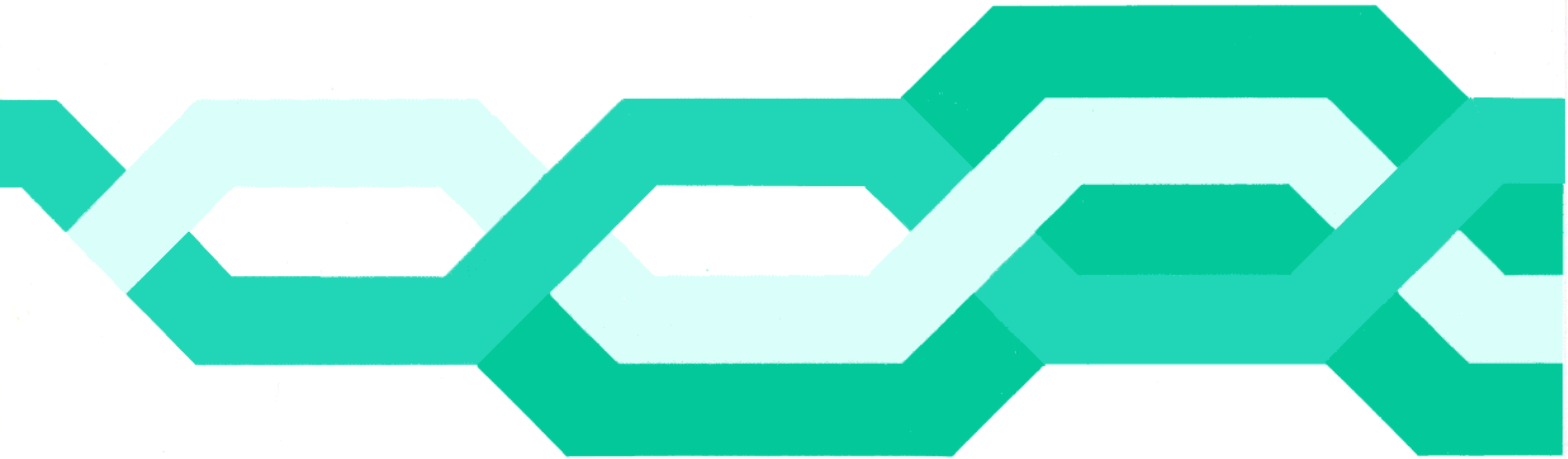
Maintenance News

20

Spring/Summer
1982



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Contents

Editorial

My editorial functions on this magazine take up only a small part of my BTHQ duties. Inevitably, therefore, time does not permit complete checking of the technical accuracy of all authors' submitted drafts. This was brought home after the distribution of *MN19* by my training colleagues who were becoming bombarded with queries on Herald training courses – all because two course numbers had been transposed. The Editorial Board have now decided that a disclaimer should be included in the magazine in future. In my other duties, concerned with the repair of electronic equipment, I am aware of the wide variety of new customer apparatus, systems and technology entering service with British Telecom – many in large numbers. The exciting and challenging era we have been waiting for has arrived, and it is up to all of us to keep ourselves informed of developments. *Maintenance News* aims to do all it can to help in this important aspect of today's world. – Editor.

Testing SSAC15 private circuits at TMCCs

by **Roy Smith** BTM/SM1.4

The success of the patching relay set used with the signalling system AC13 (SSAC13) at Trunk Maintenance Control Centres (TMCCs) resulted in the decision to introduce a similar device for circuits equipped with the AC15 equipment. The facilities offered by the tester and some constructional details are described in this article. It should be noted that this BT version has identical electrical characteristics to the Northern Telecom equipment.

Facilities

- outgoing call – including dialling to local or distant-end
- incoming call – including recording of dialled digits on a 10 or 16-digit display unit
- supervisory conditions
  - incoming call (I/C Call)
  - called subscriber answer (CSA)
  - called subscriber clear
- Monitor of circuit – tone on idle

Equipment

As shown in the circuit diagram, the main features are:

- interface relay set – loop disconnect/E and M
- transformer unit
- break-type jacks and lamp
- SSAC15 equipment

Operation

In operation, either the local or distant-end of the circuit to be tested is patched from the test jack frame (TJF) appearance to the test set, due regard being given to the TMCC standard levels. The patch should, therefore, include any necessary amplifiers and attenuators. The AC15 is normally strapped to present relative levels of + 1dBm and —4dBm. Having done this, testing can start.

❑ *Outgoing call*

The two-wire line test cord is plugged into the two-wire jack and, after operating the 'speak' and 'loop hold' keys, the required number is dialled. With restoration of the 'dial' key, supervisory tones are heard. When the distant-end answers, the lamp lights – indicating Called Subscriber Answer (CSA) – and conversation can take place.

When the called-end clears (CSA lamp off) the circuit can be released by restoring the 'loop hold' key.

❑ *Incoming call*

The customer or engineer at the distant-end can then be instructed to call back. In this case the lamp indicates an incoming call (I/C Call). The procedure already mentioned is followed, but this time the incoming dialled digits can be detected and stored on the display unit.

The circuit is released when the calling-end clears.

Benefits

Several benefits arise using this test-set, including:

- fault localisation before involving other maintenance staff
- elimination of abortive visits to customers
- improved serviceability.

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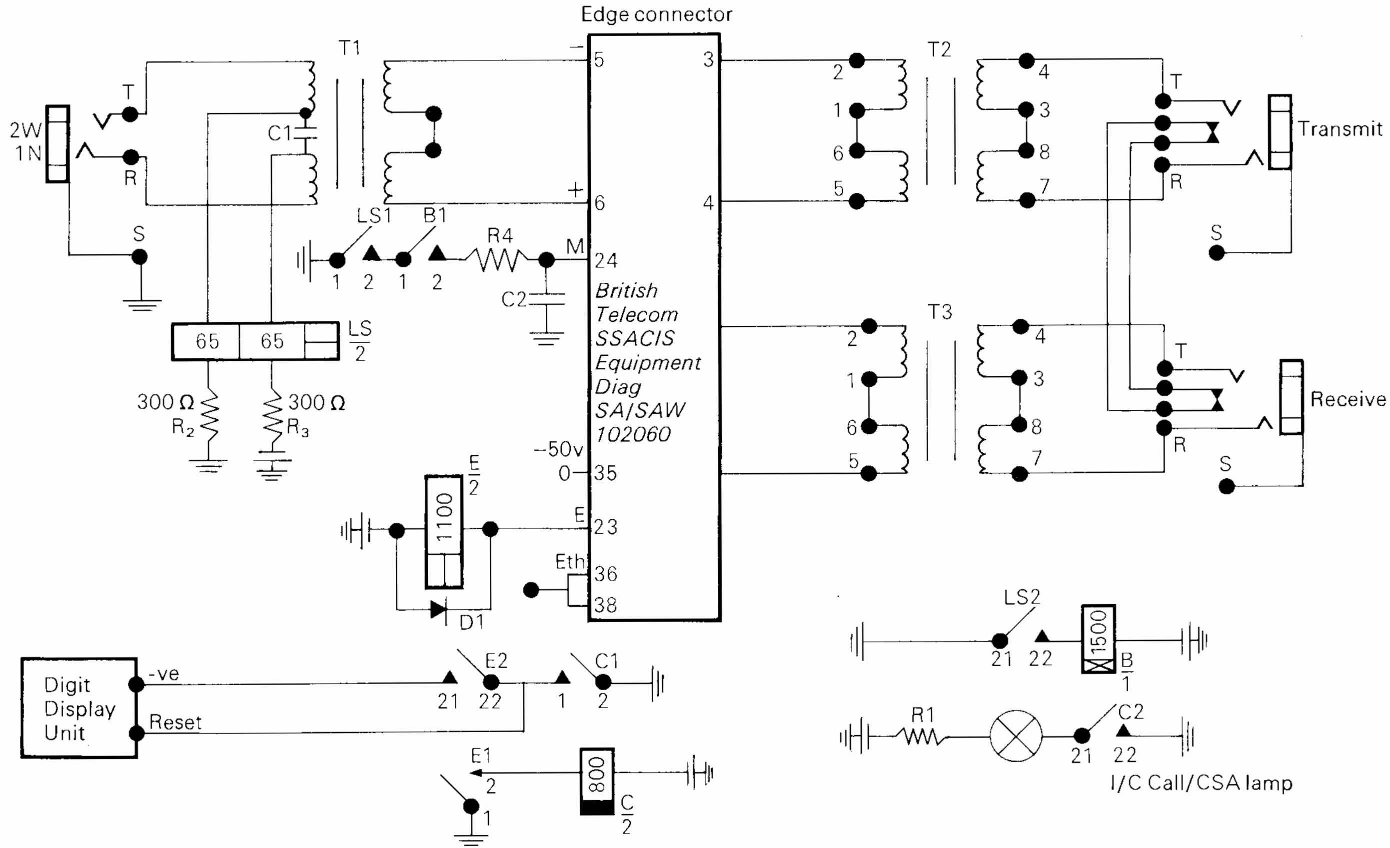

Improvement plan for overhead network

by **John Stoddart** BTSW/SV1.3.2

New developments over the past 10 years have steadily improved the performance of the overhead network. But this performance tends to deteriorate rapidly during bad weather. This inability to withstand bad weather not only stretches the manpower resources beyond the limits of the normal repair service organisation, but also has a catastrophic effect on BT's ability to restore customer service rapidly enough to achieve the TIP 2 target. Consequently, as BT is soon to aim for a 95 per cent TIP 2 target and also has a longer term TIP 1 objective of 0·29 fault reports per station per annum, further effort must be directed towards reducing the overhead plant fault rate.

Factors affecting performance

With the exception of Drop Wire 4, other recent types have been inadequate. The situation is further aggravated when there is an accumulation of drop wires on a route. Frequent failures occur because drop wires are unable to withstand abrasion and are thus susceptible to any form of abuse arising from poor construction or work practices. Resulting damage to the copper-coated steel conductor soon causes it to corrode or rust away. Before the complete failure of the drop wire, such action often manifests itself as an intermittent noise fault. Work practices considered to contribute to premature drop wire failures are:

- too many drop-wire clamps fixed to a single Bracket 22 often result in abrasion
- stripping insulation unnecessarily or failing to use the correct tool – Wire Stripper 2 – results in damage to the conductor
- jointing drop wires with Wire Insulated Connector 1A – which is for underground use
- failure to use an Aerial 32A and Tester 132 to locate a disconnection fault can result in the creation of unnecessary joints. Similarly, unwillingness to open aerial cable couplings results in additional joints external to the couplings
- insufficient tree pruning.

