Application Note

Using the AnyBus-M DPV1
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Abstract

This application note will describe an example of how to use the AnyBus-M DPV1 master (hereinafter referred to "ABM-DPV") from HMS Industrial Networks AB, and especially the interaction between the ABM-DPV and the application connected to the parallel interface of the master (hereinafter referred to "the Application".

The intention with this document is to give <u>one</u> example of how to use the ABM-DPV, it will not give information about all possible ways to use the ABM-DPV. This white paper should be used together with the "AnyBus-S Slave and Master Design Guide" and the "AnyBus-M Profibus DPV1 Fieldbus Appendix" which has information about all functions supported by the module.

The ABM-DPV module is a Profibus DPV0/V1 master in the AnyBus-S family of fieldbus interface boards.

NOTE: To use all functions described in this document, version 1.40 or later of the master firmware is required.

Referenced documents:

- AnyBus-S Slave and Master Design Guide, HMS
- AnyBus-M Profibus DPV1 Fieldbus Appendix, HMS

Other references:

- NetTool-PB Profibus Configuration tool, HMS

Power-on

When power is supplied to the ABM-DPV module and the reset signal is released, the ABM-DPV performs its internal start-up procedures and an interrupt is generated to the application when the ABM-DPV is ready to communicate via the parallel interface. See chapter 10 and Appendix C in the Design Guide for information about how to handle the start-up interrupt.

When the start-up interrupt is received, the application can start the initialisation sequence. If the application wants to trigger a hardware check command to the ABM-DPV this is the time to do it. See chapter 9 in the Design Guide for information about the hardware check mailbox message (HW_CHK).

Initialisation questions

Before the ABM-DPV module can be initialised, there are some questions that need answers regarding how the module should behave in different situations. Answer the questions before proceeding to the actual initialisation of the module (next chapter).

- **How large Input and Output data areas does the implementation need?**

The ABM-DPV can be used in Standard mode with maximum 512 bytes input data and 512 bytes output data in DPRAM. The address lines A0-A10 must be connected to the application to be able to use the master in Standard mode. However it is also possible to use the standard mode even if the address line A11 is connected. The DPRAM will then start on address 800h.

The ABM-DPV can also be used in Extended mode with maximum 1536 bytes input data and 1536 bytes output data in DPRAM. The address lines A0-A11 <u>must</u> be connected to the application to be able to use the master in Extended mode. Extended mode is enabled during initialisation in the FB_INIT mailbox message.

The actual used input and output data sizes are configured during initialisation in the ANYBUS_INIT mailbox message. See chapter 9 in the Design Guide.

NOTE: If a database is present in the master module, input and output sizes needed for this database can be fetched with the FB_APPL_GET_DATABASE_INFO mailbox message. See chapter 5 in the Fieldbus Appendix.

- **Does the application need information if someone is trying to change the operating mode for the master?**

The operating mode for the master (Operating, Clear, Stop) can be changed via the configuration interface on the master e.g. by a configuration tool. The application can be notified via a spontaneous mailbox message[1], when a change of the operation mode is to be made, and either accept the change or reject the change. This function is enabled/disabled during initialisation in the FB_INIT mailbox message. See chapter 5 in the Fieldbus Appendix.

Related mailbox message: FB_ABM_SHIFT_OPERATION_MODE_REQ (chapter 5 in the Fieldbus Appendix).

- **Does the application need information if someone is trying to download a new configuration database to the master?**

The configuration database can be downloaded via the configuration interface on the master e.g. by a configuration tool. The application can be notified, via a spontaneous mailbox message, when a database is going to be downloaded, and

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[1] A spontaneous mailbox message is a message initiated and sent by the ABM-DPV module to the application.

either accept or reject the request. This function is enabled/disabled during initialisation in the FB_INIT mailbox message.

Related mailbox message: FB_ABM_DOWNLOAD_NEW_DB_REQ (chapter 5 in the Fieldbus Appendix)

- **Does the application need information about when the database has finished download to the master?**

The master needs to be restarted (either software reset or hardware reset) and re-initialised for a new database to be valid. The application can get an indication bit in a status register and/or receive an interrupt when the database has finished downloading. This function is configured during initialisation in the ANYBUS_INIT mailbox message. If this function is disabled, the master will reset automatically when a database is downloaded.

- **Does the application need to know if a DPV1 slave has triggered an alarm?**

A spontaneous mailbox message can be sent to the application when a DPV1 slave has triggered an alarm. This function is enabled/disabled during initialisation in the FB_INIT mailbox message.

NOTE: Sending of the spontaneous mailbox is enabled by default. (E.g if FB_INIT is not used during initialisation.)

