

6103

DIGITAL RADIO TEST SET

Installation Manual

This document consists of Preliminary pages and Sections 1, 2 and 3 of the main 6103 Operator Manual. The Initial Failure Diagnosis Procedure and Problem Report Sheet are also included.

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AMENDMENT RECORD

Incorporation of amendments to this manual should be recorded on this page

Amendment No.	Incorporated By	Date
1		
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SOFTWARE COMPATIBILITY

This manual contains information compatible with software release Version 05.02G.

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YEAR 2000 COMPLIANCE

The 6103 with embedded software at issue 03.03 (or later) has been tested for and achieves Year 2000 compliance using the acceptance criteria defined in BSI DISC PD2000-1.

- RULE 1.** No value for current date will cause interruption in operation.
- RULE 2.** Date-based functionality must behave consistently for dates prior to, during and after Year 2000.
- RULE 3.** In all interfaces and data storage, the century in any date must be specified either explicitly or by unambiguous algorithms or inferencing rules.
- RULE 4.** Year 2000 must be recognized as a leap year.

Refer to Section 4 of this document, under the heading GENERAL INFORMATION / Date and Time.

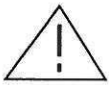
SAFETY PRECAUTIONS

SYMBOLS AND HEADINGS

The following symbols and headings are used in this handbook to indicate Safety hazards. Personnel using this equipment must read this handbook and familiarize themselves with each safety requirement before operating the equipment.

WARNING: A WARNING indicates a hazard that affects personnel. The instructions in a WARNING must be observed; if the WARNING is ignored, injury or loss of life may result.

CAUTION: A CAUTION indicates a hazard that affects the equipment. The instructions in a CAUTION must be observed; if the CAUTION is ignored, damage may be caused to the equipment.



This symbol is used on the equipment to indicate that it is necessary to refer to, and comply with, all instructions in this handbook regarding the use of such marked facilities.

GENERAL SAFETY PRECAUTIONS

Always operate the product in accordance with the instructions in this manual.

- WARNING:**
- (1) THIS IS A SAFETY CLASS 1 PRODUCT PROVIDED WITH A PROTECTIVE EARTHING CONDUCTOR INCORPORATED IN THE POWER CABLE. THE MAINS PLUG MUST ONLY BE INSERTED IN A MAINS SOCKET OUTLET PROVIDED WITH A MATCHING EARTH CONTACT. ANY INTERRUPTION OF THE EARTH CONDUCTOR, INSIDE OR OUTSIDE THE TEST SET, IS LIKELY TO CAUSE THE TEST SET TO BECOME DANGEROUS TO PERSONNEL. DELIBERATE INTERRUPTION OF THE EARTH CONDUCTOR IS FORBIDDEN.
 - (2) THE ENVIRONMENTAL OPERATING CONDITIONS SPECIFIED FOR THE EQUIPMENT MUST BE OBSERVED. DO NOT ALLOW THE EQUIPMENT TO BECOME WET, AND DO NOT ALLOW WATER TO ENTER THE EQUIPMENT. DO NOT OPERATE THE EQUIPMENT WHEN WET BECAUSE IN THIS CONDITION THE SAFETY OF THE EQUIPMENT MAY BE DEGRADED.
 - (3) THIS EQUIPMENT CONTAINS LETHAL VOLTAGES. DO NOT REMOVE THE COVERS. RETURN THE EQUIPMENT TO RACAL INSTRUMENTS LTD OR APPROVED SERVICE AGENT FOR SERVICING.
 - (4) THIS EQUIPMENT MUST BE KEPT CLEAN AND FREE FROM CONTAMINATION. IF NECESSARY, CLEAN THE EQUIPMENT AS DESCRIBED IN THIS HANDBOOK. IF THE EQUIPMENT IS SEVERELY CONTAMINATED, IT SHOULD BE RETURNED TO RACAL INSTRUMENTS LTD OR APPROVED SERVICE AGENT.

- (5) ANY DEVIATION FROM THE INSTRUCTIONS PROVIDED IN THIS HANDBOOK MAY CAUSE THE PROTECTION PROVIDED BY THE EQUIPMENT TO BE IMPAIRED.
- (6) THE MAINS FUSES MUST BE REPLACED ONLY WITH THE SAME TYPE AND RATING (SEE SECTION 3). THE USE OF OTHER FUSES OR MATERIAL MAY CAUSE A FIRE HAZARD AND IS FORBIDDEN.
- (7) SOME TYPES OF MOBILE PHONE CAN GENERATE RF POWER LEVELS THAT ARE SUFFICIENT TO CAUSE INJURY TO PERSONNEL. ALWAYS ENSURE THAT THE MOBILE PHONE IS SWITCHED OFF BEFORE CONNECTING OR DISCONNECTING RF CABLES. NEVER USE DAMAGED RF CABLES ON THE RF PORTS.

CAUTION: DO NOT OBSTRUCT THE AIR INLET TO THE FAN, OR THE AIR OUTLETS IN THE SIDE PANELS, IN ANY WAY. RESTRICTING THE FLOW OF AIR COULD CAUSE THE TEST SET TO OVERHEAT AND MAY CAUSE DAMAGE.



CE CONFORMITY

Units that carry the **CE** mark are designed to conform to standards EN 61010-1 and EN 61326-1 when used in accordance with these instructions.

ELECTROMAGNETIC COMPATIBILITY (EMC)

To ensure that EMC integrity is retained always follow good EMC practice. In particular:

- (1) Use good quality coaxial connections for signal input and output leads.
- (2) Use good quality screened data or control cables and connectors.
- (3) Ensure that cable screens are properly terminated within the connectors. Do not use cables if the terminations are loose or frayed.
- (4) Ensure that the screening is continuous through to the chassis of the equipment.
- (5) Ensure that any associated equipment is CE marked or is of good EMC design and performance.

ELECTROSTATIC DISCHARGE (ESD)

Electrostatic discharge may damage or degrade the performance of the Test Set if proper precautions are not taken:

- (1) Where they are provided, protective covers must always be fitted on any rear panel connectors that are not in use (i.e. have no cable connected). Replacement protective covers are available from Racal Instruments Ltd or approved Service Agents.
- (2) Before connecting free cables (i.e. not connected at either end) to any item of equipment, it is recommended that the cable connector pins are momentarily grounded to discharge any static build up within the cable.

DECLARATION OF CONFORMITY

CE 99

Ser. No. CE 027

We:

Supplier's Name: Racal Instruments Ltd.

Supplier's Address: 480 Bath Road
Slough
Berks.
SL1 6BE

declare under our sole responsibility that the following product(s):

Product Name: Digital Radio Test Set
Product Model Number(s): 6103
Product Options: All

to which this declaration relates conform(s) with the following standard(s) or other normative document(s):

Safety: EN 61010-1:1993 + A2:1995

EMC:

Emissions: EN61326-1:1997+A1:1998, Class B*
CISPR 16-1
CISPR 16-2

Immunity: EN61326-1:1997+A1:1998, Table 1
IEC 1000-4-2:1995 (4kV/8kV contact/air), category A
IEC 1000-4-3:1995 (3V/m), category B
IEC 1000-4-4:1995 (0.5kV, I/O cables), category A
IEC 1000-4-4:1995 (1kV, AC power), category A
IEC 1000-4-5:1995 (0.5kV/1kV, line-line/line-PE), category A
IEC 1000-4-6:1996 (3V), category A
IEC 1000-4-11:1994 (1 cycle/100%), category A

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC (as amended by Directive 93/68/EEC) and the EMC Directive 89/336/EEC (as amended by Directives 92/31/EEC and 93/68/EEC) and carry the CE mark accordingly. *For Option 07 the radiated EMC emissions from the product are compliant with the Class B limits up to an output level of +10dBm.

Name of Authorised Signatory:
(PRINT)

MICHAEL R KENYON

Professional Title of Signatory:
(PRINT)

TECHNICAL DIRECTOR

Signature of Authorised Signatory:

M.R. Kenyon

Place and Date of Issue:

Slough, Berks., England 20-12-99
(town, county, country) (date)

RIL 071D

GLOSSARY OF TERMS AND ABBREVIATIONS

ARFCN	Absolute RF Channel Number. A number in the P-GSM, E-GSM, R-GSM, DCS 1800 or PCS 1900 range of frequencies which defines the absolute radio frequency channel number.
AGCH	Access Grant CHannel
BA	BCCH Allocation. The radio frequency channels allocated in a cell for BCCH transmission.
BCC	Base Station Colour Code
BCCH	Broadcast Control CHannel
BCCH_FREQ_NCELL	Frequency of the RF carrier on which the BCCH of a neighbouring cell is transmitted.
BER	Bit Error Ratio
BS_AG_BLK_RES	The number of blocks on each common control channel reserved for access grant messages.
BSIC	Base Transceiver Station Identity Code
BS_PA_MFRMS	The number of multiframes between two transmissions of the same paging message to MSs of the same paging group.
BTS	Base Transceiver Station
Burst	A period of modulated carrier less than one timeslot. The physical content of a timeslot.
CA	Cell Allocation. The radio frequency channels allocated to a particular cell
CAT	Cell Allocation Table
CBCH	Cell Broadcast CHannel
CCH	Cell Control Channel
CCCH	Common Control CHannel
CCCH_GROUP	Group of MSs in idle mode.
CELL	Geographical area within which a defined set of channels is provided.
CELL_BAR_ACCESS	Cell access barred parameter.
CELL_RESELECT_HYSTERESIS	The RXLEV hysteresis required for cell reselection.

Class IA, IB, II	Classification of speech encoder bits depending on the degree of protection needed. Class IA and Class IB bits have protection; Class II bits have no protection. Error detection is performed on Class IA bits.
DAI	D igital A udio I nterface
DCS 1800	D igital C ellular S ystem
DTX	D iscontinuous T ransmission. Means of saving battery power (e.g. in HPU) and reducing interference by automatically switching the transmitter off when no speech or data are to be sent.
E-GSM	E xtended G lobal S ystem for M obile C ommunications
FACCH	F ast A ssociated C ontrol C Hannel
FCCH	F requency C orrection C Hannel
FER	F rame E rasure R ate
GMSK	G aussian M inimum S hift K ey
GPIB	G eneral P urpose I nterface B us
GSM	G lobal S ystem for M obile C ommunications
HPU	H and P ortable U nit
HSN	H opping S equence N umber
IMEI	I nternational M obile E quipment I dentify
IMSI	I nternational M obile S ubscriber I dentify
Kc	C ipher K ey S equence
Ki	S ubscriber A uthentication K ey
LAI	L ocation A rea I dentify
MAIO	M obile A llocation I ndex O ffset
MAT	M obile A llocation T able
MMI	M an M achine I nterface
MS	M obile S tation
MS_TXPWR_MAX_CCH	M aximum allowed transmitted RF power for MSs to access the system until commanded otherwise.
PCH	P aging C Hannel
PCS 1900	P ersonal C ommunications S ystem
P-GSM	P rimary G lobal S ystem for M obile C ommunications

PID	Protocol IDentifier
PLMN	Public Land Mobile Network
PLMN_PERMITTED	PLMN permitted for handover purposes.
RACH	Random Access CHannel
RAND	Random number used during Authentication.
RBER	Residual Bit Error Rate
R-GSM	Railways Global System for Mobile Communications
RXLEV	Received Signal LEV el parameter. A measure of the mean received signal level.
RXQUAL	Received Signal QUAL ity parameter. A measure of the mean received signal quality.
RXLEV_ACCESS_MIN	The minimum RXLEV at a MS for access to a cell.
SACCH	Slow Associated Control Channel
SACCH_TF	Slow Associated Control Channel - Traffic Full Rate
SAPI	Service Access Point Indicator
SDCCH	Stand Alone Dedicated Control CHannel
SCH	Synchronisation CHannel
SIM	Subscriber Identity Module
SMS	Short Message Service
SRES	Signature RES ponse
TCH	Traffic CHannels . Channels that carry user speech or data.
TDMA	Time Division Multiple Access
TMSI	Temporary Mobile Subscriber Identity

CHANNEL NUMBER/FREQUENCY CHARTS

P-/E-/R-GSM CHART 1 -- DOWNLINK (Base Station To Mobile)

CHANNEL NUMBERS	DOWNLINK FREQUENCIES (MHz)				
0					935.000
1 - 5	935.200	935.400	935.600	935.800	936.000
6 - 10	936.200	936.400	936.600	936.800	937.000
11 - 15	937.200	937.400	937.600	937.800	938.000
16 - 20	938.200	938.400	938.600	938.800	939.000
21 - 25	939.200	939.400	939.600	939.800	940.000
26 - 30	940.200	940.400	940.600	940.800	941.000
31 - 35	941.200	941.400	941.600	941.800	942.000
36 - 40	942.200	942.400	942.600	942.800	943.000
41 - 45	943.200	943.400	943.600	943.800	944.000
46 - 50	944.200	944.400	944.600	944.800	945.000
51 - 55	945.200	945.400	945.600	945.800	946.000
56 - 60	946.200	946.400	946.600	946.800	947.000
61 - 65	947.200	947.400	947.600	947.800	948.000
66 - 70	948.200	948.400	948.600	948.800	949.000
71 - 75	949.200	949.400	949.600	949.800	950.000
76 - 80	950.200	950.400	950.600	950.800	951.000
81 - 85	951.200	951.400	951.600	951.800	952.000
86 - 90	952.200	952.400	952.600	952.800	953.000
91 - 95	953.200	953.400	953.600	953.800	954.000
96 - 100	954.200	954.400	954.600	954.800	955.000
101 - 105	955.200	955.400	955.600	955.800	956.000
106 - 110	956.200	956.400	956.600	956.800	957.000
111 - 115	957.200	957.400	957.600	957.800	958.000
116 - 120	958.200	958.400	958.600	958.800	959.000
121 - 124	959.200	959.400	959.600	959.800	
955 - 959	921.200	921.400	921.600	921.800	922.000
960 - 964	922.200	922.400	922.600	922.800	923.000
965 - 969	923.200	923.400	923.600	923.800	924.000
970 - 974	924.200	924.400	924.600	924.800	925.000
975 - 979	925.200	925.400	925.600	925.800	926.000
980 - 984	926.200	926.400	926.600	926.800	927.000
985 - 989	927.200	927.400	927.600	927.800	928.000
990 - 994	928.200	928.400	928.600	928.800	929.000
995 - 999	929.200	929.400	929.600	929.800	930.000
1000 - 1004	930.200	930.400	930.600	930.800	931.000
1005 - 1009	931.200	931.400	931.600	931.800	932.000
1010 - 1014	932.200	932.400	932.600	932.800	933.000
1015 - 1019	933.200	933.400	933.600	933.800	934.000
1020 - 1023	934.200	934.400	934.600	934.800	

