APPENDIX BCN - INTEGRATED BEACON RECEIVER

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This appendix describes the additional functions provided by the RC4000's integrated Beacon receiver option.

Applicable to RC4000 software version 2.0x and higher.

1 Introduction

1.1 Appendix Organization

This appendix is provided as a supplement to the baseline RC4000 manual. The corresponding paragraphs in the baseline RC4000 manual are referred to when data specific to the Integrated Beacon Receiver option is described.

1.2 Features

This option provides the ability to manually and automatically tune an integrated beacon receiver for use during LOCATE and TRACK modes.

1.2.1 Software Configuration

RC4000 software configuration is presented in the form RC4Kabvwxyz where abvwxyz represents: (Mount manufacturer/Model) ***ab*** (Nav Sensor Option) ***v*** (Tracking Option) ***w*** (Remote Option) ***x*** (Receiver Option) ***y*** (Thor Receiver Option) ***z***

This feature is categorized as one of the (Digit 12) TOP CARD RECEIVER options of the RC4000.

OPTION CATEGORY	DESIGNATOR	DESCRIPTION
Spectrum Analyzer/ Beacon Receiver	N	No integrated receiver supported
	A	ASC (Atlantic Satellite Corp.) Beacon
	B	Novella Beacon
	C	Avcom Spec An
	D	Avcom Spec An & DVB
	E	ASC Beacon & DVB
	F	Avcom Spec An & Novella Beacon
	G	Avcom SBS2 SpecAn/Beacon & DVB
	H	DVB-S2
	I	DVB-S2 & Novella
	J	DVB-S2 & SBS2 Spec An/Beacon
	K	Avcom SBS2 SpecAn/Beacon
	L	Avcom SBS2 Beacon
	M	DVB-S2 & SBS2 Beacon
	P	ASC Beacon & DVB-S2
	R	DVB Receiver
	S	Novella Beacon & DVB

Software supporting the integrated beacon receiver would therefore be designated in the form RC4Kabvwx**y**z.

1.2.2 Hardware Configuration

The beacon receiver hardware may be purchased in three configurations:

1) Embedded Novella Satcoms B38 Compact Tracking Receiver.
2) Integrated Atlantic Satellite Corporation ASC350L Beacon Receiver.
3) Integrated AVCOMM SBS2-2150E Satellite Beacon Receiver.

The Receiver Option software is used for all hardware configurations. Functional and performance differences between the three hardware configurations are described in the remainder of the appendix.

1.3 Integrated Beacon Receiver Overview

For many tracking applications, it is desirable to monitor the satellite's beacon as an indication of received signal strength. Due to the relatively low power and narrow bandwidth of satellite beacons, specialized receiving equipment is required. This option allows the RC4000 ACU to internally house and control any of the three L-band beacon tracking receivers listed above.

All hardware options lock on, while measuring the level of conventional continuous wave beacons. The Novella Satcoms B38 and AVCOMM SBS2-2150E can also lock on, while measuring the signal level of BPSK modulated beacons. High immunity against false lock to telemetry subcarriers is achieved by the use of a universal anti-sideband device that is capable of identifying any sideband located between 2.5 kHz to 75 kHz away from the carrier on the Novella Satcoms B38 Tracking Receiver.

The L-band beacon signal is input to the beacon receiver from the Antenna Interface of the RC4000. Via user programming, beacon frequency may be selected to a resolution of 10 kHz. The receiver is capable of automatically locking to a satellite beacon through a search band listed in the table in section 1.4. Therefore accurate centering of the satellite beacon frequency is achieved despite the 10 kHz granularity of frequency selection.

The beacon receiver tracks the beacon signal's frequency drifts and measures its power level. The receiver generates a DC voltage output which represents, in logarithmic scale, the beacon power at the receiver's input. The output voltage to input power log-conformity is better than 0.1 dB over a 40 dB measuring range. The RC4000 monitors this DC voltage during tracking operations in order to keep the antenna peaked on the satellite.

