Practice Note 8.2.1

Application of Market Phases and Algorithm

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~~1 August 2011~~ 15 August 2011	Rules 8.2.1 – 8.2.3	Please contact Market Control:- Telephone No: ~~6236 8840~~ 6236 8820

1   INTRODUCTION

1.1   This Practice Note explains the application of the various market phases and the algorithm used by SGX-ST in computing the single price for the Opening Routine, Closing Routine and Adjust Phase.

1.2   Rule 8.2.1 says the trading hours and the application of the market phases are as published by SGX-ST.

1.3   Rule 8.2.2 says SGX-ST may vary the trading hours and application of the market phases.

1.4   Rule 8.2.3 sets out the various market phases.

2   APPLICATION OF MARKET PHASES

2.1   Summary of Market Phases

(1)   Normal Day Trading

08.30	08.59	09.00		17.00	17. 05	17.06
Pre-Open	Non-Cancel	Trading		Pre-Close	Non-Cancel	
Opening Routine				Closing Routine		

(2)   Half-Day Trading

08.30	08.59	09.00	12.30	12. 35	12.36
Pre-Open	Non-Cancel	Trading	Pre-Close	Non-Cancel	
Opening Routine			Closing Routine		

2.2   Opening Routine

(1)   The Opening Routine is a 30-minute session before normal trading starts at 09:00 hours. It comprises the Pre-Open Phase and the Non-Cancel Phase.

(2)   Pre-Open Phase (08:30 to 08:59 hours)

(a)   Orders can be entered, reduced in quantity or withdrawn in the ready and unit share markets.

(b)   Order quantity cannot be undisclosed in the ready market.

      (c)   The bid (offer) can be higher (lower) than the offer (bid).

      (d)   No matching of orders.

(3)   <u>Non-Cancel Phase (08:59 to 09:00 hours)</u>

      (a)   No input, amendment and withdrawal of orders.

      (b)   Orders that can be matched are matched at a single price computed based on an algorithm set by SGX-ST. The computed price will be the opening price for the day.

      (c)   Unmatched orders are carried forward into the morning trading session.

2.3 Trading Phase

(1)   The Trading Phase will be from 09:00 to 17:00 hours.

(2)   The Trading Phase allows order entry, reduction in order size and withdrawal of orders. Orders are matched in the order of price priority followed by time priority.

(3)   All unmatched orders after the Trading Phase are carried forward to the Closing Routine.

2.4 Adjust Phases

(1)   An Adjust Phase operates upon the lifting of a suspension of a security or Futures Contract. A trading halt operates in the same way as an Adjust Phase.

(2)   Upon Lifting of a Suspension

      (a)   The Adjust Phase sets in for 15 minutes. A longer time can be specified.

      (b)   Orders can be entered, reduced in quantity or withdrawn for the ready and unit share markets.

      (c)   Order quantity can be undisclosed in the ready market (subject to a minimum of 50,000 disclosed quantity).

      (d)   The bid (offer) can be higher (lower) than the offer (bid).

      (e)   Orders that can be matched will be matched at the end of the Adjust Phase at a single price computed based on an algorithm set by SGX-ST before normal trading resumes. Unmatched orders at the end of the Adjust Phase are carried forward into the phase of the market applicable when the Adjust Phase ends.

      (f)   However, this behaviour does not apply when the end of Adjust Phase coincides with the Opening Routine or Closing Routine. In these circumstances, orders entered are carried forward into and matched accordingly in the respective Opening Routine or Closing Routine.

(3)   During a Trading Halt

      (a)   Existing orders remain valid.

      (b)   Orders can be entered, reduced in quantity or withdrawn in the ready and unit share markets.

      (c)   Order quantity can be undisclosed in the ready market (subject to a minimum of 50,000 disclosed quantity).

      (d)   The bid (offer) can be higher (lower) than the offer (bid).

(e)   Orders that can be matched will be matched at the end of the trading halt at a single price computed based on an algorithm set by SGX-ST.

(f)   Unmatched orders are carried forward into the phase applicable to the market at the time of lifting of trading halt.

(g)   If the trading halt is not lifted by the end of a Market Day, all unmatched orders lapse.

