Appendix C: 6K vs. 6000 Programming Differences

The 6K Series product family is a “next generation” version of the existing 6000 Series product family. Because of changes in hardware and enhancements to firmware features, the command language (now referred to as the “6K command language”) is slightly different.

Features That Work Differently

I/O Handling

- Programmable and analog I/O configuration is different. Referencing requires brick identifier (<B>) — a “brick” is onboard I/O or an extended I/O brick that has any combination of 8 SIM modules for digital and analog I/O. I/O bit patterns no longer conform to old syntax. Onboard I/O are considered I/O brick zero (0). New status command (TIO) displays the controller’s I/O configuration. The “@” prefix makes a command apply to all I/O bricks (e.g., @TIN reports status of all inputs on all I/O bricks).
- Position capture only captures the dedicated axis (not all axes anymore); ANI position can no longer be captured. When trigger nA or nB is activated, the 6K performs a “hardware capture” (encoder/commanded position capture accuracy is ± 1 count) of the dedicated “n” axis: Servos capture the encoder and commanded; steppers capture the commanded position by default, or the encoder position if encoder capture is enabled (ENCCNT1). If the axis is a slave in a Following application, the position of the associated master is also captured (interpolated, accuracy is 50 µs multiplied by the velocity at the time of the capture). The Master Trigger (“TRIG-M”) does a hardware capture of the “Master Encoder and all axes (encoder on servo axes, commanded (if ENCCNT0) or encoder (if ENCCNT1) on stepper axes). TSS/SS bits 25-28 no longer indicate position captures; instead, this status information is now reported with TTRIG/TRIG.
- OUT, OUTALL, and POUTn no longer reference only the programmable outputs that have the default function assignment (OUTFNCi-A); instead, OUT, OUTALL, and POUTn now reference all programmable outputs by their absolute reference as onboard outputs or outputs on a serial I/O brick. An attempt to change an output that is not an OUTFNCi-A output will elicit an error message (message is TBD), and the command will be ignored, but command processing will keep going. No error bit is set.
- Joystick control method uses digital inputs (external serial I/O, or onboard limits or triggers) and INFNC or LIMFNC definitions (M = Release, N = Axis select, and O = Velocity select). JOYAXL, JOYAXH, JOYCDB, JOYCTR, JOYEDB, and JOYZ syntax is changed to accommodate (e.g., JOYAXH3-2 assigns analog input #2 on brick #3 to control axis 1). Range for the analog channels is -10 to +10VDC (on existing products, it's 0-2.5VDC). TINOF (bits 1-5) no longer reports joystick input status—instead, refer to the respective TIN or TLIM bits for the inputs configured as joystick inputs (M, N, and O function assignments). Because the analog input voltage range is increased to +/- 10V with 12-bit resolution and because of the requirement to use external I/O, the syntax, ranges and defaults for joystick setup commands are changed (JOYCDB, JOYCTR, JOYEDB).
- INPLC, OUTPLC, INSTW, & OUTTW now require the I/O brick prefix (<B>); otherwise, these commands are applied only to the on-board inputs or outputs. All thumbwheel inputs must be on the same brick.
- INDUST syntax is altered. To use the system status (selection "I"), you should prefix the INDUST command with the task # for the system status you want (otherwise the default is task 1) – e.g., 3%INDUST16-2I assigns user status bit 16 to the 2nd bit of system status for task 3. To use the IN input status (selection "J"), you must prefix the INDUST command with the I/O brick # (otherwise, the default is on-board triggers) – e.g., 2INDUST14-4J assigns user status bit 14 to the status of I/O point 4 on I/O brick 2 (2IN.4).
- Debounce: INDEB is now brick-specific (all triggers constitute brick 0) — i.e., the INDEB value applies to all inputs on the specified brick. Therefore the syntax is changed to <!><B>INDEB<i> (drop the first integer field, which was used for the input number). INDEB now works the same for all general-purpose and trigger inputs (using the functionality the was previously applicable only to the general-purpose inputs). A new command, TRGLOT, sets the lock-out time for only the triggers defined as Position Capture inputs (INFNCi-H) — TRGLOT overrides the INDEB setting for the affected trigger inputs. INDEB also applies to limit inputs that are assigned standard input functions (e.g., Stop input) with the LIMFNC command. If an input is assigned a limit input function (R, S, or T), the input is not debounced (INDEB has no effect).
- Limit functions are added to INFNC so that external inputs can be used as limit inputs: R = positive limit,

S = negative limit, T = home limit. If an input is assigned a limit input function, it is no longer debounced (INDEB has no affect on it), and LH applies to the input, according to the axis and limit function assignment. It is still affected by INEN.