Other causes are:

- lack of a suitable lead-in cable at block wiring points
- ageing of open wires and the inability of staff to carry out their work
- insufficient use of spiral eyes to restrict the movement of drop wires to reduce termination failures on DPs
- the conductors of both an aerial cable and drop wires terminated on the face of a terminal block often results in the drop wires being severed by the aerial cable
- failure of maintenance and installation staff to submit either forms A1024 or A2887 when they encounter or provide more than two drop wires in line of route
- too low a priority given to dealing with any of these causes.

Improvements required

❑ ***More reliable drop wire***

BTHQ seem to have accepted this and a drop wire with cadmium-copper conductors, to be known as Drop Wire 7, is to be introduced nationally.

❑ ***Improved workmanship***

Even with the introduction of a more reliable drop wire, staff need to become aware of preventive maintenance aspects, such as:

- The prevention of drop wire failures which are a result of abrasion by trees, lamp standards, roofs and so on
- Joints in drop wire must be kept to a minimum and, whenever practical, a faulty drop wire should be replaced in its entirety. Where joints are unavoidable, the correct item – Wire Connector 2A – must be used
- Staff should carry spare terminal block covers and strip-contact gas-discharge tubes which should be replaced when they are found to be corroded
- Terminal blocks should be treated with silicon spray as a matter of course
- Finally, good field supervision and adequate training are essential ingredients to improve the quality of workmanship.

Comprehensive plant improvement scheme

There is a need to introduce an all-embracing scheme which will –

- include procedures to identify sections of overhead plant which are in need of remedial attention
- be complementary to LOCAMS
- have a mechanism to control the priority of the planning and execution of plant improvement work.

To conclude, adequate numbers of the correct size working parties will be required to support such a plant improvement programme.

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Corrections

Phil Darcy's article in *MN19* on London's TXE4 contained a mis-print on page 7, column three. The second line gave a figure of 0.5 per cent. – this should have been 0.05 per cent.

Due to an error in the author's draft, the course numbers for the Herald training courses were incorrect. *Herald Newsflash No. 49* was issued by ICS7.2.2 to overcome the immediate problems experienced by training officers. – Editor.

Special services maintenance

by **Don Beckley** T5

Private circuits are the most important part of Special Services, of which amplified external extensions and Datel services are the other large elements. Because of their importance private circuits have been under the spot-light recently due to the long delays in provision. Consequently there has not been much attention focused on maintenance. This is not to say that all our customers are satisfied with their service, indeed, the need to improve the repair service still exists – especially in London.

Private circuits have always presented problems, but during the last five years their importance has gained increasing recognition within BT. Among the difficulties in maintaining private circuits is the large variety of customer terminating equipment. Some of this equipment is customer-owned, and many customers use the equipment for non-speech transmissions which make testing difficult. But the fundamental drawback is that private circuits do not fall into the patterns of responsibility so well defined for the PSTN and so well served with interfaces and test points, automatic routiners, and so on. Clearly then, to overcome these deficiencies – absence of clear boundaries of responsibilities and facilities of control – much more cooperation and extra effort will be needed.

Even before the threat of competition it was recognised that BT may not be showing enough concern, but with competition now with us we have greater reasons for satisfying our private circuit customers. In the Bell system, one-third of the revenue comes from special services, compared with four per cent in the UK, which illustrates the considerable potential for shift of revenue by our business customers.

TIP 2A

In 1979/80 TIP 2A – the percentage of all fault reports cleared by the end of next working day – was introduced as a performance indicator designed to improve speed of repair. What has been achieved ? In early 1980 the national performance was 60 per cent compared with 79 per cent in December 1981. During the period October 1980 to September 1981 the number of Areas achieving 80 per cent increased from 62 to 78 ; those achieving 90 per cent increased from 21 to 59 ; and those achieving 95 per cent increased from 6 to 20. So there has been a steady improvement. However, Areas achieving the best results do not have many private circuits.

So a very substantial proportion of faults is still not being repaired by the end of the next working day. The majority of these faults are in the large cities, more especially London, and we clearly have a long way to go to achieve the target of 95 per cent. If the target seems ambitious, let me say at once that our customers really want 'same day' clearance.

Speed of repair in itself is not the only criterion – ability to deal with repeat faults is another. It is a sad fact that many circuits are poorly installed with unsoldered joints, causing intermittent problems which are hard to identify. They cause confusion and much wasted time, especially when data transmission is involved, because the proper functioning of the circuit is only finally proven with customer's cooperation. Faults of this kind undoubtedly test the patience of the customers who cannot understand why we cannot do better. If they were aware of the real cause and the comparatively simple remedy, they would have even less sympathy ! We do not deal with repeat faults as energetically as we should. Currently about 25 per cent of all faults are repeats, having been reported previously within the last two months.

Teamwork is essential

During the last 18 months two important events have occurred, namely the establishment of Special Service Managers (SSMs) and the Datec teams. The role of the SSM is to maintain an oversight of performance and to bring action to bear when things are clearly not happening as they should. To do this job he needs good responses from all around him, whether they be internal or external. His job is to provide conscience to the service.

Regional Datec teams on the other hand were set up to deal with obscure faults not easily located by the regular staff with their limited facilities. The teams have done much valuable work, including dealing with problems of protocols in data transmission. Unfortunately, their presence is not widely enough known and they are not called upon for help as often as they might be. Any article on Special Services maintenance would be incomplete without mention of remote test access, but this is the subject of a special article (RATES) in this issue.

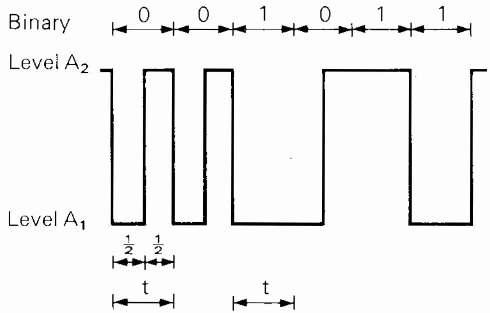
To summarise, we have accomplished a great deal, but much more remains to be done on repair and maintenance of private circuits. New services (X-Stream) are being introduced in 1982 and will make demands at least as great as the existing ones ; these new services are intended to match the competition in technical innovation. We must match the competition in the service we give.

Digital transmission – coded mark inversion

by **George Clark** T5.1.4

Previous *MN* articles on digital transmission have referred to coded mark inversion (CMI) without describing the technique.

CMI is an internationally agreed standard interface signal conforming to the general outline shown in the figure. Technically, it is a two-level non-return-to-zero code, in which Binary 0 is coded so that both amplitude levels A_1 and A_2 are attained consecutively – each for half a unit time interval (t/2). Binary 1 is coded so that either of the amplitude levels A_1 and A_2 are attained alternately for one full unit time interval (t).



Example of CMI coded binary signal

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How computers keep their cool

by **Dennis Brewer** ETA5.3.1

The provision of process cooling for large computer installations has been necessary ever since the introduction of early ICL Leo 326 computers in the mid-1960s. The exacting standards of temperature, humidity (50%RH) and dust levels specified for computers have required DPE to provide and operate purpose-designed and built computer centres throughout the country.

The purpose-built centres are designed to maintain computer rooms at 21 °C (±3°C) and 50% (±5%) RH continuously, irrespective of heat from machines, personnel and fabric, and solar gains to the building. In BT's larger centres the process cooling load is provided at 600 watts per square metre, thus the standard 1000 square metre computer room is capable of dissipating about 600 kilowatts of process heat.

The purpose of air conditioning is, of course, to establish and maintain the appropriate environmental conditions, which include retaining a static moisture level. To help achieve this level – and thus simplify the control and ducting arrangements – fresh air intake is limited to between 2-5 per cent of the total re-circulated air. The fresh air is usually provided via special equipment which also ensures the temperature of the incoming air is in the region of 13°C all the year round. The fresh-air plant also provides a positive pressure to the room and so plays a significant part in dust and odour control.

In large data processing centres the main computer room is usually split into a number of zones where each zone copes with approximately 100 kilowatts of machine heat. Each zone has its own re-circulation plant or air handling unit fully equipped with fans, cooling coils filters and its own set of controls. Temperature control is achieved by proportional control of the cooling coil. A temperature sensor is placed in the zone's return-air stream producing a signal which is passed to a controller which contains the set point signal and a comparator mechanism that proportionally drives an output signal to the valve actuator on the cooling coil. The cooling coils usually contain chilled water. The chilled water is maintained at a flow temperature of approximately 10°C – chosen to restrict the latent (moisture removed by the coil) duty of the coil. This is because the dew-point of a room held at 21 °C and 50% RH is about 10°C, so in these conditions coil temperatures below 10°C incur excessive latent duty.

Provided the moisture level in the room remains constant, the relative humidity will not exceed the specified limits of control while the temperature stays within its limits. Control of relative humidity is achieved either by adding moisture with steam electrode boilers, or dehumidifying by using a fixed fresh air input temperature. Both functions are carried out on the incoming fresh-air stream. In typical winter conditions the fresh-air content will be extremely dry and, when mixed with return air, the mixture will absorb moisture from personnel and equipment thus causing the room's relative humidity to begin to drop. The humidity detector will, under these conditions, respond by switching on steam humidifiers until the correct, specified, balance is achieved.

Because each computer centre was built or refurbished when the need arose, BT now has a great variety of buildings, refrigeration, air handling units and controls. However, a common element at most larger centres is pneumatic control of air conditioning. And these controls have proved to be extremely useful, simple and reliable. The basic system uses a pressure range of 3-13psi (0.2-09 bar approximately) operating sensor controller systems which actuate pneumatic valves, dampers, motors and micro-switches. In recent years, electronic controls have greatly improved and much more use is being made of the modular systems offered by specialist firms.

Engineer's role

The role of a building services maintenance engineer in a BT computer centre is an extremely exacting one. His skills must encompass all aspects of electrical engineering from high voltage mains to low voltage control circuits, and from pneumatic to electronic controls. He must also be able to understand the basics of refrigeration to run and maintain the large quantities of chilling plant under his control. BT has been served well by its present maintenance force with only a few hours of computing time lost in recent years.

Mr Brewer has now left ETA5 and has become a Fiald Sales Manager in Exeter Area – Editor

Parallel working of a Mic 21 with carbon microphones

The carbon microphone can shunt the Mic 21 and cause it to cut off when two or more handsets are off-hook. This can apply with Plan numbers and 2/PMBXs. The remedy for 746 type instruments is to change all transmitters to Mic 21. This is not possible in the case of trimphones (for which no linear microphone solution has been developed) or certain special range telephones employing other carbon microphones; in such cases the solution is to build out the microphone with zener adaptors or suitable resistors. Further information on Mic 21 is contained in ICS7.2.2 Newsflash 1073 dated March 1982.

