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Schedule of Site
Commissioning Tests
SCT 44
Issue 2
August 1998

**Nokia V.33 Modem,
GI74 Multiplexer
and Associated
Communications
Equipment**

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Registered Office
National Grid House
Kirby Corner Road
Coventry
CV4 8JY

Registered in
England and Wales
No. 2366977

Published by:

The National Grid Company plc
Kelvin Avenue
Leatherhead
Surrey KT22 7ST

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SCHEDULE OF SITE COMMISSIONING TESTS

NOKIA V.33 MODEM, GI74 MULTIPLEXER AND ASSOCIATED COMMUNICATIONS EQUIPMENT

1 INTRODUCTION

The purpose of this document is to:-

- (i) Specify procedures to provide evidence of the time, date and status/configuration of the system being taken into service.
- (ii) Define the tests to be carried out for commissioning Nokia and associated communications equipment for SCADA systems.
- (iii) Provide Pro-Forma documentation for the results of the above tests for assistance with future fault location and upgrade requirements.

2 TEST OBJECTIVES

The objectives of the Site Commissioning Tests are:-

- (i) To confirm the configuration of the Modems, Multiplexers and associated interface equipment contained within the Nokia DSF 3600 modem subrack (detailed installation instructions are available in the appropriate installation instruction).
- (ii) To establish the continuity, quality and performance characteristics of the associated analogue private circuits.
- (iii) To confirm the correct operation of all test facilities provided by the equipment in (i) above.
- (iv) To confirm reliable transmission of all data passed across the SCADA transmission system outlined above.

3 SYSTEM CONFIGURATION

The typical configuration of the communications equipment contained within the Nokia DSF 3600 modem subrack is outlined in Appendix A. This subrack has single or dual power supply variants.

The system consists of an analogue private circuit, (typically a KeyLine 3 Option 4 private circuit rented from BT), over which data is transmitted at up to 14,400 bps using the Nokia N1440 (DS 61720) Modem complying with the ITU-T (formerly CCITT) V.33 recommendation.

The data interface of the N1440 modem is connected to the aggregate bit stream of a Nokia DS 61800 Multiport Card to provide up to 6 channels. Various configurations are available to divide the aggregate bandwidth between the six channels, eg 6 channels at 2,400 bps or 1 channel at 9,600 bps and 2 channels at 2,400 bps (see configuration guide in Appendix B2.1 for all available options). Each Multiport card channel can be configured for synchronous or asynchronous operation.

At least one of the Multiport card channels will be configured to 2,400 bps synchronous operation, for connecting to a Version 2.0 GI74 Multiplexer (PSI 9092B). The GI74 Multiplexer, which is a National Grid Company plc (NGC) proprietary unit, provides seven low speed channels, configurable to various speed (max. 300 bps) and data formats including the GI74 protocol (see configuration guide in Appendix B3.2). Note - the configuration guide given in Appendix B3.1 is for the Version 1.0 GI74 Multiplexer (PSI 9092). These units are all in the process of being upgraded to the Version 2.0 GI74 Multiplexer (PSI 9092B), under TDC 6047.

Substation sites adjacent to a power station, normally require a dedicated channel on the Multiport card for the Electronic Despatch Logging (EDL) data service. As this data service needs to terminate in the power station, an onward-linked connection is required from the Multiport card. This is achieved using a pair of Nokia 4-wire or 2-wire Baseband modems.

The following NGC proprietary units, which are also mounted within the Nokia DSF 3600 subrack, provide alternative interface presentations for the GI74 Multiplexer.

- (i) The Telegraph Card (PSI 9096).
- (ii) The Tandem Unit (PSI 9089).

NOTE: The Telegraph card may be connected directly to the Nokia Multiport card if required.

4 SYSTEM TESTS

The system tests will validate correct operation of the following modules and facilities:-

EQUIPMENT	MODEL NO/TYPE	PSI NO	SYSTEM TESTS
Analogue Private Circuit	BT Keyline 3 Option 4	N/A	To BT KeyLine 3 Option 4 parameters specification Specification444specsss
Nokia Crate (Single PSU)	DSF 3600.7	PSI M4110	Earthing
Nokia Crate (Dual PSU)	DSF 3600.11	PSI M4109	Earthing
Nokia Power Supply	DS 62110.1	PSI M4114	Output voltages & Alarms
	DS 62115.1	None	Output voltages & Alarms
Nokia Modem - N1440 (14.4 kbps)	DS 61720.8	PSI M4115	Configuration and on board test facilities
			Aggregate Data Link Error rate
Nokia Multiport (6 Port)	DS 61800.2	PSI M4116	Configuration and on board test facilities
			Data Channel Error rate
GI74 Multiplexer Card Version 2.0	7 Low Speed Data Channels (inc. GI74)	PSI 9092B	Configuration
			Data Channel Error rate
Telegraph Interface Card	2 Channel converter	PSI 9096	Operation

