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INTRAC™-505

INTELLIGENT TRACKING ANTENNA CONTROL UNIT
(including Dual Redundant option)

INSTALLATION & USER MANUAL

ISSUE 4.2

Advantech AMT Ltd
39 Edison Road
St Ives
Cambridgeshire PE27 3LF
England

☎	UK General Enquiries	01480 357600
☎	International General Enquiries	+ 44 1480 357600
Fax	UK 01480 357601	International + 44 1480 357601
e-mail	sales.europe@advantechwireless.com	
Website	http://www.advantechwireless.com	

PREFACE

This equipment manual provides user/operational and installation information on the Advantech AMT Ltd INTRAC-505 Satellite Tracking Antenna Controller.

MANUAL SECTIONS :-

Introducing the INTRAC-505	An overview of the INTRAC-505 and INTRAC-505 basic systems.
Safety	Safe usage of the INTRAC-505.
Specification & Options	The supplied specification, the fitted options and the available options.
Operating the INTRAC-505	How to use and operate the INTRAC-505.
Alarms	A description of the alarm conditions which can occur.
Technical Description	A technical description of the operation of the INTRAC-505.
Installation	How to install and set-up an INTRAC-505 system, includes information on the external connections to the INTRAC-505 and details of the Motor Drive Cabinet.
Fault Finding	Assistance in finding any faults which may arise.
Warranty and Repair Information	Warranty and repair service provided by Advantech AMT Ltd.
Appendices	Various information, some installation specific.

SUBJECT **PAGE**

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SUBJECT **PAGE**

INTRODUCING THE INTRAC-505

The INTRAC-505 INtelligent TRacking Antenna Controller is a microprocessor based controller for tracking any nominally geostationary satellite including those at low elevation or with high angles of inclination. The tracking antenna is positioned on the satellite by a motor drive cabinet which is controlled by the INTRAC.

The INTRAC-505 builds a model of the satellite's orbit using a mathematical algorithm. To build the orbit model the INTRAC makes measurements by perturbing the antenna pointing angle very slightly and monitoring the change in received beacon signal strength. These small movements enable the INTRAC to estimate the position of the satellite and this estimate is used by the modelling algorithm.

The system always tracks the satellite from the model. The small movements of antenna pointing are used to maintain and update the model.

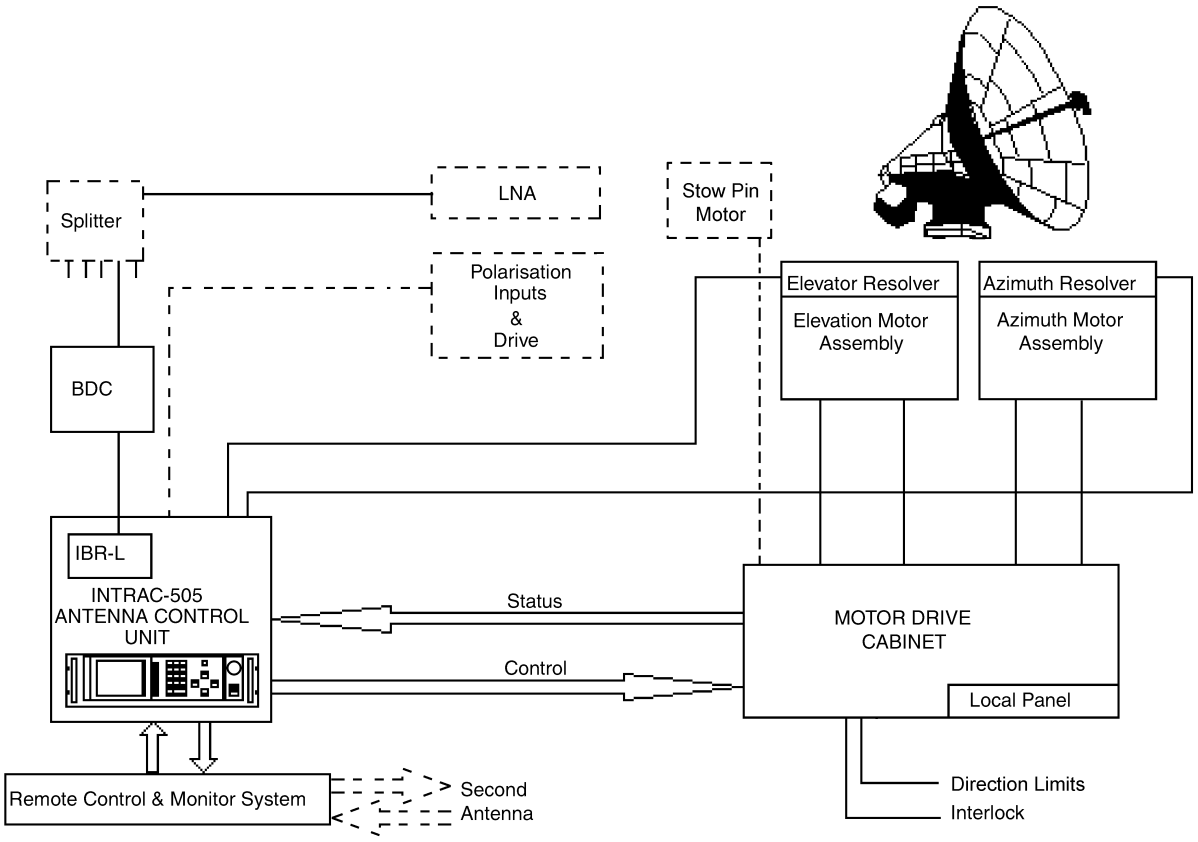
By using the model to point the antenna the INTRAC system ensures that the antenna is always pointed accurately at the satellite. This is in contrast to Step Track systems where the antenna spends most of the time not actually pointing directly at the satellite.

The regular measurements made by the INTRAC ensure that changes in the apparent orbit, due to station keeping manoeuvres or other causes, are identified. The model is modified and refined to incorporate these changes and accurate tracking is automatically maintained. The INTRAC will automatically increase the measuring rate if necessary in order to obtain sufficient information on the changing orbit.

As the INTRAC tracks using its orbit model it will continue to track the satellite if the tracking signal is degraded or lost. The satellite position may be accurately predicted from the model for up to 72hrs without a tracking signal.

The INTRAC system provides this exceptional tracking performance and robustness for satellites with any inclination, at any look angle, even in the presence of severe beacon signal degradation entirely automatically. No operator intervention or parameter setting is required when conditions or satellites are changed.

A Typical System



The antenna position resolvers provide direction information to the INTRAC. The IBR-L (beacon receiver) provides tracking signal strength. (A signal strength derived dc voltage from an external receiver may be used in place of the Advantech AMT Ltd. IBR-L.

The Motor Drive Cabinet receives the antenna drive commands from the INTRAC and drives the azimuth, elevation and polarisation (option) motors and brake assemblies.

Limit switches on the antenna prevent it from being moved beyond mechanically defined positions.

The INTRAC-505 may be controlled from its front panel or from an optional PC based Remote Control and Monitoring Terminal.

Retro Fitting

Existing Step Track or Program Track installations may be updated to INTRAC-505 systems. Advantech AMT Ltd. have considerable experience of retro fitting INTRAC systems.

DUAL REDUNDANT OPTION

The INTRAC-505 INtelligent TRacking Antenna Controller can be supplied for use in a dual redundant configuration. **If you have not ordered a dual redundant unit then there is no need to read this section**. Dual redundant operation requires a dual redundant switch box. The details of the dual redundant swtch box are not included in this manual.

Software

Dual redundant versions will be fitted with different software to a standard unit. Software V8.496 is a dual redundant version. Other versions may also be dual redundant versions.

Hardware

The hardware build for a standard INTRAC-505 and for a dual redundant INTRAC-505 are the same. The dual redundant configuration makes use of two extra inputs (on the limits connector) and two extra outputs (on the motor control connector). The functions of these additional I/O connections is described below.

Internal Links

In a dual redundant configuration the dual redundant switch box selects a single resolver source signal and routes it to all resolvers and both INTRAC units. To enable the INTRACs to work in this configuration it is necessary to ensure that the link J45 link is in the 2-3 position. Link J45 is situated on the main (top) card, a little to the right of centre about half way back down the card. Note that for non-redundant use the link must be in the 1-2 position.

Dual redundant I/O

Pin 10 of the Limit connector is an INCONTROL\ signal. This input must be shorted to ground to command the INTRAC to become the Master unit. Pin 11 of the Motor Control connector is the AutoFlagOut signal that is used for communication between the two units. The AutoFlagOut signal is connected to the AutoFlagIn (limits connector pin 11) of the other unit via the dual redundant switch box. Pin 12 of the Motor Control connector is a SwitchReq signal. It is pulsed low for about 1 second by a slave unit to request a switch over to Master. This request is initiated if a mode key is pressed on the slave unit.

Non-Redundant Use

A redundant INTRAC-505 may be used as a spare in a non-redundant configuration. To use the INTRAC in this way you must ensure that link J45 is in the 1-2 position and that pin 10 of the limits connector (INCONTROL\) is shorted to ground. No connections are required to the AutoFlagOut, AutoFlgIn or SwitchReq lines.

1. SAFETY

WARNING

POSSIBLE LETHAL POTENTIALS EXIST WITHIN THIS EQUIPMENT

THE COVERS SHOULD NOT BE REMOVED EXCEPT BY QUALIFIED PERSONNEL.

SWITCH OFF POWER AND ISOLATE SUPPLY BEFORE REMOVING COVERS.

IF IT IS NECESSARY TO OPERATE THE EQUIPMENT WITH THE COVERS REMOVED FOR SERVICING PURPOSES ALL NECESSARY PRECAUTIONS SHOULD BE TAKEN TO PROTECT AGAINST ELECTRIC SHOCKS

ELECTRICAL

Fusing

The unit is protected by a fuse in the live/phase power supply line.

Care should be taken to ensure that the power cable is correctly connected to the power source such that the live/phase connection of the INTRAC is connected to the live/phase terminal of the supply.

When replacing the fuse be sure to do so with one of the correct value and type.

Earthing

It is important that the electrical supply has a good and proper earth and that earth is connected through to the INTRAC-505 via the power cable.

Battery Disposal

The processor board contains a Nickel Cadmium (NiCd) or Lithium battery. These elements are toxic. The battery should be disposed of according to national requirements. DO NOT PLACE IN NORMAL GARBAGE OR IN A FIRE.

RF I/P Connector for IBR-L

18Vdc may be present on the inner of the N-Type connector to power the LNB/BDC. This voltage can be removed by unplugging connector J41.

Emergency Stop

There is a latching emergency stop switch on the INTRAC front panel. Pressing this switch will remove power from the antenna drive motors and the INTRAC will enter Standby mode. To restore drive the switch should be rotated clockwise (CW) and Auto Continue selected.

Facilities exist at the Motor Drive Cabinet for the connection of external emergency stop switches. It is highly recommended that those fitted be of the latching type.

MECHANICAL

Mounting The INTRAC-505 must not be mounted so that it is supported only by the front panel. A proper rack mounting kit must be used. This may be either of the fixed mounting type or the sliding rail type.

EMC

The unit is designed to meet the requirements of the EC EMC Directive and conforms to the relevant standards for EMC emissions and immunity.

Important To ensure that an INTRAC installation also complies with the EMC Directive it is important to make all interconnections between the INTRAC-505 and associated equipment using good quality screened cables as recommended in the appropriate sections of this manual.

2. SPECIFICATION & OPTIONS

The following pages contain the specification of the INTRAC-505, a list and description of the available options and a chart of the delivered configuration.

Required Mechanical Characteristics of the Antenna System

To enable the full tracking performance of the INTRAC-505 with the contactor based Motor Drive Cabinet (MC381/382) the antenna system must conform to certain overrun and tracking constraints.

The tracking drive speed must be less than $^{1}/_{10}$ of the antenna beamwidth per second and the overrun (drift) when power is removed from the motors must be less than $^{1}/_{20}$ of the beamwidth.

If the system does not conform to these requirements please consult with Advantech AMT Limited.

SPECIFICATION

Tracking Accuracy		Typically <0.05dB RMS signal degradation after tracking for 30minutes (with tracking signal).
Prediction Accuracy		Typically <0.05dB RMS signal degradation over 72hrs (after loss of tracking signal).
Tracking Signal		May be derived from an external tracking receiver or from the (optional) Integral Beacon Receiver (IBR-L).
	External	DC voltage varying directly with received signal strength (in dB). Scale factors between 0.1V/dB and 1.0V/dB can be preset with up to ± 10V offset. Lost Lock Input - Input for clean contacts - standard closed when tracking receiver lock is lost - opposite sense may be selected. Required contact rating 30V at 20mA.
	Internal	Internal IBR-L requires an L-band signal with a level in the range -80dBm to -45dBm and C/No >40dB. Stability better than ± 150KHz. The received frequency is selected from the INTRAC front panel. The signal voltage and lock lost indicators are generated internally.
Antenna Position Encoders		Single or dual resolver units. Operating frequency is 800Hz nominal.
	RE-01	Single resolver unit suitable for antennas with beamwidths greater than 0.4°.
	EG-01	Single resolver units suitable for antennas with beamwidths greater than 0.3°.
	HD-001	Electrically geared dual resolver units suitable for antennas with beamwidths from 0.06°. They are particularly recommended for beamwidths below 0.3°. They are limited motion transducers and are not suitable for antennas with a rotation range of greater than 340°.
Position Offset		The indicated pointing angles can be electrically offset in all axes to an accuracy of 0.01° to compensate for angular mounting offset in the position encoders.
Limit Switches		Inputs for antenna movement limit switches in all three axes. These limit switches should be closed when the antenna is within limits. Contacts rated at 30V 100mA.

Back-up	Time is maintained by a battery backed clock. Operating parameters, data and orbital models are held in EEPROM.
Outputs	Antenna drive. Emergency Stop contacts. Alarm contacts.
Dimensions	483mm Wide x 132mm High x 406mm Deep. (19" rack x 3U).
Mounting	Standard 19" rack mounts or rails. **DO NOT MOUNT BY FRONT PANEL LUGS ALONE** **THE UNIT MUST BE SUPPORTED ALONG ITS SIDES.**
Weight	12kg (without IRB-L). 15kg (with IRB-L).
Operating Temperature	0°C - 40°C.
Relative Humidity	10% - 90% non-condensing.
Power	220V - 240V 50Hz 50W. 110V - 120V 60Hz 50W.
Country of Origin	United Kingdom.

OPTIONS The following table shows the options available with the INTRAC-505.

The options are described in the following pages. At the end of this section is a table showing the configuration of the INTRAC-505 to which this manual corresponds.

A "•" alongside an option indicates that a change or addition is required. Any option with a "•" in the first column can be selected from the "Fitted Options" menu except for those two which require changes to the INTRAC firmware. However most of them also require changes or additions to the system hardware.

Voltage and Serial Interfaces only need a change to switch and / or connector positions within the INTRAC.

OPTION	REOUIRES SET-UP CHANGES OR ADDITIONS TO :-			
	FRONT PANEL MENU SELECTIONS	Advantech / 3rd PARTY SYSTEM HARDWARE	INTRAC-505 FIRMWARE	INTRAC-505 HARDWARE
Voltage				●
Serial Interfaces				●
IBR-L Beacon Receiver	●			●
Inv Beacon Lock - Loss of Input	●			
Polarisation	●	●		
Mount Type	●	●		
Az/El Resolver Type	●	●		
Opto Encoders	●	●	●	●
Extended Azimuth	●	●		
Geared Polarisation	●	●		
Simultaneous Axis Drive (SimAx)	●	●		
Continuous Servo Option (CSO)	●	●	●	●
Redundancy Switching		●	●	●
Stow Option	●	●		

Voltage

The power supply unit of the INTRAC-505 is switchable between 220Vac and 110Vac. The switch is located on the rear panel next to the power lead receptacle.
Ensure that the switch is in the correct position before switching the unit on.

Serial Interfaces

There are three serial ports on the INTRAC-505 which can be independently set to either RS423 or RS422. This selection can be done by the user. It involves connecting the rear panel connectors to the appropriate connectors on the main board and setting the option links as shown below.

Serial Port Configuration - Connector and Link Positions

Port Designation	RS423		RS422	
	Ribbon Cable Position	Link Position	Ribbon Cable Position	Link Position
Remote Control Port	J13	J48 Front	J16	J48 Rear
Test Port 1	J12	J44 Front	J15	J44 Rear
Test Port 2	J11	J46 Front	J14	J46 Rear

IBR-L Beacon Receiver

The INTRAC-505 can be supplied fitted with an L-band beacon receiver or the user can supply a tracking signal voltage which varies directly with the received signal strength in dB.

Beacon Pol Select

This facility allows the user to select from up to four beacon signal sources. These sources would normally be LNBs which may have different pol angles or different L.O. frequencies.

Inv. Beacon Lock

If an external receiver is used to provide the tracking signal a beacon lock input is available to indicate to the INTRAC that the tracking signal receiver is in lock. Normally an open circuit is required to indicate lock. However if “Inv. Beacon Lock” is enabled a short circuit indicates lock.

Polarisation

If the antenna has motorised polarisation the INTRAC can be configured to control the polarisation angle. The polarisation resolver may be direct drive or geared drive refer to “Geared Polarisation” on the next page.

Mount Type

Two types of antenna mount may be used with the INTRAC. An Az/El mount or a Polar mount. The appropriate one is selected in “Fitted Options” as AZ/El or Hr-Ang/Declination.

Resolver Type

Various types of resolver may be used to provide the pointing angle data to the INTRAC. The applicable type is set in "Fitted Options".

Advantech AMT Ltd. primarily provide three types of resolver for Azimuth and Elevation, they are the RE-01, the EG-01 & the HD-001.

When the Polarisation facility is fitted a Polarisation resolver is also required. The INTRAC Polarisation resolver interface is suitable for either the RE-01 or a size 11 bare resolver.

The specifications of the various resolvers are :-

POSITION ENCODERS

	Size 11	RE-01	EG-01	HD-001
RESOLUTION	16 bit	16 bit	17 bit	19 bit
BACKLASH	Not Applicable	< 0.5 Minutes	< 0.5 Minutes	Negligible
RMS ACCURACY	<0.08°	0.04°	0.02°	0.018°
GEARING RATIO	Direct	1 : 1	1 : 2	1:8 (electrical) & 1:1
SUITABILITY FOR ANTENNA 3db BEAMWIDTH	0.4° upwards	0.4° upwards	0.3° upwards	0.12° upwards
RECOMMENDED CABLE I/F	3 Twisted pair individually screened	3 Twisted pair individually screened	3 Twisted pair individually screenec	6 Twisted pair individually screened
ANTENNA POINTING DISPLAY RESOLUTION	0.01°	0.01°	0.01°	0.001°
WEATHER PROOFING	None	IP66	IP66	IP66
ROTATION LIMITS	None	None	None	340°
MOUNTING	Size 11 Synchro Case	3.5" Synchro Case	3.5" Synchro Case	3.5" Synchro Case

Note The bare Size 11 is not weatherproof although a weatherproof version is available to special order.

Extended Azimuth

Some antennas can rotate through more than 360°. In such a case the INTRAC needs to know which revolution the antenna is in. Extended Azimuth is selected in "Fitted Options".

Geared Polarisation

Position resolvers are normally coupled 1:1 to the rotational shaft. However for polarisation the resolver may be connected through gearing to the rotating shaft. In such a situation the INTRAC needs to know the gearing ratio.

Geared Pol is set as fitted in “Fitted Options” and the ratio selected in “Geared Polarisation”.

Simultaneous Axis Drive

Drive to the Azimuth & Elevation motors may be on an either/or basis or both simultaneously.
The selection of “SimAx Drive is in the “Fitted Options” menu. However SimAx requires a different Motor Controller to the standard drive which must be specified at time of order.

Continuous Servo

Antennas with dual motor (per axis) continuous torque drives may require a continuous servo system. The Continuous Servo option provides a continuous velocity demand output to control a velocity demand servo.
This option requires CS option software in the INTRAC-505 which should be specified at time of order.

Redundancy Switch Unit

The Redundancy Switch Unit links two INTRACs together in a dual redundant system. In the event of a fault occurring on the current Master unit the system automatically switches the other unit on line so that tracking continues unaffected.

Stow Option

There is provision in the INTRAC-505 configuration for Az/El preliminary and final stow positions to be set.

The “Stow” command causes the antenna to be driven to the preliminary position in both axes. Once at this position the antenna is driven to the final position. For systems which have the appropriate stow pin drive facility the stow pin(s) are then driven in.

The “Unstow” command causes the pin(s) to be removed (where appropriate) and the antenna driven to the preliminary position.

The preliminary and/or final positions can be set to “not-used” for one or both axes.

DELIVERED CONFIGURATION

Serial No.			
THE INTRAC-505 HAS BEEN CONFIGURED AS SHOWN BELOW			
Voltage	240Vac	120Vac	
Serial Interfaces	RS423	RS422	
IBR-L Beacon Receiver	YES	NO	
Inv Beacon Lock	YES	NO	
Polarisation	STANDARD	GEARED	NO
Mount Type	AZ/EL	HR/ANG/DCL	
Resolver Type	RE-01	EG-01	SIZE 11
	RE-001	HD-001	Opto Encoders
Extended Azimuth	YES	NO	
Geared Polarisation	YES	NO	
Simultaneous Axis Drive	YES	NO	
Continuous Servo Option	YES	NO	
Redundancy Switch Unit	YES	NO	
Stow Option	YES	NO	
Beam Width			
Software Version No.			

Installation engineer to circle the configured options

Comments.

Form Completed by _____ Date _____

Form Checked by _____ Date _____

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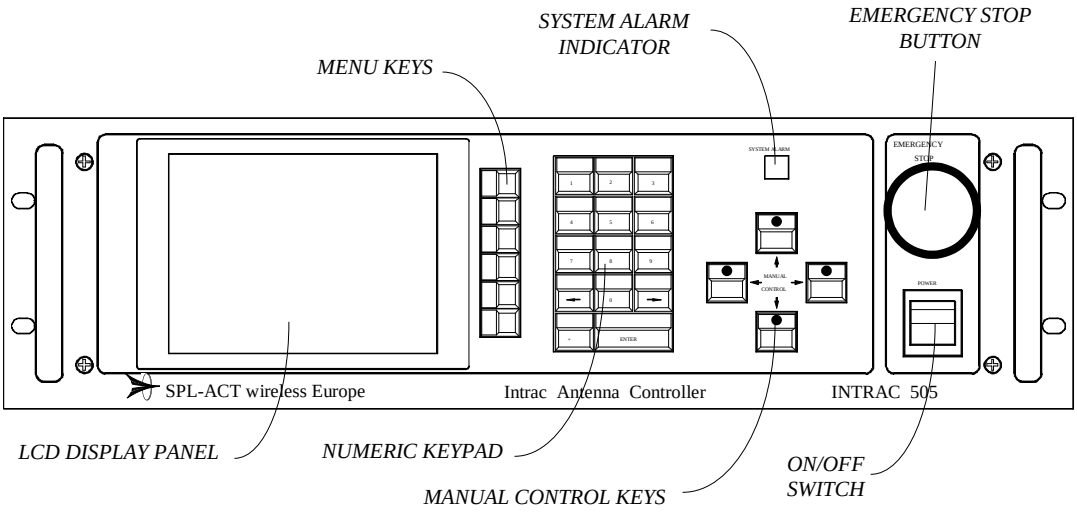
3. OPERATING THE INTRAC-505

The INTRAC-505 may be operated directly from the front panel or from the (optional) Remote Control and Monitoring Terminal.

For both methods of operating a series of menus enables a user to program the INTRAC and to invoke its modes of operation.

Operation from the front panel is described in this section of the manual. The (optional) remote terminal (the RCM-4) is described in Appendix D.

FRONT PANEL



LCD Display Panel — This displays the current status of the INTRAC-505 and the selected menu which includes the labels for the menu keys.

Menu Keys — These six keys have functions dependant on the selected menu. The right side of the menu display indicates the function of each key for that menu.

Numeric Keypad — The keypad is used to enter or edit data into the INTRAC.
The ← & → keys move the cursor left and right.
The +/- key is used to change the sign or, in some cases to insert a space character.

Manual Control Keys — For manual control of the antenna pointing when the INTRAC is in manual mode.

System Alarm Indicator — Illuminates when a primary alarm occurs and remains on until the cause of the alarm is cleared.

Note. An active primary alarm disables antenna drive.

