

Appendix DVB2

2nd Generation Integrated DVB Receiver Option

Revision: 3 March 2009, software version 1.59

This appendix describes the additional functions provided by the RC3000's 2nd Generation Integrated DVB receiver option. NOTE: the functionality of the 2nd Generation DVB receiver is very similar to the original DVB option and will be referred to generically as the integrated DVB receiver throughout this appendix.

1.1 Appendix Organization

This appendix is provided as a supplement to the baseline RC3000 manual. The corresponding paragraphs in the baseline RC3000 manual are referred to when data specific to the Integrated DVB Receiver option is described.

1.2 Software Configuration

The Integrated DVB receiver option provides the ability to mechanize a positive satellite identification feature.

RC3000 software configuration is presented in the form RC3K-ab-wxyz where ab-wxyz represents: (Mount manufacturer/Model #)-(Nav Sensor Option)(Tracking Option)(Remote Option)(Receiver Option)

This feature is categorized as one of the RECEIVER options of the RC3000.

OPTION CATEGORY	DESIGNATOR	DESCRIPTION
Integrated Receiver	N	No integrated receiver supported
	B	Integrated Beacon Receiver
	D	Original DVB Receiver
	C	Original DVB and Beacon Receivers
	R	2nd Generation DVB Receiver
	S	2nd Gen. DVB and Beacon Receivers

Software supporting the 2nd Generation Integrated DVB receiver would therefore be designated as either RC3K-ab-wxy**R** or RC3K-ab-wxy**S**.

1.3.10 Theory of "Positive Satellite Identification"

In order to overcome heading estimate errors inherent with a magnetic compass (or in the case of a "no compass" configuration - no heading estimate), an optional "positive identification" feature is available. This feature is mechanized by integrating a Digital Video Broadcasting (DVB) compatible receiver with the RC3000.

When positive identification via DVB is enabled, the LOCATE function will 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 frequency / symbol rate / forward error correction code pattern stored in the RC3000 for that satellite.

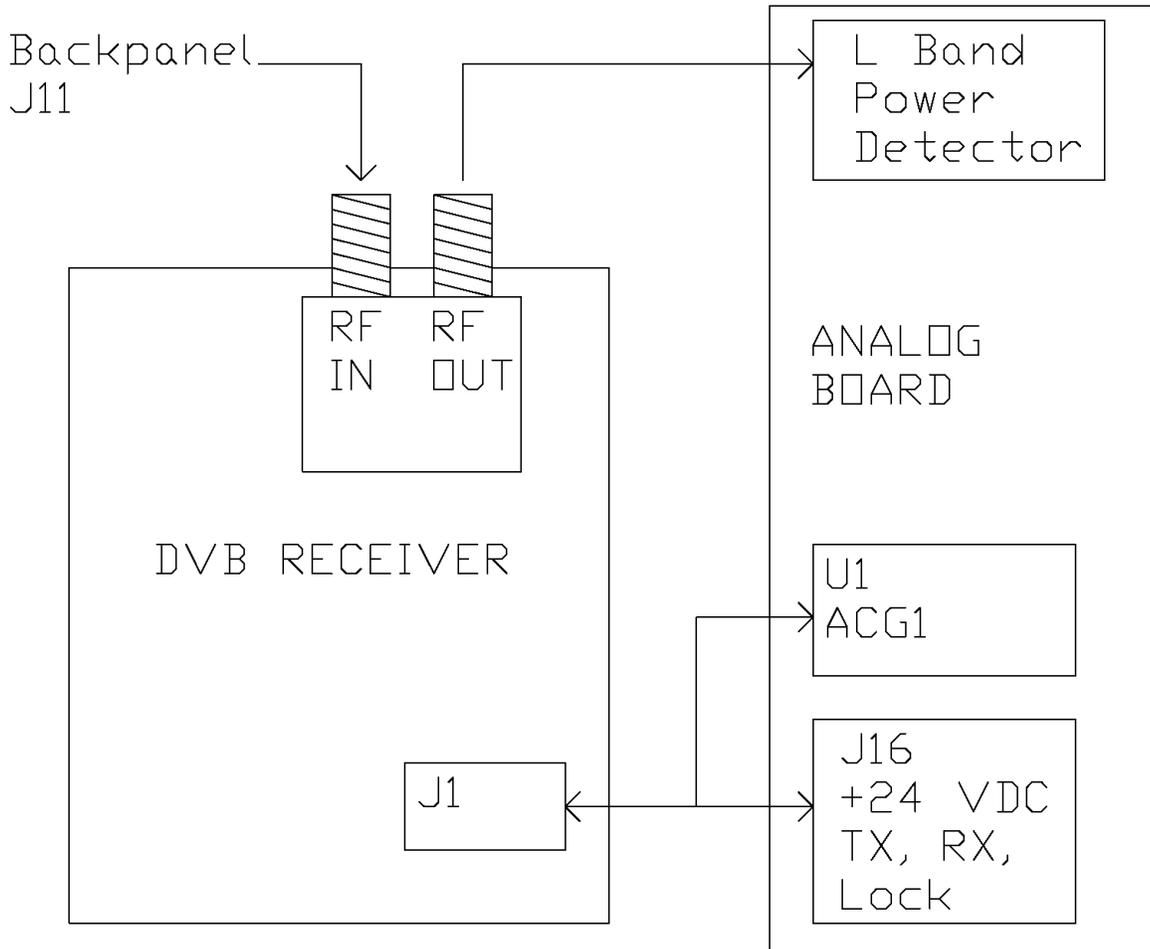
After peaking up on the identified signpost satellite, the RC3000 can perform a "fix" of the original heading estimate. After establishing the heading fix, the mount may then be moved with confidence to any satellite selected by the user.

