

## 4 GHz CARRY-CODER II User Manual



**Manual Part Number 6051412900 Rev -**

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## GLOSSARY

16QAM	Quadrature Amplitude Modulation (16 states)
64QAM	Quadrature Amplitude Modulation (64 states)
ATSC	Advanced Television Standard Committee
COFDM	Coded Orthogonal Frequency Division Multiplex
CVBS	Composite Video Baseband Signal
DCE	Data Communication Equipment
DVB	Digital Video Broadcasting
DVB-T	Digital Video Broadcasting for Terrestrial TV
EMC	Electro-Magnetic Compatibility
EU	European Union
GOP	Group Of Pictures
MPEG	Moving Pictures Engineering Group
PIN	Personal Identification Number
PID	Packet Identifier
QPSK	Quad Phase Shift Keying
US	United States of America

## LEGEND



= Idea (Highlighted operator Information)

▲ = Warning (indicates a critical or hazardous point)

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## **WARNING!**

### **RF RADIATION EXPOSURE HAZARD**

**This warning is provided by Broadcast Microwave Services (BMS) Inc. for safety purpose. The following information help to reduce the risk of RF exposure hazard.**

#### **FCC Limit of RF Exposure**

According to Federal Communication Commission (FCC), the Maximum Permissible Exposure (MPE) for FR radiation has been set to  $1.0 \text{ mW/cm}^2$  for the 4 GHz Carry-Coder II with 1Watt Power Amp equipment (OET Bulletin 65).

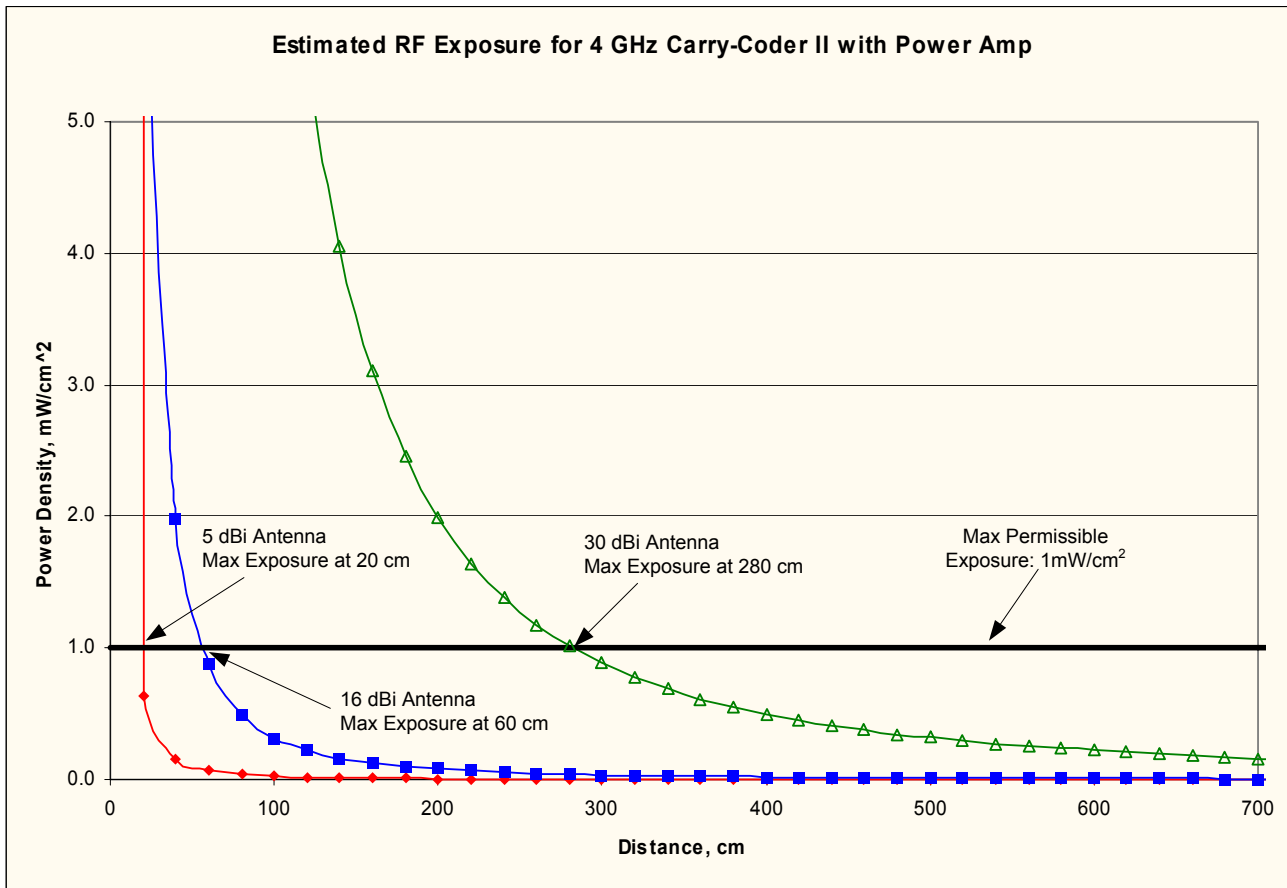
The 4 GHz Carry-Coder II with Power Amp is a non-broadcast transmitter and without an antenna it will not create RF exposure (power density) exceeding the  $1.0 \text{ W/cm}^2$  FCC limit.

