Type 436

PAN & TILT HEAD

TECHNICAL MANUAL

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ISSUE 2

Vinten RADAMEC BROADCAST ROBOTICS

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Foreword

This manual provides full and detailed maintenance and spare parts information for the Vinten Radamec Broadcast Robotics Type 436 Pan and Tilt Head.

WARNING!: Read the Safety Section on page 7 before using this head or attempting any adjustment or repair.
Maintenance and repair beyond that detailed in this manual should be carried out only by authorised and trained personnel.

It is recommended that this manual is read carefully and the illustrations studied prior to operating or servicing the head. Attention to the details contained herein will ensure that the head will operate efficiently with the minimum of attention over a long service life. Particular attention must be paid to cleaning, especially after use in adverse conditions.

To order spare parts or to obtain further information, application should be made to Vinten Broadcast Limited or to your local distributor, or visit our website at **www.vinten.com**.

NOTE: Information contained in this document is subject to change.
Vinten Broadcast Ltd reserves the right, without notice, to make changes in equipment design or performance as progress in engineering, manufacturing or technology may warrant.

Safety - Read This First!

Warning symbols in this maintenance manual

Where there is a risk of personal injury, injury to others, or damage to the pedestal or associated equipment, comments appear, highlighted by the word **WARNING!** and supported by the warning triangle symbol.

Warnings

WARNING!: There are high voltage sources in the units, do not connect to a power source with the covers removed

The motor mechanisms controlling the camera position are high-powered. Keep fingers clear.

There is a risk of injury from remotely controlled equipment. Warn personnel to stand clear.

Before operating the system, ensure that the camera equipment and attachments are properly secured.

Critical data

Mass

Mass . . . . . 25 kg (55 lb)

Maximum pan and tilt head load

436 . . . . . 50 kg (110 lb)

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Section 1

Introduction

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General

1 The 436 is the latest generation of pan and tilt head designed to support ENG/EFP cameras, lenses and teleprompters. It combines high performance remote control technology with a unique system of electronic clutches enabling it to instantly switched to a fully manual head if programme needs demand. Adjustable fluid damping is provided as standard for both the pan and tilt axes to provide a perfect feel when used manually.

Section 2

Specification

Type 436 Pan and Tilt Head

NOTE: Figures relate to both pan and tilt functions unless otherwise stated

Mechanical travel - pan	350°
Mechanical travel - tilt	±45°
Weight of Head	25 kg approx. (55lb)
Maximum payload	50 kg (110 lb.)
Resolution, pan and tilt	81,000 pulses / 360°

Section 3

Handling and Installation

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Handling

1 Prior to shipment, the four mounting studs are removed from the base flange of the pan and tilt head. The head is then packed with the tilt platform in its mid-position with the locking pin in place and such that the brake knobs are protected from damage.

2 The brakes are left free to prevent shock loads being transmitted to the gearing should the head be roughly handled during transit.

3 It is recommended that this procedure be adopted should it be necessary to de-rig the head for shipment to a new site.

Installation

Mounting the head

4 The type 436 pan and tilt head may be mounted in either the upright or inverted position on a suitable surface, ceiling plate, column or pedestal, having four equally spaced 10.5mm diameter clearance holes on a 111 mm pitch circle diameter.

5 Fit the four mounting studs into the base flange of the head. This can be done by locking a pair of nuts onto each stud in turn and tightening them fully with a spanner. Studs must be fitted with their short threaded end screwed into the base flange of the head.

NOTE: When not using the studs supplied, ensure that screws used will not be longer than the thickness of the base. Severe damage to the main bearing can occur if this instruction is not followed.

6 With the pan brake free, manually rotate the base flange to establish its mid-position, indicated by matching the red dot on the pan base with the red dot on the head casing and having set it there, lock the pan brake.

7 Offer up the head to its mounting face and enter the studs into the clearance holes, such that the camera will face in the desired direction at its mid-travel point. Fit the four 3/8" nuts and lock washers to the studs and fully tighten them.

Mounting the camera

8 Where the camera/lens system is supplied with its own support plate, it may be possible to attach this assembly directly to the tilt platform. However, it is likely that an intermediate plate will be required, having tapped holes positioned so that the centre of gravity of the system can be brought as near as practical into line with the tilt axis, using the slots provided in the tilt platform.

