

GENr8

DTMF Tone Generator

by

CircuitWerkes



Technical Manual

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Software version 1.3.5

Firmware version 4.0

Revised 01/06/10

INTRODUCTION

The CircuitWerkes GENr8 is microprocessor controlled DTMF encoder and high performance audio amplifier in one package. The GENr8 can generate all of the standard 16 DTMF tones or any one of 8 user programmable sequences of tones. Microprocessor control offers the flexibility of multiple operating modes, from simple switch inputs, a computer terminal program, or the included CircuitWerkes Graphical User Interface (GUI). The device can accept an audio stream from any balanced or unbalanced audio source, combine the DTMF tones or sequences with the audio, and then output the mixed audio to any balanced or unbalanced device. In addition to its audio capabilities, the GENr8 provides a set of relay contacts that are active whenever a tone is being generated for use in remote signaling and control applications.

CONNECTORS, JUMPERS AND CONTROLS

The following is a list of the different connectors, controls, jumpers and indicators on the GENr8 and a brief description of each.

* refer to page 12 for connector, jumper, control, and indicator locations.

J4 – Power: This is the external power connection for the device. The power requirements are 14VDC at 200mA or 12VAC at 200mA. The power jack is not polarity sensitive.

J1- I/O connector: This DB25F connector is used for connecting external switches and/or an RS232 connection to an external computer. It also provides connections to the normally open relay contacts. * Refer to **J1** pin out diagram on page 12 for details.

J10 – Audio In: This is a 1/4" TRS connector for incoming a line level audio stream. It accepts either one balanced input or two ground referenced inputs. Specifications for the input are as follows; TIP = (+) input, RING = (-) input, SLEEVE = audio ground; input impedance is 10,000 ohms minimum.

J5 – Audio Out: This is a 1/4" TRS connector which provides a mixed Audio In and DTMF output signal. The output will drive a minimum of one balanced 600ohm load or two unbalanced 600 ohm loads. The TIP = (-) output, RING = (+) output, SLEEVE = audio ground.

VR1 – Audio Volume: This is a single turn potentiometer used for adjusting the volume of the incoming audio independently of the DTMF volume setting.

VR2 – Tone Volume: This is a single turn potentiometer used to adjust the DTMF output level independently of the Audio In level setting.

JP1 and JP2 – Input enable: These jumpers independently enable or disable any of the individual switch inputs. To disable a tone simply open the jumper corresponding to that tone. The tone will still be available via the GUI or terminal interfaces. Default = All enabled (see "Installation" on pg 4 for specific details).

JP3 and JP4 – RS232 config: These jumpers configure the RS232 interface for operation with either a null modem cable or a standard serial cable. Default = NULL MODEM Cable.

CONNECTORS, JUMPERS AND CONTROLS CONTINUED:

J2 – Shift Enable: When the shift input is pulled low, activation of tone inputs, 0 through 7, instruct the GENr8 to play the string stored in any one of 8 memory locations. These strings are user programmable through a terminal program or the supplied software.

J3 – Reset: This jumper is used to erase all user information and restore factory default settings.
Reset Procedure:

- 1) Disconnect the power from J4.
- 2) Close jumper J3.
- 3) Re-apply power to J4 for at least 30 seconds.
- 4) **Disconnect the power.**
- 5) Open jumper J3.

6) Wait at least 5 seconds then re-connect the power

Default setting = disabled

***Jumper J3 MUST BE OPEN for proper operation of the GENr8.**

Red Power LED: This LED is on whenever power is applied to the device.

Yellow Busy LED: This LED is on whenever a tone is being generated by the device.

Relay K1: This is a relay that is activated whenever a tone is being generated. It provides a single set of normally open contacts capable of handling up to 20 VDC at 500 mA maximum.

Factory default jumper settings:

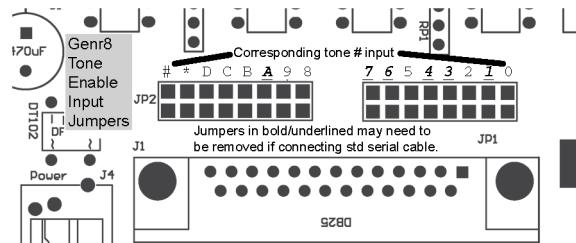
<i>J3 – Reset</i>	<i>Open</i>
<i>J2 – Shift Enable</i>	<i>Closed</i>
<i>JP3,JP4 - RS232 configure</i>	<i>Pins 1 – 2 (null modem)</i> <small>* Pins located furthest from J1</small>
<i>JP1,JP2 – Input Enable</i>	<i>All closed (see Installation, pg-4)</i>

INSTALLATION AND OPERATION

The GENr8 has three primary methods of operation, contact closures or switches, terminal program, and graphical interface software which is supplied with the unit. The last two methods of operation utilize the GENr8's on-board serial port and will be referred to as 'Serial Modes' of operation. First general installation procedures will be covered then operation by each of the above methods will be described.