2.0 INSTALLATION

In order for this option to work properly, all other normal calibration steps described in the baseline manual must be performed correctly.

2.1.5 DVB Receiver mounting

The integrated DVB receiver is mounted on top of the analog board inside the RC3000.



Power and serial communications will be mechanized via a cable between the DVB's J1 connector and the J16 connector on the analog board.

2.2.8 RF connection

L-Band signals from the system's LNB are provided to the DVB receiver via the backpanel J11 F connector. This signal will be split and provided to the L-Band power detector on the analog board.

The integrated DVB receiver card may provide 18 VDC (1.0 amp max) to a LNB by installing a jumper at position Z1.

3.0 DETAILED OPERATION

3.2.2.3.7 Unique LOCATE mode steps using the Integrated 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 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 a "no compass" configuration exists, 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.

NOTE: the user may want to review the configuration items described in this appendix associated with the DVB Detection Points (3.3.1.4) and DVB ID features (3.3.1.3.14) as they will be referred to in the following descriptions.

1) SORTING OF SIGNPOST CANDIDATES

The list of signpost satellites/transponders (3.3.1.1.4) will be sorted to decide the best signposts to first look for. NOTE: the satellite the user wants to eventually go to (selected satellite) doesn't 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 selected satellite of interest (i.e. the signpost closest to the selected satellite will be scanned for first).

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

After determining the first signpost to scan for, the bottom line will display "**SP:**" and the longitude of the signpost. For example, if a signpost at longitude 105 West is chosen, the bottom line will show "**SP:105 W**". "**ADDITIONAL MESSAGES**" showing the sequence of events will be appended following the SP: string. The additional events and the messages displayed will now be described.

2) TILT DETERMINATION

If the polarization tilt compensation is enabled via the Autopeak configuration screen (3.3.1.2.6), the first movements made will be to characterize the pitch and roll of the antenna platform as described in 3.2.2.3.6 of the baseline manual.

If a "no compass" option is present, the azimuth axis will be moved to the 0.0, -90.0 and -180.0 positions to sample elevation. These positions are used since the scan for a signpost will begin at the minus 180 position. Otherwise, elevation will be sampled at azimuth positions 90 and 45 degrees away from the start of the signpost scan.

