Change Summary

6000 Series Programmer's Guide

Rev C

In Short ...

- This manual, p/n 88-014540-01**C**, supersedes 88-014540-01**B**.
- Updated to accommodate 4.x firmware enhancements (see topics below) and the ZETA6104.
- The presentation of programming examples was modified so that you can copy them from the Help system (in Motion Architect) or from the PDF file (on our www.compumotor.com web site) and paste them directly into your program.
- Added documentation to support all 6000 products.
- Incorporated the *Following User Guide* (see Chapter 6).
- New sections:
  - *Programming Scenario*.....Page 8
  - *Controlling Multiple Serial Ports*.....Page 70
  - *RS-485 Multi-drop*.....Page 75
  - *Setup Parameters* (list of commands for common setup parameters).....Page 78
  - *ZETA610n Internal Drive Setup*.....Page 82
  - *Servo Setup*.....Page 98
  - *RP240 Remote Operator Panel*.....Page 130
  - *Host Computer Interface*.....Page 143
  - *Graphical User Interface (GUI) Development Tools*.....Page 144
  - *Compiled Motion Profiling*.....Page 163
  - *On-the-Fly Motion*.....Page 178
  - *Registration*.....Page 182
  - *Synchronizing Motion*.....Page 186
  - Chapter 6: *Following* (incorporated the *Following User Guide*).....Page 191
  - *Status Commands*.....Page 232
- New back cover with quick-reference material.

READ ON ... for a summary of the enhancements implemented in firmware revision 4.x.

Topic	Description
Commanded Direction Reversal (CMDDIR)	**Enhancement**: The commanded direction polarity reversal command (CMDDIR) is available for the 615n series, the 6270, and all stepper products (610n, AT6n00, 620n). The CMDDIR command allows you to reverse the direction that the controller considers to be the "positive" direction; this also reverses the polarity of the counts from the feedback devices. Thus, using the CMDDIR command, you can reverse the referenced direction of motion without the need to (a) change the connections to the drive or motor and the feedback device, or (b) change the sign of motion-related commands in your program. (SEE PG. 97 OR 101)
Compiled Motion	**New Feature**: (SEE PG. 163) Related commands (new): FOLRNF ....Numerator of Final Slave-to-Master Ratio, Preset Moves GOBUF.....Store a Motion Segment in Compiled Memory PLN .....Loop End, compiled motion PLOOP.....Loop Start, compiled motion POUTA.....Output on Axis 1, compiled motion POUTB.....Output on Axis 2, compiled motion POUTC.....Output on Axis 3, compiled motion POUTD.....Output on Axis 4, compiled motion [SEG].....Number of Segments Available In Compiled Memory TSEG.....Transfer Number of Segments Available, Compiled Memory VF.....Final Velocity Existing commands, modified to support compiled motion: GOWHEN ....Conditional GOs allowed in compiled motion PCOMP.....Pre-Compile a Program PRUN.....Run a Pre-Compiled Program PUCOMP ....Un-Compile a Program [SS] .....Bit #29 set if compiled memory 75% full, bit #30 set if 100% full Bit #31 is set if a compile (PCOMP) failed; cleared on power-up, reset, or after a successful compile. (See *Status Reporting, Additions* below for a list of typical causes.) TRGFN.....Execute GOWHENs or start new master cycle in compiled motion TSS .....(see [SS] description above)
Contouring (Circular Interpolation)	**Enhancement**: As of Rev 4.1, contouring is now available for all multi-axis products, steppers and servos. (SEE PG. 153)
Continuous Command Execution Mode (COMEXC1)	**Enhancement**: On-The-Fly changes (pre-emptive motion). In addition to velocity (V), acceleration (A & AA), and deceleration (AD & ADA), you may now change the positioning mode (MC & MA), the distance (D), and the Following ratios (FOLRN & FOLRD). These changes will affect the subsequent GO command executed while moving; thus, this new enhancement is referred to as "pre-emptive GOs." (SEE PG. 178) When pre-processing subsequent moves, the subsequent move may now be executed as soon as the next GO command is executed. Previous to revision 4.0, the subsequent move could not be executed until all moves on all axes were completed.
Drive Configuration & Reset	**Enhancements**: New commands added to set up the drive component of the 610n: (SEE PG. 82) DACTDP ....Enable/disable active damping for speeds greater than 3 rps. (config. procedure: see the *ZETA6104 Installation Guide*) DAREN.....Enable/disable anti-resonance. Anti-resonance is inhibited at or below 3 rps, and if active damping is enabled. DELVIS ....Enable/disable electronic viscosity for speeds at or below 3 rps. (config. procedure: see the *ZETA6104 Installation Guide*) DAUTOS ....Enable/disable automatic current standby mode in which current to the motor (& torque) is reduced by 50% if no pulses are sent for 1 second. Full current is restored upon the next pulse. DMTIND ....Motor inductance (used only for active damping—DACTDP). DMTSTT ....Motor static torque (used only for active damping—DACTDP). DWAVEF ....Motor waveform (required for matching the motor to the drive). 615n only: As of Rev 4.1, you may use the new DRESET command to reset the internal drive independent of the internal controller. The purpose of the DRESET command is to clear fault conditions with the internal drive.
Encoder Polarity Reversal (ENCPOL)	**Enhancement**: The encoder polarity reversal command (ENCPOL) is now available to all 6000 stepper products (AT6n00, 620n, & 610n). Previous to 4.0 the ENCPOL command was only applicable to the 6270. The ENCPOL command is used to reverse the polarity (counting direction) of the encoder feedback counts. This is an alternative to reversing the A+ and A- connections to the encoder. (SEE PG. 97 OR 100)

