ANT-5

SDH Access Tester

User's Guide

JDSU

JDSU ANT-5
SDH Access Tester

For software version 11.00…
and hardware versions 4565/03, 4565/04, 4565/05

Please direct all enquiries to the nearest JDSU Sales Office or Technical Assistance Centre. For locality information visit our Web Site, **www.jdsu.com**, or contact the nearest Regional Sales Office as listed on the back of the manual.

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1. Introduction

1.1 Intended use

The ANT-5 SDH Access Tester is designed to provide all the test functions required by engineers installing and maintaining SDH systems in the Access Network. It can be fitted with the optical and electrical interfaces listed below.

It has independent transmitters & receivers for connection to the following interfaces:

SDH STM-1 electrical line interface
STM-0 electrical line interface
Optional STM-1 optical interfaces, 1310 nm and/or 1550 nm wavelengths
Optional STM-4 optical interfaces, 1310 nm and 1550 nm wavelengths
Optional STM-16 optical interfaces, 1310 nm and 1550 nm wavelengths
ECL/NRZ STM-1, STM-4, and STM-16 electrical receive interface

PDH E4 electrical line interface, 140 Mbit/s
DS3 electrical line interface, 45 Mbit/s
E3 electrical line interface, 34 Mbit/s
E1 electrical line interface, 2048 kbit/s (balanced and unbalanced)
T1 electrical line interface, 1544 kbit/s

Application software is included with the product to facilitate the measurement of network transmission quality and the monitoring and injection of anomalies and defects.

This product is not to be used on telephone lines. The product is intended only for connection to circuits carrying Safety Extra Low Voltages (SELV).

1.2 Features of the SDH Access Tester application software

The SDH Access Tester application software provides a complete set of test functions for engineers who install and maintain SDH and PDH systems. Performance analysis is a key feature during the commissioning process, and the anomalies and defects of the system can be measured and recorded. The application has the following features:

- Bit error rate testing including anomaly & defect analysis, injection.
- Performance analysis: G.826 (ISM), G.826 (OOS), G.821, G.828, G.829, M.2100, M.2101 & ANSI
- Overhead testing including path tracing and injection
- Results printing and export (to PC)

Optional software for the ANT-5 is discussed in section 5. For more information on purchasing any of these specific features please contact the nearest Regional Sales Office as listed on the back of the manual.

1.3 ANT-5 Software version summary

Software Version	Base Software	Optional Software
11.0		ATM Ping (Ping, Reply to Ping, Trace Route) ATM enhanced (AAL-2 and AAL-5 support, Channel Traffic Analyzer, Extended ATM traffic analysis) IMA monitor
10.2		PLCP support

Software Version	Base Software	Optional Software
10.0…	STM-0 electrical Thru Mode/ intrusive Ext. Ref.Clock: 2048 kbps, 2 MHz, 1544 kbps, 1.5 MHz Pointer generation (INC/DEC) M13 demux of DS3 signal to DS1 or 64k channels TCM generation Bit Pattern 2E-11 QRSS20 pattern Compatibility with 2M ATM devices Enhanced language support for Remote Operation* (*Simplified Chinese support requires Windows Code Page 936.)	
09.00…	Autoconfigure Pointer generation K-byte capture DS3 code error generation PDH external timing Service disruption	VC3 ATM mappings DS1 ATM mappings
08.00…	G.828 and G.829 performance analysis Inline monitoring Offline viewer E1 PCM30C STM-16c* Optical power measurement* T1 interface, including AMI code* ECL NRZ measurement* Online help (*These features are available on selected hardware versions.)	ATM Sa bit monitoring (requires PDH Mux option) ATM Channel Explorer ATM cell BERT ATM VC-4c mapping
07.00…	E1 Code Error generation and measurement Alarm burst error generation and detection	AU3 & VT* Mappings (*requires SONET option)
06.00…	Clock offset	SONET
05.00…	AU Pointer Value – SS bit monitoring Tributary Scanning Nx64 FTP functionality User Preferences	PDH Mux/DeMux (inc Sa bit generation) VC4-4c Mapping Remote Operation Remote Control

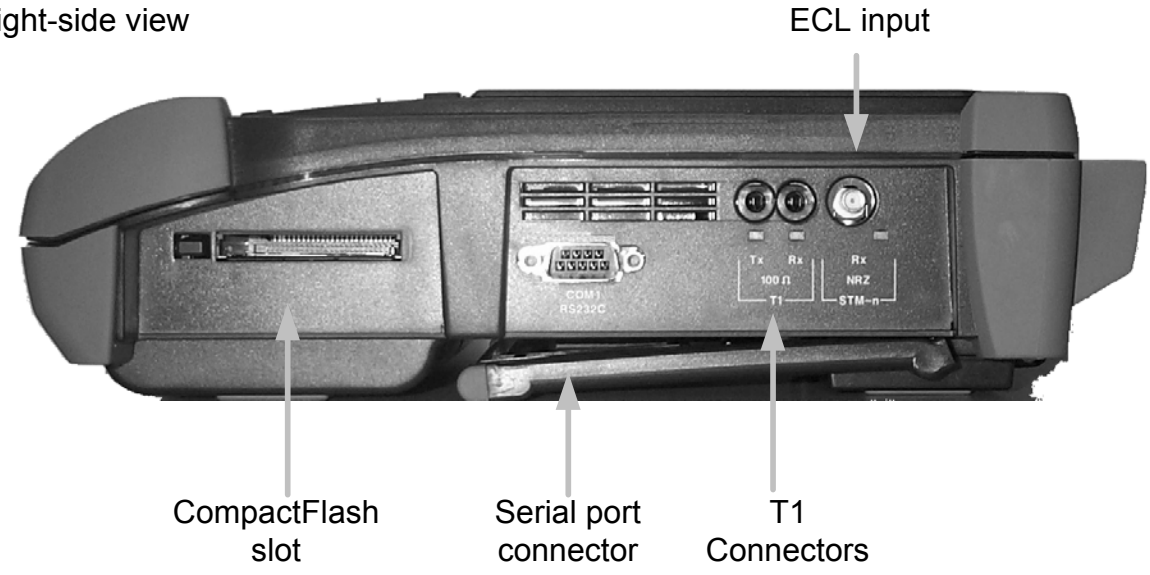
Software Version	Base Software	Optional Software
04.00…	Repetitive BERT APS Measurement Pointer Analysis Round Trip Delay	
03.00…	Tandem Connection Monitoring M2101 performance analysis	

1.4 Physical layout and connectors

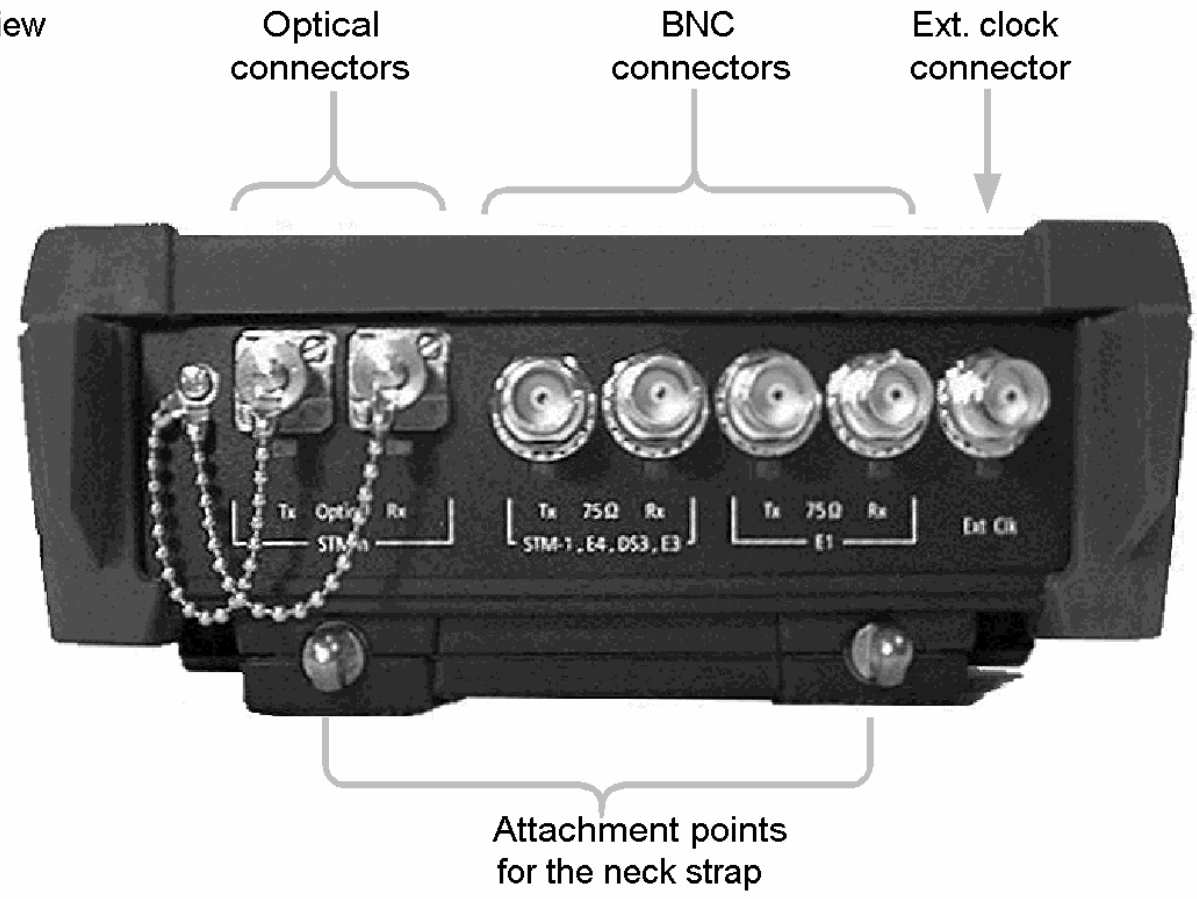
The ANT-5 has the following external connectors at the rear and side:

STM-n Optical Tx, Rx	FC/PC 1310 nm and/or 1550 nm	Tx and Rx connectors for STM-1, STM-4 or STM-16. **Note:** The optical interfaces are optional.
STM-0, STM-1, E4, DS3, E3 Electrical Tx, Rx	BNC, 75Ω, nickel plated	Unbalanced electrical Tx and Rx connectors for STM-0 and higher-order PDH payloads
E1 Tx, Rx	BNC, 75Ω, nickel plated	Unbalanced electrical Tx and Rx connectors for E1 PDH payload
T1 Tx, Rx	Bantam, 100Ω	Balanced electrical Tx and Rx connectors for T1 (1.544 Mbps) PDH payload
STM-n Rx	SMA, NRZ	ECL input
Ext Clk input	BNC, 75Ω, nickel plated	Unbalanced electrical clock input for Tx at 2048 kbps, 2 MHz, 1544 kbps, 1.5 MHz
COM 1 RS232C	D type 9-way Male	V.24 serial port

ANT-5
Right-side view



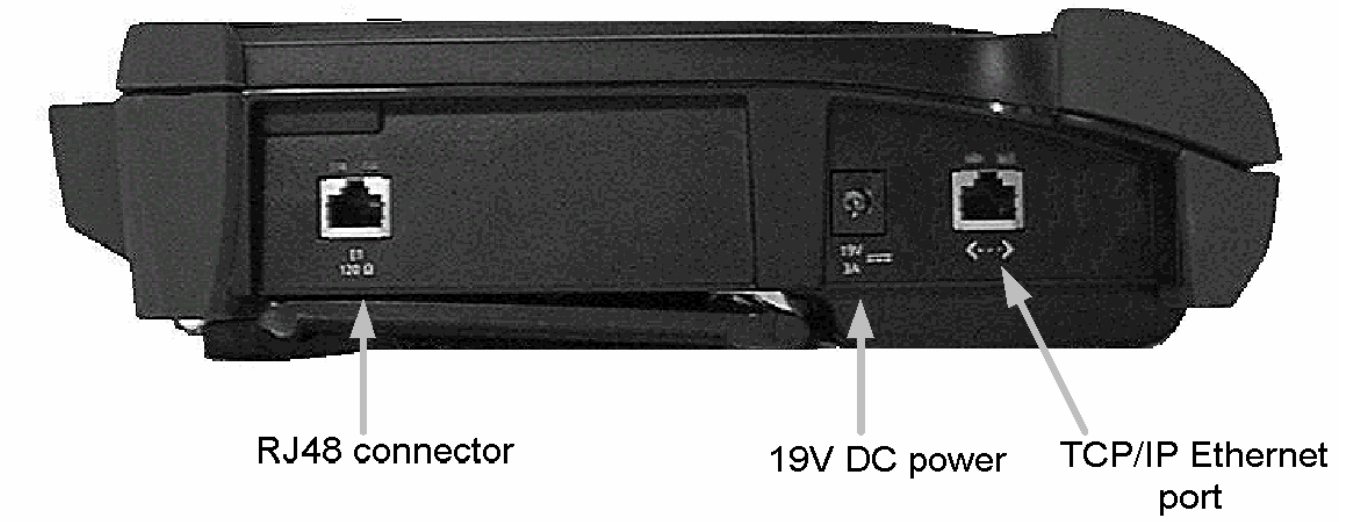
ANT-5
Rear view



The ANT-5 has the following external connectors on the left side:

E1	RJ-48, 8-wire (6 wires used)	Balanced 120Ω electrical connector for E1 PDH payload
19V DC power 3A	2.1 mm	19V Power supply input. For use with type **PPS-2 only**
<···>	RJ-45	10 base T – TCP/IP Ethernet port

ANT-5
Left-side view



Note: For reliable operation we recommend only using JDSU cables (e.g. K168, 169)

WARNING: Section 1.5, *Safety instructions*, should be read before connecting cables to the ANT-5.

Note 1: Optical connectors, where fitted, are provided with dust caps which should be used whenever an optical lead is not connected.

Note 2: Care must be taken not to connect a long-haul (high power) transmitter directly to the receiver, or not to short-circuit the Tx and Rx optical interfaces, since this can overload or even damage some receiver modules. By connecting an external optical attenuator (as supplied) this restriction can be overcome.

1.5 Safety instructions

To ensure that the ANT-5 is maintained in perfect condition and that it operates safely at all times, the instructions which follow should be read and observed.

1.5.1 Correct usage

The ANT-5 should only be used for the purpose and under the conditions for which it is intended. Operation outside these conditions may be dangerous or may damage the instrument. Refer to Section 1.1, ***Intended use***, and ***Appendix A – Specifications and ordering information*** for further details.

1.5.2 Connection to test circuits carrying dangerous voltages

WARNING: Dangerous voltages may be present on telecom circuits.

Telephone lines can have potentially dangerous voltages. The BNC, bantam and RJ connectors must be connected to Safe Extra Low Voltage (SELV) circuits only and must not be connected to any circuit carrying dangerous voltages.

1.5.3 Laser safety

The following only applies if optical interfaces are fitted:

WARNING: Class 1 Laser Product.

Optical radiation with wavelengths of 1310 nm and/or 1550 nm is present at the optical connectors. Each interface is active if the yellow LED next to the connector is on. The laser warning icon is also displayed with a yellow background when the ANT-5 laser source is active. Maintenance and repair work on the laser sources should only be carried out by qualified service operatives familiar with the risks involved.

WARNING: Invisible laser radiation.

Laser light can cause irreparable damage to the eyes, particularly to the retina.

- To deactivate the ANT-5 laser source (Tx), clear the **Laser On** checkbox in the **Interface Setup Tx** panel. See Section 4.3.1.2 for further details.
- Never look directly into the generator outputs or the connector end surfaces of the connected cables (free ends) if the laser sources are activated.
- Never use a microscope to check generator outputs if laser sources are activated.
- Do not activate laser sources until all measurement connections have been made.

1.5.4 Cleaning optical connectors

To maintain error-free operation, the ANT-5 optical connectors should be regularly cleaned using a pressurised optical duster which is intended for the purpose. The optical connectors are provided with dust caps which should always be used when an optical patch lead is not connected.

Patch lead connectors should also be cleaned by an approved method, such as a pressurised optical duster or a cassette-type cleaner, according to the manufacturer's instructions. Dust caps should be fitted to the patch leads when they are not in use.

1.5.5 Optical attenuators

WARNING: Equipment damage

Care must be taken not to connect a long-haul (high power) transmitter directly to the receiver, since this can overload or even damage some receiver modules. By connecting an external optical attenuator this restriction can be overcome.

1.5.6 Faults and damage

If it is considered that the instrument can no longer operate safely, it should be taken out of service, labelled with the fault condition and secured against unintentional use. The following are situations where this may be the case:

- if the instrument shows visible signs of damage
- if the instrument no longer operates correctly
- if the instrument has been subjected to any stresses (such as storage and transport) where the permitted range limits were exceeded.

If the rechargeable battery pack develops a fault it can be replaced locally in an appropriately equipped workshop. See Section 7.6.2, ***Replacing the ANT-5 battery pack***, for further details.

With the exception of the battery pack, there are no user serviceable parts in the ANT-5 or its accessories. Do not attempt to open the case of the instrument – any attempt to do so will invalidate the warranty.

If maintenance or repair of the instrument is required, contact the nearest JDSU Sales Office or Technical Assistance Centre. For locality information visit our web site, **www.jdsu.com**, or contact the nearest Regional Sales Office as listed on the back of the manual.

Refer to Section 8, ***Customer support*** for further details.

1.5.7 General cleaning

The outer surfaces and bumpers of the ANT-5 may be cleaned with a cloth **slightly** dampened with water or a mild detergent. Abrasives and solvents must not be used, as they will damage the finish and may remove the labelling.

Switch off and disconnect all cables before cleaning and do not allow water or any other substance to enter the instrument through the keyboard, connectors or card slot locations.

1.6 Power supplies

The ANT-5 is supplied with a built-in NiMH rechargeable battery, a PPS external power supply and a mains cable. The power supply is connected to the ANT-5 via an integral cable and jack socket.

The external power supply acts as a charger unit when the instrument is switched off. When external power is connected, the battery LED above the screen will be green. See Section 2.5, ***LED and on-screen indicators***, for further details.

WARNING: The ANT-5 must only be operated from its internal battery or from the included PPS power supply. Ensure that the correct power supply is connected to the appropriate ANT-5. Refer to section 1.4 for further details.

1.6.1 Battery charging

The internal NiMH battery is charged automatically when the instrument is connected to a live external power supply. An adequate charge will be reached within 3 hours if the instrument remains switched off whilst charging. It will automatically switch to a trickle charge mode when fully charged or when the instrument is switched on.

Note: If the temperature of the operating environment is too high, the instrument will automatically select trickle charge mode to avoid overheating.

Before the instrument is used for the first time it is recommended that the battery is conditioned by running through two full discharge/recharge cycles as described in Section 7.6.1, ***Battery conditioning***. This procedure will also establish the initial conditions for the battery charge indicator.

1.6.2 Low battery

When no external power supply is connected and the battery charge is getting low, the battery LED above the screen will come on as a steady red light and the instrument will emit an audible warning. As the battery gets very low the battery LED will start to flash and further audible warnings will be emitted. An external power supply should now be connected as the instrument will switch itself off approximately 90 seconds after the battery LED starts to flash.

1.6.3 Displaying the battery charge indicator

An on-screen display showing battery charge level is activated by selecting **Battery Level** from the **Tools** menu. This display can be cancelled by pressing the **Esc** key.

Note: If the **Battery Level** indicator shows the warning 'Reading may be inaccurate', the battery conditioning procedure described in Section 7.6.1 should be followed.

2. Getting started

2.1 Switching on and off

The ANT-5 can be switched on in two ways – either manually, by pressing the **On** key, or remotely by using a computer to apply a Ring Indicator (RI) signal to the serial port. See ***Appendix C – Serial port and adapter cables***.

In normal use the ANT-5 should be switched off by briefly pressing and releasing the **Off** key. This allows the power-down sequence to be controlled by the ANT-5 system software, which will ask the user to confirm or cancel the power-down if a test is running.

Note: For ease of use it is not necessary to close applications before switching the unit off.

In exceptional circumstances only, for example if there is an instrument malfunction, the ANT-5 can be forced to switch off without software control by holding the **Off** key down for more than 6 seconds. It can then be switched back on normally.

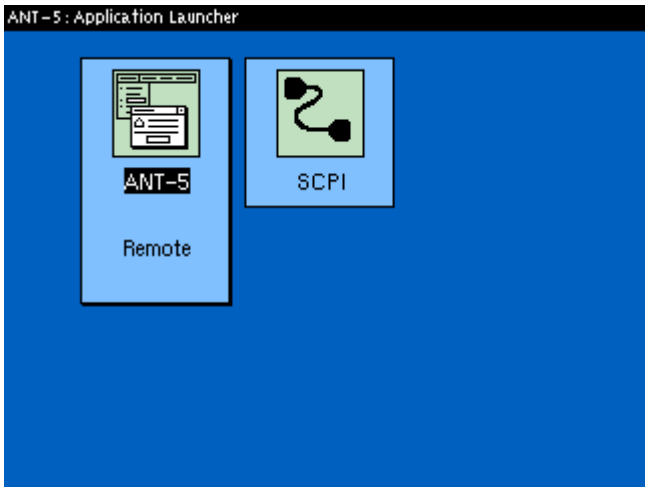
Note: The ANT-5 automatically saves results at certain intervals during a test. If you switch off the ANT-5 by holding the **Off** key, you may lose test results that have not been saved.

2.2 Start up screens

When the instrument is switched on, the ANT-5 self-test software runs automatically and the start-up logo is displayed on the screen. After this, the screen briefly displays information about system version numbers and the ANT-5 hardware.

Note: During the start-up process, clicking noises will be made by relays inside the instrument. This is a design feature and is part of the normal start-up.

Once the self-test is completed the application launcher screen will be displayed with the SDH Access Tester application represented by the **ANT-5** icon as shown.

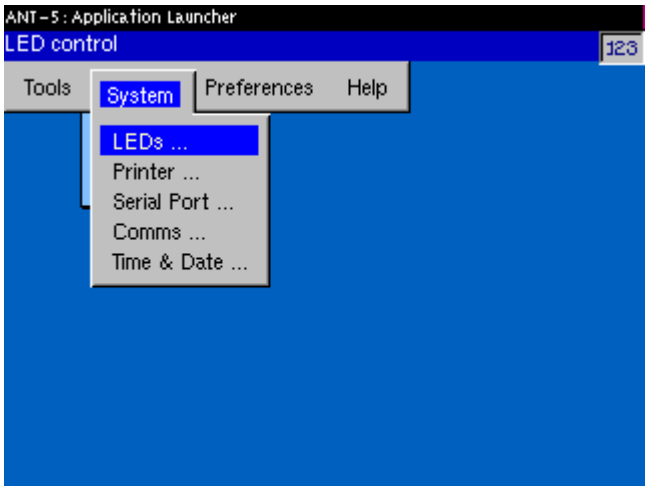


To launch the application, highlight the **ANT-5** item and press the **Enter** key. A screen with version information will be displayed whilst the instrument recovers its previous configuration from non-volatile memory and sets up its measurement hardware. This will be replaced by the **Signal Structure** setup page when the application is ready for use.

For further information on configuring and running the application, see Section 4, ***The SDH Access Tester Application***.

2.3 Menus

The operating characteristics of the ANT-5 are controlled by sets of hierarchical menus which can be displayed or hidden by pressing **Alt+Menu** (press **Menu** whist holding down the **Alt** key). The highest level of the menu structure is represented by a bar at the top of the screen with one choice highlighted. The **System** menu is shown here as an example.



Lower levels in the menu structure are displayed as cascaded lists which appear beside their parent menus.

Use the direction keys to move the highlight around each menu and then press **Enter** to either select an item or to display the next menu level in a similar way. Press **Esc** to close the current menu and move up one level.

When the setup menus are hidden and then displayed again, the same level will be shown if it is valid to do so. If a test is running, the application will not update the displayed backdrop while a menu is displayed in the foreground.

2.4 Message boxes

Message boxes pop-up in front of any other screen contents in the middle of the screen and are used to verify certain actions by the user. The message box contains labelled buttons which should be 'pressed' to carry out the action (use the directional keys to highlight the appropriate button and then press the **Enter** key to operate it).

The box will remain on the screen until a key associated with one of the buttons is pressed or until one of the default keys **Enter** or **Esc** is pressed. **Enter** is used to accept the highlighted choice and **Esc** is used to cancel the message box without accepting any choice.

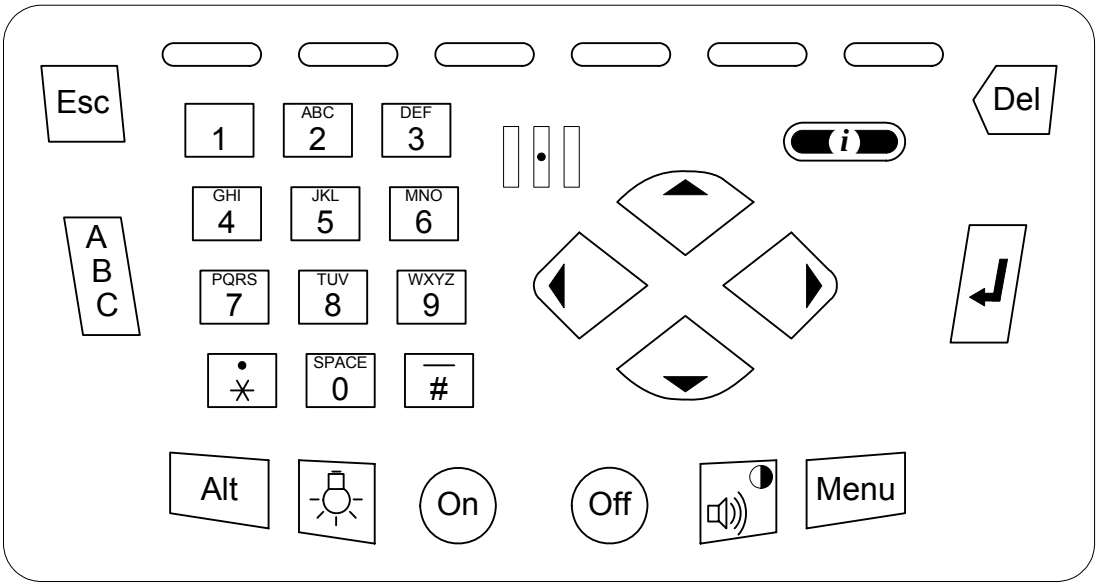
2.5 LED and on-screen indicators

The top portion of the screen is used by the tester application to simulate LED indicators on-screen in order to display information which is relevant to the current setup of the application. The behaviour of the on-screen LEDs can be set to be latching or non-latching in the **LEDs** section of the **System** menu, which can be displayed by pressing the **Alt + Menu** key at any time. For further details See Section 4.8, ***On-Screen LED Indicators***.

The four LEDs above the screen are used for general status information as follows:

	Alarm LED Signal LED	The non-latching Alarm and Signal LEDs are used by the tester application to summarise the test status, even if the screen has been blanked to save power. The Signal LED will be green if there are no alarms or errors to display on the on-screen LEDs. In this case the Alarm LED will not be lit. The Alarm LED will be red if one or more on-screen LEDs are shown in red to indicate alarm or error conditions. In this case the Signal LED will not be lit.
	Screen LED	Steady green indicates that the screen has been blanked to save battery power. Press any key to restore the screen. See Section 2.13, ***Power saving features***.
	Battery LED	Green indicates that the ANT-5 is connected to an external power supply. Flashing green indicates fast charge; steady green indicates trickle charge. Red indicates that the battery charge is low and an external power supply should be connected as soon as possible.

2.6 Using the keyboard



On Off	On, Off keys	Turn the ANT-5 on and off.
	Beeper/ Contrast key	Turn the beeper on or off when the SDH Access Tester application is running (for audible notification when defects and anomalies are detected).
Alt +	Alt+ Beeper/ Contrast key	Press with the **Alt** key held down to display a scale for adjusting the screen contrast.
Menu	Application Menu key	Displays the application menu, or turns off the menu if the menu is already displayed.
Alt + Menu	System Menu key	Displays the system menu, or turns off the menu if the menu is already displayed.
	Directional keys	The directional keys are used for moving around screens and setup menus.
	Enter key	Accept the current selection or operation.
	Information key	Display some basic help or system information on the screen. Clear this by pressing the **Enter** or **Esc** keys.

Del	Delete key	Delete text (backspace).
	Function keys	The function keys are used by the tester application. Active keys are labelled at the bottom of the screen.
Esc	Escape key	Cancel the current selection or operation.
Alt + Esc	Alt+Escape	Use **Alt+Esc** to switch between applications. See Section 3.1.1, ***Switching*** .
A B C	ABC key	The **ABC** key gives access to the alphabetic characters on the number keys. Press once to toggle between the modes.
ABC 2	Alphanumeric keypad	Multipurpose telephone-style keypad. Refer to Section 2.6.4, ***Using the alphanumeric keypad***.
Alt	Alt key	Extends the functions of the standard keys (see above).
Alt + #	Alt+Hash	Use **Alt+Hash** to save the current screen in a file or send it to a printer on the serial port, depending on the **Screen Dump** setting in the **Printer** section of the **System** menu.
	Backlight key	Toggle the backlight between high and low level.

2.6.1 Adjusting the screen contrast

To adjust the screen contrast, press the **Beeper/Contrast** key whilst holding the **Alt** key down.

The contrast is increased or decreased using the directional keys. A scale will be displayed on the screen which reflects the contrast level. To remove the scale from the screen, press the **Enter** key to accept the new setting or the **Esc** key to cancel it.

The ANT-5 will continue to operate during contrast adjustment but will not receive any keypad input until the adjustment is completed.

2.6.2 Switching the beeper on or off

The ANT-5 has an internal beeper which can be used to provide an audible notification when defects and anomalies are detected. When the SDH Access Tester application is running, this feature can be turned on or off by pressing the **Beeper/Contrast** key.

2.6.3 Function keys

The six unmarked keys at the top of the keyboard are function keys which can be used in different ways by applications. Labels will appear along the bottom edge of the screen to show that a function key is active and to indicate its purpose.

2.6.4 Using the alphanumeric keypad

The alphanumeric keypad is normally used for entering numbers in setup menus but it can also be used for entering alphabetic and special characters. Entry boxes generally have a character on their right hand side to indicate that a specific type of data is expected, such as a **b** for binary, **d** for decimal or **h** for hexadecimal.

The **ABC** key is used to enter and leave the extended alphabetic mode, in which strings of alphanumeric and special characters can be entered by using repeated key presses punctuated by short pauses. The current mode is indicated in non-specific data entry boxes by an **A** or a **1**.

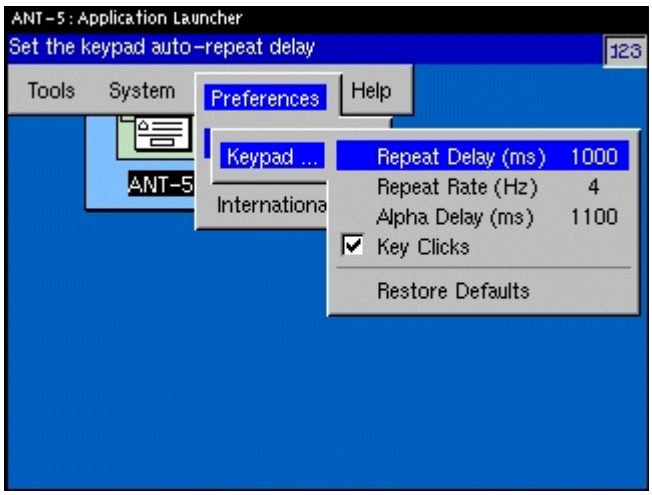
Each key has a set of characters associated with it, and the sequence will repeat in a cycle until either a different key is pressed or a pause of one second occurs.

For example, repeatedly pressing the **9** key will display the sequence W-X-Y-Z-9-W-X-Y… until there is a pause or another key is pressed. The last character will then be accepted and the screen cursor will advance to allow entry of another character. To switch between upper and lower case letters, hold any letter key down for one second or more. Use the **Del** key to backspace over any mistyped characters.

The * and # keys on either side of the **0** key are used for entering non-alphanumeric characters. The sequence for the # key includes the following characters: **- # + ! , : ” ’ & ( )**. The **0** key can be used to enter space characters.

2.6.5 Changing the keypad settings

Keypad settings such as the length of the **Alpha Delay** pause can be changed in the **Keypad** section of the **Preferences** menu.



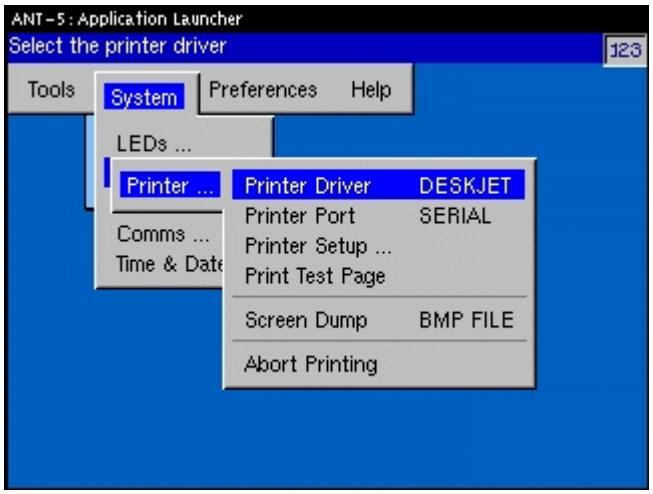
2.7 Printing the current screen

The current screen can be saved in a file or sent to a printer on the serial port by pressing the # key whilst holding down the **Alt** key. The **Screen Dump** feature can be turned off or directed to either a file or the printer in the **Printer** section of the **System** menu.

The ANT-5 will sound a series of beeps when the screen has been saved or printed. If the screen is being saved in a file, it is particularly important not to remove the card before these beeps have indicated the end of the process.

2.7.1 Printer configuration

The **Printer** section of the **System** menu allows the selection of the current printer driver and the current printer port, which can be set up for printing to the serial port or to a file. The parameters for each printer driver, such as paper size, custom paper dimensions and unprintable area, can also be set.



The available drivers support the following printers: HP Deskjet, HP Thinkjet, Epson 9-pin, Epson 24-pin, and an ASCII printer.

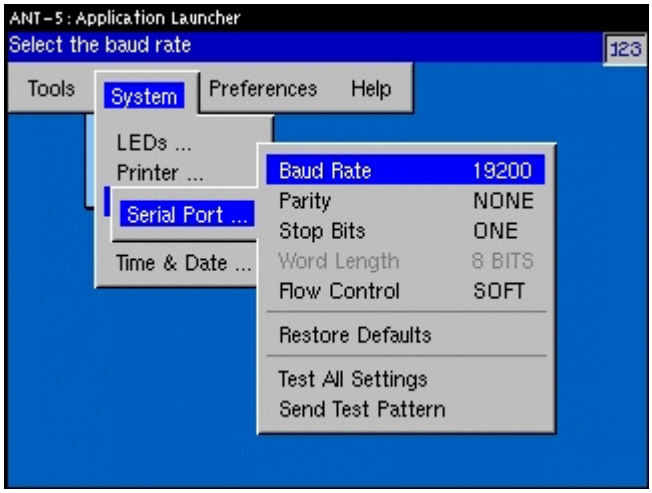
A test page facility is provided to ensure that a printer is correctly set up. The test page contains information about the current printer set up such as the driver name, printer port settings and paper dimensions. The test page also has a rectangular border that delimits the printable extent of the paper. This can be used to ensure that the paper size and unprintable area are correct. If the border is truncated (i.e. a complete rectangle is not visible) then the unprintable area may be set too small or the paper size too large. Conversely, if the border is too far from the edge of the paper then the unprintable area may be set too large or the paper size too small.

Note 1: The SDH Access Tester application also uses the **Menu** key to provide a drop down facility which can be used to print a comprehensive results and setup report via the serial port (See Section 4.7). To use this feature successfully, it is important to have the correct **Printer Driver** and **Serial Port** settings rather than relying on the simple test data mentioned in Sections 2.7.1 and 2.8.

Note 2: The K1589 serial-to-parallel adapter cable supports printing from the ANT-5 to printers with a parallel port. See Section 11.3 ***Serial-to-parallel adapter cable*** for details.

2.8 Serial port

The ANT-5 can be connected to a printer via the 9-way, male, D-type connector. The configuration of the serial port parameters such as baud rate, parity and stop bits can be set in the **Serial Port** section of the **System** menu.



A facility to send an ASCII test pattern to the serial port is provided as an aid to setting up peripherals. This is particularly useful for setting up the serial connection for a printer since most printers will print ASCII text sent to them.

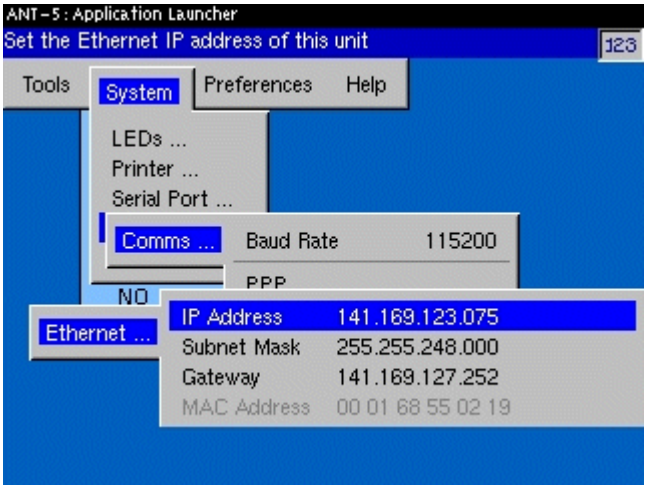
See ***Appendix C – Serial port and adapter cables*** for a diagram of the serial port.

2.8.1 Comms menu

A remote operation option is available for ANT-5, (See Section 5.4), enabling the unit to be operated remotely from a Windows PC over Ethernet.

Note: Care should be taken not to confuse the E1 120Ω (RJ-48) and the Ethernet port **<···>** (RJ-45).

The greyed out **MAC Address** of the built-in Ethernet port is shown in this graphic. Your IT department will need to know this when assigning the IP address.

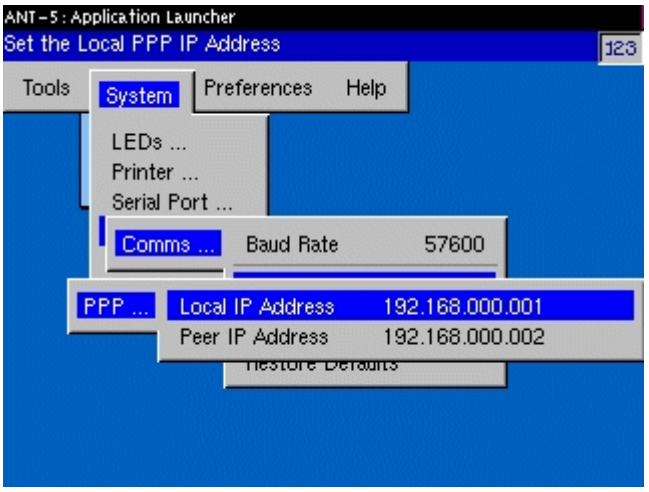


For **PPP** operation the ANT-5 acts as the server and is responsible for assigning IP addresses, conversely the PC acts as the slave.

The **Peer IP Address** is the address the ANT-5 assigns the remotely connected PC for that PPP interface, and as such is the address of the PC from the ANT-5.

The **Local IP Address** is the address of the ANT-5 from the PC.

These addresses can be edited in the same way as above.



Note 1: The **Comms** menu contains a baud rate setting which should not be confused with the baud rate setting of the serial port. This should be set up in the **Serial Port** section of the **System** menu.

Note 2: When typing in the ANT-5 IP address into a PC environment care should be taken to avoid any leading zeros. For example 141.169.126.076 would be replaced with 141.169.126.76. However, all twelve characters are needed for the ANT-5.

Note 3: Edited IP addresses will be available after the ANT-5 has been re-booted.

2.9 Card slot

The ANT-5 is fitted with a CompactFlash card slot situated on the right side. These are used for storing set-ups and results. CompactFlash cards can be formatted in the ANT-5. See Section 3.2.6 for further details.

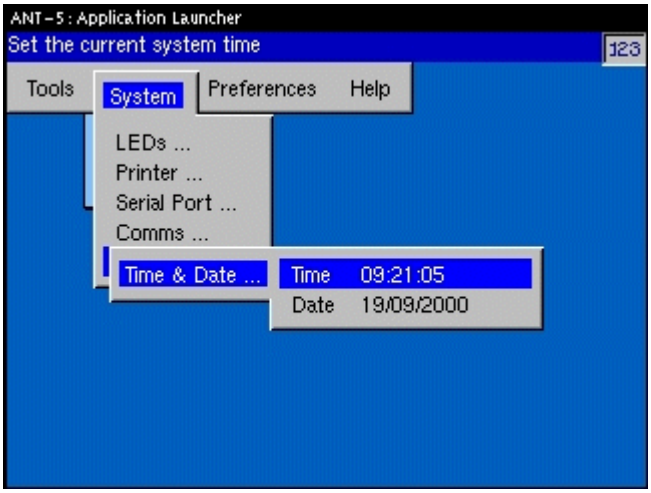
The cards should be inserted with the label side uppermost. Press into the slot until firmly located. The ANT-5 will beep to indicate it has recognised the card. If no beep is heard refer to section 7.3.

2.10 Setting the time and date

The current time and date can be set in the **Time & Date** section of the **System** menu.

After setting the time or date, power off and on the instrument. Verify that the time and date have changed.

Note: The time or date should not be changed when a measurement is running, since this will invalidate the results.

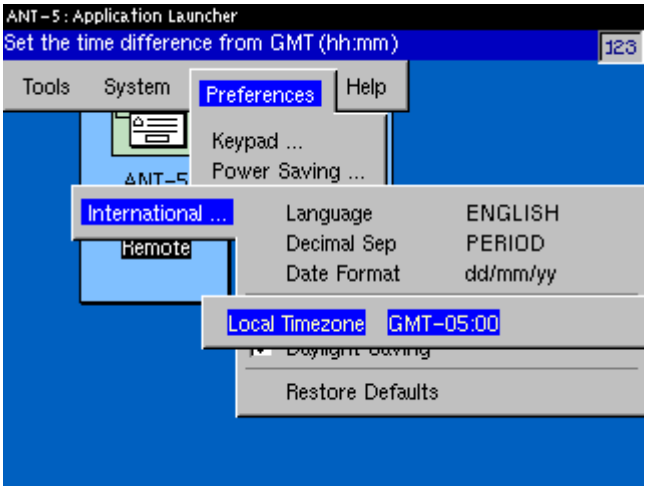


2.11 Setting the time zone

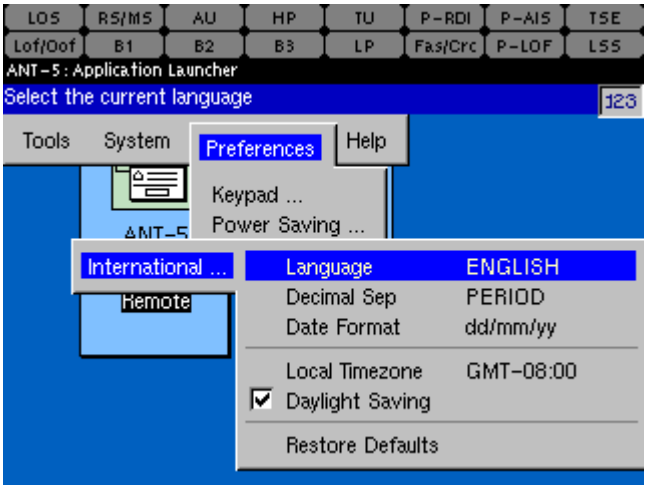
The time zone can be set in the **International** section of the **Preferences** menu.

Be sure to change the time zone when you move the instrument across time zones. Changing the time zone automatically changes the time and date.

After changing the time zone, power off and on the instrument. Verify that the time and date have changed.



2.12 Setting daylight savings time



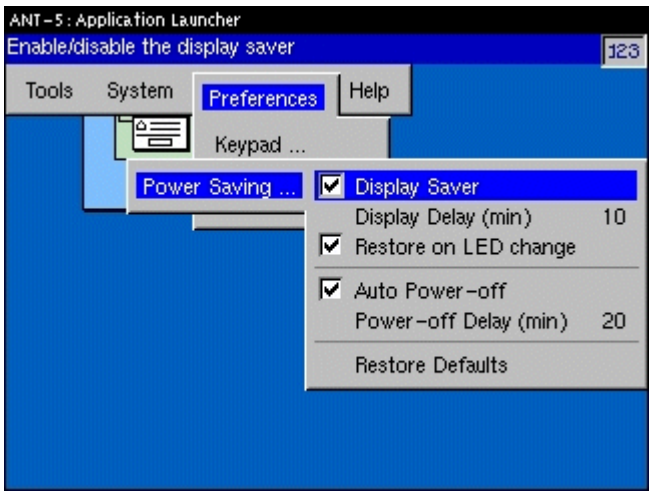
The daylight savings time indicator can be set in the **International** section of the **Preferences** menu.

When you mark the Daylight Saving checkbox, the instrument automatically adds one hour to the current time. When you clear the Daylight Saving checkbox, the instrument automatically subtracts one hour from the current time.

After making a setting for daylight savings, power off and on the instrument. Verify that the time has changed.

