DELPHI

DV User's Manual

DV Version 1.27.41.00

Document Version 1.8

DELPHI

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Revision History

Doc Version	DV Version	Date	Author	Changes
1.0	1.15.39.09	20060922	LRH	Initial revision, contains only documentation for CAN Trigger function.
1.1	1.15.39.10	20060929	LRH	Max number of CAN triggers has been increased to 45. Clarified definition of signal mask and trigger compare value.
1.2	1.16.40.06	20061031	LRH	Modified description of the Status Bar and Display Options Toolbar to match new implementation. Updated toolbar and menu descriptions. Began migrating general DV settings and use info from PowerPoint Help file.
1.3	1.19.01.03	20070712	RPA	Began Data Replay section by migrating information into Record to Video and Record to Image sections from PowerPoint Help file.
1.4	1.23.01.00	20080115	LRH	Add CAN bus config.
1.5		20080212	LRH	Add mention of XCP in status bar display
1.6	1.24.19.00	20080807	LRH	Modify CAN trigger file format specification. Signals now include scale factor and offset values. Trigger conditions are specified in engineering units.
1.7	1.26.25.00	20090320	SM	Added Video section including web cam usage for logging
1.8	1.27.41.00	20091123	SM	Updated web cam section to include the support of two different image sizes: 320x240 and 640x480.

DELPHI

1 Introduction

1.1 Supported CAN Interfaces

DV will automatically search for supported CAN cards on the host computer. Detected cards will be selected in the order indicated in the table below.

Each interface requires that the CAN hardware and drivers be correctly installed. For each supported card, the dll indicated in the table is supplied with DV, and must be located in the directory containing the DV executable (or in the library search path, which usually includes winnt\system32).

For best performance under high busload situations, Vector hardware is recommended. See Section 3.2 for info on CAN bus configuration in DV.

Table I. Supported CAN Interfaces

Brand	Search Order	Supported Cards	Required Library
Vector	1	CANCard-X CANCard-XL CANCase-XL (USB)	vcand32.dll
Softing	2	CANAC104 card (PC104)	canac104.dll
	3	CANcard-2 CANcard-SJA	cancard.dll
Kvaser	4	CANLap (PCMCIA and USB)	canlib32.dll

If more than two CAN channels are to be used simultaneously, then Vector hardware must be used, and the driver must be configured for Software time synchronization. Use the Vector Hardware tool in the Control Panel to set the synchronization method (use the tool to set General Information/Settings/Synchronize Hardware = YES). Hardware time-base synchronization and use of SyncBox and sync line not supported.

1.2 Minimum System Requirements

Processor Speed: 1.6GHz or higher

RAM Memory: 512MB or higher

Operating system: Windows 2000 or XP

Hard Disk: 1Gbyte free and relatively un-fragmented

2 Layout

2.1 Menus

DV's main menu appears in the upper left corner of the main display window.

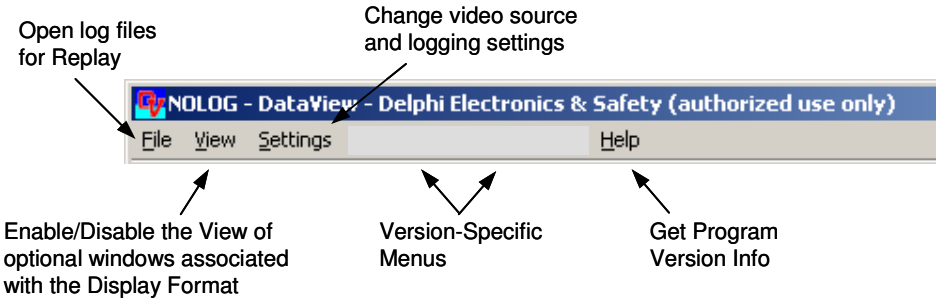


Figure 1. Main Menu

2.2 Toolbars

2.2.1 Receive / Logging

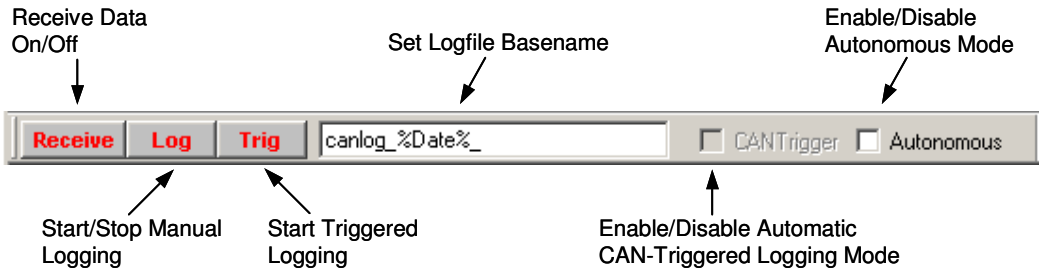


Figure 2. Receive/Logging Toolbar

2.2.2 Display Options

The display options toolbar controls how raw data is interpreted and displayed in both the Receive/Logging and Playback modes. The left-most drop-down box contains a list of the available Data Format interpretations (the sensor ACC3 is selected in the example below). The second box contains a list of the Display Formats or Views available for the selected Data Format. The remaining controls on this toolbar are specific to each particular Data/Display Format combination, and are documented elsewhere.

