MITSUBISHI ELECTRIC

700 series

INVERTER FR-A700-A1 INSTRUCTION MANUAL

Dancer Control Function

Tension Control Function

CONTENTS

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1 OUTLINE OF THE DEDICATED FUNCTIONS

The following dedicated functions for winding and unwinding machine are added to FR-A700 series standard inverter. In this supplementary instruction manual, specifications of the new functions are included. Refer to the FR-A700 Instruction Manuals for functions not explained in this supplementary instruction manual.

This product is useful when difference between minimum diameter and maximum diameter is great and when feeding speed is fast in winding machine with dancer roll.

The inverter torque is controlled by the tension control, inertia compensation and mechanical loss compensation. Thus, dancer rolls and tension controllers are not required to roll up a sheet of paper when using this product.

This product is also useful for wiredrawing machine and to roll up paper in a printer.

- Dancer control function
- Winding diameter compensation function
- Tension control function

The following table shows valid control methods for each function.

Function	Vector Control			Real Sensorless Vector Control			Advanced Magnetic Flux Vector Control	V/F Control
	Speed Control	Torque Control	Tension control (Torque Control)	Speed Control	Torque Control	Tension control (Torque Control)		
Pr.800 **setting**	**0, 2**	**1, 2**	**6**	**10, 12**	**11, 12**	**16**	**20**	**20**
Dancer control	○	×	×	○	×	×	○	○
Winding diameter compensation function	○	×	○	○	×	○	○	○
Tension Control	×	×	○	×	×	○	×	×

○: available, ×: unavailable

Inverters with dancer control function, winding diameter compensation function and tension control function are indicated with "-A1" at the end of their model names.

[Example]

FR-A720-1.5K-A1 — Inverters with dancer control function, winding diameter compensation function and tension control function (for every capacity)

2 PARAMETER LIST

Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel (FR-DU07). For the parameters not described in this Instruction Manual, refer to *the Instruction Manual of FR-A700 series*.

REMARKS

- The shaded parameters in the table allow their settings to be changed during operation even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.
- Refer to the *page 76* for instruction codes for communication and availability of parameter clear, all clear, and parameter copy of each parameter.

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
0	Torque boost	0 to 30%	0.1%	6/4/3/2/1% *1	—	
1	Maximum frequency	0 to 120Hz	0.01Hz	120/60Hz *2	—	
2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	—	
3	Base frequency	0 to 400Hz	0.01Hz	60Hz	—	
4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	—	
5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	—	
6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	—	
7	Acceleration time	0 to 3600/360s	0.1/0.01s	5/15s *3	—	
8	Deceleration time	0 to 3600/360s	0.1/0.01s	5/15s *3	—	
9	Electronic thermal O/L relay	0 to 500/0 to 3600A *2	0.01/0.1A *2	Rated inverter current	—	
10	DC injection brake operation frequency	0 to 120Hz, 9999	0.01Hz	3Hz	—	
11	DC injection brake operation time	0 to 10s, 8888	0.1s	0.5s	—	
12	DC injection brake operation voltage	0 to 30%	0.1%	4/2/1% *4	—	
13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	—	
14	Load pattern selection	0 to 5	1	0	—	
15	Jog frequency	0 to 400Hz	0.01Hz	5Hz	—	
16	Jog acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	0.5s	—	
17	MRS input selection	0, 2, 4	1	0	—	
18	High speed maximum frequency	120 to 400Hz	0.01Hz	120/60Hz *2	—	
19	Base frequency voltage	0 to 1000V, 8888, 9999	0.1V	9999	—	
20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	—	
21	Acceleration/deceleration time increments	0, 1	1	0	—	
22	Stall prevention operation level	0 to 400%	0.1%	150%	—	
23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999	0.1%	9999	—	
24 to 27	Multi-speed setting (4 speed to 7 speed)	0 to 400Hz, 9999	0.01Hz	9999	—	
28	Multi-speed input compensation selection	0, 1	1	0	—	
29	Acceleration/deceleration pattern selection	0 to 5	1	0	—	
30	Regenerative function selection	0, 1, 2, 10, 11, 20, 21	1	0	—	
31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	—	
32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	—	
33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	—	
34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	—	
35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	—	
36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	—	
37	Speed display	0, 1 to 9998	1	0	—	
41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	—	
42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	—	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	—	
44	Second acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	5s	—	
45	Second deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	—	
46	Second torque boost	0 to 30%, 9999	0.1%	9999	—	
47	Second V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	—	
48	Second stall prevention operation current	0 to 220%	0.1%	150%	—	
49	Second stall prevention operation frequency	0 to 400Hz, 9999	0.01Hz	0Hz	—	
50	Second output frequency detection	0 to 400Hz	0.01Hz	30Hz	—	
51	Second electronic thermal O/L relay	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A *2	9999	—	
52	DU/PU main display data selection	0, 5 to 14, 17, 18, 20, 21, 23 to 27, 32 to 35, 39 to 46, 52 to 57, 62 to 65, 100	1	0	*49*	
54	FM terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 39 to 44, 46	1	1	*49*	
55	Frequency monitoring reference	0 to 400Hz	0.01Hz	60Hz	—	
56	Current monitoring reference	0 to 500/0 to 3600A *2	0.01/0.1A *2	Rated inverter current	—	
57	Restart coasting time	0, 0.1 to 5s, 9999/ 0, 0.1 to 30s, 9999*2	0.1s	9999	—	
58	Restart cushion time	0 to 60s	0.1s	1s	—	
59	Remote function selection	0, 1, 2, 3	1	0	—	
60	Energy saving control selection	0, 4	1	0	—	
61	Reference current	0 to 500A, 9999/ 0 to 3600A, 9999*2	0.01/0.1A *2	9999	—	
62	Reference value at acceleration	0 to 220%, 9999	0.1%	9999	—	
63	Reference value at deceleration	0 to 220%, 9999	0.1%	9999	—	
64	Starting frequency for elevator mode	0 to 10Hz, 9999	0.01Hz	9999	—	
65	Retry selection	0 to 5	1	0	—	
66	Stall prevention operation reduction starting frequency	0 to 400Hz	0.01Hz	60Hz	—	
67	Number of retries at fault occurrence	0 to 10, 101 to 110	1	0	—	
68	Retry waiting time	0 to 10s	0.1s	1s	—	
69	Retry count display erase	0	1	0	—	
70	Special regenerative brake duty	0 to 30%/0 to 10% *2	0.1%	0%	—	
71	Applied motor	0, 1, 3 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54	1	0	—	
72	PWM frequency selection	0 to 15/0 to 6, 25 *2	1	2	—	
73	Analog input selection	0 to 7, 10 to 17	1	1	—	
74	Input filter time constant	0 to 8	1	1	—	
75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17	1	14	—	
76	Fault code output selection	0, 1, 2	1	0	—	
77	Parameter write selection	0, 1, 2	1	0	—	
78	Reverse rotation prevention selection	0, 1, 2	1	0	—	
79	Operation mode selection	0, 1, 2, 3, 4, 6, 7	1	0	—	
80	Motor capacity	0.4 to 55kW, 9999/ 0 to 3600kW, 9999 *2	0.01/0.1kW *2	9999	—	
81	Number of motor poles	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 9999	1	9999	—	
82	Motor excitation current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A *2	9999	—	
83	Rated motor voltage	0 to 1000V	0.1V	200/400V *5	—	
84	Rated motor frequency	10 to 120Hz	0.01Hz	60Hz	—	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
89	Speed control gain (advanced magnetic flux vector)	0 to 200%, 9999	0.1%	9999	—	
90	Motor constant (R1)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/0.01mΩ *2	9999	—	
91	Motor constant (R2)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/ 0.01mΩ *2	9999	—	
92	Motor constant (L1)	0 to 50Ω (0 to 1000mH), 9999/0 to 3600mΩ (0 to 400mH), 9999 *2	0.001Ω(0.1mH)/ 0.01mΩ(0.01mH) *2	9999	—	
93	Motor constant (L2)	0 to 50Ω (0 to 1000mH), 9999/0 to 3600mΩ (0 to 400mH), 9999 *2	0.001Ω(0.1mH)/ 0.01mΩ(0.01mH) *2	9999	—	
94	Motor constant (X)	0 to 500Ω (0 to 100%), 9999/0 to 100Ω (0 to 100%), 9999 *2	0.01Ω(0.1%)/ 0.01Ω(0.01%) *2	9999	—	
95	Online auto tuning selection	0 to 2	1	0	—	
96	Auto tuning setting/status	0, 1, 101	1	0	—	
110	Third acceleration/deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	—	
111	Third deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	—	
112	Third torque boost	0 to 30%, 9999	0.1%	9999	—	
113	Third V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	—	
114	Third stall prevention operation current	0 to 220%	0.1%	150%	—	
115	Third stall prevention operation frequency	0 to 400Hz	0.01Hz	0	—	
116	Third output frequency detection	0 to 400Hz	0.01Hz	60Hz	—	
117	PU communication station number	0 to 31	1	0	—	
118	PU communication speed	48, 96, 192, 384	1	192	—	
119	PU communication stop bit length	0, 1, 10, 11	1	1	—	
120	PU communication parity check	0, 1, 2	1	2	—	
121	Number of PU communication retries	0 to 10, 9999	1	1	—	
122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	9999	—	
123	PU communication waiting time setting	0 to 150ms, 9999	1	9999	—	
124	PU communication CR/LF selection	0, 1, 2	1	1	—	
125	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	—	
126	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	—	
127	PID control automatic switchover frequency	0 to 400Hz, 9999	0.01Hz	9999	—	
128	PID action selection	10, 11, 40, 41, 50, 51, 60, 61	1	40	*25*	
129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	*25*	
130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	*25*	
131	PID upper limit	400 to 600%, 9999	0.1%	9999	*29*	
132	PID lower limit	400 to 600%, 9999	0.1%	9999	*29*	
133	Target dancer position	400 to 600%, 9999	0.01%	500%	*27, 39*	
134	PID differential time	0.01 to 10.00s, 9999	0.01s	9999	*26*	
135	PID proportional band for under-set point value	0.1 to 1000%, 9999	0.1%	9999	*26*	
136	PID integral time for under-set point value	0.1 to 3600s, 9999	0.1s	9999	*26*	
137	PID differential time for under-set point value	0.01 to 10.00s, 9999	0.01s	9999	*26*	
138	Integral control presence/absence	0 to 3	1	0	*30*	
140	Backlash acceleration stopping frequency	0 to 400Hz	0.01Hz	1Hz	—	
141	Backlash acceleration stopping time	0 to 360s	0.1s	0.5s	—	
142	Backlash deceleration stopping frequency	0 to 400Hz	0.01Hz	1Hz	—	
143	Backlash deceleration stopping time	0 to 360s	0.1s	0.5s	—	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
144	Speed setting switchover	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110	1	4	—	
145	PU display language selection	0 to 7	1	0	—	
148	Stall prevention level at 0V input	0 to 220%	0.1%	150%	—	
149	Stall prevention level at 10V input	0 to 220%	0.1%	200%	—	
150	Output current detection level	0 to 220%	0.1%	150%	—	
151	Output current detection signal delay time	0 to 10s	0.1s	0s	—	
152	Zero current detection level	0 to 220%	0.1%	5%	—	
153	Zero current detection time	0 to 1s	0.01s	0.5s	—	
154	Voltage reduction selection during stall prevention operation	0, 1	1	1	—	
155	RT signal function validity condition selection	0, 10	1	0	—	
156	Stall prevention operation selection	0 to 31, 100, 101	1	0	—	
157	OL signal output timer	0 to 25s, 9999	0.1s	0s	—	
158	AM terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 39 to 44, 46	1	1	*49*	
160	User group read selection	0, 1, 9999	1	0	—	
161	Frequency setting/key lock operation selection	0, 1, 10, 11	1	0	—	
162	Automatic restart after instantaneous power failure selection	0, 1, 2, 10, 11, 12	1	0	—	
165	Stall prevention operation level for restart	0 to 220%	0.1%	150%	—	
166	Output current detection signal retention time	0 to 10s, 9999	0.1s	0.1s	—	
167	Output current detection operation selection	0, 1	1	0	—	
168	Parameter for manufacturer setting. Do not set.					
169						
170	Watt-hour meter clear	0, 10, 9999	1	9999	—	
171	Operation hour meter clear	0, 9999	1	9999	—	
172	User group registered display/batch clear	9999, (0 to 16)	1	0	—	
173	User group registration	0 to 999, 9999	1	9999	—	
174	User group clear	0 to 999, 9999	1	9999	—	
178	STF terminal function selection	0 to 14, 16 to 18, 20, 22 to 28, 30, 32 to 35, 42 to 44, 51 to 60, 62, 64 to 67, 70, 71, 83 to 93, 9999	1	60	*16*	
179	STR terminal function selection	0 to 14, 16 to 18, 20, 23 to 28, 30, 32 to 35, 42 to 44, 51 to 59, 61, 62, 64 to 67, 70, 71, 83 to 93, 9999	1	61	*16*	
180	RL terminal function selection	0 to 14, 16 to 18, 20, 23 to 28, 30, 32 to 35, 42 to 44, 51 to 59, 62, 64 to 67, 70, 71, 83 to 93, 9999	1	0	*16*	
181	RM terminal function selection		1	1	*16*	
182	RH terminal function selection		1	2	*16*	
183	RT terminal function selection		1	3	*16*	
184	AU terminal function selection	0 to 14, 16 to 18, 20, 23 to 28, 30, 32 to 35, 42 to 44, 51 to 59, 62 to 67, 70, 71, 74, 83 to 93, 9999	1	4	*16*	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
185	JOG terminal function selection	0 to 20, 22 to 28, 30, 32 to 35, 42 to 44, 62, 64 to 71, 74, 76, 83, 9999	1	5	*16*	
186	CS terminal function selection		1	6	*16*	
187	MRS terminal function selection		1	24	*16*	
188	STOP terminal function selection		1	25	*16*	
189	RES terminal function selection		1	62	*16*	
190	RUN terminal function selection	0 to 8, 10 to 16, 25, 26, 30 to 35, 39, 41 to 47, 50 to 54, 64, 70, 85, 90, 91, 93 to 99, 100 to 108, 110 to 116, 125, 126, 130 to 135, 139, 141 to 147, 150 to 154, 164, 170, 185, 190, 191, 193 to 199, 9999	1	0	*17*	
191	SU terminal function selection		1	1	*17*	
192	IPF terminal function selection		1	2	*17*	
193	OL terminal function selection		1	3	*17*	
194	FU terminal function selection		1	4	*17*	
195	ABC1 terminal function selection	0 to 8, 10 to 16, 25, 26, 30 to 35, 39, 41 to 47, 50 to 54, 64, 70, 85, 90, 91, 94 to 99, 100 to 108, 110 to 116, 125, 126, 130 to 135, 139, 141 to 147, 150 to 154, 164, 170, 185, 190, 191, 194 to 199, 9999	1	99	*17*	
196	ABC2 terminal function selection		1	9999	*17*	
232 to 239	Multi-speed setting (8 speed to 15 speed)	0 to 400Hz, 9999	0.01Hz	9999	—	
240	Soft-PWM operation selection	0, 1	1	1	—	
241	Analog input display unit switchover	0, 1	1	0	—	
242	Terminal 1 added compensation amount (terminal 2)	0 to 100%	0.1%	100%	—	
243	Terminal 1 added compensation amount (terminal 4)	0 to 100%	0.1%	75%	—	
244	Cooling fan operation selection	0, 1	1	1	—	
245	Rated slip	0 to 50%, 9999	0.01%	9999	—	
246	Slip compensation time constant	0.01 to 10s	0.01s	0.5s	—	
247	Constant-power range slip compensation selection	0, 9999	1	9999	—	
251	Output phase loss protection selection	0, 1	1	1	—	
252	Override bias	0 to 1000%	0.1%	50%	*44*	
253	Override gain	0 to 1000%	0.1%	150%	*44*	
255	Life alarm status display	(0 to 15)	1	0	—	
256	Inrush current limit circuit life display	(0 to 100%)	1%	100%	—	
257	Control circuit capacitor life display	(0 to 100%)	1%	100%	—	
258	Main circuit capacitor life display	(0 to 100%)	1%	100%	—	
259	Main circuit capacitor life measuring	0, 1	1	0	—	
261	Power failure stop selection	0, 1, 2, 11, 12	1	0	—	
262	Subtracted frequency at deceleration start	0 to 20Hz	0.01Hz	3Hz	—	
263	Subtraction starting frequency	0 to 120Hz, 9999	0.01Hz	60Hz	—	
264	Power-failure deceleration time 1	0 to 3600/ 360s	0.1/0.01s	5s	—	
265	Power-failure deceleration time 2	0 to 3600/ 360s, 9999	0.1/0.01s	9999	—	
266	Power failure deceleration time switchover frequency	0 to 400Hz	0.01Hz	60Hz	—	
267	Terminal 4 input selection	0, 1, 2	1	0	—	
268	Monitor decimal digits selection	0, 1, 9999	1	9999	—	
269	Parameter for manufacturer setting. Do not set.					
270	Dancer position A	400.1% to 600%	0.1%	600%	*30*	
271	Dancer position B	400% to 599.9%	0.1%	400%	*30*	
272	Dancer position C1	400.1% to 599.9%, 9999	0.1%	9999	*30*	
273	Dancer position C2	400.1% to 599.9%, 9999	0.1%	9999	*30*	
274	PID position gain A	0.1 to 1000%, 9999	0.1%	9999	*30*	
275	PID position gain B	0.1 to 1000%, 9999	0.1%	9999	*30*	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
276	PID position gain C1	0.1 to 1000%, 9999	0.1%	9999	*30*	
277	PID position gain C2	0.1 to 1000%, 9999	0.1%	9999	*30*	
278	PID position gain D	0.1 to 1000%, 9999	0.1%	9999	*30*	
279	Winding/unwinding length detection	0 to 9999	1	1000	*42*	
280	Winding/unwinding length unit	0, 1, 2, 3	1	0	*42*	
281	Stored winding/unwinding length	0 to 9999	1	0	*42*	
285	Overspeed detection frequency (Excessive speed deviation detection frequency)	0 to 30Hz, 9999	0.01Hz	9999	—	
286	Droop gain	0 to 100%	0.1%	0%	—	
287	Droop filter time constant	0 to 1s	0.01s	0.3s	—	
288	Droop function activation selection	0, 1, 2, 10, 11	1	0	—	
291	Pulse train I/O selection	0, 1, 10, 11, 20, 21, 100	1	0	—	
292	Automatic acceleration/deceleration	0, 1, 3, 5, 6, 11	1	0	—	
293	Acceleration/deceleration separate selection	0 to 2	1	0	—	
294	UV avoidance voltage gain	0 to 200%	0.1%	100%	—	
299	Rotation direction detection selection at restarting	0, 1, 9999	1	0	—	
331	RS-485 communication station number	0 to 31(0 to 247)	1	0	—	
332	RS-485 communication speed	3, 6, 12, 24, 48, 96, 192, 384	1	96	—	
333	RS-485 communication stop bit length	0, 1, 10, 11	1	1	—	
334	RS-485 communication parity check selection	0, 1, 2	1	2	—	
335	RS-485 communication retry count	0 to 10, 9999	1	1	—	
336	RS-485 communication check time interval	0 to 999.8s, 9999	0.1s	0s	—	
337	RS-485 communication waiting time setting	0 to 150ms, 9999	1	9999	—	
338	Communication operation command source	0, 1	1	0	—	
339	Communication speed command source	0, 1, 2	1	0	—	
340	Communication startup mode selection	0, 1, 2, 10, 12	1	0	—	
341	RS-485 communication CR/LF selection	0, 1, 2	1	1	—	
342	Communication EEPROM write selection	0, 1	1	0	—	
343	Communication error count	—	1	0	—	
359 *6	Encoder rotation direction	0, 1	1	1	—	
369 *6	Number of encoder pulses	0 to 4096	1	1024	—	
374	Overspeed detection level	0 to 400Hz	0.01Hz	140Hz	—	
376 *6	Encoder signal loss detection enable/ disable selection	0, 1	1	0	—	
380	Acceleration S-pattern 1	0 to 50%	1%	0	—	
381	Deceleration S-pattern 1	0 to 50%	1%	0	—	
382	Acceleration S-pattern 2	0 to 50%	1%	0	—	
383	Deceleration S-pattern 2	0 to 50%	1%	0	—	
384	Input pulse division scaling factor	0 to 250	1	0	*45*	
385	Frequency for zero input pulse	0 to 400Hz	0.01Hz	0	*45*	
386	Frequency for maximum input pulse	0 to 400Hz	0.01Hz	60Hz	*45*	
428 *6	Command pulse selection	0 to 5	1	0	—	
450	Second applied motor	0, 1, 3 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54, 9999	1	9999	—	
451	Second motor control method selection	10, 11, 12, 20, 9999	1	9999	—	
453	Second motor capacity	0.4 to 55kW, 9999/ 0 to 3600kW, 9999 *2	0.01kW/0.1kW *2	9999	—	
454	Number of second motor poles	2, 4, 6, 8, 10, 9999	1	9999	—	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
455	Second motor excitation current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A *2	9999	—	
456	Rated second motor voltage	0 to 1000V	0.1V	200/400V*5	—	
457	Rated second motor frequency	10 to 120Hz	0.01Hz	60Hz	—	
458	Second motor constant (R1)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/0.01mΩ *2	9999	—	
459	Second motor constant (R2)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999 *2	0.001Ω/ 0.01mΩ *2	9999	—	
460	Second motor constant (L1)	0 to 50Ω(0 to 1000mH), 9999/0 to 3600mΩ(0 to 400mH), 9999 *2	0.001Ω(0.1mH)/ 0.01mΩ(0.01mH) *2	9999	—	
461	Second motor constant (L2)	0 to 50Ω(0 to 1000mH), 9999/0 to 3600mΩ(0 to 400mH), 9999 *2	0.001Ω(0.1mH)/ 0.01mΩ(0.01mH) *2	9999	—	
462	Second motor constant (X)	0 to 500Ω(0 to 100%), 9999/0 to 100Ω(0 to 100%), 9999 *2	0.01Ω(0.1%)/ 0.01Ω(0.01%) *2	9999	—	
463	Second motor auto tuning setting/status	0, 1, 101	1	0	—	
464	Second PID proportional band	0.1 to 1000%, 9999	0.1%	9999	29	
465	Second PID integral time	0.1 to 3600s, 9999	0.1s	9999	29	
466	Second PID differential time	0.01 to 10s, 9999	0.01s	9999	29	
467	Second PID proportional band for under-set point value	0.1 to 1000%, 9999	0.1%	9999	29	
468	Second PID integral time for under-set point value	0.1 to 3600s, 9999	0.1s	9999	29	
469	Second PID differential time for under-set point value	0.01 to 10s, 9999	0.01s	9999	29	
470	Third PID proportional band	0.1 to 1000%, 9999	0.1%	9999	29	
471	Third PID integral time	0.1 to 3600s, 9999	0.1s	9999	29	
472	Third PID differential time	0.01 to 10s, 9999	0.01s	9999	29	
473	Third PID proportional band for under-set point value	0.1 to 1000%, 9999	0.1%	9999	29	
474	Third PID integral time for under-set point value	0.1 to 3600s, 9999	0.1s	9999	29	
475	Third PID differential time for under-set point value	0.01 to 10s, 9999	0.01s	9999	29	
476	Fourth PID proportional band	0.1 to 1000%, 9999	0.1%	9999	29	
477	Fourth PID integral time	0.1 to 3600s, 9999	0.1s	9999	29	
478	Fourth PID differential time	0.01 to 10s, 9999	0.01s	9999	29	
479	Fourth PID proportional band for under-set point value	0.1 to 1000%, 9999	0.1%	9999	29	
480	Fourth PID integral time for under-set point value	0.1 to 3600s, 9999	0.1s	9999	29	
481	Fourth PID differential time for under-set point value	0.01 to 10s, 9999	0.01s	9999	29	
495	Remote output selection	0, 1, 10, 11	1	0	—	
496	Remote output data 1	0 to 4095	1	0	—	
497	Remote output data 2	0 to 4095	1	0	—	
503	Maintenance timer	0(1 to 9998)	1	0	—	
504	Maintenance timer alarm output set time	0 to 9998, 9999	1	9999	—	
505	Speed setting reference	1 to 120Hz	0.01Hz	60Hz	—	
516	S-pattern time at a start of acceleration	0.1 to 2.5s	0.1s	0.1s	—	
517	S-pattern time at a completion of acceleration	0.1 to 2.5s	0.1s	0.1s	—	
518	S-pattern time at a start of deceleration	0.1 to 2.5s	0.1s	0.1s	—	
519	S-pattern time at a completion of deceleration	0.1 to 2.5s	0.1s	0.1s	—	
539	Modbus-RTU communication check time interval	0 to 999.8s, 9999	0.1s	9999	—	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
547	Parameter for manufacturer setting. Do not set.					
548						
549	Protocol selection	0, 1	1	0	—	
550	NET mode operation command source selection	0, 1, 9999	1	9999	—	
551	PU mode operation command source selection	1, 2, 3	1	2	—	
555	Current average time	0.1 to 1s	0.1s	1s	—	
556	Data output mask time	0 to 20s	0.1s	0s	—	
557	Current average value monitor signal output reference current	0 to 500/0 to 3600A*2	0.01/0.1A*2	Rated inverter current	—	
563	Energization time carrying-over times	(0 to 65535)	1	0	—	
564	Operating time carrying-over times	(0 to 65535)	1	0	—	
569	Second motor speed control gain	0 to 200%, 9999	0.1%	9999	—	
571	Holding time at a start	0 to 10s, 9999	0.1s	9999	—	
574	Second motor online auto tuning	0, 1	1	0	—	
575	Output interruption detection time	0 to 3600s, 9999	0.1s	9999	—	
576	Output interruption detection level	0 to 400Hz	0.01Hz	0Hz	—	
577	Output interruption cancel level	900 to 1100%	0.1%	1000%	—	
611	Acceleration time at a restart	0 to 3600s, 9999	0.1s	5/15s *2	—	
665	Regeneration avoidance frequency gain	0 to 200%	0.1%	100%	—	
684	Tuning data unit switchover	0, 1	1	0	—	
702	Dancer position detection level	0 to 100%	0.01%	10%	*27*	
703	Minimum number of input pulse	0 to 100kpps	0.01kpps	0kpps	*45*	
704	Maximum number of input pulse	0 to 100kpps	0.01kpps	100kpps	*45*	
706	Speed compensation gain	0 to 200%	0.1%	0%	*31*	
707	Sampling time for winding diameter calculation	0.01 to 1s, 9999	0.01s	9999	*38*	
708	Filter time constant for dancer control input	0 to 5s	0.001s	0s	*27*	
709	Integral clamp (positive polarity)	0 to 100%, 9999	0.1%	9999	*26*	
710	Integral clamp (negative polarity)	0 to 100%, 9999	0.1%	9999	*26*	
711	Signal loss detection stationary time	0 to 100s, 9999	0.01s	9999	*28*	
712	Initial winding diameter calculation dead zone 2	0 to 50%, 9999	0.1%	9999	*40*	
713	Initial inertia moment	0 to 500kg · m^2	0.01kg · m^2	0kg · m^2	*62*	
714	Roll width	0 to 5000mm	1mm	0mm	*62*	
715	Material specific gravity	0 to 20g/cm^3	0.001g/cm^3	0g/cm^3	*62*	
716	Inertia compensation cushion time	0 to 360s	0.01s	0s	*62*	
717	Tension command cushion time	0 to 360s	0.01s	0s	*61*	
718	Dancer tension setting bias	0 to 200%	0.1%	0%	*51*	
719	Dancer tension setting gain	0 to 200%	0.1%	100%	*51*	
720	Maximum winding diameter 1	1 to 6553mm	1mm	2mm	*35*	
721	Minimum winding diameter 1	1 to 6553mm	1mm	1mm	*35*	
722	Maximum winding diameter 2	1 to 6553mm	1mm	2mm	*35*	
723	Minimum winding diameter 2	1 to 6553mm	1mm	1mm	*35*	
724	Maximum winding diameter 3	1 to 6553mm	1mm	2mm	*35*	
725	Minimum winding diameter 3	1 to 6553mm	1mm	1mm	*35*	
726	Maximum winding diameter 4	1 to 6553mm	1mm	2mm	*35*	
727	Minimum winding diameter 4	1 to 6553mm	1mm	1mm	*35*	
728	Main speed analog gain 2	0 to 400Hz, 9999	0.01Hz	9999	*44*	
729	Main speed analog gain 3	0 to 400Hz, 9999	0.01Hz	9999	*44*	
730	Main speed analog gain 4	0 to 400Hz, 9999	0.01Hz	9999	*44*	
731	Dancer signal input selection	3 to 6	1	5	*27*	
732	Dancer main speed command input selection	0 to 7	1	0	*43*	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
733	Taper setting analog input selection	3 to 6, 9999	1	9999	51	
734	Dancer tension setting input selection	3 to 6, 9999	1	9999	51	
737	Stall torque setting	0 to 200%	0.1%	20%	65	
738	Speed limit for stall operation	0 to 60Hz	0.01Hz	1Hz	65	
739	Mechanical loss setting frequency bias	400 to 600%	1%	500%	64	
740	Mechanical loss setting frequency 1	0 to 400Hz, 9999	0.01Hz	9999	64	
741	Mechanical loss 1	400 to 600%	1%	500%	64	
742	Mechanical loss setting frequency 2	0 to 400Hz, 9999	0.01Hz	9999	64	
743	Mechanical loss 2	400 to 600%	1%	500%	64	
744	Mechanical loss setting frequency 3	0 to 400Hz, 9999	0.01Hz	9999	64	
745	Mechanical loss 3	400 to 600%	1%	500%	64	
746	Mechanical loss setting frequency 4	0 to 400Hz, 9999	0.01Hz	9999	64	
747	Mechanical loss 4	400 to 600%	1%	500%	64	
748	Mechanical loss setting frequency 5	0 to 400Hz, 9999	0.01Hz	9999	64	
749	Mechanical loss 5	400 to 600%	1%	500%	64	
750	Target winding diameter	1 to 6553mm	1mm	1mm	48	
751	Dancer input offset	400 to 600%	0.01%	500%	16	
752	Material thickness d1	0 to 20mm, 9999	0.001mm	9999	35	
753	Material thickness d2	0 to 20mm	0.001mm	1mm	35	
754	Material thickness d3	0 to 20mm	0.001mm	1mm	35	
755	Material thickness d4	0 to 20mm	0.001mm	1mm	35	
756	First acceleration time for main speed	0 to 3600s/360s	0.1s/0.01s	15s	46	
757	First deceleration time for main speed	0 to 3600s/360s	0.1s/0.01s	15s	46	
758	Second acceleration time for main speed	0 to 3600s/360s	0.1s/0.01s	15s	46	
759	Second deceleration time for main speed	0 to 3600s/360s	0.1s/0.01s	15s	46	
760	Third acceleration time for main speed	0 to 3600s/360s	0.1s/0.01s	15s	46, 65	
761	Third deceleration time for main speed	0 to 3600s/360s	0.1s/0.01s	15s	46	
762	Winding/unwinding selection	0, 1	1	0	34, 64	
763	Line speed input selection	0 to 7	1	0	33	
764	Pulse reference for line speed input	0.01 to 200	0.01kpps	30kpps	33	
765	Voltage reference for line speed input	0.1 to 100%	0.1%	50%	33	
766	Line speed reference	1 to 6553.4	0.1	1000	33, 49	
767	Line speed unit	0, 1, 2, 3	1	0	33, 49	
768	Line speed input filter time constant	0 to 5s	0.001s	0.025s	33	
769	Filter treatment waiting time	0 to 100s	0.01s	0s	38	
770	Filter time constant	0 to 100s	0.01s	0s	38	
771	r-r' limit value (diameter)	0 to 9.998, 9999	0.001mm	1mm	38	
772	r-r' limit disable time	0 to 100s	0.01s	0s	38	
773	Gear ratio numerator (driver side)	1 to 65534	1	1	34	
774	Gear ratio denominator (follower side)	1 to 65534	1	1	34	
775	Speed control proportion term applied diameter 1	1 to 99%, 9999	1%	9999	47	
776	Speed control proportion term applied diameter 2	1 to 99%, 9999	1%	9999	47	
777	Speed control proportional gain 1	0 to 1000%, 9999	1%	9999	47	
778	Speed control proportional gain 2	0 to 1000%, 9999	1%	9999	47	
779	Speed control proportional gain 3	0 to 1000%, 9999	1%	9999	47	
780	Speed control proportional gain 4	0 to 1000%, 9999	1%	9999	47	
781	Winding diameter storage selection	0, 1	1	0	37	
782	Stored winding diameter	1 to 6553	1mm	1mm	37	
783	Operation time with stored winding diameter	0 to 100s	0.01s	0s	37	
785	Terminal 4 function setting	1, 2, 9999	1	9999	44, 51	
786	Number of averaging for winding diameter calculation	0 to 10	1	4	38	
787	Taper ratio setting	0 to 100%, 9999	0.1%	0%	51, 61	
788	Winding diameter at taper start	1 to 6553mm, 9999	1mm	9999	51, 61	
789	Dancer tension setting	1 to 100, 9999	0.1	100.0	51	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
790	Initial winding diameter calculation start point	400% to 600%	0.01%	400%	*39*	
791	Initial winding diameter calculation dead zone	0 to 50%	0.1%	1%	*40*	
792	Accumulated amount	1 to 5000mm, 8888, 9999	1mm	160mm	*39*	
793	Speed control P gain at a start	0 to 1000%	1%	60%	*40*	
794	Speed control integral time at start	0 to 20s	0.001s	2s	*40*	
795	Integral term limit at a start	0 to 100%	0.1%	2.5%	*41*	
796	PID term limit at a start	0 to 100%	0.1%	2.5%	*41*	
797	Rotation speed at winding diameter calculated value activation	0 to 400Hz	0.01Hz	3Hz	*36, 59*	
798	Speed compensation bias	0 to 200%	0.1%	60%	*31*	
799	Winding diameter monitor reference	1 to 6553mm	1mm	1000mm	*49*	
800	Control method selection	0, 1, 2, 6, 9 to 12, 16, 20	1	20	—	
802 *6	Pre-excitation selection	0, 1	1	0	—	
803	Constant power range torque characteristic selection	0, 1	1	0	—	
804	Torque command source selection	0 to 6	1	0	—	
805	Torque command value (RAM)	600 to 1400%	1%	1000%	—	
806	Torque command value (RAM,EEPROM)	600 to 1400%	1%	1000%	—	
807	Speed limit selection	0, 1, 2	1	0	—	
808	Forward rotation speed limit	0 to 120Hz	0.01Hz	60Hz	—	
809	Reverse rotation speed limit	0 to 120Hz, 9999	0.01Hz	9999	—	
810	Torque limit input method selection	0, 1	1	0	—	
811	Set resolution switchover	0, 1, 10, 11	1	0	—	
812	Torque limit level (regeneration)	0 to 400%, 9999	0.1%	9999	—	
813	Torque limit level (3rd quadrant)	0 to 400%, 9999	0.1%	9999	—	
814	Torque limit level (4th quadrant)	0 to 400%, 9999	0.1%	9999	—	
815	Torque limit level 2	0 to 400%, 9999	0.1%	9999	—	
816	Torque limit level during acceleration	0 to 400%, 9999	0.1%	9999	—	
817	Torque limit level during deceleration	0 to 400%, 9999	0.1%	9999	—	
818	Easy gain tuning response level setting	1 to 15	1	2	—	
819	Easy gain tuning selection	0 to 2	1	0	—	
820	Speed control P gain 1	0 to 1000%	1%	60%	—	
821	Speed control integral time 1	0 to 20s	0.001s	0.333s	—	
822	Speed setting filter 1	0 to 5s, 9999	0.001s	9999	—	
823 *6	Speed detection filter 1	0 to 0.1s	0.001s	0.001s	—	
824	Torque control P gain 1	0 to 200%	1%	100%	—	
825	Torque control integral time 1	0 to 500ms	0.1ms	5ms	—	
826	Torque setting filter 1	0 to 5s, 9999	0.001s	9999	—	
827	Torque detection filter 1	0 to 0.1s	0.001s	0s	—	
828	Model speed control gain	0 to 1000%	1%	60%	—	
830	Speed control P gain 2	0 to 1000%, 9999	1%	9999	—	
831	Speed control integral time 2	0 to 20s, 9999	0.001s	9999	—	
832	Speed setting filter 2	0 to 5s, 9999	0.001s	9999	—	
833 *6	Speed detection filter 2	0 to 0.1s, 9999	0.001s	9999	—	
834	Torque control P gain 2	0 to 200%, 9999	1%	9999	—	
835	Torque control integral time 2	0 to 500ms, 9999	0.1ms	9999	—	
836	Torque setting filter 2	0 to 5s, 9999	0.001s	9999	—	
837	Torque detection filter 2	0 to 0.1s, 9999	0.001s	9999	—	
840 *6	Torque bias selection	0 to 3, 9999	1	9999	—	
841 *6	Torque bias 1	600 to 1400%, 9999	1%	9999	—	
842 *6	Torque bias 2	600 to 1400%, 9999	1%	9999	—	
843 *6	Torque bias 3	600 to 1400%, 9999	1%	9999	—	
844 *6	Torque bias filter	0 to 5s, 9999	0.001s	9999	—	
845 *6	Torque bias operation time	0 to 5s, 9999	0.01s	9999	—	
846 *6	Torque bias balance compensation	0 to 10V, 9999	0.1V	9999	—	
847 *6	Fall-time torque bias terminal 1 bias	0 to 400%, 9999	1%	9999	—	
848 *6	Fall-time torque bias terminal 1 gain	0 to 400%, 9999	1%	9999	—	
849	Analog input offset adjustment	0 to 200%	0.1%	100%	—	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
850	Brake operation selection	0, 1	1	0	—	
853 *6	Speed deviation time	0 to 100s	0.1s	1s	—	
854	Excitation ratio	0 to 100%	1%	100%	—	
858	Terminal 4 function assignment	0, 1, 4, 9999	1	0	—	
859	Torque current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A*2	9999	—	
860	Second motor torque current	0 to 500A, 9999/ 0 to 3600A, 9999 *2	0.01/0.1A*2	9999	—	
862	Notch filter time constant	0 to 60	1	0	—	
863	Notch filter depth	0 to 3	1	0	—	
864	Torque detection	0 to 400%	0.1%	150%	—	
865	Low speed detection	0 to 400Hz	0.01Hz	1.5Hz	—	
866	Torque monitoring reference	0 to 400%	0.1%	150%	—	
867	AM output filter	0 to 5s	0.01s	0.01s	—	
868	Terminal 1 function assignment	0 to 6, 9999	1	0	—	
872	Input phase loss protection selection	0, 1	1	0	—	
873 *6	Speed limit	0 to 120Hz	0.01Hz	20Hz	—	
874	OLT level setting	0 to 200%	0.1%	150%	—	
875	Fault definition	0, 1	1	0	—	
877	Speed feed forward control/model adaptive speed control selection	0, 1, 2	1	0	—	
878	Speed feed forward filter	0 to 1s	0.01s	0s	—	
879	Speed feed forward torque limit	0 to 400%	0.1%	150%	—	
880	Load inertia ratio	0 to 200times	0.1times	7times	—	
881	Speed feed forward gain	0 to 1000%	1%	0%	—	
882	Regeneration avoidance operation selection	0 to 3	1	0	*53*	
883	Regeneration avoidance operation level	300 to 800V	0.1V	380/760V *2	—	
884	Regeneration avoidance at deceleration detection sensitivity	0 to 5	1	0	—	
885	Regeneration avoidance compensation frequency limit value	0 to 10Hz, 9999	0.01Hz	6Hz	—	
886	Regeneration avoidance voltage gain	0 to 200%	0.1%	100%	—	
888	Free parameter 1	0 to 9999	1	9999	—	
889	Free parameter 2	0 to 9999	1	9999	—	
C0 (900) *7	FM terminal calibration	—	—	—	—	
C1 (901) *7	AM terminal calibration	—	—	—	—	
C2 (902) *7	Terminal 2 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	—	
C3 (902) *7	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	—	
125 (903) *7	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	—	
C4 (903) *7	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	—	
C5 (904) *7	Terminal 4 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	—	
C6 (904) *7	Terminal 4 frequency setting bias	0 to 300%	0.1%	20%	—	
126 (905) *7	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	—	
C7 (905) *7	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	—	
C12 (917) *7	Terminal 1 bias frequency (speed)	0 to 400Hz	0.01Hz	0Hz	—	

Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
C13 (917) *7	Terminal 1 bias (speed)	0 to 300%	0.1%	0%	—	
C14 (918) *7	Terminal 1 gain frequency (speed)	0 to 400Hz	0.01Hz	60Hz	—	
C15 (918) *7	Terminal 1 gain (speed)	0 to 300%	0.1%	100%	—	
C16 (919) *7	Terminal 1 bias command (torque/ magnetic flux)	0 to 400%	0.1%	0%	—	
C17 (919) *7	Terminal 1 bias (torque/magnetic flux)	0 to 300%	0.1%	0%	—	
C18 (920) *7	Terminal 1 gain command (torque/ magnetic flux)	0 to 400%	0.1%	150%	—	
C19 (920) *7	Terminal 1 gain (torque/magnetic flux)	0 to 300%	0.1%	100%	—	
C38 (932) *7	Terminal 4 bias command (torque/ magnetic flux)	0 to 400%	0.1%	0%	—	
C39 (932) *7	Terminal 4 bias (torque/magnetic flux)	0 to 300%	0.1%	20%	—	
C40 (933) *7	Terminal 4 gain command (torque/ magnetic flux)	0 to 400%	0.1%	150%	—	
C41 (933) *7	Terminal 4 gain (torque/magnetic flux)	0 to 300%	0.1%	100%	—	
989	Parameter copy alarm release	10/100	1	10/100 *2	—	
990	PU buzzer control	0, 1	1	1	—	
991	PU contrast adjustment	0 to 63	1	58	—	
Pr.CL	Parameter clear	0, 1	1	0	—	
ALLC	All parameter clear	0, 1	1	0	—	
Er.CL	Faults history clear	0, 1	1	0	—	
PCPY	Parameter copy	0 to 3	1	0	—	

*1 Differ according to capacities. 6%: 0.4K, 0.75K, 4%: 1.5K to 3.7K, 3%: 5.5K, 7.5K, 2%: 11K to 55K, 1%: 75K or higher

*2 Differ according to capacities. (55K or lower/75K or higher)

*3 Differ according to capacities. (7.5K or lower/11K or higher)

*4 Differ according to capacities. 4% for 7.5K or higher, 2% for 11K to 55K, 1% for 75K or higher

*5 Differs according to the voltage class. (200V class/400V class)

*6 Setting can be made only when the FR-A7AP/FR-A7AL is mounted.

*7 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).

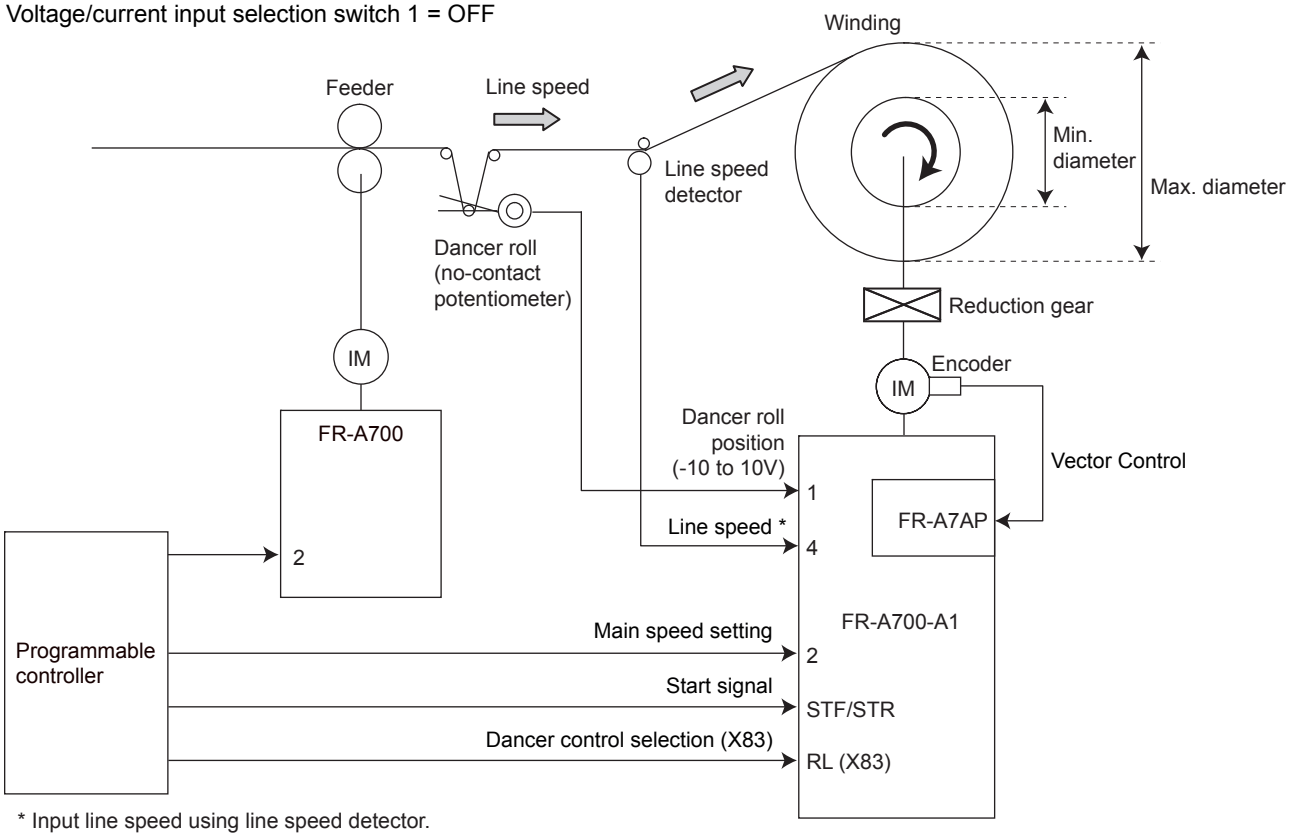
3 DANCER CONTROL/WINDING DIAMETER COMPENSATION

3.1 Dedicated specification list

Item		Description
Dancer control	Control method	PID control, PI control, P control, and PD control can be selected. Gain switchover by dancer position is available. Gain switchover by external terminal input is available.
	Dancer roll position setting	Set a point with parameter.
	Dancer roll position detection signal	Analog voltage ± 10V (terminal 1)
	Main speed acceleration/ deceleration function	Available. Three patterns are selectable with external contact signal.
	Additional function	Material break detection
Winding diameter compensation	Constant line speed control	Available
	Winding diameter calculator	Calculation method by line speed detection and rotation speed of motor, and calculation method by material thickness and rotation number of motor are selectable.
	Line speed detection	Pulse train input (A/B phase, single phase) and analog input are selectable.
	Gear ratio setting	Available
	Maximum winding diameter/ minimum winding diameter setting	Available. Four patterns are selectable with external signal.
	Speed control proportional gain compensation	Available. Straight movement (with three turns) against the roll diameter can be performed.
	Winding diameter storage	Available
Common	Dedicated input signal	Dancer/tension control selection, winding diameter compensation selection, PID gain switchover, PID integral term reset (P control selection), speed compensation gain selection, main speed acceleration/deceleration time selection, winding diameter selection, winding diameter storage clear, winding/ unwinding selection.
	Dedicated output signal	Upper limit signal, lower limit signal, dancer roll position signal, signal loss detection, initial winding diameter calculation completion, target winding diameter achieved, winding/unwinding completion.
	Dedicated monitor	Set point, measured value, deviation, main speed, winding diameter, line speed, compensation speed, winding length.

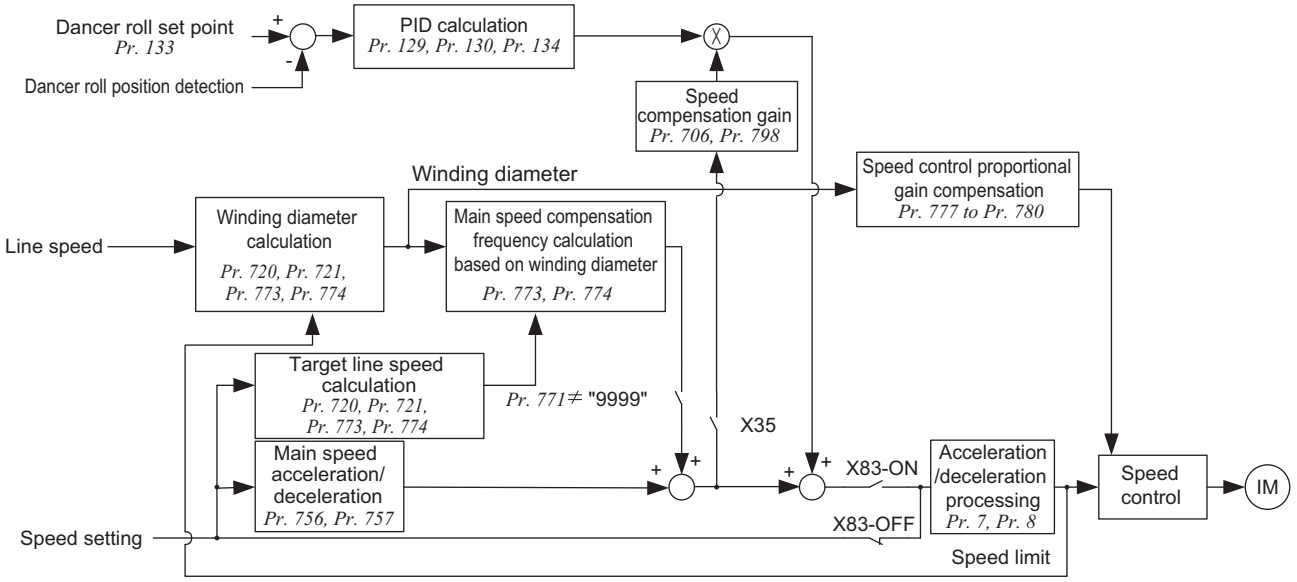
3.2 System configuration example

- *Pr. 180* = "83"
- *Pr. 762* = "0"
- *Pr. 763* = "4"
- *Pr. 267* = "1" or "2"
- Voltage/current input selection switch 1 = OFF



* Input line speed using line speed detector.

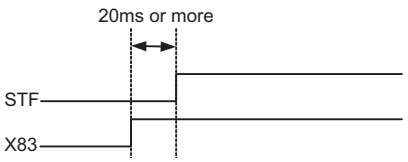
3.3 Control block diagram



3.4 Dedicated I/O signal

3.4.1 Input signal list

Use contact input signals by assigning them to *Pr. 178 to Pr. 189 (Input terminal function selection)*.

Type	*Pr. 178 to Pr. 189* setting	Signal		Description	Refer to page
Analog/Pulse	—	**Dancer roll target position**	—	Set the target position with parameter. *(Pr. 133)*	*27*
		Dancer roll position detection	Terminal 1	Input dancer roll position detection signal.	*29*
		Main speed setting	Terminal 2, etc.	Set the main speed which becomes the line speed.	*43*
		Line speed detection	—	Input detection signal of line speed. Input method can be selected from below. · Same as the main speed. · Pulse train input (single-phase pulse from terminal JOG and FR-A7AL, encoder pulse* from FR-A7AP/FR-A7AL) · Analog input (terminal 2, terminal 4) * Encoder pulse train inputs are not available during vector control.	*33*
Contact input	**30**	**PID integral term reset input**	X30	Turn ON X30 signal to reset integral term. OFF: Does not reset integral term. ON: Resets integral term. Integral term can be reset with MRS signal input when terminal is not assigned.	—
	32	**PID differential term reset input**	X32	Turn ON X32 signal to reset differential term. OFF: Does not reset differential term. ON: Resets differential term.	—
	33	**Offset displacement storage**	X33	Set an analog value, which is input to terminal 1, to *Pr. 751* as offset.	—
	34	**Integral term activation signal**	X34	Turn X34 signal ON/OFF to enable/disable the control by integral term. OFF: Disables integral term. ON: Enables integral term. Integral term is enabled when X34 signal is not assigned.	—
	35	**Speed compensation gain selection**	X35	Turn ON to select compensation by main rotation speed command. OFF: Speed compensation gain does not change regardless of main speed. ON: Speed compensation gain changes with main speed. Speed compensation gain changes with main speed when X35 signal is not assigned.	*31*
	51	**Acceleration/ deceleration time selection**	X51	Acceleration/deceleration time of main speed can be switched.	*46*
	52		X52		
	53	**Minimum/maximum winding diameter selection**	X53	Select minimum/maximum winding diameter.	*35*
	54		X54		
	55	**Stored winding diameter clear**	X55	Clears stored winding diameter calculation results.	*37*
	56	**Winding/unwinding selection**	X56	Select whether winding or unwinding shaft.	*34*
	83	**Dancer/tension control function selection**	X83	Select dancer control and winding diameter compensation function. OFF: Normal operation. ON: Activates dancer control and winding diameter compensation function. Normal operation is performed when X83 signal is not assigned. **Always set when using dancer control and winding diameter compensation function.** Turn ON/OFF the X83 in a stop status to switch between the dancer control operation and normal operation. After turning ON the X83 signal, wait 20ms or longer to input a start command (STF/STR).  	*25, 32*

Type	*Pr. 178 to Pr. 189* setting	Signal		Description	Refer to page
Contact input	84	**Winding diameter compensation selection**	X84	Select to enable/disable winding diameter compensation. When X84 is ON, winding diameter compensation is disabled (winding diameter is retained), and only the dancer control operates. (Input of X83 signal is necessary)	*25*
	85	**Dancer control selection**	X85	Select to enable/disable dancer control. When X85 signal is ON, dancer control is disabled, and only winding diameter compensation operates. (Input of X83 signal is necessary)	*32*
	86	**Winding/unwinding length clear**	X86	Clears measured winding/unwinding length.	*42*
	87	**Analog input gain selection**	X87	Changes the gain of analog input for main speed.	*44*
	88		X88		
	89	**PID gain switchover**	X89	PID gain can be switched with external terminal input.	*29*
	90		X90		
	93	**Speed control proportional gain disabled**	X93	Disables the settings of *Pr. 777 to Pr. 780 (Speed control proportional gain)*.	*47*

3.4.2 Output signal list

Use output signals by assigning them to *Pr. 190 to Pr. 196 (output terminal function selection)*.

Pr. 190 to Pr. 196 setting		Signal		Description	Refer to page
Positive logic	Negative logic				
14	**114**	**PID lower limit**	FDN	Output when dancer roll position goes lower than the setting in *Pr. 132 PID lower limit*	*29*
15	**115**	**PID upper limit**	FUP	Output when dancer roll position goes higher than the setting in *Pr. 131 PID upper limit*.	*29*
50	**150**	**Signal loss detection**	Y50	Output when dancer roll is in abnormal condition.	*28*
51	**151**	**Winding diameter calculation completion at a start**	Y51	Output when winding diameter calculation is completed at an operation start.	*41*
52	**152**	**Target winding diameter achieved**	Y52	Output when winding diameter achieves the setting in *Pr. 750* or becomes longer for winding. Output when winding diameter achieves the setting in *Pr. 750* or becomes shorter for unwinding.	*48*
53	**153**	**Winding/unwinding completion**	Y53	Output when winding/unwinding length reaches the setting in *Pr. 279* or longer.	*42*
54	**154**	**Dancer position detection**	Y54	Output when dancer roll position is commanded, and the position of dancer roll is within the set range of *Pr. 702*. This signal is also output when inverter is at a stop.	*27*

3.4.3 Analog input signals and pulse train input signals

Function	Analog input				Single-phase pulse train input		Encoder pulse train input	Refer to page
	Terminal 1 *Pr. 868*	Terminal 2	Terminal 4 *Pr. 785*	Terminal 6 (FR-A7AZ) *Pr. 406*	Terminal JOG *Pr. 291*	FR-A7AL	FR-A7AP/ FR-A7AL	
Frequency (speed) command	—	○	1	0	1, 11, 21, 100	—	—	*Refer to the Instruction Manual (Applied) of FR-A700 series*
Frequency setting auxiliary	0	—	1	—	—	—	—	
Override	—	○	1	—	—	—	—	
Magnetic flux command	1	—	—	—	—	—	—	
Regenerative torque limit	2	—	—	2	—	—	—	
Torque command	3, 4	—	—	3, 4	—	—	—	
Stall prevention operation level	4	—	—	4	—	—	—	
Torque limit	4	—	—	4	—	—	—	
Forward/reverse rotation speed limit	5	—	—	5	—	—	—	
Torque bias	6	—	—	6	—	—	—	

○: Setting available, —: Setting not available

Function	Analog input				Single-phase pulse train input		Encoder pulse train input	Refer to page
	Terminal 1	Terminal 2	Terminal 4	Terminal 6 FR-A7AZ	Terminal JOG	FR-A7AL	FR-A7AP/ FR-A7AL	
Dancer signal input selection Pr. 731	5	3	4	6	—	—	—	*27*
Dancer main speed command input selection Pr. 732	5	3	4	6	1 *1	7	2	*43*
Line speed input selection Pr. 763	5	3	4	6	1 *1	7	2	*33*
Taper setting analog input selection Pr. 733	5	3	4 *2	6	—	—	—	*51*, *61*
Dancer tension setting input selection Pr. 734	5	3	4	6	—	—	—	*51*

*1 Can be set when *Pr. 291* = "1, 11, 21, or 100".

—: Setting not available

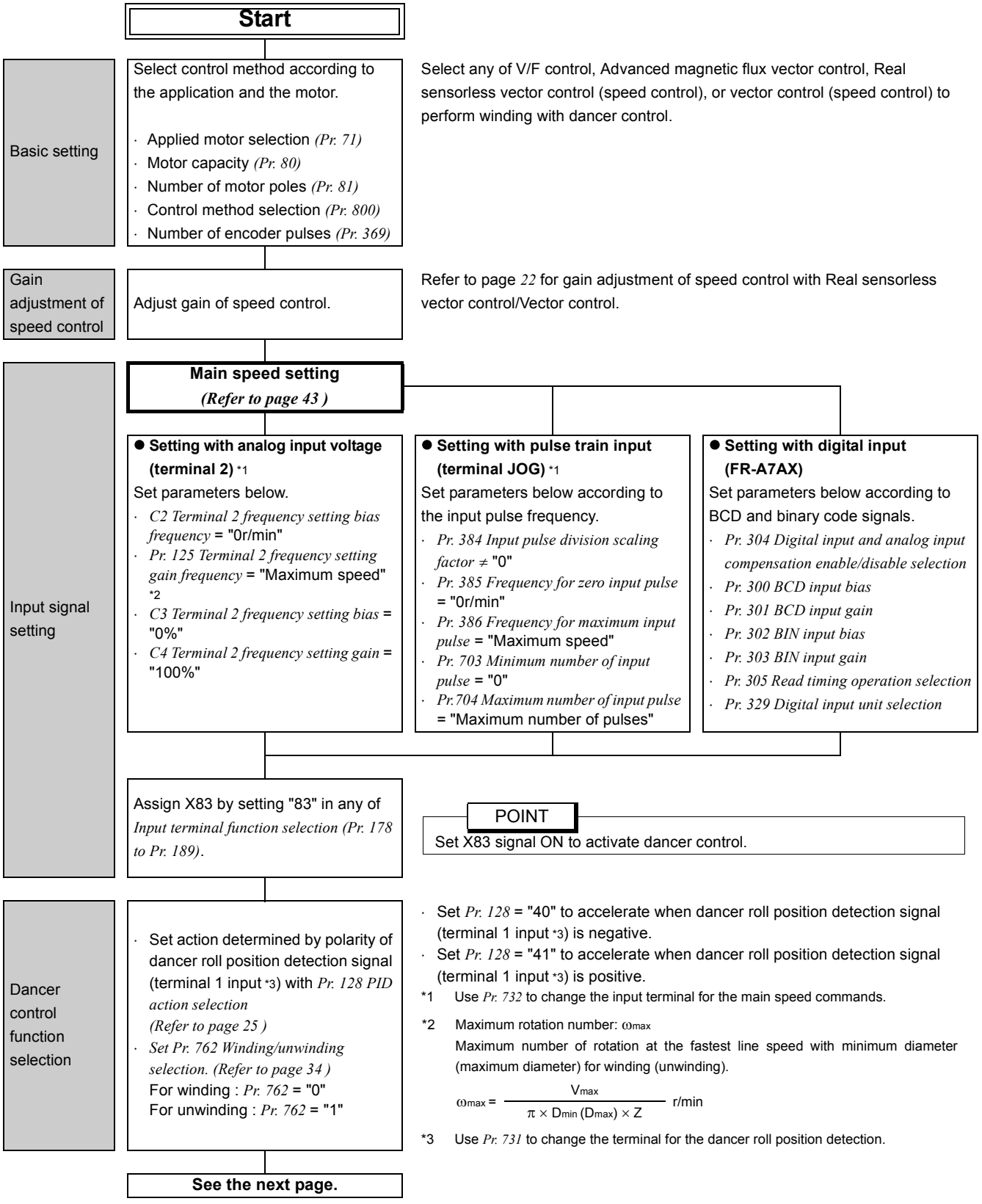
*2 Setting *Pr. 785* = "2" sets the taper ratio setting as the terminal 4 input regardless the *Pr. 733* setting.

REMARKS

- While the dancer/tension control selection X83 signal is ON, the setting values of *Pr. 731 to Pr. 734* and *Pr. 763* have higher precedence over the other assigned terminal settings such as *Pr. 868*, *Pr. 785* = "1", and *Pr. 406*. (Example: When *Pr. 731* = "5" and *Pr. 868* = "0", the terminal 1 is set to the dancer signal input.)
- For the taper setting analog input, the setting of *Pr. 785 Terminal 4 function setting* has higher precedence.
- While tension control is valid (*Pr. 800* = "6 or 16"), the following parameter settings are invalid: *Pr. 731 Dancer signal input selection, Pr. 732 Dancer main speed command input selection, and Pr. 734 Dancer tension setting input selection*.
- The dedicated-function parameters take the following precedence over each other. When several functions are assigned to a terminal, input to the function of lower precedence is regarded as 0.
  Terminal 4 function setting (*Pr. 785* = "2") > *Pr. 731 Dancer signal input selection* > *Pr. 763 Line speed input selection* > *Pr. 732 Dancer main speed command input selection* > *Pr. 733 Taper setting analog input selection* > *Pr. 734 Dancer tension setting input selection*.

3.5 Parameter setting procedure for dancer control function

The following flowchart shows the parameter setting example for the dancer control.



Continued from the last page.

Acceleration/ Deceleration time setting

Set acceleration/deceleration time as below.
(Refer to page 46)
- *Pr. 7 Acceleration time* = "0s"
- *Pr. 8 Deceleration time* = "0s"
- *Pr. 756 First acceleration time for main speed* = "Acceleration time of the line"
- *Pr.757 First deceleration time for main speed* = "Deceleration time of the line"

Pr. 756, Pr. 757:
When cushion time is considered in main speed command, set 0s.

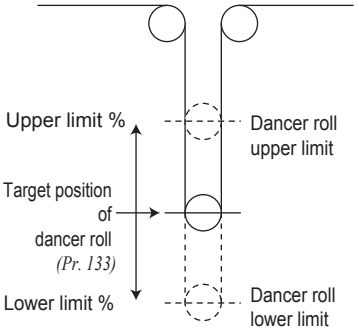
Target dancer position (*Pr. 133*) setting

Set Pr. 52 ="27" (monitor voltage % of terminal 1 input).
And record,
- Value when the dancer position is at the upper limit
- Value when the dancer position is at the lower limit

Set the value obtained from

$$Pr.133 = \frac{\%\text{ at upper limit} - \%\text{ at lower limit}}{2} + \%\text{ at lowest}$$

Alternatively, move the dancer roll to the center position, and set the monitored value of terminal 1 input voltage % to *Pr. 133*.



POINT

Turn ON the start signal when operation X83 is ON and main speed = 0r/min, and move the dancer roll up and down to check compensation directions of the dancer.

Operation check

Adjust the gain of dancer control (PID control). *(Refer to page 24)*

Refer to page *24* for gain adjustment of dancer control (PID control).

Compensation by winding diameter calculation

(Winding/ Unwinding shafts)

Perform winding diameter compensation

Winding diameter calculator setting

Set *Pr. 763 Line speed input selection*. *(Refer to page 33)*

Pr. 763 setting	Line speed input signal
0	Without line speed input signal (Main speed is the line speed.)
1	Single-phase pulse train input (terminal JOG)
2	Encoder pulse train input (FR-A7AP)
3	Analog Input (Terminal 2)
4	Analog Input (Terminal 4)
5	Analog Input (Terminal 1)
6	Analog Input (FR-A7AZ Terminal 6)
7	Single-phase pulse train input (FR-A7AL)

(Intermediate shafts)

Do not perform winding diameter compensation

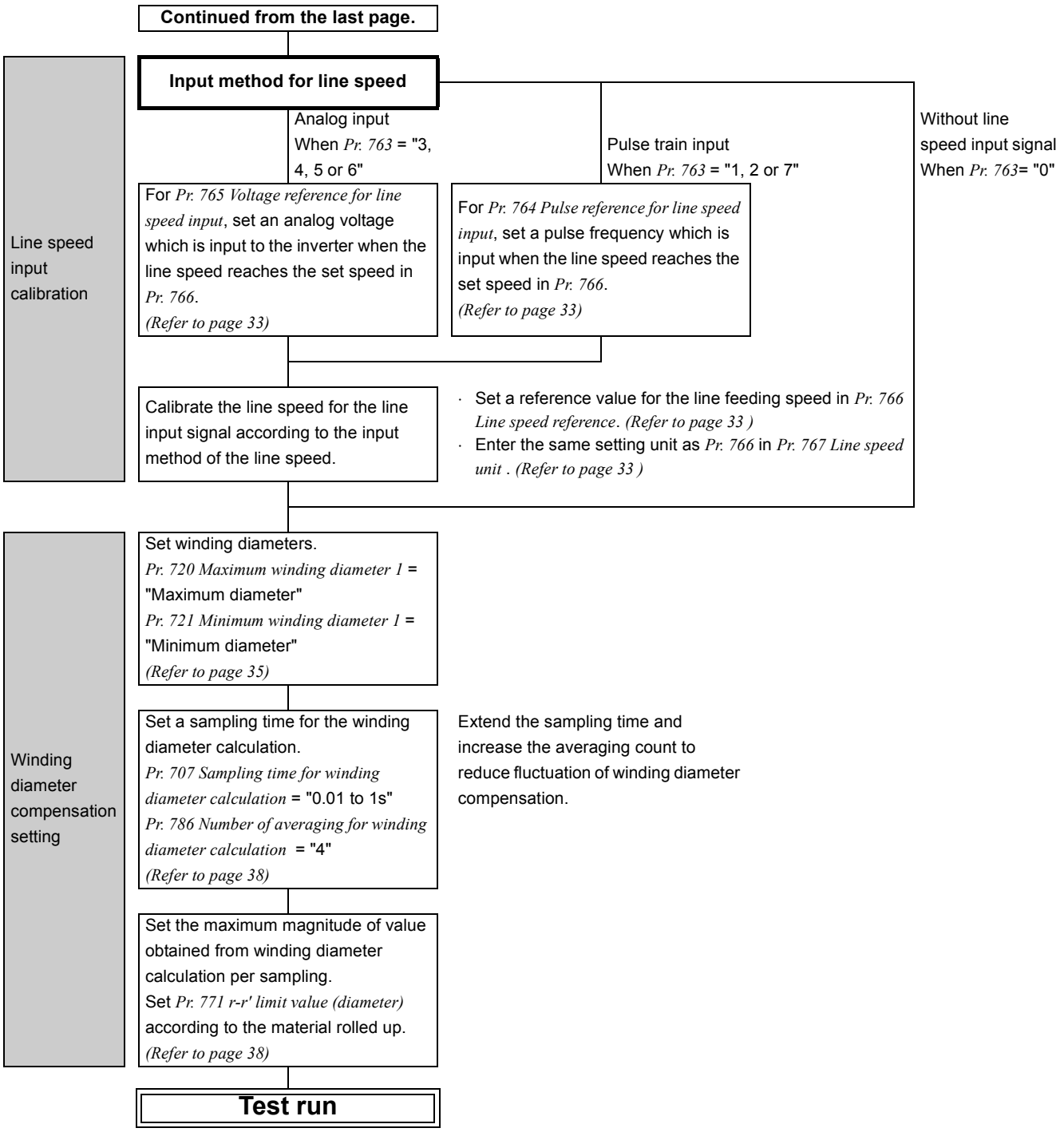
Set *Pr. 771 r-r' limit value (diameter)* = "9999" to inactivate winding diameter calculator. *(Refer to page 38)*

Test run

Gear ratio setting

Set gear ratio with *Pr. 773 Gear ratio numerator (driver side), Pr. 774 Gear ratio denominator (follower side)* when a reduction gear is installed between rolling shaft and motor output shaft. *(Refer to page 34)*

See next page



REMARKS

If winding diameter compensation does not operate at low-speed operation, check the setting of *Pr. 797 Rotation speed at winding diameter calculated value activation* (initial value is 3Hz).