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 the "with compass" option is present, the start of azimuth scan will be `dvb_scan_range` away from the estimated azimuth position of the signpost satellite.

If a "no compass" option is present, the controller will first start scanning from the -180.0 azimuth position. If the first ranked signpost is not found, the controller will then scan for the second ranked signpost from the +180.0 position since it will be at that position at the end of the initial scan. Starting from the -180 or +180 position will alternate until a signpost is found or the list of signpost candidates is exhausted.

During this action "**MOVING TO START OF SCAN**" will be displayed on the bottom line.

4) CHARACTERIZATION OF RF NOISE FLOOR

The RF value of open sky is sampled in order to determine an average noise floor coming from the L-Band power detector. This noise floor will be used during the azimuth scan to determine if the antenna is pointing at a satellite. During the scan, 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.

During this step the bottom line will display "**DETERMING RF NOISE FLOOR**". The elevation will first be moved to the 45 degree position in order 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 within 10 of 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.

If the two samples are not within 10 of each other, the controller assumes that one of the positions must have been pointing at the arc of satellites. The controller then moves five degrees more in the other direction and samples again. 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 during this step 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.

5) POSITIONING TO THE SIGNPOST ELEVATION

Next the controller moves to the elevation calculated for the signpost. During this time "**MOVING TO SIGNPOST ELEVATION**" will be displayed.

6) TUNING DVB RECEIVER

The DVB receiver is programmed with the frequency / symbol rate / FEC pattern for the currently used signpost. During this time "**INITIALIZING DVB RCVR**" will be displayed.

7) POLARIZATION ADJUSTMENT

If the signpost has a linear (H or V) orientation, polarization will then be moved to the correct position. During this time “**ADJUSTING POLARIZATION**” will be displayed.

8) AZIMUTH SCAN FOR SIGNPOST

A scan is performed looking for signal lock on the frequency/symbol rate/FEC of the currently selected signpost. The azimuth scan starts out in fast speed until it sees a RF value above a (RF noise_floor + dvb_scan_threshold) value. It then switches to slow speed and starts looking for a signal lock. The azimuth scan will go 3 degrees beyond the last indication of lock to make sure a lock from a sidelobe wasn't initially seen. During this time “**SCANNING AZIMUTH**” will be displayed.

9) CONFIRMING SIGNPOST

After scanning through a lock condition, the dish is returned to the midpoint in azimuth where lock was seen. During this time “**RETURNING TO LOCK CENTER**” will be displayed. From that position, the controller will double check that a lock condition exists.

If no lock is confirmed, the azimuth scan will continue. This condition will be annotated by the brief message “**NO LOCK FOUND – CONTINUING SCAN**”.

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. This peak up requires high resolution sensors (such as pulses) on the azimuth and elevation axes. During this time “**PERFORMING PEAK UP**” will be displayed. NOTE: this peak up will not occur if the positive identification feature is “enabled without peak” in the DVB ID configuration screen (3.3.1.1.14).

An optional "secondary identification" of the signpost may then be performed. If a signpost satellite is defined at the same longitude as the current signpost and if it has a priority of 3 (confirmation priority), the DVB receiver will tune to the frequency/symbol rate/FEC pattern of this "confirmation" signpost. During this time “**CHECKING FOR POSITIVE ID**” will be displayed.

If no "secondary signpost" is present at the current longitude, the original lock detection will be considered the positive identification of the signpost. If no lock is found for a "secondary signpost", positive identification of the signpost will not be confirmed.

If a positive identification of the signpost is not confirmed, the scan for that signpost will be completed in case we had come across a satellite using the same freq/symbol rate/FEC combination. If no positive identification happens, then a scan looking for the next signpost from the list sorted in step #1 will be done.

