66. Right-click on **Events** at the very top of the event sequence and click **Evaluate event** in the trips and events menu.

A new evaluate event will be added in a second event sequence, see Figure 72.

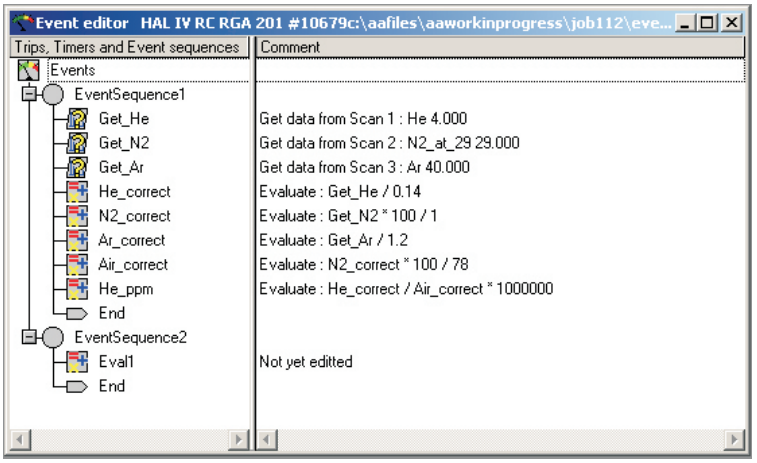

Figure 72 Event sequence with second sequence

67. Double click on **Eval1**.

The **Evaluate expression editor** is displayed.

68. Enter the name **Ar_per** and the expression **Equals= Ar_correct/Air_correct * 100**.

See Figure 73.

The resultant event sequence is shown in Figure 74.

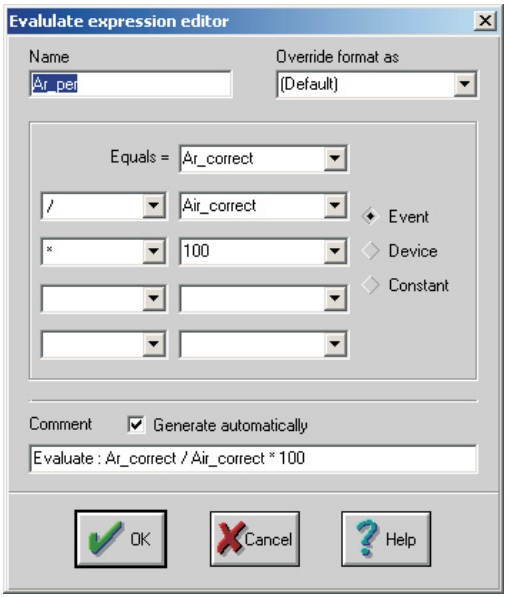

Figure 73 Evaluate expression editor, Ar_per

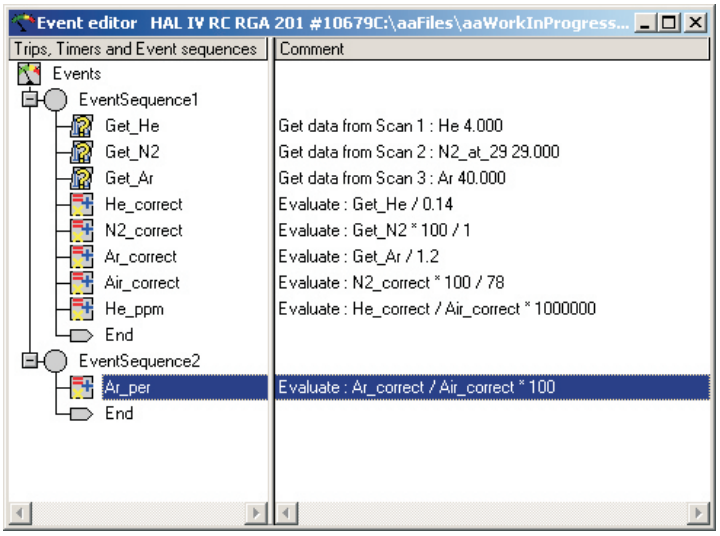

Figure 74 Event sequence with Ar_per event

69. Right-click on **Events** at the very top of the event sequence and click **f(x)input device** in the trips and events menu**.**

The event sequence will look like the one shown in Figure 75.

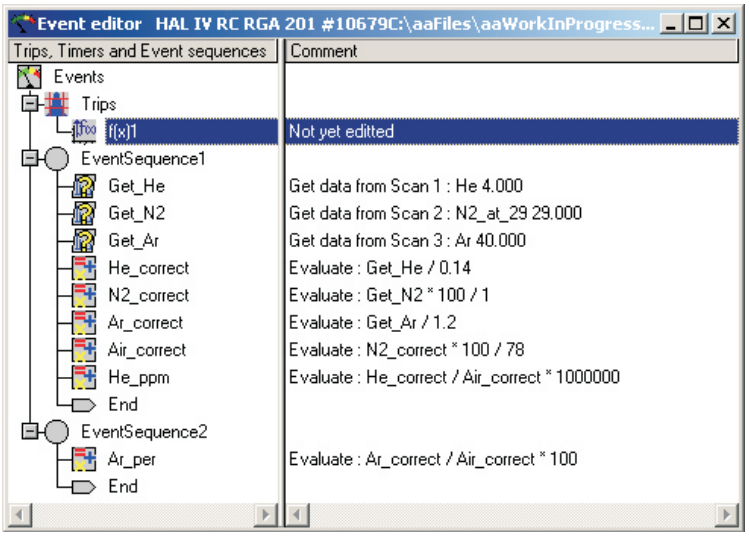

Figure 75 Event sequence with f(x)1 added

70. Double click on **f(x)1**.

    The **f(x) input device editor** is displayed.

71. In the Name: type ***ppmHe***. In the **Scan** drop down list box select **Scan 4:He_ppm**. In the **Run event sequence** drop down list box select **EventSequence1**. In the **Get input value from** drop down list box select **He_ppm**.

    See Figure 76.

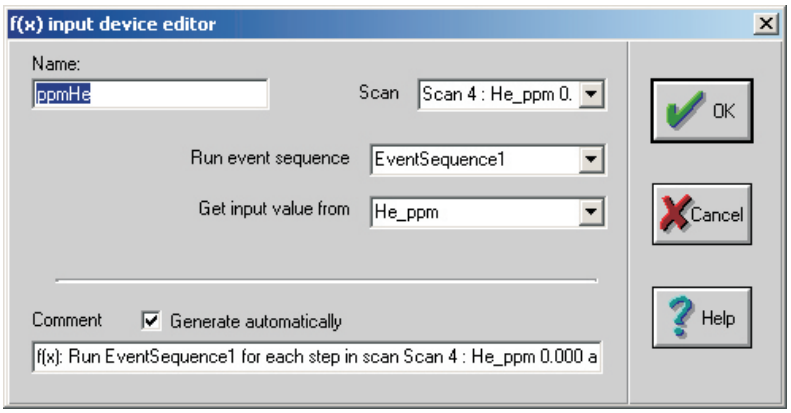

Figure 76 f(x) input device editor, ppm_He

72.	Click the **OK** button.	**f(x)1** will now be re-named **ppmHe**.
73.	In the event sequence right-click on **ppmHe** and click **f(x)input device** in the trips and events menu**.**	A new f(x)input device named **f(x)1** will added to the event sequence below **ppmHe**.
74.	Double click on **f(x)1**.	The **f(x) input device editor** is displayed.
75.	In the **Name:** text box type ***per_Ar***. In the **Scan** drop down list box select S**can 5:Ar_per**. In the **Run event sequence** drop down list box select **Ar_per**. In the **Get input value from** drop down list box select **Ar_per.**	See Figure 77.
76.	Click **OK**.	The event sequence will look like the one shown in Figure 78.

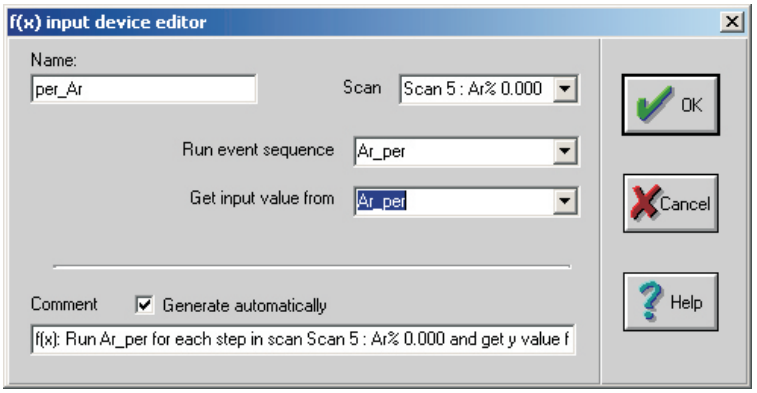

Figure 77 f(x) input device editor, Ar_per

EventSequence2 is synonymous with Ar_per because Ar_per is the first step of the sequence. If there were more than two steps Run event sequence would be the first step. Get input value from would be the Evaluate event that calculates the final value.

Get Input value from does not have to be the last step the sequence could continue to say output the ppm concentration to an analog output.

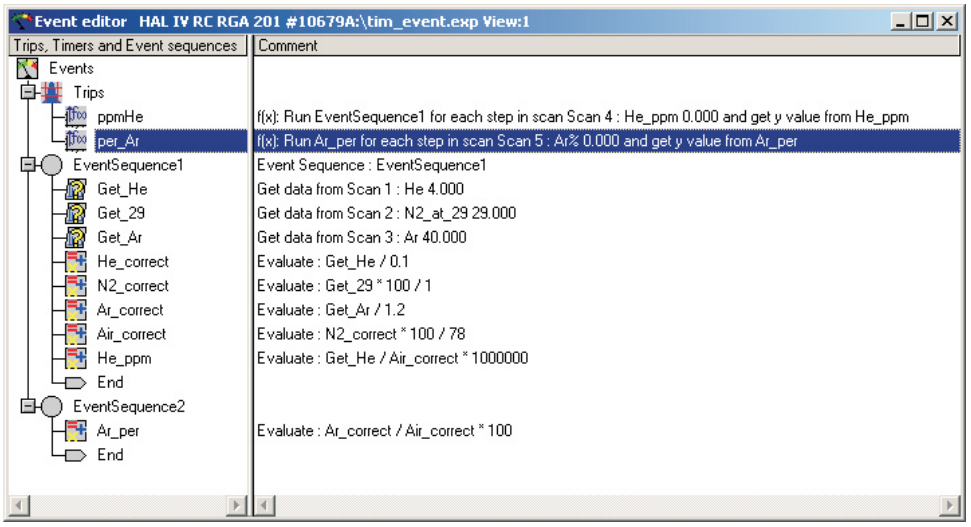

Figure 78 Completed event sequence

When the experiment file is run all the instructions are down loaded to the mass spectrometer Interface Unit via the serial communications link. The mass spectrometer hardware is then set to the values defined in the Global Environment (accessed via the Global RGA box in the scan tree).

When the scan run it measures scans 1, 2 and 3 in the normal way. After scan 3 has been run it runs scan 4. The scan 4 scan device is set to none, so the mass to be measured by the instrument is not set. Instead of reading a value from the detector the event sequence associated with scan 4 is run in the f(x) input device editor. This is event sequence 1.

The data events get the latest readings from scans 1, 2 and 3 which have just been measured. The calculations are performed by the evaluate events with the ppm concentration of Helium being left in He_ppm. The event sequence then stops, returning to the f(x) input in scan 4. The f(x) input fetches the result from He_ppm and saves it with the scan data, in exactly the same way a reading from the SEM or Faraday detector would be saved.

Next scan 5 runs. The scan 5 f(x) input runs the event sequence Ar_ppm, which calculates the ppm of Argon based on the values already fetched by data and evaluate events used to calculate the ppm concentration of helium. The value in Ar_ppm is returned to the f(x) input of scan 5.

3.3 Overriding the built in protection trips.

The Interface Unit has a number of features designed to protect the instrument from damage.

The external input **inhibit** provides an interlock with pressure gauges or turbo pump controllers. This should be wired as a fail-safe contact closure to 0V. If the input becomes open-circuit then the protection built in to the IU software will abort the scan and place HT supplies, such as the multiplier HT voltage, into a safe state.

WARNING

Do not rely on any protection features to protect operators from electric shock. Disconnect the instrument from the mains supply before carrying out any maintenance operation.

The high voltage supplies switched off by the IU protection system are designed to protect the instrument, not the operator! To ensure all high voltages are removed, switch the instrument off and unplug it from the mains supply.

RGA (Residual Gas Analysis) systems have a **ptrip** input, which monitors the pressure in the source. The ion source emission current must have reached a steady state for the **ptrip** to operate so, the filament(s) must be switched on. The **ptrip** will also activate if the RF Head is disconnected from the quadrupole mass spectrometer gauge. In a process environment it may be undesirable to abort the scan if these conditions occur. The **protection** device allows built-in protection to be disabled. If protection is disabled an effective alternative must be provided by the user.

If the **protection** device just allowed the protection to be turned off and on there would be the risk of the built-in protection inadvertently being left disabled due to a logical error or oversight in an event sequence. Therefore, the **protection** device disables built-in protection for a specified period of time. For instance setting **protection** to 5 disables protection for five seconds.

A Set event can be used to set the **protection** device. **protection** can be set to the nearest millisecond (0.001s). Once set the **protection** device starts counting down to zero in 1 millisecond steps. The **protection** device should be set to the shortest period practical and should be reset periodically. If a loop in an Event Sequence is expected to take about 100ms to execute then set **protection** to 0.2

The following example disables built-in protection during a scan. If the external trip input inhibit or ptrip occurs the scan is paused and the Interface Unit set in a safe state (disabled). When both trip inputs are clear (zero) the scan resumes.

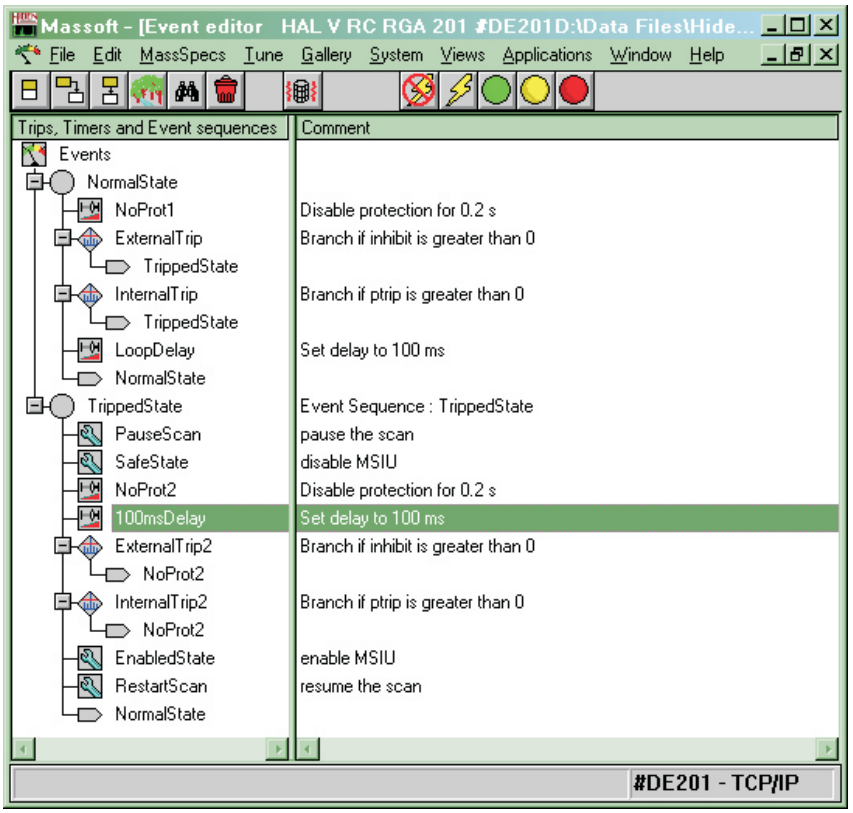

Figure 79 Event sequence, disable protection

Both loops include a step to ensure that **protection** never reaches zero. NoProt1 and NoProt2 are the same.

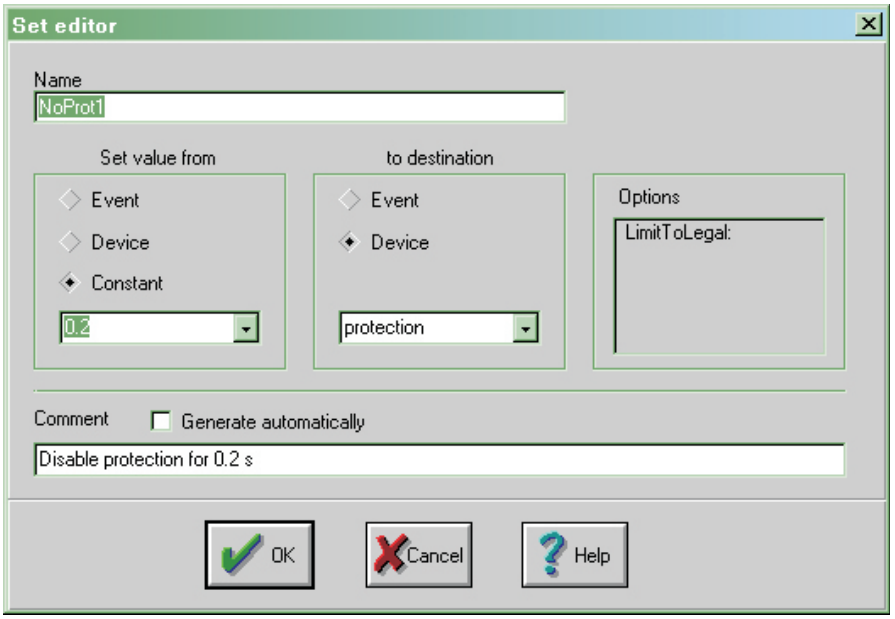

Figure 80 Set editor, disable protection

The Command events all use standard commands from the drop down list.

The sequence shown in Figure 79 could be improved by introducing a delay between EnabledState and RestartScan to allow the ion source emission to stabilise. Ideally, this would be equal to the mode-change-delay. This would require a third loop, because inhibit and ptrip would need to be checked during the delay.

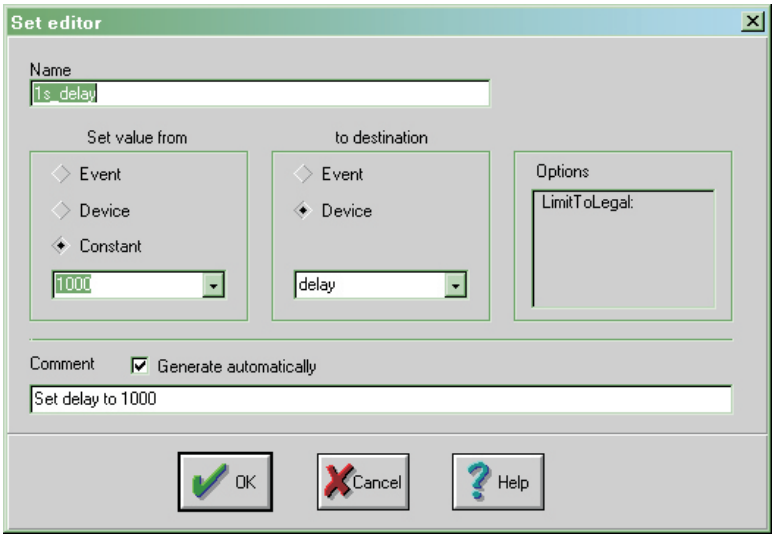

Figure 81 Set editor, delay

3.4 Stopping and Starting a scan

The following sequence monitors an IO line and uses it to stop and start a scan. This makes use of the **Automatic scan restart** option in the **Scan structure cycles** dialog box.

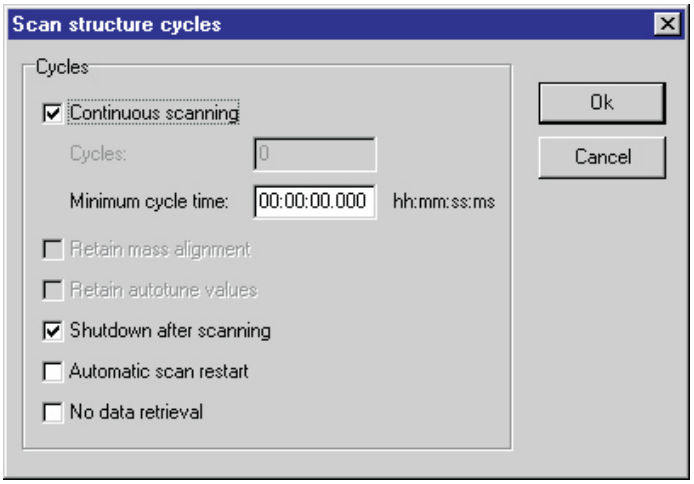

Figure 82 Scan structure dialog box

The event sequence can monitor an IO line and use this to send a command to stop scanning. With the **Automatic scan restart** option set MASsoft will, as soon as it detects the end of the data from the previous scan, automatically start a new scan, giving it the next file name in sequence. DDE links to the file are maintained.

To prevent the scan starting until signalled by the IO line the scan is immediately placed in the Pause state; this can be done in the same command that stops the scan:

sset state Abort:Pause:

The Pause: state persists through the restart.

When the IO line signals that the scan must restart the command:

sset state

clears the Pause:

A separate sequence that runs when the scan is setup places the scan in the Pause: state before the first run.

