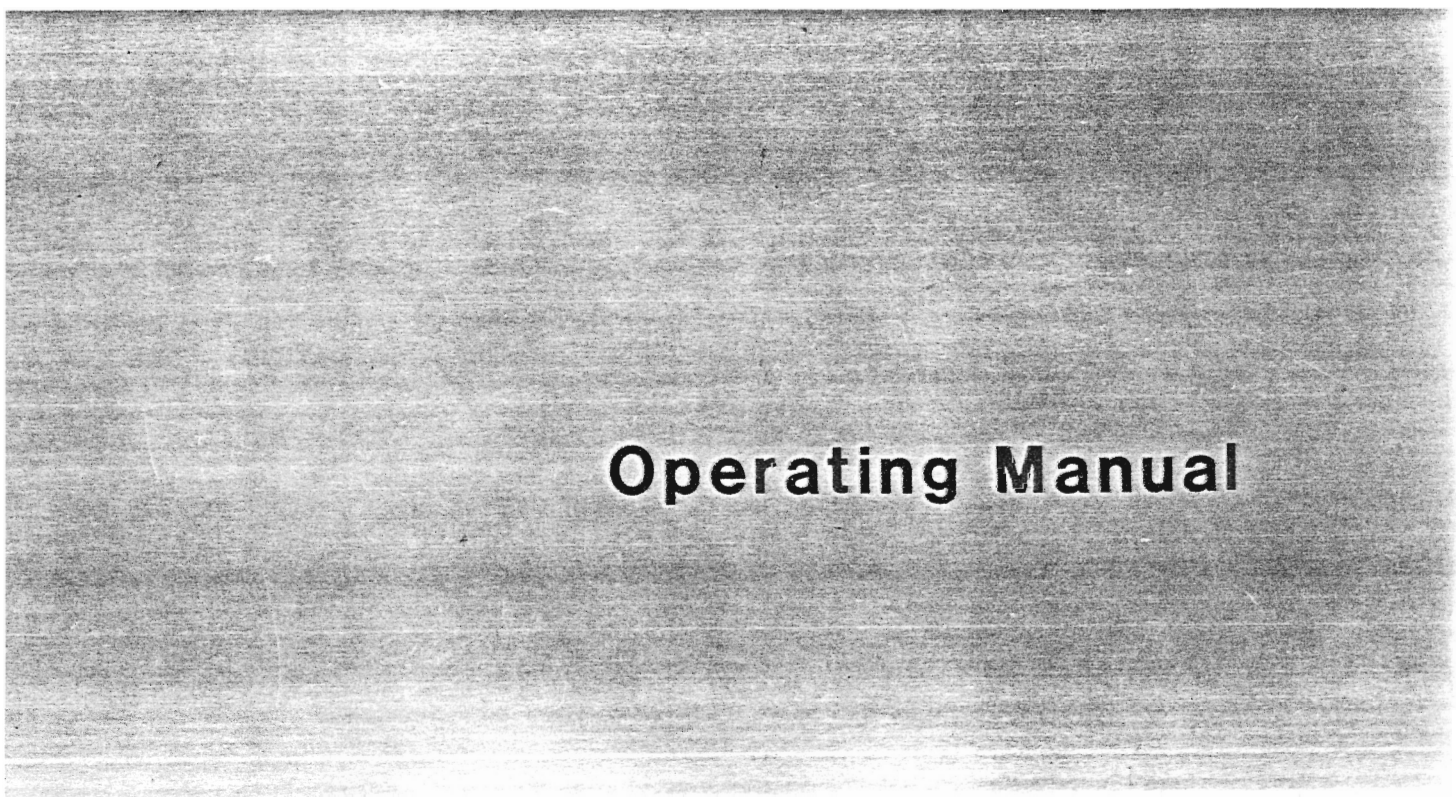
Marconi
Instruments

2958

CELLULAR RADIO

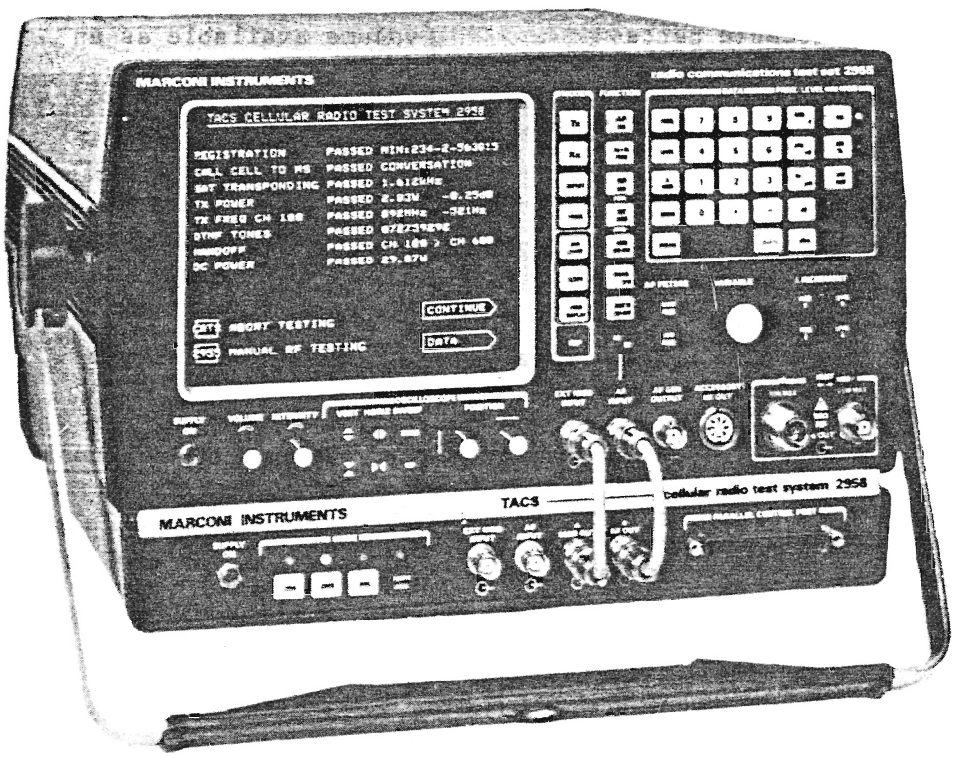
TEST SYSTEM



Operating Manual

CELLULAR RADIO
TEST SYSTEM
2958

Code No. 52958-900L



Part No. 46881-705P
Print code: A - 3/86, MI 1.1c

CONTENTS

HAZARD WARNING SYMBOLS

The following symbols appear on the equipment.

Symbol	Type of hazard	Reference in manual
⚠	Static sensitive device	Page (iv)
⚠	Dangerous voltages present	Page (iii)
⚠	Supply voltage	Page (iii)

Note ...

Each page bears the date of the original issue or the code number and date of the latest amendment (Am. 1, Am. 2 etc.). New or amended material of technical importance introduced by the latest amendment is indicated by triangles positioned thus ▶ ..... ◀ to show the extent of the change. When a chapter is reissued the triangles do not appear.

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

NOTES AND CAUTIONS

ELECTRICAL SAFETY PRECAUTIONS

This equipment is protected in accordance with IEC Safety Class 1. It has been designed and tested according to IEC Publication 348, 'Safety Requirements for Electronic Measuring Apparatus', and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the equipment in a safe condition.

Defects and abnormal stresses

Whenever it is likely that protection has been impaired, for example as a result of damage caused by severe conditions of transport or storage, the equipment shall be made inoperative and be secured against any unintended operation.

Removal of covers

Removal of the covers is likely to expose live parts although reasonable precautions have been taken in the design of the equipment to shield such parts. The equipment shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the equipment shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a skilled person who is aware of the hazard involved.

Note that capacitors inside the equipment may still be charged when the equipment has been disconnected from the supply. Before carrying out any work inside the equipment, capacitors connected to high voltage points should be discharged; to discharge mains filter capacitors, if fitted, short together the L (live) and N (neutral) pins of the mains plug.

Note also that the 12 kV e.h.t. circuit for the cathode ray tube retains its charge for a considerable time after switch off. Therefore before any handling is carried out in the vicinity of the cathode ray tube or e.h.t. unit it is essential that the supply is disconnected from the instrument and the final anode lead is shorted to the chassis several times immediately after unplugging. The residual charge on the c.r.t. itself must also be removed by shorting the anode connection to earth.

Mains plug

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension lead without protective conductor. Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous. Before fitting a non-soldered plug to the mains lead, cut off the tinned ends of the mains lead. Otherwise cold flowing of the solder could cause intermittent connections.

Fuses

Note that there is a supply fuse in both the live and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

To provide protection against breakdown of the supply lead, its connectors, and filter where fitted, an external supply fuse (e.g. fitted in the connecting plug) should be used in the live lead. The fuse should have a continuous rating not exceeding 6 A.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders shall be avoided.

CAUTION : STATIC SENSITIVE COMPONENTS

Components identified with the symbol ⚠ on the circuit diagrams and/or parts lists are static sensitive devices. The presence of such devices is also indicated in the equipment by orange disks, flags or labels bearing the same symbol. Certain handling precautions must be observed to prevent these components being permanently damaged by static charges or fast surges.

(1) If a printed board containing static sensitive components (as indicated by a warning disk or flag) is removed, it must be temporarily stored in a conductive plastic bag.

(2) If a static sensitive component is to be removed or replaced the following anti-static equipment must be used.

A work bench with an earthed conductive surface.

Metallic tools earthed either permanently or by repeated discharges.

A low-voltage earthed soldering iron.

An earthed wrist strap and a conductive earthed seat cover for the operator, whose outer clothing must not be of man-made fibre.

(3) As a general precaution, avoid touching the leads of a static sensitive component. When handling a new one, leave it in its conducting mount until it is required for use.

(4) If using a freezer aerosol in fault finding, take care not to spray programmable ICs as this may affect their contents.

WARNING : HANDLING HAZARDS

This equipment is formed from metal pressings and although every endeavour has been made to remove sharp points and edges care should be taken, particularly when servicing the equipment, to avoid minor cuts.

Cathode ray tube: When exposing or handling the cathode ray tube care must be taken to prevent implosion and possible scattering of glass fragments. Handling should only be carried out by experienced personnel and the use of safety mask and gloves is recommended. A defective tube should be disposed of in a safe manner by an authorized waste contractor.

WARNING : TOXIC HAZARD

Many of the electronic components used in this equipment employ resins and other chemicals which give off toxic fumes on incineration. Appropriate precautions should therefore be taken in the disposal of these items.

Lithium: A lithium battery is used in this equipment. Under no circumstances must any lithium battery be crushed, incinerated or disposed of in normal waste. They must be separately and securely packed and any exposed electrical connections adequately insulated to avoid a short circuit occurring during transit. They must be clearly identified to show the nature of the hazard and then disposed of by an authorized waste contractor.

EQUIPMENT ... 2957

TITLE ..... Cellular Radio Test System

CODE No..... 52957-900R

SER. Nos..... All

ACCOMPANYING
DOCUMENTS ... None

MANUAL CHANGE

The values of main a.c. supply fuses have been changed. This necessitates the following amendments:-

Chap. 2, p. 6, para. 7

Amend POWER SUPPLY REQUIREMENTS to read :

"The required supply fuses (time lag) are 400 mA for 105 to 120 V or 250 mA for 210 to 240 V."

Chap. 3, p. 5, Fig. 2

Change the Adapter's fuse rating shown from 0.5 A-T to 0.25 A-T.

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND.

Chapter 1

GENERAL INFORMATION

CONTENTS

INTRODUCTION

1. Cellular Radio Test System 2958 provides a.f. and r.f. test facilities as well as the 8 Kilobit data stream necessary for full cell site simulation. The test system utilizes a Radio Communication Test Set 2955 fitted with a GPIB interface and a TACS Cellular Radio Adapter. The two units are fitted together to form one easily portable instrument which is intended for testing cellular mobiles at the touch of a button.

Go/No-go test facility

2. The 2958 has been designed to provide a go/no-go test for rapidly sequencing through one of 4 built-in standard test routines or a user-defined routine automatically. This checks the signalling and the r.f. parameters of the radio, giving the service engineer an instant picture of what has passed and what has failed.

3. Acceptance testing and quality control checks can be carried out in a few minutes saving valuable service shop time and avoiding installation of faulty equipment. A hard copy printout can be taken to show just the failures or the complete set of passes and failures.

Auto test facility and control menus

4. A comprehensive auto test sequence provides a choice of display formats for printed results. The screen menus allow the user to select and retain desired system parameters prior to starting a test; for example, system ID test channels, number of hand-offs etc.

5. When it becomes necessary to diagnose a fault or carry out service repairs and alignment, the 2958 provides a stop-on-test mode with a split screen display. This shows simultaneously the transmitter and receiver r.f. and a.f. parameters, as well as the current test being performed. So if, for example, the mobile is failing to switch to the correct power level on command from the cell, this can be seen immediately.

6. While in the stop-on-test mode, the service engineer has the facility to select the 2955 test set function. This enables manual control of the r.f. and a.f. signal generators for alignment and fault finding purposes.

Wideband data displays

7. Another powerful feature of the 2958 is the ability to be able to look at the wideband data on the forward or reverse control or voice channels. This enables the service engineer to ascertain which data words are in error and even which bit of the word is causing problems. So it is possible to determine whether the fault lies with a mobile's logic boards or whether the mobile is having a problem with the system in which it is working.

Standard interfaces

8. The Cellular Radio Test System interfaces include an RS232C, GPIB, Centronics/parallel and disc interface fitted as standard. The RS232C or GPIB ports can be connected to an external controller to form a sophisticated ATE system. Alternatively, they and the Centronics interface can be used to drive a suitable results printer. The disc interface is compatible with a 5.25 or 3.5 inch 40/80 track, single/double sided disc drive. The disc drive may be used to down-load externally written user-defined test sequences.

2958 PERFORMANCE DATA

	Characteristic	Performance
9.	RF tests:	As 2955.
10.	Audio tests:	As 2955 plus SAT and traffic channel testing.
11.	SAT generator	
	Frequency range:	3 to 8 kHz.
	Accuracy:	±1 Hz.
	Resolution:	5 Hz.
	Deviation range:	0 to 2.5 kHz.
	Accuracy:	±9%.
	Resolution:	<15 Hz.
	Distortion:	<2%.
12.	SAT measurement	
	Frequency range:	6 kHz ±50 Hz.
	Accuracy:	As 2955 a.f. counter.
	Resolution:	As 2955 a.f. counter.
	Deviation range:	0 to 2.5 kHz.
	Accuracy:	±7%.
	Resolution:	5 Hz.
13.	AF generator:	As 2955.
14.	AF measurement:	As 2955 but also including a psophometric filter and de-emphasis.
	Psophometric filter:	CCITT filter selectable for psophometric measurements of the traffic channel. Available for use in 2955 mode. Conforms to recommendation P.53.
	De-emphasis:	6 dB per octave, 300 Hz to 3.4 kHz.

Characteristic	Performance
15. Data generator	
Modulation type:	FSK.
Data rate:	8 Kbit.
Data rate accuracy:	±1 bit/s.
Max. deviation:	±6.4 kHz peak.
Encoding technique:	Manchester.
16. DTMF decoder	
Frequency tolerance;	±2%.
17. DC power meter	
Voltage range:	0 to 25 V.
Accuracy:	5% ±1 count.
Current range:	0 to 10 A.
Accuracy:	±5% ±2 counts.
Resolution:	100 mA.
Power range:	100 mW to 100 W.
Accuracy:	±10%.
18. User interfaces	
GPIB:	GPIB subset:- SH1,AH1,T5,TE0,L4,LE0,SR1,RL1,PP0,DC1, DT0,C0,E1.
Parallel control port:	Printer - (a) Centronics compatible printer port. Control - (b) 8-way bi-directional port. 48 mA sink. (c) 4 t.t.l. outputs (unprotected). (d) 4 t.t.l inputs (unprotected). (e) +5 V d.c. supply at 100 mA accessory power (unprotected). (f) 3 analogue inputs routed to AF INPUT of 2955. Max. 10 V peak. Impedance >1 MΩ. n.b. accessible via GPIB.

Characteristic	Performance
EIA RS232C:	Subset D (asynchronous).
Disc interface:	Industry standard (Shugart S.400) interface compatible with a 5.25 or 3.5 inch, 40/80 track, single/double sided disc drive. Track to track step time <= 6 ms. 34-way IDC male socket.
EXT MOD INPUT:	As 2955 but sensitivity 0.5 V p-p for 5 kHz deviation: ±10% at 1 kHz.
AF INPUT:	As 2955.

Features (additional to 2955)

19. Call processing:	Compatible with TACS Iss. 3, Oct. 84. Registration. Call placement (cell to/from mobile). Handoff (switching call in progress). Change of output power level SAT transponding. Roaming. Bit error rate.
20. RF testing:	Automatic measurement of SINAD sensitivity. Carrier frequency accuracy. Power accuracy. Modulation frequency/level/distortion.
21. Audio testing:	Distortion/hum and noise measurements in a psophometric bandwidth. SAT measurement. Modulation limiting. Compander operation. DTMF operation.
22. User controls:	4 Buttons:- 2955 - Normal 2955 operation. CRTS - Enters cellular test mode. DISC - Selects 2958 disc menu. PSOPH - Selects psophometric filter when in 2955 mode.

General

23. Power requirements:	115 V or 230 V nominal a.c.
Voltage range:	95 to 130 V, 190 to 264 V a.c.
Frequency:	50 to 400 Hz ±10%.
Consumption:	30 VA.