EQUIPMENT	MODEL NO/TYPE	PSI NO	SYSTEM TESTS
Nokia Baseband Modem facilities	DSD 3613.1	PSI M4119	Configuration and on board test
4-Wire Rack Mount			Data Channel Error rate
Nokia Baseband Modem	DS 3610.2 (240V AC)	PSI M4120	Configuration and on board test facilities
4-Wire Standalone	DS 3610.2 (110V AC)	PSI M4121	Data Channel Error rate
Nokia Baseband Modem	DS 60150.1	PSI M4122	Configuration and on board test facilities
2-Wire Rack Mount			Data Channel Error rate
Nokia Baseband Modem	DS 60120.2 (240V AC)	PSI M4123	Configuration and on board test facilities
2-Wire Standalone	DS 60120.2 (110V AC)	PSI M4125	Data Channel Error rate

Table 1 Nokia V.33 System Tests

4.1 Private Circuit Tests

4.1.1 General

The analogue private circuit must conform to BT specification KEYLINE 3 OPTION 4 (Table 2) for reliable operation at 14,400 bps, using modems conforming to the ITU-T V.33 recommendation. If the circuit installed conforms to BT specification KEYLINE 3 OPTION 2, it is recommended that operation of the V.33 Modem equipment is limited to a maximum of 9,600 bps (V.29 operation).

With the introduction of the Vision 2000 network design for GI/SCADA communications, many existing analogue private circuits will be replaced by a voice channel on the Newbridge Corporate Communications Network (CCN). When commissioning a circuit which uses a voice channel on the Newbridge CCN, comprehensive testing of the analogue parameters is not required if previous commissioning test results are available. Only a basic end-to-end frequency response test will be required to confirm the Newbridge E + M modules are still configured and the correct routing exists across the CCN.

4.1.2 Circuit Testing

To test the analogue circuit, perform the following tests:-

- (i) Arrange for cooperation at the distant end to perform an "end to end" test of the analogue circuit.
- (ii) Confirm compliance with the specification (Table 2) by using AUTO-TIMS or appropriate analogue line test measuring instruments. NOTE - The random noise, impulse noise, signal to listner echo ratio and crosstalk measurements are optional. It may only be necessary to conduct these tests if the bit error rate test of the circuit terminating equipment (Nokia V.33 Modem/Multiport) fails.
- (iii) Record the results obtained on the Test Results Sheets in Appendix E1, or attach a test set output plot of the results - if available.
- (iv) Individual results should be obtained for each direction of transmission. Failure to do so could mask possible faults.

(v) Should the results fail to meet the specification then return the circuit to the service provider for re-engineering.

PARAMETER	FREQUENCY BAND (Hz)	LIMITS
Loss/Frequency response between customer's premises relative to the loss at 800 Hz	300-500	+2 to -6 dB
	500-2800	+1 to -3 dB
	2800-3000	+2 to -6 dB
Group delay/frequency response between customer's premises relative to the minimum delay.	500-600	3000 μ S
	600-1000	1500 μ S
	1000-2600	500 μ S
	2600-2800	3000 μ S
Random noise - Optional.		-45 dBmOp
Impulsive noise threshold (Max. of 18 impulsive noise counts to exceed threshold limit in any 15 min period) - Optional.		-21 dBmO
Signal to listener echo ratio - Optional.		20 dB
Crosstalk attenuation - Optional.		45 dB

Table 2 BT KeyLine 3 Option 4 Specification

4.2 Equipment Earthing Tests

Perform the following checks/tests to confirm satisfactory earthing arrangements for the Nokia Modem Subrack installation.

- (i) Investigate and confirm that the 19" rack has been installed in compliance with Installation Instruction No 3 (II3), Section A.
- (ii) Test with an ohmmeter that no connection exists between the 0 Volt (D0V) and Protective Earth terminals on the terminal block at the rear of the modem subrack, prior to connection of external power and earth conductors to the crate.
- (iii) Record compliance with the above on the Test Results Sheet in Appendix E2.1.

4.3 Power Supply Tests

4.3.1 General

Nokia modem subracks are available in the following two versions:-

- (i) Single Power Supply Unit subrack (with 48 V D.C. or Mains [110 V/240 V A.C.] power supply).
- (ii) Dual Power Supply Unit subrack (with 48 V D.C. or Mains [110 V/240 V A.C.] power supplies).