1.4 Beacon Receiver Specifications

	Novella Satcoms B38	ASC350L	AVCOMM SBS2
Input Range	940 to 2150 MHz	930 to 2050 MHz	950 to 2150 Mhz
Input Impedance	50 Ohm	50 Ohm	50 Ohm
Input Level	-70dBm to -110dBm	-35 to -85 dBm	0 to -115 dBm
Signal Strength Output Range	±10 VDC	0 to 10 VDC	0 to 10 VDC
Signal Strength Output Slope	2 dB/V	2 dB/V	2 dB/V
Post-detection Time Constant	100 ms	400 ms	100 ms
Threshold for Lock Reacquisition	< 43 dB-Hz	< 45 dB-Hz	<44 dB-Hz
Search Range	±200 kHz	±30 kHz	±92 kHz
Attenuation Control	0 – 40 dB	0 – 50 dB	0 – 40 dB
Demodulation	CW or BPSK	CW only	CW or BPSK

2 HARDWARE

2.1 INSTALLATION

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

2.1.1.1.1 2.1.2.4.2 Signal Strength (Receiver 2)

The RC4000 monitors the input power level signal and lock status from the beacon receiver via the External Receiver circuitry. When mounted internally, these connections are made inside the RC4000.

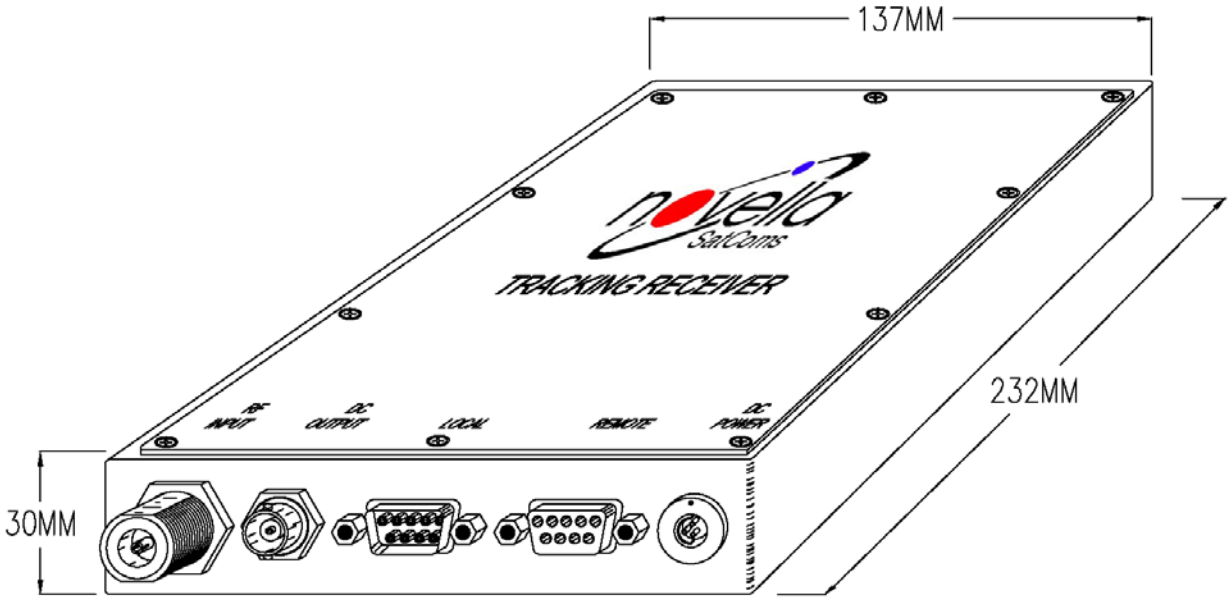
2.1.1.1.2 2.1.2.4.8 RF connection (RF Input)

When mounted internally, the J11 L-Band RF input will be split internally to the beacon receiver and the RC4000's L-Band power detector (and possibly the internal DVB receiver).

2.1.2 Beacon Receiver mounting

When only the beacon receiver is present, the beacon receiver card will be factory mounted internally above or to the side of the RC4000's board-stack, depending on the enclosure layout.

Depending on the overall size and internal layout of the RC4000 enclosure, the beacon receiver card may be housed in a small enclosure and mounted externally to the RC4000. The Novella Satcoms B38 is shown below as an example of this.



3 DETAILED OPERATION

3.1 LOCATE MODE

When the beacon receiver option is present, 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. Press <ENTER> to proceed and then select the desired polarization as usual.