	Characteristic	Performance
24.	**Dimensions and weight:**	Height: 54 mm (2.1 in). Width : 325 mm (12.8 in). Depth : 450 mm (17.7 in). Weight: 4.5 kg (9.9 lb).
25.	**Safety:**	Complies with IEC348 safety requirements.
26.	**Limit range of operation:**	0 to 55°C.
27.	**Rated range of use:**	0 to 50°C.
28.	**Conditions of storage and transport**	
	Temperature:	-40°C to +70°C.
	Humidity:	Up to 90% r.h.
	Altitude:	Up to 2500 m (pressurized freight at 27 kPa differential, i.e. 3.9 lbf/sq.in.).
29.	**Radio frequency interference:**	Conforms to the requirements of EEC Directive 76/889 as to limits of r.f. interference.

2958 ACCESSORIES

30. **Supplied**

Operating Manual, H 52958-900L, 46881-705P.
Fixing kit, 46883-879M.
Stowage cover assembly (2955 and adapter), 41690-495E.

31. **Optional**

Adapter Service Manual, H 44990-680H, 46881-
2955 Operating Manual, H 52955-900A, 46881-503M.
2955 Service Manual, H 52955-900A, 46881-504C.
The GPIB Manual, H 54811-010P, 46881-365R.
Primary pack (for cellular radio adapter), 37136-574N
Primary pack (for 2958), -
GPIB lead assembly, IEEE connectors, 43129-189U.
GPIB adapter, IEEE male to IEC female, 46883-408K.
DC supply cable kit, 46883-907V.
    4 mm to Amp 4-pole, 43130-594Z.
    4 mm to open end, 43130-595H.
N-type to t.n.c. cable, 43130-596E.
Parallel control port to Centronics, 43130-592K.
RS232 port to standard RS-232, 43130-593A.

Chapter 2

INSTALLATION

CONTENTS

UNPACKING AND REPACKING

1. Retain the container, packing material and the packing instructions note (if included) in case it is necessary to reship the instrument.

2. If the instrument is to be returned for servicing attach a label indicating the service required, type or model number (on rear label), serial number and your return address. Pack the instrument in accordance with the general instructions below or with the more detailed information in the packing instruction note.

(1) Place mains lead in suitable plastic bag and tape it to the instrument rear panel.

(2) Place the instrument within its plastic cover.

(3) Ensure that the padded fitting is in place within the inner carton and slide the instrument in, rear panel first, leaving the front panel exposed at the open end.

(4) Fit the separate front panel protecting cover over the panel and close and seal the inner carton.

(5) Place one of the moulded plastic cushions in the bottom of the outer carton and insert the inner carton so that it locates in the cushion recess.

(6) Place the remaining plastic cushion over the other end of the inner carton and close and seal the outer carton.

(7) Wrap the container in waterproof paper and secure with adhesive tape.

(8) Mark the package FRAGILE to encourage careful handling.

Note ...

If the original container or materials are not available, use a strong double-wall carton packed with a 7 to 10 cm layer of shock absorbing material around all sides of the instrument to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader; if the rear panel has guard plates or other projections a rear load spreader is also advisable.

MOUNTING ARRANGEMENTS

3. Excessive temperatures may affect the instrument's performance; therefore, completely remove the plastic cover, if one is supplied over the case, and avoid standing the instrument on or close to other equipment that is hot.

TEST SET INTERCONNECTIONS

4. If the instrument received is a complete Cellular Radio Test System 2958, it will only require connection to the power supply and peripherals to be fully operational. If, however, the instrument received is a Cellular Radio Adapter intended to convert an existing Radio Communications Test Set 2955 to a 2958, the test set must first of all be fitted with a GPIB interface if not already fitted (instructions for this are contained in the 2955 Operating Manual). Following this the instructions 'Converting 2955 to 2958' given below should be followed.

Converting 2955 to 2958

5. The 2958 consists of a 2955 which is both electrically and mechanically connected to a Cellular Radio Adapter. These connections are shown in Figs. 1 and 2. To convert a 2955 to a 2958 use the following procedure:-

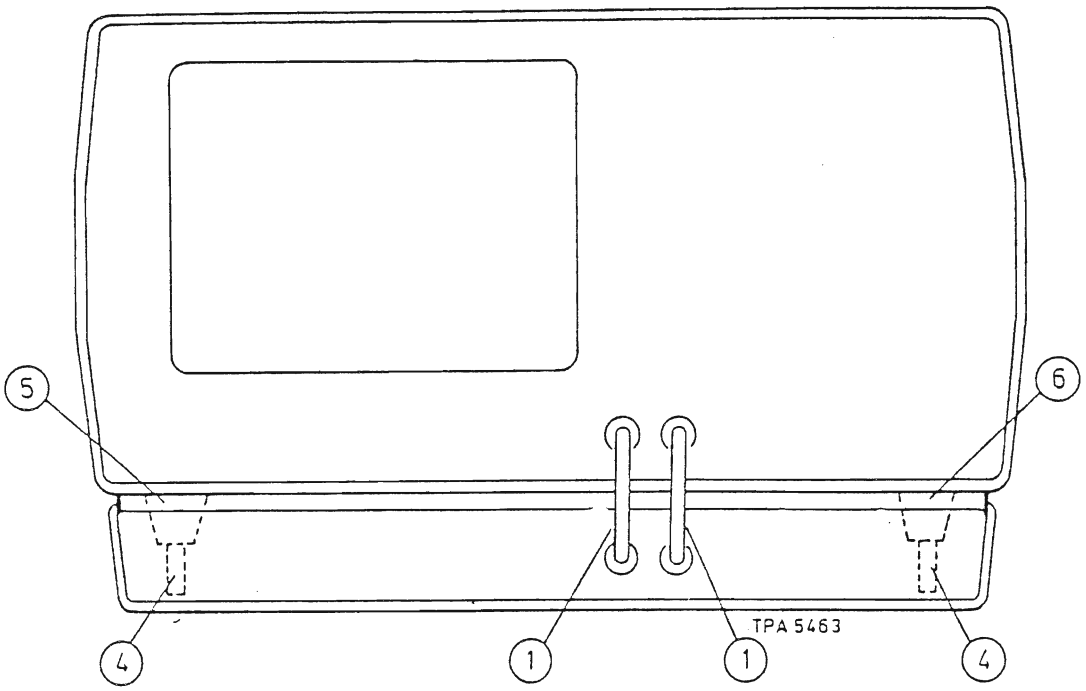


Fig. 1 Front view showing electrical and mechanical connections (item numbers relate to those given in Table 1)

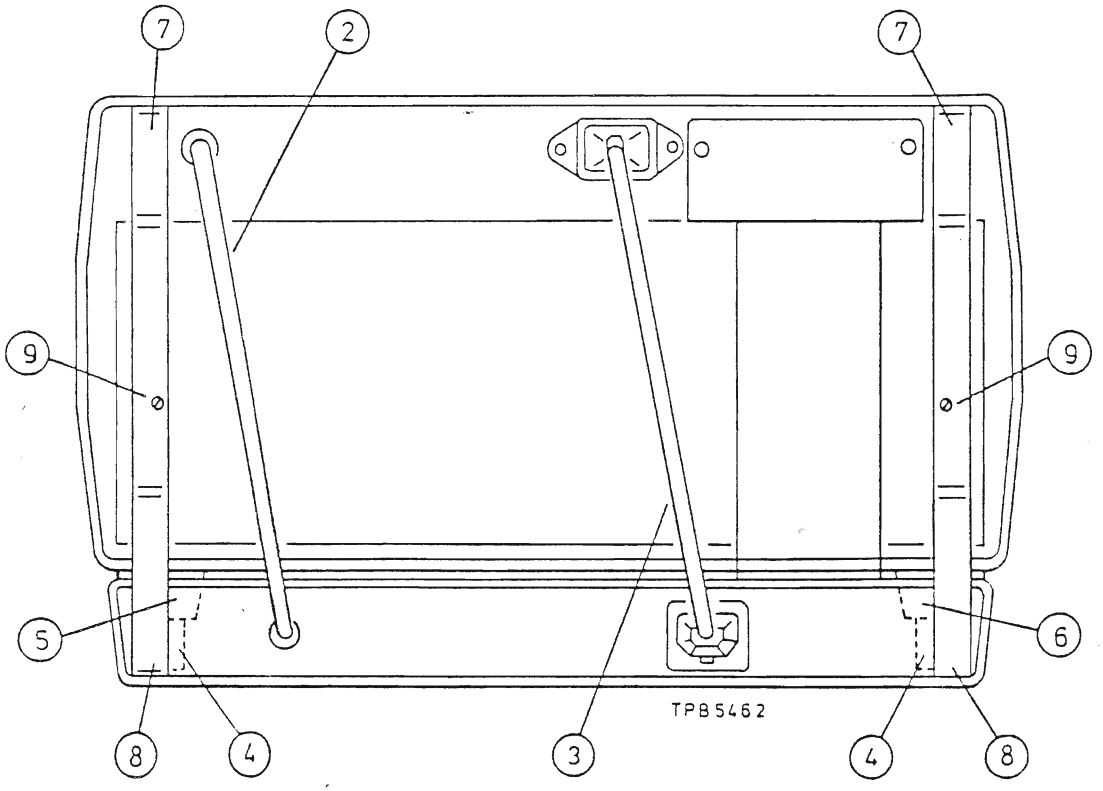


Fig. 2 Rear view showing electrical and mechanical connections (item numbers relate to those given in Table 1)

Preliminary

(1) Unpack Cellular Radio Adapter 54415-003Z and check that the accompanying Fixing Kit 46883-879M contains the items given in Table 1.

TABLE 1 FIXING KIT 46883-879M CONTENTS LIST

Item	Description and quantity	Part no.
1	Cable assembly (BNC 0.13 m), 2 off	43130-498L
2	Cable assembly (BNC 0.26 m), 1 off	43130-499J
3	Cable assembly (mains), 1 off	43130-500E
4	Threaded pillar, 4 off	33901-384Y
5	Clip (right-hand), 2 off	35905-447D
6	Clip (left-hand), 2 off	35905-448T
7	Rear support bar, 2 off	35905-457B
8	Screw pan M4 8, 2 off	21837-459D
9	Screw pan M4 12, 2 off	21837-463T

In the event of any part missing, contact your nearest Marconi Instruments representative (for address see rear cover).

Mechanical connection

(2) Turn the 2955 upside down and lever off the caps covering the screws holding the feet in place. Save the caps for possible future use.

(3) Unscrew and remove the 4 feet. Save the screws for possible future use.

(4) Insert the 4 clips in the slots in the positions formerly occupied by the feet. The clips (items 5 and 6) are handed; they are laid flat and positioned so that the screw holes in the clips line up with the screw holes in the 2955's bottom cover.

(5) Replace the 4 feet using the 4 threaded pillars (item 4) to screw them in place.

(6) With the 2955 upside down, position the Adapter, also upside down, over it so that the feet of the 2955 enter the 4 cutouts in the Adapter's top cover. At this point, both instruments should line up all the way round.

(7) Screw the 4 captive screws in the Adapter's feet into the threaded pillars (item 4) in the 2955's feet.

(8) Remove the 2 screws from the 2955's moulded rear cover. Retain the screws for possible future use.

(9) Hook the curved ends of the 2 rear support bars (item 7) into the slots in the 2955's upper 2 rear feet.

(10) Screw the other ends of the bars into the Adapter's rear casting using the 2 size 8 screws (item 8).

(11) Screw the bars into the 2955's rear cover using the 2 size 12 screws (item 9). (The bars have twin holes to enable either bar to be used in both positions.)

(12) Finally, check that both instruments are securely held together. This completes the mechanical connection.

Electrical connection

(13) Connect the Adapter's MOD OUT socket to the 2955's EXT MOD INPUT socket using one of the two coaxial cables (item 1).

(14) Connect the Adapter's AF OUT socket to the 2955's AF INPUT socket using the second of the two coaxial cables (item 1).

(15) Connect the Adapter's IF IN socket to the 2955's IF OUT socket using the coaxial cable (item 2).

(16) Connect the Adapter's AC SUPPLY OUT socket to the 2955's AC SUPPLY socket using the power supply cable (item 3).

(17) Connect the Adapter's internal GPIB ribbon cable to the 2955's GPIB socket and fasten using the lock screws provided.

(18) Finally, switch both the Adapter and the 2955 on after ensuring that both voltage selectors are set to the correct range and that the correct fuses are fitted. Press the CRTS key and check that the 2958 commences its calibration procedure.

SAFETY TESTING

6. Where safety tests on the a.c. supply input circuit are required, the following procedures can be applied. These comply with BS 4743 and IEC Publication 348. Tests are to be carried out as follows and in the order given, under ambient conditions, to ensure that a.c. supply input circuit components and wiring (including earthing) are safe.

(1) Earth lead continuity test from any part of the metal frame to the bared end of the flexible lead for the earth pin of the user's a.c. supply plug. Preferably a heavy current (about 25 A) should be applied for not more than 5 seconds.

Test limit : not greater than 0.5 Ω.

(2) 500 V d.c. insulation test from the a.c. supply circuit to earth.

Test limit : not less than 2 MΩ.

POWER SUPPLY REQUIREMENTS

7. Each of the two instruments comprising 2958, the 2955 and the Adapter, requires 105 to 120 V or 210 to 240 V a.c., 50 to 400 Hz. The required supply fuses (time lag) are 1 A for 105 to 120 V or 500 mA for 210 to 240 V. Before switching on, ensure that the rear panel voltage range switches are in their correct positions as revealed by the cut-outs in the locking plates, and that the correct value fuses are fitted. To change a mains voltage setting, reverse the locking plate after setting the slide switch to its alternative position. Ensure that the Adapter and the 2955 are both set to the same voltage range, and that the mains cable is fitted between the Adapter's AC SUPPLY OUT and the 2955's AC SUPPLY IN connectors.

8. The a.c. supply cable is fitted at one end with a female plug which mates with the a.c. connector at the rear of the Adapter. When fitting a supply plug ensure that the connections are as follows:-

Earth (ground)	- Green/Yellow
Neutral	- Blue
Live (phase)	- Brown

When attaching the mains lead to a non-soldered plug it is recommended that the tinned ends of the lead are first cut off to avoid the danger of cold flow resulting in intermittent connection.

GENERAL PURPOSE INTERFACE BUS

Private GPIB cable connection

9. The 2958 will only operate correctly with the private (internal) GPIB cable connected between the Adapter and the 2955 GPIB socket. This connection is shown in the rear panel drawing, Fig 2 in Chap. 3.

Public GPIB cable connection

10. Connection to other equipment which has a 24-way connector to IEEE Standard 488 must be made using the Adapter's rear panel GPIB socket. For this purpose, the GPIB lead assembly available as an optional accessory (see Chap. 1, Accessories) may be used. An optional IEEE-to-IEC adapter is also available (see Fig. 3 below) for interfacing with systems using a 25-way bus connector to IEC Recommendation 625.

GPIB connector contact assignments

11. The contact assignment of the GPIB cable connector and the device connector is as shown in Fig. 4 below.

Interface bus cable connection

12. The cables for the interface bus use special male-female connectors at both ends. This allows several connectors to be stacked one on top of another permitting several cables to be connected to the same source and secured by a lockscrew mechanism. Too large a stack however, may form a cantilevered structure which might cause damage and should be avoided. The piggyback arrangement permits star or linear interconnection between the

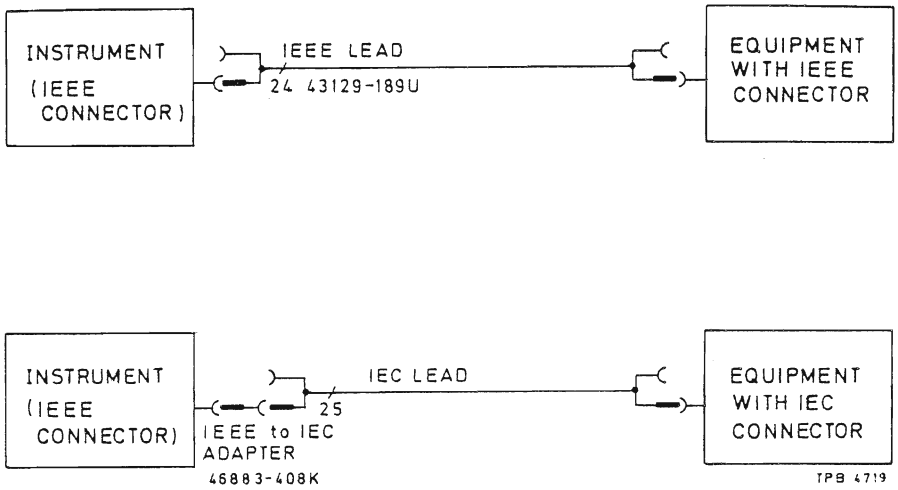


Fig. 3 GPIB interconnections

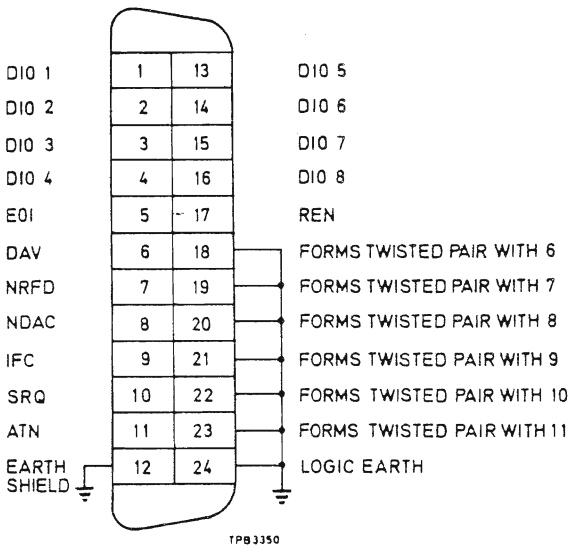


Fig. 4 GPIB connector contact assignments

devices forming a system with the restriction that the total cable length for the system must be:-

(1) No greater than 20 m (65 ft).

