



Probabilities distribution of price indicator (PDP).

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User's guide.

Hereinafter, the abbreviated name of the indicator - **PDP** (probability distribution of price).

Table of contents.

Introduction	1
1. Principles of the PDP indicator	2
2. Modes of the PDP indicator	3
3. Indicator settings	7
4. Identified by the PDP indicator of the laws of the market and how to use them for successful trading	8
5. Trading strategies using the PDP indicator	10

Introduction.

Most of the indicators currently used by traders in the Forex market were created for another market - the stock market and for another time, when there were quite monotonous trends and quotes were not so volatile as at present, when there are no trends as steady trends of unidirectional price movement. Therefore, the entire existing arsenal of indicators is not very suitable for trading in the Forex market and does not reflect the key moments of the state of this market. To assess the condition of the Forex market and its instruments, it is necessary first of all to analyze statistical histories of their quotations, which allows identifying patterns that are important for trade, which are latent for the standard indicators (supplied with the MT4 trading platform). One of these, providing a deep statistical analysis of instruments is the indicator **PDP**, which, based on the analysis of the smaller time frames, calculates in real time the probability distribution of the price for the larger time frames. The visual control of probability distributions, which provides the indicator **PDP**, allows us to achieve a deeper understanding of the modern market, namely:

- 1) statistically strictly identify the current price levels and assess the probabilities of the current (for the current moment) price in other segments of its fluctuations;
- 2) to reveal the microstructure of the true trend movement, as a sequence of such transitions from one price level to another, that have a certain shift in the balance of probabilities towards the growth of the price or its fall;

- 3) establish the beginning of a new trend movement based on the critical output of an non-lagging average beyond the current price level.

1. Principles of the indicator.

To calculate the probability distributions on time frames M5-H4, the data of the minute chart - M1, is used. For the daily is used time frame M5; for the weekly time frame and for the monthly time frame - M30. The use of smaller time frames for estimating the probability distribution in these large time frames is not advisable, and it is impossible not only because of the braking of the program loaded with large arrays, but also because there is not enough big of M1 history in (for calculating probability densities) the scales of such graphs. Therefore, before the indicator **PDP** is installed on the chart of a tool, you first need to load the history (*Tools / History Center*) quotes for this tool, and also to increase to the limit the options "*Max bars in history*" and "*Max bars in the chart*" (*Tools / Options / Charts*). Note that if on some large-scale timeframe of data for calculating the probability distribution is not enough, on the "*Experts*" tab of the window of the term MT4 there will be a message "*Download the quotation history of...*". Indicator itself is resource-intensive and requires at least a 4-core processor 2.8 GHz and 4.00 GB of RAM. If the indicator will brake the MT4 terminal, then in the indicator settings it is necessary to reduce the «*Number of countable bars of the current chart* (≤ 200)», which is the default 200.

The calculated probability distribution has a sliding character, and the interval used for calculating the data is determined by the input parameter «*The averaging period in the bars of the current graph*», which we denote **IS**; if, for example, **IS** = 15, and time frame H4, then the columns of probability values corresponding to the time moments at H4 are calculated by $15 * 4 * 60 = 3600$ points of the graph M1, i.e. the last column (zero bar $n = 0$ to H4) - over the last 3600 points of the time frame M1, the penultimate in the range of values [241, 3840], ..., nth in the interval $[240 * n + 1, 3600 + 240 * n]$ minute chart. And, if, say, **IS** = 1, then the last column is calculated according to the last 240 values of the minute chart, the penultimate column is calculated according to the values of the interval [241,480], etc., with the mapping, of course, in all cases, to H4.

The program splits the total price fluctuation for a given averaging period into **seven** equal intervals and calculates the frequency of the price hits of historical data of already small timeframes in that intervals. From these 7 intervals for each moment of the analyzed large time frame, rectangles of the probability mapping are formed (7 rectangles for each, marked by a bar of a large time frame, time point). Calculated on the basis of the statistical frequencies of the price (small timeframes) hit in the intervals specified by the program, the probability columns can be displayed in the main terminal window in two ways:

- 1) in the form of a color code, the type of the spectrum of visible light, when the most probable values are closer to the violet area, and the least probable values are close to the red, with the coloring of the intervals by the corresponding colors (the order of encoding the decreasing probability by means of the color scale is specified in the settings and can there be changed at the request of the user);
- 2) in the form of numerical values of the probability of hit in given intervals, with the corresponding colors.

2. Modes of operation of the indicator PDP.

For the convenience of reading the color-coded probability values from the indicator prob_distrib, it is desirable to make a black background on the color scheme of the main window of the MT4 terminal and display prices also with a dark line or red and green bars, the template of which is attached to this indicator.

The moving average, taken with the averaging period $2*n+1$, is known to lag behind the n bars; the sliding probability distribution that calculates the **first mode** of the **PDP** indicator also lags behind, which in this case represents the data in such form (Fig. 1).