9 It is recommended that the camera, lens and mounting plate be assembled as a unit and the approximate longitudinal position of the centre of gravity established before fitting to the pan and tilt Head. An attempt should also be made to estimate the height of the centre of gravity of the system, including pan bar and lens controls if these are to be fitted.

10 Loosen the three hex, socket screws securing the tilt platform to tilt flange and raise it to bring the estimated vertical position of the camera/lens centre of gravity in line with tilt axis and tighten the three socket screws.

11 For efficient control, it is essential that the whole load including the cables, be properly balanced about the tilt axis.

12 Connect the cables at the Head only and dress them to impose minimum drag while allowing full pan and tilt movement.

Switching on

13 With power off, remove the tilt-locking pin and transfer it to its storage position on the side of the head.

14 Release the pan and tilt brakes and set the pan and tilt dampers to minimum. Plug in the head cable and switch on the power.

15 Switch the head to Remote mode using the Local/Remote switch on the front panel of the Lens I/F Unit (or Mini Head Control Unit), which is mounted on the side of the head. Ensure that the indicator on the side of the head is illuminated confirming that the head is indeed under remote control.

16 A small movement may be observed in the pan and tilt head axes. If this is greater than 5 degrees in either pan or tilt, then there is a fault in the system.

17 Run tilt slowly from end to end and check that it does not hit its mechanical end stops. It should be noted that pan does not have a mechanical end-stop, the travel being limited electrically. Although this can be fitted at the factory by special customer order.

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Maintenance

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WARNING!: Remotely-controlled equipment may move suddenly and without prior warning. Stand well clear at all times.
Dangerous mechanisms in pan & tilt head. Keep fingers well clear.
Before mounting/demounting the camera, ensure the tilt locking-pin is engaged and pan brake is applied.
Plastic track precision potentiometers can be damaged by excess current. Use only ohmmeters having a short-circuit rating of less than 10ma.
Do not attempt to run the system unless the head is fully secured.

NOTE: Nuts and screws are metric sizes unless otherwise stated.

Mechanical maintenance

List of Tools

1 Normal workshop tools (Note that nuts and screws are metric sizes unless otherwise stated).

2 Digital multi-meter (short circuit current of resistance range less than 10mA).

3 Power Supply 0-30V dc @ 2A.

Fault diagnosis

4 Erratic, jerky or noisy operation, particularly in tilt, is most likely to be caused by incorrect balancing of the camera/lens system. Check and correct if necessary.

5 When switched to 'Local' mode, or with the power switched off, both pan and tilt can be operated manually to determine if the problem is mechanical. If this is shown to be the case, then rectify accordingly.

6 Erratic and jerky operation can also be caused by the following:

6.1 Noisy demand signal.

6.2 Noisy positional feedback potentiometer. Check and replace if necessary.

6.3 Faulty motor or tacho. Check and replace if necessary.

6.4 Loose timing belt drives. Check and tighten if necessary.

Dismantling the head

7 Fit the tilt locking pin, set pan to its mid position by lining up the red dots on the pan base and the main casting, and apply the pan brakes. remove the payload so that if necessary, the head may be transferred to a suitable working area.

8 All adjustments and replacements on tilt (except changing the motor) can be carried out by just removing the back cover. To change the tilt motor or carry out any work on pan, the main and base castings must also be separated.

9 A total of twelve M5 Hex socket screws (including four which secure it to the base casting) hold the back cover in position. A further eight of these screws are used to fix the base and main castings together. However, before any castings can be separated, the brake knobs must be removed by undoing the screw at their centres. Note that removal of the load platform, after marking its position, will make the main casting easier to handle.

Replacement a motor/tacho

10 Replacing a motor/tacho is very similar for both pan and tilt. In both cases, the back cover must be removed and the main and base castings separated as described previously. Note the colour and position of the motor and tacho wires and then un-solder them from the interference suppression PCB.

11 The motor/tacho may now be removed together with its mounting plate or bracket after first removing the four M5 hex socket screws and washers holding it in place. Note the position of the motor terminals and then separate the motor and its plate or bracket by removing the four M4 hex. socket screws and washers.