Installation

- Set jumpers JP1-1 through JP1-8 and JP2-1 through JP2-8 to the appropriate settings. These jumpers enable the switch inputs for each of the 16 tones. Since the GENr8 shares the DB25F connector, J1, with the serial port, switch inputs, and the relay output, incompatibilities with various cables may occur. In most cases, commercially made modem cables will not work without jumper changes to the GENr8. These jumpers allow individual switch inputs to be enabled or disabled thus helping to prevent possible conflicts with various interface cables. Typically, a commercially made serial cable will require jumpers for tones 1,3,4,6,7 & A to be removed. A quick method of checking cable compatibility is to connect the cable in question to the GENr8 and the RS232 port of a computer. Then power up the GENr8. If a tone is generated at this point the yellow busy LED will light. This indicates the interface cable is grounding one of the switch inputs. The problem may be eliminated by disabling the offending input or changing cables. Disabling a jumper input does not disable tone generation via software.



Set jumper J2, ***shift enable***, to the desired position. This jumper is factory set to allow DTMF sequences when inputs 0 through 7 are activated in conjunction with the shift input trigger. When activated, the GENr8 will send out a preprogrammed string of characters stored in one of seven memory locations. Memory location playback is available through serial operation even when J2 is disabled.

- Set jumper J3, reset jumper, to the open position. This jumper is only used for restoration of factory default settings and must remain open for proper operation of the GENr8.
- J1 cable connection:** Unless serial only operation is intended it will likely be necessary to construct a custom cable on-site for a given application.
 - Switch Operation:** A cable designed for connecting the GENr8 tone inputs to the GENr8 ground through contact closures (switches, relays, etc.) should be connected to J1. This is a custom cable that will be specific to an individual application and will typically be constructed by the end user.
 - Serial Operation:** A standard RS232 cable may be connected to J1 for operation with the supplied GUI or any terminal program. Jumpers JP3 and JP4 configure the GENr8 to use either a null modem cable or a standard modem cable. Typically, the factory default settings for these jumpers are satisfactory, however, if your PC is unable to communicate at all with the GENr8, you may have to change both jumpers from pins 1 and 2 to pins 2 and 3. Both jumpers must be changed simultaneously.
 - Mixed operation:** Both serial and switch operation may be utilized simultaneously with the appropriate cable. This cable will have to be custom made.
- J5 is the audio output port. It is capable of driving a 600 Ohm load to better than +15dBm. The jack is a 1/4" TRS type with tip being Plus (+) and ring being Minus (-). The sleeve is grounded. This output can be connected to either a balanced or unbalanced load. For connection to an unbalanced load, connect either the plus (+) output or the minus (-) output and ground of the Genr8 to the load. Leave the unused output line disconnected. Do not connect the unused output to ground or overheating may result. For operation with a balanced load, the GENr8 plus (+) & minus(-) outputs should be utilized. These are the 1/4" jack tip and ring connections respectively.

6. Connect an optional audio input to J10. This input can be connected to either a balanced or unbalanced audio source. For operation with an unbalanced source it is recommended that the Plus (+) input and audio ground be used. These correspond to the tip & sleeve connections on the 1/4" jack. To prevent stray noise pickup, ground the unused input to the sleeve. For operation with a balanced audio input, connections should be made between the plus(+) and minus(-) inputs of the GENr8. These are the tip & ring connections on the 1/4" jack respectively.
7. Connect an AC adapter to the power jack J4. The GENr8 requires from 12V to 15Vac or 14V to 18Vdc at 200mA. Polarity for DC supplies is not important.
8. Set VR1 (PGM Audio Gain) & VR2 (DTMF Output) to the desired volume levels.

Operation

Switch inputs:

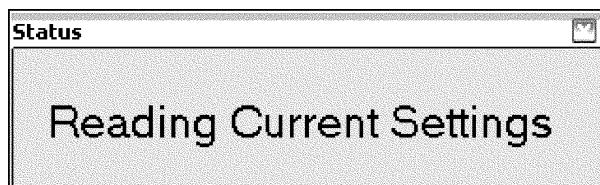
To generate any of the standard 16 DTMF tones, connect the appropriate tone trigger input to a GENr8 ground connection. This will cause the GENr8 to produce a tone as long as the connection is maintained. See the J1 pin out on page 12 for the location of the switch inputs.

