

Matching Engine

ORDER TYPES & TIME-IN-FORCE
SUPPORTED



**FUNDAMENTAL
INTERACTIONS**

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MATCHING ENGINE ORDER TYPES & TIME-IN-FORCE SUPPORT FUNCTIONALITY

At Fundamental Interactions, our state-of-the-art matching engine product is designed to support a wide variety of Time-in-Force (TIF) sessions tailored to different trading sessions, including Pre-Trading (8:00 AM to 9:30 AM), Core Market Hours (9:30 AM to 4:00 PM), After-Hours Session (4:00 PM to 8:00 PM), and Overnight Trading Session (8:00 PM to 4:00 AM or 8:00 PM to 8:00 AM). This flexibility allows market participants to execute trades efficiently and strategically throughout the trading day and night. Our matching engine accommodates an extensive range of order types, including Market Orders, Limit Orders, Reserve Orders, Hidden Orders, and advanced types like TWAP (Time Weighted Average Price) and Random TWAP. By integrating diverse TIF instructions and comprehensive order types, Fundamental Interactions ensures optimal trade execution, liquidity, and market integrity, catering to the complex needs of modern trading environments.

TIME-IN-FORCE (TIF) INSTRUCTIONS

DAY ORDER (DAY)

A regular Day order (DAY) is only executable during the normal trading session, from 9:30 AM to 4:00 PM. On shortened market trading days, a DAY order will be executable between 9:30 AM and 1:00 PM.

- **Entry Times:** DAY orders can be entered starting at 6:00 AM.
- **Processing:** DAY orders received prior to 9:30 AM are held and processed at 9:30 AM. All DAY orders received after normal operating hours are rejected.
- **Expiration:** DAY orders expire at the end of the normal trading session.

EXTENDED DAY ORDER (GTX/DAYX) AND GOOD TILL CANCEL ORDER (GTC)

An extended Day order (GTX, also known as DAYX) and a modified Good Till Cancel order (GTC) are executable within the selected P1, P2, and P3 trading sessions from 8:00 AM to 5:00 PM. On shortened market trading days, the operating hours for GTX and GTC orders are from 8:00 AM to 2:00 PM.

- **Entry Times:** GTX and GTC orders can be entered starting at 6:00 AM.
- **Processing:** GTX and GTC orders received prior to 8:00 AM are held and processed at 8:00 AM. All GTX or GTC orders received after extended operating hours are rejected.
- **Expiration:**
 - GTX orders expire at the end of the extended trading session.
 - GTC orders are canceled by the system at the end of the extended trading session.

TIME-IN-FORCE (TIF) INSTRUCTIONS

The following TIF instructions can be used to specify when the order is active:

- **P2:** Order active between 9:30 AM and 4:00 PM (similar to a Day order, expires at 4:00 PM).
- **P1 plus P2:** Order active between 8:00 AM and 4:00 PM (expires at 4:00 PM).
- **P2 plus P3:** Order active between 9:30 AM and 5:00 PM (expires at 5:00 PM).
- **P1 plus P2 plus P3 or no sessions specified:** Order active between 8:00 AM and 5:00 PM.

BEHAVIOR DURING TRADING SESSIONS

- **DAY Orders:** Executable during the normal trading session (9:30 AM - 4:00 PM), and on shortened days (9:30 AM - 1:00 PM).
- **GTX and GTC Orders:** Executable from 8:00 AM to 5:00 PM, and on shortened days (8:00 AM - 2:00 PM).

ORDER TYPE DESCRIPTIONS

MARKET MAKER ORDERS

- **Market Makers:** Order messages are directed to the Price/Time algorithm and are displayed as one-sided or two-sided bids and/or offers. Orders can also be entered as non-priced (bid=0, offer=0) as an indication of interest in the security.

LIMIT ORDER

- **Limit:** A limit order is an order to buy or sell a stock at a specific price or better. A buy limit order can only be executed at the limit price or lower, and a sell limit order can only be executed at the limit price or higher. A limit order can only be filled if the stock market price reaches the limit price.

MARKET ORDER

- **Market:** An order placed to buy or sell a set number of shares at an undetermined price, executed by the order book at the best available price.

RESERVE ORDER

- **Reserve:** The reserve order allows users to hide the full size of their order, potentially limiting its influence on prices. A reserve order is a limit order with a portion of the size displayed and the reserve portion not displayed. The reserve amount replenishes the displayed order size as executions are received, up to the total order quantity.

