WHS NanoTrader

Express Functions

www.whselfinvest.com

FIPERTEC
Financial Performance Technology

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Contents

What’s new

Version 3.0

New functions:

- GetCurrency()
- GetExpiration()
- GetMasterChartAggregation()
- GetMasterChartAggregationValue()

New features:

- Importing array values from a symbol

Introduction

This manual offers an overview of the available functions in the Express Module, intended as an educational tool to aid a step-by-step learning process. The functions are logically classified by category and grouped together to reflect a close relation to one another.

For every function, described in this manual, an example is provided to illustrate its utility and execution. The examples can be copy-pasted from this manual into the Express editor (see the appendix to the introduction for details on p. 7). Please note that the examples are solely offered for evaluation purposes, and must not be considered an adequate strategy for trading.

Before starting programming in WHS NanoTrader using the Express Module, it is important to familiarize oneself with the platform's most basic principles. These principles are well documented and explained in our platform manuals, video clips, and many forums, which can all be accessed from our client website.

Our video clips, in particular, deserve special recommendation. There are 75 video clips illustrating general platform capabilities and 42 video clips describing programming procedures. The programming video clips are distinctly separated into a theoretical explanation on the one hand and a practical example on the other.

Below is a short summary of the categories covered in this manual:

Symbol Information / Time Information / Alerting & Informing

These three function groups are very closely linked as Symbol Information and Time Information contain information that can be visually/auditory presented using Alerting & Informing functions.

Not only will the user experience freedom from his platform, as he will be duly notified by an indicator or signal, so too will the user experience freedom of creativity, thanks to an almost endless number of possible applications and customizations (colors, messages, sounds, etc.).

Loops & Arrays

This section covers the most basic and fundamental principles of programming in Express. It is an absolute must-read, and should therefore not be neglected.

Array functions, on the other hand, are intended for more experienced users with very specific needs.

Indexing & Efficient Programming

The indexing functions allow the user to identify any bar in a range in order to execute a set of instructions on that particular bar.

A very nice feature that falls under this category is CalculateAtEveryTick(), which allows the user to save a tremendous amount of computing capacity by holding calculations until the end of a period, rather than re-calculating the entire series at every tick.

IsFirstBar / IsFinalBar and Associated Functions

These functions should be used to concentrate all the instructions that do not need to be repeated at every bar. For example, this is the reason why IsFirstBar/IsFinalBar is used in conjunction with MovingAverage and ExpMovingAverage.

Mathematical Functions

This section is a straight-forward recapitulation of mathematical tools incorporated in Express, which will likely bring back fond memories of one's high-school days and teachers.

Charting Functions

This is a very interesting function area, allowing the user to express his creativity in customizing chart representation, such as background, chart color and type.

Importing Series

Answers the common request of applying one series to another, e.g. applying an RSI to a Moving Average.

Creating Customized Stops and Targets

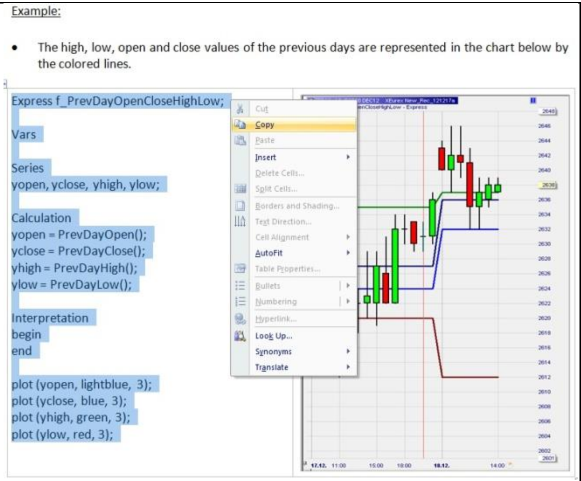
Another area where trading experience meets creativity. This function group allows the user to refine stops and targets to perfect a personalized strategy.

Predefined Interpretation Tools

This section covers an explanation of the predefined swing tools, designed to spare the user from lengthy programs.

Appendix to the Introduction

How to copy an express code from the manual and add it the express editor for display.

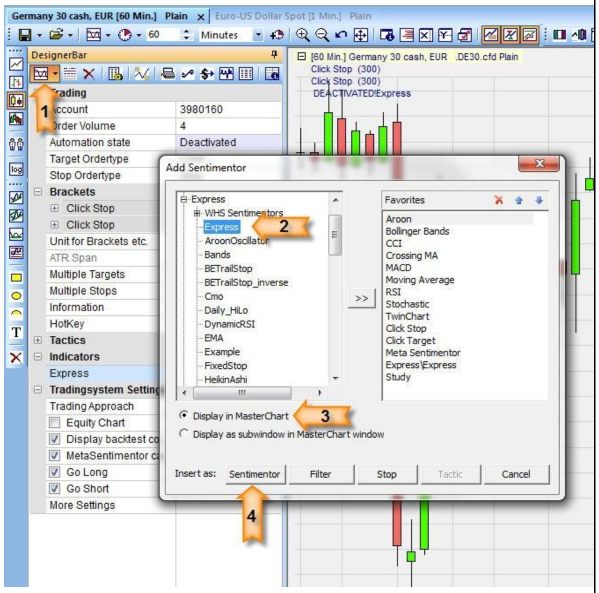


Example:

- The high, low, open and close values of the previous days are represented in the chart below by the colored lines.

```
Express f_PrevDayOpenCloseHighLow;

Vars

Series
yopen, yclose, yhigh, ylow;

Calculation
yopen = PrevDayOpen();
yclose = PrevDayClose();
yhigh = PrevDayHigh();
ylow = PrevDayLow();

Interpretation
begin
end

plot (yopen, lightblue, 3);
plot (yclose, blue, 3);
plot (yhigh, green, 3);
plot (ylow, red, 3);
```

Select the text from the manual's example (Ctrl + A), right-click, and copy (or Ctrl + C)



Germany 30 cash, EUR [60 Min.] Plain
Euro-US Dollar Spot [1 Min.] Plain
Minutes
DesignerBar
[60 Min.] Germany 30 cash, EUR .DE30.cfd Plain
Click Stop (300)
Click Stop (300)
DEACTIVATED Express
1
2
3
4

Trading	
Account	3980160
Order Volume	4
Automation state	Deactivated
Target Ordertype	
Stop Ordertype	
Brackets	
Click Stop	
Click Stop	
Unit for Brackets etc.	
ATR Span	
Multiple Targets	
Multiple Stops	
Information	
HotKey	
Tactics	
Indicators	
Express	
Tradingsystem Settings	
Trading Approach	
Equity Chart	
Display backtest co	
MetaSentimentor ca	
Go Long	
Go Short	
More Settings	

Add Sentimentor

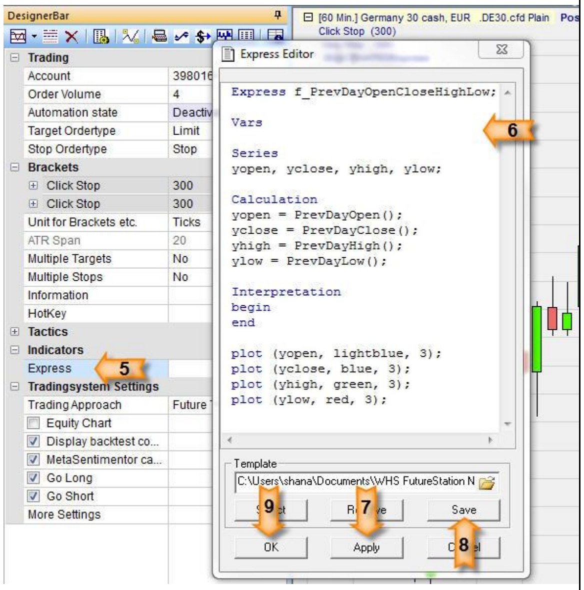
Express: WHS Sentimentors, Express, AroonOscillator, Bands, BETrailStop, BETrailStop_inverse, Cmo, Daily_HiLo, DynamicRSI, EMA, Example, FixedStop, HeikinAshi

Favorites: Aroon, Bollinger Bands, CCI, Crossing MA, MACD, Moving Average, RSI, Stochastic, TwinChart, Click Stop, Click Target, Meta Sentimentor, Express\Express, Study

(•) Display in MasterChart
( ) Display as subwindow in MasterChart window

Insert as: Sentimentor | Filter | Stop | Tactic | Cancel

1. Click Add an Indicator
2. Select Express and Express again
3. Click Display in Master Chart or in a sub window
4. Insert as Sentimentor



Trading	
Account	398016
Order Volume	4
Automation state	Deactiv
Target Ordertype	Limit
Stop Ordertype	Stop
Brackets	
Click Stop	300
Click Stop	300
Unit for Brackets etc.	Ticks
ATR Span	20
Multiple Targets	No
Multiple Stops	No
Information	
HotKey	
Tactics	
Indicators	
Express	
Tradingsystem Settings	
Trading Approach	Future
Equity Chart	
Display backtest co...	
MetaSentimentor ca...	
Go Long	
Go Short	
More Settings	

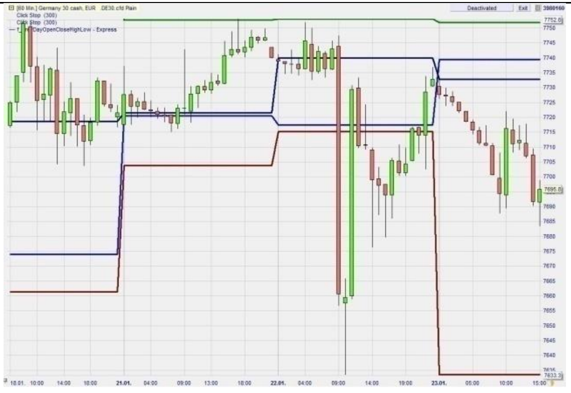
Express Editor

```
Express f_PrevDayOpenCloseHighLow;

Vars

Series
yopen, yclose, yhigh, ylow;

Calculation
yopen = PrevDayOpen();
yclose = PrevDayClose();
yhigh = PrevDayHigh();
ylow = PrevDayLow();

Interpretation
begin
end

plot (yopen, lightblue, 3);
plot (yclose, blue, 3);
plot (yhigh, green, 3);
plot (ylow, red, 3);
```

Template
C:\Users\shana\Documents\WHS FutureStation N

Select | Remove | Save
OK | Apply | Cancel

5. Double-click Express
6. Ctrl + V to paste the selected text
7. Click Apply
8. Click Save
9. Click OK



Mission Accomplished!!

Symbol information

SymbolName()

Definition:

- Returns the name of the symbol used in a study.

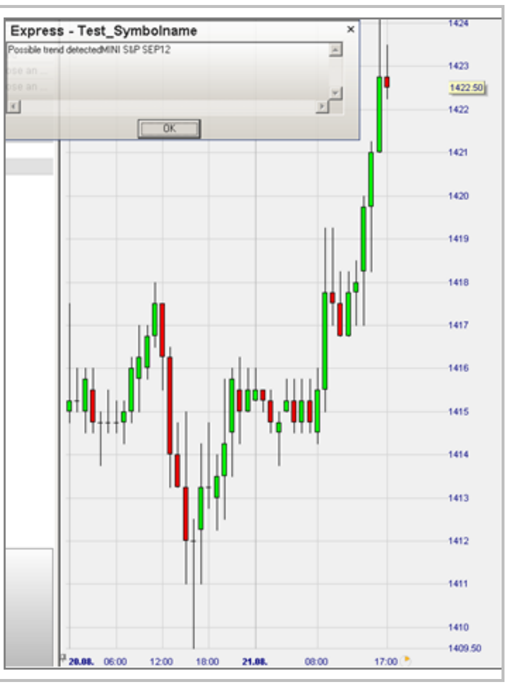
Format:

- string SymbolName()

Example:

- Below we generate a message each time the condition (close > close[1]) and (close > close[2]) is verified. The message is made of two parts, a piece of text and the name of the symbol:

```
Express f_SymbolName

Calculation

if (close > close[1]) and
   (close > close[2]) then MessageBox(
  "Possible trend detected"
  +
  SymbolName());

Interpretation
begin
end
```


Express - Test_Symbolname

Possible trend detectedMINI S&P SEP12

PointValue()

Definition:

- Shows the monetary value of one point of a given instrument.

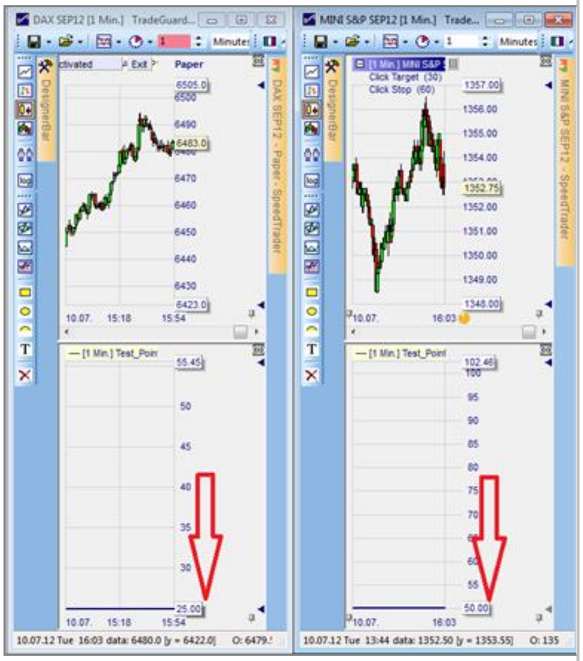
Format:

- Float PointValue()

Example:

- Displays the monetary values of a single point in DAX and MINI S&P futures: EUR 25 and USD 50 respectively.

```
Express f_PointValue

vars

Series a;

calculation

a = PointValue();

interpretation
begin
end

plot(a, blue, 2);
```



DAX SEP12 [1 Min.] TradeGuard...
MINI S&P SEP12 [1 Min.] Trade...
[1 Min.] Test_Point
25.00
50.00
10.07.12 Tue 16:03 data: 6480.0 |y = 6422.0|
10.07.12 Tue 13:44 data: 1352.50 |y = 1353.55|

TickSize()

Definition:

- Returns the tick size of the instrument.

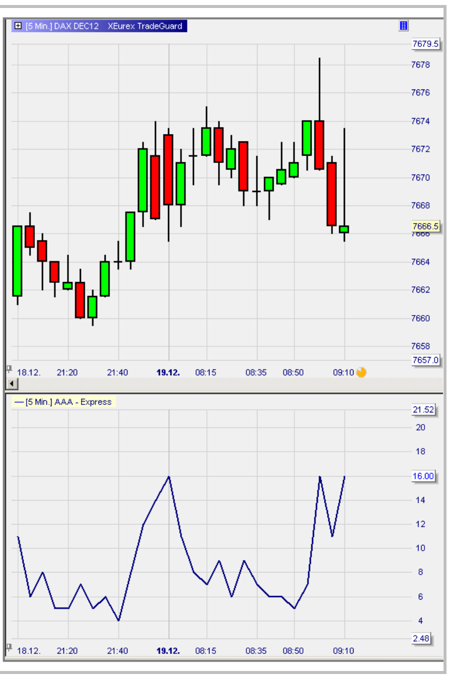
Format:

- Float TickSize()

Example:

- This indicator displays the number of ticks par bar for a given instrument.

```
Express f_TickSize

Vars

Series
a;

Calculation
a = (h-l)/TickSize();

Interpretation
begin
end

plot (a, blue, 2);
```



TickValue()

Definition:

- Returns the monetary value of one tick for a given instrument.

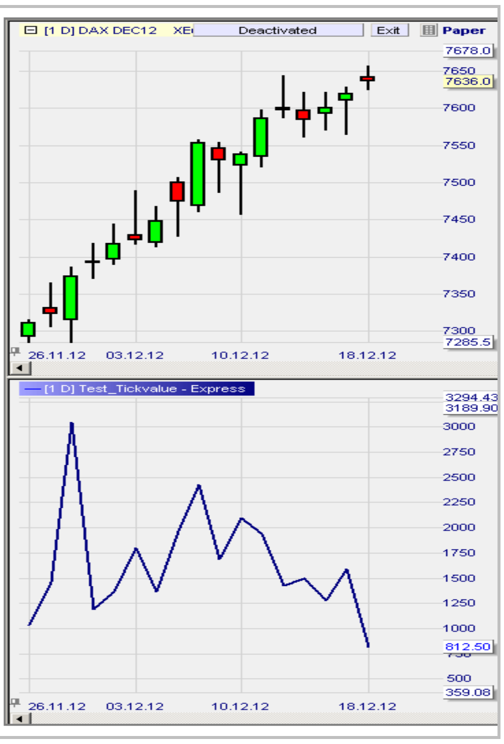
Format:

- Float TickValue ()

Example:

- Indicator a displays the monetary values of the daily price variations of a given instrument.

```
Express f_TickValue;

Vars

Series
a;

Calculation

a = (h - l)/TickSize()*TickValue();

Interpretation
begin
end

plot(a, blue, 2);
```



PrevDayHigh() / Low() / Open() / Close()

Definition:

- The functions below
  - PrevDayHigh()
  - PrevDayLow()
  - PrevDayOpen()
  - PrevDayClose()

  return the high, low, open and close values of the previous day. In case the data is not available the value returned is void.

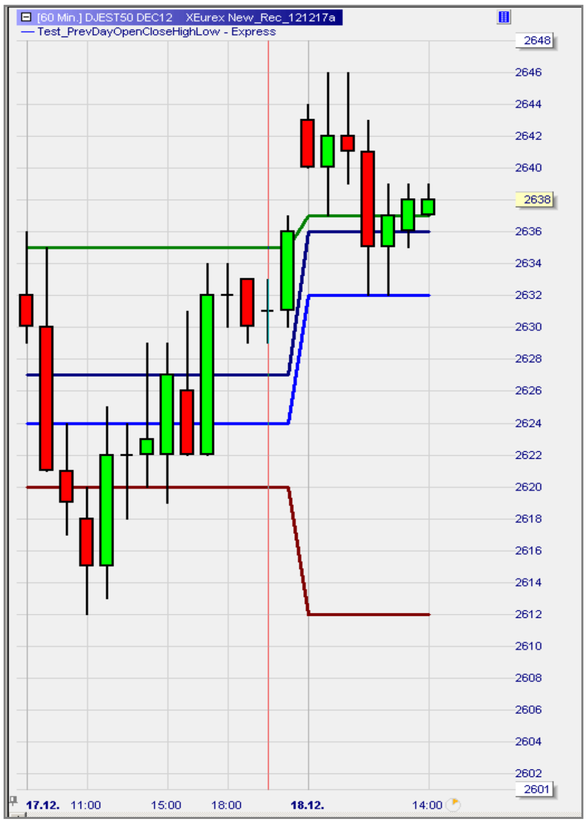
Format:

- Float PrevDayHigh() …

Example:

- The high, low, open and close values of the previous days are represented in the chart below by the colored lines.

```
Express f_PrevDayOpenCloseHighLow;

Vars

Series
yopen, yclose, yhigh, ylow;

Calculation
yopen = PrevDayOpen();
yclose = PrevDayClose();
yhigh = PrevDayHigh();
ylow = PrevDayLow();

Interpretation
begin
end

plot (yopen, lightblue, 3);
plot (yclose, blue, 3);
plot (yhigh, green, 3);
plot (ylow, red, 3);
```



PrevDayVol()

Definition:

- Returns the volume of the previous day or void in case the data is not available.

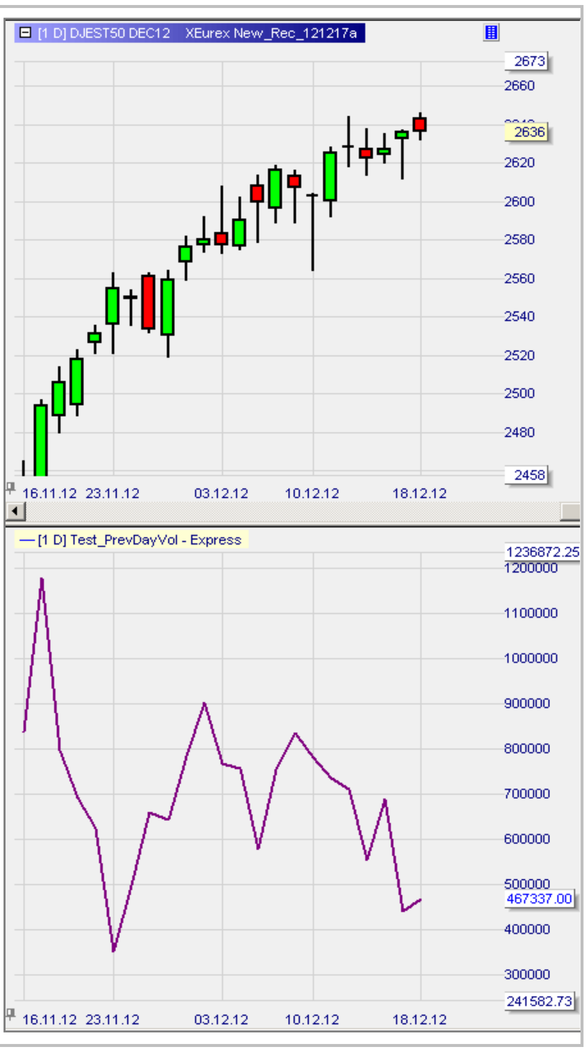
Format:

- Float PrevDayVol()

Example:

- The value of the volume of the previous days is displayed in the sub window:

```
Express f_PrevDayVol

Vars

Series
yvolume;

Calculation
yvolume = PrevDayVol();

Interpretation
begin
end

plot (yvolume, lightmagenta, 2);
```



GetCurrency()

Definition:

- Returns the base currency of the symbol used in a study.

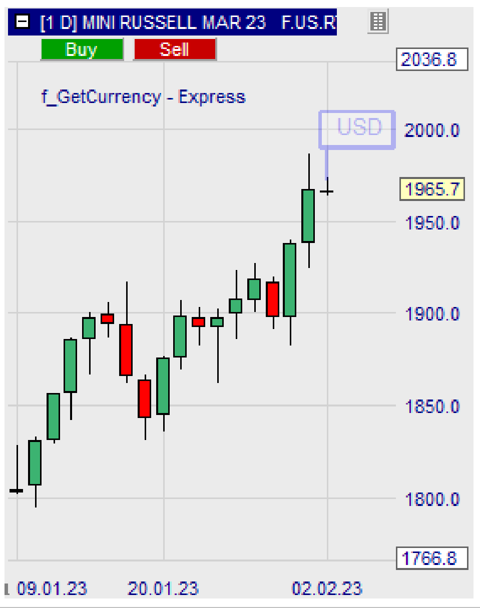
Format:

- string GetCurrency()

Example:

- The base currency of the symbol is displayed in a message box in the final bar.

```
Express f_GetCurrency

vars

calculation
if IsFinalBar() then Highlight("textabove:
"+GetCurrency(),"blue");

interpretation
begin
end
```



GetMasterChartAggregation()

Definition:

- Returns the aggregation unit of the master chart expressed as an integer between 0 and 10.
    - 0 – daily, 1 – weekly, 2 – monthly, 3 – minutes, 4 - seconds, 5 – ticks, 6 – volume, 7 – span abs, 8 – span percent, 9 – Renko abs, 10 – WL Bars

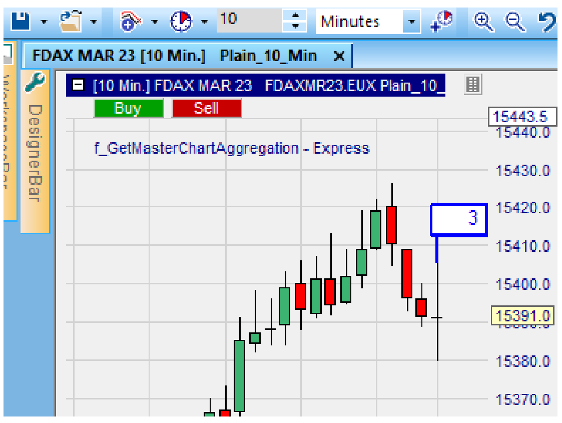
Format:

- int GetMasterChartAggregation()

Example:

- The master chart aggregation unit of the 10-Minutes chart is displayed as an integer value in a message box in the final bar.

```
express f_GetMasterChartAggregation

calculation

if IsFinalBar() then Highlight("textabove:"
+NumericToString(GetMasterChartAggregation(),
"%6.0f"),"blue");

interpretation
begin
end
```


10
Minutes
FDAX MAR 23 [10 Min.] Plain_10_Min
DesignerBar
[10 Min.] FDAX MAR 23 FDAXMR23.EUX Plain_10_
Buy
Sell
f_GetMasterChartAggregation - Express
3
15443.5
15440.0
15430.0
15420.0
15410.0
15400.0
15391.0
15380.0
15370.0

GetMasterChartAggregationValue()

Definition:

- Returns the aggregation value of the master chart expressed as a float value.

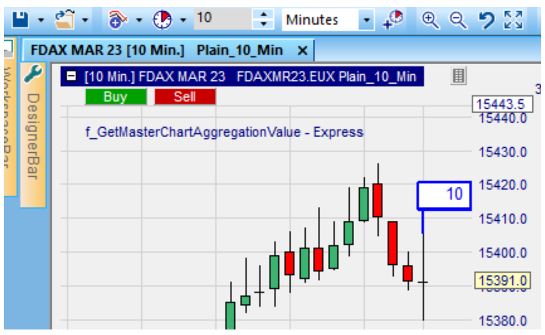
Format:

- float GetMasterChartAggregationValue()

Example:

- The master chart aggregation value of the 10-Minutes chart is displayed in a message box in the final bar.

```
express f_GetMasterChartAggregationValue

calculation

if IsFinalBar() then Highlight("textabove:"
+NumericToString(GetMasterChartAggregationValue(),
"%6.0f"),"blue,100");

interpretation
begin
end
```



10
Minutes
FDAX MAR 23 [10 Min.] Plain_10_Min
DesignerBar
[10 Min.] FDAX MAR 23 FDAXMR23.EUX Plain_10_Min
Buy
Sell
f_GetMasterChartAggregationValue - Express
10
15443.5
15440.0
15430.0
15420.0
15410.0
15400.0
15391.0
15380.0

Time information

DayOfWeek()

<u>Definition:</u>

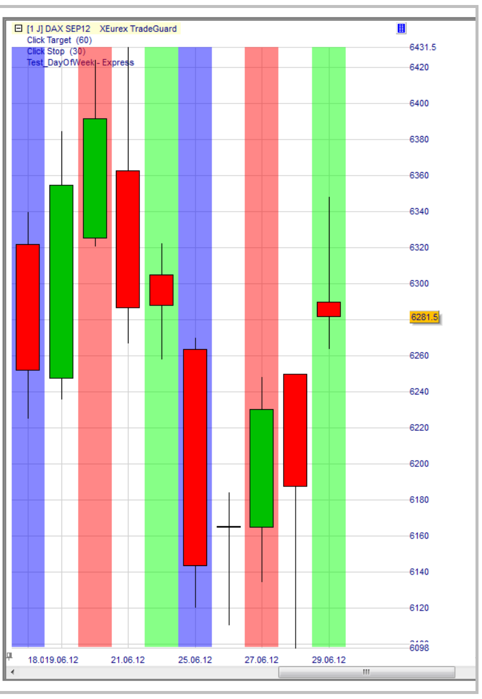
- Returns the day of the week expressed as an integer between 1 and 5:
  - 0 = Sunday, 1 = Monday, 2 = Tuesdays, 3 = Wednesday, 4 = Thursday, 5 = Friday, 6 = Saturday.

<u>Format:</u>

- int DayOfWeek (time time)

<u>Example:</u>

```
Express f_DayOfWeek

vars

calculation

if DayOfWeek(date) = 1 then Highlight("slot","lightblue");
if DayOfWeek(date) = 3 then Highlight("slot","lightred");
if DayOfWeek(date) = 5 then Highlight("slot","lightgreen");

interpretation
begin
end
```



Duration()

Definition:

- Returns the number of seconds between time t1 and time t2[1].

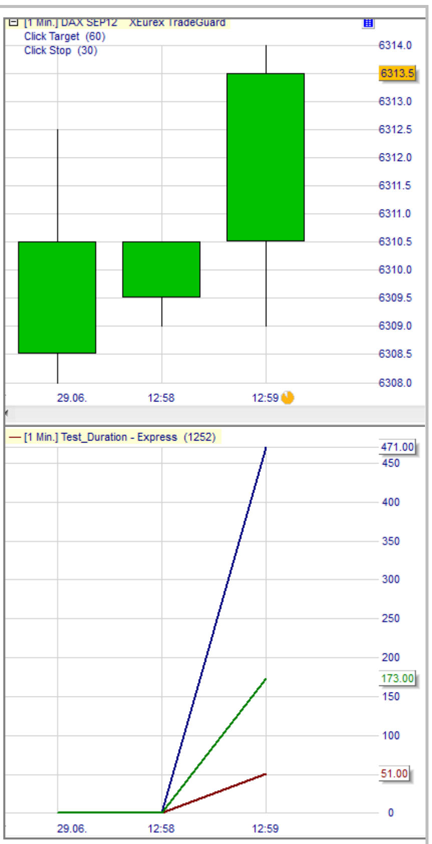
Format:

- int Duration (time start, time end)

Example:

- Below we are looking at the last candle of a 1min chart on the Dax future:
    - Open time is 12:59:00.
    - Current time is 12:59:51.
- Our indicator displays three durations in seconds between different times:
    - Red: Duration between current and open times = 51.
    - Blue: Duration between current time and $StartTime (= 12:52) = 471[2].
    - Green: Duration between current "date time" now and 3 candles ago: 173[3].

```
Express f_Duration

vars
series
a, b, d;

input
$StartTime(0800, 2359, 1252);

calculation
if IsFinalBar() then
begin
  a = Duration(timeOpen, time);
  b = Duration(NumericToTime($StartTime), time);
  d = Duration(dateTime[3], dateTime);
end

interpretation
begin
end

plot(a, red, 2);
plot(b, blue, 2);
plot(d, green, 2);
```



[1] Express predefined time series are: date, dateOpen, time, timeOpen, dateTime, dateTimeOpen.
[2] 471 seconds = 7 x 60 + 0.85 x 60 seconds = 7 minutes + 51 seconds. Hence current time is: 12:52:00 + 00:07:51 = 12:59:51.
[3] 173 seconds = 2 x 60 + 51 seconds.

IsNewDay()

Definition:

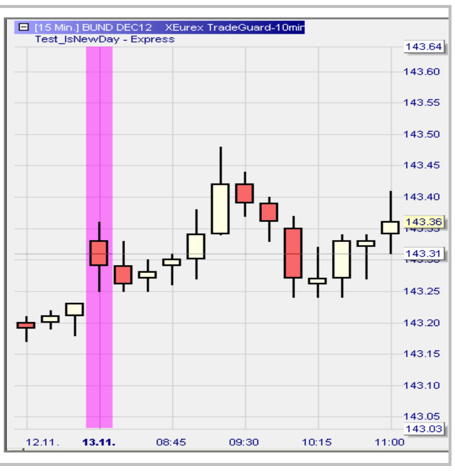
- Returns true at the first bar of each day.

