

APPENDIX TLE – TWO-LINE ELEMENT TRACKING

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This appendix describes the additional capability provided by the Two-Line Element Tracking option for a RC4000-series antenna control unit (ACU). It is provided as a supplement to the baseline manual and the inclined orbit tracking appendix (Appendix TRK).

1 Introduction

1.1 Overview

This option provides additional tracking capabilities using Two-Line Element (TLE) data. The ACU can use TLE data to calculate the current satellite position and continue following the satellite if signal is lost or no signal source is available.

2 Configuration

High-resolution sensors must work correctly to achieve repeatable, precise movements during tracking. It is suggested the drive system is tuned by making small automatic movements made using the MOVETO mode. Tracking performance will not be optimal if the ACU struggles to make good repeatable movements.

3 Detailed Operation

The following sections describe important changes when TLE Tracking is available

3.1 SETUP Mode

Two additional options are available for the TRACKING field in SETUP mode. Selecting one of these options indicates TLE data is available for the satellite.

NAME:BRASIL A1	SETUP
LON: 79.0W	INCLIN: 2
BAND:KU	TRACKING: 4
<0>NONE <1>MEM <2>STEP <3>STP/TLE <4>TLE	

TRACKING: <0> NONE <1>MEM <2>STEP <3>STP/TLE <4>TLE

- STP/TLE – The STEP/TLE mode should be used when a signal source is available. When this mode is selected, tracking will continue using TLE data when signal is lost. Once signal returns, normal tracking will resume.
- TLE – The TLE-ONLY mode should be used when no signal source is available. When this mode is selected, tracking will only use TLE data. The satellite will be tracked “open-loop” and the selected signal source will be ignored.

When a TLE tracking mode is selected, two additional screens are provided to enter the initial TLE data set. The ACU uses one screen for each line. The screens will be blank except for the first character indicating the line number.

```
TWO-LINE ELEMENT DATA:          SETUP
1
<0-9 UP(+) DN(-) BKSP ENTER>
```

The cursor will be placed in the first field. The value for each field should be entered exactly as it appears ignoring letters and spaces. Floating point values should be entered as detailed in Section 2.1.2 of the baseline manual. For complex values (e.g. "10000-3"), use the SCROLL UP key to enter a '+' and the SCROLL DN key to enter a '-'. Use the BKSP key to erase previously entered data. Press the ENTER key to advance to the next field.

The ACU will calculate the data's checksum after the last field is entered. The CHK field will indicate "OK" if the data appears good or "ERR" if an error has been detected.

```
TWO-LINE ELEMENT DATA:          SETUP
1 16276 85109 01089.41658071
-.00000230 00000-0 10000-3 0 862
<0-9 UP(+) DN(-) BKSP ENTER>    CHK: OK
```

```
TWO-LINE ELEMENT DATA:          SETUP
2 16276 3.6693 80.7624 0003295
214.0161 248.7192 1.00272265 36335
<0-9 UP(+) DN(-) BKSP ENTER>    CHK: OK
```

SETUP mode continues normally after TLE data has been entered.

3.2 RECALL/DELETE Mode

The additional track modes will be displayed under the TRK heading as appropriate. If the displayed satellite has been setup with STEP/TLE mode, S/T will be displayed. If the satellite has been setup with TLE-ONLY, TLE will be displayed.

```

                                     RECALL
#   NAME          LON  INCL BAND TRK  TBL
1   BRASIL A1    79.0W  2   KU  TLE 100%
<SCR>THRU LIST <ENTER>SELECT <MODE>EXIT
```

