Model MS-12

12-Input 100MHz Scaler Card

User Manual

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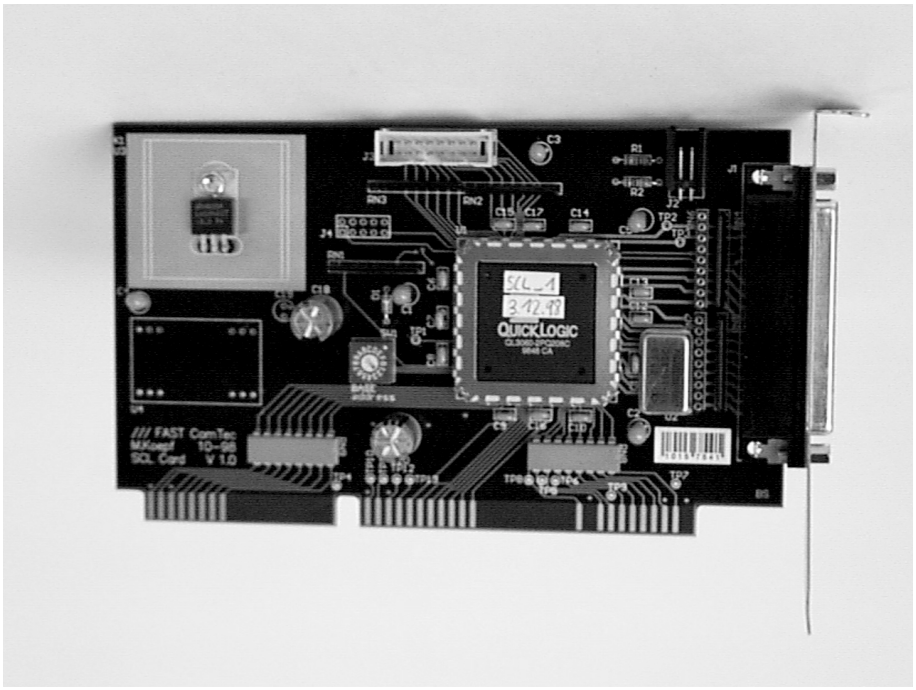

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The information in this manual describes the hardware and the software as accurately as possible, but is subject to change without notice.

Remark

Please note that the input channels are referenced differently in the hardware and software description. In the hardware description the twelve inputs are numbered from 0 to 11 whereas the software references the inputs as number 1 to 12.

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1. Introduction

The Model MS-12 is a multi input scaler that provides twelve 100MHz scalers on a single ISA bus card. Two of the scalers are presettable.

The MS-12 features a crystal time base of 10ns and a 32bit counting depth for each scaler. The first scaler can be configured as a timer with 10ns time resolution. It is also configurable to work as an in binary steps programmable timebase.

The start and stop function can also be synchronized with the 'GO'-line as used by the MPA-3 Multiparameter System or the SYNC-Line of the MCD4LAP Quad Input Multichannel Dataprocessor card.

All twelve scalers are connected to a common 'GATE' (enable) and a common 'LOAD' (reset to start value) input. Additionally each scaler is also equipped with an 'INDIVIDUAL GATE' input.

The inputs are designed to accept TTL or positive NIM pulses at a maximum rate of 100MHz. The input impedance is configurable. The standard values will be 1kΩ or 50Ω.

2. Installation Procedure

2.1. Hardware Installation

The MS-12 requires an IBM AT or compatible computer with a 386, 486, Pentium or higher processor and an available 16 bit slot. Several MS-12 cards might be installed in your computer if you have enough available slots.

A PC with Microsoft Windows 3.1, Windows 95 / 98 or Windows NT installed is required for use of the supplied control and analysis software.

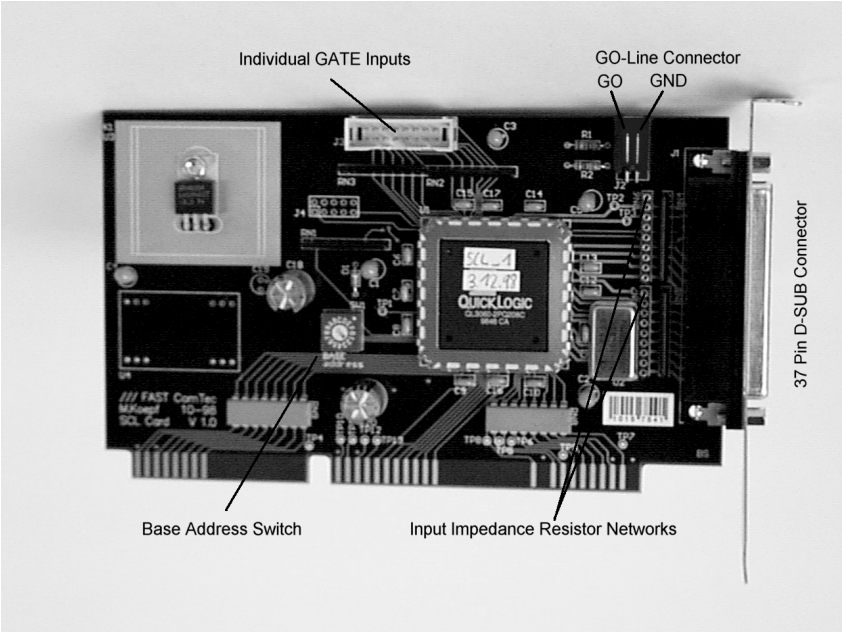

Figure 2.1: MS-12 Card

First you should locate an unused address in the I/O address space of your computer. The MS-12 has a small rotary switch (ref. Figure 2.1) that determines the base I/O address of the card. The MS-12 occupies 12 I/O addresses starting at this base address. The supported base addresses and corresponding switch settings are:

Switch	Base Address [hex]	Switch	Base Address [hex]	Switch	Base Address [hex]	Switch	Base Address [hex]
0	200	4	240	8	300	C	340
1	210	5	250	9	310	D	350
2	220	6	260	A	320	E	360
3	230	7	270	B	330	F	370

Figure 2.2: Table of the base I/O addresses

The factory setting is 330_{hex} - an address commonly not used by other devices.

2.2. Software Installation

Presently the MS-12 is supported under Windows 3.x/95/98/NT/2000/XP by a standalone program WMS12.EXE and the MCDWIN software for the FAST multichannel analyzers MCD4LAP and MCDLAP, and under Windows 98/NT/2000/XP by the MPANT software for MPA-3 and SPA-3.

To install the standalone software on your hard disk insert the MS-12 disk into drive A. Log to drive A: by clicking from the explorer, change to the proper directory corresponding to your Windows version (MS12\WIN9x or MS12\WINNT) and start the installation batch file by double clicking the INSTALL.BAT.

To install the MCD4LAP software on your hard disk insert the MCD4LAP disk into drive A. Log to drive A: by clicking from the explorer and start the setup.exe by double clicking. A directory called C:\4LAP is created on the hard disk and all MCD4LAP and MCDWIN files are transferred to this directory. Drive C: is taken as default drive and the MCD4LAP working directory as default directory. It is not mandatory that the MCD4LAP operating software is located in the original directory.

Then insert the MS-12 disk into drive A: and run the INSTALL.BAT from the proper directory MCD4LAP\WIN.. After the installation is completed you may copy the files to any other directory.

For Windows NT/2000/XP it is necessary that you install the device driver FASTMCD.SYS from the WINNT\DRIVER directory. Administrator privileges are required. Run INSTALL.BAT; you will be asked "Are you sure that you want default Registry entries for one module (If not type Ctlr-C) Press any key to continue. . .". Press the ENTER key. Now you will be asked to enter the port address in hex, enter 320 if you are using the MCD4LAP default address. Now you see the question "More devices (y,n)?". Answer with y and enter the port address of the MS-12, for example 330 if the rotary switch points to B. Again you will be asked "More devices (y,n)?". If you have only one MCD4LAP and one MS-12 answer n, otherwise install for each module the suited port address. After completion of the installation procedure restart the computer.