Format:

- bool IsNewDay()

Example:

- Below the background of the first candle of each day is highlighted in magenta:

Express f_IsNewDay
 	
calculation
 	
if IsNewDay() then Highlight("slot", "magenta");
 	
interpretation
begin
end
	

NumericToTime()

Definition:

- Converts a 4 digits number into a HHMM time value (e.g. 1545 becomes 15:45).
    - If the first 2 digits are more than 23, HH is set to 23.
    - If the second 2 digits are more than 59, HH is set to 59.

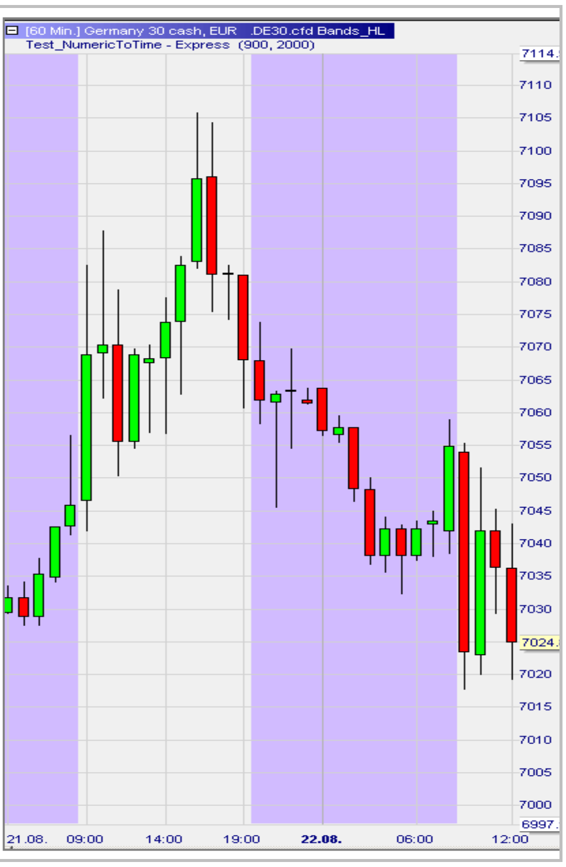
Format:

- time NumericToTime (float value)

Example:

- Below we create a blocker which blocks trades outside the 09:00 – 20:00 interval as indicated by the darker background color:

```
Express Blocker f_NumericToTime

Vars

Input
$t1(0,2400,900), $t2(0,2400,2000);

Calculation

Interpretation
begin
  if (time >= NumericToTime($t1)) and
     (time <= NumericToTime($t2)) then
  sentiment = senti_pass;
  else
  sentiment = senti_block;
end
```



TimeToNumeric()

Definition:

- Converts a HHMM time value into a 4 digits number (e.g. 15:45 becomes 1545).

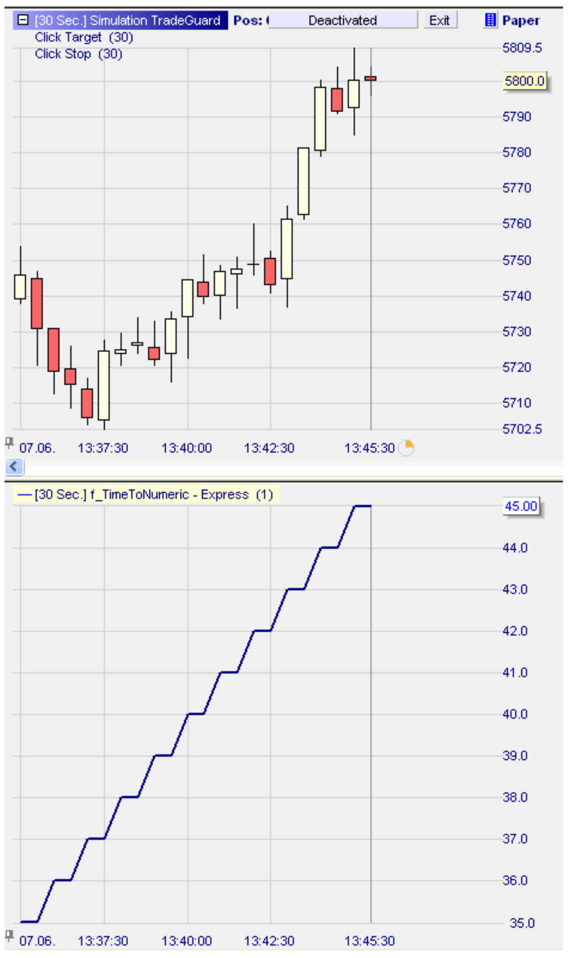
Format:

- time TimeToNumeric (float value)

Example:

- Below we display in the sub-window the number of minutes of the open time of each bar:

```
express f_TimeToNumeric

vars

series oo,cc,hh,ll,tt, hhmn, mn;
input $a(1,20,1);

calculation

hhmn = TimeToNumeric(timeopen);
mn = round(100*((hhmn/100) - floor(hhmn/100)),2);

interpretation
begin
end

plot(mn,blue,2);
```



NumericToDate()

Definition:

- Converts a 6 digits number into a YYYYMMDD time value (e.g. 130423 becomes 2013-04-23).
  - The first group of 2 digits cannot be larger than 99.
  - If the second group of 2 digits is more than 12, MM is set to 12.
  - If the third group of 2 digits is more than the number of days in a given month, DD is set to that number of days.

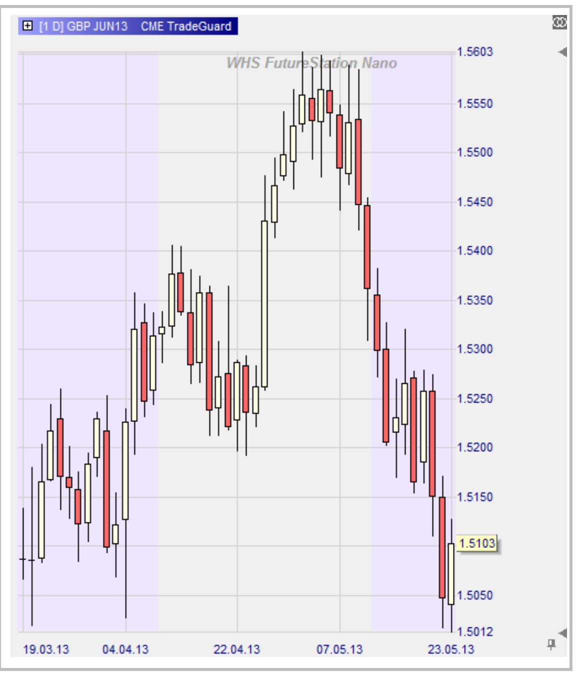
Format:

- time NumericToDate (float value)

Example:

- Below we create a blocker which blocks trades outside the [2013-04-10;2013-05-10] interval as indicated by the darker background color:

```
Express Blocker f_NumericToDate

Vars

Input
$day1(130401,131231,130410),
$day2(130401,131231,130510);

Calculation

Interpretation
begin
  if (date >= NumericToDate($day1)) and
     (date <= NumericToDate($day2)) then
  sentiment = senti_pass;
  else
  sentiment = senti_block;
end
```



DateToNumeric()

Definition:

- Converts a YYYYMMDD time value into a 6 digits number (e.g. 2013-04-23 becomes 130423).

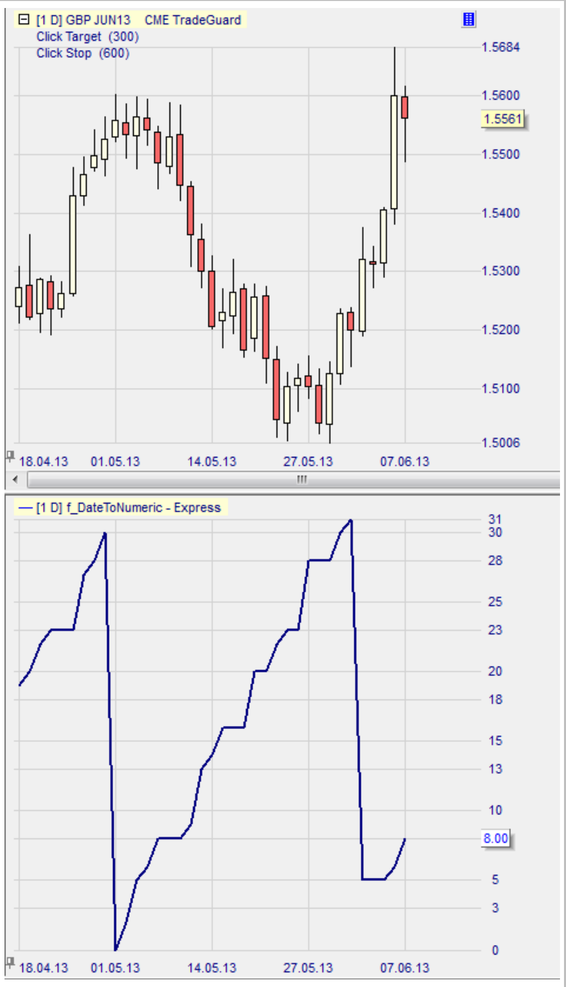
Format:

- time DateToNumeric (float value)

Example:

- Below we display in the sub-window under a daily chart the day of the month:

```
express f_DateToNumeric

vars

series yymmdd, dd;

calculation

yymmdd = DateToNumeric(dateopen);
dd = 100*round(((yymmdd/100) -
floor(yymmdd/100)),2);

interpretation
begin
end

plot(dd,blue,2);
```



GetExpiration()

Definition:

- Returns the expiration date and time of the symbol used in a study. If the symbol does not have an expiration date, the function will return January 1, 1970 at 0:00.

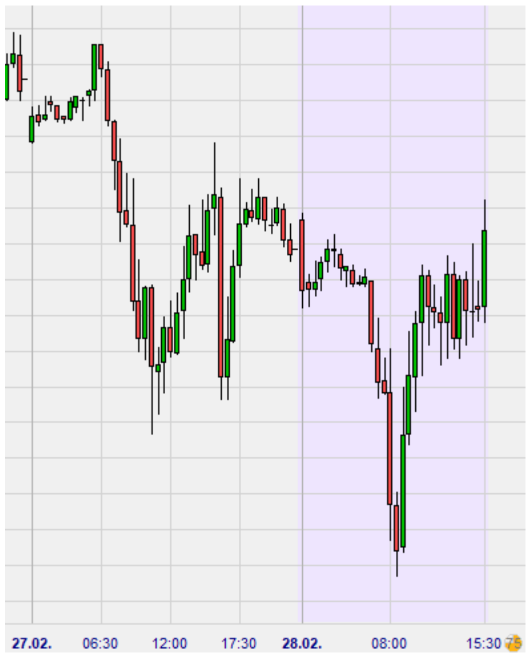
Format:

- time GetExpiration()

Example:

- In this example we use this function as a blocker to prevent the execution of trading signals on the expiration day.

```
Express f_GetExpiration

Calculation

Interpretation
begin
  if (date >= GetExpiration()) then
  begin
    sentiment = senti_block;
  end
end
```



Alerting & Informing

MessageBox()

<u>Definition:</u>

- Opens a pop-up window with a pre-defined message when a particular condition is met using a live data stream. Without live data there can be no messages.
    - Only one message box can be shown over the duration of a bar. A message box is shown once at the first occurrence.
    - To send out a message once at the end of a period use the following instruction: if IsBarCompleted() then MessageBox("Price > Moving Average");
    - To write 2 lines in a message use this instruction:
        - MessageBox("Line 1 \n Line 2”);

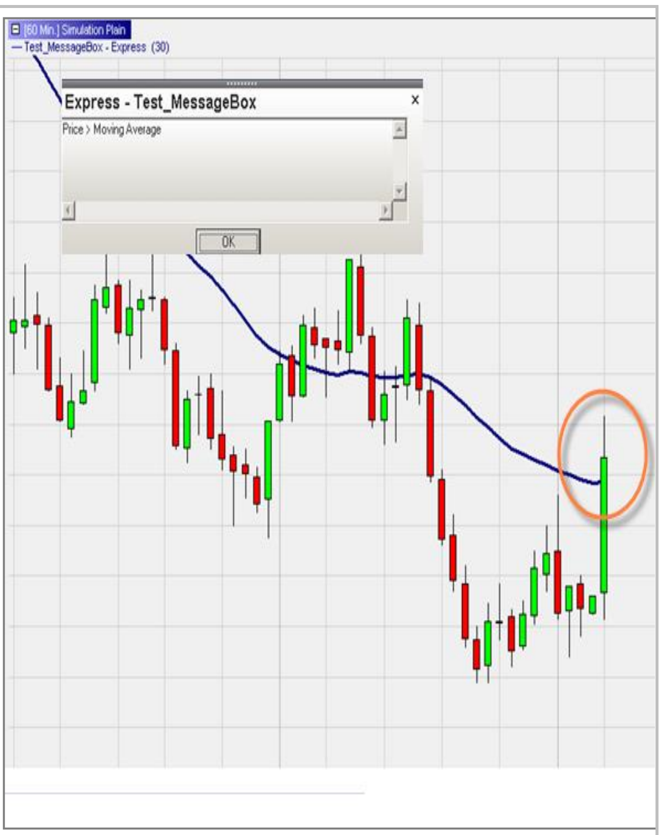
<u>Format:</u>

- void MessageBox(string message)

<u>Example:</u>

- Below we are generating messages every time the price crosses the blue moving average. Messages may appear several times within the same bar.

```
Express f_MessageBox

Vars

Series
myMA;

Input
$span(1, 200, 30);

Calculation
If IsFirstBar() then MovingAverage(close,
myMA, $span);

if CrossesAbove(close, myMA) then
MessageBox("Price > Moving Average");
if CrossesBelow(close, myMA) then
MessageBox("Price < Moving Average");

Interpretation
begin
end

plot (myMA, blue, 3);
```


[60 Min.] Simulation Plain
Test_MessageBox - Express (30)
Express - Test_MessageBox
Price > Moving Average
OK

PlaySound()

Definition:

- Plays a pre-defined sound when a particular condition is met using a live data stream. Without live data there can be no audible notifications.
    - A sound is triggered once per occurrence and per bar.
    - To play a sound once at the end of a period use the following instruction:
      if IsBarCompleted() and …… then PlaySound("gong");
- The sound files are available at the following folder: NanoTrader\Wav
- If several PlaySound() functions are triggered at the same time only the first PlaySound() function in the code will be executed.

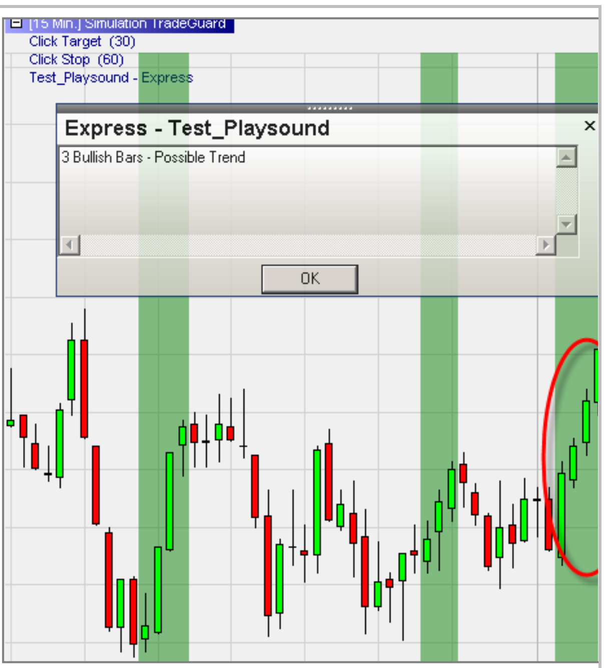
Format:

- void PlaySound(string sound)

Example:

- Here a sound is triggered every time three bullish bars occur consecutively.

```
Express f_PlaySound

vars

calculation

if (c > c[1]) and (c[1] > c[2]) and (c[2] > c[3])
then begin
  Highlightat(0, "slot","green");
  Highlightat(1, "slot","green");
  Highlightat(2, "slot","green");
  MessageBox("3 Bullish Bars - Possible
Trend");
  Playsound("corkpop");
 end

Interpretation
begin
end
```



3 Bullish Bars - Possible Trend

SendEmail()

Definition:

- Sends out an email based on selected conditions.
  - An email can be triggered only once per occurrence and per bar.
  - The email address must be entered in the platform in the field ‘Mail address for notifications’ under Extras/Options.
  - Texts must be written between “ “.
  - To send a message once at the end of a period use the following instruction: if IsBarCompleted() and …… then SendEmail();

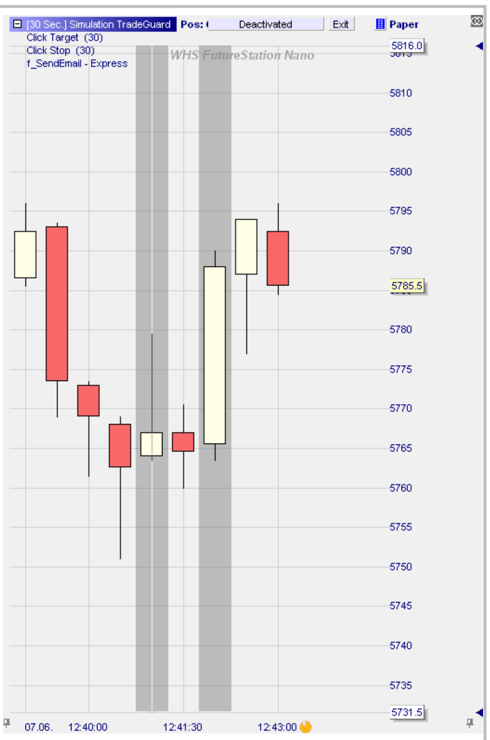
Format:

- void SendEmail(string subject, string message)

Example:

- Below we generate a notification email after the completion of a given chart pattern, i.e. Market Structure low.

```
express f_SendEmail

vars

series signal(50);

input $EmailActivate(0,1,1);

calculation

if (l > l[1]) and (l[1] < l[2]) and IsBarCompleted() then
begin
  signal = 100;
  if ($EmailActivate = 1) then
  SendEmail("Signal!","close = " + PriceToString(close));
  Highlight("slot","grey");
end

interpretation
begin
  sentiment = signal;
end
```



Screenshot()

Definition:

- Creates a screenshot file of the master chart when a particular condition is met using a live data stream. Without live data there can be no screenshot files.
- The files can be saved in a given location on a PC.
  - The path and filename are defined using a syntax similar to: "C:\NanoFiles\screenshot1.png".
- A screenshot can be created once per occurrence and per bar. To create a screenshot only at the end of a period use the following instruction: if IsBarCompleted() and …… then Screenshot("My path\filename.png").
- If several Screenshot() functions are triggered at the same time only the first Screenshot() function in the code will be executed.

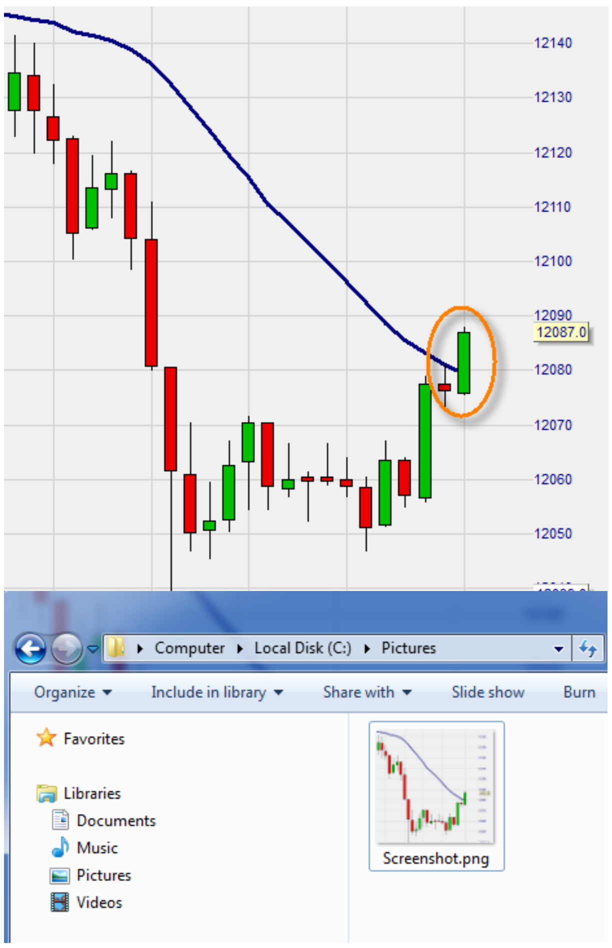
Format:

- void Screenshot(string file)

Example:

- Below we are generating a screenshot every time the price crosses the blue moving average. The screenshots are saved inside the folder "C:\Pictures\Screenshot.png").

```
Express f_Screenshot

Vars

Series
myMA;

Input
$span(1, 200, 30);

Calculation
If IsFirstBar() then MovingAverage(close,
myMA, $span);

If IsBarCompleted() then
begin
if CrossesAbove(close, myMA) then
Screenshot("C:\Pictures\Screenshot.png");
if CrossesBelow(close, myMA) then
Screenshot("C:\Pictures\Screenshot.png");
end

Interpretation
Begin end

plot (myMA, blue, 3);
```



ScreenshotEx()

Definition:

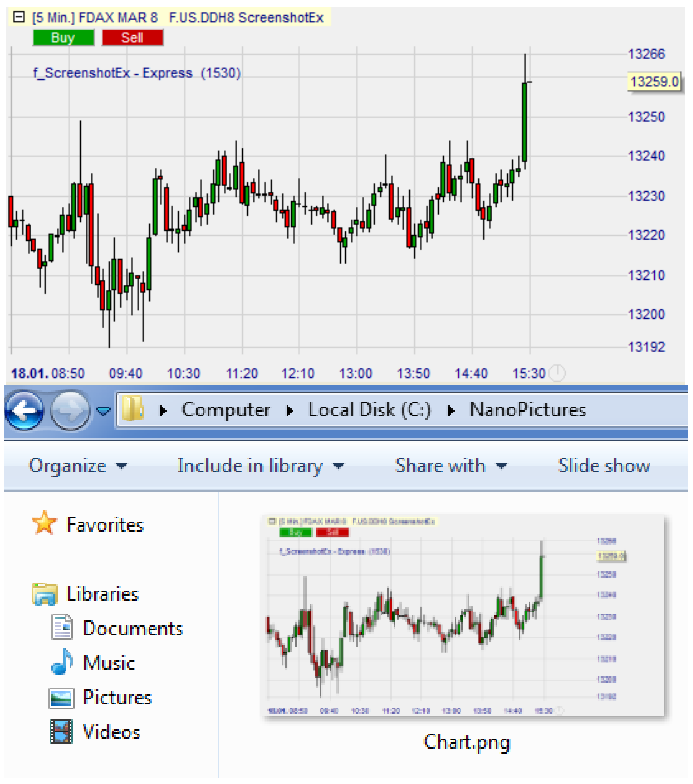
- Creates a screenshot file of either the master chart or the equity window when a particular condition is met.
- The files are saved as .png files in a given location on the PC.
    - The path and filename are defined using a syntax similar to: "C:\NanoFiles\screenshot1.png".
    - If the filename does not contain a full path, then it is saved in the general screenshot directory of NanoTrader.
- The `style' determines the elements of the MasterChart to be drawn and defines the default dimensions. The settings are as follows:
    - 0 = exactly as shown on the screen
    - 1 = less decoration, medium sized
    - 2 = even less decoration, small sized
    - 3 = show equity window, medium sized
    - 4 = show equity window, small sized
- The `width' and `height' are used to define the dimension of the created image. Set to 0 to use the default as defined by the style.
- `periodsOrDays' defines the number of periods to be displayed, counting from the last available period.
    - If set to a value greater than 0 then it defines the total number of periods to be shown.
    - If set to 0 then it shows the starting point of the current zoom in the MasterChart
    - If set to a negative number then it is interpreted as full days, e.g., -2 means "show today and yesterday".
- A screenshot can be created once per occurrence and per bar. To create a screenshot only at the end of a period use the following instruction: if IsBarCompleted().
- If several ScreenshotEx() functions are triggered at the same time only the first ScreenshotEx() function in the code will be executed.

Format:

- void ScreenshotEx(string filename, int style, int width, int height, int periodsOrDays)

Example:

- Below we are generating a screenshot every day at the same time at 3:30 PM // 15:30. The screenshots are saved inside the folder "C:\NanoPictures\Chart.png") with the same elements as shown on the screen (=0). The dimensions are 600x300 pixels and the chart is only showing the candles of the current day (=-1).

Express f_ScreenshotEx Vars Input $EnterAT(000,2359,1530); Calculation If (time >= NumericToTime($EnterAT)) AND ((time[1] < NumericToTime($EnterAT)) OR IsNewDay()) then ScreenshotEx("C:\NanoPictures\Char t.png",0,600,300,-1); Interpretation begin end	

ShowTip()

Definition:

- Displays a message when the mouse is moved over a candle.

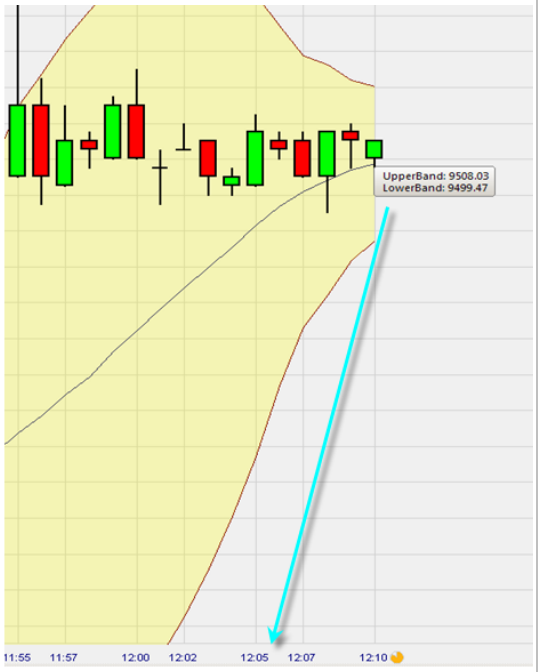
Format:

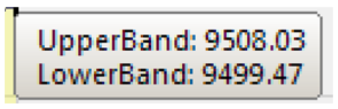
- void ShowTip (string message)

Example:

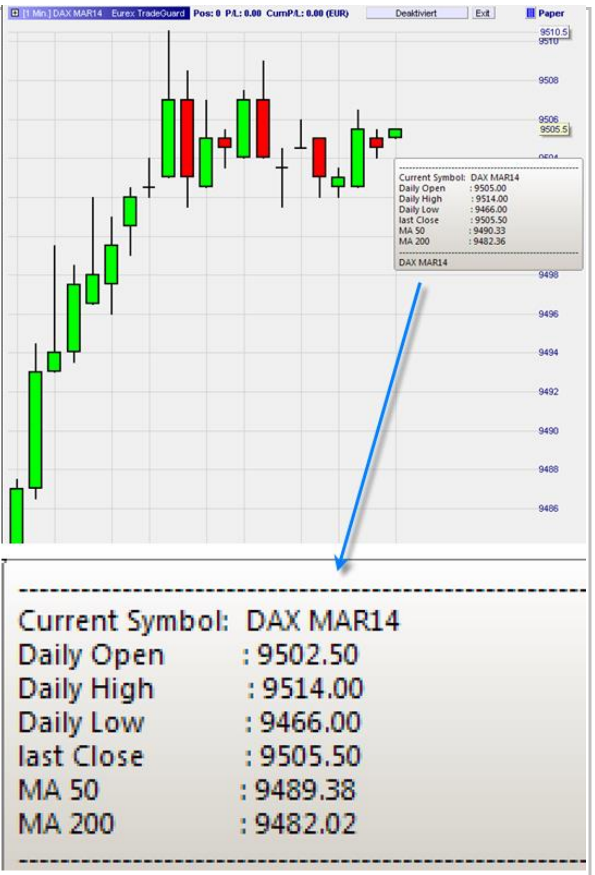
- Example 1: The Bollinger Band indicator is calculated and the values of the upper and lower band are displayed in the tip.
- Example 2: Various information of the current instrument as well as active indicator values are displayed in the tip of the last candle.

```
Express f_ShowTip_Example1

Vars

Series
TL, BL, ML, delta;

Input
$span(1, 200, 20),
$StD_factor(1, 200, 20);

Calculation
If IsFirstBar() then
begin
  MovingAverage(close, ML, $span);
  StdDev(close, delta, $span);
end
TL = ML + (($StD_factor/10) *delta);
BL = ML - (($StD_factor/10) *delta);

If IsFinalBar() then ShowTip(" UpperBand:
"+NumericToString(TL, "%6.2f"+"\n LowerBand:
"+NumericToString(BL, "%6.2f") ));

Interpretation
begin
end

plot(ML, blue, 1);
plotband(TL, "red", 1, BL, "red", 1, "lightyellow");
```




UpperBand: 9508.03
LowerBand: 9499.47

```
Express f_ShowTip_Example2

Vars

Input
$MA_50(1, 500, 50),
$MA_200(1, 500, 200);

Series
MA50,
MA200;

Numeric
MinLo,
MaxHi;

Calculation
If IsFirstBar() then
begin
MovingAverage(c, MA50, $MA_50);
MovingAverage(c, MA200, $MA_200);
end
if h > MaxHi then MaxHi = h; else MaxHi = MaxHi;
if l < MinLo then MinLo = l; else MinLo = MinLo;

If IsNewDay() then begin
MaxHi = h;
MinLo = l;
end

If IsFinalBar() then
ShowTip(
"-------------------------------------------------------"
+ "\n" + "Current Symbol:  " + Symbolname()
+ "\n" + "Daily Open        : " + NumericToString(o,"%6.2f")
+ "\n" + "Daily High         : " + NumericToString(Maxhi,"%6.2f")
+ "\n" + "Daily Low          : " + NumericToString(MinLo,"%6.2f")
+ "\n" + "last Close         : " + NumericToString(c,"%6.2f")
+ "\n" + "MA 50              : " + NumericToString(MA50,"%6.2f")
+ "\n" + "MA 200             : " + NumericToString(MA200,"%6.2f")
+ "\n" + "-------------------------------------------------------");

Interpretation
begin
end
```


[1 Min] DAX MAR14 Eurex TradeGuard
Pos: 0 P/L: 0.00 CumP/L: 0.00 (EUR)
Deaktiviert
Exit
Paper
9510.5
9508
9506
9505.5
9498
9496
9494
9492
9490
9488
9486

```
---------------------------------------------------
Current Symbol:  DAX MAR14
Daily Open       : 9505.00
Daily High        : 9514.00
Daily Low         : 9466.00
last Close        : 9505.50
MA 50             : 9490.33
MA 200            : 9482.36
---------------------------------------------------
DAX MAR14
```

```
---------------------------------------------------
Current Symbol:  DAX MAR14
Daily Open       : 9502.50
Daily High        : 9514.00
Daily Low         : 9466.00
last Close        : 9505.50
MA 50             : 9489.38
MA 200            : 9482.02
---------------------------------------------------
```

Highlight() / HighlightRGB()

Definition:

- Both functions enable the user to highlight the current bar using a specific marker and color.
- The available markers are: “ellipse”, “upTriangle”, “downTriangle”, “slot”, “bottomLine”, “topLine”, “textAbove” and “textBelow”.
- The following colors are available for the Highlight() function: “red”, “lightRed”, “green”, “lightGreen”, “blue”, “lightBlue”, “magenta”, “lightMagenta”, “yellow”, “lightYellow”, “cyan”, “lightCyan”, “grey”, “black”, “white”.
- For the HighlightRGB() function, an almost infinite number of colors can be selected using the RGB color scheme (RGB = Red-Green-Blue).
- Refer to the section on Plotting functions to learn how to create a RGB color code.

