

AIS Developer Studio

Release Version 1.0

ITU-R M.1371-5 Technology

MARINE RADIO WORKSHOP

AIS Transmission / Reception Discontinuity Detection
MODULE

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Objective

The objective for the use of the AIS Developer Studio is to create a general VDL environment using a PC and optional external RF signal generator / power pad. Where the choice of the base-band VDL / VDO and VDM data is easily analyzed and defined. As an AID to AIS

This product should only be used for the purposes intended by its developers and then only according to acceptable reference standards and operating procedures.

Any deviation from this may well be in conflict with competent regional authorities in your area.

The AIS Developer Studio and or Interface/s should not be used to alter the operational status of any AIS unit unless authorized by a competent authority.

Under no circumstances should the AIS Developer Studio and or Interface/s be used to create any signal content outside the scope of this document using any procedure or method offered by the AIS Developer Studio Interface.

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AISTE.ST formerly Sine Qua Non would like to take this opportunity to congratulate you on the purchase of one of the AIS Developer Studio suite of products. We want to assure you that this product range is designed using over 22 Years of AIS experience and thoroughly tested to ensure your complete satisfaction.

A demonstration program is provided free of charge. AISTE.ST requires that the user download the demo program and documentation from www.aiste.st and validate it for their respective use prior to placing an order for the un-encumbered licensed version.

Limited Warranty.

Where software discrepancies are identified and or module operational bugs are found. These should immediately be brought to the attention of AISTE.ST. The warranty is limited to the rectification of the discrepancy or bug by software upgrade, and should not exceed the original operational and technical specification as defined by AISTE.ST in the respective AIS Developer Studio module.

If you have any questions, queries or customisation requests related to this product, please do not hesitate to contact us by email:

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Thanking you,

AISTE.ST



Installation

The installation of AIS Developer Studio is as follows. This is a controlled distribution.

Obtain the latest version and license.txt from www.aiste.st. Create a new folder. Save the downloaded files in the folder. Run the application. This will allow the unit to run in demo mode.

AIS Developer Studio is not freeware.

Once you have evaluated it for your purpose please purchase your license file from www.aiste.st. Save your purchased license.txt file in the above-mentioned folder. This will allow the application to run in full un-unencumbered mode.

The license file will provide full user registration details.

Registered users will receive support if any problems with AIS Developer Studio arise.

ALL requests for support should be addressed to support@aise.st explaining any bug or discrepancy as well as a screenshot.

It is the intention of AISTE.ST through the current and further development of the AIS Developer Studio suite of components to continue to supply a cost effective method for development, production, integration and verification of protocols as used by AIS, ASM and VDE.

It is the intention of AISTE.ST to supply upgrades to the AIS Developer suite user group if and when they become available.

Users may subscribe to this upgrade service.



AIS 2019 Overview

For many of us, radio communication is a part of our everyday life. AIS systems have become a convenient method of communication and management. We have come to count on them! We depend on them.

Without them - we feel information is limited. Some are established as a base station to provide means of contacting other AIS units or perhaps issue virtual aids to navigation.

Others are mobile mounted to keep us informed of changes in our daily routine. Yet other types are aids to navigation or ATONS and emergency position-indicating radio beacon station AIS EPERBS. Some are fixed, some we carry around, but ALL may one day develop defects. Often they are not very serious.

The cost of re-furbishing a marine radio workshop to service AIS may prove daunting and prohibitive. In most cases hardware repairs followed by operational verification is what is required.

Add Minimal Cost AIS Capability

AIS Developer Studio provides a cost effective way of adding AIS capability to any "Radio Service Workshop".

Whilst two-way radio technicians provide hardware repair capability, the use of the standard communications monitor is desirable as in most cases it does not have to be re-capitalized.

A cheap commercial AIS receiver adds VDL reception capability to the system components.

External modulation of the Radio Communications Test Set using AIS Developer Studio PMG2 module allows real time operational verification of AIS Transceiver whilst monitoring the AIS protocol stack of the equipment under test.

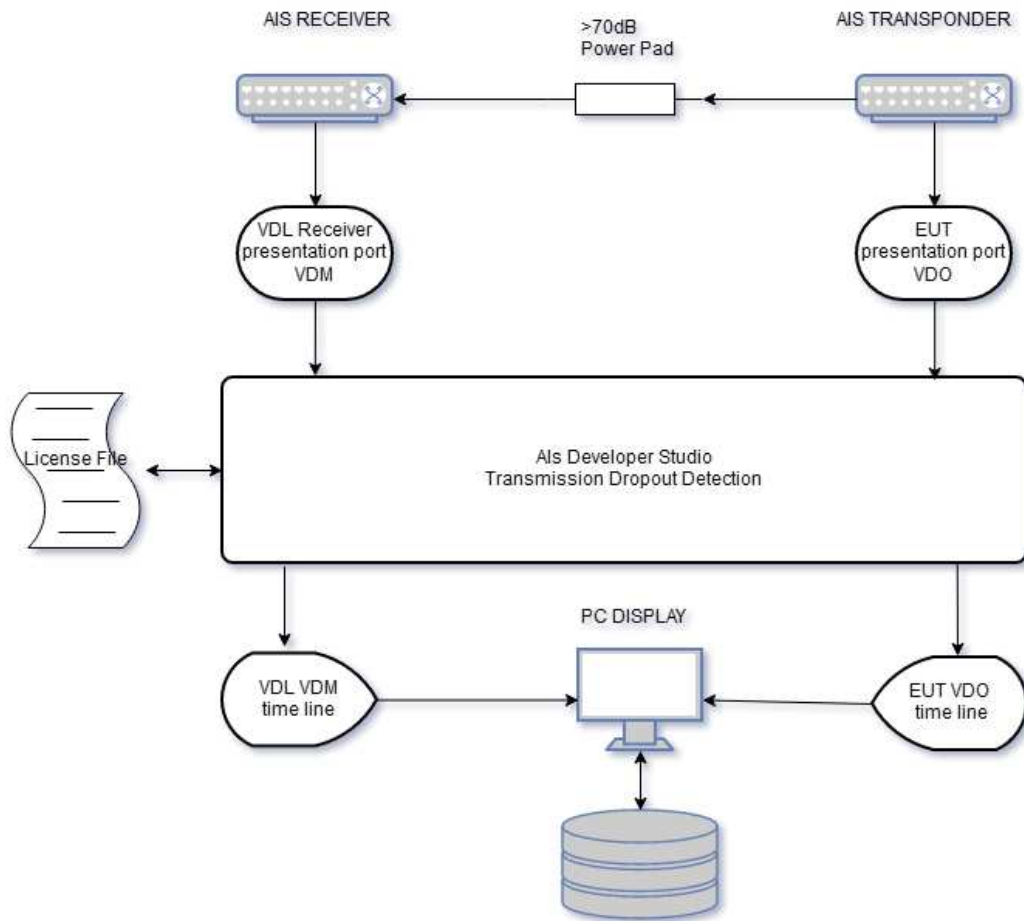
AIS Developer Studio adds [AIS Transmission / Reception Discontinuity Detection](#) to its range of modules.

Viable detection of static report rate, lost or dropped transmissions, as well as corrupted receptions, can be verified on the workbench.

This allow for a high level of confidence that the AIS hardware is performing the way it was designed.



