DBK70 User's Manual

the smart approach to instrumentation ™

IOtech, Inc.
25971 Cannon Road
Cleveland, OH 44146-1833
Phone: (440) 439-4091
Fax: (440) 439-4093
E-mail (sales): sales@iotech.com
E-mail (post-sales): productsupport@iotech.com
Internet: www.iotech.com

DBK70
User's Manual

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Note:

A PDF version of this document exists on your setup software CD-ROM (p/n 1056-0600). The document is located in the directory: **DBK70 Users Manual**. You will need to use Adobe® Acrobat® Reader to view the electronic version.

Warranty Information

Your IOtech warranty is as stated on the *product warranty card*. You may contact IOtech by phone, fax machine, or e-mail in regard to warranty-related issues.

Phone: (440) 439-4091, fax: (440) 439-4093, e-mail: sales@iotech.com

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CE Notice

Many IOtech products carry the CE marker indicating they comply with the safety and emissions standards of the European Community. As applicable, we ship these products with a Declaration of Conformity stating which specifications and operating conditions apply.

Warnings, Cautions, Notes, and Tips

Refer all service to qualified personnel. This caution symbol warns of possible personal injury or equipment damage under noted conditions. Follow all safety standards of professional practice and the recommendations in this manual. Using this equipment in ways other than described in this manual can present serious safety hazards or cause equipment damage.

This warning symbol is used in this manual or on the equipment to warn of possible injury or death from electrical shock under noted conditions.

This ESD caution symbol urges proper handling of equipment or components sensitive to damage from electrostatic discharge. Proper handling guidelines include the use of grounded anti-static mats and wrist straps, ESD-protective bags and cartons, and related procedures.

This symbol indicates the message is important, but is not of a Warning or Caution category. These notes can be of great benefit to the user, and should be read.

In this manual, the book symbol always precedes the words "Reference Note." This type of note identifies the location of additional information that may prove helpful. References may be made to other chapters or other documentation.

Tips provide advice that may save time during a procedure, or help to clarify an issue. Tips may include additional reference.

Specifications and Calibration

Specifications are subject to change without notice. Significant changes will be addressed in an addendum or revision to the manual. As applicable, IOtech calibrates its hardware to published specifications. Periodic hardware calibration is not covered under the warranty and must be performed by qualified personnel as specified in this manual. Improper calibration procedures may void the warranty.

Quality Notice

IOtech has maintained ISO 9001 certification since 1996. Prior to shipment, we thoroughly test our products and review our documentation to assure the highest quality in all aspects. In a spirit of continuous improvement, IOtech welcomes your suggestions.

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Unpacking the DBK70 1

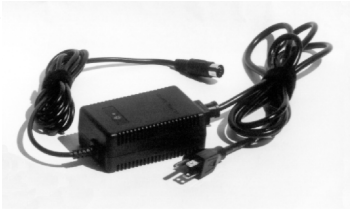
Electrostatic Discharge (ESD)

The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage. You should always handle components carefully, and you should never touch connector pins or circuit components unless you are following ESD guidelines in an appropriate ESD controlled area. Such guidelines include the use of properly grounded mats and wrist straps, ESD bags and cartons, and related procedures.

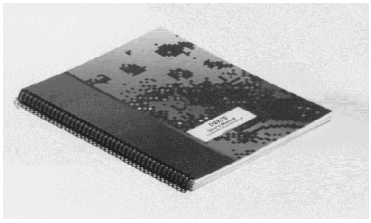
Contents

DBK70 includes the following items, with exception of cables CA-208 and CA-218, which are options. Splice Plates (p/n 232-0810) can be used to attach a DBK70 to a LogBook, WaveBook, or a Daq Device.

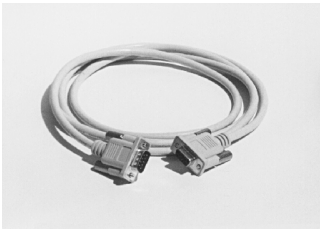
DBK70



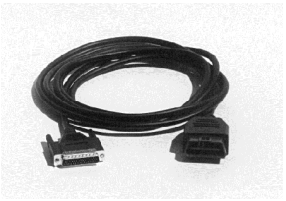
AC Power Adapter & Cable
(TR-40U and CA-1)



DBK70 User's Manual
(1056-0901)

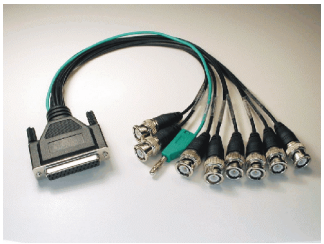


Serial Port Cable
(CA-212)



Vehicle Network Cable
(CA-210)

Setup Software CD
(1056-0600)



Analog Output Cable
(CA-208)
OPTIONAL

J1939 Vehicle Network Cable (CA-218)
OPTIONAL

If any part of your order is missing or damaged, contact IOtech or your sales agent.

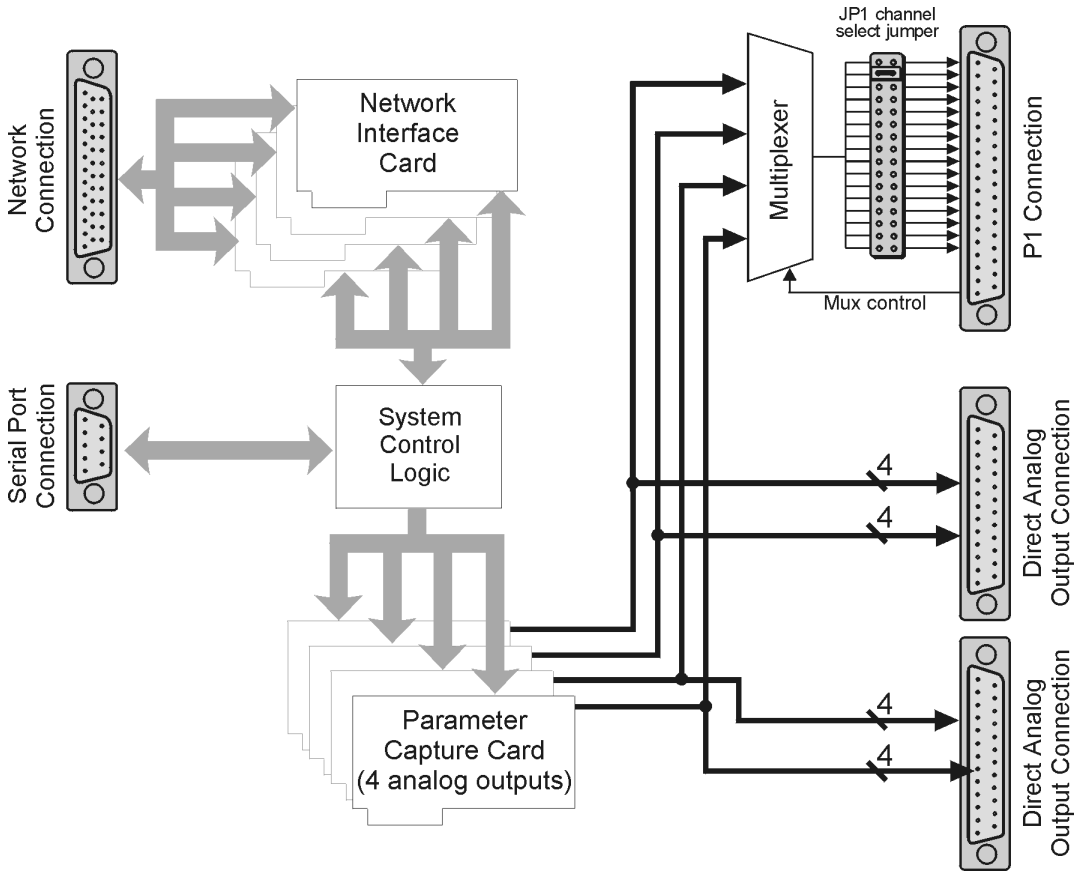
The e-mail address for sales is: sales@iotech.com.
The e-mail address for product support is: productsupport@iotech.com.


Notes

Introduction 2

The DBK70 is an electronic module that can be quickly configured to generate analog output signals that are proportional to many typical vehicle characteristics based on a single connection to the vehicle's diagnostic connector. The DBK70 provides sensor module signals of vehicle characteristics from data acquired from a vehicle's data bus (e.g., J1850, J1850 VPW, J1850 PWM, Class 2, SCP, CAN, etc.).

Once configured using the included software, the DBK70 will capture the selected vehicle network message and convert the imbedded data into a proportional analog output suitable for measurement with any IOtech data acquisition product or equivalent.



Monitoring the messages transmitted on the network eliminate the need to outfit the vehicle under test with transducers and wiring that would be redundant with the vehicle's existing transducers and wiring. Where the data rate available from a vehicle's data bus is satisfactory, the DBK70 can create output waveforms comparable to direct transducer measurement.

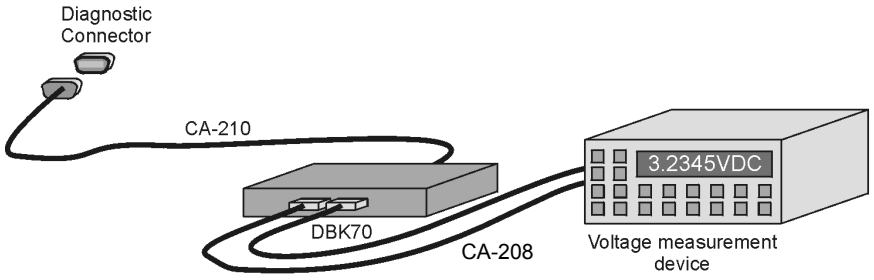
Depending on availability through the data bus, the DBK70 is also able to generate signals proportional to data internal to a vehicle's electronic modules, which is typically inaccessible for monitoring or recording. Through the vehicle data bus, the DBK70 can obtain such data from any vehicle module accessible through the same vehicle data bus that is used for vehicle diagnostics.

Through the DBK70, vehicle data contained in normally occurring messages used for the operation of the vehicle and/or available through diagnostic protocols can be monitored and used to generate scaled, analog output. Every DBK70 analog output channel is independently configured. Each data received and processed has two independent sets of scaling parameters, one to control the output signal and the other to format the data for real time display on a PC.

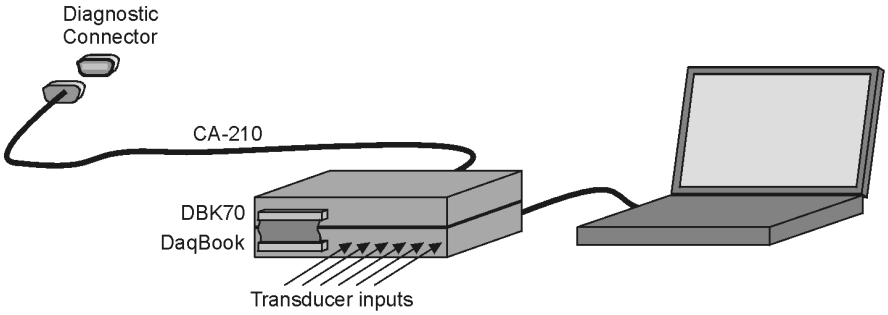
Since the DBK70 contains a non-volatile memory that holds all of its setup parameters, the PC need only be connected to initially configure the DBK70 or to make configuration changes. During normal operation, no PC connection is required. In addition to configuring the DBK70, the included software also allows the operator to view parameters on-screen in real-time. The DBK70 configuration and monitoring software runs on any PC that is using Windows 95, 98, Me, 2000, or NT.

The DBK70's operation is completely configurable through the use of supplied software and a configuration database. Through this software and database a user can quickly change the configuration of any and all output channels, monitor in real time the operation of each output channel, and/or create or edit members of the configuration database.

The DBK70 can be operated as an accessory to IOtech's DaqBook, DaqBoard, LogBook, or WaveBook product lines, or as a stand-alone device providing analog outputs for any voltage measurement instrument including hand-held meters and strip chart recorders.

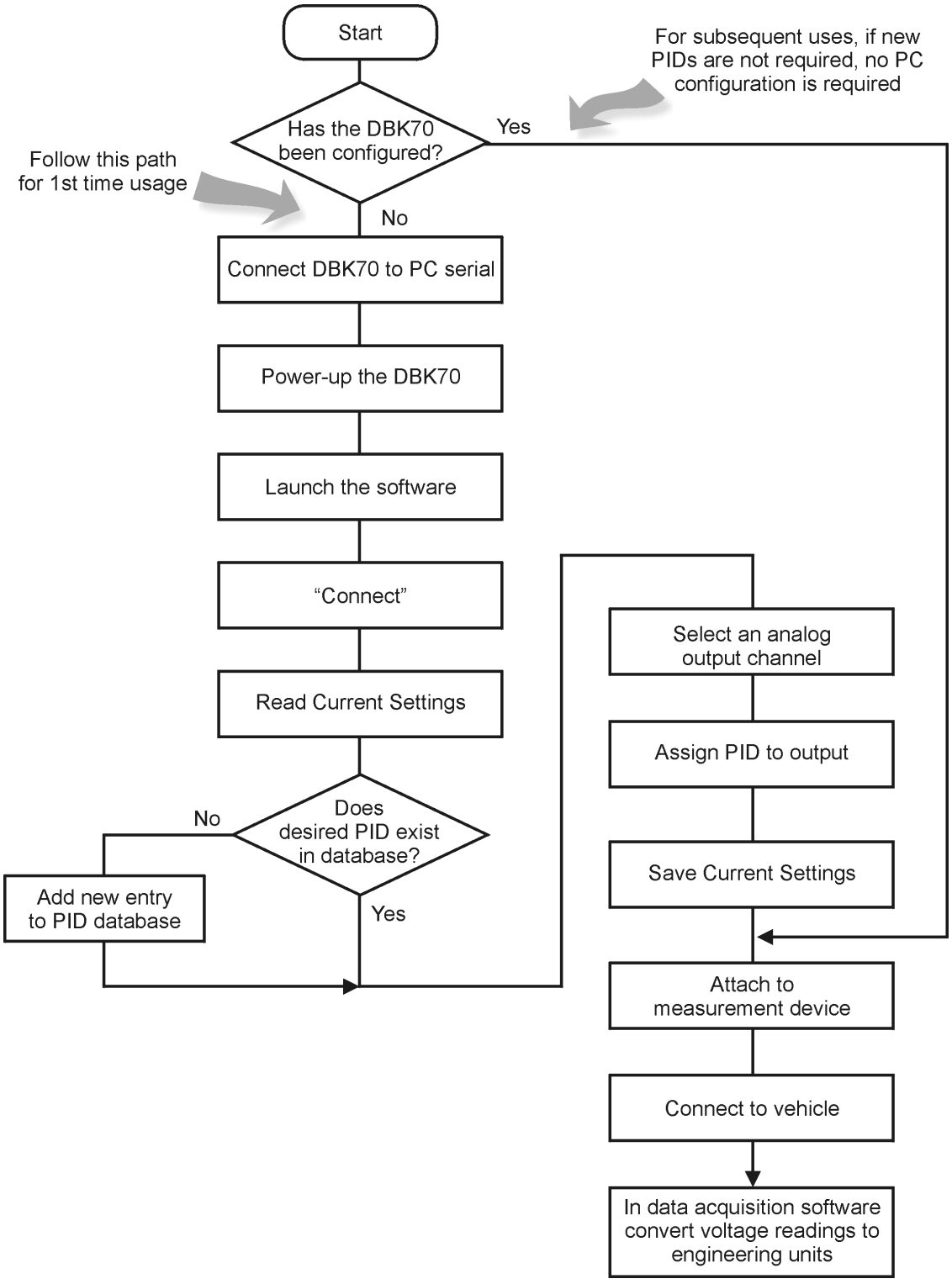


Stand-alone Mode



Used with IOtech Data Acquisition

Typically, operation of the DBK70 requires the steps indicated in the following block diagram. Note that the term **PID** means ***Parameter Identifier***. For CAN [including J1939] the terms **PGN** (***Parameter Group Number***) and **SPN** (***Suspect Parameter Number***) are used.

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Software Installation

DBK70 Software and Database Requirements

The DBK70 software and database runs under Windows 95b, 98, Me, 2000 or NT.

DBK70 Software and Database Installation

A CD ROM is distributed with the DBK70. This CD ROM contains a copy of the DBK70 software and a copy of a starter DBK70 Database (i.e., DBK70.mdb).

To install the DBK70 software and the DBK70 Database, use the following procedure.

Run Setup.exe

Place the DBK70 CD ROM in your CD ROM drive. If the Windows Auto Detect option is set, the SETUP program will start automatically. If not select "Run" from the Windows "Start" menu. Browse, if necessary, and run the "Setup.exe" program.

Carefully follow the screen prompts to install your software.

Powering the System Using Auxiliary Power or Vehicle Bus Power

The DBK70 receives its access to the vehicle's data bus and power through a connection to the vehicle's diagnostic connector. The CA-210 cable is used to connect the DBK70 to the vehicle's standard Diagnostic Connector (i.e., SAE J1962). The other end of this cable is connected to the DBK70. Typically, the power pins on the vehicle's diagnostic connector are only active when the vehicle is on.

The Vehicle Diagnostic cable must be connected to the DBK70 first and the vehicle's diagnostic connector second.

The Auxiliary Power input is primarily used to operate the DBK70 when not connected to a vehicle. In some instances, it may be preferable to configure the DBK70 outside of the vehicle, in an office or lab setting. Use the included AC power adapter in these circumstances. When not connected to a vehicle network, real-time message values cannot be monitored in the software.

Configuring a DBK70

The DBK70 generates analog output signals that are proportional to vehicle data the DBK70 acquires from a vehicle's data bus.

The DBK70 uses a connection to the vehicle's diagnostic connector to obtain access to the vehicle's data bus and to obtain the power it needs to operate and to create the output signals. A serial connection to a PC is used when configuring the DBK70's output channels and/or to monitor the vehicle data being processed by the DBK70.

Once its output channels are configured, the operation of the DBK70 is automatic. Whenever the DBK70 is connected to vehicle power, it loads the configuration information last saved in its non-volatile memory, and begins processing data and generating output signals. As the DBK70 receives data from the data bus, it creates scaled analog output signals based on the received data. Whenever the data associated with an output channel is unavailable, a channel specific default output signal value is generated.

To configure the DBK70, connect it to your PC's serial port and launch the included software application. The software provides database management and channel configuration services.

Using a DBK70 in Stand-Alone Mode

The DBK70 can be used with any voltage measurement instrument in a stand-alone mode. After configuring the DBK70 with the included software, connect it to the vehicle's diagnostic connector. When the DBK70 receives power from the vehicle, it will immediately begin monitoring the network and updating its analog outputs to reflect the values of the desired messages, as per its saved configuration.

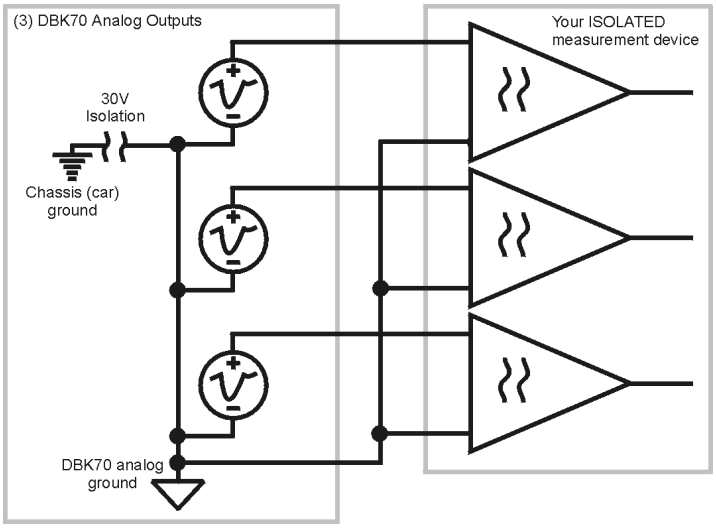
Attach your voltage measurement device to the DBK70's analog outputs through the analog output connectors.

Reference Note:
Refer to page 4-3 for more information.

The DBK70 provides single-ended analog outputs, where all outputs are referenced to the same internal analog ground. Follow the recommended guidelines below to get the best quality readings from your measurement equipment.

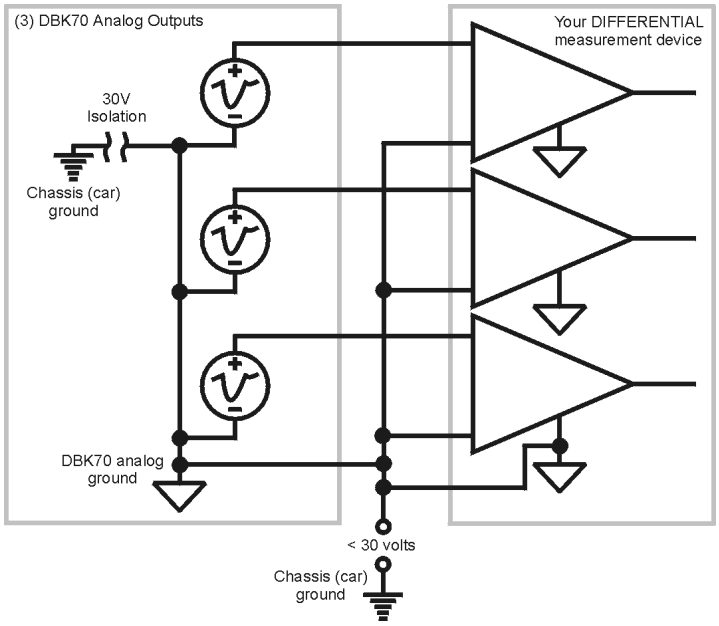
Isolated Measurements

When used with a measurement device having isolated inputs, connect any of the DBK70's ground pins to each of the low-side inputs of the measurement device. Attach each of the DBK70 analog outputs to the high-side inputs of the measurement device. It is not necessary to tie the ground of the DBK70 to the ground of the measurement device.



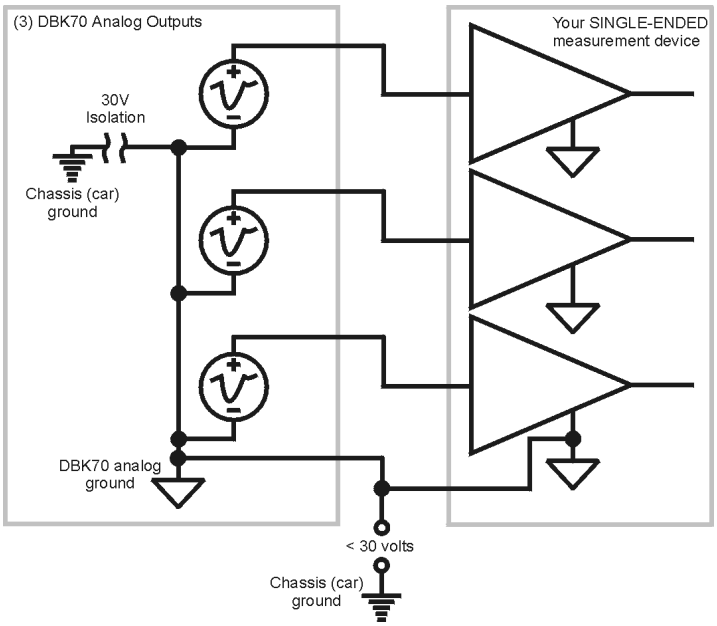
Differential Measurements

When a differential input measurement device is used, the analog ground of the measurement device must be connected to the analog ground of the DBK70. This ground can not be greater than 30 volts above the vehicle's chassis ground.



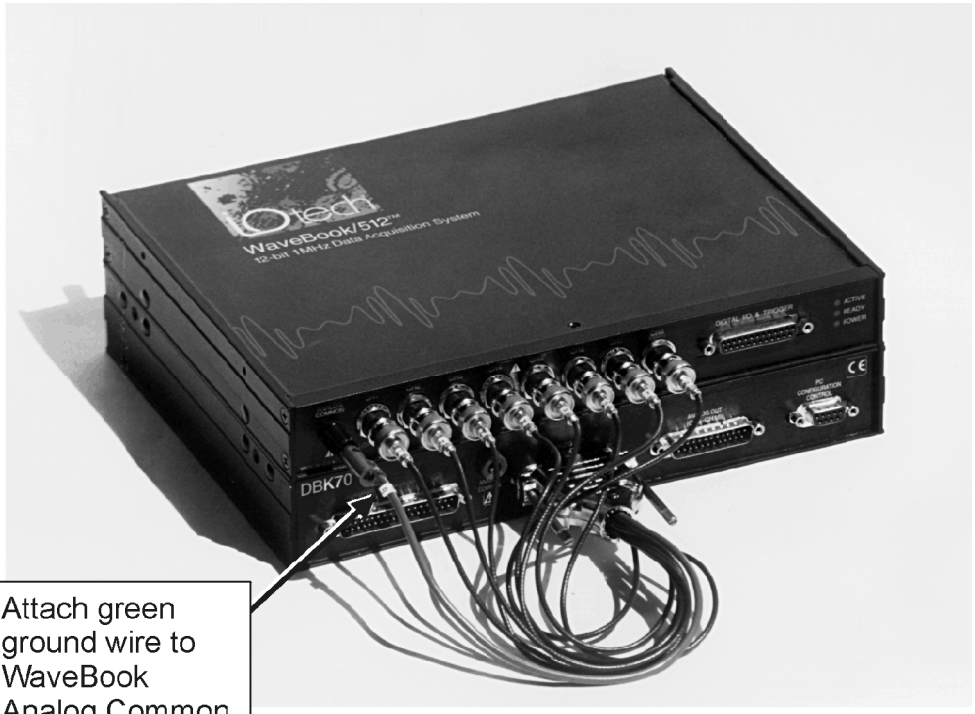
Single-Ended Measurements

When measuring the DBK70 outputs with a single-ended device, the analog grounds from the DBK70 and the measurement device must be tied together.



Using a DBK70 with a WaveBook

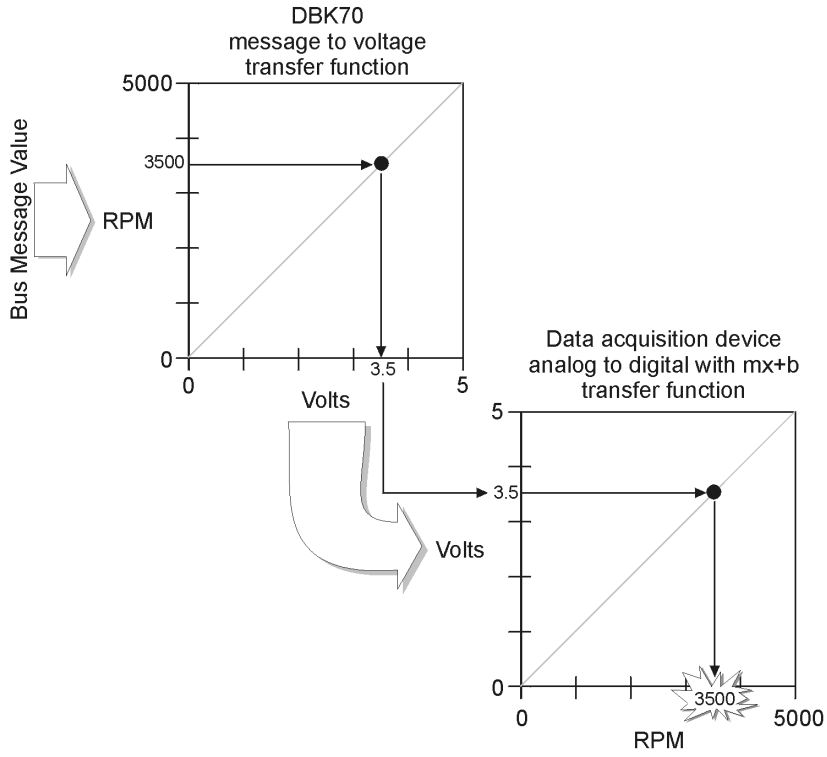
The DBK70 has both straight-through and multiplexed outputs. The multiplexed outputs are designed specifically for use with IOtech's Daq* and LogBook products. The straight-through outputs can be used with any measurement device, including IOtech's WaveBook products.