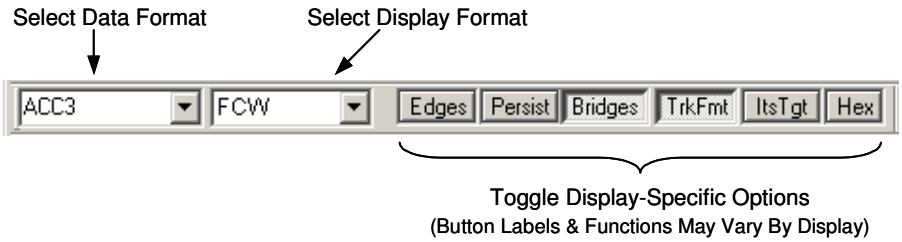


Figure 3. Display Options

2.2.3 Playback

This toolbar is visible only when a file is open for playback (e.g., the result of File/Open). The controls are self-explanatory, allowing one to move forward and back through the open file.

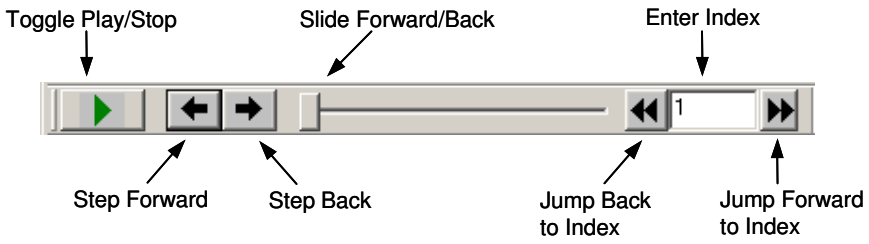


Figure 4. Replay Toolbar

For the Step Forward/Back buttons, the definition of one "step" depends on the Data/Display Format selections made on the Display Options toolbar (Section 2.2.2). For example, for a single radar sensor one step might be one scan, while for a multi-sensor system one step might move to the end of the next scan of either sensor.

All data collected with DV has some associated Index – either a native quantity supplied by the observed system (such as a scan or frame index), or one assigned by DV (such as a message or cycle counter). The nature and source of this index is dependent on the selected Data/Display Format. To account for possible rollovers in the Index, the "Jump" buttons allow one to search for a desired index in either direction.

2.3 Status Bar

DV's main Status Bar is located at the bottom of the main program window. It contains separate regions for Help, Receive Status, and CAN, Video and XCP Logging Status.

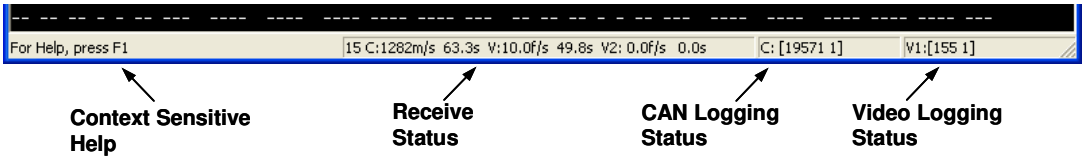


Figure 5. Main Status Bar

The help pane displays concise help information about the DV control (menu or toolbar element) the mouse is currently pointed at. Contrary to the text in the display, pressing F1 will not produce useful help. The content of the other panes is described in the next sections.

2.3.1 Receive Status Pane

The Receive Status Pane shows current statistics for CAN, Video and XCP receiving. The line below is a sample of the Receive status information for CAN plus one Video and one XCP source:

15 C: 1282m/s 63.3s V: 10.0f/s 49.8s V2: 0.0f/s 0.0s X: 40.0m/s 38.4s

The left-most element is a running counter of updates of this pane since receiving began. This counter is followed by four data blocks that provide information about the receipt of CAN (C:), Video (V:) and XCP (X:) data. Each data block contains the following information:

- Data rate (messages or frames) received per second (including any "generated" by DV)
- Data amount currently held in the queue (in seconds)

The Receive Status Pane is updated once every 4 seconds.

2.3.2 Logging Status Panes

Three Logging Status Panes show current statistics for CAN, Video and XCP logging. The example below is a snapshot of CAN (C:) logging information (video (V:) and XCP (X:) information is similar):

C: 104235 16

The two numbers in each CAN or Video block describe:

- The total number of messages or frames logged (written to file)
- The number of messages or frames remaining to be written (to catch up to receive)

The Logging Status Pane is updated once every 4 seconds.

While logging (systems with a constant average data rate), the number of messages/frames remaining will be constant or decreasing if the logging task is able to keep up with the receive task. If this number is increasing, the logging may eventually fall so far behind that new data will overwrite old data before it is written to the log file.

3 Settings

3.1 Log File Options

Log file name, location, and max duration can be selected with the menu item Settings/Log/Options. The resulting dialog box is shown below.

