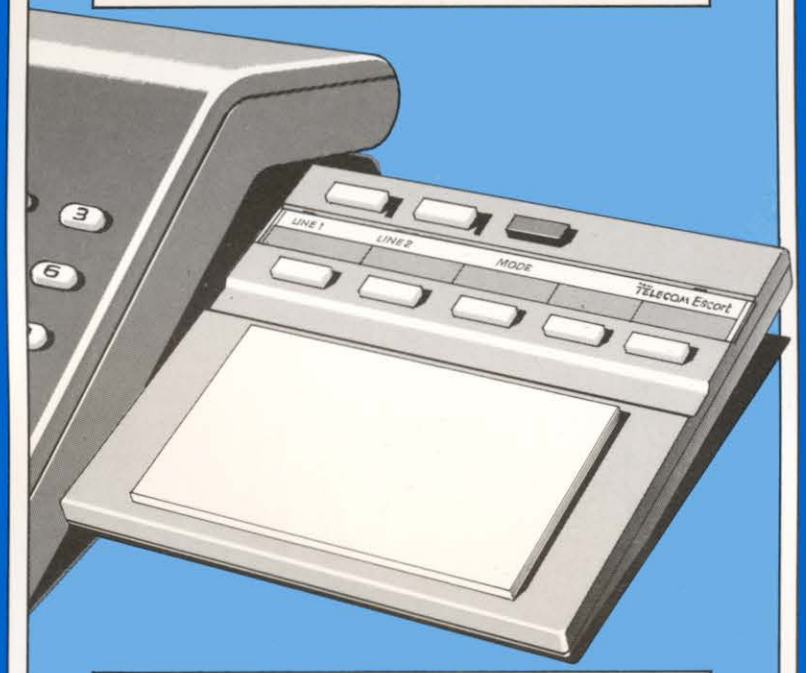
# ESCORT 2 + 6




# SWITCHING SYSTEM

## SYSTEM MANUAL

British TELECOM

BRITISH TELECOM CUSTOMER PREMISES EQUIPMENT

# E S C O R T

# S Y S T E M  M A N U A L

ESCORT SYSTEM MANUAL

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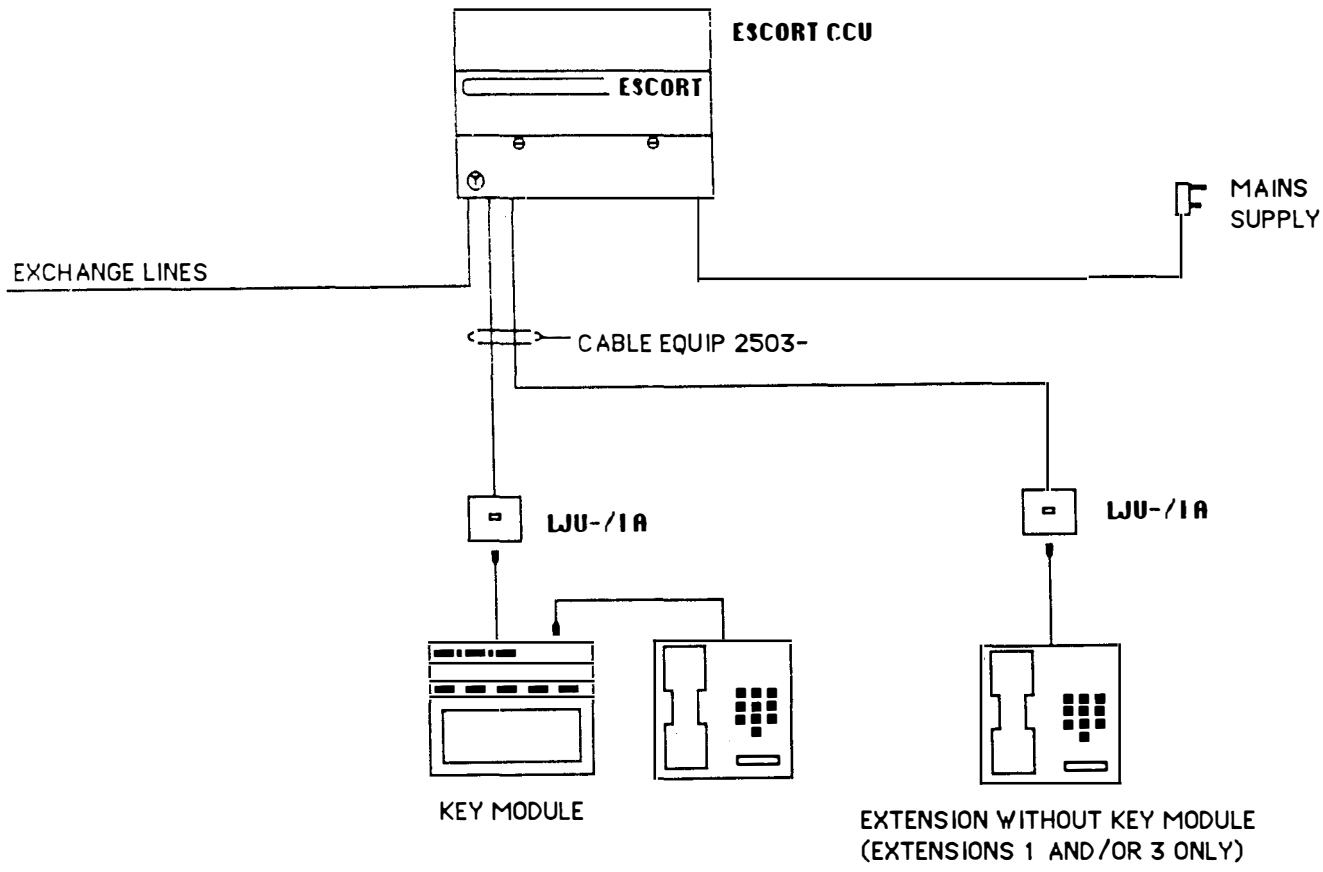
## 1. GENERAL

Escort is a 2 + 6 switching system consisting of a Central Control Unit (CCU) and up to six key modules each associated with an approved two wire telephone. The key module provides direct key access to each of the systems exchange lines and extensions, and provides visual indication of the status of each exchange line. The system is star wired, each key module requiring a 5-wire connection to the CCU. Two of the extensions may be provided without key modules, these extensions have limited access to the systems facilities and may be provided using a two wire connection to the CCU. The extension and exchange line cables are terminated directly on the CCU terminal strips, no external connection box is required. All extension equipment is connected to the system via master jacks. Fig.1.1 shows the general system configuration.

The CCU is a wall mounted, mains powered unit, having a maximum power consumption of 30VA. The CCU houses a power supply unit together with two main printed circuit boards each having a 1 + 3 capacity. The system uses custom control and decoder integrated circuits to provide the control and supervisory functions, and relay matrix space switching is used making the CCU virtually transparent to the local exchange.

The system is approved for connection to Direct Exchange Lines and those PBX's given in list "C" of the DTI Subsidiary Connection document 84/011. The system is not suitable for connection to PABX's giving a continuous ringing signal.

FIG.1.1 SYSTEM CONFIGURATION



## 2. CAPACITIES, SIZES AND WEIGHTS

The maximum capacities of the system are as follows:-

| | |
|---|---|
| Exchange lines | 2 |
| Extensions | 6 |
| Intercom circuits | 1 |

The CCU has the following dimensions and weight:

| | |
|---|---|
| height | 225mm |
| width | 320mm |
| depth | 85mm |
| weight | 4 Kg (approx) |

The key module has the following dimensions and weight:

| | |
|---|---|
| height | 40mm |
| width | 180mm |
| depth | 155mm |
| weight | 0.4 Kg |

## 3. INSTALLATION

### 3.1 LOCATION OF THE CCU

The CCU has no special site requirements other than that it should be located in a normal office environment, with adequate access for installation and maintenance.