Regent call connect system

by **Roger Isted** BTE S1.3.3.1

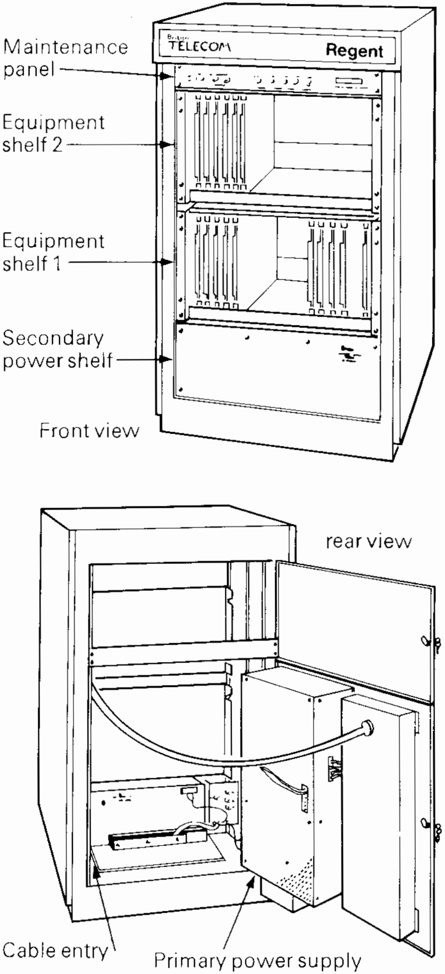
Regent is the name given to this new PABX recently launched by BT in selected areas of the country. It is based on a proprietary switching system and is complementary to the BT developed Monarch 120 described in MN15.

The Regent call connect system – initially available in BTE, BTNW and BTL/City Area – offers similar capacity to Monarch and is being marketed to give customers increased choice of BT PABXs. It has recently become available nationally.

Space division switching

Regent is an advanced electronic PABX with digital stored program control but, unlike Monarch uses CMOS space-division switching. The system capacity is 256 ports of which 184 are available for assignment to extensions, exchange lines or private circuits. The remainder are used for receivers, special functions, and the common control.

The system's capacity depends upon the way the ports are used, as an extension uses one port, an exchange line two, and a private circuit four. The maximum size of the system is 24 exchange lines and 134 extensions. Areas build a system to order from a basic



Regent Cabinet Layout

8+48 unit by the provision (or removal) of apparatus slide-in units (ASUs). The operator's console is used to configure the system-operating program. Extension ASUs have eight circuits, exchange line ASUs four, and private circuit ASUs two.

Regent consists of a single floor-standing cabinet (about the size of a domestic refrigerator) which can also house an optional, standby, power supply of between two and six hours. All connections to the equipment cabinet use three-metre cables terminating in a wall-mounted connection box (box connection 350).

The connection box uses insulation displacement connectors to terminate the building distribution wiring and a combined connection box and building distribution frame (BDF) is also available as a wall mounting unit (Box connection 520 or 530). The front door of the equipment cabinet gives access to the maintenance panel, ASUs and standby power. The rear door holds the systems primary power supply and gives access to connections for extending the system, emergency switching circuitry and standby power controls. Cable entry is through holes at either side at the bottom of the cabinet.

Re-engineered

Regent was developed by Mitel Telecom Limited and is manufactured in the company's South Wales factory. It is based on Mitel's SX-200, but has been extensively re-engineered to suit British Telecom requirements and network characteristics.

Microprocessor

Regent's 256 ports are scanned sequentially for detection of signals ; each port being scanned for 12.5 microseconds. All ports are therefore scanned every 3.2 milliseconds. During scanning, detection of call origination causes a microprocessor interrupt signal to be generated, and a speech path and receiver to be assigned to the originating extension. After dialling, the receiver is released and the called party is connected to the same speech path as the originator. There are 31 speech paths available in Regent, and each of the 256 ports has access access to all of them.

The main processor with overall system control, is an MC6800. It is supported by 8k bytes of Random Access Memory (RAM) used as a call processing transient memory – such as remembering which extensions are busy. Also, 4k bytes of RAM – battery protected – contains installation-dependent information, such as access codes and extension numbers. The system also provides up to 56k bytes of programmable Read Only Memory (PROM) containing the system-operating program. Particular versions of operating program are known as *generics.*

The operator's console contains an MC6800 microprocessor with 2k of ROM which controls the displays and monitors such things as keystrokes.

Regent uses a specially developed large scale integrated (LSI) circuit to implement a space-division switching matrix. The basis of this space division is a four-by-eight bit analogue crosspoint switch (MITEL MT8804) which is used throughout the system to connect any one of 31 speech paths to any one or more extension, exchange line, console, receiver or tone generator circuits under the control of the microprocessor.

Maintenance

The modular design of the equipment permits rapid location and replacement of defective parts. Circuit malfunctions are detected by diagnostic routines automatically initiated by the central processor unit (CPU). Preventive maintenance is limited to the replacement of the Random Access Memory (RAM) battery packs every 18 months and the optional standby power every four years.

Automatic diagnostics

In addition to 'power-up' diagnostics which checks the RAMs and PROMs, an automatic diagnostic routine runs at all times except when there are four or fewer speech paths free in the system or when an operator's console is being used to configure the system. The automatic diagnostics tests the speech path connections, MF and dial pulse generators, supervisory tones, and speech path 'biasing'. Faults found are reported as non-urgent alarms, and the failing unit is busied out, if possible. The automatic diagnostics will not busy out more than half the receivers, generators, or speech paths, so guarding against the possibility that an error in the fault detection circuitry could shut down the system.

Regent – which is exclusive to British Telecom – is an advanced solid-state PABX of exceptionally small size, noiseless in operation, and offers a comprehensive range of features and facilities to meet customers needs.

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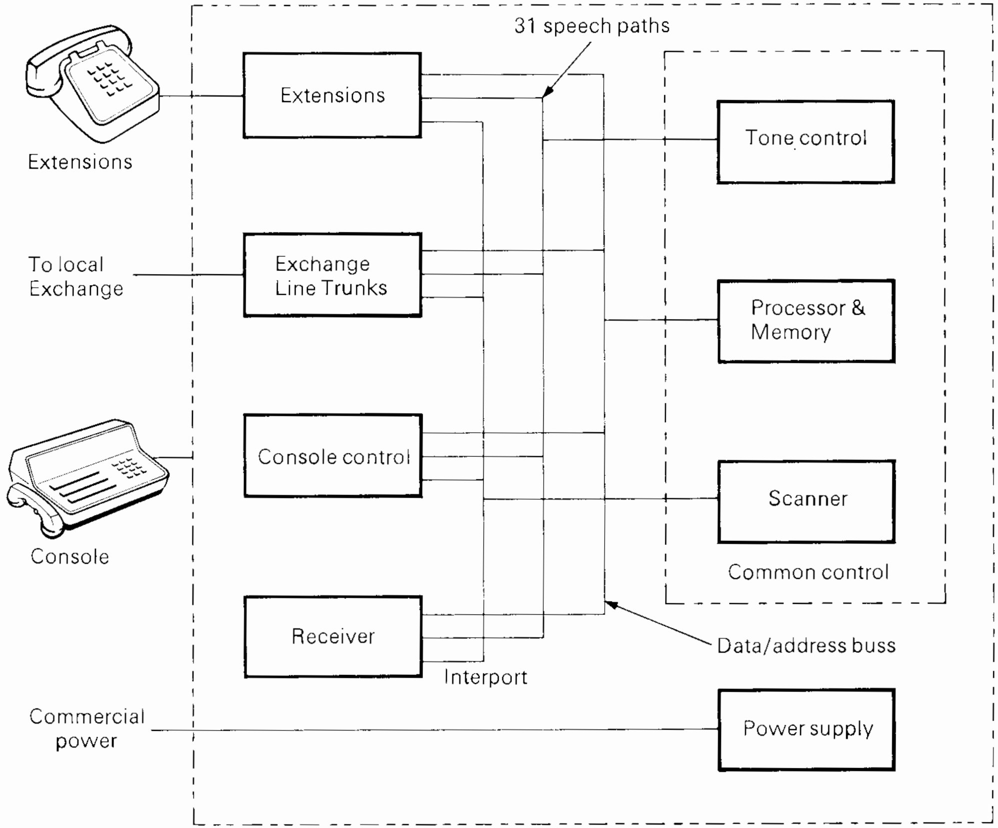
Regent System Configuration



The Irish connection

by **Douglas Gregory** T5.3.1

An agreement has been reached with the Irish telecommunications administration which should improve the handling of Private Services between the two countries. Within BT, these services – now to be recognised as 'international type connections' – will remain the responsibility of the Inland Division.

The procedures agreed are contained in the following TIs: *B3 K0037* (Marketing), *A8 K1504* (Planning and Works) and *E8 K1175* (Maintenance). Under the agreement three types of private circuits will be provided:

- Ordinary quality point-to-point
- Special quality point-to-point
- Special quality multipoint

The technical requirements will be based *CCITT Recommendations M1020* and *M1040*, and the circuits will be identified by standard international designations, such as NC – DU1 (denoting the first circuit between Norwich and Dublin, the next being NC – DU2, and so on).

Present procedures

In January 1982 there were 250 private circuits serving UK and Eire customers. Their maintenance responsibilities rested with about 65 Circuit Control centres in the UK, but with only one in Eire. To a large extent present procedures rely on individual interpretation of old working arrangements which had never been ratified by the two administrations. Inevitably problems often got out of hand and service deteriorated due to the lack of agreed technical standards and escalation procedures.

Proposed procedures

The proposed new procedures are based on those currently used for maintenance of private circuits to other countries. Each circuit will be planned and commissioned with a national section in each country, and a connecting international section. The international section will be the Group link between the respective HF terminals, one of which will be designated the Terminal International Circuit Control.

This will reduce the total number of Circuit Controls in the UK needing to make contact with Dublin Control to about 13, and will give more scope for cooperation between terminal staffs. The responsibilities of Circuit Controls and sub-controls have been re-defined and identical wording reproduced in both administrations' maintenance instructions.

Escalation

Should a problem arise in the future, engineering staff in both countries will be able to invoke a three-stage escalation procedure.

- First stage: contact between the Supervising Officer of UK Control and the Inspector-in-Charge of Dublin Control
- Second stage: contact between Executive Engineer or Special Service Manager in UK and the Executive Engineer of Dublin Control
- Third stage: contact between BTHQ/NE/T5.3.1 and the Eire P and T Department of the Engineer-in-Chief.

In addition, the procedures include guidance to staff on the kind of information that may help customers who are very dissatisfied with the service given by either administration.

Implementation

The new procedures are expected to be implemented from about mid-1982 for new circuits. Existing circuits will be programmed for re-designation and possibly re-engineering in the near future. But even before this work has been completed, maintenance staff will find the information in *TI E8 K1175* a useful aid when dealing with the Eire administration.

