APPENDIX DVB – INTERNAL DVB RECEIVER

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This appendix describes the additional functions provided by the RC4000 antenna control unit (ACU) when using an optional Internal DVB Receiver. It is provided as a supplement to the "baseline" RC4000 manual. Sections in the baseline manual are referred to when information specific to the Internal DVB Receiver is described.

1.4 THEORY OF OPERATION

1.4.1 Overview

In order to overcome heading estimate errors inherent with any magnetic compass (or in the case where no compass is available), an optional "positive identification" feature is available. This feature is mechanized by using a Digital Video Broadcasting (DVB) receiver.

When positive identification via DVB is enabled, the LOCATE function will first scan the sky looking for an identifiable satellite referred to as a "signpost". The signpost satellite will be identified via the DVB receiver locking onto a previously specified carrier signature.

After peaking up on the signpost satellite, the ACU can perform an automatic "fix" of the original heading estimate. Once the heading fix is applied, the mount may be moved with confidence to any satellite selected by the user.

1.4.2 Signpost Data

It is important to have up-to-date signpost information for this option to work properly. There are numerous sources where signpost signature data is posted online, including http://www.lyngsat.com.

In addition, with the antenna pointing to a satellite, the internal DVB receiver can perform an automatic scan and return a list of all signatures found. This feature is further discussed later in this document.

3.2 DETAILED OPERATION

3.2.2.3.7.1 Unique LOCATE Steps While Using the Internal DVB Receiver

When the DVB identification feature is enabled, additional steps will be added to the normal LOCATE sequence. Initiate the LOCATE mode as usual and select the target satellite that you want to locate. As always, lat/lon from the GPS and a heading “estimate” from the compass will be obtained and the estimated pointing angles to the selected satellite will be displayed. If no compass is available, the heading estimate will be blank and the displayed azimuth target reflects a true heading to the selected satellite. Press <ENTER> to proceed and then select the desired polarization as usual.

Descriptions of actions associated with this option will be displayed on the bottom line of the LCD. The following numbered steps describe the actions in the sequence they will occur.

3.2.2.3.7.2 SORTING OF SIGNPOST CANDIDATES

The list of signpost satellites will be sorted to decide the best signposts to search for. NOTE: The target satellite the user selected does not have to be one of the signpost satellites.

This step will prioritize the signposts according to the following criteria:
- All priority 1 signposts will be considered first.
- Signposts with the same priority will then be ranked according to their vicinity to the target satellite longitude.

This ranked list of signposts will determine the order in which signposts will be searched.

3.2.2.3.7.3 POSITIONING TO START OF AZIMUTH SCAN

The first movement of the positive identification feature will move the antenna to the starting position of the azimuth scan.

If a compass is available, the start of azimuth scan will be [DVB SCAN RANGE] away from the estimated azimuth position of the signpost satellite. If no compass is available, the controller will first start searching from the -180.0º azimuth position.

If the first ranked signpost is not found, the controller will then search for the second ranked signpost. The search process will continue until a signpost is found or the list of signpost candidates is exhausted.

3.2.2.3.7.4 CHARACTERIZATION OF RF NOISE FLOOR

The RF value of open sky is sampled in order to determine an average noise floor. This value will be used during the azimuth scan to determine if the antenna is pointing at a satellite. The elevation will first be moved to hopefully look above surrounding buildings and trees. The RF value detected will be displayed. The elevation will next be moved up five degrees and the RF value again sampled. If the two RF values are close to each other, the controller assumes that it has looked at open sky and will use the average of the two samples as the noise floor during the scan. The controller will iterate above and below the starting position several times until it gets consecutive samples within [DVB SCAN THRESHOLD] of each other. If a satisfactory noise floor value is not determined, the controller assumes that from the current azimuth position the antenna's view of the sky must be blocked. The controller will then proceed to look for the next ranked signpost.