However a high-gain antenna such as a parabolic dish will greatly enhance the 4 GHz Carry-Coder II output power density beyond the MPE limit of  $1.0 \text{ mW/cm}^2$ .

In this situation a minimum distance from the antenna needs to be calculated in order to keep the MPE always below the safety limit. The calculation has been done for 4 GHz Carry-Coder II with Power Amp based on the formula mentioned in OET Bulletin 56.

The calculations have been done for different commonly used antenna in the Public Safety/ Law enforcement applications.

Figure 1 shows the plot of the minimum exposure distance for 5dBi, 16dBi, and 30dBi antennas. The 4 GHz Carry-Coder II with Power Amp transmits the maximum power of 1Watt. The minimum exposure distances are found from the cross points of the exposure graphs (for various antennas) with the line of maximum permissible exposure (i.e.  $1 \text{ W/cm}^2$ ). Notice that the numbers in Figure 1 predict the worse case scenario, which is straight in front of the antenna (exposing to the antenna main-lobe). Obviously the side-lobe exposures are well below these numbers as the radiation intensity dramatically reduces on the side lobes.



**Figure 1**

**Summary**

In order to keep the RF exposure within the FCC limit, it is necessary to maintain the safe distance from the antenna. The results shown in Figures 1 can be summarized in the following table:

Antenna Gain (dBi)	Minimum permissible distance from antenna (cm)
5	20
16	60
30	280

Notice the above table indicates worst-case situation (straight in front of the antenna).

## OVERVIEW

4 GHz Carry-Coder II is a mobile transmitter which is used in the 4.95 – 4.99 GHz frequency range. This spectrum has been assigned to the Public Safety application according to the Subparts 90.1201, 90.1203, and 90.1207 of the FCC regulations.

BMS offers its expertise in the 4GHz Carry-Coder product family with the high-power Carry-Coder II transmitter and companion COFDM integrated receiver-decoder, the De-Coder II.

The 4GHz Carry-Coder product family includes:

- **CARRY-CODER II:** Transmitter with 1W external power amplifier.
- **DE-CODER II:** Rack-mounted COFDM integrated receiver-decoder.
- **CARRY DE-CODER II:** Mobile COFDM integrated receiver-decoder.

A simple diagram of the 4GHz Carry-Coder II system is shown in Figure 2.

