ANSI/CTA Standard

Antenna Control Interface

ANSI/CTA-909-B R-2016

(Formerly ANSI/CEA-909-B)

January 2011



Consumer Technology Association™



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FOREWORD

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Antenna Control Interface

1 Scope

CEA-909-B describes an antenna control subsystem for receiving terrestrial transmissions. The primary use is to facilitate television reception. The receiver controls the antenna apparatus to optimize the signal automatically for best reception by adjusting its configuration.

CEA-909-B allows any receiver to operate with any antenna, regardless of manufacturer. CEA-909-B defines the data algorithms used, connection standards, and other requirements. The antenna configuration is neither specified nor implied, leaving certain antenna design considerations to the manufacturer.

2 References

2.1 Normative References

The following standards contain provisions that, through reference in this text, constitute normative provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Section 2.1.1.

2.1.1 Normative Reference List

1. CEA-542-B, Cable Television Channel Identification Plan, July, 2003

2. FCC Channelization Rules, 47 CFR 73.603 Numerical designation of channel numbers

3. TIA-968-A, Telecommunications Telephone Terminal Equipment, Technical Requirements for Connection of Terminal Equipment to the Telephone Network, February, 2005

4. ANSI/SCTE 02 2006 “Specifications, F Connector, Female, Indoor,”

2.1.2 Normative Reference Acquisition

ANSI/SCTE Standards:

- Society of Cable Television Telecommunications Engineers (SCTE), 140 Philips Road, Exton PA 19341; Phone 800-542-5040; Fax 610-363-5898; Internet http://www.scte.org; Email info@scte.org

CEA & TIA Standards:

- Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO USA 80112-5776; Phone 800-854-7179; Fax 303-397-2740; Internet http://global.ihs.com; Email global@ihs.com

3 Introduction

The antenna control interface specified in this document enables the receiving system, which includes both the antenna and the DTV receiver, to provide improved digital television reception. CEA-909-B describes a means to optimize a suitably designed receiving antenna’s directional pattern, gain, polarization, and tuning for each channel. Control of the antenna parameters is via a serial bitstream issued by the receiver over one of two defined interfaces: a separate dedicated connector or the antenna input coaxial connector. The determination of optimum antenna pattern, gain, etc. is achieved within the receiver by analysis of the received signal at different antenna settings. The search algorithm to determine the optimum setting is not specified in this document, and creating a rapid and effective search routine is expected to be a point of competition among manufacturers.

Determination of the optimum antenna parameters involves more than simply maximizing the signal level. The interface in this document inherently treats the receiver and antenna as a single system. Demodulators in digital TVs can regard the antenna as an additional controllable resource, beyond gain

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control, equalization, error correction, etc. to improve signal recovery. For example, the null(s) in an antenna pattern can be steered to reduce some difficult multipath or reduce the level of interference from a particular direction.

Receivers following this Standard can determine optimum antenna settings by analyzing the received signal, using metrics already part of the digital demodulation process. Such metrics include, but need not be limited to, bit or packet error rate, equalizer activity, S/N, and signal level. Different metrics may be more appropriate at different points in the search for the optimum setting, since some metrics may indicate an undesirable setting more rapidly.

While not part of this Standard, the following comments are offered regarding the analysis of the received signal and the achievement of a quick and accurate search for the optimum antenna setting:

- In order to achieve the performance intended by this Standard, it is necessary that the signal quality be analyzed at different antenna settings. Analysis of any state cannot be complete until the equalizer, AGC, and other conditions have stabilized.
- Some metrics may be available more quickly than others and might be used to maximize speed of optimization, but conclusions about signal quality should be regarded as tentative until all metrics are known.
- Commands that change the antenna state should not be issued until analysis of the present state is complete.
- A 10 msec “pause” is specified between issuances of the serial bitstream. This is to be regarded as a minimum and is intended only to allow the antenna logic and control time constants to settle with a side benefit of enabling shorter production sample test times. Analysis of the signal by the receiver is likely to take longer than this, and signal analysis should begin after this settling time.
- The most useful search algorithms are unlikely to be those that simply step through all available states in sequence.

While much of this document is written from the standpoint of a receiver controlling an electrically steered antenna with no moving parts, the Standard also defines an optional command sequence that can be used to control a mechanically steered (rotor) antenna.

