DATUM SYSTEMS

M7 Modem Application Note

Smart Carrier Cancelling Quick Start Guide

Revision History
Rev 0.1 10-1-2014 Initial Release.
Rev 0.2 10-27-2014 Menu Photo Clean-up

1.0 Smart Carrier Cancelling Overview

Smart Carrier is a patent pending advanced second generation carrier canceller which allows 2 similar carriers to occupy the same transponder spectrum, but is different from other cancellers in that it is a baseband canceller instead of an IF canceller. It allows excellent performance with easy setup and no additional cabling. Smart Carrier is compatible with all Datum modulation types and FECs, and is well suited to be used with Sharp Roll-Off factors all the way down to 5%. Datum's technique provides improvement in the Shannon Capacity of ~ 2 dB, which is ~50 % increase in the fundamental channel capacity.

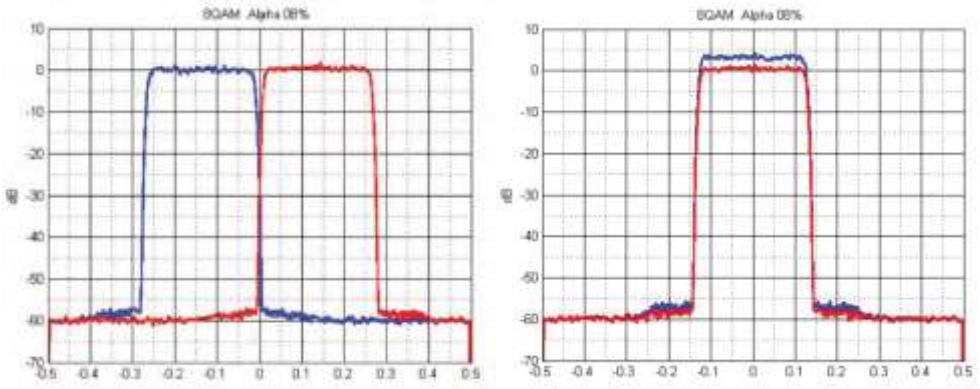

Figure 1: Smart Carrier Bandwidth Savings of 50%

1.0.1 The purpose of this Quick Start Guide;

1. Introduce you to the "Smart Carrier" Demodulator Card.
2. Show Smart Carrier network configuration
3. Provide an understanding of the Smart Carrier Terminology
4. Show setup configuration and understand status information.

2.0 About the "Smart Carrier Ready" Demod Card

To use the Smart Carrier cancelling option you must have a "Smart Carrier Ready Demod (SCR)" installed in your M7 Series modem. The part numbers for the multiple versions are listed below and can be confirmed in the menu or web browser interface of the modem under the Demod/Status section. There are 3 versions of SCR Demods::

1) M7 Smart Carrier Ready IF Demod: M714002A-1 or M714002A-2
   (PCB # DRA14002-01 or -02)

2) M7L Smart Carrier Ready L-Band Demod: M714001A-1
   (PCB # DRA14001-01)

3) M7LT Smart Carrier Ready L-Band Demod: M714001A-2
   (PCB # DRA14002-02)

2.1 Before you begin:

To verify your M7 Series modem demod is Smart Carrier Ready, go to the Dmd/Status section of the front panel menu or web browser interface. Under **"Hardware Type"**, it should show **"Smart Carrier IF Demod"** or **"Smart Carrier L-Band Demod"**, as shown in Figure: 2 below. To locate the Smart Carrier Ready Demod version, scroll down to the Status/Hardware ID and verify you have Items 1, 2 or 3 above.

Figure: 2

3.0 Terms and Definitions for Smart Carrier Demod Configuration and Status Menus

For the purposes of this Guide, the naming and definitions of the following operational and technical terms are given below in short form.

3.1 Demod Configuration:

- **"IF Smart Carrier"** This refers to Datum System's patented point-to-point Carrier Canceling technology.

- "**IF Sat Echo Delay Max**" This defines the maximum satellite echo delay that Smart Carrier will search to when looking for the undesired echo carrier. Echo delay is the time it takes the local uplink carrier to travel to the satellite and back to the same location it started from, returning as an echo. Typical geostationary satellites have an echo delay of about 240 ms.

- "**IF Sat Echo Delay Min**" This defines the minimum satellite echo delay that Smart Carrier will search from when looking for the undesired echo carrier. Echo delay is the time it takes the local uplink carrier to travel to the satellite and back to the same location it started from, returning as an echo. Typical geostationary satellites have an echo delay of about 240 ms.
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- **"IF Sat Echo Delay Search Hold"** When echo lock is lost after being locked this determines how long Smart Carrier searches +/-1 ms of the last known echo delay value before going to the full search range set by "IF Sat Echo Delay Max" and "IF Sat Echo Delay Min". The wider the echo delay search range the longer on average it takes to acquire echo lock.

