ADVANCED SHIP/SHORE AUTOMATIC TELEGRAPHY SYSTEM (ASSATS)

INTRODUCTION

1 The primary ship/shore route for telegraph messages is by SHF and UHF SATCOM, with the advantages of resistance to jamming and independence of large shore wireless stations, with HF providing a viable alternative, though restricted by ships low power transmitters and unsuitable aerial arrangements. UHF SATCOM is presently capable of being jammed, and it is foreseen that soon SHF will be so vulnerable, and both systems will become susceptible to direction finding. Additionally certain operational areas are outside the footprint of existing and planned satellites. (70 N).

2 ASSATS has been developed to:

(1) Provide ships and submarines with a management and control system for transmission of telegraph messages on HF radio equipment. The system reduces the vulnerability of the HF ship/shore system to hostile intercept, location and jamming. This is achieved by:

a. Automatic selection of the best available frequency.

b. Automatically changing the operating frequency at frequent intervals.

c. Automatically avoiding discrete interference.

d. Encoding messages and control signals for error correction and providing automatic repetition of incomplete parts of the message.

e. Reduction of fingerprinting.

(2) Overcome propagation difficulties by using two pairs of widely spaced shore stations to give good coverage of the NE Atlantic and Norwegian seas - both at present notoriously bad for HF reception ashore in the UK.

(3) Reduce operator overload in ships and ashore by carrying out ship/shore management automatically. The system will handle telegraph traffic only.

SYSTEM DESCRIPTION

3 The system provides reliable communications for mobiles operating in the North Atlantic and Mediterranean regions, including the auroral regions north of UK, as well as a restricted service to mobiles operating in the South Atlantic.

4 The system comprises shore and mobile sub-systems (Fig 5D.1). There are two widely spaced shore stations, a primary station in the UK and a secondary station in the Mediterranean area. The secondary station is required to achieve reliable communications from the auroral regions since it is not possible to achieve a good skywave path from these regions to UK. The mobile manually selects which shore station to use.

5 The two shore stations are independent, but time-locked (based on GMT), timing being derived from a Precise Time and Frequency Standard (PTFS). ASSATS timing is based around time sub-divisions, ie time slots or sub-slots during which transmissions are made (Fig 5D.2). The system will eventually operate at data transmission rates of either 75 or 110 Baud. Mobiles start to transmit at the start of predetermined time slots, the shore station transmits a sounding broadcast during each time slot. Mobiles, especially submarines, cannot receive sounding broadcasts at the same time as they are transmitting messages.

6 Each shore station consists of three sites:

a. Control Site - accommodating the main processors, encryption equipment, Supervisors VDU, printers and connections to the DCN (Figs 5D.3/4).

b. Receive Site - accommodating the receive equipment and the interference assessment system (Interference Monitor) (Fig 5D.5).

c. Transmit Site - accommodating the transmit equipment (Fig 5D.6).

The control site is connected to the transmit and receive sites by data links.

7 To provide a high degree of reliability and availability, the following facilities are duplicated - processors at the Control Site, controllers at both Transmit and Receive Sites, HF transmission equipment at the Transmit Site and data links between sites. In addition, status monitoring and automatic fault reporting of fitted equipment is carried out.

8 A number of 3 kHz channels are allocated for ship/shore traffic (Fig 5D.7). These are entered in the shore system as a list of possible ship/shore frequencies and may only be changed by the supervisor under controlled conditions. The channels are split into, up to, 16 groups spanning the maritime mobile bands. Each group has a frequency used by the shore station for "sounding" transmissions, a separate sounding being performed for each group. This sounding conveys to the mobile the return frequency allocated to each group, its interference level as measured by the Interference Monitor and system control information.

9 The interference assessment system is used to select quiet channels for ship/shore traffic. The sounding transmissions are used to inform the mobile of the available frequencies, so that they can select a best frequency according to local

conditions. All transmissions are crypto-protected with error detection and correction. Automatic repeat requests are issued by the shore station via the sounding broadcast.

10 The shore transmitter radiates an encrypted Sounding Broadcast which cycles through a number of frequencies. Each Sounding Broadcast contains information and instructions which identify the available ship/shore transmission channels. It also contains the noise level value of a particular frequency at the shore receiving station and indicates the 'best' telegraph tones in the audio baseband for each channel.

11 Mobiles can only operate ASSATS if they are fitted with ICS 3/2A or SSC (Figs 5D.8/9). The mobile analyses the Sounding Broadcast transmission and measures propagation losses to select the optimum ship/shore frequency and tone values.

12 Signals are sent by the mobile as a number of error-protected encrypted message blocks of 2048 characters. On receipt ashore, the message blocks are analysed to determine whether a section (or frame) of 64 characters has any errors which cannot be automatically corrected and instructs the mobile on the Sounding Broadcast to repeat any defective message frames. When the message block is received correctly or defective frames have been repeated the maximum number of times (depending on circuit conditions), a receipt or report is given.

13 The signal message is automatically re-assembled in the shore sub-system and is routed via the NSTN to the signal addressees.

SYSTEM OPERATION

14 Correct operation of ASSATS depends on the automatic interchange of data between the shore and mobile systems, most of which is transparent to the operator.

15 In order for the system to operate correctly, both the shore and mobile Message Transfer Control (MTC) Units must be set to common operating parameters. These are promulgated as Sounding Broadcast and Listening Out Plans. Additional information such as mobile identifier, user priority and equipment details specific to each mobile, must also be defined. These are normally entered on setting-to-work and need only be updated if details change. If memorised data is lost, the system prompts a reload of a full set of parameters.

16 Channel Allocation. ASSATS operates in the frequency range 2-30 MHz and can provide a selection of up to 256 ship/shore channels depending on suitable frequencies. Channels have an allocated bandwidth of 3 kHz and are divided into groups in each frequency band, each band having an associated sounding Broadcast channel. It is planned that groups will be numbered in decreasing frequency order and that the sounding frequency will be higher than return frequencies in the group.

17 Normally the system is programmed for eight groups of channels. Channel frequencies, total number of channels and the number of channels within a group may be programmed at the shore sub-system only. Mobiles need only to know the number of groups and the Sounding Broadcast frequencies.

