TSAN 048

Dataradio Technical Support

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Product: T-96SR Wireless Modem

Application: Determine if "Dynamic Carrier Detect Off Threshold" should be enabled or disabled.

Definition: The following paragraph defines "Dynamic Carrier Detect Off Threshold" as found in T-96SR Technical Manual Part Number 001-4006-101, Page 2-16.

Dynamic Carrier Detect Off Threshold

"The Dynamic Carrier Detect Off Threshold allows the modem to automatically adjust the Carried Detect Off Threshold based on the RSSI while receiving data. If selected, the Carrier Detect Off level will automatically adjust to approximately 15 dB below the actual signal strength. This provides rapid detection of loss-of-carrier and minimizes or eliminates 'bit dribble' at the end of transmissions."

One of the settings used in programming a T-96SR is the Carrier Detect (CD) 'ON' and 'OFF' level. See Fig.1 on next page. CD 'ON' is the RF signal required to open the receiver squelch, allowing detected audio to enter the T-96SR modem for data detection. The CD 'OFF' is the level to which the RF signal must decrease to allow the squelch circuit to close, shutting off the detected audio to the T-96SR modem.

Settings for the 'ON' and 'OFF' level are described in Paragraph 2.5.4.4 on Page 2-17 of the T-96SR Technical Manual part number 001-4006-101. See Fig. 1 on next page. Dataradio recommends a 5 dBm difference between CD 'ON' and CD 'OFF'.

In systems having strong RF signals (-80 dBm or greater), the 'ON' CD level is exceeded, detected audio is passed through to the modem and data is sent to the comport of the T-96SR. Once the RF signal is terminated, the receive signal must drop from the high level down to the CD 'OFF' level before the squelch circuit can close, shutting down the detected audio to the modem. The period of time it takes for the high signal level, loss of signal and CD shutdown creates a "Squelch Tail", a period of white noise that the modem is subjected to before CD

closes. White noise can be interpreted as erroneous data, it is also known as “bit dribble”. These extra bits of data can cause errors in SCADA system operation.

