Chapter 3 FBs-PLC Instruction Lists

3.1 Sequential Instructions

Instruction	Operand	Symbol	Function Descriptions	Execution Time	Instruction type
ORG	X,Y,M, S,T,C		Starting a network with a normally open (A) contact	0.33uS	Network starting instructions
ORG NOT			Starting a network with a normally closed (B) contact		
ORG TU			Starting a network with a differential up (TU) contact	0.54uS	
ORG TD			Starting a network with a differential down (TD) contact		
ORG OPEN			Starting a network with a open circuit contact	0.33uS	
ORG SHORT			Starting a network with a short circuit contact		
LD	X,Y,M, S,T,C		Starting a relay circuit from origin or branch line with a normally open contact	0.33uS	Origin or branch line starting instructions
LD NOT			Starting a relay circuit from origin or branch line with a normally closed contact		
LD TU			Starting a relay circuit from origin or branch line with a differential up contact	0.54uS	
LD TD			Starting a relay circuit from origin or branch line with a differential down contact		
LD OPEN			Starting a relay circuit from origin or branch line with a open circuit contact	0.33uS	
LD SHORT			Starting a relay circuit from origin or branch line with a short circuit contact		
AND	X,Y,M, S,T,C		Serial connection of normally open contact	0.33uS	Serial connection instructions
AND NOT			Serial connection of normally closed contact		
AND TU			Serial connection of differential up contact	0.54uS	
AND TD			Serial connection of differential down contact		
AND OPEN			Serial connection of open circuit contact	0.33uS	
AND SHORT			Serial connection of short circuit contact		
OR	X,Y,M, S,T,C		Parallel connection of normally open contact	0.33uS	Parallel connection instructions
OR NOT			Parallel connection of normally closed contact		
OR TU			Parallel connection of differential up contact	0.54uS	
OR TD			Parallel connection of differential down contact		
OR OPEN			Parallel connection of open circuit contact	0.33uS	
OR SHORT			Parallel connection of short circuit contact		
ANDLD			Serial connection of two circuit blocks	0.33uS	Blocks merge instructions
ORLD			Parallel connection of two circuit blocks		

Instruction	Operand	Symbol	Function Descriptions	Execution Time	Instruction type
OUT	Y,M,S	—( )	Send result to coil	0.33uS ｜ 1.09uS	Coil output instruction
OUT NOT		—(/)	Send inverted result to coil		
OUT	Y	—(L)	Send result to an external output coil and appoint it as of retentive type		
OUT L	TR		Save the node status to a temporary relay	0.33uS	Node operation instruction
LD			Load the temporary relay		
TU		—↑—	Take the transition up of the node status	0.33uS	
TD		—↓—	Take the transition down of the node status	0.33uS	
NOT		—/—	Invert the node status	0.33uS	
SET		•—(S)	Set a coil	0.33uS ｜ 1.09uS	
RST		•—(R)	Reset a coil	0.33uS ｜ 1.09uS	

● The 36 sequential instructions listed above are all applicable to every models of FBs-PLC.

3.2 Function Instructions

There are more than 100 different FBs-PLC function instructions. If put the D and P derivative instructions into account, the total number of instructions is over 300. On top of these, many function instructions have multiple input controls (up to 4 inputs) which can have up to 8 different types of operation mode combinations. Hence, the size of FBs-PLC instruction sets is in fact not smaller than that of a large PLC. Having powerful instruction functions, though may help for establishing the complicated control applications, but also may impose a heavy burden on those users of small type PLC's. For ease of use, FATEK PLC function instructions are divided into two groups, the Basic function group which includes 26 commonly used function instructions and 4 SFC instructions and the advanced function group which includes other more complicated function instructions, such as high-speed counters and interrupts. This will enable the beginners and the non-experienced users to get familiar with the basic function very quickly and to assist experienced users in finding what they need in the advanced set of function instructions.

The instructions attached with "★" symbol are basic functions which amounts to 26 function instructions and 4 SFC instructions. All the basic functions will be explained in next chapter. The details for the reset of functions please refer advanced manual.