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Register translator 14

by **Brian Harris** ES9.2.1

Development of a new processor-controlled register translator to replace the magnetic-drum type (R/T4) is now nearing completion. It is known as R/T14, and 95 have been ordered for installation in Director Central Switching Units (CSU) starting in September 1982. One R/T14 will replace two magnetic drums. An R/T14 can be installed very quickly, and though the first installations will be supplied and installed by the manufacturers, subsequent installation and commissioning will be done by British Telecom staff.

The number of R/T14 processors at any site will depend on local requirements but the minimum installation comprises of two processors and one rack of SSMF 2 sender-receivers; the two processors and one MF2 rack being referred to as a cabinet triple.

Existing register access relay sets will initially be retained in the CSU together with the register hunters. The outlets of the register hunter are cabled to Signal Conversion Circuits (SCC) on the R/T14 racks.

The SCC provides the interface between the 50v electromechanical equipment and the electronic processor equipment. The SCC is analogous to a register but the register function is performed by the processor. The SCC consists of two separate units: Signal Conversion Relays (SCR) powered from the exchange-50v supply and using type-23 relays and discrete components, and Signal Conversion Electronics (SCE) powered by +5v and using transistor-transistor logic (TTL) and discrete component relay drivers. One R/T 14 is provided with 96 SCCs which are connected to the Central Processing Unit (CPU) via an Input/Output (I/O) and highway interface unit.

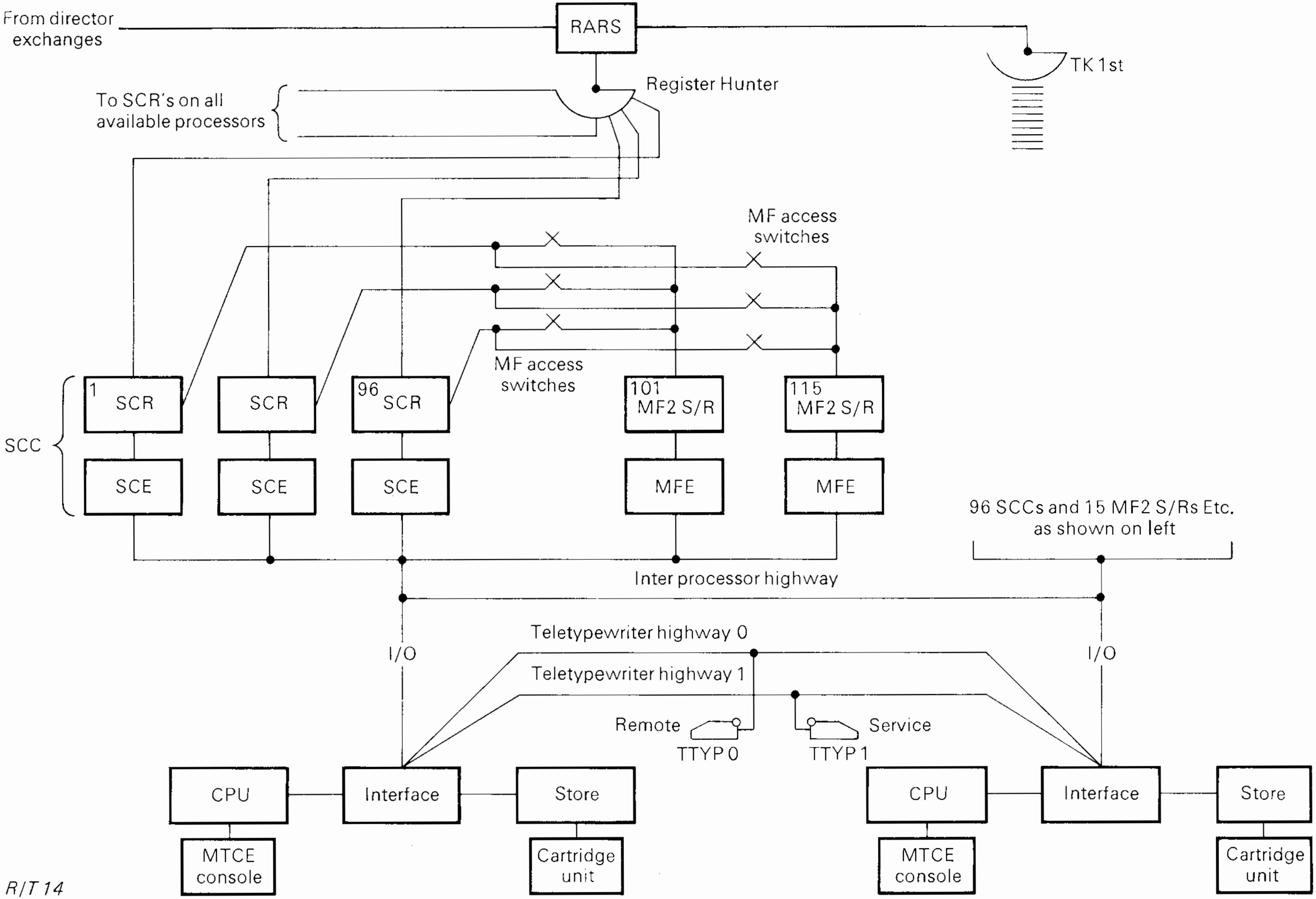
Thirty SSMF2 sender-receivers are provided on the MF rack, 15 for each R/T 14. A sender-receiver (SR) is connected via a MF electronic unit (MFE) to the I/O and then to the CPU. The CPU scans all the SCCs and MF SRs every 11.1ms and will do a limited amount of work for any SCC or SR on which a call is being set up during every 11.1ms scan period. Because the CPU is working at a very fast rate (10MHz) it is able to control up to 96 SCCs, albeit one at a time.

The CPU

The CPU is a GEC MK1P Processor, identical to that used in the processor controlling TXK1 GSC equipment. The CPU is the heart of the system where program instructions are decoded and executed to control all the actions within the R/T14. It consists of an oscillator and clock timing circuit; a register file and arithmetic unit; a micro-program from which all control sequences are derived; and a store address circuit by which the store-system is accessed. A maintenance console and console interface circuit are incorporated in the CPU to give complete manual control of the CPU during installation, commissioning, or under fault conditions when the R/T14 is out of service. When the R/T14 is in service the maintenance console is disconnected by a Yale-type lock and the key is stored in a safe.

All program and data – for example translation information – is held in dynamic Random Access Memory (RAM) within the store system. An area of store is also allocated for each SCC, known as SCC working store, where all the information for a particular call is stored. The CPU counts incoming digits and stores them in the appropriate SCC working store along with class-of-service and translation information when sufficient digits have been received to obtain a translation.

For any processor a program of instructions must be written and stored in machine-readable form to tell the processor what to do for any given set of circumstances. Most of the store is used for this program information. Each program instruction is stored in one word of store, a word being 16 binary digits (bits) and having a particular location, or address, within the store. For every step of the program the instruction word has to be located and the 16 bits of information transferred from the store to the command word register in the CPU where it is decoded and used to initiate action by the micro-program which sends out control pulses, each 100ns long, to perform the action required. Extracting the program word from


From director exchanges
RARS
TK 1st
Register Hunter
To SCR's on all available processors
MF access switches
MF access switches
SCC
1 SCR
SCR
96 SCR
101 MF2 S/R
115 MF2 S/R
SCE
SCE
SCE
MFE
MFE
96 SCCs and 15 MF2 S/Rs Etc. as shown on left
Inter processor highway
I/O
I/O
Teletypewriter highway 0
Teletypewriter highway 1
Remote
TTYP 0
TTYP 1
Service
CPU
Interface
Store
MTCE console
Cartridge unit
CPU
Interface
Store
MTCE console
Cartridge unit

R/T 14

store – known as the instruction fetch sequence – takes about 1.6 micro-seconds, the average time taken to execute an instruction being 4 micro-seconds. The processor thus can execute about 250000 instructions every second.

The Store

Because the store system uses dynamic RAM, the store contents would be lost if power was to be interrupted, so a reserve store is necessary. This store used in R/T14 is a Tandberg digital recorder which has a copy of all program and data on a magnetic tape cartridge. Should it be necessary, the store system can be reloaded in about 90 seconds.

To enable the program and data to be loaded from the digital cartridge recorder, a small loader program is stored on Programmable Read Only Memory (PROM) devices which are not affected by loss of power.

Use of Teletypewriters

Control of a R/T14 by maintenance staff is by means of a teletypewriter. First a processor is identified by its number in the range 01 to 15, then a password is entered to unlock facilities according to the status level of the password entered. A fully trained member of staff has password status level 1 which gives full facilities of the Man Machine Language (MML).

Individual SCCs or SRs can be 'busied' out of service, returned to service, meter readings can be taken and alarms can be controlled from the teletypewriter. It will be rare to make changes to the program, but changes to data, particularly translation changes, will be frequent. The R/T14 has a translation editor program which is accessed via the teletypewriter whenever translation changes are required. The translation editor enables translation changes to be entered into the processor and stored for up to seven days before they are required ; the time and date they are to become operational being entered in response to a question from the processor. Translation changes entered into one processor are automatically passed to others, thus simplifying the translation change procedure.

Should a processor fail, such that the teletypewriter is unable to access the processor, control of the processor is achieved from the maintenance console. Any failures in SCCs or SRs, or in areas of the processor, are reported as fault messages on the remote teletypewriter. A second trolley-mounted teletypewriter – known as the service teletypewriter – is used during fault location or for all unsolicited fault prints should the remote machine fail. The pair of teletypewriters can control up to 15 processors.

Maintenance and repair

Maintenance of R/T14 is on the same basis as MK1 processors in TXK1 GSCs, 50v relay units being repaired on site and printed wiring boards being sent to an Area Repair Centre (ARC) for analysis by a Membrain automatic test system. A complete set of spare printed wiring boards is held at every site for maintenance purposes. It being the task of maintenance staff to identify which board is faulty when a processor fails. Courses at BTTC Stone have started to train staff as 'systems engineers' because a total-system understanding is necessary to enable faults to be located. The processor can carry out various tests on SCCs and SRs, which can be initiated from the teletypewriter and the test results printed. Three testers will be provided at every installation ; a power supply unit tester for the DC/DC converters ; a sender-receiver tester which performs full limit testing of all MF frequencies, and a 50v unit tester for use with the 50v relay units.

Maintaining R/T14 will be a very useful introduction to processor control of telephone exchanges and the change from R/T14 to System X will be more easily accomplished.

Other uses

The possibility of using R/T14 as a replacement for types 2, 3 and 5 electromechanical register translators is presently being considered. The use of R/T14 in non-director GSCs requires the use of a new register access circuit which has already been developed using type-23 relays with all functions controlled by a microprocessor. One rack can accommodate 128 register access circuits (RAC) using just one-tenth the space of the equivalent electromechanical equipment plus giving savings on initial capital cost and considerable savings on maintenance costs.

For use in the non-director exchange with the new RAC, the processor performs the routiner function on the RAC under program control, with any fault information being printed on the teletypewriter.

