INTEGRATED CONTROLLER

Protocol Manual

Rev. J

QPT-20XD

QPT-90

QPT-130/150

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QPT-20 & QPT-90/130 Embedded Controller Protocol Rev J

(Revision history at end of document)

Pan & Tilt Communications Protocol Overview:

The controller PCB mounted internal to the QPT-20 (PTR-20-1224) and QPT-90 (PTR-90-1224) will be addressable via a dedicated RS-422 or RS-232 communications link provided by an attached remote server. The remote server will act as master and be responsible for initiating and maintaining communications with the PTR. The PTR will remain idle until the server sends a query/command. The PTR will then parse the packet, check for integrity, and respond as required.

With Rev H of this protocol, communication loss timeout becomes variable. The user may set this value in a range of 1-120 seconds or disable its detection by setting the value to 0 (see command 96H.) If enabled, a loss of communication with the host for greater than the timeout period will cause an executing remote initiated movement command (any "move to" command or running tour) to terminate. Therefore, the server should refresh the PTR at least once within the timeout period to keep the link active and may refresh more often to keep returned coordinate display data up to date. However, refresh should not occur more often than once every 120 ms..

If the timeout is disabled the user may initiate a movement command, then physically disconnect or stop refreshing the serial link without halting the system. This means that it is possible for a user to connect to the QPT, disable the timeout by setting it to 0, start a tour executing, then disconnect. The QPT will continue to run the tour until the serial link is reconnected and the QPT is told to stop. Whether timeout is enabled or disabled all other faults (limits, directional errors, etc.) will still be monitored and will stop any automated move if detected.

New Higher Resolution PTHR-90 Changes:

A new, higher resolution PTR-90 unit, denoted the PTHR-90-1224, has been added to the controller line. This unit uses 16-bit resolvers rather than 12-bit potentiometers for position feedback. Therefore, it is capable of producing resolution to 1/100th degree rather than 1/10th degree. Bit 7 of the general status bitset has been allocated for returning high resolution mode if set. If cleared, the unit is a standard resolution PTR-20 or PTR-90. The integers required and returned for angle position will be the angle multiplied by 10, i.e. an angle of 180.0° will be represented as 1800. If the bit is set when status is returned the integer angle will be the true angle multiplied by 100, i.e., an angle of 180.00° will be represented as 18000. The controlling application should be configured to read and store this bit and adjust angle conversions as required. Changes to parameters passed in specific commands is outlined in Appendix A.

Autobaud:

An automatic baud detection procedure (autobaud) has also been implemented with protocol Rev H and the companion embedded code Rev 2.11. Supported baud rates are 9600bps, 14.4kbps, 19.2kbps, 28.8kbps, 38.4kbps, and 57.6kbps. Structure is still 8 data bits, 1 stop bit, and no parity. Autobaud synchronization will only occur on power up and will not adapt "on the fly." The baud rate will be retained as long as power is applied to the PTR. However, to change baud rates, the user may power the PTR down, change host baud rate, then power the unit back up to redetect.

Normally, the user should make a practice of sending "keep alive" Get Status/Jog commands periodically if communications is lost in order to resync the PTR to the host, even without the autobaud feature. With autobaud the host must be able to transmit up to 125-150 bytes of data (worst case) without a response expected in order for the PTR to properly determine the data rate. This equates to about 15 Get Status/Jog commands. With a refresh rate of 120ms a maximum of about 2 seconds is required to determine baud rate. Once baud rate is determined the PTR will begin responding to the Get Status/Jog commands and the host software may then move on to actual operation.

Storage of Coordinate Information:

The PTR tracks absolute position using feedback from the precision potentiometers connected to the pan & tilt axes. This negates the need for a "homing" cycle at power-up. The unit inherently knows its absolute position.

The feedback from the potentiometers is converted by the 12-bit A/D section of the on-board microcontroller to a value ranging from 0-4095. The PTR uses these values, referred to as "resolver units", directly to execute any automated movement commands. Resolver units are converted to angular values only for user display. Angular values supplied by the user are converted back to resolver units for both preset storage and automated movement. The advantage of using this method is increased accuracy and higher conversion speed during movement. If a user supplies an angular input for an automated move the PTR converts it only once to a resolver unit value, then may directly compare this value to current resolver unit readings. As resolver units will never exceed 12 bits they may be stored in the preset table in a packed format, saving memory space.

This approach does have an effect, however, on the structure of preset table entries and user-defined angular corrections. Presets are stored in absolute resolver units. The angular position for those presets is a calculated value derived from the conversion of resolver units to angles and any angular offsets defined by the user. Let us say, for example, that the user has not defined any angular offset. Therefore, the 0°/0° point for the platform will truly read 0°/0°. The user then defines a preset at +20° in pan and -10° in tilt. If the user moves to this preset, the angular reading returned will be +20°/-10°. The user then decides to redefine the 0°/0° position to return -10° in pan and 0° in tilt by entering a -10° pan correction. Though the physical 0°/0° position remains the same, the angular reading for this position will now be returned as -10°/0°. If the user then moves to the former +20°/-10° preset the platform will move to the correct preset position but the angle returned will be +10°/-10°.

There is an important rational behind this coordinate system. Many will use the angular readings of the platform to observe the relative position of different targets. For example, the user may find that one object resides at -30° pan/-10° tilt relative to a true 0°/0° point. A second object resides at +25° pan/-20° tilt relative to the 0°/0° point. The user moves back to the first object and uses the "Align Angles to Center" command. This will introduce a pan angle correction of +30° and a tilt correction of +10°, adjusting the returned angular reading for the first object to 0°/0°. If the user now moves to the second object the angular reading will be +55° pan/-10° tilt, the actual angular distance from the first object.

Therefore, presets will always reflect known physical positions of the platform. No matter how the pan and tilt angles are shifted, a preset position will remain valid and correct and a command to move to that position will still return the platform to it. Introducing angular corrections will do nothing more than change the returned angular position but will not change the actual physical position of a preset.

General Communications Structure:
The general structure of the remote-to-PTR communications protocol is as follows:

Remote	STX	Command Number	Data	Checksum	ETX
PTR	ACK/NAK	Echoed Command Number	Data	Checksum	ETX

The PTR will always echo the last received command number back to the remote in its response. Remote software can be configured to accept this echo as a confirmation that the command was actually received and will be responded to. In the command breakdowns that follow, the transmission from remote to PTR will always be followed by the response from PTR to remote.

Control Characters:
The following are definitions for control characters used in data transfer.

Char	Description	Sent By	Value
STX	Start of Text	Remote	02H
ETX	End of Text	Remote/PTR	03H
ACK	Acknowledge	PTR	06H
NAK	Not Acknowledge	PTR	15H

Calculating the Checksum:
The checksum used for data transfer is a longitudinal redundancy check or LRC. It is calculated by XOR ing bytes starting with the command number and ending with the last data byte. The ACK/NAK/STX and ETX are **not**

included in the LRC. The easiest method of calculating and comparing is to XOR all data bytes, then XOR the result with the LRC checksum. The result should be 0 (zero).

Passing Data that Matches Control Character Values:
When passing full 8-bit bitsets it is possible that a value may match a control character (ACK/NAK/STX/ETX.) Therefore, the protocol needs some method of distinguishing these values from control characters. The method used is the insertion of an ESC character prior to transmitting the conflicting data byte and the setting of Bit-7 of the conflicting byte. Since we must also be able to distinguish the ESC value of 1BH we will perform the same operation on ESC s.

