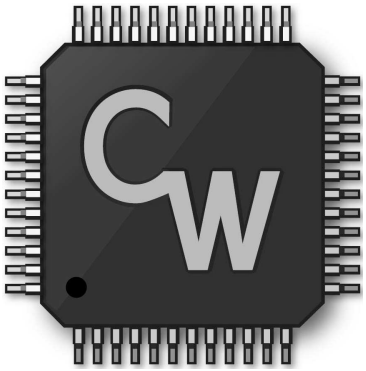
CircuitWerkes
DTMF-16e

Touchtone® Decoder



Technical Manual

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Description

The CircuitWerkes DTMF-16 is an integrated Touch Tone detector and sixteen output decoder, offering a combination of dry relay and optoisolated Darlington outputs for each of the sixteen standard DTMF tones. All outputs are fully programmable and can respond to single DTMF tones or can respond to sequences up to 6 digits in length. Outputs are individually set and can be momentary, latching or interlocked (radio button). Each output can be configured for leading or trailing edge operation. Two of the relay outputs are DPDT (dual form C) and two are SPST (Form A). Seperate emitters and collectors are available for each of the twelve remaining optocoupled outputs. The optically isolated, open collector, Darlington , outputs provide 5000 volts of isolation and are capable of sinking up to 150mA continuously (emitter-collector voltage should not exceed 30 volts). These outputs along with ground are available at the unit's D-25 pin connector. When interfacing the DTMF-16's outputs to low Voltage dc lines such as computer inputs, etc the optocouplers provide greater isolation and do not contain mechanical parts to wear out as with relays. It is **not** normally necessary or suggested to use external relays unless you are planning to switch AC Voltages or audio signals. Correct polarity must be observed for the optocouplers to work. Since any output (relay or optocoupled) can respond to any tone, the combination of optocouplers and relays allows most users to interface to everything without use of external hardware.

The D25 connector also contains serial data and can be used to program your DTMF-16. The connection settings are 2400b, N81, with no flow control or hardware handshaking. Any common termial program can be connected to the DTMF-16. Pressing the enter key brings up the programming menu where you can setup all of the configurable parameters of your DTMF-16.

Installation & Operation

Setup

The DTMF-16 comes from the factory ready to use, just hook up an audio source to the Audio In (AudIn + and -), connect your equipment to the screw terminasl for the relays or to the D25 for the remainder of the outputs, plug in the power supply and it's ready.

Jumper JP2 (STB-DLY) delays detection of the DTMF tones for a fraction of a second. The delay prevents the decoder from detecting transient audio passages containing valid DTMF frequencies from being decoded. This anti-falsing delay provides reliable detection of single DTMF tones that last for at least 1/2 second. Several satellite news/sports networks use long DTMF tones for signalling affiliate breaks and cues. You can also program a detection delay in the firmware. The hardware anti-falsing mode is easy to set, but less accurate than the programmable delay. It is also non-adjustable whereas the programmable delay is.

Mounting

The basic DTMF-16 can be either desk or wall mounted. Keyhole cutouts on the ears of the enclosure are provided for wall mounting. Two optional rack mounts, the RM-01 and RM-02 are also available for those who would like to mount one or two DTMF-16s in a 19 inch rack cabinet.

Basic Operation

The DTMF-16 requires no operator intervention. It monitors an audio source until a valid DTMF tone or combination sequence occurs, then energizes the tone's corresponding relay or optocoupler.