A decision on R/T14 non-director application is expected soon.

01-432 1332

Close encounters of the 4A kind

by **Graham Winter** BTM/SM 2.2

The first TXE4A exchange, at Belgrave in Leicester, has now been in service for over 12 months. It is a six-plane unit with 5000 installed connections serving a mainly residential urban area. Extension 1 – adding an additional 7400 connections – is currently being installed with integration starting shortly. The TXE4A system was described in MN16, and in this article we look at the maintenance of TXE4A and Belgrave's performance so far.

Maintenance

The maintenance philosophy is similar to that of TXE4 RD, in that a faulty plug-in unit (PIU) is located and replaced by a spare held in the exchange. The faulty unit is then repaired on or off site, depending on its type, complexity or type of fault.

Preventive maintenance in the form of routiners for links, outgoing junctions, registers and marker sub-systems, are run overnight. Further preventive maintenance such as dormant fault checks and periodic routines are applicable to TXE4 RD racks only. A small additional amount of routine work is carried out on the magnetic tape machines associated with the operations processing unit (OPU) and to ensure that the exchange master and reserve data tapes are kept up-to-date.

Fault printout for main control unit (MCU), supervising processing unit (SPU) marker switching network and routiner output is similar to TXE RD but in some cases utilises a slightly different format. Additional fault printout generated by the OPU is output on to the teletype used for day-to-day alterations to exchange data. Analysis of switching, MCU, marker and SPU printout is at present undertaken manually, but a method of computerised analysis using a Small Business Computer is being developed.

Location of a faulty PIU is undertaken with the aid of a fault diagnostic flow-chart, starting with a particular alarm or occurrence. YES/NO decisions lead to either replacing faulty units or the application of further tests. Figure 1 shows part of a diagnostic chart.

Performance so far

Over the first year of service the following points have been observed:

- Customer-reported faults per exchange connection were approximately 25 per cent of those for TXE4 RD, or 20 per cent of those reported for all systems combined.
- 97 per cent of all faults on exchange equipment were found as a result of inbuilt checking circuits, routines and the like. The remaining faults were found as a result of reports originating outside the exchange.
- Component failures have all been lower than the predicted failure rate (except for diodes of a particular type, a problem which became apparent during the early years of TXE4 RD).
- It is interesting to note that only one transistor failed in the first 12 months, and that integrated circuits failed at an average of only one per month.
- There have been no major service failures.

We are now on the threshold of the TXE4A installation programme, with about 300 exchanges being ordered up to 1985/6, plus extensions to TXE4 RD exchanges using TXE4A equipment. As the system will take us into early next century, it is encouraging to see from the initial performance that the objective of a more reliable service to the customer can be obtained from TXE4A.

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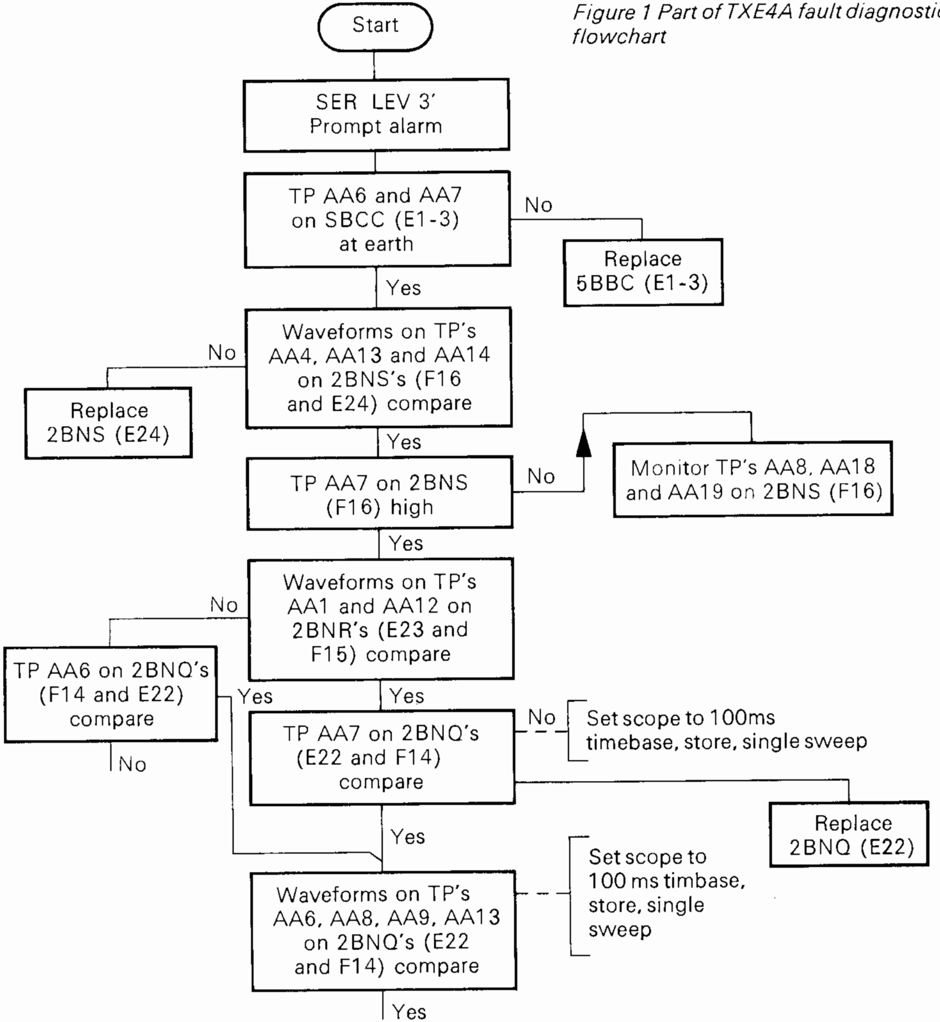


Figure 1 Part of TXE4A fault diagnostic flowchart

On reflection

This time authors (or their successors) have looked back and reported on their articles which appeared in MN 10 (Autumn 1976).

TXE 4. Mike Robards ES8.1.1 informs us that since the bringing into service of the first TXE4 at Rectory, Birmingham in February 1976, some 179 similar exchanges have opened. These exchanges – known as the Rectory Design, or TXE4(RD) – provide for over 1.7 million connections. A further 162RD types and 176 extensions are on order and should be completed during the next three years, providing a total capacity of over 4.6 million connections.

To improve service performance of the earlier RD exchanges, those currently under construction are being modified to overcome most of the known design deficiencies. It is expected that those already in service will also be upgraded.

TXE4A – the version using more modern electronic components – was described in *MN16* (Spring 1980). One exchange with some 5000 connection capacity (or multiple size) is operating at Belgrave – see this issue – and 86 more are on order as well as three extensions. During the next three years, over one million connections will become available on TXE4A exchanges.

International subscriber dialling – now known as International Direct Dialling (IDD) – has developed extensively since *MN10*, says Paul Taylor, of BT International

IN4.1.3. Now 92 per cent of the world's telephones are available on IDD from the UK. In May 1982, Egypt and the Yemen AR were added, raising the total number of participating countries to 118. Three more are due to be added in July, and further expansion is anticipated.

At present, 99.2 per cent of UK telephones have access to IDD and all customers are scheduled to have the facility by July this year. During last April, outgoing IDD calls of over 60 million paid minutes went through UK transit centres. Most of this traffic was routed through Mondial House and Stag Lane.

Dataplex. According to Roger Whitbread, T5.3.2, Dataplex has had mixed fortunes over the past few years. Dataplex 2 was based on soundly designed equipment, but service was prone to interruptions caused by local voltage variations and transmission path disturbances. Most of these systems have now been ceased, although several are still in service.

An improved design known as Dataplex 3, also based on proprietary equipment has, since *MN10*, entered service. But the introduction of the Packet Switched Service is likely to take most of the data multiplexing business. However, Prestel will continue to use Dataplex 3 to provide extended Prestel computer access at local call rates to other areas.

Smaller, less complex, equipment with similar facilities is being investigated which will provide up to eight low bit-rate channels. This may lead to a Dataplex 4 service.

Call offices

Geoff Balls, ICS7.1.2, admits that when he wrote the article for *MN10* six years ago he did not foresee such dramatic developments taking place in such short time. The far-reaching changes in payphone technology have hastened the obsolescence of the Pay-on-Answer (POA) system.

Although we have succeeded with the handset cords and door closers we expect that POA, with its remaining intractible problems, will be replaced over the next six years with a family of electronic self-contained payphones. No doubt they will bring their own problems, but the first few hundred are performing well.

Remote printout for CFDEs

Since the early equipment described in *MN10*, BT South East Region have developed an electronic version which uses two-tone signalling to accept the printout information from 25 remote CFDEs. Following earlier tests in Brighton, plans for a feasibility study in Slough are well in hand. BTSE/SM1.3.

Local radio

Bill Atkinson, of T5.2.2, states that 1980 saw a further expansion of Independent Local Radio (ILR) from the original 19 stations. About seven new stations are likely to come 'on air' each year up to the mid-1980s, bringing the total to 69. ILR will then be available to 90 per cent of the UK population.

Major changes have been the introduction of multipoint programme circuits (as opposed to point-to-point) for news distribution from London Broadcasting Company (LBC) to all companies, with a central BT control at 'London PWs' (Faraday Building). Only the enthusiasm and expertise of the Faraday staff enabled the changeover to proceed as smoothly as it did.

In addition, a 'News Contribution' network is now being provided from all ILR stations back to LBC, with remote switching facilities at programme company premises.

The ILR network is now as big as the ITV network – and is still growing.

NCC news

Terry Farres, of the National NCC (T5.2.3), reports that the declining trend of non-availability of hyper-group links continues; it has dropped to about half what it was six years ago – just as was forecast. There has also been a general improvement in failure rate. Apart from these encouraging signs not much impact has been made on working party overloads. We hope to give more details in the next issue.

It will be of interest to readers to learn that work has begun using Prestel for showing bookings for dedicated SPN and spare plant. It is hoped this will be of use to Regional NCCs in planning future work.

New generation test equipment for the fault repair service

by **Ian Blake** ES5.1.2

A field trial of Remote Line Test (RLT) equipment is now well under way at two Repair Service Controls (RSCs) – Guildford in BTSE and Carmarthen in BTWM. It is hoped that, having proved its merit, RLT will become an integral part of the repair service strategy – mentioned in MN18 – contributing to the modernisation and service improvements sought for the repair service.

Present limitations

Engineers who have worked in RSCs will be aware of the limitations of the present test gear whether mounted on test desks or included in modular RSC equipment – as well as the difficulties involved in testing over long test junctions. This is no criticism of the old style test desks which achieved the original designer's aim of testing local lines from local exchanges. But today's repair service needs equipment which can be used from one or more central locations. This may include an RSC, a centralised fault reception point or an out-of-hours RSC.