Record the details of the power supply unit(s) and all other modules to be commissioned, on the Nokia Modem Subrack Configuration Record in Appendix D1.1 (Single PSU) or D1.2 (Dual PSU).

When fitting a **mains (110 V/240 V A.C.) Power Supply unit check that the input voltage selector switch is set for the correct voltage.** This is located on the rear of the unit.

There are no option switches on the 48 V D.C. version, which is the standard power supply used in Nokia V.33 installations throughout NGC. Generally, single PSU subracks are used at Access Control Centres and dual PSU subracks are used at substations.

4.3.2 Single PSU Subrack Tests

Perform the following tests to confirm the power supply unit outputs are within specification:-

- (i) Check that the cubicle fuse which supplies power to the modem subrack, is correctly rated (max 3 Amps).
- (ii) Insert the Power Supply Unit in the modem subrack and with all other units removed switch on the power supply.
- (iii) Check the output voltages lie within the permitted range detailed in Table 3 below.

VOLTAGE	PERMITTED RANGE	ACCESS
+5.1 V $\pm$ 2%	+5.0 V to +5.2 V	D0V - J14, a4
+12 V $\pm$ 5%	+11.4 V to +12.6 V	D0V - J14, a14
-12 V $\pm$ 5%	-11.4 V to -12.6 V	D0V - J14, a12

Table 3 Power Supply Unit Output Voltages And Test Access Points

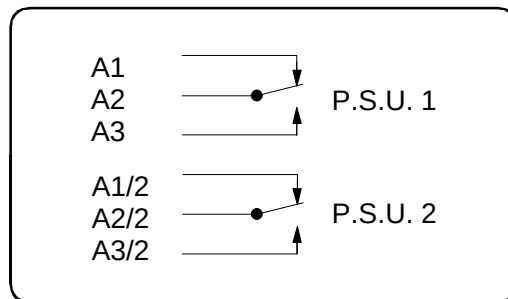
- (iv) No easily accessible test points are provided on the Crate or Power Supply. Access to connector J14 and the power rails is by removal of the clear plastic cover at the rear of the crate.
- (v) Record results obtained on the Test Results Sheet in Appendix E2.1.

4.3.3 Dual PSU Subrack Tests

- (i) Check that the cubicle fuses (Type 44A) which supply power to the modem subrack, are correctly rated (max 3 Amps each).
- (ii) Insert only the 'main' (left hand) power supply into the modem subrack and check that the output voltages produced are within tolerance (see Table 3).
- (iii) Remove the main power supply and insert the 'standby' (right hand) power supply in the adjacent slot of the subrack.
- (iv) Check the output voltages produced from the standby power supply are within tolerance.
- (v) Re-insert the main power supply and check that with both power supply units installed the voltages are still within tolerance.
- (vi) Record results obtained on the Test Results Sheet in Appendix E2.1.

4.3.4 PSU Alarms

Alarm outputs are provided at the rear of the subrack for each power supply unit. The configuration of which is depicted below. Note - only PSU 1 contacts are provided on a single PSU subrack (DSF 3600.7).



A1 - A2 is CLOSED in the Alarm and Power Off conditions
A2 - A3 is CLOSED in the Normal and Power On conditions

A1,2 & 3 - refer to PSU1
A1/2 ,2/2 & 3/2 - refer to PSU2

- (i) With the subrack power switched off, check that the alarm contacts are as stated above.
- (ii) Switch the power on to the subrack and check that the alarm contacts change to the opposite position.
- (iii) Fail the power to the subrack and check that the alarm contacts have returned to the Alarm condition.
- (iv) Record results obtained on the Test Results Sheet in Appendix E2.1.

4.4 Nokia Modem (ITU-T V.33) Tests

4.4.1 Configuration

- (i) Remove the Nokia N1440 Modems from the crate at each end of the leased circuit.
- (ii) Check the configuration links on the upper edge of the Modem cards. Record which links have been installed, noting the speed, modulation technique and method of transmitter timing, in Appendix D2.
- (iii) The configuration guide in Appendix B1 shows the links required for a 'standard' configuration (14,400 bps, V.33, transmitter timing by modem clock and Multiport card in use). For alternative configurations (eg EDL synchronous data circuits which require changes to the clocking arrangements) refer to the Nokia N1440 Installation Handbook.
- (iv) Confirm that the modem output level complies with PTT requirements (normally -13 dBm).
- (v) Confirm that the DCD threshold level is set to -26 dBm.

4.4.2 Termination

Check that the analogue leased circuit is connected to the appropriate transmit and receive terminals of the Line Termination Unit (PSI 4111) for the card position chosen (NOTE - card positions 1 and 2 are not available on dual power supply modem subracks). See Table 4 below for required connections.