18 Channel Selection. The shore sub-system scans the allocated channels and measures the noise level in each one, channels being ranked in order of noise level within each group. The two quietest channels in each group are selected and that having the lowest noise level is initially promulgated on the Sounding Broadcast as the Group Return Channel. When that channel is in use, the second selected channel replaces it on the broadcast.

19 Tone Selection. The FEK tones used in a channel are selected from 16 possibles, from 425 to 2975 Hz, spaced at 170 Hz with at least 340 Hz between the selected pair. The tones are assessed and the pair having the lowest aggregate interference level are chosen and promulgated on the broadcast.

20 Sounding Broadcast. Each Sounding Broadcast is associated with a particular group of channels and the transmission is in the following pattern:

(1) Preamble - to synchronise shore and mobile sub-systems.

(2) Channel Evaluation Information - indicating Group Return Channel frequency, selected FEK tones and level of interference on the Group Return Channel.

(3) Message Control Data - when appropriate, ships address, message control words, message identity etc.

(4) System Availability/Activity Data - indicating which channels are available at the next time slot, eg Free, Busy, Not Available.

21 The Sounding Broadcast text is encoded for EDC purposes and is sent twice. The Broadcast cycle consists of one transmission on each of the sounding frequencies in accordance with the Sounding Broadcast Plan.

22 Sounding Broadcast and Listening Out Plans. These are closely related, depending on the number of groups and are arranged to run together.

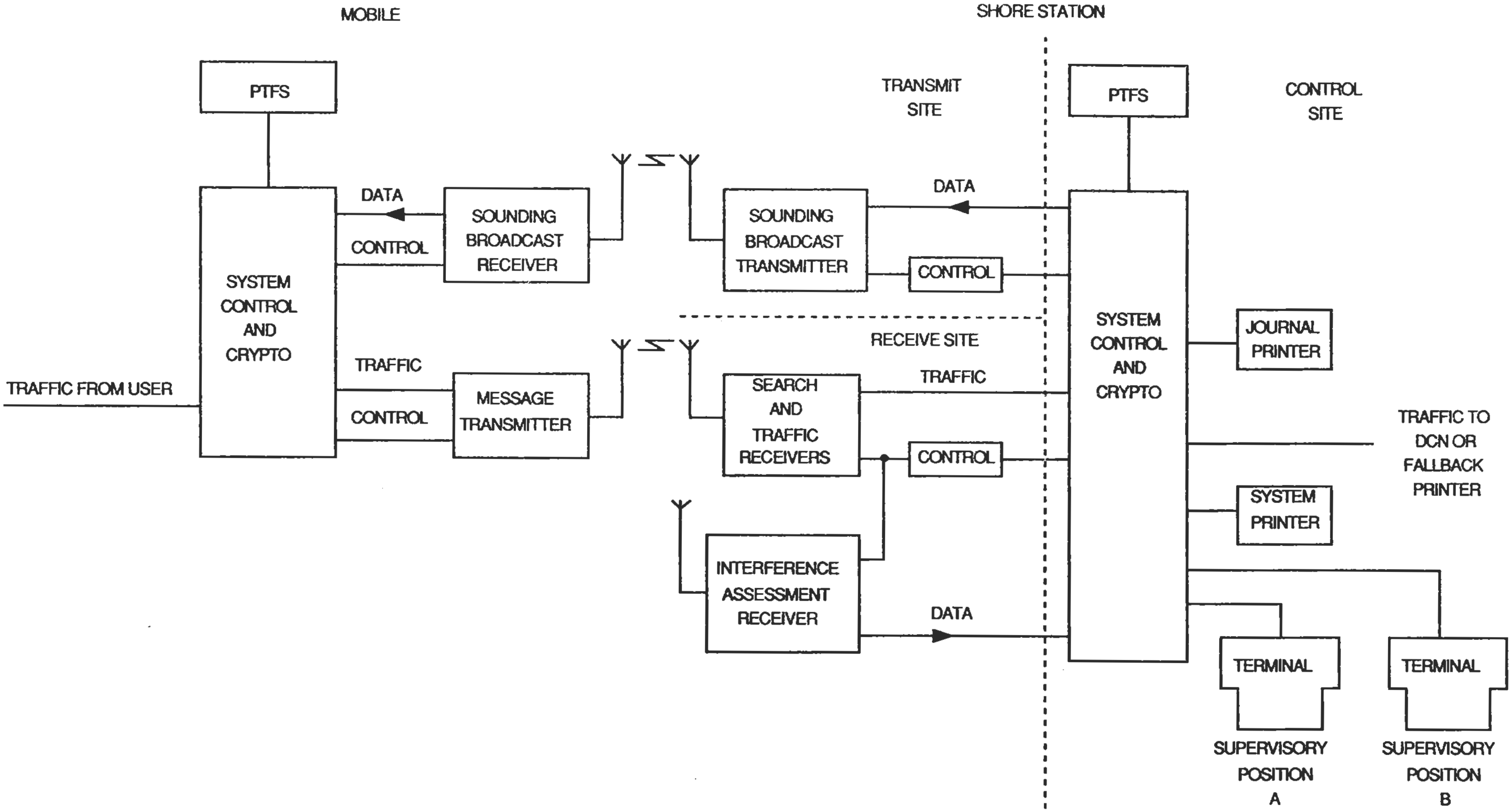
23 Up to eight Sounding Broadcast Plans can be entered into the system, each listing the Sounding Broadcast group numbers with their associated frequency and tones. In the shore sub-system the Controller uses the Sounding Broadcast Plan to control transmit frequency and tones while in the mobile the MTC controls reception parameters.

24 With a system traffic rate of 75 Baud, a Sounding Broadcast transmission occupies 9 secs, thus, making an allowance for returning and propagation delays, 10 secs is chosen as the time slot period. A new Sounding Broadcast is made in every time slot, thus with eight groups of channels activated, a sounding cycle occupies 80 secs.

25 The shore sub-system uses a number of receivers to cover the possible return frequencies at each time slot. Listening Out Plans are used to control these. In the mobile, the MTC uses the Listening Out Plan to control start of transmission so that this occurs only in a time slot in which a receiver is tuned to the Group Return Frequency.

