PC104 13A MOTION CONTROLLER

DESCRIPTION

The PC104-13A is a high-performance motion controller for 1 axis that installs directly into the Eason 2000 series intelligent operator interfaces. Using a 32-bit specialized microprocessor, the controller provides high performance without sacrificing ease of use and cost effectiveness. The PC104-13A is also flexible and can control either servo motors or step motors.

The PC104-13A achieves superior precision for servos through use of a 16-bit motor command output DAC and a sophisticated PID filter that features Kp, Ki, Kd, velocity feedforward, and acceleration feedforward and integration limits.

The PC104-13A can be used for applications involving jogging, point-to-point positioning, and contouring. Inputs from two encoders are accepted allowing PC104-13A to be used easily in electronic gearing or CAM applications. The controller eliminates jerk by programmable acceleration and deceleration with profile smoothing.

For synchronization with outside events, the PC104-13A provides uncommitted I/O, including 7 digital inputs and 3 digital outputs. Dedicated inputs are provided for forward and reverse limits, abort, home, and definable input interrupts.

The PC104-13A's intuitive programming language is easy to use and includes 126 user-defined variables, plus arithmetical operations and functions. Multiple arrays allow for real-time data capture of up to 1000 elements. Additional software is available to generate motion programs, auto-tune, view trajectories and debug motion control programs.

Other PC104-13A features include relative and absolute positioning with ±2 billion counts per move; 250-line memory for user programs, multitasking for simultaneous execution of two independent user programs, EEPROM for storing parameters on power down, sophisticated error handling, and programmable event triggers.

MODES OF MOTION

Point-to-Point Positioning: The user specifies the desired absolute position (PA) or relative position (PR), along with the acceleration rate (AC), deceleration rate (DC), and slew speed (SP). Position can be interrogated at any time using the tell position (TP) command.

Example:

PA 10000 Absolute position,10,000 counts
SP 5000 Slew speed, 5,000 counts/sec
AC 200000 Acceleration rate
DC 200000 Deceleration rate
BG Begin motion

Jogging: The jog mode allows the user to command the motor to run at a pre-scribed jog speed. The user specifies the jog speed (JG), the acceleration rate (AC), and the deceleration rate (DC). On begin (BG), the motor accelerates up to the jog speed and continues at that speed until a new speed or stop command (ST) is issued. The direction of motion is specified by the sign of the parameter 'JG'. The JG, AC, and DC parameters can be changed at any time during motion. Average speed can be interrogated at any time using the tell velocity (TV) command.

Motion Smoothing: To eliminate the jerk of mechanical systems, the PC104-13A

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provides profile smoothing. The acceleration profile is filtered with the IT command.

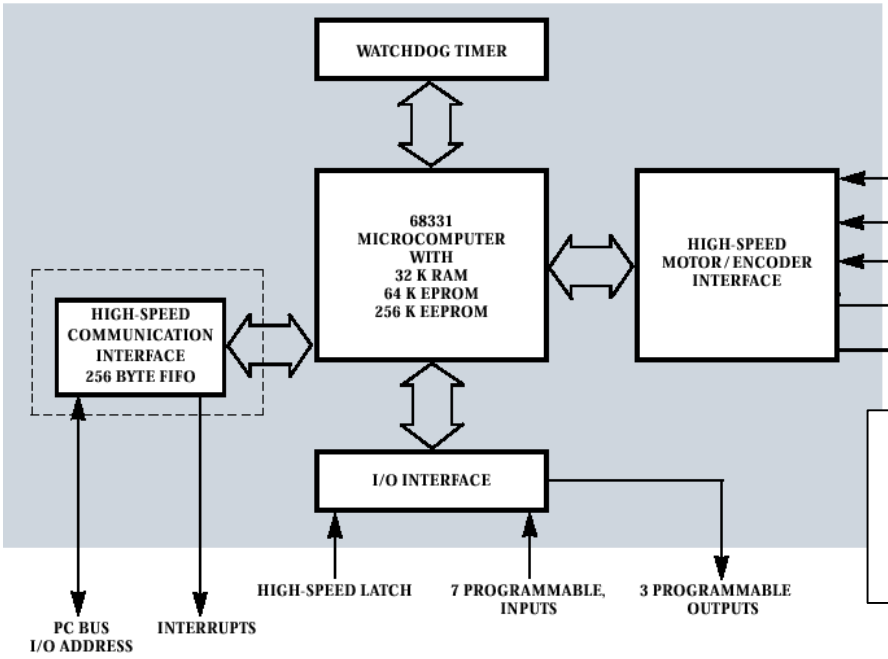
Contouring: The contouring mode allows the user to bypass the PC104-13A's motion profiler and prescribe any arbitrary position trajectory. Position increments (CD) over a time interval (DT) are specified. The contouring mode is useful when complex and computer-generated trajectories must be followed. An automatic data-recording feature allows the PC104-13A to "learn" a path and then follow it in the contour mode.