Reference Note:
Refer to the block diagram on page 2-1 to better understand the relationship between the multiplexed and straight through outputs.

To use the DBK70 with a WaveBook, connect the DBK70's analog outputs to unused WaveBook voltage inputs using the optional CA-208 cable. A single CA-208 supports 8 channels, so 2 are required to connect all 16 DBK70 analog outputs to a WaveBook and/or any WaveBook expansion modules.

In WaveView, the data acquisition software included with the WaveBook, use the **mx+b** (scale and offset) feature to convert the DBK70 voltage values into engineering units. For example, if the DBK70 is capturing vehicle RPM in the range of 0 to 5000 RPM and scaling the result to 0 to 5 volts, setting the "m" in WaveView to 1000 will convert the incoming voltage to RPM. This technique can be used in any data collection software package to convert the DBK70's output voltage to engineering units.



Reference Note:
mx + b values are included in a Microsoft Excel file: **mx+b values.xls**. The file is located in the root directory of your DBK Configuration CD (p/n 1056-0600).

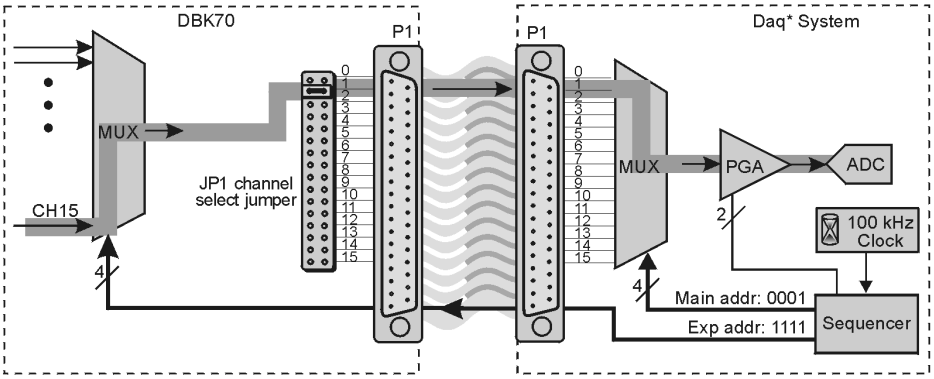
Using a DBK70 with a Daq* Product or LogBook

The DBK70 has both straight-through and multiplexed outputs. The multiplexed outputs are designed specifically for use with IOtech's Daq* and LogBook products. The straight-through outputs can be used with any measurement device, including IOtech's WaveBook products.

Reference Note:
Refer to the block diagram on page 2-1 to better understand the relationship between the multiplexed and straight through outputs.

To use the DBK70 with a DaqBook, DaqBoard, Daq PC-Card, or LogBook, connect the DBK70's P1 connector to the P1 connector of any of the aforementioned data acquisition products via a ribbon cable (CA-37).

From the perspective of, for example, the DaqBook, the DBK70 represents an analog input expansion module that is multiplexing 16 analog inputs into one of the DaqBook's analog input channels. The example diagram below shows the JP1 jumper in the DBK70 set to channel 1. When the sequencer selects base channel 1 and expansion channel 15, the voltage signal passes through the highlighted path.

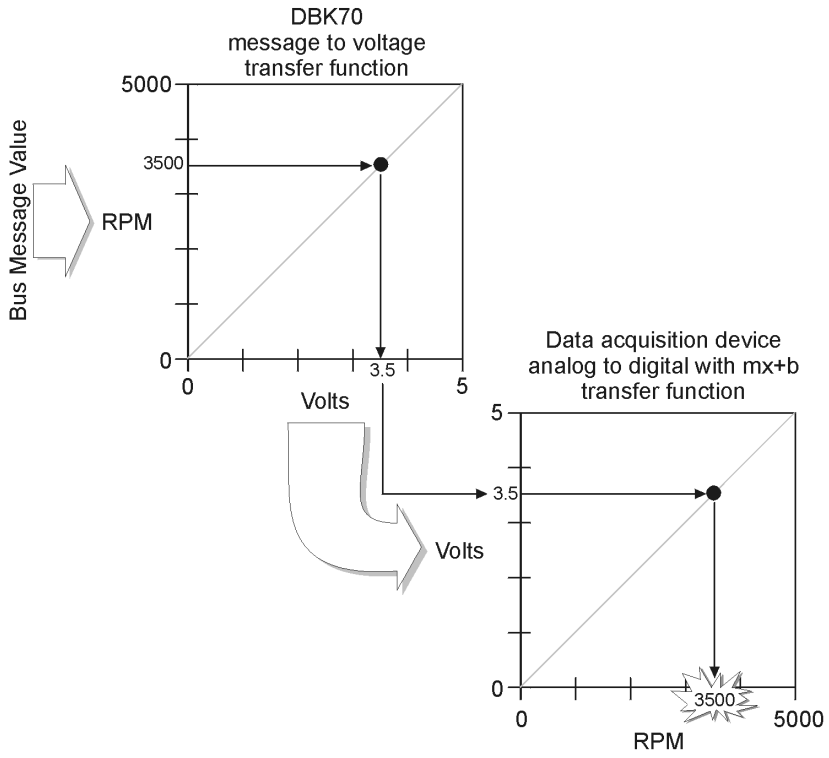


- The Daq* **sequencer** selects the channel and gain by controlling **multiplexers** (MUX) and programmable gain amplifiers (**PGA**) in both the Daq* and the DBK. The **sequencer** uses 4 expansion address lines to provide 16 unique channel addresses for each base channel.
- The DBK70 **multiplexer** selects 1 of 16 (max) channels as directed by the **sequencer**. The selected signal goes to the channel-selection jumper, and then to the Daq* via **P1**.
- The Daq* **multiplexer** selects 1 of 16 base channels from **P1** input lines as directed by the sequencer. The selected signal goes to the **PGA** and then to the A/D converter (A/D).
- The **P1** interface has a signal line for each of the 16 base channels.
- The **JP1** channel select jumper in the DBK70 can be placed on pins for channel 0 through channel 15. Each DBK70 in the system must occupy a different base unit channel. The factory default setting for the **JP1** jumper is channel 0.

Reference Note:
Refer to the DaqView or LogView documentation for instructions on how to inform the software of the presence of DBK modules and cards.

Using the steps described in the DaqView or LogView documentation, the user must provide the location of the JP1 jumper to the software.

In DaqView or LogView, use the mx+b (scale and offset) feature to convert the DBK70 voltage values into engineering units. For example, if the DBK70 is capturing vehicle RPM in the range of 0 to 5000 RPM and scaling the result to 0 to 5 volts, setting the "m" in WaveView to 1000 will convert the incoming voltage to RPM. This technique can be used in any data collection software package to convert the DBK70's output voltage to engineering units.



Reference Note:
mx + b values are included in a Microsoft Excel file: **mx+b values.xls**. The file is located in the root directory of your DBK Configuration CD (p/n 1056-0600).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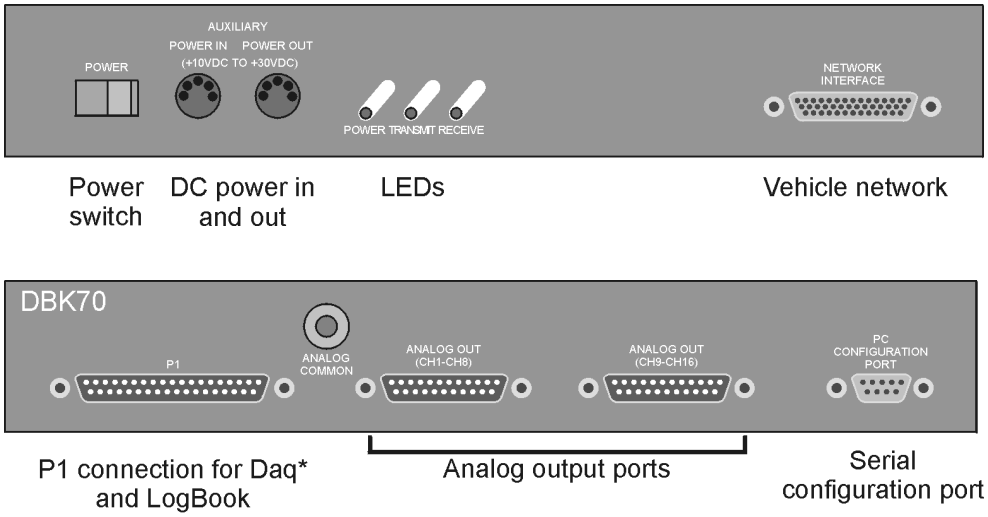
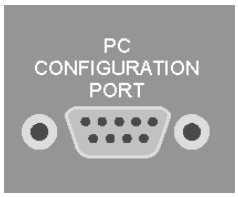
DBK70 Connectors



Serial Configuration Port

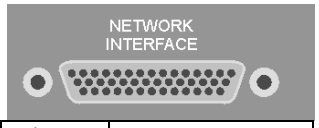
The Serial Configuration Port is used to configure the DBK70 using a PC and the included PC software. Connect this port to the PC's COM port using the included CA-212 cable.

Pin#	Name
1	NC
2	Tx
3	Rx
4	NC
5	Analog Gnd
6	NC
7	CTS
8	RTS
9	NC



Network Port

The Network Port is used to attach the DBK70 to the vehicle's network via the included CA-210 cable.



Pin#		Pin#		Pin#		Pin#	Name
1	Reserved	12	Reserved	23	Reserved	34	Reserved
2	Reserved	13	CAN-	24	Reserved	35	Reserved
3	Reserved	14	Reserved	25	ISO9141-K	36	Ground
4	J1850+	15	Reserved	26	Reserved	37	Ground
5	Reserved	16	Reserved	27	Reserved	38	Reserved
6	Reserved	17	J1850+	28	Reserved	39	Reserved
7	Reserved	18	Reserved	29	CAN+	40	Reserved
8	Reserved	19	Reserved	30	Reserved	41	Reserved
9	Reserved	20	J1850-	31	Reserved	42	Battery VDC
10	Reserved	21	Reserved	32	Reserved	43	Battery VDC
11	Reserved	22	Reserved	33	Reserved	44	Reserved

Direct Parameter Analog Output Ports 1 and 2

The Direct Parameter Analog Output Ports provide a direct connection to the analog outputs sourced by the internal 4-parameter capture cards. If four cards are installed, 16 analog outputs will be available; channels 0-7 on Port 1 and 8-15 on Port 2. These can be directly connected to any high impedance input voltage measurement device.

Port 1

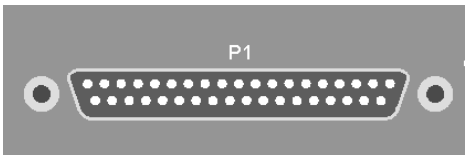
Pin#	Name	Pin#	Name	Pin#	Name
1	Analog out 1	11	NC	21	Analog Gnd
2	Analog out 2	12	NC	22	Analog Gnd
3	Analog out 3	13	NC	23	Analog Gnd
4	Analog out 4	14	Analog Gnd	24	Analog Gnd
5	Analog out 5	15	Analog Gnd	25	Analog Gnd
6	Analog out 6	16	Analog Gnd		
7	Analog out 7	17	Analog Gnd		
8	Analog out 8	18	Analog Gnd		
9	NC	19	Analog Gnd		
10	NC	20	Analog Gnd		

Port 2

Pin#	Name	Pin#	Name	Pin#	Name
1	Analog out 9	11	NC	21	Analog Gnd
2	Analog out 10	12	NC	22	Analog Gnd
3	Analog out 11	13	NC	23	Analog Gnd
4	Analog out 12	14	Analog Gnd	24	Analog Gnd
5	Analog out 13	15	Analog Gnd	25	Analog Gnd
6	Analog out 14	16	Analog Gnd		
7	Analog out 15	17	Analog Gnd		
8	Analog out 16	18	Analog Gnd		
9	NC	19	Analog Gnd		
10	NC	20	Analog Gnd		

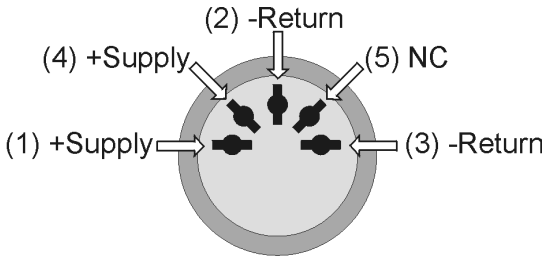
P1 Multiplexed Output Port

This port is for attaching the DBK70 to a DaqBook, DaqBoard, Daq PC-Card, or LogBook via a short ribbon cable.



Auxiliary Power Connectors

Either port can be used to supply auxiliary power to the DBK70. When attached to a vehicle network, the vehicle will supply adequate power for the DBK70, so no additional power need be connected via the Auxiliary Power Connector. To power the DBK70 in the lab or office, disengaged from the vehicle network, use the included external AC supply. The 2nd Auxiliary power connector is used to cascade externally supplied power to another piece of data acquisition equipment.



Power Issues

There are 2 methods for powering a DBK70; applying DC power to either of its Auxiliary Power inputs or through the vehicle network. When connected to a running vehicle, the vehicle power received from the diagnostic connector is all that is necessary to power the DBK70 – no further power connections are necessary.

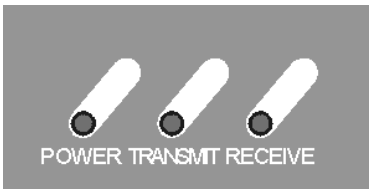
In rare instances where power is not available on the diagnostic connector, the DBK70 can be powered from its Auxiliary Power connector using a cigarette lighter power cord (IOtech p/n CA-198)

The Auxiliary Power input is primarily used to operate the DBK70 when not connected to a vehicle. In some instances, it may be preferable to configure the DBK70 outside of the vehicle, in an office or lab setting. Use the included AC power adapter in these circumstances.

The 2 Auxiliary Power connectors are attached in parallel inside the DBK70. When power is supplied to the DBK70 externally, the 2nd connector can be used to cascade the power source to another piece of equipment, like a DaqBook, WaveBook, or LogBook data acquisition product.

LED Operation

Three LEDs on the front panel of the DBK70 provide feedback as to the current state of the unit. When sufficient power supply voltage is supplied, the Power LED will blink. When both power is applied and network activity is sensed, the Power LED will remain solid. If the DBK70 is powered but not connected to the vehicle network, no activity will be sensed, therefore the Power LED will blink.



- When connected to the network of a running vehicle and the analog outputs are configured, if the Power LED is not solidly illuminating, it is likely that the vehicle bus is malfunctioning or the DBK70 network interface is not operating correctly. This could be due to having the incorrect network interface installed in the DBK70.
- The Transmit LED will flash when the DBK70 is issuing a request message onto the network. If the Update Rate field is set to 0 and/or the Message field is blank for all desired messages, the DBK70 will never issue messages onto the network, therefore the LED will never blink.
- The Receive LED will flash whenever any desired messages have been detected. A desired message is defined as a message that the DBK70 has been configured to capture. If the Receive LED never flashes, the desired bus messages, defined in the fields of the database, are not being detected. This could be due to an incorrect message definition in the database, or that the desired message needs to be requested before it is transmitted.

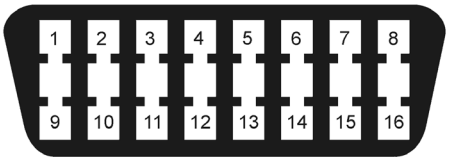
Vehicle Diagnostic Connectors

The J1962 Vehicle Diagnostic Connector is required on all new automobiles sold in the USA after model year 1995. It may also be available on a few model year '94 and '95 vehicles sold in the USA. Tentatively, it will also be required on all new automobiles sold in the EC in calendar year 2000 and later.

Different vehicle manufacturers may give different names to the vehicle's diagnostic connector. Some may call it the ALDL connector, the Class 2 connector, the SCP connector, the 16-Way, the J1850 connector, or the diagnostic connector.

The vehicle's diagnostic connector is typically mounted under the instrument panel on the driver's side of the vehicle. The connector is typically mounted in or near a center console or under the instrument panel on the driver's side of the vehicle.

16-Way Diagnostic Connector Pinout	
Pin#	**Description**
2	J1850 Bus (+)
4	Chassis Ground
5	Signal Ground
6	CAN High
7	ISO 9141-2 K Line
10	J1850 Bus (-)
14	CAN Low
16	Battery Power

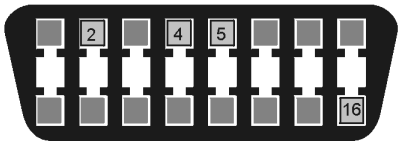


*16-Way Diagnostic Connector**

The 16-pin diagnostic connector is known by many different names. These include, but are not limited to: the 16-Way, J1962, J1850, the Class 2, and the ALDL connector.

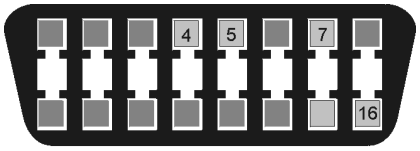
***Note**: The 9-pin J1939 diagnostic connector, used in heavy-duty vehicles, is discussed on page 4-7.

On year 1996 and later vehicles sold in the U.S., you can tell, with some level of certainty, which protocol the vehicle uses. This is done by examining the metallic contacts in the OBD II connector, as indicated in the following figures. Note that heavy-duty vehicles, such as busses, tractors, and trucks typically make use of the J1939 diagnostic connector. J1939 is discussed on page 4-7.



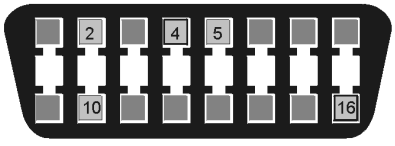
J1850-VPW

J1850-VPW--The connector should have metallic contacts in pins 2, 4, 5, and 16, but not 10.



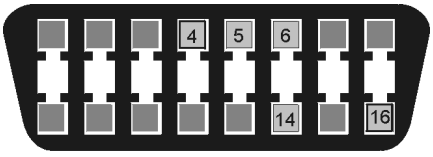
ISO 9141-2 or ISO 14230-4

ISO 9141-2 or ISO 14230-4--The connector should have metallic contacts in pins 4, 5, 7, and 16.



J1850-PWM

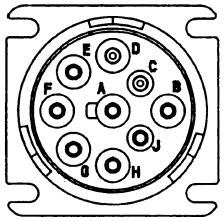
J1850-PWM--The connector should have metallic contacts in pins 2, 4, 5, 10, and 16.



J2284-CAN

J2411-CAN-The connector should have metallic contacts in pins 2, 4, 5, 6, 10, 14, and 16.

J1939 – The J1939 diagnostic connector should have metallic contact pins in A, B, C, D, and E. This connector is discussed in the section, *J1939 Vehicle Bus Cable, CA-21,* on page 4-7.

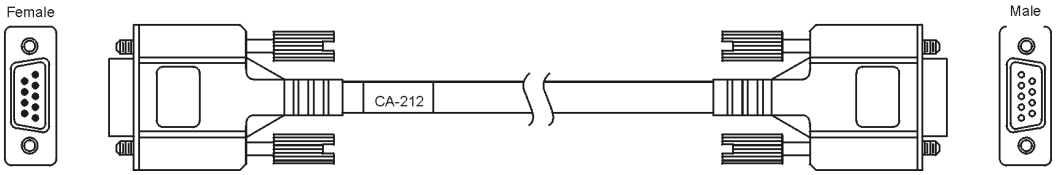


J1939

Serial Port Cable, CA-212 RS-232 [Included]

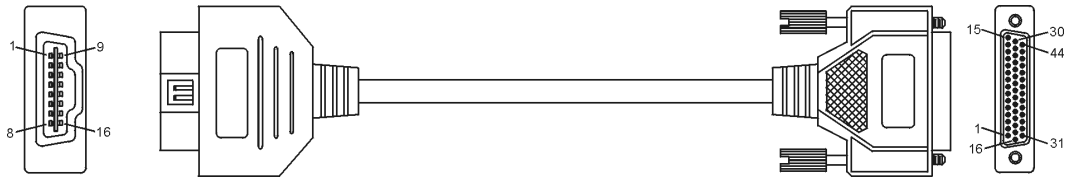
For the purpose of configuring the analog outputs, the DBK70 is connected to the PC via the included

CA-212 RS-232 cable. The CA-212 is a “straight through” serial cable – pins 1 through 9 on one end are connected to pins 1 through 9 on the other end, respectively.



Vehicle Bus Cable, CA-210 [Included]

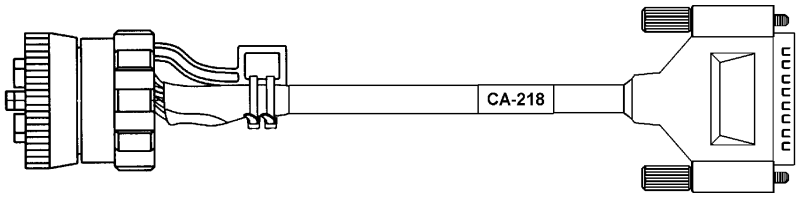
The CA-210, included with the DBK70 provides a connection between the vehicle’s diagnostic connector (OBD) and the DBK70, regardless of the type of interface supported by your vehicle. The connector is typically located under the dashboard near the steering column.



CA-210 Pinout	
OBD Connector	**DB44 Connector**
2	4, 17
5	36, 37
6	29
7	25
10	20
14	13
16	42, 43

J1939 Vehicle Bus Cable, CA-218 [Optional]

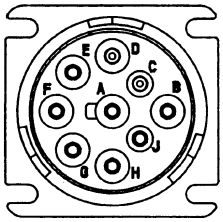
CA-218 is a cable option. It enables a properly equipped DBK70 to communicate with vehicles that support the J1939 network protocol. These vehicles are typically of the heavy-duty variety and include trucks and busses.



CA-218 Cable Pinout	
J1939 Plug Connector	**DB44 Connector**
A	36, 37
B	42, 43
C	29
D	13
E	36
F	27
G	11

J1939 Diagnostic Connector – The J1939 is a 9-pin, diagnostic connector. J1939 should have metallic contact pins in A, B, C, D, and E.

SAE-J1939 Diagnostic Connector Pinout		
Pin#	**Description**	**Comment**
A	Battery (–)	
B	Battery (+)	
C	CAN_H	
D	CAN_L	
E	CAN_SHLD	for SAE J 1939/11; or no connection for ISO 11783-2
F	SAE J 1708 (+)	currently not supported by IOtech products
G	SAE J 1708 (–)	currently not supported by IOtech products
H	--	Proprietary OEM use
J	--	Proprietary OEM use

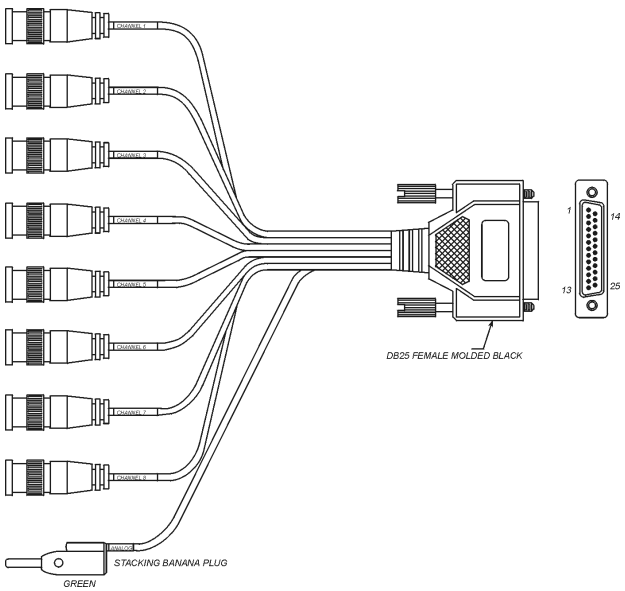


J1939 Diagnostic

Analog Output Cable, CA-208 [Optional]

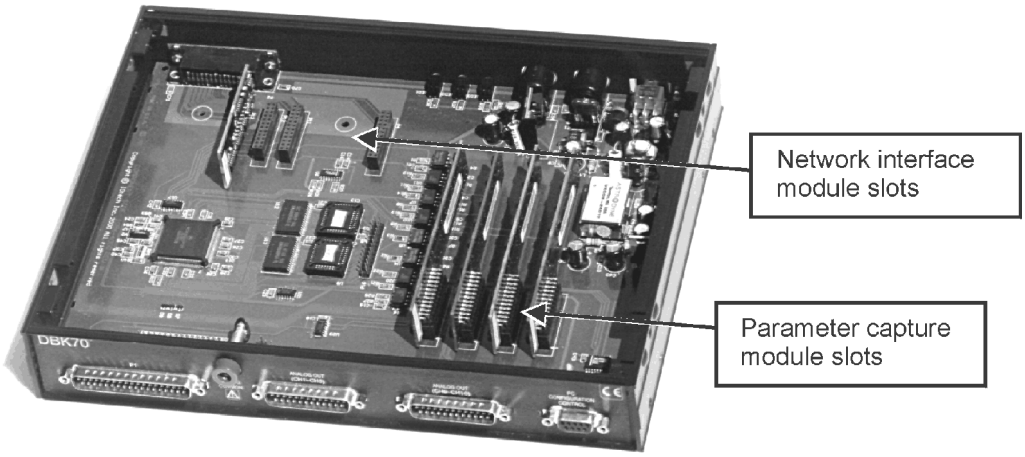
The optional CA-208 is used to break out the DB25 analog outputs to 8 BNCs.

CA-208 Pinout	
BNC	**DB25 Pin**
1	1
1 collar	14
2	2
2 collar	15
3	3
3 collar	16
4	4
4 collar	17
5	5
5 collar	18
6	6
6 collar	19
7	7
7 collar	20
8	8
8 collar	21
Green	25



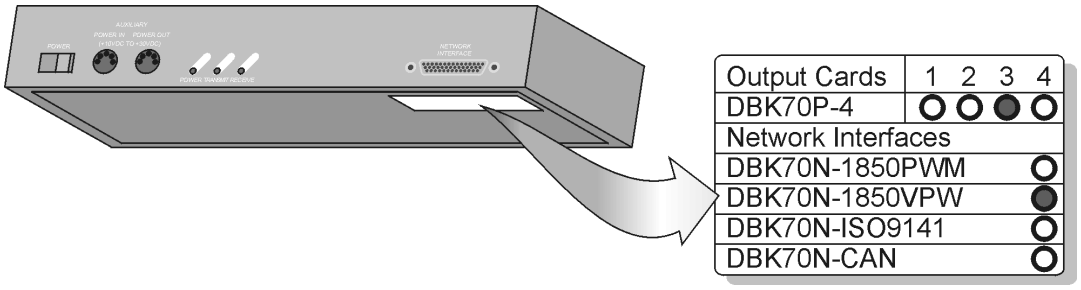
Chassis Label

The DBK70 has eight internal slots into which configuration cards can be installed. Four slots are reserved for Network Interface cards, and four slots are for Parameter Capture cards. If only one network is to be used (such as J1850-VPW), then only one Network Interface card is required. If multiple networks are to be attached to one DBK70, then up to four Network Interface cards can be installed.



