# 3700-DEM

Functional Overview

This section is intended to give the reader an functional overview of the 3700-DEM module. Details associated with the ladder logic and the memory map are not covered in this section, but can be found in Section 4 and in the Appendix.

General

The 3700-DEM module has been designed to provide a tightly integrated communications interface between the Allen-Bradley 1771 platform and the family of Honeywell Smart Transmitters.

The 3700-DEM module consists of two DE CPU microcontrollers, each which provide communications with 8 DE Smart Transmitters. The figure below shows the following functional components on the module:

- A Primary DEM controller responsible for the overall operation of the board, including:
  - Access to Shared Ram between DE CPU #1, #2
  - Backplane communications with Allen-Bradley PLC
  - Transferring data from DE processors to PLC
  - Transferring write commands from PLC to DE processors
  - Data Base Mismatch comparisons
  - LED Status indicators
- Two DE CPU 68HC11 microcontrollers, each with the following:
  - Eight data receivers which provide input signal conditioning (noise filtering, surge limiting, etc.) for the serial data inputs
  - An output channel selector and driver circuitry allowing the DE processor to output data base write commands to any channel
- The Shared RAM provides a mailbox through which the Primary controller and the two DE processors can communicate. Access to this Shared RAM is strictly controlled by the 80C32
- The DEM module is connected to a Field Terminal Assembly (FTA), not shown in diagram, which includes 250 ohm range resistors to convert the 4-20 ma current signals from the Smart Transmitters in the DE mode into 1-5 Volt signals
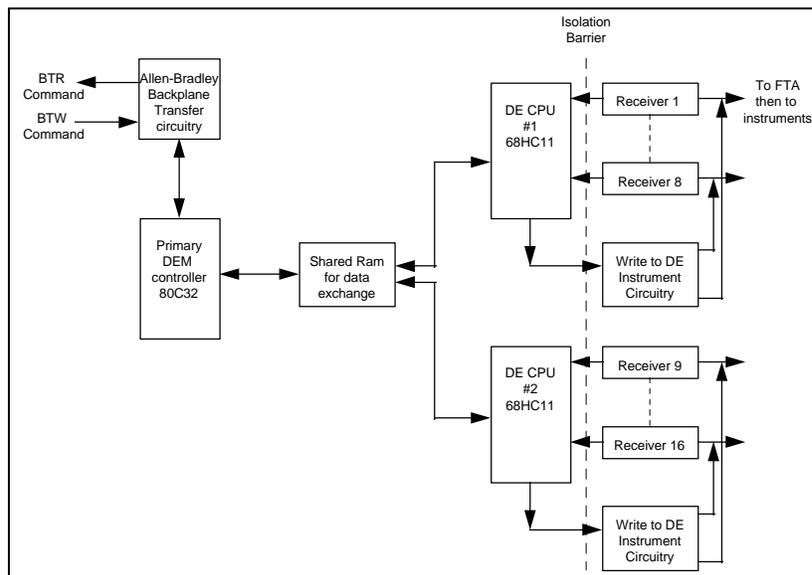
Both Single and/or Multivariable Honeywell Transmitters operating in the DE mode are supported by the module. Supported Honeywell instruments include:

- ST 3000 Smart Pressure Transmitter
- STT 3000 Smart Temperature Transmitter
- SMV 3000 Smart Multivariable Transmitter
- MagneW 300 Smart Magnetic Flowmeter
- SCM 3000 Smart Coriolis Mass Flowmeter
- SGC 3000 Smart Gas Chromatograph

There can be Single and Multi Variable instruments connected to the DEM module, in any mix totaling 16 logical DE Channels. An example configuration could be as follows:

DE Channel	Physical Type	Instrument
1	SV	ST 3000 Pressure
2	SV	STT 3000 Temperature
3	MV	PV 1 - SMV 3000
4		PV 2
5		PV 3
6		PV 4
7	MV	PV 1 - SMV 3000
8		PV 2
Boundary		Cannot cross boundary with an MV Transmitter
9	SV	ST 3000 Pressure
10	SV	ST 3000 Pressure
11	SV	STT 3000 Temperature
12	SV	STT 3000 Temperature
13	MV	PV 1 - SMV 3000
14	MV	PV 2
15	MV	PV 3
16	MV	PV 4