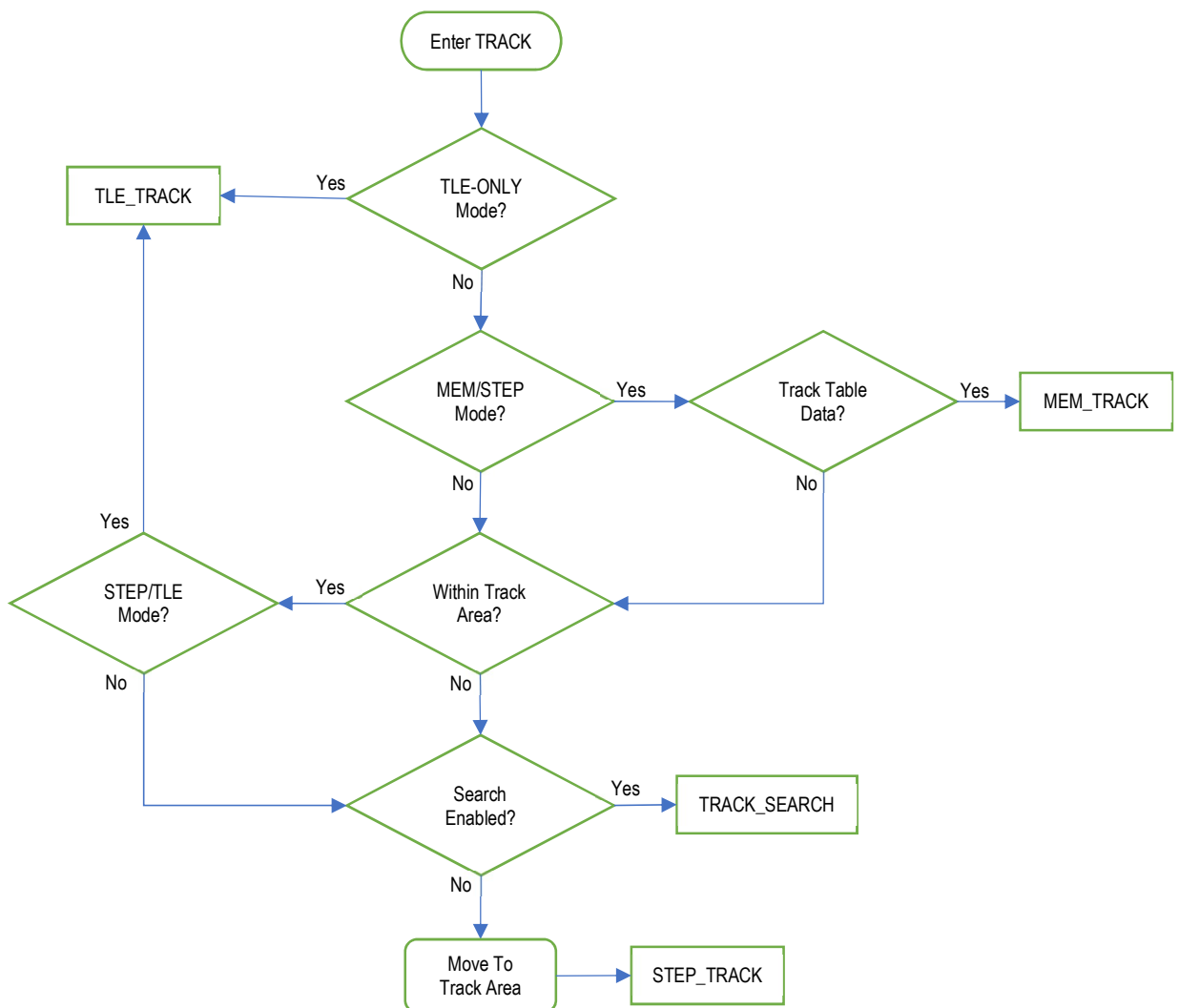
3.3 TRACK Mode

An additional sub-mode designated TLE_TRACK is added to TRACK mode. This sub-mode is active while TLE data is being used to calculate the satellite position. The selected satellite's TRACKING parameter determines when TLE-TRACK sub-mode is used.

The following sections describe the changes in operation of each sub-mode.