If the selected satellite is from the user preset list and a beacon frequency has been programmed for the selected polarization, the beacon receiver will be automatically tuned before any LOCATE movements begin. The input power level and lock status from the beacon receiver will then be available as the SS2 inputs. Normal locate and autopeak operations will then proceed using the SS2 inputs as their source.

CAUTION: Many satellites utilize the same frequencies for beacons. If the beacon frequency for the satellite of interest is not unique, the Autopeak scan function could lock onto the wrong satellite.

3.2 TRACK MODE

The inclusion of the integrated beacon receiver is basically transparent to the functionality of TRACK mode. TRACKing as described in appendix TRK will proceed as if an external receiver is providing signal strength to the SS2 input.

Prior to entering TRACK mode, the beacon should either be manually tuned via the beacon receiver maintenance screen or automatically tuned as part of a prior LOCATE.

Within the TRACK FACTORS configuration screen, the signal source should be programmed to SS2.

When the beacon receiver loses lock, its AGC output also drops to a minimum value. Therefore, loss of lock will manifest itself as a "loss of signal" situation.

3.3 Preset Satellites

In addition to the normal preset satellite data (see section 3.3.1.1.3 of baseline manual), this option allows specification of degrees of inclination.

```
SAT#: 1   NAME:TELSTAR 12    CONFIG-SATS
 LON:121.0W PO:-26.0
INCL: 3 BAND:1 POL:1
INCLINATION <1-20 DEG> <0>NON-INCLINED
```

INCL: INCLINATION <1-20 DEG> <0>NON-INCLINED

This field defines the number of degrees of inclination of the satellite. If the satellite is not in an inclined orbit, this value can be set to “0” (zero degrees.)

3.4 Beacon Detection Points

An additional CONFIG screen is available when this option is present to allow setting detailed satellite data for satellites that are saved in the Preset Satellite list (see section 3.3.1.1.3.)

```
SAT#: 1                      CONFIG-BCNR
 LON:121.0W BAND:1  FREQ:11696.00
 POL:1             DEMOD:0         LOC:0
<SCR> THRU LIST, <ENTER> TO MODIFY DATA
```

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

This field identifies the list number (1-20) that is currently being displayed. When in this field, using the Scroll Up or Scroll Dn keys will move through the list.

LON: ENTER LON IN <DDD.T> FORMAT

This field allows a user to enter a satellite’s longitude in decimal format. See section 3.1.3 of the baseline manual for instructions on how to enter satellite longitude. After the longitude is entered, the cursor will move to the POL field.

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

This field describes the polarization associated with the beacon signal for the specified satellite. H = Horizontal Linear, V = Vertical Linear, R = Right Hand Circular, L = Left Hand Circular

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

This field describes the frequency band associated with the beacon signal for the specified satellite.

FREQ: BEACON FREQUENCY <xxxxx.yy>MHz

This field describes the frequency of the beacon signal for the specified satellite. NOTE: program the actual beacon frequency, not the IF frequency beyond the LNB. The RC4000 will automatically adjust according to the LO of the LNB.

If you do not want the RC4000 to automatically tune and use a beacon for a particular satellite, program 0.00 into H and V for that satellite.

DEMOD: DEMODULATION <0-CW, 1-BPSK>

This field describes the type of demodulation required for the beacon signal. CW = Continuous Wave, BPSK = Binary Phase-Shift Keying
NOTE: this setting ignored by the Beacon Level Detector hardware.

LOC: LOCATE <0-OFF, 1-SIGNPOST, 2-CONFIRM>

This field specifies how the beacon signal for the specified satellite will be used during an automatic LOCATE.

0-OFF: The beacon signal for the selected satellite will not be used during a LOCATE.

1-SIGNPOST: Typically when there is not a DVB option, selecting SIGNPOST will allow the beacon signal on the specified satellite to act as a signpost. During a LOCATE function, the ACU will first scan the sky looking for an identifiable satellite referred to as a "signpost." When the DVB option is also used, the DVB signpost function generally has priority over the beacon signal for signpost verification.

2-CONFIRM: At the end of a LOCATE and before final peak up, the ACU will tune the beacon receiver to the appropriate frequency and peak up using the beacon signal.

The following table shows an example list of North American Ku-band satellites and their published beacon frequencies.