GENr8r Software Operation:

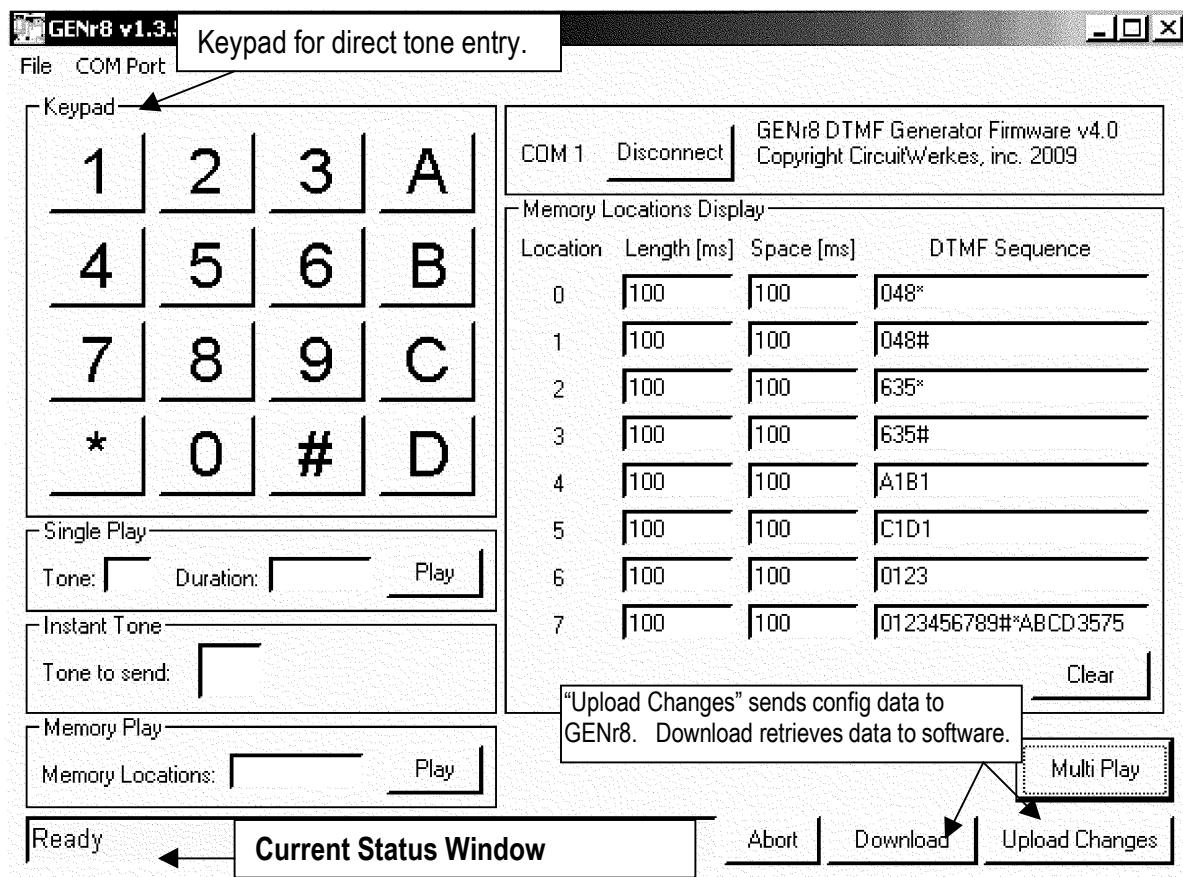
The GENr8r is a graphical interface for the GENr8. It provides access to all of the device functions and modes through an easy to use computer interface as well as additional functionality not available on the device itself. It also provides the ability to save and recall different device configurations using standard spreadsheet file format.

Startup:

- 1) Connect the GENr8 to an available serial port on the computer where the GENr8r software is installed.
- 2) Start the GENr8r software by double clicking the program icon and select the serial port where your GENr8 is attached. Then, press the connect button.
- 3) **When connecting the software to a GENr8, the software will automatically download all stored sequences in the GENr8's onboard memory locations. If you have made changes to sequences in preparation for uploading them, while disconnected from your GENr8, be sure to save the configuration file before connecting to the GENr8 or your changes will be lost.** If all com ports are busy, then another program may be using the com port or previously used the com port and not released it properly. You may need to either close the other program or reboot the PC. The GENr8r program will allow you to continue, even if there is no available com port however, you will not be able to communicate with your GENr8.



- 4) Once all of the settings have been read into memory the main program screen will be displayed. You are now ready to use your GENr8.



The following is a list of the main program areas and their function. **Your software may differ.**

Keypad: This key pad is used for immediate generation of tones. Selecting a key with the left mouse button will cause the GENr8 to send a 100 millisecond DTMF tone. Selecting a key using the right mouse button will cause the GENr8 to generate a tone as long as the button is held down. All tones generated by the on screen keypad can also be generated by the computer keyboard using the appropriate keys.

Status Display: This area displays status messages about the current operation(s).

Firmware Display: This displays the firmware revision of the currently connected GENr8.

Memory Display: This displays the contents of the strings stored in the GENr8's on board memory. The length and space correspond to the duration of each tone, in milliseconds, and the space between each tone, in milliseconds, whenever that string is selected for playback.

To modify the information stored in a particular memory location:

- 1) Select the value to be modified by clicking in its associated text box.
- 2) When all the values are changed select the "**Upload changes**" button. The software then compares the existing stored data to the current settings and uploads only the differences.

