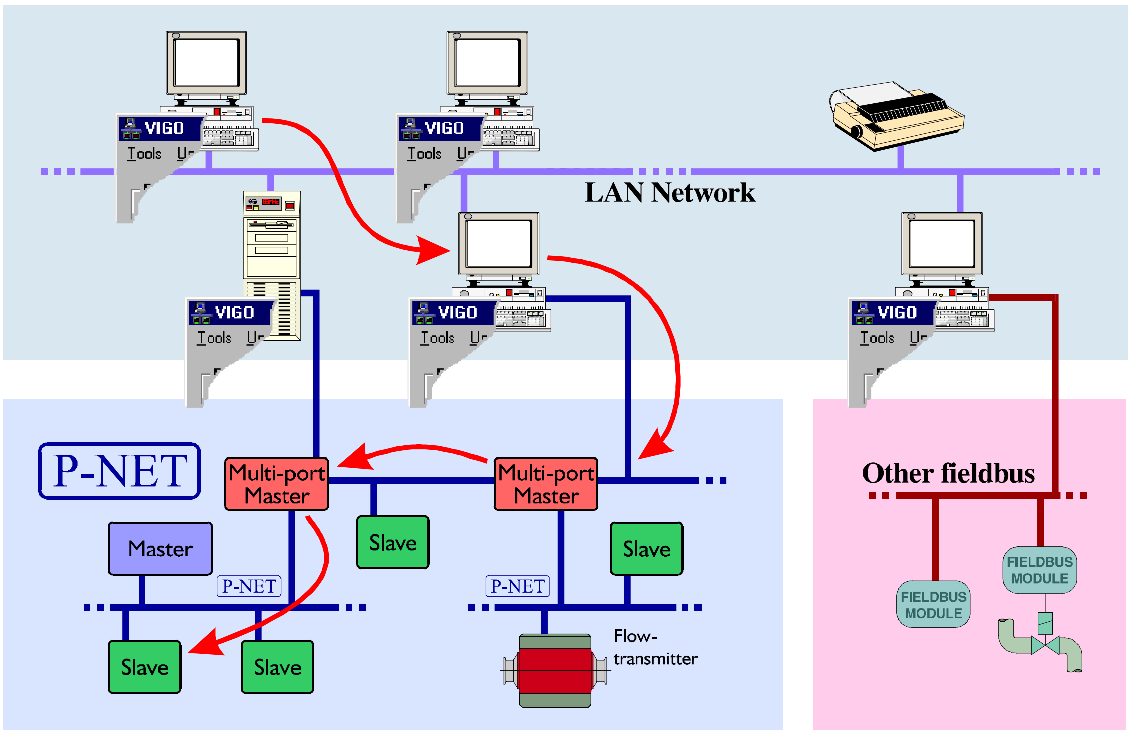
502 086 04

VIGO



The Fieldbus Management System
For Windows 95/98 and NT4.

Users Manual
for
Version 4.1

GB

May 1999

PROCES-DATA A/S, Navervej 8, DK-8600 Silkeborg, Denmark, Phone +45 87 200 300, Fax + 45 87 200 301

502 086 04

Contents

1 VIGO in General

VIGO is a Fieldbus Management System, installed on PC's running the Microsoft Windows^{TM} operating systems. VIGO is used in conjunction with process automation systems, where individual control units are distributed within a plant, and where one or more Field buses are used for the data inter-communication. Microsoft Windows^{TM} is an operating system, which executes programmes, controls the keyboard and screen, manages the hard disc and contains tools for configuration and program execution. In a similar way, VIGO is an "operating system", used to handle the different tasks specific to a Fieldbus system.

Some of these tasks are:

- To provide a uniform and well-defined communication link between standard programs in PC's, and variables and constants in modules (nodes) on a Fieldbus. These variables and constants are identified by a unique name (identifier). A standard program, could for example be an Excel spreadsheet, or it may be created using Visual Basic, Delphi, Visual C++ etc.

- To hold information about the location and type of each identifier. This information includes the node address for the interface module, a logical or symbolic address, an offset, the data structure, the data type etc.

- To execute simultaneous communication through different Fieldbus interfaces, and handle the queuing problems that occur in a Windows multi-tasking environment, when several applications wish to communicate at the same time.

- To keep track of which tools can be used with the various types of data and data structures, with consideration for the actual physical objects and interface modules used within the plant. These tools may be configuration tools, compilers, assemblers etc.

- To provide information to compilers and assemblers about variables that already exist in VIGO, so that they do not need to be declared again. It is therefore possible to create compilers where one does not need to declare global variables, because the compiler itself can load the necessary information directly from the description that VIGO holds about a plant.

- To provide an editor, in order to construct and maintain a description of the physical plant, where nodes, data types and the associated identifiers are defined. If one wants to insert, modify or delete single elements from the description, using a program other than the editor, this may be done using the editor's OLE automation interface. This might occur for example, if a plant description already exists in a file, and this is required to be used as a VIGO description of a plant.

- To associate the users program files, help files, connection diagrams, data specifications etc., with the physical objects and modules, which are contained within the VIGO description of the plant.

- To simulate plant data within the PC. This facility can be used in connection with an off-line configuration, backup / restore of plant information and when simulating plant functionality. This is useful for training purposes.

All exchange of data between inter-communicating PC application programmes and VIGO is done by means of OLE automation, (a Microsoft standard for data exchange). As an OLE automation Server, VIGO provides an open and well-defined interface to the user's application program. Any data requested from any point within the plant network, is treated and looks as if it were directly accessed from within the PC. The user does not need to consider variations in different communication protocols, data conversion or addressing methods.

From the users point of view, all these tasks are handled by VIGO, and the result is a simple, uniform and well defined interface to all data on the networks. VIGO is an open system, where the program interface is written in such a way, that new tools and new Fieldbus systems can be developed and added by the user.

The impact of using VIGO is significant, in that there is now only a need to interface to one system, no matter what the Fieldbus type is. Tools, utilities and programmes developed for use with VIGO can therefore be regarded as general purpose. This means that an increasing number of companies can provide packages for common use, which will result in a shorter development phase. This will also lead to cost savings, since an integrator needs only to understand one system.

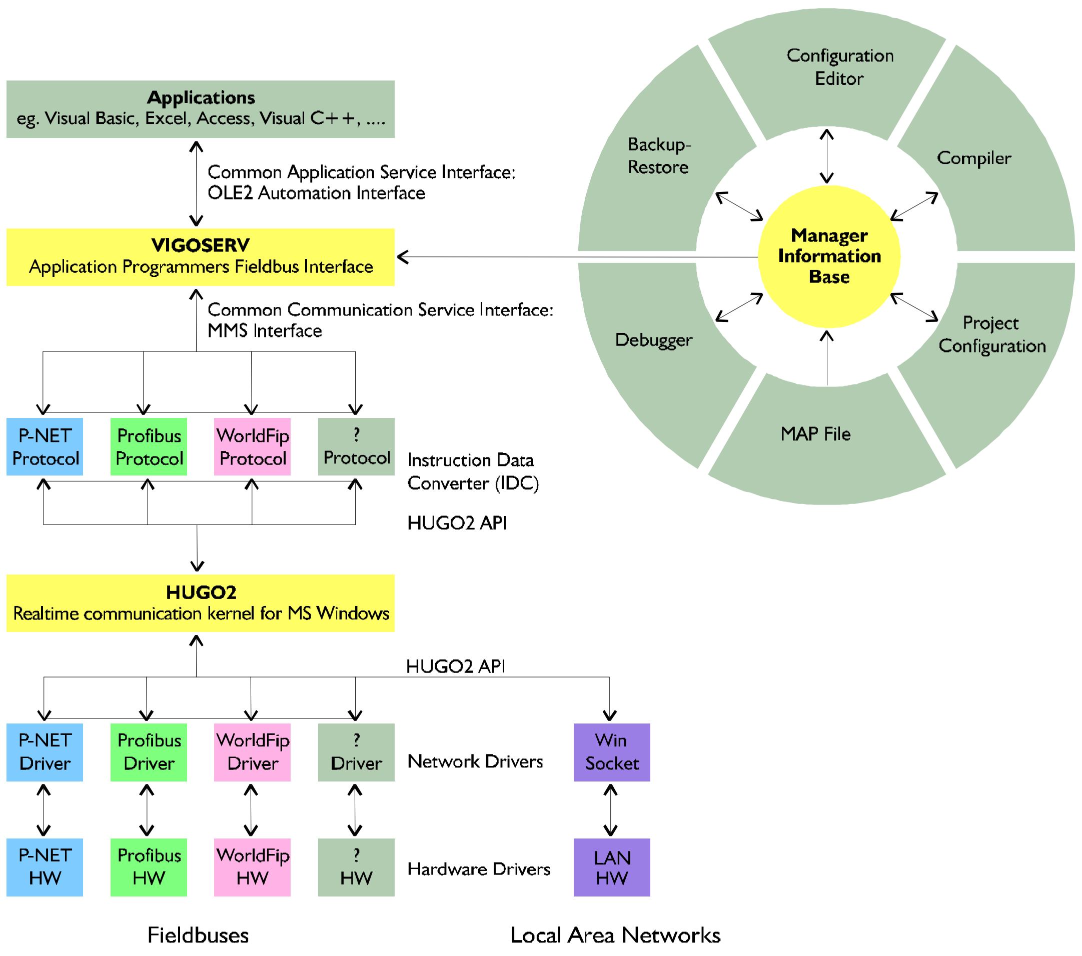
1.1 The VIGO elements

The Fieldbus Management System VIGO is a collection of several program elements. The basic elements within VIGO are *VIGOSERV,* the *MIB* and *HUGO2*. The flexible structure of VIGO allows additional elements to be easily added, and to grow with the users needs. These elements, which can be dynamically linked without requiring changes to the existing system, are *Instruction Data Converters*, *Network Drivers* and *Hardware Drivers*.

VIGO allows user applications to be designed without consideration for the underlying networks, by representing those networks as a collection of independent, installable components.
VIGO provides the opportunity for the user to dynamically add new tools, such as a Node Configuration Editor, a MAP file converter, a Backup/Restore utility, a Monitor, a Compiler, etc.

The elements of VIGO are shown below.

VIGO



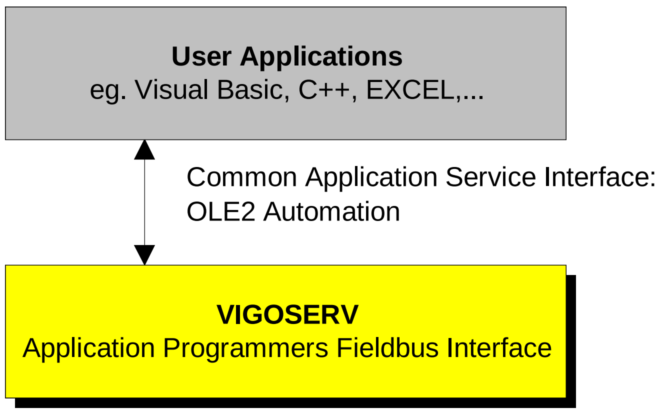
All this makes VIGO an open system, which can always be expanded for inclusion of new network connections to physical objects, and new tools for configuration. It is open, in the sense that anyone can provide a network or tool implementation, and anyone can develop an application that uses the communication functions offered by VIGO.

Within the following sections, the elements of VIGO will be examined in greater detail.

1.2 Application Programmers Fieldbus Interface

The Application Programmers Fieldbus Interface - VIGOSERV, provides a simple interface to standard program packages such as Visual Basic, Delphi and Visual C++, spreadsheets, databases, Human-Machine Interfaces and other visualisation programs such as SCADA.

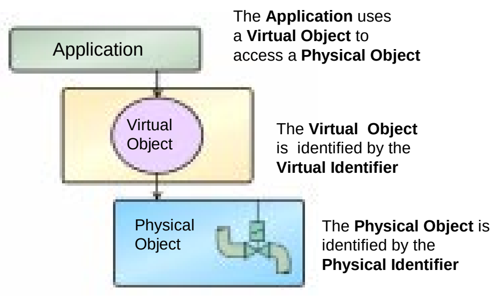
VIGOSERV is an OLE Automation Server, which creates a consistent and transparent interface between the user program (application), and the physical elements (objects) within the plant.


User Applications
eg. Visual Basic, C++, EXCEL,...
Common Application Service Interface:
OLE2 Automation
VIGOSERV
Application Programmers Fieldbus Interface

OLE Automation is a part of Object Linking and Embedding (OLE2), which is a facility within Microsoft Windows^{TM}, to enable real-time exchange of data between applications.

VIGOSERV supports functions, such as read and write to variables, upload and download of files, start, stop and reset of programs, etc., without being aware of network operations. These functions, together with all their parameters, define the Common Application Service Interface. The figure below illustrates the link between VIGOSERV and user applications.

Any manipulation of a particular physical object is achieved via its associated virtual object within VIGOSERV. Virtual objects are created by user applications, where a virtual identifier is also defined. The virtual object is made to point to the physical object by means of the physical identifier - a unique name. The physical identifier is defined in the Manager Information Base.


Application
The **Application** uses a **Virtual Object** to access a **Physical Object**
Virtual Object
The **Virtual Object** is identified by the **Virtual Identifier**
Physical Object
The **Physical Object** is identified by the **Physical Identifier**

1.3 Manager Information Base

VIGO includes a Manager Information Base - MIB. VIGO uses the MIB to describe the **whole** Fieldbus control system of a plant, which in VIGO is called a Project.

In general terms, a Fieldbus system is constructed with a number of Fieldbus devices, called Nodes. The MIB contains a description of the different Nodes in the system, and holds information about these Nodes, such as Node Identifier, Nets, Node address, Node type and other relevant information. It also holds information about the Nets within the project. From all this information, the communication path to the Node can be computed.

Furthermore, a node consists of a number of variables. The MIB contains a description of all the variables within a Node, that may be accessed via the Fieldbus. Each variable within a Node can be of simple (byte, integer, real etc.) or complex type (array, record, string).

In VIGO, the entire collection of variables within a Node can be regarded as one large variable of complex type, the Node type. Access to a variable within a Node is described using the same method as with an access to a Record in the Pascal or C languages, where the Node is the Record and the variable is a field within that Record.

In a similar way, the contents of all Nodes within a plant can be regarded as one huge variable, organised as a Record and represented by a Project identifier. Access to a Node within a Project is then described by means of the Node identifier, where the Project is the Record, and the Node is a field within the Project Record.

A global identifier, unique for a specific variable within the plant, may now be composed by combining the above mentioned structured elements. A global identifier is the same for any device within the Project and starts with the Project identifier followed by a ':'. The rest of the global identifier is then constructed, by appending the Node identifier and the sub-element identifiers, to create the complete path to the variable. Each identifier is separated by '.', in exactly the same way as access to fields in a Record, e.g.:

Project_Identifier:Node_Identifier.Variable_Identifier

Thus, a Variable definition consists of a Variable_Identifier, information about the location of the Variable, and a Type description. Such a definition must be available for any type of Variable, be that a simple variable, a complex variable, a Node or a Project.

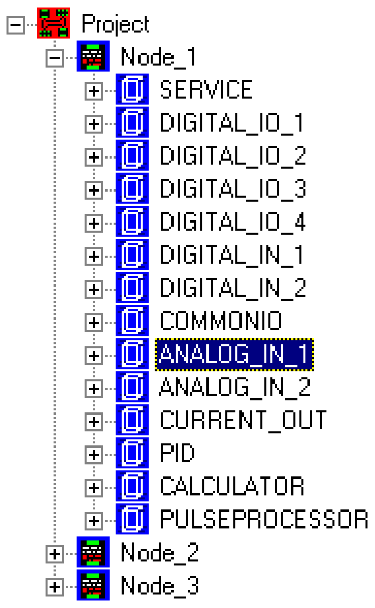
As an example, a simple Variable will be used. The Variable is identified by a Name, called the Variable_Identifier. The location of the Variable describes the internal address within a Node. The Type description for a simple Variable just defines one of the basic data types, e.g. real, byte, boolean etc.

Another example of a Variable is a Node. A Node is identified by a Name called the Node_Identifier. The location of the Variable describes the Fieldbus 'path' to the Node, including specific Fieldbus information. The Type description for a Node is given by the Node Type, which describes the internal variable structure.

If more than one Variable of identical Type is found within a Project, the Type only needs to be defined once. This includes Node Types.

Node Types are typically rather complex, but having a well-defined structure. Such types may be generated automatically from device descriptions or by compilers/assemblers.

The user interface used to monitor the contents of the MIB and to enable the structure of the system to be illustrated is handled via a MIBOCX. This is an OLE Control Extension (OCX) according to Microsoft Windows. The MIBOCX allows a browser function to be performed, and displays a tree-structure, in a similar way to standard file managers. In this case however, the elements are not drives, directories and files, but Project, Nodes, Variables, and Types. An example is shown in the figure to the right. This OCX control can be directly called and used by an object oriented programming language supporting this feature (Visual Basic, Visual C++, and Delphi). This OCX control is used within a number of different VIGO tools, including the MIB Edit.



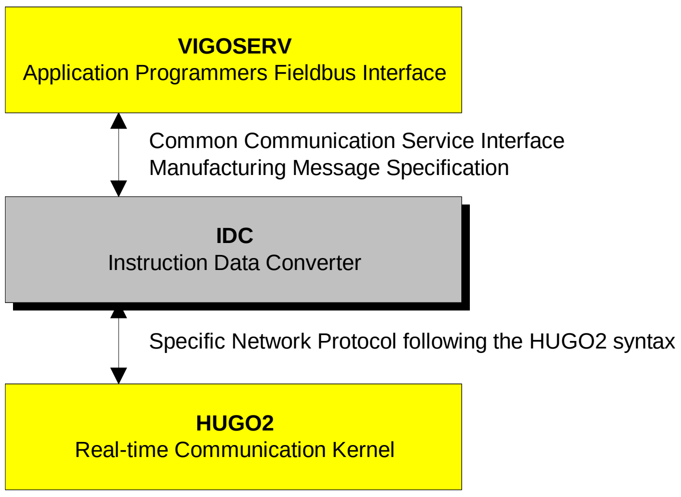
In a similar way to standard Windows programmes, the right mouse button can be used within the MIBOCX, to show dedicated menus, depending on the selected object. This means that selecting a Node and using the right mouse button results in a menu list relevant for a Node. Selecting a Project provides another menu list relevant for a Project. This is described in more details later.

As described above, the MIB contains all the information required to access a physical object, such as a digital I/O, an analog I/O, a flow meter, etc. When VIGOSERV requests information from the MIB, using a global identifier for a physical object, the MIB collates all necessary information about the physical object, and returns this to VIGOSERV.

In other words, the MIB describes how data is structured, how different data elements are related, where data is stored, and who has access to that data. It therefore enables a physical plant to be completely described as a Project, in terms of data, related data structures and data location.
Once the data definition is completed, a system is capable of automatically acquiring data from, and distributing data to, control level devices, such as Windows applications, process computers, PCs, PLC's, I/O modules, etc.

1.4 Instruction Data Converter, IDC

Different Fieldbus systems may use dissimilar data formats, syntax’s and services on a variety of networks. The purpose of VIGO is therefore to have a common application programmers interface to any Fieldbus interface. VIGOSERV defines a Common Communication Service Interface, which fulfils the demands for services and data formats for the different Fieldbus types. A plant can be built, which uses a variety of different Fieldbus systems simultaneously. For each Fieldbus within the plant, it is therefore necessary to be able to convert to/from various sets of services and data formats into the common format. This conversion is performed by a set of Instruction Data Converters, IDC's, one for each Fieldbus system.


VIGOSERV
Application Programmers Fieldbus Interface
Common Communication Service Interface
Manufacturing Message Specification
IDC
Instruction Data Converter
Specific Network Protocol following the HUGO2 syntax
HUGO2
Real-time Communication Kernel

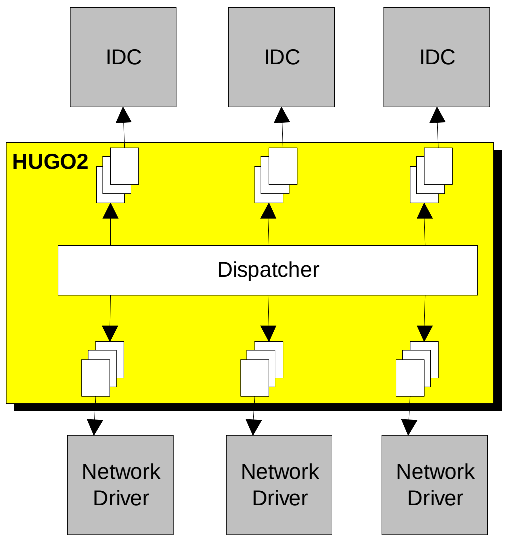
Information exchange between VIGOSERV and the IDC, is based on the RACKS specification. The Instruction Data Converter (IDC) is a Microsoft Windows^{TM} Dynamic Link Library (DLL).

The IDC must convert the VIGO data and services into the related Fieldbus data and services that are understood by the relevant Fieldbus node.

This data must be packed in such a format in order that the related network driver is able to transform it for network communication. The IDC and network driver is always closely linked to each other, by means of an internal network specific packet format.

1.5 HUGO2, the Real-time Communication Kernel

The routing and handling of several simultaneous information packages for the same, or different networks, is also managed by VIGO, via the real-time communication kernel HUGO2. HUGO2 ensures that communication packages and messages do not get mixed, in situations where several applications are trying to access the same bus system, in a multi-tasking environment. HUGO2 takes care of defining and managing networks, queuing and routing messages, establishing error handling procedures and handling interrupts at different levels. The queuing facility in HUGO2 is shown in the figure to the right.



This environment is somewhat different from the DOS operating system environment, with a single task, dealing with only one application, and therefore no queuing is required.

HUGO2 is designed for both time critical and non-time critical communication. Time critical communication is controlled by hardware interrupts, whilst non-time critical communication is performed by means of messages within the Windows environment.

HUGO2 is able to handle several communicating applications simultaneously, which may involve dealing with many requests and responses at the same time.

HUGO2 can dynamically load network drivers, which gives the user the opportunity to add new network drivers if required. Basically, HUGO2 is a transport system, which means it does not need to know what is being sent. The interpretation of Fieldbus messages is carried out by the associated IDC.

HUGO2 is also a communication system that manages data security and integrity, for data inquiries made to the plant.

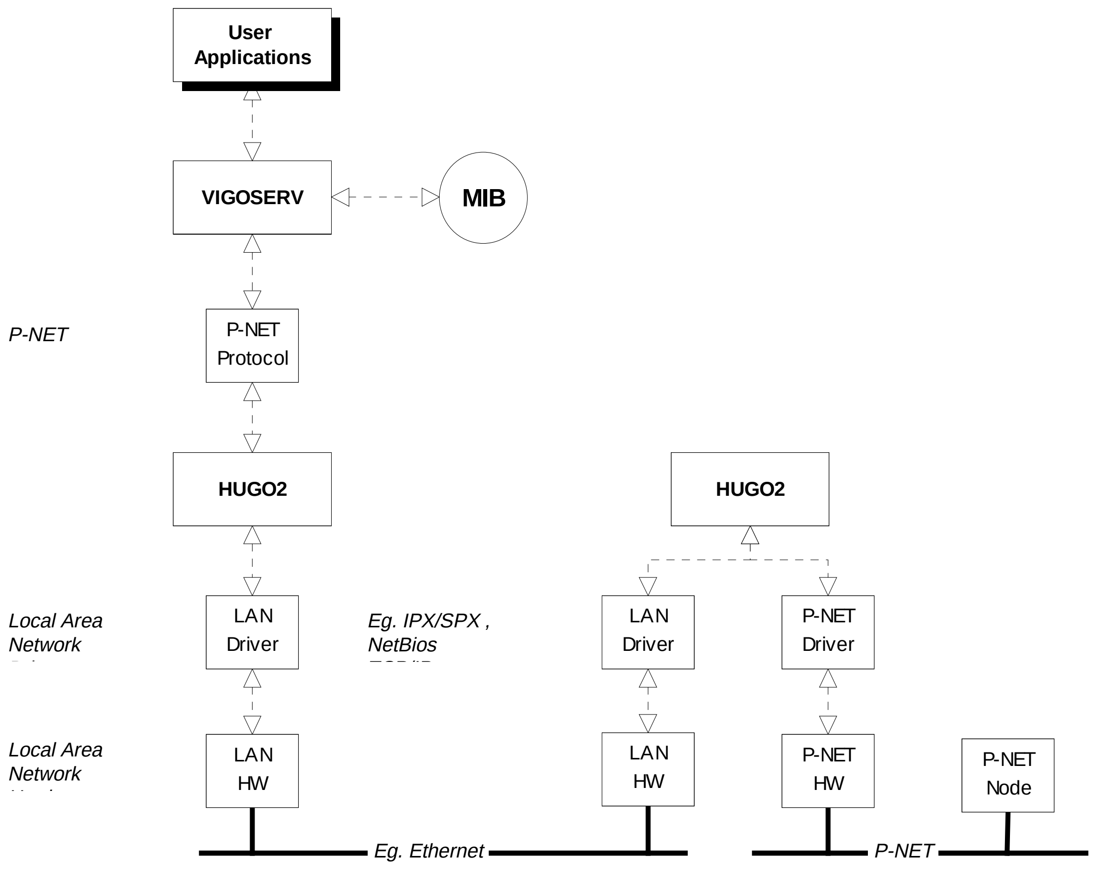
1.6 Network Driver

A HUGO2 Network Driver interface provides the connection between HUGO2 and a standard Fieldbus driver (for example P-NET), or a LAN driver (for example VIGO-IPX).

A communication network can be realised in several different ways. Three network types can be connected to HUGO2. These are Fieldbuses, Local Area Networks (LAN) and Wide Area Networks (WAN). There are distinct differences in the usage of these network types. The LAN and the WAN types are only used for transporting messages, which means they have no knowledge of what is being sent on the network, whereas Fieldbuses have built in protocols, which interpret the contents of what is being sent and received.

The combination of network types provides the capability of installing a Windows application on a PC, which has access to a Local Area Network and/or Wide Area Networks, and then routing the information via another PC, which has access to a fieldbus, to which the physical object is connected.