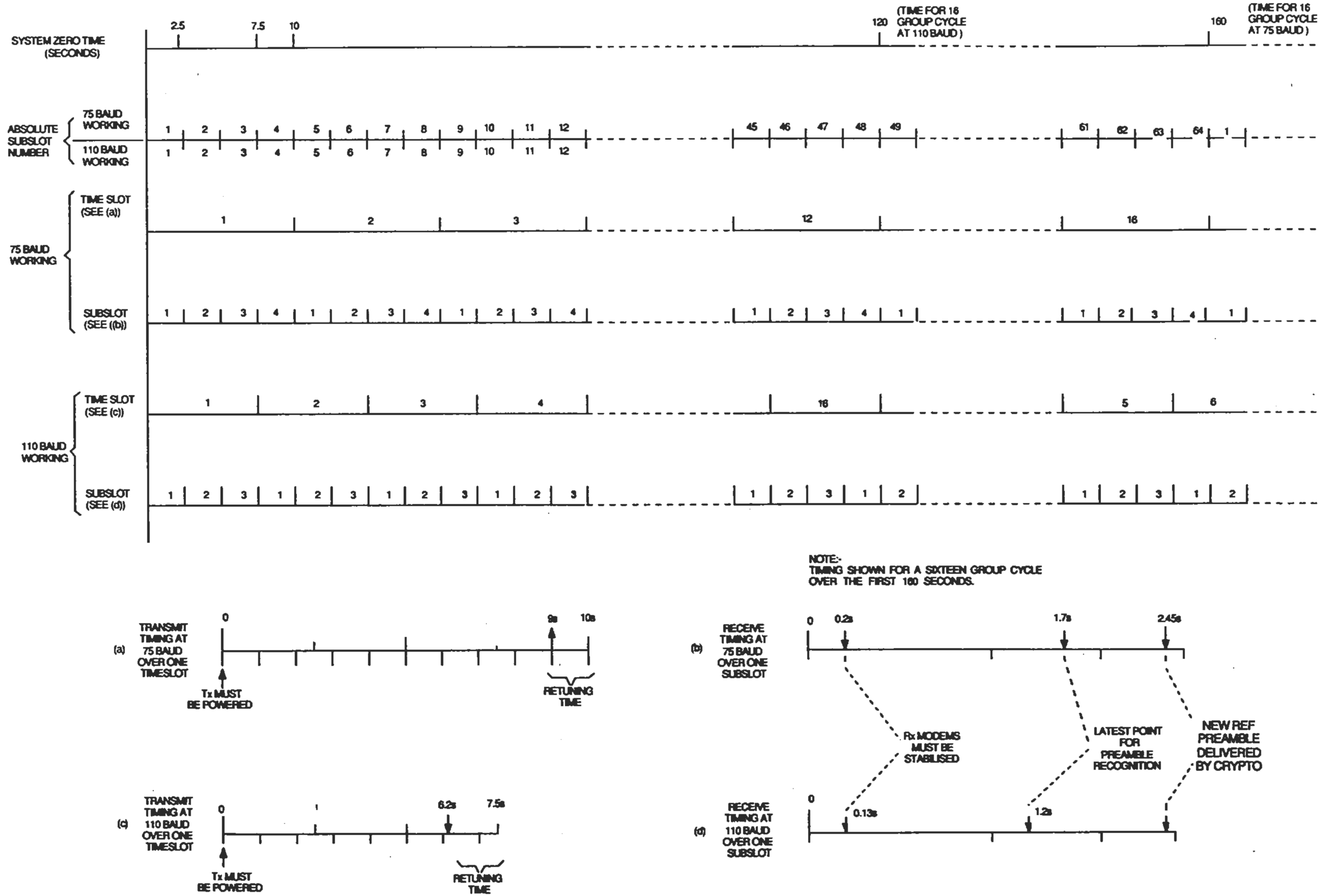
26 To provide better coverage, the 10 sec time slots are divided into 2.5 sec sub-slots, sufficiently long for receivers to tune to a new frequency and to recognise an incoming message, with an allowance for propagation delays. The receivers cover the return channel in the group of the immediately preceding Sounding Broadcast. Up to 16 Listening Out Plans can be entered into the system.

27 For successful operation, both shore and mobile must have the same Sounding Broadcast and Listening Out Plans entered and selected for use.