Example: Data to send = 02H Data sent = 1BH 82H
Data to send = 1BH Data sent = 1BH 9BH

This insertion should be performed on **any byte that is not a control character, including the LRC.** Note that this procedure should be performed immediately prior to transmission and the companion decoding should be performed prior to checksum calculation after reception. These insertions are not included in the LRC calculations. The entire receive buffer should be scanned prior to LRC check and parsed for any occurrences of ESC. The ESC should be tossed, the following byte should have Bit-7 cleared, then the buffer should be shifted down. The buffer will then be ready for LRC calculation and data parsing.

The inclusion of ESC sequences provides two distinct advantages. First, the user is assured that any reception of an ACK or ETX is valid. Unless an error occurs, these control characters will not show up as data bytes in the packet. Therefore, it is perfectly valid to cue the start of reception on any ACK character. It is also valid to cue the end of reception and begin parsing data on the reception of an ETX. Since the ACK and ETX are not used in the calculation of the LRC, the user can simply use them as starting and stopping cues. Secondly, unlike the original implementation of IBM bisync on which this protocol was based, the user is allowed to pass full 8-bit binary values.

Passing Integer Values:
As noted in the protocol command descriptions, some values sent between the remote and PTR units are integer values. These integer values should be passed and received as 16-bit signed two's-complement little endian integers simply split between two bytes. The first byte should represent the LSB of the integer with the second byte containing the MSB of the integer. Negative values are represented as the two's-complement of the positive value. For example:

Integer Value	Integer in Hex	First Byte	Second Byte
32767	7FFFH	FFH	7FH
2	0002H	02H	00H
1	0001H	01H	00H
0	0000H	00H	00H
-1	FFFFH	FFH	FFH
-2	FFFEH	FEH	FFH
-32768	8000H	00H	80H

The Programmer's Responsibility for Input Range and Format
The microcontroller used for the PTR has a relatively small amount of code space. Extensive range and format checking of all user input would seriously task the processor and limit the amount of space left for executable procedures. The listings for each command in this document present the allowable range for each byte or integer of data. The user/programmer is responsible for providing inputs that are properly formatted and within the specified numeric range for each command. However, **absolute coordinates, preset numbers and static tour step locations** are checked and flagged if out of range or otherwise invalid.

Status Definitions:
Bits are active high, i.e., set or 1 indicates the condition exists. (S)oft faults are self-healing. (H)ard faults require a RESET (RES) command to clear.

Sym	Type	Name	Description
xHL	S Fault	Hard Limit	An axis hard limit has been reached.
xSL	S Fault	Soft Limit	An axis soft limit has been reached.
TO	H Fault	Timeout	A commanded axis is not moved within the prescribed timeframe.
DE	H Fault	Direction Error	A commanded axis has moved in the wrong direction.
OL	H Fault	Current Overload	A commanded axis has tripped the current overload.
xRF	S Fault	Resolver Fault	A resolver is disconnected or not operating properly.
xxxM	Stat	Moving	The commanded axis is currently moving.
OSLR	Stat	Override Return	The controller is in soft limit override.
DES	Stat	Destination	The coordinates returned are destination coordinates, not current.
EXEC	Stat	Executing	The PTR is executing a remote initiated command
HRES	Stat	High Res	The PTHR is returning angles to 1/100th degree resolution.

Pan & Tilt Protocol Command Set:

Cmd	Name
31H	Get Status/Jog
32H	Move To Preset
33H	Move To Entered Coordinates
34H	Move To Delta Coordinates
35H	Move To Absolute 0/0
36H	Move To Home
37H	Start Preset Tour
40H	Retrieve Preset Table Entry
41H	Save Coordinates As Preset Table Entry
42H	Save Current Position As Preset Table Entry
43H	Add Aux Bytes To Preset Table Entry
50H	Flush Preset Tour
51H	Query Preset Tour
52H	Append To Preset Tour
53H	Insert Into Preset Tour
54H	Delete From Preset Tour
55H	Replace In Preset Tour
70H	Get Pan & Tilt Angle Correction
71H	Get Soft Limit
80H	Set Pan & Tilt Angle Correction
81H	Set Soft Limit To Current Position
82H	Align Angles To Center
83H	Align Angles To Coordinates
84H	Clear Angle Correction
90H	Get Center Position in RU's
91H	Set Center Position
92H	Get Minimum Speeds
93H	Set Minimum Speeds
94H	Initialize Preset Table to 0/0
95H	Get/Set Motor and Resolver Direction
96H	Get/Set Communication Timeout
97H	Get/Set Heater Power Sharing
98H	Get Maximum Speeds
99H	Set Maximum Speeds

Remote to PTR Get Status/Jog Command

This command can be used as a standard "Keep Alive" from the remote unit to continuously gather coordinate data. This command should be the one sent when no other command is required. This will keep the remote computer advised of current position and any faults that may exist. This will also confirm to the PTR that the remote computer is connected and properly communicating.

The jog bytes contain both a direction and a speed value. This allows proportional, simultaneous jog control of both axes. Holding the speed value for an axis at 0 will prohibit jogging that axis. Note that any jog command that includes a speed value other than 0 will automatically stop any automated command. Therefore, initiating a jog can be used to terminate an automated move, including a preset tour.

The two auxiliary commands are currently not implemented in hardware but have the potential to provide focus and zoom control, camera switching, time stamping commands, etc. They should be written as 0.

The "STOP" bit can also be used to stop all motors during execution of an automated movement command. For example, if a "MOVE TO" is to be executed the remote would send the "MOVE TO" command once, then return to the "GET STATUS/JOG" command to update position display. If the user wishes to stop the "MOVE TO" command from the remote the "STOP" bit should be set then, after confirmation of reception, cleared. This will cause the PTR to stop the motors, fall out of the "MOVE TO" procedure, and return to a state waiting for the next command.

The "RES" or reset bit is used to clear latching (hard) faults. These include current overloads (OL), motor directional errors (DE), and timeouts (TO). If a motor's current draw exceeds the allowable value an overload fault will be set. The unit also monitors the junction temperature of the motor drivers. If this temperature exceeds the allowable level of 145°C the overload fault will be set. A timeout fault will be set if an axis fails to move within 1 second. This may be the result of a stalled motor, an overloaded platform, or a physical obstruction prohibiting motor movement. A directional error fault will be set if an axis is detected as moving in the wrong direction. This may be the result of improper motor wiring. **Note that the DE and TO faults will only occur during automated moves.** The user should observe the angular readings during jog to confirm motors are moving the proper direction and are not stalled.

The "OSL" bit allows overriding soft limits during jog. **This bit should only be set when initially setting up the soft limits.** Its current setting will be returned in the OSLR bit.

Setting the "RU" bit forces the PTR to return any status response coordinate data as resolver units rather than angles. This function can be helpful when initially aligning potentiometers to the platform. Output range is 0-4095.

Though actual movement in pan and tilt is restricted to ±180° and ±90° respectively, a figure of double this amount may be returned by a status query. This is allowed to accommodate any angular offsets that may be set by the user.