2.5   **Closing Routine**

(1)   The Closing Routine is a 6-minute session after trading stops at 17:00 hours for normal day trading, or 12:30 hours for half-day trading. It comprises the Pre-Close Phase and the Non-Cancel Phase.

(2)   All unmatched orders are carried forward to the Closing Routine at 17:00 hours (for normal day trading) or 12:30 hours (for half-day trading).

(3)   Pre-Close Phase (17:00 to 17:05 hours/12:30 to 12:35 hours)

(a)   Orders can be entered, reduced in quantity or withdrawn in the ready and unit share markets.

(b)   Order quantity cannot be undisclosed in the ready market.

(c)   The bid (offer) can be higher (lower) than the offer (bid).

(d)   No matching of orders.

(4)   Non-Cancel Phase (17:05 to 17:06 hours/12:35 to 12:36 hours)

(a)   No input, amendment and withdrawal of orders.

(b)   Orders that can be matched are matched at a single price computed based on an algorithm set by SGX-ST. The computed price will be the closing price for the day.

(c)   All unmatched orders lapse.

(5)   This routine is designed to reduce the risk of manipulating closing prices with a single transaction at an unusually high or low price, just before the trading session ends.

3   **ALGORITHM USED BY SGX-ST TO COMPUTE THE SINGLE PRICE AT WHICH ORDERS AT THE END OF THE OPENING ROUTINE, CLOSING ROUTINE AND ADJUST PHASE ARE MATCHED**

3.1   The methodology for computing the single price at which orders at the end of the Opening Routine, Closing Routine and Adjust Phase are matched ("Equilibrium Price") is as follows[1]:-

(1)   The Equilibrium Price is the price that has the largest tradable volume and the lowest imbalance. "Imbalance" refers to the net difference between the cumulative bid volume and cumulative ask volume. See Example 1.

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[1] The examples shown are not exhaustive.

Example 1

Bid Volume	Price	Ask Volume	Cumulative Bid Volume (a)	Cumulative Ask Volume (b)	Tradable Volume	Imbalance (a)-(b)	Pressure
0	3.750	10	340	10	10	330	Buy
0	3.760	20	340	30	30	310	Buy
50	3.770	50	340	80	80	260	Buy
100	3.780	80	290	160	160	130	Buy
70	3.790	30	190	190	190	0	Nil
30	3.800	40	120	230	120	70	Sell
90	3.810	20	90	250	90	160	Sell

In this example, the Equilibrium Price is $3.790 where the tradable volume is the largest and the imbalance is the lowest. If the highest tradable volume occurs at more than one price the algorithm will then consider imbalance, see sub-paragraph (2).

(2)   If the highest tradable volume occurs at more than one price the Equilibrium Price is the price with the lowest imbalance. See Example 2.

Example 2

Bid Volume	Price	Ask Volume	Cumulative Bid Volume (a)	Cumulative Ask Volume (b)	Tradable Volume	Imbalance (a)-(b)	Pressure
0	3.750	10	340	10	10	330	Buy
0	3.760	20	340	30	30	310	Buy
50	3.770	50	340	80	80	260	Buy
100	3.780	110	290	190	190	100	Buy
70	3.790	20	190	210	190	20	Sell
30	3.800	40	120	250	120	130	Sell
90	3.810	20	90	270	90	180	Sell

In this example, the Equilibrium Price is $3.790 where the tradable volume is the largest (190) and the imbalance is the lowest (20). If the highest tradable volume and lowest imbalance occur at more than one price the algorithm will then consider market pressure, see sub-paragraph (3).

(3)   If the highest tradable volume and lowest imbalance occur at more than one price ("the price overlap") the Equilibrium Price is determined by market pressure:

(a)   with only buy pressure within the price overlap, the Equilibrium Price is the highest price within the price overlap, or

(b)   with only sell pressure within the price overlap, the Equilibrium Price is the lowest price within the price overlap. See Example 3.

Buy (sell) pressure occurs when the cumulative bid (offer) volume is greater than the cumulative offer (bid) volume at a particular price.

