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DBK70 User's Manual



the smart approach to instrumentation ™

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DBK70
User's Manual

p/n 1056-0901 Rev. 3.0

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January 2002

Printed in the United States of America

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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.

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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.



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Unpacking the DBK70 1

Electrostatic Discharge (ESD)



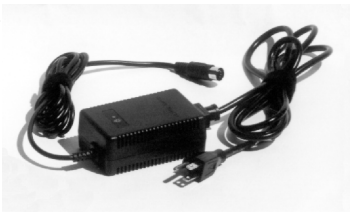
The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage. You should always handle components carefully, and you should never touch connector pins or circuit components unless you are following ESD guidelines in an appropriate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

Contents

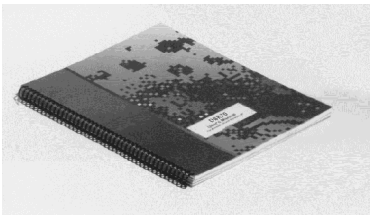
DBK70 includes the following items, with exception of cables CA-208 and CA-218, which are options. Splice Plates (p/n 232-0810) can be used to attach a DBK70 to a LogBook, WaveBook, or a Daq Device.



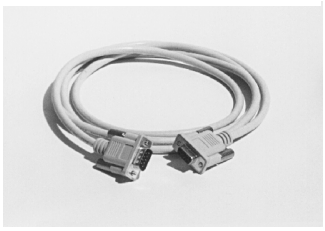
DBK70



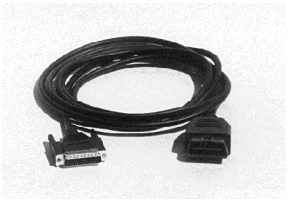
AC Power Adapter & Cable
(TR-40U and CA-1)



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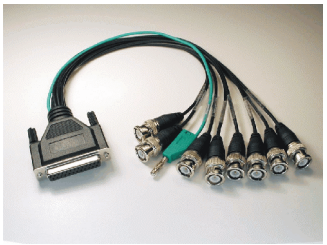
Serial Port Cable
(CA-212)



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.

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

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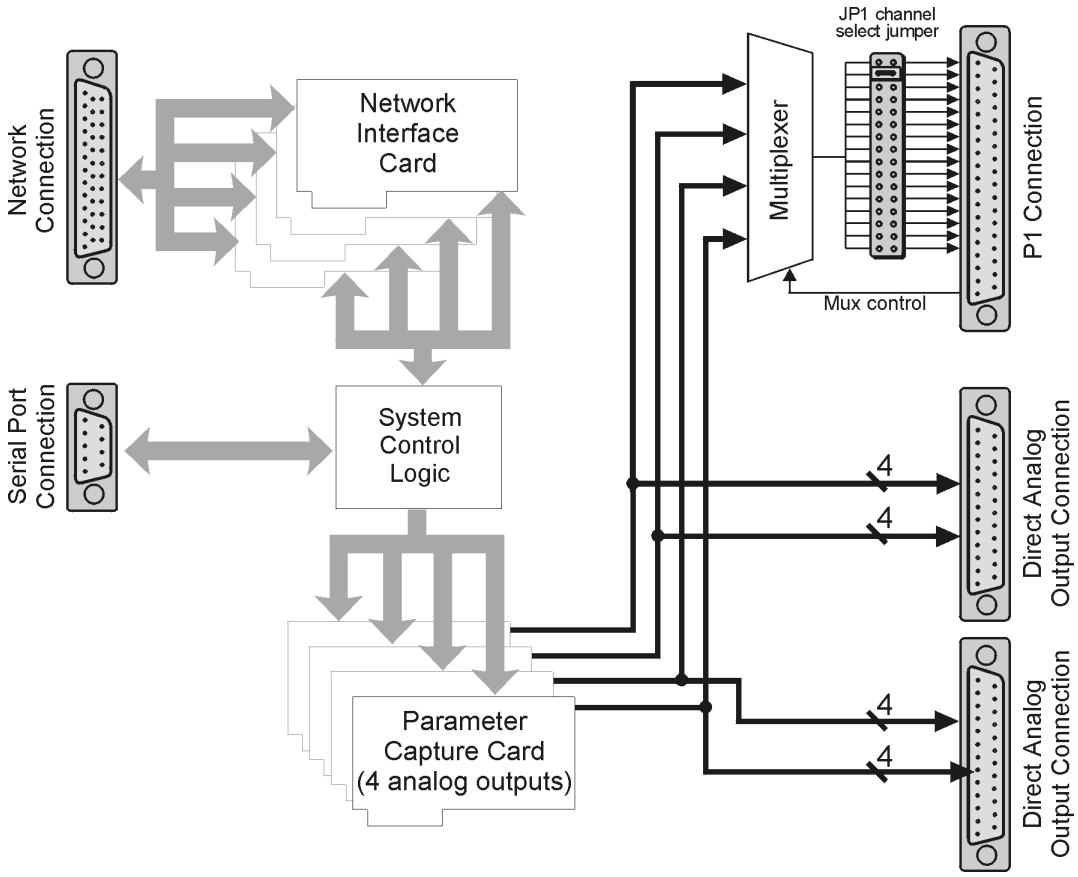


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Introduction 2

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.

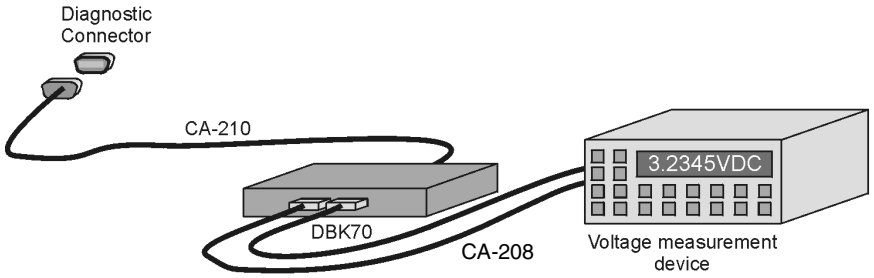
Through the DBK70, vehicle data contained in normally occurring messages used for the operation of the vehicle and/or available through diagnostic protocols can be monitored and used to generate scaled, analog output. Every DBK70 analog output channel is independently configured. Each data received and 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.

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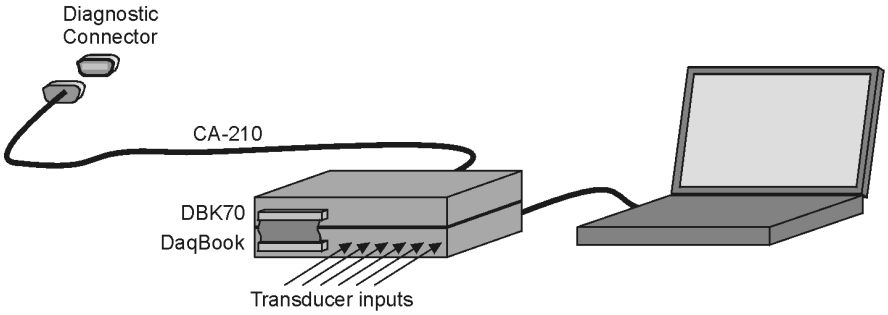
Since the DBK70 contains a non-volatile memory that holds all of its setup parameters, the PC need only be connected to initially configure the DBK70 or to make configuration changes. During normal operation, no PC connection is required. In addition to configuring the DBK70, the included software also 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.



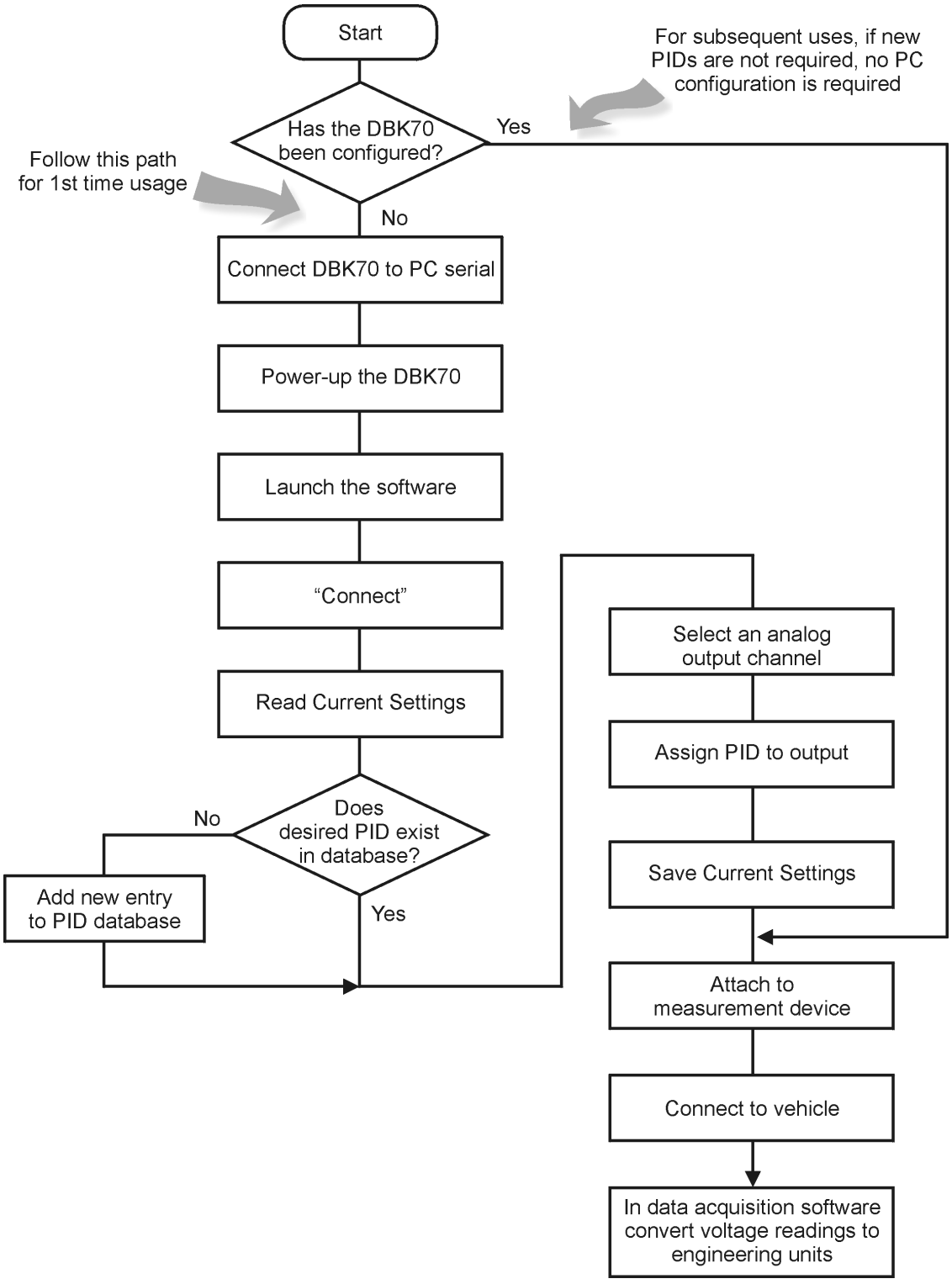
Stand-alone Mode



Used with IOtech Data Acquisition

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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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System Setup 3

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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 can not be monitored in the software.

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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.

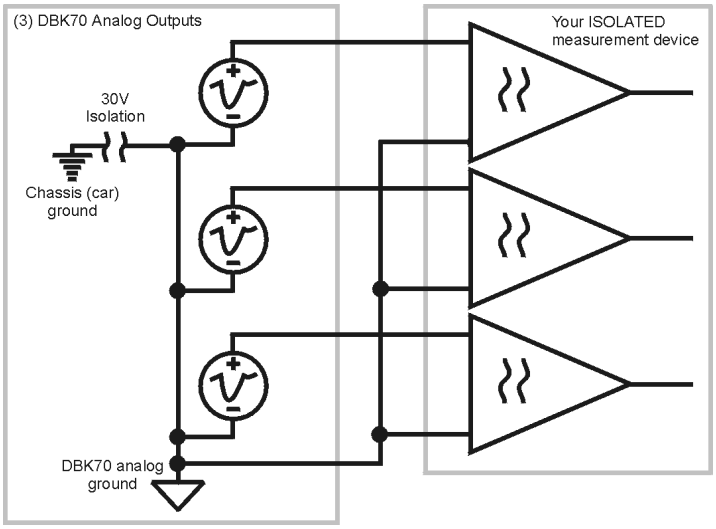


Reference Note:
Refer to page 4-3 for more information.

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

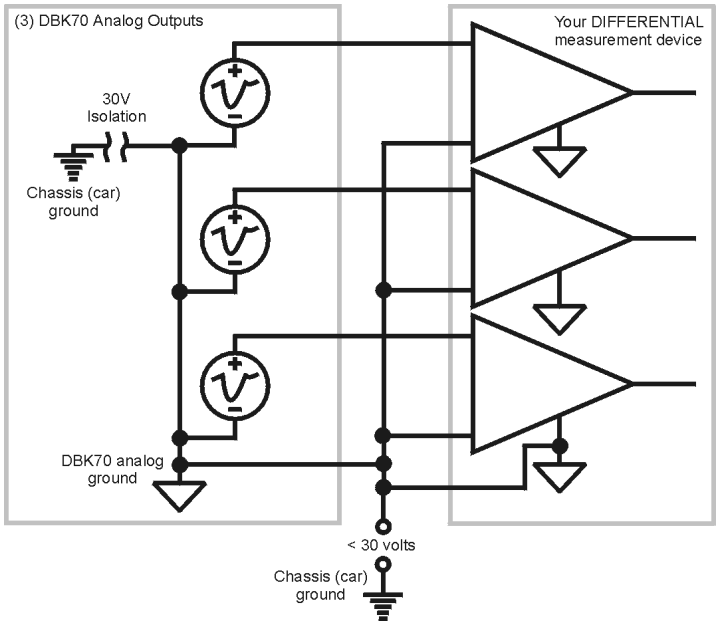
When used with a measurement device having isolated inputs, connect any of the DBK70's ground pins to each of the low-side inputs of the measurement device. Attach each of the DBK70 analog outputs to the high-side inputs of the measurement device. It is not necessary to tie the ground of the DBK70 to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



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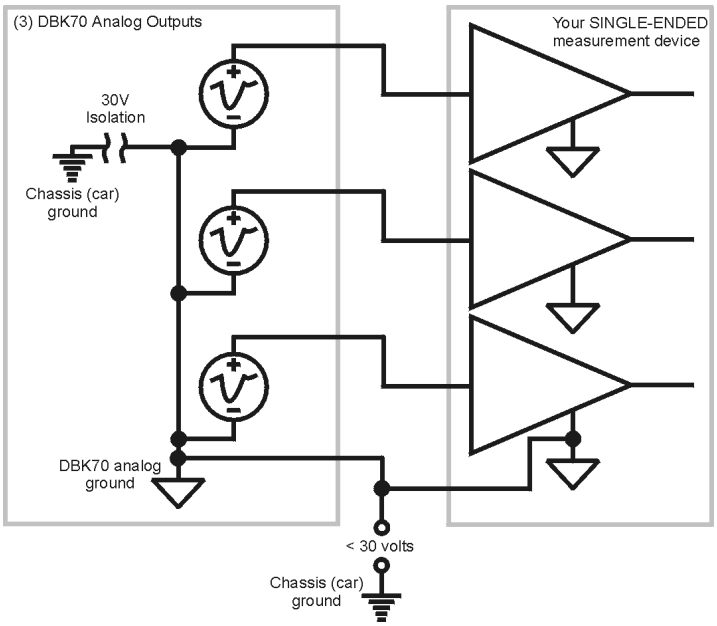
Differential Measurements

