

Telesto Repeater Manual

Telesto Repeater Manual

Revision History

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Rev	Date	Author	Description
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1. Introduction

Congratulations on your purchase of Telesto repeater. Telesto repeaters work in conjunction with Europa digitisers, greatly extending the aperture of Nanometrics terrestrial Callisto networks.

It is strongly recommended that the entire manual be read before commencing testing, configuring, or using the Telesto. On the following pages you will find a wealth of information regarding all aspects of Telesto repeater. Please read the instructions carefully.

If you have problems or need technical support, please submit requests for technical support by e-mail or fax. This permits you to fully explain your problem and include "evidence" as it allows us to submit your problem to the most knowledgeable person for reply.

by e-mail: support@nanometrics.ca

by fax: **To: Support at fax (613) 592-5929**

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2. Organization of this Manual

This manual is organized in ten major sections:

Chapter 1	Introduction	Introductory notes to this manual.
Chapter 2	Organization of this Manual	Notes on how to use this manual.
Chapter 3	Unpacking and Post Delivery Inspection	Identification of the components you have purchased. It also references an "as-shipped" section.
Chapter 4	Technical Description	Description of features and technical specifications of the Telesto.
Chapter 5	Servicing	Recommended maintenance and repair procedures.
Appendices		These list pin connections, cable drawings and outline and installation drawings.

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3. Unpacking & Post Delivery Inspection

Open and inspect the shipment for possible damage. Carefully check each item for damage or defects. The following list includes items generally included with Telesto. This list might vary from application to application. To find out the exact list of items included in your shipment refer to the shipping documents.

For the reference only, the system may include one or more of the following:

1. Telesto repeater
2. GPS Antenna and Mounting Bracket
3. GPS Antenna Cable
4. RF Antenna Cable
5. Power cable
6. Yagi or omni RF antenna
7. Telesto repeater Manual
8. As-shipped Sheet

Checking the As-Shipped Sheets

As written this manual covers the Telesto repeater. Please study the as-shipped data sheet to determine the exact configuration of the repeater. The as-shipped sheet lists the serial numbers of the parts shipped and the exact configuration parameters associated with your hardware. This will determine how your Telesto repeater operates when first turned on and how it fits within your network. Several features may have been added to the repeater since this manual was released. Such new features are described in the Release Notes which have precedence over what is in the manual.

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4. Technical Description

Overview of the Hardware

The core of Nanometrics Callisto terrestrial networks is Europa 24 bit digitiser. The Europa digitises analog seismic signal, packages and outputs information in the form of a serial data stream of a proprietary format. The data packets are transmitted to the network central site by the telemetry module of the Europa digitiser. In cases when the link between the remote and the central site can not be established in a single hop the Telesto repeaters are employed.

The Telesto integrates all the hardware necessary to receive data packets from Europa digitisers and send them towards the network central site. It also provides the reverse flow of data, by receiving various network management information from the central site and passing it to the targeted Europa digitiser. In doing so the Telesto can be configured to make use of various kinds of telemetry or various combinations of two different kinds of telemetry.

Depending on the combination of telemetry modules employed the Telesto can come in one of the following configurations::

- Telesto (VHF/UHF), with a VHF or UHF radio transmitter and receiver.
- Telesto (SS1), with a spread spectrum transceiver 902-928 MHz.
- Telesto (SS2), with a spread spectrum transceiver 2.4-2.4835 GHz.
- Telesto (SS/GPS/422), with a RS-422 interface input, spread spectrum transceiver (of any band) output, and a built-in GPS receiver.

Other custom configurations are also possible, to suit any given network topology. Regardless of the configuration, the Telesto always has the Universal Interface Board (UIB), to which other optional modules could be added, as per *Figure 1*. The options include a VHF/UHF receiver/transmitter pair, a GPS, a spread-spectrum transceiver or a fibre optic modem).