The CCU should be mounted horizontally, adjacent to a suitable socket outlet, such that the markings on the front cover have the correct orientation. There must be at least 100mm clear space all around the CCU to facilitate servicing and ventilation. The CCU should not be mounted above radiators or in direct sunlight.

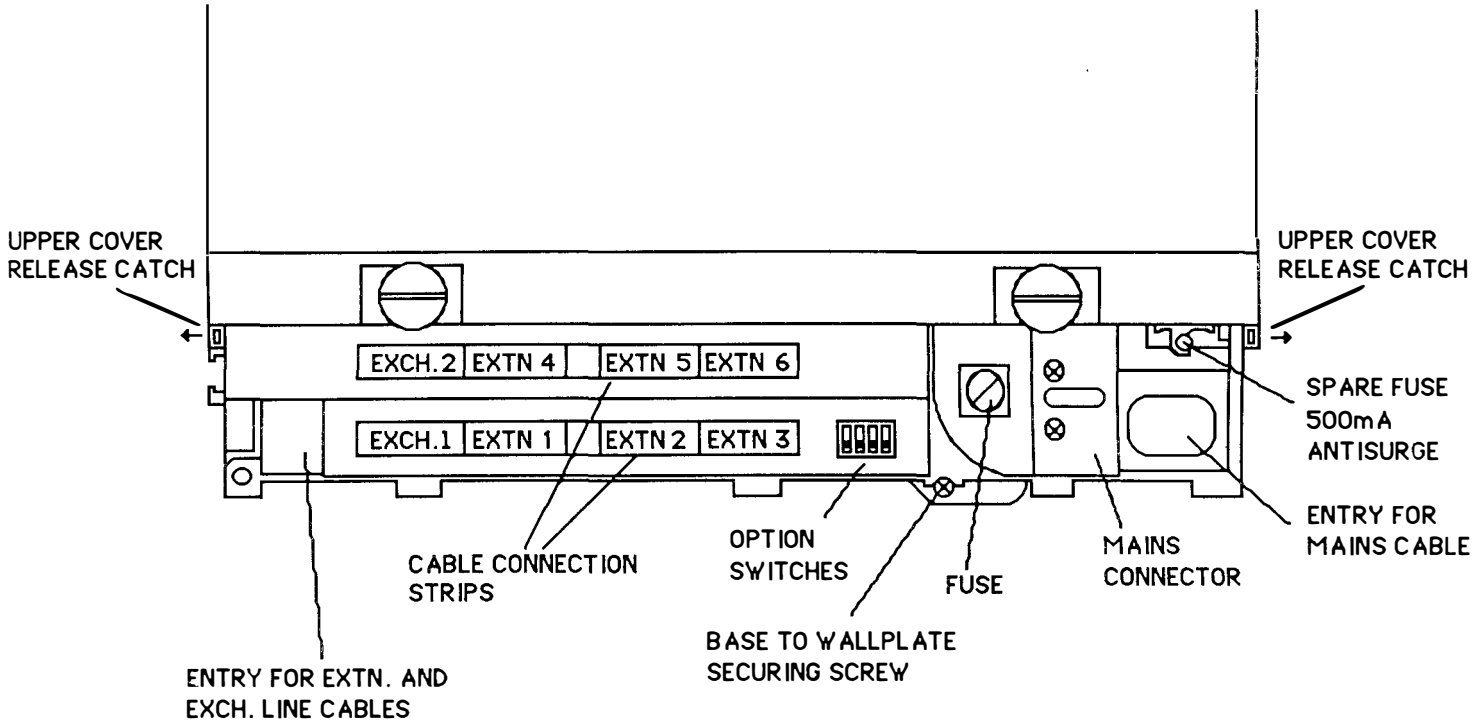
Where conditions permit the CCU should be mounted approximately 1350mm from floor level to facilitate cable connection.

### 3.2 INSTALLING THE CCU

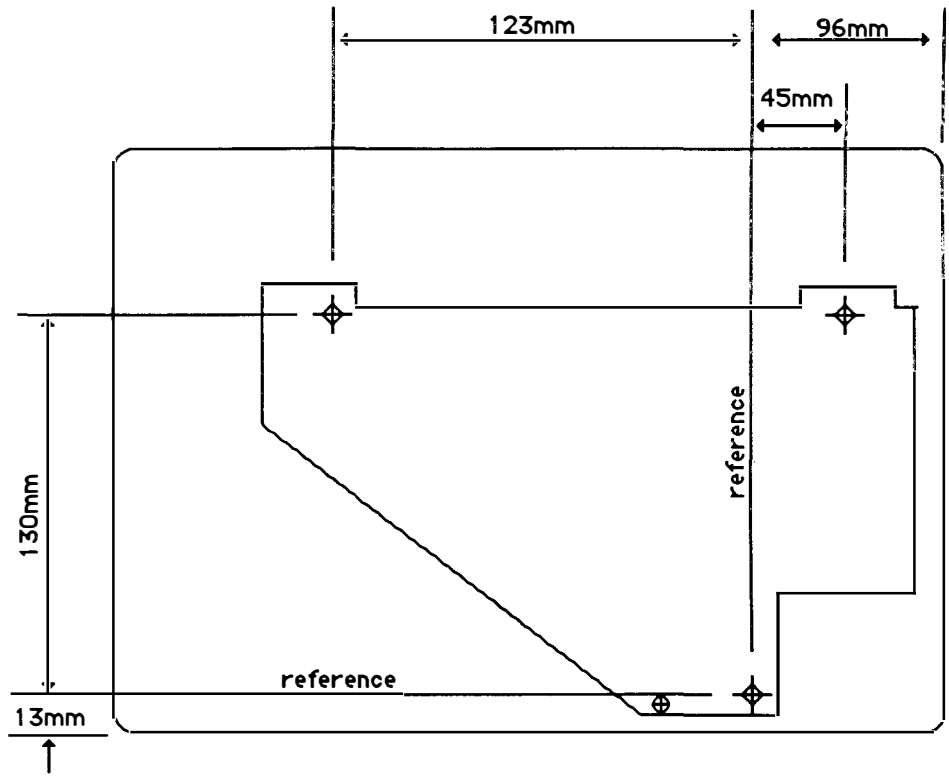
This section should be read in conjunction with fig.3.1. which shows the general layout of the CCU. Do not connect the mains supply to the CCU until all wiring and cabling has been completed.

## FIG.3.1 GENERAL ARRANGEMENT OF CCU

Shown with upper cover in place and lower cover removed.




## FIG.3.2 MOUNTING PLATE FIXING DETAILS



The front cover of the CCU is in two parts, for on-site installation and maintenance only the lower cover needs to be removed. Loosen the two large recessed screws on the front of the unit and remove the lower cover.

Remove the cross-headed securing screw adjacent to the bottom right hand corner of the lower PCB, and release the mounting plate from the CCU. Using the mounting plate as a template, mark the position of the three fixing holes required and fix the mounting plate in the chocsen location. Locate the CCU on the tabs of the mounting plate and secure by replacing the cross-headed screw. Fig. 3.2 shows the mounting plate fixing details.

If required the upper cover can be removed by releasing the two catches at the lower corners of the cover and lifting the cover off the upper locating tabs. The catches are released by inserting a small screwdriver in the catch slot and sliding them gently outwards. Note that the catches are only designed to withdrawn about 6mm, at which point the lugs on the uppper cover are fully released, any attempt to force the catches out further may cause them to fracture. The cover is replaced by seating it correctly on the locating tabs and pushing home the catches.

## 3.3 CABLING AND WIRING

All the extension and exchange line cables terminate directly on the connection blocks in the CCU, as shown in fig.3.1. The cables must be of twisted pair construction with single strand 0.5mm$^2$ conductors, and must be suitable for terminating on Insulation Displacement Connectors (IDC).It is important that only the correct type of cables are used, as the wrong type of cable may result in both poor mechanical connection and damage to the IDC terminals used on the extension line jacks.