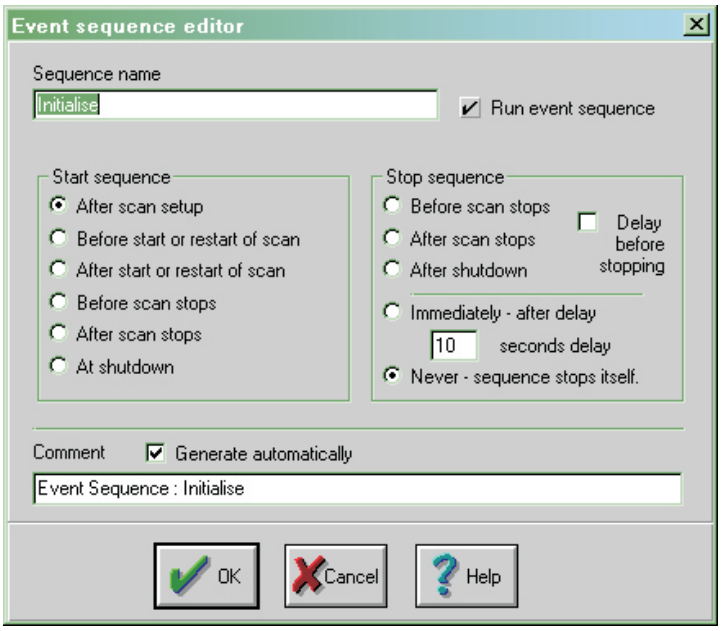

Figure 83 Event sequence editor, initialise

Pausing the scan is a standard command, as shown in Figure 84.

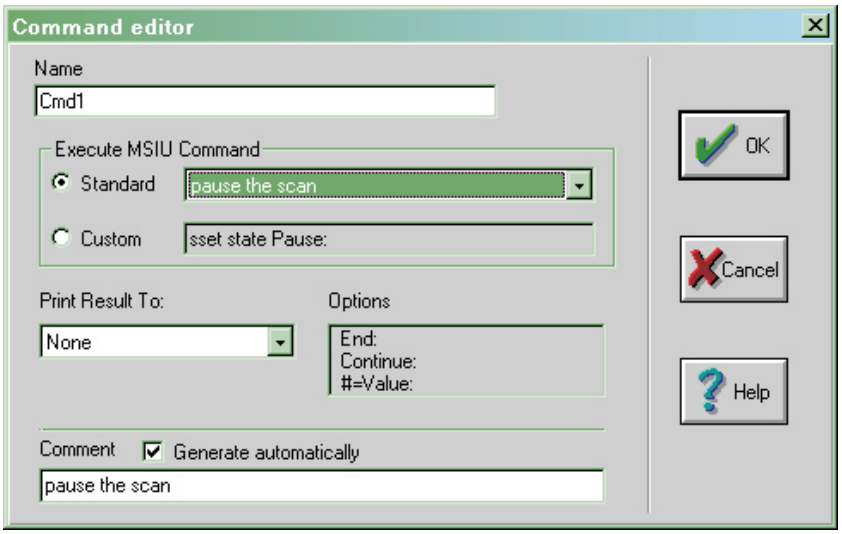

Figure 84 Command editor, pause the scan

The main sequence runs as normal.

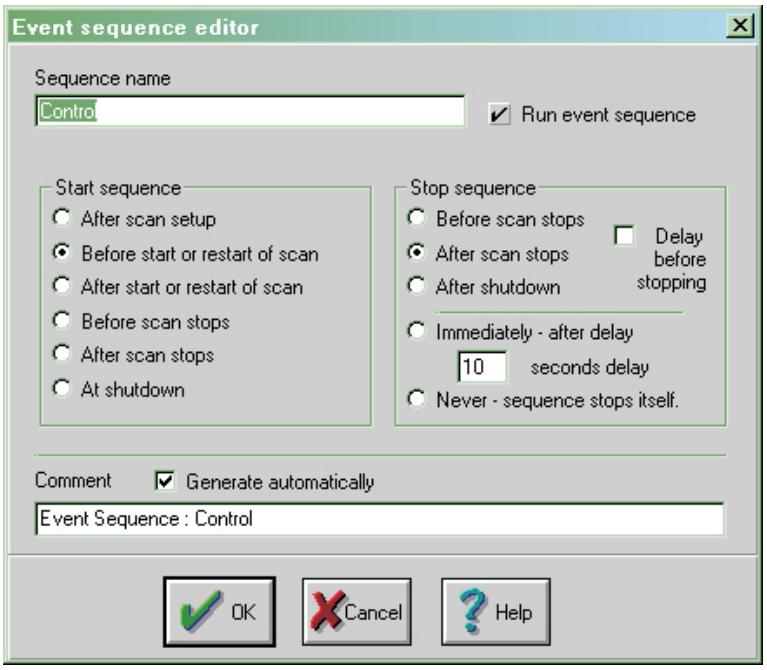

Figure 85 Event sequence editor, control

Most of the functions of these steps can be read from the comments in the Event Sequence as shown in Figure 86.

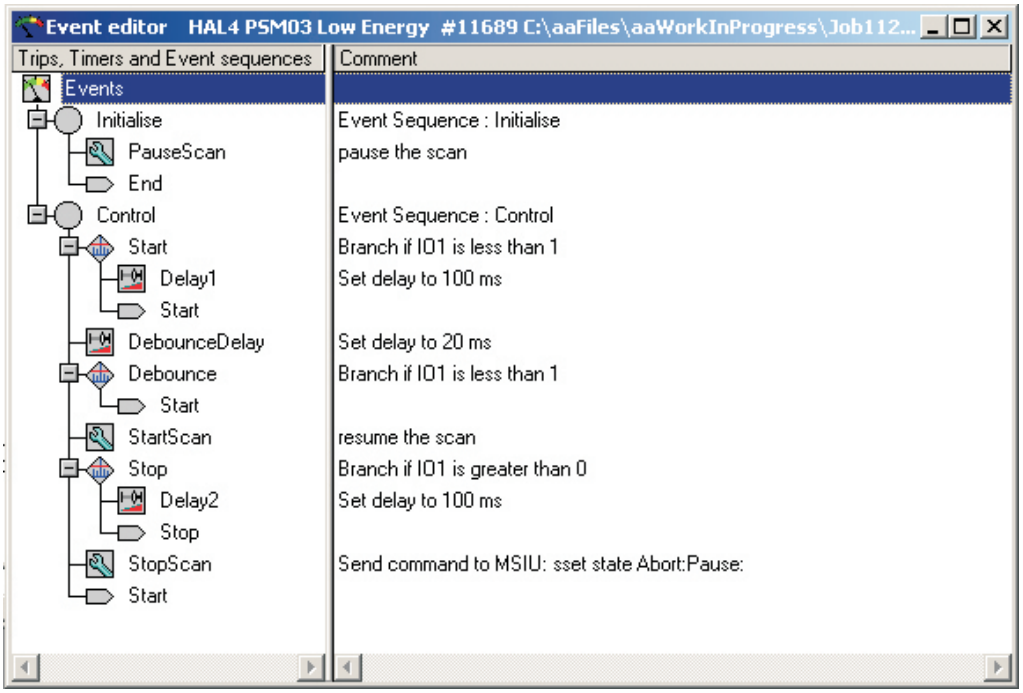

Figure 86 Event sequence, comments

The function of Delay1 and Delay2 is to slow down the execution of their associated loops. This is to allow the Interface Unit more time for other functions, like acquiring the data.

DebounceDelay and Debounce ensure IO1 is still '1' 20ms after it changed. This prevents false starts immediately after the scan is stopped if a relay is used to activate the input. Relays are prone to contact bounce – the contacts open and shut very rapidly for a few milliseconds after they change state.

StartScan is the standard command

sset state

which clears Pause:

StopScan is not a standard command:

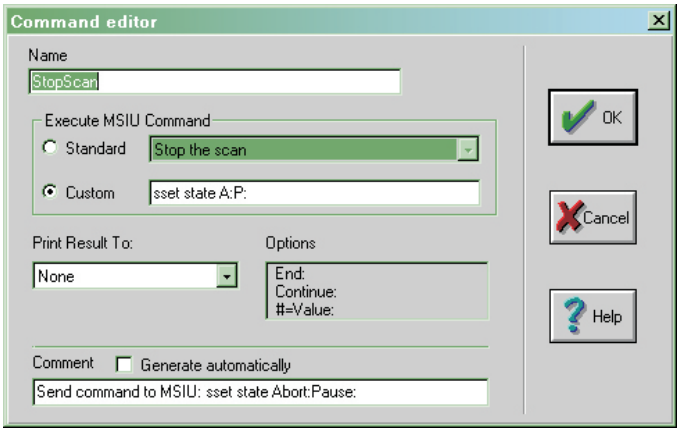

Figure 87 Command editor, Stop Scan

This command both aborts the scan and puts the scan in the Pause: state, ready for the next run.

sset state Abort:Pause: which to fit the maximum command length is abbreviated to:

sset state A:P:

The Pause: state persists through the restart.

The sequence jumps back to Start. It remains running until the Stop or Abort buttons on the toolbar are clicked, or until an external or internal trip stops the scan, in which case the error message shown in Figure 88 is displayed.

Figure 88 Scan Editor, acquisition stopped

Clicking the **OK** button will cause the dialog box shown in Figure 89 to be displayed.

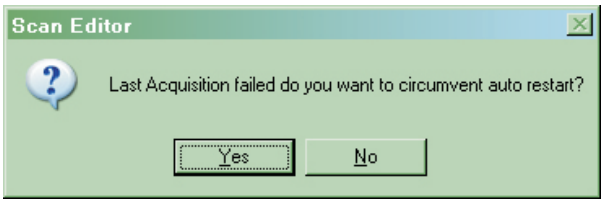

Figure 89 Scan Editor, acquisition failed

This might well be unacceptable in a process environment, in which case the user would want to incorporate the in-built protection over-ride features described in the previous section.

3.4.1 Start with built-in protection over-ridden

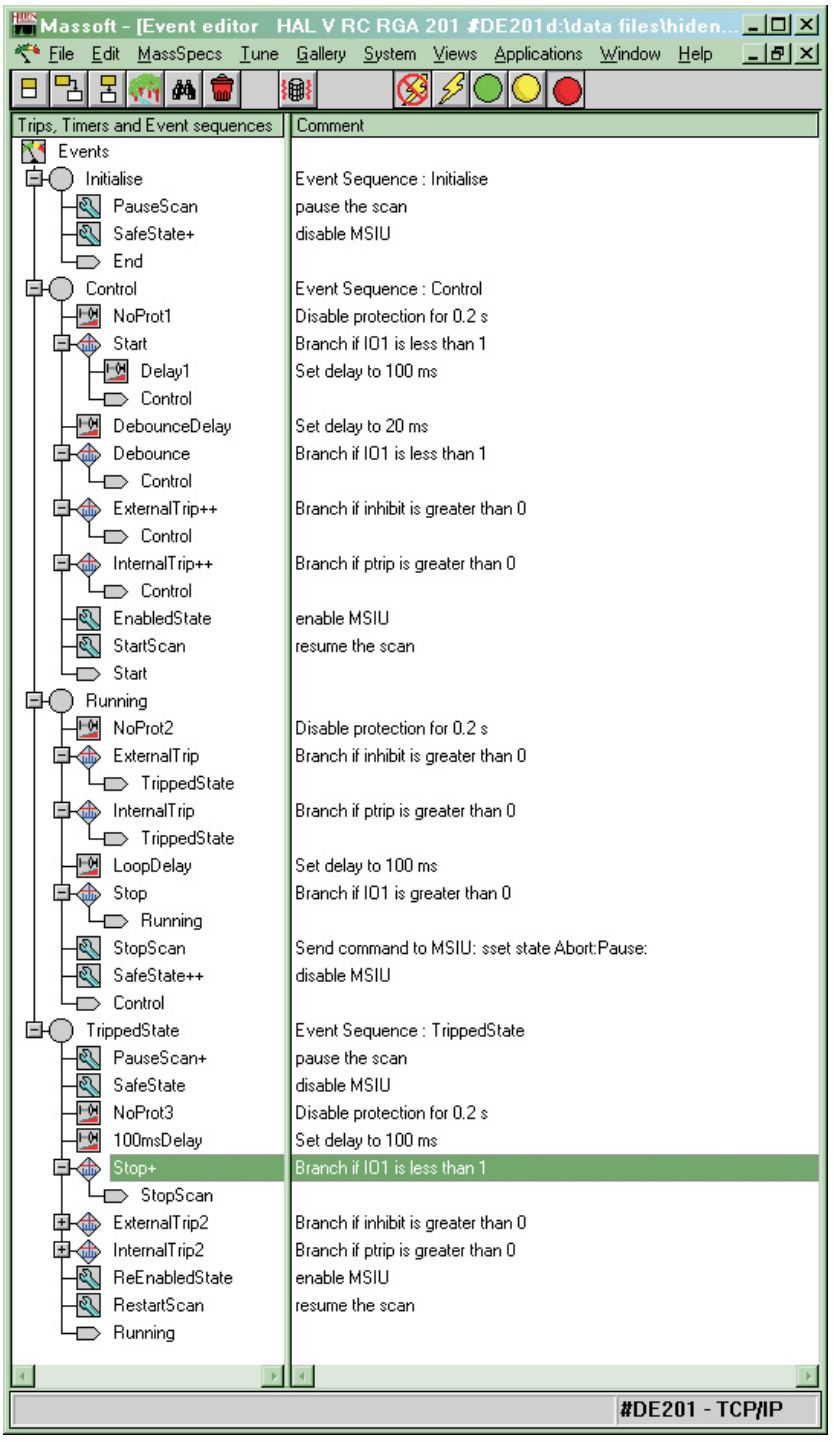

Figure 90 Starting with protection over-ridden

While in the Control loop the scan is paused and the Interface Unit is disabled. The sequence will not start the scan if either of the trips are active. The Running loop monitors the trip inputs and branches to TrippedState if a trip occurs. TrippedState exits back to Running if the trips clear or to Control if IO1 returns to 0.

3.4.2 Starting from a pulse

This sequence was designed to start from a pulse and run for a fixed number of cycles, then perform an **Automatic scan restart:**.

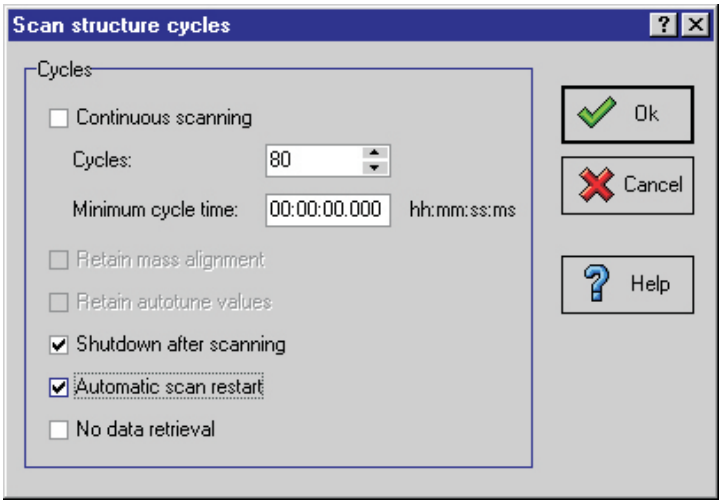

Figure 91 Scan structure cycles, 80 cycles

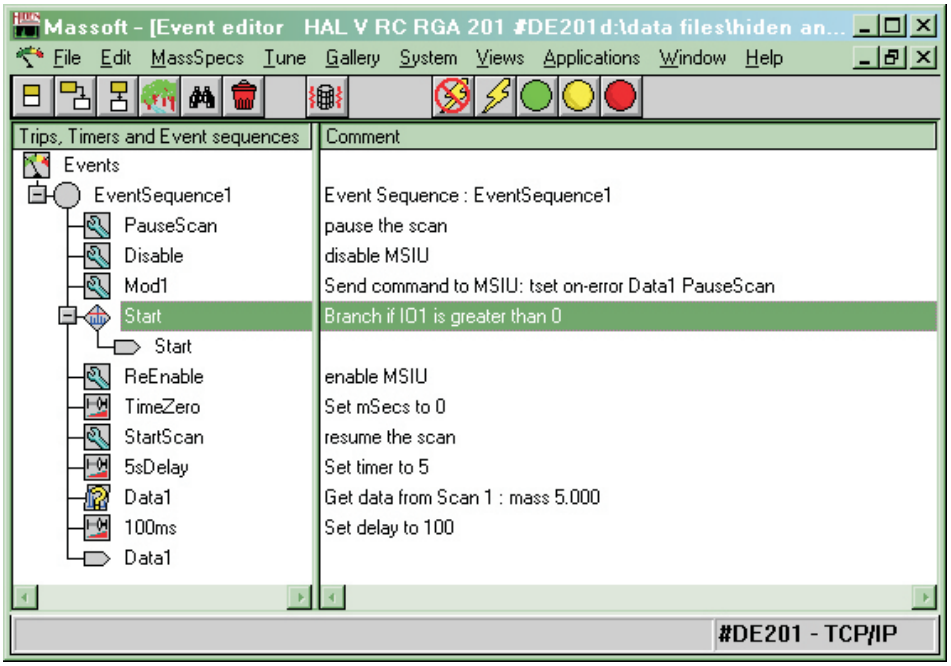

Figure 92 Event sequence, pulse start

PauseScan sends the standard command

sset state Pause:

to pause data acquisition.

Disable sends the standard command

l999 enable 0

to disable the instrument, the SEM HT is switched off, the filaments are switched off (the MASsoft status bar will still show them as on).

Mod1 modifies the sequence. It sets the on-error handler of the Data Event Data1. If there is an error Data1 will branch to PauseScan.

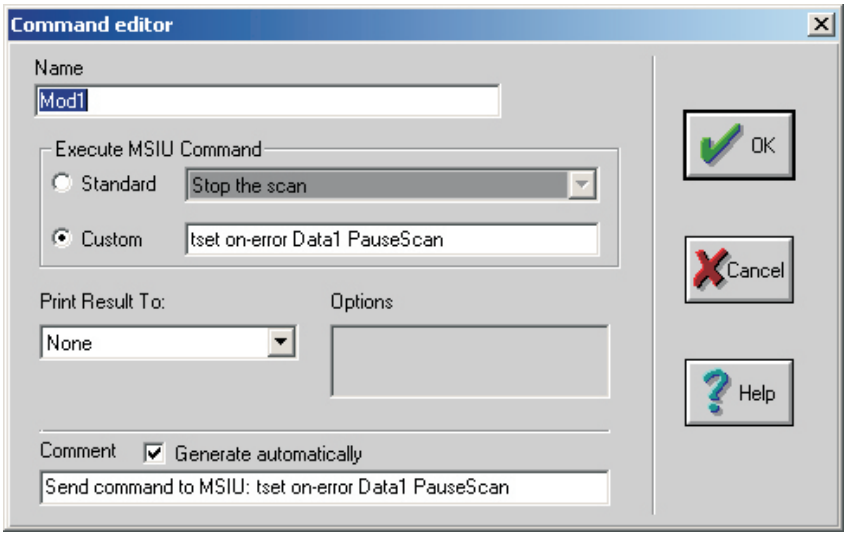

Figure 93 Command editor, Mod1

Data1 has the Scanning: option set as shown in Figure 94.

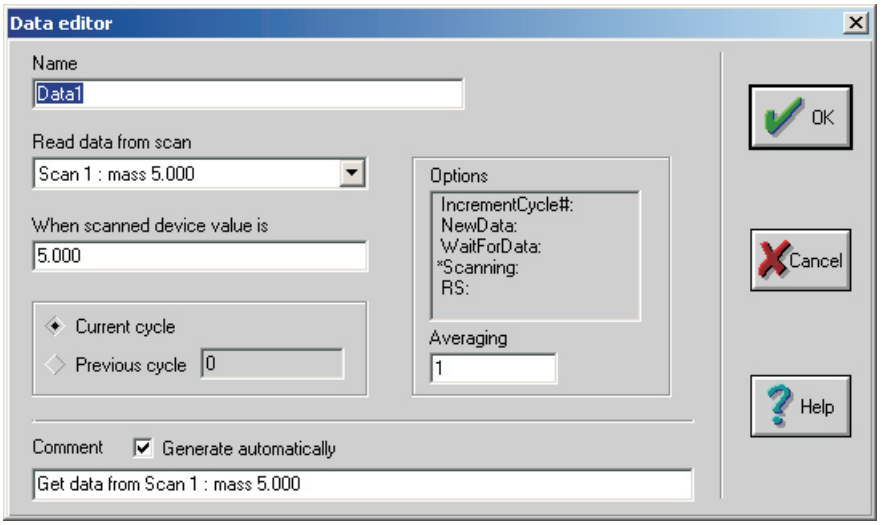

Figure 94 Data editor, Data1

After the 80th cycle the scan will stop and the sequence will go to PauseScan which will pause the next scan and turn off the filaments and the SEM HT supply.

Start is a tight loop to wait for the start signal. As the start signal is a pulse there is no need to de-bounce it.

Re-enable sets enable to 1, switches the filament and SEM on.

TimeZero resets the scan's elapsed time clock to 0 so that the X axis starts at 00:00.00.000.

StartScan clears the Pause:.

There is a 5s delay to allow the scan to start.

Data1 is then called in a loop, when the scan stops its on-error handler jumps to PauseScan.

3.5 Analogue outputs

This event sequence is part of the experiment file **5V AnalogueOutput.exp**.