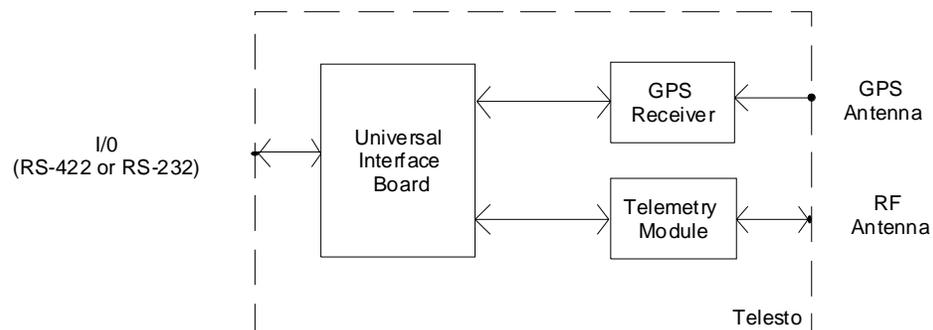


Figure 1: Telesto Repeater, General Configuration

This chapter gives a short overview of the major hardware components of each configuration.

Spread Spectrum Transceiver Module

The Telesto repeater can be configured with a spread spectrum radio transceiver operating in either 900 MHz or 2.4 GHz license-free bands under Part 15 of FCC rules. For the most part

Technical Description

configuration options and operation of these two types of transceivers are identical unless specifically mentioned otherwise.

Description and Operation

The transceiver generally operates as a wireless modem, connecting two devices by a RS-232 communication link, but it can also be configured with no connection to any particular RS-232 device. When that is the case the transceiver will receive data packets and retransmit the same packet immediately after that, over the same RF antenna. If there is a line-of-sight with both the remote site and the central site and the antenna radiation pattern covers both directions, the Telesto will effectively extend the communication link between the two.

The spread spectrum transceiver uses frequency hopping as a spreading technique. It is possible to configure the transceiver to use a specific hop table to suite various national regulatory environments. By selecting the hop table a specific portion of the frequency band is selected. Within the specified band the user can further select the number of frequencies to be used. Lastly, there are provisions to select a particular pseudo-random hopping pattern, so that different groups of transmitters within a network use different hopping patterns. This ensures that the interference between the transceivers operating in the same area is minimized allowing for the design of large networks with license-free operation.

The transceivers can be configured for point-to-point, point-to-multipoint or time division multiple access (TDMA) mode. By entering the serial number of the remote transceiver into the transceiver's call book in point-to-point and point-to-multipoint modes the user insures that the link will be established only with the selected transceivers and no interference will be caused by or incurred to the links between other transceivers in the network. In the TDMA mode the network is subdivided into the subnetworks by selecting different hopping patterns and/or network ID. Within each subnetwork the transceivers will be assigned specific time slots within a frame to transmit a message, receive a message, repeat another transceiver's message or do nothing. This protocol is a greatly enhanced version of point-to-multipoint communications, enabling creation of large networks with a reduced amount of hardware due to multiplexing of multiple data channels into one data channel of a higher baud rate.

There are other configuration parameters which can further fine tune operation of a network, such as the size of internal data packets, number of retry odds, transmit power level, serial port baud rate and so on. There are also provisions for assessing the quality of the link between two transceivers. For all these details please refer to the separate Spread Spectrum Data Transceiver manual and TDMA User Manual.

A common configuration of the Telesto repeater with the spread spectrum transceiver is a radio repeater station configuration. In such a case the Telesto is installed at a location with a line-of-sight between that location and another two locations, typically a remote site and the central site. The two locations otherwise do not have a direct line-of-sight between them, or are too far away to establish a direct link. Adding a repeater will greatly extend the link span. Multiple repeater links are also possible. *Figure 2* depicts a typical repeater site of that kind.

