

DTMF-2 Manual

Congratulations on your purchase of the DTMF-2 controller. The DTMF-2 decodes standard tones from common telephone and 2-way radio equipment, including the additional A,B,C, and D tones often found on 2-way radio equipment. The 8 control channels can sink (provide the ground side) of up to 500mA of current. Channels can be turned on or off individually or in groups. Each channel can also be turned on or off for a programmable time interval of from 0.1 seconds to 25.5 hours. A "keypad" mode allows a control channel to be turned on or off for as long as the user holds a digit on the keypad. This mode is ideal for camera pan and tilt control. Dedicated command acknowledge and audio outputs allow interfacing to phone line, 2-way radio or a local lamp or noise making device. These provide positive verification that commands were executed successfully. A status read function allows the state of any output to be remotely queried. A tone mute output allows the users tones to be masked when operating on a radio repeater system. Up to 20 codes of 1-7 digits each may be programmed and set to perform a specific function. All programming is stored in non-volatile memory and will remain permanently until changed. Two complete configurations may be programmed and selected with a jumper. Three levels of security allow you to create a system as open or as secure as your needs dictate. All connections to the board are via mini screw terminals.

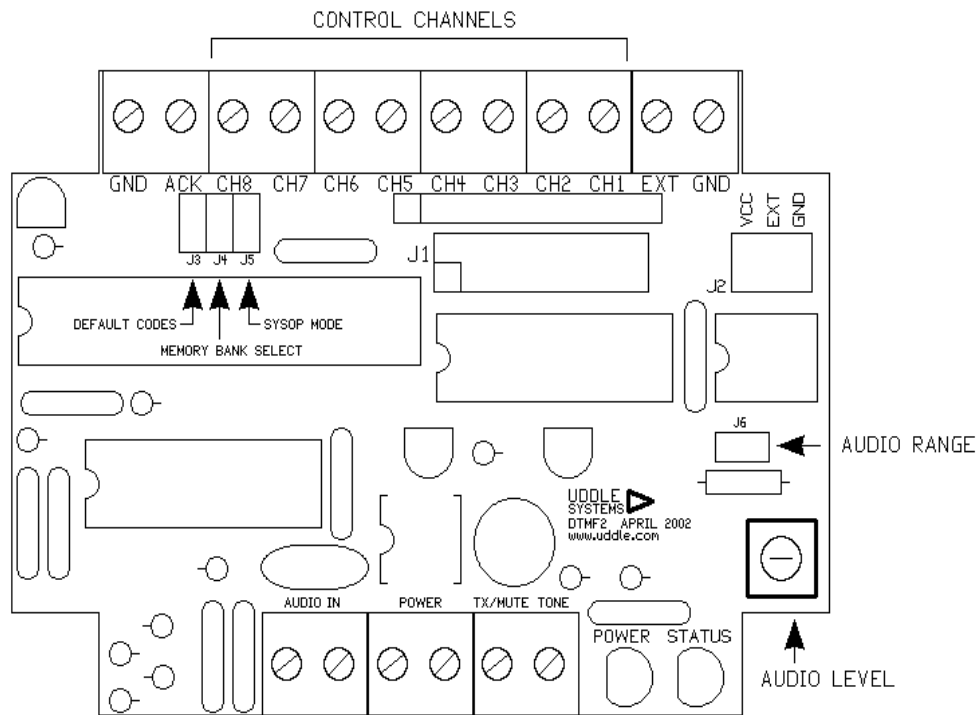


Figure 1.

Hardware

Power

Power to the DTMF-2 is supplied from the two center terminals on the bottom of the board. AC or DC of either polarity from 6 to 30 volts may be applied

Audio

Audio is applied to the bottom left 2 terminals. This is a balanced input allowing easy direct connection to balanced systems such as phone lines, broadcast equipment and some 2-way radio equipment. When connecting unbalanced audio sources (those that have a signal and a ground), the ground may be connected to either terminal. Both inputs are capacitively coupled. The DTMF-2 may be connected directly to a phone line. When connected in this manner, it will listen to the line but will not keep it off hook. The audio input level works over a wide range of signal from millivolts of signal to 5 volts. "line level" or speaker level outputs are acceptable sources of audio.

