

# 44020 DTMF DECODER MODULE



## Table of Contents

Ordering Information .....	2
General Description .....	2
Circuit Description .....	3
Application Information .....	8
Installation .....	10
Operation .....	16
Technical Specifications .....	17
Warranty .....	18

### About this Practice:

This document has been reissued to

- Renumber figures.

**Reissued Practices:** Updated and new content can be identified by a banner in the right margin.

**Issue date: September 1998**

UPDATED

### CAUTION

- Install or remove modules from the shelf only when the power is off. If you install a module in the shelf with the power on, the internal circuitry may suffer damage and the product warranty will be void.
- Remove and install circuit boards only in a static-safe environment (use antistatic wrist straps, smocks, footwear, etc.).
- Keep circuit boards in their antistatic bags when they are not in use.
- Do not ship or store circuit boards near strong electrostatic, electromagnetic, magnetic, or radioactive fields.
- For more complete information on electrostatic discharge safety precautions, refer to Bellcore™ Technical Reference # TR-NWT-000870.

# ORDERING INFORMATION

**NOTE:** This section lists the different options available for this product. To order any of the available options, contact Dantel Inside Sales through our toll-free number, **1-800-432-6835**.

OPTION NUMBER	FEATURES
A11-44020-00	DTMF (Dual Tone Multiple Frequency) Decoder
A12-49018-00	Station Selector Subassembly

## GENERAL DESCRIPTION

The 44020 DTMF Decoder Module (Decoder Module) provides DTMF to BCD decoding for:

- ◆ Remote control
- ◆ Selective signaling systems
- ◆ DTMF to rotary converters

The Decoder Module also provides separate outputs for "\*" and "#" or "A" and "C" auxiliary functions.

The Decoder Module is a plug-in printed circuit module that fits into any 400-type or similar equipment housing. The Decoder Module normally functions with the following modules in Dantel's 440 Communications Management System (440 CMS):

- ◆ 44022 Subscriber Line Interface Module
- ◆ 49018 or 49028 Station Selector
- ◆ 48020 Ringing Generator
- ◆ 49020 Tone Supply
- ◆ Use the Decoder Module with the 44023 PABX/Trunk Interface Module for making a 440 CMS off-net interface assembly.
- ◆ Use the 44021 Address Decoder for 440 CMS multiple station applications.
- ◆ Other 440 CMS modules include the 44011 Line Interface and the 44931 and 49031 Relay Modules.

A Decoder Module auxiliary circuit inhibits ringing generator operation when the 440 CMS answers a station call.

Decoder Module strap options allow:

- ◆ Input termination or bridging
- ◆ Dial tone filter in or out

CONTINUED . . .

# GENERAL DESCRIPTION

- ◆ Input level range setting
- ◆ 12- or 16-digit decoding
- ◆ \* and "#" or "A" and "C" auxiliary output (latching or momentary).

The front panel includes:

- ◆ A strobe-indicating LED
- ◆ Test points for power supply voltages and input level
- ◆ A subassembly panel opening

The functions of the 44020 Decoder Module can be enhanced with a number of subassemblies:

- ◆ The 49018 Station Selector Subassembly may be installed to provide two address decoding for a single-station site package in the 440 system. The addresses may be used for station call and all-call or group-call. Refer to the 49018 or 49028 practice for more information.
- ◆ The 49020 Tone Supply Subassembly may be installed to provide control tones for the 440 system. This subassembly is normally used on the 44020 in a multi-station package configuration. Refer to the 49020 practice for more information.
- ◆ Other subassemblies are available as the need dictates. Contact Dantel Marketing for specific information.

The 44020 DTMF Decoder Module operates on -21 to -56 VDC input power.