Card position	1	2	3	4	5	6	7	8	9	10	11	12
Transmit to line	1 a & b	2 a & b	3 a & b	4 a & b	5 a & b	6 a & b	7 a & b	8 a & b	9 a & b	10 a & b	11 a & b	12 a & b
Receive from line	1 c & d	2 c & d	3 c & d	4 c & d	5 c & d	6 c & d	7 c & d	8 c & d	9 c & d	10 c & d	11 c & d	12 c & d

Table 4 Nokia Modem Subrack Leased Line Terminations

4.4.3 Nokia V.33 Modem Tests - General

The Nokia V.33 modem tests are only required if the modem is being used WITHOUT a Nokia Multiport card or for fault diagnosis. Where a Multiport card is being used, carry out the tests specified under Section 4.5 of this document which will also test the modem and the private circuit.

NOTE - the following power-on self test should be checked, even if a Multiport card is being used.

Nokia V.33 Modem Power-On Self Test

- (i) Insert the Modem card.
- (ii) Confirm that the LED's on the front panel of the modem card function as follows, so indicating a successful self test.
 - (a) All LEDs turn ON,
 - (b) All LEDs turn OFF,
 - (c) The LEDs turn ON in the following sequence:-
 103, 106, 105, 104, 142, pause, 103, 106, 105, 104, 109, 107, Q, Q.

NOTE - the Quality LEDs give a guide to the bit error rate on the line - the approximate thresholds are as follows:-

Two LEDs ON: BER = > 1×10^{-6}
 One LED ON: BER = 1×10^{-6} 1×10^{-4}
 Zero LEDs ON: BER = < 1×10^{-4}

- (iii) Record result obtained on the Test Results Sheet in Appendix E2.2.

The tests described in Sections 4.4.4 and 4.4.5 may be omitted for installations where a Multiport card is being used. However, the tests may be necessary for fault diagnosis.

NOTE - When testing, if one of the V.33 modems is configured for EXT. Clock (circuit 113), the EXT. Clock MUST be present for the modems to synchronise and to enable all the tests to be carried out successfully.

4.4.4 Nokia V.33 Modem On-Board Test Facilities

(i) Check operation of the onboard test facilities by performing the test procedures outlined in Appendices C1.1 and C1.2. These include:-

- < Local Loop Test.
- < Remote Digital Loop Test using RL button on Local Modem.
- < Remote Digital Loop Test using DL button on Remote Modem - Only required if RL test fails.
- < End to End data test using the internally generated 511 test pattern conforming to ITU-T V.52.

(ii) Record the results in Appendix E2.2.

4.4.5 Nokia V.33 Modem - Interfaces and Analogue Private Circuit Data Quality Tests

These tests are a more meaningful indication of transmission quality of the analogue private circuit and modem data interface.

(i) Connect the 25 way 'D' type connector of a bit error rate tester (BERT) to the V.24/V.28 data interface at the rear of the modem.

(ii) Carry out the following tests which are also outlined in Appendix C1.3.

(iii) Record the results in Appendix E2.2.

4.4.5.1 Local Loop test

This test checks that the BERT is set up and connected correctly prior to testing the private circuit quality.

- (i) Set the tester for external timing and transmit a 511 pseudo random pattern.
- (ii) Depress the LL test switch on the front panel of the modem.
- (iii) The tester should synchronise with no errors detected.
- (iv) Check correct operation by injecting errors from the tester and noting receipt.
- (v) Release the LL test switch, whereupon the receiver will lose sync.

4.4.5.2 Remote Digital Loop Test

This is arguably the most meaningful test performed. The results of this test are the best indication of circuit quality. The results will be used as a basis against which to judge future performance.

- (i) Confirm that the distant end modem is powered up and connected to line.
- (ii) Set the tester for external timing and transmit a 511 pseudo random pattern.
- (iii) Operate the RL test switch on the local modem.
- (iv) The tester should synchronise with no errors detected.
- (v) Check correct operation by inserting errors from the tester and noting receipt.
- (vi) If synchronisation is not achieved then first check the status of the remote modem prior to contacting the PTT.

(vii) Reset the error counter and transmit a 511 pseudo random data pattern for a 15 minute period. Record the number of bit and block errors received over that period in Appendix E2.2. The error rate should be less than 1×10^{-6} . Should a higher result be observed then repeat the test. If the condition continues then confirm the private circuit conforms to the KeyLine 3 Option 4 specification (Table 2).

