8 LIST OF CAMM-GL III INSTRUCTIONS

*1: $-(2^{26}-1)$ — $+(2^{26}-1)$ *2: 0 — $+(2^{26}-1)$ *3: $-(2^{26}-1)°$ — $+(2^{26}-1)°$ *4: $21_{(16)}$ — $3A_{(16)}$, $3C_{(16)}$ — $7E_{(16)}$

• mode1

Instruction	Format	Meaning of Parameter [Parameter Range (Default)]		Explanation
H	H	None		Move to User Origin
D	D x1, y1..., xn, yn	xn: Absolute X-axis coordinate	[*1]	Cut Absolute Line
		yn: Absolute Y-axis coordinate	[*1]	
M	M x1, y1...xn,yn	xn: Absolute X-axis coordinate	[*1]	Tool-up to Absolute Coordinate Point
		yn: Absolute Y-axis coordinate	[*1]	
I	I x1, y1..., xn, yn	xn: Relative X-axis coordinate	[*1]	Cut Relative Line
		yn: Relative Y-axis coordinate	[*1]	
R	R x, y	xn: Relative X-axis coordinate	[*1]	Tool-up Move to Relative Coordinate Point
		yn: Relative Y-axis coordinate	[*1]	
L	L p	p: Line pattern	[-5 — +5 (0)]	Specify Line Type
B	B l	l: Pitch length	[*2 1.5% of (P2-P1)]	Specify Broke Line Pitch
X	X p,q,r	p: Coordinate axis	[0, 1]	Plot Coordinate System
		q: Tick interval	[*1]	
		r: Number	[1—32767]	
P	P c1c2...cn	cn: Character		Plot Character
S	S n	n: Character size	[0—127 (61)]	Set Character Size
Q	Q n	n: Rotation angle (90°as a unit)	[n =0 — 3 (0)]	Specify Character Rotate Angle
N	N n	n: Number of special symbol	[1—15]	Plot Special Symbol
C	C x, y, r, Ø1, Ø2(,Ød)	x, y: Center coordinates	[*1]	Cut Arc
		r: Radius	[*1]	
		Ø1•Ø2: Start angle • End angle	[*1]	
		Ød: Chord tolerance	[*1 (5°)]	
E	E r, Ø1, Ø2(,Ød)	r: Radius	[*1]	Cut Arc from Tool Position
		Ø1•Ø2: Start angle • End angle	[*1]	
		Ød: Chord tolerance	[*1 (5°)]	
A	A x, y	x: Center x coordinate	[*1 (0)]	Specify G & K Center Coordinate
		y: Center y coordinate	[*1 (0)]	
G	G r,Ø1, Ø2(,Ød)	r: Radius	[*1]	Cut Arc Around A-Instruction Center
		Ø1: Start angle	[*1]	
		Ø2: End angle	[*1]	
		d: Chord tolerance	[*1 (5°)]	
K	K n, l1, l2	n: Division line angle	[*1]	Plot Division Line
		l1: Division line end point distance	[*1]	
		l2: Division line start point distance	[*1]	
T	T n, x, y, d, t	n: Hatching pattern	[0—3]	Plot and Hatch Rectangle
		x, y: Rectangle size	[*1]	
		d: Hatching spacing	[*1]	
		t: Hatching angle	[1—4]	
^	[mode 2 instruction] [parameter]...., [parameter] [terminator]			Call mode 2