P-/E-/R-GSM CHART 2 -- UPLINK (Mobile To Base Station)

CHANNEL NUMBERS	UPLINK FREQUENCIES (MHz)				
0					890.000
1 - 5	890.200	890.400	890.600	890.800	891.000
6 - 10	891.200	891.400	891.600	891.800	892.000
11 - 15	892.200	892.400	892.600	892.800	893.000
16 - 20	893.200	893.400	893.600	893.800	894.000
21 - 25	894.200	894.400	894.600	894.800	895.000
26 - 30	895.200	895.400	895.600	895.800	896.000
31 - 35	896.200	896.400	896.600	896.800	897.000
36 - 40	897.200	897.400	897.600	897.800	898.000
41 - 45	898.200	898.400	898.600	898.800	899.000
46 - 50	899.200	899.400	899.600	899.800	900.000
51 - 55	900.200	900.400	900.600	900.800	901.000
56 - 60	901.200	901.400	901.600	901.800	902.000
61 - 65	902.200	902.400	902.600	902.800	903.000
66 - 70	903.200	903.400	903.600	903.800	904.000
71 - 75	904.200	904.400	904.600	904.800	905.000
76 - 80	905.200	905.400	905.600	905.800	906.000
81 - 85	906.200	906.400	906.600	906.800	907.000
86 - 90	907.200	907.400	907.600	907.800	908.000
91 - 95	908.200	908.400	908.600	908.800	909.000
96 - 100	909.200	909.400	909.600	909.800	910.000
101 - 105	910.200	910.400	910.600	910.800	911.000
106 - 110	911.200	911.400	911.600	911.800	912.000
111 - 115	912.200	912.400	912.600	912.800	913.000
116 - 120	913.200	913.400	913.600	913.800	914.000
121 - 124	914.200	914.400	914.600	914.800	
955 - 959	876.200	876.400	876.600	876.800	877.000
960 - 964	877.200	877.400	877.600	877.800	878.000
965 - 969	878.200	878.400	878.600	878.800	879.000
970 - 974	879.200	879.400	879.600	879.800	880.000
975 - 979	880.200	880.400	880.600	880.800	881.000
980 - 984	881.200	881.400	881.600	881.800	882.000
985 - 989	882.200	882.400	882.600	882.800	883.000
990 - 994	883.200	883.400	883.600	883.800	884.000
995 - 999	884.200	884.400	884.600	884.800	885.000
1000 - 1004	885.200	885.400	885.600	885.800	886.000
1005 - 1009	886.200	886.400	886.600	886.800	887.000
1010 - 1014	887.200	887.400	887.600	887.800	888.000
1015 - 1019	888.200	888.400	888.600	888.800	889.000
1020 - 1023	889.200	889.400	889.600	889.800	

GSM 850 CHART 1 -- DOWNLINK (Base Station to Mobile)

CHANNEL NUMBERS	DOWNLINK FREQUENCIES (MHz)				
128 - 130			869.200	869.400	869.600
131 - 135	869.800	870.000	870.200	870.400	870.600
136 - 140	870.800	871.000	871.200	871.400	871.600
141 - 145	871.800	872.000	872.200	872.400	872.600
146 - 150	872.800	873.000	873.200	873.400	873.600
151 - 155	873.800	874.000	874.200	874.400	874.600
156 - 160	874.800	875.000	875.200	875.400	875.600
161 - 165	875.800	876.000	876.200	876.400	876.600
166 - 170	876.800	877.000	877.200	877.400	877.600
171 - 175	877.800	878.000	878.200	878.400	878.600
176 - 180	878.800	879.000	879.200	879.400	879.600
181 - 185	879.800	880.000	880.200	880.400	880.600
186 - 190	880.800	881.000	881.200	881.400	881.600
191 - 195	881.800	882.000	882.200	882.400	882.600
196 - 200	882.800	883.000	883.200	883.400	883.600
201 - 205	883.800	884.000	884.200	884.400	884.600
206 - 210	884.800	885.000	885.200	885.400	885.600
211 - 215	885.800	886.000	886.200	886.400	886.600
216 - 220	886.800	887.000	887.200	887.400	887.600
221 - 225	887.800	888.000	888.200	888.400	888.600
226 - 230	888.800	889.000	889.200	889.400	889.600
231 - 235	889.800	890.000	890.200	890.400	890.600
236 - 240	890.800	891.000	891.200	891.400	891.600
241 - 245	891.800	892.000	892.200	892.400	892.600
246 - 250	892.800	893.000	893.200	893.400	893.600
251	893.800				

GSM 850 CHART 2 -- UPLINK (Mobile to Base Station)

CHANNEL NUMBERS	UPLINK FREQUENCIES (MHz)				
128 - 130			824.200	824.400	824.600
131 - 135	824.800	825.000	825.200	825.400	825.600
136 - 140	825.800	826.000	826.200	826.400	826.600
141 - 145	826.800	827.000	827.200	827.400	827.600
146 - 150	827.800	828.000	828.200	828.400	828.600
151 - 155	828.800	829.000	829.200	829.400	829.600
156 - 160	829.800	830.000	830.200	830.400	830.600
161 - 165	830.800	831.000	831.200	831.400	831.600
166 - 170	831.800	832.000	832.200	832.400	832.600
171 - 175	832.800	833.000	833.200	833.400	833.600
176 - 180	833.800	834.000	834.200	834.400	834.600
181 - 185	834.800	835.000	835.200	835.400	835.600
186 - 190	835.800	836.000	836.200	836.400	836.600
191 - 195	836.800	837.000	837.200	837.400	837.600
196 - 200	837.800	838.000	838.200	838.400	838.600
201 - 205	838.800	839.000	839.200	839.400	839.600
206 - 210	839.800	840.000	840.200	840.400	840.600
211 - 215	840.800	841.000	841.200	841.400	841.600
216 - 220	841.800	842.000	842.200	842.400	842.600
221 - 225	842.800	843.000	843.200	843.400	843.600
226 - 230	843.800	844.000	844.200	844.400	844.600
231 - 235	844.800	845.000	845.200	845.400	845.600
236 - 240	845.800	846.000	846.200	846.400	846.600
241 - 245	846.800	847.000	847.200	847.400	847.600
246 - 250	847.800	848.000	848.200	848.400	848.600
251	848.800				

DCS 1800 CHART 1 -- DOWNLINK (Base Station To Mobile)

CHANNEL NUMBERS	DOWNLINK FREQUENCIES (MHz)				
512 - 515		1805.2	1805.4	1805.6	1805.8
516 - 520	1806.0	1806.2	1806.4	1806.6	1806.8
521 - 525	1807.0	1807.2	1807.4	1807.6	1807.8
526 - 530	1808.0	1808.2	1808.4	1808.6	1808.8
531 - 535	1809.0	1809.2	1809.4	1809.6	1809.8
536 - 540	1810.0	1810.2	1810.4	1810.6	1810.8
541 - 545	1811.0	1811.2	1811.4	1811.6	1811.8
546 - 550	1812.0	1812.2	1812.4	1812.6	1812.8
551 - 555	1813.0	1813.2	1813.4	1813.6	1813.8
556 - 560	1814.0	1814.2	1814.4	1814.6	1814.8
561 - 565	1815.0	1815.2	1815.4	1815.6	1815.8
566 - 570	1816.0	1816.2	1816.4	1816.6	1816.8
571 - 575	1817.0	1817.2	1817.4	1817.6	1817.8
576 - 580	1818.0	1818.2	1818.4	1818.6	1818.8
581 - 585	1819.0	1819.2	1819.4	1819.6	1819.8
586 - 590	1820.0	1820.2	1820.4	1820.6	1820.8
591 - 595	1821.0	1821.2	1821.4	1821.6	1821.8
596 - 600	1822.0	1822.2	1822.4	1822.6	1822.8
601 - 605	1823.0	1823.2	1823.4	1823.6	1823.8
606 - 610	1824.0	1824.2	1824.4	1824.6	1824.8
611 - 615	1825.0	1825.2	1825.4	1825.6	1825.8
616 - 620	1826.0	1826.2	1826.4	1826.6	1826.8
621 - 625	1827.0	1827.2	1827.4	1827.6	1827.8
626 - 630	1828.0	1828.2	1828.4	1828.6	1828.8
631 - 635	1829.0	1829.2	1829.4	1829.6	1829.8
636 - 640	1830.0	1830.2	1830.4	1830.6	1830.8
641 - 645	1831.0	1831.2	1831.4	1831.6	1831.8
646 - 650	1832.0	1832.2	1832.4	1832.6	1832.8
651 - 655	1833.0	1833.2	1833.4	1833.6	1833.8
656 - 660	1834.0	1834.2	1834.4	1834.6	1834.8
661 - 665	1835.0	1835.2	1835.4	1835.6	1835.8
666 - 670	1836.0	1836.2	1836.4	1836.6	1836.8
671 - 675	1837.0	1837.2	1837.4	1837.6	1837.8
676 - 680	1838.0	1838.2	1838.4	1838.6	1838.8
681 - 685	1839.0	1839.2	1839.4	1839.6	1839.8
686 - 690	1840.0	1840.2	1840.4	1840.6	1840.8
691 - 695	1841.0	1841.2	1841.4	1841.6	1841.8
696 - 700	1842.0	1842.2	1842.4	1842.6	1842.8
701 - 705	1843.0	1843.2	1843.4	1843.6	1843.8
706 - 710	1844.0	1844.2	1844.4	1844.6	1844.8

DCS 1800 CHART 1 -- DOWNLINK (Base Station To Mobile)(Continued)

CHANNEL NUMBERS	DOWNLINK FREQUENCIES (MHz)				
711 - 715	1845.0	1845.2	1845.4	1845.6	1845.8
716 - 720	1846.0	1846.2	1846.4	1846.6	1846.8
721 - 725	1847.0	1847.2	1847.4	1847.6	1847.8
726 - 730	1848.0	1848.2	1848.4	1848.6	1848.8
731 - 735	1849.0	1849.2	1849.4	1849.6	1849.8
736 - 740	1850.0	1850.2	1850.4	1850.6	1850.8
741 - 745	1851.0	1851.2	1851.4	1851.6	1851.8
746 - 750	1852.0	1852.2	1852.4	1852.6	1852.8
751 - 755	1853.0	1853.2	1853.4	1853.6	1853.8
756 - 760	1854.0	1854.2	1854.4	1854.6	1854.8
761 - 765	1855.0	1855.2	1855.4	1855.6	1855.8
766 - 770	1856.0	1856.2	1856.4	1856.6	1856.8
771 - 775	1857.0	1857.2	1857.4	1857.6	1857.8
776 - 780	1858.0	1858.2	1858.4	1858.6	1858.8
781 - 785	1859.0	1859.2	1859.4	1859.6	1859.8
786 - 790	1860.0	1860.2	1860.4	1860.6	1860.8
791 - 795	1861.0	1861.2	1861.4	1861.6	1861.8
796 - 800	1862.0	1862.2	1862.4	1862.6	1862.8
801 - 805	1863.0	1863.2	1863.4	1863.6	1863.8
806 - 810	1864.0	1864.2	1864.4	1864.6	1864.8
811 - 815	1865.0	1865.2	1865.4	1865.6	1865.8
816 - 820	1866.0	1866.2	1866.4	1866.6	1866.8
821 - 825	1867.0	1867.2	1867.4	1867.6	1867.8
826 - 830	1868.0	1868.2	1868.4	1868.6	1868.8
831 - 835	1869.0	1869.2	1869.4	1869.6	1869.8
836 - 840	1870.0	1870.2	1870.4	1870.6	1870.8
841 - 845	1871.0	1871.2	1871.4	1871.6	1871.8
846 - 850	1872.0	1872.2	1872.4	1872.6	1872.8
851 - 855	1873.0	1873.2	1873.4	1873.6	1873.8
856 - 860	1874.0	1874.2	1874.4	1874.6	1874.8
861 - 865	1875.0	1875.2	1875.4	1875.6	1875.8
866 - 870	1876.0	1876.2	1876.4	1876.6	1876.8
871 - 875	1877.0	1877.2	1877.4	1877.6	1877.8
876 - 880	1878.0	1878.2	1878.4	1878.6	1878.8
881 - 885	1879.0	1879.2	1879.4	1879.6	1879.8

DCS 1800 CHART 2 -- UPLINK (Mobile to Base Station)