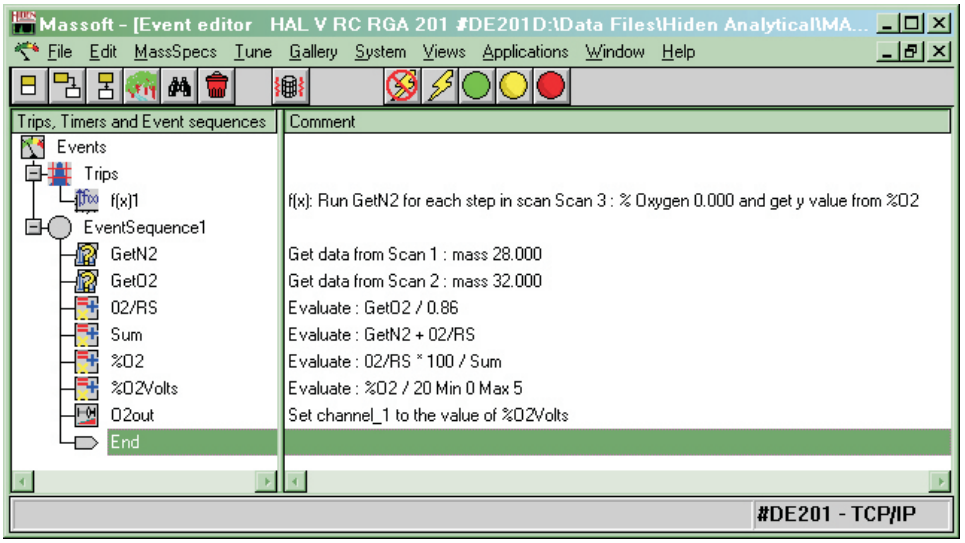

Figure 95 Event sequence, analogue output

This sequence is similar to the one shown in Section 3.2, except **%O2Volts** converts the concentration to a voltage and **O2out** outputs it to Channel1.

Name: f(x)1
Type: f(x)input device
Comment: f(x): Run GetN2 for each step in scan Scan 3 : % Oxygen 0.000 and get y value from %O2
Scan: Scan 3 : % Oxygen 0.000
Run sequence: GetN2
Get Y value from: %O2

Sequence : EventSequence1
Name: GetN2
Type: Data event
Comment: Get data from Scan 1 : mass 28.000
Source Scan: Scan 1 : mass 28.000
Device Value: 28.000
Cycle: 0
Average: 1
Options:

Name: GetO2
Type: Data event
Comment: Get data from Scan 2 : mass 32.000
Source Scan: Scan 2 : mass 32.000
Device Value: 32.000
Cycle: 0
Average: 1
Options:

Name: 02/RS
Type: Evaluate event

Comment: Evaluate : GetO2 / 0.86
Output Format:
Source 0: GetO2
Operator 1: /
Source 1: 0.86
Operator 2:
Source 2:
Operator 3:
Source 3:
Operator 4:
Source 4:

Name: Sum
Type: Evaluate event
Comment: Evaluate : GetN2 + 02/RS
Output Format:
Source 0: GetN2
Operator 1: +
Source 1: 02/RS
Operator 2:
Source 2:
Operator 3:
Source 3:
Operator 4:
Source 4:

Name: %O2
Type: Evaluate event
Comment: Evaluate : 02/RS * 100 / Sum
Output Format: f(x)
Source 0: 02/RS
Operator 1: *
Source 1: 100
Operator 2: /
Source 2: Sum
Operator 3:
Source 3:
Operator 4:
Source 4:

Note

The follow part of the event sequence converts %O2 to a voltage by dividing by 20 so that 100% corresponds to 5V output. The Min and Max operators ensure that the output does not exceed the range 0 to 5V, see Section 4.2.2.

Name: %O2Volts
Type: Evaluate event
Comment: Evaluate : %O2 / 20 Min 0 Max 5
Output Format:
Source 0: %O2
Operator 1: /
Source 1: 20
Operator 2: Min
Source 2: 0

Operator 3: Max
Source 3: 5
Operator 4:
Source 4:

Note

The next section of the event sequence outputs the voltage calculated by %O2Volts. The option LimitToLegal could be used in place of the Min0 and Max5 operations see Section 4.2.3.

Name: O2out
Type: Set event
Comment: Set channel_1 to the value of %O2Volts
Source Value: %O2Volts
To: channel_1
Options:

3.6 Using f(x) to Get the Value Returned by a Scan

The **Scan advanced** dialog box has the option to calculate a **Scan Result**. This is used by AutoTune and Mass Alignment scans to optimise the instruments settings, but there is no way to see the **Scan Result** in MASsoft.

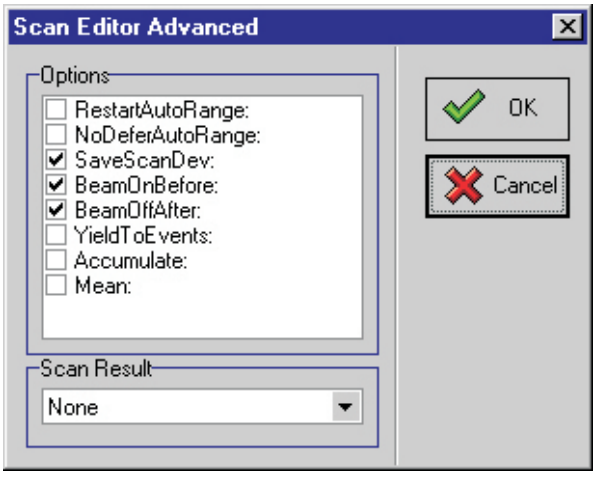

Figure 96 Scan advanced dialog box

The dialog box shown in Figure 96 shows the **Max** scan result option set. The Scan Result will be the maximum value of the scan. XvalAtMaxY is another useful possibility. In a multi-variant scan the scan result is returned to the parent scan as if it were a reading from an input device. Although MASsoft does not allow a view to be added to a scan which does not have a real input device, this facility can be used with a simple f(x) event sequence to get at this value. To do this a scan like the one shown in Figure 97 needs to be set up.

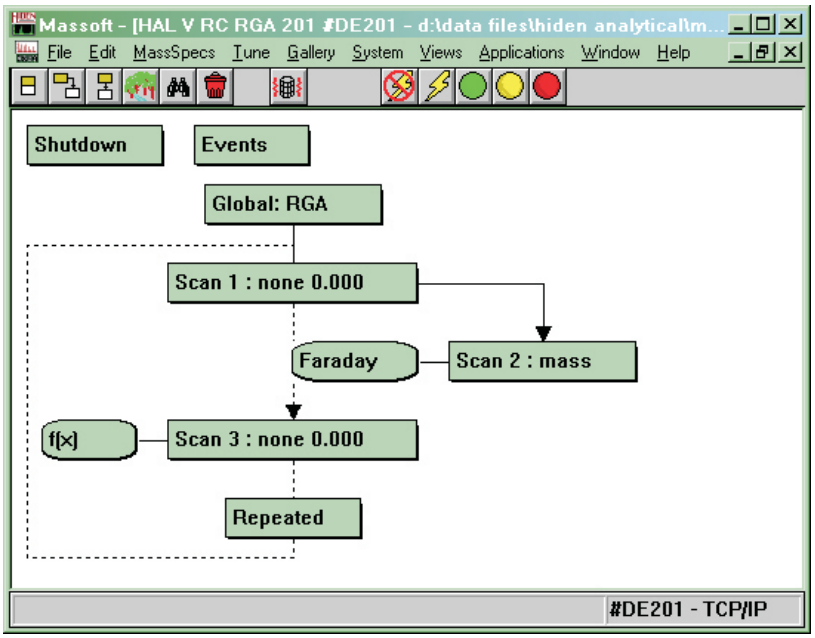

Figure 97 Scan tree, multi-variant scan

Scan 2 : is the actual scan, which is set up like a normal scan but with the required Scan Result selected in the Scan Advanced dialog box.

Scan 1 : receives the result from Scan 2, so it is set to scan none from 0 to 0.

Scan 3 : also scans none from 0 to 0, but its input is f(x).

An event sequence must be set up to get the data for the f(x) input, see Figure 98.

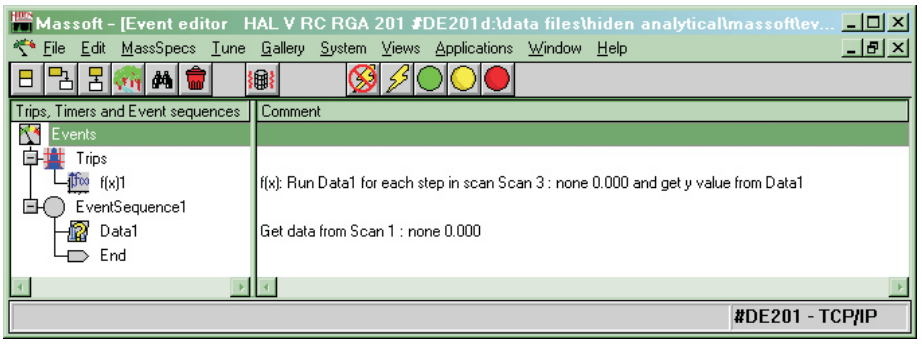

Figure 98 Event sequence, get data

The Run event sequence check box of EventSequence1 needs to be un-checked otherwise, the "Message 110, No Data" error messages will be displayed when the scan is started. The event sequence is run by the f(x) input.

The Data Event gets the data from Scan 1 (which receives the result from Scan 2).

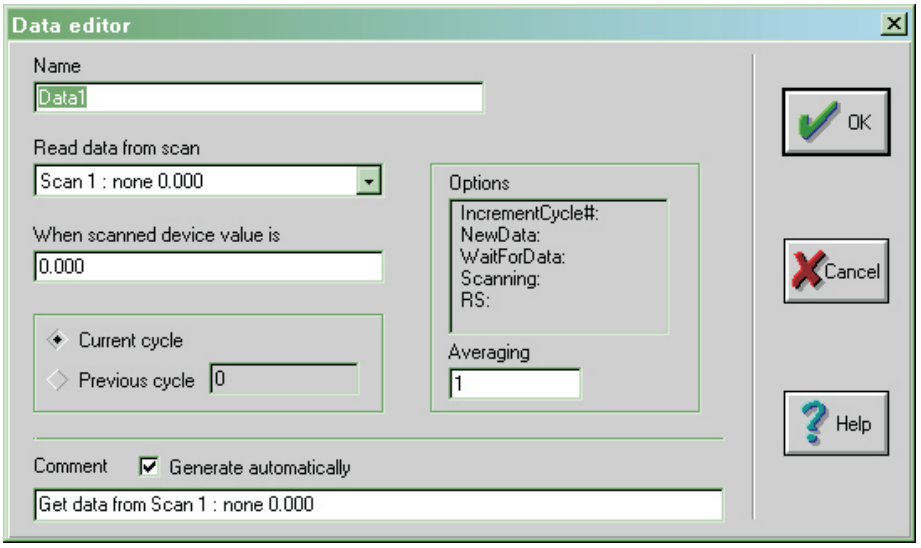

Figure 99 Data editor, scan 1

The f(x) input runs Data1 to get the value from Scan 1 and then in turn fetches the value from Data1.

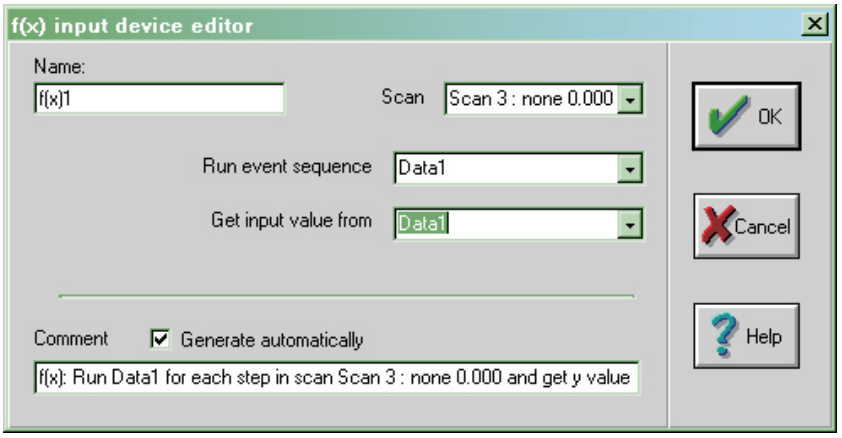

Figure 100 f(x) input device editor

A View of Scan 3 will show a trend graph of the maximum values of Scan 2.

So the path taken by the data could be summarized as:
max of Scan 2 Scan 1 Data1 f(x)1 Scan 3 View of Scan 3.

3.6.1 Driving Multiport Valves and Inlet Manifolds

See Chapter 5 in the Proteus Multistream Selector Valve Operating Manual reference HA-085-056.

3.7 Standalone operation – using Disconnect and a Startup sequence

Event Sequences in the Interface Unit are held in battery backed memory, they are retained if the IU is switched off. Therefore, it is possible to run an Event Sequence when the IU powers up.

This sequence can be used to restart data acquisition automatically if power to the IU fails. Normally this would be of no use because MASsoft would not be running or would have lost communication with the IU, however MASsoft can be run in a disconnected state, without retrieving data.

In the disconnected state the IU runs standalone. Trips and Event Sequences can still be used to process the data. To run disconnected start the run normally and select **System, Maintenance, Disconnect** from the Menu Bar.

The first step of the sequence must be called Startup, the IU looks for an event called Startup when it boots up. As only the event objects, and not the event sequence markers, are downloaded to the IU it must be a event object (in this case a Limit event object) that is called Startup.

Note

A sequence label is allowed to have the same name as the first event in the sequence.

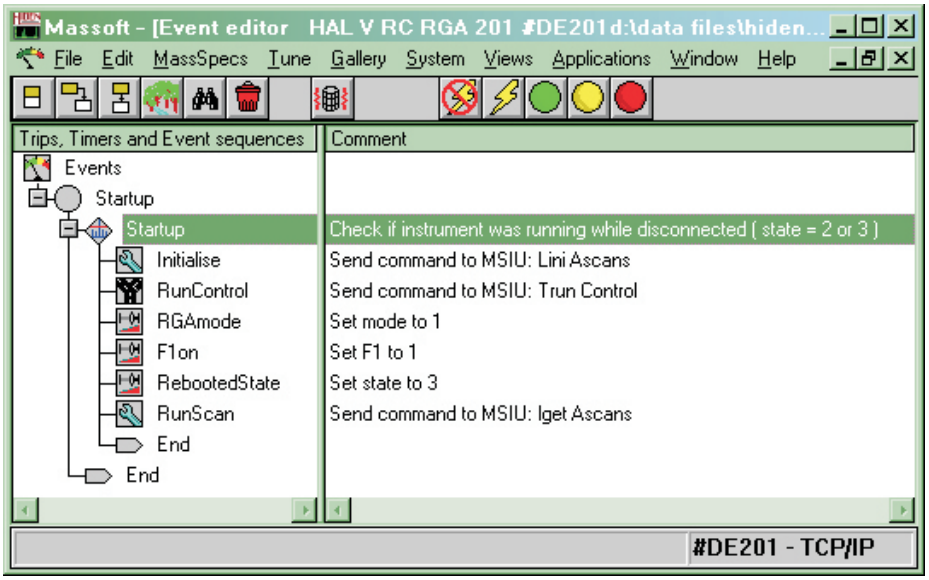

Figure 101 Startup event sequence

The Limit event checks a device called *state*. MASsoft sets *state* to 2 when it disconnects. The sequence will re-start the scan if *state* is 2 or 3, and then sets *state* to 3 so that

MASsoft knows the scan has been re-started. It re-starts if *state* is 3, as well as 2, to allow the scan to be re-started a second time when the state is already 3 after a previous re-start.

The following steps emulate what MASsoft does when it starts a scan.

Lini AScans initializes the scan data structures.

Trun Control is optional – it starts an Event Sequence called Control used to start and stop scans by means of an auxiliary IO.

Setting the *mode* device to 1 switches the IU from shutdown to RGA mode.

The sequence ensures that Filament 1 is turned on, then sets *state* to 3 as discussed above.

Finally, *lget Ascans* starts the scan.

Sequence : Startup

Name: Startup
Type: Limit event
    Comment: Check if instrument was running while disconnected (state = 2 or 3)
    Trip Logic: =
    Device Source: state
    Upper Limit: 3
    Lower Limit: 2
    Branch to: Initialise

Name: Initialise
Type: Command event
    Comment: Send command to MSIU: Lini Ascans
    MSIU Command: Lini Ascans
    Destination: NUL:
Options:

Name: RunControl
Type: Task event
    Comment: Send command to MSIU: Trun Control
    MSIU Command: Trun Control
    Destination: NUL:
Options:

Name: RGAmode
Type: Set event
    Comment: Set mode to 1
    Source Value: 1
    To: mode
Options:

Name: F1on
Type: Set event
    Comment: Set F1 to 1
    Source Value: 1
    To: F1
Options:

Name: RebootedState
Type: Set event
    Comment: Set state to 3
    Source Value: 3
    To: state
Options:

Name: RunScan
Type: Command event
    Comment: Send command to MSIU: lget Ascans
    MSIU Command: lget Ascans
    Destination: NUL:
Options:

3.8 Checking multiplier usage

The following sequence checks how long the multiplier detector has been used for. This fragment is intended for inclusion in automation sequences in process applications to warn the operator if the multiplier is due for recalibration or replacement.

It makes use of two hidden logical devices, **multiplier-use** and **multiplier-TIC**.

multiplier-use monitors the number of hours the multiplier has had HT applied to it. It updates every time the multiplier voltage is changed to 0V (normally every time the IU is switched to the ShutDown state after each scan).

multiplier-TIC accumulates the total number of counts measured by a Pulse Ion Counting (PIC) SEM. It updates after every measurement.

These devices are not yet available on all systems; to check connect to the IU using MSIU Test and use the command *lid$ all* to list all devices. Obviously, these devices are only available on systems with a multiplier, and multiplier-TIC is only applicable to PIC SEMs.

The sequence shown below displays a warning if the limits are exceeded. Appropriate limits will depend on the operating environment and must be determined by experience.

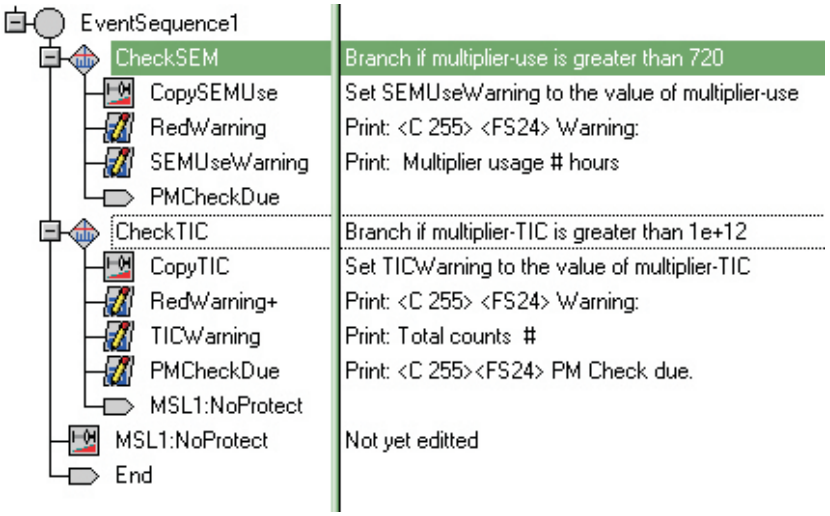

Figure 102 Multiplier usage event sequence

The limits are set in the **Limit editor** dialog boxes.

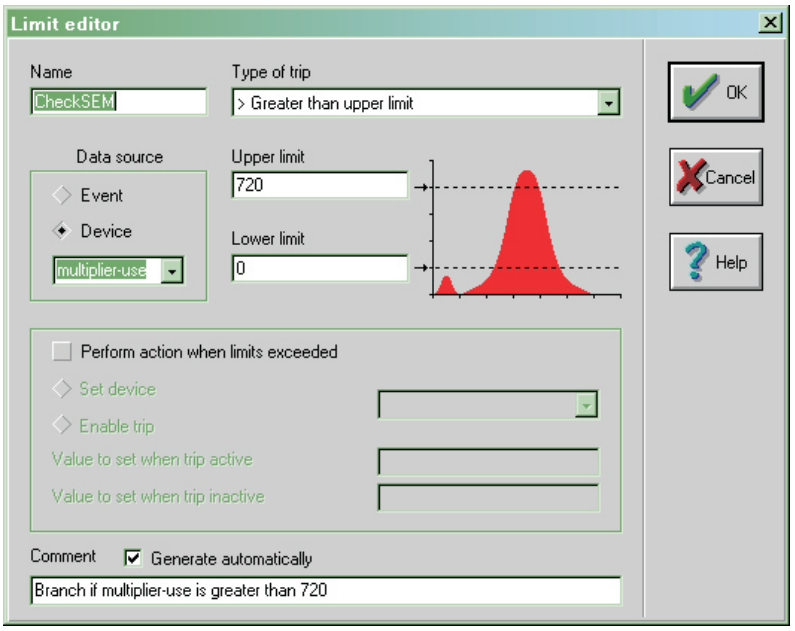

Figure 103 Limit editor, multiplier usage

The warning messages use the format tags to print the message in red and to set a larger typeface. No action is taken other than displaying a warning to the Event Log, aborting the scan would probably not be appropriate in a production environment; if spare IO is available this could be used to send a signal to a process controller or annunciator panel.