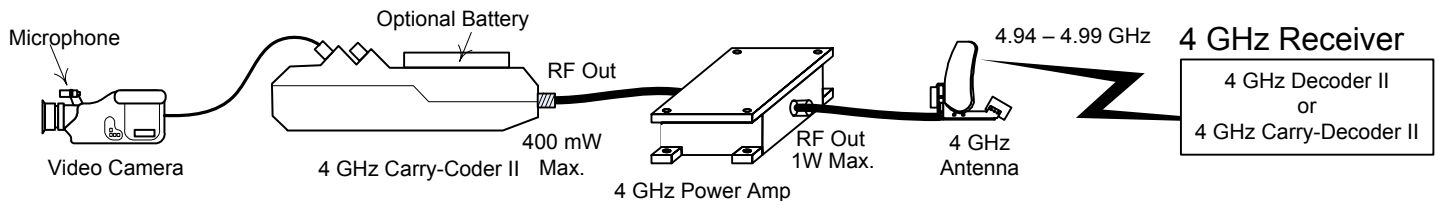
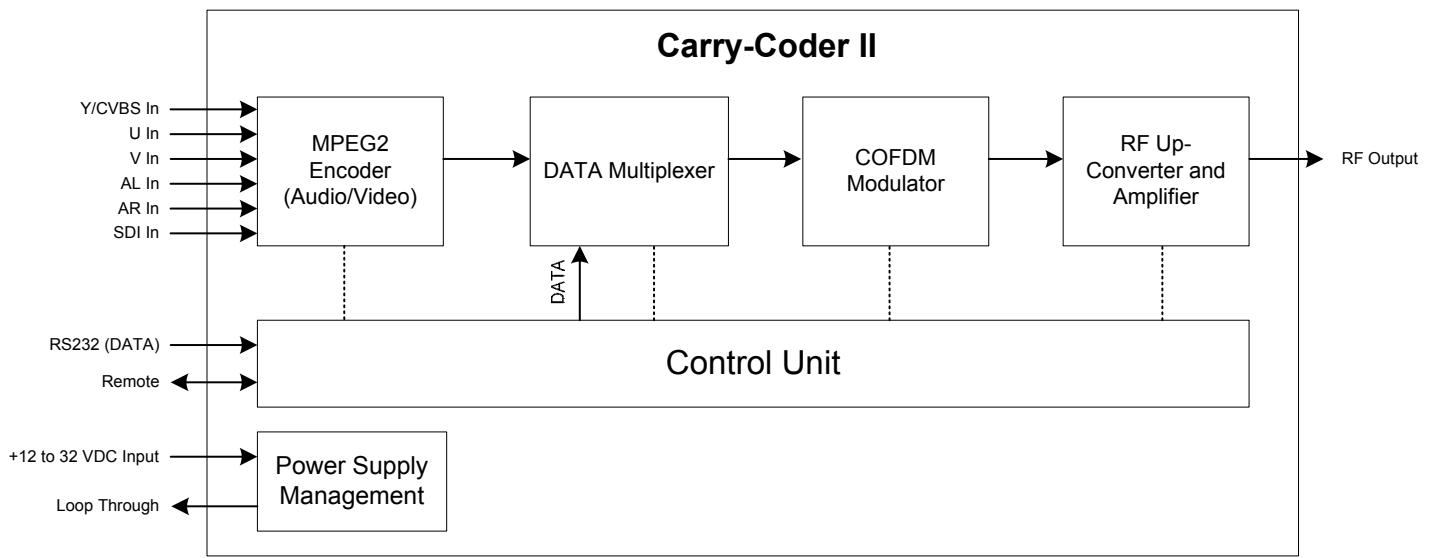


Figure 2 Simple system diagram of the 4GHz Carry-Coder II with Power Amplifier

Key features for these products are:

- Robustness
- DVB-T transmission for mobile operation in a multi-path environment.
- High quality, reliable transmission of video and audio in mobile use.
- Flexible audio, video and data interfaces.
- Compact size.
- Low-power consumption.
- The CARRY-CODER II is a mobile device that performs wireless digital transmission of audio, video and data.
- The Carry-Coder II interface consists of video and audio cables.