Note: The instrument does not automatically adjust the time for daylight savings. You must set or clear this checkbox manually.

2.13 Power saving features



The power saving features can be set up in the **Power Saving** section of the **Preferences** menu.

These take effect when the instrument has been idle for a set period of time with no keyboard activity.

2.13.1 Using the backlight

The screen has a backlight which can be switched between high and low level by pressing the **Backlight** key. Use the low level to save battery power.

2.13.2 Display Saver

When the **Display Saver** is selected, the screen will turn off after a set period of keyboard inactivity in order to save battery power. When this happens the screen LED (☒) will come on to indicate that the screen has been blanked. The full screen display can be restored by pressing any key.

The time delay before blanking occurs can be set up in the **Power Saving** section of the **Preferences** menu.

This section can also be used to set up the ANT-5 to restore the screen automatically when there is a change in the status of the on-screen simulated LEDs. The behaviour of these LEDs is controlled by the current tester application.

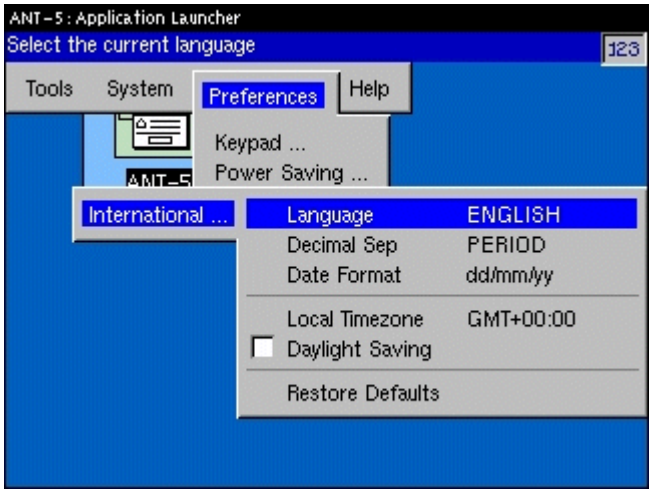
2.13.3 Auto Power-off

When **Auto Power-off** is selected, the ANT-5 will switch itself off after a set period of keyboard inactivity in order to save battery power. The time delay before this occurs can be set up in the **Power Saving** section of the **Preferences** menu.

The ANT-5 will not switch itself off if a test is running. However, if the unit is accidentally switched off, or there is no power left in the battery, results will be saved in the **user:** device of the File Manager. These will be saved as **AUTO** files, with suffixes of .A5R, the time and date will also be present so that the results are easily identified.

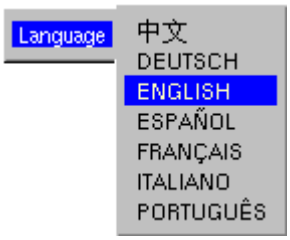
2.14 International features

The **International** section of the **Preferences** menu can be used to select various international features including the preferred operating language.



2.14.1 Setting the operating language

Select the appropriate language from those listed in the **Language** section and press the **Enter** key.



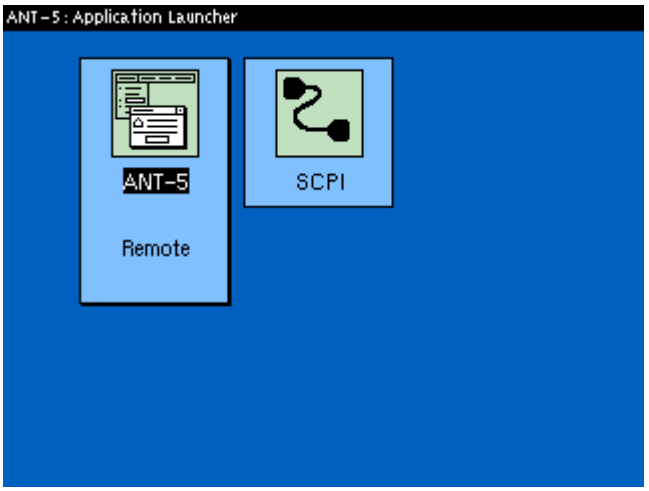
Note: The ANT-5 operating system will need to be re-started before this change can take effect. This requires turning the instrument off and then turning it on again.

3. The ANT-5 operating system

3.1 Application launcher

The ANT-5 can have one or more software applications loaded, each of which will have independent control over the configuration of the measurement hardware and its own results collection, storage and presentation. The available applications are shown as icons on the application launcher screen with the name of each application shown below the icons.

A typical application launcher screen is shown here with the ANT-5 SDH Access Tester application represented by the **ANT-5** icon.



To launch an application, use the direction keys to highlight the name of the application and then press **Enter**. The application will be launched with its last used configuration and the application launcher screen will be replaced by an application-specific screen which will make use of the whole screen area.

On terminating an application, the application launcher screen will be displayed again.

3.1.1 Switching to an ANT-5 system application

The file manager and application launcher are system applications which can be displayed at any time, without closing the SDH Access Tester application, by pressing **Alt+Esc** (press **Esc** whilst holding the **Alt** key down). This can be useful for changing the ANT-5 setup parameters without interrupting a test.

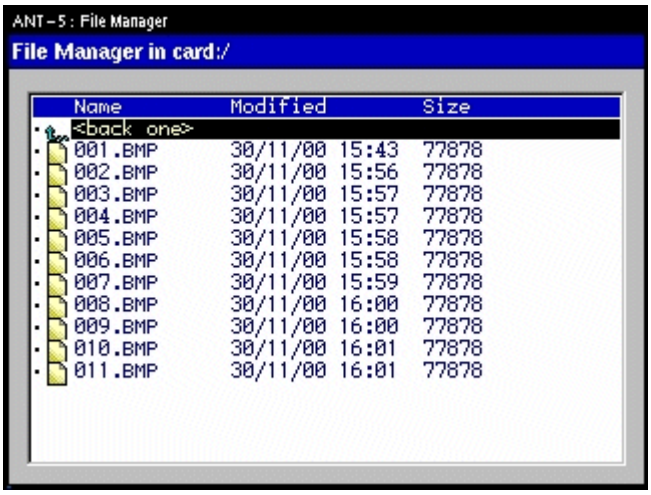
Pressing **Alt+Esc** repeatedly will switch between the ANT-5 system and the tester application in turn.

If a system application is using the screen whilst the tester application is running, the tester application will continue to run in the background and will accumulate test results as normal. In this state the test application will maintain its control of the Alarm and Signal LEDs (and) and may also be able to maintain the on-screen simulated LEDs (this will depend on the particular system application being displayed).

3.2 Using the file system and the File Manager

The ANT-5 provides an MS-DOS compatible file system with a hierarchical directory structure which uses internal RAM or a CompactFlash card as its storage medium.

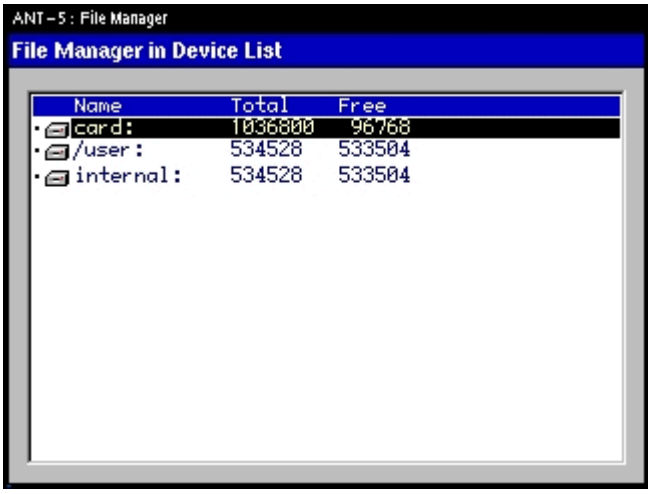
The File Manager utility is provided to allow viewing of the contents of the storage card. This utility will also allow common housekeeping operations such as formatting cards and copying, deleting and renaming files.



To run the File Manager utility, press **Alt + Menu** and select **File Manager** from the **Tools** menu. To perform an operation on an object, highlight its name using the directional keys and then press **Menu** to display a list of valid operations.

3.2.1 Navigating the file system

When the user first enters the file system browser, and there is a formatted card inserted in the slot, the screen shown here will be displayed. A message will be displayed if no storage device is available or no card is inserted.



To browse the contents of the storage card, move the highlight to the device named "**card:**" and press the **Enter** key or right directional key. The contents of the root directory of the card will then be displayed.

Note 1: The **user:** device is the internal RAM storage. In normal circumstances the ANT-5 operating system copies the data stored in this area into non-volatile memory during its power-down sequence. Data may be lost from this device in exceptional circumstances when the power-down is not controlled by the operating system, for example if the ANT-5 is switched off by holding the **Off** key down for more than 6 seconds.

Note 2: Do not modify or delete any of the files on the /internal: device as it may render the ANT-5 inoperable**.**

3.2.2 Directories

The **File Manager in…** message at the top of the screen shows the current position in the directory structure. To display the contents of a subdirectory, position the highlight over the directory name and press the **Enter** key or right directional key.

To move back to a higher directory, press the left directional key or position the highlight over the **<back one>** entry and press the **Enter** key; the contents of the parent directory will then be displayed.

To create a new directory, press **Menu** to display the File Manager menu then select **Create directory** from the **File** section.

3.2.3 Specifying a filename

At various times the user may be required to specify a filename. Typically this will be for saving and retrieving data to and from the card.

When saving a file, the directory structure is displayed and navigated in the same way as in the File Manager utility (See Section 3.2.2, ***Directories***). Before saving a file in a directory, the directory must have already been created.

To save a file using an existing filename, highlight the required file and press **Enter**.

To save a file using a new filename position the highlight over the **<new file>** entry, press the **Enter** key and enter the new filename.

3.2.4 Valid filenames

Valid filenames can have up to 8 letters or numbers in their name. They can also contain a file extension of up to 3 letters, which usually indicates the type of the file. The extension is separated from the first part of the name by a dot. Filenames are always displayed in upper case characters. The following are examples of valid filenames:

- ABC123
- RESULTS1
- TEST1.DAT

Note: The ANT-5 does not support long filenames. If a card containing files with long filenames is inserted into the ANT-5, the long filenames may be lost.

3.2.5 Saving results

A FIFO (First-In, First-Out) buffer is used to manage automatically saved files. Results from the last run test are saved as **AUTO1.A5R** in the **user:** device of the file manager when the Stop key is pressed. Only three files can be saved AUTO1, AUTO2 and AUTO3, consequently the next time a file is saved as AUTO1, the previous AUTO1 is renamed AUTO2, etc and file AUTO3 is discarded. Therefore, we recommend that important files are copied or renamed.

1. Select file manager (Press **Alt + Menu** and select **Tools > File Manager**),
2. Press enter to access the **user:** files
3. Select the appropriate AUTO file
4. Press the **Menu** key and select **File** to **Copy** or **Rename** the file.

3.2.6 Formatting a card

WARNING: Formatting the card will erase all data stored on it.

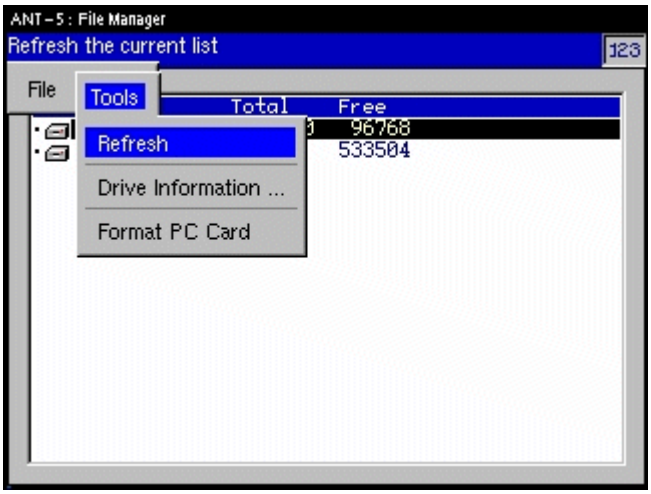
To format a card, insert an appropriate card and run the File Manager utility. If the card has already been formatted it should appear as a device named "**card:**". To examine the contents of the card prior to formatting, move the highlight to this device and press the **Enter** key or right directional key.

Use the **Menu** key to display the File Manager menu, then select **Format (PC) Card** from the **Tools** section. A warning message will be displayed to request confirmation before the data stored on the card is erased. 'Press' the **OK** button to proceed.

3.2.7 Refreshing the displayed file list

The File Manager automatically updates the displayed file list when a card is inserted or removed.

The ANT-5 can be forced to re-read the card contents by selecting **Refresh** from the File Manager **Tools** menu. This can be useful, for example, if the contents of the card have been changed by another application.



3.2.8 CompactFlash Cards

CompactFlash Cards can be read using a compatible CompactFlash card reader. Alternatively, (where the PC's IDE Controllers allow) files can be transferred from the ANT-5 to a PC, by placing the CompactFlash card into a CompactFlash card adapter, for example. The contents of the card can then be read using a PCMCIA (PC Card) compatible device.

3.3 Transferring files to a PC environment

3.3.1 Transferring files from the ANT-5 to a PC using the serial port

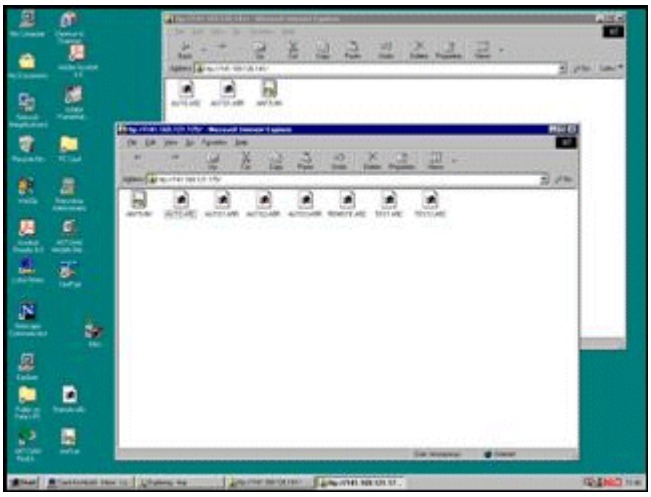
(See also 4.7.1, ***Exporting data to a spreadsheet***).

The File Manager can be used to transfer data files from the ANT-5 to a PC using the serial port. The following example assumes that Windows HyperTerminal and the COM1 port are available for use on the PC:

1. Connect an appropriate serial cable, such as K1524 or K1619, from the ANT-5 to the COM1 port on the PC/Laptop
2. Switch on the ANT-5 and make a note of the **Serial Port** settings from the **System** menu.
3. Run Windows HyperTerminal on the PC and choose a name for the connection.
4. Use HyperTerminal to establish a connection by selecting **Direct to Com1**.
5. When the COM1 properties appear in the HyperTerminal window, choose port settings to emulate those on the ANT-5 and set the flow control to **Xon/Xoff**.
6. In the HyperTerminal window click on **Transfer**, and then **Capture Text**. Give the file a name, and click on **Start**.
7. Open the ANT-5 File Manager and highlight the file to be transmitted.
8. Press the ANT-5 **Menu** key and select **Transmit…** from the **File** menu. A dialog box will appear on the ANT-5 screen confirming the transfer and the HyperTerminal screen will fill with data.
9. To stop the capture click on **Transfer** in the HyperTerminal window, followed by **Capture Text** and then **Stop**.

Note: It is also possible to send a test pattern by selecting **Send Test Pattern** under the **Serial Port** item in the ANT-5 **System** menu.

3.3.2 File Transfer



Assuming the ANT-5 is connected to a network, users are able to transfer files between the PC and an ANT-5 using either a command line FTP client or via a graphical FTP with programs such as Internet Explorer. Refer to section 2.8.1 for information on communications configuration.

In this example two sessions of Internet Explorer have been opened to transfer files between two ANT-5's, by typing in the command `ftp://` followed by the relevant IP addresses of the ANT-5.

When accessing the file system remotely, be sure to change to the `/user:` directory. Do not add or retrieve files from the `/internal:` directory.

Tip: Master configuration files for an ANT-5 can be simply copied to other units by transferring the **.A5C** files.

3.4 Available online help

The ANT-5 includes electronic documentation to facilitate testing and interpreting test results. All documentation is available from the Help menu. To access the Help menu, press **Menu** on the keypad.

Help > About	Select this option to view version information.
Help > Glossary	Select this option to view definitions of test results.
Help > Keyboard	Select this option to view a guide to generating symbols and ASCII control characters from the keyboard.
Help > SDH Structure	Select this option to view a schematic of the SDH physical layer.
Help > SONET Structure	Select this option to view a schematic of the SONET physical layer.

4. The SDH Access Tester Application

The SDH Access Tester application has three viewing modes: **Setup**, **Result**, and **Actions**. Each viewing mode has a number of tabbed pages associated with it as shown in the table below.

Note: The tabbed pages for Performance Analysis, Repetitive BERT, APS, Delay and Tributary Scan will only become available if the measurement is selected from the Measurement Selection panel. See section 4.3.1 for further details.

Tabbed Setup pages

	Signal Structure page		AAL-2 / AAL-5 Setup
	Measurement Selection		ICMP Setup (Ping, Trace Route, Reply to Ping)
	Overhead Setup		Measurement Timer Setup
	Autoconfigure		Performance Analysis Setup
	ATM setup page		Tributary Scanning Setup

Tabbed Results pages

	Results Summary page		APS page
	Performance Analysis results		Pointer Analysis page
	Anomalies and Defects page		Round Trip Delay page
	Overhead Analysis page		Tributary Scanning results
	TCM results page		Sa bit sequence results (requires PDH Mux option)
	Repetitive BERT page		Channel Traffic Analyzer (CTAN)
	Ping		IMA Monitor
	Reply to Ping		AAL Statistics
	Trace Route		

Tabbed Actions pages			
	Injection page		Pointer generator page
	Modify overhead bytes page		TCM generator page

Table 1 – Tabbed pages for **Setup, Results**, and **Actions** views

Each page can be accessed by using the directional keys to highlight its page tab.

Setup view allows the user to set up the interface and test parameters. If a test is not running, the settings can be easily changed by moving around the screen with the directional keys and selecting items with the **Enter** key. If a test is currently running the setup pages can be viewed but not changed.

Results view allows the user to view the test results as a test is running or after it has been stopped.

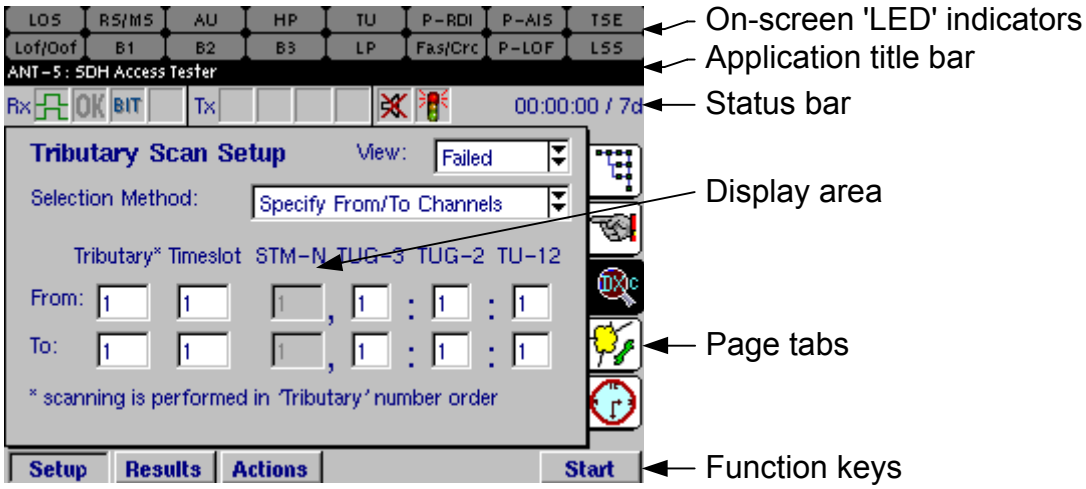
Some of the **Results** view pages are split into two halves. The left half of these pages are used for displaying results and the right half is used for setting the various test parameters.

Note: The results of a test are always displayed with regard to the test parameters which were set up at the time the test was run. These may not match the current setup parameters if any changes have been made since the test was run.

Actions view provides facilities for injecting anomalies and defects, and for changing overhead bytes and pointer values.

4.1 General screen layout

The SDH Access Tester application organises the screen into the typical areas shown below.



- The top portion of the screen is used by the application to simulate LED indicators on-screen in order to display information which is relevant to the current setup of the application. See Section 4.8. The title of the current application is shown in the application title bar.
- The status bar is used to display the status of the interface and the current test.
- The display area has a number of tabbed pages which can be made active by selecting the tabs down the right side. The display area is used for setting up tests and displaying results. For some pages the display area may be split into left and right areas and may have multiple results pages which can be selected.
- The six unmarked keys at the top of the keyboard, ⬭, are function keys to control certain features of the ANT-5. The function of each active key is identified by an animated button on the screen just above the actual key.

4.1.1 Moving around the screen

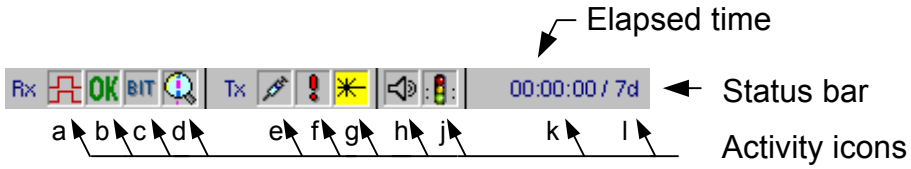
Use the directional keys for moving around active parts of the display area, such as buttons and list boxes, which are highlighted in turn. The page tabs can be highlighted by moving up and down the right side of the display area.

Press the **Enter** key to operate a highlighted button or to select a highlighted list item.

4.1.2 Status bar

The status bar is used for displaying the status information for pattern sync, defect notification and anomaly/defect injection. The elapsed time of the test in hrs:min:sec format is shown in position **k**. If a test is not running, the elapsed time of the previous

test will be displayed. Position **l** shows how long the test will run. (See Section 4.3.4 to set the duration of the test.)



Rx Icons

The pattern sync icon (position **a**) displays a steady synchronised digital signal if the instrument is synchronised on a BERT pattern.

The pattern sync icon displays an animated unsynchronised digital signal if the instrument is unable to synchronise on a BERT pattern. This defect is also known as LSS (Loss of Sequence Synchronisation).

The pattern sync icon is blanked if no BERT pattern is present or there are no containers selected to carry a BERT pattern.

The defect detected icon (position **a**) flashes if any other defect condition is currently being detected at the selected Rx input, such as LOS.

The OK icon (position **b**) is displayed if no alarm or error conditions have been detected at the selected Rx input, since the beginning of the test. It is linked to the large OK displayed on the screen and will also be displayed if the results are cleared by pressing the **Reset** function key. As soon as an alarm or error condition is detected the icon will be blanked and the large OK displayed on the screen will be replaced by another results panel showing the condition detected.

(position **c**) is displayed depending on the type of performance analysis chosen. For example BIT will be shown if G.821 is selected.

Assuming the ATM option has been purchased and enabled (see Section 6) this icon (position **d**) becomes animated when load ATM traffic is monitored at the receiver (Rx).

Tx icons

The anomaly injection icon (position **e**) displays an animated syringe when anomalies are being injected. The icon is blanked when anomaly injection is not active.

The defect injection icon (position **f**) flashes if a defect condition is currently being injected. The icon is blanked when defect injection is not active.

The TCM generator icon (position **f**) appears when TCM generation is active. The icon is blanked when TCM generation is not active.

The pointer generator icon (position **f**) appears when pointer generation is active. The icon is blanked when pointer generation is not active.

The laser warning icon (position **g**) is displayed with a yellow background when the ANT-5 laser source (Tx) is activated. The icon is greyed out when the laser is deactivated and is blanked if an electrical interface is selected.

These icons show if the beeper is turned on or off, (position **h**). Pressing the beeper key on the keyboard controls this function.

These icons (position **j**) show the current status of the test. The green light is displayed while a test is running and a red light is displayed when a test has been stopped. The amber light is displayed when a test is due to begin from a delayed start. See section 4.3.4.

4.1.3 Function keys

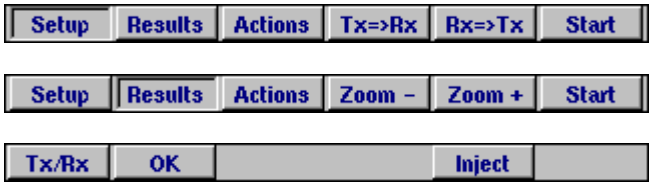
The six unmarked keys at the top of the keyboard, ⬭, are function keys to control certain features of the ANT-5. The function of each active key is identified by an animated button on the screen just above the actual key. The state of each button icon, whether it is shown pushed in or not, is also used to indicate current functional states such as **Setup** view or **Results** view. The button icons are greyed when a function is not available.

Firm key	Function
Setup	Switch to **Setup** view.
Alt + Tx/Rx	Switches to the Signal Structure setup page
Results	Switch to **Results** view.
Actions	Switch to **Actions** view.
Alt + OK	Switches to the Results summary page
Alt + Reset	If a test is running **Reset** will clear all of the counter values, elapsed test time and LEDs. If a test is not running **Reset** will clear the LEDs without clearing the existing test results.
Tx=>Rx or Rx=>Tx	Within the Signal Structure screen, copies the signal structure of the **Tx Path** to the **Rx Path**, and vice versa.
Inject	Depress the inject key injects a range of anomalies and defects into the transmission signal. See Section 4.4.3 for more details. The inject firm key appears automatically in the Injection page. Alternatively, users can select this firm key by pressing the **Alt** button from any other page.
TU	Causes generation of a tributary unit pointer.
AU	Causes generation of an administrative unit pointer.
Apply	Begins injection of new overhead bytes.

Firm key	Function
Offset - or Offset+	These keys are used from the results page when clock offset is enabled. The transmitter offset can be adjusted in steps of 0.1 ppm by pressing the required offset firm key, or offset in increments of 1.0 by pressing and holding down the firm key.
Zoom - or Zoom +	When anomalies or defects are displayed as graphs, the Zoom - and Zoom + keys can be used to adjust the units of time along the x-axis of the graph.
ASCII or HEX	When overhead analysis/injection results are displayed, the **ASCII** and **HEX** keys can be used to switch between the alpha and numeric views.
Start or Stop	**Start** a test, or **Stop** the test if one is running. (Once a test has been stopped, up to three files are automatically saved on the **user:** device, see 3.2.5 for further details).

Table 2 – Function key.

Some examples of function key positions are shown below:



(Press **Alt** to display these keys.)

4.2 AutoConfigure

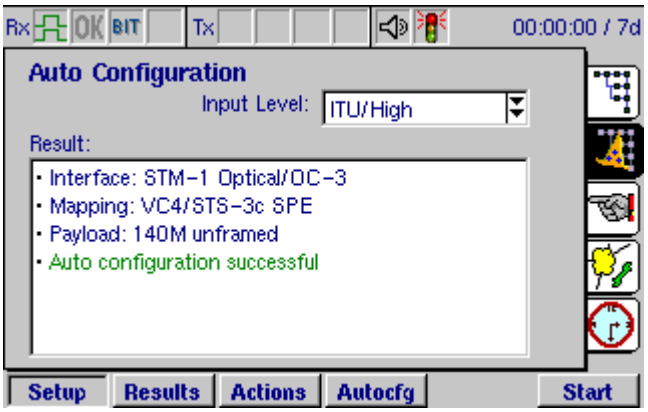
When you use the Automatic Configuration feature, the unit analyzes the signal and configures itself based on the test interface (SDH, SONET, or PDH), mapping structure, and payload (if applicable). When Auto Configuring to a 2M channel containing 64k sub-channels, the ANT-5 assumes live traffic for the 2M channel and will not determine a pattern. Auto Configure functions similarly with a 1.5M channel containing 64k sub-channels. In both instances, the unit will display an “uncertain” result. To analyze a 64k channel, you must configure the ANT-5 manually

The AutoConfigure facility can be accessed by performing the following procedure.

1. Connect the interface cables.
2. Press the **Alt+Tx/Rx** firm key to display the signal structure page.
3. Press the **Alt+Autocfg** firm key.
4. Select the input level: **ITU/High** or **PMP/Low**.
5. Press the **Autocfg** firm key.

A message appears that describes the results of the autoconfigure operation. The actual settings appear in the RX section of the structure setup page.

After initiating the autoconfigure utility, the autoconfigure tab  appears along with other setup tabs after pressing the **Setup** firm key.



4.3 Setup pages

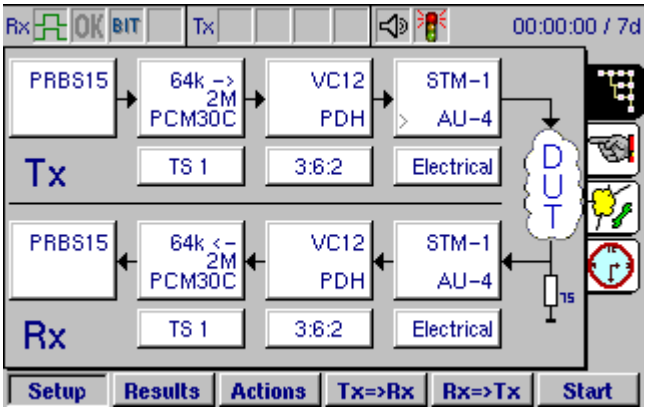
The SDH Access Tester application uses a range of tabbed setup pages to set the interface and test parameters before running a test. The settings can be easily changed by moving around the screen with the directional keys and selecting items with the **Enter** key. If a test is running, some parameters on the setup pages can be viewed but not changed and these will be greyed to indicate that they are disabled.

When making changes to the setup, any value selected for a parameter (by pressing the **Enter** key for example), becomes effective immediately unless it is not a valid value. In this case the previous value will be retained or a substitute value used.

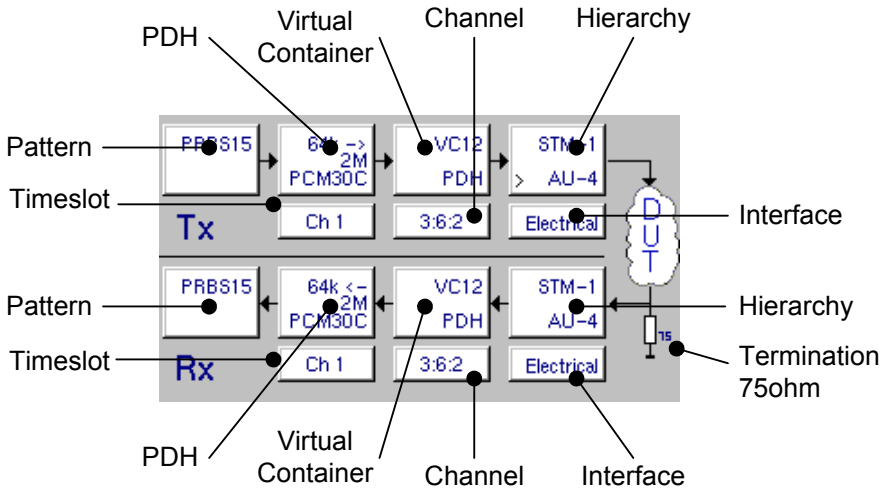
Note: Whether a test is running or not, the transmitter will start to transmit continuously as soon as a valid configuration is entered. The receiver will look for and attempt to recognise a valid signal on its Rx input in readiness for the **Start** key being pressed. When a test is not running, the LEDs and Rx icons will continuously indicate errors and alarms but any other results displayed will be the results of a previous test.

4.3.1 Signal Structure setup page

The **Signal Structure** setup page allows the configuration of both the Tx and Rx to be set up for the particular device or system under test (**DUT**).



The settings for each element of the signal structure can be changed by moving around the structure diagram using the directional keys and selecting items with the **Enter** key. A window showing the available parameters for that element will then be displayed.



The procedure for setting the Rx elements of the test structure is very similar to the setting of the Tx elements except for the **Interface Setup Rx** window, which has a different set of parameters.

The list of available parameters for each part of the structure may vary depending upon the configuration selected in the other elements. For example, if a PDH interface is selected, the Virtual Container setup dialog box will not appear, since this box is only applicable to SDH.

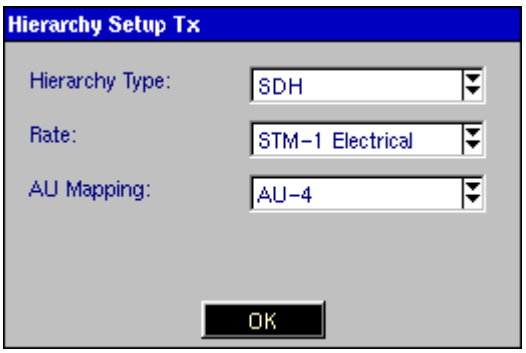
The signal structure always appears with a test pattern source and test pattern detector. If the incoming signal is expected to contain network traffic, the **Traffic** pattern may be selected to disable the receiver's pattern detection process and the reporting of LSS defects.

When setting up the various parts of the signal structure for the ANT-5, it is advisable to make changes to each element of the structure in the order that they are referred to in this chapter.

4.3.1.1 Hierarchy Setup Tx

Selecting the Hierarchy element for the transmit path opens the **Hierarchy Setup Tx** panel, allowing either SDH or PDH framing types to be selected.

If PDH is selected, the PDH line rate is determined by the Bit Rate selected in the PDH Setup screen.



Note 1: The optical **Rate** for STM-1, STM-4 and STM-16 are also selectable if the options have been purchased and enabled.

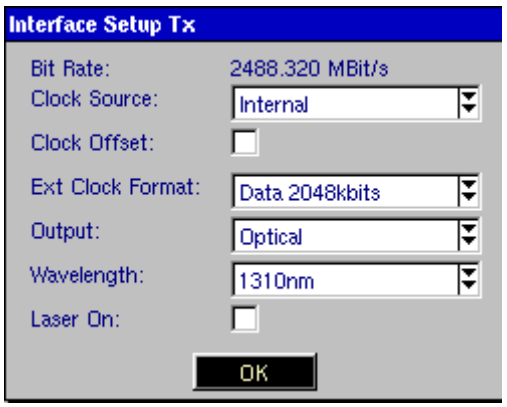
Note 2: AU-3 Mapping will also become selectable if the option has been purchased and enabled.

Note 3: The Sonet Hierarchy Type is available if the SONET option has been purchased and enabled.

Remember: Connect an external optical attenuator to the optical Rx port as care must be taken not to connect a long-haul (high power) transmitter directly to the receiver, since this can overload or even damage some receiver modules.

4.3.1.2 Interface Setup Tx

Selecting the Interface element for the transmit path opens the **Interface Setup Tx** panel, allowing electrical and optical options to be selected. The fields appearing in this panel depend on the defined hierarchy.



Clock Source The transmitter **Clock Source** can be set to **Internal**, **From Rx**, or **External**, with selections of **Data 2048kbits/s**, **Clock 2MHz**, **Data 1544kbits/s**, or **Clock 1.5MHz**.

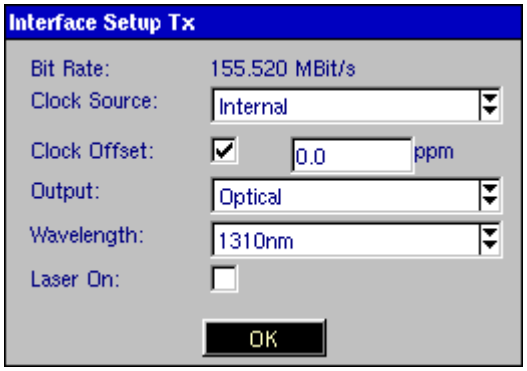
For the **Internal** setting, the clock for the transmitter is derived from the internal 2048 kbit/s clock. For the **From Rx** setting, the clock for the transmitter is derived from the Rx connector.

When selecting settings for the external clock, the clock for the transmitter is synchronised to the signal on the **Ext. Clk** connector.

Clock Offset The frequency offset of the received signal is the difference between the received frequency and the expected frequency. All network equipment (NE) can tolerate a certain amount of offset. However, if the limits are exceeded a NE will fail to synchronise to the received signal which will result in network errors.

Skewing the frequency is a standard test during installation to ensure that an installed unit can tolerate the frequency offsets occurring within the network.

The **Clock Offset** is only available when the **Clock Source** is set to **Internal**. With the Clock Offset box checked a value can be entered for the offset, from –100 to +100. However, once a test has started the clock offset can only be changed using the associated firm keys from the Results page. See Section 4.4.1 for further details.



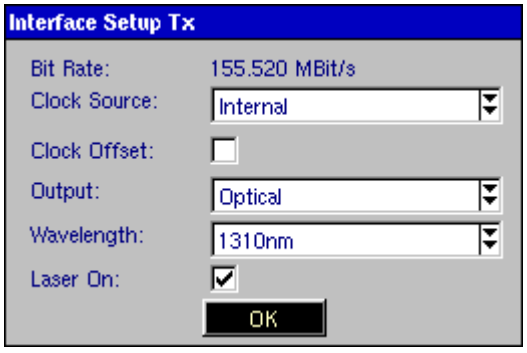
Note: If the signal structure is changed the parameters for clock offset will need to be re-established.

Output

The output interface can be set to either **Optical** or **Electrical**. If the ANT-5 is equipped with an optical interface, both electrical and optical options will be available.

If a PDH structure has been selected in the Hierarchy setup, the optical options will be disabled. If an SDH structure has been selected and the ANT-5 is equipped with an optical interface, both electrical and optical options will be available.

If the **Optical** interface is selected, the state of the **Laser On** checkbox can be toggled, and the **Wavelength** can be set to either 1310 nm or 1550 nm, depending on which optical options have been fitted to the instrument.



Line Code

The **Line Code** setting automatically defaults to the setting appropriate to the interface type, as listed in the following table. You can change the line code for the E1 and DS1 rates.

Interface	Line Code
SDH Optical	NRZ
STM-1 Electrical	CMI
STM-0 Electrical	B3ZS, HDB3
E4	CMI
DS3	B3ZS
E3	HDB3
E1	HDB3, AMI
DS1	B8ZS, AMI

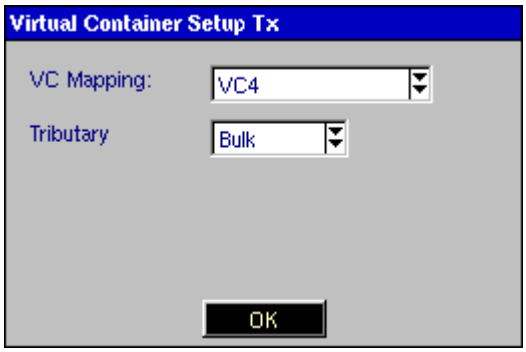
Wavelength The peak-to-peak length of the laser signal.

Laser On Indicates if the unit transmits the signal with its internal laser.

Line Type If the transmitting hierarchy type is PDH, and if the PDH High Rate is 2M (see illustration in section 4.3.1.5), you can set the line type to **Balanced** or **Unbalanced**.

4.3.1.3 Virtual Container Setup Tx

Selecting the Virtual Container element for the transmit path opens the **Virtual Container Setup Tx** panel, allowing SDH mapping options to be selected.



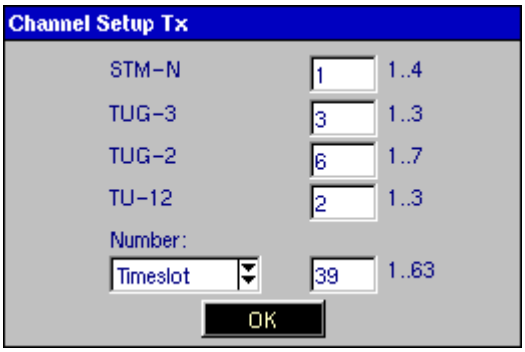
This element will not be available if a PDH interface has been selected.

Bulk should be selected as the **Tributary** if bulk testing of the virtual container is required. The test pattern will then be injected across the whole of the Virtual Container.

If testing within a PDH hierarchy is required, the **PDH** tributary should be selected. The test pattern will then be injected into the selected SDH virtual container with the selected PDH parameters.

Note: VC11/TU11 and **VC11/TU12** will also become selectable if the AU-3/VC11/SONET VT mappings option has been purchased and enabled.

4.3.1.4 Channel Setup Tx



Selecting the Channel element for the transmitter side opens the **Channel Setup Tx** panel, allowing selection of the SDH tributary channel which is to be tested.

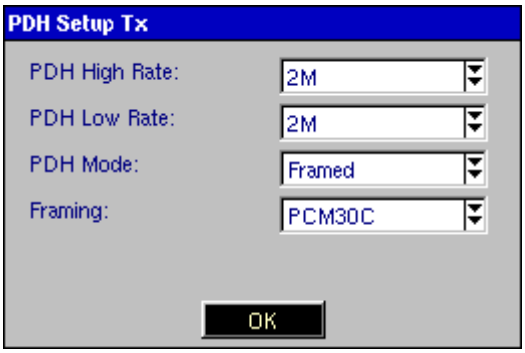
This element will not be available if a PDH interface has been selected.

The Tx channel is selected by entering the discrete TUG and TU numbers for the channel in the appropriate window. The availability of different TUG-3, TUG-2 and TU-12 groups for selection is dependent upon the SDH Virtual Container.

For example, if a VC-3 has been selected for a test, then only the TUG-3 parameter can be adjusted, enabling selection of which TUG-3 within the VC-4 will carry the VC-3 payload. Alternatively, if a VC-12 has been selected for a test, then the TUG-3, TUG-2 and TU-12 can all be adjusted, enabling selection of which TU-12 will carry the VC-12 payload.

As an alternative to selecting the discrete TUG and TU numbers, the corresponding number of the Virtual Container can be selected. This is of benefit when setting up VC-12s or other complicated mappings. On entering a VC number, the TUG and TU numbers will automatically change to match the new VC. The table in Section 12.4, ***SDH Tributary Numbering***, gives the relationship between the VC numbers and TUG numbers for the **Tributary** and **Timeslot** (ITU-T) numbering methods.

4.3.1.5 PDH Setup Tx



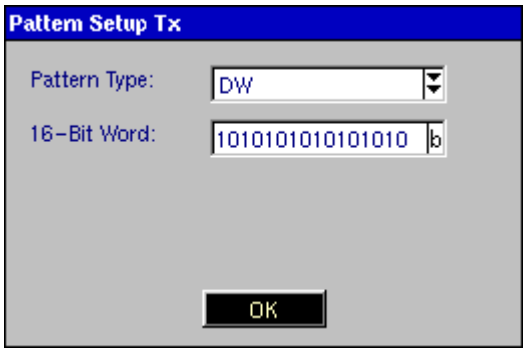
Selecting the PDH element for the transmitter side opens the **PDH Setup Tx** panel, allowing selection of the PDH parameters for the test signal.

The test signal is either injected into the SDH Virtual Container if an SDH line interface has been selected, or is passed directly to the PDH line interface if a PDH line interface has been selected.

If **Bulk** has been selected as the **Tributary** in the SDH Virtual Container then the **PDH Setup Tx** panel will not be available.

Note: If an SDH line interface has been selected, only bit rates and framing types appropriate for the SDH configuration will be displayed as options within this panel. **PDH Low Rate** is only applicable if Nx64 testing is required, See Section 4.4.12.

4.3.1.6 Pattern Setup Tx



Selecting the Patterns element for the transmit path opens the **Pattern Setup Tx** panel, allowing selection of the test pattern which will be inserted into the SDH Tx channel or PDH interface.

One pattern from a range of pattern types can be selected, including the digital word pattern, **DW**. If this is selected the content of the word can be set up in the **16-Bit Word** box which appears below the **Pattern Type** selector. Inverted patterns are also available and are indicated by an 'I' at the beginning of the pattern name, for example **IPRBS23** is the inverted form of the 2^{23}-1 pattern, **PRBS23**.

Note: The pattern element will be greyed out if the round trip delay measurement has been activated. See section 4.4.11, ***Delay***, for further information.

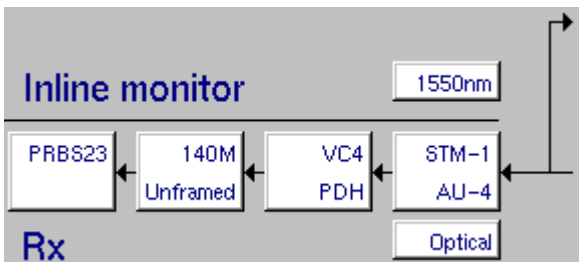
4.3.1.7 Hierarchy Setup Rx

The ANT-5 supports inline monitor, terminated, and intrusive thru mode testing for SDH, SONET, T1, and E1 interfaces. Inline monitor testing allows technicians to monitor data without disturbing live voice or data traffic. Because inline monitor testing does not disrupt the transmission of live traffic, it is more suitable for routine maintenance than terminated testing. (This requires prior break down of the line to insert the ANT-5 within the circuit.) Another advantage of inline monitor testing is that it indicates performance under actual operating conditions. Its primary disadvantage is that measurements may not be as precise as those available through terminated testing.

Inline monitor testing is generally performed for the following purposes:

- Routine maintenance—Using in-service monitoring for routine maintenance can show degrading performance before it disrupts normal operation.
- Fault isolation—In-service monitoring can aid in localising problems and minimising circuit downtime. By monitoring the circuit at various points, technicians can analyse the results and discover where problems are originating.