This is all illustrated in the figure below.



2 The VIGO programmes

The VIGO Fieldbus Management System is a collection of associated programmes, DLL's and tools. The principle window of the VIGO program is shown below. This must always be loaded (or minimised), when VIGO functionality is required.

The VIGO window consists of three tabs: **MIB View, Workspace** and **MIB Edit.**

VIGO can be used for a variety of purposes, which depend on the requirements of the user.

Before VIGO can be used, it must be configured to match the required VIGO environment. This includes establishment of a Workspace having a selection of projects enabled, together with all the parameters of the appropriate drivers correctly set.

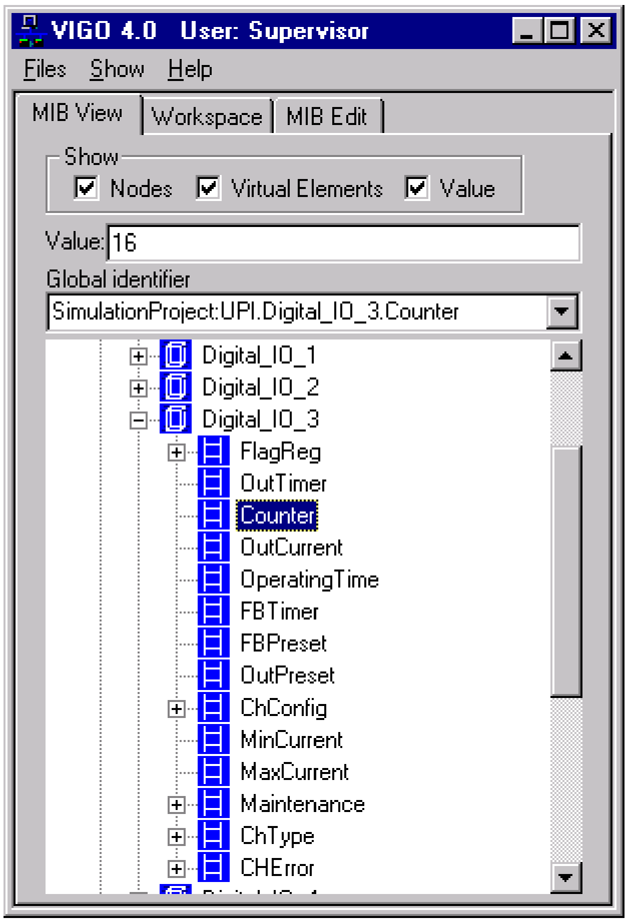
MIB Edit is used by the systems integrator who wants to set up a new, or modify an existing system, and needs to carry out the necessary configuration of the nodes. In this situation, VIGO can be started up from the Start Menu, from a shortcut or directly from the Windows Explorer.

2.1 MIB View

The **MIB View** tab shows the projects that can be accessed by the application programs that need to use VIGO. VIGO will be automatically started as soon as one application program creates a VIGO object. Under these circumstances, VIGO will be loaded in a minimised state, and will only appear in the task bar. VIGO will be automatically closed again, when VIGO objects are no longer required by the applications.

MIB View provides an illustration of the structure of a project, in terms of nodes, channels and other variables that are included in a particular system.

Furthermore, **MIB View** enables the user to find and select variables, in order to call upon other programs and tools that are relevant to the selected item. Such tools can be selected from a menu that appears when the right mouse button is clicked on a highlighted item.



VIGO 4.0 User: Supervisor

Files Show Help

MIB View | Workspace | MIB Edit

Show: [✓] Nodes [✓] Virtual Elements [✓] Value

Value: 16

Global identifier: SimulationProject:UPI.Digital_IO_3.Counter

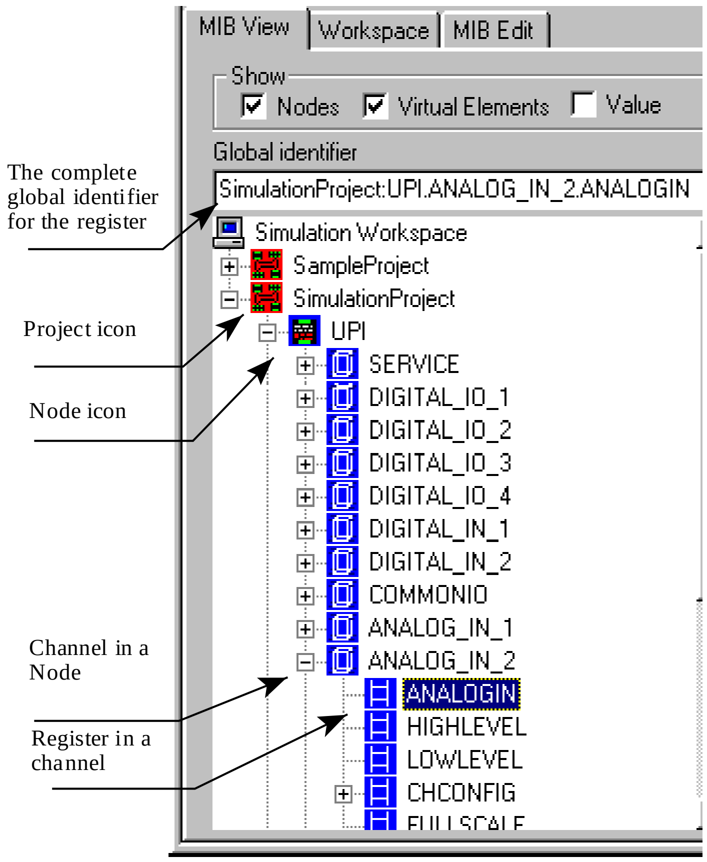
- Digital_IO_1
- Digital_IO_2
- Digital_IO_3
  - FlagReg
  - OutTimer
  - Counter
  - OutCurrent
  - OperatingTime
  - FBTimer
  - FBPreset
  - OutPreset
  - ChConfig
  - MinCurrent
  - MaxCurrent
  - Maintenance
  - ChType
  - CHError

MIB View utilises a custom control, called MIBOCX, which is an "OLE Control Extension", designed for VIGO. The MIBOCX is used to provide a visual representation of the structure and relationship of the variables within a project.

The project structure is shown in the form of a tree, in a similar way as does the Windows Explorer file manager. However, instead of showing folders and files, the MIBOCX in MIB View, illustrates the nodes and variables relating to the project description of the system. The same MIBOCX control can be included in other programs, such as those developed using Visual C++, Visual Basic or Delphi, since all of these languages support the use of such controls.

If the right mouse button is pressed when an element in the structure is highlighted, a menu is shown. This menu provides a choice of functions and tools, but which are only relevant for the selected element.

A **Project** is identified by a name, and is represented by a ***Project icon*** in the MIBOCX.
A factory can be divided into different projects or projects can represent systems at different locations.
The elements that are used to describe a physical plant within a project, consist of Nodes, Aliases and Virtual names. The Aliases and Virtual names are used as shortcuts for constructing and combining identifiers from already defined variables, thereby giving access to actual variables in a more convenient way. A Project can be expanded into it's elements, by clicking on the + sign at the Project icon.



A **Node** within the Project description (the MIB), is defined as a module or a unit within the physical plant (e.g. a PD3221- Universal Process Interface, UPI). Each Node is represented by a ***Node icon*** in the MIBOCX.

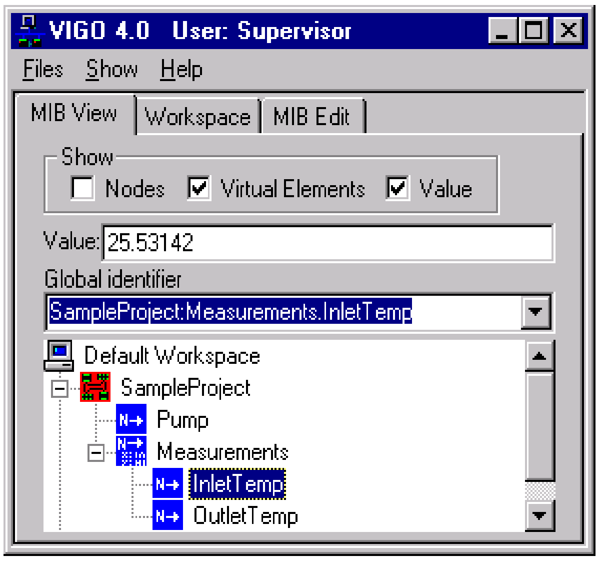
A Node, which is a variable, is based on a type, a Node type. The Node type describes the data structure within the node. The data structure of a particular Node variable, e.g. it's channels and registers, can be seen by clicking on the Node icon's + sign. A particular Node type can be used many times within a project description.

The MIB description is built using a number of inter-related elements. These elements may be of different Kinds. One Kind of element can represent a Node. Another Kind of element can represent an Array, and yet another can represent a Channel. Each Kind of element is represented with a particular icon, used to illustrate the variable in the MIBOCX.

It is also possible to select an element of an array, by changing the element index number. Click once on the selected index number, type in a new index number and then click the mouse pointer elsewhere.

In the example shown above, the Project is called "Simulation Project" and the Node is called UPI. Within the UPI node, the data structure in the form of channels can be seen. Within the ANALOG_IN_1 channel, the register ANALOGIN is highlighted. The complete global identifier for a selected variable is shown in the ***Global identifier*** field.

The ANALOGIN register shown above has the complete global physical identifier: *SimulationProject:UPI.ANALOG_IN_1.ANALOGIN*



Value: 25.53142

Global identifier: SampleProject:Measurements.InletTemp

When a Project icon is opened in the **MIB View** tab, only Nodes, Aliases and Virtual names are shown. This is the default setting. Nodes and Virtual elements can be individually excluded from the view.

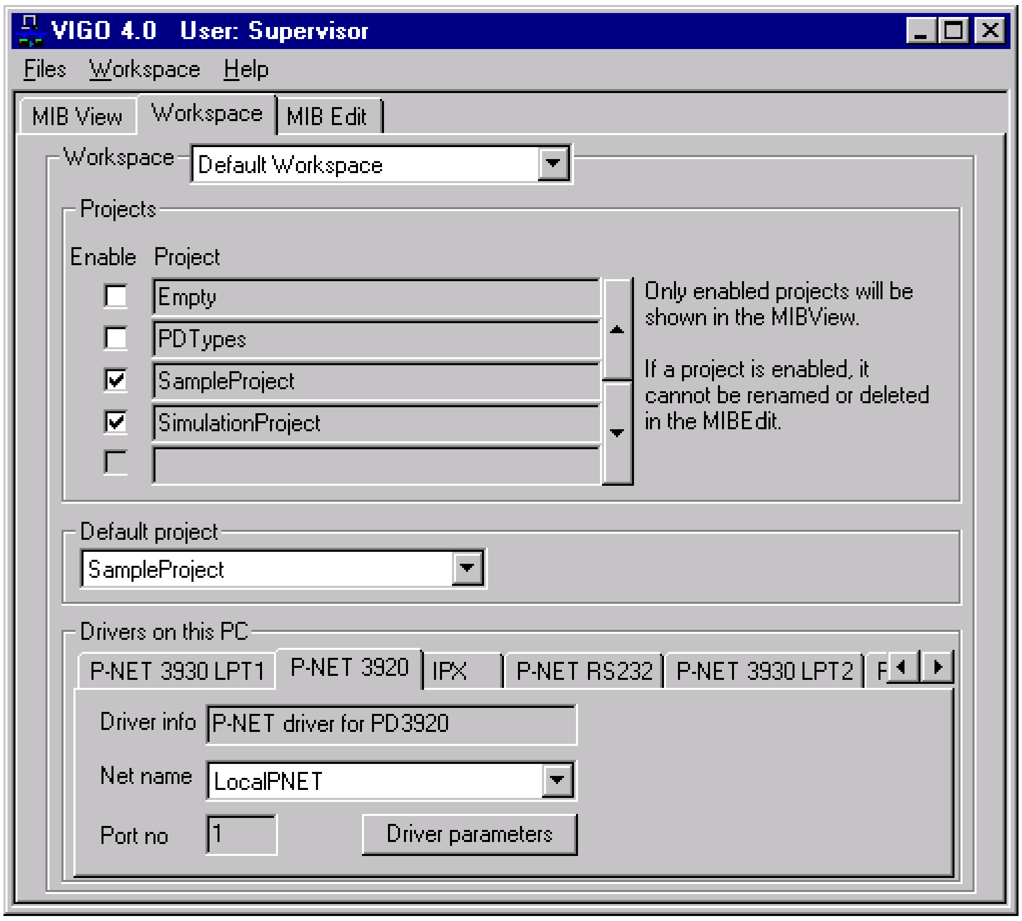
The ***Show nodes*** check box and the ***Show Virtual Elements*** check box, are used to limit the number of elements to be shown in **MIB View**.

The ***Show Value*** check box is used to add a Value field. This field shows the value of the selected variable. Entering a value, into this field followed by "Enter", will write to the variable.

2.2 Workspace.

A workspace in VIGO describes the parameters for the PC connected at a certain location. These parameters describe which projects and drivers are relevant, and specify the driver parameters for that location.

Each workspace holds its own set of parameters. The name for the workspace can be chosen to be the same as the name of the location. Workspaces can be added/deleted from the pull down menu. The workspace list box shows the selected workspace used by VIGO 4.0.



Workspace: Default Workspace

Enable	Project
☐	Empty
☐	PDTypes
☑	SampleProject
☑	SimulationProject
☐	

Only enabled projects will be shown in the MIBView.

If a project is enabled, it cannot be renamed or deleted in the MIBEdit.

Default project: SampleProject

Driver info: P-NET driver for PD3920

Net name: LocalPNET

Port no: 1

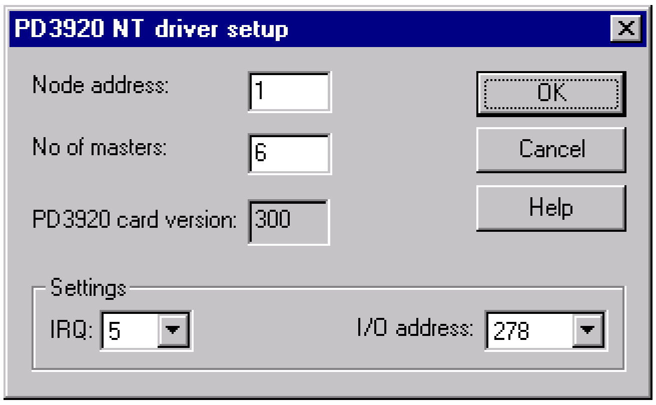
VIGO is designed to enable a PC to simultaneously handle multiple projects. Each Project is given a name, called the Project Identifier. A Project description is stored in a MIB file. The Workspace shows a list of existing projects. Only those projects, which are enabled in the actual workspace, will be shown in the MIB View.

A ***default project*** can be selected. When the global identifier is without project name, the default project is assumed. A **Project** may contain a number of networks, each with a number of Fieldbus nodes connected. These networks are specified as properties of the project.

Drivers on this PC indicate which drivers are available for use, but not whether the hardware is present. For each port in use, the Net name must be selected, and driver parameters must be correctly set.

The ***Driver Parameters*** button will display a new window, which depends on the selected driver. This window is generated by the driver in question, and is used to set up the required parameters. See also *Guidance for selecting node address …* on page 58.

This example shows the driver parameters required by the P-NET driver for the PD 3920 interface when running Windows NT. The *Settings* field is not available in Windows 95/98.


PD3920 NT driver setup

Node address: 1

No of masters: 6

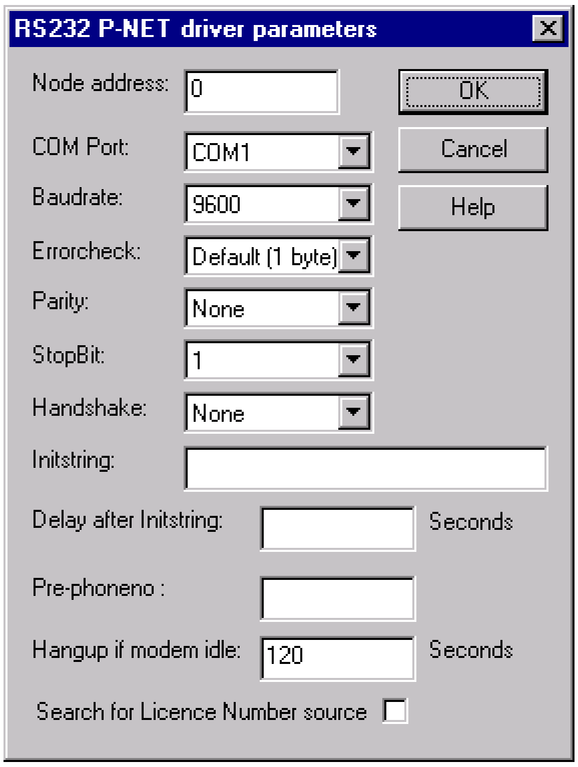
PD3920 card version: 300

Settings

IRQ: 5

I/O address: 278

This example shows the driver parameters required by the P-NET driver for the RS-232 interface. Please note that Node address 0 is NOT a valid Node address, but this is the default setting when VIGO is installed.


RS232 P-NET driver parameters

Node address: 0

COM Port: COM1

Baudrate: 9600

Errorcheck: Default (1 byte)

Parity: None

StopBit: 1

Handshake: None

Initstring:

Delay after Initstring: Seconds

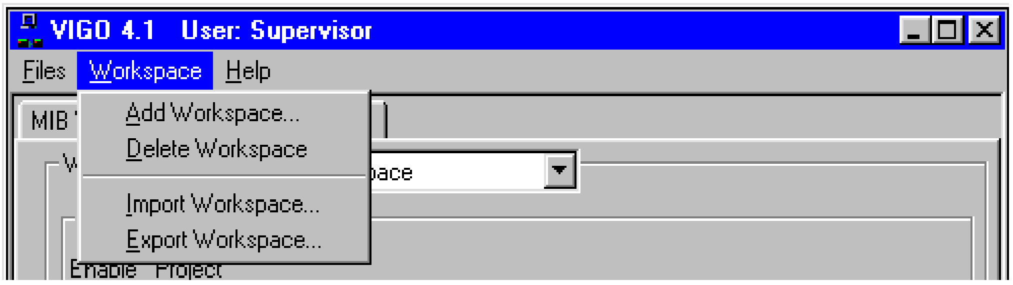
Pre-phoneno :

Hangup if modem idle: 120 Seconds

Search for Licence Number source ☐

2.2.1 Import/Export

From the “Workspace” menu it is possible to both import and export a workspace.



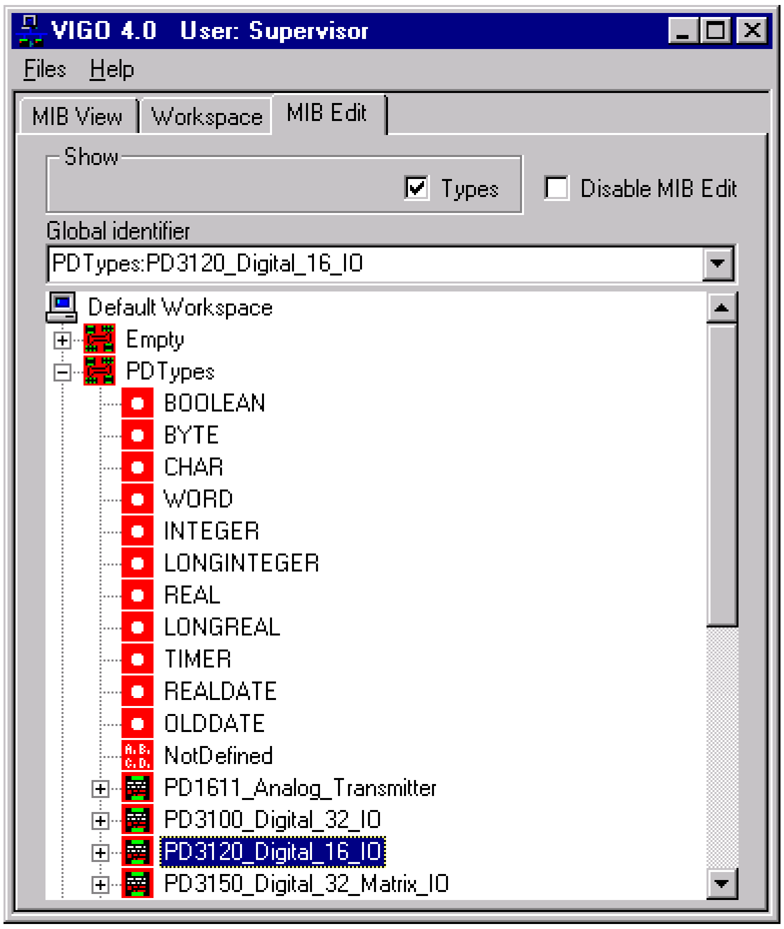
Exporting a Workspace will gather all relevant configuration data relating to the workspace (including driver parameters, MIB and SIM files for enabled projects) and put this data in a single file. This “VIGO Configuration File” will have the extension “vcf”, and can be imported from another PC.

The Import/Export feature is a fast and simple way to move a configuration from one PC to anoter. It can also be used by companies who install VIGO along with their own products. They can setup their workspace as needed, export it and copy the file to a floppy disk. Inserting the disk in the PC during the VIGO install, will force VIGO to import this configuration file instead of the default configuration files that follows with the VIGO system.

2.3 MIB Edit

The *MIB Edit* tab shows all the projects that have been set up on the PC, and is used to modify the structure and properties of nodes and variables within a project.
A Variable occupies a memory location in a physical device. Variables are therefore located within Nodes, or as previously described, a Node itself can be regarded as one huge variable. Nodes are declared as being of a particular Node type. A Node type fully describes all the types of variables contained within that Node. When a Node type has been assigned to a Node, the declared variables become available for access through VIGO.

The various **Types** used within the MIB can be divided into two distinct groups:



[✓] Types

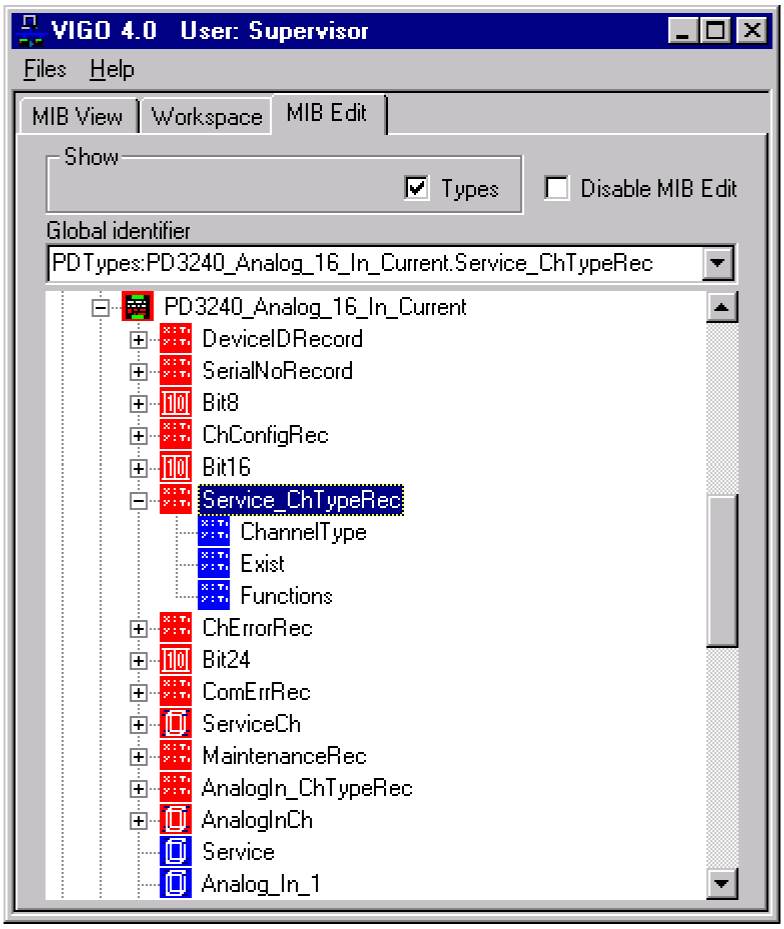
[ ] Disable MIB Edit

Global identifier: PDTypes:PD3120_Digital_16_IO

- Default Workspace
  - Empty
  - PDTypes
    - BOOLEAN
    - BYTE
    - CHAR
    - WORD
    - INTEGER
    - LONGINTEGER
    - REAL
    - LONGREAL
    - TIMER
    - REALDATE
    - OLDDATE
    - NotDefined
    - PD1611_Analog_Transmitter
    - PD3100_Digital_32_IO
    - PD3120_Digital_16_IO
    - PD3150_Digital_32_Matrix_IO

Group 1, which includes Basic types (simple types), and Array types and Strings. These types are represented on the screen by a red icon, and do not include any sub elements (simple types have no "+" sign in front of the icon).
A Basic type is described in the MIB as a *Basic Type Element*, represented by a red *Basic type Icon*. The Basic types are: Boolean, Byte, Char, Word, Integer, LongInteger, Real, LongReal, Timer, RealDate and OldDate. The *Array Type Element* also belongs to this group, and is represented by a red *Array type Icon*. The properties of an Array type element holds information about the type structure of the Array elements, as well as the minimum and maximum index for the Array. A string is a special form of an Array (consisting of an array of characters) and is represented by a red *String type Icon*.

Group 2:
This group of types (complex types) is described in the MIB as a *Type Element*, and is shown with a red icon, and having one or more *Sub Elements*, indicated with blue Icons. The Type Element properties hold the name of the type, and the structure of the type, (Nodetype, Channeltype, Recordtype etc.).


VIGO 4.0 User: Supervisor

Files Help

MIB View | Workspace | MIB Edit

Show: [✓] Types

[ ] Disable MIB Edit

Global identifier: PDTypes:PD3240_Analog_16_In_Current.Service_ChTypeRec

```
⊟ PD3240_Analog_16_In_Current
   ⊞ DeviceIDRecord
   ⊞ SerialNoRecord
   ⊞ Bit8
   ⊞ ChConfigRec
   ⊞ Bit16
   ⊟ Service_ChTypeRec
        ChannelType
        Exist
        Functions
   ⊞ ChErrorRec
   ⊞ Bit24
   ⊞ ComErrRec
   ⊞ ServiceCh
   ⊞ MaintenanceRec
   ⊞ AnalogIn_ChTypeRec
   ⊞ AnalogInCh
     Service
     Analog_In_1
```

The Sub Elements with blue icons represent Channels, Registers, Swno’s, Record fields etc. The properties of these Sub Elements describe the relative location of the sub type within the complex type, and the name of the sub type.