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

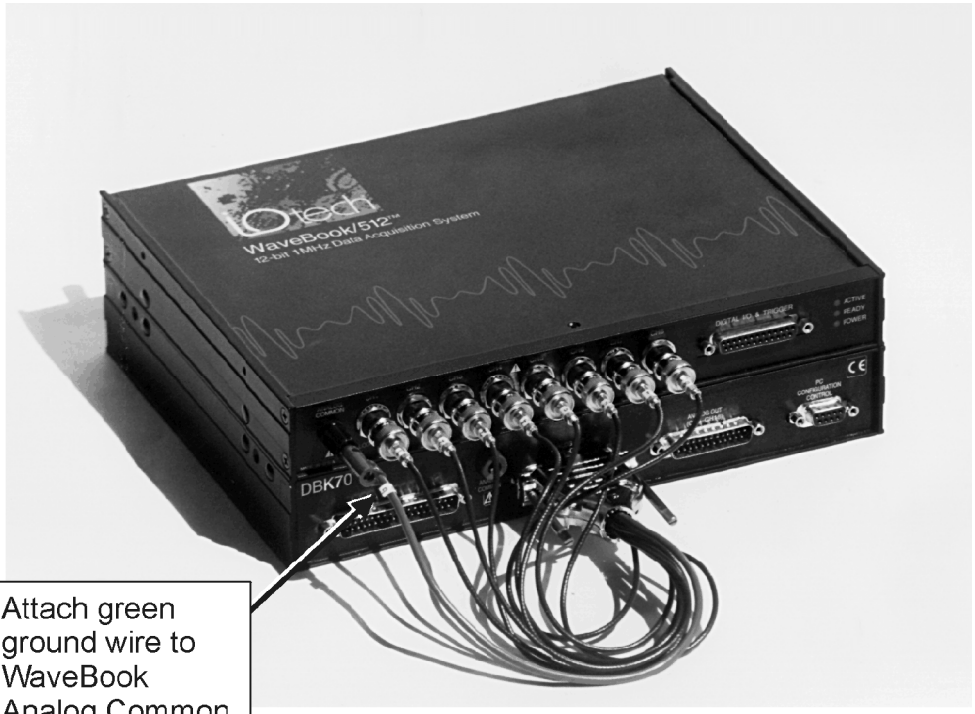
When measuring the DBK70 outputs with a single-ended device, the analog grounds from the DBK70 and the measurement device must be tied together.



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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.

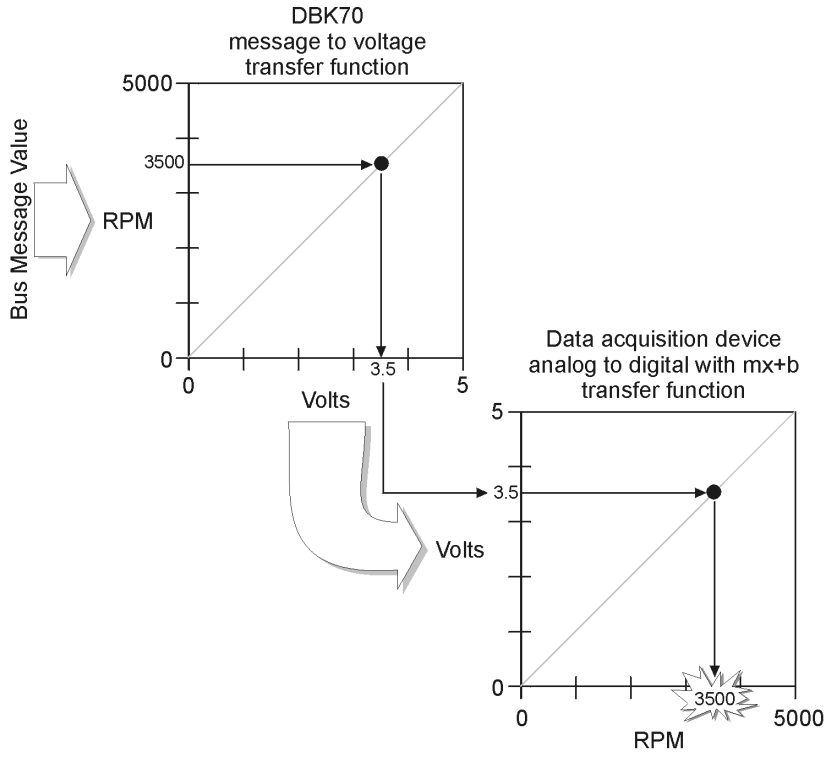


Reference Note:
Refer to the block diagram on page 2-1 to better understand the relationship between the multiplexed and straight through outputs.

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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).

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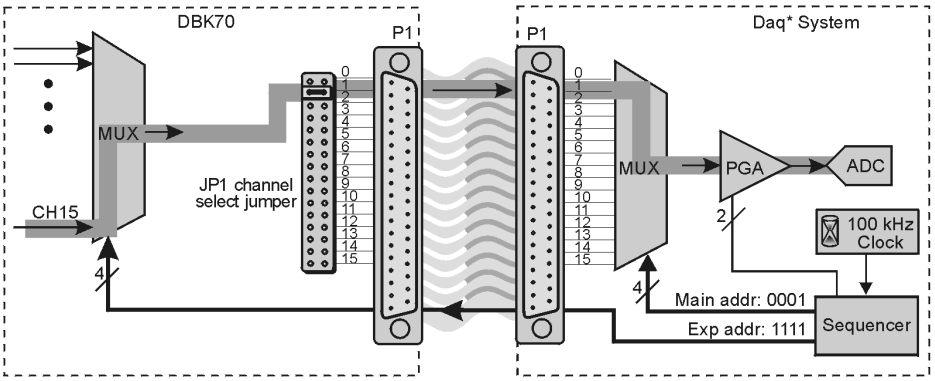


The DBK70 has both straight-through and multiplexed outputs. The multiplexed outputs are designed specifically for use with IOtech's Daq* and LogBook products. The straight-through outputs can be used with any measurement device, including IOtech's WaveBook products.

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.



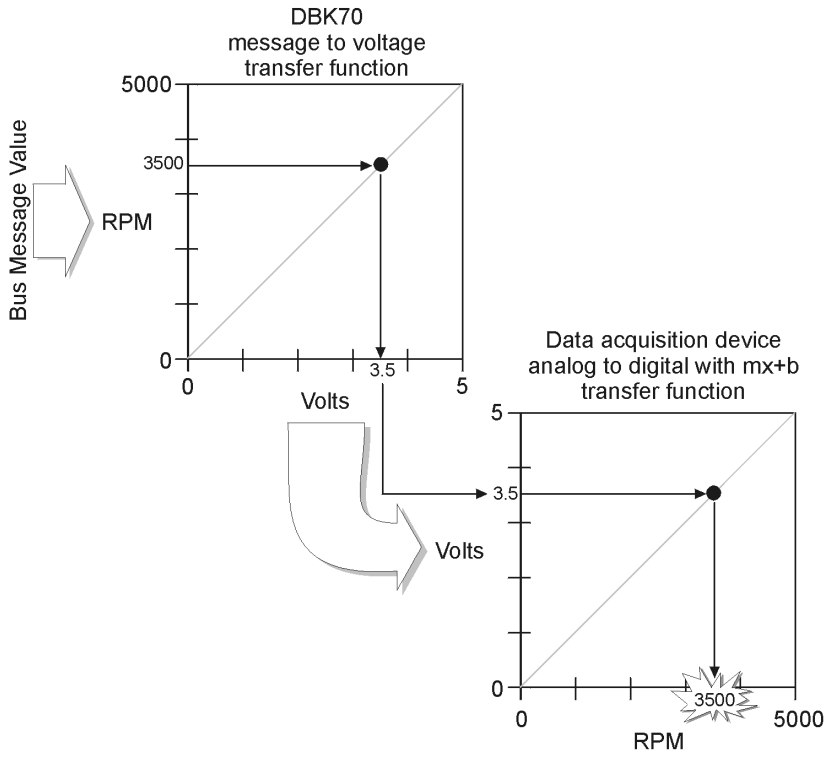
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- The Daq* **sequencer** selects the channel and gain by controlling **multiplexers** (MUX) and programmable gain amplifiers (**PGA**) in both the Daq* and the DBK. The **sequencer** uses 4 expansion address lines to provide 16 unique channel addresses 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.



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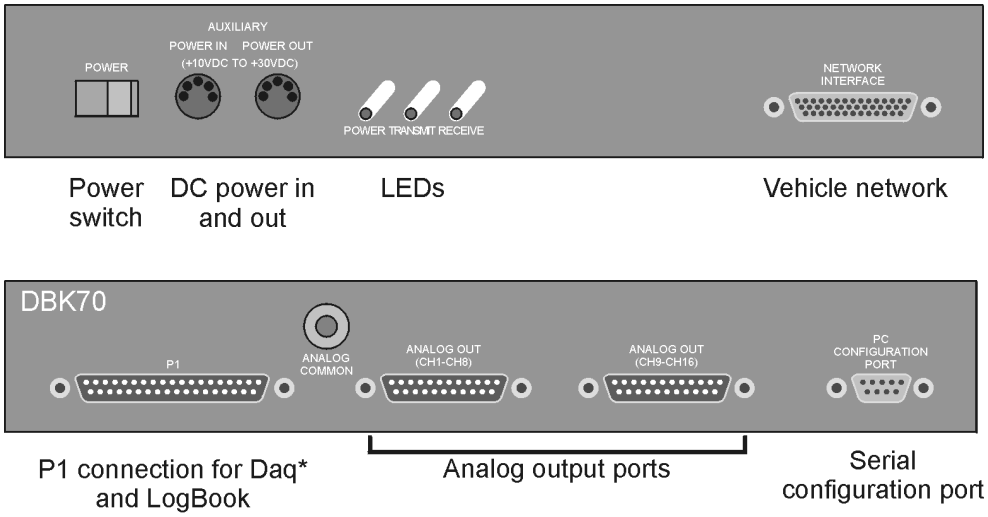


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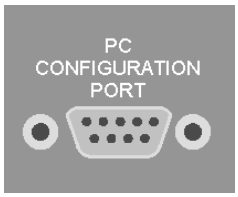
DBK70 Connectors



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.

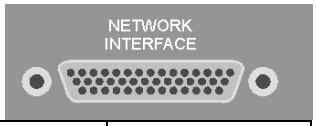
Pin#	Name
1	NC
2	Tx
3	Rx
4	NC
5	Analog Gnd
6	NC
7	CTS
8	RTS
9	NC



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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

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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

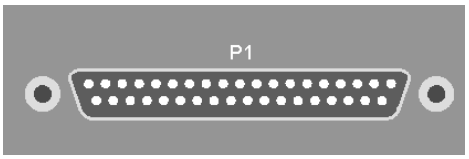
Pin#	Name	Pin#	Name	Pin#	Name
1	Analog out 1	11	NC	21	Analog Gnd
2	Analog out 2	12	NC	22	Analog Gnd
3	Analog out 3	13	NC	23	Analog Gnd
4	Analog out 4	14	Analog Gnd	24	Analog Gnd
5	Analog out 5	15	Analog Gnd	25	Analog Gnd
6	Analog out 6	16	Analog Gnd		
7	Analog out 7	17	Analog Gnd		
8	Analog out 8	18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

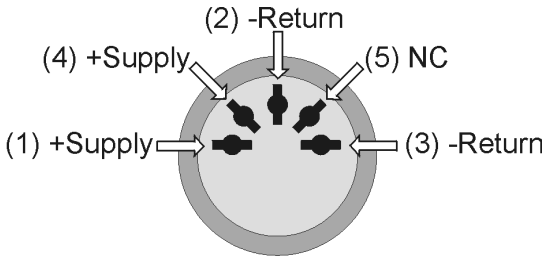
This port is for attaching the DBK70 to a DaqBook, DaqBoard, Daq PC-Card, or LogBook via a short ribbon cable.



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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.

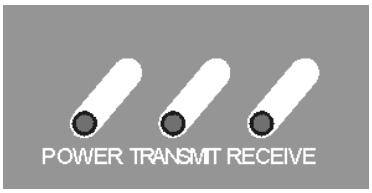
In rare instances where power is not available on the diagnostic connector, the DBK70 can be powered from its Auxiliary Power connector using a cigarette lighter power cord (IOtech p/n CA-198)

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.

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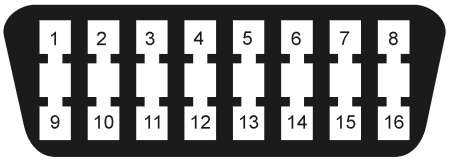
Vehicle Diagnostic Connectors

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

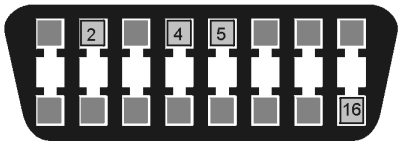


16-Way Diagnostic Connector*

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.

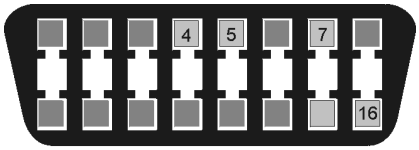
***Note**: The 9-pin J1939 diagnostic connector, used in heavy-duty vehicles, is discussed on page 4-7.

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.



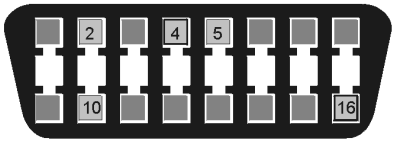
J1850-VPW

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



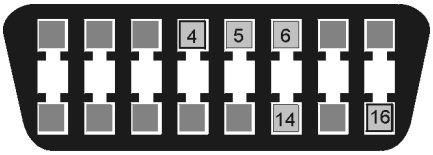
ISO 9141-2 or ISO 14230-4

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



J1850-PWM

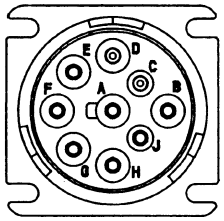
J1850-PWM--The connector should have metallic contacts in pins 2, 4, 5, 10, and 16.



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.



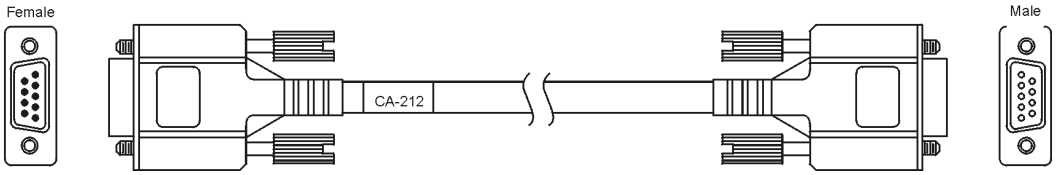
J1939

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

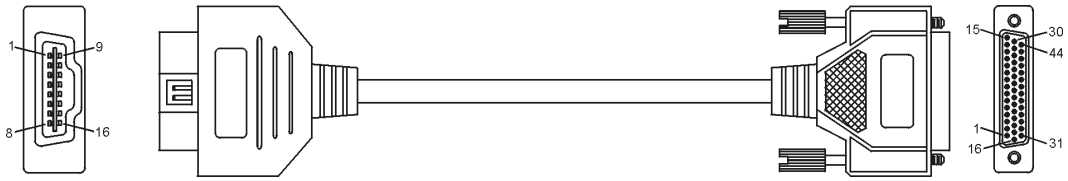
For the purpose of configuring the analog outputs, the DBK70 is connected to the PC via the included

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.