# CIRCUIT DESCRIPTION

Fig. 1 shows the 44020 DTMF Decoder Module functional schematic. The Decoder Module consists of:

- ◆ An input circuit
- ◆ Buffer amplifier
- ◆ Dial tone reject filter
- ◆ High frequency reject filter
- ◆ DTMF receiver and output buffers
- ◆ "\*" and "\*" or "A" and "C" decoder and latch circuit
- ◆ Power-up clear circuit
- ◆ Ringing generator and control circuit
- ◆ An internal voltage regulator



# CIRCUIT DESCRIPTION

Here is a brief description of each of the functional parts of the circuit:

## **Input Circuit**

The DTMF input (pins 49 and 55) is a balanced 600-ohm terminating or bridging port that provides DC isolation and overvoltage transient protection.

Transformer T1 is a high impedance bridging transformer that provides DC isolation from the lines. Capacitor C1 blocks DC loop current on the transformer primary.

Varistor V1 clamps any high voltage transients over 130 VAC RMS. Zener diodes (D1 and D2) limit lower voltage transients at about 10 VAC peak-to-peak.

Resistor R1 is strappable to provide 600-ohm line termination. Front panel test points connect across the line.

## **Buffer Amplifier**

The buffer amplifier provides a high impedance to the input stage and gain adjustment for different input signal levels.

The circuit has one integrated circuit dual operational amplifier and gain adjustment resistors.

The first operational amplifier is a noninverting voltage follower with a very high input impedance which buffers the output.

The second operational amplifier is an inverting amplifier with gain adjustment accomplished by strapping in feedback resistors (10 dB gain, 0 dB gain, or 10 dB loss). The second amplifier provides a low impedance output to the next stage.

## **Dial Tone Reject Filter**

The dial tone reject filter is an elliptical high pass filter that provides attenuation of 10 dB at 350 Hz and 20 dB at 440 Hz (CCITT standard dial tone frequencies).

Dial tone tolerance reaches +20 dB (relative to the lowest DTMF amplitude tone) in combination with the DTMF receiver IC input. Talk-off immunity decreases because of the lost energy in the lower frequencies.

A strap option bypasses the filter when the dial tone is either not present or its amplitude is less than 0 dB relative to the lower amplitude DTMF tone. Strap (out) bypasses and strap (in) inserts the filter.

The filter is an active circuit using two operational amplifiers, resistors, and capacitors.

# CIRCUIT DESCRIPTION

---

## High Frequency Reject Filter

This filter is a simple RC low pass filter that rolls off 6 dB per octave at approximately 7 kHz. This filter reduces excessive noise above 28 kHz that could interfere with the 56 kHz internal sampling frequency of the DTMF receiver IC .

---

## DTMF Receiver and Output Buffers

The DTMF receiver is a monolithic CMOS integrated circuit that combines precision active filters and analog circuits with the control logic for decoding DTMF tones.

Upon input of a valid tone pair, the receiver verifies that the tones are present for a minimum detection time (no greater than 40 ms). The receiver then puts out the corresponding code on the data outputs (D1, D2, D4, and D8) and pulls the DV output high which indicates valid data.

The DV remains high until a valid pause in the input occurs (no greater than 40 ms). When DV goes high, a timer circuit puts a 40 ms positive pulse on the strobe output (pin 38).

The strobe output buffers through FET source followers. The DV also drives a buffer that operates a front panel LED for visual decoder monitoring. The data output buffers through FET source followers to the output pins.

The DTMF receiver can be optioned for fourth-column disable (1633 Hz). Strap 12 to disable, and strap 16 to enable. A ground at the disable input (pin 19) inhibits decoder operation.

---

## Auxiliary Output and Latch Circuit

The DTMF tones "\*" and "#" or "A" and "C" decode separately from the data outputs for auxiliary functions.

The selected tone pairs route through FET source followers. When the selected code appears at the data outputs and DV (strobe) goes high, the selected outputs become true (ground). The outputs can be latched or remain true as long as DV remains high. Clear latches with an external clear (ground) or an opposite selected tone pair.

The FET source follower inputs can drive relay coils up to -56 VDC at 200 mA.

---

## Power-Up Clear

Pin 39 provides a power-up clear output. This output switches to ground for one second when you apply power to the module. This output clears associated subassemblies or 440 CMS modules.