4.5 Nokia V.33 Multiport Card Tests

4.5.1 General

The Multiport card can be configured in many different configurations. It is therefore impractical to lay down a precise schedule of tests to cover every combination of services. This SCT therefore defines tests to cover the use of the Multiport Card when configured in a typical SCADA configuration (substation with power station connected), the format of which is depicted below in Table 5.

4.5.2 Configuration

The 'standard' configuration supports the facilities outlined in Table 5 below. Two options have been shown for channel A because some of the sites with the EDL data service, now require an asynchronous communications channel. NOTE - as some sites require 2 (and sometimes more) Operational Metering Summator (OMS) channels and with the recent requirement for providing alternate routes for the EDL data service, the channel allocations given below are likely to change at some locations.

MNEMONIC	FUNCTION	TYPE	SPEED	CHANNEL
EDL	Electronic Despatch Logging	Synchronous	4,800 bps	A
EDL	Electronic Despatch Logging	Asynchronous	4,800 bps	A
ASB	Ancillary Services Business	Asynchronous	4,800 bps	B
GI74	SCADA	Synchronous	2,400 bps	C
OMS	Operational Metering Summator	Asynchronous	2,400 bps	D

Table 5 Multiport Card - Standard Services

(i) Check that the Multiport card is strapped to suit the required configuration. This will normally be for an aggregate bit rate of 14,400 bit/s with the bandwidth allocation for channels A, B, C & D set as above.

(ii) A configuration guide for the Multiport card is provided in Appendices B2.1 and B2.2 of this document.

(iii) Record the configuration for each port of the Multiport card on the configuration record in Appendix D3.

4.5.3 Nokia V.33 Multiport Card - On-Board Test Facilities and Compatibility Tests

These tests confirm operation of the on-board test facilities, which may be used in earnest at a later date, and check the basic compatibility/configuration of the local and remote port. They are simply 'go / no go' checks and do not require extended operation for performance measurement.

NOTE - If one of the V.33 modems is configured for EXT. Clock (circuit 113), the EXT. clock MUST be present for the modems to synchronise and to enable all the Multiport card tests to be carried out successfully.

Check operation of the on-board test facilities and basic compatibility of each data channel by performing the test procedures outlined in Appendix C2.1 to C2.4, for each port on the Multiport card. The tests include:-

(i) Local Loop Test using the LL button on the Local Modem (Appendix C2.1).

- (ii) Remote Digital Loop Test using the RL button on the Local Modem (Appendix C2.2).
- (iii) Remote Digital Loop Test using the RL button on the Local Multiport Card (Appendix C2.3).

NOTE - when testing synchronous onward-linked channels (eg EDL) using the RL facility on the Multiport card, a digital loop will be placed on the far-end Multiport card of the last onward-linked circuit and not the far-end of the first circuit. This is because the RL facility should be disabled for the onward-linked channel on all intermediate Multiport cards.

- (iv) Remote Digital Loop Test using the DL button on the Remote Multiport Card (Appendix C2.4) - This test is only required if the RL test on the local Multiport card fails.
- (v) Record the results in Appendix E2.3.

4.5.4 Channel/Interface Performance Tests

- (i) Confirm overall channel performance by connecting a suitably configured BERT tester to each port and checking that a bit error rate of better than 1×10^{-6} is achieved.
- (ii) Tests to confirm the above are outlined in Appendices C2.5 and C2.6. They include:-
 - < Local Aggregate loop back test (Appendix C2.5).
 - < Remote Channel Digital loop back test (Appendix C2.6).
- (iii) Record the results in Appendix E2.3.

4.6 GI74 Multiplexer Card (PSI 9092B) Tests

4.6.1 General

All new installations are to use the version 2.0 GI74 Multiplexer (PSI 9092B) and associated interface unit (PSI 9093B) and cable (PSI 9098B). These will either be newly manufactured units to the version 2.0 specification or version 1.0 units (PSI 9092, PSI 9093 & PSI 9098) modified under TDC 6047.

TDC 6047 provides the following improvements to the functionality and performance of the GI74 Multiplexer:-

- ! Support for existing CSM (Cable System Monitor) communications signalling format (75 bps, 10 Bit ASCII) and support for upgrading CSM communications to 300 bps, 10 Bit ASCII.
- ! Enabling Type 1 outstation alternate routes to be automatically monitored at the ACC's by ensuring 'half-line' failures do not occur.
- ! Desensitising the GI74 Multiplexer 'Loss of Sync' detection by introducing a 10 second delay before the 'Loss of Sync' relay and the 'DCD' outputs switch, after synchronisation is lost.
- ! Implementing measures to help prevent damage when inserting/removing from powered crates.
- ! Incorporation of the special version of firmware produced for the Five Centre Project to support STOFOR Messaging System and JET Pulse communications.