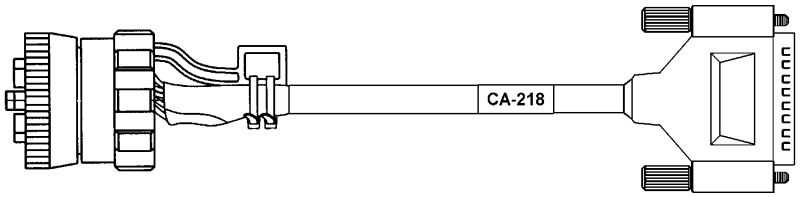


CA-210 Pinout	
OBD Connector	**DB44 Connector**
2	4, 17
5	36, 37
6	29
7	25
10	20
14	13
16	42, 43

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J1939 Vehicle Bus Cable, CA-218 [Optional]

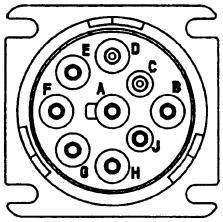
CA-218 is a cable option. It enables a properly equipped DBK70 to communicate with vehicles that support the J1939 network protocol. These vehicles are typically of the heavy-duty variety and include trucks and busses.



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



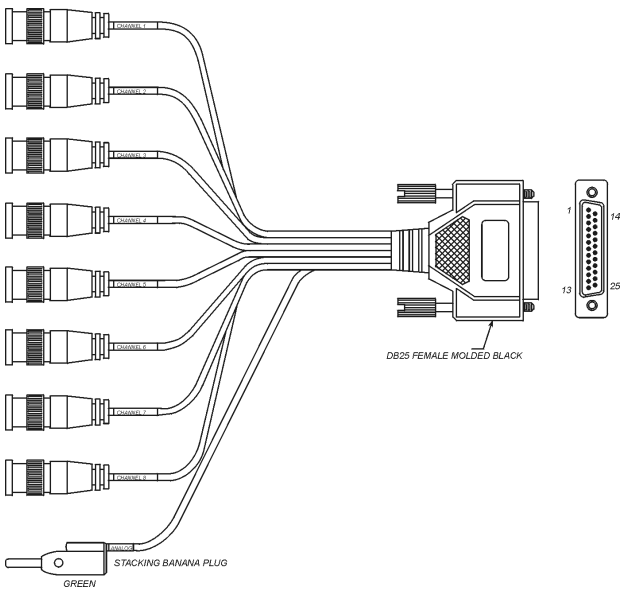
J1939 Diagnostic

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Analog Output Cable, CA-208 [Optional]

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

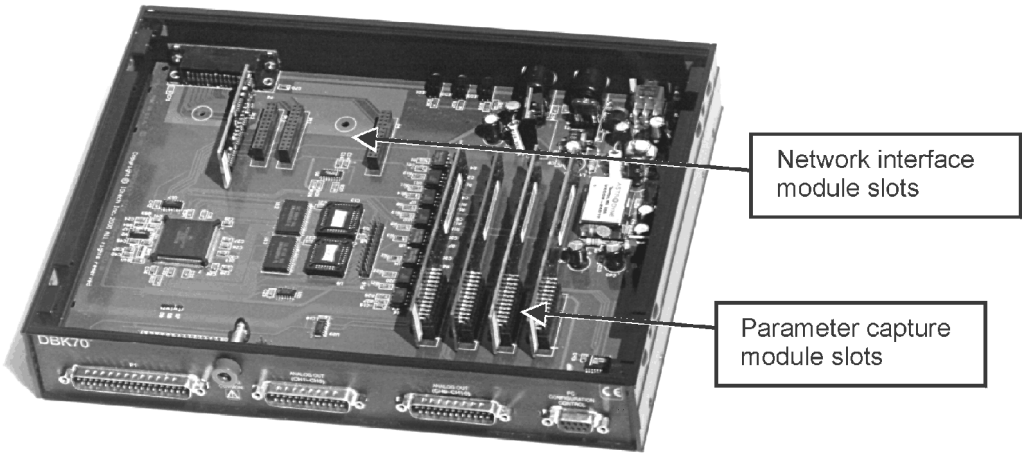
CA-208 Pinout	
BNC	**DB25 Pin**
1	1
1 collar	14
2	2
2 collar	15
3	3
3 collar	16
4	4
4 collar	17
5	5
5 collar	18
6	6
6 collar	19
7	7
7 collar	20
8	8
8 collar	21
Green	25



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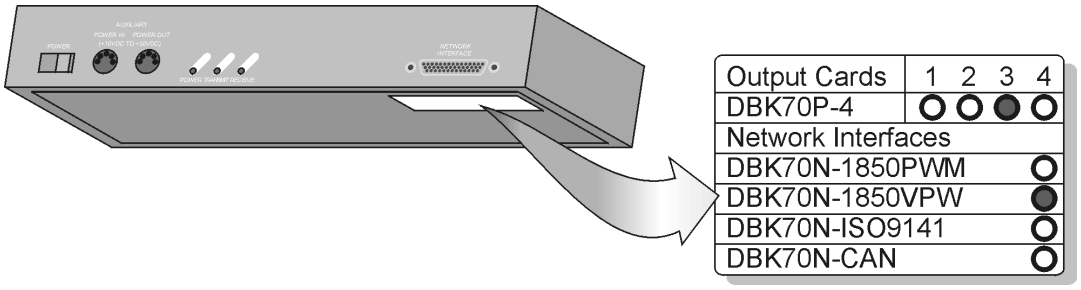
Chassis Label

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.

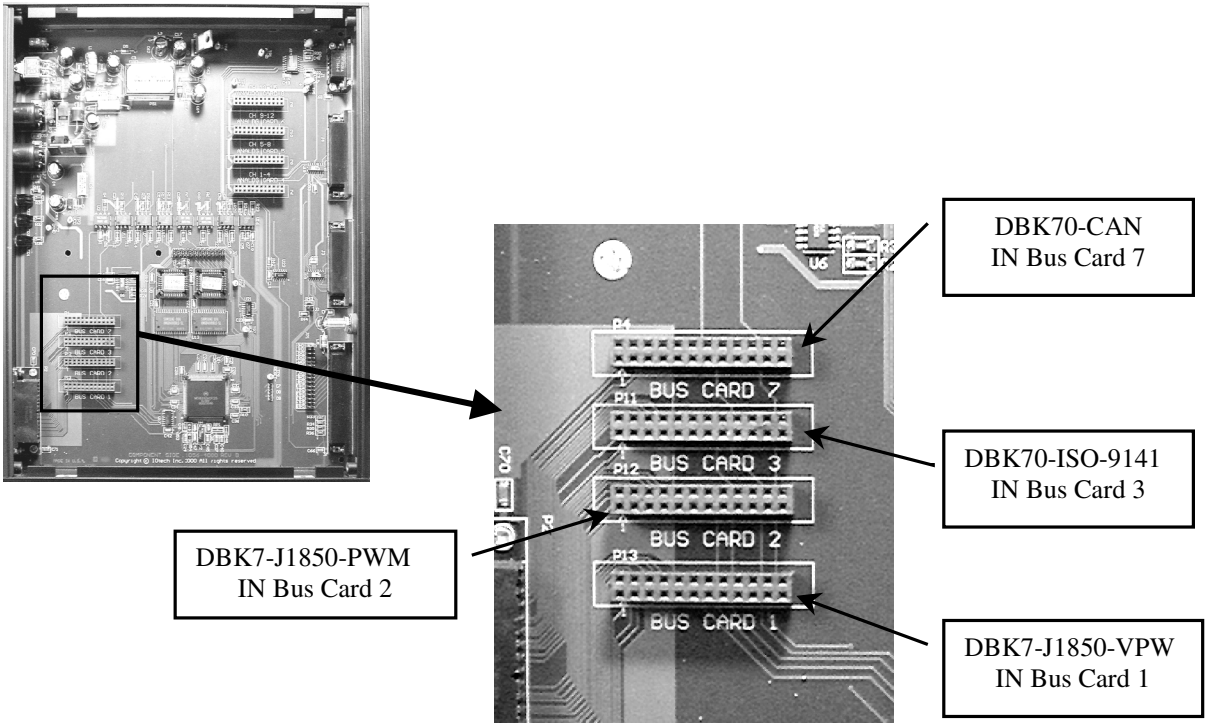
Each DBK70 is configured with plug-in cards. A label located on the bottom of the DBK70 identifies the cards installed at the factory. A colored in circle denotes the presence of the associated analog output card or network interface card. Each analog output card (parameter capture card, DBK70-P4) has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

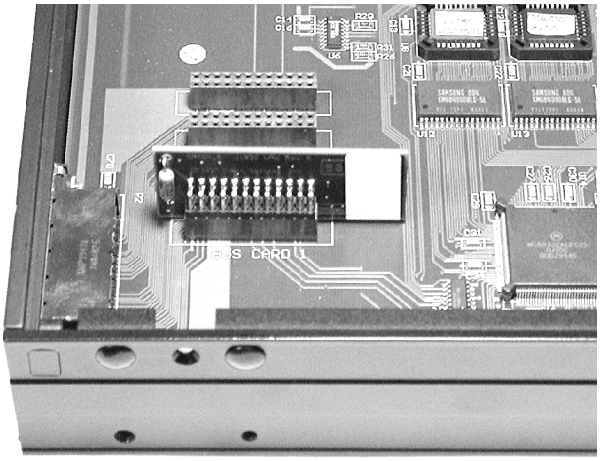


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Network Interface Cards

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.



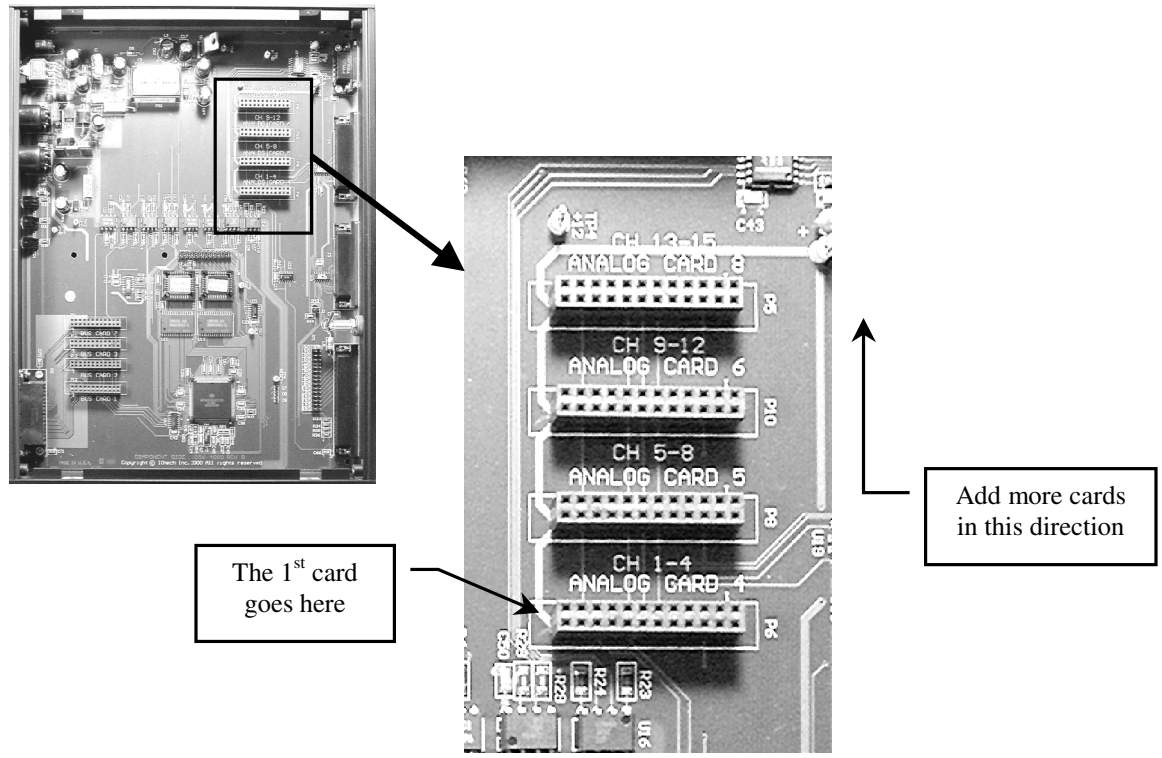


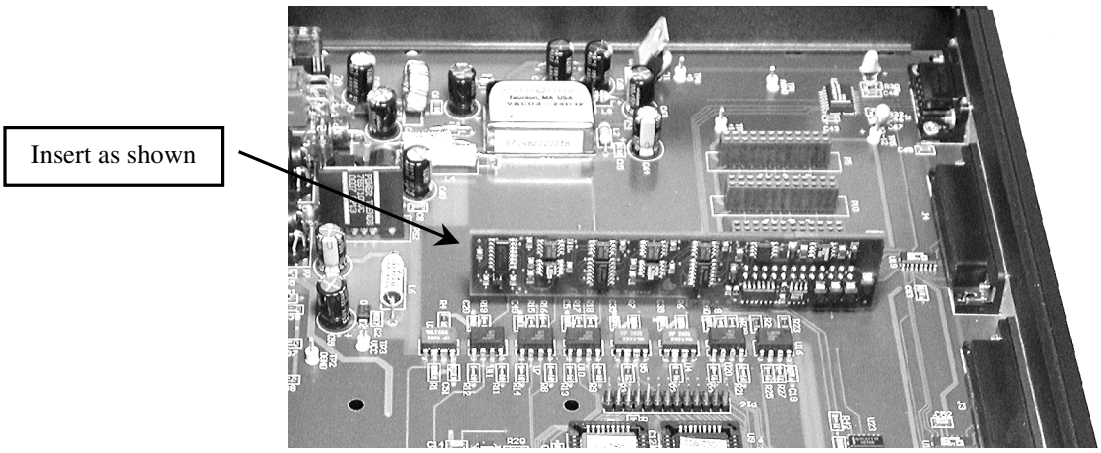
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Analog Output Cards

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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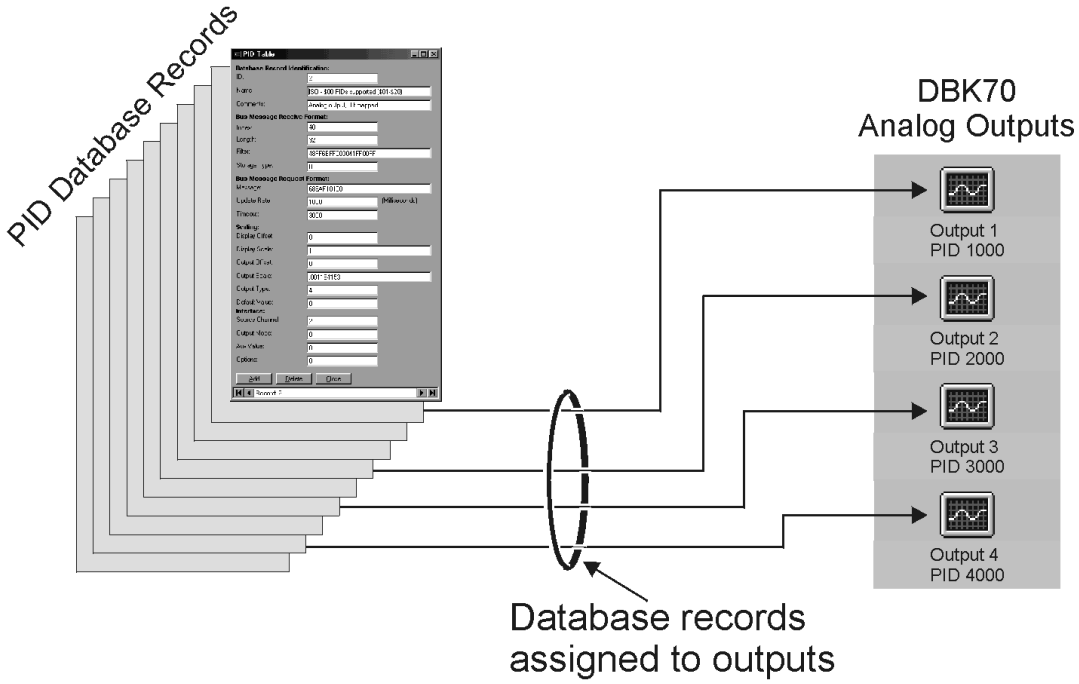
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Introduction

The software application included with the DBK70 provides the following services:

- Manages a database of message handling descriptions (add, edit, delete records)
- Assigns database items to analog outputs
- Configures the DBK70 hardware
- Manages the *current* and *saved* configurations in the DBK70
- Displays the real time value of a network message

The database shipped with the product includes the *legislated Parameter Identifiers* (PIDs) for each of the supported network types. Legislated PIDs are PIDs that are part of the network standard. Nearly every vehicle supports at least a subset of the legislated PIDs. To query the vehicle for its supported legislated PIDs, use PID 0, explained in the section *Deciphering the PID 0 Message*. PIDs that are developed by individual manufacturers for use in only their vehicles are called *proprietary PIDs*. To use proprietary PIDs, the user must enter them into the database.