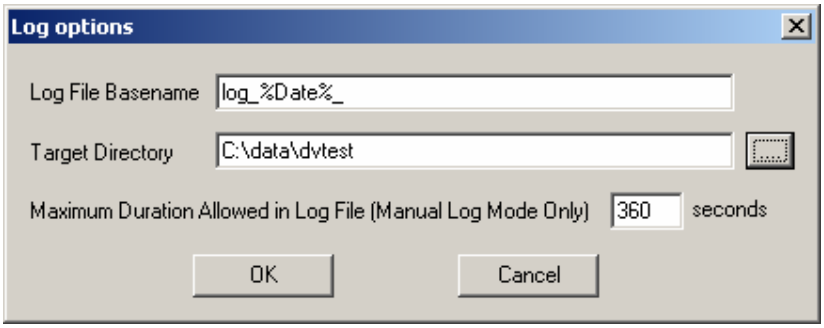


Figure 6. Log Options Dialog

3.1.1 Log Filename & Location

The user specifies the base filename and the directory where logs should be stored. DV automatically creates log filenames by appending a three-digit integer to the specified base name (e.g., mylog005.dvl). This integer increases by one for each new log file (logging event). If the specified base filename includes any of the special key strings shown in Table II, these will automatically be expanded to their respective quantities when the files are created.

Table II. Log Filename Auto-Expand Keystrings

Key string	Auto-Expands to
%Date%	Current date: yyyymmdd
%Time%	Current time: hhmmss

3.1.2 Log File Maximum Duration

The default maximum log file duration is 360 seconds (6 minutes). Once the log time has exceeded the specified duration, the current log file is closed and a new log file with incremented number is automatically started. Data during this transition period (1-2 seconds) are not logged.

3.2 CAN Bus

CAN bus options may be configured with the dialog reached via menu item Settings/CAN Bus. Currently, only the number of CAN channels to use can be selected. Verification and configuration of the channels is not performed until Receiving is started. See Section 1.1 for a list of supported hardware.

3.2.1 Channel Usage

Two or four channels may be selected for use. For PCMCIA card channels, a transceiver must be connected before channel initialization (on Receive), or the channel will not be activated.

3.2.2 Bus Parameters

CAN channel settings such as bus bit rate are currently hard-coded and not configurable. The bit rate on all configured channels is set to 500Kbps.

3.3 Video

DV can log video data up to two video sources simultaneously: one is called the Main video, the other Auxiliary video. The Main video is used as the primary video data, while the Auxiliary video is used for a second camera for ground truthing purposes.

The video data is stored in AVI files. The data from the Main video source is written to AVI files with the following naming convention: "*dvl_basename.avi*". Data from the Auxiliary video source is written to AVI files with "*dvl_basename_**v2**.avi"* naming convention.

To enable video logging, select the menu item Settings / Video Capture / Enable to enable video logging. Then select the menu Settings / Video Capture / Options to see available video sources for the Main and Auxiliary Video. **Error! Reference source not found.** and Figure 9 show the Main and Auxiliary video settings dialog boxes, respectively.

3.3.1 Main Video Settings

The Main Video Settings dialog box shown in **Error! Reference source not found.** is typically used to configure primary video logging interface. Some video sources are used specifically for customer specific programs, while others may be used for general video logging purposes.

On the dialog box, first the user selects the type of video source. Sub-options such as available video compressors (Codec) and frame rate vary depending of the video source selected.

For general video data logging purposes (e.g. to capture the driving scene), the user may select one of the following video sources: ImperX, ImperX Pro and Web Cam.

3.3.1.1 ImperX & ImperX Pro cards

There are three codec options available for these cards (uncompressed, Indeo and JpegLS). The user selects Quality for Indeo or Loss Level for JpegLS codec. In addition, the users must select the maximum logging frame rate. The recommended frame rate is 5 fps for ImperX card and 10 fps for the newer more efficient ImperX Pro card.