4 Initialization

The initialization process differs depending on whether or not the TV supports control over the coax (see section 7.2) or control via a separate dedicated connector (see section 7.1) In both cases, the TV sends interrogations to an antenna. When a smart antenna is detected per 7.1.2 or 7.2.2 the DTV receiver shall determine the operating mode. The process for this determination is defined in section 8 and its subsections.

In case of communication over the antenna coax, before applying power and control voltage, a test is required to be performed by the DTV receiver to see whether a smart antenna is connected to the coaxial connection. This test is explained in section 7.2.2 and its subsections.

> NOTE – Designers are cautioned that incidental RF energy on the antenna control connector may significantly affect antenna performance, and therefore, efforts should be made to minimize the presence of incidental RF energy on this interface.

5 Data Signaling Characteristics

5.1 Transmission Rate

The data transmission rate shall be 8 kHz ± 5%.

5.2 Symbol Rate

The symbol rate shall be 1 bit per symbol.

5.3 Symbol Period

The symbol period shall be 125 microseconds (µs) ± 5%.

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5.4 Symbol Rise & Fall Time

The rise and fall time of each pulse shall not be less than 4 µs or greater than 8 µs.

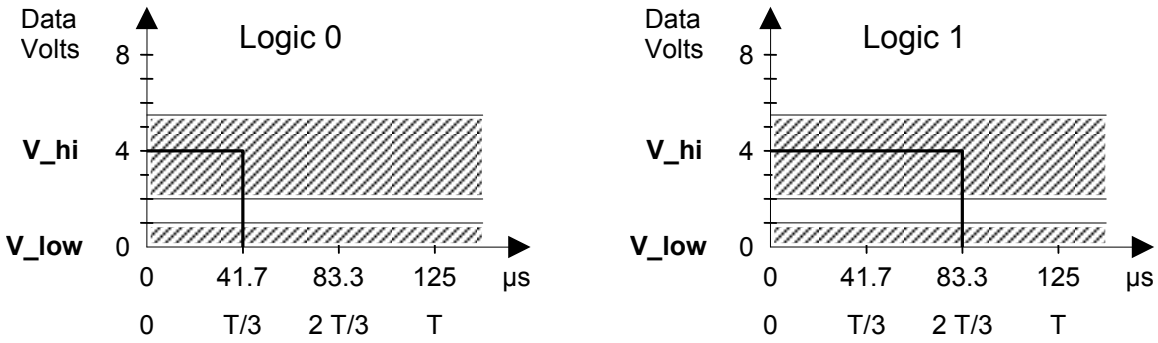


Figure 1 Logic Symbol Tolerances

5.5 Logic 0

Logic 0 shall be defined as a design center pulse width of 41.7 µs duration with a ± 5% tolerance. Pulse width shall be measured at 50% voltage point. See Figure 1.

5.6 Logic 1

Logic 1 shall be defined as a design center pulse width of 83.3 µs duration with a ± 5% tolerance. Pulse width shall be measured at 50% voltage point. See Figure 1.

6 Power Supply

A limited power supply shall be available to the antenna from the interface, pursuant to agency requirements. As an alternative to this requirement, the antenna system may provide its own power supply.

The power supply shall meet the following requirements:

The voltage shall be 12 V DC ± 10%
The P-P ripple shall be 200 mV maximum.
Up to 150 mA shall be available from the TV.
The power supply shall be capable of sustaining an indefinite period of short circuit without damage.

The power supply shall meet appropriate regulatory requirements for consumer installed equipment, and is the responsibility of the individual manufacturer.

7 Defined Interfaces

The interfaces in Section 7.1 and Section 7.2 allow detection of the presence of a smart antenna. If no such smart antenna is detected, then the TV should bypass antenna auto-programming steps to minimize the time for normal auto-programming procedures used by the TV.

7.1 Dedicated Connector

This section defines the characteristics for a dedicated connection.

7.1.1 Data Voltage Levels

Low voltage level shall be defined as 0 V to 1.0 V, and is identified as **V_low**. High voltage level shall be defined as 2.0 V to 5.5 V, and is identified as **V_hi**. See Figure 1.