3.6 Gain adjustment in actual operation

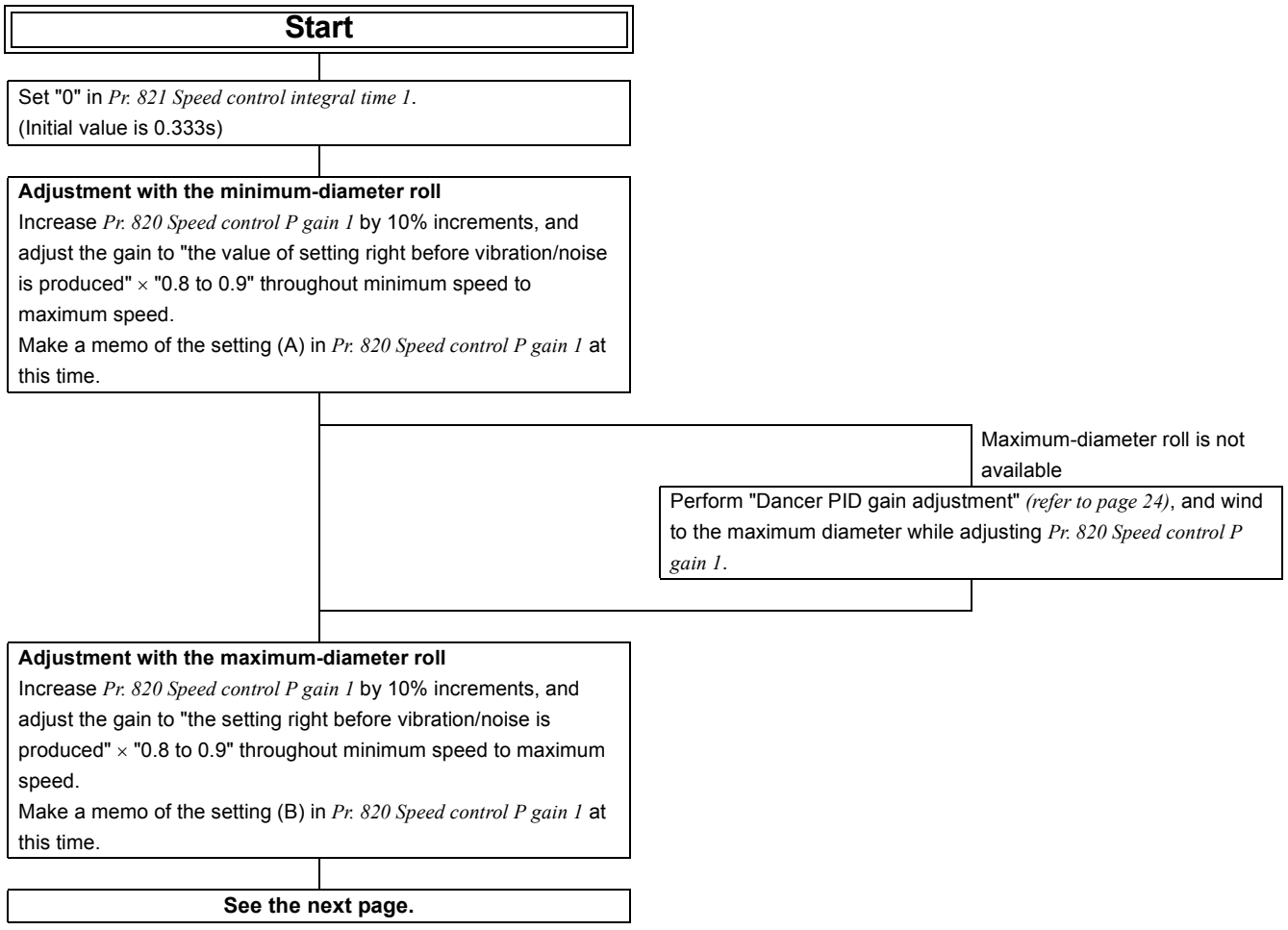
Prepare rolls of minimum, medium, and maximum diameters. (If a roll of medium diameter is not available, obtain P/I gain by calculation.)
Adjust

- Speed control "P" gain, speed control "I" gain (Real sensorless vector control/Vector control)
- Dancer "PID" gain

3.6.1 Speed control P/I gain adjustment (Real sensorless vector control/Vector control)

Set "P" gain as high as possible without setting "I" gain as a basic principle so that inverter acting as a proportional amplifier returns high response to the command from dancer roll.
Before sending material, adjust dancer roll by applying load to each spool shaft.
At this time, at least make adjustment with maximum diameter roll and minimum diameter roll.

Speed control P/I gain adjustment flowchart



Continued from the last page.

Medium diameter roll is available.

Adjustment at medium diameter roll 1
Increase *Pr. 820 Speed control P gain 1* by 10% increments, and adjust the gain to "the setting before vibration/noise is produced" × "0.8 to 0.9" throughout minimum speed to maximum speed.
Make a memo of the setting (C) in *Pr. 820 Speed control P gain 1* at this time.

Adjustment at medium diameter roll 2
Increase *Pr. 820 Speed control P gain 1* by 10% increments, and adjust the gain to "the value of setting before vibration/noise is produced" × "0.8 to 0.9" throughout minimum speed to maximum speed.
Make a memo of the setting (D) in *Pr. 820 Speed control P gain 1* at this time.

Set medium diameters.
Medium diameter roll 1
Pr. 775 Speed control proportion term applied diameter 1
= (Medium diameter roll 1 - minimum diameter)
/(Maximum diameter - minimum diameter) × 100 (%)
Medium diameter roll 2
Pr. 776 Speed control proportion term applied diameter 2
= (Medium diameter roll 2 - minimum diameter)
/(Maximum diameter - minimum diameter) × 100 (%)

Medium diameter roll is not available.

Obtain the setting(C) for *Pr. 778* from the formula below.

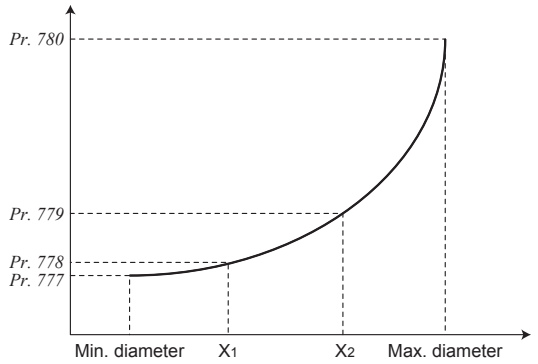
Obtain the setting(D) for *Pr. 779* from the formula below.

Refer to the memos you made, and set "A" to *Pr. 777 Speed control proportional gain 1*, "C" to *Pr. 778 Speed control proportional gain 2*, "D" to *Pr. 779 Speed control proportional gain 3*, and "B" to *Pr. 780 Speed control proportional gain 4*.

Speed control P/I gain adjustment completed

Continue to dancer control PID gain adjustment (*page 24*)

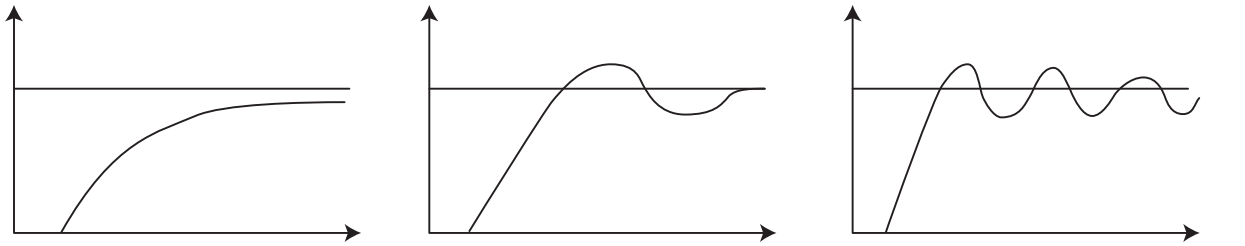
Calculation to obtain *Pr. 778 and Pr. 779*



Pr. 778 = α/5 + *Pr. 777*
Pr.779 = 8 × α/15 + *Pr. 777*
However,
α = *Pr. 780* - *Pr. 777*

3.6.2 Dancer PID gain adjustment

Set the minimum-diameter roll and connect material from the beginning to the end of machine, and increase the speed gradually while observing the movement of the dancer roll.
At this time, adjust the line speed for dancer roll to move like the below diagram 2).
Adjust to the speed where the dancer roll works without problems at acceleration, constant speed, deceleration, and sudden deceleration.
The key is to adjust to the condition where dancer PID gain is high as possible at minimum diameter.
Normally, adjust with *Pr. 129 PID proportional band* and *Pr. 130 PID integral time*.



1) When response is low (fall of dancer is great) **2) Appropriate** **3) When response is fast (hunting occurs and not stabilized)**

POINT

Adjust the line speed for the dancer roll to overshoot once or so before stabilizing to the constant position as shown in the diagram 2).

(1) Adjustment when response is low (fall of dancer is great)

- Decrease *Pr. 129 PID proportional band* by 10% increments.
- Decrease *Pr. 130 PID integral time* by 0.1s increments.
- Make several adjustments for dancer control to move like diagram 2) at each situation of acceleration, constant speed, deceleration and sudden deceleration through minimum diameter to maximum diameter.

(2) Adjustment when response is high (hunting occurs too frequently)

- Increase *Pr. 129 PID proportional band* by 10% increments.
- Increase *Pr. 130 PID integral time* by 0.1s increments.
- Make several adjustments for the dancer control to move like the diagram 2) at each situation of acceleration, constant speed, deceleration and sudden deceleration when diameter is minimum to maximum.

REMARKS

Set *Pr. 134 PID differential time* only when it is necessary as it causes hunting.
However, set a small value in *Pr. 134 PID differential time* to cease fluctuation of the dancer roll by disturbance and such at an early point. (Increase gradually starting at 0.01s.)

3.7 Dancer control detail

POINT

Turn X83 signal ON to perform dancer control and winding diameter compensation.
When X83 signal is OFF, dancer control and winding diameter compensation are not performed.
It may be necessary to perform dancer control with winding diameter compensation disabled (winding diameter is retained) for intermediate shafts. In such case, turn ON X83 signal and X84 signal together, or set *Pr. 771* = "9999" (no winding diameter calculation.)
Set "83 (X83)" and "84 (X84)" in *Pr. 178 to Pr. 189 (input terminal function selection)* to assign X83 and X84 signals.

3.7.1 PID setting (Pr. 128 to Pr. 130, Pr. 134 to Pr. 137, Pr. 709, Pr. 710)

(1) PID action selection *(Pr. 128)*

Set forward or reverse action according to the control target.
Set point/dancer signal/main rotation speed command for the dancer control function (*Pr. 128* = 40, 41) are indicated in the following table.

Pr. 128 Setting	Forward/ reverse action	Set point	Dancer signal *	Main rotation speed command
40 (Initial value)	Reverse action	*Pr. 133*	Terminal 1 (Initial value)	Same rotation speed command with normal operation speed selection.
41	Forward action			

* Use *Pr. 731 Dancer signal input selection* to change the signal input. *(Refer to page 27)*

(2) PID control proportional band *(Pr. 129)*

If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the dancer signal.

PID control formula: $G \cdot Kp \left(1+ \frac{1}{Ti \cdot S} + Td \cdot S\right)$

Gain Kp = 1/proportional band

Gain G = PID gain selection function : refer to *page 30*.

(3) PID control differential time *(Pr. 130)*

Ti is the time required for the integral (I) action to provide the same manipulated variable as that for the proportional (P) action.
As differential time becomes less, set point can be reached faster.

Pr. 130 (PID control integral time) is multiplied by:

S in $\frac{1}{Ti \cdot S}$ of

the PID control formula $G \cdot Kp \left(1+ \frac{1}{Ti \cdot S} + Td \cdot S\right)$

(4) Integral clamp at positive polarity *(Pr. 709)*/integral clamp at negative polarity *(Pr. 710)*

Limit level of PID integral control action can be set from 0 to 100% with parameters.

If *Pr. 709 Integral clamp (positive polarity)* is set while *Pr. 710 Integral clamp (negative polarity)* is not set, the setting in *Pr. 709* becomes the clamp value in positive and negative polarity.

Pr. 709	*Pr. 710*	Integral clamp (positive polarity)	Integral clamp (negative polarity)
9999	9999	100%	100%
9999	0 to 100%	100%	Setting in *Pr. 710*
0 to 100%	9999	Setting in *Pr. 709*	Setting in *Pr. 709*
0 to 100%	0 to 100%	Setting in *Pr. 709*	Setting in *Pr. 710*

(5) PID differential time *(Pr. 134)*

Set the differential time of differential (D) action. Td is the time required for (D) to provide the same manipulated variable as that for the proportional (P) action. As the differential time increases, greater response is made to a deviation change.

(6) PID gain setting for under-set point value *(Pr. 135 to Pr. 137)*

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
135	**PID proportional band for under-set point value**	0.1 to 1000%, 9999	0.1%	9999	*Pr. 129* when 9999 is set.
136	**PID integral time for under-set point value**	0.1 to 3600s, 9999	0.1s	9999	*Pr. 130* when 9999 is set.
137	**PID differential time for under-set point value**	0.01 to 10s, 9999	0.01s	9999	*Pr. 134* when 9999 is set.

PID gain can be set individually with *Pr. 135 to Pr. 137* when deviation of dancer roll position signal (terminal 1) is negative against the desired set point. When the setting is 9999, settings in *Pr. 129, Pr. 130, Pr. 134* are active independently of negative or positive deviation.

3.7.2 Dancer roll target position (Pr. 133, Pr. 702, Pr. 731)

(1) Dancer signal input selection *(Pr. 731)*

Use *Pr. 731* to assign a terminal for the dancer signal input.

Setting in *Pr.731*	Input terminal
3	Terminal 2 (0 to 100%)
4	Terminal 4 (0 to 100%)
5 (Initial value)	Terminal 1 (-100 to 100%)
6	Terminal 6 (-100 to 100%) (FR-A7AZ)

(2) PID set point *(Pr. 133)*

Set the desired set point (%) with parameter.

Set the target position of dancer roll (center position) in *Pr. 133*.

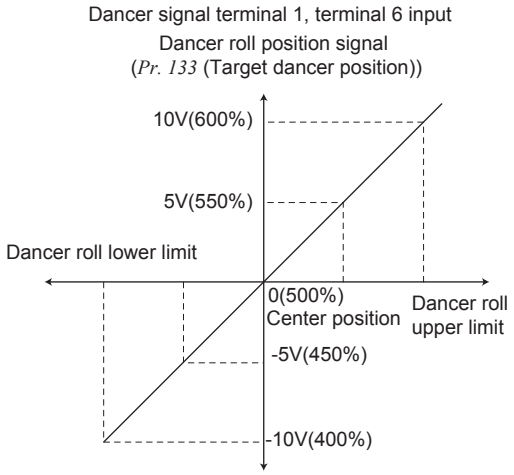
Setting in *Pr.133*	Set point
600%	+100%
500%	0%
400%	-100%

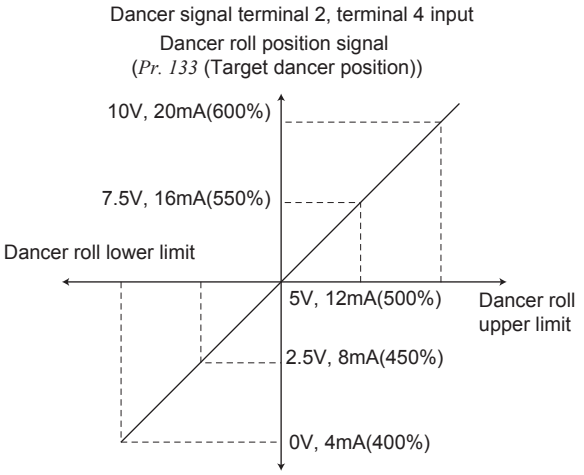
If position signal from dancer roll to the terminal 1 is 10V at the upper limit position, -10V at the lower limit position, and 0V at the center position (target position), set 500% in *Pr. 133*.

If -5V at the center (target position), set 450% to *Pr. 133*.

-10V to 10V of voltage can be input to terminal 1.

Y54 signal is ON when dancer roll, which is viewed from the target position, is within the range set in *Pr. 702* .





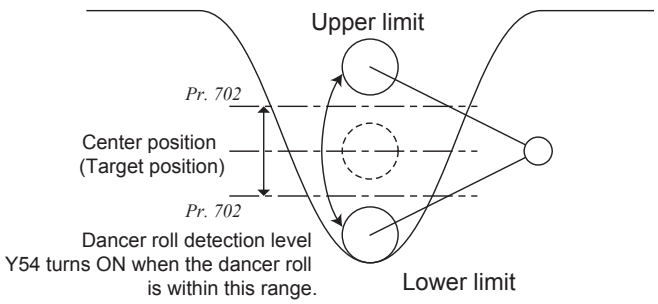
REMARKS

- Dancer position can be monitored in % by setting *Pr. 52* = "27".
- The automatic restart after instantaneous power failure function is disabled when the dancer control is valid (*Pr. 128* = "40, 41").

(3) Dancer roll position detection *(Pr. 702)*

Dancer roll position detection signal Y54 is output when dancer roll, which is viewed from the target position, is within the range set in *Pr. 702*. Set "54 (positive logic) or 154 (negative logic)" in any of *Pr. 190 to Pr. 196 (Output terminal function selection)* to assign Y54 signal to an output terminal.

Parameter Number	Name	Setting Range	Increments	Initial Value
702	**Dancer position detection level**	0 to 100%	0.1%	10%



(4) Dancer roll malposition detection (signal loss detection)

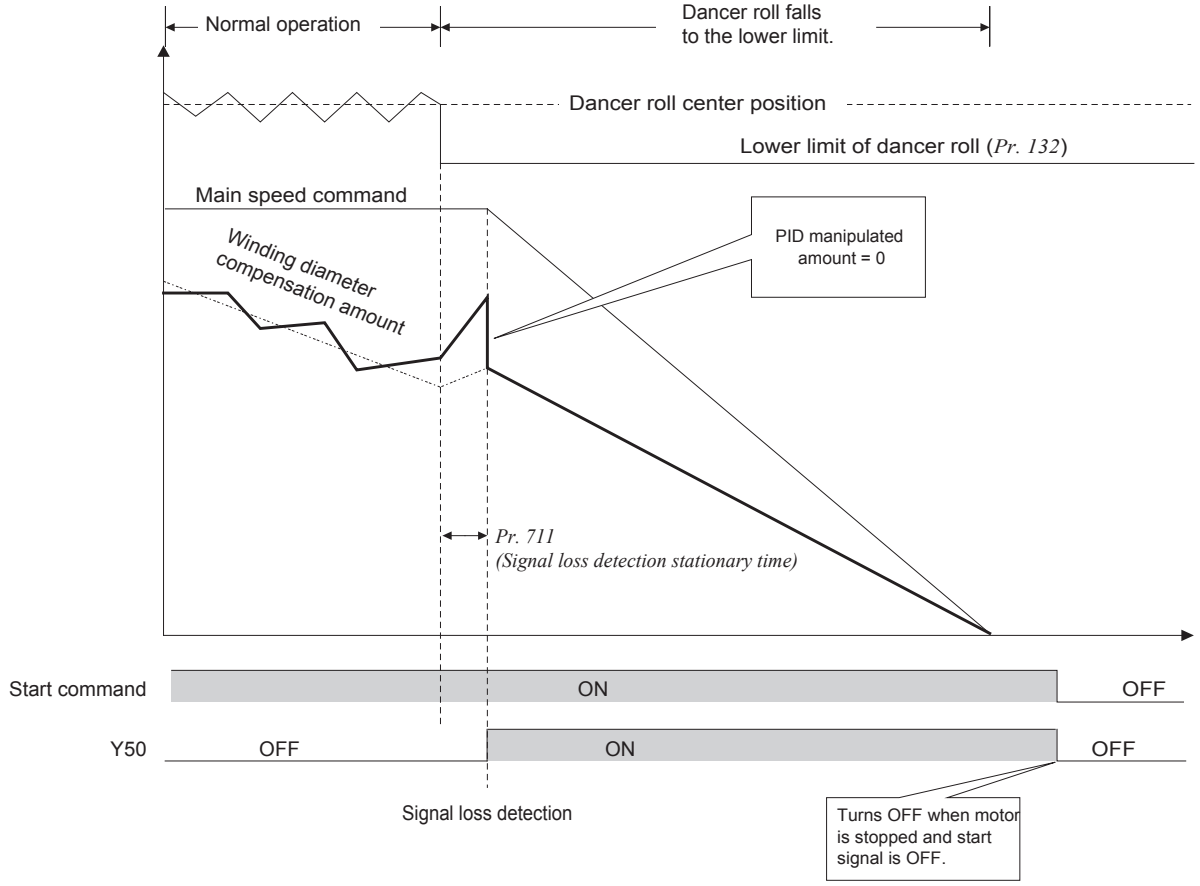
This function prevents motor speed to increase by the dancer control when dancer roll falls by signal loss.

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
131	**PID upper limit**	400 to 600%, 9999	0.1%	9999	400% → -100% 500% → 0% 600% → 100%
132	**PID lower limit**	400 to 600%, 9999	0.1%	9999	
711	**Signal loss detection stationary time**	0 to 100s, 9999	0.01s	9999	9999:No signal loss detection

- If dancer roll stays at the upper limit or the lower limit for more than *Pr. 711 Signal loss detection stationary time* , it is recognized as dancer roll malposition (signal loss), and compensation by PID control becomes 0.
  When below two conditions are both met, dancer control (PID calculation) is resumed.
  1. Motor is stopped or output is shutoff.
  2. Start signal is OFF.

- Y50 signal can be output for dancer roll malposition detection (signal loss detection).
  Set "50 (positive logic) or 150 (negative logic)" in any of *Pr. 190 to Pr. 196 (Output terminal function selection)* to assign Y50 signal to an output terminal.

Pr. 190 to Pr. 196 Setting		Signal	Function	Functions
Positive logic	**Negative logic**			
50	**150**	**Y50**	**Dancer roll signal loss detection**	Output when dancer roll malposition is detected. When below two conditions are met, Y50 signal is canceled. 1. Motor is stopped or output is shutoff. 2. Start signal is OFF.



Output speed at signal loss

3.7.3 Adjustment of target position input (Pr. 708, C3, C4, C6, C7, C13, C15, C31, C33)

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
708	Filter time constant for dancer control input	0 to 5s	0.001s	0s	
C3(902)	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	Calibration of terminal 2
C4(903)	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	
C6(904)	Terminal 4 frequency setting bias	0 to 300%	0.1%	0%	Calibration of terminal 4
C7(905)	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	
C13(917)	Terminal 1 bias (speed)	0 to 300%	0.1%	0%	Calibration of terminal 1
C15(918)	Terminal 1 gain (speed)	0 to 300%	0.1%	100%	
C31(926)	Terminal 6 bias (speed)	0 to 300%	0.1%	0%	Calibration of terminal 6 (for plug-in option FR-A7AZ)
C33(927)	Terminal 6 gain (speed)	0 to 300%	0.1%	100%	

* The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).

Position signal from dancer roll can be filtered by setting *Pr. 708*.
Set the time constant of the first-order lag filter. Set a large time constant when you want to delay the tracking of the speed command, when the analog input voltage fluctuates, etc.
Above parameters can also be used to calibrate the signal of each terminal.

3.7.4 Measured value upper/lower limit detection signal (Pr. 131, Pr. 132)

When the measured value exceeds PID upper limit *(Pr. 131)*, PID upper limit (FUP) signal is output. Likewise, when measured value falls below PID lower limit *(Pr. 132)*, PID lower limit (FDN) signal is output. Set each limit in parameter.
For output signals, assign "14, 114 (FDN)" or "5, 115 (FUP)" to any of *Pr. 190 to 196 (output terminal function selection)* .

Pr. 131, Pr. 132 setting	Limit value
600%	+100%
500%	0%
400%	-100%

3.7.5 PID gain switchover (Pr. 138, Pr. 270 to Pr. 278, Pr. 464 to Pr. 481, X89 signal, X90 signal)

(1) Second to fourth PID gain switchover

PID gain can be switched by ON/OFF of X89 signal and X90 signal.
Set "89(X89)" and "90(X90)" in *Pr. 178 to 189 (input terminal function selection)* to assign X89 and X90 signals.

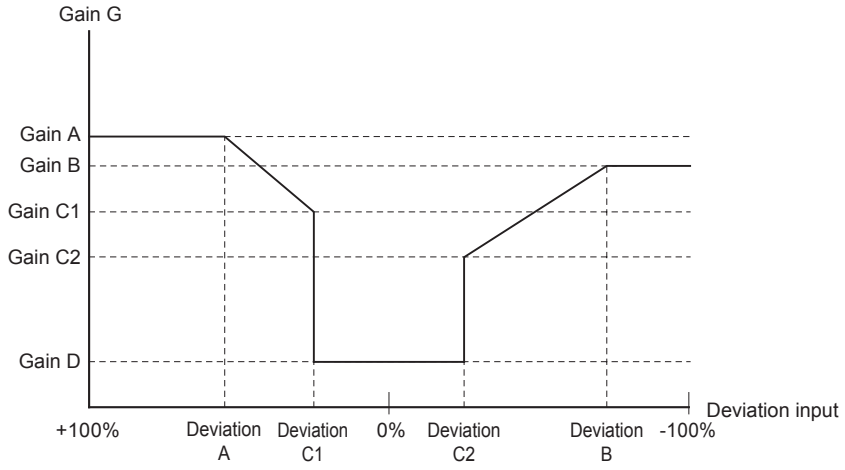
X89	X90	PID gain switchover	Parameters selected	Remarks
OFF	OFF	(First) PID gain	*Pr. 129, Pr. 130, Pr. 134 to Pr. 137*	When set to 9999, first PID gain is selected.
ON	OFF	Second PID gain	*Pr. 464 to Pr. 469*	
OFF	ON	Third PID gain	*Pr. 470 to Pr. 475*	
ON	ON	Fourth PID gain	*Pr. 471 to Pr. 481*	

Parameter Number	Name	Setting Range	Increments	Initial Value
464	Second PID proportional band	0.1 to 1000%, 9999	0.1%	9999
465	Second PID integral time	0.1 to 3600s, 9999	0.1s	9999
466	Second PID differential time	0.01 to 10s, 9999	0.01s	9999
467	Second PID proportional band for under-set point value	0.1 to 1000%, 9999	0.1%	9999
468	Second PID integral time for under-set point value	0.1 to 3600s, 9999	0.1s	9999
469	Second PID differential time for under-set point value	0.01 to 10s, 9999	0.01s	9999
470	Third PID proportional band	0.1 to 1000%, 9999	0.1%	9999
471	Third PID integral time	0.1 to 3600s, 9999	0.1s	9999
472	Third PID differential time	0.01 to 10s, 9999	0.01s	9999
473	Third PID proportional band for under-set point value	0.1 to 1000%, 9999	0.1%	9999
474	Third PID integral time for under-set point value	0.1 to 3600s, 9999	0.1s	9999
475	Third PID differential time for under-set point value	0.01 to 10s, 9999	0.01s	9999
476	Fourth PID proportional band	0.1 to 1000%, 9999	0.1%	9999
477	Fourth PID integral time	0.1 to 3600s, 9999	0.1s	9999
478	Fourth PID differential time	0.01 to 10s, 9999	0.01s	9999
479	Fourth PID proportional band for under-set point value	0.1 to 1000%, 9999	0.1%	9999
480	Fourth PID integral time for under-set point value	0.1 to 3600s, 9999	0.1s	9999
481	Fourth PID differential time for under-set point value	0.01 to 10s, 9999	0.01s	9999

(2) PID position gain switchover *(Pr. 138, Pr. 270 to Pr. 278)*

Gain can be switched according to the deviation between dancer roll position signal (terminal 1 input (initial value)) and desired set point.

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
138	**Integral control presence/ absence**	0 to 3	1	0	
270	**Dancer position A**	400.1% to 600%	0.1%	600	400% → -100% 500% → 0% 600% → 100%
271	**Dancer position B**	400% to 599.9%	0.1%	400	
272	**Dancer position C1**	400.1% to 599.9%, 9999	0.1%	9999	
273	**Dancer position C2**	400.1% to 599.9%, 9999	0.1%	9999	
274	**PID position gain A**	0.1 to 1000%, 9999	0.1%	9999	
275	**PID position gain B**	0.1 to 1000%, 9999	0.1%	9999	
276	**PID position gain C1**	0.1 to 1000%, 9999	0.1%	9999	
277	**PID position gain C2**	0.1 to 1000%, 9999	0.1%	9999	
278	**PID position gain D**	0.1 to 1000%, 9999	0.1%	9999	



$$G \cdot Kp\left(1+\frac{1}{Ti \cdot S}+Td \cdot S\right)$$

Value G of above calculation formula can be changed by the deviation of PID control input.

• Setting for gain

When 9999 is set to *Pr. 274* to *Pr. 278*, gain is operated as 100%.

• Setting for deviation

To use this function, set other than 9999 to *Pr. 272* and *Pr. 273*.

For *Pr. 270* to *Pr. 273*, make the setting to satisfy A>C1≥C2>B. Otherwise, write error occurs.

When C1=C2, larger gain between gain C1 and C2 becomes valid.

•Integral control selection

Whether to perform integral control or not when deviation is between C1 and C2 can be set by *Pr. 138*.

When no integral control is selected, integral value to that point is kept.

Pr. 138	Above A	Between A and C	Between C1 and C2	Between C2 and B	below B
0 (initial value)	Perform	Perform	Perform	Perform	Perform
1	Perform	Perform	Do not perform	Perform	Perform
2	Do not perform	Perform	Perform	Perform	Do not perform
3	Do not perform	Perform	Do not perform	Perform	Do not perform

3.7.6 Speed compensation (Pr. 706, Pr. 798)

Perform speed compensation for the result of PID calculation.

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
706	**Speed compensation gain**	0 to 200%	0.1%	0%	When setting is 0%, *Pr. 798* and X35 are inactive.
798	**Speed compensation bias**	0 to 200%	0.1%	60%	

- Turn X35 signal ON to perform compensation by main rotation speed command.
  For the X35 signal, set "35" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function.

Pr. 178 to Pr. 189 setting	Signal	Function	Description
35	**X35**	**Speed compensation gain selection**	OFF: Speed compensation gain is independent of main speed and does not change with it. ON: Speed compensation gain changes with main speed. Speed compensation gain changes with main speed when X35 signal is not assigned.

(1) When *Pr. 706* = 0% is set (initial value):

Regardless of ON/OFF of X35 signal, speed compensation gain = 100%. The *Pr. 798* setting also becomes disabled.

Speed command value = PID calculation result [%] × speed compensation gain [%] + main speed

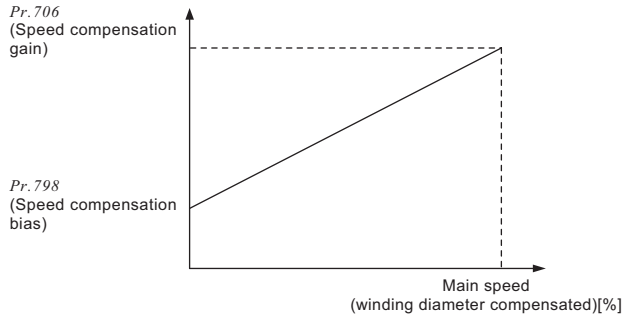
= PID calculation result + main speed

(2) When other than *Pr. 706* = 0%:

When X35 is ON:
PID manipulated variable is 0% at main speed 0%.

Speed command value = PID calculation result [%] × speed compensation gain [%] + main speed

= PID calculation result [%] × { (*Pr. 706* [%] - *Pr. 798* [%]) × main speed [%] + *Pr. 798* [%]} + main speed

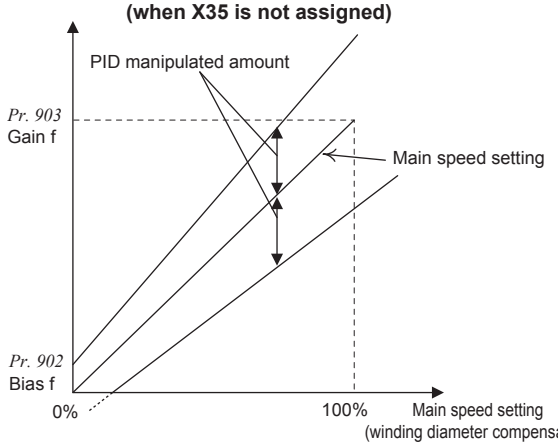


When X35 is OFF:

Speed command value = PID calculation result [%] × speed compensation gain [%] + main speed

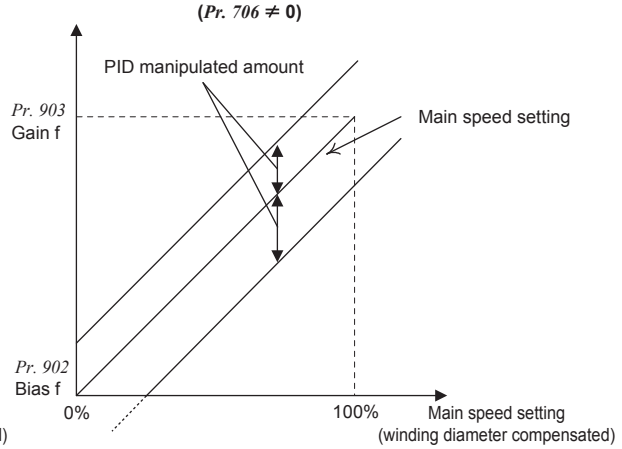
= PID calculation result [%] × *Pr. 706* [%] + main speed

When X35 is ON (fixed compensation rate) (when X35 is not assigned)



Determine the manipulated amount by multiplying the PID calculation result by the following ratio.
PID × *Pr. 706*/100 × speed command [%]/100
The manipulated amount changes with the main speed.
For the calculation, use a value reversely converted into a percentage by *Pr. 902* and *Pr. 903*.

When X35 is OFF (fixed compensation value) (*Pr. 706* ≠ 0)



Determine the manipulated amount by multiplying the PID calculation result by the following ratio.
PID × *Pr. 706*/100
The manipulated amount does not change with the main speed.

(Note) When *Pr. 73* setting is polarity reversible, manipulated amount is also output to the reverse rotation.

3.8 Winding diameter compensation function

POINT

Turn X83 signal ON to perform dancer control, tension control and winding diameter compensation.
When X83 signal is OFF, dancer control, tension control and winding diameter compensation are not performed.
To disable dancer control and perform winding diameter compensation only, turn ON X83 signal and X85 together.
Set "83 (X83)" or "85 (X84)" in *Pr. 178 to Pr. 189 (input terminal function selection)* to assign X83 and X85 signals.