When testing in inline monitor mode, the signal structure page changes. You can modify the structure of the received signal, and only the interface of the transmitted signal.

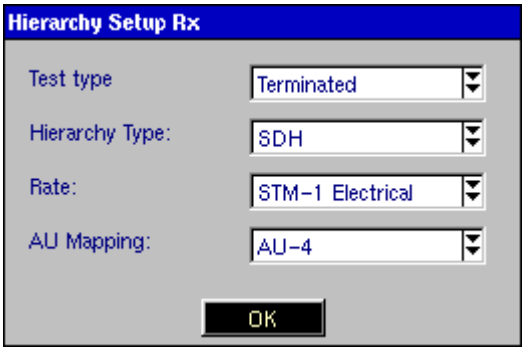


Terminated testing requires that live traffic be removed from the circuit before testing can begin. This frees the circuit for advanced testing techniques such as injecting test patterns or manipulating bit values. By simultaneously generating and analysing the received data for errors, the ANT 5 can analyse the performance of the circuit in both directions.

When testing in terminated mode, the signal structure page appears similar to that on page **Error! Bookmark not defined.**.

Selecting the Hierarchy element for the receive path opens the **Hierarchy Setup Rx** panel, allowing either SDH, SONET, or PDH framing types to be selected.

If PDH is selected in the **Hierarchy Type** field, the line rate is determined by the Bit Rate selected in the PDH Setup screen.



Testing in intrusive thru mode allows the technician to monitor live traffic and modify framing information, manipulate overhead bytes, and insert errors as the traffic passes thru the ANT-5. Anomalies and defects that would prevent the traffic from passing through the unit can not be inserted in thru mode.

The following table lists the available hierarchy types, associated rates, and ports used for physical connections.

Hierarchy	**Rate**	**Connector**
PDH	E4	STM-1, E4, DS3, E3 BNC
	DS3	STM-1, E4, DS3, E3 BNC
	E3	STM-1, E4, DS3, E3 BNC
	E1	E1 BNC or E1 RJ-45
	T1	T1 Bantam
SDH	STM-0 Electrical	STM-1, E4, DS3, E3 BNC
	STM-1 Electrical	STM-1, E4, DS3, E3 BNC
	STM-1 Optical	STM-n Optical
	STM-4 Optical	STM-n Optical
	STM-16 Optical	STM-n Optical
	STM-1 NRZ	STM-n NRZ
	STM-4 NRZ	STM-n NRZ
	STM-16 NRZ	STM-n NRZ

Hierarchy	Rate	Connector
SONET	STS-3 Electrical	STM-1, E4, DS3, E3 BNC
	OC-3 Optical	STM-n Optical
	OC-12 Optical	STM-n Optical
	OC-48 Optical	STM-n Optical
	OC-3 NRZ	STM-n NRZ
	OC-12 NRZ	STM-n NRZ
	OC-48 NRZ	STM-n NRZ

See Section 1.4, ***Physical layout and connectors***, for the locations of connectors on the ANT-5.

The signal structure always appears with a test pattern source and test pattern detector. The user may wish to disregard the BER features, whilst only monitoring SDH or PDH defects, if required.

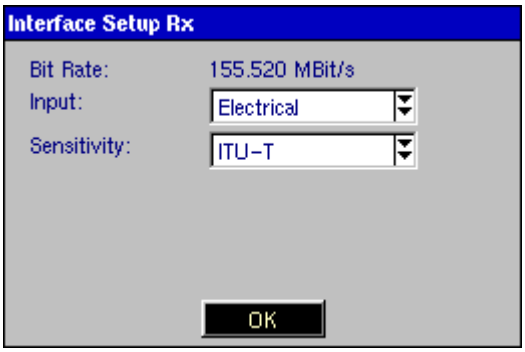
Note 1: The optical **Rate** for STM-1, STM-4 and STM-16 are also selectable if the options have been purchased and enabled.

Note 2 AU-3 Mapping will also become selectable if the option has been purchased and enabled.

Note 3: The SONET Hierarchy Type is available if the SONET option has been purchased and enabled.

4.3.1.8 Interface Setup Rx

Selecting the Interface element for the receive path opens the **Interface Setup Rx** panel, allowing electrical and optical options to be selected.



Input

The input interface can be set to either **Optical** or **Electrical**. If a PDH structure has been selected in the Hierarchy setup, the optical options will be disabled. If an SDH or SONET structure has been selected and the ANT-5 is equipped with an optical interface, both electrical and optical options will be available.

If the **Optical** interface is selected, the receiver interface will detect any optical signal within the specified receiver wavelength range (1100 nm to 1580 nm).

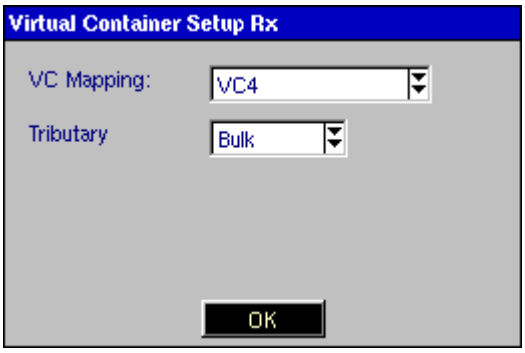
Sensitivity If the **Electrical** interface is selected, the sensitivity can be set for **ITU-T**, **PMP** (Protected Monitor Point) or **HIGH** connections. The **PMP** setting includes appropriate linear gain to compensate for the attenuation at the protected monitor point. The electrical interface will be terminated in either 75Ω (BNC) or 120Ω (RJ-48). See section 9.4.3 for further information.

Pulse Shape **HIGH** or **DSX** can be selected as the pulse shape and is used when testing PDH tributaries with a bit rate of 45M **Note:** A HIGH pulse shape should not be confused with high impedance.

Line Type If the receiving hierarchy type is PDH, and if the PDH High Rate is 2M (see illustration in section 4.3.1.11), you can set the line type to **Balanced** or **Unbalanced**.

Termination If the receiving and transmitting hierarchy types are PDH, and if the PDH High Rate is 2M (see illustration in section 4.3.1.11), then the Termination field becomes available. Select **Hi-Z** for a high-impedance monitor test, or **Terminated** for a terminated test.

4.3.1.9 Virtual Container Setup Rx



Selecting the Virtual Container element for the receive path opens the **Virtual Container Setup Rx** panel, allowing SDH mapping options to be selected.

This element will not be available if a PDH interface has been selected.

Bulk should be selected as the **Tributary** if bulk testing of the virtual container is required. The test pattern will then be injected across the whole of the Virtual Container.

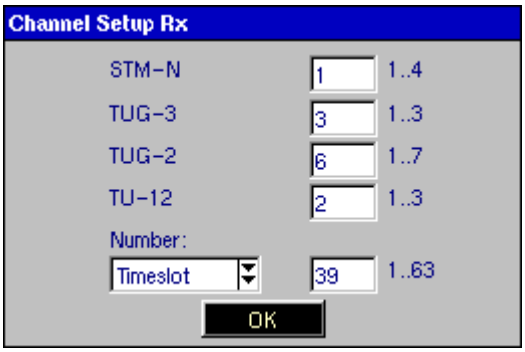
If testing within a PDH hierarchy is required, the **PDH** tributary should be selected. The test pattern will then be injected into the selected SDH virtual container with the selected PDH parameters.

Note: VC11/TU11 and **VC11/TU12** will also become selectable if the option has been purchased and enabled.

4.3.1.10 Channel Setup Rx

Selecting the Channel element for the receiver side opens the **Channel Setup Rx** panel, allowing selection of the SDH tributary channel which is to be tested.

This element will not be available if a PDH interface has been selected.

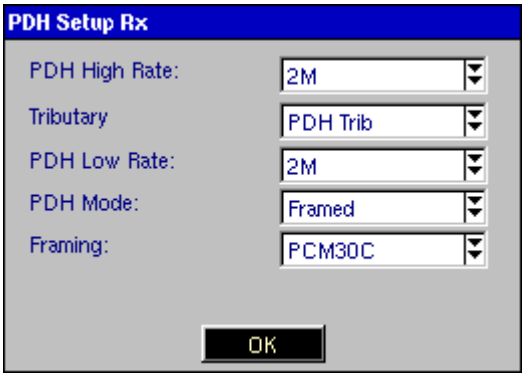


The Rx channel is selected by entering the discrete TUG and TU numbers for the channel in the appropriate window. See Section 4.3.1.4, ***Channel Setup Tx***, for further details.

4.3.1.11 PDH Setup Rx

Selecting the PDH element for the receiver side opens the **PDH Setup Rx** panel, allowing selection of the PDH parameters for the test signal.

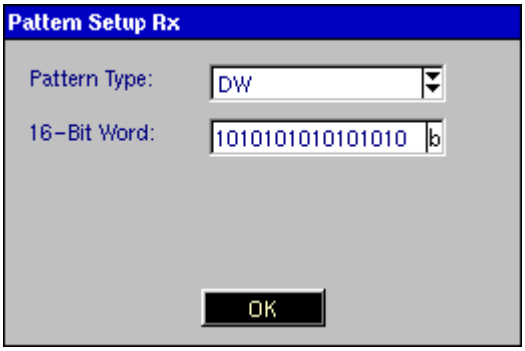
The test signal is either detected from the SDH Virtual Container if an SDH line interface has been selected, or is detected directly from the PDH line interface if a PDH line interface has been selected.



Note: If an SDH line interface has been selected, only bit rates and framing types appropriate for the SDH configuration will be displayed as options within this panel. **PDH Low Rate** is only applicable if Nx64 testing is required. See Section 4.4.12 for details.

4.3.1.12 Pattern Setup Rx

Selecting the Patterns element for the receive path opens the **Pattern Setup Rx** panel, allowing selection of the test pattern which will be extracted from the SDH Rx channel or PDH interface.



One pattern from a range of pattern types can be selected, including the digital word pattern, **DW**. If this is selected the content of the word can be set up in the **16-Bit Word** box which appears below the **Pattern Type** selector. Inverted patterns are also

available and are indicated by an 'I' at the beginning of the pattern name, for example **IPRBS23** is the inverted form of the 2^{23}-1 pattern, **PRBS23**.

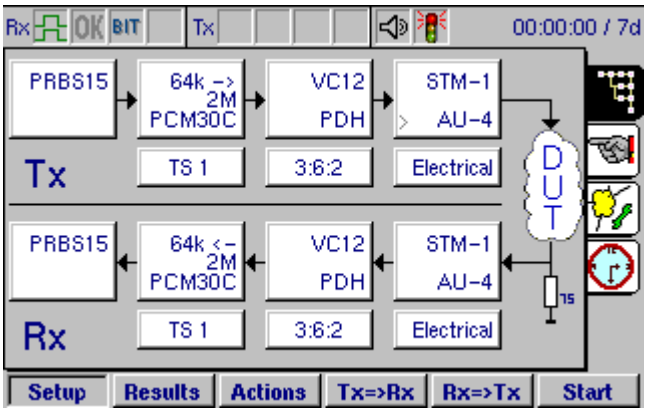
The **Traffic** pattern should be selected if the incoming signal is expected to contain network traffic. Selecting this option effectively disables the pattern detection process and the reporting of LSS defects.

4.3.1.13 Symmetrical Tx and Rx Settings

Where the system under test is symmetrical, and the Tx and Rx structures are required to be identical, time can be saved by setting up either the Tx or the Rx structure, and then pressing either the Tx=>Rx or Rx=>Tx keys as appropriate. The structure will be copied from Tx to Rx, or vice versa, as selected.

The Tx and Rx structure can also be set up independently, so that, for example, the Tx can be sending a PRBS of 2^{15}-1 in a VC-12 carried within an optical STM-1, whilst the Rx can be expecting to receive a PRBS of 2^{15}-1 in a 2 Mbit/s PDH signal.

If the structure has been set up independently, as in this example; the mappings and bit rates are automatically copied. This feature has been designed to ensure the user has selected the appropriate mapping or rate for SDH/SONET/PDH operation.

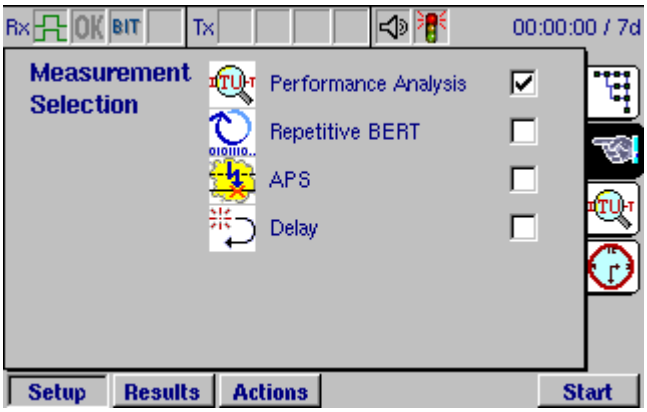


Generally, always edit the highest configuration, in this example STM-1 on the Tx takes priority over PDH on the Rx. Therefore, to change the PDH rate to 140M select the **Virtual Container Setup Tx** panel as highlighted in the graphic. Edit the **VC Mapping** to VC4, you will then notice the associated rate for the PDH Rx has changed to 140M.

Note: Previous mixed mode configurations saved prior to software version 08.00 will no longer be valid.

4.3.2 Measurement Selection

A **Measurement Selection** page has been included to ease special test mode selection, for example, a tributary scan or a delay measurement. Each measurement is mutually exclusive.



When a special measurement mode is selected, the corresponding results page will be displayed by selecting the **Results** tab. In some cases (for example, performance analysis or tributary scan) a corresponding **Setup** page will also be available. Alternatively if no setup is required, check the required measurement and press the **Start** firm key to view the appropriate results page. Refer to the relevant sections (as listed below) for a description of the test.

Feature	Section
Performance Analysis Setup	4.3.5
Capturing Values for K1 and K2 Bytes	4.4.5.3
Performance Analysis Results	4.4.3
Repetitive BERT	4.4.8
Automatic Protection Switching	4.4.9
Delay	4.4.11
VC12 Tributary Scanning Setup	4.3.6
VC12 Tributary Scanning Results	4.4.7

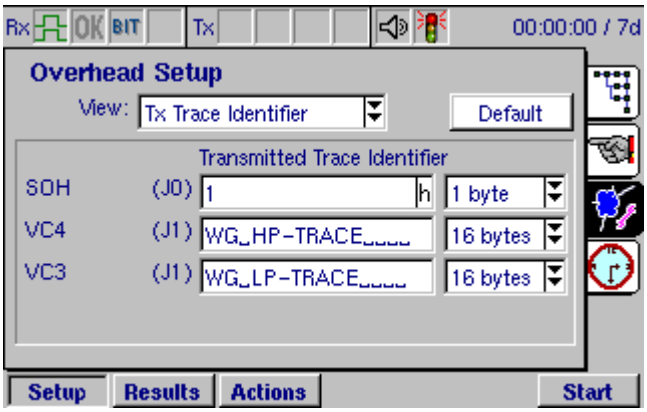
Note: To select **Tributary Scan** ensure VC12 is selected as the **Virtual Container** for the Transmitter (Tx) and the Receiver (Rx). (See Sections 4.3.1.3 and 4.3.1.9).

4.3.3 Overhead Setup

The **Overhead Setup** page has five separate sub-pages which can be viewed by selecting the appropriate entry in the **View** menu at the top of each page.

4.3.3.1 Transmitted Trace Identifiers

Selecting **Tx Trace Identifier** allows the transmitted Trace Identifiers (TI) to be set up.



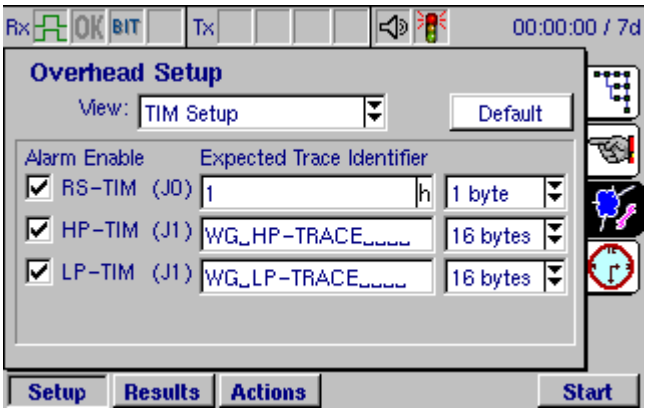
Three trace identifiers are transmitted, the Regenerator Section TI (J0), the High Path TI (J1), and the Low Path TI (J2).

The RS-TI can be set to 1 byte or 16 bytes in length. The HP-TI and LP-TI can be set to 16 bytes or 64 bytes in length.

If the RS-TI is set to 1 byte, its contents are entered in the form of two hexadecimal digits. During this entry, the function keys are temporarily assigned the alphabetical values ‘A’ to ‘F’. The two hexadecimal digits can be entered by using the keyboard for the decimal numbers and the function keys for the alpha characters.

4.3.3.2 Trace Identifiers

To set up the trace identifiers, select the **TIM Setup** view. Three trace identifiers can be optionally monitored, by checking the box alongside each trace identifier field (RS-TIM, HP-TIM or LP-TIM). If the received values differ from the values preset within this page, and the respective box is checked, a defect alarm is raised and noted within the Results pages.



The RS-TIM can be set to 1 byte or 16 bytes in length. The HP-TIM and LP-TIM can be set to 16 bytes or 64 bytes in length.

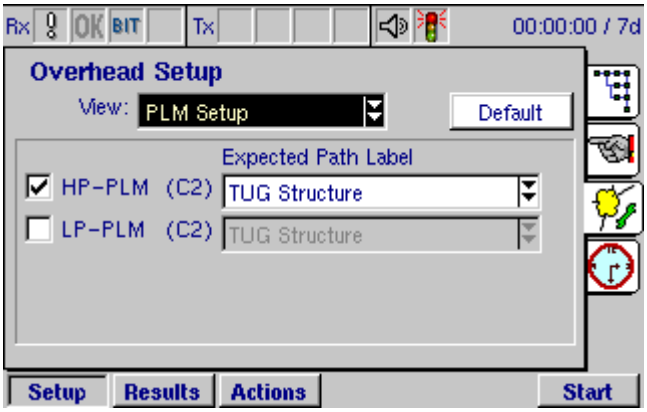
If the RS-TIM is set to 1 byte, its contents are entered in the form of two hexadecimal digits. During this entry, the function keys are temporarily assigned the alphabetical values ‘A’ to ‘F’. The two hexadecimal digits can be entered by using the keyboard for the decimal numbers and the function keys for the alpha characters.

If required the following control characters can be inserted into the trace label strings for expected and transmitted bytes. Alphanumeric characters can be entered using the keyboard keys.

NUL	Nul	**BS**	Backspace
TAB	Tabulation	**LF**	Line Feed
CR	Carriage Return	**DEL**	Delete

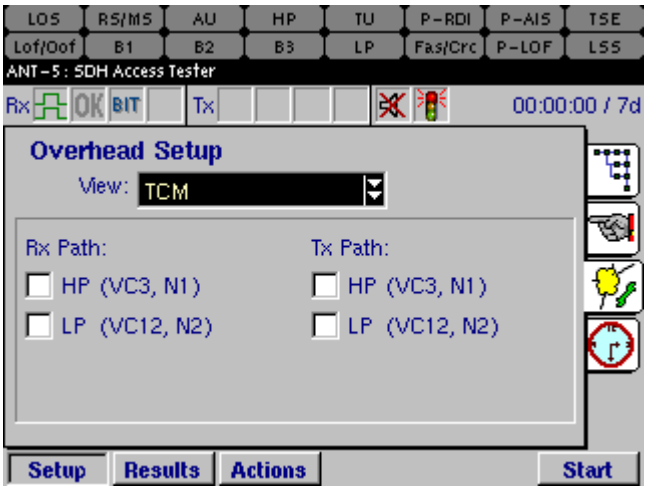
4.3.3.3 Path Labels

To set up the path labels, select the **PLM Setup** view. Two path labels can be optionally monitored, by checking the box alongside each path label field. If the received values differ from the values preset within this page, and the respective box is checked, a defect alarm is raised and noted within the Results pages.



4.3.3.4 Tandem Connection Monitoring

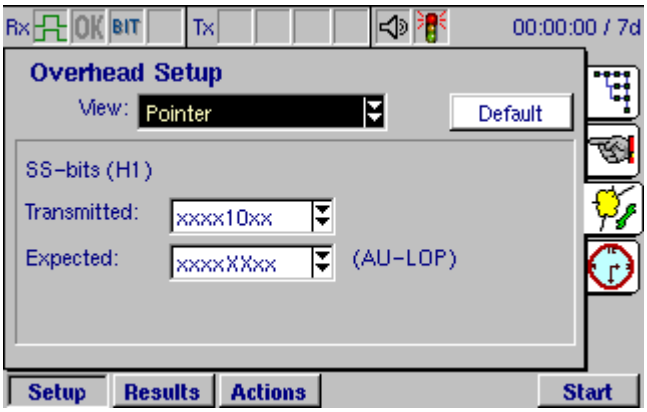
Tandem connection monitoring (TCM) allows the comparative performance of path segments to be monitored with the aid of the N bytes in the path overhead. Select the **TCM** view to set up tandem connection monitoring.



The received HP and/or LP paths can be monitored by selecting the **HP** and **LP** check boxes as required. The appropriate paths will then be activated on the **TCM** results page. If neither box is selected, the **TCM** results page will not be available. See Section 4.4.4.3, ***Anomaly Count***.

4.3.3.5 AU Pointer Value

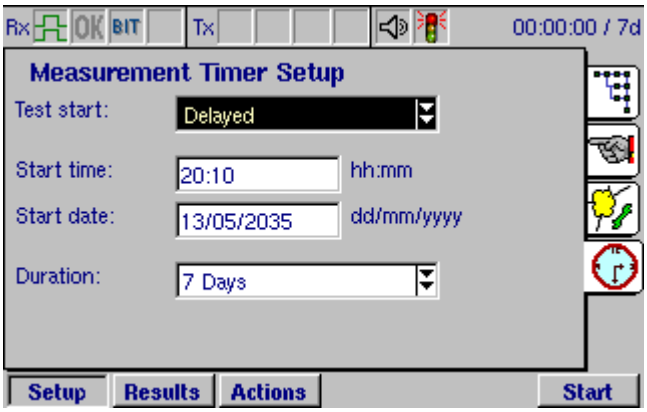
The **Expected** AU Pointer H1 byte is continually monitored, and checked against the received value. If the received AU pointer differs from the expected value a defect alarm is generated. The user can adjust the transmitted value of the SS bits within the H1 byte. Selecting the value 'XX' from with the **Expected** drop-down menu disables this monitoring.



10 = SDH signal, **00** = SONET signal.

Note: The transmitted and expected frames become visible if SDH or SONET are selected as the hierarchy type for Tx and Rx.

4.3.4 Measurement Timer Setup



The **Measurement Timer Setup** page can be used to set up a test to run with a fixed duration and/or a delayed start at some time in the future which is set by the user.

To run a test with a delayed start, set up all parameters as for a normal test and run a short test to verify the settings. Then set the timer to the required start time and press the **Start** key. The instrument will then go into a standby mode until the programmed start time, when it will begin to run a test and count results in the normal way. During the standby period the LEDs and status icons will be active to indicate the status of the line.

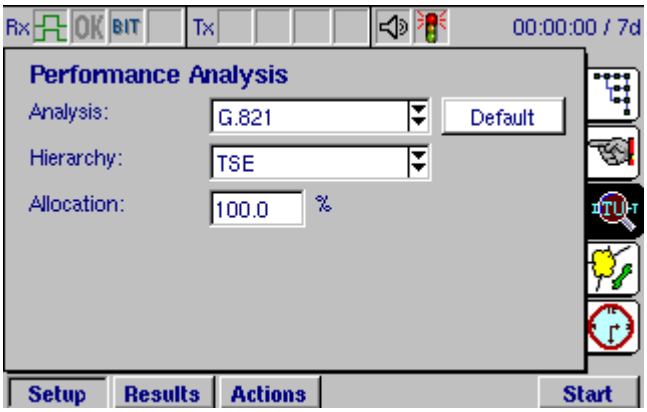
Test start	The timer can be set up for **Manual** start or **Delayed** start.
Start time / date	If **Delayed** start is selected, further entry fields can be used for setting the **Start time** and **Start date**. These can be used to enter any time and date in the future.
Duration	The test can be set to run for a specified **Duration** from 1 second up to 99 days. The time selected will be shown on the status bar.

Notes: The **Stop** key will always be available to stop tests manually, regardless of the **Timer** settings. The time and date can be set in the **Time & Date** section of the **System** menu.

4.3.5 Performance Analysis Setup

Note: The **Performance Analysis** setup tab will become available if selected from the **Measurement Selection** page. See Section 4.3.1 for further details.

The **Performance Analysis** setup page is used to determine how the performance of a system will be measured and recorded by the instrument. A wide range of options are available; see ***Appendix E – Performance Analysis Options*** for a list of the options with additional details of the measurement method for each option. The setup page has two main parameters from which to choose the option – **Analysis** and **Hierarchy**.

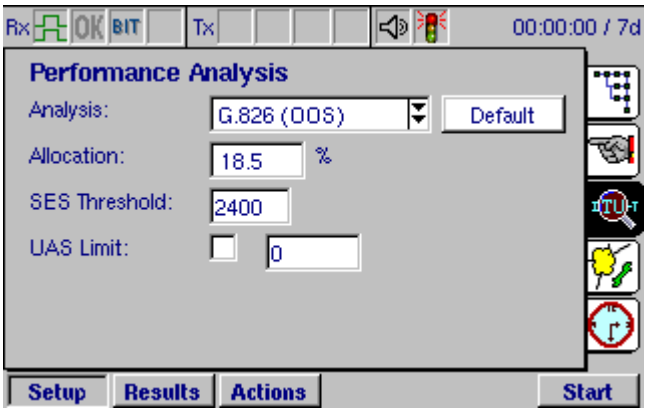


For each analysis type, a set of hierarchies are available, which are dependent upon the **Analysis** type selected. Some of these are only applicable to SDH, and will be greyed-out in the list of options if a PDH Rx interface is selected.

For each selection of **Analysis** and **Hierarchy**, selecting the **Default** button restores the default settings to the available parameters.

Allocation allows a percentage of the required performance for an HRX (Hypothetical Reference Connection) to be allocated to the current test. This allocation is typically 10-20% for Access Networks.

SES Threshold allows setting of the threshold for Severely Errored Seconds, which in G.826 is said to be 30% of the number of blocks in one second.



UAS Limit allows setting of the threshold for Unavailable Seconds, in G.826 said to be 10 consecutive seconds of SES. This can be disabled by clearing the adjacent checkbox.

4.3.6 VC12 Tributary Scanning Setup

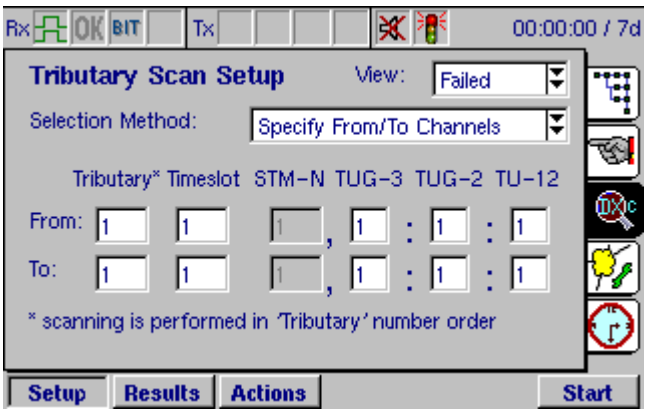
Note: The **Tributary Scan** setup tab will become available if selected from the **Measurement Selection** page. See Section 4.3.1 for further details.

The ability to switch tributary signals without fully de-multiplexing and re-multiplexing the SDH signal is a very important feature of SDH. Using either an add/drop (ADM) or cross-connect (DXC), networks can be re-configured to cater for network changes.

When implementing these changes it is important to verify the routing configuration of the network element prior to switching it onto line traffic. This can involve testing each VC12 tributary in an STM-4 – possibly 252 tributaries.

The ANT-5 is able to automatically scan individual or multiple tributaries to verify the routing and error free operation. A pass/fail indication is given for each VC12 tested.

The tributary scanning tab will only become available when VC12 in the **Virtual Container** panel for Tx and Rx are selected. Starting any test by checking the **Tributary Scan Setup** box, will scan the required tributaries. In this example, tributaries 30 to 39 will be scanned.

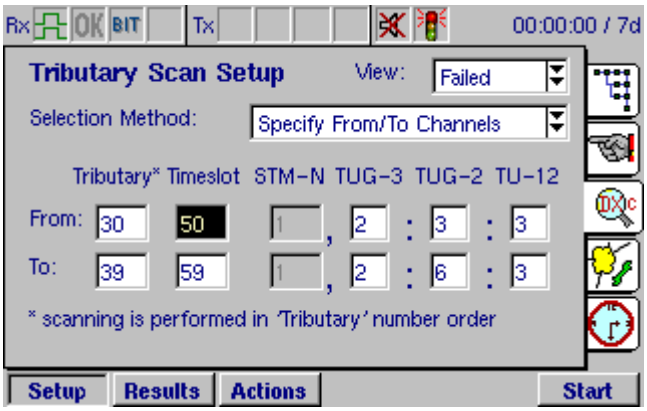


The three **Selection Methods** that can be selected are:

- All channels
- Specify From/To Channels
- Specify TUG-3's

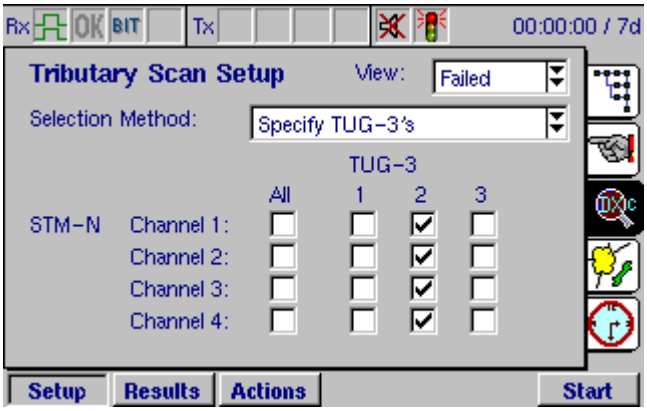
Users can select **Failed**, **Passed** or **All** from the **View** field. In these examples of the user interface all **Failed** tributaries will be listed in the tributary scan results page. See Section 4.4.7, ***VC12 Tributary Scanning Results***.

The following example shows tributaries 30-63 in channel 1 will be scanned, followed by 1-63 in channel 2, 1–63 in channel 3 and 1-39 in channel 4. For details of tributary numbering refer to section 12.4.



Note: Channels will be scanned by tributary rather than ITU-T number order.

This example will validate the tributaries within the second TUG-3 structure, for each of the STM-4 channels, (assuming the STM-4 option is installed).



Note: See Section 4.4.7, ***VC12 Tributary Scanning*** Results.

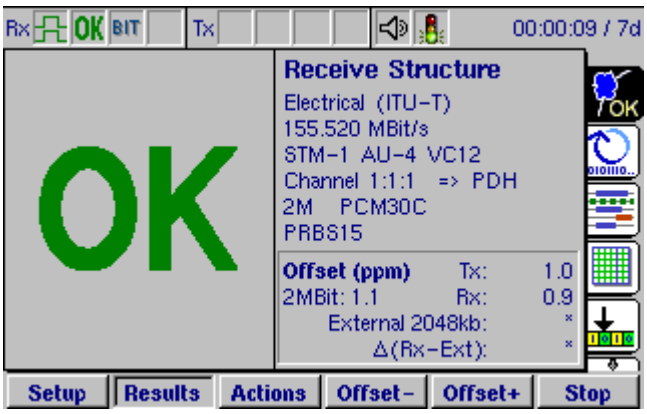
4.4 Results Pages

The results screens are selected by pressing the **Results** function key. This displays a range of tabbed pages, similar to the setup pages. Some of the results pages use a split screen layout, with the large OK in the left half of the screen, and other details of the test in the right half of the screen. Other results pages use the whole screen and may have multiple pages which can be selected from the main screen.

4.4.1 Results Summary

The first tabbed page displays a summary of test results.

The left half of the page displays the green large OK as long as there are no defects or anomalies recorded. If any defects or anomalies occur during a test, the large OK disappears and is replaced by a list of continually updated defects and anomalies that have been detected by the instrument during the test.



The right side of the page displays summary information about the detected signal.

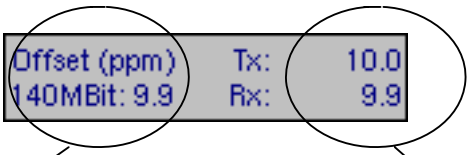
Note: Assuming the previous test was successful, the large OK will be greyed out whilst the current test is being configured.

4.4.2 Clock Offset results

Once the test has started the ANT-5 samples the received signal from the network element then calculates and displays the result of the frequency offset. The ANT-5 displays the **Rx** offset to check a network element is transmitting correctly.

The External Clock Offset result and Delta (Rx - Ext) results can be used to verify that the receive signal is within tolerance of the network's common clock. The External connector is always active and can be hooked up to a network clock using four different formats: **Data 2048kbit/s**, **Clock 2MHz**, **Data 1544kbit/s**, or **Clock 1.5MHz** (specified on the Interface Setup Tx page). The Delta (Rx - Ext) result shows the difference between the received signal and the network clock.

The transmitter offset can be adjusted in steps of 0.1 ppm by pressing the required offset firm key, or offset in increments of 1.0 by pressing and holding down the appropriate firm key. The initial value is set in the Interface Setup Tx panel. You can select a value between -100.0 and 100.0 ppm.



This is the Rx offset (in ppm) of the 140Mbit tributary carried in the VC4 being tested

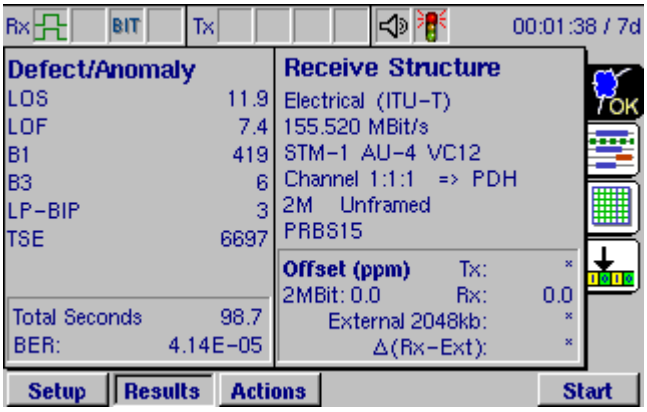
These are the Tx and Rx offsets (in ppm) for the Line Rate, for example 155.520Mbit/s

Note: The offset firm keys will be greyed out when the value reaches the end of its range.

The Defect/Anomaly list contains the total number of seconds during which each defect has been detected and the total count of each anomaly which has occurred.

The defects and anomalies are listed in order of importance and priority.

For further details, see ***Appendix D – SDH, SONET, and PDH information***.



4.4.3 Performance Analysis Results

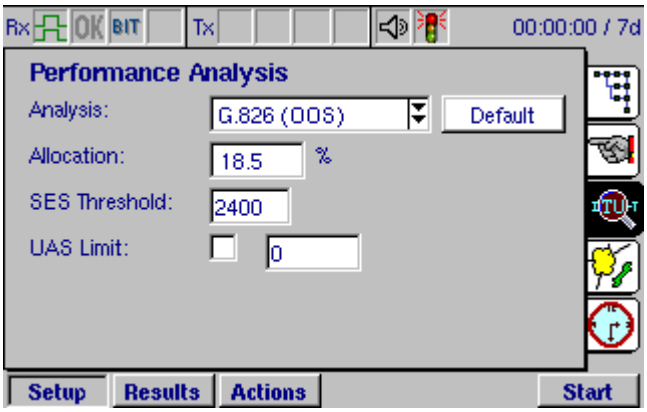
Note: The **Performance Analysis** results tab will become available if selected from the **Measurement Selection** page. See Section 4.3.1 for further details.

The **Performance Analysis** results page enables the user to view the performance of the device or system under test according to a range of standards. The standard applied is selected in the **Performance Analysis Setup** page – see Section 4.3.5.

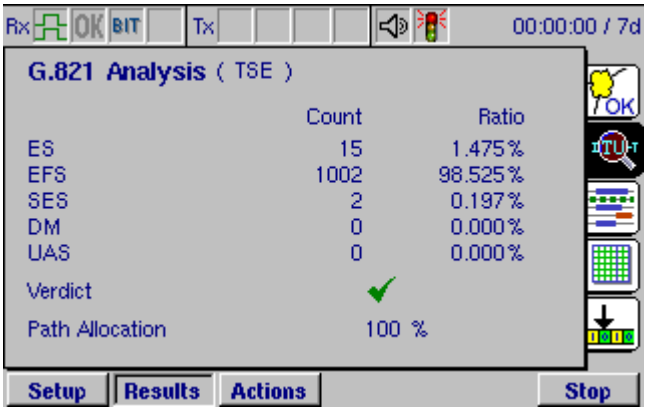
Note: The **Performance Analysis** results of any test are only valid in the context of the setup which was used at the time that the test was run and the results were recorded. It is not valid to use the **Performance Analysis** setup page to select a different **Analysis** or **Hierarchy** type in order to view existing results without running a new test.

4.4.3.1 Performance Analysis results display

Performance analysis is available for a wide range of standards; see ***Appendix E – Performance Analysis Options*** for a list of the options with additional details of the measurement method for each option. A separate analysis display is available for each type of analysis that can be selected, prior to running a test. This screen displays the Analysis standard and selected Hierarchy, and will list all relevant results parameters, in both absolute number of seconds and also as a percentage of the total test duration.



A verdict of the overall result of the test will be displayed, with either pass, fail, or uncertain presented as a green tick, red cross or yellow question mark. The uncertain result is part of the M.2100 analysis and should be followed by a further 7 day test.

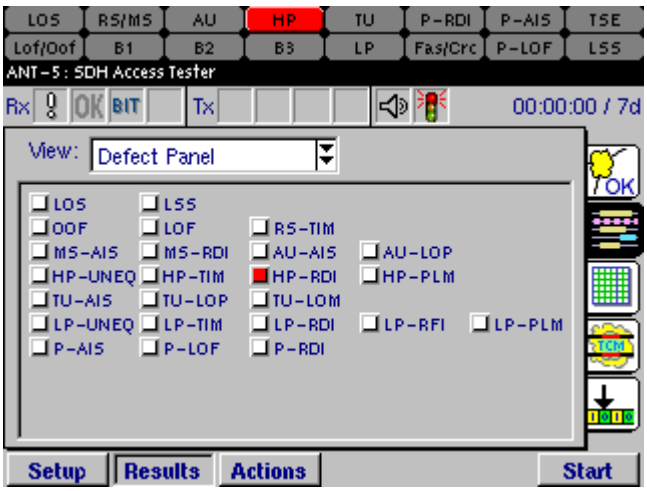


4.4.4 Anomalies and Defects results

4.4.4.1 Defect Panel

The second tabbed page displays three different views of the SDH anomalies and defects, and also PDH errors and alarms, occurring during a test. Each view can be displayed by selecting them from the drop-down view menu at the top of the page.

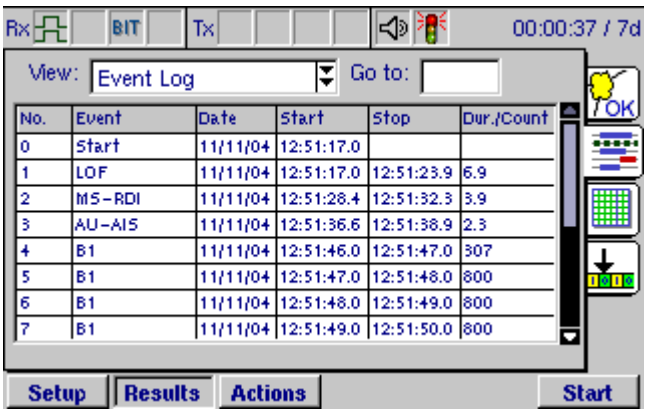
The **Defect Panel** view lists all SDH and PDH events in order of group within the SDH structure and/or PDH payload, and continually updates and displays active events in red.



Note: Defect panel LED's turn yellow during a test to show historic alarms, that is, defects that have been raised during a test but are not currently active. To reset the LEDS press **Alt** and **Menu** and select **System >LEDs >Reset LEDs**.

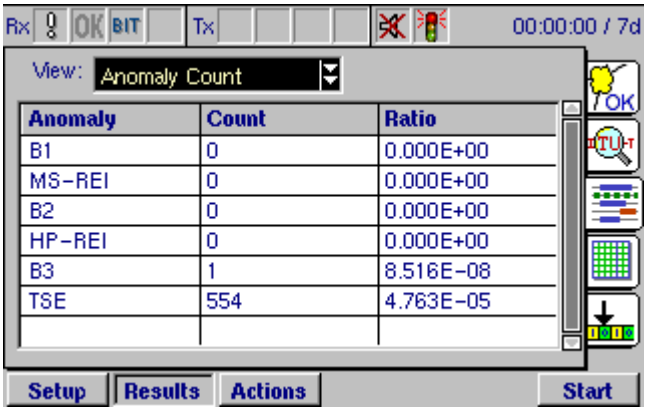
4.4.4.2 Event Log

The **Event Log** view lists all SDH and PDH events in time order as they occur during a test, including start-time, stop-time, and duration of the defect or total anomalies per second.



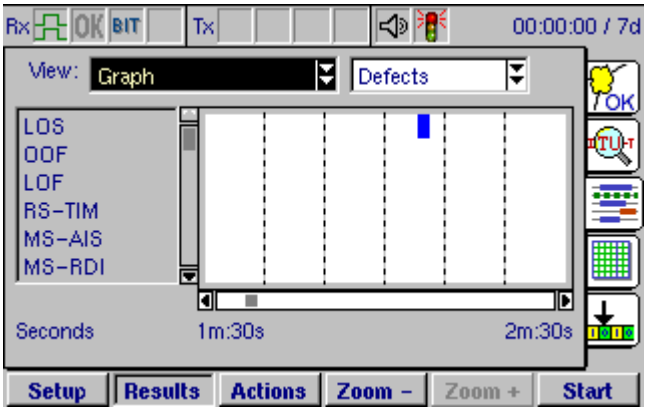
4.4.4.3 Anomaly Count

The **Anomaly Count** view lists all SDH & PDH anomalies in hierarchical order which are relevant to the current signal structure. The number of anomalies occurring during a test is counted for each anomaly type, and the ratio of each anomaly within the elapsed period of test is displayed.



4.4.4.4 Graphs

The **Graph** view displays a graphical timeline representation of any SDH anomalies or defects that have been detected during a test. The anomaly or defect occurrences are plotted as a set of horizontal bars against a time axis divided into intervals of one day, hour, minute or second. A bar is displayed to indicate that an event was detected during that time interval.



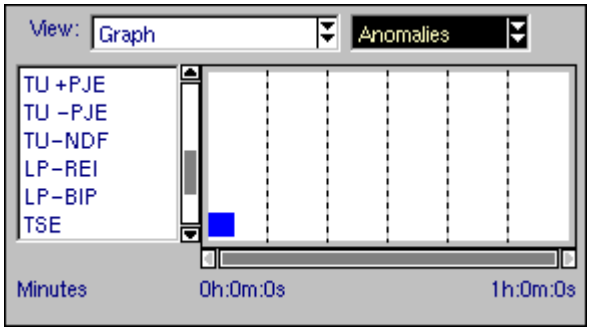
The time scale is shown under the chart, and can be set to a resolution of 60 days, hours, minutes or seconds by pressing the Zoom - and Zoom + keys. Vertical columns show sub-divisions of 10 time units. The horizontal scroll bar can be used to scroll in steps of 10 or 60 time units, as described in the example below.

The list of anomalies or defects is shown to the left of the chart and can also be scrolled vertically if required.

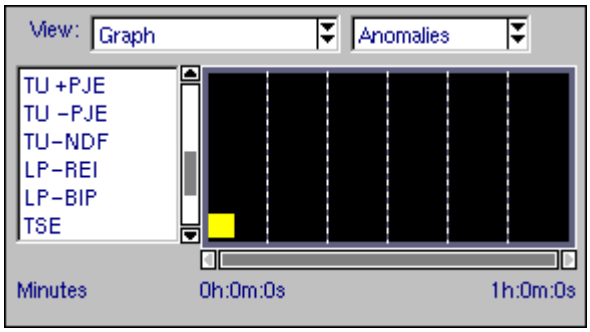
A detailed zoom feature is also available in the **Anomalies Graph**. This allows error rates to be shown down to one-second resolution, as shown in the example below.

Example: Using the detailed zoom feature in the Anomalies Graph

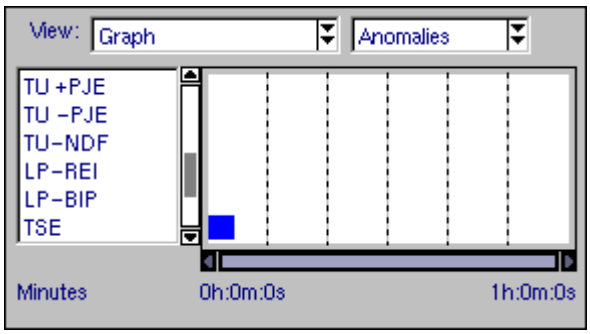
1. Select the **Anomalies** graph.