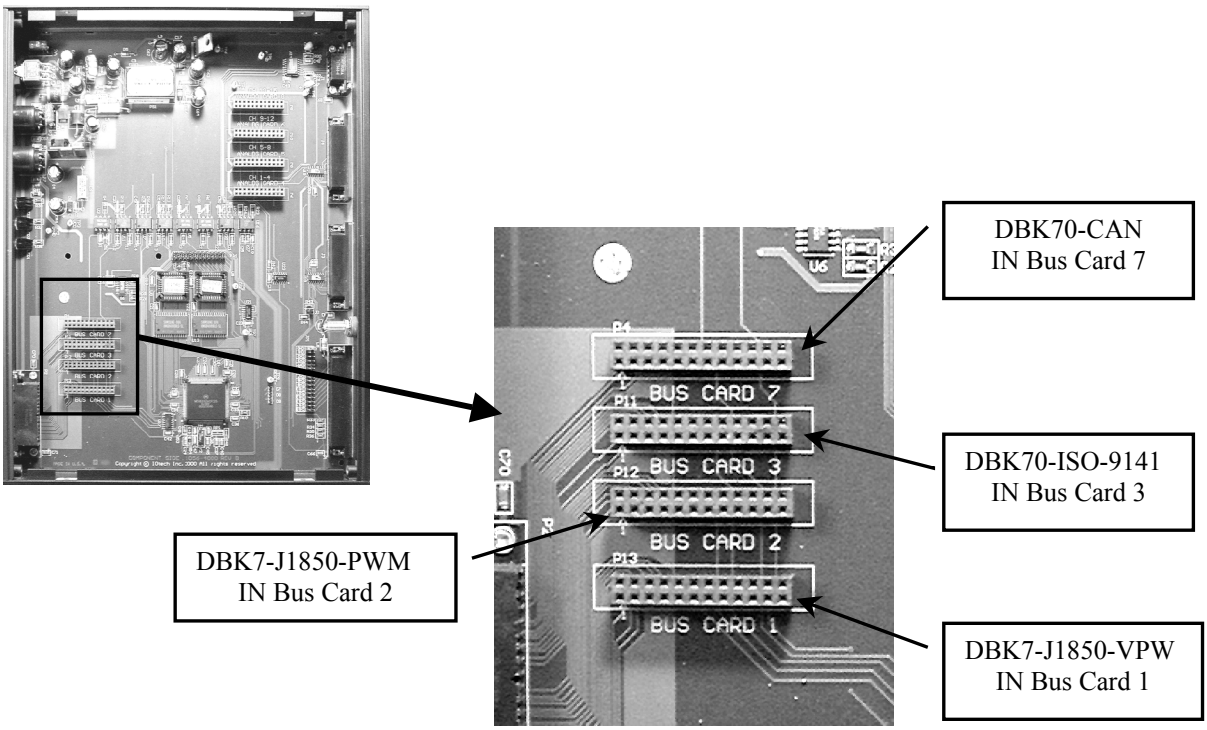
Each Parameter Capture card supplies 4 analog outputs, enabling the simultaneous capture of up to four parameters, such as four different temperatures within the vehicle. To capture more than four parameters simultaneously, additional Parameter Capture cards can be installed. Up to four cards, for a total of 16 network parameters, can be simultaneously captured by one DBK70.

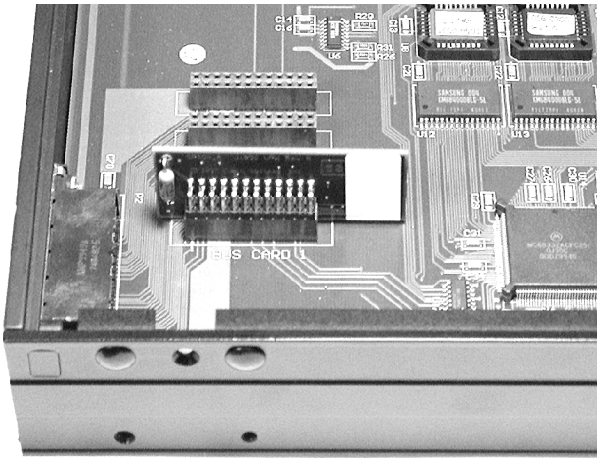
Each DBK70 is configured with plug-in cards. A label located on the bottom of the DBK70 identifies the cards installed at the factory. A colored in circle denotes the presence of the associated analog output card or network interface card. Each analog output card (parameter capture card, DBK70-P4) has four analog outputs. For example, if 3 cards are installed 12 parameters can be captured.



Network Interface Cards

The vehicle network card(s) are inserted into the 4 header sockets located adjacent to the network connector of the DBK70, on the LED-side of the product. Network cards must be inserted into the proper socket, as shown in the call-outs on the diagram below.

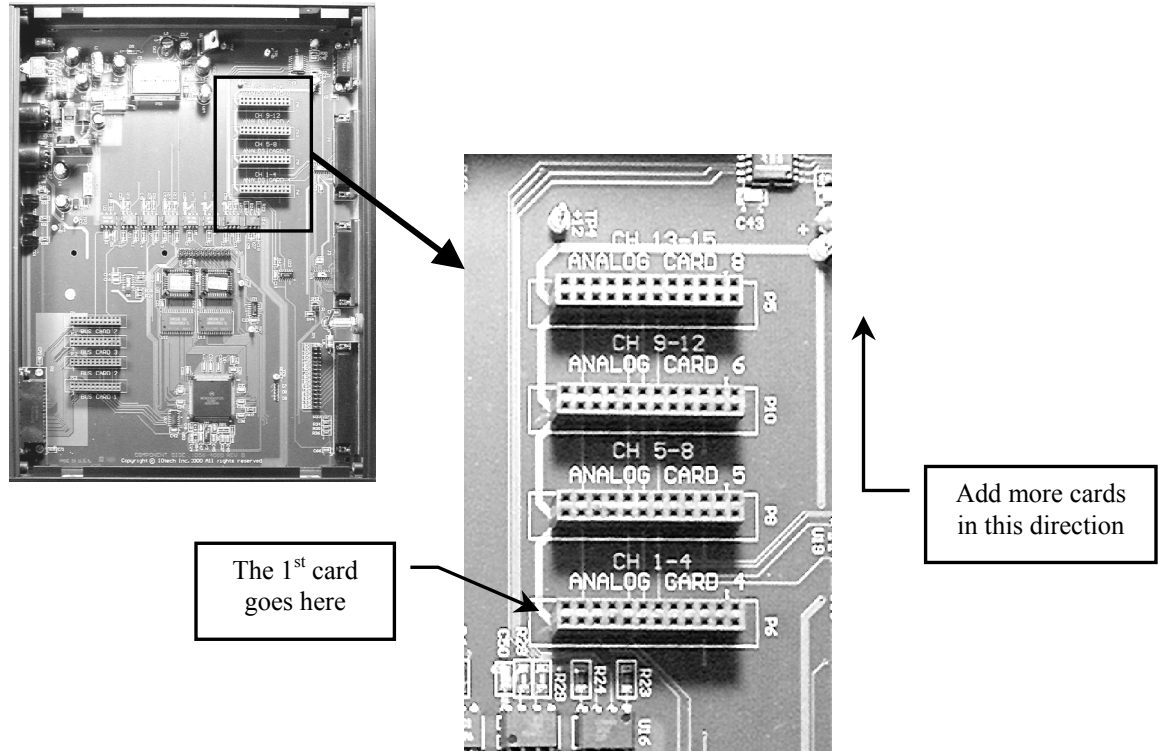


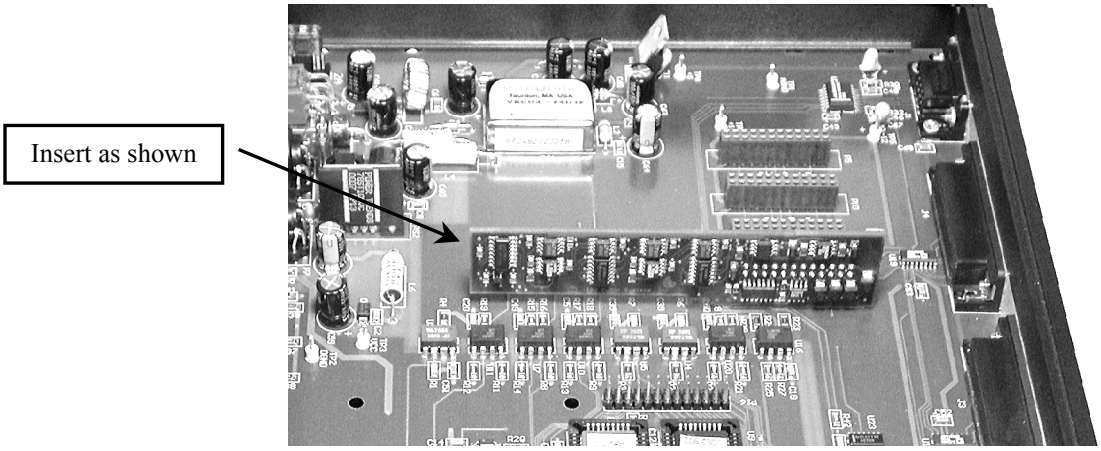


Analog Output Cards

The Analog Output Cards (DBK70-P4) are inserted into the 4 sockets adjacent to the analog output connectors on the DBK70. Populate the sockets starting with the right-most socket continuing left until the desired number of cards have been installed. Make sure no card has any open sockets to its right. The cards must be oriented as shown in the diagram below.

When the DBK70 powers-up, the DBK70-P4s are immediately recognized and initialized. Each DBK70-P4 carries its own calibration constants on an on-board memory device so cards can be inserted in the field without the necessity of re-calibration.



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Introduction

PidPRO is a Windows-based software application, which was created for use with the DBK70 Vehicle Network Interface. The user-friendly application is used to:

- Set up the DBK70 hardware to capture and report vehicle network data.
- Manage databases of network parameter identifiers (PIDs).
- Monitor the network and display network traffic.
- Record and display network parameter values.

PIDs, Analog Output Channels, and Virtual Channels

The DBK70 uses channels to capture and report network information. The captured information is converted to an analog output voltage and to an ASCII text format. A DBK70 can have up to 16 analog output channels for monitoring network parameters, one parameter per channel. In addition to analog output channels, the DBK70 can have virtual channels.

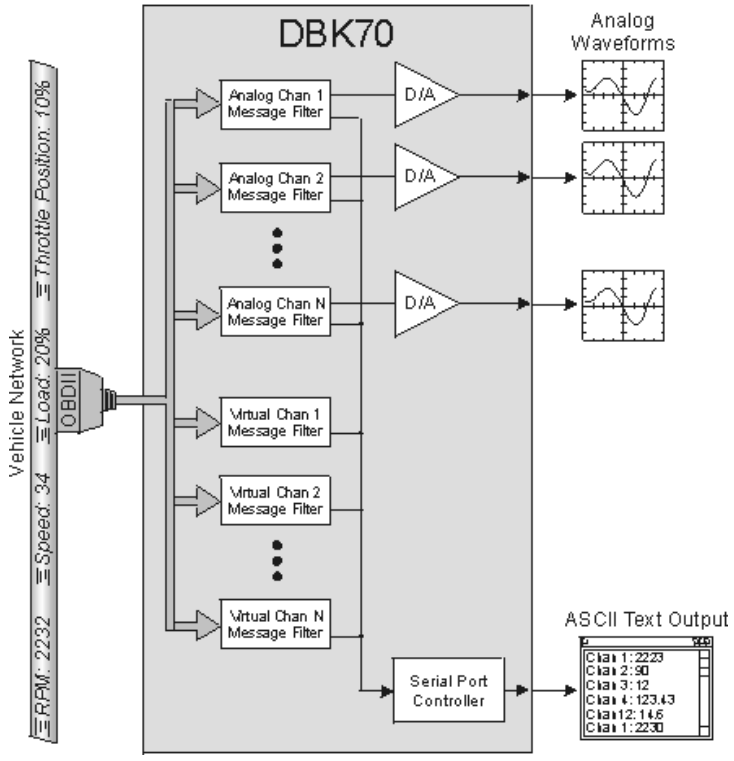
Virtual channels are setup and operated in the same manner as analog output channels, but with no associated analog output. When a virtual channel is configured, its value is reported as an ASCII string on the RS-232 port. No analog output port is updated as a result of this.

The process of monitoring a network parameter includes the following events:

(1) A parameter identifier (PID) is assigned to each analog output channel. Each PID includes a header filter and information on how to decipher the attached data.

(2) Each DBK70 channel monitors the network. The system searches for a header that satisfies the filter criteria.

(3) Once a match is discovered, the DBK70 reports the value as a proportional analog output and also reports the value on its RS-232 port as an ASCII string.



Using DBK70 and PidPRO to Acquire Data from a Vehicle Network

Using virtual channels in your data acquisition application necessitates software that can accept RS-232 data and parses ASCII strings.

Up to 70 channels can be configured in a single DBK70 using a combination of analog output channels and virtual channels. PidPRO can easily create virtual channels, configure them, and monitor/record their values. Both analog output channels and virtual channels can be used concurrently. Note that configured channels, whether analog output or virtual, are always reported on the RS-232 port.

Users of PidPRO and the DBK70 should remain aware of the following points:

- Up to 16 analog outputs can be installed in a single DBK70.
- Up to 70 channels can be configured (analog output plus virtual channels).
- All channel data is reported via RS-232 (analog output and virtual channels).
- Analog output channels report on both analog outputs and on the RS-232 port.
- Virtual channels report only on the RS-232 port.

Features of PidPRO

The standard PidPRO application offers the following features:

- Assign PID records to channels
- View channel value in real time
- Support for up to 16 channels
- Load and save multiple PID databases
- Cut and paste PID records to different PID databases
- *One-Click* channel assignment
- Automatic scale and offset calculation
- Easy PID editing

Additional features can be obtained with the purchase of the PidPRO+ add-on option. The *plus* option adds the following to the standard PidPRO package:

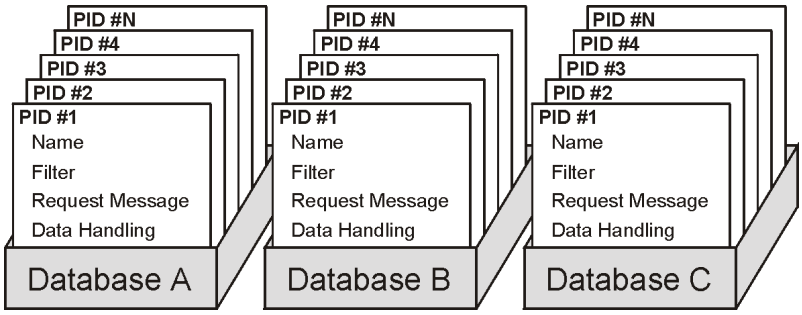
- Log channel values to disk in real time
- Support for up to 70 channels by using analog output channels and virtual channels
- A graphical network monitor for viewing data in real time
- Save and print monitored data
- Load and save DBK70 channel configurations

To use the standard PidPRO application or enable the PidPRO+ add-on, you must first open the *Authorization* Dialog box and indicate your choice of applications.

Database Concepts

A Parameter Identifier (PID) database is a collection of PID records. Each record contains a collection of parametric fields describing a request message, a reply from the network module, and data handling rules. PidPRO allows you to load a PID database then assign any PID from the database to a selected DBK70 channel.

PidPRO provides a host of database management services that allow you to easily organize your PIDs, create and edit PIDs, and save any number of databases. Note that PidPRO databases are saved in Microsoft Access format.



Three Parameter Identifier Databases

PidPRO is delivered with several databases of public domain PIDs, also called legislated PIDs. PidPRO allows you to load, edit, and save these databases, or create completely new databases of custom PIDs. Once your database is built, configuring a DBK70 is as simple as associating a PID record from your database to a DBK70 channel.

A note to users who are upgrading from DBK70Config to PidPRO or to PidPRO+:

DBK70Config, the software application that preceded PidPRO and was originally included with DBK70 units, also makes use of Microsoft Access PID databases. DBK70Config can only use one database file, DBK70.MDB.

PidPRO and PidPRO+ can load, manipulate, and save the database file DBK70.MDB, so PIDs that were modified and/or created using DBK70Config can also be used within both PidPRO applications.

If you had been using DBK70Config but are upgrading to either version of PidPRO, you should use the PID databases that are delivered with PidPRO. The databases are always being updated and those delivered with PidPRO are the latest. If you have developed custom databases and/or PID records using DBK70Config, you can load DBK70.MDB into PidPRO and make use of your custom PIDs.

To make use of such custom PIDs you should:

1. make a copy of the DBK70.MDB file
2. rename the copy
3. move the copy into PidPRO's *databases* subdirectory.

When in PidPRO, if you load an old database [that was shipped with, or modified using DBK70Config] and you encounter an error while manipulating a PID record, contact the factory to have the file upgraded. Note that very early versions of the DBK70Config database files have indexing limitations that can easily be corrected at the factory.

PidPRO Quick-Start

Software Installation

Insert the DBK70 release CD into your PC's CD drive. If auto-run does not launch the installation program automatically, run the program called SETUP.EXE from the CD's root directory. Follow the on-screen instructions to install the program.

Most of the functionality of PidPRO is password protected. The authorization code is entered while operating the PidPRO application, not at install time.

Entering the Authorization Code

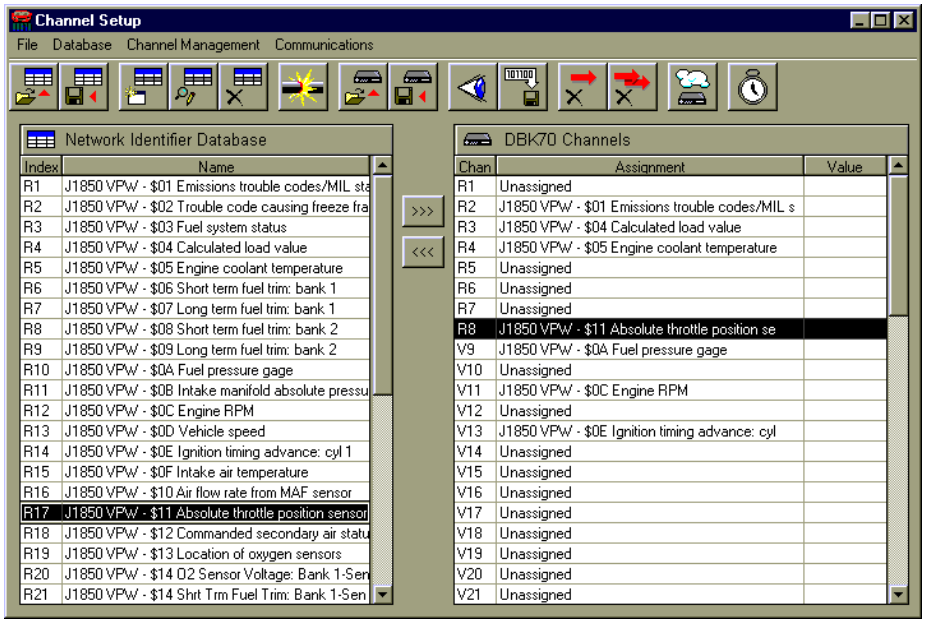
The Authorization Dialog can be accessed from the File pull-down menu. In regard to PidPRO and PidPRO+, the Authorization Dialog provides three options:

- enter the authorization code for the standard PidPRO application
- enter the authorization code for the PidPRO+ option, if purchased
- select the 30-Day Trial option (*no authorization code necessary*)

You will need to make use of one of the above options during the first startup of PidPRO. If you don't have an authorization code, select the 30-day trial option. This allows you to use PidPRO+ for 30 days without a code.

If you *purchased* the PidPRO+ option you should not use the 30-Day Trial, but instead enter the associated code. This will avoid an application timeout at the end of the 30-day period.

General Layout



Channel Setup Window

As shown in the preceding figure, PidPRO's Channel Setup Window includes of two tables. The first, the *Network Identifier Database*, is a list of database records in the currently loaded PID database. The second is a list of available *DBK70 Channels*.

To view the DBK70 channels list, the DBK70 must be physically attached to your PC and PidPRO must be *connected*. Without a DBK70 connected, only the database management features of PidPRO are enabled.

Connecting PidPRO to the DBK70 Hardware

To connect PidPRO to the DBK70 hardware, click the *Connect* button. When the hardware is recognized, PidPRO displays the current settings of the DBK70 channels in the DBK70 Channels list.

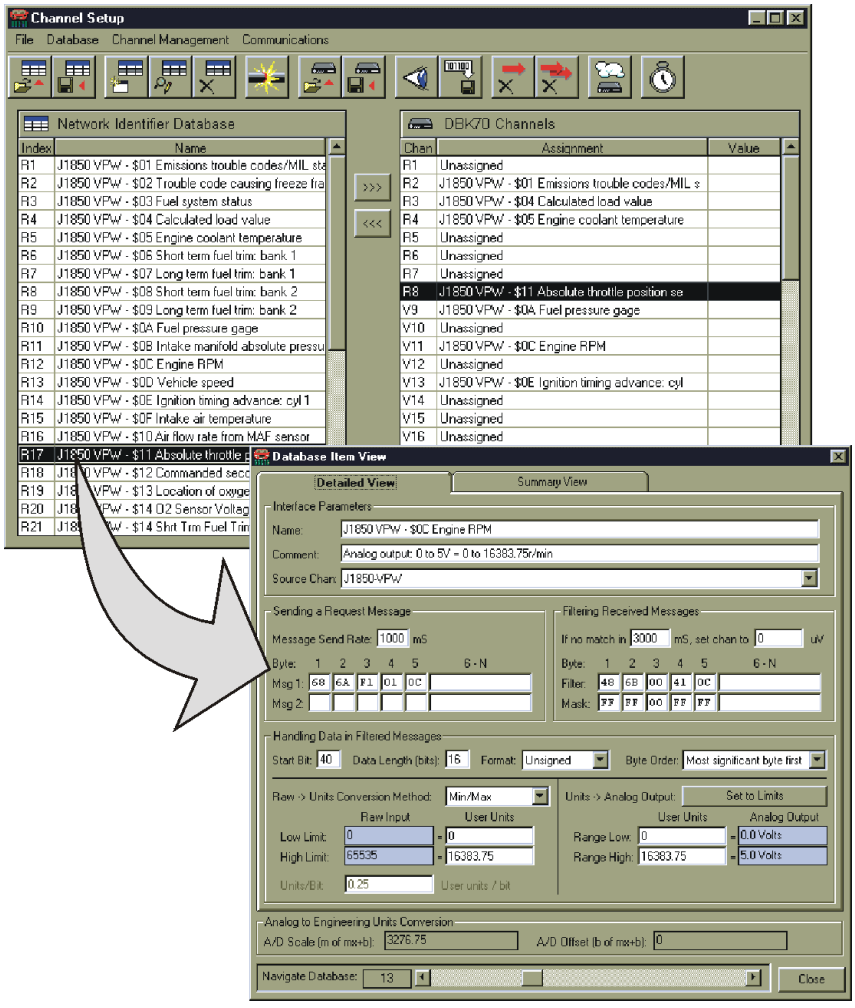
Opening and Viewing a PID Database

To load the included PID database that pertains to your network type, click the *Open Identifier Database* button, select the desired database from the file list dialog box, then click *Ok*. Several PID databases are shipped with PidPRO – one database per network protocol. Although this is the default organization of PID records, the user can organize PIDs as desired. For example, PIDs for different protocols can be all in one database, all the PIDs can be in one database, or PIDs for a particular electronic control module can be segregated into one database.

To view the contents of a PID record in the database, double-click the desired item in the database list.

Use the scroll bar at the bottom of the Database Item View window to view the content of other records. The Database Item View window does not have to be closed to operate the PidPRO main window. The Database Item View window will always display the content of the currently selected database item in the Network Identifier Database list.

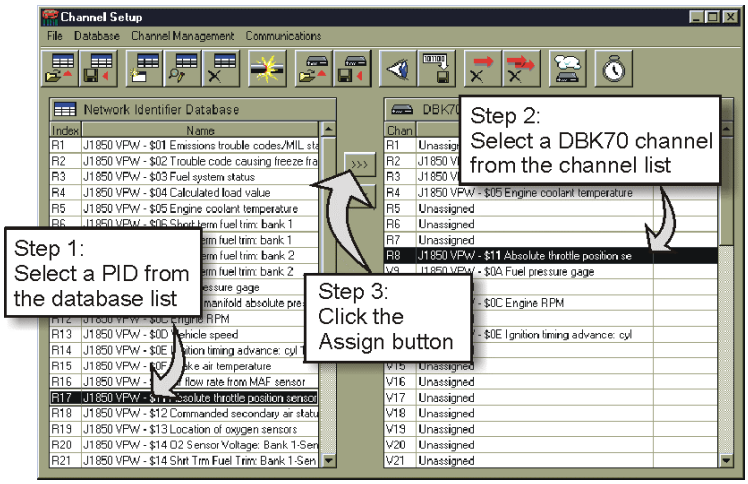
The Database Item View window has two views of the selected record; Detailed View and Summary View. Summary View's fields are identical to those found in the DBK70Config software. Detailed View provides a more comprehensive view of each PID and includes automatic scale and offset calculation features. Both views represent the same PID, so changing settings in one will result in changes to the other.



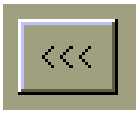
Double-Clicking on a PID Item Brings Up the Database Item View Window

Assigning a PID to a DBK70 Channel

To assign a PID in the database to a DBK70 channel: (1) select the PID in the database list, (2) select a DBK70 channel in the channel list, and (3) click the <Assign> button.



Assigning a PID to a DBK70 Channel



To capture the content of an already-assigned DBK70 channel and append it to the currently loaded database as a PID record: (1) select the DBK70 channel of interest and (2) click the <Append> button.

After a DBK70's channels have been assigned, PidPRO can be shut down and the DBK70 can be disconnected from the PC. Whenever the DBK70 is powered-up, it will assume the last configuration setup by PidPRO.

Viewing the Current Channel Values

If connected to a live network through a DBK70, PidPRO can display the current value of each assigned channel. Click the <Display Current Channel Values> button to view the channel values in real time. If the PID assigned to a channel is not seen by the DBK70, no value will be reported.

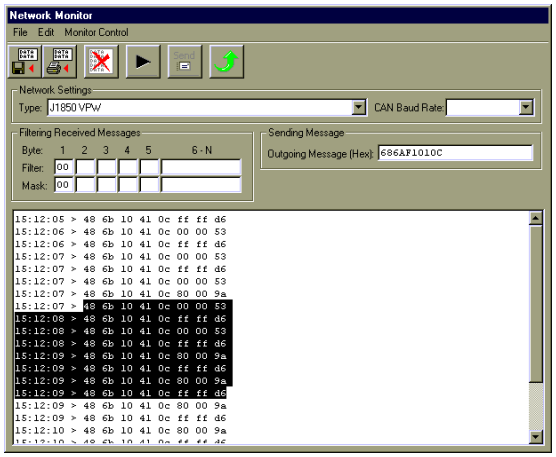
Monitoring the Vehicle Network PidPRO+ Only

During normal operation, only the *value* associated with the specified message is reported through the DBK70 channel output. After the message header is used to identify the message, the header is discarded. PidPRO+ provides a *Monitor* window for viewing the raw network data in real time.

To quickly see the network traffic, complete the following steps:

1. Expand the File pull-down menu.
2. Select *Network Monitor*.
3. Click the *Start* button while leaving the filter setting at 00.

A filter of 00 captures all messages. For more information on using the Monitor window refer to the Network Monitor section.



Network Monitor in PidPRO+

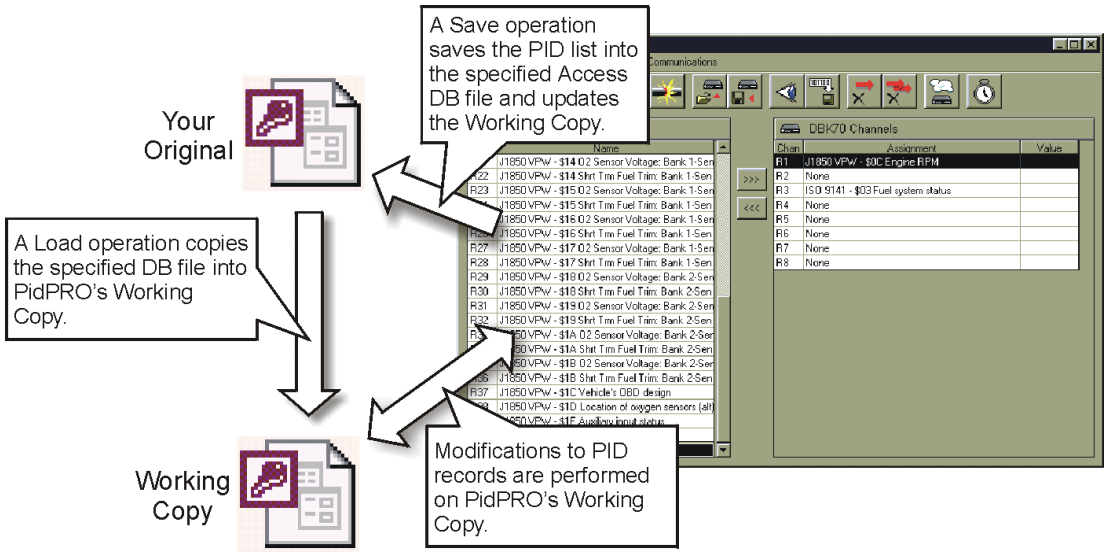
Database Management

PidPRO takes advantage of Microsoft Access database technology to organize PID collections. All database files created or modified by PidPRO are Access-compatible.