Technical Description

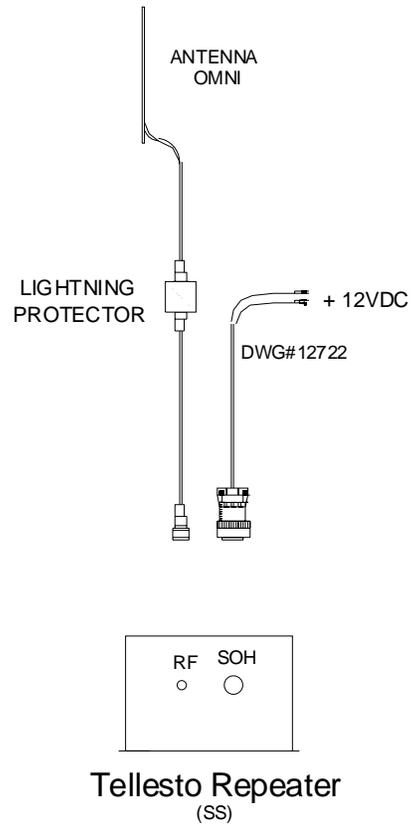


Figure 2: Tellesto repeater (SS)

Configuration

Access to the configuration port of the transceiver is provided by connecting the unit to a PC running a terminal emulator with a special test/configuration cable. The cable is labeled “Telesto (SS)(SS/GPS/422) Config Dwg 12728A”. *Figure 3*, and following information provides an explanation of how to use the cable.

Technical Description

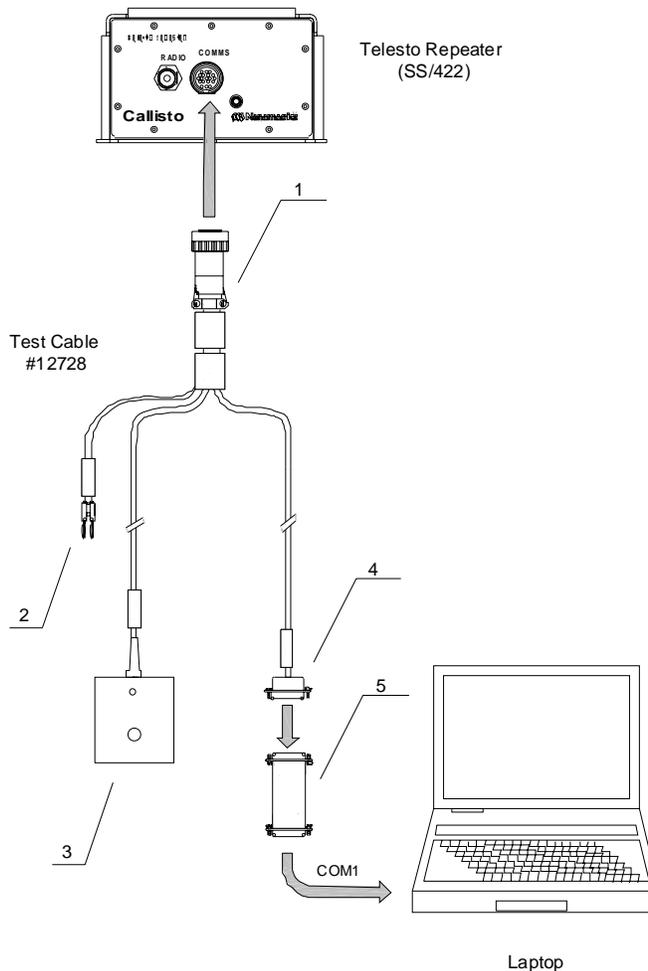


Figure 3: Telesto repeater (SS) test/configuration cable

- 1 ---- Test cable run labeled “Telesto Comms”. Plugs into the SOH connector on the Telesto repeater.
- 2 ---- Test cable run labeled “Power”. This run is used to connect external power to the unit being configured.
- 3 ---- Transceiver setup access box. The box has a touch switch and a LED built-in.
- 4 ---- Test cable run labeled “PC COM (Rx/Tx Conf)”. Plugs into the PC serial port and enables configuration of the transceiver module.
- 5 ---- RS-232 pin changeover module, dwg # 12749. When connecting please watch for proper orientation of the module.