Data	Format	Bytes	7	6	5	4	3	2	1	0
STX	02H	1								
Cmd Num	31H	1								
Cmd	Bitset	1	0	0	0	0	RU	OSL	STOP	RES
Pan Jog Cmd	Bitset	1	Pan Speed (0-127)							Dir[1]
Tilt Jog Cmd	Bitset	1	Tilt Speed (0-127)							Dir[2]
Aux 1 Cmd	xxH	1	Auxiliary Byte or Bitset							
Aux 2 Cmd	xxH	1	Auxiliary Byte or Bitset							
LRC	xxH	1								
ETX	03H	1								

[1] 1 = CW/0 = CCW 0 Speed = No Movement
[2] 1 = UP/0 = DWN 0 Speed = No Movement

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Cmd Num	31H	1								
PAN Coord	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°							
TILT Coord	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°							
PAN Status	Bitset	1	CWSL	CCWSL	CWHL	CCWHL	TO	DE	OL	PRF[2]
TILT Status	Bitset	1	USL	DSL	UHL	DHL	TO	DE	OL	TRF[2]
Gen Status	Bitset	1	HRES[3]	EXEC	DES[1]	OSLR	CWM	CCWM	UPM	DWNM
LRC	xxH	1								
ETX	03H	1								

[1]DES bit is clear if coordinates are current, set if coordinates are the destination of a MOVE TO command.
[2]The PRF and TRF resolver fault bits are only implemented in controllers fitted with synchro-resolvers.
[3]HRES set = 1/100th degree resolution. Clear = 1/10th degree resolution.

Automated "Move To" Commands:

A Special Note About The Following Automated "Move To" Commands (32H-36H):

Any Move To command should only be repeated until an acknowledgement has been received from the PTR (echo of the command number). The remote should then revert back to the standard 31H "Get Status/Jog" query. The PTR will set the EXEC (executing) bit in the general status bitset to indicate that the command is being carried out. This bit will clear once the move has been completed.

The PTR response to any automated "Move To" command will be identical to the standard status response with one exception. The response will echo the destination coordinates either as entered or retrieved from the preset table rather than the current coordinates. The setting of the destination bit DES, bit-5 of general status will indicate this. Status will then default back to current coordinates once the "Get Status/Jog" command/response resumes and the DES bit clears. The user may cue on the DES bit in order to fill a "Moving To" window with the destination coordinates.

If the PTR is detecting hard faults that will prohibit executing a Move To command it will echo the current position as the destination coordinates. This should act as a reminder for the user to check the fault status.

Movement will start once the PTR has parsed the Move To" coordinates. The setting of the appropriate axis MOVE bits in the status response will indicate this. As each axis arrives on station the respective MOVE bit will be cleared. The remote may assume the move has been completed when all MOVE bits and the EXEC bit have cleared. If a fault occurs on **any** axis **all** motors will stop. The fault will be set and all MOVE bits and the EXEC bit will be cleared.

Setting the STOP bit or setting jog speed to a value other than 0 in any following "Get Status/Jog" command will immediately terminate any automated "Move To" operation. Sending any command other than the 31H "Get Status/Jog" command during an automated move will also terminate the automated "Move To" command.

Remote to PTR Move To Preset Command:
The PTR can retain up to 32 position entries in a non-volatile table that are frequently used by the operator. This command is used to move the platform to a preset position defined in this preset table. Further information on setting up the preset table is provided under command 40H below. If a preset number greater than 31 is entered no move will occur.

Data	Format	Bytes	
STX	02H	1	
Command	32H	1	
Preset	xxH	1	Preset Number 0-31
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Command	32H	1								
PAN Coord	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°							
TILT Coord	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°							
PAN Status	Bitset	1	CWSL	CCWSL	CWHL	CCWHL	TO	DE	OL	PRF
TILT Status	Bitset	1	USL	DSL	UHL	DHL	TO	DE	OL	TRF
Gen Status	Bitset	1	HRES	EXEC	1	OSLR	CWM	CCWM	UPM	DWNM
LRC	xxH	1								
ETX	03H	1								

Remote to PTR Move To Entered Coordinate Command:
This command is used to move the platform to a specific set of manually entered coordinates. The coordinate must consist of the desired position to 1/10th degree multiplied by 10, i.e., +90.0° should be sent as 900. The user can force an axis to remain in position by sending its current position back to the PTR. However, the coordinate value 9999 (+999.9°) can also be sent in order to prohibit movement of a specific axis. For example, if the user wishes to only move PAN, send 9999 (+999.9°) as the Move To coordinate for TILT and the TILT axis will remain stationary.

The PTR will perform a range check for the input coordinates and abort the move if a coordinate is out of range. Allowable pan range is defined as -180.0° + pan angle offset to +180.0° + pan angle offset. Allowable tilt range is -90.0° + tilt angle offset to +90.0° + tilt angle offset. For an angle offset of 0°/0°, the range would be -180.0°/+180.0° and -90.0°/+90.0°. If a pan angle correction of +180.0° is entered, the allowable pan angle range would shift to 0.0° to 360.0°. If a tilt angle correction of -20.0° is entered, the allowable tilt angle range would shift to -110.0° to 70.0°.

Data	Format	Bytes
STX	02H	1
Command	33H	1
PAN Coord	Int	2
TILT Coord	Int	2
LRC	XxH	1
ETX	03H	1

PAN = -3600 to +3600 = -360.0° to +360.0° or 9999 for no move
TILT = -1800 to +1800 = -180.0° to +180.0° or 9999 for no move

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Command	33H	1								
PAN Coord	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°							
TILT Coord	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°							
PAN Status	Bitset	1	CWSL	CCWSL	CWHL	CCWHL	TO	DE	OL	PRF
TILT Status	Bitset	1	USL	DSL	UHL	DHL	TO	DE	OL	TRF
Gen Status	Bitset	1	HRES	EXEC	1	OSLR	CWM	CCWM	UPM	DWNM
LRC	xxH	1								
ETX	03H	1								

Remote to PTR Move To Delta Coordinates Command:
As opposed to moving to specific coordinates, the "Move To Delta Coordinate" command allows the user to move the platform a specific angular distance from the current position. The coordinate must consist of the desired position to 1/10th degree multiplied by 10, i.e., -20.0° should be sent as -200. The user can force an axis to remain stationary by sending 0 to the PTR for that axis.

Data	Format	Bytes	
STX	02H	1	
Command	34H	1	
PAN Coord	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°
TILT Coord	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Command	34H	1								
PAN Coord	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°							
TILT Coord	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°							
PAN Status	Bitset	1	CWSL	CCWSL	CWHL	CCWHL	TO	DE	OL	PRF
TILT Status	Bitset	1	USL	DSL	UHL	DHL	TO	DE	OL	TRF
Gen Status	Bitset	1	HRES	EXEC	1	OSLR	CWM	CCWM	UPM	DWNM
LRC	xxH	1								
ETX	03H	1								

Remote to PTR Move To Absolute 0/0 Command:
The Pan & Tilt unit potentiometer resolvers are initially aligned with the platform centered and level. This command will return the platform to that stored center position. This is a convenient method for returning the platform to factory center for maintenance or hard limit switch alignment.