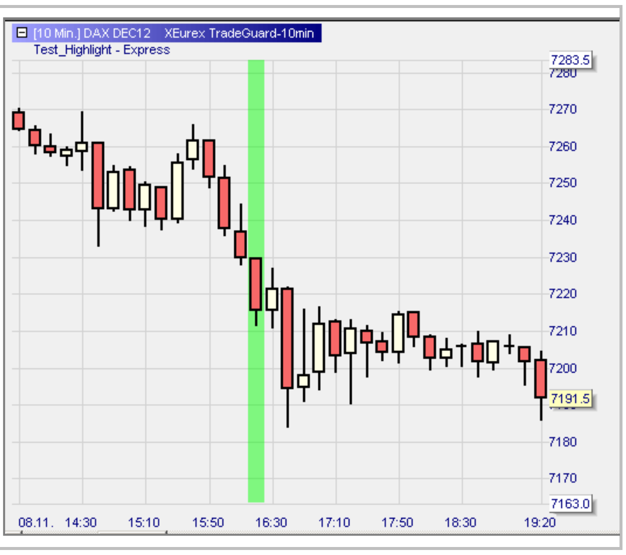
Format:

- Void Highlight (string type, string color)
- Void HighlightRGB (string type, int red, int green, int blue)

Example 1:

- Highlights the 50th candle of the chart by coloring the background behind the bar in a lightgreen color.

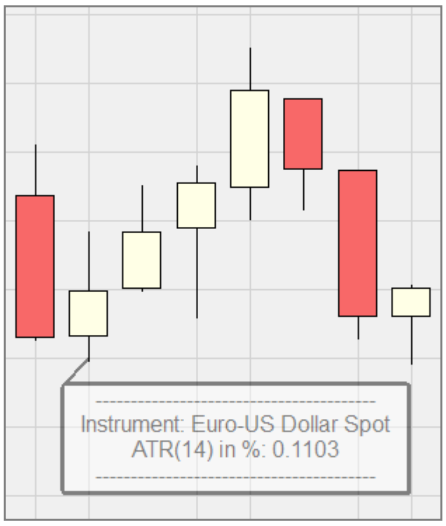
```
Express f_Highlight

vars

calculation

if CurrentBarIndex() = 50 then
Highlight("slot", "lightgreen");

interpretation
begin
end
```



Example 2:

- Here we create a box using highlight(textbelow,“black“) with a message whose information gets updated tick by tick. Note some very useful rules for creating content:
    - Pieces of texts must be surrounded with quotes: "Instrument: "
    - Numbers must be converted in a text format using NumericToString().
    - String variable can be typed without quotes: contract
    - To go to the next line use the expression: "\n"
    - All pieces must be joined with a + sign.

```
express f_Highlight2

vars

input
$period(1,100,14);

string
contract;

calculation

if (CurrentBarIndex()= (FinalBarIndex() - 20)) then
begin
  contract = SymbolName();
  HighLight("textbelow:"
  + "----------------------------------------"
  + "\n" + "Instrument: " + contract
  + "\n" + "ATR" + "(" + NumericToString($period,"") + ") in %: " +
NumericToString(atr($period),"%2.2f")
  + "\n" + "----------------------------------------"
, "black");
end
interpretation
begin
end
```



```
------------------------------------------------
Instrument: Euro-US Dollar Spot
ATR(14) in %: 0.1103
------------------------------------------------
```

HighlightAT() / HighlightRGBat()

Definition:

- Both functions enable the user to highlight a given bar using a specific marker and color. The given bar refers to a bar that is x bars away from the current bar. For example:
  - HighlightAT(0,"slot","blue"): the given bar is the current bar.
  - HighlightAT(10,"slot","blue"): the given bar is the 10th bar to the left of the current bar.
  - HighlightAT(-5,"slot","blue"): the given bar is the 5th bar to the right of the current bar.
- The available markers are: "ellipse", "upTriangle", "downTriangle", "slot", "bottomLine", "topLine", "textAbove" and "textBelow".
- The following colors are available for the HighlightAT() function: "red", "blue", "green", "yellow", "black", "grey", "white", "magenta", "lightred", lightblue", "lightgreen", "lightyellow", "black", "lightgrey", "white" and "lightmagenta".
- For the HighlightRGBat() function, an almost infinite number of colors can be selected using the RGB color scheme (RGB = Red-Green-Blue).
- Refer to the section on Plotting functions to learn how to create a RGB color code.

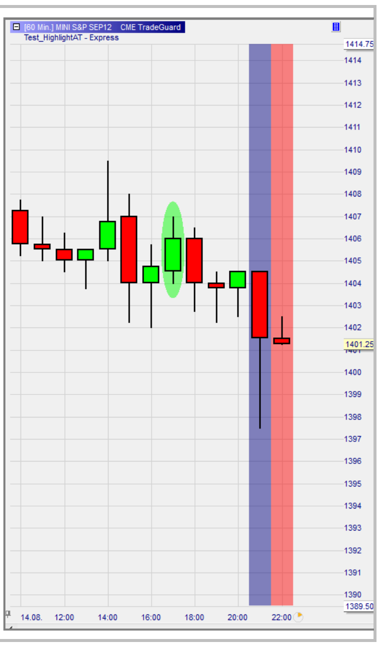
Format:

- Void HighlightAt (string type, string color)
- Void HighlightRGBAt (int offset, string type, int red, int green, int blue)

Example:

- Four applications of the HighlightAT function are displayed:

```
Express f_HighlightAT

Calculation

If IsFirstBar() then
  Highlightat(-3,"slot","magenta");

If IsFinalBar() then
begin
  Highlightat(0,"slot","lightred");
  Highlightat(1,"slot","blue");
  Highlightat(5,"ellipse","lightgreen");
end

Interpretation
begin
end
```


[60 Min.] MINI S&P SEP12 CME TradeGuard
Test_HighlightAT - Express
14.08. 12:00 14:00 16:00 18:00 20:00 22:00

Annotate() / AnnotateRGB()

Definition:

- Both functions enable the user to enrich the chart with individual notes which are added to the current bar with respect to the chosen ‘type’ in the specified ‘color’.
- The available types are: “ellipse”, “upTriangle”, “downTriangle”, “labelLeft”, “labelCenter” and “labelRight”.
- The vertical position and size of the annotation for the types “ellipse”, “upTriangle” and “downTriangle” is determined by the parameters `high’ and `low’.
- The text to be displayed with “labelLeft”, “labelCenter” and “labelRight” is appended to the type separated by a colon.
- A line break can be enforced by using the character sequence \n. Lines are not wrapped automatically.
- The vertical position of the text is determined by the parameter `high’.
- The following colors are available for the Highlight() function: “red”, “lightRed”, “green”, “lightGreen”, “blue”, “lightBlue”, “magenta”, “lightMagenta”, “yellow”, “lightYellow”, “cyan”, “lightCyan”, “grey”, “black”, “white”.
- For the HighlightRGB() function, an almost infinite number of colors can be selected using the RGB color scheme (RGB = Red-Green-Blue).
- Refer to the section on Plotting functions to learn how to create a RGB color code.

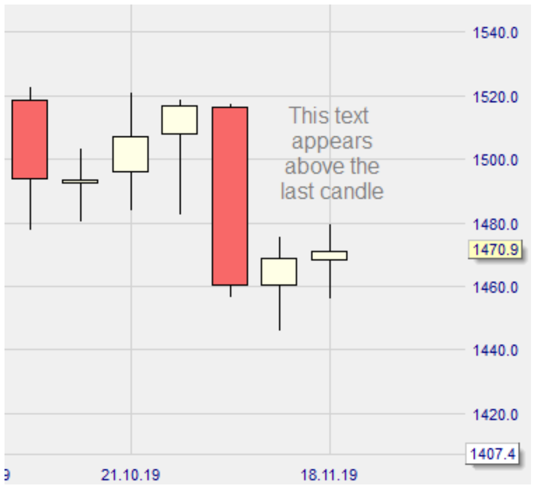
Format:

- void Annotate(string type, string color, float high, float low)
- void AnnotateRGB(string type, int red, int green, in blue, float high, float low)

Example:

- Plots an arbitrary text above the current candle.

```
Express f_Annotate

Calculation

If IsFinalBar() then Annotate("labelCenter:This text\n
appears\n above the\n last candle", "black", (h+(h-l)), 0);

Interpretation
begin
end
```



AnnotateAT() / AnnotateRGBAT()

Definition:

- Both functions enable the user to enrich the chart with individual notes which are added to a given bar with respect to the chosen ‘type’ in the specified ‘color’. The given bar refers to a bar that is x bars away from the current bar. For example:
  - HighlightAT(0,”slot”,”blue”): the given bar is the current bar.
  - HighlightAT(10,”slot”,”blue”): the given bar is the 10th bar to the left of the current bar.
  - HighlightAT(-5,”slot”,”blue”): the given bar is the 5th bar to the right of the current bar.
- The available types are: “ellipse”, “upTriangle”, “downTriangle”, “labelLeft”, “labelCenter” and “labelRight”.
- The vertical position and size of the annotation for the types “ellipse”, “upTriangle” and “downTriangle” is determined by the parameters `high’ and `low’.
- The text to be displayed with “labelLeft”, “labelCenter” and “labelRight” is appended to the type separated by a colon.
- A line break can be enforced by using the character sequence \n. Lines are not wrapped automatically.
- The vertical position of the text is determined by the parameter `high’.
- The following colors are available for the Highlight() function: “red”, “lightRed”, “green”, “lightGreen”, “blue”, “lightBlue”, “magenta”, “lightMagenta”, “yellow”, “lightYellow”, “cyan”, “lightCyan”, “grey”, “black”, “white”.
- For the HighlightRGB() function, an almost infinite number of colors can be selected using the RGB color scheme (RGB = Red-Green-Blue).
- Refer to the section on Plotting functions to learn how to create a RGB color code.

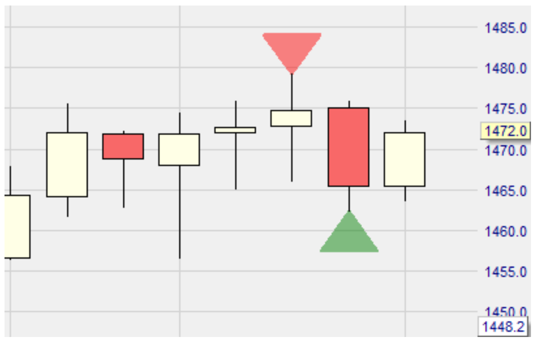
Format:

- void AnnotateAT(int offset, string type, string color, float high, float low)
- void AnnotateRGBAT(int offset, string type, int red, int green, in blue, float high, float low)

Example:

- The second last and the third last candle are highlighted with an ‘upTriangle”.

```
Express f_AnnotateAT

Calculation
If IsFinalBar() then
begin
  AnnotateAT(1,"upTriangle","green",l[1],(l[1]-(h-l)/2));
  AnnotateAT(2,"upTriangle","lightred",h[2],(h[2]+(h-
l)/2));
end

Interpretation
begin
end
```



CreateFile()

Definition:

- Creates a text file to be saved in a given location on a PC and allows writing any given text in this file.
- The path and filename are defined using a syntax similar to: "C:\NanoLogs\nano-actions.txt"
- The text must be placed between " ". If the file already exists, the given text will be added to the existing text.
- A file can be created once per occurrence and per bar. To create a file only at the end of a period use the following instruction: if IsBarCompleted() and …… then CreateFile("My Text");
- If several CreateFile() functions are triggered at the same time only the first CreateFile() function in the code will be executed.

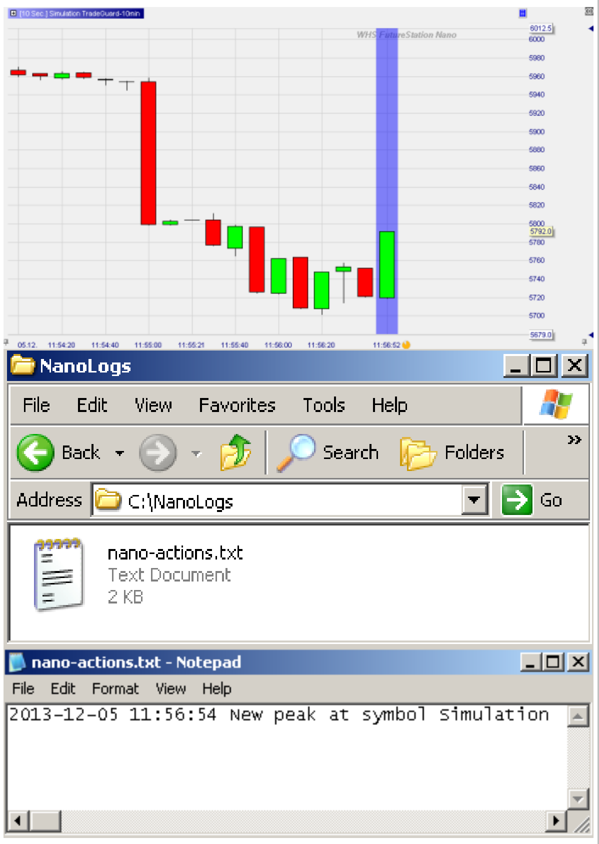
Format:

- void CreateFile(string file, string text)

Example:

- In the example below a text file with the message: "New peak at symbol " + SymbolName()" is created and saved in the folder C:\NanoLogs on their computer if the following condition is met: (close > high[1]) and (close > high[2])
- For visual purposes the candle is also highlighted in blue.

```
Express f_CreateFile

Calculation

if (close > high[1]) and (close > high[2]) then
begin
  Highlight("slot","lightblue");
  CreateFile("C:\NanoLogs\nano-actions.txt",
TimeToString(datetime, "%Y-%m-%d
%H:%M:%S")
  + " New peak at symbol " + SymbolName());
end

Interpretation
begin
end
```


NanoLogs
File Edit View Favorites Tools Help
Back Search Folders
Address C:\NanoLogs Go
nano-actions.txt
Text Document
2 KB
nano-actions.txt - Notepad
File Edit Format View Help

```
2013-12-05 11:56:54 New peak at symbol Simulation
```

NumericToString()

Definition:

- Applies to the elements of a series a given format and convert them into a string.
  - NumericToString applies the “%g” format by default.
  - Supports all formats used for the C-function “printf()”. The most important are:
    “%f” decimal floating point
    ”%6.2f” rounds to two decimals
    ”%g” discards trailing zeroes
    ”%e” scientific notation

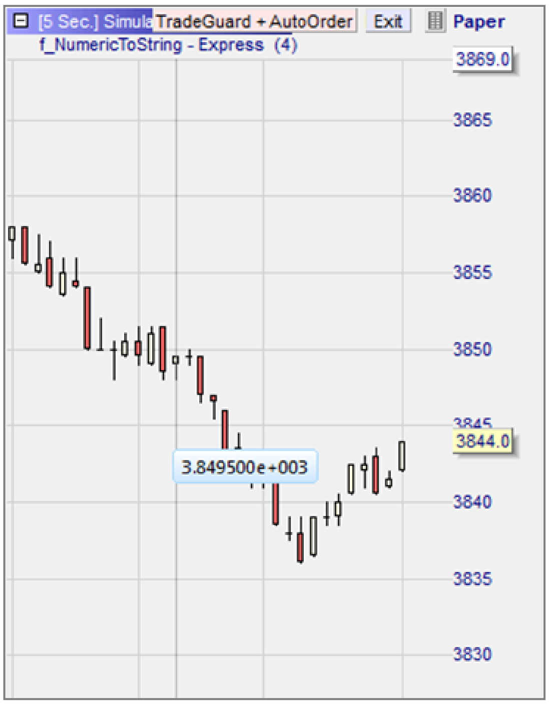
Format:

- string NumericToString (float value, string format)

Example:

- Below we display the format of the close price to be shown using the ShowTip function.
  - For example by selecting type 4 we show the price in scientific notation:

```
Express f_NumericToString

vars

input
$type(0,4,0);

calculation

// Rounds to three decimals
if $type = 1 then
ShowTip(NumericToString(c, "%6.3f"));
else
// Decimal floating point
if $type = 2 then
ShowTip(NumericToString(c, "%f"));
else
// Discards trailing zeroes
if $type = 3 then
ShowTip(NumericToString(c, "%g"));
else
// Scientific notation
if $type = 4 then
ShowTip(NumericToString(c, "%e"));

interpretation
begin
end
```



```
3.849500e+003
```

PriceToString()

Definition:

- Rounds the price to which it applies to the nearest price in respect to the defined ticksize and precision of the analyzed symbol and converts it into a string. Takes fractional notations into account.

Format:

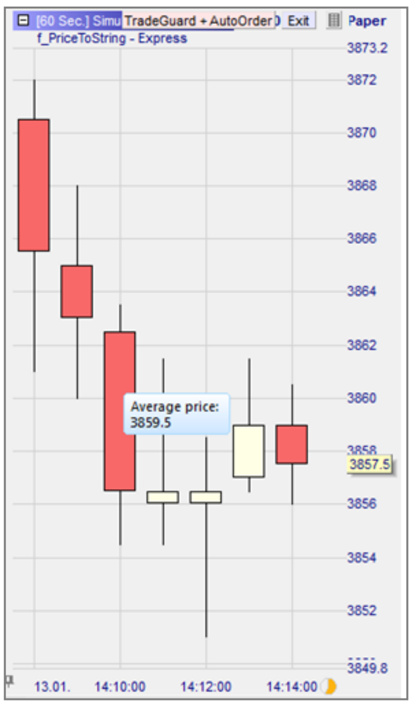
- string PriceToString (float value)

Example:

- Below we display a piece of information through a ShowTip.
    - It includes a title “Average price” followed at the next line by the average price value.
    - The format is a rational number rounded to the nearest ticksize and displayed with one decimal.

Example:

```
Express f_PriceToString

calculation

ShowTip("Average price: \n" + PriceToString((o + h + l +
2*c)/5));

interpretation
begin
end
```



TimeToString()

Definition:

- Returns a time variable using one of the formats below:

%a	Abbreviated weekday name
%A	Full weekday name
%b	Abbreviated month name
%B	Full month name
%c	Date and time representation appropriate for locale
%d	Day of month as decimal number (01 – 31)
%H	Hour in 24-hour format (00 – 23)
%I	Hour in 12-hour format (01 – 12)
%j	Day of year as decimal number (001 – 366)
%m	Month as decimal number (01 – 12)
%M	Minute as decimal number (00 – 59)
%p	Current locale's A.M./P.M. indicator for 12-hour clock
%S	Second as decimal number (00 – 59)
%U	Week of year as decimal number, with Sunday as first day of week (00 – 53)
%w	Weekday as decimal number (0 – 6; Sunday is 0)
%W	Week of year as decimal number, with Monday as first day of week (00 – 53)
%x	Date representation for current locale
%X	Time representation for current locale
%y	Year without century, as decimal number (00 – 99)
%Y	Year with century, as decimal number
%z, %Z	Time-zone name or abbreviation; no characters if time zone is unknown
%%	Percent sign

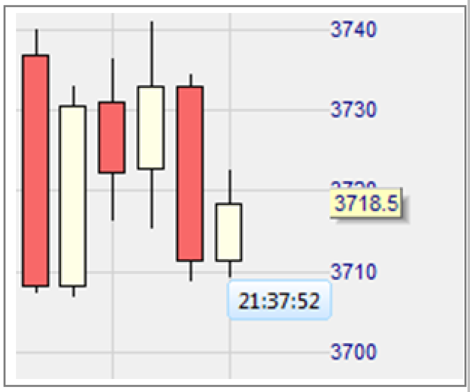
Format:

- string TimeToString (time timeVal, string format)

Example:

- Below we create a tip which shows the time when we move the mouse over a candle:

```
Express f_TimeToString

Calculation

showtip(TimeToString(time, "%H:%M:%S"));

interpretation
begin
end
```



IsBarCompleted()

Definition:

- Returns true once the current period is completed.

Format:

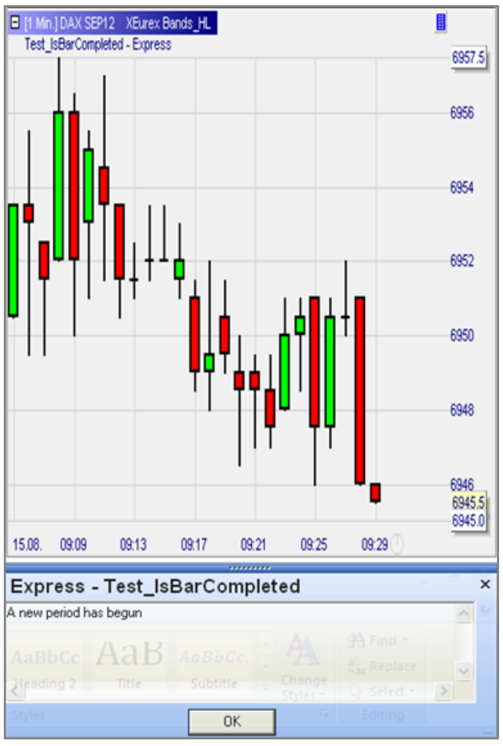
- bool IsBarCompleted()

Example 1:

- If IsBarCompleted() and (volume > 1000) then PlaySound(“gong”);

Example 2:

- Below we launch a message every time the bar is completed:
    - The window containing the message will accumulate in the chart.

Express f_IsBarCompleted Calculation If IsBarCompleted() then MessageBox("A new period has begun"); Interpretation begin end	 [1 Min.] DAX SEP12 XEurex Bands_HL Test_IsBarCompleted - Express 6957.5 6956 6954 6952 6950 6948 6946 6945.5 6945.0 15.08. 09:09 09:13 09:17 09:21 09:25 09:29 Express - Test_IsBarCompleted A new period has begun OK

Loops & Arrays

For … to / For … downto

Definition:

- Enables the execution of a loop in a program (see Syntax below).
    - A loop executes a given block of codes for a given number of times.

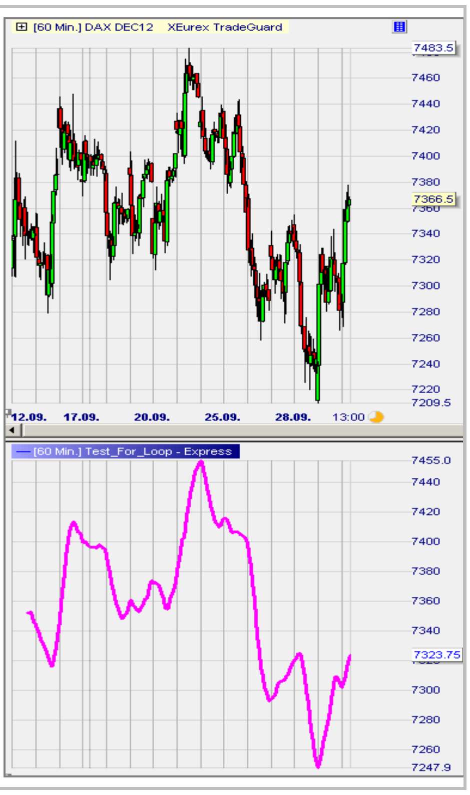
Syntax:

-
  ```
  for <variable> = <start value> to <numerical expression>
  begin
          <statement>;
          <statement>;
          ...
          <statement>;
  end
  ```

Example 1:

- Below we use For … loop to calculate the average of the last 10 bars, bar by bar. Please note:
    - The loop is run at each bar to add up the last 10 close prices. We make i vary between 0 and 9 and we execute sum = sum + close[i].
        - i = 0 is the current bar, i = 1 is the first bar on the left, i = 2 is the second bar on the left, .. etc.

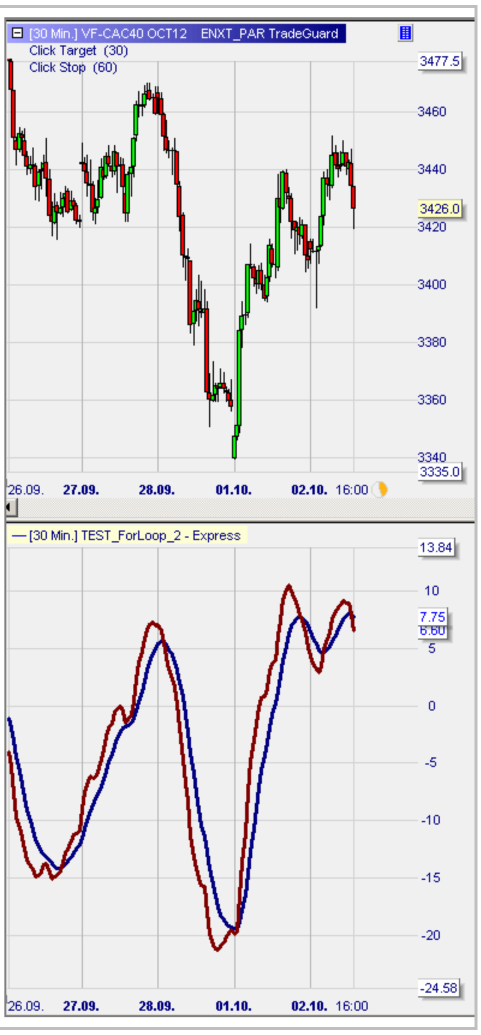
```
Express f_ForLoop_1

Vars

Numeric i;
Series avgsum, sum;

Calculation
Calculateateverytick(false);
for i = 0 to 9
begin
  sum = sum + close[i];
end
avgsum = (sum/10);

Interpretation
begin
end

plot(avgsum, magenta, 3);
```



Example 2:

- Below we create a MACD indicator using a loop to calculate the difference between two exponential moving averages. Please note:
    - Here we do all the calculations at the first bar. Exponential moving averages are easily computed using an express internal function.
    - The MACD is computed using a loop. We make i vary between 0 and FinalBarIndex.
        - We do not use ‘begin … end’ because there is only one expression.
        - Being at the first bar: i = 0 is the first bar, -1 is the second bar on the right, -2 is the third bar on the right, … etc.
        - Note: We could also have used the following instruction:
          For i = 0 downto (- FinalBarIndex())

```
Express f_ForLoop_2

Vars

Series
ema1, ema2, macd, emacd, FBI;

numeric
i;

Calculation

CalculateAtEveryTick(false);

if IsFirstBar() then
begin
  ExpMovingAverage(close, ema1, 12);
  ExpMovingAverage(close, ema2, 26);
  for i = 0 to FinalBarIndex() macd[-i] = ema1[-i] - ema2[-i];
  ExpMovingAverage(MACD, eMACD, 9);
end

Interpretation
begin
end

plot(eMACD, blue, 3);
plot(MACD, red, 3);
```



While … do

Definition:

- Enables a portion of a program to be executed several times consecutively as long as a given condition remains true (see Syntax below).

