

**Media Control Systems**  
**CTD-3104A**

**Operation Guide**  
**P/N. 950-0028-00 Version 1.9**

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## CHAPTER 1 INTRODUCTION

### 1.1 Important Notice

Like any other piece of complex equipment, the CTD-3104A Cue Tone Decoder Module will perform as designed only if it is installed, used, and serviced in accordance with the manufacturer's instructions.

All individuals who have, or will have the responsibility for installing, using, and servicing the product must carefully read this manual.

The warranties made by Media Control Systems, with respect to this product are void if the equipment is not installed, operated, and maintained in accordance with the instructions in this manual. Please protect you and your employees by following these instructions.

### 1.2 Module Description

The CTD-3104A DTMF Tone Decoder module is designed to monitor a telephone line or audio source and provide a relay closure upon receipt of up to four DTMF (dual-tone, multi-frequency) tone pairs of a pre-determined numerical sequence. These tones are identical to, and compatible with, the standard telephone tone system. It is configured as a standard 3000 series module and is designed to occupy one module space in either a CMF-3000B 3.5" by 19" rack mount frame or a CMF-1000A 1.75" by 19" rack mount frame.

The module is approximately 6.25" x 1.25" x 3.5" (L x W x H). All connections to the module are made by means of a 20-pin card-edge connector which mates with the circuit board. All controls and indicators required for normal operation are mounted on the front panel of the module.

### 1.3 Module Applications

Although engineered primarily for use in high-speed multi-digit tone decoding applications, such as switching control of satellite delivered pay TV broadcasting, the reliability and flexible arrangement of the CTD-3104A allows its use in many remote control applications. A programming switch is provided on the card for selection of the number of digits it will decode and the type of output closure it will provide after a valid signal has been received. This feature allows the decoder to be easily configured for most control requirements.

In applications which require many control functions to be performed from remote locations, several CTD-3104A modules, each preset for a different code, can be connected to the same audio (tone) input line. The relay output of each module would be wired to perform a specific function. When several modules are interfaced to a telephone line in this manner, for example, the system could be dialed-up from a remote location and any (or all) of the codes could be transmitted to perform the desired functions (i.e. turn lights on and off, switch signals, or control virtually any piece of equipment requiring a standard GPI).

## CHAPTER 2 INSTALLATION

This Section provides instructions on unpacking and inspecting the module, mounting it and making electrical connections. Note that if the module is purchased as part of a custom engineered system, it will already be installed. If it is purchased separately, the module must be installed according to the instructions given in this section.

### 2.1 Initial Inspection

Examine the shipping container for signs of damage which may have occurred in transit. Carefully inspect the components for damage. If damage to the equipment or a shortage in the shipment is noted, notify the carrier promptly. Make the proper claim with the carrier and contact Media Control Systems immediately.

### 2.2 Installation Requirements

The CTD-3104A Tone Decoder module is normally provided as part of a factory assembled control system and no installation of the module is required. However, when ordered individually, it must be mounted by the purchaser in a Media Control Systems CMF-3000B, or CMF-1000A Mounting Frame. The CTD-3104A module is supplied with a mating 20-pin card-edge connector (J1) and a rectangular aluminum frame adapter. Mounted on the frame adapter is a 12 pin Phoenix connector, which provides a means of interfacing external signals to the inputs and outputs of the decoder modules.

### 2.3 Installation Procedure

**NOTE:** If the CTD-3104A has been purchased as a replacement for an existing CTD-3004A or CTD-3002A module, installation consists merely of replacing the old module with the new. All card edge connections are compatible.

First-time installation of the CTD-3104A module consists of securing the frame adapter to the pre-drilled rear mounting rails of the CMF-3000B with the screws provided and wiring the connectors and power. The module requires regulated +12 VDC at 75 MA (maximum) for proper operation with ultra-high-speed 4-digit tone groups; this power is normally supplied by a model RPS-3002A power supply module which is also mounted in the CMF-3000B Frame. For slower-speed, less demanding applications, excellent performance can be attained with any well filtered DC power source of 8 to 14 volts.

Table 2-1 lists the wiring connections required for the CTD-3104A and also describes the function of each. When wiring, use 24 gauge or larger insulated copper wire, either solid or stranded and a good grade of resin-core solder. Keep all leads as short as possible and maintain a good air-gap between all analog signal leads. If desired, any leads not carrying audio, video or tones may be bundled and tied with waxed lacing cord or plastic wire ties.