CHANNEL NUMBERS	UPLINK FREQUENCIES (MHz)				
512 - 515		1710.2	1710.4	1710.6	1710.8
516 - 520	1711.0	1711.2	1711.4	1711.6	1711.8
521 - 525	1712.0	1712.2	1712.4	1712.6	1712.8
526 - 530	1713.0	1713.2	1713.4	1713.6	1713.8
531 - 535	1714.0	1714.2	1714.4	1714.6	1714.8
536 - 540	1715.0	1715.2	1715.4	1715.6	1715.8
541 - 545	1716.0	1716.2	1716.4	1716.6	1716.8
546 - 550	1717.0	1717.2	1717.4	1717.6	1717.8
551 - 555	1718.0	1718.2	1718.4	1718.6	1718.8
556 - 560	1719.0	1719.2	1719.4	1719.6	1719.8
561 - 565	1720.0	1720.2	1720.4	1720.6	1720.8
566 - 570	1721.0	1721.2	1721.4	1721.6	1721.8
571 - 575	1722.0	1722.2	1722.4	1722.6	1722.8
576 - 580	1723.0	1723.2	1723.4	1723.6	1723.8
581 - 585	1724.0	1724.2	1724.4	1724.6	1724.8
586 - 590	1725.0	1725.2	1725.4	1725.6	1725.8
591 - 595	1726.0	1726.2	1726.4	1726.6	1726.8
596 - 600	1727.0	1727.2	1727.4	1727.6	1727.8
601 - 605	1728.0	1728.2	1728.4	1728.6	1728.8
606 - 610	1729.0	1729.2	1729.4	1729.6	1729.8
611 - 615	1730.0	1730.2	1730.4	1730.6	1730.8
616 - 620	1731.0	1731.2	1731.4	1731.6	1731.8
621 - 625	1732.0	1732.2	1732.4	1732.6	1732.8
626 - 630	1733.0	1733.2	1733.4	1733.6	1733.8
631 - 635	1734.0	1734.2	1734.4	1734.6	1734.8
636 - 640	1735.0	1735.2	1735.4	1735.6	1735.8
641 - 645	1736.0	1736.2	1736.4	1736.6	1736.8
646 - 650	1737.0	1737.2	1737.4	1737.6	1737.8
651 - 655	1738.0	1738.2	1738.4	1738.6	1738.8
656 - 660	1739.0	1739.2	1739.4	1739.6	1739.8
661 - 665	1740.0	1740.2	1740.4	1740.6	1740.8
666 - 670	1741.0	1741.2	1741.4	1741.6	1741.8
671 - 675	1742.0	1742.2	1742.4	1742.6	1742.8
676 - 680	1743.0	1743.2	1743.4	1743.6	1743.8
681 - 685	1744.0	1744.2	1744.4	1744.6	1744.8
686 - 690	1745.0	1745.2	1745.4	1745.6	1745.8
691 - 695	1746.0	1746.2	1746.4	1746.6	1746.8
696 - 700	1747.0	1747.2	1747.4	1747.6	1747.8
701 - 705	1748.0	1748.2	1748.4	1748.6	1748.8
706 - 710	1749.0	1749.2	1749.4	1749.6	1749.8

DCS 1800 CHART 2 -- UPLINK (Mobile to Base Station)(Continued)

CHANNEL NUMBERS	UPLINK FREQUENCIES (MHz)				
711 - 715	1750.0	1750.2	1750.4	1750.6	1750.8
716 - 720	1751.0	1751.2	1751.4	1751.6	1751.8
721 - 725	1752.0	1752.2	1752.4	1752.6	1752.8
726 - 730	1753.0	1753.2	1753.4	1753.6	1753.8
731 - 735	1754.0	1754.2	1754.4	1754.6	1754.8
736 - 740	1755.0	1755.2	1755.4	1755.6	1755.8
741 - 745	1756.0	1756.2	1756.4	1756.6	1756.8
746 - 750	1757.0	1757.2	1757.4	1757.6	1757.8
751 - 755	1758.0	1758.2	1758.4	1758.6	1758.8
756 - 760	1759.0	1759.2	1759.4	1759.6	1759.8
761 - 765	1760.0	1760.2	1760.4	1760.6	1760.8
766 - 770	1761.0	1761.2	1761.4	1761.6	1761.8
771 - 775	1762.0	1762.2	1762.4	1762.6	1762.8
776 - 780	1763.0	1763.2	1763.4	1763.6	1763.8
781 - 785	1764.0	1764.2	1764.4	1764.6	1764.8
786 - 790	1765.0	1765.2	1765.4	1765.6	1765.8
791 - 795	1766.0	1766.2	1766.4	1766.6	1766.8
796 - 800	1767.0	1767.2	1767.4	1767.6	1767.8
801 - 805	1768.0	1768.2	1768.4	1768.6	1768.8
806 - 810	1769.0	1769.2	1769.4	1769.6	1769.8
811 - 815	1770.0	1770.2	1770.4	1770.6	1770.8
816 - 820	1771.0	1771.2	1771.4	1771.6	1771.8
821 - 825	1772.0	1772.2	1772.4	1772.6	1772.8
826 - 830	1773.0	1773.2	1773.4	1773.6	1773.8
831 - 835	1774.0	1774.2	1774.4	1774.6	1774.8
836 - 840	1775.0	1775.2	1775.4	1775.6	1775.8
841 - 845	1776.0	1776.2	1776.4	1776.6	1776.8
846 - 850	1777.0	1777.2	1777.4	1777.6	1777.8
851 - 855	1778.0	1778.2	1778.4	1778.6	1778.8
856 - 860	1779.0	1779.2	1779.4	1779.6	1779.8
861 - 865	1780.0	1780.2	1780.4	1780.6	1780.8
866 - 870	1781.0	1781.2	1781.4	1781.6	1781.8
871 - 875	1782.0	1782.2	1782.4	1782.6	1782.8
876 - 880	1783.0	1783.2	1783.4	1783.6	1783.8
881 - 885	1784.0	1784.2	1784.4	1784.6	1784.8

PCS 1900 CHART 1 -- DOWNLINK (Base Station To Mobile)

CHANNEL NUMBERS	DOWNLINK FREQUENCIES (MHz)				
512 - 515		1930.2	1930.4	1930.6	1930.8
516 - 520	1931.0	1931.2	1931.4	1931.6	1931.8
521 - 525	1932.0	1932.2	1932.4	1932.6	1932.8
526 - 530	1933.0	1933.2	1933.4	1933.6	1933.8
531 - 535	1934.0	1934.2	1934.4	1934.6	1934.8
536 - 540	1935.0	1935.2	1935.4	1935.6	1935.8
541 - 545	1936.0	1936.2	1936.4	1936.6	1936.8
546 - 550	1937.0	1937.2	1937.4	1937.6	1937.8
551 - 555	1938.0	1938.2	1938.4	1938.6	1938.8
556 - 560	1939.0	1939.2	1939.4	1939.6	1939.8
561 - 565	1940.0	1940.2	1940.4	1940.6	1940.8
566 - 570	1941.0	1941.2	1941.4	1941.6	1941.8
571 - 575	1942.0	1942.2	1942.4	1942.6	1942.8
576 - 580	1943.0	1943.2	1943.4	1943.6	1943.8
581 - 585	1944.0	1944.2	1944.4	1944.6	1944.8
586 - 590	1945.0	1945.2	1945.4	1945.6	1945.8
591 - 595	1946.0	1946.2	1946.4	1946.6	1946.8
596 - 600	1947.0	1947.2	1947.4	1947.6	1947.8
601 - 605	1948.0	1948.2	1948.4	1948.6	1948.8
606 - 610	1949.0	1949.2	1949.4	1949.6	1949.8
611 - 615	1950.0	1950.2	1950.4	1950.6	1950.8
616 - 620	1951.0	1951.2	1951.4	1951.6	1951.8
621 - 625	1952.0	1952.2	1952.4	1952.6	1952.8
626 - 630	1953.0	1953.2	1953.4	1953.6	1953.8
631 - 635	1954.0	1954.2	1954.4	1954.6	1954.8
636 - 640	1955.0	1955.2	1955.4	1955.6	1955.8
641 - 645	1956.0	1956.2	1956.4	1956.6	1956.8
646 - 650	1957.0	1957.2	1957.4	1957.6	1957.8
651 - 655	1958.0	1958.2	1958.4	1958.6	1958.8
656 - 660	1959.0	1959.2	1959.4	1959.6	1959.8
661 - 665	1960.0	1960.2	1960.4	1960.6	1960.8
666 - 670	1961.0	1961.2	1961.4	1961.6	1961.8
671 - 675	1962.0	1962.2	1962.4	1962.6	1962.8
676 - 680	1963.0	1963.2	1963.4	1963.6	1963.8
681 - 685	1964.0	1964.2	1964.4	1964.6	1964.8
686 - 690	1965.0	1965.2	1965.4	1965.6	1965.8
691 - 695	1966.0	1966.2	1966.4	1966.6	1966.8
696 - 700	1967.0	1967.2	1967.4	1967.6	1967.8
701 - 705	1968.0	1968.2	1968.4	1968.6	1968.8
706 - 710	1969.0	1969.2	1969.4	1969.6	1969.8

PCS 1900 CHART 1 -- DOWNLINK (Base Station To Mobile) (Continued)

CHANNEL NUMBERS	DOWNLINK FREQUENCIES (MHz)				
711 - 715	1970.0	1970.2	1970.4	1970.6	1970.8
716 - 720	1971.0	1971.2	1971.4	1971.6	1971.8
721 - 725	1972.0	1972.2	1972.4	1972.6	1972.8
726 - 730	1973.0	1973.2	1973.4	1973.6	1973.8
731 - 735	1974.0	1974.2	1974.4	1974.6	1974.8
736 - 740	1975.0	1975.2	1975.4	1975.6	1975.8
741 - 745	1976.0	1976.2	1976.4	1976.6	1976.8
746 - 750	1977.0	1977.2	1977.4	1977.6	1977.8
751 - 755	1978.0	1978.2	1978.4	1978.6	1978.8
756 - 760	1979.0	1979.2	1979.4	1979.6	1979.8
761 - 765	1980.0	1980.2	1980.4	1980.6	1980.8
766 - 770	1981.0	1981.2	1981.4	1981.6	1981.8
771 - 775	1982.0	1982.2	1982.4	1982.6	1982.8
776 - 780	1983.0	1983.2	1983.4	1983.6	1983.8
781 - 785	1984.0	1984.2	1984.4	1984.6	1984.8
786 - 790	1985.0	1985.2	1985.4	1985.6	1985.8
791 - 795	1986.0	1986.2	1986.4	1986.6	1986.8
796 - 800	1987.0	1987.2	1987.4	1987.6	1987.8
801 - 805	1988.0	1988.2	1988.4	1988.6	1988.8
806 - 810	1989.0	1989.2	1989.4	1989.6	1989.8

PCS 1900 CHART 2 -- UPLINK (Mobile to Base Station)

CHANNEL NUMBERS	UPLINK FREQUENCIES (MHz)				
512 - 515		1850.2	1850.4	1850.6	1850.8
516 - 520	1851.0	1851.2	1851.4	1851.6	1851.8
521 - 525	1852.0	1852.2	1852.4	1852.6	1852.8
526 - 530	1853.0	1853.2	1853.4	1853.6	1853.8
531 - 535	1854.0	1854.2	1854.4	1854.6	1854.8
536 - 540	1855.0	1855.2	1855.4	1855.6	1855.8
541 - 545	1856.0	1856.2	1856.4	1856.6	1856.8
546 - 550	1857.0	1857.2	1857.4	1857.6	1857.8
551 - 555	1858.0	1858.2	1858.4	1858.6	1858.8
556 - 560	1859.0	1859.2	1859.4	1859.6	1859.8
561 - 565	1860.0	1860.2	1860.4	1860.6	1860.8
566 - 570	1861.0	1861.2	1861.4	1861.6	1861.8
571 - 575	1862.0	1862.2	1862.4	1862.6	1862.8
576 - 580	1863.0	1863.2	1863.4	1863.6	1863.8
581 - 585	1864.0	1864.2	1864.4	1864.6	1864.8
586 - 590	1865.0	1865.2	1865.4	1865.6	1865.8
591 - 595	1866.0	1866.2	1866.4	1866.6	1866.8
596 - 600	1867.0	1867.2	1867.4	1867.6	1867.8
601 - 605	1868.0	1868.2	1868.4	1868.6	1868.8
606 - 610	1869.0	1869.2	1869.4	1869.6	1869.8
611 - 615	1870.0	1870.2	1870.4	1870.6	1870.8
616 - 620	1871.0	1871.2	1871.4	1871.6	1871.8
621 - 625	1872.0	1872.2	1872.4	1872.6	1872.8
626 - 630	1873.0	1873.2	1873.4	1873.6	1873.8
631 - 635	1874.0	1874.2	1874.4	1874.6	1874.8
636 - 640	1875.0	1875.2	1875.4	1875.6	1875.8
641 - 645	1876.0	1876.2	1876.4	1876.6	1876.8
646 - 650	1877.0	1877.2	1877.4	1877.6	1877.8
651 - 655	1878.0	1878.2	1878.4	1878.6	1878.8
656 - 660	1879.0	1879.2	1879.4	1879.6	1879.8
661 - 665	1880.0	1880.2	1880.4	1880.6	1880.8
666 - 670	1881.0	1881.2	1881.4	1881.6	1881.8
671 - 675	1882.0	1882.2	1882.4	1882.6	1882.8
676 - 680	1883.0	1883.2	1883.4	1883.6	1883.8
681 - 685	1884.0	1884.2	1884.4	1884.6	1884.8
686 - 690	1885.0	1885.2	1885.4	1885.6	1885.8
691 - 695	1886.0	1886.2	1886.4	1886.6	1886.8
696 - 700	1887.0	1887.2	1887.4	1887.6	1887.8
701 - 705	1888.0	1888.2	1888.4	1888.6	1888.8
706 - 710	1889.0	1889.2	1889.4	1889.6	1889.8

PCS 1900 CHART 2 -- UPLINK (Mobile to Base Station) (Continued)