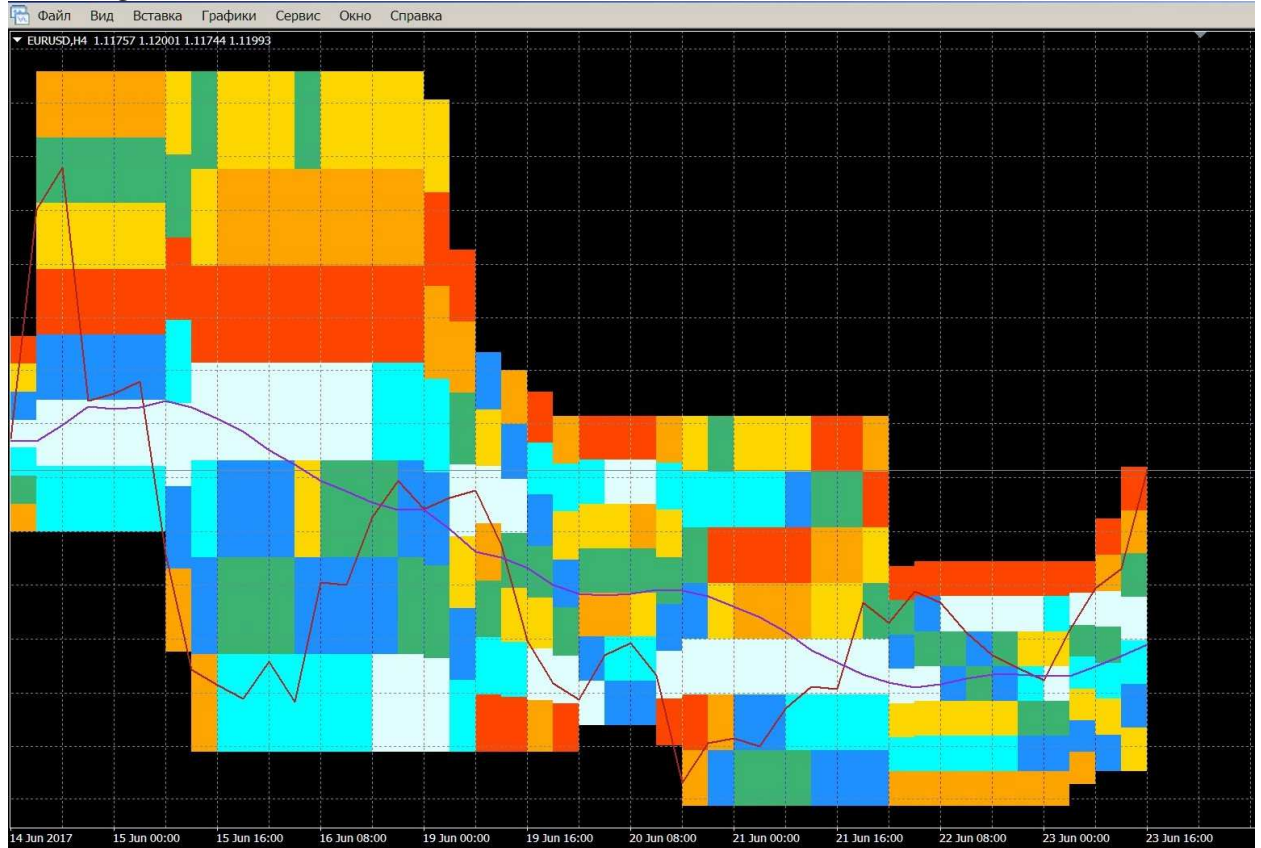


Fig. 1. Mode for calculating the sliding probability distribution of prices **IS=15**.

However, since the information on the frequencies of the price hit in given intervals is obtained on the basis of a large amount of data extracted from the lower time frames, it is possible to obtain algorithmically the **without delay probability distribution**, the calculation of which constitutes the **second mode** of operation of the indicator. In this case, the previous type of distribution is shifted to bars n to the past, and information about the distribution on the $n-1$ bar is found on the bars $2*(n-1)+1$ of a large time frame, i.e. on the points $(2*(n-1)+1)*T_L/T_S$ where T_L - the duration of a large time frame, a T_S - the duration of a small time frame, that detailing a large, the $n-k$ bar on the $2*(n-k)+1$ bars of a large time frame, i.e. on $(2*(n-1)+1)*T_L/T_S$ points, and about a zero bar on on it himself, more precisely, on an array of the prices equal quantity T_L/T_S ; at the same time, the probability distribution is calculated not on a bar that may be incomplete, but on the last such number of points of a small time frame that forms a full bar, which allows obtaining distributions for individual bars (Figure 2.1). By the same principle of using small, detailing time frames for analyzing large time frames, the **average without delay** is also calculated, which is also displayed by the indicator (blue-purple line or asterisks).

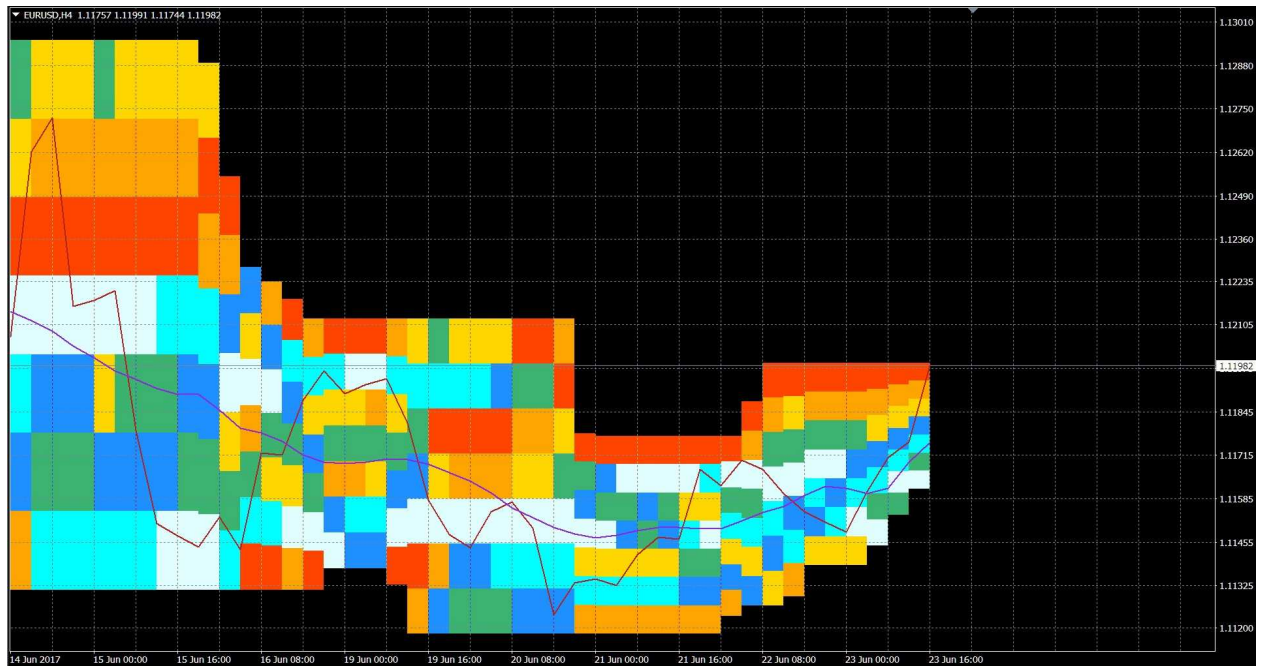


Fig. 2. The mode of calculating the without delay probability distribution and the mean without delay $IS=15$.