---

## Ringling Generator Control Circuit

This circuit enables the ringling generator when a phone rings in a 440 CMS.

CONTINUED . . .

# CIRCUIT DESCRIPTION

The circuit consists of:

- ◆ A latch
- ◆ A 90-second timer
- ◆ An open collector output transistor

A ground at pin 14 or 16 from the station selector subassembly sets the latch. The latch output at  $\overline{Q}$  turns on the output transistor which provides a ground at pin 13. The ground enables the ringing generator. The latch resets when the phone answers, either from:

- ◆ An internal connection to the decoder's on-hook off-hook logic.
- ◆ An external ground at pin 15.

Pin 15 wires to the 44022 Subscriber Line Interface Module M lead output in single-station packages only.

Use the 90 second timer to sustain ringing for group call and all-call circuits. A ground at pin 22 or 24 from the group call or all-call circuit starts the timer. The timer holds the output transistor on for 90 seconds or until you reset the timer.

---

## Internal Voltage Regulator

The internal voltage regulator regulates battery voltage from -21 to -56 VDC to internal levels of -21 and -10 VDC. These two voltages apply to an on-board connector that powers the 49018 or 49028 Station Selector.

The regulator consists of simple series pass transistors with zener voltage regulation.

# APPLICATION INFORMATION

The primary application of the 44020 DTMF Decoder Module is with the 440 Communication Management System. The 440 CMS, Decoder Module, associated subassemblies and 440 CMS modules provide a station-calling facility.

Fig. 2 shows a typical 440 CMS single-station package. Associated modules include:

- ◆ The 44022 Subscriber Line Interface Module
- ◆ The 48020 Ringing Generator

Subassemblies shown are:

- ◆ The 49018 Station Selector Subassembly
- ◆ The 49020 Tone Supply

You can use the Decoder Module in multi-station packages as described in the Dantel 440 Communication Management System documentation. The Decoder Module drives multiple address modules or other devices up to its 200 mA current capacity.

You can also use the Decoder Module with no subassemblies when you require a BDC output from decoded dialing tones.