CHANNEL NUMBERS	UPLINK FREQUENCIES (MHz)				
711 - 715	1890.0	1890.2	1890.4	1890.6	1890.8
716 - 720	1891.0	1891.2	1891.4	1891.6	1891.8
721 - 725	1892.0	1892.2	1892.4	1892.6	1892.8
726 - 730	1893.0	1893.2	1893.4	1893.6	1893.8
731 - 735	1894.0	1894.2	1894.4	1894.6	1894.8
736 - 740	1895.0	1895.2	1895.4	1895.6	1895.8
741 - 745	1896.0	1896.2	1896.4	1896.6	1896.8
746 - 750	1897.0	1897.2	1897.4	1897.6	1897.8
751 - 755	1898.0	1898.2	1898.4	1898.6	1898.8
756 - 760	1899.0	1899.2	1899.4	1899.6	1899.8
761 - 765	1900.0	1900.2	1900.4	1900.6	1900.8
766 - 770	1901.0	1901.2	1901.4	1901.6	1901.8
771 - 775	1902.0	1902.2	1902.4	1902.6	1902.8
776 - 780	1903.0	1903.2	1903.4	1903.6	1903.8
781 - 785	1904.0	1904.2	1904.4	1904.6	1904.8
786 - 790	1905.0	1905.2	1905.4	1905.6	1905.8
791 - 795	1906.0	1906.2	1906.4	1906.6	1906.8
796 - 800	1907.0	1907.2	1907.4	1907.6	1907.8
801 - 805	1908.0	1908.2	1908.4	1908.6	1908.8
806 - 810	1909.0	1909.2	1909.4	1909.6	1909.8

MS/BTS POWER CHARTS

MOBILE POWER CLASSES – PHASE 1

POWER CLASS	GSM 850 / 900		DCS 1800		PCS 1900	
	Maximum Peak Power	dBm	Maximum Peak Power	dBm	Maximum Peak Power	dBm
1	20 W	+43	1 W	+30	1 W	+30
2	8 W	+39	0.25 W	+24	0.25 W	+24
3	5 W	+37	---	---	---	---
4	2 W	+33	---	---	---	---
5	0.8W	+29	---	---	---	---

MOBILE POWER CONTROL LEVELS – PHASE 1

POWER CONTROL LEVEL	PEAK POWER (dBm)		
	GSM 850 / 900	DCS 1800	PCS 1900
0	+43	+30	+30
1	+41	+28	+28
2	+39	+26	+26
3	+37	+24	+24
4	+35	+22	+22
5	+33	+20	+20
6	+31	+18	+18
7	+29	+16	+16
8	+27	+14	+14
9	+25	+12	+12
10	+23	+10	+10
11	+21	+8	+8
12	+19	+6	+6
13	+17	+4	+4
14	+15	* +4	* +4
15	+13	* +4	* +4
16	* +13	* +4	* +4
17	* +13	* +4	* +4
18	* +13	* +4	* +4
19	* +13	* +4	* +4
20	* +13	* +4	* +4
21	* +13	* +4	* +4
22 to 28	* +13	* +4	* +30
29	* +13	* +4	* +30
30	* +13	* +4	* +30
31	* +13	* +4	* +30

Note: * = reserved values. Value shown is used as expected receive level.

MOBILE POWER CLASSES – PHASE 2

POWER CLASS	GSM 850 / 900		DCS 1800		PCS 1900	
	Maximum Peak Power	dBm	Maximum Peak Power	dBm	Maximum Peak Power	dBm
1	---	---	1 W	+30	1 W	+30
2	8 W	+39	0.25 W	+24	0.25 W	+24
3	5 W	+37	4 W	+36	2 W	+33
4	2 W	+33	---	---	---	---
5	0.8 W	+29	---	---	---	---

MOBILE POWER CONTROL LEVELS – PHASE 2

POWER CONTROL LEVEL	PEAK POWER (dBm)		
	GSM 850 / 900	DCS 1800	PCS 1900
0	+39	+30	+30
1	+39	+28	+28
2	+39	+26	+26
3	+37	+24	+24
4	+35	+22	+22
5	+33	+20	+20
6	+31	+18	+18
7	+29	+16	+16
8	+27	+14	+14
9	+25	+12	+12
10	+23	+10	+10
11	+21	+8	+8
12	+19	+6	+6
13	+17	+4	+4
14	+15	+2	+2
15	+13	0	0
16	+11	0	0
17	+9	0	0
18	+7	0	0
19	+5	0	0
20	+5	0	0
21	+5	0	0
22 to 28	+5	0	+33
29	+5	+36	+33
30	+5	+34	+33
31	+5	+32	+32

BTS POWER CLASSES

BTS POWER CLASS GSM	MAXIMUM PEAK POWER	dBm
1	320 - 640 W	+55 to +58
2	160 - 320 W	+52 to +55
3	80 - 160 W	+49 to +52
4	40 - 80 W	+46 to +49
5	20 - 40 W	+43 to +46
6	10 - 20 W	+40 to +43
7	5 - 10 W	+37 to +40
8	2.5 - 5 W	+34 to +37
Micro BTS GSM		
M1	0.08 - 0.25 W	+19 to +24
M2	0.03 - 0.08 W	+14 to +19
M3	0.01 - 0.03 W	+9 to +14

BTS POWER CLASS DCS 1800	MAXIMUM PEAK POWER	dBm
1	20 - 40 W	+43 to +46
2	10 - 20 W	+40 to +43
3	5 - 10 W	+37 to +40
4	2.5 - 5 W	+34 to +37
Micro BTS DCS 1800		
M1	0.5 - 1.6 W	+27 to +32
M2	0.16 - 0.5 W	+22 to +27
M3	0.05 - 0.16 W	+17 to +22

BTS POWER CLASS PCS 1900	MAXIMUM PEAK POWER	dBm
1	20 - 40 W	+43 to +46
2	10 - 20 W	+40 to +43
3	5 - 10 W	+37 to +40
4	2.5 - 5 W	+34 to +37
Micro BTS PCS 1900		
M1	0.5 - 1.6 W	+27 to +32
M2	0.16 - 0.5 W	+22 to +27
M3	0.05 - 0.16 W	+17 to +22

REFERENCE SENSITIVITY LEVELS

MS REFERENCE SENSITIVITY	dBm
GSM mobile class 1, 2, 3	-104
GSM hand portable class 4 & 5	-102
DCS 1800 class 1 & 2	-100
DCS 1800 class 3	-102
PCS 1900 all classes	-102

BTS REFERENCE SENSITIVITY	dBm
GSM standard BTS	-104
GSM Mini 1	-97
GSM Mini 2	-92
GSM Mini 3	-87
DCS 1800 standard BTS	-104
DCS 1800 Mini 1	-102
DCS 1800 Mini 2	-97
DCS 1800 Mini 3	-92
PCS 1900 standard BTS	-104
PCS 1900 Mini 1	-102
PCS 1900 Mini 2	-97
PCS 1900 Mini 3	-92

CONVERSION FACTORS

To convert between dB μ V (emf), dB μ V/m and dBm, use the following formulae:

$$\text{dB}\mu\text{V}(\text{emf}) = \text{dBm} + 113.0$$

$$\text{dB}\mu\text{V}/\text{m} = \text{dBm} + 136.5$$

Note: This assumes 0 dBi antenna gain and a frequency of 925 MHz
Ref. GSM Rec. 05.05 Section 5.

Some useful values are given below:

dBm	dB μ V (emf)	dB μ V/m
-110	3.0	26.5
-104.0	9.0	32.5
-102.0	11.0	34.5
-101.0	12.0	35.5
-99.0	14.0	37.5
-93.0	20.0	43.5
-85.0	28.0	51.5
-64.5	48.5	72.0
-48.0	65.0	88.5
-43.0	70.0	93.5

RX_LEV VALUES

The reported Rx_LEV values for received signal level are as follows:

Rx_LEV	Received Signal Level	Rx_LEV	Received Signal Level
0	Less than -110 dBm	40	-71 dBm to -70 dBm
1	-110 dBm to -109 dBm	41	-70 dBm to -69 dBm
2	-109 dBm to -108 dBm	42	-69 dBm to -68 dBm
3	-108 dBm to -107 dBm	43	-68 dBm to -67 dBm
4	-107 dBm to -106 dBm	44	-67 dBm to -66 dBm
5	-106 dBm to -105 dBm	45	-66 dBm to -65 dBm
6	-105 dBm to -104 dBm	46	-65 dBm to -64 dBm
7	-104 dBm to -103 dBm	47	-64 dBm to -63 dBm
8	-103 dBm to -102 dBm	48	-63 dBm to -62 dBm
9	-102 dBm to -101 dBm	49	-62 dBm to -61 dBm
10	-101 dBm to -100 dBm	50	-61 dBm to -60 dBm
11	-100 dBm to -99 dBm	51	-60 dBm to -59 dBm
12	-99 dBm to -98 dBm	52	-59 dBm to -58 dBm
13	-98 dBm to -97 dBm	53	-58 dBm to -57 dBm
14	-97 dBm to -96 dBm	54	-57 dBm to -56 dBm
15	-96 dBm to -95 dBm	55	-56 dBm to -55 dBm
16	-95 dBm to -94 dBm	56	-55 dBm to -54 dBm
17	-94 dBm to -93 dBm	57	-54 dBm to -53 dBm
18	-93 dBm to -92 dBm	58	-53 dBm to -52 dBm
19	-92 dBm to -91 dBm	59	-52 dBm to -51 dBm
20	-91 dBm to -90 dBm	60	-51 dBm to -50 dBm
21	-90 dBm to -89 dBm	61	-50 dBm to -49 dBm
22	-89 dBm to -88 dBm	62	-49 dBm to -48 dBm
23	-88 dBm to -87 dBm	63	Greater than - 48 dBm
24	-87 dBm to -86 dBm		
25	-86 dBm to -85 dBm		
26	-85 dBm to -84 dBm		
27	-84 dBm to -83 dBm		
28	-83 dBm to -82 dBm		
29	-82 dBm to -81 dBm		
30	-81 dBm to -80 dBm		
31	-80 dBm to -79 dBm		
32	-79 dBm to -78 dBm		
33	-78 dBm to -77 dBm		
34	-77 dBm to -76 dBm		
35	-76 dBm to -75 dBm		
36	-75 dBm to -74 dBm		
37	-74 dBm to -73 dBm		
38	-73 dBm to -72 dBm		
39	-72 dBm to -71 dBm		

RX_QUAL VALUES

The reported Rx_QUAL values for received signal level are as follows:

Rx_QUAL Value	Bit Error Rate Range	Mean Value
0	< 0.2 %	0.14 %
1	0.2 - 0.4 %	0.28 %
2	0.4 - 0.8 %	0.57 %
3	0.8 - 1.6 %	1.13 %
4	1.6 - 3.2 %	2.26 %
5	3.2 - 6.4 %	4.53 %
6	6.4 - 12.8 %	9.05 %
7	> 12.8 %	18.10 %

SECTION 1 TECHNICAL SPECIFICATION

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SIGNAL GENERATOR

Modulation	:	GMSK and CW
Frequency	:	
Frequency Bands	:	869 - 894 MHz (GSM 850) (Optional) 925 - 960 MHz (E-GSM) 921 - 960 MHz (R-GSM) (Optional) 1.805 - 1.880 GHz (DCS 1800) (Optional) 1.930 - 1.990 GHz (PCS 1900) (Optional)
Resolution	:	1 Hz
Main RF Input/Output Level	:	
Range	:	-40 dBm to -120 dBm
Accuracy – GSM 850	:	
Absolute	:	± 1.5 dB (Notes 1 and 2)
Typical	:	± 0.6 dB (Notes 4 and 5)
Accuracy - E/R-GSM	:	
Absolute	:	± 1.5 dB (Notes 1 and 2)
Typical	:	± 0.6 dB (Notes 4 and 5)
Accuracy - DCS 1800	:	
Absolute	:	± 2.0 dB (Notes 1 and 2)
Typical	:	± 0.7 dB (Notes 4 and 5)
Accuracy - PCS 1900	:	
Absolute	:	± 2.0 dB (Notes 1 and 2)
Typical	:	± 0.8 dB (Notes 4 and 5)
Resolution	:	0.1 dB
Auxiliary RF Input/Output Level	:	
Range	:	-25 dBm to -105 dBm

MEASURING RECEIVER

Frequency	:	
Frequency Bands	:	824 - 849 MHz (GSM 850) (Optional) 880 - 915 MHz (E-GSM) 876 - 915 MHz (R-GSM) (Optional) 1.710 - 1.785 GHz (DCS 1800) (Optional) 1.850 - 1.910 GHz (PCS 1900) (Optional)
Main RF Input/Output	:	
Impedance	:	50 Ω nominal
VSWR	:	≤ 1.3 : 1
Connector	:	N Type female
Input Level Range	:	+46 dBm to -1 dBm PEP
Maximum Power	:	80 W PEP; 10 W continuous
Auxiliary RF Input/Output	:	
Connector Type	:	TNC female
Input Level Range	:	+31 dBm to -16 dBm PEP
Maximum Power	:	2.5 W PEP; 0.3 W continuous

Section 1 TECHNICAL SPECIFICATION

MEASUREMENTS

Phase Error

Range	:	10° RMS; ± 30° peak
Accuracy RMS	:	< +0.3° at 5° phase error
Accuracy Peak	:	< +7.2°

Frequency Error

Range	:	± 2.5 kHz
Accuracy	:	< ±6.5 Hz ± frequency standard (Note 3)

Power Level

Range	:	+46 dBm to -1 dBm PEP
Absolute Accuracy	:	< ± 1.0 dB (GSM 850) (Note 2)
		< ± 1.0 dB (E-GSM) (Note 2)
		< ± 1.0 dB (R-GSM) (Note 2)
		< ± 1.3 dB (DCS 1800) (Note 2)
		< ± 1.3 dB (PCS 1900) (Note 2)
Relative Accuracy	:	< ± 0.4 dB

Power Profile

Dynamic Range	:	> 48 dB
---------------	---	---------

Time of Arrival

Accuracy	:	± 0.05 bit
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Modulation Spectrum

Dynamic Range	:	> 52 dB (Note 3)
Frequency Span	:	1 MHz (5 channels)

FREQUENCY STANDARD

Internal	:	± 1 x 10 ⁻⁶ (04T - supplied as standard fit)
(all sources of error)	:	± 1.2 x 10 ⁻⁷ (Option 04E)
	:	± 3.5 x 10 ⁻⁸ (Option 04F)

Internal Standard Output Port

(Only supplied with Options 04E and 04F).