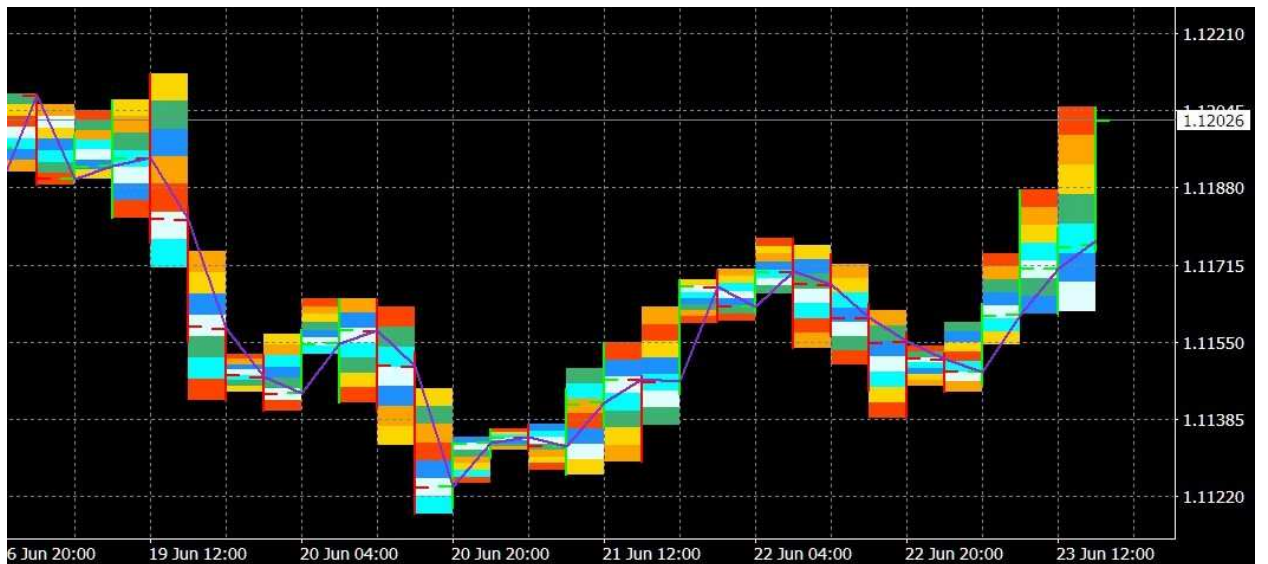


Fig. 2.1. Probability distribution over bars $IS=1$.

In the **third mode**, the algorithm for calculating the without delay probability distribution is even more complicated and, firstly, the current price channels corresponding to the averaging period are calculated at the end of the history, and secondly, by a special one (reminiscent of exponential smoothing with varying coefficients depending on the varying statistics calculation of smoothing points), suitable for this period, the filtering mean without delay (Fig. 3).

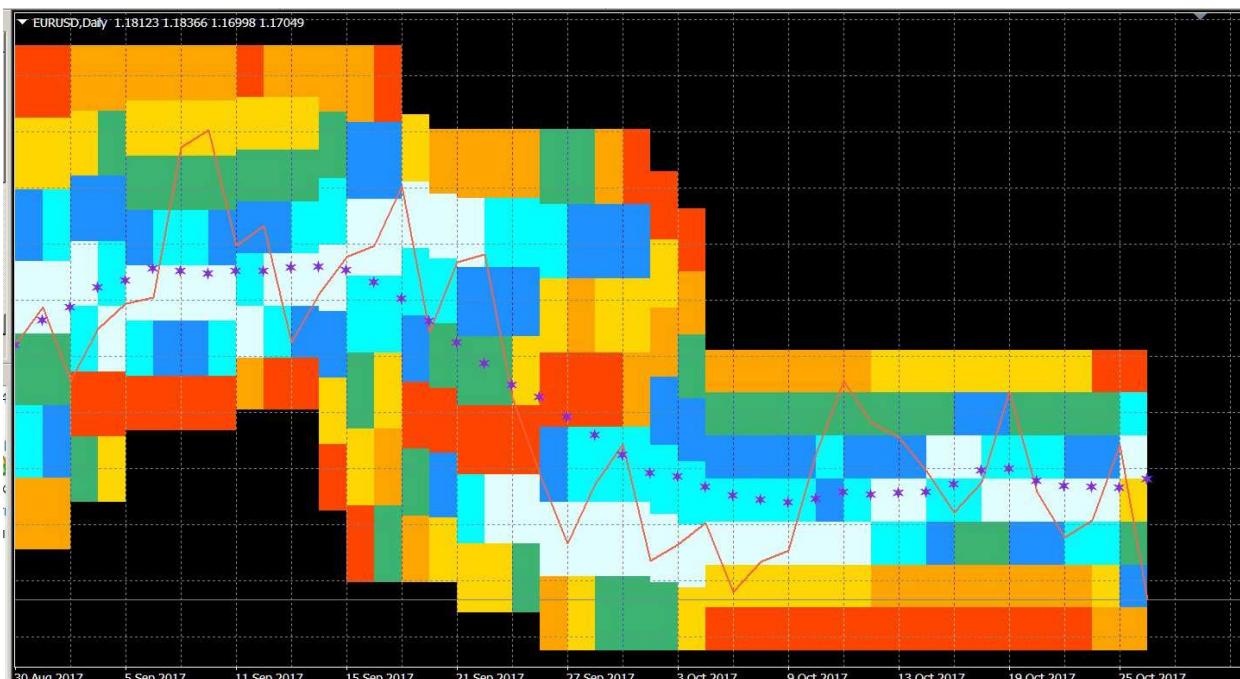


Fig. 3. The mode of calculating the without delay distribution with channels and adjusted mean $IS=15$.

In each of the above modes (1-3), the probability density mapping can be changed from its color coding (colors can be customized by the user) to the numerical presentation (Fig.4).