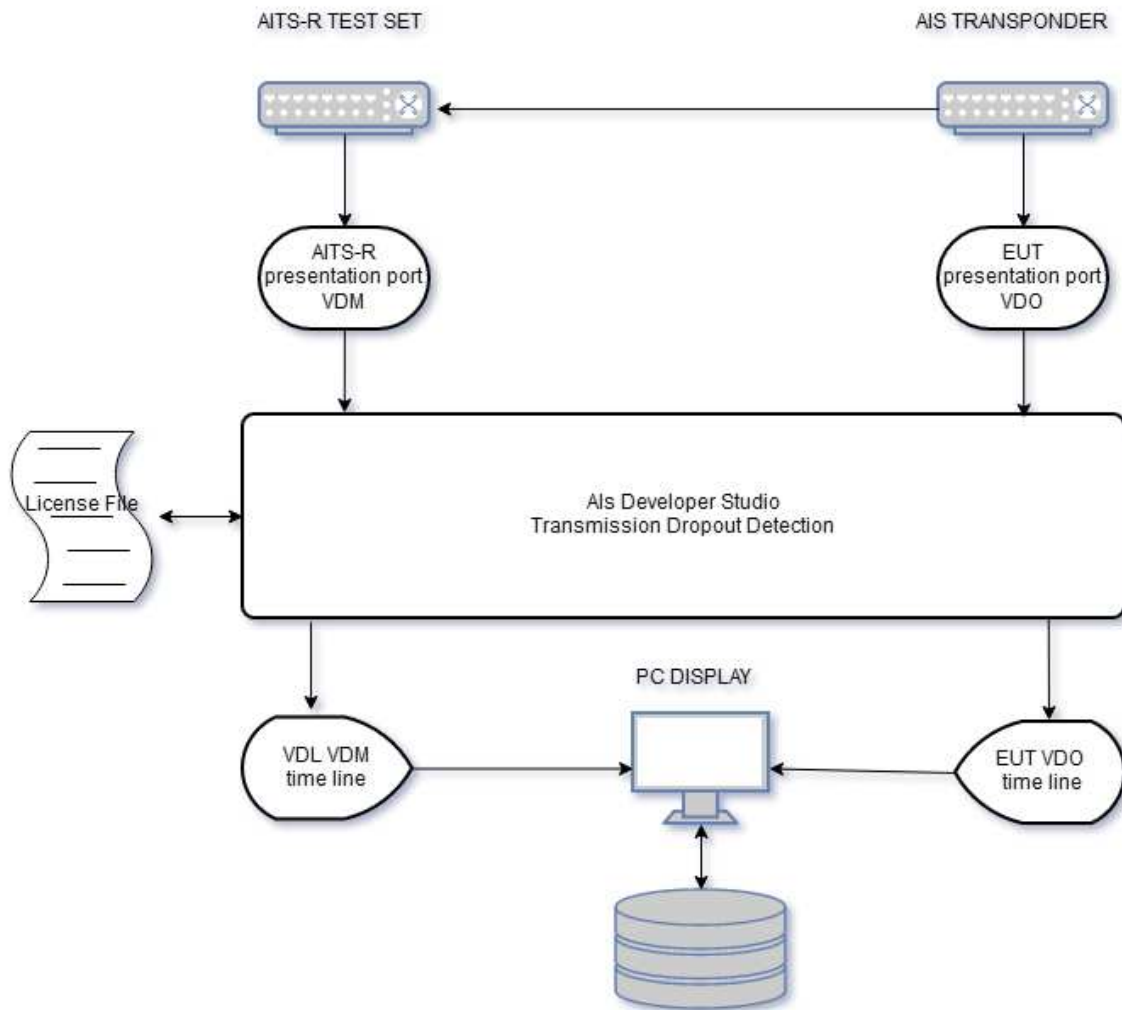
Verification set-up A - Closed VDL System



COMn = Marine Data Systems MIV AIS Transponder EUT VDO presentation port
COMn = SAAB R3 AIS Transponder VDL RX VDM presentation port



Verification set-up B - Closed VDL System



COMn = Marine Data Systems MIV AIS Transponder EUT VDO presentation port
COMn = Sine Qua Non AITS-R Test Set VDM presentation port



NTP / SNTP

The AIS Developer Studio uses NTP/SNTP network lock to obtain a relative UTC time base. All events are time stamped with the NTP/SNTP network lock.

NTP

The Network Time Protocol (NTP) is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks. In operation since before 1985, NTP is one of the oldest Internet protocols in current use. NTP was designed by David L. Mills of the University of Delaware.

SNTP

Simple Network Time Protocol (SNTP) is a simplified version of Network Time Protocol (NTP) that is used to synchronize computer clocks on a network. This simplified version of NTP is generally used when full implementation of NTP is not needed.

The accuracy of the UTC time stamp is dependent on your network lock of choice.

Method of measurement

Setup hardware as per **Verification set-up - Closed VDL System. (A or B)**

- Make use of **EXTERNAL RF POWER PADS.**
- Make use of WINDOWS compatible USB Comport to RS232 /RS422 bridges.

Please be advised that as far as USB devices are concerned WINDOWS 10 is WINDOWS 10. It stands alone.

NB: If a usb comport bridge says that it is windows compatible it is probably referring to every generation except WINDOWS 10. If it doesn't say WINDOWS 10.....

As a rule we only use USB Comport RS232 /422 Bridges that make use of FTDI technology.

FTDI supply a range of windows drivers on their site. <https://www.ftdichip.com>



Hardware Setup Procedure

Connect EUT VDO presentation port to USB to RS232 / RS422 cable bridge.
Connect VDL RX VDM presentation port to USB to RS232 / RS422 cable bridge.



Using PUTTY or similar Communications Program verify reception of EUT VDO strings.

```
COM1 - PuTTY
$PMDSSN,0054,9,4,4,4,3,1*70
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
!AIVDO,1,1,,B,1000F;QP?w<tSF014Q@>4?v01PS7,0*40
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
!AIVDO,1,1,,A,1000F;QP?w<tSF014Q@>4?v01pIN,0*00
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
!AIVDO,1,1,,B,1000F;QP?w<tSF014Q@>4?v01PS7,0*40
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
$AIALR,165341.00,006,V,A,AIS: general failure*07
!AIVDM,1,1,,B,121P7E0P?w<tSF014Q@>4?wvqd01,0*19
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
!AIVDO,1,1,,A,1000F;QP?w<tSF014Q@>4?v01pKp,0*3C
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
$AITXT,01,01,90,MODE aut RR030 SyncM V MMSI000005678 NRships001 RB N*11
$AITXT,01,01,91,VDL1 TX161975000hz .50 RX161975000hz .50 2W M G B 25kHz*42
$AITXT,01,01,91,VDL2 TX162025000hz .50 RX162025000hz .50 2W M G B 25kHz*41
$AITXT,01,01,91,VDL3 TX156525000hz .50 RX156525000hz .50 12W M F B 25kHz*50
$AITXT,01,01,92,FP 329 RP 7 PAT 394*3B
!AIVDO,1,1,,B,1000F;QP?w<tSF014Q@>4?v01d01,0*11
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
!AIVDO,1,1,,,1000F;QP?w<tSF014Q@>4?v01P00,0*66
```



Using PUTTY or similar Communications Program verify reception of VDL VDM strings.

```
COM3 - PuTTY
$GPGGA,,,,,0,00,,M,,M,,*66
!AIVDO,1,1,,B,121P7E0P?w<tSF014Q@>4?wvqd01,0*1B
$GPVTG,,T,,,,N,,K*03
$PMCAg,900,NCD,L*48
!AIVDO,1,1,,121P7E0P?w<tSF014Q@>4?wvqP00,0*6C
$GPGSV,1,1,00,,,,,,,,,,,,,*79
$GPZDA,001217.00,06,01,1980,,*64
$GPGGA,,,,,0,00,,M,,M,,*66
$GPVTG,,T,,,,N,,K*03
!AIVDM,1,1,,B,1000F:QP?w<tSF014Q@>4?v01PS7,0*42
$PMCAg,900,NCD,L*48
!AIVDO,1,1,,121P7E0P?w<tSF014Q@>4?wvqP00,0*6C
$GPZDA,001218.00,06,01,1980,,*6B
$GPGGA,,,,,0,00,,M,,M,,*66
$GPVTG,,T,,,,N,,K*03
$PMCAg,900,NCD,L*48
!AIVDO,1,1,,121P7E0P?w<tSF014Q@>4?wvqP00,0*6C
$GPZDA,001219.00,06,01,1980,,*6A
$GPGGA,,,,,0,00,,M,,M,,*66
$GPVTG,,T,,,,N,,K*03
!AIVDM,1,1,,A,1000F:QP?w<tSF014Q@>4?v01`BQ,0*06
$PMCAg,900,NCD,L*48
!AIVDO,1,1,,121P7E0P?w<tSF014Q@>4?wvqP00,0*6C
```