12 After noting the position, the toothed pulley may be removed from the motor shaft and fitted to the shaft of the new motor/tacho.

13 The new motor/tacho may now be fitted to its plate or bracket and replaced in its position in the base casting of the head. Shorten the motor and tacho wires and connect them to the interference suppression pcb. In the case of tilt, pay particular attention to how the wires are tied off on the motor and ensure that the arrangement on the new motor is identical.

14 When replacing the pan motor/tacho, fit the belt around the pulley's and adjust the belt tension by moving the motor/tacho and its mounting plate and lock them in position by tightening the M5 hex. socket screws holding the plate in position. The tilt belt cannot be fitted or tensioned until the main and base-casting are re-assembled. This re-assembly is a reversal of the procedure described previously.

15 With the tilt belt fitted around its pulley's, tensioning is achieved by moving the motor/tacho up and down on its bracket and finally tightening the M4 hex. socket screws which hold it to its bracket. The belt is correctly tensioned when there is approximately 3mm (pan) or 4mm (tilt) of lateral movement of the belt at the mid point between the pulley's.

16 After re-assembly, the head may now be returned to service.

Replacing an electro-magnetic clutch

17 When replacing an electromagnetic clutch no special gauges are required to set up the clutch gap. However, it is most important NOT to remove the spacer collar from its axis, either pan or tilt. This collar has been adjusted on assembly to ensure the correct clutch gap is achieved on its particular axis.

18 Having gained access to the head, replacing either a pan or tilt clutch is a very similar procedure, except that the pan clutch wires must be disconnected from the clutch drive PCB while the tilt wires must be disconnected from the terminal block. It should be noted that these wires are not polarised.

19 Loosen the arm locating the clutch coil, and swing it out of the way. Undo the four grub screws (two M5 and two M4) holding the clutch body to the shaft and pull the complete rotor/coil assembly off the shaft. Remove the clutch armature by undoing the three slotted screws holding it to the pulley. Do not remove the spacer collar on the shaft. Carefully remove any grub screw burrs from the shaft with a fine file.

20 Fit the new clutch armature plate to the pulley with the three slotted screws or new ones if provided. Slide the new clutch rotor/coil assembly onto the shaft so that it is against the spacer collar. Holding the ring of the coil at the coil end of the assembly, tighten the two M5 grub screws while ensuring that there is minimum end float, but also ensuring that the coil is free to rotate on the shaft. Next the two M4 grub screws should be tightened and if the coil tends to bind, repeat the tightening procedure until a satisfactory result is obtained.

21 Before fitting the coil-locating arm, carefully squeeze the arms of the coil lug together to reduce the free movement between the lug and the locating pin in the arm. On the final assembly, the arm may be rotated slightly until the pin is at a point in the lug where rotational movement of the coil is almost imperceptible. Note however, that there must be a tiny amount of slack or manual operation of the head will not be smooth.

22 The air gap between the rotor and the armature should be 0.2mm. It remains to re-connect the clutch wires as appropriate and after re-assembly, the head may be returned to service.

Routine Maintenance

23 The bearings are greased for life with Rocol MTS 1000, but the occasional application of a little light grease such as Alvania, to the teeth of the timing belts will help to ensure quiet operation. Ensure that no grease contaminates the clutches.

24 It may eventually be necessary to replace motor or tacho brushes, but this will only be after a very long period of service.

25 Should any undue noise or vibration occur, it should be investigated immediately.

Section 5

Internal serial position interface

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Configuration

1 The set-up menu is accessed via a simple 3-button interface (Fig 5.1): (S) "Select", (L) "Left" and (R) "Right". The data is displayed on an 8-character LED display. The buttons are accessed by inserting a small non-conducting rod through the three holes in the casing next to the display.

