Laser Doppler Displacement Meter™
Laser Measurement System

Software Instruction Manual

WinPipe

AUTOMATIC GENERATION OF COMPENSATION FILES
AND SERIAL LINE DOWNLOAD TO THE CNC.

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1. Introduction
   1.1. this software is realized in order to allow the machine tool operator to compensate a machine with one of the more common CNC, without the necessity of personnel that is expertise in CNC service.
   1.2. the system software is organized in two fundamental parts
      1.2.1. the compensation files generation
      1.2.2. the serial line transmission
   1.3. the operation are e utilization of the default data, introduced automatically by the software, it is possible to generate the compensation file in automatic way. The expert operator should, if think is necessary , ca modifier the settings generating a personalized calibration.

PART II APPLICATION

1. Operative sequence
   1.1. Computer setting
      1.1.1. Regional Settings
         1.1.1.1.On the desktop click on the icon Begin, Settings, Control Panel, double click on Regional (or international) Settings, click on Number: set Decimal symbol (first line) "point", Digit grouping symbol (third line) "comma", List separator (last line)"comma". Click OK for confirmation.
   1.2. Program loading
      1.2.1. turn on an IBM compatible PC, with a standard RS232 Line and Windows software.
      1.2.2. Load the program copying the Downloader.EXE program in the WinPipe directory.
      1.2.3. Star the program clicking twice on the Downloader.exe icon.
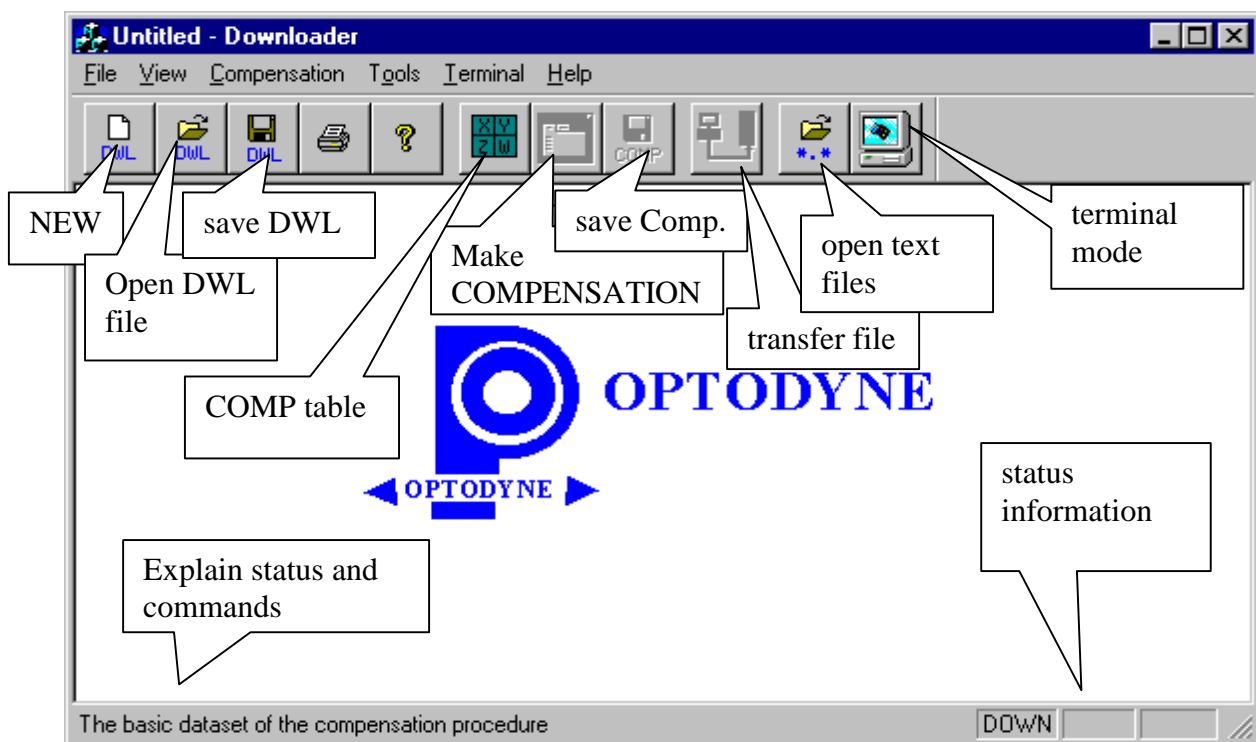
1.3 Main sequence operation:

Clear the screen and start with a new file
　　　　or **Load** an existing list of files

Compile the list of the file that contains
　　　the information for axis correction

View the data of the listed files

Generate the compensation and configuration
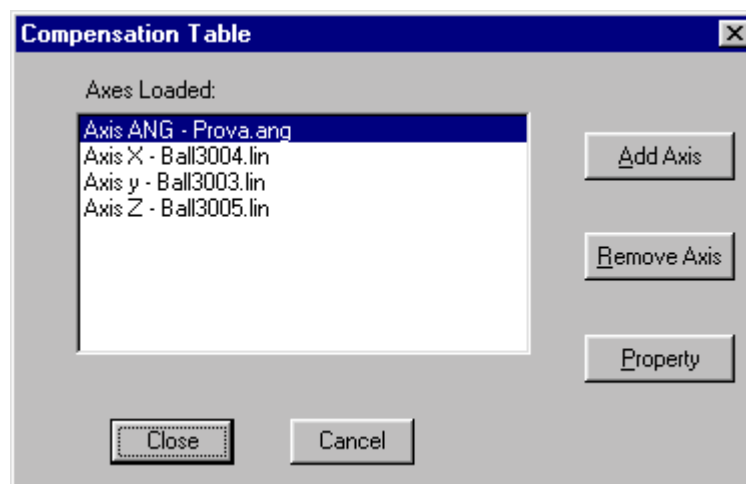　　　files accordingly with the CNC to be used.

Review the compensation and configuration file
　　　generated

Download the configuration and compensation
　　　files to CNC.

2. Comp Table: list of the files that will generate the comp table
   a list of the files of laser measurement that will compose the comp table is generated.

File selection: from the main menu select Commands and than COMPensation Table or click on
the COMP table icon it will appear a dialog windows , press the software button Add Axis to
load the first file containing the compensation data, in general the X axis. Select the files with
extention *.lin* or *.str* for the linear axes , or .ang for the rotary axes or rotary tables.

Compensation Table

Axes Loaded:

Axis ANG - Prova.ang
Axis X - Ball3004.lin
Axis y - Ball3003.lin
Axis Z - Ball3005.lin

Add Axis

Remove Axis

Property

Close　　　Cancel

2.1. Axis information: after the file is selected press open and the *axis information* windows will show the relevant information on the selected file.

The relevant information are:

2.1.1. *Machine:* Machine type (information introduced by the operator during the measuring section)it should be modified.

2.1.2. *Serial N°.* : indicate the serial number for the machine identification type (information introduced by the operator during the measuring section)it should be modified.

2.1.3. *Date:* is the date relative to laser measurement (information introduced by the operator during the measuring section)it should be modified.

2.1.4. *User:* operator name (information introduced by the operator during the measuring section)it should be modified.

2.1.5. AXIS: name of the axis to be compensated. The indication must correspond to the axis to be compensated as shown on the screen of the CNC (please consult the operator manual of the CNC).

2.1.6. Start position: initial position of measurement and of compensation (correspond to the first measurement of the laser measurement, is not possible to modified it in this screen, but during the compensation table generation).

2.1.7. End position: Last laser measurement point, it is possible to be modified changing the measuring length (it is possible to reduce only).

2.1.8. N• target positions: is the number of measuring positions, including the initial position and also the number of compensation points(in the original file corresponds to the number of the laser measuring points). It can be modified and new correction points will be calculated. The new generated file will be shown when the operation for the compensation table will be completed

2.1.9. *N° of runs:* Number of the measuring runs (is not possible to be modified in this screen, but during the compensation table generation

2.1.10. *Original data:* are shown the measuring unit and the number of points of the original file.

2.1.11. *FW only:* if crossed the laser measurement is unidirectional (corresponds to the number of the laser measuring points and is not possible to be modified).