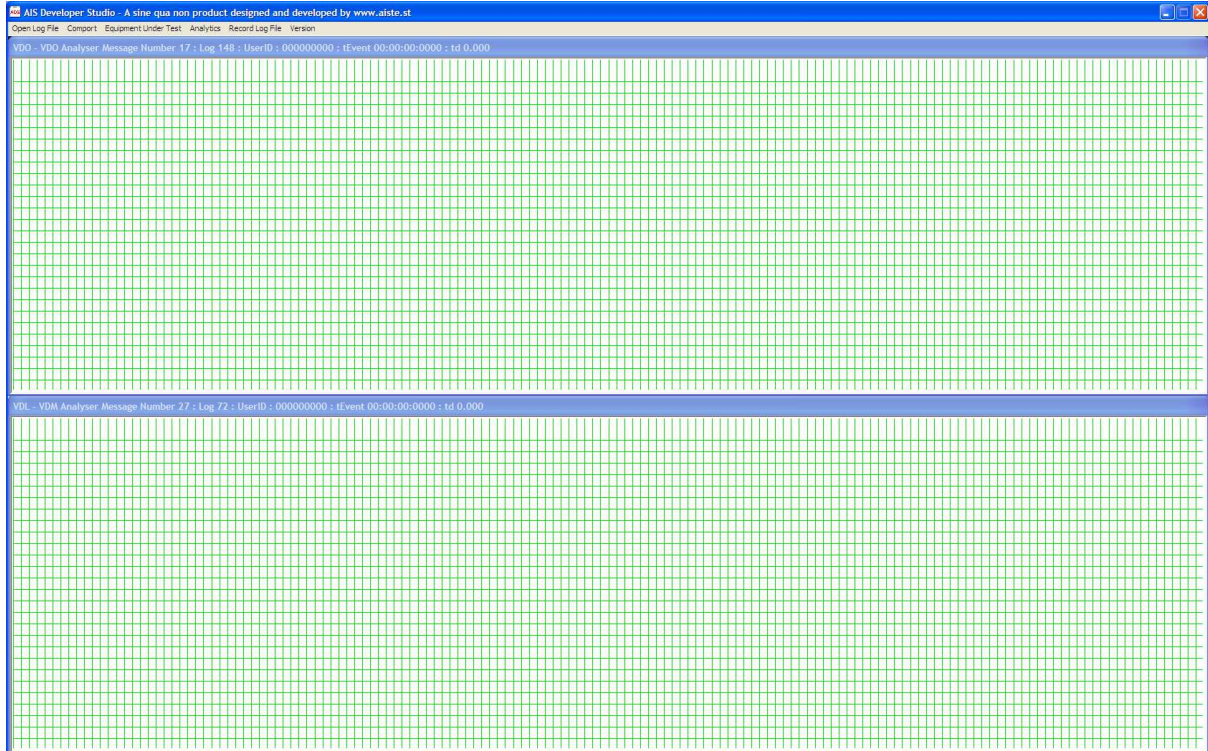
You have now verified that your hardware configuration, wiring and PC setup is functional.

You have now concluded Hardware Setup Procedure

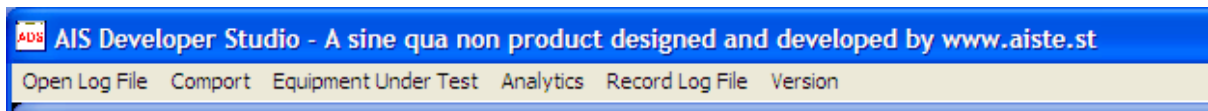


Start AIS Developer Studio

- Select and open license file
- AIS Developer Studio main VDO / VDM time line window is displayed.