Control Channels

The DTMF-2 has 8 control channels located on the top of the board. Channel one is the third terminal in from the right. These are NPN darlington outputs capable of sinking (providing the ground side) of up to 500mA (0.5 Amps) each. The DTMF-2 can directly control circuits operating from up to 50 volts.

Ground terminals

The DTMF-2 has 2 ground terminals at the extreme left and right of the top of the board. One of these must be connected to the ground of the power supply used to power the controlled devices. Even if the same DC power supply is used to power the DTMF-2, the ground must still be connected. This is because if it is not connected, all the ground current being supplied to the outputs will flow through one of the diodes on the small bridge rectifier on the board and likely destroy it. The load power supply and the DTMF-2 power supply need not be the same. The DTMF-2 can be powered by nearly any small "wall wart" type transformer. The loads can be powered from a separate supply (of the same or different voltage as the supply running the DTMF-2). The ground terminal allows the DTMF-2 to share the load supply's ground, completing the circuit.

EXT terminal

The EXT terminal (located at the top right of the board, one terminal in), is for connection of the positive lead of the load power supply. The loads on the DTMF-2 will often be relays. The coils in relays produce a negative power spike when power to the relay is removed. This spike is very hard on the transistor driving the relay. To combat this, the driver chip has a reverse biased diode connected to each output. The other end of the diode is connected to the EXT terminal. This allows these spikes to be dampened by the protection diodes. The EXT connection is not needed if non-inductive loads (such as lamps) are used.

ACK terminal

The ACKnowledge terminal is located at the top of the board, second from the left. This terminal provides a ground output (up to 200mA), which signals that a valid command has been entered. This terminal may be connected to a small lamp, noise making device, or used to key a transmitter. Most base and mobile 2-way radio equipment has a PTT (push to talk) line, which is brought to ground to key the transmitter. In this case, the ACK line may be directly connected to the radio's PTT to key it. Handheld equipment often uses the MIC line to also key the transmitter by bringing it to ground via a 1K ohm resistor. The duration of the ACK signal is programmable. This signal can also be disabled in sysop mode or temporarily if the first digit of a command is *.

TONE terminal

The audio terminal is located on the bottom right of the board. When a command is being acknowledged and the ACK terminal is active, a 1Khz signal is also present on this terminal. This can be used to add audio to your radio transmission. It can also be coupled into a phone line or fed into an audio amplifier. The level of the audio can be adjusted by a volume control at the bottom right corner of the board. The audio level also has 2 range settings. A jumper block above the volume control sets this. With the jumper installed across both terminals, the audio is in the "high" range. Use this setting for phone line or "line level" amplifier input. If the jumper is removed (or placed on only one of the two terminals), the audio will be in the "low" range. Use this setting when the audio is to feed the microphone input of a radio. The tone signal can be disabled in sysop mode or temporarily if the first digit of a command is *.

MUTE terminal

Located just to the left of the TONE terminal is the MUTE terminal. This terminal goes to ground (up to 200mA) as soon as a DTMF tone is detected and stays active for a programmable amount of time. This is used to cover entered DTMF tones when the DTMF-2 is used with a radio repeater system. The MUTE signal is used to disable transmitter audio. This can be done by grounding out the transmitter audio directly, or removing it with a relay. The mute function can be disabled in sysop mode or temporarily if the first digit of a command is #.

Jumpers

Three jumpers located at the top left corner of the board provide additional control over setup and use of the DTMF-2. J3, furthest to the left, restores the stored codes to their default settings when installed before the board is powered on. J4, in the middle, selects the "upper" or "lower" bank of memory. The on position selects "upper." J5 on the right puts the DTMF-2 into sysop mode.