*More than one memory location can be changed at one time. To change additional memory locations simply make the appropriate changes and select the update box for each location. This way you only have to press the save button once.

- 3) The GENr8r software will save the information to on board memory and re-read the device settings. This provides confirmation of the saved information.

Import/Export file: The import and export buttons provide access to the file load and save functions.

To Import a configuration file:

- 1) Select the import function by pressing the 'Import' button..
 - 2) Locate the desired configuration file.
 - 3) Double click the desired filename.
- The GENr8r software does not automatically update a GENr8 connected to the computer. To update the on-board memory press the 'All On' button then 'Save to GENr8' button.

To Export a File:

- 1) Select the Export function by pressing the 'Export' Button.
 - 2) Type in a filename.* note: The GENr8r software automatically adds the correct file extension.
 - 3) Press the 'Ok' button to save the file.
- ☞ The GENr8r software automatically saves the file to the GENr8 program directory by default.

* Note: Spreadsheet files must be saved with a '.g8r.csv' file extension in order for the GENr8r software to recognize it.

Clear: This clears all of the information in the GENr8r memory and status window.

Update: This causes the GENr8r software to re-read the information stored on a GENr8.

Reset: This forces the GENr8 to restore all factory default settings. Use this with caution as it will permanently erase anything saved in the on board memory.

Abort: This causes the GENr8 to interrupt generation of long duration tones when in Timed or Multi modes. It will not stop the playback of the on-board memory when in Memory mode.

MultiPlay Mode: MultiPlay mode allows the GENr8 to send a string of up to 20 tones with individual duration and spacing for each tone. Pressing the Multi Play button will bring up the following screen.

	Tone	Duration	Space
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

MultiPlay sends up to 20 tones with individual length and duration.

Send Data
Close
Clear Form

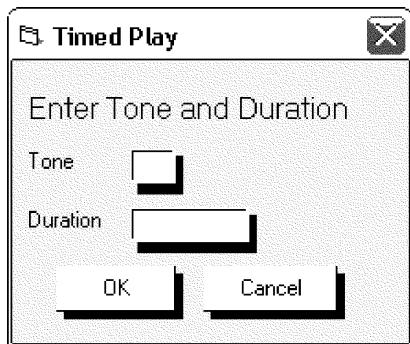
Select a data field box by clicking within the text box. Tone 1 is automatically selected by default. Enter the appropriate information for that field. Press return to move to the next field. The tone value can be any of the 16 valid DTMF tones 0-9, A-D or # and *. Duration and Space times are in milliseconds and can range from 20ms to 65534ms (about 65 1/2 seconds).

Once all data is entered, press the 'Send Data' button to transmit the information to the GENr8. If you are finished transmitting data press 'Close' to exit MultiPlay Mode.

The information contained in this form is retained even after the form is closed to allow re-sending the data at a later time if desired. To access the data at a later time simply press the 'MultiPlay' button to recall the form. To clear the form press the 'Clear Form' button.

The data in this form is saved and retrieved when a configuration file is exported or imported.

Timed Mode: Timed mode instructs the GENr8 to send out a single tone for a fixed amount of time. Pressing the 'Timed Play' button displays the following screen.



Enter a valid DTMF tone and duration. Duration times can range from 20 milliseconds to 65,535 milliseconds. Press 'Ok' to transmit the tone.

Memory Play: Memory Play mode instructs the GENr8 to send one or more of the strings stored in it's internal memory. Pressing the 'Memory Play' button displays the following screen.



To play a given memory location simply enter the number of the desired memory slot in the text box and press return or 'Ok'. To play multiple locations sequentially simply enter all of the desired locations in the text box without spaces and press 'Ok'. For example, entering '1' would tell the GENr8 to send the string contained in location in #1 while entering '013' would send the information contained in locations '0', '1' and '3' in sequential order.

Terminal Program Operation: Many of the GUI functions and all of the GENr8 on board functions can be accessed and controlled using a simple terminal program. The terminal program should be set to COM1, 9600 baud and 8N1 with a character spacing of no less than 30ms. **SEE ADDENDUM AT THE END OF THIS MANUAL FOR MORE INFORMATION REGARDING TERMINAL SETTINGS.** This will provide the proper timing needed to transmit information without conflict. It is recommended that the terminal program used be set to locally echo any typed characters to the screen in order to see all of the information sent to the GENr8. Table #2 provides a summary of the operation modes and commands.

Terminal Operation continued:

<i>Command Sequence</i>	<i>Operation Mode</i>
@F	MultiPlay Mode – Plays up to 20 tones with individual length and spacing.
@I	Timed Mode – Plays one tone for a fixed duration.
@M	Memory Play – Plays one of 8 on board memory locations.
@V	View Memory – Displays the contents of a memory location.
@S	Save Memory – Saves a string of up to 20 tones to one of 8 on board memory locations.
@R	Revision – Displays the current firmware revision of a GENr8.
\$<tone>	Plays <tone> for 100ms.
%<tone>%	Continuously sends <tone>. To end enter % without <tone>.
^r	Forces a reset to factory default values. Caution! This erases all internal memory.
K	Relay on delay (anti-chatter) timer Valid delay times are 0-65535ms

Table 2.