- **"IF Sweep Range"** This defines the frequency sweep range and needs to be set so that it is greater than the far end carrier and echo carrier maximum frequency errors. The primary cause of frequency errors is the accuracy of the reference used for the up and down converters. The satellite itself also contributes to this error and should be accounted for. In most systems a +/-30 kHz sweep is sufficient.

- **"IF Sweep Mode"** Normally this should be set to "Fast". Search mode is for special applications requiring very low symbol rates where multiple carriers can be present in the above sweep range.

3.2 Demod Status:

- **"Status Carrier"** Is the summary status of the Smart Carrier demod. This will indicate if there's an alarm, if the echo is unlocked, if a test mode is active and if the demod is locked to the far end carrier.

- **"Status Eb/No"** Is the current Eb/No of the far end carrier being received.

- **"Status Offset"** Displays both the far end carrier "Rcv" error offset frequency and the "Echo" offset frequency when they are each locked.

- **"Status Level"** Displays both the far end carrier "Rcv" level and the "Echo" level in dBm. The echo level is only valid when the echo is locked.

- **"Status Imbalance"** Displays the frequency offset imbalance between the far end carrier and the echo carrier as a percentage of the symbol rate and the level imbalance between the two carriers in dB. The default offset imbalance alarm threshold is 3.00% and the default level imbalance alarm is 10.00 dB. Generally best performance is achieved when the offset imbalance is less than 1% and the far end carrier and echo carrier level imbalance is less than 7 dB.

- **"Status Sat Echo Delay"** Displays the current satellite echo delay in milliseconds when the echo is locked. Otherwise it shows the current delay being searched in an attempt to acquire echo lock.

- **"Status Hardware Type"** Displays the type of card installed in the slot being viewed. See section 2.1.

4.0 System Configuration Requirements

The following conditions are necessary in order to operate Smart Carrier cancelling.

a. A Smart Carrier enabled modem must be used at each end of the satellite link.

b. The link must be full duplex and each end of the link must be able to see an echo (copy) of its own signal in the return (downlink) path from the satellite. Each modem will cancel its own echo using the Smart Carrier technology.

c. Smart Carrier cancelling cannot operate in spot beams type transponders and only be used within a bent-pipe transponder.

d. Power Spectral Density Ratio between the RX carrier and the Echo must be within +/- 10 dB

e. Symbol Rate Ratio between the RX carrier and the Echo must be within +/- 1/8 of the symbol rate

f. Frequency Offset between the RX carrier and the Echo must be within +/- 1/8 of the Symbol Rate

Figure 3 below shows a simple block diagram needed to operate Smart carrier. The two ends of the link are shown with their own echo carrier being received on the downlink.