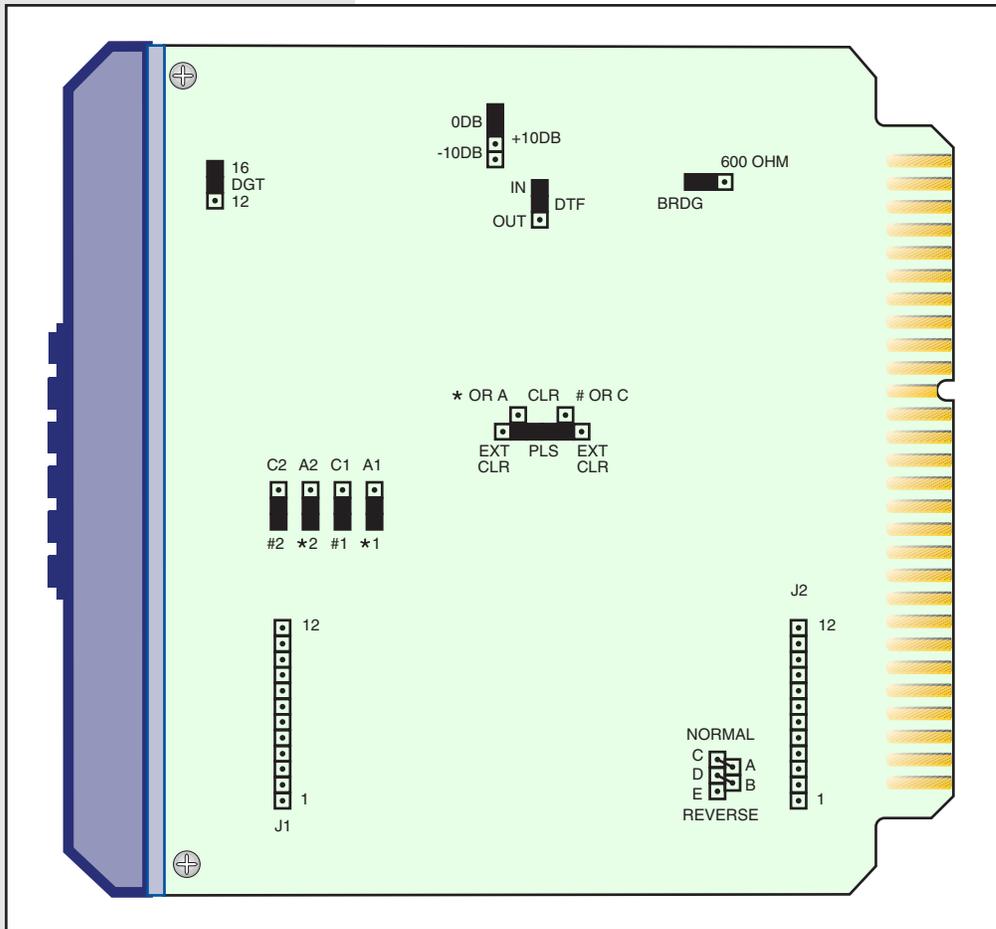
# INSTALLATION

Installation consists of setting the straps, wiring the connector, mounting the module in the shelf and checking out the module.

## 1. Install the proper strap options.

Refer to Fig. 3 and Table A.

**FIG. 3 - 44020 DTMF DECODER STRAP OPTION LOCATIONS**



**NOTE:** The straps depicted in Fig. 2 are examples only. Strap each module per usage desired. Refer to Table A.

# INSTALLATION

## STRAP OPTIONS

### Input Termination

Strappable for bridging or 600-ohm termination.

### Input Level

Three ranges of input level can be used:

- ◆ High levels of -10 dBm to +10 dBm
- ◆ Medium levels of -20 dBm to 0 dBm
- ◆ Low levels of -30 dBm to -10 dBm

No other level control is provided

### Dial Tone Filter

Strapped in when used in systems with CCITT standard tone (350 Hz and 440 Hz). Strap out when dial tone is not used.

### Fourth Column Tones

Strap for 16-digit dialing if fourth column tones are used in the system. Strap for 12-digit dialing otherwise.

### Auxiliary Outputs

Two auxiliary outputs are provided for various control applications. They are used for privacy functions in the 440 system. The outputs can be strapped to be activated by the "\*" and "#" tones or by the "A" and "C" tones.

### Latching Mode

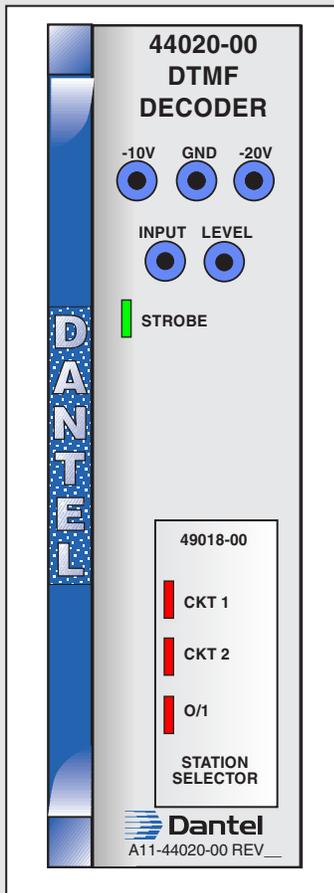
The auxiliary outputs can be strapped for three modes of latching:

- ◆ Non-latching.
- ◆ Latching that is cleared by a contact to ground.
- ◆ Latching that is cleared upon receipt of the opposite tone ("\*" clears "#" and "#" clears "\*" or "A" clears "C" and "C" clears "A").