Blue icons are also used for physical Nodes, Aliases and Virtual names. These icons are not shown in Types view.

The MIBOCX offers the ability to show ***Nodes or Virtual*** elements or both, in Variables view. The icons shown in the MIBOCX represent variables, and they are normally blue, except for the Project icon and the array index, which are red. The purpose of providing a means of selecting which elements to show reduces the total number of icons displayed, and helps to make it easier to select a particular icon.
By clicking a “+” sign, the MIBOCX will automatically find and show the icons representing the Sub elements. New nodes, and Virtual elements of an already defined type, can be easily inserted.
Virtual names and aliases can be used to give alternative names to already defined Variables.

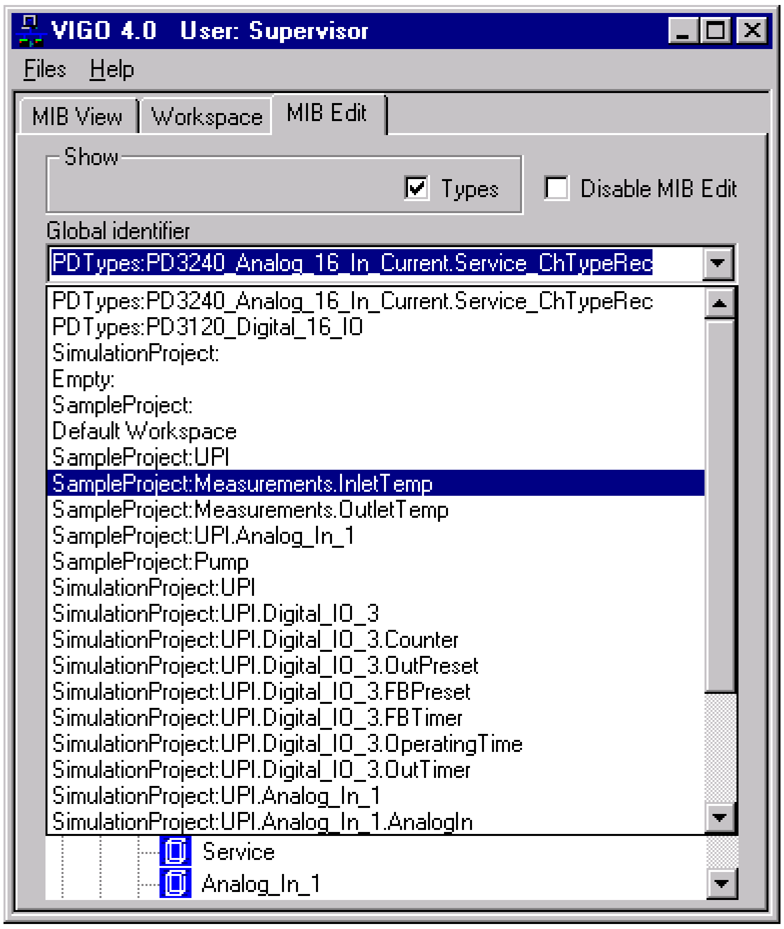
In the **Types View** mode, the MIBOCX only shows the tree structure of the types to two levels. A red icon with a “+” sign can be opened, and one or more blue icons will appear. This mode provides the opportunity to see all type definitions available within the Project, and to define new types.

When a new type is created, such as a new Nodetype, a Recordtype or an Arraytype, all the associated sub elements must already be declared, before the complex type is defined. This is similar to the procedure used when declaring types in Pascal or C++.

The Global identifier is not valid in the Types view.

However, this field can be used as the means to search for types and variables, having known names by keying these in.

Also the scroll arrow will list the searches previously made, and further selections can be made from this list.



☑ Types ☐ Disable MIB Edit

Global identifier: PDTypes:PD3240_Analog_16_In_Current.Service_ChTypeRec

```
PDTypes:PD3240_Analog_16_In_Current.Service_ChTypeRec
PDTypes:PD3120_Digital_16_IO
SimulationProject:
Empty:
SampleProject:
Default Workspace
SampleProject:UPI
SampleProject:Measurements.InletTemp
SampleProject:Measurements.OutletTemp
SampleProject:UPI.Analog_In_1
SampleProject:Pump
SimulationProject:UPI
SimulationProject:UPI.Digital_IO_3
SimulationProject:UPI.Digital_IO_3.Counter
SimulationProject:UPI.Digital_IO_3.OutPreset
SimulationProject:UPI.Digital_IO_3.FBPreset
SimulationProject:UPI.Digital_IO_3.FBTimer
SimulationProject:UPI.Digital_IO_3.OperatingTime
SimulationProject:UPI.Digital_IO_3.OutTimer
SimulationProject:UPI.Analog_In_1
SimulationProject:UPI.Analog_In_1.AnalogIn
```

The Properties of a new Element must be set up, before the new element can become operational. This is achieved by using the Properties Window, selected by using the right mouse button menu inside the MIBOCX.

The MIB Edit tab loads a copy of the MIB files into memory. These files are **not** used for communication, and during editing, VIGO will continue to use the old version of the MIB files, until the new files are saved. When the MIB files are saved, all VIGO objects will automatically be updated to reflect the contents of these new files.

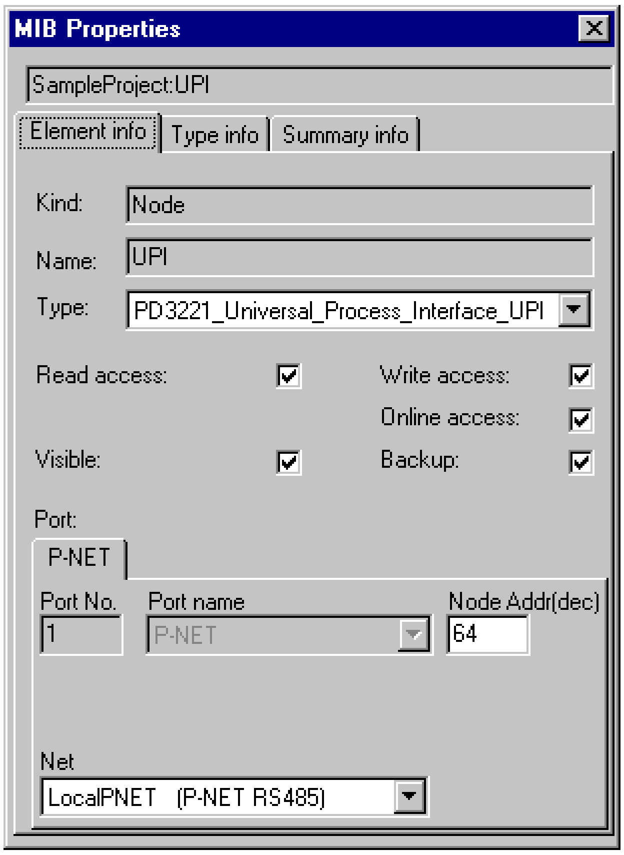
To save memory, MIB Edit can be disabled, using the Disable MIB Edit check box.

2.4 Properties Window

MIB Elements are used to describe nodes and the different variable types, within the MIB. These elements can be of different "Kinds". One Kind of element could describe a node, another Kind might describe an Array, and so on.

The MIB is a collection of such elements, which are referenced to each other as Next element or Sub element.

Each element has a set of properties, describing its relationship with other elements and various related constants. These properties must be set up before the MIB can be used. The *Properties* window for a particular element is made available using the right mouse button menu, when that element is highlighted in the MIBOCX.


MIB Properties

SampleProject:UPI

Kind: Node
Name: UPI
Type: PD3221_Universal_Process_Interface_UPI

Read access: ✓
Write access: ✓
Online access: ✓
Visible: ✓
Backup: ✓

Port:

Port No.	Port name	Node Addr(dec)
1	P-NET	64

Net: LocalPNET (P-NET RS485)

The *Properties* window is divided into two or three tabbed sheets, depending on the view mode. **Element info**, and **Type info** are always shown. In Variables View (showing Nodes and Virtual names), an additional tab sheet called **Summary info** is displayed, as shown in the figure.

If the MIBOCX is in Variables View, the **Element info** mainly applies to Nodes, for selection of the Node type, and also to select to which Network the Node is connected. The **Type info** tab provides information about the selected type, and cannot be modified from here. The **Summary info** tab shows the access conditions that VIGO is using to access the selected variable. These access conditions are not necessarily the same access conditions that are defined for the element, as shown on the **Element info** tab sheet. Furthermore, the **Summary info** shows the **Internal address** as the sum of **SWNo** and **RegisterNo** for the variable.

If the MIBOCX is in Types View, **Element info** shows the Kind of element and type Name of the selected item (red icons). For sub elements (blue icons), **Element info** is used to select the type and relative location of the sub type. The **Type info** shows the properties of the selected type and can be modified from here (modification can only be undertaken with red icons).

2.4.1 Properties in Element info

Kind
The **Kind** field shows the selected MIB Element type. Depending on the Kind actually selected, some of the following Properties can be applied, and are shown either in the **Element info** or **Type info** sheets.

The Kind is selected during the generation of new MIB elements. The ***New*** function is available in the *MIB Edit*'s right mouse menu. The Kind for a MIB element in the *MIBOCX* can only be changed, by firstly deleting it and then by adding a new MIB element of the required Kind.

The different Kind icons are listed below. The upper group being red icons and the lower group being blue icons.

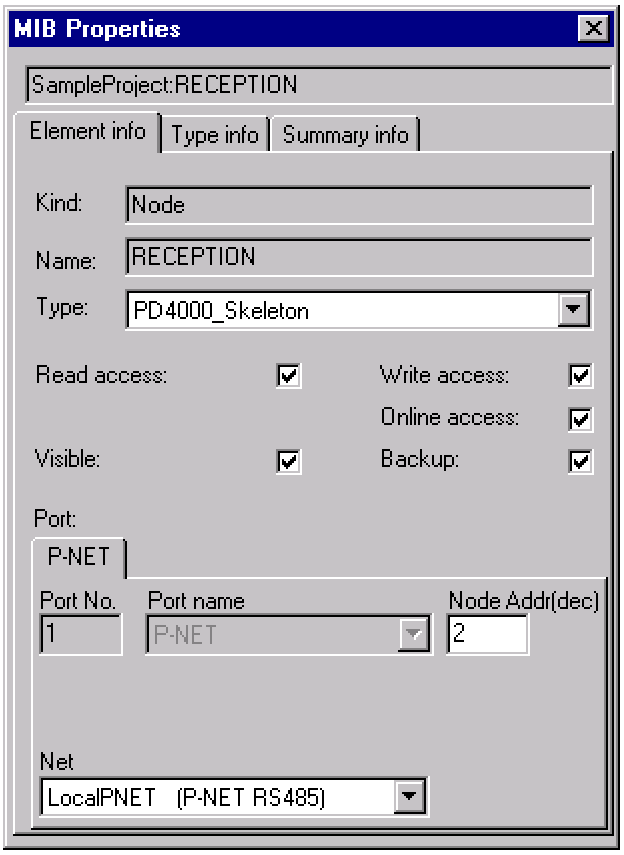
🟥	Project				
🟥	BasicType	🟥	NodeType	🟥	ChannelType
🟥	RecordType	🟥	Enumerated	🟥	ArrayType
🟥	BitArrayType	🟥	BufferType	🟥	SetType
🟥	String	🟥	BitMapType	🟥	PointerType
🟥	Procedure	🟥	Function	🟥	VirtualRecordType
🟥	VirtualArrayType	🟥	EnumeratedName		
🟦	Node				
🟦	Channel	🟦	Register	🟦	SoftwireNo
🟦	RecordField	🟦	Constant	🟦	Alias
🟦	VirtualName				

Name
The **Name** field holds the partial identifier for the variable or the type, which the MIB Element represents. The identifier can be modified, by first selecting the icon from the *MIBOCX*, then clicking the left-hand mouse button once on the name string, to enable the editing facility.

Type
The **Type** field indicates a type identifier for the variable or the type, which the MIB Element represents. In the Variables view, the Type can be selected or changed for Nodes and Virtual Names, by using the list box, and choosing one of the already defined types. In the Types View, the Type is used to select or change the sub types, which are to be included in already defined types.

Element access conditions

It is important to understand the principles of check box setting. When a check box is checked in the Project property window, it will override the equivalent checkboxes in the Nodes properties of the project, and also those in Channels and Registers. Similarly, a ticked check box in a Node will override the equivalent check boxes in Channels, Registers and SWNo. The check boxes in Channels will override those that are equivalent in Registers.


MIB Properties

SampleProject:RECEPTION

Element info | Type info | Summary info

Kind: Node

Name: RECEPTION

Type: PD4000_Skeleton

Read access: ✓ Write access: ✓

Online access: ✓

Visible: ✓ Backup: ✓

Port:

P-NET

Port No.: 1 Port name: P-NET Node Addr(dec): 2

Net: LocalPNET (P-NET RS485)

The ability to Read from and Write to a variable can be defined in the **Read/Write access** check boxes.

The **Protected write access** check box should be checked when the variable is protected by the write enable bit in the module.

The **Online access** check box is used to indicate to VIGO whether the Project, Node, variable or a field in a record, is located in an external physical Node (checked), or in a simulation file (not checked). See also page 38, *Simulation mode*.

Backup. This check box indicates to the back/restore program to include this variable in the backup.

Visible. If this box is NOT checked, the variable (and the associated sub-variables) will not be shown in MIB View. Furthermore, if the MIBOptimizer is subsequently utilised, the variable will be deleted from the resultant MIB file.

SWNo. In P-NET, a SoftWire number (SWNo), defines a logical address to identify a variable. The **SWNo** must be set in accordance with the actual value within the node.

RegisterNo - holds the number, which references the location of a variable within a Channel. (SoftWire offset)

Offset - holds the offset, (in number of bytes) of a Record Field within a Record.

Port - can contain one or more tabs, each tab having a name, the number of the Communication port, a Net name and a node address. Furthermore there can be a field for a telephone number, an IP address or an IPX address, all depending on the port type.

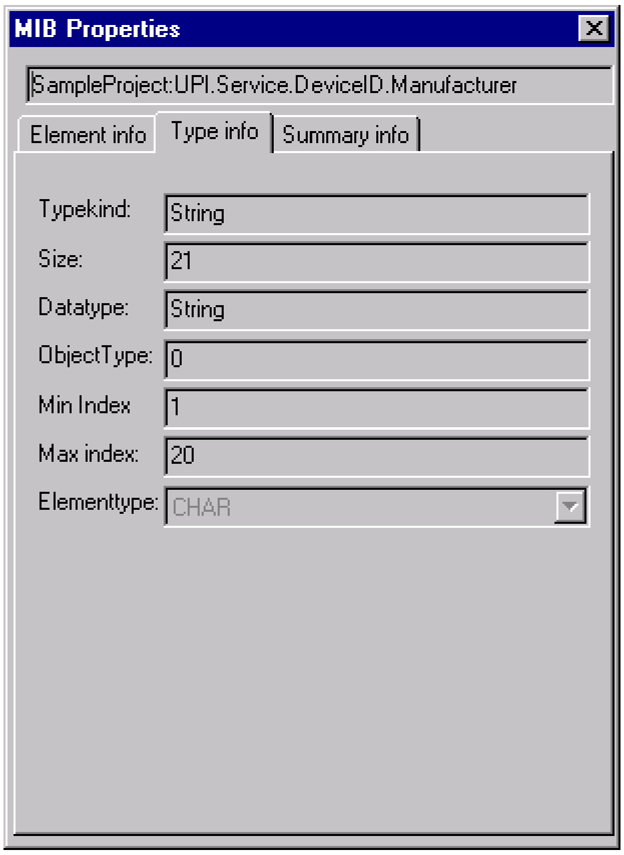
NET - is a list box, used to select to which net the node is connected. The Nets are declared within the property of the project. Only nets declared of a type that fit the port in question will be listed in the list box.

Node Addr(dec). This field holds the node address, which has been reserved for the node. This field is used together with the property of the Net, to form the complete route to the node. The Node address is a decimal value.

If the net, to which the node is connected, is of type Modem, an additional field appears within which a telephone number must be set. If the port is a LAN port, the node address is either an IP or an IPX address (help on setting up an IP or IPX connection is found on the Workspace tab under Driver parameters for the IP or IPX driver). This field is also used by P-NET, when utilising the *Set P-NET Node Address* program.

Reference is used to describe the full global identifier for an Alias. The reference can only refer to another identifier within the same project description, and therefore the Reference must be without the Project identifier.

2.4.2 Properties in Type info



SampleProject:UPI.Service.DeviceID.Manufacturer

Typekind:	String
Size:	21
Datatype:	String
ObjectType:	0
Min Index	1
Max index:	20
Elementtype:	CHAR

Capabilities. This property describes the capabilities of the destination Fieldbus Node. The coding of **Capabilities**, is Node and Fieldbus dependent. Further information about the capabilities of a particular node, may be obtained from the vendor, or from the Node manual. Reference can also be made to the Appendix, for a list of the capabilities numbers for PROCES-DATA modules.

Size. This property defines the size, in bytes, occupied by the variable within the node.

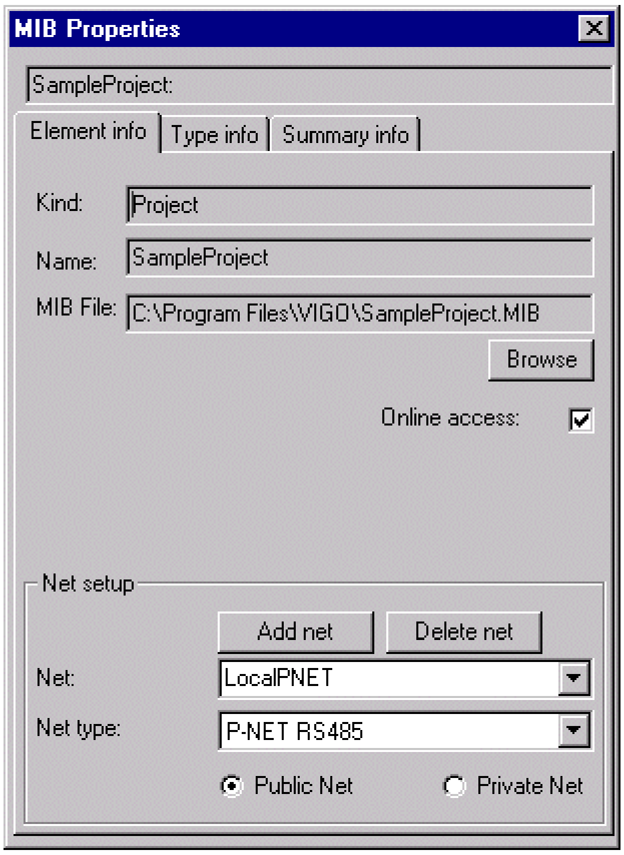
Data type. This field indicates the data type of the variable in the node.

Object Type - is used for defining the availability of right mouse menu items. The **Object Type** adheres to the numbering identification as described in the Appendix.

Min index / Max index fields, indicate the minimum and maximum index of an Array. **Element type** is used to describe the type of an Array element.

2.5 NET set up

A ***Project*** may include a number of different communication networks, each having a variety of Fieldbus nodes connected. Each network (Net) is identified with a Net Identifier. The Net identifier must be unique within a specific project. The **Net** list box is used to select a particular Net, in order to examine or modify the **Net Type** of the Net.


MIB Properties

SampleProject:

Element info | Type info | Summary info

Kind: Project

Name: SampleProject

MIB File: C:\Program Files\VIGO\SampleProject.MIB

Browse

Online access: ✓

Net setup

Add net | Delete net

Net: LocalPNET

Net type: P-NET RS485

(●) Public Net ( ) Private Net

The ***Add Net*** is used to add a new Net to the project. After ***Add Net*** is clicked, the name for the new network can be inserted in the ***Net Identifier*** field. Afterwards, the Net type can be inserted. The ***Delete Net*** is used to remove the selected Net from the project.

The Net can be selected to be public or private. Public Nets, which have been defined and named within a particular Project, are available to other projects within a given Workspace. Public Nets with identical names are assumed to be connected. Private Nets need only to have a unique name within a project. Private Nets having the same name as given in other projects are assumed to be different Nets.

A pre-defined Net type can be selected for use by a Net, such as a Local Area Network (LAN), Modem, Fieldbus etc. The Net type list box provides the means to select the required Net type for the net in question. The choice of Net types is made available by the *VIGO* program.

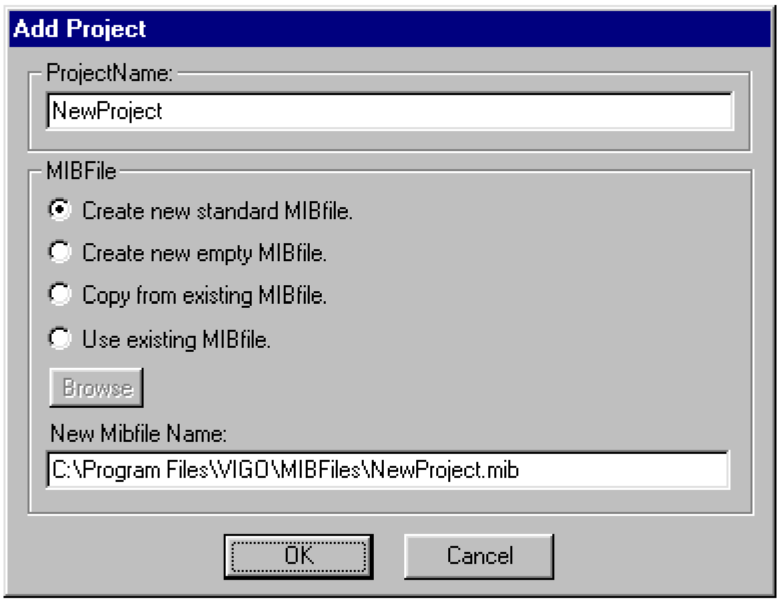
Any gateway or router must be specified in the MIB, including PC’s.

The information about all the Nets that are included in a Project is stored in the MIB file. This means that a MIB file can be located in a server, and shared with others.

2.6 Adding or Modifying Projects

Adding projects

A new project can be added to VIGO, by selecting the Workspace icon (a PC) or a Project icon, while in MIB EDIT, and clicking the right mouse button. By selecting Add Project a window is presented as shown.



Add Project

ProjectName: NewProject

MIBFile

[✓ Create new standard MIBfile.]

Create new empty MIBfile.

Copy from existing MIBfile.

Use existing MIBfile.

New Mibfile Name: C:\Program Files\VIGO\MIBFiles\NewProject.mib

Choose a name for your project, and decide whether to do one of four things:
“Create new standard MIBfile” - which means that a description file called PDTYPES.MIB is copied and associated with the new project. This file contains several predefined Types, which can be used inside other Types, or for setting up new variables or a complete Project. New Types can also be added to this Project description file.

“Create new empty MIBfile” - which means that a description file called EMPTY.MIB is copied and associated with the new project. This file contains only simple predefined Types. New Types can also be added to this Project description file.

“Copy From Existing MIBFile” – means that a new MIB is created, which is based on a MIB which already exists. Amendments to this file will not affect the MIB from which this file originated.

“Use existing MIBfile” – which means that the MIB file associated with this project is not copied but uses one that has already been generated. An existing MIB file can be selected by using the Browse facility. It should be noted that any amendments made to this file would also be seen by other projects, which have been specified to use this MIB.

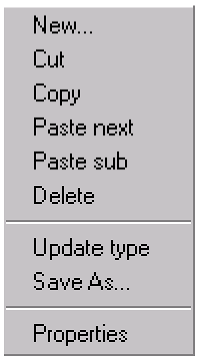
The actual name and location for a MIB file for a specific project can be found by selecting Properties on the right mouse menu for the Project in question. A new MIB file can also be selected by clicking the Browse button.

Modifying Projects

Selecting an element in a Project description is performed using the left-hand mouse button. Sub elements can be displayed if a plus [+] sign, associated with an element is clicked. Sub elements become hidden when a minus [-] sign is clicked. It is also possible to select an element of an array, by changing the element index number. Click once on the selected index number, type in a new index number and then click the mouse pointer elsewhere.

When modifying a Project description, the right mouse button menu is used to add, copy, paste and delete Elements within the MIB. This can be performed from within one Project description, or between different Project descriptions.

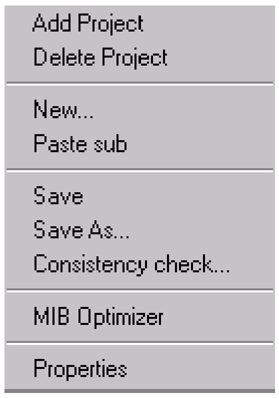
The right mouse menu is object oriented, which means that the functions in the menu vary, depending on the selected object/element. The principle is, to present only the functions and tools, applicable to the selected object.



If a NodeType icon is selected, or the Project icon is highlighted, the specific NodeType or Project can be saved, as a sub-MIB (SMB) file or as a MIB file. This is achieved by using the ***Save as*** menu item from the right mouse menu.

The saved Type can then be included in another Project description, by creating an Empty Type and using the right mouse menu item ***Update Type***.

A SMB file generated by the Process-Pascal compiler can also be arranged to be included in a Node Type in the project description.