When PidPRO opens a database file, it creates a working copy so that the selected database is not accidentally modified.

Note: If PidPRO is closed without saving the database, it still maintains all of your unsaved changes in its working copy. The next time PidPRO is launched, it will bring up its working copy, containing all of the most recent changes.

The working copy will always be maintained, regardless of whether it is ever saved under a user file name. If desired, you can operate PidPRO indefinitely without explicitly saving your changes. PidPRO will always default to its working copy, which will contain every change made.

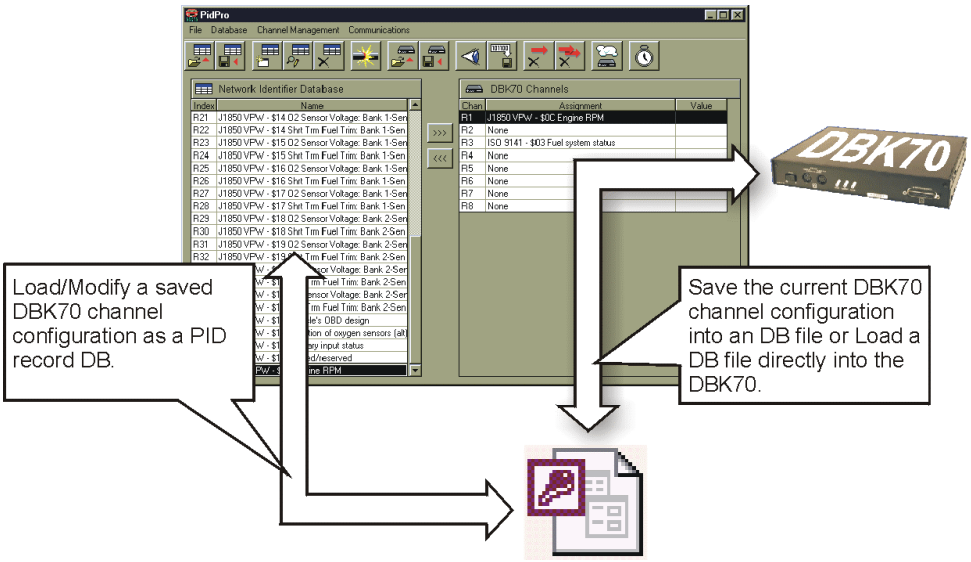


Actions that Impact PidPRO's Working Copy

To save the working copy, use PidPRO's *Save* and *Save As* commands. These commands will save an image of the working copy to the selected file name. All subsequent changes will be applied to the working copy again. To apply these changes to your specified file, you must explicitly use the *Save* command again.

PidPRO has the capability of capturing the current channel configurations of an attached DBK70 and recording the configuration to disk. Later, a DBK70 configuration file can be selected and used to completely configure an attached DBK70. This feature allows you to instantly reconfigure all the channels of a DBK70 by recalling a saved setup.

When the user saves a DBK70 channel configuration, PidPRO stores it as a Microsoft Access database using PidPRO's PID database format. This allows a saved DBK70 configuration to be loaded into PidPRO as an ordinary PID database. It also allows you take any database file and send it directly to the DBK70 as a channel configuration file. This capability provides excellent database management flexibility by allowing DBK70 configurations and PID databases to be used interchangeably. Rather than assigning each DBK70 channel, one at a time, this scheme allows you to create a database with all the desired parameters, save it, and then load it directly into a DBK70.



PidPRO Flexibility Regarding Loading and Saving Channel Configuration Files

Several PID databases are included with the PidPRO software. They will be installed in a subdirectory of PidPRO's working directory called *Databases*. These databases are organized by network interface protocol, where all of the J1850-PWM PIDs are in one database, all of the ISO9141 PIDs are in another, and so on. This organization makes for easy operation when one network interface card is being used. PID databases can be organized in any fashion that suits your application. A PID database can contain PIDs for different interface types, different protocols, and have many or few PIDs.

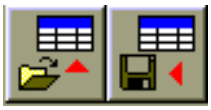
Two database files exist specifically to service the internal needs of PidPRO. These database files are in PidPRO's *System* subdirectory. Do not move, delete, or modify database files in the System subdirectory.

Main Window

File Menu

Save/Open Identifier Database

Menu: File/Save Database, File/Save Database As…, File/Open Database…



The Save command is used to save the current working copy of the PID database to a specified filename. See the preceding section, *Database Management*, for more information on the relationship between database files and PidPRO's working copy.

The Open command loads a disk-based PID database file into PidPRO. Select the desired file from the list provided in the Open dialog box. If the file is opened successfully, the database PIDs will be listed in the Network Identifier Database list on the left in the main window.

PidPRO creates a working copy of the loaded database. All subsequent changes made to the database are made to the working copy. The original database is not modified unless an explicit *Save* operation is performed. See the preceding section, *Database Management*, for more information on the database working copy.

Copy and Paste PID Record(s)

Menu: File/Copy PID Record, File/Append Copied PID Record

To move PID records from one database to another or to move a PID record to the end of the currently opened database, use these two commands. The Copy PID Record command copies all of the currently selected PID parameters into PidPRO's internal clipboard. The Append Copied PID Record command creates a new PID record at the end of the PID database list then pastes all of the copied parameters into the fields of the new record.

To move a PID record from one database to another, open the database that holds the PID you would like to move, then use the Copy command to capture the parameters. Open the destination database then use the Paste Copied command to append the copied PID record to the end of the database.

Monitor Network Traffic **PidPRO+ Only**

Menu: File/Network Monitor

This command opens the Network Monitor portion of the PidPRO+ application. For additional information refer to the section entitled *Network Monitor*, beginning on page 5-30 of this document.

Authorize

Menu: File/Authorize…

This command brings up a window allowing the user to enter a factory-issued authorization code or enable a 30-day trial period of the PidPRO+ application. If you've purchased the software, enter the code supplied by the factory and click <Apply Code>. The Status should change to Enabled. To evaluate PidPRO+ (without purchase), select the Start 30-Day Trial option.

About

Menu: File/About…

The About box holds important copy right information plus the version of PidPRO, and if a DBK70 is connected, the version of the DBK70 firmware. These version numbers are useful when requesting factory technical support.

Exit

Menu: File/Exit

This command disconnects PidPRO from the DBK70 and shuts down PidPRO.

Note: To ensure proper operation, it is recommended that you exit or disconnect (by clicking Connect again) PidPRO before removing the DBK70 from the serial port or removing power. When PidPRO is commanded to disconnect, it sends a final series of commands to the DBK70 to ensure proper operation.

Database Menu

New/Edit/Delete Database Record

Menu: Database/Add New Database Item, Database/Edit Database Item, Database/Delete Database Item

The **Add New** command clones the currently selected PID record, adding a new record to the end of the database. All the fields of the new record are identical to the PID record from which it was cloned, except for the Name field, which has an asterisk "*" prefix added to tag it as a clone.

To modify the clone, double click on it or click the **Edit** button. The Edit command opens the Database Item View window showing all of the parameters of the selected PID record. Clicking Edit is equivalent to double clicking an item in the PID list.

The **Delete** command removes the selected PID record from the database list.

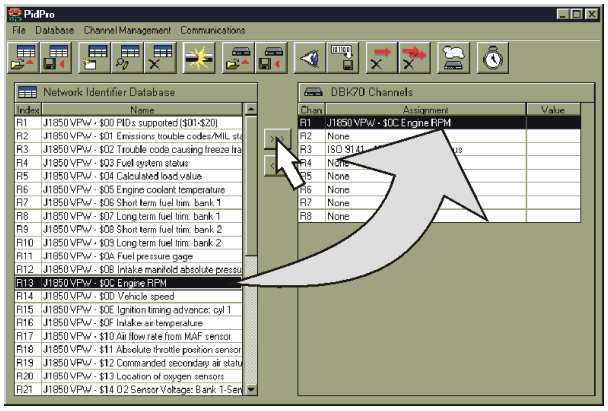
Channel Management Menu

Assign Database Item to DBK70 Channel

Menu: Channel Management/Assign Database Item to DBK70 Channel

This command takes the parameters in the currently selected PID record in the Network Identifier Database list and assigns them to the currently selected channel in the DBK70 Channels list.

The DBK70 will automatically save all of the parameters associated with the channel into its non-volatile memory. Neither exiting PidPRO nor power cycling the DBK70 will alter these settings.



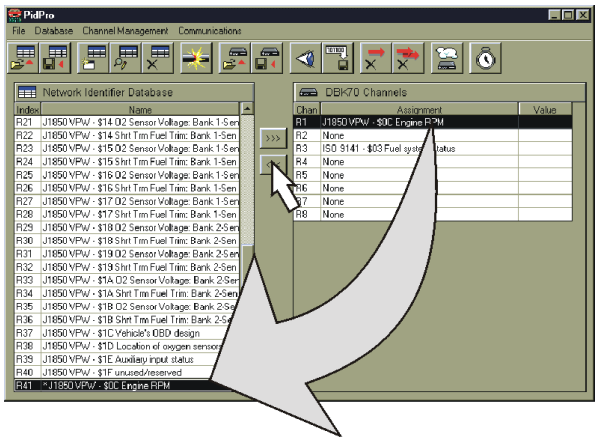
Assigning a Database Item to a DBK70 Channel

Append DBK70 Channel to Database

Menu: Channel Management/Append DBK70 Channel to Database

The Append command collects all of the parameters assigned to a channel, consolidates them into a PID record, and appends the record to the end of the working copy of the database.

Aside from the channel update rate, it is not possible to modify any of the parameters assigned to a DBK70 channel directly. However, there are two indirect methods.



Appending a DBK70 Channel to a Database

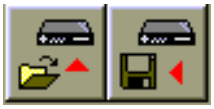
To change a parameter associated with a DBK70 channel, you can either

(a) modify the parameter in an existing PID record and assign it to the desired channels, or

(b) append the channel to the database, make the necessary changes in the database, then assign the database record back to the channel.

Save/Load DBK70 Channel Configuration **PidPRO+ Only**

Menu: Channel Management/Save Current DBK70 Config to File,
Channel Management/Load DBK70 from Saved Config File



In PidPRO+ the Load command prompts the user for a filename; then loads the selected channel configuration into the channels of a connected DBK70. This action will completely purge the DBK70's current channel configuration. Any DBK70 database file or previously saved channel configuration can be selected. Each record in the database will be sequentially assigned to a channel. If the number of records in the database exceeds the number of real output channels in the DBK70, virtual channels will automatically be created. If the number of records exceeds the number of real and virtual channels allowed by the DBK70, the excess records will be ignored.

The Save command prompts the user for a file name, then saves the current channel configuration of the attached DBK70 to disk. As mentioned in the *Database Management* section of this manual, the channel configuration is saved in a standard DBK70 database format so that this file can be loaded as a database and manipulated.

Display and/or Store Current Channel Values ***Store Current Channel Values* applies to PidPRO+ only.**

Menu: Channel Management/Show Current DBK70 Channel values,
Channel Management/Stream Values to Disk

The Display command displays the current channel value of the an assigned channel in the Value column of the DBK70 Channel list. For any assigned channel, if the DBK70 does not find a header that matches the filter, no value will be reported. Typical networks broadcast some messages more often than others, so it is not unusual to see some channels updating faster than others. Clicking the button in the toolbar will enable the display. Pushing it a second time turns the display off.

The Stream to Disk command records all channel values to disk using the filename assigned using the command Channel Management/Set Data Destination Filename.

Note: The DBK70's analog output will proportionately track your parameter with 16-bit resolution, but only integer values are reported to the PC. If the parameter of interest has a relevant fractional component that needs to be reported on the PidPRO screen, use the Raw -> Units Conversion fields in the Database Item View to rescale your parameter so that the fractional component is not truncated. For additional information refer to the Raw -> Units Conversion Method section on page 5-22 of this document.

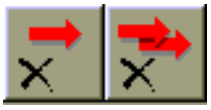
Set Data Destination File Name **PidPRO+ Only**

Menu: Channel Management/Set Data Destination Filename

This command pops up a dialog box allowing the selection of a filename that can be later used as a destination file for the command Stream Values To Disk (see above).

Unassign Channel(s)

Menu: Channel Management/Unassign DBK70 Channel, Channel Management/Unassign All DBK70 Channels…



The Unassign command removes the channel configuration of the channel currently selected in the DBK70 channel list. The Unassign All command removes the current configurations of all the channels in the channel list.

Set Virtual Channel Count **PidPRO+ Only**

Menu: Channel Management/Set Number of Virtual Channels…

This command pops up a window that allows you to enter an integer number representing the number of virtual channels you desire. Real channels are reported as analog outputs and on the DBK70's serial port, while virtual channels are reported only on the serial port. This document's introduction includes additional information on virtual channels.

A default value of 0 virtual channels configures the DBK70 to list only its analog output channels. The DBK70 Channel list on the right side of the main screen displays a row for each analog output channel and each virtual channel. Changing the number of virtual channels will change the number of rows in this list. As shown on the right, analog output channel numbers show a prefix of "R" for *real* and virtual channels show a prefix of "V" for *virtual*.

R5	Unassigned
R6	Unassigned
R7	Unassigned
R8	J1850 VPW - $11 Absolute throttle position se
V9	J1850 VPW - $0A Fuel pressure gage
V10	Unassigned
V11	J1850 VPW - $0C Engine RPM
V12	Unassigned

"R" Signifies Real Channel
"V" Signifies Virtual Channel

Set Channel Update Rate

Menu: Channel Management/Set Channel Update Rate…

This command allows the Update Rate parameter of the channel currently selected in the DBK70 channel list to be modified. To modify other parameters, use the Append command to move the selected channel's parameters to the database list, modify the desired parameter(s), then use the Assign command to move all of the parameters back to the selected channel. This window accepts integer numbers representing an update rate in milliseconds. A value of –1 tells the channel to send its request message only once, when the DBK70 is powered up.

Refer to the segments entitled *Append DBK70 Channel to Database* and *Assign Database Item to DBK70 Channel* for additional information. The segments begin on page 5-12 of this document.

Communications Menu

Connect

Menu: Communications/Connect

The Connect command uses the COM port specified in the Setup Communications list to search for the DBK70 and collect the parameters of its current setup. Once communications is established, the DBK70 channel list on the right side of the main window will fill in with the settings for the configured DBK70 channels.

A successful connection will enable the previously disabled controls in the main window. All operations of PidPRO are now accessible.

Note: To ensure proper operation, it is recommended that you exit or disconnect (by clicking Connect again) PidPRO before removing the DBK70 from the serial port or removing power. When PidPRO is commanded to disconnect, it sends a final series of commands to the DBK70 so that it can operate properly autonomously.

Set COM Port

Menu: Communications\Setup Communications\COM1…4

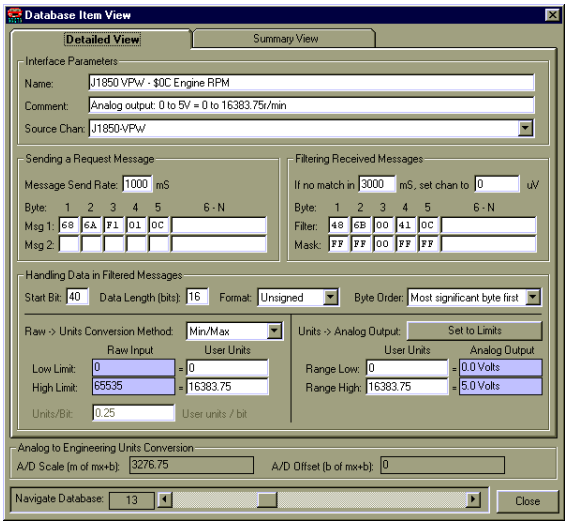
Before clicking Connect, make certain that you've selected the COM port that is being used to communicate with the DBK70.

Database Item View Window

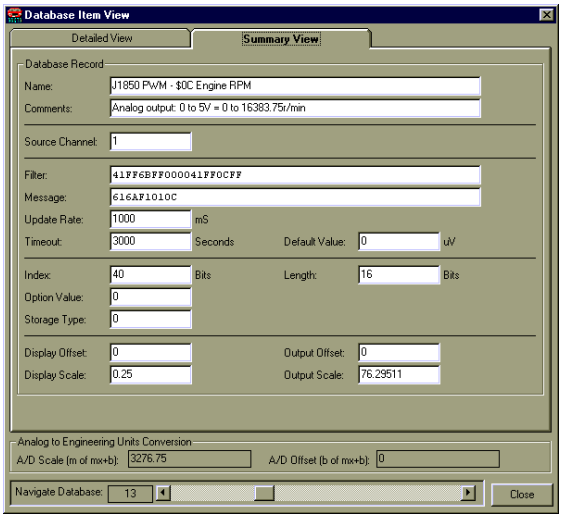
Each record in a PID Database has several fields, which can be viewed in the Database Item View window. To access the window either:

(a) click the Edit Database Record tool (see page 5-12), or
(b) double-click the desired PID record in the Network Identifier Database list (see page 5-7).

For each record, two views are accessible from the tabs at the top of the window; these are: *Detailed View* and *Summary View*. Since these are two different ways of viewing the same information, changing field values in one view will change related field valus in the other view.



Detailed View



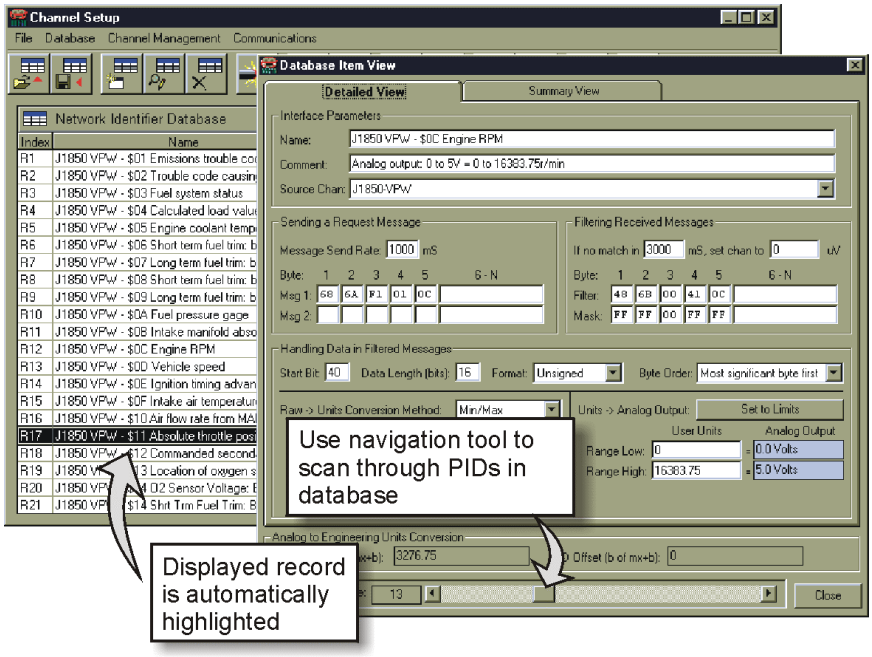
Summary View

The fields in the *Summary View* are identical to those in the DBK70Config program (PidPRO's predecessor). This view is primarily for users migrating from that software. However**, the *Detailed View* provides an easier interface to the fields and provides several automatic calculation features so that *offsets* and *scales* do not need to be developed manually**.

Database Item View Window – Field Labels*						
	Detailed View	**Summary View**			**Detailed View**	**Summary View**
1	Name	Name		14	Raw	*No field associated**
2	Comments	Comments		15	Low Limit / High Limit	*No field associated**
3	Source Channel	Source Channel		16	Units/Bit	*No field associated**
4	Message Send Rate	Update Rate		17	Binary Point	*No field associated**
5	Msg 1 and Msg 2	Message		18	Range Low / Range High	*No field associated**
6	If no match in __mS	Timeout		19	Analog To Engineering Units Conversion	Analog To Engineering Units Conversion
7	set chan to µV	Default Value				
8	Filter	Filter		20	*No field associated**	Output Scale
9	Mask	Filter		21	*No field associated**	Output Offset
10	Start Bit	Index		22	*No field associated**	Display Scale
11	Data Length (bits)	Length		23	*No field associated**	Display Offset
12	Format	Storage Type				
13	Byte Order	Option Value				

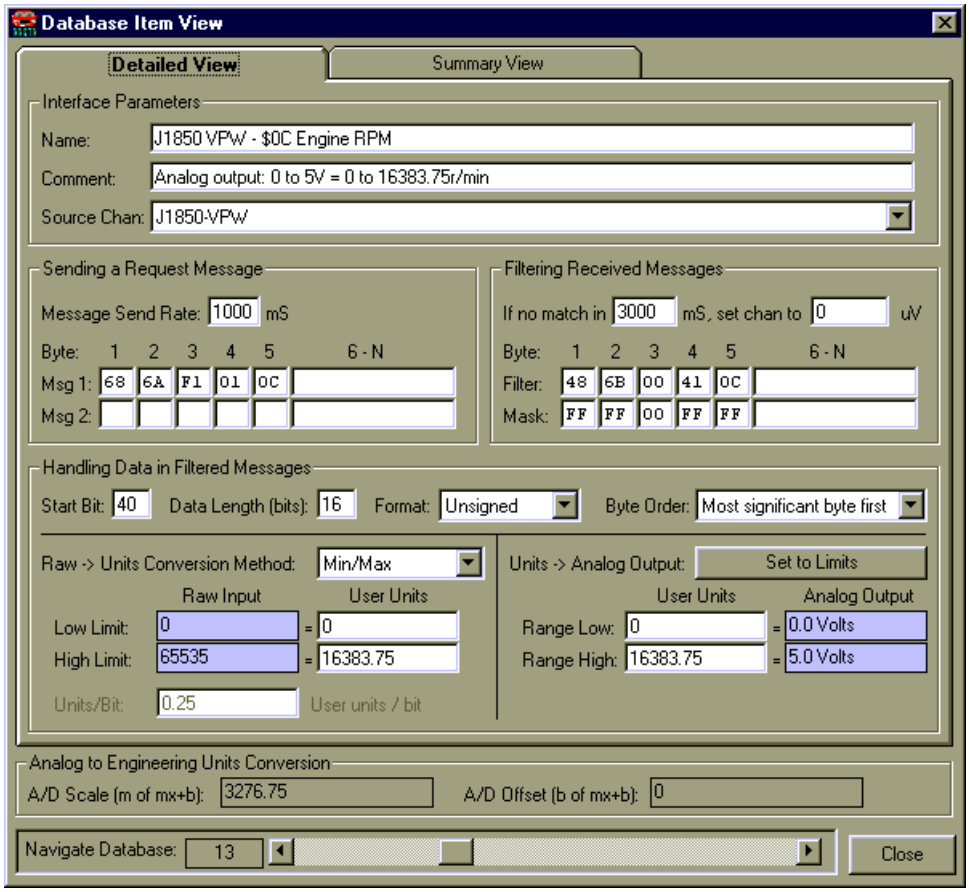
* *No field associated* means that there is no one directly associated field between Detailed View and Summary View for a given parameter.

The Database Item View window does not have to be closed to return to the main window. If the main window is brought into the foreground by clicking it, selecting any PID in the Database List will automatically show its parameters in the Database Item View window. This feature allows easy browsing of the database list. Conversely, when using the navigation tool at the bottom of the Database Item View window, the PID selection in the Database list on the main window will track accordingly.



Using the Navigation Tool to Track Through PIDs

Detailed View



Database Item View Window, Detailed View Tab

Name

Each record of the DBK70 Database has a Record Name field. The contents of the **Name** field should be something that is meaningful to the user of the DBK70. Typically the contents of this field are used to identify something about the configuration such as the type of data bus, the name of data being processed, and the output type, e.g., PWM J1979 DTC Count.

The **Name** field can be up to 29 characters, including blanks.

When the fields of a record [from the DBK70 Database] become the configuration for an output channel, the **Name** field is included.

Comments

Like the Record Name field, a configuration's Comments field can be used to help the user understand something about the data being processed. Generally, the Comments field shows the *general signal to data conversion* that is supported by the configuration.

An example of a Comments field is: 0v = 0 psi, 5v = 100 psi , 0Hz = 0 RPM, 6,000Hz = 6,000 RPM
The example can be considered as a good one since the general conversion values are easily recognized.

The maximum size of this field is 39 characters.

Source Channel

This field specifies the source channel setting to select the appropriate network interface and protocol.

In the case of ISO9141, the different Source Channel settings enable unique initialization sequences for establishing communications on a working network. Since the DBK70's physical ISO9141 interface cannot support more than one initialization sequence concurrently, make sure that all the configured channels that are using the ISO9141 interface have the same Source Channel assignment.

In the case of CAN, the different Source Channel values enable different physical transceivers on the CAN interface card. Since the DBK70's physical CAN interface cannot support more than one transceiver concurrently, make sure that all the configured channels that are using the CAN interface have the same Source Channel assignment.

Network Type	Source Channel Value
J1850-PWM	1
J1850 VPW	3
ISO9141:	
Standard ISO9141	2
ISO14230-4	7
ISO with no initialization	8
CAN:	
ISO11519-2	4
ISO11898	4
ISO11898/3	4
ISO11992	5
J1939	4
J2284	4
J2411	6
OBD CAN	9

Message Send Rate

Some modules will not broadcast the desired information on the network unless the information is explicitly requested. In these cases, the Message Send Rate field [the same as Update Rate in *Summary View*] must contain a number above 0 representing the number of milliseconds between times the DBK70 will issue the request message found in the message fields (Msg 1 and Msg 2). If the Message Send Rate is 0, no request message will be sent.

If it is desired that the message in the Message fields be transmitted one time, rather than periodically, set the Message Send Rate field to a value of -1. This will cause the DBK70 to send the message in the message field when it is powered on and/or if the timeout occurs.

Note that vehicle manufacturers have limits on the rate at which outside messages can be sent onto the data buses of their vehicles. This rate may vary from vehicle to vehicle within the same manufacturer and same model year. For legislated PIDs on J1850, an aggregate request rate of about 10Hz should not be exceeded. For ISO 9141, the aggregate update rate should not exceed about 8Hz. This means that for J1850, all the enabled channels in the DBK70 should not collectively issue request messages faster than 10Hz. For example, it is acceptable to have one channel enabled with an update rate of 100mS or 2 channels enabled with an update rate of 200mS each. But, it is not recommended to have an update rate for 2 enabled channels at 100mS each.

These limitations are due to the fact that the networks on some vehicles can easily be overwhelmed by request messages that are broadcast too frequently. When the network traffic is too great, the vehicle network may malfunction temporarily. If the specified rates grossly exceed the recommended rates, the DBK70 will attempt to adjust the rates.

There is no soft or hard limit on CAN bus. Most fast CAN PGNs do not need to be requested. They automatically update by their source module without a request message. When issuing request messages on the CAN network, limit the aggregate request rate to about 100 per second.

The values for Message Send Rate range from 0 to 32000 milliseconds.

Msg 1 and Msg 2

These fields specify a message that is to be broadcast by the DBK70 on the vehicle's network at the rate specified by the Message Send Rate parameter.

The codes to be used for the message fields (Msg 1 and Msg 2) are hexadecimal byte values, i.e., 00 to FF. The maximum length is dependent on the type of vehicle data bus to be used, e.g., 12 bytes for J1850.

Request messages are used to obtain data when the data to be processed by an output channel is not normally available on the vehicle's data bus but can be obtained by sending a request for it.

Typically only one message needs to be sent as a request message to an electronic control module.

If no match in ___ mS and

set chan to ____ uV (two separate, but closely related fields)

These two fields work together to manage a DBK70's analog output voltage when the expected message does not arrive within a specified timeout period.