Powering up

Connect one or more devices to be controlled to the DTMF-2. Start with channel 1. Small lamps work well for testing. Connect a lamp, relay, piezo beeper, or 2-way radio PTT line to the ACK terminal. Connect a power supply. Just about any low voltage wall transformer of 6 volts or greater is acceptable. A 9 volt battery may also be used. Provide a source of audio which will contain your DTMF tones. If you have a 2-way radio with a keypad, you can use a second radio or scanner to receive the signal from it. Some radios allow you to hear the DTMF tones being

transmitted through their own speaker. If you have such a radio, its earphone jack may be used. A stand alone keypad can also be used. There are numerous battery powered DTMF keypads out there from the early days of competitive long distance service. Simply disconnect the internal speaker (or solder a pair of wires across it), and route the wires to the DTMF-2's audio inputs. Finally, if all else fails, connect the DTMF-2 audio inputs to your phone line. Just be careful not to accidentally make any international calls while testing!

Before applying power, make sure that the three configuration jumpers are all in the off position. Unused jumpers may be stored by placing them on only 1 of the two pins. Apply power to the board. The green LED at the lower right corner of the board should light. If it does not, check the power source and connections. Enter a DTMF tone. The red led should light for as long as the DTMF digit is held. If it does not, check audio source, connections, and audio level.

Test Drive

Now you are ready to try and control something. Apply power to the board. On your tone pad enter **1** and then *****. The device connected to channel 1 should turn on and stay on. If it does not and the red led blinked as each digit was hit, check the power connections to your device. The device you connected to the ACK output should also have activated for about one second and then shut off. Check connections if this did not happen. By the way, in case you used a piezo beeper or something loud and it's starting to get annoying, the code to turn it off is **1 #**. The default codes allow you to turn on and off the 8 channels by entering the channel number (1-8) followed by a ***** for on or a **#** for off. If you have more than one device connected, try turning on a few of them. Now enter **0 #**. Notice that all devices were turned off simultaneously. After each command is entered, your ACK device will be activated. Try entering an invalid command such as **1 0**. Notice that nothing happens. Enter it again and then hit **1 *** immediately afterwards. Notice that after entering incorrect digits and then immediately entering a correct command, your command is not recognized. That is because the DTMF-2 thought you actually entered **1 0 1 *** which is not a valid command. When you first enter a digit, a timer starts. If you enter another digit before the timer reaches zero, the timer restarts. The length of time before the timer expires is called the **digit time**. By default, the digit time is 2.5 seconds. That is the maximum time allowed between digits before the DTMF-2 gives up and waits for a new command. Notice that if you enter **1** wait about 3 seconds and then enter ***** the command doesn't work either. There are two lessons to be learned here. First, enter each digit of your command within about 2 seconds of the previous digit. Second, if you make a mistake, wait about 3 seconds for the DTMF-2 to give up and discard the digits it currently has before re-entering your command. The length of the digit timer can be changed in the sysop mode. Once a command has been successfully entered the timer is reset immediately. This means that right after entering **1 *** to turn on channel 1, you can enter **2 *** to turn on channel 2 and your command will be recognized.

Turn on channel 1 by entering **1 ***. Now enter **** 1**. Your ACK device should activate for a relatively long time. The red led will also be on for the same amount of time. This is the **read function**. The long beep indicates that the channel is on. Now repeat the command using a channel number that is not on (such as 7). Enter **** 7**. Notice that the ACK device and led come on for only 1/3rd the time. If you have the TONE output connected, an off condition is indicated by a short beep, while an on condition is indicated by a double beep. The duration of the ACK can also be programmed.

The DTMF-2 has two user levels of security. Commands can be set to require that the user be "logged in" in order to execute them. The DTMF-2 can also be set to auto login at startup. This is how it has been setup for the default codes. Codes can be programmed for login and logout. A logout code has not been programmed, however, a login code has been. Why would you want to login if you are already logged in? Well, when the board logs in at startup, it stays that way until changed. After entering the login code, a login timer is started. After any valid command, this

