SimPL

A Tool for programming the DMC

User's Manual 1.1

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Installation

System Requirements

The following hardware and software is required for proper installation and operation of SimPL:

- PC running Windows 95 or 98.
- 5 MB Free Disk Space.
- 1 Free Serial Port.
- DMC Digital Motion Controller with Programming Cable.

Installation Procedure

To install SimPL:

1. Insert the SimPL installation disk, labeled “Disk 1/3” into the floppy drive.
2. From Windows, run A: SETUP.EXE (B: SETUP.EXE).
3. Follow the directions given in the setup program.

If you use the CD ROM User's Manual:

1. Click on INSTALLATION at the SimPL page.
2. Follow the directions given in the setup program.

When the installation is completed, a program group named “Inmotion” and program icon labeled “SimPL” will be created. To start SimPL, double-click on the SimPL icon.

Getting started

AN EXAMPLE APPLICATION

To help get started using SimPL, an example application will be examined, illustrating step by step, how SimPL can be used to realize a system. The example application is a linear actuator that is controlled via digital I/O. Digital inputs will be used to command the actuator to move between its home position and a fixed destination position. Digital outputs will indicate when the actuator is at home or its destination position. Also included is a ready output that will indicate when the DMC is enabled and ready to accept commands. A diagram showing the details of the system is shown in Figure 1 below.

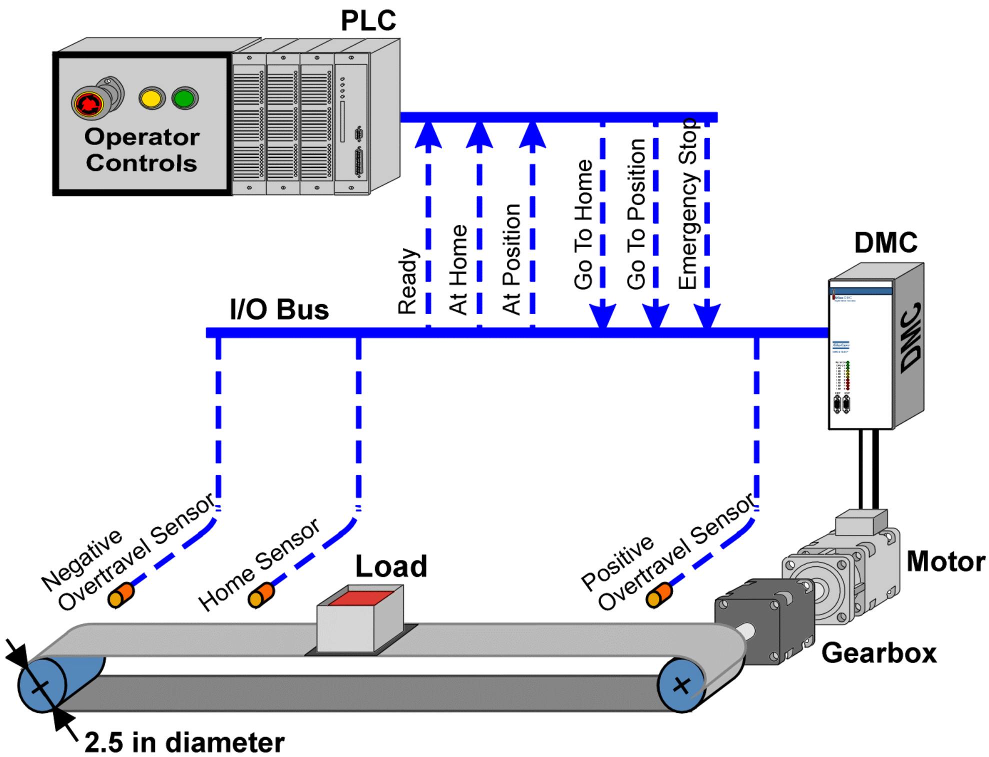


Figure 1. Example application diagram.

STARTING A NEW APPLICATION

To start a new SimPL application, select the New Application option from the File menu. A dialog will appear asking for a file name to use for the new application. An example of this file dialog is shown in Figure 2. For this example, the name EXAMPLE.DMC has been selected. After the file name is chosen, it will be displayed in the caption of the SimPL main form.

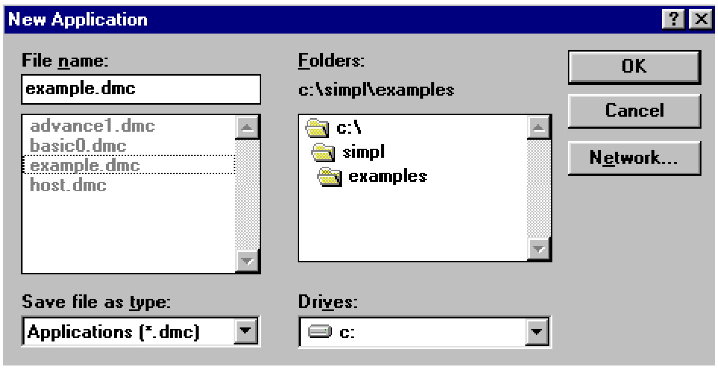


Figure 2. New application file dialog.

SELECTING THE MOTOR AND DMC

After starting the new application, the next step is to define what hardware is being used in the application. At this point, the motor model and DMC model should be selected from the database provided with SimPL. To do this click on the Drive / Motor Selection option from the Hardware menu. The form shown in Figure 3 is displayed.

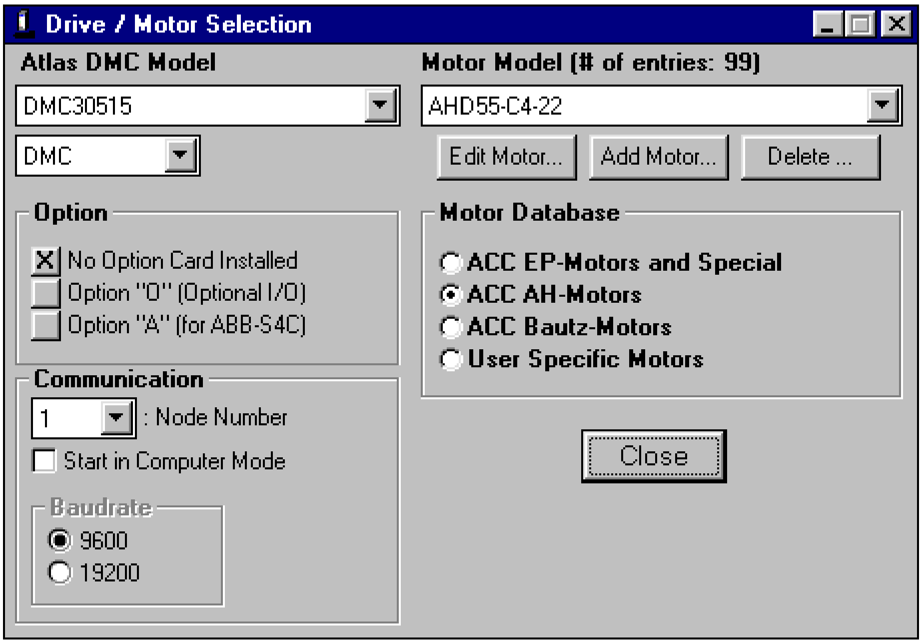


Figure 3. Drive/motor selection form.

Select the DMC and motor model from the drop down lists on the form. Also included on this form is a section for selecting any option cards that are installed in the DMC. For this example no option card is used.

SETTING SERVO GAINS

To enable testing of the system an initial set of servo regulator gains must be selected. For each motor and drive combination in the database, a set of default gains is provided. While these gains may not give optimum performance, they will offer an initial starting point with stable operation. To load default parameters, click on the Servo Parameters option of the Hardware menu. The form shown in Figure 4 is displayed. To load default values, click on the Load Defaults button.

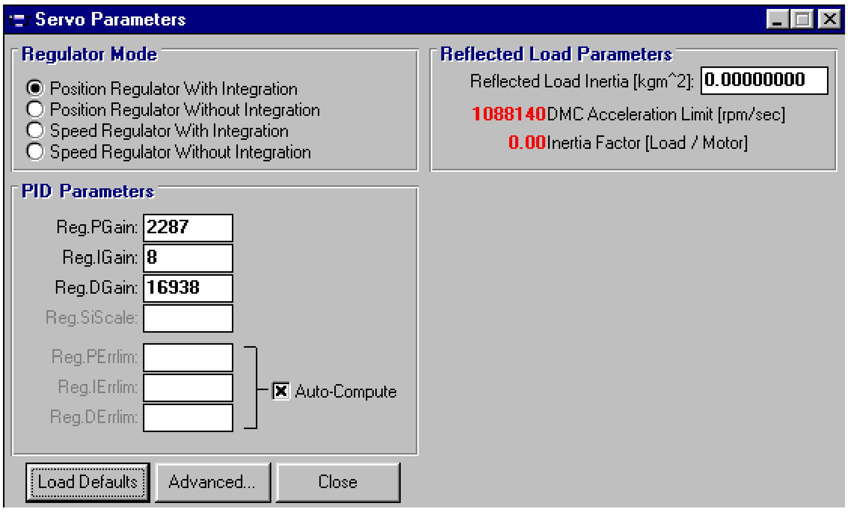

Servo Parameters
Regulator Mode
Position Regulator With Integration
Position Regulator Without Integration
Speed Regulator With Integration
Speed Regulator Without Integration
Reflected Load Parameters
Reflected Load Inertia [kgm^2]: 0.00000000
1088140 DMC Acceleration Limit [rpm/sec]
0.00 Inertia Factor [Load / Motor]
PID Parameters
Reg.PGain: 2287
Reg.IGain: 8
Reg.DGain: 16938
Reg.SiScale:
Reg.PErrlim:
Reg.IErrlim:
Reg.DErrlim:
Auto-Compute
Load Defaults
Advanced...
Close

Figure 4. Servo parameters form.

ASSIGNING DIGITAL INPUTS

In the diagram of the system shown in there are a total of 6 digital inputs required. Assigning names and functions to the digital inputs is accomplished by selecting the Input Assignment option from the Hardware menu. The Input Assignment form, shown in Figure 5 is displayed.

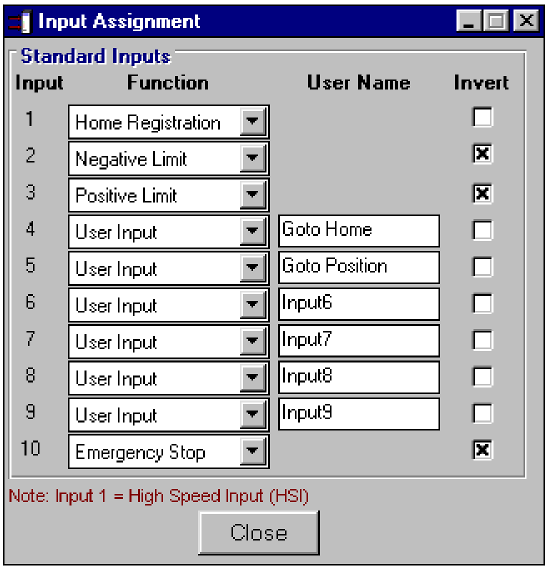


Figure 5. Input Assignment form.

Three of the input functions, positive limit, negative limit and Emergency Stop input, are directly supported by SimPL and need only to be assigned to a digital input. To assign a pre-defined function to an input, select an entry from the drop down list associated with the input. The other two inputs are to be used in the program to perform specialized tasks. In the case of these inputs, the input function is set to User Input and a meaningful User Name is assigned. These inputs will be checked and acted upon using commands in the program.

ASSIGNING DIGITAL OUTPUTS

For the example application there are a total of 3 digital outputs required. Assigning names and functions to the digital outputs is accomplished by selecting the Output Assignment option from the Hardware menu. The Output Assignment form, shown in Figure 6 is displayed.

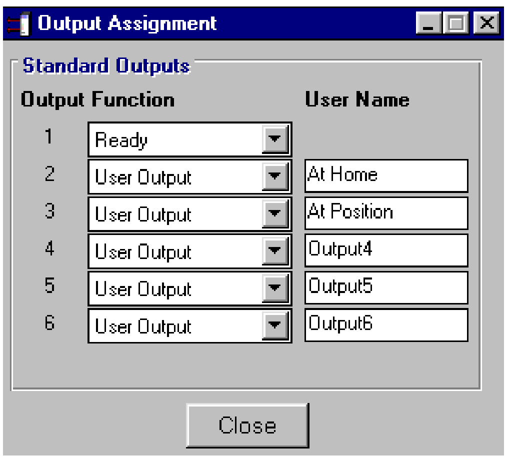


Figure 6. Output Assignment form.

The Output Assignment form is similar to the Input Assignment form described above. The Ready Output function is a predefined function and is assigned using the drop down list. The other two outputs have specialized functions and are setup as User Outputs with meaningful names. These outputs will be controlled by program commands defined later.

DEFINING APPLICATION UNITS

Now that the hardware being used is defined, the next step is to define the units to be used when entering motion related parameters. Since SimPL allows position and velocity units to be arbitrarily defined, a conversion factor between motor revolutions and the position/velocity units must be defined. This is accomplished by selecting the Application Units options from the Hardware Menu. The Application Units form is shown in Figure 7 below.

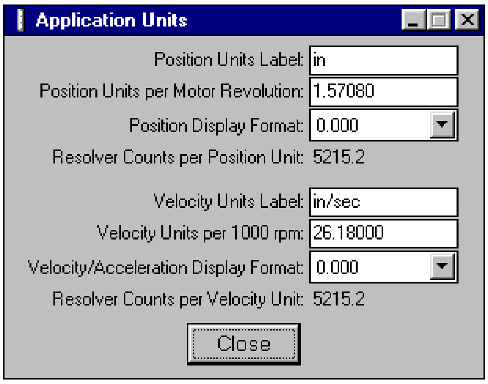


Figure 7. Application units form.

In the example application, the position units are to be defined in inches. Since a gear reducer with a 5:1 reduction is being used to drive a belt system driven by 2.5 inch diameter pulleys, the conversion factor is found to be:

Position Units per Motor Revolution = 2.5 in x $\pi \div 5 = 1.570795$ in.

The velocity units for the example are inches per second. As with the position units, a conversion factor must be entered for the velocity units. The conversion factor is found to be:

Velocity Units per 1000rpm = 1000rpm $\div$ 60sec $\times$ 2.5in x $\pi \div 5 = 26.18$ in/sec.

Now that these conversions have been entered, it is possible to enter positions and distances in inches and velocities in inches per second.

SETTING ESTOP / FAULT PARAMETERS

The application generated by SimPL contains extensive error handling and detection routines to respond to a variety of fault conditions. Some of these routines require parameters specific to the application itself. These parameters are entered using the EStop / Fault Parameters form displayed in Figure 8 below. To access this form, select the EStop / Fault Parameters option from the Functions menu.

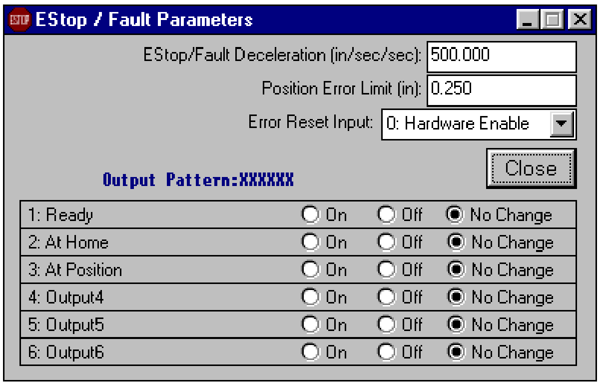


Figure 8. Fault parameter form.

The first parameter to be entered is a fault deceleration. This is used to set the rate (deceleration) at which the motor comes to a stop when an EStop/Fault occurs, such as a limit switch being activated.
The second of these parameters is the Position Error Limit. This defines the maximum error that may exist between the desired motor position and the actual motor position. If this value is ever exceeded, the DMC will disable output power to the motor and indicate an error on the front panel LED's. A position error can occur for many reasons and is a good indication of a mechanical or electrical failure. For this example, the position error limit has been set to 0.25 inches.

Once motion has ceased, the DMC digital outputs are modified according to the options selected on this form. If a particular output should be turned on or off after an emergency stop, simply select that state for the output. If no change is desired, click on the "No Change" option for that output.

BUILDING THE PROGRAM

After all hardware, input functions and output functions are defined, the actual program, which will be operating in the DMC, must be defined. To add a new program to the application, select the New Program option from the Program menu.

A SimPL Program Editor form will be displayed. On this form are places to enter the program name and number. For this example, the program number is set to zero and the program name is set to "Main Example Program". Since SimPL can support up to 32 different programs in the same application, it is necessary to give each program a unique number. The program name is set to make it easier to identify programs by a name, in addition to a number. The example application being discussed here is very basic and has only one program.

Figure 9 shows the program used in this application to move the linear actuator in response to the digital input commands. It also includes the commands to control the digital outputs, which indicate the current position of the actuator.

Line 12 of the program is not visible but contains a Jump command to go back to line 2.