HIDDEN ORDERS

- **Hidden:** Orders can optionally be designated as fully hidden by setting the maximum display size to zero. These orders will be processed the same as normal limit orders until they are posted to the order book. Once posted, they will have no displayed size and will not contribute to the quote.

ATTRIBUTABLE, NON-ATTRIBUTABLE

- **Attributable and Non-Attributable for MPID:** The attributable option will display an order under the MPID of the market maker firm. The non-attributable option will display an order under the ATS MPID.

FILL OR KILL (FOK)

- A **Fill or Kill (FOK):** Order is a type of trading order that must be executed immediately in its entirety or not at all. If the order cannot be completely filled at the specified price (or better) at the time it is placed, it is canceled instantly.

PRIMARY PEG

- **Primary Peg:** order follows the best bid when buying a security and the best offer when selling a security.

MID-POINT PEG

- **Mid-Point Peg:** A pegged-to-midpoint order provides a means for traders to seek a price at the midpoint of the Best Bid and Offer (BBO). The price automatically adjusts to peg the midpoint as the markets move.

POST ONLY

- **Post Only:** A limit order to remain on the ATS and execute at the best possible price (up to the limit order price) without regard to displayed liquidity on away markets.

MINIMUM QUANTITY

- **Minimum Quantity:** Instruction that applies to a minimum executable size.

ALLOW PRICE SLIDING

- **Allow Price Sliding:** Orders can optionally include the Allow Price Sliding execution instruction. These orders will behave like 'Post Only on Order Entry' orders but will be displayed one tick¹ away from the opposite inside (i.e., one tick higher than the National Best Bid for a sell order or one tick lower than the National Best Offer for a buy order), if its limit price L/C's the opposite CBBO inside.

CROSS TRADE ORDER TYPE

- **Cross Trade Order Type:** refers to an order type where a broker facilitates a trade by matching a buy order and a sell order from different clients, or from the same client, within the same brokerage.

Price and Volume: The price at which the trade is executed must be within the current market price range to ensure fairness and market integrity. The volume of the buy and sell orders must match exactly for the cross trade to occur.

STOP & STOP LIMIT ORDER

- **Stop Order:** An order to buy or sell a security once its price surpasses a specified stop price. When the stop price is reached, a stop order becomes a market order and is executed at the best available price.
- **Stop Limit Order:** Similar to a stop order, but once the stop price is reached, the order becomes a limit order to buy or sell at a specified price (or better). This type ensures that the order is executed at the limit price or better, but it may not be filled if the limit price is not reached.

TRAILING STOP & TRAILING STOP LIMIT

- **Trailing Stop Order:** An order to buy or sell a security if it moves in an unfavorable direction by a specified percentage or dollar amount from its highest price reached since the order was placed. For a buy order, the stop price is set below the market price; for a sell order, it is set above.
- **Trailing Stop Limit Order:** Combines the features of a trailing stop order and a stop limit order. The stop price is adjusted as the market price moves favorably. Once the stop price is hit, the order becomes a limit order to buy or sell at the specified limit price (or better).

ONE CANCELS OTHER (OCO)

- **One Cancels Other (OCO) Order:** A pair of orders stipulating that if one order is executed, the other is automatically canceled. This type of order is often used to manage risk and ensure that only one of the two orders is executed. For example, an investor might place an OCO order with a limit order to sell a stock at a higher price and a stop order to sell the same stock if it falls to a lower price. When one of these orders is executed, the other is automatically canceled.

SMART ROUTER: SWEEP LIMIT AND SWEEP MARKET

- **Sweep Limit:** Begins with the inside price level as the starting price and continues until the limit price is reached, the order is no longer marketable, or the order is complete.
- **Sweep Market:** Similar to a Sweep Limit order, it keeps working at the current inside price (best bid, best offer) and exhausts the current inside price level before moving to the next level. It keeps working until filled, expired, or canceled.

SERIAL PING

- **Serial Ping Order:** This type of ping order sends small test orders to dark pools sequentially, one after another. The goal is to detect the presence of liquidity by gradually probing different dark pools to see where an order might be filled. This method helps to minimize market impact by breaking up a large order into smaller parts and executing them in a series.

PARALLEL PING

- **Parallel Ping Order:** Unlike the serial ping, a parallel ping order sends multiple small test orders to different dark pools simultaneously. This approach allows for a quicker detection of liquidity across multiple venues, providing a broader view of available trading opportunities at the same time. It can lead to faster execution but may increase the risk of market impact due to multiple simultaneous order entries.