Multivariable Considerations
The following 'rules' must be followed when integrating multivariable devices:
1. No instrument can be physically wired to the FTA terminals within the logical limits of another instrument
2. Cannot cross from Channel 8 to 9 with an MV transmitter, or rollover from Channel 16 to 1
3. The Tag ID must be identical and non-blank across all logical channels configured for use by a multivariable device
4. You must perform a Download Command on the physical channel in order to change the number of PVs being transmitted (DECONFIG can only be written to the first slot of a multivariable transmitters

Data transfer between the module and PLC ladder logic is implemented using standard Block Transfer commands (BTR and BTW). There is a large amount of data that is returned from each instrument, and all of this data is made available to the ladder logic. The data being returned from the module is detailed in the Appendix.

Through the use of ladder logic programming, applications can be developed which can:
1. Use all of the data being returned from the module (as in the SCAN 3000 configuration) or,
2. Selectively extract only the data relevant to the application from the BTR data buffer

The decision on which data to use from the module is completely a function of the programmer and of the application. A great deal of the PLC data base layout was designed with the Honeywell SCAN 3000 system in mind, but if not using the SCAN 3000 to interface with the PLC then the PLC data base can be modified.

Data Flow

The movement of data between the transmitter and the PLC is important to understand. The diagram below depicts the data movement paths which are supported in this application (Diagram shows SCAN 3000 implementation, but functionality will be similar for other interfaces).
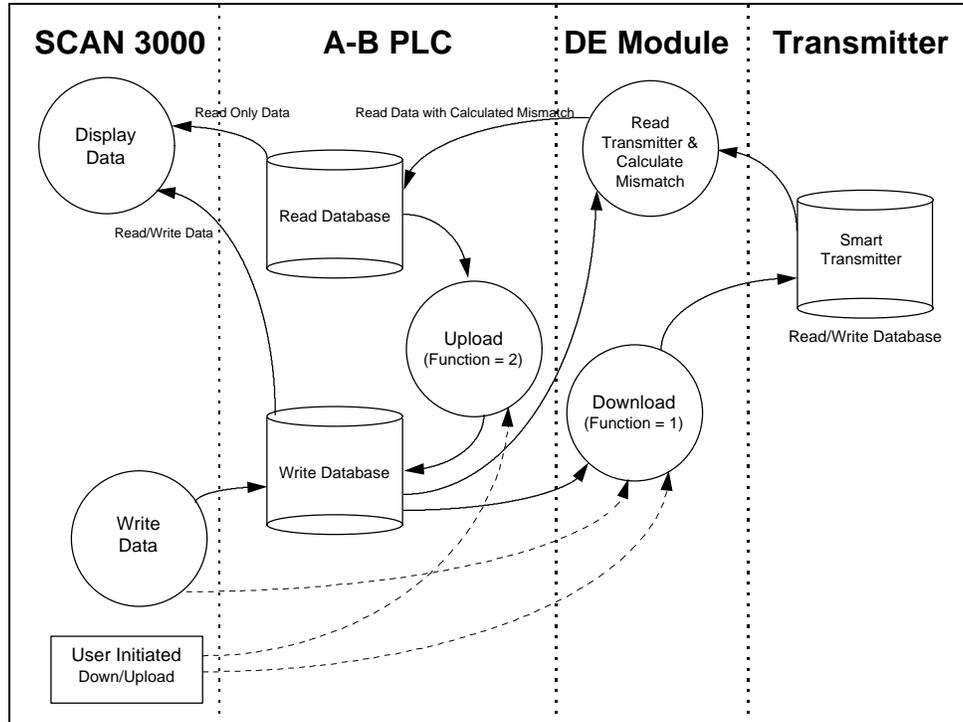
Important

One of the underlying concepts which must be understood is that the PLC is considered the 'owner' of the data. Therefore the contents of the PLC data space, in particular the Write Data space, are the data to which all other data is compared.