timer is reset. If no valid command is entered before the timer expires, the DTMF-2 logs out. Enter **1 2 3 4** now. You will get an ACK, but nothing else will appear to happen. Wait for one minute without entering anything else. You will get another ACK. This one is telling you that the timer has expired and the DTMF-2 is now logged out. Now try turning on and off some channels and reading their status. You should notice that only the **1 *** and **1 #** commands are available to you. Nothing else works. Now enter **1 2 3 4** again. You will get an ACK. Notice that you can now enter all the commands you did before. Each command you enter extends the login time for another minute. This duration is, of course, programmable. Once you stop entering commands, the DTMF-2 logs out again. The timer can also be disabled so that login and logout only happen when their respective code is entered. Since the default configuration has the board logging in at startup, resetting the board by removing and re-applying power will return the board to the permanently logged in state. This reset can also be accomplished without removing power from the sysop mode. By the way, the ACK that is generated when the login times out is called a **timer ACK**. This is because it happens in response to a timed event rather than entry of a code. The other two situations which cause a timer ACK are a timeout from sysop mode, or a channel's on or off time expiring. Timer ACKs may be turned off so that only entry of a correct code generates an ACK. This may be desirable in situations where the ACK is connected to a radio PTT and you don't want the radio keying unattended or when the frequency might be in use. This completes the tour of the pre-programmed codes. You have used all but one of them. To venture further into the mysteries of the DTMF-2, you will need to enter sysop mode.

DTMF-2 Operation

The DTMF-2 provides 3 levels of security. These are user, logged, and sysop. The **sysop** or SYStem OPERator is the person who sets up the board and has access to the programming functions and control of what functions are available in the other two modes. The DTMF-2 provides control of its 8 outputs via up to 20 **user odes** which are defined by the sysop. Each code can be from 1-7 DTMF digits in length. All 16 DTMF tones are valid within a code in any combination. Each code has a **command** associated with it. The command is a number which defines what action will be performed when the associated code is entered. Many commands also have a 2nd piece of data associated with them called an **argument**. The argument provides additional information such as a time value. When codes are setup, they can be defined as **logged**. When a code is setup as logged, the user must be "logged in." in order to use that code. The login itself is programmed as a separate code. The time the user can stay logged in without executing a valid command is also programmable. A **logout** command may also be programmed. The DTMF-2 can also be setup to be logged in when the board is powered on and remain that way until changed. This provides a more open environment where all user codes are available until a logout is executed.

Jumpers

The DTMF-2 has 3 jumpers at the upper left which provide additional options. The leftmost jumper (J3) restores the DTMF-2 programming to the default condition. This is done for **the currently selected bank only**. To restore defaults, remove power from the DTMF-2. Install J3. Re-apply power. The red LED will flash several times and remain on when finished. When programming is complete, remove J3. Power does not need to be removed again after programming. J4 selects the memory bank in use. The DTMF-2 can store 2 complete configurations. With J4 removed, the DTMF-2 uses the "lower" bank. With J4 installed, the DTMF-2 uses the "upper" bank. The jumper may be installed or removed with power applied. This function is useful for keeping a backup, alternate, or test copy of codes. Any changes made in the sysop mode will apply to **the currently selected bank**. Consider using an ACK of a different length to remind you which bank you are currently using. The sysop mode contains two commands for copying from one bank to another. This allows "cloning" your current configuration, or restoring a backup configuration. J5 places the DTMF-2 into sysop mode. This is useful if you forget the programmed sysop code, or have not programmed one for security reasons. To exit sysop mode remove J5. You must still logout of sysop mode by entering **99**.

SYSOP mode

The sysop mode is where the DTMF-2's codes, commands and options are programmed. While in sysop mode a totally different set of commands are available and the user and logged codes are not available. Sysop mode is entered in one of two ways. The first is via a pre-programmed code, just like any other command. The second way is by installing J5 on the board. When J5 is in the on position the DTMF-2 is forced into sysop mode immediately. This is useful in case you forget the sysop code and need to get in to change it or if your security needs dictate that sysop mode is entered only when someone has physical access to the DTMF-2. In that case you simply don't program a sysop code. Like the login code, sysop mode has a timer which exits when no command has been entered in a programmable amount of time. The default is 2 minutes. If at some point you are unsure whether or not you are in sysop mode, try entering one of the regular user codes, like 1 * If it works, you are no longer in sysop mode.