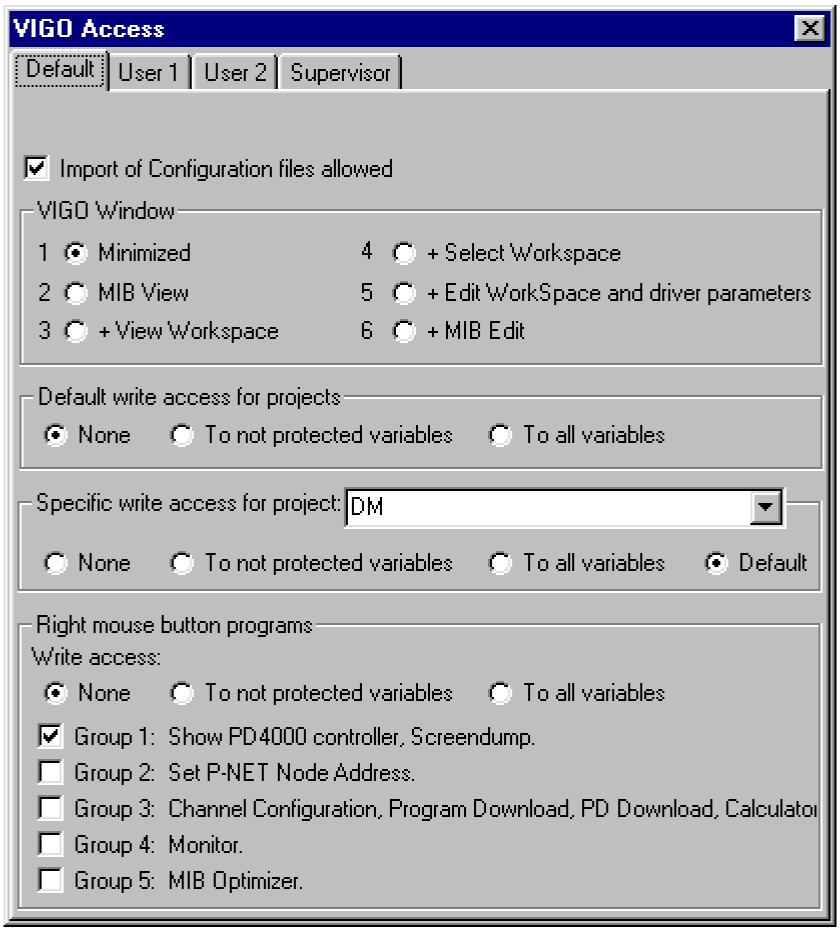
To ensure that all types within a Project description are declared before they are used, a ***Consistency check*** can be performed (selected by using the right mouse button, when the project icon is selected).

The result of the Consistency check is automatically displayed in the form of a dialogue box indicating OK, or by providing a list of errors.

The Properties for any element are set from the *Properties* window, available from the right mouse button menu, when the element is selected.

2.7 VIGO access control

The access to the different functionality in VIGO can be limited according to the operators' responsibility. As an example, the daily operator is limited to only read/write non-protected variables. The local electrician is trained in how to replace and configure nodes. Therefore, he is allowed more functionally. The person who has installed the system can be the supervisor and is allowed unlimited access.


VIGO Access

Default | User 1 | User 2 | Supervisor

[✓] Import of Configuration files allowed

VIGO Window
1 [✓ Minimized]
2 MIB View
3 + View Workspace
4 + Select Workspace
5 + Edit WorkSpace and driver parameters
6 + MIB Edit

Default write access for projects
[✓ None] To not protected variables To all variables

Specific write access for project: DM
None To not protected variables To all variables [✓ Default]

Right mouse button programs
Write access:
[✓ None] To not protected variables To all variables
[✓] Group 1: Show PD4000 controller, Screendump.
[ ] Group 2: Set P-NET Node Address.
[ ] Group 3: Channel Configuration, Program Download, PD Download, Calculator
[ ] Group 4: Monitor.
[ ] Group 5: MIB Optimizer.

VIGO allows four types of users, each with their own level of access. A **Default** user without password protection, **User 1**, **User 2** and **Supervisor** with password protection. The names "**User1**" and "**User 2**" can be changed.
The access level relates to the VIGO window (MIB View, Workspace and MIB Edit), write access to variables, and availability of programmes in the toolbox (right mouse button) menu.

Import Of Configuration files
Determines wheter or not the user will be able to import configuration files from the "Workspace" menu.

The **VIGO Window** function can be selected to be one of the following:

- **Minimized**: The VIGO window can not be opened, only shown minimized on the task bar.
- **MIB View**: Only the MIB View tab is visible.
- **+View Workspace**: Means that both the MIB View tab and the Workspace tab are active.
- **+Select Workspace**: allows in addition, that different workspaces can be selected.
- **+ Edit Workspace and drivers parameters**: Allows in addition, that the workspace and driver parameters can be edited.
- **+ MIB Edit**: Allows the user to edit the MIB, together with all other functions.

Default write access for projects
The write access for the Application programs that use VIGO, can be set individually for each Project, or a default setting can be used.

If **None** is selected, no writing to any variable is permitted, but they can all be read.

When **To not protected variables** is selected, normal unprotected variables can be written to.

When **To all variables** is selected, there is no limitation on reading or writing.

Generally, if the property of a variable in the MIB indicates no write access, the above selection will have no effect, and the result will be no write access to that variable.

Besides the default write access for projects, a **Specific write access for project** can be defined. In this way, the write access can be defined individually for each or a specific project. The write access definition for a specific project will overwrite the default definition.

The availability of certain **Right mouse button programs** can be limited for the different types of users. The right mouse button programs are divided into five groups, and each of the groups can be selected as available or not. The selection will be directly reflected on the right mouse button menu when selecting the elements in the MIB using the MIBOCX.

3 The Common Communication Service Interface

3.1 Single virtual objects

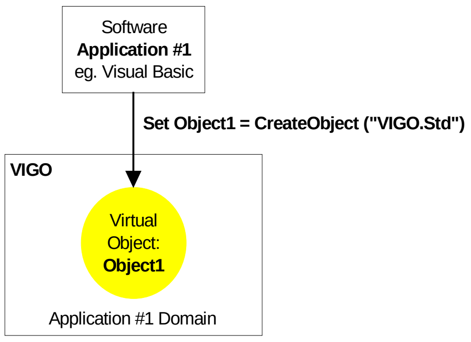
The following section describes the use of VIGO. The description uses as a basis, the programming language Visual Basic, but this can be translated into Visual C++, Delphi or Access forms without difficulty.
From a development point of view, it is a simple procedure to create an application, which has access to the physical objects.

There are only three steps to follow.

Step 1:
The first step is to create a virtual object recognised by a virtual object identifier. In this example the virtual object identifier is set to "Object1".

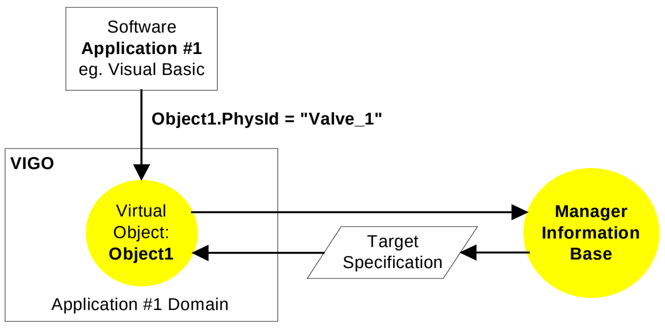
set Object1 = CreateObject("VIGO.Std")

From now on, the application will point to the Virtual Object by using the Virtual object Identifier.



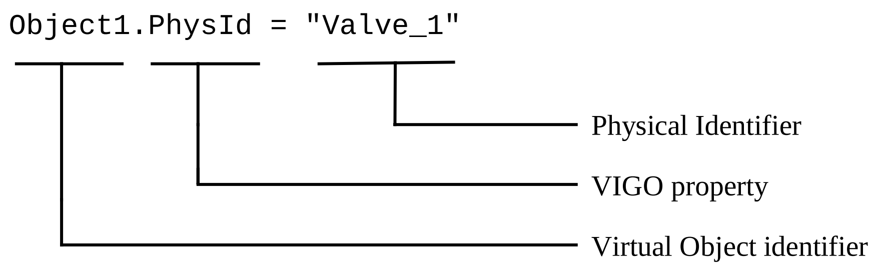
Step 2:
The next step is to associate the virtual object with the physical object.

The virtual object within VIGO, has a property called PhysId, which contains the Physical Identifier.



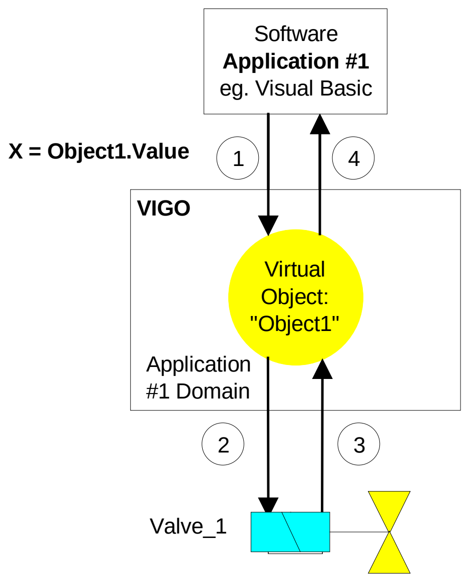
All information that is necessary to access the physical object will be obtained from the previously configured Manager Information Base (MIB), by setting the PhysId property. See the figure above.

For example, a valve is the Physical Object, and labelled as 'Valve_1'. In the Manager Information Base, the 'Valve_1' is used as the Physical Identifier for this valve and points to the physical Valve.



Step 3:

Once the virtual object points to the physical object, it is possible to operate upon the physical object. For example, it is possible to read or write to a variable.



In the case of the valve identified as Valve_1, it is now possible to get (read) or set (write) the state of Valve_1.

The valve state is read using the following code:

```
X = Object1.Value
```

By assigning the Value property of the virtual object "Object1" to the local application variable X, X will contain a Boolean value indicating the valve state of the physical object.

The valve is closed (set to OFF) using the following code:

```
Object1.Value = OFF
```

If the application needs to manipulate another physical object, step 2 and step 3 have to be carried out again.

For example, to read the value within a physical object uniquely identified as "FlowRate" and then to read a temperature in a different object, the following code would be used when using the same virtual object.

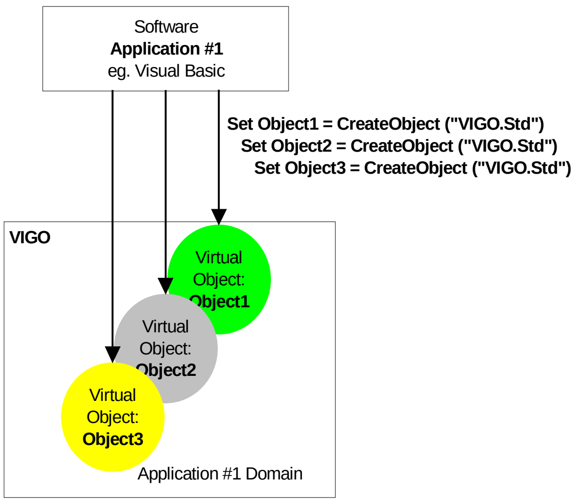
```
Object1.PhysId = "FlowRate"
Y = Object1.Value
```

The temperature is known to be found in the Project called *SampleProject*, in a Node identified as *UPI* having an analogue input channel, with the temperature value contained in the measurement register.

```
Object1.PhysId = "SampleProject:UPI.ANALOG_IN_1.ANALOGIN"
Z = Object1.Value
```

3.2 Multiple virtual objects

For an application that needs to communicate with many physical objects repeatedly, several objects can be created.
For example, a device number, a valve position and a temperature are to be monitored continuously.



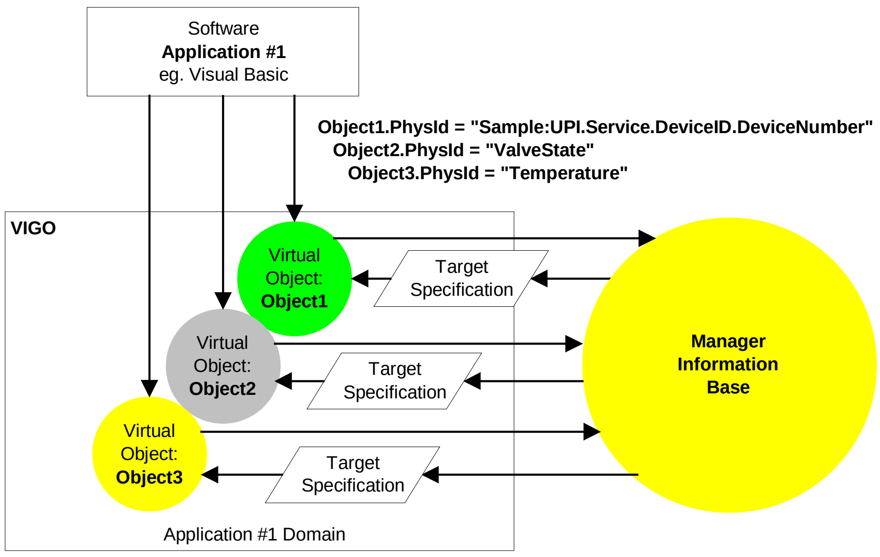
Step 1:
To create multiple virtual objects within VIGOSERV, The OLE function *Create-Object* must be called, for each instance of a new virtual object.

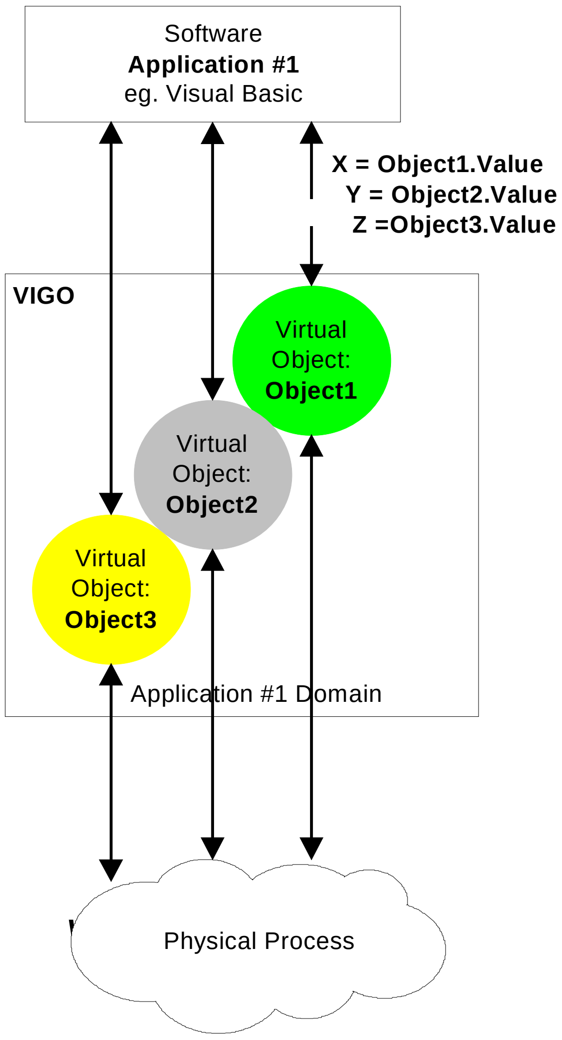
For example:
```
Set Object1 = CreateObject("VIGO.Std")
Set Object2 = CreateObject("VIGO.Std")
Set Object3 = CreateObject("VIGO.Std")
```

Step 2:
The second step is to get the virtual objects to point to the Physical Objects.

The association of virtual objects with physical objects only needs to be carried out once. This means that the procedure of calling the MIB with the global identifier, in order to retrieve the related information and apply it to the Target Specification, is only done once. Following this, the physical objects can be directly manipulated via the virtual objects, leading to a faster access, because all the network and address information is available within the Target Specification.

For example:
```
Object1.PhysId = "Sample:UPI.Service.DeviceId.DeviceNumber"
Object2.PhysId = "ValveState"
Object3.PhysId = "Temperature"
```





Step 3:
Now that the virtual objects are pointing to their associated physical objects, each of the three physical objects can be operated upon via the virtual objects (Object1, Object2 and Object3).
The current values for the valve position, device number and the temperature can now be monitored as shown below:

(Read device number)
X = Object1.Value

```
(Read valve state)
Y = Object2.Value
(Read temperature)
Z = Object3.Value
```

The first assignment will enable the device number to be ascertained from the application’s local variable X. The second assignment will enable the valve position to be determined by the local variable Y. The third assignment will ensure that the variable Z contains the temperature value.

When it is required to update the values several times, only step 3 needs to be carried out again. No further calls to the Manager Information Base will be carried out, because all the required data are already contained within the virtual objects.

3.3 Application domains and shared physical objects

Each application accessing VIGOSERV has its own application domain within VIGO. An application can only access the virtual objects it has created.

If a number of separate applications need to operate on the same physical object, each application has to create its own private virtual object, and point to the same physical object as the other applications.

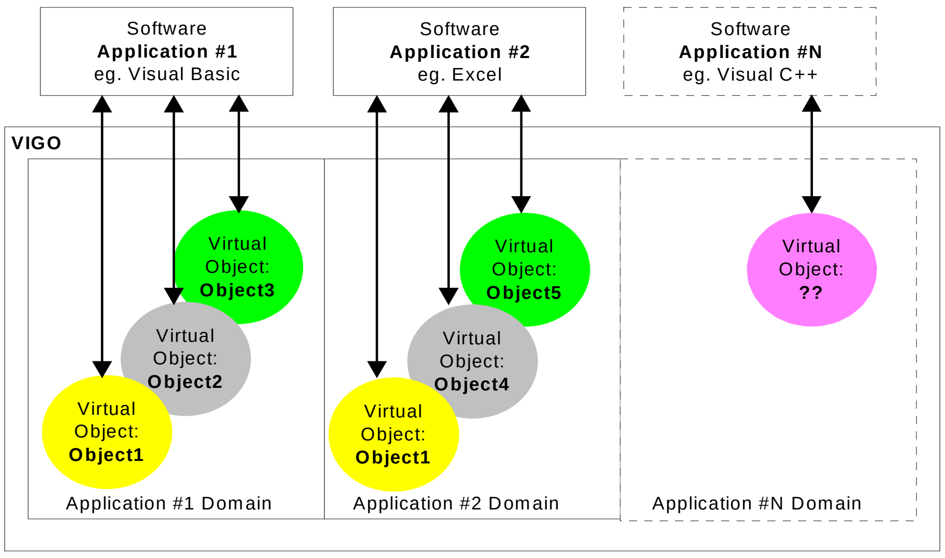
For example, two applications want to access the same measurement value, identified as "Temperature":

Application #1 (Eg: Excel)
Appl1 = CreateObject("VIGO.Std")
Appl1.PhysId = "Temperature"

Application #2 (Eg:Visual Basic)
Appl2 = CreateObject("VIGO.Std")
Appl2.PhysId= "Temperature"

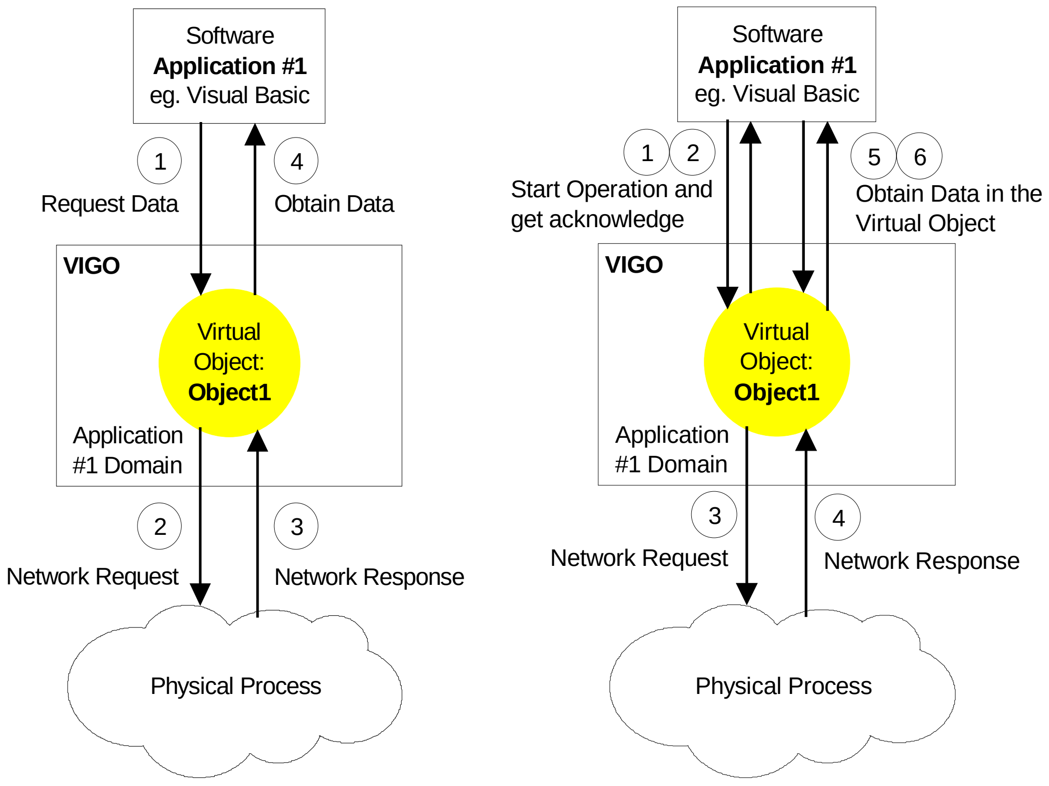
In this situation, both the virtual objects *Appl1* and *Appl2*, are pointing to the same physical object.

Different applications may use the same identifier for the virtual object, but VIGOSERV will still contain a virtual object for each application, as illustrated in the figure below.



3.4 Two ways of accessing variables over the fieldbus

Two different modes can be used to access a physical object. The first mode is called **Direct-access,** which sends a command via the network, i.e. a read command, waits for the result and then returns to the application when the command has finished and data has been obtained from the physical process system. The Direct-access approach is shown in the figure below, in the figure to the left.



The second mode is called **Buffered-access,** which also sends a command via the network, i.e. a read command, but here VIGOSERV will return immediately to the requesting application before the command has finished and the data has been obtained from the physical object. After a while, VIGOSERV will return the result to the specific VIGOSERV property associated with that particular physical object, and it is now up to the application to read the result. This is shown in the figure above, to the right. To initiate a request using Buffered-access, two Methods called *DoRead* and *DoWrite* are used. The VIGO object must be created as a VIGO.PRO object to get access to these methods.

The idea behind Buffered-access is to make parallel execution possible. For example, by initiating the reading of ten different values from the process system, the latest sampled results held within VIGOSERV can be read later by the application, when required.

Example using **Direct- access:**
Read the Valve State

```
X = Object1.Value
```

Set the Valve State to OFF

```
Object1.Value = OFF
```

Example using **Buffered- access:**
Start obtaining the Valve State

```
Object1.DoRead
```

Later in the user application program, read the Valve State

```
X = Object1.InValue
```

Set the Valve State to OFF

```
Object1.InValue = OFF
Object1.DoWrite
```

If a new result has not yet been obtained by the virtual object property following a DoRead, by the time the application requires the use of it, the property will act like Direct-access. In this case, the return to the application will only occur when the result has been obtained.

3.5 Operating on Complex Variables

It is possible for the user application to operate on complex variables contained within a node. In order to do this, it is necessary to understand how the complex data are handled by VIGOSERV.

VIGOSERV is able to transfer a complex variable from a node into a virtual object, using a single request from the user application. To do this, the property PhysId already knows the variable is of a complex type, and by using the DoRead Method, the data is obtained in the virtual object.

For example, the complex variable "Coordinate" is composed of X_Value, Y_Value and Z_Value.

```
Coordinate
    X_Value
    Y_Value
    Z_Value
```

The physical identifer for the complex variable would therefore be:

```
Object1.PhysId = “Coordinate”
```

The next step is to obtain the complex variable from the node, for the virtual object, Object1.

```
Object1.DoRead
```

The above mentioned complex data is now available within the virtual object

To select one of the sub-fields within the complex structure, another property called *SubPhysId* must be used. The internal access property InValue is used to operate on these data elements in the sub-fields.

For example:

```
Object1.SubPhysId = “X_Value”
X = Object1.InValue
Object1.SubPhysId = “Y_Value”
Y = Object1.InValue
Object1.SubPhysId = “Z_Value”
Z = Object1.InValue
```

In a similar way to reading the entire complex variable with a single request, it is also possible to write the complete complex variable, using a single request from the user application. For example:

```
Object1.DoWrite
```

This way of handling complex data structures can reduce the total number of data transmissions on a network. This feature also gives the ability to obtain information, which is closely related, and time synchronised.

3.6 Error handling

VIGO provides extensive information about any errors that may occur during each of the communication tasks and during the use of VIGO.

When using properties or methods for an object, the VIGO system will set an *ErrorCode* Property to a value that corresponds to the result of the performed action. The *ErrorCode* may relate to errors in communication, conversion errors or errors from searching in the MIB.

The *ErrorCode* can be monitored by the application, following any access to a property or method for the object. If an error occurs, the *ErrorCode* is set to a unique number. If no error occurs, the ErrorCode will be SUCCESS (0x0000).

The application can also read the *ErrorCode* as a text string. The error string is contained in the *ErrorString* Property. When reading the *ErrorString* property, a translation of the *ErrorCode* into a text string is automatically performed. If an error occurs, the application can be programmed to take specific action, as shown in the examples below.

Error handling in VIGO follows the OLE Automation Exception rules contained within the Microsoft Windows^{TM} OLE2 specification. When virtual objects are created, Exceptions are disabled.

It is possible to disable and enable exceptions using the following property for the object:

```
Object1.EnableExceptions    = True        (* or False *)
```

Below is a Visual Basic program example using Exceptions:

```
Sub Timer1_Timer ()
            On Error GoTo ErrorHandler ‘Exception
            TempText.Text = Object1.Value
Finish:     Exit Sub

ErrorHandler:
      TempText.Text = Object1.ErrorString
      Resume Finish
End Sub
```

The example above shows that the error information given by the object property *ErrorString*, will be shown instead of the temperature "Object1.Value", in cases where an error occurs.

Below is a Visual Basic example, where the ErrorCode is monitored following an access to a read Property:

```
Object1.PhyId ="Temperature"
Temp = Object1.Value
If Object1.ErrorCode Is SUCCESS Then
  TempText.Text = Temp
Else
  TempText.Text = Object1.ErrorString
End If
```

The error information given by the object property *ErrorString* will be shown in the text field identified by TempText, in cases where an error occurs.