Connections

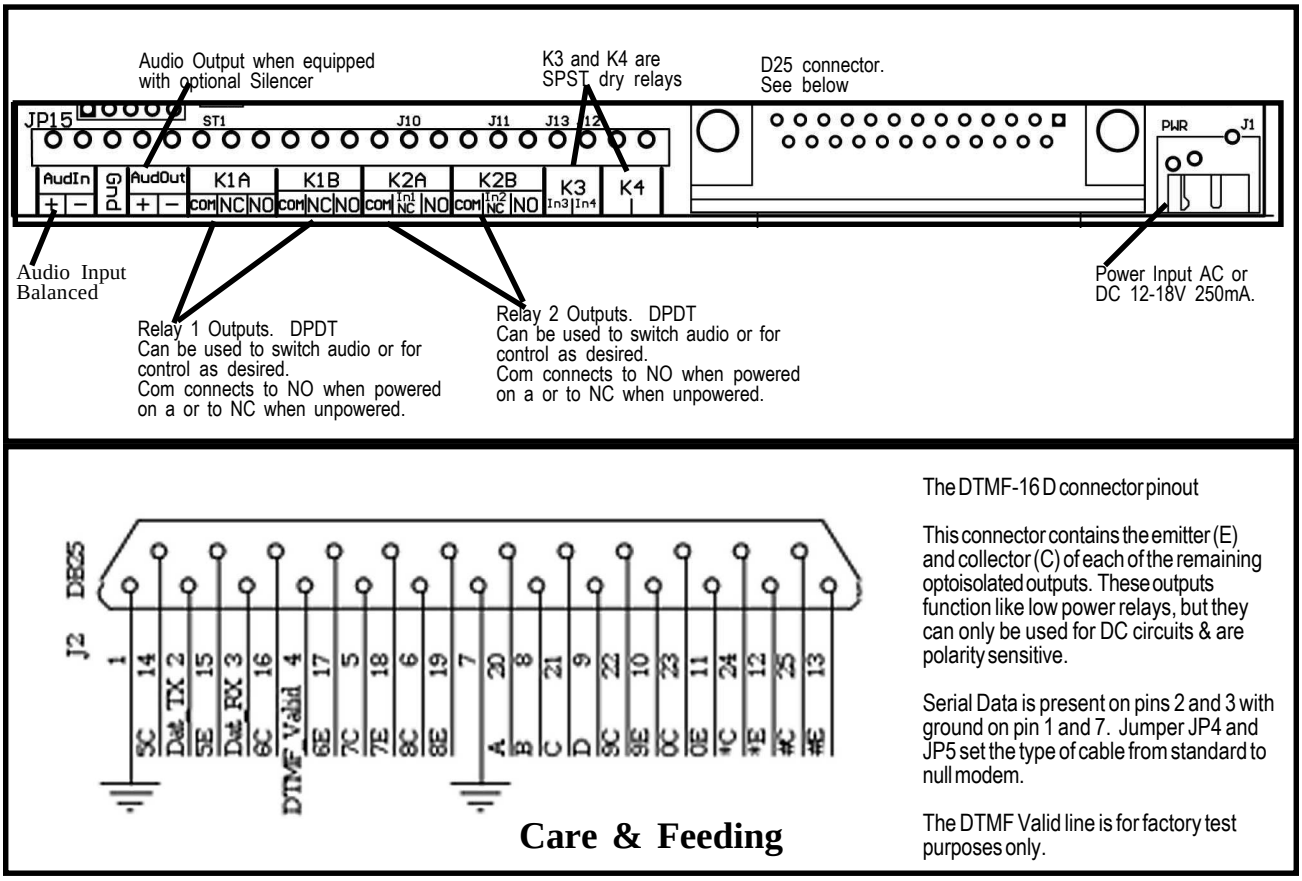
The power connection is made via 2.1 mm coaxial jack and will accept from 8 to 18 Vac. A power supply is provided with each DTMF-16; however, if you wish to supply your own, it must be able to provide at least 200ma.

The DTMF-16's audio connection is balanced, bridging and is made via the screw terminals marked AudIn (+) and (-) When connecting to an unbalanced feed, use (+) and ground with (-) tied to ground as well.

Audio input level should be between 0.1 and 2 volts peak to peak

Connecting the DTMF-16 to other equipment:

The DTMF-16 has two types of outputs, relays and optocouplers. Relays are dry switches that can be used to interface to anything within the relay's mechanical operating parameters including audio, digital logicand general purpose controls. The relays on the DTMF-16 should not be used for handling dangerous Voltagesbecause they are not rated for that and it is extremely unsafe to connect any such Voltage to the DTMF-16 due to the possibility of accidental electrocution. Just don't do it. Ever.



The DTMF-16 D connector pinout

This connector contains the emitter (E) and collector (C) of each of the remaining optoisolated outputs. These outputs function like low power relays, but they can only be used for DC circuits & are polarity sensitive.

Serial Data is present on pins 2 and 3 with ground on pin 1 and 7. Jumper JP4 and JP5 set the type of cable from standard to null modem.

The DTMF Valid line is for factory test purposes only.

Care & Feeding

Generally, the DTMF-16 may be placed anywhere other electrical equipment is in operation. As always, it is best to avoid extreme temperatures, immersion, or high impacts.