3.2.2.3.7.5 TUNING DVB RECEIVER

Next the controller moves to the elevation calculated for the signpost. The DVB receiver is programmed with the frequency / symbol rate / FEC signature for the currently selected signpost.

3.2.2.3.7.6 AZIMUTH SCAN FOR SIGNPOST

A scan is performed looking for signal lock on the currently selected signpost. During the search, if the sampled RF value is [DVB SCAN THRESHOLD] above the noise floor, the controller will assume that it is pointed at a satellite and change the scan speed from fast to slow. After scanning through a lock condition, the dish is returned to the midpoint in azimuth where lock was seen.

3.2.2.3.7.7 CONFIRMING SIGNPOST

From that center of lock position, the controller will double-check that a lock condition exists. If lock is confirmed, a local peak up of signal strength is performed in order to place the dish as precisely as possible on the signpost satellite. If no lock is confirmed, the azimuth scan will continue.

If a signpost satellite is present at the same longitude as the current signpost and has a priority of 2, the DVB receiver will tune to the signature of this "confirmation" signpost. If no lock is found for the secondary signpost, positive identification will not be confirmed, and the azimuth scan will continue.

If no secondary signpost is present at the current longitude, the original lock detection will be considered the positive identification of the signpost.

Once the signpost identity is confirmed, an azimuth delta will be computed and used to fix the original heading estimate.

3.2.2.3.7.8 POSITIONING TO SATELLITE OF INTEREST

If the selected satellite is at same longitude as the positively identified signpost, there is no need to perform further movement. Otherwise, with the heading fixed, the antenna can then be moved to the selected satellite with confidence.

3.2.2.3.7.9 FINAL TARGET PEAKING

At this point, a final RF peakup may be performed to put the dish on the selected satellite as precisely as possible. The type of peakup performed is determined by [TARGET PEAK].

3.0 CONFIGURATION

3.3.1.2.9 DVB Detection Points

The controller allows the user to customize a list of 10 signpost satellites. The positive identification feature will prioritize this list when a LOCATE is performed. This list can be edited via the DVB DETECTION POINTS configuration screen.

```
SP#: 5                          CONFIG-DVBR
LON: 95.0W FRQ:11780 FEC:3
POL:1 BA:1 SYM:20760 PRI:1
<SCR> THRU LIST, <ENTER> TO MODIFY DATA
```

SP#: <SCR> THRU LIST, <ENTER> TO MODIFY DATA

This item identifies the list number (1-10) that is currently being displayed. When in this field, the Scroll Up or Scroll Dn keys will move through the list. To modify the data press the Enter key.

FRQ: FREQUENCY <1000 – 30000> MHZ

This item specifies the frequency associated with this signpost. This data is used to tune the receiver.

FEC: FEC <1-3 5-7> ex. 3=3/4

This item specifies the forward error correction code associated with this signpost. This data is used tune the receiver. Enter the first number of the FEC scheme; for example, enter 5 to select 5/6.

POL: POLARIZATION <1-H 2-V 3-R 4-L>

This item specifies the polarization associated with this signpost. This data is used to orient the polarization axis correctly. R(ight) and L(eft) handed implies circular polarization and no polarization movement will be made.

BA: BAND <0-C 1-Ku 2-CK 3-L 4-X 5-Ka 6-S>

This item specifies the band of this signpost. This data is used to decide which signposts should be considered for search.

SYM: SYMBOL RATE <1000 – 30000> kS/sec

This item specifies the symbol rate associated with this signpost. This data is used to tune the receiver.

PRI: PRIORITY <0-DISABLE, 1-TOP, 2-LOWER>

This item allows the user to specify the priority to be placed on this signpost. This data is used by the positive identification feature to prioritize which signposts to search for first. The following is a brief explanation of each priority level:
0 – This signpost will not be considered for search.
1 – This signpost will be considered for search.
2 – This signpost will be used for additional verification.