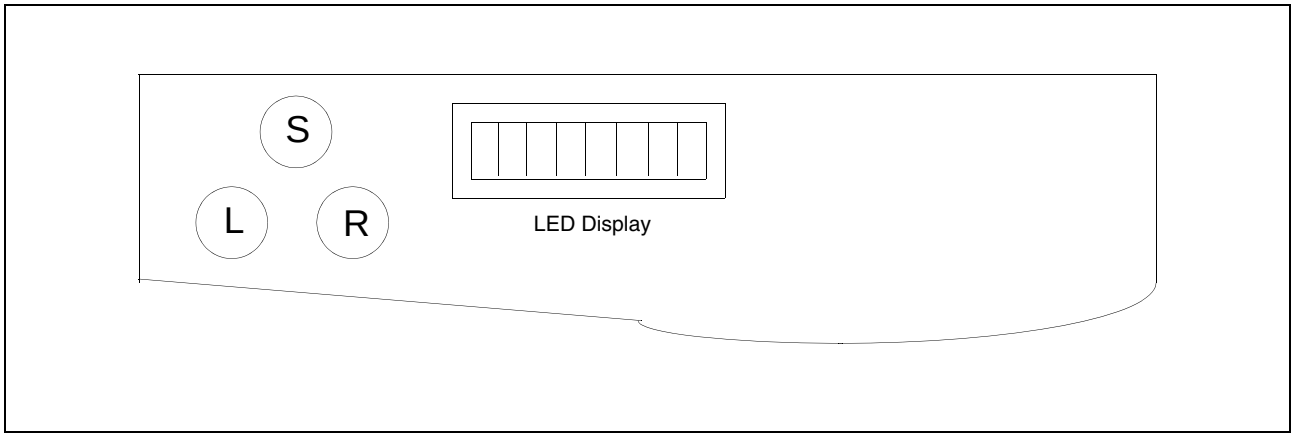

Fig 5.1 Set-up Menu

Power up display

2 Software <version number> is displayed for one second after power up.

Positional information menu

3 Press (L) and (R) to cycle through the following data:

3.1 <Pan Angle> - <Tilt Angle> - <Zoom Value*> - <Focus Value> - <X> - <Y> - <H>

NOTE: When the [AA] block is selected the zoom display is replaced with lens angle in degrees.

Example display:

Item	Example Display	Units
<Pan Angle>	P 100.50	Degrees
<Tilt Angle>	T -30.50	Degrees
<Zoom Value>	Z 2110	none
<Lens Angle>	L 4.00	Degrees
<Focus Value>	F 9552	none
<X>	X 0000	Millimetres
<Y>	Y 0000	Millimetres
<H>	H 0000	Millimetres

Set-up menu

4 Press (S) to enter the Setup Menu from the Positional Information Menu.

5 Press (L)eft or (R)ight to cycle through the options, and (S)elect to edit the following options:

5.1 **<Info> -** <version no.> - <date> - <s/w name>

5.2 **<Baudrate> -** <38.4K> - <115.2K>. This is the Baudrate of the RS422 serial port sending the position data.

5.3 **<Data Block> -** <A0> - <A2> - <A6> - <A8> - <AA>. This selects the protocol of the transmitted data block. (See Section 4.0)

5.4 **<Camera> -** <1 to 16>. This is the Camera number that is transmitted in the data block.

5.5 **<Pan mount> -** <Normal> - <Reversed>. This is defined as the position of the pan axis housing when standing behind the camera. Its effect is to reverse the pan direction and is required whenever the camera is reverse mounted (in the ceiling perhaps).

5.6 **<Tilt mount> -** <Left> - <Right>. This is defined as the position of the tilt axis housing when standing behind the camera. Its effect is to reverse the tilt direction and is required whenever the camera is mounted on the head pointing in the opposite direction.

5.7 **<Zoom mount> -** <Normal> - <Reversed>. Occasionally it is necessary to use an intermediate gear wheel when mounting the zoom and focus encoders. This menu item corrects for this by allowing the zoom direction to be reversed.

5.8 **<Focus mount> -** <Normal> - <Reversed>. This menu item allows the focus direction to be reversed.

5.9 **<Test> -** <GL> - <PC> - <RP> - < RBU>. Diagnostic data.

5.9.1 <GL> "GL 12345" Genlock pulse count. Used as a diagnostic aid to ensure that the unit is correctly detecting a Genlock signal. For a 50Hz frame rate the Genlock count should increment by 50 every second.

5.9.2 <PC> "PC 12345" This works like the Genlock, but instead counts the number of poll requests received from the PC.