Electronic Gearing: This mode allows the motor to be electronically geared to an auxiliary encoder. The master may rotate in both directions and the geared axis will follow at the specified ratios (GR). The gear ratio can be changed during motion. An axis can be geared and do an independent move simultaneously which is useful for the precise synchronization required in flying-shear applications.

Electronic Cam: This mode allows synchronizing the motor with a master encoder according to any function. The cam functions, which are specified by a table, define the required position of the follower point by point along the motion cycle. The master may rotate in either direction. The follower axis may be engaged or disengaged independently at specific points along a cycle. This allows starting and stopping the slave with no discontinuity in speed. The electronic cam is an ideal mode for periodic operation, especially those requiring varying gear ratio along the motion cycle. Such applications include flying shears, rotating knives and packaging systems.

Dual Loop: The dual-loop encoder feature enables PC104-13A to compensate for backlash. There are two compensation methods: The continuous dual loop, which performs the correction along the move, and the sampled dual loop, which performs the correction at the final point. In both cases two encoders are used for each axis. The two are mounted on the motor and on the load. The continuous dual loop, which is activated with the instruction DV1, closes the position loop with the load encoder and derives the damping terms from the motor encoder. This method provides backlash compensation along the motion path. The sampled dual loop performs the correction at the end of the move.

Homing: The home (HM) command can be used to home the motor to an external mechanical reference and an encoder index signal. The home speed (SP) is programmable and the polarity of the home switch is selectable using the (CN) command. Alternative homing sequences can be created with the FE and FI commands.



PC104-13A Functional Elements

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EXAMPLE COMMANDS

MOTION
AB Abort motion
AC Acceleration
BG Begin motion
CD Contour data
CM Contour mode
DC Deceleration
DT Contour time interval
EB Enable cam mode
EG Start cam motion
EM Modulus for cam
EP Master counts per table entry
EQ Stop cam motion
ET Cam table entry
FE Find edge
FI Find index
GR Gear ratio
HM Home
IP Increment position
IT Smoothing time constant–independent
JG Jog mode
KS Stepper smoothing
PA Position absolute
PR Position relative
SP Speed
ST Stop

PROGRAM FLOW
AD Wait for specified distance
AI Wait for specified input
AM Wait for motion complete
AP Wait for absolute position
AR Wait for relative distance
AS Wait for “At Speed”
AT Wait for elapsed time
EN End program
HX Halt task
IN Input variable
II Input interrupt
JP Jump to program location
JS Jump to subroutine
MG Message
MC Wait for “In Position”
MF Forward motion past position
MR Reverse motion past position
NO No operation
RE Return from error subroutine
RI Return from interrupt
WC Wait for contour data
WT Wait for elapsed timeXQ Execute program
ZS Zero subroutine stack
TW Timeout for “In Position”

CONFIGURATION
AL Arm latch
BN Save parameters in EEPROM
BP Burn program (1412 only)
BV Burn variables and array (1412 only)
CB Clear output bit
CC Configure 2nd RS232 port (1412 only)
CE Configure encoder type
CN Configure switches
DA Deallocate arrays
DE Define dual encoder position
DL Download program
DM Dimension arrays
DP Define position
ED Edit mode
EI Enable ISA interrupts (1410, 1411)
EO Echo off
LS List program
MO Motor off
MT Motor type
OB Define output bit
OP Output port
PF Position format
QD Download array
QU Upload array
RA Record array
RC Record
RD Record data
RS Reset
SA Set address (1412 only)
SB Set output bit
UI User interrupt (1410, 1411)
UL Upload program
VF Variable format

CONTROL FILTER SETTINGS
DV Damping for dual loop
FA Acceleration feedforward
FV Velocity feedforward
GN Gain
IL Integrator limit
KD Derivative constant
KI Integrator constant
KP Proportional constant
OF Offset
SH Servo here
TL Torque limit
TM Sample time
ZR Zero