**Table 2-1**

<b>Edge Connector Pin Out</b>			
<b>A</b>	Ground	<b>1</b>	Ground
<b>B</b>	Logic Input (+12vdc relay on, 2.5vdc relay off)	<b>2</b>	<i>No Connection</i>
<b>C</b>	+12vdc input at 80mA	<b>3</b>	<i>No Connection</i>
<b>D</b>	Output Relay K1 )Form A) N.O.	<b>4</b>	<i>No Connection</i>
<b>E</b>	Output Relay K1 (Form C) N.O.	<b>5</b>	<i>No Connection</i>
<b>F</b>	Set Line (Sets CTD to ON state)	<b>6</b>	<i>No Connection</i>
<b>H</b>	Reset line (Resets CTD to normal state)	<b>7</b>	Output Relay K1 (Form C) N.C.
<b>J</b>	Output K1 (Form A) Common	<b>8</b>	Lo-Z tone input, 600 ohms
<b>K</b>	Output K1 (FormC) Common	<b>9</b>	Hi-Z tone input 50K ohms
<b>L</b>	Ground	<b>10</b>	Ground

2-1 Using the CTD-3104A as a pulse-shaper.

Later versions of the CTD-3104A incorporate a jumper plug (J3) and a driver transistor (Q2) to facilitate operation of the module from contact closure or low-going logic-level pulses supplied by some outboard equipment such as stereo processors. See Figure 3-1.

With jumper plug J3 connected, a 0 vdc (ground) signal or low-going (ground) pulse applied to the high-impedance audio input (edge connector Pin 9) will actuate the module relay output. The relay outputs will remain energized **ONLY** as long as the input remains at a 0 VDC (ground) level.

## CHAPTER 3 OPERATION

This section describes the operation of the indicators on the front panel of the module. In addition, it provides instructions on how to configure the module and perform initial adjustments.

### 3-1. Controls and Indicators

LED indicators are provided on the front panel of the CTD-3104A which indicate the status of virtually all important functions of the module. Adjacent to each indicator is a label that identifies it functionally. A list of these indicators and their related functions is contained in Table 3-1.

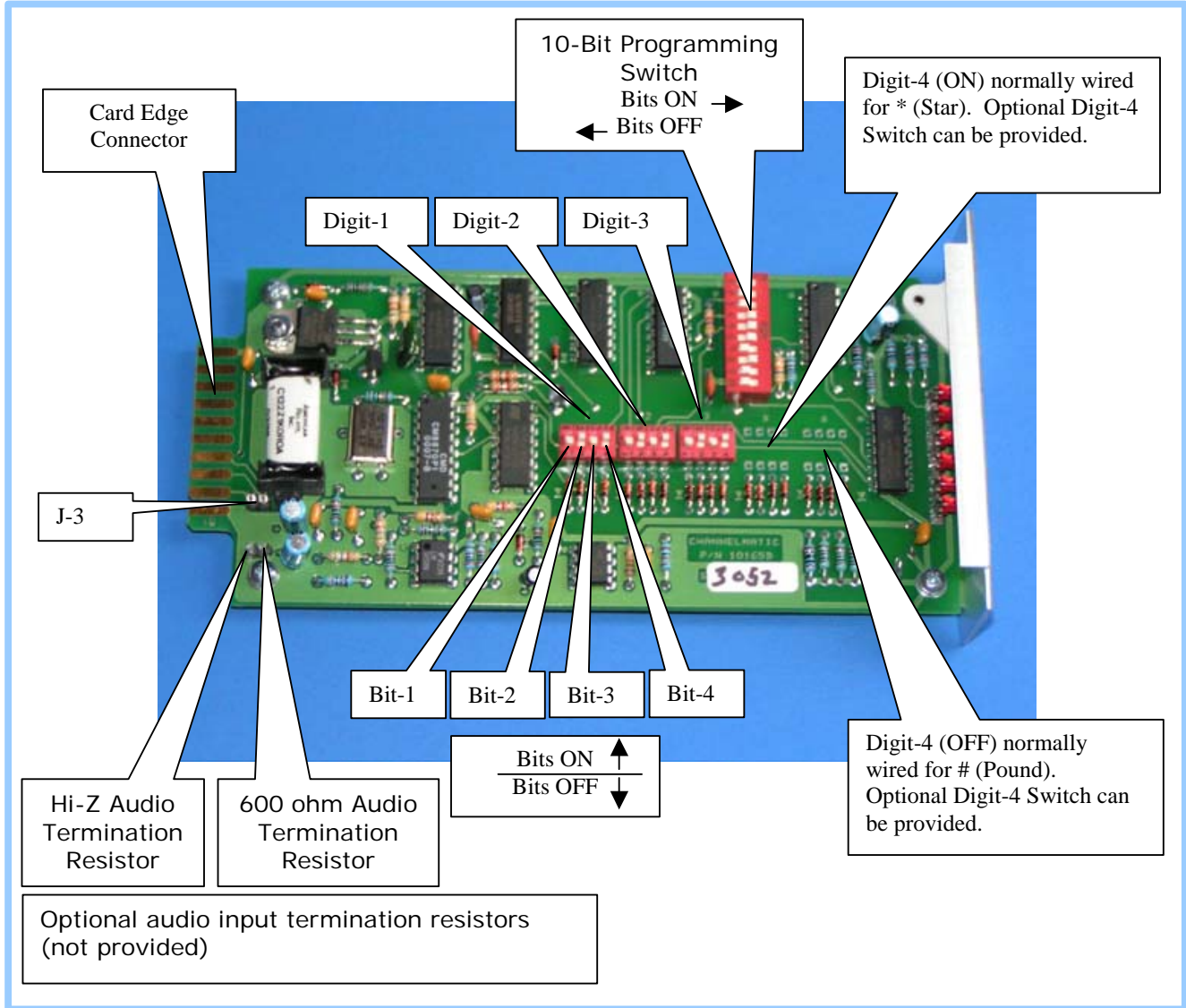
There are no normal operating controls on the CTD-3104A module.