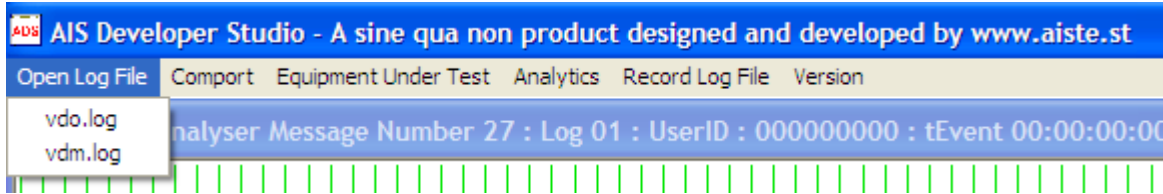


Main Menu

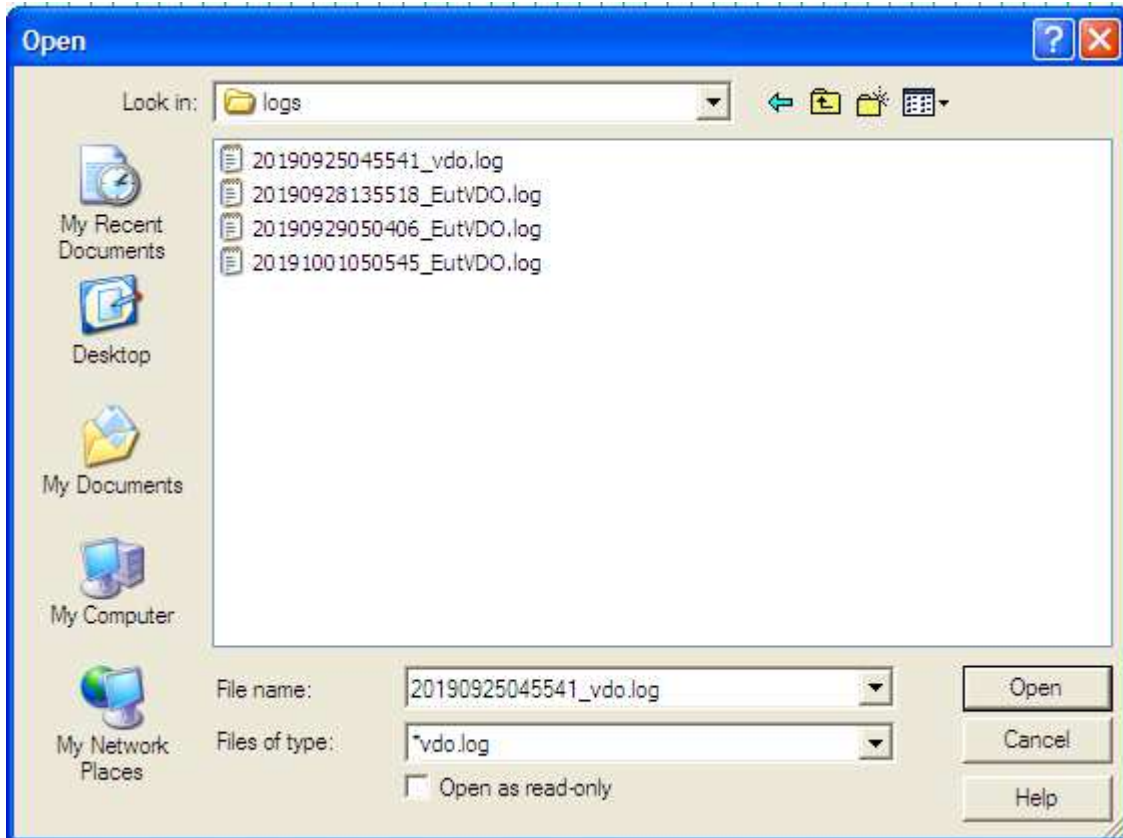




Open Log File

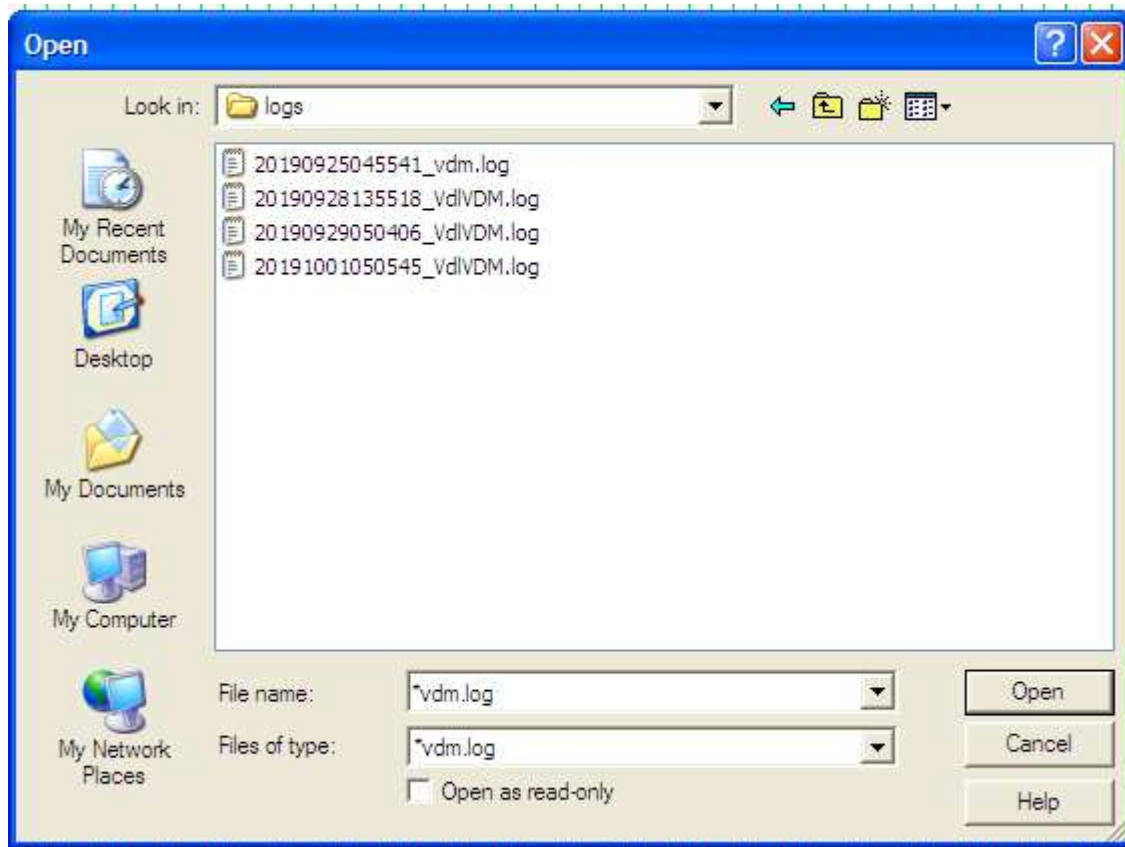


Vdo Log File: display snapshots of all recorded vdo.log sessions





Vdm Log File: display snapshots of all recorded vdm.log sessions

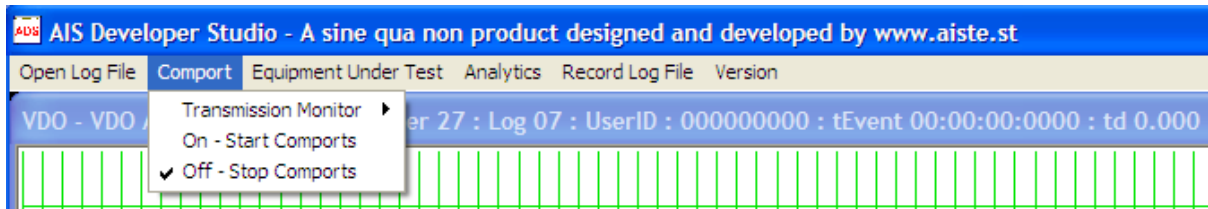


NOTE:

You must use matching date and time stamped vdo.log and vdm.log files.



Select Menu ->Comport

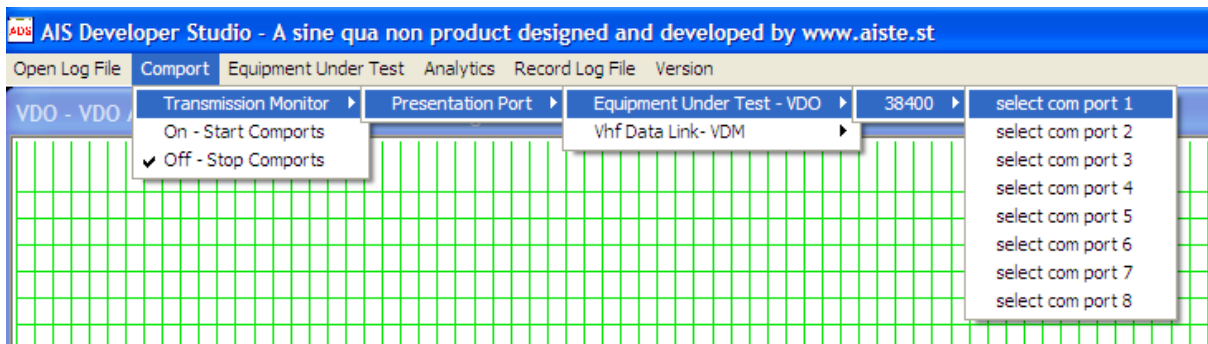


Transmission Monitor-> requires that you setup two comports.
One for EUT VDO strings and one for VDL VDM strings.

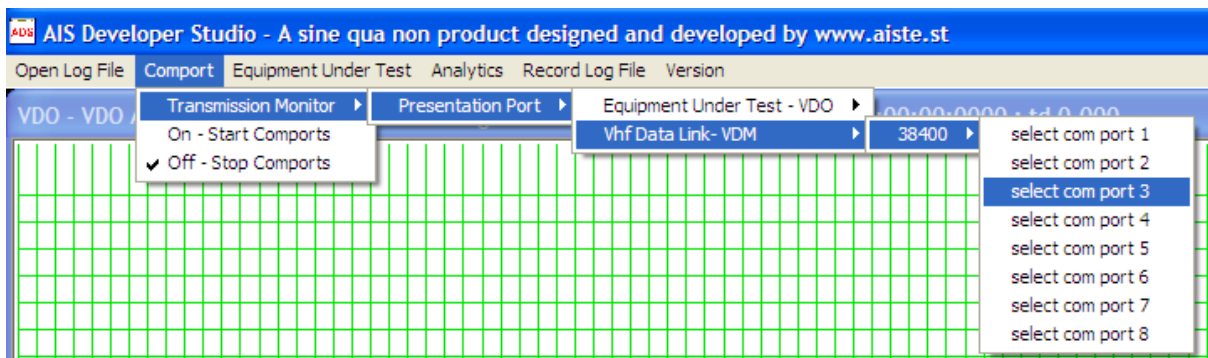
You have already found and verified the two comports on your (PC) machine in the Hardware Setup Procedure.

We allocate those two comports as follows.

EUT VDO



VDL VDM

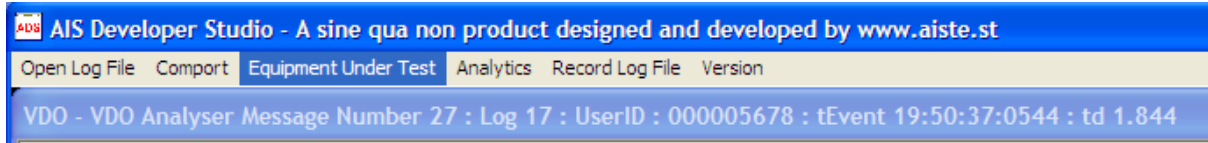


ON – Start Comports:
Selecting this will enable comport string's.

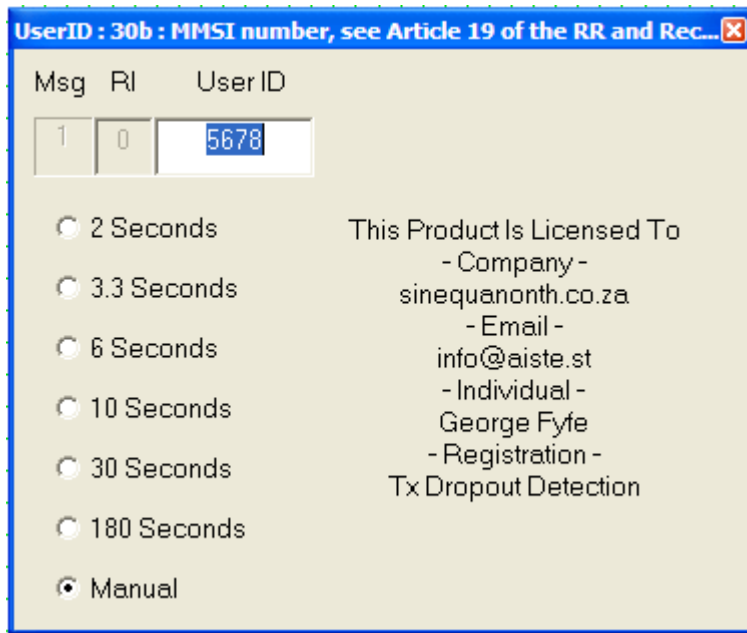
OFF – Start Comports:
Selecting this will disable comport string's.



Select Menu ->Equipment Under Test



Set Equipment Under Test UserID



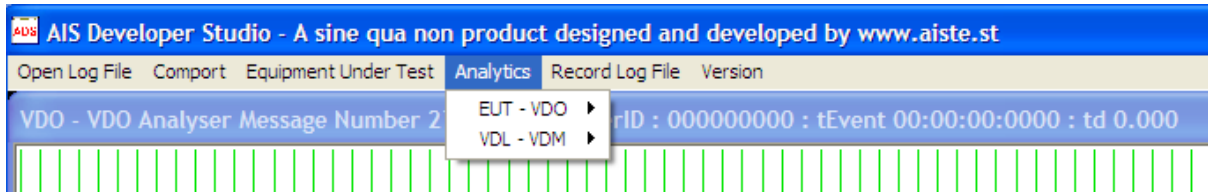
NOTE:

If you are recording a snapshot then you must enter the EUT userID.

If you are analyzing a recorded snapshot then you must enter the recorded snapshot reporting rate.



Select Menu ->Analytics

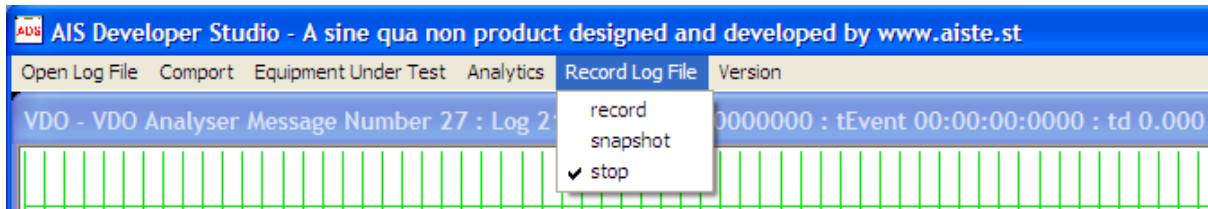


Selection of slot timing or slot offset can be made using this menu option. It must be made for the VDO time line as well as the VDM time line.