3.7 Error messages and Error Files

The object property *ErrorString* contains a text string that describes the current error in plain text. The error may have occurred from within VIGOSERV, an IDC, a network (eg. P-NET Fieldbus, LAN etc.), the MIB that holds the project description, or the communication kernel HUGO2.

The error message is converted from an error code into an error message, which is automatically translated into the same language as that selected on the machine in which VIGO is running. The error messages are found in files, having the file-extension corresponding to the language definition specified by Microsoft. A VIGO standard installation provides texts for Danish and English errors. The text files are found in the VIGO program folder with the extension DAN and ENG respectively.

If an error text file is not found for the chosen language, a file with the extension ENU will be selected. The default language for files with extension ENU is set to English.

Copying an existing error text file into another file with the same file name can create an error text file for a new language, but with a file extension that matches the new language. The error messages can then be translated into the new language within the new file.

3.8 Simulation mode

One of the property settings of a VIGO object determines whether specific variables are located externally within an actual physical node on a network, or are held internally within the PC for simulation purposes. This property, called "OnLineaccess" can only be set when using VIGO.PRO.
The state of this property can be assigned from within an OLE compliant application programme written, for example, in Visual Basic or Delphi.

The corresponding property in the MIB, called "Online access" can also be set to specify whether variables are located externally or internally.

If the **OnLineAccess** property for a VIGO object is set to false (not-checked in the properties window), it means that the value of a particular variable can be read or modified from an internal location (on the PC), rather than relying on the fact that the physical node would normally have to be connected. This facility can be extremely useful during the commissioning and testing phases of a new project. Once one of the properties have been set, VIGO ensures that any reading or writing to a declared variable, will be directed to the internal simulated variable. Any additional operations on this variable, such as, for example, to simulate the incrementing of a counter, would be arranged using a separate simulation-test program, which will run in parallel with the application being tested.

3.9 OLE Automation Interface

VIGOSERV has been designed in accordance with OLE Automation rules, defined for the Microsoft Windows^{TM} environment. VIGOSERV gives access to object properties and methods, which can be used by any application supporting OLE Automation. For a virtual object, a property represents a variable and a method represents a procedure.

Each property offers a pair of functions, one to get (read) the property value and one to set (write) the property value. Therefore, when object properties are used in application programmes through VIGOSERV, one of two things are performed:

Set the value of a property (Write)
Get the value of a property (Read)

With most properties, their values can either be read or set according to the needs of the application. Properties that can be read or set are called read-write properties. Some properties only allow an application to get their value. These are called read-only properties.

A method performs an action on an object, and may or may not return a value. Methods may take a number of arguments. Arguments can be passed by value or by reference.

3.10 Performance

The performance of VIGO is not dependent on the user application, because VIGO is built for real-time communication, which is performed using interrupts. The communication task will not stop, even if the loading of a large file is taking place or a word processing program is being started.

VIGO is able to handle several hundred external data requests per second. However, performance depends on the efficiency of the underlying network driver and network performance.

4 Advanced VIGO Programming.

In VIGO version 4.0, there are two 32-bit OLE automation interfaces, structured as InProc OLE servers.
These interfaces are called VIGO standard and VIGO professional.

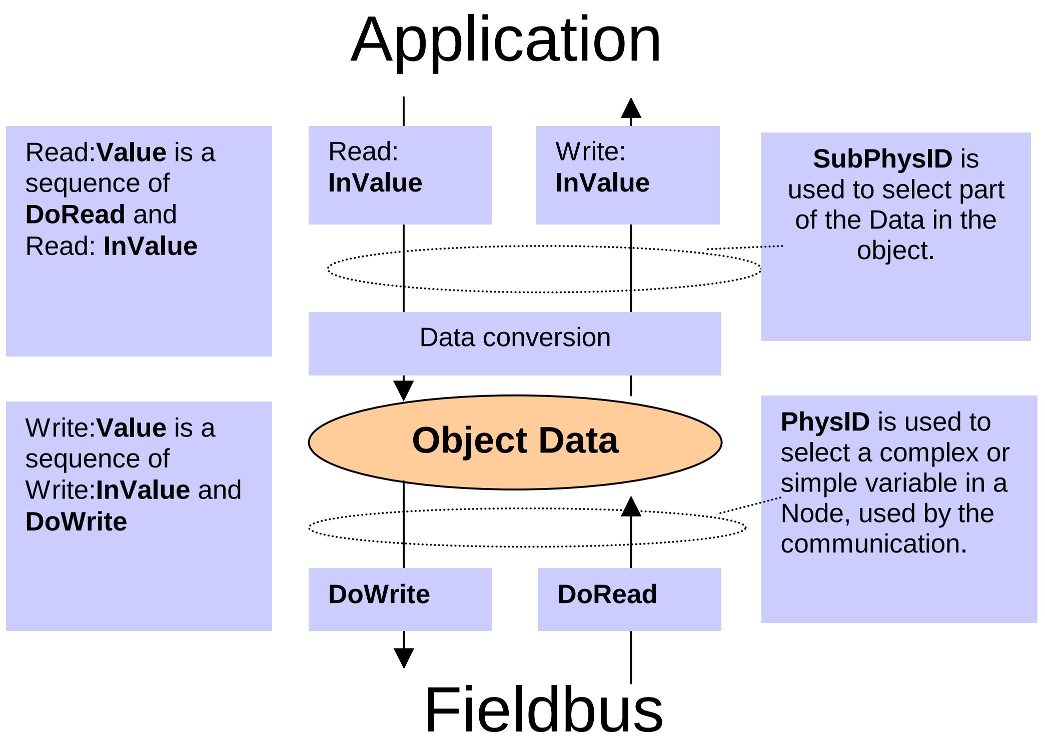
VIGO standard is a reduced interface for ease of use, where the number of properties available is limited to the following: **PhysId, Value, ErrorCode, ErrorString**. All commonly used read and write operations can be achieved.
To establish contact with VIGO standard, an OLE automation object must be created, where the OLE name for the VIGO standard object is "VIGO.STD".
Invoking a particular command, which depends on the programming language being used, performs this.

In Visual Basic, the command is: Set Obj = CreateObject ("VIGO.STD")
In Delphi, the command is: Obj:= CreateOleObject ('VIGO.STD');
In Visual C++, the command is: Obj -> CreateDispatch("VIGO.STD");

VIGO professional is used for advanced programming, with an extended set of properties and methods.
To establish contact with VIGO professional, an OLE automation object must be created, where the OLE name for the VIGO professional object is "VIGO.PRO".
Invoking a particular command, which depends on the programming language being used, performs this.

In Visual Basic, the command is: Set Obj = CreateObject ("VIGO.PRO")
In Delphi, the command is: Obj:= CreateOleObject ('VIGO.PRO');
In Visual C++, the command is: Obj -> CreateDispatch("VIGO.PRO");

4.1 Properties and methods in VIGO professional


Application
Read:**Value** is a sequence of **DoRead** and Read: **InValue**
Read: **InValue**
Write: **InValue**
SubPhysID is used to select part of the Data in the object.
Data conversion
Write:**Value** is a sequence of Write:**InValue** and **DoWrite**
Object Data
PhysID is used to select a complex or simple variable in a Node, used by the communication.
DoWrite
DoRead
Fieldbus

A Read of a variable within a node into an application is divided into two steps. First, the content of the variable is loaded into the Object Data. The next step is to convert the received data, and then transfer the converted data to the application. A similar situation occurs to Write, except that the first step is to convert data sent from the application, and then to store the converted data in Object Data.

4.1.1 PhysId

PhysId is used to relate the VIGO object to a variable within a Node. Assigning the Global Identifier to the PhysId will achieve this**.** The normal format for a Global Identifier is:

ProjectIdentifier:NodeIdentifier.ChannelIdentifier.Register…

If the global Identifier does not contain a ProjectIdentifier, the default project selected in the Workspace tab in VIGO will be assumed.

Writing to this property will start a search in the **MIB.** This search will return all the necessary information about the variable, such as the Addresses and Offsets needed to access the variable within a particular Node.

Writing to the **PhysId** property will resize and clear the Object Data to zero.

The following Properties of an object are set according to the contents of the MIB:

NodeAddress, InternalAddress, Offset, BitNo, ICDNo, Size, ObjectType, DataType, NodeCapabilities.

DoRead/ DoWrite methods, or a read/write of the **Value** property, will use these properties when accessing Variables in Nodes via the fieldbus.
The following assignments are also performed:

SubOffset= 0
SubDataType= DataType ,
SubBitNo= BitNo,
SubSize=Size

These properties are used when reading/writing to the **Value** and **InValue** properties.

The result of the search in the MIB, will also set the following properties**:**

ReadAccess, WriteAccess, OnLineAccess

The **ErrorCode** will be set, depending on the result of the search in the MIB.

4.1.2 SubPhysId

SubPhysId is used to specify a sub-part of a complex variable already specified in **PhysId.**

The SubPhysId must be assigned with the additional *.Identifier* , e.g. a record field identifier. The **PhysId** can be set to point to a complex array-variable. The SubPhysId property can then, for example, be used to specify a specific array element.

The **SubPhysId** property cannot hold: *Project, Node, Channel, Register or SwNo*, only Array [index] ’s and Record field Identifiers. The **PhysId** must be pointing to at least a SwNo or a Register in a Channel, before **SubPhysId** can be used to select part of the SwNo or the Register.

Writing to the **SubPhysId** property will start a search in the **MIB,** to get the value of the following properties: **SubOffset, SubDataType, SubBitNo, SubSize.**
No other properties are affected, including Object Data.

If the **SubPhysId** is set as an empty string, the following assignment is performed: **SubOffset= 0, SubDataType= DataType, SubBitNo= BitNo, SubSize=Size.**

The **ErrorCode** will be set according to the result of the search in the MIB. The properties set by **SubPhysId** have an influence on the access, when using the **InValue** property and **Value** property.

Read/Write to **InValue**:

If **SubPhysId** is empty, the entire variable specified by the **PhysId** will be transferred between the application and the VIGO object.
If **SubPhysId** is not empty, only the part of the variable specified by the **SubPhysId,** will be transferred between the application and the VIGO object.

4.1.3 InValue

InValue represents a sub-part of the variable in Object Data, as specified by the **SubPhysId**. The **InValue** property is declared as a Variant type, and can handle all kinds of data (Integer, Real, String, Arrays, etc.). A Read of this property will return the specified part of the internal variable in the VIGO object. Similarly, a Write will write to the Object Data. There is no fieldbus communication.

When reading **InValue,** VIGO converts the part of Object Data specified by the **SubDataType,** and returns this data as a Variant**.** A part of this conversion task, is also to swap the bytes, according to the little/big endian principle (Intel/Motorola). The data-conversion is **ONLY** performed on simple data-types (Boolean, byte, integer, real...). It is therefore **not** recommended to use **InValue** on complex variables.
In the same way, a Write to **InValue**, will convert the Variant from the application to the correct data type appropriate for the variable in the field device, and will then store the data in the internal Object Data.

If the **SubPhysId** holds a part of an identifier, only the part specified by the **SubPhysId** will be transferred between the application and the object.

4.1.4 DoRead

The **DoRead** method is used to load a variable from a node into Object Data. The variable is specified by the properties set by **PhysId (NodeAddress, InternalAddress, Offset, BitNo, Size, ObjectType, DataType, IDCNo, NodeCapabilities**). The data is NOT converted.

DoRead starts the communication, and then immediately returns to the calling application. The Data will arrive later in Object data. If a new **DoRead** is started, within the same VIGO object, before the previous **DoRead** or **DoWrite** has been completed, the process will not return to the application, before the former **DoRead/DoWrite** is completed and the new DoRead has been started.

The **DataReady** property will be FALSE, until a completed response from the Node is received.

4.1.5 DoWrite

The **DoWrite** method is used to transfer the data from Object Data into a variable in a node. The variable is specified by the properties set by **PhysId (NodeAddress InternalAddress, Offset, BitNo, Size, ObjectType, DataType, IDCNo, NodeCapabilities**). The data is NOT converted.

DoWrite starts the communication, and returns immediately to the calling application. The response will arrive later. If a new DoWrite is started, within the same VIGO object, before a previous **DoRead** or **DoWrite** has been completed, the process will not return to the application before the former **DoRead/DoWrite** is completed and the new DoWrite has been started. The DataReady property will be FALSE, until the completed response from the Node is received.

4.1.6 Value

Value is a property, representing the variable specified by **PhysId** and the **SubPhysId**. The **Value** property is declared as a Variant type, and can handle all kinds of data (Integer, Real, String, Arrays, etc.).

A Read or Write to this property is equivalent to a read or write to the variable. VIGO returns to the calling application when the data is available, or when no response has been received after a timeout of a maximum of two seconds.

During a Write to **Value**, VIGO takes care of converting the Variant received from the application into the correct data type appropriate for the variable in the field device. It also swaps the bytes according to the little/big endian principle (Intel/Motorola). When reading **Value**, VIGO converts the loaded data into a Variant, using the properties set by **SubDataType.** The data conversion is **ONLY** performed on simple data types (Boolean, byte, integer, real etc.). It is therefore **not** recommended to use **Value** on complex variables.

A Read to **Value** is performed by first calling **DoRead,** followed by Reading **InValue**,
A Write to **Value** is performed by Writing to **InValue,** followed by calling **DoWrite.**

If the **SubPhysId** is not empty, only the part specified by the **SubPhysId** will be transferred between the application and Object Data, but the *whole* variable will be transmitted on the network to/from the Node. *Be careful if SubPhysId is not empty when using Value ! Some of the data in the object may be zero.*

4.1.7 ExAnd (And)

The ExAnd property is a P-NET specific property, to AND a value to a variable in a P-NET module. The **ExAnd** property is declared as a Variant type. Writing to this property will perform a logical AND function between Data written to the property and the Data already in the variable. The result is stored in the Variable.

4.1.8 ExOr (Or)

The ExOr property is a P-NET specific property, to OR a value to a variable in a P-NET module. The **ExOr** property is declared as a Variant type. Writing to this property will perform a logical OR function between Data written to the property and the Data already in the variable. The result is stored in the Variable.

4.1.9 TestAndSet

The TestAndSet property is a P-NET specific Read Only property, to Test-And-Set a Boolean in a P-NET Node. Reading this property will start a special communication service that reads and sets the Boolean true in the Node. The result of the reading is returned to the application as a Variant.

4.1.10 ErrorCode,

ErrorCode is a Read Only property of the type Integer (2 bytes). This property indicates whether an error has occurred, after accessing certain properties and methods.

ErrorCode = 0 indicates that there is no Error. If the **ErrorCode** <> 0, this indicates, that some aspect of a transfer has been found to be incorrect.

The following properties and methods will generate an **ErrorCode**:

PhysId, SubPhysId, Value, Invalue, DoRead, DoWrite, Download, Upload, ProgramState, ModelName, Revision, Programname, NodeAddress, Vendor, Start, Stop, Reset, Resume, Kill, SelectProgram, UnSelectProgram, DeleteDomain, TerminateDownload, ExAnd, ExOr and TestAndSet.

The ErrorCode is not changed until one of the mentioned VIGO properties or methods is used again. The **ErrorCode** can be read as error text in the **ErrorString** property.

4.1.11 InformationInErrorCode

This Boolean property controls if Historical Errors are visible in the **ErrorCode**. If **InformationInErrorCode** is set to TRUE, then Historical Errors are also visible in **ErrorCode**. The default value for **InformationInErrorCode** is FALSE.

4.1.12 ErrorString

The **ErrorString** is defined as a Read Only string (max 150 characters). In reading this property, a text string will be returned, containing an explanation of the ErrorCode. The language of the error string depends on the language that has been selected on the machine. If the selected language is not supported in VIGO, English will be chosen.
If the ErrorCode is zero, the ErrorString will be empty.

4.1.13 DataReady

DataReady indicates whether a **DoRead, DoWrite, Upload or Download** cycle has finished. **DataReady** should be tested before a new **DoRead** or **DoWrite** is used on the same object, DataReady returns False when a DoRead or DoWrite method is in progress. DataReady returns to the calling application immediately.

4.1.14 SetMessage

This method is used to set up a message that will be sent when a **DoRead** or **DoWrite** on the particular object has finished.
The method is called with four parameters:
SetMessage(parameter1, parameter2, parameter3, parameter4)

1. parameter: Type "Long".
Handle of Window that the message will be sent to.

2. parameter: Type "Long".
MessageNumber that will be posted after DoRead/DoWrite has finished.

3. parameter: Type "Long".
Optional userdata. This value will be posted along with the message itself as the wParam of the Windows message.

4. parameter: Type "Long".
Optional userdata. This value will be posted along with the message itself as the lParam of the Windows message.

An application can call this method before starting a **DoRead** or **DoWrite**. This way it is not necessary for the application to continuously call **DataReady** to check if the **DoRead/DoWrite** has finished. The **SetMessage** method must be called before starting the **DoRead** or **DoWrite**.

4.1.15 EnableExceptions

If **EnableExceptions** is set TRUE, all errors from VIGO will perform an Error Exception in the client program. The client program must then handle the exception.

The default value for EnableException is FALSE.

The ErrorCode and ErrorString can then be read by the Exception handler.

4.2 Properties set by PhysId

PhysId normally sets the following properties. These properties can be read, and by doing so, the MIB can be checked. In very special situations, the application program can, with care, write to these properties.

4.2.1 InternalAddress

The **InternalAddress** property is designed to hold the “internal address” of a variable in a Fieldbus module.
For P-NET, the “internal address” is a softwire number, but it can also be a physical address in a module. If **PhysAddress** is true, a physical address is assumed.
The **InternalAddress** is used by **DoRead, DoWrite, Download** and **Upload,** and indirectly by **Value.**
InternalAddress is automatically set when writing to a **PhysId.**

4.2.2 BitNo

The **BitNo** property is used to select a single bit in a BitArray. This property is used when accessing a field device. The **BitNo** is used by **DoRead, DoWrite** and indirectly by **Value.**
It is automatically set when writing to a **PhysId.**
Writing to the **BitNo** property will copy **BitNo** to **SubBitNo**.

4.2.3 Offset

The **Offset** property is used to specify a byte offset within a complex variable in a Node. When a record field within a larger complex variable is to be selected, the offset specifies the position of the first byte of this field within the record. **Offset** is used by **DoRead, DoWrite, Download** and **Upload** and indirectly by **Value.**

When the **Offset** property is changed, **SubOffset** is automatically set to 0.

The offset is automatically set when writing to a **PhysId.**

4.2.4 Size

The **Size** property indicates the size of the Variable (in bytes), to be accessed via the fieldbus. It indicates to the communication stack the number of bytes to be transferred. It is also used to allocate memory for the VIGO object. **Size** is used by **DoRead, DoWrite** and indirectly by **Value.**

Size is automatically set when writing to a **PhysId.**

Writing to the **Size** property will copy **Size** to **SubSize**.

4.2.5 ObjectType

The **ObjectType** property holds an integer value associated with a particular type of object. The object type is used to identify whether the object (specified by PhysId), is a particular type of Node, Channel, SwNo, or Register. As an example, all the different Channel types have different object type numbers. The **ObjectType** should reflect the actual data type in the field device.
An application program can use this property for testing the object type. For example, the download program can only work with a Program Channel as the target. A list of Object types for channels and modules can be found in the Appendix.

ObjectType is automatically set when writing to **PhysId.**

4.2.6 DataType

The **DataType** property holds an integer value, which defines a particular data type. This object type should reflect the actual data type in the field device. It **is *not*** used for data conversion. A list of data types can be found in the Appendix.

DataType is automatically set when writing to **PhysId.**

4.2.7 WriteAccess.

The property **WriteAccess** holds the status of a variable, selected by **PhysID.** When writing to **PhysId,** this property is set to True, if all elements in the Global Identifier have "Write Access" checked (Project, Node, Channel, Register or SwNo) else it will be set to False.

4.2.8 ReadAccess.

The property **ReadAccess** holds the status of the variable, selected by **PhysID**. When writing to **PhysId,** this property is set to True, if all elements in the Global Identifier have "Read Access" checked (Project, Node, Channel, Register or SwNo), otherwise it will be set to False.

4.2.9 OnlineAccess

OnlineAccess is a Boolean property, used to indicate whether a **DoRead, DoWrite** or indirectly by **Value,** shall access an external Node or an internal simulation file**.** If **OnlineAccess** is True, there will be communication on the Fieldbus network. If **OnlineAccess** is false, the data will be read from or stored in a simulation file. When writing to **PhysId,** this property is set to True, if all elements in the Global Identifier have "Online**Access**" checked (Project, Node, Channel, Register or SwNo), otherwise it will be set to False.

4.2.10 ProtectedWriteAccess.

This property reflects the state of the “Protected” checkbox of the variable selected by **PhysID. ProtectedWriteAccesss** = True, means that the variable is protected by Write Enable. It is also used to prevent the user accessing variables with **ProtectedWriteAccess,** when VIGO Access is not granting write access to write protected variables.

4.2.11 NodeCapabilities

The **NodeCapabilities** property informs the IDC which protocol limitations that shall be used for read or write to a specific Node.

The value in **NodeCapabilities** depends on the format that can be used on specific Fieldbuses. A list of the capabilities numbers for P-NET can be found in the Appendix.

NodeCapabilities is used by **DoRead, DoWrite** and indirectly by **Value.** It is automatically set when writing to **PhysId.**

4.2.12 NodeAddress

The **NodeAddress** property holds the full address of a Node on the Fieldbus. The format for the Node address must follow the HUGO2 standard for building a Node address.

NodeAddress is automatically set when writing to **PhysId**.

4.2.13 MaxRetry

Reserved for future use.

4.2.14 PhysAddress

The **PhysAddress** property is of type Boolean. When the property is set TRUE, VIGO will inform the PNET IDC to use physical addressing, instead of logical addressing.

The physical address used must be written in the **InternalAddress** property.

This property is set false when writing to **PhysId.**

4.2.15 IDCNo.

The **IDCNo** property must hold the number for the IDC that is appropriate for the target Node. **PhysId** normally sets this property**.** This property should only be accessed in very special circumstances.

4.3 Properties set by SubPhysId

SubPhysId normally sets the following properties. These properties can be read, and by this means, the MIB can be checked. In very special situations, the application program can, with care, write to these properties.

4.3.1 SubBitNo

The **SubBitNo** property is used to select a single bit in a BitArray. This property is used when the application exchanges data with the VIGO object, and the data type is a Bit array. The **SubBitNo** is used by **InValue** and indirectly by **Value.**

SubBitNo is automatically set when writing to **PhysId** or **SubPhysId.**

4.3.2 SubOffset

The **Suboffset** property is used to specify the byte offset within a complex variable, located in a VIGO object. When a record field within a larger complex variable is to be selected, the offset specifies the location of the first byte of this field within the record. The **SubOffset** is used by **InValue** and indirectly by **Value.**

SubOffset is automatically set when writing to a **PhysId or SubPhysID.**

4.3.3 SubSize

The **SubSize** property indicates the size (in bytes), of the selected part of the Variable in the VIGO object. This property is used when the application exchanges data with the VIGO object. The **SubSize** is used by **InValue** and indirect by **Value.**

SubSize is automatically set when writing to **PhysId** or **SubPhysId.**

4.3.4 SubDataType

The SubDataType property holds an integer value that identifies a particular data type. The number should reflect the actual data type of the selected part (**SubPhysId**) of the variable in the VIGO object. This **SubDataType** is used by the conversion function when the application exchanges data with the VIGO object. A list of data types can be found in the Appendix. When writing to **PhysId** or **DataType**, the new value of DataType is copied to SubDataType.

The **SubDataType** is used by **InValue** and indirectly by **Value.**

4.4 RACKS (MMS) related properties and methods

4.4.1 Vendor

This Read only property will return the name of the **Vendor** of the Node selected by **PhysID**.

4.4.2 ModelName

This Read only property will return the model name of the Node selected by **PhysID**.

4.4.3 Revision

This Read only property will return the revision of the Node selected by **PhysID**.

4.4.4 ProgramState

The **ProgramState** property follows the MMS standard, and is used in Program channels. These channels must be of object type 11, otherwise **ProgramState** cannot be used.

Further information about ProgramState can be found in the manual for any of the nodes that have a program channel.

4.4.5 ProgramName

The **ProgramName** property follows the MMS standard, and is used in Program channels. These channels must have the ObjectType property set to 11, otherwise **ProgramName** cannot be used.

Further information about ProgramName can be found in the manual for any of the nodes that have a program channel.

4.4.6 FileName

This property is of type string. It is used to hold a path to a file when **Download** or **Upload** is called.

4.4.7 Progress

Progress is a Read Only property of Integer type, that holds the number of bytes transmitted in percentage of the total number of bytes, to be transmitted. The Progress property is valid with **Download** or **Upload.**

The Progress property is very useful, for indicating to the user that the data transmission is still running.

4.4.8 StopSequence

The StopSequence method can stop a data transmission, which has been started with **DoRead, DoWrite, Download** or **Upload.**

4.4.9 Download

This method is used to download a program to a standard Program Channel. The paths must be set prior to its use, in **Filename.**

4.4.10 Upload

This method is used to upload a program from a standard Program Channel. The paths must first be set in **FileName. This method is not implemented in VIGO 4.0.**

4.4.11 DeleteDomain

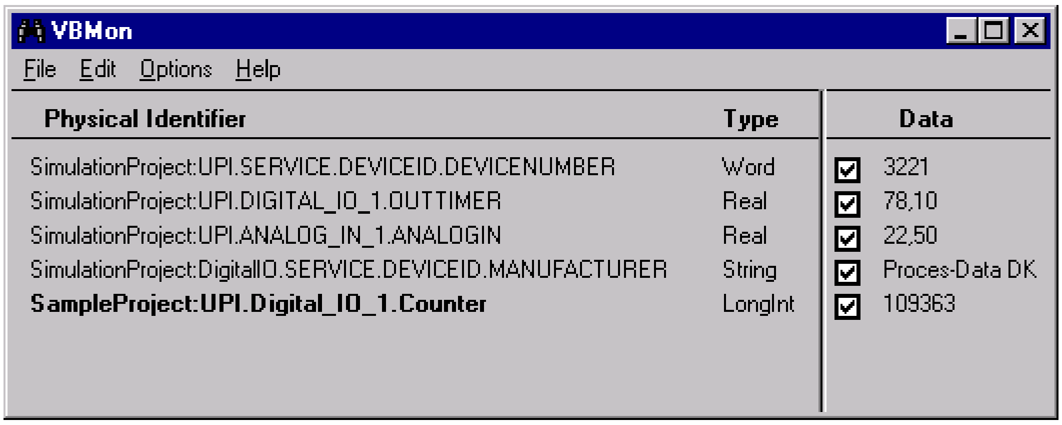
This method is used to delete the selected domain in a standard Program Channel. The domain must be selected first**.**

4.4.12 Start, Stop, Resume, Reset, Kill

These methods can be used with a standard P-NET Program Channel. They provide equivalent name functions, as described in the standard for the Program Channel.