**Table 3-1. CTD-3104A Front Panel Indicators**

<b>CTD-3104A Front Panel Indicators</b>	
<b>Indicator</b>	<b>Function</b>
<b>ON REC'D</b>	Lights to indicate receipt of a valid "ON" tone group. May not light if "momentary" operation is selected on internal programming switch. Internal switch may also be used to cause ON REC'D indicator to light on every other valid tone group.
<b>DIGIT 1</b>	Lights to indicate receipt in proper sequence of each digit in preset tone group. (See Note below)
<b>DIGIT 2</b>	
<b>DIGIT 3</b>	
<b>DIGIT 4</b>	
<b>TONE</b>	Flashes to indicate receipt of audio with peak levels in excess of 2.1 volts peak-to-peak. Steady ON indication signifies audio levels in excess of normal operating range.

NOTE: A DTMF digit is composed of a high group (high frequency) tone and a low group (lower frequency) tone, which occur simultaneously when a correct digit is transmitted. As a valid digit is being received, none of the DIGIT indicators will light. As the trailing edge or end of receipt of a valid digit occurs, the appropriate indicator will light. The digits must be received in proper order and within one second of each other. When a DIGIT indicator is ON and the next digit of the sequence is not received within 1 second, OR if an improper digit is received in the sequence (i.e.: 611\* instead of 601\*), the digit counter will automatically assume an invalid code and RESET. Therefore, the maximum time a DIGIT indicator will be ON is one second, with the minimum time being determined by the speed at which the tones are received.

**Figure 3-1. CTD-3104A Internal Parts Placement**



### 3-2. Start-up Procedure

Before operating the module, the internal programming switch must be set to properly configure the module for its intended application. The internal digit pre-select DIP switches must be set for the tone sequence to be recognized. In addition, the audio (tone) level applied to the module must be adjusted to assure proper module operation.

### 3-3. Program Switch Configuration

A ten-bit programming DIP switch is located on the etched circuit board. These bits are numbered 1 through 10; an OFF and ON position is also designated. It is important that this bank of bit switches be properly programmed for each application. If the application is specified when ordering, or if a complete system is shipped, the CTD-3104A module is always shipped with the programming switch preset for the application. In other situations, or if it is desired to re-configure a system, refer to Program Switch Configuration, Table 3-2 and Operational Mode Explanation, Table 3-3 for instructions on proper programming.

### 3-4. Pre-selecting the Digits to be Decoded

Each digit in the tone sequence to be decoded is pre-selected by setting the Digit Pre-Select DIP Switch for that digit. To pre-select the digits to be decoded, refer to Internal Parts Placement, Figure 3-1 and Digit Pre-select Switch Settings, Table 3-4.