Topic	Description
Error Checking Conditions	**Enhancements**: (SEE PG. 31) • 610n: The *drive fault* error (reported with error status bit #4 and axis status bit #14) can be caused by any one or combination of the factors list below. To ascertain the exact cause, use the extended axis status (TASX or ASX): - Motor fault (disconnected/faulty motor cable or short in motor) — bit #1 - Low-voltage (power) — bit #2 - Maximum drive temperature (131°F, 55°C) exceeded — bit #3 • Error status enhancements - Error bit #8 is set if a stop input (assigned with INFNCi-D) is activated. - Error bit #10 is set if the target position specified for a pre-emptive GO or a registration move is not achievable at the time the pre-emptive GO command is executed or the registration input is activated. This condition also sets bit #30 in the axis status register (reported with TAS & AS). To clear error bit #10 and axis bit #30, execute another GO command. - Error bit #16 is set if a bad command was detected; clear with TCMDER. • Related commands: [ER]..... Error Status (assignment or comparison) ERROR ..... Error-Checking Enable ERRORP.... Error Program Assignment TER..... Transfer Error Status
Fast Status (bus-based products)	**Correction**: The bit assignments for the Limits status in block 5 are not the same as those for the TLIM report. (SEE PG. 43) **Clarification**: The input buffer is 256 bytes.
Following	**Enhancements**: • The new Following Kill (FOLK) command allows you to limit what will kill the Following profile. That is, it allows the slave to remain in synchronization with the master even after the occurrence of a drive fault, user fault input, excess position error, or enable input. Servo products only. • The new Numerator of Final Slave-to-Master Ratio, Preset Moves (FOLRNF) command designates that the motor will move the load the distance assigned in the preset GOBUF segment, completing the move at a final ratio of zero. FOLRNF applies only to the first subsequent GOBUF, which marks an inter-mediate "end of move" within a Following profile. The FOLRNF command is only useful for compiled Following moves. (SEE PG. 166) • The *Following User Guide* has been incorporated into this document (SEE PG. 192).
Homing	**Clarification**: Avoid using pause and resume functions during the homing operation. A pause command (PS or !PS) or pause input (input configured with the INFNCi-E command) will pause the homing motion. However, when the subsequent resume command (C or !C) or resume input (INFNCi-E input) occurs, motion will resume at the beginning of the homing motion sequence.
Memory Management	**Enhancements**: • Compiled Memory status commands: - System status (TSS & SS) bit #29 is set if compiled memory is 75% full, bit #30 is set if compiled memory is 100% full - TSEG & SEG report the number of available segments in compiled memory • All stand-alone products are shipped with 150,000 bytes of memory. The -M option has thus been eliminated for these products. • The second field in the MEMORY command is re-defined to be for "compiled memory" (i.e., anything compiled with the PCOMP command). (SEE PG. 12) • These commands are automatically saved in non-volatile memory: (SEE PG. 33) CMDDIR.... Commanded Direction Polarity (6104, 615n, 620n, 6270 only) DMTIND.... Motor Inductance (6104 only) DMTSTT.... Motor Static Torque (6104 only) DRPCHK.... RP240 check (6104, 615n, 620n, & 625n only) ENCPOL.... Encoder Polarity (6104, 620n, & 6270 only)
On-The-Fly Motion (AKA: *Pre-Emptive GOs*)	**Enhancements**: (SEE PG. 178) • The two basic ways of creating a complex profile are with compiled buffered motion, or with pre-emptive GOs. With compiled buffered motion, portions of a profile are built piece by piece, and stored for later execution. Compiled buffered motion is appropriate for motion profiles with motion segments of pre-determined velocity, acceleration and distance. With pre-emptive GOs, the motion profile underway is pre-empted with a new profile when a new GO is issued. The new GO both constructs and launches the pre-empting profile. Pre-emptive GOs are appropriate when the desired motion parameters are not known until motion is already underway. *Continued on next page*