The field *If no match in* defines a timeout period. The timeout period specifies the maximum time, in milliseconds, between messages received for an output channel. If this interval is exceeded without receiving a new message, the value in microvolts entered in the *set chan to* field will become the output channel's signal value.

The value of *If no match in* ranges from 10 to 65535 seconds. The value of *set chan to* ranges from 0 to 5,000,000 microvolts, i.e., 0 to 5 volts.

These fields have no affect on virtual channels.

Note that in *Summary View*, these two fields are labeled "Timeout" and "Default Value," respectively.

Filter

The Filter fields specify the information to be used to identify messages received by the DBK70 from the vehicle's data bus that contain the data that is to be processed by an output channel.

The coding of the Filter fields is hexadecimal byte values.

The Filter field defines bit values that must be matched by corresponding bits in the received message in order to pass through the filter and be processed by the output channel.

Each message that is received by the DBK70 from the vehicle's network is processed by the Filter values of all defined output channels in the DBK70. A given message may pass the Filter of multiple output channels.

Reference Note:
For more information refer to *Fundamentals* in Chapter 6.

Mask

The mask bytes correspond to the Filter bytes above and specify which bits of the filter are to be compared to the bits of the corresponding byte in the received message. A mask bit value of 1 mandates a comparison, while a mask bit value of 0 represents a *don't care* bit. For example, a mask byte of FF means all bits in the corresponding filter byte are to be compared. A mask byte of 03 means only the least significant 2 bits are to be compared – all others are *don't care*.

Reference Note:
For more information refer to *Fundamentals* in Chapter 6.

Start Bit

This field specifies, by bit offset, where in a received message the desired data begins. The first (high order) bit of the first byte of a message has a value of 0. The values for Start Bit range from 0 to 95. Note that the Start Bit field is the same as the "Index" field in *Summary View*.

Reference Note:
Refer to Fundamentals in Chapter 6 for more information; including information regarding CAN.

Data Length (bits)

Once a message has been accepted [by the filtering process] the data within the message must be located and deciphered. The Data Length and Format fields specify the layout of the data embedded in the message. The Data Length field specifies the number of bits in the data and the Format field specifies whether the data is signed or unsigned. The values of the Data Length field can range from 1 to 32 inclusive. The Data Size and Format fields regulate the low and high limit of the incoming binary data. Changes in either field automatically updates the Binary Low and High Limit fields.

The following table shows examples of Data Length and Format value settings and how they affect the Binary Low and High Limit fields. Note that in *Summary View*, the Format field is labeled "Storage Type."

	Example #1	Example #2	Example #3	Example #4
Data Length	8	16	8	16
Format	Signed	Signed	Unsigned	Unsigned
Resultant Binary Low Limit	-128	-32768	0	0
Resultant Binary High Limit	127	32767	255	65535

Reference Note:
Refer to Fundamentals in Chapter 6 for more information; including information regarding CAN.

Format

The Format field specifies whether the data is *signed* or *unsigned*. See the preceding "Data Length (bits)" description for related information. Note that in *Summary View*, the Format field is labeled "Storage Type" and uses a "0" for *unsigned* and a "1" for *signed*.

Byte Order

This field specifies the order that the data bytes should be in before they are converted to user units. Typically, data is in first-byte-first format, i.e., the Most Significant Byte first (MSB). A notable exception is the J1939 standard, which uses last-byte-first (Least Significant Byte first (LSB)). Note that in Summary View the Byte Order field is labeled as Option Value and uses 0's and 1's for MSB and LSB, respectively.

Protocol	Byte Order (Detailed View)	Option Value (Summary View)
J1939	Least Significant Byte first (LSB))	1
J1850 VPW	Most Significant Byte first (MSB).	0
J1850 PWM	Most Significant Byte first (MSB).	0
ISO-9141	Most Significant Byte first (MSB).	0
ISO-14230-4	Most Significant Byte first (MSB).	0
ISO-11898	Most Significant Byte first (MSB).	0
J2411	Most Significant Byte first (MSB).	0
ISO-11992	Most Significant Byte first (MSB).	0
ISO-11519-2	Most Significant Byte first (MSB).	0
J2284	Most Significant Byte first (MSB).	0
OBD CAN	Most Significant Byte first (MSB).	0

Raw -> Units Conversion Method

Once the binary data of a specified message has been captured, the DBK70 converts it to user units, for example: RPM, temperature, percent load, or pressure. This unit conversion occurs before the data is displayed in the PidPRO interface or supplied on the DBK70's serial port for other programs.

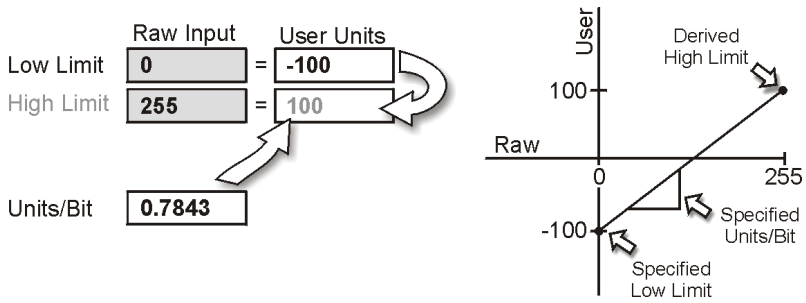
PidPRO provides 3 different methods for specifying the conversion information. These are:

- Units/Bit (Units per bit)
- Min/Max (2-point)
- Binary Point

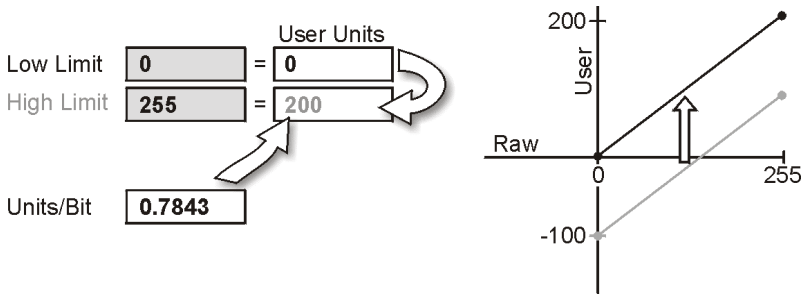
The different methods are supplied to accommodate the different ways in which ECM and vehicle manufacturers state scaling information.

Units/Bit essentially specifies the resolution of the binary data relative to the user units. For example, if the binary data is being converted to temperature, a Units/Bit value of 1 means that one binary count in the raw data equals one degree of temperature. A Units/Bit value of 0.1 means that one binary count in the raw data equals one tenth of a degree and 10 counts equals 1 degree. When using this method, the Units/Bit and the User Units Low Limit fields are used to specify the conversion parameters. The User Units High Limit is disabled, but the value is shown as an informational aid.

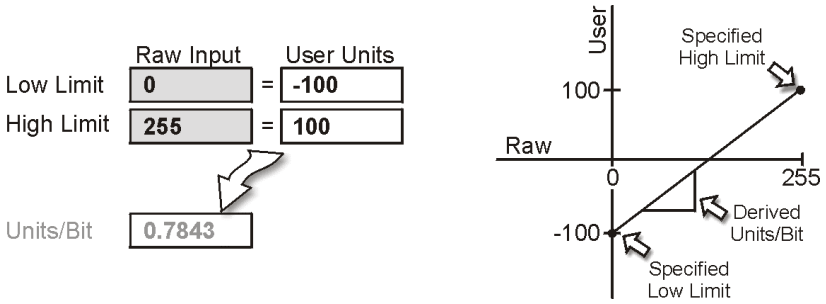
In the example below, a data length of 8 bits and a data format of *unsigned* produces a span of 0 to 255 in the raw incoming data. A Units/Bit value of 0.7843 provides a span of 200 units and a Low Limit of -100 provides an offset so that the limits of the user units [relative to the limits of the incoming data] is -100 to +100.



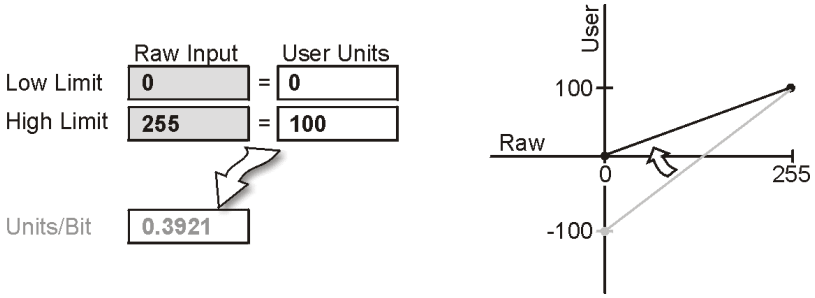
If the User Units Low Limit is changed to 0, the transfer function will be shifted so that the user units limits will be 0 to +200.



The **Min/Max** method allows you to specify the equivalent user unit values for the Raw Low and High Limits. The User Units High and Low Limits fields are enabled. The Units/Bit field is disabled but the value is shown as an informational aid. The example below shows how entering 2 points of the transfer function can derive the Units/Bit value.



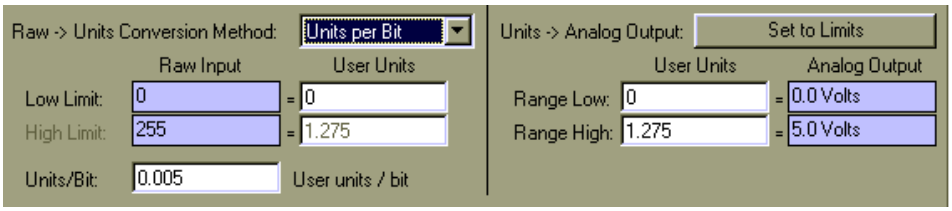
Moving either of the 2 points changes the Units/Bit value because the slope of the line changes.



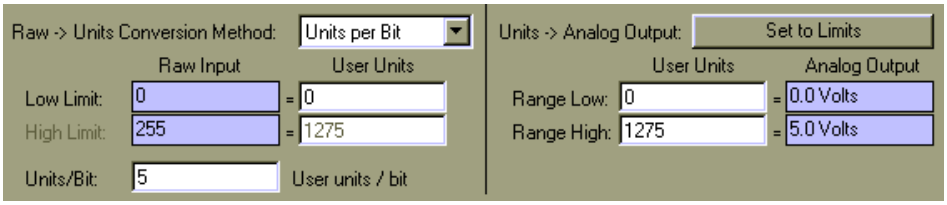
The **Binary Point** method is essentially the same as Units/Bit except that the resolution is stated in terms of where an implied decimal point is located in the data bytes. When using this method, the Binary Point and the User Units Low Limit fields are used to specify the conversion parameters. The User Units High Limit is disabled, but the value is shown as an informational aid.

The DBK70's analog output will proportionately track your parameter with 16-bit resolution, but only integer values are reported on the RS-232 port for PC programs, including PidPRO. If the parameter of interest has a relevant fractional component that needs to be reported on the PidPRO screen, you will need to adjust your Raw to Units conversion fields to account for the factional component of the parameter.

The graphic below shows the settings for a typical oxygen sensor. The raw value limits are 0 to 255 and the equivalent user units vary from 0 to 1.275 volts. Using these settings, an assigned analog output would smoothly vary from 0 to 5 volts as the parameter moved from 0 to 1.275. The value reported on the DBK70's serial port would, however, show either 0 or 1, but no values in between.

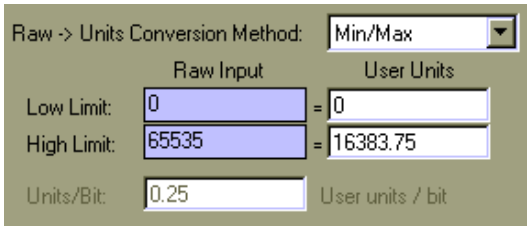


To provided higher data resolution on the serial port for this parameter, it is recommended that the parameter be rescaled to report millivolts rather than volts. The graphic below shows that multiplying the Units/Bit by 1000 changes the scaling of the parameter so that it reports millivolts. As the raw value varies from 0 to 255, the value on the serial port smoothly varies from 0 to 1275 millivolts.



Low Limit / High Limit

This section of the GUI consists of 4 fields. The two Raw Input fields are for viewing only, showing the extreme values of the incoming raw binary data. The user fills in the equivalent User Units value for the high and low limits. The Raw Input Low and High Limit fields are gray because you cannot affect these fields directly. These values are driven by the settings in the Data Length and Format fields.



The User Units Low and High Limit fields show the user unit values associated with the raw value extremes shown in the gray Raw Input Low and High Limit fields. Network parameters are often stated in terms of the realizable low and high data values, e.g., raw input 0 = -40, and raw input 255 = +215 degrees C.

If the Binary -> Units Conversion Method field is set to Min/Max, the User Units Low and High Limit fields are enabled for you to enter the user unit values associated with the stated raw input extreme values.

If the conversion method is Units/Bit or Binary Point, only the User Units Low Limit field needs to be defined by the user. The High Limit field is disabled.

Units/Bit

The Units/Bit field shows how many user units are associated with one binary count of the raw data. It would state, for example, how many degrees C was represented by one binary count in the raw data. If the unit per bit is 1, each count equals one degree C. If the units per bit is 0.5, each binary count equals 0.5 degrees. This is essentially a scaling factor for the raw data. The Units/Bit field is enabled when the Binary -> Units Conversion Method setting is Units/Bit. For informational purposes, it is displayed but disabled when the method setting is Min/Max.

Binary Point

The Binary Point field is functionally equivalent to Units/Bit, except that the scaling factor is stated in terms of an implied decimal point in the raw binary number. For example, with a Binary Point setting of 2, a raw binary value of 10101101 (173 decimal) would be interpreted as 101011.01 (173/4 = 43 decimal). The Binary Point field is enabled when the Binary -> Units Conversion Method setting is Binary Point.

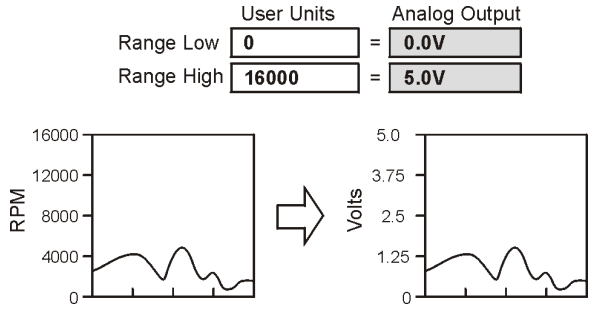
Set to Limits (Button)

The Set to Limits button sets the value of the Range Low and Range High fields so that the 0 to 5V range of an analog output will span the limits of the raw binary data. See Range Low / Range High below.

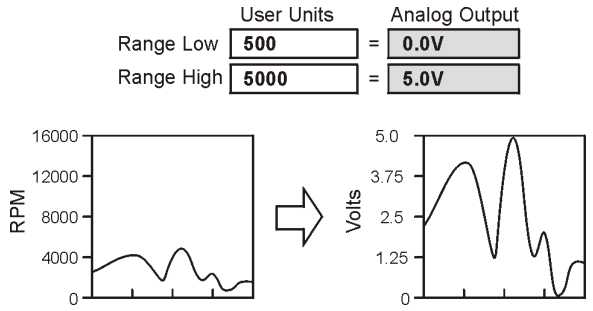
Range Low / Range High

An assigned analog output channel will span 0 to 5V, proportional to the converted value of the captured binary data. The Range Low and High fields specify the user units values that are associated with the analog output range. As a default, or if the Set to Limits button is clicked, the range of the analog output matches the limits of the raw input.

In instances where the realized value of the parameter varies only slightly, relative to the limits of the raw binary data, the analog output will also vary only slightly, causing poor measurement resolution. For example, the limits specified for the RPM parameter may be 0 to 16000 RPM, but during your test, the value may only vary from 500 to 5000. In this case, the analog output will only vary by about 1.35V, which is 27% of the full-scale value of 5V.



To maximize the dynamic range of the 0 to 5V analog output, set the Range Low and High values to the realized span of the parameter for your application. In the example above, setting the Range Low to 500 and the Range High to 5000 would scale the 0 to 5V output to span only the realized range. With these settings, 100% of the dynamic range of the 0 to 5V output is used, where 500RPM = 0V and 5000RPM = 5V.



These parameters have no affect on virtual channel assignments because there is no analog output associated with virtual channels.

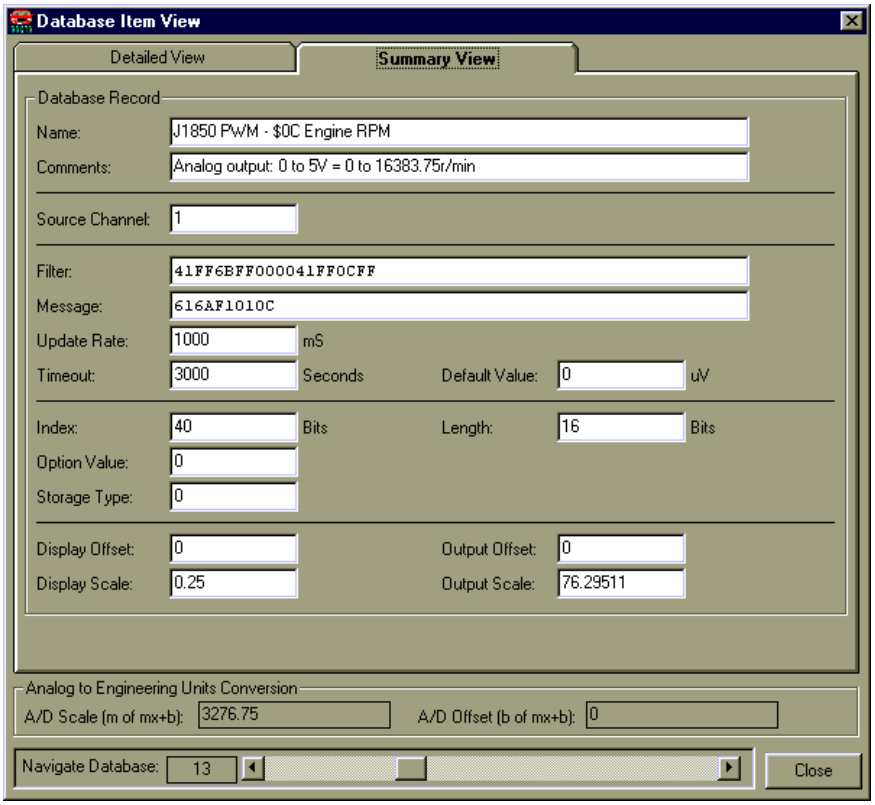
Analog to Engineering Units Conversion

Analog to Engineering Units Conversion Panel
Located near the bottom of the Database Item View Window

The section at the bottom of the Database Item View provides useful information for setting up the analog input channel on your data acquisition product to read the parameter in user units.

The DBK70's analog output will provide a voltage from 0V to 5V, proportional to the PID value. When read on an analog input channel of a data acquisition system, the value will be 0V to 5V. IOtech data acquisition products provide a means of supplying an offset and scale to each channel so that the value captured will be in user units, e.g., RPM or Degrees C. Sometimes these settings are called mx+b, which represents the equation for a linear transfer function, where m = scale, and b = offset. Using the A/D Offset and A/D Scale settings in the fields shown will translate the 0 to 5V signal from the DBK70's analog output into the desired user units in your data acquisition system.

Summary View



Summary View Tab, in the Database Item View Window

Note: Remember that *Detailed View* and *Summary View* are two different ways of viewing the same information. Changing fields in one view will change related fields in the other view.

The fields in the *Summary View* are identical to those in the DBK70Config program (PidPRO's predecessor). Summary View is primarily for users who are migrating from that software. The *Detailed View* provides an easier interface to the fields and provides several automatic calculation features so that offsets and scales do not need to be developed manually.

The Database Item View window does not have to be closed to return to the main window. If the main window is brought into the foreground by clicking it, selecting any PID in the Database List will automatically show its parameters in the Database Item View window. This feature allows easy browsing of the database list. Conversely, when using the navigation tool at the bottom of the Database Item View window, the PID selection in the Database list on the main window will track accordingly.

In regard to *Summary View*, each record of the DBK70 Database has 19 fields. Descriptions of each field follow, except when the field directly corresponds to a field in the *Detailed View*. In the latter case, a reference is provided, rather than a repeat of material. In several cases, fields in Summary View have different labels than do the corresponding fields found in *Detailed View*. These instances are pointed out and both field names are provided.

Name - See "Name" in *Detailed View*, page 5-17.

Comments - See "Comments" in *Detailed View,* page 5-17.

Update Rate - See "**Message Send Rate**" in *Detailed View*, page 5-19.

Source Channel - See "Source Channel" in *Detailed View*, page 5-18.

Index- See "**Start Bit**" in *Detailed View*, page 5-20.

Length - See "**Data Length (bits)**" in *Detailed View*, page 5-21.

Storage Type - See "**Format**" in *Detailed View*, page 5-21.

Output Scale

This field specifies the value that the received data will be multiplied by as apart of the output scaling process. The result of this multiplication is added with the value of the Output Offset field to complete the scaling processes and specifies the value for an output channel.

The Output Scale field can be defined with an integer or a floating-point type of value (e.g., 123, 17.45, 3590, etc). The range of the values for this field is +/- 2^{-31} to +/- 2^{+31}. If the Output Scale field is given a value of 0, then any connection to the data being received is lost.

Reference Note:
Appendix B, *Scale and Offset in Summary View*, discusses the mathematics pertaining to various aspects of scale and offset.

Output Offset

The Output Offset is an integer value. The range of values for the Output Offset field is -2^{31} to $+2^{31}$ (i.e., 2,147,483,647).

Reference Note:
Appendix B, *Scale and Offset in Summary View*, discusses the mathematics pertaining to various aspects of scale and offset.

Display Scale

This field and the Display Offset field are similar to the Output Scale and Output Offset fields. The difference is that the resultant scaled value is displayed in an Output Channel Icon on the screen of a PC using the DBK70 software rather than used to affect the output channel's signal. These fields are particularly useful when it is meaningful to display the data in a way that is different from the way the value of the associated output channel signal is calculated.

The range of values for this field is the same as for the Output Scale field.

Reference Note:
Appendix B, *Scale and Offset in Summary View*, discusses the mathematics pertaining to various aspects of scale and offset.

Display Offset

The range of values for this field are the same as for the Output Offset field. Refer to the explanation for the Display Scale field above for more information.

Reference Note:
Appendix B, *Scale and Offset in Summary View*, discusses the mathematics pertaining to various aspects of scale and offset.

Option Value – See "**Byte Order**" in *Detailed View*, page 5-21.

Message – Similar to "**Msg 1 and Msg 2**" in *Detailed View*, page 5-19.

This field specifies a message that is to be sent by the DBK70 on the vehicle's data bus at the rate specified by Update Rate parameter.

The codes to be used for the Message field are hexadecimal byte values (i.e., 00 to FF). The maximum length is dependent on the type of vehicle data bus (e.g., 12 bytes for J1850) to be used.

Request messages are used to obtain data when the data to be processed by an output channel is not normally available on the vehicle's data bus but can be obtained by sending a request for it.

To issue one message, make sure there are no spaces in your string of hex characters. To issue more than one message packet, insert one space between the independent groups of hex characters.

Filter – See "Filter" in *Detailed View*, page 5-20.

Timeout – See "**If no match in ___mS** " in *Detailed View*, page 5-20.

Default Value – See "**set chan to __µV**" in *Detailed View*, page 5-20.

Analog to Engineering Units Conversion

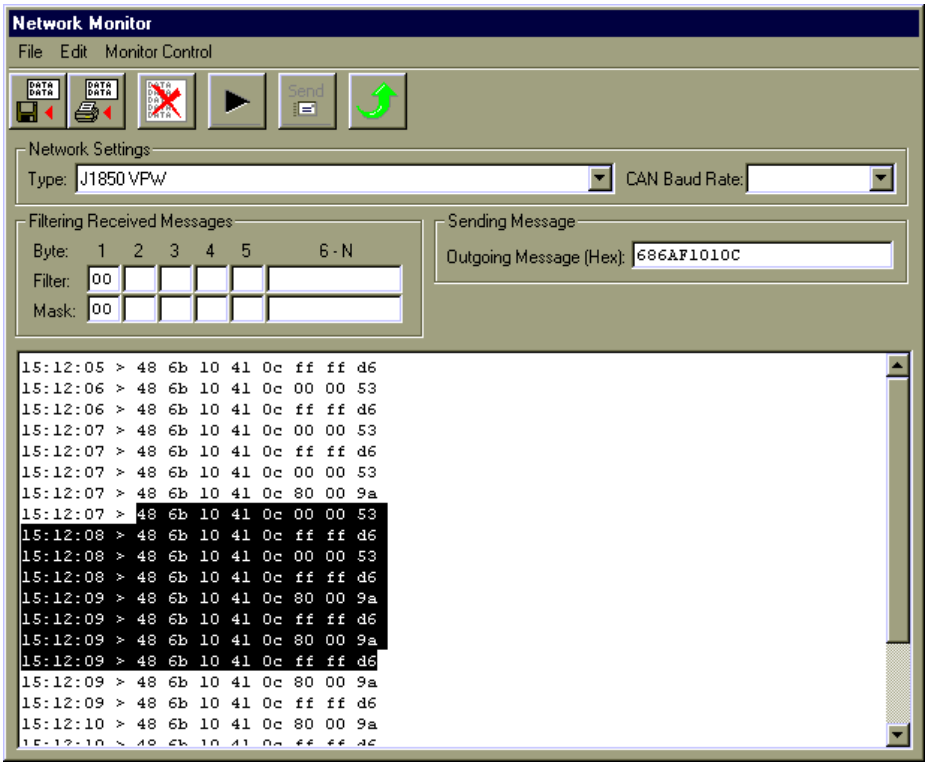
– See "Analog to Engineering Units Conversion" in *Detailed View*, page 5-26.

Network Monitor PidPRO+ Only

The purpose of the Network Monitor is to view, in real time, complete network messages that include both the header and data. In its standard operating mode, the DBK70 strips off the header and provides only the scaled data. The Network Monitor exposes the entire message, including the header.

The Monitor is a very useful tool when little is known about the network, its messages, or its reaction to requests.

To open the Network Monitor window, select File/Network Monitor from the main window.



Network Monitor

Quick Start for Network Monitor PidPRO+ Only

To passively capture every message being broadcast by any module on the network, following these steps.

1. Set both the Mask and Filter to 00, as shown in the screen shot.
2. Select the desired Network type from the drop down list.
3. Click the *Begin Monitoring* button. 

If messages are being transmitted, they will begin scrolling in the text window at the speed in which they are captured. If a request message is required to stimulate a module to provide data, enter the request message in the Outgoing Message field in hexadecimal format, then while still in the Monitoring mode, click the Send Outgoing Message button. 

If fashioned properly, your request message should evoke a response from the selected module immediately and a captured message will appear in the text window. Click the Send Outgoing Message button every time you would like to get a response from the network module.

Filter and Mask

The filter controls provide a means of displaying only the messages of interest. See Filter and Mask, on page 5-20, for detailed information.

Type

The Network Type allows you to select any of the networks types supported by your DBK70. Although the DBK70 supports several network types, in the Monitor window, only one network at a time can be enabled.

CAN Baud Rate

This control is enabled when any of the CAN interface types are selected. Depending on the CAN type, different baud rates will be made available. For proper communication to take place the correct CAN type and Baud rate must be selected.

Outgoing Message

The Outgoing Message field allows you to broadcast a message, typically a data request message, on to the network. Using Hexadecimal format, enter your message into the field; then click the Send Outgoing Message button to broadcast the message. The Send button can be clicked before, during, or after monitoring.

Text Window

The text window can hold 500 lines of scrolling message text. Like a typical text window, you can place your cursor into the text and input text, delete text, and copy, cut, and paste. These features allow you to paste network data into other application, make notes in the scrolling data, delete messages, and more. When monitoring is turned off, the text window can be saved to disk in ASCII format, or printed.

Save Text Window

Menu: File/Save Text Window…

The Save Text Window command will take all the text currently in the text window and store it to the specified filename. This commands pops up a Save dialog box so that you can browse for and/or specify a filename. The Save command can only be accessed when monitoring is off.