Data	Format	Bytes
STX	02H	1
Command	35H	1
LRC	XxH	1
ETX	03H	1

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Command	35H	1								
PAN Coord	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°							
TILT Coord	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°							
PAN Status	Bitset	1	CWSL	CCWSL	CWHL	CCWHL	TO	DE	OL	PRF
TILT Status	Bitset	1	USL	DSL	UHL	DHL	TO	DE	OL	TRF
Gen Status	Bitset	1	HRES	EXEC	1	OSLR	CWM	CCWM	UPM	DWNM
LRC	xxH	1								
ETX	03H	1								

Remote to PTR Move To Home Command:
A special preset position number 31, referred to as "Home", may be entered and stored by the PTR. This command requires no preset number or coordinate input and will always return the pan and tilt unit to this "Home" position.

Data	Format	Bytes
STX	02H	1
Command	36H	1
LRC	XxH	1
ETX	03H	1

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Command	36H	1								
PAN Coord	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°							
TILT Coord	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°							
PAN Status	Bitset	1	CWSL	CCWSL	CWHL	CCWHL	TO	DE	OL	PRF
TILT Status	Bitset	1	USL	DSL	UHL	DHL	TO	DE	OL	TRF
Gen Status	Bitset	1	HRES	EXEC	1	OSLR	CWM	CCWM	UPM	DWNM
LRC	xxH	1								
ETX	03H	1								

The Preset Table:

The PTR can retain up to 32 (0-31) preset positions in non-volatile memory that are frequently used by the operator. The user can store, retrieve, or move to these coordinates by modifying and using the preset table as outlined below. Two additional byte values, "AUX1" and "AUX2", are available for storing generic preset information. Though not currently implemented in hardware, these values could be used for zoom level, iris level, etc. For future compatibility, they should be written as 0 when storing a preset position to the table.

A special preset, referred to as "Home" position, can be directly driven to without referencing a preset number using command 36H. It should be saved at preset position 31. This position can also be assigned as a generic preset and can be included in a static preset tour.

Any command to store or retrieve a preset entry will echo back the preset's coordinates. If a preset number greater than 31 is entered the preset number will be echoed as FFH and the remainder of the data will be 0's.

Remote to PTR Retrieve Preset Table Entry Command:
The operator may retrieve the stored coordinate position and auxiliary byte values for any preset.

Data	Format	Bytes
STX	02H	1
Command	40H	1
Preset Num	xxH	1
LRC	XxH	1
ETX	03H	1

Data	Format	Bytes
ACK	06H	1
Command	40H	1
Preset Num	xxH	1
Preset Pan	Int	2
Preset Tilt	Int	2
Aux 1	xxH	1
Aux 2	xxH	1
LRC	xxH	1
ETX	03H	1

Remote to PTR Save Coordinates As Preset Table Entry Command:
This command allows the user to load a specific set of coordinates and aux bytes to the preset table. The PTR will perform a range check for the input coordinates and abort saving if a coordinate is out of range. Allowable pan range is defined as -180.0° + pan angle offset to +180.0° + pan angle offset. Allowable tilt range is -90.0° + tilt angle offset to +90.0° + tilt angle offset. For an angle offset of 0°/0°, the range would be -180.0°/+180.0° and -90.0°/+90.0°. If a pan angle offset of +180.0° is entered, the allowable pan angle range would shift to 0.0° to 360.0°. If a tilt angle offset of -20.0° is entered, the allowable tilt angle range would shift to -110.0° to 70.0°. The user may save coordinates that exceed both soft and hard limits.

Data	Format	Bytes	
STX	02H	1	
Command	41H	1	
Preset Num	xxH	1	0-31 (0-1FH)
Preset Pan	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°
Preset Tilt	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°
Aux 1	xxH	1	0-255 (0-FFH)
Aux 2	xxH	1	0-255 (0-FFH)
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	41H	1	
Preset Num	xxH	1	0-31 (0-1FH) or FFH if preset out of range
Preset Pan	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°
Preset Tilt	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°
Aux 1	xxH	1	0-255 (0-FFH)
Aux 2	xxH	1	0-255 (0-FFH)
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Save Current Position As Preset Table Entry Command:
This command allows the user to store the platform's current position as a preset table entry. Command 43H allows the user to also add auxiliary byte data to this type of preset.

Data	Format	Bytes	
STX	02H	1	
Command	42H	1	
Preset Num	xxH	1	0-31 (0-1FH)
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	42H	1	
Preset Num	xxH	1	0-31 (0-1FH) or FFH if preset out of range
Preset Pan	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°
Preset Tilt	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°
Aux 1	xxH	1	0-255 (0-FFH)
Aux 2	xxH	1	0-255 (0-FFH)
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Add Aux Bytes To Preset Table Entry Command:
Command 43H allows the user to add or modify auxiliary byte data in a preset table entry.

Data	Format	Bytes	
STX	02H	1	
Command	43H	1	
Preset Num	xxH	1	0-31 (0-1FH)
Aux 1	xxH	1	0-255 (0-FFH)
Aux 2	xxH	1	0-255 (0-FFH)
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	43H	1	
Preset Num	xxH	1	0-31 (0-1FH) or FFH if preset out of range
Preset Pan	Int	2	PAN = -3600 to +3600 = -360.0° to +360.0°
Preset Tilt	Int	2	TILT = -1800 to +1800 = -180.0° to +180.0°
Aux 1	xxH	1	0-255 (0-FFH)
Aux 2	xxH	1	0-255 (0-FFH)
LRC	xxH	1	
ETX	03H	1	

The Static Preset Tour:

The PTR can hold three 63-step (0-62) static preset tours. Static preset tours are built only from assigned presets and allow the pan and tilt unit to sequentially move to a preset in the tour, wait a defined period of time, move to the next preset in the tour, wait a defined period of time, etc. Tours will be continuously executed until a "STOP" or jog command is received or a command other than a status query is received. **If a fault occurs or a soft or hard limit is reached the tour will stop executing.**

Tours are built by first flushing the existing tour. This will reset the tour pointer to 0. The user then sequentially adds preset numbers (0-31) and wait times (0-255 secs) to each stop in the tour. Once built, the tour can be started using the "Start Preset Tour" command, selecting which tour to execute.

The user also has the capability to edit the preset tour using the "Append To Preset Tour", "Insert Into Preset Tour", "Delete From Preset Tour", and "Replace In Preset Tour" commands. The first command simply adds a preset to the end of the tour. The second allows the user to insert a preset into the tour while retaining the presets that follow. The third allows the user to remove a preset while retaining the presets that follow. In both cases, the presets that follow will be shifted up or down as required to keep the tour complete. The fourth command allows the user to replace a tour entry without disturbing the remaining tour entries. Note that the special "Home" preset 31 can be included in a tour.

Remote to PTR Start Preset Tour" Command:
This command allows the user to start either one of the three static preset tours or the dynamic preset tour. If the tour is empty FFH will be returned. See each type below for further tour information.

Data	Format	Bytes	
STX	02H	1	
Command	37H	1	
Tour Num	xxH	1	0-2 for static or 3 for dynamic
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Command	37H	1								
Tour Num	xxH	1	0-2 for static, 3 for dynamic, or FFH if selected tour is empty							
LRC	xxH	1								
ETX	03H	1								

Remote to PTR Flush Static Preset Tour Command:
The operator may completely clear a tour and ready it for building by using this command.