For using the MS-12 with the MPA-3, SPA-3 or MCDLAP the same installation procedure is necessary. Again the FASTMCD.SYS driver must be installed for the MS-12 under Windows NT. The installation of the MPA-3 or SPA-3 software is as usual, the FASTMPA driver is necessary for the MPA-3 or SPA-3 hardware.

The base address of the MS-12 module(s) must fit to the addresses in the file SCALER.CFG containing the MS-12 settings, see software description. If you are using more than one MS-12 modules, for each device a proper port address must be installed. The number of MS-12 modules and port addresses must be entered in the SCALER.CFG file.

3. Functional Description

3.1. Overview

The MS-12 card essentially is built of twelve 32bit synchronous counters (ref. Figure 3.1). Each counter has a count enable and a load input. Load overrides the enable and resets the counter. In case of counter 0 and 1 the loaded value corresponds to the selected preset. The other counters are reset to zero. Counting performs when enable is true (ref. Figure 3.2 on how the enable is derived). Connected to each counter is a capture register to enable synchronous readout of all scalers on a common capture command. Scalers 0 and 1 also have a carry out available on the 37pin D-SUB connector. These go low for at least 100ns (!) when the counters reach $FFFFFFFF_{hex}$. When a preset is enabled for scaler 0 and/or 1 all counters stop synchronously when the selected preset is reached.

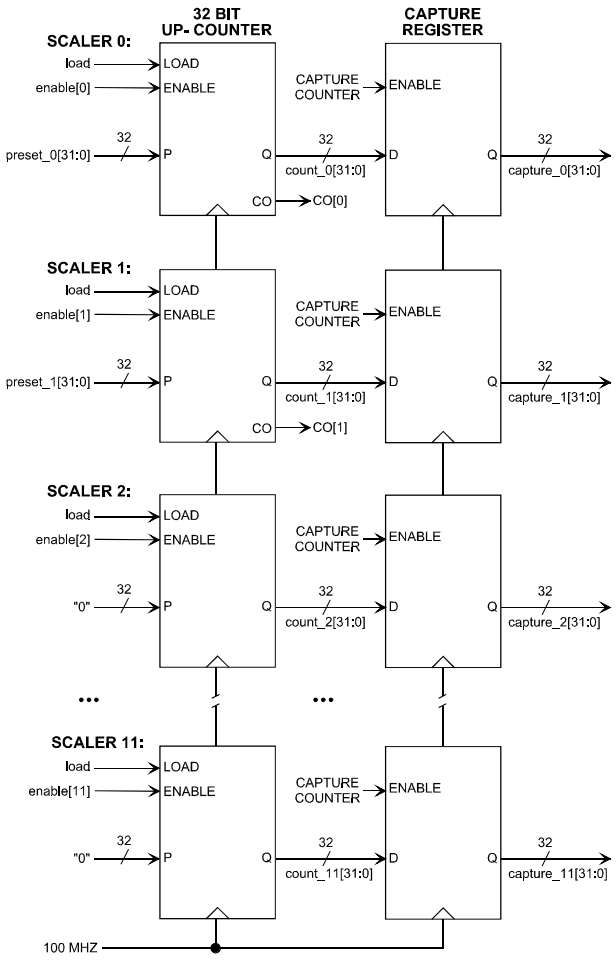

Figure 3.1: Simplified Block Diagram of Counters

Counting performs when the corresponding enable is true. This enable is derived by a logic AND of several control signals (GO-line, COMMON GATE, indiv. GATE, not PRESET REACHED) and a rising edge on the COUNT INPUT (ref. Figure 3.2).

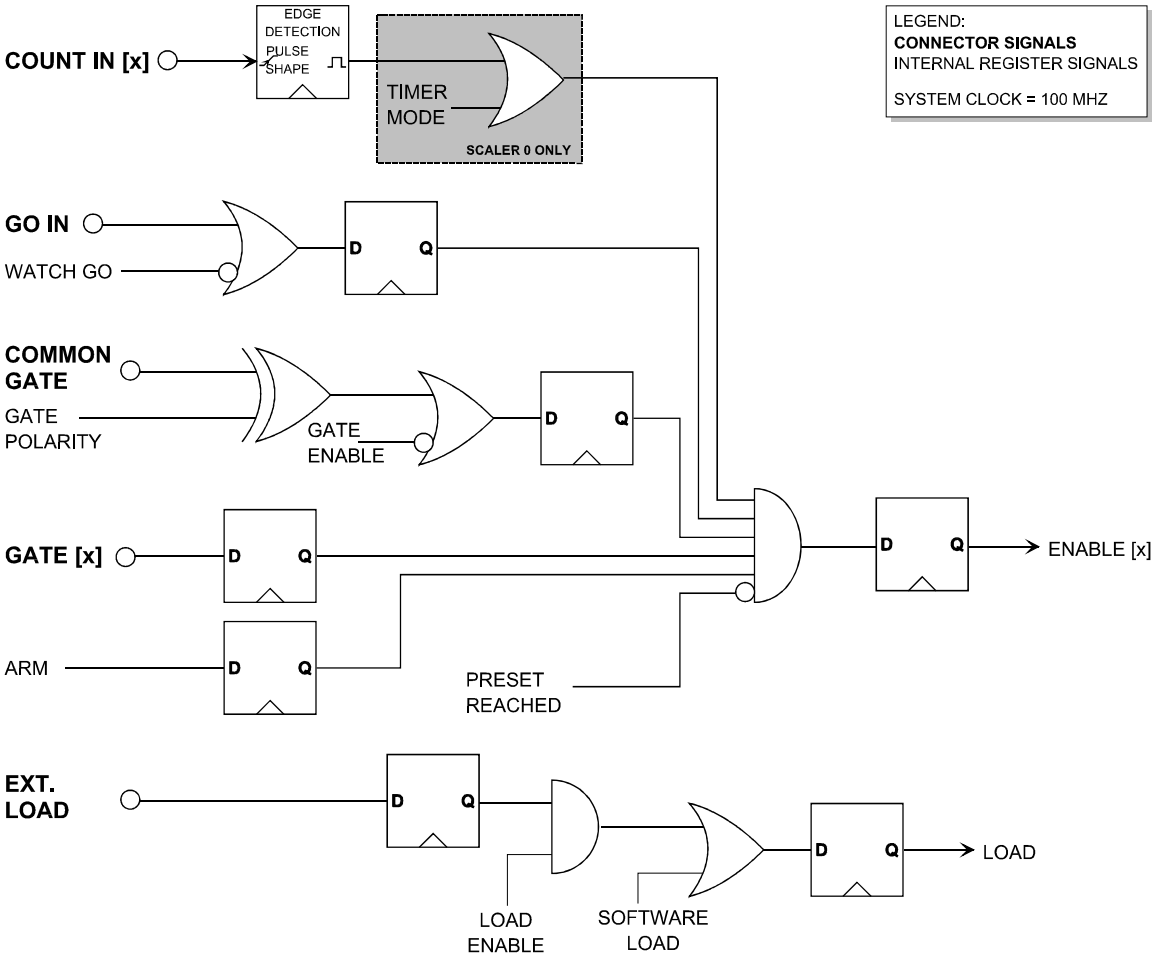

Figure 3.2: Schematic of Scaler Inputs

3.2. Inputs

All COUNT INPUTs as well as COMMON GATE and EXTERNAL LOAD are available on the 37pin female D-SUB connector. The input impedance is selectable by installation of 8R/9pin resistor networks in the SIL sockets on board (ref. Figure 2.1; the lines lead to pin 1 = GND). Fixed resistors of 1kΩ are soldered in parallel to the SIL sockets. Thus, with no additional networks the input impedance is 1kΩ. 56Ω networks in the sockets will result in approximately 50Ω.