(2) No greater than 2 m (6 ft) times the total number of devices (including the controller) connected to the bus.

PARALLEL CONTROL PORT CONNECTOR

13. The contact numbering of the 37-way control port connector is shown in Fig. 5 as viewed from the front of the instrument. The functions of the contacts are given in Table 2.

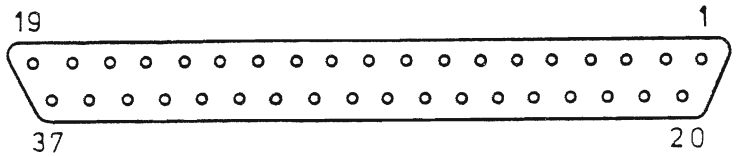


Fig. 5 Parallel control port connector (contact numbering as viewed from front of instrument)

TABLE 2 PARALLEL CONTROL PORT CONTACT ASSIGNMENTS

Contact		Assignment	Contact		Assignment
Connector	board		Connector	board	
1	37	+5 V OUT	20	36	GROUND
2	35	LATCH IN 2	21	34	LATCH IN 1
3	33	LATCH IN 4	22	32	LATCH IN 3
4	31	MODULATOR INPUT	23	30	RSSI INPUT
5	29	I/O CONTROL (TCL)	24	28	DISCRIMINATOR INPUT
6	27	DATA 7	25	21	DATA 8
7	25	LATCH OUT 2	26	24	DATA 6
8	23	LATCH OUT 3	27	2	GROUND
9	21	DATA 5	28	20	LATCH OUT 1
10	19	DATA 3	29	18	DATA 4
11	17	DATA 1	30	16	DATA 2
12	15	I/O CONTROL (DCL)	31	14	I/O CONTROL (CL)
13	13	LATCH OUT 4	32	12	I/O CONTROL (SPARE)
14	11	GROUND	33	10	GROUND
15	9	GROUND	34	8	GROUND
16	7	VOLTMETER INPUT	35	6	VOLTMETER INPUT
17	5	NOT CONNECTED	36	4	NOT CONNECTED
18	3	NOT CONNECTED	37	2	NOT CONNECTED
19	1	NOT CONNECTED			

SERIAL PORT CONNECTOR

14. The contact numbering of the 15-way RS232C interface connector is shown in Fig. 6 as viewed from the side of the instrument. The functions of the contacts are given in Table 3.

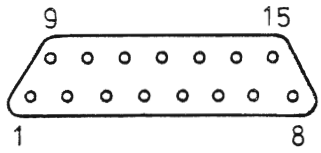


Fig. 6 Serial port connector (contact numbering as viewed from side of instrument)

TABLE 3 SERIAL PORT CONTACT ASSIGNMENTS

Contact	Function	Contact	Function
1 Rx	Received data, t.t.l.	9 RTS	Request to send, RS232C
2	Ground	10	Ground
3 Rx	Received data, RS232C	11 RTS	Request to send, t.t.l.
4	Ground	12	Ground
5 Tx	Transmitted data, t.t.l.	13 CTS	Clear to send, RS232C
6	Ground	14	+5 V in
7 Tx	Transmitted data, RS232C	15 CTS	Clear to send, t.t.l.
8	Ground		

DISC INTERFACE CONNECTOR

15. The contact numbering of the 34-way disc interface connector is shown in Fig. 7 as viewed from the side of the instrument. Note that if a non-polarized connector is used, ensure that pin 1 (arrow marking and/or stripe on cable) is to the front. Contact functions are given in Table 4.

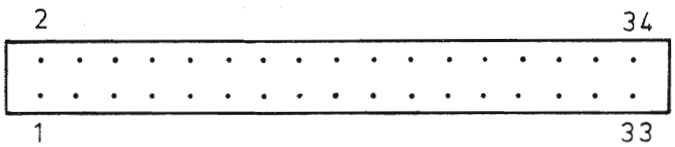


Fig. 7 Disc interface connector (contact numbering as viewed from side of instrument)

TABLE 4 DISC INTERFACE CONNECTOR CONTACT ASSIGNMENTS

Contact	Name	Contact	Name
1	UNUSED	2	UNUSED
3	UNUSED	4	UNUSED
5	UNUSED	6	UNUSED
7	GROUND	8	INDEX
9	GROUND	10	DS0
11	GROUND	12	DS1
13	UNUSED	14	UNUSED
15	GROUND	16	MOTOR ON
17	GROUND	18	DIRECTION
19	GROUND	20	STEP
21	GROUND	22	WRITE DATA
23	GROUND	24	WRITE GATE
25	GROUND	26	TRACK 00
27	GROUND	28	WRITE PROTECT
29	GROUND	30	READ DATA
31	GROUND	32	SIDE SELECT
33	UNUSED	34	UNUSED

Chapter 3

OPERATION

CONTENTS

CONTENTS (continued)

INTRODUCTION

1. The 2958 is a combined instrument formed from a Radio Communications Test Set 2955 and a Cellular Radio Adapter. Since this chapter is intended solely to describe the method of operation of Cellular Radio Test System 2958, the operation of the 2955 is not explained except where pertinent to the system. Full details of 2955 operation are given in the 2955 Operating manual (See Chap. 1, Optional Accessories).

INTERCONNECTIONS

2. For correct operation of the system, the 2955 and the Adapter must be interconnected according to the instructions given in Chap. 2, interconnections.

POWER SUPPLY

3. Both instruments comprising the 2958 operate only from a.c. mains. Although the 2955 test set has a d.c. supply capability it should not be used in the 2958 configuration. Note also that the Adapter's d.c. input sockets are for connecting to the d.c. power supply of the unit-under-test - they are not d.c. supply sockets. Power supply connection and fusing details for both instruments are given in Chap. 2, 'Power Supply Requirements'. In operation, both instruments must be switched on.

CONTROLS AND CONNECTORS

2958 front panel

4. Front panel controls and connectors shown in Fig. 1 are as follows:-

(1) SUPPLY switches. When both switches are set to ON, power is supplied from the rear panel AC SUPPLY IN plug (21) to the Adapter, and from plug (26) to the 2955. Note that the Adapter's SUPPLY switch does not control power to the AC SUPPLY OUT socket (22): plug (21) and socket (22) are wired in parallel.

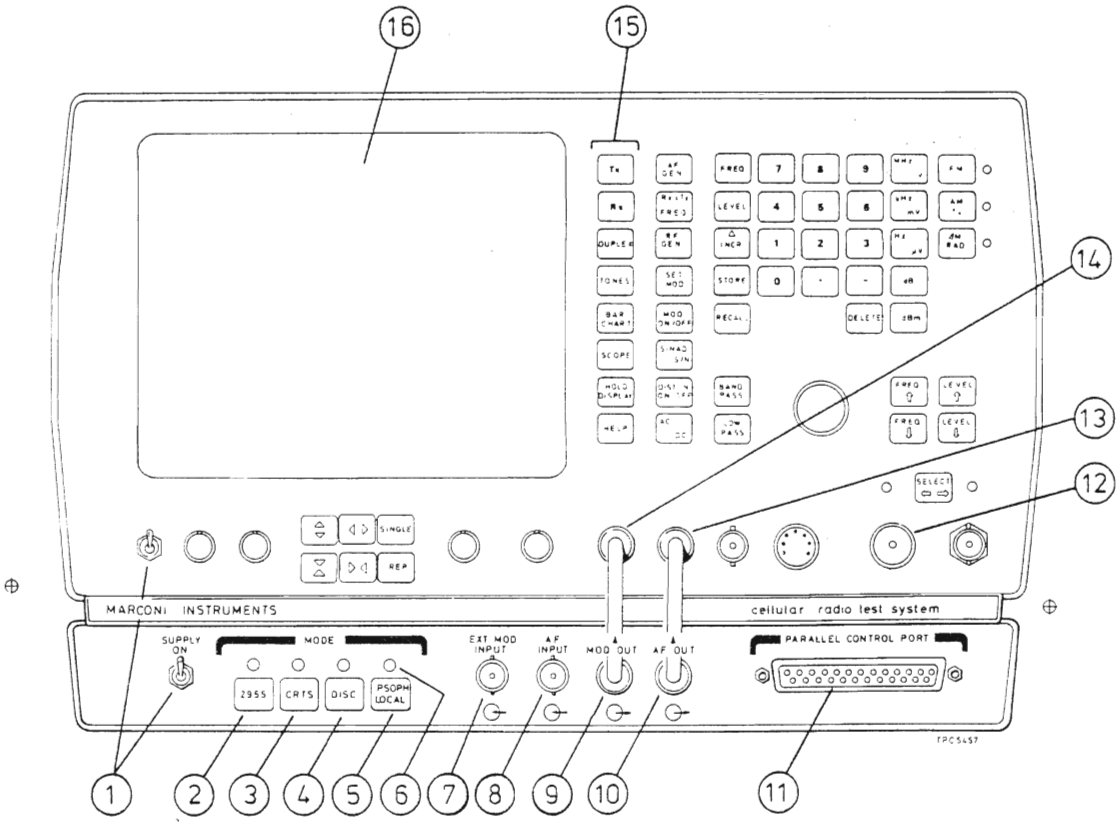


Fig. 1 2958 Front panel controls and connectors

(2) 2955 MODE key. Selects the normal mode of operation for the 2955. During this mode the 2958 is mainly passive.

(3) CRTS MODE key. Selects the Cellular Radio Test System mode of operation with the 2958 controlling the 2955. When this key is first pressed, the instrument commences its calibration procedures. These procedures are omitted on subsequent key presses. When this key is pressed immediately following 2955 operation, the 2958 returns to the menu previously selected (if permissible). It can also be used to abort a particular test sequence during a pause.

(4) DISC MODE key. Selects a menu which permits user-defined sequences to be loaded and saved using an accessory disc drive.

(5) PSOPHO/LOCAL MODE key. Only active when in the 2955 mode. It toggles between removal and insertion of the psophometric filter in the a.f. input path, and switches control from external, i.e. GPIB to local control.

(6) MODE key l.e.d's. These light to indicate that the selected mode is enabled and functioning. One or more l.e.d.s flashing indicates a following fault condition:-

All 4 l.e.d.s	-	Volatile RAM fault
2955 l.e.d.	-	2955 not responding
CRTS	-	Motherboard ROM checksum incorrect.*
DISC	-	Non-volatile RAM fault.*
PSOPH	-	Personality ROM fault.*

*Flashing can be cancelled by pressing another Adapter MODE key. If either CRTS or DISC is then pressed and the associated l.e.d. flashes, it indicates that either the 2955 or the disc drive is not connected or not addressable.

(7) EXT MOD INPUT socket. BNC connector for the application of an external modulation source if required for additional tones signalling.

(8) AF INPUT socket. BNC connector for an a.f. or modulated d.c. input.

(9) MOD OUT socket. BNC socket for connection to the 2955's EXT MOD INPUT socket (14). Modulates the 2955 signal generator with serial data and tones.

(10) AF OUT socket. BNC socket for connection to the 2955's AF INPUT socket (13).

(11) PARALLEL CONTROL PORT. 37-pin interface connector. Used for connection to a Centronics-type parallel printer.

(12) RF IN/OUT socket. N-type socket for the r.f. input. Impedance 50 Ω.

(13) AF INPUT socket. BNC socket for the a.f. output from the Adapter's AF OUT socket (10).

(14) EXT MOD INPUT socket. BNC socket for the modulating output from the Adapter's MOD OUT socket (9).

(15) Soft keys. When in CRTS mode, these soft keys enable a user to select a programmed function. The function performed is displayed on the screen alongside the activating key.

(16) Display. Used to display the operating menus and test sequences. At times, certain of the Adapter's hard keys are depicted on the screen. This indicates that the keys may be used if so desired.

2958 rear panel

5. Rear panel controls and connectors shown in Fig. 2 are as follows:-

(17) DC in/out connectors. Used for making power consumption measurements. The d.c. supply for the cellular radio is connected to the leftmost pair of terminals. The d.c. output to supply the radio is connected to the rightmost pair of terminals. In both cases the upper, red terminal is positive (+) and the lower, black terminal is negative (-).

(18) IF IN socket. BNC socket for connection from the 2955's IF OUT socket (29).

(19) AC supply voltage selector. To change the Adapter's a.c. range. The 2955's supply voltage selector (28) must agree with this setting. For adjustment details see Chap. 2, Installation.

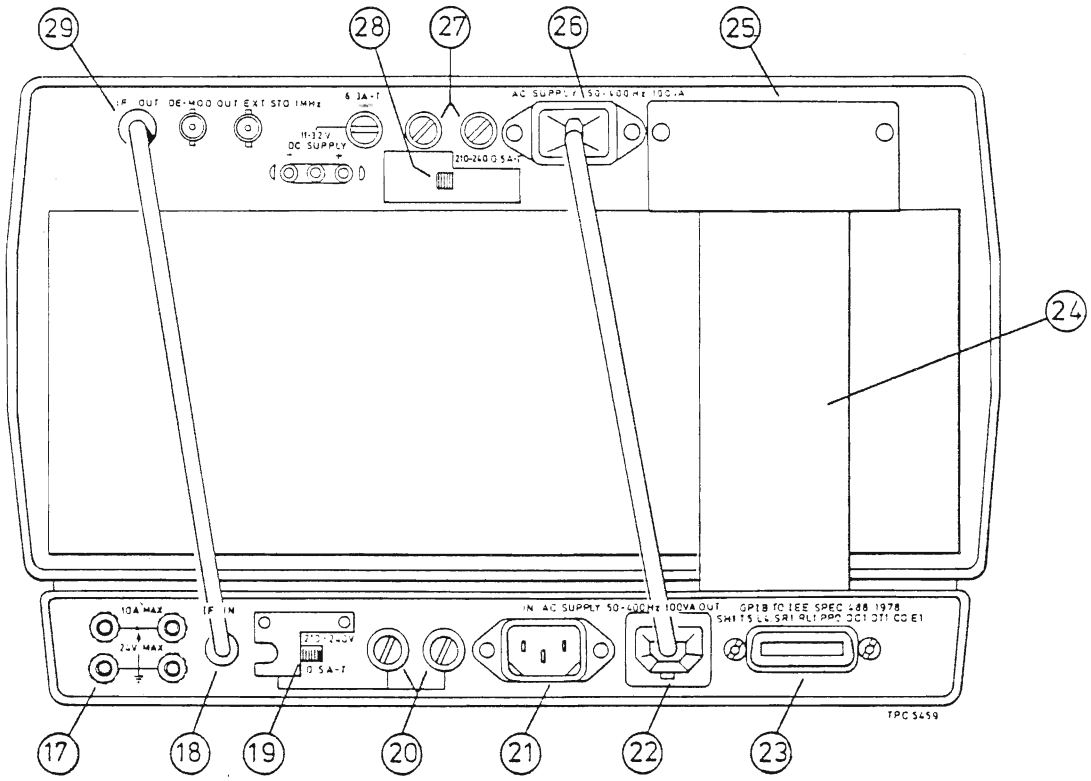


Fig. 2 2958 rear panel controls and connectors

(20) AC supply fuses. Time delay cartridge type for fusing the Adapter. For fusing details see Chap. 2, Installation.

(21) AC SUPPLY IN socket. 3-pin a.c. input connector supplying both the Adapter and the 2955 (via AC SUPPLY OUT socket (22)).

(22) AC SUPPLY OUT socket. AC supply outlet for supplying power to the 2955's AC SUPPLY socket (26).

(23) External GPIB connector. Socket for 24-way public GPIB connector. Enables the 2958 to be remotely controlled using the IEEE 488 (or IEC 625 via an adapter) bus. May also be used for the connection of a printer in listen only mode.

(24) Internal GPIB connector and cable. 24-way private GPIB cable and connector for connection to the 2955's GPIB socket (25).

(25) GPIB socket. Connected to the Adapter's GPIB cable (24) to enable the Adapter to assume control of the 2955.

(26) AC SUPPLY socket. Input connector supplied with power from the Adapter via (22). Fused by (27).

(27) AC supply fuses. Time delay cartridge type for fusing (26). For fusing details see Chap. 2, Installation.

(28) AC supply voltage selector. To change the range. Must be set to agree with the setting of the Adapter's supply voltage selector (19).

(29) IF OUT socket. BNC socket supplying a 110 ±10 kHz i.f. output to the Adapter's IF IN socket (18).

2958 side panel

6. Side panel connectors shown in Fig. 3 are as follows:-

(30) DISC INTERFACE. 34-pin socket for the connection of a floppy disc drive. Enables user-defined tests to be loaded into or unloaded from the 2956's 8 K non-volatile memory. The interface is mechanically compatible with a Shugart-type connector.

(31) SERIAL PORT. 15-pin RS232C interface connector. Used for the connection of a serial printer, or of a computer to transfer user-defined sequences, or from an external controller for the same purpose as for the public GPIB interface.

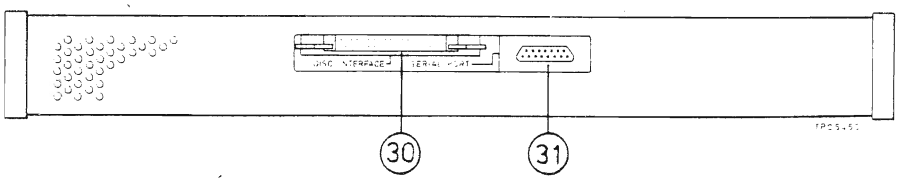


Fig. 3 2958 side panel connectors

OPERATING SUMMARY

7. The 2958 tests and exercises a cellular radio by simulating the functions of a cell site or base station. The correct protocol is generated by the instrument to allow calls to be placed to and from the cellular radio, for handoffs and clearing to be performed, whilst the r.f. and a.f. performance is measured. Additional tests are provided which allow other measurements to be made such as distortion, frequency response and d.c. power consumption.