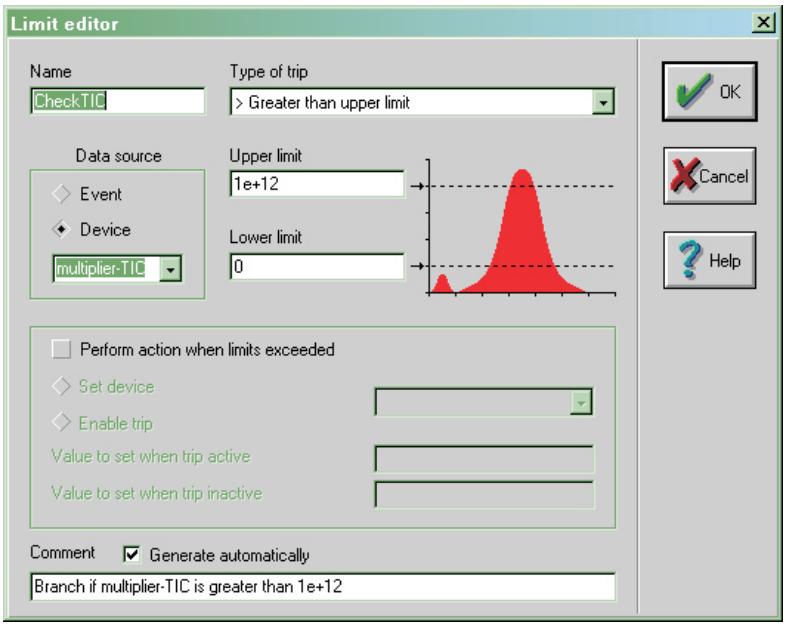

Figure 104 Limit editor, total counts

3.9 PC watchdog

3.9.1 Example of a trip and event structure

Monitor is used to monitor communications between the PC and the IU to give a warning if the link to the PC is broken.

Figure 105 shows the expanded **Monitor** sequence**.**

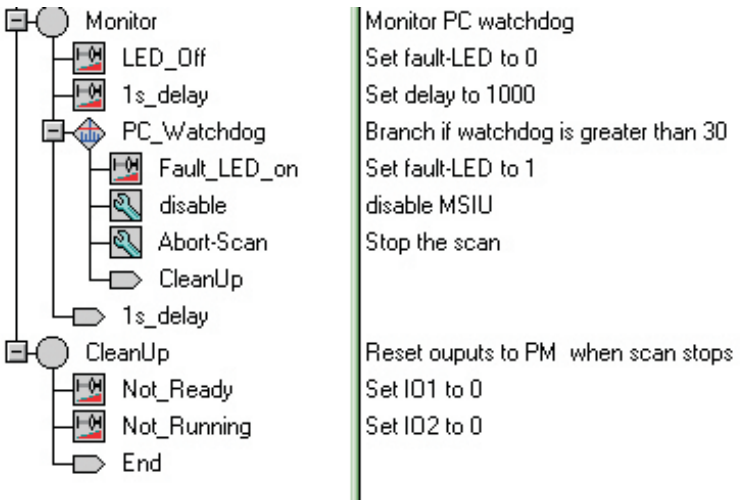

Figure 105 Event sequence, watchdog

The **1s_delay** is set up by the **Set editor** dialog box, see Figure 81.

delay is a timer in the IU which takes a value in milliseconds, see Section 4.7.4. In this case it pauses the sequence for one second.

PC_Watchdog is set up by the **Limit editor** dialog box, see Figure 106.

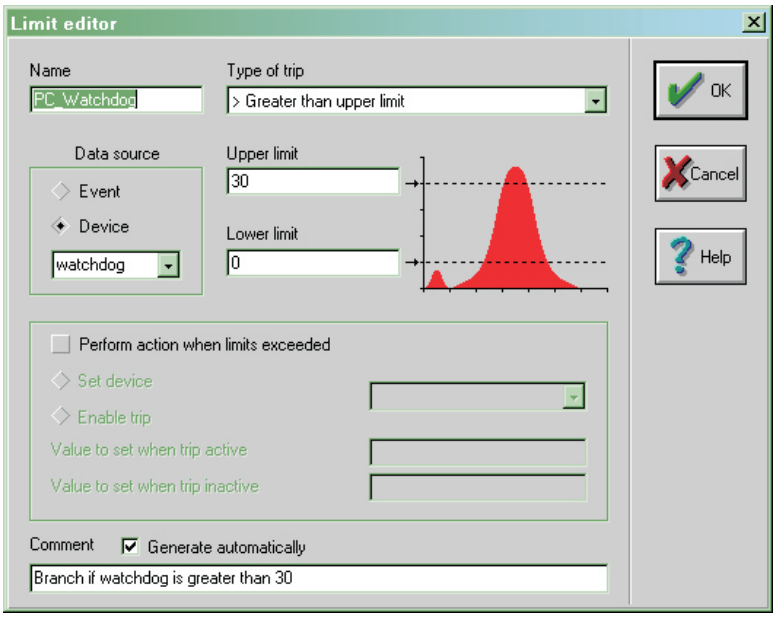

Figure 106 Limit editor, watchdog

watchdog is a device which increments every second, but is reset to zero when the error buffer in the IU is read, see Section 4.7.4. This buffer should be read periodically by the PC. Time-out is executed if the **watchdog** value exceeds 30 (seconds), and turns on a warning lamp to indicate that the MSIU has lost contact with the PC, sets enable to 0 to set the MSIU's power supplies to safe voltages and stops the scan, finally it jumps to cleanup.

If communication is okay the sequence repeats because the **End** icon branches to **Monitor**, see Figure 105.

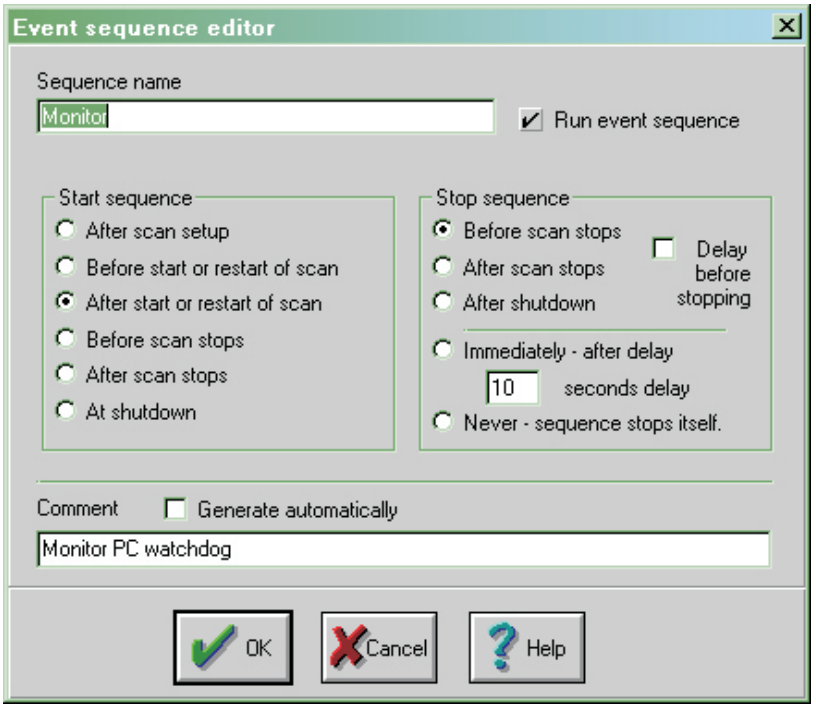

Figure 107 Event sequence editor, watchdog

The **Monitor** sequence is started after the scan starts because the error buffer is not read while the scan is being set up. See Figure 107

Cleanup can be used when IO lines are being used to interface the MSIU to other equipment; in this case it may be necessary to set the IO into a known state at the end of a scan. **Cleanup** is run after the scan ends.

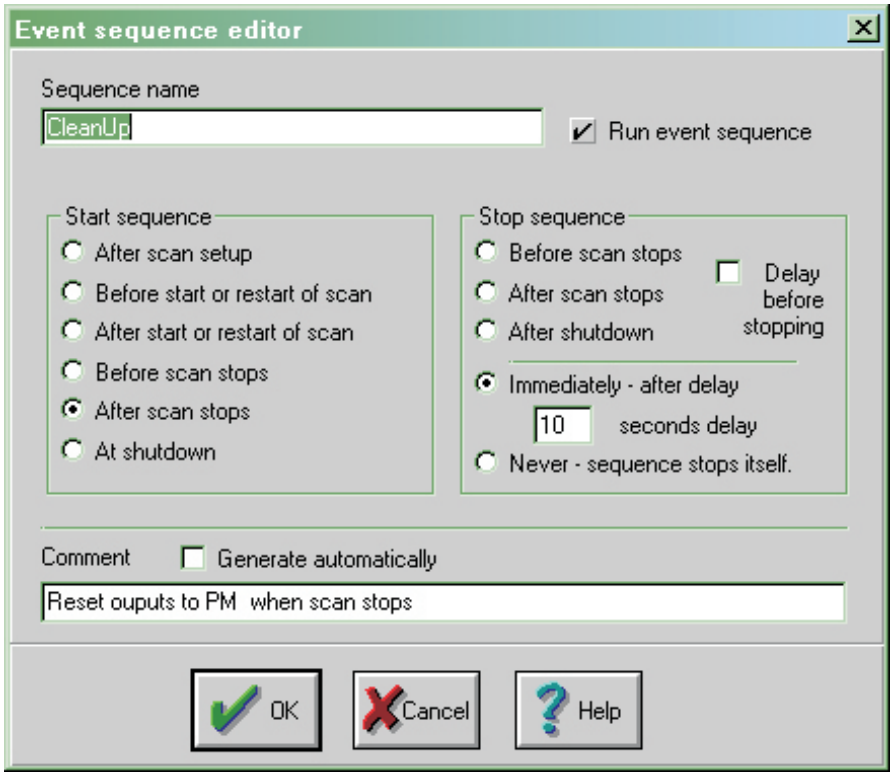

Figure 108 Event sequence editor, cleanup

Using the **Immediately – after delay** option causes MASsoft to wait until the sequence ends before shutting down. See Figure 108.

4 Event sequence reference

4.1 Editing a trip and event structure

Inserting a new trip or event object in a structure.

To insert a new trip or event object in a structure, either:

1.	Right click the marker or object above the point where the new object is to be inserted.	The trip and event menu shown in Figure 109 is displayed. This menu has **Edit** and **Delete** options (see Sections 4.1.5 and 4.1.1 respectively) in addition to the list of trips and event objects.
2.	On the trip and event menu click the required object.	A new object is inserted in the event sequence.

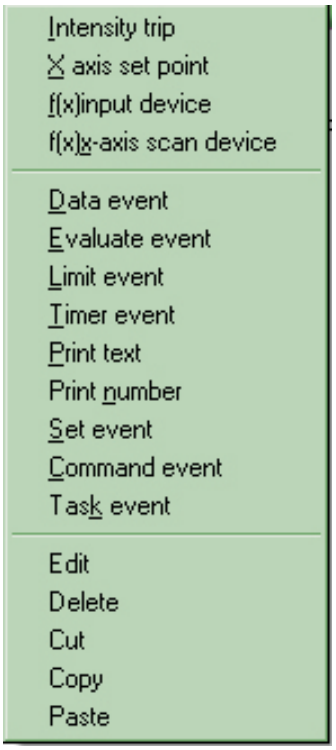

Figure 109 Trip and event menu, right click

or

1.	Click the marker or object above the point where the new object is to be inserted.	
2.	On the **Edit** menu click **New trip or event.**	The trip and event menu shown in Figure is displayed.
3.	Click the required object.	A new object is inserted in the event sequence.

4.1.1 Deleting an object or marker

To delete a trip or event object, or marker, either:

1.	In the event sequence click the object or marker.	
2.	On the MASsoft Toolbar click the **Dustbin**,  , button.	A warning message, to confirm deletion, will appear for an event sequence marker or a limit event object; otherwise the event object is deleted.

or

1.	Right click the event object or event sequence marker.	The trip and event menu is displayed, see Figure 109.
2.	On the trip and event menu click **Delete**.	A warning message, to confirm deletion, will appear for an event sequence marker or a limit event object; otherwise the event object is deleted.

or

1.	Click the event object or event sequence marker.	Multiple selections may be made by the standard Windows technique using the Ctrl or Shift keys.
2.	On the **Edit** menu click **Delete.**	A warning message, to confirm deletion, will appear for an event sequence marker or a limit event object; otherwise the event object is deleted.

4.1.2 Copying an object, or marker

To copy a trip or event object, or marker:

1.	Right click the event object or event sequence marker.	The trip and event menu is displayed, see Figure 109.
2.	On the trip and event menu click **Copy**.	

or

1.	Click the event object or event sequence marker.	Multiple selections may be made by the standard Windows technique using the Ctrl or Shift keys.
2.	On the **Edit** menu click **Copy**.	

When copying a Limit event the Limit event and the entire branch will be copied. Likewise with a Timer event. Therefore, only select the Limit event itself, not its branch; this can often best be achieved by contracting the Event tree.

If both the Limit event and its branch are selected the events in the branch will be copied twice into two different places. This is best illustrated by example.

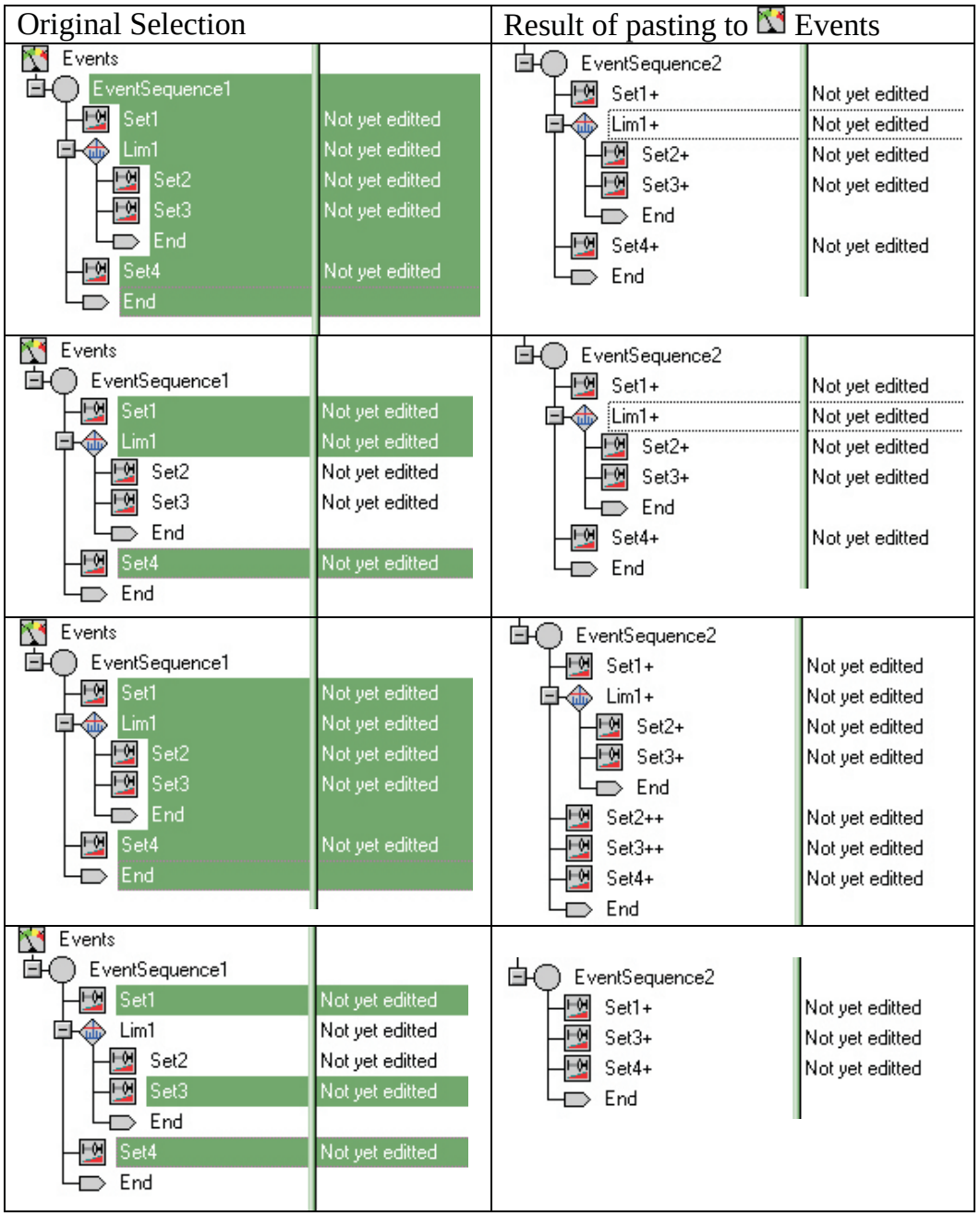

Figure 110 Copying, an example

4.1.3 Paste an object or marker

To paste a trip or event object, or marker:

1.	Right click the event object or event sequence marker above the point where the copied items are to be pasted.	The trip and event menu is displayed, see Figure 109.
2.	On the trip and event menu click **Paste**.	The copied event objects are pasted below the selection.

or

1.	Click the event object or event sequence marker.	
2.	On the **Edit** menu click **Paste**.	The copied event objects are pasted below the selection.

When pasting into an Event Sequence paste will resolve conflicting event-object names by adding + characters to the end of the name, up to the maximum name length, until the name is unique; if this cannot generate a unique name the default name e.g Set1, Set2 … etc will be used.

When pasting a trip or Data Event from one file to another the link in the trip or event to the scan is broken. The trip or event must be edited and a scan selected.

4.1.4 Cut an object, or marker

When trip or event objects, or markers, are cut the software first copies the objects, then deletes them.

To cut a trip or event object, or marker:

1.	Right click on the event object or event sequence marker.	The trip and event menu is displayed, see Figure 109.
2.	On the trip and event menu click **Cut**.	A warning message, to confirm deletion, will appear for an event sequence marker or a limit event object; otherwise the event object is deleted.

or

1.	Click the event object or event sequence marker.	

2.	On the **Edit** menu click **Cut**.	A warning message, to confirm deletion, will appear for an event sequence marker or a limit event object; otherwise the event object is deleted.

4.1.5 Editing an object or event sequence marker

An edit dialog box can be opened for any object or event sequence marker.

Note:

The Start marker and Trip list markers cannot be edited.

To edit an event object or event sequence marker, either:

1.	Double click the event object or event sequence marker.	The appropriate edit dialog box is displayed, see the following Sections for details.

or

1.	Right click the event object or event sequence marker.	The trip and event menu is displayed, see Figure 109.
2.	On the trip and event menu click **Edit**.	The appropriate dialog box is displayed, see the following sections for details.

or

1.	Click the event object or event sequence marker.	
2.	On the **Edit** menu click **Edit trip or event**.	The appropriate dialog box is displayed, see the following sections for details.

4.2 The event sequence marker

The event sequence marker,  , identifies the start of an event sequence. If any events are programmed in this sequence, they appear directly underneath the marker. Several sequences may be programmed as required.

Event sequences can contain functions in any order. Functions are executed in order from top to bottom unless a branch is taken.

To edit the marker name, either:

1. Double click the event sequence marker. — The **Event sequence editor** dialog box is displayed, see Figure 111.

or

1. Right click the event sequence marker. — The trip and event menu is displayed, see Figure 109.
2. On the trip and event menu click **Edit**. — The **Event sequence editor** dialog box is displayed, see Figure 111.

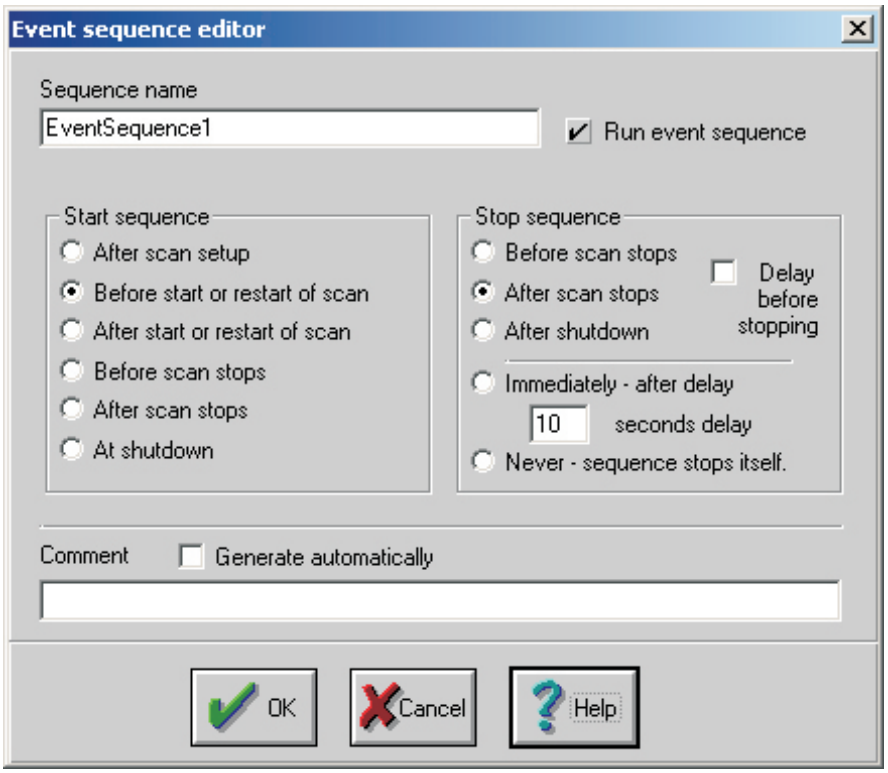

Figure 111 Event sequence editor dialog box

or

1. Click the event sequence marker.
2. On the **Edit** menu click **Edit trip or event.** — The **Event sequence editor** dialog box is displayed, see Figure 111.