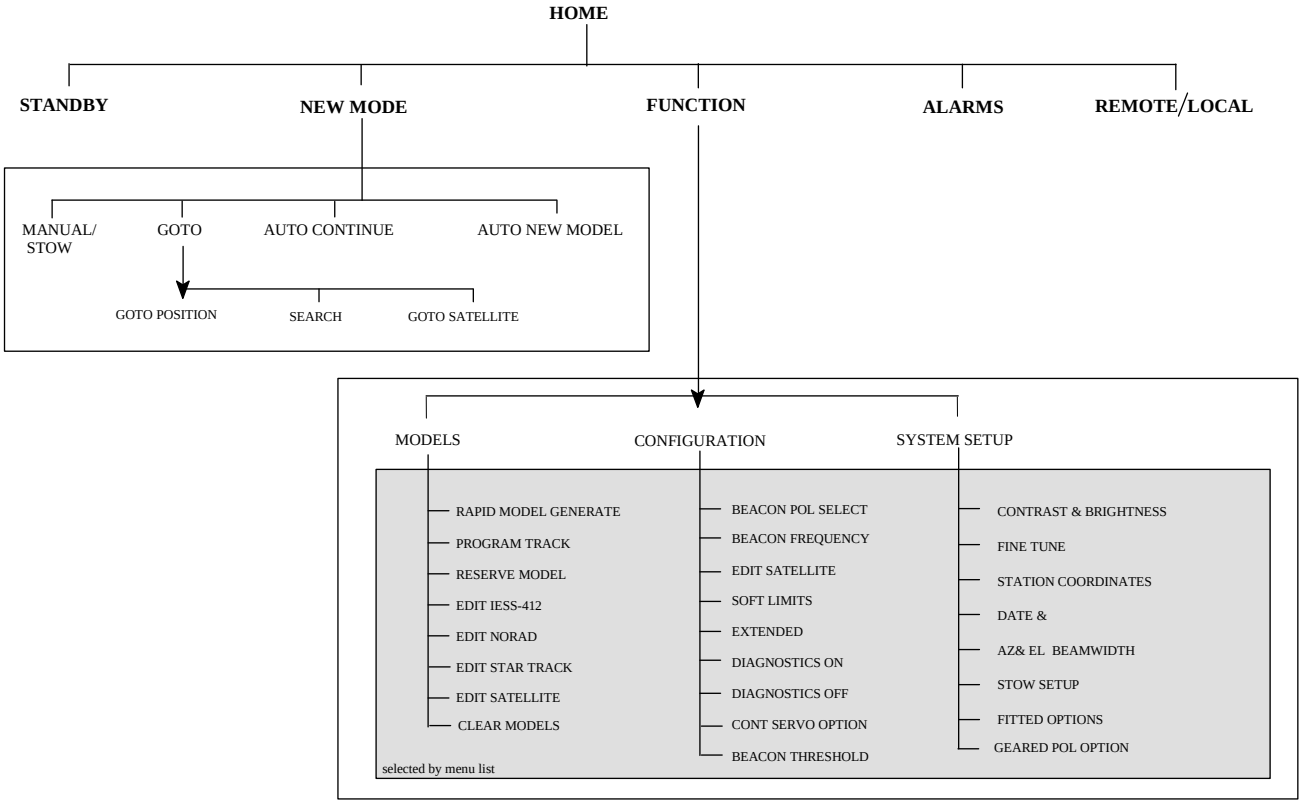
Emergency Stop Button

Pressing the button removes all drive from the antenna. The button locks in the safe position when pressed. To enable drive to return to the antenna the button must be rotated clockwise until it releases.

On/Off Switch

Illuminated rocker switch to apply power to the INTRAC-505. Illuminated when the INTRAC is on.

THE MENU STRUCTURE



The diagram above shows the various menus in a “tree” structure.

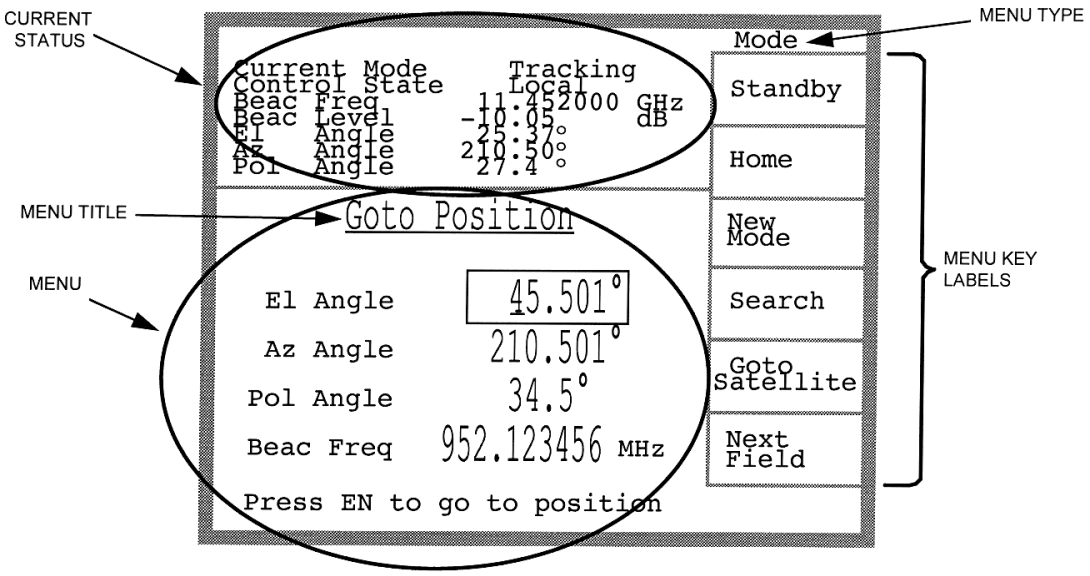
The menu headings in heavy type are selected by the six menu keys from the “HOME” menu. The headings in the box below “NEW MODE” are selected by the menu keys in NEW MODE. The shaded area headings are sub menus of the MODELS, CONFIGURATION and SYSTEM SETUP menus. They are accessed by using the “Next Field” menu key from the appropriate menu followed by the “ENTER” key on the numeric keypad.

Example

To select “STOW SETUP” from the HOME menu :-

FUNCTION	(menu key)
SYSTEM SETUP	(menu key)
NEXT FIELD	(menu key) press five times.
ENTER	(numeric keypad)

THE MENU SCREEN



A typical menu display screen is shown above. In this example it is the “Goto Position” used to drive the antenna to a particular pointing angle.

The top section shows the current mode of the INTRAC, whether the control is remote or local and the various pointing angles of the antenna.

Note On some screens (e.g., HOME) the current status display expands to fill the lower part of the screen.

Down the right side of the screen are the current functions of the six menu keys.

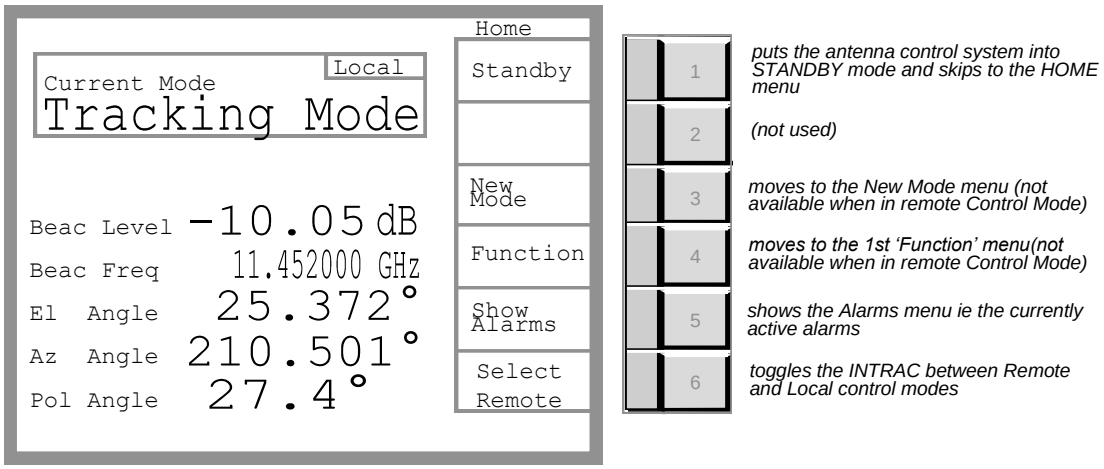
Above the key labels is the menu type designator, i.e., one of the six main menu headings.

The main part of the display relates to the selected menu.

The individual menus are described on the following pages in order of the menu tree shown above. The order is from left to right and taking the branches as they come.
On the next page is an alphabetical index of the menus to assist in the quick location of a specific function.

ALPHABETICAL INDEX OF MENUS

HOME



Path HOME

Note This menu can be reached directly from **almost** every menu by pressing Menu Key 2.

Description This is the root Menu as shown in the menu structure diagram on page 12.
It is from here that the five main menus are accessed directly by use of the Menu Keys.

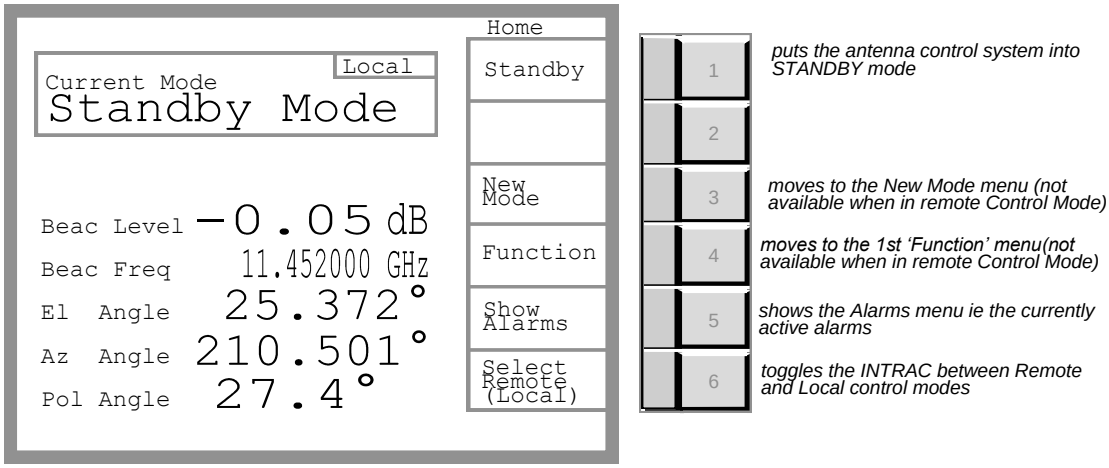
Beamwidth Select Control

Some INTRAC-505 units have a facility for selecting between two different beamwidths using a logic input (pin 5 of Aux 3 connector). When this option is implemented the "Beac Freq" display line is replaced by a "Beamwidth" line that shows a parameter "Normal" or "Alternate".

Open circuit or logic high on the select input selects Normal. A logic low current sink to ground (short circuit to ground, pin 18 of Aux 3) selects Alternate.

Refer to page 41, AZ & EL BEAMWIDTH for setting the two beamwidths.

STANDBY



Path — STANDBY

Note — This menu can be reached directly from **almost** every menu by pressing Menu Key 1.

Description

Standby is a monitoring but no movement mode.
The antenna is not driven in this mode but its position and the beacon signal strength are monitored and displayed.
External inputs are also monitored and any appropriate alarm(s) become active. The System Alarm indicator will illuminate and the alarms may be viewed by pressing "Show Alarms".

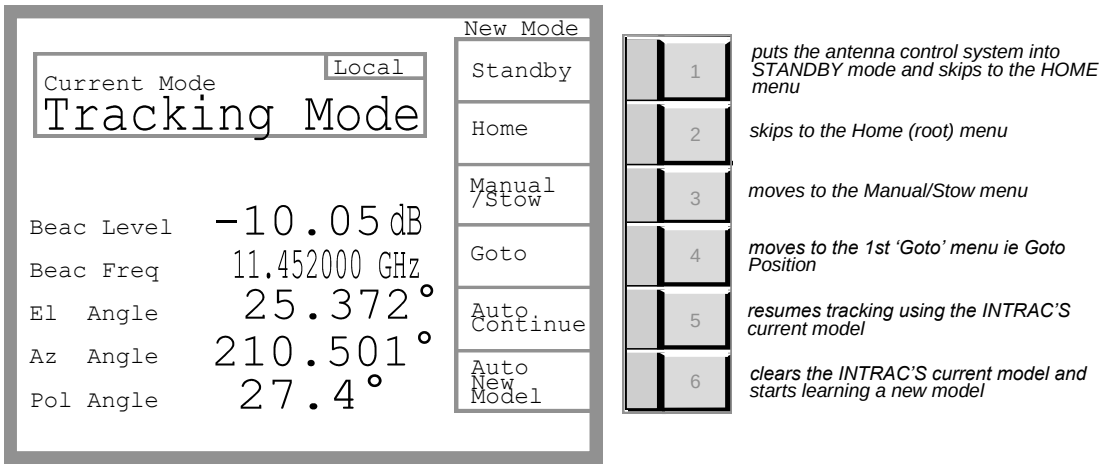
Standby mode is entered in one of three ways :-

— by being selected by the operator using Menu Key 1.

— by a primary alarm becoming active.

— at the end of a Goto move or at the end of a search.

NEW MODE



Path — Menu key 3 from the "HOME" or "STANDBY" menus.

Description — Displays the current mode and antenna pointing angles on the full screen.

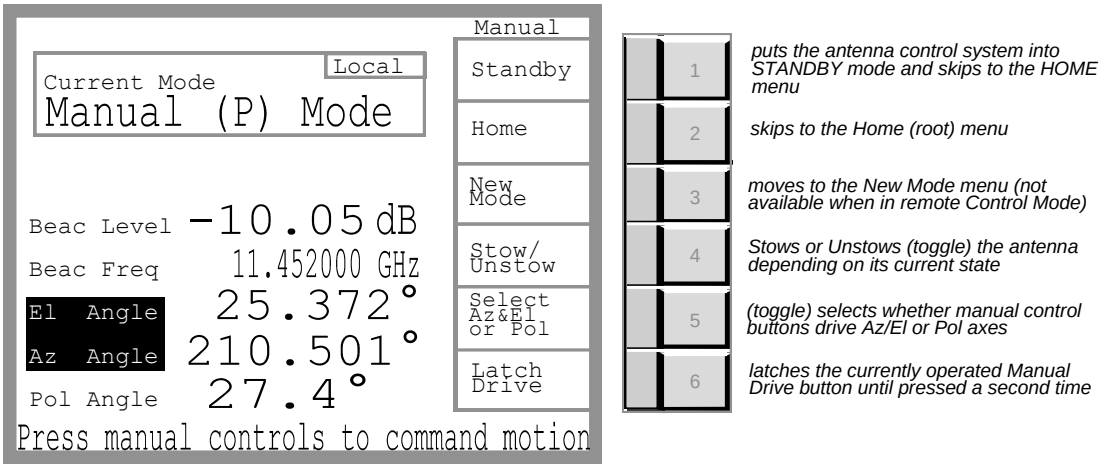
This is the entry menu for moving the antenna.

Menu key 3 leads to the Manual antenna control and antenna stow menu.

Menu key 4 leads to the "Goto" menu for "Goto Position", "Goto Satellite" and "Search".

Menu key 5 resumes tracking using the current model. (Assuming that there is a valid model).

Menu key 6 clears the existing model and starts learning a new model for the satellite at the current pointing.



Path HOME - NEW MODE - MENU KEY 3

Description

Manual

This menu screen enables the antenna pointing direction to be changed manually by use of the Manual Control Keys on the front panel. Menu key 5 enables either azimuth & elevation or the polarisation motors to be driven.

Azimuth is driven by the left and right manual keys.
Elevation is driven by the upper and lower manual keys.
Polarisation is driven by the left (ccw) and right (cw) manual keys.

Menu key 6 latches which ever manual key is pressed and drives at an increased speed. (useful for large distance moves) Pressing key 6 again releases the latching effect.

Stow

Menu key 4 (alternate functions) causes the antenna to be driven to the pre-set stow position (via the preliminary stow position) and, where appropriate, the stow pins to be driven into locking position.
If the antenna is “stowed” key 4 causes the stow pins to be withdrawn, where appropriate, and the antenna to drive to the preliminary stow position. (see Stow Setup)

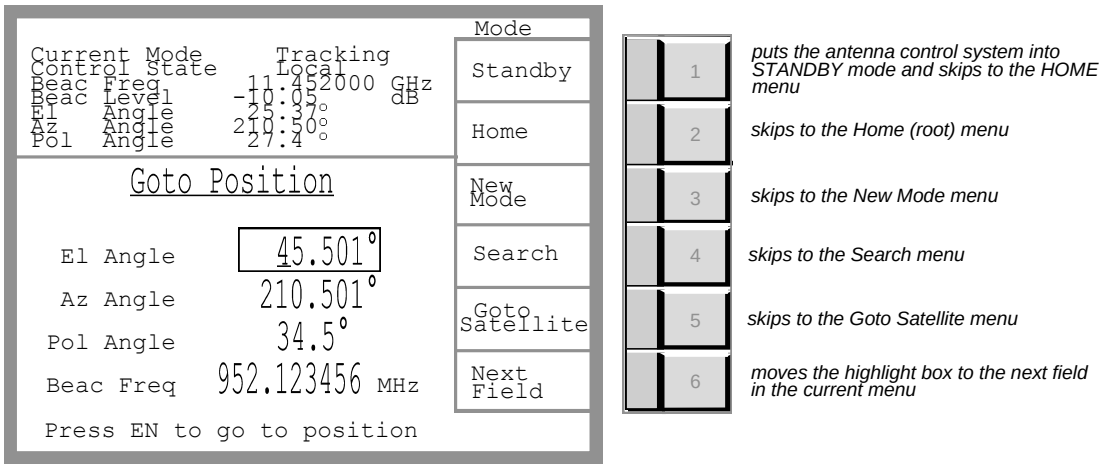
Notes

The Drive Fail alarm does not work in Manual (P) mode.

The antenna may be driven through azimuth 0° (North) in Manual (P) mode (azimuth 180° [South] in Southern Hemisphere).

Manual (P) mode is local (front panel) control as opposed to remote manual control which is Manual (A) Mode.

GOTO (Position)



Path — HOME - NEW MODE - MENU KEY 4

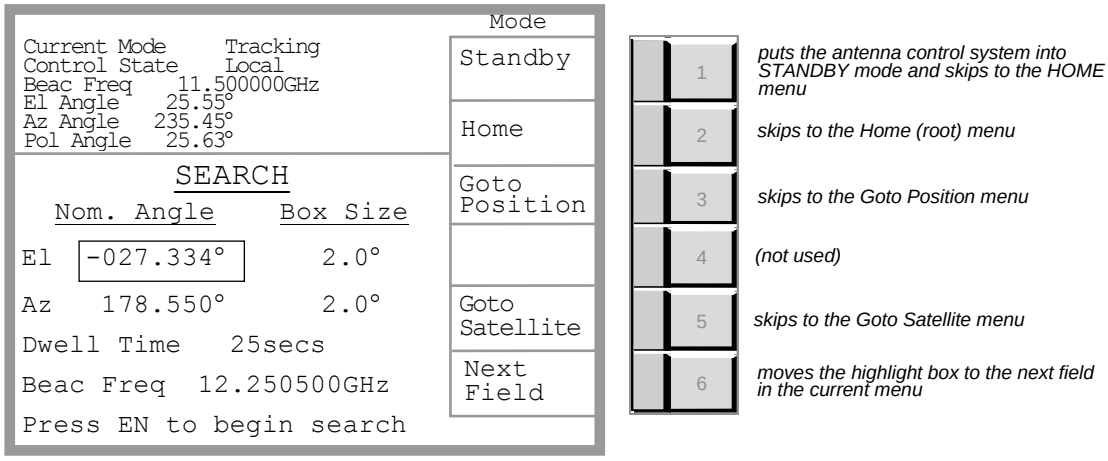
Note — Pressing menu key 4 (Goto) on the New Mode menu leads to the Goto Position (as opposed to Goto Satellite) menu. Goto Satellite and Search are accessed from this (Goto Position) menu by Menu Keys 5 and 4 respectively.

Description — Used to drive the antenna to the co-ordinates displayed.

The co-ordinates can be set by using menu key 6 (Next Field) to step through the three angles and the Beacon Frequency. The co-ordinate enclosed in the box can be edited from the numeric keypad. The ← & → keys are used to move the cursor to the desired character.

Pressing the ENTER key causes the antenna to commence driving to the set co-ordinates. When the antenna reaches the position the INTRAC enters STANDBY Mode.

SEARCH



Path — HOME - NEW MODE - GOTO (Position) - MENU KEY 4

Description

Used to search a specific area of sky for the strongest signal on the beacon frequency.

The antenna may be driven to the nominal co-ordinates of the required satellite by either the Goto Position or Goto Satellite commands or manually. Alternatively the Az & El co-ordinates can be entered on this screen.

Using Menu Key 6 (Next Field) and the numeric keys the satellite's position and beacon frequency may be entered.

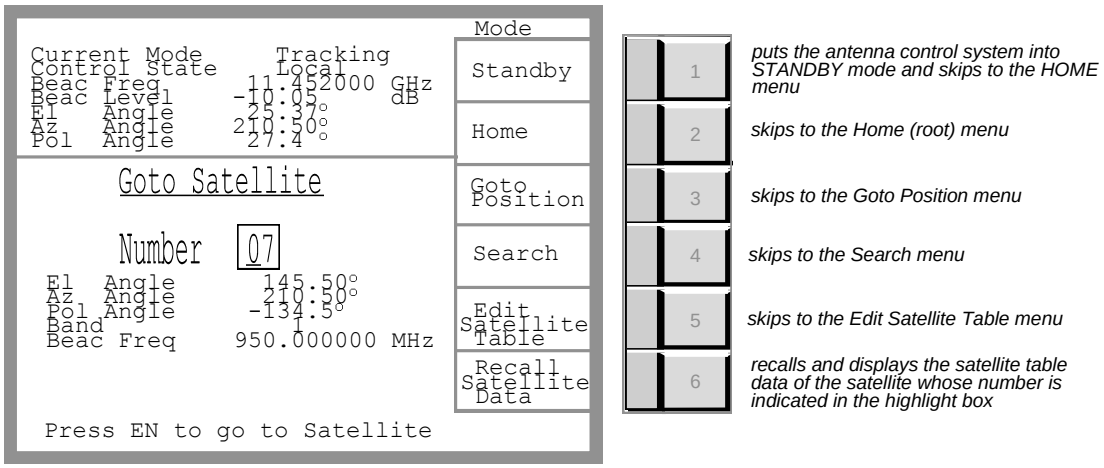
The search box size and the antenna dwell time are also entered in the same manner.

The box size parameters are either side of the nominal angle thus entering 2° will cause a 4° scan.

The dwell time is the time that the antenna will remain at each step. It is the lock time of the beacon receiver. For the IBR-L (The Advantech AMT Ltd. supplied Integrated Beacon Receiver) the default dwell time of 25 seconds is correct.

Once all the co-ordinates are set pressing ENTER will start the search. The antenna will drive to the nearest corner of the search box before commencing the search pattern.

GOTO SATELLITE



Path — HOME - NEW MODE - GOTO (Position) - MENU KEY 5

Description

The INTRAC-505 can store the co-ordinates, polarisation angle and beacon frequency of 40 satellites. With this screen the antenna can be driven to any satellite whose parameters have been stored.

When this screen is accessed the displayed parameters refer to the current satellite.

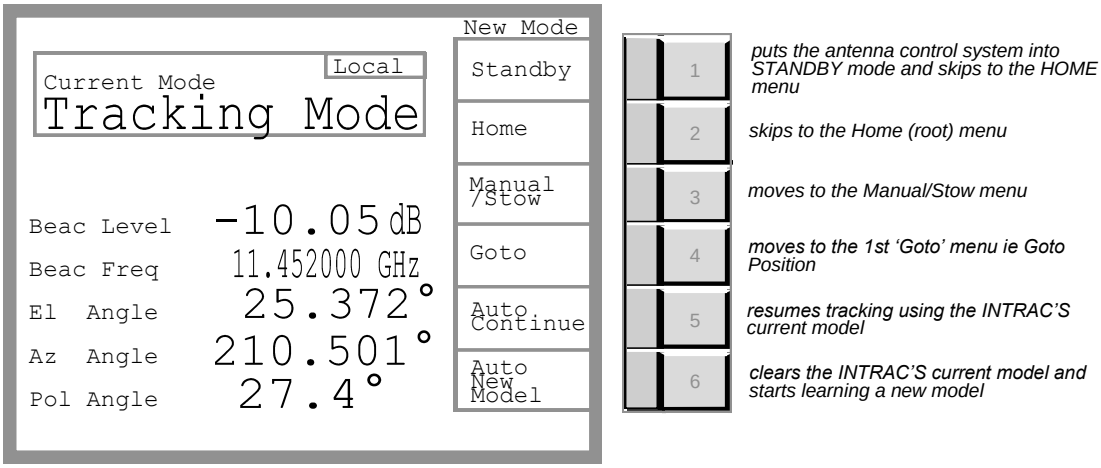
To move to a new satellite key in the required satellite's number using the numeric keypad. (Press Menu Key 6 to view the stored parameters if required)

Press ENTER and the antenna will drive to the new satellites co-ordinates. Select Home (Menu key 2) to leave this menu without moving to a new satellite.

If the satellite's parameters need to be changed Menu Key 5 switches to the Edit Satellite screen. For an explanation of that facility see "Edit Satellite Table".

Menu key 6 is used to view the data of a satellite after entering the "Number".

AUTO CONTINUE



Path — HOME - NEW MODE - MENU KEY 5

Description — This facility does not have a screen of its own. It is a function enabled by a menu key on the New Mode menu.