Signal	:	10 MHz sinewave
Output Level	:	0 dBm ±2 dB into 50 Ω
Connector Type	:	BNC (female)

Reference Output Port

(Only supplied with Options 04E and 04F).

Connector Type	:	BNC (female)
Frequency	:	Same as frequency standard in use (10 MHz or 13 MHz)
Level	:	+9 dBm nominal into 50 Ω (Option 04E and 04F)

Reference Input Port

Connector Type : BNC (female)

Reference Input

An external reference signal that meets the following specification may be applied to the REF. IN connector:

Frequency	:	10 MHz or 13 MHz (Option 04E and 04F), ± 2.5 ppm		
Input Level	:	0.1 to 2.0 V rms into 50 Ω (-2 to +19 dBm)		
Impedance/Coupling	:	50 Ω nominal / a.c.		
Harmonics	:	<-25 dBc		
Spurious Signals	:	<-90 dBc for offsets <100 kHz (excluding line spurs)		
SSB Phase Noise (Max permitted)	:		@ 10 MHz	@ 13 MHz
		<u>Offset (Hz)</u>	<u>dBc/Hz</u>	<u>dBc/Hz</u>
		1	-85	-83
		10	-115	-113
		100	-135	-133
		1000	-138	-136
		≥ 10000	-138	-136
Line Spurs (Max permitted)	:		@ 10 MHz	@ 13 MHz
		<u>Offset (Hz)</u>	<u>dBc</u>	<u>dBc</u>
		50	-69	-67
		100	-75	-73
		150	-79	-77
		200 to 500	-81 to -89	-79 to -87

INTERFACES

Memory Cards

Type	:	2 off PC card (PCMCIA v 2.0) Type 2 sockets
Card types	:	SRAM, Flash EEPROM and Hard disk drives complying with PC Card ATA Standard. PC Cards should have a CIS in common or attribute memory.
Number of cards	:	One or two of Type I or Type II, or one Type III

Synchronisation Output : TTL

GPIB : ANSI/IEEE 488.2 - 1987

Compatibility Subset : SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT0, C0, E1

RS232

2 configurable ports : 9-way male D-type

Parallel Printer : 25-way female D-type

Section 1 TECHNICAL SPECIFICATION

GENERAL CHARACTERISTICS

Power Supplies

Voltage Ranges	:	85 - 130 V AC and 180 - 264 V AC
Frequency Range	:	45 - 66 Hz
Power Consumption	:	225 VA maximum

Dimensions and Environmental Characteristics

Height	:	210 mm
Width	:	350 mm
Depth	:	420 mm
Weight	:	12 kg approx.
Operating Temperature	:	0° to 50° C
Calibration Period	:	1 year
EMC and RFI	:	Complies with EN61326-1.
Safety	:	Complies with EN61010-1

- Note:**
- (1) For signals greater than -110 dBm.
 - (2) Valid for 15° C to 35° C.
 - (3) 10 bursts averaged, non hopping, Options 04E or 04F.
 - (4) For signals > 89.9 dBm into 50 Ω.
 - (5) Valid from 15 °C to 31 °C.

SECTION 2 GENERAL DESCRIPTION

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INTRODUCTION

The Racal Instruments Digital Radio Test Set Model 6103 is designed to test mobile radio telephones operating on the GSM 850, E-GSM, DCS 1800, PCS 1900 and R-GSM Digital Cellular Radio systems.

The Test Set is fully self contained in one portable unit and requires no other external equipment. All functions are available through use of the front panel hard/soft keys and spinwheel. For production test systems, remote control of all tests and readings can be achieved via the IEEE488 (GPIB) interface.

The 6103 provides a range of test and measurement functions to enable quick and easy testing of GSM 850 / E-GSM / DCS 1800 / PCS 1900 / R-GSM Mobiles in a production or field maintenance environment.

The 6103 contains an RF generator and measuring receiver enabling a comprehensive range of tests to be performed. These include signalling tests, Bit Error Ratio (BER) tests on the Mobile's receiver using the loopback facility, and GSM 850 / E-GSM / DCS 1800 / PCS 1900 / R-GSM specific transmitter tests including phase trajectory, power and modulation measurements.

A loopback mode within the 6103 Test Set allows the audio section of the mobile to be tested via the RF connector. This is complemented by the ability to record voice messages and replay them.

The 6103 can accept an external 10 MHz (or 13 MHz with Option 04T fitted) frequency standard.

The 6103 provides a variety of timing signals, including bit rate, markers, slot number markers and a programmable trigger signal. These signals can be used for synchronising external equipment and for gating an external spectrum analyser.

DESIGN FEATURES

The user interface is designed to allow operators of any skill level to test and fault-find GSM 850, E-GSM, DCS 1800, PCS 1900 and R-GSM mobile telephones. The front panel controls are particularly easy to use, and a 'no button' test feature allows telephones to be tested quickly without operating any keys. Another mode allows all the important measurements to be viewed simultaneously: any reading that is out of limits is highlighted to facilitate rapid repair.

Special integrated transmitter and receiver tests perform several measurements simultaneously to reduce the complexity of the test procedure, and the processing time, to a minimum.

For testing sub-systems, or diagnosing faulty mobile telephones, the Unsynchronised Mode provides a flexible signal source and measuring receiver with an automatic signal capture facility.

An automatic test sequence mode is provided where predefined test sequences, or user written sequences, are executed.

A 6103 Test Set can operate on the E-GSM and DCS 1800 bands (Option 02), or on the E-GSM and PCS 1900 bands (Option 03). With Option 06 fitted, it can operate on E-GSM, DCS 1800 and PCS 1900 bands; the addition of Option 05 to Option 06 provides operation on R-GSM bands as well. With Option 08 fitted, it can operate on GSM 850 and PCS 1900 bands. The combinations of frequency bands provided by valid combinations of Options fitted is illustrated in the following table.

Section 2 GENERAL DESCRIPTION

Options	Software Enabled Frequency Bands			
02	E-GSM	---	DCS 1800	---
03	E-GSM	---	---	PCS 1900
06	E-GSM	---	DCS 1800	PCS 1900
06 + 05	E-GSM	R-GSM	DCS 1800	PCS 1900
08	GSM 850	---	---	PCS 1900

TEST INFORMATION

To test the signalling procedures in the Mobile, the 6103 is used to simulate a GSM 850, DCS 1800, PCS 1900, E-GSM or R-GSM base station. This enables tests such as Call Set-up and Termination to be performed. Using the 6103 to perform Bit Error Ratio measurements allows the Mobile's receiver sensitivity to be measured.

Test Modes

There are five basic test modes available:

- Single Test mode
- Test Sequences mode
- Multimode
- Unsynchronized mode
- Remote Operation

Single Test Mode

The single test mode enables the user to select and perform a single test, either once, or continuously. The result of the test can be either a *Pass/Fail* and a set of measured parameters, or a set of measured parameters only. Before running the test, the user can vary the conditions under which the test is performed.

During execution of a test the Mobile is (normally) placed automatically into the correct state by the 6103, using signalling over the RF link.

At the end of a test in the single test mode, the state of the Mobile will not be changed. This allows subsequent tests to be completed in the minimum time, thus enabling the programmer to use these tests to form the basis of an optimised test sequence in a production test system.

Test Sequences Mode

In this mode, test sequences can be defined and run from the 6103 front panel. The sequences can then be stored as files on a DOS compatible memory card for future use. Any test from the Single Tests menu may be used. Each test in a sequence can be programmed to terminate on *Hold*, *Continue*, *Exit* or *Repeat*, and test results may be printed on *Pass* or *Fail*, or both. Instrument set-up files are loaded as part of the test sequence. Individual test parameter changes may be made while defining a test. A summary can be displayed at the end of the sequence and printed, if required.

Multimode

This mode of operation is particularly useful for fault finding and diagnosis. In this mode the Test Set performs all the major GSM 850 / E-GSM / DCS 1800 / PCS 1900 / R-GSM measurements, and the cycle of measurements runs continuously. The operator can vary most of the test parameters without terminating the call. Results are displayed and updated constantly during the course of testing, and can be compared to marked limits. Bargraphs are used to give the user a pictorial indication of results. If the results exceed the limits, the bars change colour. PASS/FAIL indications are given where possible, including highlighting the measured reading.

The operator can switch the 6103 between five 'zoom' sub-modes, each of which provides a more detailed presentation of results.

The five 'zoom' sub-modes are:

- BER
- Phase Error Graph
- Power Profile Graph
- Modulation Spectrum Display
- Audio Speech Loopback

Unsynchronised Mode

If a mobile has faults that prevent the air interface signalling protocol being used, the 6103 in Unsynchronised Mode provides the user with suitable diagnostic test facilities.

In Unsynchronised Mode, the 6103 can act as a signal generator and tuned receiver to allow RF diagnostic tests to be performed on both uplink and downlink functions. No error limits are applied to the results obtained in this mode.

To test the transmitter function, a PC or service facility is used to command the mobile to enter Test Mode and transmit signals to the 6103. The 6103 will automatically lock on to any signals and can be used to measure power, power profile, frequency, phase, modulation spectrum, etc, of the transmitted signal.

To test the receiver function, the 6103 is used as a signal generator to provide suitable modulations, frequency, level, etc, and the mobile's response can be studied.

The receiver has an automatic scanning capability which can be disabled if the uplink frequency is known. The measuring receiver can capture and analyse modulated or unmodulated signals.

Remote Operation

Internal facilities for remote control of the 6103 via a GPIB interface are available. The interface protocol allows the full range of parameters and tests to be utilised, including Multimode and Unsynchronised Mode. The commands and responses for each test are listed in Section 6 of this Volume of the Manual.

The interface messages and responses comply with IEEE 488.2 - 1987 standard Digital Interface for Programmable Instrumentation, "Standard Codes, Formats, Protocols, and Common Commands".

Section 2 GENERAL DESCRIPTION

LIST OF TESTS

The following is a summary of the tests that can be performed by the 6103 Test Set:

Functional Tests

(Refer to Section 4 / FUNCTIONAL TESTS)

Test	Purpose
Synchronisation / Registration	<p>To check that the mobile can detect the control channel (CCH) transmitted by the base station (Test Set).</p> <p>To check that the mobile can perform Periodic Location Updating procedure.</p>
Call Setup	<p>To check that the Mobile correctly performs the initial communication and exchange of data and timing information between itself and the Test Set.</p> <p>To check that the Mobile can correctly set-up a call between itself and the Test Set when the call set-up is initiated by the Test Set (Base Station).</p> <p>To check that the Mobile can correctly set-up a call between itself and the Test Set, when the call is initiated by the Mobile.</p>
Call Termination	<p>To check that the Mobile can correctly perform a (Base Station initiated) termination of a call set-up between the Test Set (Base Station) and the Mobile.</p> <p>To check that the Mobile can correctly perform a (Mobile initiated) termination of a call set-up between the Test Set (Base Station) and the Mobile.</p> <p>To establish the correct action of the Mobile when a radio link failure occurs and a call is lost.</p>
Handover	<p>To test the Mobile's ability to perform a handover dynamically during a call. (This applies to intra-cell handovers only).</p>
Dual Band Handover	<p>Checks the ability of a dual-band mobile to be re-assigned to a new ARFCN on the alternative band or to a new ARFCN in the neighbour cell of the same band. GSM 850 / PCS 1900 (Option 008) or E-GSM / DCS 1800 bands only. (This applies to inter-cell handover only.)</p>

Transmitter Tests

(Refer to Section 4 / TRANSMITTER TESTS)

Test	Purpose
Transmitter Test	To establish whether the Mobile is transmitting a signal with the prescribed GMSK modulation (phase) accuracy. This test is also used to measure the fine frequency error. Measures the Mobile's transmitter power and burst profile. Checks that the Mobile's average transmitter output burst power is in accordance with the defined limits. To display the GMSK modulation spectrum.
Power Levels / Steps	To measure the Mobile's average transmitter output power at different power levels.
Timing Advance	To establish whether the Mobile can correctly adjust the timing advance of its burst transmissions.

Receiver Tests

(Refer to Section 4 / RECEIVER TESTS)

Test	Purpose
Receiver Test	To measure the ability of the Mobile to operate correctly at low input signal levels. Note: This is a compliance test, i.e. it tests that the bit error ratio (BER) is sufficiently low for a given input signal level. The BER is measured for Class Ib and Class II bits. FERs are also recorded. Tests that the Mobile can compensate for Doppler shift. Tests the ability of the Mobile to correctly encrypt and decrypt messages. To perform this test, a test SIM is required which contains known encryption parameters. To establish the ability of the Mobile to maintain call operation in a frequency hopping environment, without appreciable degradation in link quality. Checks that the reported RXLEV and RXQUAL values are consistent with the test conditions.
Sensitivity	Measures the absolute sensitivity of the Mobile for a given BER.