There are two main types of instructions the GENr8 accepts, Immediate mode and Command mode. Immediate mode instructions cause the Genr8 to act on the instruction instantly. These instructions consist of a command character plus a qualifier. Command mode instructions consist of an attention character, which places the GENr8 into command mode, the instruction itself and a parameter list that may consist of multiple characters. The command mode attention character for the GENr8 is the '@' symbol.

Command Mode Instruction Formats:

MultiPlay = @Ftone0,ontime,offtime <enter>
tone1,ontime,offtime<enter>...Tone19,ontime,offtime<enter>{ enter }

Tone	= Any of the 16 valid DTMF characters. Up to 20 total.
Ontime	= The time in milliseconds the GENr8 should send the tone.
OffTime	= Time in milliseconds between tones.

To terminate data entry and instruct the GENr8 to play the data input, simply enter a blank line by pressing 'Enter' after the last entered offtime. You must specify ontine & offtime for each tone to be played. Note that DTMF decoders typically require 50ms minimum spacing.

Timed Mode = @itone,time<enter>

Tone	= Any of the 16 valid DTMF characters.
time	= The time in milliseconds. Valid times are 20 to 65534. Duration < 20 means continuous play. Press ESC to abort continuous play.

Command Mode Instruction Formats continued:

Memory Mode = @Mlocation

Location = Memory location for the GENr8 to send.

View Mode = @Vlocation

Location = Memory location for the GENr8 to display. This displays the recorded tone sequence stored in the specified memory location.

Save String = @Slocation<enter>ontime,offtime<enter>tone0.....tone19{.}

Location = Memory location to save data to (0 to 7).

ontime = Time in milliseconds the GENr8 will use to play tones stored in this memory location. Do not hit enter and go to “offtime”.

offtime= Time in milliseconds the GENr8 will use to space tones.

tone = Tones to store in the given memory location. Up to 20 maximum.

To terminate data entry with less than 20 tones enter a period,'.', after the last desired tone.

Location = Memory location for the GENr8 to send.

Firmware Revision = @R

Immediate Mode Instructions:

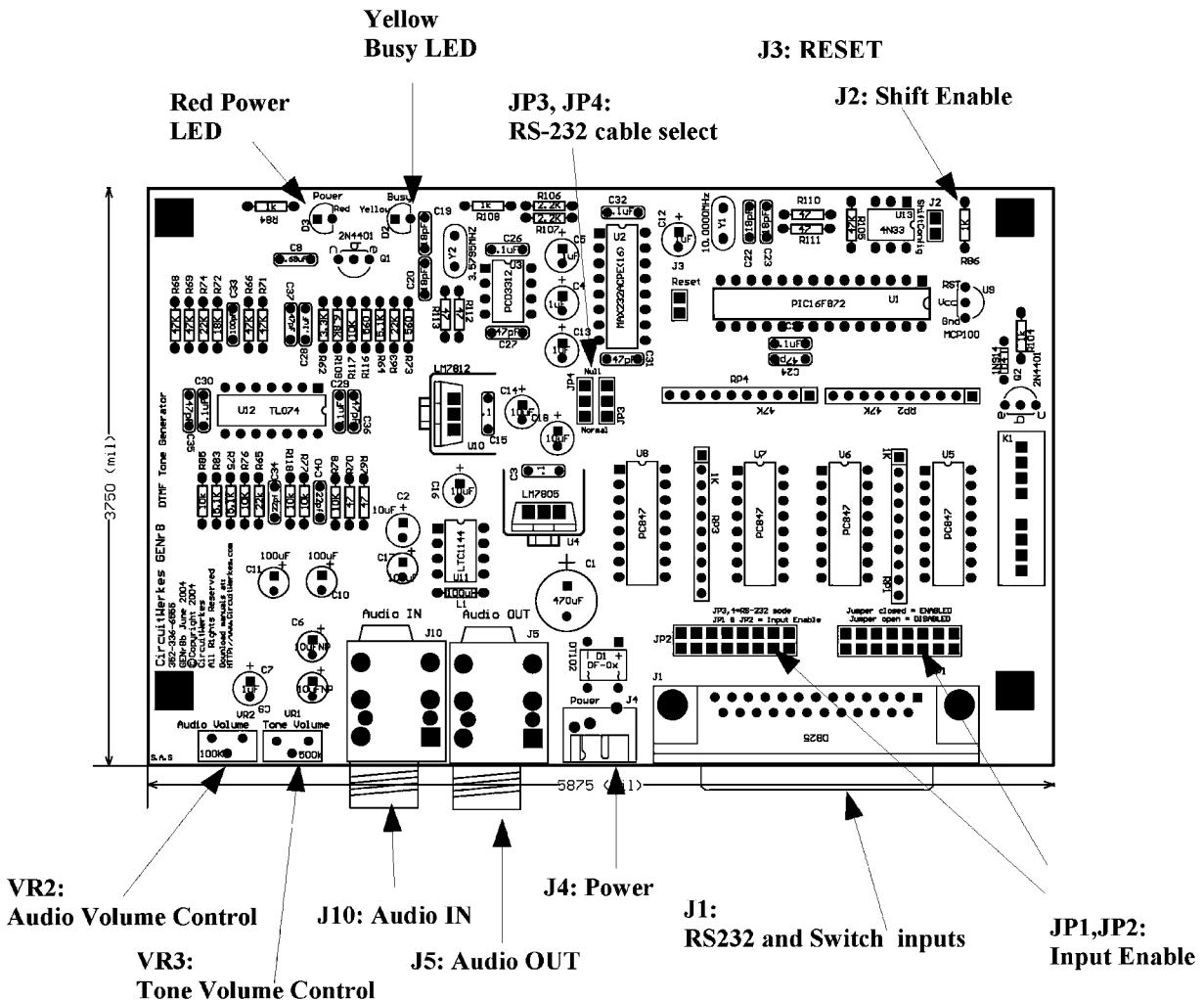
\$tone = The dollar (\$) symbol followed by a valid tone tells the GENr8 to send a 100ms pulse of the selected tone.