To configure the Telesto (SS) the user should follow this procedure:

1. Set the baud rate on the terminal emulator to 19200 baud.
2. Press the button on box 3. The transceiver main menu should appear on the screen. Navigate through the submenus and edit the configuration if necessary.
3. Press “Esc” several times to exit the menu mode. If the transceiver is configured to point-to-point or point-to-multipoint mode and the link is established with a remote transceiver the LED will turn green which signals there is a carrier detected. In the

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TDMA mode the LED will remain red even when the link is established but will blink for each data packet sent.

4. Disconnect the cable.

The Telesto (SS) is now configured and ready for operation.

RS-422 Interface Module

There are certain installations such as caves, tunnels, deep ravines, buildings, etc. where the sensor is located in a location with no direct line-of-sight with the central site or the next repeater site and no suitable place for the GPS antenna. In these situations the Europa (HRD/422) can be used at the sensor location while the Telesto (SS/GPS/422) can be installed within a couple of kilometers at a location with a good line-of-sight and clear view of the sky needed for the GPS antenna installation. The two boxes are then connected with a multi-pair RS-422 cable and the whole arrangement will then meet the contradictory requirements of such an installation.

To cater for that and many other possible configurations each Telesto repeater has the Universal Interface Board (UIB) built-in. The UIB is designed to provide the following key features:

- Optically isolated RS-422 interface with 4 receivers and 4 transmitters
- Optically isolated RS-232 interface with 4 receivers and 4 transmitters
- Non-isolated RS-232 interface with 4 receivers and 4 transmitters
- Non-isolated CMOS interface with 4 receivers and 4 transmitters
- Optically isolated TTL interface for 2 lines
- Power switch on 5V power to GPS controlled by external RS 232/422 line
- Power switch on 12V power to spread spectrum transceiver controlled by external RS 232/422 line
- Supports Trimble ACE, Trimble Lassen and Rockwell Microtracker GPS
- GPS support includes battery backup and power control
- Supports spread spectrum radio transceiver
- Supports fibre optic modem with 4 channel receiver and transmitter (multiplexes 4 to 1 on Rx and Tx)

Description and Operation

The HRD is configured to output data in RS-422 levels. The data is then sent to the Telesto repeater over the RS-422 cable as shown in *Figure 3*.

Technical Description

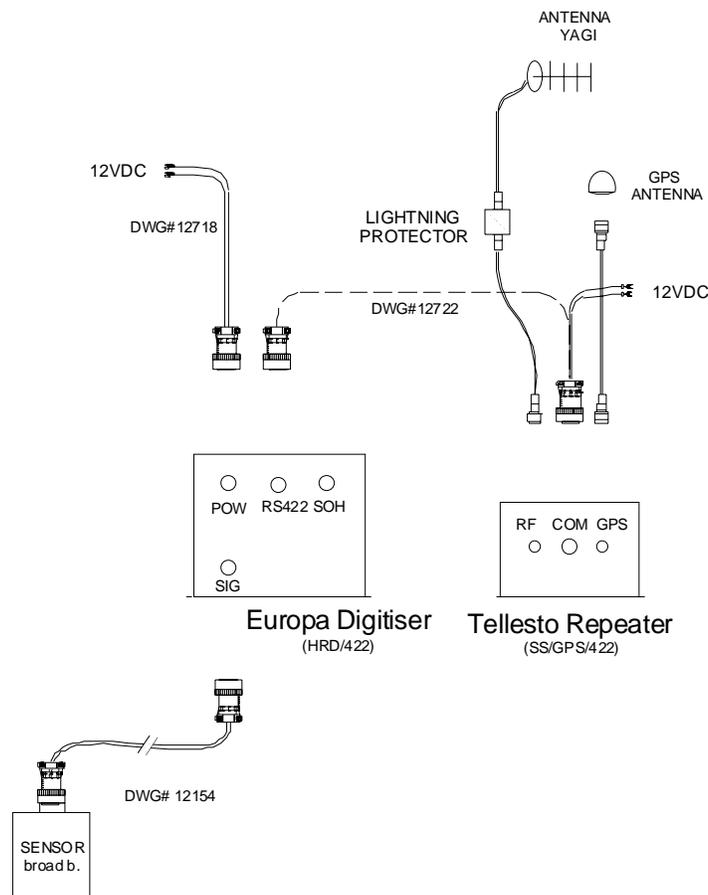


Figure 4: Connecting Telesto (SS/GPS/422)