• mode2

Instruction	Format	Meaning of Parameter [Parameter Range (Default)]		Explanation
AA	AA x,y,Øc(,Ød);	x, y: Absolute center coordinates	[*1]	Arc Absolute
		Øc:Center angle	[*1]	
		Ød: Chord tolerance	[*1 (5°)]	
AR	AR x, y,Øc(,Ød);	x, y: Relative center coordinates	[*1]	Arc Relative
		Øc: Center angle	[*1]	
		Ød: Chord tolerance	[*1 (5°)]	
CA	CA n; CA;	n: Character set No.	[0 — 4, 6 — 9, 30 — 39]	Alternate Character set
CI	CI r(,Ød);	r: Radius	[*1]	Circle
		Ød: Chord tolerance	[*3 (5°)]	
CP	CP nx,ny; CP;	nx: Number of characters in X-axis direction	[*1]	Character Plot
		ny: Number of characters in Y-axis direction	[*1]	
CS	CS n; CS;	n: Character set number		Standard Character Set
DF	DF;	None		Default
DI	DI run, rise; DI;	run: X-axis direction vector	[*1 (1)]	Absolute Direction
		rise: Y-axis direction vector	[*1 (0)]	
DR	DR run, rise; DR;	run: X-axis direction vector	[*1 (1)]	Relative Direction
		rise: Y-axis direction vector	[*1 (0)]	
DT	DT t;	t: Label terminator	[[ETX]]	Define Label Terminator
EA	EA x, y;	x, y: Absolute XY coordinates of opposite angle of rectangle	[*1]	Edge Rectangle Absolute
ER	ER x, y;	x, y: Relative XY coordinates of opposite angle of rectangle	[*1]	Edge Rectangle Relative
EW	EW r, Ø1, Øc(,Ød);	r: Radius	[*1]	Edge Wedge
		Ø1: Start angle	[*3]	
		Øc: Center angle	[*3]	
		Ød: Chord tolerance	[*3 (5°)]	
FT	FT n(,d(,Ø)); FT;	n: Pattern	[1 — 5 (1)]	Fill Type
		d: Spacing	[*2 ((P2x-P1x) x 0.01)]	
		Ø: Angle	[*3 (0°)]	
IM	IM e; IM;	e: Error mask value	[0 — 255 (223)]	Input Mask
IN	IN;	None		Initialize
IP	IP P1x, P1y, P2x, P2y; IP;	P1x, P1y: XY coordinates of P1	[*1]	Input P1 & P2
		P2x, P2y: XY coordinates of P2	[*1]	

Instruction	Format	Meaning of Parameter [Parameter Range (Default)]	Explanation
IW	IW LLx, LLy, URx, URy; IW;	LLx, LLy : lower left coordinates of window URx,URy : Upper right coordinates of window	Input Window
LB	LB c1c2c3...cn [label terminator]	c: Character string	Label
LT	LT n(,l); LT;	n: Pattern number [0 — 6 (solid line)] l: 1 pitch length [*2 (1.5% of (P2-P1))]	Line Type
OA	OA;	None	Output Actual Point
OC	OC;	None	Output Commanded Position
OE	OE;	None	Output Error
OF	OF;	None When the PNC-950 receives an OF instruction from the computer, "40,40 [TERM]" is output.	Output Factor
OH	OH;	None	Output Hard-Clip Limits
OI	OI;	None When the PNC-950 receives an OI instruction from the computer, "950 [TERM]" is output.	Output Identification
OO	OO;	None When the PNC-950 receives an OO instruction from the computer, "0,0,0,0,1,0,0,0 [TERM]" is output. The "1" in this output indicates that circle and arc commands have been loaded	Output Option Parameter
OP	OP;	None	Output P1 & P2
OS	OS;	None	Output Status
OW	OW;	None	Output Window
PA	PA x1, y1(...,xn, yn); PA;	xn, yn: Absolute XY coordinates [*1]	Cut Absolute
PD	PD x1, y1(...,xn, yn); PD;	xn, yn: XY coordinates [*1]	Tool Down
PR	PR 1, y1(... xn, yn); PR;	xn, yn: Relative XY coordinates [*1]	Cut Relative
PT	PT d; PT;	d: Pen thickness (mm) [0—5 (0.3)]	Pen Thickness
PU	PU x1, y1(...,xn, yn); PU;	xn, yn: XY coordinates [*1]	Tool Up
RA	RA x, y;	x, y: Absolute XY coordinates of opposite angle of rectangle [*1]	Shade Rectangle Absolute
RR	RR x, y;	x, y: Relative XY coordinates of opposite angle of rectangle [*1]	Shade Rectangle Relative
SA	SA;	None	Select Alternate Set
SC	SC Xmin, Xmax, Ymin, Ymax; SC;	Xmin, Ymin: User XY coordinates of P1 [*1] Xmax, Ymax: User XY coordinates of P2 [*1]	Scaling
SI	SI w, h; SI;	w: Character width (cm.) [-128 — +127.99999 (3.8)] h: Character height (cm.) [-128 — +127.99999 (5)]	Absolute Character Size
SL	SL tanØ; SL;	tanØ: Character slant [*1 (0)]	Character Slant
SM	SM s; SM;	s: Character or symbol [*4 (Default: Clears symbol mode)]	Symbol Mode
SR	SR w, h; SR;	w: Character width (%) [*1 (3.8)] h: Character height (%) [*1 (5)]	Relative Character Size
SS	SS;	None	Select Standard Set
TL	TL lp(,lm); TL;	lp: Tick length in positive direction [*2 (0.5%)] lm: Tick length in negative direction [*2 (0.5%)]	Thick Length
UC	UC (c,) x, y,(c,) ,...., xn, yn; UC;	c: Tool control value [-(67108863) — -99, +99 — +(67108863)] xn: Units of movement in X-axis direction [-99< xn<+99] yn: Units of movement in Y-axis direction [-99< yn<+99]	User Defined Character
VS	VS v; VS;	v: Tool speed (cm/sec.) [1 — 40]	Velocity Select
WG	WG r, Ø1, Øc(,Ød);	r : Radius [*1] Ø1 : Start angle [*3] Øc : Center angle [*3] Ød : Chord tolerance [*3 (5°)]	Shade Wedge
XT	XT;	None	X-Tick
YT	YT;	None	Y-Tick