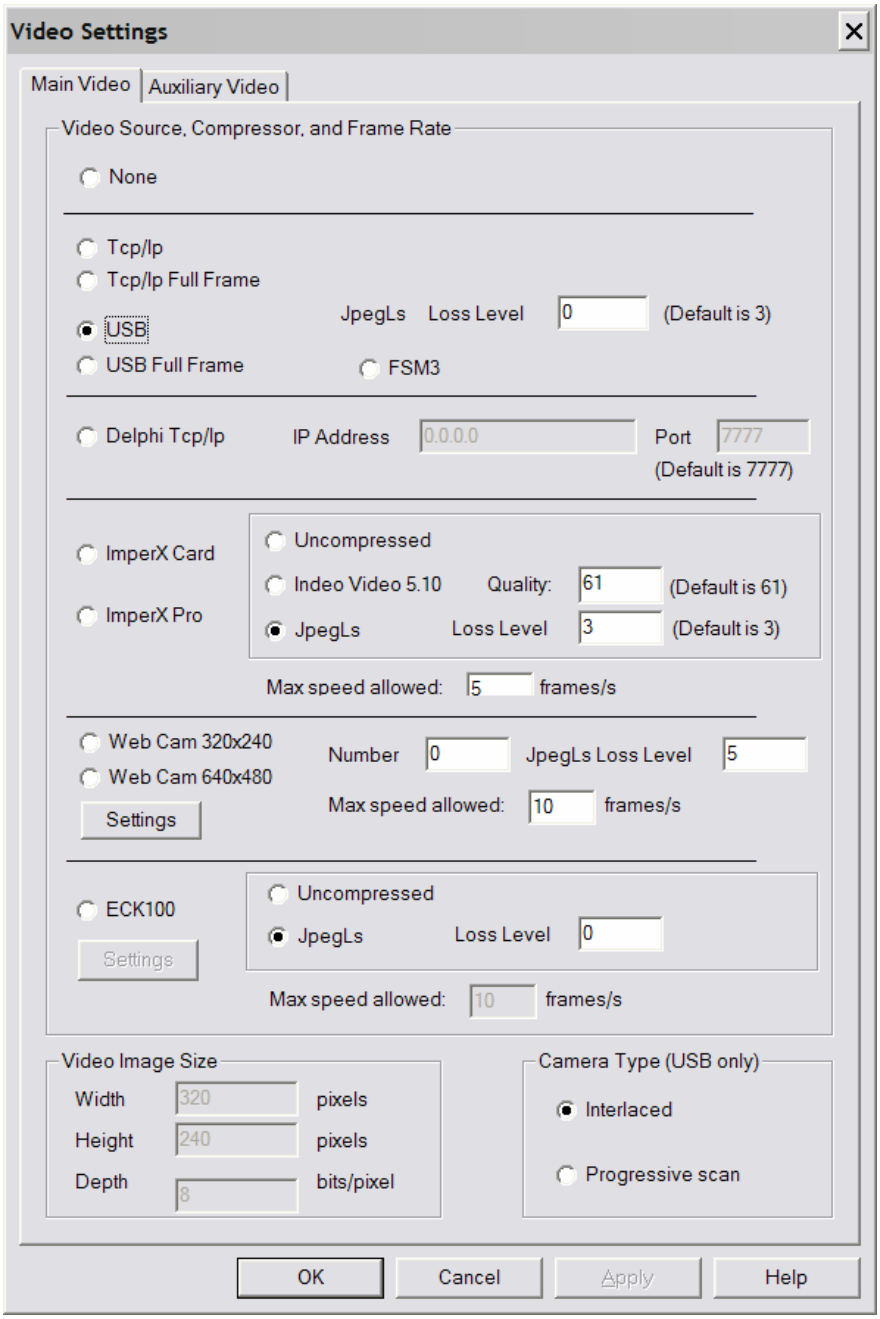


Figure 7. Main Video Settings

3.3.1.2 Web Cam

A web cam which supports VFW (Video For Window) interfaces can be used to log video data in DV. To use the web cam, follow the following steps:

1. Connect the web cam to the laptop
2. On the Main video settings dialog box, select Web Cam with your choice of image size, either 320x240 or 640x480, as the video source.
3. Click on the "Settings" button under the Web Cam radio box.

4. On the popup dialog box (should be the same or similar to the one shown in Figure 8), select the image resolution that matches your choice of image size. If there are codec options available, select RGB or uncompressed. If neither RGB nor uncompressed is available, select any of the codecs (a faster one is better) and make sure that the selected codec has been installed on the machine.
5. Leave the Number to 0.
6. Select a JpegLS loss level. Default is 3.
7. Choose a frame rate. Recommended frame rate is 10 – 15 fps. The user can verify the actual frame rate received during logging by watching DV status bar (see Status Bar section for details).
8. To lower the video file size, the user can either increase the loss level (the image quality become lower) or decrease the frame rate or both.

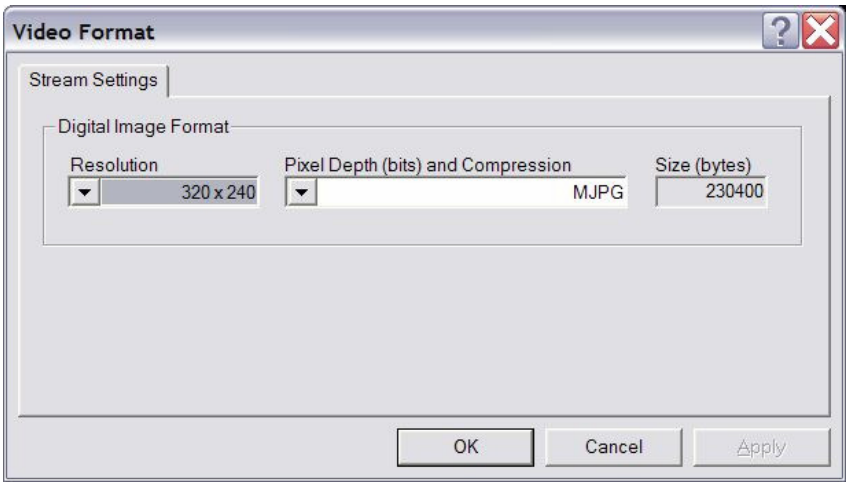


Figure 8. Web Cam Settings Dialog

3.3.2 Auxiliary Video Settings

The Auxiliary Video Settings dialog box shown in Figure 9 is typically used to configure a second camera for ground truthing purposes. There are less video sources supported for the Auxiliary video. Select “Not used” as the video source if there is data from a second camera to be logged.