There are several data streams between the digitiser and the repeater going in both directions. The direction from the digitiser to the repeater and further towards the central site is often referred to as *inbound*, while the opposite direction is *outbound*. The data streams between the two boxes are:

Inbound:

- *HRD Tx Data* (data stream transmitted by the HRD, containing real time seismic signal and SOH information).
- *HRD GPS Data Tx* (control information sent from the HRD to the GPS).
- *HRD Reset* (reset signal sent by the HRD when the GPS information has not been received for a predetermined time causing the power for the GPS to cycle).

Outbound:

- *HRD Rx Data* (data stream broadcast by the central site containing requests for retransmission of missing packets, calibration and control information).
- *HRD GPS Data Rx* (real time packets transmitted by the GPS engine containing information about time and location).
- *HRD 1Hz Rx* (1 pps stream transmitted by the GPS engine).

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The cable connecting the two modules should be plugged into the RS-422 connector on the front plate of the Europa digitiser and the COM connector on the front plate of the Telesto repeater. Suggested cable drawing can be found in the Appendix

Configuration

The same cable labeled “Telesto (SS)(SS/GPS/422) Config Dwg 12728A” which is used to configure Telesto (SS) is used for Telesto (SS/GPS/422), as shown in *Figure 5*. . There are no software configurable parameters related to the GPS receiver or RS-422 module. All the configurable parameters are those of the spread spectrum transceiver. Note that in addition to the test cable to configure Telesto (SS) one must use the #12749 adapter plugged into the serial port of the computer. By contrast, to configure Telesto (SS/GPS/422) instead of that adapter other two adapters are used: the RS-232 to RS-422 adapter and the #12771 adapter, as presented bellow.