The extension and exchange line cables enter the CCU through the cable entry hole in the lower left corner of the base. A separate cable entry hole in the lower right corner of the base is provided for the mains cable. Care should be taken to ensure that the cables do not obstruct the ventilation gap formed between the lower cover and the base.

Strip the sheaths of the cables so that only about 20mm of the sheath enters the CCU. The wires are terminated by stripping about 6mm of the insulation off the wire, and inserting the bare end under the wire clamping plate of the terminal, making sure that the insulation of the wire is just clear of the clamping plate. It is not necessary to wrap the wire around the screw on this type of terminal. Tighten the terminal screw with a small screwdriver. **Take great care not to over tighten the screws as they are liable to shear if too much force is used.**

### 3.3.1 Connecting the exchange lines

Run a 6 wire cable to the exchange line or host PBX connection point and terminate on the exchange line terminal strips in the CCU as shown in fig.3.3.

### 3.3.2 Connecting the extensions

Run a separate 6 wire cable from the CCU to each extension position and terminate the cable as shown in fig.3.4, it is recommended that all six wires are terminated in the line jack. Extensions with key modules use 5 wires of the cable and extensions without key modules use only two wires of the cable. If more convenient a larger paired cable may be provided to a central point, and the individual extension cables radiated out from there. To comply with the current regulations the extensions must not share the same cables as any other circuits.

The following schedule shows the connection details for British Telecom Cable Equipment 2503-.

| CCU Extension connections | Wire colour | LJU-/1A connections | Circuit |
|---|---|---|---|
| A | W-B | 5 | Speech 'A' |
| B | B-W | 2 | Speech 'B' |
| C | W-O | 4 | 0v |
| D | G-W | 1 | Key signals |
| E | W-G | 6 | LED signals |

The loop resistance of the extension cables must not exceed that stated for the various approved telephones in the systems PXML. The majority of the telephones are approved for a loop resistance of 50 ohms, as a guide this is equivalent to 300 metres of 0.5 copper cable.

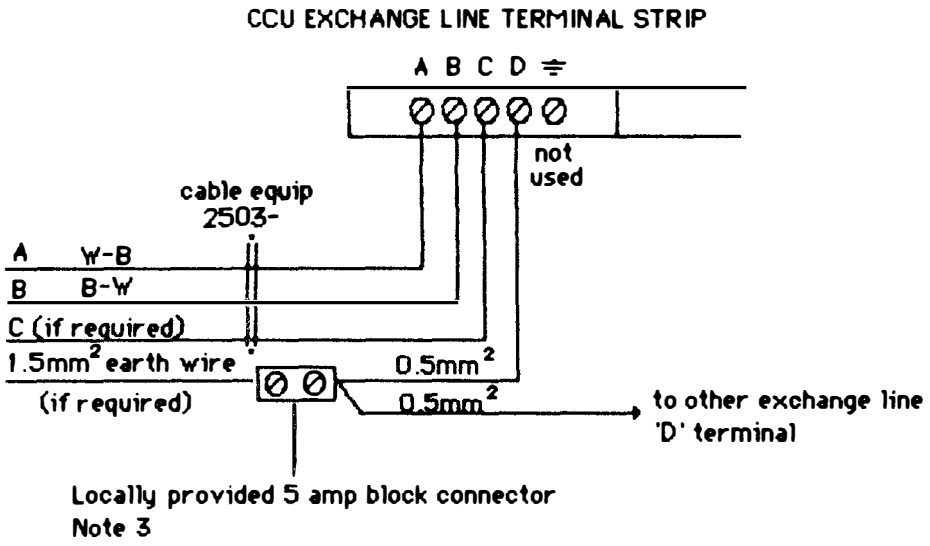
### 3.3.3 Functional Earth Connection

The system only requires an earth when it is connected to a host PBX requiring earth signalling. Where exchange line surge protection is required external protective devices must be provided.

Fig.3.3 shows the earth connection details. Provide a 1.5mm$^2$ insulated earth cable from a proven building earth point to the CCU. Terminate the earth wire in a locally provided 5-amp block connector, and provide a 0.5 mm$^2$ insulated wire from the connector to each of the 'D' terminals on the exchange line terminal strips. Suitable connectors are the B.T Block Terminal 58A/12 and Farnell Electronic Components order code 146-260.

The earth connection should be confirmed using a Line Earth Loop Impedance Tester. The impedence of the earth connection must not exceed 4 ohms.

## FIG.3.3 CONNECTING THE EXCHANGE LINES

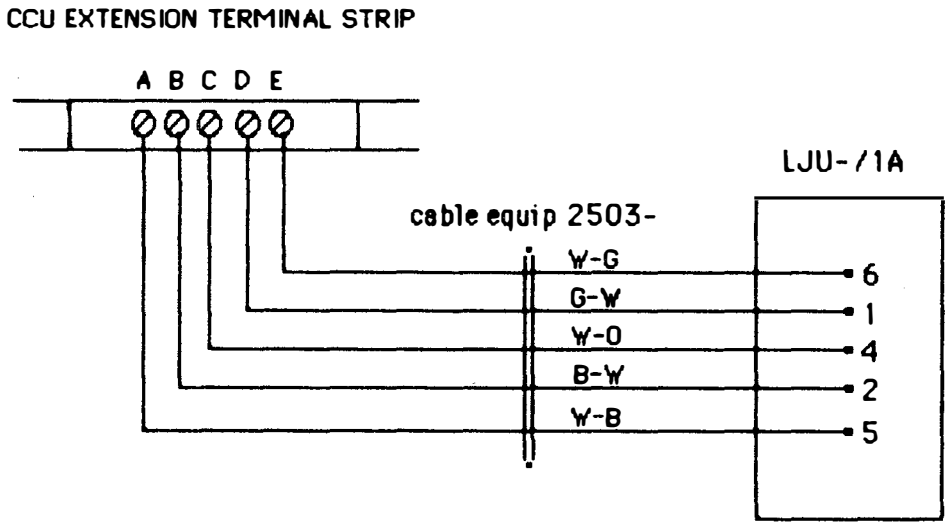



NOTE 1. For earth recall, provide functional earth and strap B-C

NOTE 2. For C-wire signalling, provide functional earth and set option switch 3 to the 'ON' position.

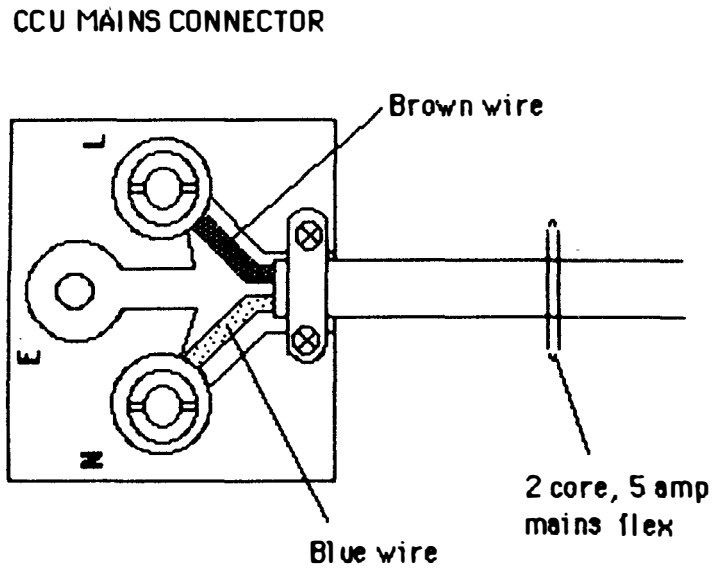
NOTE 3. Suitable connectors are B.T. Block Terminal 58A/12 and Farnell Electronic Comonents order code 146-260