Example 3

Bid Volume	Price	Ask Volume	Cumulative Bid Volume (a)	Cumulative Ask Volume (b)	Tradable Volume	Imbalance (a)-(b)	Pressure
0	3.750	10	260	10	10	250	Buy
0	3.760	20	260	30	30	230	Buy
50	3.770	50	260	80	80	180	Buy
0	3.780	110	210	190	190	20	Buy
90	3.790	0	210	190	190	20	Buy
30	3.800	40	120	230	120	110	Sell
90	3.810	20	90	250	90	160	Sell

In this example there is only buy pressure in price overlap, the Equilibrium Price is $3.790 which is the highest price in the price overlap.

(4)   If the highest tradable volume and lowest imbalance occur at more than one price and there is both buy and sell pressure or nil pressure within the price overlap, the Equilibrium Price is:

(a)   the price within the price overlap that is the closest to the last traded price, or

(b)   where there is no last traded price, the lowest price within the price overlap. See Example 4.

Example 4

Bid Volume	Price	Ask Volume	Cumulative Bid Volume (a)	Cumulative Ask Volume (b)	Tradable Volume	Imbalance (a)-(b)	Pressure
0	3.750	10	260	10	10	250	Buy
0	3.760	20	260	30	30	230	Buy
50	3.770	50	260	80	80	180	Buy
0	3.780	130	210	210	210	0	Nil
90	3.790	0	210	210	210	0	Nil
30	3.800	40	120	250	120	130	Sell
90	3.810	20	90	270	90	180	Sell

In this example, assuming that the last traded price was $3.800, the Equilibrium Price is $3.790.

(1)   A bid (offer) may be executed at a lower (higher) price.

(2)   The cumulative bid (offer) volume at any price is the bid (offer) quantity at that price plus the sum of bid (offer) quantities at all higher (lower) prices.

(3)   Sell (buy) pressure occurs when the cumulative offer (bid) volume is greater than the cumulative bid (offer) volume at a particular price. Zero pressure occurs when the cumulative offer volume is equal to the cumulative bid volume at a particular price.

(4)   The tradable volume at any price is the lower of the cumulative bid or offer volume.

(5)   The price overlap is the range of prices where tradable volumes are possible.

(6) ~~The equilibrium is the price range within the price overlap where buy pressure changes to sell pressure (see Example 1). The computed price is either one of the following:-~~

~~(a) The price within the equilibrium that has the largest trade volume, or~~

~~(b) If there is no unique price, the average of all prices within the equilibrium with the maximum trade volume, or~~

~~(c) The average is rounded to the next multiple of the minimum price multiple for this security or Futures Contract in the direction of the last traded price, or[2]~~

~~(d) If there is no last traded price, the average price is rounded to the next lower price multiple.~~

(7) ~~If there is only buy or sell pressure within the price overlap (see Example 2), the computed price will be one of the following:-~~

~~(a) With only buy pressure within the price overlap, the highest price within the overlap with a non-zero trade volume, or~~

~~(b) With only sell pressure within the price overlap, the lowest price within the overlap with a non-zero trade volume.~~

(8) ~~If there is zero buy and sell pressure within the price overlap (see Example 3), the computed price will be one of the following:-~~

~~(a) The simple average of the highest and the lowest price within the overlap of zero pressure, or~~

~~(b) If the price average is not the correct multiple, the average is rounded to the next multiple in the direction of the last traded price, or~~

~~(c) If there is no last traded price, the average price is rounded to the next lower price multiple.~~

(9) ~~If the buy pressure and sell pressure are separated by a range of prices within the price overlap with zero pressure (see Example 4), the computed price will be one of the following:-~~

~~(a) The simple average of the highest and the lowest prices within the overlap of zero pressure, or~~

~~(b) If the price average is not the correct multiple, the average is rounded to the next multiple in the direction of the last traded price, or~~

~~(c) If there is no last traded price, the average price is rounded to the next lower price multiple.~~

3.2 ~~The following examples demonstrate how the single price is determined. However, the examples shown are not exhaustive.~~

~~Example 1~~

~~Cumulative Bid Volume~~	~~Bid Qty~~	~~Price $~~	~~Offer Qty~~	~~Cumulative Offer Volume~~	~~Buy/Sell Pressure~~	~~Tradable Volume~~
~~-~~	~~-~~	~~10.80~~	~~22~~	~~101~~	~~-~~	~~-~~

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[2] Revised, effective 3 April 2008. Circular No. GM/74/2008 (20 March 2008).