Without connecting the DBK70 to the PC, the software allows the user to page through the records, edit the fields of the records, delete records, and add new records. To assign a record to an analog output, the DBK70 must first be connected to the PC's serial port.

Using the DBK70 Software with and without the DBK70

The DBK70 software can be used without a connection to a DBK70 to review or modify the DBK70 Database.

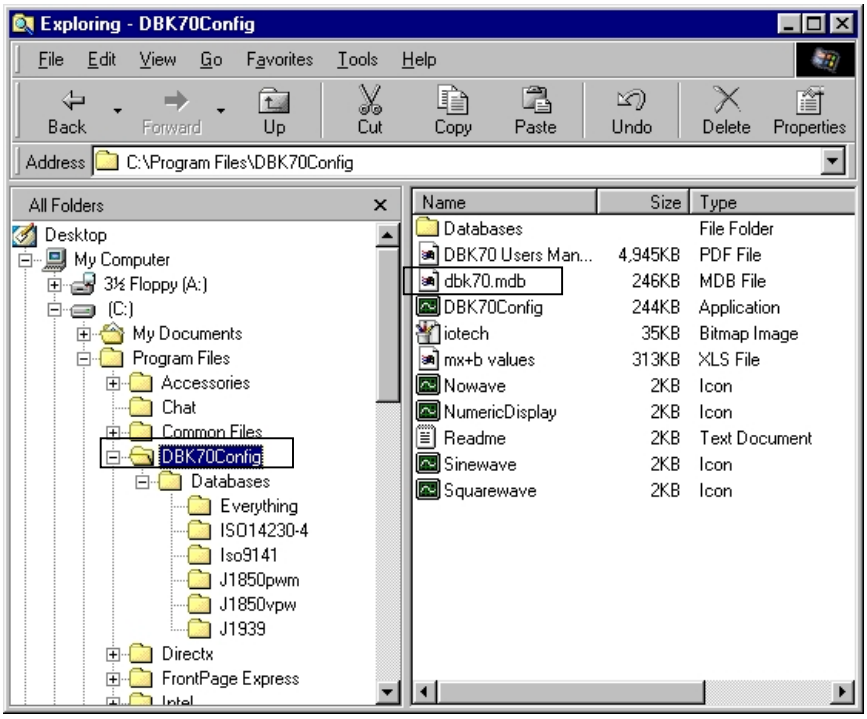
In order to change the configuration of the output channels on a DBK70, the DBK70 software must be connected to a DBK70 that at least has a connection to power.

To use the DBK70 software to monitor active vehicle data, the DBK70 software must be connected to a DBK70 that is powered and connected to an active vehicle data bus with the ignition turned on.

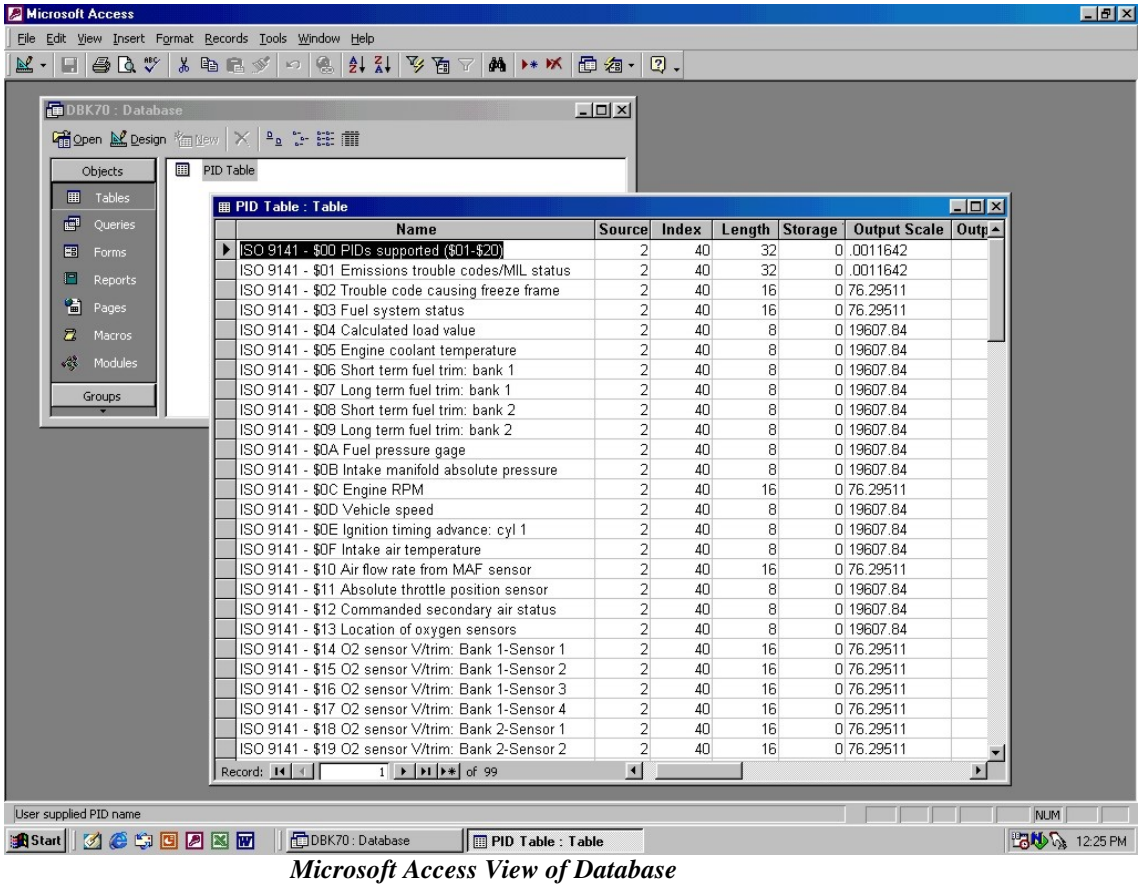
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Using Microsoft Access to Manipulate the Database

The DBK70 database containing the PID records is placed in the folder shown below during the installation process. Since it is a standard Microsoft Access database, owners of Access can simply double click the **DBK70.MDB** file in Microsoft Explorer to open the database within the Access application.



Exploring - DBK70 Database Location

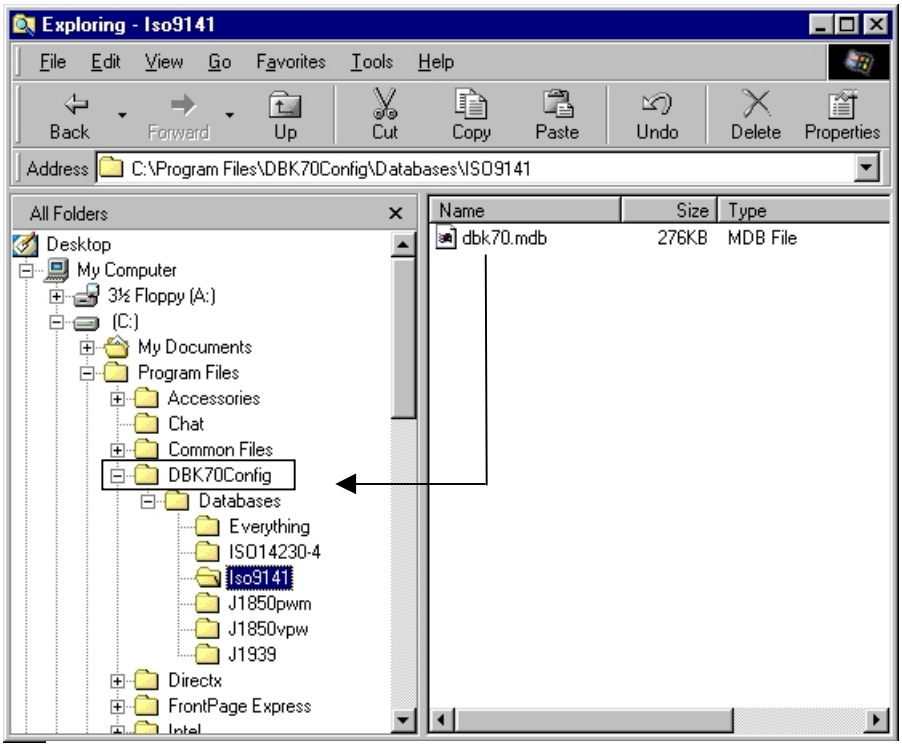


Microsoft Access View of Database

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The database initially installed in the DBK70Config folder contains all the database records for every supported network interface type. Another copy of this database is stored in the folder DBK70Config\Databases\Everything, as shown below. If your database is corrupted due to inappropriate user changes, simply copy the database in the Everything folder into the DBK70Config folder.

For users who are interested in only specific network interfaces, using the entire database containing all the PID records may not be preferred. Five subset databases are also provided in the Databases folder. To use a specific subset database, which contains only the PIDs for that network interface, copy the **DBK70.MDB** file from the appropriate folder into the DBK70Config folder.

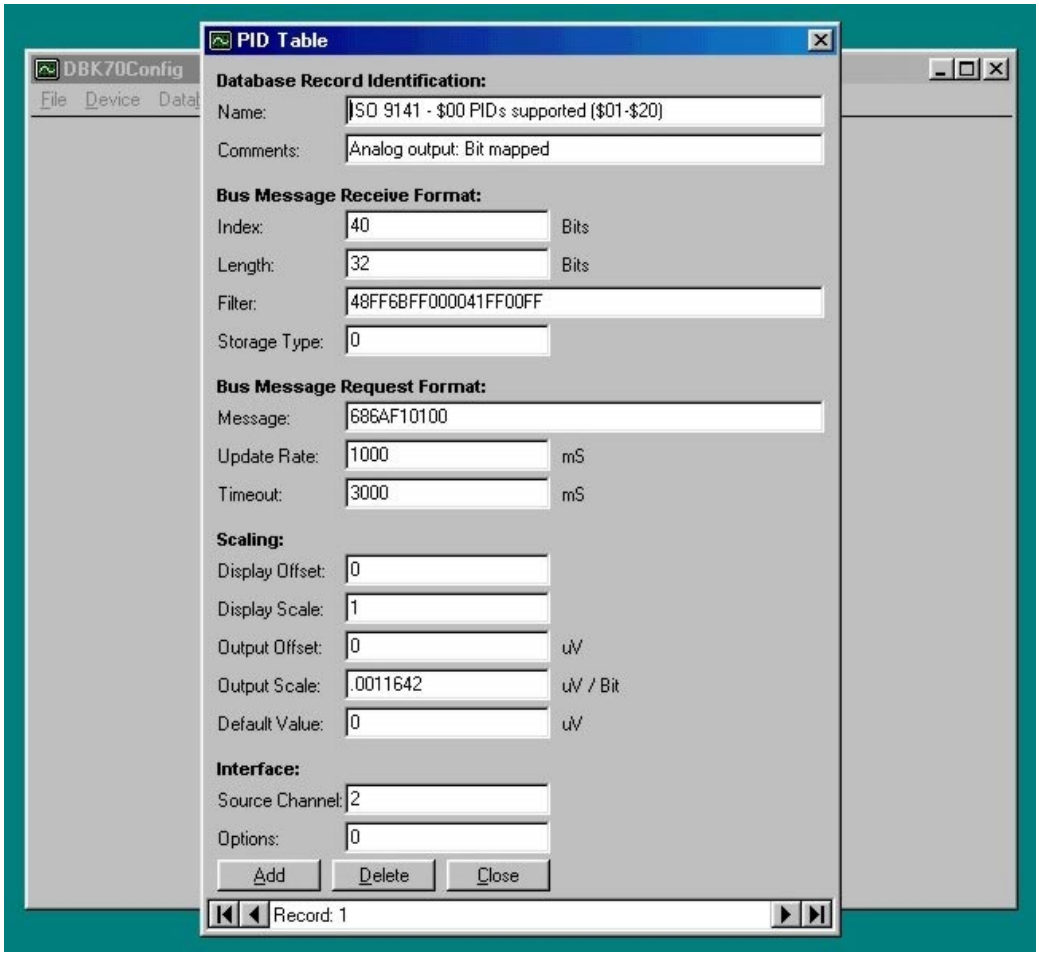


Placing a Copy of the DBK70.MDB File into the Common Files Folder

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DBK70 Software Startup—Database View

To view the default DBK70 database, select “View” under the “Database” menu item.



View of the DBK70 Database

Moving Between Records of the Database

Four tape recorder style icons may be used (shown from left to right respectively in the picture below) to select the first record, the previous record, the next record, or the last record of the DBK70 Database.



Reference Note:
Refer to the procedures below for instructions for doing the Add, Edit, and Delete record functions.

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Adding a New Record to the Database

To monitor proprietary PIDs, PIDs that are not legislated as part of the network standard, a new database entry must be created. To create a PID record in the PID database, intimate knowledge of the PID is required. Typically, only the vehicle manufacturer will have the necessary information to create a new PID record.

To bring up a new record form for adding a new record to the DBK70 Database click the ADD button.



The Add operation will clone, then display the currently displayed database record with the name: **New Record for User Customization**. This record is added at the end of the database.

Edit the fields of the temporary database record.

The Tab key can be used to move from one field to the next.

Once all the fields have entries that are within range, the user can complete the addition of the newly created entry into the DBK70 Database by inserting it into the database. To insert and new record into the DBK70 Database, use one of the options for moving to a new database record (i.e., use of the Next Record, or Previous Record functions is recommended).

Note that until the new record or an edited record is accepted into the database it can not be used to define the configuration of an output channel. If a Change Configuration service is selected in a Output Channel Icon and the currently displayed configuration record has not been accepted into the database, the last displayed accepted record will be used to define the output channel's configuration.