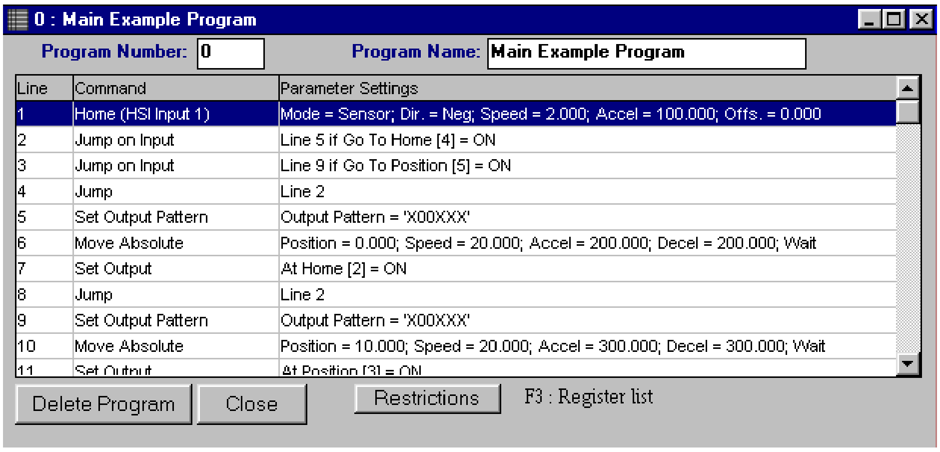


Figure 9. SimPL program editor form.

To define a program line in SimPL, double click on the desired cell in the Command column of the grid. If adding a line to the end of the program, double click on the blank command line at the end of the program. To insert a line, click on the line of the program to come after the new line, either press the <Insert> key or select Insert from the Edit menu.

After double clicking on a cell in the Command column, a form will appear, showing all available program commands that may be selected. This form is shown in Figure 10.

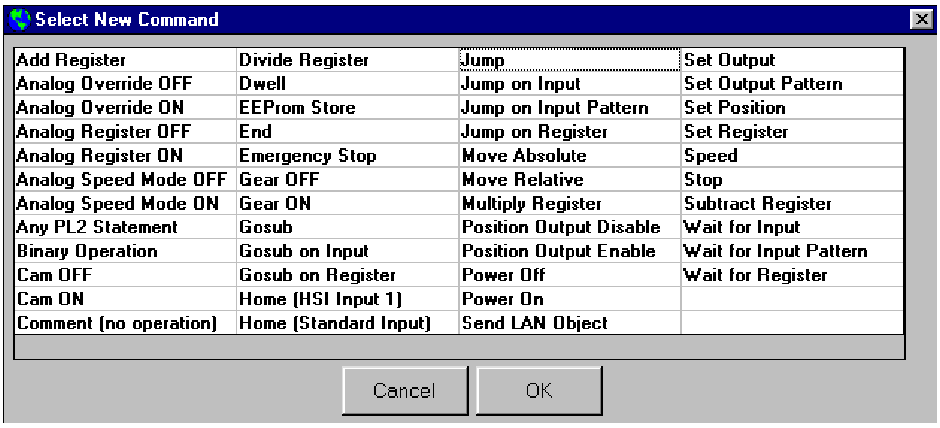


Figure 10. Select new command form.

After selecting a command from the list, the new command name will be displayed in the program grid. The Command Parameters cell for this program line will indicate that the parameters are not yet defined. To define the parameters, double-click on the Command Parameters cell of the desire program line to display the command parameter form. For example, when defining the Set Output Pattern command in line 5, the parameter form shown in Figure 11 is displayed.

Building the Program

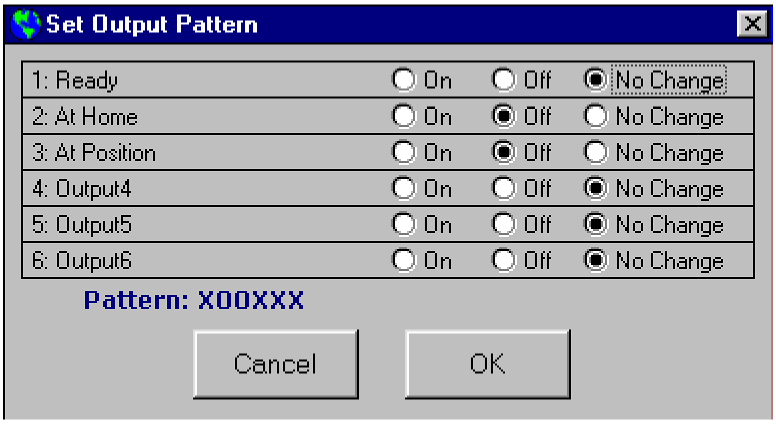


Figure 11. Set output pattern parameters form.

This command allows the state of all digital outputs to be defined in a single command. As shown Figure 11, this command will turn off the “At Home” and the “At Position” outputs and leaves all others unaffected.

The above procedure of selecting a command and setting its parameters is repeated, until the program is complete. Below in Table 1 is a description of each of the program lines in the example program.

Line	Command	Purpose
1	Home	Searches for the Home input in the negative direction and sets the position of the sensor to zero.
2	Jump on Input	If “Goto Home” input is on then jump to line 5, where the commands to set the digital outputs and the command to move to the zero position are located.
3	Jump on Input	3 If “Goto Position” input is on then jump to line 9, where the commands to set the digital outputs and the command to move to the destination position are located.
4	Jump	Go back to line 2 to check the inputs again
5	Set Output Pattern	Turn off the “At Home” and “At Position” outputs, since the actuator is about to be moved.
6	Move Absolute	Move the actuator to the home position.
7	Set Output	Turn on the “At Home” output, since the actuator is now at the home position.
8	Jump	8 Go back to line 2 and wait for the next input command.
9	Set Output Pattern	Turn off the “At Home” and “At Position” outputs, since the actuator is about to be moved.
10	Move Absolute	Move the actuator to the destination position of 10 inches from home.

Line	Command	Purpose
11	Set Output	Turn on the “At Position” output, since the actuator is now at the destination position.
12	Jump	Go back to line 2 and wait for the next input command .

Table 1. Program commands

CONFIGURING PROGRAM EXECUTION

After the program is defined, it is necessary to select how and when the program will be executed. This selection is made using the Program Execution Control option of the Programs Menu. When this option is selected, the form shown in Figure 12 is displayed.

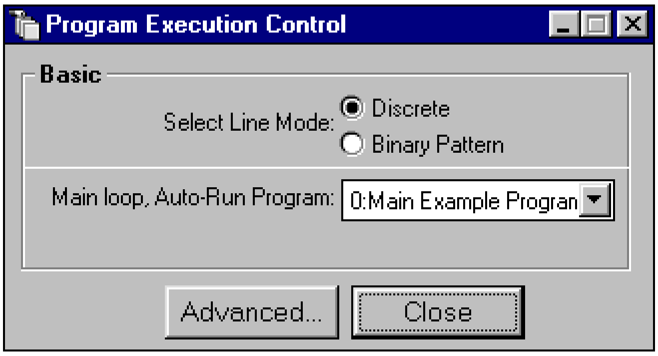


Figure 12. Program execution control form.

On the form is a section for select line mode. This only applies in the case where digital input lines are used to select and start execution of different programs. In this example, no such input lines are defined. Instead, the program is setup to execute automatically, whenever the DMC is powered up and enabled. To set a program to be automatically executed, select it from the drop down list labeled “Main loop, Auto-Run Program”.

GENERATING AND DOWNLOADING THE APPLICATION

Now that the application is fully defined, it is necessary to generate and compile the code that will be executed in the DMC.

This is accomplished by selecting the Generate and Compile option from the Generate Menu. There are two options presented when selecting this menu item. If the DMC contains a battery-backed RAM, the program can be downloaded over an RS232 line. In this case, select the Generate and Compile for Download option. If the DMC is using an EPROM for program storage, select the Generate for EPROM option to create a file that can be sent to an EPROM programmer. In this example, it is assumed that a battery-backed RAM module is installed in the DMC.

After a generate option is selected, the application is checked to make sure that all parameters are valid and all required setting are made. If an error is detected, a window will be displayed showing all warnings and errors that were found. If the application is verified, the application code will be generated and compiled.

Refer to **Verify Setup** for a complete description. After the application has been successfully generated, it must be downloaded to the DMC. This is accomplished by selecting the Download to DMC option from the Generate menu. When this option is selected, a form will appear showing the file to be downloaded. Please refer to **Download to DMC** for a complete description.

TESTING THE APPLICATION

To test the application, the DMC must be reset. This can be done by cycling power to the DMC or by selecting the Reset DMC option from the Tools menu. Once this is done, the DMC can be enabled and the program will begin to execute.

In order to observe the status of the DMC and the application it is executing, an application trace utility is included in SimPL. To access this feature, select the Application Trace option from the Tools menu. The Application Trace from is shown in Figure 13 below.

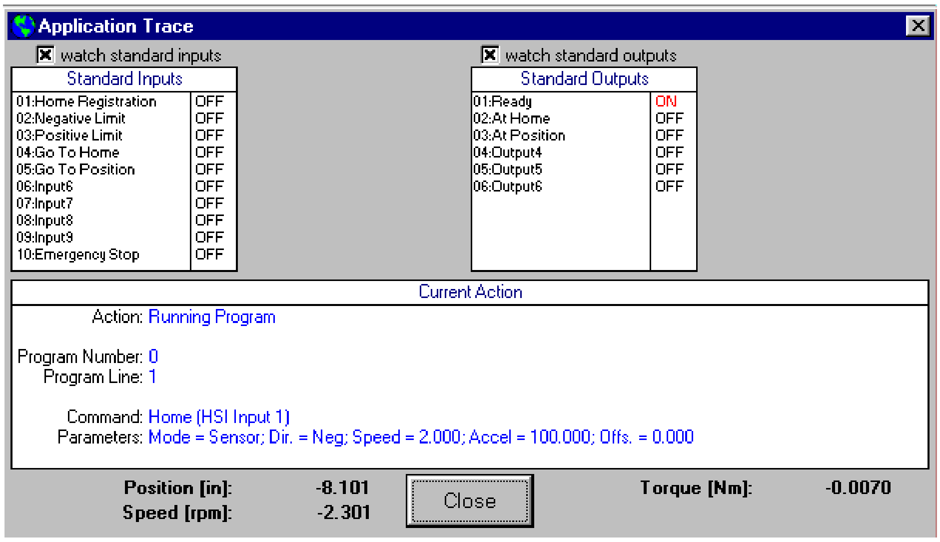


Figure 13. Application trace form.

On the application trace form, the state of the digital inputs and digital outputs are monitored. Also, the action being taken in the application is displayed. Figure 13 shows the application trace form at the time when the program is executing the Home command and is searching for the Home Input. This utility is useful in tracking and debugging programs as well as diagnosing faults and error conditions.

After monitoring execution and observing performance, the application can be repeatedly changed, downloaded and tested until proper operation is achieved.

File menu

THE FILE MENU

The File Menu contains all menu items used to load, save and print application settings. The content of the File Menu is shown in Figure 14.

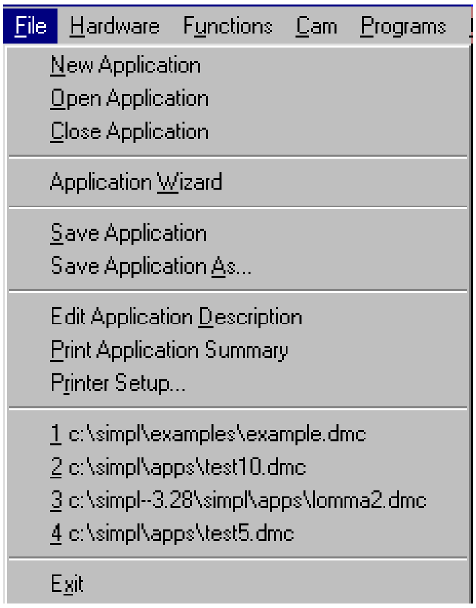


Figure 14. File menu.

NEW APPLICATION

The New Application menu item is used to start a new application with default settings. When this menu item is selected, a file dialog is displayed. Enter a new file name or select an existing file to overwrite. All SimPL application files have a *.DMC file extension. All additional files generated by SimPL share the same name but have different extensions.

OPEN APPLICATION

The Open Application menu item is used to load a previously saved application. When this menu item is selected, a file dialog is displayed. Enter the application file name to open. Also note that the names of the last 4 applications loaded into SimPL are displayed at the bottom of the File menu. To re-open one of these applications, simply select it from the list.

SAVE APPLICATION

The Save Application menu item is used to save any changes to the current application. The application is saved to the file name displayed in caption of the main form.

SAVE APPLICATION AS

The Save Application As menu item is used to save the current application under a new name. When this menu item is selected a file dialog is displayed. Enter a new name or select an existing file to overwrite. All subsequent files generated for this application will use the new name.

EDIT APPLICATION DESCRIPTION

The Edit Application Description menu item is used to enter any comments concerning the application. These comments will be included in the header of the generated PL2 code as well as in the printed application summary. When this menu item is selected, a form is displayed containing a small text editing area where these comments can be entered.

PRINT APPLICATION SUMMARY

The Print Application Summary menu item is used to print summary of all settings made for the current application. The printout will contain all settings, programs, index moves and cams used in the application.

PRINTER SETUP

The Printer Setup menu item displays a standard printer setup dialog. This dialog is used to change printers, printer settings, paper size and orientation.

EXIT

The Exit menu item is used to exit SimPL and return to Windows. If the current application has changes that have not been saved, a warning will be displayed before exiting.

Hardware menu

GENERAL

The Hardware Menu contains all menu items used to specify and configure the hardware used in the application, along with assignment of functionality to the digital I/O of the system. The content of the Hardware Menu is show in Figure 15.

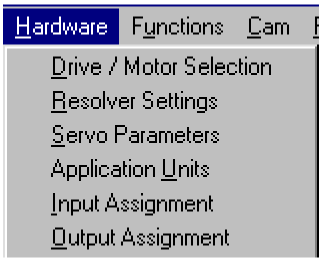


Figure 15. Hardware menu.

DRIVE/MOTOR SELECTION

The Drive / Motor Selection menu item is used to specify which motor, DMC model and option card are being used in the application. When this menu item is selected, the form shown in Figure 16 is displayed. Since multiple DMC's can be connected together in a daisy chain configuration, it is necessary to assign each unit a unique hexadecimal node address. Valid node addresses are between 1 and F. To select a new node address, pick one of the available choices from the list. This node address is included in the generated application. Each time the DMC is powered up or reset, it defaults to this node address and all communications must be directed to this node address.

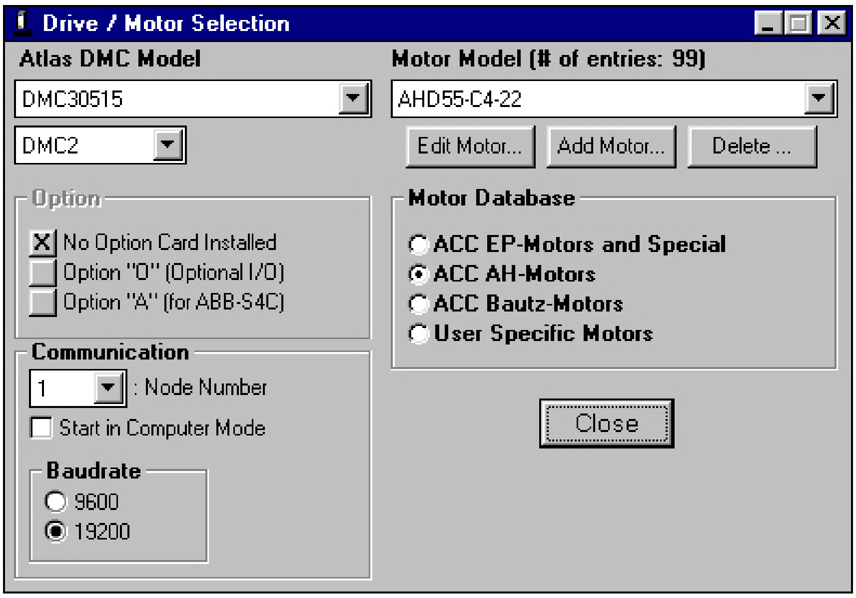


Figure 16. Drive/Motor selection.

DMC MODEL SELECTION

A database is included with SimPL, which contains all DMC models. This database contains current ratings for each drive, which is critical for properly computing default servo gains and torque limits. To select a new model, simply select an item from the list.

MOTOR MODEL SELECTION

The database provided with SimPL also includes all of the standard motors available from Inmotion Technologies. This database contains current ratings and resolver parameters for each motor. To select a new motor, pick an item from the list.

DMC OPTION CARDS

The DMC can contain an internally mounted option card. The option "O"card provides the DMC with additional 7 digital inputs and 7 digital outputs. The Option "A" card allows the DMC to interface with resolvers, which are not excited by a DMC. Only select an option card if it was ordered with the DMC since these options change the availability of certain functions.

ADDING A NEW MOTOR

If the motor to be used is not found in the current motor database, it is possible to add a new motor. To add a motor, click on the Add Motor button to display the form shown in Figure 17 below.