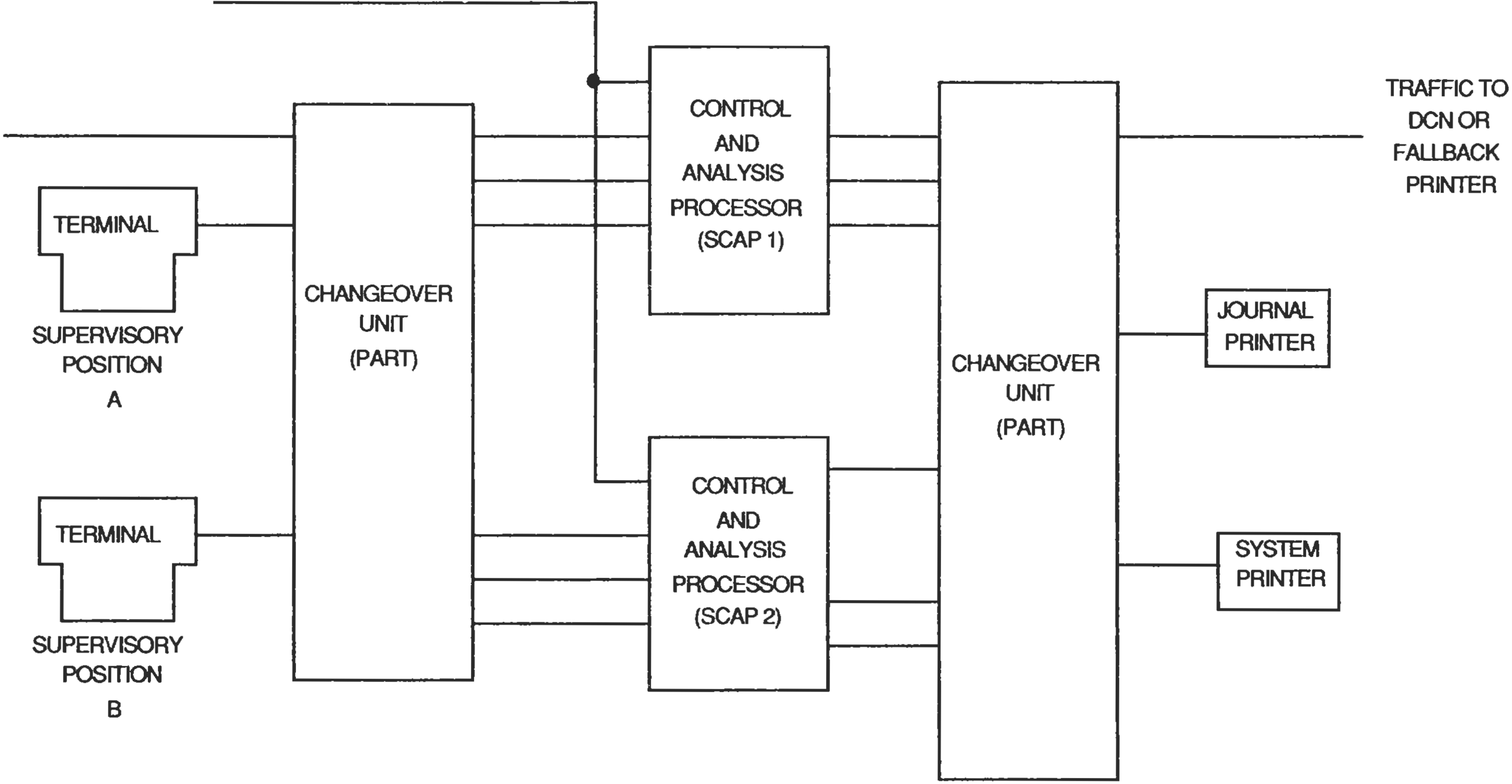


ADVANCED SHIP TO SHORE AUTOMATIC TELEGRAPHY SYSTEM.(ASSATS)
- BLOCK DIAGRAM

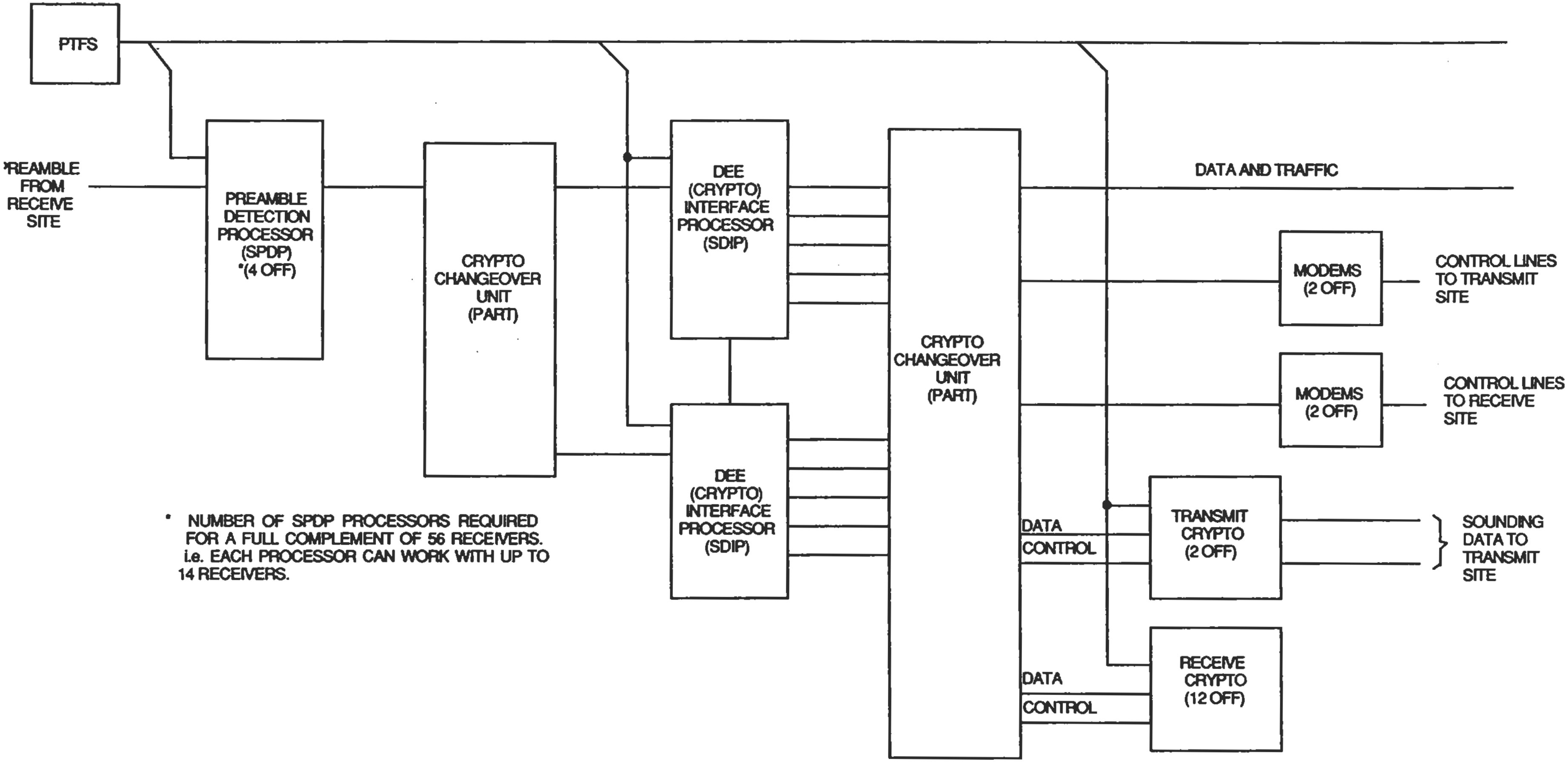
FIG 5D.1



ADVANCED SHIP TO SHORE AUTOMATIC TELEGRAPHY SYSTEM (ASSATS)
TIMING DIAGRAM