## FIG.3.4 CONNECTING THE EXTENSIONS



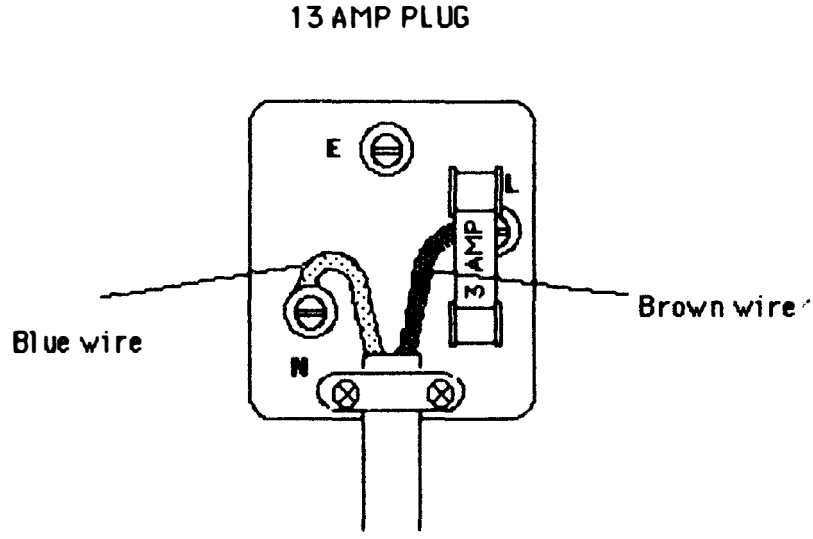

Connections C, D and E are not required for two wire extensions

## FIG. 3.5 CONNECTING THE MAINS SUPPLY TO THE CCU




NOTE. The CCU does not require a mains protective earth.

## FIG.3.6 CONNECTING A 13AMP PLUG



3.3.3.1 Earth recall

On each exchange port requiring recall, strap together terminals B and C. Earth recall will be given when the extension presses the mode button on an established call.

Two wire extensions may be provided with earth recall in one of two ways: if the extension has been provided over a 6 wire connection the white-orange wire may be connected to the locally provided earth block in the CCU, if however the extension has been provided over a two wire connection it will be necessary to provide a separate functional earth for that extension as described above.

3.3.3.2 C-wire signalling

The system is set for C-wire signalling by setting switch 3 of the option switch block to the 'ON' position.

### 3.3.4 Connecting the mains supply

The system is set at manufacture for 240v a.c operation, and is connected to the mains supply using a suitable length of 2 core, 5 amp sheathed mains flex. The mains cable should be terminated and clamped in the CCU as shown in fig 3.5. Fig.3.6 shows the termination details for a standard 13 amp plug, the plug must be fused at 3 amps.

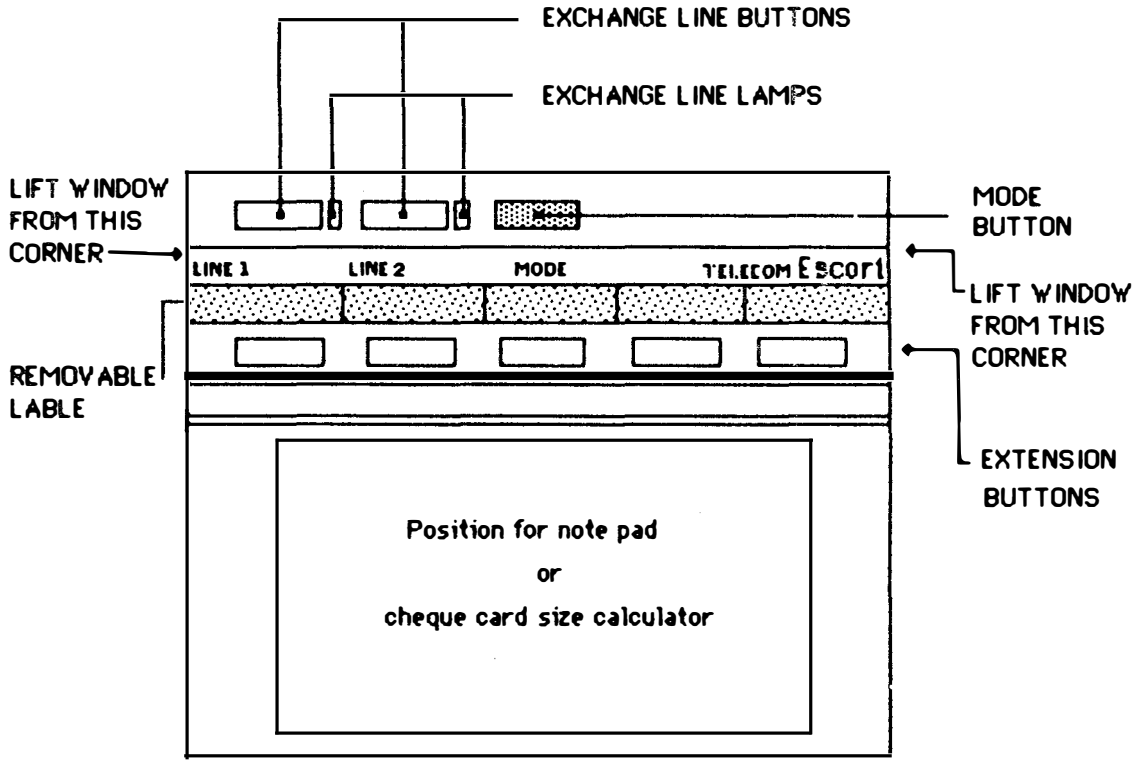
## 3.4 INSTALLING THE KEY MODULES AND TELEPHONES

Fig. 3.7 shows the general layout of the key module. The key modules may be either free standing or wall mounted using the two key hole slots provided in the base. When the key module is wall mounted it should normally be fitted such that its centre is 1350mm from floor level.

The key module is connected to the system by plugging its cord into the extension socket, the associated telephone is then plugged into the shuttered socket at the rear of the module.

The key module label may be removed so that the numbers and/or names of the other extension users may be written on it. The label is printed on both sides so that it may be reversed when wall mounting. The label should always be fitted such that the 'mode' marking is adjacent to the orange mode key. To remove the label window gently lift the window upwards by the two corners opposite the extension buttons. To replace the window, locate the four tabs in the corresponding slots in the window recess and gently hinge downwards, ensuring that the upper two tabs locate correctly in their respective slots.

FIG 3.7 LAYOUT OF THE KEY MODULE




The key module has two recesses in its upper cover, the larger is designed to take a standard 76 x 126mm note pad as supplied with the unit, and the smaller recess a credit card sized calculator.

### 3.4.1 Numbering the extension keys

The module extension keys number numerically from left to right omitting their own extension number. For example the extension keys on extension 2 are numbered 1, 3, 4, 5, and 6.

## 3.5 SETTING THE OPTION SWITCHES

The option switches are set on installation to tailor the system to the customers requirements. A 4-way miniature switch block is located adjacent to extension 3 terminal block in the CCU. The switches are set by the manufacturer to the 'OFF' position and the facilities are invoked when the switches are set to the 'ON' position.

The switches have the following functions:-

| | |
|---|---|
| Switch 1 | Two wire working on extension 1 |
| " 2 | Two wire working on extension 3 |
| " 3 | C-wire signalling |
| " 4 | Exclusive line facility on extension 4 |

## 3.6 TELEPHONES

### 3.6.1 Telephone signalling

As Escort is a 'transparent' system, the telephone signalling must be compatible with the signalling of the exchange or host PBX to which the system is connected. For example when the system is connected to a PBX employing MF signalling, MF telephones must be used. Earth recall, if required, is a system facility and is given when the 'mode' key is pressed on an established call, if timed break recall is required telephones offering this facility must be provided.

### 3.6.2 Approved telephones

Only certain telephones are approved for connection to the system, these are listed in the system's PXML. For each telephone listed in the PXML a maximum loop resistance is specified, it is important that this is not exceeded. The majority of the telephones are approved for a 50 ohm loop resistance, this is equivalent to 300m of 0.5 copper cable.