Placing the mouse cursor on either the EUT VDO or VDL VDM timelines and right clicking the mouse will display the analysis graph for the current 150 tracks on display.



Select Menu ->Record Log File

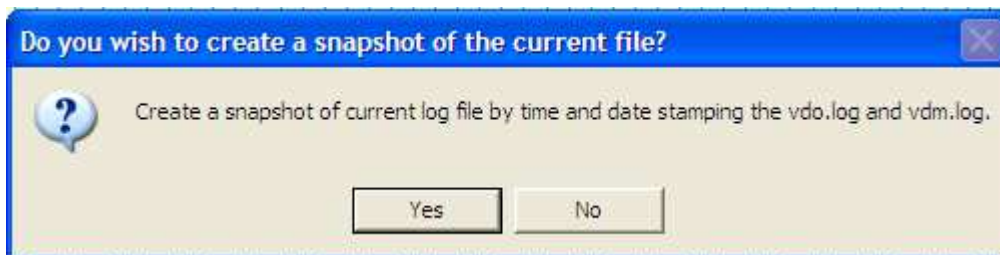


RECORD-> if already open-truncates file size to zero. If not open automatically creates two files for logging data. You must enter a EUT UserID in order for recording to take place.



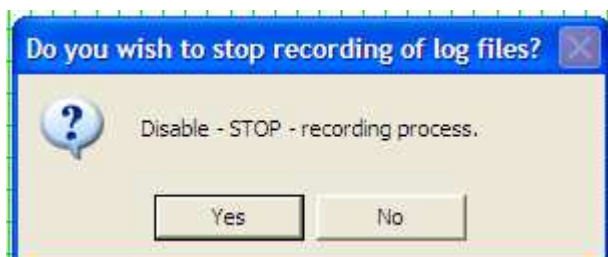
VdIVDM.log
EutVDO.log

SNAPSHOT->Date and time stamps VdIVDM.log and EutVDO.log files.



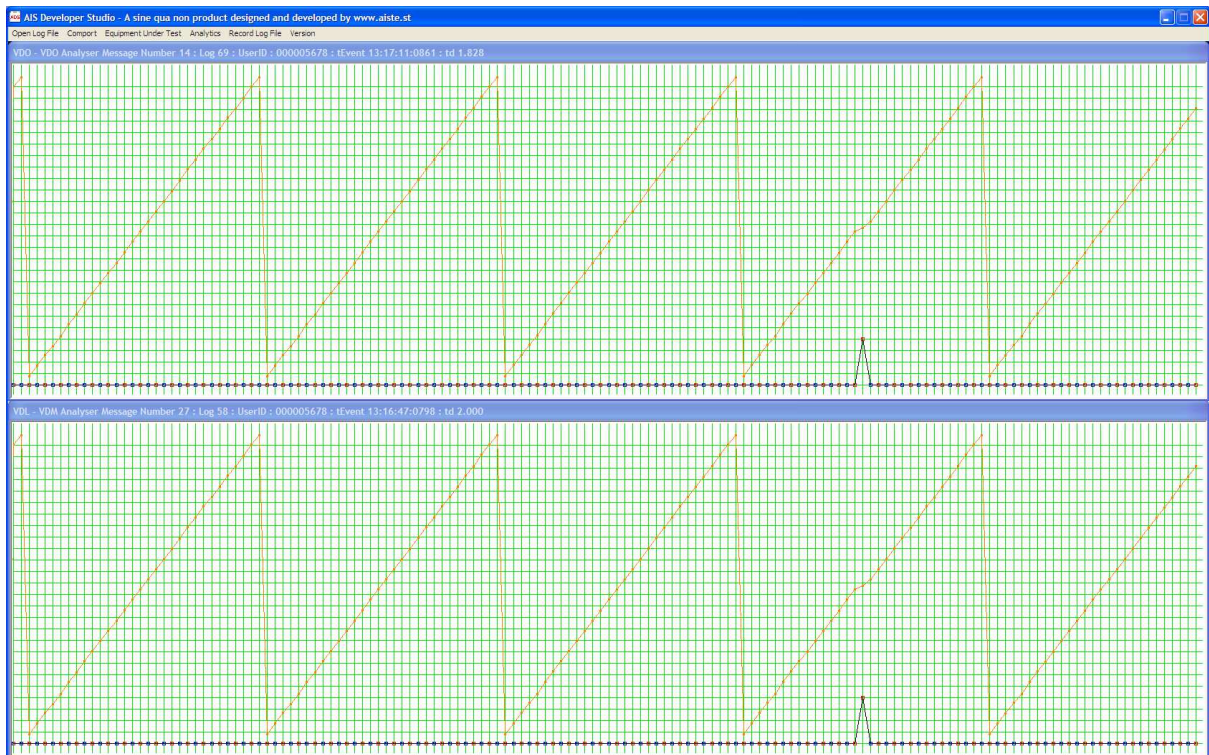
20191002091921_VdIVDM.log
20191002091921_VdIVDO.log

STOP->Disables recording process of VdIVDM.log and EutVDO.log





Real Time Analysis Of Verification set-up A - Closed VDL System
Create a folder for your version of AIS Developer Studio
Save the ADS application supplied to you in this folder
Save the ADS license file supplied to you in this folder
Complete Hardware Setup Procedure
Validate the Network Time Synchronization capability on your PC
Start your version of AIS Developer Studio
Open License File
Enable Comports
Enter Equipment Under Test UserID
Enable Comport Strings = On - Start Comports
Verify UserID VDO display in timelines
Verify UserID VDM display in timelines



Select Menu -> Record Log File -> record
First Log UTC Start Time Stamp -> 2019.09.24.19.50.03.528
You now need to allow the recording process to continue for the time you have allotted for the evaluation.
Select Menu -> Record Log File -> snapshot
Last Log UTC Stop Time Stamp -> 2019.09.25.04.55.41.403
Select Menu -> Record Log File -> stop
Disable Comport Strings = Off - Stop Comports
At this point you have created two log files of data which have been time stamped by the application using the SNTP UTC lock on your PC.
You have disabled any further real time input via the comports.



In the following order....

Menu Item -> Open Log File -> Open vdo snapshot file - 20190925045541_vdo.log

Menu Item -> Open Log File -> Open vdm snapshot file - 20190925045541_vdm.log

Make sure time stamps are the same!