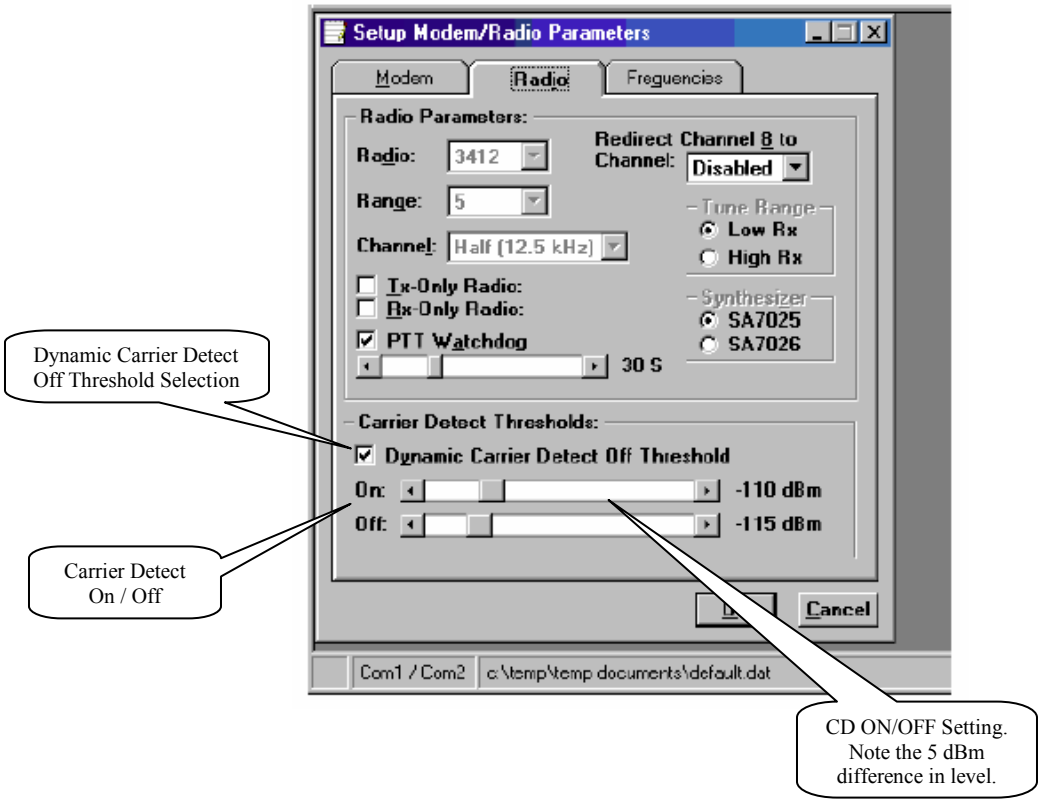

Fig. 1

When enabled, ‘Dynamic Carrier Detect Off Threshold’, adjusts the CD ‘OFF’ level to within approximately 15 dB below the actual carrier level. This feature provides an advantage in systems having strong received signal levels (RSSI), generally in excess of -80 dBm, or fade margins* of 20 dB or greater. By raising the ‘OFF’ level of the CD, receive squelch reaction to signal loss becomes very fast, eliminating squelch tail noise and providing protection against bit dribble.

* *Fade margin is defined as the amount of signal available in excess of the amount of signal required to maintain reliable data throughput. See Example 1.*

Example 1:

Atmospheric noise and interfering RF signal (Noise Floor):	-105 dBm
RF signal needed to transfer data with 70% or better reliability:	-100 dBm
RF signal available:	- 80 dBm

Fade margin: (-80 dBm) – (-100 dBm) = **20 dB**

Determining Noise Floor:

The above example deals with a specification called “Noise Floor”. This specification is the combination atmospheric noise, electro-mechanical interference, and unwanted interfering RF signals that a SCADA telemetry system is subjected to.

When available, a spectrum analyzer makes an effective tool for measuring noise floor. Attaching the SCADA site antenna to the spectrum analyzer will allow the integrator to measure the amount of noise the site will actually be subjected to.

If a spectrum analyzer is not available, the T-96SR field programming software can be used for measuring unwanted signals and noise. By using the Offline Diagnostic screen, see Fig. 2, the RSSI color bar will display signal level in near real time. Monitoring the RSSI level when the SCADA system is off-line will provide a level (in dBm) the Integrator/Installer can use as the “Noise Floor”.

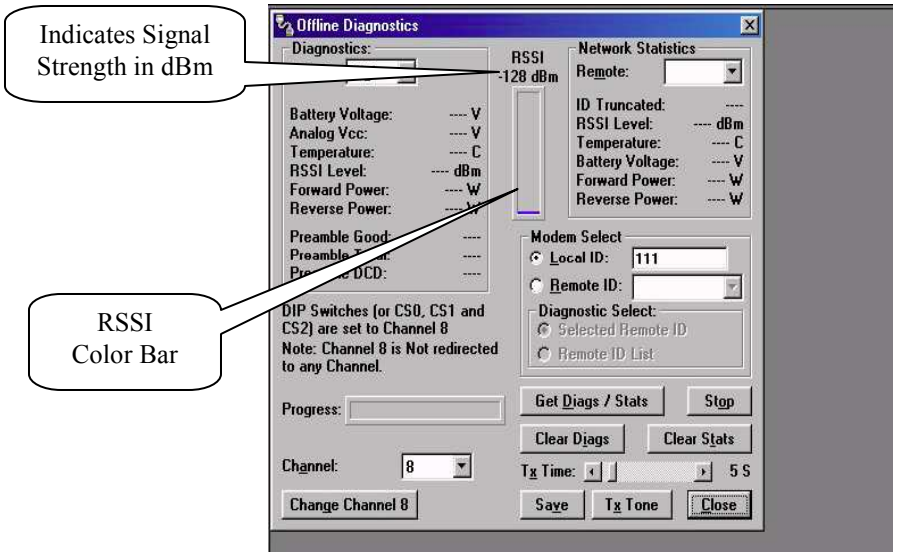

Fig. 2

Determining Fade Margin:

Diagnostic data provided by the T-96SR wireless modem and field programming software is not intended to replace laboratory grade test equipment. In the absence of field test equipment, the diagnostics will provide relative values that can be used to determine a base line for signal levels sufficiently accurate for normal site maintenance and evaluation.