Data	Format	Bytes	
STX	02H	1	
Command	50H	1	
Tour Num	xxH	1	0-2
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	50H	1	
Tour Num	xxH	1	0-2
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Query Static Preset Tour Command:
The operator may examine the sequential steps of a tour by using this command. If the response returns FFH for the step number, the requested step does not exist in the tour.

Data	Format	Bytes	
STX	02H	1	
Command	51H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH)
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	51H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH) or FFH for all if the step does not exist
Preset Num	xxH	1	0-31 (0-1FH)
Wait Time	xxH	1	0-255 (0-FFH) seconds
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Append To Static Preset Tour Command:
The operator may append a preset to the tour by using this command. The step number returned by the response represents the tour position where the preset was saved. If FFH is returned the tour is full and the preset was not accepted.

Data	Format	Bytes	
STX	02H	1	
Command	52H	1	
Tour Num	xxH	1	0-2
Preset Num	xxH	1	0-31 (0-1FH)
Wait Time	xxH	1	0-255 (0-FFH) seconds
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	52H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH) or FFH for all if the current tour is full
Preset Num	xxH	1	0-31 (0-1FH)
Wait Time	xxH	1	0-255 (0-FFH) seconds
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Insert Into Static Preset Tour Command:
The operator may insert a preset into the tour by using this command. Any steps that follow the insertion will be moved out one step. If a step number of FFH is returned the tour is full and the preset was not accepted. If the step number returned is less than the step number sent the step did not originally exist and the new entry was appended to the tour.

Data	Format	Bytes	
STX	02H	1	
Command	53H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH)
Preset Num	xxH	1	0-31 (0-1FH)
Wait Time	xxH	1	0-255 (0-FFH) seconds
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	53H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH) or FFH for all if the current tour is full
Preset Num	xxH	1	0-31 (0-1FH)
Wait Time	xxH	1	0-255 (0-FFH) seconds
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Delete From Static Preset Tour Command:
The operator may delete a preset in the tour by using this command. Any steps that follow the deletion will be moved down one step. If a step number of FFH is returned the tour did not contain the step to be deleted.

Data	Format	Bytes	
STX	02H	1	
Command	54H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH)
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	54H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH) or FFH for all if the step does not exist
Preset Num	xxH	1	0-31 (0-1FH)
Wait Time	xxH	1	0-255 (0-FFH) seconds
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Replace In Static Preset Tour Command:
The operator may replace a preset in the tour by using this command. All other existing steps will be unaltered. If a step number of FFH is returned the tour did not contain the step to be replaced.

Data	Format	Bytes	
STX	02H	1	
Command	55H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH)
Preset Num	xxH	1	0-31 (0-1FH)
Wait Time	xxH	1	0-255 (0-FFH) seconds
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	55H	1	
Tour Num	xxH	1	0-2
Step Num	xxH	1	0-62 (0-3EH) or FFH for all if the step does not exist
Preset Num	xxH	1	0-31 (0-1FH)
Wait Time	xxH	1	0-255 (0-FFH) seconds
LRC	xxH	1	
ETX	03H	1	

PTR Operating Parameters:

Most parameters may be queried from the PTR. A reduced set of PTR parameters may also be modified through the remote interface.

Get/Set Pan & Tilt Angle Correction Command:
The pan & tilt unit is internally calibrated to reflect an absolute relationship between the bottom mounting plate, the enclosure, and the tilt frame. However, the situation may arise where the user wishes to offset the degree display. This may be a result of mounting orientation or the desired method of measuring. To correct the reading, the user may provide an offset value for the displayed pan and tilt coordinates. Entry of a positive offset will simply increase the respective degree display. Negative will decrease the degree display. Internal orientation will not change, only the displayed angle.

Sometimes it is beneficial to correct coordinate display for the platform relative to your point of reference. This can be manually performed by calculating and entering pan and tilt angle offsets. However, the "Align to Center" and "Align to Coordinate" commands listed below can be used to allow the PTR to perform these calculations for you.

Note that any change in pan and tilt offset will also modify the displayed position of presets, soft limits, etc. The relative angles will be correct, however. For example, assume a unit has a 0° tilt offset, the tilt frame is level at 0° and the preset will move it to -20°. Executing the preset move will move the tilt frame to -20°. If a +10° tilt offset is loaded a unit with a level tilt frame will display +10° and, after moving to the preset, -10° will be

displayed. The unit has still moved 20° relative to the unit. The displayed angle has been altered to accommodate for the offset. **Therefore, it is recommended that any modification of pan & tilt angle offset be followed by a reloading of the preset table and soft limits if normally displayed in your application.**

Remote to PTR Get Pan & Tilt Angle Correction Command:

Data	Format	Bytes
STX	02H	1
Command	70H	1
LRC	xxH	1
ETX	03H	1

Data	Format	Bytes	
ACK	06H	1	
Command	70H	1	
Pan Offset	Int	2	PAN = -1800 to +1800 = -180.0° to +180.0°
Tilt Offset	Int	2	TILT = -900 to +900 = -90.0° to +90.0°
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Set Pan & Tilt Angle Correction Command:
The PTR will check the input range of both pan and tilt angle corrections and will not save invalid entries.

Data	Format	Bytes
STX	02H	1
Command	80H	1
Pan Offset	Int	2
Tilt Offset	Int	2
LRC	xxH	1
ETX	03H	1

PAN = -1800 to +1800 = -180.0° to +180.0°
TILT = -900 to +900 = -90.0° to +90.0°

Data	Format	Bytes	
ACK	06H	1	
Command	80H	1	
Pan Offset	Int	2	PAN = -1800 to +1800 = -180.0° to +180.0°
Tilt Offset	Int	2	TILT = -900 to +900 = -90.0° to +90.0°
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Align To Center Command:
"Align To Center" will automatically calculate the pan and tilt angle corrections required to realign the angular position display for the platform so that the current position is considered a center position displaying a pan and tilt angle of 0°.

Data	Format	Bytes
STX	02H	1
Command	82H	1
LRC	xxH	1
ETX	03H	1

Data	Format	Bytes	
ACK	06H	1	
Command	82H	1	
Pan Offset	Int	2	PAN = -1800 to +1800 = -180.0° to +180.0°
Tilt Offset	Int	2	TILT = -900 to +900 = -90.0° to +90.0°
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Align To Coordinate Command: (Currently Not Implemented)
"Align To Coordinate" allows entry of the desired position to display. For example, if the platform were moved to point at an object and you desired the reading to be -10° in tilt and +160° in pan you would enter these figures. Pan and tilt corrections will be calculated and stored and the display will be updated to show the new coordinates of -10° in tilt and +160° in pan.

Data	Format	Bytes	
STX	02H	1	
Command	83H	1	
PAN Coord	Int	2	PAN = -1800 to +1800 = -180.0° to +180.0°
TILT Coord	Int	2	TILT = -900 to +900 = -90.0° to +90.0°
LRC	XxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	83H	1	
Pan Offset	Int	2	PAN = -1800 to +1800 = -180.0° to +180.0°
Tilt Offset	Int	2	TILT = -900 to +900 = -90.0° to +90.0°
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Clear Angle Corrections Command:
This command will reset any angular corrections to zero, realigning the platform angular display to the true 0/0 position.