AUTOMATIC PING

- **Automatic Ping Order:** An automatic ping order utilizes algorithmic trading strategies to continuously and automatically send small test orders to various dark pools based on predefined criteria. This type of order dynamically adjusts its probing based on market conditions and the feedback from previous pings. The automation helps optimize the search for liquidity without constant manual intervention, aiming for efficient and effective order execution in dark pools.

SELF-TRADE PREVENTION

- **Self-trade prevention (a.k.a. anti-internalization):** can be enabled on an order basis with execution instruction. Firms can optionally be configured for self-trade prevention for all their orders across the board or just all their orders on a given FIX session.

If the firm is configured for self-trade prevention for all their orders across the board or just all their orders on a given FIX session, the execution instruction does not need to be entered on any orders and will be ignored. If the firm is not configured for self-trade prevention for all their orders across the board or just all their orders on a given FIX session, the execution instruction is required on both the resting and incoming orders. If only one or neither order includes the execution instruction, the orders can match.

When enabled, the following cancel/reduce method will be used:

- If the size of the incoming order is less than the resting order, the incoming order will be canceled, and the resting order will be reduced by the size of the canceled incoming order.
- If the size of the incoming order is greater than the resting order, the resting order will be canceled, and the incoming order will be reduced by the size of the canceled resting order.
- If the size of the incoming order is the same as the resting order, both the incoming order and the resting order will be canceled.

INTERMARKET SWEEP ORDERS (ISO)

- **Intermarket Sweep Orders:** Orders can optionally include the ISO execution instruction. ISO orders will not be routed to external marketplaces and can trade through those marketplaces. ISO conveys that the firm has taken responsibility for sending orders directly

to the external marketplaces to access their better-priced liquidity. ISO orders cannot trade through posted OTC Link NQB IDQS orders.

Since an ISO order is treated as Immediate-Or-Cancel (IOC), the Time-in-Force (TIF) will be superseded by the ISO execution instruction. The ISO execution instruction also supersedes all other execution instructions.

SMART ROUTER: SWEEP LIMIT, MARKET

SWEEP LIMIT

- **Sweep Limit orders:** will always begin with the inside price level as the starting price. The Sweep Limit will continue until the limit price is reached, the order is no longer marketable, or the order is complete.

SWEEP MARKET

- **Sweep Market orders:** function similarly to Sweep Limit orders but will keep working at the current inside price (best bid and best offer). They will exhaust the current inside price level before moving on to the next level. Sweep Market orders will continue working until filled, expired, or canceled.

VIRTUAL CROSSING OF PASS-THROUGH ORDERS

- **Virtual Crossing:** order type has been designed to track orders sent to external market centers and look for internal crossing opportunities. Orders are pulled back and matched based on various rules.

The Virtual Crossing logic supports three basic rules for crossing:

1. **Basic Limit Order:**
 - Matched based on price/time.
2. **Market/Peggable Order:**
 - Matched based on the current NBBO, allowing for market/reverse/midpoint matching.
3. **Liquidity-Based Matching:**
 - Considers rebates on top of existing price matching rules. Options include:
 - Normal rebates based on time of arrival (provider/taker).
 - Liquidity provider only (where certain orders may not match due to both demanding liquidity rebates).
 - Disabling the crossing for a specific order.

This structure ensures optimal matching by dynamically adjusting to different order types and liquidity considerations, providing flexibility and efficiency in order execution.

OPENING CROSS

ON-OPEN-TIME-IN-FORCE

For securities enabled for the Opening Cross Auction, orders can optionally include the On Open order Time-In-Force (TIF) as "At the Open."

LIMIT ON OPEN (LOO) ORDERS

- **A Limit On Open (LOC):** order is designated by the Time-In-Force (TIF) and a specific price. LOO orders can be entered starting at the same time as DAY and extended DAY orders. At a configurable time before market open, typically 10 minutes (e.g., 9::20 am), LOO orders cannot be modified or canceled. After another configurable time, typically 2 minutes (e.g., 9:28 am), they can no longer be entered.

MARKET ON OPEN (MOC) ORDERS

- **A Market On Open (MOO):** order is designated by the Time-In-Force (TIF) and is treated as a market order. Any entered price will be ignored. MOO orders can be entered starting at the same time as DAY and extended DAY orders. At the same configurable time before market open as LOO orders, typically 10 minutes (e.g., 9:20 Am), MOO orders cannot be modified or canceled. After another configurable time, typically 5 minutes (e.g., 9:25 am), they can no longer be entered.