8. The instrument offers 4 built-in test sequences which provide a good compromise between the depth of testing and the time taken to complete the test. These are stored in ROM in the form of a tokenised high level language. This high level language consists of commands rather like those used to control the 2955 remotely via the GPIB. In addition, most commands can be used in an immediate mode. Each individual test also requires certain parameters to be defined before the test can be carried out, i.e. the pass and fail limits etc. Additional commands are provided to allow simple conditional branching and descriptive comments to be written either on the screen or to the printer.

9. In addition to the ROM-based test sequences, the user may define a test sequence using this same language. To do this, the sequence or program is created as a text file on an external computer. It can then be block-transferred via the GPIB or RS232C interface to the 2958 in a learn mode. The sequence is then tokenised and stored in non-volatile RAM. Once stored it can be used without further use of the external computer, even after the power is removed. The user then has the choice of which test sequence is to be used on a given radio, i.e. the user-defined or the internal standard sequence.

10. To further enhance the flexibility of the instrument, any floppy disc drive (electrically equivalent to a single-sided 40 track 5.25") can be connected directly to the 2958. The user's sequences can then be stored and retrieved without the external computer, up to 10 per disc.

11. Provided the ports are not in use by some other peripheral, a printer can be connected to the public GPIB port in a listen only mode, the RS232C port in a serial mode or to the parallel port in a Centronics mode. The printer can then be made to print a summary of the tests performed or just the failures as these occur.

12. The mobile under test is normally controlled by the off-air signalling which is generated internally, however, there are occasions when the signalling system does not allow certain tests to be performed. Under these conditions the mobile must be controlled manually (refer to the mobile's service manual) and used in conjunction with the 2955 and the 2958 in MANUAL TESTING mode.

13. At any point in the execution of a test sequence a key can be pressed to cause the instrument to pause, from this point the user may select the 2955 key or a soft key. Pressing the 2955 key allows control to be passed back to the 2955 front panel where the 2955 can be used normally. Pressing the soft key displays a menu showing a summary of the signalling data passed between the mobile and the 2958 during the last test. Pressing CRTS or RETURN causes the test sequence to be returned to.

14. Once a test sequence is complete a results summary is displayed showing up to the first nine failures to occur. The available tests are listed below:-

Non-system specific test functions:-

Test 1. TX r.f. power
Test 2. TX r.f. frequency
Test 3. TX a.f. distortion and noise
Test 4. TX modulation limiting
Test 5. TX modulation compression
Test 6. RX SINAD and distortion
Test 7. RX sensitivity
Test 8. RX demodulation expansion
Test 9. DC power consumption
Tests 10-19 - not implemented nor defined

System-specific test functions (TACS):-

Test 20. Registration of mobile on control channel
Test 21. Call placement from cell to mobile
Test 22. Call placement from mobile to cell
Test 23. Handoff from current to chosen voice channel
Test 24. Auto handoffs from first to chosen voice channel
Test 25. SAT transponding
Test 26. Clearing down from cell
Test 27. Clearing down from mobile
Test 28. TX r.f. power
Test 29. Bit error rate
Test 30. DTMF tones

INTERCONNECTING TEST EQUIPMENT

15. To test a cellular radio receiver and transmitter in accordance with the procedures given in this manual, interconnect the equipment in the manner shown in Fig. 4 and described below. Note, however, that the cellular radio and test interface connections will vary slightly between manufacturers:-

(1) Connect the 2955's N-type RF IN/OUT socket to the transceiver's aerial. This connection is essential for all tests.

(2) Connect the 2955's AF GEN OUTPUT socket and the Adapter's AF INPUT socket to the audio paths between the mobile's handset and its transceiver unit. This connection is required for the BRIEF and COMPREHENSIVE TESTING routines. A test interface is required to access the two audio paths and may also be needed to boost the audio output level above the 2955's sensitivity level of approximately 100 mV.

(3) Connect the mobile's d.c. power input leads to the d.c. supply via the Adapter's DC in/out connectors. These connections are only required for measuring the mobile's input power in the COMPREHENSIVE TESTING routines, or in the MANUAL test mode.

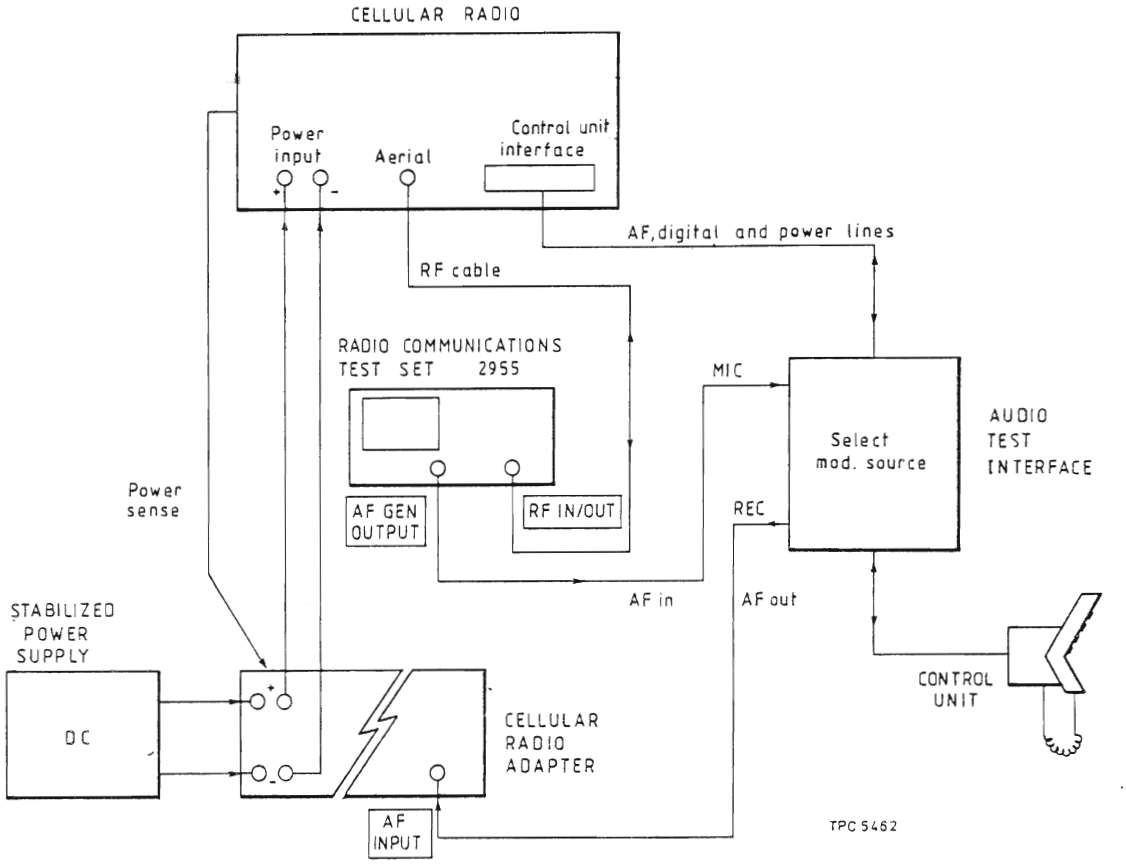


Fig. 4 Interconnections for testing cellular radio

TACS SPACIFICATION SUMMARY

16. The specification for the Total Access Communication System TACS is summarized in Table 1.

TABLE 1 TACS SPECIFICATION SUMMARY

Number of channels:	1000
Allocation of channels:	1-299 to RACAL-VODAPHONE 300-600 to TSCR (CELLNET) 601-1000 reserved.
Dedicated control channels:	23-44 to RACAL VODAPHONE 323-344 to CELLNET.
First mobile Tx frequency:	890.0125 MHz.
First mobile Rx frequency:	935.0125 MHz.
Duplex offset:	45 MHz.
Channel spacing:	25 kHz.
FM voice deviation:	Up to ±9.5 kHz.
Data type:	FSK-BCH and Manchester encoded
Data rate:	8 Kbit/s ±1 bit/s.
Data deviation:	±6.4 kHz.
SAT frequencies:	5.97, 6.0 and 6.03 kHz.
SAT deviation:	1.675 kHz.
Other tones:	DTMF from the mobile. 8 kHz signalling tone.
Filtration required:	CCITT, psophometric.

ACCESSING THE CELLULAR RADIO TEST SYSTEM

17. To access the CRTS mode proceed as follows:-

(1) Switch on both the 2955 and the Adapter (there is no particular order of switching on). The test set automatically enters the 2955 RECEIVER TEST mode as shown by the display, and by the l.e.d. lighting above the 2955 key on the front panel of the Adapter.

(2) Press the CRTS key. The display changes to TACS CELLULAR RADIO TEST SYSTEM 2958 and shows that the Adapter's SAT, DTMF and data signalling are being calibrated. Calibration takes approximately 35 s to complete. To hear the various tones turn up the 2955's VOLUME control. No further calibration will be carried out until the next time the 2956 is switched on and the CRTS key is pressed.

(3) When the calibration is successfully completed, the main CRTS menu appears on the screen. This menu is the starting point for accessing the various cellular test functions. If calibration is unsuccessful, messages are displayed on the screen to help identify the fault (see 'Calibration error messages' below). A screen prompt allows testing to continue.

Calibration error messages

18. When a fault occurs during calibration, the appropriate bit in the error byte is set and an error message is displayed. At any time during remote operation the error byte may be read by sending RD56 in immediate mode. Error messages displayed on the screen are shown below together with the relevant bit which is set in the error byte and the reason for the failure:-

MESSAGE	ERROR BYTE	MEANING
SAT : UNLOCKED	Bit 0 = 1(1)	>±10 Hz of nominal centre frequency.
SAT : LEVEL	Bit 1 = 1(2)	>20% of f.s. or >5% of nominal.
SAT : DETECTOR	Bit 2 = 1(4)	Not detected off or on.
SAT : DTMF	Bit 3 = 1(8)	Error in the 16 tones tested.
DATA: REF CLOCK	Bit 4 = 1(16)	>10 Hz of nominal centre frequency.
DATA: LEVEL	Bit 5 = 1(32)	>20% of f.s. or >10% of nominal.
DATA: DETECTOR	Bit 6 = 1(64)	Signalling tone detector failed.
DATA: MODEM	Bit 7 = 1(128)	Transmission not received. Fault with modem/UART.
DATA: CORRUPT	Bit 7 = 1(128)	Data received not same as transmitted.

MAIN CRTS MENU

19. The main CRTS menu shows the FULL AUTO TEST, the GO/NO-GO TEST and the MANUAL TEST modes. These are summarized below:-

FULL AUTO TEST: Executes a series of tests and includes a choice of display formats and other facilities for diagnostic and repair work. Provides access to the CHANGE FORMAT menu used to define the test parameters.

GO/NO-GO TEST: This is a special version of the FULL AUTO TEST and provides a quick appraisal of the unit-under-test. The display format is SUMMARY and the pause is MANUAL ONLY. All other parameters are as specified in FULL AUTO TEST.

MANUAL TEST: Provides for a test which may not be available in the test sequencies, or may be one that the user wishes to repeat whilst making a particular repair.

The main CRTS menu may be returned to at any time by pressing the CRTS key.

20. Most of the menu operations are carried out by pressing the blue MODE keys on the 2955. The functions of these soft keys have been re-defined in accordance with the labels on the screen alongside.

FIRST TIME OPERATION

21. When operated for the first time the test parameters will normally need to be defined and selected before testing is carried out. This is done using the CHANGE FORMAT menu. To access this menu, press FULL AUTO TEST which gives the options of CHANGE FORMAT to set the parameters or START TEST to commence testing once the parameters have been defined. Press CHANGE FORMAT to obtain the menu.

CHANGE FORMAT MENU

22. The CHANGE FORMAT menu allows the user to define and select test parameters before testing is carried out. The current settings are stored in non-volatile memory. This menu is accessed when CHANGE FORMAT is selected from the FULL AUTO TEST menu. The CHANGE FORMAT menu consists of two pages of labels, each one indicating the appropriate soft key for accessing a particular parameter or format display. Pressing a CHANGE key enables numerical settings to be changed by entering a new value on the 2955 keypad. Once the value has been entered it is locked in by pressing the soft key once more.

Example: To change the AREA ID to 03592:-

(1) Press the SYSTEM PARAMETERS key (wait for new display).

(2) Press AREA ID (CHANGE) key (becomes ENTER).

(3) Enter 03592 on the 2955 keypad. If a mistake is made, press the DELETE key then enter the correct character. Also, any change may be aborted by simply pressing any other soft key.

(4) Press the ENTER key, (becomes CHANGE again) to lock in the data. If a mistake is now found in the data, the number must be re-entered after pressing CHANGE.

(5) Press RETURN to restore the CHANGE FORMAT menu.

23. Keys that are labelled SELECT are changed by repeatedly pressing the soft key to scroll through the choices until the desired setting is obtained. No locking is required for these settings.

Example: To select PAUSE ON FAILURE:-

(1) Press the DISPLAY FORMAT soft key (wait for new display).

(2) Press the PAUSE (SELECT) key until the statement reads PAUSE ON FAILURE.

Press RETURN to restore the CHANGE FORMAT menu.

24. Page 1 of the CHANGE FORMAT menu enables changes to be made using the following menus:-

SYSTEM PARAMETERS
MOBILE PARAMETERS
DISPLAY FORMAT
TEST SEQUENCE

Pressing PAGE 2 selects page 2 of the menu, RETURN restores the FULL AUTO TEST menu, and CRTS restores the main CRTS menu.

System parameters

25. Selecting SYSTEM PARAMETERS enables the following changes to be made:-

AREA ID: Enter a 5-digit number to represent the traffic area in which the cellular radio is operating.

CONTROL CHANNEL: Enter a number between 1 and 1000. This will be the control channel that the mobile will initially lock onto Channels 23 to 44 and 323 to 344 are the control channels adopted by Racal-Vodaphone and Cellnet respectively.

VOICE CHANNEL: Enter two sets of numbers between 1 and 1000. The first set must be lower than the second. The first number corresponds to the initial voice channel that the mobile will be assigned to when it goes into conversation mode. The last number corresponds to the final voice channel that the mobile will be assigned to in the handoff test.

HANDOFF INC: Enter a number between 1 and 1000 as the channel increment for stepping from the initial voice channel to the final one as selected above in the handoff test.

SAT FREQUENCY: Select either 5.970, 6.000 or 6.030 kHz as the SAT frequency assigned to the mobile when it goes into conversation mode.

DCC: The digital colour code is a numerical value (0,1 or 2), which represents a mobile status. The DCC value changes automatically when the SAT key is pressed every three times.

Pressing RETURN restores page 1 of the CHANGE FORMAT menu, and CRTS restores the main CRTS menu.

Mobile parameters

26. Selecting MOBILE PARAMETERS enables the following changes to be made:-

MOBILE NUMBER: Normally this would automatically be entered when the mobile transmits its MIN (Mobile Identity Number) during the initial registration test. However, if the unit fails to transmit its MIN correctly, the user may enter the number using the keypad so enabling the 2958 to perform other signalling tests.

CHANGE RATE: Enter a value between 0 and 1023 according to the current change rate.

Pressing RETURN restores page 1 of the CHANGE FORMAT menu, and CRTS restores the main CRTS menu.

Display format

27. Selecting DISPLAY FORMAT enables the following changes to be made:-

DISPLAY FORMAT IS: Selects the display format to be used in the FULL AUTO TEST mode. The choice is between FULL and SUMMARY. FULL format displays one test at a time in the centre of the screen. The top half displays the r.f. and a.f. parameters of the mobile while the bottom half

displays results and test limits. SUMMARY format displays all tests. The GO/NO-GO TEST mode is automatically set at SUMMARY format irrespective of the settings in the DISPLAY FORMAT menu.

PAUSE: Selects the method of halting a test sequence in the FULL AUTO TEST mode. Select from ALWAYS, MANUAL ONLY, ON FAILURE. In GO/NO-GO TEST mode, the pasuse facility is always set at MANUAL ONLY.

NUMBER FORMAT IS: Selects the number format in which the mobile's ESN (Equipment Serial Number) is displayed on the screen in the call processing tests. Select from HEXADECIMAL, DECIMAL, OCTAL or STANDARD depending on the manufacturer's format used on the transceiver unit.

Pressing RETURN restores page 1 of the CHANGE FORMAT menu, and CRTS restores the main CRTS menu.

Test sequence

28. Selecting TEST SEQUENCE enables the following changes to be made:-

TEST SEQUENCE IS: Applies to GO/NO-GO and FULL AUTO TEST. Select from BRIEF TESTING, COMPREHENSIVE TESTING, CALL PROCESSING ONLY, CALL AND RF TESTING or the title of a user-defined routine held in the 2958's non-volatile memory. If the title has not been written into the user-defined routine, or there is nothing in RAM, NO SEQUENCE DEFINED will be displayed in this space.

DTMF IS: Including or excluding this test in the test routines is selected by ENABLED or DISABLED.

HOOKFLASH IS: Including or excluding this test in the test routines is selected by ENABLED or DISABLED.

Pressing RETURN restores page 1 of the CHANGE FORMAT menu, and CRTS restores the main CRTS menu.

29. Page 2 of the CHANGE FORMAT menu enables changes to be made using the following menus:-

PRINTER
GPIB INTERFACE
SERIAL INTERFACE
MISCELLANEOUS

Pressing PAGE 1 selects page 1 of the menu, RETURN restores the FULL AUTO TEST menu, and CRTS restores the main CRTS menu.

Printer

30. Selecting PRINTER enables the following changes to be made:-

PRINTER PORT IS: Selects which of the three printer ports, GPIB TALK-ONLY, SERIAL RS232, PARALLEL, is to be connected to the printer for producing a hard copy of the results in the GO/NO-GO TEST or FULL AUTO-TEST modes. If no printer is to be used, select UNASSIGNED otherwise error messages will be displayed during the test sequence.