Data	Format	Bytes
STX	02H	1
Command	84H	1
LRC	xxH	1
ETX	03H	1

Data	Format	Bytes	
ACK	06H	1	
Command	84H	1	
Pan Offset	Int	2	PAN = 0
Tilt Offset	Int	2	TILT = 0
LRC	xxH	1	
ETX	03H	1	

Get/Set Pan & Tilt Soft Limits Command:
The PTR can contain degree positions that, when exceeded, can stop platform travel. These values are referred to as software or soft limits. Soft limits act as redundant safety stops in addition to the hard limit switches. Soft limits

are normally set just inside the hard limits, making the soft limit the primary stop and the hard limit the redundant stop.

Though it would be possible to allow setting the soft limits by entering coordinates through the remote interface this feature has not been included in the interests of safety. We feel it is critical that the platform be observed while soft limits are being set in order to avoid collisions. Therefore, soft limits can only be set using a "move to and assign" method.

The user should jog the platform to the desired limit position, then send the command with the appropriate axis identified in order to set the soft limit. The user may override any existing soft limit by setting the OSL (Override Soft Limit) bit in the jog command. **This bit should only be used to assist in establishing soft limits.** The returned OSLR will show when this bit is set.

Note that any change in pan and tilt offset will also modify the displayed position of presets, soft limits, etc. The relative angles will be correct, however. Therefore, it is recommended that any modification of pan & tilt angle offset be followed by a reloading of the preset table and soft limits if normally displayed in your application.

Remote to PTR Get Pan & Tilt Soft Limits Command:

Data	Format	Bytes	
STX	02H	1	
Command	71H	1	
Axis Number	xxH	1	0 = CW, 1 = CCW, 2 = Up, 3 = Down
LRC	xxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	71H	1	
Axis Number	xxH	1	0 = CW, 1 = CCW, 2 = Up, 3 = Down
Soft Limit	Int	2	PAN = -3600 to +3600, TILT = -1800 to +1800
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Set Pan & Tilt Soft Limits Command:

Data	Format	Bytes	
STX	02H	1	
Command	81H	1	
Axis Number	xxH	1	0 = CW, 1 = CCW, 2 = Up, 3 = Down
LRC	xxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	81H	1	
Axis Number	xxH	1	0 = CW, 1 = CCW, 2 = Up, 3 = Down
Soft Limit	Int	2	PAN = -3600 to +3600, TILT = -1800 to +1800
LRC	xxH	1	
ETX	03H	1	

PTR Factory Setup Parameters:

Getting/Setting Pan & Tilt Potentiometer Center Position:

The pan & tilt unit uses precision potentiometers to track absolute position. A 12-bit ADC converts a voltage returned from each potentiometer to a digital value. Therefore, the possible range of values is 0-4095. Each potentiometer should be centered as closely as possible when the pan & tilt unit is at its midpoint of travel (tilt level, pan centered.) This will result in the best accuracy and reduce the chance of potentiometer damage due to over-travel.

A yellow indicator for each axis will illuminate when the potentiometer reading is within ±24 counts (approximately ± 2°) of the center of travel. When initially aligning the unit the potentiometer sprockets should be loosened, the pan & tilt unit should be moved to a center position using jog (with soft limit override as required), the potentiometers should be adjusted until each yellow indicator illuminates, then the sprockets should be tightened. The user should then command the PTR to save the potentiometer center positions. It is not critical that the potentiometers be exactly centered. The PTR is able to discount any offset. It is important that the potentiometers be near center in order to reduce the possibility of over-travel damage.

Setting the "RU" bit in the "Get Status/Jog" command will cause the PTR to return the current coordinates in resolver units, the raw ADC potentiometer readings, rather than angles. This can be very helpful when aligning the potentiometers to center.

The first command will allow the user to retrieve the current stored value for potentiometer center for each axis in resolver units. A properly aligned system will return values very close to 2048.

The second command will allow the user to command the PTR to read the potentiometers, then save the reading as the center positions. This should be performed immediately after the potentiometers have been aligned to the platform. The result will be re-aligned returned coordinates of 0°/0° (with companion 0°/0° angle offsets.)

Remote to PTR Get Pan & Tilt Potentiometer Center Position Command:

Data	Format	Bytes
STX	02H	1
Command	90H	1
LRC	xxH	1
ETX	03H	1

Data	Format	Bytes	
ACK	06H	1	
Command	90H	1	
Pan Count	Int	2	PAN = 0 - 4095
Tilt Count	Int	2	TILT = 0 - 4095
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Set Pan & Tilt Potentiometer Center Position Command:

Data	Format	Bytes
STX	02H	1
Command	91H	1
LRC	xxH	1
ETX	03H	1

Data	Format	Bytes	
ACK	06H	1	
Command	91H	1	
Pan Count	Int	2	PAN = 0 - 4095
Tilt Count	Int	2	TILT = 0 - 4095
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Get Minimum Speeds Command:
The following two procedures allow the user to retrieve and set the minimum motor speeds for pan and tilt. Nominal settings will be stored in the microcontroller for each type of QPT. However, if the user is operating with an extremely heavy load or has finer positioning requirements with a very light load, jog functions may be more responsive when minimum speed is adjusted. The values of 0-255 represent total motor speed range from no power applied to absolute top speed.

Data	Format	Bytes
STX	02H	1
Command	92H	1
LRC	xxH	1
ETX	03H	1

Data	Format	Bytes	
ACK	06H	1	
Command	92H	1	
Pan Speed	xxH	1	Speed = 0 - 255
Tilt Speed	xxH	1	Speed = 0 - 255
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Set Minimum Speeds Command:

Data	Format	Bytes	
STX	02H	1	
Command	93H	1	
Pan Speed	xxH	1	Speed = 0 - 255
Tilt Speed	xxH	1	Speed = 0 - 255
LRC	xxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	93H	1	
Pan Speed	xxH	1	Speed = 0 - 255
Tilt Speed	xxH	1	Speed = 0 - 255
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Initialize Preset Table to 0/0 Command:
This command initialize the entire preset table to 0°/0° (pan and tilt center) and set the auxiliary bytes to 0. This can be used at initial setup to quickly clear the entire preset table. Reload the table into your application as required after issuing this command. Though the PTR will quickly respond with a confirmation, **actual initialization can take up to 100ms to complete.**

Data	Format	Bytes
STX	02H	1
Command	94H	1
LRC	xxH	1
ETX	03H	1

Data	Format	Bytes
ACK	06H	1
Command	94H	1
LRC	xxH	1
ETX	03H	1

Remote to PTR Get/Set Motor and Potentiometer/Resolver Direction Command:
As the controller is fitted to different QPT types, motors and resolvers will be connected through different drive systems that may require reversing readings or direction of rotation in order to make them relate properly to the platform. As code is specifically written for each QPT type, "normal" and "reverse" operation will already be properly initialized at start-up. However, this command allows altering these standard directions of operation for the motors and resolvers on a test basis. Any changes made with this command will **not** be stored in EEPROM.