Snapshot VDO and VDM timelines should be displayed

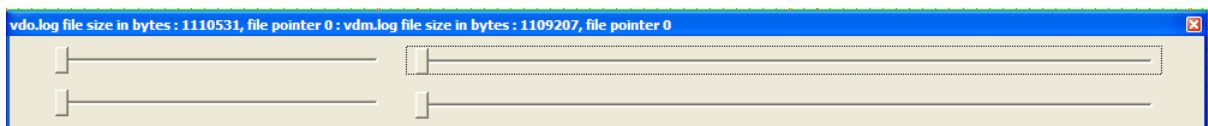


Select Menu ->Equipment Under Test

Select recorded report rate = 2 secs

Close Equipment Under Test dialog

Press PC Keyboard ->Space Bar-> File Pointer Dialog is displayed

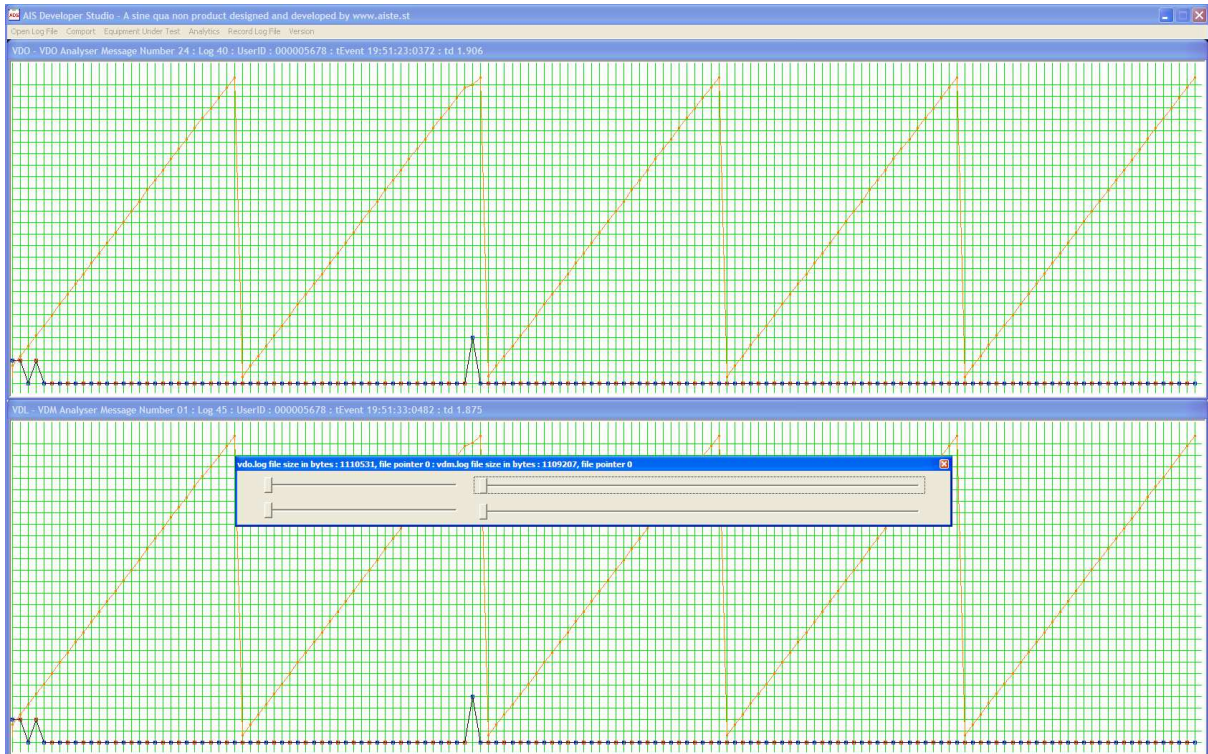


This dialog is used to change / set the file display pointers.

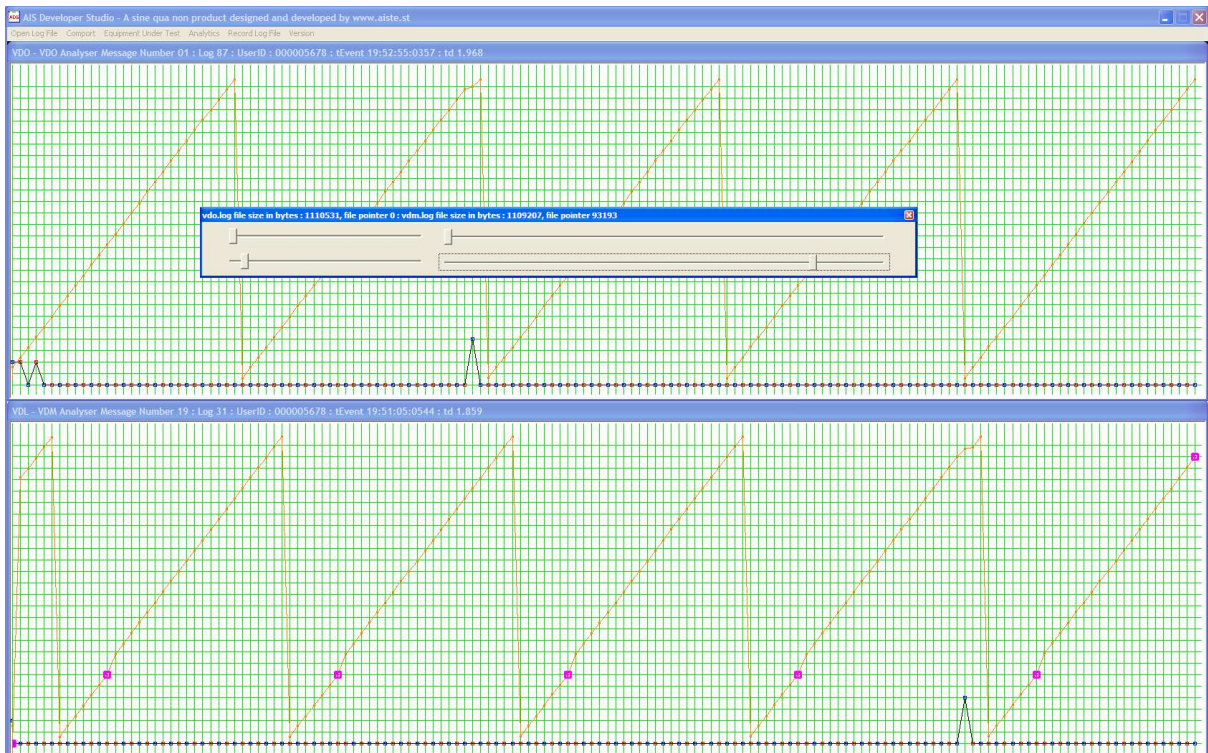
Use the mouse to click on or move the vdo and vdm slider.

At this point the two snapshot files are loaded into memory. The report rate for the analysis gives an indication of when a transmission should happen. By selecting this radio button the application will automatically indicate any discontinuity of transmission.

Once static report rate has been selected the display will indicate the starting point of a transmission discontinuity (missing transmission) with a purple square.



The read file pointer is made from the sum of the MSB and LSB tracker bars.
Using the file sliders, fast scan through the display(file) looking for a purple marker that will indicate the start of a transmission discontinuity.





AIS Developer Studio V2

If we place the AIS Developer Studio mouse cursor on the purple marker we can read the tEvent UTC time stamp.

The first set of transmission / reception **errors** are found at the following tEvent stamps.

Purple Marker tEvent	Next Marker tEvent	tDiff(seconds)
20:36:13:419	20:36:17:497	4.078
20:37:13:419	20:37:17:497	4.078
20:38:13:419	20:38:17:497	4.078
20:39:13:419	20:39:17:497	4.078
20:40:13:450	20:40:17:607	4.157

Prior to this first test the reporting rate as set on the Marine Data System MIV was 2 sec.
So all transmissions should have a **NOMINAL** 2 sec slot offset.

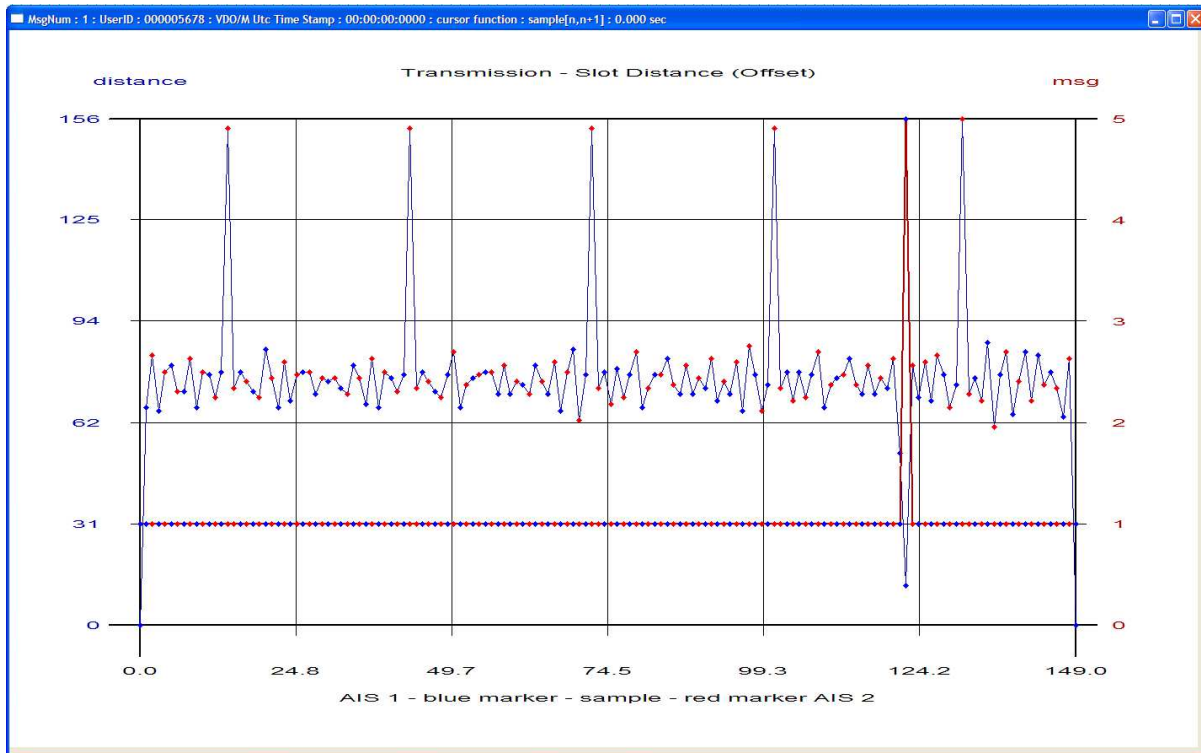
Using the tracker bars place the purple markers in the center of the timeline screen.