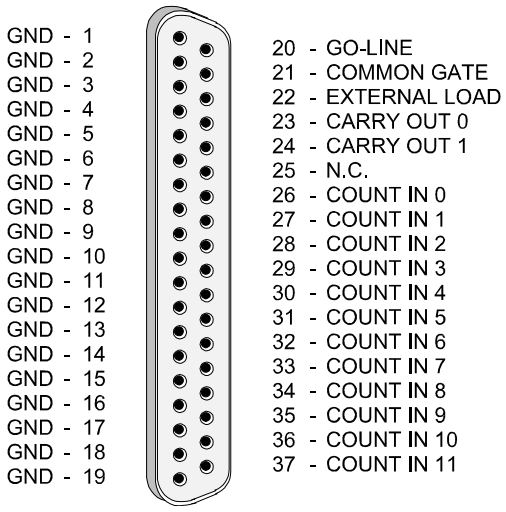

Figure 3.3: Connector Assignment D-SUB 37

Individual GATE inputs are implemented on the 16 pin four-walled header. The input impedance is 4.7kΩ to +5V. The supplied ribbon cable connects to a 15 pin female D-SUB connector fixed on a mounting bracket.

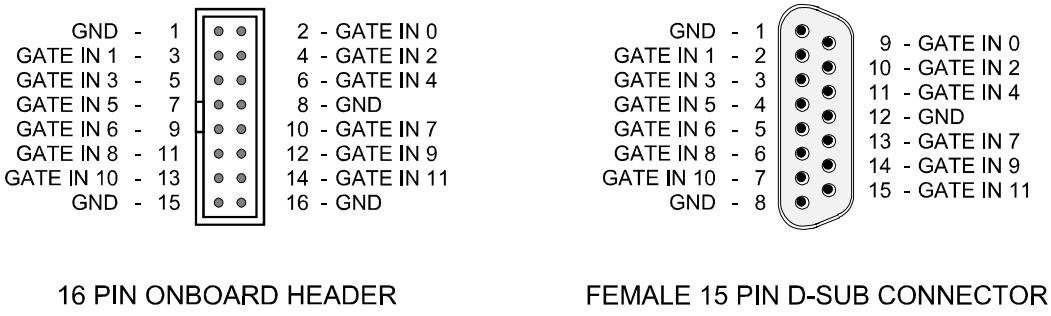

Figure 3.4: Individual GATE Input Connector

A low on the individual GATE will disable counting of the corresponding scaler.

3.3. Outputs

The carry outputs of scaler 0 and 1 are available on the 37pin D-SUB connector. An internal pulse stretcher produces at least 100ns wide pulses.

Carry Output 0 is software selectable to be either the carry out of scaler 0 - which is active low on overflow of the counter - or it's data bit 31 … 17 respectively. This enables scaler 0 to be used as binary selectable timebase for another counter which then may work as timer with the programmed time resolution. The difference between carry out and bit 31 is that carry out is active for ~100ns only while bit 31 has a duty cycle of 50%.

3.4. GO-Line

The bidirectional, open drain GO-line is available on the 37pin D-SUB connector. For synchronization of several PC cards inside the same computer it is also available on a 2pin header (ref. Figure 2.1).

The GO-line is compatible to the MPA-3 Multiparameter System and the MCD4LAP Quad Multichannel Dataprocessor.

The GO-line enables to synchronously control (start / stop) all connected measurement devices.

The GO-line of the MS-12 may be used in level sensitive mode (high = Go, low = Halt) or edge sensitive (a rising edge starts and the subsequent falling edge ends counting). For the MCD4LAP use it edge sensitive, for the MPA-3 level sensitive.

4. Software Description

The software consists essentially of a 32 bit DLL named DMS12.DLL. It contains the low level routines to control the hardware and a dialog box to set the parameters. The DLL can be used either by the standalone program WMS12.EXE or presently by the respective server programs for the FAST multichannel analyzers MCD4LAP and MCDLAP or the multiparameter system MPA-3. A dialog box for setting the MS-12 parameters can be entered from the System dialog of the MCDWIN or MPANT software:

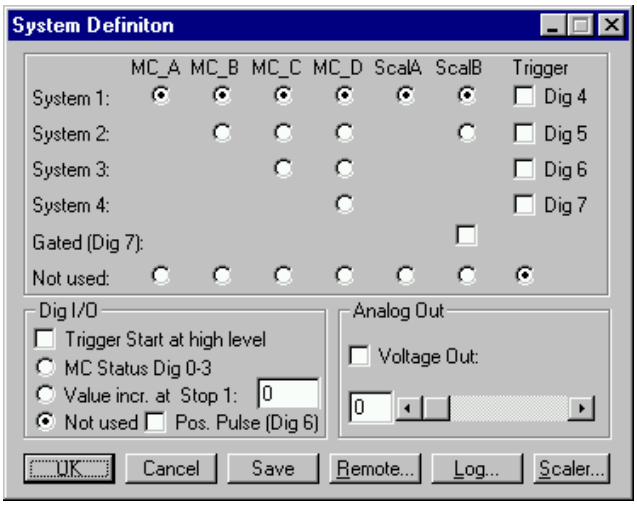

Figure 4.1: System dialog of the MCD4LAP server

Press the Scaler... button to enter the MS-12 Settings dialog. Most settings can be edited in this dialog and are saved in a file named SCALER.CFG when pressing the OK button. But there are two lines in this file that must be edited by hand: the first line scdevices=1 must be changed if you are using more than one MS-12 module, write scdevices=2 for 2 modules and so on, and the second line scbase=330,340,350,360 must contain the port addresses used for the MS-12 modules.