If no positive identification of any signpost is accomplished, the LOCATE will stop and display the message “**NO POSITIVE IDENTIFICATION**”. The hpa disable signal will remain to prevent transmission.

If a positive identification is confirmed, an azimuth delta will be computed and used to fix the original heading estimate.

10) 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 estimate fixed, the antenna can then be moved to the selected satellite with confidence. During this time **“SIGNPOST FOUND- GO TO SELECTED SATELLITE”** will be displayed.

11) SELECTED SATELLITE POLARIZATION ADJUSTMENT

The controller adjusts polarization to achieve the orientation requested for the selected satellite.

If tilt compensation has been enabled, the polarization angle is additionally adjusted according to which direction the satellite is with respect to the tilt of the platform. Hopefully this will leave the polarization axis positioned to achieve adequate cross-pol isolation. During this time **“ADJUST POL TO COMPENSATE FOR TILT”** will be displayed.

12) FINAL TARGET PEAKING

A final RF peakup may be performed to put the dish on the selected satellite as precisely as possible. During this time **“PERFORMING PEAKUP”** will be displayed.

NOTE: this peak up will occur according to how the target_peak configuration item is programmed in the DVB ID configuration screen (3.3.1.3.14).

3.3.1 Configuration Mode

3.3.1.1.4 DVB Detection Points

This group allows the user to customize a list of 10 “signpost” satellites. The LOCATE mode’s positive identification feature will prioritize from this list.

```

SP#: 1                                CONFIG-DVBR
LON:121.0W FRQ:11724 FEC:1
POL:2          SYM:20000 PRI:1
<SCR> THRU LIST, <ENTER> TO SELECT

```

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

This field 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. The cursor will move to the LON field.

LON: **ENTER LON IN <DDD.TT> FORMAT**

This field allows a user to enter a signpost satellite’s longitude in decimal format. See section 3.1.4 for instructions on how to enter satellite longitudes. After the longitude is entered, the cursor will move to the POL field.

If you do not wish to change the current longitude, pressing the Scroll Up key will move to the POL field. Scroll Dn will move back to the SP field.

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

This field allows the user to specify the polarization associated with this signpost. This data is used by the positive identification feature to orient the polarization axis correctly for receiving the DVB data.

R(ight) and L(ef) handed implies circular polarization and no polarization movement will be made.

FRQ: **FREQUENCY<1000 – 13000> MHZ**

This field allows the user to specify the frequency associated with this signpost. This data is used by the positive identification feature to tune the DVB receiver.

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

This field allows the user to specify the symbol rate associated with this signpost. This data is used by the positive identification feature to tune the DVB receiver.

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

This field allows the user to specify the forward error correction code associated with this signpost. This data is used by the positive identification feature to tune the DVB receiver.

Enter the first number of the FEC scheme. Example: to select 5/6, enter 5.

PRI: **PRIORITY <0-DISABLE, 1-TOP, 2-LOW,3-CONFIRM>**

This field 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 - a signpost with this priority will not be considered for scanning

1 - all priority 1 signposts will be scanned before any priority 2 signposts.

2 - after scans for priority 1 signposts are completed, priority 2 signposts will be attempted

3 - if a priority 1 or 2 signpost is found at the same longitude, a lock from a priority 3 signpost will be used as a confirmation that the signpost has been found.

NOTE: the signpost list only contains data about a DVB transport stream to be used as a “signpost”. With respect to the RC3000 there is sometimes confusion between the preset list and the list of STOREd satellite data (3.2.2.4). STOREd data contains both satellite and mount (azimuth, elevation, polarization) position data. The signpost list is an additional list that should not be confused with the other lists mentioned.

The following table shows a typical list of signpost that might be used for a system operating in North America.