Related mailbox messages (chapter 5 in the Fieldbus Appendix):
FB_ABM_MSAL1_ALARM_IND
FB_ABM_MSAL1_ALARM_CON

- **Which master operation mode is desired after the initialisation sequence is finished and the fieldbus communication is started?**

When the ABM-DPV has finished its initialisation sequence, the fieldbus communication will start. The master can start-up the fieldbus in three different operating modes, Operating, Clear or Stopped. The start-up operating mode is configured during initialisation in the FB_INIT mailbox message.

- What shall happen with the input data for a slave if the slave goes off-line?

The input data for a slave can be either cleared or freezed when the slave goes off-line (E.g. if the bus cable is disconnected). The behaviour is configured during initialisation in the ANYBUS_INIT mailbox message.

- **Shall the Watchdog Input counter be used?**

The watchdog input counter is used to determine if the application is running or not. If the application fails, the watchdog times out, and the ABM-DPV will go to operation mode STOP. The timeout value of the Watchdog update is configured

during initialisation in the ANYBUS_INIT mailbox message. See chapter 4 in the Design Guide for information about the Watchdog input counter.

Initialisation

When all questions in the previous chapter are answered, we have enough information to continue with the actual initialisation sequence of the ABM-DPV module.

FB_APPL_GET_DATABASE_INFO

If a database is present in the master, the application can get information about the required input and output data sizes in the current database to use in ANYBUS_INIT, by sending this mailbox message. If no database is present, it is indicated in the response.

Example: In the example below, the returned required size for the input area is 4 bytes for configuration 1 and 9 bytes for configuration 2.

	Configuration 1 Input data area		Configuration 2 Input data area
Byte 1	Slave 1	Byte 1	Slave 1
Byte 2	Slave 2	Byte 2	
Byte 3	Slave 3	Byte 3	
Byte 4		Byte 4	
Byte 5		Byte 5	Slave 2
Byte 6		Byte 6	
Byte 7		Byte 7	
Byte 8		Byte 8	Slave 3
Byte 9		Byte 9	

NOTE: The information about the required input and output initialisation size is presented in Extended word 3 and 4. The information in Extended word 1 and 2 contains the actual number of used input and output bytes, 4 bytes for both configuration 1 and 2 above.

START_INIT

The initialisation sequence starts by sending the START_INIT mailbox message. START_INIT can only be sent once, and there is no other way to go back to the state before START_INIT was sent but to reset the module.
No parameters or data are sent with the START_INIT mailbox message.

When the START_INIT mailbox has been sent, the ABM-DPV waits for the actual initialisation messages. The ABM-DPV has two initialisation messages FB_INIT and ANYBUS_INIT. If only basic functionality is used, it is enough to use the ANYBUS_INIT message, but if the application shall take use of the full AnyBus and Profibus functionality, the FB_INIT mailbox is also needed.

FB_INIT

If FB_INIT is used, it <u>must</u> be sent before ANYBUS_INIT.

Below is an example of how to use the FB_INIT message.

Register name	Mailbox Command	Expected response	
Message Id	(ID)	(ID)	
Message information	0x4002	0x0002	
Command	0x0001	0x0001	
Data size	0x0006	0x0006	
Frame count	0x0001	0x0001	
Frame number	0x0001	0x0001	
Offset high	0x0000	0x0000	
Offset low	0x0000	0x0000	
Extended word 1	-	-	
Extended word 2	-	-	
Extended word 3	-	-	
Extended word 4	-	-	
Extended word 5	-	-	
Extended word 6	-	-	
Extended word 7	-	-	
Extended word 8	-	-	
Command data word 1	0x0001	0x0001	DPRAM mode
Command data word 2	0x000C	0x000C	Special functions
Command data word 3	0x00C0	0x00C0	Start-up operation mode

DPRAM mode

Command data word 1	0x0001	DPRAM mode

Extended mode – The ABM-DPV will use 4kb of DPRAM for the data exchange -> maximum sizes of I/O data is 1536 bytes of input data and 1536 bytes of output data.

Special functions

Command data word 2	0x000C	Special functions

- The ABM-DPV will send the spontaneous mailbox message FB_ABM_MSAL1_ALARM_IND if a DPV1 slave has triggered an alarm.
- The ABM-DPV will send the spontaneous mailbox message FB_ABM_MSAL1_ALARM_CON when the slave has received the alarm acknowledge from a DPV1 slave.
- The ABM-DPV will send the spontaneous mailbox message FB_ABM_DOWNLOAD_NEW_DB_REQ if a new database is going to be downloaded.
- The ABM-DPV will send the spontaneous mailbox message FB_ABM_SHIFT_OPERATION_MODE_REQ if the operation mode is about to be changed.