If the indication is in the EUT VDO timeline->select analytics->EUT VDO->slot offset

If the indication is in the VDL VDM timeline->select analytics->VDL VDM->slot offset

Place the mouse cursor in the indicating VDO or VDM time line display->Right click the mouse.

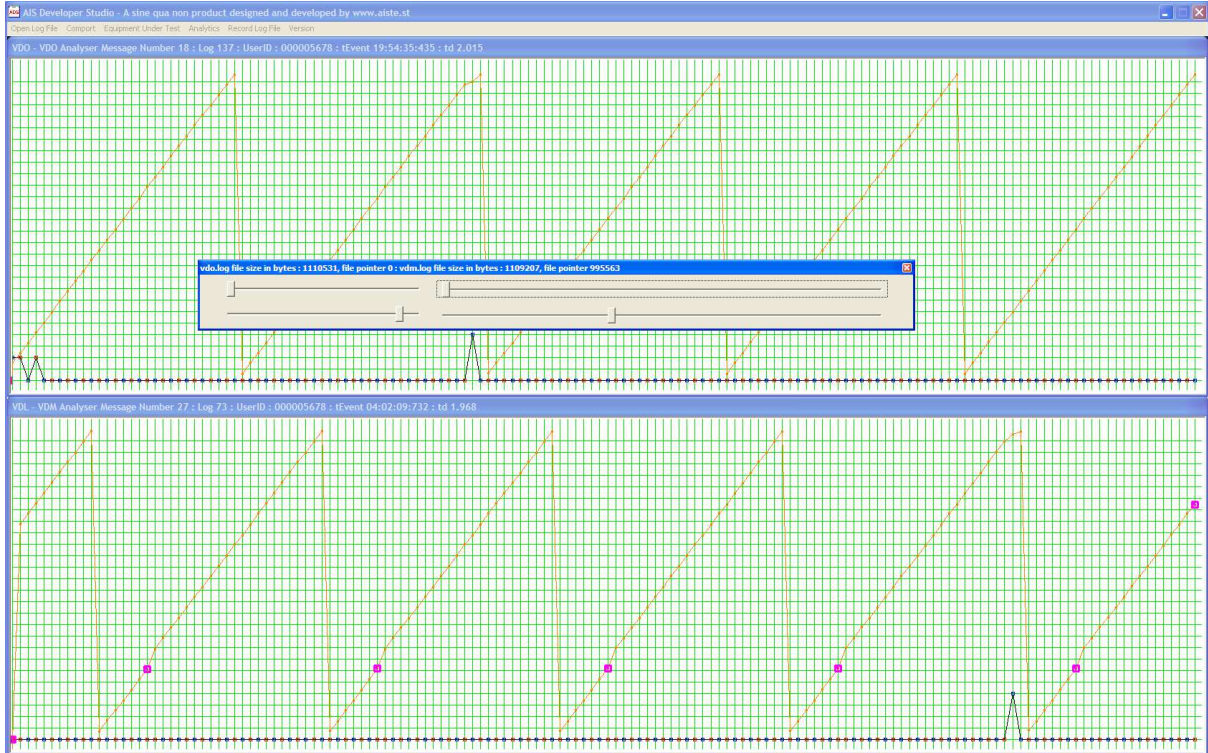
The Transmission Slot Offset Graph will be displayed.



If we view the VDM slot offset graph the discontinuities will become very evident. The nominal slot distance would be $(2s / 0.02666666s) = 75$. Any missing transmission will become graphically evident in the slot distance plot.

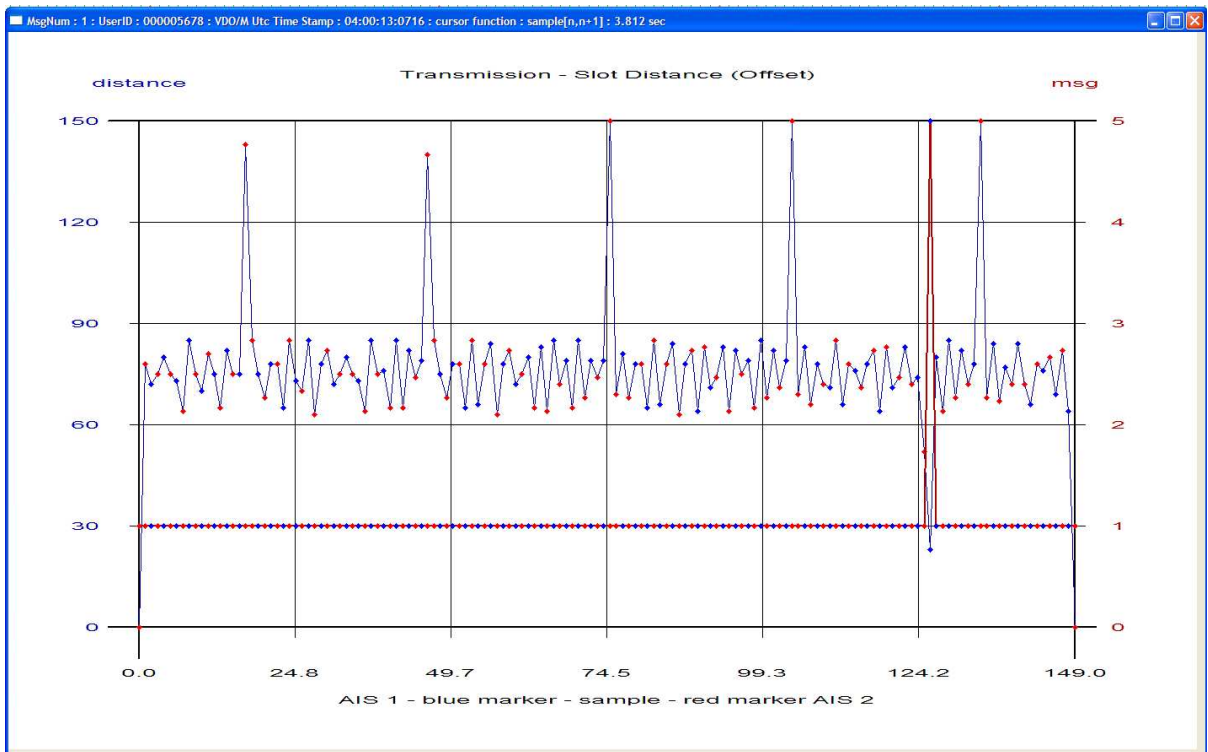
Number of actual VDO tracks to VDM tracks – 2 second report rate	
20190925045541_vdo.log	16552
20190925045541_vdm.log	16533

Non correlation between VDO and VDM tracks



A second set of identical transmission / reception errors are found starting at the following tEvent stamp.

Purple Marker tEvent	Next Marker tEvent	tDiff(seconds)
04:00:13:716	04:00:17:528	3.812



If we view the VDM slot offset graph the discontinuities will become very evident.