**Table 3-2. CTD-3104A, 10 bit Program Switch Configuration**

Mode	1	2	3	4	5	6	7	8	9	10
4T-MOM				ON			ON		ON	
4T A/A-MOM				ON		ON	ON	ON		
4T ON/OFF LATCH				ON	ON			ON		
4T A/A-ON/OFF				ON	ON	ON		ON		
4T ON LATCH*				ON	ON	ON				
4T OFF LATCH*				ON	ON	ON			ON	
3T-MOM			ON				ON		ON	
3T ON/OFF LATCH			ON		ON			ON		
3T ON LATCH*			ON		ON					
3T OFF LATCH*			ON		ON				ON	
2T-MOM		ON					ON		ON	
2T ON/OFF LATCH		ON			ON			ON		
2T ON LATCH*		ON			ON					
2T OFF LATCH*		ON			ON				ON	
1T-MOM	ON						ON		ON	
1T ON/OFF LATCH	ON				ON			ON		
1T ON/LATCH*	ON				ON					
1T OFF LATCH*	ON				ON				ON	



Notes:

1. "T" designates one DTMF digit. For example, 729\* would be a 4T group.
2. (\*) – Music Test Position: With SW9 OFF, the output will switch on and stay on after the selected "ON" tone group is received. With SW9 ON and the output on, the output will switch off and stay off after the selected "OFF" group is received.
3. SW10: When ON, disables the automatic reset. Used for test purposes.

**Table 3-3. CTD-3104A, Operational Mode Explanation**

MOM (Momentary)	The output turns on for approximately 1 second after the last tone of the selected group is received. No "OFF" tone (#) is utilized: each time the appropriated code is applied (say 729*), a momentary relay closure will occur for 225 milliseconds.
A/A-MOM (Alternate Action Momentary):	The output turns on for approximately 1 second after the last tone of the "ON" group is received (usually*) and the "ON" LED lights. The last tone in the next group received must be the "OFF" group tone selected (usually #): this will give a momentary output and turn the LED off.
ON/OFF LATCHING	The output is turned on and stays on after the last tone of the "ON" group is received (usually *). The same group must be received again to turn the output off (no "OFF" group is utilized).
A/A-LATCHING (Alternate Action Latching):	Same as ON/OFF LATCHING, but the last tone group must be an "OFF" group (say 729#) to turn the output off.

The CTD-3104A module is supplied in standard form with the fourth digit of the ON sequence as \* and the fourth digit of the OFF sequence as #. These are the specified international standard ON and OFF tone digits. If it is desired to change the fourth digit of a four-digit code to any other digit, additional DIP switches must be added to the module at the factory. Contact our Service Department for information.

**Table 3-4. CTD-3104A, Digit Pre-select Switch Settings**

DTMF Digit	S1, S2, S3, S4, S5 Settings			
	SW1	SW2	SW3	SW4
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF
5	ON	OFF	ON	OFF
6	OFF	ON	ON	OFF
7	ON	ON	ON	OFF
8	OFF	OFF	OFF	ON
9	ON	OFF	OFF	ON
0	OFF	ON	OFF	ON
*	ON	ON	OFF	ON
#	OFF	OFF	ON	ON
A	ON	OFF	ON	ON
B	OFF	ON	ON	ON
C	ON	ON	ON	ON
D	OFF	OFF	OFF	OFF

### 3-5. Audio Level Adjustment

The CTD-3104A Tone Decoder module(s) used in your system is supplied with an audio tone input from either the audio output of a satellite receiver or other similar source, or the output of a UAD-3000A Unattended Telephone Answering Device module, or both. If a UAD-3000A module is incorporated in your system, its output has been internally wired to a secondary tone input on the CTD-3104A module(s).

The primary (program tone) input to the CTD-3104A is connected to one of the terminal board screw terminals (see Table 2-1). This input has a high impedance (about 50,000 ohms) and may be connected directly to a 150 or 600 ohm program audio line without any detrimental loading or other effects.

In some applications, it may be necessary to terminate the tone audio being applied to one or both inputs of the CTD-3104A. To terminate input audio, perform the procedure in Paragraph 3-7, Audio Termination.

To assure proper operation of the module, input audio level, connect the audio source to the module and adjust the output level control at the audio source. The correct adjustment is indicated by the TONE indicator on the front panel of the CTD-3104A module. Optimum performance is obtained when the audio level is adjusted as follows:

1. When TONES are carried on a Program Audio Channel (such as satellite network programming)- Adjust the output level control at the source until the TONE indicator on the front panel of the CTD module flashes regularly on program audio peaks.
2. When TONES are on a dedicated audio channel- Adjust the output level control at the source upward until the TONE indicator on the front panel of the CTD module just lights during a tone burst or test tone transmission. Then adjust the level slightly downward from that point.

NOTE: Although the input circuitry of the CTD-3104A module has been designed to perform with a wide variation in input levels, non-standard tone levels may cause the module to miss an occasional tone burst. Periodic checks of the tone audio level are advised to optimize reliability.

### 3-6. Changing the Standard Fourth digit

Although the international standard fourth digit for a DTMF ON sequence is \*, and the standard fourth digit for an OFF sequence is #, occasionally a reason for using a different digit is encountered. The CTD-3104A module can be modified at the factory to enable different fourth digits to be utilized. Contact our Service Department for information.