To enter sysop mode with the default codes enter **5 6 7 8** You will get an ACK. You are now in sysop mode. Refer to the **DTMF Programming Codes** sheet for a list of the available commands. For now ignore the top half and look at the bottom half of the page, which starts with **Sysop commands:** The first 8 commands allow the programming of various parameters. All of these commands require a three digit number (represented by "nnn") to be entered to complete the command. If the number is 10, for example, you will enter it as 010. The number can range from 000-255. Let's look at these commands.

Initial Condition - 000 nnn

The initial condition is the state the outputs are set to when the DTMF-2 is first powered on. In some cases you will want to have outputs that will be normally on. By setting the initial condition, you can ensure the outputs will be in your desired state before any commands have even been entered. The number you enter here is a binary value that is written directly to the output. See Appendix A for information on determining this value. The default value is 000, which turns all outputs off.

Digit Timeout – 001 nnn (0.1 S)

This is the first time duration parameter and it sets the length of time you are allowed to pause between digits before the board gives up on the current entry. The value is in intervals of 0.1 sec or a tenth of a second. This value can be increased if you need more time between digits, or decreased if you are a DTMF pad speed demon and don't want to wait as long to enter a command after you make a mistake. The default is 25 (2.5 seconds).

Mute time - 002 nnn (0.1 S)

This is the length of time that the MUTE terminal stays active after a tone is released. The default is 10 (1.0 seconds).

Acknowledge time – 003 nnn (0.1 S)

This is the length of time the acknowledge signal (ACK and TONE terminals) stays active after a successful command is entered. The default is 010 (1.0 seconds).

Read duration 004 nnn (0.1 S)

This is the time that the ACK signal stays active for an OFF condition when the read status command is used. The length of time for an ON is 3 times that of an OFF. Default is 005 (0.5 seconds).

Login timeout - 005 nnn (10 S)

The login timeout is the time before an automatic logout occurs when no commands have been entered. This number is specified in 10 second increments. A value of 0 will disable the timer and no automatic logout will occur. Remember that this timer applies only when a manual login code is entered. An automatic login is permanent, until manually logged out or manually logged in followed by a timeout. The default is 006 (1 minute).

Sysop timeout – 006 nnn (10 S)

This sets the idle time after which a automatic logout from sysop mode will occur. This timer can also be disabled by setting it to 0, however, this is not recommended. The default is 012 (2 minutes).

Options – 007 nnn

Like the initial condition, this is another binary value. Add the values for each option you want enabled to get the correct code. The default value is 031 which enables all options.

Timer ACK	16	Timer ACKs are enabled
Login	8	Auto login at startup
Sound	4	The TONE terminal is enabled
ACK	2	The ACK terminal is enabled
Mute	1	The MUTE terminal is enabledCode and Command Programming

The next section of the code sheet deals with programming of the DTMF codes that the user will enter to perform various functions and what happens when each code is entered. There are 20 locations numbered 01-20. Each location can have a DTMF code of 1-7 digits, or be disabled. Each location also has a command code associated with it. When a particular DTMF code is entered, the command associated with it will be performed. There are a total of 172 commands which can be chosen. They fall into the following categories: turn channel on, turn channel off, turn channel on for as long as a key is held, turn channel off for as long as a key is held, turn a group of channels on, turn a group of channels off, login, logout, read channel status, set all channels to a specified state (direct), and enter sysop mode. In addition when a channel is turned on or off, the time that is stays on or off can be specified. The command codes are listed on the top half of the DTMF-2 Programming Codes sheet. The DTMF code, command code, and argument (if required) are all programmed separately. Each is entered by entering the code location (01-20) followed by a function code. Function 1 programs the command. Function 2 programs the argument. Function 9 changes the DTMF code. For example, the command **02 1 192** would make location 02 into a logout command. Before you change anything you need to know what is already programmed so you don't change something you didn't intend to. When you setup your own codes and commands a nice black piece of paper is HIGHLY recommended. Here is the layout for the default codes:

Location	DTMF code	Command code	Argument	Function
01	1 *	016	000	Channel 1 on
02	1 #	000	000	Channel 1 off
03	2 *	025	000	Channel 2 on - logged
04	2 #	009	000	Channel 2 off - logged
05	3 *	026	000	Channel 3 on - logged
06	3 #	010	000	Channel 3 off - logged
07	4 *	027	000	Channel 4 on - logged
08	4 #	011	000	Channel 4 off - logged
09	5 *	028	000	Channel 5 on - logged
10	5 #	012	000	Channel 5 off - logged
11	6 *	029	000	Channel 6 on - logged
12	6 #	013	000	Channel 6 off - logged
13	7 *	030	000	Channel 7 on - logged
14	7 #	014	000	Channel 7 off - logged
15	8 *	031	000	Channel 8 on - logged
16	8 #	015	000	Channel 8 off - logged
17	0 #	232	000	All off - logged
18	* *	208	000	Read - logged
19	1 2 3 4	193	000	Login
20	5 6 7 8	240	000	Sysop mode

Now you have enough information to be able to make some intelligent changes. If you are not already in sysop mode, enter it now with **5 6 7 8**. Now enter **01 1 027**. Exit sysop mode by entering **99**. You are now back to the regular user mode. The sysop command you entered should have changed the command in location 01 from “turn on channel 1” to “turn on channel 4 – logged.” The default setup has the DTMF-2 logging in at startup and that hasn’t been changed, so you should still be logged in. Enter **1 *** Instead of channel 1 turning on, this time channel 4 should turn on. **4 #** will turn it off. Only the on command was altered. The code location and the DTMF code entered have nothing to do with what actually happens. Only the command code matters. This is important to keep in mind. Now go back to sysop mode. Enter **01 1 016**. This will put the **1 *** command back to turning channel 1 on. Now let’s change its DTMF code. Let’s make it 2734. To make the change enter **01 9 2734**. This time something different will happen. You will get an ACK but it will take a couple seconds. This is because after the **01 9** command, you can enter a code of 1-7 digits, or no code at all if you wish to disable a location. The DTMF-2 has now way of knowing how many digits are coming (unless you enter the maximum of 7). It waits until for a digit timeout to determine that you are done entering digits. Now the location 01 DTMF code should be changed. Exit sysop mode by entering **99**. Enter **2734**. Channel 1 should turn on. You should now have a good idea of how codes and commands are programmed. The only other item you will need to program is an argument. This is an extra number used as a time delay when momentary outputs are used, or a binary value that defines certain channels. The argument is a number from 000-255 and is programmed by entering the two digit location number, followed by **2** and then the number.

There is one more function in this section to be aware of. That is function code **5**. When you enter a location number followed by **5**, the command will be executed just as if its DTMF code had been entered from the user mode. This is useful for ensuring that a certain location contains the command you think it does. It is also useful if you need to execute commands while you happen to be in sysop mode.

Commands

Now that you know how to program DTMF codes and commands, let's take a more detailed look at the command codes.

On-Off Commands

Most of the table consists of on and off codes for the various channels. These are divided into 4 periods. The periods are 0.1 seconds, 1 second, 1 minute, and 6 minute. These are the intervals used when a non zero argument is programmed for that location. If the argument is zero, the time period is ignored. When the argument is zero, any of the channel on commands will turn that channel on and any of the channel off commands will turn it off. Nothing else happens. When the argument is some non zero number, an on command will turn a channel on. A timer is started that uses the argument as its count. The count decrements every "period" amount of time. When the timer reaches zero, the output will be turned off. The default codes are all from the 0.1 second table. This means that the argument count decrements every 0.1 seconds. An argument value of 010 would be 1 second. Let's program that into location 01. We'll go through the entire process as if we had no idea what was programmed in location 01. Enter sysop mode with **5 6 7 8**. Enter **01 1 016**. This sets the command code to "Channel 1 on – 0.1 sec period." Now enter **01 2 010**. This sets the location 01 argument to 010. Now enter **01 9 1***. This sets the location 01 DTMF code to 1 * Now let's try the sysop run command discussed in the last section. Enter **01 5**. Channel 1 should come on for 1 second and then go off. Now lets try the command from user mode. Enter **99** to exit sysop mode. Enter **1 ***. Channel 1 should again turn on for 1 second and then turn off. Congratulations, you have just programmed a complete command. With 4 periods and an argument of 000-255, you have the ability to program a momentary time of 0.1 seconds – 25.5 hours. This can be used for anything from resetting piece of equipment with a 0.5 sec pulse up to enabling a battery charger for a 15 hour charge.