5 VBMon

The *VBMon* program is a service tool for monitoring fieldbus variables, and to enable parameters to be configured within fieldbus based control systems. The monitor can be used to both display and modify the value of variables. Variables are usually identified using a globally recognised name, called the Physical Identifier (PhysId).



Physical Identifier	Type	Data
SimulationProject:UPI.SERVICE.DEVICEID.DEVICENUMBER	Word	✓ 3221
SimulationProject:UPI.DIGITAL_IO_1.OUTTIMER	Real	✓ 78,10
SimulationProject:UPI.ANALOG_IN_1.ANALOGIN	Real	✓ 22,50
SimulationProject:DigitalIO.SERVICE.DEVICEID.MANUFACTURER	String	✓ Proces-Data DK
SampleProject:UPI.Digital_IO_1.Counter	LongInt	✓ 109363

The monitor can display the value of many variables at the same time, each one allocated to a separate line.

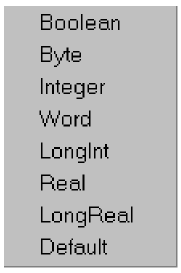
Specified variables can be located within different projects, nets and nodes. Normally, each line is divided into three fields: **Physical Identifier**, **Type** and **Data**. An optional **Offset** field can also be shown. The width of the Physical Identifier, Offset and Data fields, can be adjusted by dragging the vertical line shown between the Type and Data fields, and by re-sizing the window.

The **Physical Identifier** field is used to define which variable to display. Double clicking a line in this field will cause it to change into a white editing field, which also includes a ***MIB*** button. The contents of the Physical Identifier field can now be keyed in manually, or alternatively, by pressing the ***MIB*** button. The required variable can now be selected from the project structure. The format of a Physical Identifier entry would normally consist of a "project name" followed by a colon, then the rest of the identifier, which includes the node name and the variable name. For example: "Test**:**UPI1**.**SERVICE**.**WDTIMER". The project identifier and the colon can in fact be omitted. It is then assumed that the Default Project, as previously specified, will act as the project identifier.
The MIB is used to convert the Physical Identifier into the actual "address", required to access the variable.

5.1 The Type Field

Under normal circumstances, the MIB also returns the data type of the variable in question, which is then automatically inserted into the **Type** field. In certain cases, it may be preferable to manually key in a Softwire number. This can be achieved, by formatting the Physical Identifier as: Project identifier: "Node identifier.Softwire number". For example, "SampleProject:UPI1.18" (or UPI1.$12 in Hex) In this case, the data type must also be set manually. Clicking the right mouse button from within the Type field will produce a list of available data types for display. Clicking on one of these will insert the data type name into the Type field, and the displayed variable will be formatted as such.

If the Physical Identifier specifies an Array or Record, the Type field shows "-----", because it is not possible to present the complete value of a complex variable.
When accessing a variable using a softwire number, or part of a complex variable using an offset, the data type must be selected manually. As previously described, this is done by clicking the right mouse button within the **Type** field, and then selecting the appropriate data type. If the selected data type differs from the data type specified in the MIB, it is shown enclosed in brackets, e.g. [LongInt], and the readings seen may be unpredictable. By selecting ***Default***, the type specified by the MIB is used.



5.2 The Offset Field

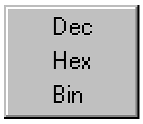
The value within this optional field is always assumed to be zero, for variables of simple data type. For variables of complex type (array or records), the **Offset** field can be used to manually define an offset, in bytes, to a sub element of the variable. Double clicking within the Offset field, enables the offset value to be changed from zero. However, this means that the Physical Identifier no longer fully represents the data value displayed.

5.3 The Data Field

This field displays the value of the variable, pointed to by the Physical Identifier field. A check box in the field is used to enable automatic updating of data values. The refresh rate can be specified in the ***Options*** menu. The default rate is two updates per second.

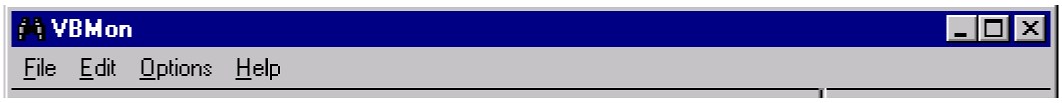
Writing a value to a variable is performed by double clicking on the appropriate Data field line, entering the new value, and then pressing Enter.

The readout format can be selected to be in either Decimal (default), Hexadecimal or Binary, for the following data types: Byte, Integer, Long Integer and Word. The number of digits displayed after the decimal point can be selected for variables of the Real data type The selection can be made by using the right mouse button, when the cursor is pointing to a particular value in the **Data** field.

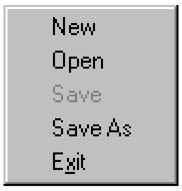


If an error message or any other information relating to a variable is received, these are appended in the **Data** field. As default, only error messages are shown. Display of additional information can be enabled from the ***Options*** menu.

5.4 Main menu



5.4.1 File



The ***File*** menu contains the following items, which all relate to VBMon screen layouts.

File:New This function creates a screen layout with five empty lines. The ***insert*** item in the ***Edit*** menu can be used to add extra lines.

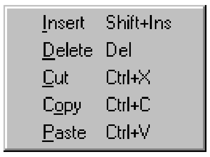
File:Open The ***Open*** function reloads the screen layout from a previously saved file. The included identifiers will automatically be converted into the "address" needed to access the variable. This is performed using the contents of the MIB, and will therefore reflect any changes that have been made to the MIB since the last screen save.

File:Save The ***Save*** function will store the screen layout parameters together with the list of included Identifiers. Such files are saved with the file extension .scr.

File:Save as This provides an opportunity to store the screen layout as a file, having a specified name and path.

File:Exit is used to close the program. When the monitor is closed, the current screen layout is automatically saved in a file, as the default screen layout. Next time the monitor is started, the default screen layout is automatically loaded.

5.4.2 Edit



The ***Edit*** functions are used to customise a screen layout. They apply to the currently selected line. One or more lines are selected by clicking on them with the left-hand mouse button, which will then be highlighted. The ***Edit*** menu can also be made available, by clicking the right mouse button, when the pointer is within the Physical Identifier field.

Edit:Insert The ***Insert*** function will insert an empty line above the selected line.

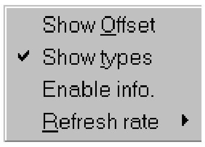
Edit:Delete The ***Delete*** function will delete the selected line.

Edit:Cut The ***Cut*** function will delete the selected line, and save the line in the clipboard.

File:Copy The ***Copy*** function will save a copy of the selected line in the clipboard.

Edit: Paste The ***Paste*** function will insert a line from the clipboard above the selected line.

5.4.3 Options

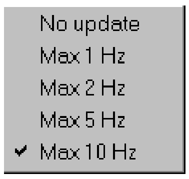


The default fields in a VBMon line are: **Physical Identifier**, **Type** and **Data**. However, it is possible to customise the lines using the ***Options*** menu.

Options: Show Offset is used to enable the **Offset** field. The **Offset** field is disabled as default.

Options: Show types is used to enable the **Type** field. The **Type** field is enabled as default.

Options: Enable Info. When reading or writing to a variable, an error message and/or other information relating to the variable, may be received from the node.
An error message is always appended to the **Data** field. Activating the ***Enable info*** function will also append any additional information to the **Data** field.



Options: Refresh rate*.* The refresh rate is defined as the number of full screen (all lines) updates per second. The refresh rate has a default value of 2 Hz, meaning that all values in the data field will be updated twice each second. The refresh rate can be selected from one of the following: 1, 2, 5 and 10 Hz. Selecting a low frequency, will reduce data traffic on the bus.

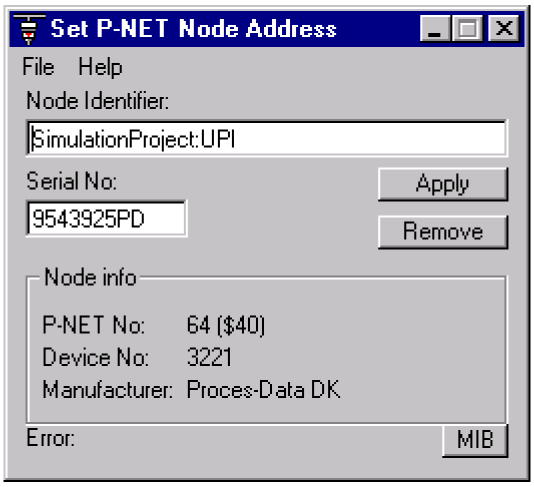
5.4.4 Help

Guidance in using VBMon is available from the Help menu.

6 P-NET Tools

A number of tools that are specifically used in conjunction with the P-NET Fieldbus, are available in the VIGO program package. Some of the more general-purpose tools that can be used with all P-NET standard modules are described in this chapter.

6.1 Set P-NET Node Address



Node Identifier: SimulationProject:UPI
Serial No: 9543925PD
Node info
P-NET No: 64 ($40)
Device No: 3221
Manufacturer: Proces-Data DK
Error:

Each P-NET node that is located within a single bus segment must be configured with a unique node address. P-NET nodes are normally shipped from a manufacturer with the node address set to zero. Since node address zero is not permitted to be used for normal communication, the connection of such a node will not interfere with any of the other nodes already running on the network. When a new node is connected to the network, the desired node address can be set, by using a special feature of P-NET. Sending a broadcast message to all nodes, consisting of the new node address, together with the serial number of the node in question performs this.

The purpose of this program, is to enable the setting of the node address within a physical node, by means of using it's serial number.

This program is launched from the MIB browser *MIBOCX*, by selecting it from the right mouse button menu, when a Node is highlighted.

Selecting a different Node in the MIBOCX (by activating the ***MIB*** button), will automatically update the **Node Identifier** in the *Set P-NET Node Address* program window, and will display data about that node.

If the node is recognised as a P-NET master module, a **No. Of Masters** field is also shown. This indicates the maximum number of masters currently allowed to be connected to the network segment.

The node in question must be included in the project description in the MIB, and it's properties must also be set correctly, including the desired node address.

When the program is opened and a node is selected, the following four situations can occur:

1: If the node specified in the **Node-Identifier** field cannot be found at the node address as specified in the MIB, the serial number of the should be keyed in, and then the ***Apply*** button should be pressed. The function of the ***Apply*** button is to send a broadcast message to all nodes, commanding the node with serial number xxxxxxx, to set its node address to the attached value. If a node with the specified serial number is found, the **Node info** for the module in question will be shown.
If contact with the node cannot be established, the **Node info** field will display "No contact with Node". If this is the case, it should be checked that the serial number of the module is correct, and that the module has been correctly connected to the network.

2: A node is found on the network, and the serial number and the **Node info** is automatically displayed for that node. If this information corresponds to what is required, as specified in the MIB, the communication parameters for the node are correctly set up, and no further action needs to be taken.

3: A node is found, and the **Node info** is shown, but the node is not the expected node as specified in the MIB. This indicates that the node has been configured with the wrong node address, and it must be removed to ensure future communication integrity. By pressing the ***Remove*** button, the node is removed from the network as far as communication is concerned. This is done by setting the node address to zero. The **Node info** will now display "No contact with Node" and situation 1 will now apply.

4: A node is found, and the **Node info** is shown, but the node is not the expected node as specified in the MIB, or random communication errors occur. This could mean that two or more nodes are configured for the same node address, and these nodes should be removed and re-configured to maintain communication integrity.

Guidance for selecting Node Address and No of Masters for a Project
The P-NET node address can be in the range from 1 to 125. The No. of Masters can be in the range from 1 to 32. The lower numbers are reserved for Master modules. Node addresses for Slaves must always be higher than the No. of Masters.
If for example a project consists of 5 Master modules and 15 Slave modules, the No. of Masters and Node Addresses could be selected in the following way:

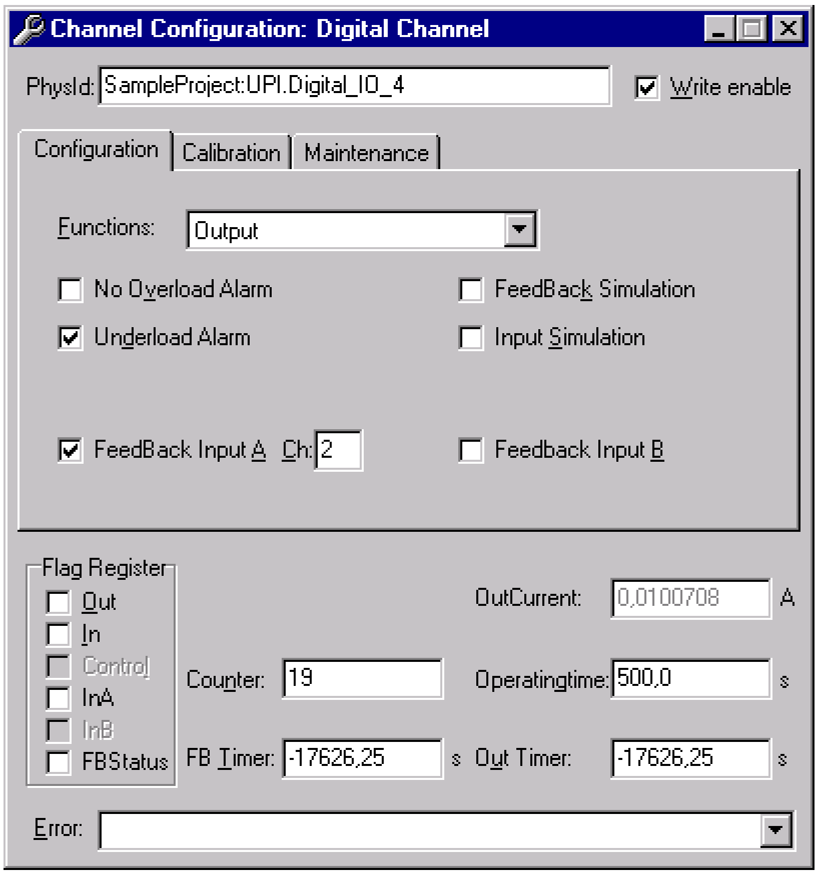
> No of Masters = **6**   (one master number is reserved for future extension)
> Node Address for the Master modules are then in the range from **1** to **6**
> Node Address for the Slave modules are then in the range from **7** to **125**

Help
Help on the use of the *Set P-NET Node Address*, is provided from the ***Help*** menu. The help file consists mainly of parts of this manual.

6.2 Channel Configuration

The purpose of this utility program is to enable a node channel to be configured, maintained and monitored. It is launched from the *MIBOCX* using the right mouse button menu, when a channel is selected.

The *Channel Configuration* program is designed to recognise a number of standardised channels.



PhysId: SampleProject:UPI.Digital_IO_4 ✓ Write enable

Functions: Output

☐ No Overload Alarm ☐ FeedBack Simulation
✓ Underload Alarm ☐ Input Simulation
✓ FeedBack Input A Ch: 2 ☐ Feedback Input B

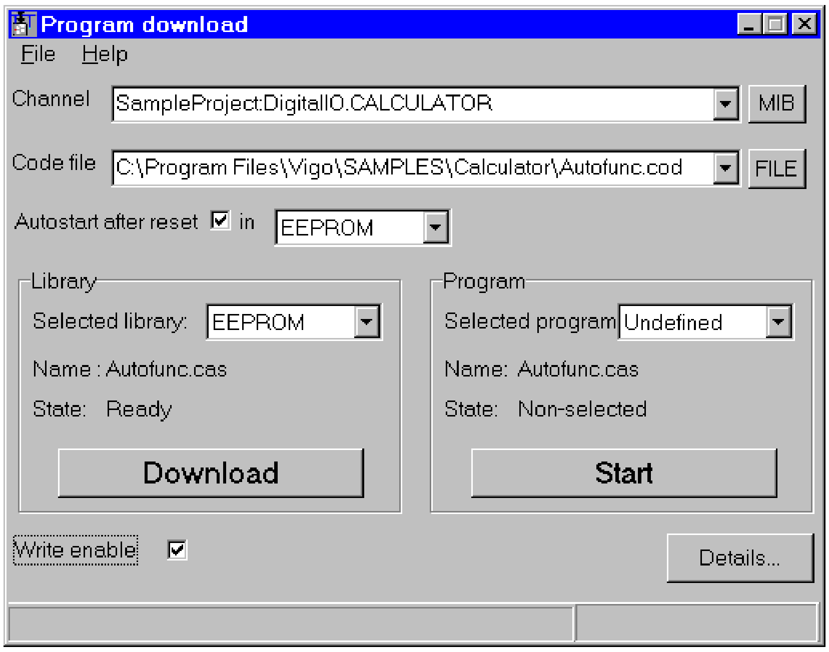
OutCurrent: 0,0100708 A
Counter: 19 Operatingtime: 500,0 s
FB Timer: -17626,25 s Out Timer: -17626,25 s
Error:

This provides the user with a convenient way of configuring the various channels, which make up a module.
The Channel configuration window is divided into three sections. The upper section contains the **PhysId** field, which displays the identity of the Channel. The **Write enable** check box is common for the entire node and must be checked, to allow the contents of configuration registers to be changed.

The middle section consists of a number of tab sheets, each containing a formatted view of the various configuration registers, enabling ease of amendment or monitoring.
The lower section provides a display of real-time values, which are specific to the selected channel type. Although the values shown depend on serviceable communication and the state of the current process associated with the channel, many can be amended locally, using the PC keyboard or mouse, e.g. resetting a counter to zero, or changing the state of a digital output.
The ability to display a particular channel configuration screen, depends on that channel type being included and selected within a node already defined in the MIB project file.
Screens are available for the following Channel types: Service, Digital I/O, AnalogIn, PID, AnalogOut, Weight, Communication and Program Channel.

6.3 Program Download

The purpose of this program is to provide the means to download program code, i.e. Process-Pascal code or Calculator Assembler code. The code can be downloaded to all modules supporting a P-NET standard Program Channel, such as the PD5000 series of controllers from PROCES-DATA A/S. *Program Download* is called from the *MIBOCX* using the right mouse button menu, when a Program Channel is selected.



Channel: SampleProject:DigitalIO.CALCULATOR
Code file: C:\Program Files\Vigo\SAMPLES\Calculator\Autofunc.cod
Autostart after reset ☑ in EEPROM

Library
Selected library: EEPROM
Name : Autofunc.cas
State: Ready

Program
Selected program: Undefined
Name: Autofunc.cas
State: Non-selected

Write enable ☑

The *Program Download* utility also supports the downloading of Calculator programs, to other modules supporting the P-NET standard Program Channel, such as the PD3120 module.
When this program has been launched via the *MIBOCX*, the **Channel** identifier is automatically inserted. Pressing the MIB button and selecting a new Program Channel can change the identity of a Channel. A File browser can be opened for selecting a ***Code file*** by pressing the ***FILE*** button The node to which a program is to be downloaded, must first be defined in the MIB, before a download can proceed.

Clicking the ***Details*** button opens a window, from where the selected program can be stopped, started, killed etc. In addition, the Actual size, Max size, Code type, and Version of the program in the selected library can be seen.

6.3.1 Channel

The **Channel** combo box is used to insert the name of the channel, to which a program is to be downloaded. The selected channel must be a standard Program Channel, of object type 11. The object type is defined in the MIB. If the selected channel is not of object type 11, a message box will display "Error in PhysId name".

A channel identifier can be selected using four alternative methods. When this program has been launched via the *MIBOCX*, the channel identifier is automatically inserted. The channel Identifier can also be inserted from the MIB by clicking the ***MIB*** button, and then double clicking on a channel name within the MIBOCX. It can be included as a start up parameter for *Program Download*, or it can be directly keyed in into the combo box.

When a new channel identifier is inserted, it will always become the highlighted item in the ***Channel*** combo box list. The selected item will be inserted at the top of the list. If the selected channel was not previously included in the list and the list is full, the oldest channel identifier will be deleted. Once a channel identifier is included in the combo box, it can be easily selected from the list, which can hold up to 6 channel identifiers.

6.3.2 Code file

The **Code file** combo box is used to specify the file to be downloaded. The extension is normally ".COD" for e.g. Process-Pascal programs and Calculator programs, or " CXE " for calculator programs developed under Windows 3.11. The selected code file must contain the kind of program code expected by the selected channel. The code type is checked prior to the program being downloaded.

A code file name can be inserted in the **Code file** combo box using three methods. The code file name can be included as a start up parameter for Program Download. Alternatively, it can be selected from the Open file dialog, by clicking the ***FILE*** button, or it can be directly keyed in into the combo box.

When a new file name is inserted, it will always become the highlighted item in the ***Code file*** combo box list. The selected item will be inserted at the top of the list. If the selected file was not previously included in the list and the list is full, the oldest file name will be deleted. Once a file name is included in the combo box, it can be easily selected from the list, which can hold up to 6 file names.

6.3.3 Autostart after reset

The **Autostart after reset** check box, defines how the selected program will behave, following a reset being applied to the node holding the program. If Autostart is checked, the selected program will perform an auto start after a reset. If it is not, the selected program will be put in the Idle state after a reset. The check box reflects the state of ChConfig.EnableBit[0] in the Program Channel.

Some node types can hold several programs within a library. With PD controllers, these programs can be stored in different memory types. The list box adjacent to **Autostart after reset**, defines which program will be started, if **Autostart after reset** is checked.

The list box reflects the value of ChConfig.Ref_A in the Program Channel. The state of the Autostart check box and list box can only be changed, if Write enable is checked.

6.3.4 Selected library

The selection in the **Library** list box defines, to which library domain the program is to be downloaded. The list shows the possible choices for the selected channel. The possible values are read from the selected channel, in the variable called MemoryInfo.

The **Name** and **State** fields in the **Library** panel show the name and state of the selected program in the library. The library list can also be used to monitor the names and states of other programs in the library. Library State can take the following values:

0: Non-existent
1: Loading
2: Ready
3: In-use
4: Complete
5: Incomplete
14: Deleting

The **Selected library** list box reflects the value of LibraryStatus.LibraryIndex in the Program Channel. When a new value is selected, it is stored in LibraryControl.LibraryIndex in the Program Channel.

6.3.5 Selected program

The **Selected program** list box is used to select a program. The list shows the possible values for the selected channel. The possible values are read in the selected channel, in the variable called MemoryInfo.

If a program is already running when selecting a new program, the running program will be stopped and killed, and the new program will be selected, which will be put into the Idle state.

After selecting a program, the program can be started by pressing the ***Start*** button.

The **Name** and **State** fields in the Program panel show the name and state of the selected program. Program state can take the following values:

0: Non-selected
1: Unrunable
2: Idle
3: Running
4: Stopped
5: Starting
6: Stopping
7: Resuming
8: Resetting

The **Selected program** list box reflects the value of ProgramStatus.SelectedProgram in the Program Channel. When a new value is selected, it is stored in ProgramControl.ProgramToSelect.

6.3.6 Download button

Before downloading, a channel must be specified, a code file and a library must be selected, and Write enable must be checked. Clicking the ***Download*** button starts the downloading procedure, for the code file selected in the **Code file** combo box, to the channel and library defined in the **Channel** combo box and the **Selected library** list box.

If the download parameters specify a memory area that is already in use, by being in a state of e.g. running or selected, a message box showing 'Selected library in use ! Continue ?' will appear. If Yes is selected, the program that is currently running or selected, will be stopped and killed, and the new program will be downloaded.

6.3.7 Start button

Clicking the ***Start*** button will start the **Selected program**. Clicking the ***Start*** button only has an effect, if a program is selected, and the program is in the Idle state.

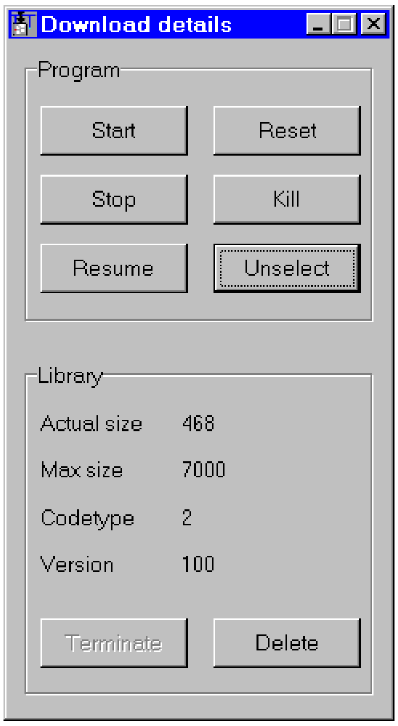
6.3.8 Write enable

The **Write enable** check box enables the values in ChConfig of the selected channel to be changed, using the values available in the **Autostart after reset in** list box. Write enable must also be checked to download programs.
If Write enable is not checked, Autostart after reset and Download are disabled, and greyed out.

6.3.9 Details

Pressing the ***Details*** button opens a window with more detailed information about the selected channel. The **Program** field in the *Download details* window provides buttons to ***Start***, ***Stop***, ***Resume***, ***Reset***, ***Kill*** and ***Unselect*** the program defined in the **Selected program** list box.

The **Library** field in the *Download details* window, shows **Actual size**, **Max size**, **Code type** and **Version** of the program defined in the **Selected library** list box. The **Library** field also includes a ***Terminate*** button, which will terminate downloading to the selected library, and a ***Delete*** button, which will delete the program in the selected library.