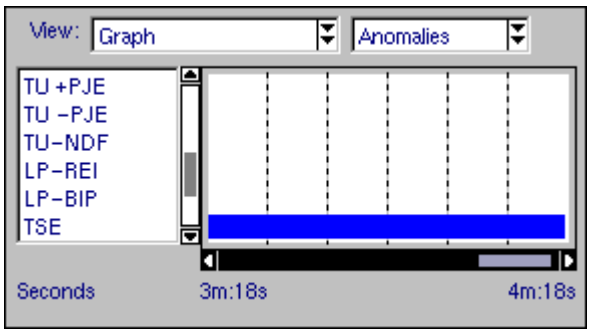
2. Use the directional keys to highlight the timeline section.



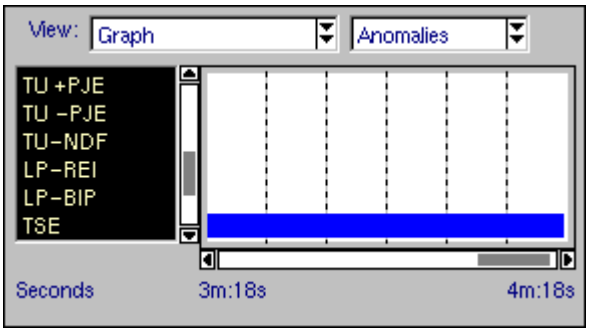
3. Press the **Enter** key to activate the timeline section; in this state the scroll bar will be highlighted.



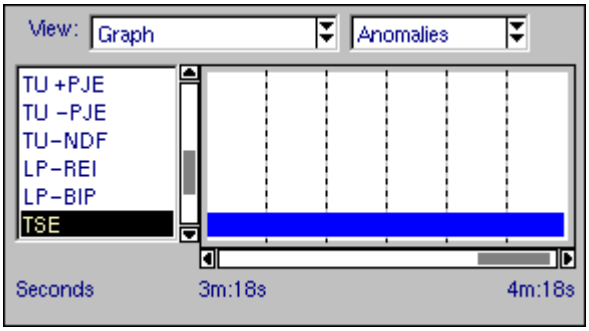
4. Press the Zoom – and Zoom + keys to select an appropriate time scale.
5. Use the left/right directional keys to scroll the graph horizontally in steps of 10 time units. For faster scrolling hold the **Alt** key down to increase the step size to 60 time units.



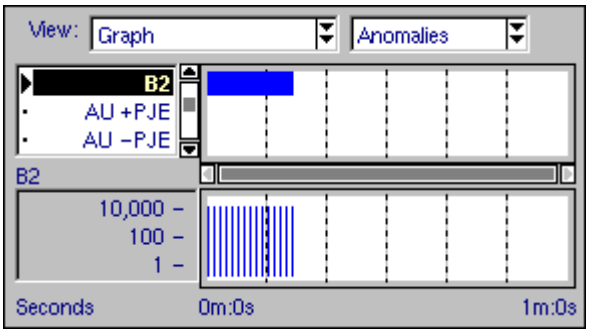
6. Press the **Esc** key to deactivate the timeline section.
7. Use the directional keys to highlight the anomalies list.



8. Press the **Enter** key to activate the anomalies list. In this initial state there will not be a selected item but one anomaly will be highlighted. The vertical scroll bar may be active if there are further items not displayed.



9. Use the up/down keys to navigate the list and press the **Enter** key again to select items for detailed viewing. A histogram will be displayed under the timeline as shown. Total anomalies during each interval (second, minute, hour, or day) will be shown by order of magnitude. For example, a bar of height 100 represents 100 to 999 counts.

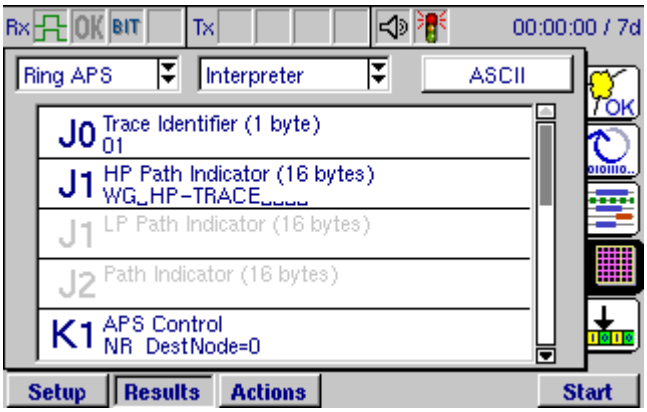


10. Press the **Esc** key to deactivate the list section. Use the directional keys to move to another part of the screen.

4.4.5 Overhead Analysis

The SDH and SONET overhead byte structures can be displayed for either transmit or receive paths by selecting the tab for Overhead Analysis/Injection.

4.4.5.1 Interpreter View



In Interpreter View, a message appears that describes the overhead bytes detected in the received signal.

To display the Interpreter View, select **Interpreter** from the middle list box.

The interpreter displays different messages depending on the selected architecture: **Linear (G.783)** or **Ring (G.841)**.

The messages can be displayed and scrolled using the method described below:

1. Use the directional keys to highlight the message section.
2. Press the **Enter** key to activate the message section; in this state the scroll bar will be highlighted as shown.
3. Use the directional keys to scroll vertically through the frame.
4. Press the **Esc** key to deactivate the list section. Use the directional keys to move to another part of the screen.
5. Toggle the **Hex/ASCII** button to modify the display of numerical values.

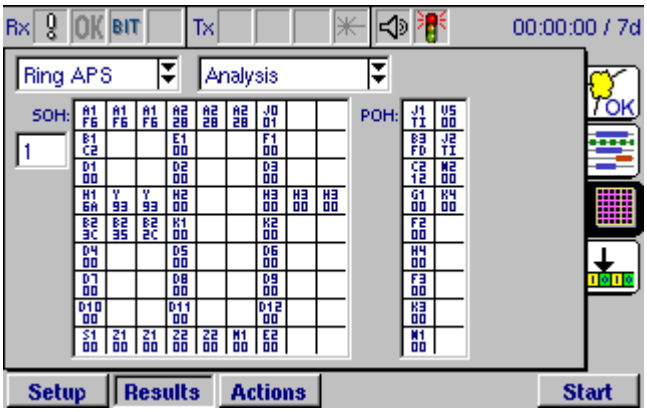
Note: Bytes not used in the current test will be greyed out.

J0	Trace Identifier
J1	HP Path Indicator
J1	LP Path Indicator
J2	Path Indicator
K1	APS Control

K2	APS Control
S1	Sync Status
V5	Error Monitor
C2	HP Container Format
C2	LP Container Format

Table 3 – Overhead bytes which can be displayed in Interpreter View

4.4.5.2 Analysis View



In Analysis View, a pair of tables representing the complete contents of the overhead structure is displayed.

To display the Analysis View, select **Analysis** from the middle list box.

The values displayed do not depend on the selected architecture: **Linear (G.783)** or **Ring (G.841)**.

If the **Rate** is set to **STM-4** or **STM-16**, a numerical entry box will be available to select the channel.

The received section and path overhead bytes (SOH & POH) are displayed, and are continually updated every second.

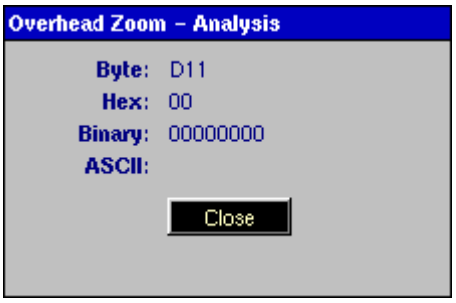
Byte values are shown as follows:

Hex value	The hexadecimal value of the received or transmitted byte.
'—'	'—' appears to indicate bytes for which a value cannot be determined.
'TI'	'TI' appears to indicate bytes for which a correct trace identifier value has been recognised.

The POH table is displayed on the right of the window, and its contents will depend upon the signal structure that has been selected.

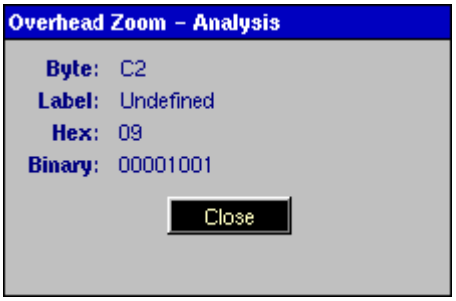
The value of individual received overhead bytes may be examined in detail using the **Overhead Zoom** feature.

To zoom in on a particular overhead byte, select the appropriate table using the directional keys and press the **Enter** key; individual bytes can then be selected using the directional keys. When a byte is selected and the **Enter** key is pressed, the **Overhead Zoom - Analysis** window will appear with the details of that byte.



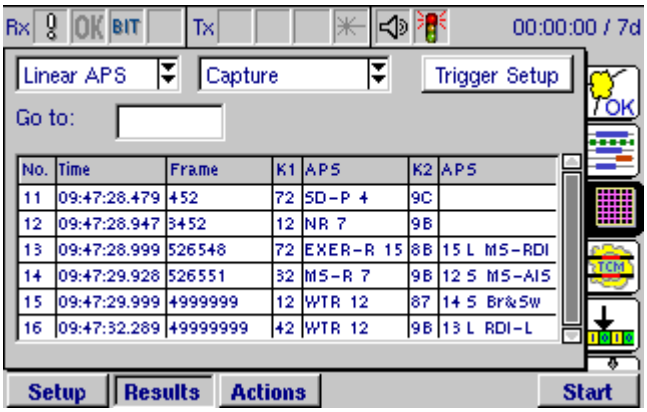
Where an overhead byte is used for a special purpose, such as carrying status messages (S1) or labels (C2), these values will also be displayed and alternative values may be selected from a list.

To conclude the examination of individual bytes, press the **Esc** key to deselect the table and return to the page tabs.



4.4.5.3 Capturing Values for K1 and K2 Bytes

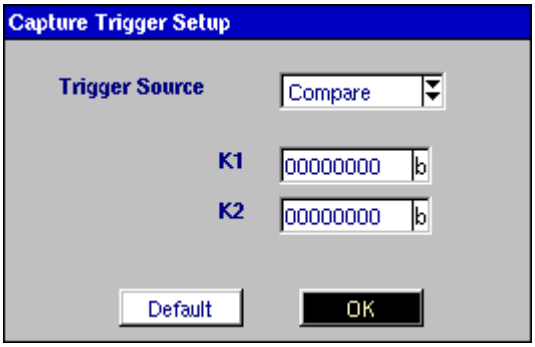
The values for detected K1 and K2 overhead bytes can be captured and displayed.



Note: This feature is available only after selecting Overhead Capture in the Measurement Selection page. See Section 4.3.1 for further details.

To initiate capture, select **Capture** from the middle list box.

The viewer displays different values depending on the selected architecture: **Linear (G.783)** or **Ring (G.841)**.



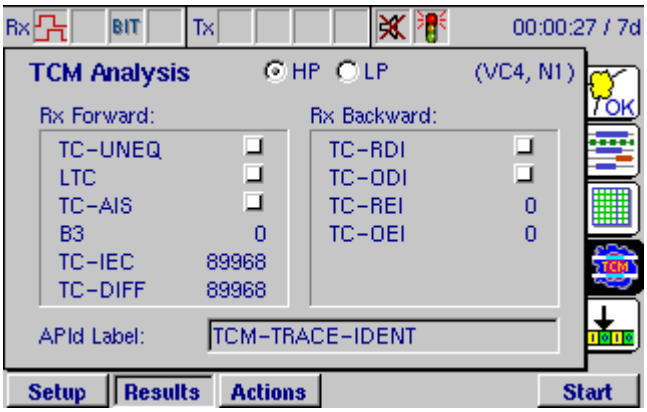
Triggers can be defined for starting and stopping the capture. Using the directional keys, highlight **Trigger Setup** and press Enter. In the Capture Trigger Setup dialog box, make one of the following selections in the **Trigger Source** list:

- Manual: Capture starts after pressing Start firm key.
- Compare: Capture starts when the K1 and K2 bytes equal the value you enter.
- Compare Not: Capture starts when neither the K1 nor the K2 bytes equal the values you enter.

When entering K1 or K2, the function keys are temporarily assigned the values **0**, **1** and **X** to allow entry of binary values with “don’t care” bits.

4.4.6 TCM results summary

Tandem connection monitoring (TCM) allows the comparative performance of path segments to be monitored with the aid of the N bytes in the path overhead. The **TCM** results summary page is used for monitoring results for the forward and backward directions in a tandem connection. The **APId Label** (application ID path label) is also shown.



The received HP or LP path can be viewed by selecting the **HP** or **LP** radio button at the top of the page. The current path and its associated network operator byte will be shown in the top right corner of the page.

More detailed results can be found in the **Event Log**, as described in Section 4.4.4.2.

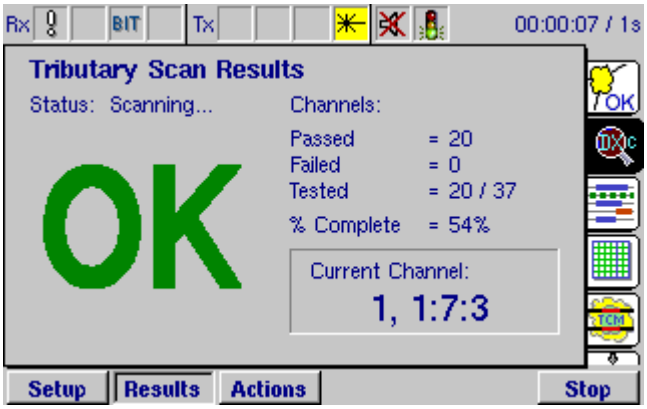
For an application note on this topic, visit our Web Site, **www.jdsu.com**, or contact the nearest Regional Sales Office as listed on the back of the manual.

Note: The received HP and/or LP paths should be activated before starting the test. This can be done by selecting the **HP** and **LP** check boxes as required in the **TCM** view of the **SOH Setup** page. If neither box is selected, the **TCM** results page will not be available. For details See Section 4.3.3.4, ***Tandem Connection Monitoring***.

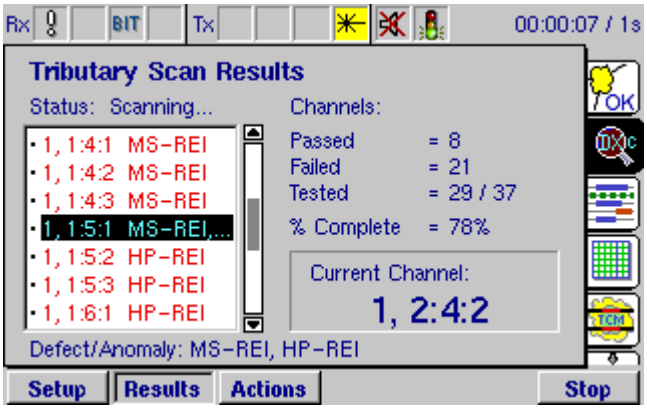
4.4.7 VC12 Tributary Scanning Results

Note: Select **Tributary Scan** from the **Measurement Selection** page. See Section 4.3.6 to configure the required setup.

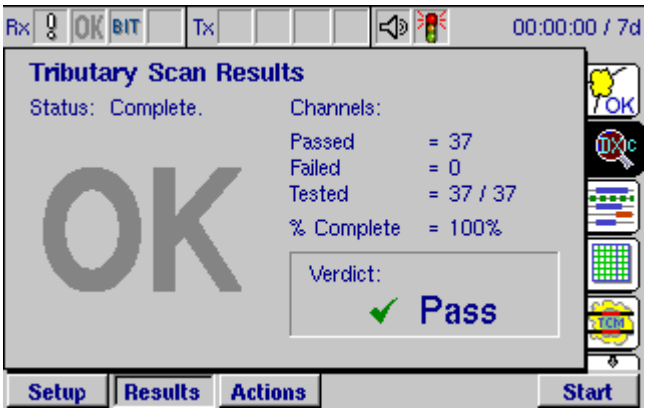
Once the **Start** button is pressed, the screen will automatically change to the Tributary Scan results page to display the test.



Tributaries that have failed the test are listed in order of severity. Users can scroll through the list to locate specific channels. (Multiple failures are indicated below the list). In this example MS-REI and HP-REI failures are present in the 1,1:5:1 tributary.



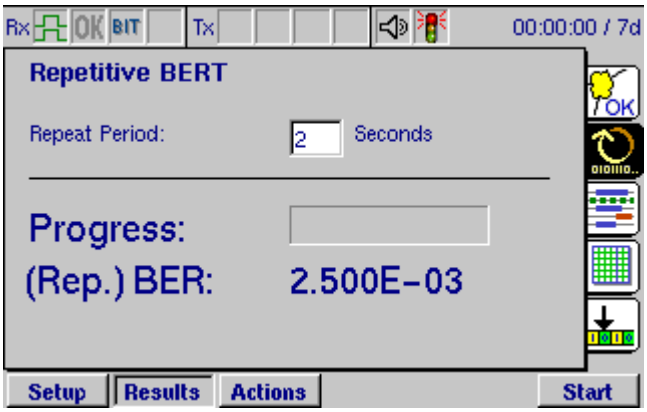
A verdict of the overall result will be displayed on completion of the test.



4.4.8 Repetitive BERT

Note: The **Repetitive BERT** tab will become available if selected from the **Measurement Selection** page. See Section 4.3.1 for further details.

Repetitive BERT is useful when commissioning a microwave link. The commissioning operator may be required to plot a graph BER against C/N (carrier-to-noise ratio). This is achieved by attenuating the signal until a specific BER is reached, and then noting the attenuation used. For example, in an SDH network the measurements could be made on a single channel within an STM-1 signal, where the required BER will probably be between 1E-6 and 1E-3.



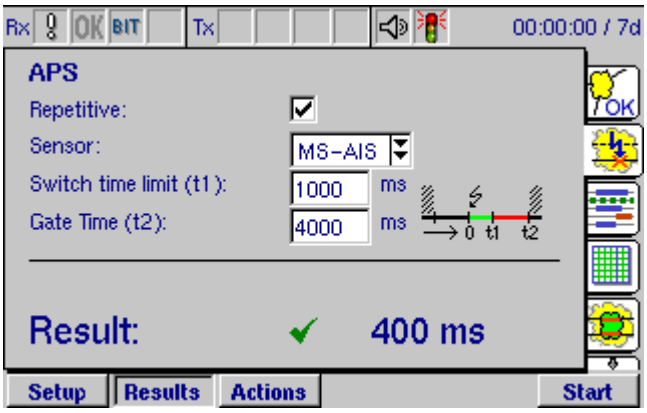
A **Repeat Period** of 1 second is adequate for measuring high error rates, but this period can be adjusted to a maximum of 99 seconds to test for lower rates.

Note: It is important not to confuse the results of the repetitive BERT test for a specific interval with those on the results page which show the results for the duration of the test. Further a repetitive BERT is not recommended from a delayed start.

4.4.9 Automatic Protection Switching

Note: The **APS** tab will become available if selected from the **Measurement Selection** page. See Section 4.3.1 for further details.

Automatic Protection Switching (APS) allows network devices to switch traffic onto a redundant line in the event of network problems (e.g. high error rates or heavy congestion). However, the switch over has to occur within a specified time, less than 50 ms for most lines as specified by ITU-T (G.841 7.2.2). This is generally tested by breaking the working line at a pre-determined point and monitoring how long the disruption lasts.



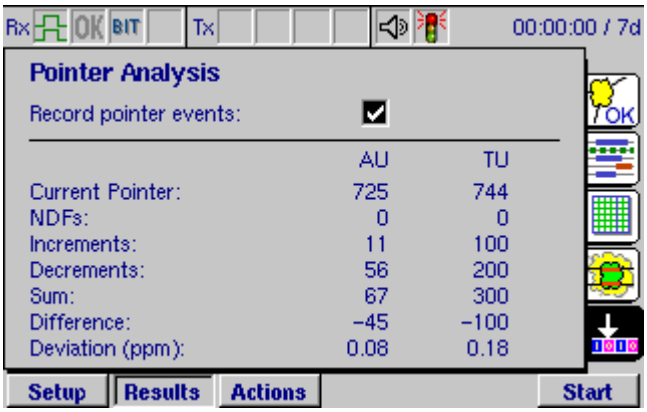
Detection can be achieved by monitoring the reduction in Quality of Service (QoS) or monitoring the resultant alarms. Depending on the signalling structure the following **sensors** can be selected, TSE, MS-AIS, AU-AIS, TU-AIS and Service Disruption. When selecting Service Disruption, the sensor activates upon detecting any of the following events: TSE, AIS, LOS or LOF.

The **Switch time limit (t1)** can be set within the range of 10 to 2000 ms. The **Gate Time (t2)** is used to monitor multiple switches and is achieved by continuing the detection process for an extended period, with a range from 100 to 5000 ms.

By checking the **Repetitive** box the test will repeat automatically once the switch has been detected. A green tick shows that the test has passed. A test will fail (shown by a red cross) if the switch time has not been fast enough or there has been any defect).

4.4.10 Pointer Analysis

Differences in the phase and frequency of the Virtual Containers with respect to the STM-N frame are compensated for via pointer movements. Healthy systems should exhibit low numbers of pointer events. Typically operators look for less than 70 pointer events in a 24-hour period. Large numbers of pointer events can indicate network synchronisation issues such as tributary signals operating at large offsets or network elements not operating from the correct reference clock.



ANT-5 displays the current pointer value together with counts of the numbers of **Increments** (+PJE), **Decrements** (-PJE) and **New Data Flags** (NDFs). The **Sum** is the number of increments and decrements, the **Difference** is the number of increments less the number of decrements. The **Deviation** (in ppm) is the number of times the pointer has moved in relation to the number of bits received. By checking the

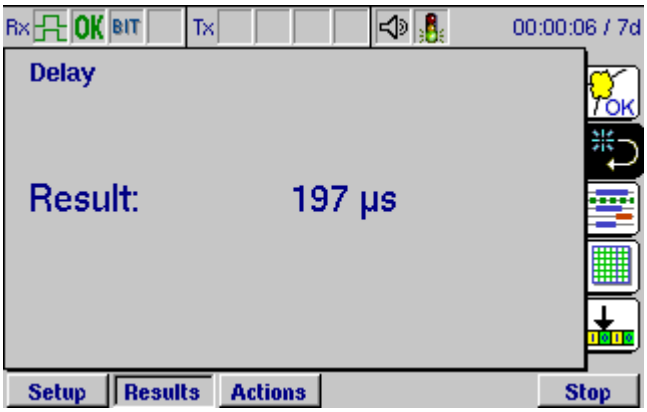
Record pointer events box these events are also time stamped and recorded in the event log and displayed in the results summary page.

Note: The pointer analysis page will only be available when there is an SDH signal on the Rx. The TU column will only be visible if there is a tributary path set within the signal structure. It is advisable that **From Rx** is set as the **Clock Source** in the **Interface Setup Tx panel**.

4.4.11 Delay

Note: The **Delay** tab will become available if selected from the **Measurement Selection** page. See Section 4.3.1 for further details.

The propagation of delays can significantly affect the Quality of Service (QoS). Delays in the network are characterised by the round trip delay time. This is the time taken for a signal to transmit from the transmitter to the receiver on a loop back and is achieved by sending a known payload across the network. Factors affecting delay include the type of Network Element deployed and the line length.



Delay measurements start when the start button is pressed, and measurements continue to repeat until the test is stopped.

The **Result** shows the latest value, there is no history. If a good signal is received, the units for the result are displayed in µs if the result is less than 1 ms, or ms if it is greater. Where there is no valid result, an asterisk is displayed, or alternatively the cause of the problem is displayed if the result is due to signal problems, e.g. LOS.

Note 1: When the Delay Measurement is turned on, the PRBS button contains the word Delay on the signal structure page, which is greyed out.

Note 2: The Delay result will display **Error** if the transmit settings do not match the receive settings when the test is started.

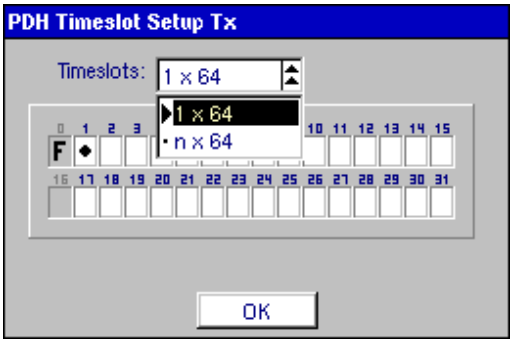
4.4.12 Nx64

The ANT-5 can perform BER testing on a single user selectable 64k timeslot; where each timeslot has traditionally been used to carry a voice channel; alternatively multiple timeslots can be tested, supporting data pipe services which can consist of any permutation of timeslots.

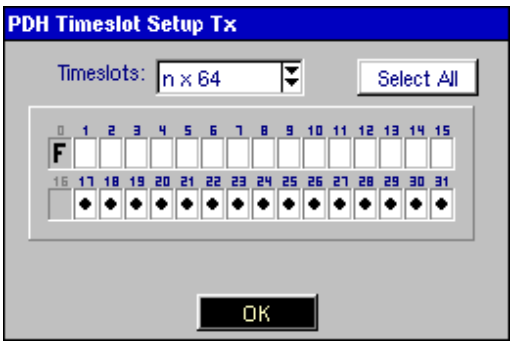
Note: The timeslot page will only be available if 64k is set as the **PDH Low Rate** in the **PDH Setup** panel. Choose 2M as the **PDH High Rate** to select up to 32 x 64 kbit/s timeslots, or alternatively choose 1.5M as the **PDH High Rate** to select up to 24 x 64 kbit/s timeslots.

Selecting the Timeslot element for Tx or Rx opens the **Timeslot Setup** panel. (The element is referred to **Ch1** see the graphic in section 4.3.1).

1. Once opened select **1x64** for a single channel or **nx64** for multiple channel selection from the dropdown menu.



2. Select the required timeslots using the directional and enter keys as required.
3. Press the **Esc** key to deactivate the list section and use the directional keys to select **OK** or to move to another part of the screen.



Note: The ANT-5 will only be able to transmit and receive nx64 when E1 framing is part of the hierarchy. Channel 0 is used for FAS/NFAS and will always be greyed out; channel 16 (used for signalling purposes) will be greyed out if either PCM30 or PCM30C are selected as part of the framing structure.

4.5 Actions Pages

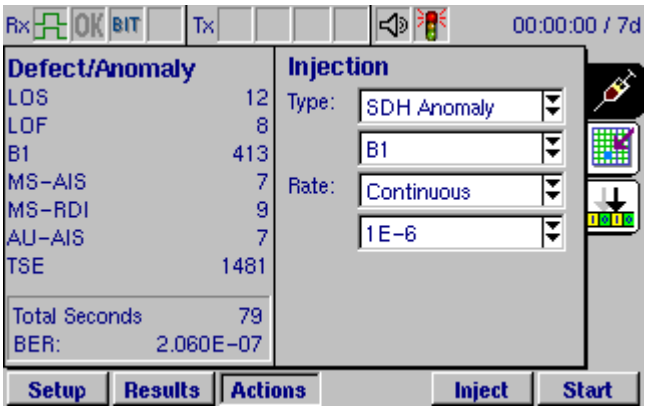
4.5.1 Injection of Defects and Anomalies

A wide range of anomalies, modifications, and defects can be injected into the transmitted signal, depending upon the signal structure selected.

If an SDH or SONET line interface is selected, the relevant anomalies and defects can be injected. If a PDH test signal is injected into the SDH virtual container, the relevant PDH anomalies and defects can also be injected. If, however, a PDH line interface is selected, then only the PDH anomalies can be injected.

In addition to injecting into either the SDH, SONET or PDH structures, injection of TSEs (bit errors) into the relevant payload is also available using the Transmit Pattern.

4.5.1.1 Injection of Anomalies



The **Injection** page can be used to inject a range of different anomalies into the transmit structure, either singly or at an average rate of between one error in every 10^2 bits and one error in 10^{10} bits, of the appropriate type.

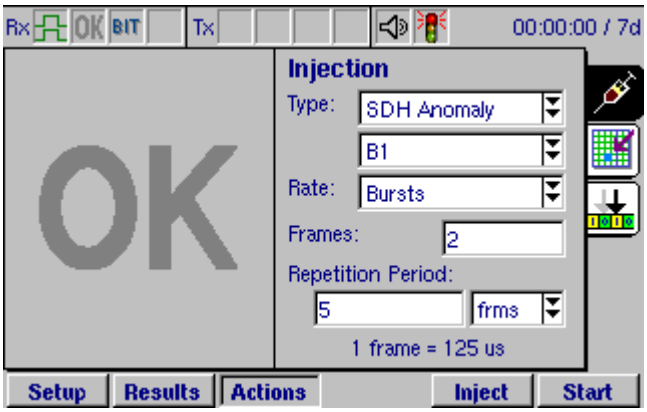
The type of anomalies to be injected is selected from the **Type** list box. The list of available anomaly types depends on the type of framing being used, and also whether SDH, SONET, or PDH hierarchies and line interfaces have been selected.

The number of anomalies to be injected is selected from the **Rate** list box and can be set to **Single** or **Continuous**. The **Continuous** rates available are **1E-2**, **1E-3**, **1E-4**, **1E-5**, **1E-6**, **1E-7**, **1E-8**, **1E-9** or **1E-10**, the available rates depending upon which anomaly is selected.

To inject a single anomaly into the Tx path, set the **Rate** to **Single** then press the **Inject** firm key. The Inject firm key will now be depressed indicating that anomalies are being injected. To inject anomalies at a **Continuous** rate, set the **Rate**, then press the **Start** firm key. The injection icon,  , displays an animated syringe when anomalies are being injected. To stop injecting, press the **Stop** firm key, the injection icon now disappears.

The **Inject** firm key appears automatically in the **Injection** page. To allow injection from any other page, users can view the **Inject** firm key by pressing the **Alt** button.

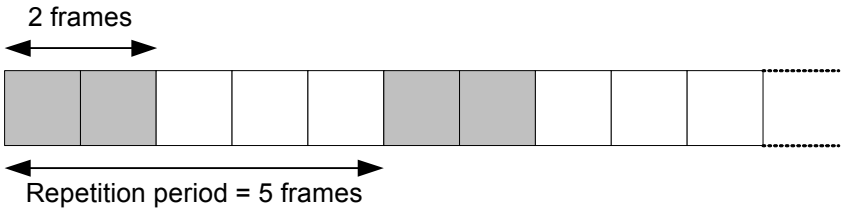
4.5.1.2 Injection of Bursts errors



As well as single or continuous errors, **Bursts** can also be injected into the **SDH Anomaly** or **SONET Anomaly** structures. The benefit of this feature is that these errors allow network elements to be stressed more closely under conditions that emulate real errors.

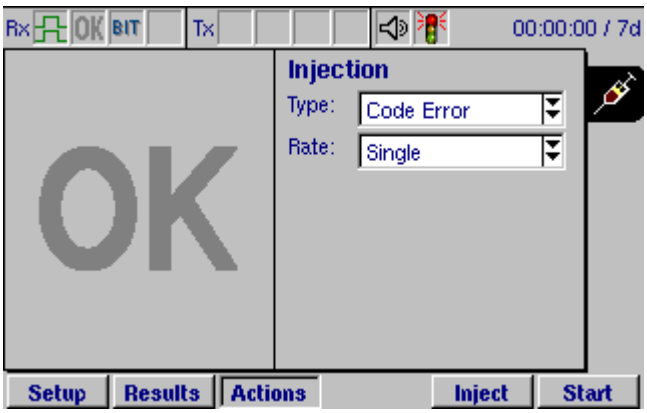
Errors are injected into consecutive SDH or SONET frames. This process is then repeated, the **Repetition Period** is defined in frames or seconds which gives a convenient method of testing frame synchronization.

Up to 4,800,000 consecutive frames can be errored. In this example, 2 consecutive frames are errored every 5 frames.



Note: The value for the **Repetition Period** is always greater than the value of the **Frames**. The ANT-5 will automatically adjust the values if necessary.

4.5.1.3 Injection of Code errors

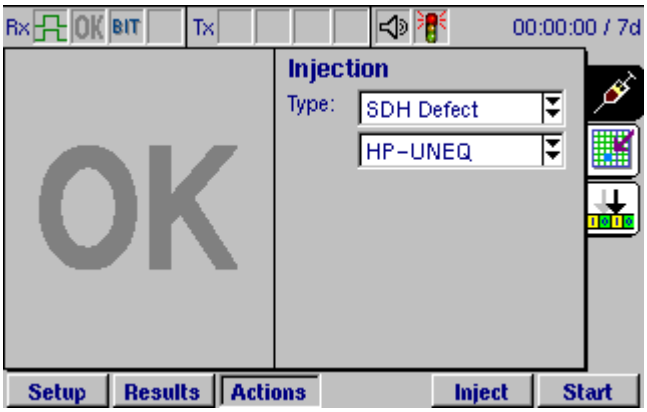


To allow for in-service performance analysis, E1 (2M), DS3, or STM-0 code errors can be injected into the PDH structure.

Continuous errors are injected at a ratio of $1x10^{-n}$ where n = 3 to 8.

Note: Ensure that PDH is selected as the hierarchy type and the PDH Rate is set to 2M or 45M.

4.5.1.4 Injection of Defects



The **Injection** page can also be used to inject a range of different defects into the transmit structure.

The type of defect to be injected is selected from the **Type** list box. The list of available defect types depends on the type of framing being used, and also whether SDH, SONET, or PDH hierarchies and line interfaces have been selected.

To inject a defect into the Tx path, select the type of defect required and press the **Start** firm key. The Inject firm key will now be depressed and the injection icon, , displays an animated syringe when defects are being injected. To stop injecting, press the **Stop** firm key, the injection icon now disappears.

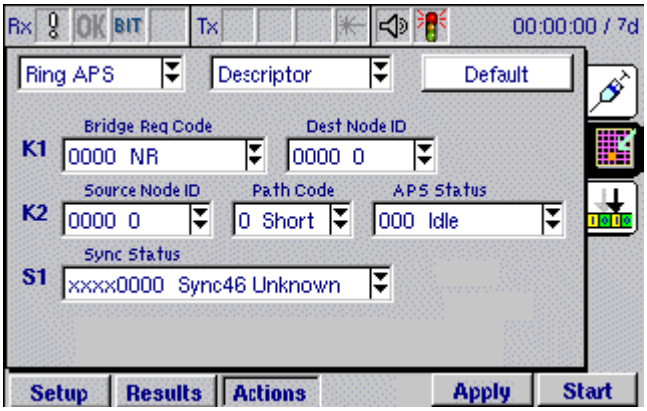
The **Inject** firm key appears automatically in the **Injection** page. To allow injection from any other page, users can view the **Inject** firm key by pressing the **Alt** button.

4.5.2 Injection of Overhead Bytes

The overhead bytes can be manipulated by injecting specific values into each byte. This feature is available if the SDH or SONET hierarchy is selected.

Injection of overhead bytes is available from the tab on the Actions page.

4.5.2.1 Injecting into bytes K1, K2, and S1 using Descriptor View



In the Descriptor View the following bytes can be modified: K1, K2 and KS1.

To display the Descriptor View, select **Descriptor** from the middle list box.

The descriptor displays different fields depending on the selected architecture: **Linear (G.783)** or **Ring (G.841)**.

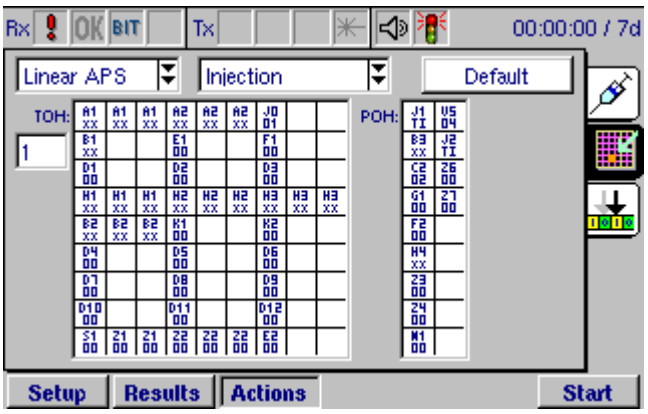
Values for the overhead bytes can be modified using the method described below:

1. Use the directional keys to highlight a field for the byte.
2. Select the desired value.
3. Repeat for other fields to be changed.
4. To begin injection of the new byte settings, press the **Apply** firm key.

Press **Default** to reset the byte values to those specified for the defined hierarchy and topology.

Note: If you change to **Injection** view before pressing **Apply**, the values in the **Descriptor** view revert to those in the **Injection** view.

4.5.2.2 Injecting into all overhead bytes using Injection View



In Injection View, a pair of tables representing the complete contents of the overhead structure is displayed.

To display the Injection View, select **Injection** from the middle list box.

The viewer displays different values depending on the selected architecture: **Linear (G.783)** or **Ring (G.841)**.

If the **Rate** is set to **STM-4** or **STM-16**, a numerical entry box will be available to select the channel.

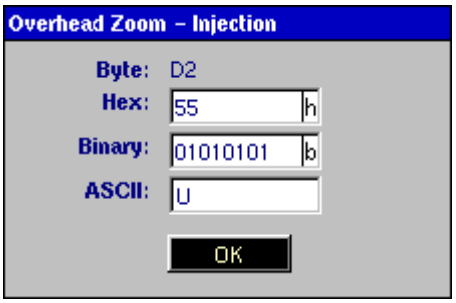
Selecting **Default** applies default values for the selected topology.

Byte values are shown as follows:

Hex value	The hexadecimal value of the received or transmitted byte.
'—'	'—' Indicate bytes for which a value cannot be determined.
'TI'	'TI' indicates bytes for which a correct trace identifier value has been recognised.
'xx'	'xx' indicates bytes which may not be injected.

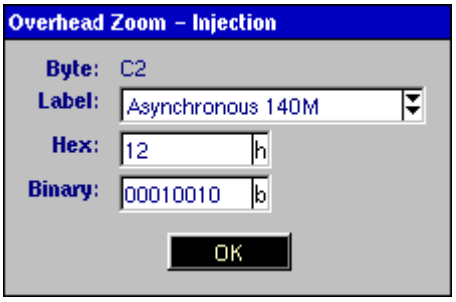
The POH table is displayed on the right of the window, and its contents will depend upon the signal structure that has been selected.

To modify a particular overhead byte, select the appropriate table using the directional keys and press the **Enter** key; individual bytes can then be selected using the directional keys. When a byte is selected and the **Enter** key is pressed, the **Overhead Zoom - Injection** window will appear with the details of that byte.



Modify the value of the byte by changing its hexadecimal, binary, or ASCII value. When one of these fields is highlighted, the function keys change to support data entry. For more information on entering data in hexadecimal, binary, or ASCII fields, see Section 4.3.3.2, ***Trace Identifiers***.

Where an overhead byte is used for a special purpose, such as carrying status messages (S1) or labels (C2), these values will also be displayed and alternative values may be selected from a list.



To apply the entered value, select **OK**.

To conclude the modification of individual bytes, press the **Esc** key to deselect the table and return to the page tabs.

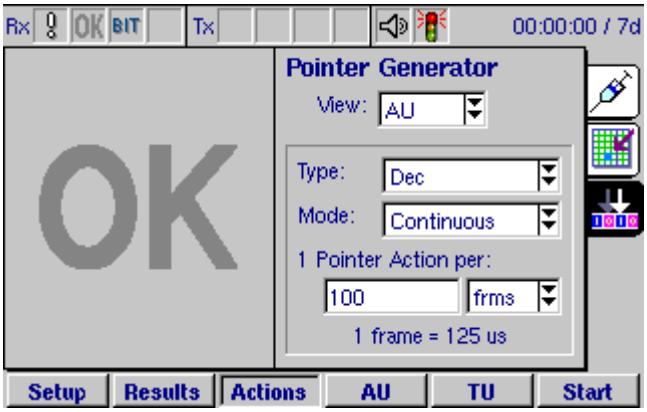
The new values for overhead are transmitted immediately after you change them in the **Overhead Zoom – Injection** window.

To inject overhead bytes over a specific time span, press the **Start** and **Stop** firm keys.

4.5.3 Pointer generator

Each SDH frame contains an Administrative Unit (AU-n) and a Tributary Unit (TU) pointer. The value of the pointer can be changed on the Pointer Generator page. The Pointer Generator page can be displayed by pressing the **Actions** button and then selecting the  tab.

Select the pointer you want to modify from the View list: **AU** or **TU**. In the Type field, select the type of adjustment to make, **DEC** for decrement, **INC** for increment, or INC/DEC to increment and then decrement the pointer at the frame rate you specify.



If you select INC/DEC, the frame pointer will be incremented after the specified number of frames are detected, and then decremented after the next series of frames are detected. For example, if you specify 100 as the frame rate for INC/DEC insertion, the unit will increment the pointer after it detects 100 frames, and then decrement the pointer after it detects the next 100 frames.

From the mode list, select the method for incrementing or decrementing the pointer. If you specified INC/DEC as the adjustment type, or selected **Continuous** as the mode, the Frame Rate field appears. In the field, type the number of frames after which the adjustment occurs. For example, if you type 400, the frame pointer is incremented or decremented after detection of 400 frames. The Frame Rate field accepts values between 100 and 8000.

If you specified INC/DEC as the adjustment type, and **Single** as the mode, the Interval field appears. In the field, type the interval (in us) after which the adjustment occurs.

Pressing the **TU** or **AU** firm key initiates the pointer generator using the current settings.

4.5.4 TCM generator

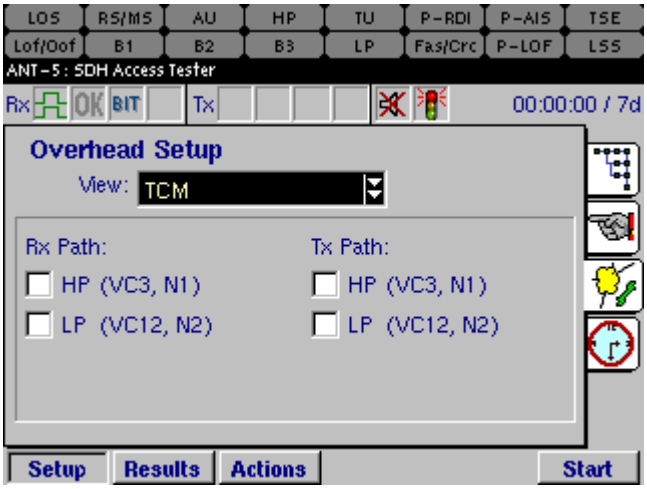
The overhead bytes for the current mapping (N1 high path, N1 low path, and N2 low path) can be manipulated by inserting or removing alarms and defects into the TCM generator. Before inserting alarms and defects, you must configure the ANT-5 for TCM generation.

To enable this feature, do the following:

Press the Setup button, and then select the  tab to display the Overhead Setup page.

Set the View to TCM.

Under Tx Path, select HP, LP, or both (if you want to edit the values for both the N1 and N2 byte).



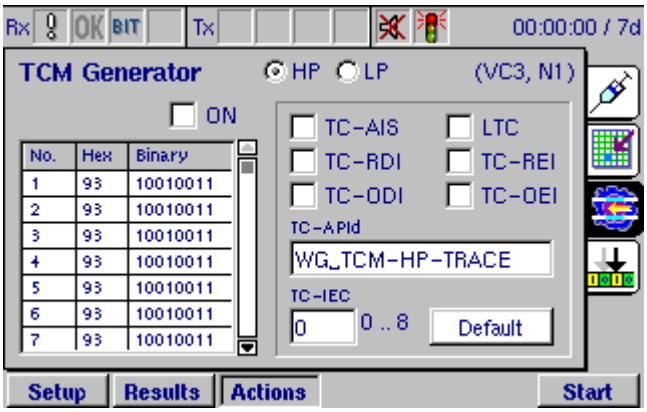
4.5.4.1 Sending alarms and defects to the TCM generator

To send alarms and defects to the TCM generator, do the following:

Press the Actions button, and then select the TCM tab.

Select the byte (HP or LP) for TCM generation.

Select the alarms and defects you want to insert.



If you want to insert a TC-APid identifier, use the keypad to type the id. The TC-APid field accepts up to 15 alpha-numeric characters.

If you want to insert a TC-IEC error, use the keypad to type the value. The TC-IEC field accepts values ranging from 0 to 8 for the N1 byte, or 0 to 2 for the N2 byte.

Select ON. The values are sent to the TCM generator for the currently selected byte.

If you want to send alarms and defects to the generator for the other byte, select the byte, and then repeat the process above.

Note: Selecting the Default button restores the default settings.

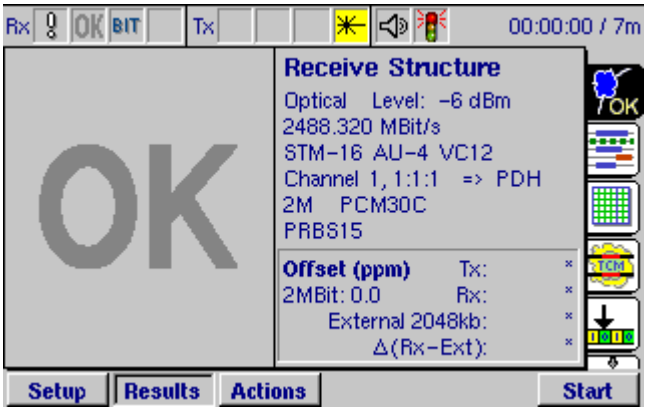
If you change your selections or modify the TC-APid or TC-IEC values after selecting ON, an Apply firm key appears. You must select Apply to send the new alarms, defects, or values to the TCM generator.