ImperX and ImperX Pro can be used to log the secondary video data for general purposes. For the settings of these cards, see ImperX and PmperX Pro in the Main Video Settings section.

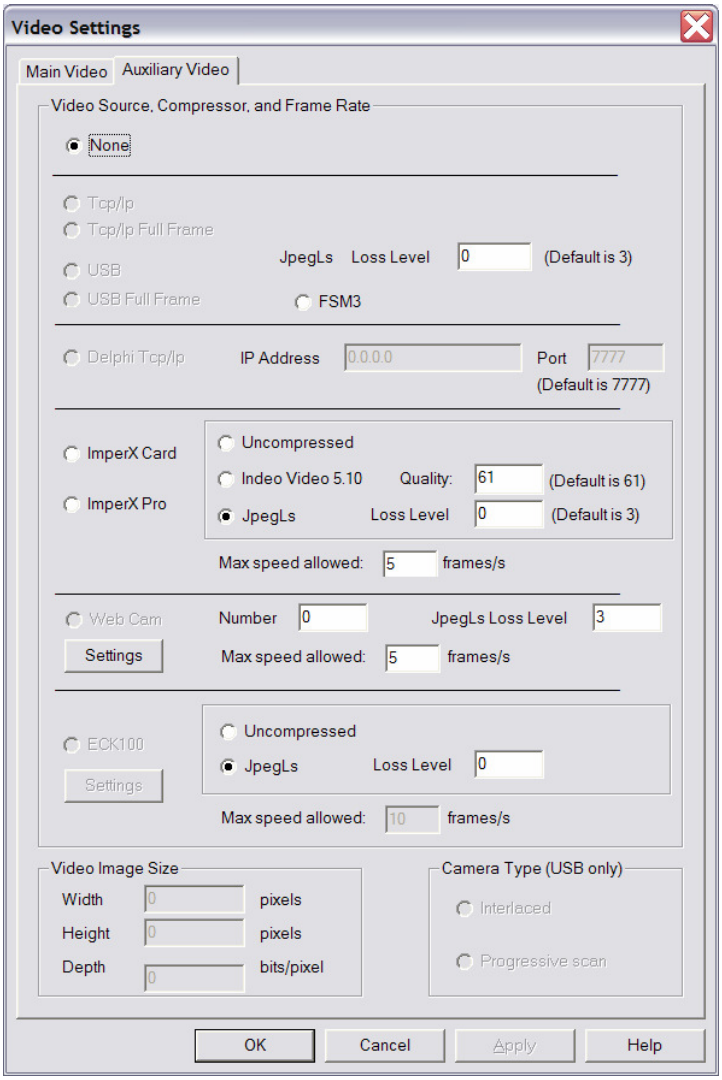


Figure 9. Auxiliary Video Settings

4 Manual Logging (This section not implemented)

4.1 Continuous Logging (This section not implemented)

4.2 Triggered Logging (This section not implemented)

5 Automatic Logging (CAN Trigger)

DV has the ability to automatically initiate logging when certain user-specified conditions are met in the received CAN data. For instance, one could identify the Signal *Warning* as certain bits of a particular CAN message, and then define a trigger Condition that is signaled each time Warning=1 occurs.

The current implementation initiates a fixed-length triggered log every time a defined trigger condition transitions from false to true.

5.1 Enable / Disable

Status of the Automatic Logging feature is reported by the CANTrigger checkbox on the Receive/Logging Toolbar (Section 1). This function is available only if DV is launched with the command line option **/t**. In addition, a specially formatted trigger configuration file (see Section 5.2) is required to define the CAN Signals and Trigger Conditions for the function. This file must be in the directory with the DV executable. Upon launch, DV will parse the configuration file, and construct a CAN Signal and Trigger Condition database. If no errors are detected, then Auto-logging will be made available (CANTrigger checkbox will be un-grayed) and the function will immediately be active/enabled (checkbox checked).

☐ CANTrigger	Not Available
☑ CANTrigger	Available, Enabled
☐ CANTrigger	Available, Disabled

When available, operation of the Automatic Logging feature can be enabled or disabled by the user. Disabling the feature will cause DV to ignore all trigger conditions and prevent auto-logging. This setting is not remembered from one launch to the next (use of the **/t** switch always enables auto-logging). When logging is not desired, the function must be manually disabled or receiving stopped.