- The new LIMEN command adds INEN functionality for physical limit inputs (on the "LIMITS" connector), regardless of the inputs' assigned LIMFNC function. LH is still used to enable checking the state of the EOT limits (LH1, LH2 or LH3 is still required to detect errors).
- Limit inputs are programmable with the LIMFNC command. The default power-up state is such that each limit input is assigned to the correct LIMFNC function (e.g., the positive travel EOT limit for axis one is assigned LIMFNC1-1R). When an external input on and I/O brick is assigned a limit function, the user should reassign the hardware limit input as a general-purpose input (LIMFNCi-A) or as a different non-limit LIMFNC function. When left in the default function assignment (R, S, or T), the limits are not debounced; but if assigned other LIMFNC functions (including LIMFNCi-A), they are debounced with the INDEB setting for the on-board inputs.
- The functions of LHLVL and HOMLVL have been consolidated into LIMLVL (same bit assignments as LIM & LIMEN).
- INFEN and OUTFEN have been removed. Use the new DRFEN command to enable or disable checking the drive fault input.
- The digital outputs on the serial I/O bricks will be sinking or sourcing, depending on the jumper setting (on the I/O brick). The controller will auto-detect the jumper setting on power up and set the OUTLVL accordingly.
- TRGFN syntax changes: It now requires an axis identifier prefix, eliminating the succession of 8-bit patterns for each axis. Only A, B and M are allowed for the trigger identifier. When web registration (Following enhancements) is released, an additional function will be added to the TRGFN syntax.
- Analog input voltage range can be set with ANIRNG. Default is -10V to +10V. Other options are: 0 to +5V, -5 to +5V, and 0 to +10V.

Stepper Axis Behavior

- No Encoder position feedback (closed loop) features for steppers. MANY references to operation being different based on ENC. These features are no longer available to steppers: ENC Mode, Position Maint. features, Target Zone mode, and TPER & PER.
- Can't capture encoder position unless ENCCNT1 is used (and then commanded position can't be captured).
- Steppers no longer stop instantaneously on a kill, drive fault, limit, etc. — steppers now stop at LHAD/LHADA.
- Stepper axes now support s-curve profiles.
- Commanded position (AKA "motor" position) for steppers is now reported with the PC, TPC, & TPCC commands. The PM, TPM, PCM, and TPCM commands can still be in the product but they will not be documented.
- FOLK is now applicable to steppers.
- Output on Position works for steppers, now.

Encoders

- EFAIL added to detect encoder failures. Error reported with TASX bit 5 and error bit 17. Works only on differential encoders. By default, the 6K is compatible with differential encoders, but if you jumper pins 8 & 9 on the encoder connector (this feature requires a PCB modification) you can connect a single-ended encoder.
- New commands for addressing only the "Master Encoder", to check position (TPME, PME), captured position (TPCME, PCME), set absolute position (PMESET, PMECLR), change polarity (MEPOL), change to step and direction input (MESND).
- "FOLSND" is changed to "ENCSND" to avoid confusion about the functionality (does not depend on Following). FOLSND is still available as a hidden command for users of existing 6000 products.
- No counter commands (CNTE, CNT, CNTINT, CNTR). Instead, you must use ENCSND.