4.6 Enhanced Functionality

4.6.1 Optical Power Measurement

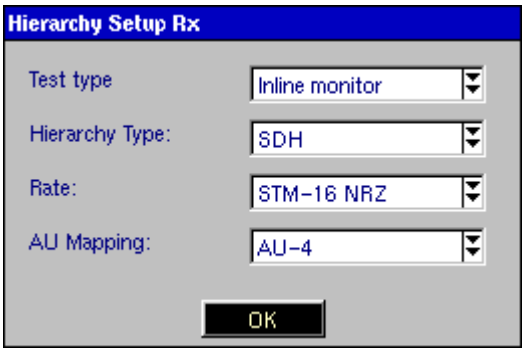
To identify optical level problems, the optical power measurement measures the received optical signal level to a resolution of 1 dBm with an accuracy of ±3 dB. In this example, an **Optical Level** of -14 dBm has been received.

Overload protection is active during optical power tests. If an overload occurs, the protection switch opens and a message appears in the Results Summary page. Pressing OK in the message box clears the alarm and closes the protection switch.



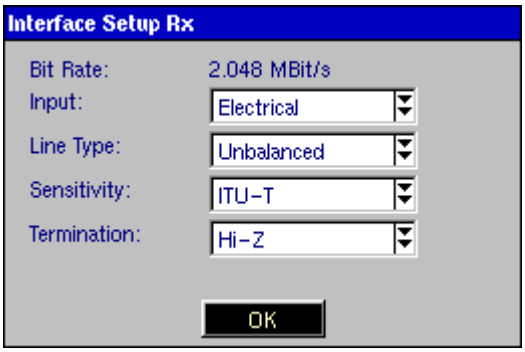
4.6.2 PECL NRZ STM monitor port

With the Rate set to **STM-1 NRZ**, **STM-4 NRZ**, or **STM-16 NRZ**, signals can be monitored at the electrical monitor point without the need for optical splitters.



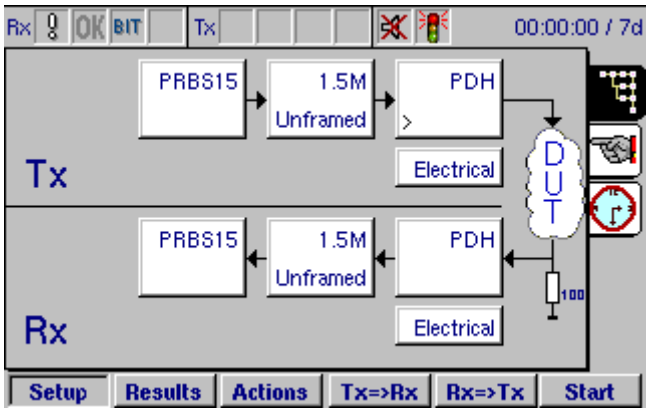
4.6.3 E1 Hi-Z input

A high input impedance setting for the E1 port enables E1 signals to be monitored without a PMP.



4.6.4 Testing PDH T1 Interfaces

Using a standard Bantam cable, the ANT-5 can test T1 ANSI based tributaries as illustrated in this graphic.



4.7 Saving and exporting results and setups

Pressing the **Menu** key and selecting **File** provides a drop-down menu which can be used to **Open, Save** and **Export** configuration data and results and to **Print** results to the serial port. Selecting **Options** from the **Tools** menu shows the **Current** options installed. This area is also used to **Install** and **Uninstall** features as required. The **Help** Menu provides access to application information features.

File > Open > Configuration Select this option to load an instrument configuration into the ANT-5, which has previously been saved either to a card or to the ANT-5 RAM. The file window will list all valid configuration files on either the card if it is inserted, or in the ANT-5 RAM, along with their date and time of creation and a brief description.

File > Open > Results Select this option to load a set of test results from a previous test into the ANT-5, which has previously been saved either to a card or to the ANT-5 RAM. The file window will list all valid results files on either the card if it is inserted, or in the ANT-5 RAM, along with their date and time of creation and a brief description. The results file also includes the corresponding configuration from the time of the saved test, and will change the configuration of the instrument when the results file is loaded.

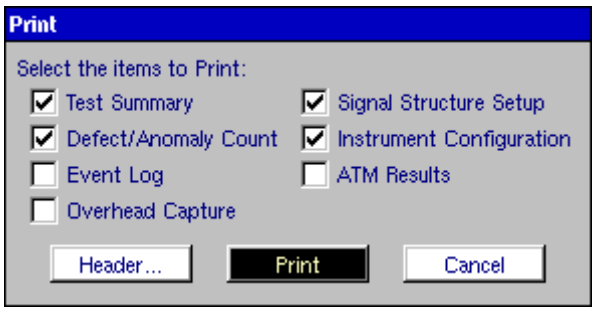
File > Save > Configuration Select this option to save an instrument configuration from the ANT-5 either to a card or to the ANT-5 RAM. A configuration can either be saved to an existing file, or a new file can be created. If a new file is required, the new file name and a brief description can be manually entered using the ANT-5 keyboard. Assuming the ANT-5 is networked the configuration can also be saved and transferred to other units using FTP.

File > Save > Results Select this option to save a set of test results from the ANT-5 either to a card or to the ANT-5 RAM. The set of results can either be saved to an existing file, or a new file can be created. If a new file is required, the new file name and a brief description can be manually entered using the ANT-5 keyboard. Results saved using this option can only be read back into the ANT-5 instrument.

File > Export > Configuration Select this option to export an instrument configuration to a card in CSV (comma separated values) format. Results exported using this option can be read by other PC applications, but cannot be imported back into the ANT-5 instrument.

File > Export > Results Select this option to export a summary of the test results to a card in CSV (comma separated values) format. Results exported using this option can be read by other PC applications, but cannot be imported back into the ANT-5 instrument.

File > Print > Select this option to print the test results to the serial port. A typical printout is shown on the next page.



Note 1: To use the **Print Results** feature successfully, it is important to have the correct **Printer Driver** and **Serial Port** settings rather than relying on the simple serial port tests mentioned in Sections 2.7.1 and 2.8.

Note 2: Previous mixed mode configurations saved prior to software version 08.00 will no longer be valid.

Performance Analysis (M.2100)

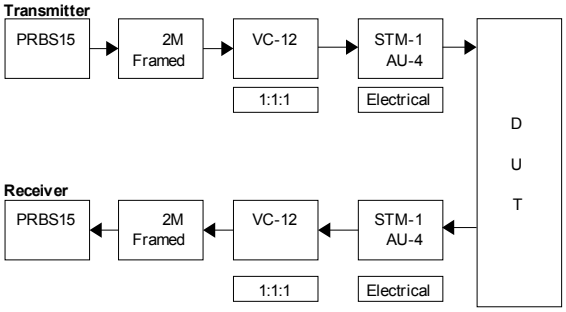
	Near End		Far End	
ES	6	2.40964%	0	0.00000%
EFS	243	97.59035%	217	100.00000%
SES	6	2.40964%	0	0.00000%
UAS	20	7.43494%	26	10.69959%
Verdict	✗		✓	
Path Allocation	100%			

Test Summary

Total seconds: 268
BER: 0.000E+00

Signal Structure Setup

Transmitter



Transmitter

Interface Setup

Clock Source:	Internal
Output:	Electrical
Line Code:	CMI

Channel Setup

STM-N	STM-1
TUG-3	1
TUG-2	1
TUG-12	1
Timeslot	1

Hierarchy Setup

Hierarchy Type:	SDH
SDH Rate:	STM-1
AU Mapping:	AU-4

Virtual Container Setup

VC Mapping:	VC-12
Bulk:	OFF

PDH Setup

PDH Rate:	2M
PDH Mode:	Framed
Mapping Mode:	Async.
Framing:	PCM30 CRC

Pattern Setup

Pattern Type:	PRBS15

Defect/Anomaly

LOF	5
B1	1
MS-AIS	19
B3	1
RDI-2	25

Receiver

Interface Setup

Input:	Electrical
Line Code:	CMI
Sensitivity:	ITU-T

Channel Setup

STM-N	STM-1
TUG-3	1
TUG-2	1
TUG-12	1
Timeslot	1

Hierarchy Setup

Hierarchy Type:	SDH
SDH Rate:	STM-1
AU Mapping:	AU-4

Virtual Container Setup

VC Mapping:	VC-12
Bulk:	OFF

PDH Setup

PDH Rate:	2M
PDH Mode:	Framed
Mapping Mode:	Async.
Framing:	PCM30 CRC

Pattern Setup

Pattern Type:	PRBS15

4.7.1 Exporting data to a spreadsheet using a storage card

Assuming that an appropriate driver is available on the PC or laptop, the following example demonstrates how test results can be saved to a spreadsheet.

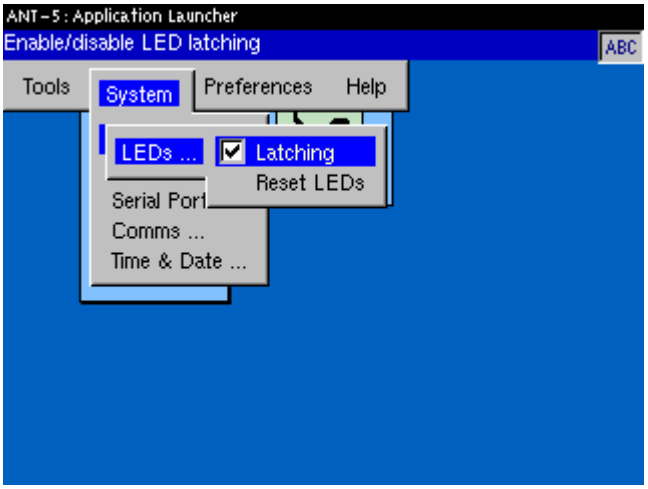
1. Insert an appropriate card into the ANT-5.
2. **Stop** the test and press the **Menu** key.
3. Select **Export** from the **File** menu option.
4. Select **Results**.
5. Using the arrow keys highlight **card:** and press the enter key.
6. Select **<new file>** and enter a filename. (The file will automatically be saved with the extension .csv)
7. Insert the card into the appropriate slot on the PC or laptop and using a suitable application open the file.

Note: Ensure that the necessary drivers are enabled and the card is located in the correct slot. Contact your IT department for further assistance if required.

8. This file displays a host of information relevant to the results and the configuration of the unit.

4.8 On-Screen LED Indicators

The top portion of the screen is used by the SDH Access Tester application to simulate LED indicators on-screen. Red LED's are used to display information that is relevant to the current setup, whilst yellow LED's show historic alarms. The LED will stay yellow until a new test is started or of a configuration is changed.



LEDs can be set to be latching or non-latching in the **LEDs** section of the **System** menu, which can be displayed by pressing the **Alt** + **Menu** key at any time. If the **Latching** box is checked, you can reset all latched LED's by selecting **Reset LEDs** from the **System menu** or alternatively LEDs can be reset from within the ANT-5 application by pressing **Menu**, and selecting **Tools > Reset LEDs**.

The sixteen on-screen LEDs are arranged as shown below:

LOS	RS/MS	AU	HP	TU	P-RDI	P-AIS	TSE
Lof/Oof	B1	B2	B3	LP	Fas/Crc	P-LOF	LSS

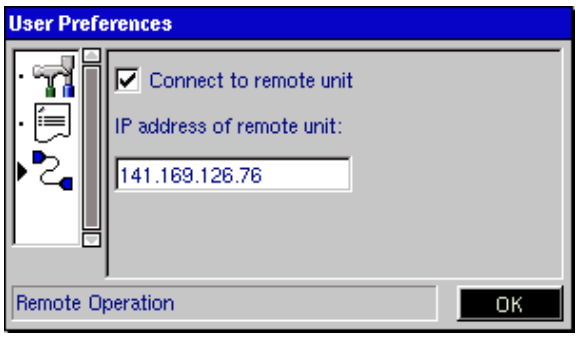
LOS	Loss of Signal
RS/MS	Regen / Multiplex Sections
AU	Administrative Unit
HP	High Order Path
TU	Tributary Unit
P-RDI	Path Remote Defect Ind.
P-AIS	Path AIS
TSE	Test Sequence Err. (Bit Err.)

Lof/Oof	Loss of Frame
B1	Regen. Section error monitor
B2	Mux section error monitor
B3	HO path error monitor
LP	Low Order Path
Fas/Crc	FAS / CRC Error
P-LOF	Path Loss of Frame
LSS	Loss of Sequence Sync.

4.9 User Preferences

User preferences enable the user to 'customise' parts of the ANT-5 setup to suit their typical requirements.

User preferences can be set from within the ANT-5 application by pressing **Menu** and selecting **Preferences** from the **Tools** menu.

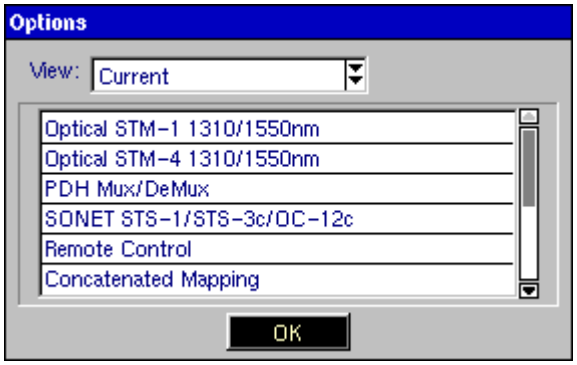


1. Use the directional keys to highlight the icons.
2. Press the **Enter** key to activate this area.
3. Use the directional keys to select either the **General Preferences** or the **Printer Header Defaults** screen. The graphic above shows the General Preferences screen which indicates that the laser, speaker and the ANT-5 application will launch automatically. The name of the operator and user information can be inserted from the Printer Default screen.

Note: Another icon will be present only when the GUI is used with the Remote Operation option. Select the cable icon to change the **IP Address of the ANT-5**. If the IP address is edited whilst running the application, close and restart to enable the change.

4.10 Installed options

Options currently installed can be displayed by pressing the **Menu** key from within the ANT-5 application, and selecting **Options** from the **Tools** menu. This screen is also used to install and uninstall options, See Section 5.1, ***Enabling customer-installed options***, for further details.



5. Optional software for the ANT-5

Options that can be currently purchased include:

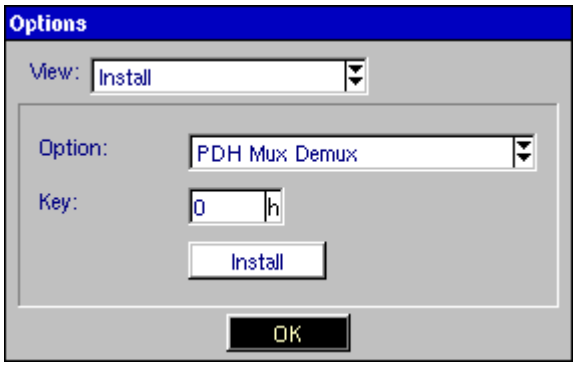
Option	BN Number
PDH Mux/DeMux	4565/93.58 (New Build)
Concatenated Mapping	4565/93.59 (New Build)
Remote Operation	4565/93.60 (New Build)
Remote Control	4565/93.61 (New Build)
SONET	4565/93.62 (New Build)
AU3 & VT* Mappings (*requires SONET option)	4565/93.53 (New Build)
ATM (see section 6)	4565/93.54 (New Build)
PLCP for ATM in DS3	4565/93.67 (Factory Installed)
IMA Monitor	4565/93.64 (New Build)
ATM Ping	4565/93.65 (New Build)
ATM Enhanced (requires ATM option)	4565/93.66 (New Build)

Note: Options purchased with a factory built ANT-5 will already be installed.

5.1 Enabling customer-installed options

New, customer-installed options purchased for the ANT-5 will be supplied with an access code. Options are enabled as follows:

From within the application an access **Key** is used to install the option into the unit by pressing **Menu** and selecting **Options** from the **Tools** menu.



Note: If an invalid key has been entered incorrectly three times, refer to the nearest technical assistance centre for advice. (This will not prohibit the unit being used for other purposes).

Options that can be currently purchased include:

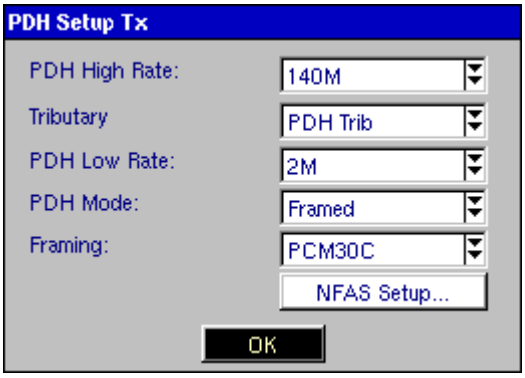
Option	BN Number
PDH Mux/DeMux	4565/95.58 (Customer Installed)
Concatenated Mapping	4565/95.59 (Customer Installed)

Option	BN Number
Remote Operation	4565/95.60 (Customer Installed)
Remote Control	4565/95.61 (Customer Installed)
SONET	4565/95.62 (Customer Installed)
AU3 & VT* Mappings (*requires SONET option)	4565/95.53 (Customer Installed)
ATM (see section 6)	4565/95.54 (Customer Installed)

5.2 PDH Mux/DeMux

5.2.1 PDH Mux Tx

SDH, SONET, and PDH network elements process PDH signals from various hierarchies. Complex, interlocking signal paths can result, particularly within modern optical cross-connects. Here, the ANT-5 can be used to test complex switching functions.



The PDH Mux feature allows the generation of ITU-T Mux chains from E1 to E4, starting and finishing at any intermediate rate with the exception of E2 (i.e. E1/E3, E1/E4, E3/E4).

The generation feature allows the insertion of alarms and errors at all levels in the chain (including E2).

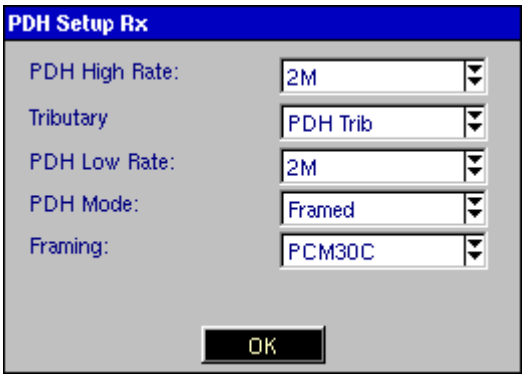
Selecting **NFAS setup…** opens the **NFAS Setup Tx** panel. (This is available only when the 2 Mbit/s (E1) signal structure has been selected for transmission).

Note: The Tx hierarchy type should be set to PDH to activate the PDH Mux.

5.2.2 PDH DeMux Rx

The PDH DeMux feature allows the analysis of ITU-T DeMux chains from E4 to E1 with the exception of E2 (i.e. E3/E1, E4/E1, E4/E3).

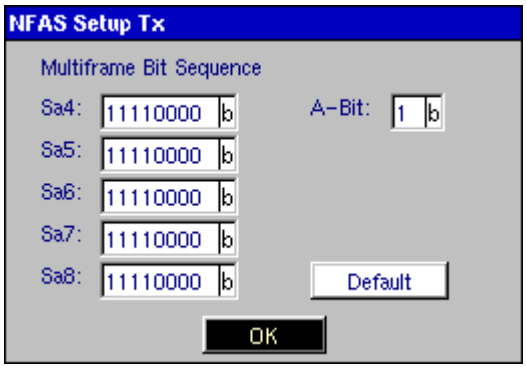
The analysis feature allows detection of all the alarms and errors generated. This enables in-service monitoring of specific channels contained in PDH signals.



Note: The Rx hierarchy type should be set to PDH to activate the PDH de-Mux.

5.2.3 Sa Bit generation Tx

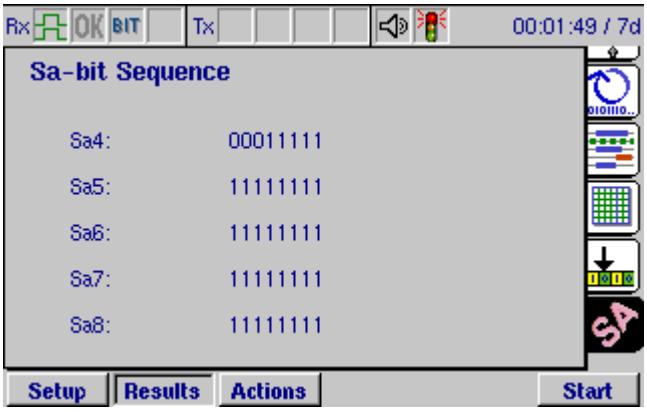
The Spare (Sa) bits in the NFAS (Not Frame Alignment Signals) of an E1 frame are available for specific purposes, and can be used, for example, to provide a remote loop back of a far end tributary. Bits can be used to control far end equipment for testing, typically using a loop-back.



The **A-Bit** (indicating the remote alarm) and spare Sa bits (**Sa4 – Sa8**) can be set. For each Sa bit it is possible to set 8 binary values. These will be transmitted in consecutive NFAS.

5.2.4 Sa Bit monitoring

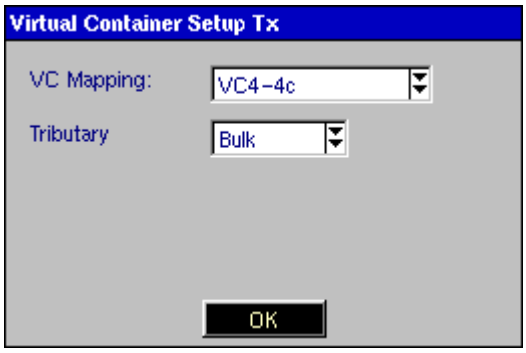
Assuming the Rx signal structure is configured to receive framed E1 signals, then Sa bits can also be monitored by pressing the **Results** firm key and selecting the SA tab.



5.3 Concatenated Mapping

Concatenated STM-4 is being used increasingly to carry high data rate services such as, ATM, IP and multimedia.

Concatenated Mapping supports bulk contiguous concatenation, which treats the STM-4 payload as a contiguous virtual container. The alternative (which is not supported) is virtual concatenation (STM-4v); this uses 4 x VC4 containers to create a virtual VC4-c container.



A test pattern can be injected throughout the contiguous concatenated payload of the Virtual Container in either transmit or receive mode as required.

1. Set the **Rate** within the **Hierarchy Setup** panel to **STM-4 Optical**.
2. Set **VC Mapping** within the **Virtual Container Setup** panel to **VC4-4c**.

Note: VC4-16c is available when the interface is set to **STM-16**.

5.4 Remote Operation

5.4.1 Setting up the remote ANT-5

Remote Operation is achieved by establishing a suitable communications link over an Ethernet LAN. Once the link has been successfully set up, the PC/Laptop can communicate with the ANT-5 using the supplied version of the ANT-5 GUI faceplate.

Note 1: The following illustrates how remote access can be achieved using the network, it is not exhaustive and other scenarios may be equally valid. Please ensure the cable is less than 3 metres from the ANT-5 to the RJ-45 socket.

Note 2: Care should be taken not to confuse the E1 120Ω (RJ-48) and the Ethernet port **<···>** (RJ-45). See the illustration on page **Error! Bookmark not defined.**.

Note 3: Remote operation currently supports the SDH Access Tester Application and is available in all languages supported by the ANT-5 local GUI.

The following is required and assumed to be working:

- Complete ANT-5 unit with all necessary cables.
- 10BaseT connection.

1. Liaise with your IT department for a static IP address, the Subnet Mask and Gateway of the network to which the ANT-5 will be connected.
2. In the **Systems** > **Comms** > **Ethernet** menu of the ANT-5, edit the **IP Address**, **Subnet Mask** and **Gateway** to those specified by the IT department and the **Transceiver** to the network connection type.
3. A connection to an external power supply is advisable. Reboot the ANT-5, launch the **REMOTE** application and leave on.

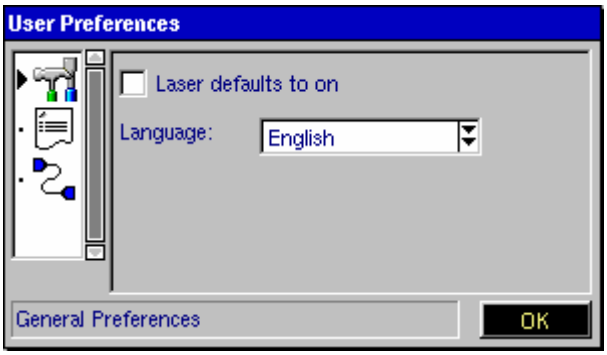
Note: As an example, the connection to the network can be made via an Ethernet card plugged into the RJ-45 Ethernet connector **<•••>** on the left side of the ANT-5 (see illustration on page **Error! Bookmark not defined.**). A static IP address will be required for the particular MAC address of the PC card. Refer to section 2.8.1 for information on communications configuration.

5.4.2 Selecting the Language

Follow steps 1–4 below to select the language for the Remote Operation Client.

1. Launch the ANT-5 Remote Operation client.

4. Display the User Preferences page using the top icon in the list.



3. Select the language for remote operation.
4. Exit the Remote Operation Client, and then launch it again.

The language is set for remote operation.

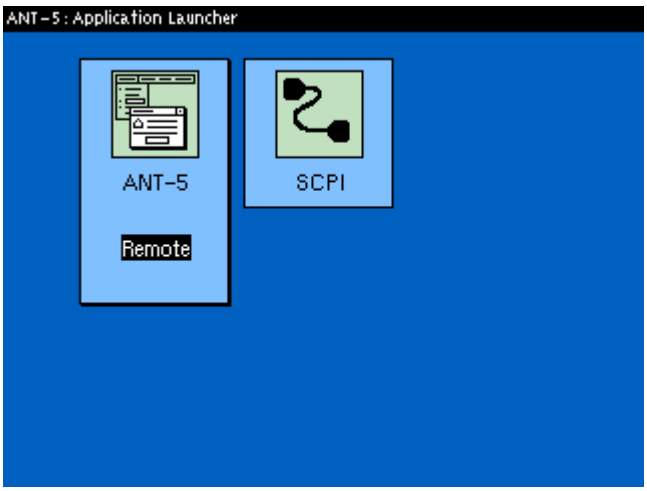
Note: For instructions on setting up the ANT-5 to support Simplified Chinese text, see Appendix F – Simplified Chinese Language Support.

5.4.3 Software Installation and operation

Note: Ensure that the ANT-5 unit has been fully upgraded and that the corresponding version of the client software has been installed and is used.

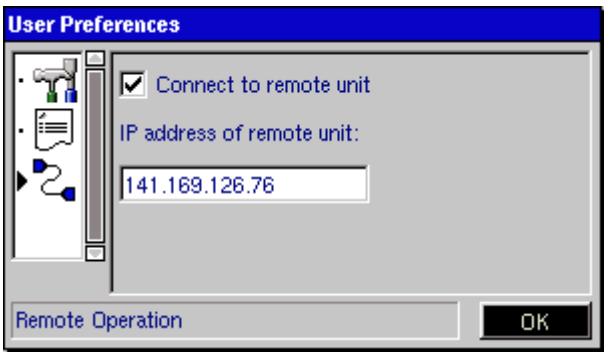
Follow steps 1–3 below if the remote operation client needs to be installed.

1. Insert the ANT-5 Upgrade CD-ROM into the CD drive of the PC.
2. From Windows click on **Start > Run** and type in **D:\ANT-5 Remote Operation Client\setup.exe** (replace D with the drive letter for your CD-ROM drive if necessary).
3. Follow the on-line instructions to complete the installation.
4. Highlight **REMOTE** and press enter.



5. The ANT-5 unit will then display **Waiting for connection…** to alert other users of the unit's purpose.
6. From the PC launch the application by clicking on **Start > Programs > ANT-5 Remote Operation Client**.

7. When the application is launched you will be prompted for the **IP address of remote unit** which is either the **Ethernet > IP Address** or the **PPP > Local IP Address** of the remote ANT-5 depending on the type of connection made. (Refer to section 2.8.1 for further information).



Note 1: The next time the application is launched, the previous IP address will be shown as default, click on **OK** to proceed. If required, the IP address can be edited.

Note 2: When typing in the ANT-5 IP address into a PC environment care should be taken to avoid any leading zeros. For example 141.169.126.076 would be replaced with 141.169.126.76. However, all twelve characters are needed for the ANT-5.

Note 3: Edited IP addresses will be available after the ANT-5 has been re-booted.

After a short while the ANT-5 graphical user interface will load on the PC, green LEDs will flash in the Tx and Rx boxes of the ANT-5 indicating that the link has been established.

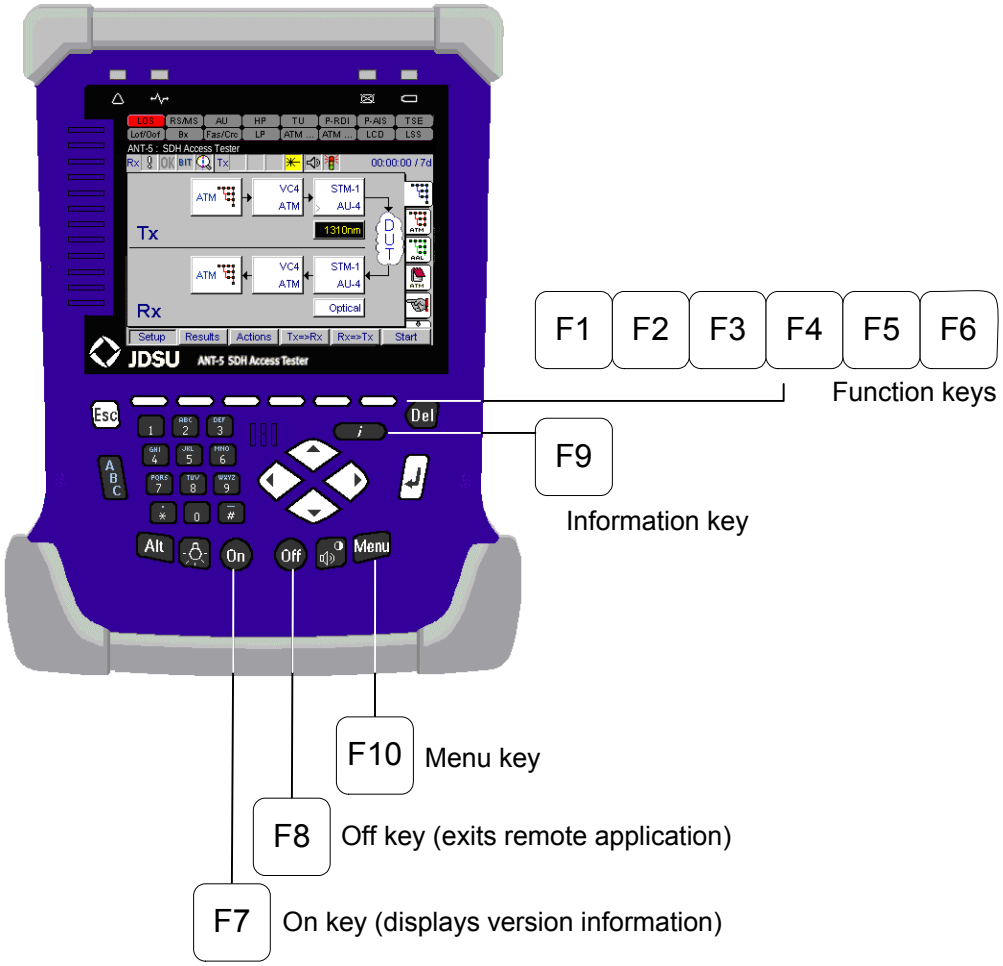
The PC's mouse and keyboard are used to operate the remote ANT-5 just as if you were sitting in front of it.

Use the PC's keyboard cursor keys to move around the ANT-5 and the mouse to select the ANT-5 keyboard keys. For ease-of-use the function keys F1-F6 match the function keys on the ANT-5. Key F10 takes on the role of the ANT-5 menu key.

Tip: Create a directory on your PC, e.g. **ANT-5**. Select **Menu > File > Save > Configuration** to save configuration files to this directory which later can be opened by selecting **Menu > File > Open > Configuration**. Alternatively files can be copied to other units using FTP, See Section 3.3.2, ***File Transfer*** for further details.

5.4.4 Keyboard equivalents

While working in remote mode, you can use your PC's function keys to emulate pressing various keys on the instrument. The following illustration shows the mapping between function keys and instrument keys.



In addition, the following keyboard keys correspond to keys on the ANT-5:

Enter	↵	**Del**	Del
Alt	Alt	**Esc**	Esc
Cursor keys	↑ ← → ↓		

5.4.5 Exporting

From the GUI faceplate select **Menu > File > Export**. From the standard Windows dialog box, .csv files can be saved to any directory on your PC.

5.4.6 Printing

From the GUI faceplate select **Menu > File > Print**. A standard Windows dialog box will allow users to select and configure a printer.

5.4.7 Remote Operation Troubleshooting

5.4.7.1 General Troubleshooting Tips

1. Ensure that all physical connectors are secure
2. Check that IP address of the physical ANT-5 matches the one used from the GUI faceplate. (See Sections 2.8.1 and 4.9).
3. Press  from the GUI faceplate. If the **M/M Version** shows a series of zeros, check the IP address and re-launch the application from the PC.
4. Errors may occur on re-launching the ANT-5 application if previously it has failed to shutdown correctly. In this instance delete the **Auto.A5C** file from your **C:** drive and re-launch the application from your PC.
5. The Remote Operation Client may have terminated improperly during a prior session, leaving a process running on your PC. To delete the process, launch the Task Manager, and then select the Processes tab. Find the process named **ant5rc.exe**, and then end the process.
6. On occasion, Windows Updates can cause a loss of communications. If this occurs, please disable the Windows Updates while using the Remote Operation feature.

5.4.7.2 Troubleshooting for Windows XP

If you are using Windows XP, perform the following steps to improve performance of remote operation:

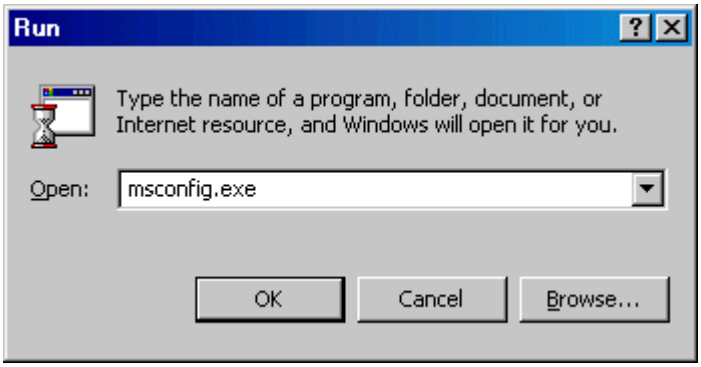
1. Select **Start->Settings->Control Panel**. Double-click **System**, and click the **Advanced** tab. Select **Settings** under the **Performance** category. Select the Advanced tab on the Performance Options page. Select **Background Services** for Processor Scheduling.
2. Ensure you have as few applications open as possible in order to give priority to the Remote Operation Client. Ideally you should reboot your machine and have nothing running. Ensure your firewall is allowing communication to and from the PC.
3. Remove the `ctmon.exe` process. This removes Alternative User Input which may be required by Chinese users. For detailed instructions on removing `ctmon.exe`, see http://support.microsoft.com/default.aspx?kbid=282599.

5.4.7.3 Removing the Time Zone environment variable

Previous versions of the ANT-5 software required definition of a time zone variable. If you defined a time zone variable, you must remove it.

Windows 95:

1. Select **Start > Run**.



2. In the Run dialog box, type msconfig.exe and click OK. The System Configuration Utility appears.
3. Click the **Autoexec.bat** tab.
4. If there is a statement such as SET TZ=GMT+1 (or similar), delete it.
5. Click OK, and exit the System Configuration Utility.

Windows NT:

1. Select **Start > Settings > Control Panel > System**.
2. Click the **Environment** tab.
3. If an environment variable TZ appears, delete it.
4. Exit the Control Panel.

Windows 2000 and Windows XP:

1. Select **Start > Settings > Control Panel > System**.
2. Click the **Advanced** tab.
3. Click **Environment Variables**.
4. If an environment variable TZ appears, delete it.
5. Exit the Control Panel.

5.5 Remote Control

Refer to the ANT-5 Remote Control User Manual for more information.

5.6 SONET

5.6.1 Introduction

Synchronous optical network, known as SONET, is the standard for synchronous operation used primarily in North America and is defined by ANSI T1. (American National Standards Institute – Telecommunications 1).

SONET and SDH share many common principles of operation and architecture. A comparison of the transmission rates supported by ANT-5 is given below:

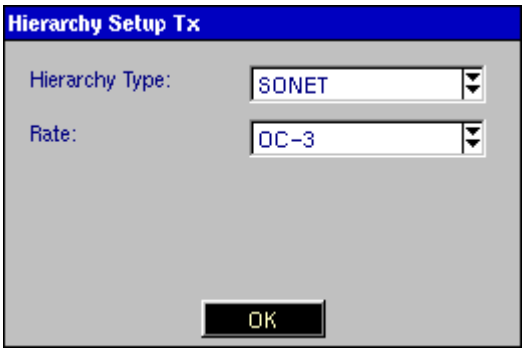
SONET signal		SDH signal	Transmission Rate Mbit/s
Electrical STS-3	Optical OC-3	STM-1	155.52
	Optical OC-12	STM-4	622.08
	Optical OC-48	STM-16	2488.32

The bit rates depend on the mapping options fitted.

5.6.2 Hierarchy Setup

SONET can be chosen as the **Hierarchy Type** by selecting the Hierarchy element from the Tx or Rx panel as required.

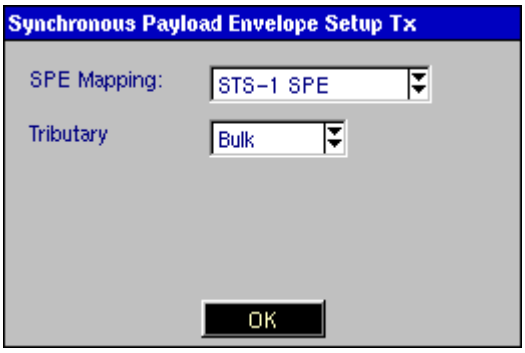
If an optical option is fitted then by selecting an optical **Rate** e.g. OC-3 as in this example, the **Output** will automatically change to **Optical** in the Interface Setup panel.



5.6.3 Synchronous Payload Envelope Setup

SPE Mappings can be selected from the Synchronous Payload Envelope Setup element. This element will not be available if a PDH interface has been selected.

Bulk should be selected as the **Tributary** if bulk testing of the virtual container is required. The test pattern will then be injected across the whole of the Synchronous Payload Envelope.



If the unit supports Concatenated Mapping (See Section 5.3) then a test pattern can be injected throughout the contiguous concatenated payload in either transmit or receive mode as required by:

1. Setting the **Hierarchy Type** to **SONET**.
2. Set the **Rate** to **OC-12**.
3. Set **SPE Mapping** within the **Synchronous Payload Envelope** panel to **STS-12c SPE**.

Note: VT1.5 and **VT2** mapping will also become selectable if the AU3/VC11/SONET VT mappings option has been purchased and enabled.

5.6.4 Channel Setup

The channel for testing will depend on the parameters set for the hierarchy and synchronous payload envelope.

Mappings to the OC Channel

OC	1	2	3	4	5	6	7	8	9	10	11	12
STS-N	1	1	1	2	2	2	3	3	3	4	4	4
AU-3 channel	1	2	3	1	2	3	1	2	3	1	2	3

5.6.5 PDH Setup

Only bit rates and framing types appropriate to the SONET configuration will be displayed as options within this panel.

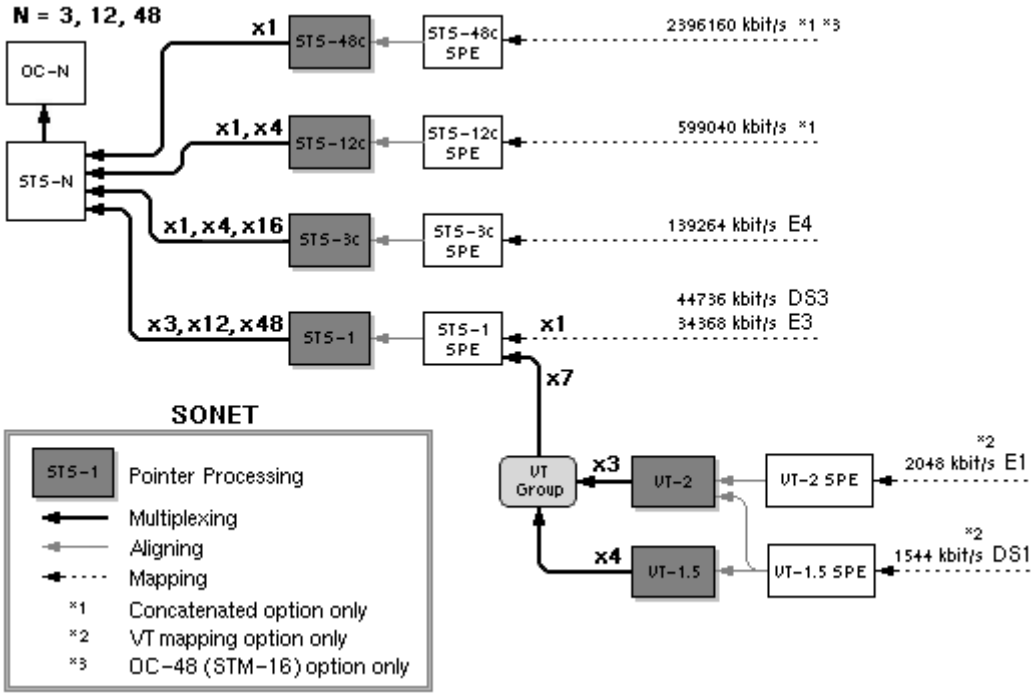
5.6.6 SONET LED Indicators

LOS	Loss of Signal
Line-L	Line overhead
STS-P	STS Path overhead
VT-V	VT Path overhead
P-RDI	Path Remote Defect Ind.
P-AIS	Path AIS
TSE	Test Sequence Err. (Bit Err.)

Lof/Oof	Loss of Frame
B1	Section error monitoring
B2	Line error monitoring
B3	SP error monitoring
Fas/Crc	FAS / CRC Error
P-LOF	Path Loss of Frame
LSS	Loss of Sequence Sync.

5.6.7 SONET information

SONET structure for ANT-5



SONET Anomalies and Defects

The following table lists the SONET Anomalies and Defects pertinent to ANT-5, their meanings and detection criteria.