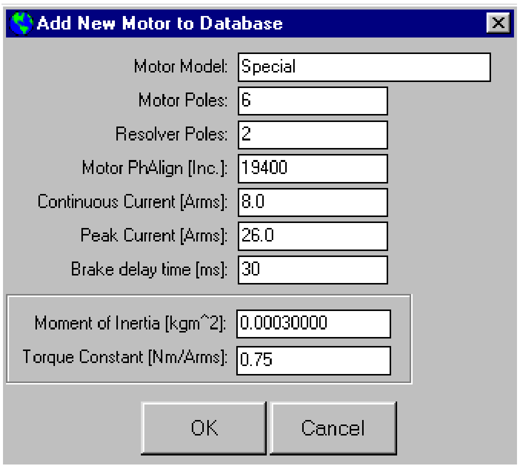


Figure 17. Add New Motor form.

Enter the proper motor parameters using this form and click on the OK button. This new motor will be added to the list of motors and automatically selected.

RESOLVER SETTINGS

The Resolver Settings menu item is used to specify which of the resolver inputs of the DMC are used and how they are excited. When this menu item is selected, the form shown in Figure 18 is displayed.

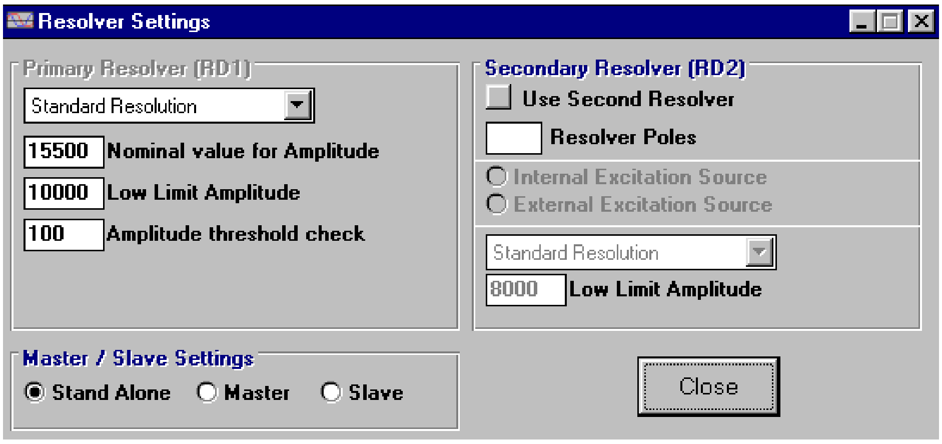


Figure 18. Resolver settings form.

PRIMARY RESOLVER EXCITATION

The primary resolver on the Atlas DMC is the resolver attached to the motor driven by the DMC. {The only time this setting must be made for this resolver is if the Option "A" card is used. If an Option "A" card is being used and the primary resolver is being excited by an external source, select the external excitation option}.

ENABLING A SECONDARY RESOLVER

The secondary resolver on the Atlas DMC is used to support Master/Slave functions such as electronic gearing and position lock cam tables. If a second resolver is not used by the application, make sure that there is no "X" in the "Use Second Resolver" button. If the second resolver option is turned on, routines for monitoring its amplitude are included in the generated application. These routines will generate a fault if no second resolver is attached.

SECONDARY RESOLVER POLES

If a second resolver is used for Master/Slave functions, it is necessary to set the number of resolver poles for the resolver. Enter the number of resolver poles in the edit box on the form. The number of poles determines how electronic gears and CAM functions operate. If the wrong number of resolver poles is entered, scaling of CAM tables and electronic gearing will be computed incorrectly.

MASTER / SLAVE SETTINGS

When two or more DMCs share resolvers, they must be synchronized. This is accomplished through the sync lines located on the front panel connectors on the DMC. These sync lines must be controlled by a single DMC. This DMC should be designated as the Master and the others should be designated as Slaves. If a DMC does not need to synchronize with another DMC, select the stand-alone option to have it ignore the sync lines altogether.

SERVO PARAMETERS

The Servo Parameters menu item is used to set the default parameters used in the DMC servo regulator. When this menu item is selected, the form shown in Figure 19 is displayed.

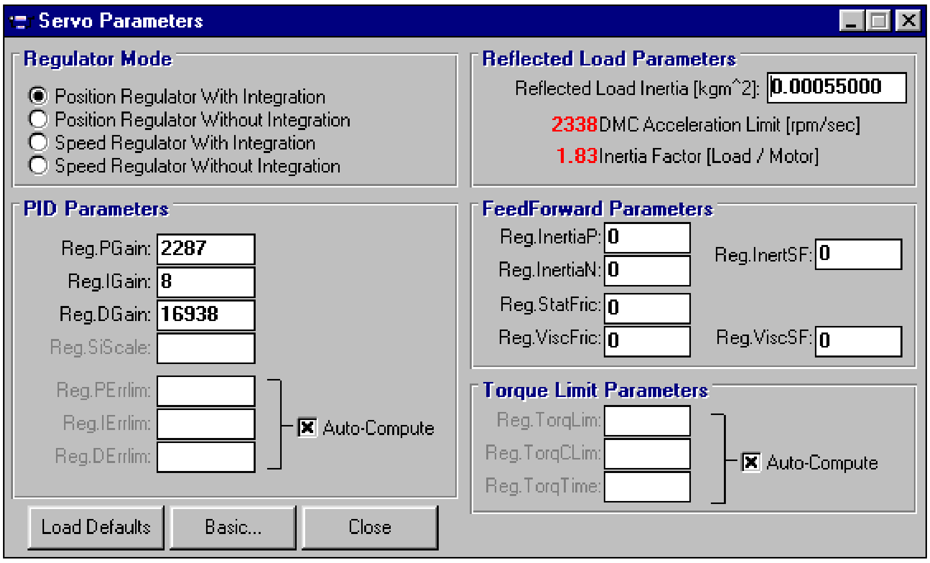


Figure 19. Servo parameters form.

BASIC AND ADVANCED PARAMETERS

The Servo Parameters form allows for setting all of the parameters, which control the operation of the DMC servo regulator. When this form is displayed for the first time, only a basic set of parameters is displayed. These parameters relate to basic PID control functions. If desired, all servo parameters can be displayed and edited, by clicking on the advanced button located at the bottom of the form. Operators with a good understanding of the DMC regulator should only modify these advanced parameters. If the advanced parameters are displayed, it is possible to return to the basic parameter set by clicking on the Basic button.

REGULATOR MODES

The DMC servo regulator can operate in several different modes. The two primary modes are position and speed, each with an option for using integrated error. Depending on which of the four modes is selected; different PID parameters are used. Those parameters, which are not used, have their associated displays disabled.

As a position regulator, the DMC computes an output torque based on both the speed and position error of the system. This mode is used in positioning systems where the actual position of the motor is critical. At each servo cycle, the DMC compares the actual motor speed and position with the commanded speed and position. These differences are then multiplied by the appropriate regulator gains to produce the output torque to the motor. In addition to these computations, it is possible to specify if the integral of the position error is also used in the torque calculations. If integration is turned on, the regulator will produce increasing torque until a zero position error is achieved. However, position error integration can also have the effect of causing overshoot and some oscillations in the system. Therefore this mode should be used carefully with moderate values of the integral PID gain.

When used as a speed regulator, the DMC ignores the position error of the motor and concentrates only on the speed error. This mode is used when the drive is desired to run at specified speeds without regard to its actual position. In speed regulator mode, it is also possible to use the integral of the speed error in the output torque calculations. The use of integration in this mode increases the holding torque of the motor.

PID PARAMETERS

There are three main parameters used in the PID control loop implemented in the DMC. Each of these gains also has an associated error limit with it. The `Reg.PGain` parameter is multiplied with the position error to generate an output torque.

Its associated error limit `Reg.PErrlim` is used to limit the maximum position error that is used in the computation. This is important in preventing saturation of the regulator. These limits can be set manually or can be automatically computed by SimPL to prevent saturation. To have all error limits computed automatically, simply click on the Auto-Compute box in the PID Parameters section of the form.

The `Reg.IGain` parameter and its error limit parameter `Reg.IErrlim` are used to compute an output torque based on integrated error values. If the DMC is using a position regulator, the integrated position error is multiplied by this factor. If using a speed regulator, the integrated speed error is multiplied by this factor. Because integrated speed errors can be large, an additional parameter `Reg.SiScale` is provided. This parameter is used to scale the integrated speed error by a factor of `2 -Reg.SiScale`. The `Reg.IErrlim` parameter limits the maximum amount of integrated error that is used in the torque computation.

The `Reg.DGain` parameter and its error limit `Reg.DErrlim` are used to compute an output torque based on the speed error. The `Reg.DErrlim` parameter limits the maximum amount of speed error that is used in the torque computation.

FEED FORWARD PARAMETERS

The DMC has several additional parameters that are useful in optimizing performance. These parameters do not depend on speed or position errors. The are referred to as feed forward parameters because they bypass the PID portion of the regulator and generate a torque output based on commanded speed and acceleration values.

The Reg.StatFric parameter adds a constant amount of output torque, based on the sign of the commanded speed. This parameter is used to overcome a constant frictional force on the motor. If the commanded speed is positive, a positive offset equal to Reg.StatFric is added to the output torque. Likewise, a negative speed command adds a negative offset.

The Reg.ViscFric parameter is used to overcome viscous friction in the system. It produces a feed forward torque proportional to the commanded speed. Since commanded speeds command can sometimes be large, an additional parameter Reg.ViscSF is provided. This parameter is used to scale the command speed by a factor of 2 -Reg.ViscSF .

There are two parameters used to compensate for system inertia. These parameters produce a torque feed forward which is proportional to the commanded acceleration. The parameter Reg.InertiaP affects torque when accelerating in a positive direction and Reg.InertiaN affects torque when accelerating in a negative direction. As with speeds, accelerations can be large, so there is a scale factor Reg.InertSF that scales the commanded acceleration by 2 -Reg.InertSF .

TORQUE LIMIT PARAMETERS

In order to prevent damage to motors, drives and mechanics it is often necessary to limit the amount of torque-producing current that is generated by the DMC. This is accomplished by using three parameters available in the DMC regulator.

With these parameters it is possible to set a peak torque and continuous torque limit for the drive. The values of these parameters are set using the fact that a torque limit of 8191 is equal to 100% of the rated peak torque of the DMC. If desired, these values can be computed automatically by selecting the Auto-Compute option in the Torque Limit section of the form. If Auto-Compute is selected, torque limits will be set at the highest continuous and peak torque that will not damage the DMC or the motor.

The parameter Reg.TorqLim limits the peak torque produced by the drive. This parameter prohibits any current output greater than the amount specified in this parameter. The parameter Reg.TorqCLim limits the continuous torque produced by the drive. This parameter works in conjunction with the Reg.TorqTime parameter that contains a value in milliseconds. The way the continuous torque limit works is that the DMC is allowed to output a torque greater than Reg.TorqClim but less than Reg.TorqLim for the number of milliseconds stored in Reg.TorqTime. After this time has expired the torque limit is reduced to the value stored in Reg.TorqCLim. This feature allows the peak outputs from the drive and motor to be utilized without risk of exceeding their continuous ratings.

LOADING DEFAULT SERVO PARAMETERS

If a motor and DMC have already been selected, the Load Defaults button can be clicked to fill the parameters with values that will ensure a good starting point for servo loop performance. Selecting this option will set the regulator to position regulator mode and set error limits and torque limits to auto-compute.

APPLICATION UNITS

The Application Units menu item is used to specify what system of units will be used to enter positions, speeds and acceleration into the SimPL application. When this menu item is selected the form shown in Figure 20 is displayed. This application units feature permits specifying positions in any arbitrary units such as inches, millimeters, revolutions, etc. Similarly, speeds and accelerations can also be arbitrarily defined.

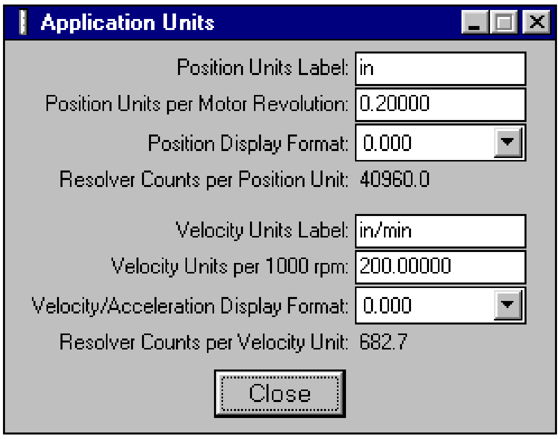


Figure 20. Application units form.

POSITION UNITS

To specify position units for the application, a label for the units must be entered, along with the number of units per motor revolution. For example, if the motor is attached to a screw with a 0.2 inch lead. The text “in” can be entered as the position unit’s label and 0.2000 can be entered as the number of position units per motor revolution. This allows all positions, distances, and cam tables to be entered in inches. The position display format setting is used to determine how many decimal places are to be used when entering and displaying position values. To set the format, select an option from the pull-down list. Notice that the number of resolver counts per units is computed and displayed on the form.

VELOCITY UNITS

To specify velocity units for the application, a label for the units must be entered, along with the number of units per 1000 rpm. For example, if the motor is attached to a screw with a 0.2 inch lead and velocity units of “in/min” is desired, the text “in/min” can be entered as the velocity units label and 200 can be entered as the number of velocity units per 1000 rpm.

This allows all speeds to be entered in “in/min”. All accelerations are as velocity units per second. In the above example, all acceleration would be handled as “in/min/sec”. The velocity/acceleration display format setting is used to determine how many decimal places are to be used when entering and displaying velocity and acceleration values. To set the format, select an option from the pull-down list

RESOLVER COUNT CONVERSIONS

Although SimPL allows motion parameters to be entered in user-defined application units, there are cases when it is necessary to use raw positioning units in an application. The DMC converts the analog resolver signal to resolver counts, where there are 4096 counts for every resolver pole. For example, if a motor has a two-pole resolver, each motor revolution will result in a change in position of 8192 counts. This value is important when user registers are specified for parameters in SimPL program sequences. If the register is to contain a position, speed or acceleration, the value contained in the register is in resolver counts, not application units. In order to facilitate the conversion from application units to resolver counts, the number of resolver counts per position unit and velocity units are displayed on the Application Units form.

INPUT ASSIGNMENT

The Input Assignment menu item is used to assign names and functionality to the available digital inputs of the DMC.

When this menu item is selected, the form shown in Figure 21 is displayed. Notice that the form shown in Figure 21 contains standard as well as optional inputs. The optional inputs are only available and visible when the Option “O” card is specified in the hardware setup. Otherwise, only the standard inputs can be assigned.

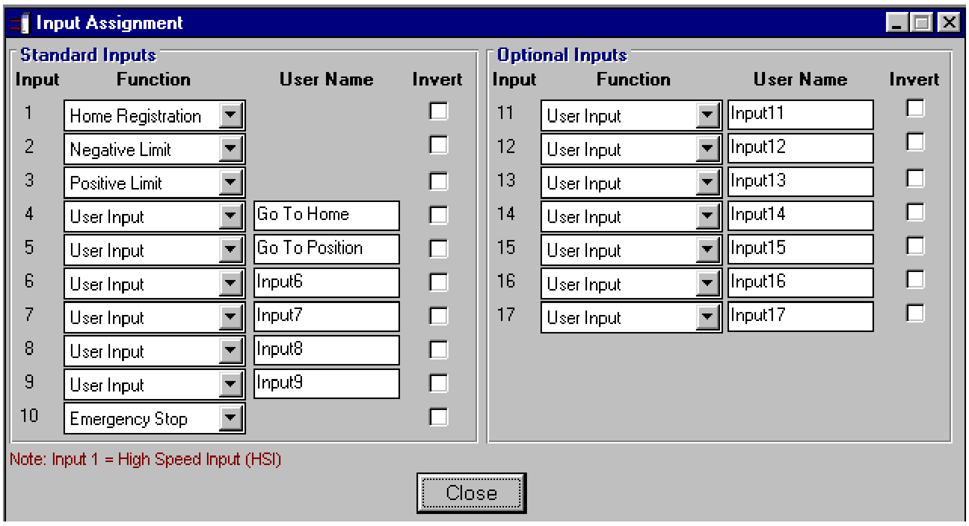


Figure 21. Input Assignment form.

There are pre-defined input functions that may be assigned to digital inputs. Inputs can also be designated as user inputs and have functionality only as they are used in programs. If input is designated as user input, a name can be assigned to it for easier programming.

There are limitations as to which inputs can be assigned to particular functions. This result from the fact that only the standard DMC inputs can generate interrupts and only digital input 1 can be used as a position capture input. Valid input assignments are shown in Table 2, followed by a description of each of the possible input functions.

Input Function	Digital Input 1	Standard Inputs	Optional Inputs
Home Registration	X		
Option A function	X	X	

Input Function	Digital Input 1	Standard Inputs	Optional Inputs
Program Abort	X	X	
Program Pause	X	X	
Feedrate Override	X	X	
Zero Position	X	X	
Emergency Stop	X	X	
Negative Limit	X	X	
Positive Limit	X	X	
Program Select Line	X	X	X
Program Initiate	X	X	X
Index Select Line	X	X	X
Index Initiate	X	X	X
Jog Slow	X	X	X
Jog Negative	X	X	X
Jog Positive	X	X	X
Home Initiate	X	X	X
User Input	X	X	X

Table 2. Valid input function assignments.