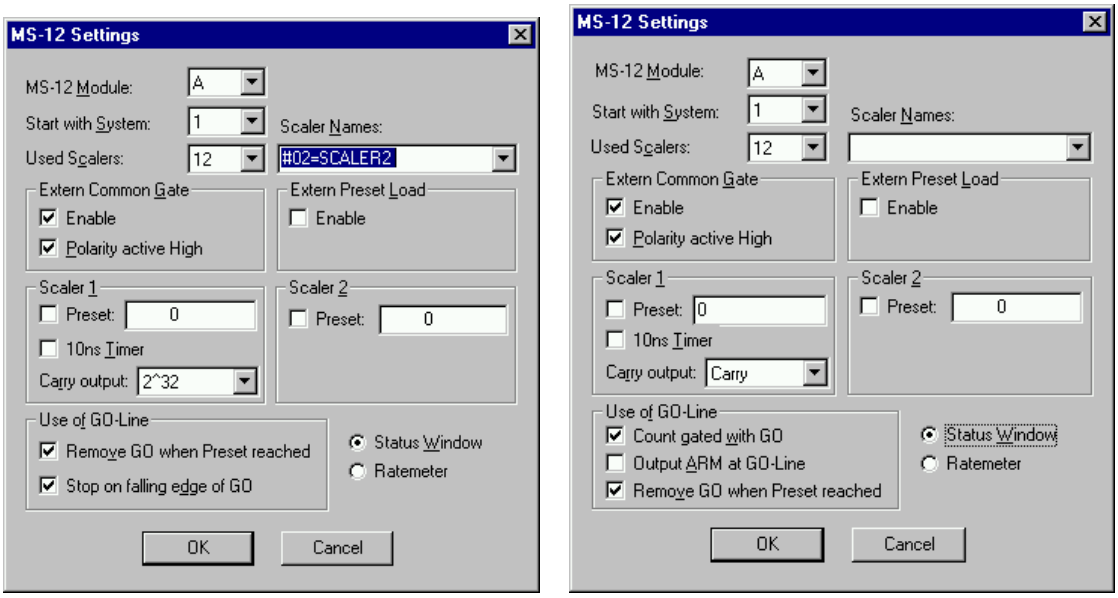

Figure 4.2: MS-12 Settings dialog, left: used with MCD4LAP, right: with MPA-3

If you have more than one MS-12 modules installed, choose the module to be set using the drop-down list labeled MS-12 Module. "Start with System: " binds the scaler to the system number to be started and stopped simultaneously. "Used Scalers" defines the number of scalers used. "Scaler Names" allows to define names for the individual scalers. The two checkboxes in the box labeled "Extern Common Gate" enable or disable the gate and define the polarity. The "Enable" checkbox in the box "Extern preset load" allows to control the preset loading by an external signal. Scaler 1 and 2 are presettable, the preset can be enabled and the value defined in the corresponding boxes labeled Scaler1 and Scaler 2. Scaler 1 can be used with a 10 ns timer, this can be defined with a corresponding checkbox. And the carry out signal CO[0] for Scaler 1 can be defined to be "Carry" or the bits 2^32, 2^31, ..., 2^18. This way by connecting the CO[0] to the input of Scaler 1 higher preset values than 32 bit can be realized. The Use of the GO line can be defined in the corresponding box.

The MCD4LAP uses this line as "Preset-Bus" in a way that any falling edge can stop an acquisition if "Any Preset stops all" is enabled in the "MCD4LAP Settings" dialog. So the upper checkbox labeled "Remove GO when Preset reached" can stop the MCD4LAP when a preset is reached in the MS-12, and the lower checkbox "Stop on falling edge of GO" stops the MS-12 controlled by a preset reached in the MCD4LAP.

The MPA-3 multiparameter system and SPA-3 have a global GO-Line that is high when the acquisition is running and at low level when it is stopped. So there are three checkboxes "Count gated with GO", "Output ARM at GO-Line" and "Remove GO when Preset reached" to synchronize the MS-12 scaler.

There is a choice of two different status displays of the scalers, the "Status Window" displays all scaler contents, the time, and the rate of scaler 1, the "Ratemeter" can show in addition a graphic display of the rate of 4 selected scalers. The maximum of the graphic bars can be set using an edit field.

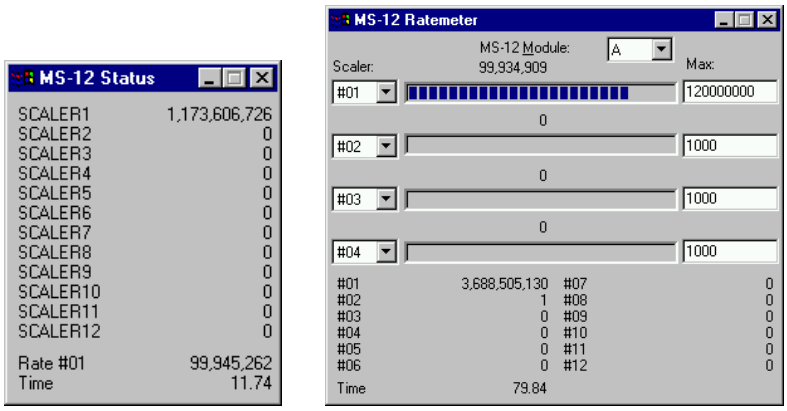

Figure 4.3: left: MS-12 Status window, right: Ratemeter

The scaler settings and contents are automatically saved into the spectra data files. A typical example is shown here:

```
[MS-12 A]                    ; indicates data of first MS-12 module
scactive=1                   ; belongs to system 1
scalnum=12                   ; 12 scalers used
sccontrol=4058               ; control register in hex
sccosel=0                    ; carry out select
scpreset0=0                  ; Scaler 1 Preset value
scpreset1=0                  ; Scaler 2 Preset value
scrtime=28.26                ; Real time in seconds (measured by software)
scrtstart=925311042.970      ; 04/28/1999 15:50:42
                             ; Start time in absolute seconds since 1. Jan 1970
sc#01=52516 ; SCALER1        ; Scaler contents...
sc#02=0     ; SCALER2
sc#03=0     ; SCALER3
sc#04=0     ; SCALER4
sc#05=0     ; SCALER5
sc#06=0     ; SCALER6
sc#07=0     ; SCALER7
sc#08=0     ; SCALER8
sc#09=0     ; SCALER9
sc#10=0     ; SCALER10
sc#11=0     ; SCALER11
sc#12=0     ; SCALER12
```

A detailed documentation of the DLL including examples and sourcecode for Visual Basic and LabVIEW is optional available.

4.1. The stand-alone MS-12 Control program WMS12.EXE

The WMS12.EXE is a standalone program for the MS-12 to perform measurements, write a log file and save data.

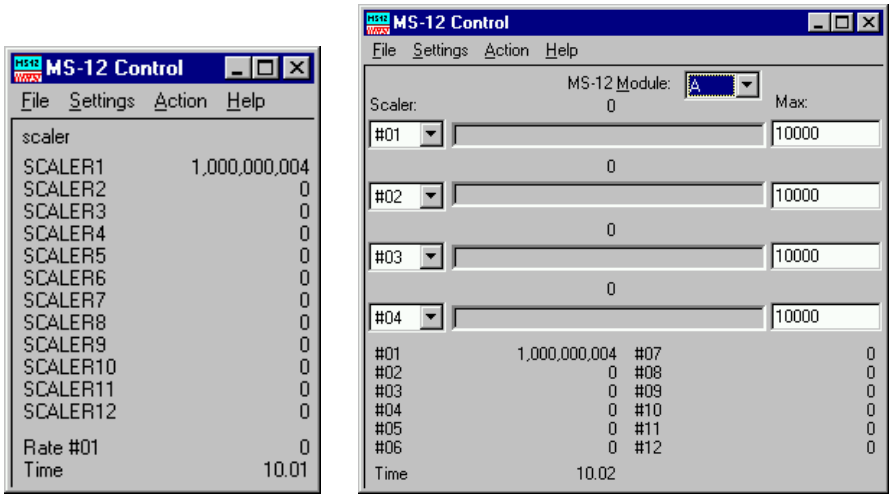

Figure 4.4: MS-12 Control program, left: status window, right: ratemeter

At program start the configuration file scaler.cfg (contains - for example - the number of MS-12 modules and port addresses, see Figure 4.5) and status file scaler.sts are loaded. It shows a status window that can be changed to a ratemeter display.

If a scaler.cfg file is not found, a default file will be written at the first time when the scaler settings dialog is finished by pressing the OK button. In the scaler.cfg file some settings and the hardware configuration is defined. Two lines in this file eventually must be edited by hand: the number of MS-12 modules by the line scdevices= and the port addresses in the line scbase= must be specified.