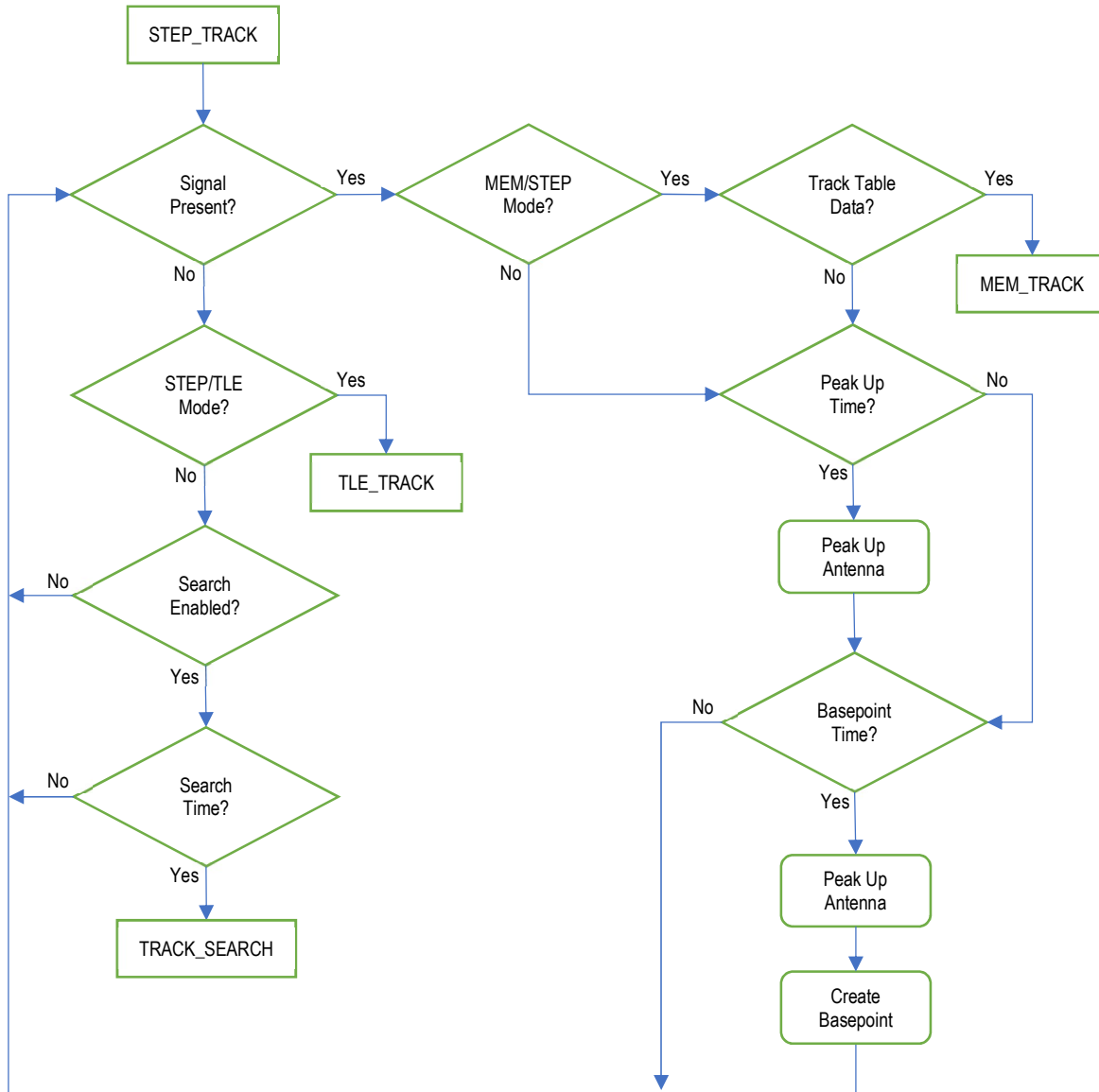
3.3.1 Track Startup

startup, the ACU will perform any needed data initializations and switch to the initial sub-mode. The TLE_TRACK sub-mode will become active if the track mode is TLE-ONLY or if the track mode is STEP/TLE and the antenna is pointed within the track area. The following diagram illustrates this procedure.