### 3-7. Terminating Input Audio

Although the audio inputs to the CTD-3104A module are labeled HIGH IMPEDANCE and LOW IMPEDANCE, in actuality both inputs are designed to appear as a high impedance load on input circuitry.

In some systems, these high-impedance inputs may be unsuited to a particular audio output stage. Either or both inputs may be terminated in any desired value. To terminate the inputs, perform the following procedure:

#### **CAUTION!!**

*Damage which occurs to circuit boards modified outside of Media Control Systems factory may void the equipment warranty. DO NOT ATTEMPT THE FOLLOWING MODIFICATION UNLESS YOU ARE QUALIFIED TO REPAIR COMPLEX ELECTRONIC CIRCUITRY CONTAINING INTEGRATED CIRCUITS.*

1. Remove the CTD-3104A module from the rack frame and place on a clean, flat work surface.

2. Loosen and remove the four screw and lock washers securing the circuit board to its metal card carrier.
3. Determine the value of the audio input termination needed and the actual input on which the termination is desired.
4. Refer to Figure 3-1 and locate the solder pins to which the terminating resistor(s) will be mounted.

**CAUTION!!**

*The circuit traces on this and all other high-density circuit boards are very thin. Using any pressure on these traces may cause the copper trace to become detached from the fiberglass backing. Use extreme caution when removing residual solder from these traces.*

5. Using a 25 watt, isolated tip soldering pencil.
6. Form the resistor leads to align with their mounting pins and carefully insert the leads into the pins.
7. Carefully solder the resistor(s) to the solder pins using only a good quality, high tin content resin core electronic solder and a 25 watt soldering pencil with an isolated tip.
8. Trim any excess from the resistor leads with a pair of diagonal cutting pliers and inspect the circuit board for any solder or resin bridges. Clean all residual soldering resin from the circuit board with isopropyl alcohol or a similar solvent.
9. Mount the circuit board to its metal card carrier using the screws and lock washers previously removed.
10. Check the settings of the internal programming DIP switch and the digit pre-select switches.
11. Reinstall the module in the rack frame.

## CHAPTER 4 THEORY OF OPERATION

This section contains a functional description of the CTD-3104A Tone Decoder operation and a brief discussion of its electrical circuitry.

### 4-1. DTMF Tones

As electronic switching systems were introduced to more and more land-line telephone networks, the need arose for a more rapid and accurate method of customer dialing. Bell Telephone laboratories, as a result, developed a dialing method which utilizes tones instead of pulses.

As most telephone networks incorporate filters which greatly attenuate frequencies lying outside the normal speech range, this tone dialing system had to, of necessity, utilize frequencies within the range normally generated by the human voice (usually considered to be the range between 200 and 3400 Hz.).

The dialing tones, to remain free from interference from speech signals on the same circuit, are comprised of two tones of separate frequency transmitted simultaneously. Since two tones transmitted together can create harmonic frequencies which also occur within the natural speech range, the tones were selected especially to avoid any harmonic content which could distort or otherwise interfere with normal communications on the circuit.

The standard touchpad utilized on most tone-type telephones consists of twelve unique pushbuttons arranged in three vertical columns of four pushbuttons each. The pushbuttons represent the digits 0 through 9 and the symbols \* and # (also known as tones E and F respectively). The complete tone pushbutton matrix, as designed by Bell Telephone Laboratories, consists of an additional four pushbutton column. Although seldomly used except in industrial data transmission, these additional four pushbuttons represent the tones A, B, C and D. The inclusion of these four tones fill out the touchpad to a square (4 by 4) matrix.

Each column of the tone matrix shares a common high-band tone, while each row shares a common low-band tone. Pressing any of the sixteen pushbuttons causes two tones (the high-band component tone and the low-band component tone) to be transmitted simultaneously. Since each digit is comprised of two tones, and the frequencies transmitted together remain unique to that digit, the common international term used to describe this method of tone transmission is “Dual-Tone, Multi-Frequency” or DTMF.

Not only did the advent of DTMF tone dialing allow rapid and accurate call routing, but, since the dialing tones could be transmitted through the central office switching equipment to the telephone receiver at the call’s destination, several other uses for the tones became popular. Since the tones are unused once the call routing is completed, after a connection has been made, they may be utilized to access any peripheral equipment which is capable of decoding the tones and can be attached to the telephone circuit.

