SUBSCRIBERS CARRIER SYSTEM (WB 900)

System Description

(As this instruction has been completely REVISED, individual paragraphs have not been "starred".)

1 GENERAL The Subscribers Carrier System WB 900 permits the provision of two exclusive exchange connexions over a single cable pair. One connexion operates at speech frequencies and the other at frequencies above the audio range. They are known as the "audio" and "carrier" circuits respectively. Normally the equipment will be used to provide an additional exchange line over a working pair.

Low pass filters connected at each end of the pair prevent mutual interference between the two circuits. No additional equipment is required for the audio circuit, but a carrier unit is provided at each end of the carrier circuit. Power for the exchange unit is provided by the 50 volt exchange battery, and a small rechargeable Nickel-Cadmium (Ni-Cd) battery provides power for the Subscribers Carrier Unit. The Ni-Cd battery charging current is drawn from the exchange battery over the physical pair when the audio circuit is not in use.

2 LIST OF PARTS The following list of items are associated with the carrier system:

Exchange Unit WB 900/1 - for use in TXS and TXE
Manufacturer GEC Ltd
Exchange Unit WB 900/2 - for use in TXS, TXK and TXE
Manufacturer GEC Ltd
Exchange Unit WB 900/3 - " " " " " " "
Manufacturer STC Ltd
Exchange Unit WB 900/4 - " " " " " " "
Manufacturer GEC Ltd in cases of Radio Interference
Exchange Unit WB 900/5 - for use in TXS, TXK and TXE
Manufacturer STC Ltd in cases of Radio Interference
Subscribers Unit WB 900/1)
Subscribers Unit WB 900/4) manufactured by GEC Ltd
Subscribers Unit WB 900/3)
Subscribers Unit WB 900/5) manufactured by STC Ltd
Filter Unit No. 8A
Filter Unit No. 10A
Mounting 1/WBM 28890)
Mounting 2/WBM 28890) see TI A4 F1602
Power Unit WB 900/...
Battery Secondary No. 21
Power Unit No. 137 - for charging up to 10 Batteries Secondary No. 21

A complete system comprises:

1 Subscriber Unit WB 900/...
1 Exchange Unit WB 900/...
1 Battery Secondary No. 21
1 Filter Unit No. 8A or 10A

A mounting .../WBM 28890 and Power Unit WB 900/.. can accomodate 10 of the above systems.

All the Exchange Units are mechanically compatible with both types of Mounting.

Installation procedures for all the subscribers units are identical.

Some of the Exchange Units and Subscriber Units are not compatible with each other. Table 1 shows which units can be associated with each other.

TABLE 1

EXCHANGE UNITS	SUBSCRIBER UNITS			
	900/1	900/3	900/4	900/5
900/1	YES	NO	NO	NO
900/2	YES	NO	NO	NO
900/3	NO	YES	NO	NO
900/4	NO	NO	YES	NO
900/5	NO	NO	NO	YES

The Units can be identified as follows:

(i) Exchange Units WB 900/1 - Grey handles
" " WB 900/2 } - Red handles or
" " WB 900/4 } Red spot on grey handle
" " WB 900/3 }
" " WB 900/5 } - White handles

(ii) Subscriber Units WB 900/1 and WB 900/4 have grey covers.
Subscriber Units WB 900/3 and WB 900/5 have white covers.

3 ASSOCIATED DIAGRAMS AND DRAWINGS

WB 28945 - Line Conditions Subscriber Carrier System
WB 28923 - Exchange Wiring
WB 28947 - Exchange Jumpering
WBM 28894

Sht 1 - Mountings
Sht 2 - Layout of Mountings on 2000 Type MAR
Sht 3 - Bars for Mounting 1/WBM 28890
Sht 4 - Bars for Mounting 2/WBM 28890

N 5183 - Exchange Jumpering
N 5182 - Filter Unit No. 8A and 10A Installation
N 5181 - Carrier Unit Wiring Subscribers Premises

4 ASSOCIATED TIs

Planning and Control	A2 C1069
Installation of Equipment at Exchanges	A4 F1602
Jumpering and Installation of the Carrier Circuits	C3 A0020
Subscribers Apparatus Maintenance	E9 E2710
Maintenance of Exchange Terminal Equipment including OCB and TOS Procedure	E9 E2712