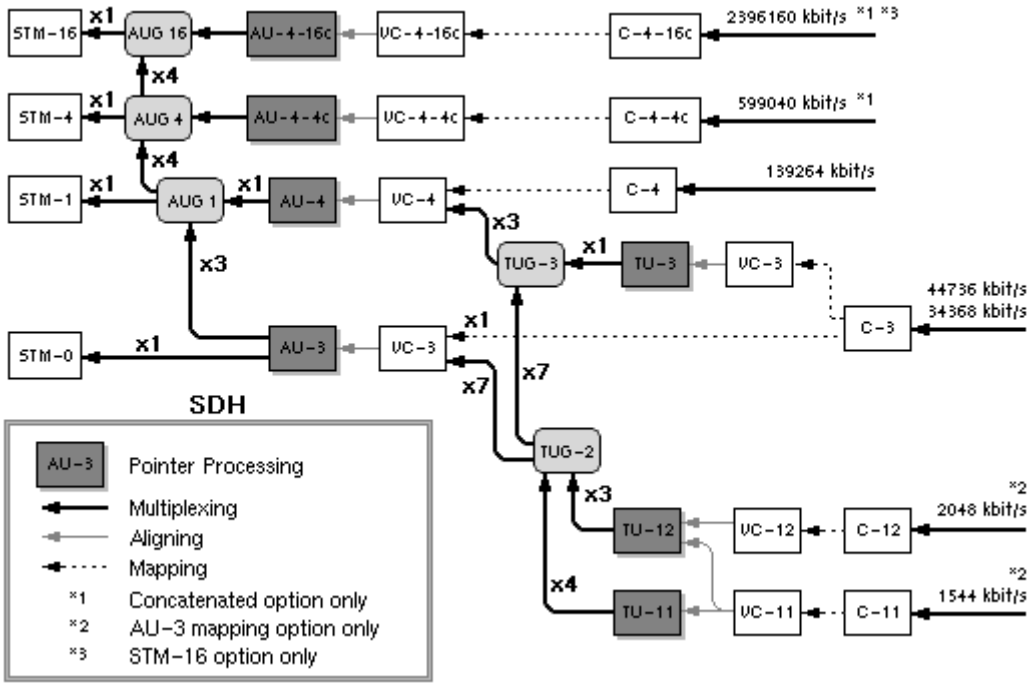
	Anomalies	Detection Criteria
LOS	Loss of signal	All-zero pattern for 2.3 µs ≤ T ≤ 100 µs
LOF	Loss of frame	If SEF persists for ≥ 3 ms
AIS-L	Alarm Indication Signal – Line	K2 (bits 6,7,8) = 111 for ≥ 5 frames
RDI-L	Remote Defect Indication – Line	K2 (bits 6,7,8) = 110 for ≥ z frames (z = 5 to 10)
LOP-P	Loss of Pointer – STS Path	8 to 10 NDF enable 8 to 10 Invalid pointers
AIS-P	Alarm Indication Signal – STS Path	All “1” in the STS pointer bytes H1, H2 for ≥ 3 frames
UNEQ-P	Unequipped – STS Path	C2 = “0” for ≥ 5 (≥ 3 as per T1.231) frames
RDI-P	Remote Defect Indication – STS Path	G1 (bit 5) = 1 for ≥ 10 frames

	Anomalies	Detection Criteria
TIM-P	Trace Identifier Mismatch – STS Path	Mismatch of the accepted and expected Trace Identifier in byte J1 (64 bytes sequence)
PLM-P	Payload Label Mismatch – STS Path	Mismatch of the accepted and expected Payload Label in byte C2 for ≥ 5 (≥ 3 as per T1.231) frames

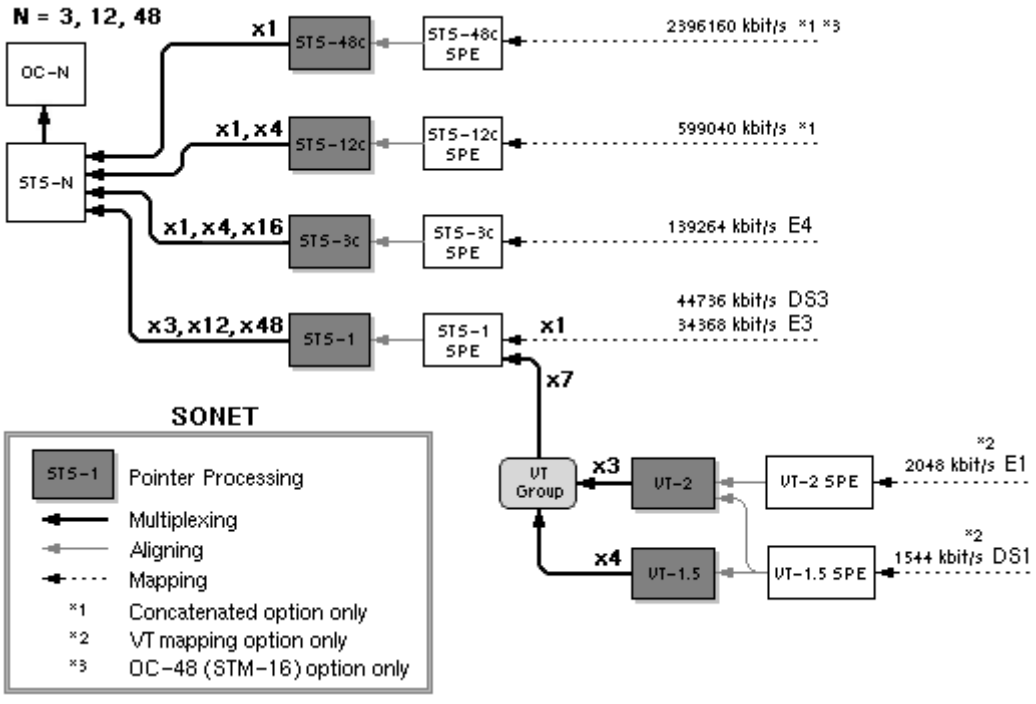
	Defects	Byte or Detection Criteria
B1	Section error mismatching	B1
B2	Line error mismatching	B2
REI-L	Remote Error Indication – Line	Number of detected B2 errors in the sink side encoded in byte M0 or M1 of the source side
B3	Path error mismatching	B3
REI-P	Remote Error Indication – STS Path	Number of detected B3 errors in the sink side encoded in byte G1 (bits 1, 2, 3, 4) of the source side

5.7 SDH AU-3/SONET VT Mapping

AU-3 Mapping enables the testing of DS-1, E1, E3 and DS3 tributaries mapped into STM-1 via VC-3/ AU-3, as shown in the following diagram.



The VT mapping function enables the testing of DS-1 and E1 tributaries mapped into an STS-1 SPE via VT1.5 and VT2 SPEs as shown in the following diagram. However, this option also requires the SONET option BN 4565/00.62.



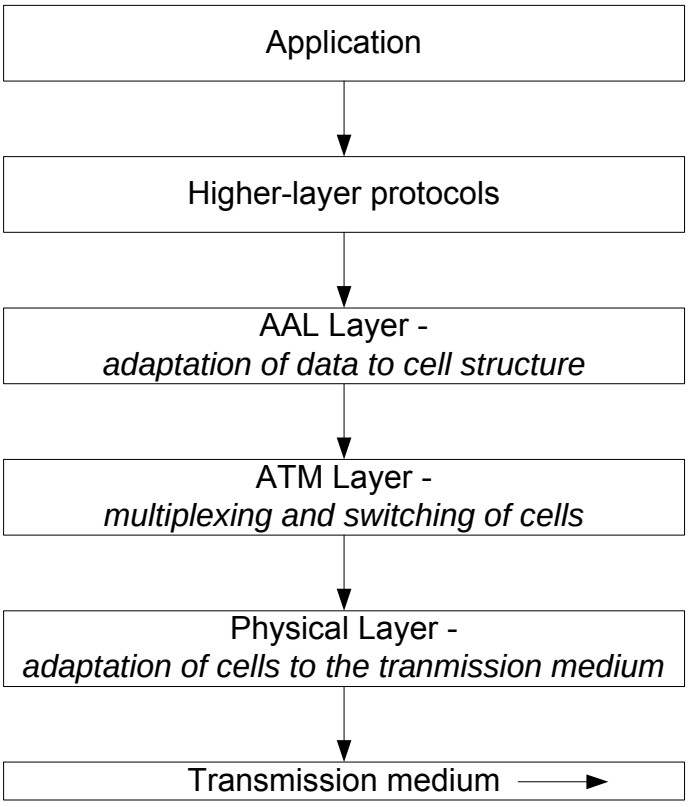
6. Asynchronous Transfer Mode – ATM

6.1 ATM Overview

ATM is a cell-oriented switching and multiplexing technology that uses fixed-length packets to carry different types of traffic. Like packet switching technologies such as frame relay and TCP/IP, ATM integrates the multiplexing and switching functions but in contrast to circuit switching it is also well suited for bursty traffic. ATM therefore allows communication between devices that operate at different speeds.

6.1.1 The ATM Reference Model

In the sections that follow, the user interface has been described with reference to the ATM model, namely, the Physical layer, the ATM layer and the Adaptation layer. The following diagram shows a basic layer model for ATM.



6.2 Introduction

The ATM S/W option (4565/93.54) expands the applications of the ANT-5 to cover use in ATM networks. The measurement methods and user interface have been designed for applications involving user-network interfaces (UNI) and network-network interfaces (NNI). ATM testing is available for the STM-1/4/16, OC-1/3/12/48, DS1/3 and E1/3 data rates.

Note: This section assumes that you are familiar with the functionality of the graphic user interface. However, before proceeding you may wish to review section 4, ***The SDH Access Tester Application***.

6.2.1 ATM Setup and Result tabs

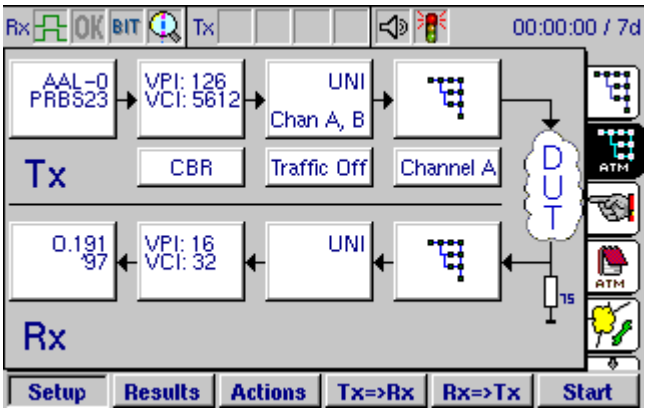
ATM Tabbed Setup pages

	ATM Setup Summary		ATM setup page
	Channel explorer setup page		AAL-2 / AAL-5 setup page

ATM Tabbed Result pages

	ATM Cell Statistics		ATM Quality of Service
	Channel Explorer results		AAL Statistics
	Channel Traffic Analyzer (CTAN)		

6.3 Configuring the Physical Layer



The signal structure for the particular device or system under test has to be configured before setting any ATM parameters.

Following the Tx setup, this example shows a **PRBS23** pattern passing into a **140M**bit/s **Unframed** PDH signal. This is mapped into a virtual container **VC-4** which is then aligned into an administrative unit **AU-4** and finally multiplexed into an **STM-1**, using an **electrical interface**. See section 4.3.1, ***Signal Structure setup page*** for further details on configuring the physical layer.

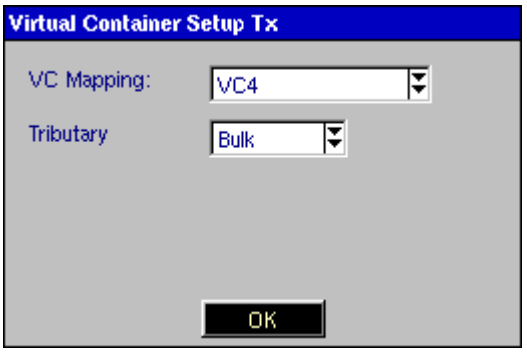
In most cases the user interface for the Tx is the same as the user interface for the Rx. An exception to this rule is the ATM Header Rx, where a VCI and/or a CLP filter can be enabled. See section 6.4.2 for further details.

Where the system under test is symmetrical, and the Tx and Rx structures are required to be identical, time can be saved by setting up either the Tx or the Rx structure, and then pressing either the Tx=>Rx or Rx=>Tx keys as appropriate. The structure will be copied from Tx to Rx, or vice versa, as selected.

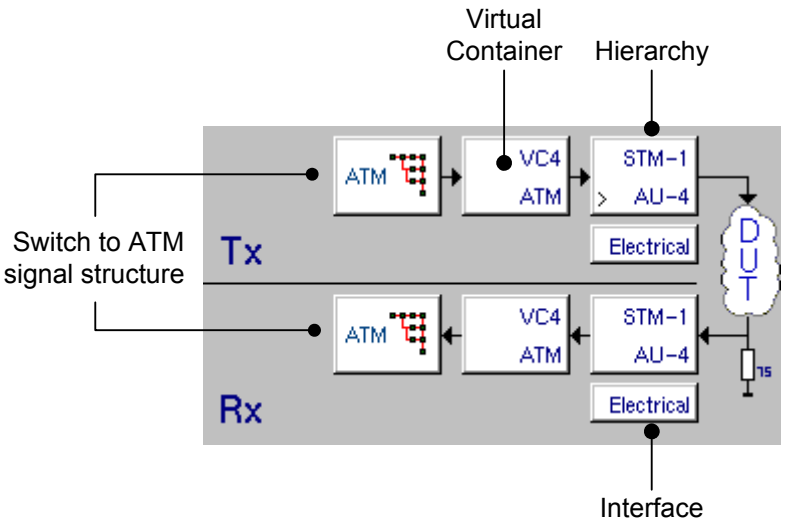
Note: When the physical interface is 2M, and PCM31 or PCM31C framing is selected, you can reserve timeslot 16 on the PDH Setup Tx and Rx pages to allow compatibility with other 2M ATM devices.

6.3.1 Virtual Container Setup Tx

Once the physical layer is configured correctly, open the **Virtual Container Setup Tx** panel, and select the **Tributary ATM** from the dropdown menu, then click on **OK**.



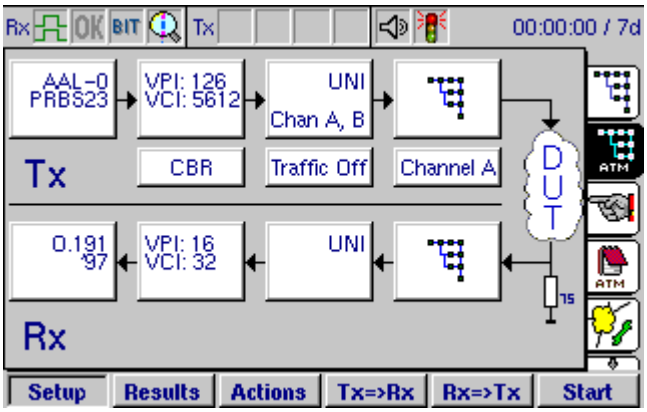
You will notice that the signal structure page has changed, similar to the diagram shown below.



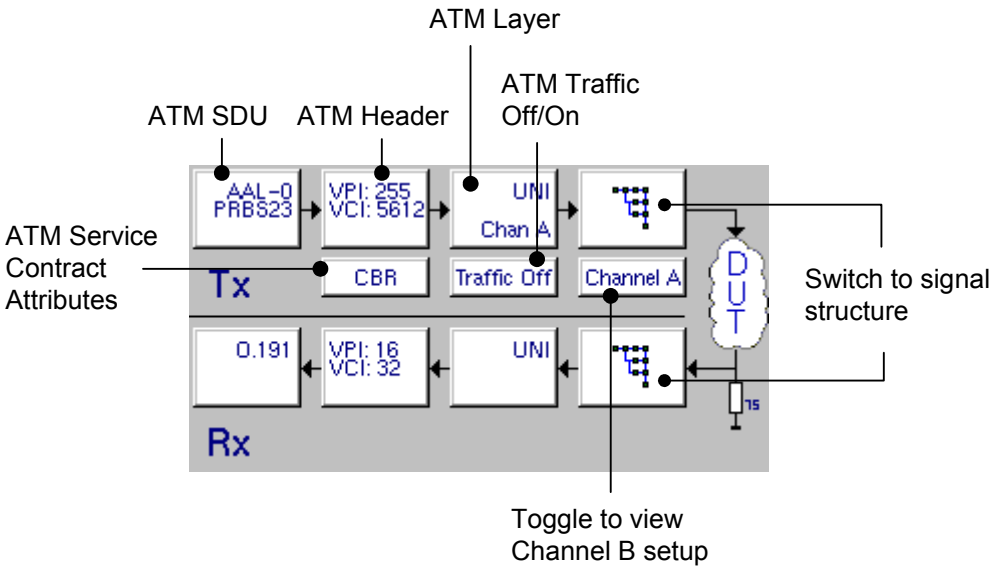
6.4 Configuring the ATM Layer

6.4.1 The ATM structure

Select either the  tab from the right of the screen, or the ATM icon from the structure setup page. A graphic similar to the one on the right will be displayed. The ATM structure can now be configured.

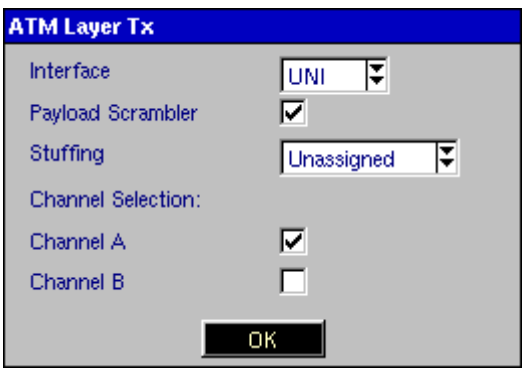


In this diagram **Channel A** is displayed as the channel under test. The Channel A panel is used to switch to view other channel setups, (assuming concurrent channels have been selected). See section 6.4.



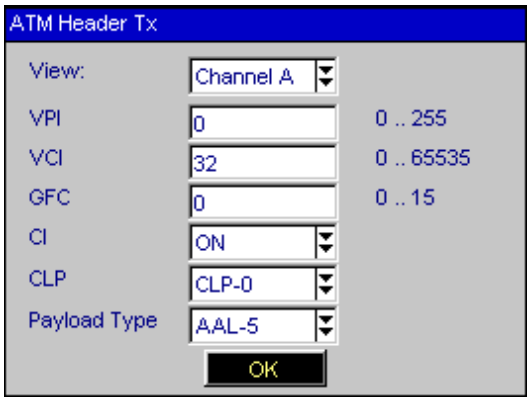
Note: Use the tab  or icon to switch to the physical signal structure layer at any time.

UNI or **NNI** can be selected as the **Interface**. In this example the **Interface** is set to **UNI** and the **Payload Scrambler** has been turned on. The transmitter can send **Idle** or **Unassigned** cells. In this example, the ATM cell stream will be stuffed with **Unassigned** cells when no traffic is sent. Finally, select the **Channel**. Channel A tests the foreground channel, and Channel B is used to carry a fixed payload type on the background channel. Click on **OK** when you have set the parameters.



From the signal structure page move the directional keys over **Traffic Off** panel. The Enter key can be used to switch **Traffic On** or **Traffic Off** as required.

6.4.2 ATM Header Tx



Sets the parameters for the ATM Header. The Virtual Path Indicator **VPI** and Virtual Channel Indicator **VCI** are used for switching purposes.

VPI identifies the cell belonging to a particular path, whilst the VCI identifies the cell belonging to a particular channel.

Four bits are used for Generic Flow Control **GFC**. These bits control the flow of data between the user and the network. GFC can only be set if **UNI** is selected as the **Interface**. See section 6.4, ***Configuring the ATM Layer*** for further details.

The **CI** field indicates if the congestion indicator is **ON** or **OFF**. When ON, the network elements reduce the allowed cell rate during network congestion.

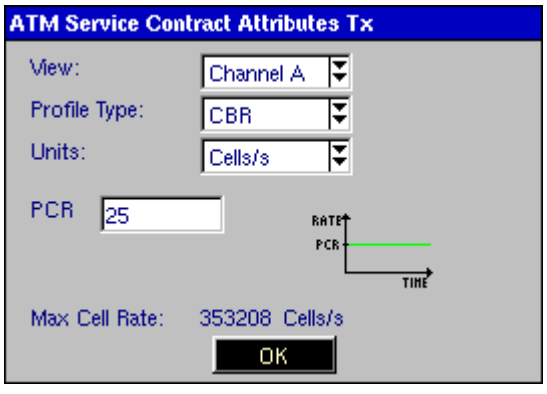
Cell Loss Priority **CLP** allows cells to be classified as high priority **CLP-0** or low priority **CLP-1**. In the event of congestion, cells that are set to CLP-1 will be discarded first.

The **Payload Type** field selects the ATM payload. If you select AAL-2 or AAL-5, an additional "AAL" block appears, replacing the ATM SDU box and an AAL tab appears.

Note: AAL-2 and AAL-5 are part of the "ATM Enhanced" option.

Click on **OK** when you have set the parameters.

6.4.3 ATM Service Contract Attributes Tx



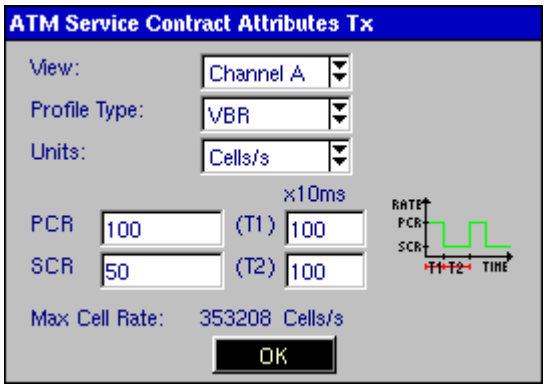
Sets the parameters for the Service Contract. A Constant Bit Rate **CBR** or a Variable Bit Rate **VBR** can be selected as the **Profile Type**. In this example a **CBR** has been selected.

A CBR is a class of service that guarantees the transmission at a constant bit rate, thus emulating a dedicated transmission link.

In this example a Peak Cell Rate **PCR** of 25 cells per second will be sent.

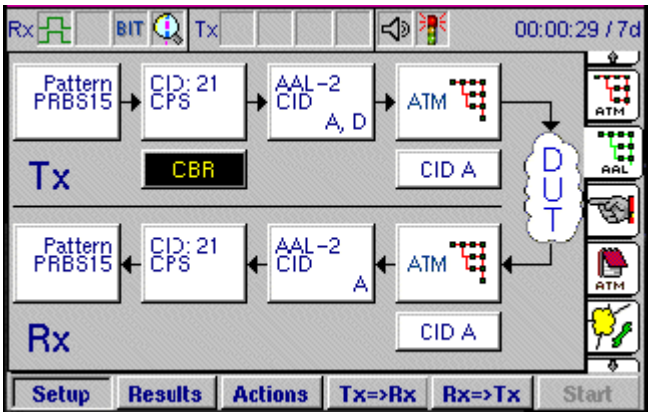
Note: Cells sent at a rate close to 100% of the maximum cell rate will be rounded-up.

In this example a **VBR** has been selected as the **Profile Type**. The user can define the PCR and the Sustainable Cell Rate **SRC**. In this example a repeated pattern of 100 PCR cells will be sent during T1, where T1 in this example = 1 second. This will be followed by 50 SCR cells during T2, where T2 = 1 second (100x10 ms)



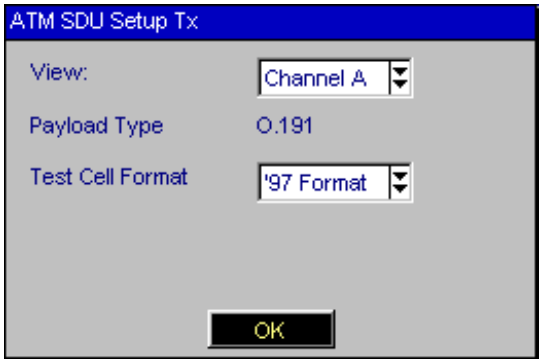
6.5 Configuring the Adaptation Layer

Select either the AAL tab from the right of the screen, or the AAL icon from the structure setup page. A graphic similar to the one on the right will be displayed. The AAL structure can now be configured.



6.5.1 ATM SDU Setup Tx

Sets the Service Data Units SDU for the device under test. In this example the **Payload Type** has been set to **O.191**.



O.191 describes a diagnostic model for performance analysis in which test cells are transported over an agreed virtual connection. The O.191 measurement tests performance on a cell-by-cell basis in the ATM layer.

The function and performance of other payload types must be considered separately. For example, the payload type for Channel B will be fixed.

Note: If you select AAL-0 as the payload type, you can select a PRBS pattern as the payload data.

The **Test Cell Format** standard is **'97 Format**. For example, this format is backward compatible with the ANT-20 Broadband Analyzer/Generator module. The ’95 Format is backward compatible with equipment that uses legacy applications.

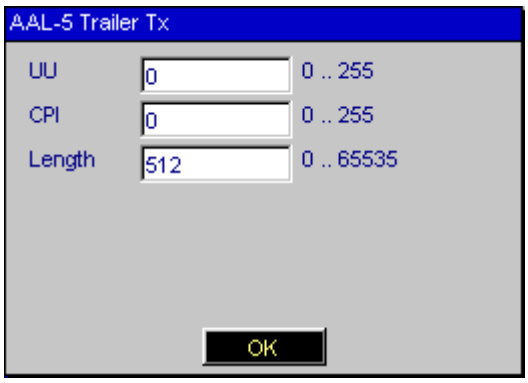
6.5.2 AAL-5 Setup

If AAL-5 was set as the Payload Type on the Header Setup, additional parameters must be set.

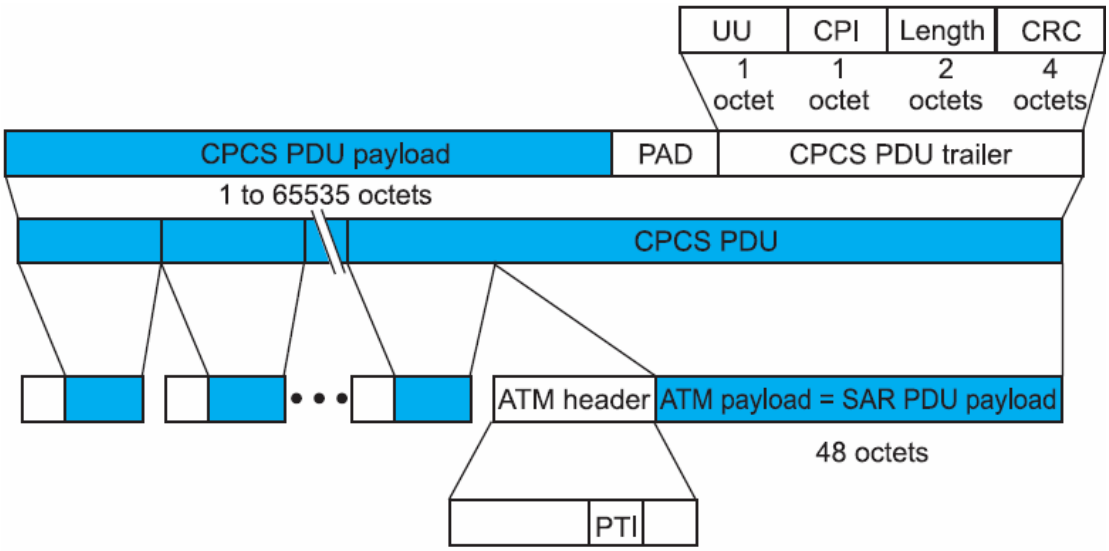
6.5.2.1 AAL-5 Trailer TX

Sets the AAL-5 trailer information.

Enter the User to User Indication (UU) and Common Part Indicator (CPI) bytes. Specify the two-byte trailer length.



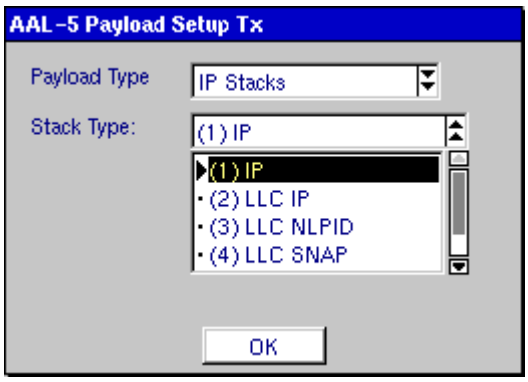
The graphic below outlines the AAL-5 structure.



6.5.2.2 AAL-5 Payload Setup Tx

Sets the Payload Type. If you select Pattern as the payload type, select the Pattern type; if you select IP stacks, select the stack type.

The number in parenthesis is used to identify the stack in the overview.

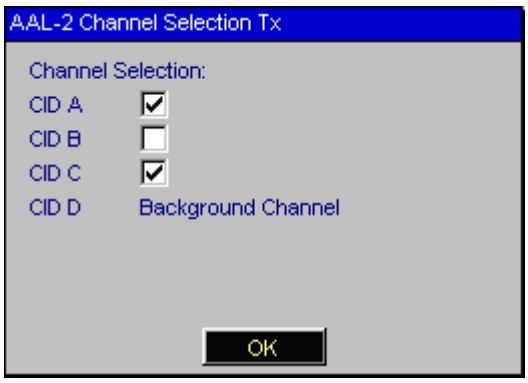


6.5.3 AAL-2 Setup

If AAL-2 was set as the Payload Type on the Header Setup, additional parameters must be set.

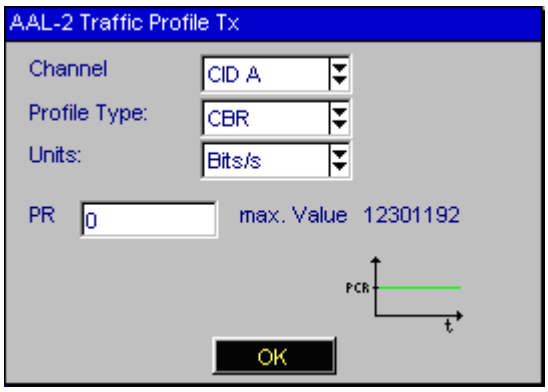
6.5.3.1 AAL-2 Channel select TX

Specifies which AAL-2 channel(s) should be active. CID D on the TX side is the background channel..

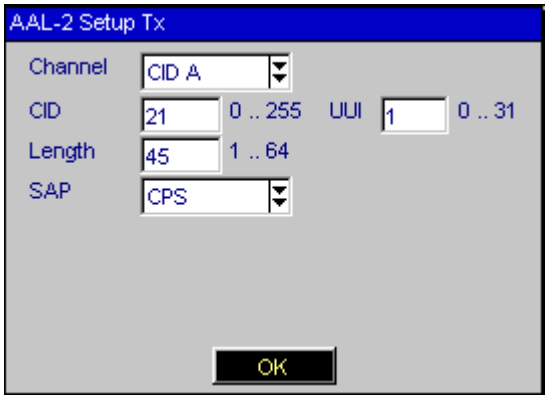


6.5.3.2 AAL-2 Traffic Profile TX

Specifies the traffic profile. The “max. Value” is displayed in the selected “Units,” in this case in bits per second (Bit/s).



The AAL-2 Setup screen specifies additional AAL-2 settings.
The selections vary depending on the “SAP” selected.

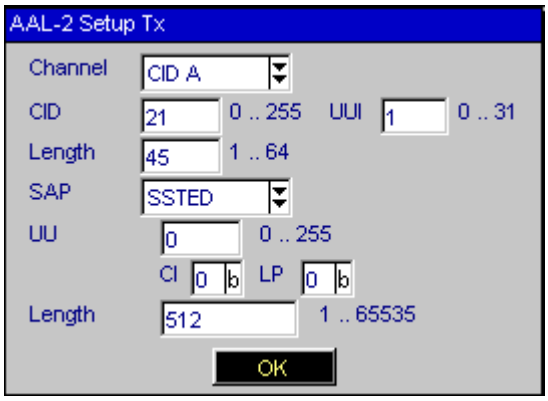


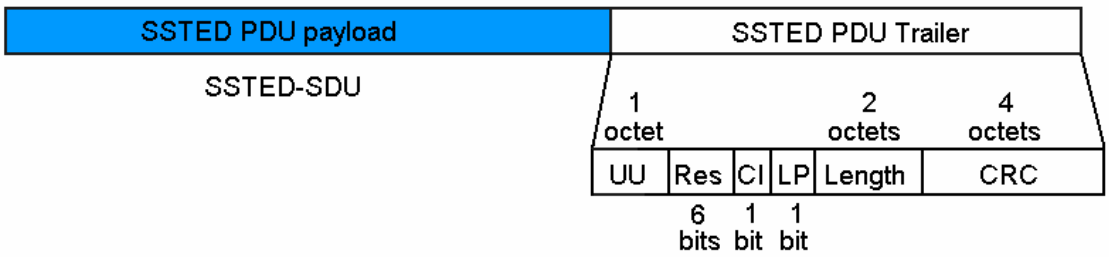
6.5.3.3 AAL-2 Channel Setup

Specifies additional AAL-2 settings.

Select the **SAP** (service access point) type. Select the **CID**, **LI**. The other selections vary depending on the SAP type. Set the **UU**, then enter the **CI** and **LP**. Set the trailer **length**.

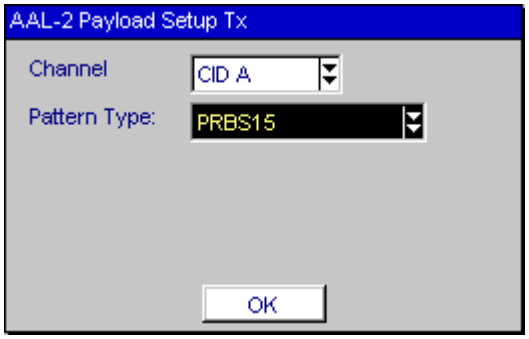
The selections vary depending on the "SAP" selected, as outlined in the graphic below.





6.5.3.4 AAL-2 Payload Setup Tx

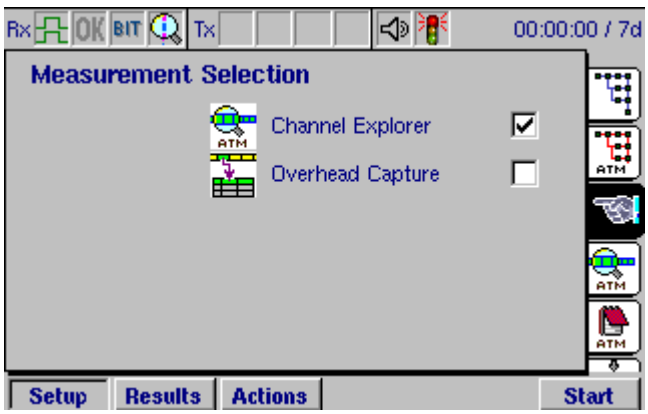
Sets the **Pattern** used as the payload for each channel.



6.6 Configuring Channel Explorer

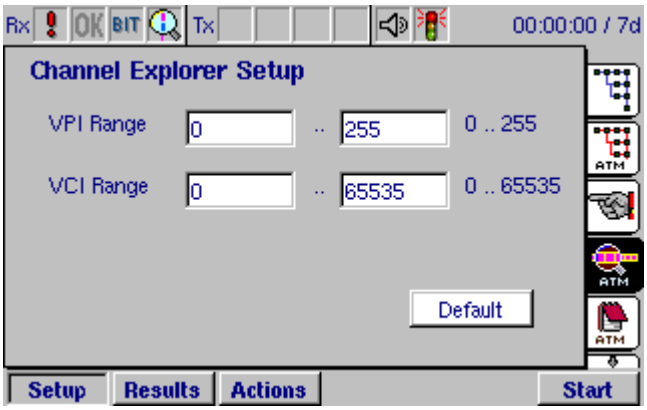
6.6.1 Enabling the Channel Explorer

Select the  tab to display the Measurement Selection page. Select **Channel Explorer** to enable the ATM explorer.



6.6.2 Configuring Explorer Channels

Select the  tab to display the Channel Explorer Setup page. Type the channel ranges for which the Explorer displays results. In this example, the Explorer displays the **VPI channels 0–255**, and within each VPI channel, it displays the **VCI channels 0–65535**.



6.7 Traffic Analyzer

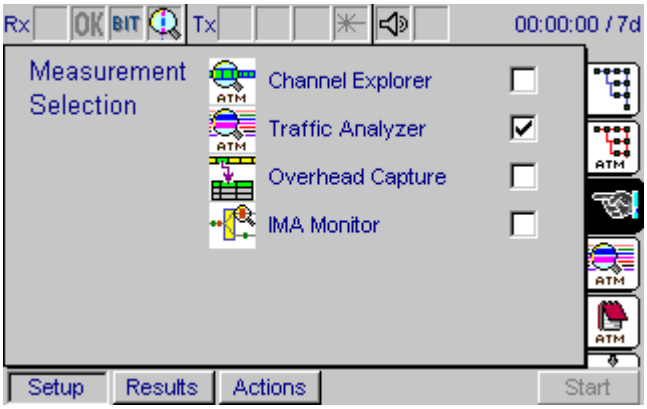
The Traffic Analyzer is very similar to the Channel Explorer. The difference in the Channel Explorer and the Traffic Analyzer is that the Traffic Analyzer provides real-time results.

Note: Traffic Analyzer is part of the “ATM Enhanced” option.

6.7.1 Enabling the Traffic Analyzer

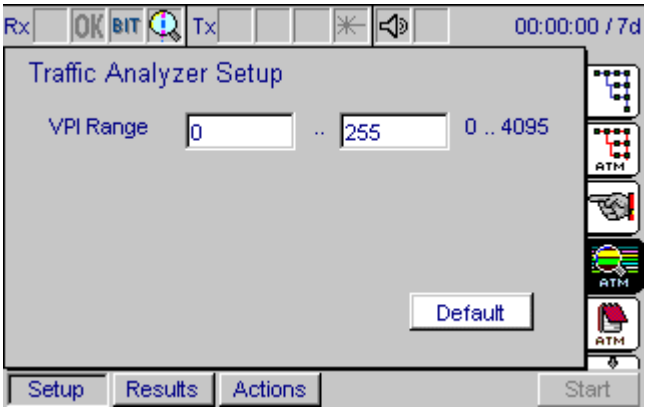
Select the  tab to display the Measurement Selection page. Select **Traffic Analyzer** to enable the traffic analyzer.

On the ATM structure page, the RX line now ends with the UNI/NNI block and a “Scan” block appears. The “Scan” block indicates that the Channel Traffic Analyzer mode is running and no PRBS measurements can be done on a specific ATM channel.



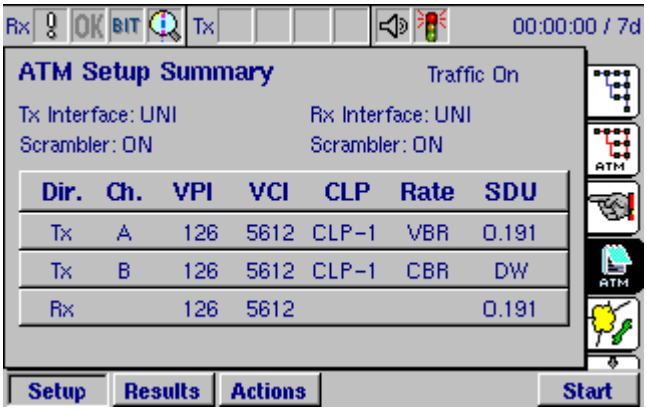
6.7.2 Configuring Traffic Analyzer Channels

Select the  tab to display the Traffic Analyzer Setup page. Type the channel ranges to be analyzed. In this example, the Explorer displays the **VPI channels 0–255**.



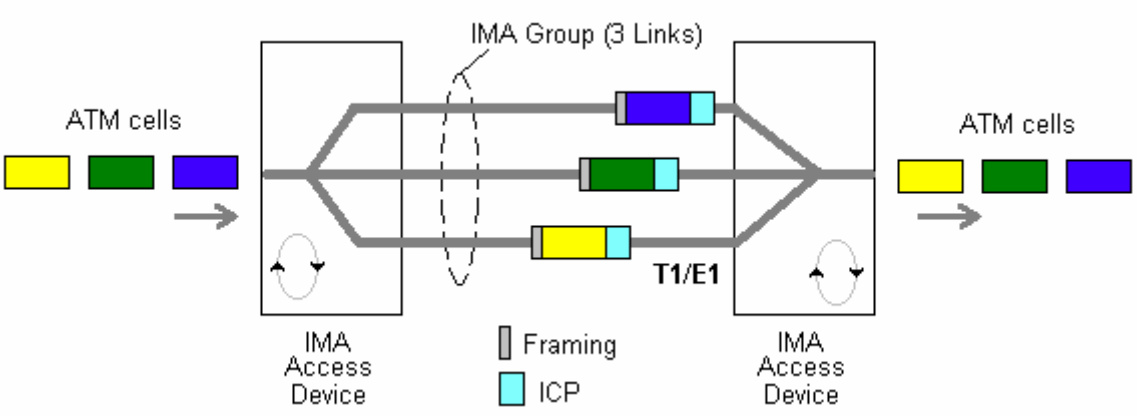
6.8 ATM Setup Summary

The **ATM Setup Summary** page displays the parameters that have been selected for testing.



6.9 IMA Monitor

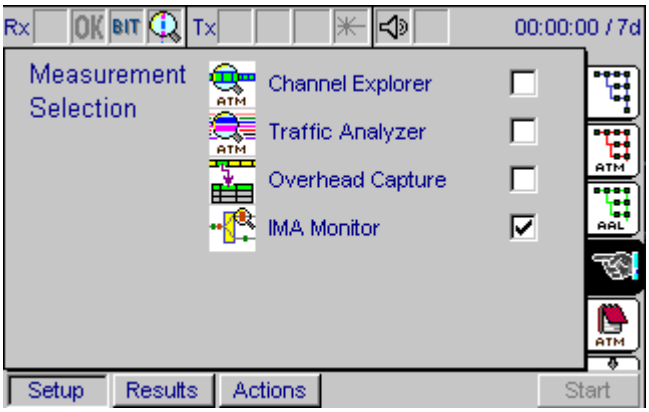
Inverse Multiplexing for ATM (IMA) is governed by the ATM Forum. IMA devices divide an aggregate stream of ATM cells across multiple cost effective T1/E1 (1 – 32) links on a cell by cell basis. The main advantages of IMA are reduction of cost, fault tolerance, traffic management and link control.



IMA defines two new types of OAM cells, the filler cells and the ICP cells. The filler cell (53 bytes) is used for rate decoupling at the IMA sublayer. The ICP cell (53 bytes) contains information about the IMA link and is available on each link belonging to the group.

6.9.1 Enabling the IMA Monitor

Select the tab to display the Measurement Selection page. Select **IMA Monitor** to enable the IMA monitor.



Note: This selection requires the “IMA Monitor” option.

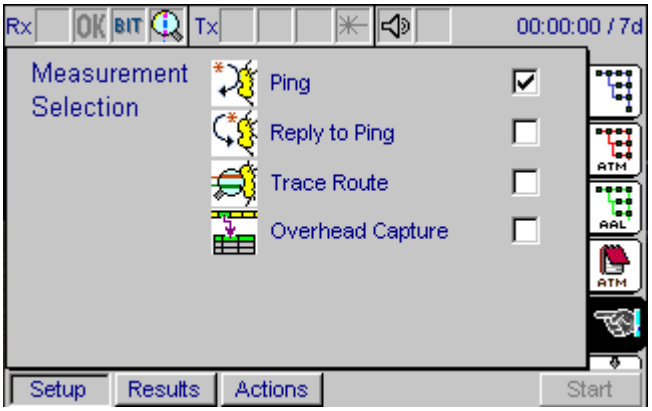
The IMA Monitor looks at the ICP cells and reports statistics in the IMA Summary and IMA Link results panes.

6.10 Ping

Note: Ping requires the “ATM Ping” option.

6.10.1 Enabling Ping

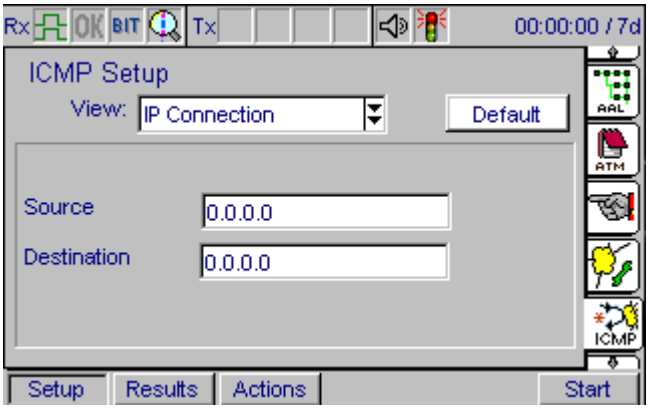
Select the tab to display the Measurement Selection page. Select **Ping** to enable Ping transmit, **Reply to Ping** to enable Ping reply, or **Trace Route** to enable trace route. These selections are only available if the AAL-5 payload is set to IP Stack.



6.10.2 ICMP Setup

Select the tab to display the ICMP Setup page.

Enter the **Source** and **Destination** addresses for the IP connection.



Additional ICMP settings must be specified, and can be found in additional menus. These additional menus can be viewed by selecting a category from the "View" drop-down menu. The following table defines which settings apply for the different applications.

	Ping	Reply to Ping	Trace Route
IP Connection			
Source Address	✓	✓	✓
Destination Address	✓	✗	✓
ICMP Data			
Data	✓	✗ ①	✓
Packet size	✓	✗ ①	✓
Ping Profile			
Mode	✓	✗	✗
Number of pings	✓	✗	✗
Pause	✓	✗	✗
IP Settings			
TTL	✓	✓	✗
TOS	✓	✗ ①	✓
Don't fragment	✓	✗ ①	✓
Limits			
Timeout	✓	✗	✓
Trace Route			
Start TTL	✗	✗	✓
Max. hops	✗	✗	✓

① The values are taken from the incoming ICMP Echo Request message.

Select **ICMP Data** from the drop-down menu. Enter the **Data** byte. This is used as payload inside the ICMP message. Enter the **Packet size**. This is the size of the ICMP message. Since ICMP uses an 8-byte header, the number of transmitted data bytes is (Packet Size – 8).

Select **Ping Profile** from the drop-down menu. Select either Multiple (number of pings) or Continuous **Mode**. If you selected Multiple, enter the **Number of pings** to be sent out, and the time to **Pause** between each message.

Select **IP Settings** from the drop-down menu. Set the time to live (**TTL**), **Type of Service**, and whether to set the **Don't Fragment** flag in the IP header.

Select **Limits** from the drop-down menu. Set the **Timeout**, in seconds. This is the amount of time to wait before timing out.

Select Trace Route from the drop-down menu. Set the **Start TTL**. This is the initial time to live used in the first outgoing packet. (This can be used to set the start offset for the Trace Route algorithm.) Enter the **max**imum number of **hops**.

6.10.3 Activating a ping test

Ping is an automatic measurement sequence. Pressing the Start Button activates the ping measurement. When running a ping test, the transmitter sends out a ping request packet to which the destination (target) responds by sending a response packet. Ping tests tell you if the destination is alive and awake, how fast the ping went to the destination and back to the receiver, and if ping packets were dropped and lost along the way.

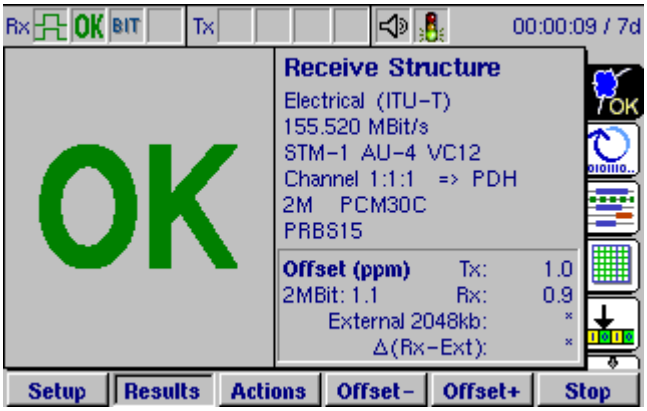
If the mode is set to continuous, ping stops either after the measurement time is reached or when the measurement is stopped manually.