As communications networks expanded to include microwave satellite up and downlinks, DTMF tones were utilized to signal the beginning and ending points of transmissions and, later, to surround time slots of special interest to those receiving the transmissions. Satellite-transmitted Cable Television networks now commonly use DTMF tone codes to signify the beginning and end of periods allotted for the insertion of local commercials into their programming by individual cable systems receiving the network.

To hold to a minimum the disruption in program audio to the consumer, these Satellite Network “Cue-tones” consist of three unique digits and a \* (START) or # (END) digit transmitted at a high-speed rate of 40ms per digit with 40ms of silence between each digit. This high rate of transmission speed requires specialized and highly accurate electronic circuitry for dependable cue-tone decoding to be possible.

Other tone decoding problems exist on Satellite Networks in addition to the high speed of transmission. Some networks transmit their cuetones on the same channel used for program audio. A tone decoder utilized for these networks must be highly selective to avoid “false tripping” by program audio conditions containing the components of the DTMF tones. Loud popular music and crowd noise, for instance, may contain the components of every DTMF digit at one time or another. To remain dependable, then, a DTMF tone decoder used with these networks must contain circuitry which disregards random tones with a high level of consistency.

Also, the vagaries of satellite transmission may, upon occasion, cause audio levels to vary as much as 10db. A DTMF tone decoder must therefore be designed to operate dependably over a wide range of input levels.

As some Cable Television Systems utilize DTMF tone decoders on as many as sixty networks at one time, tone decoders used as spares in case of malfunction should be easily modified to decode whatever tone group may be desired.

#### 4-2. CTD-3104A Description

The Media Control Systems CTD-3104A Four-Digit, High-Speed Digital DTMF Tone Decoder Module has been designed to offer the convenience and dependability of digital DTMF decoding circuitry with high selectivity and sensitivity.

The module features two separate audio input op-amps. Either one may be utilized, depending upon the application. Input termination for impedance matching is provided by the addition of appropriate loading resistors. The module is shipped un-terminated and may be terminated by the user as desired.

The audio input labeled “Hi-Z” (or high impedance) is most commonly used for satellite receiver interface and is provided with an audio level LED indicator. The driver for this LED is adjusted to allow the indicator to reach full brightness when the audio input to the module is at a level of 1.2 volts peak to peak. Input audio levels of between 100mv and 4 volts peak to peak are within the range required for dependable tone decoding.

Amplified audio from either of the two input op-amps is applied to an 8870 Decoder Circuit. This circuit splits input audio into two frequency ranges. One range contains all the frequencies utilized in the DTMF LOW tones, while the other range encompasses only DTMF HIGH tones.

The leading edge of an audio tone group which clears both filter ranges, simultaneously starts two crystal-controlled timers. These timers measure the pulse repetition rate (or frequency) of the audio signal. If the two tones match those of a standard DTMF digit, a Binary Coded Decimal (BCD) output is generated by the circuit. Internal timing in the decoder circuit minimizes the detection errors caused by slight audio dropouts and non-standard audio signals which might accidentally contain valid tone components. This timer is factory-adjusted to allow DTMF tone bursts as fast as 22ms ON / 22ms OFF to be detected, while even valid tones which may occur farther apart than 2 seconds cause a module RESET to await the next tone group.

A group of three Dual Inline Package (DIP) switches mounted on the module allow the user to pre-select the exact DTMF tone group which must be received to “turn on” the module (cause an output pulse to be transmitted). The fourth digit of the ON sequence is factory set to the international standard “\*”, while the fourth digit of the OFF sequence is set to the international standard “#” OFF digit. These fourth digits may be changed to any other digit desired with the addition of optional DIP switches at the factory.

BCD signals from both the first digit DIP switch and the output of the decoder circuit are applied to a Comparator circuit. If both BCD signals are identical, an output is applied to a 4022 counter circuit which causes it to switch the DIP switch corresponding to the next digit in the sequence to the input of the comparator. If the BCD signals do not match, an output is applied to the 4022 which causes it to RESET to the first digit position.

In this manner, continuous error detection is present during the decoding sequence. Not only do tone groups of non-standard timing patterns cause a RESET, the circuit also RESETS if a non-desired or out-of-order digit is detected.

The 4022 counter advances each time a scheduled valid digit is decoded until the last digit has been received. The CTD-3104A module may be programmed (with another onboard DIP switch) to decode a sequence of from two to four digits. The last digit causes the 4013 Flip-Flop circuit to perform its desired function. The 4013 is also programmed via DIP switch.

The user may elect to have the module output consist of momentary pulses as an ON or OFF tone group is received, a pulse which begins when an ON group is received and ends when an OFF group is received, or simply a momentary pulse when an ON tone is received. This flexibility allows the module to be used for virtually any purpose desired.