Period	Maximum Delay
0.1 seconds	25.5 seconds
1 second	255 seconds (4 minutes, 15 seconds)
1 minute	255 minutes (4 hours, 15 minutes)
6 minute	25.5 hours

There is another way these delays can be used. When using an off command the action is reversed. The channel is first turned off and after the delay has expired, it is turned on. This is useful in situations where you want an output to be normally on and briefly turned off by a command. It can also be used as a delay before turning something on. Consider using this as a way to disable some function or piece of equipment overnight and return it to service the next morning, for example.

Keypad Mode

Sometimes you need to be able turn on (or off) an output for as long as you hold a key. Camera pan and tilt control is a good example of this. Another example would be starting a car. The starter cranks as long as you hold the key and stops when you release it. The keypad mode of the DTMF-2 gives you this kind of control, and yes, you can start your car with it! Simply program a command using one of the codes from the keypad table. The output goes active (on or off) for as long as the **last digit** of the command is held. One digit commands are perfectly acceptable. Program 4 outputs to 4 different codes, connect the outputs to the 4 inputs of a pan and tilt

camera base and you have your complete pan and tilt control. You can use one digit logged commands and use the login code for your security, or use 2 or more digits for each command. The argument value is ignored with this command.

Direct

Sometimes you will want to control more than one output with a single command. The DTMF-2 offers you two ways to do this. The first of these is **direct**. The direct command uses the argument value to explicitly set the value of all 8 outputs to a desired state. The default codes use this command in the **0 #** code to turn off all outputs. See Appendix A for a description of how to determine the value to set the outputs to your desired state.

Group

The group command is the second way of controlling multiple channels with a single command. The on command will turn on all channels whose bit position is a 1. Unlike the direct command, however, any other channels that were already on will stay on. The off command works in reverse. Any bit positions **set to 1** will be turned off, however other positions that are on will not be turned off. Use this command for turning on or off only certain channels without disturbing the state of other channels.

Read

The read command enables the reading of a channels status (off or on). You program only the prefix (the part before the channel number). The channel number itself is collected by the command. In the test drive earlier, commands such as * * **1** to read the status of channel 1 were demonstrated. The actual DTMF code programmed for this is * *. This command will not work from sysop mode using function 5 as described earlier. There is another way to do a read from sysop mode which is described below.

Miscellaneous Sysop Commands

There are a few stray sysop commands which will now be described

Read – 30 n

Entering **30 n**, where n is a channel number from 1-8 will execute a read from sysop mode. This command is available even if a user read command has not been programmed.

Copy Upper Memory to Lower – 25

This command copies the contents of the “upper” memory bank into the “lower” one. This can be used to make a backup copy of your codes or restore a backup.

Copy Lower Memory to Upper – 52

This command does the same thing as the above except the source and destination bank are reversed.

Software Reset - 86

Executing this command has the same effect as cycling power to the board. The outputs will return to the initial condition. You will now longer be in sysop mode. The DTMF-2 will be logged in only if auto login is enabled.

Direct – 95 nnn

Entering **95 nnn**, where nnn is a binary value from 000-255 does the same thing as a user mode direct command except that in sysop mode the value is entered and executed immediately. This command can be used to quickly set the outputs to any desired state. It is also always available in sysop mode even when no user direct command(s) have been programmed. Need to turn off everything and there is no “all off” command programmed? Just enter **95 000**.