PRINT: Selects the criteria for printing a test and its result as ALL, ON FAILURE or ON PASS. If a printout is not required, select OFF.

TERMINATE WITH: Selects the characters used to terminate a line. Selections are <CR><LF>, <LF>,<CR>.

Pressing RETURN restores page 2 the CHANGE FORMAT menu, and CRTS restores the main CRTS menu.

GPIB interface

31. Selecting GPIB INTERFACE enables the following changes to be made:-

PUBLIC GPIB ADDRESS: Enter the 2-digit GPIB address using the keypad. Note that the 2955 address is set at 06.

GPIB IS: Select TALK-ONLY if the port has been assigned for printing purposes, and TALKER/LISTENER if it is being used for external control purposes.

Pressing RETURN restores page 2 of the CHANGE FORMAT menu, and CRTS restores the main CRTS menu.

Serial interface

32. Selecting SERIAL INTERFACE enables the following changes to be made:-

BAUD RATE IS: In order to accommodate different types of printers on the RS232C interface, the user can select the serial baud rate from 75, 150, 300, 600, 1200, 2400, 4800, 9600.

LENGTH/PARITY IS: Length and parity are selected from 7/EVEN, 7/ODD, 7/NONE, 8/EVEN, 8/ODD, 8/NONE.

STOP BITS IS: Selected from 1 or 2.

Pressing RETURN restores page 2 of the CHANGE FORMAT menu, and CRTS rstores the main CRTS menu.

Miscellaneous

33. Selecting MISCELLANEOUS enables the following changes to be made:-

DE-MOD SOURCE IS: Select the method of demodulating the mobile's transmitted signal as INTERNAL i.e. 2958, or EXTERNAL i.e via a modulation meter. Demod source is automatically set at INTERNAL when the 2958 is switched on.

Pressing RETURN restores page 2 of the CHANGE FORMAT menu, and CRTS restores the main CRTS menu.

GO/NO-GO TESTING

34. The GO/NO-GO TEST mode executes the test routine selected in the CHANGE FORMAT menu. It may be one of the 4 built-in test routines or an externally written test routine loaded into the 2958's memory. Each test is displayed sequentially on the screen i.e. the SUMMARY display. Some of the initial tests in the built-in routines require some sort of user interaction with the unit under test, e.g. taking the handset off its holder.

35. Results of each test are displayed using values in some cases, but the main purpose of using the GO/NO-GO mode is to make a quick appraisal of the mobile, so a PASS, ERROR or FAILED sign is displayed for every test to save the user time interpreting data or checking measurements.

36. The user may obtain a printout of the tests and their results via one of the user ports. The format of the printout may be all tests, failed tests or passed tests only, depending on the user's selection in the CHANGE FORMAT menu.

37. As there may be more than 10 tests in a routine, scrolling is employed when the screen is full. Failed tests are collected at the top of the screen until the sequence is finished. When this happens, a summary screen is displayed.

38. The user may halt the tests by pressing the PAUSE key. The sequence will be stopped at the end of the current test, and the STOP-ON-MODE screen will appear.

39. At the end of the test sequence a summary of the tests is displayed so that the user can see which tests the mobile has failed. If the CONTINUE key is pressed, the mobile's identity number (MIN) and the equipment serial number (ESN) will be displayed at the bottom of the screen. Pressing RETURN restores the main CRTS menu.

BUILT-IN TEST ROUTINES

40. The 2958 contains a number of tests designed to check a cellular radio's operation, some of these tests are combined into built-in test routines which may be executed in the GO/NO-GO TEST and FULL AUTO TEST modes. There are 4 built-in test routines to choose from in the CHANGE FORMAT menu, CALL PROCESSING ONLY, CALL AND RF TESTING, BRIEF TESTING and COMPREHENSIVE TESTING. The 2958 also offers a MANUAL TEST mode which contains individual tests (see 'Manual Testing')

Call processing only

41. The CALL PROCESSING ONLY routine is the basis of all of the built-in test routines. It consists of a series of data signalling tests to check the mobile's ability to initiate and receive calls and to respond to system commands. It is intended as a first line test of cellular radios reported as being faulty to retailers and installers. It can also be used as a validation test to determine whether a unit is suitable for sale or installation. The only connection required is from the mobile's aerial to the N-type RF IN/OUT socket on the 2958 (see Fig. 4). The sequence is as follows:

Registration
Call mobile to cell
Clear down from mobile
Call cell to mobile
Auto handoff
Clear down from cell

Call and r.f. testing

42. The CALL AND RF TESTING routine as well as performing the CALL PROCESSING tests also measures the pertinent r.f. parameters on all of the channels selected in the SYSTEM PARAMETERS menu. It is intended to be used by workshops for first line testing. This routine can also be performed using the r.f. connection alone. The sequence is as follows:-

Registration
Call mobile to cell
Clear down from mobile
Call cell to mobile
Handoff
Transponded SAT
Tx r.f. power
Tx r.f. frequency
Clear down from cell

Brief testing

43. The BRIEF TESTING routine performs some of the standard transceiver tests in addition to the CALL AND RF TESTING tests. It is intended for use by small workshops and regional service centres as their main test facility. One feature that is specific to BRIEF TESTING is that it performs the audio and r.f. tests on three voice channels: the first voice channel (FVC) is that selected in the SYSTEM PARAMETERS menu, the second and third are determined by the HANDOFF INCREMENT. It is necessary to connect the audio paths between the mobile and the handset to the test system for this routine as well as from

the mobile's aerial to the N-type RF IN/OUT socket (see Fig. 4). The sequence is as follows:-

Registration
Call mobile to cell
Clear down from mobile
Call cell to mobile
Bit error rate
Handoff
Transponded SAT
Tx r.f. power
Tx r.f. frequency
Tx a.f. distortion
Tx modulation limiting
Rx distortion
Rx sensitivity
Clear down from cell

Comprehensive testing

44. The comprehensive testing routine is intended for major service centres and manufacturers who wish to test more of the mobile's operational aspects. All of the connections shown in Fig. 4 are required for this test routine. The sequence is as follows:-

Registration
Call mobile to cell
Clear down from mobile
Call cell to mobile
DC power
Bit error rate
Handoff
Transponded SAT
Tx r.f. power
Tx r.f. frequency
Tx a.f. distortion
Tx residual noise
Tx modulation limiting
Tx companding
Rx distortion
Rx sensitivity
Rx expansion
Clear down from cell
DC power quiescent

SYSTEM SPECIFIC TESTS

45. The tests which are specific to the TACS system are described below:-

Registration: Checks the mobile's ability to register on the system as being operational as follows:-

(1) User must ensure that the handset is in place.

(2) Cell indicates a free control channel for the mobile to lock onto.

(3) Mobile locates the free CC and locks onto it.

(4) Cell responds with REQUEST ID.

(5) Mobile sends its MIN and ESN.

(6) Cell receives and displays MIN with a PASS.

If the mobile cannot lock onto the control channel, the cell tries again in the other system. This will be displayed on the screen.

Call mobile to cell: This checks the mobile's ability to place a call:-

(1) Cell asks the user to PLACE CALL.

(2) User keys some digits on the handset (which are stored in its memory), and then picks it up or presses the SEND key.

(3) Cell responds with REQUEST ID.

(4) Mobile sends its MIN and ESN with the called number.

(5) Cell receives and displays called digits with a PASS.

If the mobile fails this test, it is repeated.

Clear down from mobile: This checks the mobile's ability to terminate the call it has made in the previous test:-

(1) Cell asks user to END CALL.

(2) User replaces the handset or presses the END key.

(3) Cell displays CLEARED DOWN with PASS if the test is successful.

Call cell to mobile: This checks the mobile's ability to answer an incoming call:-

(1) Cell sends a message of an incoming call to the mobile and instructs it to begin ringing. At the same time it asks the user to ANSWER CALL.

(2) When the ringing starts, the user picks up the handset or presses the SEND key.

(3) Cell displays CONVERSATION with PASS if the mobile goes into conversation mode.

Handoff: This checks the mobile's ability to retune to another voice channel (defined by the user in the CHANGE FORMAT menu) whilst in conversation mode (e.g. Voice channel:001 to 600, Handoff inc:300):-

(1) Cell assigns first voice channel, e.g. FVC ASSIGN CH 001.

(2) Mobile tunes to this VC and sends acknowledgement.

(3) Cell assigns new VC, e.g. CH 001 > CH 301.

(4) Mobile switches to new channel and screen displays PASS.

(5) When the r.f. and a.f. tests on that channel have been completed, the mobile does another handoff to the next selected channel.

Auto handoff: This test is based on the Handoff test, however, in this test the mobile must step through all the traffic channels defined by the user in the CHANGE FORMAT menu in the one test (e.g. Voice channel:001 to 180, Handoff inc:44).

For the example the test is as follows:-

(1) Cell assigns first voice channel, i.e. FVC ASSIGN CH 001.

(2) Mobile tunes to this VC and sends acknowledgement.

(3) Cell displays CH 001 > CH 045.

(4) This is repeated for channels 090, 135 and 180.

(5) When the mobile has switched through all these channels, a PASS will be displayed.

Clear down from cell: This is the final test in all 4 built-in test routines. It is similar to Clear down from mobile except that it checks whether the mobile can acknowledge a call termination by the other party:-

(1) Cell asks user to END CALL.

(2) User replaces the handset if it is off hook and a CLEARDOWN message is displayed on the screen.

Tx r.f. power: This test checks up to all 8 of the power levels.

(1) Cell instructs the mobile to set the power level.

(2) Mobile sets power level.

(3) Cell measures mobile's power level with reference to the power class read from the Station Class Mark (SCM).

(4) Cell instructs the mobile to reset the power level, then repeats the test. Pass is displayed for a successful test.

DTMF tones: Checks the mobile's ability to generate DTMF tones of the correct frequency.

(1) Cell displays DTMF TONES ACTIVE and announces WAITING FOR TONES.

(2) User presses the number and other data keys on the handset. This transmits tone pairs with each key press (tones can be heard if the VOLUME is turned up).

(3) Cell displays the data symbols for confirmation on the screen sequentially as they are received.

(4) User checks the symbols for accuracy, then presses CONTINUE when ready to leave the test.

Transponded SAT: This test measures the SAT frequency deviation.

(1) Cell sends the SAT and displays SAT TRANSPONDING ACTIVE.

(2) Mobile transponds.

(3) Cell displays SAT DETECTED. Then measures and displays the level with % error and the frequency.

Bit error rate: Tests the accuracy of the mobile's message reception.

(1) Cell sets the mobile's r.f. level.

(2) Cell displays BIT ERROR RATE ACTIVE then instructs the mobile to change frequency to the same channel.

(3) Mobile returns the signalling tone.

(4) Cell checks that the SAT is present, then the test is repeated.

(5) After 100 tests, PASS is displayed together with the % bit error rate.

Hook flash: This checks the mobile's ability to send a hook flash signalling tone of the correct duration, and then interrogates the mobile for the hook flash data.

(1) Cell displays HOOK FLASH ACTIVE and asks the user to SEND FLASH.

(2) User enters data on the handset then presses the SEND button. A signalling tone of nominally 400 ms duration is transmitted (the tone can be heard if the VOLUME control is turned up).

(3) Cell receives the tone, measures the duration, then asks the mobile to send the called address.

(4) Mobile sends the called address.

(5) Cell displays the called address for confirmation on the screen.

NON SYSTEM-SPECIFIC TESTS

46. The tests which are not specific to the TACS system are described below together with any applicable error messages and their meanings.

Tx r.f. power

47. Reads Tx r.f. power from the 2955. Not used in built-in test sequences since they test at system-specific power levels.

FAIL NO TX POWER	If power <1 mW (probably no carrier so not displayed as very low power level).
FAIL READING UNSTABLE	If, after 15 attempts, could not obtain 2 consecutive readings within 20%.

Tx r.f. frequency

48. First ensures that a carrier is present, then auto-tunes to measure r.f. frequency. For cellular radios, then manually retunes to channel.

FAIL NO TX POWER	Power <1 mW assumes no carrier so cannot take meaningful frequency measurement.
FAIL READING UNSTABLE	Frequency not within 1% after 15 readings.

Tx a.f. distortion and noise

49. Attempts to set a.f. level to produce a reference modulation level (but not for residual noise test). Routes 2958 demod signal to a.f. input of 2955, and measures audio as for Rx distortion/SINAD (rather than using Tx tests in 2955). Residual noise test measures deviation of carrier in the absence of a modulating signal. S/N measured by reading the demod level with and without a modulating signal.

FAIL LOW DEMOD LEVEL	2958 internal demod level <100 mV either due to 2958 fault or ref mod level too low to produce 100 mV demod.
FAIL READING UNSTABLE	Demod level not within 10% after 15 readings.
FAIL READING UNSTABLE	Demod noise level not within 100% after 15 readings (S/N test).
FAIL READING UNSTABLE	Distortion etc., not within 20% after 5 readings.
FAIL READING UNSTABLE	Residual noise not within 50% after 10 readings.

Tx modulation limiting

50. Attempts to set an a.f. level to produce a reference modulation level, then increases a.f. level by overload factor; measures resulting deviation.

FAIL LOW SENS MIC I/P	The a.f. level required to set the transmitter to ref mod level was too high to overload by the factor given (max. output 2.5 V).

FAIL NO MODULATION	Deviation <100 Hz/1%/0.1 rad measured.
FAIL READING UNSTABLE	Deviation not within 10% after 5 readings.

Tx compression

51. Attempts to set a.f. level to produce a reference mod level, then alters a.f. level by ±10 dB and measures resulting change in mod level. Result is (20 dB)/(mod level change in dB).

FAIL LOW DEMOD LEVEL	Demod level below 100 mV (demod level is ref +compressed 10 dB change).
FAIL LOW DEMOD LEVEL	Demod level below 10 mV (demod level is ref -compressed 10 dB change).
FAIL READING UNSTABLE	Demod not within 10% after 15 readings.
FAIL NO MODULATION	±10 dB change in AF GEN OUTPUT produced <1 dB change in TX modulation.
FAIL LOW SENS MIC I/P	Can't set (ref +10 dB).

Rx SINAD and distortion

52. Sets Rx modulation level directly, and measures distortion/SINAD/S/N directly from 2955, routeing 2956 AF IN (mobile Rx audio) to 2955 AF IN.

FAIL LOW DEMOD LEVEL	Rx audio level <100 mV.
FAIL READING UNSTABLE	Distortion etc., not within 20% after 5 readings.

Rx sensitivity

53. Attempts to adjust Rx level until mobile Rx audio produces the reference SINAD reading required; result is the r.f. level.

FAIL LOW DEMOD LEVEL	Rx audio level <100 mV.
FAIL NO DEMODULATION	Reached Rx level limit at -90 dBm or -130 dBm without reaching reference SINAD level.
FAIL READING UNSTABLE	SINAD not within 20% after 5 readings and 10 iterations of setting level.

Rx expansion

54. Sets Rx mod level directly to (ref -5 dB) and (ref +5 dB): measures resulting change in Rx audio level in dB.

FAIL LOW DEMOD LEVEL	Demod level below 10 mV (ref -5 dB).
FAIL LOW DEMOD LEVEL	Demod level below 100 mV (ref +5 dB).
FAIL READING UNSTABLE	Demod not within 10% after 15 readings.
ERROR: MODULATION LIMIT	Can't modulate to (ref +5 dB).

DC power consumption

55. Routes voltages corresponding to (DCV/25) and (DCA/10) to 2955, measures d.c. voltages and calculates power.

FAIL NO DC POWER	<250 mV or <100 mA or <100 mW.
FAIL READING UNSTABLE	Not within 10% after 15 readings.

STOP-ON-TEST MODE FACILITY

56. In the GO/NO-GO TEST MODE the sequence may be halted by pressing the PAUSE key. In the FULL AUTO TEST mode the PAUSE function can be activated manually, automatically after every test or when a test has failed. This depends on which was selected in the CHANGE FORMAT menu. In all cases the test sequence will only be halted at the end of a test. The user may then access the STOP-ON-TEST mode facilities DATA, MANUAL RF TESTING, ABORT TESTING, CONTINUE.

Reverse data

57. The DATA key accesses the REVERSE DATA display which contains the data words sent by the mobile during the last signalling test. The words are displayed in the lower half of the screen in hexadecimal format together with the number of times each word has been sent. A word can be selected for analysis by pressing the step keys until the word is positioned in the small window. The word is then displayed in the top half of the screen in binary. The labelling and description (conforming to the TACS specification) help the user to interpret the data.

58. A hexadecimal word containing an errored digit is indicated by an E at the side. If the word is moved into the box using the cursor keys, the errored binary digits are indicated in reverse video. This helps the user to determine whether the fault is located on the mobile's logic boards or whether the mobile is having problems with the system in which it is working.

Forward data

59. The FORWARD DATA display is accessed by pressing the FORWARD key. The menu calls up part of the data stream sent by the 2958 which is the most relevant to the test performed, and enables the user to see what the 2958 is doing.

CONTROL FILLER words: are null data sent when no active information is being transmitted. This enables mobiles to scan continuously for a strong signal to which they can lock onto.

OVERHEAD MESSAGE words: contain information relating to the system parameters of the local network e.g. AID, available control channels.

MOBILE STATION CONTROL words: contain commands and messages sent to a particular mobile on the forward control channel during registration and call set-up, and on the forward voice channel during a call i.e. handoff. Each word is is repeated a number of times to ensure that the mobile receives the correct data.

60. The format and operation of the FORWARD DATA display is similar to the REVERSE DATA display except that no errors are indicated because the data generated by the 2958 is not supposed to confuse the mobile. The RETURN key is pressed to return to the test sequence at the point where it was halted.