2.1.12. ***mm:*** when crossed the measurement are expressed in the metric system. To change to Inch click on the square box near Inch.

2.1.13. ***Inch:*** when crossed the measurement are expressed in the Imperial unit. To change to mm click on the square box near mm.

2.1.14. ***Run length****:* is the measured length (in the original file corresponds to laser measuring length, it is possible to reduce The End position value will be recalculated) .

2.1.15. *Air pressure* pressure of the air at the moment of the laser measurement (corresponds to laser measurement data, is possible to modifier it, but the data will not be modified).

2.1.16. *Air temp.* : temperature of the air at the moment of the laser measurement (corresponds to laser measurement data, is possible to modifier it, but the data will not be modified).

2.1.17. *Umidity:* The air Humidity at the moment of the laser measurement (corresponds to laser measurement data, is possible to modifier it, but the data will not be modified).

2.1.18. MTE : Material temperature expansion. Include temperature and material coefficient of the air at the moment of the laser measurement (corresponds to laser measurement data, is possible to modifier it, but the data will not be modified).

2.1.19. Alpha: Thermal expansion coefficient of the material of the machine or the measuring system of the air at the moment of the laser measurement (corresponds to laser measurement data, is possible to modifier it, but the data will not be modified).
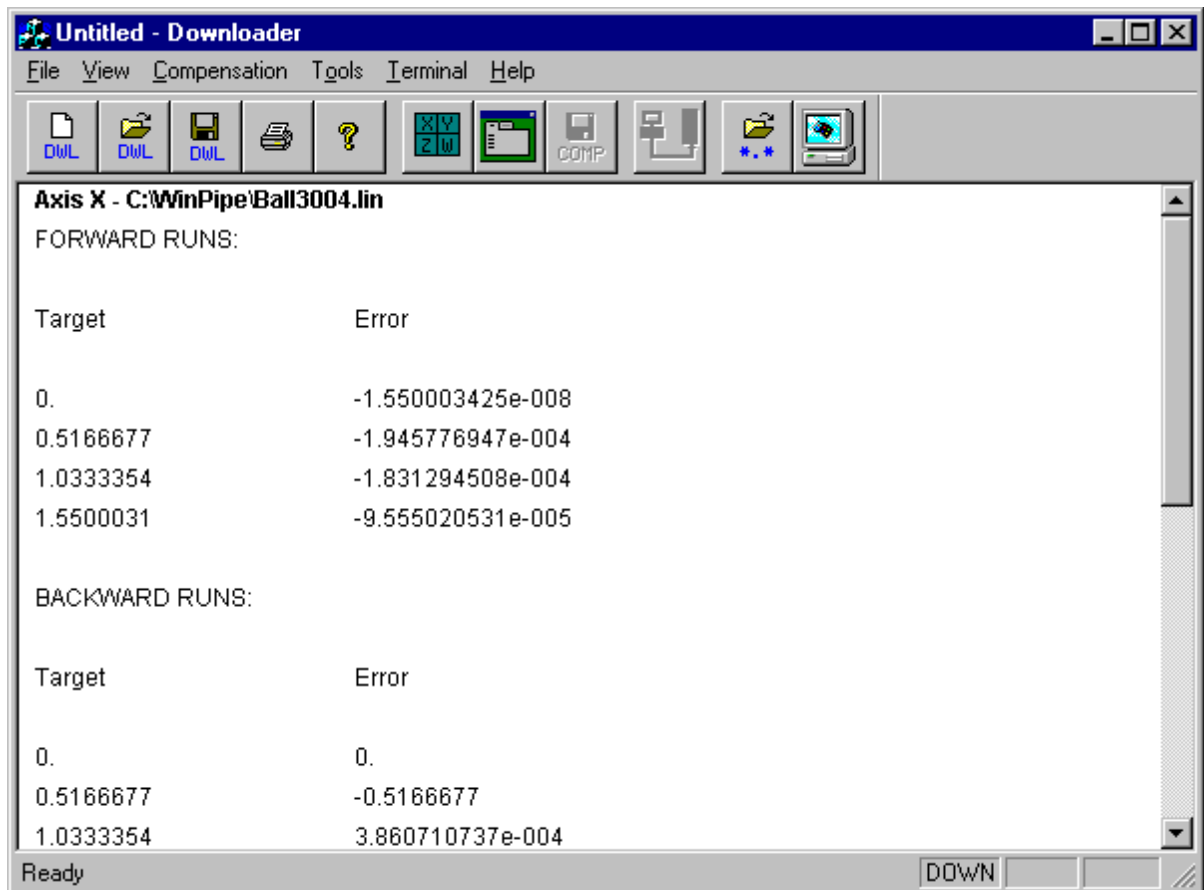