Print Text Window

Menu: File/Print Text Window

This command prints the contents of the text window to the default printer. It can only be accessed when monitoring is off.

Clear Text Window

Menu: Edit/Clear Text Window

This command clears all of the current contents of the text window.

Begin Monitoring

Menu: Monitor Control/Monitor On

This command toggles the state of monitoring.

Send Outgoing Message

Menu: Monitor Control/Send Network Message

This command will send the hexadecimal message in the Outgoing Message field onto the selected network. This command can be executed while monitoring is on or off. Typically, it should be executed while monitoring is on, so that the response from the target module can be captured and displayed.

Close Monitor

Menu: File/Close Window

This command closes the Monitor window and returns control to the PidPRO main window.

Parsing Serial Strings

Introduction

When the DBK70 captures a data value for an assigned analog output or virtual channel, it automatically reports the value, as an ASCII string, on its RS-232 serial port. Each captured channel value is reported as one line, terminated with a carriage return <CR> and line feed <LF>.

The format of the string is as follows, where *ch#* is the channel number of the DBK70 and *value* is the integer value of the parameter in user units.

```
NC1 ch#,100,value
```

For example, if RPM is assigned to channel 12 and it's newly captured value is 1,593 RPM, the string reported on the serial port will be:

```
NC1 12,100,1593
```

A value string is reported on the serial port only when a new network message satisfying a channel's filter settings has been captured. If no such messages are detected, no values are reported on the serial port.

Examples

The following examples are designed to parse a DBK70 data string to extract the value of channel 5.

C++

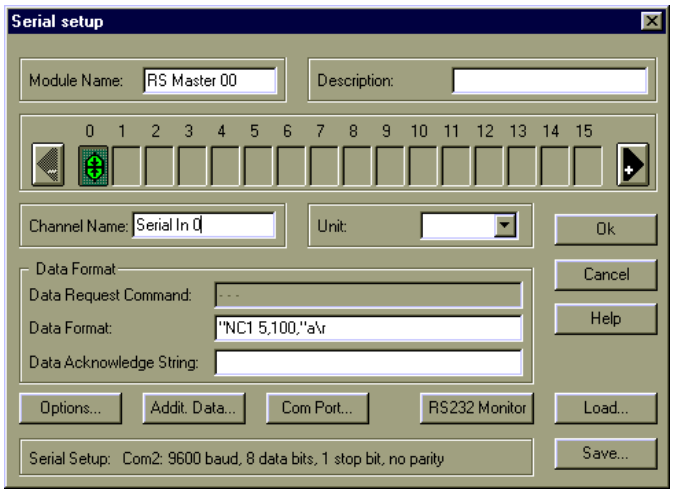
```
if(sscanf(dbk70String,"NC1 5 100,%d",&parameter) > 0)
 {
    printf(%s, parameter);
 }
```

VB

```
'dbk70String is the string from the DBK70. DataString is the extracted data
'value. If the header is not found, no value will be assigned to DataString.
If InStr(1, dbk70String, "NC1 5,100,") then
  DataString = mid$(dbk70String, InStr(1, dbk70String, "100,") + 4, 10)
  Debug.Print DataString
End if
```

DASYLab

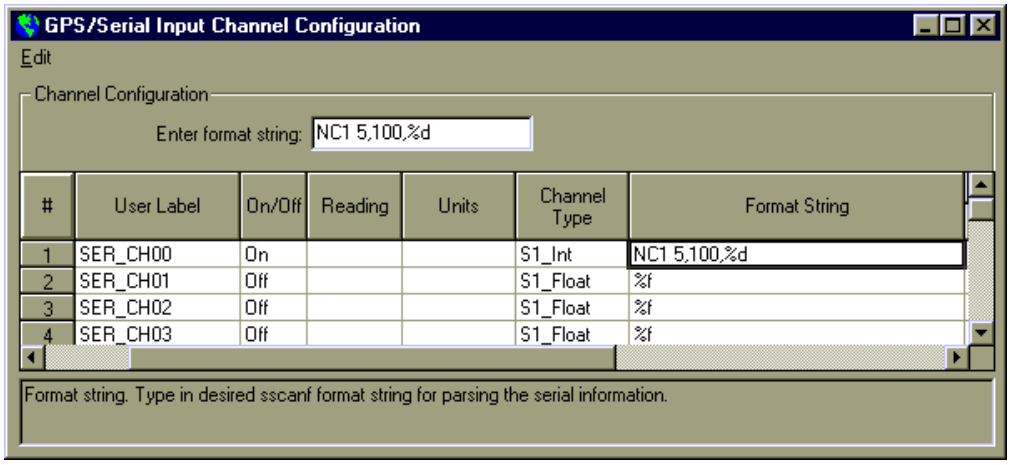
Place an RS-232 input module on your worksheet then double click the module. Assign a formatting string to the desired channel as shown.



Assigning a Data Format String in DASYLab

LogView

In LogView, open the GPS/Serial Input Channel Configuration window and enter a Format String as shown below. This format string will match then discard the string “NC1 5,100,” then convert the succeeding characters into an integer.



Assigning a Format String in LogView

Fundamentals of Obtaining Vehicle Data 6

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DBK70-CAN Limitations (For J1939 Only) …… 6-18

General Operation

The basic operating premise of the DBK70 is that data about a vehicle, whose value is desired to be monitored and/or available for recording in the form of a physical signal, is available one way or another through a data bus in the vehicle. The desired data may be available in a message that is always re-occurring on the data bus and/or is available if requested, generally as a response to a diagnostic request message. Since model year 1988, as more and more vehicle data becomes available through the data buses that are being used in more and more vehicles, this data can be monitored and/or recorded by accessing it from the data bus through a DBK70. The DBK70 can also provide access to data that is created in electronic modules as they go about doing their job, data that is only available from inside the module and not available at all through any add-on sensor.

The data available through a data bus is found in messages that are transmitted and received on the data bus. Two basic types of messages can be found on a vehicle data bus, *operational messages* and *diagnostic messages*. Operational messages are messages that are transmitted and received by electronic modules attached to the bus in order for the vehicle to operate properly. These messages normally appear on the data bus on an ongoing basis at a rate that is adequate to support the data availability needs of modules that need the data in order to do their job successfully. Operational messages include only the data that is absolutely necessary for the electronic modules to do their jobs. Diagnostic messages are messages that are used to obtain data that is available through the data bus but is not available or not adequately available in an operational message. Diagnostic messages usually involve a request and response message pair.

A diagnostic tool external to the vehicle obtains a connection to the vehicle's data bus through a diagnostic connector. The diagnostic tool sends a diagnostic request message to the data bus and receives one or more diagnostic response messages from the data bus. Vehicle electronic modules that have a connection to the data bus receive diagnostic request messages, and analyze the request messages to see if the module should respond to it. If an electronic module is responsible for responding to the request message, it does so and typically generates a response diagnostic message. Typically, a very large number of data values can be obtained from a vehicle through diagnostic messages and by comparison, relatively few data values are available through operational messages.

While many data values may be available on most or all vehicles, particularly new models or future models, the actual data available will generally vary from model to model, even within the same manufacturer or product line. Because one model has a data value doesn't mean another will have it.

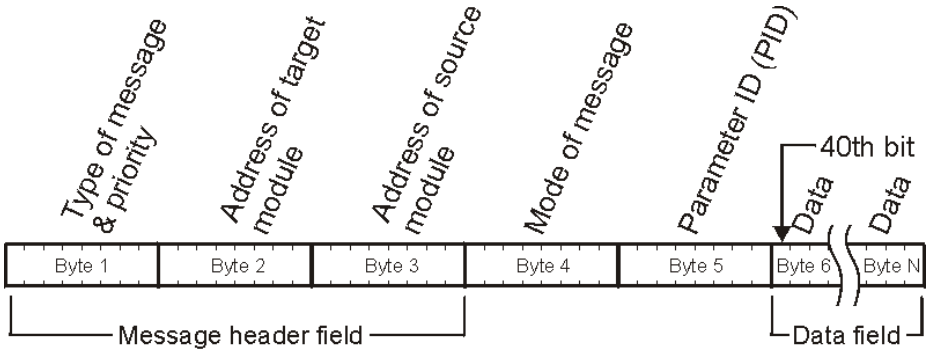
Reference Note:
Information regarding obtaining vehicle data for CAN, including J1939, begins on page 6-8.

If the desired data is available at an acceptable rate in an operational message then the **Message** field for this database record should be blank and the **Update Rate** field should be defined as 0.

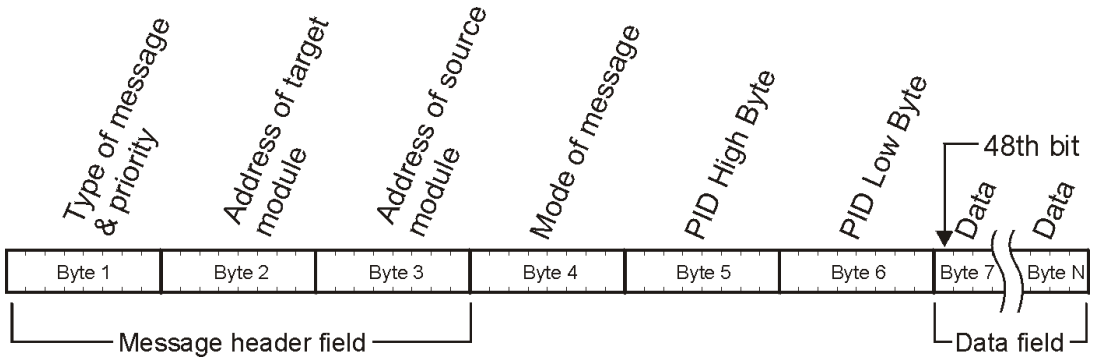
If the desired data is not normally available at an acceptable rate in an operational message and is available through a diagnostic message then the diagnostic request message must be defined in the **Message** field and an **Update Rate** value that is suitable for obtaining the data must be defined.

Note: The address of the DBK70 (off-board diagnostic tool) can be F1 through FD. The address F1 is used throughout this document and in the DBK70 database included with the application software.

Each message broadcasted on the network contains a message header field, mode field, PID field, and a data field. Sometimes the data field is broken down into multiple sub-fields. Messages are typically 5 to 12 bytes in length.

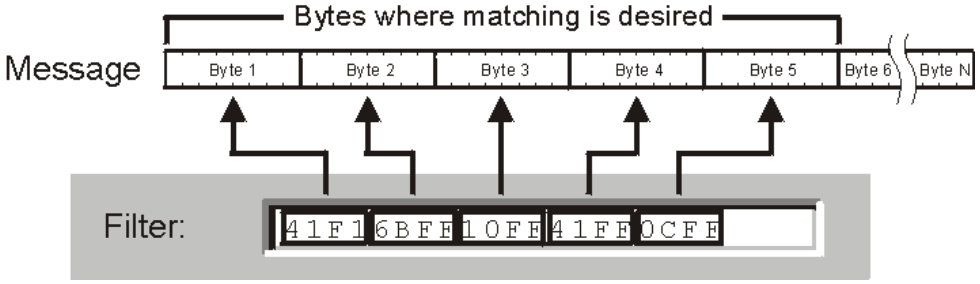


5 byte message format

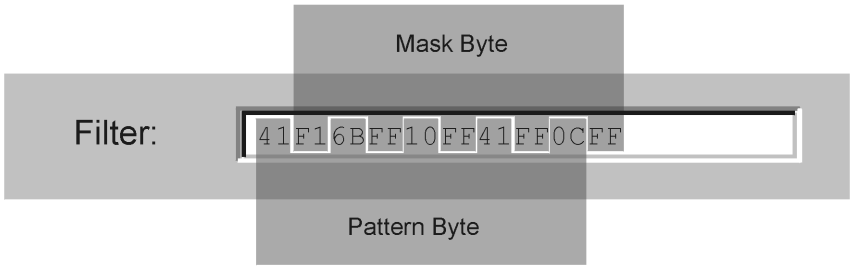


6 byte message format

The **Filter** field defines a bit pattern which is compared with network messages. The DBK70 compares each message on the network with the hexadecimal pattern in the **Filter**. When a match is found, the attached data is captured, scaled, and output on the assigned analog output. The **Filter** is one or more two byte sets, typically 5 or 6 sets to match the message size. Hexadecimal coding is used. The **Filter** definition must contain a 2-byte-set (4 hex characters) for every byte in the message that is to be compared.
A 5 byte message header would require a **Filter** definition of 10 bytes (20 characters), for example.

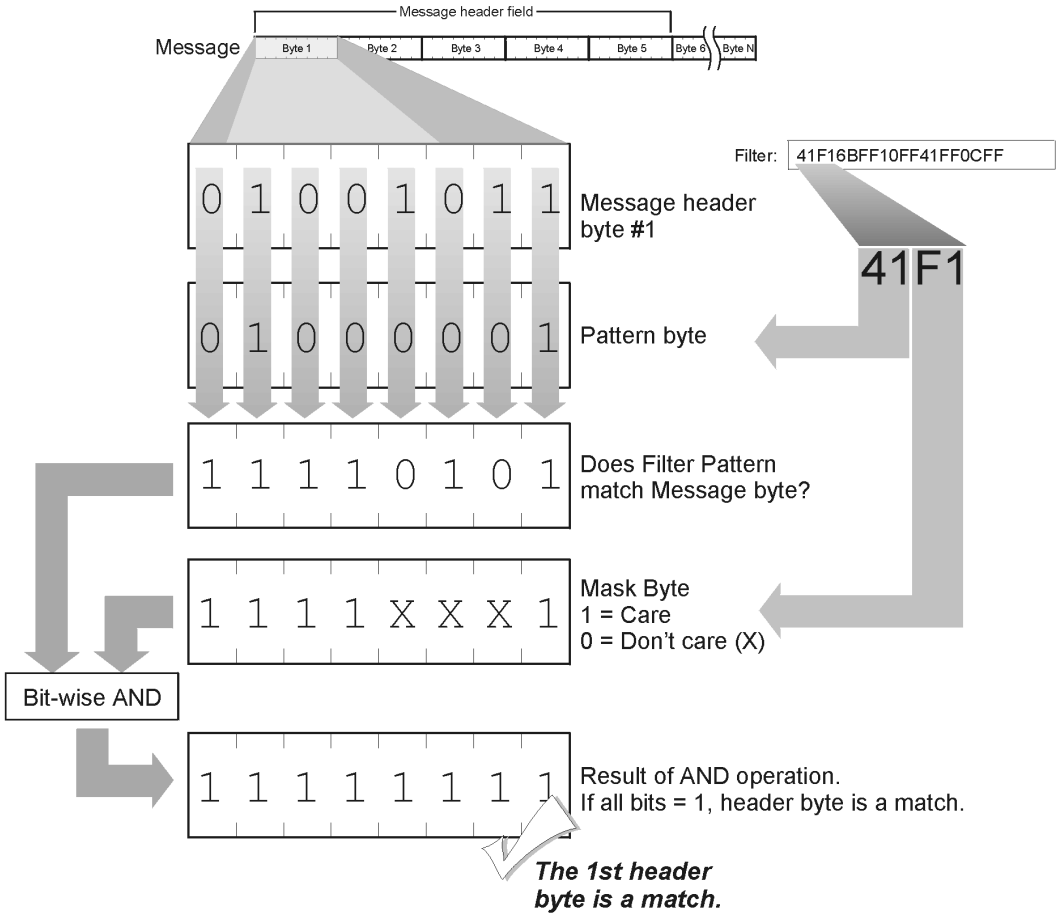


The first byte of a 2-byte-set defines the bit-by-bit data values that must be matched by a received message in order to be passed by the filter and processed by an output channel. The second byte of a 2-byte-set is a mask byte that defines which bits are to be checked for a match.

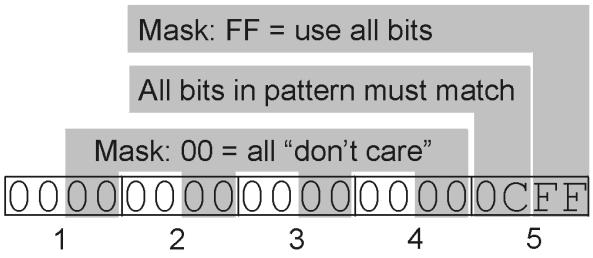


As the DBK70 receives network messages, it processes each of the bytes one-at-a-time, comparing each with its associated 2-byte-set in the **Filter** definition. The DBK70 processes each byte in the header by first comparing it, bit-for-bit, with the Pattern Byte. The result of the comparison is then ANDed with the Mask Byte. A zero in the Mask Byte represents a Don't Care which results in a 1 when ANDed with either a 1 or 0.

Filter definitions must be as specific as possible so as not to pass inappropriate messages to the output channel.

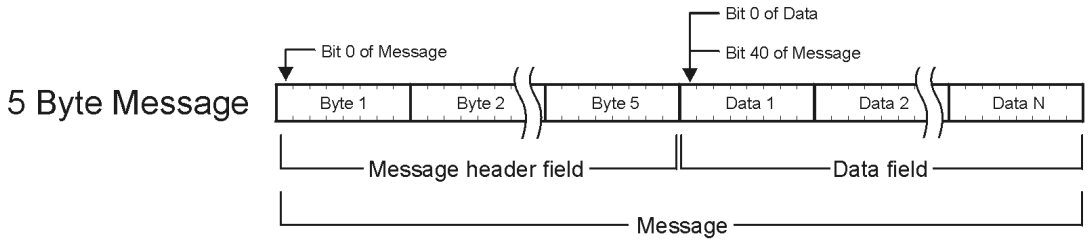


The *don't care* bits are used in instances where specific bit values in the header are not significant. For example, if only the PID byte was significant and the Source, Target, and other header bytes were to be ignored, the **Filter** for a 5 byte header would appear as follows.



In this example, any header with a PID byte of 0C(hex) would be accepted and its parameter value would be processed, regardless of the byte values found in the other bytes.

The **Index** and **Length** values define where in a received message that has passed the **Filter,** the desired data starts and how long it is, respectively. The first bit of a received message, the high order bit of the first byte of the message, has an **Index** value of 0. The first high order bit of the second byte has a value of 8. If the header field is 5 bytes, the data will typically begin at an **Index** of 40. **Length** values are typically in multiples of 8 (8, 16, 24, or 32). Occasionally, the data is one or a few bits in size. In these cases the **Length** value would be 1, 2, 3, etc. If the length of the data is one byte, the **Length** value will be 8.



The **Storage Type** value indicates whether the data should be processed as 2's complement signed data or as unsigned data. Most data is unsigned, but once in a while data is signed. Another way to look at this is to ask if the raw data in the received message can be negative. This does not refer to the scaled value of the data, only to the raw data in the received message.

Received data is multiplied by the value of the **Output Scale** field and the result of that multiplication is added to the value of the **Output Offset** field (i.e., **y = m * x + b**, where x is the received data, m is the **Output Scale**, b is the **Output Offset**, and y = the scaled result). The values of **Output Scale** and **Output Offset** depend on the resolution of the received data, the range of the scaled data derived from the received data, and the desired range and lowest value of the proportional output signal.

Example Setup from SAE J2190

Note: Although most of the vehicle and network module manufacturers comply with the SAE J2190 standard, it is not a requirement. Contact the vehicle or node manufacturer for the exact specifications of the protocol for the specific vehicle under test.

The following example shows how to develop the **Filter** and **Message** fields for a mode 22 message defined in the SAE J2190 document. The following diagram is a excerpt from the standard.

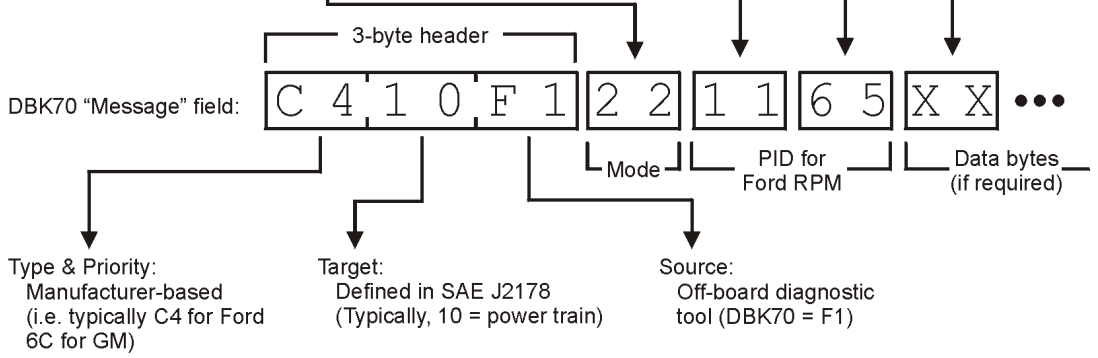
SAE J2190 Issued JUN93

5.10.3 Mode $22 Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6 to #n-1	#n
Request from Tool to Vehicle							
Request data by PID	22	PID (high byte)	PID (low byte)	Value for Byte 4 (optional): Same definition as Data Byte #3 for Mode $21 Value for Byte 5 (optional if byte 4 supported): 00 - send data until requested to stop nn - max. number of responses to send			
Vehicle Response to Request for Data (Multiple response messages will be sent if data rate requested periodic data reporting)							
Report data by PID	62	PID (high byte)	PID (low byte)	Data byte	Additional optional data bytes that are in response to the request may be added to fill the message up to the maximum number of available data bytes.		

The standard defines the network message structure for the data request from the DBK70 and the data response from the target network module on the network. The following diagram details how the DBK70 **Message** field is constructed using the 1st half of the J2190 excerpt shown above, "Request from Tool to Vehicle". This example sets up a channel to receive RPM from a Ford vehicle.

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6 to #n-1	#n
Request from Tool to Vehicle							
Request data by PID	22	PID (high byte)	PID (low byte)	Value for Byte 4 (optional): Same definition as Data Byte #3 for Mode $21 Value for Byte 5 (optional if byte 4 supported): 00 - send data until requested to stop nn - max. number of responses to send			



The J2190 document shows byte #1 as the mode number, but in actuality, there is an implied 3-byte header on each message that contains the Type & Priority, Target address, and Source address bytes.
The Type & Priority byte is defined by the manufacturer of the vehicle, the Target is the address of the network module holding the desired data, and the Source is the DBK70. For this example, configure the DBK70's channel 1 with a **Message** field of C410F1221165. Since the target module will only respond when this message is sent, set the channel's **Update Rate** to the desired sample frequency.

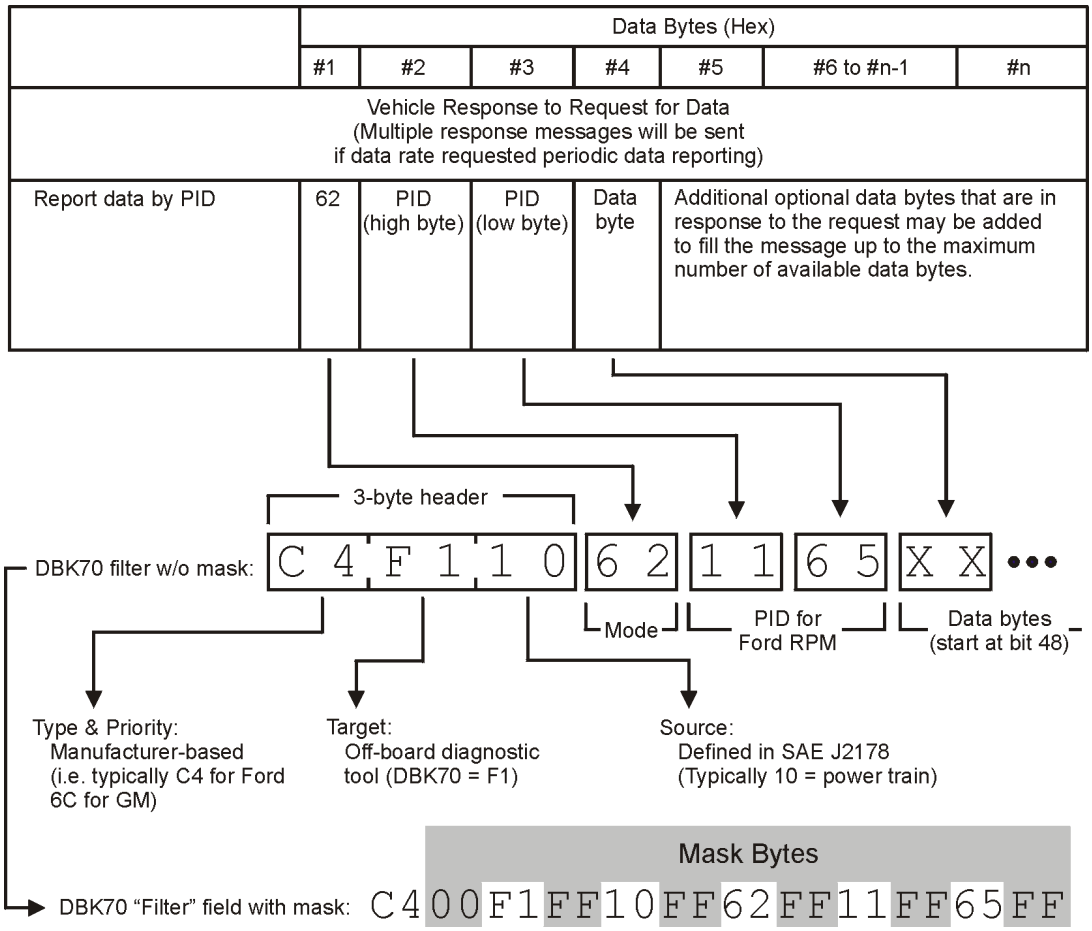
In the previous diagram, the J2190's byte #4 description directs the reader to the definition of "Data byte #3 for Mode $21". Mode 21 describes this byte as follows.

Byte Value	***Description***
No byte	1 response
00	Stop sending data
01	Send 1 response
02	Repeat at slow rate
03	Repeat at medium rate
04	Repeat at fast rate
05-FF	Manufacturer defined

To capture the response, the channel's **Filter** must match the unique features of the response message broadcast by the target network module. The diagram below shows how the 2nd part of the J2190 document, "Vehicle Response to Request for Data", is used to develop the DBK70's **Filter**.

For the response, the DBK70 is now the Target of the network message and the power train module, 10H, is the Source. The mode is 62H, as defined in the standard (typically, the mode for the response message is equal to the mode of the request message plus 40H). After the **Filter** is developed, the mask bytes must be applied so that the DBK70 will know which bits are significant and which are not. In many cases, only a small part of the return message is truly needed for matching. For example, if RPM is desired, the value of the Type & Priority byte is probably irrelevant, and it likely doesn't matter who it is directed to (the target) or who sent it (the source). In this case, only the mode and PID bytes are significant, all other bytes could be masked with 00H, or don't care.

For this PID, the response data begins on bit 48 and the length of the data is 2 bytes, so the **Index** should be set to 48 and the **Length** should be set to 16. In cases were the bits are embedded in a larger block of data, the **Index** should be set to point to the 1st of the desired bits.



In cases where the network module can be directed to continually send the desired message, the DBK70 can be programmed to send the request message just one time. This will minimize the amount of network traffic. To send the request message in the DBK70 **Message** field just one time, set the **Update Rate** field to –1. The request message will be sent when the DBK70 is powered on or whenever the **Timeout** value is exceeded.

Using Diagnostic Data Packet

Diagnostic Data Packets (DDP), as defined in SAE J2190, allow more than one data value from a network node to be encapsulated into a single, user-defined, message packet. Due to the compactness of the transmission, DDP messages can provide diagnostic data over the network at a faster rate than by conventional means.

The following information will assist you in using DDP on the DBK70. Consult the J2190 document for a complete explanation of DDP and its usage.