The following block diagram gives an overview of 4 GHz CARRY-CODER II architecture:



**The CARRY-CODER II is comprised of the following sub-systems:**

- An MPEG-2 Encoder (1 video channel + 2 audio channels) compliant to ISO/IEC 13818 (MP@ML).
- A Data Multiplexer.
- A COFDM Digital Modulator (“2K” sub-carriers) compliant to ETS 300 744 (the DVB-T standard).
- An RF Up-Converter and RF Amplifier (providing up to 400 mW transmitter output power (without external power amp).
- A detachable hand held remote offering a user-friendly displayed interface for control and system status.

**The CARRY-CODER II includes the following input/output connections:**

- Composite video input (CVBS)
- SDI input
- Component video input (YUV)
- Analog audio line inputs (L+R)
- ASI Input
- 1 RS232 data interface (for user applications)
- 1 remote control port
- 1 RF output port
- 1 power supply input (11-32VDC nominal)
- 1 battery docking connector with “loop-through” power output.



## INSTALLATION

Typical system the 4GHz Carry-Coder II with Power Amplifier is shown in Figure 3.

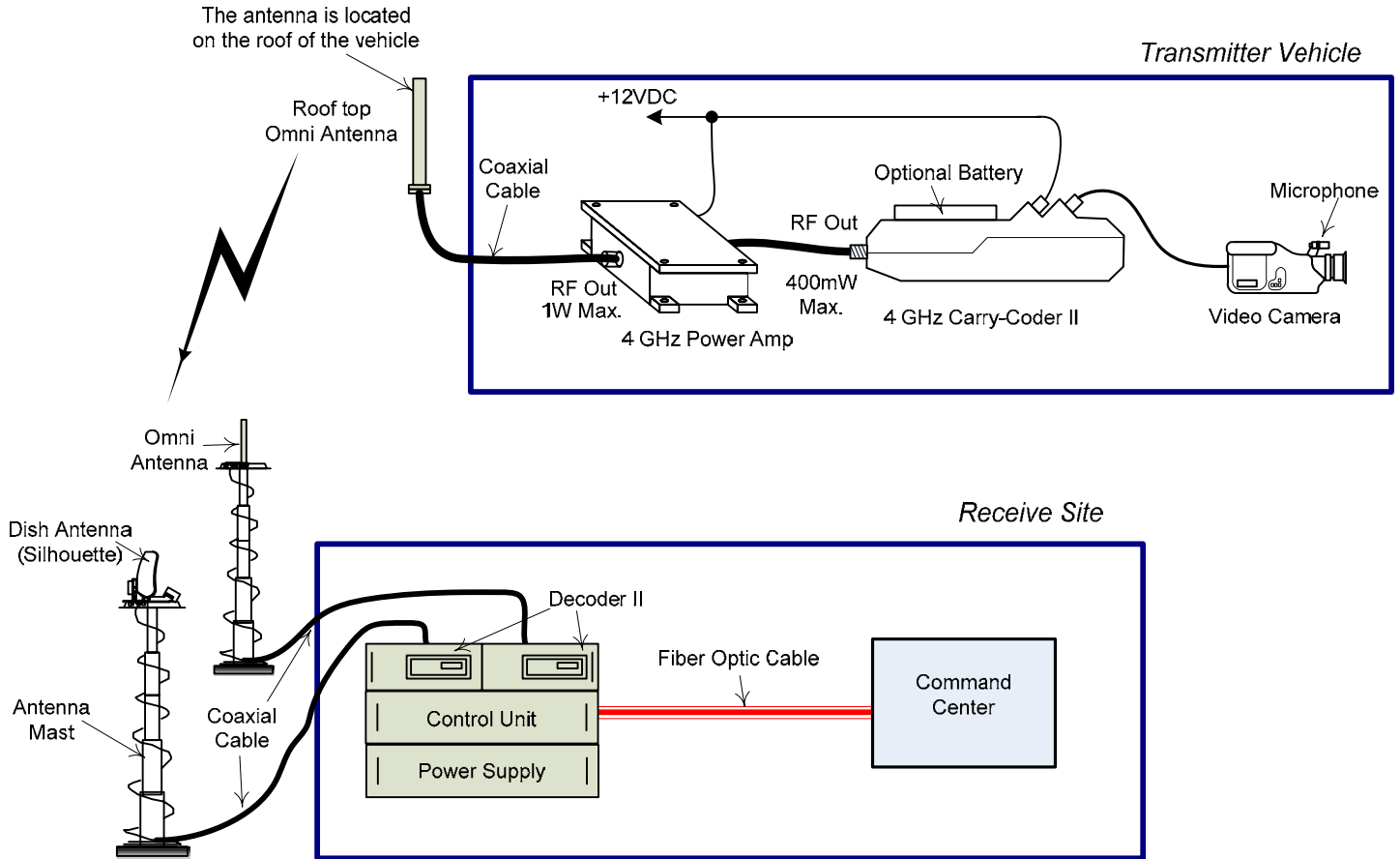


Figure 3 Typical system of 4GHz Carry-Coder II with Power Amplifier

### Mobile and Fixed Platforms

- The system of Figure 3 can demonstrate both mobile and fixed applications. The transmitter part including the Carry-Coder II Transmitter, Power Amplifier and the video camera are all mounted inside a truck.
- An omni-directional antenna placed on the vehicle roof-top (without any obstruction) transmit uniformly in all azimuth directions. This allows the mobile transmitter to communicate with the Receive Site while the vehicle is moving freely.
- In the Receive Site the omni-directional antenna on the mast will receive the transmitter signal without any need for tracking.
- Because of low antenna gain (both on transmit and receive ends) the Power Amplifier will be crucial in order to boost the transmitter power and ensure the minimum practical range.