A device set for reverse operation is not necessarily an indication of miswiring or incorrect installation. It may simply be that the particular QPT type requires a motor or resolver to operate in the opposite direction due to design. For example, a cable belt drives the potentiometer on a QPT-20 directly from a sprocket mounted to the tilt drive gear. This means the potentiometer turns the same direction as the gear. However, on a QPT-130, the potentiometer is driven by a small spur gear meshing with the drive gear. This causes the potentiometer to turn in the opposite direction of the drive gear. One will be in "reverse" mode while the other will be in "normal" mode. Setting a bit to 0 will configure that device for the pre-defined "Normal" mode. Setting the bit to "1" will configure it for "Reverse" mode.

Data	Format	Bytes	7	6	5	4	3	2	1	0
STX	02H	1								
Command	95H	1								
Pan/Tilt	xxH	1				Query	TRES	PRES	TMTR	PMTR
LRC	xxH	1								
ETX	03H	1								

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Command	95H	1								
Pan/Tilt	xxH	1				Query	TRES	PRES	TMTR	PMTR
LRC	xxH	1								
ETX	03H	1								

Remote to PTR Get/Set Heater Configuration Command:
Some QPT units are fitted with heaters. As the PTR unit is normally used with low voltage DC systems the user may be limited as to the total power available for operating the unit, especially if operating from batteries. This command will allow the user to select an operating mode for the heater to match power availability as required. Option 1 will prohibit heater operation, reducing overall current draw. Option 2 and 3 will automatically cycle the heater as dictated by the on-board thermal sensor. However, in option 2 mode, a heater that is on will be turned off whenever the axis motors are operating, then be powered back on once motion has stopped. This limits instantaneous current draw. Option 3 will operate the heater as required concurrently with motor operation.

Data	Format	Bytes	
STX	02H	1	
Command	97H	1	
Config	xxH	1	0 = Query, 1 = No Heat, 2 = Share, 3 = Full Heat
LRC	xxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	97H	1	
Config	xxH	1	1 = No Heat, 2 = Share, 3 = Full Heat
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Get/Set Maximum Speeds Command:
The following two procedures allow the user to retrieve and set the maximum motor speeds for pan and tilt units. If the user is operating with an extremely heavy load jog and automated move functions may be more reliable when maximum speeds are adjusted. Adjustment of this value may also be performed if the user wishes to perform an automated move at a specific speed (plotting of antenna patterns, time-intensive image recognition, etc.) The values of 1-255 represent a motor speed range from minimum to absolute top speed. If the maximum speed is set to less than minimum speed (see command 92H/93H) the platform will run no slower than minimum speed. The platform normally ramps down to a speed of 80 when completing an automated move. If the maximum speed is less than 80, the maximum speed value will be used for ramp-down.

Data	Format	Bytes
STX	02H	1
Command	98H	1
LRC	xxH	1
ETX	03H	1

Data	Format	Bytes	
ACK	06H	1	
Command	98H	1	
Pan Speed	xxH	1	Speed = 1 - 255
Tilt Speed	xxH	1	Speed = 1 - 255
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Set Maximum Speeds Command:

Data	Format	Bytes	
STX	02H	1	
Command	99H	1	
Pan Speed	xxH	1	Speed = 1 - 255
Tilt Speed	xxH	1	Speed = 1 - 255
LRC	xxH	1	
ETX	03H	1	

Data	Format	Bytes	
ACK	06H	1	
Command	99H	1	
Pan Speed	xxH	1	Speed = 0 - 255
Tilt Speed	xxH	1	Speed = 0 - 255
LRC	xxH	1	
ETX	03H	1	

Remote to PTR Get/Set Communication Timeout Command:
The embedded controller's sole method of operating and providing feedback is via the communication interface. Timely return of position and status information is important for many applications. However, some applications exist where feedback is of little or no use. For example, if a QPT unit is used to simply move a camera through a series of presets for viewing, constant return of positional information may not be needed. The user is only

interested in the picture returned by the camera. In this case, the user may wish to simply load a tour into the unit, start execution of the tour, then remove the communication connection and allow the unit to "free run." As two-wire RS-485 starts being introduced into the PTR line it may not be possible or desired for a user's communications software to address all of the units in the communications daisy chain quickly. The capability to adjust or defeat the communication timeout value allows the user to assign a priority to the importance of constant communication.

Normally, a communication timeout is considered a fault of sufficient weight to stop any automated movement of the platform. If the data returned to the user's computer is critical, especially in determining the next move, the timeout should be set to a fairly low level (1-2 seconds.) If the user's software must share processing time and cannot service the QPT unit quickly a higher level can be set. If the user wishes the QPT to operate autonomously without the requirement for constant communication the user can set the timeout value for 0, defeating any stop due to a communication fault. Of course, all other faults will still remain active.

Setting the Query bit will instruct the PTR to return the current value without changing it. Clearing the Query bit will actually load the new value into the EEPROM and update the fault timer.

Data	Format	Bytes	7	6	5	4	3	2	1	0
STX	02H	1								
Command	96H	1								
Timeout	xxH	1	Query	0(defeat) - 120 seconds						
LRC	xxH	1								
ETX	03H	1								

Data	Format	Bytes	7	6	5	4	3	2	1	0
ACK	06H	1								
Command	96H	1								
Timeout	xxH	1	0	0(defeat) - 120 seconds						
LRC	xxH	1								
ETX	03H	1								

Revision History:

12/22/00 First Revision A

Rev B 01/02/01

1 Re-examined to also encompass use with the QPT-90 and QPT-130.

2 Addition of DES bit in status response to indicate that the returned coordinates reflect a destination as opposed to current position.

3 Shifted JOG direction bits from bit-7 to bit-0.

4 Reduced "Query Static Tour" to return only preset number instead of complete preset information.

5 Added information on integer-to-byte structure.

6 Corrected "Start Preset Tour" command from 36H to 37H

7 Shifted position of "Home" preset from FFH to 00H.

Rev C 01/11/01

1 Restructured soft limit get and set.

2 Addition of OSLR "Override Soft Limit Return" bit to status and move to responses.

Rev D 01/24/01

1 Removed return of 9999 for invalid automated move-to coordinates. This specifically effects commands 32H-34H. The PTR will always echo back the destination coordinates. If the unit is in fault it simply will not

move and the current position will be returned. The PTR will also not look forward to see if a soft limit will be exceeded but will execute the move.

2 Re-shifted position of "Home" preset from 00H to 1FH.

3 Clarified the ESC insertion to include any byte and the LRC but excluding the ACK/STX and ETX.

4 Added further range checking but also programmer's responsibility for range and format checking.

5 Corrected return values for automated move-to commands when in hard fault to the current position.

6 Corrected return values for invalid static tour manipulation.

7 Corrected the static tour range from 0-63 down to 0-62 for a total of 63 steps.

8 Added "RU" bit for resolver unit coordinate display.

9 Expanded static tour wait time from 0-99 to 0-255 seconds.

Rev E 02/08/01

1 Added motor and resolver reverse (95H) command. Note, however, that this command will NOT change the settings permanently in EEPROM and the unit will revert to its original settings at restart. This is essentially only for test use.

2 Added heater configuration command (97H).

3 Removed capability to get/set QPT type command (94H.) Embedded code for each unit will be QPT dependent.

4 Added command 94H to initialize the entire preset table to 0/0/0/0 for pan/tilt and aux bytes 1 and 2.

Rev F 06/15/01

1 Added get/set maximum speeds (98H/99H) command for stepper based units.

Rev G 08/23/01

1 Modified embedded controllers for brush motors to also accept get/set maximum speeds (98H/99H) command for stepper based units.