Topic	Description
On-The-Fly Motion *(continued)*	• Affected Commands: COMEXC ....COMEXC1 mode allows pre-emptive motion with buffered commands GO.....Allows pre-emptive D, MC, MA, FOLRN, & FOLRD changes TAS & AS ..Bit #30 is set if the load has already passed the target position (D) specified in a pre-emptive GO. (also sets error status bit #10) TER & ER ..Error status bit #10 is set if axis status bit #30 is set.
Registration	**Enhancements**: (SEE PG. 182) • New Commands: REGLOD ....Registration Lock-Out Distance. Establishes a *lock-out* distance (measured from the start of motion to the current actual position) to be traveled before a registration move is allowed. REGSS.....Registration Single-Shot. Allows only one registration move on the specified axis. Prevents other triggers from interrupting the registration move in progress. • Axis status bit #28, reported by the TAS and AS commands, is set to 1 when a registration move has been initiated by any registration input (trigger). Bit #28 is cleared (set to Ø) upon the next GO command for that axis. • If, when the registration input is activated, the registration move profile cannot be performed with the specified parameters, the 6000 controller will kill the move in progress and set axis status bit #30 (see TAS & AS). If error-checking bit #10 is enabled with the ERROR command, the controller will also set error status bit #10 (see TER & ER) and branch to the assigned ERRORP error-handling program. Axis status bit #30 and error status bit #10 are cleared (set to Ø) upon the next GO command for that axis. • As of revision 4.1, Registration is now available all 6000 products (previous to 4.1, Registration was available only for stepper products).
Serial Communication	**Enhancements**: (SEE PG. 70) • BOT command was created to control the beginning-of-transmission characters for all responses from the 6000 product. • XONOFF command (new) enables/disables XON/XOFF ASCII handshaking. • Additional features to control multiple serial ports on stand-alone products: [.....Send response from the subsequent command to both ports.].....Send response from the subsequent command to the alternate port from the one selected with the most recent PORT command. DRPCHK ....Configures the serial port (specified with the last PORT command) to be used with an RP240, or 6000 commands, or both. PORT.....Determines which serial port is affected by the subsequent DRPCHK, E, ECHO, BOT, EOT, EOL, ERRORK, ERRBAD, ERRDEF, ERRLVL, and XONOFF commands. • As of 4.0, the ECHO command was enhanced with options 2 and 3. The purpose is to accommodate an RS-485 multi-drop configuration in which a host computer communicates to the "master" 6000 controller over RS-232 (COM1 port) and the master 6000 controller communicates over RS-485 (COM2 port) to the rest of the units on the multi-drop. For this configuration, the echo setup should be configured by sending to the master the following commands executed in the order shown. In this example, it is assumed that the master's device address is set to 1. Hence, each command is prefixed with "1_" to address only the master unit. 1_PORT2...Subsequent command affects COM2, the RS-485 port 1_ECHO2...Echo characters back through the other port, COM1 1_PORT1...Subsequent command affects COM1, the RS-232 port 1_ECHO3...Echo characters back through both ports, COM1 and COM2
Servo Updates Changed (Servo Products Only)	*(see SSFR command description for full explanation of table contents)*