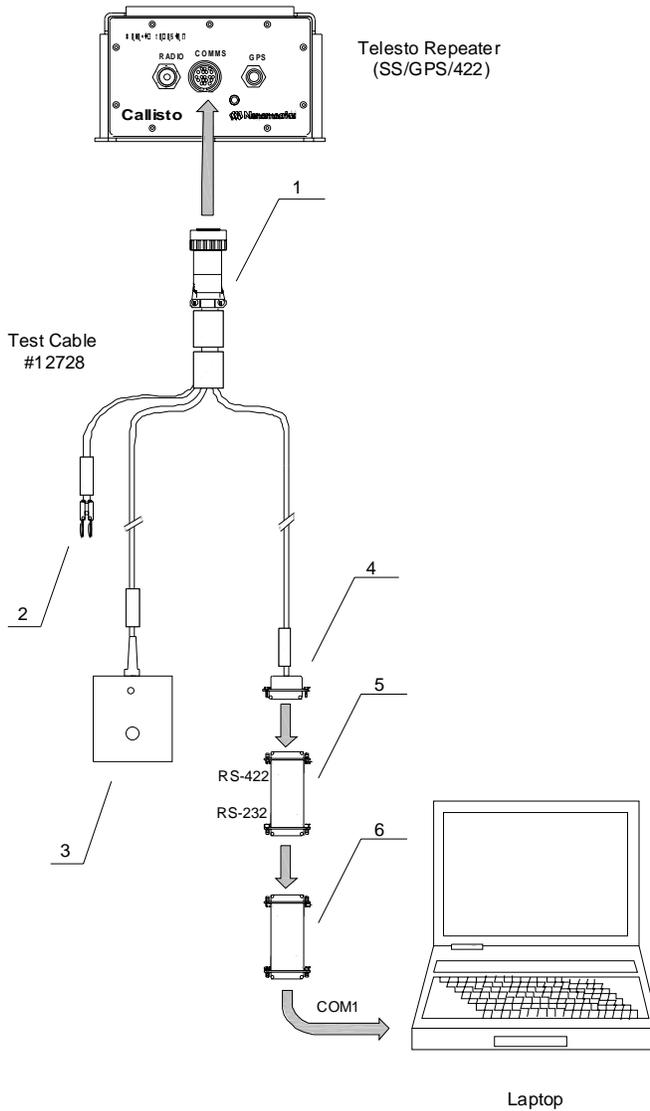


Figure 5: Telesto repeater (SS/GPS/422) test/configuration cable

The explanation of the symbols:

Technical Description

- 1 ----- *Test cable run labeled "Telesto Comms"*. Plugs into the SOH connector on the Telesto repeater.
- 2 ----- *Test cable run labeled "Power"*. This run is used to connect external power to the unit being configured.
- 3 ----- *Transceiver setup access box*. The box has a touch switch and a LED built-in.
- 4 ----- *Test cable run labeled "PC COM (Rx/Tx Conf)"*. Plugs into the PC serial port and enables configuration of the transceiver module.
- 5 ----- *RS-232/RS-422 converter*. Converts RS-422 level data from the Telesto into RS-232 data, to connect to the serial port of the PC.
- 6 ----- *Interface module for RS-422/RS-232 converter*. Provides power for the converter.

The procedure is identical to the one described in the spread spectrum transceiver module part of this manual.

5. Servicing

Basic troubleshooting

The Telesto repeater is always used as a part of a network containing Europa digitisers. Therefore troubleshooting the Telesto usually involves setting up some combination of digitiser-repeater-central site equipment in laboratory conditions. In some cases it might be easier to reconfigure the unit to work as a master in point-to-point mode for the duration of the test. In such a way the serial port of the radio transceiver can be checked for data continuity, which is a sufficient proof that the transceiver is operational.

Before you attempt any troubleshooting check all the connections, batteries and fuzes, to rule out the possibility that the malfunctioning is caused by one of these reasons.

Unable to communicate with the Telesto

If the Telesto fails to send any data or the transceiver menu appears inaccessible check the settings of the terminal emulator. In most cases the mismatch in baud rate settings is the cause of this problem.

GPS not locking

When Europa (HRD/422) is used in conjunction with Telesto (SS/GPS/422) and there is a reason to believe that the digitiser is not properly time synchronized, the GPS receiver and antenna should be checked.

Most problems with the GPS engines can be traced to a poorly placed antenna. If the GPS is not receiving well, try repositioning the antenna to a more favorable location. Lastly, ensure the antenna cable is not hanging from the antenna. Secure the antenna cable with a few tie wraps near the antenna to carry the weight of the cable.

The GPS should lock on its own if there is sufficient signal strength. If the GPS is not locking within 15 minutes of power-on, a further investigation is necessary. Even though the GPS engine is built into the Telesto box, the troubleshooting should proceed on the digitiser side. Refer to the digitiser manual and follow the procedure:

1. Connect the digitiser test cable and run Viewdat, the digitiser bench test program.
2. Go to the GPS screen on Viewdat.
3. Examine the GPS status on the screen. Are any satellites being tracked?
4. Examine the signal strength values. The signal strength (S/N) from the satellites should be greater than 38.
5. Reposition the antenna to a better location.
6. Check the link between the digitiser and the repeater.

When the Europa is integrated in a Nanometrics Digital Seismograph System, for further testing and troubleshooting procedures refer to the Remote Site Installation section of the system documentation.

Disassembly and Reassembly

The objective is to troubleshoot to the board level and replace the board. Try to identify a faulty board by swapping in the boards from a working unit. The necessary tools are:

1. Phillips screwdriver.
2. Allan key 3 mm for socket head cap screws.

Servicing

Disassembly Instructions

1. Disconnect all the cables from the Telesto repeater.
2. Remove the screws around the edge of the front plate of the enclosure box.
3. Remove the tray with the Universal Interface Board (UIB), and other boards (if applicable) from the can.
4. Undo the screws attaching the UIB to the tray, and (if applicable) screws attaching the radio transceiver and the GPS engine to the UIB.