• Instructions in mode1 and mode2

Instruction	Format	Meaning of Parameter [Parameter Range (Default)]	Explanation
!NR	!NR [terminator]	None	Not Ready
!PG	!PG n [terminator]	n: [-24998 — +24998 mm]	Page Feed
!ST	!ST n [terminator]	n: [0, 1]	Select Tool

9 LIST OF DEVICE CONTROL INSTRUCTIONS

Device control instructions are used to determine the communication sequence between the PNC-950 and computer through RS-232C interface and update the computer the current PNC-950 state. Among them, some device control instructions set the output specifications of CAMM-GL III instructions.
Each device control instruction is organized with three letters: [ESC] , "." and one uppercase letter. Device control instructions are of two types: one with parameters and the other without parameters.
Parameters can be omitted. A semicolon ";" is used as a delimiter to separate parameters if they are input in succession. A ";" without parameters means that parameters were omitted.
If parameters are omitted, the default value is set. For a device control instruction with parameters, a terminator needs to be input in order to signify the end of instructions. A colon ":" is used as the terminator which cannot be omitted.

Instruction	Format	Parameter	Range ([ ] is default)	Explanation
Handshake Instructions				
ESC .B Output Remaining Buffer Capacity	[ESC].B	None		Outputs the current remaining buffer capacity to the computer.
ESC .M Set Handshake Output Specifications (1)	[ESC].M<P1>;<P2>; <P3>;<P4>;<P5>;<P6>:	P1: Delay time P2: Output trigger character P3: Echo terminator P4: Output terminator P5: Output terminator P6: Output initiator	0—32767 (msec) [0 (msec)] [0 (Sets nothing)] [0 (Sets nothing)] [13 ([CR])] [0 (Sets nothing)] [0 (Sets nothing)]	Sets handshake output specifications. Note: When you specify some values to <P4> and <P5>, always set 0 to <P6>. When you specify some value to <P6>, always set 0 to <P5>.
ESC .N Set Handshake Output Specifications (2)	[ESC].N<P1>;<P2>; <P3>; ••••• ;<P11>:	P1: Intercharacter delay P2-P11 : Xoff character (for Xon/Xoff) Immediate response character (for ENQ/ACK)	0—32767 (msec) [0 (msec)] [All 0 (Sets nothing)]	Sets an intercharacter delay, and also an Xoff character for performing the Xon/Xoff handshake.
ESC .H Sets ENQ/ACK Handshake Mode1	[ESC].H<P1>;<P2>; <P3>; •••••••• ;<P12>:	P1: The number of bytes for data block P2: ENQ character P3-P12 : ACK character (only when <P2> is set)	0—15358 (byte) [80 (byte)] [0 (Sets nothing)] [All 0 (Sets nothing)]	When receiving the ENQ character set by <P2>, compares the value set by <P1> and the remaining buffer capacity, and returns the ACK character to the host computer when the remaining buffer capacity is larger. The [ESC].H with no parameter performs a dummy handshake.
ESC .I Set Xon/Xoff Handshake and ENQ/ACK Handshake Mode2	[ESC].I<P1>;<P2>; <P3> ; •••••••• ;<P12>:	P1: Limit of the remaining buffer capacity (for Xon/Xoff) The number of data block bytes (for ENQ/ACK (mode2)) P2: ENQ character (for ENQ/ACK (mode2)) 0 (for Xon/Xoff) P3-P12 : Xon character(for Xon/Xoff) ACK character (for ENQ/ACK (mode2))	0—15358 (byte) [80 (byte)] [0 (Sets nothing)] [All 0 (Sets nothing)]	Used for performing the Xon/Xoff handshake and the ENQ/ACK handshake mode 2. The [ESC].I instruction with no parameter performs a dummy handshake. In a dummy handshake, always returns the ACK character to the host computer, regardless of the remaining buffer capacity, when receiving the ENQ character.
ESC .@ Controls DTR	[ESC].@ P1;P2:	P1: Ignored P2: DTR signal control	 0—255 [1]	Controls the DTR signal (No. 20 pin of RS-232C). An even number parameter (e.g. 0) always sets the DTR signal to High without performing the hardware handshake. An odd number parameter (e.g. 1) performs the hardware handshake and controls the DTR signal according to the remaining buffer capacity.
Status Instructions				
ESC .O Outputs the Status of Buffer, Pause	[ESC].O	None		Outputs the status codes of PNC-950 shown in the table below.