- When the Transmitter Unit is stationary (i.e. the vehicle is stalled for a while) then the tracking dish antenna in the Receive site will be able to track the transmitter and establish a line of site transmission. This is considered a fixed situation and the high gain of the dish antenna will increase the minimum range. In the fixed platform the transmitter antenna can be changed from omni to a tracking dish antenna.

- Regardless of the mobile and fixed applications the installation procedure for transmitter site will be similar as explained in the following section:

## ***Installation Procedure***

The 4GHz Carry-Coder II with Power Amplifier can be installed inside a vehicle such as a truck. The symbolic diagram of the installation is given in Figure 3. The installation procedure is as follows:

1. Install the omni-directional antenna on the vehicle roof-top using the brackets and instructions that are supplied in the accessory kit.
  2. Secure the Carry-Coder II transmitter and the Power Amplifier inside the truck. The two units may be one or 2 feet apart.
  3. To ensure sufficient ventilation, at least 3" clearance is recommended from each side of the units.
- Using N-type coaxial cable (about 3 feet long) connect the output of the Carry-Coder II transmitter to the input of the Power Amplifier.
  - Using Coaxial cable and N to SMA adaptor, connect the output of the Power Amplifier to the SMA input port of the omni antenna.
  - Using the special power cords connect the Transmitter and the Power Amplifier to the 12V DC voltage.
  - Connect the interface cables from the camera to the appropriate CARRY-CODER II connector(s).
  - Using the supplied Remote Control Display, set the Transmitter frequency, power, modulation scheme ...etc. as will be explained in the next section.

## ***Installing the Battery on the Carry-Coder II***

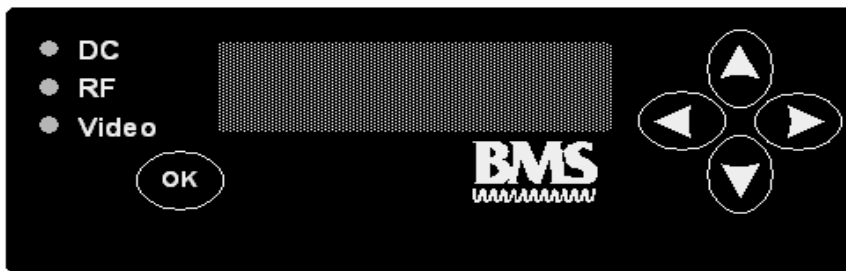
The Carry-Coder II can be run by its own battery as well. The procedure for battery installation is as follows:

- Slide the battery in to the receptacle located underneath the CCII until it locks into place
- Connect the power cable coming from the battery connector socket to the CARRY-CODER II.
- Switch on the power for the camera and the CARRY-CODER II.