Section 2 GENERAL DESCRIPTION

Speech / SMS Tests

(Refer to Section 4 / SPEECH / SMS TESTS)

Test	Purpose
Voice Loop-Back	Speech data transmitted from the Mobile is looped back by the Test Set after a programmable delay. This allows a qualitative assessment to be made of the Mobile's audio system.
Receive Speech From Mobile Send Speech To Mobile	Tests the Mobile's ability to receive and transmit speech data. (Up to 10 seconds of speech may be stored on memory card and used). A memory card is required for these tests.
Point To Point Message - Send Point To Point Message - Receive	Tests the Mobile's ability to send and receive Short Message Service messages during a call or in the idle state.
Short Message - Extended Send Short Message - Extended Receive	Same as Point to Point Message Send/Receive with more extensive results. (Option 320)
Point to Point Message - Status Report (GPIB test only).	Checks the ability of the mobile to receive a point to point Short Message Status Report. (Option 320)
Point to Point Message - Command (GPIB test only).	Checks the ability of the mobile to send a point to point Short Message Command. (Option 320)
Voice Quality Assessment	Allows subjective analysis of speech quality (similar to Voice Loopback). It also allows transmission of pre-recorded audio patterns (including ETSI test patterns) and makes available audio data in many different formats for user post-processing

Data / Fax Tests

(Refer to Section 4 / DATA / FAX TESTS)

Test	Purpose
Send Data to Mobile	Checks that known data from memory card or from an external source can be transmitted from the Test Set to the mobile. A count of bytes and elapsed time enables the data rate to be assessed, together with parity errors and successful transfer.
Receive Data from Mobile	Checks that known data can be transmitted from the mobile to the Test Set and recorded on memory card or external equipment. A count of bytes and elapsed time enables the data rate to be assessed, together with parity errors and successful transfer.
Bi-directional Data	Checks that the mobile can simultaneously send and receive data. Checks that known data from an external source can be transmitted from the Test Set to the mobile and simultaneously from the mobile to the Test Set. A count of bytes and elapsed time enables the data rate in both directions to be assessed, together with parity errors and successful transfer.
Send Fax to Mobile	Using a typical GSM fax terminal and modem, fax data is transmitted from the Test Set to the mobile. A count of bytes and elapsed time enables the data rate to be assessed, together with parity errors and successful transfer.
Receive Fax from mobile	Using a typical GSM fax terminal and modem, fax data is transmitted from the mobile to the Test Set. A count of bytes and elapsed time enables the data rate to be assessed, together with parity errors and successful transfer.

Section 2 GENERAL DESCRIPTION

Test Sequences

(Refer to Section 4 / TEST SEQUENCES)

Turbo Test Sequence - Single Band	This performs a pre-defined short sequence of tests to give a quick check of the mobile's functionality at the top, middle and bottom of the frequency band. The transmitter and receiver capabilities are tested at each ARFCN. The mobile power level is set to maximum power for the first test, minimum power for the third test, and a power level in the middle for the second test.
Turbo Test Sequence - Dual Band	This sequence performs the same sequence of tests as for Single Band, and includes a dual band handover after the third test on the first band. The first three tests are then repeated on the second band, using MID, LOW and HIGH ARFCNs appropriate to the new band. For the second set of three tests, the Mobile Power Level starts at the lowest value, changes to MID for the second test and HIGH MAX for the third test.
Quick Auto Test Sequence	This performs a pre-defined short sequence of tests to give a quick check on the mobile's functionality at the top, middle and bottom of the frequency band.
Full Auto Test Sequence	This performs a pre-defined long sequence of tests to give a thorough check on the mobile's functionality at the top, middle and bottom of the frequency band.
'No Button' Test Sequence	<p>This performs a brief sequence of tests, initiated automatically from the Main Menu following mobile registration and call setup. The transmitter test and the receiver test are executed at a single frequency in the middle of the frequency band.</p> <p>The test performs 10 key measurements in less than 15 seconds.</p>
Battery Life Test	An RIBASIC sequence is available for battery life testing. This performs a sequence of tests to check the battery life of a mobile.

Interactive Modes

(Refer to Section 4 / INTERACTIVE MODES)

Multimode	Allows the operator to modify parameter values in real time and see the effect (on measurements) of changing the operating conditions of the mobile.
Unsynchronised Mode	Allows the operator to use the 6103 as a signal generator and tuned receiver to run engineering and RF diagnostic tests on a mobile with severe faults. (No error limits applied).

Self Check Tests

(Refer to Section 4 / SELF CHECK TESTS)

Self Check BER	Tests the BER of the 6103 Test Set using an internal loopback. Performs the Bit Error Ratio measurement between the start of the Transmit path and the end of the Receive path.
Self Check Burst Analysis	Analyses the burst parameters of the 6103 Test Set using an internal loopback. Measures the phase error and power profile of the Test Set transmitter, and displays the modulation spectrum.
Self Check Unsynchronised Mode	This is a continuous self-check mode which analyses the burst parameters of the 6103 Test Set using an internal loopback. It measures the phase and frequency error, power profile and timing offset of the transmitted pulses, and displays the modulation spectrum.

SECTION 3 PREPARATION FOR USE

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PACKAGING

Unpack the Test Set carefully to avoid unnecessary damage to the factory packaging.

If the Test Set is to be returned for calibration or repair, consult the Service Manager or the local Racal Instruments agent for instructions before shipment.

If the Test Set is returned, the original packaging should be used whenever possible. If this is not available, a strong shipping container, fitted with internal packing capable of preventing movement of the Test Set within the container, must be used.

Note: The packaging is made from recyclable materials.

WARNING: THE EQUIPMENT MUST BE POSITIONED SO THAT THE MAINS POWER INPUT CABLE CAN BE EASILY DISCONNECTED IN AN EMERGENCY.

ACCESSORIES

The following accessories are included with the Test Set at shipment:

Description	Qty
Power lead (2 m) with plug	1
Fuse, 3.15 A(T) (plus 1 spare)	2
6103 Digital Radio Test Set Operator Manual	1
Software Release Note (Note)	1

Note: The Software Release Note contains up-to-date information on new features, possible restrictions, etc.

INSTALLATION

The 6103 is a free standing Test Set that is self contained and needs no other test equipment to perform the tests defined in this Handbook.

The Test Set power supply unit is an auto-ranging unit that will automatically adjust itself to the power supply input. Check that the local power voltage is within the range indicated on the rear panel of the Test Set, and that the power fuse has the correct value.

A warm up time of at least 10 minutes should be allowed before the Test Set becomes operational. After this time the Test Set reference oscillator will have stabilised sufficiently for the mobile to synchronise to the Test Set. (Test Sets fitted with the 04T option may require in excess of 15 minutes to stabilise adequately). To make frequency or power measurements to the specified accuracy, a warm-up time of 30 minutes is recommended. Alternatively, an external frequency standard that meets the required accuracies listed in Section 1 Technical Specification may be used.

Note: Test Sets that have been stored un-powered for greater than 2 weeks will require a longer time period to achieve the necessary frequency stability.

WARNING: IF THE EQUIPMENT HAS BEEN STORED AT LOW TEMPERATURES, TIME SHOULD BE ALLOWED FOR RECOVERY TO THE LOCAL AMBIENT TEMPERATURE BEFORE USE. WHERE CONDENSATION OF WATER VAPOR IS EITHER PRESENT OR LIKELY TO BE PRESENT, ALLOW THE EQUIPMENT TO DRY OUT BEFORE USE. CONDENSATION IS LIKELY TO OCCUR WHEN A COLD OBJECT ENCOUNTERS A WARMER, HUMID, ENVIRONMENT.

Section 3 PREPARATION FOR USE

FRONT PANEL CONNECTIONS

The 6103 front panel layout is shown in Figure 3.1

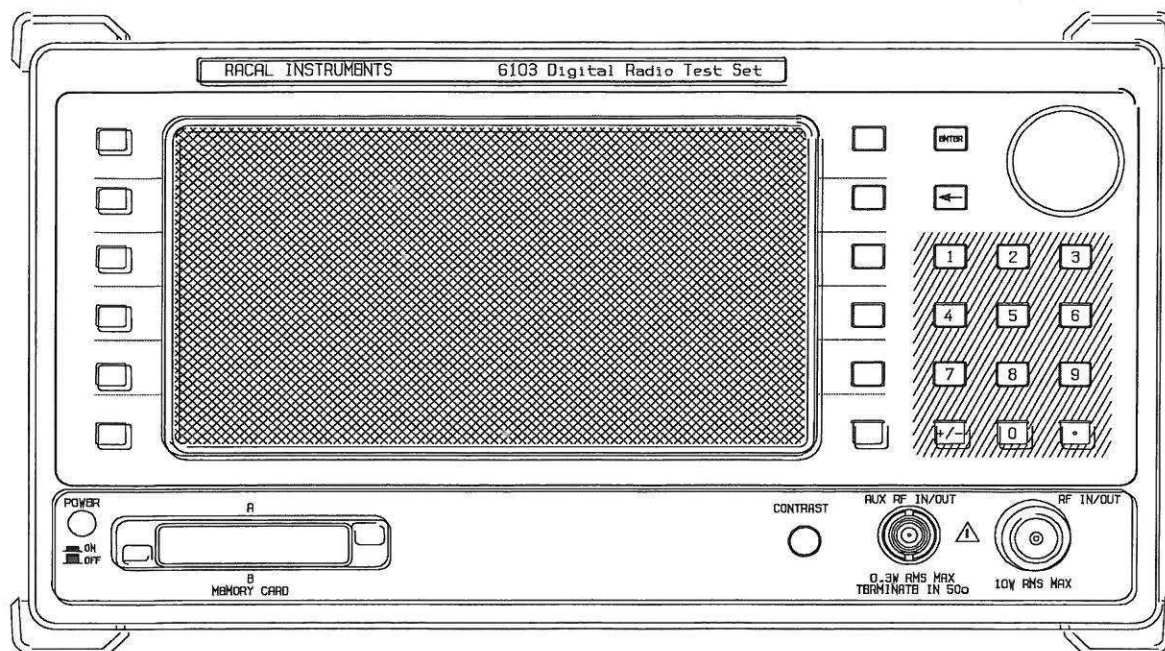


Figure 3.1 6103 Front Panel

RF IN/OUT and AUX RF IN/OUT Connectors

The mobile under test is connected to the Test Set by means of the main RF IN/OUT connector on the front panel of the 6103. No other connection to the mobile is required.

If a higher signal level is required, the power attenuator may be bypassed by taking the signal from the AUX RF IN/OUT connector on the front panel.

- CAUTION:**
- (1) This connection has only limited power handling capability - normal MS output power must NOT be connected at this point.
 - (2) If the AUX RF IN/OUT connector is not used, it must be terminated using the 50-ohm load provided. Power level measurement will be affected if the connector is not correctly terminated.

Memory Card Interface

CAUTION: Electrostatic discharge can damage electronic equipment. Touch a grounded metal object before handling the memory card.

This is a PCMCIA interface version 2.00. The dual socket supports SRAM, Flash EEPROM and Hard Disk Drive cards to PC Card ATA Standard, as follows:

- One or two Type I cards
- One or two Type II cards, or
- One Type III card

Insert a Memory Card in one of the two Memory Card sockets (A or B) as required.

Note: Due to the general nature of the PCMCIA standard, there is some variation between cards made by different manufacturers. Users are advised to test a particular card for compatibility before bulk purchase. The following PCMCIA Cards are approved for use with the 6103 Test Set and are available from Racal Instruments Ltd:

Option	Description	Manufacturer	Remarks
77	Memory Card (2 Mbyte)	Centennial	SRAM type (rechargeable battery - recharges in socket).
78	Flash Memory Card (10 Mbyte)	Sandisk	
79	Removeable Hard Disk (650 Mbyte)	Calluna	

Section 3 PREPARATION FOR USE

REAR PANEL CONNECTIONS

The 6103 rear panel layout is shown in Figure 3.2 and Figure 3.3.

Note: INT. STD. OUT and REF OUT connectors are not supplied with Option 04T frequency standard.

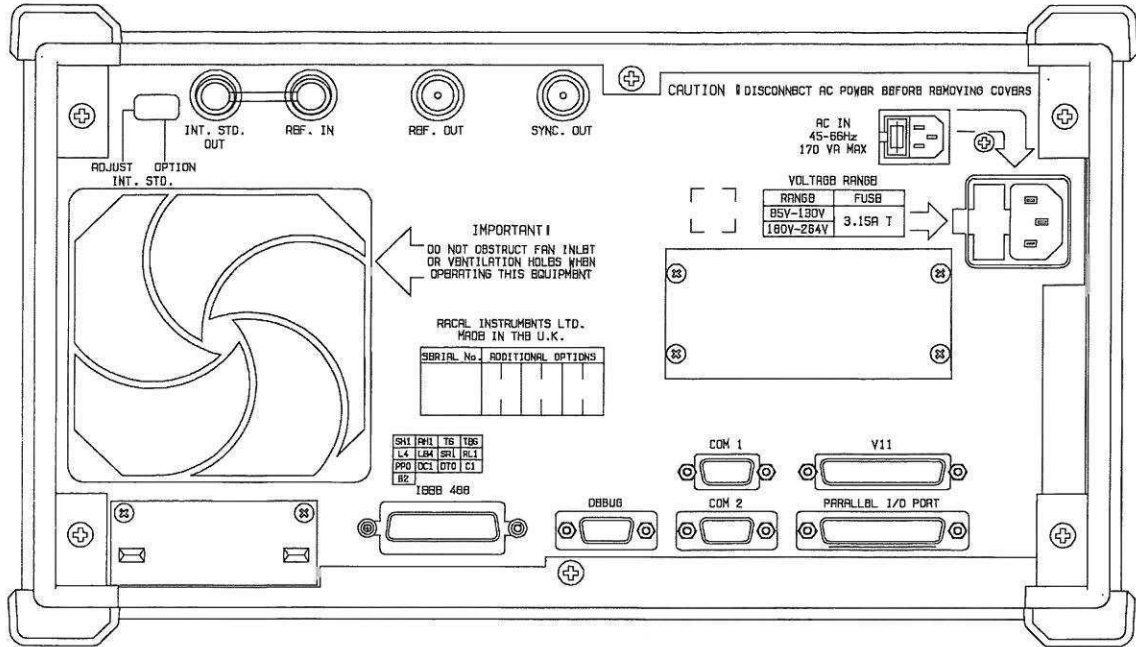


Figure 3.2 6103 Rear Panel (Early Models)