## 3.7 EXTENSION BELLS

The ringing generator on Escort is designed to ring all extension ports simultaneously provided that the Ringer Equivalent Number (REN) on each port does not exceed 2.0.

Approved extension bells, as listed in the systems PXML, can therefore be connected to extension ports where the telephone has a REN of one or less. The bells are hardwired to terminals 3 and 5 of the extensions line jack.

## 3.8 INSTALLATION AND SYSTEM FACILITIES

The systems PXML requires that at least one extension must be provided with a key module. This rule is made to ensure that visual status of call progress is available. Apart from this mandatory requirement the following points should also be considered.

### 3.8.1 Mains fail connection and exchange line ringing

Extensions 1 and 4 provide mains fail connection and default ringing for exchange lines 1 and 2 respectively. These extensions should therefore be provided when the corresponding exchange line is provided.

### 3.8.2 Divert

As the system's divert facility is limited to a fixed diversion table, ie extension 2 can only divert calls to extension 1, it is important that the extension numbers are allocated with due regard to the customers operational requirements.

## 3.9 TESTING

Before connecting the system to the mains, check the mains fail operation of the system by going off-hook at extensions 1 and 4 and checking that exchange dial tone is heard.

Connect Escort to the mains. Lift off the handset on each terminal and check that both exchange lines can be seized. Check that each terminal can both make and receive exchange line and intercom calls. Remember that if the exclusive line facility is used, only extension 4 will be able to make and receive calls on exchange line 2.

If extensions 1 and/or 3 are provided as two wire extensions check that extension 2 is called when either of these extensions lift their handsets.

The most common faults likely to be encountered on installation are disconnected or reversed signalling wires, these will result in variety of signalling faults such as no lamp signals and failure to correctly recognise key actions.

Some faults due to wiring errors may not be immediately noticeable, it is therefore important to check that there are no short circuits or reversals in the cabling.

## 4. SUPERVISORY SIGNALS

### 4.1. RINGING SIGNALS

The system provides three distinct ringing cadences, all of which are announced by the extensions telephone.

| SIGNAL | CADENCE |
|---|---|
| Internal ringing | 1 sec."ON", 1 sec."OFF" |
| Reminder ringback | 0.5 sec."ON", 0.5 sec."OFF" |
| Exchange ringing | Echoes exchange ringing cadence |

### 4.2 LAMP SIGNALS

Each exchange line key on the key module is associated with an LED, the LED will be in one of five states:

| SIGNAL | INDICATION |
|---|---|
| Exchange line free | LED OFF |
| Exchange line busy | LED ON continuously |
| Exchange line ringing | LED echoes cadence of exchange ringing |
| Exchange line held | LED cadenced at 0.5 sec."ON" 0.5 sec."OFF" (at holding station only) |
| Incoming intercom call whilst engaged on an exchange line call | LED cadenced at 1 sec."ON", 1 sec."OFF" (at called and calling stations only) |

### 4.3. TONES

| TONE | FREQUENCY AND CADENCE |
|---|---|
| Call Waiting Tone. Introduced on the intercom circuit to indicate that an exchange line call is waiting to be answered | 500Hz, echoed at the cadence of incoming ringing. |

# 5. FACILITIES

## 5.1 FACILITIES LIST

Receive and originate exchange line calls with secrecy
Receive and originate non-secret intercom calls
Exchange line hold
Reminder ringback on hold
Enquiry
Transfer exchange calls
Call diversion
Internal conference
Exchange line conference
Call Shuttle(broker service)
Programmed exchange line ringing
Visual indication of exchange line status
Call waiting tone
Capability of labelling keys
Exclusive use of exchange line 2 by extension 4 (note 1)
Optional 2-wire working on extensions 1 and 3 (note 1)
C wire signalling (note 1)
Mains fail call announcement and connection

Note 1. These facilities are set during installation and cannot be changed by the user.

## 5.2 FACILITIES DESCRIPTION

### 5.2.1 Intercom

The intercom circuit is non-secret. In the idle state all stations are connected to the intercom circuit, and any station lifting its handset will be connected to any existing intercom call in progress, or any other station that has lifted its handset and not yet pressed an exchange line key.

Any station may call any other station by lifting the handset and pressing the required extension key. The called station will ring at intercom ringing cadence until answered by the called station lifting his handset. If there is no reply from the called station, the originating station may make a follow-on call to another station or an exchange line, without replacing his handset.

If the called station is engaged on an exchange line call, the call will be announced by the exchange line LED flashing at the intercom ringing cadence. This signal is also given to the calling station.

No indication is given if the called station does not exist.

### 5.2.2 Incoming exchange call

An incoming exchange call is announced visually at every station, by the exchange LED of the calling line flashing at the exchange ringing cadence. The call will also be announced audibly at the exchange cadence, at each station that has been programmed to ring to incoming calls on that line.

If all stations programmed to receive incoming ringing on a particular line are engaged, the system will ring all free stations irrespective of their ringing status and introduce call waiting tone on the intercom circuit. Note that if the exclusive line facility is being used incoming calls on exchange line 2 will only be audibly announced on extension 4.

An incoming call may be answered at any station by lifting the handset and pressing the key of the calling line. The exchange LED at each station changes state to a steady "ON" condition.

A station which is already engaged on another call, may also answer the call by pressing the key of the calling line. If the existing call was an exchange call, it will automatically be held.

### 5.2.3 Outgoing exchange call

Any station may make an exchange call on any free line by lifting the handset and pressing the line button. When exchange dial tone is received, the number is dialled from the station telephone. At each station the LED of the seized line glows steadily.

If the system is connected to a PBX using earth recall, pressing the "mode" button on an established call will recall the PBX.

The exchange line is released when the originating station replaces his handset. The exchange LED extinguishes.

### 5.2.4 Exchange line hold

Any station having originated an exchange line call may subsequently hold the call by pressing the exchange line key used to make the call. At the holding station the exchange line LED flashes at the hold cadence, at all other stations the LED continues to glow steadily. If the holding station replaces his handset reminder ring back will be given after a short delay.

The line may be reseized at any time by pressing the line key again. The exchange LED reverts to a steady 'ON' condition.

The exchange line may be incoming or outgoing and there is no limit to the number of times a call may be held. Any station may hold both exchange lines if required.

### 5.2.5 Enquiry

Any station may hold an exchange line and make an enquiry call to either the other exchange line or another station. The original exchange call may be incoming or outgoing and there is no limit to the number of enquiry calls that can be made.

**Enquiry to another station:-**

On an established exchange line call pressing the key of another station automatically holds the exchange line and attempts an intercom call to the required station. Alternatively the exchange line can be held as described in 5.2.4, and then the required station key pressed.

In either case the exchange LED flashes at the hold cadence, and if the originating station replaces his handset reminder ringback will be given.

At the end of the enquiry call, the exchange line is reconnected by pressing the key of the held line. The exchange LED reverts to steady glow.

**Enquiry to the other exchange line**

On an established exchange line call, any station may make an enquiry call on the other exchange line, if it is free, by pressing its line key. The original exchange call is put on hold and its exchange LED flashes at the hold cadence. An enquiry call may now be established over the other exchange line in the normal way.

The station may now shuttle between the two exchange line calls by alternately pressing the line keys.

At the end of the enquiry call the station replaces his handset and waits for the exchange line LED of the current call to extinguish. The station then lifts his handset again and presses the key of the held exchange line key to recover it from hold.

### 5.2.6 Call transfer

Any station may transfer an exchange line call to any other station, the exchange line call may be incoming or outgoing and there is no limit to the number of times it may be transferred.

To transfer a call, an enquiry call is first established to the station to which the call is to be transferred, as descibed in 5.2.5. The call may then be transferred in one of two ways:

**Automatic Transfer**

The enquiring station announces the call and replaces his handset, the call will automatically be transferred to the called station.

**Manual Transfer**

Alternatively the enquiring station can tell the called station which line he is on and ask him to pick up the call by pressing the line button. As soon as the called station presses the line key, the call is transferred leaving the enquiring station free to make a follow-on call without having to replace his handset.