3.8.1 Winding diameter calculation and compensation by winding diameter calculation

(1) Winding diameter calculation

1) Winding diameter calculation using line speed
Calculate winding diameter "D" from input line speed "V" and main speed (actual speed).

$$\pi \cdot D \cdot \omega fb \cdot Z = V \qquad D = \frac{V}{\pi \cdot \omega fb \cdot Z}$$

V : line speed
ωfb : actual motor speed
Z : gear ratio

(Example) Calculation when line speed V = 409.9m/min · actual motor speed ωfb = 659.0r/min · gear ratio Z = 0.396

$$D = \frac{V}{\pi \cdot \omega fb \cdot Z} = \frac{409.9[m/min] \times 1000}{\pi \times 659.0[r/min] \times 0.396} = 499.97[mm]$$

2) Winding diameter calculation using addition of material thickness
Calculate winding diameter "D" from winded (unwinded) material thickness "d".

$$D = D1 \pm 2 \cdot d \cdot N \cdot Z$$

D1 : initial diameter
d : material thickness
N : roll rotation number
Z : gear ratio

(2) Target line speed

Calculate target line speed "V*", which is desired to be constant, from main speed setting "ω*" and initial diameter.

$$V^* = \pi \cdot D1 \cdot \omega^* \cdot Z$$

ω* : main speed setting (r/min)
D1 : initial diameter
Z : gear ratio

(3) Main speed compensation amount calculation

Calculate main speed compensation amount from the diameter "D", which is obtained from winding diameter calculation (or from stored winding diameter), and target line speed "V*", which is desired to be constant.

$$\omega = \frac{V^*}{\pi \cdot D \cdot Z}$$

ω : main speed compensation
D : winding diameter calculation result (stored winding diameter)
V* : line speed which is desired to be constant
Z : gear ratio

3.8.2 Line speed input setting (Pr. 763 to Pr. 768)

(1) Line speed input selection (*Pr. 763*)

Select input terminal of line speed command to perform winding diameter calculation.
When material thickness is set to *Pr. 752 Material thickness d1* (*Pr. 752* ≠ "9999"), calculate winding diameter not from line speed but from the addition of material thickness and rotation number of a roll, but not from line speed. *(Refer to page 35)*.

Pr.763 Line speed input selection	Unit	Line speed input terminal
0 (initial value)	—	— (Calculate line speed from main speed)
1	Pulse (kpps)	Terminal JOG single-phase pulse train input
2		FR-A7AP connection: encoder pulse input (24V open collector/5V differential (A, B phase)) *1
3	Voltage (V)/ Current (mA)	Terminal 2 input (analog value 0 to 100%) *2
4		Terminal 4 input (analog value 0 to 100%) *3
5		Terminal 1 (analog value 0 to 100%)
6		Terminal 6 (analog value 0 to 100%) (FR-A7AZ)
7	pulse [kpps]	FR-A7AL connection: single-phase pulse train input

*1 Not available during vector control.
*2 To switch among 0 to 5VDC, 0 to 10VDC, and 0 to 20mA, use *Pr. 73* setting as well as voltage/current input switch. (Refer to the Instruction Manual for details.)
*3 To switch among 0 to 20mA, 0 to 10VDC, and 0 to 5VDC, use *Pr. 267* setting as well as voltage/current input switch. (Refer to the Instruction Manual for details.)

(2) Unit conversion for line speed *(Pr. 764, Pr. 765, Pr. 766, Pr. 767)*

Convert pulse input unit (kpps) and analog input unit (%), which are selected in *Pr.763 Line speed input selection*, to line speed unit (mm(m)/min(sec)).

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
764	**Pulse reference for line speed input**	0.01 to 200kpps	0.01kpps	30kpps	
765	**Voltage reference for line speed input**	0.1 to 100%	0.1%	50%	
766	**Line speed reference**	1.0 to 6553.4	0.1	1000.0	
767	**Line speed unit**	0, 1, 2, 3	1	0	0 : m/min 1 : m/sec 2 : mm/min 3 : mm/sec

(3) Input filter *(Pr. 768)*

Set the time constant of the first-order lag filter. Set a large time constant when you want to delay the tracking of the speed command, and when the analog input voltage fluctuates, etc.
Filters can be applied to pulse train input when *Pr. 763* = "1, 2 or 7" by using *Pr. 768 Line speed input filter time constant*.
Filters can be applied to analog input with input filter time constant of *Pr. 74* when *Pr. 763* = "3, 4, 5 or 6".

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
768	**Line speed input filter time constant**	0 to 5s	0.001s	0.025s	0: without filter

3.8.3 Setting at driving shaft (Pr. 762, Pr. 773, Pr. 774, X56 signal)

(1) Winding/unwinding selection with parameter *(Pr. 762)*

Select whether driving roll is a winding shaft or unwinding shaft.
(Initial winding diameter of winding shaft is the minimum diameter, initial winding diameter of unwinding shaft is the maximum diameter.)

Pr. 762 Winding/unwinding selection	Winding/unwinding
0	Winding
1	Unwinding

(2) Winding/unwinding selection by external terminal input (X56 signal)

When **X56 is assigned to any input terminal *(Pr. 178 to Pr. 189)*, the setting in *Pr. 762* becomes disabled,** and winding/unwinding shaft is selected by the ON/OFF of input terminal.

X56 signal	Winding/unwinding
ON	Winding
OFF	Unwinding

(3) Gear ratio calculation *(Pr. 773, Pr. 774)*

Set a gear ratio when a reduction gear is installed between the driving shaft and motor shaft.

Parameter Number	Name	Setting Range	Increments	Initial Value
773	**Gear ratio numerator (driver side)**	1 to 65534	1	1
774	**Gear ratio denominator (follower side)**	1 to 65534	1	1

Gear ratio calculation

$$\text{Gear ratio } Z = \frac{Pr.\ 773}{Pr.\ 774}$$

POINT

Set the gear ratio accurately.
The gear ratio is recommended to be in the range of 1/50 to 1/20.

3.8.4 Material thickness, maximum/minimum winding diameter setting (Pr. 720 to Pr. 727, Pr. 752 to Pr. 755, X53 signal, X54 signal)

(1) Winding diameter calculator setting by the material thickness *(Pr. 752 to Pr. 755)*

When a value other than 9999 is set in *Pr. 752*, the winding diameter is calculated from the product of the material thickness and the number of rotations of the roll.
To select this method, input encoder pulses by using optional FR-A7AP or FR-A7AL.
The material thickness can be selected by switching ON/OFF external input terminal X53/X54.

Parameter Number	Name	Setting Range	Increments	Initial Value
752	Material thickness d1	0 to 20mm, 9999	0.001mm	9999
753 to 755	Material thickness d2 to Material thickness d4	0 to 20mm	0.001mm	1mm

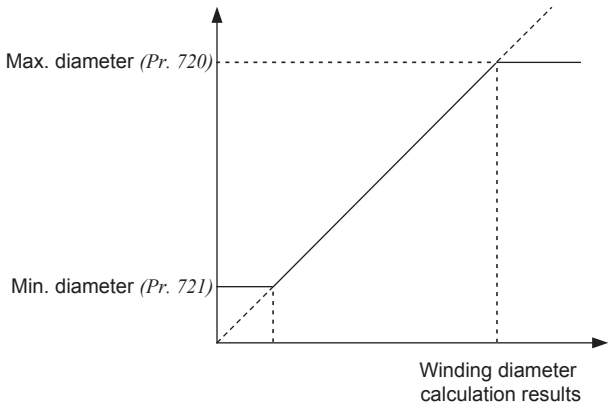
(2) Minimum winding diameter/maximum winding diameter selection *(Pr. 720 to Pr. 727)*

Winding diameter calculation values are clamped at minimum diameter *(Pr. 721)* and at maximum diameter *(Pr. 720)*.

Parameter Number	Name	Setting Range	Increments	Initial Value
720	Maximum winding diameter 1	1 to 6553mm	1mm	2mm
721	Minimum winding diameter 1	1 to 6553mm	1mm	1mm
722	Maximum winding diameter 2	1 to 6553mm	1mm	2mm
723	Minimum winding diameter 2	1 to 6553mm	1mm	1mm
724	Maximum winding diameter 3	1 to 6553mm	1mm	2mm
725	Minimum winding diameter 3	1 to 6553mm	1mm	1mm
726	Maximum winding diameter 4	1 to 6553mm	1mm	2mm
727	Minimum winding diameter 4	1 to 6553mm	1mm	1mm

REMARKS

Make *Pr. 720* setting larger than *Pr. 721*.
If *Pr .721* ≥ *Pr. 720*, winding diameter calculator does not operate.



(3) Minimum winding diameter/maximum diameter and material thickness selection by external terminal input (X53 signal, X54 signal)

By switching ON/OFF X53 signal and X54 signal, minimum/maximum winding diameter can be selected.
For the X53/X54 signal, set "53(X53)/54(X54)" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function.
When X53/X54 are not assigned, maximum diameter is *Pr. 720*, and minimum diameter is *Pr. 721*.
Material thickness 1 to 4 can be selected with X53/X54 signals when the winding diameter calculation method based on the material thickness is selected.

External input signal		Maximum winding diameter/minimum winding diameter	Material thickness
X53	X54		
OFF	OFF	Maximum winding diameter 1 *Pr. 720*/Minimum diameter 1 *Pr. 721*	Material thickness d1 *Pr. 752*
ON	OFF	Maximum winding diameter 2 *Pr. 722*/Minimum diameter 2 *Pr. 723*	Material thickness d2 *Pr. 753*
OFF	ON	Maximum winding diameter 3 *Pr. 724*/Minimum diameter 3 *Pr. 725*	Material thickness d3 *Pr. 754*
ON	ON	Maximum winding diameter 4 *Pr. 726*/Minimum diameter 4 *Pr. 727*	Material thickness d4 *Pr. 755*

POINT

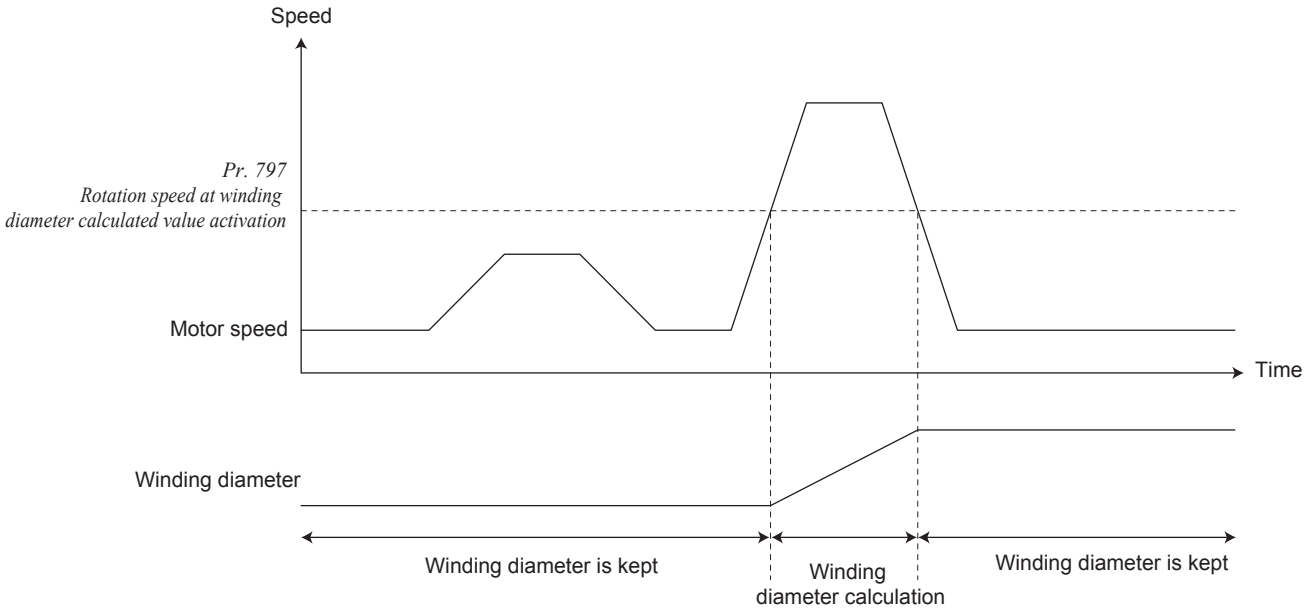
Set the maximum diameter at unwinding and the minimum diameter at winding accurately.

3.8.5 Rotation speed at winding diameter calculated value activation (Pr. 797)

Parameter Number	Name	Setting Range	Increments	Initial Value
797	**Rotation speed at winding diameter calculated value activation**	0 to 400Hz	0.01Hz	3Hz

When rotation speed of motor reaches or becomes faster than *Pr. 797 Rotation speed at winding diameter calculated value activation*, winding diameter calculation is performed, and result of winding diameter calculation is updated.
When rotation speed does not reach *Pr. 797 Rotation speed at winding diameter calculated value activation*, winding diameter calculation is not performed and last winding diameter value is kept.
Change of winding diameter, which is caused by calculation error at low-speed operation, can be reduced.

Winding diameter calculation is performed when main rotation speed reaches or becomes faster than *Pr. 797*.
Result obtained from winding diameter calculation is kept when main rotation speed does not reach *Pr. 797*.



REMARKS

This function is disabled when initial diameter calculation function is valid.

3.8.6 Storage and clear of winding diameter calculation result (Pr. 781 to Pr. 783, X55 signal)

Results of winding diameter calculation can be stored in inverter.

Parameter Number	Name	Setting Range	Increments	Initial Value
781	Winding diameter storage selection	0, 1	1	0
782	Stored winding diameter	1 to 6553	1mm	1mm
783	Operation time with stored winding diameter	0.00 to 100.00s	0.01s	0s

(1) Winding diameter storage selection *(Pr. 781)*

Select whether to store winding diameter or not when main power or winding diameter compensation function turns OFF by setting *Pr. 781 Winding diameter storage selection*.

Pr. 781 Setting	Winding diameter storage	Initial winding diameter when power or winding diameter compensation function turns ON.
0	Does not store winding diameter	Maximum winding diameter *(Pr. 720, Pr. 722, Pr. 724, Pr. 726)* or minimum winding diameter *(Pr. 721, Pr. 723, Pr. 725, Pr. 727)* are used as the initial winding diameter.
1	Stores winding diameter	Stored winding diameter in an inverter are used as the initial winding diameter. Winding diameter is stored when power or winding diameter compensation function turns OFF. The last stored winding diameter are used as the initial winding diameter when the power or winding diameter compensation function turns ON.

Winding diameter is kept independently of *Pr. 781* setting when start commands (STF, STR) are OFF.
The winding diameter compensation function can be turned ON/OFF by X83 signal, *Pr. 771* setting, and a prioritized operation such as JOG operation.
If the calculated winding diameter is no greater than ± 10mm of last stored diameter when winding diameter compensation function is OFF, the calculated winding diameter is not stored.
The values are rounded to the nearest integer.
Stored winding diameter can be cleared with X55 signal.

REMARKS

If the power supply is disconnected, the winding diameter may be lost. To make sure that the winding diameter is stored, use X83 signal to turn OFF the winding diameter compensation function.

(2) Stored winding diameter *(Pr. 782)*

Winding diameter presently stored can be monitored with *Pr. 782*.
Stored winding diameter can be changed by overwriting desired value in *Pr. 782*.

(3) Operation time with stored winding diameter *(Pr. 783)*

Winding diameter is kept for the duration set in *Pr. 783* after start command is given.
Set any value other than "0" (0.01s increments) when using winding diameter storage (*Pr. 781* = "1").

(4) Stored winding diameter clear (X55)

Stored winding diameter is cleared when X55 turns ON from OFF. After the clear, winding diameter is decided by setting of *Pr. 762 Winding/unwinding selection* and ON/OFF of X53 to X56 signals. *(Refer to page 35)*
For the X55 signal, set "55" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function.

X55 signal	Winding/unwinding selection (*Pr. 762* , X56)	Value after stored winding diameter clear (X53/X54)
OFF → ON	Winding (*Pr. 762* ="0" or X56 signal ON)	Minimum value (*Pr. 721, Pr. 723, Pr. 725, Pr. 727*)
	Unwinding (*Pr. 762* ="1" or X56 signal OFF)	Maximum value (*Pr. 720, Pr. 722, Pr. 724, Pr. 726*)

When exchanging a spool in a winding (unwinding) shaft, always perform stored winding diameter clear (turn ON X55) and set to the initial value.

3.8.7 Sampling time and restricted increase of winding diameter (Pr. 707, Pr. 771, Pr. 772, Pr. 786)

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
707	**Sampling time for winding diameter calculation**	0.01 to 1s, 9999	0.01s	9999	When 9999, approx. 10ms
771	**r-r' limit value (diameter)**	0 to 9.998, 9999	0.001mm	1mm	When 9999, no calculation
772	**r-r' limit disable time**	0 to 100s	0.01s	0s	
786	**Number of averaging for winding diameter calculation**	0 to 10	1	4	

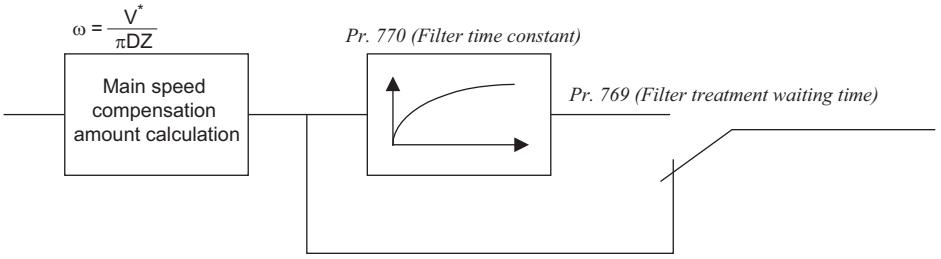
- Set the sampling time for winding diameter calculation in *Pr. 707*. Set how often winding diameter calculation needs to be performed.
- To avoid sudden change of calculated winding diameter, amount of change per sampling can be restricted with *Pr. 771*.
- Setting the duration to inactivate *Pr. 771* to *Pr. 772* may be useful to roll up material to the specified winding diameter faster at an operation start. However, be cautious to use this function because the winding diameter may change drastically causing dancer roll to swing up and down during the set time in *Pr. 722*.
- When speed ripples happen frequently, set greater number in *Pr. 786* to reduce the influence of speed ripples.

3.8.8 Filter treatment for compensated main rotation speed by winding diameter calculation (Pr. 769, Pr. 770)

Compensated main rotation speed by winding diameter calculation can be filtered.

Parameter Number	Name	Setting Range	Increments	Initial Value
769	**Filter treatment waiting time**	0 to 100s	0.01s	0s
770	**Filter time constant**	0 to 100s	0.01s	0s

- Set a waiting time before applying first-order lag filter to main speed, which is compensated by winding diameter calculation, in *Pr. 769* after a start.
- In *Pr. 770*, set a filter time constant which will be applied to compensated main rotation speed by winding diameter calculation . When "0" is set, no filter is applied.



3.8.9 Winding diameter calculation at start (Pr. 133, Pr. 712, Pr. 790 to Pr. 796)

Winding diameter is calculated when dancer roll moves from the upper limit position to the target position or from the lower limit position to the target position at a start.

Parameter Number	Name	Setting Range	Increments	Initial Value
133	Target dancer position	400% to 600%, 9999	0.01%	500%
712	Initial winding diameter calculation dead zone 2	0 to 50%, 9999	0.1%	9999
790	Initial winding diameter calculation start point	400% to 600%	0.01%	400%
791	Initial winding diameter calculation dead zone	0 to 50%	0.1%	1%
792	Accumulated amount	1 to 5000mm, 8888, 9999	1mm	160mm
793	Speed control P gain at a start	0 to 1000%	1%	60%
794	Speed control integral time at start	0 to 20s	0.001s	2s
795	Integral term limit at a start	0 to 100%	0.1%	2.5%
796	PID term limit at a start	0 to 100%	0.1%	2.5%

(1) Winding diameter calculation at start

Calculate initial winding diameter "D" from the accumulated amount "L" when dancer roll moves from the upper limit position to the center position or from the lower limit position to the center position at a start.

$$D = \frac{2 \cdot L}{\pi \cdot n \cdot Z}$$

L : accumulated amount
n : motor rotation number
Z : gear ratio

When an encoder is used (vector control), number of motor rotation "n" is calculated from the number of encoder pulses.
When encoder is not used (V/F control, Advanced magnetic flux vector control, Real sensorless vector control), number of motor rotation "n" is calculated from the integration of output frequency "f".

$$n = \int \frac{120 \cdot f}{P} \cdot dt$$

P : number of motor poles

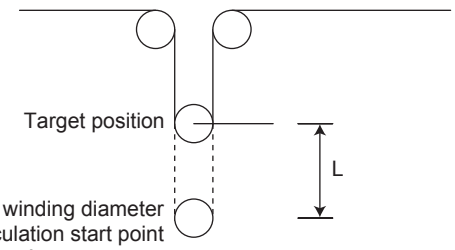
When *Pr. 792* = "8888", dancer roll is lifted with PI gain at a start, but initial winding diameter calculation is not performed. This operation is useful to wind up sagging material slowly.
When *Pr. 792* = "9999", winding diameter calculation is not performed, and the winding diameter, which has been used, is kept. In a case like this, use PI gain of speed control for normal operation instead of gain for winding diameter calculation.

CAUTION

Do not use *Pr. 78 Reverse rotation prevention selection* when using initial winding diameter calculator function.
Set *(Pr. 73) Polarity reversible setting* to adjust the overshoot amount at an initial winding diameter calculation.
To minimize fluctuation of dancer roll when shifting from initial winding diameter calculation to normal operation, set *Pr. 13* = "0".

(2) Initial winding diameter calculation start point *(Pr. 790)*, Accumulated amount *(Pr. 792)*

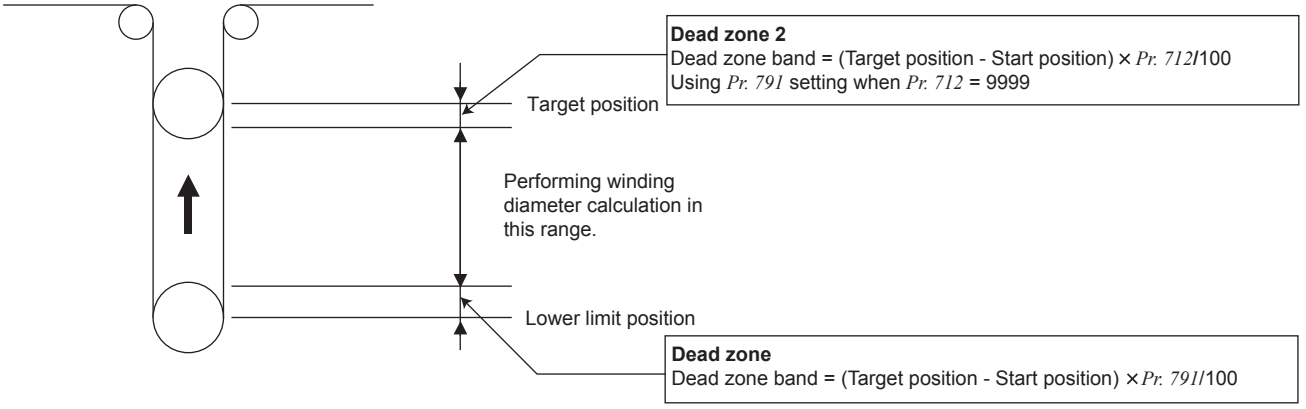
Set *Pr. 790 Initial winding diameter calculation start point* and *Pr.792 Accumulated amount* for the initial winding diameter calculation.



Accumulated amount = 2 × L

(3) Initial winding diameter calculation dead zone *(Pr. 791)*, Initial winding diameter calculation dead zone 2 *(Pr. 712)*

When performing initial winding diameter calculation, initial winding diameter calculation dead zone for dancer position can be set.



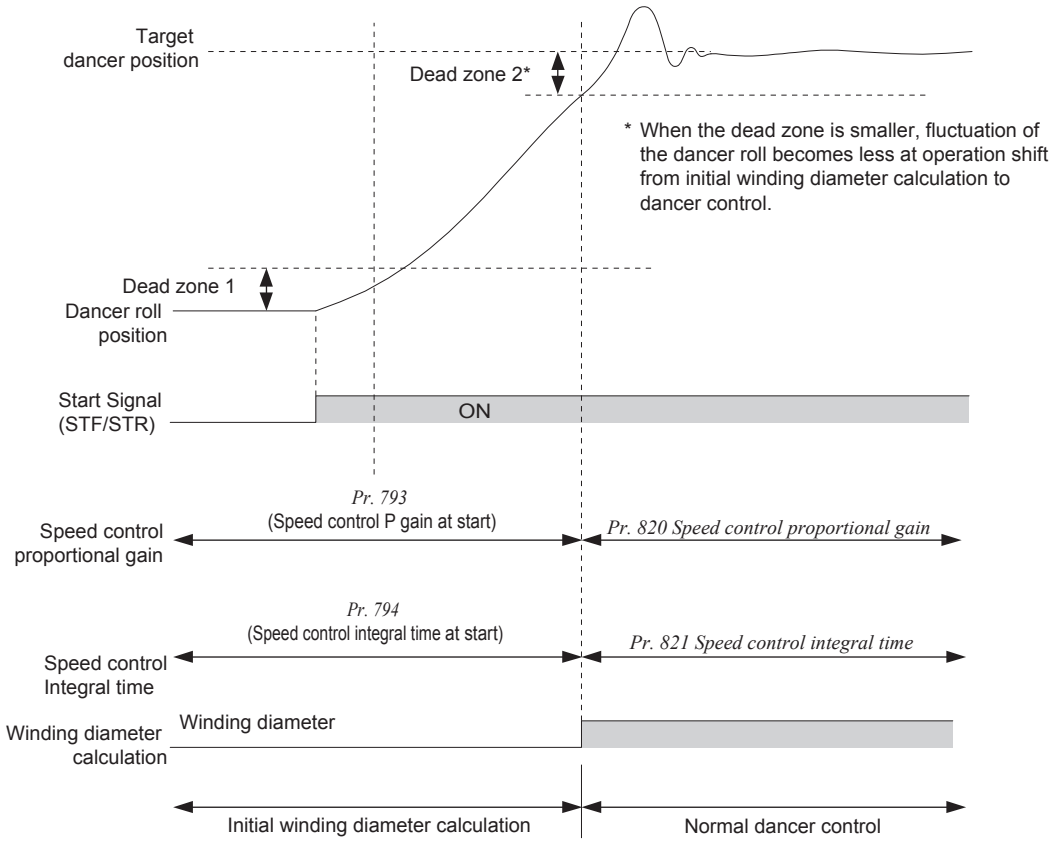
POINT

To set a dead zone, adjust *Pr. 792 Accumulated amount* for the amount of dead zone to accurately calculate the winding diameter.

(4) Speed control proportion/integral time at a start (*Pr. 793, Pr. 794*)

When performing initial winding diameter calculation under vector control or Real sensorless vector control, inverter's speed control proportional gain and integral time during winding diameter calculation can be set separately.
After winding diameter calculation is completed, normal speed control gain is applied.

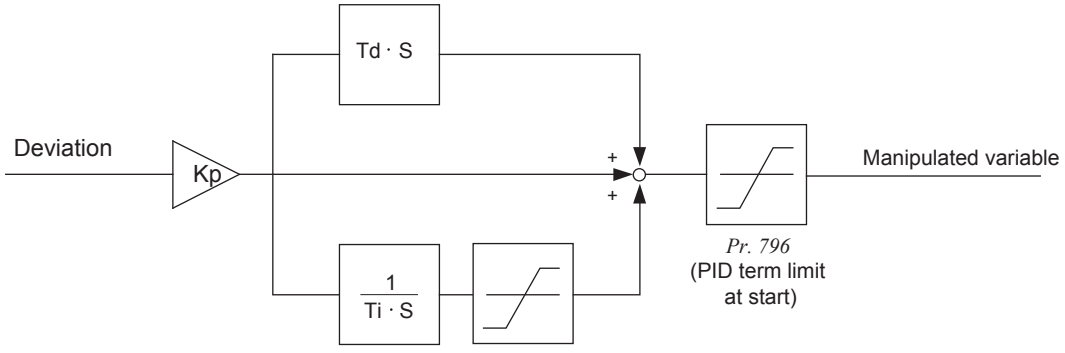
Parameter Number	Name	Setting Range	Increments	Initial Value
793	**Speed control P gain at a start**	0 to 1000%	1%	60%
794	**Speed control integral time at start**	0 to 20s	0.001s	2s



(5) Integral term limit at start *(Pr. 795)*/ PID term limit at start *(Pr. 796)*

Set the limit for manipulated variable of PID control for dancer roll to prevent a motor from over-speeding at an initial winding diameter calculation. Set the limit for integral control action of PID control in *Pr. 795*, and set the limit for manipulated variable of PID control in *Pr. 796*.

$$\text{PID calculated value} = kp\left(1 + \frac{1}{Ti \cdot S} + Td \cdot S\right)$$



(6) Output signal for winding diameter calculation completion at start (Y51 signal)

After winding diameter calculation at start is completed, Y51 signal can be output. Completion of winding diameter calculation can be checked by looking at Y51 signal when using initial winding diameter calculator function.

After Y51 signal turns ON, increase the main speed setting, and accelerate the line speed. (Provide mechanical interlocks for operation of devices and Y51 signal)

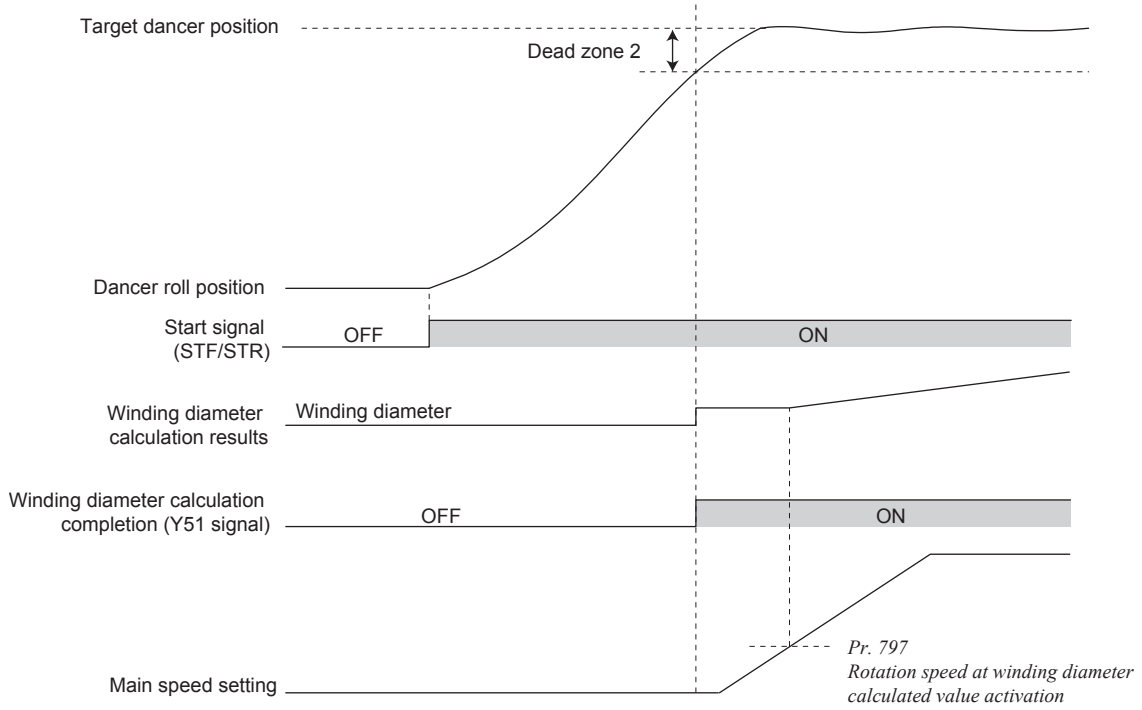
If the dancer roll falls below the initial winding diameter calculation start point during STF=OFF, the signal output becomes OFF.

Set "51 (positive logic) or 151 (negative logic)" in any of *Pr. 190 to Pr. 196 (Output terminal function selection)* to assign Y51 signal to an output terminal.

Pr. 190 to Pr.196 Setting		Signal	Function	Description
Positive logic	Negative logic			
51	151	Y51	Winding diameter calculation completion at a start	The signal is output when winding diameter calculation at a start is completed.

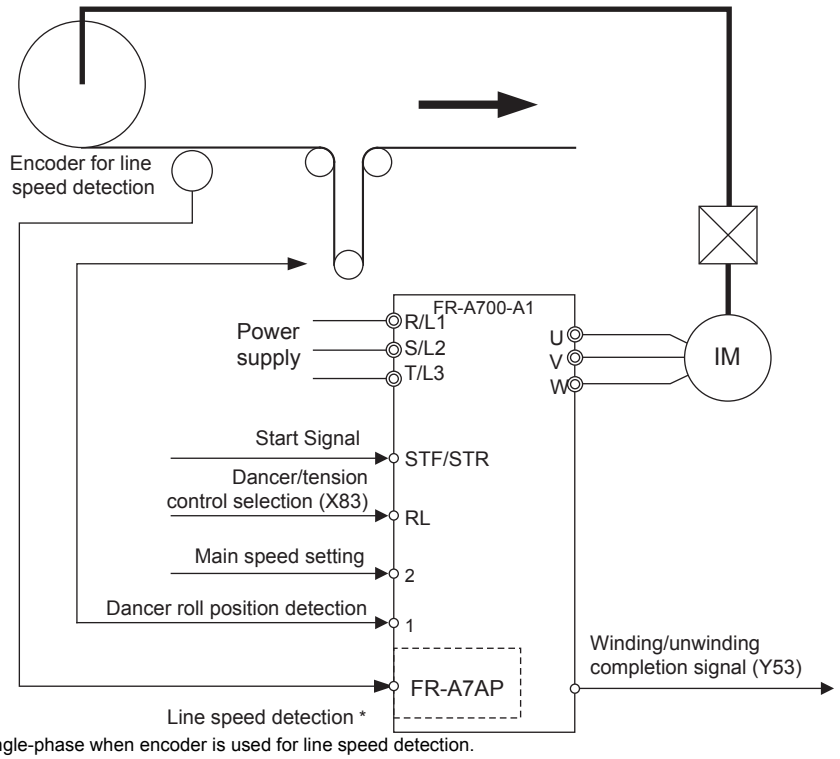
REMARKS

Y51 signal is in OFF state during reset.



3.8.10 Storage and clear of winding/unwinding length (Pr. 279 to Pr. 281, X86 signal, Y53 signal)

When selecting line speed input (*Pr. 763* = 1 to 7), winding (unwinding) length can be displayed.