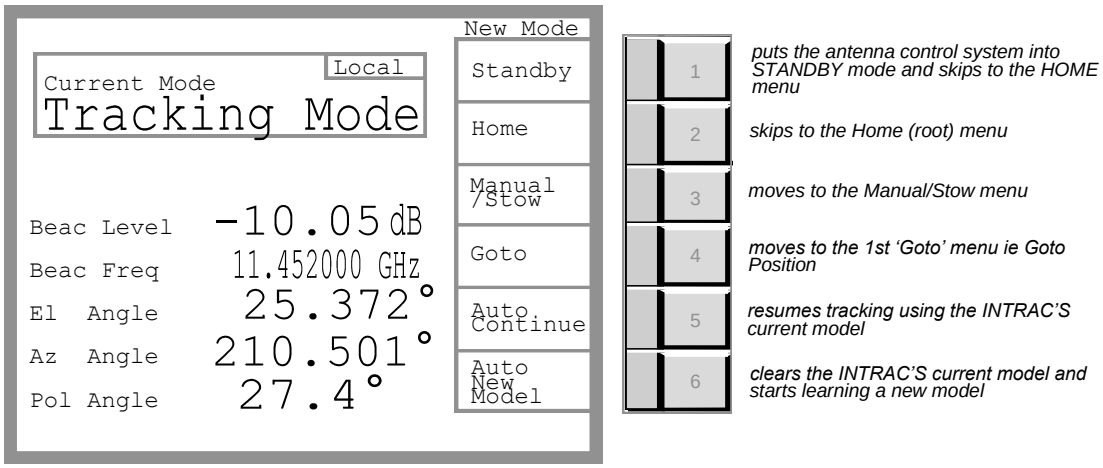
If the INTRAC had been in Learning or Tracking mode and had been taken out of that mode, and the model was still valid, pressing Auto Continue will return the INTRAC to that mode.

The antenna may have been stowed or moved off satellite for some other reason. Alternatively the INTRAC may have gone into Standby due to an alarm. In either case (once the antenna has been unstowed) pressing Auto Continue will cause the antenna to drive back to the satellite and continue Learning or Tracking.

If the INTRAC had been Tracking but the time off satellite was too long for the model to be relied on it will restart in Learning mode to build a new model.

Note — Until and unless the orbit model is cleared pressing Auto Continue will cause the antenna to be driven to the satellite of that model. Thus if a new satellite is required to be tracked the antenna must be driven to that satellite's location and "Auto New Model" used to cause the INTRAC clear the existing model and start to build a new one.
(see Auto New Model on the next page)

AUTO NEW MODEL



Path — HOME - NEW MODE - MENU KEY 6

Description

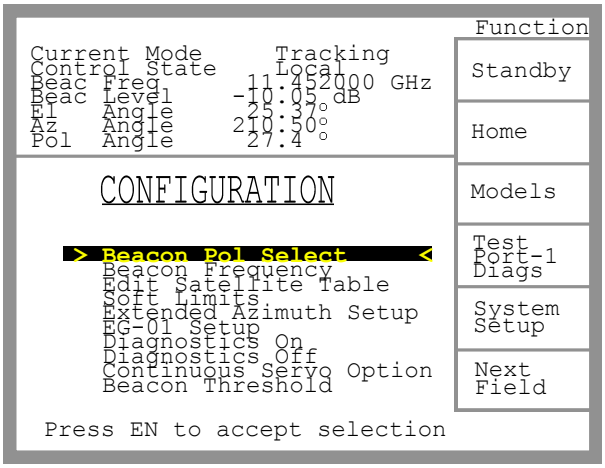
This facility does not have a screen of its own. It is a function enabled by a menu key on the New Mode menu.

Auto New Model is used when it is required to track a new satellite. It causes the INTRAC to clear the existing model (if there is one) and start to build a new model of the orbit of the satellite whose beacon signal it is receiving.

Thus before pressing the Auto New Model key the antenna must be peaked on the required satellite's main transmission lobe. The peaking may be done in manual mode or automatically using Search Mode.

On pressing Auto New Model the INTRAC will enter Learning mode. After 24hrs of learning the orbit and building the model the INTRAC will enter Tracking mode.

FUNCTION (Configuration)



puts the antenna control system into STANDBY mode and skips to the HOME menu

skips to the Home (root) menu

skips to the Models menu

controls whether 'Angles' or 'Diagnostics' appear on Test Port 1

skips to the System Setup menu

moves the highlight box to the next field in the current menu

Path — HOME - MENU KEY 4

Note — There are three separate menus under the FUNCTION heading. Pressing Menu Key 4 (FUNCTION) on the "Home" menu leads to the CONFIGURATION menu from which the MODELS menu and the SYSTEM SETUP menu are reached via Menu Keys 3 & 5 respectively.

This Configuration menu can also be reached by Menu Keys from the MODELS & SYSTEM SETUP menus

Description — The Configuration menu contains seven sub menus plus Diagnostics On & Off.

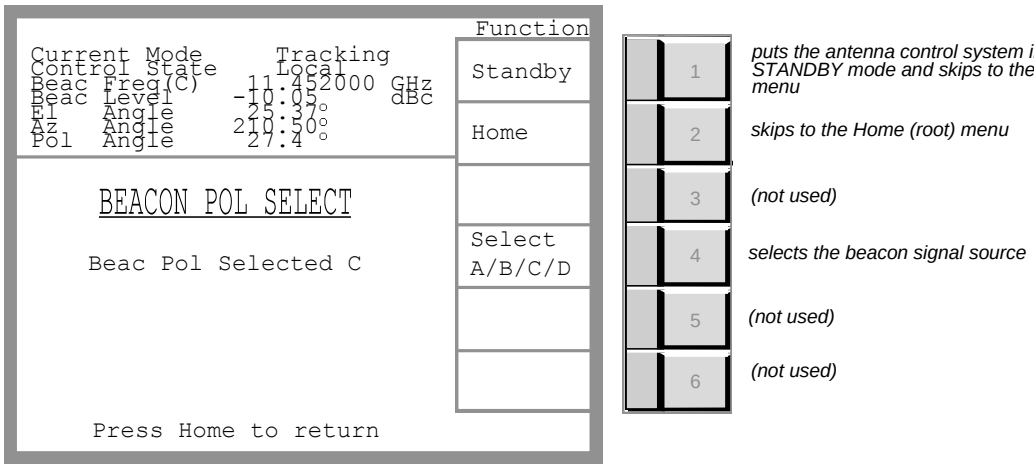
The sub menus are described on the following pages.

The Diagnostics On & Off keys are used to route the INTRAC diagnostic data to the Remote Control port. This facility enables one PC to be used as both the remote control terminal and the diagnostics receiving terminal. However it cannot do both at the same time.

WHEN IT IS REQUIRED TO CONTROL THE INTRAC FROM THE REMOTE TERMINAL DIAGNOSTICS MUST BE SWITCHED OFF.

Menu Key 4 — Test Port - 1 Diags (Angles)
The data available at Test Port - 1 is either INTRAC diagnostic data (the same diagnostic data as mentioned above) or angles data. Selection between these two is by Menu Key 4 whose label toggles between "Diags" & "Angles"

BEACON POL SELECT



Path — HOME - FUNCTION - ENTER

Description — This function allows the source of the beacon signal to be selected. The selection is from one of four souces.

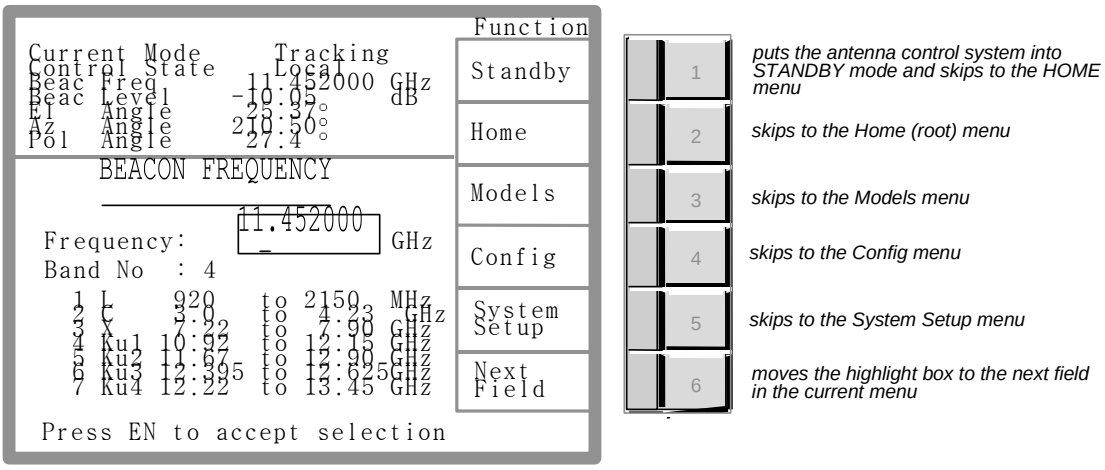
Four LNBs may be fitted to the antenna at different polarisation angles or with different L.O. frequencies.

Note — This facility is an option and requires extra hardware to function.

Beacon pol select must be set to “Fitted” in the System Setup - Fitted Options menu.

Pressing Menu Key 4 steps the selection through A - B - C - D and back to A.

BEACON FREQUENCY



Path — HOME - FUNCTION - MENU KEY 6 - ENTER

Description — This function effects the tuning of the IBR-L (if fitted) to the beacon frequency of the satellite to be tracked.

The IBR-L operates over the frequency range 920MHz to 2.15GHz (L-band). A block down converter is required to convert the actual beacon frequency to the L-band range.

Note — The conversion from the operating frequency to the L-band frequency for the IBR-L is performed automatically for BDCs with standard local oscillator frequencies.

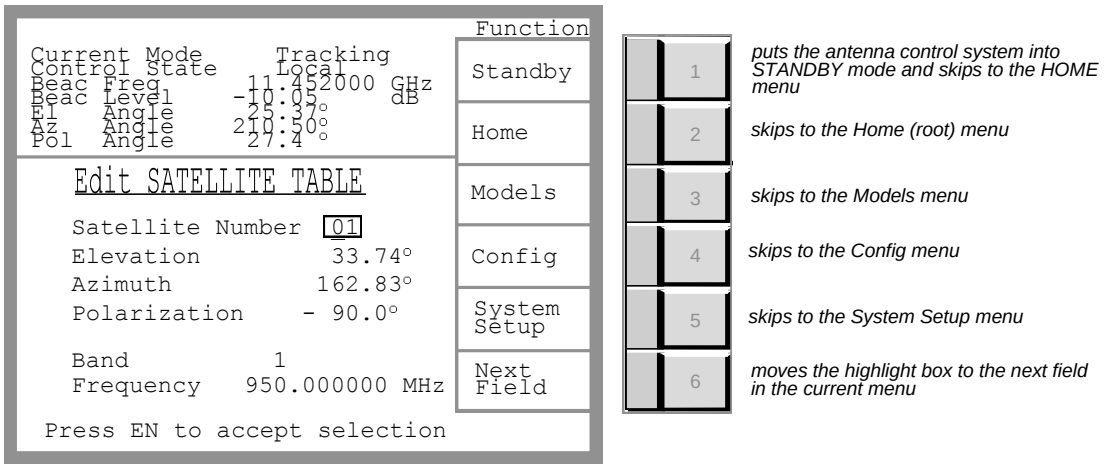
Setting Frequency — Menu Key 6 (Next Field) selects either the Frequency or Band No. for editing. The Band No. **must** be set first otherwise the frequency cannot be entered.
Use the numeric keypad to overwrite the band number and/or frequency as required.

The down conversions assumed by the INTRAC-505 are :-

Band No.	Conversion
1	none
2	5.15GHz - C band
3	X band - 6.3GHz
4	Ku1 band - 10GHz
5	Ku2 band - 10.75GHz
6	Ku3 band - 11.475GHZ
7	Ku4 band - 11.3GHZ

Notes — Whilst bands 4 to 7 cover, in part, the same frequency range the down conversion frequency is different.

EDIT SATELLITE TABLE



Path — HOME - FUNCTION - MENU KEY 6 (X2) - ENTER

or — From Models or System Setup:-
CONFIG - MENU KEY 6 (X2) - ENTER

Description — The INTRAC-505 can store bearing parameters for 40 satellites.
This function allows the editing of previously stored data and/or the addition of new data.

Menu Key 6 steps the edit box through the six fields. Using the numeric keypad enter the satellite's parameters and the number it is to be stored under.

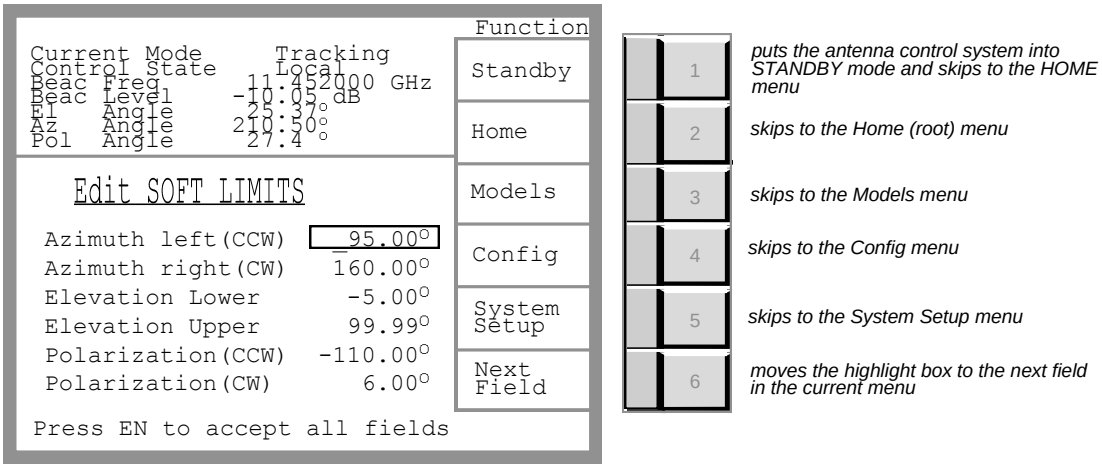
Pressing ENTER sets the new values.

Note 1 — The Satellite Number must be between 1 and 40 inclusive.

Note 2 — If the frequency is between 12.55GHZ and 12.75GHZ ensure that the correct band number is set for the down converter frequency, i.e., band 6 or band 7.
(see previous page - Beacon Frequency)

To view the data relating to a satellite number use the Goto Satellite menu, page 22.

SOFT LIMITS



Path — HOME - FUNCTION - MENU KEY 6 (x3) - ENTER

or — From Models or System Setup :-
CONFIG - MENU KEY 6 (x3) - ENTER

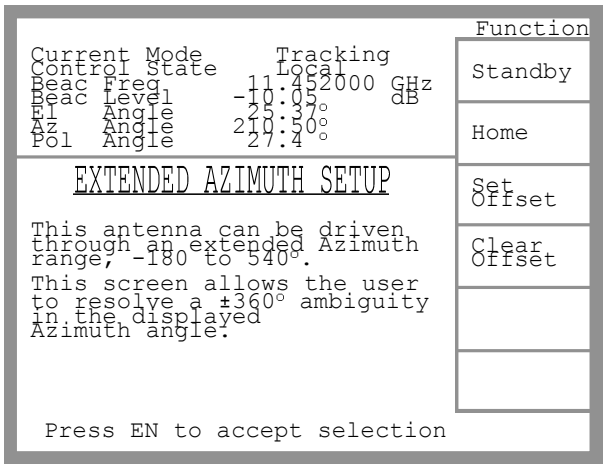
Description — Antenna movement limits may be programmed which will stop the antenna drive (and raise a primary alarm) if any one of them is reached.

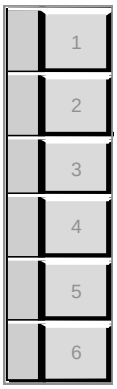
Note 1 — **These are software limits they do not physically break the drive circuits to the antenna motors.**

Note 2 — DRIVE IN MANUAL MODE IS NOT INHIBITED BY THE SOFT LIMITS.

Setting — Menu Key 6 (Next Field) steps the edit box through the six fields. Data is overwritten with the numeric keypad. Pressing ENTER accepts all the fields.

EXTENDED AZIMUTH SETUP





puts the antenna control system into STANDBY mode and skips to the HOME menu

skips to the Home (root) menu

sets the Extended Azimuth offset

clears the Extended Azimuth offset

(not used)

(not used)

Path — HOME - FUNCTION - MENU KEY 6 (x4) - ENTER

or — From Models or System Setup :-
CONFIG - MENU KEY 6 (x4) - ENTER

Note — This function is only available if “Extended Az” has been set to “Fitted” in the System Setup - Fitted Options Menu. (see page 43)

If the “Resolver Type” in System Setup - Fitted Options has been set to “EG-01 Fitted” this line of the Configuration menu reads “EG-01 Setup”. (see next page)

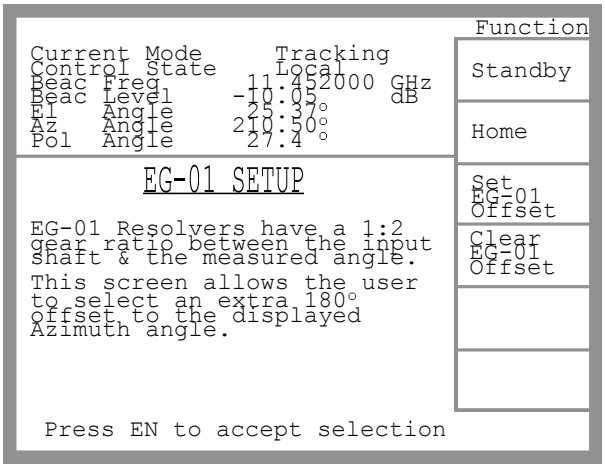
Description — For antennas which can be driven through more than 360° it is necessary for the INTRAC to “know” which revolution the antenna is in at any one time.

When powered-up for the first time the INTRAC-505 assumes the first revolution. If the antenna is actually in the second revolution this function is used to add 360° to the displayed angle. The off-set state is stored in EEPROM so that it is preserved through power failures.

Setting — Menu Keys 3 & 4 are used to set or clear the 360° offset. Key 3 sets (or adds) the offset. Key 4 clears a previously set offset.

Note — This function is only used during installation of, or when replacing, an INTRAC-505 unit.

EG-01 SETUP



puts the antenna control system into STANDBY mode and skips to the HOME menu

skips to the Home (root) menu

sets the offset for the EG-01 resolver

clears the offset for the EG-01 resolver

(not used)

(not used)

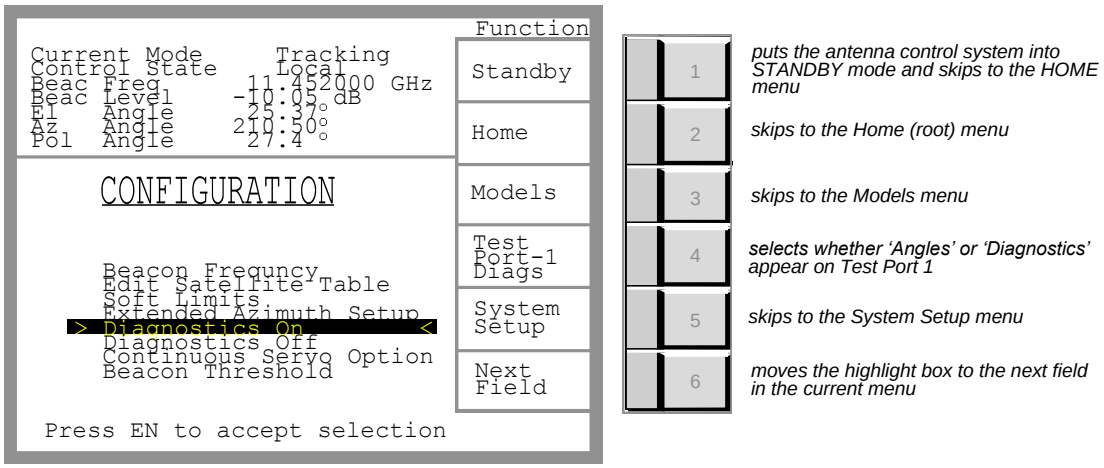
Path — HOME - FUNCTION - MENU KEY 6 (x4) - ENTER

or — From Models or System Setup :-
CONFIG - MENU KEY 6 (x4) - ENTER

Note — This function is only available if the “Resolver Type” in System Setup - Fitted Options has been set to “EG-01 Fitted”. If the “Extended Az” in System Setup - Fitted Options has been set to “Fitted” this line of the Configuration menu reads “Extended Azimuth Setup”. (see previous page)

Description — The EG-01 resolvers have a 1:2 gear ratio between the input shaft and the angle data output. This is in order to achieve higher resolution. However it means that the output moves through 720° for 360° of input rotation. Thus in Azimuth the INTRAC seeks to initially resolve this 180° ambiguity.

DIAGNOSTICS ON / DIAGNOSTICS OFF



Path — HOME - FUNCTION - MENU KEY 6 (x5 for ON) (x6 for OFF) - ENTER

or — From Models or System Setup
CONFIG - MENU KEY 6 (x5 or 6) - ENTER

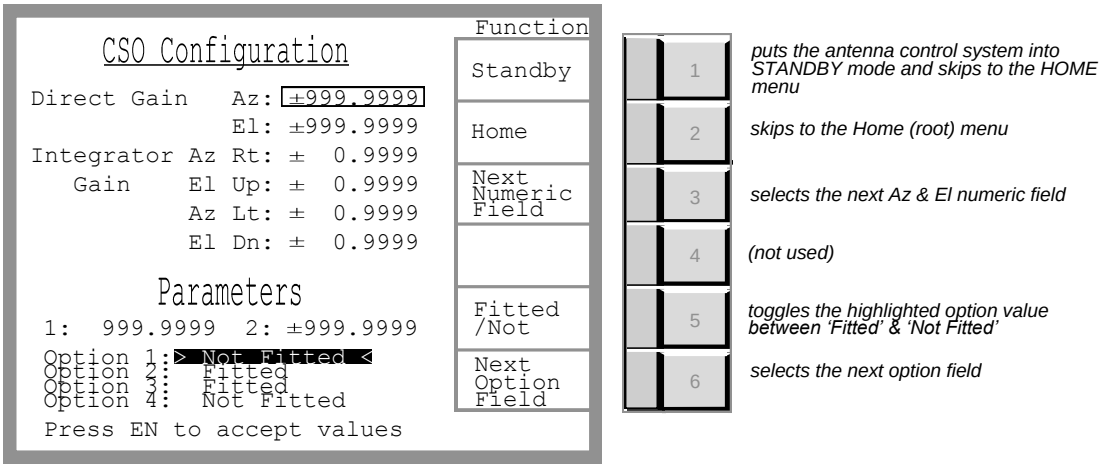
Description — Diagnostics On & Off are used to route the INTRAC diagnostic data to the Remote Control port.

Use Menu Key 6 to step the highlight bar to the ON or OFF line and press ENTER to set.

Note — This facility enables one PC to be used as both the remote control terminal and the diagnostics receiving terminal. However it cannot do both at the same time.

WHEN IT IS REQUIRED TO CONTROL THE INTRAC FROM THE REMOTE TERMINAL DIAGNOSTICS MUST BE SWITCHED OFF.

CONTINUOUS SERVO OPTION



Path — HOME - FUNCTION - MENU KEY 6 (x7) - ENTER

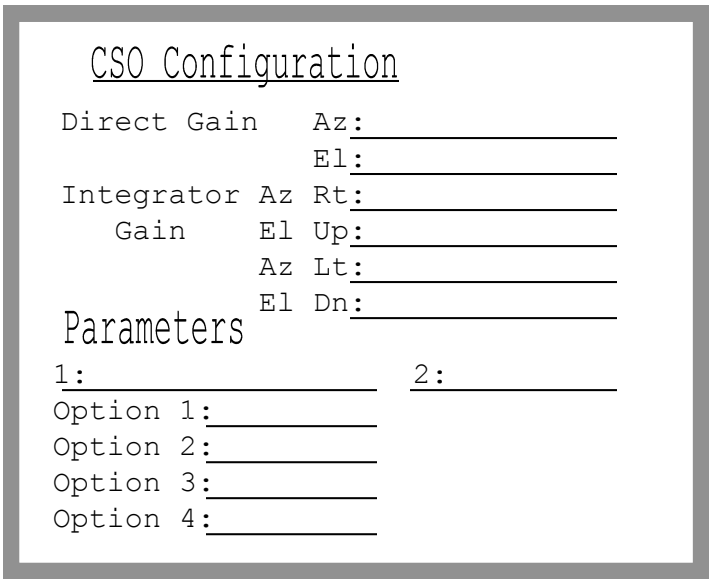
or — From Models or System Setup
CONFIG - MENU KEY 6 (x7) - ENTER

Note — This facility is not available unless the Continuous Servo Option was ordered as part of the system

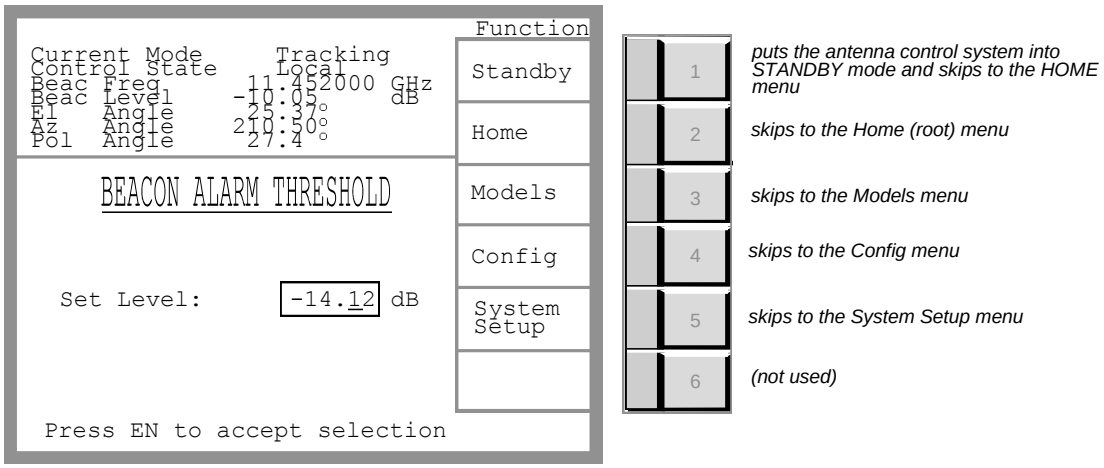
Description — This menu is used to set the various parameters for the Continuous Servo Drive option.