# of Axes (INDAX)	SSFR Setting	Servo Sampling Update Frequency (samples/sec.)	Servo Sampling Update Period (µsec)	Motion Trajectory Update Frequency (samples/sec.)	Motion Trajectory Update Period (µsec)	System Update Frequency (samples/sec.)	System Update Period (µsec)
1	1	3030	330	3030	330	757	1320
1	2	5405	185	2703	370	675	1480
Default, Single-Axis 1	4	6250	160	1563	640	520	1920
1	8	6667	150	833	1200	417	2400
2	1	2353	425	2352	425	588	1700
2	2	3571	280	1786	560	446	2400
Default, Two-Axis 2	4	3571	280	893	1120	446	2400
2	8	3571	280	446	2240	446	2400
3	1	1667	600	1667	600	555	1800
3	2	2222	450	1111	900	555	1800
3	4	2353	425	588	1700	588	1700
4	1	1250	800	1250	800	417	2400
4	2	1667	600	833	1200	417	2400
Default, Four-Axis 4	4	2000	500	500	2000	500	2000

Topic	Description
Status Reporting	**Enhancements**: (SEE PG. 232) • New transfer (display status) commands: TASX ..... Transfer extended axis status. Bit assignments are as follows: Bit #1: Motor fault (6104 only) Bit #2: Drive low voltage fault (6104 only) Bit #3: Drive over-temperature fault (6104 only) Bit #4: Drive fault input is active TSEG ..... Transfer number of segments available in compiled memory • New assignment/comparison operators: SEG .....Number of segments available in compiled memory ASX .....Extended axis status information • Pre-emptive Motion and Registration status: TAS & AS ...Axis status bit #28 is set if a registration move occurs. Bit #30 is set if the profile specified for a pre-emptive GO or registration move is not possible at the time of the GO or the registration input (also sets error status bit #10). TER & ER....Error status bit #8 is set if a stop input (INFNCi-D) is activated. Bit #10 is set if axis status bit #30 is set. Bit #16 is set if a bad command is detected; cleared with TCMDER. • Compiled profile status: TSS & SS....System status bit #29 is set if compiled memory is 75% full. Bit #30 is set if compiled memory is 100% full. Bit #31 is set if a compile (PCOMP) failed, cleared on power-up, reset, or after a successful compile. Possible causes include: - Errors in profile design (e.g., change direction while at non-zero velocity, distance & velocity equate to < 1 count/system update, preset move profile ends in non-zero velocity) - Profile will cause a Following error (see TFS & FS status) - Out of memory (see system status bit #30) - Axis already in motion at the time of the PCOMP command - Loop programming errors (e.g., no matching PLOOP or PLN, more than 4 embedded PLOOP/END loops) TSEG & SEG Report number of available segments in compiled memory. • Drive Fault Input Status: As of revision 4.1, extended axis status (TASX & ASX) bit #4 is now available to check the drive fault input status whether or not the drive is enabled (DRIVE1) or disabled (DRIVEØ). Previous to revision 4.1, the status of the drive fault input could only be checked while the drive was enabled (DRIVE1) and was reported only with axis status (TAS & AS) bit #14 and error status (TER & ER) bit #4. The branch to the error program has not been changed—the error program is called only if the drive fault occurs while the drive is enabled. • The INDUST command (which allows you to create your own custom status word based on other status registers) now allows you to use the status bits from the extended axis status (see TASX description above). In the syntax INDUSTi-ic, the options for "c" (the status register source) now include L, M, N and O, representing the extended axis status registers for axes 1, 2, 3 and 4, respectively. For additional details on creating a custom user status word, refer to the INDUST command description. • As of Rev 4.1, the TVELA command is now applicable to all stepper controllers using encoder feedback (previously only for servos). For steppers, the TVELA command reports the current velocity (in revs/sec) as derived from the encoder. The reported value is <u>not</u> affected by scaling. The VELA assignment/comparison operator for TVELA is now available as of rev 4.0.
Target Zone	• The Target Zone mode allows you to define what the controller considers a "completed move," based on specified end-of-move distance, velocity, and settling time parameters. As of revision 4.0, the Target Zone mode is now applicable to <u>all</u> 6000 products (previous to 4.0, the Target Zone mode was available only for servo products). NOTE: Steppers require encoder feedback (and ENC1 mode) for this feature. (SEE PG. 105) • Target Zone Commands: STRGTE.... Target Zone Mode Enable/Disable STRGTD.... Target Distance Zone STRGTT.... Target Settling Timeout Period STRGTV.... Target Velocity Zone