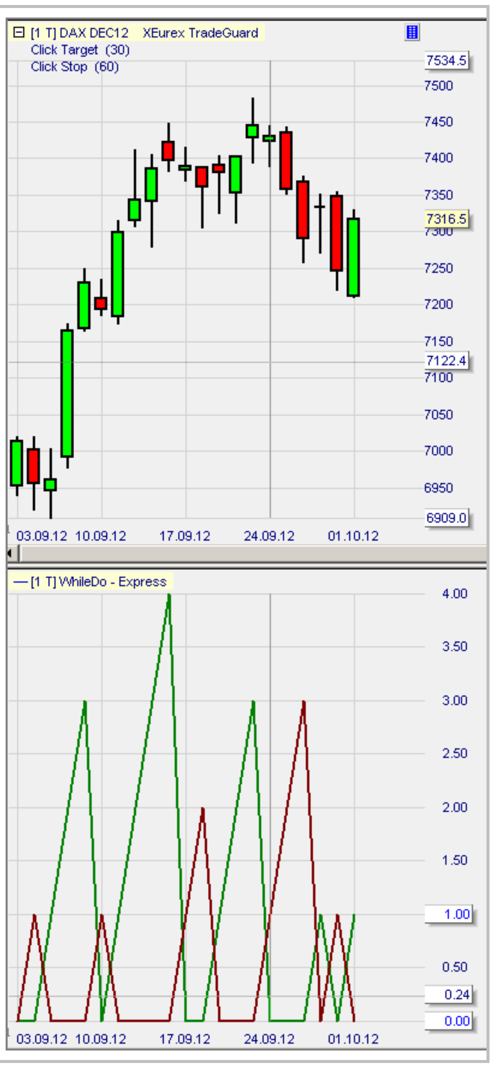
Syntax:

-
  ```
  while <boolean expression>
  begin
          <statement>;
          <statement>;
          ...
          <statement>;
  end
  ```

Example:

- Below we count how many times the price closes consecutively higher (green line) and lower (red line) and record the results bar by bar.

```
express f_WhileDo;

vars
series longPeriods, shortPeriods;
numeric counter;

calculation
counter = 1;
longPeriods = 0;
while (c[counter-1] >= c[counter]) and (c[counter] <> void)
begin
  longPeriods = longPeriods + 1;
  counter = counter +1;
end
counter = 1;
shortPeriods = 0;
while (c[counter-1] <= c[counter]) and (c[counter] <> void)
begin
  shortPeriods = shortPeriods + 1;
  counter = counter +1;
end

interpretation
begin
end

plot(longPeriods, green, 2);
plot(shortPeriods, red, 2);
```



SetArrayTo() / SetArraySize() / GetArraySize()

Definitions:

- An **array** is a set of a given number of elements used to store numbers.
  - a[0] = 12, a[1] = 45, a[2] = -1, a[3] = -4/5 are the 4 elements of an array called a.
  - To define array abc containing 4 elements we write under section Vars:
    Array abc[4];

- Elements of an array are set by default to zero. To affect 500 to all elements we write:
  - SetArrayTo(abc, 500);

- Array abc may be resized to 250 elements by writing:
  - SetArraySize(abc, 250);

- To get the size of array abc we write:
  - GetArraySize(abc)

- To attribute a number to a given element of array abc we write:
  - First element: abc[0] = 10;
  - Second element: abc[1] = -7;
  - Element i: abc[i-1] = -5;

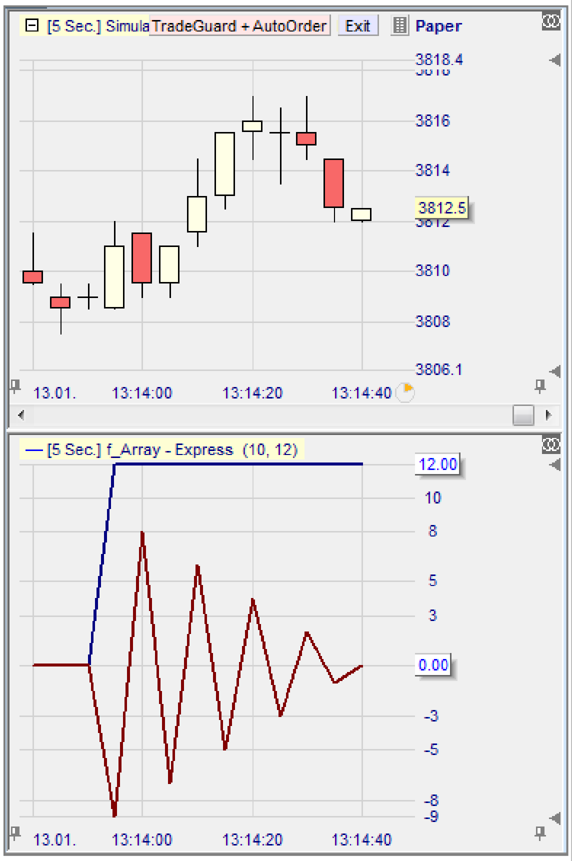
Format:

- void SetArrayTo (array arr, float value)
- void SetArraySize (array arr, int size)
- int GetArraySize (array arr)

Example:

- The indicator below displays the elements of an array.
  - At the final bar we display the elements of the array in a blue series ShowResults.
  - We modify the elements and display the new elements in a red series ShowResults2.

```
Express f_Array;

vars

input
$AbcSize(1, 100, 10), $AbcValue(1, 100, 15);

array
abc[0];

series
ShowResults, ShowResults2;

numeric
i;

calculation

if IsFinalBar() then
begin
  SetArraySize(abc, $AbcSize);
  SetArrayTo(abc, $AbcValue);
  for i=0 to GetArraySize(abc)-1
  begin
    ShowResults[i] = abc[i];
    abc[i] = i * power(-1,i);
    ShowResults2[i] = abc[i];
  end
end

interpretation
begin
end

plot(ShowResults, blue, 2);
plot(ShowResults2, red, 2);
```



Indexing & Efficient programming

CurrentBarIndex() / FinalBarIndex()

Definition:

- For a given chart FinalBarIndex() indicates the number of bars displayed on the chart minus one.
  For example:
  - The index of the first bar on the left of a chart is 0
  - The index of the last or final bar on the right of a chart is 99
  - If a chart displays 1000 bars, FinalBarIndex() = 999
- CurrentBarIndex() indicates the index number of a bar.
  For example:
  - When considering the first bar CurrentBarIndex() = 0
  - When considering the second bar CurrentBarIndex() = 1
  - When considering the 10th bar CurrentBarIndex() = 9
  - When considering the nth bar CurrentBarIndex() = n - 1

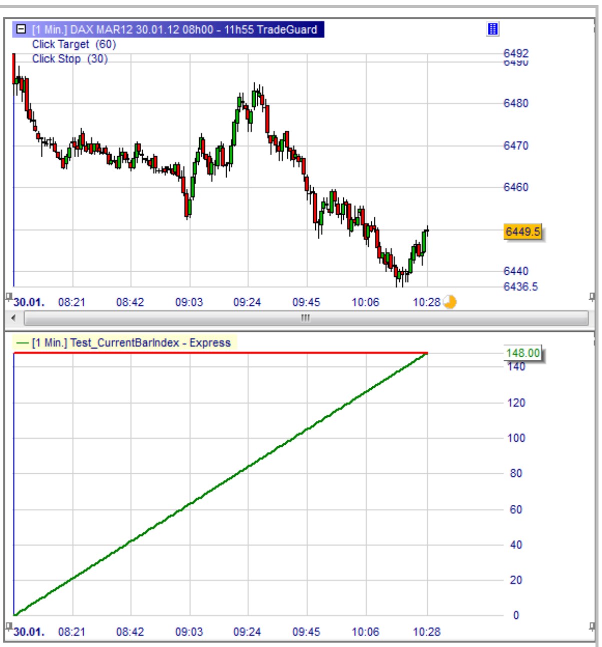
Format:

- int CurrentBarIndex()

Example:

- CurrentBarIndex() is assigned to series x and FinalBarIndex() is assigned to series y. These two series are plotted underneath the main chart:
  - CurrentBarIndex() is the green straight line starting from 0 up to 148
  - FinalBarIndex() is the red horizontal line at 148
  - Presently there are 149 (= 148 + 1) bars in this chart

```
Express f_CurrentBarIndex

vars

series x,y;

calculation

x = CurrentBarIndex();
y = FinalBarIndex();

interpretation
begin
end

plot (x, green, 2);
plot (y, lightred, 2);
```



IndexOfHighest() / IndexOfLowest()

Definition:

- Returns the index of the highest / lowest value for the elements series[0], ... series[span – 1].

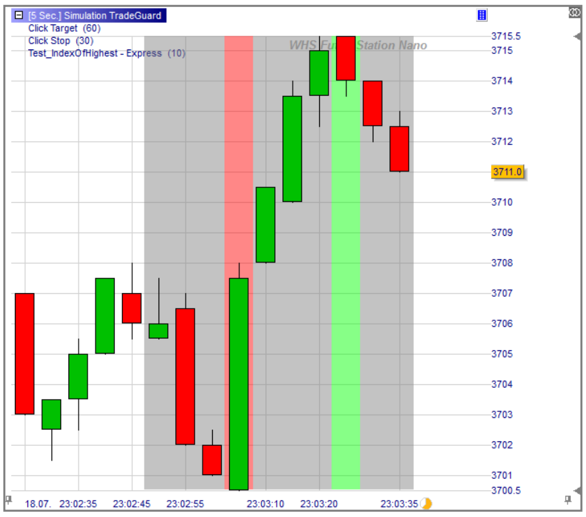
Format:

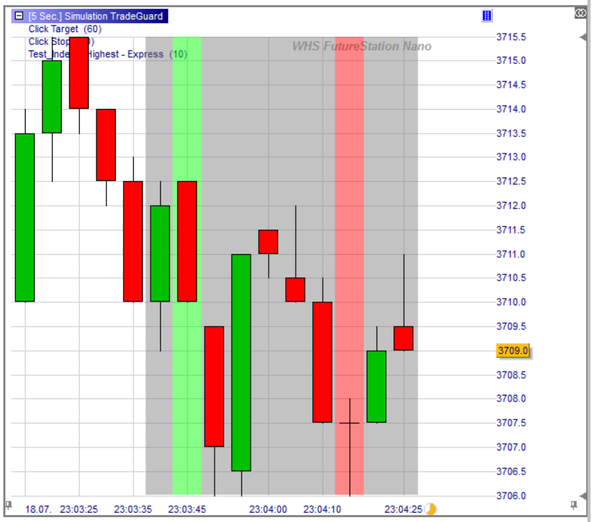
- int IndexOfHighest (series series, int span)

Example:

- Below we first color the background of the last 10 candles in grey.
- We then identify the highest and the lowest bars of the last 10 candles by coloring in green or red the background of the chart. For that purpose we need to indicate the index of the bars to the function HighlightAT:

```
Express f_IndexOfHighest

vars

input $period(1,50,10);

calculation

if (CurrentBarIndex() > (FinalBarIndex() - $period))
then Highlight("slot","grey");

if IsFinalBar() then
begin
  for i = 0 to ($period - 1)
  begin
    if ((FinalBarIndex() - i) =
IndexOfHighest(h,$period)) then
HighlightAT(i,"slot","lightgreen");
    if ((FinalBarIndex() - i) =
IndexOfLowest(l,$period)) then
HighlightAT(i,"slot","lightred");
  end
end

interpretation
begin
end
```





CalculateAtEveryTick()

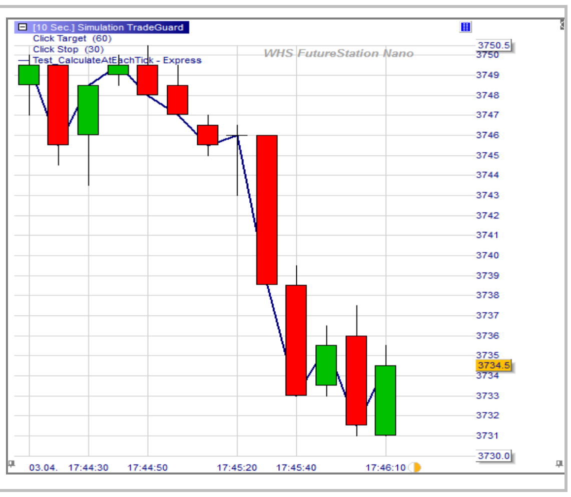
Definition:

- This function can be used in two modes:
    - With **CalculateAtEveryTick(false)** an express code is calculated once at the close of the bar.
        - This instruction is used when the result of a program is only required at the close of the bar or when the user wants to limit the number of iterations and CPU usage.
    - With **CalculateAtEveryTick(true)** an express code is calculated at every tick. When this instruction is not present in a code the program is executed by default at every tick.
        - Users should realize that express codes are executed every time a new tick is received by the platform. As long as the number of bars and the number of iterations are limited this instruction can be neglected.

Example 1:

- Here we calculate at every tick.
- The blue line plotted below passes through the close prices. As the close price of the last candle gets updated at each incoming tick, so too does the blue line: The blue line moves in line with the close price.

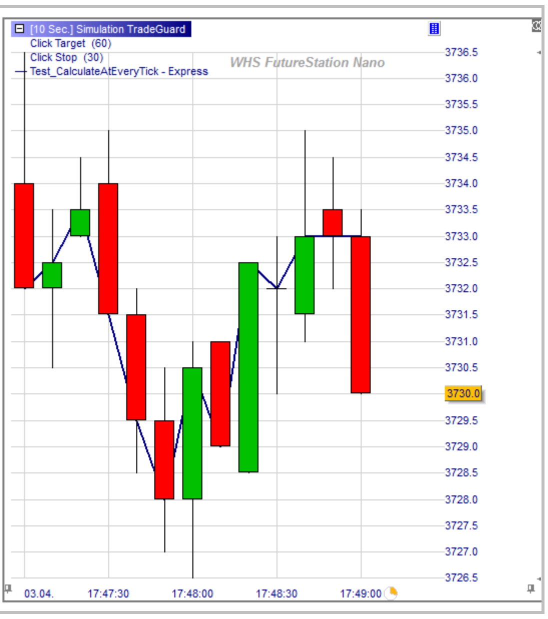
```
Express f_CalculateAtEveryTick

vars
series x;

calculation
x = c;

interpretation
begin
end

plot(x,blue,2);
```



Example 2:

- Here we calculate only at the close of the bar.
- Contrary to above here the blue line gets updated only once at the close of each bar: The blue line is fixed, positioned on the previous close, while the close price keeps going down.

```
Express f_CalculateAtEveryTick

vars
series x;

calculation

CalculateAtEveryTick(false);
x = c;

interpretation
begin
end

plot(x,blue,2);
```



IsFirstBar / IsFinalBar and associated functions

IsFinalBar() / IsFirstBar()

<u>Definition:</u>

- Returns true if at the first bar.
    - IsFirstBar() is used with the If … then expression to identify the first bar on the left of the chart.
- Returns true if at the final bar.
    - IsFinalBar() is used with the If … then expression to identify the last bar on the right of the chart.
    - These are very useful functions which can be used to reduce the number of iterations in express codes. These functions ought to systematically be used in conjunction with the following express functions: MovingAverage, ExpMovingAverage, StdDev and RSI.

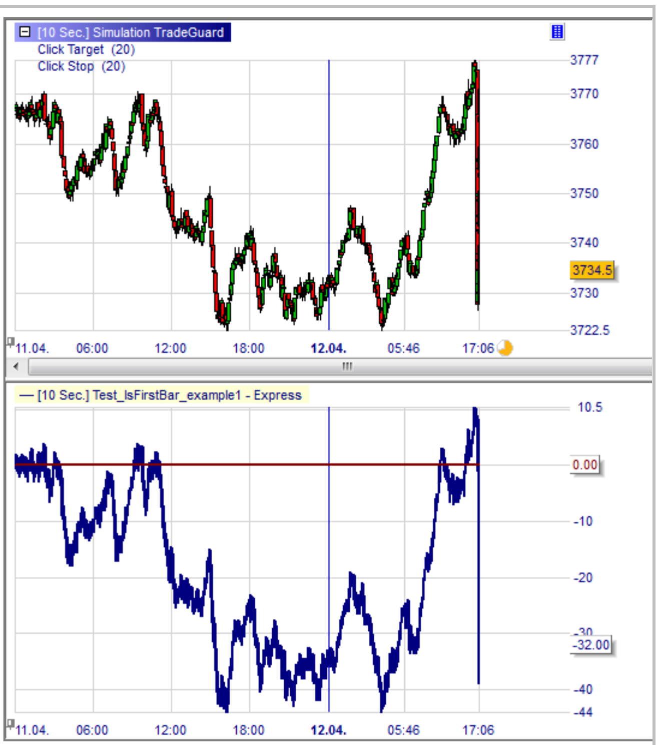
<u>Format:</u>

- bool IsFinalBar()
- bool IsFirstBar()

<u>Example 1:</u>

- Here we need to calculate a constant numeric variable which will be used at every successive bar. The constant K equals the opening price of the first bar. The result, series x, is the difference between the close price and the opening price of the first bar.

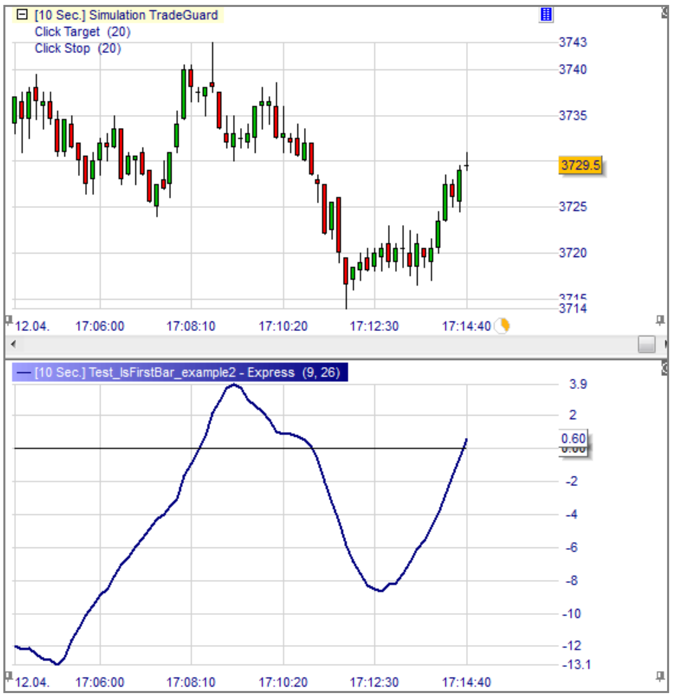
```
Express f_IsFirstBar_example1

vars
series x, zero;
numeric k;

calculation

if IsFirstBar() then
begin
  k = o;
end

x = c – k;

interpretation
begin
end

plot(x, blue, 2);
plot(zero, red, 2);
```



Example 2:

- Here we would like to calculate and plot the MACD line.
- We first have to calculate an exponential moving average (9) and an exponential moving average (26). Their difference resulting in the MACD line.
- Exponential moving average (9) and exponential moving average (26) are calculated at the first bar using the ExpMovingAverage function.
    - Why aren't they calculated at every bar? Because like this we eliminate unnecessary calculations:
        - The ExpMovingAverage function produces series ema based on series close. Let's imagine that our chart displays 1000 bars. Series ema is first obtained after the first execution of the ExpMovingAverage function at the first bar. If we permitted the execution of the ExpMovingAverage at every other bar we would just produce 999 times the same result as what we obtained at the first bar. Hence we impose a onetime only execution of the ExpMovingAverage function. We are actually being more efficient using fewer resources.

```
Express f_IsFirstBar_example2

vars

series ema1, ema2, macd, zero;
input $period1(1, 50, 9);
input $period2(1, 100, 26);

calculation

if IsFirstBar() then
begin
  ExpMovingAverage(c, ema1, $period1);
  ExpMovingAverage(c, ema2, $period2);
end

macd = ema1 - ema2;

interpretation
begin
end

plot(macd, blue, 2);
plot(zero, black, 1);
```



MovingAverage()

Definition:

- Returns the moving average of a series over a given period of time.
    - This function should only be used in combination with IsFirstBar() or IsFinalBar() in order to save a tremendous amount of computation (see IsFirstBar or IsFinalBar).

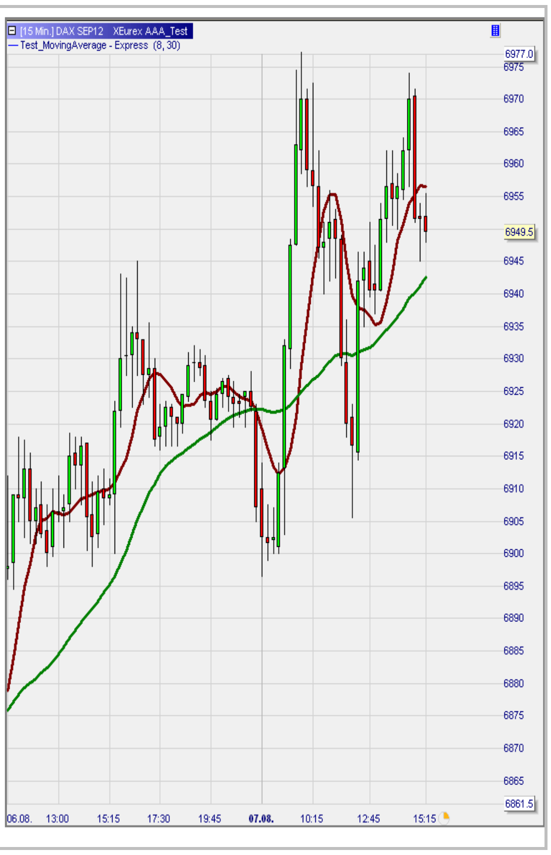
Format:

- MovingAverage(series source, series target, int span)

Example:

- Below we draw two moving averages MA1 and MA2.
- Note: Since series MA1 and MA2 are calculated at the first bar we do not execute the MovingAverage function at other bars (see IsFirstBar and IsFinalBar for more details).

```
Express f_MovingAverage

Vars

Series
MA1, MA2;

Input
$spanMA1(1, 200, 8), $spanMA2(1, 200, 30);

Calculation

If IsFirstBar() then begin
  MovingAverage(close, MA1, $spanMA1);
  MovingAverage(close, MA2, $spanMA2);
end

Interpretation
begin
end

plot (MA1, red, 3);
plot (MA2, green, 3);
```



ExpMovingAverage()

Definition:

- Returns the exponential moving average of a series over a given period of time.
  - This function should only be used in combination with IsFirstBar() or IsFinalBar() in order to save a tremendous amount of computation (see IsFirstBar and IsFinalBar).

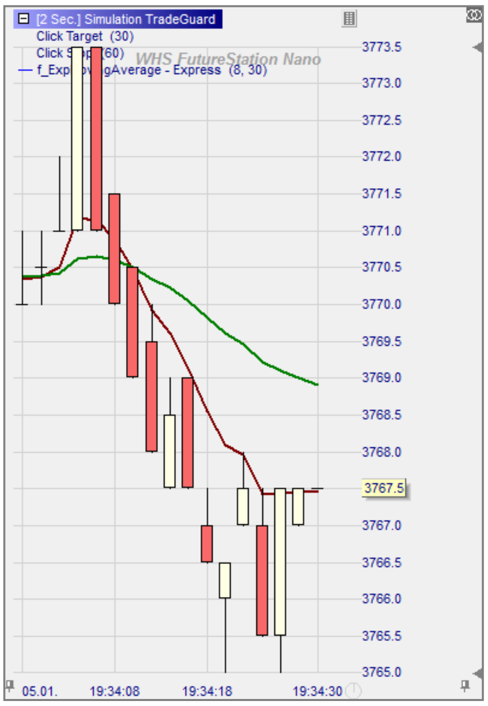
Format:

- ExpMovingAverage (series source, series target, int span)

Example:

- Below we draw two exponential moving averages MA1 and MA2.
- Note: Since series MA1 and MA2 are calculated at the first bar we do not execute the ExpMovingAverage function at other bars (see IsFirstBar and IsFinalBar for more details).

```
Express f_ExpMovingAverage

Vars

Series
MA1, MA2;

Input
$spanMA1(1, 200, 8), $spanMA2(1, 200, 30);

Calculation

If IsFirstBar() then
begin
  ExpMovingAverage(close, MA1, $spanMA1);
  ExpMovingAverage(close, MA2, $spanMA2);
end

Interpretation
begin
end

plot (MA1, red, 2);
plot (MA2, green, 2);
```



RSI()

Definition:

- Returns the relative strength index of a series.
  - The function should only be used in combination with IsFirstBar() or IsFinalBar() in order to save a tremendous amount of computation (see IsFirstBar or IsFinalBar).

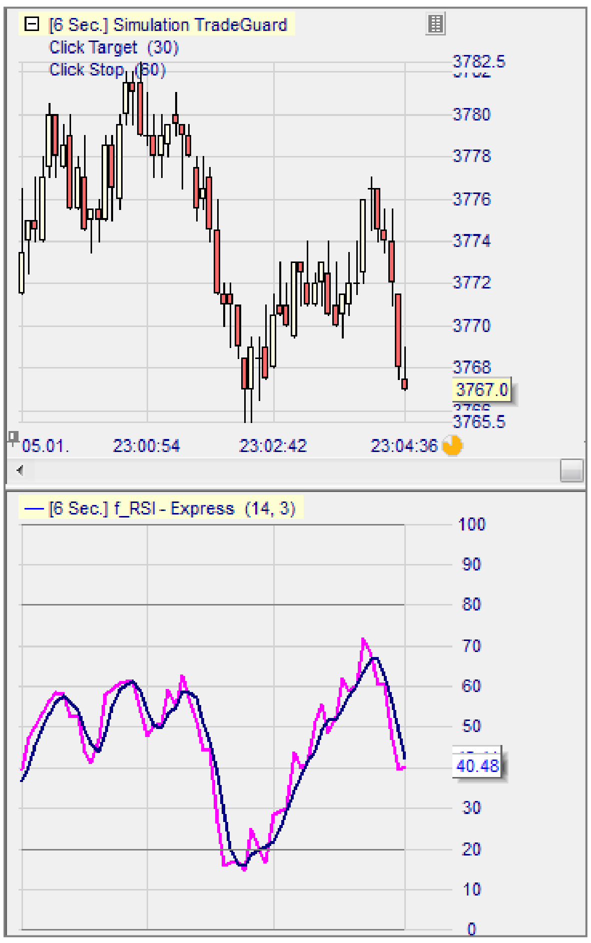
Format:

- RSI(series source, series target, int span)

Example:

- Below we draw a smoothed RSI.
- Note: Since series RSI and smoothedRSI are calculated at the first bar we do not execute the RSI and MovingAverage functions at other bars (see IsFirstBar and IsFinalBar for more details).

```
Express f_RSI

Vars

Series
myRSI, smoothedRSI;

Input
$a(1,100,14), $b(1,100,3);


Calculation
If IsFirstBar() then
begin
  RSI(close, myRSI, $a);
  MovingAverage(myRSI, smoothedRSI, $b);
end


Interpretation
begin
end

plot(myRSI, magenta, 2);
plot(smoothedRSI, blue, 2);
plotline(0, grey, 1);
plotline(20, grey, 1);
plotline(80, grey, 1);
plotline(100, grey, 1);
```



StdDev()

Definition:

- Returns the standard deviation of a series for a given period.
    - This function should only be used in combination with IsFirstBar() or IsFinalBar() in order to save a tremendous amount of computation (see IsFirstBar or IsFinalBar).

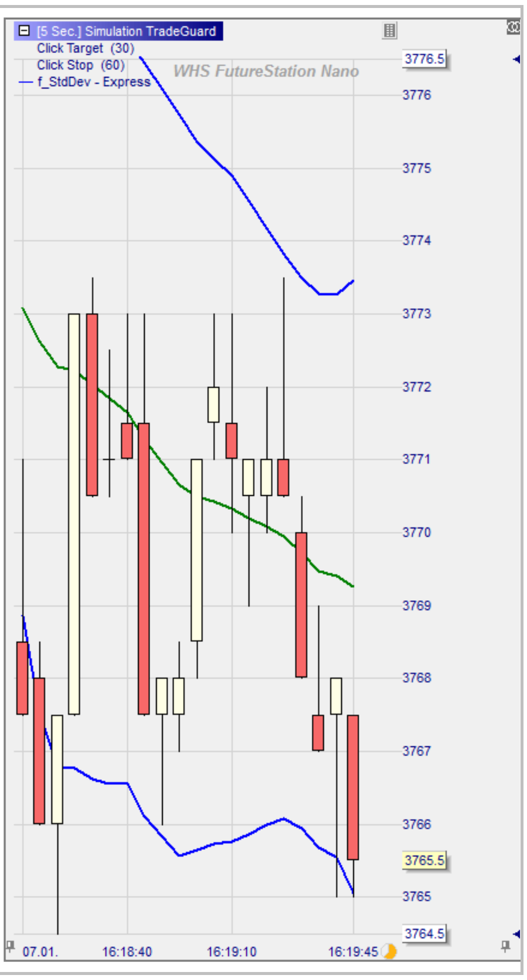
Format:

- void StdDev (series source, series target, int span)

Example:

- Below we draw the Bollinger Bands which are based on a 20 periods moving average plus and minus two times the standard deviation.
- Note: Since series RSI and smoothedRSI are calculated at the first bar we do not execute the RSI and MovingAverage functions at other bars (see IsFirstBar and IsFinalBar for more details).

```
Express f_StdDev

Vars

Series
MA, SD, BBH, BBL;

Calculation

If IsFirstBar() then
begin
  MovingAverage(close, MA, 20);
  StdDev(close, SD, 20);
end

BBH = MA + 2*SD;
BBL = MA - 2*SD;

Interpretation
begin
end

plot(MA, green, 2);
plot(BBL, lightblue, 2);
plot(BBH, lightblue, 2);
```



Unaggregate()

Definition:

- Takes an indicator in a large time unit, e.g. a 5 minute MACD, and projects its values into another indicator that can be displayed in the master chart in a smaller time unit, e.g. 1 minute.
- This function should only be used in combination with IsFirstBar() or IsFinalBar() in order to save a tremendous amount of computation (see IsFirstBar or IsFinalBar).

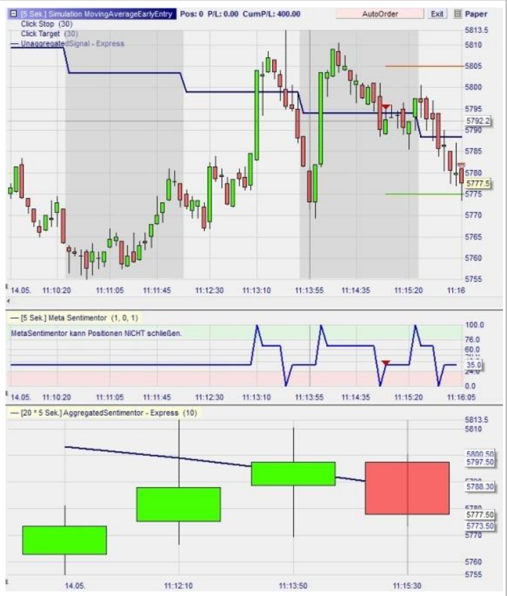
Format:

- Void Unaggregate(series source, series target)

Example:

- We start by displaying a 5 second candle chart in the master chart.
- We then upload two indicators:
  - First, AggregatedSentimentor is uploaded in a sub-window. It displays a candle chart with a Moving Average of 10 periods called MAbig. This candle chart is set with an aggregation of 20x[4].
  - Second, UnaggregatedSignal is uploaded in the master chart. This indicator imports MAbig and uses the Unaggregate function to transform the Moving Average aggregated values, e.g. MAbig, into unaggregated values, e.g. MA[5].
- The interpretation is defined by the crossing of two curves: close and MA. That makes it possible to enter in position earlier than if we had to wait for the close of the 100 second candles.
- Another application can be to import price levels from a large time unit chart to define stops, targets, indicator, etc.

```
express AggregatedSentimentor

vars
series MAbig, colorbig ;
input $Span(1,200,10);

calculation
CalculateAtEveryTick(false);
if IsFirstBar() then MovingAverage(c,MAbig,$Span);
if (colorbig[1] = 0) then colorbig = 1; else colorbig = 0;

interpretation
begin
end

plot(MAbig,blue,2);
plotcandles(o,c,h,l);
```



[4] Right-click on the upper left blue label, select Aggregation, and type 20.

[5] To make it clearer the master chart's background color alternates with each new aggregated bar.

```
express UnaggregatedSignal

vars
series
colorbig(AggregatedSentimentorExpress.colorbig),color,
MAbig(AggregatedSentimentorExpress.MAbig), MA;

calculation
CalculateAtEveryTick(false);
if IsFirstBar() then
begin
  Unaggregate(colorbig,color);
  Unaggregate(MAbig,MA);
end
if (color = 0) then HighlightRGB("slot",192,192,192);

interpretation triggerline(c,MA);

plot(MA,blue,2);
```

Mathematical functions

AbsValue()

Definition:

- Returns the absolute value of a number.

Format:

- float AbsValue (float value)

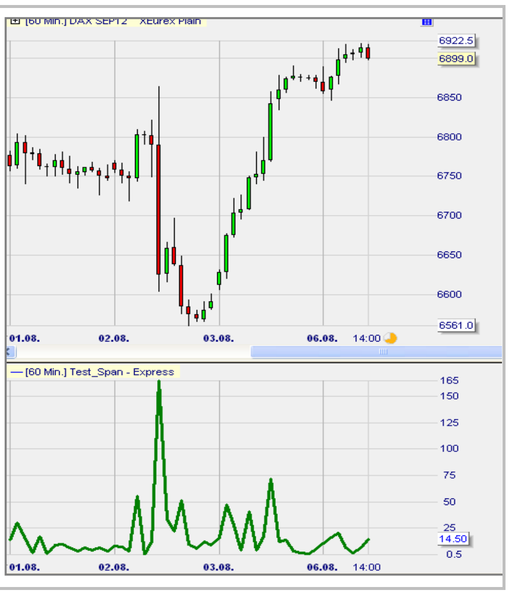
Example 1:

- AbsValue(5) = AbsValue(-5) = 5

Example 2:

- Below we display the absolute value of the difference in points between the open and close prices of every candle.

```
Express f_AbsValue

Vars

Series
span;

Calculation
span = AbsValue(open-close);

Interpretation
begin
end

plot (span, green, 3);
```



Sign()

Definition:

- Returns the sign of a given number.
  - The sign of a negative number is -1.
  - The sign of a positive number is 1.
  - The sign of zero is 0.