New Error Messages

- "`ALTERNATIVE TASK NOT ALLOWED`": Attempted to execute a LOCK command in another task.
- "`AXIS NOT PART OF TASK`": A task is attempting to execute a contouring path whose participating axis or axes (PAXES) are not associated with the task (TSKAX).
- "`COMMAND/DRIVE MISMATCH`": The command (or ≥ one field in the command) is not appropriate to the AXSDEF configuration (e.g., attempting to execute a servo tuning command on a stepper axis).
- "`COMMAND NOT ALLOWED IN PROGRAM`": Attempted to place a non-allowed command (e.g., scaling command) in a program.
- "`INCORRECT BRICK NUMBER`": Attempted to execute a command that addresses an I/O brick that is not connected to your 6K controller.
- "`INVALID TASK IDENTIFIER`": Attempting to launch a PEXE or EXE command into the supervisor task (task 0).
- "`INPUT NOT DEFINED AS JOYSTICK INPUT`": Attempting to execute JOYCDB, JOYCTR, JOYEDB, or JOYZ before executing JOYAXH or JOYAXL to assign the analog input to an axis.

Communications

- COM1 is the connector labeled “RS-232” or “ETHERNET”, and COM2 is the connector labeled “RS-232/485”.
- LOCK allows users to tie up the COM ports for a specific task (affects port handling — [,], DRPCHK, PORT)
- RS-422 in 6K only
- Baud rate adjusted with BAUD command (new) — default is 9600.
- Fast status (FASTAT) is removed. Status information is fixed and accessed through the Communications Server.
- Interrupts are now “alarms” and are available only through use of the Communications Server and ActiveX control (via Ethernet only)
- RP240 canned menus are different (run only); DVARI & DVARB are new; DSTP to enable/disable RP240 Stop button.

Miscellaneous

- Scaling changes: Scaling commands are now automatically stored in battery-backed RAM, and they are no longer allowed in a program (must be outside — this is handled by Motion Planner). Separate contouring and linear interpolation path scaling parameters (PSCLA, PSCLD, PSCLV) are no longer required; instead, use the SCLD value to scale all path motion (accel/decel, velocity, and distance).
- Command syntax & reporting formats have been modified to accommodate 8 axes (e.g., added fields per axis).
- Servo updates are fixed (this obsoletes the SSFR & INDAX commands); Only one system update now (2 ms)
- Status bit information (axis, system, error, user, Following, TSTAT, etc.) — deletions, additions, alterations:

  ASX: bit 5 for encoder fail,
  bit 6 for Z channel state (1 = active, 0 = inactive)

  ER: bit 16 for command error (Cleared with TCMDER),
  bit 17 for encoder fail (if EFAIL1. Cleared with EFAIL0)
- Error conditions/handling — Each task has its own error status register and error program.
- SYNTAX: Syntax change for REG: axis specific, only A and B are allowed.
- SYNTAX: Bit select syntax (syntax that required "-" before now allows you to use "=" instead, but not vice versa)
- SYNTAX: New ability to address a command to a specific address (and group of addresses of n, n+1, n+2, etc.)
- Timer enhancement: TIMST syntax has an additional optional field (<r>) — new syntax is TIMST<b>,<r>. If TIMST0, then <r> represents an absolute time; if TIMST1, then <r> represents a task number (timer will resume with the value of the timer for the specified task). Timer resolution is fixed at 2 ms.
- Program interrupts (ON conditions) — Each task has its own ON conditions and ONP program.
- Memory allocation for all 6K products most closely resembles the allocation for existing AT6000 products.
- 6K does not support COMEXK and COMEXP modes.
- Following enhancements— Geared Advance (FGADV) and virtual master and sine wave (FVMACC, FVMFRQ, SINAMP, SINANG, SINGO).
- Contouring enhancements — axes may now have different DRES and PULSE (steppers) and feedback resolutions (servo). Mechanical resolutions may also be different.