New Commands in Revision 4.x *(including product compatibility)*

Command	Name	AT6200	AT6400	AT6250	AT6450	610n	615n	620n	625n	6270
[	Send Response to All Ports					X	X	X	X	
]	Send Response to Alternate Port					X	X	X	X	
ASX	Extended Axis Status	X	X	X	X	X	X	X	X	
BOT	Beginning of Transmission Characters	X	X	X	X	X	X	X	X	
DACTDP	Active Damping					X				
DAREN	Anti-Resonance					X				
DAUTOS	Auto Current Standby					X				
DELVIS	Electronic Viscosity					X				
DMTIND	Motor Inductance					X				
DMTSTT	Motor Static Torque					X				
DRESET	Drive Reset						X			
DRPCHK	Remote Port Check					X	X	X	X	
DWAVEF	Waveform					X				
FOLK	Following Kill			X	X		X		X	
FOLRNF	Numerator of Final Slave-to-Master Ratio	X	X	X	X	X	X	X	X	
GOBUF	Store a Motion Segment in a Buffer	X	X	X	X	X	X	X	X	
PCOMP *	Compile a Program	X	X	X	X	X	X	X	X	
PLN	Loop End, Compiled Motion	X	X	X	X	X	X	X	X	
PLOOP	Loop Start, Compiled Motion	X	X	X	X	X	X	X	X	
PORT	Designate Communications Port					X	X	X	X	
POUTA	Output on Axis 1, Compiled Motion	X	X	X	X	X	X	X	X	
POUTB	Output on Axis 2, Compiled Motion	X	X	X	X			X	X	
POUTC	Output on Axis 3, Compiled Motion	X	X	X	X					
POUTD	Output on Axis 4, Compiled Motion	X	X	X	X					
PRUN *	Run a Compiled Program	X	X	X	X	X	X	X	X	
PUCOMP *	Un-Compile a Program	X	X	X	X	X	X	X	X	
REGLOD	Registration Lock-Out Distance	X	X	X	X	X	X	X	X	
REGSS	Registration Single Shot	X	X	X	X	X	X	X	X	
[SEG]	Number of Free Segment Buffers	X	X	X	X	X	X	X	X	
TASX	Transfer Extended Axis Status	X	X	X	X	X	X	X	X	
TSEG	Transfer Number of Free Segment Buffers	X	X	X	X	X	X	X	X	
[VELA]	Velocity (Actual) Assignment	X	X	X	X	X	X	X	X	
VF	Final Velocity	X	X	X	X	X	X	X	X	
XONOFF	Enable/Disable XON/XOFF					X	X	X	X	

* *Modified to support compiled motion (previously, these commands supported only path contouring).*