# *Real-time Analytics Methodology*

| New High/Low | |
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| **Intro** | New High/Low alerts are generated once daily when a stock hits a new 13 Week, 26 Week or 52 Week High/Low. |
| **Computation** | Each second of the trading day, the stock price is compared to its previous 13 Week, 26 Week and 52 Week High/Low. As soon as the price hits a new High/Low over any of those periods, an alert is generated and will stay active for the remainder of the trading day. If a stock gaps up or down and reaches a new high or low for 13 and 26 weeks or 13, 26 and 52 weeks, only the breach of the longest lookback window will be triggered.<br><br>New High/Low alerts will be published between the hours of 9:30am ET and 4:00pm ET on full trading days and between the hours of 9:30am ET and 1:00pm ET on half days in the market. |
| **Timing** | **When can I receive signals?**<br>9:30am – 4:00pm ET<br><br>**When do signals expire?**<br>4:00pm ET Daily |

| Unusual Volume | |
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| **Intro** | Unusual Volume alerts are generated when the volume of a stock in the past 30 minutes is atypically high. |
| **Computation** | Each second of the trading day, the trailing 30 minute volume of the stock will be compared to a high-volume threshold. The high-volume threshold represents the top percentile of the historical volume observations over the previous 30 trading days. Alerts are published if the 30 minute volume exceeds the historical volume threshold.<br><br>Historical volume ranges are calculated based on 30 days of trading history, and are time-of-day specific (i.e. market open is different from mid-day, which is different from market close). |
| **Timing** | **When can I receive signals?**<br>10:00am – 3:30pm ET<br>10:00am – 1:00pm ET on FOMC Announcement Days<br>Not published on market half days<br><br>**When do signals expire?**<br>Expires when the 30 minute volume returns back to historical volume ranges |

| RSI Break | |
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| **Intro** | The Relative Strength Index (RSI), developed by J. Welles Wilder, is a momentum oscillator that measures the speed and change of price movements. The RSI oscillates between zero and 100. Traditionally the RSI is considered overbought when above 70 and oversold when below 30. Movements above the 30 level are viewed as a bullish indicator, while movements below the 70 level are considered a bearish indicator. |

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| **Computation** | Each second of the trading day, the 14 Day RSI is calculated and an alert will get published as soon as the RSI breaks above the 30 level or below the 70 level. The alerts will remain active and visible for the remainder of the trading day even though the RSI value may subsequently move back below 30 or back above 70 over the course of the trading day. |
| **Timing** | **When can I receive signals?**<br>9:30am – 4:00pm ET<br><br>**When do signals expire?**<br>4:00pm ET Daily |

| **Stochastic Break** | |
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| **Intro** | The Slow Stochastic Oscillator is a momentum indicator that shows the location of the close relative to the high-low range over a set number of periods. The indicator can range from 0 to 100.<br><br>The closing price tends to close near the high in an uptrend and near the low in a downtrend. If the closing price then slips away from the high or the low, then momentum is slowing. Stochastics are most effective in broad trading ranges or slow moving trends. Two lines are graphed, the slow oscillating %K and a moving average of %K, commonly referred to as %D.<br><br>The difference between the Slow and Fast Stochastic Oscillator is the Slow %K incorporates a %K slowing period of 3 that controls the internal smoothing of %K. Setting the smoothing period to 1 is equivalent to plotting the Fast Stochastic Oscillator. |
| **Computation** | Each second of the trading day, the Slow Stochastic %K is calculated and an alert will get published as soon as the %K line breaks above the 20 level or below the 80 level. The alerts will remain active and visible for the remainder of the trading day even though the Slow Stochastic %K value may subsequently move back below 20 or back above 80 over the course of the trading day. |
| **Timing** | **When can I receive signals?**<br>9:30am – 4:00pm ET<br><br>**When do signals expire?**<br>4:00pm ET Daily |

| **Bollinger Band Break** | |
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| **Intro** | Bollinger Bands are a type of price envelope developed by John Bollinger. (Price envelopes define upper and lower price range levels.) Bollinger Bands are envelopes plotted at a standard deviation level above and below a simple moving average of the price. Because the distance of the bands is based on standard deviation, they adjust to volatility swings in the underlying price.<br><br>Bollinger Bands use 2 parameters, Period and Standard Deviations, StdDev. The default values are 20 for period, and 2 for standard deviations, although you may customize the combinations. |