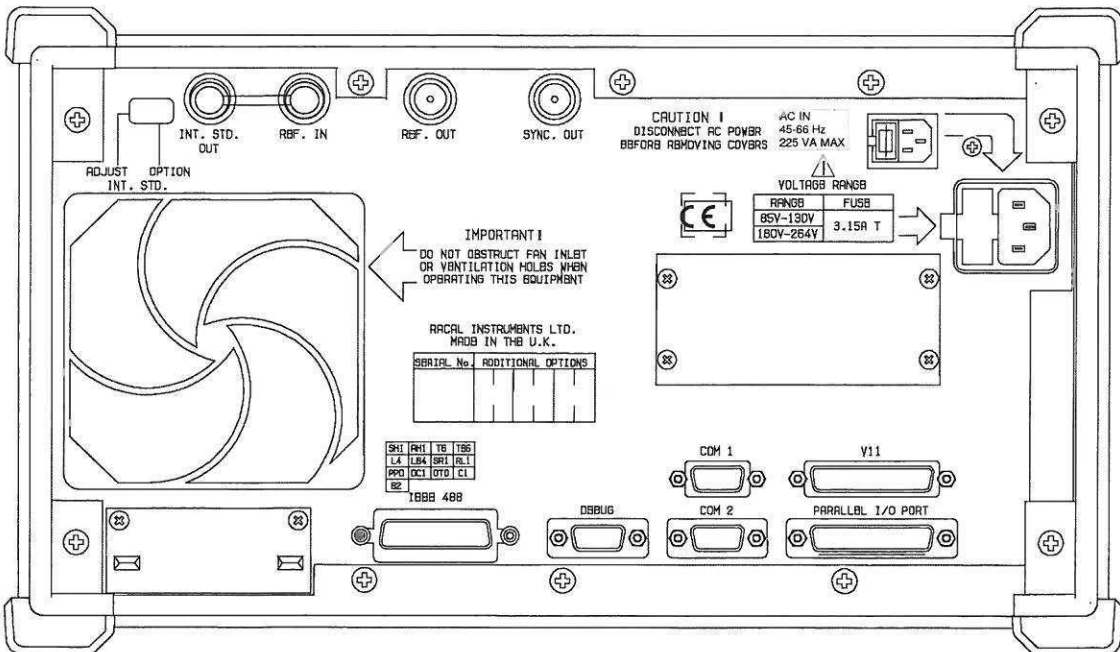


Figure 3.3 6103 Rear Panel

SYNC OUT Connector

This output provides a programmable TTL level signal for synchronising an external spectrum analyser or logic analyser. Connection is via a BNC socket.

On and Off times are selectable on any position within a frame (specified by bit positions) with 1/16 bit resolution.

All outputs are active high, i.e. output goes high at start of defined period.

Default state for all outputs: Low

Output voltage swing (each output):	Low:	< 0.5 V (max sink current 5 mA)
	High:	> 4.0 V (max source current 5 mA)

The 13 MHz output from the internal frequency standard can also be routed to this output.

DEBUG Connector

(For Racal Instruments Use Only)

Although not a supported feature of the 6103, this port can provide additional information (suitable for designers and manufacturers) about the mobile-to Test Set signalling. Contact Racal Instruments Ltd Help Desk to discuss possible applications.

Section 3 PREPARATION FOR USE

RS232 Connectors COM 1 and COM 2

These two connectors provide access to the RS232 interface. They can also be allocated to the following functions:

- Printer
- Remote control (including code and test sequence download)

Both connectors are 9 pin D-type (male). Standard PC RS232 connection cables should be used.

The pinout connections for the connectors are:

COM 1		COM 2	
Pin	Function	Pin	Function
1	CD	1	CD
2	RX	2	RX
3	TX	3	TX
4	DTR	4	DTR
5	Ground	5	Ground
6	DSR	6	DSR
7	RTS	7	RTS
8	CTS	8	CTS
9	Spare	9	Spare

Both interfaces are configurable, and the default configuration is the 'three wire' type interface using Xon/Xoff flow control. The following parameters may be selected:

Baud Rate	:	600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Number of data bits	:	6, 7, 8
Number of parity bits	:	none, even, odd, mark, space
Number of stop bits	:	0, 1, 2

The ports can be used to monitor various internal signalling states within the Test Set. To access these non-supported 'debug' functions, connect a VT220 compatible terminal to the RS232 port and set to:

Baud Rate	-	9600
Data Bits	-	8
Parity	-	None
Stop bits	-	2
Scroll	-	Jump scroll

If a PC is used then the serial interface (COM1) on the PC should be configured as above. This is achieved by including the following line in the PC's AUTOEXEC.BAT program (stored in the root directory):

```
MODE COM1:96,N,2
```

Refer to Racal Instruments Ltd, Digital Radio Product Support Group, for details of information available at the port.

If a port is used to drive a printer over the serial interface, then it should be configured as follows:

Baud Rate	-	9600
Data Bits	-	8
Parity	-	None
Stop bits	-	2

Parallel I/O Connector

This is a standard parallel interface port that is used for attaching a printer to the Test Set.

Connector Type: 25-way D-type (female)

Pinout Connections:

Pin	Signal	Pin	Signal
1	STROBE	14	AUTOFD
2	D0	15	ERROR
3	D1	16	INIT
4	D2	17	SLIN
5	D3	18 to 25	GROUND
6	D4		
7	D5		
8	D6		
9	D7		
10	ACK		
11	BUSY		
12	PE		
13	SLCT		

A standard parallel printer cable can be used. This is available from Racal Instruments Ltd as Option 92

V11 Connector

This port is not currently used.

IEEE 488 Connector

This is a standard GPIB interface port which may be used for external control of the Test Set from a GPIB controller. A standard GPIB cable should be used.

Connector Type: 24-way IEEE 488 (female)

Pinout Connections:

Pin	Signal	Pin	Signal
1	D1	13	D5
2	D2	14	D6
3	D3	15	D7
4	D4	16	D8
5	EOI	17	REN
6	DAV	18 to 24	GROUND
7	NRFD		
8	NDAC		
9	IFC		
10	SRQ		
11	ATN		
12	GROUND		

Section 3

PREPARATION FOR USE

REF IN Connector

The input to this port can be:

- (1) 10 MHz input from the INT. STD. OUT port (04T frequency standard Option only). Substitute the link connection provided.
- (2) 10 MHz input from an external frequency standard.
- (3) 13 MHz input from an external frequency standard (04E or 04F frequency standard Options only).

(See heading Frequency Standard Selection for further details).

Connector Type: BNC (female)

REF OUT Connector

(04E or 04F Frequency Standard Options only).

The output from this port is a buffered version of the signal received at the REF IN connector (see heading Frequency Standard Selection for further details).

Connector Type: BNC (female)

INT. STD. OUT Connector

(04E or 04F Frequency Standard Options only).

The output from this connector is a 10 MHz signal from the internal frequency standard. If this signal is required for internal use it is linked to the REF IN connector using the link supplied. (See heading Frequency Standard Selection for further details).

Connector Type: BNC (female)

Frequency Standard Selection

Note: Reference frequency sources are pre-calibrated and should not be adjusted because this will invalidate the instrument Calibration.

If adjustment of the frequency reference is required, the Test Set should be returned to Racal Instruments Ltd or approved Service Centre for calibration.

There are three frequency standard Options available for the 6103 Test Set:

04T
04E
04F

04T Option

The basic option 04T uses a 13 MHz oscillator. On the MMI display, use the *Test Set Settings* option from the Self Tests / System Menu to select 'INT 13 MHz' to use this 'free-running' mode of operation. Refer to Section 5 / SELF TESTS / SYSTEM MENU.

If required, the 13 MHz oscillator may be phase-locked to an external 10 MHz precision reference (which must be connected to the REF IN connector). On the MMI display, use the *Test Set Settings* option from the Self Tests / System Menu to select 'EXT 10 MHz' to use this mode of operation. Refer to Section 5 / SELF TESTS / SYSTEM MENU

04E and 04F Options

The higher-precision Options 04E and 04F each have an on-board precision reference 10 MHz oscillator and a 13 MHz oscillator from which internal 13 MHz signals are derived.

An output from the precision reference 10 MHz oscillator is available at the REF OUT connector on the rear panel.

The 13 MHz oscillator can be phase-locked to either a 10 MHz reference signal, or a 13 MHz reference signal, which must be connected to the REF IN connector.

- (1) To phase lock the 13 MHz oscillator to a 10 MHz signal, use the *Test Set Settings* option from the Self Tests / System Menu to select '10 MHz' mode of operation. The 10 MHz signal can be derived from an external customer-supplied source, or from the internal 10 MHz oscillator (by linking REF OUT to REF IN using the link supplied). Refer to Section 5 / SELF TESTS / SYSTEM MENU.
- (2) To phase lock the 13 MHz oscillator to a 13 MHz signal, use the *Test Set Settings* option from the Self Tests / System Menu to select '13 MHz' mode of operation. The 13 MHz signal must be derived from an external customer-supplied source. Refer to Section 5 / SELF TESTS / SYSTEM MENU.

Note: If an external frequency reference is used, it must conform to the specification defined in Section 1 Technical Specification otherwise the performance of the Test Set may be impaired.

Section 3 PREPARATION FOR USE

POWER SUPPLY

Voltage Setting

The Test Set power supply unit is an auto-ranging unit that senses the voltage and frequency of the supply input and automatically adjusts the output to the correct voltage. No selection or adjustment by the user is necessary.

A.C. power applied to the Test Set can be in the following ranges:

Voltage: 85 - 130 V a.c. or 180 - 264 V a.c.

Frequency: 45 - 66 Hz

The Power ON/OFF switch is on the front panel.

Equipment Power Fuse

The power fuse holder is incorporated in the power input connector unit. Before attempting to remove or fit a fuse, ensure that the Test Set is switched OFF and the power lead is disconnected from the power input connector.

The fuse is a 5 mm x 20 mm glass cartridge, surge-resist type. The fuse ratings are as follows:

Voltage Range	Fuse Type	Rating	Racal Part Number
85 - 130 V	IEC 127, Sheet 3	3.15AT 250 V	23-0025
180 - 264 V	IEC 127, Sheet 3	3.15AT 250 V	23-0025

The System is normally supplied fitted with a 3.15 A(T) fuse for use on both ranges. A spare fuse is also stored in the fuse holder. (Instructions for changing a fuse are given under the heading SERVICE AND MAINTENANCE at the end of this Section).

WARNING: DO NOT USE FUSES OF A DIFFERENT SPECIFICATION.

Power Lead

A power lead is supplied for use with the Test Set. If this lead is used in the UK, a 5 A fuse should be fitted in the power plug. The socket connector that mates to the Test Set is a right-angle connector to allow the Test Set to stand on its rear feet.

POWER-ON SELF CHECKS

The POWER ON/OFF switch on the front panel is a two-position button switch. When the switch is set to ON, the Test Set goes through an automatic start-up procedure and automatically runs the start-up self tests. After approximately 2 seconds the display is initialised and the screen displays test information as each test runs. At the end of the test sequence, the 6103 GSM logo is displayed and then, after a short pause, the Main Menu softkeys are displayed.

If a failure is detected during start-up, the BITE (built in test equipment) failure indication given to the operator will depend upon the phase of start-up in which it is detected. There are three distinct phases of start-up, before the application software is activated:

- Hard Boot
- Soft Boot
- Self Checks

During the Hard Boot phase, a detected failure is indicated by a series of 'beeps' on the buzzer, as shown below.

Test	Failure Indication
Boot PROM check sum	Buzzer (10 beeps)
SCSI Controller	Buzzer (9 beeps)
Internal Processor Functions	Buzzer (2 beeps)
DRAM checks	Buzzer (3 beeps)
Flash Boot Code check sum	Buzzer (4 beeps)

Note: If one of these failure indications occurs, the unit is unserviceable and should be switched off and returned to Racal Instruments or an approved Service Centre.

When the Hard Boot phase is completed, the Soft Boot phase commences and carries out an extensive series of Self Checks before application software is downloaded and initiated.

During the Soft Boot phase, progress is shown in two successive tables which appear on the Test Set display, as illustrated below:

Power up Tests	
Internal QUICC Peripherals	√
PLD Configuration	√
Key Pad	√
Main DRAM check	√

Power up tests Cont...	
Serial EEPROM checksums	√
Application Code Checksums	√
Base Band Processor Boot Code self checks	√
Download of Base Band Processor code	√
Initialising Main Processor Code	√

- Note:**
- (1) When each test is completed a √ appears in the right hand column.
 - (2) If a test fails, an X is shown instead in the right hand column. Instructions telling the user what to do are presented as a line of text at the bottom of the table.

Section 3

PREPARATION FOR USE

When the Self Checks are completed (with no failures), the Main Menu screen is displayed and the operator can begin to use the MMI facilities; however, the warm-up period must be complete (as described above under the heading INSTALLATION) before reliable measurements can be taken.

INTERFERENCE FROM NETWORK SIGNALS

Under certain test conditions it is possible for a mobile phone to detect an RF signal from an operational GSM 850, GSM 900, DCS 1800 or PCS 1900 network. Should this arise, it may cause the phone to fail to recognise the signals from the 6103 Test Set. This problem is caused by:

- (1) The mobile taking its frequency reference from the network signal and not from the 6103 Test Set.
- (2) The network signals having carrier frequencies that are derived from a timebase that is different to the Test Set by more than a certain value. (This difference varies from mobile to mobile, but is typically 1 ppm).