When an attempt is made to add a new or changed record to the database, range checks of some of the fields of the record will be done. If values of any fields of the record being added are out of range, an error dialog will be displayed. This error dialog will show the acceptable range of values. After clicking the OK button in the error dialog, the cursor will be positioned at the field with the error. Correct the error and try to insert the record again.

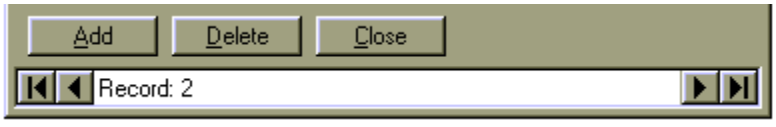
Editing a Record of the Database

To edit a record of the DBK70 database:

1. Display the record.
2. Using the Tab key or the mouse pointer, select a field to be edited.
3. Edit the field(s).
4. If satisfied with all the edits to the record, click the Next or Previous Record buttons. Doing this will cause the newly edited record to be inserted into the database and replace the previous version of this record.
   Even if the Name field was changed during the edit, the newly edited version replaces the previously version of this record. Once the record is accepted into the database, the UNDO option will not be able to remove any of the changes.
5. Click the close button to save the database.

Deleting a Record from the Database

To delete a record of the DBK70 Database, display the record to be deleted using any of the browse buttons, then click the Delete button.



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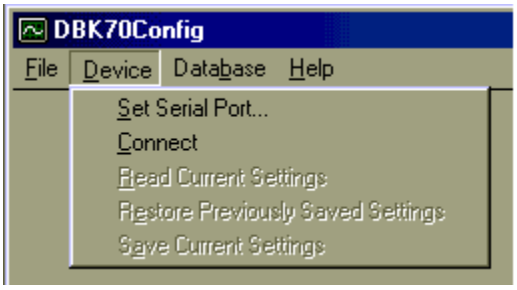
Connecting the DBK70 Software to the DBK70

In order to change the configuration of the output channels of a DBK70, the DBK70 software must be connected to a powered DBK70.

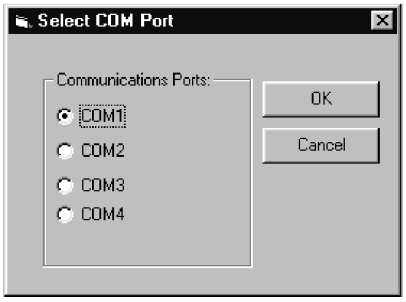
In order to also display the data being processed by the output channels, the DBK70 software must be connected to a DBK70 that is in turn connected to a vehicle's power and active (i.e., the ignition is on) data bus.

To connect the DBK70 software to a DBK70:

1. Ensure the DBK70 is connected to a power source. Typically this means the DBK70 is connected to a vehicle's diagnostic connector. A CA-210 cable is available to connect the DBK70 to a vehicle's diagnostic connector.
2. Ensure the DBK70 is also connected to a serial port on a PC. A CA-212 cable is available to connect the DBK70 to a PC serial port. One end of this cable must be connected to a connector on the front panel of the DBK70. The other end must be connected to a serial port on the PC.
3. Start the DBK70 software if it hasn't been started yet.
4. If not using **COM1** [Serial Port] on the PC, Select the **Set Serial Port** option on the **Device** menu.



5. On the Select COM Port window that appears, identify the PC's serial communication port that is being used to connect to the DBK70. Click the OK button in this window.



6. If you select a COM port that is unsupported or already in use by another program, the following error message will be displayed:



If you get this error message Icon, check to make sure that the serial port you selected is available for use on your PC, and is not being used by another program.

7. Click the Connect button on the main screen or under the Device menu.

At this point, if the communication between the PC's serial port and the DBK70 are working, Output Channel Icons for each configured output channel on the DBK70 will appear, as indicated in the following figure, page 5-8.

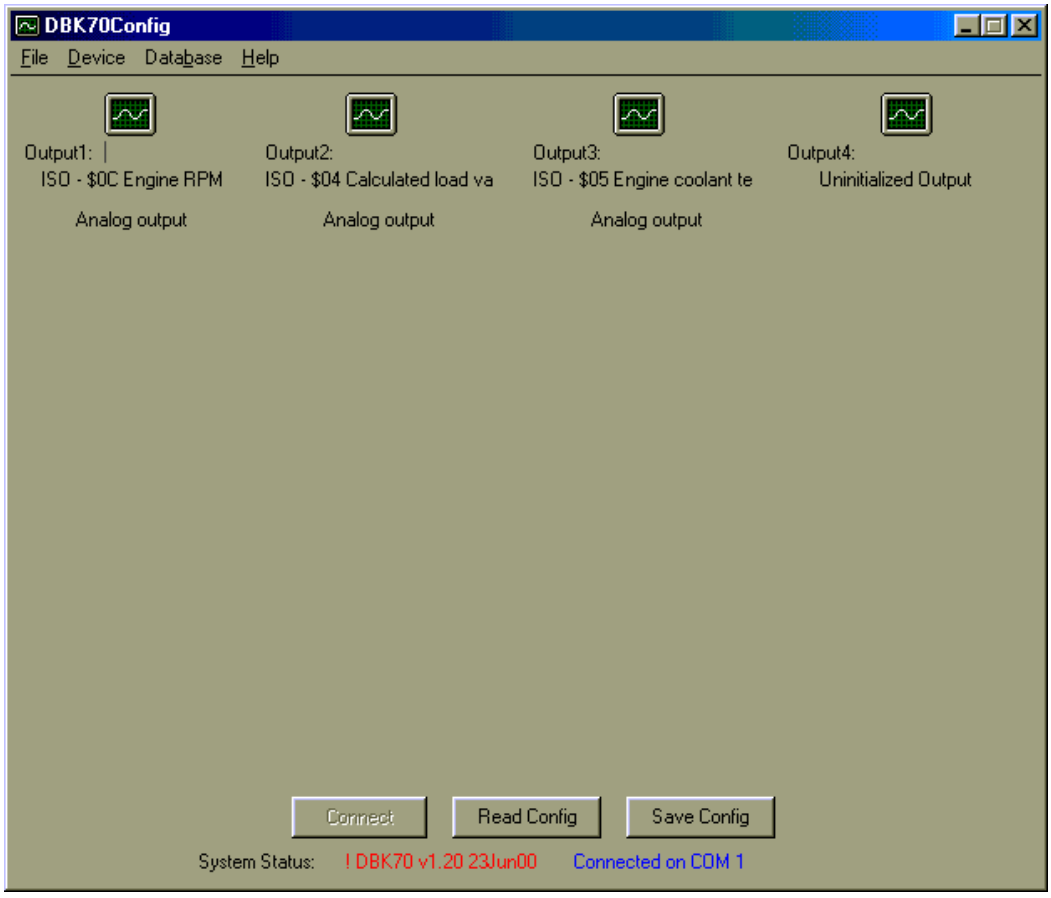
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Output Channel Icons

If the DBK70 software can communicate with the DBK70, a series of up to 16 Output Channel Icons will be displayed on the PC's screen. There will be one Output Channel Icon displayed for each configured output channel in the DBK70. Each Output Channel Icon will show a channel number. The part of the contents of the Record Name field and the Comment field of the configuration loaded in each output channel will be displayed in the Output Channel Icon. The Current Value shows the data being processed in real time by the channel and scaled by the PC Display Scale and PC Display Offset values of the configurations loaded in the output channel.

When reporting real-time values of network parameters on-screen in the DBK70 Config software, only the integer portion of the data is shown. Digits to the right of the decimal point in floating point numbers are truncated. The associated analog output, however, will be correct because the entire floating point number is used when updating the analog output value. For example, if the value of a parameter is 1.35, the DBK70 Config software will show a value of 1 under the associated icon. If the value becomes 0.97, the software will show a value of 0. The analog level, however will correctly represent the exact floating point number with the user-specified scaling.

Especially when dealing with values from 02 sensors, typically floating point numbers between 0 and 2, the on-screen integer value may not reasonably reflect the actual floating point number, but the associated analog output voltage will be correct.



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Initially after the first Read Current Settings function is selected, all the Output Channel Icons will be displayed in rows of four.

Each Output Channel Icon displays: the first 29 characters of the Record Name field and first 26 characters of the Comment field of the record in the DBK70 Database that was used to configure the output channel, as well as the current data value being received by the output channel as scaled by the values in the PC Display Scale and PC Display Offset fields.

Note about the DBK70 factory default: Each DBK70 is shipped from the factory with output 1 assigned to the Engine RPM, for each network type installed.

DBK70 Output Channel Configurations

Each DBK70 output channel has two configurations; the *saved* configuration and the *current* configuration. A DBK70 output channel processes data from the vehicle data bus based upon the information in the output channel's **current** configuration.

Saved configuration data is stored in the DBK70's non-volatile memory. *Current* configuration data is stored in volatile memory. The *current* configuration is loaded from the *saved* configuration when the DBK70 is powered up or when the *Restore Current Settings* option on the *Device* menu is selected.

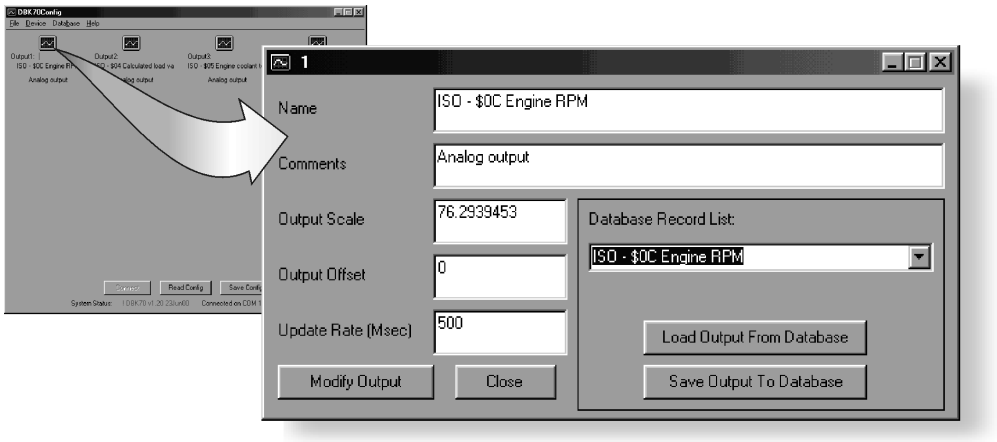
To make an output channel operational, the parameters of a database record must be assigned to it. Once the assignment is performed, all of the parameters found in the fields of a database record are stored in the DBK70 as the *current* configuration for the associated channel.

In addition to assigning the parameters of a database record to an output channel, it is also possible to create a database entry from the channel parameters stored in the DBK70.

Initializing an Analog Output Channel

To initially define or to redefine the *current* configuration of an output channel using information from the DBK70 database, perform the following actions:

1. If it has not been done yet, select the Read Current Settings option on the Device menu in order to establish communication between the DBK70 software and the DBK70.
2. Click on the Output Channel Icon to be modified.
3. In the Output Channel Window, click on the down arrow of the Database Record List combo box.



4. Select the configuration record of the DBK70 Database that has the output channel configuration values that are to become the current configuration of the selected channel.
5. Click on the Load Output From Database button.
6. Click on the Close button.

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To create a record in the database from the parameters currently assigned to a channel in the DBK70, perform the following actions:

1. If it has not been done yet, select the Read Current Settings option on the Device menu in order to establish communication between the DBK70 software and the DBK70.
2. Click on the Output Channel Icon to be read into the Database.
3. Click on the *Save Output To Database* Button.
4. Click on the Close button.

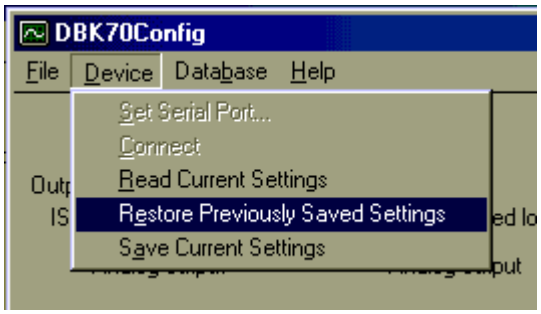
Modifying the Settings for an Analog Output Channel

Clicking on an Output Channel Icon automatically opens an **Output Channel Window** which references the *Name*, *Comments*, *Output Scale*, *Output Offset* and *Update Rate* for that channel. Editing the text appearing therein, and subsequently clicking on the *Modify Output* button will modify any of these fields in the current configuration for the output channel inside the DBK70. If the DBK70 finds any conflicts between the output channel and the desired settings, the entire configuration will be rejected and an error message to that effect will be displayed by the DBK70 software.

Even if the new configuration is accepted by the DBK70, the configuration does not automatically become saved in the DBK70's non-volatile *saved* memory. If the DBK70 lost and recovered power at this point, the last *saved* configuration in the output channel's non-volatile memory would become the *current* configuration. To save the current configuration into the DBK70's non-volatile memory, select Device/Save Current Settings from the menu of the main window or press the **Save Config** button.

Restoring the Current *Configurations of All DBK70 Output Channels*

To restore the *current* configurations of **All** output channels of a DBK70 from their respective *saved* configuration either cycle the DBK70's power or use the **Restore Previously Saved Settings** option on the Device menu.



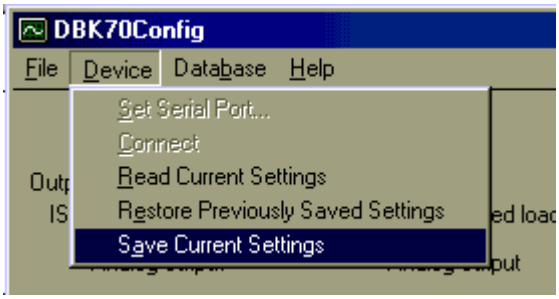
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Saving an Output Channel's Current *Configuration as its* Saved *Configuration*

In order to permanently save a new configuration as the output channel's *saved* configuration, select the Save Current Settings option on the Device menu after the configuration is downloaded to its channel or press the **Save Config** button.



This will save the current configurations for ALL the DBK70 channels. Be careful if multiple configurations have been downloaded to a DBK70 between powering the DBK70 and selecting the Save Current Settings function.



Data from a Single Message is Processed by Multiple Output Channels

There may be some cases where it is desired to have the same data in the same received message processed by multiple output channels. There may a need to create both an analog signal and a digital/pulse signal for the same data value. For example, there may be a need to create output signals that have different scaling values. There may also be cases where there are multiple pieces of data in the same received message that are to be processed by different channels.

As outlined above, when data from a single received message is to be processed by multiple output channels, each channel configuration must have the same **Filter** field. If a request message must be sent by the DBK70 to obtain the data, only one channel configuration should include the **Message** and **Update Rate** values required. The other channel configurations that are to also process this same message must have a blank Message field and a Update Rate value of 0.

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Database Record Fields

Each record of the DBK70 Database has 19 fields. The following describes each of these fields.

Record Name

The configuration records in the database are presented in Record Name field order.

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 (e.g., the type of data bus, the name of data being processed, output type, etc. (e.g., PWM J1979 DTC Count)).

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

When the fields of a record of the DBK70 Database become the configuration for an output channel, the **Name** field is included. When a **Read Current Values** option on the **Device** menu is selected, the Output Channel Icons that are created show the first 29 characters, blanks included, of the **Name** field.