* Use JOG terminal for single-phase when encoder is used for line speed detection.

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
279	**Winding/unwinding length detection**	0 to 9999	1	1000	Unit can be changed with *Pr. 280*
280	**Winding/unwinding length unit**	0, 1, 2, 3	1	0	0: 1m 1: 10m 2: 100m 3: 1km
281	**Stored winding/unwinding length**	0 to 9999	1	0	Unit can be changed with *Pr.280*

(1) Winding diameter storage selection *(Pr. 781)*

By setting *Pr. 781 Winding diameter storage selection* to "1", winding (unwinding) length is stored.
Winding (unwinding) length is stored at the same time with winding diameter. (Refer to page *37* for unwinding diameter storage.)

(2) Stored winding/unwinding length *(Pr. 281)*

Winding or unwinding length presently stored can be monitored with *Pr. 281*.
Stored winding length can be changed by overwriting a desired value in *Pr. 281*.

(3) Stored winding/unwinding length clear (X86 signal)

Stored winding or unwinding length is cleared when X86 signal turns ON.
Set "86" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign X86 signal.
(Stored winding/unwinding length is not cleared by stored winding diameter clear (X55 signal input).)

(4) Winding/unwinding length detection (Y53 signal)

Winding/unwinding completion signal (Y53) turns ON when winding (unwinding) length of material exceeds the set length in *Pr. 279 Winding/unwinding length detection*.
Set "53 (positive logic) or 153 (negative logic)" in any of *Pr. 190 to Pr. 196 (Output terminal function selection)* to assign Y53 signal to an output terminal.

3.9 Main speed setting

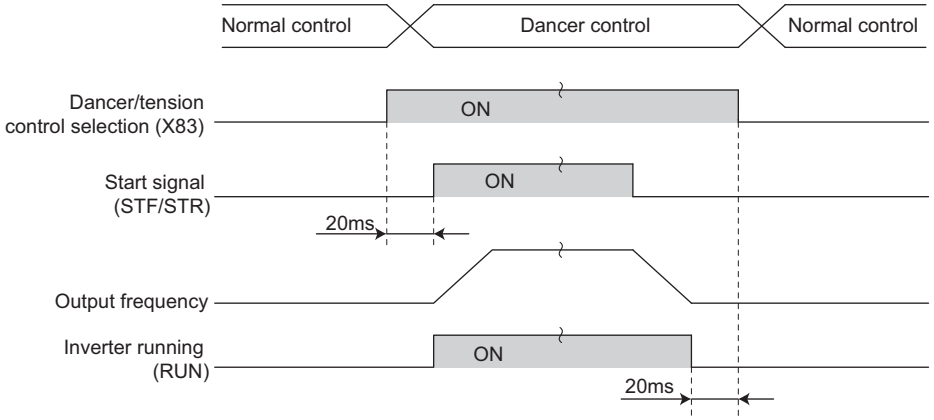
3.9.1 Input method of main speed command (Pr. 732)

Pr.732	Input terminal	Remarks
0 (initial value)	Follows the frequency command	
1	Terminal JOG Single-phase pulse train input	*Pr. 291* must be set.
2	FR-A7AP/FR-A7AL Encoder pulse train input	
3	Terminal 2 (0 to 100%)	Calibrated with *Pr. 125* and *C2 to C4*
4	Terminal 4 (0 to 100%)	Calibrated with *Pr. 126* and *C5 to C7*
5	Terminal 1(-100 to 100%)	Calibrated with *Pr. 125* and *C2 to C4*
6	FR-A7AZ Terminal 6(-100 to 100%)	Calibrated with *C30 to C33*
7	FR-A7AL Single-phase pulse train input	

Setting of main speed is same as the setting at normal operation.

Operation mode	Rotation speed selection	
External operation	Pulse train input	Terminal JOG (single-phase pulse train input) + terminal 4 (compensation)
	Digital input	FR-A7AX (digital input) + terminal 4 (compensation)
	Multi-speed + terminal 4 (compensation)	
	Analog input (terminal 2 + terminal 4 (compensation))	
External/PU combined operation (mode 1)	Multi-speed + terminal 4 (compensation)	
	PU operation (frequency) + terminal 4 (compensation)	
PU/external combined operation (mode 2)	Pulse train input	Terminal JOG (single-phase pulse train input) + terminal 4 (compensation)
	Digital input	FR-A7AX (digital input) + terminal 4 (compensation)
	Multi-speed + terminal 4 (compensation)	
	Analog input (terminal 2 + terminal 4 (compensation))	
Network operation (*Pr. 339* = "0" network)	Network operation (terminal) + terminal 4 (compensation)	
	Network operation (rotation speed setting) + terminal 4 (compensation)	
Network operation (*Pr. 339* = "1" external)	Pulse train input	Terminal JOG (single-phase pulse train input) + terminal 4 (compensation)
	Digital input	FR-A7AX (digital input) + terminal 4 (compensation)
	Multi-speed + terminal 4 (compensation)	
	Analog input (terminal 2 + terminal 4 (compensation))	
PU operation	PU operation (frequency) + terminal 4 (compensation)	

- Main speed changes by the priorities of above operation modes. (JOG signal > X83 signal > multi-speed setting > X14 signal > analog input)
  However, the input method selected for line speed is not available for main speed command.
- Dancer control is not disabled with input of multi-speed.
  However, **dancer control/winding diameter compensation function is disabled by the input of Jog operation (JOG signal)**.
- Main rotation speed selection is only enabled when *Pr. 128* = "40 or 41".
- Terminal 4 input compensation is enabled when *Pr. 785* = "1".
- The terminal 1 is used for frequency compensation inputs during normal operation. To use analog inputs for the normal operation, which is often switched over to the dancer control operation, disable the function of the terminal 1 by setting "9999 (no function)" in *Pr. 868 Terminal 1 function assignment*.
- To switch between dancer control operation and normal operation during operation, **leave 20ms or more for the initialization of dancer control/winding diameter compensation as shown in the following chart.**



3.9.2 Main speed command by analog input

(1) Analog input gain selection (*Pr. 728 to Pr. 730*, X87 signal, X88 signal)

The gain of analog input for the main speed setting can be changed by X87 signal and X88 signal.
Set "87" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign X87 signal.
Set "88" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign X88 signal.

Terminal input		Analog input gain
X87	X88	
OFF	OFF	Gain frequency of the selected analog input terminal
ON	OFF	Main speed analog gain 2 *(Pr. 728)*
OFF	ON	Main speed analog gain 3 *(Pr. 729)*
ON	ON	Main speed analog gain 4 *(Pr. 730)*

(2) Compensation input by terminal 4 *(Pr. 785)*

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
785	**Terminal 4 function setting**	1, 2, 9999	1	9999	1: Compensation input 2: Analog input signal for taper setting 9999: Terminal 4 is disabled

Main rotation speed is compensated when *Pr.785* = "1" (Terminal 4 input compensation).
All of main rotation speed commands are compensated with terminal 4.

Terminal 4 function setting *(Pr.785)*	Analog input selection *(Pr.73)*	Function		Terminal 4 function
		Override	Polarity reversible	
9999	—	×	×	No function
1	0			Additional compensation for frequency command
	1			
	2			
	3			
	4	○		Override signal
	5			
	6	×		Additional compensation for frequency command
	7			
	10		○	
	11			
	12			
	13			
	14	○		Override signal
	15			
	16	×		Additional compensation for frequency command
	17			
	Out of range			
2	—	—	—	Analog input signal for taper setting

(3) Override bias/gain *(Pr. 252, Pr. 253)*

Extended range of override is available when override is selected in *Pr. 73 Analog input selection*.

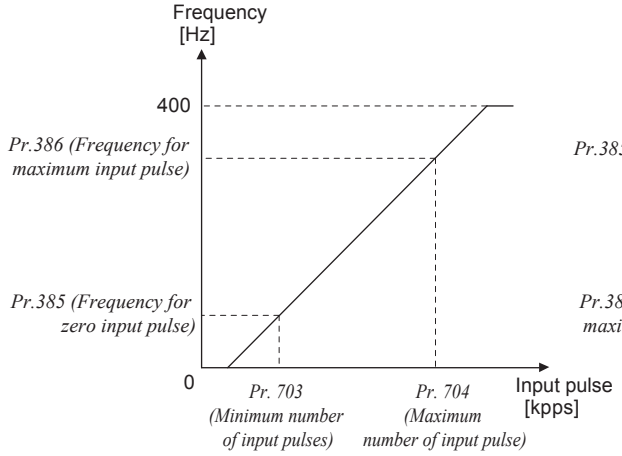
Parameter Number	Name	Setting Range	Increments	Initial Value
252	**Override bias**	0 to 1000%	0.1%	50%
253	**Override gain**	0 to 1000%	0.1%	150%

3.9.3 Main speed command by terminal JOG single-phase pulse train input (Pr. 384 to Pr. 386, Pr. 703, Pr. 704)

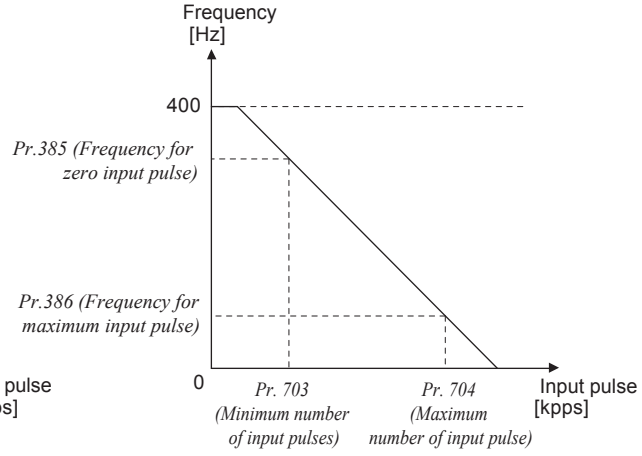
At JOG input (single-phase pulse train input), input from terminal JOG is converted to main rotation speed frequency (Hz).
Pulse input unit (kpps) → main rotation speed frequency (Hz)
The following shows conversion methods of pulse input, which is input to terminal JOG, to a main rotation speed frequency.
Set *Pr. 384 Input pulse division scaling factor* = "1"

Parameter Number	Name	Setting Range	Increments	Initial Value
384	**Input pulse division scaling factor**	0 to 250	1	0
385	**Frequency for zero input pulse**	0 to 400Hz	0.01Hz	0Hz
386	**Frequency for maximum input pulse**	0 to 400Hz	0.01Hz	60Hz
703	**Minimum number of input pulse**	0 to 100kpps	0.01kpps	0kpps
704	**Maximum number of input pulse**	0 to 100kpps	0.01kpps	100kpps

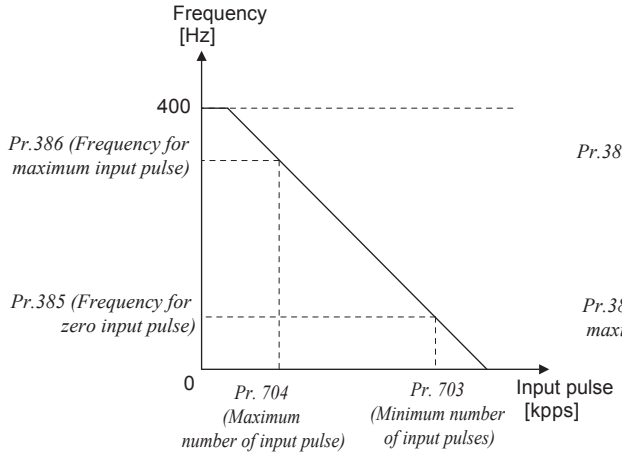
1) ***Pr. 385 < Pr. 386, Pr. 703 < Pr. 704***



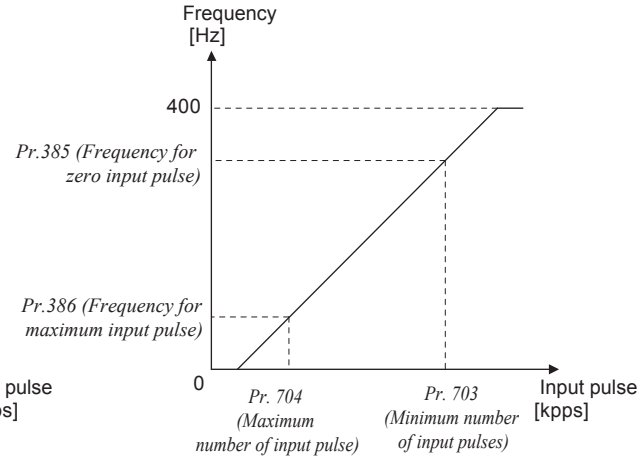
2) ***Pr. 385 > Pr. 386, Pr. 703 < Pr. 704***



3) ***Pr. 385 < Pr. 386, Pr. 703 > Pr. 704***



4) ***Pr. 385 > Pr. 386, Pr. 703 > Pr. 704***



3.9.4 Acceleration/deceleration time setting (Pr. 756 to Pr. 761, X51 signal, X52 signal)

(1) Acceleration/deceleration time setting for main speed *(Pr. 756 to Pr. 761)*

Set acceleration/deceleration time for main speed by setting acceleration time *(Pr. 756, Pr. 758, Pr. 760)* and deceleration time *(Pr. 757, Pr. 759, Pr. 761)*. Setting range and minimum setting increments of *Pr. 756, Pr. 758, Pr. 760, Pr. 757, Pr. 759, Pr. 761* change with the setting of *Pr. 21 Acceleration/deceleration time increments*.

Pr. 21 Setting	Acceleration/Deceleration Time	Minimum Setting Increments	Setting Range
0	*Pr. 756, Pr. 757, Pr. 758, Pr. 759, Pr. 760, Pr. 761*	0.1s	0 to 3600s
1		0.01s	0 to 360s

(2) Second and third acceleration/deceleration time selection for main speed (X51 signal, X52 signal)

Acceleration/deceleration time for main speed can be selected with X51 signal and X52 signal.
Set "51" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign X51 signal.
Set "52" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign X52 signal.

External Terminal Input		Acceleration/Deceleration Time
X51	X52	
OFF	OFF	First acceleration/deceleration time for main speed *(Pr. 756, Pr. 757)*
ON	OFF	Second acceleration/deceleration time for main speed *(Pr. 758, Pr. 759)*
OFF	ON	Third acceleration/deceleration time for main speed *(Pr. 760, Pr. 761)*
ON	ON	Third acceleration/deceleration time for main speed *(Pr. 760, Pr. 761)*

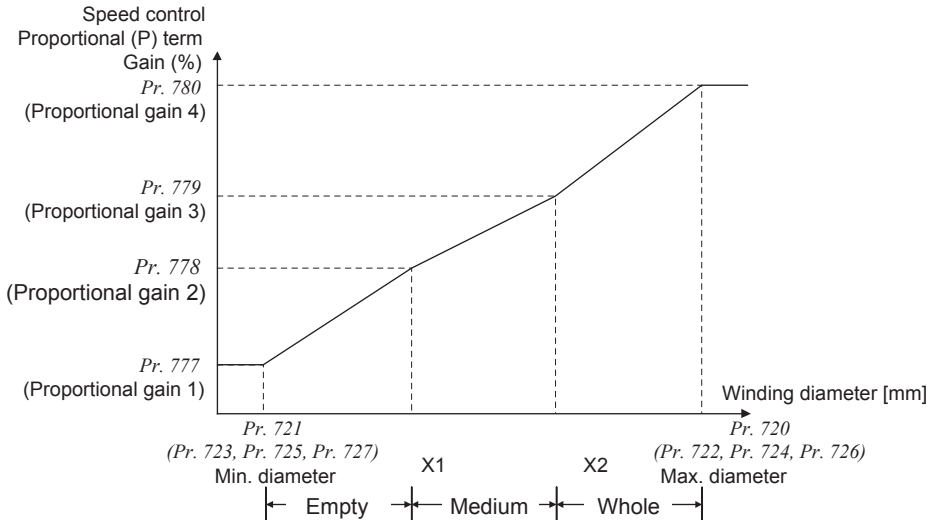
REMARKS

When acceleration/deceleration time set for normal operation *(Pr. 7, Pr. 8, Pr. 44, Pr. 45, Pr. 110, Pr. 111)* are longer than acceleration/deceleration time for the main speed *(Pr. 756 to Pr. 761)*, acceleration/deceleration time for the main speed *(Pr. 756 to Pr. 761)* are disabled.

3.9.5 Speed control proportional gain selection based on winding diameter compensation result (Pr. 775 to Pr. 780)

Speed control proportional gain at vector control and Real sensorless vector control can be changed based on a winding diameter calculation result.

Parameter Number	Name	Setting Range	Increments	Initial Value
775	**Speed control proportion term applied diameter 1**	0 to 100%, 9999	1%	9999
776	**Speed control proportion term applied diameter 2**	0 to 100%, 9999	1%	9999
777	**Speed control proportional gain 1**	0 to 1000%, 9999	1%	9999
778	**Speed control proportional gain 2**	0 to 1000%, 9999	1%	9999
779	**Speed control proportional gain 3**	0 to 1000%, 9999	1%	9999
780	**Speed control proportional gain 4**	0 to 1000%, 9999	1%	9999



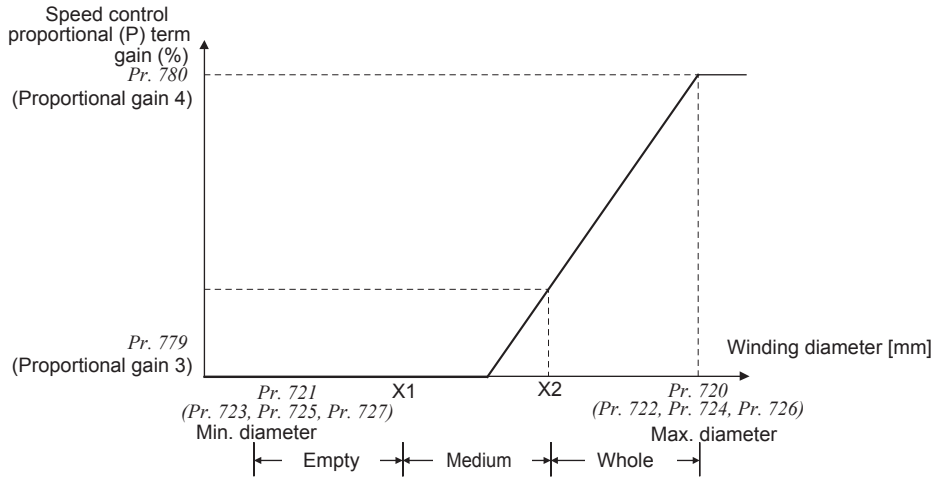
X1 = ((Maximum winding diameter - minimum winding diameter) × *Pr. 775*/100) + minimum winding diameter

X2 = ((Maximum winding diameter - minimum winding diameter) × *Pr. 776*/100) + minimum winding diameter

This function activates when two or more settings of *Pr. 777 to Pr. 780 (speed control proportional gain 1 to 4)* are set.
If two or more setting are not set, *Pr. 820 Speed control P gain 1* is valid with RT signal OFF, *Pr. 830 Speed control P gain 2* is valid when RT signal ON.
Pr. 777 to Pr. 780 can be set disabled with the speed control proportional gain disabled signal (X93).

Winding diameter calculation	X93	Speed control gain
Disable	OFF	*Pr. 820/Pr. 830*
Disable	ON	*Pr. 820/Pr. 830*
Enable	OFF	*Pr. 777 to Pr. 780*
Enable	ON	*Pr. 820/Pr. 830*

A machine operates at 33% when *Pr. 775 Speed control proportion term applied diameter 1* = "9999", at 66% when *Pr. 776 Speed control proportion term applied diameter 2* = "9999." When *Pr. 775* = *Pr. 776*, bigger value between proportional gain 3 and proportional gain 4 is valid. Below graph shows the value of speed control proportional gain when two settings are made.



3.9.6 Target winding diameter achieved signal (Pr. 750, Y52 signal)

Result of winding diameter calculation in inverter and *Pr. 750 Target winding diameter* are compared. When the winding diameter exceeds its target, target winding diameter achieved signal Y52 turns ON.
Set "52 (positive logic) or 152 (negative logic)" in any of *Pr. 190 to Pr. 196 (Output terminal function selection)* to assign Y52 signal to an output terminal.

Parameter Number	Name	Setting Range	Increments	Initial Value
750	**Target winding diameter**	1 to 6553mm	1mm	1mm

3.10 Dedicated monitor function

3.10.1 Dedicated monitor list

(1) Monitored item list

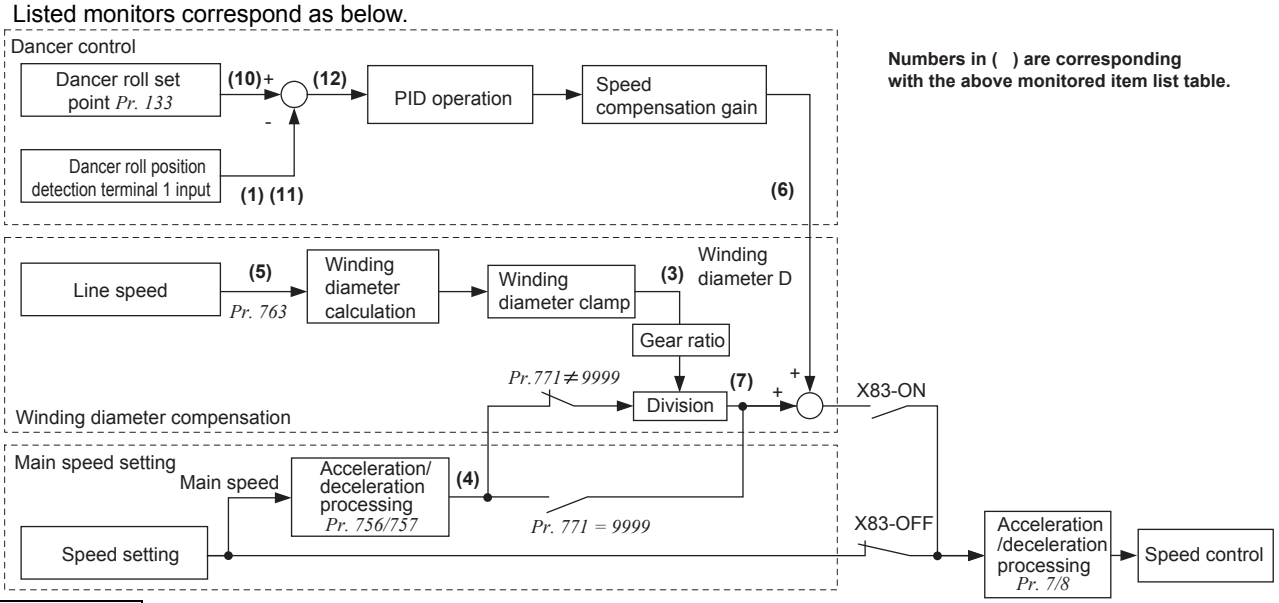
The following functions can be set for a dedicated control monitor.

No.	Monitor Description	Increments	*Pr. 52* Setting		*Pr. 54 (FM)* *Pr. 158 (AM)* Setting	Full-Scale Value of FM and AM	Modbus-RTU	Mitsubishi inverter protocol
			DU	PU Main Monitor			Register	Monitoring Number
1	Terminal 1 input voltage	0.1V	26		—	—	40226	1A
		0.1%	27		—	—	40227	1B
2	Dancer tension command	—	39		39	100%	40239	27
3	Winding diameter	0.1mm	40		40	*Pr. 799* (Monitor standard for winding diameter)	40240	28
4	Main speed	0.01Hz	41		41	*Pr. 55*	40241	29
5	Line speed	m/min, m/s, mm/min, mm/s	42		42	*Pr. 766* (Unit can be changed with *Pr. 767*)	40242	2A
6	Dancer compensation speed	0.01Hz	43		43	*Pr. 55*	40243	2B
7	Winding diameter compensation speed	0.01Hz	44		44	*Pr. 55*	40244	2C
8	Winding/unwinding length	m, 10m, 100m, km	45		—	(Unit can be changed with *Pr. 280*)	40245	2D
9	Dancer tension command 2	—	46		46	—	40246	2E
10	Dancer roll set point	0.1%	52		—	—	40252	34
11	Measured dancer roll value	0.1%	53		—	—	40253	35
12	Dancer roll position deviation	0.1%	54		—	—	40254	36
13	Line speed pulse monitor	kpps	62				40262	3E
14	Tension command	0.1%	63				40263	3F
15	Mechanical loss compensation	0.1%	64				40264	40
16	Inertia compensation	0.1%	65				40265	41

(2) Monitor reference

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
766	Line speed reference	1.0 to 6553.4	0.1	1000.0	
767	Line speed unit	0, 1, 2, 3	1	0	0: m/min 1: m/sec 2: mm/min 3: mm/sec
799	Winding diameter monitor reference	1 to 6553	1mm	1000mm	

Listed monitors correspond as below.



REMARKS

To display a monitor on the PU main monitor, set the corresponding number of each monitor in *Pr. 52*. Selected monitor is displayed on PU instead of voltage monitor.

3.10.2 Terminal 1 input voltage monitor

Voltage applied to terminal 1 (dancer roll position) is displayed in a monitor by setting *Pr. 52* = "26 or 27".
It is only displayed in DU/PU main monitor and is not output to terminal FM/terminal AM.
The displayed percentages [%] are the analog input values calibrated with *Pr. 917* and *Pr. 918*.

Terminal 1 input voltage	Monitor value	
	Pr. 52 = "26" (Voltage (V))	*Pr. 52* = "27" (Percentage (%))
-10V to -0.1V	110V to 100.1V	0 to 499.9%
0V	0V	500%
0.1V to 10V	0.1V to 10V	500.1 to 1000%

3.10.3 Winding diameter monitor

Calculated winding diameter in inverter is displayed in PU/DU monitor and output to terminal FM/AM.
Displayed increments is as follows in PU/DU.

Monitor indication	Display digit	Increments	
		0 to 999.9	1000.0 or more
PU	5 digits	0.1mm	0.1mm
DU	4 digits	0.1mm	1mm
Communication	5 digits	0.1mm	0.1mm

REMARKS

0 is displayed when dancer control/winding diameter compensation is disabled.

3.10.4 Line speed pulse monitor function

The pulse train input values, which are used to set the line speed, can be displayed.
Monitoring is available when the following conditions are satisfied: the PID control for dancer control / winding diameter calculation is valid, and the pulse train setting (*Pr. 763* = "1, 2") is selected for the line speed input selection. If the above conditions are not satisfied, "0" is displayed.
The number of input pulses is displayed as an absolute value. The upper limit is 200Kpps.
The number of pulses is affected by the *Pr. 707 Sampling time for winding diameter calculation* and *Pr. 768 Line speed input filter time constant* settings.

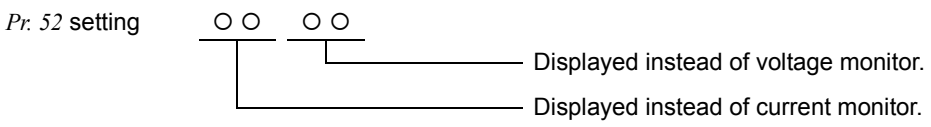
Function	Monitoring Number	Input Pulse Range	Display range	Remarks
Line speed pulse monitor	62	0.01 to 200.00Kpps	0 to 200.00	No unit is displayed on PU

REMARKS

- FR-DU07 can display only four digits. The upper four digits of the Kpps values are displayed.
- The number of pulses input to FR-A7AP and FR-A7AL are multiplied by four.

3.10.5 Multiple monitor (Pr. 52)

To select two monitors for adjustment simultaneously, set 3939 or greater number in *Pr. 52*. Selected two monitors can be displayed using 4 digits. The monitor corresponding with the first two digits is displayed instead of current monitor, and the monitor of the last two digits is displayed instead of voltage monitor.



Example) When *Pr. 52* = "4042"
First 2 digits are 40 (Winding diameter monitor) → Winding diameter monitor is displayed instead of current monitor
Last 2 digits are 42 (Line speed monitor) → Line speed monitor is displayed instead of voltage monitor
For 3-step monitor of FR-PU07, the monitors selected in *Pr. 52* are also displayed.

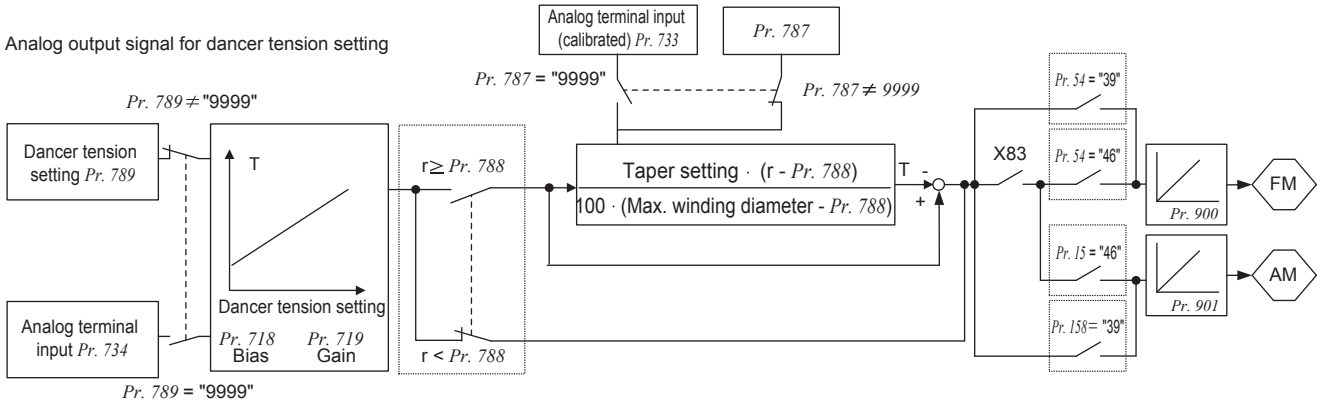
3.10.6 Analog output signal for dancer tension setting (Pr. 718, Pr. 719, Pr. 733, Pr. 734, Pr. 785, Pr. 787 to Pr. 789)

Dancer is controlled with an air cylinder. Set an analog signal, which is output for tension setting to control the air cylinder, with terminal FM/AM.

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
718	Dancer tension setting bias	0 to 200%	0.1%	0%	
719	Dancer tension setting gain	0 to 200%	0.1%	100%	
733	Taper setting analog input selection	3 to 6, 9999	1	9999	3: terminal 2 4: terminal 4 5: terminal 1 6: terminal 6 (FR-A7AZ) 9999:disabled
734	Dancer tension setting input selection				
785	Terminal 4 function setting	1, 2, 9999	1	9999	1: compensation input 2: analog input signal for taper setting 9999:terminal 4 is disabled
787	Taper ratio setting	0 to 100%, 9999	0.1%	0%	9999:input from the analog terminal assigned by *Pr. 733*.
788	Winding diameter at taper start	1 to 6553mm, 9999	1mm	9999	9999:taper start at minimum winding diameter
789	Dancer tension setting	1 to 100, 9999	0.1	100	9999:input from the analog terminal assigned by *Pr. 734*.

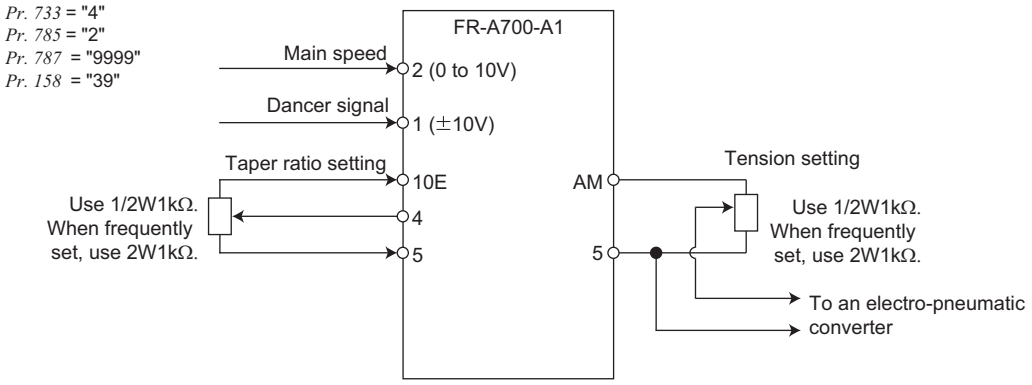
Set *Pr. 785 Terminal 4 function setting* and *Pr. 733 Taper setting analog input selection* to use the taper setting analog input signal with an analog input terminal.

(1) Control diagram



(2) Connection example

When potentiometer is input



(3) Tension output command setting

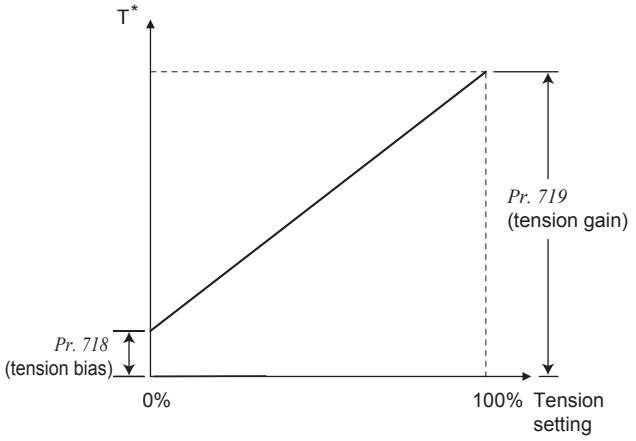
To output tension commands from an inverter, set the AM and FM output terminals as follows.

Signal Type	Minimum Increment	Parameter Setting			
		Pr.52		*Pr.54*	*Pr.158*
		DU LED	PU main monitor	Terminal FM	Terminal AM
Dancer tension command	1%	39	39	39	39
Dancer tension command 2	1%	46	46	46	46

Use *Pr. 900* to calibrate the terminal FM, and *Pr. 901* for the terminal AM.