5.9.3 <RP> "RP 12345" This counts the number of data packets received from the RP2 robot, if connected.

5.9.4 <RBU> "RBU 00" Tests the Frame and Engage buttons on the RBU (Remote Button Unit)

5.10 **<Exit> -** Press (S) to take you back to the Positional Information Menu.

General

Camera ID number and the RBU

6 The Camera ID can be set up from the setup menu. It is transmitted with all block types and may be used by the receiving software to identify the head.

7 The Remote Button Unit (RBU) is a unit that fits onto the pan bar and plugs into the head. It has two buttons labelled "Full Frame" and "Engaged"; the Engaged button is fitted with an LED.

8 The Camera ID and the RBU button status are transmitted in the packets as a single byte with bits 0:4 used for the Camera ID, bit 6 for the Engage button, and bit 7 for the Full Frame button. Bit 5 is reserved. The button bits are normally 0 and will change to a 1 each time the button is pressed.

Checksum

9 The checksum is calculated by subtracting the total sum of each byte of the block from 40H.

Zoom and focus readings

10 The Zoom and Focus values are expressed as a 24-bit number in arbitrary units related to the rotation of the 'zoom or focus ring' on the camera lens. It will be necessary for the host system to convert this to a true zoom or focus value based on the type and particular sample of lens and camera in use.

11 The zoom and focus values do not retain their readings after a power cycle. To obtain absolute positions the lens must be initialised on start up by the operator moving the lens fully to one end stop (usually zoom fully telephoto and focus at infinity) and the host VR software records reference readings at this position. These reference readings are then subtracted from all further zoom and focus readings to give an absolute position.

12 However the [AA] packet treats zoom and focus differently as it uses the built in lens calibration facility. See the section on the [AA] packets for more information.

SPI (Serial Positional Interface) compatibility

13 Unlike the previous SPI box, the 436 head has no index pulses on pan and tilt, as the correct angles are retained after a power cycle. It is now no longer necessary to pan and tilt the head through the index pulses on power up. The unit is factory calibrated so that zero pan angle is when the two red dots on the base of the head line up and tilt is zero when the camera is level.

14 The old [A1], [A3] and [A5] SPI packets are no longer supported.

Power up self-test

15 On power up the unit runs through a comprehensive self-test routine. If a fault is detected during the checking then an error number will start flashing on the display as follows:

Error ID	Description
1,3,5	Fault with the Pan encoder
2,4,6	Fault with the Tilt encoder
7,8,9	Fault on the main circuit board
10	The configuration EEROM has not been initialised
11	The configuration EEROM is corrupted
12	The configuration EEROM is out of date
14 - 21	Fault on the main circuit board
>100	Internal software error

16 The error message can be cleared from the display by pressing (S)elect but this will NOT clear the actual error. If an error occurs please make a note of the error number and then power cycle the unit. If the problem persists seek advice from the manufacturer.

Appendix A

Block Types

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Type [A2] - Position data (including X,Y and height) 8

Type [A6] - Position data (including X,Y and height) 14

Type [A8] - Position data scaled in degrees. 18

Type [AA] - Position data with lens factor 22

1 Several basic block types have been defined, which are identical to the operation of the SPI interface:

A0	Position data excluding X,Y and Height
A2	Position data including X,Y (includes fractional mm),height
A4	Command (Poll)
A6	Position data including X,Y (no fractional mm),height

2 Two new block types have been defined with more intuitive scaling, in degrees, and are recommended for new systems:

A8	Position data in degrees
AA	Position Data with lens calibration factor

3 An emulation of the Free-d packet type is also provided:

D1	Free-d Data packet

Type [A0] - Position Data (excluding X Y and Height)

4 The [A0] block is used for transferring the current position of Pan, Tilt, Zoom and Focus. Each axis position data is transmitted as 24 bit numbers most significant byte first.