Repair Service Control Procedures	E9 E2790
Advice Note Works - Installers Procedures	C4 C1001
Installation Controls - Control Duty, Function and Procedure	C4 C1101
Installation Controls - Routing and Records Duty - Functions and Procedures	C4 C1102
Advice Note, Minor Work Advices and Extra Maintenance	C4 C3001

5 DESCRIPTION OF CARRIER SYSTEM (FIG 1 AND FIG 2) The carrier circuit of the subscriber carrier system is derived by means of double side-band amplitude modulation, using two carriers with frequencies of 64 kHz for Exchange to Subscriber and 40 kHz Subscriber to Exchange. The system is designed to work on any line with an attenuation not exceeding 43 dB at 64 kHz. This allows the system to be used on any line within the standard planning limit (10 dB at 1600 Hz). There are no adjustments to be made on installation as the carrier levels are self-aligning. In the quiescent condition neither carrier is transmitted to line. The 40 kHz oscillator in the subscribers unit is switched on when a loop is extended from the telephone installation. The presence of carrier is detected by the Exchange Unit, and the derived dc voltage is used to operate a reed relay, which provides the dc loop into the exchange auto equipment. The dial tone modulates the 64 kHz carrier oscillator, which has been switched on by the dc from the detected 40 kHz. The dial tone is detected at the subscribers unit, amplified and fed to the telephone instrument. When the subscriber dials, the 40 kHz carrier is interrupted at 10 ips. These pulses are reconstituted into loop-disconnect pulses by the reed relay. When the carrier subscriber is called, the presence of ringing current is detected and the 64 kHz carrier switched on and off at the ringing cadence and modulated by the 25 Hz ringing current. This is detected then amplified and fed to the telephone instrument to ring the bell.

6 POWER Power for the exchange unit is provided by a Power Unit WB 900/... which is fitted onto a Mounting 1/WBM 28890 or 2/WBM 28890 and will provide power for up to 10 Exchange Units. The power unit is a simple series regulator which supplies 12 volts to the exchange unit from the exchange battery.

Power for the subscribers unit is provided by a rechargeable nickel-cadmium battery, known as a Battery Secondary No. 21, which has a nominal terminal voltage of 10.5 volts. The charging current for the battery is fed over the line from the exchange battery. The value of current drawn from the exchange battery will depend upon the line length, will be constant for that line and will not be less than 10 mA. The current flowing into the battery will depend upon the state of charge of the battery. It should be noted that unlike a lead acid battery the voltage at the terminals is no indication of the state of charge.

In order not to degrade the transmission and signalling performance of the audio circuit and to maintain standard line conditions the power feeding circuit at the exchange and subscriber are automatically disconnected whenever the audio circuit is in use. Sensors at each end of the circuit monitor the line conditions and as soon as the audio circuit is in use either due to an outgoing or incoming call or during testing, the charging circuits are disconnected. Delay circuits ensure that charging cannot commence for at least 55 seconds after the audio circuit restores to normal.

Since the carrier unit is battery powered, and the battery cannot charge when the audio subscriber is using his telephone, the system is unsuitable for use with very high calling rate audio and carrier subscribers. In practice few situations cause difficulty, provided that a carrier subscriber with a calling rate of approximately 50 calls per day is not associated with a busy audio line such as the first choice of a PBX or an order office line.

When local powered from a Power Unit No. 53 not more than one system shall be powered by any one power unit.

The Battery Secondary No. 21A is delivered charged by the manufacturer, but should normally be recharged on receipt in an Area. There are only two approved methods of charging the battery. When available, Areas will be supplied with a Power Unit 137A, which is a mains operated battery charger with an automatic discharge/charge cycle. It will hold 10 batteries at a time and should be used to recharge batteries which remain in stock in the Area for more than 12 months. Only one PU 137A will be provided per Area. The alternative method of charging a battery is to install it in a Subscribers Unit WB 900 with its line terminals connected irrespective of polarity to a 50 volt supply. With this method a minimum charging time of 15 hours is required, but the battery can remain connected indefinitely. Unapproved methods of charging the battery must be avoided since they will reduce its useful life.

7 TEEING POINTS The points at which the audio and carrier circuits are connected to the cable pair are known as teeing point. At the exchange the teeing point is on the Exchange Unit WB 900. The carrier subscriber can be teed off the audio circuit anywhere along the route provided the loop resistance between audio and carrier subscribers installation does not exceed 500 ohms. In the majority of cases this teeing point, where it will be necessary to connect a low pass filter in series with the audio circuit, will be at the DP.