The parameters are decided empirically during the installation which will be carried out by engineers from SPL-ACT wireless Europe Limited.

The values at installation were :-



BEACON THRESHOLD



Path — HOME - FUNCTION - MENU KEY 6 (x8) - ENTER

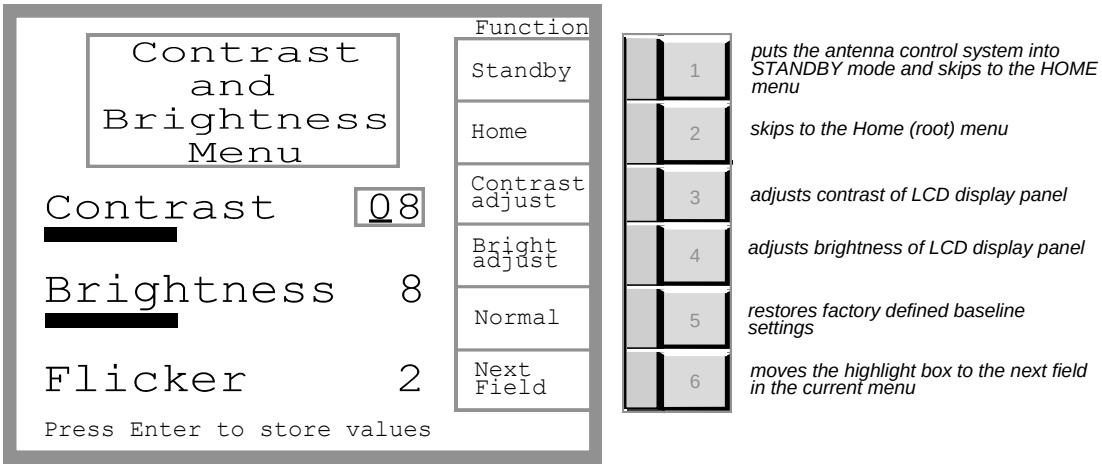
or — From Models or System Setup
CONFIG - MENU KEY 6 (x8) - ENTER

Description — On this screen the beacon signal strength at which the beacon level alarm trips is set.

Edit the value in the “Set Level” box using the numeric keypad. The ← & → move the cursor.

Note — The only function of the beacon level alarm is to operate a relay for external use. It is not used by the INTRAC algorithm and, when it occurs in isolation without an alarm from the IBR-L, has no effect on the INTRAC operation or mode.

CONTRAST & BRIGHTNESS



Path — HOME - FUNCTION - SYSTEM SETUP - ENTER

or — From Models or Configuration
SYSTEM SETUP - ENTER

Description — The screen Contrast and Brightness can be adjusted in this menu.
The Contrast range is from 0 to 15 and the Brightness range is from 0 to 8.

The levels are set using Menu Key 3 for contrast and Menu Key 4 for brightness.
Each press of a key increases the displayed number by one and the screen brightness or contrast changes.

When the display is at its most visible press ENTER to store the values.
Menu Key 5 (Normal) sets the Brightness and Contrast to the default values which are 8 in both cases.

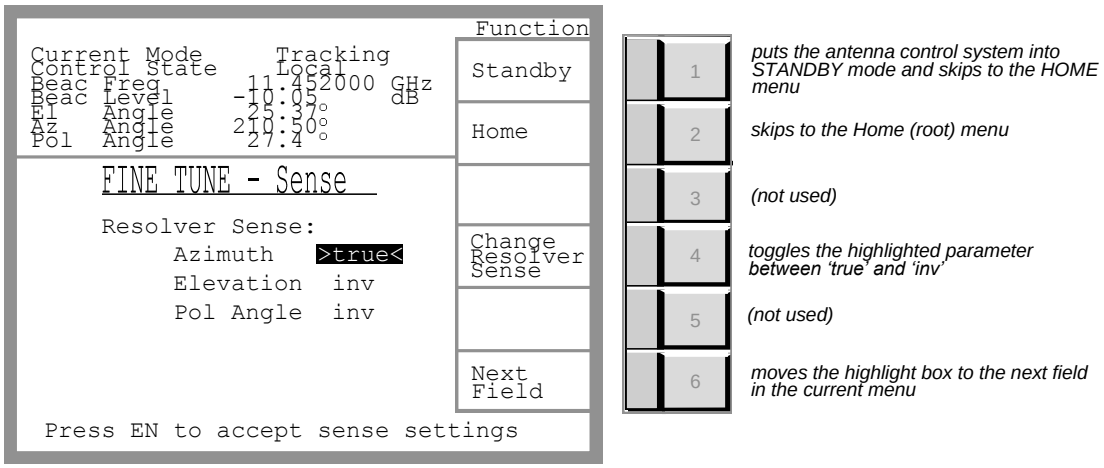
Note — The Flicker setting is not an operator controllable parameter.

Warning

When adjusting the brightness and/or contrast it is possible to blank the display! If this happens do not panic, continuing to press the same key will return the display to visible. Alternatively Menu Key 5 can be pressed which sets the default brightness and contrast levels. If a wrong key is pressed so that the INTRAC is no longer in the brightness and contrast setting facility, continuing to press keys could cause the loss of the orbit model.

In the INTRAC is out of brightness & contrast setting, carryout the following. Press the emergency stop button, switch the INTRAC off, release the emergency stop button, switch the INTRAC on. Press the following keys, allowing time between each pressing, press Menu Key 1, press Menu Key 4, press Menu Key 5, press Enter, press Menu Key 5, the display should now be visible. Check that no parameters have been affected by key presses when the display was blank.

FINE TUNE - sense



Path HOME - FUNCTION - SYSTEM SETUP - MENU KEY 6 (x2) - ENTER

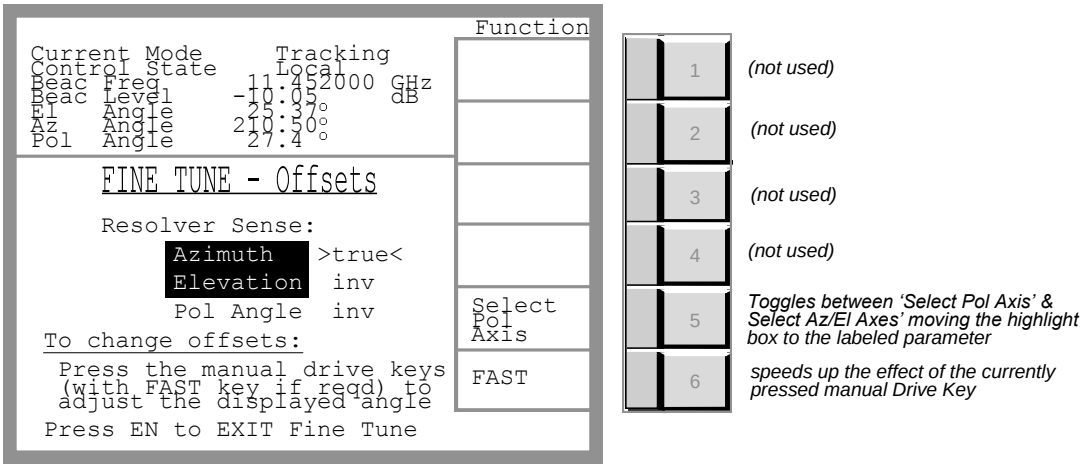
or From Models or Configuration SYSTEM SETUP - MENU KEY 6 (x2) - ENTER

Description This menu allows the “sense” of the Azimuth, Elevation and Polarisation resolvers to be inverted. This is necessary to allow for different mounting arrangements for the resolvers.

Use Menu Key 6 to step the edit highlight through the three angles. Use Menu Key 4 (Change Resolver Sense) to toggle between “true” and “inv.”

Pressing ENTER accepts the settings and moves on to the “FINE TUNE - Offsets” menu. (see next page)

FINE TUNE - Offsets



Path — See “FINE TUNE - Sense” on previous page.

Description — This menu allows an offset to be inserted between the “angle” from the resolver and the displayed angle in order to calibrate the system for any difference between the actual antenna angle and the resolver angle.

The actual pointing angles of the antenna are accurately established and the displayed angles are set to those angles using this facility.

Azimuth & Elevation or Polarisation are selected using menu key 5.

The setting of the offset is done using the manual drive keys. For Az & El the right and left keys offset the Az and the upper and lower keys offset the El. For Pol the right and left keys are used.

The angles displayed in the upper section of the menu screen change in real time. Menu Key 6 may be used together with the direction key to increase the rate of change.

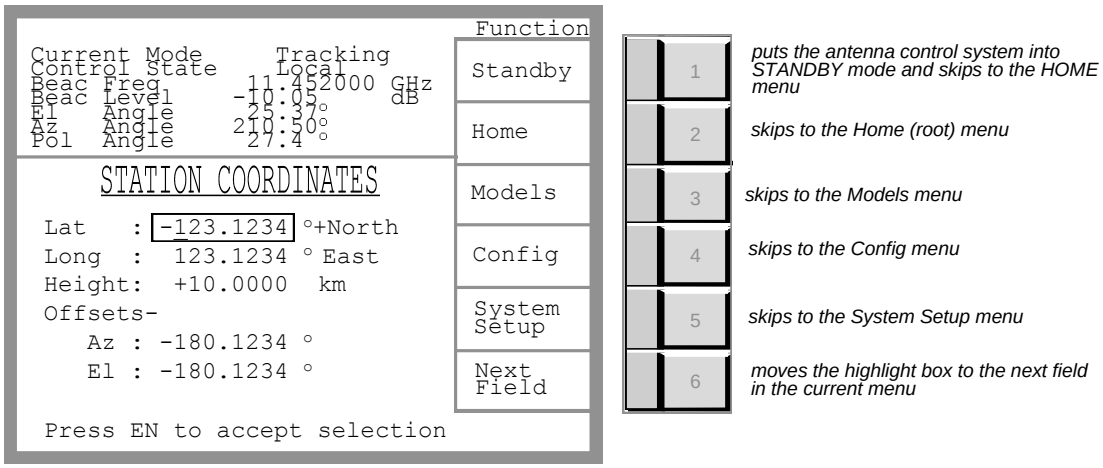
The actual amount of offset is not displayed.

The offset can be returned to zero for any angle by pressing the opposite keys at the same time.
Care should be taken to release both keys at the same time otherwise another offset will be inserted.

Note — This should only be carried out at commissioning or on the installation of a new resolver or if the relationship between the antenna and a resolver has changed.

Caution — **Inserting any offset will reset the orbit model.**

STATION CO-ORDINATES



Path — HOME - FUNCTION - SYSTEM SETUP - MENU KEY 6 (x2) - ENTER

or — From Models or Configuration
SYSTEM SETUP - MENU KEY 6 (x2)

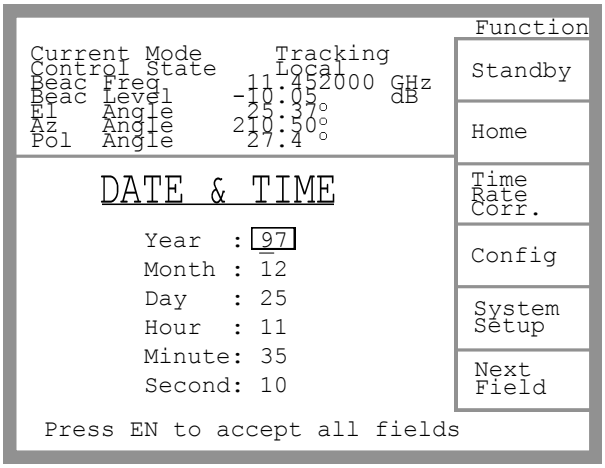
Description — The co-ordinates of the earth station are entered in this menu. Also any offsets required if the antenna base is not perpendicular.

The five edit fields are stepped through using Menu Key 6 (Next Field). The values are entered using the Numeric Keypad.

Pressing ENTER accepts the values.

Note — These parameters are not required by the INTRAC-505 for its orbit modelling. However they are required if IESS-412 or NORAD Ephemeris data is to be used and for Star Track Mode.

DATE & TIME



puts the antenna control system into STANDBY mode and skips to the HOME menu

skips to the Home (root) menu

moves to the Time Rate Correction menu

skips to the Config menu

skips to the System Setup menu

moves the highlight box to the next field in the current menu

Path — HOME - FUNCTION - SYSTEM SETUP - MENU KEY 6 (x3) - ENTER

or — From Models or Configuration
SYSTEM SETUP - MENU KEY 6 (x3) - ENTER

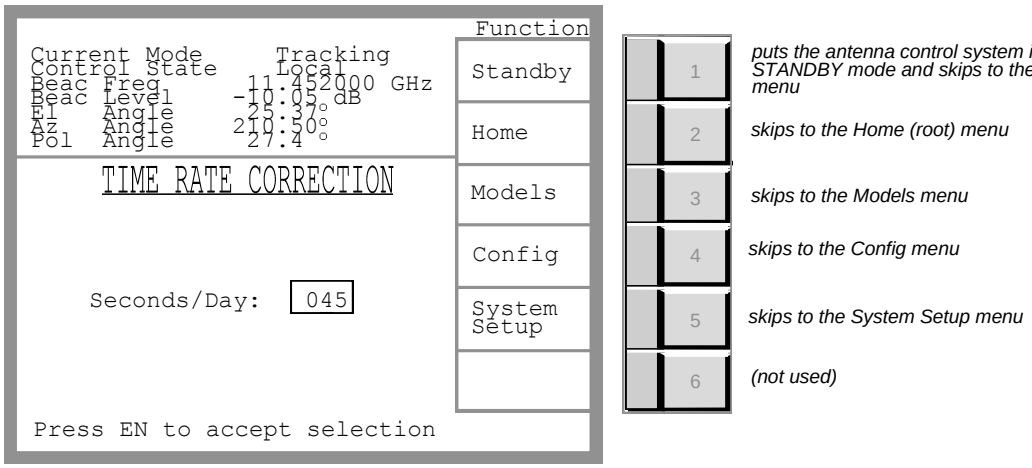
Description — The date and time are entered in this menu.
The edit box is stepped through the six fields using Menu Key 6 (Next Field). The values are entered using the Numeric Keypad. The clock uses the 24hr system.

Pressing ENTER accepts the values displayed.

Note 1 — The clock is battery backed.

Note 2 — The clock frequency can be adjusted by up to +/- 180 seconds per day in the “Time Rate Correction” menu which is accessed by Menu Key 3. (see next page)

TIME RATE CORRECTION



Path

HOME - FUNCTION - SYSTEM SETUP -
MENU KEY 6 (x3) - ENTER - MENU KEY 3

Description

Allows the time keeping accuracy of the clock to be adjusted.

The adjustment is in the range from minus 180 seconds per day to plus 180 seconds per day,

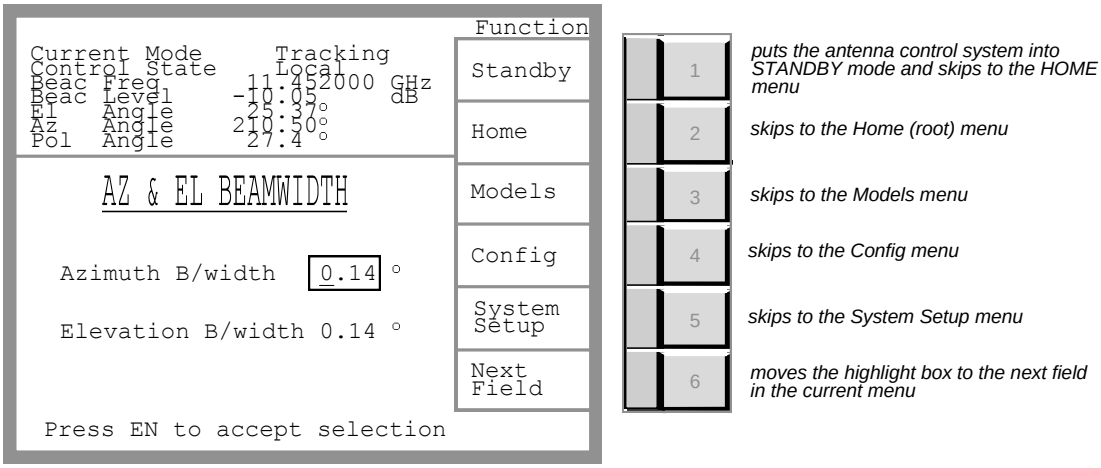
Use the Numeric Keypad to enter the value. The +/- key is used to set gain or loss.

Pressing ENTER accepts the displayed value.

Note

Changing the Time Rate Correction value does not affect the orbit model.

AZ & EL BEAMWIDTH



Path — HOME - FUNCTION - SYSTEM SETUP - MENU KEY 6 (x4) - ENTER

or — From Models or Configuration
SYSTEM SETUP - MENU KEY 6 (x4) - ENTER

Description — This menu enables the setting of the antenna's Azimuth and Elevation 3dB beamwidths at the beacon frequency. These values are used by the INTRAC-505 to calculate the cross scan movement.

The edit box is stepped between Azimuth and Elevation with Menu Key 6 (Next Field). The beamwidth values are entered from the Numeric Keypad.

Pressing the ENTER key accepts the displayed values.

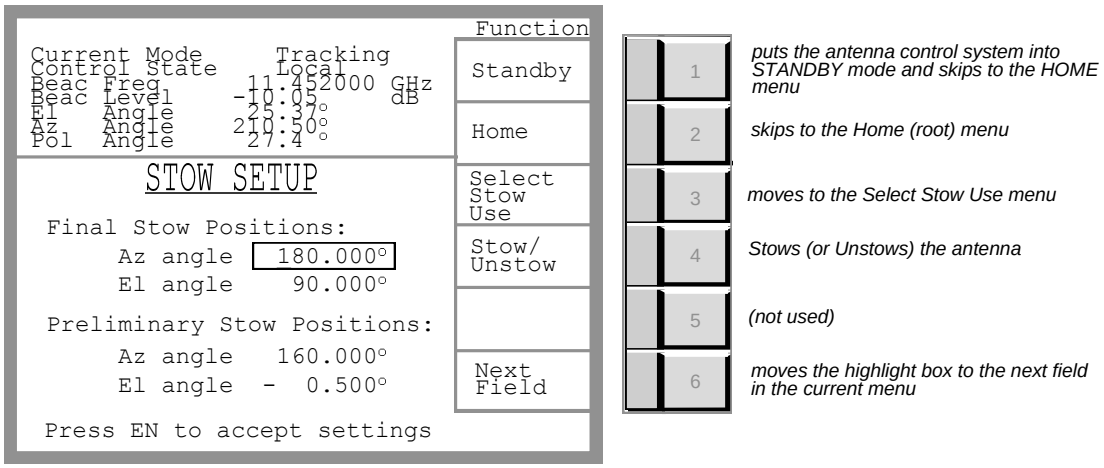
Beamwidth Select Control

Some INTRAC-505 units have a facility for selecting between two different beamwidths using a logic input (pin 5 of Aux 3 connector). When this option is implemented the function of MENU KEY 5 is changed to "Toggle Beamwith" and the screen title is prefixed by "Normal" or "Alternate".

The "Toggle Beamwidth" button is used to select whether to edit the "Normal" or "Alternate" beamwidths.

Refer to page 16, HOME, for information on the logic input used to switch between the two beamwidths.

STOW SETUP



Path — HOME - FUNCTION - SYSTEM SETUP - MENU KEY 6 (x5) - ENTER

or — From Models or Configuration SYSTEM SETUP - MENU KEY 6 (x5) - ENTER

Description — This menu is used to set the co-ordinates for the preliminary and final antenna stow positions.

With the antenna not in the Stow position pressing the Stow/Unstow key causes the antenna to be driven to the Final Stow Position via the Preliminary Stow Position.

Note — The Preliminary and/or Final positions may be set to “used” or “not used” in the “Select Stow Use” menu (Menu Key 3). (see next page)

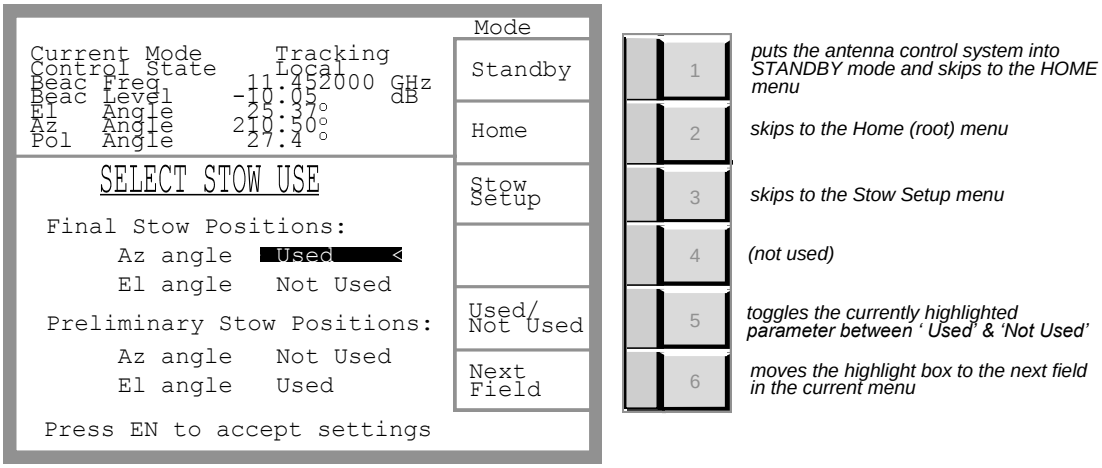
Menu key 6 (Next Field) steps the edit box through the four angle fields. The co-ordinates can be changed using the Numeric Keypad.

Notes — If all positions are enabled the antenna is driven, in both axes, to the Preliminary Stow Position. When both axes reach that position the antenna is driven to the Final Stow Position and, where appropriate, the Stow Pins are driven in.

Unstow removes the Stow Pins (if appropriate) and drives the antenna to the Preliminary Stow Position.

The only antenna command possible from the Stow Position is Unstow.

SELECT STOW USE



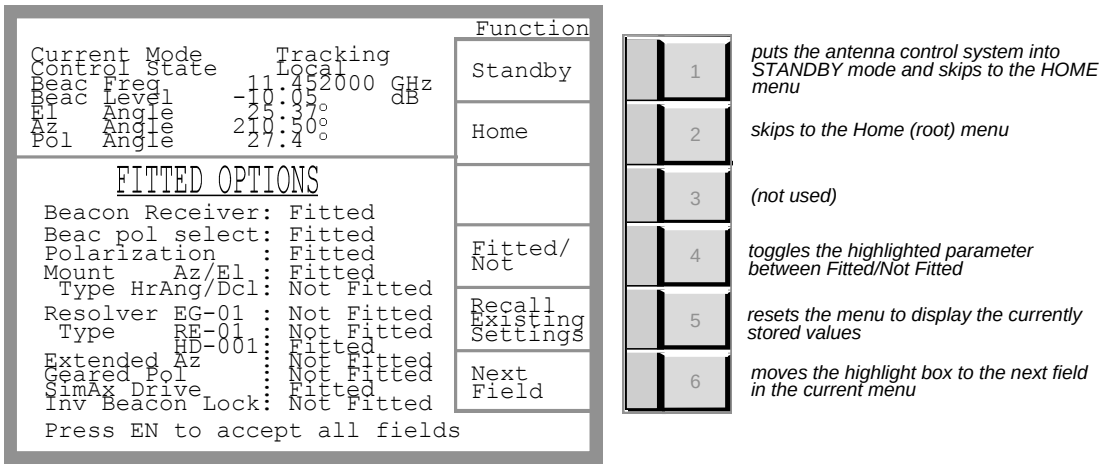
Path — MENU KEY 3 from “Stow Setup” on previous page.

Description — Allows the Azimuth and Elevation Preliminary & Final Stow Positions to be enabled or disabled.

Note — If both Preliminary Stow axes are disabled the antenna will drive direct to the Final Stow position on pressing the Stow key. If only one Preliminary axes is disabled the antenna will drive in the other axis to its Preliminary position before carrying on to the Final position.

Menu key 6 (Next Field) steps the edit highlight through the four fields. Menu Key 5 (Used/Not Used) toggles the selected field between used and not used.
Pressing ENTER accepts the displayed settings and returns to the “STOW SETUP” menu.

FITTED OPTIONS



Path HOME - FUNCTION - SYSTEM SETUP - MENU KEY 6 (x6) - ENTER

or From Models or Configuration SYSTEM SETUP - MENU KEY 6 (x6) - ENTER

Description

Various options such as polarisation drive and simultaneous axis drive are available on the INTRAC-505. Their use has to be programmed into the INTRAC in order for them to be usable. That programming is carried out in this menu.