5 The [A0] block contains 15 bytes as follows:

Item	Bytes	Description
<HEADER>	1	The Packet Header is [A0] hexadecimal
<CAMERA>	1	Bits 0:4 Camera Number, Bit 5 reserved,bit 6 Engage button, bit 7 Full frame button

Item	Bytes	Description
<PAN>	3	Camera Pan Angle in units of 1/900 degree
<TILT>	3	Camera Tilt Angle in units of 1/900 degree
<ZOOM>	3	Camera Zoom ring position in encoder counts
<FOCUS>	3	Camera Focus ring position in encoder counts
<SUM>	1	Sum of all previous bytes subtracted from 40H

6 The Pan and Tilt position are given in 1/900 of a degree increments with 0° degrees represented by 07FFFFH in HEX. These numbers run between -179.99° (05872EH) to +180° (0A78CFH).

7 The Zoom and Focus positions are given as raw encoder counts starting at 7FFFFH. The readings are relative positions from the starting position after power-on. To obtain absolute positions the user must move the zoom and focus to an end stop and the host VR software recording reference readings at this position.

Type [A2] - Position data (including X,Y and height)

8 The [A2] block is similar to the [A0] block above, with the addition of robotic pedestal position X,Y, Height and Orientation.

9 The [A2] block contains 30 bytes as follows:

Item	Bytes	Description
<HEADER>	1	The Packet Header is [A2] hexadecimal
<CAMERA>	1	Bits 0:4 Camera Number, Bit 5 reserved,bit 6 Engage button, bit 7 Full frame button
<PAN>	3	Camera Pan Angle in units of 1/900 degree
<TILT>	3	Camera Tilt Angle in units of 1/900 degree
<ZOOM>	3	Camera Zoom ring position in encoder counts
<FOCUS>	3	Camera Focus ring position in encoder counts
<HEIGHT>	3	Camera Height in units of 1/82.2 mm
<X FRACTION>	2	X fraction of mm position
<X INTEGER>	2	X integer of mm position
<Y FRACTION>	2	Y fraction of mm position
<Y INTEGER>	2	Y integer of mm position
<ORIENTATION>	2	Orientation angle of the pedestal in 1/100° increments.
<STATUS>	2	Status word of bit flags - Not used
<SUM>	1	Sum of all previous bytes subtracted from 40H

10 See [A0] block for descriptions of Pan Tilt Zoom and Focus values.

11 The Height is expressed as a 24-bit integer in units of 1/82.2 mm. The range of values is from -102,051.2 mm (800000 hex) to +102,051.2 mm (7FFFFF hex). Height is also referred to as the Z position.

12 The X-Position and Y-Position are expressed in units of millimetres as a 16-bit integer part and a 16-bit fractional part. The range of values is from -32,768 mm (integer part 8000 hex, fractional part 0000hex) to almost +32,768 mm (integer part 7FFF hex, fractional part FC00hex).

13 Example: If the X, Y, and orientation values were 2550.5mm,1560.75 and 5° then the pedestal information sent would be:

< X FRACTION >	= 80H, 00H
< X INTEGER >	= 09H, F6H
< Y FRACTION >	= BFH, FFH
< Y INTEGER >	= 06H,18H
< ORIENTATION >	= 01H, F4H

Type [A6] - Position data (including X,Y and height)

14 The [A6] block is similar to the [A2] block above, with the exclusion of fractional measurements of X and Y position. This is intended to reduce the length of the message.

15 The [A6] block contains 26 bytes as follows:

Item	Bytes	Description
<HEADER>	1	The Packet Header is [A6] hexadecimal
<CAMERA>	1	Bits 0:4 Camera Number, Bit 5 reserved,bit 6 Engage button, bit 7 Full frame button
<PAN>	3	Camera Pan Angle in units of 1/900 degree
<TILT>	3	Camera Tilt Angle in units of 1/900 degree
<ZOOM>	3	Camera Zoom ring position in encoder counts
<FOCUS>	3	Camera Focus ring position in encoder counts
<HEIGHT>	3	Camera Height in units of 1/82.2 mm
<X INTEGER>	2	X integer of mm position
<Y INTEGER>	2	Y integer of mm position
<ORIENTATION>	2	Orientation angle of the pedestal in 1/100 degree.
<STATUS>	2	Status word of bit flags - Not used
<SUM>	1	Sum of all previous bytes subtracted from 40H

16 See [A0] block for descriptions of Pan Tilt Zoom and Focus values.

17 See [A2] block for a description of the Height Value.

Type [A8] - Position data scaled in degrees.

