# BUSH HOUSE INFORMATION SHEET

## BU-SK Carrier Equipment

### Introduction.

The BU-SK carrier equipment replaces the six physical Skelton chains. It is designed to occupy a 48KHz band in the P.O. frequency-division multiplex system. The output consists of twelve 3•4KHz bandwidth channels, spaced apart by 4KHz. The channel frequencies are 64, 68, 72, 76, 80, 84, 88, 92, 96, 100, 104 & 108 KHz. The carrier equipment is manufactured by Pye-TMC Ltd., and housed in a P.O. Type-62 bay. Six sets of BBC split-band equipment convert the six chain inputs into twelve narrow-band circuits and these feed the carrier equipment. The split-band equipment includes a pluggable spare, and these, together with an interconnection U-link panel, are housed in three cabinets whose dimensions match those of the P.O. bay.

The carrier equipment is capable of sending and receiving, and the equipments at Bush House and Skelton are identical in all respects. The split-band equipment EP2/2 however differs in detail when used for sending v receiving (see DDTM 2.184(70)).

### Carrier Generation.

The twelve carrier frequencies are derived by harmonic generation from the 4KHz output of a crystal-controlled oscillator in the Master Oscillator card EC515533/1. The crystal is maintained at 60°C in a thermostatically-controlled oven; the oven requires 35 minutes warm-up before the oscillator frequency is stable. The frequency of oscillation is 8KHz (sinusoidal). This waveform is subsequently squared and used to trigger a bistable divider, thus producing the 4KHz square-wave output.

The 4KHz square-wave is fed to the filter card EC504660/1, which contains a band-pass filter centred on 4KHz. This removes all harmonics of 4KHz leaving a pure sine-wave.

The 4KHz sine-wave is passed to the Harmonic Generator card, EC521511/3, where it is subjected to successive amplification and differentiation to produce a waveform of alternate polarity which is rich in odd harmonics of 4KHz. Even harmonics are produced by full-wave rectification of a portion of the odd harmonics. The Harmonic Generator thus has two outputs, one consisting of odd harmonics of 4KHz and the other consisting of even harmonics of 4KHz. These two outputs are both fed to the Harmonic Filter card, EC504657/1, which removes the unwanted harmonics, i.e. those below 56KHz and those above 120KHz. The remaining harmonics are amplified by cards EC504624/1 and EC501607/2 which supply enough power for distribution to the six channel filter cards, EC504651/1-6, 3 each for even and odd harmonics.

Each channel carrier filter card extracts two carrier frequencies, and as these two frequencies are both either odd or even harmonics, the separation between the two frequencies is 8KHz, making filtering easier and reducing crosstalk.

Table 1 shows the allocation of carrier frequencies to channels, and the pairing of channels on cards.

Table 1

| ODD HARMONICS | | EVEN HARMONICS | |
|---|---|---|---|
| Channel 1 | 108 KHz | Channel 2 | 104 KHz |
| 3 | 100 KHz | 4 | 96 KHz |
| Channel 5 | 92 KHz | Channel 6 | 88 KHz |
| 7 | 84 KHz | 8 | 80 KHz |
| Channel 9 | 76 KHz | Channel 10 | 72 KHz |
| 11 | 68 KHz | 12 | 64 KHz |

Channel Translating Equipment (Fig. 2).

After extraction by filtering, the carrier signals are fed to their respective Channel Translating cards, EC529550/1 - 12, where they are modulated by the 250-3400 Hz outputs of the split-band equipment. After modulation, the lower sideband frequencies are selected by a band-pass filter and passed to the Group card, EC530514/1, where they are mixed with the lower-sideband signals from the other channel cards. Amplifier Card EC501633/1 raises the level to line to +5dB. Because lower sidebands only are sent to line, all the transmitted frequencies lie within the 60 - 108 KHz band.

Power Supply Equipment.