■ General Timer/Counter Function Instructions

FUN No.	Name	Operand	Derivative Instruction	Function descriptions
★	T nnn	PV		General timer instructions (“nnn” range 0～255, total 256)
★	C nnn	PV		General counter instructions (“nnn” range 0～255, total 256)
★ 7	UDCTR	CV,PV	DP	16-Bit or 32-Bit up/down counter

■ Single Operand Function Instructions

★ 4	DIFU	D	P	To get the up differentiation of a D relay and store the result to D
★ 5	DIFD	D	P	To get the down differentiation of a D relay and store the result to D
★ 10	TOGG	D	P	Toggle the status of the D relay

■ Setting/Resetting

★	SET	D	DP	Set all bits of register or a discrete point to 1
★	RST	D	DP	Clear all bits of register or a discrete point to 0
114	Z-WR	N	P	Zone set or clear

■ SFC Instructions

★	STP	Snnn		STEP declaration
★	STPEND			End of the STEP program
★	TO	Snnn		STEP divergent instruction
★	FROM	Snnn		STEP convergent instruction

■ Mathematical Operation Instructions

★ 11	(＋)	Sa,Sb,D	D P	Perform addition of Sa and Sb and then store the result to D
★ 12	(－)	Sa,Sb,D	D P	Perform subtraction of Sa and Sb and then store the result to D
★ 13	(＊)	Sa,Sb,D	D P	Perform multiplication of Sa and Sb and then store the result to D
★ 14	(／)	Sa,Sb,D	D P	Perform division of Sa and Sb and then store the result to D
★ 15	(＋1)	D	D P	Adds 1 to the D value
★ 16	(－1)	D	D P	Subtracts 1 from the D value
23	DIV48	Sa,Sb,D	P	Perform 48 bits division of Sa and Sb and then store the result to D
24	SUM	S,N,D	D P	Take the sum of the successive N values beginning from S and store it in D
25	MEAN	S,N,D	D P	Take the mean average of the successive N values beginning from S and store it in D
26	SQRT	S,D	D P	Take the square root of the S value and store it in D
27	NEG	D	D P	Take the 2's complement (negative number) of the D value and store it back in D
28	ABS	D	D P	Take the absolute value of D and store it back in D
29	EXT	D	P	Take the 16 bit numerical value and extend it to 1 32 bit numerical value (value will not change)
30	PID	TS,SR,OR, PR,WR		PID operation
31	CRC	MD,S,N,D	P	CRC16 checksum calculation
32	ADCNV	PI,S,N,D		Offset and full scale conversion

FUN No.	Name	Operand	Derivative Instruction	Function descriptions
33	LCNV	Md,S,Ts,D,L	P	Linear Conversion
34	MLC	Rs,SI,Tx,Ty,TI, D	P	Multiple Linear Conversion
200	I→F	S,D	D P	Integer to floating point number conversion
201	F→I	S,D	D P	Floating point number to integer conversion
202	FADD	Sa,Sb,D	P	Addition of floating point number
203	FSUB	Sa,Sb,D	P	Subtraction of floating point number
204	FMUL	Sa,Sb,D	P	Multiplication of floating point number
205	FDIV	Sa,Sb,D	P	Division of floating point number
206	FCMP	Sa,Sb	P	Comparison of floating point number
207	FZCP	Sa,Sb	P	Zone comparison of floating point number
208	FSQR	S,D	P	Square root of floating point number
209	FSIN	S,D	P	SIN trigonometric function
210	FCOS	S,D	P	COS trigonometric function
211	FTAN	S,D	P	TAN trigonometric function
212	FNEG	D	P	Change sign of floating point number
213	FABS	D	P	Take absolute value of floating point number
214	FLN	S,D	P	Floating point napierian logarithm
215	FEXP	S,D	P	Floating point exponential function
216	FLOG	S,D	P	Floating point logarithm
217	FPOW	Sy, Sx,D	P	Floating point power function
218	FASIN	S,D	P	Floating point arc sine function
219	FACOS	S,D	P	Floating point arc cosine function
220	FATAN	S,D	P	Floating point arc tangent function