Assembly Instructions

The assembly instructions are the reverse of the disassembly instruction. Make sure that repaired unit has the same configuration parameter values the faulty unit had. Refer to the as-shipped sheets for the configuration parameters. After power up check the following by connecting the test cable:

- The transceiver menu is accessible.
- The digitiser is transmitting data.
- The GPS gets locked.
- Retransmitted packets are received from the central site.

Appendix A - Connector Pinouts

Pin Number	Signal Name
A	N/C
B	N/C
C	N/C
D	N/C
E	SS Tx DATA
F	N/C
G	12V PWR RTN
H	+12V PWR
J	ISO GND
K	CD
L	ISO GND
M	N/C
N	N/C
P	N/C
R	N/C
S	SS Rx DATA
T	CHASSIS
U	SS MENU
V	N/C

Table 1: Telesto (SS) Comms Connector Pinout

Pin Number	Signal Name
A	+GPS Rx DATA
B	-PWR RESET
C	+PWR RESET
D	-SS Tx DATA
E	+SS Tx DATA
F	-SS Rx DATA
G	12V PWR RTN
H	+12V PWR
J	ISO GND
K	CD
L	ISO GND
M	+GPS 1Hz
N	-GPS 1Hz
P	-GPS Rx DATA
R	+GPS Tx DATA
S	+SS Rx DATA
T	CHASSIS
U	SS MENU
V	+GPS Tx DATA

Table 2: Telesto (SS/GPS/422) Comms Connector Pinout

Appendix A

The GPS antenna connector is a standard female TNC bulkhead jack.

Table 3: GPS Antenna Connector

The RF antenna connector is a standard female N type bulkhead jack.

Table 4: RF Antenna Connector

Appendix B - External Cable Drawings

Associated Drawings		Revisions			
Parts List :12728a		Rev	Description	Date	Approved
		A	Initial Revision	01-12-2000	
		B	Changed circuitry on page 2	02-03-2000	

MECHANICAL DRAWING

From			To			Wire				
Signal Name	Conn	Pin	Signal Name	Conn	Pin	Part	Run	Colour	Pairing	Length
+12V	P1	H		P3	+			RED	NONE	1.5m
+12V	P1	H	+12V	P4		W2		RED	NONE	1.5m
12V RTN	P1	G		P3	-			BLK	NONE	1.5m
-Tx DATA	P1	D	-Tx DATA	P2	2	W1		BLK	NONE	1.5m
+Tx DATA/RS232 Tx	P1	E	+Tx DATA/RS232 Tx	P2	7	W1		GRN	NONE	1.5m
+Rx DATA/RS232 Rx	P1	S	+Rx DATA/RS232 Rx	P2	3	W1		RED	NONE	1.5m
-Rx DATA	P1	F	-Rx DATA	P2	8	W1		WHT	NONE	1.5m
ISO GND	P1	L	ISO GND	P2	4	W1		DRAIN	NONE	1.5m
ISO MENU	P1	U	MENU	P4		W2		GRN	NONE	1.5m
CD	P1	K	CD	P4		W2		WHT	NONE	1.5m
ISO GND	P1	J	ISO GND	P4		W2		BLK	None	1.5m