# INSTALLATION

TABLE A - 44020 DTMF DECODER STRAP OPTIONS

OPTION	INSTALL JUMPER
<b>INPUT</b>	
600 Ohms Bridging	600 ohms BRDG
<b>INPUT LEVEL</b>	
+10 to -10 dBm	-10
0 to -20 dBm	0
-10 to -30 dBm	+10
<b>DIAL TONE FILTER</b>	
In	DTF IN
Out	DTF OUT
<b>DIALING</b>	
12-Digit	12 DGT
16-Digit	16 DGT
<b>AUXILIARY OUTPUTS</b>	
* and # A and C	*1, *2, #1, #2 A1, C1, A2, C2
<b>* AND A LATCHING</b>	
* or A Nonlatching * or A externally cleared * or A cleared by # or C	PLS EXT CLR # or C CLR
<b># AND C LATCHING</b>	
# or C Nonlatching # or C externally cleared # or C cleared by * or A	PLS EXT CLR * or A CLR



## 2. Wire the connector.

If you wire the connector, refer to Fig. 4 for the module connector pin wiring assignments. Normally the shelf slot is prewired.

## 3. Mount the module in the equipment shelf.

Slide the module along the guide slots then firmly seat the edge connector in its receptacle.

## 4. Check out the module.

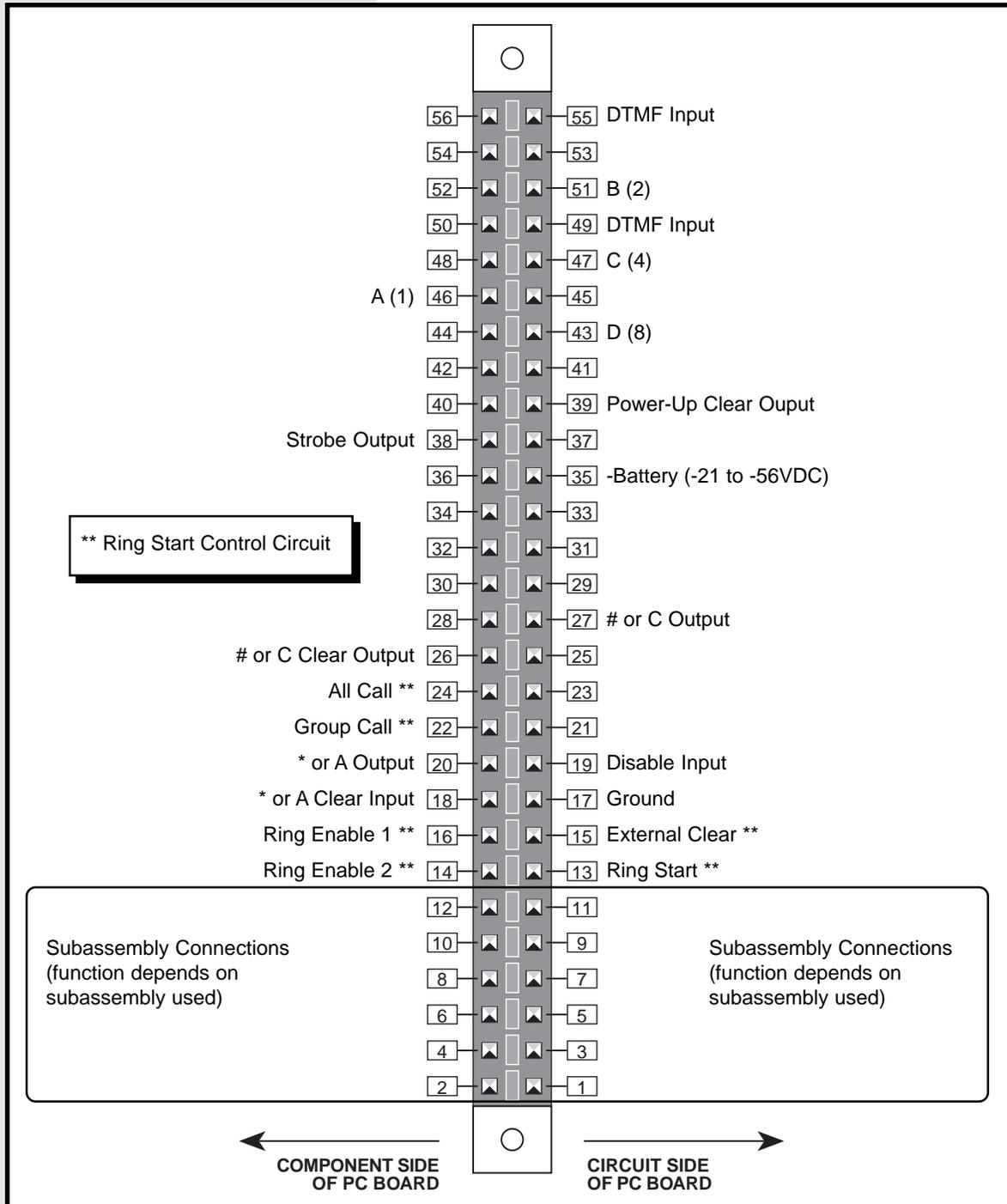
Refer to Table B for checkout procedures. Refer to Table C for decoder output logic.