NOTE: The MSAL1_ALARM mailboxes are enabled by <u>clearing</u> the corresponding bit in the FB_INIT message, while the DOWNLOAD_NEW_DB and SHIFT_OPERATION_MODE mailbox messages are enabled by <u>setting</u> the corresponding bit.

Start-up operation mode

Command data word 3	0x00C0	*Start-up operation mode*

The master will start up the network in operation mode OPERATE.

ANYBUS_INIT

This is the main initialisation mailbox message, containing all information needed for the ABM-DPV to start communicating. If the module should use default settings only, it is enough to send this mailbox message.

Below is an example of how to use the ANYBUS_INIT mailbox message.

Register name	Mailbox Command	Expected response	
Message Id	(ID)	(ID)	
Message information	0x4001	0x0001	
Command	0x0002	0x0002	
Data size	0x0012	0x0012	
Frame count	0x0001	0x0001	
Frame number	0x0001	0x0001	
Offset high	0x0000	0x0000	
Offset low	0x0000	0x0000	
Extended word 1	-	-	
Extended word 2	-	-	
Extended word 3	-	-	
Extended word 4	-	-	
Extended word 5	-	-	
Extended word 6	-	-	
Extended word 7	-	-	
Extended word 8	-	-	
Command data word 1	0x0320	0x0320	Input I/O Length
Command data word 2	0x0320	0x0320	Input DPRAM Length
Command data word 3	0x0320	0x0320	Input Total Length
Command data word 4	0x03E8	0x03E8	Output I/O Length
Command data word 5	0x03E8	0x03E8	Output DPRAM Length
Command data word 6	0x03E8	0x03E8	Output Total Length
Command data word 7	0x0010	0x0010	Operation Mode
Command data word 8	0x0008	0x0008	Event Notification Config
Command data word 9	0x07D0	0x07D0	Watchdog Timeout Value

Input I/O Area Configuration

Command data word 1	0x0320	Input I/O Length
Command data word 2	0x0320	Input DPRAM Length
Command data word 3	0x0320	Input Total Length

The implementation will use maximum 800 bytes of input data that will reside in the DPRAM. See chapter 7 in the Design Guide for more information about the I/O configuration.

Output I/O Area Configuration

Command data word 4	0x03E8	Output I/O Length
Command data word 5	0x03E8	Output DPRAM Length
Command data word 6	0x03E8	Output Total Length

The implementation will use maximum 1000 bytes of output data that will reside in the DPRAM. See chapter 7 in the Design Guide for more information about the I/O configuration.

Operation mode

Command data word 7	0x0010	Operation Mode

A slaves input data are cleared if a slave is not in Data Exchange.

The RDR bit is set to get an indication (in the module status register) when a new database has finished downloading. If this bit is not set, the ABM-DPV will reset automatically when a database is downloaded, without notifying the application. It is recommended to use this Reset notification. An event notification can also be connected to this reset notification, see Event notification config below.

Event notification config

Command data word 8	0x0008	Event Notification Config

The application will get an interrupt when a new database has finished downloading (RST bit set).

NOTE: If the RDR bit is not set in the Operation mode register in the ANYBUS_INIT mailbox message, this event notification will not be enabled.

Watchdog timeout value

Command data word 9	0x07D0	Watchdog Timeout Value

A watchdog timeout value of 2s will be used –> If the application does not copy the "Watchdog counter output" to the "Watchdog counter input" register for 2s, the watchdog will time out and the master will interpret this as if the application is not working anymore. The master will go to operation mode STOP.

END_INIT

The initialisation sequence ends with the END_INIT mailbox message. When the response of this mailbox is received, the ABM-DPV is ready for data exchange with the fieldbus side and the application side. No parameters or data are sent with the END_INIT mailbox message.

NOTE: If there is no valid database downloaded to the module when END_INIT is sent, the module will start with the parameters specified during initialisation, but the fieldbus communication will not be started.

Normal operation

Now, the ABM-DPV module is initialised with the desired functions and data area sizes, and the normal operation of the network has started. During normal operation, several events can occur which has to be taken care of by the application.

NOTE: The following events can occur if the module is initialised according to the example in the previous chapter.

Set operation mode request

When the operation mode is about to be changed e.g. by a configuration tool, the spontaneous mailbox FB_ABM_SHIFT_OPERATION_MODE_REQ is sent to the application. The application must take care of this mailbox message, and send a response if it is ok or not to change the operation mode. It is also possible to provide an application specific status code with the response. See chapter 5 in the Fieldbus Appendix for information about the FB_ABM_SHIFT_OPERATION_MODE_REQ mailbox message.