7.1 Low Pass Filters There are two low pass filters in the carrier system, one at each end of the circuit in series with the audio pair. The filter at the exchange is part of the Exchange Unit WB 900. For inserting in the cable pair external to the exchange two types of fully weatherproofed filter units are available. The Filter Unit 8A is rectangular and is designed for mounting on flat surfaces, eg in subscribers premises or adjacent to wall DPs. It can also be used at pole heads or underground. The alternative Filter Unit 10A has been designed primarily for use at pole heads where overcrowding becomes a problem, and should be used when more than two filters are needed on one pole. It is a tubular unit which clamps to the drop wire clamp, but can also be used in other situations if required. The external filters will in the majority of cases be connected in circuit at the teeing point (Diagram N 5182 refers) but can be fitted in alternative positions provided the conditions in para 8 are met.

8 LINES

8.1 Exchange to Teeing Point (DP) The Carrier system will work over any unloaded aerial or underground cable pairs up to the standard limit of 10 dB. No open wire is permitted in this section of the route. The carrier will not operate on a line used for shared service, and will suffer interference if used in a cable which also carries Datel 48K. (A8 F1002 refers.)

8.2 DP to Carrier Subscriber Premises Where the distribution from the teeing point is overhead, the number of spans of drop-wire that can safely be used will be determined by whether radio interference is present. In general it will be found that two spans are acceptable but there may be instances where radio interference is at a particularly high level and no drop-wire can be tolerated.

8.3 DP to Audio Subscriber Premises If necessary open wire may be included in the audio circuit provided it occurs between the audio subscribers premises and the low pass filter.

9 SUBSCRIBERS FACILITIES Certain subscribers facilities cannot be provided with the Subscribers Carrier System.

9.1 Audio Subscriber The only facilities precluded are:-

(a) Subscribers controlled transfer (except TXE2/TXK3 dial up systems).

(b) Subscribers private metering.

9.2 Carrier Subscriber Any speech or data service requiring normal speech frequency bandwidth can be provided over the carrier circuit. The battery voltage limits the current which is supplied to the telephone installation, and precludes the use of certain line powered apparatus. It also limits the maximum loop resistance between the telephone installation and subscribers unit to 50 ohms (300 metres of 0.5 mm Cu cable), which includes the distance to any extension telephone. Signalling is limited to loop disconnect in the dir ction subscriber to exchange and 25 Hz ringing in the other direction. The ringing current will normally supply not more than two series connected magneto bells, but exceptionally up to four may be connected although the level of ringing from all the bells may be reduced.

The following table lists the facilities which cannot be provided by the carrier circuit.

1 Pay on answer coin boxes
2 Malicious call alarm
3 PABX exchange lines
4 PMBX exchange lines
5 Subscriber controlled transfer (except TXE2/TXK3 dial up systems)
6 Subscriber trunk barring
7 Subscriber private metering
8 Loudspeaking Telephone No. 1
9 Speaker Set No. 2
10 Strowger self-contained keyphone
11 Plan 107 } Internal Extensions can be provided if
12 Plan 105 } 50 ohm limit of extension is observed
13 Handsets No. 14A

10 RADIO INTERFERENCE (RI) There is the possiblity of radio interference occurring on some carrier systems. It will be most commonly experienced on long aerial cable routes, but can occur on underground systems adjacent to low frequency transmitters. It may be caused by in band or out of band signals as described:-

10.1 Out of Band Signals These are signals from local high power transmitters with frequency ranges outside the bandwidth of the carrier system (60-68 kHz Subscriber Unit, 36-44 kHz Exchange Unit). These types of signal are usually heard as speech, music or morse in the telephone instrument. Normal RI techinques can be applied to eliminate these signals, ie screening, suppressor chokes and capacitors or ferrite beads on input lead.

10.2 In Band Signals These signals usually originate from powerful low frequency transmitters, the main transmitters being Rugby 60 kHz, Innskip 62 kHz, Criggon 64.55 kHz. There are other low power transmitters which may come within the bandwidth of the carrier system in particular air field beacons and other navigational aids. The signals which originate from these transmitters can usually be heard in the telephone instrument either as high speed morse, ordinary morse or 1 sec pips. The level of these interfering signals depends upon the balance and length (attenuation) of the cable pair. Poor balance will result in high levels of interfering signals on the pair and long lines with high attenuation will reduce the signal to noise ratio.