Use the following test equipment for module checkout:

- ◆ AC/DC Multimeter (Weston Model 666 or similar equipment)
- ◆ DTMF Pad, which can be located anywhere in the communications system if it can transmit a signal
- ◆ Extender Card, 400 type with 56-pin edge connector (Dantel Part Number A15-00440-00)

# INSTALLATION

FIG. 4 - 44020 DTMF DECODER MODULE PIN DESIGNATIONS



# INSTALLATION

TABLE B - 44020 DTMF DECODER CHECKOUT PROCEDURE

STEP	ACTION	RESULTS
1	Plug in module and apply power.	No visible indication.
2	Set a multimeter on DC and connect leads to front panel GND and -20 V test points.	Read $-20 \pm 3$ VDC
3	Move multimeter leads to front panel GND and -10 V test points.	Read $-10 \pm 1.5$ VDC
4	Set multimeter on AC and connect to front panel INPUT LEVEL test points.	
5	Apply a DTMF tone to the input by operating a touch pad somewhere in the system. The touch pad can be connected at the front panel INPUT LEVEL test points, but the decoder does not provide talk battery at these points.	Read a level between -30 dBm and +10 dBm. Verify the proper input level range strapping per Table A.
6	Repeatedly apply DTMF tones.	Verify operation of STROBE LED.
7	<p>Make the following check if the decoder output is connected to a following BCD input device, such as a 49018 Station Selector Subassembly or a 44021 Address Decoder:</p> <ul style="list-style-type: none"> <li>• Clear the decoder by applicable means. (This depends on the system strapping requirements.)</li> <li>• Dial an address code that is valid for the BCD input device.</li> <li>• Clear the decoder</li> </ul>	<p>BCD input device gives valid code response.</p> <p>BCD input device returns to normal.</p>
8	<p>Make the following check if the decoder output is <b>not</b> connected to a following BCD input device, or if the following device is not functional:</p> <ul style="list-style-type: none"> <li>• Install the module in an extender card.</li> <li>• Set the multimeter on DC and connect the ground (+) lead to the front panel GND test point. Connect a 100Kohm resistor from the front panel -10V test point to the negative probe.</li> <li>• Connect the negative probe of the meter to pin 46, of the edge connector.</li> <li>• Dial digit 1, 3 or any digit that produces a "1" at the A output. (Refer to Table C.)</li> <li>• Move the negative probe to pin 51.</li> <li>• Dial digit 2, 3, etc. to check the B output.</li> <li>• Move the negative probe to pin 47.</li> <li>• Dial digit 4, 5, etc. to check the C output.</li> <li>• Move the negative probe to pin 43.</li> <li>• Dial digit 8, 9, etc. to check the D output.</li> </ul>	<p>Read -10VDC</p> <p>Read -10 VDC</p> <p>Read 0 VDC</p>

CONTINUED . . .