**Transferring calls to two wire extensions**

If stations 1 and/or 3 are configured for 2 wire working, any station initiating a transfer to these stations must use the following method to transfer the call.

An enquiry call is made to the two wire station in the normal way, but before the calling station replaces his handset he must press the extension key of the called station again. Note that 4 seconds must elapse from the time the two wire extension answers, before the enquiring station replaces this handset to transfer the call. The transfer is unreliable if this proceedure is not observed.

### 5.2.7 Conference

#### 5.2.7.1 Exchange line conference

An exchange line conference call may be set up between the exchange line and any two Escort extensions, the exchange line call may be incoming or outgoing.

Any station may extend an exchange line call into a conference by first establishing an enquiry call to the required station as described in section 5.2.5. If the station agrees to join the conference the originating extension presses his mode button, completing the connection. The exchange LED glows steadily.

If the called station does not wish to join the conference the originating extension may make an enquiry call to another extension, or reconnect the exchange line as required.

**Leaving an exchange line conference call**

An exchange line conference call is cleared by both extensions replacing their handsets. If one extension continues in conversation with the exchange line, the other extension will be reconnected into the conference if he lifts his handset whilst the call is still in progress.

#### 5.2.7.2 Internal Conference

An established intercom call may be extended into an internal conference by either party pressing the key of the required extension. As soon as the extension lifts his handset he will be connected into the conference.

The system does not automatically limit the number of extensions connected on an internal conference, but four extensions should be considered a maximum because of transmission deterioration.

### 5.2.8 Call diversion

Any station may arrange for calls to his station to be diverted to another station as shown in the table below, no other diversions are possible. For the duration of the divert all incoming calls for the diverting station will call the host. The host may still make internal calls to the diverting station in the normal way.

When a divert is invoked, the host station takes on the programmed ringing status of the diverting station. Thus if the diverting station is programmed to ring on both exchange lines but the host station has cancelled ringing on both lines, the host will be forced to respond.

When a divert is set up to a two wire station, only internal calls will be diverted to ring at the host station. Exchange line calls are not diverted as two wire stations do not have full access to the systems facilities. If the diverting station is the only station programmed to ring on a particular line, diverting calls to a two wire extension could lead to reports of ring tone no reply.

| | | |
|---|---|---|
| Station 1 | to | Station 2 |
| Station 2 | to | Station 1 |
| Station 3 | to | Station 1 |
| Station 4 | to | Station 2 |
| Station 5 | to | Station 6 |
| Station 6 | to | Station 5 |

Note that where a pair of terminals can only divert to each other e.g. stations 1 and 2, only one station at a time can use the divert facility. The divert facility can be daisy chained, ie. station 4 can invoke a divert to station 2, which in turn can invoke a divert to station 1.

**To invoke a divert:**

Lift the handset
Press and release the 'mode' key
Press and release the extension key opposite line 1 key
Replace the handset

**To cancel divert:**

Lift the handset
Press and release the 'mode' key
Press and release the extension key opposite line 2 key

### 5.2.9 Programming exchange ringing

Each station may program his telephone bell to respond to calls on one or both exchange lines subject to the following restrictions:

When the system is first powered up station 1 rings to incoming calls on line 1, and station 4 rings to incoming calls on line 2. These stations may only cancel this default ringing if at least one other terminal is programmed to ring on the correspomding exchange line. If all other stations subsequently cancel their programmed ringing on a particular exchange line, the system forces the appropriate station into the default condition.

**To invoke programmed ringing:**

Lift the handset
Press and release the 'mode' key
Press and release the required exchange line key
Repeat steps 2 and 3 for the other line if required
Replace the handset

**To cancel programmed ringing:**

Lift the handset
Press and release the 'mode' key twice
Replace the handset

Note that this proceedure cancels the programmed ringing on both exchange lines. If the station is still required to ring on one line, follow the proceedure descibed for invoking programmed ringing.

### 5.2.10 Exclusive line facility

Extension 4 may be set to have exclusive use of exchange line 2. This facility is set on installation by moving switch no.4 of the 4-way miniature switch block to the "ON" position. The switch block is located next to extension 3 terminal strip on the main PCB.

When the exclusive line facility is set only extension 4 will be able to make and receive calls on exchange line 2, but the line status will continue to be given at each station by the exchange LED. Other stations may only use exchange line 2 if extension 4 transfers it to them as described in section 5.2.6, or diverts it to them as described below. If extension 1 is configured for two wire working incoming calls on line 2 will not be diverted.

Two modes of divert are available to extension 4 when the exclusive line facility is set.

STANDARD DIVERT All calls for extension 4 are diverted to extension 1 (not extension 2 as described in section 5.2.8.). Extension 1 may both make and receive calls on line 2 for the duration of the divert.

**To invoke standard divert:**

Lift the handset
Press and release the 'mode' key
Press and release the extension key opposite line 1 key
Replace the handset

EXCLUSIVE DIVERT All calls are diverted to extension 1 with the exception of calls on exchange line 2 which continue to ring at extension 4.

**To invoke exclusive divert:**

Lift the handset
Press and release the 'mode' key
Press and release the extension key opposite the 'mode' key
Replace the handset

The system allows you to alternate between the two divert modes without the need to cancel the existing setting. Both modes are cancelled in the same way.

**To cancel divert:**

Lift the handset
Press and release the 'mode' key
Press and release the extension key opposite line 2 key
Replace the handset

### 5.2.11 Two wire extensions

Extensions 1 and/or 3 may both be configured as simple telephones without key modules, these extensions are limited to the facilities of making and receiving calls. Extension 1 will ring to incoming calls on exchange line 1, but extension 3 does not ring to incoming calls on either line. Both extensions must make all outgoing intercom and exchange line calls via extension 2, which is called automatically whenever a two wire extension lifts his handset. Two wire extensions cannot use the enquiry or transfer facilities, set up conference calls or use the system's divert and programmed ringing features. Note that when a divert is set up to a two wire extension, exchange line calls are not diverted.

Extensions 1 and/or 3 may be configured for two wire working by changing the settings on the 4-way miniature switch block in the CCU. The switch block is located next to extension 3 terminal strip on the main PCB. Moving switches 1 and/or 2 to the "ON" position sets extensions 1 and 3 for two wire working respectively.

See section 5.2.6 for the method to be used when transferring calls to two wire extensions.

**To make an intercom call from a two wire extension:**

Lift the handset, if the intercom circuit is free extension 2 will be called automatically, if the circuit is busy try again later.

When extension 2 answers, ask him to call the required extension for you.

Extension 2 presses the required extension key, and when the called extension answers announces the call and replaces his handset. A call is now established between the two wire extension and the called extension.

**To make an exchange line call from a two wire extension:**

Lift the handset, if the intercom circuit is free extension 2 will be called automatically, if the circuit is busy try again later.

When extension 2 answers, ask him to connect you to an exchange line.

Extension 2 presses a free exchange line key and waits for exchange dial tone. Extension 2 then presses the key of the two wire extension and replaces his handset. The exchange line is transferred to the two wire extension who may then dial the required number. Alternatively extension

2 can dial the call and transfer it when it is established.

In the case of extension 1 only if extension 2 does not answer within 15 seconds, extension 1 will automatically be connected to a free exchange line

Note 1. If another extension lifts his handset whilst extension 2 is being called, that extension will intercept the call, and will be able to connect you to either another extension or an exchange line as described for extension 2.

### 5.2.12 Systems connected to a PBX

Escort is on "LIST A" in DTI document 84/011 for subsidary operation. One or both of the exchange lines may be connected to the extension ports of any PBX in "LIST C" of that document. Escort is not suitable for connection to any PABX which gives a continuous ringing signal. This is because Escort only senses an extension off-hook condition during off periods of any incoming ringing cadence.

**Recall**

If the system is configured for earth recall, pressing the mode key on an established call to the PBX, will cause an earth to be applied to the line to recall the PBX.