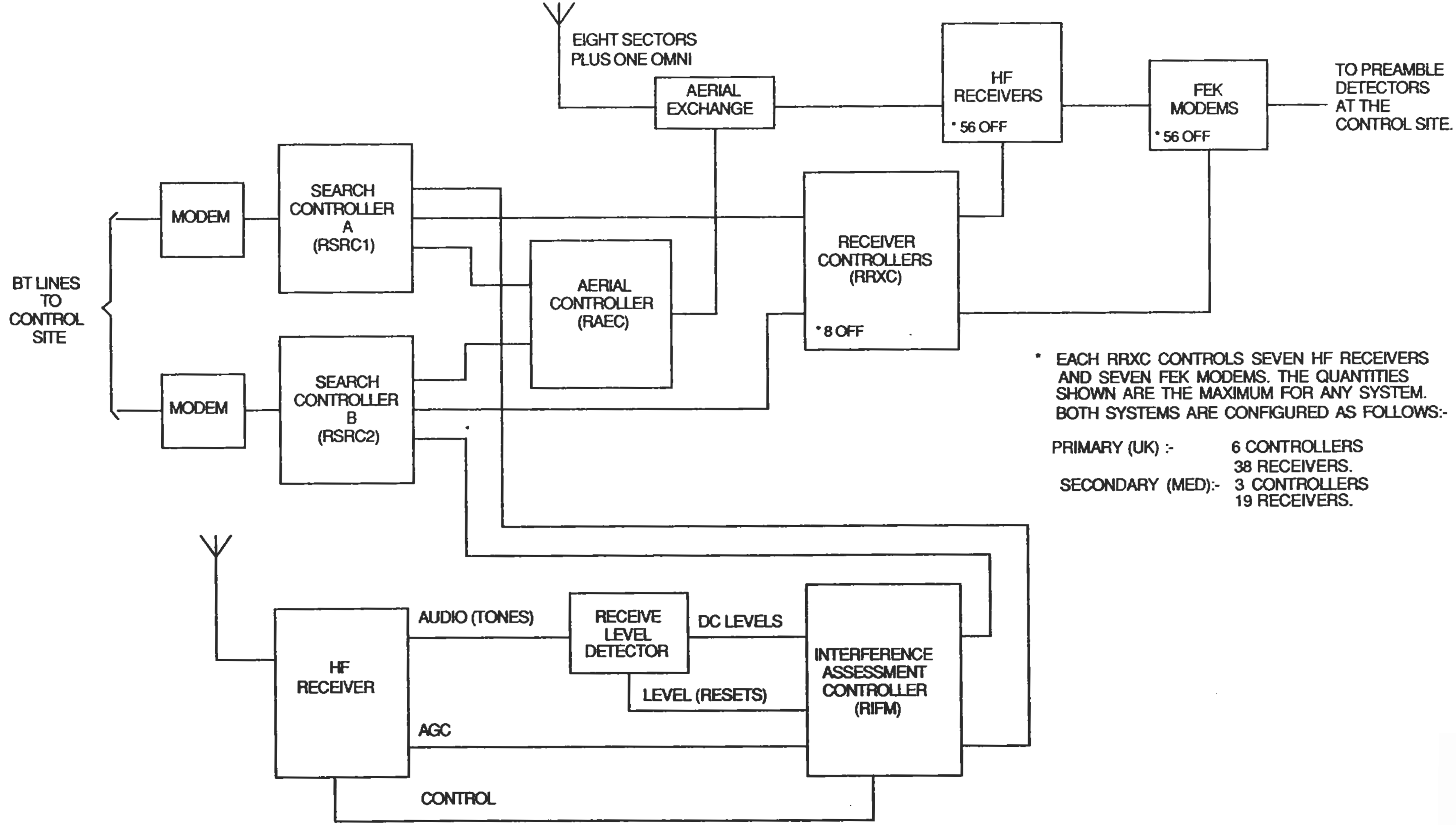
ASSATS CONTROL SITE
- BLOCK DIAGRAM



* NUMBER OF SPDP PROCESSORS REQUIRED FOR A FULL COMPLEMENT OF 56 RECEIVERS. i.e. EACH PROCESSOR CAN WORK WITH UP TO 14 RECEIVERS.

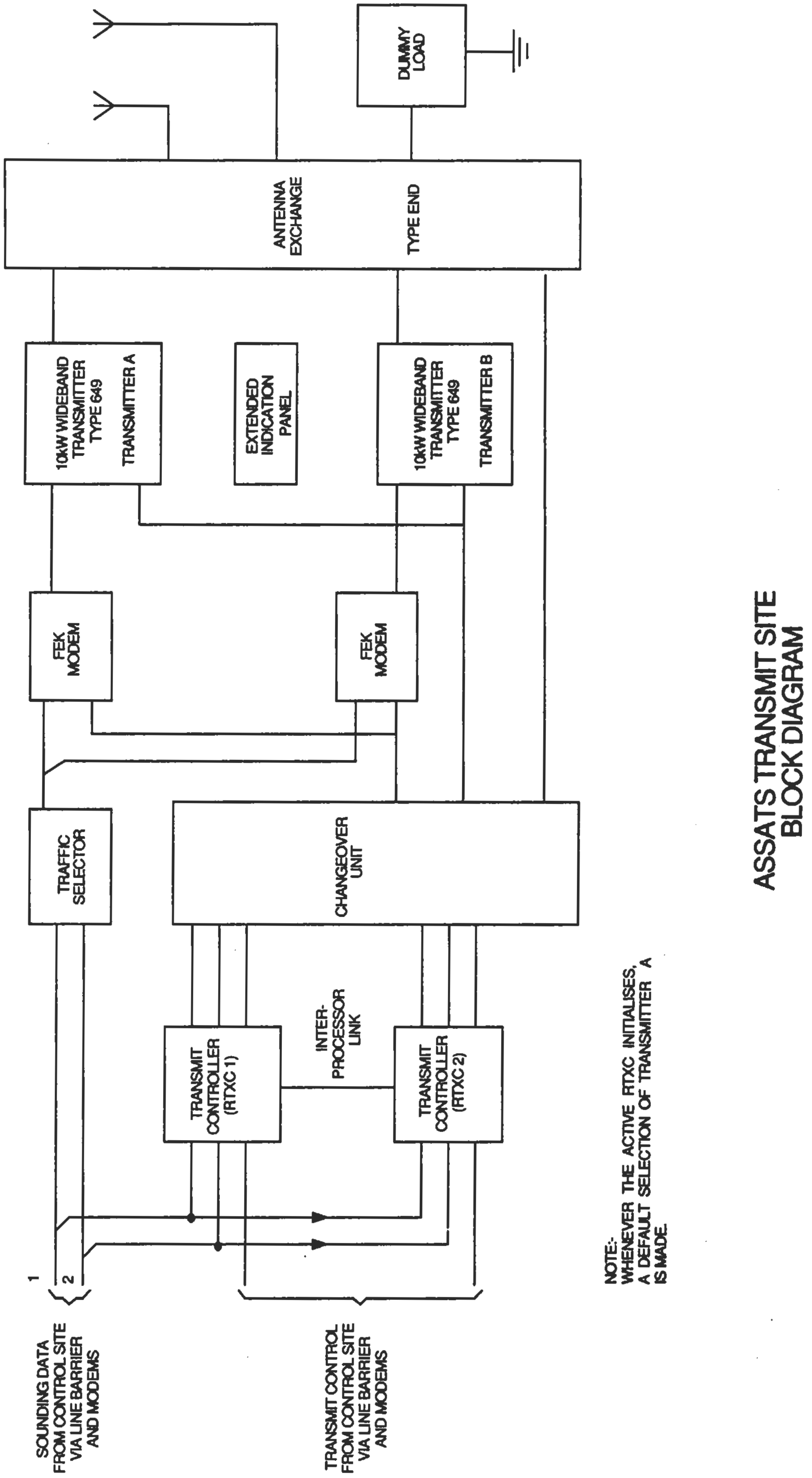
ASSATS CONTROL SITE
BLOCK DIAGRAM.