Abort testing

61. The CRTS key aborts the test sequence and accesses the main CRTS menu. This allows the user to enter the MANUAL TEST facility to carry out specific tests for more detailed fault-finding or to start another test routine.

Manual r.f. testing

62. When the screen displays the 2955 key, the user may press the 2955 key to call up the DUPLEX screen which has been automatically set to the parameters of the last test. The user now has manual control of the r.f. and a.f. signal generators for alignment and fault finding purposes on the mobile's transceiver circuits. The CRTS key is pressed to return to the test sequence.

Continue

63. Pressing the CONTINUE key simply restarts the test sequence from the point at which it was halted.

FULL AUTO TESTING

64. The FULL AUTO TEST mode is similar to the GO/NO-GO TEST mode in that it uses the same routines. However, it offers a split screen display facility in addition so that the service engineer can monitor the r.f. and a.f. parameters during the tests. The FULL AUTO TEST mode is accessed from the main CRTS menu by pressing the FULL AUTO TEST key.

65. The FULL AUTO TEST menu contains a summary status of the desired test parameters and display formats held in the non-volatile memory since the CHANGE FORMAT menu was last accessed. To change any of these, the CHANGE FORMAT key is pressed. To start the test routine, the START TEST key is pressed.

66. If the display format chosen is SUMMARY, the screen will display the test sequence in the same way as for the GO/NO-GO TEST. However, if FULL was chosen, the screen will split into two halves. The bottom half of the screen displays the test sequence being executed one test at a time. The top half displays the 2955 DUPLEX screen, which allows the service engineer to monitor the r.f. and a.f. parameters of the transmitter and receiver during each test. This is particularly useful during a change of channel or power level.

67. The PAUSE key is used for the STOP-ON-TEST mode. It can be activated manually, automatically after every test or when a test has failed depending upon which was selected from the CHANGE FORMAT menu. The facilities available during a pause are the same as those for the GO/NO-GO TEST.

68. At the end of the test routine a summary screen is displayed showing the tests failed and the number of failures. The user can return to the main CRTS menu by pressing CRTS. A hard copy may be obtained using the CHANGE FORMAT menu as for the GO/NO-GO TEST.

MANUAL TESTING

69. The MANUAL TEST mode provides for a test which may not be available from the test sequences and is accessed from the main CRTS menu by pressing the MANUAL TEST key. The MANUAL OPERATION screen consists of a generated section shown on the upper half and a measured section shown on the lower half. Besides scanning the keys and checking the data, the system every second detects and measures the SAT level and displays the voltage then the current and d.c. power.

70. The MODE key allows the user to select a signalling test mode depending on the state of the mobile under test. When the user selects a mode, screen prompts will be displayed for the user to enter test parameters. The modes are:-

IN SERVICE modes	CONVERSATION modes
FCC	
Registration	Conversation
Call mobile	Handoff*
Place call	Power level*
Data off	Cleardown
Dotting	

*When these modes are selected, screen prompts will be displayed after a few seconds requesting the user to enter test parameters, i.e. channel selection for HANDOFF, 0 to 7 for POWER LEVEL.

71. Some of the modes are the same as those in the built-in test routines, whereas the others generate a pattern of data which are primarily intended to test a mobile's modem. The user may access the WIDEBAND DATA screens by pressing the DATA key to check the mobile's response.

Manual operation

72. The generated parameters are selected as follows:-

(1) To set the channel number: Press the CHANNEL key (changes to ENTER) Enter the number using the 2955 keypad and end by pressing ENTER.

(2) To set the SAT frequency, SAT level and data level: Press the CHANGE key (changes to NEXT). Enter each of the three parameters using the 2955 keypad, and terminate each time by NEXT.

(3) To set the mode: When the user accesses the MANUAL TEST mode, the mode will be set at FCC if the mobile is in the service state, or to CONVERSATION if it is in the conversation state. Press the MODE key (changes to SELECT) and scroll through the selections available in the state until the required mode appears.

73. Pressing the CRTS key returns to the main CRTS menu, while the 2955 key accesses the r.f. duplex test mode.

DISC OPERATION

Preparation

74. Connect the disc drive to the power supply and switch on. Connect the drive ribbon cable (for connector compatibility, see Chap. 2) to the DISC INTERFACE connector. The connector is on the right-hand side (looking from the front) of the 2958. Insert the disc in the slot in the drive and close the door if necessary.

75. Press the DISC key. The disc operating menu is displayed and the disc drive should start up (CAT flashes) and the disc catalogue will be displayed. If, however, the message DISC FAULT appears it indicates that the catalogue cannot be read as the disc has not been formatted (see ´Format´ below). If the message DRIVE NOT READY is displayed, there has been no response from the drive. Remove the disc drive cable, check the connections and supply, then reconnect the drive cable. Press CAT to re-attempt to read the disc catalogue. If DRIVE NOT READY is again displayed, there is probably a fault with the disc drive. If NO DISC INSERTED is displayed, insert or re-insert the disc and press CAT.

Disc catalogue and menu

76. The DISC CATALOGUE shows files 0 to 9 together with their titles or NO FILE where appropriate. The menu shows all the disc functions performed using the ACCESS, CAT, LOAD, SAVE, DELETE and FORMAT soft keys. If a fault message is displayed during operation, refer to ´Fault messages´ below for the action to take.

Format

77. Before a new, blank disc can be used, it must be formatted for the 2956 disc filing system. To do this, press the FORMAT key. FORMAT and ENTER flash. Since formatting will automatically erase all previously saved files, the message DATA ON DISC WILL BE LOST, PRESS ENTER TO CONFIRM is displayed. To abort the formatting process, press any other soft key but ENTER. Otherwise, press ENTER to confirm. Formatting takes place and when completed, the catalogue is updated while CAT flashes. When it stops NO FILE is shown against all ten files. Note that discs separately formatted for 40 and 80 track drives are not interchangeable.

Save

78. To save a file press the SAVE key. SAVE flashes and the file number is requested. Enter the number using the keypad, or abort by pressing any soft key. If a file already exists for that number the message OVERWRITE EXISTING FILE? PRESS ENTER TO CONFIRM is displayed and ENTER flashes. To abort the saving process, press any other soft key but ENTER. Otherwise, press ENTER (changes to SAVE) to confirm. Saving on disc takes place and when completed, the catalogue is updated while CAT flashes. When it stops, the file name or NO SEQUENCE DEFINED is shown against the file number.

Load

79. To load a file, press the LOAD key. LOAD flashes and the file number is requested. Enter the number using the keypad, or abort by pressing any soft key. Loading to memory takes place and when completed, LOAD stops flashing.

Delete

80. To delete a file, press the DELETE key. DELETE flashes and the file number is requested. Enter the number using the keypad, or abort by pressing any soft key. If no file is present the message FILE DELETED is displayed. If a file is present the message ABOUT TO DELETE FILE, PRESS ENTER TO CONFIRM is displayed and ENTER flashes. To abort the deletion process, press any other soft key but ENTER. Otherwise, press ENTER (changes to DELETE) to confirm. File deletion takes place and when completed, the catalogue is updated while CAT flashes. When it stops, --NO FILE-- is shown against the file number.

Access

81. To lock a file so as to prevent it being overwritten or deleted by SAVE, FORMAT or DELETE, or to unlock a previously locked file, press the ACCESS key. ACCESS flashes and the file number is requested. Enter the number using the keypad, or abort by pressing any soft key. The catalogue is then updated while CAT flashes. When it stops, L is shown against the file number to indicate that it is now locked, or removed to show that the file has been restored to its normal, unlocked state.

Catalogue

82. Normally, the catalogue is kept updated, but if the disc is changed or following a disc drive fault condition, it will be necessary to press the CAT key in order to read the catalogue. While the catalogue is being updated, CAT flashes. When it stops the current catalogue is displayed.

Fault messages

83. The fault messages, together with their meanings and suggested remedies are listed below:-

Fault message	Meaning	Remedy
DRIVE NOT READY	There is no response from the drive.	Check disc inserted correctly. Check all connections. Check power supply. Replace faulty drive.
NO DISC INSERTED	No disc is present, or not properly inserted in the drive.	Insert disc in drive correctly.
FILE DELETED	No file is present.	—
FILE LOCKED	The file has been locked to prevent the file being overwritten.	Unlock using ACCESS if file not required.
DISC FAULT	(1) The disc has not been formatted, or belongs to a different system.	Format using FORMAT.
	(2) Discs formatted for 40 and 80 track drives have been mixed.	Keep different track formats separate.

Fault message	Meaning	Remedy
	(3) There is a verification error i.e. disc unreliable or dirty heads.	Replace disc or clean heads.
	(4) Faulty drive.	Replace drive.
	(5) Head misalignment between drives.	Try a different drive or, use the same drive for saving and loading.
DISC CHANGED	The disc has been changed since the catalogue was last updated.	Press CAT to get catalogue for new disc or, Replace original disc.
WRITE PROTECTED	The disc has been mechanically protected against overwriting.	Remove protection if no longer required.

REMOTE OPERATION

84. The 2958 may be operated remotely either via the RS232 interface using a computer or terminal, or via the GPIB interface using a GPIB controller. The following operating description assumes that the equipment is correctly connected and that the appropriate programming procedure is used (refer to manufacturer's literature).

85. With the system powered up normally in 2955 local mode (screen displaying LCL) proceed as follows:-

(1) For GPIB operation, send REMOTE followed by the GPIB address; the 2958 enters the remote state. For RS232 operation, the system enters remote as soon as the first character is received.

(2) Send CRTS <RETURN>. The system enters the FULL AUTO TEST mode and displays the message: WAITING FOR RUN. At this point, one of three selections may be made: RUN, Change or LEARN.

Run

86. RUN followed by <RETURN> (equivalent to pressing START TEST in local mode) causes the test sequence displayed on the screen to be performed. The test sequence is that previously selected either from the CHANGE FORMAT menu or by using the Change procedure (see below).

Change

87. Changes are entered as immediate mode commands which change the test sequence, format, etc. Sending e.g. TSI2 changes the test sequence to CALL PROCESSING ONLY (see 'GPIB Commands Summary').

Learn

88. To enter a user-defined test sequence send LEARN <RETURN>. Then enter the sequence which must be terminated with the END statement. Pressing <RETURN> redisplays the message: WAITING FOR RUN. If required, the program may be saved on disc using the SAVE command.

PROGRAMMING INTRODUCTION

89. A learn mode is provided to enable user-defined test routines to be written. A standard series of tests is provided within the instrument for testing cellular radios. The user has the option, by using these instructions, to change the parameters of these tests and also the order and frequency with which the tests are made. The instrument's default test sequence is also written with these codes. This allows changes to be easily made as experience grows.

90. Commands can also be used in the immediate mode, that is, the commands will have immediate effect when sent, or may be completely ignored. Many of the commands can also be used in the learn mode.

91. Commands take the form of mnemonics or standard English words and abbreviations can be used. This not only provides the potential for a large number of commands but also improves the intellegibility of the command strings. Both upper and lower case characters will be considered the same. To minimize the memory used for these commands they are stored as tokens; only literals and numerical data will be stored in ASCII form.

TOKENISING

92. To reduce the number of bytes used to store the program sequences the commands are tokenised. This means that each mnemonic or word is reduced to a single byte which increases the speed when executing a stored sequence. All commands entering the public GPIB port are tokenised whether they are in the form of immediate or stored type commands. Numerical and ASCII-literals are not tokenised. Note that ASCII-literals must be enclosed within single or double quotes.

93. Token bytes are identified by having a value of greater than 7F hexadecimal and are thus distinguishable from the ASCII. Use is made of this fact to delimit instructions. This gives a maximum of 127 separate command and terminator mnemonics. All numerical information is in ASCII, and is delimited by either a comma or a token. ASCII data is stored without parity, i.e. with the most significant bit set to 0.

GPIB COMMANDS SUMMARY

94. Listed below are all the 2958 commands each with its equivalent token number, syntax type, function performed and data format used. Most commands may be used in abbreviated form as shown by the initial capital letters (to a maximum of three). An asterisk preceding a command denotes that that command may not be used in immediate mode. Syntax type is explained later. In the 2955 mode, all commands are passed to the 2955 unchanged. The following is a list of commands recognized by the 2958 when not in 2955 mode:-

PROGRAM COMMANDS

COMMAND	TOKEN	SYNTAX TYPE	FUNCTION	DATA FORMAT
Aid	93	2	(AREA/SYSTEM ID)	(5 dig)
BRi	89	2	(BAUD RATE IS) Set serial port baud rate	(1 dig)
*BUffer	E3	-	(BUFFER) Contents of buffer	-
CCH	A3	2	(CCH) Set up control/calling channel	(4 dig)
CCI	8A	2	(CONTROL/CALLING CHANNEL IS)	(4 dig)
*CLr	E2	1	(CLEAR) Clear printer buffer	-
COMmand	AA	6	(COMMAND) Commands 2955 directly	ASCII string
#CONtinue	-	-	(CONTINUE)	-
CRi	8D	2	(CRI) Charge rate is	(4 dig)
*Date	F9	-	(DATE) - Provisional	-
#Date	-	6	(DATE) - Provisional	ASCII string
DCc	8B	2	(DCC) Digital colour code is	(1 dig)
DEFault	82	1	(DEFAULT) Load default parameters	-
DFi	8E	2	(DISPLAY FORMAT IS)	(1 dig)
*DIsable	E0	-	(DISABLE PRINTER) Used when assembling	-
DTmf	94	2	(DTMF) Enable = 1, disable = 0	(1 dig)
#ECho	-	-	(RS232 ECHO ON/OFF)	(1 dig)
*ENAble	E1	-	(ENABLE PRINTER) Used when assembling	-
*END	FF	1	(END) End user program. exit learn mode	-
*ESN	F6	-	(ESN) Equipment serial number	-
Ftc	90	2	(FSTTCH) First traffic channel is	(4 dig)
Fvc	90	2	(FSTVCH) First voice channel is	(4 dig)
*Gosub	AD	2	(GOSUB) Go to subroutine at label	LABEL (3 dig)
HNd	92	2	(HANDOFF INCREMENT)	(4 dig)
HOOK	95	2	(HOOK) Flash enable = 1, disable = 0	(1 dig)
*IND	F3	-	(STATUS INDICATOR)	-
*JBC	99	5	(JUMP IF BIT CLEAR)	Bit no(1 dig), label(3 dig)
*JBS	98	5	(JUMP IF BIT SET)	Bit no(1 dig), label(3 dig)
*JEq	9A	5	(JUMP IF EQUAL)	Data(3 dig), label(3 dig)
*JNe	9B	5	(JUMP IF NOT EQUAL)	Data(3 dig), label(3 dig)
*JOE	A4	2	(JUMP ON ERROR)	Label(3 dig)
*JOF	97	2	(JUMP ON FAIL) to label	Label(3 dig)
*JOP	96	2	(JUMP ON PASS) to label	Label(3 dig)
*JUmp	86	2	(JUMP) Unconditional jump to label	Label(3 dig)
*Key	8F	1	(KEY) Wait for key press	-
*LAbel	85	2	(LABEL) Program label	(3 dig)
#LEarn	-	-	(LEARN MODE) Enter learn mode	-
*LIne	E4	-	(LINE) First line of buffer	-
#LOad	-	2	(LOAD FROM DISC)	(1 dig)
#LOCal	-	-	(GOTO LOCAL) - (RS232 only)	-
LTC	91	2	(LSTTCH) Last traffic channel is	(4 dig)
LVC	91	2	(LSTVCH) Last voice channel is	(4 dig)
#Min/Msn	-	6	(MIN/MSN) Set mobile phone number	ASCII string
*Min/Msn	F5	-	(MIN/MSN) Print mobile phone number	-
*NExt	88	1	(NEXT) Next pass of loop	-
NFi	A9	2	(NUMBER FORMAT IS) Serial no. format	(1 dig)
#NOrmal	-	-	(NORMAL) 2955 mode	-

COMMAND TOKEN	SYNTAX FUNCTION TYPE			DATA FORMAT
*NXtch	A6	1	(NXTCH) Next channel	-
*PARameter	81	3	(PARAM) Parameter definition	Test(3 dig), no(3 dig), data(string)
#PAUse	-	-	(PAUSE)	-
PEI	9C	2	(PEEK I/O)	Port no(3 dig)
PEM	9D	2	(PEEK MEMORY)	Adress(5 dig)
PMi	A1	2	(PAUSE MODE IS)	(1 dig)
POI	9E	5	(POKE I/O)	Port no(3 dig)
POM	9F	5	(POKE MEMORY)	Address(5 dig), data(3 dig)
PPi	A0	2	(PRINTER PORT IS)	(1 dig)
PRInt	83	4	(PRINT) Current printer port	ASCII string
PRO	A8	2	(PRINTER ON/OFF) On = 1, off = 0	(1 dig)
PTi	A7	2	(PRINT TERMINATOR IS)	(1 dig)
#RD	-	-	(READING NUMBER) - See below	(2 dig)
*REPeat	87	2	(REPEAT) Loop n times	(3 dig)
*RESult	F4	-	(RESULT) field for 'write or print'	-
*RETurn	AE	1	(RETURN) from subroutine	-
*RPtch	A5	1	(RPTCH) Repeat from FSTVCH to LSTVCH	-
#RUn	-	-	(RUN) test sequence	-
#SAve	-	2	(SAVE) program on disc	(2 dig)
SCc	8C	2	(SCC) SAT colour code	(1 dig)
*SEqttl	F0	-	(SEQTTL) Sequence title	-
#SEqttl	-	6	(SEQTTL) Define sequence title	ASCII string (max. 20 chars.)
SId	93	2	(AREA/SYSTEM ID)	(5 dig)
#SRq	-	-	(SRQ) enable/disable	(1 dig)
*STAtus	F2	-	(STATUS) field for 'write or print'	-
*STEp	AC	1	(STEP) channels from first	-
*SUMmary	F7	-	(SUMMARY) Test sequence summary	-
TA	93	2	(TRAFFIC AREA)	(2 dig)
TCh	A2	2	(TCH) Set up traffic channel	(4 dig)
*TEst	80	2	(TEST) Execute test	(2 dig)
#TIMe	-	6	(TIME) - Provisional	ASCII string
*TIMe	F8	-	(TIME) - Provisional	-
*TITle	F1	-	(TITLE) field for 'write or print'	-
TRI	8D	2	(TRI) Tariff rate is	(2 dig)
#TSi	-	-	(TEST SEQUENCE IS)	(1 dig)
VCh	A2	2	(VCH) Set up voice channel	(4 dig)
#VMother	-	-	(MOTHERBOARD) software issue number	-
#VPers	-	-	(PERSONALITY) software issue number	-
*WAit	AB	2	(WAIT) n milliseconds	(5 dig)
WRite	84	4	(WRITE) to 2955 screen	x(2 dig), y(2 dig), ASCII string

* Can only be actioned in program/learn mode.
# Can only be actioned in immediate mode.