The Event sequence editor dialog box options are:

Sequence name	The marker name can be typed in this text box.
Run event sequence	If this option is checked, the trip list starts at the same time as data acquisition. If this option is not checked, the sequence does not start unless run by another trip or event.
Start sequence	Specifies the point at which to run the event sequence
After scan setup	The sequence is started as soon as the scan and Event Sequence have been downloaded to the IU. If **Automatic scan restart** is enabled (see Section 3.4) the sequence is only started before the first run starts. If the stop option is **Immediate – after delay** then the sequence will run until completion or until the delay time expires, whichever is sooner, before the scan starts.
Before start or restart of scan	The sequence is started immediately before data acquisition starts on every run. If the stop option is **Immediate – after delay** then the sequence will run until completion or until the delay time expires, whichever is sooner, before the scan starts.
After start or restart of scan	The sequence is started immediately after data acquisition starts on every run. If the stop option is **Immediate – after delay** then the sequence will run until completion or until the delay time expires, whichever is sooner, before MASsoft starts to display data; to avoid the instrument's data buffer becoming full the delay time should be kept short.
Before scan stops	The sequence is run before stopping the scan. If the stop option is **Immediate – after delay** then the sequence will run until completion or until the delay time expires, whichever is sooner, before MASsoft stops the scan. During this time data is not displayed; to avoid the instrument's data buffer becoming full the delay time should be kept short.
After scan Stops	The sequence is run after the scan has stopped, but before switching to shutdown. This option should be used to write a sequence to return IO devices to a known state at the end of a run. If the stop option is **Immediate – after delay** then the sequence will run until completion or until the delay time expires, whichever is sooner, before proceeding.

At shutdown	The sequence runs when the mode changes to Shutdown. Note if the file closed before switching to shutdown then the sequence will not be run. If the stop option is **Immediate – after delay** then the sequence will run until completion or until the delay time expires, whichever is sooner, before proceeding.
Stop sequence	Specifies when to stop the sequence
Before scan stops	The sequence is stopped before stopping the scan. If the **Delay before stopping** check box is selected MASsoft will wait until the sequence self-terminates or until the delay time expires, whichever is sooner, before MASsoft stops the sequence. During this time data is not displayed; to avoid the instrument's data buffer becoming full the delay time should be kept short.
After scan stops	The sequence is stopped after stopping the scan but before switching to Shutdown. If the **Delay before stopping** check box is selected MASsoft will wait until the sequence self-terminates or until the delay time expires, whichever is sooner, before MASsoft stops the sequence.
After shutdown	The sequence is stopped after switching to Shutdown. If the **Delay before stopping** check box is selected MASsoft will wait until the sequence self-terminates or until the delay time expires, whichever is sooner, before MASsoft stops the sequence.
Immediately – after delay	When MASsoft starts the sequence it performs the following actions: Start sequence – delay – Stop sequence The delay should be long enough to allow the sequence to complete. If the sequence completes before the delay expires the delay is terminated and the Stop sequence action is omitted. If two sequences with this option have the same Start sequence option then one will run to completion before the other starts, but the order in which they run can not be relied on. The delay time is always used with this option even if **Delay before stopping** is not selected.
Never – sequence stops itself.	MASsoft does not stop the sequence, it must self terminate (end on an End marker). If sequences are left running various errors may be encountered such as: No free task. Illegal trip type. Programme stopped. Device in use Scan not initialized

Delay before stopping	Allows time for an event sequence to run to completion before trying to stop it. The delay time can be specified. If the sequence does not stop within the delay time then MASsoft will send the command to force it to stop. The delay time starts at point specified by the Stop sequence radio-button.
Comment	A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option
Generate automatically	MASsoft will generate a comment from the entries in the dialog box.

4.2.1 Data events

Data already acquired and stored may be retrieved using the Data event function,  . Any scan may be used as the data source; either current or previous cycles may be accessed, provided the data is still stored in the IU. When referenced by other event functions, this function supplies the data it has retrieved. The **Data editor** dialog box is displayed when the object is edited, see Figure 112.

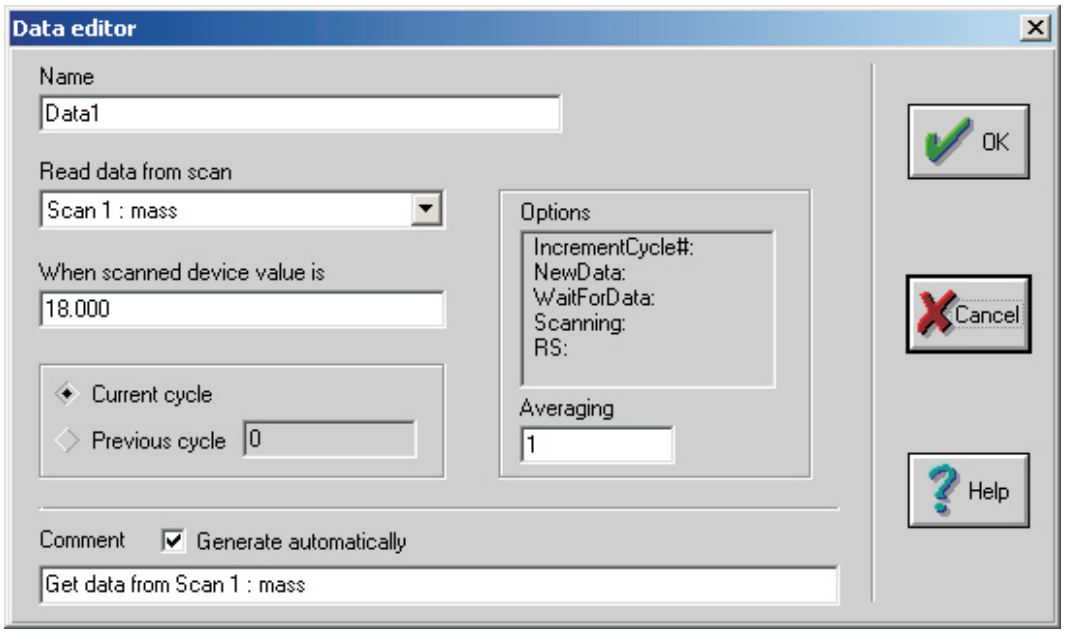

Figure 112 Data editor dialog box

Name	This text box allows the object name to be changed.
Read data from scan	Selects the scan from which input data is to be obtained.
When scanned device value is	A value for the selected scan's output device must be entered in this box to ensure that only one value is fetched. For most scans, this would be the mass value in amu. If data is required direct from an input, this can be read by other events.
Current cycle	When checked, data is fetched from the current cycle.
Previous cycle	When checked, data is fetched from a previous cycle, defined by the number entered in the adjacent box. A positive value obtains data from the corresponding cycle number, a negative value obtains data from a cycle relative to the current cycle.
Options	A list of options supported by the firmware version of the instrument is displayed. Double click on an option to select or deselect it. A selected option is preceded by a *****.

Averaging	The event object's value will be the average of the data for the specified number of cycles; If the specified number of cycles have not been acquired then the average of all available cycles is used Note: This feature does not operate correctly in firmware prior to release 5.4.
Comment	A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option
Generate automatically	MASsoft will generate a comment from the entries in the dialog box

Options list box items:

Option	**Function**	**Firmware Version**
IncrementCycle#	The cycle number is incremented each time the Data event successfully fetches data.	R2.4 onwards
NewData:	The Data event will only process a datapoint once. If the Data event has processed the current data point previously it will suspend the Event Sequence task until new data are available.	R2.4 onwards
WaitForData:	If no data yet been acquired the Data event will suspend the Event Sequence until data is available. If this option is not selected the Data event will generate a "No Data" error and the sequence will continue.	R2.4 onwards
Scanning:	Generates a "Not scanning" error if the scan is not scanning.	R3.4 onwards
RS:	Applies the Relative Sensitivity to the data. This option is not supported by MASsoft yet.	R5.6 onwards

Note

*If a Data Event is pasted from one file to another then the **Read data from scan** test box is not copied.*

*If the **Read data from scan** text box is left empty the event sequence will not download and the file containing it will not run.*

4.2.2 Evaluate events

The **Evaluate event** function,  , can take data from other events (e.g. a Data event) or direct from input devices and manipulate it using the arithmetic operators (+, -, * and /). From Firmware R5.6 onward Log, Invlog, Power, Root, Min and Max are also available. A typical use is to convert an absolute MID-channel reading to be a percentage of another MID-channel. When referenced by other event functions, this supplies the result of the manipulation. The **Evaluate expression editor** dialog box is displayed when the object is edited, see Figure 113.

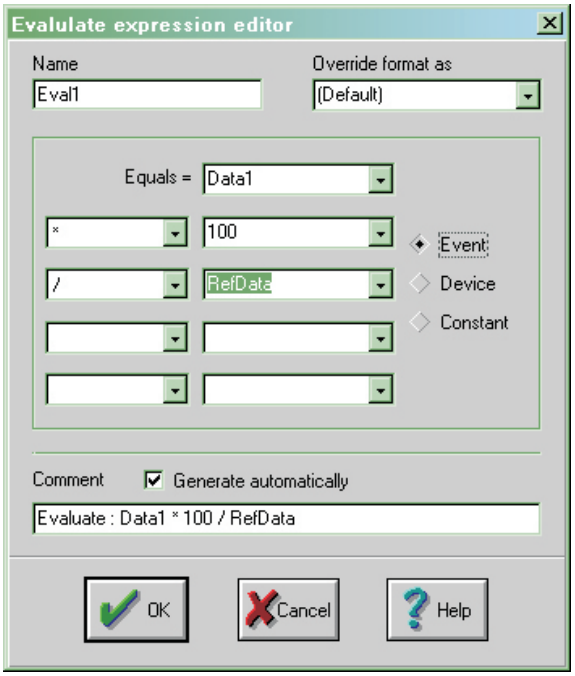

Figure 113 Evaluate expression editor dialog box

Name This text box allows the object name to be changed.

Override format as This combination box sets the storage format of the result of this event.

Choosing **(Default)** sets the format to the default input device of the instrument, i.e. **SEM** on a pulse counting instrument, **Faraday** on a Faraday instrument.

Choosing **SEM** in a pulse counting instrument results in an integer format. Choosing **Faraday** or **auxiliary1** results in a floating point format.

Comment A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option.

Generate automatically	MASsoft will generate a comment from the entries in the dialog box.

In the main evaluation frame, up to five values, derived from an **Event**, a **Device** or a **Constant**, may be manipulated using up to four arithmetic operators to produce the event's result. The radio buttons **Event**, **Device** and **Constant** select the content of the drop down list boxes in the value edit boxes; select the edit box first, then click on the required radio button, before entering the value.

Input values are processed in the order shown in the dialog box; no operators have precedence. Unused operator-value pairs may be left blank. The example in Figure 113 derives the value of the intensity in **Data1** as a percentage of the intensity in **Refdata**; The radio buttons show that **RefData**, the selected value, is an **Event**.

Operator	Function	Value to right of operator	Firmware version
+	Add	Value added	All
-	Subtract	Value subtracted	All
*	Multiply	Multiplier	All
/	Divide	Divisor	All
Log	Log	Base	R5.6 onwards
Invlog	Inverse log (anti-log)	Base	R5.6 onwards
Power	Raise to power n	Exponent, n	R5.6 onwards
Root	Take n^{th} root	n	R5.6 onwards
Max	Maximum	Maximum value	R5.6 onwards
Min	Minimum	Minimum value	R5.6 onwards

If Base is 0 or 1 or 2.718 then the exact value for e is used as the base. The absolute value of Base is always used, its sign is ignored.

Note

The minimum and maximum operators should be read as "a minimum of" or "a maximum of", not "the minimum (i.e least) of " or "the maximum (i.e greatest) of ".

4.2.3 Set events

Values fetched from input devices or other events, or a constant value, can be set into either an output device or an event using the **Set event** function,  . This can be used to define unambiguously the state of an output device such as a trip relay. Double-clicking the icon opens the **Set editor** dialog box, see Figure 114.

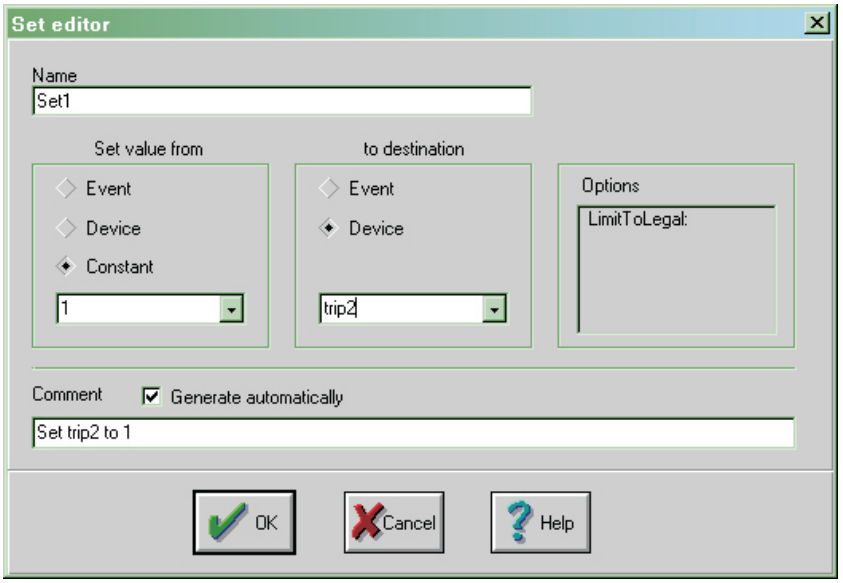

Figure 114 Set editor dialog box

Name This text box allows the object name to be changed.

Set value from A value can be selected from this frame which is loaded into the **to destination Event** or **Device** when the event is executed.

Set value from frame

Event When selected, provides a list of available events and trips in the associated combination box.

Device When selected, provides a list of available devices in the combination box.

Constant When selected, the required constant value can be entered in the combination box.

Similarly, selection of **Event** or **Device** in the **to destination** frame provides the appropriate lists in the associated combination box.

Options A list of options supported by the firmware version of the instrument is displayed. Double click on an option to select or deselect it. A selected option is preceded by a *****.

Comment A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option

Generate automatically MASsoft will generate a comment from the entries in the dialog box

Option	Function	Firmware version
LimitToLegal:	If the destination is a device this option ensures the value set is within the legal limits for the device. If the value exceeds the limits then the device's minimum or maximum value is used, as appropriate. This option prevents "Logical device value out of range" errors occurring.	R5.6 onwards

4.2.4 Print text events

The **Print text**,  , function can be used to send messages to other instruments (e.g. a process computer). A user-entered message of up to 30 ASCII characters can be defined which can be transmitted on one of the MSIU's communications links. Double-clicking the icon opens the **Print text** editor dialog box, see Figure 115.

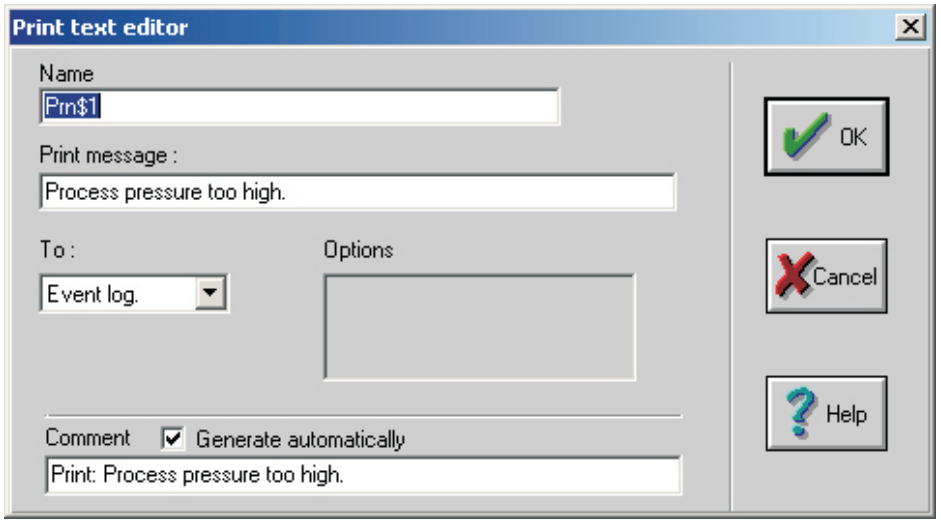

Figure 115 Print text editor dialog box

Name This text box allows the object name to be changed.

Print message: A message of up to 30 characters may be typed directly into this text box. The message scrolls left and right as required.

Several print events may follow each other to create lines greater than 30 characters long. The last print event MUST have the *End:* option set. MASsoft may become unstable if EventLog messages are extremely long.

To: To send the message, an output port must be chosen from the list in this box. The message is sent to the event log file if **EventLog** is selected. The event log file can be displayed on the PC monitor.

Options A list of options supported by the firmware version of the instrument is displayed. Double click on an option to select or deselect it. A selected option is preceded by a *****.

Comment A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option

Generate automatically	MASsoft will generate a comment from the entries in the dialog box

Note:

*The **To:** field depends on the **[STREAMS]** entries in the HIDEN.INI file; if this section is missing the **To:** list box will be blank.*

Option	Function	Firmware version
End:	The message does not continue. The next message will start on a new line.	R5.6 onwards
Continue:	The message continues. The next message follow on the same line as this message.	R5.6 onwards
#=Value	A # character embedded in the message will be replaced with the event's value, using the value's associated device format. Use a Set event to store the value in the Print Text event.	R5.6 onwards

For backwards compatibility with old Event Sequences if neither **End:** nor **Continue:** are selected then the message must end in **.** (full stop) **, :** (colon), **!** (exclamation mark) or **?** (question mark) to start the next message on a new line; failure to end the message will cause MASsoft to crash.

4.2.5 Print number events

The **Print number**,  , function can be used to send a value as an ASCII string to other instruments (e.g. a process computer). A value can be taken from an input device or an event function, converted to an ASCII string using a choice of formats, and can then be transmitted on one of the IU's communications links. Double-clicking the icon opens the **Print number editor** dialog box, see Figure 116.

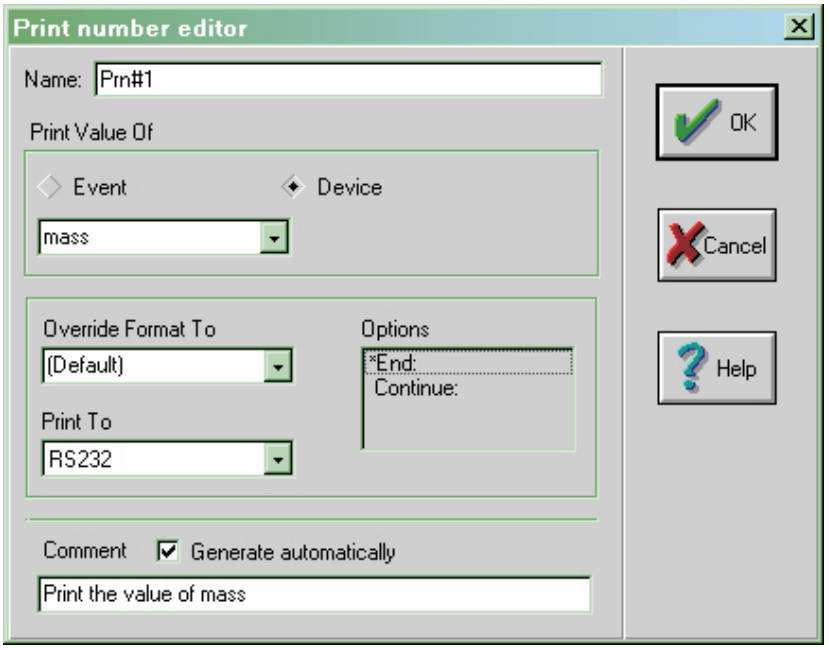

Figure 116 Print number editor dialog box

Name	This text box allows the object name to be changed.
Print value of	The value to be output can be selected using the controls in this frame:
Event	When selected, the combination box lists the available events and trips.
Device	When selected, the combination box lists the available devices.
Override Format To	This combination box allows the output format of this event result to be chosen. Choosing **(Default)** sets the format to the default input device of the instrument, i.e. **SEM** on a pulse counting instrument, **Faraday** on a Faraday instrument.

Choosing **SEM** in a pulse counting instrument results in an integer format, choosing **Faraday** or **auxiliary1** results in a floating point format.

Print To An output port must be chosen from the list in this box in order to send the number. If **EventLog** is selected in the **Print To:** box in both the **Print number editor** and **Print text editor** dialog boxes, the number is appended to the message in the event log file.

Options A list of options supported by the firmware version of the instrument is displayed. Double click on an option to select or deselect it. A selected option is preceded by a *****.

Comment A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option.

Generate automatically MASsoft will generate a comment from the entries in the dialog box.

Option	Function	Firmware version
End:	The message does not continue. The next message will start on a new line.	R5.6 onwards
Continue:	The message continues. The next message follow on the same line as this message.	R5.6 onwards

For backwards compatibility with old Event Sequences if neither End: nor Continue: are selected then the message continues; the Print Number event must be followed by a Print Text event which ends the message; failure to end the message will cause MASsoft to crash.

Note:

The **Print To:** *field depends on the* **[STREAMS]** *entries in the HIDEN.INI file; if this section is missing the* **Print To:** *list box will be blank.*

4.3 Limit events

In a Limit event,  , data taken from other events (e.g. Data event), or direct from input devices, may be compared with upper and lower limit values. Comparison operators are:

><	active when data within limit values.
<>	active when data outside limit values.
<	active when data less than lower limit.
>	active when data greater than upper limit.
<<	active when data less than lower limit with hysteresis.
>>	active when data greater than upper limit with hysteresis**.**
=	active when data equal to either upper or lower limit value.

When this function is active, it can:

Set a value into an output device (e.g. one of the trip relays).

Enable another trip.

Cause a branch to another sequence.

The **Limit editor** dialog box is opened when a limit event is edited, see Figure 117.