If you wish to clean the outside of the DTMF-16, use a damp cloth soaked in a mild soap and water solution. Detergents, alcohol, or solvents may remove the screen printing or mar the case.

Programming

*RS232 Configuration: **2400** Baud, **8** data bits, No Parity, 1 Stop Bit, No Flow Control.*

There is a hardware setting on the board that allows you to choose the type of cable that you will be using. This is done by changing jumpers JP4 and JP5. You may select either null-modem or normal serial cable. The default cable setting for the DTMF-16 is "normal", but many of the commercial D-9 to D-25 cables are setup for null modem in order to connect to external modems. If you are not making your own cable, you should probably try the null position.

The DTMF-16 user defined settings consist of a global configuration setting and a 16-channel table, called *Prog. Table*, that will hold all the custom trigger codes and trigger settings programmed by the user. For each channel, the customer can program 3 parameters: Trigger Edge Mode, Latching Mode, and one or two DTMF Trigger Codes (DTC).

Channel Settings:

- **Trigger Edge Mode**- Determines whether the channel will trigger on the Leading or Falling Edge of the last digit of the DTC received on the audio input
- **Latching Mode**- Determines how the channel output will react once the DTC is received.
    - Momentary- Output will remain High for the duration of the last digit of the DTC.
    - Latching-Output will remain High until the corresponding off code DTC is received.
    - Interlocked Latching-Output will be pulled High and all other outputs in the interlocked group will be pulled low. Output will remain high until the global interlocked off code DTC is received.
    - Fixed Duration-Output will remain High only for the preconfigured global Fixed Duration time(this is set in the *config* routine).
- **DTMF Trigger Codes (DTC)**- Each channel setting has a maximum of two DTCs that can act to turn the triggered channel on or off, depending on the Latching Mode. The first code is always an ON code. For the Momentary and Fixed Duration modes, the second code is simply a different ON code and either will pull the output High. For the Latching mode, the second code is the OFF code and the output will remain high until this is received. For the Interlocked mode, the second code is the global interlocked OFF code. This code is shared by all channels in the interlocked group and only affects those channels.

Program procedure:

The DTMF-16 SPT can operate with any terminal program such as Hyperterminal. Setup simply consists of connecting a parallel-to-serial cable or a null modem cable, as setup by JP4 and JP5, from your pc's 9-pin Serial port to the 25-pin connector on the DTMF-16, choosing the correct COM port in the terminal setup, and configuring the terminal program to the RS-232 settings (2400, N, 8, 1) as specified above.

Upon reception of any RS232 signal on the Tx input of the DTMF-16's 25-pin connector, the device will enter the programming interface routine automatically. You may have to hit the "ESCape" key to get started. The blank terminal screen will now say:" Welcome to the CW DTMF-16 Serial Interface." At this point the Interface is in Idle mode and is waiting for text instructions to perform a specific action. These action routines are entered by typing certain keywords (case insensitive) followed by the Enter, or Carriage Return, key as listed below. If no user input is received after 20 seconds, the SPT will timeout. **Hit escape at any time to return to the main menu.**

- ***pgm***- Routine for configuring a single channel on the DTMF-16 to trigger.
- ***config***-Routine to set the Fixed Duration mode duration time and to set the Trigger Reset Flag.
- ***dft***-Routine to simply return the DTMF-16 to default factory settings.
- ***clear***-Routine to clear the entire Prog. Table or simply clear a single channel in the Prog. Table.
- ***tbl-***Routine to view the Prog. Table.
- ***esc-***the escape key can be used to exit from any menu.

Programming modes time out after 20 seconds of inactivity. If you stop programming a sequence and thry to resume after the timeout, you may see an "invalid Input" response. That means you need to start over.

clear- typing "clear" and enter will prompt the user "Clear All or Single? (a or s):". If the user then types "a" (case sensitive) and then enter, this will clear the entire Prog. Table. Typing "s" and enter will prompt the user for the channel to clear. THIS MUST BE TYPED AS A 2-DIGIT # (e.g. 04, not 4) followed by Enter, or the wrong channel might be cleared.

dft- typing "dft" and Enter will reset the Prog. Table to default settings. The default setting for a channel is momentary latching mode, leading edge triggered and one ON code that mirrors the channel #(e.g. channel 4's code will be '4') . This also resets the global config. settings to Trigger Reset and 2.55 s fixed duration latch time. This action can also be performed by the Power-On Reset sequence.

