Reset / Over / Clear (send alpha) Break (transmission) C.W. (Morse) / Direct reception Continuous Mark / Space transmission Loop test (info. flow and control signals)
Test circuit	Built-in testing device with lamp indications; DC and AC up to 1MHz. For check and fault location during operation and loop tests.
External controls and indications	Start ARQ / FEC Reset / Over / Clear C.W. Mark / Space units received Receiving / Traffic in store Receive / Transmit timing Repetition / Error / Idle alpha received
Control box	Additional to external controls and indication: local teleprinter switch Morse key connection free relay contact for external alarm teleprinter motor control
Automatic controls	1. Start ARQ or FEC at signal reception 2. Revert to stand-by after a period of signal absence 3. State of operation maintained after mains failure, excessive voltage dips and surges 4. Starting and stopping of teleprinter motor 5. Starting and stopping of magnetically controlled tape reader depending on condition of buffer store 6. Local copy interrupted if buffer store fails 7. Change of traffic direction after 'who are you' procedure for release of 'answer-back' code

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