Notes ...

(1) The number of digits represents the maximum decimal number; for (3 dig) this maximum is 255 (FF hex).

Notes ... (continued)

(2) Tokens E0 to E4 relate to the PRINT command only and always follow the print command, e.g. PRINTBUFFER (83E3).

(3) Tokens F0 to FE represent special variables used for PRINT or WRITE to pick up internal values and results, e.g. PRINT20,5,RESULT (8332302C352CF4).

Syntax

95. As shown in the command summary above, there are six syntax types. The construction is shown in flow diagram form below together with simple examples to show the methods of use. In the diagrams upper case denotes compulsory items, lower case denotes optional items and the following abbreviations are used:

HPD (High Priority Delimiter) = <LF>, <ETX>, <ETB>.
LPD (Low Priority Delimiter) = comma, semicolon, space, <CR>.
TDL (Text Delimiter) = single quote, double quote.

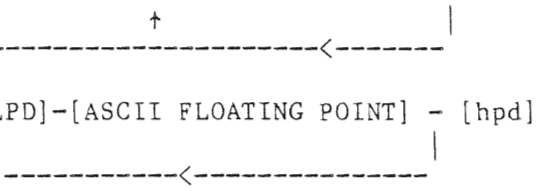
Type 1: [COMMAND]-[hpd,lpd]

Example: DEFAULT <LF>
(Set default parameters).

Type 2: [COMMAND]- [ASCII INT]-[hpd,lpd]

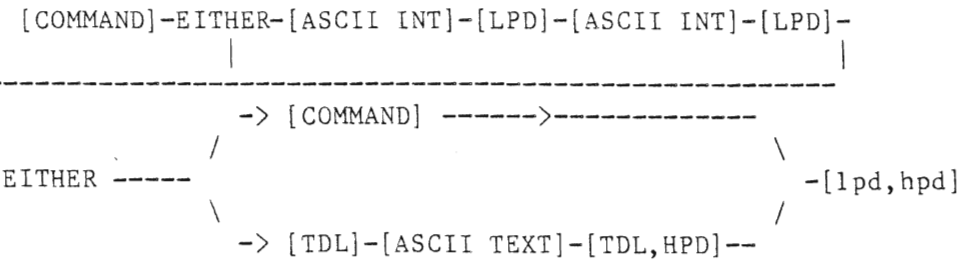
Example: TEST28 <LF>
(Execute test 28).

Type 3:



Example: PARAMETER9,2,30W,5W<LF>
(Set Tx noise parameters).

Type 4:



Example: WRITE3,9,"WARNING"<LF>
(Print WARNING at column 4, row 10)

Type 5: [COMMAND]-[ASCII INT]-[LPD]-[ASCII INT]-[lpd,hpd]

Example: POM32768,42
(Poke 42 into memory address 32768)

Type 6: [COMMAND]-[ASCII TEXT/DATA]-[HPD]

Example: COMMANDTX1P0FI1<LF>
(Set up 2955's parameters).

RD commands

96. RD, reading number, commands are used in immediate mode only. They have the form RDn where n represents a number from 0 to 58. When next addressed to talk, the system will send the reading or setting specified in n as follows:-

0 - 39	2955 readings (refer to 2955 Operating Manual)
40 - 49	Last 10 screen summary lines, with 40 the most recent
50	MIN/MSN
51	ESN
52	Result field
53	Test field
54	Error field
55	Error code (disc or calibration)
56	Serial poll status byte (RS232C operation:- Bit 0 = - Bit 1 = - Bit 2 = Ready to start Bit 3 = System paused Bit 4 = Error Bit 5 = Busy, system running Bit 6 = SRQ Bit 7 = Data ready
57	Unassigned
58	Read continuous summary lines whilst running a test sequence
>58	Unassigned

TACS TESTS AND PARAMETERS

97. The tests performed by the 2958 are divided into non-system specific and system specific tests.

Non-system specific tests

98. These are tests 1 to 19. For user-defined test routines the parameters are defined down to bit level. Each test takes up to 4 parameters, PAR1 to PAR4. These are defined in a standard block as follows:-

PAR1:Flag:-

Bits 0,1	Result type	0	Ref. and max. error (RME)
		1	Upper and lower limits (U & LL)
		2	Single upper or lower limit
		3	Ref. max. error (RME*)
			Where reference = current channel
Bits 2,3	Filter type	0	15 kHz low-pass filter
		1	Band-pass filter
		2	300 Hz low-pass filter
		3	Psophometric filter
Bits 4,5	Test type	0	Distortion
		1	SINAD
		2	S/N
		3	Residual noise
Bit 7	Mobile type	0	Companding
		1	Not companding

PAR2:Floating point no., units:-

Test upper limit
Test reference
Test single limit

PAR3:Floating point no., units:-

Test lower limit
Test max. error
Other, dependent on test

PAR4:Floating point no., units:-

Nominal modulation level

Notes ...

(1) Parameter type Upper & Lower Limit: PAR2 and PAR3 must both be expressed in the same units. PAR3 must have the same range of values as PAR2.

Notes ... (continued

(2) Parameter type Ref. Max. Error: If the error is in the same units as the reference range checking checks that PAR2 ±PAR3 is in range. Otherwise max. error is limited to ranges:-

0 - 100%
0 - 30 dB
0 - 1000 ppm.

(3) PAR4 (modulation) always complies with the range:-

100 Hz - 25 kHz
1% - 70%
0.1 rad - 10 rad

Where applicable, this is denoted as 'standard modulation'.

Parameters

99. The parameters specific to each test together with the default parameters used by the 2958 as follows:-

TEST 1: Tx r.f. power

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0,1	RME, U & LL
	Filter	Bits 2,3 = 0	Not used
	Test	Bits 4,5 = 0	Not used

PAR2:	Unit	Range	Remarks
	W	10 mW to 30 W	
	dBm	10 dBm to 44 dBm	
	dBW	-20 dBW to 14 dBW	

PAR3:	Unit	Range	Remarks
	W	10 mW to 30 W	
	%	0% to 100%	
	dB	0 dB to 30 dB	

PAR4: Not used

Default parameters: PAR1 = 1 (01H) Result type U & LL
PAR2 = Ref. power 6.5 dBW
PAR3 = Max. error 0.5 dBW

TEST 2: Tx r.f. frequency

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0,1,3	RME, U & LL, RME*
	Filter	Bits 2,3 = 0	Not used
	Test	Bits 4,5 = 0	Not used
	Bit 7	Bit 7 = 0,1	Cellular, PMR

PAR2/3:	Unit	Range	Remarks
	Hz	1.5 MHz to 1000 MHz	PAR2 not used for Result 3

PAR3:	Unit	Range
	Hz	1.5 MHz to 1000 MHz
	%	0% to 100%
	ppm	0 ppm to 1000 ppm

Default parameters: PAR1 = 3(03H) Ref. freq. is current channel
PAR2 = N/A
PAR3 = Max. error is 2.3 kHz

TEST 3 : Tx a.f. distortion and noise

(a) Distortion -

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0	Not used
	Filter	Bits 2,3 = 0,1	15 kHz l.p., b.p.
	Test	Bits 4,5 = 0	Distortion
	Mobile	Bit 7 = 0,1	CCITT 2:1 companding, not companding

PAR2:	Unit	Range	Remarks
	%	0% to 30%	Upper limit

PAR3: Not used.

PAR4: Standard modulation.

(b) SINAD, S/N -

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0	Not used
	Filter	Bits 2,3 = 0,1	15 kHz l.p., b.p.
	Test	Bits 4,5 = 1,2	SINAD, S/N
	Mobile	Bit 7 = 0,1	CCITT 2:1 companding, not companding

PAR2:	Unit	Range	Remarks
	dB	14 dB to 30 dB	Lower limit

PAR3: Not used.

PAR4: Standard modulation.

(c) Residual noise

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0	Not used
	Filter	Bits 2,3 = 0,1,2	15 kHz l.p., b.p., 300 Hz l.p.
	Test	Bits 4,5 = 3	Residual noise
	Mobile	Bit 7 = 0,1	CCITT 2:1 companding, not companding

PAR2: Standard modulation units and ranges.

PAR3: Not used.

PAR4: Standard modulation.

Default parameters: PAR1 = 20 (14H) SINAD test, b.p. filter, companding
PAR2 = Lower limit 26 dB
PAR3 = N/A
PAR4 = Ref. mod. level 2.3 kHz

TEST 4: Tx modulation limiting

PAR1:	Flag	Bit value	Selection
	Mobile	Bit 7 = 0,1	CCITT 2:1 companding, not companding

PAR2: Standard modulation. Upper limit (max. deviation)

PAR3:	Unit	Range	Remarks
	dB	0 dB to 30 dB	Overload factor

PAR4: Standard modulation.

Default parameters: PAR1 = 0(0H) Companding
PAR2 = Max. deviation 9.78 kHz
PAR3 = Overload factor 20 dB
PAR4 = Ref. mod. level 5.7 kHz

TEST 5: Tx modulation compression

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0,1	RME, U & LL
	Filter	Bits 2,3 = 0	Not used
	Test	Bits 3,4 = 0	Not used
	Mobile	Bit 7 = 0,1	CCITT 2:1 companding not companding

PAR2/3:	Unit	Range	Remarks
	None	0 to 10	Compression ratio

PAR3:	Unit	Range	Remarks
	None	0 to 10	
	%	0 to 100%	

PAR4: Standard modulation.

Default parameters: PAR1 = 0 (00H) Result type RME
PAR2 = Compression ratio 2:1
PAR3 = Max. error 5%
PAR4 = Ref. mod. level 2.3 kHz.

TEST 6: Rx SINAD and distortion

(a) Distortion -

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0	Not used
	Filter	Bits 2,3 = 0,1,3	15 kHz l.p., b.p., psophometric
	Test	Bits 4,5 = 0	Distortion

PAR2:	Unit	Range	Remarks
	%	0 to 30%	Upper limit

PAR3:	Unit	Range	Remarks
	V	0.023 µV to 22 µV	} RF generator level
	dBm	-140 dBm to -80 dBm	

PAR4: Standard modulation.

(b) SINAD, S/N -

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0	Not used
	Filter	Bits 2,3 = 0,1,3	15 kHz l.p., b.p., psophometric
	Test	Bits 4,5 = 1,2	SINAD, S/N

PAR2:	Unit	Range	Remarks
	dB	14 dB to 30 dB	Lower limit

PAR3:	Unit	Range	Remarks
	V	0.023 µV to 22 µV	} RF generator level
	dBm	-140 dBm to -80 dBm	

PAR4: Standard modulation.

Default parameters: PAR1 = 20(14H) SINAD test, b.p. filter
PAR2 = Lower limit 24 dB
PAR3 = RF generator level -80 dBm
PAR4 = Ref. mod. level 2.3 kHz.

TEST 7: Rx sensitivity

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0	Not used
	Filter	Bits 2,3 = 0,1,3	15 kHz l.p., b.p., psophometric
	Test	Bits 4,5 = 0	Not used
	Mobile	Bit 7 = 0,1	CCITT 2:1 companding, not companding

PAR2:	Unit	Range	Remarks
	V	0.175 µV to 4 µV	} Upper limit r.f. level
	dBm	-122 dBm to -95 dBm	

PAR3:	Unit	Range	Remarks
	dB	14 dB to 30 dB	Reference SINAD

PAR4: Standard modulation

Default parameters: PAR1 = 12(0CH) Psophometric filter, not companding.
PAR2 = Upper limit r.f. level -113 dBm
PAR3 = SINAD ref. 20 dB
PAR4 = Ref. mod. level 2.3 kHz.

TEST 8: Rx demodulation expansion

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0,1	RME, U & LL
	Filter	Bits 2,3 = 0	Not used
	Test	Bits 4,5 = 0	Not used

PAR2/3:	Unit	Range	Remarks
	None	0 to 10	Expandsion ratio

PAR3	Unit	Range	Remarks
	None	0 to 10	
	%	0 to 100%	

PAR4: Standard modulation

Default parameters: PAR1 = 0(00H Result type RME
PAR2 = Compression ratio 2:1
PAR3 = Max. error 5%
PAR4 = Ref. mod. level 2.3 kHz

TEST 9: DC power consumption

PAR1:	Flag	Bit value	Selection
	Result	Bits 0,1 = 0,1	RME, U & LL
	Filter	Bits 2,3 = 0	Not used
	Test	Bits 4,5 = 0	Not used

PAR2/3:	Unit	Range	Remarks
	W	100 mW to 200 W	

PAR3:	Unit	Range	Remarks
	W	100 mW to 200 W	
	%	0% to 100%	

PAR4: Not used.

Default parameters: PAR1 = 1(01H) Upper and lower limit
PAR2 = Upper limit 100 W
PAR3 = Lower limit 1 W

TESTS 10 to 19

Not implemented.

System specific tests

100. These are tests 20 to 29. For user-defined test routines the parameters are defined down to bit level. Each test takes up to 4 parameters, PAR1 to PAR4 as shown below:-

TEST 20: Registration of mobile on control channel

TEST 21: Call placement from cell to mobile

TEST 22: Call placement from mobile to cell

TEST 23: Handoff from current to last voice channel

TEST 24: Auto handoffs from first to last voice channel

TEST 25: Transponded SAT

PAR1: Bits 0 and 1 give test type
value 0 = trandponding only
value 1 = transponding and level
value >1 = transponding, level and frequency

PAR2: Max. error in level (dB,%,Hz)

Assumed parameters: Nominal level = 1.675 kHz
Nominal freq. = (as SCC)
Max. freq. error = 15 Hz

Default parameters: PAR1 = 1(01H) Transponding and level
PAR2 = Max. error in level 20%

TEST 26: Clearing down from cell

TEST 27: Clearing down from mobile

TEST 28: Tx r.f. power

PAR1: Bits 4 to 7 give reading units -
value 0 = Watts
value 1 = dBW
value >1 = dBm

Bits 0 to 3 give power level -
value 0 to 7 = test individual level
value >7 = test all power levels

PAR2: Upper limit deviation from specification (dB and % only).

PAR3: Lower limit deviation from specification (dB and % only).

Default parameters: PAR1 = 8(08H) Test all power levels in Watts.
PAR2 = Upper limit deviation 2 dB.

TEST 29: Bit error rate

PAR1: Not used.

PAR2: Lower limit (%).

PAR3: RF generator level (dBm)

Default parameters: Lower limit 95%.

TEST 30: DTMF tones

TEST 31: Hook flash

CHANGING THE PARAMETERS

101. The method of changing the parameters to redefine a test is illustrated by the following example:-

Example: Change the Test 3 parameters for use in a user-defined test to measure Tx residual noise using a band-pass filter, with upper limit 20% and ref. mod. level 2 kHz -

(1) Referring to the Parameter data for Test 3 under 'TACS tests and parameters' the following is derived:-

PAR1 = Result bits 0,1 = 0 (Not used)
Filter bits 2,3 = 1 0.3-3.4 kHz band-pass filter
Test bits 4,5 = 3 Residual noise test
Mobile bit 7 = 1 Not companding

Therefore PAR1 = 10110100 = 180
PAR2 = 20%
PAR3 = N/A
PAR4 = 2 kHz

(2) Referring to the 'GPIB commands summary' the syntax type for PARameter is 3 and looking at 'Syntax' for type 3 the format is:-

[COMMAND]	=	PARAM
[ASCII INTEGER]	=	3
[LPD]	=	,
[ASCII INTEGER]	=	1 (see Note below)
[LPD]	=	,
[ASCII INTEGER]	=	180
[LPD]	=	,
[ASCII FLOATING POINT]	=	20%
[LPD]	=	,
[N/A]	=	,
[ASCII FLOATING POINT]	=	2 kHz
[HPD]	=	<LF>

The Test 3 parameters are passed by the string PARAM3,1,180,20%,,2 kHz<LF> and the test is executed by sending TEST3<LF>. Examples of this and other tests can be found in the 'Internal test sequences' which follow.

Note ...

In the case of the PARAM command the number of the first parameter is always given, this allows an abbreviated form to be used, e.g. to alter just PAR4 (the ref. mod. level) in the above examples the string PARAM3,4,3kHz can be used.

TEST MESSAGES

102. All of these tests display the test title and check the parameters for validity and consistency. If an error is found in parameter 1 (the flag byte) then ERROR: PARAMETERS FLAG or ERROR: <filter byte> FILTER is displayed in the result field. Otherwise, the parameters given are displayed under the test title so that the user can determine the source of error.

103. If a parameter is too large or too small to be sensibly displayed (e.g. there is garbage in a parameter) then it is displayed, e.g. '>9.99' or '<0.01' as appropriate. This can also show whether the user has not understood the syntax of parameter entry since the display shows the 2958's interpretation of the parameters. During the d.c. power test, additional information is displayed, i.e. the measured d.c. voltage and current. Note that the parameters and d.c. readings are only shown if the display format is FULL. If the display format is SUMMARY, only the single line giving the test title, status and result is displayed.