FIG 5D.4



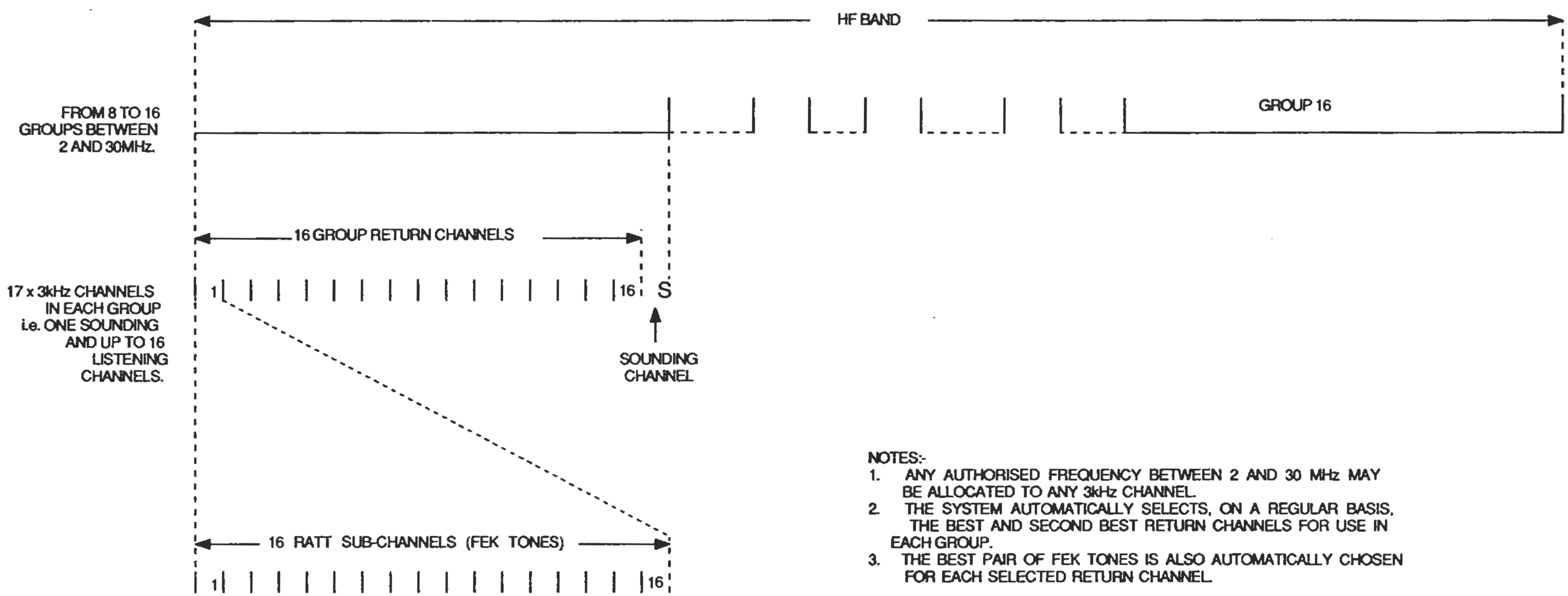
ASSATS RECEIVE SITE.
BLOCK DIAGRAM

FIG 5D.5



ASSATS TRANSMIT SITE
BLOCK DIAGRAM
DUMMY LOAD
ANTENNA EXCHANGE
TYPE END
10KW WIDEBAND TRANSMITTER TYPE 649
TRANSMITTER A
EXTENDED INDICATION PANEL
10KW WIDEBAND TRANSMITTER TYPE 649
TRANSMITTER B
FEK MODEM
FEK MODEM
TRAFFIC SELECTOR
CHANGEOVER UNIT
INTER-PROCESSOR LINK
TRANSMIT CONTROLLER (RTXC 1)
TRANSMIT CONTROLLER (RTXC 2)
1
2
SOUNDING DATA FROM CONTROL SITE VIA LINE BARRIER AND MODEMS
TRANSMIT CONTROL FROM CONTROL SITE VIA LINE BARRIER AND MODEMS
NOTE:-
WHENEVER THE ACTIVE RTXC INITIALISES, A DEFAULT SELECTION OF TRANSMITTER A IS MADE.