Each record of the DBK70 Database must have a unique **Name** field. The records of the database are sorted in alphabetical order by the contents of the **Name** field. The contents of the **Name** field determine which record is shown when a user selects the first record, the next record, the previous record, or the last record of the DBK70 database.

Other than perhaps describing the data processed by the record, and determining the order in which the records of the database are sorted, the **Name** field has no other intrinsic use.

Comments

Like the Record Name field, the contents of the Comments field of a configuration are used to help the user understand something about the data being processed by a configuration. Generally, the Comments field shows the general signal to data conversion supported by the configuration
(e.g., 0v = 0 psi, 5v = 100 psi , 0Hz = 0 6,000Hz = 6,000 RPM, etc.).

Like the Name field, when a Read Current Values option on the Device menu is selected, the Output Channel Icons that are created will show the first part of the Comments field of the configuration that is being used by the channel.

The contents of the **Comments** field are saved like the contents of the **Name** field, as part of an output channel's configuration in a DBK70. When Output Channel Icons are created by the **Read Current Values** option on the **Device** menu of the DBK70 software, the contents of the comments field of each configured output channel are shown under the Output Channel Icons.

One use of this field is to document the general conversion values for the channel
(e.g., 0v = 0 psi, 5v = 100 psi).

The maximum size of this field is 39 characters.

Update Rate

Some modules will not broadcast the desired information on the network unless the information is explicitly requested. In these cases, the Update Rate field must contain a number above 0 representing the number of milliseconds between times the DBK70 should issue the request message found in the **Message** field. If the Update Rate is 0, no request message will be sent.

If it is desired that the message in the Message field be transmitted one time, rather than periodically, set the Update 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 if the timeout occurs.

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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.

Note: 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 the Update Rate range from 0 to 32000.

Source Channel

This field specifies the source channel value for the specified network type. Use the Source Channel Value from the table below corresponding to the network type.

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

Index

This field specifies, by bit offset, where in a received message the desired data begins. The first (i.e., high order) bit of the first byte of a message has an Index value of 0. The values for Index range from 0 to 95.



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

Length

This field specifies, in bits, the length of the desired data in the received message. The values of the Length field can range from 1 to 32 inclusive.



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

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Storage Type

This field specifies the way the data in the received message identified by Index and Length parameters is to be interpreted relative to the use or non-use of signed value encoding. The values of the Storage Type field and the type of data they represent are 0= unsigned data, and 1= signed data.

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.

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).

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 effect 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.

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.

Option Value

The option value tells the DBK70 in what order the bytes are read. If the option value is, 1 then the bytes are read Least Significant Byte first (LSB). If the option value is 0, then the bytes are read Most Significant Byte first (MSB)..

Protocol	Option Value
J1939	1
J1850 VPW	0
J1850 PWM	0
ISO-9141	0
ISO-14230-4	0
ISO-11898	0
J2411	0
ISO-11992	0
ISO-11519-2	0
J2284	0

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Output Type

Reserved. Always set this field to a value of 4.

Message

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

The Filter field specifies 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 an output channel.

The coding of the Filter field is hexadecimal byte values.

The Filter field is made up of a series of two-byte sets. The first byte of a set 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. The second byte of the set is a data mask. The mask specifies which bits of the data byte part of the set are to be compared to the corresponding bits of the corresponding byte in received messages.

The first two-byte set processes the first byte of the received message. The second set processes the second byte of the received message. And so on for as many two byte sets as are needed to uniquely identify the message to be processed from all the messages that may appear on the vehicle's data bus.

Each message that is received by the DBK70 from the vehicle's data bus 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:
Refer to Fundamentals in Chapter 6 for more information.

Timeout

The Timeout field 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 entered in the *Default Value* field will be the output channel's signal value.

The value of this field ranges from 10 to 65535 (i.e., 65.535 seconds) inclusive.

Default Value

See the *Timeout* field above. The codes to be used for this field range from 0 to +/- 5,000,000 µV inclusive, for a 0 to 5.0V analog type output channel.



Reference Note:
Refer to the Timeout field above.

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Output Mode

Reserved. Set this field value to 0.

Aux Value

Reserved. Set this field value to 0.

Scaled Received Data (SRD)

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 (i.e., Data Field Start), what the size of the data is (i.e., Data Field Length), and whether the data is to be interpreted as a signed or as an unsigned value (i.e., Data Field Type), and
- The scale and offset parameters (i.e., 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., **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).



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 DBK70 Configuration CD (p/n 1056-0600).

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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.

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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.

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

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

$= -2400 * 0.125$

$= -300$

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Fundamentals of Obtaining Vehicle Data 6

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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.

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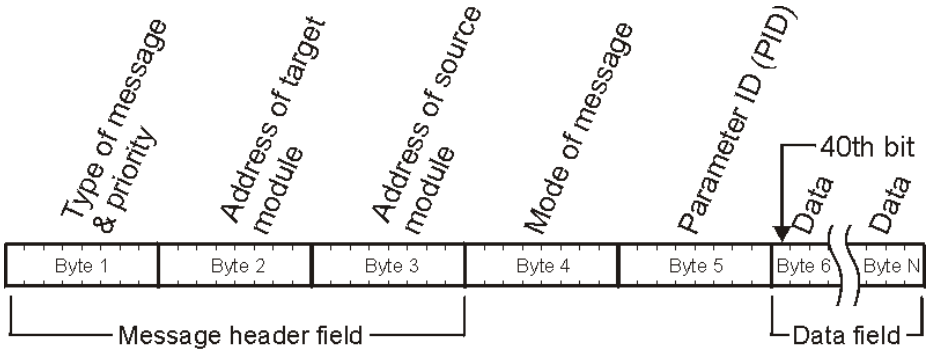
Reference Note:
Information regarding obtaining vehicle data for CAN, including J1939, begins on page 6-8.

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.

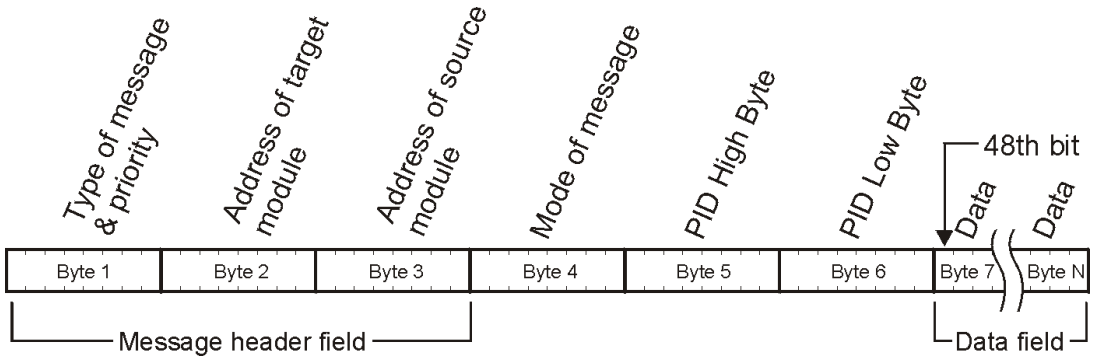
If the desired data is not normally available at an acceptable rate in an operational message and is available through a diagnostic message then the diagnostic request message must be defined in the **Message** field and an **Update Rate** value that is suitable for obtaining the data must be defined.

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.



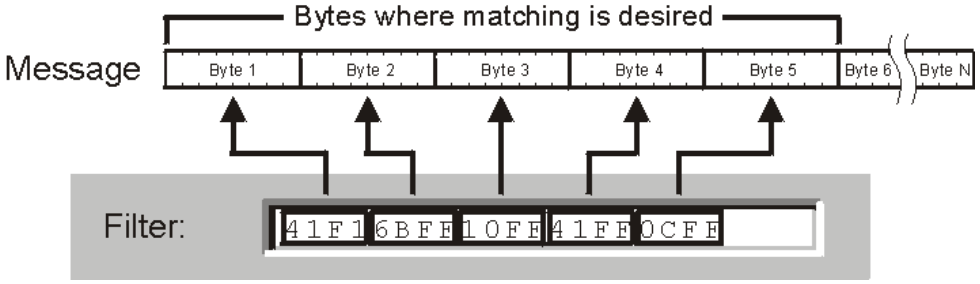
5 byte message format



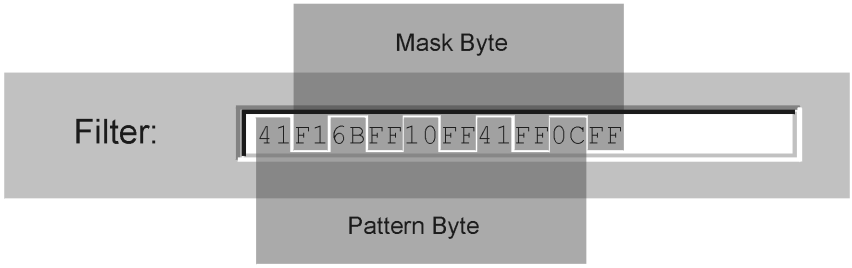
6 byte message format

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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.



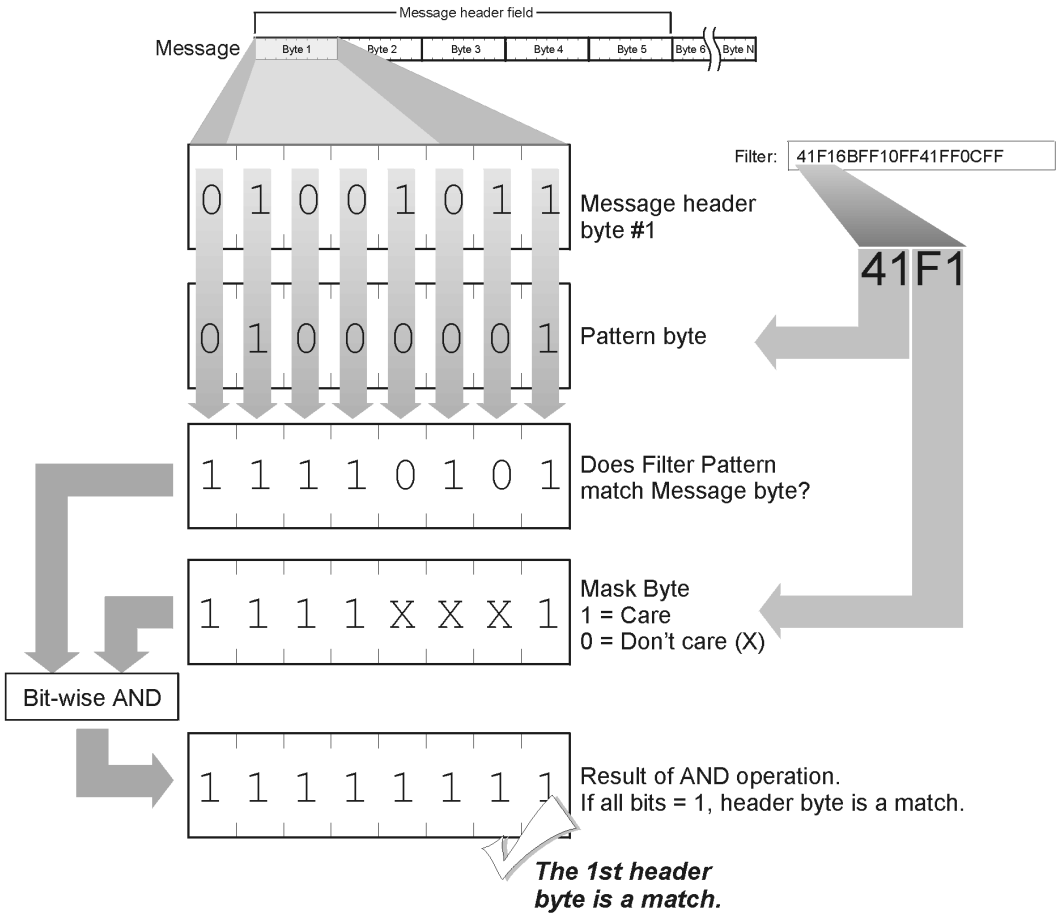
The first byte of a 2-byte-set defines the bit-by-bit data values that must be matched by a received message in order to be passed by the filter and processed by an output channel. The second byte of a 2-byte-set is a mask byte that defines which bits are to be checked for a match.



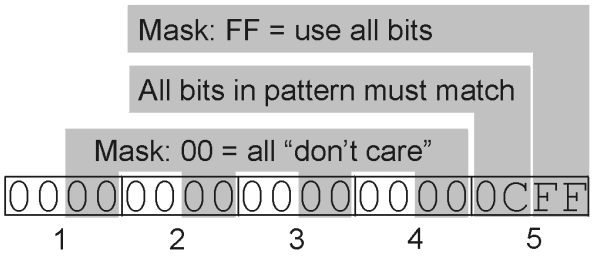
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As the DBK70 receives network messages, it processes each of the bytes one-at-a-time, comparing each with its associated 2-byte-set in the **Filter** definition. The DBK70 processes each byte in the header by first comparing it, bit-for-bit, with the 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.



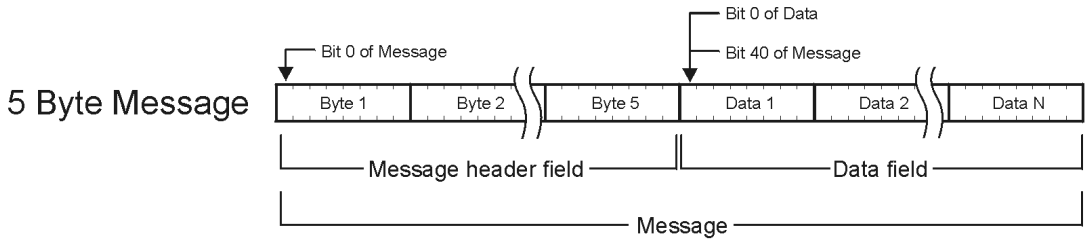
The *don't care* bits are used in instances where specific bit values in the header are not significant. For example, if only the PID byte was significant and the Source, Target, and other header bytes were to be ignored, the **Filter** for a 5 byte header would appear as follows.



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.

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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.



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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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.