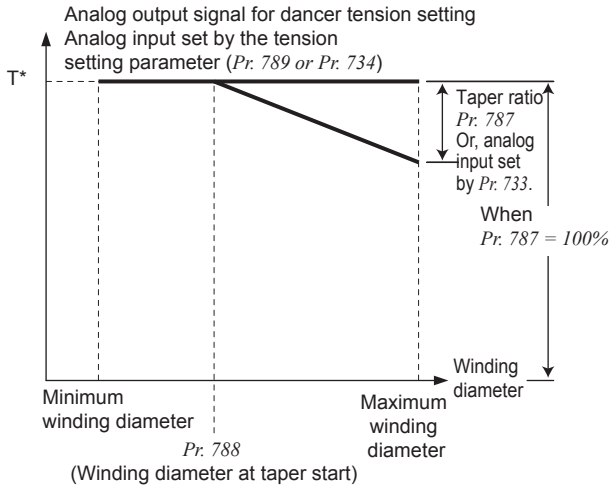
(4) Tension adjustment *(Pr.718, Pr.719)*

Dancer tension setting bias/gain

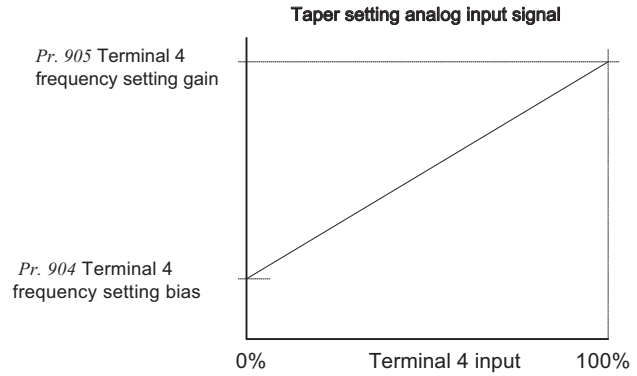


Set 0% in *Pr. 718* (tension setting bias).
Set 100% in *Pr. 719* (tension setting gain).

Taper control



When no analog input terminal is assigned (*Pr. 787* = "9999"), the taper setting becomes 0.
When *Pr. 789* = "9999", an input value to the analog terminal is set to the tension setting T*. The analog terminal is assigned by *Pr. 734*. Analog values are clamped between 0 and 100.0.
If no analog input terminal is assigned because of a prioritized function or *Pr. 734* = "9999" setting, etc., the tension setting T* is set to "0".



Operation with the X83 signal

The dancer tension command and the dancer tension command 2 are monitored by turning ON/OFF the X83 signal.

Monitoring Number	X83 signal ON	X83 signal FF
39	Monitor output	Monitor output
46	Monitor output	0 output

The dancer tension command is determined by the winding diameter. Set *Pr. 781* = "1" to enable the winding diameter storage when using the dancer tension command.
If the winding diameter storage is set disabled with *Pr. 781* = "0", the winding diameter is initialized by turning ON the X83 signal, possibly leading to a sudden change in outputs. When the X83 signal turns OFF, the preceding winding diameter is kept to calculate the outputs. Caution is required when turning ON the X83 signal.

3.11 Regeneration avoidance function *(Pr. 882)*

This function detects a regeneration status and increases the frequency to avoid the regeneration status.

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
882	Regeneration avoidance operation selection	0 to 3	1	0	0: Regeneration avoidance function disabled 1: Always enabled 2: Enabled only at constant speed operation 3: Enabled only while start signal is ON

Setting *Pr. 882* = "1 to 3" enables the regeneration avoidance function.
Setting the parameter to "3" enables the regeneration avoidance function during normal operation, and disables the function during deceleration-to-a-stop operation initiated by turn-OFF of the start signal. In this way, the machine can be stopped quickly by using the regenerative braking equipment.

3.12 Operation command source and speed command source *(Pr. 338, Pr. 339)*

In the Network operation mode, commands from the external terminals and network are as listed below.
(Different signals can be assigned with the input terminal function selection.)

Parameter Number	Name	Setting Range	Increments	Initial Value	Remarks
338	Communication operation command source	0, 1	1	0	0: Command source is NET 1: Command source is external terminal
339	Communication speed command source	0 to 2	1	0	0: Command source is NET 1: Command source is external terminal 1 2: Command source is external terminal 2

Operation Location Selection					*Pr. 338* Communication operation command source	0: NET			1: External			Remarks
					Pr. 339 Communication speed command source	0 : NET	1: External	2: External	0 : NET	1: External	2: External	
Fixed function (terminal-equivalent function)					Running frequency from communication	NET	—	NET	NET	—	NET	
					Terminal 2	—	External	—	—	External	—	
					Terminal 4	—	External		—	External		
					Terminal 1 (dancer roll position detection)	External *						
Selective function	*Pr.178 to Pr.189* setting	0	RL	Low-speed operation command/remote setting clear		NET	External		NET	External		*Pr.59* = "0" (Multi-speed) *Pr.59* = "1,2" (Remote)
		1	RM	Middle-speed operation command/ remote set deceleration		NET	External		NET	External		
		2	RH	High-speed operation command/ remote set acceleration		NET	External		NET	External		
		3	RT	Second function selection		NET			External			
		4	AU	Current input selection		—	Combined		—	Combined		
		5	JOG	Jog operation selection		—			External			
		6	CS	Selection of automatic restart after instantaneous power failure		External						
		7	OH	External thermal relay input		External						
		8	REX	15-speed selection		NET	External		NET	External		*Pr.59* ="0" (Multi-speed)
		9	X9	Third function selection		NET			External			
		10	X10	Inverter run enable signal		External						
		11	X11	FR-HC connection, instantaneous power failure detection		External						
		12	X12	PU operation external interlock		External						
		13	X13	External DC injection brake operation start		NET			External			
		14	X14	PID control valid terminal		NET	External		NET	External		
		16	X16	PU-External operation switchover		External						
		17	X17	Load pattern selection forward rotation reverse rotation boost		NET			External			
		18	X18	V/F switchover		NET			External			
		20	X20	S-pattern acceleration/deceleration C switching terminal		NET			External			
		22	X22	Orientation command		NET			External			
		23	LX	Pre-excitation		NET			External			

Operation Location Selection			*Pr. 338 Communication operation command source*		0: NET			1: External			Remarks
			Pr. 339 Communication speed command source		0 : NET	1: External	2: External	0 : NET	1: External	2: External	
Selective function	*Pr.178 to Pr.189* setting	24	MRS	Output stop	Combined			External			*Pr. 79* ≠ "7"
				PU operation interlock	External						*Pr. 79* = "7" When the X12 signal is not assigned
		25	STOP	Start self-holding selection	—			External			
		26	MC	Control mode changing	NET			External			
		27	TL	Torque limit selection	NET			External			
		28	X28	Start-time tuning start external input	NET			External			
		30	X30	PID integral term reset input	NET			External			
		32	X32	PID differential term reset input	NET			External			
		33	X33	Terminal 1 offset displacement	NET			External			
		34	X34	Integral term activation selection	NET			External			
		35	X35	Speed compensation gain selection	NET			External			
		42	X42	Torque bias selection 1	NET			External			
		43	X43	Torque bias selection 2	NET			External			
		44	X44	P/PI control switchover	NET			External			
		51	X51	Acceleration/deceleration time selection	NET			External			
		52	X52	Acceleration/deceleration time selection	NET			External			
		53	X53	Minimum/maximum winding diameter selection	NET			External			
		54	X54	Minimum/maximum winding diameter selection	NET			External			
		55	X55	Winding diameter storage clear	NET			External			
		56	X56	Winding/unwinding selection	NET			External			
		57	X57	Inertia compensation acceleration	NET			External			
		58	X58	Inertia compensation deceleration	NET			External			
		59	X59	Inertia compensation second acceleration/ deceleration time selection	NET			External			
		60	STF	Forward rotation command	NET			External			
		61	STR	Reverse rotation command	NET			External			
		62	RES	Reset	External						
		63	PTC	PTC thermistor selection	External						
		64	X64	PID forward rotation action switchover	NET	External		NET	External		
		65	X65	PU-NET operation switchover	External						
		66	X66	External-NET operation switchover	External						
		67	X67	Command source switchover	External						
		68	NP	Simple position pulse train sign	External						
		69	CLR	Simple position droop pulse clear	External						
		70	X70	DC feeding operation permission	NET			External			
		71	X71	DC feeding cancel	NET			External			
		83	X83	Dancer control/winding diameter compensation function selection	NET			External			
		84	X84	Winding diameter calculator selection	NET			External			
		85	X85	Dancer control selection	NET			External			
		86	X86	Winding/unwinding length clear	NET			External			
		87	X87	Analog input gain selection	—	NET	—	—	External	—	
		88	X88	Analog input gain selection	—	NET	—	—	External	—	
		89	X89	PID gain switchover	NET			External			
		90	X90	PID gain switchover	NET			External			
		91	X91	Winding diameter measurement	NET			External			
		92	X92	Stall operation	NET			External			
		93	X93	Speed control proportional gain disabled	NET			External			

* Compensation when dancer control is not selected.

External: Operation is enabled only from external terminal signal.

NET: Operation is enabled only from network.

Combined: Operation is enabled from either of external terminal or network.

— : Operation is disabled from neither of external terminal or network.

Compensation: Operation is enabled only from external terminal when *Pr. 28 Multi-speed input compensation* = "1".

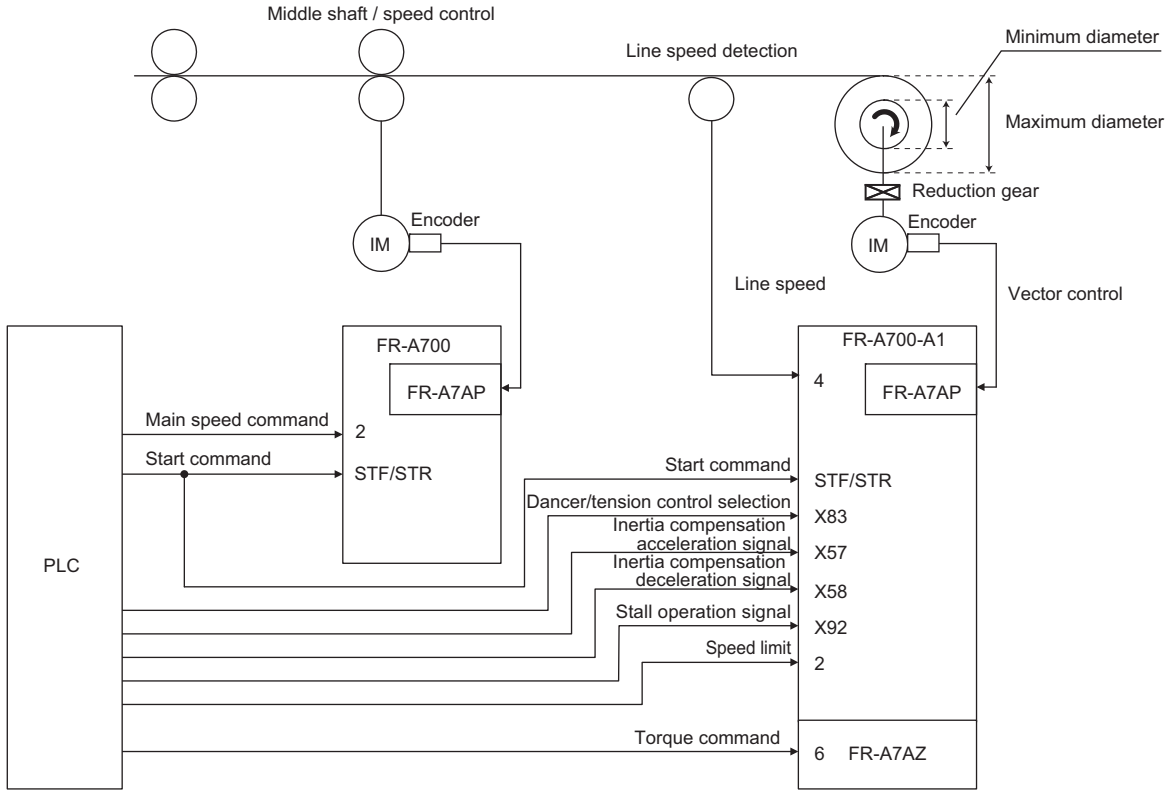
4 TENSION CONTROL

4.1 Dedicated function list

Item		Description
Tension control	Taper function	Set a taper ratio.
	Inertia compensation function	Compensates the inertia during acceleration and during deceleration separately using external signals.
	Mechanical loss compensation function	Interpolates linearly against the speed (with 5 break points).
Common	Dedicated input signal	Dancer/tension control selection, inertia compensation acceleration, inertia compensation deceleration, inertia compensation second acceleration/ deceleration time selection, winding diameter measurement, stall operaion
	Dedicated output signal	Winding diameter calculation completion
	Dedicated monitored item	Tension command, mechanical loss compensation, inertia compensation

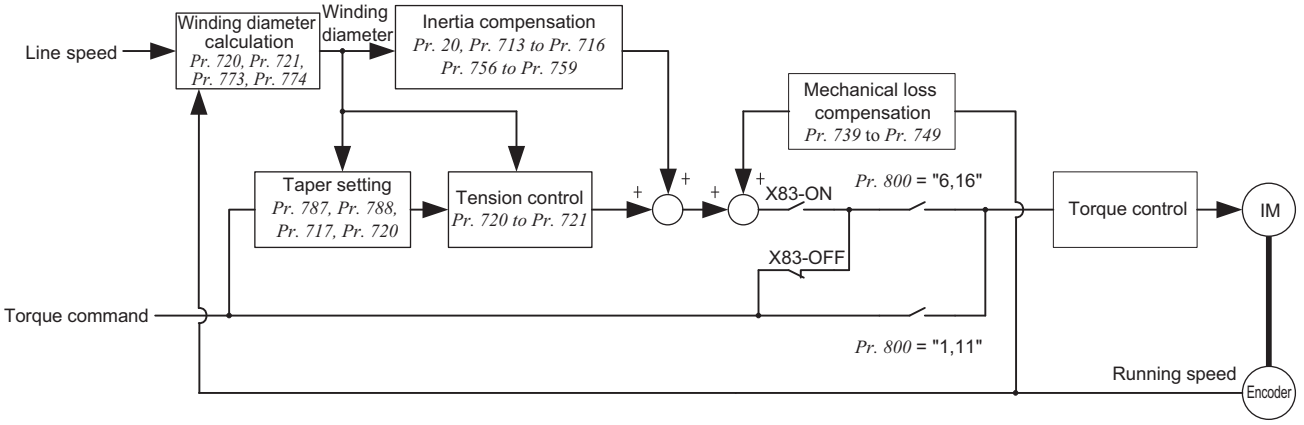
Refer to *page 32* for the winding diameter compensation function.

4.2 System configuration example



4.3 Block diagram of the control

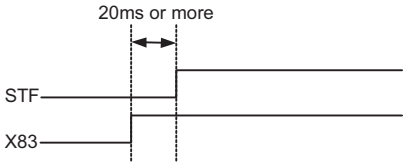
4.3.1 Block diagram of the tension control



4.4 Dedicated I/O signal

4.4.1 Input signal list

Use contact input signals by assigning them to *Pr. 178 to Pr. 189 (input terminal function selection)*.

Type	*Pr.178 to Pr.189* setting	Signal		Description	Refer to page
Contact input	**57**	**Inertia compensation acceleration**	X57	Compensates the inertia during acceleration.	*62*
	58	**Inertia compensation deceleration**	X58	Compensates the inertia during deceleration.	*62*
	59	**Inertia compensation second acceleration/ deceleration time selection**	X59	Switches the inertia compensation acceleration/deceleration time.	*62*
	83	**Dancer/tension control selection**	X83	Enables/disables the tension control and the winding diameter compensation function. OFF: Normal operation. ON: Tension control and winding diameter compensation are valid. When the X83 signal is not assigned, normal operation is performed. **To use the tension control and the winding diameter compensation function, make sure to assign this signal.** Turn ON/OFF the X83 in a stop status to switch between the tension control and normal operation. After turning ON the X83 signal, wait 20ms or longer to input a start command (STF/STR). 	*32, 59*
	91	**Winding diameter measurement**	X91	Turn the X91 signal ON to select the winding diameter measurement mode.	*59*
	92	**Stall operation**	X92	Turn the X92 signal ON to bring the motor into the stall status.	*65*

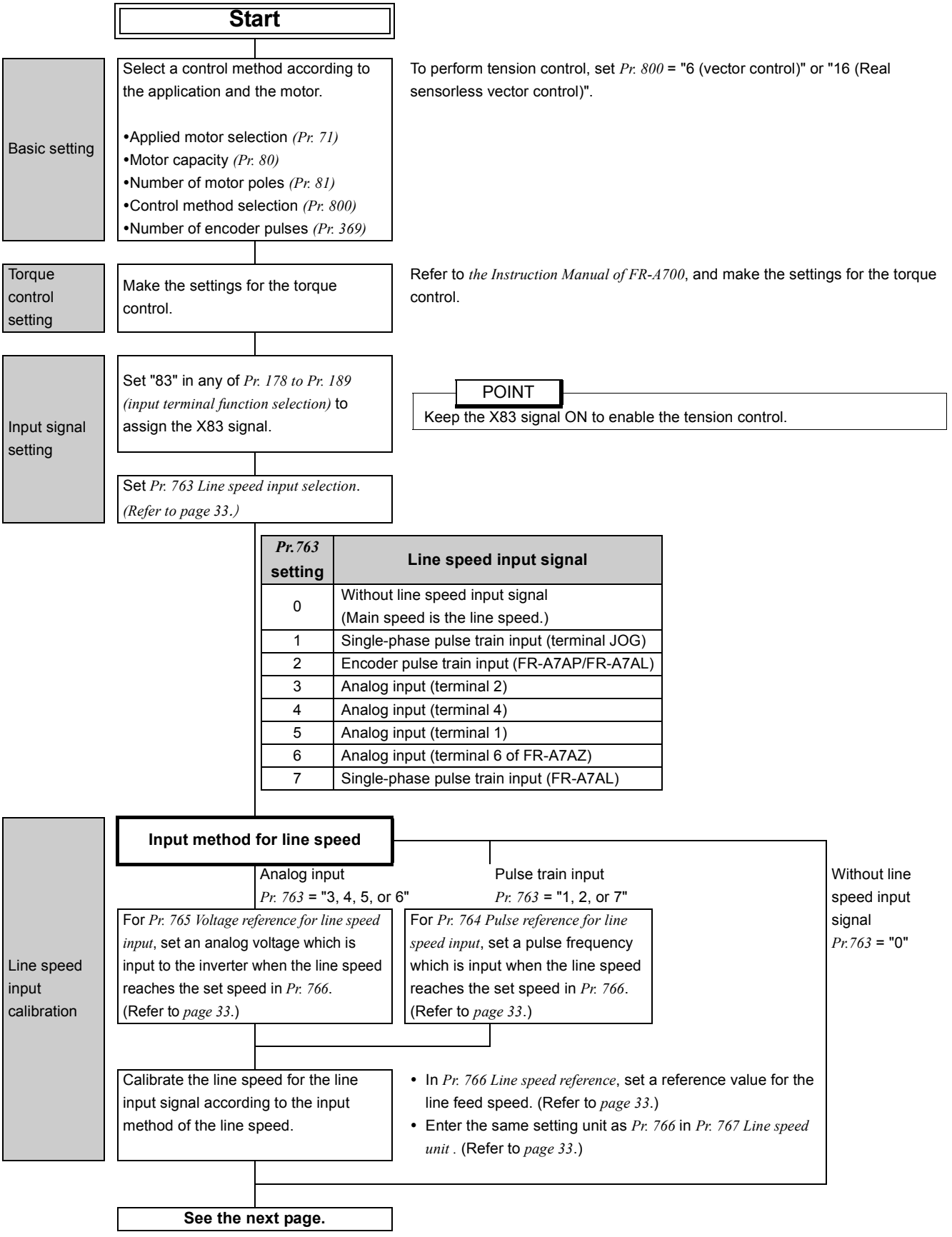
4.4.2 Output signal list

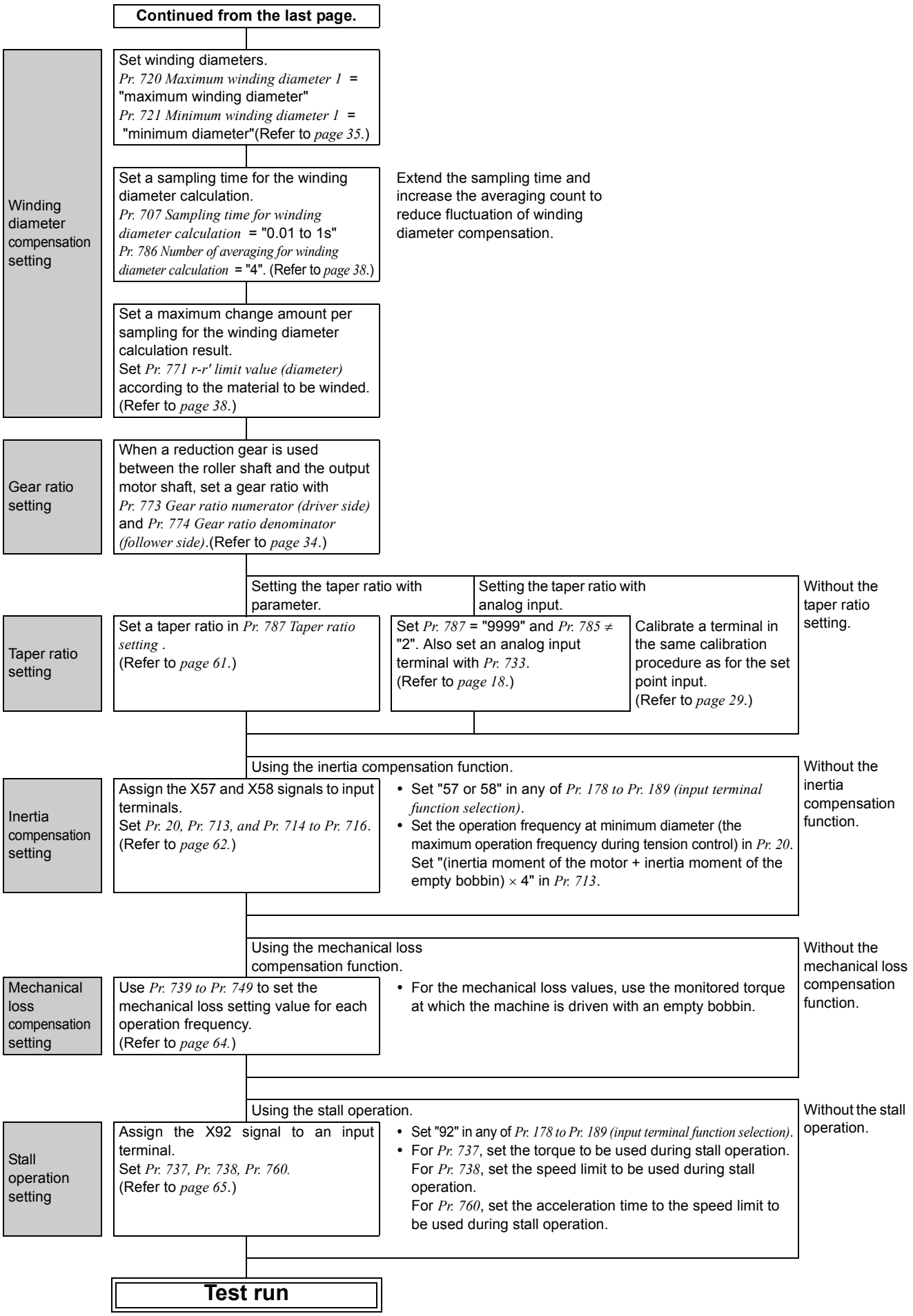
Use output signals by assigning them to *Pr. 190 to Pr. 196 (output terminal function selection)*.

Pr. 190 to Pr. 196 setting		Signal		Description	Refer to page
Positive logic	Negative logic				
51	**151**	**Winding diameter calculation completion at a start**	**Y51**	Output when winding diameter calculation is completed at an operation start.	*60*

4.5 Tension control parameter setting procedure

The following flowchart shows the parameter setting example for the tension control.




Continued from the last page.
Winding diameter compensation setting
Set winding diameters.
Pr. 720 Maximum winding diameter 1 = "maximum winding diameter"
Pr. 721 Minimum winding diameter 1 = "minimum diameter"(Refer to page 35.)
Set a sampling time for the winding diameter calculation.
Pr. 707 Sampling time for winding diameter calculation = "0.01 to 1s"
Pr. 786 Number of averaging for winding diameter calculation = "4". (Refer to page 38.)
Extend the sampling time and increase the averaging count to reduce fluctuation of winding diameter compensation.
Set a maximum change amount per sampling for the winding diameter calculation result.
Set Pr. 771 r-r' limit value (diameter) according to the material to be winded.
(Refer to page 38.)
Gear ratio setting
When a reduction gear is used between the roller shaft and the output motor shaft, set a gear ratio with Pr. 773 Gear ratio numerator (driver side) and Pr. 774 Gear ratio denominator (follower side).(Refer to page 34.)
Setting the taper ratio with parameter.
Setting the taper ratio with analog input.
Without the taper ratio setting.
Taper ratio setting
Set a taper ratio in Pr. 787 Taper ratio setting .
(Refer to page 61.)
Set Pr. 787 = "9999" and Pr. 785 ≠ "2". Also set an analog input terminal with Pr. 733.
(Refer to page 18.)
Calibrate a terminal in the same calibration procedure as for the set point input.
(Refer to page 29.)
Using the inertia compensation function.
Without the inertia compensation function.
Inertia compensation setting
Assign the X57 and X58 signals to input terminals.
Set Pr. 20, Pr. 713, and Pr. 714 to Pr. 716.
(Refer to page 62.)
• Set "57 or 58" in any of Pr. 178 to Pr. 189 (input terminal function selection).
• Set the operation frequency at minimum diameter (the maximum operation frequency during tension control) in Pr. 20. Set "(inertia moment of the motor + inertia moment of the empty bobbin) × 4" in Pr. 713.
Using the mechanical loss compensation function.
Without the mechanical loss compensation function.
Mechanical loss compensation setting
Use Pr. 739 to Pr. 749 to set the mechanical loss setting value for each operation frequency.
(Refer to page 64.)
• For the mechanical loss values, use the monitored torque at which the machine is driven with an empty bobbin.
Using the stall operation.
Without the stall operation.
Stall operation setting
Assign the X92 signal to an input terminal.
Set Pr. 737, Pr. 738, Pr. 760.
(Refer to page 65.)
• Set "92" in any of Pr. 178 to Pr. 189 (input terminal function selection).
• For Pr. 737, set the torque to be used during stall operation.
For Pr. 738, set the speed limit to be used during stall operation.
For Pr. 760, set the acceleration time to the speed limit to be used during stall operation.
Test run

4.6 Details of the tension control

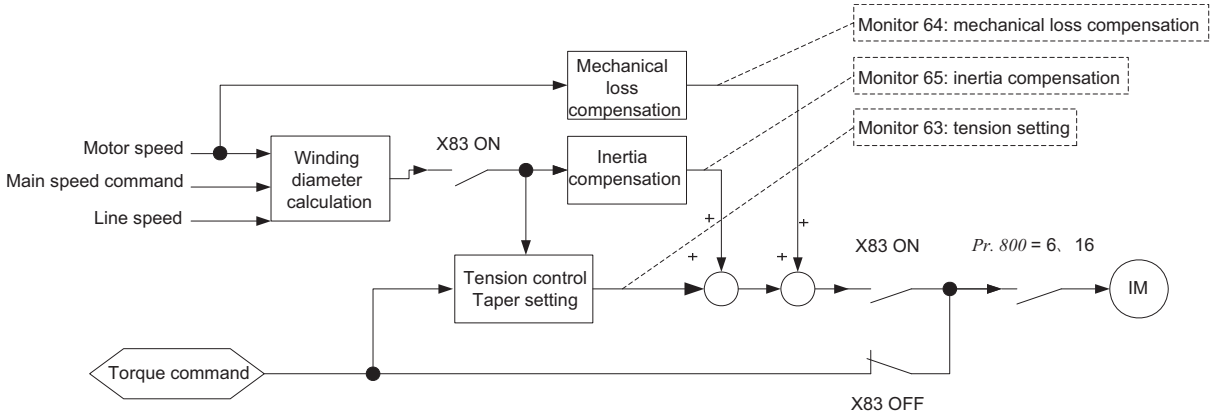
POINT

To use the tension control, set *Pr. 800* = "6 (vector control)" or "16 (Real sensorless vector control)".
Turn ON the X83 signal to activate the tension control.
Tension control is unavailable while the X83 signal is OFF.
To assign the X83 signal, set "83" in any of *Pr. 178 to Pr. 189 (input terminal function selection)*.

4.6.1 Winding diameter calculation during tension control (Pr. 797, X91 signal, Y51 signal)

The winding diameter calculation is also enabled during torque-controlled winding operation. The obtained winding diameter will be used for the tension control, inertia compensation, and taper ratio setting.
Turn ON the dancer/tension control selection signal (X83) to perform winding diameter calculation.

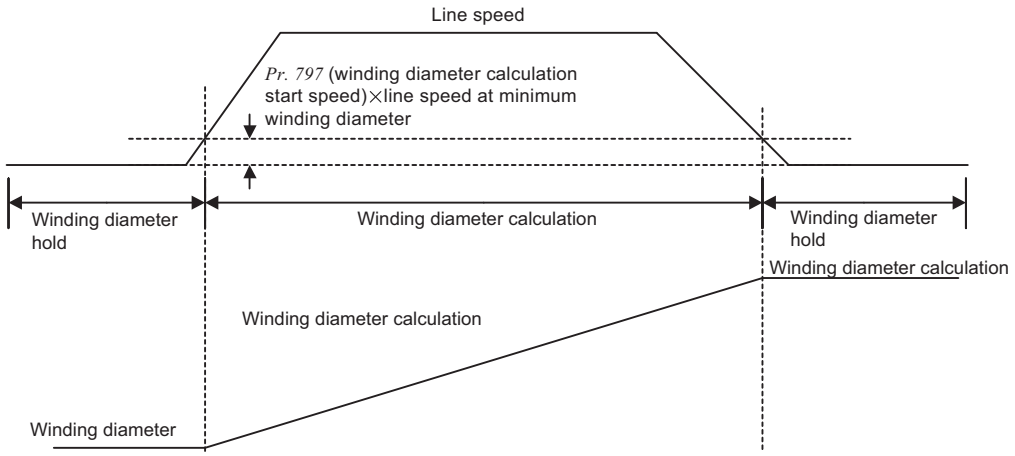
(1) Control block diagram



(2) Winding diameter hold in the low frequency range of the motor operation *(Pr. 797)*

The winding diameter calculation can be paused while the motor operation frequency is low. While pausing, the last winding diameter calculation result is held.

Parameter Number	Name	Setting Range	Setting Increments	Initial Value	Remarks
797	**Calculated winding diameter start speed**	0 to 400Hz	0.01Hz	3Hz	



Winding diameter calculation starts when the line speed exceeds [*Pr. 797* × (minimum diameter setting)].
For *Pr. 797*, set a motor's operation frequency where the winding diameter calculation starts in a winding operation started with a bare roll.

(3) Initial winding diameter measurement (X91 signal, Y51 signal)

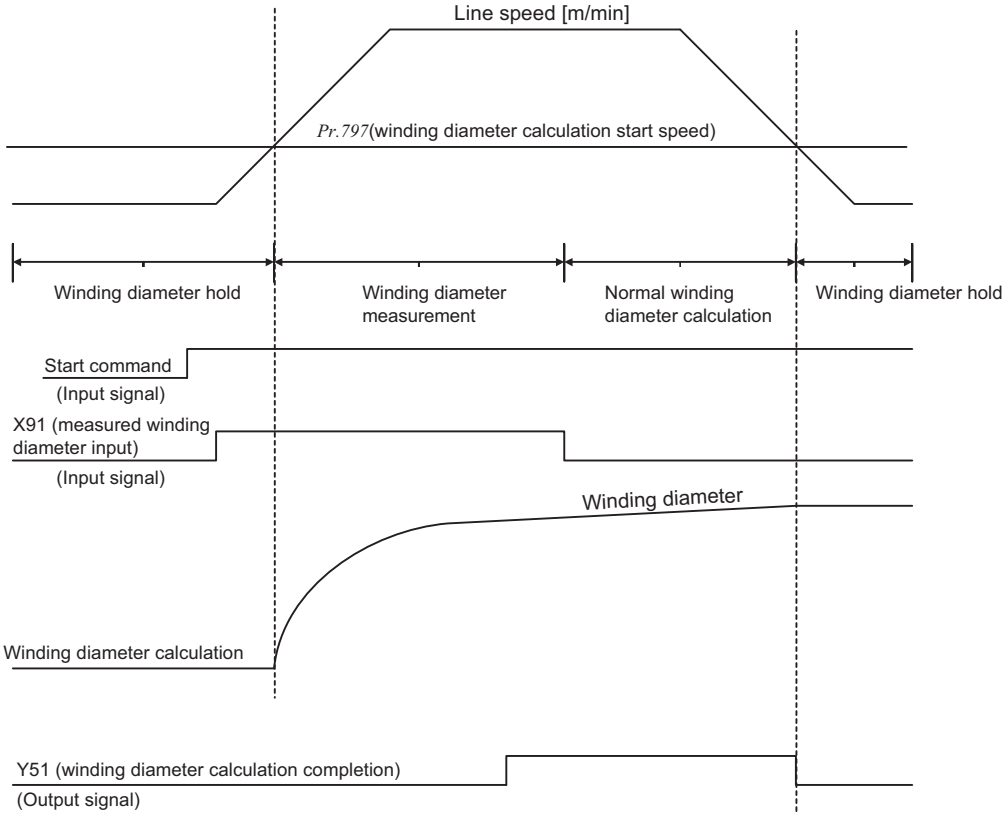
- When resuming a winding operation with a medium-size-roll (not a bare roll) after a pause, the actual winding diameter is different from what is recognized by the inverter. The initial winding diameter must be set. For such a case, perform the initial winding diameter measurement with an external contact signal.

- Measured winding diameter input signal (X91)

To use the measured winding diameter input signal, set "91" in any of *Pr. 180 to Pr. 189 (input terminal function selection)*.