Code	Meaning
0	Data remaining in buffer.
8	Buffer empty.
16	Data remaining in buffer. PNC-950 being paused (Pause On being displayed).
24	Buffer empty. PNC-950 being paused (Pause On being displayed).

<table>
<tr><th>Instruction</th><th>Format</th><th>Parameter</th><th>Range ([ ] is default)</th><th>Explanation</th></tr>
<tr><td>ESC .E
Output RS-232C Error Code</td><td>[ESC].E</td><td>None</td><td></td><td>Outputs an error code related to RS-232C interface (see the table below), and clears the error simultaneously. At the same time, the error being displayed is canceled.

<table><tr><th>Error code</th><th>Possible cause and action</th></tr><tr><td>0</td><td>No I/O errors</td></tr><tr><td>10</td><td>Cause: after execution of an output command, other output instructions are sent before the output was not completed.
Action: let the computer to read the PNC-950 output by the output instruction and then send another output instruction.</td></tr><tr><td>11</td><td>Cause: an error occurs in a device control instruction.
Action: correct your program.</td></tr><tr><td>12</td><td>Cause: incorrect parameter are set to a device control instruction (the default value is set to the erroneous parameter)
Action: correct your program.</td></tr><tr><td>13</td><td>Cause: parameters are overflowing.
Action: correct your program.</td></tr><tr><td>14</td><td>Cause: the number of the parameters set is more than specified or a colon ':' was not used to terminate.
Action: correct your program.</td></tr><tr><td>15</td><td>Cause: framing error, parity error or over-run error at the time of data receipt.
Action: match the communication protocols of both computer and PNC-950 (baud rate, data bit length, stop bit length).</td></tr><tr><td>16</td><td>Cause: the I/O buffer overflows.
Action: This error does not occur when hardware handshake is performed, but may occur when software handshake is performed. If this error occurs, check the remaining buffer capacity of the PNC-950 and send less data than the remaining buffer capacity.</td></tr></table></td></tr>
<tr><td>ESC .L
Output I/O buffer size</td><td>[ESC].L</td><td>None</td><td></td><td>PNC-950 outputs the size of the I/O buffer to the computer when receiving this instruction.
It usuallyoutputs 1024 (bytes).</td></tr>
<tr><td colspan="5">Abort Instructions</td></tr>
<tr><td>ESC .J
Abort Device Control Instruction</td><td>[ESC].J</td><td>None</td><td></td><td>Aborts both the currently executed device control instruction and output.</td></tr>
<tr><td>ESC .K
Abort CAMM-GLIII Instruction</td><td>[ESC].K</td><td>None</td><td></td><td>Continues to execute the CAMM-GL III instruction in operation, aborts other incoming CAMM-GL III instructions and clears the data buffer.</td></tr>
<tr><td>ESC .R
Initialize Device Control Instruction</td><td>[ESC].R</td><td>None</td><td></td><td>Initializes all settings established by the device control instructions. Execution of [ESC].R brings the same states as the following device control instructions are executed.
[ESC].J, [ESC].M:, [ESC].N:, [ESC].H:, [ESC].I: and [ESC].@:</td></tr>
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