Important notice: The data in **BOLDED characters** should be modified by the operator and have large importance in the compensation file, any change have to be carefully evaluated.
The new data are software recalculated using linear interpolation.

2.1.20. push OK to confirm the selected file, that will be added to the list.

2.1.21. push cancel to delete.

2.1.22. Remove axis: cancel the selected axis (after a confirmation).

2.1.23. Property: Show the table Axis Information's and allow to verify the data and correct it.

2.1.24. Table confirmation: When added all the axes to be compensated to the list, click CLOSE to confirm or CANCEL for annullation.

2.2. Screen Display: On the screen will be displayed the loaded file with the following format:

2.2.1. Title : Axis name ,file name

2.2.2. Data: Table with two column on the first the Target position , on the second the position error.

2.3. Saving the COMP TABLE file: Click on the icon:
or select File Save or Save as..

2.4. If the comp table file do not have a name, will be proposed a menu with the possibility to save the table with a name, the DWL extension will be added automatically.

2.5. open a saved COMP table:

Axis X - C:\WinPipe\Ball3004.lin

FORWARD RUNS:

Target	Error
0.	-1.550003425e-008
0.5166677	-1.945776947e-004
1.0333354	-1.831294508e-004
1.5500031	-9.555020531e-005

BACKWARD RUNS:

Target	Error
0.	0.
0.5166677	-0.5166677
1.0333354	3.860710737e-004

3. COMPENSATION FILE GENERATION

3.1. Make comp File: Click on the icon make COMP
   or select from the main menu Compensation and Make comp
   will appear a dialog windows named : Numeric control setting

---
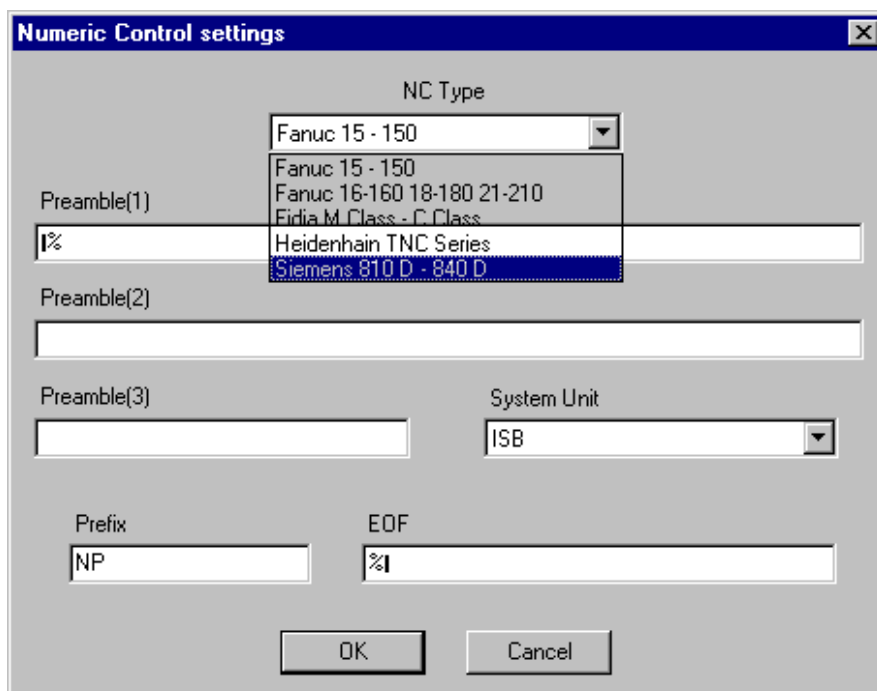
3.2. Select the CNC type from the list, after selection will appear the data set specific for any specific CNC.