The following modifications are required to implement these improvements:-

- (i) Upgrade the firmware revision of IC2 & IC9 to Version 2.0.
- (ii) Modify the tracks on the PCB (two tracks cut and two links installed).
- (iii) Modify GI74 Multiplexer composite port cable PSI 9098, to cable PSI 9098B.
- (iv) Replace the DIN 41612 plug with a DIN 41612 plug which has 'leading' pins on the power supply rails.
- (v) Move the DIN 41612 socket on the PSI 9093 backplane rearwards by one mm.
- (vi) Change the labelling to reflect the modifications completed.

4.6.2 Configuration

The low speed channel interfaces provide GI74, ASCII and Baudot code transport facilities. Configuration of the channels to obtain the desired facilities is achieved by setting DIP switches SWA & SWB on the GI74 Multiplexer card.

The GI74 Multiplexer configuration options are given in Appendix B3, where Appendix B3.1 details the configuration requirements for the version 1.0 GI74 Multiplexer and Appendix B3.2 details the configuration requirements for version 2.0 GI74 Multiplexers. NOTE - DIP switch SWA is physically placed to the right of DIP switch SWB on the pcb.

Check that all DIP switches are set to the required configuration and record the details on the configuration record in Appendix D4.

4.6.3 Testing

(i) Check that the GI74 Multiplexer's composite port is connected to a Nokia Multiport card channel configured for synchronous operation at 2400 bps (usually channel C), using cable PSI 9098B (Note - cable PSI 9098 must be used if a version 1.0 GI74 Multiplexer is being commissioned).

(ii) Before commencing the GI74 Multiplexer tests, confirm that successful end-to-end tests have been carried out on the Multiport channel to be used.

(iii) Insert the GI74 Multiplexer card at each end of the circuit. NOTE - Switch the Nokia subrack power supply unit off if the GI74 Multiplexer is a version 1.0 unit.

(iv) Check that the green sync LED glows on both GI74 Multiplexer cards. The green sync LED on the GI74 Multiplexer should glow after approximately 1 second, when the correct sync code has been received from the remote GI74 Multiplexer card. For Version 2.0 units, the synchronisation code is only generated by the GI74 Multiplexer card when it detects a SPACE (+12V) condition on the V.24/V.28 DCD output from the Multiport card.

(v) If the sync LED fails to glow when both GI74 Multiplexer cards are inserted then place a Local Loop on the local Nokia V.33 modem and confirm that the local GI74 Multiplexer synchronises. If this test is successful, then request that the same test is repeated at the remote end to isolate the problem.

(vi) With both ends synchronised, ensure that all loop conditions and connections have been removed from the GI74 Multiplexer channel ports at each end. Confirm that the 'Txd' and 'Rxd' LEDs are extinguished on all the channels of both GI74 Multiplexers. If any are lit, the appropriate channels are faulty.

(vii) Check the operation of the 'Loss of sync' relay on the GI74 Multiplexer and check the operation of the DCD output on each channel, as detailed below:-

(a) When the GI74 Multiplexer is in sync, check that there is a short circuit between the 'NO' (Normally Open) and 'C' (Common) terminals.

(b) Using a 'V.24/V.28 Breakout Box' and the BERT test cable shown in Appendix C3, check that the DCD output is ON (in the SPACE, +12V) condition for all 7 channels.

(c) Press the 'DL' (Digital Loop) switch on the V.33 modem to cause a loss of sync.

(d) Check that after approximately 10 seconds, there is a short circuit between the 'NC' (Normally Closed) and 'C' (Common) terminals, and the DCD output is OFF (in the MARK, -12V) condition for all 7 channels. NOTE - for the version 1.0 GI74 Multiplexer, the loss of sync. relay switches after 5 seconds and the DCD outputs switch immediately.

(e) Remove the digital loop & check sync LED illuminates.

(viii) Perform a BERT (Bit Error Rate Test) on each channel of the GI74 Multiplexer, as detailed below:-

(a) Connect BERT tester to channel 1 and request the remote end to connect a GI74 Multiplexer Loop Test Plug to channel 1 (see Appendix C3 for test setup and specification of test cables).

(b) Configure the BERT tester for the appropriate data format and speed.

NOTE - For testing GI74 channels, configure the BERT tester to 8 data bits, even parity, 2 stop bits and the appropriate speed (300 or 150 bps).

- (c) Conduct a BERT test (511 PRBS or FOX) for a minimum period of 5 minutes and confirm that no bit errors are received.
- (d) Repeat tests (a) to (c) for channels 2 to 7. For channels which are not to be used directly after commissioning, configure them to 300 bps G174 for the BERT tests.