■ Logical Operation Instructions

★ 18	AND	Sa,Sb,D	D P	Perform logical AND for Sa and Sb and store the result to D
★ 19	OR	Sa,Sb,D	D P	Perform logical OR for Sa and Sb and store the result to D

35	XOR	Sa,Sb,D	D P	Take the result of the Exclusive NOR logical operation made between Sa and Sb, and store it in D
36	XNR	Sa,Sb,D	D P	Take the result of the Exclusive NOR logical operation made between Sa and Sb, and store it in D

■ Comparison Instructions

★ 17	CMP	Sa,Sb	D P	Compare the data at Sa and data at Sb and output the result to function outputs (FO0~FO2)
37	ZNCMP	S,S_U,S_L	D P	Compare S with the zones formed by the upper limit S_U and lower limit S_L, and set the result to FO0~FO2

■In Line Comparison Instructions

170	＝	Sa,Sb	D	Equal to compare
171	＞	Sa,Sb	D	Greater than compare
172	＜	Sa,Sb	D	Less than compare
173	＜＞	Sa,Sb	D	Not equal to compare
174	＞＝	Sa,Sb	D	Greater than or equal to compare
175	＝＜	Sa,Sb	D	Less than or equal to compare

■ Data Movement Instructions

FUN No.	Name	Operand	Derivative instruction	Function descriptions
★ 8	MOV	S,D	D P	Transfer the W or DW data specified at S to D
★ 9	MOV/	S,D	D P	Invert the W or DW data specified at S, and then transfers the result to D
40	BITRD	S,N	D P	Read the status of the bits specified by N within S, and send it to FO0
41	BITWR	D,N	D P	Write the INB input status into the bits specified by N within D
42	BITMV	S,Ns,D,Nd	D P	Write the status of bit specified by N within S into the bit specified by N within D
43	NBMV	S,Ns,D,Nd	D P	Write the Ns nibble within S to the Nd nibble within D
44	BYMV	S,Ns,D,Nd	D P	Write the byte specified by Ns within S to the byte specified by Nd within D
45	XCHG	Da,Db	D P	Exchange the values of Da and Db
46	SWAP	D	P	Swap the high-byte and low-byte of D
47	UNIT	S,N,D	P	Take the nibble 0 (NB0) of the successive N words starting from S and combine the nibbles sequentially then store in D
48	DIST	S,N,D	P	De-compose the word into successive N nibbles starting from nibble 0 of S, and store them in the NB0 of the successive N words starting from D
49	BUNIT	S,N,D	P	Low byte of words re-unit

FUN No.	Name	Operand	Derivative instruction	Function descriptions
50	BDIST	S,N,D	P	Words split into multi-byte
160	RW-FR	Sa,Sb,Pr,L	D P	File register access
161	WR-MP	S, Bk,Os, Pr,L,WR	P	Write memory pack
162	RD- MP	Bk,Os,Pr L,D PR,WR	P	Read memory pack

■ Shifting/Rotating Instructions

★ 6	BSHF	D	D P	Shift left or right 1 bit of D register
51	SHFL	D,N	D P	Shift left the D register N bits and move the last shifted out bits to OTB. The empty bits will be replaced by INB input bit
52	SHFR	D,N	D P	Shift right the D register N bits and move the last shifted out bits to OTB, The empty bits will be replaced by INB input bit
53	ROTL	D,N	D P	Rotate left the D operand N bits and move the last rotated out bits to OTB
54	ROTR	D,N	D P	Rotate right the D operand N bits and move the last rotated out bits to OTB