The RLT equipment

As its name implies, RLT has been designed to resolve these problems. It also provides the accuracy and range of tests needed to enable an RSC to achieve its full potential as a fault diagnosis and distribution control. Being microprocessor controlled, RLT also has the potential to keep pace with the evolution of customer apparatus and the local network.

Before the field trial Guildford and Carmarthen RSCs were equipped with Modular RSC Equipment which consisted of three modules providing the Test, Test Access and Reception functions mounted on an office-style desk. When RLT was introduced, a visual display terminal (VDT) known as an RLT Controller was provided in place of the Test and Test Access modules. The Reception module was retained to provide all the incoming and outgoing call requirements of the RSC.

As shown in the diagram (Figure 3), the system consists of RLT Controllers at each RSC position which obtain access to remote test units in the local exchanges through a switchblock and speech-band private circuits. Most exchanges in the RSC area will be equipped with one or more of these remote units. The remote unit consists of a shelf of electronic equipment mounted on a miscellaneous apparatus rack, and is connected to the existing test access equipment and the exchange common services. Like the RLT Controller, the remote unit is microprocessor controlled. It sets the test access equipment and performs all test functions under the control of data received from an RLT Controller in the RSC. All test result information and details of line conditions are returned to the RSC in this form for subsequent display on the Controller. The remote unit has been designed to work into all existing exchange types capable of providing test access – with the exception of System X which incorporates its own test facilities.

Included in the tests and conditions which can be applied by the RLT remote unit are:

- automatic check for ac mains contact immediately a line is accessed for test purposes
- several automatic line test sequences which can include insulation resistance across the pair, wire to earth and wire to exchange battery in all combinations
- measurement of capacitance in all configurations which can also be included in an automatic test sequence
- measurement of ac and dc volts, current and loop resistance
- check of dial and MF4 signals, also coin pulses from pay-on-answer coinboxes
- application of interrupted ringing current, and battery and earth conditions to enable speech over the system
- high impedance monitoring
- howler
- 50Hz longitudinal pulses to check operation of customers' private meters

- ability to make calls into the exchange over the test access.

In addition, there are some novel tests which have not previously been available to the repair service. For example, a means of identifying if all bells have been turned off or telephones unplugged on a 'new-plan' installation; and a way of forcing full test access to lines on Strowger exchanges which are permanently engaged.

Night routining

RLT can be programmed to carry out night routining of the local network and so take over from the existing fault-prone local line insulation routine (LLIR) equipment. One RLT Controller wil lbe capable of driving about 10 remote units and 'downloading' lists of lines found faulty during the night onto a printer in the RSC or External Plant Maintenance Centre (EPMC). Service-affected lines will be indicated on the printout.

Other benefits

During the course of the field trial it may be possible to provide and evaluate further test

Figure 1. The desk layout used at Guildford – the Reception module is at the left and the RLT Controller in the centre. The pigeon holes are used for storage of fault cards and timesheets.

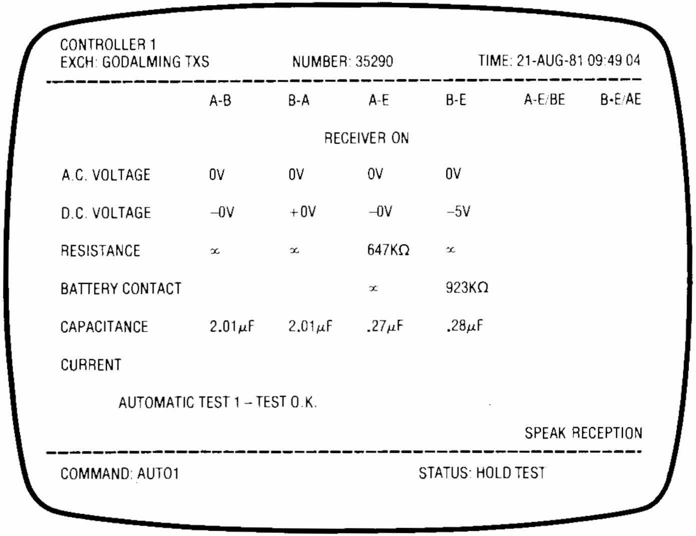
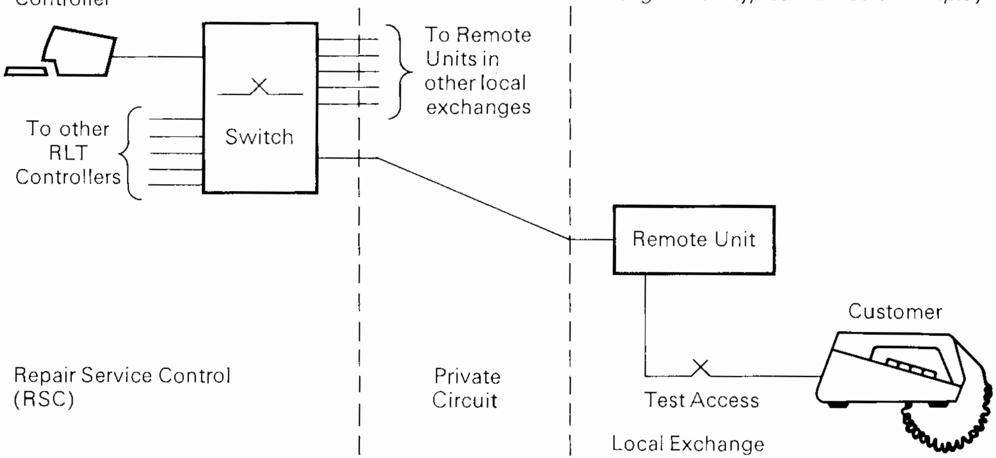


Figure 2. A typical VDT screen display



facilities. For example, identifying the presence and approximate location of series high resistance faults, and enabling the remote unit to test lines on more than one exchange using test junctions. This may sound contradictory for a remote line test system but the microprocessor in the remote unit could be programmed to take into account the affects of any test junction before returning the test results to the RSC. The results displayed on the RLT Controller in the RSC would then relate only to the customer's line and not include the parameters of the test junction. This capability would reduce the number of remote units needed in rural areas and represent a large financial saving nationally.

Further phases of development planned for RLT are: to integrate it with the RSC computerised administration system (ARSCC) – also mentioned in *MN18* – and to enable it to interwork with the System X test network to provide comparable test facilities on customers' lines served by System X exchanges.

01-432 2351

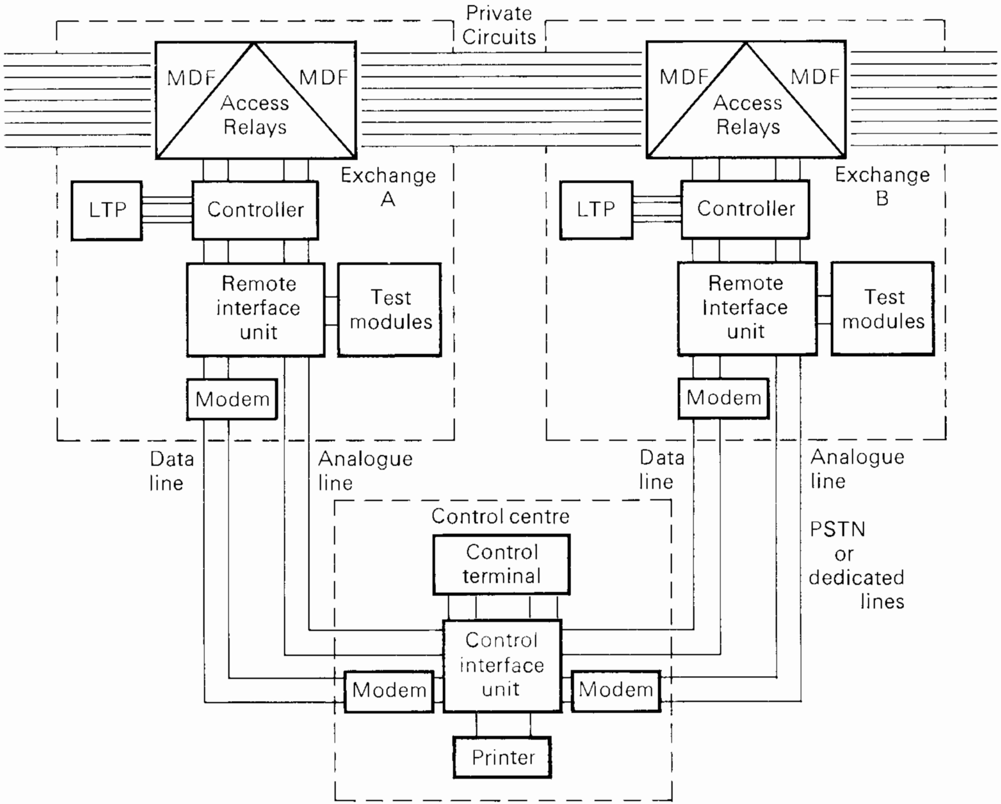
Faster RATES for private circuits

by **David Kennard** – NE/T5.3.1

Computer-controlled relay equipment is now on trial for intercepting and testing private circuits from a distant centre. The equipment, known as RATES (Remote Access and Test Equipment System), can be jumpered into existing private circuits or other special circuits in local exchanges, and will be controlled over dial-up or dedicated circuits from a central fault reporting point.

Until now, it has not been possible to test private circuits automatically from a central point – as can be done on telephone circuits using test selectors. Of course, private circuits can be tested over tie-lines or test-trunks, but there is a limit to the distance over which successful tests can be made, and the connection between the tie-line and private circuit has to be applied manually. The delay in conducting manual testing at MDFs or TJFs – which often requires a visit to an unattended exchange – contributes to the high outage times for fault reports. The national outage average for private circuits at present is about 20 hours, and the RATES facilities could help to reduce this, as well as the number of intermittent and repeated faults which occur.

Several different types of equipment are being examined, and the most notable version at the moment is based on an American design, shown in the Figure 1. This version is on trial at Manchester, and current plans are to install the equipment in 15



RATES – Remote Access Test Equipment System exchanges to intercept about 18 000 circuits, which can then be tested remotely from one of two control centres. If this stage of the trial is successful, it may be expanded to about three times the size later, which will include most of the large exchanges in the Manchester conurbation. Other trials, using a simpler type of equipment developed by BTLR, have been started at Albert Docks (London) and Reading. In each case, the equipment is fitted in a single exchange to intercept up to about 1000 circuits. The simplification stems from the application of short-distance control circuits to operate the relays indirectly, rather than utilise longer-distance data lines as in the Manchester scheme.