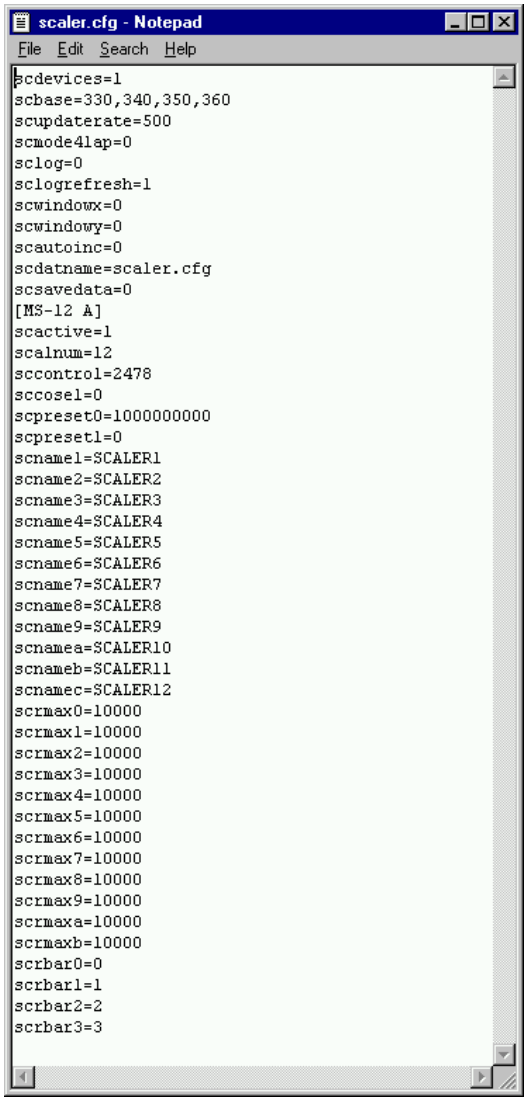

Figure 4.5: Sample Scaler.cfg file

In the following the several dialogs are described in detail:

Clicking in the File menu on the Data... item opens the Data Operations dialog box.

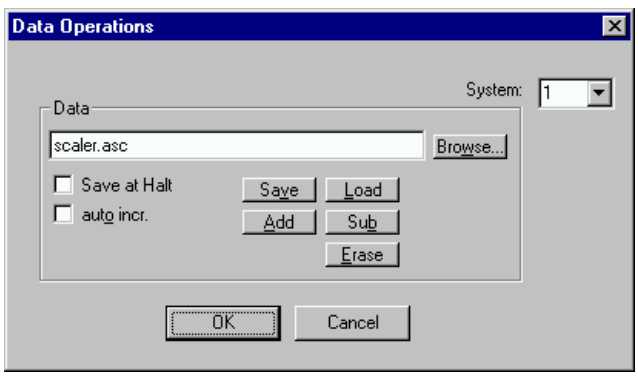

Figure 4.6: Data Operations dialog box

This dialog allows to edit the data filename and perform operations like Save, Load, Add, Subtract, and Erase. For more than one scalers make a choice using the **System** drop-down list box of the system containing a set of scalers as defined in the Scaler Settings. It is possible to save and load data or execute commands from a control file. Click the **Browse...** button to look for files. Two types of files can be loaded: ASCII files (extension .ASC) or control files (.CTL). The ASCII file contains settings and scaler data. The **Save** button saves the present data. The **Load** button loads data from a file. The **Add** button adds scaler data from a file to the actual scaler values. The **Sub** button subtracts scaler data contained in a file from the actual scaler values. Clicking the **Erase** button erases the actual scaler values. The **Save at Halt** checkbox enables automatic saving of data after stopping a measurement. The **auto incr.** checkbox enables automatic incrementing of filenames after each saving operation.

The Settings Menu contains commands for changing Scaler and Log settings. The Scaler Settings dialog is already described, see Fig. 4.2. The box describing the use of the GO-line in this dialog depends on the parameter **scmode4lap** defined in the default configuration file scaler.cfg.

The menu item Log... in the Settings menu opens the Log Settings Dialog.

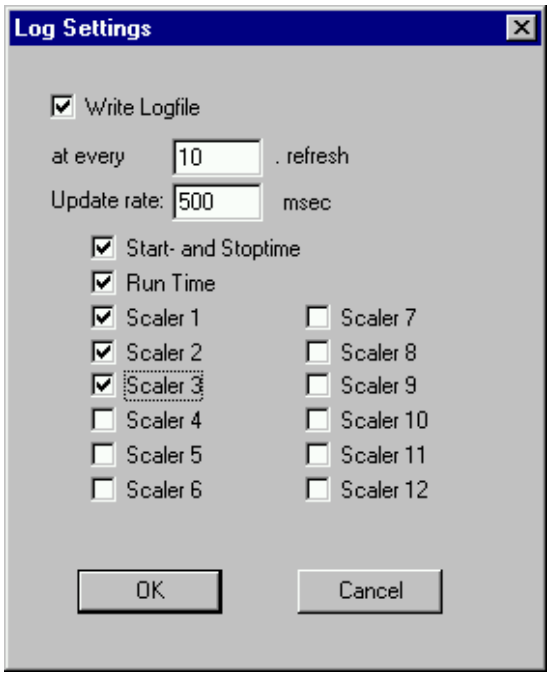

Figure 4.7: Log Settings dialog box

The **Write Logfile** checkbox enables log output into a file with actual name and extension .log. Specify how often a line is output by editing the field **at every . refresh** The **Update rate** in msec specifies how often the status is updated. The following checkboxes specify which data is logged: **Start- and Stoptime** outputs time and date of any start and stop action. **Run Time** is the time of actual acquisition measured by software. **Scaler 1** ... **Scaler 12** enable writing the respective values into the log file.

4.2. Control Language of WMS12.EXE

A sequence of commands that is stored in a file with extension .CTL can be executed by the WMS12.EXE program with the „**Load**“ command. A lot of these commands are already known as the configuration file scaler.cfg or the data files with extension .ASC contain such commands to set the parameters. Each command starts at the beginning of a new line with a typical keyword. Any further characters in a line may contain a value or a comment. Following methods are available to execute commands:

- Load the command file using the Load command in the file menu.
- Enable remote mode in the server and send commands via the serial connection. The COMCTL.DLL is necessary which is part of the optional available MCDLAN software.
- Open a DDE connection and send the commands via DDE as described in section 4.3. The application name for opening the DDE connection with the standard 7886 server program W7886.EXE is W7886, the topic is 7886-. Implemented are the DDE Execute to perform any command, and the DDE Request with items RANGE and DATA.
- Send the commands over a TCP/IP net using a remote shell and the optional available MCDLAN software. It is necessary to have a TCP/IP Winsock installed like the Trumpet winsockets and that the remote shell daemon program MCWNET is running. See the readme file on the installation disk.
- Send the commands via the DLL interface from LabVIEW, a Visual Basic program or any other application (software including the complete source code of the DLL and examples optional available).
- From your own Windows application, register a Windows message and then send the command as can be seen in the DLL source code.

The file scaler.cfg contains a complete list of commands for setting parameters. An example is:

```
scdevices=1                 ; Number of installed MS-12 modules
scbase=330,340,350,360      ; Port addresses of MS-12 modules (hex)
scupdaterate=500            ; Update rate in msec for status display
scmode4lap=0                ; Mode of GO line use: 1 = MCD4LAP, 0 = MPA-3 compatible
sclog=0                     ; Write log file
sclogrefresh=1              ; Write a line into the log file for every nth update
scwindowx=0                 ; Window left corner
scwindowy=0                 ; Window upper corner
scautoinc=0                 ; Auto increment data file
scdatname=test.asc          ; Name of data file
scsavedata=0                ; Save at Halt
[MS-12 A]                   ; Following section pertains to first MS-12 module
scactive=1                  ; Module is in system 1
scalnum=12                  ; Number of scalers used (max. 12)
sccontrol=78                ; Hex value of control register:
                            ; bit 1: output arm on GO line
                            ; bit 2: GO watch
                            ; bit 3: remove GO when preset reached
                            ; bit 4: Gate polarity, 1=active high
                            ; bit 5: enable Gate input
```