The Power Unit, EC511526/1B, provides the stabilised -20V d.c. and unstabilised -24V d.c. for the active units and relays in the TMC equipment. (The split-band equipment is self-powered). The mains input to this unit is protected by a 2A fuse (FS1). The method of generating the -24V supply entails a common fuse (FS2) protecting both -20V and -24V supplies. This fuse is rated at 4A, and will also rupture when the -20V rail exceeds -23V or the -24V rail exceeds -28 5V, i.e. over-volt conditions. An over-volt test facility is provided. Switch SB (O/V TEST) is non-locking, and simulates over-volt conditions without rupturing fuse FS2. In this test, a meter connected to the test jack TJ2 should measure 22mA.

The -24V supply is obtained by adding a nominal 4V d.c. to the -20V stabilised supply. The -20V supply is adjustable by straps on a resistor chain, and the -24V rail should be 3 - 5V higher than the stabilised supply. Either supply rail on-load voltage can be measured at test jack TJ1 by connecting the negative side of the load to Pin 9 of the multi-way connector. The -24V supply is additionally protected by FS3 (2A).

Both of these supplies are distributed via the Fuse Unit, EC528502/1, which contains the alarm fuses P.O. type 44A. This unit may be partially withdrawn from from the bay to gain access to the fuses without disconnecting the supplies in use.

Alarms.

Alarm loops to the station alarm circuit are given for power failure, rupture of a distribution fuse, abnormal oscillator oven temperature and carrier/oscillator failure. There are no alarms on the split-band equipment.

The alarm output of Fuse Unit EC528502/1 is wired to the Alarm Unit EC518514/1 which houses fuse alarm and power fail relays. Failure of a power distribution fuse operates the respective FA relay which lights its associated lamp on the front panel (-20V or -24V) and provides a loop to the station alarm. Failure of either supply, e.g. rupture of a fuse in the power unit, releases the respective power fail relay (PF) which lights its associated lamp on the front panel (-20V or -24V) and closes the station alarm loop. The alarm is cleared by replacing the faulty fuse.

The temperature of the oven which houses the oscillator crystal is thermostatically controlled at 60°C. This temperature is maintained by a circuit which incorporates a mercury-in-glass contact thermometer. The oven circuit also incorporates two bi-metallic strip contacts, both of which are open at the working temperature. One of these contacts closes if the oven temperature falls to 50°C and the other contact closes if the temperature rises to 70°C. These contacts light the appropriate lamp on the oscillator front panel, and send an alarm level (0V instead of -3V) to the Monitor Card EC527534/2. The OVEN RESET button must be operated following an over-temperature alarm, otherwise the oven would cool to room temperature.

Carrier level is monitored by units whose d.c. output varies with a.c. input. Two of these units are mounted in the Monitor Card, and measure the levels of the ODDS and EVENS outputs of the second harmonic amplifier, EC501607/1, situated adjacent to the Monitor Card. If the input level falls by 3dB or more, the output goes from -3V to 0V.

The Monitor Card EC527534/2 accepts four alarm inputs, of which three are used, viz. ODDS harmonics level, EVENS harmonics level and oven temperature. These inputs are normally held at -3V. If any input goes to 0V or o/c, the alarm is initiated. The ALARM lamp on the monitor card front panel is lit, and a normally-operated relay releases. This relay closes the station alarm loop via contacts of the RECEIVE ATTENTION key. Operation of the REC ATT key lights its associated lamp and opens the alarm loop. The alarm loop is again closed when the relay is re-energised until the REC ATT key is restored to normal.

Split-Band Equipment EP2/2.

This equipment is fully described in Designs Dept. Tech. Mem. 2.184(70). A brief summary of its operation is as follows.

The 6 KHz bandwidth audio input is used to modulate a 12·4 KHz carrier. The resulting lower sideband is filtered off and split into two parts, 12·6 - 9·6 KHz and 9·6 - 6·2 KHz, which are related respectively to the lower and upper audio

frequencies. The 12.6 to 9.6 KHz band is used to modulate a 9.3 KHz carrier, and the 9.6 to 6.2 KHz band is used to modulate a 6.2 KHz carrier. The resulting lower sidebands are selected by filtering and form the two outputs, respectively the lower band (bandwidth 300-3000Hz) and upper band (bandwidth 250-3400 Hz). These two outputs feed two carrier channels via U-links.