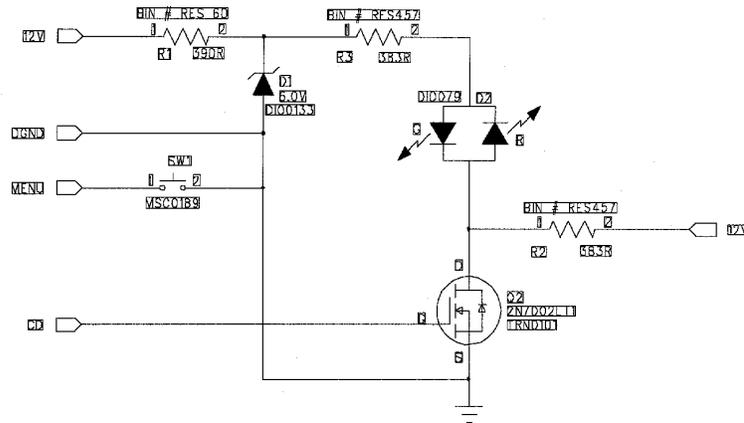
<p>Nanometrics 250 Hertzberg Road Kanata, Ontario, Canada K2K 2A1</p>	Title Telesto (SS) (SS/GPS/422) Config. Cable				
	DWG No.	File Name	Drawn By	Engineering Approval	Date
	12726	12726b.axd	B.Prahl		
	Revision	Page	Date	Production Approval	Date
B	1 OF 2	02-03-2000			

Appendix B

Associated Drawings	Revisions			
	Rev	Description	Date	Approved
	A	Initial Revision	01-12-2000	
	B	Changed circuitry on page 2	02-03-2000	

Assembly Instructions

1. Assemble P4 using the mechanical drawing and schematic, Fig.1
2. Isolate solder joints and resistors with heat shrink tubing.
3. Assemble the cable as per the mechanical drawing and wiring list.
4. Install 1/16" shrink tubing on all soldered connections.
5. Assemble P4 as shown in fig.1 and the cable drawing.
6. Install labels.



250 Hertzberg Road Kanata, Ontario, Canada K2K 2A1	Title Telesto (SS)(SS/GPS/422) Config. Cable				
	DWG No.	File Name	Drawn By	Engineering Approval	Date
	12726	12726b.axd	B. PRAHL		
	Revision	Page	Date	Production Approval	Date
B	2 of 2	02-03-2000			

Appendix B

Doc. Number:	12749	Approved:	Date:
Revision:	A	Hardware Eng.	
File Name:	N:\Drawings\12749a.lwp	System Eng.	
Title:	Callisto Telesto (SS) RS232 pin change over module as		
Originator:	H Booyens		
Date:	March 3, 2000		

Revision History:

Rev.	Date	Author	Description
A	March 3, 2000	HLB	Initial revision.

Callisto Telesto (SS) RS232 pin change over module assy instructions

1. Obtain a DB-9 modular jumper box (Part #9PFFJB from B&B Electronics).
2. Set the jumpers of the adapter according to the jumper table, Table 1 given below.
3. Label the adapter with the drawing number and revision, and the title "Telesto SS pin change over module".
4. Label the connector on the one end "PC com port" and the other "Telesto SS". The labels should correspond to the pin configuration in the jumper table.

Telesto SS		PC Com Port	
DB-9 Pin	Signal Name	DB-9 Pin	Signal Name
7	SS Tx	2	RX
3	SS Rx	3	TX
4	GND	5	GND

Table 1: Jumper Box Setting

Appendix B

Doc. Number:	12771	Approved:	Date:
Revision:	A	Hardware Eng.	
File Name:	N:\Drawings\12771a.lwp	System Eng.	
Title:	Interface Module for B&B electronics 422LP9R Rs422/2		
Originator:	H Booyens		
Date:	March 3, 2000		

Revision History:

Rev.	Date	Author	Description
A	March 3, 2000	HLB	Initial revision.

Interface Module for B&B electronics 422LP9R Rs422/232 Converter

1. Obtain a DB-9 modular jumper box (Part #9PMFJB from B&B Electronics).
2. Set the jumpers of the adapter according to the jumper table, Table 1 given below.
3. Label the adapter with the drawing number and revision, and the title "DWG12771 422LP9R Interface Module".

Male Connector		Female Connector	
DB-9 Pin	Signal Name	DB-9 Pin	Signal Name
3	Tx	3	TX
2	Rx	2	RX
5	GND	5	GND
7	RTS	4	DTR
4	DTR	4	DTR

Table 1: Jumper Box Setting

Appendix C - Outline and Installation Drawing