5.2 Auto-Logging Modes

DV is intended to support the Auto-logging modes shown in Table III. Each of these modes is controlled by one of the following Trigger Objects:

- CAN Message Receipt – Monitors receipt of CAN messages with specified CAN Id and channel. Does not monitor data in the CAN message except possibly to determine that the correct message has been received (e.g., particular value in first data byte might signal the first of a sequence of same-Id messages).
- CAN Trigger Condition – A trigger Condition is defined as a list of one or more *Primitives*, each of which performs a single logical comparison on a defined Signal on the CAN bus. For example, a primitive might represent the comparison Speed > 30, or Warning = 1. The trigger Condition is *set* or *true* only when all of its primitives evaluate to true (e.g., TrigCondition = $Primitive_1$ AND $Primitive_2$ AND… $Primitive_N$).

Table III. Description of Autonomous Logging Modes

Mode	Trigger Object	Log Type	Description
ID	CAN Message Receipt	Fixed-length (pre+post trigger seconds) Triggered Log	Initiate a log when a particular CAN Message is received. The data in the message is not consulted. (not yet / no longer implemented)
EDGE	CAN Trigger Condition	Fixed-length (pre+post trigger seconds) triggered log	Initiate a log when the Condition transitions from false to true.
LEVEL	CAN Trigger Condition	Variable-length Continuous Log	Initiate a continuous log when Condition becomes true. Continues logging while Condition remains true. (not yet implemented)

The current system implements only the EDGE mode, designed to trigger on the rising edge of a Trigger Condition. It triggers when the Condition becomes true, and cannot re-trigger until the Condition becomes true again (necessarily becoming false in-between).

The various modes produce one of two types of logs:

- Fixed-length Triggered Log – Log collected as if the user pressed the Trig button on the Receive/Logging toolbar. The length of the log is pre+post trigger seconds (see Section 4.2 for details).
- Variable-length Continuous Log – Log collected as if the user pressed the Log button on the Receive/Logging toolbar. The log begins at the time of the event (no pre-trigger), and continues until the trigger Condition is no longer satisfied.

In all modes,the system will mark the location in the data where the trigger occurred. [It would be nice if the (name of?) the Condition that triggered the log was also recorded, but this is not yet implemented.]

5.3 CAN Trigger Definition File

The CAN trigger definition file contains the specification of CAN Signals in a way similar to how one might define a *Signal* in a Canalyzer Database (e.g. which message ID, which bits, etc.). The file also allows the specification of conditions or tests on these Signals that will trigger logging.

5.3.1.1 Format

The CAN trigger definition file is a text file consisting of three parts: the Version Identification Block, the Signal Definition Block, and the Trigger Condition Definition Block. These blocks must appear in the order listed. The beginning of each block is marked by a line containing a specific key string, and followed by subsequent lines that contain the signal or trigger definitions. The key string and format of each block are described in the following paragraphs, in which the sample definition file shown in Figure 10 is used as an example.

Any line beginning with a pound sign (#) denotes a comment. The parser ignores both comment and blank lines. All key strings and names (e.g., signal and trigger names) are case-sensitive. Detected file errors are described in Section 5.3.1.2.

```
#DV_CAN_TRIGGER V1.1
#
#   Configuration:  Sample Project X
#   Version:  2.1
#   Author: Lisa Hamilton
#   Date:  21 Sept 2006
#   Source: Project X Canalyzer Database V4.5 (projX.dbc)

CAN_SIG_DEF
# SIGNAL_NAME = CH, ID, START, SIZE, MASK, SIGN, FACTOR, OFFSET
Warning   = 2,074,3,1,10,U,1,0
#                                   true speed = signal/16 m/s
Speed     = 1,600,0,2,ffff,U,0.0625,0.0
#                                   true yaw rate = signal/16 d/sg

Yawrate   = 1,600,2,2,ffff,S,0.0625,0.0
Scan      = 1,601,0,2,ffff,U,1,0
ScanLow   = 1,601,0,2,1fff,U,1,0

CAN_TRG_ENA
```

```
# TRIG_NAME = SIGNAL, LOGIC, VALUE; SIGNAL, LOGIC, VALUE; ...
#                                                    30 m/s
HighSpeedWarn       = Speed,GE,30.0; Warning,EQ,1
LowSpeedWarn        = Speed,LT,30.0; Warning,EQ,1
Every6Min           = ScanLow,EQ,4096
#                                                    5 d/s
HighYawRight        = Yawrate,GT,5.0
HighYawLeft         = Yawrate,LT,-5.0
```

Figure 10. Sample CAN Trigger Definition File.

5.3.1.1.1 Version Identification

The first line of the configuration file must contain the specific Version Identification Key String that tells DV how to interpret the rest of the file. The current version string is: *#DV_CAN_TRIGGER V1.1.* Comments should be used in this block to provide custom version, date, author, and source information.

5.3.1.1.2 CAN Signal Definition

The CAN Signal Definition Block defines the CAN signals that DV will extract and monitor. Its beginning is denoted by a line containing the key string *CAN_SIG_DEF*. Subsequent lines provide the signal definitions, one per line.

Each signal is described by a unique name followed by a series of comma-separated descriptors as follows:

SIGNAL_NAME = CH, ID, START, SIZE, MASK, SIGN, FACTOR, OFFSET

A description of the parameters used to define the signal is presented below:

SIGNAL_NAME: Unique, descriptive name of CAN signal

CH: CAN channel to monitor, “CH1” or “CH2” (range: 1, 2).