■ Code Conversion Instruction

★ 20	→BCD	S,D	D P	Convert binary data of S into BCD data and store the result to D
★ 21	→BIN	S,D	D P	Convert BCD data of S into binary data and store the result to D
55	B→G	S,D	D P	Binary to Gray code conversion
56	G→B	S,D	D P	Gray code to Binary conversion
57	DECOD	S,Ns,NL,D	P	Decode the binary data formed by NL bits starting from Ns bit within S, and store the result in the register starting from D
58	ENCOD	S,Ns,NL,D	P	Encoding the NL bits starting from the Ns bit within S, and store the result in D
59	→7SG	S,N,D	P	Convert the N+1 number of nibble data within S, into 7 segment code, then store in D
60	→ASC	S,D	P	Write the constant string S (max. 12 alpha-numeric or symbols) into the registers starting from D
61	→SEC	S,D	P	Convert the time data (hours, minutes, seconds) of the three successive registers starting from S into seconds data then store to D
62	→HMS	S,D	P	Convert the seconds data of S into time data (hours, minutes, seconds) and store the data in the three successive registers starting from D
63	→HEX	S,N,D	P	Convert the successive N ASCII data starting from S into hexadecimal data and store them to D

64	→ASCⅡ	S,N,D	P	Convert the successive N hexadecimal data starting from S into ASCII codes and store them to D

■ Flow Control Instructions

★ 0	MC	N		The start of master control loop
★ 1	MCE	N		The end of master control loop
★ 2	SKP	N		The start of skip loop
★ 3	SKPE	N		The end of skip loop
	END			End of Program
22	BREAK		P	Exit from FOR-NEXT loop
65	LBL	1～6 alphanumeric		Define the label with 1~6 alphanumeric characters
66	JMP	LBL	P	Jump to LBL label and continues the program execution
67	CALL	LBL	P	Call the sub-program begin with LBL label
68	RTS			Return to the calling main program from sub-program
69	RTI			Return to interrupted main program from sub-program
70	FOR	N		Define the starting point of the FOR Loop and the loop count N
71	NEXT			Define the end of FOR loop

■ I/O Function Instructions

FUN No.	Name	Operand	Derivative instruction	Function descriptions
74	IMDIO	D,N	P	Update the I/O signal on the main unit immediately
76	TKEY	IN,D,KL	D	Convenient instruction for 10 numeric keys input
77	HKEY	IN,OT,D,KL	D	Convenient instruction for 16 keys input
78	DSW	IN,OT,D	D	Convenient instruction for digital switch input
79	7SGDL	S,OT,N	D	Convenient instruction for multiplexing 7-segment display
80	MUXI	IN,OT,N,D		Convenient instruction for multiplexing input instruction
81	PLSO	MD, Fr, PC UY,DY,HO	D	Pulse output function (for bi-directional drive of step motor)
82	PWM	TO,TP,OT		Pulse width modulation output function
83	SPD	S,TI,D		Speed detection function
84	TDSP	S,Yn,Dn, PT,IT,WS		7/16-segment LED display control
86	TPCTL	Md,Yn,Sn,Zn, Sv,Os,PR IR,DR,OR,WR		PID Temperature control
139	HSPWM	PW,OP,RS, PN,OR,WR		High Speed PWM pulse output

■ Cumulative Timer Function Instructions

87	T.01S	CV,PV		Cumulative timer using 0.01S as the time base
88	T.1S	CV,PV		Cumulative timer using 0.1S as the time base
89	T1S	CV,PV		Cumulative timer using 1S as the time base

■ Watch Dog Timer Control Function Instructions

90	WDT	N	P	Set the WDT timer time out time to N mS
91	RSWDT		P	Reset the WDT timer to 0

■ High Speed Counter Control Function Instructions

92	HSCTR	CN	D P	Read the current CV value of the hardware HSCs, HSC0～HSC3, or HST on ASIC to the corresponding CV register in the PLC respectively
93	HSCTW	S,CN,D	D P	Write the CV or PV register of HSC0～HSC3 or HST in the PLC to CV or PV register of the hardware HSC or HST on ASIC respectively

■ Report Function Instructions

94	ASCWR	MD,S,Pt	P	Parse and generate the report message based on the ASCII formatted data starting from the address S. Then report message will send to port1

■ Ramp Function Instructions

FUN No.	Name	Operand	Derivative instruction	Function descriptions
95	RAMP	Tn,PV,SL, SU,D	P	Ascending/Descending convenient instruction
98	RAMP2	Om,Ta Td,Rt Rc,WR		Tracking type ramp function for D/A output

