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F=# Function Command Overview

The F command value allows Enabling or Disabling of special firmware functions of the SmartMotor Processor and Drive Stage.

Syntax: F=value

The Value is a Binary Bit weighted value with each bit controlling a specific feature.

Bit Value Functions are as follows:

- 1 Decelerate to stop on limit switch input (as opposed to just turning off)
- 2 * Invert Communication (Changes Shaft rotation)
- 4 Any Report commands transmit to Com 1 only. (Use with Extreme Caution)
- 8 Clear PID integral term at trajectory-end to avoid possible slow settling
- 16 * Mode Cam positions are relative for each re-entry into CAM table (from either direction)
- 32 * GOSUB1 is issued under motor fault condition C1 can not be called again prior to receiving a RETURNF
- 64 * GOSUB2 is issued on user input G transition from high to low C2 can not be called again prior to receiving a RETURNI
- 128 * Internal Slave Counter = base + dwell module while in CAM Mode
- 256 ** Set T.O.B. to be active for entire move profile
- 512 ** Suppress T.O.B. until Target Velocity has been reached
- 1024 ** Enables Port G to Index trigger latch function (only in SM2316D/DT-PLS2 and > = 4.93 firmware)

* Note: Only Applies to >=v4.77 and higher, "plus"

**Note: Must specify 4.78T firmware

F Command is Binary Bit flag additive:

Example:

F=21 would break down to F=(16+4+1).

Motor would run CAM Mode relative, redirect print statements to port 1, and decelerate on limits collectively.

Warning: C1 has priority over C2. C1 can be activated when in C2.

The F value can be changed on-the-fly while in an Interrupt subroutine to change its effect.

An example would be turning off the G interrupt once in C2 to prevent any subsequent calls.

Modes of Operation:

- MP Set Controller for Position Mode, pending a G
- MV Set Controller for Velocity Mode, pending a G
- MT Immediately set controller to Torque Mode
- MFx Immediately set Controller to Mode-Follow (Electronic Gearing to follow External Encoder) where x = 1,2,4
- MS Immediately Set Controller to Step-Mode (Step and Direction Input)
- MC Initialize Mode Cam awaiting a G
- MTB Mode Torque Brake (Dynamically brake)
Note: MTB applies to PLS firmware only.

Position Commands:

- A Value of absolute acceleration
- A=expression Set Acceleration for Position and Velocity Modes (unsigned 16-bit value)
- V Value of buffered requested velocity
- V=expression Set required Velocity for Position and Velocity Modes (Signed 32-bit value)
- D Value of buffered relative position, phase offset, and [Dwell (F=16, F=128)]
- D=expression Set Relative Distance for Relative Position Mode, (signed 32-bit value)
Set Phase Offset Distance In Electronic Gearing, Set Dwell in Cam Mode (See F-Function Commands for more)
- P Value of buffered target position
- P=expression Set buffered target Position for Absolute Position Mode (signed 32-bit value)
- G Start buffered motion profile or trajectory;
Initiate Mode Follow Ratio in Electronic Gearing
Initiate Phase Offset Move in Electronic Gearing
Initiate all buffered move profile values such as Velocity, Acceleration, etc.
- TWAIT Halt program command execution until trajectory completed
- X Decelerate to a stop using present buffered acceleration value
- S Decelerate to a stop using firmware fixed high rate of deceleration
- I Index Pulse Position of Internal Encoder at last point of capture
- O=expression Reset Origin in Position Register (to a signed 32-bit value)
- E Value of Maximum Allowable Following Error in Encoder Counts
- E=expression Set Maximum allowable Position Error (unsigned 0-300000 max)
- AMPS Value of the power limit
- AMPS=expression Set PWM Power limit, 0 to 1023 represents 0-100% allowable PWM
- OFF Turn off Drive Stage of SmartMotor™ servo
- T Value of Commanded Torque (Open-Loop Commanded PWM to Drive Stage)
- T=expression Set torque magnitude and direction, (signed values of -1023 to 1023)

External Encoder Motion Commands:

MFO	Reset secondary encoder counter to zero
MS0	Reset secondary encoder to zero
MFDIV	Value of Mode Follow Ratio Divisor
MFDIV=expression	Set Ratio divisor value (16-bit signed value)
MFMUL	Value of Mode Follow Ratio Multiplier
MFMUL=expression	Set Ratio Multiplier value (16-bit signed value)
MSR	Calculate New Buffered Step Mode Ratio values from MFMUL and MFDIV, pending a G
MFR	Calculate New Buffered Follow Mode Ratio values from MFMUL and MFDIV, pending a G
MCx	Initialize Cam Mode awaiting a G, where x =2, 4, or 8 times result
CI	Mode Cam Table Index Value, (present Cam table pointer)
BASE=expression	Cam Mode periodic encoder base where SIZE < BASE <= 32767
SIZE=expression	Number of Array Points in Cam Table for Cam Mode operation where 2 <= SIZE <= 100
CTR	External Encoder Position Register Value
CTR=0	Set External Encoder Register to Zero
ENC0	Close Position Loop on Internal Encoder (Default State)
ENC1	Close Position Loop on External Encoder (Optional State)

Program Flow Structures:

Nesting program flow structure is permitted (6 levels deep)

IF expression ...	Beginning of "IF" code block
ELSEIF expression	Next "IF" test case, extended only if "IF" above is false
ELSE	Remaining "IF" test case
ENDIF	End of IF, ELSEIF, and ELSE code block
SWITCH expression ...	ENDS SWITCH code block (resultant value of expression stored in the variable zzz)
CASE value	Individual SWITCH test case
BREAK	Jump to exit of WHILE or SWITCH
DEFAULT	If all SWITCH test cases false
ENDS	End of SWITCH code block
WHILE expression	WHILE code block
LOOP	End of WHILE code block
RUN	Executed the stored EEPROM program, from the beginning
!	Suspend program execution until ANY Incoming Communications is received
RUN?	Stop program executing at point of command until RUN command is received

BREAK	Jump to exit of WHILE or SWITCH
GOSUBnnn	Execute subroutine at statement label nnn, and then return to next statement
GOTOnnn	Jump to program statement label nnn
C#	Program Location Label for GOT and GOSUB calls, C0 to C999
RETURN	Return subroutine to program address on the stack (just below GOSUB call)
WAIT=expression	Suspend program execution for given number of PID cycles, ~4069cycles = 1sec
Z	Perform Software CPU Reset of SmartMotor™
END	Stop Program Code Execution

User Program EEPROM Read/Write Commands:

LOAD	Receive and Store into EEPROM a compiled SmartMotor™ program file
UPLOAD	Upload User Program to host terminal
UP	Upload Compiled User Program and Header file to host terminal
RCKS	Report Compiled User Program EEPROM checksum

Variable/Data Storage EEPROM Read/Write Commands:

EPTR=expression	Set user EEPROM memory pointer where n is 0 to 32255
VLD (variable, number)	Load contiguous user variables from user EEPROM number is the number of variables to be loaded
VST (variable, number)	Store contiguous user variables into user EEPROM, number is the number of variables to be stored

Variables/System-Variables:

@P	Value of measured position
@PE	Value of measured position error
@V	Value of measured velocity
a thru z	32-bit Signed Integer value variables
aa thru zz	32-bit Signed Integer value variables, (shares memory location with array variables)
aaa thru zzz	32-bit Signed Integer value variables, (shares memory location with array variables)
ab[0] thru ab[200]	8-bit Signed Integer Array Variables, (shares memory location with aa-zz, and aaa-zzz)
aw[0] thru aw[100]	16-bit Signed Integer Array Variables, (shares memory location with aa-zz, and aaa-zzz)
al[0] thru al[50]	32-bit Signed Integer Array Variables, (shares memory location with aa-zz, and aaa-zzz)



System State Flags:

The follow binary values can be tested by IF and WHILE control flow expressions, or assigned to any variable. They may all be reported using RB{bit} commands and are ideal for Fault Detection and control when operating via Serial Communications.