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| | Bollinger bands help determine whether prices are high or low on a relative basis. They are used in pairs, both upper and lower bands and in conjunction with a moving average. Further, the pair of bands is not intended to be used on its own. Use the pair to confirm signals given with other indicators. |
| **Computation** | Each second of the trading day, the upper and lower Bollinger Bands are calculated and an alert will get published as soon as the stock price breaks above or below one of the bands. Alerts are triggered when the stock price closes the previous day inside the bands and breaks out to the upside or downside. Alerts are also published when the stock price closes the day outside of the Bollinger Bands and breaks back into the bands intraday. The alerts will remain active and visible for the remainder of the trading day even though the stock price can subsequently move back inside or outside of the Bollinger Bands over the course of the trading day. |
| **Timing** | **When can I receive signals?**<br>9:30am – 4:00pm ET<br><br>**When do signals expire?**<br>4:00pm ET Daily |

| **MACD Crossover** | |
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| **Intro** | The Moving Average Convergence/Divergence indicator is a momentum oscillator primarily used to trade trends. Although it is an oscillator, it is not typically used to identify over bought or oversold conditions. It appears on the chart as two lines which oscillate without boundaries. The crossover of the two lines give trading signals similar to a two moving average system. |
| **Computation** | Each second of the trading day, the MACD line and Signal line is calculated and an alert will get published as soon as the MACD line crosses above or below the Signal line. The alerts will remain active and visible for the remainder of the trading day even though the MACD line value may subsequently move back above or below the Signal line over the course of the trading day. |
| **Timing** | **When can I receive signals?**<br>9:30am – 4:00pm ET<br><br>**When do signals expire?**<br>4:00pm ET Daily |

| **ADX Crossover** | |
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| **Intro** | The Directional Movement Index (DMI) assists in determining if a security is trending and attempts to measure the strength of the trend. The DMI disregards the direction of the security. It only attempts to determine if there is a trend and that trends strength.<br><br>The indicator is made up of four indicator lines:<br>1. Positive Directional Indicator (+DMI) shows the difference between today's high price and yesterday's high price. These values are then added up from the past 14 periods and then plotted.<br>2. Negative Directional Indicator (–DMI) shows the difference between today's low price and |

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| | yesterday's low price. These values are then summed up from the past 14 periods and plotted.<br>3. Average Directional Movement Index (ADX). ADX is a smoothing of the DX.<br>4. Average Directional Movement Index Rating (ADXR) is a simple average of today's ADX value and the ADX from 14 periods ago. |
| **Computation** | Each second of the trading day, the DI+ and DI- values are calculated and an alert will get published as soon as the DI+ and DI- lines cross. The alerts will remain active and visible for the remainder of the trading day even though the DI+ and DI- values may subsequently move back above or below over the course of the trading day. |
| **Timing** | **When can I receive signals?**<br>9:30am – 4:00pm ET<br><br>**When do signals expire?**<br>4:00pm ET Daily |

| **SMA Crossover** | |
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| **Intro** | Moving averages are one of the core indicators in technical analysis, and there are a variety of different versions. Simple Moving Average (SMA) is the easiest moving average to construct. It is simply the average price over the specified *period*. The average is called "moving" because it is plotted on the chart bar by bar, forming a line that moves along the chart as the average value changes. One SMA crossing another SMA is a common trading signal. For example, when a shorter period SMA crosses above a longer period SMA, it may be considered a bullish indicator or it may be considered a bearish indicator when the short-term SMA crosses below the long-term SMA. |
| **Computation** | Each second of the trading day, the Simple Moving Averages will be calculated and an alert will get published as soon as the shorter term SMA crosses above or below the longer term SMA. The alerts will remain active and visible in the tool for the remainder of the day even though the SMA values may subsequently move in the opposite direction. |
| **Timing** | **When can I receive signals?**<br>9:30am – 4:00pm ET<br><br>**When do signals expire?**<br>4:00pm ET Daily |

| **Market Divergence** | |
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| **Intro** | A market divergence signal alert is activated when the return of a stock diverges from the return of a market index-tracking ETF. The following table shows the broad market indices and the ETFs we consider in our computations. Stocks are assigned to the Index ETFs for comparison purposes using the following market hierarchy. |

| **Market Index** | **ETF** |
|---|---|
| NASDAQ 100 | QQQ |
| S&P 500 | SPY |

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| | <table><tr><td>RUSSELL 1000</td><td>IWB</td></tr><tr><td>RUSSELL 2000</td><td>IWM</td></tr><tr><td>RUSSELL 3000</td><td>IWV</td></tr></table> |
| **Computation** | Each second of a trading day, the mid-quote of the stock is compared with price bands generated by using an exponentially-weighted moving average of the stock price, the return of the relevant market index ETF, correlation coefficient, "Beta", between the stock and relevant ETF, and historical ranges of "excess return" of the stock relative to the ETF. An alert is generated when the stock is quoted outside of the bands, which represent the top and bottom percentile of the excess return ranges, based on 30 days of trading history. Factors such as market volatility and mis-quotes could trigger signal alerts.<br><br>For each stock, the correlation coefficient, "Beta", is calculated by regressing the return of the stock against the return of the ETF, using 30 days of price data.<br><br>Excess return for each stock relative to market index is calculated as the return difference between the stock and the beta-adjusted ETF return. Historical ranges of excess return are calculated based on 30 days of trading history, and are time-of-day specific (i.e. market open is different from mid-day, which is different from market close). |
| **Timing** | **When can I receive signals?**<br>10:00am – 3:30pm ET<br>10:00am – 1:00pm ET on FOMC Announcement Days<br>Not published on market half days<br><br>**When do signals expire?**<br>Expires 20 minutes from the time the alert was triggered. |