4.7 Telegraph Card (PSI 9096) Tests

4.7.1 General

The Telegraph card converts telegraph (contact to earth) signalling, to ITU-T V.28 levels which are then suitable for transmission over a G174 Multiplexer on a channel configured for over-sampling (or Baudot code if applicable). If required, the Telegraph card can be connected directly to a V.33 Multiport card port, configured for synchronous operation.

The Telegraph card provides two independent and isolated channels, including the earth connections.

4.7.2 Configuration

There are no configurable options on the Telegraph card.

4.7.3 Testing

The following tests check the function of the local telegraph card and the transmission medium up to and including the remote G174 channel card. It does NOT test the function of the remote telegraph card. To check the remote telegraph card reverse the roles of the 'Instation' and 'Remote' ends.

4.7.3.1 Tests For Channel A

- (i) Refer to Appendix C4.1 for schematic diagram of Telegraph card test setup for Channel A.
- (ii) At the Instation end:
 - (a) Connect Channel A of the Telegraph Interface card (PSI 9095) to a G174 Multiplexer channel configured for over sampling, using cable PSI 9090.
 - (b) Connect a -48 Volt battery to terminal 1 of TB1.
 - (c) Connect a -48 Volt battery, via a 2.2 kΩ, 0.5 W resistor, to terminal 5 of TB2.
 - (d) Connect an earth to terminal 6 of TB2.
 - (e) Connect a volt meter between terminals 5 & 6 of TB2. (-ve lead to 5, +ve lead to 6).
- (iii) At the Outstation end - Connect the Loop Test Lead to the appropriate channel on the G174 Multiplexer. On the version 1.0 G174 Multiplexer only channels 6 and 7 are configurable for over-sampling, whereas on the version 2.0 G174 Multiplexer channels 3 to 7 are configurable for over-sampling.
- (iv) At the Instation end - Connect a test lead at earth potential to terminal 7 of TB2 and observe the reaction of the volt meter. The voltage indicated should fall to zero on application of the earth potential at terminal 7 of TB2.
- (v) If the voltmeter fails to respond as above then remove the connection to the G174 Multiplexer, plug in a loop test lead in the channel A connector and check again. A remote loop of the G174 Multiplexer channel on the Multiport card can also be invoked to localise the problem. NOTE - This action will interrupt the communications to all other G174 Multiplexer channels.

4.7.3.2 Tests For Channel B

- (i) Refer to Appendix C4.2 for schematic diagram of Telegraph card test setup for Channel B.
- (ii) At the Instation end:
 - (a) Connect Channel B of the Telegraph Interface card (PSI 9095) to a G174 Multiplexer channel configured for over sampling, using cable PSI 9090.
 - (b) Connect a -48 Volt battery to terminal 1 of TB1.

- (c) Connect a -48 Volt battery, via a 2.2 kΩ, 0.5 W resistor, to terminal 10 of TB2.
 - (d) Connect an earth to terminal 11 of TB2.
 - (e) Connect a volt meter between terminals 10 & 11 of TB2. (-ve lead to 10, +ve lead to 11).
- (iii) At the Outstation end - Connect the Loop Test Lead to the appropriate channel on the GI74 Multiplexer. On the version 1.0 GI74 Multiplexer only channels 6 and 7 are configurable for over-sampling, whereas on the version 2.0 GI74 Multiplexer channels 3 to 7 are configurable for over-sampling.
- (iv) At the Instation end - Connect a test lead at earth potential to terminal 12 of TB2 and observe the reaction of the volt meter. The voltage indicated should fall to zero on application of the earth potential at terminal 12 of TB2.
- (v) If the voltmeter fails to respond as above then remove the connection to the GI74 Multiplexer, plug in a loop test lead in the channel A connector and check again. A remote loop of the GI74 Multiplexer channel on the Multiport card can also be invoked to localise the problem. NOTE - This action will interrupt the communications to all other GI74 Multiplexer channels.

4.8 Nokia 4-Wire Baseband Modem

4.8.1 General

These baseband modems are mainly used for onward-linking Nokia V.33 or Newbridge data circuits from substations to power stations. There are two types of Nokia 4-wire baseband modems available - a rack mount [Nokia DSF 3600 modem subrack] version (DS 3613) and a standalone version (DS 3610). The standalone version is available with either a 240 V A.C. or 110 V A.C. power supply. The main application within NGC is for extending EDL (Electronic Despatch Logging) data circuits, but also some OMS (Operational Metering Summator) and ASB (Ancillary Services Business) data circuits.