SAT NAME	LON	Horizontal Frequency	Vertical Frequency
Nahuel 1	71.8 W	11700.00	11701.00
AMC-6	72.0 W	11702.00	12198.00
AMC-5	79.0 W	11701.00 11702.00	
AMC-9	83.0 W	11702.00	12198.00
IA-6	93.0 W	11702.00	12198.00
IA-5	97.0 W	11702.00	12198.00
AMC-4	101.0 W	11702.00	12198.00
AMC-1	103.0 W	12198.00	
AMC-15	105.0 W	11702.00	12198.00

3.5 Beacon Signal Factors

This screen defines how the signal strength input is used. The Beacon Signal Factors screen is generally used in place of the SS2 Signal Strength Factors (Section 3.3.1.2.8 of baseline manual).

```
   LOCK:0        TIME:1.0     CONFIG-BCN
  THRES:2800      POL:0
SCAN RG: 8    SRCH AZ: 3   SRCH EL: 3
LOCK TYPE <0>NONE <1>HI <2>LO
```

LOCK: LOCK TYPE <0>NONE <1>HI <2>LO

When the autopeak source is set to Beacon, this item defines whether a discrete signal lock input is required to indicate a satellite has been found. The signal lock input may help in distinguishing the correct satellite while doing a LOCATE.
If a signal lock input is used, it may be defined as either having a HI (>3.5 VDC) or LO (< 0.8 VDC) level that indicates lock.

TIME: LOCK TIME <0.0-10.0> SECONDS

This item defines how long the RC4000 will wait after each step before sampling signal strength. Increasing this value may be required to allow equipment such as a modem to generate an AGC output.

THRES: SCAN SLOW THRESHOLD <0-1000>

The threshold item defines what the minimum signal strength indication for the channel is required for the tracking system to “recognize” that a satellite is present. **NOTE: these items are only applicable to TRACK mode.** When the signal strength reaches this threshold level, the scan movement will transition from fast to slow speed.
If different bands are received that exhibit different “off satellite” signal strengths, the highest “off satellite” value should be used to avoid the possibility of recognizing noise as a satellite.

SENSE: INPUT SENSE POLARITY <0>NEG <1>POS

The polarity flag tell the controller what the sense is on the signal strength input voltage used for tracking and autopeak operations. A positive sense is defined as one that increases in magnitude as the RF signal strength increases. If the signal strength voltage decreases as the RF signal increases, its polarity is considered negative.

SCAN RG: SCAN RANGE <1-90 DEGREES>

The scan_range item defines how many degrees to either side of the nominal azimuth target the scan autopeak operation will search.

SRCH AZ: SPIRAL SEARCH AZIM LIMIT <1 – 20 DEGREES>
SRCH EL: SPIRAL SEARCH ELEV LIMIT <1 – 15 DEGREES>

The search_azim/elev_limit items define the area that the spiral search pattern is allowed to search to recognize a satellite. If a satellite is not recognized after searching the area defined by these limits, the spiral search will return to the normal target position. The larger the limits, the longer time a search might take. If the limits are too small to account for azimuth target inaccuracy due to heading error or to account for the amount of elevation movement an inclined orbit satellite may exhibit, the spiral search may quit before moving over the satellite.

3.6 Beacon Receiver Maintenance

When the integrated beacon receiver option is present, the MAINTENANCE menu allows the user to select Beacon Receiver maintenance by pressing the ENTER key (symbolized by <>).

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

This mode allows the user to manually tune and test the Beacon Receiver's ability to lock onto a satellite's beacon. When the mode is entered, it displays the current IF frequency to which the receiver is tuned. Also displayed is the current attenuation (AN:) setting from the receiver.

```
a:-107.4          SS: 623 L .-AN:32   BCN
e: 25.7           RF: 486   5-FR:12198.90
p:  2.6         <>DM:CW       LO:10750.00
<5,9,.,<>>TUNE BCN          9-IF: 1448.90
```

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 if 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 tune the beacon receiver.

5-FR: RF <xxxxx.yy> MHz

This field allows the user to enter the actual frequency of the satellite's beacon. When the frequency is entered, the IF frequency will be derived from the LO frequency. The resulting IF frequency is displayed in the IF field. The beacon receiver will then be tuned to that IF frequency.

NOTE: upon entering this screen the RF field will be blank.

9- IF: IF <940.00-2150.00> MHz

The intermediate frequency to program the beacon receiver to may be entered via this field.