HOME REGISTRATION INPUT (HSI INPUT)

The Home Registration input function captures the motor position the instant the input is activated. This functionality is used exclusively during homing routines. If this function is not assigned, homing will not be allowed in the application. Home routines can be initiated either in a program or with the Home Initiate input. Refer to **Homing (HSI Input 1)** for a description of how to setup the homing routine activated by the Home Initiate input. Section **Program menu** described the command used to start homing in a program.

OPTION A FUNCTION

The Option A function is used to switch between Resolver 1 and Resolver 2 Input on the Option A card. This function is normally used to drive two motors with one DMC and will perform a resolver calibration and a motor counter reset each time the input changes.

FEEDRATE OVERRIDE INPUT

The Feedrate Override input is used to turn on the analog feedrate override function. When this function is active, all velocities will be scaled according to the voltage present at analog input 1 or 2. This scaling is setup using the form described in Analog Override.

ZERO POSITION INPUT

The Zero Position input causes the current position to be automatically set to zero.

EMERGENCY STOP INPUT

The Emergency Stop input causes all motion to stop and all digital outputs to be set to a defined state. After motion has ceased, the DMC is disabled and the motor brake is engaged. The rate at which motion is stopped and the states of the outputs are set using the form described in **Emergency Stop / Fault Parameters**.

NEGATIVE LIMIT INPUT

The Negative Limit input causes all motion to stop when activated. This input should be used for over travel protection. After motion is stopped, the drive is disabled and a fault is indicated. Any programs or index moves will be aborted.

POSITIVE LIMIT INPUT

The Positive Limit input causes all motion to stop when activated. This input should be used for over travel protection. After motion is stopped, the drive is disabled and a fault is indicated. Any programs or index moves will be aborted.

PROGRAM SELECT LINE INPUTS

The Program Select Line inputs are used to select which program is to be initiated when the Program Initiate input is activated. Any number of digital inputs can be assigned to this function. For more information on how these inputs functions, refer to Section **Program Execution Control**

PROGRAM INITIATE INPUT

The Program Initiate input starts execution of the program designated by the Program Select Line inputs. If a program or index move is already executing, this input will be ignored.

INDEX SELECT LINE INPUT

The Index Select Line inputs are used to select which index move is to be initiated when the Index Initiate input is activated. Any number of digital inputs can be assigned to this function. For more information on how these inputs function, refer to Section Index Moves.

INDEX INITIATE INPUT

The Index Initiate input starts execution of the index move designated by the Index Select Line inputs. If an index move or program is already executing, this input will be ignored.

JOG SLOW INPUT

The Jog Slow input is used to select the speed at which the DMC will jog when either the Jog Negative or Jog Positive input is activated. If the Jog Slow input is active when a jog move is started, the motor will be moved at the slow jog speed. For more information on setting jog speeds and acceleration refer to Section **Jogging**

JOG NEGATIVE INPUT

The Jog Negative input causes the DMC to jog in the negative direction. The speed at which the motor moves is determined by the state of the Jog Slow input and the settings entered using the form described in Section **Jogging**.

JOG POSITIVE INPUT

The Jog Positive input causes the DMC to jog in the positive direction. The speed at which the motor moves is determined by the state of the Jog Slow input and the settings entered using the form described in Section **Jogging**.

HOME INITIATE INPUT

The Home Initiate input causes the homing routine to be initiated. To use this function, digital input 1 must be set as the Home Registration input. Refer to Section **Homing (HSI Input 1)** for a description of the homing routine.

USER INPUT

Any of the digital inputs of the DMC can be used as user inputs. These inputs can be assigned a name. There is no automatic functionality assigned to these inputs. However, these inputs can be monitored and used to control program flow.

OUTPUT ASSIGNMENTS

The Output Assignment menu item is used to assign names and functions to the available digital outputs of the DMC. When this menu item is selected, the form shown Figure 22 is displayed. Notice that the form shown in Figure 22 contains standard as well as optional outputs. The optional outputs are only available and visible when the Option “O” card is specified in the hardware setup. Otherwise, only the standard outputs can be assigned.

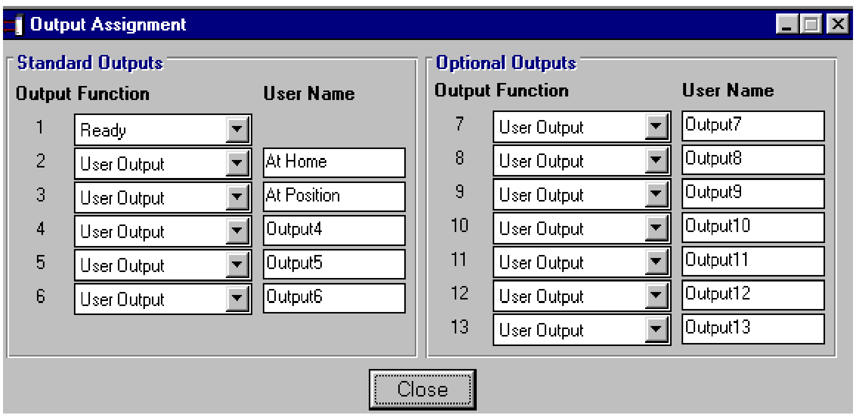


Figure 22. Output assignment form.

Output Assignments

There are pre-defined output functions that may be assigned to digital outputs. Outputs can also be designated as user outputs and have functionality only as they are used in programs. If an output is designated as a user output, a name can be assigned to it for easier programming. Below is a description of each of the output functions that can be assigned.

HOME COMPLETE OUTPUT

The Home Complete output is activated after a homing sequence has been successfully completed. This output is used to indicate that the DMC has an absolute position reference.

FAULT OUTPUT

The Fault Output is activated any time a fault has occurred that results in motion being stopped and the drive being disabled. This output will remain activated until the fault is cleared.

IN MOTION OUTPUT

The In Motion output is activated any time the DMC is commanding a motor velocity other than zero.

POSITION ERROR OUTPUT

The Position Error output is activated when the position error limit has been exceeded and the drive has been disabled. The position error limit is specified using the form described in Section **Position Error Limit**

PROGRAM RUNNING OUTPUT

The Program Running output is activated any time the DMC is executing a program sequence. The output remains active even is program execution has been paused.

READY OUTPUT

The Ready Output is activated whenever the DMC is enabled and no fault conditions exist.

TRAVEL LIMIT OUTPUT

The Travel Limit output is activated when activation of one of the travel limit inputs has been activated.

RESOLVER ERROR OUTPUT

The Resolver Error output is activated when the amplitude on the resolver input is too low and the drive has been disabled.

ENABLE OUTPUT

The Enable output is activated 500 ms before a software power-on and deactivated 500 ms after a software power-off. This function is normally used together with the Option A card to switch between two motors.

USER OUTPUT

Any number of the digital outputs of the DMC can be used as user outputs. These outputs can be assigned a name. There is no automatic functionality assigned to these outputs. However, these outputs can be controlled in programs.

Functions menu

GENERAL

The Function Menu contains menu items that allow setup of the functionality provided by the digital input assignments. The content of the Functions Menu is show in Figure 23.

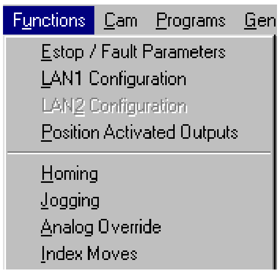


Figure 23. Functions menu.

EMERGENCY STOP / FAULT PARAMETERS

The EStop/ Fault Parameters menu item is used to setup the emergency stop routine and to specify parameters to how the DMC decelerates after faults occur or the Emergency Stop input is activated. When this menu item is selected, the form shown in Figure 24 is displayed.

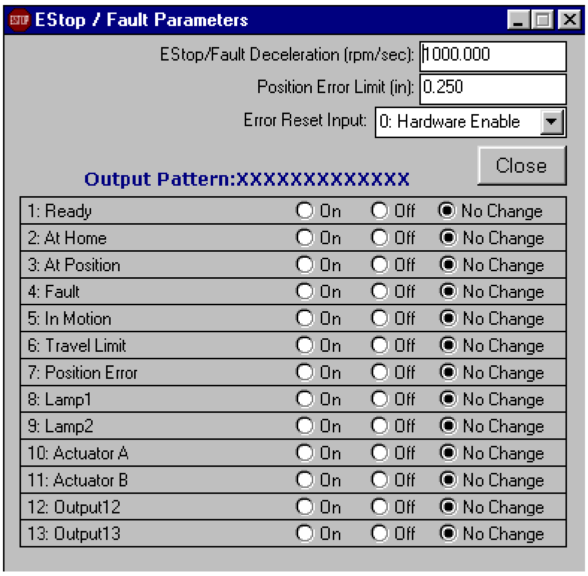


Figure 24. Emergency stop form.

Whenever the EStop input is activated or after faults occur, all motion is stopped and the motor is decelerated using the value entered on this form. Once motion has ceased, the DMC digital outputs are modified according to the options selected on this form. If a particular output should be turned on or off after an emergency stop, simply select that state for the output. If no change is desired, click on the "No Change" option for that output.

FAULT DECELERATION

The fault deceleration determines how fast the DMC decelerates when faults such as over travel limits or over temperatures occur. Some faults such as position error will immediately disable the drive without deceleration because they indicate conditions where the drive is out of control and cannot be properly decelerated.

POSITION ERROR LIMIT

The position error limit setting is used to determine the maximum amount of error between the commanded position and the actual position before a fault is generated. Note that when the servo regulator is used in velocity mode, this parameter is not used and position error is not monitored.

ERROR RESET INPUT/REGISTER

The error reset Input/Register is used to reset all DMC errors after a fault condition.

POSITION ACTIVATED OUTPUTS

The Position Activated Outputs menu item allows digital outputs to be activated, deactivated or pulsed based on the position of the motor. When this menu item is chosen, the form shown in Figure 25 is displayed.

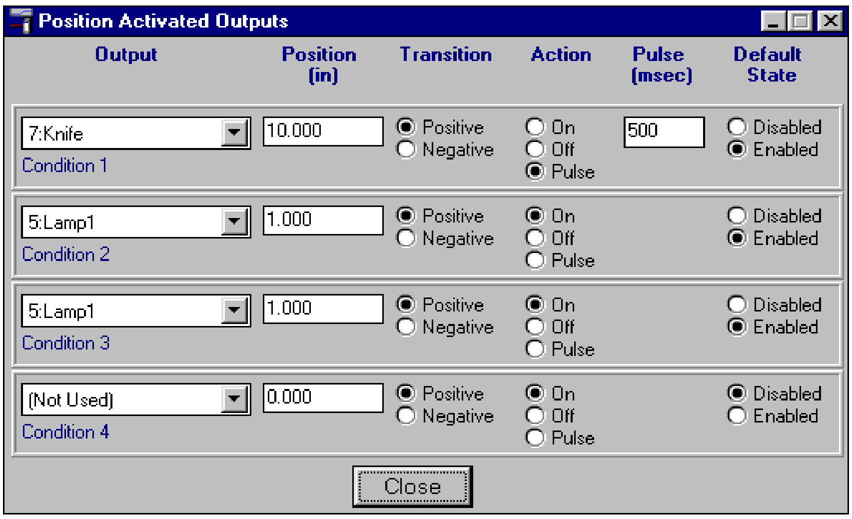


Figure 25. Position activated outputs form.

There are four sets of conditions that can be setup. For each condition, the digital output, transition position, transition type and action must be specified.

For example, if the application requires digital output 7 to be pulsed for 500 milliseconds every time the motor passes a position of 10 inches in the positive direction, the settings shown in the first condition set in Figure 25 would be used.

Note that if the motor then passed the position of 10 inches in the negative direction no action would be taken.

Similarly, outputs can be set to turn on or off when moving in different directions. For example, the second and third condition sets in Figure 25 would have digital output 5 turn on when passing 1 inch in the positive direction and turn off when passing the same point in the negative direction.

Position activated outputs are monitored as part of a background process in the Atlas DMC. Every 20 milliseconds, the DMC checks if the motor has passed any of the transition positions defined for the outputs. If this has occurred, the output is changed or pulsed based on the action selected for it. The position activated output monitoring is active any time the drive is enabled and not in a fault condition.

It is possible to enable and disable checking of any of the four conditions within a SimPL program sequence. It is also possible to have these conditions automatically enabled or disabled when power is turned on to the DMC. This is accomplished by clicking on the enabled or disabled Default State for each condition.

HOMING (HSI INPUT 1)

The Homing menu item is used to setup the homing routine that is started using the Home Initiate Input. When this menu item is selected, the form shown in Figure 26 is displayed.

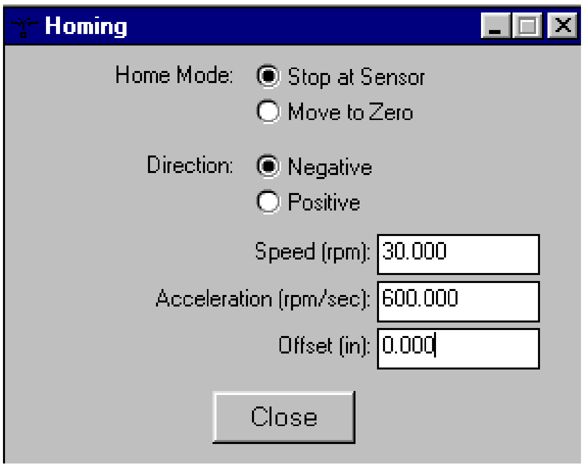


Figure 26. Homing form.

When the homing routine is initiated, the motor begins moving in the specified direction until the Home Registration input (HSI Input: DMC Input 1) is activated. At this time, the motor decelerates and returns to the position at which the input activated. Once in position, this location is set equal to the position entered in the offset entry on the form. If the Stop at Sensor option is selected, the homing routine is complete. If the Move to Zero option is selected, the motor is moved to the newly defined zero position.

JOGGING

The Jogging menu item is used to setup the jog routine that is initiated using the Jog Positive, Jog Negative and Jog Slow inputs. When this menu item is selected, the form shown in Figure 27 is displayed.

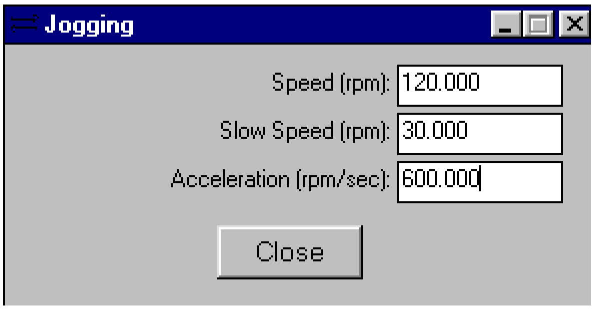


Figure 27. Jogging form.

When either the Jog Positive or Jog Negative input is activated, the motor moves using the acceleration and speeds entered on this form. If the Slow Jog input is active when the jogging begins, the slow speed is used. Otherwise, the normal speed will be commanded.

ANALOG OVERRIDE

The Analog Override menu item is used to setup the feedrate scaling implemented when the Feedrate Override input is activated. When this menu item is selected, the form shown in Figure 28 is displayed.

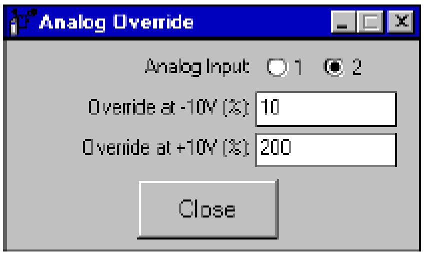


Figure 28. Analog override form.

When the analog override function is active, all jog moves, index moves and program move operations have their velocities scaled according to the values input on this form. The analog voltage, which controls the feedrate override, is taken from an analog input on the DMC. The voltage range of the analog input is -10V to +10V. If the settings shown in Figure 28 were active and the jog speed was set to 10 in/min, it would be possible to adjust this speed via an analog input to range between 1 in/min and 20 in/min.

It is important to note that the speed scaling is only read at the beginning of a move. As a result once a move has started, adjustments in the override voltage input do not take effect until the move is complete and a new one is started.

INDEX MOVES

The Index Moves menu item is used to set up a table of defined index moves that are initiated via digital input control signals. When this menu item is selected, the form shown in Figure 29 is displayed.

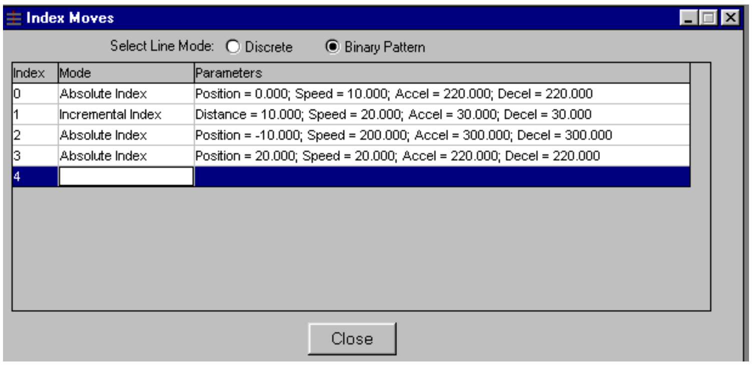


Figure 29 . Index moves form.

The index move table can contain up to 32 different index moves. These moves may be either absolute positioning moves or incremental moves. Index moves entered in this table can only be executed when the DMC is not executing a program sequence.