104. All tests display the result by means of a common routine; if the result type in parameter 1 is reference and maximum error (RME), then the routine checks that the maximum error is in units consistent with the reference units for purposes of calculation. Table 2 shows which reference and maximum error units are compatible.

105. Tx r.f. distortion and Tx modulation limiting attempt to set the Tx carrier to a reference modulation level deviation by varying the a.f. generator output. Both will display NO MODULATION or READING UNSTABLE if unable to set the ref. mod. level.

TABLE 2 REFERENCE AND MAX ERROR UNITS COMPATIBILITY

REFERENCE →

MAX ERROR ↓

	NONE	V	Hz	A	W	s	dB	dBm	dBV	dBW	rad	ppm	%
# NONE	✓												
# V		✓											
# Hz			✓										
# A				✓									
# W					✓								
# s						✓							
* dB		✓		✓	✓		✓	✓	✓	✓			
# rad											✓		
* ppm	✓	✓	✓	✓	✓	✓					✓	✓	
* %	✓	✓	✓	✓	✓	✓					✓		✓

* Test result error calculated as Result : Reference (ratio)
\# Test result error calculated as Result - Reference (difference)

ERROR MESSAGES

106. The following messages are displayed when errors are found in user-defined test sequences:-

ERROR: PARAMETERS FLAG	Illegal bit combination in parameter 1, i.e. test type/result invalid.
ERROR: XXXXXXXXX FILTER	Illegal parameter 1, i.e. invalid filter.
ERROR: PARAMETERS UNITS	Invalid units for one or more parameters.
ERROR: PARAMETERS RANGE	Parameters outside permitted range.
ERROR: NOT IMPLEMENTED	Tests 10 to 19 not yet in use.
ERROR: ZERO REFERENCE	For result type Ref. and max. error (RME), the reference cannot be zero unless max. error in same units as reference (see Table 2).
ERROR: MODULATION LIMIT	For Rx expansion, (ref. mod. level +5 dB) must be within capability of 2955.

INTERNAL TEST SEQUENCES

107. The internal, built-in, test sequences are listed below in detail to enable them to be used as programming examples. Also, sections may be abstracted and used, after modification, in user-defined test sequences.

Test sequence BRIEF TESTING

TOKEN/ASCII(HEX)	DECODE	REMARKS
AD3430	GOSUB40	Put up heading and prepare buffer
83332C31	PRINT3,1,"BRIEF TESTING"	
2C224252		
49454620		
54455354		
494E4722		
AD3530	GOSUB50	Perform registration and output buffer
AD3630	GOSUB60	Do common call processing
AC	STEP	Start by handoff to first channel
832222	PRINT""	New line
83	PRINT"	
22202020		
20205445	TEST	
53542020		
20202020		
20202020		
20202020		
204C4F57	LOW CHANNEL	
20434841		
4E4E454C		
20202020		
20		
20202020		
4D494420	MID CHANNEL	
4348414E		
4E454C20		
20202020		
20202020		
48494748	HIGH CHANNEL"	
20434841		
4E4E454C		
22		
832222	PRINT""	New line
83E0	PRINTDISABLE	
83E2	PRINTCLEAR	Clear buffer
8334302C	PRINT40,9,"F =	
392C2246		
203D2046	FAILURE,	
41494C55		
52452C20		
45203D20	E = ERROR"	
4552524F		
5222		
803233	TEST23	Handoff from current channel

TOKEN/ASCII(HEX)	DECODE	REMARKS
83302C	PRINTO,0,TITLE	
302CF1		
833233	PRINT23,0,RESULT	
2C302CF4		
833230	PRINT20,0,IND	
2C302CF3		
973130	JOF10	Skip on if handoff failed
803235	TEST25	Transponded SAT
83302C	PRINTO,1,TITLE	
312CF1		
833233	PRINT23,1,RESULT	
2C312CF4		
833230	PRINT20,1,IND	
2C312CF3		
803238	TEST28	Measure Tx r.f. power
83302C	PRINTO,2,TITLE	
322CF1		
833233	PRINT23,2,RESULT	
2C322CF4		
833230	PRINT20,2,IND	
2C322CF3		
8032	TEST2	Measure Tx r.f. frequency
83302C	PRINTO,3,TITLE	
332CF1		
833233	PRINT23,3,RESULT	
2C332CF4		
833230	PRINT20,3,IND	
2C332CF3		
8033	TEST3	Measure Tx a.f. distortion
83302C	PRINTO,4,TITLE	
342CF1		
833233	PRINT23,4,RESULT	
2C342CF4		
833230	PRINT20,4,IND	
2C342CF3		
8034	TEST4	Measure Tx modulation limiting
83302C	PRINTO,5,TITLE	
352CF1		
833233	PRINT23,5,RESULT	
2C352CF4		
833230	PRINT20,5,IND	
2C352CF3		
8036	TEST6	Measure Rx distortion
83302C	PRINTO,6,TITLE	
362CF1		
833233	PRINT23,6,RESULT	
2C362CF4		
833230	PRINT20,6,IND	
2C362CF3		
8037	TEST7	Measure Rx sensitivity
83302C	PRINTO,7,TITLE	
372CF1		
833233	PRINT23,7,RESULT	
2C372CF4		
833230	PRINT20,7,IND	
2C372CF3		

TOKEN/ASCII(HEX)	DECODE	REMARKS
853130	LABEL10	
A6	NXTCH	Go round again for next channel
803233	TEST23	Handoff
833433	PRINT43,0,RESULT	
2C302CF4		
833430	PRINT40,0,IND	
2C302CF3		
973131	JOF11	
803235	TEST25	Transponded SAT
833433	PRINT43,1,RESULT	
2C312CF4		
833430	PRINT40,1,IND	
2C312CF3		
803238	TEST28	Measure Tx r.f. power
833433	PRINT43,2,RESULT	
2C322CF4		
833430	PRINT40,2,IND	
2C322CF3		
8032	TEST2	Measure Tx r.f. frequency
833433	PRINT43,3,RESULT	
2C342CF4		
833430	PRINT 40,3,IND	
2C332CF3		
8033	TEST3	Measure Tx noise
833433	PRINT43,4,RESULT	
2C342CF4		
833430	PRINT40,4,IND	
2C342CF3		
8034	TEST4	Measure Tx modulation limiting
833433	PRINT43,5,RESULT	
2C352CF4		
833430	PRINT40,5,IND	
2C352CF3		
8036	TEST6	Measure Rx distortion
833433	PRINT43,6,RESULT	
2C362CF4		
833430	PRINT40,6,IND	
2C362CF3		
8037	TEST7	Measure Rx sensitivity
833433	PRINT43,7,RESULT	
2C372CF4		
833430	PRINT40,7,IND	
2C372CF3		
853131	LABEL11	
A6	NXTCH	Go round again for next channel
803233	TEST23	Handoff from current channel
833633	PRINT63,0,RESULT	
2C302CF4		
833630	PRINT60,0,IND	
2C302CF3		
973132	JOF12	
803235	TEST25	Transponded SAT
833633	PRINT63,1,RESULT	
2C312CF4		
833630	PRINT60,1,IND	
2C312CF3		

TOKEN/ASCII(HEX)	DECODE	REMARKS
803238	TEST28	Measure Tx r.f. power
833633	PRINT63,2,RESULT	
2C322CF4		
833630	PRINT60,2,IND	
2C322CF3		
8032	TEST2	Measure Tx r.f. frequency
833633	PRINT63,3,RESULT	
2C332CF4		
833630	PRINT60,3,IND	
2C332CF3		
8033	TEST3	Measure Tx a.f. distortion
833633	PRINT63,4,RESULT	
2C342CF4		
833630	PRINT60,4,IND	
2C342CF3		
8034	TEST4	Measure Tx modulation limiting
833633	PRINT63,5,RESULT	
2C352CF4		
833630	PRINT60,5,IND	
2C352CF3		
8036	TEST6	Measure Rx distortion
833633	PRINT63,6,RESULT	
2C362CF4		
833630	PRINT60,6,IND	
2C362CF3		
8037	TEST 7	Measure Rx sensitivity
833633	PRINT63,7,RESULT	
2C372CF4		
833630	PRINT60,7,IND	
2C372CF3		
853132	LABEL12	
83E1	PRINTENABLE	Print results
83E3	PRINTBUFFER	
832222	PRINT""	
863939	JUMP99	Skip on to common exit

Test sequence COMPREHENSIVE TESTING

AD3430	GOSUB40	Put up heading and prepare buffer
83332C31	PRINT3,1,	
2C22434F	"COMPREHENSIVE	
4D505245		
48454E53		
49564520		
54455354	TEST"	
22		
AD3530	GOSUB50	Perform registration and output buffer
AD3630	GOSUB60	Do common call processing

-- PERFORM ONCE ONLY TESTS --

803239	TEST29	Bit error rate

TOKEN/ASCII(HEX)	DECODE	REMARKS
	--PERFORM TESTING ON ALL CHANNELS REQD --	
A5	RPTCH	Handoff to new channel
832222	PRINT""	
8322204E	PRINT" NEW	
45572054	TRAFFIC	
52414646		
49432043	CHANNEL"	
48414E4E		
454C22		
803233	TEST23	Handoff from current channel
973939	JOF99	If failed skip on to end
803235	TEST25	Transponded SAT
813238	PARAM28,1,7	Set Tx r.f. power parameters
2C312C37		
803238	TEST28	Measure Tx power level 7
8039	TEST9	Measure d.c. power level 7
813238	PARAM28,1,6	Set Tx r.f. power parameters
2C312C36		
803238	TEST 28	Measure Tx power level 6
8039	TEST 9	Measure d.c. power level 6
813238	PARAM28,1,5	Set Tx r.f. power parameters
2C312C35		
803238	TEST28	Measure Tx power level 5
8039	TEST9	Measure d.c. power level 5
813238	PARAM28,1,4	Set Tx r.f. power parameters
2C312C34		
803238	TEST28	Measure Tx power level 4
8039	TEST9	Measure d.c. power level 4
813238	PARAM28,1,3	Set Tx r.f. power parameters
2C312C33		
803238	TEST28	Measure Tx power level 3
8039	TEST 9	Measure d.c. power level 3
813238	PARAM28,1,2	Set Tx r.f. power parameters
2C312C32		
803238	TEST28	Measure Tx power level 2
8039	TEST 9	Measure d.c. power level 2
813238	PARAM28,1,1	Set Tx r.f. power parameters
2C312C31		
803238	TEST28	Measure Tx power level 1
8039	TEST9	Measure d.c. power level 1
813238	PARAM28,1,0	Set Tx r.f. power parameters
2C312C30		
803238	TEST28	Measure Tx power level 0
8039	TEST9	Measure d.c. power level 0
8032	TEST2	Measure Tx r.f. frequency
8133	PARAM3,1,4,5%	Set Tx distortion parameters
2C312C34		
2C3525		
8033	TEST3	Measure Tx noise
81	PARAM3,1,56,570Hz	Measure Tx residual noise
332C312C		
35362C35		
3730487A		
8033	TEST3	Measure Tx noise

TOKEN/ASCII(HEX)	DECODE	REMARKS
8034	TEST4	Measure Tx modulation limiting
8035	TEST5	Measure Tx compression
8036	TEST6	Measure Rx distortion
8037	TEST7	Measure Rx sensitivity
8038	TEST8	Measure Rx expansion
A6	NXTCH	Go round again for next channel
83E2	PRINTCLEAR	
83E4	PRINTLINE	
863939	JUMP99	Skip on the common exit

Test sequence CALL PROCESSING ONLY

AD3430	GOSUB40	Put up heading and prepare buffer
83332C	PRINT3,1,	
312C2243	"CALL	
414C4C20		
50524F43	PROCESSING	
45535349		
4E47204F	ONLY"	
4E4C5922		
AD3530	GOSUB50	Perform registration and output buffer
AD3630	GOSUB60	Do common call processing
803234	TEST24	Auto handoff
863939	JUMP99	Skip on to common exit

Test sequence CALL AND RF TESTING

AD3430	GOSUB40	Put up heading and prepare buffer
83	PRINT3,1	
332C312C		
2243414C	"CALL PROCESSING	
4C205052		
4F434553		
53494E47		
20414E44	AND RF TESTING"	
20524620		
54455354		
494E4722		
AD3530	GOSUB50	Perform registration and output buffer
AD3630	GOSUB60	Do common call processing
83E2	PRINTCLEAR	
83E4	PRINTLINE	
83	PRINT	
2248414E	"HANDOFF/CHANNEL	
444F4646		
2F434841		
4E4E454C		
20202020		
20202054	TX POWER PLO	
5820504F		
57455220		
504C3020		
20202020		
202020		

TOKEN/ASCII(HEX)	DECODE	REMARKS
20202054	TX FREQ	
58204652		
45512020		
20202020		
20202020		
53415420	SAT DEVIATION"	
44455649		
4154494F		
4E22		
A5	RPTCH	Handoff to new channel
83E2	PRINTCLEAR	Clear buffer
83E0	PRINTDISABLE	
863233	TEST23	Handoff
963330	JOP30	Skip on if OK
83E1	PRINTENABLE	
83	PRINT	
222A2A2A	"***	
2048414E	HANDOFF	
444F4646		
20464149	FAILED	
4C454420		
2A2A2A22	***"	
863939	JUMP99	Skip on to common exit
853330	LABEL30	
83302C	PRINT0,0,RESULT	
302CF4		
813238	PARAM28,1,0	Set Tx r.f. power parameters
2C312C30		
803238	TEST 28	Measure Tx power level 0
833230	PRINT20,0,IND	
2C302CF3		
833232	PRINT22,0,RESULT	
2C302CF4		
8032	TEST 2	Measure Tx r.f. frequency
833430	PRINT40,0,IND	
2C302CF3		
833432	PRINT42,0,RESULT	
2C302CF4		
803235	TEST25	Transponded SAT
833630	PRINT60,0,IND	
2C302CF3		
833632	PRINT62,0,RESULT	
2C302CF4		
83E1	PRINTENABLE	
83E4	PRINTLINE	
A6	NXTCH	Go round again for next channel
83E2	PRINTCLEAR	Clear buffer
83E4	PRINTLINE	
8334	PRINT40,0	
302C302C		
2246203D	"F =	
20464149	FAILURE,	
4C555245		
2C204520	E =	
3D204552	ERROR"	
524F5222		

TOKEN/ASCII(HEX)	DECODE	REMARKS
83E4	PRINTLINE	
863939	JUMP99	Skip on to common exit
	-- HEADING AND PREPARE BUFFER --	
853430	LABEL40	
8322	PRINT"	
4D415243	MARCONI	
4F4E4920		
494E5354	INSTRUMENTS	
52554D45		
4E545320		
43454C4C	CELLULAR	
554C4152		
20524144	RADIO	
494F2054	TEST	
45535420		
53595354	SYSTEM	
454D2032	2958"	
39353822		
832222	PRINT""	New line
82	DEF	Set default parameters
83E2	PRINTCLEAR	Clear buffer
AE	RETURN	
	-- REGISTRATION --	
853530	LABEL50	
83E0	PRINTDISABL	
803230	TEST20	Registration of mobile
83322C	PRINT2,7	
372C2244	"DATE:	
4154453A		
2E2E2E22	---"	
8334	PRINT40,7	
302C372C		
22544553	"TESTER:	
5445523A		
2E2E2E2E	..."	
963531	JOP51	
83	PRINT3,4,	
332C342C		
222A2A2A	"***	
20524547	REGISTRATION	
49535452		
4154494F		
4E20		
4641494C	FAILED	
4544202A	***"	
2A2A22		
863532	JUMP52	
853531	LABEL51	
83332C	PRINT3,3,	
332C2245	"ESN:"	
534E3A22		

TOKEN/ASCII(HEX)	DECODE	REMARKS
8338	PRINT8,3,ESN	
2C332CF6		
83332C	PRINT3,5,	
352C224D	"MIN:"	
494E3A22		
8338	PRINT8,5,MINMSN	
2C352CF5		
853532	LABEL52	
83E1	PRINTENABLE	
83E3	PRINTBUFFER	
AE	RETURN	
	--COMMON CALL PROCESSING TESTS --	
853630	LABEL60	
A2333030	VCH300	Start at centre frequency
8732	REPEAT2	Two attempts at placing call
803232	TEST22	Call from mobile
963631	JOP61	Skip on if passed
88	NEXT	
83	PRINT"SOME	
22534F4D		
45205445	TESTS	
53545320		
41424F52	ABORTED"	
54454422		
863632	JUMP62	Miss next test if failed
	-- CONTINUE TESTS REQUIRING USER INTERVENTION --	
853631	LABEL61	
803330	TEST30	DTMF test
803331	TEST31	Hook flash test
803237	TEST27	Clear from mobile
	-- NOW CALL FROM CELL --	
853632	LABEL 62	Now place call
8732	REPEAT2	Make 2 attempts
803231	TEST 21	Call from CELL to mobile
963633	JOP63	If passed, skip on
88	NEXT	Else try again
853633	LABEL63	
AE	RETURN	
	-- COMMON EXIT POINT --	
853939	LABEL99	
83E2	PRINTCLEAR	
83E4	PRINTLINE	
83E4	PRINTLINE	

TOKEN/ASCII(HEX)	DECODE	REMARKS
803236	TEST26	Clear from CELL
83E4	PRINTLINE	
83E4	PRINTLINE	
83E4	PRINTLINE	
83	PRINT25,0	
32352C30		
2C225445	"TEST	
53542053	SUMMARY:"	
554D4D41		
52593A22		
833339	PRINT39,0,SUMMARY	
2C302CF7		
83E4	PRINTLINE	
83220C22	PRINT"0C"	Print a form feed
FF	STOP	

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