The RSSI level displayed in the color bar shown in Fig. 2 will help determine receive fade margin between Master and Remote. When the Master unit transmits to the Remote unit, the received RSSI level at the Remote unit is the level used to determine the Fade Margin for that Remote site. By taking the RSSI reading, and comparing it to the signal strength required for reliable data throughput, Fade Margin is obtained as shown in Example 1 above.

Note: Additional information concerning fade margins and system optimization can be found in section 2.7, page 2-38 of T-96SR Technical Manual part number 001-4006-101 which can be downloaded free of charge from Dataradio's website at: www.dataradio.com/downloads.html .

Enable Dynamic Carrier Detect Off Threshold:

Factory default for CD ON and OFF levels is -110 dBm ON and -115 dBm OFF. When the on-channel RF signal of -80 dBm is received, the CD turns "ON". When the RF signal is gone, the RSSI level must drop from -80 dBm to -115 dBm to turn the CD "OFF". As explained on page 1, this extra time can cause a "Squelch Tail". The 'Dynamic Carrier Detect Off Threshold' moves the CD "OFF" setting to within -15 dB of the actual received RF signal. Instead of dropping from -80 dBm to -115 dBm, the RSSI level need only drop to -95 dBm, helping to prevent "Squelch Tail" and bit dribble. In Example 1, the 20 dB fade margin is sufficient in signal level to allow the Dynamic Carrier Detect to be effective, allowing the CD to close rapidly with a -15 dB drop in signal without the noise floor affecting the operation. In Example 1, enabling Dynamic Carrier Detect Off Threshold is recommended.

Disable Dynamic Carrier Detect Off Threshold:

There are instances when Dynamic Carrier Detect Off Threshold is not recommended. One such instance would be a situation when the fade margin is less than 15 dB. See Example 2.

Example 2:

Atmospheric noise and interfering RF signal (Noise Floor):	- 98 dBm
RF signal needed for data transfer:	- 95 dBm
Amount of on-channel RF signal available:	- 85 dBm

Fade margin: (-85 dBm) – (-95 dBm) = **10 dB**

Note that the noise floor is considerably higher in Example 2 than it was in Example 1. Because the noise floor is higher, a stronger on-channel RF signal is required for data throughput. The on-channel signal is at -85 dBm leaving a fade margin of 10 dB.

The normal factory default of CD "ON" of -110 dBm and "OFF" of -115 dBm would not be sufficient to squelch out the noise floor of -98 dBm given for Example 2. The system integrator would likely program the T-96SR CD levels to -90 dBm "ON" and -95 dBm "OFF" to reliably squelch out this noise level.

Dynamic Carrier Detect Off Threshold sets the CD "OFF" level to 15 dB below the carrier level. If the RSSI level is -85 dBm, as in Example 2, the CD "OFF" is now set for -100 dBm. The noise floor being at -98 dBm is stronger than the CD "OFF" level. This means the CD will not turn off. An open squelch (CD) will subject the T-96SR modem to constant white noise. This noise may create erroneous data bits, possibly affecting system performance.

Disabling this option would leave the CD "OFF" level at -95 dBm. When the on-channel RF signal is gone, the RSSI level would drop to -98 dBm (noise floor level) allowing the CD to close. Since the change in signal level is so small, the CD would switch very quickly reducing the possibility of bit dribble. This would be a good application where the 'Dynamic Carrier Detect Off Threshold' should be ***disabled***.

Recommendations:

Consider these two recommendations when deciding whether to ***disable*** 'Dynamic Carrier Detect Off Threshold':

1. SCADA telemetry system has a noise floor of -100 dBm or greater.
2. The SCADA telemetry system has a fade margin of less than 20 dB.