STATUS
RP Report command position
RL Report latched position
SC Stop code
TB Tell status
TC Tell error code
TD Tell dual encoder position
TE Tell position error
TI Tell input
TP Tell position
TR Trace program
TS Tell switches
TT Tell torque
TV Tell velocity

ERROR AND LIMITS
BL Reverse software limit
ER Position error limit
FL Forward software limit
OE Off on error

EDITOR
ED Edit mode
<return> Save line
<cntrl>P Previous line
<cntrl>I Insert line
<cntrl>D Delete line
<cntrl>Q Quit editor

ARITHMETIC FUNCTIONS
@SIN Sine
@COS Cosine
@ABS Absolute value
@FRAC Fraction portion
@INT Integer portion
@RND Round
@SQR Square root
@IN Return digital input
+Add
- Subtract
* Multiply
/ Divide
& And
|Or
( ) Parentheses

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EASON PC104 13A MOTION CONTROLLER

PERFORMANCE

Servo loop cycle time: 375 µsec
Block execution time: In contour mode, up to 1000 blocks (moves)/sec with full trajectory calculation.
Position accuracy: ±1 quadrature count
Velocity accuracy:
Long-term: phase-locked, better than .003%.
Short-term: system dependent.
Position capture accuracy: .1 µsec

PARAMETER RANGES

Position range: ±2,147,483,647 counts/move; automatic rollover; no limit in jog mode.
Velocity range: Up to 8,000,000 counts/sec for servos.
Accel./decel.: 1,024 to 67,107, 840 c/sec^2
Error limit: ±32,767 counts
Gear ratio: ±127.9999
Filter constants:
Kp: 0 to 1023.968
Kd: 0 to 4095.968
Ki: 0 to 2047.968
Motor cmd resolution: 16 bits or .0003 V.
Step motor control mode: Full, half or microstep.
Step pulse frequency: 2,000,000 pulses/sec.
Number of variables: 126
Array size: 1000 elements in up to 6 arrays.
Memory size: 250 lines x 40 characters.

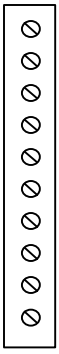
INPUTS/OUTPUTS

Feedback: Two channels of A/B quadrature with third channel for index. In servo mode, includes auxiliary encoder inputs for each axis. Single-ended or differential. Can be con-figured for quadrature or pulse and direction.
General purpose inputs: 7 TTL inputs
General purpose outputs: 3 TTL ouputs
Dedicated inputs per axis: Forward and reverse limits, high-speed position latch, home.
Dedicated outputs per axis: Analog motor command, pulse and direction, amplifier enable, encoder output compare.

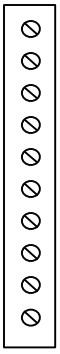
I/O Pin-Out:

OUT1-3	General purpose outputs
IN1-7	General purpose inputs
Error	PC104-13A error status
Abort	PC104-13A program abort
Dir	Stepper direction output
Pulse	Stepper pulse output
I+/-	Diff. Encoder Index Input
B+/-	Diff. B Channel Encoder In
A+/-	Diff. A Channel Encoder In
ACMD	+/-10V Analog Servo Cmd
AMPEN	High True amp. enable Out
AuxB+/-	Diff. B Channel Aux Enc. In
AuxA+/-	Diff. A Channel Aux Enc. In

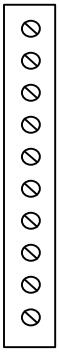
Rear Panel Interconnect Pinout:



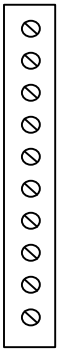
J4:
1. GND
2. OUT3
3. OUT2
4. OUT1
5. ERROR
6. RESET
7. ABORT
8. GND
9. DIR
10. PULSE



J5:
1. GND
2. IN7
3. IN6
4. IN5
5. IN4
6. IN3
7. IN2
8. IN1
9. -LIMIT
10. +LIMIT



J3:
1. SHIELD
2. GND
3. I-
4. I+
5. B-
6. B+
7. A-
8. A+
9. +5V
10. HOME



J2:
1. +12V
2. SHIELD
3. GND
4. ACMD
5. AMPEN
6. GND
7. AUXB-
8. AUXB+
9. AUXA-
10. AUXA+

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