## ***Controlling the CARRY-CODER II Transmitter***

### **Control Unit Features**

- The CARRY-CODER II control unit is designed for the convenience of the user.
- The control unit can be attached or disconnected at any time.
- Easily readable four line display.
- Operator navigation of menu with four intuitive directional buttons.
- Operational command entry using the <OK> button.
- Display includes status icons at right portion of top line.
- Text menu line one displays operating frequency.
- Text menu lines two and three are for system control functions.
- Text menu line four displays system status.



## ***Transmitter Operating Configuration***

When the CARRY-CODER II is powered up for the first time, the operator can easily review the operating parameters using the control unit. Here is a listing of the parameters, in operating menu sequence.

- RF Output Operating Frequency
- RF Output Power (OFF LOW MID HIGH MAX).
- Transmission Mode Robustness (LOW MID HIGH).
- Recall Configuration (Presets 1 to 9).
- Save Configuration (Presets 1 to 9).
- Video Input (CVBS, YUV, ASI, SDI).
- Video Mode (PAL, NTSC).
- Audio Input (analog, AES, SDI).
- Audio Level Left
- Audio Level Right
- Data Port Baud Rate (1.2, 4.8, 9.6 Kbps)
- Encryption (OFF or PIN code entry).
- User Mode (NORMAL, EXPERT)

## **CARRY-CODER II Transmitter <EXPERT> Operating Mode Configuration**

**NOTE:** Most users will operate the system in <NORMAL> mode. The <EXPERT> mode provides user control of certain DVB-T parameter settings. Here is a listing of those parameters in operating menu sequence:

- Resolution (1/1, 3/4, 2/3, 1/2)
- GOP Structure (I, IP, IBP, IBBP, 422IBBP)
- GOP Length (6, 12, 18, 24)
- Constellation (QPSK, 16QAM, 64QAM)
- Guard Interval (1/32, 1/16, 1/8, 1/4)
- Code Rate (1/2, 2/3, 3/4, 5/6, 7/8)



Certain operating parameters are used on a repeated basis. These settings should be stored in memory as Configuration Presets 2 through 9. This provides fast restoration of parameter settings that are used most often.



A good backup plan is to maintain commonly used parameter settings (i.e., high robustness and maximum power) in a known configuration preset memory. If a problem occurs that won't go away, a known good parameter setting can be recalled from memory. This should help to resolve a problem. Another method is to adjust each parameter one by one, beginning with changing the operating frequency, to ensure that the link is not being affected by another signal on your selected operating frequency.



The <DEFAULT> option in the RECALL CONFIGURATION Menu will set all the parameters of the CCII to the factory defaults.

## **OPERATING INSTRUCTIONS**

### **Start-Up Indications**

The CARRY-CODER starts with display showing the status of the system. During system initialization, the CARRY-CODER II goes through self-test of its MPEG-2 encoder, COFDM modulator and RF sections. System initialization 10 seconds and will display as follows:

```
BMS Inc. 4 GHz CarryCoder 2
Freq Agile 4940-4990 MHz
Software Ver. 2.01
Resetting /
```

At the completion of the initialization process, the display should look like this:

```
4965.00 MHz
FREQUENCY
4990.00 MHz
```

If the self-test finds that a sub-system does not respond correctly, a status message is displayed on the fourth line of the display. For example, if the camera is not sending video to the transmitter, the display will include the appropriate message:

4965.00 MHz FREQUENCY 4965.00 MHz NO VIDEO
---



When the CARRY-CODER starts up, it is in the same condition as when it was powered down. This allows the user to replace the battery with no need to touch the controls.