2 Started embedded code revision tracking at Rev 2.00. Fully compatible with Rev G protocol.

3 Adjusted maximum refresh rate from 50ms to 120ms.

Rev H 10/02/01

1 Added variable/defeatable communication timeout command (96H).

2 Added automatic baud rate detection at power up covering 9600, 14.4k, 19.2k, 28.8k, 38.4k and 57.6k.

3 Embedded code revision for Rev H starts at Rev 2.11.

Rev I Skipped

Rev J 10/26/01

1 Added high precision ($1/100^{th}$ degree) flag to general status bit 7. If clear the returned integer angles are all multiplied by 10 for $1/10^{th}$ degree resolution, i.e., 3600 = 360.0 degrees. If set the returned integer angles are all multiplied by 100 for $1/100^{th}$ degree resolution, i.e., 36000 = 360.00 degrees.

2 Added Appendix A with command changes for high resolution unit.

QPT-20 & QPT-90/130 Embedded Controller Protocol
Appendix A
Rev A

PTHR-90 Hi Resolution Overview:

The PTHR-90 controller PCB employees resolvers rather than potentiometers for higher accuracy and resolution. This allows the PTHR-90 to return angles to 1/100th degree as opposed to the 1/10th degree resolution provided by the PTR-20 and PTR-90. However, the original protocol and code for the embedded controllers was developed around the 1/10th degree figure. Therefore, to accommodate the higher resolution, some changes in command structure are required and a few limitations must be imposed.

Indication of High Resolution Unit:

Bit 7 of the general status bitset has been allocated for returning high resolution mode. If cleared, the unit is a standard resolution PTR-20 or PTR-90. If set, the unit is a high resolution PTHR-90. This bit should be read at startup and be stored for reference as not all return data packets that contain an angular value also contain the high resolution bit.

Angle Representation:

The integers required and returned for angle position for the high resolution unit will be the raw angle multiplied by 100, i.e. an angle of 180.00° will be represented as 18000. Conversely, any angular value sent to the PTHR-90 should also be converted to an integer representing the angle multiplied times 100.

Command Differences:

The following commands are listed in the same order as presented in the protocol documentation:

31H Remote to PTR Get Status/Jog Command

Outgoing: No Change
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
HRES Bit 7 of general status will be set.

32H Remote to PTR Move To Preset Command:

Outgoing: No Change
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
HRES Bit 7 of general status will be set.

33H Remote to PTR Move To Entered Coordinate Command:

Outgoing: The special "9999" value will not work to hold an axis stationary as "9999" is the valid coordinate 99.99°. User must read and return the current coordinate value to hold an axis stationary.
Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
HRES Bit 7 of general status will be set.

34H Remote to PTR M ove To Delta Coordinates Command:

Outgoing: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
HRES Bit 7 of general status will be set.

35H Remote to PTR Move To Absolute 0/0 Command:

Outgoing: No Change
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
HRES Bit 7 of general status will be set.

36H Remote to PTR Move To Home Command:

Outgoing: No Change
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
HRES Bit 7 of general status will be set.

40H Remote to PTR Retrieve Preset Table Entry Command:

Outgoing: No Change
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.

41H Remote to PTR Save Coordinates As Preset Table Entry Command:

Outgoing: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.

42H Remote to PTR Save Current Position As Preset Table Entry Command:

Outgoing: No Change
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.

43H Remote to PTR Add Aux Bytes To Preset Table Entry Command:

Outgoing: No Change
Incoming: Pan coordinates = -32700 to 32700 = -327.00° to 327.00°.
Tilt coordinates = -18000 to 18000 = -180.00° to 180.00°.

37H Remote to PTR Start Preset Tour" Command:

Outgoing: No Change
Incoming: No Change

50H Remote to PTR Flush Static Preset Tour Command:

Outgoing: No Change
Incoming: No Change

51H Remote to PTR Query Static Preset Tour Command:

Outgoing: No Change
Incoming: No Change

52H Remote to PTR Append To Static Preset Tour Command:

Outgoing: No Change
Incoming: No Change

53H Remote to PTR Insert Into Static Preset Tour Command:

Outgoing: No Change
Incoming: No Change

54H Remote to PTR Delete From Static Preset Tour Command:

Outgoing: No Change
Incoming: No Change

55H Remote to PTR Replace In Static Preset Tour Command:

Outgoing: No Change
Incoming: No Change

70H Remote to PTR Get Pan & Tilt Angle Correction Command:

Outgoing: No Change
Incoming: Pan offset = -14700 to 14700 = -147.00° to 147.00°.
Tilt offset = -9000 to 9000 = -90.00° to 90.00°.

80H Remote to PTR Set Pan & Tilt Angle Correction Command:

Outgoing: Pan offset = -14700 to 14700 = -147.00° to 147.00°.
Tilt offset = -9000 to 9000 = -90.00° to 90.00°.
Incoming: Pan offset = -14700 to 14700 = -147.00° to 147.00°.
Tilt offset = -9000 to 9000 = -90.00° to 90.00°.

82H Remote to PTR Align To Center Command:

Outgoing: No Change
Incoming: Pan offset = -14700 to 14700 = -147.00° to 147.00°.
Tilt offset = -9000 to 9000 = -90.00° to 90.00°.

84H Remote to PTR Clear Angle Corrections Command:

Outgoing: No Change
Incoming: No Change

71H Remote to PTR Get Pan & Tilt Soft Limits Command:

Outgoing: No Change
Incoming: Pan limit = -32700 to 32700 = -327.00° to 327.00°.
Tilt limit = -18000 to 18000 = -180.00° to 180.00°.

81H Remote to PTR Set Pan & Tilt Soft Limits Command:

Outgoing: No Change
Incoming: Pan limit = -32700 to 32700 = -327.00° to 327.00°.
Tilt limit = -18000 to 18000 = -180.00° to 180.00°.

90H Remote to PTR Get Pan & Tilt Potentiometer Center Position Command:

Outgoing: No Change
Incoming: Pan Count = -32768 to 32767.
Tilt Count = -32768 to 32767.

91H Remote to PTR Set Pan & Tilt Potentiometer Center Position Command:

Outgoing: No Change
Incoming: Pan Count = -32768 to 32767.
Tilt Count = -32768 to 32767.

92H Remote to PTR Get Minimum Speeds Command:

Outgoing: No Change
Incoming: No Change

93H Remote to PTR Set Minimum Speeds Command:

Outgoing: No Change
Incoming: No Change

94H Remote to PTR Initialize Preset Table to 0/0 Command:

Outgoing: No Change
Incoming: No Change

95H Remote to PTR Get/Set Motor and Potentiometer/Resolver Direction Command:

Outgoing: No Change
Incoming: No Change

97H Remote to PTR Get/Set Heater Configuration Command:

Outgoing: No Change
Incoming: No Change

98H Remote to PTR Get/Set Maximum Speeds Command:

Outgoing: No Change
Incoming: No Change

99H Remote to PTR Set Maximum Speeds Comma nd:

Outgoing: No Change
Incoming: No Change

96H Remote to PTR Get/Set Communication Timeout Command:

Outgoing: No Change
Incoming: No Change

Revision History:

11/01/01 First Revision A

11/02/2001 MN00056