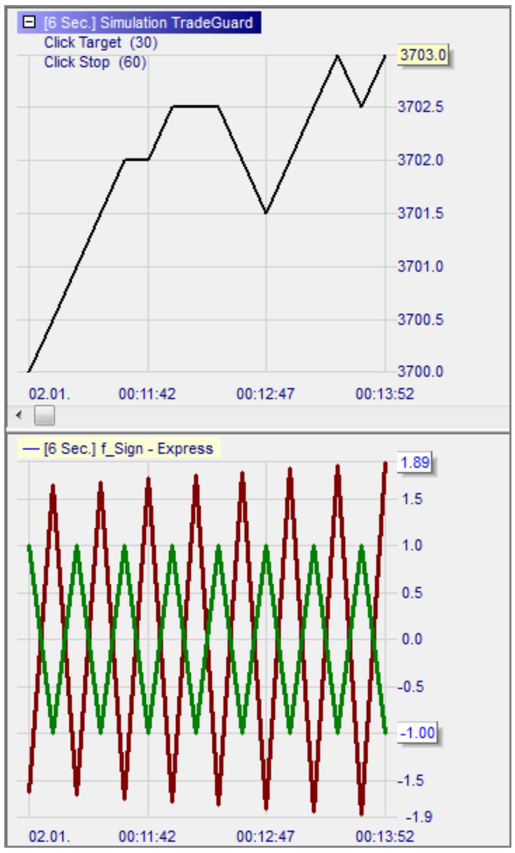
Format:

- Sign(float value).

Example:

- Below we draw a curve Y in red and another one in green which shows the opposite sign of the Y:

```
Express f_Sign

Vars

Series
Y, OppositeSignY;

Calculation

Y = Power(-1.01, CurrentBarIndex());
OppositeSignY = -Sign(Y);

Interpretation
begin
end

plot(Y, red, 3);
plot(OppositeSignY, green, 3);
```



Floor() / Ceiling()

Definition:

- floor() returns the biggest integer which is less than or equal to a given number.
- ceiling() returns the smallest integer which is greater than or equal to a given number.

Format:

- float Floor (float value)

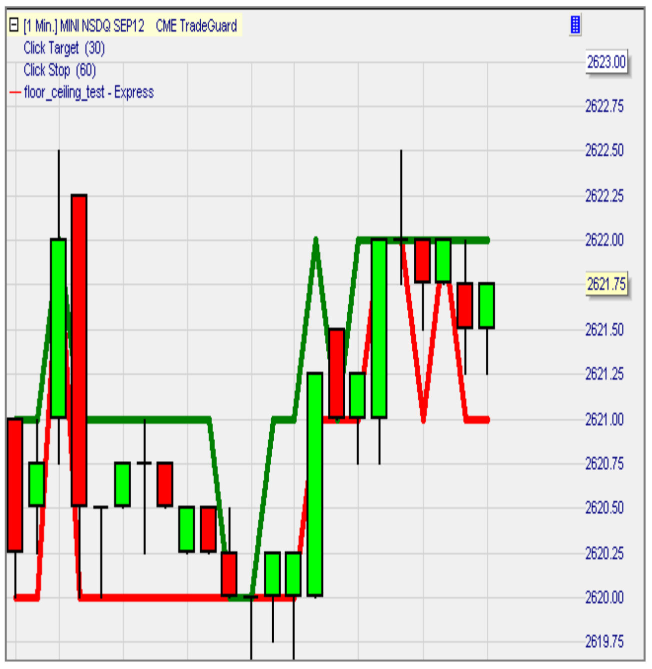
Example 1:

x	floor(x)	ceiling(x)
2.3	2.0	3.0
5.7	5.0	6.0
0.0	0.0	0.0
-0.5	-1.0	0.0
-1.5	-2.0	-1.0

Example 2:

- Below we draw a green line of ceiling values and a red line of floor values.

```
Express f_Floor_Ceiling

Vars

Series
line_floor, line_ceiling;

Calculation

line_floor = floor(c);
line_ceiling = ceiling(c);

Interpretation
begin
end

plot (line_floor, lightred, 3);
plot (line_ceiling, green, 3);
```



Sum()

Definition:

- Returns the sum of the elements series[0], ... series[span – 1].
    - Returns void if at least on element is void.

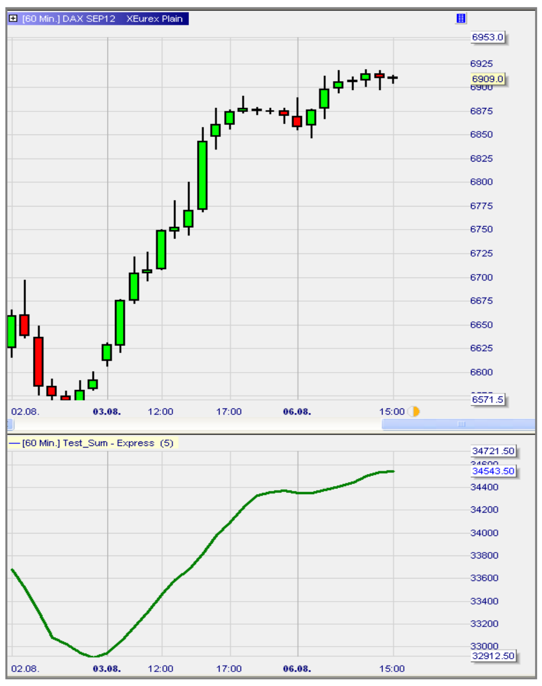
Format:

- float Sum(series series, int span)

Example:

- Below we draw the sum of the last five close prices:

```
Express f_Sum

Vars

Series
amount;

Input
$span(1, 100, 5);

Calculation

amount = sum(close, $span);

Interpretation
begin
end

plot (amount, green, 3);
```



Atr()

Definition:

- Measures the price volatility over a given period as a percentage value. It is an average of True Range over a given period. True Range being defined as follows:
  TrueRange = high - low;
  If (previous close <= high) then TrueRange = max(TrueRange, high - previous close);
  If (previous close >= low) then TrueRange = max(TrueRange, previous close - low);
  Atr(14) is TrueRange’s moving average over 14 periods divided by the close price.

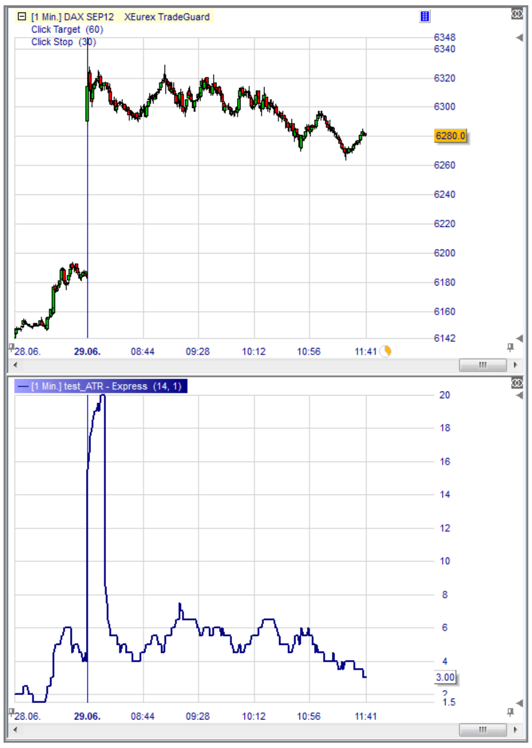
Format:

- float Atr (int span)

Example:

- The indicator below plots three different versions of the ATR: 1/ ATR in points, 2/ ATR in percent and 3/ ATR in ticks

```
Express f_Atr

Vars

input
$Period(1, 50, 14), $Type("points;percent;ticks",1);

series
ATRpoints, ATRpercent, ATRticks, ATRline;

calculation

// ATR in points
if $Type = 0 then ATRline =
Round(Atr($Period)/100*close/TickSize(),0)*TickSize()
;

// ATR in percent
if $Type = 1 then ATRline = Atr($Period);

//ATR in ticks
if $Type = 2 then ATRline =
Round(Atr($Period)/100*close/TickSize(),0);

interpretation
begin
end

plot (ATRline,blue,2);
```



AtrAbs()

Definition:

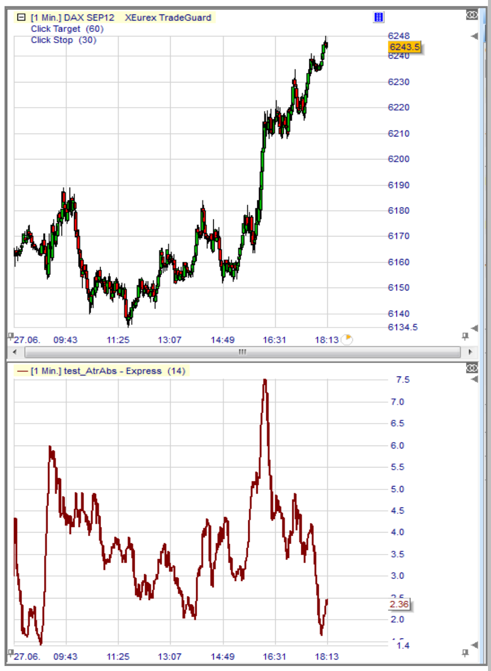
- Measures the price volatility over a given period in points[6]. It is an average of True Range over a given period. True Range being defined as follows:
  TrueRange = high - low;
  If (previous close <= high) then TrueRange = max(TrueRange, high - previous close);
  If (previous close >= low) then TrueRange = max(TrueRange, previous close - low);
  AtrAbs(14) is TrueRange's moving average over 14 periods.

Format:

- float AtrAbs (int span)

Example:

```
Express f_AtrAbs

vars

input $Period(1, 50, 14);
series ATRline;

calculation

ATRline = AtrAbs($Period);

interpretation
begin
end

plot (ATRline,red,2);
```

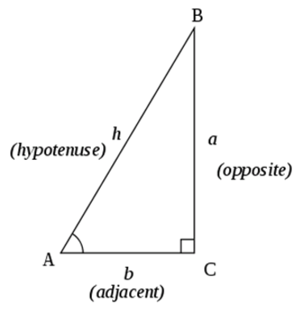


[6] AtrAbs() differs from Atr() in that it is expressed as an absolute value (= points) and not as a percentage value.

Sine()

<u>Definition:</u>

- Returns the sine value of a given angle.
    - Considering the triangle aside sine of angle AB-AC equals the ratio (a/h):



<u>Format:</u>

- float Sine(float value)

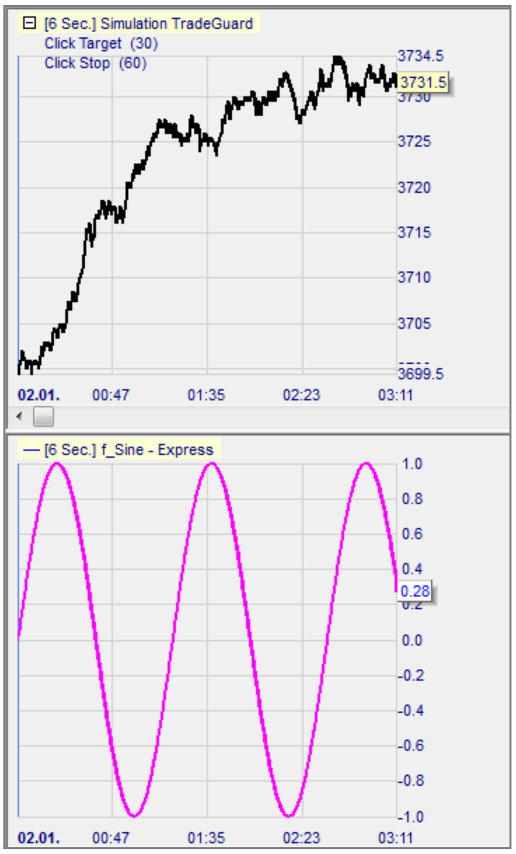
<u>Example 1:</u>

- Sine(0) = 0
- Sine(45) = 0.7071…
- Sine(90) = 1

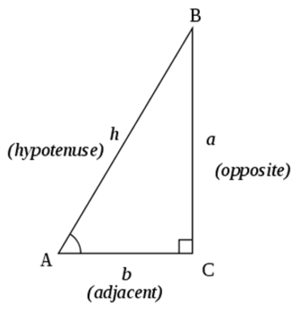
<u>Example 2:</u>

- Below we draw the sine of the index of the bars:

```
Express f_Sine

Vars

Series
val;

Calculation
val = sine(CurrentBarIndex());

Interpretation
begin
end

plot (val, magenta, 2);
```



Cosine()



Definition:

- Returns the cosine value of a given angle.
    - Considering the triangle aside cosine of angle AB-AC equals the ratio (b/h):

Format:

- float Cosine (float value)

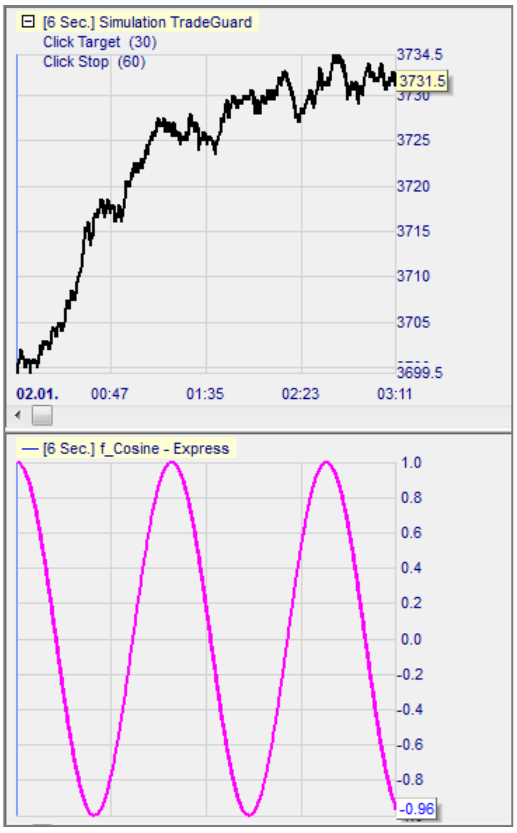
Example 1:

- Cosine(0) = 1
- Cosine(45) = 0.7071…
- Cosine(90) = 0

Example 2:

- Below we draw the cosine of the index of the bars:

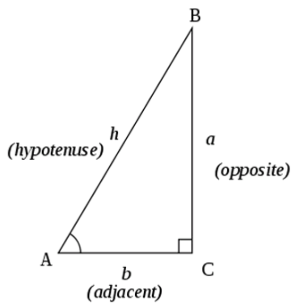
```
Express f_Cosine

Vars

Series
val;

Calculation

val = cosine(CurrentBarIndex());

Interpretation
begin
end

plot (val, magenta, 2);
```



Tangent()

Definition:

- Returns the tangent value of a given angle.
    - Considering the triangle aside tangent of angle AB-AC equals the ratio (a/b):



Format:

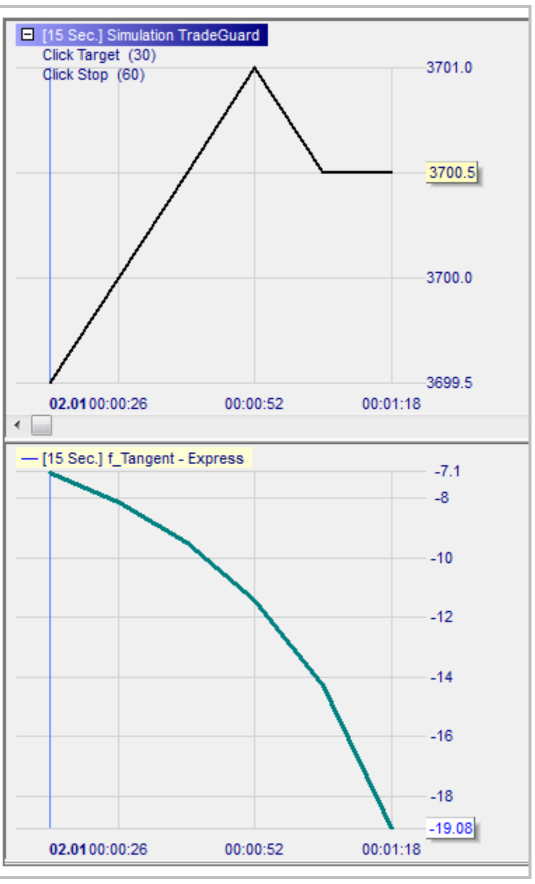
- float Tangent (float value)

Example 1:

- Tangent(0) = 0
- Tangent(45) = 1

Example 2:

- Below we draw the tangent of the index of the bars:

Express f_Tangent
 	
Vars
 	
Series
value;
 	
Calculation
 	
value = tangent(FinalBarIndex() - CurrentBarIndex());
 	
Interpretation
begin
end
 	
plot (value, cyan, 3);
	

ArcTangent()

Definition:

- Is the reciprocal function of the Tangent() function:
  - ArcTangent(Tangent(angle)) = angle
  - The returned angle is expressed as a number between – 90° and +90°
    - ArcTangent(0) = 0
    - ArcTangent(1) = 45

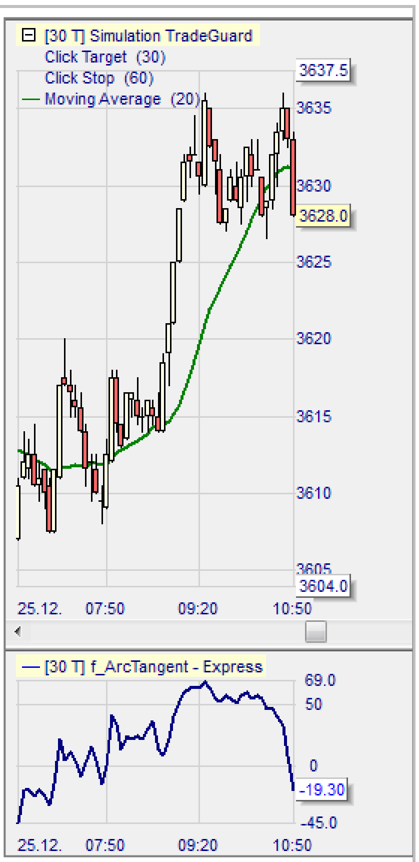
Format:

- float ArcTangent (float value)

Example:

- Below we display the angle defining the slope of the green moving average line.
  - To adjust the measure of the angle with what we see we enter two parameters:
    - Number of candles per centimeter
    - Number of points per centimeter
  - In the example below the angle goes from 0° (bottoming green line) to around 50° (steadily rising green line) before returning to 0° (flattening green line).

```
Express f_ArcTangent

vars

series
ma, angle;

input
$NumberOfpointsPerCM(0.1, 10.0, 2.9, 0.1, 1),
$NumberOfcandlesPerCM(0.1, 10.0, 4.0, 0.1, 1), $period(1, 50, 10);

calculation

if IsFirstBar() then
begin
  CalculateAtEveryTick(false);
  MovingAverage(c, ma, $period);
end
angle = ArcTangent((ma -
ma[1])/$NumberOfpointsPerCM*$NumberOfcandlesPerCM);

interpretation
begin
end

plot(angle,blue,2);
```



Exp()

Definition:

- Returns the exponential value of a given number.
  - It is the value of the constant *e* powered to a given number.
  - *e* is a transcendental number that is the base of natural logarithms and is equal to approximately 2.718281828….

Format:

- float Exp(float value)

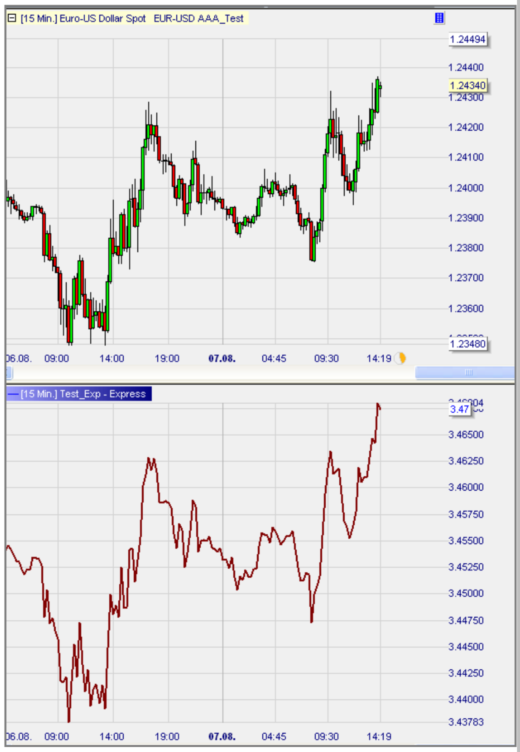
Example 1:

- Exp(0) = 1
- Exp(1) = 2.718281828….

Example 2:

- Below we draw the exponential value of the close:

```
Express f_Exp

Vars


Series
val;

Calculation

val = exp(close);

Interpretation
begin
end

plot (val, red, 2);
```



Log()

Definition:

- Returns the logarithm value in base *e* of a given number.
    - e is a transcendental number that is the base of natural logarithms and is equal to approximately 2.718281828….
    - Log(Exp(number) = number.

Format:

- float Log (float value)

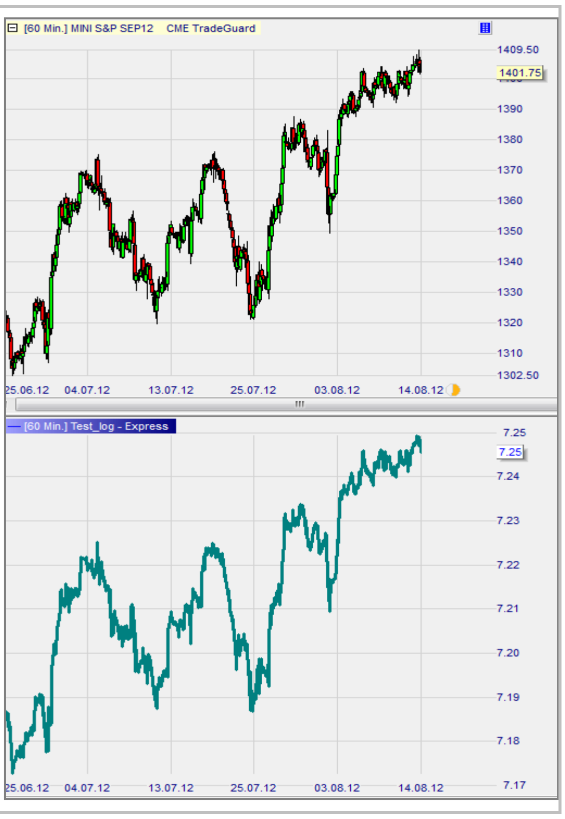
Example 1:

- Log(0.1) = -2.30…
- Log(1) = 0
- Log(1000) = 6.91…

Example 2:

- Below we draw the logarithm in base *e* of the close:

```
Express f_Log

Vars

Series
val;

Calculation

val = log(close);

Interpretation
begin
end

plot (val, cyan, 3);
```



Power()

Definition:

- Returns the result of a number raised to a given power.

Format:

- float Power (float value, float exponent)

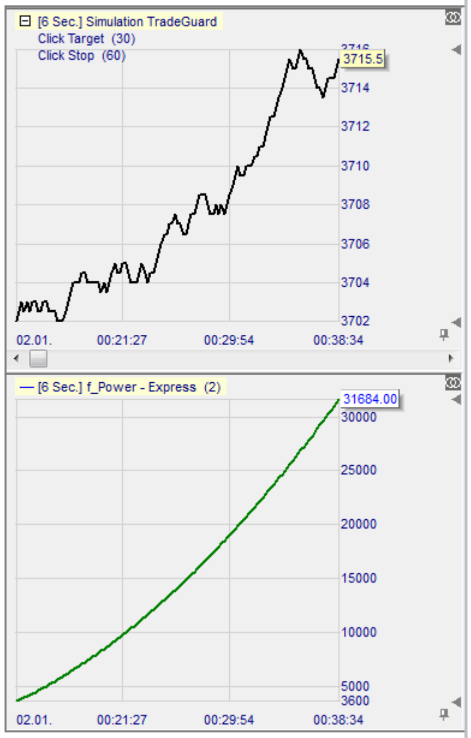
Example 1:

- Power(3, 0) = 1
- Power(3, 1) = 3
- Power(3, 2) = 9

Example 2:

- Below we draw an exponential curve equal to the bar indices raised to power 2:

```
Express f_Power

Vars

series
Result;

input
$Exponent(1, 50, 2);

Calculation

Result = Power(CurrentBarIndex(), $Exponent);

Interpretation
begin
end

plot(Result, green, 2);
```



SquareRoot()

Definition:

- Returns the square root value of a given number.
    - Note: The number must be positive or null.

Format:

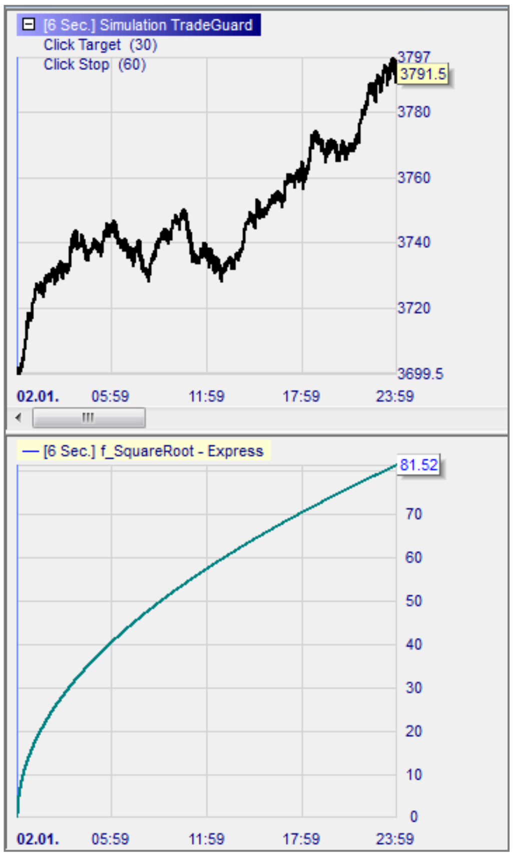
- float SquareRoot (float value)

Example 1:

Number	SquareRoot(Number)
1	1
4	2
9	3
16	4

Example 2:

```
Express f_SquareRoot

Vars

Series
val;

Calculation

val = SquareRoot(CurrentBarIndex());

Interpretation
begin
end

plot (val, cyan, 2);
```



Highest()

Definition:

- Returns the highest value for the elements series[0], ... , series[span – 1].

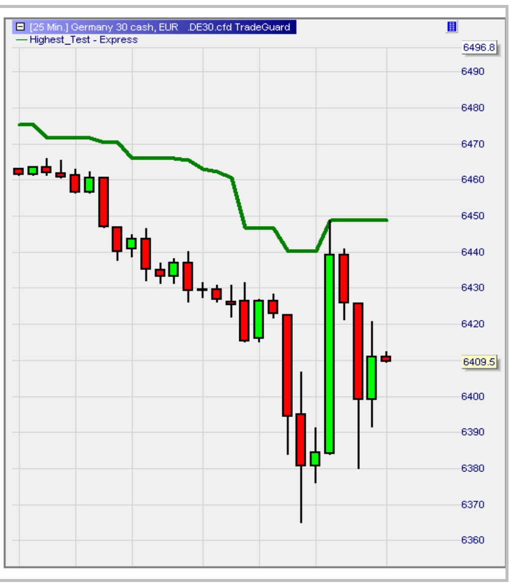
Format:

- Float Highest (series series, int span)

Example:

- Below the green line TenBarHigh returns the highest value of the ten previous highs:

```
Express f_Highest

Vars

Series TenBarHigh;

Calculation

TenBarHigh = Highest(High, 10);

interpretation
begin
end

plot (TenBarHigh, green, 4);
```



Lowest()

Definition:

- Returns the lowest value for the elements series[0], ... , series[span – 1].

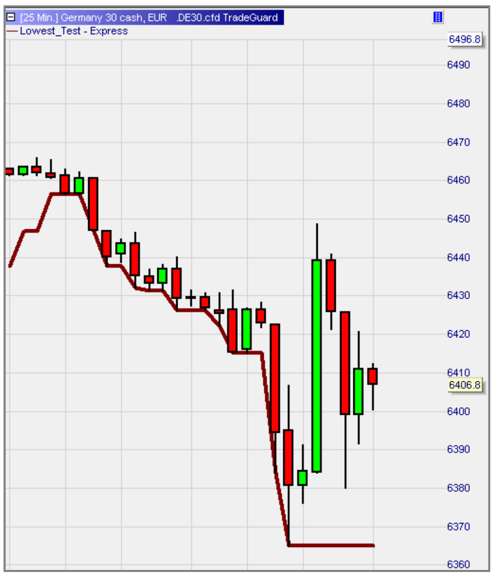
Format:

- float Lowest (series series, int span)

Example:

- Below the red line TenBarLow returns the lowest value of the ten previous lows:

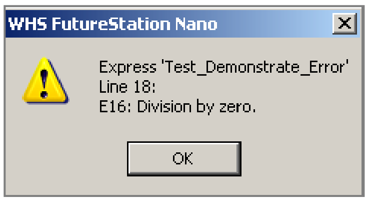
```
Express f_Lowest

Vars

Series TenBarLow;

Calculation

TenBarLow = Lowest(Low, 10);

interpretation
begin
end

plot (TenBarLow, red, 4);
```



IsZero()

Definition:

- IsZero(number) returns true if AbsValue(number) <= 0.000 001
  - Consequence 1: This function treats as zero a non null number if it is smaller than 0.000 001.
  - Consequence 2: If one divides a number by a another non null number which is less than 0.000 001 the following message will appear:


WHS FutureStation Nano

Express 'Test_Demonstrate_Error'
Line 18:
E16: Division by zero.

OK

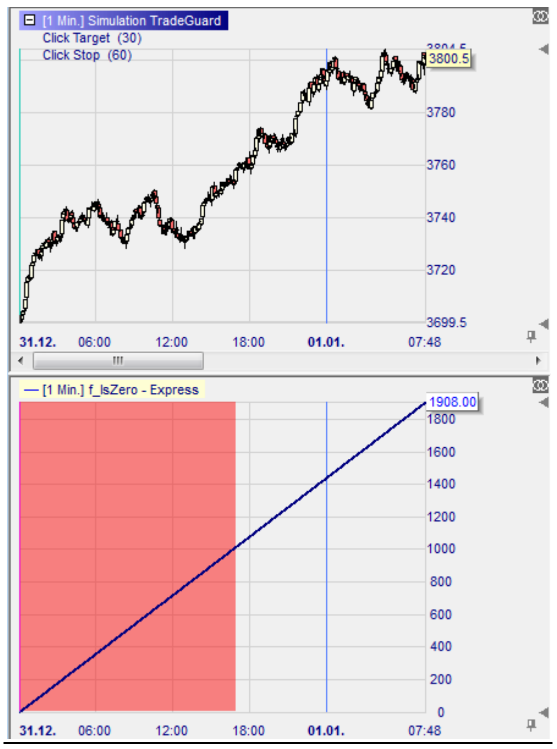
Format:

- bool IsZero(float value)

Example:

- Below we draw the CurrentBarIndex line and highlight the background in light red if IsZero(CurrentBarIndex()/1 000 000 000) is true:
  - For the first 1001 bars the condition is true and the background is light red.
  - From the 1002 bar onwards the condition is false.