The various options are shown on this screen.

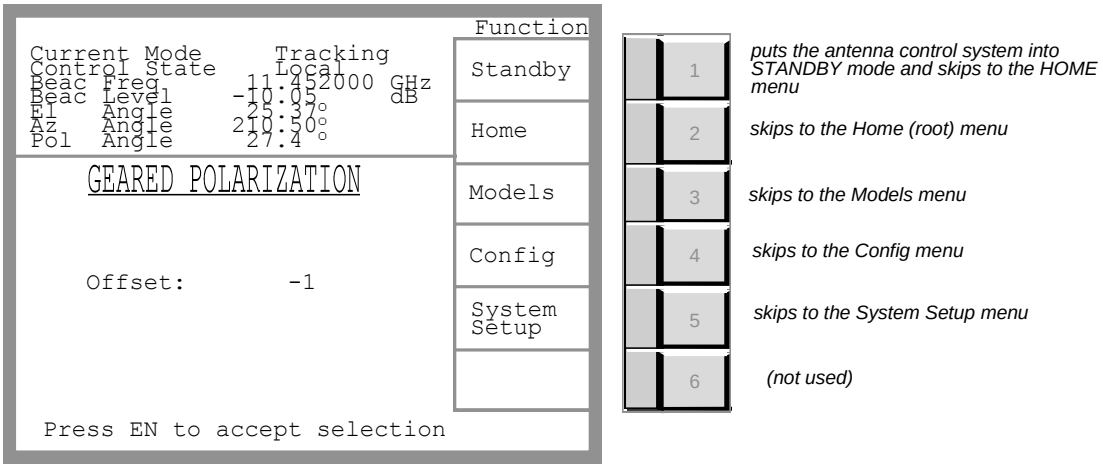
Menu Key 6 (Next Field) steps the highlighted edit line through the options.

Menu Key 4 (Fitted/Not) toggles the option between fitted and not fitted.

Menu Key 5 (Recall Existing Settings) resets the options to the state they were in when this menu was entered.

Pressing ENTER accepts the displayed settings.

GEARED POL



Path — HOME - FUNCTION - SYSTEM SETUP - MENU KEY 6 (x7) - ENTER

or — From Models or Configuration SYSTEM SETUP - MENU KEY 6 (x7)

Description — The polarisation resolver may be geared to the antenna polarisation mechanism in such a way that there is not a 1:1 relationship between the resolver rotation and the polarisation rotation. If this is the case a special version of software is required to include the gearing ratio which must be specified at time of order.

Typically the resolver rotates faster than the polarisation angle and there is initially an ambiguity as the INTRAC does not know which segment the polarisation angle is in. The offset value (integer) is used to define the segment so that the displayed polarisation angle is correct.

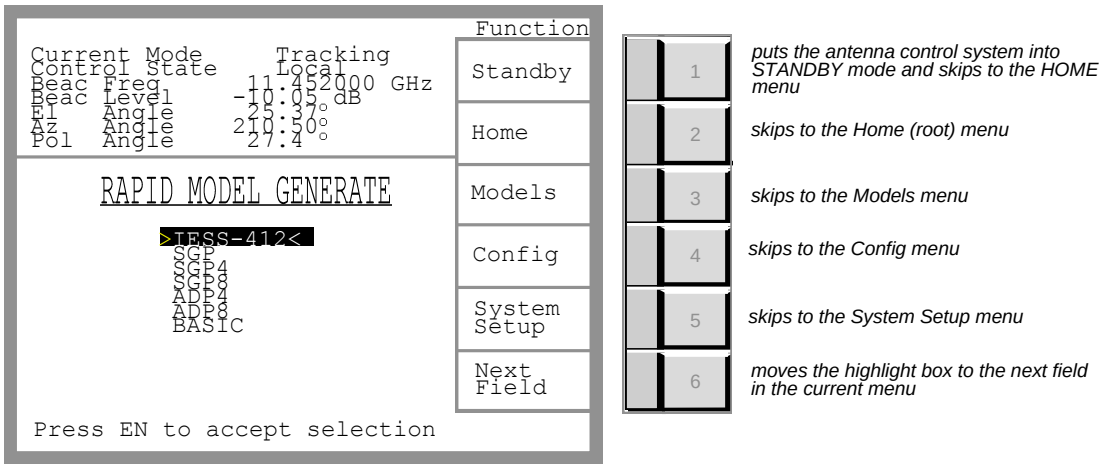
After the initial segment definition, provided that the polarisation is not adjusted with the INTRAC switched off, the INTRAC will track the angle throughout the entire polarisation range.

Note — It is set-up during commissioning and/or replacements only.

The offset value (between -3 and +2) is entered from the numeric keypad. Pressing ENTER accepts the displayed value.

Note — This menu is only available if “Geared Pol” is set as fitted in the “Fitted Options” menu. (see previous page)

RAPID MODEL GENERATE



Path — HOME - FUNCTION - MODELS - ENTER

or — From Configuration or System Setup
MODELS - ENTER

Description

IESS-412 & NORAD ephemeris data can be loaded into the INTRAC-505. This data is primarily for Program Track use. HOWEVER the INTRAC-505 can use this data to generate an ORBIT MODEL for the satellite. The advantage of this is that the model is available immediately rather than after the 24hrs it would take if the INTRAC had to learn the orbit. The INTRAC is then immediately immune to long beacon outage or power failures.

The INTRAC will accept the ephemeris data two days either side of the data's actual validity period.

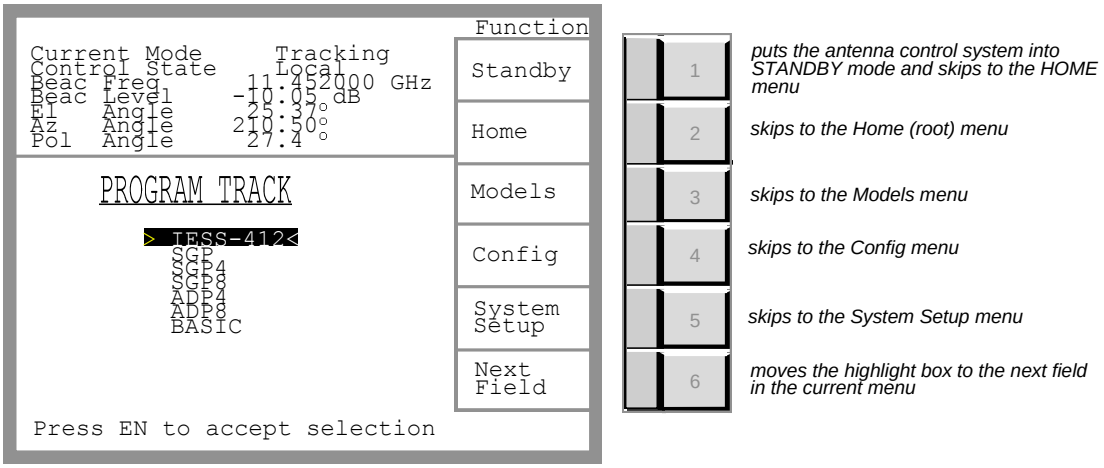
The SGP/SDP modelling algorithms for the NORAD data will give slightly different pointing results for a given set of data. Except that the SGP4/8 algorithms are for Near Earth orbits and SDP4/8 are for Deep Space orbits. (Geostationary Orbits are SDP). The INTRAC will not allow a model to be made using the wrong type of orbit algorithm.

It is assumed that the user will know which NORAD algorithm applies for the data being used.

Menu Key 6 (Next Field) steps the selecting highlight through the seven selections. Once the required selection is highlighted pressing ENTER causes the model to be generated and the INTRAC to enter Tracking Mode.

Note — For more information on working with IESS-412 & NORAD data see page 68.

PROGRAM TRACK



Path — HOME - FUNCTION - MODELS - MENU KEY 6 - ENTER

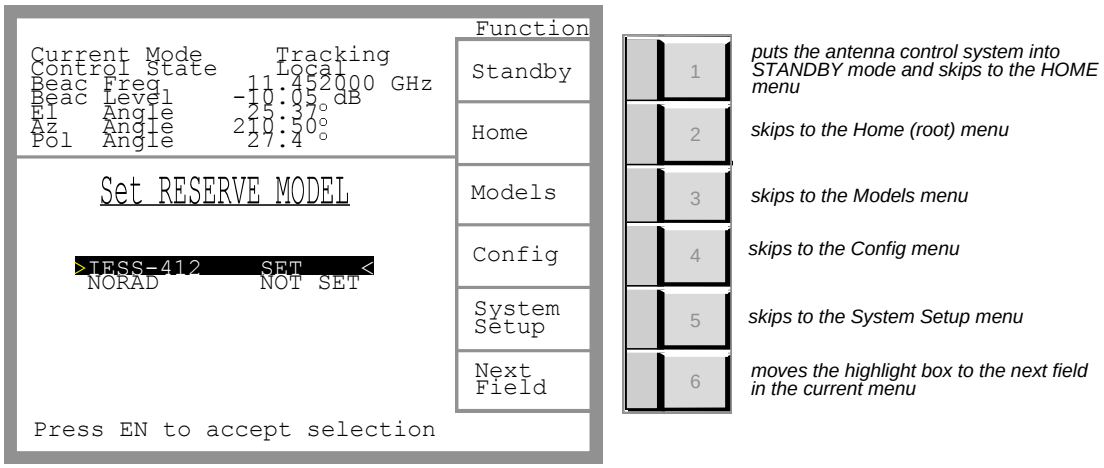
or — From Configuration or System Setup
MODELS - MENU KEY 6 - ENTER

Description — IESS-412 or NORAD ephemeris data can be used, if required, to operate the INTRAC-505 in Program Track mode.

Note — Much better tracking is achieved by the INTRAC either building an orbit model from its learning mode or by generating an orbit model from IESS-412 or NORAD data.

Menu Key 6 (Next Field) steps the highlighted selection bar through the seven algorithm selections. Pressing ENTER accepts the highlighted selection and initiates IESS Track mode, i.e., Program Tracking.

RESERVE MODEL



Path HOME - FUNCTION - MODELS -
MENU KEY 6 (x2) - ENTER

or From Configuration or System Setup
MODELS - MENU KEY 6 (x2) - ENTER

Description Once the INTRAC-505 has built an orbit model it can track the satellite with no tracking signal for 72hrs. After this time if there is still no signal the INTRAC deems the model to be expired and ceases to track.
In such a situation the INTRAC can fall back into Program Track mode using the “Reserve Model”.

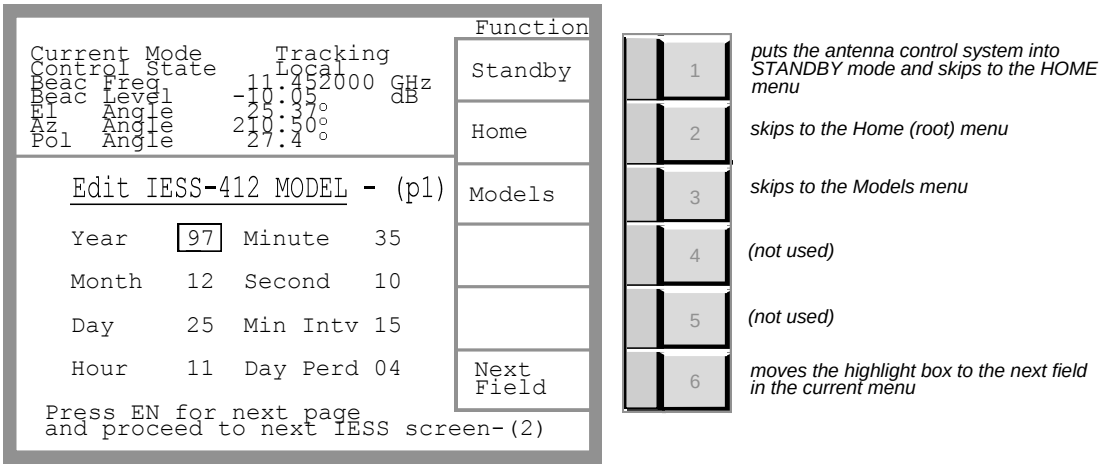
The “Reserve Model” requires that valid IESS-412 or NORAD data be loaded and that the required reserve model is selected.

In this menu the required reserve model, IESS-412 or NORAD is set.

Menu Key 6 (Next Field) steps through the two selections. Pressing ENTER accepts the highlighted selection.

Note The words SET and NOT SET following IESS-412 and NORAD refer to the previous selection. Pressing ENTER will make the highlighted selection SET and the other NOT SET regardless of the current displayed state.

EDIT IESS-412



Path — HOME - FUNCTION - MODELS -
MENU KEY 6 (x3) - ENTER

or — From Configuration or System Setup
MODELS - MENU KEY 6 (x3) - ENTER

Description — This menu is used to input IESS-412 data. It comprises three screens the first of which is shown above. The full IESS-412 data is entered into the three screens. Pressing enter after all the data has been entered causes a check to be made on the data for validity. If the check is OK the data is accepted.

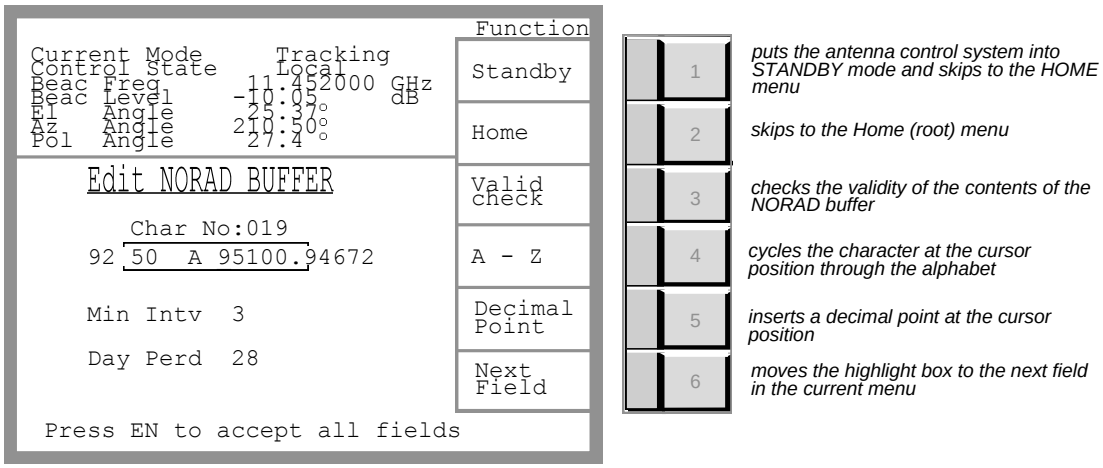
For more information on working with IESS-412 data see page

Menu Key 6 (Next Field) steps the edit box through the edit fields. The data is input using the numeric keypad. Pressing ENTER steps onto the next page.

Menu Key 4 returns to the first page from page two or page three. Pressing ENTER on page three causes the data to be checked and accepted if valid.

Note — In the IESS-412 data supplied the LMO value is in the range -180° to +180°. The INTRAC-505 cannot accept negative values for this field from the front panel. (It can from the RCM-4) It is therefore necessary to add 180° to the supplied value when entering from the front panel.
This only applies to the LM0 data field.

EDIT NORAD BUFFER



Path — HOME - FUNCTION - MODELS -
MENU KEY 6 (x4) - ENTER

or — From Configuration or System Setup
MODELS - MENU KEY 6 (x4) - ENTER

Description — This menu is used to input NORAD Ephemeris data.

Menu Key 6 (Next Field) steps the edit box through the three entry fields. The NORAD string data is entered in the top box. Char No: ___ indicates the position of the cursor in the data string. As the cursor reaches the right end of the edit box the data scrolls.

Data is entered/edited using Menu Keys 4 & 5 (A - Z and Decimal Point) and the Numeric Keypad.

To enter an alphabet character position the cursor and press Menu Key 4. Each press steps the character at the cursor position through the alphabet.

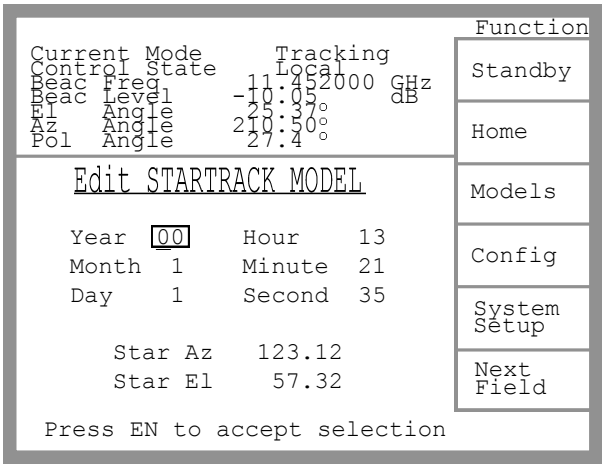
Menu Key 5 inserts a decimal point at the cursor position.

The +/- key on the Numeric Keypad inserts a - or a space at the cursor position. One press inserts a - and the next a space.

Note — Inserting a number causes the cursor to step to the next character position. However inserting a letter, a - or a space does not and the → key must be used to move on.

Min Intv = Minimum Interval
Day Perd = Day Period

EDIT STAR TRACK



puts the antenna control system into STANDBY mode and skips to the HOME menu

skips to the Home (root) menu

skips to the Models menu

skips to the Config menu

skips to the System Setup menu

moves the highlight box to the next field in the current menu

Path — HOME - FUNCTION - MODELS -
MENU KEY 6 (x5) - ENTER

or — From Configure or System Setup
MODELS - MENU KEY 6 (x5) - ENTER

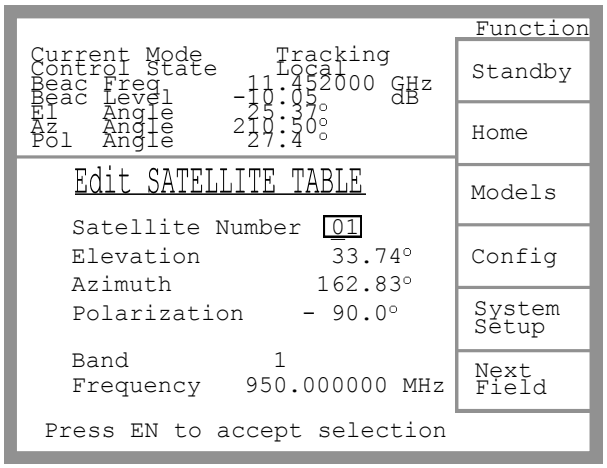
Description — The Star Track Model keeps the antenna pointed at a specific star by compensating for the rotation of the earth.

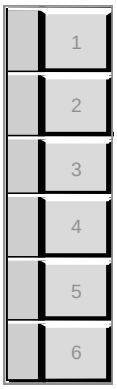
It requires the co-ordinates of the star to be input together with the date and time of those co-ordinates.
The model is then built using above data and the Station Co-ordinates. (see Station Co-ordinates menu on page 38)

Menu Key 6 (Next Field) steps the edit box through the eight data fields. The data is entered using the Numeric Keypad. Pressing ENTER accepts the displayed data and enters Star Track mode.

Note — This facility is used for engineering purposes.

EDIT SATELLITE TABLE





puts the antenna control system into STANDBY mode and skips to the HOME menu

skips to the Home (root) menu

skips to the Models menu

skips to the Config menu

skips to the System Setup menu

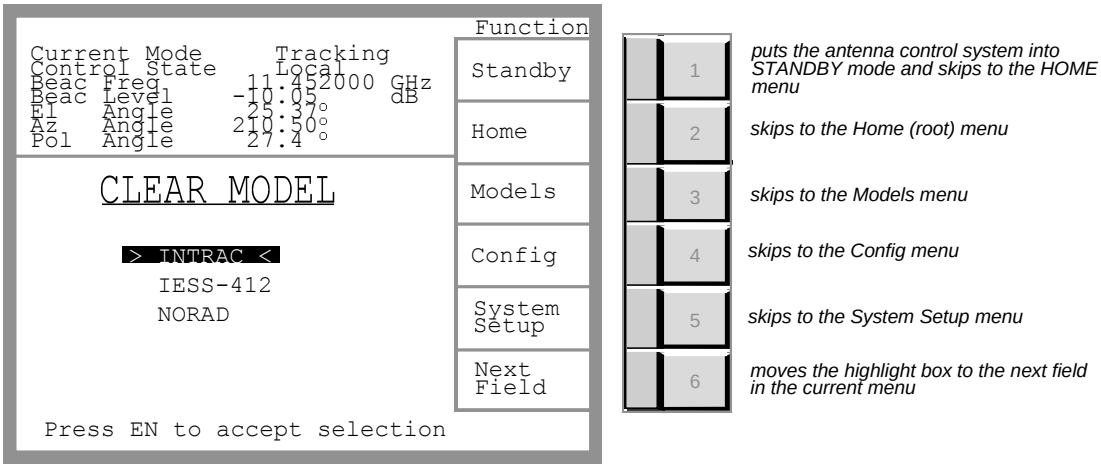
moves the highlight box to the next field in the current menu

Path — HOME - FUNCTION - MODELS - MENU KEY 6 (x6) - ENTER

or — From Configuration or System Setup MODELS - MENU KEY 6 (x6) - ENTER

Description — This is the same menu as “Edit Satellite Table” under the Configuration Menu. (see page 28)

CLEAR MODELS



Path — HOME - FUNCTION - MODELS -
MENU KEY 6 (x7) - ENTER

or — From Configuration or System Setup
MODELS - MENU KEY 6 (x7) - ENTER

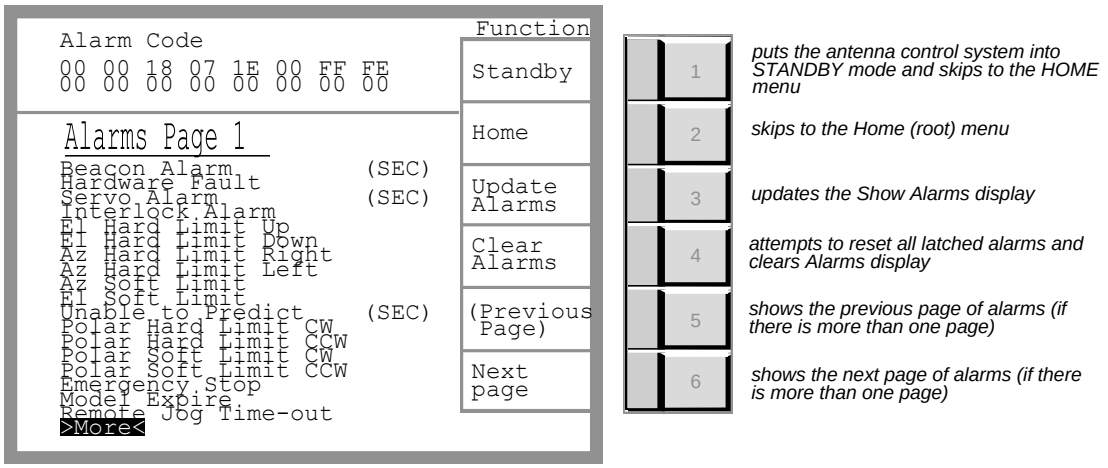
Description — With this menu the actual INTRAC orbit model is cleared or the IESS-412 data and/or the NORAD data is flagged as being no longer valid.

If, after clearing the INTRAC model, Auto Continue is pressed the INTRAC enters Learning Mode.

If, after clearing the IESS-412 Model, IESS412 is selected for “Rapid Model Generate” or for “Program Track” the INTRAC enters the “Edit IESS-412” menu for the data to be updated.

Similarly if NORAD is selected for “Rapid Model Generate” or “Program Track” after the NORAD Model has been cleared the INTRAC enters the “Edit NORAD” menu for the data to be updated.

SHOW ALARMS



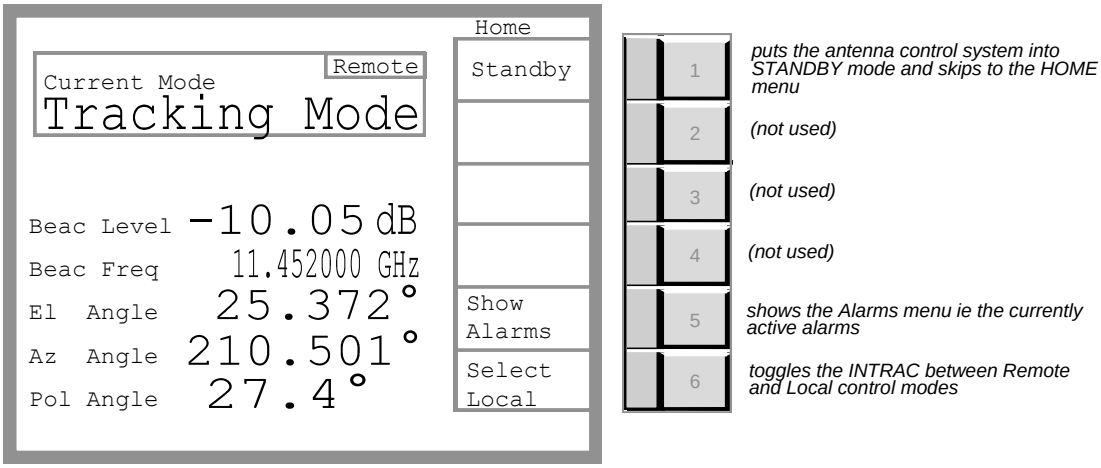
Path — HOME - SHOW ALARMS (Menu Key 5)

Description — This screen shows all the currently active alarms, both primary and secondary. If there are more alarms active than can be displayed on one page “MORE” is appears at the bottom of the screen. Menu Keys 5 & 6 can then be used to move through the pages of alarms. If there is only one page of alarms Menu Keys 5 & 6 are not labelled.

