Mike Foster
Director of Engineering
Young Design, Inc.
8000 Lee Highway
Falls Church, VA 22042
(703) 205-0073
mf@ydi.com

Timco Engineering Inc.
849 NW State Road 45
Newberry, Florida 32669

Reference: Job # 270UC2
FCC ID: NM5-2458-AL

Mr. Sid Sanders,

In response to your question, "Please explain how the RF power output is limited."

Please refer to the NM5-2458-AL System block diagram as shown in Figure 1, and as submitted to Timco Engineering's web site.

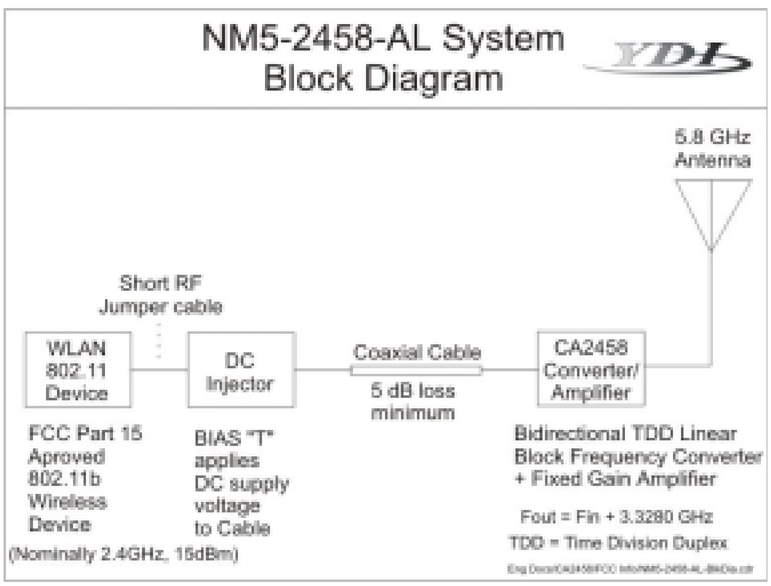


Figure 1 - System Block Diagram

The WLAN 802.11b card has a transmit level regulated on-board to +15dBm (ref: Agere datasheet), as measured at the output connector of the device. The RF jumper cable and DC Injector have a combined insertion loss of approximately 1.5 dB. The coaxial cable loss from the Injector to the outdoor converter/amplifier module is specified to be a minimum of 5 dB. The outdoor module is a linear frequency block converter with fixed transmit conversion gain amplification set to 14 dB.

The system installation manual stipulates that the system requires professional installation, and that a minimum cable length (and specific amount of loss) is required between the DC Injector and the outdoor module. Tables of commonly used cables and their minimum required lengths are provided to aid the installer. Given the specifications of nominal 15 dBm P-out from the WLAN device, the 1.5 dB loss from the jumper and DC Injector, and a specified minimum insertion loss of 5 dB for the coaxial cable, the nominal input level to the CA2458 outdoor module is at or below 10 dBm which is well within linear operation of the module.

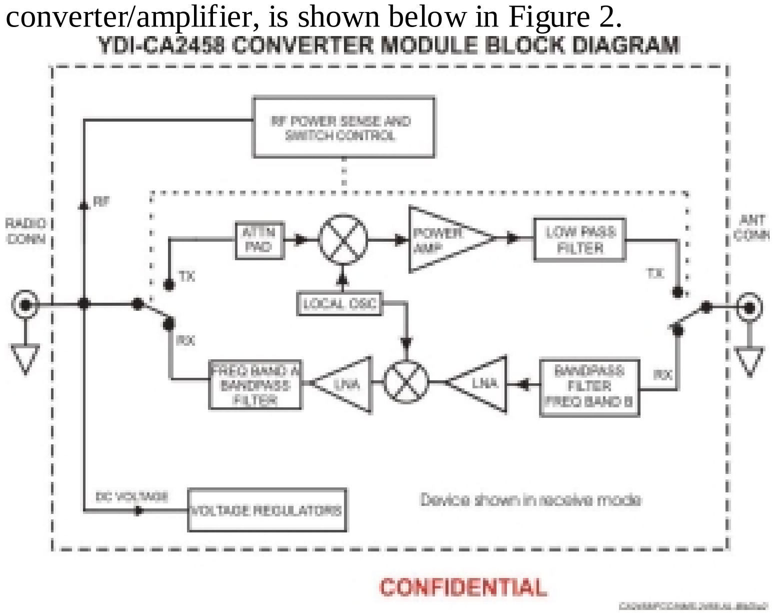
In summary, the RF power is limited because the RF transmit power is limited by the WLAN device, and because the system employs fixed / minimum losses between that device and the fixed-gain outdoor module.