NOTE—These logic levels cover TTL and low voltage (3.3 V) CMOS. However, the recommended interface from the TV receiver is an NPN transistor with a 1000 ohm pull-up resistor to 5 V. This allows “wired OR” for a return transmission from the antenna if Mode B is used. This type of interface also allows a simple but effective interface to microprocessors that

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might not support even these relaxed logic voltage levels. It additionally provides a more rugged interface for ESD than a direct connection to the microprocessor.

7.1.2 Detection of a Smart Antenna with Dedicated Interface

The antenna shall provide a 2,200 ohm ± 10% load on the logic line to ground. The resulting current flow may be detected in the TV to determine that an antenna using the interface is connected.

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7.1.3 Connector

The connector shall be a modular telephone connector, as defined in TIA-968-A [3]Section 6 for a 6-conductor set, with the latch relocated to the position indicated in Figure 2 (for the plug) and Figure 3 (for the jack). In addition, the plug shall comply with the dimensions specified in Figure 2, and the jack shall comply with the dimensions specified in Figure 3.

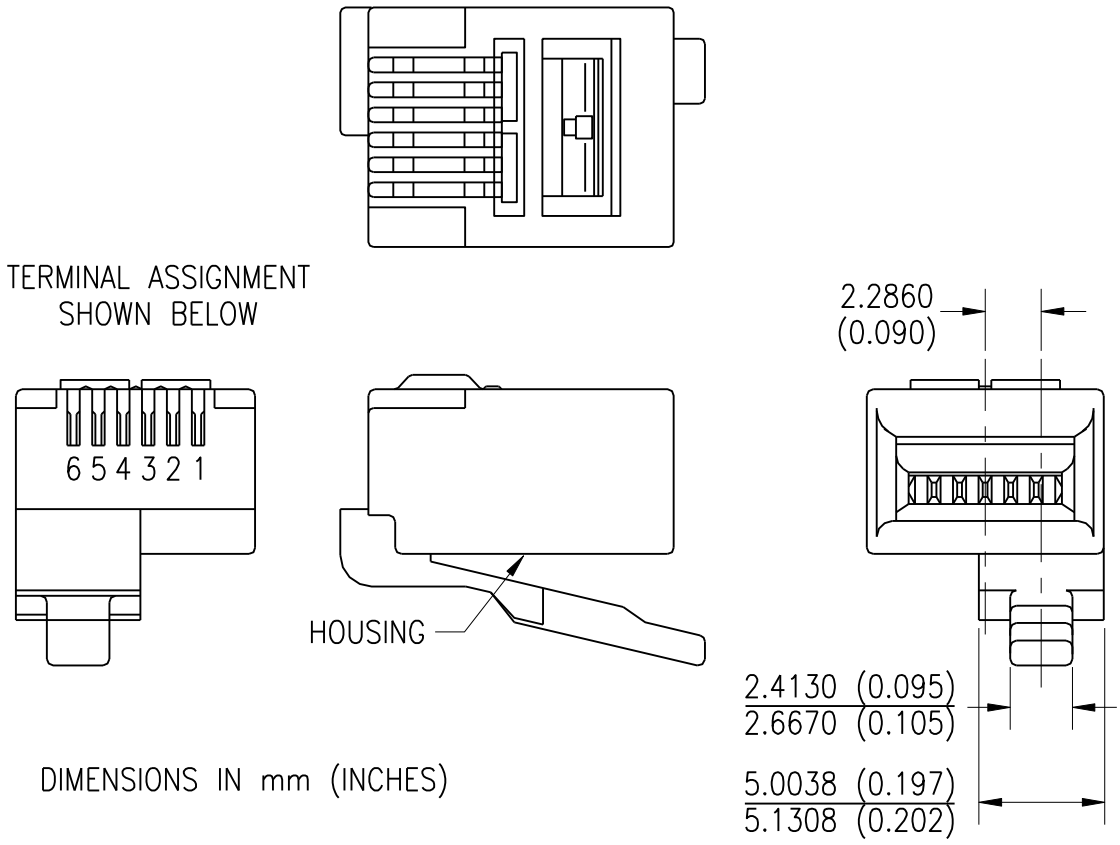


Figure 2 Offset Latch Modular Plug

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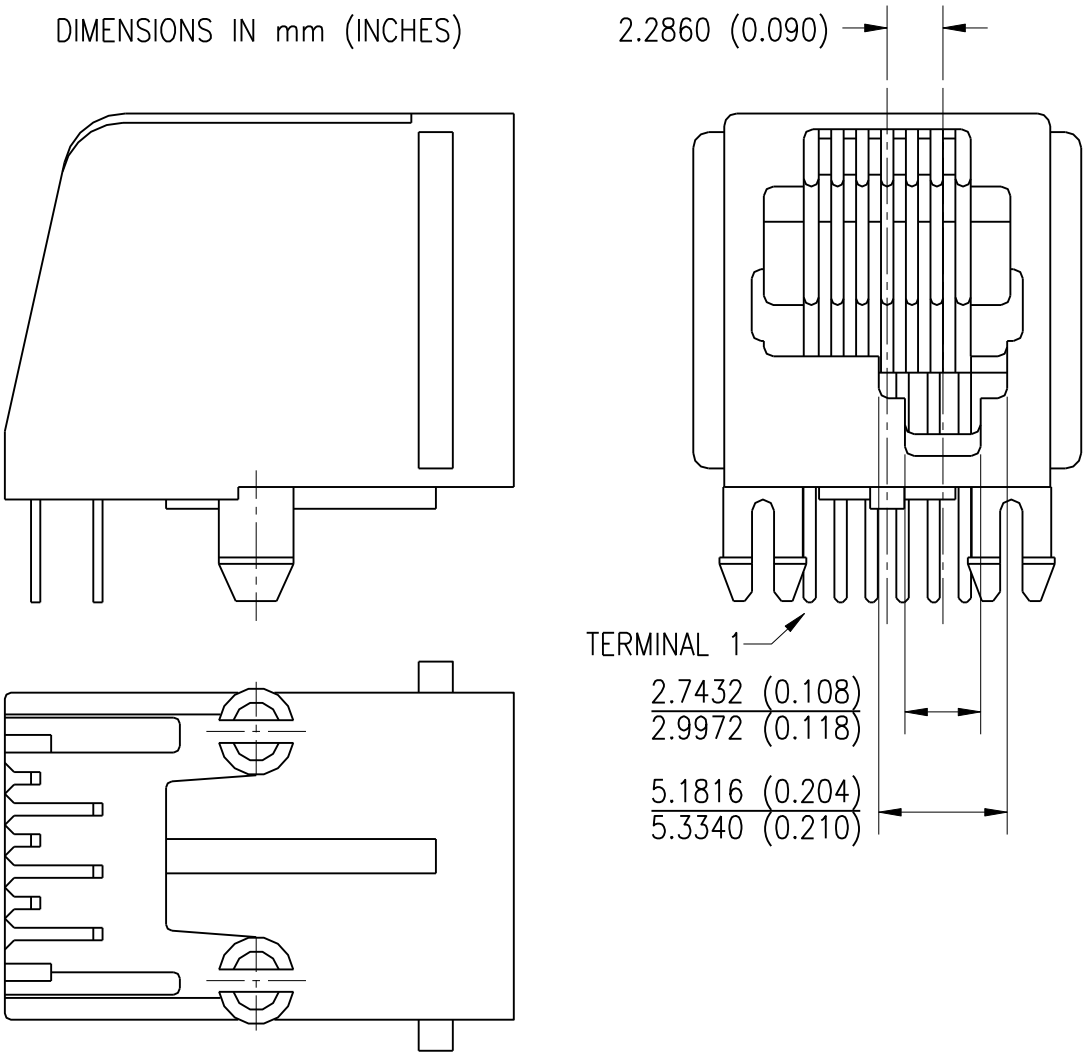


Figure 3 Offset Latch Modular Jack

7.1.3.1 Terminal Assignments

Terminal 2 shall be connected to the 12 V power supply. Terminal 5 shall be connected to the data line. Terminals 1, 3, 4, and 6 shall be connected to ground at both ends of the interface. See Table 1.

Pin Number	Assignment
1	Ground
2	+ 12 V DC
3	Ground
4	Ground
5	Data
6	Ground

Table 1 Pin Assignments

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7.1.3.2 Conductor Size

Recommended conductors are 26 gauge copper wire although other cables may be used and supplied with a specific antenna product at the responsibility of that antenna product manufacturer.