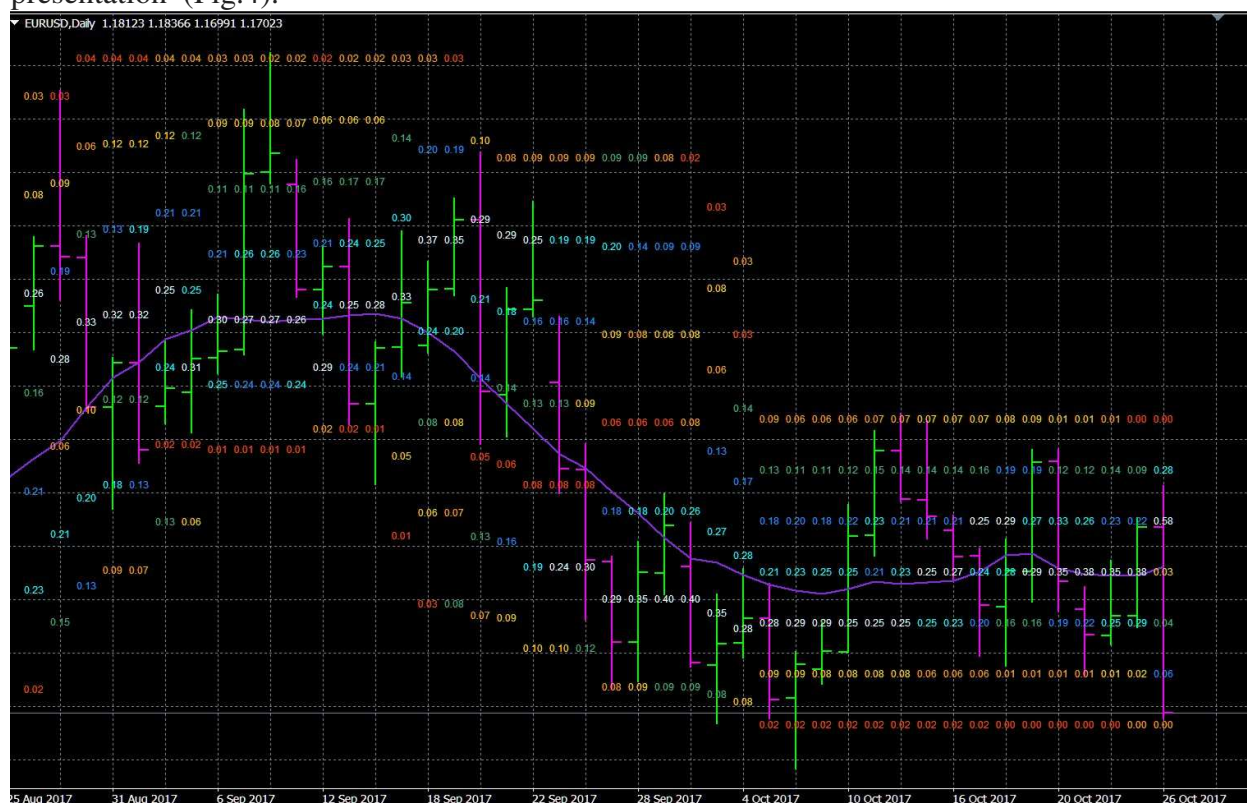


Fig. 4. The third mode with numerical probability mapping $IS=15$.

In the third mode, based on the calculated channel limits (which then need to place stops), the deposit and the specified risk level, you can also calculate the lot size for the trade within this channel, the lot information is displayed in the main window

where its location is configured and can be selected, both at the bottom of the channel and at the top (Fig. 5).