If the PBX requires timed break recall, the recall function must be generated by the station telephone.

**To make a call to a PBX extension:**

Go off hook and press a free line key to seize the PBX, and wait for PBX dial tone.

Dial the number of the PBX extension required

**To make an exchange line call through the PBX:**

Go off hook and press a free line key to seize the PBX and wait for PBX dial tone.

Dial the PBX exchange line access code. If required by the PBX operating proceedure wait for exchange dial tone and then dial the required number, otherwise dial the required number immediately.

### 5.2.13 Power fail

Failure of the mains supply will result in station 1 being connected to exchange line 1, and station 4 being connected to exchange line 2. All other stations and facilities will be inoperative. Calls in progress at the time of failure may be lost, but no call will be interrupted when power is restored.

## 6. MAINTENANCE

All voltages and other parameters given in this section are given as an indication of their expected values, these values are all subject to a 5% tolerance.

### 6.1 GENERAL

In order to restore customer service as quickly as possible a policy of maintenance changeout should be adopted. Neither the CCU or the key module require any routine maintenance and on site maintenance will be limited to changing the the fuse in the CCU.

### 6.2 TEST CONDITIONS

Exchange line Ports. The exchange line interface incorporates components to enable it to test as a normal DEL. Because the circuit contains voltage dependent resistors for protection it will test low loop if tested with a megger.

Extension Ports. In the idle state i.e. no calls in progress and all extensions on hook, the extensions are connected to the intercom path, and a voltage of about 42 volts should be measured across the speech pair. No voltage should be measured between the terminals "C" and "E"(LED signals). Approximately 21 volts should be indicated between terminals "C" and "D"(key signals).

### 6.3 FAULT LOCATION AND RECTIFICATION

The following table will assist fault location down to major sub-system level. Faults proved to any subsystem of the CCU or to the key module should result in the faulty unit being changed. When using the table the possible faults and actions should be considered in the order given.

TABLE 6.1 SYSTEM FAULT LOCATION

| SYMPTOM | POSSIBLE FAULT | ACTION |
|---|---|---|
| 1. System in mains fail. | A. Loss of power supply | 1) check fuse<br>2) check incoming mains supply |
| | B. Failure of power supply or control circuits | 1) change CCU |
| 2. Speech or signalling fault on one terminal. | A. telephone speech circuit | 1) check using test telephone<br>2) check extn wiring and line jack |
| | B. key module switch or LED fault | 1)check extn wiring<br>2)change key module |
| | C. control circuit or extension interface circuit failure. | 1) change CCU |
| 3. Speech or signalling fault on all terminals | A. Loss of power supply | 1) check fuse<br>2) check mains supply |
| | B. failure of control or power supply circuits. | 1) change CCU |

### 6.3.1 Changing the CCU

Having proved that the CCU is faulty, the unit minus its cover should be replaced as follows:-

First disconnect the unit from the mains supply and then remove the cover. Mark for identification purposes and disconnect the wires connected to the screw terminals, and remove the CCU from the wall. Refer to the installation section of this manual when fitting the replacement unit.

The customers original cover should be fitted to the replacement unit and the new cover returned with the faulty unit.

Note the position of the switches and links in the faulty unit, and set the switches and links in the replacement unit to the same setting.

### 6.3.2. Transportation

The CCU should be handled with care and be transported with the cover in place in the packing of the replacement item.

## 7. SYSTEM ARCHITECTURE

The CCU houses two main printed circuit boards, a Control board and an Extension board. The control board contains all the circuitry required for a 1 + 3 system, and would be capable of independent operation. The extension board extends the capacity of the system to 2 + 6.

All voltages and other parameters given in this section are given as a guide to their expected values, if no tolerence is given, a 5% tolerence should be assummed.

### 7.1. CONTROL

Control of the system is achieved by the use of 3 custom LSI chips, a single NMOS control chip which is provided on the Control PCB only, and decoder chips which are provided on both the control and extension PCB's.

The control chip receives information on the current status of the extensions and exchange lines and simultaneously scans the module keys, looking for and identifying a depressed key.

From the information gathered, the control chip decides what actions are necessary and transmits data to the two decoder chips. The decoder chip converts the received data into switching and LED indicator signals which are sent to the extension and exchange line interface circuits.

### 7.2. SWITCHING MATRIX

The system uses a space switched relay matrix providing a metallic path for both intercom and exchange line connections. This method of switching makes the system virtually transparent to the local exchange or host PBX. The matrix relays are controlled from the decoder circuit outputs via discrete transistor relay driver circuits. The matrix is arranged such that any extension may be switched to either exchange line, the intercom circuit or the ringing highway.

### 7.3. POWER SUPPLY

The incoming mains supply is stepped down to 30v-0-30v by a centre tapped transformer and full wave rectified. The rectified voltages are regulated giving a final output of $\pm$ 22 volts. These voltages are used to drive all the systems circuit elements

## 7.4. INTERCOM POWER SUPPLY

Power for the intercom circuit is provided from the ± 22 volt outputs of the power supply which are fed via a noise reduction circuit and constant current sources.

## 7.5. TONE GENERATORS

The control circuit generates a 500 Hz tone which is fed onto the intercom circuit in certain circumstances to indicate that an exchange call is waiting to be answered.

## 7.6. EXCHANGE LINE INTERFACE CIRCUIT

A simplified exchange line interface circuit is shown in figure 7.1. Each exchange line interface circuit consists of the following circuit elements:

Loop detector
Ringing detector
Hold relay
Recall relay
Surge protection
Series capacitor and resistor to emulate DEL connection

The two detector outputs provide status information to the control chip and the Hold and Recall relays are controlled by the decoder chips.

## 7.7. EXTENSION INTERFACE CIRCUITS

A simplified extension interface circuit is shown in figure 7.2. Each extension has an extension interface circuit which consists of the matrix relays described in 7.2., together with loop detector, LED driver and scanning control circuits

It should be noted that the relays for extension circuits 1 and 4 are energised for connection to the intercom line. In the unenergised or power fail condition, these relays connect extension 1 to exchange line 1, and extension 4 to exchange line 2.

## 7.8. VOLTAGE COMPARATOR CIRCUIT

This circuit element enables the control circuit to determine which button on a key module has been operated. Each button on the key module inserts a different resistance into the circuit. The resulting current flow, via the extension scanning circuit in the extension interface, is applied to the voltage comparator circuit which outputs a 4-bit control word to the control IC.

## 7.9. RINGING GENERATOR

The ringing generator is provided by an astable multivibrator and two pairs of Darlington transistors. A terminal sounder will see the output as 17-25 Hz and approximately 75v peak to peak.

## 7.9 INCOMING EXCHANGE LINE CALL

As an example of the system operation, the handling of an incoming exchange line call will now be described.

If the incoming ringing from the exchange line is within specification, the exchange line interface circuits ringing detector will be activated, and will signal the incoming call to the Control IC. The output of the ringing detector is a pulse train corresponding to the ringing cadence, modulated at the ringing frequency.