6.11 ATM Results

The results screens are selected by pressing the **Results** function key.

6.11.1 Results Summary

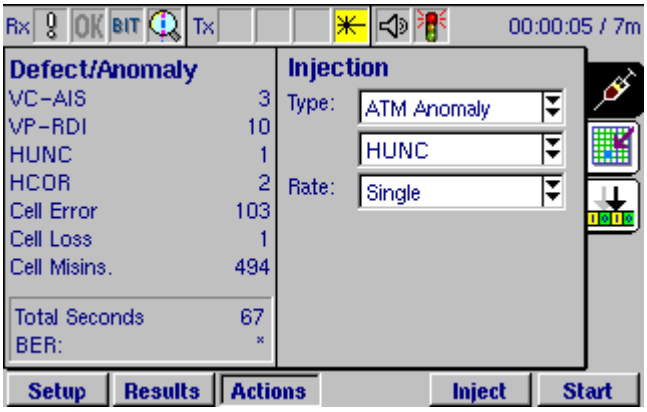
The left half of the screen displays the large OK, as long as there are no defects or anomalies recorded. If any defects or anomalies occur during a test, the large OK is replaced by a list of continually updated defects and anomalies that have been detected by the instrument during the test.



6.11.2 Injection of ATM Anomalies and Defects

Before anomalies or defects can be injected, check that the following parameters are set.

1. Ensure that **Channel A** is checked and **Traffic On** has been selected. See section 6.4.
2. Ensure that the value of the **PCR** is greater than zero. See section 6.4.3.



To inject an anomaly or defect into the Tx path, press the **Actions** firm key, and then select either **ATM Defect** allowing the injection of VC-AIS, VC-RDI, VP-AIS and VP-RDI defects. Alternatively, select **ATM Anomaly** allowing the injection of HCOR, HUNC, Cell Error and Cell Loss anomalies. If you are using AAL-2 or AAL-5, applicable anomalies can be injected.

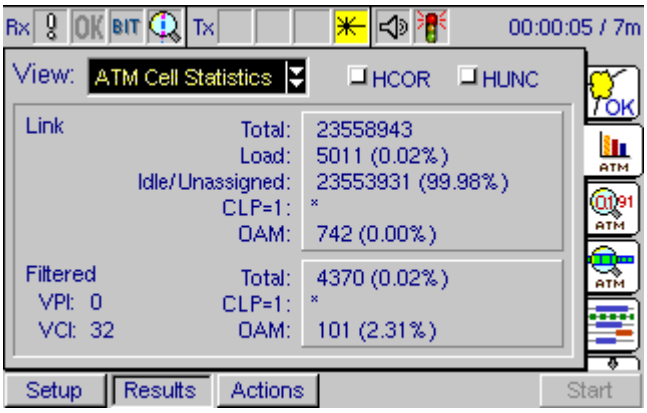
Once the parameters are set, press the **Inject** firm key. The Inject firm key will now be depressed and the injection icon, , displays an animated syringe when defects or anomalies are injected. To stop injecting, press the **Inject** firm key, the injection icon now disappears.

The **Inject** firm key appears automatically in the **Injection** page. To allow injection from any other page, users can view the **Inject** firm key by pressing the **Alt** button.

6.11.3 ATM Cell Statistics

The **ATM Cell Statistics** page displays information relating to cells received on the receiver Rx. Details of the statistics are given below and related to the associated graphic.

HCOR or **HUNC** shows if cells have been received which contain **cor**rectable or **unc**orrectable header errors.



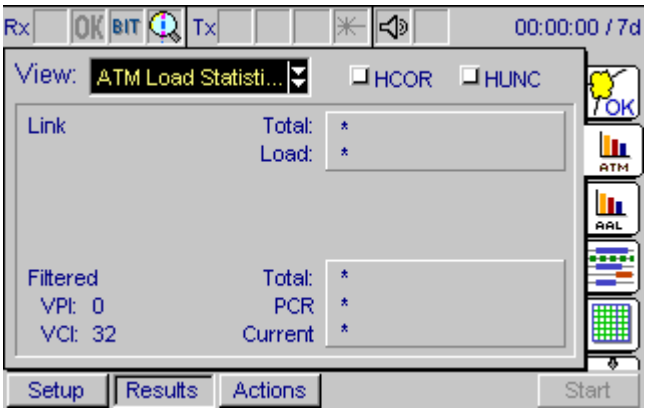
The Link

- **Total** is the number of cells received
- **Load** is the number or percentage of cells that contains user information, including OAM cells
- **Idle/Unassigned** is the number or percentage of cells received
- **CLP =1** Count of cells where CLP=1. If congestion causes a problem, the network will discard these cells first
- **OAM** is the number or percentage of cells that are used for network management purposes.

The Specific ATM Path/Channel under test

- **VPI** and **VCI** shows the path and channel of the cell under test
- **Filtered** shows the number or percentage of cells which match the selected VCI/VPI. This value is with reference to the total value.
- **CLP =1**. Count of cells where CLP=1. If congestion causes a problem, the network will discard these cells first which match the VCI/VPI
- **OAM** is the number or percentage of cells that have been used for network management purposes that match the VCI/VPI. This value is with reference to the number of filtered cells.

6.11.4 ATM Load Statistics



The **ATM Load Statistics** page displays information relating to the ATL load. Details of the statistics are given below and related to the associated graphic.

HCOR or **HUNC** shows if cells have been received which contain **cor**rectable or **unc**orrectable header errors.

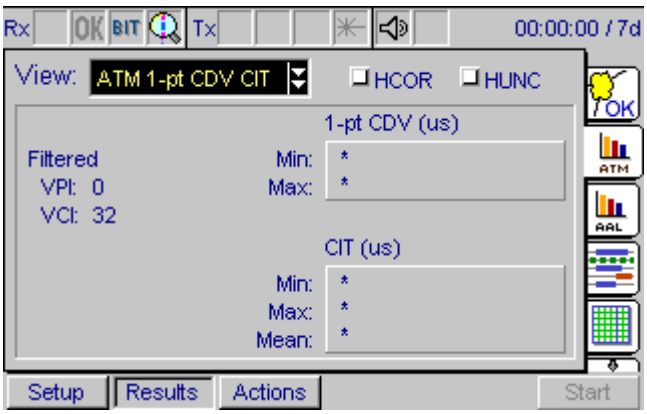
The Link

- **Total** is the number of cells received
- **Load** is the number or percentage of cells that contain user information

The Specific ATM Path/Channel under test

- **VPI** and **VCI** shows the path and channel of the cell under test
- **Total** is the number of cells received on this channel/path
- **PCR** is the peak cell rate
- **Current** is the actual, current load

6.11.5 ATM 1-pt CDV CIT



The ATM **1-pt CDV CIT** page displays information relating to the 1-point cell delay variation and the CIT (Cell Interarrival Time. The distance between two ATM cells.). For the CDV, the minimum and maximum are reported.

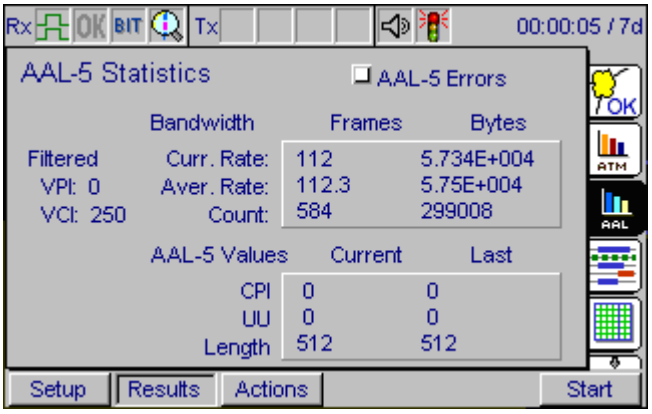
For CIT, the minimum, maximum, and mean (average) are reported.

HCOR or **HUNC** shows if cells have been received which contain **cor**rectable or **unc**orrectable header errors.

6.11.6 AAL Results

6.11.6.1 AAL-5 Statistics

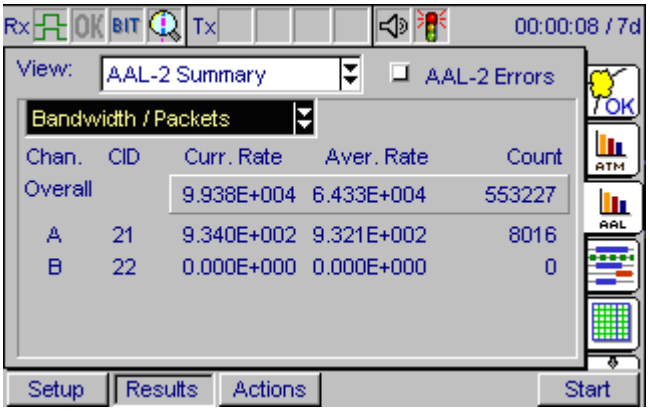
The AAL-5 statistics page reports the current (**Curr. Rate**), average (**Aver. Rate**) and **count** of Bandwidth Frames and Bytes. In addition, it reports the **current** and **last** values for the **CPI**, **UU**, and **length**.



6.11.6.2 AAL-2 Statistics

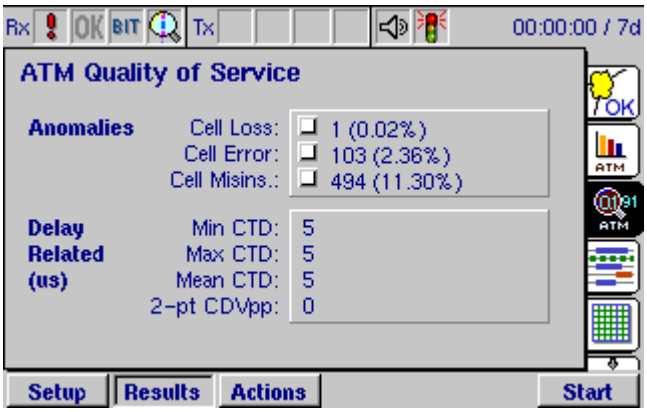
The AAL-2 Summary page reports the current (**Curr. Rate**), average (**Aver. Rate**) and **count** of Bandwidth Frames and Bytes. In addition, it reports the **current** and **last** values for the **CPI**, **UU**, and **length**.

The display can be changed from Bandwidth/Bytes to Packets.



6.11.7 ATM Quality of Service

The **ATM Quality of Service** page shows the results of the QoS test as defined in ITU-T Recommendation I.356.



Delay measurements include:

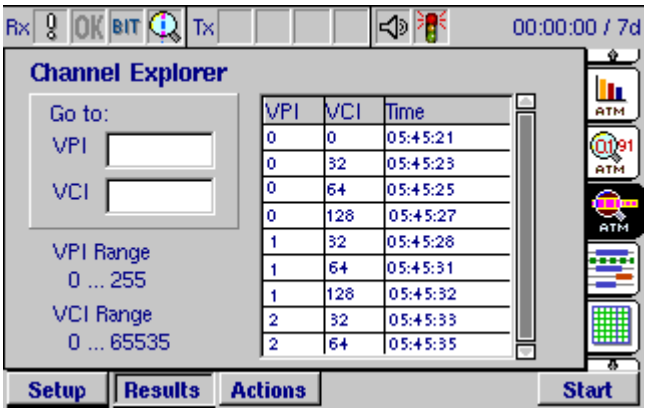
1. Cell transfer delay **CTD**, is the time between t2 and t1 of the test cell where:
   - t1 = the time the cell enters the device under test
   - t2 = the time the cell leaves the device under test
2. Cell delay variation **CDV**, is the degree of variation in the CTD of the virtual connection. By defining the QoS it is possible to offer different levels of service, for

example, by offering different guaranteed maximum cell loss rates. This gives service providers a means for structuring the changes made for the service, but also, the service provider must be able to demonstrate the QoS to ITU-T O.191.

Cells exceeding the specified maximum delay are assumed to be of significantly reduced value to the application.

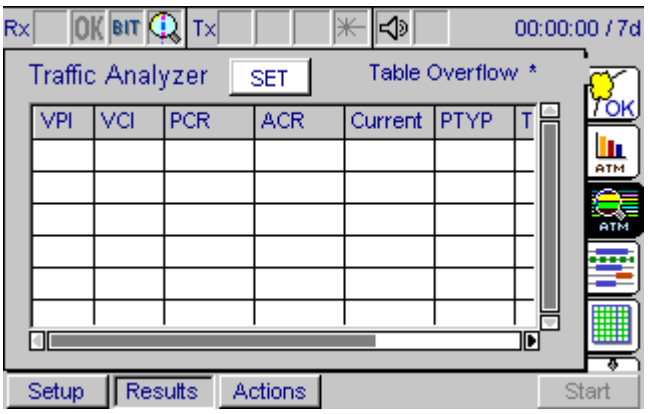
6.11.8 Viewing Results from the Channel Explorer

The Channel Explorer lists results for channels on which the ANT-5 conducts tests. You can scroll down the entire list of channels, or type channel numbers in the **VPI** and **VCI** text boxes. If you type the number of a channel that is not available, the Explorer lists the next lowest channel. The time stamp indicates the most recent time a VPI/VCI channel was detected.

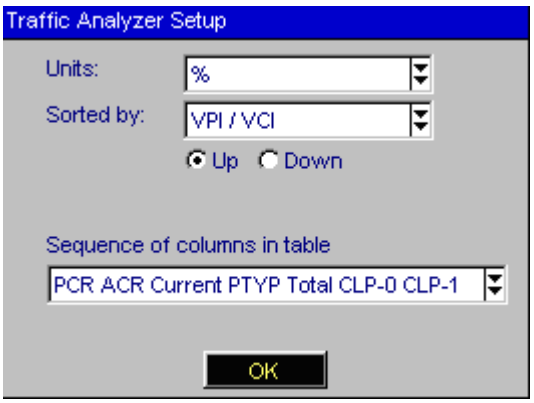


6.11.9 Viewing Results from the Traffic Analyzer

The Channel Traffic Analyzer (CTAN) lists results for channels on which the ANT-5 conducts tests. The time stamp indicates the most recent time a VPI/VCI channel was detected.



Select **SET** to specify the units of measure, sort method, and column sequence.



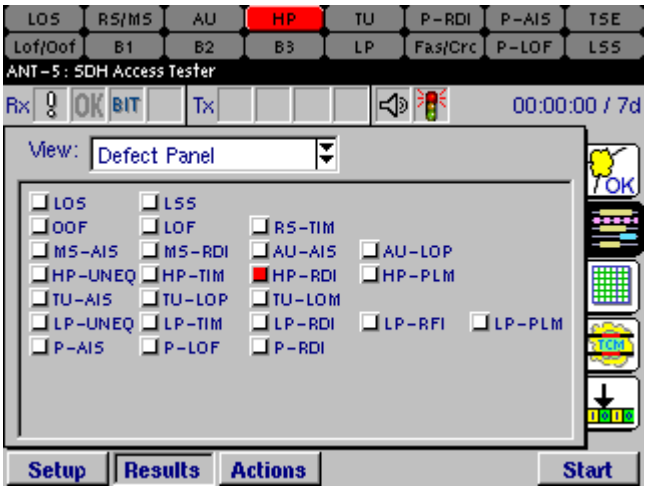
Note: For the payload type (PTYP), only AAL-5 and AAL-2 can be detected.

When the CTAN is started, it will gather the channels and analyze the traffic in real time. If the number of channels exceeds the limit of CTAN an “overflow” message will appear.

6.12 ATM anomaly and defect results

6.12.1 Defect Panel

The **Defect Panel** view lists the ATM defects, namely LCD, VC-AIS, VC-RDI, VP-AIS and VP-RDI defects. If you are using AAL-2 or AAL-5, applicable defects will also be reported here. The defect panel continually updates, displaying active events in red. The defect panel LED's turn yellow during a test to show historic alarms, that is, defects that have been raised during a test but are not currently active. To reset the LEDS press **Alt** and **Menu** and select **System** >**LEDs** >**Reset LEDs**.

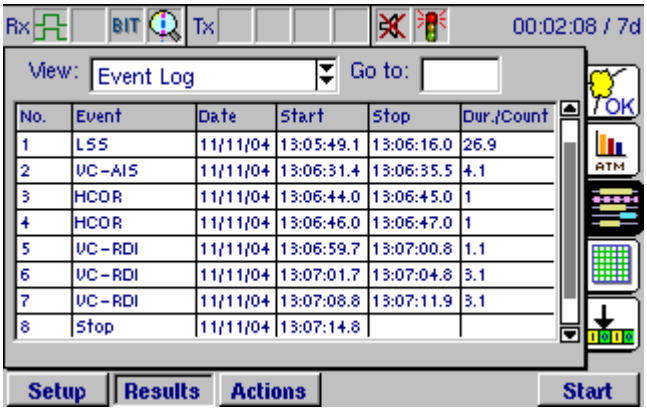


Note 1: PLM, UNEQ and TIM alarms are associated with G.832 framing in PDH E3 or E4 mode. If these alarms are generated the **HP** soft led situated at the top of the screen will light up.

Note 2: The CTM (Cell Type Mismatch) LED indicates whether the OAM type received matches the type specified in the receiver setup.

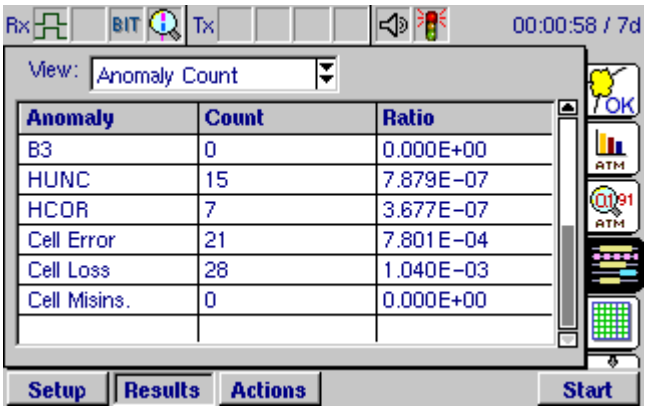
6.12.2 Event Log

The **Event Log** view lists ATM events in time order as they occur during a test, including start-time, stop-time and duration of the defect or total anomalies per second. If you are using AAL-2 or AAL-5, applicable events will also be reported here.



6.12.3 Anomaly count

The **Anomaly Count** view lists the ATM anomalies in hierarchical order which are relevant to the current test. The number of anomalies occurring during a test are counted for each anomaly type, and the ratio of each anomaly within the elapsed period of test is displayed. If you are using AAL-2 or AAL-5, applicable anomalies will also be reported here.

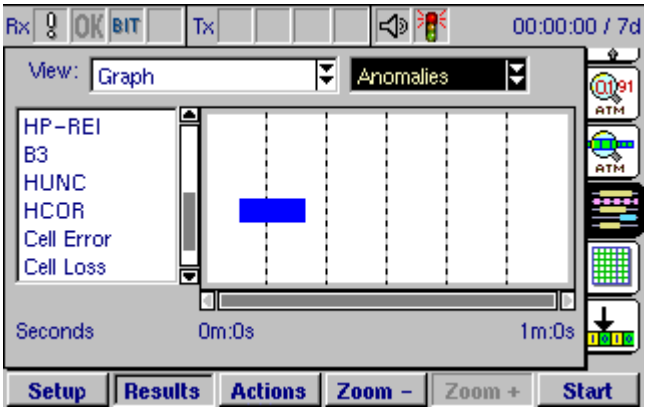


6.12.4 Graphs

The **Graph** view displays a graphical timeline representation of ATM anomalies or defects that have been detected during the test. The bar displayed indicates that an event was detected during the time interval. If you are using AAL-2 or AAL-5, applicable anomalies or defects will also be reported here.

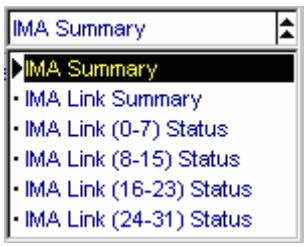
The list of anomalies or defects is shown on the left of the chart and can also be scrolled vertically if required.

Refer to section 4.4.4.4, ***Graphs***, for an example on how to use the detailed zoom feature. The benefit of the zoomed feature is it allows time to be shown in different units for maximum effect.



6.13 IMA Results

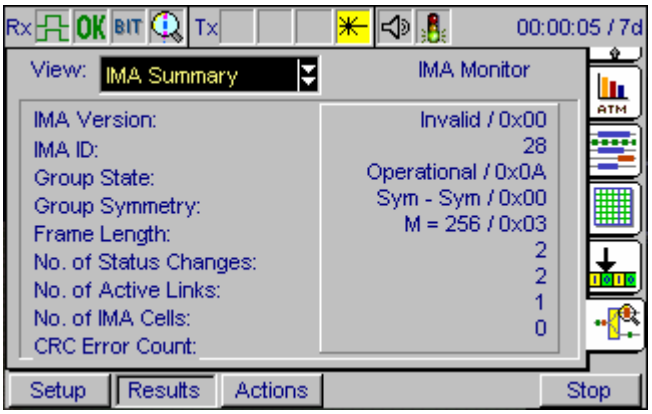
The IMA results are divided into two main categories: **Summary** and **Link Status**. For Link Status, there are two types: **Link Summary** and **Link Status** for a group of 8 links.



6.13.1 IMA Summary Results

The **IMA Summary** view lists the IMA results which are relevant to the current test.

During the test, the result will turn white if there is a change in status.

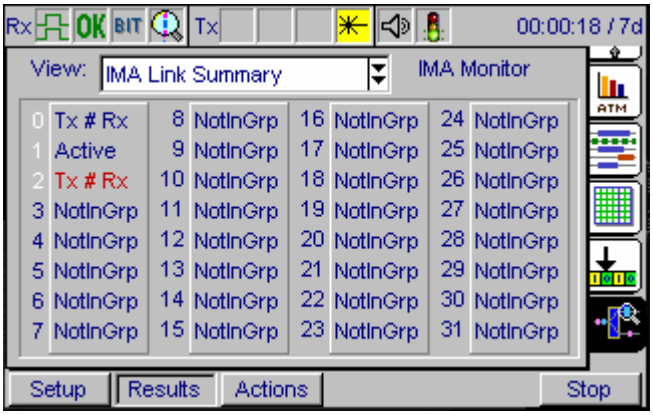


6.13.2 IMA Link Summary

The **IMA Link Summary** view lists the IMA status for all of the 32 links.

During the test, the channel number or link status will turn white if there is a change in status. In this example, link 0, 1, and 2 are active; all other channels are “Not in Group,” meaning not active.

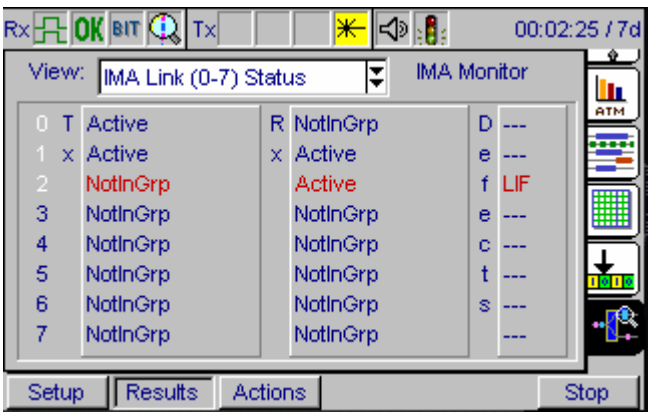
Red indicates there was a defect during the measurement. On link 2, there is an actual defect at the moment. White indicates there was a status change on this link during the measurement, meaning it is different from the sample captured at the start of measurement. “Tx # Rx” indicates that the transmit and receive status are not the same. To view more detail, select **IMA Link (0-7) Status**.



6.13.3 IMA Link Status

The **IMA Link Status** view lists the IMA status, in detail, for 8 links. The numbers in parenthesis identify which links are listed.

The TX state, RX state, and any defects are listed.



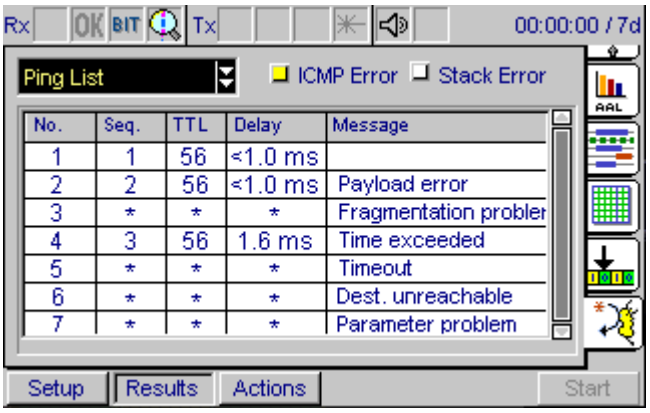
6.14 Ping Results

6.14.1 Ping List

The **Ping List** view lists all of the ping events.

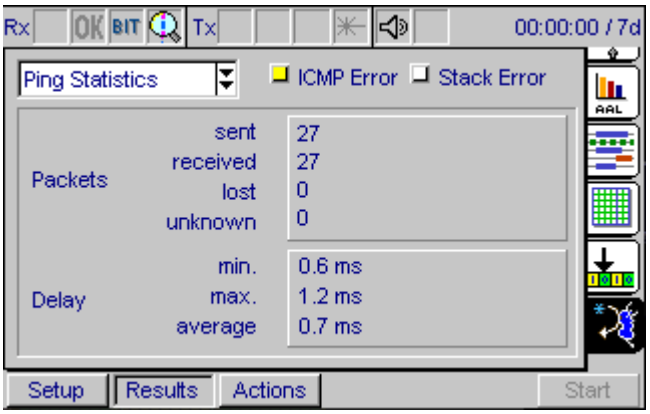
The “Message” column is used to give a little bit more information what happened. Internal states and the ICMP type and code field are taken to generate this message.

The capacity of the ping list is limited to 270 entries. If the limit is reached, a “List overflow” message is displayed.



6.14.2 Ping Statistics

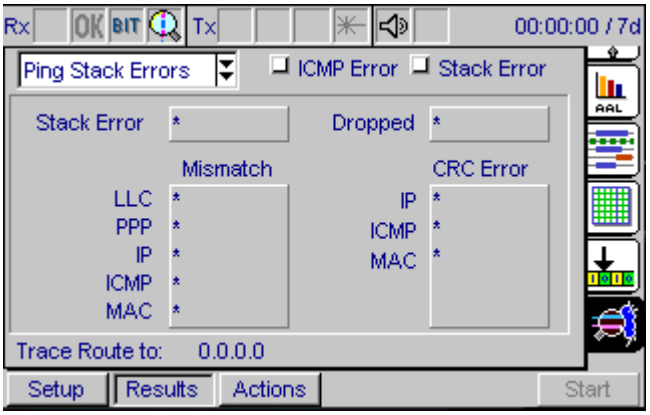
The **Ping Statistics** view lists the number of ping packets sent, received, lost, and number of unknown packets. It also lists the max, min, and average delay.



6.14.3 Ping Stack Errors

The **Ping Stack Errors** view lists any errors that caused a problem in the stack.

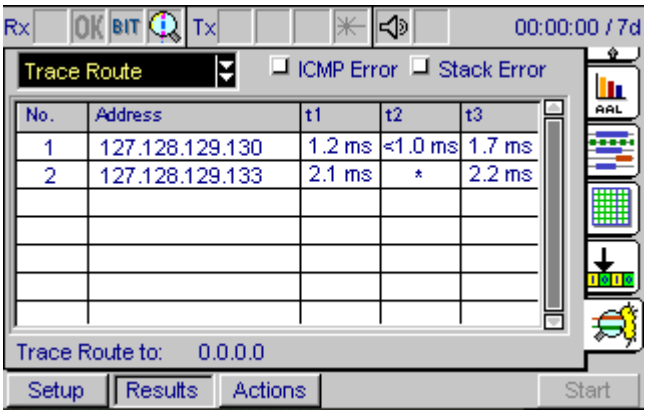
If the “ICMP Error” or “Stack Error” is illuminated this page can give helpful additional information to see what went wrong.



6.14.4 Trace Route Results

The **Trace Route** view lists all of the hops found in the trace.

The capacity of the Trace Route list is limited to 90 entries. If the limit is reached a “List overflow” message is displayed.



6.15 ATM LED Indicators

The sixteen on-screen LEDS relevant to ATM testing are arranged as shown below:

LOS	Loss of Signal
RS/MS	Regen / Multiplex Sections
AU	Administrative Unit
HP	High Order Path
TU	Tributary Unit
P-RDI	Path Remote Defect Ind.
P-AIS	Path AIS
TSE	Test Sequence Err. (Bit Err.)

Lof/Oof	Loss of Frame
Bx	Section or path error monitor
Fas/Crc	FAS / CRC Error
LP	Low Order Path
ATM VP	Virtual Path alarm
ATM VC	Virtual Channel alarm
LCD	Loss of Cell Delineation
LSS	Loss of Sequence Sync.

6.16 Further reading

A useful resource is JDSU’s ATM Pocket Guide. (Literature order number: TP/EN/PG04/0400/AE Repl. 1020.) This guide introduces the basics of ATM and gives some details on various measurement methods.

7. Troubleshooting

7.1 Self-test failure

When the ANT-5 is switched on, it automatically runs a self-test sequence which runs from left to right across the screen and indicates the progress through the test. If the progress bar stalls at any point please refer to Section 8, ***Customer support***, and contact the nearest JDSU Sales Office or Technical Assistance Centre.

Note: When the battery charge is very low, it may be possible for the ANT-5 to switch on but fail to complete its self-test procedure before automatically switching off due to the low battery. This is not a self-test failure and can be corrected by charging the battery.

7.2 No screen image

If the screen shows no image and no backlight, it may have turned itself off in order to save battery power. If this is the case the screen LED (⊠) should be on to indicate that the screen has been blanked. The full screen display can be restored by pressing any key. See Section 2.13, ***Power saving features***.

If the screen shows no image with the backlight on, it is possible that the LCD contrast needs adjustment. See Section 2.6.1, ***Adjusting the screen contrast***.

7.3 No beep when the storage card is inserted

If the ANT-5 does not beep when a storage card is inserted, then the following should be checked:

- The card is firmly inserted and correctly seated in the slot.
- If a CompactFlash card has been used, ensure that it has been formatted with an MS-DOS compatible file system. If the card can be read normally by a PC with a suitable slot, then it is possible that there is a problem with the ANT-5. See Section 3.2.6.

If the failure continues please refer to Section 8, ***Customer support***, and contact the nearest JDSU Sales Office or Technical Assistance Centre.

If it is necessary to send the ANT-5 for repair, the storage card should be included if possible.

7.4 Screen dump fails

If a screen dump fails to be saved in a file or sent to the serial port, the **Screen Dump** feature may have been set to **DISABLED** in the **Printer** section of the **System** menu. The settings used for the other parameters in the **Printer** and **Serial Port** sections should also be checked.

7.5 Errors caused by poor optical connections

Unexplained errors may be caused by poorly aligned or dirty optical connectors. If this problem is suspected, remake the optical connections as follows:

WARNING: Invisible laser radiation.

Note: Read the safety information in Section 1.5.3, ***Laser safety***, before proceeding.

1. Deactivate the ANT-5 laser source (Tx), by clearing the **Laser On** checkbox in the **Interface Setup Tx** panel. See Section 4.3.1.2 for further details.
2. Deactivate the incoming laser source connected to the Rx connector of the ANT-5.
3. Unscrew each patch lead and lift it away to break the connection.
4. Clean the ANT-5 connectors and patch lead connectors by an approved method such as those outlined in Section 1.5.4, Cleaning optical connectors.
5. Holding the ANT-5 in a vertical position with the rear connectors facing upwards, carefully locate and screw on the patch lead connectors making sure that each locating lug is in the correct position and the patch lead is held straight.
4. Re-activate the laser sources after both patch leads have been reconnected.

7.6 Battery performance and conditioning

If the ANT-5 battery is put through a large number of incomplete cycles of charging and discharging, the process of monitoring the charge level will gradually become less certain. The **Battery Level** indicator will warn of this situation by displaying the message 'Reading may be inaccurate'. If this occurs, the battery conditioning procedure described below should be followed to re-establish the upper and lower limits for the charge indicator.

7.6.1 Battery conditioning

The battery can be conditioned by performing two full discharge/recharge cycles as follows:

1. Disable the timed **Auto Power-off** feature in the **Power Saving** section of the **Preferences** menu.
2. Discharge the battery by leaving the ANT-5 switched on with the external power supply disconnected. The ANT-5 will switch itself off when the battery is fully discharged.
3. Reconnect the external power supply and check that the battery LED ▭ is lit.
4. Leave the ANT-5 switched off whilst the battery is charging. An adequate charge will be reached within 3 hours and the ANT-5 will automatically switch to a trickle charge mode when fully charged.
5. Repeat actions 2, 3 and 4 for a second discharge/recharge cycle.
6. Re-enable the timed **Auto Power-off** feature if required.

7.6.2 Replacing the ANT-5 battery pack

If the rechargeable battery pack develops a fault it can be replaced locally in an appropriately equipped workshop where protection can be provided from contamination and static discharge. Replacement battery packs can be obtained from your nearest JDSU Sales Office or Technical Assistance Centre.

The battery pack can be replaced as follows:

WARNING: Static Sensitive.

Note: Replacing the ANT-5 battery pack may unavoidably cause the setup information under the **System** and **Preferences** menus to return to their default settings. However, data can be retained if an external power supply is connected.

1. Switch off the ANT-5 and disconnect all connections and the external mains power supply.
2. Invert the ANT-5 so that the underside is uppermost and the front bumper is closest to you. Take care to protect the screen and keyboard if the ANT-5 is placed on a hard surface.
3. The battery compartment is located underneath the ANT-5, just behind the front bumper. Access is provided by two screws at the rear edge of the battery compartment cover.
4. Remove the two screws and open the cover to reveal the battery pack. **Do not remove any other screws**.
5. Carefully lift out the battery pack and disconnect the battery cable at the plastic connector where it emerges from inside the ANT-5.
6. Plug in the replacement battery pack and place it in the battery compartment.
7. Refit the battery compartment cover.
8. The battery pack should now be charged and conditioned as described in Section 7.6.1, ***Battery conditioning***. This procedure will establish the initial conditions for the battery charge indicator.

7.7 Accessing test results if the unit has been powered down

The ANT-5 will not switch itself off if a test is running. However, if the unit is accidentally switched off, or there is no power left in the battery, results will be saved in the **user:** device of the File Manager. These will be saved as **AUTO** files, with suffixes of .A5R; the time and date will also be present so that the results are easily identified.

8. Customer support

8.1 Questions about JDSU products

Any questions regarding the installation, operation, maintenance or repair of any product in the JDSU product range should be addressed to the nearest JDSU Sales Office or Technical Assistance Centre. For locality information visit our web site, **www.jdsu.com**, or contact the nearest Regional Sales Office as listed on the back of the manual.

8.2 Customer Services

Global Services and Solutions markets a broad portfolio of services including consultancy and training, enabling customers to aggressively build their competitive advantage within the markets they serve. Information can be found on our web site under Services or by contacting the nearest JDSU Sales Office.

8.3 Service procedure

If it is necessary to send the instrument for maintenance or repair, please contact the nearest JDSU Sales Office or Technical Assistance Centre as above.

To assist our service engineers in responding to your enquiry, the fault which occurred should be fully described and a note made of the circumstances at the time and any error messages seen. The version information listed in Section 8.4 should also be included where possible.

If possible, the original packing should be used for returning the instrument, otherwise suitable packaging should be used to avoid damage in transit. Insurance against loss or damage in transit is also recommended.

8.4 Version information and serial numbers

The version information and serial numbers of the instrument and application software can be obtained as follows:

- The serial number of the instrument, located on its underside.
- The hardware/software version information and electronic identity numbers can be displayed by pressing the **Alt+Menu** key, then selecting **About** from the **Help** menu.
- The version information for the SDH Access Tester application can be displayed by pressing the  key from within the application. Press the **Enter** or **Esc** keys to remove the **About** screen and, if you do not want to remain in the application, press **Alt+Esc** to switch to the application launcher.

- The options currently installed can be displayed by pressing **Menu** and selecting **Options** from the **Tools** menu. This function can also be used to install and uninstall software options, which is generally carried out at a JDSU Sales Office, or Technical Assistance Centre.

If required, the **About** screens can be saved in a file or sent to a printer on the serial port by pressing **Alt+#**. See Section 2.7, ***Printing the current screen***.

8.5 Software loading

The ANT-5 is designed to provide an easy path for future upgrades and enhancements, not only in the form of software applications, but also by replacing the core software for the ANT-5 itself.

Software will usually be supplied on a CD ROM, although other formats may also be employed in the future. To load any software into the ANT-5, refer to the instructions supplied with the software media.

8.5.1 Deleting software applications

WARNING: Do not do this unless you intend to delete an application.

Software applications can be deleted by highlighting the appropriate icon in the application launcher screen and pressing **Alt+Del** (press **Del** whilst holding the **Alt** key down). Next time the ANT-5 is switched on it will run a purging routine to reclaim the memory which has been made available.

9. Appendix A – Specifications and ordering information

Note: These specifications are valid under the nominal operating conditions, unless otherwise stated. Error limits are stated as operating errors or as intrinsic errors and variations, these terms being as defined in IEC 359.

9.1 General

Serial port	9-way, male, D-type connector
CompactFlash card slot	Single, standard CompactFlash Card
Supported CompactFlash cards	Types I & II
Dimensions (L×W×H)	approx. 275 mm × 197 mm × 76 mm (10.95" × 7.9" × 3")
Weight	approx. 2.2 kg (4.85 lb)

9.2 External Power Supply

Type	PPS-2
Input	100-240 V, 1.6A, 47/63 Hz, AC
Output	19 V, 3 A, DC

Note: The PPS external power supply is supplied with an integral DC cable and a separate AC mains cable. The country of use must be specified when ordering the mains cable so that the correct plug is supplied.

9.3 Environment

Storage temperature	-20°C to +60°C (-4°F to +140°F)
Battery charging temperature	+5°C to +30°C (41°F to +86°F)
Operating temperature	+5°C to +45°C (41°F to +113°F)
Condensation	Occasional short-term condensation is allowed but performance is not guaranteed
Humidity	Continuous operation in hot, humid climates is not guaranteed

9.4 Electrical and Mechanical

9.4.1 G.703 Transmitters

Interface		ITU-T G.703
Connectors and Impedance	BNC (unbalanced)	75Ω
	RJ-48 (2048 kbit/s balanced)	120Ω
Bit rate		2048, 34368, 44736, 51840, 139264, 155520 kbit/s
Line code		CMI, B3ZS, HDB3, AMI
Clock source	SDH hierarchy	Internal, From Rx, Ext. Data 2048 kbit/s, Ext. Clock 2 MHz, Ext. Data 1544 kbit/s, Ext. Clock 1.5 MHz
	PDH hierarchy	Internal, From Rx, Ext. Data 2048 kbit/s, Ext. Clock 2 MHz, Ext. Data 1544 kbit/s, Ext. Clock 1.5 MHz
Isolation, BNC and RJ-48		for connection to SELV circuits only

9.4.2 G.703 Receivers

Interface		ITU-T G.703
Connectors and Impedance	BNC (unbalanced)	75Ω
	RJ-48 (2048 kbit/s balanced)	120Ω
Bit rate		2048, 34368, 44736, 51840, 139264, 155520 kbit/s
Jitter performance		To ITU-T G.823 G.824 for DS3, G.825 for SDH
Line code		CMI, B3ZS, HDB3
Isolation, BNC and RJ-48		for connection to SELV circuits only

9.4.3 Protected Monitor Point

PMP -20 dB to -26 dB linear attenuation to ITU-T G.772. ANT-5 is fully compliant with ITU-T G.772, sections 2.2 and 3.2 (PMP incorporated in transmission equipment).

Compliance with sec 2.3 and 3.3 (PMP between transmission equipment) is achieved subject to the following conditions:

Bit errors may be encountered when √f and jitter are both at their maximum permitted values. In addition the following precautions should be taken:

The ANT-5 should be allowed to stabilise to an ambient temperature for a period of 5 minutes before any measurements are taken.

For E3, root-f between 0 ≤ attenuation ≤ 6 dB (max) is permitted.

Performance at E1, E3 and DS3 extends to –26 dB (linear attenuation) for full compatibility with older types of transmission equipment.

9.4.4 G.957 Optical Transmitter and Receiver

The following only applies if optical interfaces are fitted:

Connector	FC/PC
Line code	scrambled NRZ
Transmitter wavelengths	1310 nm and/or 1550 nm (Depending on optical option fitted)
Line bit rates	155.52 Mbit/s 622.080 Mbit/s 2488.32 Mbit/s (Depending on optical option fitted)
Receiver wavelength range	1100 nm to 1580 nm

9.4.5 Optical Output and Input levels

Optical transmitter specifications:

Optical Option	Line rate	Wavelength	Tx Output power @ 1310nm	Tx Output power @ 1550nm
BN4565/00.01	STM1	1310SR	-8dBm to -15dBm	
BN4565/00.03	STM1	1310SR/1550LR	-8dBm to -15dBm	+2dBm to -4dBm
BN4565/91.13	STM1/4	1310SR	-8dBm to -15dBm	
BN4565/00.14	STM1/4	1310SR/1550LR	-8dBm to -15dBm	+2dBm to -4dBm
BN4565/91.15	STM1/4	1310LR/1550LR	+2dBm to -4dBm	+2dBm to -4dBm
BN4565/91.16	STM1/4/16	1310LR/1550 LR	+3dBm to -3dBm	+3dBm to -3dBm

Optical receiver specifications:

Optical Option	Line rate	Wavelength	Rx Dynamic range @ 1100 to 1600nm	Rx Optical overload
BN4565/00.01	STM1	1310SR	-8dBm to -28dBm	N/A
BN4565/00.03	STM1	1310SR/1550LR	-8dBm to -28dBm	N/A
BN4565/91.13	STM1/4	1310SR	-8dBm to -28dBm	N/A
BN4565/00.14	STM1/4	1310SR/1550LR	-8dBm to -28dBm	N/A
BN4565/91.15	STM1/4	1310LR/1550LR	-8dBm to -28dBm	N/A
BN4565/91.16	STM1/4/16[1]	1310LR/1550 LR	-8dBm to -28dBm	-6dBm

9.4.6 ECL NRZ monitor specifications

Connector	SMA, unbalanced (coaxial)
Impedance	AC Coupling, 50Ω
Line code	NRZ (scrambled)
Bit rate	155.52 Mbit/s, 622.08 Mbit/s, 2488.32 Mbit/s
Input voltage range (peak to peak)	200 mV to 1 V

9.4.7 PDH T1 Interface

Connector	Bantam, balanced
Input impedance	100 Ω
Bit rate	1.544 Mbps
Line codes	AMI, B8ZS

9.4.8 External Clock

Connector	BNC (unbalanced) 75Ω
Input	External Data 1544 kbit/s, External Clock 1.5 MHz
	External Data 2048 kbit/s, External Clock 2 MHz

[1] PMax for receivers on STM16 units is -6dBm.

9.5 Specification and features of the SDH Access Tester application

9.5.1 SDH STM-1 Mappings – base software

Containers	C-12, C-11, C-3, C-4
Administrative Units	AU-4

9.5.2 Timers

Manual	User start / stop
Timed	User start, stop after pre-defined duration
Automatic	Start at pre-defined time, Stop after pre-defined duration

9.5.3 Storage

Measurement results and instrument configuration can be stored in non-volatile memory or on the storage card. The amount of storage depends on the size of card used. Results can also be sent to a printer or exported to a PC.

9.5.4 Test Patterns

Test patterns may be executed on any of the provided bit rates either directly at the SDH interface or within the STM-n substructure. ITU-T & Non ITU-T.

PRBS	2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23}-1, 2^{31}-1
Inverted PRBS (IPRBS)	2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23}-1, 2^{31}-1

QRSS20

Programmable 16-bit digital word

Traffic (Rx only)

The Traffic pattern should be selected if the incoming signal is expected to contain network traffic. Selecting this option effectively disables the pattern detection process and the reporting of LSS defects.

9.5.5 Defects and Anomalies Monitoring

All anomalies and defects for STM-n, E4, DS3, E3 and E1

For 2048 kbit/s, PCM30, PCM30C, PCM31 and PCM31C framing supported

9.5.6 Defects and Anomalies Injection

All defects and anomalies may be injected

Single, Rate or Continuous injection

LEDs and beeper for audible/visual notification

9.5.7 Overhead Analysis and Injection

The following bytes within SOH and POH may be analysed and injected:

C2, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, E1, E2, F1, F2, F3, G1, J0, J1, J2, K1, K2, K3, K4, M1, N1, N2, S1, V5, Z1, Z2.

The following bytes within SOH and POH may be analysed but NOT injected:

A1, A2, B1, B2, B3, H1, H2, H3, H4, Y.

9.5.8 Performance Analysis

PDH Rates	G.821, G.826, M.2100
SDH STM-n	G.826, G.828, G.829, M.2100, M.2101
SONET	ANSI

9.6 Optional Accessories

The range of optional accessories available for the ANT-5 includes a shoulder bag, neck strap and hard carrying cases. Please contact the nearest JDSU Sales Office or Technical Assistance Centre for the latest information. For locality information visit our web site, **www.jdsu.com**, or contact the nearest Regional Sales Office as listed on the back of the manual.