If an operational mode is selected which requires alternating ON and OFF tone groups, once an ON group has been received, the decoder circuitry begins looking for an OFF tone group. Additional ON tone groups will have no effect on the module output.

Front panel LED indicators provide a continuous report of module status. In addition to the HI-Z audio input level indicator, other LED’s are provided to show receipt of individual digits and the ON status of the module. Although the high speed nature of most tone transmissions cause the Digit Indicators to flash so rapidly as to be almost impossible to detect, a slower tone transmission used during module troubleshooting will allow an accurate display of module operation to be observed. Likewise, in a “momentary” operational mode, the ON REC’D indicator will only flash during the period when an output pulse is being transmitted but during troubleshooting, the “momentary” operation may be defeated and the module’s ON status observed at will.

Since the CTD-3104A provides three separate outputs, it may be used in many different types of equipment. One of the outputs (Pin B) provides a logic-compatible signal of +12.5vdc when the module is OFF and +2.5vdc when the module is ON. The other two outputs are relay-generated and output signals may be high or low-going and of whatever voltage range is desired, as long as current flow through the relay is below 500ma at 12vdc. One set of relay contacts provides a Form A output (SPST-normally open), while the other provides a Form C (DPDT) output.

An input is provided to allow an external source to generate a low-going RESET/DISABLE command. The external source must be capable of sinking 0.5ma at 5vdc.

The module requires a supply voltage of between +8 and +14vdc (nominal +12vdc) at 50ma.

The CTD-3104A has been designed to be pin for pin compatible with all other Media Control Systems Tone Decoder Modules.

## CHAPTER 5 MAINTENANCE

This section contains information for maintaining proper operation under field conditions, troubleshooting guidelines for locating the causes of malfunctions and procedures for replacing defective modules.

### 5-1. Periodic Maintenance

The CTD-3104A has been engineered to provide the utmost in reliability and requires no periodic maintenance of any kind.

### 5-2. Troubleshooting

The following troubleshooting information is provided to help in quickly locating a system defect so it can be remedied and the system placed back on-line as soon as possible.

Since overall system operation can be affected electronically by many different things, the troubleshooting table, (Table 5-1) should be used first to locate the fault. An understanding of the modules Theory of Operation is helpful in properly troubleshooting the system. If the problem cannot be located using the Troubleshooting Guide, contact our service center at (619) 599-1050, Monday – Friday between 8:00 am and 5:00 pm PST.



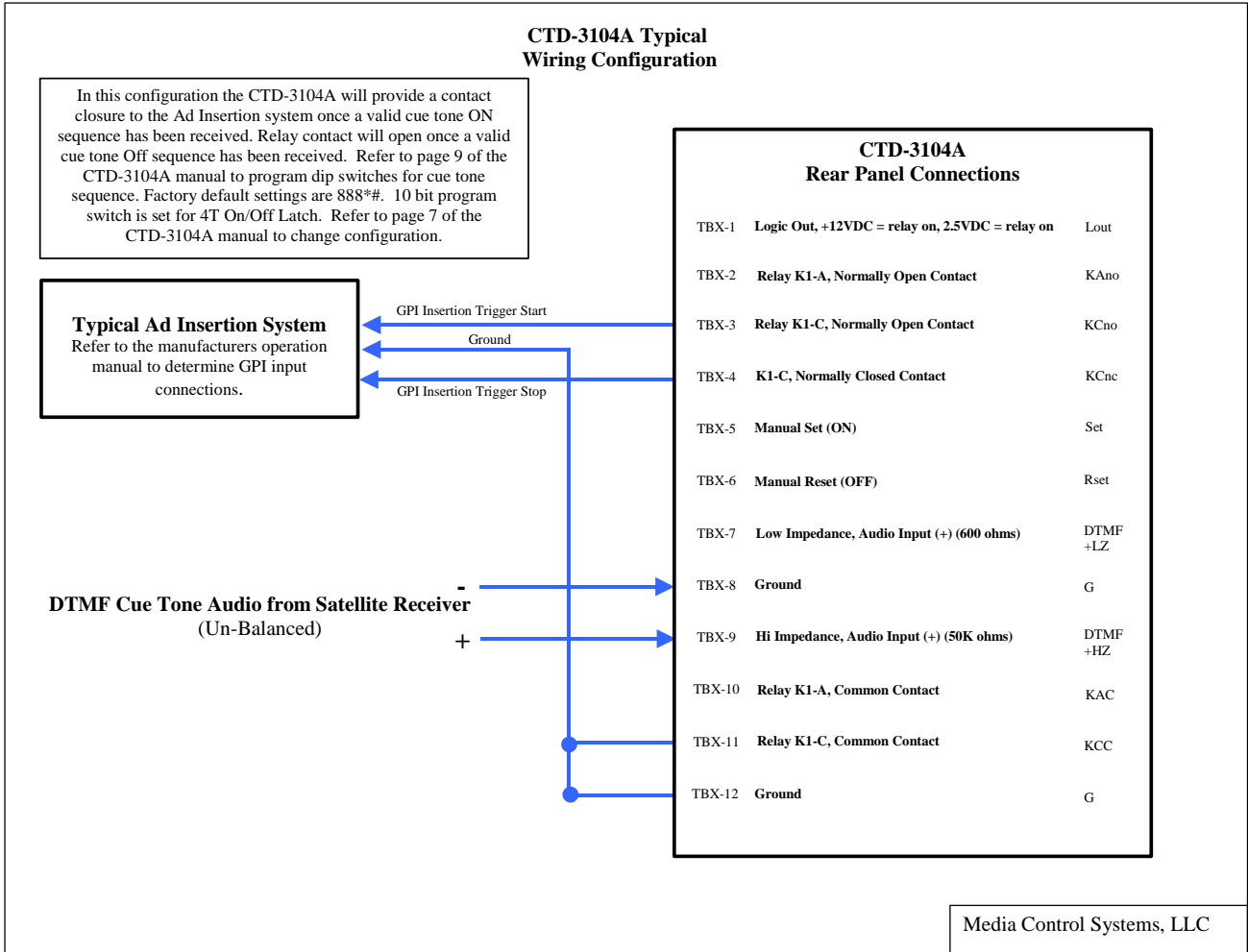
**Table 5-1. CTD-3104A, Troubleshooting Guide**