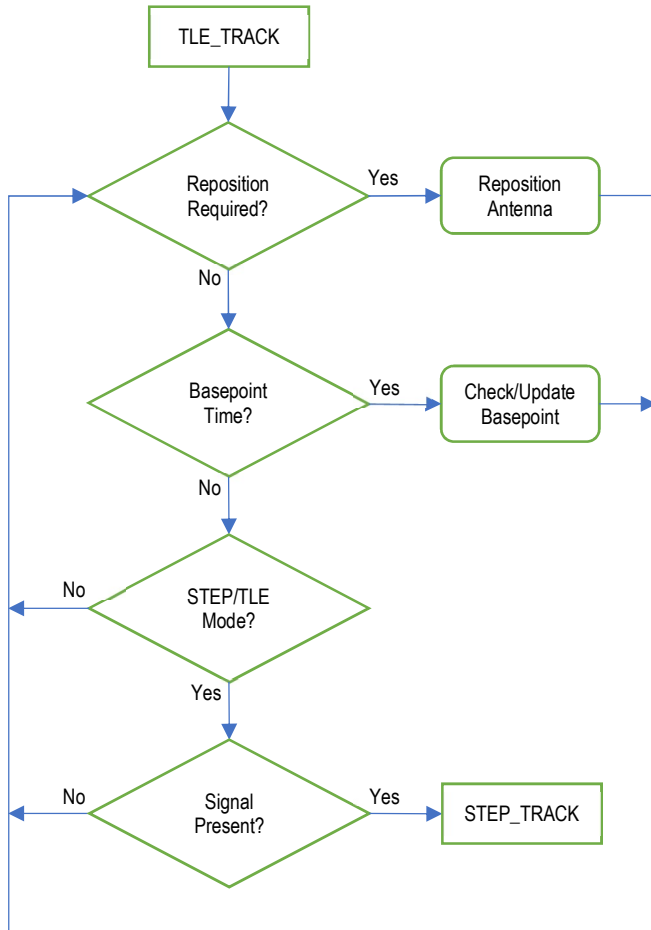
3.3.2 Step Track

In the STEP_TRACK sub-mode, the TLE_TRACK sub-mode receives control if the track mode is STEP/TLE and the satellite signal is lost. The following diagram illustrates this procedure.



3.3.3 TLE Track

In the TLE_TRACK sub-mode, the ACU periodically uses TLE data to calculate the current satellite position and repositions the antenna. The following diagram illustrates this procedure.



The pointing error is calculated based on the antenna's beamwidth and radiation pattern. The maximum tracking error is determined by the Max Track Error configuration item.

Following a successful reposition, the track table entry will be updated and the update flag will be set to indicate the entry was generated by TLE data.

The following status messages may be displayed in this sub-mode:

**TLE:IDLE
WAITING TO REPOSITION**

The ACU is waiting to reposition the antenna.

**TLE:REPOSITION
MOVING TO STAY WITHIN MAX TRACK ERROR**

The ACU is currently repositioning the antenna to a position calculated from TLE data.

This sub-mode will pass control to another TRACK sub-mode in the following circumstances:

STEP_TRACK

STEP_TRACK receives control if the track mode is STEP/TLE and a satellite signal is present.

TRACK_ERROR

TRACK_ERROR receives control if an error occurs.

3.3.4 Track Error

In the TRACK_ERROR sub-mode, all tracking operations are halted. This sub-mode is active whenever an error is detected.

AZIM:	32974	8.3	SS1:756	TRACK
ELEV:	8824	35.3	SAT:SBS 4	(Ku)
POL:	71.1 V		ERROR:PEAK_LIMIT	
* ERROR - TRACKING HALTED * <MODE>EXIT				

An additional TRACK mode error is provided as described below:

ERROR: BAD TLE DATA

This error indicates that the TLE data for the satellite is missing or invalid. The TLE should be confirmed using CONFIG > TLE 1 DATA / TLE 2.DATA. The track can be restarted via RECALL mode.