18 The [A8] message block contains 25 bytes as follows:

Item	Bytes	Description
<HEADER>	1	The Packet Header is [A8] hexadecimal
<CAMERA>	1	Bits 0:4 Camera Number, Bit 5 reserved,bit 6 Engage button, bit 7 Full frame button
<ZOOM>	3	Camera Zoom ring position in encoder counts
<FOCUS>	3	Camera Focus ring position in encoder counts
<PAN>	3	Pan angle in units of 1/1000 degree (-180000 to 179999)
<TILT>	3	Tilt angle in units of 1/1000 degree (-180000 to 179999)
<ROLL>	3	Roll angle in units of 1/1000 degree (-180000 to 179999)
<X>	2	X position in mm (-32768 to 32767)
<Y>	2	Z position in mm (-32768 to 32767)
<HEIGHT>	2	Height in mm (0 to 32767)
<COUNT>	1	Number of packets transmitted modulus 256. (0 to 255)
<SUM>	1	Sum of all previous bytes subtracted from 40H

19 The zoom and focus readings are relative positions from the starting position after power-on. To obtain absolute positions the user must move the zoom and focus to an end stop and the host VR software records reference readings at this position.

20 The <PAN> <TILT> and <ROLL> outputs are signed 24-bit integer values in units of 1/1000 degree, with zero degrees corresponding to the position of the camera when the red dots line up on the Pan and Tilt head. The <Roll> output will normally be zero and is provided for future compatibility only.

21 The <X> <Y> <Z> outputs are all signed 16-bit integer value in unit of mm and will only change from zero when connected to a Radamec Robotic Pedestal.

Type [AA] - Position data with lens factor

22 This message block contains 25 bytes as follows:

Item	Bytes	Description
<HEADER>	1	The Packet Header is [AA] hexadecimal
<CAMERA>	1	Bits 0:4 Camera Number, Bit 5 reserved,bit 6 Engage button, bit 7 Full frame button
<LENS FACTOR>	3	Lens factor as 1/1000 percent (1 to 8388607)

Item	Bytes	Description
<FOCUS FACTOR>	3	Focus factor as 1/(1/100 per mm) (0 to 1000000)
<PAN>	3	Pan angle in 1/1000 degree (-180000 to 179999)
<TILT>	3	Tilt angle in 1/1000 degree (-180000 to 179999)
<ROLL>	3	Roll angle in 1/1000 degree (-180000 to 179999)
<X>	2	X position in mm (-32768 to 32767)
<Y>	2	Z position in mm (-32768 to 32767)
<HEIGHT>	2	Height in mm (0 to 32767)
<COUNT>	1	Number of packets transmitted modulus 256. (0 to 255)
<SUM>	1	Sum of all previous bytes subtracted from 40H

23 The <LENS FACTOR> represents a zoom multiplication factor and is related to the horizontal lens angle using the following equation.

24 Horizontal lens angle = 2*atan (100000/<LensFactor>)

25 So for example a lens factor of 100000 (100%) corresponds to horizontal lens angle of 90 degrees, and a lens factor of 241421 (241%) corresponds to a horizontal lens angle of 45 degrees.

26 The <FocusFactor> is the inverse of the distance in units of 1/100 millimetres between the subject and the camera, with zero corresponding to the lens focused on infinity and 100000 when the lens is focused on a subject 1 metre away. The <FocusFactor> is provided for virtual reality systems that have a defocus control.

27 A valid lens angle or focus depth of field is only available after power-up when the lens has been moved to the telephoto end stop, and focus is set to infinity. The use of the built in lens calibration requires the use of an external software package that runs on a laptop connected to the head. Once the calibration process is complete the head stores the lens calibration information and the laptop is no longer required. Please contact Radamec for further information and availability.

28 The <Pan> <Tilt> and <Roll> outputs are signed integer values in units of 1/1000 degree, with zero degrees corresponding to the position of the camera when the red dots line up on the Pan and Tilt head. The <Roll> output will normally be zero and is provided for future compatibility only.

29 The <X> <Y> and <Z> outputs are all signed 16-bit integer values in units of mm and will only change from zero when connected to a Radamec Robotic Pedestal.