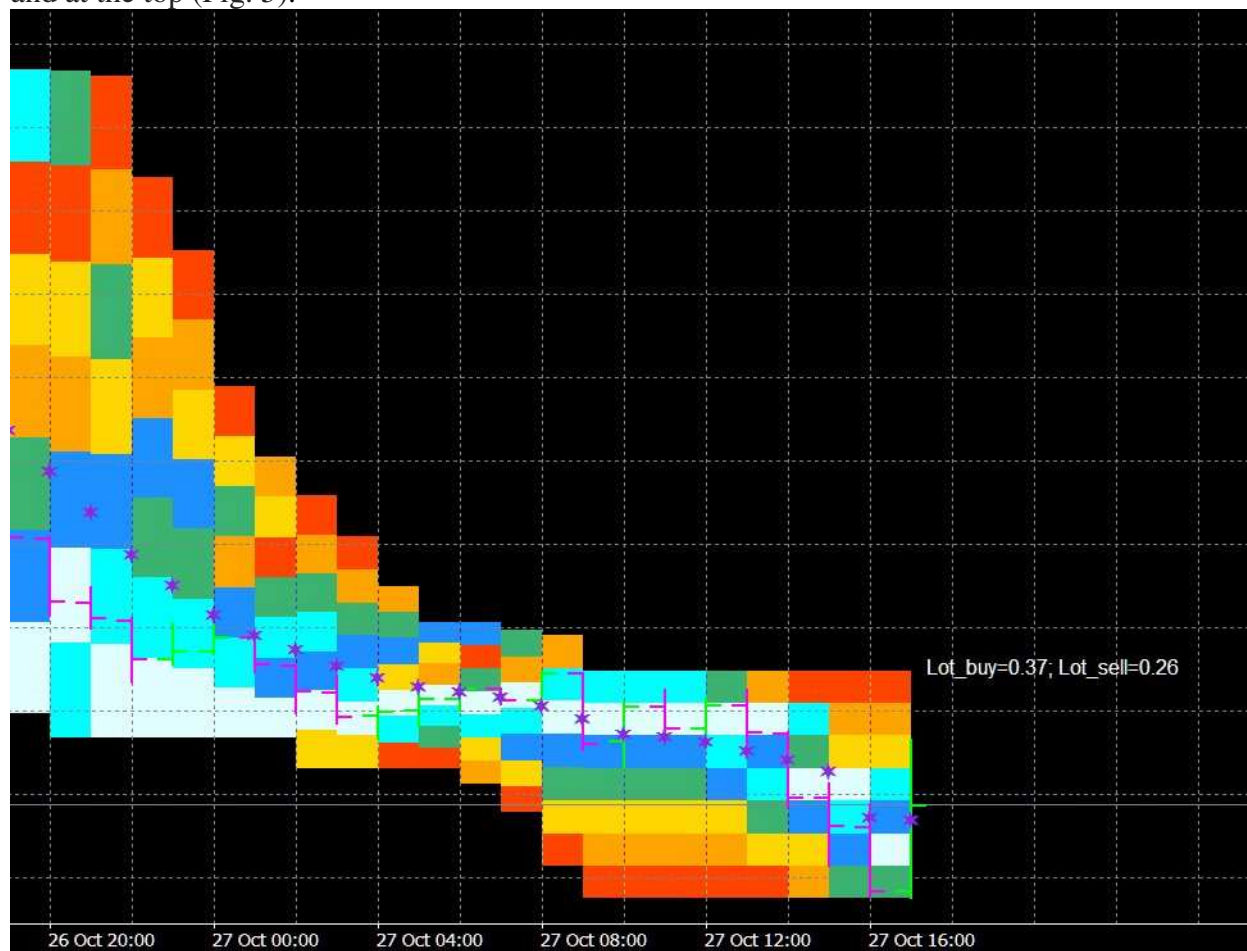


Fig. 5. The third mode with the calculation of the lot.

The indicator is resource-intensive and calculates a small number of bars, but to search for possible new channels, the calculation area can be moved deep into history, for which the «*Shifting the calculation area of the indicator*» parameter is set in the settings.

The current mode of operation and all its characteristics are printed on the "Experts" tab of the window of the terminal MT4.

Time	Message
2018.01.10 22:04:23.541	PDP EURUSD,M15: initialized
2018.01.10 22:04:23.540	PDP EURUSD,M15: The averaging period in the bars of the current graph (2n+1) IS=15
2018.01.10 22:04:23.540	PDP EURUSD,M15: Number of countable bars of the current chart (<=200) L_Hist=200
2018.01.10 22:04:23.540	PDP EURUSD,M15: Shifting the calculation area of the indicator SHT=0 bars
2018.01.10 22:04:23.540	PDP EURUSD,M15: Deposit in \$ Depo=5000.00
2018.01.10 22:04:23.540	PDP EURUSD,M15: Allowable losses in % Risk=2.00
2018.01.10 22:04:23.540	PDP EURUSD,M15: The non-lagging distribution is calculated
2018.01.10 22:04:23.540	PDP EURUSD,M15: The current channel and the non-late mean is calculated

Fig. 6. Information about the indicator mode.

3. The indicator settings.

The indicator settings are shown in Fig. 7, where they are described in the terminal window “inputs”.

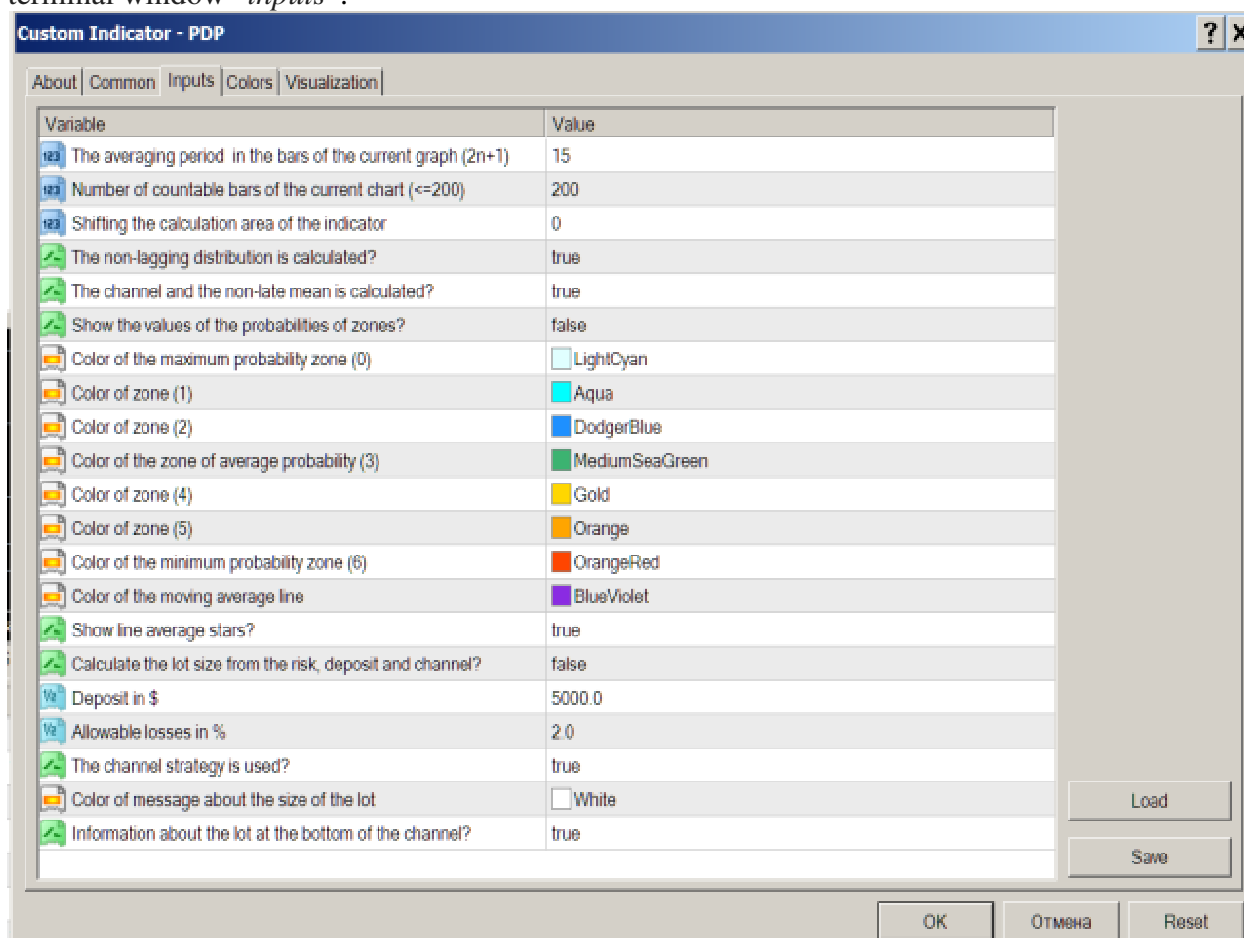


Fig. 7. Indicator settings.