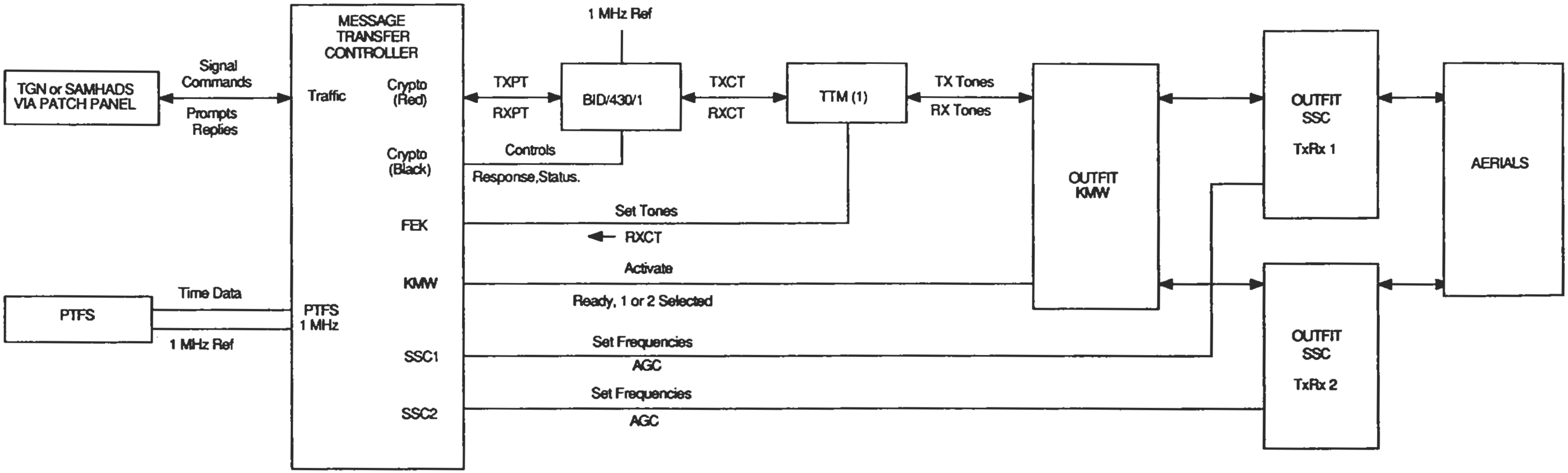
FIG 5D.6



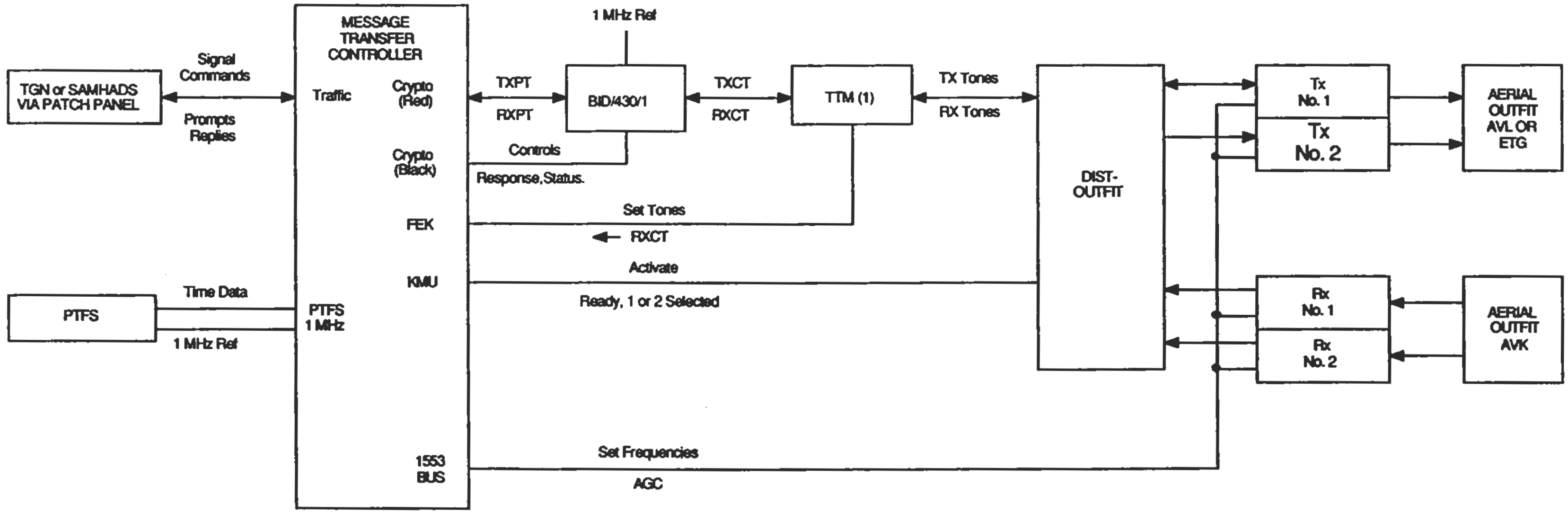
NOTES:-

1. ANY AUTHORISED FREQUENCY BETWEEN 2 AND 30 MHz MAY BE ALLOCATED TO ANY 3kHz CHANNEL.
2. THE SYSTEM AUTOMATICALLY SELECTS, ON A REGULAR BASIS, THE BEST AND SECOND BEST RETURN CHANNELS FOR USE IN EACH GROUP.
3. THE BEST PAIR OF FEK TONES IS ALSO AUTOMATICALLY CHOSEN FOR EACH SELECTED RETURN CHANNEL.

ADVANCED SHIP TO SHORE AUTOMATIC TELEGRAPHY SYSTEM (ASSATS) CHANNEL ALLOCATION.



ASSATS SUBMARINE INSTALLATION



ASSATS SHIP INSTALLATION

PILOT FLAG SUPPORT SYSTEM (PFSS)

INTRODUCTION

1 Currently an experiment is underway to define the requirements for a future system to provide task force commanders and their staffs afloat with improved CCIS facilities, linked to shore headquarters, for planning, decision-making and briefing purposes. The use of ADP in the picture compilation is of extreme importance.