Power-On Reset is achieved by holding the reset button on the hardware device down while power-ing up the device and then letting go of the reset button.

tbl- typing "tbl" followed by Enter will simply display the Prog. Table consisting the latching mode, trigger mode and two DTCs. TBL is a good place to start any programming becuase it shows you a snapshot of what's currently programmed.

Note: When using a commercially made 9 to 25pin serial cable or adaptor, your DTMF-16's serial port type selector jumpers (JP4 and JP5) will usually need to be set for "Null Modem". You have to take the top off of the box to set these.

The Default programming of the Dtmf-16 is as follows:

Ch.	Latch	Edge	Code_A	Code_B
01	M	L	1XXXXX	.....
02	M	L	2XXXXX	.....
03	M	L	3XXXXX	.....
04	M	L	4XXXXX	.....
05	M	L	5XXXXX	.....
06	M	L	6XXXXX	.....
07	M	L	7XXXXX	.....
08	M	L	8XXXXX	.....
09	M	L	9XXXXX	.....
10	M	L	0XXXXX	.....
11	M	L	*XXXXX	.....
12	M	L	#XXXXX	.....
13	M	L	AXXXXX	.....
14	M	L	BXXXXX	.....
15	M	L	CXXXXX	.....
16	M	L	DXXXXX	.....

pgm-Upon typing “pgm” followed by Enter, the DTMF-16 will enter the Prog. Table mode to set the configurations for each channel.

First, the user must choose the Channel to program (only one channel at a time). Again, THIS MUST BE TYPED AS A 2-DIGIT # (e.g. 04, not 4) followed by Enter. Once the channel is chosen, the user is prompted for which DTC(1 or 2) they want to program. The DTCs are memory locations. Each channel has two possible DTCs. For latching relays one DTC is the on code and the other DTC is the off code. For momentary relays, it is possible to program two different "on" codes, if desired, but you don't have to have two. Leave the second DTC blank when only one on code is needed. Normally you will program the primary on code into DTC 1. If the user chooses ‘2’, the SPT assumes that the first code and other settings for this channel have already been programmed. If it has not, THE USER MUST ACCOUNT FOR THE RESULTING ERROR. In other words, if you program an off code without having programmed a corresponding on code, your channel won't work, but you can still go back and program those other settings without destroying the DTC #2 setting. If the user chooses ‘1’, the user then chooses the latching mode and trigger mode. Finally, the user is prompted to program the actual DTC, starting with specifying the presumed length of the DTC, 1 to 6. After the length is chosen, the user will enter the DTC. Once the correct # of digits is received, the SPT will automatically reset and the terminal screen is cleared, ready for the next command.

In the case of Latching or Interlocked modes, the user is forced to program an OFF code (DTC #2). In the case of Interlocked mode, the user can choose to set a new global interlocked OFF code or use the one that already exists. If none exists, the user is prompted to choose a new OFF code. Making a new global interlocked OFF code will not only set the current channel’s OFF code, but will then copy that code to the OFF code of all other interlocked channels. Choosing an existing code will simply copy the existing code to the current channel’s OFF code.

See the next page for an example of programming an output with a new tone sequence.

Programming Example:

Example: Change relay 2 to respond to code 3474.

Upon connecting, hit the "esc" key. You will see the folllowing screen:

Serial Programming Terminal

Commands:
tbl - View sequences
pgm - Program sequences
clear - Clear sequences
dft - Load default sequences
config - Configuration screen

Enter the "PGM" command. The DTMF-16 responds with:

"Press ESC to return to the main menu."
"Choose Output to Program (01-16):"

Enter the relay that you want to change, in this case it is 02 (not 2, it's 02). followed by the enter key.

The DTMF-16 then asks "Which code for Output 02? (1 or 2):" Each output can respond to two codes. When a relay is set to momentary mode, both codes can be used to turn the relay on. When used in a latching mode, the first code is the "ON" code and the second is the "OFF" code. For momentary relays, you do not have to set the second code to anything unless you actually want the output to respond to more than one code., so you would normally enter: 1 followed by the enter key.

The DTMF-16 will then ask you to pick the relay operation mode as seen below:

Choose Mode for Output 02_1:
1:Momentary
2:Latching
3:Interlocked
4:Momentary: Fixed Duration
Mode:

For standard momentary mode, enter 1.