The indicator settings are divided into:

Algorithm settings:

- The averaging period in the bars of the current graph (2n+1) - averaging period (1-99).
- Number of countable bars of the current chart (<=200) - number of calculated indicator graph bars (1-200).
- Shifting the calculation area of the indicator - global indicator shift (0-100).
- The non-lagging distribution is calculated - calculate a non-lagging distribution.
- The channel and the non-late mean is calculated - calculate the current channel and non-lagging mean.
- Show the values of the probabilities of zones - display area probability values.

Color and display settings:

Colors in probability density descending order.

- Color of the maximum probability zone (0);
- Color of zone (1);
- Color of zone (2);
- Color of the zone of average probability (3);
- Color of zone (4);

- Color of zone (5);
- Color of the minimum probability zone (6);
- Color of the moving average line; - average color
- Show line average stars; - display average line as stars (false - as a line)

Trading mode settings:

- Calculate the lot size from the risk, deposit and channel
- Deposit in \$
- Allowable losses in %
- The channel strategy is used - true - intra-channel strategy (false - channel breakthrough strategy)
- Color of message about the size of the lot
- Information about the lot at the bottom of the channel (false - information at the top of the channel)

4. Identified by the PDP indicator of the laws of the market and how to use them for successful trading.

Looking at the color maps of the probability distribution, it is easy to notice that the places where the price "trampled on" the most, form on all time frames rather extensive horizontal bands (Figure 8-9), which are similar to discrete energy levels, when the price from one level to another passes jump, almost avoiding intermediate points, in which the probability density of its hit are sometimes minimal. And, if the averages move smoothly, falling into such zones of maximum probability by passing through all intermediate points (and otherwise can not be) and do not distinguish similar probability concentration bands, these zones are easily identifiable by the indicator **PDP**, since they really form are constant levels that are essentially discrete or torn apart from each other.

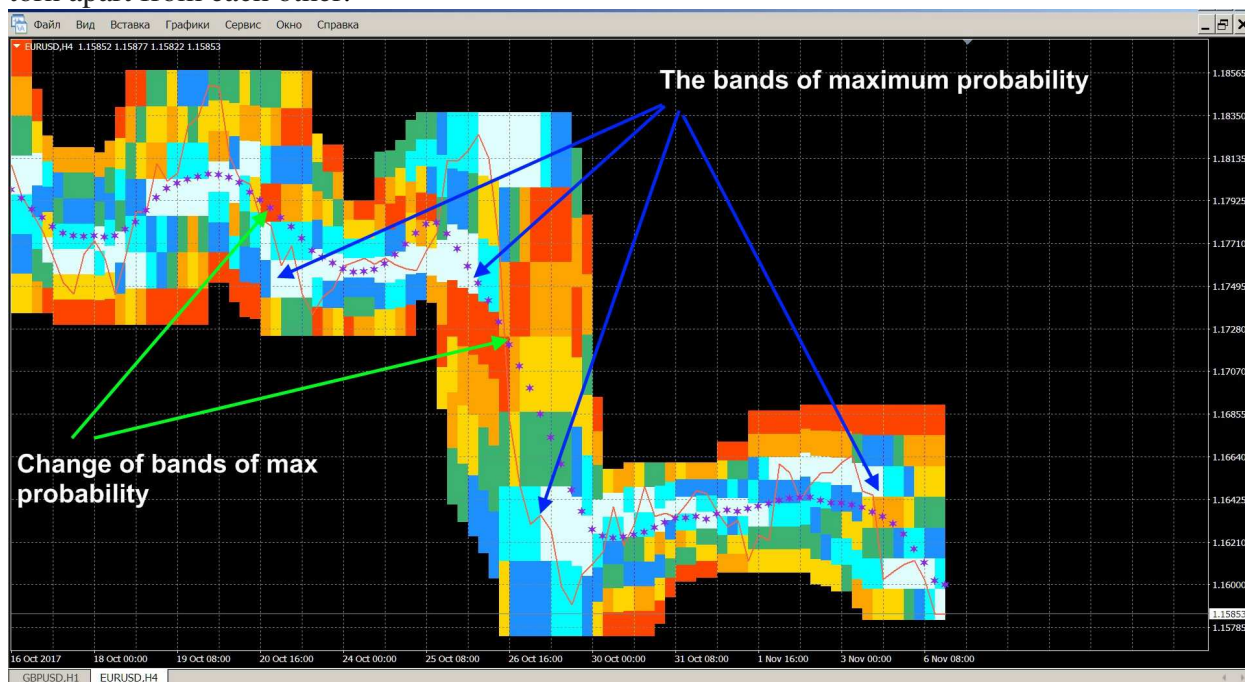


Fig. 8. The bands of the maximum probability concentration on H4.

The existence of such zones can be explained from a psychological standpoint, as a consequence of the habit of key market participants, which determines pricing, when they are confident in the adequacy of certain price values determined at a given

moment. This key market participants try set this price for some time, which continues until important events occur. Such levels, imprinted in the memory of these participants, acquire a strong tendency to repeat, which can also be seen on the color distribution of the probability and should be used in the game. Namely, if a trend has been signify, say, to an increase in the price, then necessary (by examining the probability distribution on history, for which it may be necessary to shift the indicator calculation area in the past by the «*Shifting the calculation area of the indicator*» option) to identify maximum probability zone above current price, where to place the take-profit, since it is possible that the direction of price motion will change after this zone, but price will reach its with a high probability. From the analytical point of view, the existence of such price zones and their isolation from each other is also understandable, since highly nonlinear equations, in principle, describe such complex systems as the market, have huge sets of sharply differing solutions that jump and unpredictably replace each other in points of bifurcation, after which the price only fluctuates around such solutions until the next bifurcation.