The equipment at Manchester will be fitted near the MDF in each exchange, and will consist of one or two racks of the access-relays and control units which are cabled to the MDF to intercept existing jumpers for the private circuits as shown in the Figure. Each relay is a miniature-type which will switch up to three pairs at a time, to cater for two-wire, four-wire and signalling circuits. The relays are selected and operated from the local controller unit, which is a microprocessor activated either indirectly from the control centre or directly from a local test panel (LTP). The local test panel has a key-pad which will allow all the normal testing facilities to be made, usually for sub-location work, or where faults are referred to the local exchange for initial testing.

With the majority of fault reports which are received at the control centre, the testing officer keys-in the commands on a visual display terminal (VDT) to operate the system, after first looking up the customer and circuit details on card records. Once the exchange and circuit number is known, a data cartridge tape for the exchange is plugged into the terminal, and the appropriate section of the tape is selected for identifying and operating the relevant access relays. A dial-up or dedicated link is then set up between the control interface unit and the remote interface unit at the exchange. Control signals and return signals pass over a 300 baud data line, while a second line can be connected for monitoring, speaking or exchanging other analogue signals. The data signals are abbreviated to speed up the operations, and all the normal test parameters can be applied or measured by activating the particular test module at the local exchange. The control terminal has duplicated facilities which permit two separate exchanges to be accessed at a time, so that end-to-end tests between exchanges can be made over a long-distance private circuit. Once tests have been completed, the full test log can be printed out at the control centre, if a record is needed.

The results of the trials so far are very promising, and full evaluation will continue to determine to what extent the equipment can contribute to reducing the outages of private-circuits due to faults.

01-432 9148

Automatic testing methods

by **Steve Plumb** ES 5.4.1

MN13 introduced readers to Automatic Test Systems (ATS). This article gives some idea of the testing methods used to locate faults on such complex digital electronic units as System X or Herald central processors. It relates particularly to the Membrain MB7700 series of ATS now installed at some Area Repair Centres (ARCs). These ATS are not generally equipped to test analogue units such as Mobile Radio Sets or frequency division multiplex (FDM) units.

There are many different types of digital units containing general purpose logic devices – such as the Texas 7400 series of integrated circuits (ICs) – and these are normally straightforward to test. Other units contain 'custom made' devices such as Uncommitted Logic Arrays (ULAs), where a single chip provides all the logic found on an entire plug-in unit (PIU) of about four or five years ago. Other complex devices such as Read Only Memories (ROMs) and Random Access Memories (RAMs) all present problems to the fault diagnostician. The types of components used, and the way they have been connected, therefore influences the test method used with a particular unit.

Testability

Testability means designing a circuit so that it can be tested and faulted using an ATS, as well as performing its intended system task. Typical problems for an ATS include long counter chains, microprocessors, oscillators and the complex devices already mentioned which require many logic inputs for complete testing – especially where they are 'hidden' in the circuit by other complex devices.

Testability can involve electrically breaking long counter chains into manageable lumps, providing additional connections into the circuit to enable control of microprocessors and oscillators, as well as the ability to test some parts of a circuit in isolation from other parts.

Test programs

Test programs and other relevant information – such as the full circuit description including component types, names, pin connections and so on – are created for particular circuits. Modifications to a circuit often require a new database with some changes to the original test program as well as to the associated information.

Generating test programs is a time-consuming task so, where possible, various aids are used. One main aid is a simulator which lists the possible faults that could occur on the PIU, then indicates the parts of the circuit that have been adequately tested. It also generates a 'fault dictionary' for the particular faults that can be detected. The simulator can then inform the operator of the program's 'quality' – that is, the difference between those faults detected and those undetected. Usually it is only test programs generated using the simulator that have the necessary accompanying information enabling the ATS to automatically locate the fault in a circuit. The automatic fault location is mainly carried out by the ATS operator placing a 'guided probe' on components as requested by the ATS.

A simulated test program is normally written to test as much of the circuit as is possible and practical. However, certain tests and techniques cannot be used with the simulator. The test programs written without the simulator are usually referred to as 'manual' programs. This stems from the fact that although error messages can be included in such a program to indicate the expected problem or fault, confirmation and final diagnosis normally has to be carried out manually by the operator. Usually, manual programs are only written where operator interaction is required (such as to operate switches, observe LEDS, and so on.) A non-simulated test program also lacks the information confirming which faults are detected and the resulting quality figures.

When a circuit is tested, the idea is to detect any faults relating to disconnected or high resistance component connections, device output stages stuck at logic '1' or '0', timing devices, and to carry out full functional checks of each device. The simulator indicates which faults are detected, but it is not able to state whether all the function checks have been made. To help the program confirm that function tests produce the expected results, the simulator outputs all device output states related to the programmed input states.

High speed tests

Most ATS generally apply tests to a PIU at a rate of tens-of-thousands per second. However, there is often the facility of loading the test information into a fast memory and then 'firing' it at the Unit Under Test (UUT). With this technique the Membrain ATS can change any or all of the pin states five million times per second. This allows testing of a UUT with clock signals and data running at typical system speeds. Because modern circuit speeds are increasing ATS manufacturers are trying to speed up their machines, but at high speeds various timing difficulties can arise. Just adding a foot or so of wire to a sensitive high speed area of a UUT can stop the circuit functioning altogether. So high-frequency transmission concepts also have to be considered when testing.

General logic tests

As already mentioned, testing circuits containing general logic devices is normally straightforward, although poor testability can cause problems.

When tackling general logic, test programs are written to find the possible faults rather than to immitate the system from which the circuit came. In this way the programmer does not have to learn the intimate system details of every circuit he sees, but instead should be very conversant with logic principles and have the basic information about the circuit.

Complex devices

□ *ULA tests*

The main problem with ULAs is that there might be only very small quantities of particular types depending on the number of PIUs made. For such unique devices there will not be a model of its operation in the ATS simulator's library. This means using much effort to generate a model otherwise it prevents a simulated test program from being generated.

Again, testability is a major consideration, but in this case it should have been thought of when the complex chip was designed.

Often data sheets and full functional descriptions are available for simple devices, but not for custom ones. This can make the test programming task much harder, especially when the circuit diagram for the custom device is not available.

□ *RAM and ROM tests*

Large memory devices such as these are very common in modern PIUs. Typically, ROMs (which contain fixed data) have 16,384 separate cells, each holding the logic value 0 or 1. RAMs (in which the data can constantly be changed) can contain 2,000 cells.

ROMs are tested by reading all the cells and checking that the correct data is present. This is fine when all the PIUs of a particular type have identical data in the ROMs, but sometimes the data differs from system site to site. In cases where there are many variants of the data, the ideal solution is to remove the ROM from the PIU and check it separately, with a test ROM inserted in the PIU. If the ROM is soldered-in (instead of being in a socket) a further problem arises as it cannot easily be removed.

To test RAMs, each cell must have both the logic value '0' written in and read out, then the value 1. However, to properly check a RAM for faults between the cells, a pattern of 1s and 0s should be written and read. Much debate exists on which patterns are best. Normally a 'chequer-board' pattern of 1s and 0s is used, which is then reversed.

To check ROMs and RAMs, the principles used to write the tests can be fairly simple, but the length of the test program, and time taken to write it, can be formidable and even unrealistic. In very large programs the floppy disc storage can be exceeded, requiring two or more discs to hold the full program. However, one facility that is available – called Live Data Compression (LDC) – carries out a time-related summation of all the logic state changes of the circuit.

With LDC, short routines used in a repetitive manner can often replace lengthy continuous patterns. This saves much floppy disc storage space and shortens the time taken to write the tests, at the expense of a slightly longer testing time. LDC is only geared to indicating a failure and does not allow automatic diagnosis of the fault, although failure messages can be included as in a manual test program. In this way a simulated program can be used first to check most of a PIU, followed by an LDC program, with messages to state which particular ROM/RAM has failed.

□ *Microprocessor tests*

A microprocessor by itself is basically a data manipulator. It functions by taking in an instruction, for example add one number to another, then acquires any extra information required (the two numbers, say) and finally outputs the result.

It has been estimated that to fully test a typical microprocessor with every combination of function, data and speed limit, would take 10 years, (by which time the system it came out of may well have been scrapped). We obviously have to settle for a realistic set of tests that give a high degree of confidence that the microprocessor is working well. This normally means a check of each function with its fixed set, in addition to trying a pattern of logic 0s and 1s in each memory element (register cell).

If the ATS has sufficient control of the microprocessor then the tests are easily manageable.

Bus structured PIUs

An electronic BUS is a set of communication lines taken to various devices – such as the ROMs, RAMs and microprocessors mentioned above. The BUS allows any device connected to it to communicate with any other device.

Obviously some controlling logic ensures the correct devices are 'talking' and 'listening' at any one time. It is common to have an 'address' and 'data' BUS on such PIUs which typically consist of eight or 16 lines each. The address BUS is used to select the required device (memory element, for example) and the data BUS to convey any information or results.

A well-designed testable PIU operating mainly on the BUS principle is relatively straightforward to test. The number of tests for each device on the BUS might be considerable, but the approach is basically that of tackling one device at a time.

A final word

ATS programmers are to be found in some Area Repair Centres, BTHQ, BT Factories and outside consultants. Although an ATS does not solve all our problems, as a general-purpose software-controlled tester it is capable of very effective fault diagnosis. This naturally depends on good quality test programs and operation of the ATS to its best advantage. Also, once a test program has been generated – often with a significant investment in skilled programmers' time – it is always available when required for that type of PIU.

It is hoped this rather long article has helped readers appreciate something of the various ATS techniques that can be used to thoroughly test a PIU – assuming that testability has been designed-in. ATS techniques are used typically when other methods would take too long or be excessively complicated.

01-932 2894

New cable alarm saves money

by **Eric Woodgate** BTE/Colchester Area

A new cable-pressure alarm system, devised in Colchester Area and developed in BTE, has paid for itself in just one day.

The system, which uses Zener diodes, has been on field trial at Ipswich since April 1980. It was devised by a Precision Test Officer and developed by staff in the External Plant Maintenance Centre (EPMC).

One January morning the pressure failure detection equipment at Ipswich EPMC issued a deferable alarm on the 542-pair Ipswich to London No 2 cable. This was followed almost immediately by an urgent alarm locating the Manningtree area. A jointing team was promptly directed to the scene. On arrival they discovered the manhole full of water, and on pumping it out, the team found a very large fracture in the cable's lead sheath.

Timely warning and the quick action by staff had prevented a total failure of this very important cable with, in this case, little more than half-an-hour to spare. Certainly had the old type of alarm system still been in use, the inevitable delay in detecting the fault would have resulted in considerable loss of service in the trunk network. The repair cost would also have been more than £2,000.

The Zener alarm system – which employs just two pairs from the EPMC to test up to 1000 circuits, and can discriminate between CRE and cable pressure failures – costs about £1,000, excluding installation charges.

0206 72960

WHAT IS TIER 2?

Tier 2 is the next generation of coin telephone for PCO's – and there will be a Renters' version. It is the main replacement for POA.