INDEX SELECT LINE MODE

An index move is executed when the Index Initiate input is activated. The index to be executed is determined by the state of the Index Select Line inputs. The Index Select Line inputs operate in two different modes. In discrete mode, each line selects an individual index move. For example, if digital inputs 12 and 13 were set as index select lines and the select line mode was set to discrete, a total of three index moves could be accessed. Table 3 shows how the index moves would be selected based on the state of the Index Select Line inputs.

Select Index move.	Input 12	Input 13
0	OFF	OFF
1	ON	OFF
2	OFF	ON

Table 3. Discrete index select line example.

If the Index Select Line inputs are operating in binary mode; the input states are converted into a binary value that selects the index move to be executed. In this manner, only 5 digital inputs would be required to access all 32 index moves. In computing the selected move, the first assigned input is given a value of 1, the second a value of 2, the third a value of 4, and so on. If digital inputs 12 and 13 were set as index select lines and the select line mode was set to binary, a total of four index moves could be accessed. Table 4 shows how the index moves would be selected based on the state of the Index

Index Moves

Select Index move.	Input 12	Input 13
0	OFF	OFF
1	ON	OFF
2	OFF	ON
3	ON	ON

Table 4 . Binary index select line example.

USING THE INDEX TABLE EDITOR

Editing an index move is quite simple. Simply double-click on an index move to displays a form that allows changes to the index parameters. This form is shown in Figure 30 below. Selecting absolute index mode causes the motor to move to the absolute position specified. Selecting incremental index mode causes the motor to move the specified distance from its current position.

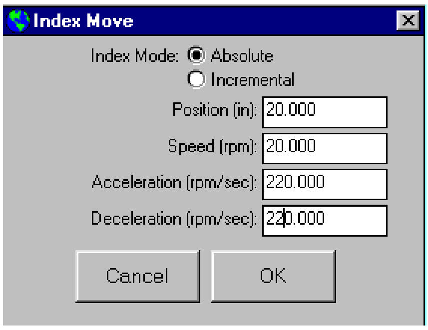


Figure 30. Index Move editor form.

Whenever the Index Table Editor is active, an Edit Menu will appear in the SimPL Menu Bar. This menu contains options to insert, delete, copy, cut and paste index lines. In addition to these menu items, it is also possible to use keyboard shortcuts. To insert a new index move into the table, click on a row in the table. Press the <Insert> key and a new line will be inserted above the selected line. Likewise, the <Delete> key can be used to delete a move from the table. In addition to these simple operations it is possible to copy, cut and paste lines by using the standard <Ctrl-Insert>, <Shift-Delete> and <Shift-Insert> key combinations.

Cam menu

General

The Cam Menu contains all menu items required for designing and maintaining the electronic cam functions of the DMC. The contents of the Cam Menu are shown in Figure 31 below.

Figure 31. Cam menu.

SimPL support the creation of up to 4 different cam tables, each containing a maximum of 1025 points. Any existing cam tables are listed at the bottom of the Cam Menu. Electronic Cam tables are activated through use of the Cam On and Cam Off program command.

How Cams Work in the DMC

An electronic cam is implemented in the DMC as a look-up table. A table containing evenly spaced input positions and corresponding output positions is set up. The input position is read either from the resolver 2 input or from the internal clock of the DMC. The output position is then determined by looking up the input position in the cam table. If the input position falls between points in the table, the output commands position is interpolated from the nearest table points.

New Cam

The New Cam menu item is used to create a cam table. When this item is selected a new cam is created with a default number and name. A cam editor window is displayed containing the new cam table. The cam name, number and all cam points are modified using the Cam Editor described in Using the Cam Editor below.

Using the Cam Editor

When a new cam is created or an existing cam is selected from the Cam Menu, a cam editor window is displayed as shown in Figure 32. From this form, the shape of the cam and the number of cam points can be modified. Also, the input position range and scaling is set using this form.

Using the Cam Editor

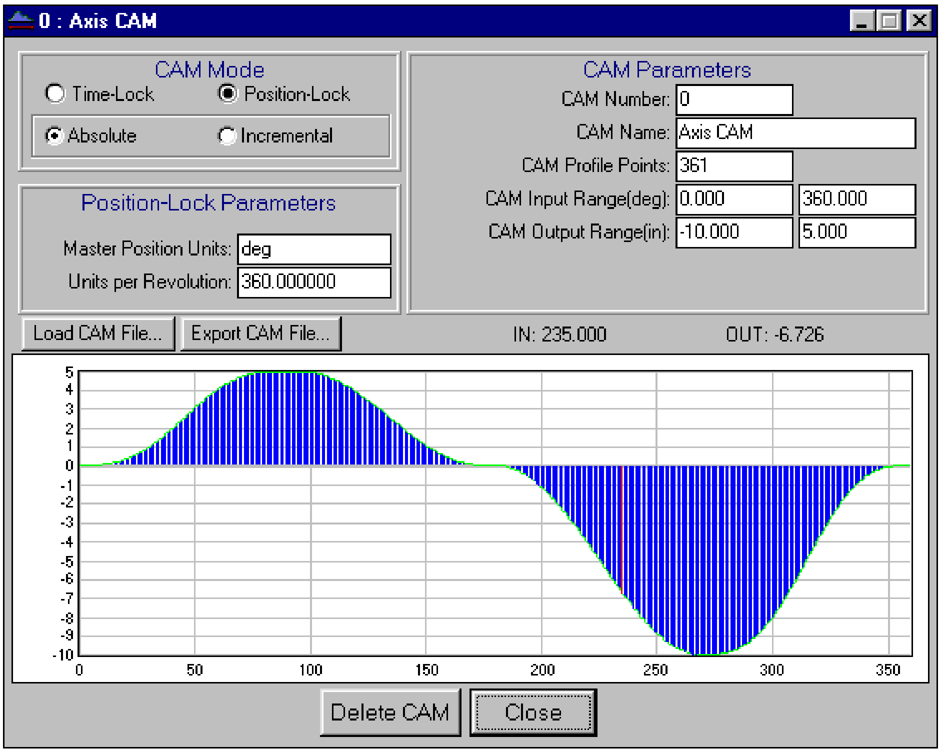


Figure 32. Cam editor form.

CAM NUMBER

When a cam table is activated using a Cam ON command in a program, the cam number is used to identify which table to use. Valid cam numbers are between 0 and 3. To change a cam number, simply type a new number into the edit box. If the number is invalid or already in use a warning is displayed.

CAM NAME

The Cam Name field is added to make programming and application development easier. The name can be any arbitrary description. Any time that SimPL needs a cam number as a parameter, cam names are also displayed to help prevent selection of the wrong cam table.

CAM MODES

There are two different cam modes supported by the DMC. The first mode is a time-lock cam. In this mode, the input position of the cam is taken from the internal clock of the DMC. Using this mode it is possible to generate a continuous arbitrary motion cycle in the DMC. When this mode is selected, the input position (time) can be specified in seconds or milliseconds.

The second cam mode is the position-lock cam. In this mode the input position is taken from the resolver 2 input of the DMC. When this mode is selected, the numbers of poles of the second resolver and the units to be used for that resolver are entered as parameters. For example, resolver 2 can be setup to have two poles and have each motor revolution represent 360 degrees. If these settings are made, the input range of the cam and all input positions are entered in degrees.

CAM POINTS

The cam points' setting determines how many points will be used in the cam table. This number should be set to the lowest value that results in smooth output definition. Each cam point takes up one line in the DMC program memory. Since there are only 2048 lines available for cam tables and the remaining application, this number should be chosen carefully. If this number is changed, the existing output profile is resampled to help maintain its current shape.

CAM INPUT RANGE

The cam-input range determines what the length of the input position cycle will be. For example, if the cam motion repeats every 360 degrees at the input, the range should be set to 360.

CAM OUTPUT RANGE

The cam output range is used to setup the graphical display on this form and should be set large enough to show the entire range of output values. If it is set too small, the output will be clipped. If set too large, poor visual resolution will result.

EDITING CAM POINT VALUES

There are two methods of editing a cam point output value. The first method is to double-click on the vertical line representing the cam point. When this is done, the form shown in Figure 33 is displayed.

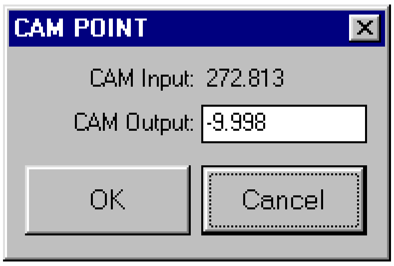


Figure 33. Cam point editor form.

The input position of this cam point is displayed, along with the current output value. To change the output value, type the new value into the box provided.

The second method for editing the cam output position is to draw them using the mouse. To do this, move the mouse pointer to the position in the table to change. Hold down the right mouse button and drag the mouse up and down to reposition the output value. The mouse can also be dragged left and right to change adjacent points.

IMPORTING CAM FILES

It is possible to import a comma delimited data file (*.CSV) into the SimPL cam editor. Typically this is done by exporting a Microsoft Excel™ sheet as a *.CSV file. The file must contain 2 columns of data. The first column must contain the input positions and the second column must contain the matching output positions. After the file is loaded, the input and output ranges are automatically computed. To start the import procedure, click on the Load Cam File button located on the form.

EXPORTING CAM FILES

It is also possible to export a cam table from SimPL to a comma delimited file (*.CSV). To do this, click on the Export Cam File button and select a name to save to. The cam table is saved as two columns of data containing the input and output positions of the table.

DELETING A CAM

To delete a cam table, click on the Delete Cam button located at the bottom of the form. A warning message appears before permanently deleting the cam table.

Program menu

GENERAL

The Program menu contains all menu items used in creating, editing and specifying control of program sequences in the application. The content of the program menu is shown in Figure 34.

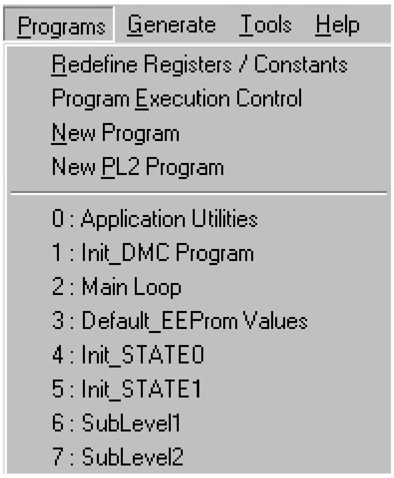


Figure 34. Programs menu.

SimPL support the creation of up to 32 different program sequences. Any existing programs will be listed at the bottom of the Programs Menu. These programs can be executed automatically at reset or can be started using digital inputs. Also supported is the ability to call a program from within another program. SimPL encapsulates the functionality of the PL2 programming language into a series of simplified program commands. However, if a situation occurs when the standard SimPL commands are not capable of perform complex functions, it is possible to write a program in the native PL2 code of the DMC and call it from another SimPL program.

REDEFINE REGISTERS

The Redefine Registers menu item is used to define new names for the DMC Registers. When this menu item is selected, the form shown in Figure 35 is displayed.

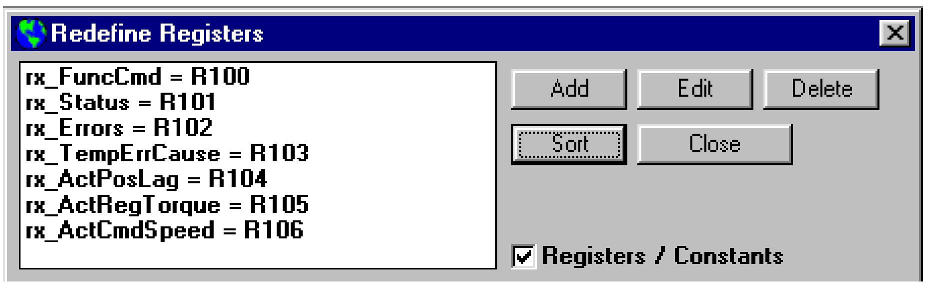


Figure 35. Redefine registers form.

All redefined registers can be used in a standard SimPL or a PL2 program. A list of all Register and Constants is available by pressing the F3 key wherever a register is allowed. (Figure 41). Note that the PL2 code generated by SimPL will also use the same redefined register.

PROGRAM EXECUTION CONTROL

The Program Execution Control menu item is used to specify how program execution is initiated and how programs are selected. When this menu item is selected, the form shown in Figure 36 is displayed.

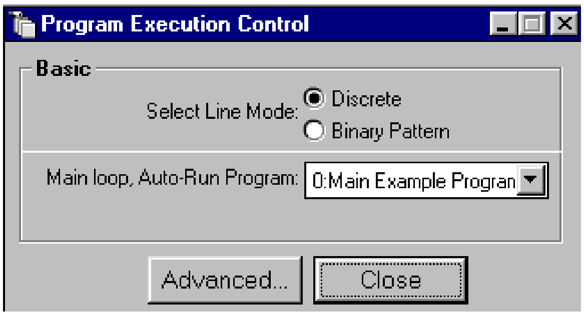


Figure 36. Program execution control.

Refer to Section Program Execution for a complete description on how to use the advance settings.

PROGRAM SELECT LINE MODE

A program is executed whenever the Program Initiate input is activated. The program to be executed is determined by the state of the Program Select Line inputs. The Program Select Line inputs operate in two different modes. In discrete mode, each line selects an individual program. In binary mode, the select lines are used to read a binary pattern, which selects the program to be executed. These modes operate in a manner similar to the Index Select Line inputs described in Section **Index Select Line Mode**.

MAIN LOOP, AUTO RUN PROGRAM

Any one of the defined program sequences can be set to execute each time the controller is reset or powered-up. To specify an auto run program, use the drop-down list on this form. The Auto run program is executed each time it’s entering the Main Loop (State 1). The SimPL State diagram is described in Section STATES diagram.

NEW PROGRAM

The New Program menu item is used to create a new program sequence, which can contain SimPL program commands. When this item is selected a new program is created with a default program number and name. A program editor window is displayed containing the new program. The program name, number and all program lines are changed using the SimPL Program Editor described in Section Using the SimPL Program Editor.

NEW PL2 PROGRAM

The New PL2 Program menu item is used to create a new program sequence containing PL2 code. When this item is selected a new program is created with a default program number and name. A program editor window is displayed which allows setup of the program name and number. Also located on the form is an area used to edit the text of the PL2 program being written. The use of the PL2 Program Editor is described in Section Using the PL2 Program Editor.

USING THE SIMPL PROGRAM EDITOR

When a new SimPL program is created or an existing program is selected from the Programs Menu, a program editor window is displayed as shown Figure 37 below. From this form, program lines can be added, deleted and changed.
There are three columns on the editor form. The first column contains the program line number. This number is used when entering parameters for jump commands. The second column contains the program command. The third column displays all of the associated parameters required for the program command.

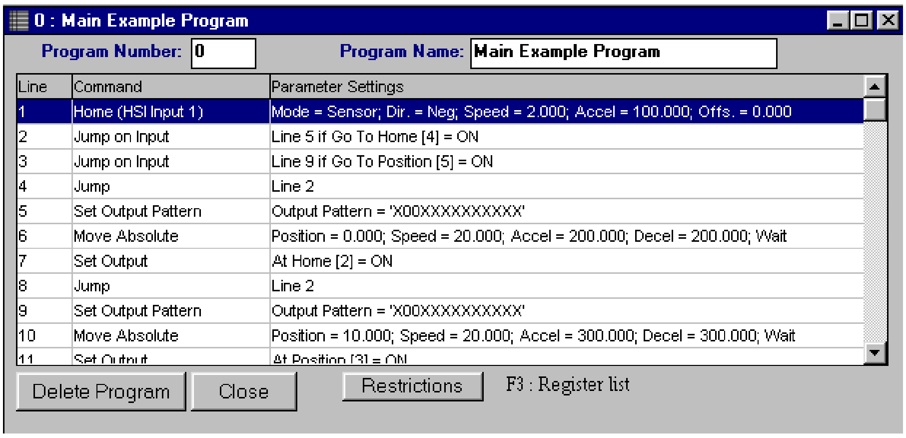


Figure 37. Program editor form.

Whenever a Program Editor is active, an Edit Menu will appear in the SimPL Menu Bar. This menu contains options to insert, delete, copy, cut and paste index program lines. In addition to these menu items, it is also possible to use keyboard shortcuts. To insert a new line into the program, click on a row in the program. Press the <Insert> key and a new line will be inserted above the selected line. Likewise, the <Delete> key can be used to delete a line from the table. In addition to these simple operations it is possible to copy, cut and paste lines by using the standard <Ctrl-Insert>, <Shift-Delete> and <Shift-Insert> key combinations.

PROGRAM NUMBER

When executing a program using a Gosub command or using digital I/O, the program number is used to identify the program. Valid program numbers are between 0 and 15. To change a program number, simply type a new number into the edit box. If the number is invalid, or already in use, a warning will be displayed.

PROGRAM NAME

The Program Name field is added to make programming and application development easier. The name can be any arbitrary description. Any time that SimPL need a program number as a parameter, program names are displayed to help prevent selection of the wrong program.

SELECTING PROGRAM COMMANDS

To select a new command for a program line, either move to the command column of the line to change and press <Enter> or double-click on the cell containing the command to be changed. The command selection form is displayed, showing a list of the available program commands. This form is shown in Figure 38 below.