- Winding diameter calculation completion signal (Y51)

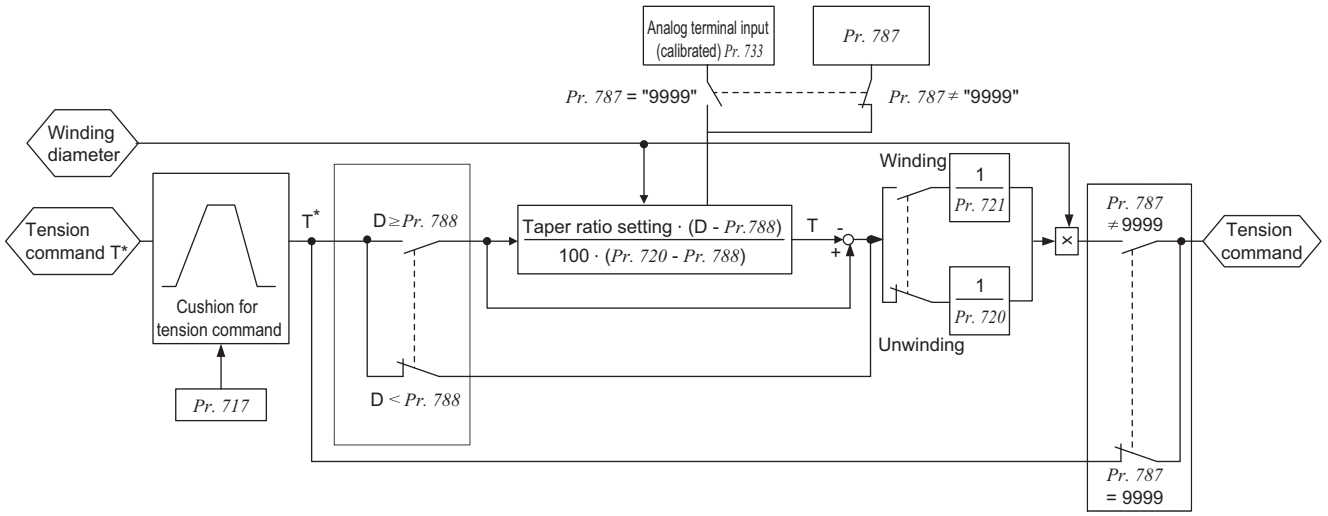
The winding diameter calculation completion signal turns ON when the winding measurement started by the ON of the measured winding diameter input signal is completed.
After the winding diameter calculation completion signal turns ON, turn OFF the measured winding diameter input signal.
To use the measured winding diameter calculation completion signal, set "51" in any of *Pr. 190 to Pr. 196 (output terminal function selection)*.



4.6.2 Winding taper function (Pr. 717, Pr. 787, Pr. 788)

Parameter Number	Name	Setting Range	Setting Increments	Initial Value	Remarks
717	Tension command cushion time	0 to 360s	0.01s	0s	
787	Taper ratio setting	0 to 100%, 9999	0.1%	0%	9999: Analog terminal input
788	Tapering start diameter	0 to 9998mm, 9999	1mm	9999	9999: Starts tapering from the minimum winding diameter.

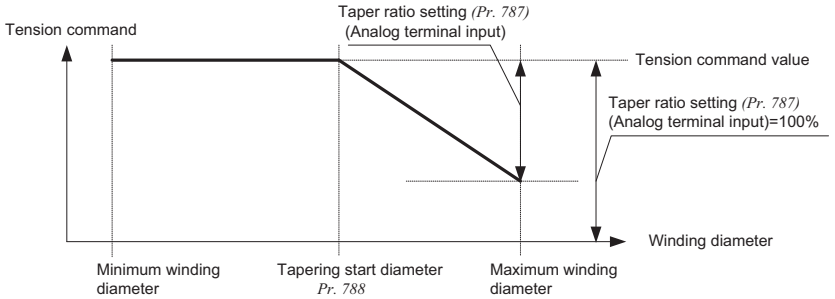
(1) Control block diagram



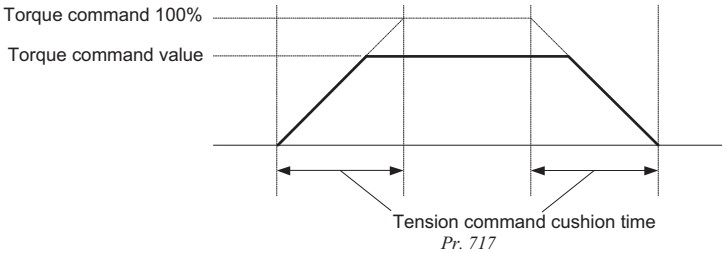
(2) Operation/setting procedure

- Find the winding diameter by the winding diameter calculation, and set a tension to be applied at the winding diameter, as a taper ratio.
- The tension command at the minimum winding diameter is 100%. Set how much to loosen the tension at the maximum winding diameter, as a taper ratio in percent.
- When *Pr. 787* ≠ "9999", the taper ratio is the setting value of *Pr. 787*.
- When *Pr. 787* = "9999", the taper ratio is the analog terminal input (selected among terminals 1, 2, 4, and 6).
- When the taper ratio = 0%, the material is winded at a constant tension through the minimum winding diameter *(Pr. 721)* to the maximum winding diameter *(Pr. 720)*.
- Taper control is enabled at *Pr. 788* setting value or higher.

$$T^* - \frac{T^* \cdot \text{Taper ratio setting value}}{100 \cdot (Pr.\ 720 - Pr.\ 788)} \cdot (D - Pr.\ 788)$$



- Tension command cushion time is the time to reach the 100% torque command.



- Find the torque command T from the taper control output T_{TP} and the winding diameter calculation result.
  The initial winding diameter is the minimum diameter in a winding operation, and the maximum diameter in an unwinding operation.

$$T = T_{TP} \times \frac{\text{Winding diameter}}{\text{Initial winding diameter}}$$

(3) Taper ratio input

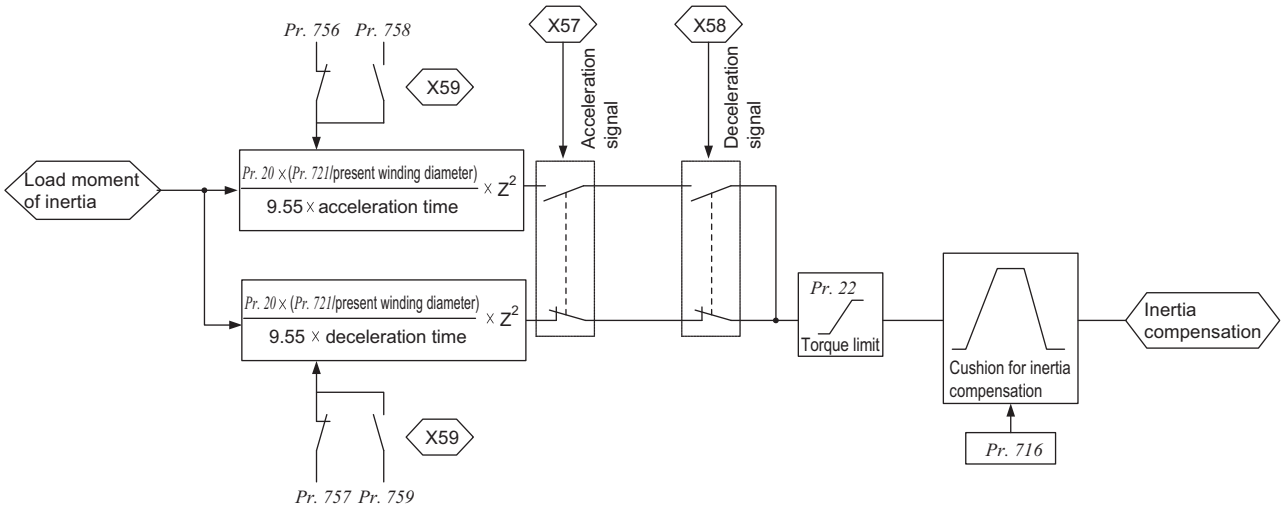
The input method of the taper ratio can be set by the following parameters.

Pr. 787	*Pr. 785*	*Pr. 733*	Taper setting
0 to 100%	—	—	Setting value of *Pr. 787*
9999	2	—	Terminal 4 input
	1, 9999	3	Terminal 2
		4	Terminal 4
		5	Terminal 1
		6	Terminal 6
		9999	No function

4.6.3 Inertia compensation function (Pr. 713 to Pr. 716, X57 signal, X58 signal, X59 signal)

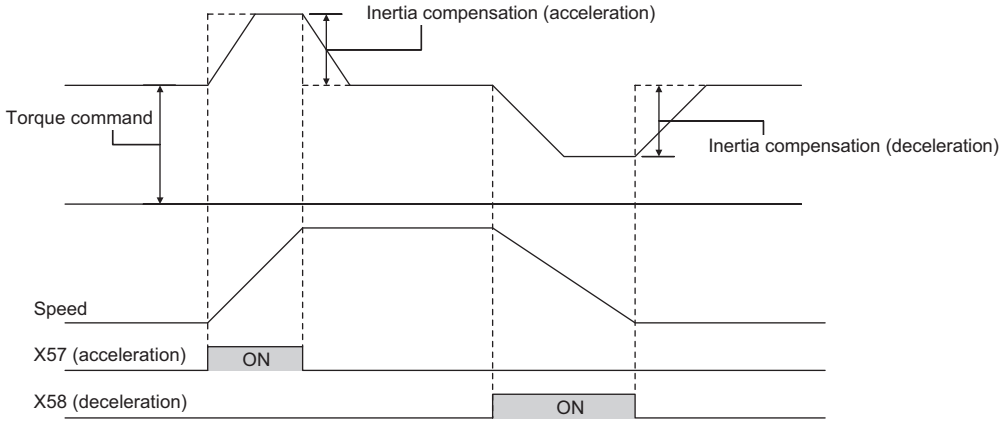
Parameter Number	Name	Setting Range	Setting Increments	Initial Value	Remarks
713	**Initial inertia moment**	0 to 500kg · m^2	0.01kg · m^2	0kg · m^2	
714	**Roll width**	0 to 5000mm	1mm	0mm	
715	**Material specific gravity**	0 to 20g/cm^3	0.001g/cm^3	0g/cm^3	
716	**Inertia compensation cushion time**	0 to 360s	0.01s	0s	

(1) Control block diagram



(2) Operation/setting procedure

- The acceleration torque amount is added while the acceleration inertia compensation signal (X57) is ON. The deceleration torque amount is subtracted while the deceleration inertia compensation signal (X58) is ON.



X57 signal	X58 signal	Inertia compensation
OFF	OFF	Not performed
ON	OFF	Acceleration
OFF	ON	Deceleration
ON	ON	Not performed

- Use the X59 signal to choose acceleration and deceleration time setting parameters for the inertia compensation.

X59 signal	Acceleration time for inertia compensation	Deceleration time for inertia compensation
OFF	*Pr. 756*	*Pr. 757*
ON	*Pr. 758*	*Pr. 759*

$$Ta = (J_M+J_L)\ \frac{Pr.\ 20\ \times\ \dfrac{Pr.\ 721}{\text{Present winding diameter}}}{9.55 \times t}\ (N \cdot m)\ \times Z^2$$

J_M: [inertia moment of the motor + inertia moment of the empty bobbin] × 4 *(Pr. 713)*

J_L: Material moment of inertia

Pr.20 : Reference acceleration/deceleration speed (r/min) (operation speed at minimum diameter)

t: Acceleration time or deceleration time *(Pr. 756, Pr. 757, Pr. 758, Pr. 759)*

Z: Gear ratio *(Pr.773, Pr.774)*

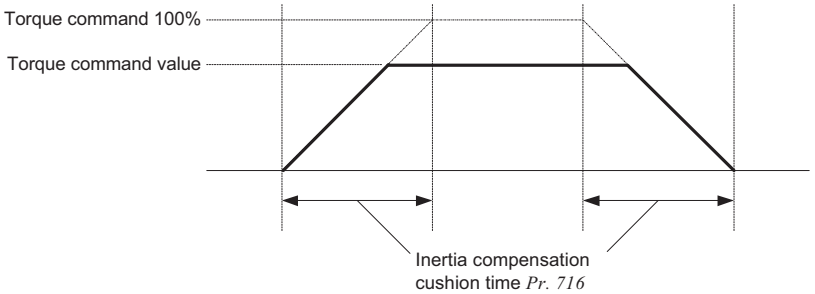
$$\text{Material } J_L = \frac{1}{32}\pi \times Pr.\ 715\ (g/cm^3) \times Pr.\ 714\ (m) \times D^4\ (m) - Pr.\ 721^4\ (m)$$

D, diameter obtained by the winding diameter calculation (m); *Pr. 715*, material specific gravity (g/cm^3); *Pr. 714*, roll width (m); *Pr. 721*, roll diameter (m).

$$\text{Inertia compensation torque T (\%)} = \frac{Ta}{\text{Rated motor torque } T_M} \times 100(\%)$$

- Inertia compensation cushion time

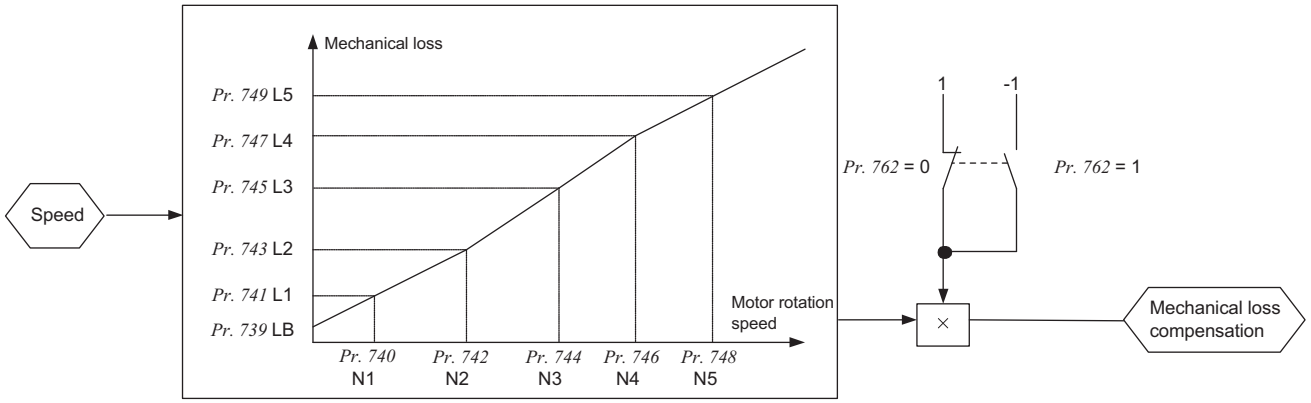
Inertia compensation cushion time is the time to reach the 100% torque command.



4.6.4 Mechanical loss compensation (Pr. 739 to Pr. 749, Pr. 762)

Parameter Number	Name	Setting Range	Setting Increments	Initial Value	Remarks
739	Mechanical loss setting frequency bias	400 to 600%	1%	500%	
740	Mechanical loss setting frequency 1	0 to 400Hz, 9999	0.01Hz	9999	No mechanical loss is set when "9999" is set as the frequency. Set at least two mechanical loss points.
741	Mechanical loss 1	400 to 600%	1%	500%	
742	Mechanical loss setting frequency 2	0 to 400Hz, 9999	0.01Hz	9999	
743	Mechanical loss 2	400 to 600%	1%	500%	
744	Mechanical loss setting frequency 3	0 to 400Hz, 9999	0.01Hz	9999	
745	Mechanical loss 3	400 to 600%	1%	500%	
746	Mechanical loss setting frequency 4	0 to 400Hz, 9999	0.01Hz	9999	
747	Mechanical loss 4	400 to 600%	1%	500%	
748	Mechanical loss setting frequency 5	0 to 400Hz, 9999	0.01Hz	9999	
749	Mechanical loss 5	400 to 600%	1%	500%	
762	Winding/unwinding selection	0, 1	1	0	

(1) Control block diagram



(2) Operation/setting procedure

- The maximum of five approximate break points can be set as mechanical loss points. Use *Pr. 739 to Pr. 749* .
- The setting values of *Pr. 739, Pr. 741, Pr. 743, Pr. 745, Pr. 747, Pr. 749* minus 500 are the mechanical loss setting values. The values can be set in the range of ±100%.

Parameter Setting	Mechanical Loss Setting
-100% to -1%	400 to 499%
0%	500%
1% to 100%	501 to 600%

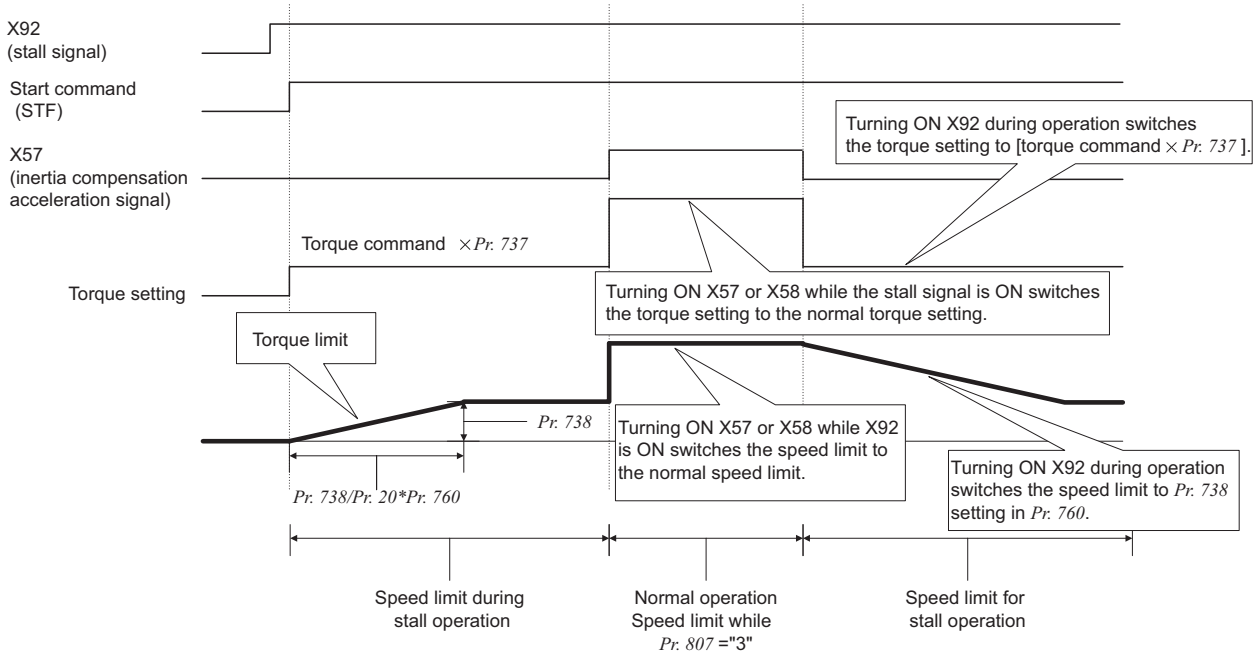
- The mechanical loss compensation amount is calculated from the lines connecting neighboring points of *Pr. 739 to Pr. 749*.
- The linearly interpolated mechanical loss compensated value is clamped in the range of ±100%.
- When *Pr. 739* ≠ 0 and *Pr. 740 to Pr. 749* = "9999", the *Pr. 739* setting value is used as the bias.
- Operate with a load (with a bobbin inside), and set the motor operation frequency and the monitored torque value in *Pr. 74* ☐ *and Pr. 74* ☐ *+1*.
- The mechanical loss amount is considered according to the settings of the winding and unwinding shafts.
  Unwinding shaft: tension command = torque command - mechanical loss compensation
  Winding shaft: tension command = torque command + mechanical loss compensation
- For the compensation, *Pr. 740, Pr. 741 to Pr. 748, and Pr. 749* settings are automatically sorted by their set frequencies in the inverter.
- When the same frequency is set in *Pr. 740 to Pr. 749*, the setting in the smallest *Pr.* number takes precedence.
- When 0Hz is set in the mechanical loss setting frequencies 1 to 5, the *Pr. 739* setting is ignored.

4.6.5 Stall operation signal (Pr. 737, Pr. 738, Pr. 760, X92 signal)

Turn ON the stall operation signal (X92) to bring the motor into the stall status and to apply tension to a sheet of paper to be winded.
Doing this spreads out the sheet of paper tightly before it is winded.

Parameter Number	Name	Setting Range	Setting Increments	Initial Value	Remarks
737	**Stall torque setting**	0 to 200%	0.1%	20%	
738	**Speed limit for stall operation**	0 to 60Hz	0.01Hz	1Hz	
760	**Third acceleration time for the main speed**	0 to 3600s/0 to 360	0.1s/0.01s	15s	The setting increment is determined by the *Pr. 21 Acceleration/deceleration time increments* setting. Set the time period to reach the *Pr. 20 Acceleration/deceleration reference frequency.*

Name	Setting	Terminal Signal	Remarks
Stall operation signal	**92**	X92	ON: Stall operation OFF: Normal operation



- Turning ON the X92 (stall operation signal) and a start signal pushes up the speed limit to the *Pr. 738* setting in *Pr. 760*.
- Use *Pr. 737* to set the torque for the stall operation. The torque during stall operation is [torque command × *Pr. 737* setting].
- Turning ON the X57 or X58 signal cancels the stall operation and sets the torque command and the speed limit back to the normal settings.
- Mechanical loss compensation is disabled while the X92 signal is ON.
- If the stall operation signal turns ON again during operation, the torque setting changes to the [torque command × *Pr. 737*]. The speed limit also changes to the *Pr. 738* setting in *Pr. 760*.
- The LX, X13, and forced stop signals have higher precedence than the stall operation signal.
- Turning OFF the start signal while the X92 signal is ON decelerates the motor to a stop in *Pr. 760*.

4.6.6 Tension control monitor output (Pr. 52)

The internally converted values during tension control can be output as monitored items to the PU/DU display.
Set a value corresponding to the desired monitored item in *Pr. 52*.
The selected monitored item is displayed on PU/DU instead of the voltage monitor.
When the tension control is disabled, 0% is displayed.

Signal Name	Minimum Increment	*Pr.52* Setting	Modbus-RTU Register	Mitsubishi Inverter Protocol Monitoring Number
Tension command	0.1%	63	40263	3F
Mechanical loss compensation	0.1%	64	40264	40
Inertia compensation	0.1%	65	40265	41

The value displayed on the monitor is a signal value plus 500%.

Signal Value	Monitor Display
-400% to -0.1%	100 to 499.9%
0%	500.0%
0.1% to 400%	500.1 to 900%

5 APPLICATION EXAMPLE

5.1 Dancer control with winding diameter compensation for printers

Dancer control is useful for rolling up a sheet of paper of a printer.
A sheet of paper can be rolled up faster and in better quality with dancer control with winding diameter compensation.

(1) Feature

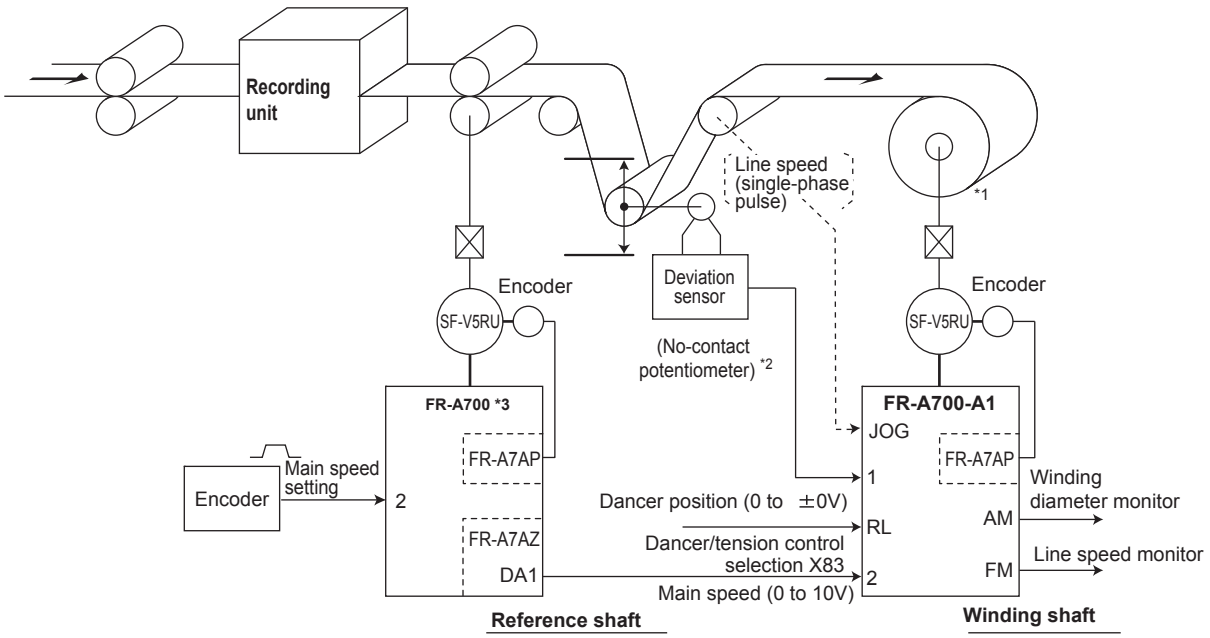
For a system like this, the speed of roll up is important.
Furthermore, fluctuation of dancer roll should be kept minimum to avoid sagging and unevenness of the sheet rolled up.

Purpose	Feature
Sagging and unevenness prevention	Low percentage of speed fluctuation.
Speed up	Speed response level (internal response is 300rad/s) when vector control with encoder is used.
Cost reduction	Function of dancer roll controller is embedded.

(2) Outline

FR-A700 series inverter installed in the intermediate shaft controls the line speed of the whole print paper. Dancer roll regulates the tension applied on the sheet of paper, and wind-up the sheet of paper.
For the rolling shaft, use FR-A700-A1 series inverter with dancer control function. Keep the tension constant while rolling up the sheet of paper by stabilizing the position of dancer roll with dancer control.
The rim speed of paper is also kept constant by winding diameter compensation function.
The following functions are added to FR-A700-A1 series, compared to FR-A700 series.

Additional Function	Description
Dancer control function	Controls the speed of wind-up shaft to keep the position of dancer roll steady.
Analog signal output for dancer control	Tension command for dancer roll is output by analog signal.
Winding diameter compensation function	Controls rotation speed of motor to keep the rim speed constant by calculating the diameter of wind-up shaft. By using winding diameter compensation, hunting of dancer control can be suppressed. Winding diameter compensation and PID calculator are not necessary.

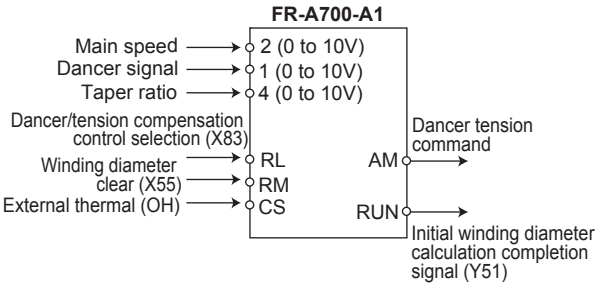


*1 The main speed is constant, so the winding speed decelerates as the winding diameter increases.
In FR-A700-A1 series, the speed is calculated automatically by winding diameter compensation.
*2 The position of the deviation sensor (no-contact potentiometer) is kept constant by dancer control (PID control), and frequency is compensated.
*3 FR-A700 series with FR-A7AP (vector control with encoder) are used when steady operation to low speed, speed accuracy (small speed fluctuation), and response speed to stabilize position of dancer roll are necessary.

(3) Example 1 of FR-A700-A1 parameter setting

[Machine specification] Winding device (for paper)

Minimum diameter: 100mm, Maximum diameter: 1000mm
Gear ratio: 1/3 , Maximum line speed: 200m/min
Dancer signal: 0 to 10V input
Main speed command: 0 to 10V analog signal (with 60s of acceleration/deceleration cushion time)
Initial winding diameter calculation: enabled, Accumulated amount: 300mm, Diameter storage: enabled, tension setting output: necessary
Taper control: enabled, Diameter at taper start: 800mm, Taper ratio: 40%
Taper ratio setting: analog 0 to 10V



Parameter	Name	Initial Value	Setting	Description
1	Maximum frequency	120Hz	90Hz	About 1.1 times (10% compensation by dancer roll) of the maximum rotation speed (at V_{max} with D_{min}.) 79.58Hz × 1.1 ≒ 90Hz
7	Acceleration time	15s	0s	Setting is necessary to perform dancer control.
8	Deceleration time	15s	0s	
9	Electronic thermal O/L relay	Rated inverter current	0A	For vector control dedicated motor (motor overheat protection by Klixon)
10	DC injection brake operation frequency	3Hz	0.5Hz	
13	Starting frequency	0.5Hz	0Hz	Setting is necessary to avoid operation interruption at initial winding diameter calculation completion.
18	High speed maximum frequency	120Hz	90Hz	
52	DU/PU main display data selection	0	4042	Setting for monitoring ("4042": winding diameter(40) is set in the second monitor, line speed (42) is set in the third monitor.) Other monitor settings related to dancer control 27: Dancer position (%), 41: Main speed, 43: Dancer compensation speed, 44: Winding diameter compensation speed 45: Winding/unwinding length, 54: Dancer position deviation
71	Applied motor	0	30	Mitsubishi vector control dedicated motor (SF-V5RU)
72	PWM frequency selection	1	15	
73	Analog input selection	1	10	Main speed 0 to 10V, Dancer 0 to 10V, polarity reversible
80	Motor capacity	9999	15kW	
81	Number of motor poles	9999	4P	
125	Terminal 2 frequency setting gain frequency	60Hz	79.58Hz	
128	PID action selection	40	40	Dancer control (reverse action)
129	PID proportional band	100%	100%	
130	PID integral time	1s	10s	
133	Target dancer position	500%	550.0%	Target dancer position is set after confirming upper and lower limit dancer positions (set *Pr. 52* = 27 to show %).
134	PID differential time	9999	9999	Should be set gradually starting with 0.01s to bear mechanical disturbance (fluctuation). (Should not be set unless it is necessary as it causes hunting.)
158	AM terminal function selection	1	39	39: Dancer tension command
180	RL terminal function selection	0	83	Dancer/winding diameter compensation are enabled by the RL signal ON. (Setting must be made when dancer control function is used.)
181	RM terminal function selection	1	55	Stored winding diameter clear: cleared by RM signal ON.
186	CS terminal function selection	6	7	To input external signal of Klixon for SF-V5RU
190	RUN terminal function selection	1	51	Output when winding diameter calculation is completed signal (positive logic)
267	Terminal 4 input selection	0	2	Input 0 to 10V (taper setting input)
369	Number of encoder pulses	1024	2048	
706	Speed compensation gain	0%	100%	Setting when compensation rate needs to be constant. Setting for X35 is not necessary.
707	Sampling time for winding diameter calculation	9999	0.1s	Setting when result of calculated winding diameter fluctuates by large.

Parameter	Name	Initial Value	Setting	Description
712	Initial winding diameter calculation dead zone 2	9999	0%	Setting to reduce large dancer movement when shifting to normal operation after initial winding diameter calculation has completed.
720	Maximum winding diameter 1	2mm	1000mm	Initial diameters (maximum value at unwinding shaft, minimum value at winding shaft) should be input accurately.
721	Minimum winding diameter 1	1mm	100mm	
756	First acceleration time for main speed	15s	0s	Less time than acceleration/deceleration of main speed setting (terminal 2-5) is set. (In this case, cushion time is already included by the high-order system.)
757	First deceleration time for main speed	15s	0s	
763	Line speed input selection	0	0	No line speed input (line speed is calculated from main speed.)
771	r-r' limit value (diameter)	1mm	0.2mm	Longer value than the increment in winding diameter calculation at *Pr. 707 Sampling time for winding diameter calculation* is set.
773	Gear ratio numerator (driver side)	1	1	Gear ratio of unwinding shaft is set. Should be set accurately.
774	Gear ratio denominator (follower side)	1	3	
777	Speed control proportional gain 1	9999	60%	Response level is improved by adjusting the speed control proportional gain according to the winding diameter. Speed control proportional gain is adjusted with maximum diameter*(Pr. 780)* and minimum diameter*(Pr. 777)*. *Pr. 778* = α/5 + *Pr. 777*, *Pr. 779* = 8 × α/15 + *Pr. 777* (α = *Pr. 780* - *Pr. 777*)
778	Speed control proportional gain 2	9999	80%	
779	Speed control proportional gain 3	9999	120%	
780	Speed control proportional gain 4	9999	200%	
781	Winding diameter storage selection	0	1	Input of diameter clear signal X55 is necessary to assign to a terminal when winding diameter storage is enabled. Winding diameter (EEPROM write) is stored when power is shut off or X83 is OFF. It is not stored to EEPROM when RES signal is ON. Should not input RES unless inverter alarm or fault occurs. When RES input is necessary for an inverter alarm or in such case, turn X83 signal OFF before RES input, then input X83 again so that stored winding diameter can be used.
783	Operation time with stored winding diameter	0	0.01s	Setting is always necessary to activate winding diameter storage. (If not set, stored data is not updated.)
785	Terminal 4 function setting	9999	2	2: Analog input signal for taper setting
787	Taper ratio setting	100	9999	9999: Terminal 4 input
788	Winding diameter at taper start	9999	800mm	
789	Dancer tension setting	100%	100%	
790	Initial winding diameter calculation start point	400%	500.0%	
791	Initial winding diameter calculation dead zone	1.0%	10%	
792	Accumulated amount	160mm	270mm	Measured value is 300mm. As initial winding diameter calculation dead zone*(Pr. 791)* = 10%, 300mm × 0.9 = 270mm.
795	Integral term limit at a start	2.5%	1.5%	Setting to adjust the winding speed at initial winding diameter when tension is applied.
796	PID term limit at a start	2.5%	1.5%	
797	Rotation speed at winding diameter calculated value activation	3Hz	1Hz	
800	Control method selection	20	0	0: Vector control (speed control)
821	Speed control integral time 1	0.333s	0s	When dancer control is activated, integral time is set invalid so that the inverter operates as a proportional amplifier.
862	Notch filter time constant	0	10	Setting to reduce whining sound at a motor stop.
863	Notch filter depth	0	2	
868	Terminal 1 function assignment	0	9999	9999: No function (so that voltage input by dancer control is not compensated when X83 signal is OFF.)
902	Terminal 2 frequency setting bias	0Hz/0%	0Hz/3%	Calibration of offset for speed commands.
903	Terminal 2 frequency setting gain	60Hz/ 10V	79.58Hz /100%	V_{max} = 200m/min, 10V input, D_{min} = 100mm, gear ratio = 1/3 Set according to the rotation speed at V_{max}, D_{min} and the speed command at the time (maximum voltage command for terminal 2 to 5.) $\omega = V_{max}/(\pi \times D_{min} \times \text{gear ratio}) = 200 \times 10^3/(\pi \times 100 \times 1/3)/30 \fallingdotseq 79.58$Hz
904	Terminal 4 frequency setting bias	20%	0%	Calibration of taper ratio setting
905	Terminal 4 frequency setting gain	100%	40%	

5.2 Dancer control with winding diameter compensation for wiredrawing machine

Dancer control is useful for winding movement in wiredrawing machine.
High speed winding under high load inertia is enabled by embedded dancer control with winding diameter compensation.

