

### SPIKES Volatility Index

The SPIKES Volatility Index (index symbol: SPIKE), is a measure of the expected 30-day volatility in the SPDR<sup>®</sup> S&P 500<sup>®</sup> ETF (SPY). SPY is the largest exchange traded fund in the world and tracks the most watched stock index in the United States.

SPIKES is built using the popular variance swap methodology and uses live SPY option prices to calculate volatility. This is consistent with the way the trading community is used to modelling risk and hedging exposure.

### SPIKES Futures

SPIKES Futures are offered by MGEX<sup>™</sup> via the CME Globex<sup>®</sup> platform, and are cleared by MGEX.

The SPIKES Index and volatility products offer a number of unique features designed to produce highly accurate, robust data and create a transparent and open auction settlement process.

MIAX<sup>®</sup> is pleased to partner with T3 Index and MGEX to offer SPIKES Futures - for more confident volatility trading.

### The SPIKES Formula

SPIKES has a defined rules-based approach to selecting components—a series of options on the SPY—and weighting them to derive a single price for the index. The general formula for the SPIKES Index is as follows:

$$\text{SPIKES} = 100 \times \sqrt{\left( \frac{t_1}{t_M} \frac{t_2 - t_M}{t_2 - t_1} \sigma_1^2 + \frac{t_2}{t_M} \frac{t_M - t_1}{t_2 - t_1} \sigma_2^2 \right)}$$

- t<sub>1</sub>** Time (in seconds) to near-term expiration
- σ<sub>1</sub>** Estimated volatility computed by variance swap formula, near-term
- t<sub>2</sub>** Time (in seconds) to next-term expiration
- σ<sub>2</sub>** Estimated volatility computed by variance swap formula, next-term
- t<sub>M</sub>** Number of seconds in 30 days (30 x 86,400 = 2,592,000)

The formula for expected T-term variance is as follows:

$$\sigma^2 = \frac{1}{T} \left[ 2e^{RT} \sum_i \frac{\Delta K_i p_i}{K_i^2} - \left( \frac{e^{RT} (p_{ATM}^c - p_{ATM}^p)}{K_{ATM}} \right)^2 \right]$$

- T** Time to options expiration (in years, with 1-second precision)
- K<sub>i</sub>p<sub>i</sub>** A list of unique SPY options strikes, ordered from lowest to highest, and corresponding SPY options prices; of a call if K<sub>i</sub> > K<sub>ATM</sub>; and of a put if K<sub>i</sub> < K<sub>ATM</sub>; if K<sub>i</sub> = K<sub>ATM</sub> then an average between the ATM SPY put and call prices
- ΔK<sub>i</sub>** Half the difference between the strikes on either side of K<sub>i</sub>

$$\Delta K_i = \frac{(K_{i+1} - K_{i-1})}{2}$$

- p<sup>c</sup><sub>ATM</sub>** Price of the at-the-money (ATM) SPY call option
- p<sup>p</sup><sub>ATM</sub>** Price of the ATM SPY put option
- K<sub>ATM</sub>** Strike closest to the point where linearly interpolated SPY call and put prices intersect

- R** Risk-free interest rate to option's expiration
- For the last (highest and lowest) selected strikes, ΔK<sub>i</sub> is simply the absolute difference between K<sub>i</sub> and the nearest selected option's strike

## Calculation Process

SPIKES is calculated using only standard options on the SPY that expire on the third Friday of each calendar month. Although weekly options on SPY are available, these are **not** used in the calculation of SPIKES.

The following process is used to calculate SPIKES:

<b>STEP 1</b>	<b>STEP 2</b>	<b>STEP 3</b>	<b>STEP 4</b>	<b>STEP 5</b>
<b>Select two SPY expirations</b>	<b>Apply “Price Dragging” technique</b>	<b>Select option inputs</b>	<b>Apply variance swap formula</b>	<b>Calculate SPIKES</b>
Select the two SPY expiration months. The SPIKES calculation begins with the universe of regular monthly SPY options and selects the first monthly expiration with more than two full days to expiry and the next monthly expiration.	Apply “Price Dragging” technique to determine option price inputs. Price Dragging uses eligible trades, bids, and offer prices to reduce erratic movements of the index value that could result from illiquid out-of-the-money options.	Select option inputs. For each expiration, choose the at-the-money and all out-of-the-money options, limited by truncation.	Apply variance swap formula. For each expiration, the volatility is estimated using the variance swap formula, with the selected options’ prices weighted according to the formula [2] above.	Calculate SPIKES. Compute the 30-day weighted average of the near- and next-expiration variances, take the square root, and multiply by 100 as illustrated in the formula [1] above.

## MIAX Settlement Auction

SPIKES Special Settlement Auction (a modified Opening Process)

The SPIKES Special Settlement Auction occurs on MIAX Options in the SPY options that have 30 days to expiration on the Wednesday that is 30 days prior to the third Friday of the calendar month immediately following the month in which the contract expires. If that Wednesday or the expiration Friday that is 30 days following that Wednesday is a holiday, the final settlement date for the contract shall be on the business day immediately preceding that Wednesday.

Before and during the opening process for each relevant SPY option, MIAX Options will disseminate robust imbalance information over its AIS feed. Anyone (members and non-members) may subscribe to the AIS feed.

New liquidity types called Settlement Auction Only (SAO) orders and SAO eQuotes were created for this process.

MIAX Options now allows SPIKES Combination Orders – orders to buy or sell one or more SPIKES options series and the offsetting number of SPIKES Combinations to be delta neutral – with ratios of up to eight to one. SPIKES Combinations are the purchase (or sale) of a SPIKES call option and sale (or purchase) of a SPIKES put option with the same expiry and strike.

## Combo Linked to Future (CLF)

The “Combo Linked to Future” (CLF) is a strategy type that is available for trading in two distinct segments. It will incorporate both a Related Futures Cross (RFC) on MIAX for the options component and either an Exchange for Related Position (“EFRP”) on MGEX or most likely the Exchange of Contract for Related Position (“ECRP”) on other futures exchanges. These simultaneous execution types allow for the exchange of SPIKES (SPK) futures for SPIKES option combinations. Other highly correlated futures may also be eligible for trading versus SPIKES option combinations. Please see the [CLF](#) document for a brief description and [MIAX](#) or [MGEX](#) rulebooks for additional details.

## Trading fees

For trading fees, see [SPIKES Futures Rate Card](#) or the [MGEX fee schedule](#) for SPIKES Futures.

## SPIKES Futures: Summary

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