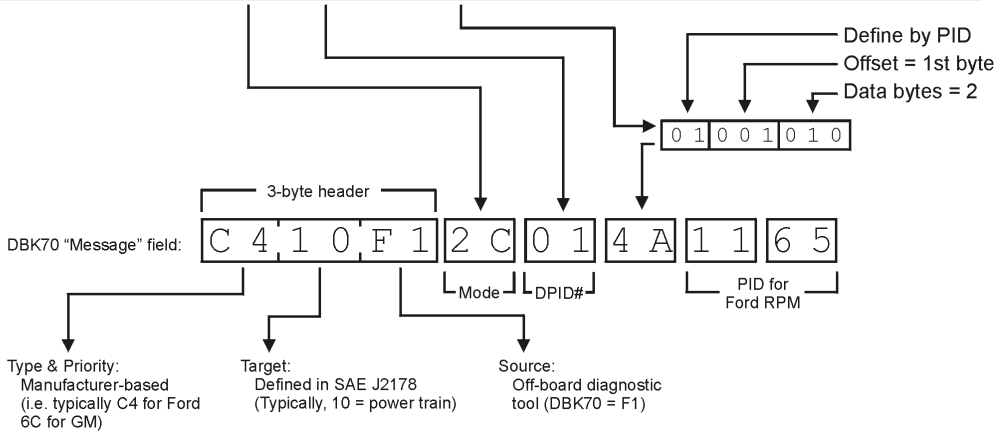
Using DDP requires 3 basic steps; defining a data packet, requesting the data packet, and receiving and parsing the data packet. The defining and requesting steps are required only one time. After these steps are executed, the defined data packet is constantly broadcast on the network, allowing the diagnostic tool to receive the data packets as they are being broadcast.

During the definition process, multiple messages are sent to the target module to construct a DDP. Each definition message adds another data item to the user-defined DDP. The following diagram shows how to derive a DBK70 **Message** from the information provided in the J2190 document. This example uses the DDP definition message to add the 1st data item to a newly defined DDP, Data Packet ID #1 (DPID#). Sending this message will add engine RPM, a 2 byte data item, to data packet #1.

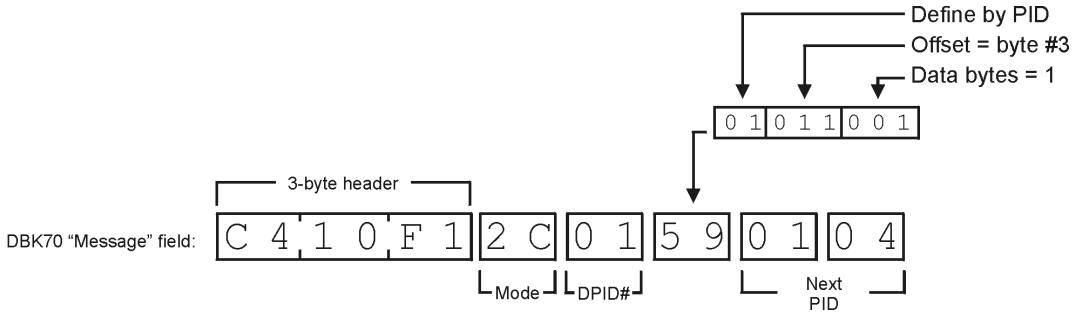
SAE J2190 Issued JUN93

5.19.2 Message Data Bytes

	Data Bytes (Hex)				
	#1	#2	#3	#4 to #n-1	#n
Request from Tool to Vehicle					
Define diagnostic data packet	2C	DPID#	Data byte #3 Bits 7, 6 if 00 - define by offset (1 byte) if 01 - define by PID (2 bytes) if 10 - define by memory address (3 bytes) if 11 - manufacturer defined Bits 5, 4, 3 starting byte for data, where 001 is the 1st byte after the PID# Bits 2, 1, 0 number of data bytes for this parameter Data bytes starting at byte #4 contain either the offset, PID, memory address, or manufacturer defined value of the data to be included in the packet.		



Transmit additional DDP definition messages, in the same manner, to add more data items to DPID #1. The following diagram illustrates how another data item is added to DPID #1. At this point, DPID #1 already contains RPM, a 2 byte value, so we'll offset the data for this next data item by 2 bytes, starting it at an offset of 3.



The following diagram is an excerpt from the J2190 standard showing the layout of the DDP request and response messages. Once the request message has been transmitted, the target module will periodically transmit the requested DDP, so no further transmissions of the request message are necessary.

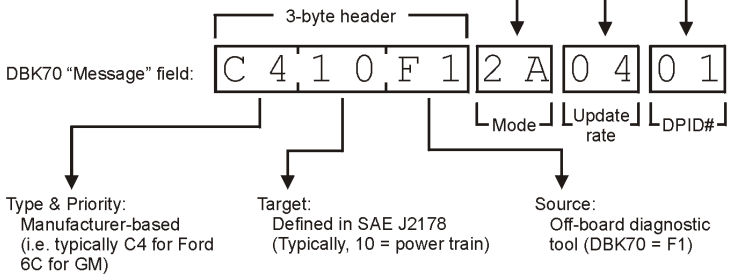
SAE J2190 Issued JUN93

5.17.2 Message Data Bytes

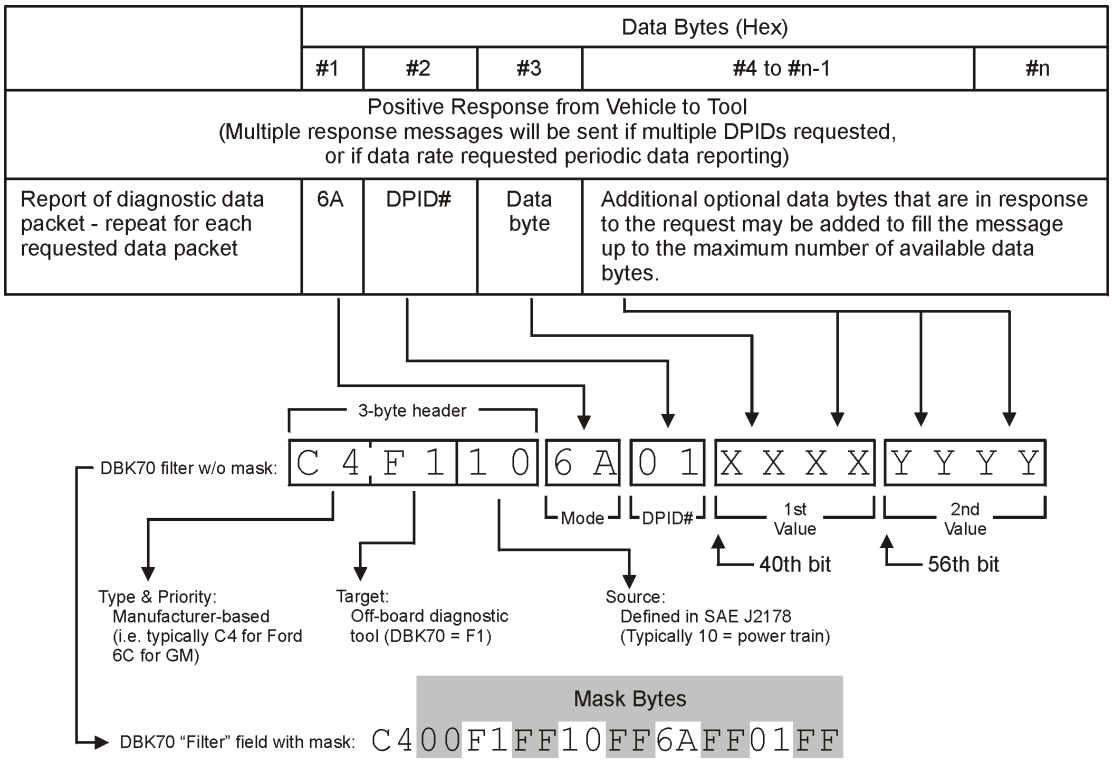
	Data Bytes (Hex)				
	#1	#2	#3	#4 to #n-1	#n
Request from Tool to Vehicle					
Request diagnostic data packets	2A	Data rate	DPID#	Additional optional data packet IDs may be requested to fill the message up to the maximum number of available data bytes.	
Positive Response from Vehicle to Tool (Multiple response messages will be sent if multiple DPIDs requested, or if data rate requested periodic data reporting)					
Report of diagnostic data packet - repeat for each requested data packet	6A	DPID#	Data byte	Additional optional data bytes that are in response to the request may be added to fill the message up to the maximum number of available data bytes.	

The following diagram shows how to construct a request message. This message, which stimulates the network module to continually transmit the specified DPID#, is issued after the DDP is defined. It includes the DPID# and the desired data rate.

	Data Bytes (Hex)				
	#1	#2	#3	#4 to #n-1	#n
Request from Tool to Vehicle					
Request diagnostic data packets	2A	Data rate	DPID#	Additional optional data packet IDs may be requested to fill the message up to the maximum number of available data bytes.	



The following diagram shows how to construct the DBK70 **Filter** to capture the DDP response message. The **Filter** provides the information for matching the header, the mode, and the DPID#. To capture 2 data items from the same DDP response message, assign the identical **Filter** to 2 DBK70 channels, then set the appropriate **Index** and **Length** in each to target just the data bytes pertaining to the desired data element.



Most networks that support DDP have a built-in timeout mechanism that turns off the continuous broadcast of defined DDPs if the off-board diagnostic tool is no longer present. To keep the broadcast alive, the DBK70 must periodically send a *Tester Present* message. Create a DBK70 channel specifically for this purpose by assigning its **Message** field to C410F13F and its **Update rate** to 3000. This will send the "Tester Present" message every 3 seconds from the DBK70 (address F1) to the target module (address 10).

Now that the necessary definition and request **Messages** and **Filters** have been derived, DBK70 database records can be constructed and assigned to DBK70 output channels.

Each configured DBK70 channel has an associated **Message**. This **Message** is transmitted on the network at a rate designated by the **Update Rate** field. When using DDP, multiple definition messages then one request message must be transmitted one time by the DBK70, after which the DDP will be continually transmitted by the associated network module.

When using DDP, all of the messages from the DBK70 to the network module that are necessary to facilitate the DDP must be encapsulated in the **Message** fields of the assigned DBK70 channels.
For example, monitoring 3 parameters using 3 DBK70 channels, the following messages from the DBK70 would be required.

- *Definition message* to add the 1st PID to DPID#1. Sent 1 time.
- *Definition message* to add the 2nd PID to DPID#1. Sent 1 time.
- *Definition message* to add the 3rd PID to DPID#1. Sent 1 time.
- *Request message* to initiate the transmission of DPID#1 from the network module. Sent 1 time.
- *Tester Present message* to tell the network module that the DBK70 is still present. Sent periodically.

These messages, sent by the DBK70, must be encapsulated in the **Message** fields of the 3 assigned DBK70 channels.

For any one record in the DBK70 database, the **Filter** and **Message** fields are only loosely related. For non-DDP applications, the **Message** field is used to transmit messages onto the network at a rate specified by the **Update Rate** to stimulate a response that is captured by the **Filter**. Regardless of whether the network module responds or not, the **Message** will continue to be transmitted at the **Update Rate**. Transmission of the **Message** and capturing the response are completely separate DBK70 tasks. The **Message** field is unaware that the **Filter** field is seeking a specific response, just as the **Filter** field is unaware that the **Message** field is requesting a response.

Due to this loose coupling between **Message** and **Filter**, the DDP messages can be packaged into the **Message** fields of the 3 DBK70 channels in a variety of different ways. The following is an example of one possible scheme.

Channel 1 will send 2 definition messages to add 2 PIDs to our defined DDP, identified as DPID#1. The individual messages are separated by one space. We'll set its **Update Rate** to –1 so that the DBK70 will send this message only once – either at power-up or if a timeout occurs.

```
Message:       C410F12C014A1165 C410F12C01591310
Filter:        C400F1FF10FF6AFF01FF
Update rate:   -1
Index:         40
Length:        16
```

Channel 2 will send 1 more definition message to add the 3rd PID to DPID#1, then the request message to get the network module broadcasting our newly defined DPID#1. We'll set its **Update Rate** to –1 so that the DBK70 will send this message only once.

```
Message:       C410F12C01621671 C410F12A0401
Filter:        C400F1FF10FF6AFF01FF
Update rate:   -1
Index:         56
Length:        8
```

Channel 3 will send the *Tester Present* message every 3 seconds so that the network module will continue to transmit DPID#1.

```
Message:      C410F13F
Filter:       C400F1FF10FF6AFF01FF
Update rate: 3000
Index:        64
Length:       16
```

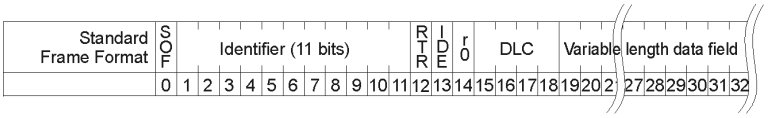
Note that the **Filter** for all three channels is identical because they're all looking for the same DPID#1. Once found, each channel will find its data using the **Index** and **Length** fields.

Obtaining Vehicle Data for CAN, Including J1939 & OBD CAN

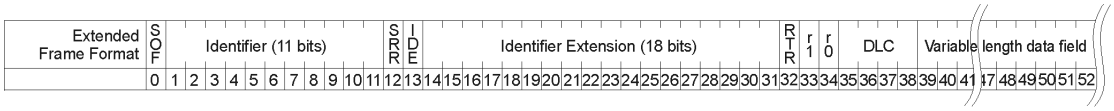
All CAN communication is executed in data packets called *frames*. Four frame types are defined; Data Frame, Remote Frame, Error Frame, and Overload Frame. For the purpose of using the DBK70 to collect data from a CAN network, only the Data Frame is relevant.

Data Frame

A Data Frame is used by nodes on the network to transmit data to other nodes. It consists of header information and a variable length data field. Two header formats are described in the CAN specification; Standard Format (11-bit) and Extended Format (29-bit). Most newer systems use the Extended Format exclusively.



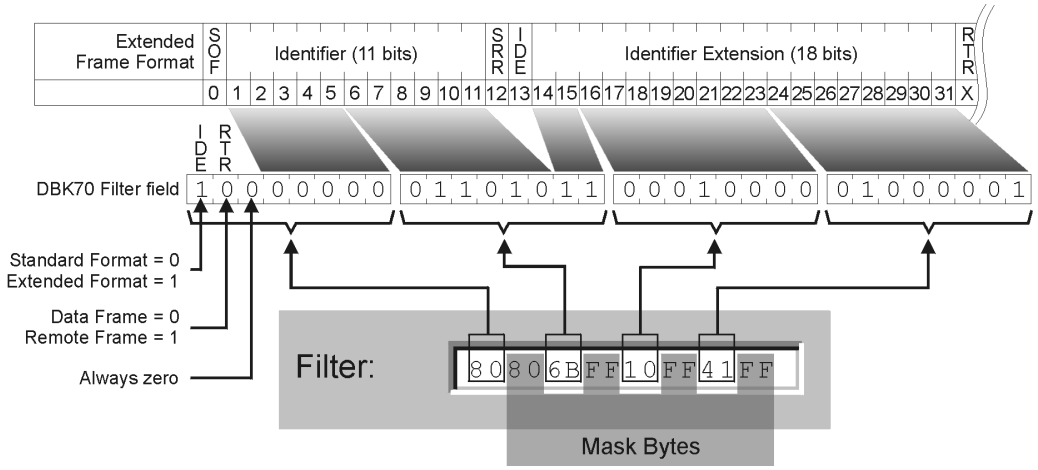
Standard Data Frame



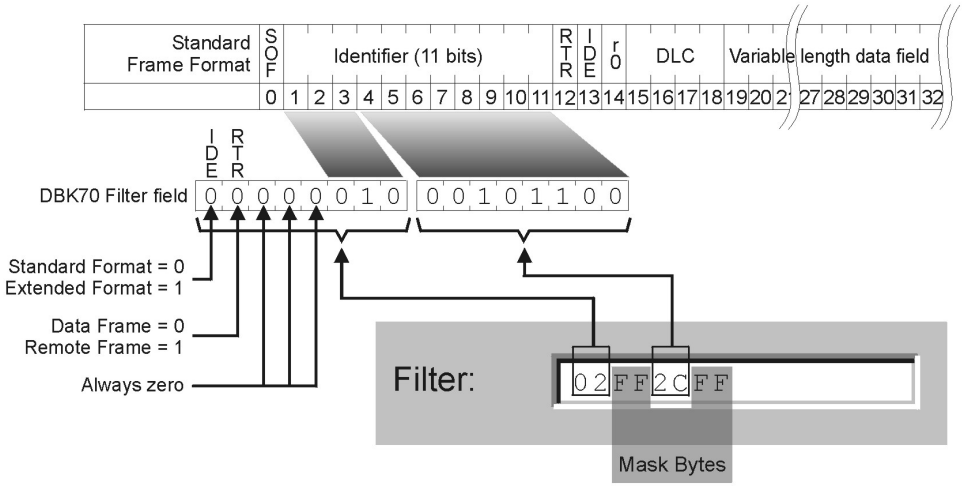
Extended Data Frame

The DBK70 **Filter** field defines a bit pattern, which is compared with the frame header. The DBK70 compares each frame header on the network with the hexadecimal pattern in its **Filter** field. When a match is found, the attached data is captured, scaled, and output on the assigned analog output. The **Filter** field is one or more two byte sets. Hexadecimal coding is used. The **Filter** definition must contain a 2-byte-set (4 hex characters) for every expected byte in the header. An Extended Format Data Frame of 4 bytes would require a Filter definition of 8 bytes (16 hex characters), for example.

The following diagram shows the alignment of the bytes in the DBK70's Filter field with the bits in the Data Frame for Extended CAN Format.

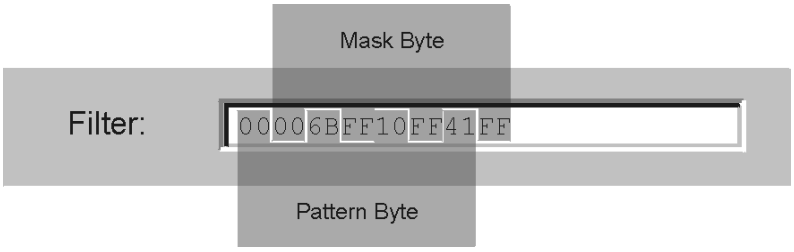


Filter for Extended Frame Format



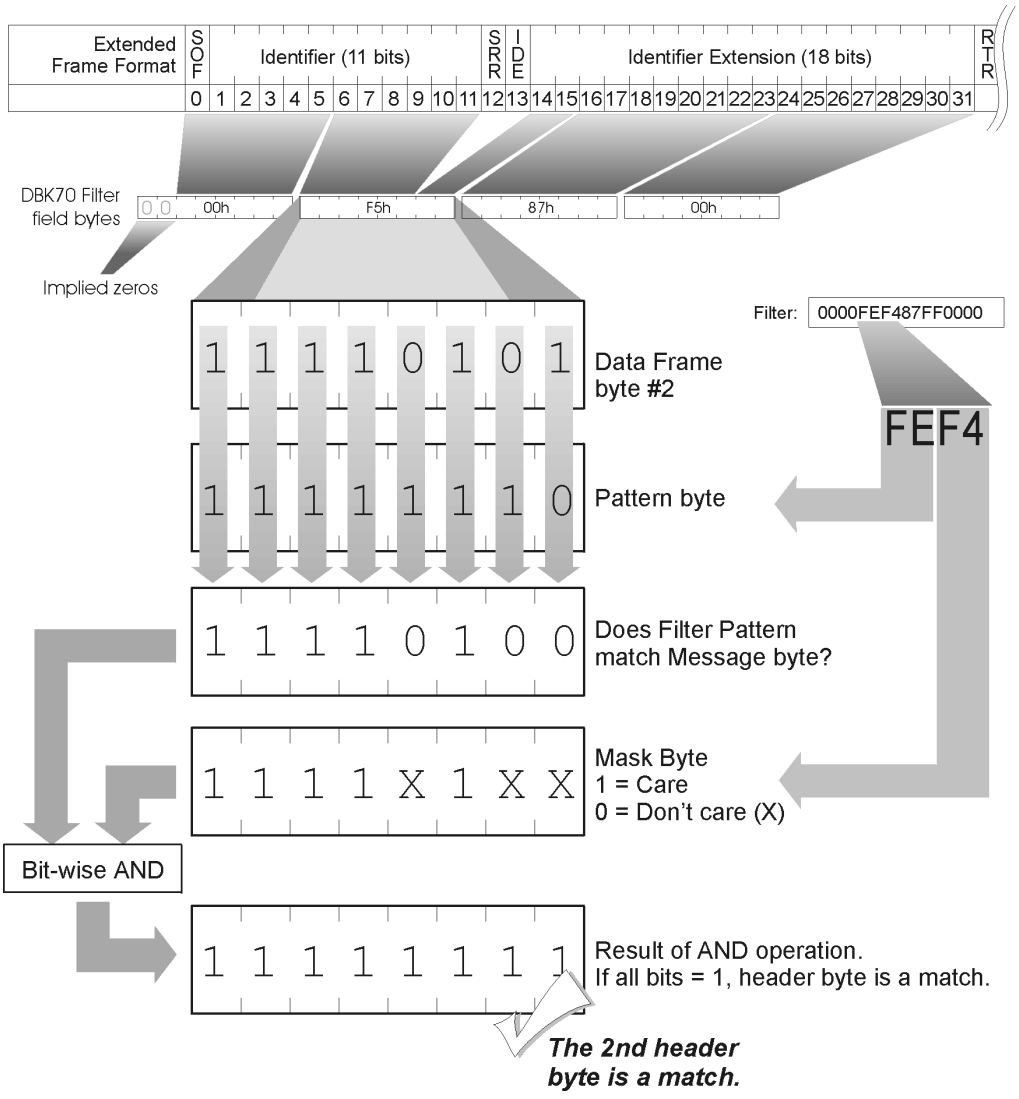
Filter for Standard Frame Format

The first byte of a 2-byte-set defines the bit-by-bit data values that must be matched by a received message in order to be accepted by the filter and processed by an output channel. The second byte of a 2-byte-set is a mask byte that defines which bits are to be checked for a match.

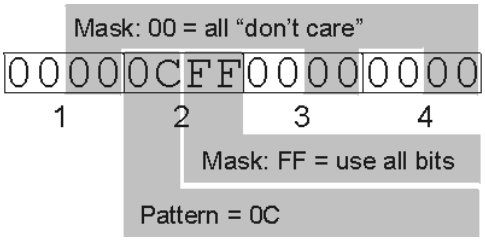


As the DBK70 receives network messages, it processes each of the bytes in the header one-at-a-time, comparing each with its associated 2-byte-set in the Filter definition. The DBK70 processes each byte in the header by first comparing it, bit-for-bit, with the Pattern Byte, shown below. The result of the comparison is then ANDed with the Mask Byte. A zero in the Mask Byte represents a Don't Care which results in a 1 when ANDed with either a 1 or 0.

Filter definitions must be as specific as possible so as not to pass inappropriate messages to the output channel.

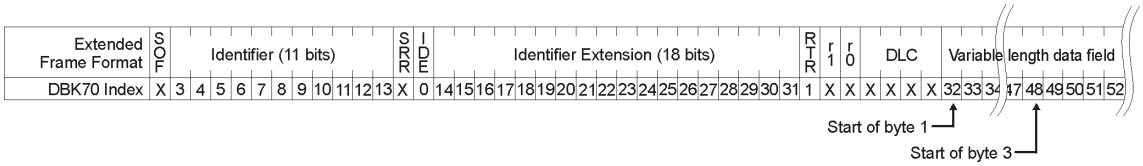


The *don't care* bits are used in instances where specific bit values in the header are not significant. For example, if only the 2nd byte in the data frame is significant, the Filter field would appear as follows.

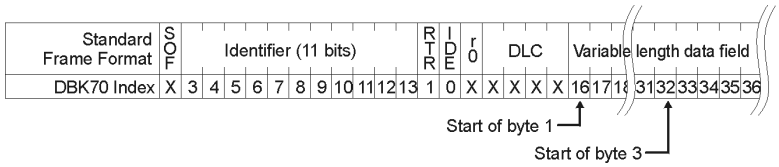


In this example, any header with a 2nd byte of 0C(hex) would be accepted and its parameter value would be processed, regardless of the byte values found in the other header bytes.

The **Index** and **Length** values define where in a received message, that has passed the **Filter,** the desired data starts and how long it is. See the Index numbers in the diagram below. For CAN Extended Format, the index of the 1st data bit is 32. Additional bytes will be at multiples of 8 bits (32, 40, 48, 56…).



Indexes for Extended Frame Format



Indexes for Standard Frame Format

Many Data Frames contain several data items. To capture individual items in a Data Frame containing more than one data item, create multiple DBK70 database records – one for each data item of interest. The fields in these database records will be identical except for the Index and possibly the Length fields.

The **Length** value is typically in multiples of 8 bits (8, 16, 24, 32, ….). Occasionally, the data is one or a few bits in size. In these cases the **Length** value would be 1, 2, 3, etc. If the length of the data is one byte, the **Length** value will be 8.

The Storage Type value indicates whether the data should be processed as 2's complement signed data or as unsigned data. Most data is unsigned, but once in a while data is signed. Another way to look at this is to ask if the raw data in the received message can be negative. This does not refer to the scaled value of the data, only to the raw data in the received message.

Received data is multiplied by the value of the Output Scale field and the result of that multiplication is added to the value of the Output Offset field (i.e**., y = m * x + b**, where x is the received data, m is the Output Scale, b is the Output Offset, and y = the scaled result). The values of Output Scale and Output Offset depend on the resolution of the received data, the range of the scaled data derived from the received data, and the desired range and lowest value of the proportional output signal.

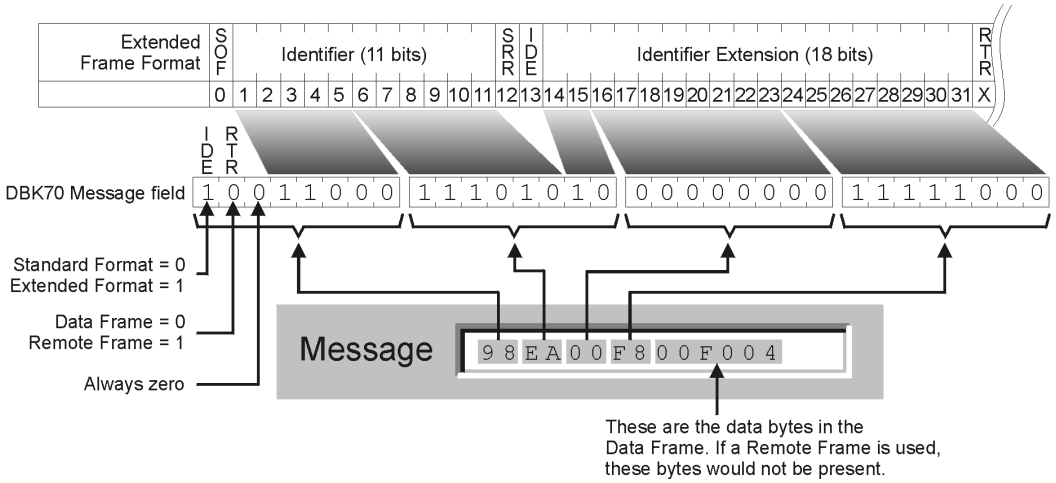
Creating a Request Message

Some Data Frames are only broadcast on the network when the node containing the desired data receives a request for the information. To stimulate a node to broadcast the desired message, sometimes a specific Data Frame is required, other times a specific Remote Frame is required. For Data Frames, either a Standard or Extended format can be used, depending on the network and the node.

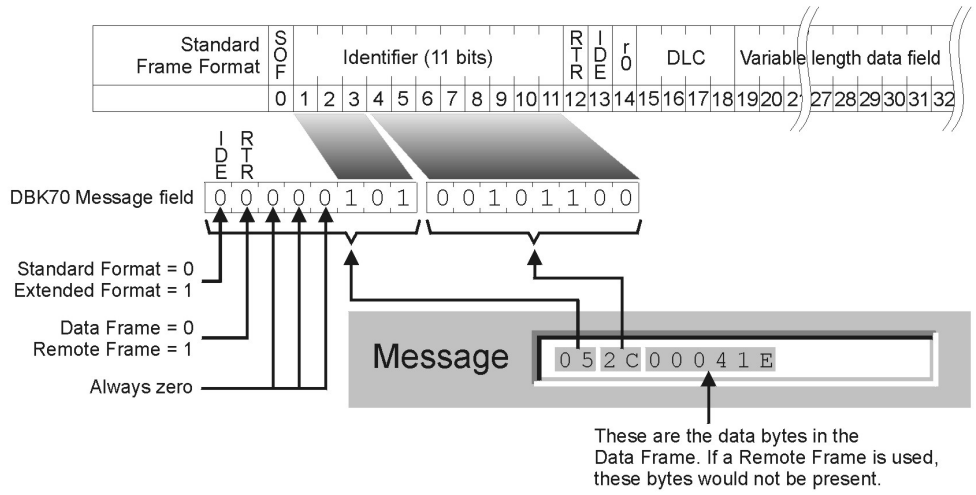
When a request message is necessary, the Message field in the DBK70 software must be filled in and the Update field must contain a number greater than zero.