3.3. For a simple use the default configuration contain all the information necessary for any specific CN control, he for GE Fanuc 15-150 and GE Fanuc 16-18-20 it is necessary verifier if the system units are corresponds to the SU selected in the CNC, the default is ISB, that correspond to .001mm, .00001 Inch, .001 deg.

3.4. The information indicated will be included in the comp file as preamble (at the beginning of the file), as prefix (for each line or data) and end of file. The information in this section do not needs any modification for the simple operation; in case of particular use, the operation would be done by experts in the specific CNC use, consult the CNC manual for details.

3.5. Click OK for confirmation.

3.6. Axis compensation parameter windows will appear with the scope to confirm or modifier the data related to the first axis of the list generated with the precedent procedure. The mask is composed by:

.

3.6.1. Axis name: Axis identification of the axis to be compensated, if the axis name do not correspond to the exact identification requested by CNC, follow the procedure indicated in comp table list, for the modification.

3.6.2. Step size: is the distance between two compensating points.

3.6.3. Compensation length : is the length of the travel that will be compensated.

3.6.4. Reference point: correspond to the reference point of the machine, the compensation in this point will be set to zero by default but can be modified. In general it will correspond to the home position.

3.6.5. Start Position : compensation initial position or the most negative point. If modified the end position will change according with the compensation length.
With Siemens 840D if there is module the initial position have to be positive.

3.6.6. End position: final compensation position.

3.6.7. Backlash: is the error of inversion. It is calculated as the average value on all the positive and negative travel. This data should be modified typing a different value. The data will be automatically loaded into the CNC together with the other compensating data.

3.6.8. Shift : add a constant value to all the compensation table values, is done to refine the compensation or for adding a compensation to the reference point. Must be used by experts, a value different from zero should reduce the machine accuracy, if not properly used.

3.6.9. MTE-1 correction: correction factor of the temperature expansion, the compensation is proportional to the run length. Change the curve slope accordingly with the coefficient introduced in PPM(part per million). Introducing a positive number if a positive slope exist, the slope increase , with a negative number decrease or became negative. Example of use: the file of the measurement include a slope due to thermal expansion and the intention is to compensate for the non linearity only. Read the from the error table or the plot the error at the unit of length in use(the error at 1meter) that is 10 micrometers for instance. If I put –10 in the MTE-1 correction box I will have a slope variation that will put the error at 1m near to zero. Must be used by experts, a value different from zero should reduce the machine accuracy, if not properly used.

3.6.10. Scale factor K: this value multiply all the value of the table. A negative value -1 will reverse the compensation. Must be used by experts, a value different from 1 should reduce the machine accuracy, if not properly used.

3.6.11. Module: is used for cyclic axis. For non cyclic axis is zero for both linear and rotative, introduce the module 360 for instance.

3.6.12. *Start Address:* Is active for Fanuc, it is for default 0 for the first axis, 100 for the second, 200 for the third axes and so on. Must be used by experts if a special memory distribution is required.

3.6.13. *Pitch magnification:* is active for Fanuc, it is the multiplication factor of the pitch compensation. Is optimized by the compensation software and should not be modified. Must be used by experts, a value different from the one calculated should reduce the machine accuracy, if not properly used, for better details see the CNC manual.

3.6.14. *Comp Data Set:* Includes by default all the positive measurement cycles (with values that are increasing). For the modification of the set of measurement on which to calculate the automatic correction use the commands on the right side. The automatic compensation is calculated with the average of all the positive measurements (unidirectional Forward compensation). Any modification of the set of data should decrease the accuracy of the machine if not properly used. Must be used by experts.

3.6.15. *Master/slave :* select if the axis is master or slave, is active with FIDIA controller

3.7. After all the data for the first axis are checked to pass to the next axis press the >> button or to go back press << . All the data for each axis that compose the compensation table will be shown and have to be confirmed.