RW Report Status Word (See Individual Status Bits Below)

Bt =1 if trajectory in progress,	Bit: 0, value: 1
Br =1 if Positive Travel Limit Exceeded	Bit: 1, value: 2
Bl =1 if negative limit crash occurred	Bit: 2, value: 4
Bi =1 if new index report available	Bit: 3, value: 8
Bw =1 if Wrap Around occurred	Bit: 4, value: 16
Be =1 if position error occurred	Bit: 5, value: 32
Bh =1 if Exceeded Thermal Limit	Bit: 6, value: 64
Bo =1 if Drive Stage is OFF	Bit: 7, value: 128
Bx =1 if Drive Stage is OFF	Bit: 8, value: 256
Bp =1 if on Positive Travel Limit,	Bit: 9, value: 512
Bm =1 if on Negative Travel Limit ,	Bit:10, value:1024
Bd =1 if math overflow occurred,	Bit: 11 value:2048
Bu =1 if user array index error occurred,	Bit: 12, value:4096
Bs =1 if syntax error occurred,	Bit: 13, value:8192
Ba =1 if over current occurred,	Bit: 14, value:16384
Bk =1 if EEPROM I/O error occurred,	Bit :15, value:32768

Other Status Bit Flags:

Bb =1 if comm parity error occurred
Bc =1 if comm buffer overflow occurred
Bf =1 if comm framing error occurred
By =1 if step direction change overrun occurred (V4.40 only)

Reset System State Flag:

Za	Reset (Ba) over-amps flag bit
Zb	Reset (Bb) comm parity flag bit
Zc	Reset (Bc) comm overflow flag bit
Zd	Reset (Bd) math overflow flag bit
Ze	Reset (Be) Position Error flag bit
Zf	Reset (Bf) comm framing flag bit
Zl	Reset (Bl) negative limit crash flag bit
Zr	Reset (Br) positive limit crash flag bit
Zs	Reset (Bs) syntax error flag bit
Zu	Reset (Bu) array index error flag bit
Zw	Reset (Bw) position wrap flag bit
Zy	Reset (By) step dir bit (Ver. 4.40 only)
ZS	Reset all reset-able system flags

Report to Host Commands:

R{user variable} report user variable to host
User variable is a thru z, aa thru zz, aaa thru zzz, ab[0] thru ab[200], aw[0] thru aw[100], or al[0]

R{X} report to host various commands (where {x} can be position comands, variables, system state flags, communication commands, etc.)

Motor Over Travel Limit Commands:

UCP	Assign pin C to positive limit switch input, (default state) Note: Disable with either or UCO or UCI
UDM	Assign pin D as negative limit switch input, (default state) Note: Disable with either or UDO or UDI
The following apply to non-PLS firmware only:	
SLD	Disable software limits (always disable prior to changing values below)
SLP=expression	Assign value in encoder counts to Programmable Positive Software Travel Limit
SLN=expression	Assign value in encoder counts to Programmable Negative Software Travel Limit
SLE	Enable software limits

Motor I/O Commands:

RU	Report all I/O states A-G in one 7 bit number
UG	Assign pin G to synchronous "GO" (default State)
U{pin}O	Assign pin to be an output
U{pin}=expression	Set pin output latch to 0 or 1 where 0 is zero volts, and 1 is 5VDC
U{pin}I	Assign pin to be a general input
var=U{pin}I	Assign digital value of pin to variable (returns a 0 or 1)
var=U{pins}A	Assign 10-bit analog value of a pin to a variable

In all above cases:

{pin} is A, B, C, D, E, F, or G

exp. is 0 or 1

var is any variable a thru z,
aa thru zz,
aaa thru zzz,
ab[0] thru ab[200],
aw[0] thru aw[100], or
al[0] thru al[100]

Examples: UAi, UBO, c=UDI, UE=0, f=UGA

AniLink™ I/O Commands:

AIN{port}{input}	value of 8-bit analog input
AOUT{port},{exp.8}	output byte to analog port
DIN{port}{channel }	AniLink digital input byte
DOUT{port}{channel},{exp.8}	output digital byte value to AniLink
{port} is A, B, C, D, E, F, G, or H	
{input} is 1, 2, 3, or 4	
{channel} is 0 thru 63	
{exp.8} i is 8 bit value: 0 thru 255	

Brake Commands:

BRKENG	Engage the brake (requires hardware brake)
BRKRLS	Release the brake (requires hardware brake)
BRKSRV	Engage break whenever servo off (requires hardware brake)
BRKTRJ	Engage break when trajectory is not running (requires hardware brake)
BRKC*	Re-direct brake control from internal brake pin to Port C (Ver. 4.15b or higher firmware only) UCO must be issued prior to this command Automatic Functionality follows BRKTRJ or BRKSRV commands as listed above
BRKG*	Re-direct brake control from internal brake pin to Port G (Ver. 4.15b or higher firmware only) UGO must be issued prior to this command Automatic Functionality follows BRKTRJ or BRKSRV commands as listed above
BRKI*	Redirect brake control to internal brake control pin (Default state) (Ver. 4.15b or higher firmware only)

*Note: Not available with 440c firmware (i.e. SM2315D and SM2315DT)

PID Filter Commands:

PIDx	Set PID update rate where x=1, 2, 4, or 8 (default is PID1)
KA	Value of buffered acceleration feed forward gain coefficient
KA=expression	Set buffered acceleration feed forward gain coefficient
KD	Value of buffered derivative gain coefficient
KD=expression	Set buffered PID derivative gain coefficient
KG	Value of buffered PID constant coefficient
KG=expression	Set buffered PID constant coefficient
KI	Value of buffered integral gain coefficient
KI=expression	Set buffered PID integral gain coefficient
KL	Value of buffered PID integral term contribution limit
KL=expression	Set buffered PID integral limit
KP	Value of buffered PID proportional gain coefficient
KP=expression	Set buffered PID proportional gain coefficient
KS	Value of buffered KS differential sample rate coefficient
KS=expression	Set buffered PID differential sample rate
KV	Value of buffered velocity feed forward gain coefficient
KV=expression	Set buffered PID velocity feed forward gain
F	Apply buffered filter coefficients to PID calculation

Communication Commands:

ADDR=exp	set motor address between 0 and 99
BAUDX	Set baud rate to (x=2400, 4800, 9600, 19200, 38400 bps)
SADDRaddress	Set SmartMotor™ address, were address = 0 to 115
ECHO	Set Channel 0 (Main RS-232 Port) to Echo all received data to the transmit line
ECHO_OFF	Turn off Echo function above, Default state is ECHO_OFF
SILENT	Prohibit outgoing messages onto Channel 0, (RS-232) originating from within user program
SILENT1	Prohibit outgoing messages onto Channel 1, (RS-485) originating from within user program
SLEEP	Prohibit SmartMotor executing received Channel 0 commands except WAKE
SLEEP1	Prohibit SmartMotor executing received Channel 1 commands except WAKE1
TALK	Permit outgoing messages originating from within user program to Channel 0 (RS-232)
TALK1	Permit outgoing messages originating from within user program to Channel 1 (RS-485)
WAKE	Permit any Received Commands on Channel 0 (RS-232) to be executed
WAKE1	Permit any Received Commands on Channel 1 (RS-232) to be executed
OCHN	(type,comm,parity,bit rate,stop bits,data bits, specification)

Open a communications channel where:

- type** is RS2 or RS4
- comm** is either primary channel 0 or secondary channel 1
- baudrate** 2400, 4800, 9600, 19200, or 38400 (bps)
- data bits** is 8
- stop bits** is 1
- specification** is C (for command) or D (for data)

PRINT ()	Print to Com Ch. 0 (RS-232 main channel)
PRINT1 ()	Print to Com Ch 1 (RS-485)
PRINT{port}()	Print to AniLink™ port choice of A thru H

Note: See Animatics User's Guide for more information on PRINT commands

GETCHR	Capture next character from Com Ch.0 input buffer
GETCHR1	Capture next character from Com Ch.1 input buffer
LEN	Number of characters presently in Com Ch.0 buffer
LEN1	Number of characters presently in Com Ch.1 buffer

Note: See Animatics User's Guide for more information on PRINT commands

Miscellaneous Commands:

CLK	Value of SmartMotor™ clock
CLK=expression	Set/Reset value of SmartMotor™ clock
TEMP	Value of Slave processor unit temperature in degrees C. (It must be assigned to a variable to be reported.)
UIA	Value of motor current in 100ths of Amps (It must be assigned to a variable to be reported)
UJA	Value of motor DC bus Voltage in 10ths of Volts. (It must be assigned to a variable to be reported)