The very tendency to change the level of maximum probability is expressed (Fig. 9) in the intersection of the moving average and the band with a fairly low probability (from gold to red-orange), which should be identified by probability distribution without delay and moving average without delay to avoid signal lag.

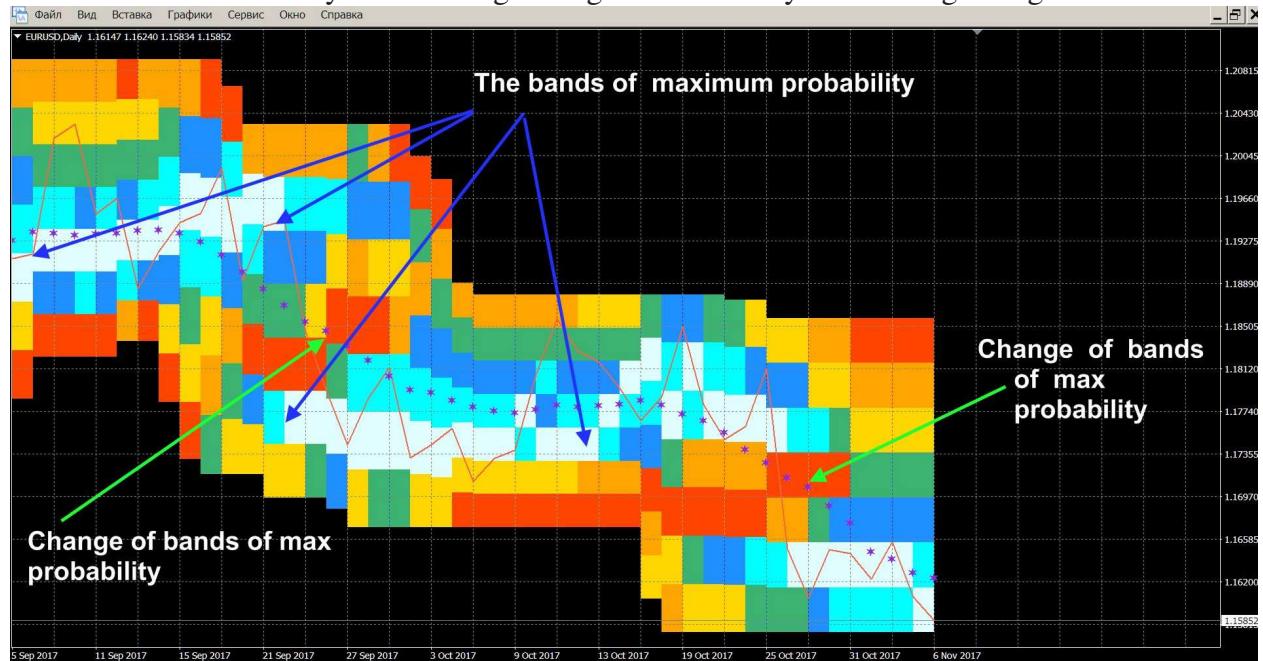


Fig. 9. The bands of maximum probability concentration and the order of their change to D1.

5. Successful trading strategies using only PDP indicator.

Preliminary actions.

First, on the timeframe chosen by you for trading (M30-D1), roughly estimate the average length of the white bands $\langle l \rangle = \frac{1}{N} \sum_{i=1}^N l_i$, where N - the number of bands visible on the chart, l_i - their extent.

The indicator for both strategies is used in the **third mode**, where are calculated channels, probability distributions and mean without lag. The indicator channel and, accordingly, is intended mainly for trading through channels.

1. In-channel strategies.

The indicator **PDP** allows you to reliably trade in *channel strategies*. Such trade should be carried out on the already well-drawn (but not too long compared to their average lengths) white bands $\langle l \rangle / 4 \leq l \leq \langle l \rangle / 2$ and, of course, beforehand (at least 2 hours for trading on H1 and H4) before *important news* that may shift the price level to the new channel. In this case, the opening of positions should be done when the current price is either in the yellow or green sectors, and take the take-profit in the middle of the white line. The stops are placed slightly further than the full distribution channel (Figure 10). The value of the lot is calculated by the indicator itself, if in the indicator settings "Is channel strategy used?" set **true**.