; bit 6: Load polarity, 1=active high
; bit 7: Load enable
; bit 10: Preset enable counter 0
; bit 11: Preset enable counter 1
; bit 13: Scaler 0 as Timer 10 ns
; bit 14: Enable 0 wait state transfer

sccosel=0 ; Counter 0 carry out select
; 0=Carry out, 1=D31, 2=D30, ... 15=D17

scpreset0=0 ; Preset for counter 0

scpreset1=0 ; Preset for counter 1

scname1=SCALER1 ; Scaler names...

scname2=SCALER2

scname3=SCALER3

scname4=SCALER4

scname5=SCALER5

scname6=SCALER6

scname7=SCALER7

scname8=SCALER8

scname9=SCALER9

scnamea=SCALER10

scnameb=SCALER11

scnamec=SCALER12

scrmax0=10000 ; Ratemeter maximum scales...

scrmax1=10000

scrmax2=10000

scrmax3=10000

scrmax4=10000

scrmax5=10000

scrmax6=10000

scrmax7=10000

scrmax8=10000

scrmax9=10000

scrmaxa=10000

scrmaxb=10000

scrbar0=0 ; Ratemeter bar selection...

scrbar1=1

scrbar2=2

scrbar3=3

Data files like scaler.asc or scaler.sts show in addition some data pertaining to the actual measurement:

scrtime=28.26 ; Real time in seconds (measured by software)

scrtstart=925311042.970 ; 04/28/1999 15:50:42
; Start time in absolute seconds since 1. Jan 1970

sc#01=52516 ; SCALER1 ; Scaler contents...

sc#02=0 ; SCALER2

sc#03=0 ; SCALER3

sc#04=0 ; SCALER4

sc#05=0 ; SCALER5

sc#06=0 ; SCALER6

sc#07=0 ; SCALER7

sc#08=0 ; SCALER8

sc#09=0 ; SCALER9

sc#10=0 ; SCALER10

sc#11=0 ; SCALER11

sc#12=0 ; SCALER12

The following commands perform actions and therefore usually are not included in the SCALER.CFG file:

start ; Clears the data and starts a new acquisition. Further
; execution of the .CTL file is suspended until measurements
; stops due to a preset.

start2 ; Clears and starts system 2. Further execution suspended (see start).

start3 ; Clears and starts system 3. Further execution suspended (see start).

start4 ; Clears and starts system 4. Further execution suspended (see start).

halt ; Stops acquisition of system 1 if running.

halt2 ; Stops acquisition of system 2 if running.

halt3 ; Stops acquisition of system 3 if running.

halt4 ; Stops acquisition of system 4 if running.

cont ; Continues acquisition of system 1. If a time preset is already reached,
; the time preset is prolongated by the value which was valid when the
; start command was executed. Further execution of the .CTL file is
; suspended (see start).

cont2 ; Continues acquisition of system 2 (see cont).

cont3 ; Continues acquisition of system 3 (see cont).

cont4 ; Continues acquisition of system 4 (see cont).

SC_A ; Sets actual module to SC_A for the rest of
; the controlfile.

SC_B ... S**C_D** ; Sets actual module to SC_B ... SC_D for the
; rest of the controlfile.

savedat ; Saves data of actual multichannel analyzer. An existing file
; is overwritten.

load ; Loads data; the filename must be
; specified before with a command datname=...

add ; Adds data; the filename must be
; specified before with a command datname=...

sub ; Subtracts data; the filename
; must be specified before with a command datname=...

eras ; Clears the data of system 1.

eras2 ; Clears the data of system 2.

eras3 ; Clears the data of system 3.

eras4 ; Clears the data of system 4.

exit ; Exits the WMS12 program

alert Message ; Displays a Messagebox containing Message and an OK
; button that must be pressed before execution can continue.

waitinfo 5000 Message; Displays a Messagebox containing Message, an OK
; and an END button. After the specified time (5000 msec)
; the Messagebox vanishes and execution continues. OK
; continues immediately, END escapes execution.

beep * ; Makes a beep. The character '*' may be replaced with
; '?', '!' or left empty. The corresponding sound is defined in the
; WIN.INI file in the [sounds] section.

delay 4000 ; Waits specified time (4000 msec = 4 sec).

run controlfile ; Runs a sequence of commands stored in controlfile. This
; command cannot be nested, i.e. from the controlfile called a
; second run command cannot be executed.

onstart command ; The command is executed always after a start action when the
; acquisition is already running. The command can be any valid
; command, also 'run controlfile' is possible.

onstart off ; Switches off the 'onstart' feature. Also a manual Stop command
; switches it off.

onstop command ; The command is executed always after a stop caused by a
; preset reached. This can be used to program measure
; cycles. For example the command 'onstop start' makes a
; loop of this kind.

onstop off ; Switches off the 'onstop' feature. Also a manual Stop command
; switches it off.

lastrun=5 ; Defines the file count for the last run in a measure cycle. After a
; file with this count or greater was saved with autoinc on, instead
; of the 'onstop command' the 'onlast command' is executed.

numruns=5 ; Defines the file count for the last run in a measure cycle. The
; last count is the present one plus the numruns number.After a
; file with this count was saved with autoinc on, instead of the
; 'onstop command' the 'onlast command' is executed.

onlast command ; The command is executed after a stop caused by a preset
; reached or trigger instead of the 'onstop command', when the
; last file count is reached with autoinc on. This can be used to
; finish programmed measure cycles.

onlast off ; Switches off the 'onlast' feature. Also a manual Stop command
; switches it off.

exec program ; Executes a program. Example:
; exec notepad test.ctl opens the notepad editor and loads
; test.ctl.

The execution of a control file can be finished from with any Halt command from the Action menu.

4.3. Controlling the WMS12.EXE via DDE

The WMS12 program can be a server for DDE (Dynamic Data Exchange). Many Windows software packages can use the DDE standard protocols to communicate with other Windows programs, for example GRAMS, FAMOS or LABView. In the following the DDE capabilities of the WMS12 program are described together with a demo VI („Virtual Instrument“) for LabVIEW. It is not recommended to use the DDE protocol for LabVIEW, as also a DLL interface is available that is much faster. The following should be seen as a general description of the DDE conversation capabilities of the WMS12 program.

4.3.1. Open Conversation

application: WMS12
topic: MS12

Any application that wants to be a client of a DDE server, must open the conversation first by specifying an application and a topic name. The application name is WMS12 and the topic is MS12.

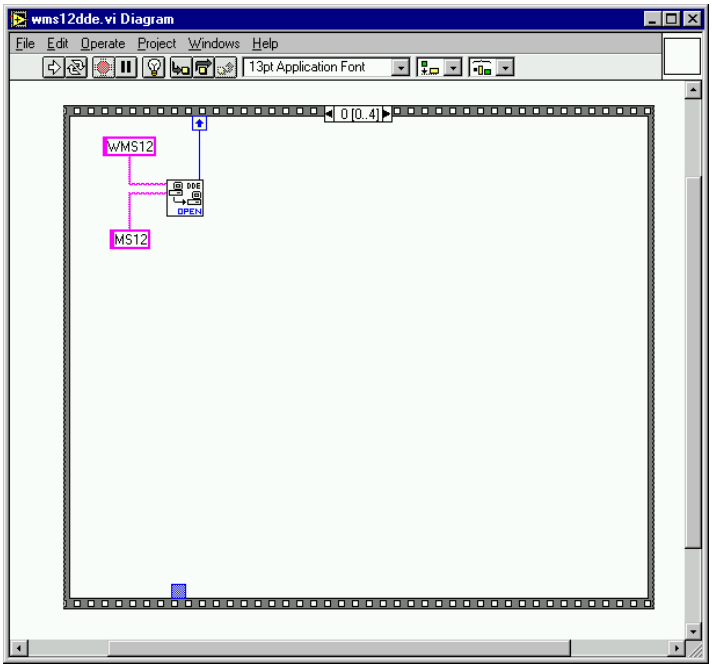

Figure 4.8: Opening the DDE conversation with the WMS12.EXE in LabVIEW

4.3.2. DDE Execute

The DDE Execute command can be used to perform any action of the WMS12 program. Any of the Control command lines described in section 4.2 can be used. For example a sequence of control commands saved in a file TEST.CTL can be executed by specifying the command

RUN TEST.CTL

The WMS12 program then executes the command and, after finishing, it sends an Acknowledge message to the DDE client. This can be used to synchronize the actions in both applications.