The DTMF-16 then asks for the length of the program code, which would be 4.

You will then be promted to enter the actual four digits that the DTMF-16 will respond to, which would be the 3474 code.

When viewed in the termianl window, the netire process looks like this:
Choose Output to Program (01-16): 02
Which code for Output 02? (1 or 2): 1
Choose Mode for Output 02_1:
1:Momentary
2:Latching
3:Interlocked
4:Momentary: Fixed Duration
Mode: 1
Choose length of program code from 1-6: 4
Choose program code(All Caps, Max.= 6):

NOTE: Relay 3's on code, in the above example, must be changed. Otherwise, the pre-programmed 3 in relay 3 will superceed the sequence of 3474 in relay two because the single digit 3 will complete a sequence, resetting the buffer. An alternative solution is to use the "config" function to change the trigger reset mode from 1 to 0. Setting the mode to zero allows multiple sequences to be decoded, but also requires at least a 2 second break between new sequences to avoid accidental decoding.

Programming functions continued

config- typing "config" followed by Enter will enter the configuration settings mode. Here the user can choose the fixed duration latch time from 0 to 2.55 s in 10ms increments, the global delay up to 1 minute in increments of 100ms The user can also choose to change the Trigger Reset mode. Entries for fixed duration or global delay times are entered as three digit sequences.

The fixed duration latch time causes outputs to be on for the duration selected, regardless of how long or how short the incoming DTMF tone is. To set the fixed duration latch time, hit escape to get to the main menu, then type config + enter. Choose option 1 but do not hit enter. Next enter the delay time as 3 digits. For 500ms, enter 005.. Now, whenever a DTMF tone is decoded and the mode is set to fixed duration (mode 4), the output will be on for 500ms.

The Global Delay sets the minimum time that a DTMF tone must be present before being detected as a legitimate tone. This feature is an anti-falsing filter that prevents accidental firing of tones during talk or other programming. It should only be used when single DTMF digits are being sent.

Trigger Reset- If Trigger Reset is set as 1, then during run time the first valid DTC received by the DTMF-16 audio input will trigger the appropriate channel and then any other running matches are discarded. If Trigger Reset is set as 0, the reception of a valid DTC will trigger the appropriate channel and the DTMF-16 will keep listening for running matches. In other words, if TR=0 and '123' is the DTC for ch. 8 and '1239' is the DTC for ch.2, and '123' is received by the audio input during run time, then ch. 8 is triggered and the DTMF-16 is still listening for a subsequent '9'. If the '9' is received before the program has timed out (10s), then ch.2 will also be triggered. If TR=1, ch.2 would not have been triggered.

Trouble Shooting

The DTMF-16d has a red LED marked DV that should light whenever a tone is detected. If you have problems, check that LED for operation during a tone. If it's not operating, then there's an audio input problem with input connector or your wiring or the M8870 decoder chip/ associated circuit is bad. If you have an amplified speaker, listen to your source audio at the jack's wiring connector to verify that the audio is getting that far. If the light does come on, then hook up your external connectors in the normal way that they will be used and, using a D.C. Voltmeter (preferrably analog), look at the two pins associated with the tone that you are using. When there is no tone, you should see Voltage from whatever source you're trying to switch. Verify that the collector pin is high and that the emitter is low. If they are reversed, the unit will not work. If there's no Voltage from your source, then either your source is bad or your wiring is faulty. If there is Voltage, then verify that it's not more than 30 Volts and wait for a tone. During the tone, the Voltage should fall to nearly zero. If it does, then the decoder is working. If not, then there is a problem with the processor chip, an output chip/relay. If you suspect an output chip, there are 3 identical chips, each containing 4 optocouplers. You can swap them around to test any particular output.

Note: Excessive current or Voltage through the emitter collector junction of the optocouplers will destroy them.

Options

The Silencer option board, combined with your DTMF-16 lets you recieve DTMF control signals while completely removing the tones from your audio path. Your talent or producer in the field can fire ID's, start breaks, fully automated remote broadcasts, light up an attention flasher, or control just about anything else right in the program path, without getting any tones on the air. On channel, Silenced, DTMF tones easily allow for sophisticated network control without the expense of additional control channels. The Silencer can be field retrofitted in this version of the DTMF-16. Contact your CircuitWerkes Dealer for more information on CircuitWerkes products.