The Control IC senses the ringing detectors signal and:

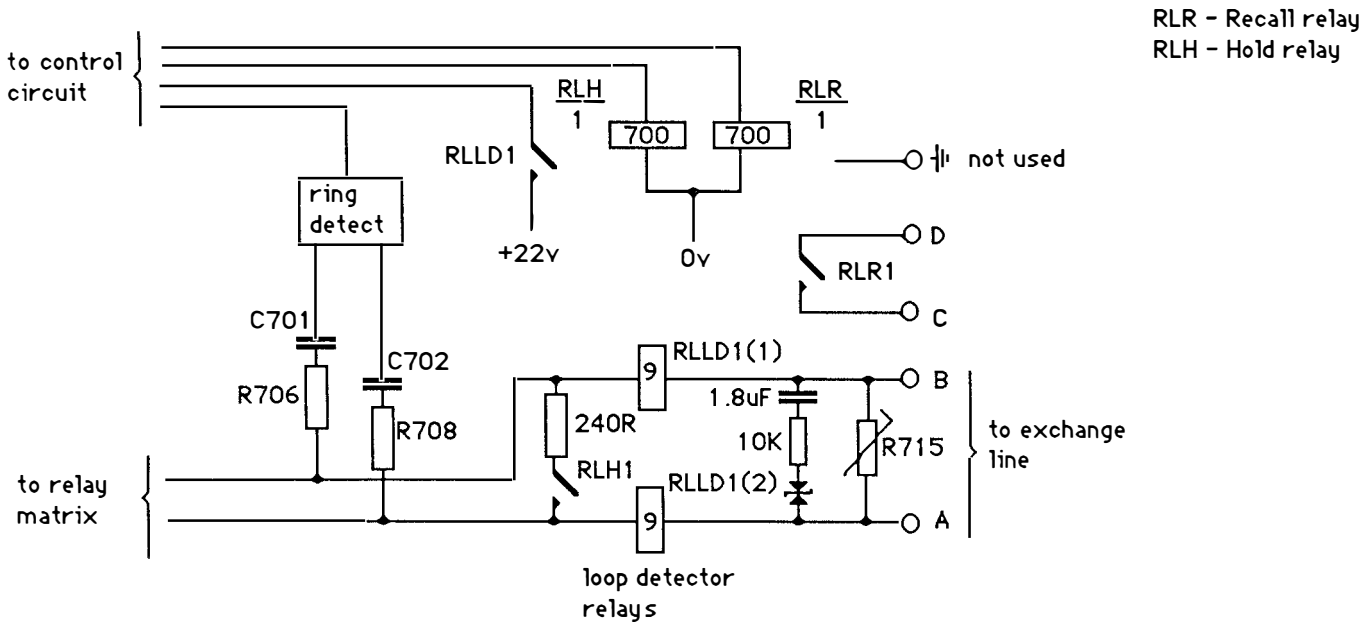
- Rings any terminal programmed to receive exchange line ringing by switching the terminal between the intercom and ringing highways.

- Flashes the exchange line LED's for that exchange line on all terminals at the incoming ringing cadence.

During the incoming ringing the Control IC is continually scanning the terminals, each complete scan taking 14mS. For the exchange line call to be answered the Control IC expects to see a terminal off-hook signal followed by the depression of the key of the calling line. When the answering terminal goes off-hook, an off-hook signal is generated by the terminal loop detector which stops the matrix relay switching to the ringing highway. When the terminal presses the key of the calling line, the Control IC sends data to the appropriate Decoder IC which sets the matrix relays to connect the terminal to the calling exchange line. The exchange line call is now established.

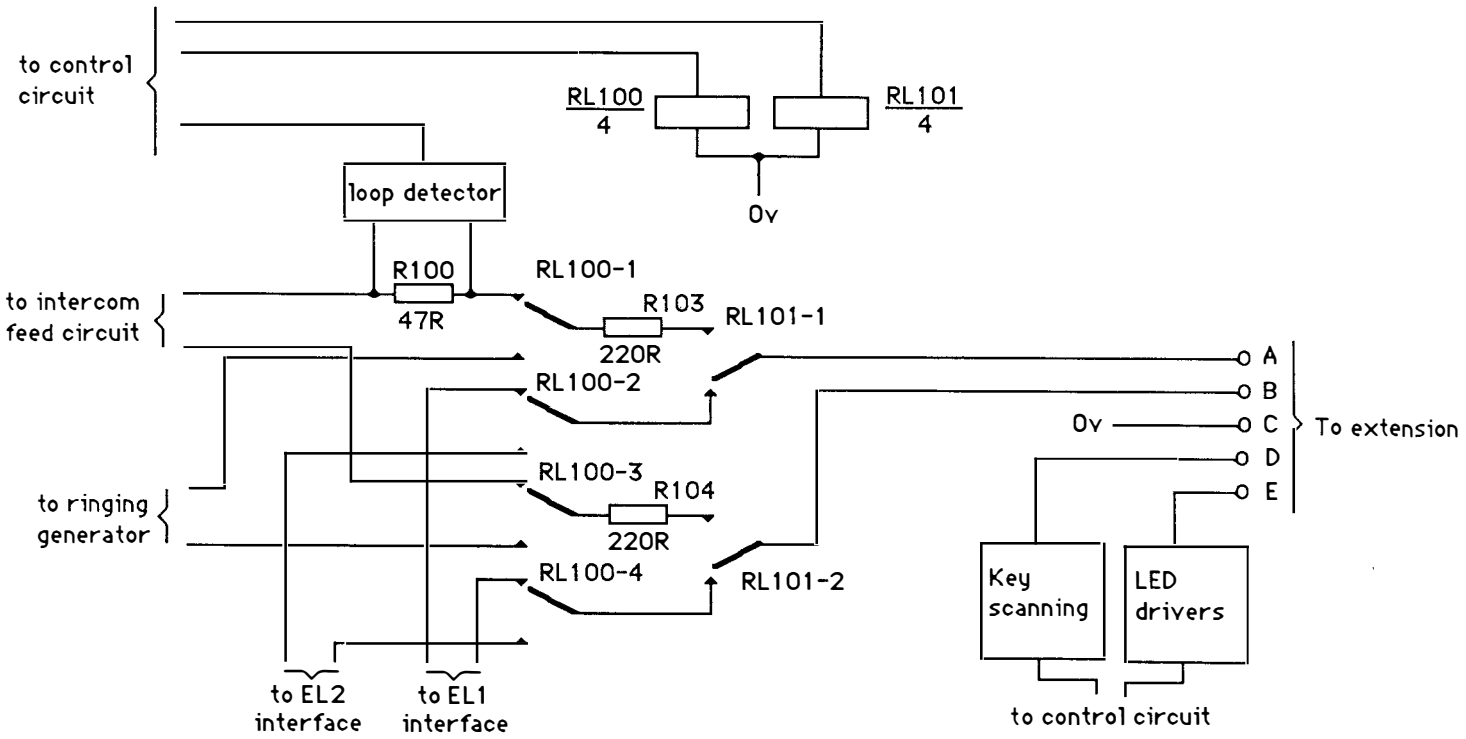
## FIG. 7.1 EXCHANGE LINE INTERFACE

component numbering shown for exchange line 1




## FIG.7.2 EXTENSION INTERFACE CIRCUIT

component numbering for extension 1



## 8. SPECIFICATION

| | |
|---|---|
| Mains supply | 180-260v ac, 50Hz |
| Power consumption | 30W max. |
| Dimensions | width 320mm, height 225mm, depth 85mm. |
| Weight | 4kg |
| Environment | Normal operation -5 to 45°C, with max. humidity 95% non-condensing.<br><br>Storage -20 to 60°C |
| Line conditions | Total dc loop resistance between any terminal and the local exchange not to exceed 1250 ohms, with a local battery voltage of 45v to 52v.<br><br>Total dc loop resistance between the CCU and any terminal not to exceed 250 ohms. Note that this limit is overridden by the approval conditions of the individual telephones approved for connection. |
| Intercom circuit | 42 volt feed, maximum current limited to 80mA. |
| Station ringing voltage | The minimum open circuit ringing voltage available at the CCU is 75v peak to peak, with frequency between 17 and 25 Hz. The ringing generator is capable of ringing all six extension ports simultaneously provided the REN on each port does not exceed 2.0 |
| Exchange line loop detector | An exchange line seized condition is detected when a loop current greater than 18mA is present. A released condition is detected when a current less than 5 mA is present. |
| Exchange line ringing detector | IC ringing will be detected if its amplitude is greater than 35v pk-pk, and frequency between 15 and 65 Hz. |
| Insertion loss | The insertion loss between an exchange line port and an extension port, when connected via the CCU, is less than 0.5dB. This assumes a 600 ohm resistive termination at both ports. |

**E N D**

**APPROVED**
for connection to telecommunications systems specified in the instructions for use subject to the conditions set out in them.

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