# INSTALLATION

**TABLE B (CONTINUED) - 44020 DTMF DECODER CHECKOUT PROCEDURE**

STEP	ACTION	RESULTS
9	<p>Make the following check if it is desired to confirm the operation of the auxiliary outputs:</p> <ul style="list-style-type: none"> <li>• Leave the module in the extender card and the positive lead of the meter in the GND test point. Leave the resistor connected between the -10V test point and the negative probe.</li> <li>• Clear the decoder (if strapped for latching).</li> <li>• Connect the negative probe to pin 20.</li> <li>• Dial "*" digit (or "A", if so strapped).</li> <li>• Clear the decoder (if strapped for latching).</li> <li>• Move negative probe to pin 27.</li> <li>• Dial "#" digit (or "C", if so strapped).</li> <li>• Clear the decoder (if strapped for latching).</li> </ul>	<p>Read -10 VDC</p> <p>Read -10 VDC</p> <p>Read 0 VDC (remains, if strapped for latching)</p> <p>Read -10 VDC</p> <p>Read 0 VDC (remains, if strapped for latching)</p>
10	<p>Make the following check if it is desired to confirm the operation of the power-up clear output:</p> <ul style="list-style-type: none"> <li>• Leave the module in the extender card and the positive lead of the meter in the GND test point.</li> <li>• Connect the negative probe to pin 39.</li> <li>• Remove power from the module and reapply.</li> </ul>	<p>Read -10 VDC</p> <p>Read 0 VDC for approximately one second after power is applied.</p>
11	End of test. Remove meter and extender card.	

**TABLE C - DTMF FREQUENCIES AND BCD OUTPUT CODES**

INPUT DTMF CODE	FREQUENCIES (HZ)		OUPUTS			
	LOWER	UPPER	D	C	B	A
1	697	1209	0	0	0	1
2	697	1336	0	0	1	0
3	697	1477	0	0	1	1
4	770	1209	0	1	0	0
5	770	1336	0	1	0	1
6	770	1477	0	1	1	0
7	851	1209	0	1	1	1
8	851	1336	1	0	0	0
9	851	1477	1	0	0	1
0	941	1336	1	0	1	0
*	941	1209	1	0	1	1
#	941	1477	1	1	0	0
A (4th column)	697	1633	1	1	0	1
B (4th column)	770	1633	1	1	1	0
C (4th column)	851	1633	1	1	1	1
D (4th column)	941	1633	0	0	0	0

# OPERATION

The 44020 DTMF Decoder Module operates when you apply power. Operation of the Decoder Module consists of observing the STROBE LED on the front panel which flashes when the Decoder Module decodes a digit.