IMBALANCE ONLY (IO) ORDERS

- **An Imbalance Only (IO):** order is designated by the Time-In-Force (TIF) and a specific price, and is marked as Imbalance Only. IO orders cannot be entered at market price. IO orders can be entered starting at the same time as DAY and extended DAY orders and up through market open at 9:30 am. At the same configurable time before market open as LOO orders, typically 10 minutes (e.g.,9:20 am), IO orders cannot be modified or canceled. At market close, for the purposes of disseminated price values, any IO order priced more aggressively than its same-side inside (based on the NBBO) will be repriced to that inside price.

CLOSING CROSS

ON-CLOSE-TIME-IN-FORCE

For securities enabled for the Closing Cross Auction, orders can optionally include the On Close order Time-In-Force (TIF) as "At the Close."

LIMIT ON CLOSE (LOC) ORDERS

- **A Limit On Close (LOC):** order is designated by the Time-In-Force (TIF) and a specific price. LOC orders can be entered starting at the same time as DAY and extended DAY orders. At a configurable time before market close, typically 10 minutes (e.g., 3:50 pm), LOC orders cannot be modified or canceled. After another configurable time, typically 2 minutes (e.g., 3:58 pm), they can no longer be entered.

MARKET ON CLOSE (MOC) ORDERS

- **A Market On Close (MOC):** order is designated by the Time-In-Force (TIF) and is treated as a market order. Any entered price will be ignored. MOC orders can be entered starting at the same time as DAY and extended DAY orders. At the same configurable time before market close as LOC orders, typically 10 minutes (e.g., 3:50 pm), MOC orders cannot be modified or canceled. After another configurable time, typically 5 minutes (e.g., 3:55 pm), they can no longer be entered.

IMBALANCE ONLY (IO) ORDERS

- **An Imbalance Only (IO):** order is designated by the Time-In-Force (TIF) and a specific price, and is marked as Imbalance Only. IO orders cannot be entered at market price. IO orders can be entered starting at the same time as DAY and extended DAY orders and up through market close at 4:00 pm. At the same configurable time before market close as LOC orders, typically 10 minutes (e.g., 3:50 pm), IO orders cannot be modified or canceled. At market close, for the purposes of disseminated price values, any IO order priced more aggressively than its same-side inside (based on the CBBO) will be repriced to that inside price.

OTHER SPECIAL-ORDER TYPES

ORDER PROTECTION

TRADE-THROUGH

Trade-Through: The order protection mechanism checks for trade-through or locked markets before directing the order to the order book and cancels or reprices it if required.

1. OPR Re-Price: Orders designated as **OPR Re-Price** will prevent trade-through, cross, or locked markets by repricing the order based on the National Best Bid Offer (NBBO). OPR Re-Price can be enabled on all order flows through a gateway or on individual orders to prevent trade-through.

2. OPR Reject: Orders designated as **OPR Reject** will prevent trade-through, cross, or locked markets by canceling the order based on the National Best Bid Offer (NBBO). OPR Reject can be enabled on all order flows through a gateway or by individual orders to prevent trade-through.

GUARANTEED MINIMUM FILL (GMF)

- **Guaranteed Minimum Fill:** On their stock of responsibility Market Makers guarantee automatic one price fills at the NBBO for regular marketable client orders that include the GMF-Eligible tag set to Y and that are equal to or less than the GMF size when there is not enough volume in the order book book to fill the incoming GMF eligible order. The Market Makers guaranteed facility is available for eligible orders.

The orders in the book are eligible for fills before the designated Market Maker responsible for the stock auto trades with eligible orders up to the fill amount set for the stock.

The GMF size is set by size as agreed upon by the designated market maker.

- **Market Maker Participation (MMP):** is an optional feature that enables the Market Maker, for their stock of responsibility, to automatically trade passively up to 40% of all regular orders at the NBBO that are at or under the GMF volume set on the stock. Incoming orders will trade with the order book before trading with the Market Maker Participation.

If the volume of the incoming order is at or under the GMF volume but is greater than the displayed volume, there is no Market Maker Participation. GMF eligible orders are not affected by Market Maker Participation, and these orders continue to be guaranteed by the Market Maker at the best displayed price.

The Market Maker Participation feature is only available post-open between 9:30 AM ET and 4:00 PM ET.

The split between booked orders and the Market Maker will start with the first (100 shares) trading with the book. Incoming orders of less than two (200 shares) will therefore not be subject to Participation, as a 100 (1 board lot) share order will be sent to the book. Orders of 200 shares will be split: 100 to the book and 100 to the Market Make and etc. Participation Values: % of incoming orders buy/sell side, Participation Volume Buy/sell side, Participation On/off for buy or sell side, can be configured by Market Ops or by the Market Maker using Market Command through their FIX session.