Additional Programming Examples

Example #2: Change relay 1 to respond to DTMF tone 1, but with a fixed 500ms duration

Upon connecting, hit the "esc" key. You will see the folllowing screen:

Serial Programming Terminal

Commands:
tbl - View sequences
pgm - Program sequences
clear - Clear sequences
dft - Load default sequences
config - Configuration screen

Enter the "PGM" command. The DTMF-16 responds with:

"Press ESC to return to the main menu."
"Choose Output to Program (01-16):"

Enter the relay that you want to change, in this case it is 01 (not 1, it's 01). followed by the enter key.

The DTMF-16 then asks "Which code for Output 02? (1 or 2):" Each output can respond to two codes. When a relay is set to momentary mode, both codes can be used to turn the relay on. When used in a latching mode, the first code is the "ON" code and the second is the "OFF" code. For momentary relays, you do not have to set the second code to anything unless you actually want the output to respond to more than one code., so you would normally enter: 1 followed by the enter key.

The DTMF-16 will then ask you to pick the relay operation mode as seen below:

Choose Mode for Output 01_1:
1:Momentary
2:Latching
3:Interlocked
4:Momentary: Fixed Duration
Mode:

For fixed duration momentary mode, enter 4.

The DTMF-16 then asks for the length of the program code, which would be 1.

You will then be promted to enter the actual digit (or digits) that the DTMF-16 will respond to, which would be the DTMF digit that we want to operate this channel, in this case 1.

When viewed in the termianl window, the entire process looks like this:
Choose Output to Program (01-16): 01
Which code for Output 02? (1 or 2): 1
Choose Mode for Output 01_1:
1:Momentary
2:Latching
3:Interlocked
4:Momentary: Fixed Duration
Mode: 4
Choose length of program code from 1-6: 1
Choose program code(All Caps, Max.= 6): 1

Part 2:

Hit the ESCape key and type "config" followed by the "enter" key. The DTMF-16 responds with "Enter parameter that you wish to modify". Select 1 (Fixed duration delay) but do not hit the enter key. The DTMF-16 asks what delay value to use and you enter someting like 050.for 500ms. For 1 second it's 100. This setting affects all outputs that are set to mode 4.

Example #3: Change relay 1 to latching mode with a distinct on and off code using DTMF 1 for ON and C (yes there's a "C") for OFF.

Upon connecting, hit the "esc" key. You will see the folllowing screen:

Serial Programming Terminal

Commands:
tbl - View sequences
pgm - Program sequences
clear - Clear sequences
dft - Load default sequences
config - Configuration screen

Enter the "PGM" command. The DTMF-16 responds with:

"Press ESC to return to the main menu."
"Choose Output to Program (01-16):"

Enter the relay that you want to change, in this case it is 01 (not 1, it's 01). followed by the enter key.

The DTMF-16 then asks "Which code for Output 02? (1 or 2):" Each output can respond to two codes. When a relay is set to momentary mode, both codes can be used to turn the relay on. When used in a latching mode, the first code is the "ON" code and the second is the "OFF" code. For momentary relays, you do not have to set the second code to anything unless you actually want the output to respond to more than one code., so you would normally enter: 1 followed by the enter key.

The DTMF-16 will then ask you to pick the relay operation mode as seen below:

Choose Mode for Output 01_1:
1:Momentary
2:Latching
3:Interlocked
4:Momentary: Fixed Duration
Mode:

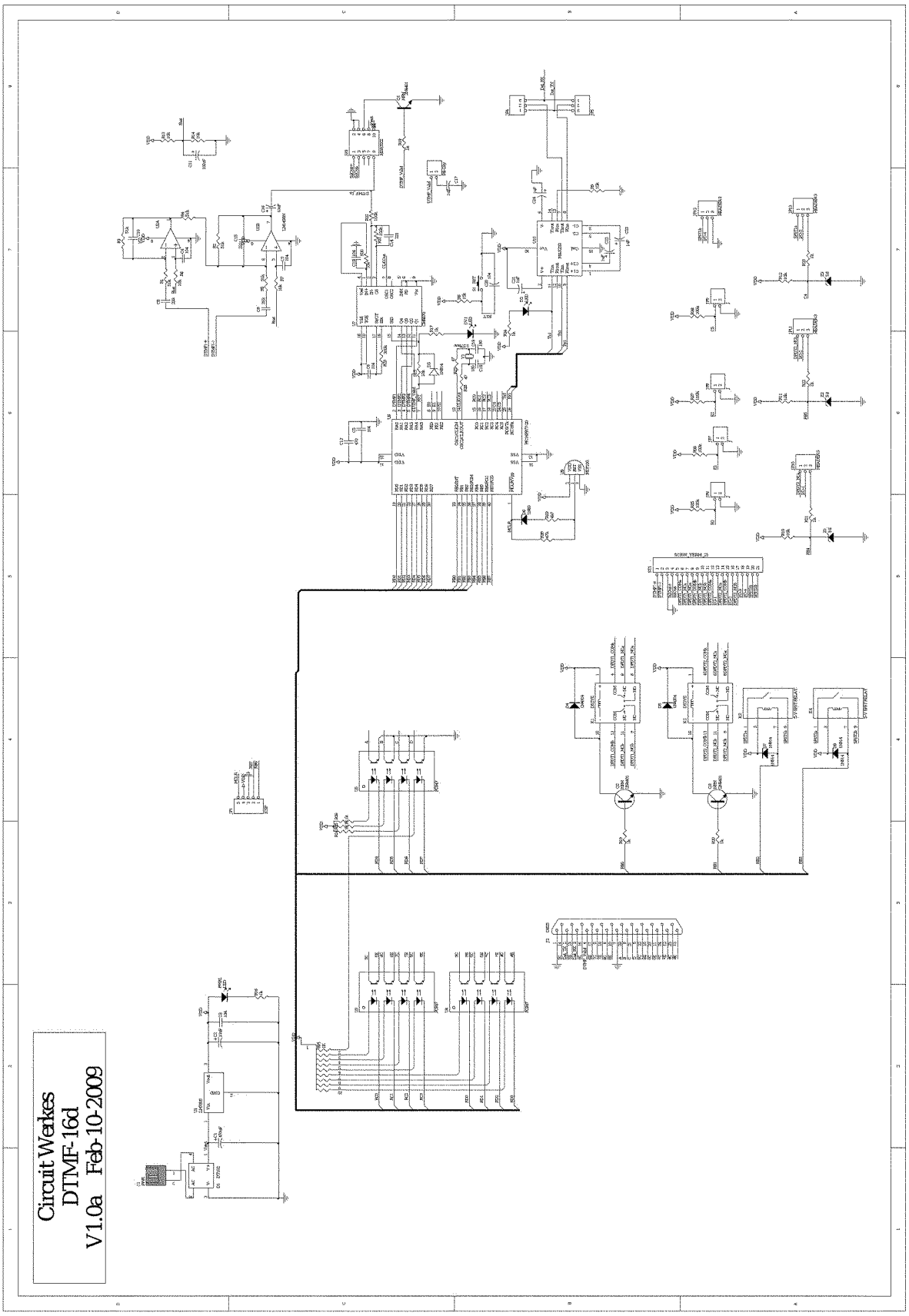
For latching mode, enter 2.

The DTMF-16 then asks for the length of the program code, which would be 1.

You will then be promted to enter the actual digit (or digits) that the DTMF-16 will respond to, which would be the DTMF digit that we want to operate this channel, in this case 1.

You will then be prompted to enter the second code which is entered as a capital C.