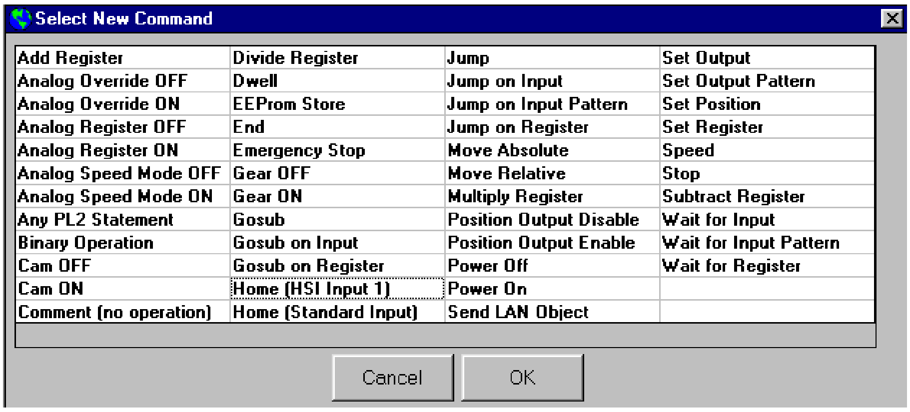


Figure 38. Program command selection form.

To select a command from the list, double-click on the selection, move to the cell and press <enter>, or move to the cell and click on the OK button.

SETTING PROGRAM COMMAND PARAMETERS

After a command has been selected for a program line, it is necessary to select any parameters for that command. To set new parameters, either move to the parameter column of the line to change and press <Enter> or double-click on the cell containing the parameters to be changed. The parameter entry form for the associated command is displayed. An example of this form for the Wait for Input command is shown in Figure 39 below.

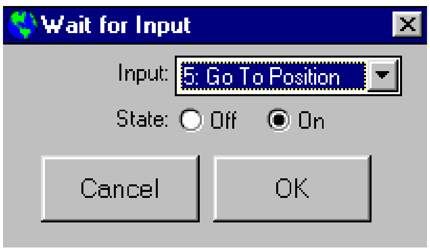


Figure 39. Program command parameter form.

Each program command has a parameter entry form associated with it. For a complete description of all available commands and their parameters refer to Section Program menu

DELETING A PROGRAM

In order to delete an entire program, open the program editor form and click on the Delete Program button located at the bottom left corner of the form. A confirmation message is displayed before permanently deleting the program.

USING THE PL2 PROGRAM EDITOR

When a new PL2 program is created, or when an existing PL2 program is selected from the Program Menu, a PL2 Program Editor form is displayed. An example of a PL2 program editor is shown in Figure 40 below.

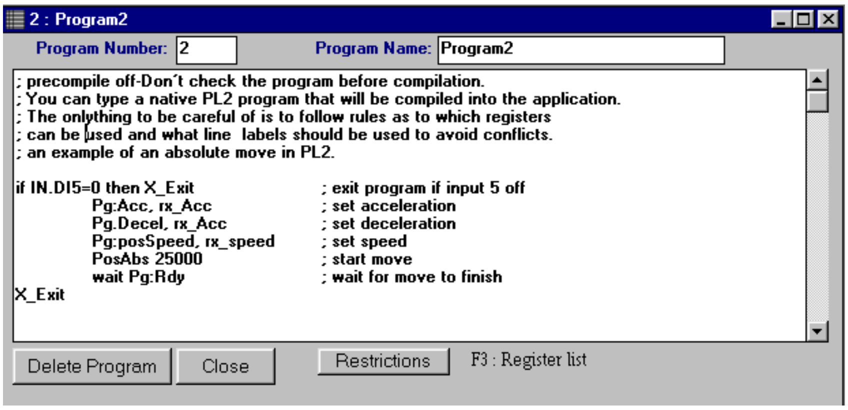


Figure 40. PL2 Program editor.

This form is similar to the SimPL Program editor except that the program command grid is replaced with a text-editing window. The PL2 code entered in this window will be compiled into the generated application. Caution should be used when changing user registers. To prevent conflicts with registers used in the rest of the application, limit the registers used to R100-R200. Also, if any line labels are to be used, start all labels with “x” followed by the program number. This will prevent any conflict with PL2 code generated by SimPL. For more information press the Restrictions button.

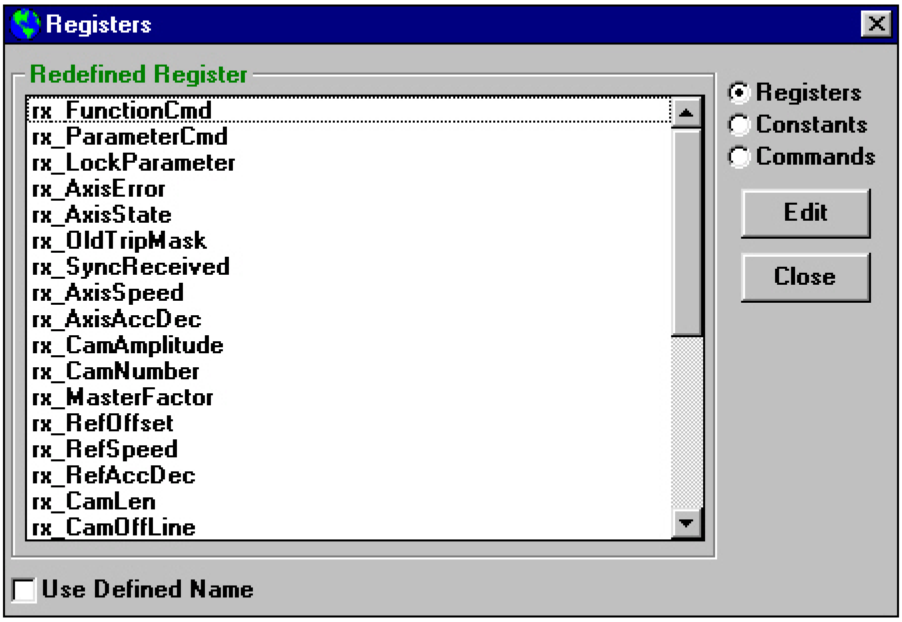


Figure 41. Register and commands.

For more information concerning PL2 programming, refer to the Inmotion DMC Programmer's Guide and the DMC User's Manual.

Generate menu

General

The Generate Menu contains all menu items used in generating, compiling and downloading the application to the DMC for execution. The content of the Generate menu is shown in Figure 42.

Figure 42. Generate menu.

Verify Setup

The Verify Setup menu item is used to check that all of the required information for an application has been entered and that the information is correct. When this menu item is selected, a form appears, showing the progress of the verification process. If any warnings or errors are encountered, a form is displayed which contains the associated error messages and warnings. If any PL2 programs have been created as part of the application, these will be pre-compiled individually to detect any syntax errors before generating the application. If an error is found in a PL2 program, an error file will be created along with a message indicating where to look for more information on the error. Note that this option does not actually create any PL2 code or additional files. If, for some reason, the PL2 program should not be pre-compiled, just add on the first line (Figure 40) the command "; precompiled off" to disable the syntax check.

Generate and Compile

The Generate and Compile menu item is used to generate the PL2 source code file and compile it. When this menu item is selected, a secondary choice is presented, allowing the PL2 source code to be compiled for downloading to a DMC with a battery backed RAM module or for programming an EPROM for the DMC. Before generating the code, SimPL performs a setup verification identical to that described in Section Verify Setup above. After verifying setup, the PL2 code is generated. While this is happening, a form is displayed to monitor progress. After the source code is generated, the Atlas DMC PL2 compiler is started. The compiler may take up to a minute to complete, depending upon processor speed. After this step is complete, the source code with a *.PL2 extension is created, along with a hexadecimal file with a *.HEE extension. At this point, the hexadecimal file is ready to be downloaded to the DMC, or programmed into an EPROM.

Download to DMC

The Download to DMC menu item is used to send a hexadecimal file to the DMC for execution. When this menu item is selected, the form shown in Figure 43 is displayed.

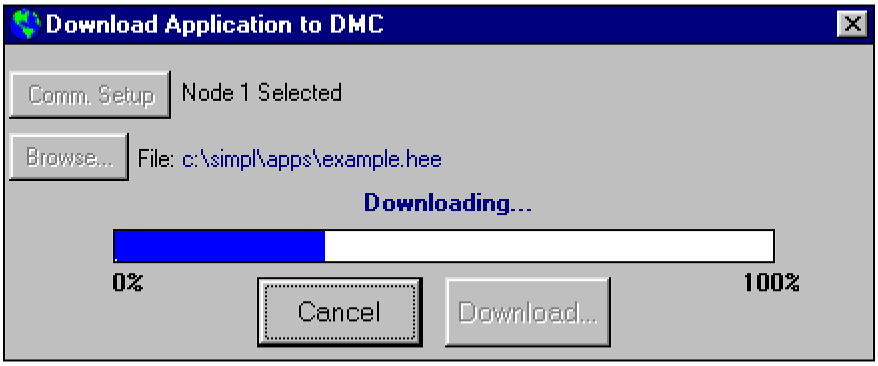


Figure 43. Download application form.

As default, the hexadecimal file for the current application is selected. However, if a different file is to be downloaded, clicking on the Browse button can choose it. Also included on the form is a selection of the serial port to use in the download and the node address of the DMC to download to. Once these settings are made, click on the Download button to start the download process. As the file is being downloaded a progress meter appears, showing status of the download. If an error occurs, verify that the node address is set properly and that all cables are properly connected.

SAVE, GENERATE, DOWNLOAD, RUN5

This menu item will perform all the above functions.

Tools menu

GENERAL

The tools menu contains all menu items used in determining version information, talking directly to the DMC and tracing program execution. The content of the Tools Menu is shown in Figure 44 below.

Figure 44. Tools menu.

COMMUNICATION SETTINGS

The Communications Settings menu item is used to specify how the computer will communicate with the Atlas DMC Controller being used in the application. When this menu item is selected, the form shown in Figure 45 is displayed.

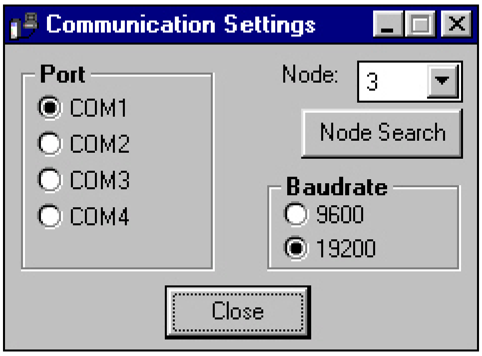
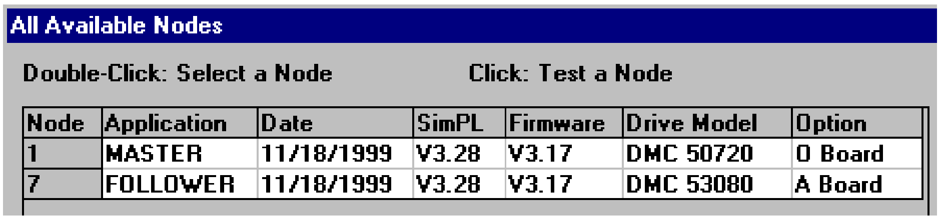


Figure 45. Communication Settings form.

Select the COM port by clicking on the appropriate option button. This setting has no affect on the generated application. It is only relevant during downloading and debugging.

NODE SEARCH

The Node Search menu item is used to scan the entire Serial Network for connected DMCs. This will take about 10 seconds and at the end the form shown in Figure 46 is displayed.


All Available Nodes

Double-Click: Select a Node   Click: Test a Node

Node	Application	Date	SimPL	Firmware	Drive Model	Option
1	MASTER	11/18/1999	V3.28	V3.17	DMC 50720	0 Board
7	FOLLOWER	11/18/1999	V3.28	V3.17	DMC 53080	A Board

Figure 46. All Available Nodes form.

GET VERSION INFORMATION FROM DMC

The Get Info from DMC menu item is used to upload data from the DMC running a SimPL application. When this menu item is selected, the form shown in Figure 47 is displayed.

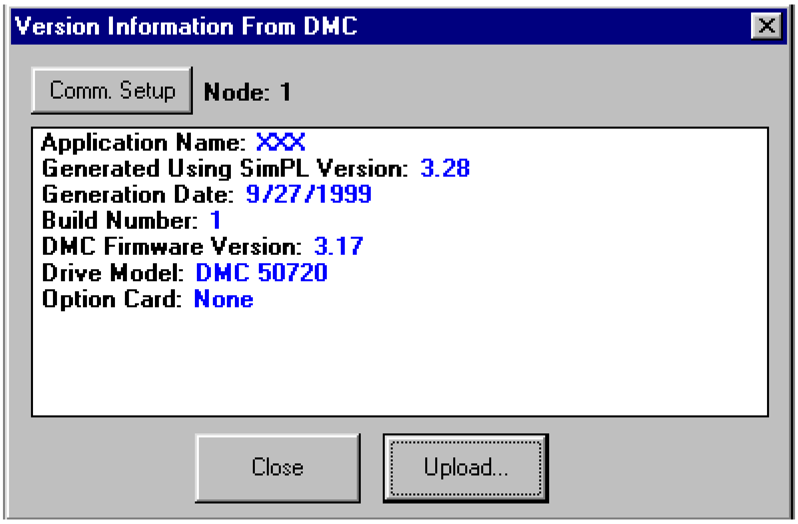


Figure 47. Version information form.

After selecting the proper serial port and node address, the Upload button is used to read and display the important version information on the form. Information includes the application name, the version of SimPL that was used in generating the application, the date it was generated, the build number for the application (number of times it was previously generated), the firmware version, the Drive Model and Option Card of the DMC running the application.

REGISTER MONITOR

The Register Monitor menu item is used to trace register or changing Servo Regulator Setting. When this option is selected, the form shown in Figure 48 is displayed.

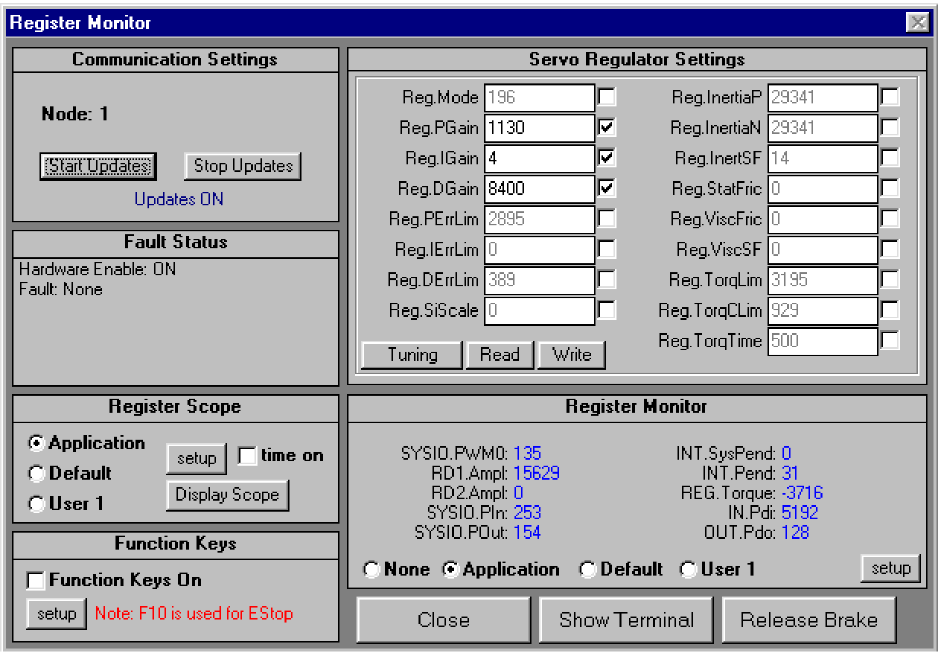


Figure 48. Register monitor form.

By clicking the Start Updates button, all selected Registers and Fault Status are monitored. By clicking the Default option, you select pre-defined Registers normally used for debugging. The Register Scope section is used to setup the scope function.

APPLICATION TRACE

The Application Trace menu item is used to follow the execution of the application running in the DMC. When this option is selected, the form shown in Figure 49 is displayed.

Application Trace

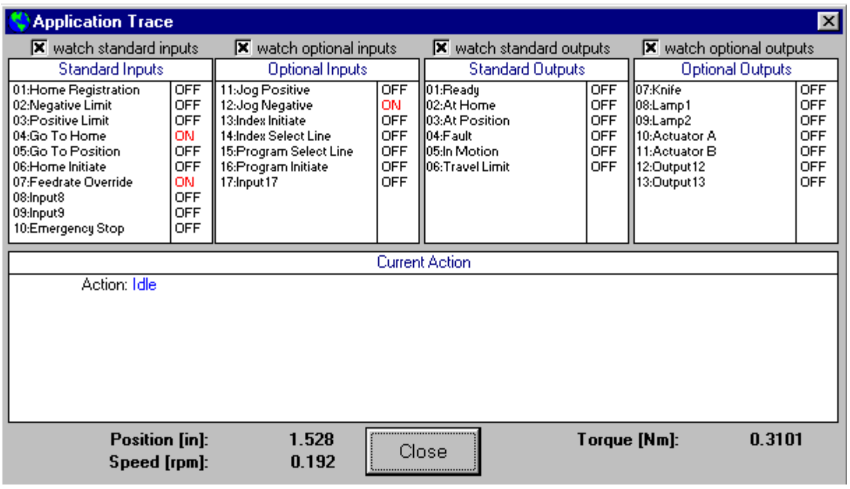


Figure 49. Application trace form.