After entering the IF frequency, a tuning command will be sent to the beacon receiver. The success of the programming is then confirmed by a status check of the receiver. During the time of tuning and status checking, the IF field will show "TUNING". If the status check shows that the receiver is now tuned to the entered IF frequency, then the IF value will be displayed in the field. If the status check does not confirm the programming, then the field will be filled with "*****.**".

NOTE: as described above (5-FR:), the IF field may also be derived by entering an RF value. After entering the RF value, the IF field will display "TUNING" just as if the IF value had been entered directly.

.-AN: ATTENUATION <0-40> dB

This field allows the user to change the input attenuation of the beacon receiver. Press the STOP (.) key to enter this field.

NOTE: the internal attenuation of the Beacon Level Detector is fixed at 10 dB. Attempting to modify this setting will result in "**" being displayed in this field.

<>DM:CW (BP)

The ENTER key may be pressed to toggle the beacon receiver's demodulation mode between continuous wave (CW) or BPSK (BP) settings. NOTE: ignored by the Beacon Level Detector.

LO:xxxxx.yy (MHz)

This field indicates the LO frequency of the LNB. The LO is defined in the CONFIG – FEED DEFINITION screen (refer to baseline RC4000 manual, section 3.3.1.2.5.)

LK:----, LOCK

This field indicates the current lock status from the beacon receiver. "----" indicates that the beacon receiver currently has not established a lock on the tuned frequency. "LOCK" indicates that a lock has been established.

RF: / SS: / AD:

The signal level seen by the L-band (RF) power detector, the beacon receiver's AGC (SS) or a level internal to the beacon receiver (AD) is shown in this field. The Scroll Down key will scroll between RF, SS and AD.

Upon entering this screen, the beacon receiver's AGC (SS) value will be displayed. The SS value will probably be of most use for determining the functionality of the beacon receiver.

The RF value is an indication of total L-band power. This may be useful for finding a satellite while jogging the antenna from this screen.

The AD value is an internal beacon receiver signal level value that will probably only be useful for debugging purposes by RCI personnel.

3.7 Beacon receiver checkout

To confirm that the beacon receiver is able to lock onto the beacons from satellites of interest, use the beacon receiver maintenance screen described in 3.3.2.12 of this appendix. Position the antenna onto candidate satellites and observe that the beacon receiver is able to tune to the beacon and obtain lock.

NOTE: when initially looking for beacons, set the beacon receiver's attenuation to 0 in order to provide the most sensitivity to signals. If the receiver's attenuation has to be increased to 40 dB in order to bring the observed signal strength to values less than 700, then separate attenuation on the input line may be needed. Any required attenuation for the Beacon Level Detector must be provided externally in the L-Band input (the internal attenuation level of the Beacon Level Detector is fixed at 10dB.)

The user may want to edit the Preset Satellite list (3.3.1.1.3) and Beacon Detection Points (3.3.1.2.10) to include beacon frequencies for satellites of interest.

The following table may be used to log observations from multiple satellites.

SAT NAME	LONGITUDE	POLARIZATION	BEACON FREQUENCY	DEMOD. (CW / BPSK)	LOCK STATUS	SIGNAL STRENGTH

The user should also manually scan in azimuth across beacons in SLOW speed. If a lock does not appear, it indicates that the mount's azimuth slow speed is too fast and the automatic scan function may not recognize the lock indication. Adjust the azimuth's slow speed (4.1.5 of baseline manual) to a point where a lock indication is apparent for at least one second as the antenna moves across the satellite.

NOTE: make sure that the LO frequency of the system's LNB has been programmed in the FEED DEFINITION screen (3.3.1.2.5.)

3.8 Mechanizing Automatic Locates

The integrated beacon receiver will be interfaced to the baseline RC4000 via the SS2 lock and signal strength inputs.

4 TROUBLESHOOTING

If the functionality of the beacon receiver is in question, first go to the maintenance screen and confirm communication with the receiver. If the receiver cannot be tuned, check the internal cabling between the beacon receiver and the rest of the RC4000.

If a LOCATE to a satellite does not work, manually position onto the satellite and confirm (via the maintenance screen) that a lock can be obtained at that frequency.

The inability to obtain lock may be due to low signal level reaching the beacon receiver. From the maintenance screen, set the attenuation to 0 to make the receiver as sensitive as possible.