ID: CAN message ID containing the desired signal, written as a 3-digit hexadecimal value (range: 0-7ff)

START: Byte offset to the byte containing the msb of the signal in the message (range: 0-7). Note that the byte numbering begins with 0 to match that used in the Message Layout view in Canalyzer.

SIZE: Size of the signal in bytes (range: 1-4). Single-bit boolean flags shall use a size of ‘1’ byte with the unused bits masked off using the MASK parameter.

MASK: Hexadecimal value used to mask ‘don’t care’ bits from the defined signal. The signal will be created by AND'ing this mask with the selected signal bytes and then shifting the result so that the least significant bit of the signal corresponds to the least significant high-bit in the mask. To use entire byte, set mask to "FF" for a 1-byte value, "FFFF" for a 2-byte value, etc. A mask of "A0" will result in a 3-bit signal created from the three high bits of the byte (but the value of the middle bit will be ignored, or treated as zero, when computing the signal value).

SIGN: Signal value should be treated as signed (S) or unsigned (U).

FACTOR: Multiplier used to compute actual signal value from CAN message bits(s). Equivalent to Vector CANdb++ Editor definition of signal FACTOR.

OFFSET: Constant offset applied after scale FACTOR to compute actual signal value. Equivalent to Vector CANdb++ Editor definition of signal OFFSET.

BYTE_ORDER: Byte order (not yet implemented). Only Motorola is currently supported.

Comments should be used in this block to clarify the meaning or units of signals and to note other useful information such as scale factors. See Table V for limits imposed on the number of Messages and Signals defined.

Examples

EX #1: Define the single-bit warning signal as bit 4 of the fourth byte of CAN message 0x074, channel 2.

```
Warning = 2,074,3,1,10,U,1,0
```

EX #2: Define Speed as the first two bytes of CAN message 0x600 on channel 1.

```
#                                   true speed = byte_value/16 m/s
Speed       = 1,600,0,2,ffff,U,0.0625,0.0
```

EX #3: Define the signed16-bit Yawrate as the third and fourth bytes of CAN message 0x600 on channel 1.

```
#                                   true yaw rate = byte_value/16 d/s
Yawrate     = 1,600,2,2,ffff,S,0.0625,0.0
```

EX #4: Define Scan as the first two bytes of CAN message 0x601 on channel 1. Also define ScanLow as the lower 13 bits of the same quantity.

```
Scan        = 1,601,0,2,ffff,U,1,0
ScanLow     = 1,601,0,2,1fff,U,1,0
```

5.3.1.1.3 CAN Trigger Condition Definition

The CAN Trigger Condition Block begins with the key string *CAN_TRIG_ENA* and defines the trigger conditions that DV will monitor. Following the key string line are trigger conditions, one per line.

Each trigger condition is defined according to the following syntax that specifies one or more primitives separated by semicolons:

TRIGGER_NAME = SIGNAL, LOGIC, VALUE; SIGNAL, LOGIC, VALUE; ...

The trigger condition descriptives are as follows:

TRIGGER_NAME: Unique, descriptive name of CAN trigger condition

SIGNAL: Name of signal defined in Signal Definition Block

LOGIC: Name of logical test to perform. The valid tests are:

- EQ : Equal to VALUE
- NE : Not equal to VALUE
- LT : Less than VALUE
- LE : Less than or equal to VALUE
- GT : Greater than VALUE
- GE : Greater than or equal to VALUE

VALUE: Comparison value defining scaled signal value (expressed in engineering units, e.g. m/s) that will initiate trigger.

Comments can be used in this block to clarify the meaning of triggers and to note other useful info such as scale factors. See Table V for limits imposed on the number of Primitives and Triggers defined and on the number of Primitive defined for a single Signal.

Examples

EX #1: Trigger when a warning is issued (Warning bit set to 1) and the Speed >= 30m/s. Speed comparison value includes scale factor of 128 needed to compensate for un-scaled signal.

```
#                                                    30 m/s
HighSpeedWarn          = Speed, GE, 30.0; Warning, EQ, 1
```

EX #2: Trigger when a warning is issued (Warning bit set to 1) and the Speed < 30m/s.

```
#                                                    30  m/s
LowSpeedWarn= Speed, LT, 30.0; Warning, EQ, 1
```

EX #3: Trigger every six minutes (6.8 minutes measured using low bits of a 100ms counter present in CAN data).

```
Every6Min       = ScanLow, EQ, 4096
```

EX #4: Trigger when yaw rate exceeds 5 degrees/sec.

```
#                                                5 d/s
HighYawRight   = Yawrate, GT, 5
HighYawLeft    = Yawrate, LT, -5
```

5.3.1.2 File Parse Errors

DV cannot validate the data in the trigger configuration file, but the parser can detect the various syntactical and file errors shown in Table IV. Additionally, certain limits are imposed on how many Messages, Signals, and Triggers are defined and used (see Table V). All error details (including line number, where applicable) are reported to the user via DV's regular error reporting methods (see Section 9, Error Reporting).