From this form, it is possible to monitor all of the digital I/O of the DMC during application operation. Also displayed is the current action being taken by the DMC. This could include the program line (if any) being executed, jogging status, homing status, or any fault conditions that may have occurred.

REGISTER UTILITIES

The Register Utilities menu item is used to Upload, Download, Edit or Save the EEProm or other register values. When this option is selected, the form shown in Figure 50 is displayed.

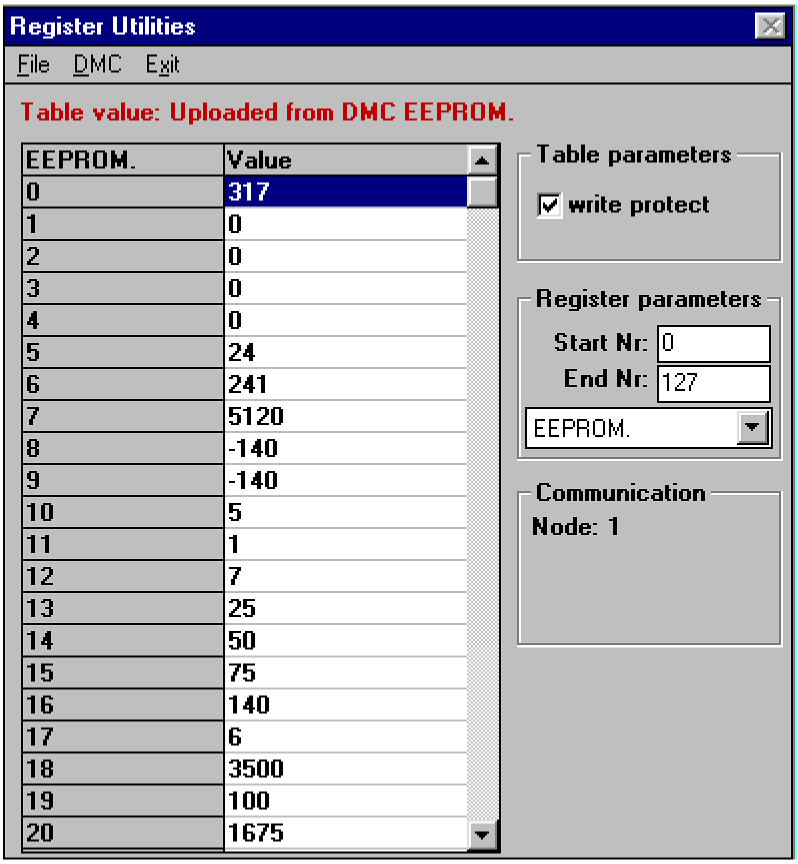


Figure 50. Register utilities form.

RUN TIME UTILITIES

The DMC application generated by SimPL has several Run Time Utilities built into it. These utilities are initiated by using the form shown in Figure 51 or manually by stopping program execution and typing RUN followed by the number of the utility to execute. This operation can be performed using any terminal program connected to the DMC. To stop program execution, hold down the <Ctrl> key and type C several times. A message should be displayed indicating that the program has been stopped. Type RUN (n) followed by pressing the <Enter>, where (n) is the Run Utility Number. The Run Utilities include EEPROM operations and a utility to perform an automatic motor to resolver alignment. Below is a description of the Run Utilities supported by SimPL applications.

RUN 1 (NORMAL OPERATION)

The Run 1 utility causes the DMC to operate as it would when normally powered up or reset. This has no special function and can be used to restart the application after using one of the other Run Utilities.

RUN 2 (STORE EEPROM REGISTERS)

The Run 2 utility takes the values stored in the EEPROM extended registers and permanently stores them to the EEPROM. Any values written directly to the EEPROM extended register group will be stored. To store modified regulator parameters, use the Run 3 Utility.

RUN 3 (COPY REGULATOR TO EEPROM AND STORE)

The Run 3 utility copies all servo regulator parameters to the corresponding locations in the EEPROM extended register group. It then permanently stores them to the EEPROM.

RUN 4 (PERFORM MOTOR-RESOLVER ALIGNMENT)

The Run 4 utility performs an operation that computes the number of motor poles and the alignment between the motor and the resolver. If a standard Atlas Copco motor is used and this motor is selected from the SimPL motor list, these settings will already be known and this procedure will not be required. However, if a non-standard motor is used, or if resolver wiring is modified for any reason, this utility can be used to ensure proper motor operation. This procedure can take up to a minute to execute and during the course of the operation, the motor will move approximately 1/4 turn. After completing the procedure, use the Run 2 utility to store the new alignment values to the EEPROM.

RUN 5 (RESTORE APPLICATION DEFAULT VALUES)

The Run 5 utility is used to go back to the default parameters generated by SimPL. This can be helpful if regulator gains or motor parameters have been changed and unstable operation is occurring. Executing the Run 5 utility will restore all default values and then store them permanently in the EEPROM.

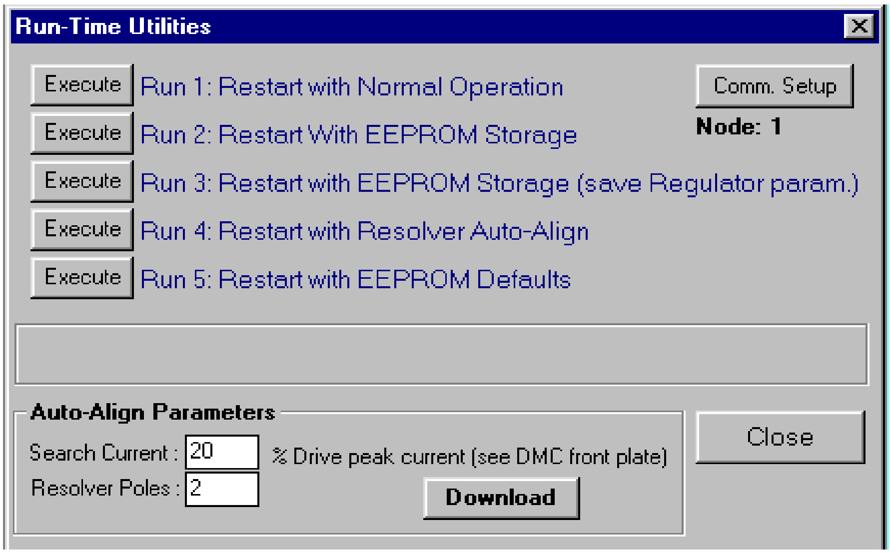


Figure 51. Run time utilities form.

TERMINAL

The Terminal menu item displays a simple terminal emulator, which can be used to communicate directly with the DMC. This option is only useful for, and should only be used by, individuals who are knowledgeable in operation of the DMC.

RESET DMC

The RESET DMC menu item sends a reset command to the DMC attached to the serial port. This option is useful after downloading a new application file to the DMC. This will simulate a power-up condition in the DMC. When this option is selected, a choice of node addresses is presented. Select the node address of the DMC to be reset.

Program commands

GENERAL

SimPL supports different commands that are used for building program sequences. These commands control motion, digital I/O and other special functions of the DMC. Below is a description of each of the program commands available.

COMMAND	DESCRIPTION
Add Register	The Add Register command is used to add a value to one of the user registers in the DMC. Valid User registers are between R100 through R200. The value added to the register can be any 32-bit integer number or can be another user register.
Analog Override Off	The Analog Override Off command is used to deactivate the analog feedrate override feature of the DMC. After this command is executed, all future moves will be made at 100% of the commanded velocity.
Analog Override On	The Analog Override On is used to activate the analog feedrate override feature of the DMC. When activated, the voltage present at the DMC's analog input is used to scale the commanded velocities of all future motion. Entering the percent override at -10V and +10V sets the override range. When any move is commanded, the actual velocity is set based on the voltage at the analog input. The Analog Override Off command is used to deactivate this feature.
Analog Register Off	The Analog Register Off command, disconnects the specified analog input/output from any user register that it may be attached to.
Analog Register On	The Analog Register On command connects an analog input/output to a user register in the DMC. The scaling is setup to get any range of values from the -10V to +10V. This register can then be used in any other program commands that support the use of registers as parameters.
Analog Speed Mode Off	The Analog Speed Mode Off command deactivates the analog speed reference mode of the DMC. After this command is executed, motion is stopped and the analog speed reference signal at analog input 1 is ignored.
Analog Speed Mode On	The Analog Speed Mode On is used to convert the voltage at analog input 1 or 2 to a velocity command for the DMC's regulator. When activated, the DMC reads the voltage on the Analog Input every millisecond and issues a new speed command. The parameters used in this command is the speed at -10V, the speed at +10V and the acceleration to be used in following the changing speed command input. The Analog Speed Mode Off command is used to deactivate this feature.
Any PL2 Statement	The Any PL2 statement command is used to add one PL2 code line. Please refer to the DMC User's Manual Part B for all available commands.
Cam Off	The Cam Off command is used to deactivate the currently active cam table and stop motion.

General

Cam On	The Cam On feature is used to activate a cam table in the DMC. The parameter for this command is the number of the cam designed using the SimPL cam editor. Once activated, the DMC will execute the cam function until the Cam Off command is issued.
Divide Register	The Divide Register command is used to divide one of the user registers by the value specified. Valid user registers are between R100 through R200. The value to divide by is any 16 bit integer number or can be another user register.
Dwell	The Dwell command is used to pause program execution for a fixed number of milliseconds. The number of milliseconds is entered as a parameter. Once the specified time has elapsed, execution will continue at the next program line.
EEProm Store	The EEProm Store command is used to copy the actual Regulator Settings into the EEProm extended register (RAM memory) group and store all the EEProm extended register parameters (EEProm.0 to EEProm.63) permanently to the EEPROM chip (non volatile memory). The application is waiting until the store is done (normally 200ms).
End	The End command is used to end execution of the current program. If the program was called using a Gosub command from another program, execution of the calling program will continue at the line following the Gosub command.
Emergency Stop	The Emergency Stop command is used to start the EStop routine from within a program. Refer to Section EMERGENCY STOP INPUT for a complete description of the EStop routine.
Gear Off	The Gear Off command is used to deactivate the electronic gearing function of the DMC. When this command is executed, motion is stopped and the DMC is taken out of slave mode.
Gear On	The Gear On command is used to activate the electronic gearing function of the DMC. When activated, the DMC acts as though it were mechanically coupled to the resolver attached to its resolver 2 input. The gear ratio is entered as a fraction with numerator and denominator as parameters. In addition to the ratio, there is also a ramping factor that can be used to smoothly activate the gearing function. When this parameter is entered, the numerator of the gear ratio is started at zero and is increased by the ramp factor every millisecond. For example, if the numerator is 1000 and the ramp factor is set to 1, it will take 1000 milliseconds for the gearing to be fully activated.
Gosub	The Gosub command is used to call a program from within a program. The parameter for this command is the number of the program to be called. Once the called program is finished, execution continues at the next line.

Gosub on Input The Gosub on Input command is used to call a program based on the state of the specified digital input

Gosub on Register The Gosub on Register command is used to call a program based on the value of a register.

Home (HSI Input 1) The Home command is used to start a homing routine from within a program. Note that the parameters used in the home program command are independent of the parameters entered for the homing input function. Refer to Section Homing (HSI Input 1) for a complete description of the homing routine and the parameters used.

Home (Standard Input) The Home command (Figure 52) is used to start a homing routine from within a program. Note that this routine needs the Positive/Negative Limit switches and a USER Input (interrupt Input 1 - 10). This routine can be used only once.

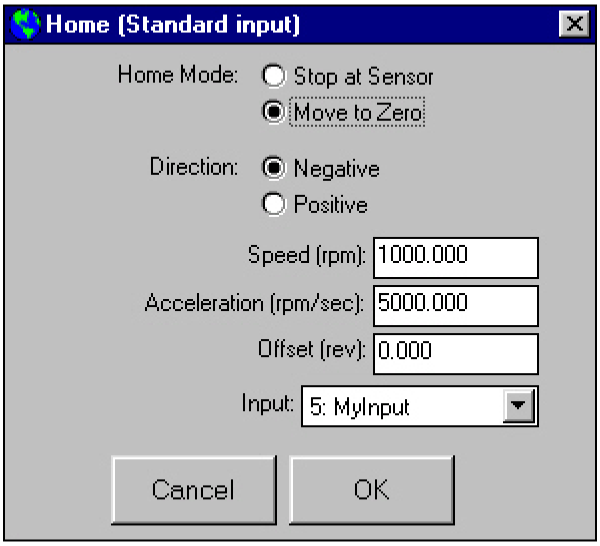


Figure 52. Homing form. (Standard input).

When the homing routine is started, the motor begins moving in the specified direction (Negative or Positive parameter) until an event occur (Positive/Negative Limit switches or Home Input interrupt).The positive limit interrupt will stop the motion then search negative and viceversa the negative limit interrupt, see Figure 53
If the motor is on the home switch at the start of the homing routine, the motor will travel in the negative direction. The position reference is the first resolver zero position after hitting the positive edge of the home switch with positive speed. Once in position, this location is set equal to the position entered in the offset entry on the form. If the Stop at Sensor option is selected, the homing routine is complete. If the Move to Zero option is selected, the motor will move to the newly defined zero position.

General

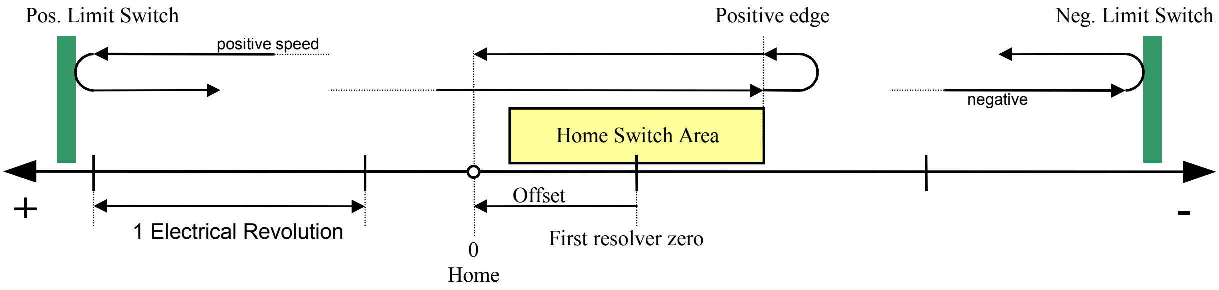


Figure 53. Homing sequence.

Jump
The Jump command is used to shift execution of the program to the line number entered as a parameter.

Jump On Input
The Jump On Input command is used to shift program execution to the line number entered as a parameter based on the state of the specified digital input. The program line to jump to, the digital input and the input state are entered as parameters. If the input is not in the specified state, execution continues at the next line.

Jump On Input Pattern
The Jump On Input Pattern command is used to shift program execution to a new line number based on the state of all of the DMC digital inputs. The program line to jump to and the states of the digital inputs are entered as parameters. If an input is not to be considered, simply select “don’t care” for its state. If the inputs do not match the specified pattern, execution continues at the next program line.

Jump on Register
The Jump of Register command is used to shift program execution to a new line based on the value of a user register. Three different conditions can be specified. They are greater than (>), less than (<) or equal to (=). The value to use in the comparison must be a 16-bit integer in the range of -32768 to 32767. In addition to entering a constant value, another user register can be specified instead. If the specified condition is evaluated as false, execution continues at the next program line.

Move Absolute
The Move Absolute command is used to move the DMC to an absolute position. Position, speed, acceleration and deceleration are entered as parameters and may be linked to user registers. If user registers are to be used, all values are interpreted in resolver counts and not in the application units used by SimPL.

Move Relative
The Move Relative command is used to move the DMC to a new position where the position is referenced to the current commanded position. Position, speed, acceleration and deceleration are entered as parameters and may be linked to user registers. If user registers are to be used, all values are interpreted in resolver counts and not in the application units used by SimPL.