%tone% = The percent, (%), symbol followed by a tone instructs the GENr8 to send a continuous tone. A second percent, (%) symbol, or the escape key, terminates continuous mode.

K followed by a numeric time value to set the slave relay recovery delay in milliseconds. This is how long the slave relay remains closed after sending a tone & can be used to avoid relay chatter between tones or sequences. Time must be between 0 and 65535. 0 is default.

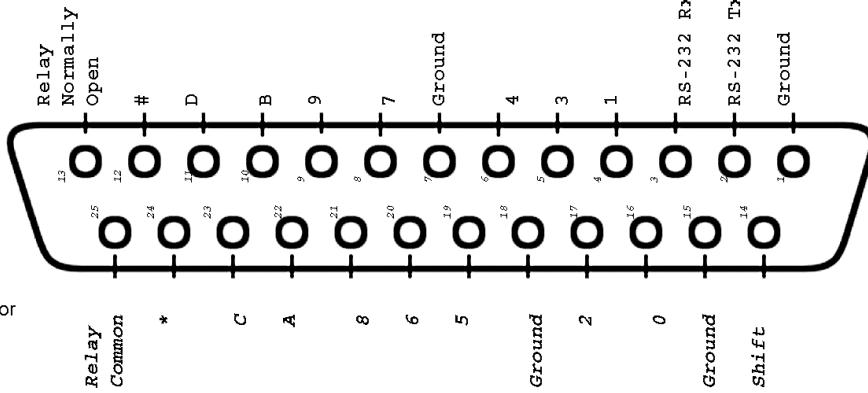
^r = Causes the GENr8 to erase all memory and restore factory defaults.