In many cases RI can result from line plant imperfections, if interference is present check for:

1 Low insulation resistance
2 Corroded joints in block terminals etc
3 Loose connections
4 Split pairs
5 Correct loop resistance
6 Correct installation of the Low Pass Filter
7 Capacitive unbalance.

When all the points listed above have been examined then the Exchange Unit and Subscribers Unit can be changed for Units as indicated in Section 2.

Figures 1 and 2 follow

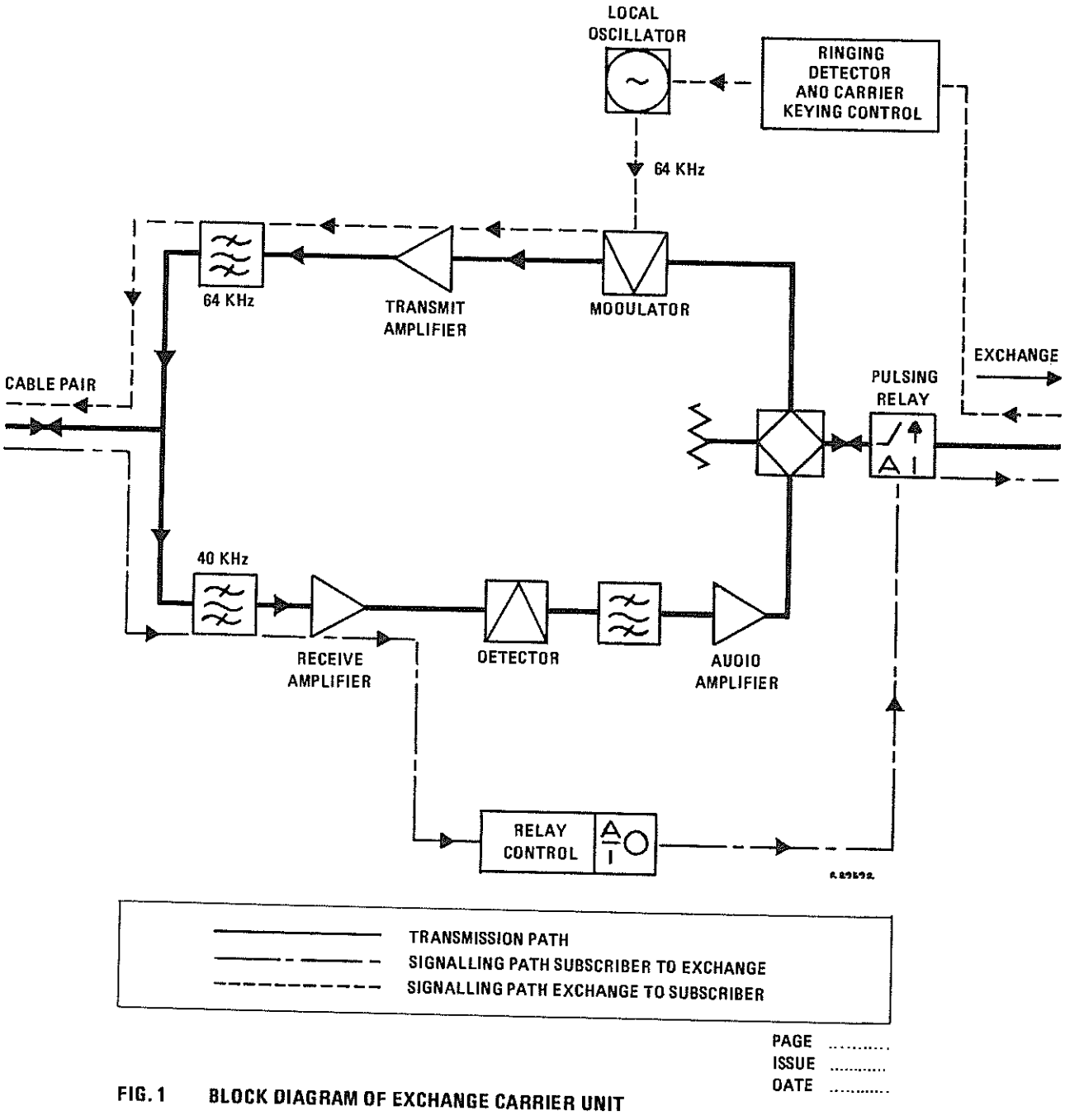

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FIG. 1 BLOCK DIAGRAM OF EXCHANGE CARRIER UNIT

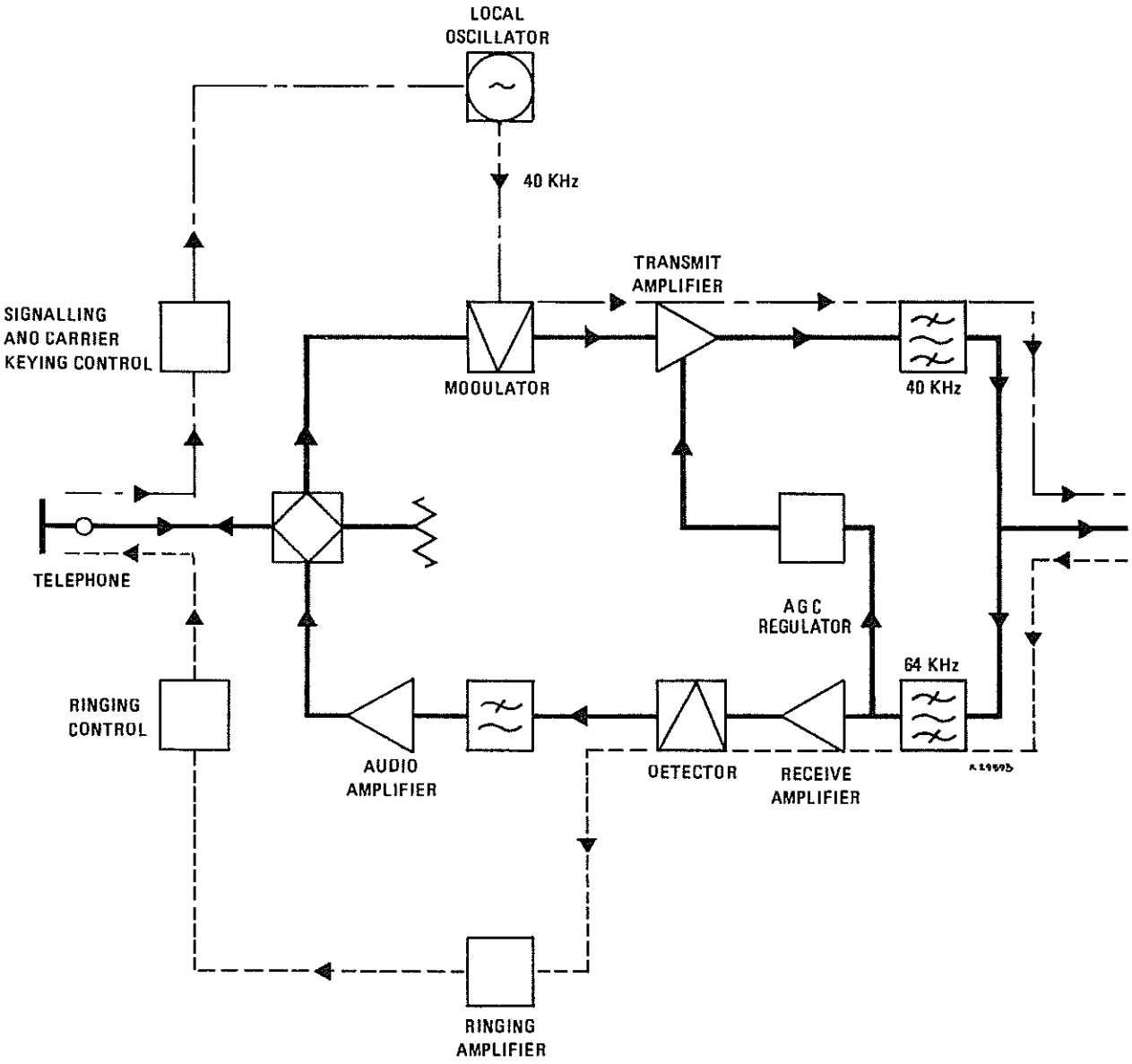

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FIG. 2 BLOCK DIAGRAM OF SUBSCRIBERS CARRIER UNIT