3.8. Press FINISH for the final confirmation.

3.9. Compensation File, save. will be shown a windows for saving the file with a name default is COMP.TXT.

3.10.   Save a Comp File Click on the icon
or select from the main menu Compensation and
save COMP file

4. Parameter Configuration File : when applicable, as for Fanuc CNC, a configuration file is generated toghether with the compensation file. The config. file will automatic take the name: *file name*_CFG.TXT.   The configuration file have to be transferred before the compensation file.
5. Download the configuration and compensation files:
   5.1. Load the file to be Downloaded clicking on The icon:
       (in case a compensation file was generated and is already in
        the computer memory it is not necessary to do this step)

   5.2. Connect the RS232 cable between the PC and the CNC. For more detailed instruction on the specific CNC see appendix 1.
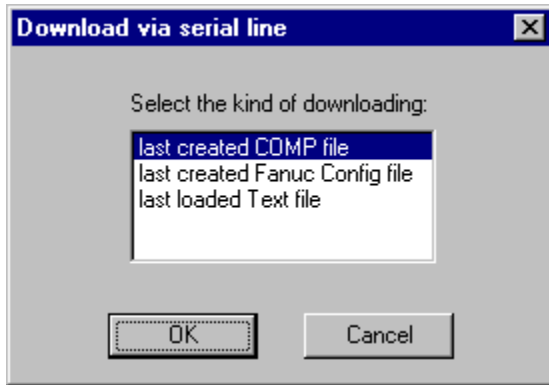   5.3. Configure the serial port by the menu Commands and Setting Port in the way to have compatibility with the CNC setting port configuration. See Appendix 3 for more details on the specific CNC.
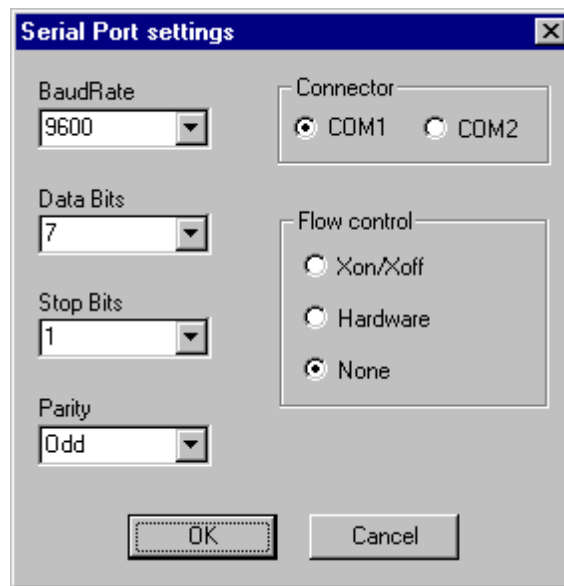
   5.4. Set the CNC waiting for the file. For more detail on the specific CNC see the appendix 2 or the CNC Manual.

   5.5. Click on the DOWLOADING MANAGER Icon
or Select from the main menu TOOLS and Download …
the following windows will be shown.

Download via serial line

Select the kind of downloading:

last created COMP file
last created Fanuc Config file
last loaded Text file

OK   Cancel

5.6. Select the file to be downloaded. In case a configuration file is generated, transfer the configuration file first.   Press OK the file will be transferred by serial line, at the end a message will advise for the end, click on OK to cancel.