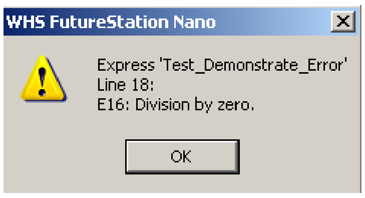
```
Express f_IsZero

Vars

series
x, y;

numeric
a, b;

Calculation

if IsFirstBar() then a = 1/1000000000;

x = a*CurrentBarIndex();
y = CurrentBarIndex();

if IsZero(x) then Highlight("slot", "lightred");

Interpretation
begin
end

plot(y, blue, 2);
```



IsNonZero()

Definition:

- IsNonZero(number) returns true if AbsValue(number) > 0.000 001
    - Consequence 1: This function does not catch a non null number if it is smaller than 0.000 001.
    - Consequence 2: If one divides a number by a another non null number which is less than 0.000 001 the following message will appear:



WHS FutureStation Nano

Express 'Test_Demonstrate_Error'
Line 18:
E16: Division by zero.

OK

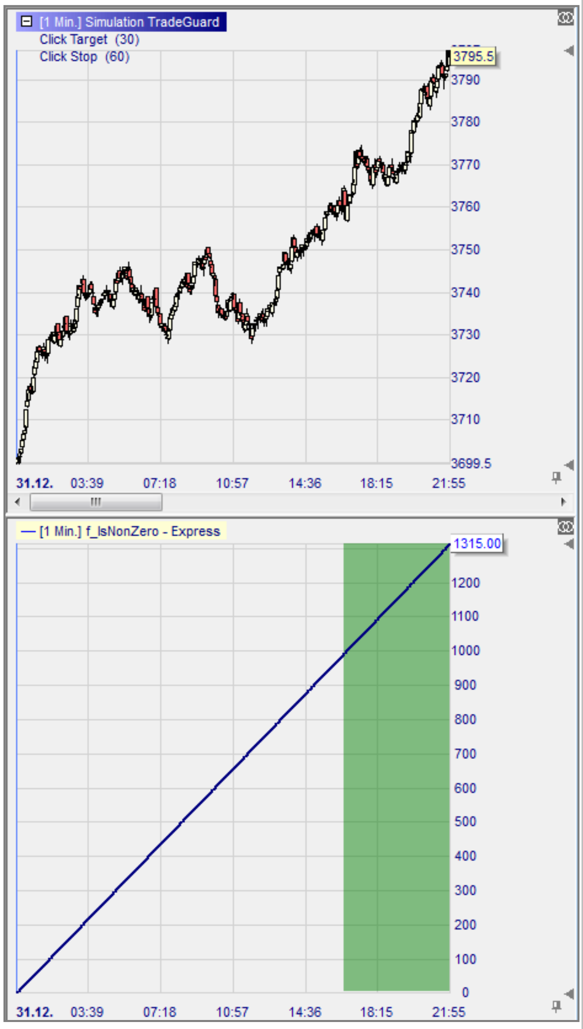
Format:

- bool IsNonZero(float value)

Example:

- Below we draw the CurrentBarIndex line and highlight the background in green if IsNonZero(CurrentBarIndex()/1 000 000 000) is true:
    - For the first 1001 bars the condition is false.
    - From the 1002 bar onwards the condition is true and the background is green.

```
Express f_IsNonZero

Vars

series
x, y;

numeric
a, b;

Calculation

if IsFirstBar() then a = 1/1000000000;

x = a*CurrentBarIndex();
y = CurrentBarIndex();

if IsNonZero(x) then Highlight("slot", "green");

Interpretation
begin
end

plot(y, blue, 2);
```



Max()

Definition:

- Returns the greater of two numbers.

Format:

- float Max(float value1, float value2)

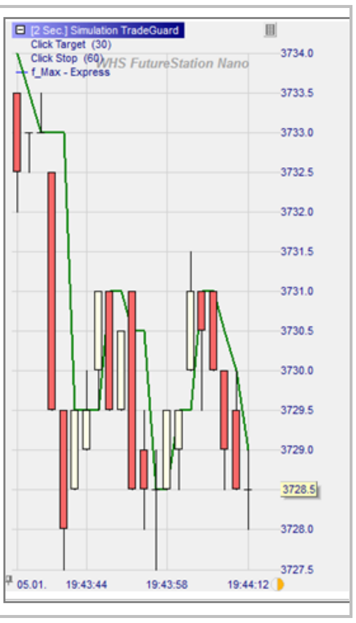
Example 1:

- Max(3, 8) returns 8.

Example 2:

- Below we draw a line made of the maximum of the previous two close prices:

```
Express f_Max

Vars

series
MaxClose;

Calculation

MaxClose = Max(close[2], close[1]) ;

interpretation
begin
end

plot(MaxClose, green, 2);
```



Min()

Definition:

- Returns the lesser of two numbers.

Format:

- float Min(float value1, float value2)

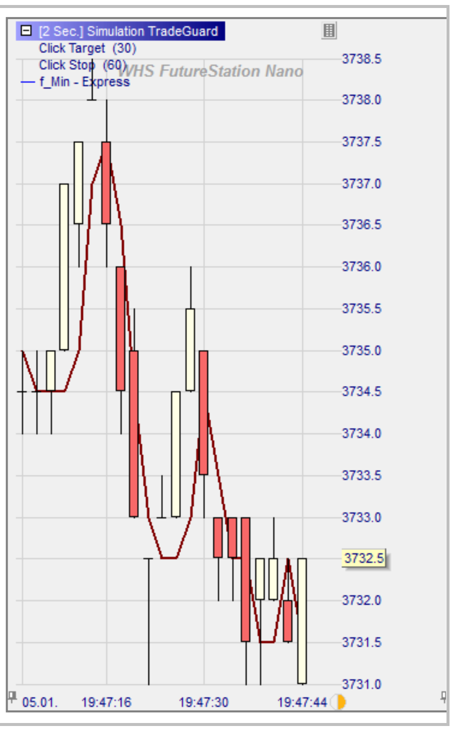
Example 1:

- Min(3, 8) returns 3.

Example 2:

- Below we draw a line made of the minimum of the previous two close prices:

```
Express f_Min

Vars

series
MinClose;

Calculation

MinClose = Min(close[2], close[1]) ;

interpretation
begin
end

plot(MinClose, red, 2);
```



Round()

<u>Definition:</u>

- Returns the nearest rational number to a given number for a given number of decimals.
    - Midpoint (0.5) is rounded up to nearest rational number.

<u>Format:</u>

- float Round (float value, int precision)

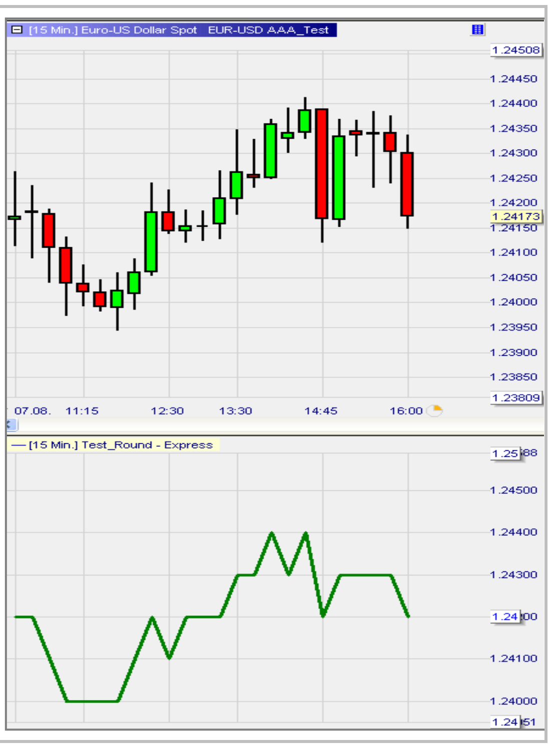
<u>Example 1:</u>

- Round(1.1550, 0) = 1
- Round(1.1550, 1) = 1.2
- Round(1.1550, 2) = 1.16
- Round(1.1550, 3) = 1.155

<u>Example 2:</u>

- Below we draw a curve made of the rounded values to three decimals of EUR/USD prices:

```
Express f_Round

Vars

series
myClose;

Calculation

myClose = Round(close, 3);

Interpretation
begin
end

plot (myClose, green, 3);
```



<div style="text-align:center">

</div>

RoundMultiple()

Definition:

- Returns a number which is the nearest multiple of a given base to a given number. For example:
    - If the base is 2.5 and the number is 3743.5 the result is 3742.5:
        - 3743.5 / 2.5 = 1497.4 which is rounded to 1497.0
        - 1497 x 2.5 = 3742.5
    - If the base is 2.5 and the number is 3739.5 the result is 3740.0:
        - 3739.5 / 2.5 = 1495.8 which is rounded to 1496.0
        - 1496 x 2.5 = 3740.0

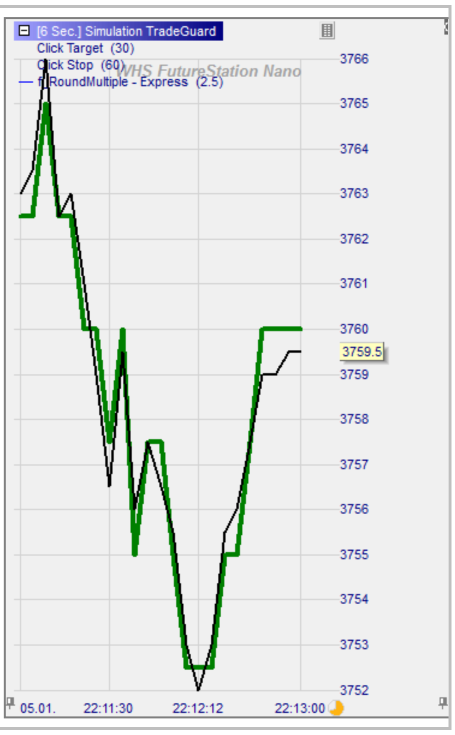
Format:

- float RoundMultiple (float value, float multiple)

Example:

- Below we draw in green the line of the RoundMultiple applied to the close and based on a multiple of 2.5:

```
Express f_RoundMultiple

Vars

input
$Base(0.1, 5.0, 2.5, 0.1, 1);

Series
val;

Calculation
val = RoundMultiple (close, $Base);

Interpretation
begin
end

plot (val, green, 4);
```



NormalCDF()

Definition:

- Returns the value of the normal cumulative distribution function (CDF).
  - It is the cumulative distribution function with a mean of 0 and a standard deviation of 1.
    - It can be useful for computing probability-based pricing functions such as Black-Scholes.

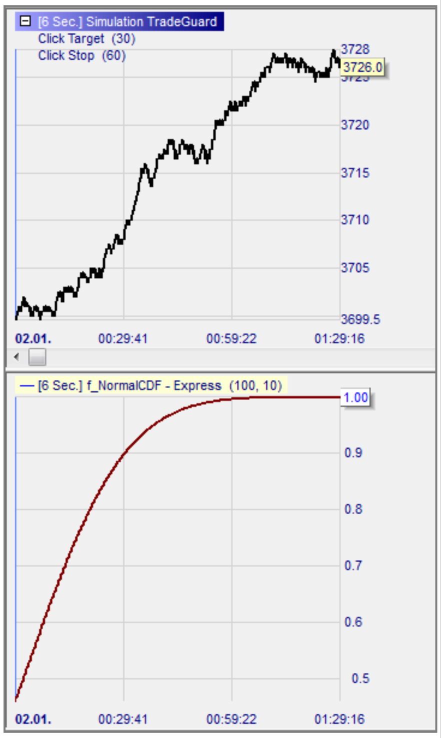
Format:

- NormalCDF (float value)

Example:

- Below we draw the curve representing the normal CDF function (use parameters a and b to adjust it):

```
Express f_NormalCDF

vars

series
CBI, x;

input
$a(1, 500, 100), $b(1, 500, 10);

calculation

CBI = CurrentBarIndex();
x = NormalCDF((CBI - $b) / $a);

interpretation
begin
end

plot(x, red, 2);
```



NormalPDF()

Definition:

- Returns the value of the normal probability density function (PDF).
    - It is the probability density function with a mean of 0 and a standard deviation of 1.
        - It can be useful for computing probability-based pricing functions such as Black-Scholes.

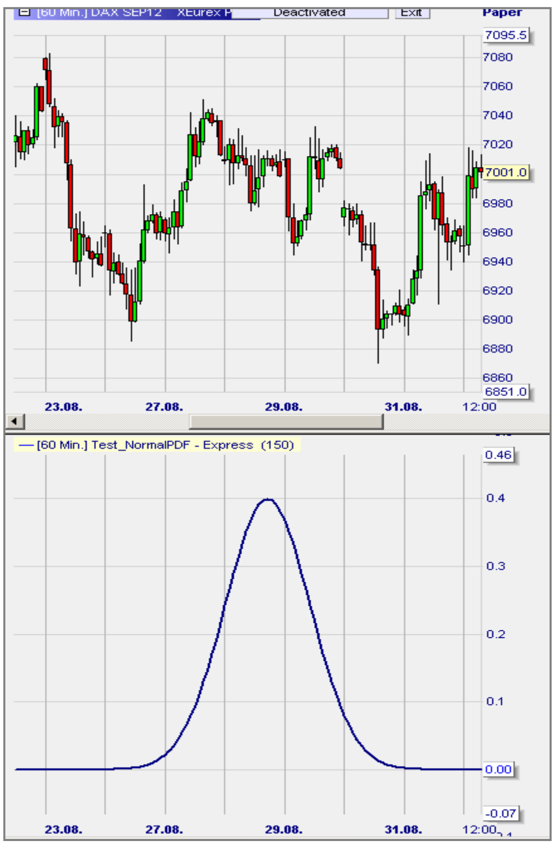
Format:

- NormalPDF (float value)

Example:

- Below we draw the curve representing the normal PDF function (use parameters a and b to adjust it):

```
Express f_NormalPDF

vars

series
CBI, x;

input
$a(1,500,10), $b(1,500,150);

calculation

CBI = CurrentBarIndex();
x = NormalPDF((CBI - $b)/$a);

interpretation
begin
end

plot(x, blue, 2);
```



Charting functions

Plotline()

<u>Definition:</u>

- Draws a line at a given level.
    - Both predefined and RGB colors can be used.

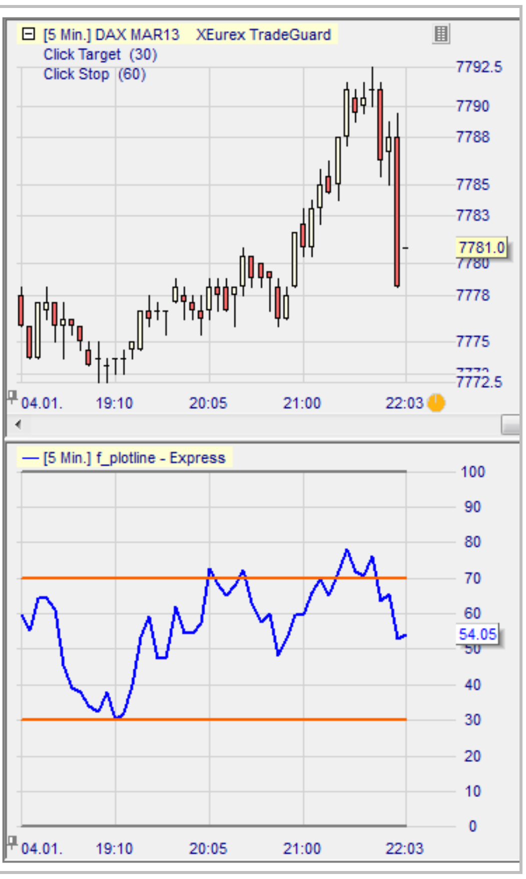
<u>Format:</u>

- plotline (<constant or variable>, <colorname>, <pen width>);

<u>Example:</u>

- Below we draw a RSI:
    - The 100 and 0 horizontal lines are colored using a predefined color, grey.
    - The 70 and 30 horizontal lines are colored using RGB and defined using numeric variables.

```
Express f_plotline

Vars

Series
myRSI;

Numeric
upper(70), lower(30);

Calculation

If IsFirstBar() then RSI(close, myRSI, 14);

interpretation
begin
end

plot(myRSI, “lightblue”, 2);
plotline(upper, 250, 100, 0, 2);
plotline(lower, 250, 100, 0, 2);
plotline(0, “grey”, 2);
plotline(100, “grey”, 2);
```

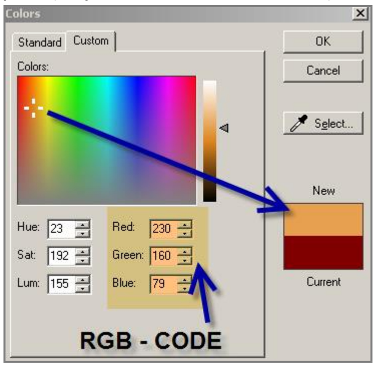


Plot()

Definition:

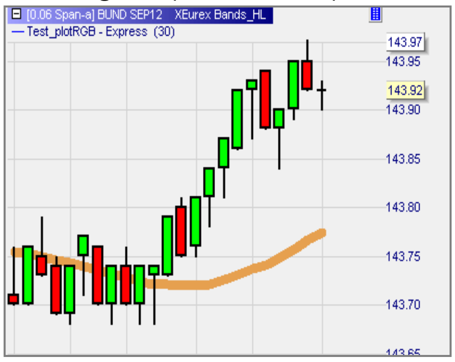
- Draws a simple curve.
  - Both predefined[7] and RGB colors (RGB= Red-Green-Blue) can be used.
  - In case of a typo in defining the color, the color is blue.
  - RGB colors are defined with three numbers. For example:

plot(myMA, 230, 160, 79, 8);



Hue: 23
Sat: 192
Lum: 155
Red: 230
Green: 160
Blue: 79

Resulting line (thickness = 8):



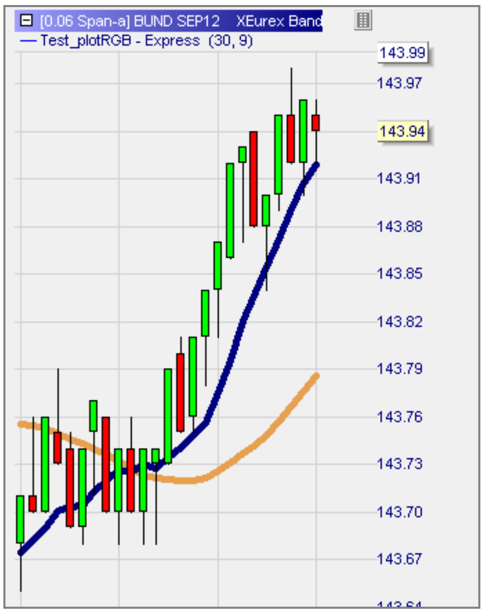
Format:

- plot(<series name>, "<color name>", <pen width>);

Example:

- Below we draw two simple moving averages:
  - The first one is based on the RGB code.
  - The second one on the predefined color "blue".

```
Express f_plotRGB
Vars
Series
myMA, myMA2;

Calculation
If IsFirstBar() then
begin
  MovingAverage(close, myMA, 30);
  MovingAverage(close, myMA2, 10);
end

Interpretation
begin
end
plot(myMA, 230, 160, 79, 5);
plot(myMA2, "blue", 5);
```



[7] Predefined colors are black, white, red, green, blue, magenta, yellow, grey, lightred, lightgreen, lightblue.

Plotband()

Definition:

- Draws a band made of two curves and paints in one color the space in between.
- For Plotband() an almost infinite number of colors can be selected using the RGB color scheme (RGB = Red-Green-Blue).
- Refer to the section on Plotting functions to learn how to create a RGB color code.

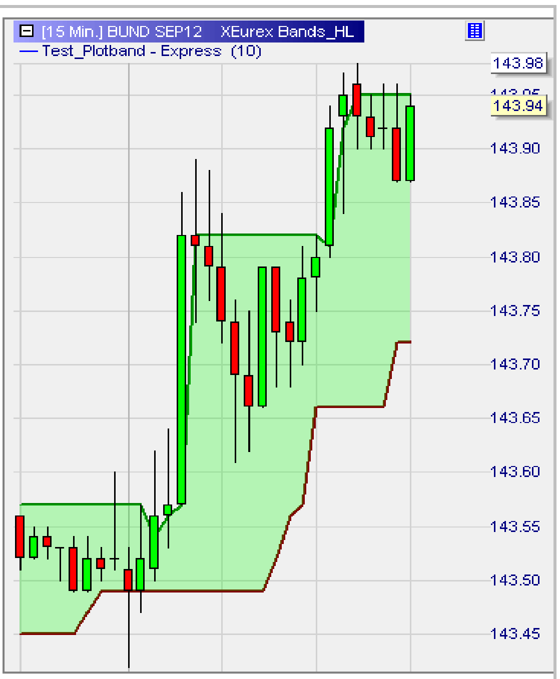
Format:

- plotband(<upper series name>, <color name>, <pen width>, <lower series name>, <color name>, <pen width>,<fill color>);
- plotband(<upper series name>, int red, int green, int blue, <pen width>, <lower series name>, int red2, int green2, int blue2, <pen width>, int red3, int green3, int blue3);

Example:

- Below we draw a band based on the highest highs and lowest lows of the last 10 bars:
    - The highest highs curve is in green and the lowest lows curve is in red.
    - The area between the two curves is in lightgreen.
    - Colors must be put in quotes: “blue”.

```
Express f_plotband

Vars

series
upper, lower, upper1, lower1;

input
$span (0, 200, 10);

Calculation
upper1 = Highest(close, $span);
lower1 = Lowest(close, $span);

upper = upper1[1];
lower = lower1[1];

interpretation Bands (close, lower, upper);

PlotBand(upper, "green", 2, lower, "red", 2,
"lightgreen");
```



Plotcrossinglines()

Definition:

- Draws a band made of two curves and paints in two colors the space in between.
- For Plotcrossinglines() an almost infinite number of colors can be selected using the RGB color scheme (RGB = Red-Green-Blue).
- Refer to the section on Plotting functions to learn how to create a RGB color code.

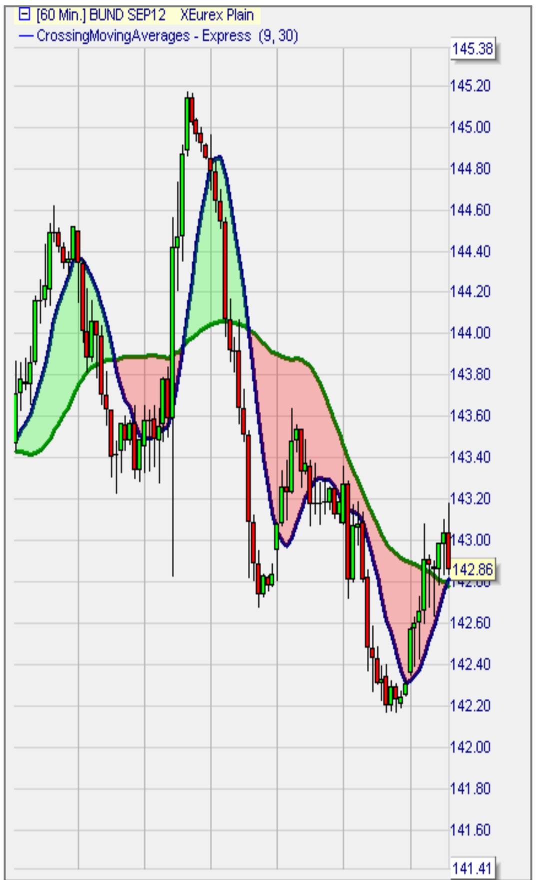
Format:

- plotcrossinglines (<series1 name>, <color name>, <pen width>, <series2 name>, <color name>, <pen width>, <fill color series1 above series2>, <fill color series1 below series2>);
- plotcrossinglines (<series1 name>, int red, int green, int blue, <pen width>, <series2 name>, int red2, int green2, int blue2, <pen width>, int red3, int green3, int blue3, int red4, int green4, int blue4);

Example:

- Below we draw a band based on the highest highs and lowest lows of the last 10 bars:
  - The highest highs curve is in green and the lowest lows curve is in red.
  - The area between the two curves is in lightgreen when the fast MA is above the slow MA and in lightred otherwise.
  - Colors must be put in quotes: “blue”.

```
Express f_CrossingMovingAverages

Vars

Series
FastMA, SlowMA;

Input
$spanFMA(1, 200, 9), $spanSMA(1, 200, 30);

Calculation

If IsFirstBar() then
begin
  MovingAverage(close, SlowMA, $spanSMA);
  MovingAverage(close, FastMA, $spanFMA);
end

Interpretation
begin
end

plotcrossinglines(SlowMA, "green", 3, FastMA,
"blue", 3, "lightred", "lightgreen");
```



Plotbars()

Definition:

- Draws a bar chart.
  - By default, the colors of the bar chart are the same as in the master chart. The default colors of the bar chart can be modified in Extras / Colors (Bar Bull, Bar Bear).
  - However also custom colors can be used (both predefined and RGB colors are possible).
  - Refer to the section on Plotting functions to learn how to create a RGB color code.

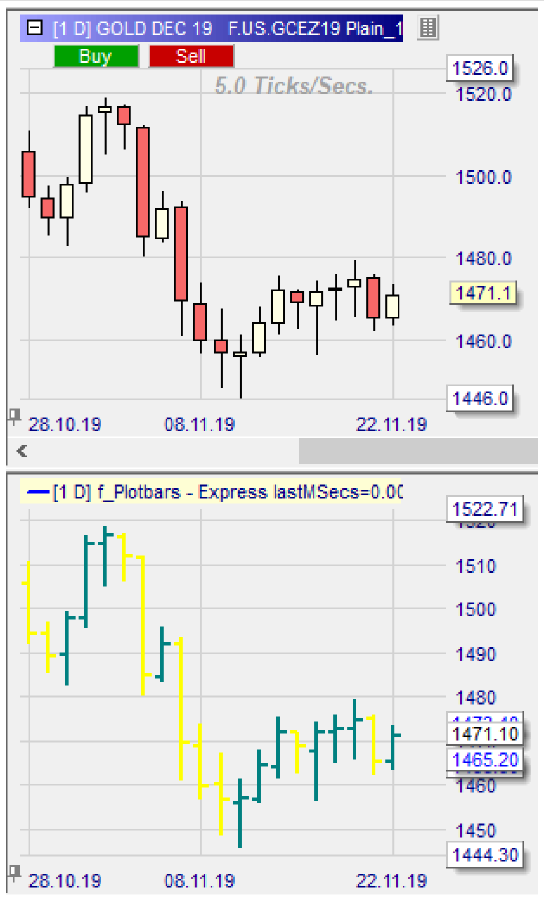
Format:

- plotbars(<open series>, <close series>, <high series>, <low series>);
- plotbars(<open series>, <close series>, <high series>, <low series>, <color name bull bar>,<color name bear bar>);
- plotbars (<open series>, <close series>, <high series>, <low series>, int red1, int green1, int blue1, int red2, int green2, int blue2);

Example:

- Below we draw a bar chart with custom colors for the bars:

```
Express f_Plotbars

Calculation

Interpretation
begin
end

plotbars(o ,c, h, l, "cyan","lightyellow");
```



Plotcandles()

Definition:

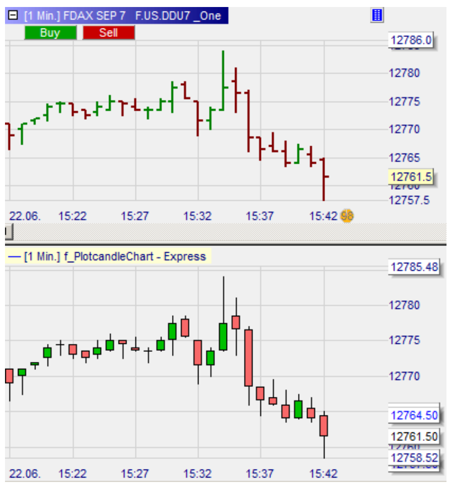
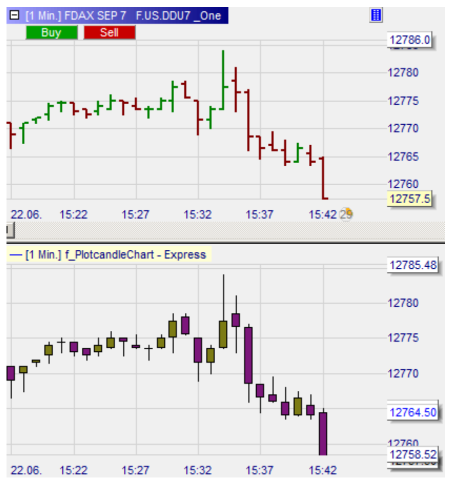
- Draws a candle chart.
  - By default, the colors of the candle chart are the same as in the master chart. The default colors of the candle chart can be modified in Extras / Colors (Candle Bull, Candle Bear).
  - However also custom colors can be used (both predefined and RGB colors are possible).
  - Refer to the section on Plotting functions to learn how to create a RGB color code.

Format:

- plotcandles(<open series>, <close series>, <high series>, <low series>);
- plotcandles(<open series>, <close series>, <high series>, <low series>, <color name bull candle>,<color name bear candle>);
- plotcandles(<open series>, <close series>, <high series>, <low series>, int red1, int green1, int blue1, int red2, int green2, int blue2);

Example:

- Below we draw two candle charts based on the above bar chart with both the predefined and custom RGB colors.

Express f_PlotcandleChart vars calculation interpretation begin end plotcandles (open, close, high, low);	 [1 Min.] FDAX SEP 7 F.US.DDU7 _One Buy Sell [1 Min.] f_PlotcandleChart - Express
Express f_PlotcandleChart vars calculation interpretation begin end plotcandles (open, close, high, low, 124, 123, 532, 124, 534, 123);	 [1 Min.] FDAX SEP 7 F.US.DDU7 _One Buy Sell [1 Min.] f_PlotcandleChart - Express

GetPriceFormat()

Definition:

- Applies the format of the MasterChart's y-axis into the sub-window.