It is nearly ready for trial. Plessey, THQ Development and THQ Maintenance Groups (and many others) are working very closely to develop one of the best coin telephones in the world. The latest in technology and the grottiest from every day field experience have been fed into the electronic, mechanical and physical design to produce a payphone which will give every modern facility and stay in service come whatever.

Of course, we shall not produce the perfect PCO – but we hope to get nearer than ever before.

When? With luck, Trial starts in October, production starts early '83 with general availability by mid 1983.

ICS 7.1.2
01-432 9178
D POPHAM
Head of Payphone Maintenance Group

New electronic work bench

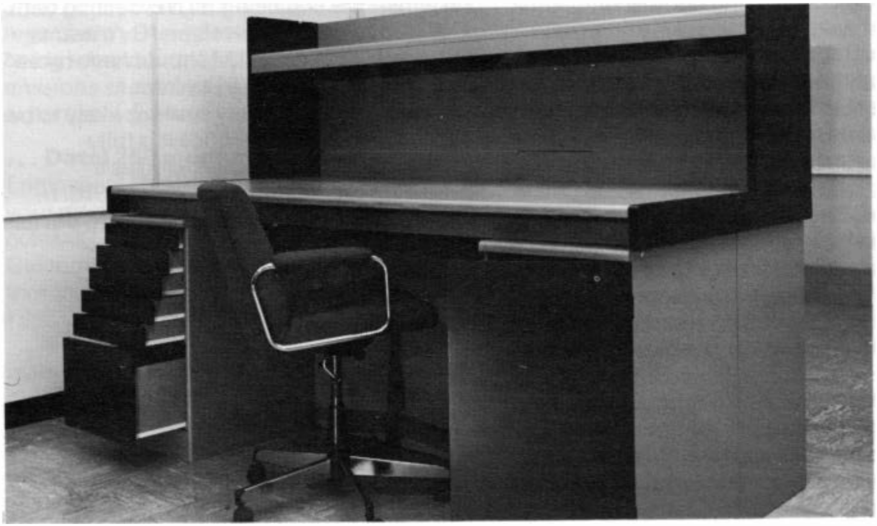
by **Ron Quinney** ES5.4.3
Repair of modern electronic equipment demands a high standard of workmanship and often requires a large amount of bench area to accommodate test equipment and other fault diagnostic aids.

With the introduction of Area Repair Centres (ARCs) – see *MN17* – it was apparent that there was a need to satisfy both these factors. There was also a pressing need to meet the newly-defined minimum standards laid down in the safety TIs. So, in cooperation with the Property Services Agency (PSA) – who supply all furniture to BT – ARC staff were asked about their needs. Note was taken of their experiences of the variety of types of benching available, as well as the required safety features, and a compromise design was produced for an electronic work bench.

The prototype shown in the photograph differs slightly from the production items, but illustrates the general style. It does not show the optional box which fits along the rear of the bench-top to allow the 13A power sockets to be brought forward for the convenience of the technician, and allows small items of test equipment to be raised to a more convenient height.

The main features of the new electronic work bench are –

- modular construction
- choice of pedestals – drawers or cupboard
- large lino-covered surface area (2100mm x 1050mm)
- half-length bench available (1050mm x 1050mm)
- full or half-length upstand to support test equipment
- all insulated construction
- concealed housing for mains isolation transformers
- rear insulating barrier to give electrical isolation between benches sited back-to-back
- plastic trunking to house wiring to 13A power sockets, with removable panel for optional use, local signal sources and so on
- optional raised box to bring power sockets forward if required



The first 100 benches have been delivered to various ARCs direct from the manufacturer and assembled on site. Further contracts have been placed by PSA and the bench components listed in the furniture catalogues. Local accommodation staff ought to have all relevant information.

The benches have been well received by staff in ARCs, and Union representatives, and it can be expected that many other users will be quick to see the benefits. Retrospective demands will also arise from the need to satisfy the new safety requirements.
01-432 2806

Introducing regional service improvement centres

by **Alan Kelly** ES9.1.3

In the past, BTHQ held onto the national responsibility for development, planning, service and works for all exchange systems long after they had become well established – in fact, for as long as the systems had been in the network.

Naturally, this meant that various BTHQ divisions had the responsibility of committing staff to an ever-increasing number of established systems. At the same time, new systems and facilities were putting greater demands on the available resources. Commitment to the new systems was given top priority by BTHQ, and it was felt that support for established systems would suffer unless methods were changed.

It was decided that once a system was fully established within the national network, all responsibility for development, planning, service and works for that system would be transferred to a specific Region. BTHQ would thus be better able to concentrate on the new systems.

A region allocated the control of a system, will, among other criteria, be one with a large proportion of that system, so will be able to provide system-trained staff from within the region.

Staff who are brought together within the region to take on this work will all belong to the same group – unlike BTHQ where jobs are spread over various divisions. These new groups are known as Regional Service Improvement Centres (RSICs).

First for north east

Different regions will set up RSICs to take over the national responsibility for different systems – the first being BTNE, dealing with TXK1 Local and GSC systems. By the time this article appears, BTM should have taken over the Strowger (TXS) system.

These are not the only systems likely to be affected. Any system – once it is fully established – will be considered as a candidate for the formation of an RSIC. In this way BTHQ will always be able to put its major effort into the evolution of new systems.

In the next issue of *MN*, we shall be taking a look at BTNE's RSICs at Leeds.
01-432 1300

Letters

... John Vidler of BTSW writes on the A346/349 procedure

Our colleagues in the Installation and Works groups are continually providing new plant and equipment. Once provided, this becomes a maintenance responsibility for the rest of its life – possibly 30 or 40 years. So not only is it necessary for maintenance staff to know in advance what is being provided, and how, but also – because our colleagues do not give us a guarantee – it is absolutely essential that we should have the opportunity of inspecting it before we accept it.

Service targets – which have to be achieved if we are to stand the test of competitiveness – are constantly hampered by the lack of records, so often caused by little or no knowledge of the work being carried out. Working party interruptions and damage to existing plant, both contribute to the failure to meet our aims and cause customer dissatisfaction, things we can ill afford to tolerate. Two procedures exist to assist maintenance.

The A346 procedures are not new and have been ,or should have been, used for notifying the Maintenance AEE of all works of construction, renewal, and rearrangement taking place within his maintenance area.

The A349 is the relatively new procedure for accepting into maintenance new or altered external plant. It is set out to advise the Maintenance AEE of the pending works through to completion. A check is made to ensure that all works have been carried out in a standard manner, and handed over to maintenance with all items correct.

It is of paramount importance that internal and external plants are of the highest operational order at all times. To find that new circuits, racks, or cable networks are of such a poor standard that they immediately become a maintenance problem is not only illogical and budget-consuming, but is guaranteed to lose customer confidence.

Construction staff often question the need for maintenance staff to check their work. But consider, if the result of a maintenance check proves the need for improved workmanship then unnecessary expenditure will be reduced and, more importantly, a better standard of service will result. And that's what our customers will appreciate and be prepared to pay for.

T1 L5 A0025, A2 C1202 refer.

John Vidler
BTSW/GR03

Thanks, John, for bringing to our notice once again the need for promoting the basis for reliable and satisfactory customer service. – Editor.

. . . call for a TRT119 – once again

Can any reader help me please?

I continue to have a need for a TRT119 Test Call Sender. The item is obsolescent in the Vocabulary and stock is exhausted. Enquiries throughout the area and regional offices have drawn a blank. I would be pleased to hear from anyone who knows the location of a TRT119 which is, for one reason or another, no longer required.

R S King, Mtce AEE, M35 Cambridge T.A. 0223 353648.

. . . stores liaison

Dear Editor,

Maintenance Heads of Division in Areas who require to know how things are doing on their patch, could learn a lot from a chat with their local Section Stock small-stores man. Many I am certain, would be amazed to learn of the cases where the storeman has to dust-off essential items.

In addition to this, what better way is there to assess the amount of lead-sheathed cable still in the ground, than to study the solder demand rate?

We in the stores have a few good tips to offer too.

David Watkins, EC 252, Cardiff. (0222 398396).

You have a good point there, David. The contributions Stores people can make are often overlooked, but we have always regarded the Area Stores Liaison duties as being a key point. Maybe maintenance divisions should make more use of this expertise. – Editor.

. . . Datel 200 modem testing.

Engineer: "I have completed my tests on your modem Sir, it passed with flying colours"

Customer: "But you can't leave yet, my terminal still doesn't work. Now what do I do."

Anyone involved in Datel installation or maintenance will be familiar with a dialogue along these lines, and if a customer distrusts your tester (that box full of flashing lights) you are at a distinct disadvantage. To have to tell him that your unnecessary visit will also cost him money just adds insult to injury.

Many thousands of Datel 200 users gain access to their computer via the PSTN and it is these customers that seem to have most trouble in identifying the problems.

How much better it would be if the customers could do a simple 'go or no-go' test for themselves, but to do so effectively needs access to another computer, with a knowledge of its operating procedure and passwords.

In Reading we have developed a program for a NASCOM 1 microcomputer that allows it to be connected to a modem 2B and exchange line. It answers an incoming call, introduces itself and, without the use of access codes or passwords, allows the customer to perform a go/no-go test of modem and terminal. At least when we are called in, we know that the fault is somewhere local.

To use the system, all our customers have to do is call Reading 861670 and when they get the data tone, put their terminal 'on line', then type 'Z' until the system responds. From the 'Z' the microcomputer decides which speed is in use (110 or 300 baud), and will echo back what is typed in, or send 'Quick Brown Fox' messages or alphabets. An engineering option (protected by a password) is included. This allows us – if the customer's terminal is suitable – to change speed or parity when, having repaired any faults, we use the system ourselves as a final check that all is well, or to demonstrate to customers that the repairs were effective.

The system is very popular with Reading Area customers, and goes some way to reducing unnecessary visits, improving our image, and saving money. Future systems can be provided for a cost of less than £200.

Much better than saying "Sorry Sir, I have done all I can, perhaps its the computer?"

R. A. Collins
M4.9 Reading Area
0734 866353.

– It's good to hear of instances where local initiative has been applied, not only to give a better customer satisfaction but also in making better use of maintenance staffs' valuable time – Editor.

Maintenance News aims to provide a medium for two-way communication – that is, between Headquarters and the field. If you want to write about anything you may have seen in *Maintenance News*, or indeed, about any maintenance topic, send your letter to: The Editor, Maintenance News, Room 301, 203 High Holborn, London, WC1V 7BU. Say what you like, but the Editor may tone comments down if he decides to publish. Do please give your full address.

If you have a contribution to offer to *Maintenance News* other than a letter to the editor, please forward it through normal channels to the *Maintenance News* agent for your Region or Telecommunications Board. The list is shown below. The Editor cannot publish anything to do with current awards suggestions, neither can he be held responsible for technical inaccuracies in authors' submitted text.

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