6. Terminal Mode

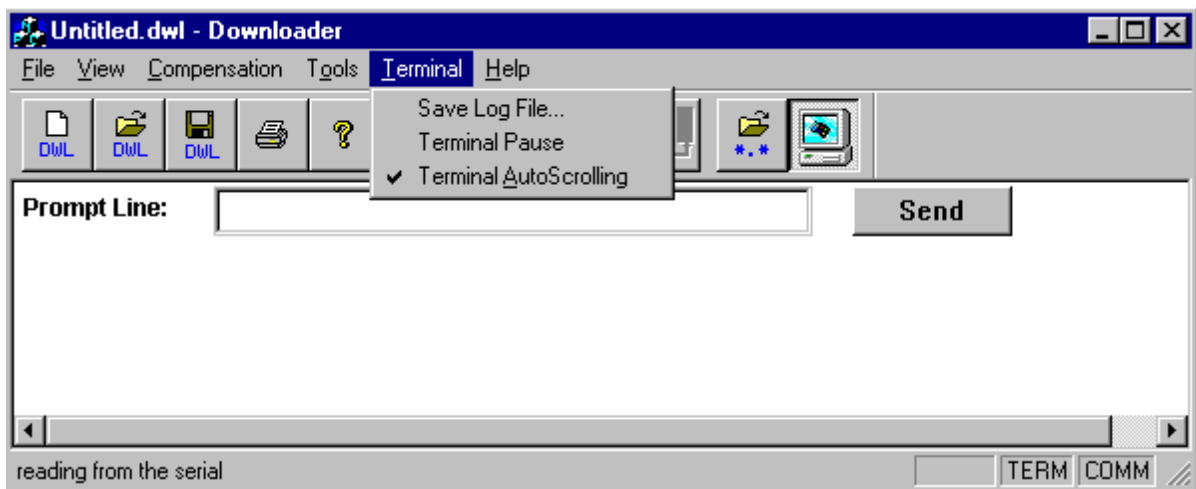The terminal mode can perform the followings:

A- Read compensation and configuration files or more generic text files

B- Send the loaded file by serial line.

C- Capture by serial line files or information, read it and memorize.

D- Send and receive string of text or files in full duplex operation.

6.1. Read files : Click on the icon:
    or select from the menu :
    Tools and Load file.
    load a file that will be displayed.

6.2. Download file: load a text file following the instruction at the point 6.1 ,
     follow the procedure from point 5.1 to 5.4 for connection settings and down loading.

6.3 *Send and receive from the serial line*: Follow the procedure to the point 5.2 and 5.3
    for connection and settings,   click on the icon
     or select tools and terminal mode.
    the following screen will be shown:

Untitled.dwl - Downloader

File   View   Compensation   Tools   Terminal   Help

Save Log File...
Terminal Pause
✓ Terminal AutoScrolling

Prompt Line: **Send**

reading from the serial   TERM COMM

6.2.1. The received messages will be displayed on the screen and should be saved with the command Terminal and Save log file...

6.2.2. to stop temporally the receiving function use terminal and terminal pause

6.2.3. for a message transmission write a text on the windows on the screen and click on SEND button.

6.2.4. to close terminal function click again on terminal icon

7. Print: Clicking the icon :
                  or selecting or selecting file and Print..
                  Print Preview or Print setup is possible to print
                  the file on the screen

APPENDIX 2

Specific Procedure for Data Downloading

the reported information should be not exact and exhaustive, the information are realized as an help for the operator. For complete information please refers to the CNC manual.

1   CNC GE Fanuc models 15/150 16/160 18/180 21/210

Two files are generated by the WinPipe software, the Configuration file and the compensation file. The configuration file is generated automatically together with the compensation file. The configuration file is saved in the same directory of the compensation file, with the same name of compensation file with the addition of: _conf.txt (example conp.txt and comp_conf.txt)

1.2 Download of the parameter file in the CNC (This operation have to be performed before of the pitch error data transfer)
    1.2.0   Go to the page PARAMETERS
    1.2.1   Push Chapter
    1.2.2   Push the button with the right direction arrow
    1.2.3   Push on Read
    1.2.4   Push : Parameter: the control start waiting for data transfer and the indication READ is start flashing.
    1.2.5   transfer the Parameter file, point 5. of the manual.
    1.2.6   When the data are transferred the indication READ disappear.
1.3 Download the PITCH ERROR in the CNC
    1.3.0   Go to the page PARAMETERS
    1.3.1   Push Chapter
    1.3.2   Push the button with the right direction arrow
    1.3.3   Push on Read
    1.3.4   Push Pitch Error: the control start waiting for data transfer and the indication READ is start flashing.
    1.3.5   transfer the Pitch Error file, point 6. of the manual.
    1.3.6   When the data are transferred the indication READ disappear.
1.4 Reading the Pitch error file from the CNC
    1.4.0   Prepare the PC for the data reading following the procedure 7.3
    1.4.1   open the page PARAMETERS
    1.4.2   push Chapter
    1.4.3   push right arrow
    1.4.4   push Punch
    1.4.5   push Pitch Error : the control transmit the data, when the data are transferred the flashing indication PUNCH disappear.
1.5 Reading the Parameter file from the CNC
    1.5.0   Prepare the PC for the data reading following the procedure 7.3
    1.5.1   open the page PARAMETERS
    1.5.2   push Chapter
    1.5.3   push right arrow
    1.5.4   push Punch
    1.5.5   push Parameters : the control transmit the data, when the data are transferred the flashing indication PUNCH disappear

2   SIEMENS 840 D

The compensation file generated by WinPipe software will act as a part program and contains the commands for backlash and also the information of the path, and the enc_disable and enc_enable commands.