SP#	LON	POL	FRQ	SYM	FEC	ID	PRI
1	119.0W	R	12224	20000	5/6	119W	2
2	79.0W	V	11742	11110	3/4	0W	1
3	95.0W	H	11780	20760	3/4	191E	1
4	148.0W	R	12224	20000	5/6	148W	1
5	121.0W	V	11724	20000	1/2	121W	1
6	110.0W	R	12224	20000	5/6	110W	1
7	105.0W	V	11720	26000	2/3	15W	2
8	61.5W	R	12224	22000	5/6		2
9	119W	R	12239	20000	5/6	119W	1
10	103.0W	H	11840	26,670	7/8	23W	2

Notes:

SP #1 is given priority 2 since it is actual used by multiple spot beams that may not be visible in various areas of North America.

SP #8 is given priority 2 since its FREQ/SYMBR/FEC pattern is the same as many other potential signpost satellites.

SP #10 is given priority 2 as it is only used occasionally for uplinks.

3.3.1.3.14 DVB ID

This group allows the user to customize the operation of the positive identification feature.

ENABLED : 1	CONFIG-DVB ID
TARGET : 2	RANGE : 30
LO FREQ : 10750	TH : 15
<0>DISABLED	<1>WITH PEAK <2>W/O PEAK

ENABLED: **<0>DISABLED <1>WITH PEAK <2>W/O PEAK**

This field allows the positive identification feature to be disabled (0).

If the feature is enabled, it may be specified whether or not an automatic peakup on the signpost and selected satellites will be performed. If high resolution sensors are available for the azimuth and elevation axes, it is recommended that the automatic peakup (1) option be chosen. If high resolution sensors are not available, automatic peakups cannot be performed and option 2 should be chosen.

TARGET: **TARGET PEAK <0>NONE <1>AZEL <2>ELEV ONLY**

This item defines what the controller will do when it positions to the selected satellite following a successful identification of a signpost satellite. If 0 is chosen, no attempt to peak up on the selected 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.

NOTE: since the controller at this time will be 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, choosing option 2 may be the preferred choice.

LO FREQ: **LNB LO FREQUENCY <1000 – 30000>**

This field allows the frequency of the LNB's local oscillator to be specified.

This value will be automatically subtracted from a signpost's downlink frequency in order to describe the intermediate frequency that the DVB receiver will receive.

NOTE: if a particular mount has multiple feeds, a LO frequency associated with each feed will be contained in the configuration screen for that feed.

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.

This number should be somewhat larger than the worst case error that can be obtained from the compass. Example: if you have 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.

3.3.2 Maintenance Items

3.3.2.11 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	4-SIG MAINT
5-LIMITS	6-GPS COM	7-FG COM	8-MOVETO
9-FG CAL	0-SHAKE	+/-DVB	.-CI RECORD
			Z1-FTRv1.55

Two different DVB maintenance modes may be then selected from the following screen:

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

3.3.2.11.1 Manual Tuning

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

-208.3	CCW	SS:128	-	5-SP:??	DVB
43.7		S	9-SYM:12345	7-RF:?????	
-14.5			+/-FEC:3	LO:10750	
TUNE DVB				IF: 951	

Manual Antenna Control

Azimuth, elevation and polarization angles and limit status are shown in the two left columns of 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.

Other keys will be used to program the DVB receiver.

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 will scroll between RF and SS.

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

Upon entering the mode, SP will be "*" since it is not known if the current tuning is from a stored signpost.

<7> FRQ: ENTER FREQUENCY <10000 – 13000> MHz

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.

Upon entering the mode, SP will be "*" since it is not known if the current tuning is from a stored signpost.

<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> ex. 3 = 3/4

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.

LK: ----, lock, LOCK

This field indicates the current lock status from the DVB receiver. "----" indicates that the DVB receiver currently has not established a lock on the programmed parameters. "lock" indicates that the DVB receiver has initial lock on the data stream. "LOCK" indicates that it has established a better lock indicating that it is able to internally estimate a bit error rate from the data stream.

3.3.2.11.2 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:1.00
<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 as described in section 3.3.1.1.4. The criteria described in section 2.4.8 concerning what constitutes a reliable signpost should be followed.