9.6.1 Hardware options and order numbers

Option		Order Number
STM-1	1310 SR	4565/00.01
STM-1	1310 SR/1550 LR	4565/00.03
STM-1/-4	1310 SR	4565/91.13
STM-1/-4	1310 SR/1550 LR	4565/00.14
STM-1/-4	1310 LR/1550 LR	4565/91.15
STM-1/-4/-16	1310 LR/1550 LR	4565/91.16

9.6.2 Cables

Balanced E1 Cable RJ-48 / 2xCF	K1597

For the serial port, a serial printer cable (K1524), modem cable (K1550) and null modem cable (K1619) are available. See ***Appendix C – Serial port and adapter cables***.

9.6.3 CompactFlash Cards

Optional CompactFlash card 16 Mbyte + adapter	BN 4548/00.42

9.7 Ordering information

Please contact the nearest JDSU Sales Office or Technical Assistance Centre. For locality information visit our web site, **www.jdsu.com**, or contact the nearest Regional Sales Office as listed on the back of the manual.

9.8 Upgrade information

To receive information on available upgrades, contact the nearest JDSU Sales Office or Technical Assistance Centre. For locality information visit our web site, **www.jdsu.com**, or contact the nearest Regional Sales Office as listed on the back of the manual.

Note: When purchasing further items to expand existing hardware and software, some identification details may be required. Refer to Section 8.4, ***Version information and serial numbers***, for further information.

10. Appendix B – Standards Compliance

10.1 Electromagnetic Compatibility

This instrument meets the following standards for electromagnetic compatibility:

- EN 61326: 1997 - Electrical Equipment for Measurement, Control, and Laboratory Use—EMC Requirements:
  - EN 61000-3-2: 1995 — Harmonic Current Emissions
  - EN 61000-3-3: 1994 — Voltage Fluctuations/Flicker
  - EN 61000-4-2: 1995 — Electrostatic Discharge Immunity
  - EN 61000-4-3: 1995 and ENV 50204: 1996 — Radiated Electromagnetic Field Immunity
  - EN 61000-4-4: 1995 — Electrical Fast Transient/Burst Immunity
  - EN 61000-4-5: 1995 — Surge Immunity
  - EN 61000-4-6: 1996 — Conducted Radio-Frequency Immunity
  - EN 61000-4-11: 1994 — Voltage Dips and Interruptions
- EN 55022 (CISPR 22): 1994 with Amendments Al and A2 — Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment:
  - EN 55022 (CISPR 22): 1994 — Radiated Emissions -Class B
  - EN 55022 (CISPR 22): 1994 — Conducted Emissions -Class B
- Title 47 of the CFR, Part 15, Subpart B for a Class B Digital Device:
  - Section 15.107 (a) — Conducted Emissions
  - Section 15.109(a) — Radiated Emissions
- ICES-003 Issue 3 Interference Causing Equipment Standard for Digital Apparatus:
  - From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, “Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003” (EMCAB-3, Issue 2, July 1995): “At present, FCC and ICES technical requirements are essentially equivalent. Therefore, if you have FCC approval (either by meeting Part 15 of the FCC Rules or CISPR Publication 22), the only additional requirements are: to attach a note to the report of the test results for FCC compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003.”

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

10.2 Safety

The instrument complies with the safety objective of:

- UL 60950, 3rd Edition – Safety of Information Technology Equipment
- CSA C22.2 No. 60950, 3rd Edition – Safety of Information Technology Equipment
- EN 60950, 2000 – Safety of Information Technology Equipment, including Electrical Business Equipment

IEC 60950, 2nd and/or 3rd Edition – Safety of Information Technology Equipment, including Electrical Business Equipment

The following only applies if optical interfaces are fitted:

WARNING: Class 1 Laser Product.

10.3 R&TTE Directive

Hereby JDSU declares that this SDH Tester is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

10.4 EC Declaration of Conformity

ACTERNA

CE

EC Declaration of Conformity

Type of instrument: ANT-5 Order number **BN:4565/50**

Including Modules and Options as follows:

Name	BN	Name	BN
STM-1 1310nm	4565/00.01	STM1/4 1310/1550nm	4565/00.14
STM-1 1310/1550nm	4565/00.03	STM1/4 1310/1550nm LR	4565/91.15
STM-1/4 1310nm	4565/91.13	STM1/4/16 1310/1550nm	4565/91.16

Manufactured for Acterna, ul. Malinowska 28, 83-100 Tczew, Poland

EU Address: Acterna Portland House, Aldermaston Park, Aldermaston, Berkshire, RG7 4HR United Kingdom

Samples of this instrument type have been tested and have been found to conform with the *Council Directive dated 3rd May 1989 on the approximation of the laws of the Member States relating to* ***electromagnetic compatibility*** *(89/336/EEC), modified by the Council Directive on 28th April 1992 (92/31/EEC) and on 22nd July 1993 (93/68/EEC)* using the following standard:

EN 61326-1:1998 Electrical equipment for measurement, control and laboratory use – EMC requirements

In addition the instruments comply with the safety objective of the *Council Directive dated 19th February 1973 on the approximation of the laws of the Member States concerning* ***electrical operating equipment for use within certain voltage limits*** *(low voltage directive) (73/23/EEC), amended by the Council Directive dated 22nd July 1993 (93/68/EEC).*

To test the compliance the following standards were used

EN 60950, 2000 Safety of Information Technology Equipment, including Electrical Business Equipment

Instruments of this type comply with all the requirements for affixing the

CE-Mark

The mark was first applied to this instrument in 2000

This EC Declaration of conformity is prepared in accordance with and for the sole purpose of the Manufacturer's declaration requirements of the above-mentioned Council Directives. The signatory is empowered to sign for the manufacturer or his authorized representative.

Date **07 November 2003**

Signature

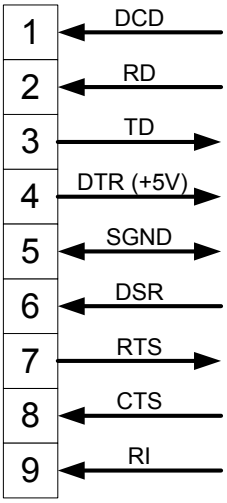
Steve Bryant
Director of Quality & Reliability

11. Appendix C – Serial port and adapter cables

11.1 Serial port

The ANT-5 serial port is 9-way, male, D-type connector which is wired as a DTE.

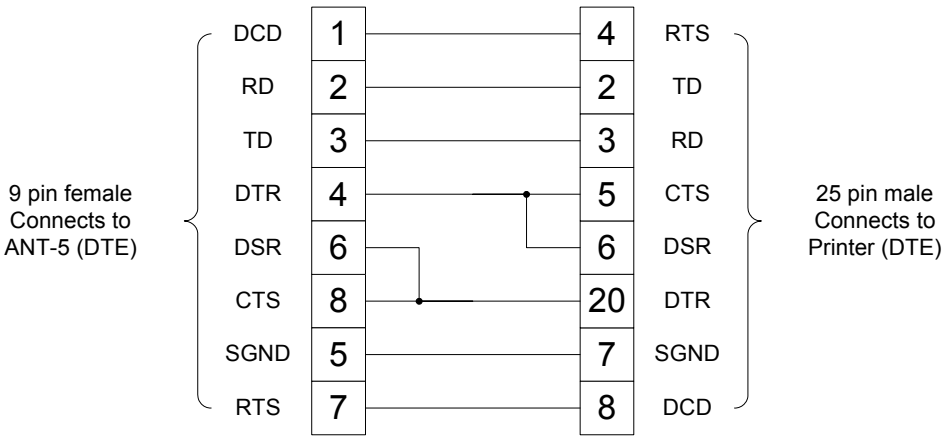
Serial port connections (DTE)



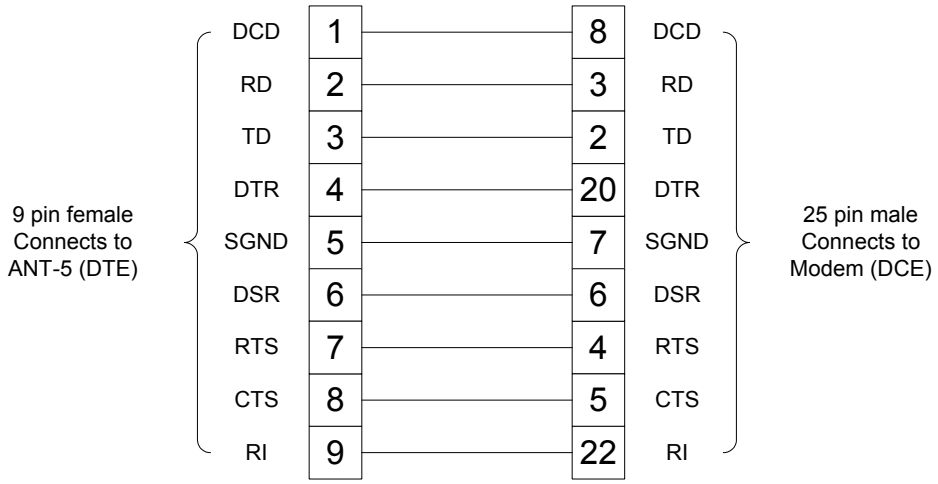
11.2 Serial adapter cables

A serial printer cable (K1524), modem cable (K1550) and a null modem cable (K1619) are available as shown below.

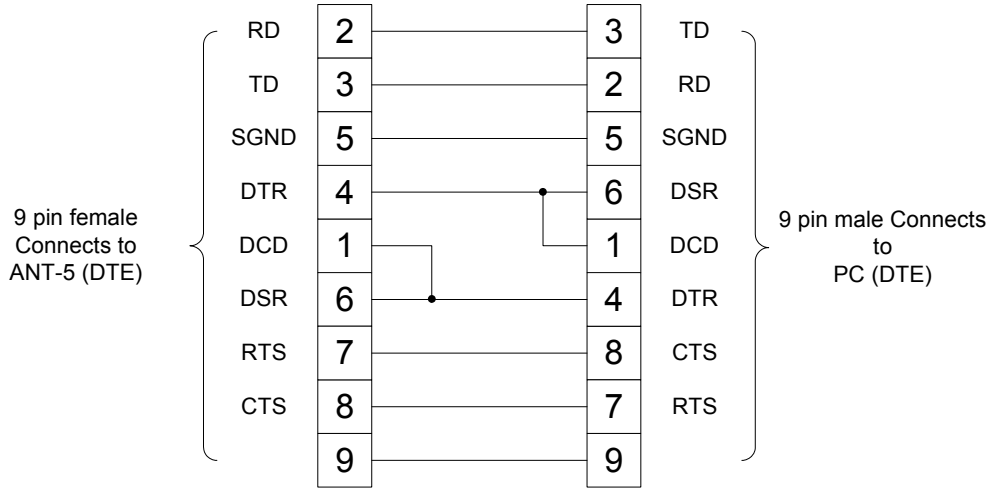
Printer cable K1524



Modem cable K1550



Null modem cable K1619



11.3 Serial-to-parallel adapter cable

A serial-to-parallel printer cable, K1589, is available to convert the serial output from the ANT-5 for use with parallel printers. It comes with a 9-way to 25-way adapter. It is advisable to connect the printer cable to the ANT-5 before switching the unit on.

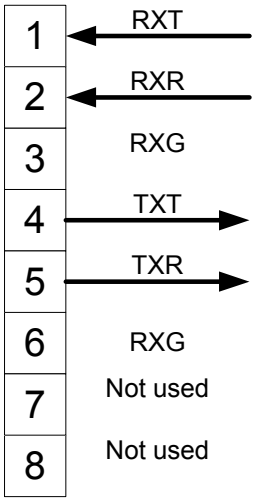
This cable has a number of internal jumper settings which must be configured by the user prior to use. These settings must match the settings in the **Serial Port** section of the **System** menu. The jumpers are accessible by removing the four securing screws in the headshell; further details are supplied with the cable. K1589 has been tested with the HP DeskJet 320 printer in the following configuration:

Baud Rate	19200	Parity	NONE	Stop Bits	ONE
Word Length	8 BITS	Flow Control	SOFT		

Note: Cable K1589 is classified as Limit A according to EN55022.

11.4 RJ-48 Connector

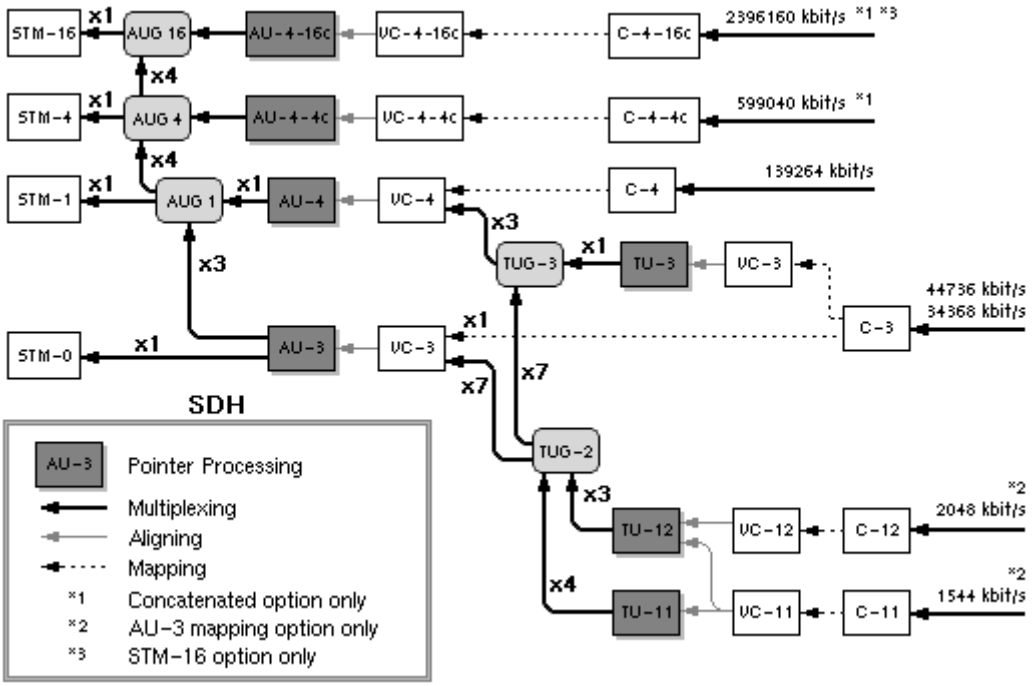
RJ48 Connector



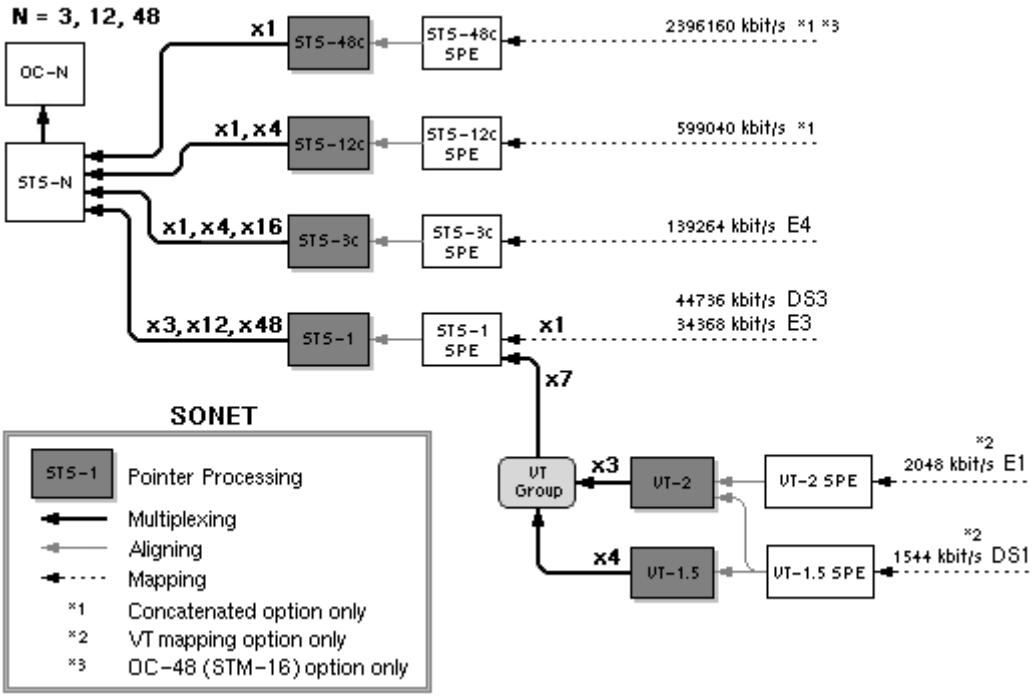
XT=Tip, XR=Ring and XG=Ground

12. Appendix D – SDH, SONET, and PDH information

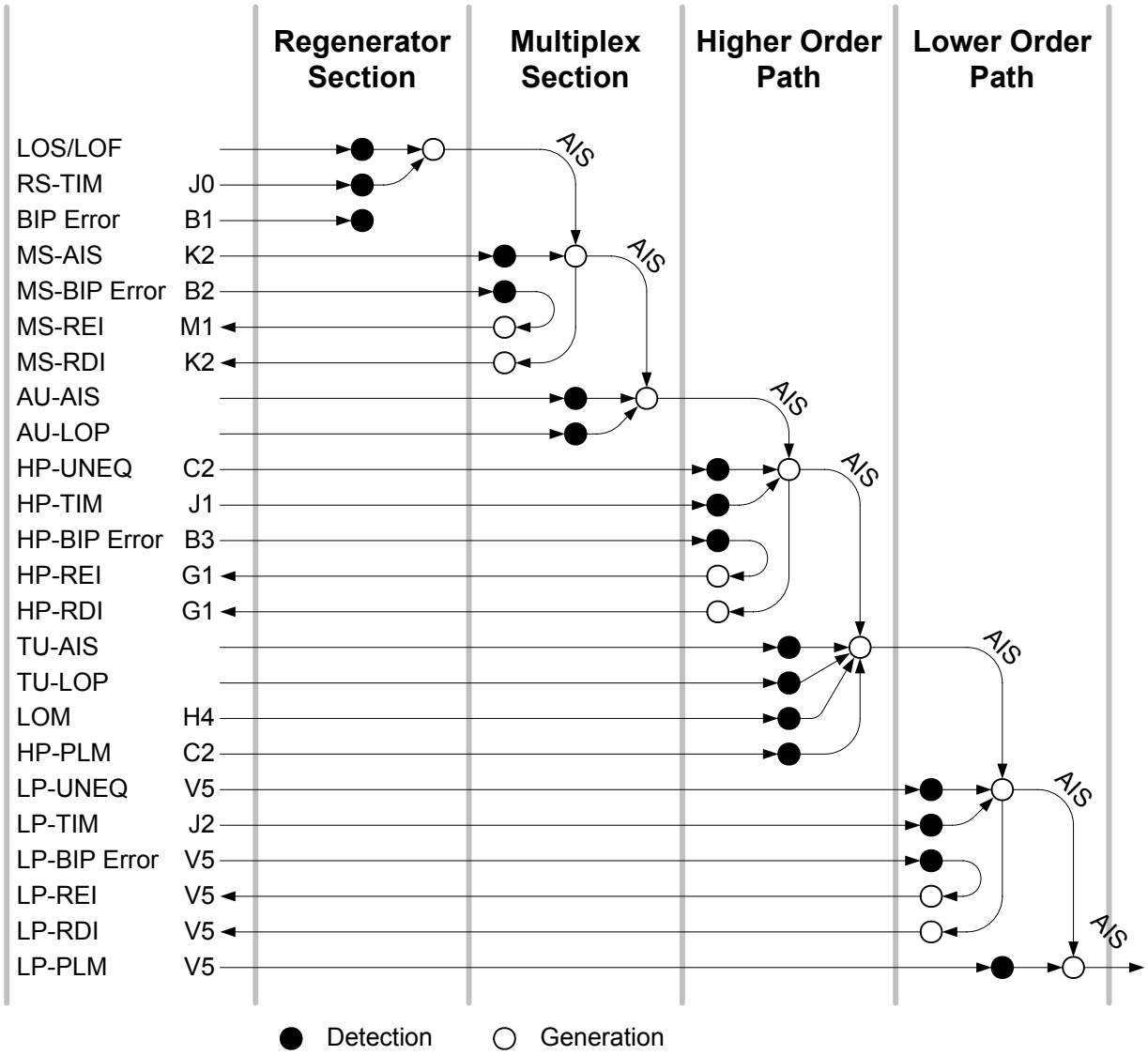
12.1 SDH structure for ANT-5



12.2 SONET structure for ANT-5



12.3 SDH defect hierarchy



12.4 SDH Tributary Numbering

Tributary Method	**TU-12**	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
	TUG-2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	
	TUG-3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	VC#	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	
ITU-T Method	**TUG-12**	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	TUG-2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	
	TU-13	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	

Tributary Method	**TU-12**	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
	TUG-2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	
	TUG-3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	VC#	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	
ITU-T Method	**TUG-12**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	TUG-2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	
	TU-13	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	

Tributary Method	**TU-12**	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
	TUG-2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	
	TUG-3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	VC#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
ITU-T Method	**TUG-12**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	TUG-2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	
	TU-13	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	

12.5 SDH Anomalies and Defects

SDH	Description	Overhead Byte	Intrusive Thru Mode
LOS	Loss of signal		
TSE	Test sequence error (bit error)		
LSS	Loss of Sequence Synchronisation		
AIS	Alarm indication signal		
Regenerator Section			
OOF	Out of frame	A1, A2	
LOF	Loss of frame	A1, A2	

B1	Regenerator section error monitoring	B1	available
RS-TIM	RS trace identifier mismatch	J0	
Multiplex Section			
MS-AIS	Multiplex section AIS	K2	
MS-RDI	Multiplex section remote defect indication	K2	
MS-REI	Multiplex section remote error indication	M1	available
B2 (24 bits)	Multiplex section error monitoring	B2	available
Administrative Unit			
AU-LOP	Loss of AU pointer	H1, H2	
AU-NDF	New data flag AU pointer		
AU-AIS	Administrative unit AIS	AU incl. H1, H2	
AU+PJE	AU positive pointer justification event	H1, H2	
AU-PJE	AU negative pointer justification event	H1, H2	
High Order Path			
HP-UNEQ	HO path unequipped	C2	
HP-RDI	HO remote defect indication	G1	
HP-REI	HO remote error indication	G1	available
HP-TIM	HO path trace identifier mismatch	J1	
HP-PLM	HO path payload label mismatch	C2	
B3	HO path error monitoring	B3	
Tributary Unit			
TU-LOP	Loss of TU pointer	V1, V2	
TU-NDF	New data flag TU pointer		
TU-AIS	TU alarm indication signal	TU incl. V1 to V4	
TU-LOM	TU loss of multiframe	H4	
TU+PJE	TU positive pointer justification event	H1, H2	
TU-PJE	TU negative pointer justification event	H1, H2	
Low Order Path			
LP-UNEQ	LO path unequipped	V5	
LP-RDI	LO path remote defect indication	V5	

LP-REI	LO path remote error indication	V5	available
LP-RFI	LO path remote failure indication	V5	
LP-TIM	LO path trace identifier mismatch	J2	
LP-PLM	LO path payload label mismatch	V5	
BIP-2	LO path error monitoring (VC-11/VC-12)	V5	available
B3	LO path error monitoring (VC-3)	B3	available
Tandem Connection Monitoring			
HP-IEC	HP incoming error count	N1	
HP-ODI	HP outgoing defect indicator	N1	
HP-OEI	HP outgoing error indicator	N1	
HP-TC-AIS	TC alarm indication signal	N1	
HP-LTC	Loss of tandem connection (i.e. loss of FAS)	N1	
HP-TC-RDI	TC remote defect indication	N1	
HP-TC-REI	TC remote error indication	N1	
HP-TC-UNEQ	TC unequipped (i.e. not set up)	N1	
LP-BIP	LO path error monitoring (VC-12)	N2	
LP-IEC	LP incoming error count	N1*, N2*	
LP-ODI	LP outgoing defect indicator	N1*, N2*	
LP-OEI	LP outgoing error indicator	N1*, N2*	
LP-TC-AIS	TC alarm indication signal	N1*, N2*	
LP-LTC	Loss of tandem connection (i.e. loss of FAS)	N1*, N2*	
LP-TC-RDI	TC remote defect indication	N1*, N2*	
LP-TC-REI	TC remote error indication	N1*, N2*	
LP-TC-UNEQ	TC unequipped (i.e. not set up)	N1*, N2*	

*N2 in VC-12, N1 in VC-3

12.6 PDH Anomalies and Defects

The following PDH Anomalies and Defects may be detected inside the SDH structure and at the line interface.

DS1 Defect	**Description**
LOS	Loss of Signal
LOF	Loss of Frame
AIS	Alarm Indication Signal
YELL	Yellow Alarm
DS1 Anomaly	**Description**
FAS	Frame Alignment Signal
CRC-6	Cyclic Redundancy Check Error
TSE	Test Sequence Error
CODE	Code Error
DS3 Defect	**Description**
LOS	Loss of Signal
LOF	Loss of Frame
OOF	Out of Frame
AIS	Alarm Indication Signal (1010 payload)
IDLE	DS3 Idle (1100 payload)
YELLOW	Yellow alarm (Far End Alarm)
LSS	Loss of Sequence Synchronisation
DS3 Anomaly	**Description**
FAS	Frame Error
MFAS	Multiframe Error
CP-Bit	Path Parity Error
CODE	Code Error
P-Bit	Parity-Bit Error
REI	Remote Error Indication
TSE	Test Sequence Error
E4 Defect	**Description**
LOS	Loss of Signal
LOF	Loss of Frame

AIS	Alarm Indication Signal
RDI	Remote Defect Indication
LSS	Loss of Sequence Synchronisation
E4 Anomaly	**Description**
FAS	Frame Alignment Signal
TSE	Test Sequence Error
E3 Defect	**Description**
LOS	Loss of Signal
LOF	Loss of Frame
AIS	Alarm Indication Signal
RDI	Remote Defect Indication
LSS	Loss of Sequence Synchronisation
E3 Anomaly	**Description**
FAS	Frame Alignment Signal
TSE	Test Sequence Error
E1 Defect	**Description**
LOS	Loss of Signal
LOF	Loss of Frame
AIS	Alarm Indication Signal
RDI	Remote Defect Indication
LSS	Loss of Sequence Synchronisation
E1 Anomaly	**Description**
FAS	Frame Alignment Signal
CRC-4	Cyclic Redundancy Check Error
E-Bit	Remote Cyclic Redundancy Check Error
TSE	Test Sequence Error
CODE	Code Error

12.6.1 Intrusive Thru mode PDH Anomalies

The following PDH Anomalies may be injected inside the SDH structure during Intrusive Thru mode testing.

Anomaly	Description
FAS-2	Frame Alignment Signal 2

CRC	Cyclic Redundancy Check Error
E-Bit	Remote Cyclic Redundancy Check Error
FAS-1.5	Frame Alignment Signal 1.5

12.7 Comparison of SDH/SONET anomalies and defects

SDH/SONET	Description
LOS	Loss of signal
TSE	Test sequence error (bit error)
LSS	Loss of Sequence Synchronisation
LTI	Loss of incoming Timer Intervals

SDH (ITU-T: G.707 G.783)		SONET (ANSI: T1.105)	
REGENERATOR SECTION		**SECTION**	
OOF	Out of Frame	OOF	Out of Frame
LOF	Loss of Frame	LOF	Loss of Frame
B1(8 bits)	Regenerator section error monitoring	B1(8 bits)	Section error monitoring
MULTIPLEX SECTION		**LINE (L)**	
B2 Nx24 bits	Multiplex section error monitoring	B2 Nx8 bits	Line error monitoring
MS-AIS	Multiplex Section AIS	AIS-L	L-AIS
MS-RDI	Mux Section Remote Defect Indication	RDI-L	L-Remote Defect Indication
MS-REI	Mux section Remote Error Indication	REI-L	L- Remote Error Indication
ADMINISTRATIVE UNIT (AU)		**STS – PATH (SP)**	
AU-LOP	Loss of AU Pointer	LOP-P	SP Loss of Pointer
AU-NDF	New Data Flag AU Pointer	NDF-P	SP New Data Flag
AU-AIS	AU-AIS	AIS-P	SP AIS
AU-PJE	AU Pointer Justification		
HIGH ORDER PATH (HO)			
B3 (8 bits)	HO Path errors monitoring (VC-4)	B3 (8 bits)	SP error monitoring

SDH (ITU-T: G.707 G.783)		SONET (ANSI: T1.105)	
HP-UNEQ	HO Path UNEQuipped	UNEQ-P	SP UNEQuipped
HP-RDI	HO Path Remote Defect Indication	RDI-P	SP Remote Defect Indication
HP-REI	HO Path Remote Error Indication	REI-P	SP Remote Error Indication
		PDI-P	SP Payload Defect Indication
HP TIM	HO Path Trace Identifier Mismatch	TIM-P	SP Trace Identifier Mismatch
HP-PLM	HO Path Label Mismatch	PLM-P	SP Path Label Mismatch
TRIBUTARY UNIT (TU)		**VT – PATH (VP)**	
TU-LOP	Loss of TU Pointer	LOP-V	VP Loss of Pointer
TU-NDF	New Data Flag TU Pointer	NDF-V	VP-New Data Flag
TU-AIS	TU-AIS	AIS-V	VP AIS
TU-LOM	Loss of Multiframe (H4)	LOM	Loss of Multiframe
LOW ORDER PATH (LO)			
BIP-2	LO Path error monitoring (VC-12)	BIP-2	VP error monitoring
B3 (8 bit)	LO Path error monitoring (VC-3)		
LP-UNEQ	LO Path UNEQuipped	UNEQ-V	VT UNEQuipped
LP-RDI	LO Path Remote Defect Indicator	RDI-V	VP Remote Defect Indicator
LP-REI	LO Path Remote Error Indicator	REI-V	VP Remote Error Indicator
LP-RFI	LO Path Remote Failure Indicator	LP-RFI	VP Remote Failure Indicator
		PDI-V	VP Payload Defect Indicator
LP-TIM	LO Path Trace Identifier Mismatch	TIM-V	VP Trace Identifier Mismatch
LP-PLM	LO Path Payload Label Mismatch	PLM-V	VP Payload Label Mismatch

13. Appendix E – Performance Analysis Options

For an application note on this topic, visit our Web Site, **www.jdsu.com**, or contact the nearest Regional Sales Office as listed on the back of the manual.

13.1 Analysis and Hierarchy Validity

Analysis	PDH	SDH	SONET	Appropriate Anomalies
OFF				(none)
G.821	x	x		TSE
G.826 (ISM)		x		B1, B2SUM, HP B3, LP BIP2/8, E2 FAS, E4 FAS, E3 FAS, E1 FAS, E1 CRC-4
G.826 (OOS)	x	x		TSE
G.828 (ISM)		x		B1, B2, TSE
G.829 (ISM)		x		B1, B2, B3, TSE, LP-BIP
M.2100	x	x		E4 FAS, E3 FAS, E2 FAS, E1 FAS, E1 CRC-4, DS3 P-Bit, DS3 FAS, TSE
M.2101		x		B1, B2SUM, HP B3, LP BIP2/8, TSE
ANSI	x	x	x	TSE, B1, B2, B3, DS3FAS, DS3CPAR

13.2 Summary of performance analysis standards

The quality of digital links is determined with the aid of bit error ratio tests (BERT). The results of such measurements must be classified in some way, not least because the quality of a transmission path is often the subject of a contract between the network provider and the telecommunications user. For this reason an objective means of classifying a line as either “good” or “bad” is required. The ITU-T Recommendations G.821, G.826, G.828, G.829, M.2100 and M.2101 are internationally recognised standards that specify these parameters.

13.2.1 Recommendation G.821

This Recommendation was originally specified for international circuit-switched nx64 kbit/s connections and expanded to include higher bit rates as time went on. A hypothetical reference connection is the basis used for determining quality parameters; this comprises an international long-distance segment, a national segment and a subscriber access segment.

G.821 definitions:

- Errored second (ES): A one-second time interval in which one or more bit errors occurs.

- Severely errored second (SES): A one-second time interval in which the bit error ratio exceeds 10^{-3}.
- Unavailable second (UAS): A circuit is considered to be unavailable from the first of at least ten consecutive SES. The circuit is available form the first of at least ten consecutive seconds which are not SES.
- Degraded minute (DM): A one-minute time interval in which the bit error ratio exceeds 10^{-6}.
- Error-free second (EFS): A one-second time interval in which no bit errors occur.

The disadvantage of G.821 is that it relies on the evaluation of bit errors and so the test channel must be taken out of service to perform the measurement.

13.2.2 Recommendation G.826

This Recommendation takes higher bit rates into account and allows in-service measurement as it relies on the evaluation of block errors.

G.826 definitions:

- Errored second (ES): A one-second time interval containing one or more errored blocks.
- Errored block (EB): A block containing one or more errored bits.
- Severely errored second (SES): A one-second time interval in which more than 30% of the blocks are errored or which contains at least one severely disturbed period (SDP).
- Background block error (BBE): An errored block that is not a SES.
- Unavailable second (UAS): see under G.821 above.

The results are referred to the measurement time. This gives the following error parameters: Errored seconds ratio (ESR), severely errored seconds ratio (SESR), and background block error ratio (BBER). The specified quality requirements refer too a particular path.

The recommended measurement time for G.821 and G.826 is 30 days.

13.2.3 Recommendation G.828

Unlike G.826, recommendation G.828 provides a precise block length for each bit rate. For example, the number of blocks monitored per second for bit rates from VC3 upwards remains constant at 8000.

13.2.4 Recommendation G.829

G.829 is based on the principle of monitoring block errors, allowing measurements to be made in-service. The recommendation defines the block size, number of blocks per

SDH frame, number of blocks transmitted per second and the error detection code (EDC) to be used for the various SDH bit rates that your ANT-5 supports.

13.2.5 Recommendation M.2100

Recommendation M.2100 specifically applies to commissioning and maintenance. Commissioning consists of a 15-minute line up phase followed by a 24-hour in-service measurement. Once the line up phase is completed successfully, errors may occur within certain limits. If this is the case, the line remains in service, but must continue to be monitored for a further 7 days. The measurement procedures are defined in M.2110 and M.2120. The limit values are derived from the performance parameters specified in G.821 and G.826.

13.2.6 Recommendation M.2101

This recommendation is very close to M.2100 in terms of purpose and format, but it deals exclusively with SDH systems. Recommendation M.2101 for SDH systems can be considered as a sister recommendation to M.2100 for PDH systems.

14. Appendix F – Simplified Chinese Language Support

To display and print Simplified Chinese text, the ANT-5 Remote Operation Client program requires Windows XP and Windows code page 936.

To setup support for code page 936 text services:

1. Go to **Start>Control Panel>Regional and Language Options**, and then select the **Languages** tab.
2. Under Supplemental language support, select **Install files for East Asian Languages** box. If this check box is already checked, go directly to step 5.
3. Click **OK**. You may be prompted to insert a Windows CD-ROM at this time from which to copy the files.
4. After installation of the East Asian files is complete, reboot the system.
5. Go to **Start>Control Panel>Regional and Language Options**, and then select the **Advanced** tab.
6. Select **Chinese (PRC)** as the language version of the non-Unicode programs.
7. Under Code page conversion tables, ensure that 936 (ANSI/OEM - Simplified Chinese GBK) is selected.
8. Select the **Languages** tab. Under Text services and input languages, select the **Details** button.

   The Text Services and Input Languages dialog box appears.
9. Select the **Settings** tab, and then under Default input language, choose **English (United States) - US**.
10. Click **OK** on the Text Services and Input Languages dialog box, and then click **OK** again on the previous dialog box.

    Note: If a message appears stating: "The required files are already installed on your hard disk...", click **Yes**.
11. After the language selection is complete, reboot the system.
12. Run the ANT-5 Remote Operation Client application, and then select Chinese as the language on the General Preferences page.
13. Exit, and then re-start the ANT-5 Remote Operation Client program.

Note 1: The Ant5rc.exe application requires that the ANT-5 fonts (helv11.fon, helv13.fon, helv13b.fon, helf13x.fon, helv15.fon, helv15b.fon, helv22.fon, xm4x6.fon, xm6x10ex.fon, and xm7x14ex.fon) are located in either the installation target directory or that they have been installed into the Windows Control Panel → Fonts in order to display all standard ASCII characters along with the Chinese characters. If these fonts are not available, the ASCII characters will be substituted as closely as possible by Windows, but the resulting text will not appear to fit correctly on the displayed pages. A TrueType font suitable for Chinese (such as SimSun) must also be available.

Note 2: When the PC has been configured to support code page 936, the ANT-5 application may occasionally display incorrect characters when a language other than Chinese is selected because accented characters and printable control codes utilize codes beyond the standard 128 character ASCII set.

15. Appendix G – Glossary & Acronyms

1-CDV	1-Point Cell Delay Variation
2-CDV	2-Point Cell Delay Variation
A1	Frame synchronisation byte; 1111 0110 (RSOH)
A2	Frame synchronisation byte; 0010 1000 (RSOH)
AAL-n	ATM Adaptation Layer, Type n = 1, 2, 3/4 or 5
ABR	Available Bit Rate
ACR	Average Cell Rate
ADM	Add/Drop Multiplexer
AIS	Alarm Indication Signal
ANSI	American National Standards Institute
APS	Automatic Protection Switching (channels K1, K2)
ARP	Address Resolution Protocol
ATM	Asynchronous Transfer Mode
AUG	Administrative Unit Group
AU-n	Administrative Unit; Level n = 3, 4
B1	BIP-8 parity word in regenerator section (RSOH)
B2	BIP-N x 24 parity word in multiplex section (MSOH)
B3	BIP-8 parity word in VC-3, 4 path (POH)
BBE, BBER	Background Block Error, Background Block Error Ratio
BER, BLER, BERT	Bit Error Ratio, Block Error Ratio, Bit Error Rate Test
BIP-2	BIP-2 parity word in VC-1, 2 path (POH)
BIP-N	Bit Interleaved Parity; N bits
BIS[P]O	Bringing into service [performance] objectives
C2	Signal label (VC-3, 4 POH)
CAS	Channel Associated Signalling
CBR	Constant Bit Rate
CCM	Cross-Connect Multiplexing
CDV	Cell Delay Variation
CDVT	Cell Delay Variation Tolerance
CER	Cell Error Rate
CI	Congestion Indication
CLP	Cell Loss Priority (low: CLP=1; high: CLP=0)

CLR	Cell Loss Ratio
CMIP	Common Management Information Protocol
C-n	Container; n = 1, 2, 3, 4
CPI	Common Part Indicator
CPS	Common Part Sublayer
CS	Convergence Sublayer
CSES	Consecutive Severely Errored Seconds
CTAN	Channel Traffic Analyzer
CTD	Cell Transfer Delay
CTM	OAM Cell Type Mismatch
D1-3	196 kbit/s DCC for regenerator section (RSOH)
D4-12	576 kbit/s DCC for multiplex section (MSOH)
DCC	Data Communication Channel
DCN	Data Communication Network
DM	Degraded Minutes
DS1	Electrical interface signal, 1544 kbit/s
DS3	Electrical interface signal, 44736 kbit/s
DSAP	Destination Service Access Point
DUT	Device Under Test, either an individual item of equipment or a network element which is the interface to a larger system
DXC	Digital Cross-Connect
E1	Electrical interface signal, 2048 kbit/s. Also service channel (voice) in regenerator section (RSOH).
E2	Electrical interface signal, 8448 kbit/s. Also service channel (voice) in multiplex section (MSOH).
E3	Electrical interface signal, 34368 kbit/s
E4	Electrical interface signal, 139264 kbit/s
EBC	Errored Block Count
ECC	Embedded Communication Channel
ECL	Emitter Coupled Logic
EDC	Error Detection Code
EFS	Error-Free Second
ESF	Extended Super Frame
ES, ESR	Errored Second, Errored Second Ratio

F1	User channel, e.g. for operational service purposes (RSOH)
F2	Path user channel for an end-to-end connection (POH)
FAS	Frame Alignment Signal
FTM	DS3 Frame Type Mismatch
FTP	File Transfer Protocol
G1	End-to-end path status (POH)
GFC	Generic Flow Control
GUI	Graphical User Interface
H1	Pointer byte 1: Bit nos. 1 to 4: New data flag; bit nos. 5, 6: (Unspecified); bit nos. 7, 8: Pointer value (highest 2 bits)
H2	Pointer byte 2: Pointer value (lowest 8 bits)
H3	Pointer byte 2: Negative justification opportunity
H4	Payload indication (POH)
HCOR	Correctable header errors
HEC	Header Error Control
HUNC	Uncorrectable header errors
HP	Higher-order Path
IAT	Inter Arrival Time
ICMP	Internet Control Message Protocol
ICP	IMA Control Protocol
IMA	Inverse Multiplexing for ATM
InARP	Inverse Address Resolution Protocol
IP	Internet Protocol
IS, ISM	In-Service, In-Service Measurement
ISDN	Integrated Services Digital Network
ISO	International Standardisation Organisation
J0	Regenerator section trace (RSOH)
J1	Path trace (POH in VC-3, VC-4)
J2	Path trace (POH in VC-12)
K1, K2	APS channels for APS sig. & back-up line switching (MSOH)
K3, K4	APS channels for APS sig. & back-up line switching (POH)
LAN	Local Area Network
LCD	Loss Cell Delineation
LLC	Logical Link Control

LO	Lower Order
LOF	Loss Of Frame
LOM	Loss Of Multiframe
LOP	Loss Of Pointer
LOS	Loss Of Signal
LP	Lower-order Path or Loss Priority
LSS	Loss of Sequence Synchronisation
M1	MS-REI byte (MSOH)
MAC	Media Access Control
MBS	Maximum Burst Size
MCR	Minimum Cell Rate
MCTD	Maximum Cell Transfer Delay
MI	Management Information
MO	Managed Object
MPOA	Multi-Protocol Over ATM
MS	Multiplexer Section
ms	Milliseconds
MSOH	Multiplexer Section Overhead
MTIE	Maximum Time Interval Error
N1	Network operator byte for TCM in VC-3, VC-4
N2	Network operator byte for TCM in VC-12
NDF	New Data Flag
NE	Network Element
NFAS	Not Frame Alignment Signal
NLPID	Network Layer Protocol Identifier
NNI	Network Node Interface
OAM	Operation, Administration and Management
OC-N	Optical Carrier; N = 1, 3, 12, 48, 192
OH	Overhead
OOF	Out-Of-Frame
OOS	Out-Of-Service
OUI	Organizational Unique Identifier
PCR	Peak Cell Rate

PDH	Plesiochronous Digital Hierarchy
PDU	Protocol Data Unit
PLL	Phase-Locked Loop
PLM	Payload Label Mismatch
PMP	Protected Monitor Point
POH	Path Overhead
PRBS	Pseudo-Random Binary Sequence
PRC	Primary Reference Clock
PPP	Point to Point Protocol
PPPoA	Point to Point Protocol over ATM
PPPoE	Point to Point Protocol over Ethernet
PTI	Payload Type Identifier
QoS	Quality of Service
RDI	Remote Defect Indicator
REI	Remote Error Indicator
ROSE	Remote Operations Service Element
RSOH	Regenerator Section Overhead
S1	Synchronisation status byte (MSOH)
SAP	Service Access Point
SAR	Segmentation and Reassembly
SDH	Synchronous Digital Hierarchy
SCR	Sustainable Cell Rate
SDU	Service Data Unit
SEC	SDH Equipment Clock
SEFS	Severely Errored Framed Seconds
SELV	Safety Extra Low Voltage
SEP	Severely Errored Period
SES, SESR	Severely Errored Second, Severely Errored Secs Ratio
SHR, BSHR	Self-Healing Ring, Bi-directional Self-Healing Ring
SMN, SMS	SDH management network, SDH management sub-network
SN	Sequence Number
SNAP	Sub Network Access Point
SOH	Section Overhead

SPE	Synchronous Payload Envelope
SPRING	Shared Protection Ring
SSAP	Source Service Access Point
SSCS	Service Specific Convergence Sublayer
SSSAR	Service Specific Segmentation and Reassembly Sublayer
SSTED	Service Specific Transmission Error Detection Sublayer
STM, STM-N	Synchronous Transport Module; Level N = 0, 1, 4, 16, 64
STS, STS-N	Synchronous Transport Signal; Level N = 1, 3
TIM	Trace Identifier Mismatch
TOH	Transport Overhead
TMN	Telecommunications Management Network
TSE	Test Sequence Error
TU, TU-m	Tributary Unit; Level m = 1, 2, 3
TUG-m	Tributary Unit Group; Level m = 1, 2
UAS, UAT	Unavailable Second, Unavailable Time
UBR	Unspecified Bit Rate
UI	Unit Interval
UNEQ	Unequipped
UNI	User-Network Interface
µs	Microseconds
UUI	User to User Indication
V5	POH byte (VC-1, 2)
VBR	Variable Bit Rate
VC, VC-n	Virtual Channel, Virtual Container; Level n = 1, 2, 3, 4
VC-n-Xc	Concatenated virtual container, level n, X concatenated VCs
VCI	Virtual Channel Identifier
VP	Virtual Path
VPI	Virtual Path Identifier
VT	Virtual Tributary
WDM, DWDM	Wavelength Division Multiplexing, Dense WDM

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