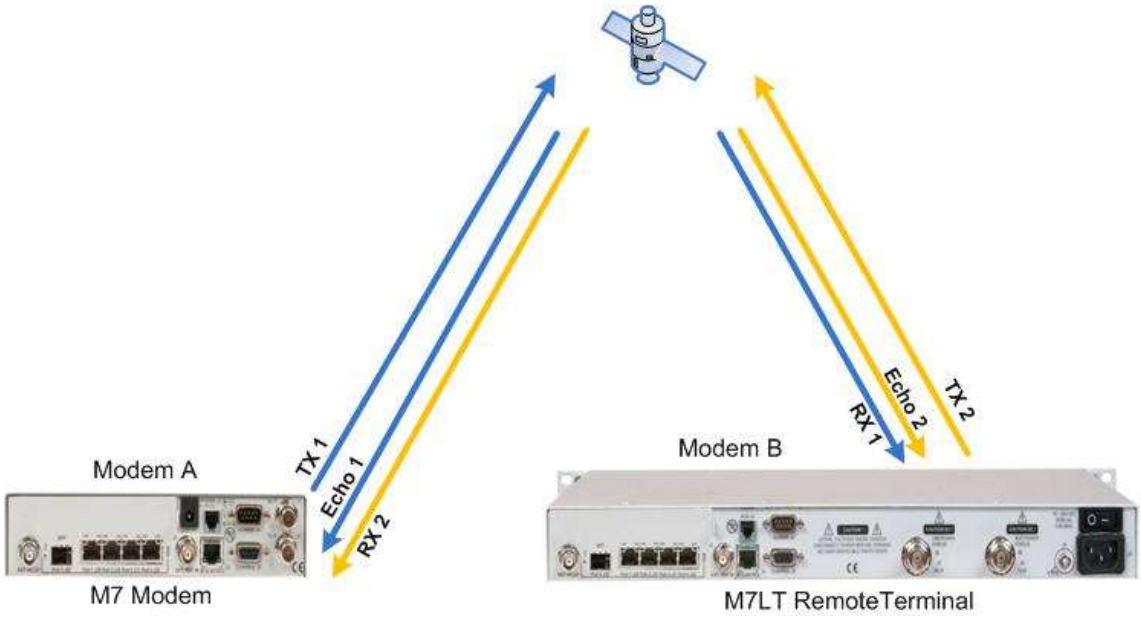


Figure: 3

5.0 Modem and Smart Carrier Operating System and Status Menu's

5.1 Demod Configuration Menus (Menu's Show Recommended Default Factory Settings)

The following configuration menus are related to Smart Carrier cancellation operation and use. Smart Carrier was designed to be easy to set-up with trouble free operation. It is recommended to start with the factory default settings (shown below). The menus for configuration are found in the Demod/IF menu section, using the Front Panel or the Web Browser interface, and are provided below with helpful descriptions.

<Dmd: IF Smart Carrier –Enabled> enables Smart Carrier operation.

<Dmd: IF Sat Echo Delay Maximum – 2.0 to 320.0 ms > Sets the maximum satellite echo search delay. The recommended initial value is 290.0 ms.

<Dmd: IF Sat Echo Delay Minimum – 0.0 to 318.0 ms > Sets the minimum satellite echo search delay. The recommended initial value is 230.0 ms for geostationary satellite operation and 0.0 ms for test bench operation.

<Dmd: IF Sat Echo Delay Search Hold – 0.0 to 600.0 Sec > Sets the amount of time a narrow +/-1 ms delay search hold is active until returning to the full delay sweep range set by "IF Sat Echo Delay Maximum" and "IF Sat Echo Delay Minimum" after echo lock is lost. This speeds echo reacquisition when brief interruptions occur.

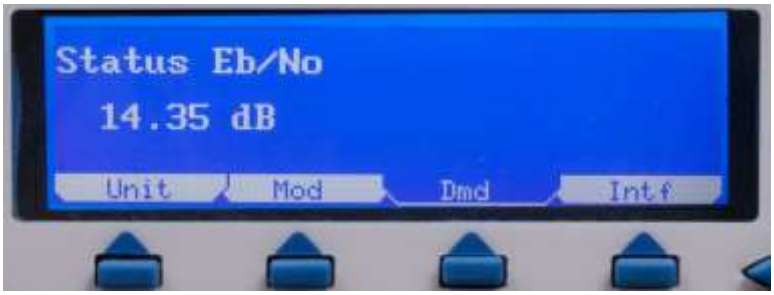
<Dmd: IF Sweep Range – 0.100 kHz to 3.250 MHz> Sets the +/- carrier frequency acquisition sweep range.

<Dmd: IF Sweep Mode – Fast or Search> "Fast" enables fast acquisition mode. Search mode is only used with very low symbol rates where multiple carriers can be within the IF Sweep Range. Should be set to "Fast" under normal conditions.

5.2 Demod Status Menus

Detailed Smart Carrier status menus are provided to assist in simple set-up and operation, as well as providing the tools for easy troubleshooting of the cancelled satellite link. Below are the related status menus and descriptions.

<Status: Carrier – Locked, OK> Shows far end Carrier Locked and Normal.



<Status: Eb/No – 30 to 0 dB> Shows real-time Eb/No level of the far end carrier being received when the demod is locked.

<Status: Offset – Rcv> Shows the far end carrier offset frequency being received.
<Status: Offset – Echo> Shows the echo offset frequency being received.

<Status: Level – Rcv> Shows the far end carrier level being received.
<Status: Level – Echo> Shows the echo carrier level being received.

<Status: Imbalance – Offset> Shows the frequency offset imbalance between the far end carrier and the echo carrier as a percentage of the receive symbol rate. For best performance the two carriers should be close together in frequency, typically the difference should be less than 1% of the symbol rate.

<Status: Imbalance – Level> Shows the level imbalance between the far end carrier and the echo carrier. Positive values indicate the far end carrier level is greater than the echo carrier level. Negative values indicate the echo level is greater than the far end carrier level.

<Status: Sat Echo Delay – Edit > When viewing the “Status Sat Echo Delay” and the echo is locked, pressing Edit or the 0 key will bring up this option. Pressing Enter will then set the “IF Sat Echo Delay Maximum” to the currently received echo delay plus 4 ms and the “IF Sat Echo Delay Minimum” to the currently received echo delay minus 4 ms. This +/-4 ms delay range will allow for normal geostationary satellite movement while providing the fastest possible echo reacquisition time when reception is interrupted.

End of Quick Start Guide