Sysop Logout – 99

After entering **99** you will exit sysop mode. The login state will be the same as it was when you entered sysop mode (unless there has been a login timeout). Note that if sysop mode was entered via installing J5, you must first remove J5 before logging out.

Applications

We hope that the description of inner workings of the DTMF-2 has spurred your imagination as to how to put it to use, but we'd like to make some suggestions. Remember that if you require additional control channels, you can use more than one DTMF-2. As long as each one uses different codes you can add as many as you need.

Phone Line Use

The DTMF-2 will accept audio from almost any source, including directly from a phone line. When used with a phone line, the DTMF-2 will not answer the line or even hold it off hook, however, it will also not interfere with normal operation either. You can connect it at any point on your line and it will happily take input from any phone on that line. For dialup control all you need is something to answer the phone. An answering machine or even a FAX machine will do. As long as the device you are using stays off hook, the DTMF-2 will also be listening. Tie the TONE output to one of the phone line terminals for an audible response to your commands. Consider using the DTMF-2 to indicate an important call when you do not wish to be disturbed. Simply turn off the ringers on your phones and provide important callers with a code to enter. Have that code trigger a noise making device for a couple seconds. You could even use it to indicate who a call is for by using multiple noise making devices.

Radio Use

The DTMF-2 works equally well via radio. The ACK line can be used to control the PTT (push to talk) line of a 2-way radio. The TONE output can add audio to your transmission. The MUTE line provides tone muting ability when used with a repeater. Readily available FRS (Family Radio Service) radios work well with the DTMF-2. There is an Audiovox base unit with a MIC input that can be had for \$20. Many Ham radio handhelds with DTMF keypads can be made to talk to these radios. A battery powered keypad meant for phone use can also be used with any handheld or mobile that lacks a keypad. Radio control adds another unique dimension. You may wish to control some function at multiple locations. This gives rise to the idea of using the same code for a certain function at multiple locations or a "regional" code that performs the same function at a group of locations. Remember that since there are no restrictions on how many codes you can have to control a particular output, there is nothing stopping you from having a unique and a regional code to enable/disable the same output.

Controlled Devices

The DTMF-2 can operate small low voltage devices drawing under 500mA and operating on under 50 volts directly. For higher voltages or currents a relay will most often be used. While the programming functions of the DTMF-2 allow you to have a relay energized all the time (normally on), we recommend you avoid this if at all possible. If the DTMF-2 will be used to reset a device that is powered through a relay, consider wiring the relay so that the device receives power in the relays de-energized position. The outputs can also be used to in situations where continuity is needed. When the output is off, there will be an extremely high resistance between the output and ground. When the output is on it will appear as a diode. Because of this, you may have to reverse the two wires in order for the DTMF-2's output to control some devices that are looking for a contact closure. An example of a contact closure device is the X10 powerflash module. This is a device designed to turn lights or appliances on and off via signals sent on the power line. They work well with the DTMF-2.

Appendix A – Binary Values

The initial condition, direct, group, and option commands require a *binary value*. This is a number from 000-255 which represents 8 on or off conditions. An on condition is represented by a 1 and an off condition is represented by a 0. The **binary conversion table** lists all possible combinations of 1's and 0's and the 3 digit number they correspond to. In the case of coming up with a number to represent a desired group of channels, channel 8 is the leftmost digit and channel 1 is the rightmost digit. Here is a shortcut for finding your desired pattern. Take the **first four** digits from your desired pattern. Look them up in the first 16 entries at the upper left of the table, but comparing them to the **last four digits** of the pattern. You will come up with a number from 0-15. Now jump to the section of the table under that number. Now compare the **last four** digits of your pattern with the last four of that section of the table. You should arrive at your complete desired pattern.

The second method of coming up with your number is mathematically. Each of the 8 positions has a value associated with it.

Ch8	Ch7	Ch6	Ch5	Ch4	Ch3	Ch2	Ch1
128	64	32	16	8	4	2	1

Add the values above for each channel you want **on**. The result is your number.