Jumper / Connector location diagram

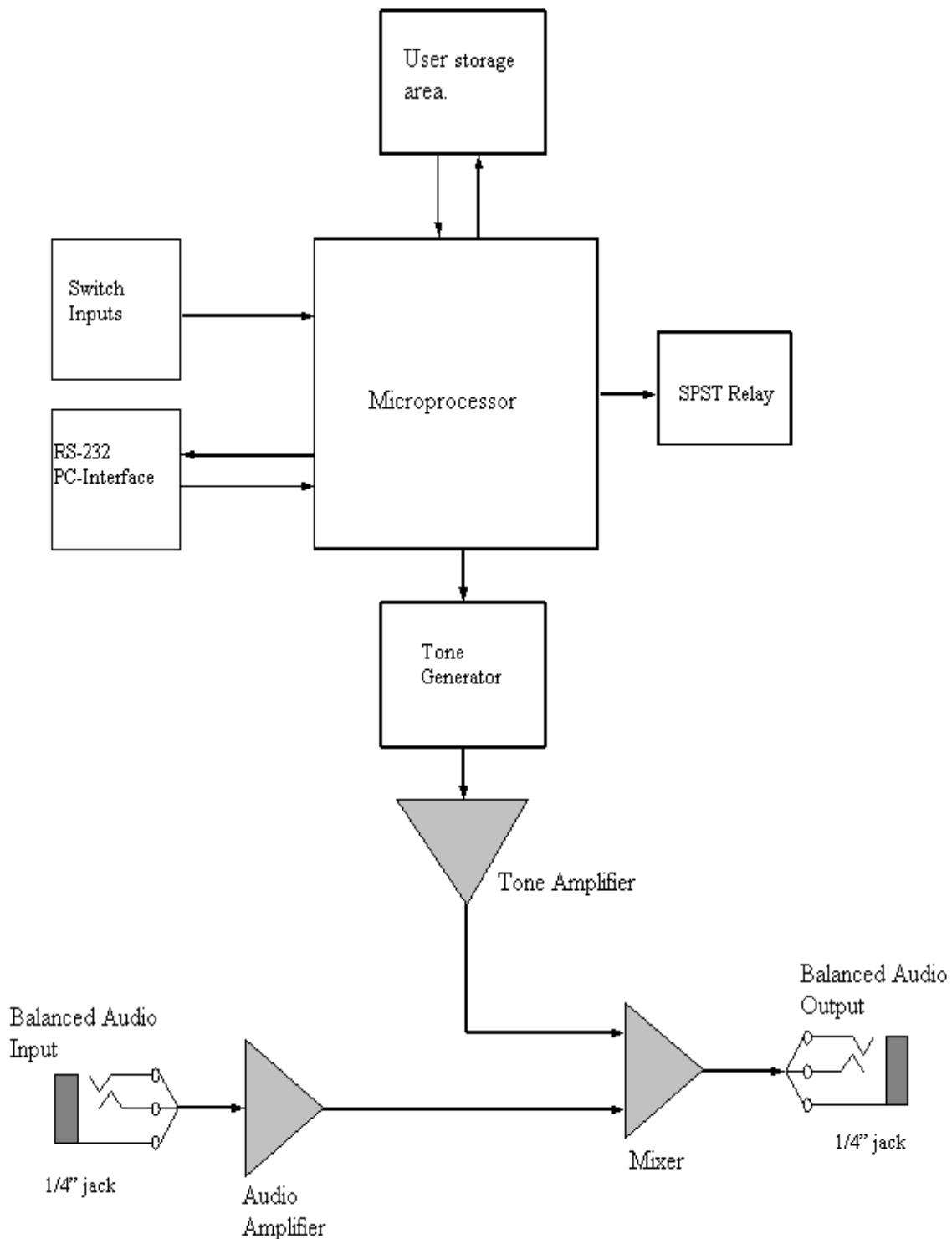


**DB-25F
I/O Port
(front view)**

Be sure
to use
correct pin
numbers on
mating connector



GENr8 Block Diagram:



6) Specifications:

- ☞ Power Supply Requirements:
 - ☞ 14 Vdc @ 200mA minimum. Polarity insensitive
 - ☞ 12 Vac @ 200 minimum
 - ☞ Red LED power on indicator.
- ☞ Audio Amplifier:
 - ☞ Input Impedance = 10,000 Ohms minimum
 - ☞ Balanced Output Impedance: less than 200 Ohms
 - ☞ Balanced Output:
 - ☞ +17dBm into 600 Ohms maximum
 - ☞ Ground Referenced Output:
 - ☞ +15dBm into 600 Ohms maximum
- ☞ DTMF Generator :
 - ☞ 16 Active Low Inputs
 - ☞ Tones 0 through 9, #,*A,B,C,D
 - ☞ Balanced Output: + 15 dBm into 600 Ohms
 - ☞ Ground Referenced Output: +7.5 dBm into 600 Ohms maximum.
 - ☞ Yellow Output Active LED
 - ☞ Duration times from 20 milliseconds to 65,534 milliseconds (65 ½ seconds)
- ☞ Relay Output.
 - ☞ One (1) normally open set of relay contacts
 - ☞ Energized whenever a tone output is present.
 - ☞ Maximum 0.5A @ 20 VDC
- ☞ RS-232 Communications Port.
 - ☞ One (1) bi-directional RS-232 port for programming and control.
 - ☞ 9600 baud 8,N,1
- ☞ Connectors:
 - ☞ Two 1/4" phone jacks for Audio In and Mixed Audio/Tone out
 - ☞ Balanced or unbalanced
 - ☞ One DB-25 female for contact closure inputs and RS-232 communications.
 - ☞ One standard 5.5mm barrel with 2.1mm id power jack
- ☞ Physical Dimensions:
 - ☞ 7.0”W x 4.25” H x 1.5”D
 - ☞ Weight: 0.70lbs (317.5 gm)

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. Be sure to include your contact information (address - not PO Box - telephone numbers) and best time to call.

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Addendum:

Terminal programs used, such as **Hyperterminal**, must have the ability to set both character spacing delay and line delay if text scripts are to be used. To set the character and spacing delay in Hyperterminal :

- 1) Create a terminal session through the appropriate COM port.
- 2) Select the File- > Properties submenu
- 3) Select the Settings tab in the properties window that opens.
- 4) Then select the ASCII setup button. This opens the ASCII setup window.
- 5) Then set the Line Delay and Character delay values to at least 30 milliseconds each.
- 6) Accept the values by selecting 'OK'.