2.2 Switch on the CNC or push the NCK reset

2.3 Back up: Before to start the procedures for the download of compensation it is safer to do a back up of the machine data following the instruction of the CNC manual.

2.4 Axis identification: from the initial page of the CNC named SCM identifier the name and the axes sequence that will be reported in the Comp Table (see chapter 2). The axes sequence will be the same on witch the files will be loaded on the compensation table and visualized on the list *Axes loaded.* Will be indicated, on the Axis Information Windows and in the cell Axis: Write AX1 for the first axis and AX2 for the second axis and so on.

2.5 *Compensation, Check for the number of correction point :* before to start the procedure for the compensation data loading, it is necessary to verifier if a sufficient number of compensation points for the introduction of the compensation does exist. From the main menu press in sequence: Service, Machine data, Axis-specific, than search : 38 000, to the line 38000_ENC_COMP_MAX_POINT (selecting also the measuring system 1 or 2) will appear.

<div align="center">

Axis 1

Axis 2

……..

</div>

At this point insert the number or point as in the window Axis information in the box *target points* (in the case of axis with module the number of points is Number of *target points –1).*
At the end, the message 4400 will be visualized: the modification of machine dato will imply the lost of data. it is necessary to do a memory back up.

2.6 Back up: the following operation is critical and if not performed correctly will imply the lost of data. This operation have to be performed by expertise personnel following the instruction of the CNC manual. The following procedure is reported with the scope of memo and should be not exhaustive or correct.

2.7 push in sequence Services, extension [>] , MEAS

2.8 will appear a screen on which NC and With Compensation have to be selected, insert the File name as for instance: COMPNCK, push the button File at the end of memorization on the hard disk will appear the message: Order done.

    2.8.0   Reload the archive: push Read File, than select the archive, in the example COMPNCK, than push start, the data will be loaded.

    2.8.1   *Download the compensation table:* Select the main menu; than in sequence push Service, Interface, V24.

2.9 Set the port com 1 or com 2 in conformity to the settings of the serial line of the PC; for instance Bode rate 19 200, no parity, 1 stop bit, 8 data bit, Format punch tape CR+LF. Push OK, push Data Load, push V24. The CN will wait for data, transmit the data from the PC, at the end of the transmission push OK for data saving.

2.10   The file will be memorized in the CNC Hard disk: into Source data programs, part program

2.11   PROGRAM EXECUTION: to be effectively loaded, the data have to written in the proper locations, this operation will be executed running the file as a program. Execute the following instructions:

    2.11.0 push the button |M| and than the button |=>]| (automatic)

2.11.1 Than program index and, Part programs

2.11.2 Select the loaded compensation program

2.11.3 Push, selection, if all is okay on the cursor on the upper part of the screen the name of the selected program will be displayed push the button | ^ |

2.11.4 Put the override to zero

2.11.5 START, |GREEN BUTTON|. The program is runned.

2.12   Verification on the effective loading of the compensation data.

2.12.0 Do a power on or a rest pushing | NCK| ;

2.12.1 do axes homing.

2.12.2 push in sequence the buttons, Main Menu, Diagnostic, Service display, Service, axis, compensation value, and verifier that the data introduced have been accepted.

2.12.3 Save the archive: at the end of the data loading operations it is better to do a back up.

2.12.4 select: CN and With Compensation data.

3 FIDIA   M class

One file named AXVCAL.SET is generated by the compensation software

4 Heidenhain

The compensation software generate one file each axes named: ASSE(axis name).COM and one configuration file named CONFIG.CMA