| Step	Description
Power Up	The read database will be populated by the DEM from the Smart Transmitter, and the write database will remain unchanged from it's initial value in the PLC. The user can then choose to upload or download
Read DE Transmitter & Calculate Mismatch	The module continuously transfers from the Smart Transmitter database to the read database, comparing the Write and Read files in the PLC for mismatch. The module performs a mismatch comparison between the two and sets the status in the read database accordingly
Upload	Populates write database with that of the Smart Transmitter (via the read database in the PLC). Upload may be a continuous loop if the module is to be configured in an unsecure mode. Otherwise, the Upload should only be initiated by a user
Download	Download populates the Smart Transmitter with the values in the write database from the PLC. First download will put the Smart Transmitter in the DE mode (future) (if it isn't already)

Reading from Honeywell Smart Transmitters

The ProSoft 3700-DEM module allows the PLC to read the real time data, the status data, and the configuration parameters in the Smart Transmitter's database. An overview of the data which is

available from a transmitter follows (A detailed listing and description of the data is in Appendix A of this manual) :

Type	Description
Real Time	PV Value (Last Good Value and NaN value)
	SV Value (Last Good Value and NaN value)
Status	Module Status - Health indication
	Data Base Mismatch Status flags
	PV Update Counter
	SV Update Counter
	Communication Error Counter
	Status Messages - ASCII
Configuration	Function - Download/Upload
	Tag Name - ASCII
	Serial Number - ASCII
	DE Configuration - Data base mode
	Damping Value
	PV Characterization
	Sensor Type
	PV Number (channel # on MV transmitter)
	Number of PVs - (# of channels on MV Transmitter)
	Upper Range Value - URV
	Lower Range Value - LRV
	Upper Range Limit - URL
	Lower Range Limit - LRL

The Status and Configuration values are being received from the Smart Transmitter on a continuous basis to the DEM. The DEM will not actually receive these values until a complete data base has been acquired from the instrument. This cycle can take anywhere from 15 to 90 seconds, depending on the instrument type. Once the data base has been read into the DEM module, the cycle will automatically start over again. In this fashion the DEM module, and therefore the PLC Read Database, are being updated completely on a regular basis.

The flow of data from the instrument all of the way to the Operator display is shown in the following diagram.
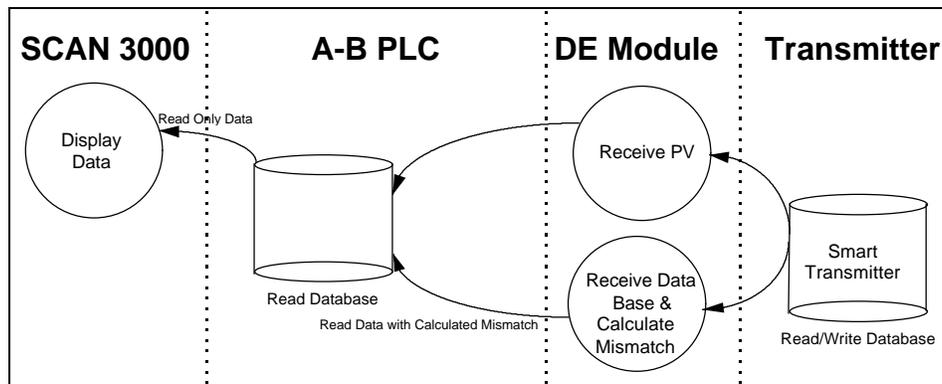
Writing to Honeywell Smart Transmitters

In addition the read functionality described above, the ProSoft 3700-DEM module will allow the PLC application to change some of the configuration values in the Honeywell Smart Transmitter. These values are written to the instrument by pre-loading the appropriate register locations in the PLC and initiating a Download (Function = 1) cycle.

The module will execute the Download Command and return the completion status in the Device Status word. Upon receipt of the completion bit, the Download write register should be cleared.

> The example ladder provided with the module and listed in the Appendix performs the logic necessary to implement the Download functionality. We recommend the use of this logic, at least as a starting point, with simple modifications to the addressing.