The following diagram shows the composition of the Message field in the DBK70 software, relative to the bits in the Extended CAN format. The example shows a Data Frame, which typically contains data bytes after the header. If a Remote Frame is used, no data bytes follow the header.

For J1939, the supplied database of PGNs contains the necessary Messages.



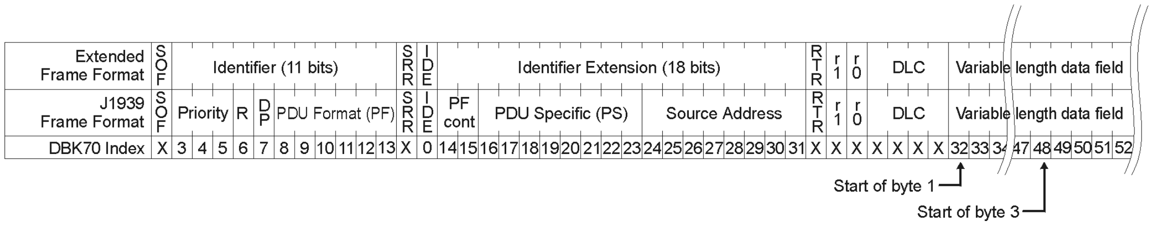
Message for Extended Frame Format



Message for Standard Frame Format

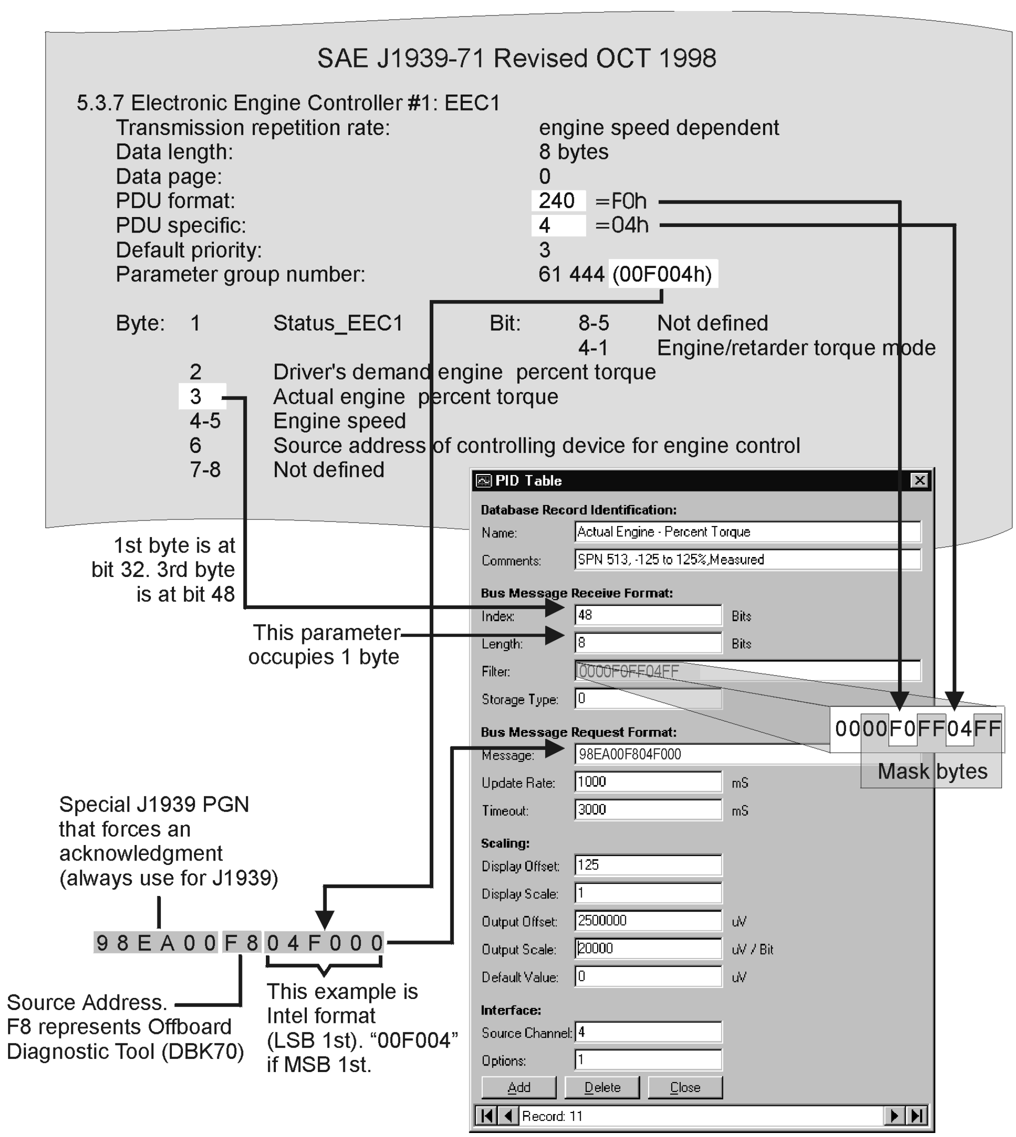
J1939 Considerations

J1939 is a CAN standard adopted primarily by the truck industry. It further specifies the Data Frame of CAN's Extended Format. In addition, a large number of parameters, typically known as Parameter Group Numbers (PGNs) are specified. For ease of operation, a database of several hundred J1939 PGNs is included with the DBK70 software.



Note: For J1939 only, the address of the DBK70 (diagnostic tool) is always F8.

If your vehicle under test supports J1939, use the included database to specify desired PGNs. The following diagram shows how PGNs, per the J1939 standard, are formatted in the DBK70 database. The following is an example of how to develop a DBK70 database record from the J1939 PGN, "Actual engine percent torque".



OBD CAN Considerations

The database records for OBD CAN are just like the legislated J1979 Mode 1 requests. The PID numbers are the same, as are all of the scales and offsets. However, the message and filter fields differ from those seen in the J1979.

Supported Standards

Standard	Description	Typical application	Electrical	Speed
ISO11519-2	Low speed multiplexing	Automobile	Low voltage differential	< 125Kbps
ISO11898	High speed multiplexing	Automobile, diagnostics	Low voltage differential	< 1Mbps
ISO11898/3	Low speed multiplexing	Automobile	Low voltage differential	<125Kbps
ISO11992	Medium speed multiplexing	Truck	High voltage differential	< 250Kbps
J1939	Medium speed multiplexing	Truck	Low voltage differential	< 250Kbps
J2411*	Low speed multiplexing	Automobile	Low voltage, single wire	< 100Kbps
J2284	High speed multiplexing	Automobile	Low voltage differential	< 500Kbps

* Single wire CAN (J2411) is only available with a revision B DBK70-CAN network card and firmware v2.10, or higher.

DBK70-CAN Limitations (For J1939 Only)

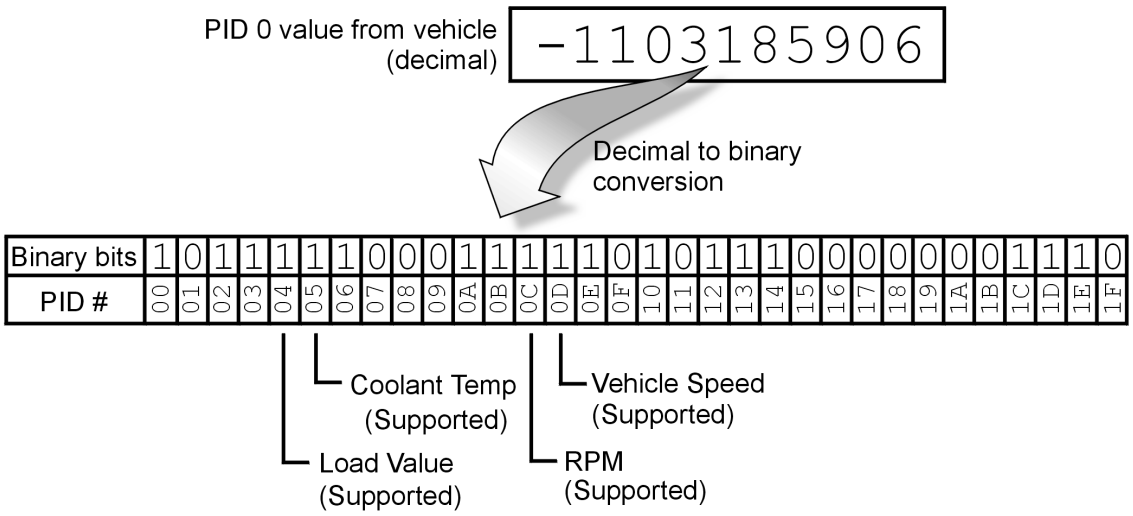
1. J1939 ASCII PGNs are not supported.
2. Multiple messages that extend beyond 96 bits (byte 8) in the variable length data field are not currently supported. Contact the factory for availability of this feature.

Deciphering the PID 0 Message 7

Note: **This chapter applies only to J1850, ISO 9141, ISO 14230-4, and OBD CAN**.

PID 0 is a legislated PID that returns a bit-map message indicating which of the other legislated PIDs are supported by the vehicle. Typically, PID 0 will return a 32-bit value, with each bit location representing a legislated PID.

To record the PID 0 value, assign PID 0 to an output channel of the DBK70. Then with the PC attached and running the configuration software, connect the DBK70 to the vehicle. When the value is displayed on the PC screen, enter the decimal value into a calculator capable of decimal to binary conversion. Each bit in the binary number represents a legislated PID value. If the bit has a value of 1, the PID is supported. If the value is 0, the PID is not supported.



The PID 0 message from the vehicle never changes, so once it has been read and recorded, the DBK70 output can be assigned to another useful PID.

The following is a table of the legislated PIDs which may or may not be supported by any specific vehicle. The PID 0 response will provide a map of the vehicle's support. These legislated PIDs are included in the PidPRO database so that any of these parameters, if supported by the vehicle, can easily be assigned to a DBK70 output without any knowledge of the required messaging details.

Hex Value	Description
$00	PIDs supported ($01-$20)
$01	Emissions trouble codes/MIL status
$02	Trouble code causing freeze frame
$03	Fuel system status
$04	Calculated load value
$05	Engine coolant temperature
$06	Short term fuel trim, bank 1
$07	Long term fuel trim, bank 1
$08	Short term fuel trim, bank 2
$09	Long term fuel trim, bank 2
$0A	Fuel pressure gage
$0B	Intake manifold absolute pressure
$0C	Engine RPM
$0D	Vehicle speed
$0E	Ignition timing advance, cyl 1
$0F	Intake air temperature
$10	Air flow rate from MAF sensor
$11	Absolute throttle position sensor
$12	Commanded secondary air status
$13	Location of oxygen sensors
$14	O2 Sensor Voltage: Bank 1-Sensor 1
$14	Shrt Trm Fuel Trim: Bank 1-Sensor 1
$15	O2 Sensor Voltage: Bank 1-Sensor 2
$15	Shrt Trm Fuel Trim: Bank 1-Sensor 2
$16	O2 Sensor Voltage: Bank 1-Sensor 3
$16	Shrt Trm Fuel Trim: Bank 1-Sensor 3
$17	O2 Sensor Voltage: Bank 1-Sensor 4
$17	Shrt Trm Fuel Trim: Bank 1-Sensor 4
$18	O2 Sensor Voltage: Bank 2-Sensor 1
$18	Shrt Trm Fuel Trim: Bank 2-Sensor 1
$19	O2 Sensor Voltage: Bank 2-Sensor 2
$19	Shrt Trm Fuel Trim: Bank 2-Sensor 2
$1A	O2 Sensor Voltage: Bank 2-Sensor 3
$1A	Shrt Trm Fuel Trim: Bank 2-Sensor 3
$1B	O2 Sensor Voltage: Bank 2-Sensor 4
$1B	Shrt Trm Fuel Trim: Bank 2-Sensor 4
$1C	Vehicle's OBD design
$1D	Location of oxygen sensors (alt)
$1E	Auxiliary input status
$1F	unused/reserved

Troubleshooting 8

Symptom	Possible Cause / Solution	Manual reference
Attached to vehicle but no Power LED	Make sure the power switch is in the On position.	3-1
	Some vehicles only supply power to the OBD connector when the engine is running. Start the engine or apply external power.	3-1
	Some vehicles do not supply adequate power from the OBD connector. Apply external power.	3-1
Doesn't "connect" to PC	Check the Power LED. If it is not flashing or on solid, adequate power has not been supplied or the power switch is in the off position. Apply adequate power.	3-1
	The serial cable between the PC and the DBK70 must be a straight-through cable. Serial cables called "null-modem" swap the receive and transmit signals. A null-modem cable is not compatible with the DBK70.	3-2
	Check to make sure you're connected to the right COM port of the PC, or that the connected COM port has been selected properly in the software.	—
Output not tracking selected parameter	Check the Power LED. If it is not flashing or on solid, adequate power has not been supplied or the power switch is in the off position. Apply adequate power.	3-1
	If the PID definition is incorrect, the associated output may be tracking the wrong PID or a PID that does not exist. As a troubleshooting tool, connect a PC to the DBK70 while the vehicle is running to show the present value of the PID associated with a channel in real-time. Check the fields of your PID record for correctness. Check to make sure the desired PID is associated with the desired output. If the Receive LED is not flashing, then none of the assigned PIDs are being received.	6-1
	If the Power LED is flashing, no network traffic is being detected. When network traffic is sensed, the Power LED will come on solid. This could be due to a network type that is incompatible with the network interface(s) currently installed in the DBK70, or the desired messages need to be requested before they are transmitted. Make sure you have the correct network interface installed in the DBK70. If the messages need to be requested, make sure the PID record has the appropriate entry in the Message field. If request messages are being used, the Transmit LED should flash.	4-4
	If the LEDs are responding as expected, it could be that the analog outputs are being improperly measured or loaded by the measurement device. Check your connections. Make sure your measurement device has adequate high input impedance.	—
	If you forget to save your PID assignments after configuring the DBK70, all assignments will be lost when the system is powered down. Re-configure and save the configuration.	5-9
Output is erratic	If the timeout duration in the "If no match in __mS" field (in *Detailed View*) or "Timeout" field (in *Summary View*) is exceeded before the message is received by the DBK70, the output voltage will return to the value specified in the "set chan to __uV" field (in *Detailed View*), [the "Default Value" in *Summary View*]. Increase the timeout value.	5-19
LogView reads all DBK70 channels as Channel 0.	Should this problem occur, it can be resolved by taking the simple steps provided on the next page.	8-2

Special Notice for LogBook Users

This notice applies to the use of a DBK70 with a LogBook.

Symptom - LogView reads all DBK70 channels as Channel 0.

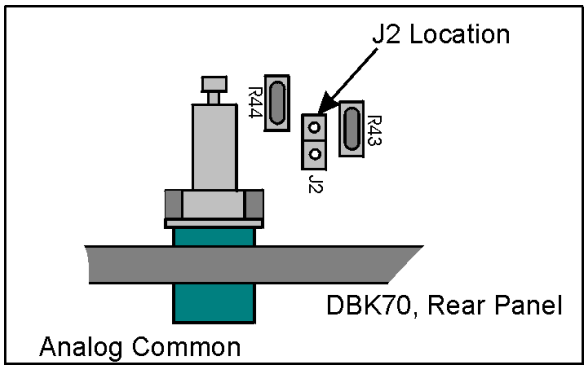
Solution - Should this problem occur, it can be resolved by taking the simple steps provided below.

Note that both *hardware-related* and *software-related* steps must be taken to ensure that all channels will read correctly.

Hardware Related Steps

1. With power off to the DBK70, remove cover plate.
2. Check the DBK70 board to see if there is a header labeled "J2."

   Refer to the following figure for location.



J2 Location Reference

3. If the "J2" header is present, verify that it is free of a jumper.
   If a jumper is present, remove it.

Note: Most DBK70 modules shipped after September 1, 2001 do not have the "J2" header.

4. Replace the cover plate.

Regarding Configuration in LogView

1. When you configure the list of expansion modules in LogView, use the setting "**DBK13 Analog Multiplexer**" instead of "DBK70 Vehicle Bus Interface." This is done when configuring the base channel to which the DBK70 is assigned. Refer to your *LogBook User's Manual* (461-0901) if needed.
2. Make sure that the range selected for each channel is the default setting of -10.0 to +10.0 volts. Other range settings will produce incorrect results.

This completes the corrective action.

Specifications 9

Physical

Dimensions: 280mm W x 216mm D x 44mm H (11” x 8” x 1.75”)

Weight: 1.1kg (2.5lbs)

Connectors:

- Serial configuration: DB9 female
- Network port: HD44 female
- Direct parameter output ports: DB25 male
- Data acquisition cascade port: DB37 male
- Power: DIN5 female

Environmental

Operating temperature: -20°C to +70°C

Electrical

Power consumption: 0.11A @ 12V

Supply voltage: 10 to 30VDC

Analog Outputs

Output resolution: 16 bits, auto dependent

Integral Non-Linearity: ±4 bits max

Differential Non-Linearity: ±2 bits max

Gain temperature coefficient: 10 ppm / °C max

Settling time (0-5V): 50uS + 0.01 max

Output offset error: 1mV max

Output gain error: 0.015% max

Rise time (10% o 90%) 5V: 25uS max

Offset temperature coefficient: 10uV / °C max

Time stability: 50 ppm / month

Maximum output capacitance: 5000pF

Output short circuit: ±15 mA typical

Output load resistance:

- 2 outputs at 5V: 1K Ω min
- All outputs at 5V: 10K Ω min

Type of outputs: Single ended

Voltage range: 0.0V to 5.0V

Isolation range: ±30V

Software Requirements

Operating system: Windows 98, Me, 2000, XP, and NT.

Driver compatibility (using the driver of the data acquisition product):
Windows 98, Me, 2000, XP, NT, C++, VB, Visual Basic, LabView, DASYLab.


Notes

Appendix A – DBK70 Firmware Upgrades A

Overview

IOtech periodically releases new firmware to improve the DBK70's functionality, which may include the addition of new features. Each firmware upgrade is delivered as a single file that permits PidPRO to update the DBK70's internal software. Without the file, PidPRO will not attempt an upgrade.

Reference Note:
To obtain either an upgrade file and/or information about upgrades, contact IOtech at productSupport@iotech.com.

Performing an Upgrade

To perform a firmware upgrade, review the following cautions then continue with the steps below.

CAUTION

The following process will completely remove the existing firmware of the DBK70 and replace it with new firmware. In addition, the channel configuration will be purged.

CAUTION

Never disturb a DBK70 during an upgrade! Interruption of the upgrade process may render the DBK70 unusable and require a factory return.

Step 1: Copy the firmware file named **NC1.TXT** into the PidPRO home directory.

Step 2: Launch PidPRO.

Step 3: Click the **<Connect>** button.

Step 4: Open the *About* dialog box by selecting "**About**" from the **File** pull-down menu.

Step 5: Click the **<Upgrade Firmware>** button.

Step 6: Follow the on-screen instructions.

Once the process begins it will take less than 5 minutes to complete.


Notes

Appendix B – Scale and Offset in Summary View B

Note: This appendix is for users of Summary View who want to understand the mathematics behind scale and offset functions.

One of the most important concepts to understand when configuring a DBK70 output channel is the concept of **Scaled Received Data** (**SRD**). The value of output channel signals are based on its SRDs. SRD is the result of scaling data from a received message.

A DBK70 output channel configuration includes information that identifies:

- The received message that will include the data to be processed for the channel
- Where [in the received message] the data begins (Data Field Start), what the size of the data is (Data Field Length), and whether the data is to be interpreted as a signed or as an unsigned value (Data Field Type)
- The scale and offset parameters (Output Scale and Output Offset) that are to be used to calculate the SRD

The SRD that results from this process is the input to the process that determines the signal generated by the output channel.

The output channel configuration parameters mentioned above, the receive message filtering process, the scaling process, the output signal generating process, and other associated processes that result in producing SRD and the output signal will be described in further detail below. Where SRD is referenced in this document, it is the result of the scaling process applied to data received from a vehicle data bus message and the value used to determine the characteristics of the signal generated by an output channel.

Another scaling process that uses a separate set of scale and offset parameters (i.e., PC Display Scale and PC Display Offset) included in a channel configuration is used to scale the received data for display in an Output Channel Icon on a PC screen. The same received message data used to calculate the SRD is used to calculate the data value displayed in the Output Channel Icon. These parameters and the data display process will be described in further detail below. The scaling process used here is the same process used to calculate the SRD.

Mathematically, the SRD is interpreted as a 32 bit signed integer value (i.e., a long integer in C). The SRD is the result of multiplying the received data by the Output Scale and adding to the result of the multiplication the Output Offset and then converting the result this addition into an 32 bit signed integer value (i.e., $\mathbf{y = mx + b}$, where SRD = integer of the y value, where x is the received data, m is the scale value, b is the offset value, and y = the result of the scaling process).

The received data is the data from a message that was received from a vehicle data bus and passed through the Filter defined for an output channel. The Index and Length specify where in the received message the data starts and how long it is. Storage Type specifies whether the received data is interpreted as either a signed or an unsigned value. The Output Scale and Output Offset values may be positive or negative and may be defined in an integer or floating point form (i.e., floating point means defined with a decimal point and with or without fractional values). An SRD may be a positive or a negative value.

The signal generated by an output channel is determined by the SRD's value and the way a given output channel processes that value. Storage Type, Output Mode, and Aux Value determine the way an output channel processes an SRD.

Format for the Display of Received Data in an Output Channel Icon

The data displayed in an Output Channel Icon uses the same scaling process as is used to calculate the SRD but with the PC Display Scale and PC Display Offset values instead of the Output Scale and Output Offset values.

Data displayed in an Output Channel Icon is displayed as a signed 32 bit integer (i.e., -2^{31} to $+2^{31}$). Details for calculating PC Display Scale and PC Display Offset parameters are shown below.

Processing of SRD by Analog Output Channels

For analog output signals, the SRD is interpreted as a μVDC (i.e., 0.000001 VDC) value. The lowest signal value above 0 is 1 μVDC (i.e., SRD = 1) and the highest signal value is 5,000,000 μVDC (i.e., SRD = 5,000,000).

- If SRD < 0, then signal = 0 VDC (i.e., no signal)
- If SRD >/= 5,000,000, then signal = 5,000,000 μVDC (i.e., 5.000000 VDC)
- If 1 </= SRD </= 5,000,000, then signal = SRD μVDC

Calculating Scale and Offset

General Scale and Offset Calculations

To calculate the scale and offset field values used to create a scaled output signal or a displayed value from the received data, the following formulas can be used.

Where: V_H = Highest output channel value (e.g., 5,000,000 μ)

V_L = Lowest output channel value (e.g., 0 μVDC)

D_H = Highest scaled data value (e.g., 10,000 RPM)

D_L = Lowest scaled data value (e.g., 0 RPM)

S_H = Highest transmitted value

S_L= Lowest transmitted value

R = Resolution = Scaled data value/bit of received data value (e.g., 0.25 RPM/bit)

$$\text{Scale} = [(V_H - V_L)/ (D_H – D_L)] * R$$

$$\text{Offset} = [(S_L-D_L)/(R)] * \text{Output Scale}$$

The following sections contain examples of calculating Output Scale and Offset values for analog output signals, and calculating of PC Display Scale and Offset values.

Calculating Output Scale and Offset Values for Analog Output Signals

Example 1

Calculate Output Scale and Offset for an analog output signal with a signal range 0 to 5 VDC being equivalent to an RPM range of 0 to 10,000 RPM, where the resolution of the received data is 0.25 RPM/bit and has a range of 0 to 16082 RPM. (i.e., V_H = 5,000,000µVDC, V_L = 0, D_H = 10,000, RPM, D_L = 0 RPM, R = 0.25 RPM/bit, S_L=0, and S_H=16082):

Output Scale = $[(V_H - V_L) / (D_H – D_L)] * R$

= [(5,000,000 – 0) / (10,000 – 0)] * 0.25

= [5,000,000 / 10,000] * 0.25

= 500 * 0.25

= 125

Output Offset = $[(S_L-D_L) / R] *$ Output Scale

= (0 - 0 / 0.25) * 125

= 0

Example 2

Create a full range analog output signal (i.e., 0 to 5 VDC) equivalent to a temperature range of -50 °F to +250 °F, where the data received from the vehicle data bus has a resolution of 0.125 °F /bit and has a range of -300 °F to 300 °F (i.e., V_H = 5,000,000µVDC, V_L = 0, D_H = +300 °F, D_L = -300°F, and R = 0.125 °F/bit

Output Scale = $[(V_H - V_L) / (D_H – D_L)] * R$

= [(5,000,000 – 0) / (+250 – (-50))] * 0.125

= [5,000,000/300] * 0.125

= 16666.6667 * 0.125

= 2083.3333

Output Offset = $[(S_L-D_L) / R] *$ Output Scale

= [(-300)-(-50)]/(0.125)] * 2083.3333

= -250/.125 * 2083.3333

= -2000 * 2083.3333

= -4166667

Calculating Display Scale and Offset Values

Output Channel Icons are created for all channels supported in a DBK70 when the Read Current Settings option on the Device menu is selected. One Output Channel Icon is created for each output channel in a DBK70. Each Icon displays the channel number associated with the channel, the first 29 or so characters of the Record Name and Comment fields of the DBK70 Database record used to configure the channel, and a real time display of the value of the received data. The PC Display Scale and Offset, Record Name, and Comments fields are described in an earlier section DBK70 Database Record Fields. A PC screen with Output Channel Icons is shown later in the section Output Channel Icons.

This section describes the calculation of the PC Display Scale and Offset values used to scale received data for display in an Output Channel Icon.

In absolute terms, the values that can be displayed in Output Channel Icons are integers that range from -2^{31} to $+2^{31}$.

Example 1

Create a full range display in an Output Channel Icon (i.e., 0 to 10,000) equivalent to an RPM range of 0 to 10,000 RPM, where the data received from the vehicle data bus has a resolution of 0.25 RPM/bit (i.e., $V_H = 10{,}000$, $V_L = 0$, $D_H = 10{,}000$ RPM, $D_L = 0$ RPM, and $R = 0.25$ RPM/bit):

If $V_H = 10{,}000$, $V_L = 0$, $D_H = 10{,}000$ RPM, $D_L = 0$ RPM, and $R = 0.25$ RPM/bit

PC Display Scale $= [(V_H - V_L) / (D_H - D_L)] * R$

$= [(10{,}000 - 0)/ (10{,}000 - 0)] * 0.25$

$= [10{,}000 / 10{,}000] * 0.25$

$= 1 * 0.25 = 0.25$

PC Display Offset $= [(D_L)/(R)] * \text{PC Display Scale}$

$= [\ 0 / 0.25]$

$= 0$

Example 2

Create a display with a range of -330 to +300 in an Output Channel Icon that is equivalent to a temperature range of -300 °F to +300 °F, where the data received from the vehicle data bus has a resolution of 0.125 °F /bit (i.e., $V_H = 300$, $V_L = -300$, $D_H = +300$ °F, $D_L = -300$°F, an $R = 0.125$ °F/bit

PC Display Scale $= [(V_H - V_L) / (D_H - D_L)] * R$

$= [(300 - (-300)) / (+300 - (-300))] * 0.125$

$= [600/600] * 0.125$

$= 1 * 0.125$

$= 0.125$

PC Display Offset $= [(D_L)/(R)] * \text{PC Display Scale}$

$= [(-300)/(0.125)] * 0.125$

$= -2400 * 0.125$

$= -300$