The CARRY-CODER II will not transmit with out video. If the System is powered up without video, the CARRY-CODER II will automatically reboot once video input starts. The CARRY-CODER II will transmit with ASI.

## Operator Menu Summary

When the control panel display shows normal system status (no Error or Warning status message) and if there is no operator use of the control panel, the display goes dark to save battery life. Pressing any key on the control unit restores the display to show the status of the system.



If there is a status message, the display will remain lit (will not go dark) until the problem is resolved.

The user menus can be accessed from the status screen by pressing any key. Then, the user can scroll the menus by pressing the « ↑ » and « ↓ » keys.

After 30 seconds of keypad inactivity, the display automatically returns to the status screen.



Pressing the « ↑ » and « ↓ » keys simultaneously will cause the display to go to the status screen without having to wait 30 seconds.

## INPUT/OUTPUT CHARACTERISTICS

### Composite Video (CVBS)

Type	Composite Video Baseband Signal (CVBS)
Systems	NTSC 525 lines / 60 Hz / Fsc = 3.58 MHz PAL 625 lines / 50 Hz / Fsc = 4.43 MHz
Standard	ITU-R BT 470-6
Impedance	75 Ohms

### Component Video (YUV)

Type	YUV (formerly Y / Pb / Pr)
Systems	NTSC 525 lines / 60 Hz PAL 625 lines / 50 Hz
Standard	ITU-R BT 470-6
Impedance	75 Ohms

## Analog Audio

Type	Balanced Line
Channels	2 separate channels (Left and Right)
Nominal input level	Adjustable from -10 dBu to +4 dBu (0 dBu = 775 mV rms)
Headroom	12 dB
Sampling frequency	48 kHz – 20 bits
Frequency response	30 Hz – 20 kHz (+/- 1dB)
Signal-to-Noise Ratio	65 dBA
Diaphony	60 dBA
Total Harmonic Distortion	< 0.1 % @ 1 kHz
Impedance	> 10 K ohms



If a low impedance input (600 Ohms) is required, the user can make a specific interface cable with 600 Ohm resistors between the +/- lines of balanced audio conductors.

## Data Input

Type	RS-232
Possible Bitrates	9600, 4800 and 1200 bauds (selectable)
Format	N, 8, 1 (1 start bit, 8 data bits, 1 stop bit, no parity)
Protocol	None (no XON/XOFF)



For full bandwidth (100% continuous) data, set the decoder to a higher bit rate than the CCII to alleviate losses due to asynchronous transmission.

## Remote Control Port

Type	RS232
Bit rate	9600 Bps
Format	N, 8, 1 (1 start bit, 8 data bits, 1 stop bit, no parity)
Maximum cable length	100 m
Format and protocol	Proprietary



It is recommended to use a shielded DB9 cable in order to increase reliability.

## RF Output

The versions CARRY-CODER II are available for specific frequencies. Please refer to the CARRY-CODER II serial ID for information on the operating frequency for the unit.

Frequency Range	4.94 – 4.99 GHz
Channel Bandwidth	6/7/8 MHz
Format	COFDM (2K carriers)
Standard	ETS 300 744 (DVB-T)
Output Power	10 mW, 25 mW, 100 mW and 400 mW
Shoulders at +/- 4.2 MHz	> 30 dB for 1W > 35 dB for 250 mW or less
Harmonic and Spurious	< -60 dBc (DC to 6 GHz)
In-Band Ripple	< +/- 1dB
Return Loss	18 dB (typical)
Impedance	50 Ohms
Connector	N - Female



Never use the CARRY-CODER II without a 50 Ohms load or antenna properly connected to the RF output, since this could damage the RF output stage.



The system can operate with several COFDM signals located on 8 MHz adjacent channels. When analog transmissions are active in-band it is recommended to leave a free 8 MHz channel between COFDM signals and the active analog signals.

## Power Supply Input

The CARRY-CODER II can be powered either with a battery pack or through the 4 pin connector. This enables the use of an external power source such as a battery belt or any appropriate power supply (+11 to 32 VDC @ 4A).