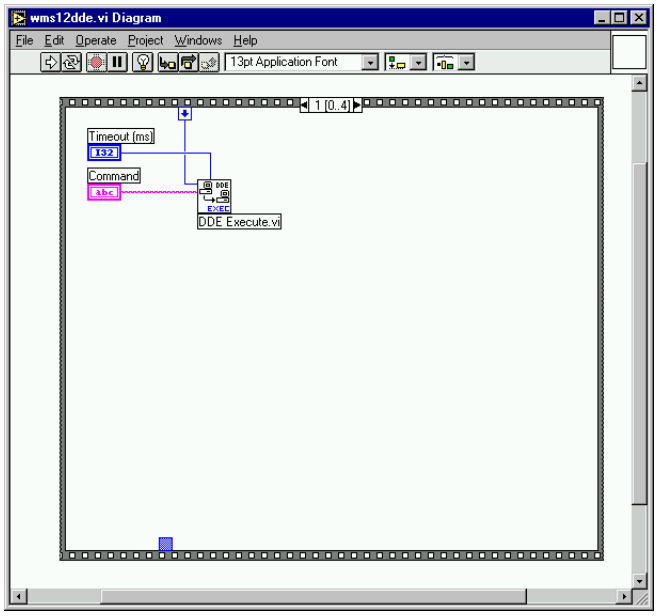

Figure 4.9: Executing a WMS12 command from a LabVIEW application

4.3.3. DDE Request

The DDE Request is a message exchange to obtain the value of a specified item. Only two items are defined for DDE request up to now: RANGE and DATA. The value is obtained as an ASCII string, i.e. it must be converted by the client to get the numbers. All other parameters concerning the WMS12 Setup can be obtained by the client application by reading and evaluating the configuration file.

RANGE

The RANGE item can be used to obtain the total number of data.

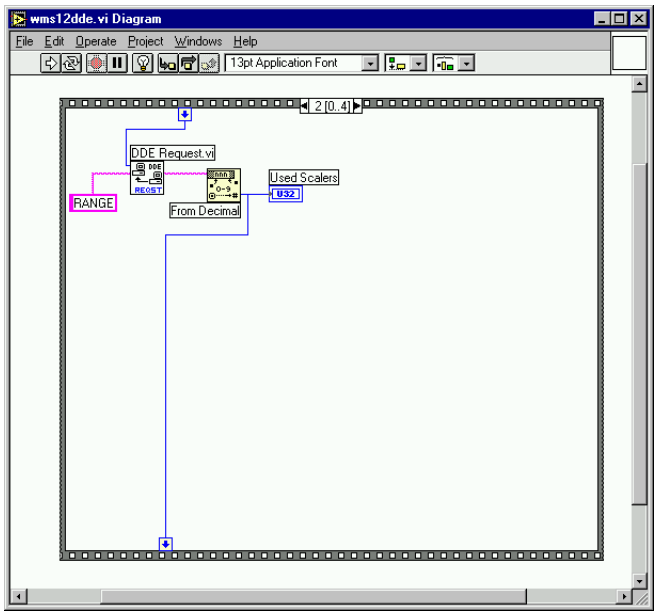

Figure 4.10: Getting the total number of data with LabVIEW

DATA

With the DATA item the data is obtained. The value of this item is a multiline string that contains in each line a decimal number as an ASCII string.

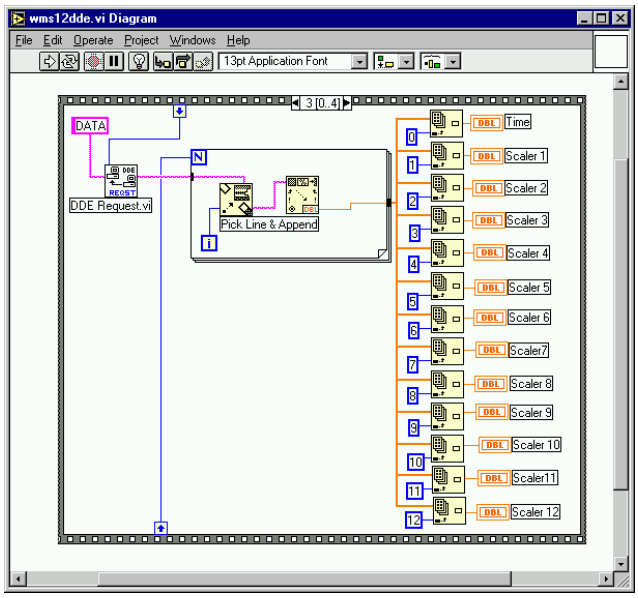

Figure 4.11: Getting the data with LabVIEW

4.3.4. Close Conversation

After finishing the DDE communication with the WMS12 program, it must be closed.

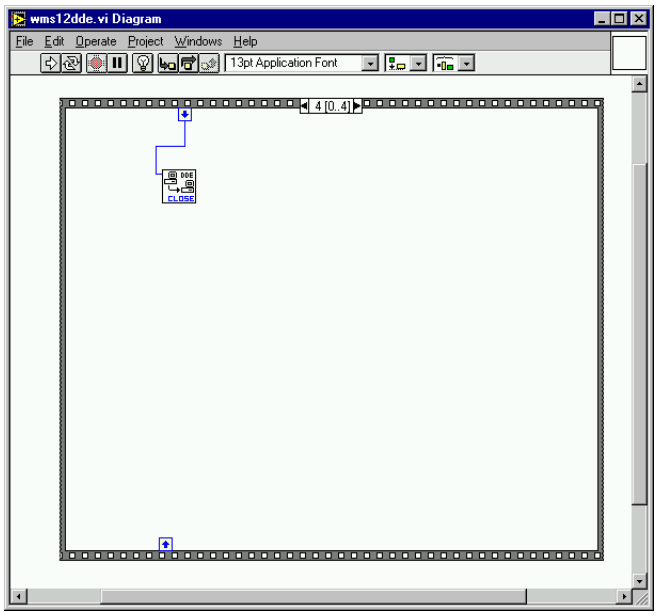

Figure 4.12: Closing the DDE communication in LabVIEW

The following figure shows the „Panel“ of the described VI for LabVIEW.

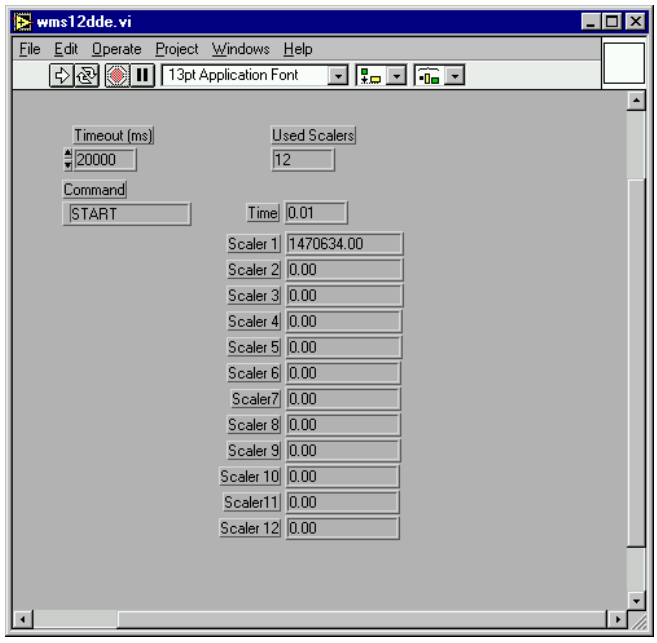

Figure 4.13: Control Panel of the demo VI for LabVIEW

5. Programming

5.1. Register Specification

The MS-12 is controlled via input and output to some I/O port registers. The base address is defined by the rotary switch setting (ref. chapter Hardware Installation; standard: B corresponding to 330h).