The configuration parameters which can be written to the instrument are as follows:

Type	Description	Write to Transmitter	Mismatch Tested
Configuration	Function - Download/Upload	N	N
	Tag Name - ASCII	Y	Y
	DE Configuration	Y	Y(1)
	Damping Value	Y	Y
	PV Characterization	Y	Y
	Sensor Type	Y	Y
	Upper Range Value - URV	Y	Y
	Lower Range Value - LRV	Y	Y
	Upper Range Limit - URL	N	Y(2)
	PV Num -	N	Y(2)
	Number of PV	N	Y(2)

(1) DE Configuration modes which disable the database read also disable Mismatch testing
(2) These values are written to the module for Mismatch testing purposes

Performing a Download - Function 1

The Download Function performs the step of writing the new data to the instrument. Until the Function is set to 1, the Write Database is not moved the instrument.

The flow of write data from the operator interface station to the instrument is shown in the following diagram. The Write Database image in the PLC is being moved to the DEM module for Mismatch comparison purposes.
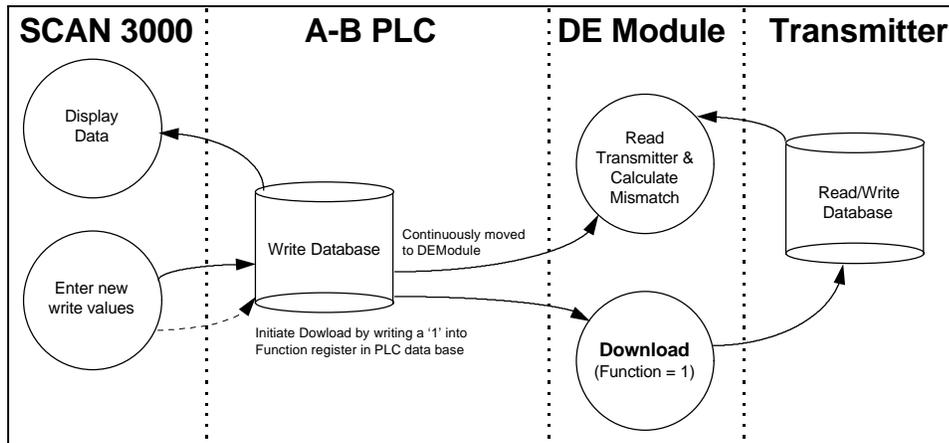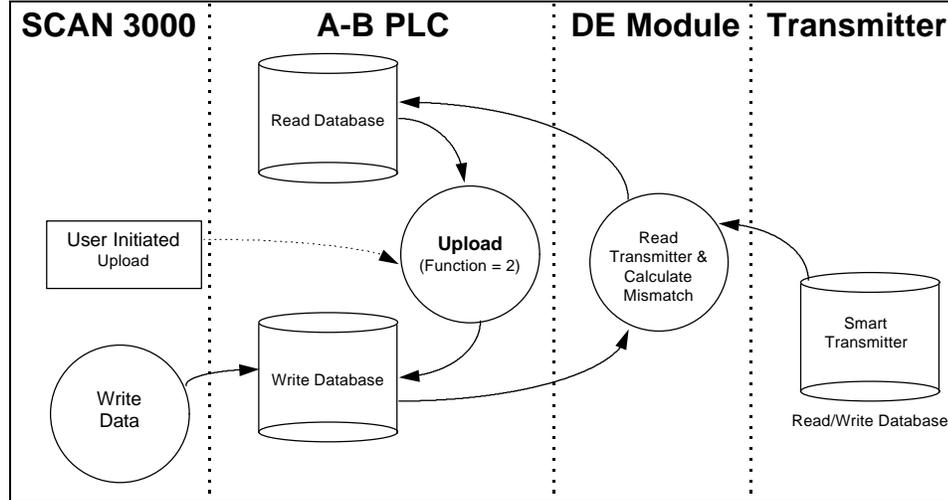

Performing an Upload - Function 2

The Upload Function performs the step of moving the data that has been read from the instrument database from the PLC Read database into the PLC Write database.

This function is useful for initializing the Write database when the Read database is known to contain good data. Performing this step will clear any Mismatch conditions which exist.