## WARRANTY AND RETURN TO FACTORY

The CARRY-CODER II is warranted for a 2 years period, starting from delivery date.

In case of CARRY-CODER II failure, please use the following process:

- First have a look at the troubleshooting section of this manual in order to see if an immediate solution can be found.
- Before contacting BMS with questions about units, be sure to have the following information with you so we will be better able to help you.

The diagram shows a rectangular warranty label with a rounded top-left corner. It contains the following fields and labels:

- Contract Number or Customer Name:** A large empty rectangular box at the top.
- BMS Broadcast Microwave Services, Inc. SAN DIEGO, CA-3V822:** The BMS logo and company name and address.
- BMS Part/Model Number:** A field labeled "Model No." with an adjacent empty box.
- Serial Number:** A field labeled "Serial No." with an adjacent empty box.
- Description and special customer related specification:** Two empty rectangular boxes below the serial number field.
- USA:** A small box at the bottom right of the label.

- Customer Name
  - Contract Number
  - BMS Model Number
  - Serial Number
  - Description of problem with as much detail as possible.
  - Name of person to contact who might have further information on the failure.
  - Contact information such as phone number and/or email address.
  - Return Information
- Contact BMS technical support.
  - If the technical support cannot solve the problem over the phone an RMA will be issued. Please send the unit at your expense to BMS. Include all necessary explanations about the failure and mark the RMA number on the package and unit. Please provide a PO to authorize a \$350 evaluation fee if the failure is found to not a covered under warranty. Always use original packing for transport.



- Warranty position will be established upon receipt of inoperative equipment. If equipment is confirmed defective and is the responsibility of BMS, repair action will be initiated immediately at no expense to the customer. When the malfunction is determined to be the responsibility of the user, BMS will provide a quote to repair. Work to repair the unit will be initiated after confirmation with the user's buying authority.
- BMS will send back the unit at its expense via UPS ground.



There are no user serviceable parts inside the CARRY-CODER. Opening the device without prior authorization from BMS will cause the warranty loss.

## LINEAR POWER AMPLIFIER (BPA-1CC-4)

BPA-1CC-4 is a linear power amplifier with 1 watt maximum RF power and operating at Public Safety band (4.94 – 4.99 GHz). This power amplifier is used in conjunction with 4 GHz Carry-Coder II.

### Application

Because the internal amplifier of the 4 GHz Carry-Coder II is only capable to provide 400 mW max. RF power, an external amplifier is needed to boost the transmitter power in order to compensate the path loss and ensure the acceptable Received Signal Level (RSL) at the destination. The BPA-1CC-4 will increase the RF power to the maximum 1W, without adding spurious and distortions to the transmitter output. The output of the power amplifier is directly connected to the 4 GHz transmitting antenna.



BPA-1CC-4 Linear Power Amplifier

### Specification:

Frequency	4.94 – 4.99 GHz
Output Power	1 Watt (30 dBm)
Input Voltage	28 VDC
Input Current	6.5 Amp
Input RF Power	400 mW (23 dBm) max.
Gain @ 23 dBm input	7 dB
Gain Flatness	± 0.5 dB Over 50 MHz
Gain vs. Temperature	± 1 dB Over Temperature
Operating Temperature	-20° to +50°C
Storage Temperature	40° to +90°C
Dimensions	9.5" x 5" x 3"
Weight	5 lbs
RF Input Connector	Type "N"
RF Output Connector	Type "N" Isolator Protected

## CONTACT INFORMATION

Broadcast Microwave Services, Inc.

Phone: 1.858.391.3050  
Fax: 1.858.391.3049  
Shipping address: 12367 Crosthwaite Circle  
Dock 10  
Poway, CA 92064  
Website: <http://www.bms-inc.com>  
Email: [support@bms-inc.com](mailto:support@bms-inc.com)  
[sales@bms-inc.com](mailto:sales@bms-inc.com)