<u>In response to your request for an explanation of why Processing Gain tests were conducted at 2.4 GHz.</u>

In the past, the Commission has noted that amplification of IEEE 802.11b signals do not impact the system Processing Gain.

YDI's application is for a direct sequence spread spectrum system operating on the 5725 to 5850 MHz band, as authorized by Section 15.247, that complies with all technical requirements in that section.

This system is comprised of 2.4 GHz and 5.8 GHz elements, as shown above in Figure 1. The block diagram depicting the internal functions of the 5.8 GHz module, a CA2458 converter/amplifier, is shown below in Figure 2.



<u>Figure 2 - Converter Module Block Diagram</u>

The 5.8 GHz section of the system, within the CA2458, does not transmit, or receive, but rather translates and amplifies. There is no modulation or demodulation occurring in the CA2458 and this component provides frequency translation and signal amplification without any additional modulation, or demodulation, coding, or decoding. As the processing gain is achieved by the modulation and coding methods in the baseband transmitter, and is realized in the baseband receiver section, the processing gain at 2.4 GHz sets the system Processing Gain.

Since the Commission acknowledges that amplification of IEEE 802.11b DSSS signals do not impact the system Processing Gain, we are asserting that a linear frequency translation also does not impact the system Processing Gain. As an example, Complementary Code Keying (CCK) modulation used in IEEE 802.11b achieves processing gain via bandwidth reduction (9dB) and coding gain (2dB). A linear amplification, and linear block frequency conversion of such signals neither modifies the occupied bandwidth of the signal or in any way modifies the coding methods employed. Indeed, no companding, compression, or notable distortion or non-linearities are introduced in to the signal transmission channel. In addition, no modifications to the 802.11b device receive threshold or receive sensitivity are made. If a module or device were to modify or distort the modulation envelope of the desired signal, or degrad the SNR or the J/S signal ratio, degradation of the Processing Gain would occur.

For this reason, since that the CA2458 is a bi-directional, linear block frequency converter with fixed linear gain amplification, used as a module in this system, the processing gain of the receiver, operating at 2.4 GHz sets the system Processing Gain.

In order to demonstrate that the CA2458 section of this system operates as a linear block converter and amplifier, and provides net system gain without modification of the modulation, sample laboratory measurements are hereby summarized:

Input Frequency (MHz)	Output Frequency +/- 10kHz
2400.00	5728.00
2405.00	5733.00
2410.00	5738.00
2415.00	5743.00
2420.00	5748.00
2425.00	5753.00
2430.00	5758.00
2435.00	5763.00
2440.00	5768.00
2445.00	5773.00
2450.00	5778.00
2455.00	5783.00
2460.00	5788.00
2465.00	5793.00
2470.00	5798.00
2475.00	5803.00
2480.00	5808.00
2485.00	5813.00
2490.00	5818.00

A sample of data collected on the CA2458 module demonstrating linear frequency translation is shown in Figure 3. Conversion is a clean, linear translation of 3.32800 GHz in both directions. Phase noise of the LO used in the module for the conversion is better than:

-75dBc/Hz @ 10kHz

-95dBc/Hz @ 100kHz

Figure 3 - Table of Measured Frequency Conversion Linearity

Treating the CA2458 as a simple active mixer, and using an HP8753E Network Analyzer configured to measure conversion loss linearity, a plot was taken (with 1dB used as the vertical scale resolution) to demonstrate the flatness across the band. Reverse gain is similarly measured for linearity.