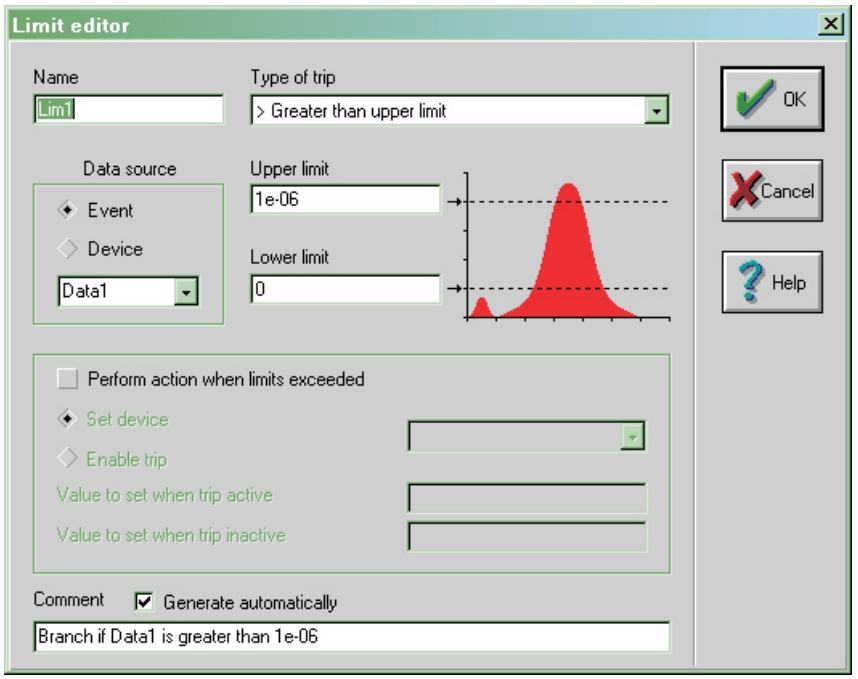

Figure 117 Limit editor dialog box

Name This text box allows the object name to be changed.

Data source	This frame contains the controls which select the available events or input devices:
Event	When selected, the combination box in the frame displays the available events.
Device	When selected, the combination box in the frame displays the available devices.
Type of trip	This control gives a list of the comparison functions available and these are associated with the values entered into the **Upper limit** and **Lower limit** text fields.
Upper limit	Sets the upper limit value, in the units of the **Event** or **Device** in the **Data source** frame.
Lower limit	Sets the upper limit value, in the units of the **Event** or **Device** in the **Data source** frame.
Comment	A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option
Generate automatically	MASsoft will generate a comment from the entries in the dialog box

The second frame contains controls which allow the event's output action to be programmed:

Perform action when limits exceeded	If this option is checked, an output action is performed when the parameters set in the frame are met. These parameters are set by choosing the **Set device** or **Enable trip** radio button. If this option is not checked a branch to another event is executed when the event's limits are exceeded, see below.
Set device	When selected, the available output devices are displayed when the associated combination box is selected. The values in the **Value to set when trip active** and **Value to set when trip inactive** fields are set into the output device selected in the combination box when the trip switches between active and inactive modes.
Enable trip	When selected, the **Value to set when trip active** and **Value to set when trip inactive** fields are greyed (unavailable) and the combination box contains a list of the trips and events which can be enabled. When the event goes active, the selected trip or event is enabled and vice-versa.

If the **Perform action when limits exceeded** option is not checked, a branch to another event is executed when the event's limits are exceeded. This condition is shown in the

Events window by a branch target indicator below the event icon, with the branch target identified. Double-clicking the icon hides or reveals the branch target.

The other controls in the action frame are greyed when the **Perform action when limits exceeded** option is not checked. The branch target is edited by double-clicking the branch icon; this opens the **Sequence marker editor**, see Figure 118.

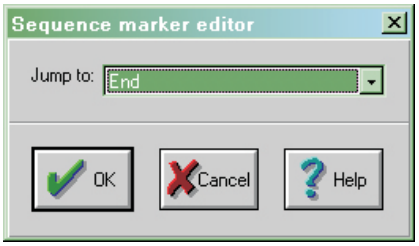

Figure 118 Sequence marker dialog box

In this dialog box the **Jump to** list may be used to select the branch target.

To insert an object between the limit object (**Lim1**) and the branch target (**Set2**), right click on the branch target and select from the menu list (see Figure 109).

To add an object below the limit object (**Lim1**), right click the limit object and select from the list.

4.4 Timer event

When the timer event,  , expires, it can:

Set a value into an output device (e.g. one of the trip relays).

Enable another trip.

Cause a branch to another sequence.

To start a timer use a Set event to set the timer to 0. See Figure 27.

The **Timer editor** dialog box is displayed when a Timer event is edited, see Figure 119.

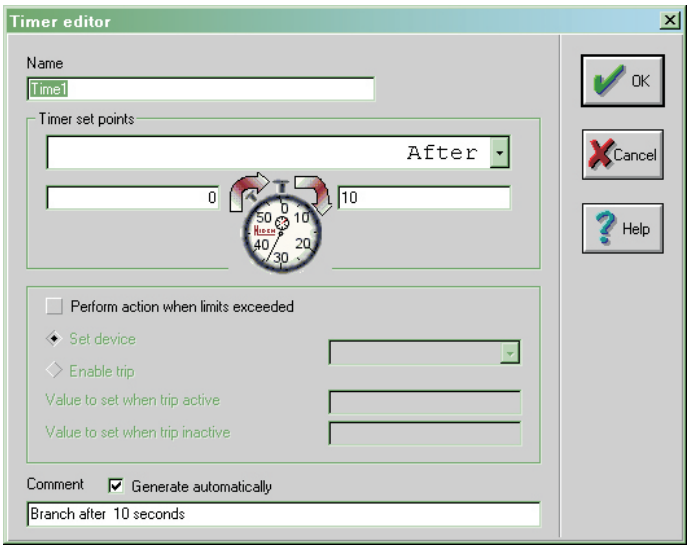

Figure 119 Timer editor dialog box

Name	This text box allows the object name to be changed.
Timer set points	This control gives a list of the comparison functions available and these are associated with the values entered into the **Left hand value** and **Right hand value** text fields.
left hand value (before)	Sets the earlier timer set point in seconds. Sets the frequency in seconds for **Every** and **Every Until**
right hand value (after)	Sets the later timer set point in seconds.
Comment	A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option
Generate automatically	MASsoft will generate a comment from the entries in the dialog box

The following comparison functions are available in the **Timer set points** control.

After (Right hand value)
Before (Left hand value)
Every (Left hand value)
Every (Left hand value) Until (Right hand value)
Before (Left hand value) or After (Right hand value)
Between (Left hand value) and (Right hand value)
When (Left hand value) and When (Right hand value)

Use **Every** or **Every Until** to repeat the action periodically.

Use **Before 0** if no action is to be taken.

The bottom frame contains controls which allow the event's output action to be programmed:

Perform action when limits exceeded	If this option is checked, an output action is performed when the parameters set in the frame are met. These parameters are set by choosing the **Set device** or **Enable trip** button. If this option is not checked a branch to another event is executed when the event's limits are exceeded, see below.
Set device	When selected, the available output devices are displayed when the associated combination box is selected. The values in the **Value to set when trip active** and **Value to set when trip inactive** fields are set into the output device selected in the combination box when the trip switches between active and inactive modes.
Enable trip	When selected, the **Value to set when trip active** and **Value to set when trip inactive** fields are greyed (unavailable) and the combination box contains a list of the trips and events which can be enabled. When the event goes active, the selected trip or event is enabled and vice-versa.

If the **Perform action when limits exceeded** option is not checked, a branch to another event is executed when the event's limits are exceeded. This condition is shown in the **Events** window by a branch target indicator below the event icon, e.g. , with the branch target identified (**Set2** in this case). Double-clicking the icon hides or reveals the branch target.

4.4.1 Command events

CAUTION

This function should be used under guidance from Hiden Analytical Limited and with great care, as operation of the IU may be compromised by the use of an inappropriate command.

The Command event function,  , provides access to the IU command language. Double-clicking the icon opens the **Command editor** dialog box, see Figure 120.

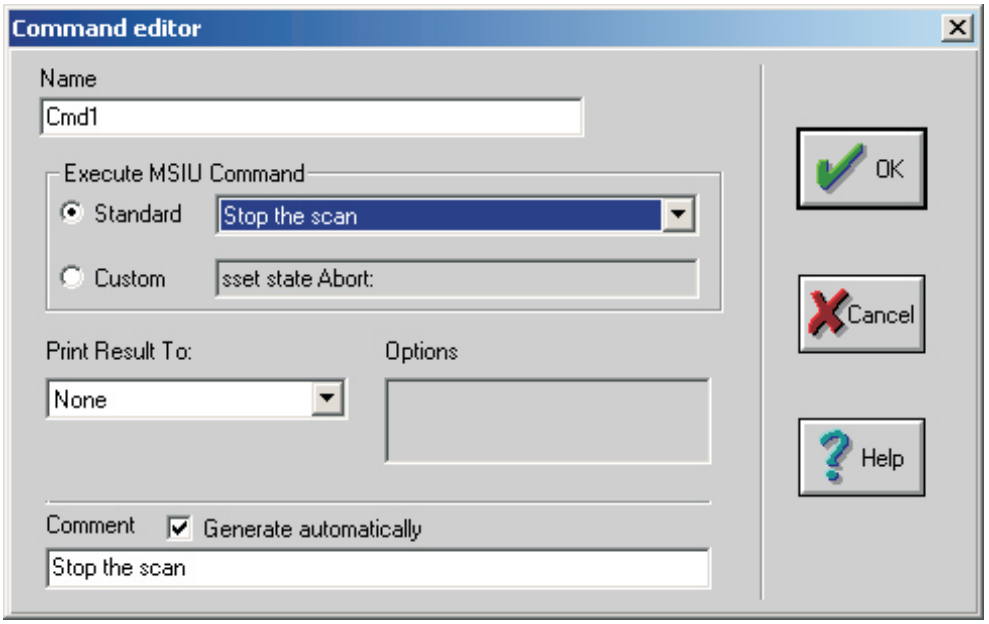

Figure 120 Command editor dialog box

Name	This text box allows the object name to be changed.
Execute MSIU command	An IU command may be entered into this box; this is executed when the event executes.
Print Result To	If required, any output generated as a result of the command execution can be directed to an output port using this control.
Options	A list of options supported by the firmware version of the instrument is displayed. Double click on an option to select or deselect it. A selected option is preceded by a *****.
Comment	A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option

Generate automatically	MASsoft will generate a comment from the entries in the dialog box

Option	Function	Firmware version
End:	The message does not continue. The next message will start on a new line. This option is not required if printing results to **None**	R5.6 onwards
Continue:	The message continues. The next message follows on the same line as the output from the command.	R5.6 onwards
#=Value	A # character embedded in the message will be replaced with the event's value, using the value's associated device format. Use a Set event to store the value in the Command event. This option can be used to pass a value as an argument to a command	R5.6 onwards

For backwards compatibility with old Event Sequences if neither End: nor Continue: are selected then the message continues; the Command event must be followed by a Print Text event which ends the message; failure to end the message will cause MASsoft to crash.

Note:

*The **Print result to** field depends on the **[STREAMS]** entries in the HIDEN.INI file; if this section is missing the **Print result to** list box will be blank, see Appendix .*

Standard commands are obtained from the file "msiu commands.txt" in the MASsoft program folder. Custom commands may be any legal MSIU command.

4.4.2 Task event

CAUTION

This function should be used under guidance from Hiden Analytical Limited and with great care, as operation of the IU may be compromised by the use of an inappropriate command.

Note:

This function is only available if the EPROMs fitted to the system are V3.4 or above.

A Task event,  , is similar to a Command event, see Section 4.4.1; the specified command is executed as a task by the IU, running in the background. Users who require this function should contact Hiden Analytical Limited for help. Double-clicking the icon opens the **Task editor** dialog box, see Figure 121.

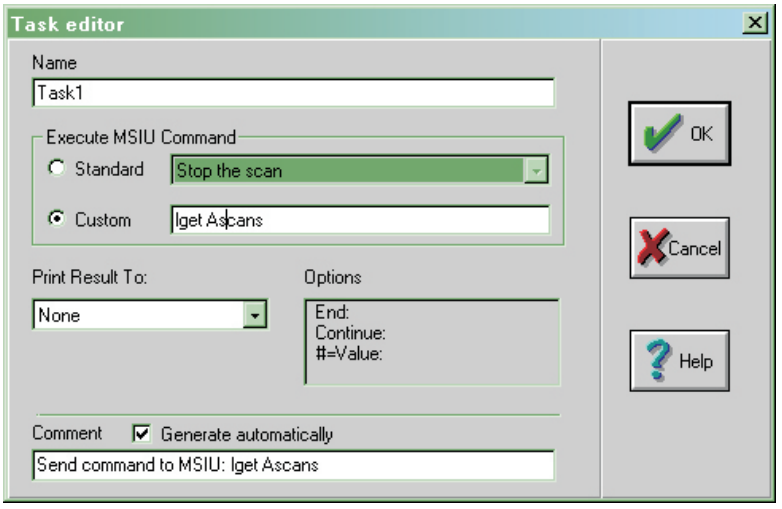

Figure 121 Task editor dialog box

The options available in this dialog box are identical to those in the **Command editor** dialog box, see Section 4.4.1.

Note:

The **Print result to** *field depends on the* **[STREAMS]** *entries in the HIDEN.INI file; if this section is missing the* **Print result to** *list box will be blank.*

4.4.3 f(x) Input Device

The f(x) Input Device,  , is used to associate a f(x) input with an event sequence to calculate and return the result.

f(x) Input Devices appear under the Trip list marker,  .

The sequence specified in **Run event sequence** is run once for each step in the scan specified by **Scan** and the value read from the step specified by **Get input value from** is returned as the result, as if it were a reading from a normal input device.

The scan specified by **Scan** must have f(x) as its input device.

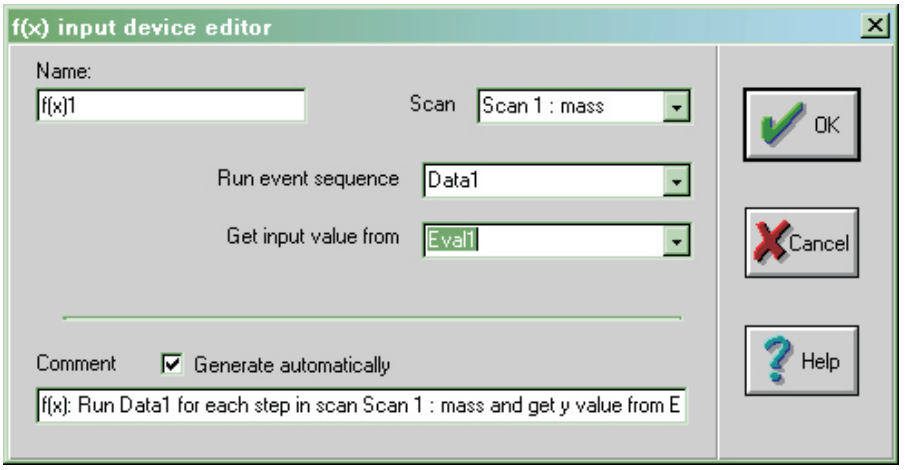

Figure 122 f(x) input device editor dialog box

In Figure 122 when the f(x) input device on Scan 1 is read the sequence starting at Data1 is run. The sequence runs to completion, that is until a  End sequence marker is reached, then the result is read from Eval1's value and returned to the scan.

Name:	This text box allows the object name to be changed.
Scan	Specifies the scan which's f(x) input is to be calculated.
Run event sequence	Specifies the sequence step to run. May be omitted if the result has already been calculated by an earlier call to a f(x) input.
Get input value from	Specifies the sequence step to read the value from.

Comment	A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option
Generate automatically	MASsoft will generate a comment from the entries in the dialog box

Note

*If a Data Event is pasted from one file to another then the **Read data from scan** test box is not copied.*

*If the **Read data from scan** text box is left empty the event sequence will not download and the file containing it will not run.*

4.5 x-axis Scan device

The f(x) output device,  , is used associate an f(x) output (i.e the scan's scanned device) with an event sequence; this sequence can then take the x axis ordinal and use it to calculate a value to output.

f(x) Output Devices appear under the Trip list marker,  .

For each step in the scan specified by **Scan** the X axis value is stored in the step specified by **Store X axis value in** and the sequence specified in **Run sequence** is run.

The scan specified by **Scan** must have f(x) as its output device.

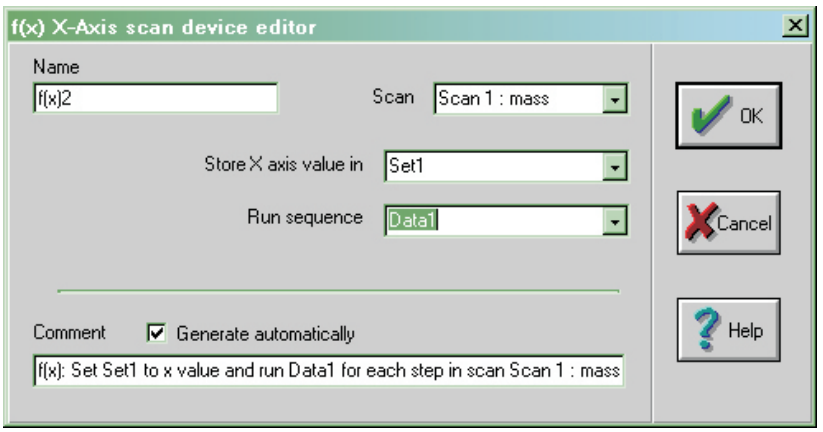

Figure 123 f(x) X-Axis scan device editor dialog

In Figure 123 when the f(x) input device on Scan 1 is read the sequence starting at Data1 is run. The sequence runs to completion, that is until a  End sequence marker is reached, then the result is read from Eval1's value and returned to the scan.

Care must be taken that the step referred to in **Store X axis value in** does not have its value over-written by running the sequence before the value has been retrieved.

Name	This text box allows the object name to be changed.
Scan	Specifies the scan for which the f(x) output is to be calculated.
Store X axis value in	Specifies the sequence step to store the X axis value for each step of the scan in.
Run sequence	Specifies the sequence step to run.
Comment	A comment can be entered here. It appears in the right hand pane of the listing. Typing in this text box disables the **Generate automatically** option
Generate automatically	MASsoft will generate a comment from the entries in the dialog box

Note

*If a Data Event is pasted from one file to another then the **Read data from scan** test box is not copied.*

*If the **Read data from scan** text box is left empty the event sequence will not download and the file containing it will not run.*

4.5.1 Sequence end marker events

The sequence end marker,  , marks the end of an event sequence; it is used either to end that particular event task or to branch to another event or sequence. Double-clicking the icon opens the **Sequence marker editor** dialog box, see Figure 124.

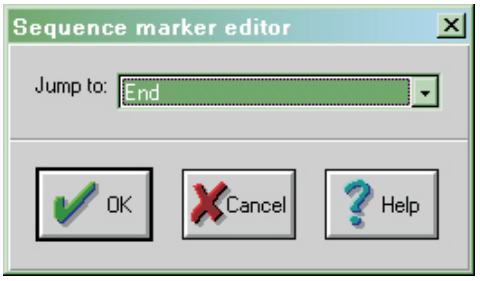

Figure 124 Sequence marker editor dialog box

Jump to	This combination box lists all the available icons. The default target is **End**, which terminates the attached sequence.

4.6 Event log

4.6.1 Event log display

Print text and Print number event messages can be sent to the event log file by selecting **EventLog** in the **To:** box of their respective editor dialog boxes, see Sections 4.2.4 and 4.2.5.

The messages in the event log file can be viewed by selecting the Menu Bar **Views**, **Events log** command. This opens the **Event log** window, see Figure 125.

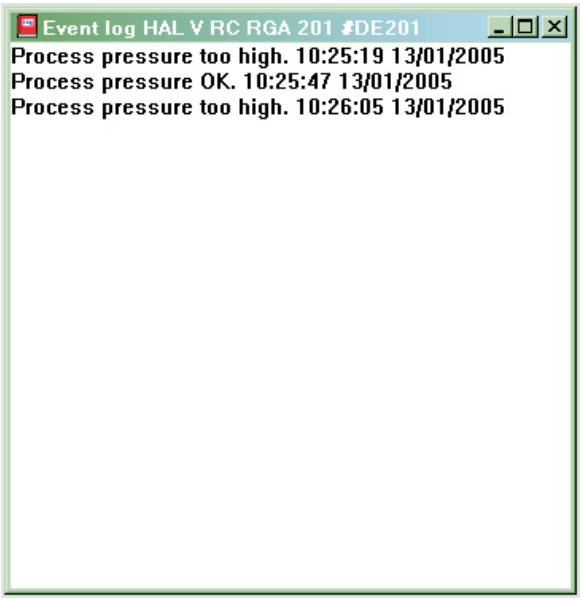

Figure 125 Event log window

When messages are received during acquisition, **Event** log windows are created, on a per mass spectrometer basis, if not already open. Each new message from a given mass spectrometer is displayed below the last (unless an <FF> form feed control character is present on the line). The window automatically scrolls to ensure the most recent message is visible.

Right clicking with the cursor in the **Event log** window opens the **Event log** window menu, see Figure 125.