Multiply Register
The Multiply Register command is used to multiply one of the user registers with the value specified. Valid user

	registers are between R100 through R200. The value to multiply by can be any 16-bit integer number or can be another user register.
Position Output Disable	The Position Output Disable command is used to disable one of the 4 position activated output conditions defined using the Functions Menu.
Position Output Enable	The Position Output Enable command is used to enable one of the 4 positions activated output conditions defined using the Functions Menu.
Power Off	The Power Off command is used to disable the drive.
Power On	The Power On command is used to enable the drive.
Set Output	The Set Output command is used to activate or deactivate one of the DMC digital outputs. The output number and state are specified as parameters.
Set Output Pattern	The Set Output Pattern command is used to set the state of all of the DMC digital outputs using a single command. Outputs that are to be left in their current state can be specified as “no change” and will not be affected by the command.
Set Position	The Set Position command is used to set the current position of the DMC to a new value. This is useful if during a program cycle, a new zero position is to be set, or an offset is to be created. The new position is entered in application units.
Set Register	The Set Register command is used to store a value into a user register. The value must be a 32-bit integer value. It is also possible to specify another user register instead of a value.
Speed	The Speed command is used to have the DMC move at a specific speed. The speed and acceleration are entered as parameters and may be linked to user registers. The DMC will continue to operate at the commanded speed until another Speed command, Stop command or move command is issued.
Stop	The Stop command is used to stop motion of the DMC. Acceleration is entered as a parameter and may be linked to a user register. This command will stop motion caused by any previous move or speed command.
Wait For Input	The Wait For Input command pauses program execution until the specified input is in the state entered as a parameter. Once this condition is met, execution continues at the next program line.
Wait For Input Pattern	The Wait For Input Pattern command pauses program execution until all DMC inputs match the specified pattern. The pattern can contain “don’t care” inputs, which are ignored in the comparison. Once the pattern is matched, execution continues at the next program line.
Wait For Register	The command, Wait For Register is used to pause program execution based on the value of a user register. Three different conditions can be specified. They are greater than (>), less than (<) or equal to (=).

General

The value to use in the comparison must be a 16-bit integer in the range of -32768 to 32767. In addition to entering a constant value, another user register can be specified instead. When the specified condition is evaluated as true, execution continues at the next program line.

DMC front panel LED definitions

LED DEFINITIONS

The DMC has a series of 10 LED's located on the front panel. These programmable LED's take on the same meaning in all SimPL applications. The function of each LED is described in detail below.

POWER ON LED

The power on LED is used to indicate that a logic level power source is present in the DMC. This supply can be generated internally by the DMC from the 3-phase AC power input or the DC Bus. It is also possible to supply this supply via the 24V-power supply input. If this LED is not illuminated, check that power is properly connected to the DMC.

CPU OK LED

The CPU OK LED is controlled by the SimPL application. Whenever the SimPL application is running, this LED will flash at a steady rate to indicate that application is running. If this LED is not flashing, verify that a valid SimPL application has been downloaded and the DMC has been reset.

LED 1 (Main Loop – State 1)

LED 1 is used to indicate that the application is in the Main Loop (State 1). When this LED is illuminated, no fault conditions exist, the drive can be enabled and the DMC can command torque to the motor according to the selected regulator settings. Whenever LED 1 isn't illuminated, an Error Reset sequence is needed before all other operations.

LED 2 (Software Enable)

LED 2 is used to indicate when the DMC is in Power On mode.

LED 3 (Node Selected)

LED 3 is used to indicate when the DMC is the selected communication node. When DMCs are connected in a serial daisy chain, only one DMC can be addressed at a time and only one of the DMCs should have LED 3 illuminated. When operating in stand-alone mode, this light should always be on when communicating.

LED 4 (Current Limit Warning)

LED 4 is used to indicate that the servo regulator is requesting more torque than is allowed by the continuous and peak current limits for the application. If this LED illuminates frequently, check that there is no mechanical binding in the system. If the LED continues to illuminate on a regular basis, the motor drive combination may be undersized for the application.

LED 5 (Over Temperature Fault)

LED 5 is used to indicate when an over temperature fault has occurred. This LED illuminates if any of the three thermistor inputs on the DMC opens. If this occurs, check the value contained in the temperature fault status register to determine if the drive, motor or auxiliary thermistor input detected the fault.

LED 6 (Resolver Fault)

LED 6 is used to indicate a resolver fault. A resolver fault occurs when an active resolver input detects insufficient amplitude for proper operation. A faulty motor resolver or cable normally causes this. The fault register can be interrogated to determine which resolver input generated the fault.

LED 7 (DRIVE FAULT)

LED 7 is used to indicate different (and hopefully very rare) error.

1. Bleeder error (Shunt regulator)
2. DC-Bus high voltage
3. Current regulator error
4. Power output stage short circuit error (This is normally caused by a shorted motor winding or cable)
5. Any other error that shuts down power stage automatically

If this LED is illuminated, it will be necessary to interrogate the fault register (R20) to determine the cause of the fault condition.

LED 8 (POSITION ERROR)

LED 8 is used to indicate a position error. This is the most important and probably the most occurring fault (especially during program debugging and machine installation).

Application Program structure

GENERAL

A DMC application program can be written in many different ways. The given things are the programming language (PL2) syntax and a large amount of controller data provided by the operating system. How the data is managed and how the program is structured is left completely up to the user.

The basic features of SimPL fulfill the following requirements:

- Able to handle 90 to 95% of all DMC applications.
- Clear and simple main program structure.
- Simple tools and commands used to control motion, digital I/O and more.
- Full error processing and recovery.
- Resolver tuning and alignment to motor.
- Correct current limit settings for motor/drive combination.
- Default regulator gains settings (PID and Inertia Feed Forward parameters).

Should your application require special functions, which are not handled by the basic features, then advance features allow the following:

- Multitasking capability (Background and two SubLevel tasks).
- Write a PL2 code (native DMC programming language).
- Include a file with special functions or CAM tables.
- An initialization program to setup application variables or communication channel.
- Possibility to redefine registers with application appropriate name.

SimPL is a higher level programming tool for the DMC and therefore generates the PL2 code used for the application. However, the programmer can also directly use PL2 syntax in SimPL and furthermore he has the possibility to include a PL2 file (it is about the same as binding a DLL in a VisualBasic application). This makes usually sense if standard functions are predefined for a global project, for instance the reduced “DeviceNet” protocol.

For this reason it is very important to use **prefix** (see the PDF document named CodingCoventions_SimPL) on all PL2 stuff used in combination with SimPL. One of the main reasons is to avoid conflicts with labels, registers or subroutines automatically created by SimPL.

Program Execution

When this menu item is selected, the form shown in Figure 54 is displayed.

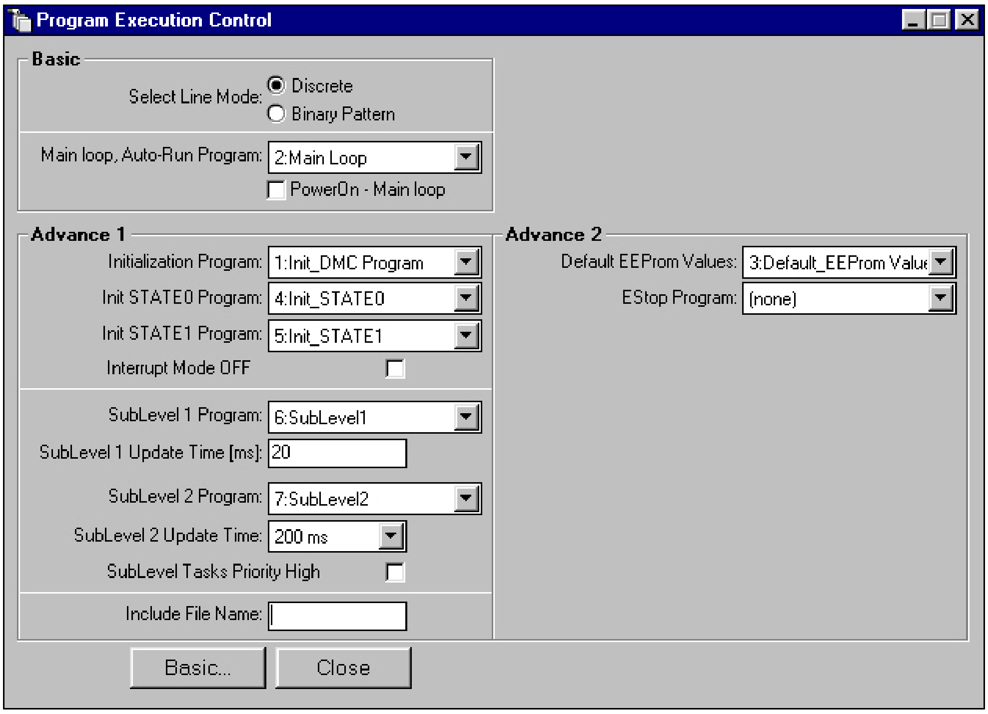


Figure 54. Program Execution Control.

The advance setting properties are:

1. Power On – Main loop: When entering the Main loop the Software Power On is executed automatically.
2. Initialization Program: This program is executed only once, after a Power Up or Reset and before starting the Background task.
3. SubLevel 1 Program: This program is running with a predefined sample rate.
4. SubLevel 1 Update Time: Sample rate for SubLevel 1 Program (def. 20 ms)
5. SubLevel 2 Program: This program is running with a predefined sample rate.
6. SubLevel 2 Update Time: Sample rate for SubLevel 2 Program (def. 200 ms)
7. Include File Name: File to be included at the end of the PL2 code

STATES DIAGRAM

The diagram below (Figure 55) shows all states and the possible transitions (arrows) between the states.
States consist either of a program sequence (e.g. Error/EStop handling) or of an endless program loop (e.g. Main Loop)

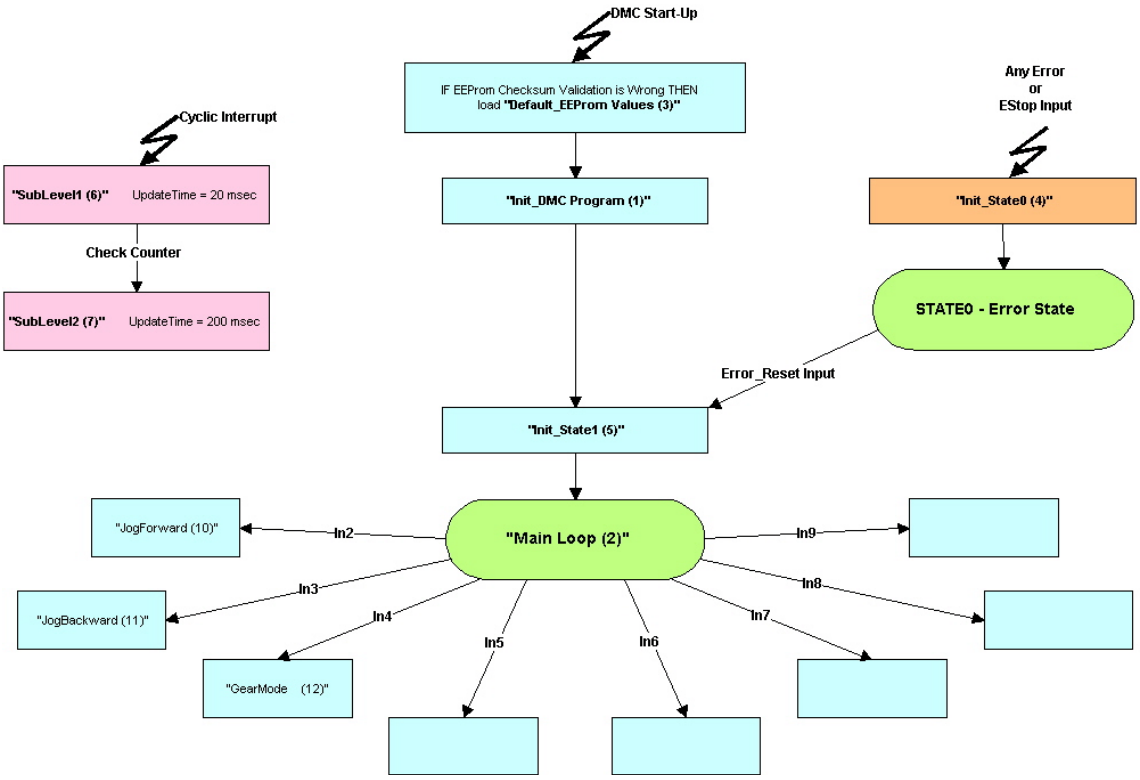


Figure 55. States and possible transitions.

APPLICATION PROGRAM TIMING

The following example, see Figure 56 shows the timing of Background and SubLevel tasks:

c_TimeBase	= 20ms	SubLevel 1 update time
c_SL2_T	= 5	SubLevel 2 update time (5 * c_TimeBase = 100ms)

The timing diagram will look as follows:

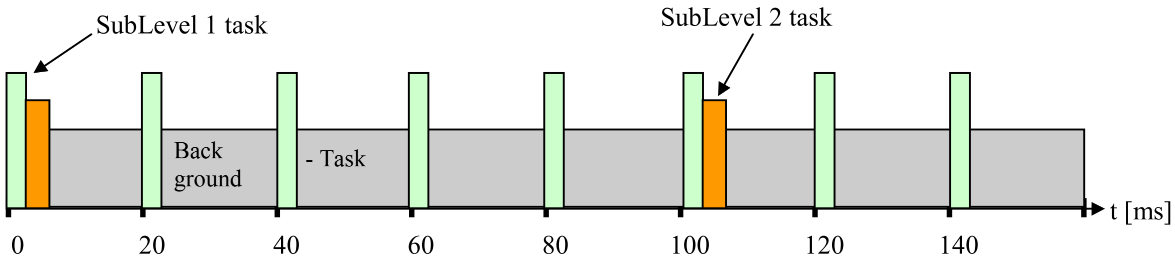


Figure 56. Timing of background and SubLevel task.

If the SubLevel tasks execution time exceed the predefined update time (20ms), the SubLevel program will just run as fast as it can and the Background task will not run.

WARNING

- **The SubLevel task program should never ever contain a dwell-time, a loop or a jump somewhere else in the application**

EEprom definition

General

During development of a SimPL application, settings such as regulator gains, motor parameters and communication settings are selected. These values are used as defaults and will be in effect the first time the application is run in the DMC.

These parameters are not hard coded into the application and can be changed. This is possible because these parameters are stored in the EEPROM of the DMC. New settings can be saved to the EEPROM, overwriting the default values. This EEPROM feature is useful for situations where the same application is being used in a number of similar machines. Since no two installations are identical, certain parameters, especially servo regulator gains, may need to be adjusted for each machine. Instead of maintaining many versions of the same SimPL application, a single application with reasonable defaults can be maintained, using the flexibility of EEPROM parameter storage to accommodate different machine dynamics.

The Inmotion DMC, on power-up copies the contents of its EEPROM chip into the EEPROM extended register group. These registers can then be read and modified. Changes to the values in the EEPROM extended register group are not permanent until one of the Run Utilities is used to physically store them in the EEPROM chip.

Below is a Table showing the definition of the EEPROM registers used by SimPL. Note that only the registers with the description “Free for USER parameter” are free for custom uses. Registers EEPROM.0 through EEPROM.8 have functions defined by the DMC firmware. For more information concerning these firmware registers, refer to the Atlas DMC User’s Manual.

Table 5 . EEPROM definitions.

Register	Description
EEPROM.0	DMC firmware version number
EEPROM.1	(reserved for System use)
EEPROM.2	(reserved for System use)
EEPROM.3	(reserved for System use
EEPROM.4	(reserved for System use)
EEPROM.5	Overtemp mask: Drive, Motor, Aux PTC
EEPROM.6	Forced Run, Baud Rate and Comm Node
EEPROM.7	Terminal Length and Comm Mode
EEPROM.8	CAN network init param (LAN1.ini)
EEPROM.9 – 12	CAN1 ACC protocol CAN TxID and RxID
EEPROM.13 – 17	CAN2
EEPROM.18 – 27	(reserved for System use)
EEPROM.28	Correction for EEProm.0 - EEProm.27 to get proper checksum
EEPROM.29	Checksum for EEProm.0 - EEProm.28
EEPROM.30	“MOTOR.Poles” register (number of motor poles)
EEPROM.31	Number of resolver poles (will set MOTOR.PPR)
EEPROM.32	“MOTOR.Mode” register (motor mode switch)
EEPROM.33	“MOTOR.PhAlign” register (commutation alignment)
EEPROM.34	“MOTOR.PhDelay” register (commutation delay)
EEPROM.35	“REG.Mode” register
EEPROM.36	“REG.PGain” register

General

EEPROM.37	“REG.IGain” register
EEPROM.38	“REG.DGain/100” register scaled by 100 to allow large values
EEPROM.39	“REG.SiScale” register
EEPROM.40	“REG.Pole” / “REG.Zero” ratio for filter registers
EEPROM.41	“REG.SetTorq” register
EEPROM.42	“REG.InertiaP” register
EEPROM.43	“REG.InertiaN” register
EEPROM.44	“REG.InertSF” register
EEPROM.45	“REG.StatFric” register
EEPROM.46	“REG.ViscFric” register
EEPROM.47	“REG.ViscSF” register
EEPROM.48	“REG.TorqCLim” register
EEPROM.49	“REG.TorqTime” register
EEPROM.50	“REG.TorqLim” register
EEPROM.51	(reserved)
EEPROM.52	“INT.PosErr” register (motor position error Limit)
EEPROM.53	Resolver 1 Data (RD1.ShAdj+128*SYSIO.PWM0 - resolver adjust.)
EEPROM.54	Resolver 2 Data (RD2.ShAdj - resolver adjustment parameter)
EEPROM.55	Free for USER parameter
EEPROM.56	Free for USER parameter
EEPROM.57	Free for USER parameter
EEPROM.58	Free for USER parameter
EEPROM.59	Free for USER parameter
EEPROM.60	Free for USER parameter
EEPROM.61	Free for USER parameter
EEPROM.62	Correction for EEProm.30-EEProm.61 to get proper checksum
EEPROM.63	Checksum for EEProm.30 - EEProm.62