TIME WEIGHTED AVERAGE PRICE (TWAP) ALGORITHM

- **The Time Weighted Average Price (TWAP):** algorithm is designed to execute an order over a specified timeframe based on a linear volume profile. This approach aims to minimize market impact by spreading the execution of the order evenly throughout the designated period.
- **Default Behavior:** The algorithm attempts to buy at the bid price and sell at the offer price. It adjusts its strategy to become more aggressive to ensure the complete execution of the order within the given timeframe. The goal is to balance the execution evenly from the order's start time to its end time.
- **Volume Limit Constraints:** The algorithm incorporates volume limit constraints, allowing users to reduce market impact. Users have control over the execution method, enabling them to adjust how aggressively the algorithm prices the orders. Any adjustments to the algorithm's execution strategy may increase the probability that the order will not be fully completed by its expiration time.

RANDOM TIME WEIGHTED AVERAGE PRICE (RANDOM TWAP)

- **Random TWAP:** algorithm adds a layer of randomness to the execution schedule, breaking the order into random time intervals and varying sizes while ensuring the entire order is executed within the overall scheduled timeframe.

Example:

- A non-randomized TWAP might send ten orders of 1,000 shares each at ten-second intervals over a period of 100 seconds.
- If the user sets the size randomization to 50%, each slice size will vary by $\pm 50\%$, resulting in slices ranging from 500 to 1,500 shares.
- Similarly, setting time randomization to 50% means intervals between slices will vary between 5 and 15 seconds.
- For a size randomization set to 30%, slice sizes will vary between 700 and 1,300 share

VERTICAL GRID (ORDER TYPES)

This grid provides a comprehensive overview of the order types and their supported Time-in-Force instructions, helping traders to understand which TIFs are applicable for each order type.

Order Type	DAY	GTC	IOC	GTX	P2	P1 + P2	P2 + P3	P1 + P2 + P3	FOK
Day Order (DAY)	✓				✓				
Extended Day Order (GTX/DAYX)				✓		✓	✓	✓	
Good Till Cancel Order (GTC)		✓				✓	✓	✓	
Market Maker Orders			✓						✓
Limit Order	✓	✓	✓	✓	✓	✓	✓	✓	✓
Market Order	✓		✓		✓				✓
Reserve Order	✓		✓		✓	✓	✓	✓	
Hidden Orders	✓	✓	✓		✓				
Attributable Orders	✓	✓	✓		✓	✓	✓	✓	
Non-Attributable Orders	✓	✓	✓		✓	✓	✓	✓	
Primary Peg	✓		✓		✓				
Mid-Point Peg	✓		✓		✓				
Post Only	✓		✓		✓				
Minimum Quantity	✓	✓	✓		✓	✓	✓	✓	
Allow Price Sliding	✓	✓	✓		✓	✓	✓	✓	
Cross Trade Order	✓		✓		✓				
Stop Order	✓	✓			✓				
Stop Limit Order	✓	✓			✓				

Trailing Stop Order	✓	✓			✓				
Trailing Stop Limit Order	✓	✓			✓				
One Cancels Other (OCO) Order	✓	✓			✓				
Sweep Limit	✓		✓		✓				
Sweep Market	✓		✓		✓				
Serial Ping Order	✓		✓		✓				
Parallel Ping Order	✓		✓		✓				
Automatic Ping Order	✓		✓		✓				
Self-Trade Prevention	✓	✓			✓	✓	✓	✓	
ISO Orders	✓		✓		✓				
Virtual Crossing of Pass-Through Orders	✓	✓			✓	✓	✓	✓	
Opening Cross	✓				✓				
Limit On Open (LOO) Orders	✓				✓				
Market On Open (MOO) Orders	✓				✓				
Imbalance Only (IO) Orders	✓				✓				
Closing Cross	✓				✓				
Limit On Close (LOC) Orders	✓				✓				
Market On Close (MOC) Orders	✓				✓				
Order Protection	✓	✓	✓	✓	✓	✓	✓	✓	
Guaranteed Minimum Fill (GMF)	✓	✓			✓				
Market Maker Participation (MMP)	✓	✓	✓		✓	✓	✓	✓	
TWAP Algorithm	✓	✓		✓	✓	✓	✓	✓	
Random TWAP	✓	✓		✓	✓	✓	✓	✓	
Fill or Kill (FOK) Order									✓