# TECHNICAL SPECIFICATIONS

DESCRIPTION	VALUE
Input Impedance	600 ohms or Bridging (>10K ohms)
Input Type	Transformer Coupled, DC Blocked
Input Level Range	-30 dBm to +10 dBm
Maximum Input Voltage	130 VAC
Input Filter	Dial Tone Reject (strap option)
DTMF Receiver Characteristics	Minimum                      Typical                      Maximum
Frequency Detect Bandwidth	±(1.5%+2Hz)                      ±2%                      ±3%
Minimum Acceptable Twist	-8 dB                      ---                      +4 dB
Detection Time	20ms                      25ms                      40ms
Pause Time	25ms                      32ms                      40ms
60 Hz Tolerance w/ Filter	---                      ---                      +20 dB
60 Hz Tolerance w/o Filter (referenced to lower level tone)	---                      ---                      0 dB
Noise Tolerance (Mitel Tape CM7290) (referenced to lower level tone)	---                      ---                      -12 dB
BCD Outputs	A, B, C, D plus Strobe
Logic	Modified Hexadecimal 12- or 16-digit BCD (Compatible w/ 44021 & 49018 Station Selectors)
BCD Duration	As long as key is pressed
Strobe Pulse Duration	40ms Nominal
BCD Terminals	Buffered w/ open emitter driver, switched to GND
Maximum Output Current	200 mA
Maximum External Source Voltage on Output	-56 VDC
Auxiliary Outputs	"*" and "#" or "A" and "C"
Auxiliary Terminals	Buffered w/ open emitter driver, switched to GND
Maximum Output Current	200ms
Maximum External Source Voltage on Output	-56 VDC
Nonlatching	Strappable. Outputs operated for duration of tone
Latching	Strappable. Outputs operated until cleared
Clear	Strappable to clear by external contact or on receiving opposite auxiliary tone. ("*" clears "#", "#" clears "*" or "A" clears "C", "C" clears "A")
External Clear Input	Ground to clear, open normal
Power-up Clear Output	Buffered with open emitter driver, switching to ground for 1 second on power-up
Maximum Output Current	200 mA
Maximum External Source Voltage on Output	-56 VDC
Power Output to Piggy-back Subassembly	-10 VDC @ 100 mA -20 VDC @ 30 mA
Input Voltage Range	-21 VDC to -56 VDC
Input Power Requirements	
Idle	34 mA @ -21 to -56 VDC
Full Load	38 mA @ -21 to -56 VDC
Heat Dissipation	
Idle	2.4 to 6.5 BTU/Hr @ -21 to -56 VDC
Full Load	2.7 to 7.3 BTU/Hr @ -21 to -56 VDC
Physical Dimensions	1.4" x 6.0" x 5.6"
Weight	6 oz.
Operating Temperature Range	0° C. to 60° C.

# WARRANTY

## LIMITED WARRANTY

The Seller warrants that the standard hardware products sold will be free from defects in material and workmanship and perform to the Seller's applicable published specifications for a period of 18 months for hardware, and 3 months for software, from the date of the original invoice. The liability of the Seller hereunder shall be limited to replacing or repairing, at its option, any defective products which are returned F.O.B. to the Seller's plant, (or, at the Seller's option, refunding the purchase price of such products). In no case are products to be returned without first obtaining permission and a customer return authorization number from the Seller. In no event shall the Seller be liable for any consequential or incidental damages.

Equipment or parts which have been subject to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation are not covered by warranty. The Seller shall make the final determination as to the existence and cause of any alleged defect. No warranty is made with respect to custom equipment or products produced to the Buyer's specifications except as specifically stated in writing by the Seller in the contract for such custom equipment.

This warranty is the only warranty made by the Seller with respect to the goods delivered hereunder, and may be modified or amended only by a written instrument signed by a duly authorized officer of the Seller and accepted by the Buyer.

Warranty and remedies on products not manufactured by the Seller are in accordance with warranty of the respective manufacturer. **THE SELLER MAKES NO OTHER WARRANTY OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED; AND ALL IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEEDS THE AFORESAID OBLIGATIONS IS HEREBY DISCLAIMED BY THE SELLER.**

## IN CASE OF DIFFICULTY

If you experience difficulty with this equipment, check the following, as appropriate:

- 1. Switch settings**
- 2. Signal levels**
- 3. Software configuration**
- 4. Connections between Dantel's equipment and your equipment.**

If there is still a problem, substitute equipment that is known to be good. For additional assistance, call Dantel's Technical Field Service Department weekdays, 6 A.M. to 5 P.M. pacific time:

**1-800-4DANTEL (1-800-432-6835).**

If a thorough checkout shows a piece of equipment has malfunctioned, you may return it to the factory. For repairs and emergency replacements, obtain a Return Material Authorization (RMA) number from the Customer Service Representative at **1-800-4DANTEL (1-800-432-6835)**.

To ensure expedient processing of your order, provide a purchase order number and shipping and billing information when requesting an RMA number. Also, when the units are returned to Dantel, include a description of the failure symptoms for each unit returned. Send defective equipment to:

**Dantel, Inc. • 2991 North Argyle Avenue • Fresno, California 93727-1388**