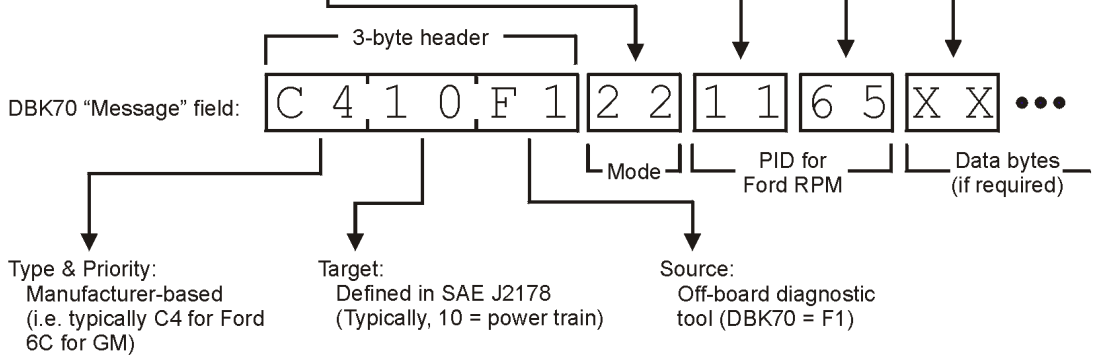
SAE J2190 Issued JUN93

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			



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The J2190 document shows byte #1 as the mode number, but in actuality, there is an implied 3-byte header on each message which 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

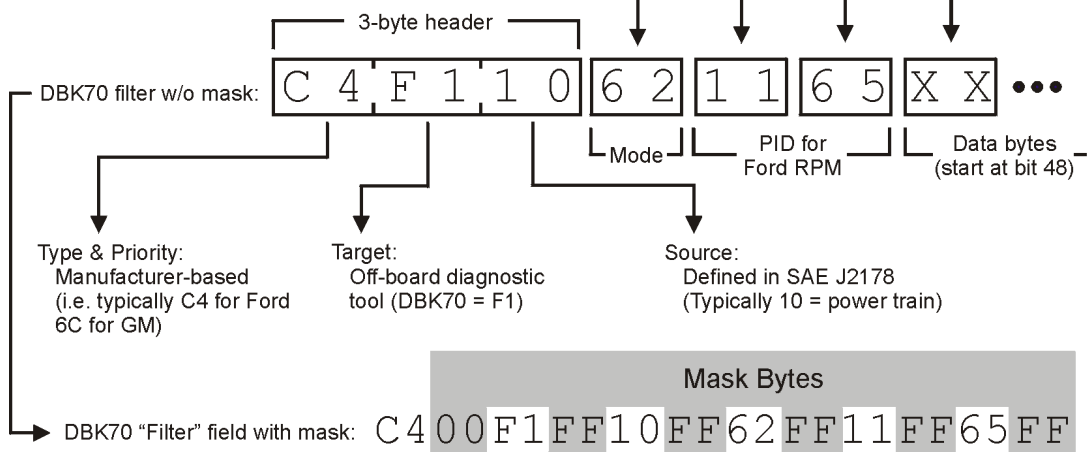
To capture the response, the channel's **Filter** must match the unique features of the response message broadcast by the target network module. The diagram below shows how the 2nd part of the J2190 document, "Vehicle Response to Request for Data", is used to develop the DBK70's **Filter**.

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.

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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.

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6 to #n-1	#n
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.		



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.

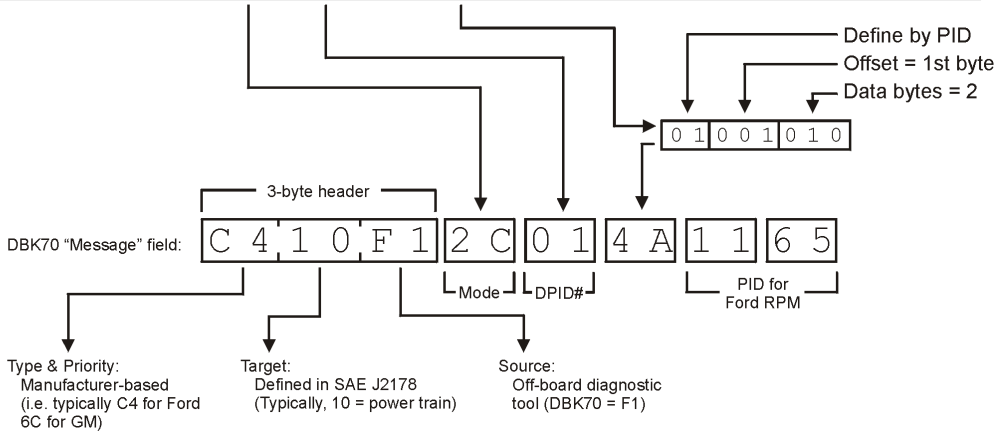
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During the definition process, multiple messages are sent to the target module to construct a DDP. Each definition message adds another data item to the user-defined DDP. The following diagram shows how to derive a DBK70 **Message** from the information 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.

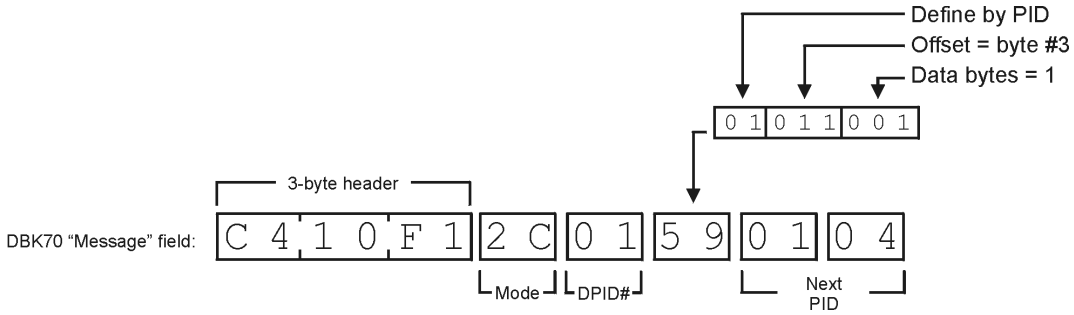
SAE J2190 Issued JUN93

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.



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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.

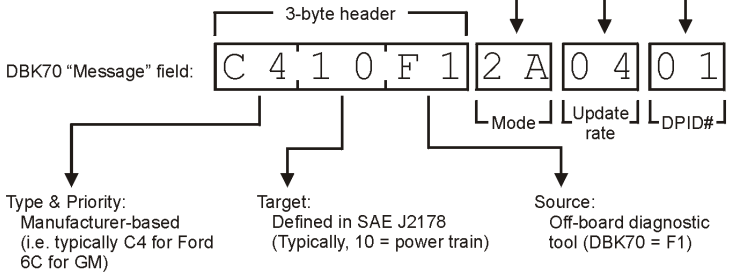
SAE J2190 Issued JUN93

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.	

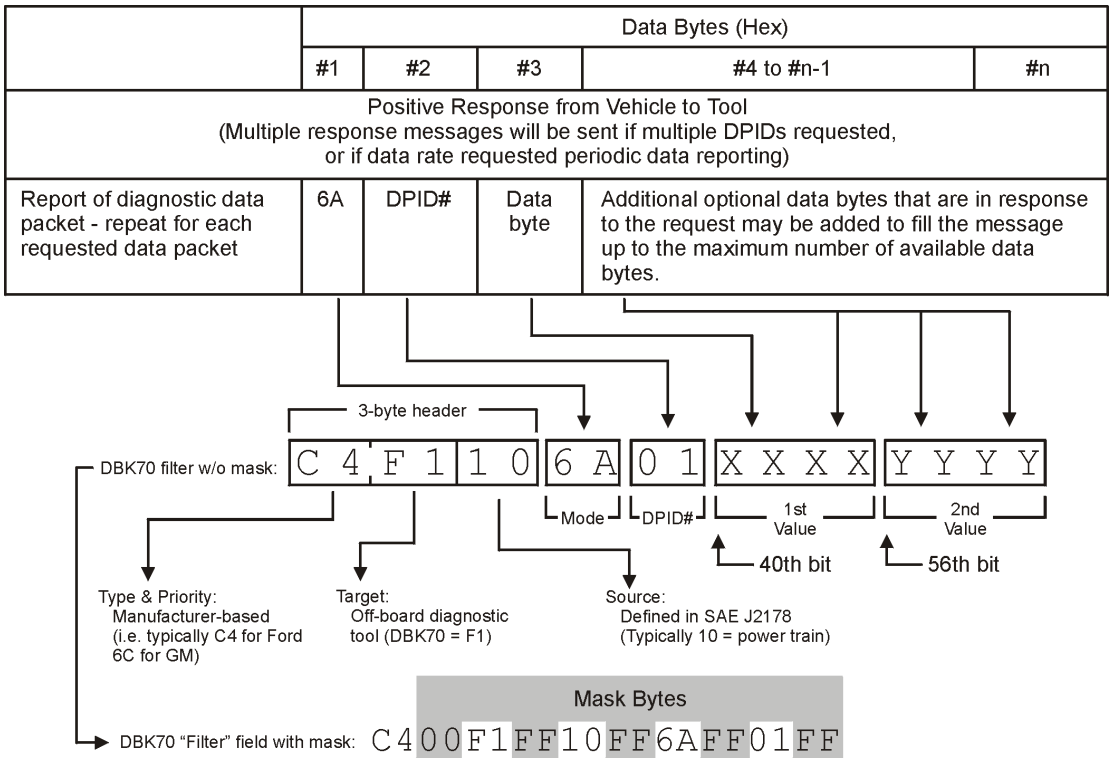
The following diagram shows how to construct a request message. This message, which stimulates the network module to continually transmit the specified DPID#, is issued after the DDP is defined. It includes the DPID# and the desired data rate.

	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.	



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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.