7.2 Coaxial Input Connector and Shared Use

The receiver antenna input shall be a type F coaxial connector e.g. ANSI/SCTE 02 2006 “Specifications, F Connector, Female, Indoor,” [**Error! Reference source not found.**] for all cases, either RF input only or when used for a shared signaling path.

This section defines the characteristics for sharing the TV’s RF input F-connector by adding power and data voltages. The shield shall be considered the reference (ground) for the voltages that are defined. Smart antennas using the RF coax path to this F-connector for power and signals shall not draw more than 150 mA.

Note that this smart antenna interface is intended for use when no other devices are connected between the DTV receiver and the smart antenna. Receiver manufacturers are reminded that devices other than smart antennas may be connected to this connection, some of which may not be installed in accordance with their installation instructions. Designs should attempt to accommodate such erroneous connections beyond the extent required and described in section 7.2.2.1 by including in the installation instructions associated warnings with regard to such other devices that place emphasis on the importance of their correct installation.

7.2.1 Data Voltage Levels

Data voltages on the shared connector are biased by the presence of the power voltage. The data voltages in Figure 1 are to be added to the DC power voltage. Low logic level shall be defined as less than 13.2 V, and is identified as **V_low** in Figure 1. High logic level shall be defined as 14.0 to 17.5 volts, and is identified as **V_hi** in Figure 1.

> NOTE—These logic levels enable simple detection circuits floating with respect to the 12 V power.

7.2.2 Detection of Smart Antenna Controlled over the Coaxial Input

.The DTV receiver shall provide means to detect the presence or absence of a smart antenna and to protect other types of devices that might be connected to this terminal. This test shall be performed when the set is turned on or when the presence of a signal cannot be detected. After this test, a Mode B capable DTV receiver shall issue a Mode B detection command and evaluate results per Section 8 before issuing Mode A commands.

The smart antenna shall have a silicon diode in series with the DC path of the connection.

Under a first test condition, the controlling device shall apply a test voltage of 0.3 V (+/- 0.1 V) to the antenna connection, and current shall be sensed. Current supplied shall be limited to 30 mA maximum.

The current drawn by the smart antenna with an applied DC voltage of 0.3 V shall be less than 0.1 mA.

A second test voltage of 2.0 V (+/- 0.2 V) shall also be applied and the current sensed. Current supplied shall be limited to 30 mA maximum.

The current drawn by the smart antenna with an applied DC voltage of 2.0 V shall be greater than 1.0 mA.

The current drawn by the smart antenna with an applied DC voltage of 12.0 V shall be >= 15 mA and <= 150 mA.

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Current at 0.3 V	Current at 2 V	Detected condition
< 0.1 mA	< 0.1 mA	Disconnect or open-circuit device
< 0.1 mA	> 1 mA	Smart antenna
> 1 mA	> 1 mA	Other device

Table 2 Summary of Nominal Detection Conditions

7.2.2.1 Explanation of Test Conditions and Procedures

The smart antenna has a silicon diode in series with the DC path of the connection. This simple expedient provides the means to detect the presence of a smart antenna; other devices that might plausibly be connected inadvertently to the single-wire smart antenna interface will not have such a diode. See the example functional block diagram in Figure 16 in Annex A, section A.3.

Because of the diode, at a test voltage of 0.3 V (or other voltage below the diode conduction threshold) the current drawn by the smart antenna is negligible compared to the current drawn by other devices such as signal splitters, passive antenna balun transformers or certain active devices, such as some types of set top boxes. At a test voltage above the diode threshold (for example, 2 V), both the smart antenna and other devices will draw easily measurable current.

The means by which the test voltages can identify a smart antenna from other devices can be understood from the diagram of Figure 4.This diagram shows two overlapping regions, one for the smart antenna and one for other devices that might be connected to the TV receiver. The region of smart antenna resistance represents the range of currents that may be drawn by a smart antenna at various voltages. Passive devices such as splitters are expected to have a maximum resistance of 225 ohms, which determines the left edge of the region of passive device resistance. The exception to these rules is the case of a device that presents an open circuit to the connection at DC.

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