Database download

When a database is about to be downloaded e.g. by a configuration tool, the spontaneous mailbox message FB_ABM_DOWNLOAD_NEW_DB_REQ is sent to the application. The application must take care of this mailbox message and send a response if it is ok to download a new database or not. The application might be in a state where it is not appropriate to stop all communication and download a new database.

When the database is completely downloaded, the application will get an interrupt, and the RST bit in the Event Notification Cause register will be set. The application now has to reset the ABM-DPV (either via a software reset or a hardware reset), <u>and</u> re-initialise the module, for the new database to be valid.

DPV1 Alarm

If a DPV1 slave triggers an alarm, the spontaneous mailbox message FB_ABM_MSAL1_ALARM_IND is sent to the application. The application has to respond to this message, which will trigger an acknowledge to the slave. The slave will confirm with the spontaneous mailbox message FB_ABM_MSAL1_ALARM_CON. The application does not need to respond to this message.

See chapter 5 in the Fieldbus Appendix for information about the Alarm mailbox messages.

Slave Configured List

In the Slave Configured List, the application can get information about which slaves are configured in the configuration database that is downloaded to the master. The information can be read after a successful initialisation. See chapter 6 in the Fieldbus Appendix for information about the Slave Configured List.

Data Transfer List

When a slave is in the Data Exchange state (i.e. its data is valid in the data areas), the corresponding bit is set in this area.
See chapter 6 in the Fieldbus Appendix for information about the Data Transfer List.

Slave Diagnostic List

When a bit in the Slave Diagnostic List is set, the corresponding slave reports extended diagnostics. The actual diagnostics can then be read with the mailbox message FB_APPL_GET_SLAVE_DIAG.
See chapter 5 in the Fieldbus Appendix for information about the FB_APPL_GET_SLAVE_DIAG mailbox message.
See chapter 6 in the Fieldbus Appendix for information about the Slave Diagnostic List.

- Example of other functions that the application can use during normal operation. See the Fieldbus Appendix for information about the respective function.

- Get slave diagnostics
- Get slave config
- Get Livelist
- Set Slave Address
- Set slave mode (Global control)

Troubleshooting

Q: Why is there no information in the DPRAM when I use the default 2kb mode?
A: If the address line A11 is connected to the application processor, the DPRAM will start at address 800h when using the 2kb mode.

Suggestion: Always write your application code as if the A11 address line is connected, in that case the code will work on both applications <u>with</u> the A11 address line connected, and applications <u>without</u> the A11 address line connected.

Q: Why do I get an error message when I try to send the FB_APPL_GET_SLAVE_DIAG mailbox message to a slave that is not in the current database?
A: The "Type of request"- parameter in the FB_APPL_GET_SLAVE_DIAG mailbox message determines if the diagnostic information should be retrieved from the internal buffer in the master (for slaves in the database), or if an explicit request should be sent to the slave on the bus (possible to use for all slaves).

Q: What is the configuration connector on the ABM-DPV used for? Can I write my own application to access the master via the configuration interface?
A: The configuration interface is used by the NetTool Profibus configuration tool to download the database and to monitor the network. HMS does not actively support the use of this interface. Contact HMS for more information.

Q: If I download a new database, without resetting the module, will the master continue to run with the "old" database until the module is restarted?
A: Yes, the master will continue with the old database until the module is restarted and re-initialised, however to be able to download a new database, the ABM-DPV has to be in operation mode STOP.

Q: The diagnostic bit for a specific slave in the "Slave Diagnostic List" is not set despite the slave has reported/changed the diagnostic data. Why does not the master give an indication about this sometimes?
A: The extended diagnostic bit must be set in the diagnostic message from the slave for the bit to be set in the Slave Diagnostic List.

Q: Can I use the Internal memory for my I/O data in the ABM-DPV?
A: Yes, the Internal memory can be used, but slaves that need high data throughput is not recommended to place in the internal memory, since the data exchange with this area is based on the mailbox interface.

NOTE: If both internal memory and DPRAM is used for the I/O data, there will be a problem with the consistency of the data for a slave that is placed on both areas (overlapping DPRAM area and internal data area).

Q: Why do I not get the RST event notification when a new database is downloaded to the module, even if the RST bit is set in the Event Notification Source register?
A: The RST interrupt only works if the RDR bit in the Operation mode register in ANYBUS_INIT is set during initialisation (which enables the database downloaded reset notification).

Q: I have performed a successful initialisation of the ABM-DPV, but all of the LED indicators are off. Why do I not get any information from the LED indicators?
A: If the ABM-DPV module is initialised without having a valid configuration database downloaded, the fieldbus will not be initialised (since the module does not have any information about how the initialisation shall be performed), and the LED indicators will all be off.