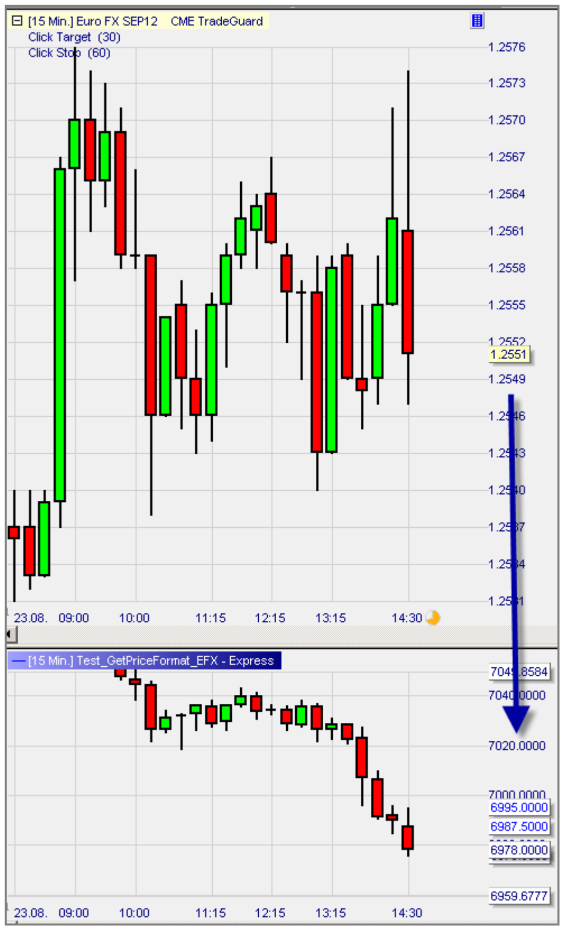
Format:

- string GetPriceFormat()

Example:

- Below we are applying to our indicator's y-axis the same format as the MasterChart's.

```
Express f_GetPriceFormat_EFX

Vars

series
daxopen(studyDaxsep.open),
daxclose(studyDaxsep.close),
daxhigh(studyDaxsep.high),
daxlow(studyDaxsep.low);

Calculation
SetYscaleFormat (GetPriceFormat());

Interpretation
begin
end

plotcandles(daxopen, daxclose, daxhigh, daxlow);
```



SetYscaleFormat()

Definition:

- Defines the format of the y-axis in the sub window where indicators are plotted when they are not in the MasterChart.
    - Supports all formats used for the C-function "printf()". The most important are:
      "%f" decimal floating point
      "%6.2f" rounds to two decimals
      "%g" discards trailing zeroes
      "%e" scientific notation

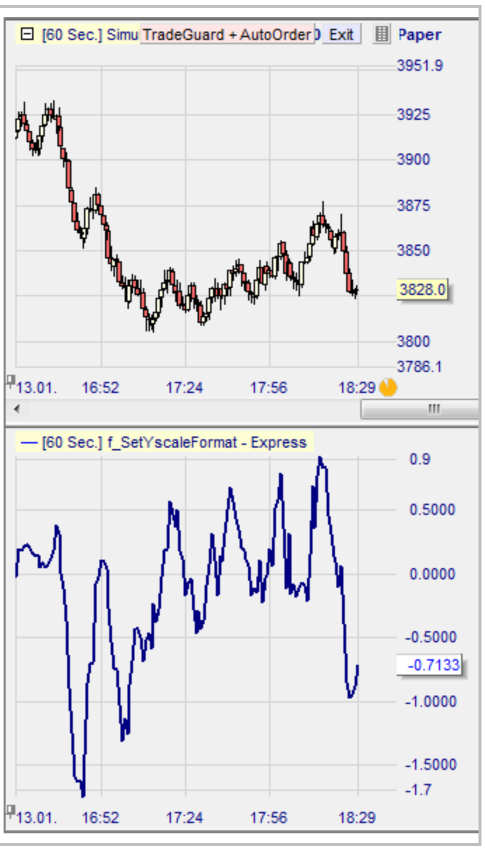
Format:

- Void SetYscaleFormat (string format)

Example:

- Below we set the format of the y-axis in the sub window as numbers with four decimals.

```
express f_SetYscaleFormat

vars

series
a;

numeric ;
input ;

calculation

a = (c - c[10])/c[10]*100;
SetYscaleFormat("%9.4f");

interpretation
begin
end

plot(a, blue,2);
```

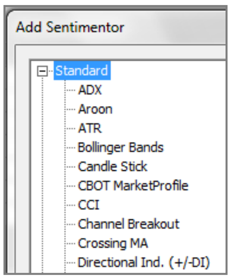


Importing series

Importing a series from a platform built-in indicator

<u>Definition:</u>

- Import a series from one of the standard indicator of the platform (see for an extract of the list of standard indicators on the right).



Add Sentimentor

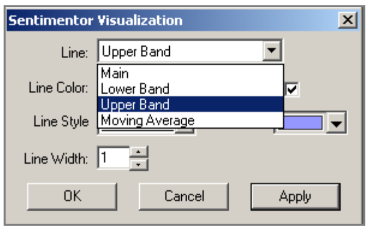
- Standard
  - ADX
  - Aroon
  - ATR
  - Bollinger Bands
  - Candle Stick
  - CBOT MarketProfile
  - CCI
  - Channel Breakout
  - Crossing MA
  - Directional Ind. (+/-DI)

<u>Syntax:</u>

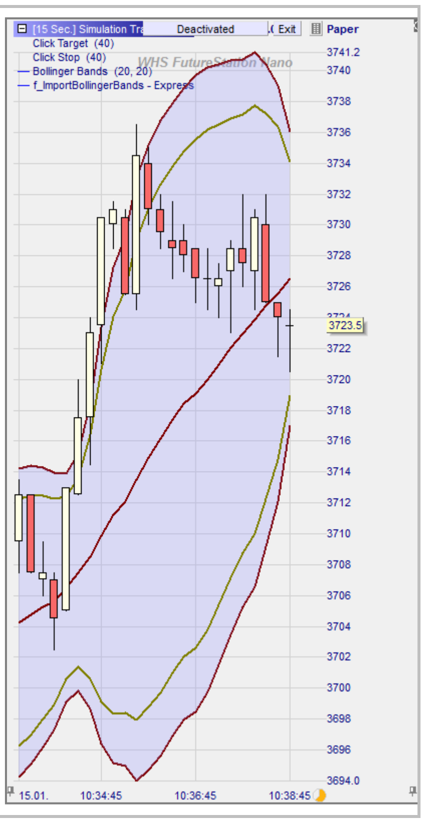
- series myseries (indicatorName.seriesName);
  - Important: When writing the indicatorName remove all space and non alphabetical characters, i.e. numbers, _, -, +, /, …, etc.
  - I there are two of the same indicator we need to indicate which one we want to import, i.e. series BBUB(BollingerBands.UpperBand2), the number 2 indicates that is the series that belongs to the second indicator.

<u>Example:</u>

- Below we create two bands similar to the Bollinger Bands: Same moving average but bands 20% narrower.
  - We get the names of the series from the visualization window (see on the right).



```
Express f_ImportBollingerBands

Vars

series

BBMA(BollingerBands.MovingAverage), NBUB, NBLB,
BBUB(BollingerBands.UpperBand),
BBLB(BollingerBands.LowerBand);

Calculation

NBUB = BBMA + (BBUB - BBLB)*0.8*0.5;
NBLB = BBMA - (BBUB - BBLB)*0.8*0.5;

interpretation
begin
end

plot(NBUB, yellow, 2);
plot(NBLB, yellow, 2);
```



Importing a series from another express indicator

Definition:

- Import a series from an indicator that is coded in express.

Syntax:

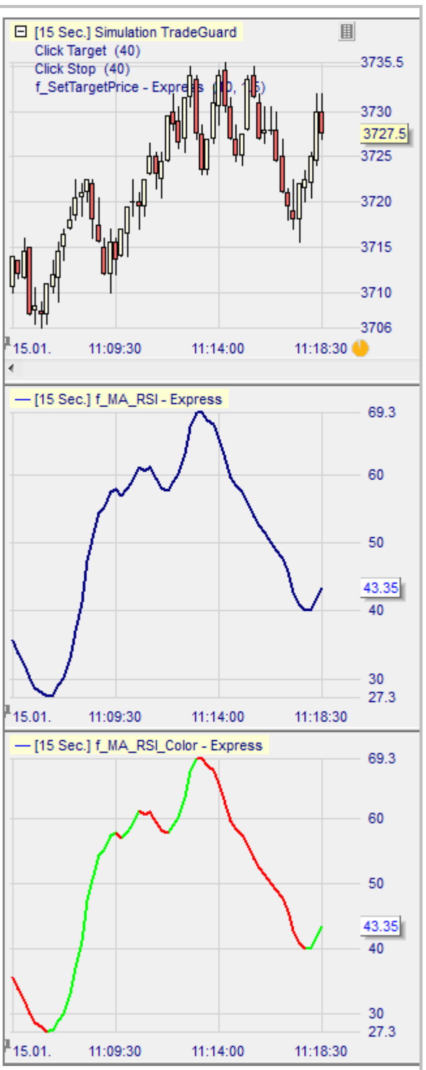
- series myseries (indicatorName**Express**.seriesName);
    - Note the addition of the term **Express** above.
    - Important: When writing the indicatorName remove all space and non alphabetical characters, i.e. numbers, _, -, +, /, …, etc. Please note that this restriction does not apply to the name of the series itself.

Example:

- The first indicator below creates a moving average 6 of RSI(14) called MAR (2nd chart). The second indicator imports MAR and displays it back in color:

```
Express f_MA_RSI

Vars

Series
R, MAR;

Calculation

If IsFirstBar() then
begin
  RSI(c, R, 14);
  MovingAverage(R, MAR, 6);
end

Interpretation
begin
end

plot(MAR, blue, 2);
```

```
express f_MA_RSI_Color

vars

series
MAR(fMARSIExpress.MAR),
MARup, MARdw;

calculation

if MAR >= MAR[1] then
begin
  MARup = MAR;
  MARup[1] = MAR[1];
end
else MARup = void;

if MAR < MAR[1] then
begin
  MARdw = MAR;
  MARdw[1] = MAR[1];
end
else MARdw = void;

interpretation
begin
end

plot(MARup, lightgreen, 2);
plot(MARdw, lightred, 2);
```



Importing a price series from a symbol

Definition:

- Imports any of symbol 2's open, close, high, low and volume series into a symbol 1's study.

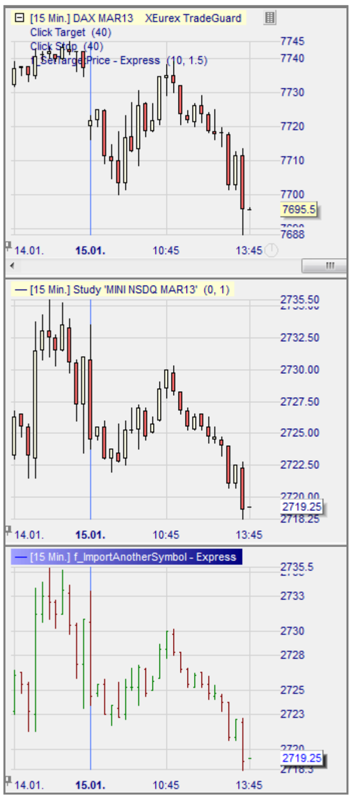
Syntax:

- series myseries (**study**SymbolName.seriesName);
  - We use the indicator Study to embed symbol 2 in our study.
    - Symbol 2's chart can be displayed in a sub window or in the main chart.
  - Note the term Study above followed by symbol name. SeriesName can be open, close, high, low or volume.
  - Important: When writing the indicatorName remove all space and non-alphabetical characters, i.e. numbers, _, -, +, /, …, etc.
  - If we import only one symbol, we can drop some of the information contained in the expression "studySymbolName" (see the example below).

Example:

- Below symbol 1 is the Dax future. The imported symbol 2 is the Mini Nasdaq future. The top chart refers to symbol 1. The middle chart refers to symbol 2. The bottom chart is a bar chart constructed with the imported price series from symbol 2.
  - Because we are importing only one symbol, we can work with reduced expression like studyMININSDQ.close instead of studyMININSDQMAR.close.

```
express f_ImportAnotherSymbol

vars

series
oo(studyMININSDQMAR.open),
cc(studyMININSDQ.close),
ll(studyMINI.low),
hh(study.high);

numeric ;
input ;

calculation

interpretation
begin
end

plotbars(oo, cc, hh, ll);
```



Importing array values from a symbol

Definition:

- Imports an array value from a second symbol into an express script.
- Examples of use:
  - Transfer of indicator values from a higher time frame into a lower timeframe.
  - Import of indicator values from a different symbol.

Syntax:

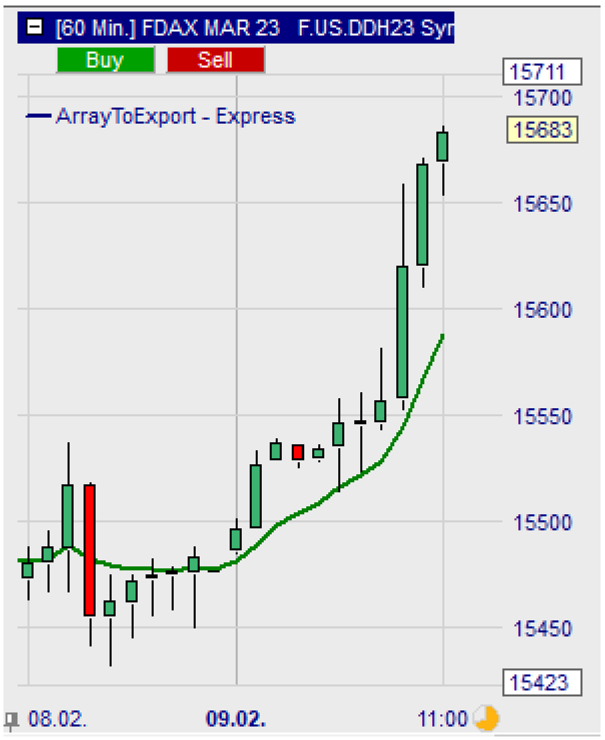
- We need an exporting indicator in symbol 1 and an importing indicator in symbol 2.
- Both indicators need an array variable (exporting array variable → importing array variable)
- Export value (symbol 1):
  - array arrayName[0];
- Import value (symbol 2):
  - array arrayName[study.indicatorName.arrayName];
- Important: When writing the indicatorName remove all space and non-alphabetical characters, i.e. numbers, _, -, +, /, …, etc.

Example:

- In this example we calculate a simple moving average in the 60-minute aggregation (symbol 1) and import the current value of the moving average into the 10-minute aggregation (symbol 2) using the array variables. Both symbols are displaying the FDAX Future in the two different time frames.

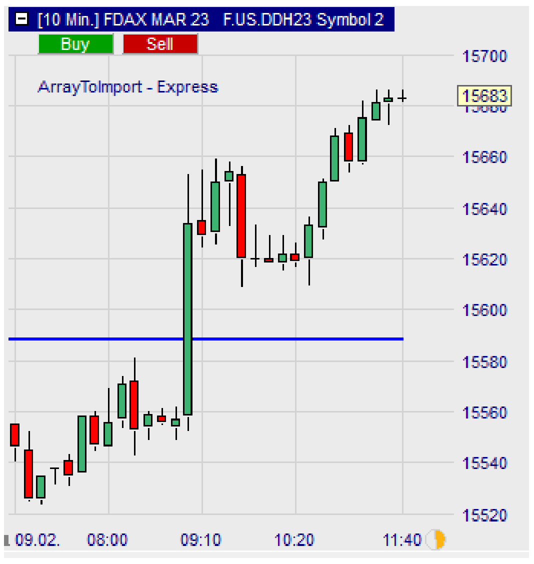
  - Exporting syntax + exporting chart:

```
express ArrayToExport

vars

array
exportdata[0];

series
ma;

calculation
If IsFinalBar() then
begin
  MovingAverage(c,ma,10);
  SetArraySize(exportdata, 1);
  Exportdata[0] = ma;
End

Interpretation begin end
Plot (ma, green, 2);
```



- Importing syntax + importing chart:

```
express ArrayToImport

vars

array
importdata[study.ArrayToExportExpress.exportdata];

calculation
if IsFinalBar() then SetArraySize(importdata,1);

interpretation
begin
end

plotline (importdata[0], blue, 2);
```



Creating customized stops and targets

SetIntraPeriodUpdate()

This function can only be used with stops.

Definition:

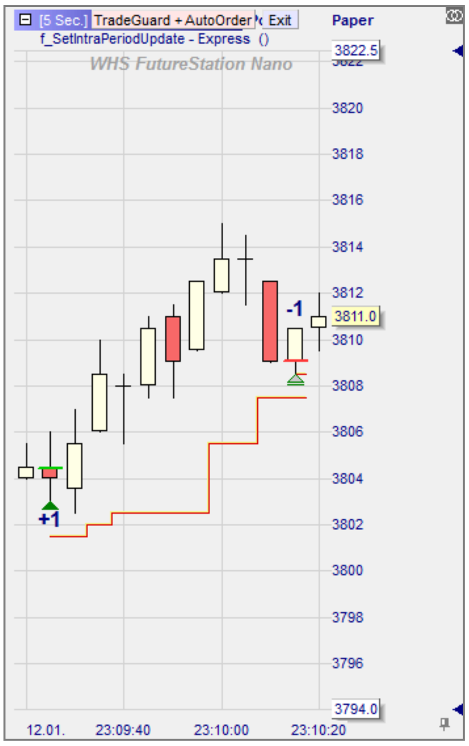
- Enables the stop to be updated tick by tick at every bar.
    - If a position is opened without SetIntraPeriodUpdate, the stop is updated tick by tick only at the first bar (the entry bar). At subsequent bars the stop is updated once at the close of every bar.
    - Stops with SetIntraPeriodUpdate are ignored in backtesting.

Format:

- void SetIntraPeriodUpdate()

Example:

- Below we create a High/Low stop which is updated tick by tick so it is positioned at the lowest lows of the last 5 bars or at the highest highs of the latest 5 bars.

express Stop f_SetIntraPeriodUpdate
 	
Calculation
 	
SetIntraPeriodUpdate();
 	
If Marketposition() = 1 then SetStopPrice(lowest(l, 5));
If Marketposition() = -1 then SetStopPrice(highest(h, 5));
	 [5 Sec.] TradeGuard + AutoOrder Exit
	Paper
	f_SetIntraPeriodUpdate - Express ()
	WHS FutureStation Nano
	3822.5
	3820
	3818
	3816
	3814
	3812
	3811.0
	3810
	3808
	3806
	3804
	3802
	3800
	3798
	3796
	3794.0
	+1
	-1
	12.01.
	23:09:40
	23:10:00
	23:10:20

EntryPrice()

This function can only be used with stops.

Definition:

- Returns two different values depending on whether TradeGuard[8] was activated and when:
    - TradeGuard deactivated: EntryPrice = Executed price[9].
    - TradeGuard activated before opening of position: EntryPrice = Executed price[3].
    - TradeGuard activated after opening of position: EntryPrice = TradeGuard activation price[3].

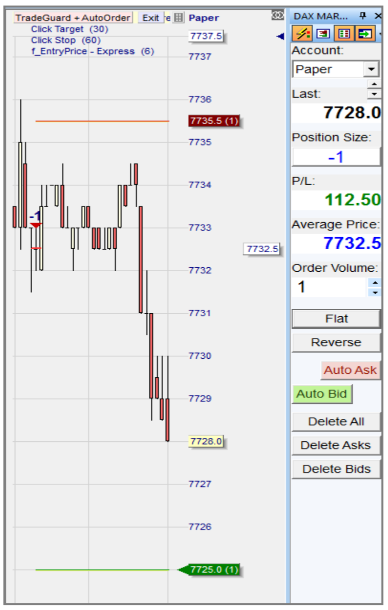
Format:

- float EntryPrice()

Example:

- Below we create a fixed stop at 6 ticks (3 points) from the entry price. As the TradeGuard was activated when the position was opened entry price = executed price:
    - Executed price of 7732.5 as can be under Average Price.
    - On the chart the stop is 3 points (6 ticks) above 7732.5 as expected.

```
Express Stop f_EntryPrice

vars

numeric
StopLong, StopShort;

calculation

if BarsSinceEntry() = 0 then
begin
  StopLong = EntryPrice() - 6*TickSize();
  StopShort = EntryPrice() + 6*TickSize();
end
If MarketPosition() = 1 then SetStopPrice(StopLong);
else
if MarketPosition() = -1 then SetStopPrice(StopShort);
```



Account: Paper
Last: 7728.0
Position Size: -1
P/L: 112.50
Average Price: 7732.5
Order Volume: 1

[8] With the activation of the Tradeguard stops are being placed automatically by the platform.
[9] We are referring to two prices. The first is the actual price at which we opened the position. It is called **Executed price**. The second is the price when we activated the TradeGuard. It is called **TradeGuard activation price**. These prices are different.

EntryPriceOriginal()

This function can only be used with stops.

Definition:

- Returns the executed price[10].

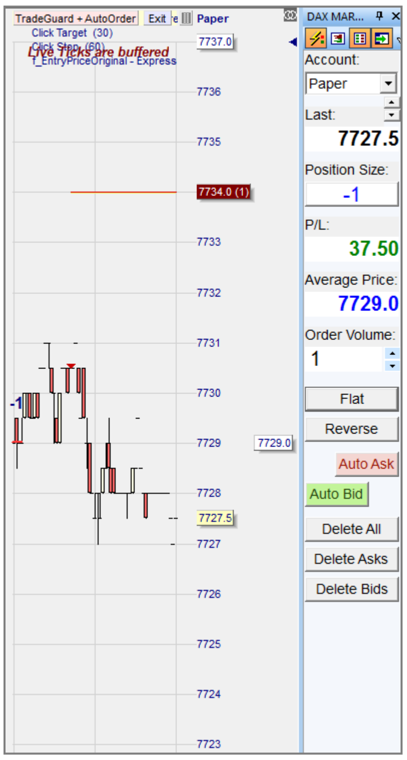
Format:

- float EntryPriceOriginal()

Example:

- Below we create a fixed stop at 10 ticks (5 points) from the entry price original:
    - We opened the position at the executed price of 7729.0 as can be seen under Average Price and on the chart with the '-1 mark'.
    - We activated the TradeGuard afterwards and the platform positioned our stop 10 ticks (5 points) above as we wanted.

```
express Stop f_EntryPriceOriginal

vars

numeric
StopLong, StopShort;

calculation

if BarsSinceEntry() = 0 then
begin
  StopLong = EntryPriceOriginal() - 10*TickSize();
  StopShort = EntryPriceOriginal() + 10*TickSize();
end

If MarketPosition() = 1 then SetStopPrice(StopLong);
else
if MarketPosition() = -1 then SetStopPrice(StopShort);
```



TradeGuard + AutoOrder | Exit | Paper
Click Target (30)
Click Stop (60)
Live Ticks are buffered
f_EntryPriceOriginal - Express

DAX MAR...
Account: Paper
Last: 7727.5
Position Size: -1
P/L: 37.50
Average Price: 7729.0
Order Volume: 1

[10] We are referring to two prices. The first is the actual price at which we opened the position. It is called **Executed price**. The second is the price when we activated the TradeGuard. It is called **TradeGuard activation price**. These prices are different.

BarsSinceEntry()

This function can only be used with stops.

Definition:

- Returns the number of bars since the position was opened.
    - Returns 0 at the first bar, 1 at the second bar, 2 at the third bar, …

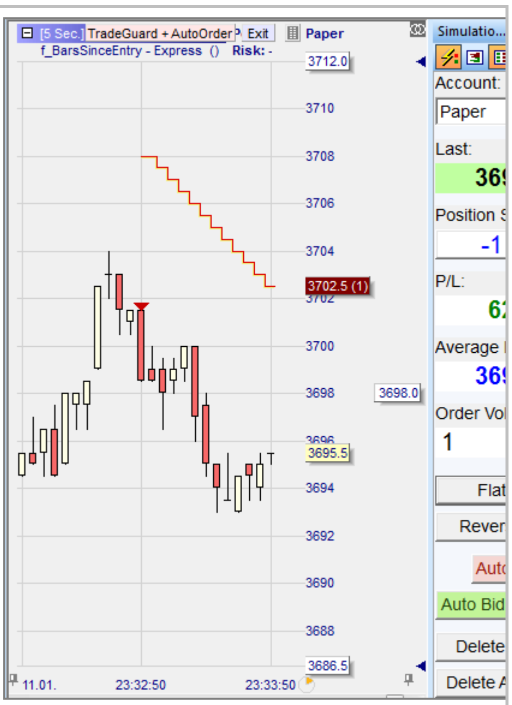
Format:

- int BarsSinceEntry()

Example:

- Below we create a linear stop which starts 20 ticks away from our entry price before moving by one tick at the close of each bar. BarsSinceEntry() is used to define the bar of the entry and then to adapt the stop bar by bar.

```
express Stop f_BarsSinceEntry

vars

numeric
StpLong, StpShort;

calculation

if BarsSinceEntry() = 0 then
begin
  StpLong = EntryPriceOriginal() - 20*TickSize();
  StpShort = EntryPriceOriginal() + 20*TickSize();
end
else
begin
  StpLong = max(StpLong, c - (20 +
BarsSinceEntry())*TickSize());
  StpShort = min(StpShort, c + (20 -
BarsSinceEntry())*TickSize());
end

if MarketPosition() = 1 then SetStopPrice(StpLong);
if MarketPosition() = -1 then SetStopPrice(StpShort);
```



IsIntradayEntry()

This function can only be used with stops.

Definition:

- Returns true if the position has been opened in the current and not yet closed period.

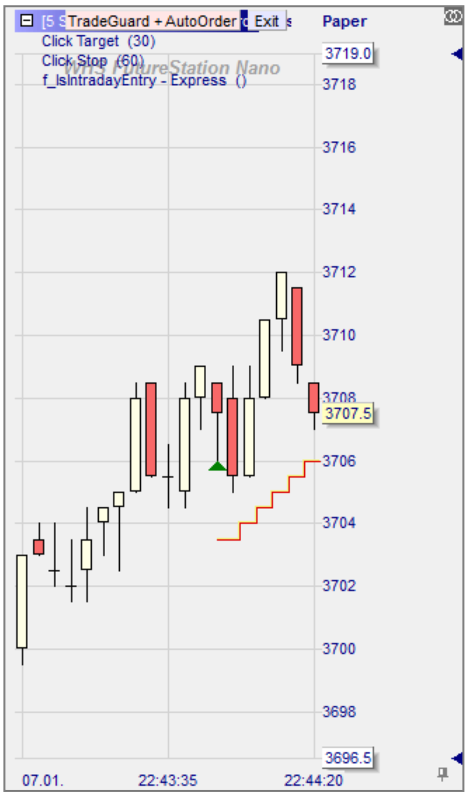
Format:

- bool IsIntradayEntry()

Example:

- Below we create a linear stop which starts 10 ticks away from the original entry price before evolving one tick by one tick at the close of each bar. IsIntradayEntry is used to define the bar of the entry (in the same way as BarsSinceEntry() = 0 does it).

```
Express Stop f_IsIntradayEntry

vars

numeric
last, StopL, StopS;

calculation

if MarketPosition() = 1 then
begin
  if IsIntradayEntry() then
  last = EntryPriceOriginal() - 10*TickSize();
  else last = max(last, last + TickSize());
end
else if MarketPosition() = -1 then
begin
  if IsIntradayEntry() then
  last = EntryPriceOriginal() + 10*TickSize();
  else last = min(last, last - TickSize());
end
SetStopPrice(last);
```



MarketPosition()

This function can only be used with stops.

Definition:

- Returns the current position: 1 = long, -1 = short.
    - Note: MarketPosition() = 0 or other number does not work.

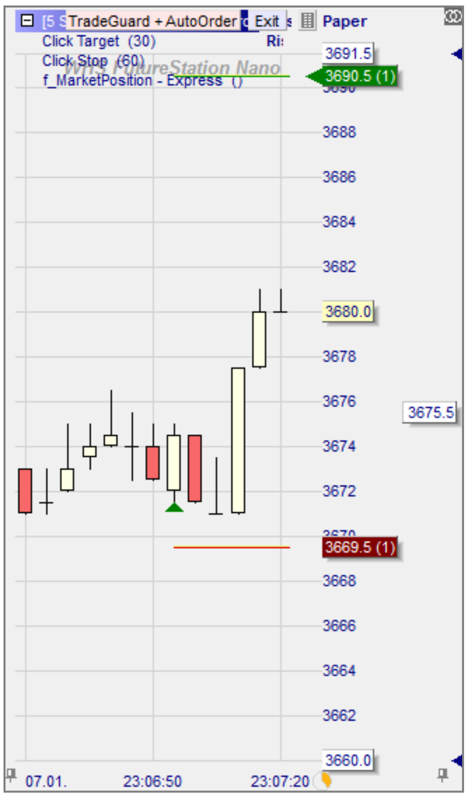
Format:

- int MarketPosition()

Example:

- Below we create a fixed stop placed at 10 ticks from the original entry price. MarketPosition enables us to place a stop for each position long or short:

```
express Stop f_MarketPosition

vars

numeric
StopLong, StopShort;

calculation

if BarsSinceEntry() = 0 then
begin
  StopLong = c - 10*TickSize();
  StopShort = c + 10*TickSize();
end

if MarketPosition() = 1 then SetStopPrice(StopLong);
else
if MarketPosition() = -1 then SetStopPrice(StopShort);
```



MinPriceEntryBar() / MaxPriceEntryBar()

This function can only be used with stops.

Definition:

- MinPriceEntryBar()
  If a position is opened when TradeGuard is activated, MinPriceEntryBar returns the lowest price traded at the first bar (the bar of the entry) after the position is opened.
  If TradeGuard is activated when a position is already open, MinPriceEntryBar returns the lowest price traded at the first bar after the activation of TradeGuard.

- MaxPriceEntryBar()
  If a position is opened when TradeGuard is activated, MaxPriceEntryBar returns the highest price traded at the first bar (the bar of the entry) after the position is opened.
  If TradeGuard is activated when a position is already open, MaxPriceEntryBar returns the highest price traded at the first bar after the activation of TradeGuard.

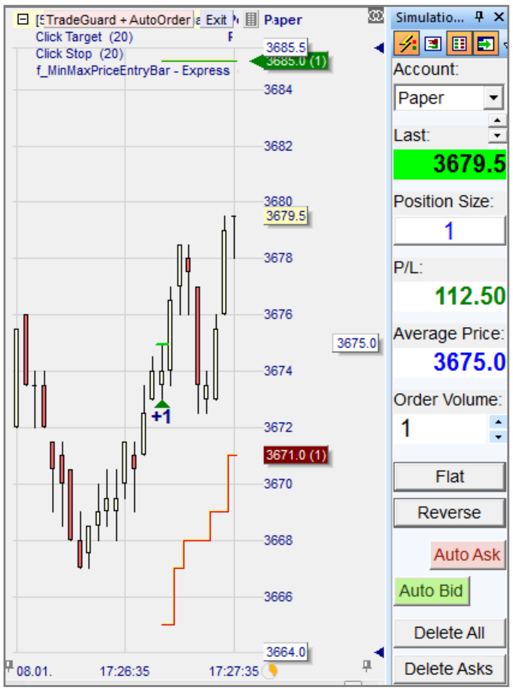
Format:

- float MaxPriceEntryBar(), float MinPriceEntryBar()

Example:

- Below we create a stop which is initially 20 ticks away from the

```
Express Stop f_MinMaxPriceEntryBar

Vars

numeric
StopH, StopL;

Calculation

if BarsSinceEntry() = 0 then
begin
  StopH = MaxPriceEntryBar() + 20*TickSize();
  StopL = MinPriceEntryBar() - 20*TickSize();
end
else
begin
  StopH = min(StopH, Highest(h, 10));
  StopL = max(StopL, Lowest(l, 10));
end

If (MarketPosition() = -1) then SetStopPrice(StopH);
Else SetStopPrice(StopL);
```



SetLongTrigger() / SetShortTrigger()

Definition:

- Create conditional entry levels[11].
    - Following a given signal, we define a price level at which a market, stop or limit order will be triggered to potentially open a position. If the order is not executed during the first period that follows the signal, it will be automatically cancelled and we will have to wait for another signal.