2	2	10.70	41	79	S	2
18	16	10.60	20	38	S	18
40	22	10.50	14	18	B	18
78	38	10.40	2	4	B	4
167	89	10.30	2	2	B	2
267	100	10.20	-	-	-	-

In this example, trades are possible at prices between $10.30 and $10.70. However, the buy pressure changes to sell pressure from $10.50 to $10.60. Since the same number of trades can be executed at both prices, the computed price is either $10.50 or $10.60, depending on which price is closer to the last traded price.

Example 2

Cumulative Bid Volume	Bid Qty	Price $	Offer Qty	Cumulative Offer Volume	Buy/Sell Pressure	Tradable Volume
-	-	0.345	-	5	-	-
-	-	0.320	-	5	-	-
16	16	0.310	-	5	B	5
16	-	0.305	-	5	B	5
16	-	0.300	5	5	B	5
16	-	0.255	-	-	-	-
26	10	0.250	-	-	-	-

In this example, trades are possible at prices between $0.300 and $0.310. Buy pressure from $0.300 to $0.310. The computed price is $0.310, the highest price within the overlap with a non-zero trade volume.

Example 3

Cumulative Bid Volume	Bid Qty	Price $	Offer Qty	Cumulative Offer Volume	Buy/Sell Pressure	Tradable Volume
-	-	0.440	5,000	11,000	-	-
-	-	0.435	2,000	6,000	-	-
4,000	4,000	0.430	-	4,000	-	4,000
4,000	-	0.425	-	4,000	-	4,000
4,000	-	0.420	-	4,000	-	4,000
4,000	-	0.415	-	4,000	-	4,000
4,000	-	0.410	-	4,000	-	4,000
4,000	-	0.405	4,000	4,000	-	4,000
7,000	3,000	0.400	-	-	-	-

In this example, trades are possible at prices from $0.405 to $0.430, where there is neither a buy nor a sell pressure. The computed price would be $(0.405 + 0.430) / 2 =

~~$0.4175; since this does not fall under the correct multiple, it will be rounded to the next multiple in the direction of the last traded price.~~

~~Example 4~~

~~Cumulative Bid Volume~~	~~Bid Qty~~	~~Price $~~	~~Offer Qty~~	~~Cumulative Offer Volume~~	~~Buy/Sell Pressure~~	~~Tradable Volume~~
~~-~~	~~-~~	~~0.440~~	~~5,000~~	~~11,000~~	~~-~~	~~-~~
~~-~~	~~-~~	~~0.435~~	~~2,000~~	~~6,000~~	~~-~~	~~-~~
~~1,000~~	~~1,000~~	~~0.430~~	~~-~~	~~4,000~~	~~S~~	~~1,000~~
~~4,000~~	~~3,000~~	~~0.425~~	~~-~~	~~4,000~~	~~-~~	~~4,000~~
~~4,000~~	~~-~~	~~0.420~~	~~-~~	~~4,000~~	~~-~~	~~4,000~~
~~4,000~~	~~-~~	~~0.415~~	~~-~~	~~4,000~~	~~-~~	~~4,000~~
~~4,000~~	~~-~~	~~0.410~~	~~-~~	~~4,000~~	~~-~~	~~4,000~~
~~5,000~~	~~1,000~~	~~0.405~~	~~3,000~~	~~4,000~~	~~B~~	~~4,000~~
~~5,000~~	~~-~~	~~0.400~~	~~1,000~~	~~1,000~~	~~B~~	~~1,000~~
~~8,000~~	~~3,000~~	~~0.395~~	~~-~~	~~-~~	~~-~~	

~~In this example, trades are possible at prices from $0.400 to $0.430. The buy pressure is separated from the sell pressure by a range of prices without pressure, i.e. between $0.410 and $0.425. The computed price would be $(0.410 + 0.425) / 2 = $0.4175; since this does not fall under the correct multiple, it will be rounded to the next multiple in the direction of the last traded price.~~

Key:
Blue, <u>underlined</u>:   Additions
Blue, ~~strucktrhough~~:   Deletions