(1) Feature

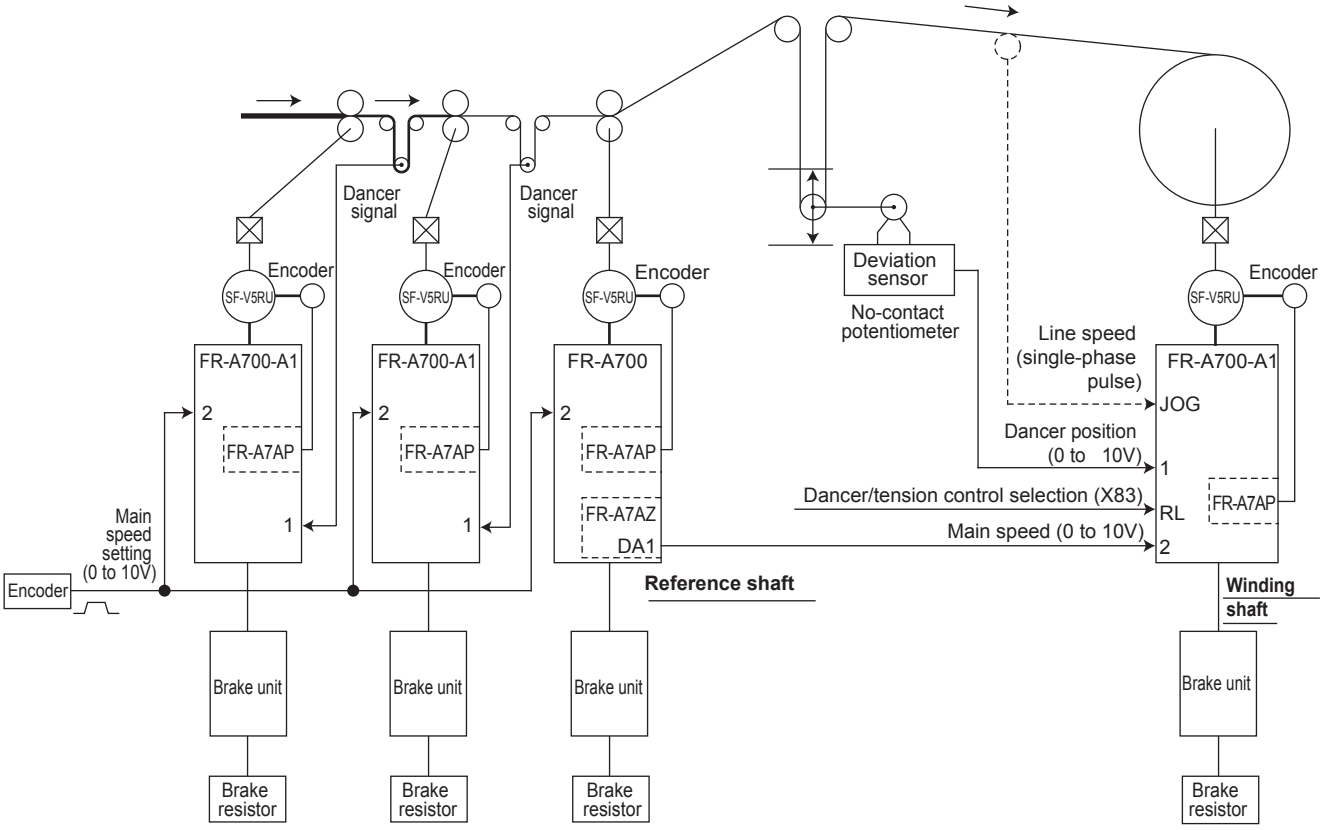
For a system like this, it is important to wind fast under high load inertia by keeping the position of dancer roll constant.

Purpose	Feature
Steadiness of dancer roll	Low percentage of speed fluctuation
Winding under high load inertia	Speed response level (internal response is 300rad/s) when vector control with encoder is used.
Cost reduction	Dancer roll controller is embedded.

(2) Outline

In a wiredrawing section, a wire is pulled at constant speed to be thinner. The wire is then winded with constant tension, which is regulated by dancer roll. For the winding shaft, dancer control of FR-A700-A1 series is used to keep the position of dancer roll and the tension constant. Rim speed of winding bobbin is also kept constant by winding diameter compensation function.
The following functions are added to FR-A700-A1 series, compared to FR-A700 series.

Additional Function	Description
Dancer control function	Controls the speed of wind-up shaft to keep the position of dancer roll steady.
Winding diameter compensation function	Controls the rotation speed of the motor to keep the rim speed constant by calculating the diameter of the wind-up shaft. By using winding diameter compensation, hunting of dancer control can be suppressed. Winding diameter compensation and PID calculator are not necessary.



(3) Example 2 of FR-A700-A1 parameter setting

[Machine specification] Winding shaft of wiredrawing machine

Minimum diameter: 280mm, Maximum diameter: 400mm
Gear ratio: 1/1.2 , Maximum line speed: 2000m/min
Dancer signal: 0 to 10V input
Main speed command: 0 to 10V analog signal (with 90s of acceleration/deceleration cushion time)
Initial winding diameter calculation: disabled
Diameter storage: enabled, Tension setting output: unnecessary

Parameter	Name	Initial Value	Setting	Description
7	Acceleration time	5s	0.1s	Setting to perform dancer control (0.1s is set for EMI influence. Performance of dancer control deteriorates if the setting is too large.)
8	Deceleration time	5s	0.1s	
9	Electronic thermal O/L relay	Rated inverter current	0A	For vector control dedicated motor (motor overheat protection by Klixon)
10	DC injection brake operation frequency	3Hz	0Hz	
13	Starting frequency	0.5Hz	0Hz	
52	DU/PU main display data selection	0	4042	Setting for monitors ("4042": winding diameter(40) is set in the second monitor, line speed (42) is set in the third monitor.) Other monitor settings related to dancer control 27: Dancer position (%), 41: Main speed, 43: Dancer compensation speed, 44: Winding diameter compensation speed, 45: Winding/unwinding length, 54: Dancer position deviation
71	Applied motor	0	30	Mitsubishi vector control dedicated motor (SF-V5RU)
73	Analog input selection	1	0	Main speed (terminal 2) 0 to 10V, dancer (terminal 1) ±10 setting, polarity irreversible
79	Operation mode selection	0	2	Fixed to External operation mode
80	Motor capacity	9999	7.5kW	
81	Number of motor poles	9999	4P	
125	Terminal 2 frequency setting gain frequency	60Hz	90.95Hz	Setting is made according to the rotation speed at V_{max}, D_{min} and the speed command at the time (maximum voltage command for terminal 2 to 5.) $\omega = V_{max}/(\pi \times D_{min} \times$ gear ratio)
128	PID action selection	10	41	Dancer control (forward action) (Compensation direction is reversed when minimum dancer input is 8V and maximum is 2V)
129	PID proportional band	100%	250%	
130	PID integral time	1s	5s	
133	Target dancer position	500%	550.0%	Upper and lower limit dancer positions (set *Pr. 52* = "27" to show %) are confirmed before setting target dancer position.
134	PID differential time	9999	0.05s	Setting to suppress transient fluctuation caused by traverse edge. Should be set gradually starting from 0.01s to bear mechanical disturbance (fluctuation). (Should be cautious as it causes hunting.)
180	RL terminal function selection	0	83	When dancer/winding diameter compensation are enabled ... X83 signal is ON. (Setting must be made when dancer control function is used.)
181	RM terminal function selection	1	55	Diameter storage clear: cleared by X55 signal is ON.
186	CS terminal function selection	6	7	To input external signal of Klixon for SF-V5RU.
242	Terminal 1 added compensation amount (terminal 2)	100%	0%	Dancer signal input is not added when normal operation is performed with X83 OFF. (No terminal 1 added compensation)
369	Number of encoder pulses	1024	2048	
706	Speed compensation gain	0%	100%	Setting when compensation rate needs to be constant. Setting for X35 is not necessary.
707	Sampling time for winding diameter calculation	9999	1s	Setting to make operation smooth by filtering winding diameter calculation.

Parameter	Name	Initial Value	Setting	Description
720	Maximum winding diameter 1	2mm	400mm	Especially, initial diameters (minimum value at winding shaft) should be input accurately.
721	Minimum winding diameter 1	1mm	280mm	
756	First acceleration time for main speed	15s	0.5s	Less time than acceleration/deceleration of main speed setting (terminal 2 to 5) is set. (In this case, cushion time is already included by high-order system. 0.5s is set as EMI measure.)
757	First deceleration time for main speed	15s	0.5s	
763	Line speed input selection	0	0	No line speed input. (Line speed is calculated from the main speed.)
771	r-r' limit value (diameter)	1mm	0.1mm	Longer value than the increment in winding diameter calculation at *(Pr. 707) Sampling time for winding diameter calculation* is set.
773	Gear ratio numerator (driver side)	1	10	Gear ratio of unwinding shaft is set. Should be set accurately.
774	Gear ratio denominator (follower side)	1	12	
777	Speed control proportional gain 1	9999	100%	Response level is improved by adjusting the speed control proportional gain according to the winding diameter. Speed control proportional gain is adjusted with maximum diameter *(Pr. 780)* and minimum diameter *(Pr. 777)*. *Pr. 778* = $\alpha/5$ + *Pr. 777*, *Pr. 779* = 8 × $\alpha/15$ + *Pr. 777* (α = *Pr. 780* - *Pr. 777*)
778	Speed control proportional gain 2	9999	140%	
779	Speed control proportional gain 3	9999	200%	
780	Speed control proportional gain 4	9999	300%	
781	Winding diameter storage selection	0	1	Input of diameter clear signal X55 is necessary to assign to a terminal when winding diameter storage is enabled. Winding diameter (EEPROM write) is stored when power is shut off or X83 is OFF. It is not stored to EEPROM when RES signal is ON. Should not input RES unless inverter alarm or fault occurs. When RES input is necessary for an inverter alarm or in such case, turn X83 OFF before RES input, then input X83 again so that stored winding diameter can be used.
783	Operation time with stored winding diameter	0s	0.01s	Setting is always necessary to activate winding diameter storage. (If not set, stored data is not reflected.)
792	Accumulated amount	160mm	9999	Without initial winding diameter calculation
800	Control method selection	20	0	0: Vector control (speed control)
821	Speed control integral time 1	0.333s	0s	When dancer control is activated, integral time is set invalid so that the inverter operates as a proportional amplifier.
822	Speed setting filter 1	9999	0.5s	Setting when EMI is superpositioned in analog signal.
862	Notch filter time constant	0	20	Setting to reduce whining sound at a motor stop.
863	Notch filter depth	0	2	
903	Terminal 2 frequency setting gain	60Hz/ 10V	90.95Hz/ 100%	V_{max} =2000m/min, 10V input, D_{min}=280mm, gear ratio=1/1.2 Set according to the rotation speed at V_{max}, D_{min} and the speed command at the time (maximum voltage command for terminal 2 to 5.) $\omega = V_{max}/(\pi \times D_{min} \times \text{gear ratio}) = 2000 \times 10^3/(\pi \times 280 \times 1/1.2)/30$ $\fallingdotseq$ 90.95Hz

5.3 Tension control for the winding operation of printers

This function is useful for rolling up a sheet of paper into a printer.
The inverter torque is controlled by the tension control, inertia compensation and mechanical loss compensation. Dancer rolls and tension controllers are not required to roll up a sheet of paper.

(1) Feature

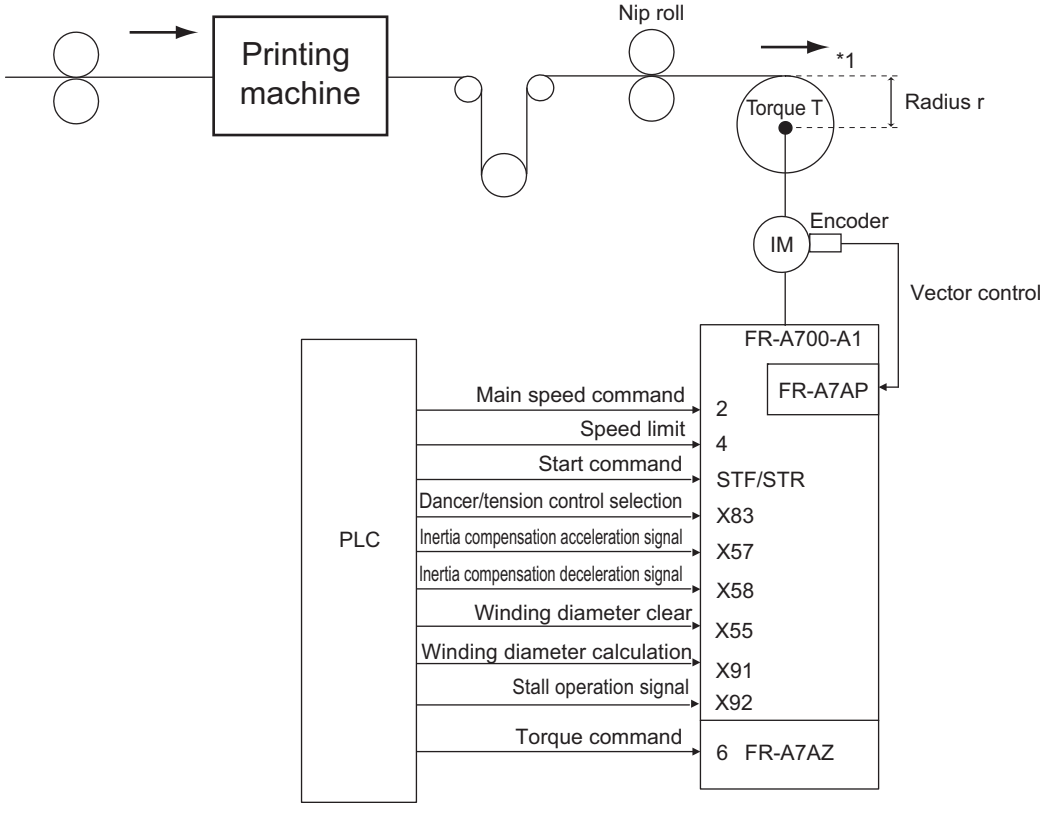
This control method is suitable for a winding application where a reasonable finish is required in about half the dancer-roll-winding machine speed.

Purpose	Feature
Cost reduction	Eliminate the dancer roll and the tension controller (by tension control).
Stable tension	Keep the tension steady during operation including acceleration/deceleration (by inertia compensation, mechanical loss compensation).

(2) Outline

The FR-A700-A1 series inverters are dedicated to winding machines.
FR-A700-A1 controls the motor output torque to make paper tension constant. The winding diameter of a paper roll is calculated to perform such operation.
Usually, the paper tension loosens when paper feeding speed to a printer is accelerated (decelerated). To make the paper tension constant, the acceleration (deceleration) torque, which is calculated based on the paper roll inertia, is used in controlling the motor.
A taper ratio can be also set to prevent the roll from getting too tight.
The FR-A700-A1 series inverters have the following additional functions compared to the FR-A700 series inverters.

Added Function	Description
Winding diameter calculation function, tension control	Controls the motor torque based on the paper roll diameter to make the paper tension constant.
Taper function	Reduces the tension when the winding diameter increases in order to prevent the roll from getting too tight. This reduction ratio can be set to a parameter.
Inertia compensation function	The acceleration torque and deceleration torque are used to keep the paper tension constant even when the paper feeding speed are being accelerated/decelerated.
Mechanical loss compensation function	The torque command, which is calculated in consideration of the mechanical loss amount, is given to avoid tension changes due to mechanical losses.



*1 To make the tension constant, the torque is controlled based on the winding diameter. Tension T = Torque τ / Radius r

6 APPENDIX

6.1 Compatible plug-in options

Compatible plug-in options are listed below.

Name	Type
Vector control	FR-A7AP
Vector control/encoder pulse dividing output	FR-A7AL
16-bit digital input	FR-A7AX
Digital output/extension analog output	FR-A7AY
Relay output	FR-A7AR

Name	Type
Bipolar analog output/high resolution analog input/motor thermistor interface	FR-A7AZ
CC-Link communication	FR-A7NC
LONWORKS communication	FR-A7NL
PROFIBUS-DP communication	FR-A7NP
FL-remote communication	FR-A7NF

6.2 Differences from the standard inverter

The following functions are added or deleted in the FR-A700-A1 series, compared to the FR-A700 series.

Function	Application to FR-A700-A1 series
Adjustable 5 points V/F	*Pr. 100 to Pr. 109* are deleted.
Bypass-inverter switchover function	*Pr. 139* is deleted. *Pr. 135 to Pr. 138* are changed to dancer control function parameters.
Stop-on contact control/load torque high speed frequency control	*Pr. 270 to Pr. 276* are changed to dancer control function parameters.
Brake sequence function	*Pr. 282 to Pr. 284* are deleted. *Pr. 278 to Pr. 281* are changed to dancer control function parameters.
Simple position control	*Pr. 419, Pr. 482 to Pr. 494* are deleted. *Pr. 464 to Pr. 481* are changed to dancer control function parameters.
Position control	*Pr. 420 to Pr. 427, Pr. 429, Pr. 430* are deleted.
Orientation control	*Pr. 350 to Pr. 358, Pr. 360 to Pr. 366, Pr. 393, Pr. 396 to Pr. 399* are deleted.
Encoder feedback control	*Pr. 367, Pr. 368* are deleted.
Energy saving monitor function	*Pr. 891 to Pr. 899* are deleted.
Stop selection	*Pr. 250* is deleted.
First cushion voltage/time for restart	*Pr. 163, Pr. 164* are deleted.
Monitor	*Pr. 52* setting range "26, 27, 40 to 45, 62 to 65" are added. "50, 51" are deleted. "39, 46" are used for dedicated function monitors. *Pr. 54, Pr. 158* setting range "39 to 44" are added, "50, 52, 53" are deleted. "46" is used for dedicated function monitor.
Applied motor	*Pr. 71, Pr. 450* setting range "2" is deleted.
PID control	*Pr. 128* setting range "40 to 41" are added, "20, 21" are deleted. *Pr. 131 to Pr. 133* setting range "0 to 100%" was changed to "400 to 600%." *Pr. 575* initial value "1s" was changed to "9999".
Input terminal function selection	Setting range "30, 32 to 35, 51 to 56, 83 to 90, 93" are added. "15, 19, 74" are deleted.
Output terminal function selection	Setting range "50 to 54" are added. "17 to 20, 120" are deleted.
Override	Setting range "0 to 200%" was changed to "0 to 1000%."
Automatic acceleration/deceleration	*Pr. 292* setting range "7, 8" are deleted.
Dancer control/Winding diameter compensation function/ Tension control function	*Pr. 702 to Pr. 704, Pr. 706 to Pr. 734, Pr. 737 to Pr. 799* are added.
Regeneration avoidance function	*Pr. 882* setting range "3" is added.

REMARKS

Functions not mentioned above are the same as FR-A700 series standard inverter.

Refer to FR-A700 series catalog or instruction manual for general specifications.

6.3 Parameter change when replacing FR-A500-A1 with FR-A700-A1

Parameter Name	Parameter Number		Changed Items			Remarks
	FR-A500-A1	FR-A700-A1	Setting Change	Parameter Number Change	Deleted	
PID action selection	128	128				
PID proportional band	129	129				
PID integral time	130	130				
PID upper limit	131	131	○			For dancer signal ± 10V input, 500% setting is changed to 0% setting. When replacing, add 500 to the present setting value.
PID lower limit	132	132	○			For dancer signal ± 10V input, 500% setting is changed to 0% setting. When replacing, add 500 to the present setting value.
Target dancer position	133	133	○			For dancer signal ± 10V input, 500% setting is changed to 0% setting. When replacing, add 500 to the present setting value.
PID differential time	134	134				
Integral clamp (positive polarity)	501	709		○		Parameter number is changed.
Integral clamp (negative polarity)	502	710		○		Parameter number is changed.
Integral (I) gain	503	Deleted			○	Deleted as the function is the same as PID integral time *(Pr. 130)*.
Speed compensation gain	506	706		○		Parameter number is changed.

Input Terminal Function Changed Setting Value	Parameter Settings		Remarks
	FR-A500-A1	FR-A700-A1	
Dancer function selection	14	83	In FR-A500 series, the setting was the same as standard PID function "14," but in FR-A700 series, the function was distinguished individually, and "83" was newly assigned to the function.

Changes in parameter setting due to new functions

(1) Acceleration/deceleration time for the main speed setting function

Parameter Name	Parameter Number	Initial Value	Changed Setting	Remarks
First acceleration time for main speed	756	15s	Acceleration time *(Pr. 7)* setting	Sets acceleration/deceleration time of the line speed
First deceleration time for main speed	757	15s	Deceleration time *(Pr. 8)* setting	

(2) Winding diameter compensation function

Parameter Name	Parameter Number	Initial Value	Changed Setting	Remarks
r-r' limit value (diameter)	771	1mm	9999	9999: Without winding diameter compensation function

6.4 Control mode-based parameter (function) correspondence and instruction code

Refer to the table below for available functions under each control mode and the instruction codes of the parameters different from FR-A700 series standard inverter.
Refer to the *FR-A700 series Instruction Manual* for available functions with the control mode and instruction code, which are not mentioned below.

*1 These instruction codes are used for parameter read and write by Mitsubishi inverter protocol with the RS-485 communication.
(For RS-485 communication, refer to the *FR-A700 series Instruction Manual*.)

*2 Availability of parameter functions under each control mode is as follows:
○:Usable parameter
×: Unusable parameter
△: Parameters available only during position control set by parameter

*3 "○" indicates valid and "×" indicates invalid of "parameter copy", "parameter clear", and "all parameter clear".

Parameter	Name	Instruction Code *1			Control Mode-based Correspondence Table *2							Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	V/F control	Advanced magnetic flux Vector Control	Vector Control			Real Sensorless Vector Control				
							Speed control	Torque control	Position control	Speed control	Torque control			
135	PID proportional band for under-set point value	23	A3	1	○	○	○	×	×	○	×	○	○	○
136	PID integral time for under-set point value	24	A4	1	○	○	○	×	×	○	×	○	○	○
137	PID differential time for under-set point value	25	A5	1	○	○	○	×	×	○	×	○	○	○
138	Integral control presence/ absence	26	A6	1	○	○	○	×	×	○	×	○	○	○
270	Dancer position A	4E	CE	2	○	○	○	×	×	○	×	○	○	○
271	Dancer position B	4F	CF	2	○	○	○	×	×	○	×	○	○	○
272	Dancer position C1	50	D0	2	○	○	○	×	×	○	×	○	○	○
273	Dancer position C2	51	D1	2	○	○	○	×	×	○	×	○	○	○
274	PID position gain A	52	D2	2	○	○	○	×	×	○	×	○	○	○
275	PID position gain B	53	D3	2	○	○	○	×	×	○	×	○	○	○
276	PID position gain C1	54	D4	2	○	○	○	×	×	○	×	○	○	○
277	PID position gain C2	55	D5	2	○	○	○	×	×	○	×	○	○	○
278	PID position gain D	56	D6	2	○	○	○	×	×	○	×	○	○	○
279	Winding/unwinding length detection	57	D7	2	○	○	○	×	×	○	×	○	○	○
280	Winding/unwinding length unit	58	D8	2	○	○	○	×	×	○	×	○	○	○
281	Stored winding/unwinding length	59	D9	2	○	○	○	×	×	○	×	○	×	×
464	Second PID proportional band	40	C0	4	○	○	○	×	×	○	×	○	○	○
465	Second PID integral time	41	C1	4	○	○	○	×	×	○	×	○	○	○
466	Second PID differential time	42	C2	4	○	○	○	×	×	○	×	○	○	○
467	Second PID proportional band for under-set point value	43	C3	4	○	○	○	×	×	○	×	○	○	○
468	Second PID integral time for under-set point value	44	C4	4	○	○	○	×	×	○	×	○	○	○
469	Second PID differential time for under-set point value	45	C5	4	○	○	○	×	×	○	×	○	○	○
470	Third PID proportional band	46	C6	4	○	○	○	×	×	○	×	○	○	○
471	Third PID integral time	47	C7	4	○	○	○	×	×	○	×	○	○	○
472	Third PID differential time	48	C8	4	○	○	○	×	×	○	×	○	○	○
473	Third PID proportional band for under-set point value	49	C9	4	○	○	○	×	×	○	×	○	○	○
474	Third PID integral time for under-set point value	4A	CA	4	○	○	○	×	×	○	×	○	○	○
475	Third PID differential time for under-set point value	4B	CB	4	○	○	○	×	×	○	×	○	○	○
476	Fourth PID proportional band	4C	CC	4	○	○	○	×	×	○	×	○	○	○

Parameter	Name	Instruction Code *1			Control Mode-based Correspondence Table *2							Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	V/F control	Advanced magnetic flux Vector Control	Vector Control			Real Sensorless Vector Control				
							Speed control	Torque control	Position control	Speed control	Torque control			
477	Fourth PID integral time	4D	CD	4	○	○	○	×	×	○	×	○	○	○
478	Fourth PID differential time	4E	CE	4	○	○	○	×	×	○	×	○	○	○
479	Fourth PID proportional band for under-set point value	4F	CF	4	○	○	○	×	×	○	×	○	○	○
480	Fourth PID integral time for under-set point value	50	D0	4	○	○	○	×	×	○	×	○	○	○
481	Fourth PID differential time for under-set point value	51	D1	4	○	○	○	×	×	○	×	○	○	○
702	Dancer position detection level	02	82	7	○	○	○	×	×	○	×	○	○	○
703	Minimum number of input pulse	03	83	7	○	○	○	×	×	○	×	○	○	○
704	Maximum number of input pulse	04	84	7	○	○	○	×	×	○	×	○	○	○
706	Speed compensation gain	06	86	7	○	○	○	×	×	○	×	○	○	○
707	Sampling time for winding diameter calculation	07	87	7	○	○	○	×	×	○	×	○	○	○
708	Filter time constant for dancer control input	08	88	7	○	○	○	×	×	○	×	○	○	○
709	Integral clamp (positive polarity)	09	89	7	○	○	○	×	×	○	×	○	○	○
710	Integral clamp (negative polarity)	0A	8A	7	○	○	○	×	×	○	×	○	○	○
711	Signal loss detection stationary time	0B	8B	7	○	○	○	×	×	○	×	○	○	○
712	Initial winding diameter calculation dead zone 2	0C	8C	7	○	○	○	×	×	○	×	○	○	○
713	Initial inertia moment	0D	8D	7	×	×	×	○	×	×	○	○	○	○
714	Roll width	0E	8E	7	×	×	×	○	×	×	○	○	○	○
715	Material specific gravity	0F	8F	7	×	×	×	○	×	×	○	○	○	○
716	Inertia compensation cushion time	10	90	7	×	×	×	○	×	×	○	○	○	○
717	Tension command cushion time	11	91	7	×	×	×	○	×	×	○	○	○	○
718	Dancer tension setting bias	12	92	7	○	○	○	×	×	○	×	○	○	○
719	Dancer tension setting gain	13	93	7	○	○	○	×	×	○	×	○	○	○
720	Maximum winding diameter 1	14	94	7	○	○	○	×	×	○	×	○	○	○
721	Minimum winding diameter 1	15	95	7	○	○	○	×	×	○	×	○	○	○
722	Maximum winding diameter 2	16	96	7	○	○	○	×	×	○	×	○	○	○
723	Minimum winding diameter 2	17	97	7	○	○	○	×	×	○	×	○	○	○
724	Maximum winding diameter 3	18	98	7	○	○	○	×	×	○	×	○	○	○
725	Minimum winding diameter 3	19	99	7	○	○	○	×	×	○	×	○	○	○
726	Maximum winding diameter 4	1A	9A	7	○	○	○	×	×	○	×	○	○	○
727	Minimum winding diameter 4	1B	9B	7	○	○	○	×	×	○	×	○	○	○
728	Main speed analog gain 2	1C	9C	7	○	○	○	×	×	○	×	○	○	○
729	Main speed analog gain 3	1D	9D	7	○	○	○	×	×	○	×	○	○	○
730	Main speed analog gain 4	1E	9E	7	○	○	○	×	×	○	×	○	○	○
731	Dancer signal input selection	1F	9F	7	○	○	○	×	×	○	×	○	○	○
732	Dancer main speed command input selection	20	A0	7	○	○	○	○	×	○	○	○	○	○
733	Taper setting analog input selection	21	A1	7	○	○	○	×	×	○	×	○	○	○
734	Dancer tension setting input selection	22	A2	7	○	○	○	×	×	○	×	○	○	○
737	Stall torque setting	25	A5	7	×	×	×	○	×	×	○	○	○	○
738	Speed limit for stall operation	26	A6	7	×	×	×	○	×	×	○	○	○	○
739	Mechanical loss setting frequency bias	27	A7	7	×	×	×	○	×	×	○	○	○	○
740	Mechanical loss setting frequency 1	28	A8	7	×	×	×	○	×	×	○	○	○	○
741	Mechanical loss 1	29	A9	7	×	×	×	○	×	×	○	○	○	○

Parameter	Name	Instruction Code *1			Control Mode-based Correspondence Table *2							Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	V/F control	Advanced magnetic flux Vector Control	Vector Control			Real Sensorless Vector Control				
							Speed control	Torque control	Position control	Speed control	Torque control			
742	Mechanical loss setting frequency 2	2A	AA	7	×	×	×	○	×	×	○	○	○	○
743	Mechanical loss 2	2B	AB	7	×	×	×	○	×	×	○	○	○	○
744	Mechanical loss setting frequency 3	2C	AC	7	×	×	×	○	×	×	○	○	○	○
745	Mechanical loss 3	2D	AD	7	×	×	×	○	×	×	○	○	○	○
746	Mechanical loss setting frequency 4	2E	AE	7	×	×	×	○	×	×	○	○	○	○
747	Mechanical loss 4	2F	AF	7	×	×	×	○	×	×	○	○	○	○
748	Mechanical loss setting frequency 5	30	B0	7	×	×	×	○	×	×	○	○	○	○
749	Mechanical loss 5	31	B1	7	×	×	×	○	×	×	○	○	○	○
750	Target winding diameter	32	B2	7	○	○	○	×	×	○	×	○	○	○
751	Dancer input offset	33	B3	7	○	○	○	×	×	○	×	○	○	○
752	Material thickness d1	34	B4	7	○	○	○	×	×	○	×	○	○	○
753	Material thickness d2	35	B5	7	○	○	○	×	×	○	×	○	○	○
754	Material thickness d3	36	B6	7	○	○	○	×	×	○	×	○	○	○
755	Material thickness d4	37	B7	7	○	○	○	×	×	○	×	○	○	○
756	First acceleration time for main speed	38	B8	7	○	○	○	×	×	○	×	○	○	○
757	First deceleration time for main speed	39	B9	7	○	○	○	×	×	○	×	○	○	○
758	Second acceleration time for main speed	3A	BA	7	○	○	○	×	×	○	×	○	○	○
759	Second deceleration time for main speed	3B	BB	7	○	○	○	×	×	○	×	○	○	○
760	Third acceleration time for main speed	8C	BC	7	○	○	○	×	×	○	×	○	○	○
761	Third deceleration time for main speed	3D	BD	7	○	○	○	×	×	○	×	○	○	○
762	Winding/unwinding selection	3E	BE	7	○	○	○	×	×	○	×	○	○	○
763	Line speed input selection	3F	BF	7	○	○	○	×	×	○	×	○	○	○
764	Pulse reference for line speed input	40	C0	7	○	○	○	×	×	○	×	○	○	○
765	Voltage reference for line speed input	41	C1	7	○	○	○	×	×	○	×	○	○	○
766	Line speed reference	42	C2	7	○	○	○	×	×	○	×	○	○	○
767	Line speed unit	43	C3	7	○	○	○	×	×	○	×	○	○	○
768	Line speed input filter time constant	44	C4	7	○	○	○	×	×	○	×	○	○	○
769	Filter treatment waiting time	45	C5	7	○	○	○	×	×	○	×	○	○	○
770	Filter time constant	46	C6	7	○	○	○	×	×	○	×	○	○	○
771	r-r' limit value (diameter)	47	C7	7	○	○	○	×	×	○	×	○	○	○
772	r-r' limit disable time	48	C8	7	○	○	○	×	×	○	×	○	○	○
773	Gear ratio numerator (driver side)	49	C9	7	○	○	○	×	×	○	×	○	○	○
774	Gear ratio denominator (follower side)	4A	CA	7	○	○	○	×	×	○	×	○	○	○
775	Speed control proportion term applied diameter 1	4B	CB	7	○	○	○	×	×	○	×	○	○	○
776	Speed control proportion term applied diameter 2	4C	CC	7	○	○	○	×	×	○	×	○	○	○
777	Speed control proportional gain 1	4D	CD	7	○	○	○	×	×	○	×	○	○	○
778	Speed control proportional gain 2	4E	CE	7	○	○	○	×	×	○	×	○	○	○
779	Speed control proportional gain 3	4F	CF	7	○	○	○	×	×	○	×	○	○	○
780	Speed control proportional gain 4	50	D0	7	○	○	○	×	×	○	×	○	○	○

Parameter	Name	Instruction Code *1			Control Mode-based Correspondence Table *2							Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	V/F control	Advanced magnetic flux Vector Control	Vector Control			Real Sensorless Vector Control				
							Speed control	Torque control	Position control	Speed control	Torque control			
781	Winding diameter storage selection	51	D1	7	○	○	○	×	×	○	×	○	○	○
782	Stored winding diameter	52	D2	7	○	○	○	×	×	○	×	○	○	○
783	Operation time with stored winding diameter	53	D3	7	○	○	○	×	×	○	×	○	○	○
785	Terminal 4 function setting	55	D5	7	○	○	○	×	×	○	×	○	○	○
786	Number of averaging for winding diameter calculation	56	D6	7	○	○	○	×	×	○	×	○	○	○
787	Taper ratio setting	57	D7	7	○	○	○	×	×	○	×	○	○	○
788	Winding diameter at taper start	58	D8	7	○	○	○	×	×	○	×	○	○	○
789	Dancer tension setting	59	D9	7	○	○	○	×	×	○	×	○	○	○
790	Initial winding diameter calculation start point	5A	DA	7	○	○	○	×	×	○	×	○	○	○
791	Initial winding diameter calculation dead zone	5B	DB	7	○	○	○	×	×	○	×	○	○	○
792	Accumulated amount	5C	DC	7	○	○	○	×	×	○	×	○	○	○
793	Speed control P gain at a start	5D	DD	7	○	○	○	×	×	○	×	○	○	○
794	Speed control integral time at start	5E	DE	7	○	○	○	×	×	○	×	○	○	○
795	Integral term limit at a start	5F	DF	7	○	○	○	×	×	○	×	○	○	○
796	PID term limit at a start	60	E0	7	○	○	○	×	×	○	×	○	○	○
797	Rotation speed at winding diameter calculated value activation	61	E1	7	○	○	○	×	×	○	×	○	○	○
798	Speed compensation bias	62	E2	7	○	○	○	×	×	○	×	○	○	○
799	Winding diameter monitor reference	63	E3	7	○	○	○	○	○	○	○	○	○	○

6.5 Index

T

W

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Nov. 2008	IB(NA)-0600372ENG-A	First edition
Jan. 2009	IB(NA)-0600372ENG-B	Partial modification
Oct. 2012	IB(NA)-0600372ENG-C	Addition • Tension control function

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