Primary alarms will cause the System Alarm indicator to illuminate drawing attention to the fact that an alarm has become active. Secondary alarms do no illuminate the indicator but will still be displayed on the alarms screen even if there are no primary alarms.

Note — The alarm conditions do not update automatically whilst being displayed. To check if an alarm state has changed press Menu Key 4 (Clear Alarms) to clear the display. Follow this by pressing Menu Key 3 (Update Alarms) to display the current alarm state.

REMOTE/LOCAL



Path HOME - MENU KEY 6

Menu Key 6 toggles the INTRAC-505 between Local (Front Panel) and Remote control/operation.

Compare the above screen (remote selected) with the one for the Home menu (local selected).

With Remote selected only three functions are available on the front panel. The ability to display the active alarms (Show Alarms), the ability to select Standby and the ability to return control to Local.
All other menu functions are transferred to the Remote Terminal.

Note Because the Diagnostics On/Off selection in the Configuration Menu affect the Remote Port (see page 32) in order to be able to use the Remote Terminal facility Diagnostics MUST be set to OFF.

NORMAL OPERATION

Continuing Tracking

With the INTRAC-505 operating normally it will be in Tracking Mode and will require no operator input.

Should it become necessary to move the antenna off satellite for some reason, such as to stow it because of wind, all that is required to resume tracking is to select Auto Continue. (after the antenna has been unstowed)

To Track a new Satellite

Set the Beacon Frequency.
Set the Polarisation angle if motorised Pol fitted.
Point the antenna at the required satellite using Manual control, Goto Position or Goto Satellite.
Peak the antenna on the beacon signal using Manual control or Search.

When the antenna is peaked on the beacon signal cause the INTRAC to enter Learning Mode by selecting Auto New Model.

After 24 hours of learning the INTRAC will automatically enter Tracking Mode.

Note

If Auto Continue is selected instead of Auto New Model and the previous model has not been cleared the antenna will drive back to the previous satellite and continue tracking it.

If the beacon signal is lost the INTRAC will enter Predicting Mode. It will then track the satellite by predicting from the model for a period of time depending on how long it has been learning. If Tracking Mode had been achieved before the signal is lost the INTRAC will track in Predicting Mode for up to 72 hours after which time it will deem the model to no longer be accurate enough.

When the beacon signal returns, if the INTRAC is still in Predicting Mode, Tracking Mode will be resumed. If the INTRAC has entered Standby, due to the period without signal being too long, Learning Mode will have to be invoked from the front panel.

4. ALARMS & ERRORS

The INTRAC-505 has two type of alarm condition. Primary Alarms and Secondary Alarms. The system will go into Standby mode if a Primary Alarm is triggered. Secondary Alarms leave the INTRAC in its current mode.

PRIMARY ALARMS

A Primary Alarm becomes active if one (or more) of the following conditions arise :-

- Antenna movement limit switch activated.
- Software limit tripped.
- Emergency Stop button operated.
- Interlock switch activated.
- Motor drive failure. (Drive Fail Alarm)
- Antenna moves in wrong direction. (Drive Fail Alarm)
- Hardware (processor) fault.
- Antenna driven within 1.4° of 0° Az in the Northern Hemisphere or within 1.4° of 180° Az in Southern Hemisphere (Drive Fail Alarm).
- Resolver fault. (Synchro alarm) (apparent position change of more than 1.4° in $^{1}/_{64}$ second).

Drive Fail Alarm

The Drive Fail Alarm encompasses a number of other alarms. If there has been no change in the least significant bit (LSB) of the resolver output within 10 seconds of drive being activated. If either Az or El axis drive more than 1.4° in the wrong direction. If the antenna is driven within 1.4° of North (Azimuth 0°) {or 1.4° of South (Az 180°) Southern Hemisphere}.

The Drive Fail Alarm is not activated in Manual (P) Mode.

If a drive time-out occurs the INTRAC enters Standby Mode. This prevents the drive motors being damaged by continually re-starting.

When any Primary Alarm becomes active the red “System Alarm” indicator on the INTRAC front panel illuminates and the system enters Standby Mode. The actual alarm which has occurred can then be viewed on the screen by pressing Menu Key 5 (Show Alarms) in the Home menu.

SECONDARY ALARMS

There are three Secondary Alarms :-

- Unable to Predict Alarm.
- Beacon Alarm.
- Servo Alarm.

Unable to Predict

This alarm is raised when the INTRAC has not enough confidence in the orbit model to be able to predict the satellites position. e.g. during the early part of learning a new model or after there had been no beacon signal for more than 72 hours.

Beacon Alarm

The Beacon Alarm is raised when the signal strength does not vary during step cycles or when beacon lock is lost.

Servo Alarm

The Servo Alarm is raised when the INTRAC fails to detect the expected amount of antenna movement during a step cycle. This can be caused by the servo performance not corresponding to the routine's model of the antenna drive characteristics. The INTRAC reacts by repeating the step cycle with a larger drive demand.

Secondary Alarms do not, necessarily, mean that there is a system fault nor do they illuminate the System Alarm indicator. The occurrence of a secondary alarm may be checked by selecting Show Alarms in the Home menu.

ALARM OUTPUTS

Three sets of changeover relay contact outputs are available on a 25-way D-type connector on the INTRAC rear panel. There is one relay for a Primary Alarm, one for a Secondary Alarm and the third indicates that the beacon signal has fallen below the user set beacon threshold.

RECOVERING FROM ALARMS

All Primary Alarms, except the Hardware Alarm in Auto Mode, cause the unit to be put into Standby Mode. Recovery from Drive Fail, Synchro and Hardware (other than when in Auto Mode) Alarm conditions are cleared by pressing any Mode selection key. Soft Limit and hard limit alarms can only be cleared by driving back from the limit using Manual Mode. Emergency Stop and Interlock alarms can only be cleared by removing the cause of the alarm.

If a Hardware Alarm occurs when the INTRAC is in Auto Mode the unit will perform a processor reset and then enter learning mode to re-learn the orbit model.

POWER FAILURE

The INTRAC incorporates non-volatile memory and a battery backed real time clock. The onset of a power failure is detected and the current mode is stored before the processor ceases to operate. When power is restored the INTRAC performs an automatic recovery as below :-
If the unit was in Auto (Tracking) Mode at the time of the power failure and no Primary Alarms have become active the unit will resume tracking. The antenna will be moved (if necessary) to the current satellite position based on the orbit model and the real time clock.

If the unit was in Auto (Learning) Mode it will resume in that mode. However whether it continues learning or re-starts to learn depends on the ratio of the completed learning time to the period without power. (i.e. how dependable the learnt orbit will now be)

If the INTRAC was in any other Mode or if a Primary Alarm had occurred the unit will power up in Standby Mode with a power-up alarm.

ERRORS

Errors are user errors and involve the entry of non valid data.

Where data is entered outside the allowable limits for that data such as setting the beacon frequency outside the range of the selected band. The entered data is changed to the limit nearest to the entered value and marked with an asterisk (*). On the bottom of the screen the message :-

"ENTRY ERROR!, limits forced =*"

is displayed.

The forced limit data may be accepted by re-pressing the ENTER key or the correct value keyed in.

IESS-412 DATA

Where IESS-412 data is entered with the incorrect 170hr checksum the checksum is corrected by INTRAC in the same manner as above. However it is up to the user to ascertain that it was the checksum which was wrong and not that wrong value data was entered.

Deliberately blank

5. TECHNICAL DESCRIPTION

This section looks at and explains the Operational Modes and Functions of the INTRAC-505 and at the tracking algorithm that makes the INTRAC-505 one of the most accurate tracking antenna controllers available.

The INTRAC-505 achieves its very high accuracy satellite tracking by building a model of the satellite's orbit and then by using that orbit model to direct the antenna.

The algorithm used to build the orbital model has been continually developed and enhanced by Advantech AMT Ltd. Since 1983.

The tracking accuracy is typically similar to that achieved by a monopulse system and can, under some conditions, be better than that achieved by a monopulse system.

THE TRACKING ALGORITHM

During initial acquisition the INTRAC algorithm tracks the satellite using a third order (for each axis) unbiased tracking filter. This algorithm dynamically adjusts the period between the step cycles to match the perceived orbit inclination and received beacon signal level fluctuations and noise level. During this initial period the tracking accuracy is only very slightly lower than the full long term INTRAC tracking accuracy.

The most significant difference during the learning period (first 24hrs) is not the accuracy of tracking but the time for which the system can predict in the event of loss of the beacon signal. This can be overcome by using Intelsat IESS-412 or NORAD data to establish an initial INTRAC model so that the full prediction ability is available from the start. This model is then modified and optimised by the INTRAC algorithm in the same manner as it would continuously update a model it had "learnt".

The key to deriving a reliable and accurate orbital model is the ability to derive accurate estimates of the many parameters involved in the model. Much specialised noise processing expertise and experience has been applied in the design of the INTRAC algorithm to ensure that INTRAC can build an accurate model and can maintain it even when the beacon signal is subject to severe fluctuations.

The INTRAC algorithm uses a robust pointing error estimator to obtain the raw satellite position estimate, normally at 10 minute intervals. The raw satellite position estimate is filtered with a narrow noise-bandwidth tracking filter to produce the basic, multi parameter, orbital model. To correct short-term errors in the basic model resulting from modelling error, windage and satellite station keeping manoeuvres, the difference between the raw satellite position estimate and the

orbital model is filtered with another tracking filter (known as the "relationship algorithm") capable of tracking and correcting transients. This is then combined with the basic model to form a reliable predictor that tracks mean windage, refraction and stationkeeping manoeuvres without error.

The INTRAC tracking filters are designed in such a way as to enable the model to provide the required accurate pointing prediction at all times. Even when not verified by measurements, as for example occurs with loss of beacon, the tracking filters are capable of accurately predicting the satellite orbit for many days. Under INTRAC control, pointing is always controlled from the internal satellite orbit model. When a measurement cycle is performed it is always done as a perturbation with respect to current pointing. Thus, unlike conventional steptrack, INTRAC is always on track when a measurement cycle is performed. INTRAC never uses the measurement cycle for the purpose of directly bringing the beam on track. INTRAC simply performs one measurement cycle in each axis every 10 minutes in order to up-date the parameters used in the orbital model and for the rest of the time keeps the beam correctly pointed.

As a result of the combination of thermal noise, fade, scintillation, random windage-induced platform-reference motion and other noise sources the beacon signal will, during a measurement cycle, contain noise additional to that directly attributable to the measurement cycle itself. Careful algorithm design ensures that this noise has zero mean value and has a value of standard deviation such that it is equivalent to thermal noise of a certain effective value of C/No. By special design of the measurement cycle the INTRAC system minimises this effective value of C/No in a way that is not possible with conventional steptrack methods. Furthermore the INTRAC measurement cycle design discriminates so effectively against the slow component of received beacon signal power fluctuation, caused for example by rain fades, that it almost completely suppresses errors caused by linear beacon ramps of all practicable slopes.

The INTRAC algorithm also incorporates adaptive compensation for imperfections in the antenna drives. As a result its performance is largely unaffected by servo backlash, AC track motor drive rate and transportation rate (motor to axis rate) and coast because of the specific choice of perturbation pattern and the use of high resolution position transducers. The INTRAC servo algorithm dynamically calibrates the mechanical coast of the antenna and automatically compensates for it if it is within reasonable limits (less than 1/20 beamwidth).

Wind affects tracking in two ways. The antenna structure is distorted by the wind load and this distortion shifts the beam pointing relative to the angle transducer reading. This component of beam shift is not visible to the position transducers. The mean of the reference shift is tracked by the

INTRAC algorithm in a similar way to a stationkeeping manoeuvre.

The component of beam shift that is visible to the position transducers is entirely tracked by INTRAC within a 10 MHz noise bandwidth. When the position transducers accurately reflect beam deflection in wind INTRAC continuously tracks this antenna deflection at 16 sec updates. To support tracking of visible wind-induced beam deflection between measurement cycles the INTRAC servo control algorithm maintains a short-term average of beam pointing. When deciding whether to update beam pointing INTRAC references this average rather than the current pointing. A further small deadband is also applied to suppress unnecessary hunting.

The INTRAC tracking filter distinguishes received beacon signal power fluctuations, fades and noise from the mean component of windage-induced beam-pointing, orbit changes and beam refraction. The effect of the fluctuations, fades and noise on the INTRAC tracking filter is as if these were a zero mean position random noise source. The variance of these is brought within specification by tracking the position estimates with a narrow noise bandwidth tracking filter. The mean components of windage-induced beam-pointing, orbit changes and refraction are seen as transients to be tracked by the INTRAC relationship algorithm. The design of the relationship algorithm is a carefully evolved working compromise between transient performance and noise suppression which provides high accuracy tracking under all conditions likely to be encountered in practice.

THE MODES

The INTRAC-505 has six major operational modes :-

- Standby
- Auto - (tracking but includes learning & predicting)
- Manual
- Goto - (Goto Satellite, Goto Position & Search)
- Sleep - (alarm induced, not user selectable)
- Remote (transfers control to a remote terminal)

Standby

Standby mode is a “no movement” mode, the antenna is not driven (the brakes where fitted will be applied) but the pointing angles and beacon signal level are monitored and displayed. External inputs to the INTRAC are also monitored and any primary alarms which occur are indicated. Any primary or secondary alarms will be displayed if “Show Alarms” is selected.

Standby mode is entered in one of three ways :-

- selected by the operator
- a primary alarm occurs
- at the end of a Goto move or at the end of a search

Auto (normal operating mode)

After pointing and peaking the antenna at the required satellite Auto New Model should be selected. This will cause the INTRAC to enter its period of learning the satellite’s orbit.

The INTRAC performs cross scans to determine the satellite’s position. These scans are performed at intervals (normally ten minutes but more frequently if INTRAC deems necessary) and the pointing parameters used to build the orbital model. When carrying out a cross scan the antenna describes a small cross (normally +/- 5% of the antenna’s 3dB beamwidth) in the sky to determine the satellite position estimate.

After 24hrs the INTRAC has built the full orbital model. However during the building process the INTRAC maintained a simple orbit model for the satellite which allowed INTRAC to track with very nearly the same accuracy as its long term accuracy.

Once the model is complete the INTRAC enters Tracking Mode. The model is used to point the antenna and because of

the high accuracy of the model the tracking is within 0.05dB of peak signal tracking.

In Tracking Mode the INTRAC continuously updates the model by making small perturbations of the antenna and incorporating the resultant data into the model. During periods when the satellite's orbit is changing because of station keeping manoeuvres the INTRAC may increase the frequency of the perturbations.

If the beacon receiver stops providing a useful signal* the INTRAC will enter "Predicting" sub mode. In this mode the INTRAC will continue to point the antenna according to the model but will not update the model. Once "Tracking Mode" has been achieved "predicting" can continue for 72hrs. If the beacon receiver returns to providing a useful signal* within this period the INTRAC returns to updating the model. If, after 72hrs, the beacon is still not producing a useful signal* the model is deemed to have expired. If this occurs the INTRAC can fall back on the "Reserve Model" which is a Program Track using either IESS-412 or NORAD data. (see Reserve Model - page 48)

* useful signal — A useful signal is defined as one that varies sensibly during antenna movements, is neither over or under range and the beacon receiver is in lock.

Manual

Manual Mode allows the operator to drive the antenna using the Manual Control keys on the INTRAC front panel. It is normally only used for small movements of the antenna such as peaking when the position of the satellite is known with close accuracy.
For larger antenna movements one of the Goto modes is faster and where the satellite's position is only roughly known search is employed to peak the antenna.

There are two Manual Modes. Manual (P) Mode is manual control from the front panel. Manual (A) Mode is manual control from the Remote Terminal. (see section 9). The antenna can be driven through North (Azimuth 0°), in the Northern Hemisphere, or South (Az 180°), in the Southern Hemisphere, only in Manual (P) Mode.

Goto

There are three Goto sub modes. Goto Position and Goto Satellite provide a convenient method of driving the antenna to a specific position. Search mode is the automatic scanning of an area of sky for a satellite.

Goto Position

In this mode the operator enters the co-ordinates and beacon frequency of the required satellite and presses the enter key. The entered co-ordinates are checked for validity (i.e. are they within the soft limits?). If they are invalid the INTRAC sets the maximum possible angle(s) in the required direction and

prompts the operator for action. If the co-ordinates are valid the INTRAC drives the antenna to those co-ordinates and enters Standby. The antenna can then be peaked using manual mode or search mode (see below) before selecting Auto New Model.

Note

If Auto Continue is selected at the end of Goto and there is a model in existence the INTRAC will continue to track using that model. To commence learning a new orbit either Auto New Model should be selected or any existing model cleared before selecting Auto Continue.

Goto Satellite

This mode allows one of the previously programmed satellites (up to 40 can be programmed) to be selected by number and its position driven to. Using the "Edit Satellite" sub menu of the Goto Satellite menu a new satellite can be added or an existing one edited. Having selected the required satellite pressing the enter key causes the antenna to be driven to that satellite. The INTRAC enters Standby when the antenna is at the satellite's position. Antenna position peaking can then be carried out manually or in search mode (see below). To commence tracking this new satellite select Auto New Model or if there is no existing model Auto Continue may be selected. (see Note above)

Search

Search Mode conducts a search of the sky based on parameters entered in this menu. When the menu is entered the displayed parameters are those of the current antenna pointing. e.g. the parameters from a Goto move. If these parameters are not those required they may be edited in this menu. (see page 21)
The search box size angles are plus and minus on the nominal angle. Thus entering 2° by 2° would cause a search box of 4° square.

The search begins in the nearest corner of the defined box to the antenna's current pointing. The search pattern is a "toast rack" or "serpent shape. The scanning comprises full scans in elevation for each move in azimuth. The azimuth move is equal to the 3dB beamwidth of the antenna commencing $^1/_2$ of the 3dB beamwidth in from the edge of the box.
The position of the highest beacon signal strength during these scans is recorded. At the end of the "serpentine" search the antenna is driven to the point of highest signal strength found during those scans and phase two of the search is commenced.
This is the peaking phase and causes the antenna to search a smaller area of sky around the point of highest signal strength for the peak level. Again the position of the highest signal strength is recorded and at the end of this phase the antenna is driven to that position and the INTRAC enters Standby. At this point the peak may be confirmed manually and/or learning mode entered by selecting Auto New Model.

Sleep

Sleep Mode is the mode the INTRAC enters when it cannot drive the antenna due to some disabling occurrence. INTRAC continues to monitor the occurrence and when it has cleared antenna drive control continues.

Sleep mode is entered under three conditions.

1. if the antenna is unable to be driven due to a power failure at the Motor Drive Cabinet (which does not affect the INTRAC itself).
2. if the Motor Drive Cabinet is switched into local control.
3. if an interlock switch is operated.

Conditions 2 & 3 are detected by the INTRAC by the Interlock alarm becoming active.

Condition 1 is detected by all four direction limit switches becoming active. This occurs because relays are normally operated and drop out with no power.

The Primary alarm is activated and the INTRAC screen displays “SLEEP”.

When the condition causing Sleep mode ceases the INTRAC will attempt to return to the mode it was in prior to Sleep mode. If this was Tracking the INTRAC will re-position the antenna according to the model and continue tracking.

Note If the INTRAC is in Remote Mode when Sleep is entered the remote will appear to be in Standby Mode with the Interlock alarm or all four limit switches active.

Remote

Remote Mode transfers control of the INTRAC to a remote terminal.
It is selected with Menu Key 6 (Select Remote) from the Home menu. Once in Remote Mode only four functions are available from the INTRAC front panel. The emergency stop switch will inhibit the antenna drive as normal, the alarms can be displayed, Standby Mode can be entered and control can be returned to the front panel again with Menu Key 6 (Select Local).

USING IESS-412 OR NORAD DATA

The INTRAC-505 can make use of Intelsat IESS-412 11-parameter or NORAD ephemeris information in two ways.

1. The information can be used by the INTRAC to generate an INTRAC model of the satellites orbit. This model can then be used by the INTRAC as it would use a model it had learnt itself. This means that there is not the need for the 24hr learning period. The model is then updated as any INTRAC model would be.

2. The INTRAC can be commanded to Program Track using positions calculated from the ephemeris data set.

The IESS-412 and NORAD data sets can be entered either manually from the INTRAC front panel or from a PC. A stand alone program is available for loading the data file from a PC. This program can be used alone or in conjunction with the Remote Control Terminal RCM-4. A description of this program is given appendix C.

The IESS-412 data

The IESS-412 data set comprises 21 fields of data :-

IESS Epoch Year	range: 80 to 99 (20th century) 00 to 79 (21st century)
IESS Epoch Month	range: 1 to 12
IESS Epoch Day	range: 1 to 31
IESS Epoch Hour	range: 0 to 32
IESS Epoch Minute	range: 0 to 59
IESS Epoch Second	range: 0 to 59
IESS Minutes Interval	range: 0 to 59
IESS Days Validity	range: 0 to 28
IESS Sat LM0	range: 0 to 360 deg
IESS Sat LM1	range: -9.99 to 9.99 deg/day
IESS Sat LM2	range: -9.99 to 9.99 deg/deg/day
IESS Sat LONC	range: -9.99 to 9.99 deg
IESS Sat LONC1	range: -9.99 to 9.99 deg/day
IESS Sat LONS	range: -9.99 to 9.99 deg
IESS Sat LONS1	range: -9.99 to 9.99 deg/day

IESS Sat LATC	range: -9.99 to 9.99 deg
IESS Sat LATC1	range: -9.99 to 9.99 deg/day
IESS Sat LATS	range: -9.99 to 9.99 deg
IESS Sat LATS1	range: -9.99 to 9.99 deg/day
IESS Sat LONG170	range: 0 to 360 deg
IESS Sat LAT170	range -9.99 to 9.99 deg/day

Also required to be set are the IESS Az & El offsets which are input on the Function - System Setup - Station Coordinates menu screen.

The IESS Epoch defines the time instant at the start of the period of the IESS data. The IESS Minutes Interval defines the period in minutes between pointing updates in Program Track mode. The IESS Days Validity (normally 7) defines the period of validity of the data. The INTRAC will accept and use the data two days either side of the validity period.

The parameters IESS Sat (LM0, LM1, LM2, LONC, LONC1, LONS, LONS1, LATC, LATC1, LATS, LATS1) are the IESS-412 11-element ephemeris. The parameters IESS Sat (LONG170, LAT170) are the IESS-412 11-element ephemeris 170hr parity check.

Note The data ranges shown above as +/- 9.99 actually accept more than two places of decimals.

Note The LMO value is given in the range -180° to +180°. The INTRAC-505 cannot accept negative values for this field from the front panel. (It can accept them from the RCM-4). It is therefore necessary to add 360° to the supplied value if it is negative when entering from the front panel. This only applies to the LMO data field.

NORAD data

The NORAD ephemeris data consists of a string of 166 characters. The first 160 characters are split into two “Card Element Sets” of 80 characters each. The next two characters (161 & 162) comprise the Minutes Interval and characters 163 & 164 comprise the Period of Validity of the ephemeris. The final two characters (165 & 166) are the check sum.

There are ten blocks of orbital element parameters contained in the NORAD ephemeris character string :-

Charas.	Data	Description
19 - 32	EPOCH	format - YYDDD.DDDDDDDD
34 - 43	XNDT20	1st rate of change (rev/day/day)
45 - 52	XNDD60	2nd rate of change (rev/day/day/day)

54 - 61	BSTAR	damping factor (er**-1)
89 - 96	XINCL	inclination (deg)
98 - 105	XNODEO	ascending node (deg)
107 - 113	EO	eccentricity
115 - 122	OMEGAO	argument of perigee (deg)
124 - 131	XMO	mean anomaly (deg)
133 - 143	XNO	mean motion (rev/day)

RAPID MODEL GENERATION

The INTRAC-505 can use the IESS-412 or NORAD data to build the satellite's orbit model instead of having to learn the orbit over a 24hr period.

The IESS-412 data is simply selected for the Rapid Model Generation in the Models menu and ENTER pressed. The orbit model is calculated and the INTRAC enters Tracking Mode.

For the NORAD data there are five choices of NORAD algorithm. These are SGP, SGP4, SGP8, SDP4 & SDP8 and each gives a slightly different Az/El pointing for the same NORAD data.

—	SGP	the original NORAD algorithm
—	SGP4	applies to Near Earth Orbits
—	SGP8	applies to Near Earth Orbits
—	SDP4	applies to Deep Space Orbits
—	SDP8	applies to Deep Space Orbits

Orbits are differentiated by their period. Those of less than 225 minutes are Near Earth Orbits and those of more then 225 minutes are Deep Space Orbits. Geostationary satellites are in Deep Space Orbit.
It is assumed that the user know which algorithm applies to the data to be used. However INTRAC will not allow a Near Earth Orbit algorithm to be used with Deep Space Orbit data and vice-versa.