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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
```

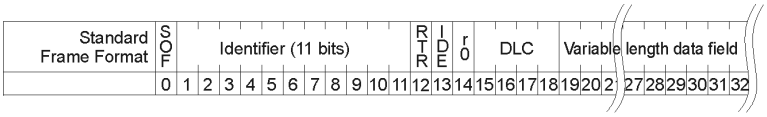
Note that the **Filter** for all three channels is identical because they're all looking for the same DPID#1. Once found, each channel will find its data using the **Index** and **Length** fields.

Obtaining Vehicle Data for CAN, Including J1939

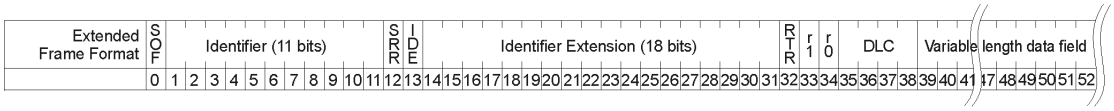
All CAN communication is executed in data packets called *frames*. Four frame types are defined; Data Frame, Remote Frame, Error Frame, and Overload Frame. For the purpose of using the DBK70 to collect data from a CAN network, only the Data Frame is relevant.

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

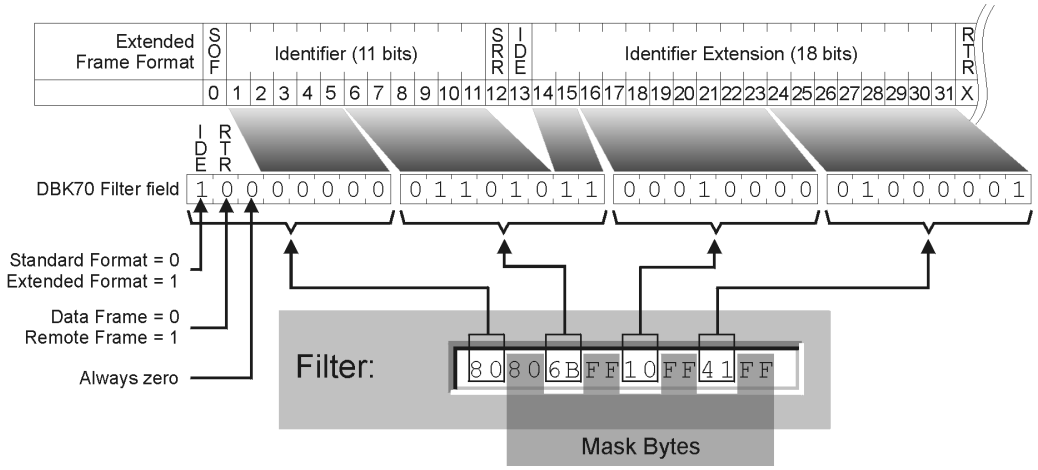


Extended Data Frame

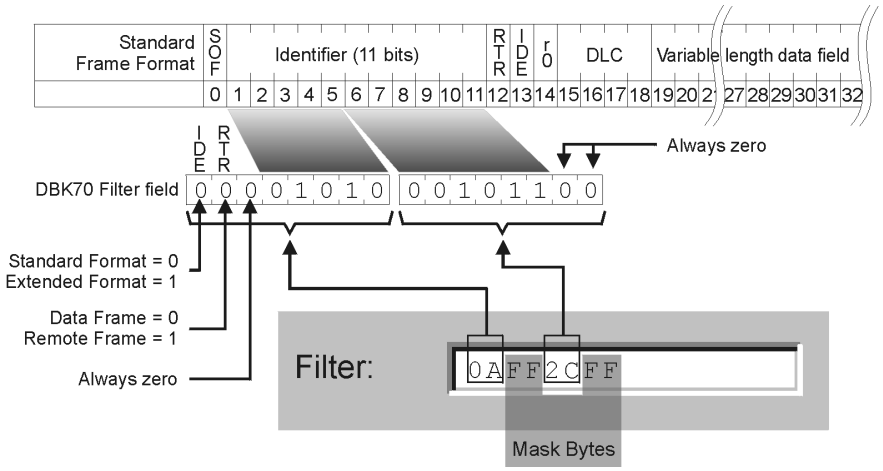
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The DBK70 **Filter** field defines a bit pattern which is compared with the frame header. The DBK70 compares each frame header on the network with the hexadecimal pattern in its **Filter** field. When a match is found, the attached data is captured, 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.



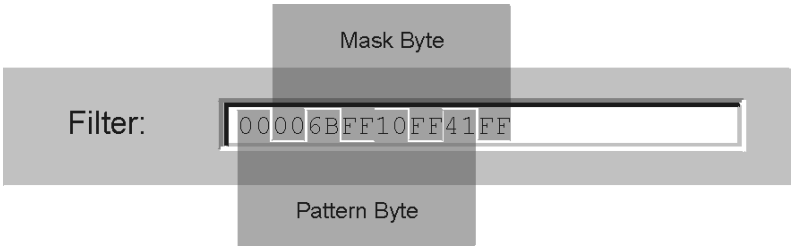
Filter for Extended Frame Format



Filter for Standard Frame Format

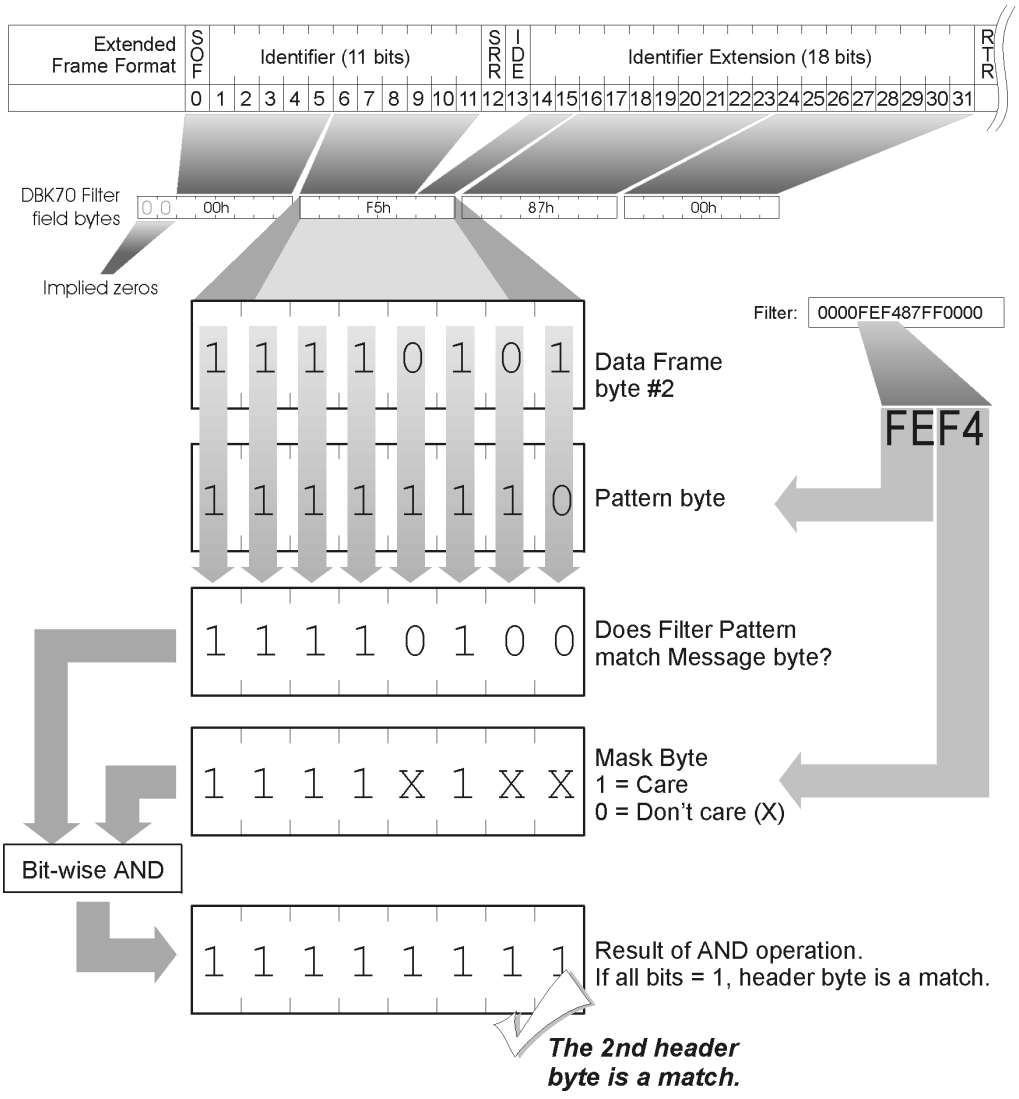
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The first byte of a 2-byte-set defines the bit-by-bit data values that must be matched by a received message in order to be accepted by the filter and processed by an output channel. The second byte of a 2-byte-set is a mask byte that defines which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



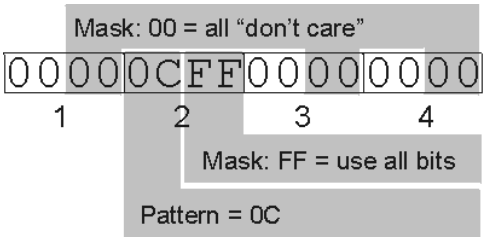
As the DBK70 receives network messages, it processes each of the bytes in the header one-at-a-time, comparing each with its associated 2-byte-set in the Filter definition. The DBK70 processes each byte in the header by first comparing it, bit-for-bit, with the Pattern Byte, shown below. The result of 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.



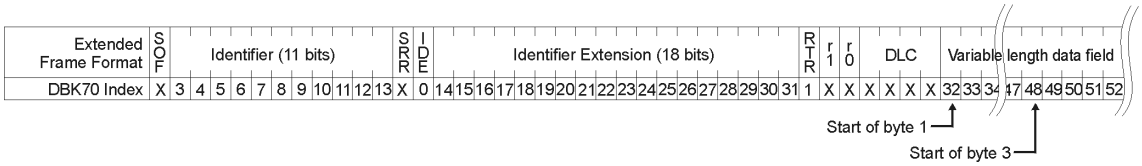
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The *don't care* bits are used in instances where specific bit values in the header are not significant. For example, if only the 2nd byte in the data frame is significant, the Filter field would appear as follows.

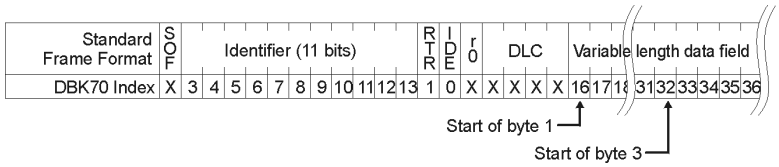


In this example, any header with a 2nd byte of 0C(hex) would be accepted and its parameter value would be processed, regardless of the byte values found in the other header bytes.

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.



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 DBK70 Configuration CD (p/n 1056-0600).

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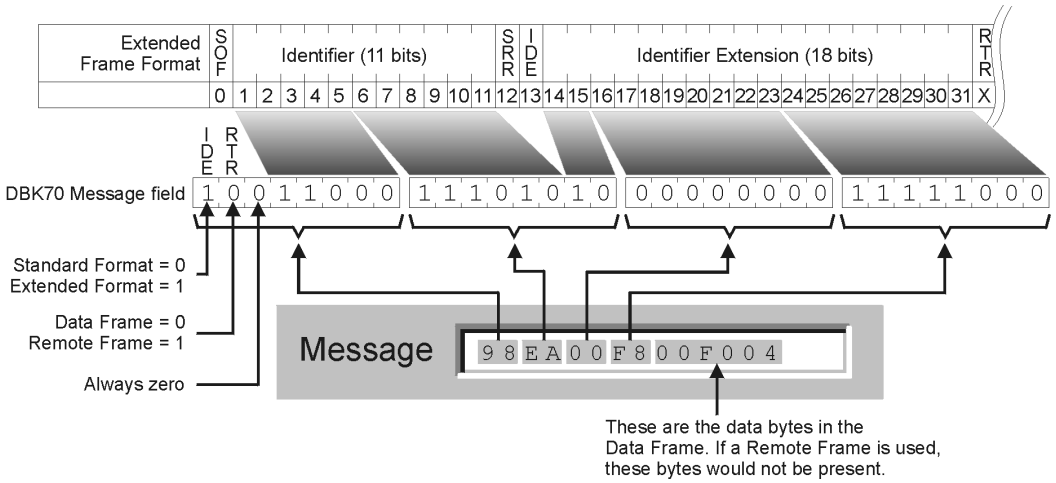
Creating a Request Message

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.

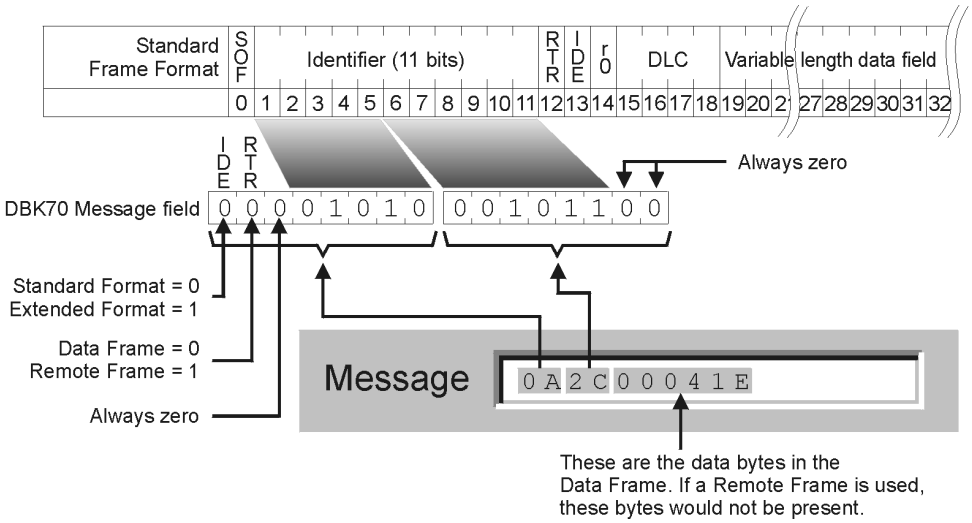
When a request message is necessary, the Message field in the DBK70 software must be filled in and the Update field must contain a number greater than zero.

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

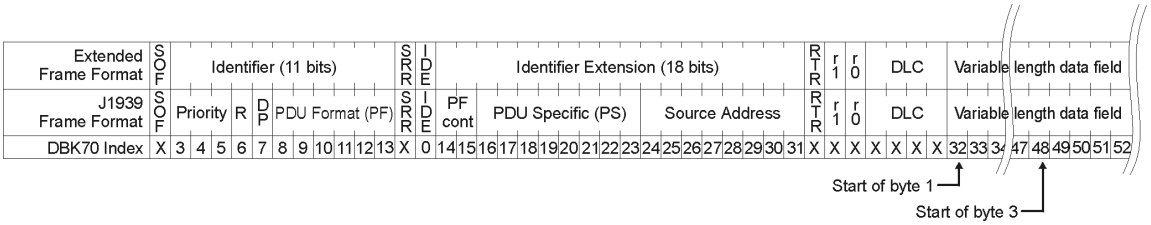


Message for Standard Frame Format

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J1939 Considerations

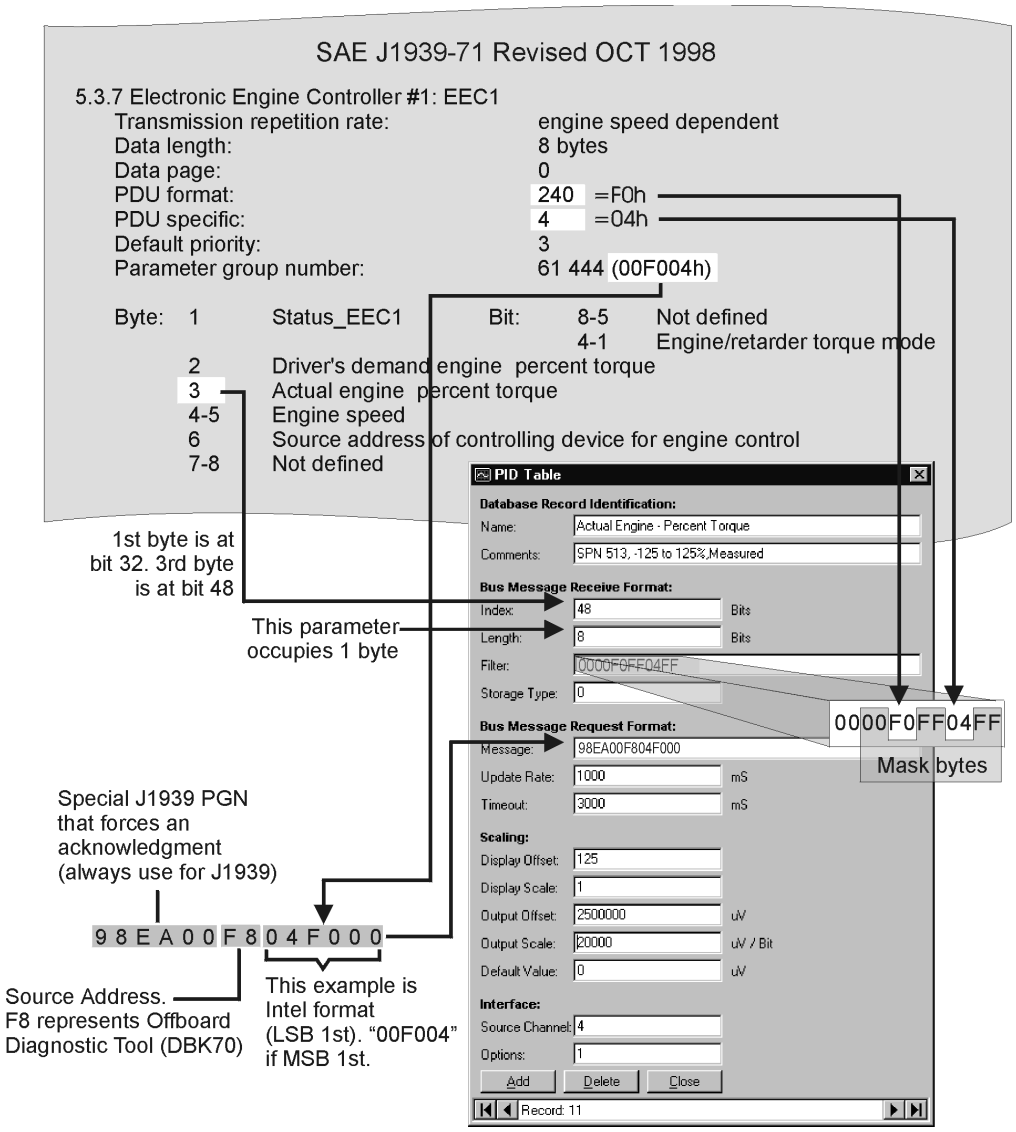
J1939 is a CAN standard adopted primarily by the truck industry. It further specifies the Data Frame of CAN's Extended Format. In addition, a large number of parameters, typically known as Parameter Group Numbers (PGNs) are specified. For ease of operation, a database of several hundred J1939 PGNs is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

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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

* Contact factory for availability.

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.

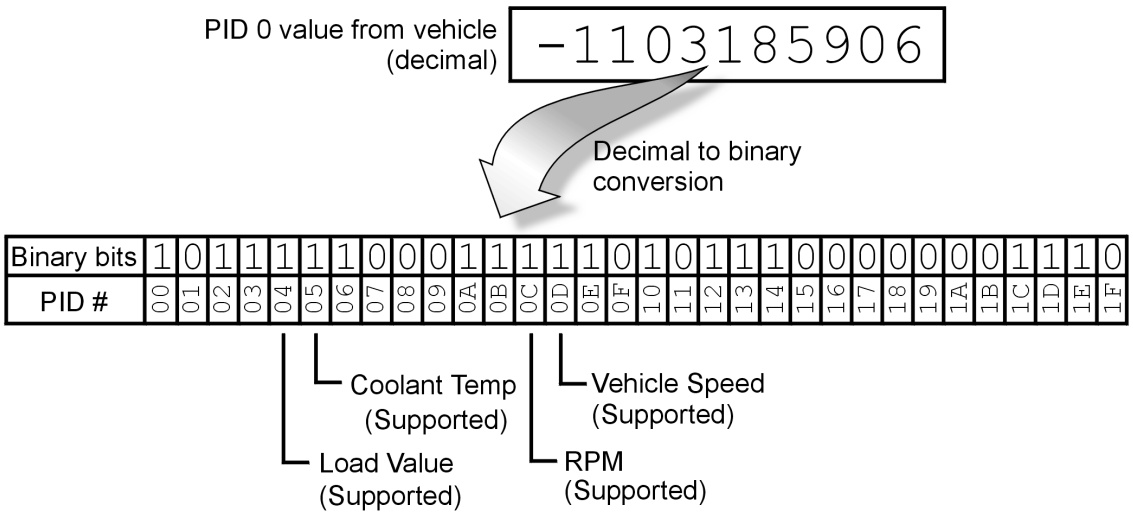
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Deciphering the PID 0 Message (for J1850, ISO 9141, and ISO14230-4) 7

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

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.

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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 DBK70 configuration software's 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

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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.	5-7
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 an adequately 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 properly.	5-11
Output is erratic	If the timeout duration entered in the Timeout field of the PID record is exceeded before the message is received by the DBK70, the output voltage will return to the specified Default Value. Increase the timeout value.	5-15
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

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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.

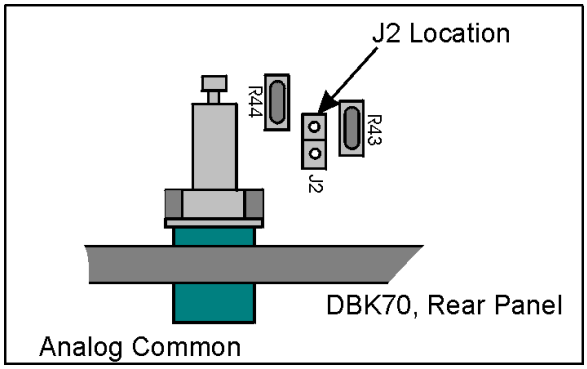
Solution - Should this problem occur, it can be resolved by taking the simple steps provided below.

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.

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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 9x, Me, 2000, and NT.

Driver compatibility (using the driver of the data acquisition product):
Windows 9x, Me, 2000, NT, C++, VB, Visual Basic, LabView, DASYLab.

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