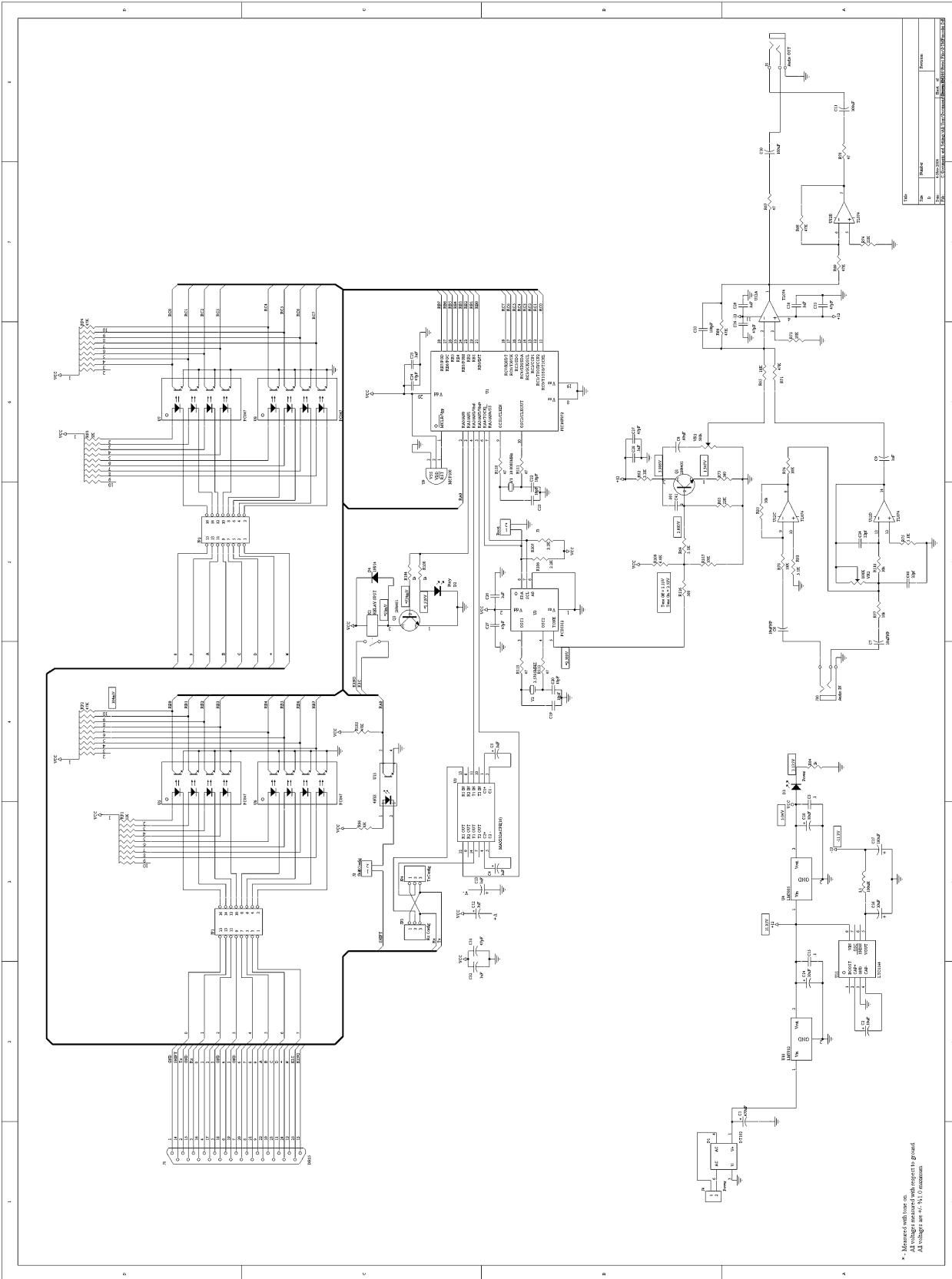
Firmware Upgrades:

Starting with version 4.0, the GENr8 firmware can be upgraded in the field whenever new features are added or other changes are made. Starting with version 1.3.5, the GENr8 software includes a firmware upgrade utility that is used to "flash" the upgrades to your GENr8. Firmware upgrades will be posted in the support area of the CircuitWerkes web site whenever they are released. It is not possible to use the flash upgrade utility on GENr8 firmware prior to v4.0. Note that the flash upgrade process resets all programming to factory defaults, so be sure to save your current configuration data before upgrading, if you want to re-use your previous setup.

Software compatibility and upgrades:

The software and firmware version must be compatible to work properly together. **ALWAYS** upgrade both at the same time.

Software v1.3.5, or newer, should not be used with older GENr8 firmware due to possible incompatibility issues. Uploading configuration data from this software version to older firmware should never be attempted because doing so will very likely corrupt your device & require a reset to factory defaults.



* All voltages are with respect to Ground.
All voltages are +/- 1% maximum.