THE PILOT SYSTEM

2 PFSS consists of three independent sub-systems, Joint Operational Tactical System (JOTS), Operational Control (OPCON) and Air Staff Management Aid (ASMA).

JOTS

3 JOTS is a collection of programs developed for the USN. The JOTS program runs on a Hewlett Packard desktop computer with additional CPU cards and memory, and peripherals including disc drives, plotter and cartridge tape drive.

4 The system offers a Tx/Rx and display facility with a wide range of support programs for ASW, ASUW, EW and AAW.

5 JOTS may be and is used as a "stand alone" planning tool with no communication links. As part of PFSS, Northwood houses the "JOTS Fusion Centre" for co-ordinating connections to ships.

OPCON

6 A shore-based ADP system to meet command and control requirements ashore. Terminals incorporated into PFSS provide access to the OPCON database ashore and to the Naval Shore Telecommunications Network (NSTN) to allow sharing of data by commands ashore and afloat, reducing conventional signal traffic.

7 The onboard system consists of an ICL small computer with VDU, keyboard and printer. This is essentially a "dumb terminal" and only operates when a satcomm link allows data exchange with the remote host.

8 Ashore the system is connected through the TANDEM computer at Northwood, providing access to both OPCON and the NSTN.

ASMA

9 A network connecting RAF stations in the UK and overseas via communications links and databases similar to OPCON. As part of the PFSS, ASMA allows task force commanders at sea the capability of co-ordinating air defence with the RAF.

10 The hardware used for ASMA onboard is identical to that used for OPCON.

11 Access to the shore system is through Northwood to High Wycombe.

CONNECTIVITY

12 PFSS connectivity is as shown in Fig 5E.1.

13 In the ship fit, to ensure separation of data, asynchronous data from JOTS is encrypted prior to being multiplexed with ASMA and OPCON synchronous data. The composite data stream is encrypted and transmitted on the SCOT 2.4 kbps data channel to Northwood via RAF or NATO Oakhanger as appropriate.

14 At Northwood, the data stream is decrypted and demultiplexed into individual data streams for distribution as required, ie to High Wycombe (ASMA), Northwood TANDEM (OPCON) or to other ships or shore headquarters (JOTS).

15 Connectivity is two-way, data from shore to ship uses the reverse path to that described.

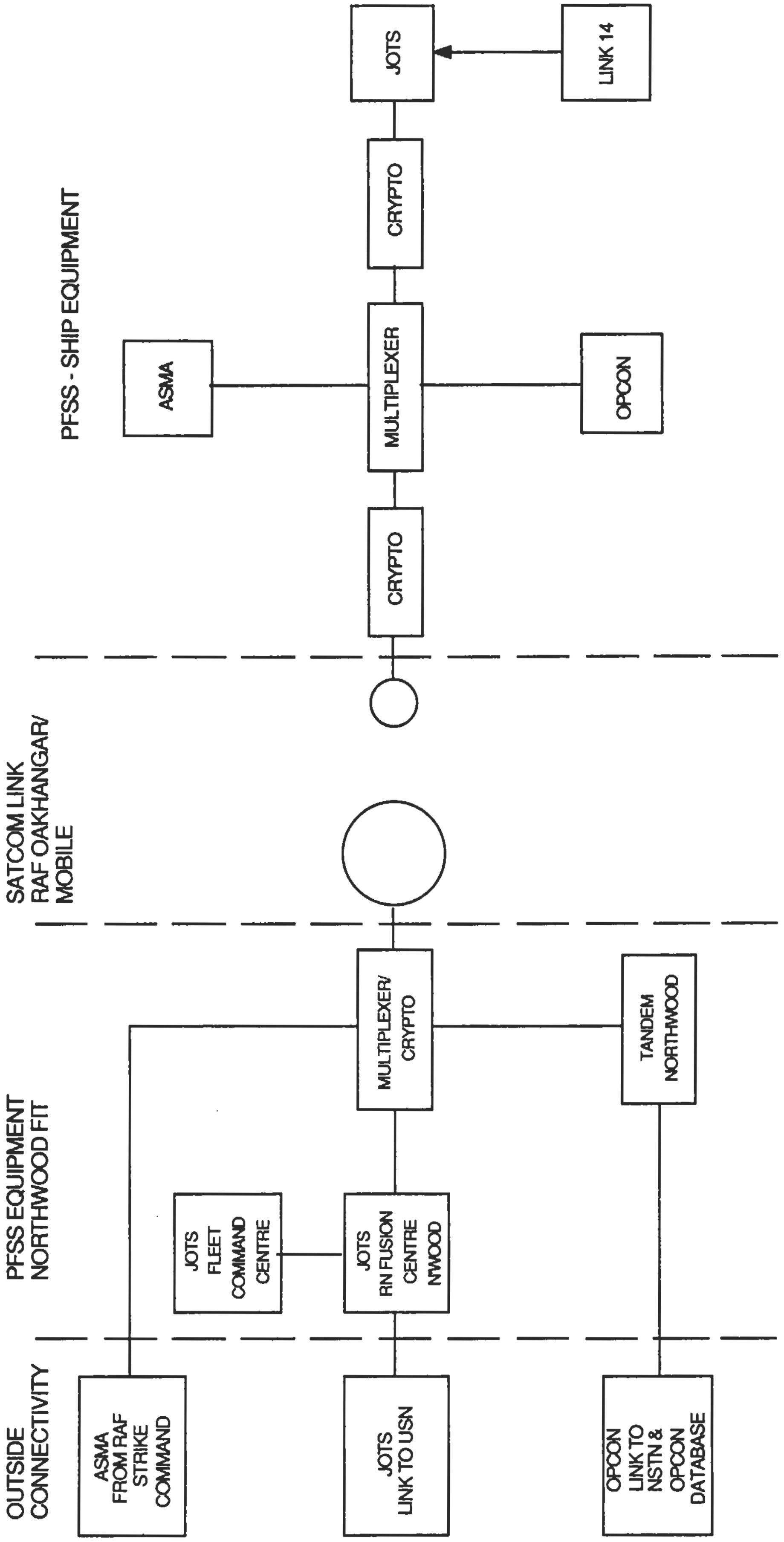


FIG 5E.1 PFSS SYSTEM - OVERALL CONNECTIVITY