The flow of write data from the during the Upload function is shown in the following diagram:

SCAN 3000   A-B PLC   DE Module   Transmitter

Read Database

User Initiated
Upload

Upload
(Function = 2)

Read
Transmitter &
Calculate
Mismatch

Smart
Transmitter

Write
Data

Write Database

Read/Write Database

PV Value Integrity

A great deal of effort is put into the task of assuring the integrity of the PV value presented to the PLC. Two forms of the PV and SV variables are made available to the PLC:

PV - Last Good Value
This value is the PV value unconditioned by the Data Base Mismatch. Care should be exercised when using this PV value as the scaling, which is based on the URV/URL/LRV parameters, may not be accurate.

PV - NaN Value
This value represents the 'safe' PV value, as this value has been conditioned by the Data Base Mismatch logic. If a condition affecting the integrity of the PV value is detected, the PV Value is forced to a NaN value (Not A Number)

During the normal operation the DEM module is performing integrity checks of the health of the PV value. Should a condition be detected which could affect the integrity, the Bad PV Flag is set (Device Status Word 1/13). The four conditions which will cause the Bad PV Flag to be set are:

PV Update Timeout
If the PV value has not been updated within 6 seconds (24 PV update cycles), the flag will be set

Data Base Mismatch
If any data base mismatch condition is detected, the flag will be set

SFC Write Detected
If an SFC write to the instrument data base is detected, the flag will be set. Note that in a redundant application, the SFC Write Detected condition will be detected when a Download command is executed from the other module or from the SFC unit.

FTA Not Present
If the FTA connector or the 24 VDC power supply is disconnected, the flag will be set.

In order to clear the Bad PV Flag, the offending condition will need to be cleared, and under most circumstances will have to wait until a new data base has been received from the instrument.

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Data Base Mismatch

Data base mismatch testing is performed by the DEM module on the write parameters received from the PLC. The mismatch status is returned to the PLC for use by the ladder logic or for status available to the PLC in via the Data Mismatch Active Flag in Device Status Word #1.

Bit	**Description**
0	Mismatch - URL
1	Mismatch - LRV
2	Mismatch - URV
3	Mismatch - Damping
4	Mismatch - DE Configuration
5	Mismatch - PV Characterization
6	Mismatch - Sensor Type
7	Mismatch - Tag ID
8	Mismatch - PV Number
9	Mismatch - Number of PV Values
10	Mismatch - Cold Junction Reference
11	Mismatch - Open Thermo Couple Detection
12	Mismatch - Freq 50

Important

The mismatch condition is performed in the DEM module on the write parameters everytime the module receives a new copy of the parameters from the PLC.

Clearing the data base mismatch condition is executed in one of several ways:
1. Wait for the mismatch condition to clear. If the mismatch was generated as the result of a Download Command, the mismatch will be cleared when the next data base is fully read from the instrument
2. Perform a Download Command to the instrument. If the write data is known to be correct executing a Download will move the new values to the instrument. If the Download is successful, the mismatch condition will clear when the next data base is fully read from the instrument
3. Perform an Upload Command.

PLC Scan Time

The DEM module's performance can be adversely affected if the scan time of the PLC becomes excessive. Two ways in which performance can be impacted are discussed below

Slow PV Updates

As the PLC scan time increases the frequency of Block Transfer execution decreases. As the module uses the Block Transfer commands to transfer the updated PV values (as well as all other data) to the PLC, the PV update time will be impacted.   To gauge the impact of scan time, we have prepared the following table indicating the Block Transfer Read frequency of Block ID 0 (PV Update Block) as a function of scan time:

PLC Scan Time	Block ID 0 Update Time (Local rack)
5 ms	80 ms
20 ms	100 ms
40 ms	220 ms
60 ms	340 ms
70 ms	400 ms
80 ms	480 ms

Resolving PLC Scan Time Issues

There is a very simple solution which is available if an application is encountered where either the PV update time is unsatisfactory or the PLC scan time s excessive.