New Commands/Features for the 6K

Commands

% ..... Task Identifier
ANIEN ..... Analog Input Enable
ANIFB ..... Assign Analog Inputs as Axis Feedback
ANIMAS .. Assign Analog Inputs to Axes
ANIRNG .. Analog Input Voltage Range
AXSDEF . Axis Definition
BAUD..... Baud Rate
[DKEY] .. Value of RP240 Key
DRFEN .... Drive Fault Input Enable
DSTP ..... Enable/Disable RP240 Stop Key
DVARB ... Display Binary Variable on RP240
DVARI ..... Display Integer Variable on RP240
EFAIL ..... Encoder Failure Detect
ENCCNT . Encoder Count Reference Enable
ENCSND.. Encoder Step & Direction Mode
EXE ..... Execute Program from a Compiled PLCP Program
FGADV ... Following Geared Advance
FVMACC . Virtual Master Count Frequency Acceleration
FVMFRQ . Virtual Master Count Frequency
LIMEN..... Enable Limit Inputs Defined as Non-Limit Inputs
LIMFNC .. Limit Input Function
LIMLVL .... Limit Input Active Level
LOCK ..... Lock Resource to Task
MEPOL .... Master Encoder Polarity
MESND.... Master Encoder Step & Direction Mode
NTADDR . IP Address for Ethernet Communication
NTMASK.. Network Mask for Ethernet Communication
[PCMS] . Captured Master Cycle Position
PESET..... Establish Encoder Absolute Position Reference
PEXE ..... Execute Compiled Prog. from Compiled PLCP Prog.
PLCP ..... Compiled PLC Program
[PCME] .. Captured Master Encoder Position
[PME]..... Position of Master Encoder
PMECLR.. Clear Master Encoder Absolute Position Reference
PMESET.. Establish Master Encoder Absolute Position Reference

SCANP ... Scan Compiled PLCP Program
SINAMP .. Virtual Master Internal Sine Wave Amplitude
SINANG .. Virtual Master Internal Sine Wave Angle
SINGO .... Virtual Master - Initiate Internal Sine Wave
[SWAP] . Task Swap Assignment
[TASK] .. Task Number Assignment
TIO ..... Transfer Current Expansion I/O Configuration
TNTMAC . Transfer Ethernet Address
TPCME .... Transfer Position of Captured Master Encoder
TPCMS ... Transfer Captured Master Cycle Position
TPME..... Transfer Position of Master Encoder
TRACEP . Program Flow Mode Enable
TRGLOT . Trigger Lockout Time
[TRIG] ... Trigger Capture Status
TSCAN..... Scan Time of Last PLCP Program
TSKAX .... Task Axis
TSKTRN .. Task Turns Before Swapping
TSWAP ... Transfer Task Swap
TTASK .... Transfer Task Number
TTRIG ..... Transfer Trigger Capture Status
VARI ..... Integer Variable Assignment
WRVARI . Write an Integer Variable

Features

- Multi-tasking (impact: task-specific commands & report-backs, and syntax)
- PLC Scan mode
- Following enhancements: Geared Advance and Virtual Master
- Integer variables (VARI)
- Master encoder handling
- TRACEP (trace mode enhancement)
- Compiled conditionals (not first release)
- Baud rate changed with command (BAUD) only
- RP240 menus, DVARI, DVARB, DSTP
- Ethernet communication and “alarm” event handling
- Additional syntax symbols (% for addressing specific tasks, <B> for addressing specific I/O bricks)

6000 Commands not in the 6K Command Language

ANI Option
- ANIPOL
- ANV
- ANVO
- ANVOEN
- CA
- PCA
- TCA
- TPCA

Counter
- CNT
- CNTE
- CNTINT
- CNTR
- TCNT

Command Processing
- COMEXK
- COMEXP

Encoder
- EMOVDB
- ENC
- EPM
- EPMDB
- EPMG
- EPMV

Feedrate
- FR
- FRA
- FRH
- FRL
- FRPER

Servo (misc.)
- INDAX
- SSFR
- SDTAMP
- SDTFR

Interrupt
- INTCLR
- TINT

Data Streaming Mode
- SD
- STD
- STREAM

Scaling (contouring and linear interpolation only)
- PSCLA (use SCLA instead)
- PSCLD (use SCLD instead)
- PSCLV (use SCLV instead)

Product Specific: ZETA610n
- DACTDP
- DAREN
- DAUTOS
- DELVIS
- DMTIND
- DMTSTT
- DWAVEF

Product Specific: APEX615n
- DRESET

Product Specific: 6270
- DACMIN
- LDT
- LDTGRD
- LDTPOL
- LDTRES
- LDTUPD
- PCL
- SGAFN
- SGIN
- SGPN
- SGVFN
- SGVN
- SOFFSN
- SSWD
- SSWG
- TLDT
- TPCL

Miscellaneous
- OUTANA
- SSV
- TANV
- TEST
- FASTAT