When viewed in the termianl window, the entire process looks like this:
Choose Output to Program (01-16): 01
Which code for Output 02? (1 or 2): 1
Choose Mode for Output 01_1:
1:Momentary
2:Latching
3:Interlocked
4:Momentary: Fixed Duration
Mode: 1
Choose length of program code from 1-6: 1
Choose program code 1 (All Caps, Max.= 6): 1
Choose program code 2 (All Caps, Max.= 6): C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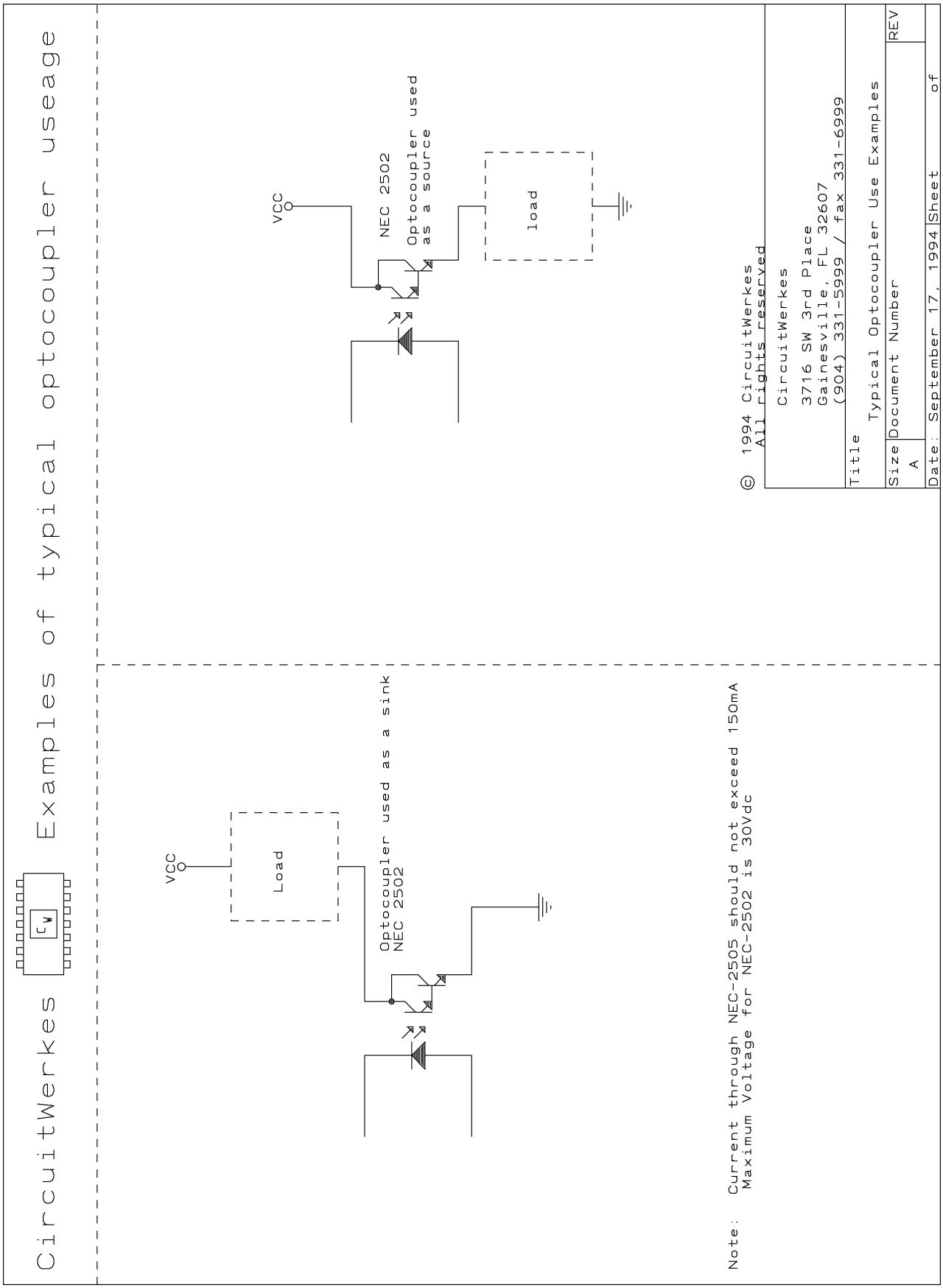

Typical DTMF-16 output wiring.
Specific examples for interfacing the DTMF-16 to relays and TTL/CMOS inputs can be found on page 9.

REPAIR OR SERVICE INFORMATION

In the event of the need for service or repair, call CircuitWerkes at (352) 335-6555 for a Return Merchandise Authorization number (RMA). Then carefully package the unit along with a note of the problem and send it to the address below. Clearly indicate the RMA number on the outside of the box. We cannot accept returns without an RMA. Be sure to include your address (not a PO box), telephone number and best time to call.

CircuitWerkes, Inc.
ATTN: RMA #
2805 NW 6th Street
GAINESVILLE, FL 32609

CircuitWerkes Limited Warranty

This product is warranted against defects for two years from date of purchase from CircuitWerkes and CircuitWerkes authorized distributors. Within this period, we will repair it without charge for parts and labor. Proof of purchase-date required. **Warranty does not cover transportation costs, or a product subjected to misuse, accidental damage, alteration (except as authorized by CircuitWerkes), improper installation, or consequential damages.**

Except as provided herein, CircuitWerkes makes no warranties, express or implied, including warranties of merchantability and fitness for a particular purpose. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.