This solution involves calling the logic containing the Block Transfer instructions more often. In the example in the Appendix, this would mean calling Subroutine 3 more frequently. This could easily be accomplished by inserting several additional JSR 3 instructions strategically in the main ladder logic.
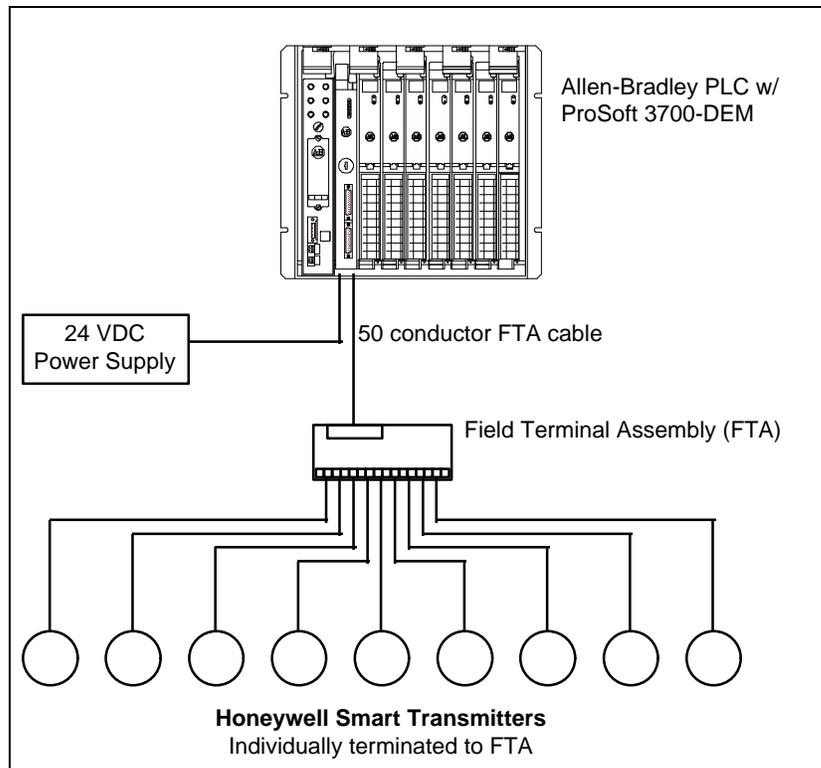
> **Using the STI functionality**
> Do not attempt to resolve PLC scan time issues with the DEM module by enabling the STI to call the Block Transfer logic (ie., SBR 3). When a BT Command is within the operation of an STI routine, the BT Timeout bit is set. This will cause erratic Block Transferring with the DEM module. This method is **not** recommended.

Terminating Instruments to the Module

The method for terminating the Honeywell Smart Transmitters to the 3700-DEM is through one of several Field Terminal Assembly (FTA) units. Several different FTA units are available from ProSoft as part of the 3700-DEM product package.

The transmitters are connected to the FTA through twisted pair wiring on a point to point basis. An FTA Cable, available in lengths from 1.5 meters to 50 meters, is used to cable the FTA to the 3700-DEM module. A typical connection hierarchy is shown in the following diagram.

Allen-Bradley PLC w/ ProSoft 3700-DEM

24 VDC Power Supply

50 conductor FTA cable

Field Terminal Assembly (FTA)

Honeywell Smart Transmitters
Individually terminated to FTA

The module, in its current release, requires an external 24 VDC power supply to provide instrument power. The 24 VDC power source is connected to the front of the 3700 module via screw terminals.

Non-Redundant Configurations

In a typical Non-Redundant configuration, a single FTA will be connected to a single module. The FTA available in this configurations is:

Honeywell FTA Model	Description	Size
MU-TSTX03	Compression Terminals	15.24 x 12.065 cm

Note : This unit is provided by ProSoft Technology

This unit is shipped standard with each 3700-DEM unit, along with a 3 meter cable. If other configurations are required, simply contact the factory.

Redundant Configurations

The DE I/O system supports the implementation of redundancy at the I/O level very easily. Using a standard Redundant FTA, a set of instruments can be connected to two 3700-DEM modules. These two 3700 modules can be in separate racks or in the same racks, with either one or two PLC processors themselves in a redundant configuration.

Honeywell FTA Model	Description	Size
MU-TSTX13	Compression Termnals	30.73 x 12.065 cm
MU-TSTX53	Screw Terminals	30.73 x 12.065 cm

Note : These units are available from ProSoft Technology upon request