<b>Symptom</b>	<b>Probable Cause</b>	<b>Corrective Action</b>
No power to unit.	1) No power available at AC outlet. 2) Loose or no connection to AC power. 3) Open AC power fuse. 4) Defective +12vdc power supply.	1) Repair AC outlet. 2) Reconnect AC line cord. 3) disconnect unit from AC power and replace fuse. 4) Check and repair or replace DC power supply.
Does not decode tones (consistently or intermittently)	1) No power to modules. 2) Module not correctly programmed. 3) Digits not pre-selected. 4) Tone level too high or too low. 5) Module defective.	1) See above (No power to unit). 2) Check 1- position DIP switch for proper settings (Table 3-2). 3) Check digit pre-select switches for correct settings (Table 3-4). 4) Check audio input level (paragraph 3-5). 5) Replace module.

### 5-3. Corrective Maintenance

Since the CTD-3104A is a highly complex electronic device, no user-performed maintenance is recommended. No component-level maintenance is recommended by Media Control Systems, any damage caused to either the circuit board or mounted components during maintenance by non-factory personnel will automatically void any warranties.

## 6.0 Typical Wiring Configurations.



## LIMITED WARRANTY

MEDIA CONTROL SYSTEMS, LLC, Warrants each new product manufactured by it to be free of defective materials and workmanship, and agrees to remedy any such defect by repair or replacement at no extra charge for a period of one (1) year from the original date of purchase.

This warranty does not extend to any MCS product subject to misuse, neglect, accident, improper wiring or installation, or used in violation of MCS instructions. Nor does it extend to equipment that has been altered outside MCS's factory without prior written approval, nor to equipment that has had the serial number removed, nor to accessories used herewith, which were not manufactured by MCS. Fuses and batteries are specifically excluded from this Warranty. Equipment sold by but not manufactured by MCS is warranted by the original equipment manufacturer.

The owner must deliver equipment covered by this warranty with all transportation charges prepaid, to the MCS factory for examination. If examination discloses, by MCS's judgement, that this is thus defective, the equipment will be repaired or replaced at no charge. Equipment returned prepaid under warranty and repaired in MCS's factory will be returned with all transportation charges, surface freight only, paid by MCS. Units that fail under conditions cited above, as being outside of the warranty extension will be repaired on a time-and-material basis after notification to and approval by owner. All freight incurred in repairing equipment not under warranty will be the responsibility of the owner.

In respect to any and all equipment furnished by MCS, this warranty is in lieu of any other warranty, obligation, or liability expressed or implied including warranty of merchantability or fitness for a particular purpose. No person, including a company representative, is authorized to assume for MCS any other liability in connection with the sale of its products.

Under no circumstances shall MCS be liable in contracts or in tort for any economic loss, including any loss of profits, or for any special or consequential damage.

All inquires relating to either product operation or warranty service should be directed to:

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