Application Note

Calculation of Maximum time for flying start

The measurement is based on the time constant for the motor T_S . T_S can be calculated from R_S and L_S for the motor: $T_S = L_S / R_S$. (The stray inductively is considered part of L_S).

The following table gives T_S for the motor with corresponding nominal VLT size:

VLT	5001	5002	5003	5004	5005	5006	5008	5011	5016	5022	5027
kW_{motor}	0,75	1,1	1,5	2,2	3	4	5,5	7,5	11	15	18,5
T_S [sec]	0,07	0,10	0,10	0,15	0,12	0,17	0,2	0,26	0,28	0,35	0,45

VLT	5032	5042	5052	5060	5075	5100	5125	5150	5200	5250
kW_{motor}	22	30	37	45	55	75	90	110	132	160
T_S [sec]	0,49	0,64	0,70	0,80	0,74	0,87	1,06	1,53	1,56	1,46

1. First a 10 Hz is sent to the motor in order to determine the RPM direction, and the peak current is measured at the same time. This event takes about $2xT_S$.

2. Then a magnetising current is adjusted to the right value, at the search frequency. This event also takes about $2xT_S$.

3. A search for the motor frequency is now started from the max. ref. frequency +10%. Either a course search of 0,1 Hz / per sample or a fine search of 0,025 Hz / per sample is initiated. Each sample time is approximately 0,002 sec.
If the peak current as detected under point 1. is high, then the course search is used; but as the search frequency is close to the motor frequency, then the current is lower and the fine search is initiated, this is also the case if the frequency is below 5 Hz.
The search time is therefore dependent of the motor frequency and peak current.
(If only one direction is selected in parameter 200, then the output RPM can only be in one direction, and if this direction is scanned without finding a motor frequency, then a DC brake-current is applied according to the setting in parameter 125/126.

If both directions have been selected in parameter 200, then the scan will be done first for the direction found in 1., and then in the other direction, if the first has failed. (No DC brake is applied after double scan).
The search time is therefore also dependent of selection in parameter 200, and whether the frequency was found during the first scan.

4. Adjustment time provides increase of the voltage to the motor under supervision of the current regulator, with the right frequency found under 3. This event takes about $1xT_S$.

Maximum time from flying start is initiated to the motor frequency starts to increase, is therefore:
$5 \times T_S + 2 \times$ (search time) $= 5 \times T_S + 2 \times ((1{,}10 \times F_{max}\text{ .ref })/0{,}025) \times 0{,}002) =$
$5 \times T_S + 2 \times (1{,}1 \times F_{max}$ ref. $\times\ 0{,}08)$.

See the calculation of maximum time for the following VLT/motor:
Maximum “catching” time for a VLT 5008 with corresponding 5,5 kW motor, programmed for running in both directions and max ref. of 50 Hz.

Maximum catch time = 5 x 0,2 + 2 x 1,1 x 50 x 0,08 = 1 + 8,8 = 9,8 sec.

Most likely the 10Hz has found the right direction and only one scan is needed, therefore decreasing the 8,8 sec to half = 4,4 sec., and only a small part of the time is used for the fine search, therefore further reducing the search time with 4. Search time is realistic 1,5 sec.
This brings a realistic catch time of about 2,5 sec.