In spite of the double modulation process and the selection of lower sidebands in each stage, the two outputs remain inverted by virtue of the fact that the lower sideband of the second stage results in impossible negative frequencies. These frequencies therefore appear in the same sense as the modulating frequencies, i.e. inverted. When checking the outputs, either on the meter or on headphones, the lower band output will be appreciably louder than the upper band because most of the energy of the input is below 3KHz.

The split-band equipment, EP2/2, is designed for portable or unattended operation, and contains a reserve battery which powers the equipment in the event of mains failure. This battery is being charged whilst the equipment is mains powered but discharges fully after 1½-2 hrs. when on load. If it is desired to power-down the equipment, this should be done using the rotary switch on the front panel of the unit as this also disconnects the internal battery.

Seven sets of split-band equipment are provided, six duty units plus a spare. Three duty units are mounted in each of two cabinets, and the third cabinet houses the spare unit and the U-link tablet, where connection of line-feeding amplifiers to split-band equipment input and split-band output to carrier channel input are carried out.

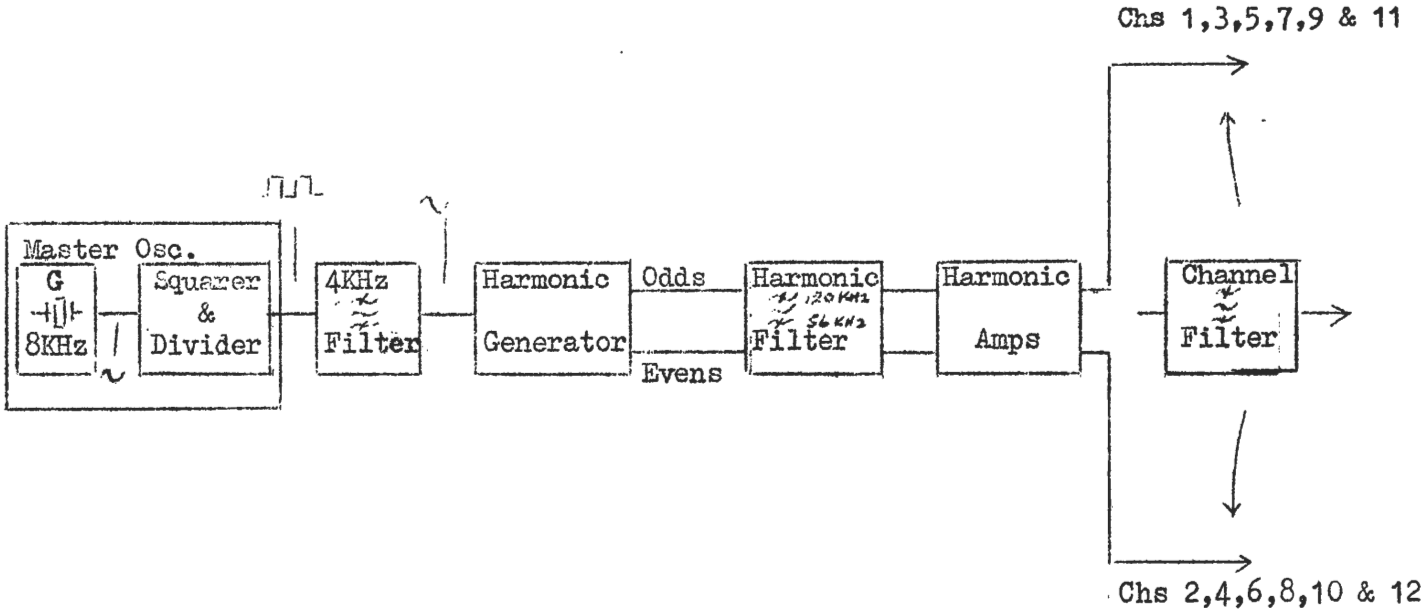


FIG.1 Carrier Generation Equipment

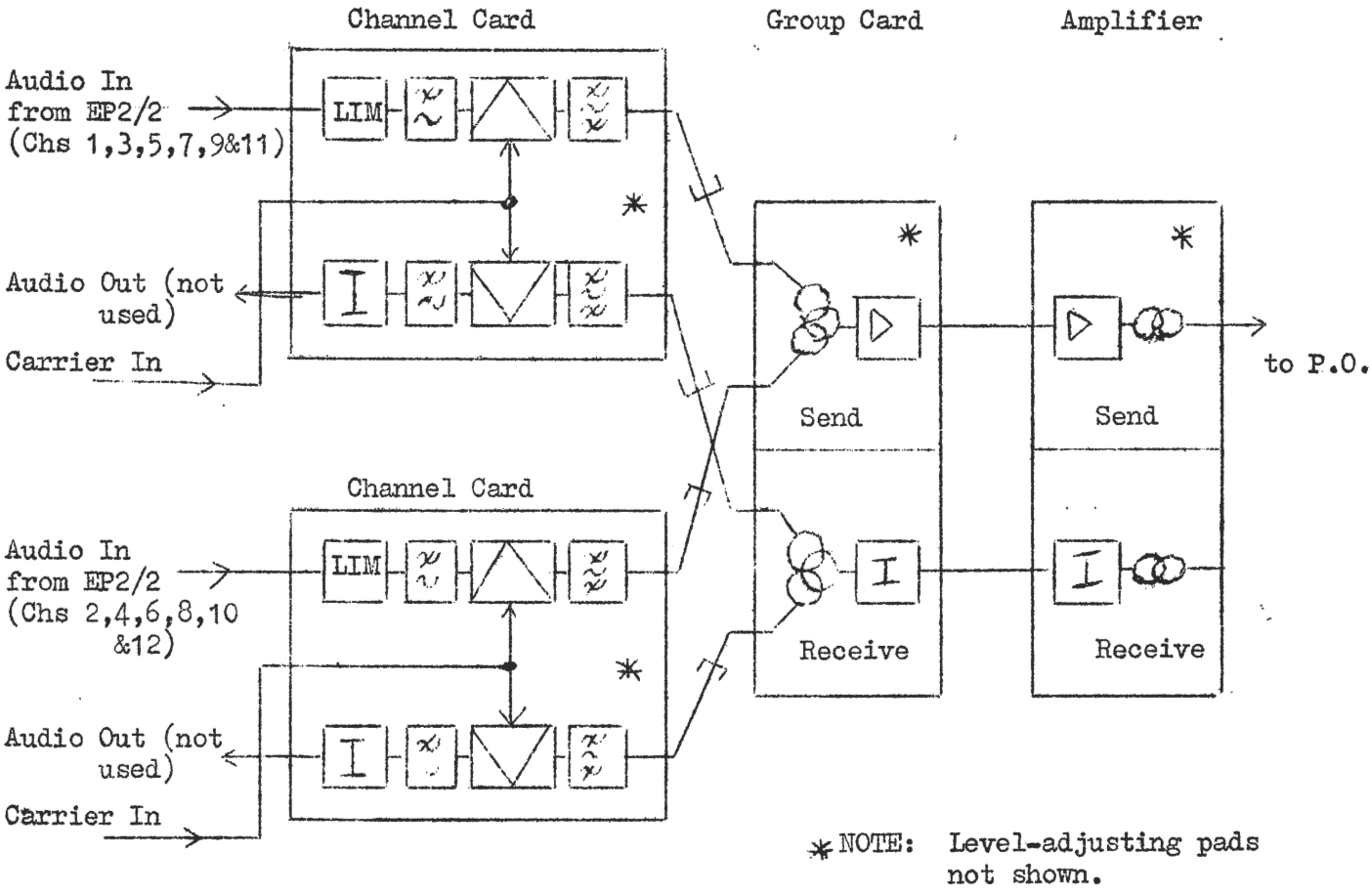


FIG.2 Channel Translating Equipment