Consequently the mobile is unable to demodulate the signals from the Test Set because it cannot recognise them.

The following steps can be taken to avoid this situation:

- (1) Set the Test Set control channel and traffic channel levels to -40 dBm. The default is -85 dBm.
- (2) Use a high stability frequency standard such as Option 04E or laboratory house standard.
- (3) Provide a screened enclosure for the mobile or conduct the tests in a screened environment.

SOFTWARE UPDATES

As additional features become available on the Test Set, new versions of the Software will be distributed to holders of software support contracts. (Users who do not currently have a Racal Instruments Support Contract can purchase one at any time from Racal Instruments Ltd or approved Agent). Each new release will be supplied on a floppy disc together with a Software Release Note that gives details of changes since the previous release and instructions on performing the download. A PC and RS232 cable, or GPIB cable, to connect the PC to the Test Set are necessary to accomplish the update; alternatively, a memory card can be used to reduce the time taken to transfer the code to the Test Set.

Note: Prior to installation a prompt for a unique password is displayed: this applies to Software Version 02.01 and beyond.

Software Update Using a PC

Use an RS232 cable (Null Modem, e.g. Option 90) to connect the PC to the COM1 port on the Test Set, or a GPIB cable to connect the PC to the IEEE 488 connector on the Test Set.

A software utility (WINLOAD) is supplied with the new software to download the software from floppy disc via drive C: to the Test Set. Follow the instructions provided in the Software Release Note.

Note: This procedure can take up to half an hour to perform.

Software Update Using a PC Card

The new software is supplied as *.BIN files, which may be copied to a DOS formatted PC Card memory card.

To load the software from the PC Card to the Test Set, insert the PC Card in one of the slots in the front panel of the Test Set and follow the instructions provided in the Software Release Note.

Note: This procedure takes approximately 5 minutes.

Section 3

PREPARATION FOR USE

SERVICE AND MAINTENANCE

The 6103 is modular in design to enable ease of servicing to either module or component level. However, users are invited to take advantage of the repair and calibration services offered by Racal Instruments and their worldwide network of support centres.

Routine Maintenance

- (1) Every month the fan filter should be checked, and cleaned if necessary (see Repair Procedures).
- (2) Every twelve months the fan filter should be replaced (Racal Part No. 24-0262) (see Repair Procedures).
- (3) After 5 to 7 years approximately, depending on usage, it may be necessary to replace the LCD backlight. The Test Set must be returned to Racal Instruments or to an approved Service Agent for this work to be done.
- (4) After 8 years service it may be necessary to replace the frequency standard if the tuning range becomes too restricted. The Test Set must be returned to Racal Instruments or to an approved Service Agent for this work to be done.
- (5) Every ten years the lithium battery for non-volatile memory should be replaced. The Test Set must be returned to Racal Instruments or to an approved Service Agent for this work to be done.

Calibration Requirements

The 6103 Test Set should be returned for calibration to Racal Instruments Ltd, or approved Service Centres, not less than once a year.

Repair Procedures

Fitting a New Power Fuse

WARNING: LETHAL VOLTAGES MAY BE PRESENT. BEFORE REPLACING A FUSE, ENSURE THAT THE TEST SET AND MAINS POWER SUPPLY ARE SWITCHED OFF AND THE POWER CABLE IS DISCONNECTED FROM THE TEST SET.

- (1) Using a screwdriver or suitable small instrument, prise forward the fuse tray from the power connector assembly, as shown in Figure 3.4 and Figure 3.5.

Note that the first slot in the tray holds a spare fuse (as supplied) and the second slot (nearest the power connector assembly) holds the fuse in use.

- (2) Check that the spare fuse is of the correct rating, as follows:

Voltage Range	Fuse Type	Rating	Racal Part Number
85 - 130 V	IEC 127, Sheet 3	3.15AT 250 V	23-0025
180 - 264 V	IEC 127, Sheet 3	3.15AT 250 V	23-0025

Remove the fuse in use and replace it with the spare fuse, then push the fuse tray back into place.

- (3) Ascertain the cause of the failure and repair as necessary before next power-up.

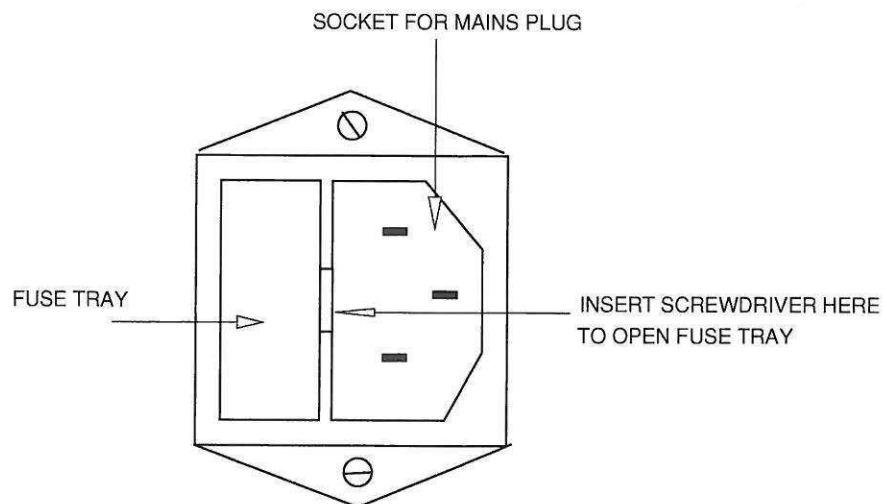


Figure 3.4 Power Connector Assembly - Fuse Tray Closed

Section 3 PREPARATION FOR USE

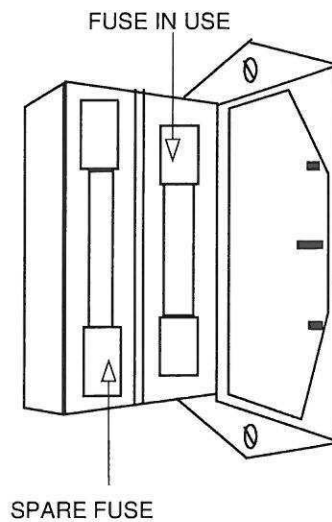


Figure 3.5 Power Connector Assembly - Fuse Tray Open (Side View)

Cleaning The Test Set

The 6103 Test Set should be cleaned as follows:

- (1) Ensure that the Test Set is switched OFF and disconnected from the mains power supply and other equipment.
- (2) If the Test Set has recently been used and the case is warm, wait until it cools to approximately ambient temperature.
- (3) Using a clean damp cloth, wipe the Test Set carefully and thoroughly to remove dust and grime. Take care to avoid ingress of moisture into connectors, keys, buttons, slots, etc.
- (4) Wipe the Test Set dry with a clean dry cloth and/or wait until it is completely dry before reconnecting it to the mains power supply and other equipment.

Cleaning the Fan Filter

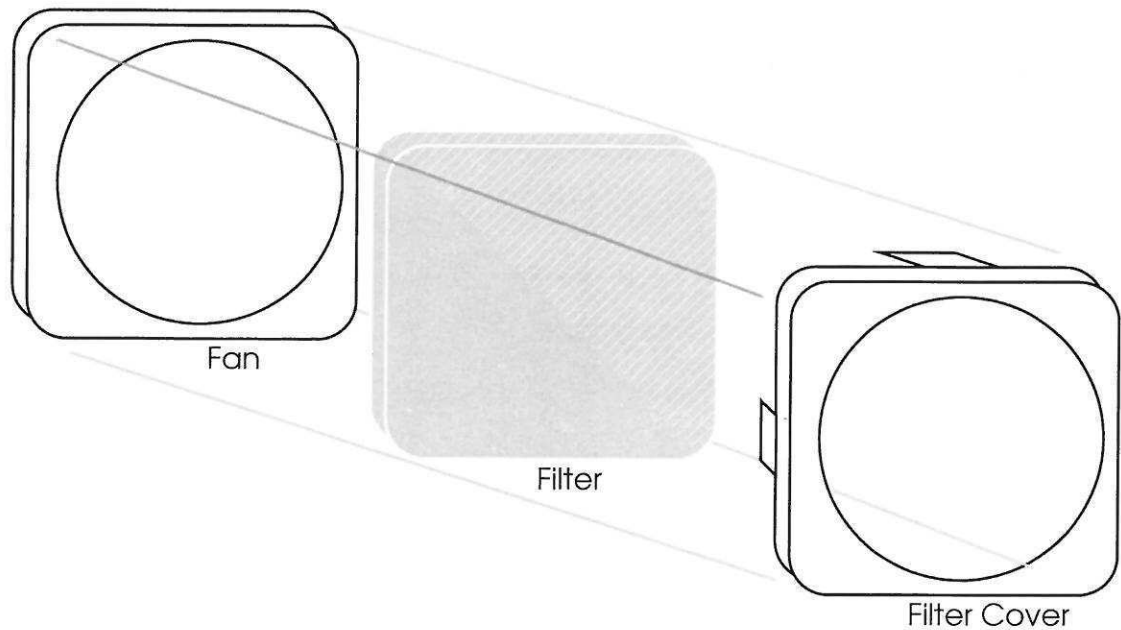


Figure 3.6 Fan/Filter/Filter Cover Assembly

Figure 3.6 illustrates the fan, filter and filter cover assembly. The procedure for cleaning the filter, or fitting a new filter, is as follows:

- (1) Release the four clips holding the filter cover on the fan and then carefully remove the filter cover from the fan.
- (2) Remove and clean the filter. Wash it in soapy water, rinse, and allow it to dry thoroughly.
- (3) Place the filter back inside the filter cover and refit the cover on the fan.

Section 3

PREPARATION FOR USE

FAULT REPORTING

If problems are found with the operation of the 6103 software or hardware (that are not caused by an obvious hardware failure) or with this manual, a Problem Report Sheet should be copied, filled in, and faxed to the Racal Instruments Help Desk at the number quoted on the sheet. A blank Problem Report Sheet can be found at the end of this Manual; this will ensure that your enquiry is dealt with promptly by Racal Instruments Customer Service Department.

Please ensure that the Problem Report (FAX) Sheet includes the following information:

- (1) Customer Company Name and Location.
- (2) Name of person reporting the problem.
- (3) Unit serial number (marked on the rear of the Test Set).
- (4) Current Software Issue in use
(i.e. Unit Software Version and
Software Versions: MAIN, BBP, DSP, Hardboot, Softboot).
- (5) A full description of the problem, including details of whether the fault is continuous or occasional, what operations preceded the occurrence of the fault, and any other relevant information.
- (6) Date.
- (7) Severity of the fault (i.e. causes Test Set to become non-functional, causes some tests to become non-functional, causes a test or part test to become non-functional, etc).

When the Problem Report Sheet is received, Racal Instruments will reply as soon as possible with a faxed Response Sheet. If further investigation is required, another Response Sheet will be generated when the problem has been cured.

6103 INITIAL FAILURE DIAGNOSIS PROCEDURE

Before reporting problems with the 6103 Test Set, try to answer the following questions. Some of the more common faults can be rectified by working through this procedure.

Does the Test Set power up?

If not:

- Check the mains fuses.
- Check the display contrast control.

Do all the Self Checks pass?

- Do the boot checks pass and display the Main menu?
- Do the Self Tests pass? (See the Self Tests / System Menu)

Does the mobile register (location updating)?

If not:

- Check the RF connector and cables.
- Does the mobile lock onto the live network?

If so:

- Try a manual network selection.
- Try using a test SIM.
- Try shielding the mobile from the network.
- Try powering up the mobile after connecting it to the Test Set.
- If possible check that the frequency standard in use is within specification.
- Check the external standard settings.

Can you set up a call to the Test Set?

If not:

- Try using a test SIM.
- Try a network call to verify the phone.
- Do you get any error messages?
If so, what are they?

Are the transmit power readings too low?

If so:

- Check for losses and poor VSWR in the cable, use the offset function to compensate.
- Is the cable rated for 1 GHz or 2 GHz for DCS 1800?
- Are you using too many RF adaptors?

Are the sensitivity readings too low?

If so:

- Check for losses and poor VSWR in the cable, use the offset function to compensate.
- Is the cable rated for 1 GHz or 2 GHz for DCS 1800?
- Are you using too many RF adaptors?
- Does the RXLEV report from the mobile confirm the expected level? Use Multimode.
- Are you using a live network SIM, if so try a test SIM.

For any unsolved problem, complete the Problem Report Sheet with all relevant information, such as:

- Error/status messages (if any).
- The tests and actions that preceded the problem.
- Is the failure repeatable? If so what are the steps?
- Any work around that you have discovered?

FACSIMILE TRANSMISSION

Sheetof

TO: Racal Instruments Help Desk
 Racal Instruments Ltd
 480 Bath Road, Slough, Berkshire
 SL1 6BE, United Kingdom

FAX No : +44 (0) 1628 - 662017
Telephone: +44 (0) 1753 - 741010
Date:

PROBLEM REPORT SHEET
 (To Be Copied)

Racal Office Use
 Log No.
 Date Received

USER DETAILS:
 Company:
 Contact Name:
 Telephone:
 Fax:
 Address:

PRODUCT DETAILS:
 Product: **6103 Digital RadioTest Set**
 Serial No:
Software Versions: UNIT:
 MAIN: BBP:
 DSP:
Firmware Versions:
 Hardboot: Softboot:

PC OR GPIB CONTROLLER (if used):
 Manufacturer:
 DOS Version:
 Windows™ Version:

DESCRIPTION OF PROBLEM OR QUESTION: (Please include any supporting documentation)

What error messages were displayed ?

PROBLEM RATING: (please circle one)
A: Major Fault **B:** Minor Fault **C:** Documentation Error **D:** Suggested Enhancement