Format:

- void SetLongTrigger (float value)

Example 1:

- Below we generate automated signals based on the crossing of two moving averages. We are trying to enter at more favorable prices with a **conditional limit**[12] order placed at the mid price of the signal bar. Note below the set-up conditions and the description of what happens in blue:

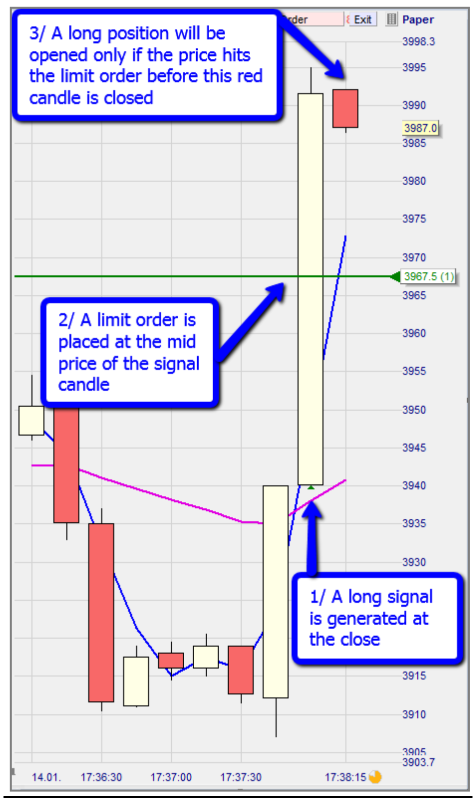
Express Stop f_SetTrigger

Vars

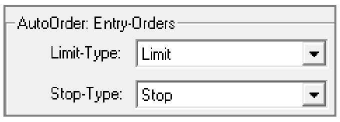
numeric
bl, bs;

Calculation

bl = (h + l)/2;
bs = (h + l)/2;
SetLongTrigger(bl);
SetShortTrigger(bs);

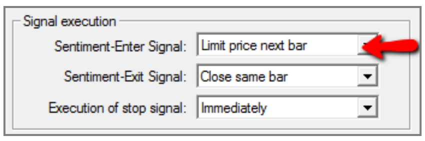


Set-up of Order Default:



AutoOrder: Entry-Orders
Limit-Type: Limit
Stop-Type: Stop

Set-up of Evaluator Settings:



Signal execution
Sentiment-Enter Signal: Limit price next bar
Sentiment-Exit Signal: Close same bar
Execution of stop signal: Immediately

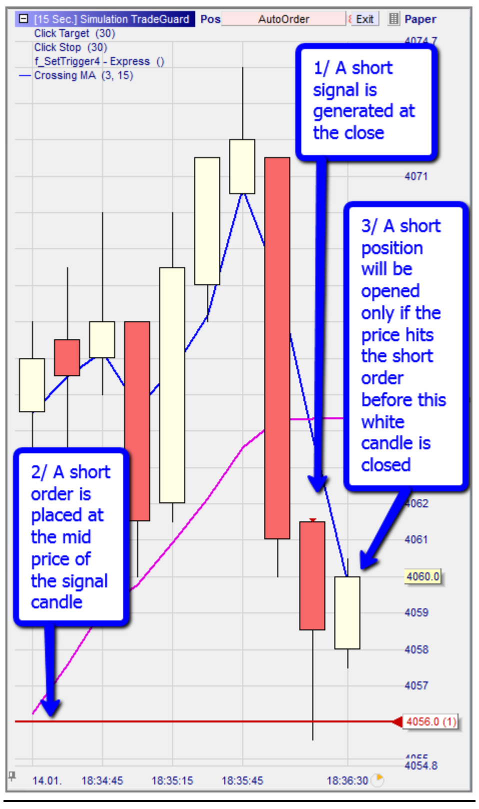
[11] Only apply to automated trades (AutoOrder must be activated) with AutoOrder Entry Orders set on “Limit = Limit” and “Stop = Stop” (To set up in Order Defaults) and Entry signals set on “confirmation price next bar” or “limit price next bar” (To set up in Evaluator Settings).

[12] If Evaluator Settings is set on “limit price next bar” and there are no functions like SetLongTrigger or SetShortTrigger in a program, the limit price will be set to the close of the period generating the signal. In case many indicators call this routine the strictest price is taken.

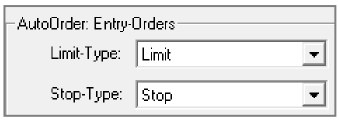
Example 2:

- Below we generate automated signals based on the crossing of two moving averages. We are trying to enter at more favorable prices with a **conditional stop**[13] order placed 5 ticks away from the close price of the signal bar. Note below the set-up conditions and the description of what happens in blue:
  - When a signal is created the platform places a stop order at the start of the next bar at the price level given by SetLongTrigger or SetShortTrigger.
  - If the stop is hit before the next bar closes a position is opened, otherwise the stop order is cancelled.

```
Express Stop f_SetTrigger

Vars

numeric
bl, bs;

Calculation

bl = c + 5* TickSize();
bs = c - 5*TickSize();
SetLongTrigger(bl);
SetShortTrigger(bs);
```



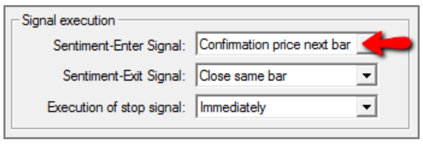
Set-up of Order Default:



AutoOrder: Entry-Orders

Limit-Type:	Limit
Stop-Type:	Stop

Set-up of Evaluator Settings:



Signal execution

Sentiment-Enter Signal:	Confirmation price next bar
Sentiment-Exit Signal:	Close same bar
Execution of stop signal:	Immediately

[13] If Evaluator Settings is set on "confirmation price next bar" and there are no functions like SetLongTrigger or SetShortTrigger in a program, the stop price will be set to the high/low of the period generating the signal. In case many indicators call this routine the strictest price is taken

SetStopPrice()

This function can only be used with stops.

Definition:

- Places a stop order at a given price level.

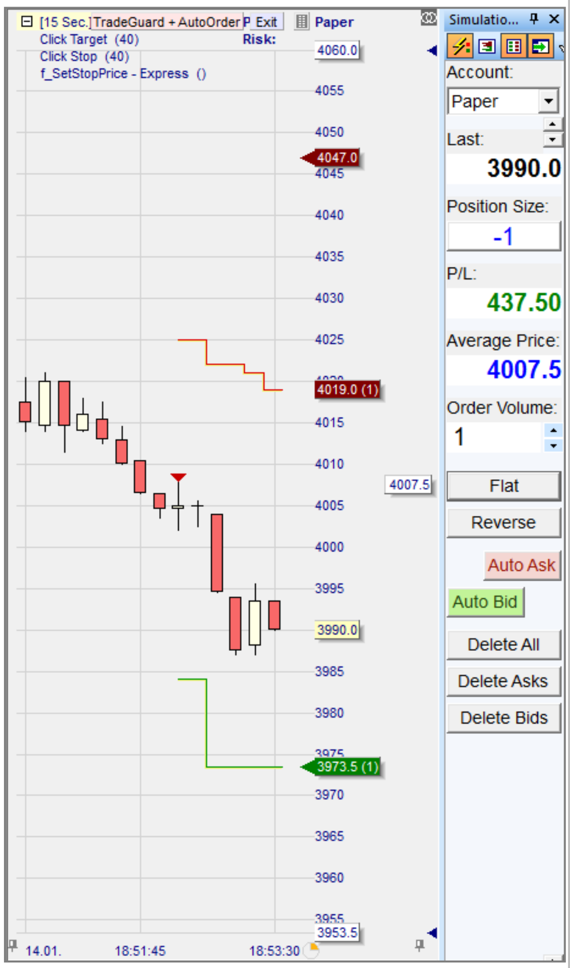
Format:

- void SetStopPrice (float value)

Example:

- Below we place a stop 2 ticks away from the lowest lows or the highest highs of the last 10 candles:
    - As we entered short two stops were positioned. The click stop at 4047 and the stop we programmed below which is 2 ticks above the line of the highest highs.

```
Express Stop f_SetStopPrice

vars

series
ll, hh;

Calculation
ll = Lowest(l, 10);
hh = Highest(h, 10);

If MarketPosition() = 1 then
SetStopPrice (ll - 2*TickSize());
else
if MarketPosition() = -1 then
SetStopPrice (hh + 2*TickSize());
```



SetTargetPrice()

This function can only be used with stops.

Definition:

- Places a target order at a given price level.

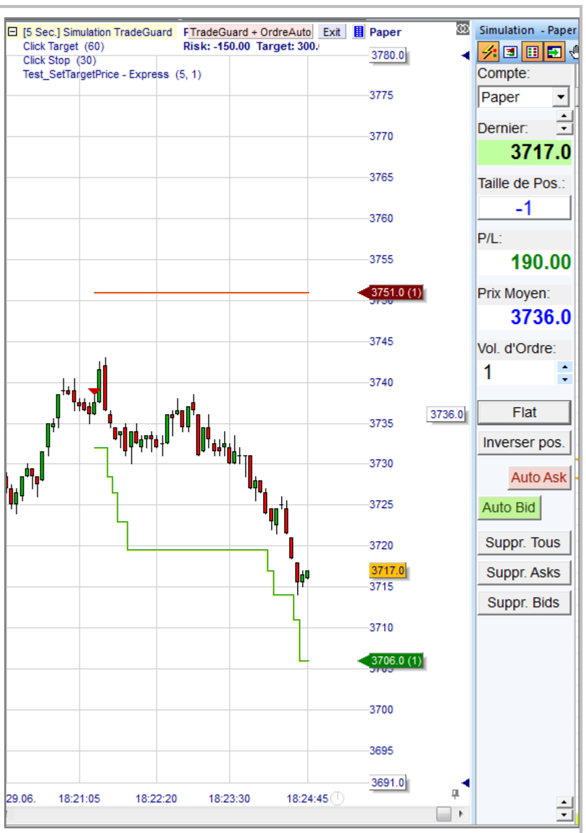
Format:

- void SetTargetPrice (float value)

Example:

- Below we create a dynamic target which is depends on the range between the highest highs and lowest lows of the latest 5 bars.
    - Just after the entry the range was increasing so the target price was moved down at 3720.
    - Later the range contracted so our target remained at the same level.
    - Then as the range started again to expand while the market moved down our target moved down as well.

```
express Stop f_SetTargetPrice

vars

numeric
TargetL, TargetS, Range;

input
$n(1, 50, 5), $k(0.1, 2.0, 1.0, 0.1, 1);

calculation

Range = Highest(h, $n) - Lowest(l, $n);
if BarsSinceEntry() = 0 then
begin
  TargetL = c + $k*Range;
  TargetS = c - $k*Range;
end
else
begin
  TargetL = max(TargetL, c + $k*Range);
  TargetS = min(TargetS, c - $k*Range);
end

If MarketPosition() = 1 then SetTargetPrice(TargetL);
else
if MarketPosition() = -1 then SetTargetPrice(TargetS);
```



Predefined interpretation tools

CrossesAbove() / CrossesBelow()

Definition:

- Functions used to detect the crossing of two curves.
  - CrossesAbove(curve, trigger) = true if (curve[1] <= trigger[1]) and (curve > trigger)
  - CrosseBelow(curve, trigger) = true if (curve[1] >= trigger[1]) and (curve < trigger)

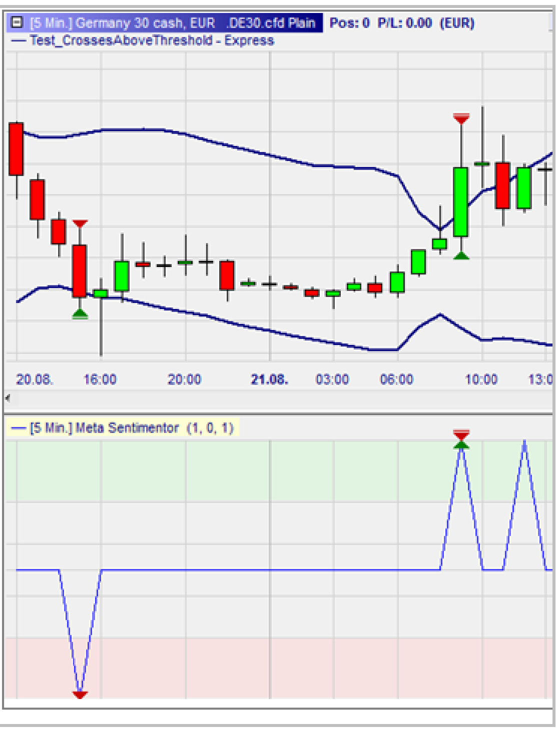
Format:

- bool CrossesAbove (series curve, series trigger)

Example:

- Below the indicator is a Bollinger Bands indicator (which has been imported).
- The CrossesAbove and CrosseBelow functions help define the interpretation:
  - A long signal is triggered when the close crosses above the upperband
  - A short signal is triggered when the close crosses below the lowerband

```
Express f_CrossesAboveThreshold

Vars

Series
upperband(BollingerBands.upperband),
lowerband(BollingerBands.lowerband);

Calculation

Interpretation
begin
  if CrossesAbove(close, upperband) then sentiment
= 100;
  if CrossesBelow(close, lowerband) then sentiment
= 0;
end

plot (upperband, blue, 2);
plot (lowerband, blue, 2);
```



CrossesAboveThreshold() / CrossesBelowThreshold()

Definition:

- Functions used to detect the crossing of a given threshold by a curve.
  - CrossesAboveThreshold(curve, threshold) = true if (curve[1] <= threshold) and (curve > threshold)
  - CrosseBelowThreshold(curve, threshold) = true if (curve[1] >= threshold) and (curve < threshold)

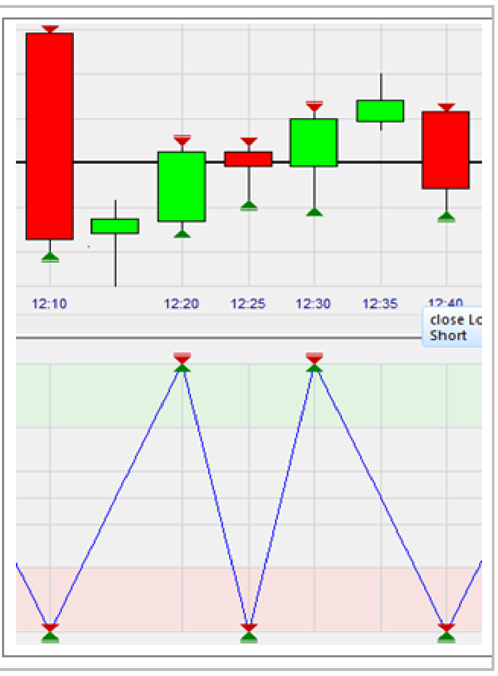
Format:

- bool CrossesAboveThreshold (series curve, float threshold)

Example:

- Below the indicator is a horizontal line (the threshold at 6930 points).
- The CrossesAboveThreshold and CrosseBelow functions help define the interpretation:
  - A long signal is triggered if the close price crosses above 6930
  - A short signal is triggered if the close price crosses below 6930

```
Express f_CrossesAboveBelowThreshold

Vars
series;
input $span (0, 200, 10);

Calculation

interpretation
begin
if CrossesAboveThreshold(close, 6930) then sentiment =
100;
if CrossesBelowThreshold(close, 6930) then sentiment = 0;
end

plotline(6930, black, 2);
```



Triggerline()

Definition:

- Interpretation scheme for indicators based on the crossing by a curve of another curve.
    - For example the close price crossing a moving average.

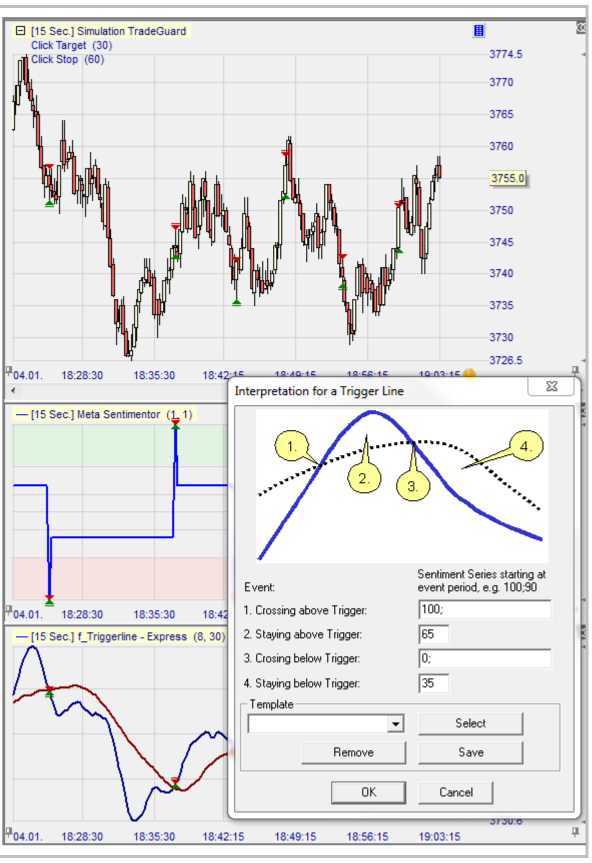
Format:

- TriggerLine (series curve, series trigger)

Example:

- Below the indicators are two moving averages.
- The interpretation is defined using the TriggerLine interpretation.
- By right clicking on the indicator and selecting Edit Interpretation one can display a window where the interpretation parameters can be modified.
    - Here we buy when the fast moving average crosses above the slow moving average (= 100) and we sell when the fast moving average crosses below the slow moving average (= 0).

```
Express f_Triggerline

Vars

Series
FastMA, SlowMA;

Input
$spanFMA(1, 200, 8), $spanSMA(1, 200, 30);

Calculation

If IsFirstBar() then
begin
  MovingAverage(close, SlowMA, $spanSMA);
  MovingAverage(close, FastMA, $spanFMA);
end

Interpretation triggerline(FastMA, SlowMA);

plot (FastMA, blue, 2);
plot (SlowMA, red, 2);
```



Interpretation for a Trigger Line

Event:

Sentiment Series starting at event period, e.g. 100;90

1. Crossing above Trigger: 100;
2. Staying above Trigger: 65
3. Crosing below Trigger: 0;
4. Staying below Trigger: 35

Template

Swing()

Definition:

- Interpretation scheme based on upwards and downwards swings in a curve.
    - For example the swings of the momentum indicators or other oscillators.

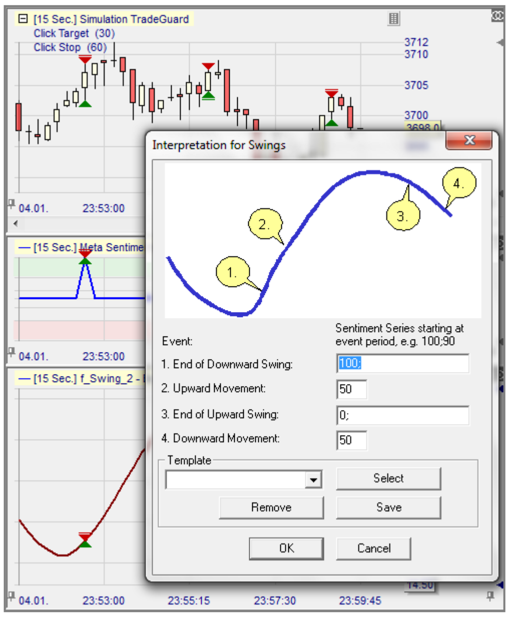
Format:

- void Swing (series series, input spanLeft, input spanRight)

Example:

- Below the indicator is a moving average of a RSI.
- The interpretation is defined using the Swing interpretation.
- By right clicking on the indicator and selecting Edit Interpretation one can display a window where the interpretation parameters can be modified.
    - Here we buy at the start of a new upswing (= 100).
        - A new upswing starts after a downswing as soon as there are two consecutive new highs (this parameter can be adjusted).
    - We sell at the start of a new downside (= 0).
        - A new downswing starts after an upswing as soon as there are two consecutive new lows (this parameter can be adjusted).

```
Express f_Swing

Vars

Series
myRSI, smoothedRSI;

Input
$spanLEFT(1,100,2), $spanRIGHT(1,100,2),
$RSIspan(1, 100, 14), $MAspan(1, 200, 10);

Calculation

If IsFirstBar() then
begin
  RSI(close, myRSI, $RSIspan);
  MovingAverage(myRSI, smoothedRSI, $MAspan);
end

Interpretation Swing(smoothedRSI, $spanLEFT,
$spanRIGHT);

plot(smoothedRSI, red, 2);
```



Interpretation for Swings

Sentiment Series starting at event period, e.g. 100;90

Event:	
1. End of Downward Swing:	100;
2. Upward Movement:	50
3. End of Upward Swing:	0;
4. Downward Movement:	50

Template

Bands()

Definition:

- Interpretation scheme for indicators based on the crossing by a curve of two other curves forming a band.
    - For example the close price crossing these types of bands: Bollinger Bands, Donchian-Channel, Price-Channel, Commodity-Channel, ….

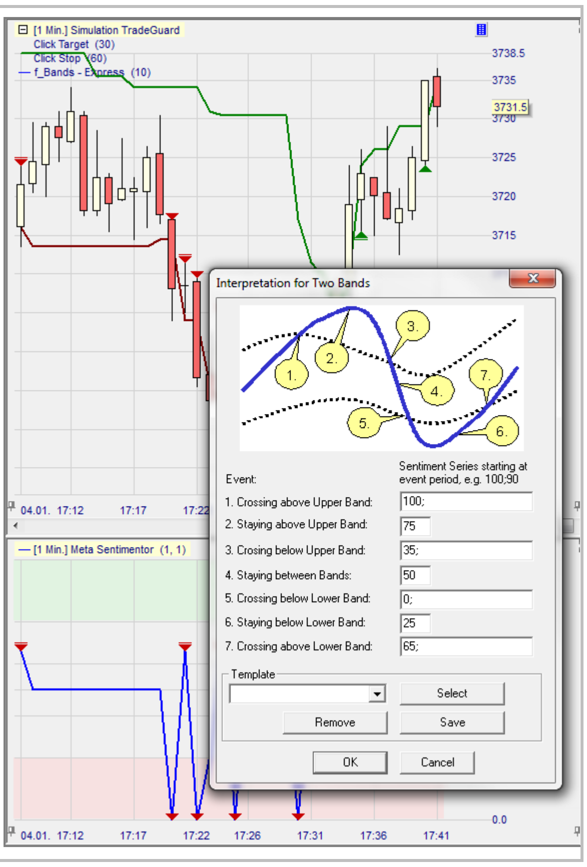
Format:

- void Bands (series series, series lower, series upper)

Example:

- Below the indicator is a channel based on the highest highs and lowest lows over 10 bars.
- The interpretation is defined using the Bands interpretation.
- By right clicking on the indicator and selecting Edit Interpretation one can display a window where the interpretation parameters can be modified.
    - Here we buy when the close crosses the upper curve (= 100) and we sell when the close crosses below the lower curve (= 0).

```
Express f_Bands

Vars

series
upper, lower, upper1, lower1;

input
$span (0, 200, 10);

Calculation

upper1 = Highest(h, $span);
lower1 = Lowest (l, $span);

upper = upper1[1];
lower = lower1[1];

interpretation Bands (close, lower, upper);

plot (upper, green, 2);
plot (lower, red, 2);
```



Interpretation for Two Bands

Event:	Sentiment Series starting at event period, e.g. 100;90
1. Crossing above Upper Band:	100;
2. Staying above Upper Band:	75
3. Crosing below Upper Band:	35;
4. Staying between Bands:	50
5. Crossing below Lower Band:	0;
6. Staying below Lower Band:	25
7. Crossing above Lower Band:	65;

TwoThresholds()

Definition:

- Interpretation scheme for indicators based on the crossing by a curve of two horizontal lines.
    - For example, a RSI, a stochastic or other oscillators crossing two upper and lower lines.

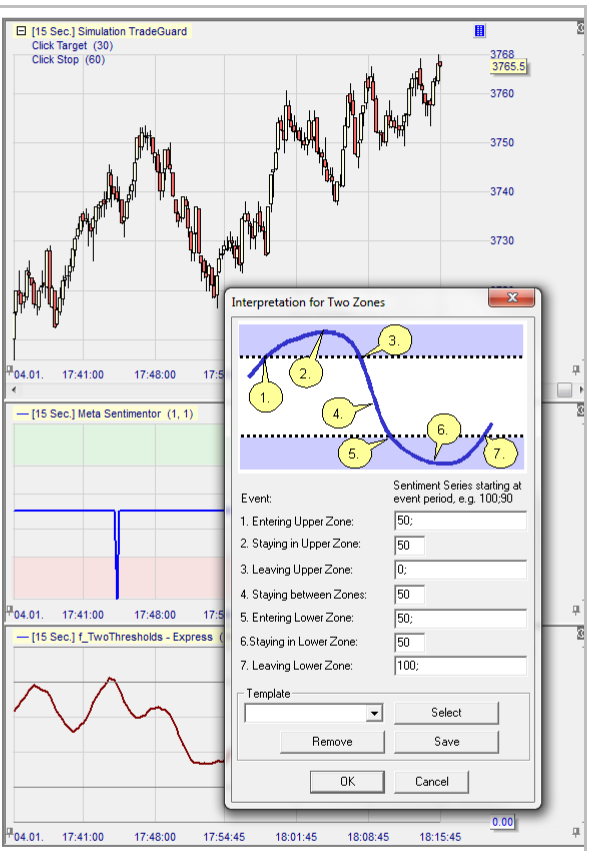
Format:

- void TwoThresholds (series series, input upThreshold, input downThreshold)

Example:

- Below the indicator is a moving average over 10 bars of a RSI(14).
- The interpretation is defined using the TwoThresholds interpretation.
- By right-clicking on the indicator and selecting Edit Interpretation one can display a window where the interpretation parameters can be modified.
    - A long signal is triggered in case #7
    - A short signal is triggered in case #3

```
Express f_TwoThresholds

Vars

Series
myRSI, smoothedRSI;

Input
$RSIspan(1, 100, 14), $MAspan(1, 200, 10),
$upperzone(51, 99, 80), $lowerzone(1, 49, 20);

Calculation
If IsFirstBar() then
begin
  RSI(close, myRSI, $RSIspan);
  MovingAverage(myRSI, smoothedRSI, $MAspan);
end

Interpretation TwoThresholds(smoothedRSI,
$upperzone, $lowerzone);

plot(smoothedRSI, red, 2);
plotline(100, grey, 1);
plotline(80, grey, 1);
plotline(20, grey, 1);
plotline(0, grey, 1);
```



Interpretation for Two Zones

Event: | Sentiment Series starting at event period, e.g. 100;90

1. Entering Upper Zone: 50;
2. Staying in Upper Zone: 50
3. Leaving Upper Zone: 0;
4. Staying between Zones: 50
5. Entering Lower Zone: 50;
6.Staying in Lower Zone: 50
7. Leaving Lower Zone: 100;

Additional tips

Using external text editors

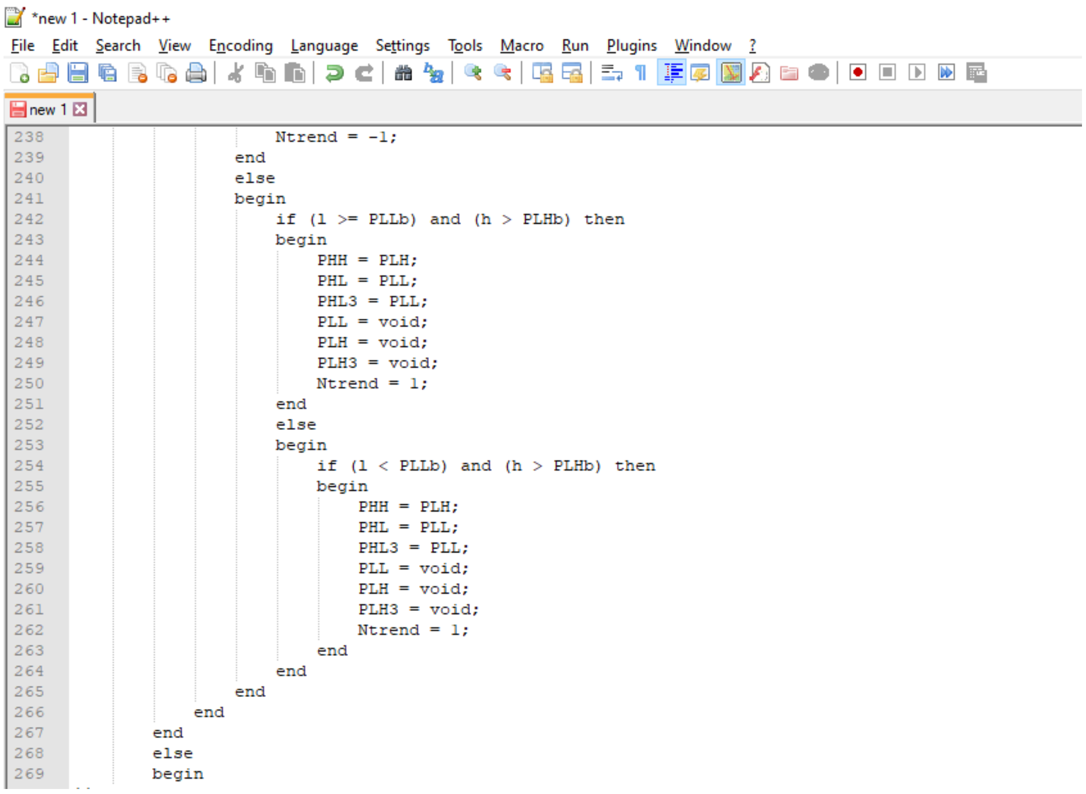
A powerful, fast and secure way to improve the programming experience in NanoTrader is to resort to external text editors like Notepad++, UltraEdit etc. Some of them are completely free and provide very helpful features such as:

- Autosave
- Finding and replacing strings of code
- Move blocks of code by one TAB to the right
- Vertical alignments
- Working on several scripts simultaneously

In order to use an external text editor simply copy&paste the code from the external text editor into NanoTrader's Express editor and vice versa.

Example:

Below shows a piece of NanoTrader Express code which was copied into the free Notepad++ text editor.


*new 1 - Notepad++
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
new 1

```
                    Ntrend = -1;
                end
                else
                begin
                    if (l >= PLLb) and (h > PLHb) then
                    begin
                        PHH = PLH;
                        PHL = PLL;
                        PHL3 = PLL;
                        PLL = void;
                        PLH = void;
                        PLH3 = void;
                        Ntrend = 1;
                    end
                    else
                    begin
                        if (l < PLLb) and (h > PLHb) then
                        begin
                            PHH = PLH;
                            PHL = PLL;
                            PHL3 = PLL;
                            PLL = void;
                            PLH = void;
                            PLH3 = void;
                            Ntrend = 1;
                        end
                    end
                end
            end
        end
        else
        begin
```