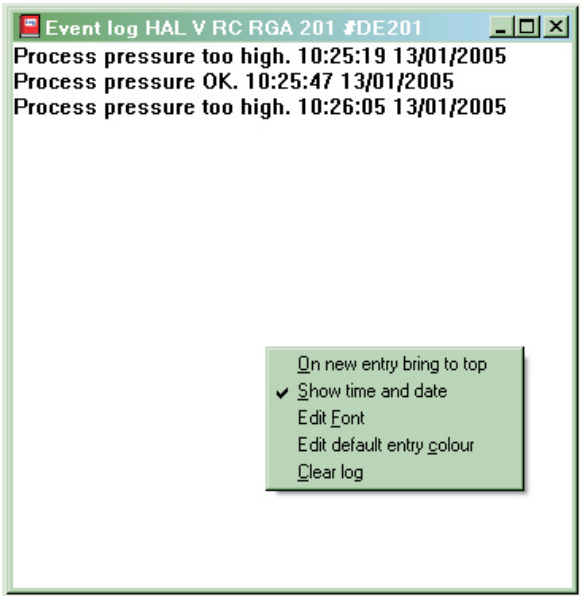

Figure 126 Event log window pop-up menu

The following options can be selected from this menu:

On new entry bring to top	When this option is selected and a new message arrives, the Event log window is brought to the front of the display.
Show time and date	When selected, this option displays, at the end of the message, the time and date at which the message arrived.
Edit font	This opens a dialog box which allows the text font on the Event log window to be changed.
Edit default entry colour	This opens a dialog box which allows the text colour of new messages to be defined.
Clear log	The **Clear Log** option will archive the events, resulting in an empty Event log.

Note:

MASsoft will only display events in the Event log and then only up to a maximum of 500 events. However, both the Archive and Event logs are text files and can be viewed via any text editor.

4.6.2 Event log creation

When the Event log window is created the Event log will be interrogated before the most recent events are displayed. If the Event log exceeds 64kb it will be reduced in size by about 25%, with the oldest events being archived. The Archive log will then be interrogated and if it exceeds 1Mb it will be reduced in size by about 10%, with the oldest events being discarded. This ensures neither log grows indefinitely and the most recent events are retained.

4.6.3 Event log formatting

The event log display can be formatted by inserting one or more format tags in the **Print text editor** dialog box **Print message:** text box; see Figure 127. The format tags can be placed before or after the message.

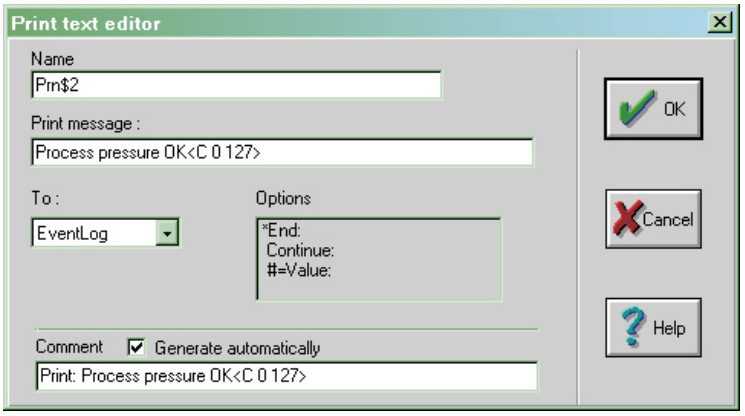

Figure 127 Print text editor, message format tag

The following format tags are available:

<FF> Form feed: each line containing this appears at the top of the **Event log** window. The event log then scrolls from line to line containing this character.

<FSxxx> Specifies the height of the line, defined by the number **xxx**. **xxx** is the font size, in pixels for positive numbers, in points for negative numbers.

<BEEP> If Windows sound is enabled, an audible “beep” is made when a line containing this control character is received.

<C xxx xxx xxx> Defines the colour of the text in the line in the primary colour sequence Red, Green, Blue. **xxx** represents a number, having a value between zero and 255, for each primary colour. Combinations of numbers can be used to create different colours, e.g.

<C 255>	Red
<C 000 255>	Green
<C 000 000 255>	Blue
<C 255 000 255>	Magenta

The monitor colour resolution may limit the display of these colours.

4.7 Internal trip devices

4.7.1 General

Several input and output devices, suitable for use in trip lists, are available in the IU.

Note:

The device names are case sensitive and must be typed exactly as shown in the following sections.

4.7.2 Input devices

inhibit This is a logical device which indicates the state of the IU's rear panel inhibit input. Device values are **1** when operation is inhibited and **0** when enabled.

emok This is a logical device which indicates that the required electron emission current in the ion source is being achieved. Device values are **1** when the required emission is being achieved and **0** when the required emission is not being achieved.

ptrip (Analogue instruments only.) Reads the over pressure trip input from the RF head. Device values are **1** when operation is inhibited and **0** when enabled.

4.7.3 Output devices

trip1 and trip2 These are logical devices connected to the MSIU's trip relays 1 and 2. A usage counter is associated with these devices so that they can be shared with multiple intensity trips. **Intensity** trips should set the device with a value of **1**, which increments the usage counter, and reset the device with a value **-1**, which decrements the counter. When the counter value is **>0** the relay is energised, and when the counter value is **0**, the relay is de-energised.

Event sequences should initially set the trips to a known state, and then must keep track of the relay state if more than one limit is exceeded. Event sequences should set the device with a value of **1**, and reset it with a value of **0**. See the example in Section 3.9.1, which shows how to use these devices in an event sequence.

fault-LED This is a logical device connected to the IU's front panel red fault Light Emitting Diode (LED). Device values are **1** to turn the LED on, **0** to turn it off.

beep Sounds the beeper in the IU. It takes the values of **1**, **0** and **-1** and operates in the same way as **trip1** and **trip2**.

4.7.4 Timers

delay	Inserts a delay into a sequence; it can be set with a value in milliseconds.
timer	Inserts a delay into a sequence. It can be set to a value in seconds. (This function is only available if the EPROMs fitted to the system are V3.9 or above.)
watchdog	Increments once per second. It is reset to zero each time the PC interrogates the IU's error buffer, and may be read to check that the PC is still connected and running MASsoft. Under normal circumstances, the PC will read the buffer at least once per second.
protection	Can be used to disable the built-in protection trips. The device is set to the number of seconds for which the protection is to be disabled. After this time has elapsed protection will be re-enabled. This device must be reset periodically to keep protection disabled.

Note:

This function is only available if the EPROMs fitted to the system are V3.4 or above.

4.7.5 Commands

lini (device)	Initialises an output device to its default setting.
sset state Abort:	Stops all scanning immediately.
sset state	Starts a paused scan, see below.
sset state Wait:	Makes a scan pause at the start of a cycle until the state is cleared by the **sset state** command.
sset state Pause:	Makes a scan pause after the current reading. The scan is restarted by the **sset state** command.
sset state Stop:	Makes a scan stop at the end of the current cycle.
trun <event>	Runs an event sequence. When used in a command event, **<event>** is run as a sub-routine. When used in a task event **<event>** is run as a stand-alone task. **<event>** must be an event object, not a sequence marker.

5 Training document - Quick Start Guide

This section of the manual reproduces the MASsoft training document "Advanced MASsoft: Event Sequences".

5.1 The Events Editor

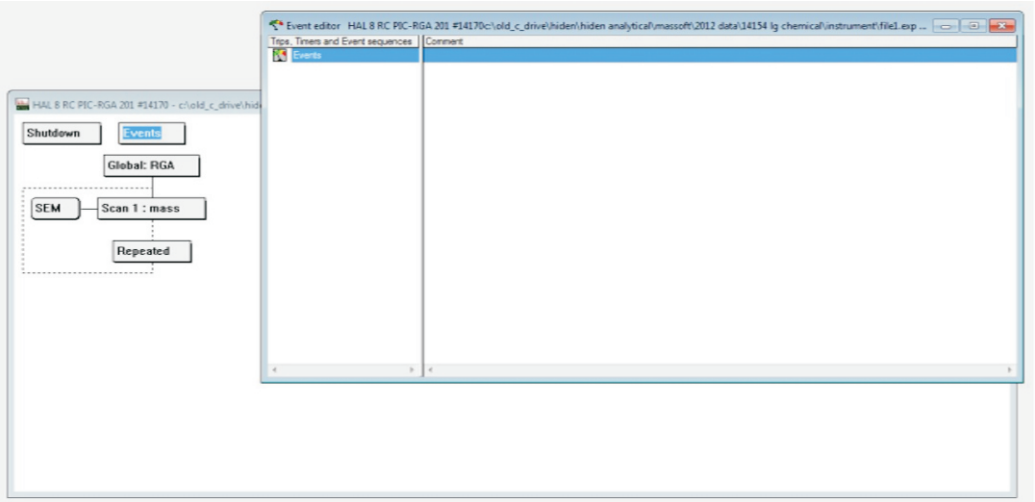

Figure 128 Events editor window

The Event editor allows the user to program commands or calculations which will be performed in real time simultaneously with the data acquisition.

A series of calculation lines can be programmed to create a sequence. Think of it like a big calculator or a spreadsheet.

5.1.1 Steps to create an event sequence, most common commands

Firstly, create your file as you would normally, either profile, bar or MID of your chosen masses with your chosen detector ranges.

In the Scan Tree double click on **Events** box. This opens up the **Event editor** window.

The **Event editor** window works separately from the scan tree.

5.1.1.1 Data event

A command called Data event is used to link the data in a scan into the Event editor box.

In the **Event editor** window right click on **Events** and select **Data event** to add a data event line to the event sequence.

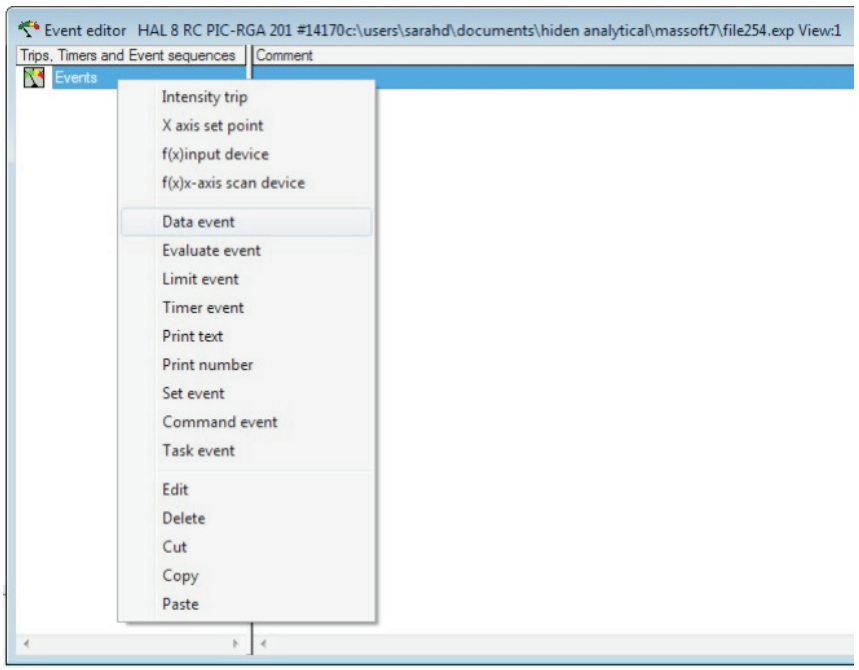

Figure 129 Data event

Double click on the newly added **Data1** line to open the **Data editor**.

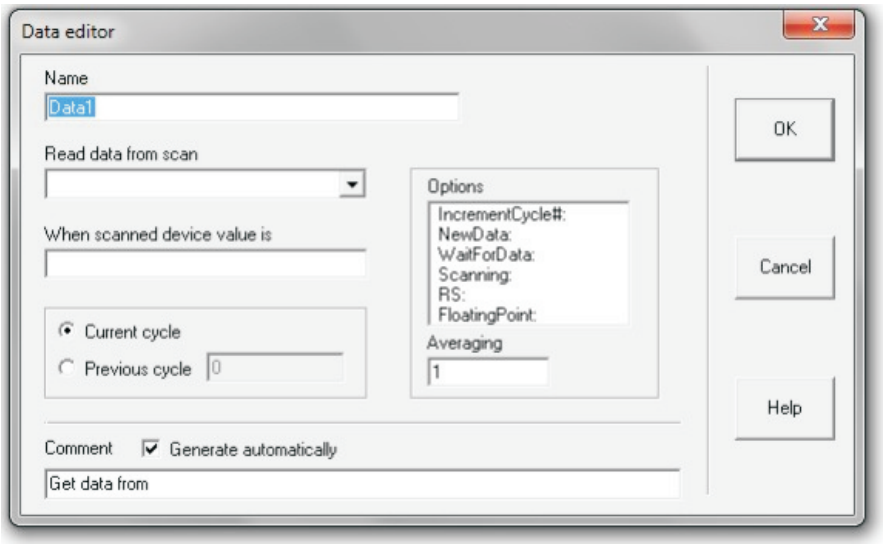

Figure 130 Data editor

Here you assign a name to the line, select from which scan in your file the data will be read and select the mass from within that scan that you want to perform the calculation on.

When selecting a name the first seven characters need to be different for each event line you add.

An example would be to use ‘28_get’ to read the value from a scan that contains data for mass 28.

Note

You cannot use spaces when naming event sequence lines.

5.1.1.2 Evaluate event

A command called Evaluate event is used to perform calculations on the data that have been read into the event editor box.

Right click on the last line in your event sequence and select **Evaluate event**. Eval1 will be added to the event sequence. Double click on **Eval1** to open the **Evaluate expression editor**.

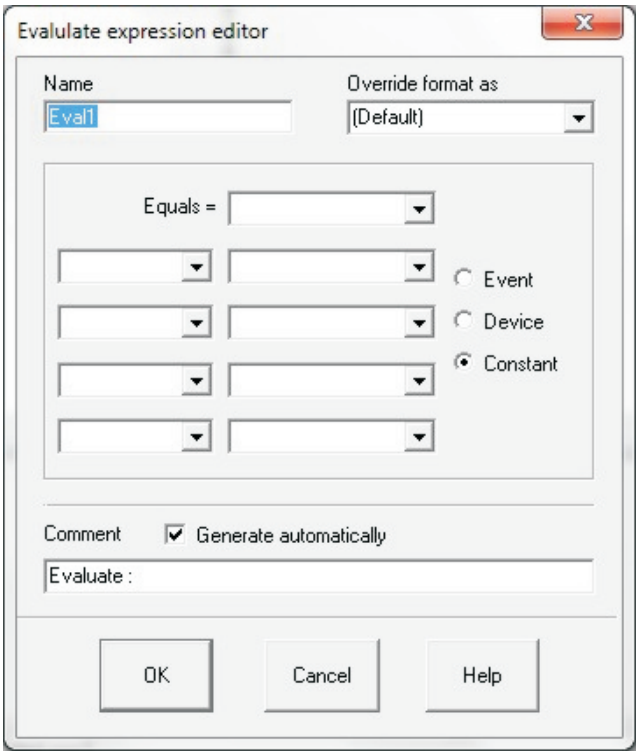

Figure 131 Evaluate event editor

Here you can assign the event a name and select the calculation you want to perform.

Selecting Event will allow a list of current event lines that you have made to be displayed when you click on the drop down box.

Available actions to perform on the data include:

+, -, x, ÷, power, root, log.

5.1.1.3 f(x) input

The command f(x)input device is used to link your calculated functions back into the scan tree in order for it to be displayed alongside your raw data values when you run the scan.

To do this additional scans need to be added to your scan tree in to which the newly calculated data can be linked.

In the **Event editor** window right click on **Events** and select **f(x)input device**.

Below a line called **Trips** an **f(x)1** line will be added.

Double click on this line to open the **f(x) input device editor**.

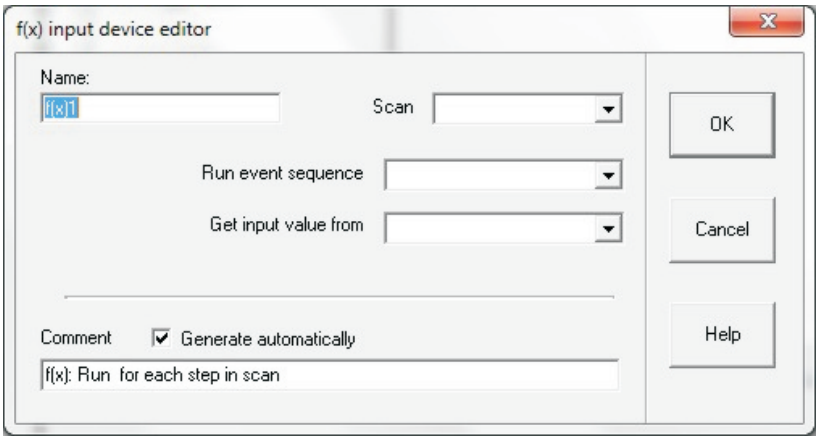

Figure 132 f(x) input device editor

Here you tell MASsoft which scan box in your file you want to input your calculated value from your event sequence.

The name can be left as the default **f(x)1**.

Scan	The Scan number in the scan tree that you want your value to be displayed in.
Run event sequence	The point in the sequence from where you want the calculations to be performed. This is always **EventSequence 1** for the first f(x) line as you want all of the events to be run and calculated from the beginning of the event sequence.
Get input value from	The event line that once calculated will be input into the scan box and displayed.

5.1.2 How it works

When you start your scan the software applies the settings in the **Global: RGA** box then moves onto **Scan 1**. The arrows in the scan tree show that after that data has been collected it moves onto **Scan 2** and so on.

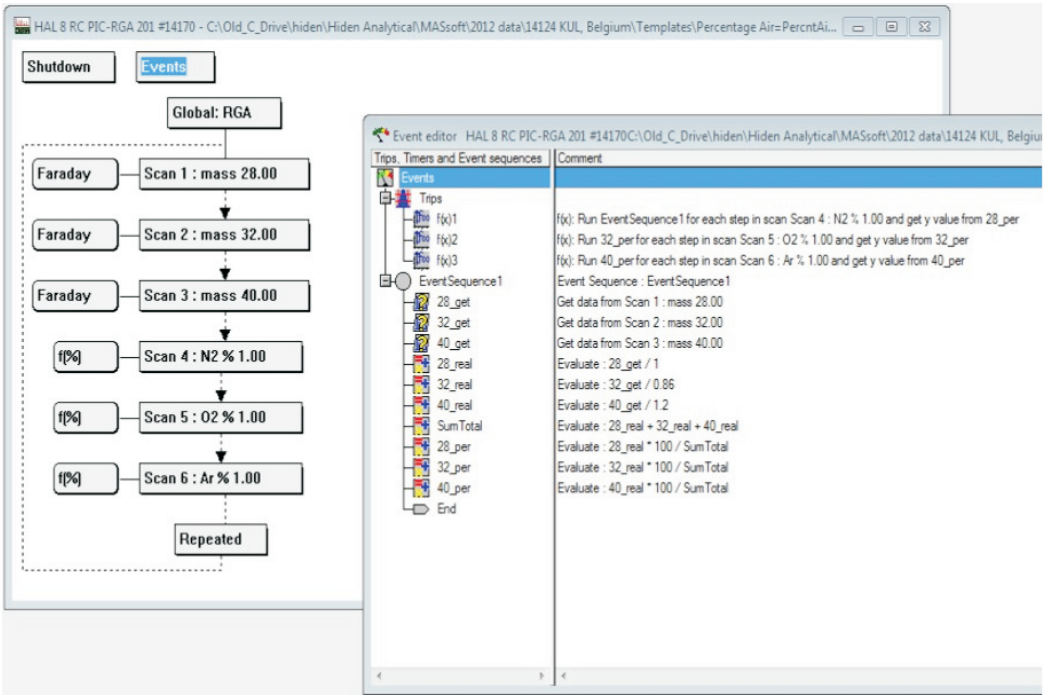

Figure 133 Event sequence operation

By using the f(x) input device command you are creating a ‘virtual trip’. This means when the software reaches scan 4, for example, it ‘trips’ and links into the Event Sequence. At this point it performs the commands as per the f(x) input device that is linked to Scan 4 i.e. run through the event sequence that inputs the raw data from the file, perform the calculations and then input the calculated data back into the scan box.

The software then moves onto the next scan, Scan 5 and another virtual trip is applied as per f(x)2 in the event sequence.

This is all still on the first cycle of data.

When the final scan has been performed the software returns to the start of the scan tree again and will continue cycling through until stopped by the user.

5.2 Examples

5.2.1 Simple ratio calculation

This example sets out to calculate the ratio between the 36 peak and the 40 peak seen when sampling pure argon.

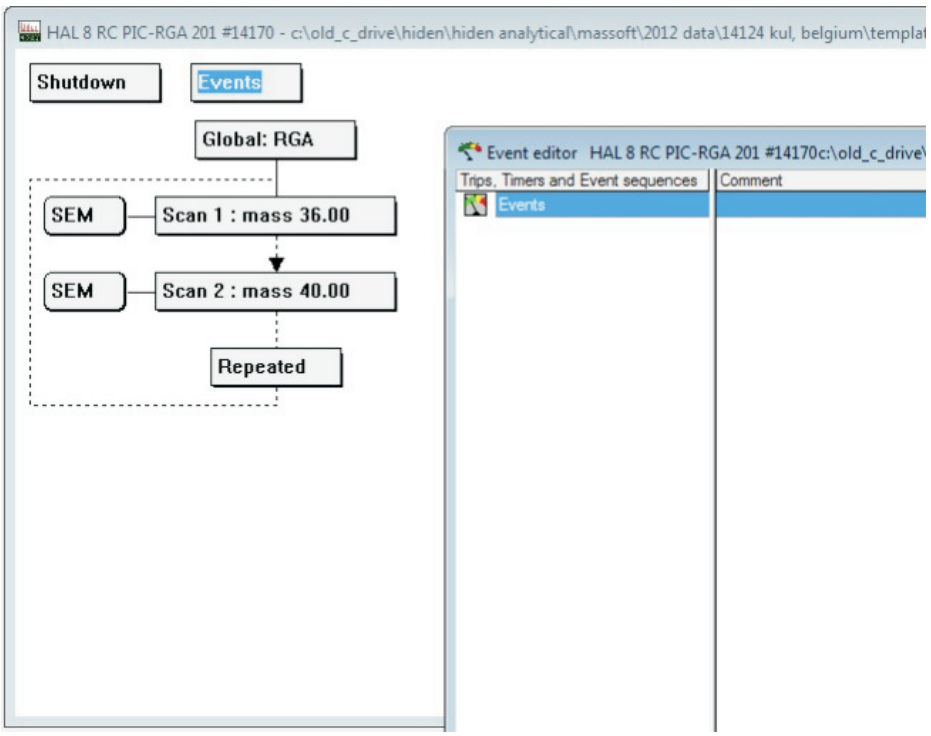

Figure 134 Argon ratio event sequence

Firstly two MID scans are made to monitor mass 36 and mass 40.