Address BASE +	Width [bits]	Write Operation	Read Operation	Comment
0	16	CONTROL	CONTROL	
1	8	ROUTE	ROUTE	selects capture register no. for read
2	16	PRESET_LO_0	PRESET_LO_0	lower word
3	8		STATUS	
4	16	PRESET_HI_0	PRESET_HI_0	upper word
5	8			
6	16	PRESET_LO_1	PRESET_LO_1	lower word
7	8			
8	16	PRESET_HI_1	PRESET_HI_1	upper word
9	8			
10	16		CAPTURE_LO_OUT	lower word
11	8			
12	16		CAPTURE_HI_OUT	upper word

Figure 5.1: Register Overview

Control register
Base + 0

The control register is accessed by a 16 bit output or input to the base address + 0. The bits in the control register are defined and used as follows:

Bit	Name	Meaning
0	ARM	Arm Scaler card.
1	GO_ARM	Outputs ARM onto GO-line.
2	GO_WATCH	Count when GO == TRUE only.
3	GO_PRESET	Remove GO when preset reached.
4	GATE_POL	Ext. GATE polarity: 0 = act. Low; 1 = act. High
5	GATE_ENB	Enable Common GATE input
6	*reserved*	*must be 1*
7	LOAD_ENB	Ext. LOAD enable
8	LOAD	Load Counter Presets by Software
9	CAPTURE	Capture all Counter values
10	PRESET_EN0	Preset enable Scaler 0
11	PRESET_EN1	Preset enable Scaler 1
12	PRESET_CLR	Clear Preset reached
13	TIMER_EN	Scaler 0 as Timer @ 10 ns
14	MODE4LAP	0 = Halt when GO == FALSE (level sensitive); 1 = Stop (finish counting) on falling edge of GO
15	RESET	Reset system

Figure 5.2: Control register

Route register
Base + 1

The Route register is accessed by an 8 bit output or input to the base address + 1. The bits in the Route register are defined and used as follows:

Bit	Name (Write)	Meaning
0	ROUTE[3:0]	selects capture (scaler output) register no.
1		"ROUTE" for read transfer
2		
3		
4	CO_SEL[3:0]	selects which data bit is used for CO[0]: 0=CO,
5		1=D[30], 2=D[29],...15=D[16]
6		
7		

Figure 5.3: Route register

Status register
Base + 3

The Status register is accessed by a 8 bit input from the base address + 3. The bits in the Status register are defined and used as follows:

Bit	Name (Read)	Meaning
0	PRESET	preset_reached
1	GO_IN	GO input
2	GATE	GATE input
3	LOAD	LOAD input
4	VERSION	FPGA Version number
5		
6		
7		

Figure 5.4: Status register

PRESET_LO_0
Base + 2

The lower word of the scaler 0 preset is input and output at this port address. When enabled, the scaler 0 starts counting from this value and stops at FFFFFFFFh.

PRESET_HI_0
Base + 4

The higher word of the scaler 0 preset is input and output at this port address.

PRESET_LO_1
Base + 6

The lowerr word of the scaler 1 preset is input and output at this port address. When enabled, the scaler 1 starts counting from this value and stops at FFFFFFFFh.

PRESET_HI_1
Base + 8

The higher word of the scaler 1 preset is input and output at this port address.

CAPTURE_LO_OUT
Base + 10

The lower word of the scaler selected by the ROUTE register is input from this port address.

CAPTURE_HI_OUT
Base + 12

The higher word of the scaler selected by the ROUTE register is input from this port address.

6. Appendix

6.1. Absolute maximum ratings

Supply voltage (VCC):	(PC power supply)	-0.5 to 6.0V
Input voltage (any port):		-0.5 to VCC + 0.5V
DC Input current (any port):		±20mA

6.2. Recommended operating conditions

Supply voltage:	(PC power supply)	5V
Temperature range:		0 to 50°C
GO Line load:		min. 1kΩ to VCC
		min. 2kΩ to GND

6.3. DC characteristics

Input HIGH voltage[1]:		min. 1.75V
Input LOW voltage:		max. 0.9V
Output HIGH voltage:	(I_{OH} = -12mA)	min. 2.4V
	(I_{OH} = -500µA)	min. 2.8V
Output LOW voltage:	(I_{OL} = 16mA)	max. 0.45V
	(I_{OL} = 1.5mA)	max. 0.35V

6.4. AC characteristics

Input frequency:	(any count input)	max. 100MHz
Input LOW time:	(any count input)	min. 2.5ns
Input HIGH time:	(any count input)	min. 2.5ns
Delays:	GO_{INPUT} → counter ON	35 ± 5ns
	GO_{INPUT} → counter OFF	35 ± 5ns
	PRESET REACHED → GO_{OUTPUT}	22 ± 2ns
	PRESET REACHED → counter OFF	30ns
	COMMON $GATE_{INPUT}$ → COUNT DISABLE	35 ± 5ns
	COMMON $GATE_{INPUT}$ → COUNT ENABLE	35 ± 5ns
	INDIVIDUAL $GATE_{INPUT}$ → COUNT DISABLE	25 ± 5ns
	INDIVIDUAL $GATE_{INPUT}$ → COUNT ENABLE	25 ± 5ns

[1] Note: input and output voltages are measured at the internal logic pads not at the external connectors. Thus, the corresponding pull and series resistors must be considered to get the external voltages

6.5. I/O Signals

COUNT inputs:

Location: ..... 37-pin female D-SUB

Polarity: ..... rising edge senstiv

Input impedance: ..... ≤ 1kΩ[2] to GND

COMMON GATE:

Location: ..... 37-pin female D-SUB

Polarity: ..... programmable

Input impedance: ..... ≤ 1kΩ[3] to GND

LOAD input:

Location: ..... 37-pin female D-SUB

Polarity: ..... active HIGH

Input impedance: ..... ≤ 1kΩ[4] to GND

Individual GATES:

Location: ..... 16 pin four-walled header
..... 15-pin female D-SUB

Polarity: ..... active LOW

Input impedance: ..... 4.7kΩ to VCC

'GO'-line

Location: ..... 37-pin female D-SUB
..... 2 pin header

Polarity: ..... active HIGH

Connector type: 2 pin header: ..... LUMBERG 2,5 MSFW 2(MBX)
suitable socket connector: ..... LUMBERG 2,5 MBX 2

Line Type : ..... open drain / wired-AND

Input impedance: ..... 100kΩ to VCC

Series resistor: between connector and logic 22Ω

CO 0 & 1 outputs:

Location: ..... 37-pin female D-SUB

Polarity: (carry out of counters) ..... active LOW

Pulse width: (int. pulse stretching) ..... min. 100ns

Option: CO 0 programmable output: ..... carry out or data bits 17…31

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[2] Note: depends on user mountable resistor networks in SIL sockets. SIL resistors are paralleled by 1kΩ

[3] Note: depends on user mountable resistor networks in SIL sockets. SIL resistors are paralleled by 1kΩ

[4] Note: depends on user mountable resistor networks in SIL sockets. SIL resistors are paralleled by 1kΩ

6.6. Physical

Size:	short ISA bus card	166 x 97mm
Weight:	(excl. accessories)	125g