4.8.2 Configuration

The units are used in both synchronous and asynchronous modes. In synchronous mode, the standard configuration is for the baseband modem at the substation to be externally clocked from the Nokia V.33 Multiport card or Newbridge DTU, and for the power station end to be slave/receive clocked. See Appendices B4.1/B4.3 and B4.2/B4.4 for configuration options for the rack mount and standalone baseband modems respectively (Rev: 001 and 002 modem options are given).

NOTE - the configuration straps are different for the rack mount and standalone baseband modems.

Check that the baseband modems are configured to suit the required configuration. The configuration guides for specific applications are detailed in drawing no. RDB/DISP/111 and RDB/DISP/113 for EDL synchronous and asynchronous services respectively, and in drawing no. GC/OMS/101 for the OMS service. Record the modem configurations in Appendix D5 for the rack mount and/or standalone modem.

4.8.3 Testing

The 4-wire baseband modems provide a Local Loop/Analogue Loop test switch and a Digital Loop test switch. The modems have no on-board test pattern generators or Remote Digital Loop facilities.

Perform the tests detailed in Appendix C5 and record the results in Appendix E3.1.

NOTE - when performing either asynchronous loop back tests or tests where the baseband modem is used for onward linking another asynchronous data circuit, the test set MUST be configured to use 2 Stop Bits. This is especially important on the Rev: 002 4-wire baseband modems.

4.9 Nokia 2-Wire Baseband Modem

4.9.1 General

These baseband modems are also mainly used for onward-linking Nokia V.33 or Newbridge data circuits from substations to power stations. There are two types of Nokia 2-wire baseband modems available - a rack mount [Nokia DSF 3600 modem subrack] version (DS 60150) and a standalone version (DS 60120). The standalone version is available with either a 240 V A.C. or 110 V A.C. power supply.

The rack mount version is a two modem card which has a special interface on the subrack backplane for connection of the two V.24/V.28 data connections which are presented on 25 way 'D' type female connectors. The special interface is known as Nokia Connector Converter Unit (DC 60155) and must be installed on the upper Euroconnector for the appropriate slot, at the rear of the DSF 3600 modem subrack. The line interfaces for each baseband modem on the rack mount version are presented on the rear terminal strip on connections a & b and c & d, for modems 1 and 2 respectively. When connecting the two wire line to the remote modem, the connections may be wired either way round.

The main application within NGC is for extending EDL data circuits, but also some OMS and ASB (Ancillary Services Business) data circuits.

4.9.2 Configuration

The units are used in both synchronous and asynchronous modes. In synchronous mode, the standard configuration is for the baseband modem at the substation to be externally clocked from the Nokia V.33 Multiport card or Newbridge DTU, and for the power station end to be slave/receive clocked. Also, the substation baseband modem should be set to use the ANSWER channel and the power station baseband modem should be set to use the CALL channel.

See Appendices B4.5 and B4.6 for configuration options for the rack mount and standalone modems respectively. Each type of modem has two configuration sheets - one for the DIP switches and one for the straps (removeable links). The DIP switch options are for the settings which more commonly require changing. There is normally no requirement to change the strap (link) settings from the factory defaults - this applies to both the rack mount and standalone versions.

NOTE - the identification of the configuration straps/switches are the same for the rack mount and standalone baseband modems.

Check that the modems are configured to suit the required configuration. Record the modem configurations in Appendices D6.1 and D6.2 for the rack mount and standalone baseband modems respectively.

4.9.3 Testing

The 2-wire baseband modems provide a Local Loop, Digital Loop and Remote Digital Loop test switches. An on-board 511 test pattern generator is available which conforms to ITU-T V.52.

Perform the tests detailed in Appendix C6 and record the results in Appendix E3.2.

NOTE - when performing either asynchronous loop back tests or tests where the baseband modem is used for onward linking another asynchronous data circuit, the test set MUST be configured to use 2 Stop Bits.

5 TEST EQUIPMENT

5.1 Record of Calibrated Test Equipment used during Commissioning

	Manufacturer and Type	Serial No	Date Last Calibrated	Date Next Calibration Due
Digital Multimeter				
Frequency Meter or Multimeter				

AUTO-TIMS or Selective Level Meter				
Bit Error Rate Tester				
Group Delay Measuring Set				
Psophometric & Impulse Noise Counter				
Others (state function)				

5.2 Other Test Equipment

- (i) GI74 Multiplexer Loop-back Plug.
- (ii) GI74 Multiplexer to BERT tester Test Lead.
- (iii) Resistor 2.2 kΩ, 0.5 W.
- (iv) V.24/V.28 Breakout Box