The Basic algorithm available in the Rapid Model Generation table is not of NORAD origin. It has none of the embellishments found in the NORAD routines and is meant for test purposes only.
Once the orbital model has been built using the ephemeris data the INTRAC tracks the satellite from it and updates and improves it over the following hours and days.

PROGRAM TRACK

The IESS-412 and NORAD data can also be used by INTRAC to calculate the satellite's path which is then used for a simple Program Track operation.

The selections available in Models - program Track are the same as are available in Rapid Model Generate. On selecting the required algorithm and pressing ENTER the INTRAC enters Program Track mode.

Program Track is an open loop method of tracking and as such is unable to correct for any transducer errors or distortions to the antenna caused by wind.

RESERVE MODEL

Once the orbital model has been built the INTRAC tracks the satellite extremely accurately by continuously monitoring the satellite's position and updating the model. When the beacon signal is not present INTRAC can still track accurately by predicting the satellite's position from the model. However if the beacon signal is lost for more than 72hrs INTRAC deems the model to be no longer valid. In such a situation INTRAC can fall back to a Reserve Model. This is a Program Track model built from either the IESS-412 or the NORAD data. The selection is made in Models - Reserve Model. Assuming the appropriated data has been loaded and is valid INTRAC will automatically fall back to this model when it can no longer predict accurately.

CLEAR MODELS

The "Clear Models" menu is used to clear one or more of the INTRAC Model, the IESS-412 Model or the NORAD model. Clearing the INTRAC Model clears the current satellite model. Selecting Auto Continue after this clearing will cause the INTRAC to enter Learning Mode.
Clearing the IESS-412 or NORAD Models simply marks the ephemeris data as being no longer valid. Selecting IESS-412 or NORAD for Rapid Model Generate or Program Track will cause the menu to jump to the Edit IESS or NORAD data menus for new data to be input. Also clearing the data will mean that Reserve Model will not function.

ANTENNA MOTION LIMITS

There are two methods of limiting the travel of the antenna; a software method and a hardware method. If either type of limit is reached in any direction in an automatic mode a primary alarm is raised, the System Alarm indicator is illuminated and the relevant alarm may be viewed using the Show Alarms menu.

Soft Limits

Soft Limits are set in the Configuration - Soft Limits menu. If they are reached in any mode other than Manual an alarm is raised and the INTRAC enters Standby mode.
In either Manual (P) or Manual (A) mode the antenna may be driven through the soft limits with no warning.

Hard Limits

Hard limits are physical normally closed contact switches mounted at the maximum points of travel at each end of all driven axes. When the antenna reaches one of these switches the switch becomes open circuit. This open circuit condition breaks power to the motors and (depending on the installed system) signals the INTRAC that a limit has been reached. The removal of drive is such that the antenna cannot be driven any further in the limit direction but can be driven in the opposite direction.
When a limit is reached the INTRAC is automatically put into Standby Mode except when in Manual (P) Mode. In this mode the antenna cannot be driven any further in the limited direction but can be driven in the opposite direction.

AXES POSITION

Resolver units are fitted to the driven axes of the antenna. These units supply positional information to the INTRAC's resolver interface circuits.
Depending on the system "Extended Azimuth" or "EG-01" and/or "Geared Pol" offsets may need to be set.
Fine Tune offsets may be set to calibrate the resolver outputs to the actual antenna pointing angle.

TRACKING SIGNAL

An L-band Integrated Beacon Receiver (IBR-L) is an option with the INTRAC-505. When fitted this receiver is tuned to an L-band frequency by the INTRAC based on the "Beacon Frequency" set for the satellite. If the beacon frequency of the satellite to be tracked is not in the L-band a Block Down Converter will be required to convert the signal to L-band. (In some systems this BDC may also be used to convert the traffic signals).
The calculation of the correct L-band frequency for the IBR-L is performed automatically by the INTRAC for BDCs with standard local Oscillator frequencies so that the beacon frequency may be entered at the actual receive frequency.

Beacon Pol Select

The beacon signal input to the IBR-L may be selected, from the "Beacon Pol Select" menu, from one of four sources. These sources would typically be different LNBs which may have different polarisations or different L.O. frequencies.
The facility requires extra hardware in the shape of an external RF switching unit which can be supplied, as an option, by SPL. This unit connects to and is controlled from the AUX 2 connector of the INTRAC-505.

Note

If an IBR-L is not fitted the INTRAC requires a dc voltage level which is proportional to the received signal strength from the satellite.

6. INSTALLATION

Introduction

This section assumes a standard Advantech AMT Ltd antenna control sub-system comprising the INTRAC-505 controller and MC-3NN Motor Control Cabinet.

Details of the motor controller are contained in appendix A.

WARNING

POSSIBLE LETHAL POTENTIALS EXIST WITHIN THIS EQUIPMENT

THE COVERS SHOULD NOT BE REMOVED EXCEPT BY QUALIFIED PERSONNEL.

SWITCH OFF POWER AND ISOLATE SUPPLY BEFORE REMOVING COVERS.

IF IT IS NECESSARY TO OPERATE THE EQUIPMENT WITH THE COVERS REMOVED FOR SERVICING PURPOSES ALL NECESSARY PRECAUTIONS SHOULD BE TAKEN TO PROTECT AGAINST ELECTRIC SHOCKS

Installing the INTRAC-505 sub-system comprises mounting the Controller in a 19" rack. Connecting the controller to the Motor Control Cabinet. Connecting that cabinet to the antenna drive motors. Fitting positional resolvers to the antenna axes and connecting those resolvers to the controller.

Note THE INTRAC-505 MUST NOT BE MOUNTED ONLY BY THE FRONT PANEL LUGS.
IT MUST BE SUPPORTED ALONG ITS SIDES

Connections (general)

Before making connections to either the INTRAC Controller or the Motor Cabinet ensure that they are isolated from the power source.

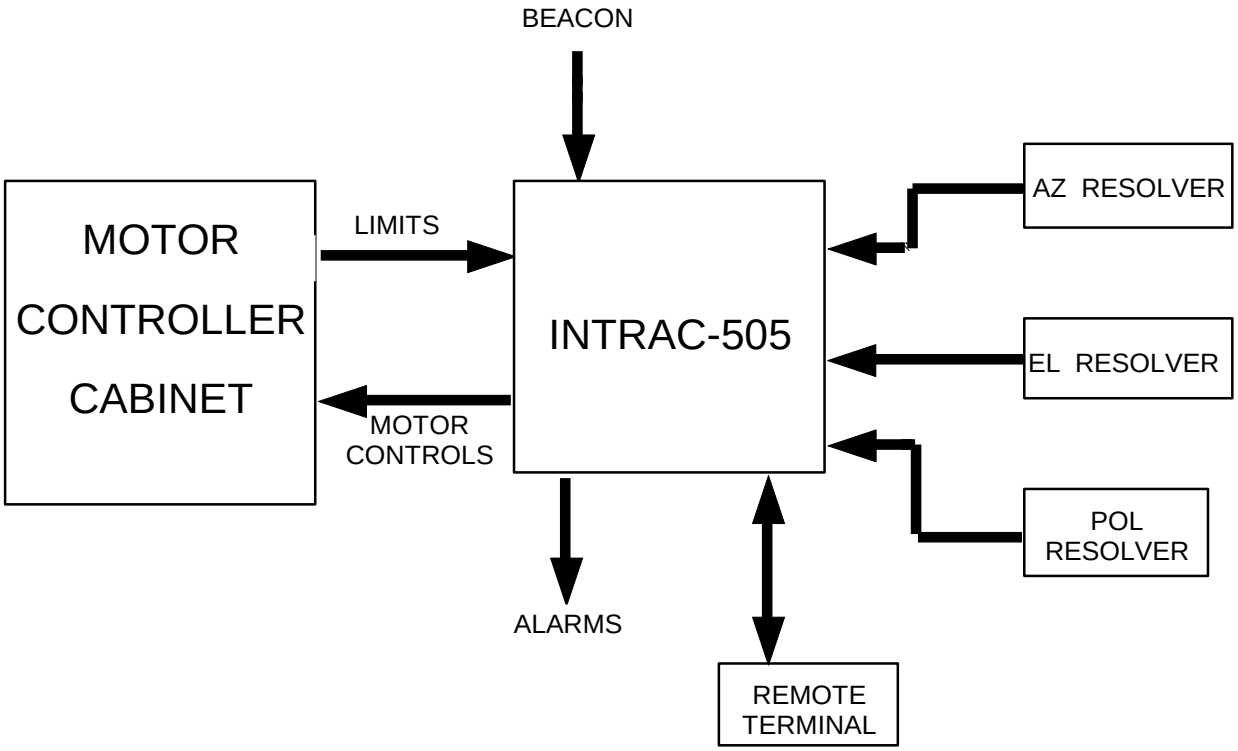
Connect the cables between the Motor Cabinet and the INTRAC.

There should be no earth connection between the INTRAC and the Motor Cabinet. All connections are via relays which provide inter-unit isolation.

All connections between the INTRAC and the Motor Cabinet should be via multi twisted pair cables with individual pairs screened or an overall screen.

THE SCREEN(S) SHOULD ONLY BE CONNECTED AT THE INTRAC END.

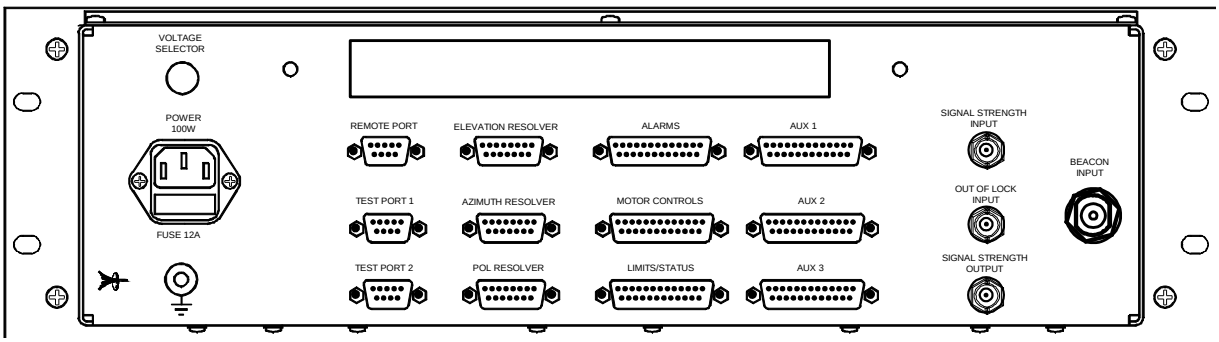
Connections Block Diagram



All connections to the INTRAC-505 are made via its rear panel. The following connectors are available :-

Remote Port (I/O)	9-way D-type	socket
Test Ports 1 & 2 (I/O)	9-way D-type	sockets
Resolver I/Ps x3	15-way D-type	sockets
Alarm outputs	25-way D-type	socket
Motor Controls Output	25-way D-type	plug
Limits/Status (I/O)	25-way D-type	socket
Auxiliary 1 & 3 (I/Ps)	25-way D-type	socket
Auxiliary 2 (O/P)	25-way D-type	plug
Signal Strength I/P	BNC	socket
Beacon Out-of-Lock I/P	BNC	socket
Signal Strength O/P	BNC	socket
Beacon Signal I/P	N-type (L-band)	socket

Rear Panel Layout



  Advantech Wireless

CONNECTOR PIN ALLOCATIONS

Az & El Resolvers

There are six or ten connections for each of the Az & El resolvers depending on type. The recommended cable is one with five individually screened twisted pairs.
Correctly terminated cables can be supplied by Advantech AMT Ltd.

INTRAC™ 505 – Az/El Resolver Cable Connections

INTRAC™ 505 – Az/El Resolver Connector		Cable Pairing	Resolver type		
			EG01/RE01	HD001	RE-001 (Special Software only)
15 Way D-Type Socket	Signal Name		10 Way Circular Socket	16 way Circular Socket	MS-E Socket
1	ResSource	1a	A	J	F
2	CoarseSin	2a	F	E	B
3	CoarseCos	3a	G	G	D
4	ResSource			-	L
5	FineSin	4a		A	H
6	FineCos	5a		C	J
7	RefIn			-	
8	Screen		N/C	N/C	
9	Ground	1b	B	K	E
10	Ground	2b	D	F	A
11	Ground	3b	E	H	C
12	Ground			-	K
13	Ground	4b		B	G
14	Ground	5b		D	I
15	Ground			-	

The connector genders in the table are those on the units concerned. The connecting cable should thus be terminated in the mating gender.

Recommended cable is Belden 8778 or equivalent for HD-001 or RE-001 and Belden 8777 or equivalent for RE01 or EG01.
Screen should be connected at INTRAC end only.

Polarisation Resolvers

There are six connections for the Polarisation resolver which may be a RE-01 or a “size 11” bare resolver. The recommended cable is one with individually screened twisted pairs.
Correctly terminated cables can be supplied by Advantech AMT Ltd.

INTRAC-505 Pol Resolver Connection		Cable	Size 11 Resolver		RE-01 Resolver	Andrew Pol Resolver
15 Way D Socket	Signal Name	Pairing	Resolver Wires	Extended Wires	10 Way Circular Socket	Resolver Wires
1	TxResSource	1a	Red/White	Red	A	Green
2	RxPolSin	2a	Red	White	F	Red
3	RxPolCos	3a	Yellow	Green	G	White
4	TxResSource					
5	TxPolSin					
6	TxPolCos					
7	N/C					
8	Screen		N/C	N/C	N/C	N/C
9	Ground	1b	Yell/White or Black/White	Black (of red)	B	Black
10	Ground	2b	Black	Black (wht)	D	Black
11	Ground	3b	Blue	Black (grn)	E	Black
12	Ground					
13	Ground					
14	Ground					
15	N/C					

The connector genders in the table are those on the units concerned. The connecting cable should thus be terminated in the mating gender.

Recommended cable is Belden 8777 or equivalent.

Screen should be connected at INTRAC end only.

Limits

The cable for the Limits connection should comprise twisted pair cable with an overall screen. Eight twisted pairs are required if Pol is fitted or six if no Pol.

INTRAC™ 505 Limits Connector		Cable Pairing	Motor Drive Cabinet
25 Way D Socket	Signal Name		Limit Switch Connections
1	Interlock	1a	JB PIN 8
2	AzLeftLimit	2a	JB PIN 18
3	AzRightLimit	3a	JB PIN 20
4	ElDownLimit	4a	JB PIN 14
5	ElUpLimit	5a	JB PIN 16
6	(Rx)PolClkLimit	6a	JB PIN 12
7	(Rx)PolCClkLimit	7a	JB PIN 10
8	EmergStop1	8a	JB PIN 2
9	EmergStop2	8b	JB PIN 1
10	TxPolClkLimit or AuxLim0 INCONTROL\ (Dual Redundant)		N/C
11	TxPolCClkLimit or AuxLim1 AutoFlagIn (Dual Redundant)		N/C
12	AuxLim2		N/C
13	Screen		N/C
14	Ground	1b	JB PIN 7
15	Ground	2b	JB PIN 17
16	Ground	3b	JB PIN 19
17	Ground	4b	JB PIN 13
18	Ground	5b	JB PIN 15
19	Ground	6b	JB PIN 11
20	Ground	7b	JB PIN 9
21	Ground		
22	Ground		
23	Ground		
24	Ground		
25	Ground		

The connector gender in the table is that on the INTRAC. The connecting cable should thus be terminated in the mating gender.

Recommended cable is Belden 9508 (or 9506 if no Pol) or equivalent.

Motor Control

The INTRAC-505 outputs low voltage low current motor drive signals to the Motor Drive Cabinet.
The standard Motor Drive Cabinet drives the Az & El axes.
Various options are available such as two speed drive and Polarisation drive.

INTRAC™ 505 Motor Controls Connector			Cable Pairing	Motor Drive Cabinet Connections	
25 Way D type Plug	Signal Name (Non Simax)	Signal Name (SimAx)		Non Simax	SimAx
1	DrvSelect	ElSelect	1a	JA PIN 14	JA PIN 8
2	Az	ElUp	2a	JA PIN 18	JA PIN 6
3	Fast	ElFast	3a	JA PIN 16	JA PIN 16
4	Up/Rt	AzSelect	4a	JA PIN 20	JA PIN 12
5		AzRight	5a		JA PIN 10
6		AzFast	6a		JA PIN 18
7	PolSelect	(Rx)PolSelect	7a	JA PIN 2	JA PIN 2
8	PolCw	(Rx)PolCw	8a	JA PIN 4	JA PIN 4
9		ExtendHold or AuxMot0			
10		TxPolSelect or AuxMot1			
11		TxPolCw or AuxMot2 AutoFlagOut (Dual Red)			
12		AuxMot3 SwitchReq (Dual Red)			
13	Ground	Screen		N/C	N/C
14	EXT24V	EXT24V	1b	JA PIN 13	JA PIN 7
15	EXT24V	EXT24V	2b	JA PIN 17	JA PIN 5
16	EXT24V	EXT24V	3b	JA PIN 15	JA PIN 15
17	EXT24V	EXT24V	4b	JA PIN 19	JA PIN 11
18	EXT24V	EXT24V	5b		JA PIN 9
19	EXT24V	EXT24V	6b		JA PIN 17
20	EXT24V	EXT24V	7b	JA PIN 1	JA PIN 1
21	EXT24V	EXT24V	8b	JA PIN 3	JA PIN 3
22	EXT24V	EXT24V			
23	EXT24V	EXT24V			
24	EXT24V	EXT24V			
25	EXT24V	EXT24V			

The connector gender in the table is that on the INTRAC.
The connecting cable should thus be terminated in the mating gender.

Recommended cable is from the Belden 95nn range (depending on required number of pairs) or equivalent.

Note **For a single speed Motor Drive Cabinet do not connect the “Fast” signal line(s). Doing so will cause the INTRAC to shut down the Motor Drive Cabinet should “fast Speed” be selected.**

Alarms

The alarm outputs are C form contacts for use by external alarm systems.

INTRAC™ 505 Alarms Connector 25 way D type Socket	Signal Name	User Alarm Monitoring System
1	PriAlmCommon	
2	PriAlmClosed	
3	PriAlmOpen	
4	BeacAlmCommon	
5	BeacAlmClosed	
6	BeacAlmOpen	
7	SecAlmCommon	
8	SecAlmClosed	
9	SecAlmOpen	
10	BeacLevelAlmCommon	
11	BeacLevelAlmClosed	
12	BeacLevelAlmOpen	
13	Ground / Screen	
14	-	
15	-	
16	-	
17	-	
18	-	
19	-	
20	-	
21	-	
22	-	
23	-	
24	-	
25	-	

The connector gender in the table is that on the INTRAC. The connecting cable should thus be terminated in the mating gender.

Recommended cable is multicore with an overall screen such as Belden 9536 or 9541 (depending on required number of cores).

Serial Ports

There are three serial ports on the INTRAC-505, “Remote Port”, “Test Port 1” and “Test Port 2”. Each can be independently configured as either RS423 or RS422.

The pin allocations for both are given in the tables below.

INTRAC™ 505 Serial Port Connections (RS423)

INTRAC™ 505 Serial Port Connector		Signal Name	Remote Control PC	
9 way D type Socket	Signal Type		Signal Type	PC Connector
1	Passive *	DCD		
2	Output	RXD	Input	
3	Input	TXD	Output	
4				
5	GND	GND	GND	
6	Passive *	DSR		
7				
8	Passive *	CTS		
9	N/C		N/C	

* The “Passive” signal lines are pulled up to 5v by a resistor.

INTRAC™ 505 Serial Port Connections (RS422)

INTRAC™ 505 Serial Port Connector		Signal Name	Remote Control PC	
9 way D type Socket	Signal Type		Signal Type	PC Connector
1				
2	Output	RXDB = RXD-	Input	
3	Input	TXDB = TXD-	Output	
4				
5	GND			
6	Output	RXDA = RXD+	Input	
7	Input	TXDA = TXD+	Output	
8				
9				

The INTRAC-505 is wired as a DCE unit suitable for direct 1 to 1 connection to the 9-way serial port of a PC AT.

TXD and RXD data flow directions are standard (relative to the DTE). Handshake lines are pulled to the ON condition.

The factory default setting for the three serial ports is RS423. How to set to RS422 is shown on the next page.

Serial Port RS422/423 Setting

Setting the Serial Ports to RS422 or RS423 is achieved by positioning the rear panel ribbon cables and by link positions. The table below shows the positions.

INTRAC™ 505 Serial Port Configuration - Connector & Link Positions

INTRAC-505 Serial Port	RS423		RS422	
	Ribbon Cable position.	Link Position	Ribbon Cable position.	Link Position
Remote Control Port	J13	J48 Front	J16	J48 Rear
Test Port 1	J12	J44 Front	J15	J44 Rear
Test Port 2	J11	J46 Front	J14	J46 Rear

Serial Port Usage

The three ports can be used to connect a Remote Control Terminal, to monitor diagnostic data or to monitor angle data. The specific uses for each port are:-

Remote Port

A Remote Control and Monitoring Terminal may be connected to this port.
Diagnostic data can be monitored by selecting “Diagnostics On” in the “Function - Configuration” menu. Remote control of the INTRAC is achieved only if “Diagnostics Off” is selected in the Configuration menu.

Test Port 1

Diagnostic data is also available at this port together with Angles data. The selection between Diagnostics and Angles is made by Menu Key 4 on the “Function - Configuration” menu. The key switches between “Test Port-1 Diags” and “Test Port-1 Angles”

Test Port 2

This port is for a Remote Control Terminal only.

The Remote Port allows one PC to be used as a remote control unit and as a diagnostics monitoring unit. However it cannot do both at the same time.

Note

For correct remote control of the INTRAC-505 via the Remote Port <u>Diagnostics must be set to OFF.</u> Diagnostic data can be monitored during remote operation by using a second PC connected to Test Port 1.

Beacon Signal Connector

When an IBR-L beacon receiver is fitted there will be a "N-type" RF connector on the INTRAC rear panel. It is to this that the beacon signal is connected.

Note

18Vdc may be connected to the inner connector of the N-type in order to power the Block Down Converter.

The 18V can be removed from the "N" connector by power connector J41 on the INTRAC Interface board.

Beacon pol select

If the 4 way beacon source select unit is supplied it should be installed as follows:

Ensure that the AUX 2 connector on the INTRAC-505 rear panel is connected to J24 on the INTRAC interface PCB.
Mount the switch unit in the rack close to INTRAC 505.
Connect the switch unit to the AUX 2 connector.
Connect the signal output on the unit to the INTRAC input.
Connect the four input beacon signals to the four inputs (A,B,C,D) on the switch unit.
In the Fitted Options Menu ensure that "Beac pol select" is set as "Fitted"
The Beacon Pol selection can be set from the Beacon Pol Select Menu on the Functions screen.

When using customer provided beacon selection hardware, 24v dc relays (up to 50ma) should be connected between the Beacon Select output and the corresponding BeacSel_24v pins. These relays will be powered according to the following table.

Selected Beacon BeacSel_Output	**2**	**1**	**0**
A	1	0	0
B	0	1	1
C	1	1	0
D	1	0	1

a 1 indicates that the relay will be energised.

Signal Strength Output

When an IBR-L is fitted a dc voltage proportional to the received beacon signal strength expressed in dB is available on a BNC connector on the INTRAC rear panel.

Signal Strength Input

Where no IBR-L is fitted the INTRAC-505 requires a dc voltage generated by an external receiver. This voltage must be directly proportional to the received signal strength in dB. The signal strength input is via a BNC connector on the INTRAC rear panel.

Out of Lock Input

When an external receiver is used to provide the tracking signal a receiver out of lock signal may be provided to indicate to the INTRAC that the tracking signal is no longer valid. This signal should be provided by a pair of relay contacts which close to indicate loss of lock.

Aux 1 & Aux 3

These connectors provide Auxilliary and Additional inputs for any special facilities which are supplied. Special, customer or option specific, software is required in order to be able to use these inputs.

INTRAC™ 505 Aux1 and Aux3 Connectors				
25 way D type Socket	Aux 1 Signal	Possible Use	Aux 3 Signal	Possible Use
1	AuxIp0		AddIp0	
2	AuxIp1		AddIp1	
3	AuxIp2		AddIp2	
4	AuxIp3		AddIp3	
5	AuxIp4		AddIp4	Beamwidth Select
6	AuxIp5	Auto Stow	AddIp5	
7	AuxIp6		AddIp6	
8	AuxIp7		AddIp7	
9	AuxIp8		-	
10	AuxIp9		-	
11	AuxIp10		-	
12	AuxIp11		-	
13	Screen		Screen	
14	Ground		Ground	
15	Ground		Ground	
16	Ground		Ground	
17	Ground		Ground	
18	Ground		Ground	Beamwidth Select Return
19	Ground	Auto Stow Return	Ground	
20	Ground		Ground	
21	Ground		Ground	
22	Ground		Ground	
23	Ground		Ground	
24	Ground		Ground	
25	Ground		Ground	

The connector gender in the table is that on the INTRAC. The connecting cable should thus be terminated in the mating gender.

The “Possible use” column may not correspond to the use in your system.

Aux 2

This connector provides outputs for any special facilities which are supplied. Special, customer specific, software is required in order to be able to use these outputs.

Note

The outputs may be configured as Open Collector Darlington outputs or as relay contacts by plugging the internal ribbon cable into one of two possible headers. (J24 is for open collector Darlingtons, J25 is for relay contacts).