Table IV. Errors detected in CAN trigger configuration files.

Error Text	Subtext
Cannot open trigger specification file <filename>.	
Error in Signal specification on line <#> of <filename>. {Subtext} Signal skipped.	Incorrect sign specification <string>.
	Incorrect number of valid tokens found <# found>.
Error in Trigger specification on line <#> of <filename>. {Subtext} Trigger Skipped.	Cannot find trigger name.
	Incorrect number of valid tokens found <# found>.
	Invalid relation specification <string>.
{Message/Signal/Trigger Limit Errors, see Table V}	
Multiple Signals defined with the name <name>.	
Trigger condition <name> refers to undefined Signal <name>.	
Failed post-processing of trigger data in file <filename>.	

Table V. Limits imposed on Signal and Trigger definitions.

Quantity	Limit	Limit Description
MAX_MESSAGES	20	Total number of CAN message ID's

		referenced.
MAX_SIGNALS_PER_MESSAGE	20	Number of signals defined for one message.
MAX_PRIMITIVES_PER_SIGNAL	20	Number of primitives that depend on each Signal.
MAX_PRIMITIVES_PER_TRIGGER	5	Number of primitives allowed per trigger.
MAX_TRIGGERS	45	Total number of triggers defined.

6 Remote Control

DV allows trigger and some other requests to be input remotely. Currently, one must have a particular piece of hardware installed in the data-logging machine (usually a PiP computer) for this function. In the future, a switch/LED circuit connected to the logging laptop parallel port will do. Remote operations include start/stop manual logging, enable/disable CAN triggered logging, request triggered log, etc. System pulse and other diagnostic signals can be displayed to the driver via LED.

7 Command Line Options

The supported command line options are shown in Table VI. These can be used on the command line of a DOS shell window, or they can be specified in the Properties page of a shortcut to DV.

Table VI. Command Line Options.

	Option	Description
Receive / Logging	/r	Start receiving immediately on launch.
	/l	Start logging immediately on launch. (Use with /r)
	/t	Enable Automatic Logging (CANTrigger) mode. (See Section 5)
Replay	*.dvl	Open the specified log file on launch.
	/snnn	Automatically jump forward to the first instance of the index specified by "nnnn". Must be used with the filename option above. (Note, there is no "space" between the /s characters and the index number).

8 Data Replay

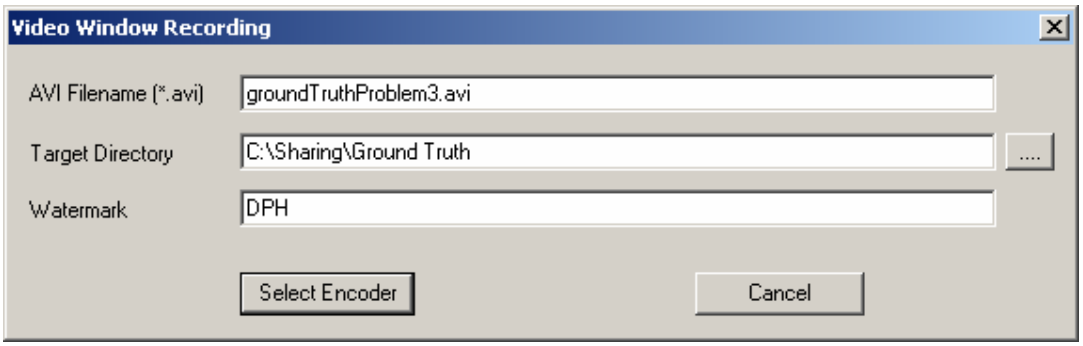
8.1 Main Video Display

8.1.1 Creating Video Clips with Overlay

Recording the main video display to a video will output a selection of both the underlying video file and the DV-generated overlay. This output will be a separate video file that can be viewed in any media player, without the need for DV.

Recording a video is initiated by selecting Record Main Video Display/Start in the right-click menu of the main video display. Filename, target directory, and watermark can be selected. The “.avi”

must be included at the end of the chosen file name; the watermark is an optional text overlay of the video.



After an encoder is selected, recording begins. Any frame viewed is added to the recording; moving backwards will cause a reversal of action in the recording, rather than change its overall stopping point. Recording is terminated through the same right-click menu through which it was begun.

The recommended encoder is “x.264” used with default settings, which will generate a recording with reasonable image quality as well as small file size. It can be found on *http://www.free-codecs.com/x264_Video_Codec_download.htm*.

8.1.2 Saving Single Images with Overlay

Recording the main video display to a picture will output a single frame of both the underlying video file and the DV-generated overlay, which can then be opened in any image program.

Recording and image is initiated by selecting Output Window in the right-click menu of the main video display. The image can be saved as a bitmap file or exported to the clipboard, where it can be pasted into any image program and subsequently saved. If bitmap is selected, filename, target directory, and watermark can again be specified; the “.bmp” extension must be included at the end of the chosen file name.

9 Error Reporting (This section not implemented)

Index (This section not implemented)

Error! No index entries found.