Actual size 468
Max size 7000
Codetype 2
Version 100

6.3.10 Starting the Download Utility from a shortcut

Program Download is normally started from within the MIBOCX, via the right mouse button menu, when a Program Channel of object type 11 is selected. If this method is used, the identity of the selected Program Channel will be automatically inserted into the **Channel** combo box.
Program Download may also be started up using a previously prepared shortcut. Using this method, it is also possible to include two parameters. The first parameter is the PhysId of the channel to which the program code is to be downloaded. The value of this parameter will then be automatically inserted in the **Channel** combo box. The second parameter is the name of the code file to be downloaded. The value of this parameter will be automatically inserted in the **Code file** combo box. The parameters can be included by selecting *Properties* of the shortcut icon and appending them to the command line.

When the *Program Download* tool is closed, the contents of the **Channel** and **Code file** combo boxes are saved in a file called {PD}PROGRAMDOWNLOAD.CFG. This file is placed in the current folder, which would typically be the VIGO folder. When *Program Download* is started again, the contents of the 2 combo boxes will be restored, if no start up parameters have been given.

6.3.11 PD5000 Controller

A PD5000 controller has two Program Channels, OPSYSCH and PPPROGCH.

OPSYSCH holds the controllers' operating system, and PPPROGCH holds a Process-Pascal program.

These two programs are inter-dependent. If the Process-Pascal program is running, a new operating system cannot be downloaded.

If a Process-Pascal program is present in the Flash library, a new operating system cannot be downloaded to Flash, because the operating system is located at the beginning of the Flash memory area, and the Process-Pascal program is loaded immediately after it.

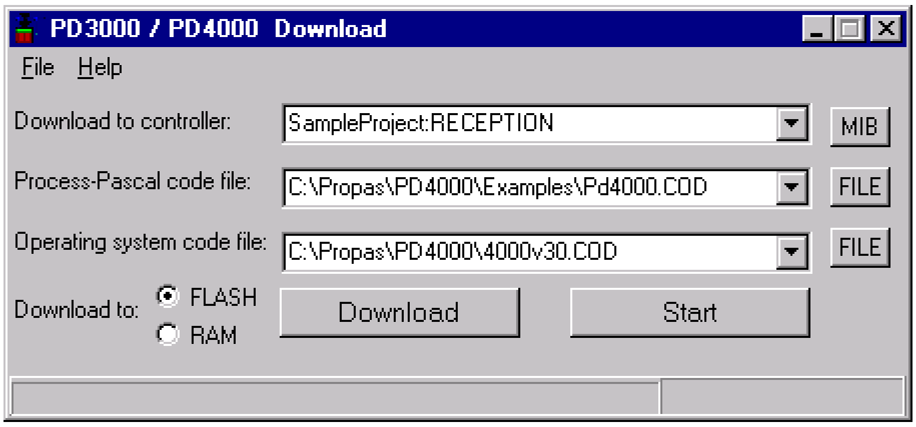
The situations described above are just two of the aspects which the Program Download utility automatically monitors, to ensure download integrity. Should any other prohibited situations occur, the utility will provide any necessary warnings, before a program is automatically stopped or deleted.

7 Tools for PROCES-DATA modules

The tools described in this chapter relate only to modules manufactured by PROCES-DATA A/S.

7.1 PD 3000 / PD 4000 Download

The purpose of this program is to download Process-Pascal code to modules not originally designed to support the P-NET standard Program Channel. This applies to the PD3000 and PD 4000 series of controllers with older operating systems. The utility can be called from the MIBOCX, using the right mouse button menu, when the appropriate node is selected.


PD3000 / PD4000 Download

File Help

Download to controller: SampleProject:RECEPTION

Process-Pascal code file: C:\Propas\PD4000\Examples\Pd4000.COD

Operating system code file: C:\Propas\PD4000\4000v30.COD

Download to: [✓ FLASH] RAM

The program is downloaded to the controller specified by the identifier inserted in the **Download to controller** edit field. After a program has been downloaded, it can be started by clicking the ***Start*** button.

If the selected node is a PD4000 controller, and it is required to store the code in flash memory, the Process-Pascal program must be downloaded together with an operating system. The name of the file holding the operating system is inserted in the **Operating system code file** edit field.

When a controller, a Process-Pascal code file, and possibly an operating system code file, have been specified, the program can be downloaded, by clicking the ***Download*** button.

7.1.1 Download to controller

The **Download to controller** edit field is used to insert the name of the controller to which a program is to be downloaded. The selected controller must be of type PD3000 or PD4000.

A controller identifier can be inserted using four alternative methods. When this program has been launched via the *MIBOCX*, the controller identifier is automatically inserted. The controller name can also be included as a start up parameter. It can be inserted from the MIB, by clicking the ***MIB*** button and then double clicking on a controller name within the MIBOCX, or it can be directly keyed in into the edit field.

The integrity of the controller identifier is NOT checked, until the ***Download*** button or the ***Start*** button is clicked. When either of these actions occur, a test will establish whether the controller is of the correct type and version. The version must be 2.00 or later.

7.1.2 Process-Pascal code file

The **Process-Pascal code file** edit field is used to identify the file to be downloaded, which contains the Process-Pascal program code. The selected file must be a Process-Pascal ".COD" file, generated by the Process-Pascal compiler version 2.00 or later.

A code file name can be inserted using three alternative methods. The code file name can be included as a start up parameter when launching the *PD3000 / PD4000 Download* program. It can be selected from an Open file dialog, by clicking the ***FILE*** button and then opening the file, or it can be directly keyed in into the edit field. The integrity of the name, type and version of the selected file is not checked, until the ***Download*** button is clicked.

7.1.3 Operating system code file

The **Operating system code file** edit field is used to specify the file to be downloaded, which contains the Operating system. This file is only required when a Process-Pascal program is to be downloaded to FLASH memory, in a PD4000 controller.

The selected file must contain the PD4000 operating system, as a ".COD" file, version 2.00 or later, (NOT a ".HEX " or ".EP0" file), as provided by PROCES-DATA A/S. For example, the file might be called "4000v30.COD".

A operating system code file name can be inserted using three alternative methods. The code file name can be included as a start up parameter when launching the *PD3000 / PD4000 Download* program. It can be selected from an Open file dialog, by clicking the ***FILE*** button and then opening the file, or it can be directly keyed in into the edit field. The integrity of the name, type and version of the selected file is not checked, until the ***Download*** button is clicked.

7.1.4 Download to

The **Download to** radio buttons define to which memory type the program is to be downloaded. If the controller is a PD3000, the program can only be downloaded to RAM. If the controller is a PD4000, the program can be downloaded to either RAM or FLASH.

If **FLASH** is selected, the name of a file containing the PD4000 operating system must be inserted in the Operating system code file edit field, before clicking the ***Download*** button. The correct selection of RAM or FLASH options is not checked, until the ***Download*** button is clicked.

Clicking the ***Download*** button commences the process of downloading the code file(s) specified in the code file edit field(s), to the selected controller.
Before a program is actually downloaded, the controller is stopped and reset.

If **FLASH** is selected, the FLASH memory is first cleared, which takes about 20 seconds. The operating system is then downloaded. Finally, the Process-Pascal program is downloaded.
Once a program has been downloaded, it can be started by clicking the ***Start*** button.

The state of the **Download to** radio buttons should not be changed during the period between download and start.

7.1.5 Starting PD3000 / PD4000 Download

When the *PD3000 / PD4000 Download* utility has been started from the MIBOCX, the contents of the **Download to controller** edit field are automatically inserted.

PD3000 / PD4000 Download may also be started by setting up a shortcut. In this situation, it is also possible to transfer 4 command line parameters, by amending the shortcuts properties. The first parameter is the controller identity, to which the program is to be downloaded. The value of this parameter will be inserted in the **Download to controller** edit field. The second parameter is the name of the Process-Pascal code file, and this will be inserted in the **Process-Pascal code file** edit field. The third parameter is the name of the Operating system code file, which will be inserted in the **Operating system code file** edit field. The fourth parameter defines the state of the **Download to** radio buttons. If the value of this parameter is ’RAM’, the RAM button will be checked, otherwise the FLASH button will be checked.

When the *PD3000 / PD4000 Download* program is closed down, the contents of the **Download to Controller, Process-Pascal code file** and **Operating system code file** edit fields, and the state of the **Download to** radio buttons, are all saved in a file called {PD}PDDOWNLOAD.CFG. This file would normally be located in the current folder, e.g. VIGO. When the *PD3000 / PD4000 Download* program is started again, these values are restored, if no start up parameters have been specified.

7.2 Calculator Assembler

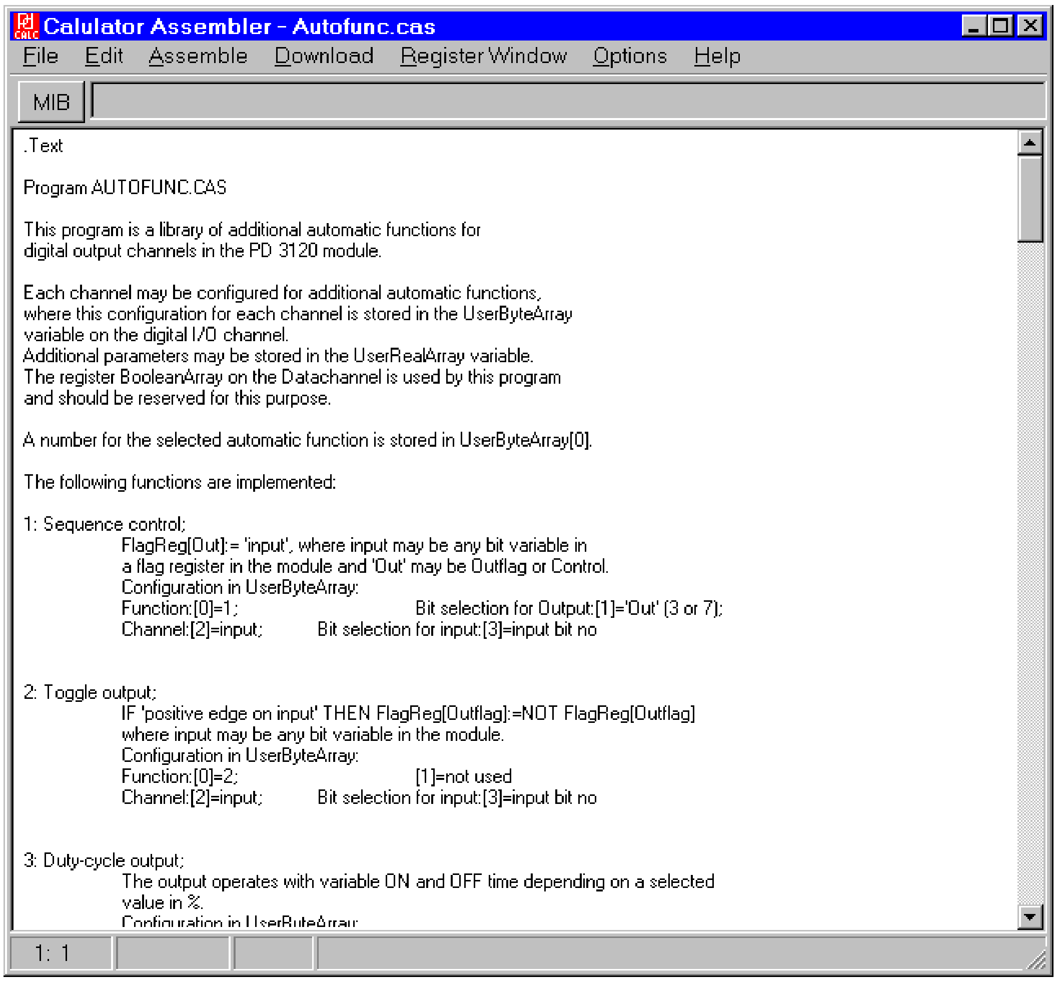
The Calculator Assembler provides all the necessary services for a programmer to design, edit, assemble and download programs to calculator channels in P-NET modules, from a PC. The Calculator Assembler is an integrated program with an editor, an assembler, a debugger and a loader for P-NET. Calculator programs are written as assembler instructions in text files. By using the editor, the source text is edited and saved. By using the assembler, the source text is assembled to generate the calculator instructions. These instructions are downloaded to the Calculator channel, and the program can then be started. It is possible to debug the downloaded program by single steps or a break point.

An example of a calculator program with some typical instructions.

```
        Move #D,CR1             ; Let CR1 point out the pulse processor
                                ;channel in a PD 3221
Start:  Move #0,IR1             ; First element
Loop:   Move CR1:#A[IR1], Acc   ;Load pulse processor registers[elementNo]
        Add 100
        Move Acc, CR1:#A[IR1]   ; Store back incremented value
        Inc IR1                 ; Next element
        Move IR1, Acc           ; Load IR1 into Acc
        Comp Acc > 15           ; Is last element treated?
        Jump.False Loop         ; No: then repeat loop
Finish: .                       ; Yes: then ....
        .
        .
        Jump Start              ; Last instruction must be an unconditional
                                ; jump to a label
End                             ; End of program
```

7.2.1 User Interface

The program's main window contains a menu bar at the top and a status line at the bottom. A file can be opened for editing and assembling. Furthermore, the program has a MIB button used to select the destination module for download and debugging.



```
.Text

Program AUTOFUNC.CAS

This program is a library of additional automatic functions for
digital output channels in the PD 3120 module.

Each channel may be configured for additional automatic functions,
where this configuration for each channel is stored in the UserByteArray
variable on the digital I/O channel.
Additional parameters may be stored in the UserRealArray variable.
The register BooleanArray on the Datachannel is used by this program
and should be reserved for this purpose.

A number for the selected automatic function is stored in UserByteArray[0].

The following functions are implemented:

1: Sequence control;
        FlagReg[Out]:= 'input', where input may be any bit variable in
        a flag register in the module and 'Out' may be Outflag or Control.
        Configuration in UserByteArray:
        Function:[0]=1;              Bit selection for Output:[1]='Out' (3 or 7);
        Channel:[2]=input;     Bit selection for input:[3]=input bit no


2: Toggle output;
        IF 'positive edge on input' THEN FlagReg[Outflag]:=NOT FlagReg[Outflag]
        where input may be any bit variable in the module.
        Configuration in UserByteArray:
        Function:[0]=2;              [1]=not used
        Channel:[2]=input;     Bit selection for input:[3]=input bit no


3: Duty-cycle output;
        The output operates with variable ON and OFF time depending on a selected
        value in %.
```

In the following paragraphs, the different parts of the program are covered in detail separately.

7.2.2 Editing a file

The editor is used to edit a calculator program. Files can be opened by the 'File | Open...' command in the menu. Files are also saved and printed from the File menu. Calculator assembler source files have CAS as default extension.

A new (blank) file window corresponding to a new assembler file can be created with the 'File | New' command.

The standard edit commands (listed in the Edit menu) for copy, cut and paste of a selected text are available in the editor. Text can be exchanged to and from the Windows clipboard. The editor can undo the last cut command. Marked text will be replaced when new text is entered. The search and replace operations are listed in the Search Menu.

In the status line the cursor’s position is shown. It is also indicated if the file has been modified since the last time it was saved.

Note that when the register window (used when debugging) is shown, the content of the edit window is locked. If changes have to be made, close the register window, make the changes, assemble the program and download it again. Then reopen the register window to see the effect of the changes.

7.2.3 Assembling a program

The assembling of a source file is started from the Assemble Menu. A status dialogue displays the line number and size of the generated code during the assembling.

When an error is found, a dialogue will pop up to inform the user about the error. After pressing the OK button in the status dialogue, the assembling process continues. Pressing the cancel button in the status dialogue can interrupt the assembling process.

During the assembling process a debug (*.deb) file is generated. It contains a list of line numbers, instruction addresses and label names. The list is used for debugging.
After a successful assembling (No errors found), it is possible to download the generated code to a calculator channel. The download command in the main menu is the means to do that.

Using the Assemble menu, generated code can be saved in a file. The ’Write to INC file’ command in the ’Assemble’ menu, will create an include file for Process-Pascal. The ’Save to COD file’ command will save to a file on disk, ready to be downloaded to a calculator channel.

*.inc	The generated calculator instructions as Process-Pascal source text. May be included in a Process Pascal program (ASCII).
*.cod	The generated calculator instructions in a binary format.

7.2.4 Downloading a program

For downloading of calculator programs, a calculator channel must be selected as destination. A calculator channel is a channel with a physical ID ending with ’.CALCULATOR’.
To select a calculator channel, activate the MIB button at the top left of the screen. This changes the edit window into a MIB viewer. Use the mouse to expand the MIB structure

to find the desired calculator channel. When the calculator channel is highlighted, click on the MIB button again or double click the channel. This will close the MIB viewer and the edit window reappears. The selected channel is now shown to the right of the MIB button.

When the desired destination channel is shown, select the Download menu. This will start the standard P-NET downloader application. For further information on the download program, refer to the documentation for the downloader.

7.2.5 Debugging a program

The Calculator Assembler supports interactive debugging of a calculator program downloaded to a calculator channel. The debugger makes it possible to single step through the calculator instructions or to set a break point.

After an assembling of a source text, the generated codes must be downloaded to a calculator channel, and the module must be reset to reinitialise the calculator. The debugger is started by selecting Register Window in the main menu. When debugging starts, the register window will show the calculator's registers. It is not possible to edit the program source when the register window is shown.

The user can single step through the program, by pressing a key (F7). To set a break point, the user places the cursor on the line containing the instruction at which a stop is required, and then press the F4 key. The calculator then starts, and runs until the break point is reached. When the execution stops the calculator's internal registers can be inspected in the register window. The register values can also be changed. To restart the calculator program from the first instruction, the F2 key can be pressed.

The register window also contains three buttons, which acts as shortcuts to the *Debug Step*, *Debug Goto cursor* and *Debug Reset* commands. The Debug Reset command stops the calculator if it is running, and resets the calculator's instruction pointer to the first program instruction. When the debugger is reset, has been single stepped or has reached a breakpoint, the line containing the next instruction to be executed, is highlighted as marked text.

7.2.6 Calculator programming

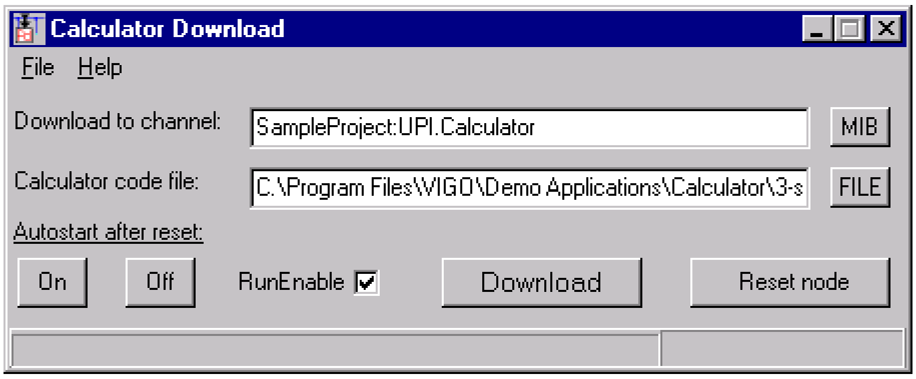
Details about the calculator programming, the calculator registers and the instruction set are found in the Calculator Programming Manual (PD Calculator Assembler, ref. no. 502 061).

7.2.7 Help

Online information about this program, is available by using the Help menu.

7.3 Calculator Download

The purpose of this program is to download Calculator code to modules **not** supporting the standard P-NET Program Channel. It is used to download calculator program code to the Calculator Channels included in the PD3221 UPI and PD3230 Weight modules produced by PROCES-DATA A/S. It may be started from within the Calculator Assembler, or it can be launched from the MIBOCX using the right mouse button menu, when a Calculator channel has been selected.
When a program has been downloaded, it can be started, by checking the **RunEnable** option.



Download to channel: SampleProject:UPI.Calculator

Calculator code file: C:\Program Files\VIGO\Demo Applications\Calculator\3-s

RunEnable ☑

If this utility program is called using the right mouse button menu, the identity of the Channel to which the download is to be made, is automatically provided. The Channel identity can be changed, by pressing the ***MIB*** button, and then selecting a new Calculator Channel. A File browser can be opened for selecting a Code file, by pressing the ***FILE*** button. The node containing the Calculator Channel must be defined in the MIB, before any Download procedure can be started.

The program is downloaded to the Calculator Channel, specified by the identifier inserted in the Download to channel edit field. The name of the file holding the calculator code, is specified in the **Calculator code file** edit field.

Before downloading, a channel must be specified, and a code file selected. The *Calculator Download* program automatically controls the state of the WriteEnable flag in the Node. Following a download, the WriteEnable state is set back to the value it had, before the start of the download.

7.3.1 Download to channel

The **Download to channel** edit field is used to insert the identifier of the channel, to which a calculator program is to be downloaded. The selected channel must be a Calculator Channel in a PD3221 UPI or PD3230 Weight node. These channels have an object type of 7.

A channel name can be inserted using four alternative methods. If this program is launched using the right mouse button menu, the identity of the Channel is automatically inserted. The channel name can also be included as a start up parameter. It can be selected from the MIB, by clicking the ***MIB*** button and then double clicking on a channel name within the MIBOCX, or it can be directly keyed into the edit field.

7.3.2 Calculator code file

The **Calculator code file** edit field is used to select the file containing the calculator program to be downloaded. The selected file must be a calculator file, having an extension of ".COD", which has been generated by the Calculator Assembler produced by PROCES-DATA A/S. However, Calculator programs developed under Windows 3.11 may use the extension ".CXE".

A code file name can be inserted using three alternative methods. The code file name can be included as a start up parameter. It can be selected from an Open file dialog, by clicking the ***FILE*** button and opening the required file, or it can be directly keyed into the edit field.

Once a program has been downloaded, it can be started by checking **RunEnable**.

7.3.3 RunEnable

The **RunEnable** check box reflects the state of the boolean variable RunEnable, in the selected calculator channel. Whenever RunEnable is true, indicated by a tick in the check box, the calculator program will be running. When the downloading of the program is complete, RunEnable is automatically set to false, so that the calculator program doesn't start until **RunEnable** is checked.

The RunEnable variable is stored in a memory type called RAMInitEEPROM. This means, that there are in fact two variables, one in RAM and one in EEPROM. It is the state of RunEnable in RAM that determines, whether the calculator program is running or not. It is the state of RunEnable in RAM that is mirrored by the **RunEnable** check box.

After a reset of a UPI or Weight node, the state of RunEnable is copied from EEPROM to RAM. If the state is TRUE, the calculator program will automatically start running.

The state of RunEnable in EEPROM can be set True, by clicking the ON button under **Autostart after reset**. If RunEnable in RAM was False, it will be set True for a short period, during this operation.

The state of RunEnable in EEPROM can be set False by clicking the OFF button under Autostart after reset. If RunEnable in RAM was True, it will be set False for a short period, during this operation.

7.3.4 Download

Clicking the ***Download*** button will begin the procedure of downloading the code file, specified in the **Calculator code file** edit field, to the selected channel.

Before the program is downloaded, the calculator is stopped, by setting RunEnable to False. RunEnable remains False, so that the program doesn't start automatically after downloading has been completed.

7.3.5 Reset node.

Clicking the ***Reset node*** button will reset the UPI or Weight node. The button is provided as a convenient way to ensure that the calculator behaves, as it should, following a reset. That is, whether it autostarts or not.

7.3.6 Starting the Calculator Download program

Calculator Download may be started from within the Calculator Assembler, or it may be launched from within the MIBOCX, via the right mouse button menu, when the Calculator Channel in a PD3221 UPI or a PD3230 Weight module has been selected. These Calculator Channels are of object type 7.

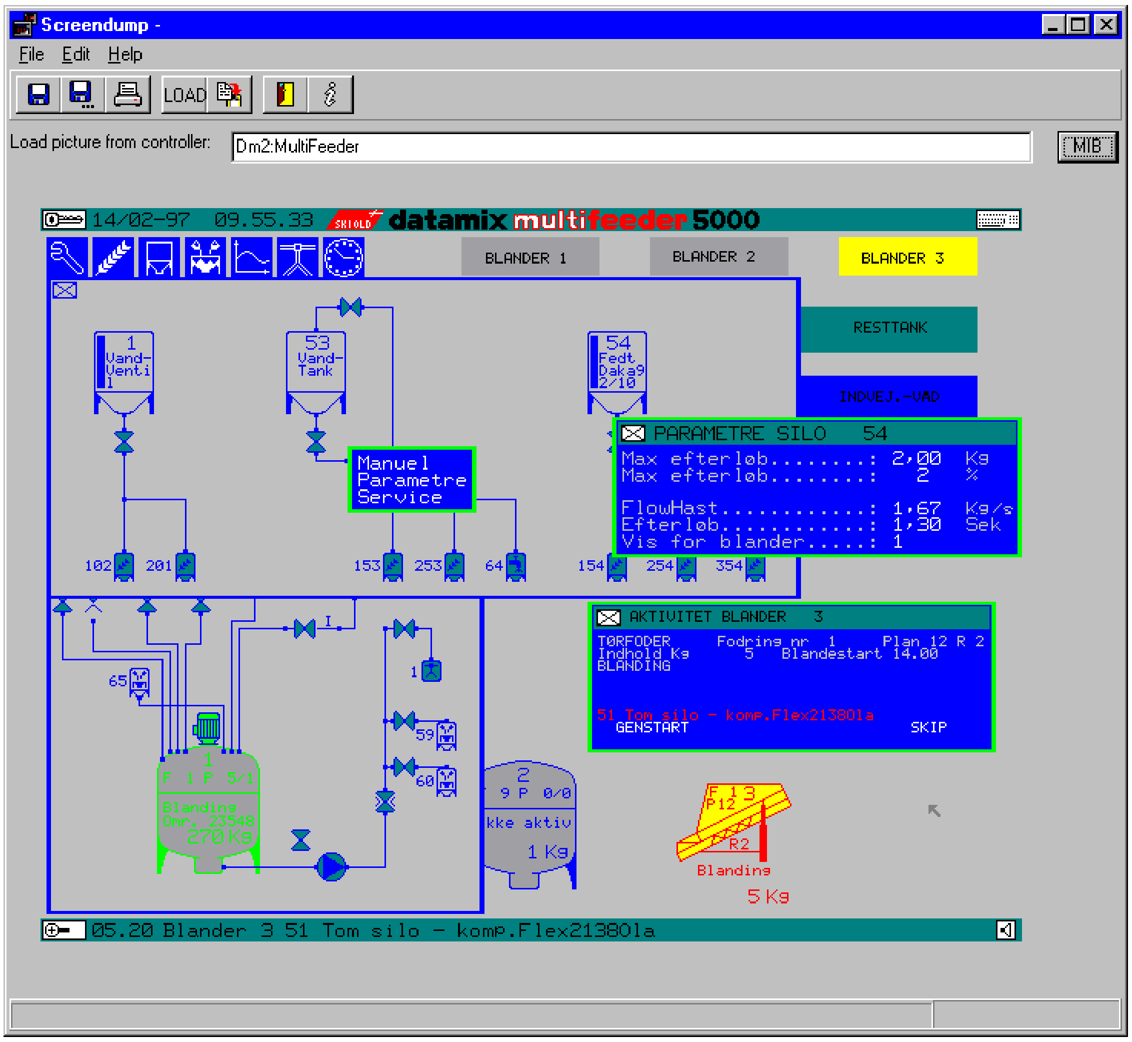
Calculator Download may also be started using a previously set up shortcut. In this case, it is possible to include two command line parameters, by amending the shortcut properties. The first parameter is the identity of channel, to which the program is to be downloaded. The value of this parameter will be shown in the **Download to channel** edit field. The second parameter is the name of the Calculator code file, and will be shown in the **Calculator code file** edit field.
If *Calculator Download* is started from within the Calculator Assembler, these two parameters are automatically transferred.