INTRAC™ 505 Aux2 Connector				
25 way D type Plug	Open Collector Signal (using J24)	Possible Use	Relay Contact (Using J25)	Possible Use
1	AuxOp0	Beacon Select_0	ComAuxOp0	
2	AuxOp1	Beacon Select_1	NCAuxOp0	
3	AuxOp2	Beacon Select_2	NOAuxOp0	
4	AuxOp3		ComAuxOp1	
5	AuxOp4		NCAuxOp1	
6	AuxOp5		NOAuxOp1	
7	AuxOp6		ComAuxOp2	
8	AuxOp7		NCAuxOp2	
9	AuxOp8		NOAuxOp2	
10	AuxOp9		ComAuxOp3	
11	AuxOp10		NCAuxOp3	
12	AuxOp11		NOAuxOp3	
13	Screen		Screen	
14	Aux24v	24V for BeacSel_0	ComAuxOp4	
15	Aux24v	24V for BeacSel_0	NCAuxOp4	
16	Aux24v	24V for BeacSel_0	NOAuxOp4	
17	Aux24v		ComAuxOp5	
18	Aux24v		NCAuxOp5	
19	Aux24v		NOAuxOp5	
20	Aux24v		ComAuxOp6	
21	Aux24v		NCAuxOp6	
22	Aux24v		NOAuxOp6	
23	Aux24v		ComAuxOp7	
24	Aux24v		NCAuxOp7	
25	Aux24v		NOAuxOp7	

The connector gender in the table is that on the INTRAC. The connecting cable should thus be terminated in the mating gender.

The “Possible use” column may not correspond to the use in your system.

RESOLVERS

The RE-01, EG-01 and bare size 11 resolvers are capable of continuous rotation. However the HD-001 resolver may only be rotated through 340°. It will be damaged if rotated through more than 340°.

Fitting to the Antenna

Exactly how the resolvers are fitted to the antenna depends on the antenna concerned. However either the shaft or the body of the resolver has to be coupled directly to the Az, El or Pol rotational axis and that part of the resolver which is not coupled to the rotational axis has to be very firmly fixed to a non moving surface.

For the coupling between the resolver shaft and the antenna axis we recommend a flexible “bellows” type coupler which allows for some miss-alignment between the shafts but does not introduce any backlash or windup.

Setting up

Put the INTRAC into Manual Mode.

Determine in which direction each resolver shaft will rotate, viewed from the faceplate of the resolver, for an increasing angle of antenna pointing. In the Function - System Setup - Fine Tune - Sense menu the resolver sense can be set to “true” or “inv”. If the shaft rotates clockwise for an increase in the angle set the appropriate (Az / El / Pol) sense to “inv”, if the shaft rotates counter clockwise for an increase in the angle set the sense to “true”.

Zero the Fine Tune - Offsets.
Ensure that the antenna is away from the hardware limit switches. Determine the actual pointing angles of the antenna. The Elevation angle should be between 0° and 90°. The Azimuth angle should be between 90° (E) and 270° (W) via 180° (S) (for the Northern Hemisphere) or between 270° (-90°) and +90° via 360° / 0° (N) for the Southern Hemisphere. The Polarisation angle should be between -90° and +90°.
Loosen the couplings between the resolver units and their respective antenna shafts. Rotate each resolver shaft slowly until the INTRAC displayed Az, El and Pol angles are as near as possible to the actual angles of the antenna.

Note

If a resolver angle is, or becomes, outside the software limits an alarm will be raised. In this situation the software limits may be set wider.

When the displayed angles are as near as possible (at least within 10°) to the actual angles tighten the resolver couplings ensuring that the angles remain as set.

Use the Fine Tune - Offsets facility to change the displayed angles to the actual antenna angles.

Southern Hemisphere

Set-up in the Southern Hemisphere is the same as for the Northern Hemisphere except that the antenna rotation will be +/- 90° of North instead of +/- 90° of South.
Selection of Southern or Northern Hemisphere within the INTRAC is automatic based on a positive or negative input for Latitude in System Setup - Station Co-ordinates.

TRACKING SIGNAL INPUT

The tracking signal may be provided as a dc voltage from an external receiver or from the optional IBR-L internal receiver.

With IBR-L

The IBR-L requires a L-band beacon signal at a level within the range -80dBm to -45dBm with a carrier to noise ratio (C/No) of better than 40dBHz. To allow some margin for exceptional propagation conditions we suggest that the normal clear sky level when peaked on the satellite should be in the range -70dBm to -50dBm. Severe signal fades will be handled by the INTRAC algorithm entering Prediction mode for the duration of the fade.
If the signal is greater than -50dBm attenuation must be inserted and if it is lower than -80dBm a higher gain LNA/LNB must be used.
An input level of -45dBm corresponds to a displayed level of +25dB.

Note

In some installations the LNA/LNB power is carried on the L-band signal cable and special arrangements have to be made to ensure continuity for the dc power when attenuation is added in this cable.

Without IBR-L

The tracking signal, provided from an external receiver, needs to be a dc voltage between -10v and +10v. This voltage should vary proportionally (in dBs) with the received signal strength.
The INTRAC can be adjusted for a fixed offset and a proportionality constant between 0.1v/dB and 1.0v/dB in either polarity.

Setting offset & gain

Connect a switchable attenuator in the IF feed to the tracking (beacon) receiver.
Connect the dc tracking signal to the INTRAC Signal Strength Input BNC.
Remove the top cover to the INTRAC-505.
Link J31 and potentiometers R12 & R55 are used in the set-up.
Link J31 can be changed for -ve or +ve polarity signals.
R12 adjusts the gain of the tracking signal buffer.
R55 adjusts the offset.
Set the switchable attenuator to 0 dB.

Adjust R55 so that the signal level displayed on the INTRAC-505 is between -10dB and +20dB.
Adjust R12 so that 2dB attenuation of the receiver IF signal causes the displayed signal to decrease by 2.0dB.

Finally adjust R55 to read +20dB when the maximum clear sky tracking signal is being received.

Note It may be necessary to adjust the links J31 depending on the polarity of the tracking signal. The link options are both links should be either vertical or horizontal.

OPERATIONAL CHECKS

Manual Operation

This test checks the operation of the motor drives and limit switches.

Ensure that all limit and interlock switches are in the normal operating condition.

Switch on the INTRAC. If the System Alarm indicator illuminates press the Standby key. If it remains illuminated view the Show Alarms display to what is causing the alarm. Take the necessary action to clear the cause(s) of the alarm.

Select Manual (P) Mode from the New Mode menu.

Using the Manual Control keys drive the antenna to the full extent of its travel in each direction. Confirm that the antenna actually moves in the required direction. Check that when a limit switch is reached the motor stops and the System Alarm indicator illuminates.

Note Only one Manual Control key should be pressed at one time and it should be fully released before pressing another control key.

If a Dual Speed Motor Drive Cabinet is fitted check that the “FAST” key operates correctly. Pressing the “FAST” key when pressing a Manual Control key should latch fast drive in the required direction. Pressing any Manual Key when in latched Fast Drive should have no effect. Pressing the Fast key again should remove drive.

Emergency Stop Check

Check the operation of the front panel Emergency Stop switch by pressing it when one or more motor’s is running. Ensure that the motor(s) stop and will not re-start until the Emergency Stop switch is released and the and the appropriate drive command re-instated.
If external emergency stop switches are fitted check their operation in the same way.
It must not be possible to re-start any motor whilst any emergency stop switch is in the operated state.

Auto Operation

After manually pointing the antenna towards the required satellite use the Search facility to peak the antenna on the satellite. Check that this function works correctly.
Select Auto New Model and check that INTRAC enters Learning Mode and makes periodic cross scans interspersed with pointing adjustments.
Check that after 24 hours of Learning the INTRAC enters Tracking Mode.

Remote Control

If a Remote Control and Monitoring Terminal (RCM-4) package has been supplied check that this works correctly. (see appendix D for an explanation of the RCM-4)

7. FAULT FINDING

WARNING

POSSIBLE LETHAL POTENTIALS EXIST WITHIN THIS EQUIPMENT

THE COVERS SHOULD NOT BE REMOVED EXCEPT BY QUALIFIED PERSONNEL.

SWITCH OFF POWER AND ISOLATE SUPPLY BEFORE REMOVING COVERS.

IF IT IS NECESSARY TO OPERATE THE EQUIPMENT WITH THE COVERS REMOVED FOR SERVICING PURPOSES ALL NECESSARY PRECAUTIONS SHOULD BE TAKEN TO PROTECT AGAINST ELECTRIC SHOCKS

Introduction

Advantech AMT Limited recommend that users return faulty INTRAC-505 units to Advantech AMT Ltd. for repair. Advantech have a specially equipped repair facility and are able to repair and return a unit rapidly if required. However if the problem is of an intermittent nature it may be beneficial to allow us to soak test the unit for a longer period. A replacement unit may be available from Advantech during the repair period. Please ask for details of this service.

Repairs carried out by Advantech are warranted for 90 days.

For those users who would prefer to repair their own unit this section is intended to help with locating the faults. However:- **Advantech AMT Limited ACCEPT NO RESPONSIBILITY OR LIABILITY FOR ANY HARM CAUSED TO ANY THIRD PARTY PERSONNEL FROM WORKING INSIDE THE INTRAC-505.**

Advantech AMT Ltd ACCEPT NO RESPONSIBILITY OR LIABILITY FOR ANY DAMAGE CAUSED TO THE INTRAC-505 BY ANY THIRD PARTY PERSONNEL AS A DIRECT OR INDIRECT RESULT OF THIS SECTION OF THIS MANUAL.

ANY THIRD PARTY WORK INSIDE THE INTRAC-505 DURING THE WARRANTY PERIOD WILL INVALIDATE THE WARRANTY

Because the INTRAC-505 forms part of a system, parts of which respond to signals from the INTRAC-505 and parts of which send signals to the INTRAC-505, deciding whether a fault lies with the INTRAC-505 or the external equipment can be difficult.

The simplest method to prove if the fault lies with the INTRAC-505 or some other equipment is to replace the INTRAC with a spare unit. However care must be taken in such a case that any fault with the external equipment does not cause damage to the replacement INTRAC. Also you must ensure that the replacement unit is set correctly for the installation.
This fault finding guide goes no further than the replacement of the major assemblies such as power supply, IBR-L or complete printed circuit assemblies.

The INTRAC-505 consists of six major assemblies :-

- Main Interface PCB
- Processor PCB
- Low voltage power supply
- LCD Display panel
- Front panel keys assembly
- Beacon receiver (optional)

Note — The LCD display panel has a replaceable backlight which has a finite life span. This light will need replacing within the working life of the INTRAC-505. Included in this section are instructions on replacing the lamp.

FAULT SYMPTOMS

INTRAC doesn't appear to power up — Check that the main power-on switch glows green when switched on. If not check INTRAC fuse, power cable and power source

Display screen blank/dark — Data is visible on screen but display is very dark.
Try to adjust display brightness and contrast. Contrast adjustment has some effect but brightness has none.
LCD backlight or its inverter has failed.

Note — To adjust brightness or contrast press menu keys 2 - 4 - 5 followed by the Enter key. Menu key 4 will now control brightness and menu key 3 will control contrast.

Display is bright but there is no data visible. Brightness control has some effect but contrast does not.
Check power supply voltages :-

- V1 = +5v to com)
- V2 = +15v to com)
- V3 = 12v across + & –)
- V4 = 24v across + & –)

Voltages should be within 5% of stated values.

If voltages are correct fault is with LCD, ribbon cable to J18 (Interface PCB) or the Interface PCB itself.

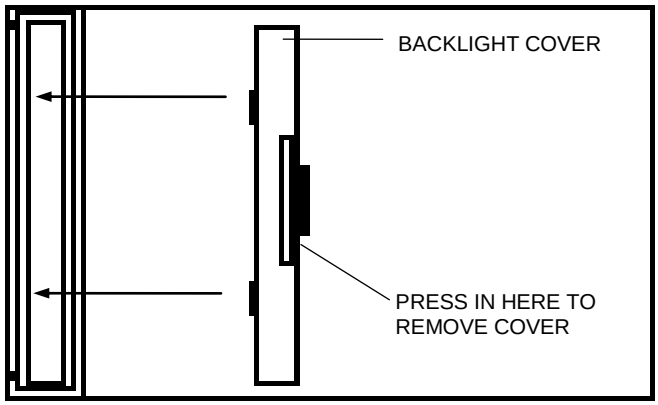
Replacing the LCD backlight — Remove the top cover from the INTRAC-505. The rear of the LCD panel is then visible.
Two different types of LCD panel have been used in the INTRAC-505. One made by Epson and the other by Hitachi. The Hitachi version has a PCB as large as the display whereas the Epson has two PCBs each about one quarter the size of the display.

The Epson display — Disconnect the two white wires, which go to the LCD display, from orange connector at the front corner of the Interface PCB.

On the rear of the LCD display at one end is a plastic panel the height of the display and about 11mm wide which the two wires disappear behind. This panel clips into its surround at

three points, two on one side and one on the other. The single clip is next to a thin slot which is pressed inwards to release the clip. The panel can then be lifted out.

REAR OF LCD PANEL



de) which is loos

th
e
c
over on.

Connect the two lamp wires to the outer terminals of the orange connector.

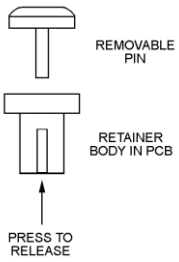
Replace unit top cover, re-connect power, switch on and verify that lamp illuminates.

The Hitachi display

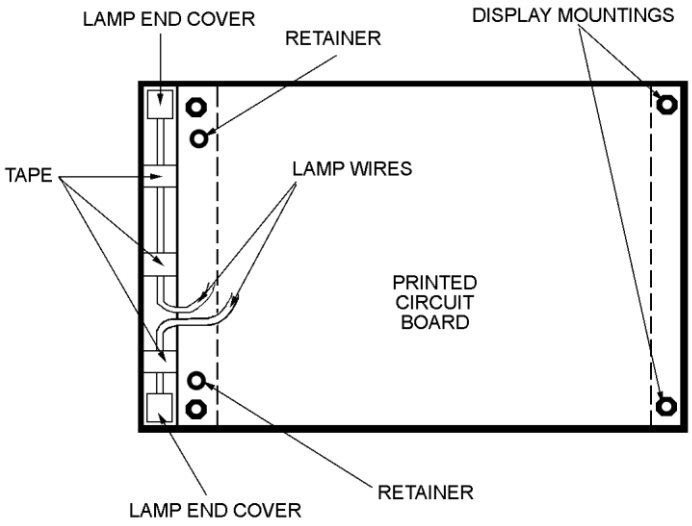
Disconnect the two lamp wires from the orange connector at the front corner of the Interface PCB. Disconnect the LCD panel flex cable from Connector J64 on the Interface PCB.

Remove the four screws which hold the INTRAC front panel to the sides and drop down the front panel. Remove the four nuts which hold the display assembly to the front panel and remove the display unit from the front panel. Lay it face down on a soft surface.

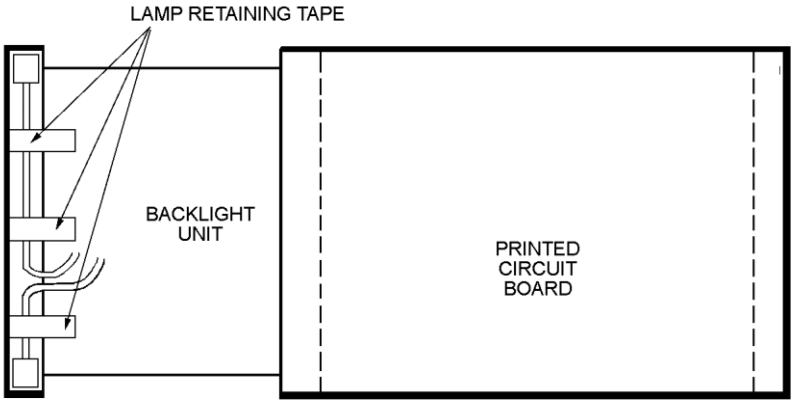
Press down on the centre of the two retainers (see diagrams)



TWO PART
RETAINING PIN



Turn the display face up. Remove the retainer pins. Remove the metal cover. Turn the display face down on a soft surface. Gently slide the backlight unit from the display unit. (see diagram)



Remove the three tapes which secure the lamp reflector.
Remove the lamp and wire assembly.
Install new lamp and wire assembly.
Wrap reflector sheet around lamp.
Replace securing tapes to secure reflector.
Turn unit face up and ensure that backlight is free from contamination - dust may be blown free.
Slide backlight into display unit.
Replace metal cover over backlight.
Replace retainers, press centre to secure.
Locate display unit over the four studs and fit the nuts.
Re-fit INTRAC front panel to side panels, reconnect flex cable and lamp wires.
Replace INTRAC top cover, reconnect power, switch on and verify that the lamp illuminates.

Some, or all, front panel keys do not function

The six menu keys, the numerical keypad and the manual control keys are all connected in a matrix. There are three supply lines to the matrix and eight return lines. If any one of these lines fails at least three keys will cease to function. The fault may be the ribbon cable to J27 (Interface PCB), the connectors or the Interface PCB itself.

If only one key does not function the fault will be with that key and the front panel PCB will have to be replaced. This board is held on the front panel by six threaded studs. Disconnect the ribbon cable and the emergency stop switch (note which wire goes to which terminal). Remove the six nuts and lift the PCB off the studs.

Emergency Stop Switch Fails

Pressing the front panel emergency stop switch should cause the System Alarm indicator to illuminate and the INTRAC to enter Standby Mode.

The switch consists of two normally closed (N.C.) contacts pressing the switch opens both sets of contacts. The switch connects to the Interface PCB through the front panel PCB and the ribbon cable. If the switches are OK and there is continuity to connector J27 on the Interface board the fault is on that board.

Pointing Angles Incorrect

The resolvers consist of three coils two of which move with respect to the third. A continuous signal is sent from the INTRAC to the fixed coil and is induced into the other two coils. The amount of induction in each coil is dependant on the respective position of the coils.
The signal sent from the INTRAC is the same for all resolvers.

angles constantly varying

Constantly changing angles is caused by noise on the two return signal lines. This implies that the source signal is not present in the resolver. For one angle (i.e. Az, El or Pol) to be changing either the circuit to the resolver is broken or the resolver itself is faulty.
If all the angles are changing the fault is on the Interface PCB.

wrong angle displayed

If the displayed angle changes to be near 0° or 90° it is probable that one of the two return signal circuits from the resolver is broken or the resolver itself is faulty.
If the displayed angle changes to any angle other than near 0° or 90° the fault is on the Interface PCB.

angle doesn't change when antenna is moved

If the displayed angle doesn't change when the antenna is being driven first ensure that the antenna is actually moving in the relevant plane.

Select Manual Mode and drive the antenna in the appropriate direction and either check that the beacon level changes or actually look at the antenna.
If the antenna is moving and the displayed angle is not changing the problem is the connection of the resolver to the antenna.

No Antenna Drive

Check that the LEDs in the Manual Control keys illuminate when antenna drive is commanded. If not the fault is on the Interface PCB.
The Motor Controls connector (25-way D-type) on INTRAC rear panel should have +24v on pins 14 to 25 measured with respect to pin 13 (Gnd). The drive signals are on pins 1 to 12 and are from open collector transistors which pull down to drive. Thus 24v should be present across the appropriate pin (1 to 12) and any pin 14 to 25 when the relevant drive command is given.

Each drive signal has two opposite functions such as on/off, up/down, left/right and so on. One function occurs when the signal is on and the other when it is off.
The two tables below indicate which signals are on for which antenna movement. The first table is for single axis drive and the second for simultaneous axis drive.

An X indicates an energised signal, thus that pin should be pulled down to (near) zero volts and 24v should be measured between it and the 24v pins.

Single Axis Drive Systems

Direction & Speed	Drv Select	Az	Fast	Up/Rt	Pol Select	Pol Cw
	pin 1	pin 2	pin 3	pin 4	pin 7	pin 8
Left/Slow	X	X	O	O	O	O
Left/Fast	X	X	X	O	O	O
Right/Slow	X	X	O	X	O	O
Right/Fast	X	X	X	X	O	O
Up/Slow	X	O	O	X	O	O
Up/Fast	X	O	X	X	O	O
Down/Slow	X	O	O	O	O	O
Down/Fast	X	O	X	O	O	O
PolCw	O	O	O	O	X	X
PolCcw	O	O	O	O	X	O

Simultaneous Axis Drive Systems

Direction & Speed	El Select	El Up	El Fast	Az Select	Az Right	Az Fast	Pol Select	Pol Cw
	pin 1	pin 2	pin 3	pin 4	pin 5	pin 6	pin 7	pin 8
Left/Slow	O	O	O	X	O	O	O	O
Left/Fast	O	O	O	X	O	X	O	O
Right/Slow	O	O	O	X	X	O	O	O
Right/Fast	O	O	O	X	X	X	O	O
Up/Slow	X	X	O	O	O	O	O	O
Up/Fast	X	X	X	O	O	O	O	O
Down/Slow	X	O	O	O	O	O	O	O
Down/Fast	X	O	X	O	O	O	O	O
Pol Cw	O	O	O	O	O	O	X	X
Pol Ccw	O	O	O	O	O	O	X	O

example SimAx System - Elevation Up Fast - there should be (near) 24v between pins 1 & 14, 2 & 15 and 3 & 16.

See Section - Installation - Connector Pin Allocation - Motor Control.

If the drive signals from the INTRAC are correct the fault lies with the Motor Drive Cabinet, the antenna drive motors or the intervening wiring.

For details of the Motor Drive Cabinet see Appendix.

Tracking Signal (IBR-L)

If the beacon signal falls to a non-usable level the INTRAC automatically enters Predicting Mode and continues to track the satellite from the model. There is no way of knowing from the INTRAC whether the loss of signal is due to the satellite or the IBR-L. Thus when the displayed beacon level falls below normal the user should check the signal by some other means before assuming an IBR-L problem. The beacon should be checked with a spectrum analyser on a narrow sweep range so that the actual beacon frequency can be seen and measured.

Although the loss of or reduction in displayed beacon level could be caused by a fault on the Interface PCB the most likely cause is a faulty IBR-L.

Deliberately blank

8. WARRANTY & REPAIR

WARRANTY

Advantech AMT Limited warrants the INTRAC-505 Antenna Control Unit, the (optional) IBR-L integral L-band beacon receiver and other associated products designed, manufactured and supplied by Advantech AMT Limited for a period of 365 days from the date of delivery.

The liability of Advantech AMT Limited under this warranty shall be limited to repair or replacement of defective units or parts thereof, at Signal Processor's option, which are returned, carriage and insurance paid, to Advantech AMT Limited, 39 Edison Road, St Ives, Cambridgeshire PE27 3LF, England. The returned unit(s) must be accompanied by a document declaring that the equipment is returned for repair under warranty and describing clearly and fully the reason for the return of the unit.
Subject to the unit being eligible for warranty repair Advantech AMT Limited will effect the repair and return the unit by pre-paid shipment to the originating location. Subject to the shipment charges being the same as, or less than, that to the original location the unit may be shipped to some other location as the customer may specify.
Under no circumstances shall Advantech AMT Limited be liable for any consequential or incidental costs or damage.

Exclusions

This warranty does not apply to any equipment which has been damaged through abuse, accident (such as lightning strike), negligence or failure to comply with Advantech AMT instructions for storage, installation and use as contained in the equipment manual(s).

Except as specifically provided above Advantech AMT Limited makes no warranties, expressed or implied, as to the merchantability or fitness for a particular purpose.

REPAIR SERVICE

Advantech AMT Limited will provide a repair service for all equipment manufactured by Advantech AMT Limited for a period of ten (10) years.

Returning equipment for repair

Prior to the return of any equipment for repair, whether under warranty or by payment, Advantech AMT Limited must be contacted. The purpose of this contact is to discuss the problem and confirm that equipment needs to be returned. Also to agree the most effective solution to the problem and to discuss the method of return in order to avoid unnecessary duties and ensure that the packing is adequate to protect the equipment during shipment.

The cost of returning the equipment to Advantech AMT Limited will be paid by the customer.

Repairs not under warranty

Repairs to equipment not under warranty will be paid for by the customer. On receipt of the defective unit Advantech

AMT Europe Limited will investigate the fault, determine the most effective repair technique and issue a repair cost estimate.
Repair work will not commence until the cost is authorised by the customer either by a Purchase Order or through a Repair Contract.
In certain circumstances repairs may be carried out on site by prior agreement.

Documentation

On completion of the repair the unit(s) will be returned to the customer together with a Repair Report and a repair contact name at Advantech AMT Limited.

Return shipment

The repaired unit(s) will be returned to the originating location with Advantech AMT Limited bearing the cost of shipment and in transit damage or loss.
The equipment may be returned to some other location at the request of the customer subject to the shipment cost being the same as, or less than, that to the original location.

Invoices for repairs not covered by a warranty will be issued at the time the equipment is despatched. The Invoice(s) is/are payable within 30 days.

Warranty of repairs

Advantech AMT Limited will warrant the repaired unit, in respect of the work and material of the repair, for a period of ninety (90) days from the date of return of the unit to the customer. However where the remaining time of the standard warranty exceeds 90 days the repaired unit will be warranted for that remaining period.

NOTE

Advantech AMT Limited reserves the right to charge for rectification of any faults caused as a result of attempts to repair equipment by third parties.