In the scan tree double click on the **Events** box to open the **Event editor**.

In the **Event editor** right click on **Events** and select **Data event**.

Double click on **Data1** to open the **Data editor**.

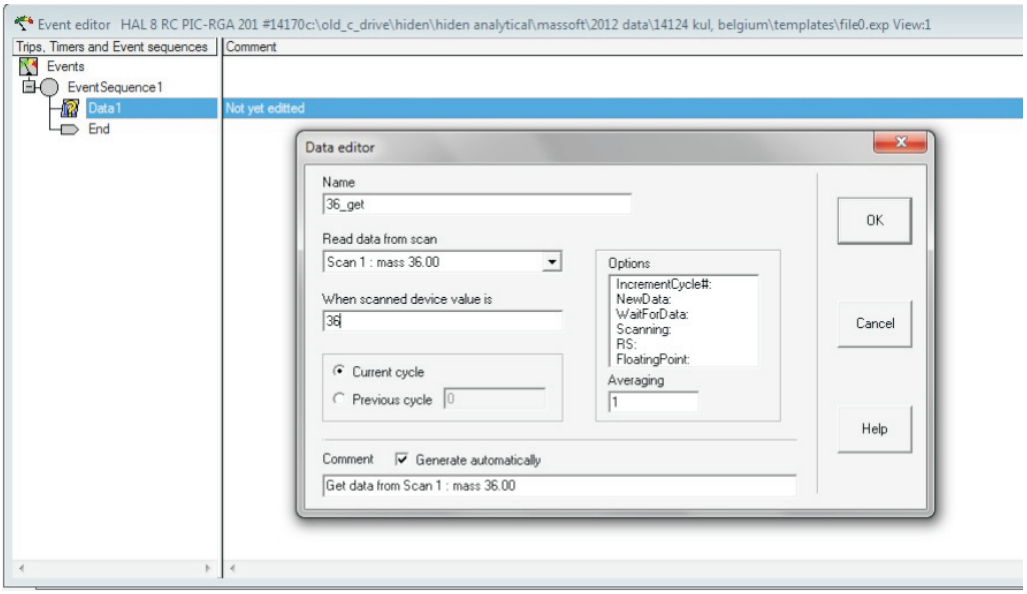

Figure 135 Argon ratio Data editor

In the **Data editor** dialog box input the following:

Name	36_get
Read data from scan	Scan1: mass 36
When scanned device value is	36

Click **OK**.

Create another Data event line beneath this for the 40 peak in Scan 2.
Now to calculate the ratio right click on the line **40_get** and select **Evaluate event**.
Double click on **Eval1** to open the **Evaluate expression editor** as shown in Figure 136.

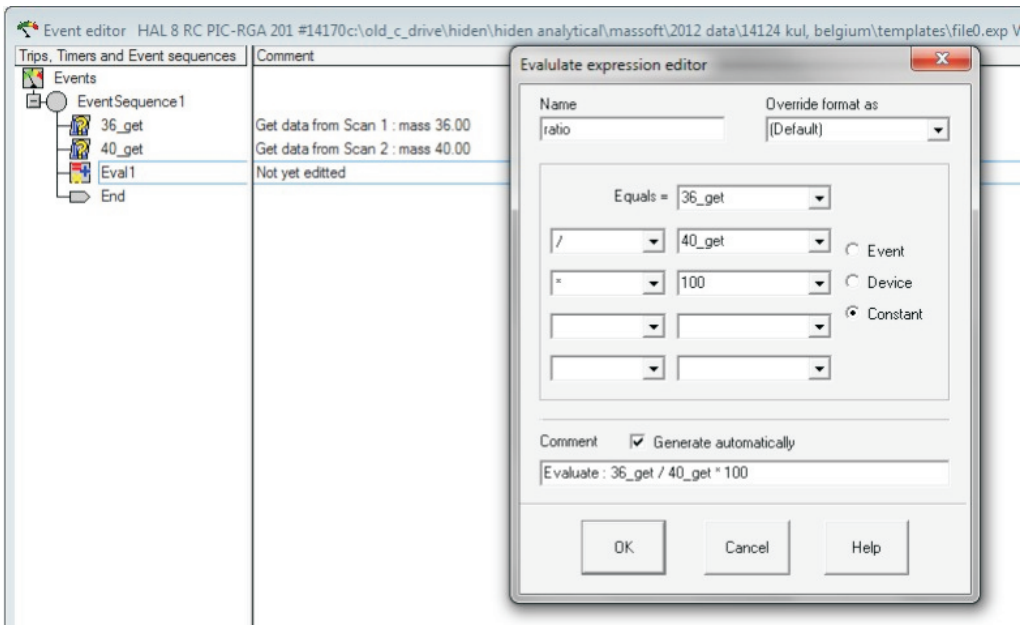

Figure 136 Argon ratio Evaluate expression editor

In the **Evaluate expression editor** dialog box input the following:

Name	ratio
Equals =	36_get
/	40_get
x	100

Click **OK**.

Back in the Scan tree add another scan for the ratio value to be read into.
Select the **MID** tab and then input the following:
Available to Scan: none
Scan Legend: Ar Ratio.
In the **Faraday** box change the available input to f(x)
as shown in Figure 137.

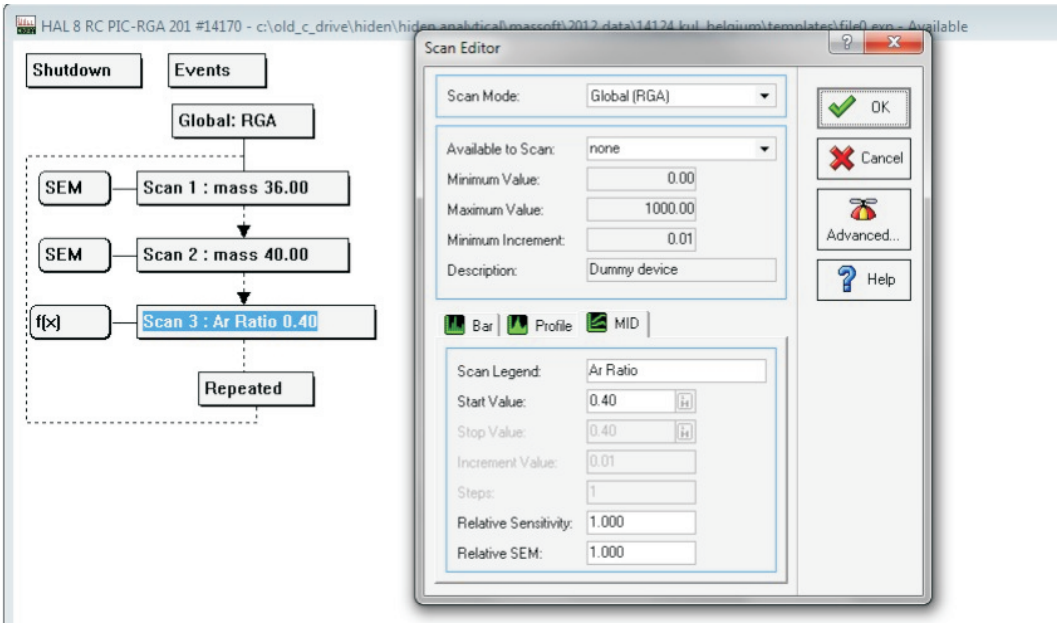

Figure 137 Argon ratio Scan 3

Finally, in the scan tree double click on the **Events** box to open the **Event editor**.

Right click on **Events** then select **f(x)input device**.

Double click on **f(x)1** to open the **f(x) input device editor** as shown in Figure 138.

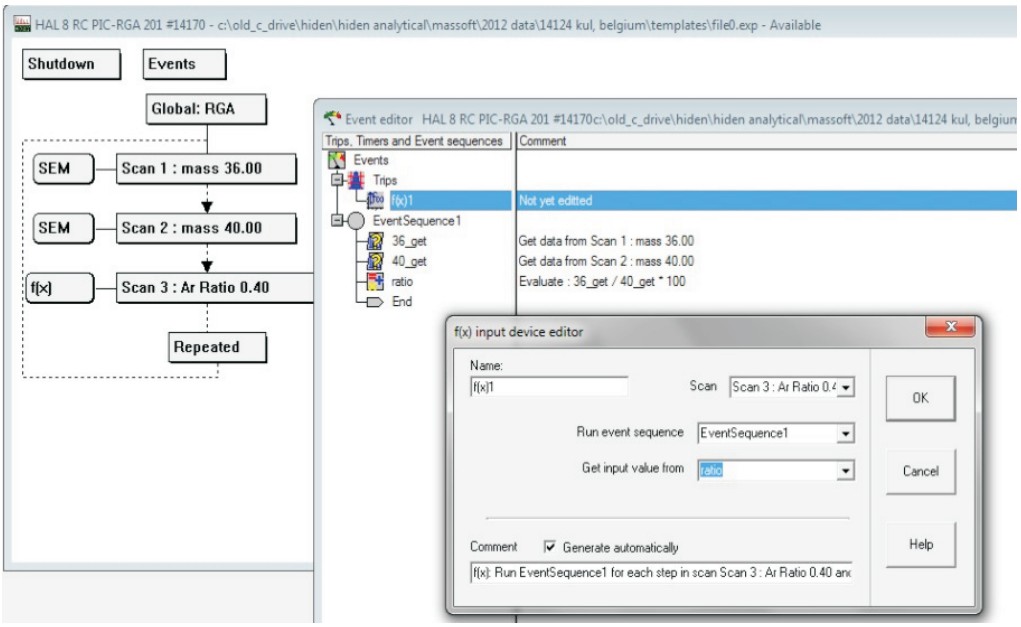

Figure 138 Argon ratio, add the ratio

In the **f(x)input device editor** dialog box input the following:

Scan	Scan 3: Ar ratio 0.4
Run Event Sequence	EventSequence1
Get input value from	ratio

Now when you start the scan you can view the ratio of the 36 peak and the 40 peak in real time by creating a view of Scan 3.

5.2.2 A Percentage file

This example sets out to calculate the percentage values of the three main air gases; nitrogen (N_2), oxygen (O_2) and argon (Ar).

For increased accuracy it will include the relative sensitivity of each gas.

The relative sensitivity is a factor we use that accounts for the probability of ionisation of the gas by the source of the mass spectrometer, relative to N_2. i.e the RS factor for N_2 is 1.

Firstly create your file to monitor the desired masses, in this case MID scans of masses 28, 32 and 40.

In the scan tree double click on **Events** to open the **Event editor**.

In the **Event editor** right click on **Events** and select **Data event**.

Double click on **Data1** to open the **Data editor**.

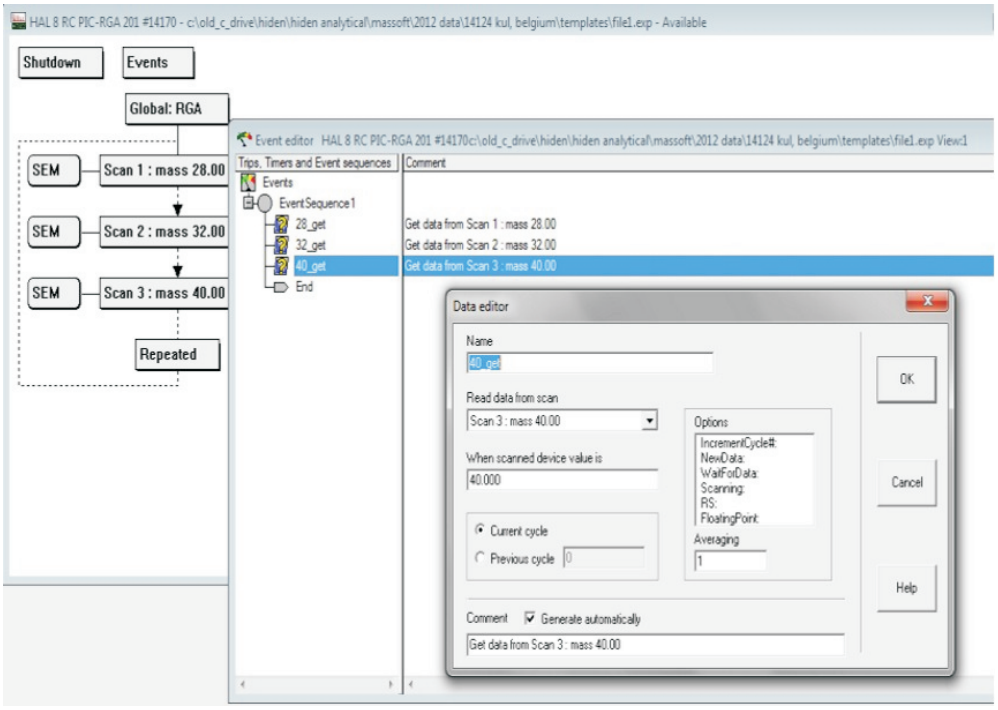

Figure 139 Percentage file, Data editor

In the **Data editor** dialog box input the following:

Name	28_get
Read data from scan	Scan1: mass 28
When scanned device value is	28

Click **OK**.

Repeat this procedure to create Data event lines for masses 32 and 40.

Refer to Figure 139.

Next right click on the line **40_get** and select **Evaluate event**.

This is where we divide the data by the gases relative sensitivity.

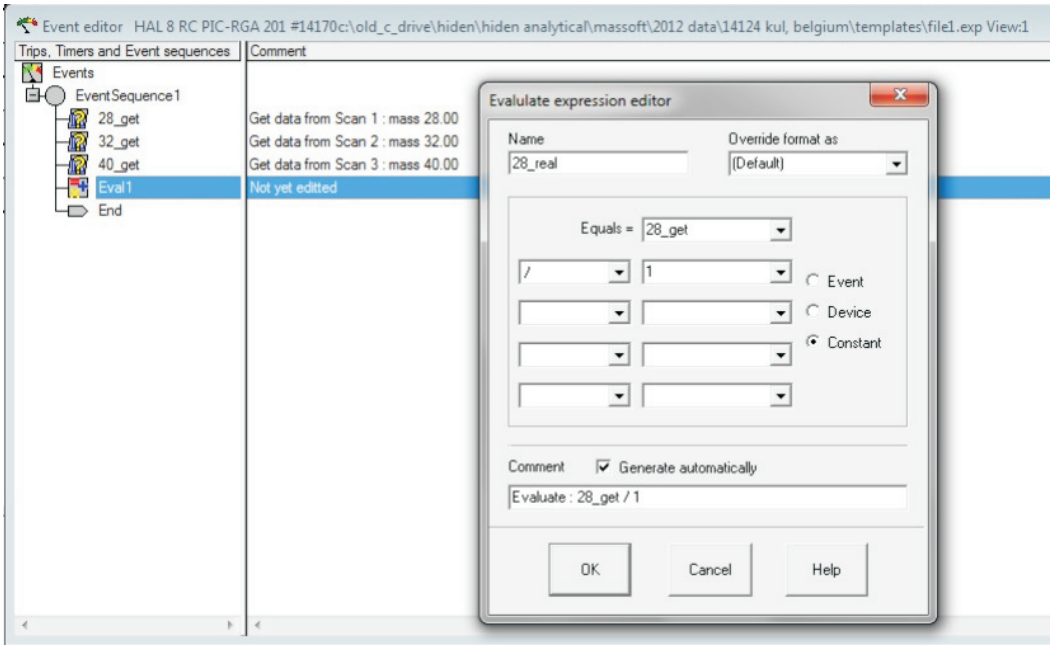

Figure 140 Percentage file, Evaluate expression editor

Double click on Eval1 and in the **Evaluate expression editor** dialog box input the following:

Name	28_real
Equals =	28_get
/	1

Refer to Figure 140.

Click **OK**.

Note

*The default relative sensitivities for common gases can be found in **Edit**, **Library**. In this example 1, 0.86 and 1.2 are used for N_2, O_2 and Ar respectively.*

Create two more Evaluate event lines for masses 32 and 40.

The next step is to sum the three gases of interest using another Evaluate event line.

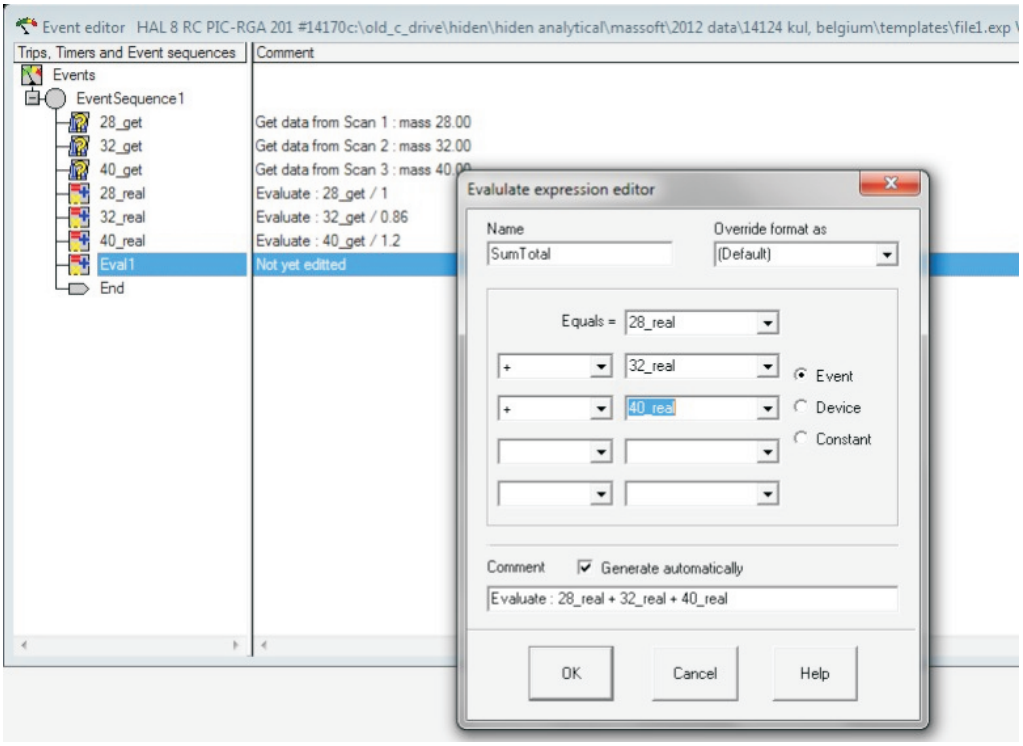

Figure 141 Percentage file, Sum the gases

In the **Evaluate expression editor** dialog box input the following:

Name	SumTotal
Equals =	28_real
+	32_real
+	40_real

Refer to Figure 141.

Click **OK**.

Now calculate the percentage value of N_2 in another Evaluate event line.

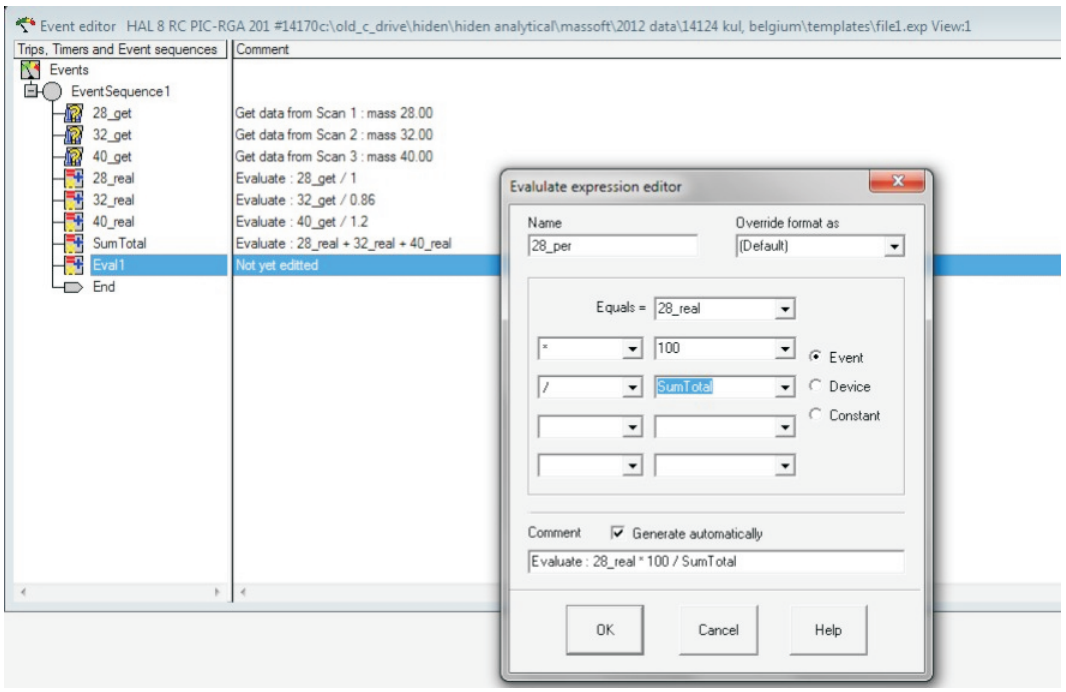

Figure 142 Percentage file, Nitrogen percentage

In the **Evaluate expression editor** dialog box input the following:

Name	28_per
Equals =	28_real
x	100
/	SumTotal

Refer to Figure 142.

Click **OK**.

Repeat this two more times creating Evaluate lines for 32 and 40.