3.3.1.2.10 DVB ID

The operation of the positive identification feature can be customized via the DVB ID configuration screen.

```
                                CONFIG-DVB ID
 TARGET:2        RANGE:30
                    TH: 10
TARGET PEAK <0>NONE <1>AZEL <2>EL ONLY
```

TARGET: TARGET PEAK <0>NONE <1>AZEL <2>EL ONLY

This item defines what the controller will do when it positions to the target satellite following a successful identification of a signpost satellite. If 0 is chosen, no attempt to peak up on the target satellite is attempted. If 1 is chosen, the controller will attempt to peak the RF value in both azimuth and elevation while selecting 2 will cause the controller to peak RF in elevation only. The default value is 2.

NOTE: Since the controller is sampling the total L-Band power (RF), movements in azimuth may cause the RF value to be unduly biased by signals from adjacent satellites. To avoid this situation, the preferred choice is usually to peak in elevation only.

RANGE: DVB SCAN RANGE +/-<10-90> DEGREES

This field specifies the number of degrees on either side of the estimated signpost position that will be scanned. The default value is 30 degrees.

NOTE: This number should be somewhat larger than the worst case error that can be obtained from the compass. For example, if there is confidence that the compass will never have more than a 15 degree error, then the scan range could be set to a value of 20.

TH: DVB SCAN THRESHOLD <10 – 500>

This field specifies at what value above the open-sky noise floor that the scan for a signpost will transition from high speed to low speed. This value should be set low enough that slow speed will be triggered quickly as the scan approaches a satellite. Conversely, it should be set at a high enough value that the transition won't be fooled by noise in the open-sky value, leading to very slow scanning. The default value is 10.

3.3.2 MAINTENANCE

3.3.2.12 DVB Receiver Maintenance

When the DVB option is present, the MAINTENANCE menu allows the user to select DVB maintenance actions by pressing the BKSP(+/-) key.

```
1-VOLTS   2-DRIVE   3-TIME          MAINT
5-LIMITS  6-GPS COM 7-CMP COM 8-MOVETO
9-CMP CAL 0-SHAKE   +/-DVB
^-IP                            .SYS INFO
```

Two different DVB maintenance modes are available from the following screen.

```
<1>MANUALLY TUNE DVB & JOG ANTENNA   DVB
<2>AUTOMATICALLY SCAN FOR SIGNPOSTS
```

3.3.2.12.1 Manually Tune DVB & Jog Antenna

This mode allows the user to test the DVB receiver's ability to lock onto a signpost satellite. When this mode is entered, the current tuning parameters are read from the DVB receiver and displayed.

Azimuth, elevation and polarization angles are also shown on the display. The antenna may be moved as it is in the MANUAL mode. The azimuth may be manually jogged via the 4 and 6 keys, elevation via the 2 and 8 keys, and polarization via the 1 and 3 keys. Speed may be toggled via the 0 key.

```
A:   0.0 STW        RF:423 L 5-SP: 5 DVB
E:  45.4          9-SYM:20760 7-FR:11780
P:  89.9         +/-FEC:3       LO:10750
<5,7,9,+/->TUNE DVB             IF: 1030
```

SS / RF:

The signal level seen by the L-band (RF) power detector or the DVB receiver's AGC (SS) is shown in this field. The Scroll Down key toggles the signal between RF and SS.

Next to the signal level, the current lock status is displayed. A "-" indicates that the DVB receiver has not established a lock with the programmed parameters. A "L" indicates that the DVB receiver has a lock and is able to read the data stream.

<5>SP: ENTER SIGNPOST# <1–10>

This key allows the user to select a signpost from the stored list of DVB signposts. The index of the signpost will be displayed.

NOTE: Any time individual signpost parameters are entered as described below, a "**" will be shown to indicate that the current set of parameters do not necessarily come from a stored signpost.

<7>FRQ: ENTER FREQUENCY <1000–30000>

The frequency for a potential signpost may be individually entered. After entering the frequency, the new frequency along with the current symbol rate and FEC will be programmed into the DVB receiver.