■ Communication Function Instructions

150	M-Bus	Pt, SR, WR	P	Modbus protocol communication
151	CLINK	PT, WD, SR, WR	P	FATEK/Generic protocol communication

■ Table Function Instructions

100	R→T	Rs,Td,L,Pr	D P	Store the Rs value into the location pointed by the Pr in Td
101	T→R	Ts,L,Pr,Rd	D P	Store the value at the location pointed by the Pr in Ts into Rd
102	T→T	Ts,Td,L,Pr	D P	Store the value at the location pointed by the Pr in Ts into the location pointed by the Pr in Td
103	BT_M	Ts,Td,L	D P	Copy the entire contents of Ts to Td
104	T_SWP	Ta,Tb,L	D P	Swap the entire contents of Ta and Tb
105	R-T_S	Rs,Ts,L,Pr	D P	Search the table Ts to find the location with data different or equal to the value of Rs. If found store the position value into the Pr
106	T-T_C	Ta,Tb,L,Pr	D P	Compare two tables Ta and Tb to search the entry with different or same value. If found store the position value into the Pr
107	T_FIL	Rs,Td,L	D P	Fill the table Td with Rs
108	T_SHF	IW,Ts,Td, L,OW	D P	Store the result into Td after shift left or right one entry of table Ts. The shift out data is send to OW and the shift in data is from IW
109	T_ROT	Ts,Td,L	D P	Store the result into Td after shift left or right one entry of table Ts.
110	QUEUE	IW,QU,L, Pr,OW	D P	Push IW into QUEUE or get the data from the QUEUE to OW (FIFO)
111	STACK	IW,ST,L, Pr,OW	D P	Push IW into STACK or get the data from the STACK to OW (LIFO)
112	BKCMP	Rs,Ts,L,D	D P	Compare the Rs value with the upper/lower limits of L, constructed by the table Ts, then store the comparison result of each pair into the relay designated by D (DRUM)
113	SORT	S,D,L	D P	Sorting the registers starting from S length L and store the sorted result to D

■ Matrix Instructions

120	MAND	Ma,Mb,Md,L	P	Store the results of logic AND operation of Ma and Mb into Md
121	MOR	Ma,Mb,Md,L	P	Store the results of logic OR operation of Ma and Mb into Md
122	MXOR	Ma,Mb,Md,L	P	Store the results of logic Exclusive NOR operation of Ma and Mb into Md
123	MXNR	Ma,Mb,Md,L	P	Store the results of logic Exclusive NOR operation of Ma and Mb into Md
124	MINV	Ms,Md ,L	P	Store the results of inverse Ms into Md
125	MCMP	Ma,Mb,L Pr	P	Compare Ma and Mb to find the location with different value, then store the location into Pr
126	MBRD	Ms,L,Pr	P	Read the bit status pointed by the Pr in Ms to the OTB output
127	MBWR	Md,L,Pr	P	Write the INB input status to the bits pointed by the Pr in Ms
128	MBSHF	Ms,Md,L	P	Store the results to Md after shift one bit of the Ms. Shifted out bit will appear at OTB and the shift in bits comes from INB
129	MBROT	Ms,Md,L	P	Store the results to Md after rotate one bit of the Ms. Rotated out bit will appear at OTB.
130	MBCNT	Ms,L,D	P	Calculate the total number of bits that are 0 or 1 in Ms, then store the results into D

■ NC Positioning Instruction

140	HSPSO	Ps,SR,WR		HSPSO instruction of NC positioning control
141	MPARA	Ps,SR		Parameter setting instruction of NC positioning control
142	PSOFF	Ps	P	Stop the pulse output of NC positioning control
143	PSCNV	Ps,D	P	Convert the Ps positions of NC positioning to mm, Inch or Deg
147	MHSPO	Gp,SR WR,		Multi-Axis high speed pulse output
148	MPG	Sc,Ps,Fo,Mr,W		Manual pulse generator for positioning

■ Disable/Enable Control of Interrupt or Peripheral

145	EN	LBL	P	Enable HSC, HST, external INT or peripheral operation
146	DIS	LBL	P	Disable HSC, HST, external INT or peripheral operation