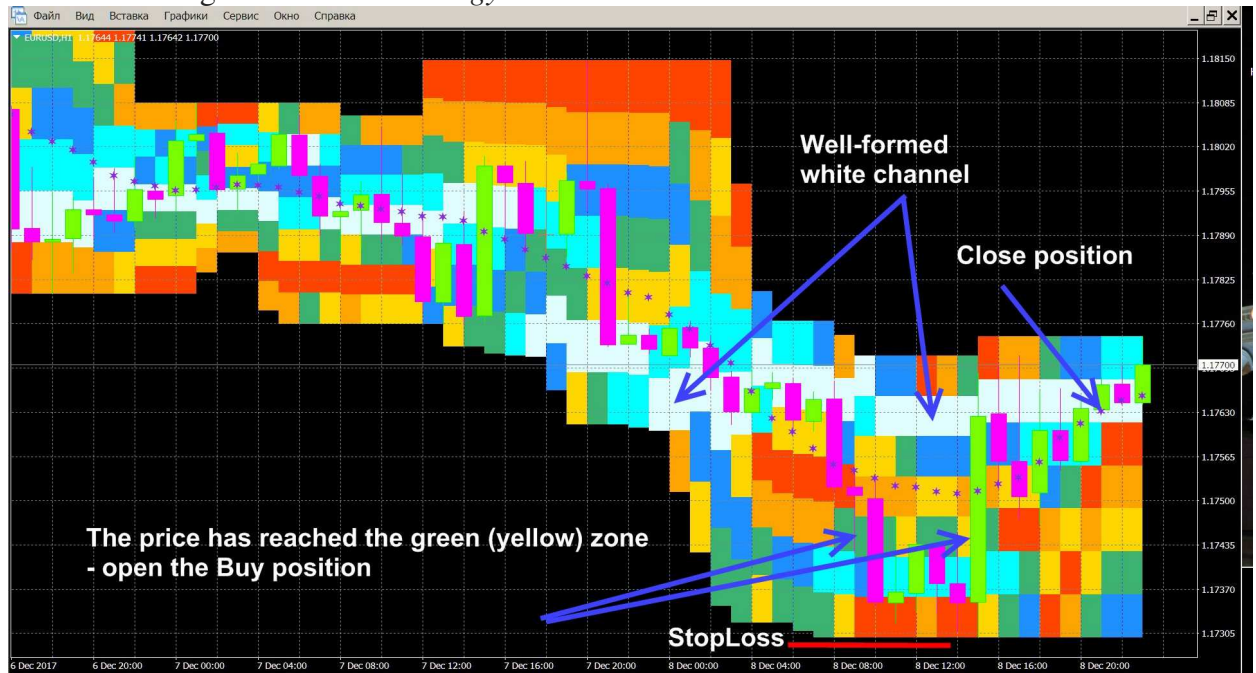


Fig. 10. Channel strategy.

2. Strategies for channel breakdown.

The bands of maximum probability jump discontinuously at the intersection of the without lagging mean of the red strip, which is the band with the minimum probability. Therefore, with the PDP indicator, the channel breakdown strategy can also be implemented in the form of a breakdown of the lowest possible level in an absolutely established channel $l \approx \langle l \rangle$, namely: put a pending order in the middle of the current red band (Buy_stop - if the red band is above the white and Sell_stop - if the red band is below white). A profitable order is closed manually when the price reaches a new established white band $l \approx \langle l \rangle / 4$. Stoploss is also placed a little further than the full probability distribution channel (Fig. 11). To calculate the lot, the option "Is channel strategy used?" must be set to **false**.

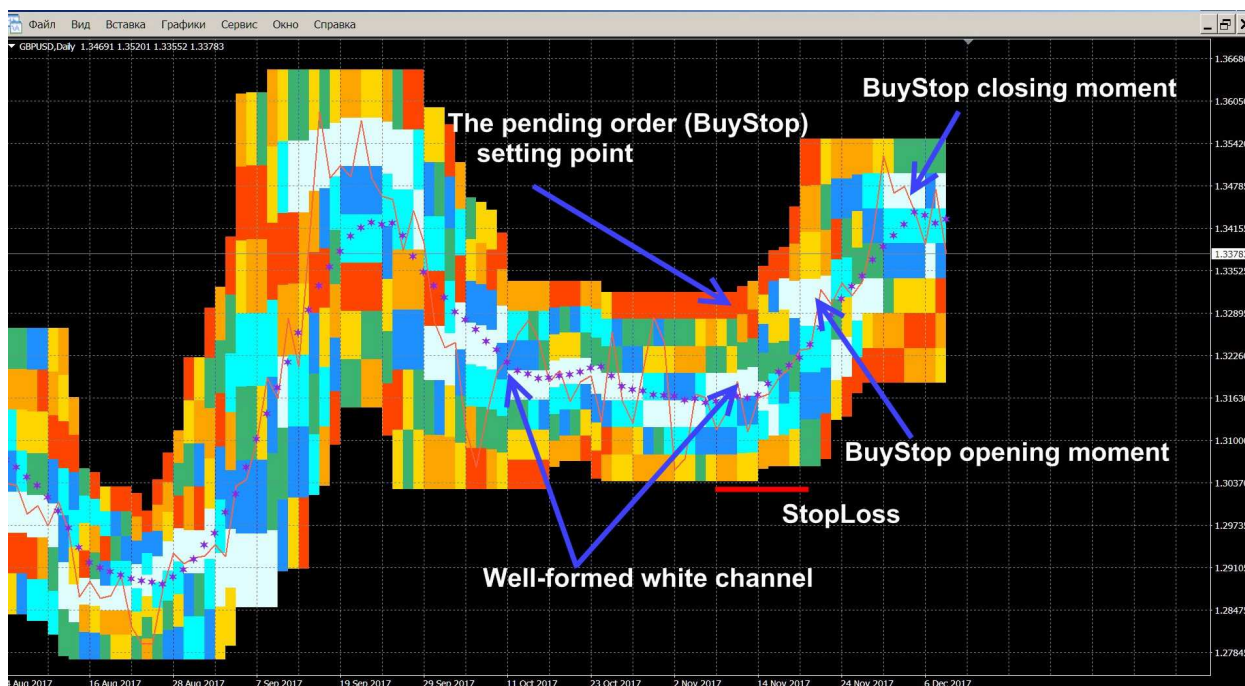


Fig. 11. Channel breakdown strategy.

With this indicator, you can also use the classic form of the channel breakdown strategy by placing a pair of pending orders (**Buy_stop** and **Sell_stop**) and their stops just below both boundaries of the established channel.

3. Trend strategy.

For currency pairs, the trend strategy in pure form is realized only on very large-scale charts. If the trend and, most importantly, the high probability of its continuation in the same direction are established (fundamental analysis together with other indicators), then the **PDP** indicator can be used for the trend strategy for order placement and **Stop Loss**, more precisely, (3.1) the **Buy Stop** order for the uptrend (and **Sell stop** for the downtrend) and **Stop Loss** are set as in the channel breakdown strategy. It is possible (3.2) also to open an order as in the case of an in-channel strategy, i.e. when rolling back, when the price falls in the green or yellow sectors, separated from the white in the direction opposite to the trend (Fig. 12). In this case, the lot is calculated according to the appropriate types of channel strategies. Then, when the price steadily $\langle l \rangle / 4 \leq l \leq \langle l \rangle / 2$ takes a new price level, **Stop Loss** is transferred in accordance with the boundaries of the new channel, etc., with a profitable closing of the **Stop Loss** order, when the price starts to unfold. In this case, if the trend is identified, for example, by MN, then the channel is determined by W1, if the trend is identified by W1, then the channel by D1, the trend is identified by D1, the channel by H4.



Fig. 12. Trend strategy with opening of a warrant on rollback and iteration of modifications **Stop Loss**.

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Information on other statistical indicators is available on the manufacturer's website <http://www.statlab.simplesite.com>.