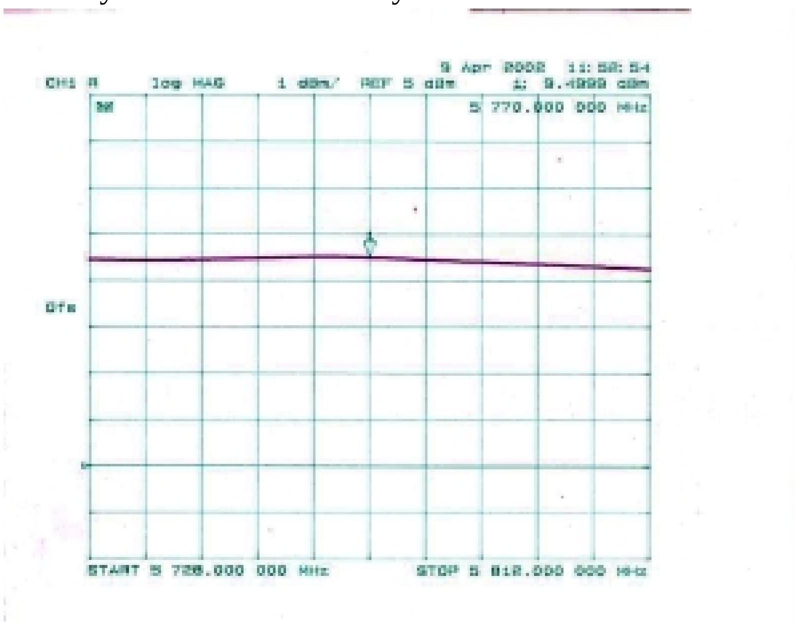


Figure 4 - 'Conversion Loss' Measured Linearity

Figure 5 depicts the CA2458 as configured for the conversion measurements on the Network Analyzer.

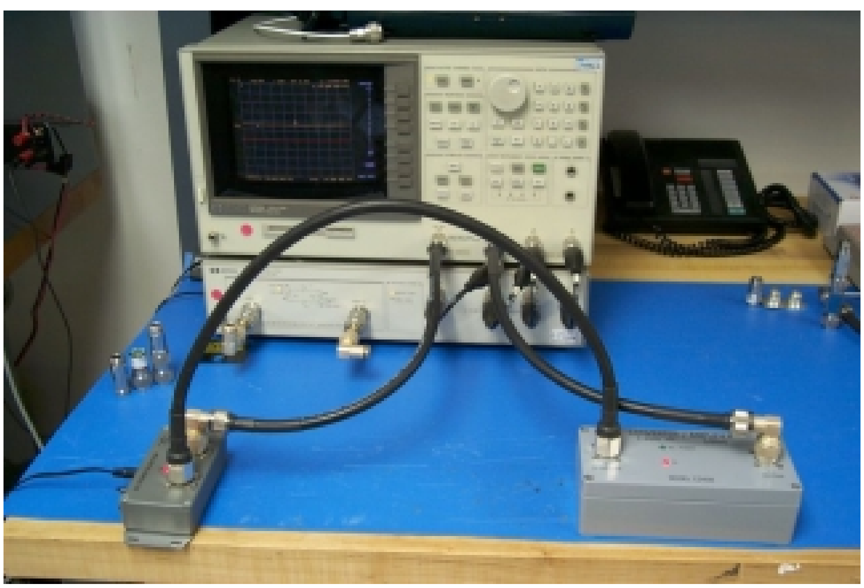


Figure 5 - 'Conversion Loss' Linearity Verification

The CA2458 was measured for amplifier and power gain linearity. A representation of this linearity is depicted in Figure 6, and the test equipment configuration is shown in Figure 7.

Figure 6 - Power Gain Measured Linearity

Figure 7 - Power Gain Linearity Verification

Finally, in order to demonstrate that use of CA2458 modules to upconvert and downconvert 802.11b signals appear in this system as a straightforward gain block, the test configuration in Figure 8 (two modules connected back-to-back via an attenuator) was configured and the system performance measured.

Figure 8 – Linearity of Conversion 2.4 -> 5.8 -> 2.4 GHz Verification

The CA2458 performs substantially as a gain block in the transmission channel, and the required bit error rate (BER) and the tolerable jammer-to-signal (J/S) ratio of the 2.4 GHz receiver are not modified by the CA2458 module. Processing Gain is proportional to the improvement of the received SNR of the system. The CA2458 provides amplification but makes no alterations to the modulation, coding, spreading, or de-spreading of the modulated signal.

For this reason, given that the CA2458 module, used in this system as a bi-directional, linear block frequency converter with fixed linear gain amplification, the processing gain of the 2.4 GHz receiver sets the minimum Processing Gain for the system.

Regards,

Mike Foster
Director of Engineering,
Young Design, Inc.

10 April 2002