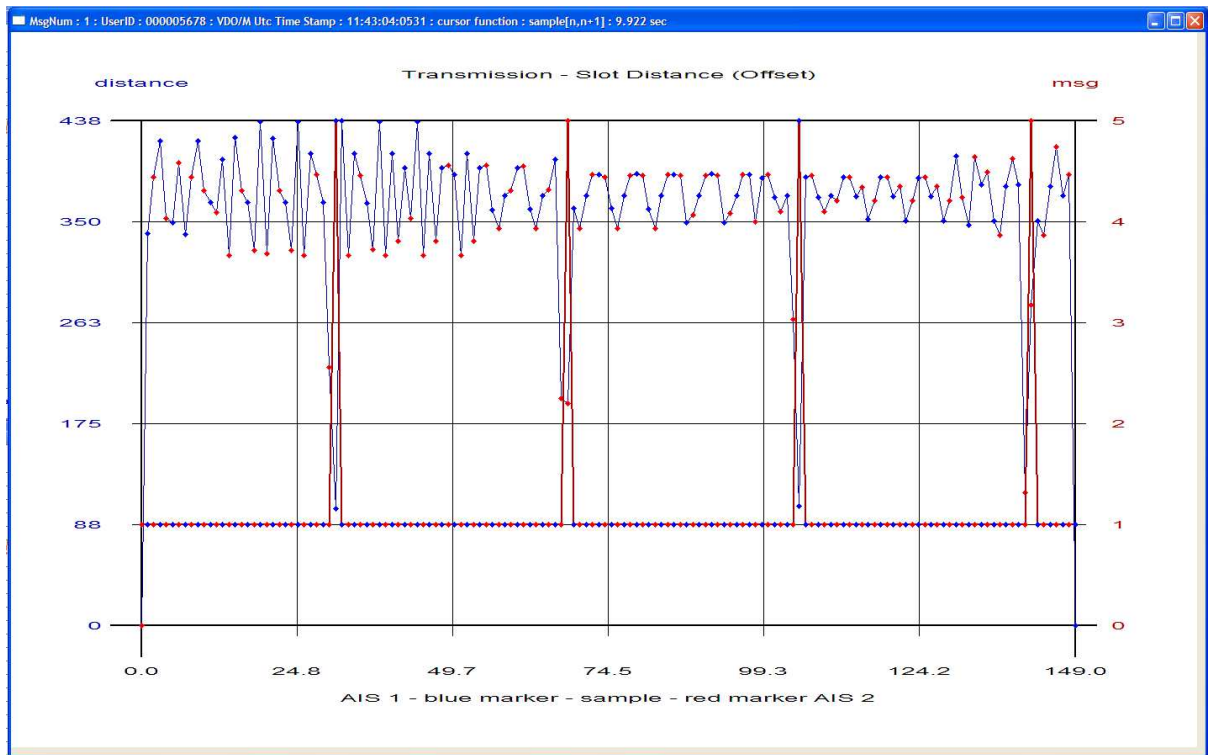
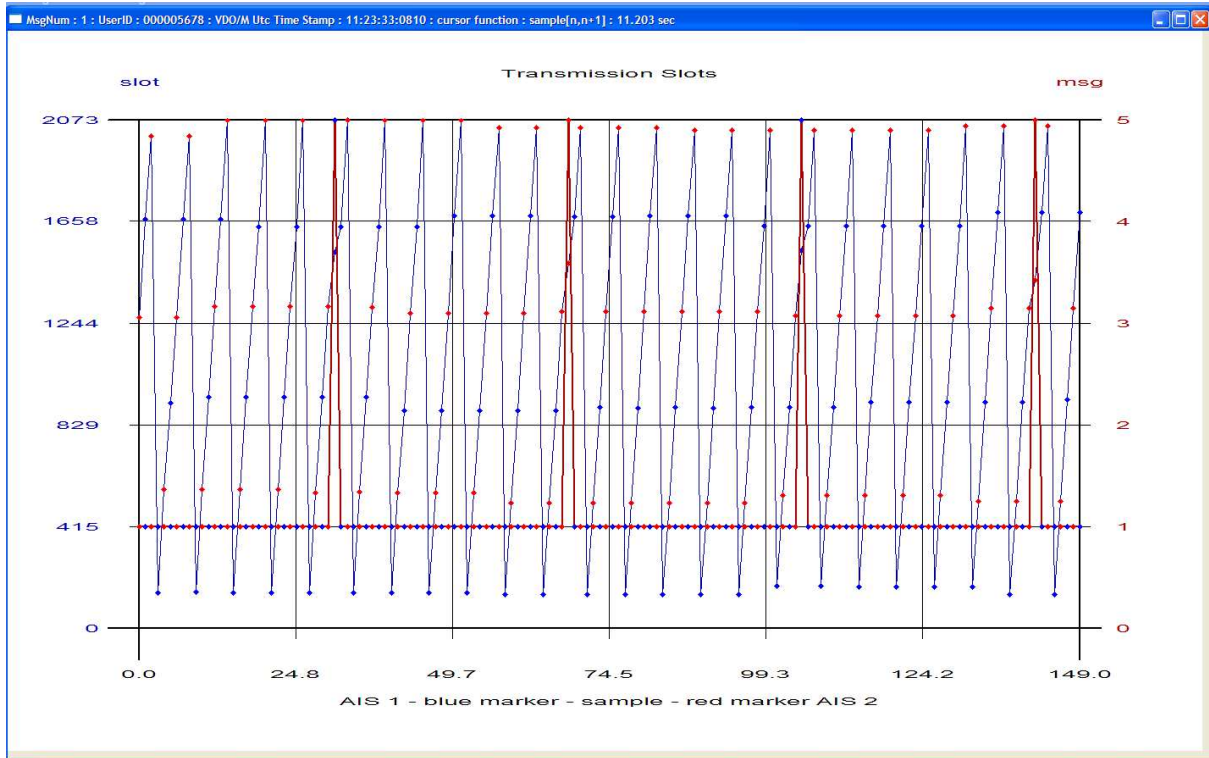


AIS Developer Studio V2

A second test setup was created using a third control. One of which we have a lot of confidence in. Namely our own AITS-R test set with the following results.

Real Time Analysis Of Verification set-up B - Closed VDL System
Create a folder for your version of AIS Developer Studio
Save the ADS application supplied to you in this folder
Save the ADS license file supplied to you in this folder
Complete Hardware Setup Procedure
Validate the Network Time Synchronization capability on your PC
Start your version of AIS Developer Studio
Open License File
Enable Comports
Enter Equipment Under Test UserID
Enable Comport Strings = On - Start Comports
Verify UserID VDO display in timelines – 10 second updates
Verify UserID VDM display in timelines – 10 second updates
Start recording - 2019:09:30:11:23:33:810
Stop recording - 2019:10:01:05:05:43:580
Enable Comport Strings = Off - Stop Comports
Comparison of VDO /VDM as for Real Time Analysis Of Verification set-up A





The nominal slot distance would be $(10s / 0.02666666s) = 375$.

Number of actual VDO tracks to VDM tracks – 10 Second Report Rate	
20191001050545_EutVDO.log	6728
20191001050545_VdIVDM.log	6728
100% pass on all VDO and VDM tracks	



Abbreviations

The following is a list of abbreviations used in the AIS Developer Studio Suite

1pps	1 pulse per second
ACK	Acknowledge
AIS	Automatic Identification System
AIS1	Automatic Identification System channel 1 (161.975 MHz)
AIS2	Automatic Identification System channel 2 (162.025 MHz)
ANT	Antenna
BER	Bit Error Rate
BIT	Built In Self Test
BS	Base Station
BT	Bandwidth Time product
COG	Course over Ground
DBR	Differential Beacon Receiver
DSC	Digital Selective-Calling
DTE	Data Terminal Equipment
ECDIS	Electronic Chart Display and Information System
ECS	Electronic Chart System
EPFS/D	Electronic Position Fixing System/Device
ETA	Estimated Time of Arrival
GPS	Global Positioning System
HDLC	High-level Data Link Control
IEC	International Electro-technical Commission
IO	Input-Output
ITU	International Telecommunication Union
KDU	Keyboard Display Unit
LR	Long Range
MMSI	Maritime Mobile Service Identities
PMG	Programmable Modulation Generator
PA	Power Amplifier
PC	Personal Computer
PER	Packet Error Rate
PI	Presentation Interface
RF	Radio Frequency
ROT	Rate of Turn
RX	Receive
SOG	Speed over Ground
TDMA	Time Division Multiple Access
TX	Transmit
UTC	Coordinated Universal Time
VDL	VHF Data Link
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio
ADS	AIS Developer Studio V2
NTP	Network Time Protocol
SNTP	Simple Network Time Protocol
ADS	AIS Developer Studio
SNAPSHOT	EUT VDO + VDL VDM recording session



Reference Documents

List of standards and specifications

Document Number	Title
IEC 61162-1	Maritime Navigation and Radio Communication Equipment and Systems - Digital Interfaces: Part 1 - Single Talker and Multiple Listeners.
IEC 61162-2	Maritime Navigation and Radio Communication Equipment and Systems - Digital Interfaces: Part 2 - Single Talker and Multiple Listeners High Speed Transmission.
IEC 61993-2 IEC 62287 IEC 62320	Universal Shipborne Automatic Identification System (AIS).
ITU-R M.1084-2	Interim solutions for improved efficiency in the use of Band 156-174Mhz by stations in the Maritime Mobile Service.
ITU-R M.1371-5	Technical characteristics for a universal ship-borne automatic identification system using time division multiple access in the maritime mobile band.
ITU-R M.493	Digital Selective Calling (DSC) system for use in the Maritime Mobile Service.
ITU-R M.823-2	Technical characteristics of differential transmissions for global navigation satellite systems from maritime radio beacons in the frequency band 283.5 - 315 kHz in region 1 and 285-325 kHz in regions 2 and 3.
ITU-R M.825-3	Characteristics of a transponder system using DSC techniques for use with vessel traffic services and ship-to-ship identification.
ITU Manual	ITU Manual for use by the Maritime mobile and Maritime Mobile-Satellite Services.
IEC 61108-1	Global navigation satellite systems (GNSS) - Part 1: Global positioning system (GPS) - Receiver equipment - Performance standards, methods of testing and required test results.
IEC/EN 60945	Maritime Navigation and Radio communication equipment and systems – General requirements-methods of testing and required results

List of Related Software and Manuals

Module	Description	Part number
AIS Developer Studio Software for Windows. Verified to run on WINXP and WIN10	A Windows based application for configuring and testing various AIS products. Various levels of user access available dependent on licence.	Client dependent
PuTTY	Communications Application <i>PuTTY is copyright 1997-2019 Simon Tatham.</i>	



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