When the *Calculator Download* program is closed down, the contents of the Channel and code file edit fields are saved in a file called {PD}CALCULATORDOWNLOAD.CFG. This file is placed in the current folder, which is typically the VIGO folder. When *Calculator Download* is started up again, these values are restored, if no new parameters have been specified.

7.4 Screen Dump

The *Screen Dump* utility is used to up load screens displayed on P-NET controllers, manufactured by PROCES-DATA A/S. Once a picture has been up loaded, it can be printed out, saved in a file, or transferred to the clipboard. The program is useful when creating documentation applicable to Process-Pascal application programs.

Screen Dump is able to up load display screens from PD3010, PD4000, PD5010, PD5015 and PD5020 controllers. However, to obtain a picture from a PD5020, which has a larger screen, a special task and set of variables (VGALOAD) must be incorporated in the Process-Pascal program in the controller.



Load picture from controller: Dm2:MultiFeeder

```
14/02-97  09.55.33
```

```
PARAMETRE SILO      54
Max efterløb........: 2,00  Kg
Max efterløb........:    2  %

FlowHast............: 1,67  Kg/s
Efterløb............: 1,30  Sek
Vis for blander.....: 1
```

```
AKTIVITET BLANDER   3
TØRFODER     Fodring nr   1     Plan 12 R 2
Indhold Kg       5   Blandestart  14.00
BLANDING

51 Tom silo - komp.Flex213801a
GENSTART                                SKIP
```

```
05.20 Blander 3 51 Tom silo - komp.Flex213801a
```

Screen Dump can be started from the MIBOCX, using the right mouse button menu, when a node of the following controller type is selected: PD3010, PD4000 or PD5010, PD5015 or PD5020. These form one of the Object Types - 3000, 4000 or 5000.

If this procedure is used, the Controller Identifier will be automatically transferred to the **Load picture from controller** edit field.

Screen Dump may also be started from a shortcut, in which case the controller identifier may be transferred as a parameter.

When the identifier of a controller has been specified, the display screen can be up loaded by pressing the ***LOAD*** button. After a picture has been loaded, it can be stored in a Windows bitmap file ".BMP", by means of the ***Save*** or ***Save as*** menu items.

The picture can also be printed by means of the ***Print*** command in the ***File*** menu. If required, the picture can be copied to the clipboard, and then imported into other programs, such as Paintbrush, WordPerfect or Word.

The size and location of the *Screen Dump* window on the PC screen may be changed. When the *Screen Dump* program is closed the actual size and location of the window is saved, along with the controller identifier, and the name of the file last used. These values are restored the next time *Screen Dump* is started. The controller identifier is not restored, if *Screen Dump* is launched from within the MIBOCX or with a parameter.

7.4.1 Save / Save as

The *Save / Save as* dialogues can be called by clicking the ***Save*** or ***Save as*** toolbar buttons, or from the ***File*** menu, or by pressing "Ctrl + S" on the keyboard.
If a file name has not yet been defined, this can be done using the file dialogue. Once a file name has been chosen, it will be shown in the header of the *Screen Dump* window. The file is saved as a Windows bitmap file, with the default extension ".BMP".

7.4.2 Print

A loaded screen can be directed to print from within the *Screen Dump* program, by means of the *Print* dialogue. This dialogue is called by clicking the ***Print*** button, or from within the ***File*** menu, or by pressing "Ctrl + P" on the keyboard.

7.4.3 Load

Once a controller identifier has been inserted into the controller edit field in the program window, the current controller screen image can be up loaded by clicking the ***LOAD*** button.

Loading pictures from a PD3010, PD4000, PD5010 or PD5015 only takes a few seconds. However, loading pictures from a PD5020 can take up to several minutes. If the loading of a picture from a PD5020 is cancelled (by pressing the ***Cancel*** button), a new picture load must not be initiated during the next 30 seconds.

7.4.4 Copy to clipboard

Once a picture is loaded, it can be transferred to the standard Windows clipboard. From here, it can be imported into other Windows programs. The loaded picture is copied to the clipboard by pressing the ***Copy to clipboard*** button, or from the ***Edit*** menu, or by pressing "Ctrl + C" on the keyboard.

7.4.5 Load picture from controller

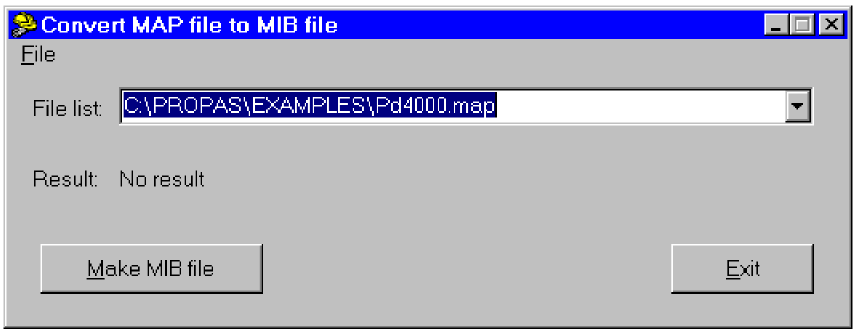
The **Load picture from controller** edit field is used to insert the identifier of the controller holding the screen image to be up loaded.

The selected controller must be of type PD3010, PD4000, PD5010, PD5015 or PD5020. The Controller Identifier can be inserted using four alternative methods. If this program is launched using the right mouse button menu, the identity of the controller is automatically inserted. It can also be inserted using the MIB, by clicking the ***MIB*** button, and then double clicking on the required Controller Identifier within the MIBOCX. The Controller Identifier can also be inserted during *Screen Dump* start up, by using a saved parameter, or it can be directly keyed in into the edit field.

7.5 MapToMIB

The *MapToMIB* program is a conversion utility used to convert MAP files to SMB files.This utility is only required for programs compiled by Process-Pascal compiler versions prior to 4.00.
A MAP file is generated by older versions of the Process-Pascal compiler, and contains an ASCII text description of the variable names and their types, as declared in a Process-Pascal program.

The SMB file (produced by the *MapToMIB* program), is a binary representation of the same information, but in a format that can be read by the *MIB Edit* program. SMB is short for SubMIB.



C:\PROPAS\EXAMPLES\Pd4000.map

No result

A SMB file is used to update or create a new Node type in the MIB database.

Using the MapToMIB program

The following section describes the functionality of the menus and buttons in the program window. For a detailed description of how to create or update a Type in the MIB database, refer to 'Step-by-step Instructions'

File List

The **File List** contains a list of MAP files for selection. These are the MAP files that are to be converted by the *MapToMIB* program. To add or remove files, use the ***File: Open*** and ***File: Clear File List*** menu commands.

The program can either convert one file or all the files in the **File List** (***File: Make*** or ***File: Make All***). Clicking the down arrow to the left of the **File List**, and then clicking the filename can select a single file.

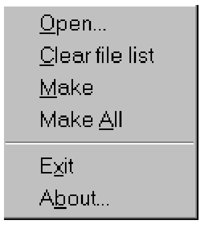
Result

This field contains a message indicating the result of a conversion, e.g. an error message.

Make SMB File
Pressing this button will convert the selected MAP file into a SMB file. This is the same as selecting ***File: Make*** in the menu.

Exit
Pressing this button will terminate the program.

File: Open
The ***File: Open*** command will show an open-dialog box. The selected file will be added to the **File List**.



File: Clear File List
This command clears the **File List**.

File: Make
The ***File :Make*** command will convert the selected MAP file in the **File List** into a SMB file, which will be placed in the same folder as the MAP file. This is the same as clicking the ***Make SMB File*** button.

File: Make All
All the MAP files in the **File List** will be converted to SMB files, and will be placed in the same folder as the MAP files

File :Exit
This command terminates the program.

File :About
Selecting this command will show an About box, stating the program name and the current version.

Step-by-step Instructions
The following procedures should be used to update or create a node Type in the MIB database, based on the variables and types declared in a Process-Pascal program.

1. Generate a MAP file with the Process-Pascal compiler.

2. Start the *MapToMIB* program. Add the MAP file to the **File List** by using the ***File: Open*** command. Ensure that the MAP file is selected in the **File List**. If it is not, select it by clicking the down arrow in the **File List** and then clicking the filename. Note, that the contents of the **File List** are preserved between each session of the *MapToMIB* program, so once a file has been added, it will remain there until ***File: Clear File List*** is selected.

3. Convert the MAP file into a SMB file by clicking the ***Make SMB File*** button. If no errors occur, terminate the *MapToMIB* program by clicking the ***Exit*** button.

4. Select the *MIB Edit* tab and select ***View: Show Types*** in the menu. This should reveal all the Types (red icons) currently defined in the MIB database.

5. If it is a new Type, it should be created as described in this section. If it is an existing type that is to be updated, the following steps (5.a to 5.e) should be skipped.

   a. Right click the project icon (e.g. SampleProject) and select ***New*** from the menu.

   b. Ensure that **Add New as: Sub Element** is selected.

   c. Select **Node Type** as New Kind.

   d. Key in a Type name for the new node in the **New Name** field.

   e. Press the ***OK*** button.

6. Right click the new type and select ***Update Type*** from the pop up menu. This will show an Open File Dialog box. Select the SMB file created by the *MapToMIB* program.

   The type is now updated / created

7. If the node is a PD3000 or a PD4000 Controller, the following steps (7.1a to 7.1d) should be performed:

   1a. Right click the new node type and select ***Properties*** from the pop up menu. The *Properties* window will now open.

   1b. In the *Properties* window select the **Type Info** tab and enter the following values:

Capabilities:	130
Object Type	3000 or 4000

   1c. Close the *Properties* window.

   1d. Select ***View: Show Nodes/Virtual Names*** in the *MIB Edit* window.

If the node is a PD5000 Controller, the following steps (7.2a to 7.2f) should be performed:

2a. Right click the new node type and select ***Properties*** from the pop up menu. The *Properties* window will now open.

2b. In the *Properties* window select the **Type Info** tab and enter the following values:

Capabilities:	32
Object Type	5000

2c. Expand the node-tree in the *MIB Edit* tab window by clicking the '+' sign to the left of the new type name.

Use the scroll-bar on the right-hand side of the *MIB Edit* window, and scroll down to find the following channel types:

Channel Name	Object Type
Service	1
LedCh	2
AlarmCh	2
OpSysCh	11
PPProcCh	11

The Object type of each channel name should be changed in accordance with the above table. To do this, perform the following procedure (2d) for each channel name.

2d. Right click the channel name in the *MIB Edit* window, and select ***Properties*** from the pop up menu. In the Properties window, note the Type under **Element info**. This is the Typename of the channel, e.g. 'TypeNo117'.

Use the scrollbar on the right-hand side of the *MIB Edit* window to find the typename of the channel. Left click the typename to update the *Properties* window with the type information of the channel typename.

Select **Type Info** in the *Properties* window and change the **Object Type** to the value in the above table.

Repeat this for each channel name in the table.

2e. Close the *Properties* window.

2f. Select ***View:Show Nodes/Virtual Names*** in the *MIB Edit* window.

8. An instance of this newly created node type can now be incorporated within the project. If it is a new Node, it should be created as described in this section. If the node of this node type already exists, the node type will have already been updated, and this step can be skipped.

   To create a new Node, right click the project icon in the *MIB Edit* window and select ***New*** in the pop up menu. In the **Add Element** dialog box, make sure that **Add new as: Sub Element** is selected. Select **Node** in the **New Kind** combo box. Type a name for the node in the **New Name** edit box. Now click the ***OK*** button.

   Right click the new node icon and select ***Properties*** from the pop up menu. Under the **Element Info** tab in the *Properties* window, select the new node type name in the **Type** combo box. Select the network to which the Node is connected in the **Net** combo box.

   Close the *Properties* window.

9. Right click the WorkSpace icon in the *MIB Edit* window, and select ***Refresh*** from the pop up menu.

   The new node is now ready to be used.

8 Appendix A

The following tables will prove to be useful to programmers designing application programs, who wish to use the facilities offered by VIGO.

Table 1 contains the Properties which can be used in VIGO STANDARD (VIGO.STD).

Table 2,3 and 4 show the Properties and Methods which can be used in VIGO PROFESSIONAL (VIGO.PRO).

Table 5 and 6 contain a short description of the Kinds/elements that are used in the MIB database.

Table 7 contains the data types that are defined for P-NET modules, which VIGO also uses.

Table 8 contains the Object Types for all Standard P-NET Channels. In addition, the Object Types for some company specific channel types, owned by PROCES-DATA A/S, are also given.

Further information about the P-NET Standard Channels can be found in the "P-NET Standardized General Purpose Channel Types" manual, from the International P-NET User Organization.

Table 9 contains the values for ***Capabilities*** *and* ***ObjectType*** for a selection of PROCES-DATA modules, which may be used in VIGO. In the MIB definitions, the Capabilities and Objecttype for all NodeTypes must be set to the correct value, in order to list the appropriate relevant tools from the right mouse menus in the MIBOCX.

IMPORTANT NOTE TO PROGRAM DEVELOPERS:
Most application programmes using VIGO create objects using VIGO Standard (VIGO.STD). These applications use the PhysID to select the variable to access. By setting the PhysID property for an object, all other associated properties are automatically set in accordance with the MIB contents.

In cases where a program developer is using VIGO Professional (VIGO.PRO) objects, and, for some reason, wants to modify some of the properties, it is entirely the programmers’ responsibility to set ALL the other related properties to ensure that these are compatible. Otherwise, errors may occur in transmission or data conversion.

Table 1

Properties for VIGO STANDARD (VIGO.STD)

Name	Data type	Description	OLE2 Type
PhysId	String	Identifies the physical object. This function fills out the specification of the physical object obtained from the Manager Information Base.	Property
ErrorCode	Integer	This variable contains a unique error code, in case an error occurs when accessing an object property or method.	Property
ErrorString	String	This variable contains an error message in plain text. This could be used in a Message Box.	Property
Value	Variant	Used to operate on all data types. This Property must be used for directly receiving and sending data to variables in VIGO STANDARD.	Property

Table 2

Properties and Methods for VIGO PROFESSIONAL (VIGO.PRO)

Name	Data type	Description	OLE2 Type
PhysId	String	Identifies the physical object. This function fills out the specification of the physical object obtained from the Manager Information Base.	Property
ErrorCode	Integer	This variable contains a unique error code, in case an error occurs when accessing an object property or method.	Property
ErrorString	String	This variable contains an error message in plain text. This could be used in a Message Box.	Property
Value	Variant	Used to operate on all data types. This Property must be used to receive and send data directly to variables in VIGO PROFESSIONAL.	Property
DoRead	Void	Used to start reading data into the Buffer. Data can be read using InValue	Method
DoWrite	Void	Used for writing to the contents of the Buffer. Data can be send to the buffer using InValue	Method
SubPhysId	String	Identifying a simple element in a complex structured variable, identified and obtained by PhysId, and located in a Virtual Object.	Property
InValue	Variant	Used to operate on all data types. This Property must be used to receive and send data to the Buffer, when using the DoRead or DoWrite Methods in VIGO PROFESSIONAL.	Property
DataReady	Boolean	This property indicates if the command has finished and the data are ready when the Buffer is used to Read / Write data.	Property
Progress	Float	Indicates the progress of a certain command, e.g. how much (%) of a file is downloaded.	Property
StopSequence	Void	Used to stop a sequence running within the IDC, e.g. download or upload.	Property
EnableExceptions	Boolean	Used to enable exception handling procedures build into the virtual object.	Property

Setting the Physical identifier will overwrite the other properties.

Table 3

Properties and Methods for VIGO PROFESSIONAL (VIGO.PRO)

Name	Data type	Description	OLE2 Type
Download	Void	Download a domain to a node. Function returns immediately. Filename must be written in the Fileame property before Download is called. The Progress property can be read during the Download process.	Method
Upload	Void	Upload a domain (program) from a node. This method is not implemented in VIGO 4.0.	Method
DeleteDomain	Void	Delete a domain within a node.	Method
Start	Void	Start a program execution.	Method
Stop	Void	Stop a program execution.	Method
Resume	Void	Resume a stopped program.	Method
Reset	Void	Reset a stopped program.	Method
Kill	Void	Kill a program execution	Method
SelectProgram	Void	Select a domain to be part of a program invocation. Domain is passed as parameter.	Method
UnselectProgram	Void	Unselect the domain within a program invocation. Domain is passed as parameter.	Method
ProgramState	Integer	Program invocation state.	Property
ProgramName	String	The name of the domain used within the Program Invocation.	Property
FileName	String	File name for the file to Down Load or Up Load	property
Vendor	String	Vendor name of a node (MMS).	Property
ModelName	String	Model name of a node (MMS).	Property
Revision	String	Revision of a node (MMS).	Property
ExAnd	Variant	P-NET specific. The passed parameter is and'ed with the data specified by PhysId, eg. VigoObj.And(Var)	Method
ExOr	Variant	P-NET specific. The passed parameter is or'ed with the data specified by PhysId, eg. VigoObj.Or(Var)	Method
TestAndSet	Variant	P-NET specific. The value of the returned parameter depends on the Test And Set conditions, eg. res =VigoObj.TestAndSet(Var)	Method

Setting the Physical identifier will overwrite the other properties.

Table 4

Properties and Methods for VIGO PROFESSIONAL (VIGO.PRO)

Name	Data type	Description	OLE2 Type
IDCNo	Integer	This property contains information about which Instruction/Data Converter is to be used for communication with the end Node. This property is mainly used by VIGO to determine which IDC is to be called.	Property
NodeAddress	String	This property contains a network address determined by the HUGO2 format. It contains the route to the end Node.	Property
InternalAddress	LongInteger	This is an address that is local for the single Node. E.g. SoftWire number or socket number.	Property
Offset	Long	This is an internal node parameter, e.g. used to access a specific offset for a complex variable.	Property
SubOffset	Long	This property is similar to the Offset property, but it is only used when SubPhysID is used.	Property
BitNo	Byte	This is an internal node parameter.	Property
Size	Long	This property contains the size of the data structure in bytes.	Property
SubSize	Long	This property is similar to the Size property, but it is only used when SubPhysID is used.	Property
ObjectType	Integer	Description of a specific node object, e.g. for P-NET it could be a analogue channel, digital channel, etc.	Property
DataType	Integer	Defining the type that is to be requested within a node. Only used for non standardized types.	Property
SubDataType	Integer	This property is similar to the DataType property, but it is only used when SubPhysID is used.	Property
InformationInErrorCode	Boolean	Enables that Historical Errors are visible in the ErrorCode.	Property
ReadOnly	Boolean	Indicating that the Property/Method is read only.	Property
WriteOnly	Boolean	Indicating that the Property/Method is write only.	Property
MaxRetry	Short	Reserved for future use.	Property
NodeCapabilities	String	Indicating the capabilities of the node, e.g. support bitno, offset, etc.	Property
PhysAddress	Boolean	Enables physical addressing. The physical address must be set using InternalAddress.	Property
OnlineAccess	Boolean	Enables that the data are accessable from a file and not from the network. This may be used for simulation purposes.	Property
SetMessage	Void	This method is used to specify a message to receive when a DoRead or DoWrite method has completed	Method

Table 5

Kinds of MIB elements used in a **Project** description

Kind	Type	Description
Project	Project	The Project holds information about the whole Project description. The data are stored in a MIB-file.
BasicType	Type	Boolean, Byte, Char, Word, Integer, LongInteger, Real, LongReal, OldReal, Timer, RealDate and OdDate are all BasicTypes, from which all other types are constructed.
NodeType	Type	NodeTypes holds information about the entire data structure to use in a node. The elements (channels and softwire numbers) inside are all set up as SubElements
ChannelType	Type	A ChannelType holds a description for a channel in a Node. The elements (Registers) inside are set up as SubElements.
RecordType	Type	Complex structures for variables are set in a RecordType. The elements (RecordFields) inside are set up as SubElements.
Enumerated	Type	Enumerated holds identifier for logic names used in reeling off. The elements inside (EnumeratedName) are set up as SubElements.
ArrayType	Type	In ArrayType an array of a specified type can be created.
BufferType	Type	In BufferType a buffer of a specified buffer element type can be created.
BitArrayType	Type	In BitArrayType a boolean array can be specified. Instead of occupying a byte to each boolean value, the BitArrayType only uses one bit for a boolean.
SetType	Type	To give special values to a type, SetType is used.
StringType	Type	StringType is used to define a string, which consists of a length (in bytes) and an array of char.
VirtualRecordType	Type	The VirtualRecordType is used to give a Virtual description of the physical plant. The elements inside VirutalRecordType (Alias, Constant, VirutalRecordType and VirtualArrayType) are set up as SubElements, and can be accessed using these subnames.
VirtualArrayType	Type	The VirutalArrayType is used to give a Virtual description of the physical plant. The elements inside VirutalArrayType (Alias, Constant, VirtualRecordType and VirtualArrayType) are set up as SubElements, and can be accessed by using index values.
BitMapType	Type	To define a Bitmap of a specific type, BitMapType is used.
PointerType	Type	A Pointer to another Type definition is created from PointerType
Procedure	Type	To reserve a name for a Procedure in an application the Kind: Procedure is used.
Function	Type	To reserve a name for a Function in an application the Kind: Function is used.

Kinds (Variables) in the MIB

Table 6

Kind	Type	Description
Node	Variable	Nodes are used to gain contact to modules within the physical plant. Nodes are only set up from the kind: NodeTypes.
Channel	Variable	Channels are used in the description of a NodeType. Channels are set up from the kind: ChannelType.
Register	Variable	Registers are used to describe all variables inside a ChannelType. Registers can be set from all Type Kinds, except ChannelType and NodeType.
SWNumber	Variable	If the SoftWire number is known, this can be given directly. SWNumbers are used in NodeType.
RecordField	Variable	A RecordField holds all Type Kinds, except ChannelType and NodeType. RecordFields can only be used inside a RecordType.
Constant	Constant	To set a Constant in the Project description the Constant element can be used.
EnumeratedName	Constant	As SubElements to Enumerated, EnumeratedNames are used. The Names represent a specified value.
Alias	Variable	Aliases are used to set up pointers, which can act as short cut to elements within the Project description.
VirtualName	Variable	In Virtual descriptions the VirtualName consist the VirtualRecordType or the VirtualArrayType to use.

List of datatypes for P-NET modules.

P-NET Data Type	Number Hex	Decimal	Length in bytes
Empty	0x20	32	-
Integer	0x22	34	2
LongInteger	0x23	35	4
Real	0x24	36	4
LongReal	0x25	37	8
RealDate	0x27	39	8
String	0x28	40	-
Boolean	0x2B	43	1
OldDate	0x2E	45	8
Byte	0x31	49	1
Word	0x32	50	2
UserDefined	0x3D	61	-

Table 7

Object types for P-NET Channels.

The object types for P-NET Standard Channels and some company specific channels are found in the following table.

Object	Description
0	Object type is not used or the object type is a non-standard type
1	Service channel
2	Digital IO channel
3	Common I/O channel
4	Analog measurement channel
5	Current output channel
6	PID-regulator channel
7	Calculator channel
8	Pulse Processor channel
9	Printer channel
10	Weight channel
11	Program channel
12	Power Monitor channel
14	Communication channel
32769	PROCES-DATA specific Data channel
32770	PROCES-DATA specific Common I/O channel
32771	PROCES-DATA specific Thyristor Switch
32773	PROCES-DATA specific Key/Mouse
32774	PROCES-DATA specific Display
32775	PROCES-DATA specific GateWay
32776	PROCES-DATA specific Generator Switch

Table 8

Object types for PROCES-DATA modules.

The following table shows the object type and the capabilities for a selection of standard modules from PROCES-DATA A/S.

Module number	ObjectType	Interpretation of capabilities	Capabilities
PD340	340	NoOffset,NobitAddress,OldType	7
PD1611	1000	NoOffset,NobitAddress,OldType	7
PD3100	1000	NoOffset,NobitAddress	3
PD3120	1000	NobitAddress	2
PD3150	1000	NoOffset,NobitAddress	3
PD3221	1000	NobitAddress,NoOffsetInlong	130
PD3230	1000	NobitAddress,NoOffsetInlong	130
PD3240	1000	NobitAddress	2
PD3250	1000	NobitAddress	2
PD3260	1000	NobitAddress	2
PD3920	1000	NobitAddress	2
PD3930	1000	NobitAddress	2
PD3940	1000	NobitAddress	2
PD3000	3000	NobitAddress, ExtendedPNET	34
PD4000	4000	NobitAddress, ExtendedPNET	34
PD4500	4500	ExtendedPNET	32
PD5000	5000	ExtendedPNET	32
PD5010	5000	ExtendedPNET	32
PD5015	5000	ExtendedPNET	32
PD5020	5000	ExtendedPNET	32

Table 9