## Sector Divergence

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| **Intro** | A sector divergence signal alert is activated when the return of a stock diverges from the return of a sector index-tracking ETF. All stocks are mapped to a sector ETF based on GICS classification. The following table shows the sector-tracking ETFs we consider in our computations:<br><br><table><tr><th>Sector Index</th><th>ETF</th></tr><tr><td>Communication Services Select Sector SPDR Fund</td><td>XLC</td></tr><tr><td>Materials Select Sector SPDR Fund</td><td>XLB</td></tr><tr><td>Energy Select Sector SPDR Fund</td><td>XLE</td></tr><tr><td>Financial Select Sector SPDR Fund</td><td>XLF</td></tr><tr><td>Industrial Select Sector SPDR Fund</td><td>XLI</td></tr><tr><td>Technology Select Sector SPDR Fund</td><td>XLK</td></tr><tr><td>Consumer Staples Select Sector SPDR Fund</td><td>XLP</td></tr><tr><td>Utilities Select Sector SPDR Fund</td><td>XLU</td></tr><tr><td>Health Care Select Sector SPDR Fund</td><td>XLV</td></tr><tr><td>Consumer Discretionary Select Sector SPDR Fund</td><td>XLY</td></tr><tr><td>Vanguard REIT ETF</td><td>VNQ</td></tr></table> |
| **Computation** | Each second of a trading day, the mid-quote of the stock is compared with price bands generated by using an exponentially-weighted moving average of the stock price, the return of the relevant |

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| | sector ETF, correlation coefficient, "Beta", between the stock and relevant ETF, and historical ranges of "excess return" of the stock relative to the ETF. An alert is generated when the stock is quoted outside the bands, which represent the top and bottom percentile of the excess return ranges, based on 30 days of trading history. Factors such as market volatility and mis-quotes could trigger signal alerts.<br><br>For each stock, the correlation coefficient, "Beta", is calculated by regressing the return of the stock against the return of the ETF, using 30 days of price data.<br><br>Excess return for each stock relative to the sector ETF is calculated as the return difference between the stock and the beta-adjusted ETF return. Historical ranges of excess return are calculated based on 30 days of trading history, and are time-of-day specific (i.e. market open is different from mid-day, which is different from market close). |
| **Timing** | **When can I receive signals?**<br>10:00am – 3:30pm ET<br>10:00am – 1:00pm ET on FOMC Announcement Days<br>Not published on market half days<br><br>**When do signals expire?**<br>Expires 20 minutes from the time the alert was triggered. |

| **Trading Range** | |
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| **Intro** | A trading range signal alert is activated when the return of a stock diverges from its normal range. |
| **Computation** | Each second of a trading day, the mid-quote of the stock is compared with price bands generated by using an exponentially-weighted moving average of the stock price and historical ranges of return of the stock. An alert is generated when the stock is quoted outside the bands, which represent the top and bottom percentiles of the return distribution that is computed from 30 days of trading history. Factors such as market volatility and mis-quotes could trigger signal alerts.<br><br>Historical ranges of return are calculated based on 30 days of trading history, and are time-of-day specific (i.e. market open is different from mid-day, which is different from market close). |
| **Timing** | **When can I receive signals?**<br>10:00am – 3:30pm ET<br>10:00am – 1:00pm ET on FOMC Announcement Days<br>Not published on market half days<br><br>**When do signals expire?**<br>Expires 20 minutes from the time the alert was triggered. |

| **Corporate Events** | |
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| **Intro** | This intent of the alert is to help you identify potential opportunities for stocks that have |

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| | consistently generated positive returns during the period between the dividend announcement date and ex-dividend date. |
| **Computation** | The corporate event alert is generated when a new dividend announcement is made, and the last four dividend announcements were followed by a rise in the stock price between announcement date and ex-dividend date.<br><br>The alert will be triggered if each of the last four dividend announcements generated a positive return between dividend announcement and ex-dividend dates, and the average return for all four periods was at least 1%. The return calculation incorporates any dividends that were paid out. |
| **Timing** | **When can I receive signals?**<br>These alerts are published the morning after a dividend announcement when at least the last four dividend announcements were followed by a rise in the stock price.<br><br>**When do signals expire?**<br>These alerts will expire on the Ex-Dividend Date. |