<9>SYM: ENTER SYMBOL RATE <1000–30000>kS/sec

The symbol rate for a potential signpost may be individually entered. After entering the symbol rate, the new symbol rate along with the current frequency and FEC will be programmed into the DVB receiver.

+/-FEC: ENTER FEC <1-3, 5-7>

The FEC for a potential signpost may be individually entered. After entering the FEC, the new FEC along with the current frequency and symbol rate will be programmed into the DVB receiver.

3.3.2.12.2 Automatic Signpost Scanning

This mode allows the integrated DVB receiver to "learn" the identification parameters of DVB streams transmitted by a satellite. In order to use this feature, the ACU must first be peaked up in azimuth, elevation and polarization on an identified satellite.

The length of time it will take the DVB receiver to scan for identifiable transport streams is a function of the minimum symbol rate that the receiver is requested to search for. The smaller the symbol rate, the longer it will take to search the full (950 - 2150) frequency range. Upon entering this mode, the minimum symbol rate is set to 10 MSamples per second. The estimated time to complete a scan is shown.

```
<1> MIN SYMBOL RATE: 10 MS/s          DVB
ESTIMATED SCAN TIME:  90   Sec.
                                    FW:2.20
<2> START AUTOMATIC SIGNPOST SCAN
```

FW:

This field shows the firmware version running in the DVB receiver.

<1> MINIMUM SYMBOL RATE <1-45> MSymbols/sec

The user may reduce the estimated scan time by increasing the minimum symbol rate to scan for. Pressing the 1 key allows the user to enter a minimum symbol rate from 1 to 45 MSamples per second. After entering a new minimum, a new estimated scan time will be displayed. The following table shows the estimated scan time given different minimum symbol rates.

Minimum Symbol Rate (MSymbols/sec)	Estimated Scan Time (Seconds)
31	10
23	15
16	30
12	45
8	90
6	120
4	240
3	450
2	900
1	3600

NOTE: Transport streams with symbol rates less than the minimum rate chosen will not be identified by the scan.

<2>START AUTOMATIC SIGNPOST SCAN

After a minimum symbol rate is chosen, the user may initiate the automatic scan by pressing the 2 key. The following screen appears to show the progression of the scan.

```
 ESTIMATED TIME:  90 Sec.            DVB
   ELAPSED TIME:   1
SIGNPOSTS FOUND:   0
SCAN IN PROGRESS    <.>STOP   <MODE>EXIT
```

The estimated scan time (in seconds) is displayed as a reference and the elapsed time since initiation of the scan is updated.

As the DVB receiver identifies transport streams, the "SIGNPOSTS FOUND" field is incremented.

NOTE: This field should initially show 0 as an indication that the DVB receiver has acknowledged the request to automatically scan for transport streams. If this field shows -1, it indicates that the request to scan was not acknowledged by the DVB receiver. This unlikely condition probably indicates that communication with the DVB receiver is not functioning.

The scan may be stopped at any time by pressing the STOP key.

If no DVB transport streams are found, the scan will end with the following screen:

```
                                        DVB

* NO SIGNPOSTS FOUND          <MODE>EXIT *
```

If transport streams have been found and after the DVB receiver has finished scanning the 950 – 2150 range of frequencies, the following screen will be displayed with the parameters for the first transport stream. The user may scroll through the list of identified transport streams by using the SCROLL UP and SCROLL DN keys.

```
SP FREQ SYMBR FEC                       DVB
 1  951 21345  5

<SCROLL UP/DN>THRU SCAN RESULTS
```

If the user wishes to use a transport stream, it can be entered into the DVB Detection Points (signpost) list. The criteria described earlier in this document concerning what constitutes a reliable signpost should be followed.

NOTE: Frequencies displayed as a result of a signpost scan are IF (L-Band). The correct LO offset must be applied when entering them into DVB Detection Points list.